

# *Treaty Series*

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*Treaties and international agreements  
registered  
or filed and recorded  
with the Secretariat of the United Nations*

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# *Recueil des Traités*

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*Traités et accords internationaux  
enregistrés  
ou classés et inscrits au répertoire  
au Secrétariat de l'Organisation des Nations Unies*

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VOLUME 1431

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VOLUME 1431

1986

Annex A — No. 18961

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*(Only the authentic Chinese and English texts of the Amendments registered under No. A-18961 are reproduced in this volume. The authentic French and Russian texts appear in volume 1432 and the authentic Spanish text appears in volume 1433.)*

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*Traités et accords internationaux  
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au Secrétariat de l'Organisation des Nations Unies*

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VOLUME 1431

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Annexe A — N° 18961

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**N° 18961. Convention internationale de 1974 pour la sauvegarde de la vie humaine en mer. Conclue à Loudres le 1<sup>er</sup> novembre 1974 :**

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*(Seuls les textes authentiques chinois et anglais des Amendements enregistrés sous le numéro A-18961 sont reproduits dans le présent volume. On trouvera les textes authentiques français et russe dans le volume 1432 et le texte authentique espagnol dans le volume 1433.)*

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#### NOTE BY THE SECRETARIAT

Under Article 102 of the Charter of the United Nations every treaty and every international agreement entered into by any Member of the United Nations after the coming into force of the Charter shall, as soon as possible, be registered with the Secretariat and published by it. Furthermore, no party to a treaty or international agreement subject to registration which has not been registered may invoke that treaty or agreement before any organ of the United Nations. The General Assembly, by resolution 97 (I), established regulations to give effect to Article 102 of the Charter (see text of the regulations, vol. 859, p. VIII).

The terms "treaty" and "international agreement" have not been defined either in the Charter or in the regulations, and the Secretariat follows the principle that it acts in accordance with the position of the Member State submitting an instrument for registration that so far as that party is concerned the instrument is a treaty or an international agreement within the meaning of Article 102. Registration of an instrument submitted by a Member State, therefore, does not imply a judgement by the Secretariat on the nature of the instrument, the status of a party or any similar question. It is the understanding of the Secretariat that its action does not confer on the instrument the status of a treaty or an international agreement if it does not already have that status and does not confer on a party a status which it would not otherwise have.

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\* \*

Unless otherwise indicated, the translations of the original texts of treaties, etc., published in this *Series* have been made by the Secretariat of the United Nations.

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#### NOTE DU SECRÉTARIAT

Aux termes de l'Article 102 de la Charte des Nations Unies, tout traité ou accord international conclu par un Membre des Nations Unies après l'entrée en vigueur de la Charte sera, le plus tôt possible, enregistré au Secrétariat et publié par lui. De plus, aucune partie à un traité ou accord international qui aurait dû être enregistré mais ne l'a pas été ne pourra invoquer ledit traité ou accord devant un organe des Nations Unies. Par sa résolution 97 (I), l'Assemblée générale a adopté un règlement destiné à mettre en application l'Article 102 de la Charte (voir texte du règlement, vol. 859, p. IX).

Le terme «traité» et l'expression «accord international» n'ont été définis ni dans la Charte ni dans le règlement, et le Secrétariat a pris comme principe de s'en tenir à la position adoptée à cet égard par l'Etat Membre qui a présenté l'instrument à l'enregistrement, à savoir que pour autant qu'il s'agit de cet Etat comme partie contractante l'instrument constitue un traité ou un accord international au sens de l'Article 102. Il s'ensuit que l'enregistrement d'un instrument présenté par un Etat Membre n'implique, de la part du Secrétariat, aucun jugement sur la nature de l'instrument, le statut d'une partie ou toute autre question similaire. Le Secrétariat considère donc que les actes qu'il pourrait être amené à accomplir ne confèrent pas à un instrument la qualité de «traité» ou d'«accord international» si cet instrument n'a pas déjà cette qualité, et qu'ils ne confèrent pas à une partie un statut que, par ailleurs, elle ne posséderait pas.

\*  
\* \*

Sauf indication contraire, les traductions des textes originaux des traités, etc., publiés dans ce *Recueil* ont été établies par le Secrétariat de l'Organisation des Nations Unies.

**ANNEX A**

*Ratifications, accessions, prorogations, etc.,  
concerning treaties and international agreements  
registered  
with the Secretariat of the United Nations*

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**ANNEXE A**

*Ratifications, adhésions, prorogations, etc.,  
concernant des traités et accords internationaux  
enregistrés  
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[CHINESE TEXT — TEXTE CHINOIS]

No. 18961. 一九七四年国际海上人命安全公约

海安会决议 MSC .6 (48)<sup>1</sup>

(1983年6月17日通过)

通过1974年国际海上人命安全公约的修正条款

海上安全委员会,

注意到1974年国际海上人命安全公约(以下简称“公约”)有关公约附则(不包括附则的第一章在内)修正程序的第八条第二款,

还注意到公约赋予海上安全委员会审议并通过公约修正案的职能,

已在其第四十八届会议上审议了公约的建议修正案,并根据公约第八条第二款第(一)项的规定将修正案分发,

1 根据公约第八条第二款第四项的规定通过公约第II-1章、第II-2章、第III章、第四章和第VII章的修正条款,其文字见本决议的附件,

2 根据公约第八条第二款第(六)项第2目第(2)段的规定作出决定:第II-1章、第II-2章、第III章、第四章和第VII章的修正条款将被视为已在1986年1月1日得到接受,除非在该日期前,本公约有三分之一以上的缔约国政府或其商船队的总吨位不少于世界商船队总吨位50%的缔约国政府已发出通知反对这些修正条款,

3 请各缔约国政府注意,根据公约第八条第二款第(七)项第2目,在按上述第2段规定得到接受后,公约第II-1章、第II-2章、第III章、第四章和第VII章的修正条款将于1986年7月1日生效,

4 要求秘书长根据公约第八条第二款第(五)项的规定,将本决议和附件中修正条款文本的核证无误的副本发给1974年国际海上人命安全公约的所有缔约国,

5 还要求秘书长把本决议和附件的副本发给不是公约缔约国的本组织成员国。

<sup>1</sup> Resolution published for information by the Secretariat of the United Nations — Résolution publiée pour information par le Secrétariat de l'Organisation des Nations Unies.



## 1974年国际海上人命安全公约的修正条款

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### 第 II -1 章

#### 构造——分舱与稳性、机电设备

用附于决议 MSC.1(XLV) 内的 1974 年国际海上人命安全公约的第 II-1 章修正条款的文本替代公约的第 II-1 章，并作如下进一步修订：

#### 第 1 条

##### 适用范围

第 1.1 段第 3 行：把“1984 年 9 月 1 日”改为“1986 年 7 月 1 日”。

第 1.3.2 段第 2 行：把“1984 年 9 月 1 日”改为“1986 年 7 月 1 日”。

把整个第 2 段改为：

“除非另有明文规定，对 1986 年 7 月 1 日之前建造的船舶，主管机关应保证使之符合经决议 MSC.1(XLV) 修正的 1974 年国际海上人命安全公约第 II-1 章中所适用的要求。”

删去脚注。

第 3 段第 4 行和第 9 行：把“1984 年 9 月 1 日”改为“1986 年 7 月 1 日”。

删去第 5 段，把第 6 段改为第 5 段。

#### 第 3 条

##### 与 C、D 和 E 部分有关的定义

把第 19 段更改如下：

“‘化学品液货船’是指建造或改造用于散装运输下述文件所列任何一种液货的货船，以适用者为准：

- .1 经海安全决议 MSC.4(48) 通过的、可由本组织加以修订的《国际散装运输危险化学品船舶构造和设备规则》（以下简称《国际散装化学品规则》）的第十七章；或
- .2 经本组织大会决议 A.212(VII) 通过的、本组织已作修订或可加修订的《散装运输危险化学品船舶构造和设备规则》（以下简称《散装化学品规则》）的第六章。”

把第 20 段改为：

“‘气体运输船’是指建造或改建用于散装运输下述文件所列任何液化气体或其它产品的货船，以适用者为准。

- . 1 经海安会决议 MSC.5(48) 通过、可由本组织修订的《国际散装运输液化气体船舶构造和设备规则》(以下简称《国际气体船规则》)的第十九章; 或
- . 2 经本组织大会决议 A.328(1X) 通过、本组织已作修订或可加修订的《散装运输液化气体船舶构造和设备规则》(以下简称《气体船规则》)的第十九章。”

#### 第 5 条

##### 客船渗透率

把第 4.1 段改为:

“4.1 若系第 6.5 条所要求的特种分舱, 则位于机器处所之前或之后的整个部分的同一平均渗透率应为  $95-35b/V$ , 其中:

$b$  = 位于机器处所以前或以后、限界线之下、肋板顶部之上(或内底之上、或艏尖舱之上, 视情而定)、被指定为或用作作为装货处所、煤或燃油舱、物料储藏室、行李邮件室、锚链舱和淡水柜等处所的总容积;

$V$  = 船舶在限界线以下、机器处所以前或以后部分的总容积。”

#### 第 6 条

##### 客船许可舱长

将本条第 5 段的标题改为: “达到第 III 章第 20 条之 1.2 要求的船舶之特殊分舱标准。”

增加新的 5.3 和 5.4 如下:

“5.3 计算可浸长度曲线时应采用本章第 5 条之 4 所给出的关于渗透率的特种规定

5.4 如主管机关在考虑了拟定的航程性质和条件后认为只要满足第 II-2 章和本章的其他规定即已足够, 则可不必要再符合本款的要求。”

#### 第 41 条

##### 主要电源和照明系统

第 1.3 段第 3 行, 在“流向”后加上“交替”。

#### 第 42 条

##### 客船应急电源

本条之 2.1.1 修改如下:

“ .1 第 III 章第 11 条之 4 和第 III 章第 15 条之 8 所要求的每一集合站、登乘站和舷外。”

增加新条文 2.1.2 如下:

“ .2 第 III 章第 11 条之 5 所要求的通达集合站与登乘站的走廊、梯道和出入口。”

将 2.1.2 至 2.1.7 编号分别改为 2.1.2 至 2.1.8。

第 2.3.4 段第 2 行, 将“手动失火报警器”改为“手工操作报警按钮”。

#### 第 43 条

##### 货船应急电源

本条之 2.1 修改如下:

“2.1 第 III 章第 11 条之 4 和第 III 章第 15 条之 8 所要求的每一集合站、登乘站和舷外的 3 小时应急照明。”

第 2.4.4 段第 2 行, 将“手动失火报警器”改为“手工操作报警按钮”。

#### 第 49 条

##### 在驾驶台对推进机器进行控制

第 3 段第 6 行, 用“主要机器处所”代替“机器处所”。

用“主要机器控制舱室”代替“机器控制舱室”。

### 第二部分

#### 第 II-2 章

##### 构造——防火、探火和灭火

将附于决议 MSC.1 (XLV) 内的第 II-2 章的文本替代公约第 II-2 章, 并作如下进一步修改:

#### 第 1 条

##### 适用范围

本条之 1.1 中第 3 行, 删去“1984 年 9 月 1 日”, 代以“1986 年 7 月 1 日”。

本条之 1.3.2 中第 2 行, 删去“1984 年 9 月 1 日”, 代以“1986 年 7 月 1 日”。

本条之 2 全文改为:



“除另有明文规定外，对1986年7月1日之前建造的船舶，主管机关应保证使之符合决议MSC.1(XLV)所修正的1974年国际海上人命安全公约第II-2章所适用的要求。”

本条之3中第4行及第9行，删去“1984年9月1日”，代以“1986年7月1日”。

删去脚注。

### 第3条

#### 定义

本条之30改为：

“‘化学品液货船’是指建造或改建用于散装运输下述规则之一（视何者适用而定）所列的任何易燃性液体产品的液货船：

- .1 经海安会决议MSC.4(48)通过的并可能由本组织修订的《国际散装运输危险化学品船舶的构造和设备规则》（以下简称“国际散装化学品规则”）中第十七章；或
- .2 经本组织大会决议案A.212(VII)通过的并已经或可能由本组织修订的《散装运输危险化学品船舶的构造和设备规则》（以下简称“散装化学品规则”）的第六章。”

本条之31修改如下：

“‘气体运输船’是指建造或改建用于散装运输下述规则之一（视何者适用而定）所列的任何液化气体或其他易燃性物质的液货船：

- .1 经海安会决议MSC.5(48)通过的并可能由本组织修订的《国际散装运输液化气体船舶的构造和设备规则》（以下简称“国际气体运输船规则”）的第十九章；或
- .2 经本组织决议A.328(IX)通过的并已经或可能由本组织修订的《散装运输液化气体船舶的构造和设备规则》（以下简称“气体运输船规则”）中第十九章。”

新增32如下：

“32‘货物区域’是指船上包含液货舱、污水水舱和泵室的部分，包括液货泵舱、隔离空舱、相邻于液货舱的压载舱或空舱，以及这些区域上方的整个船宽和船长的甲板区域。”

#### 第4条

##### 消防泵、消防总管、消防栓和消防水带

本条之3.3.2.6中第3行的“控制室”改为“控制站”。

#### 第7条

##### 机器处所的灭火设备

本条之1.2中第1行和第2行的“空气泡沫装置”改为“泡沫喷洒装置”。

#### 第11条

##### 机器处所内的特别布置

本条之8中第1行的“经认可的自动探火与报警系统”改为“固定式探火与报警系统”。

#### 第13条

##### 固定式探火和失火报警系统

本条之2.1中第1、2、3及5行的“手动报警按钮”改为“人工操作报警按钮”。

#### 第14条

##### 定期无人值班机器处所的固定式探火和失火报警系统

本条之1第1行改为“符合……的经认可类型的固定式探火和失火报警系统”。

#### 第15条

##### 燃油、滑油和其他易燃油类的布置

新增6如下：

“6 艏尖舱内禁止载运易燃油类  
艏尖舱不得载运燃油、滑油和其他易燃油类。”

#### 第20条

##### 消防控制图表

本条文1第14行和第15行将“本国语言”改为“船旗国的官方语言”。

第 26 条载运 36 名以上乘客的船舶舱壁及甲板的耐火完整性

本条文 2.2(1) 第 4 行, 将“防火控制及记录站”改为“防火控制室及失火记录站”。

第 27 条载运不超过 36 人的船舶舱壁及甲板的耐火完整性

本条之 2.2(1) 第 4 行, 用“室”代替“站”。

本条之 27.1 表内第 2 行第 4 栏、第 3 行第 4 栏、第 4 行第 4 栏和第 4 行第 5 栏中, 将 B - 0 e/ 改为 A - 0 e/

A - 0 e/ 改为 A - 0 e/

本条之 4 第 4 行, 删去“本章”改为“本节”。

第 32 条通风系统

本条之 1.4.3.1, 第 1 行, 将“有限的”改为“低量的”。

第 36 条全文改为:

“第 36 条固定式探火和失火报警系统,自动喷水器、探火和失火报警系统

凡适用本部分所规定的任何船舶, 除实质上没有失火危险的处所如空室、盥洗室等处, 在所有起居处所和服务处所以及主管机关认为必要时在控制站内, 不论是垂直的还是水平的每一独立分隔区中, 均应普遍设置下列两者之一:

- .1 符合本章第 13 条规定的一种认可型式的固定式探火和失火报警系统, 其安装和布置足以探知上述处所内火灾的发生; 或
- .2 符合本章第 12 条规定的一种认可型式的自动喷水器、探火和失火报警系统, 其设置和布置足以保护上述处所; 此外, 还应有符合本章第 13 条规定的一种固定式探火和失火报警系统, 其安装和布置应在起居处所的走廊、梯道和脱险通道内提供感烟式探测保护。”

### 第 37 条

#### 特种处所的保护

本条之 1.4.1 全文修改如下：

“ 1.4.1 在特种处所内应保持有效的巡逻制度。在整个航行期间，未保持连续消防值班的任何上述处所内，应装设符合本章第 13 条要求的固定式探火和失火报警系统。该固定式探火系统应能迅速探知火灾的开始。探测器的间隔和位置应在考虑到通风和其他有关因素影响的情况下调试至使主管机关满意。”

本条之 2.2.1 全文修改如下：

“2.2.1 在可预期集积可爆性蒸气的任何车辆运载甲板或平台上（如设有），可能构成可燃蒸气燃点源的设备，特别是电气设备与电缆，应装设在距甲板或平台 450 毫米以上之处，但具有足够尺寸的开口，使汽油蒸气能够向下渗透的平台除外。装设在距甲板或平台 450 毫米以上之处的电气设备，应为封闭并受保护以防止火花外逸的类型。但是，如果主管当局确信电气设备及电缆装于距甲板或平台不足 450 毫米之外为船舶安全操作所必需时，电气设备及电缆可如此装设，但应为经认可而且能在可爆性汽油与空气混合体中使用的类型。”

### 第 40 条

#### 消防巡逻、探火、失火报警和广播系统

本条之 1 和 2 改为：

“ 1 应设置符合本章第 13 条要求的人工操作报警按钮。”

“ 2 应设置经认可类型的固定式探火和失火报警系统。”

### 第 49 条

#### 可燃材料的使用限制

本条之 3 全文修改如下：

“甲板基层敷料如在起居处所、服务处所和控制站内涂敷，则应为不易着火的，或在高温下不致产生有毒气体或爆炸危险的认可材料。 \* \* ”

### 第 51 条

#### 生活用气体燃料的布置

将“其布置、储存、分配和利用应……”改为“其储存、分配和利用的布置应……”。

## 第 52 条

### 固定式探火和失火报警系统， 自动喷水器、探火和失火报警系统

本条之 1、2、3 全文修改如下：

“ 1 采用 I C 法的船舶，应设有符合本章第 13 条要求的一种认可型的固定式探火和失火报警系统，其安装和布置应在起居处所的所有走廊、梯道和脱险通道内提供感烟式探测保护和人工操作报警按钮。

2 采用 II C 法的船舶，应设有符合本章第 12 条要求的一种认可型的自动喷水器、探火和失火报警系统，其安装和布置应能保护起居处所、厨房和其他服务处所，但实质上没有失火危险的处所（如空室、盥洗室等）除外。此外，还应设有符合本章第 13 条要求的固定式探火和失火报警系统，其安装和布置应在起居处所的所有走廊、梯道和脱险通道内提供感烟式探测保护和人工操作报警按钮。

3 采用 III C 法的船舶，应设有符合本章第 13 条要求的一种认可型的固定式探火和失火报警系统，其安装和布置应在所有起居处所和服务处所内能探知火灾的发生，但实质上没有失火危险的处所（如空室、盥洗室等）除外。”

删去本条之 4。

## 第 53 条

### 装货处所内的防火安排

本条之 2.1 中第 1 行的“应装设一个经认可的自动探火和失火报警系统”改为“应装设一个固定式探火和失火报警系统”。

本条之 2.4.2 全文改为：

“.2 在通风系统设计为、并在运转中能够在装载车辆时提供连续货物区域通风，换气率达每小时 10 遍的条件下，在甲板和在除具有足够尺寸的开口，能够允许汽油蒸气向下渗透的平台之外的每一设置的载车平台 450 毫米高度以上，可允许封闭及受保护以防止火花外逸类型的电气设备作为一种替代方法。”

## 第 54 条

### 载运危险货物船舶的特殊要求

在表 54.2 的注 f 中，将“除本表所列举的特殊考虑外”改为“除符合本表所列举的各项要求外”。

本条之 2.3, 第 1 行改为: “在所有封闭货物区域, 包括封闭车辆甲板区域, 应装设经认可类型的固定式探火和失火报警系统。”

#### 第 55 条

##### 适用范围

本条之 2 全文改为:

“如果旨在载运上述 1 所指货物以外的液体货物或能引起额外失火危险的液化气体, 应采取使主管机关满意的额外安全措施, 并应根据情况需要, 适当注意到国际散装化学品规则、散装化学品规则、国际气体运输船规则和气体运输船规则的有关规定。”

本条之 6 全文改为:

“除配备有使主管机关满意的选择性和补充性装置者外, 化学品液货船和气体运输船应符合本部分的各项规定, 并应根据情况需要, 适当注意到国际散装化学品规则、散装化学品规则, 国际气体运输船规则和气体运输船规则的有关规定。”

#### 第 56 条

##### 各处所的位置和分隔

本条全文改为:

“1 机器处所应位于货油舱和污水水舱的后方, 也应位于货油泵舱和隔离空舱的后方, 但不必位于燃油舱的后方。任何机器处所均应以隔离空舱、货油泵舱、燃油舱或固定压载舱同货油舱和污水水舱隔开。凡设有供压载相邻于货油舱和污水水舱处所的泵及其附件的泵舱和设有燃油驳运泵的泵舱, 均应认为与本条内的货油泵舱等效, 但这些泵舱所具有的安全标准应与货油泵舱所要求者相同。然而, 货油泵舱的下部可以凹入 A 类机器处所, 以备安置货油泵, 其条件是凹入部分的顶板高度一般不超过龙骨上面型深的  $\frac{1}{3}$ , 但载重吨不超过 25,000 吨的船舶除外。在这种船上, 如能证明为便于进入凹入部分和妥善布置管系的需要, 上述深度下能做到时, 则主管机关可准许凹入部分超过上述高度, 但不得超过龙骨上面型深的一半。”

2 起居处所, 货油主控制站、控制站和服务处所(独立的起货设备储藏室除外)均应位于所有货油舱、污水水舱、货油泵舱和用以隔开货油舱或污水水舱与机器处所的隔离空舱的后方, 但不必位于燃油舱的后方。在确定这些处所的位置时, 不必计及本条之 1 所述的凹入部分。”

3 如认为必要时,起居处所、控制站、A类以外的机器处所以及服务处所可允许位于装货区域的前方,但是这些处所应以隔离空舱、货油泵舱、燃油舱或固定压载舱同货油舱和污水舱隔开,并须具备经主管机关认为等效的安全标准和具有足够的灭火装置。此外,如认为船舶的安全或航行之需要,主管机关可允许设有功率大于375KW并不作为主推进机械的内燃机的机器处所位于货物区域的前方,但其布置应符合本款的规定。

4 仅适用于混装船:

- 1 污水舱应以隔离空舱围隔,但如污水舱在干货航程中可能载运污油水,且其界面为船体、主货物甲板、货油泵舱舱壁或燃油舱者则可除外。这些隔离空舱不得向双层底、管隧、泵舱或其他封闭处所开孔。应设有向隔离空舱灌排水的装置。如污水舱的界面为货油泵舱舱壁时,该泵舱不得向双层底、管隧或其他封闭处所开口,但可以允许设有气密螺栓盖的开口。
- 2 应提供设施以切断连接泵舱和本条之4.1所述污水舱的管系。切断设施应包括一只阀后接双环盲板法兰或具有适当盲板法兰的短管。此项装置应邻接于污水舱,但若此种布置不合理或不可行时,可以设置在泵舱内直接位于贯穿舱壁的管系之后方。应设有独立的泵及管系装置,以便当船舶从事于干货运输时将污水舱内的污物直接经开敞甲板排放。
- 3 污水舱的舱口和舱柜清洗开口只允许设在开敞甲板上,并应配备关闭装置。这些关闭装置应有锁紧设施,并由负责的高级船员控制,但如具有螺柱板而螺栓间距保证水密者可以除外。
- 4 如设有边货舱时,甲板下的货油管系应设在这些边舱内。但主管机关可允许货油管系设在能充分清洗和通风的特别管道内,其布置应使主管机关满意。倘若未设边货舱,则甲板下的货油管系应设在特别管道内。

5 如经证明有必要把驾驶室布置在货油舱区域的上方,则此处所只能用于驾驶目的,并且必须用一个高度至少为2米的开敞空间使之与货油舱甲板隔开。此外,这种驾驶室的防火还应符合本部分第58条之1和第58条之2对控制处所的要求,以及本部分中可适用的其他规定。

6 应设有使甲板上溢油与起居和服务区域隔开的设施。该设施可以是安装一个有适当高度并延伸至两舷的连续的固定挡板。对于具有尾部装油设施的船舶,此项挡油布置应予特别考虑。

7 环绕起居处所的上层建筑和甲板室的外部限界面包括支承这些起居处所的任何悬架甲板，其面向货油舱的全部限界面及前方限界面之后 3m 之内，应隔离至“A-60”级标准。对于这种上层建筑和甲板室的各个侧面，此项分隔应达到主管机关认为必要高的级别。

8.1 通往起居处所、服务处所和控制站的入口、空气进口和开口不得面向货物区域。它们应位于不面向货物区域的横向舱壁上，或位于上层建筑或甲板室的外档一侧，距离至少为船舶长度的 4%，但距离面向货物区域的上层建筑或甲板室的末端不少于 3m。然而，这个距离毋须超过 5m。

8.2 在上述 8.1 所指的限制范围之内不准设门，但不能通往起居处所、服务处所和控制站的处所之门，主管机关可准许设置。这些处所可以为货物控制站、食物库和物料库。如上述门为在货物区域后方的处所之门，则该处所的限界面应分隔至“A-60”级标准，但面向货物区域的限界面除外。在上述 8.1 所指的限制范围之内可设置螺栓紧固的板门，作为拆移机器之用。操舵室的门窗可以位于上述 8.1 所规定的限制范围之内，只要它们的设计能保证驾驶室迅速而有效地达到气密和蒸汽密。

8.3 面向货物区域和在上述 8.1 所指的限制范围内上层建筑及甲板室侧边上的舷窗应为永闭（不能开启）型。在主甲板上第一层的这种舷窗应装有钢质或其他等效材料制成的内部罩盖。”

### 第 58 条

#### 舱壁和甲板的耐火完整性

在表 1 注 b 中，将第 1 行的“b”改为“b”。

本条之 4，第 4 行，将“这些要求”改为“这部分”。

### 第 59 条

#### 透气、清除、除气和通风

本条之 2，第 16 行，将“气”改为“蒸汽”。

第 18 行，将“气”改为“蒸气”。

第 16、17 和 18 行，“当……水平”是本条之 2 的一部分，必须移到本条之 2 的空白处。

本条之 3.3 修改如下：

在第三句中，将“第 56 条之 1”改为“第 56 条之 4”。

在第四句中，将“货油舱区域”改为“货物区域”。



### 第 61 条

#### 固定式甲板泡沫系统

本条之 1 中，将“货油舱区域”改为“货油舱甲板区域”。

本条之 2 的第二句中，将“货油舱区域”改为“货物区域”。

本条之 3.1 中，将“货舱甲板面积”改为“货油舱甲板区域”。

本条之 7 的第一和第二句中，将“货舱甲板”改为“货油舱甲板”。

本条之 8 的第 3 行中，将“400 L”改为“400 L/min”。在第四句中，将“货油舱甲板的任何区域”改为“货油舱甲板区域的任何部分”。

### 第 62 条

#### 惰性气体系统

本条之 9.1 甲第 2 和第 3 行，将“19.2”和“19.3”分别改为“19.3”和“19.4”。

本条之 10.2 中，将“货油舱区域”改为“货物区域”。

本条之 14.1 改为：

“14.1 应设有一个或多个压力—真空防护装置，以防止货油舱遭受到：

- .1 在以最大速率装货油而所有其他出气口被关闭时，产生一个超过货油舱的试验压力的正压；或
- .2 在以货油泵的最大额定排量卸货油而惰性气体鼓风机失灵时，产生一个超过 700 毫米水柱压力的负压。

上述防护装置如果不设在第 59 条之 1.1 所要求的通风系统上，或者不设在个别货油舱上，就应设在惰性气体总管上。”

本条之 20.1 中最后一行改为“10.2、10.7、10.9、11.3、11.4、12、13.1、13.2、13.4.2、14.2 及 19.8；”

本条之 20.2 中最后一行改为“12、13.1、13.2 和 14.2。”

### 第三部分

#### 第 III 章

#### 救生设备与装置

##### A 部分 通则

#### 第 1 条

#### 适用范围

- 1 除有明文规定者外，本章应适用于在 1986 年 7 月 1 日或以后，安放龙骨或处于相似建造阶段的船舶。
- 2 本章内，“相似建造阶段”系指在该阶段：
  - .1 开始可确定为是一艘具体船舶的建造，并
  - .2 该船已动工装配至少 50 吨，或 1% 全部结构材料的估计重量，取其小者。
- 3 本章内：
  - .1 “建造的船舶”系指“已安放龙骨或处于相似建造阶段的船舶”；
  - .2 “一切船舶”系指“在 1986 年 7 月 1 日以前，之日，或以后建造的船舶”；“一切客船”和“一切货船”系指按此建造者；
  - .3 不论何时建造的货船，改装为客船者应作为在改装开始之日建造的客船对待。
- 4 对于 1986 年 7 月 1 日以前建造的船舶，主管机关应：
  - .1 以 4.2 段和 4.3 段的规定为前提，确使达到 1974 年国际海上人命安全公约第 III 章中所规定的那些在 1986 年 7 月 1 日前便有效、适用于新船或现有船的要求；
  - .2 对船没有达到 4.1 段要求的救生设备与装置加以考虑，以便在合理、可行的情况下确使它们尽早地基本达到那些要求；
  - .3 当这些船舶更换救生设备或装置，或当这些船舶进行要涉及到更换或增设救生设备或装置的重大修理、改装或改建时，在合理可行的情况下，要确使这些救生设备和装置达到本章要求。但是，如果更换的只是救生艇筏而不包括降艇设备，或是更换的只是降艇设备而不包括救生艇筏的话，救生艇筏或降艇设备是可以与被更换者是相同类型的；

- . 4 案批按本条第6段配备的救生设备, 对于1991年7月1日前在船上配备的救生设备, 如能保持良好状况, 主管机关可允许它们不完全达到本章要求;
- . 5 除4.3段所述的那些救生艇筏和降艇设备外, 要保证在1991年7月1日或以后更换或安装的救生设备确实根据第4条和第5条的要求得到鉴定、测试和批准。

5 至于1986年7月1日之前建造的船舶, 第8、9、10、18和25条的要求适用, 而且在其所述的范围内, 第19条也适用。

6 第6条之2.3、第6条之2.4、第21条之3、第21条之4、第26条之3、第27条之2、第27条之3和第30条之2.7, 应在1991年7月1日以前适用于在1986年7月1日以前建造的船舶。

## 第2条

### 免 除

1 主管机关如考虑到航程的遮蔽性及条件, 认为实施本章的任何具体要求为不合理或不必要时, 可对在航程中驶距最近陆地不超过20海里的个别船舶或某类船舶, 免除这些要求。

2 客船用于特种业务, 例如朝山进香, 载运大量特种业务旅客者, 主管机关如认为实施本章要求为不切实际时, 可对此类船舶免除这些要求, 但此类船舶完全符合下列规则的规定:

- . 1 1971年特种业务客船协定的附则; 与
- . 2 1973年特种业务客船舱室要求议定书所附的规则。

## 第3条

### 定 义

除另有明文规定者外, 本章内的定义如下:

1 执证人员系指执有主管机关按照生效的海员培训、发证和值班标准的国际公约要求, 授权发给的或承认有效的精通救生艇筏业务证书的人员; 或执有非该公约缔约国家的主管机关为与该公约证书有相同目的而签发的或承认有效的证书的人员。

2 探测系指幸存者或救生艇筏位置的测定。

- 3 登乘梯系指设置在救生艇筏登乘站以供安全登入降落下水后的救生艇筏的梯子。
- 4 漂浮脱离降落系指艇筏从下沉中船舶自动脱离并立即可用的救生艇筏下水方法。
- 5 自由下降降落系指载足全部乘员和属具的艇筏在船上脱离并在没有任何制约装置的情况下，任其下降到海面的救生艇筏下水方法。
- 6 保暖救生服系指减少在水中穿着该服人员体热损失的保护服。
- 7 气胀式设备系指依靠非刚性的充气室作浮力，而且在使用前通常保持不充气状态的设备。
- 8 充气式设备系指依靠非刚性的充气室作浮力，而且无论何时均保持充气状态的立即可用的设备。
- 9 降落设备或装置系指将救生艇筏或救助艇从其存放位置，安全地转移到水上的工具。
- 10 长度系指在位于自龙骨上面量得最小型深的85%的水线上的总长度的96%，或在较长时，在该水线上从船艏柱前面量到舵杆中心线的长度。船舶设计具有倾斜龙骨者，作为测量本长度的水线应平行于设计水线。
- 11 型深
  - .1 型深是指从龙骨上面量到在船舷处的干舷甲板梁上面的垂直距离，对木质船舶和铁木混合结构船舶，垂直距离是从龙骨槽的下缘量起。凡船舶中央横剖面的下部具有凹形，或装有厚龙骨翼板者，垂直距离是从船底平坦部分向内引伸与龙骨侧面相交的一点量起。
  - .2 具有圆舷形舷边的船舶，型深应量到甲板型线和船舶外板型线相交之点，这些线的引伸是把该舷边看作是设计为角形的。
  - .3 凡干舷甲板为阶形甲板并且其升高部分延伸过决定型深的点以上者，型深应量到自甲板较低部分延伸而与升高部分平行的参考线。
- 12 新颖救生设备或装置系指具有未被本章各规定所充分说及的新特征，但提供同等的或更高的安全标准的救生设备或装置。
- 13 救助艇系指为救助遇险人员及集结救生艇筏而设计的小艇。
- 14 找回系指幸存者或艇筏的安全找回。
- 15 逆向反光材料系指光束射到后，向射入的相反方向反射出去的材料。
- 16 短程国际航行系指在该航线中，船舶距离能够安全安置旅客和航员的港口或地点不超过200海里的国际间航行。启航国最后停靠港至最终目的港之间距离与返航航次均不得超过600海里。最终目的港系指船舶开始返航回到启程国的计划航次中的最后停靠港。

- 17 救生艇筏系指从弃船时候起能维持遇险人员生命的艇筏。
- 18 保温用具系指采用低导热率的防水材料制成的袋子或衣服。

#### 第4条

##### 救生设备与装置的鉴定、试验及认可

- 1 除按照本条之5和6的规定外，本章所规定的救生设备与装置应经主管机关认可。
- 2 在救生设备与装置予以认可之前，主管机关应确使该项救生设备与装置：
  - .1 按照海事组织的建议书\*加以试验，证实符合本章的要求；或
  - .2 在主管机关满意的情况下，成功地经受基本上等效于该项建议书所规定的试验。
- 3 在新型救生设备或装置予以认可之前，主管机关应确证该项设备或装置：
  - .1 提供至少等效于本章所规定的安全标准，并按照海事组织的建议书\*\*加以鉴定和试验；或
  - .2 在主管机关满意的情况下，成功地经受基本上等效于该项建议书的鉴定和试验。
- 4 主管机关所采用的认可程序尚应包括继续认可或撤消认可的条件。
- 5 在接受主管机关从未加认可的救生设备与装置之前，主管机关应证实该救生设备与装置符合本章的要求。
- 6 本章所规定的救生设备的详细技术要求未列入第三节者，应满足主管机关的要求。

#### 第5条

##### 生产试验

主管机关应要求，救生设备必须经受必要的生产试验，以确使这些救生设备是按与认可的原型设备的同一标准进行制造的。

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\* 参阅海事组织所通过的决议A.〔 〕(XIII)所制定的“救生设备的试验建议书”。

\*\* 参阅海事组织所通过的决议A.〔 〕(XIII)所制定的“原型新颖救生设备与装置的鉴定、试验与认可实施规则”。

## B 部分 船舶要求

### 第 I 节 客船与货船

#### 第 6 条

#### 通 信

1 第 2.3 和 2.4 段适用于所有船舶。对于 1986 年 7 月 1 日前建造的船舶，第 2.3 和 2.4 段应在不迟于 1991 年 7 月 1 日适用。

#### 2 无线电救生设备

##### 2.1 救生艇筏用手提式无线电设备

2.1.1 应配备达到第四章第十四条要求的救生艇筏用的手提式无线电设备。该手提式无线电设备应保存在有保护、易于到达、在紧急情况下能随时移到任何一只救生艇筏上去的位置。对于救生艇远远地分置于船艏和船艉的船舶则允许例外；在这种船上，该手提式无线电设备应保存在离船上主发报机最远的救生艇的附近。

2.1.2 如果达到第四章第十三条要求的无线电设备是装在船舶每舷的救生艇内或装在第 26 条之 1.2.1 所说的从艉部降落的救生艇上的话，可不必按 2.1.1 段的要求办。

2.1.3 如果由于船舶航行时间较短，主管机关认为救生艇筏用的手提式无线电设备是不必要的话，主管机关可以允许免除这种设备。

##### 2.2 救生艇用无线电报装置

在从事非短途国际航行的客船上：

- .1 如果船上的总人数在 199 人以上但不足 1,500 人的话，第 20 条之 1.1.1 段要求的救生艇中至少有一只要装有达到第四章第十三条要求的无线电报设备；
- .2 如果船上的总人数为 1,500 人或 1,500 人以上的话，每舷至少有一只救生艇要装有此无线电设备。

##### 2.3 救生艇筏应急示位无线电标

船舶每舷应配备一达到第四章第十四条第一款要求的手动激发应急示位无线电标。它们应存放在能迅速搬入第 26 条之 1.4 所要求的救生艇筏以外的任何救生艇筏上。

##### 2.4 双向无线电话设备

2.4.1 应配备符合第四章第十四条第三款要求的双向无线电话设备，以供救生艇筏之间，救生艇筏与船舶之间，和船舶与救助艇之间的通信联系。没有必要每艘救

生艇筏都配备一具此项设备，但无论如何，每艘船舶应至少配备三具此项设备。本要求亦适用于船上的其他设备，但该设备必须符合第四章第十四条第三款的相应要求。

2.4.2 对于1986年7月1日以前建造的船舶，此类设备仅要求符合第四章第十四条第三款的频率要求。

### 3 遇险火焰信号

应配备不少于12支符合第35条要求的火箭降落伞火焰信号，并应保存在驾驶台或其附近。

### 4 船上通信与报警系统

4.1 应配备一套固定式或手提式设备或两种型式设备的应急设备，供船上应变管制站、集合和登乘地点与要害位置之间的双向通信联系使用。

4.2 应配备符合第50条要求的通用紧急报警系统，以供召集旅客与船员至集合地点和采取应变部署表所列行动之用。该系统尚应以有线广播系统或其他适宜的通信设施作为补充。

## 第7条

### 个人救生设备

#### 1 救生圈

1.1 符合第31条之1要求的救生圈：

.1 应分放在船舶两舷容易拿到之处，并在可行范围内，分放在所有延伸到船舷的露天甲板上；至少有1个应放在船尾附近；

.2 其存放应能迅速取下，并不得以任何方式使永久紧固。

1.2 船舶每舷至少有一个救生圈应装有符合第31条之4要求的可浮救生索，其长

1.3 不少于总数一半的救生圈应设有符合第31条之2要求的自亮浮灯；不少于2个的此项救生圈尚应设有符合第31条之3要求的自发烟雾信号，并应能自驾驶室迅速抛投；设有自亮浮灯的，和设有自亮浮灯及自发烟雾信号的救生圈应相等地分布在船舶两舷，并不应是按上面1.2段要求的装有救生索的救生圈。

1.4 每个救生圈应以粗体罗马字母标明其所属船名和船籍港。

#### 2 救生衣

2.1 应为船上每个人员配备一件符合第32条之1或第32条之2要求的救生衣并，另外：

.1 尚应配备船上旅客人数至少10%的适合儿童穿用的救生衣，或按可能规定为每个儿童配备1件救生衣的更多数量；

.2 尚应配备供值班人员使用的, 并供设置在很远的救生艇筏地点使用的  
足够数量救生衣。

2.2 救生衣应存放在容易到达之处, 其位置应加明显标志。凡由于船舶的特殊布置, 按上面 2.1 段要求配备的救生衣变得无法拿到时, 可制定满足主管机关要求的  
交通规定, 可以包括增加配备救生衣的数量。

### 3 浸没服

3.1 每个指派为救助艇艇员的人员应配备一件适当尺码的、符合第 33 条要求的  
浸没服。

## 第 8 条

### 应变部署表与应变须知

- 1 本条适用于一切船舶。
- 2 应为船上每个人员配备一份在万一应变时必须遵循的明确的须知。
- 3 符合第 53 条要求的应变部署表应展示在全船各明显之处, 包括驾驶台、机舱和  
各船员起居处所。
- 4 应在客房张贴, 并在集合地点及其他旅客处所明显地展示, 用适当文字书写的图  
解和应变须知, 向旅客通告:
  - .1 他们的集合地点;
  - .2 应变时必须采取的必要行动;
  - .3 救生衣的穿着方法。

## 第 9 条

### 操作须知

- 1 本条适用于一切船舶。
- 2 应在救生艇筏的及其降落操纵器的上面或附近, 设置告示或标志, 它们应:
  - .1 说明此操纵器的用途及此项设备的操作程序, 并提出有关须知或注意  
事项;
  - .2 在应急照明情况下, 容易看清;
  - .3 使用符合海事组织建议要求的符号。

## 第 10 条

### 救生艇筏的配员与监督

- 1 本条适用于一切船舶。



- 2 船上应有足够人数的受过训练的人员来召集和协助未受训练的人员。
- 3 船上应有足够人数的船员（他们可以是驾驶员或执证人员）来操作船上总人数弃船所需要的救生艇筏及其降落装置。
- 4 每艘必须使用的救生艇筏，应由一名驾驶员或执证人员负责指挥。但主管机关经适当考虑到航程的性质、船上人数和船舶的特点，可以准许精通救生筏的降放、回收和操作的人员来代替具有上述资格的人员负责指挥救生筏。救生艇尚应指派1名副指挥。
- 5 负责人应有一份该救生艇筏船员名单，并确保在其指挥下的船员是熟悉他们的各项任务的。救生艇的副指挥亦应有一份该救生艇艇员名单。
- 6 每艘按第6条之2.2要求配备无线电报设备的救生艇，应指派1名能操作该设备的人员。
- 7 每艘机动救生艇筏应指派1名能操作该发动机和进行小调整的人员。
- 8 船长应确保2.3和4段所指人员妥善地分配到船舶救生艇筏中。

### 第11条

#### 救生艇筏集合与登乘布置

- 1 备有认可降落装置的救生艇和救生筏，应存放在尽可能靠近起居和服务处所的地方。
- 2 集合地点应设在紧靠登乘站的地方。每个集合地点应有足够的场所容纳指定在该地点集合的所有人员。
- 3 集合与登乘地点均应设在容易从起居和工作处所通往的地方。
- 4 根据情况，集合与登乘地点应使用第II-1章第42条或第43条按所要求的应急电源供电的照明系统，给予足够的照明。
- 5 通往集合与登乘地点的通道、梯道和出口应加照明。该照明系统应能根据情况由第II-1章第42条或第43条所规定的应急电源供电。
- 6 吊艇架降落的救生艇筏集合与登乘地点的布置，应能使担架病人搬进救生艇筏。
- 7 每处降落地点或每两处相邻的降落地点应设置符合第48条之7要求的登乘梯一具，每一个登乘梯在不利的纵倾情况下和在船舶向任何一舷横倾不少于15°时，可从该甲板延伸到最轻载航海水线。但无论如何，在船舶每舷应至少设有1具登乘梯的情况下，主管机关可准许以供登入在水面上的救生艇筏的认可装置来代替这些梯子。第26条之1.4所规定的救生筏可准许用其他登乘设施。

8 凡有必要者，应设置将吊艇架降落的救生艇筏贴靠并系留在船舷的装置，以便人员能安全登乘。

### 第 12 条

#### 降艇站

降艇站的位置应确保使安全降落水中，应该特别注意离开推进器及船体陡斜悬空部分，除救生艇筏专门设计为自由下降降落者外，应尽可能使救生艇筏能从船舷平直部分降下水。如设置于船的前部，则应设置在防撞壁后面有遮蔽的地方，对此，主管机关应对吊艇架的强度给予特别的考虑。

### 第 13 条

#### 救生艇筏的存放

1 每艘救生艇筏的存放应：

- . 1 使该救生艇筏及其存放装置均不得干扰置在任一其他降艇站的任一其他救生艇筏或救助艇的操作；
- . 2 在安全和可行的情况下尽可能靠近水面，而且，不用于抛出船外降落的救生艇筏，应处于这样的位置，即：在登乘位置上的救生艇筏，当满载船舶在不利纵倾情况下向任何一舷横倾达  $20^\circ$  或横倾到船舶露天甲板的边缘浸入水中的角度（以三者中较小角度者为准）时，应离水线不少于 2m。
- . 3 处在持续使用准备状态，使 2 名艇员能在少于 5min 内完成登乘准备工作；
- . 4 配齐本章所规定的装备；
- . 5 在可行范围内，在安全的并有遮蔽的地方，并加保护免受火灾和爆炸引起的伤害。

2 顺船舷降落的救生艇应存放在推进器之前可行范围内尽量远的地方。在船舶的长度为 80m 及 80m 以上但少于 120m 的货船上，救生艇应存放在使救生艇尾端至少在推进器之前不少于救生艇长度的地方。在船舶的长度为 120m 或 120m 以上的货船与 80m 及 80m 以上的客船上，救生艇应存放在使救生艇尾端至少在推进器之前不少于一倍半救生艇长度的地方。凡合适者，船舶的布置应对在存放位置的救生艇加以保护使其免受巨浪引起的损害。

3 救生艇的存放应附连于降落设备。

4 救生筏不仅要达到第23条和第29条的要求，其存放还要做到能用人工将救生筏从其系固装置上解脱开来。

5 吊筏架降落的救生筏应存放在吊筏钩可到达的范围内，除备有在1.2段所规定的纵倾和横倾范围内或由于船舶摆动而不致造成无法操作的某些转移设施者外。

6 用于抛出舷外降落的救生筏的存放应能容易地转移到船舶的任何一舷以便降落，除船舶每舷已存放第26条之1所要求的必须能在任何一舷降落的总容量的救生筏者外。

#### 第14条

##### 救助艇的存放

救助艇的存放应：

- .1 外在少于5min以内进行降落下水的持续使用准备状态；
- .2 在适宜于降落并收回的地方；
- .3 使该救助艇及其装置不干扰置在任一其他降落地点的任一其他救生艇筏的操作；
- .4 如救助艇兼作救生艇者，符合第13条要求。

#### 第15条

##### 救生艇筏降落与回收装置

- 1 一切救生艇筏应配有符合第48条要求的降落装置，除非：
  - .1 从最轻载航海水线以上少于4.5m的甲板上登乘的救生艇筏，而且：
    - .1.1 救生艇筏的质量不大于185kg；或
    - .1.2 救生艇筏是存放在处于不利的纵倾达10°和船舶向任何一舷横倾不少于20°时，直接从存放地点降落下水；
  - .2 质量不大于185kg的救生艇筏，并且是按船上总人数200%的数目来配备的救生艇筏。
- 2 每艘救生艇应配有一台能降落和收回该救生艇的设备。
- 3 降落与回收装置应使该设备的操作人员在救生筏降落期间的任何时候，以及在救生艇回收期间的任何时候，能在船上观察到救生艇筏。
- 4 船上所配备的类似救生艇筏仅应使用一种型号的脱开机械装置。
- 5 在任一降艇站，救生艇筏的准备工作和操作应不干扰任一其他降艇站的任一救生艇筏或救助艇的迅速准备工作和操作。

6 凡使用者，吊艇索的长度应于船舶最轻载航海在不利纵倾情况下及船舶向任何一舷横倾不小于 $20^{\circ}$ 时，足使救生艇到达海面。

7 在准备和降落过程中，救生艇筏、它的降落设备以及必须降落的水面，根据情况应使用第II-1章第4.2条或第4.3条所要求的应急电源供电的照明系统给以足够的照明。

8 应备有在弃船过程中，防止船舶的任何排水排到救生艇筏上。

9 如救生艇筏有被船舶防摇翼造成损坏的危险者，则应备有由应急电源驱动的能将防摇翼收回船内的装置，驾驶室应设有应急电源运转的指示防摇翼位置的指示器。

10 如配备符合第4.2条或第4.3条要求的救生艇者，应装设吊艇架横张索，在其上设置不少于二根足够长度的救生索，能于船舶最轻载航海在不利的纵倾情况下及船舶向任何一舷横倾不小于 $20^{\circ}$ 时到达水平。

### 第16条

#### 救助艇的登乘、降落与回收装置

1 救助艇的登乘与降落装置应在尽可能最短的时间内，使能登上并降落救助艇。

2 如救助艇是船舶救生艇筏中一艘者，其登乘布置与降落地点尚应符合第1.1条和第1.2条各项要求。

3 降落装置应符合第1.5条要求。但无论如何，一切救助艇应能在船舶于平静水面前进航速达到5节时降落下水，凡有必要者可利用艇艙缆。

4 应能迅速地回收载足全部乘员及属具的救助艇。如救助艇兼作救生艇者，应能迅速地回收载足救生艇属具并经认可的至少6人的额定乘员的救助艇。

### 第17条

#### 抛绳设备

应配备一具符合第4.9条要求的抛绳设备。

### 第18条

#### 弃船训练与演习

1 本条适用于一切船舶。

2 手册

每间船员餐室及文娱室，或每间船员房应配有一份符合第5.1条要求的训练手册。

### 3 集合演习与操练

3.1 每个船员每月应至少参加一次弃船演习和一次消防演习。若有 25 % 以上的船员未参加该特定船上的上个月弃船和消防演习者，应在该船离港后 24 h 内举行该两项船员演习。如果某类船舶这样做是不可行的话，主管机关可同意至少是相当的其他安排。

3.2 在从事非短程国际航行的客船上，应在旅客上船后 24 小时内举行旅客集合演习。应向旅客讲授救生衣的用法和应变时采取的行动。如在已举行过应变演习后，只有少数旅客在港口上船，则应请这些旅客注意第 8 条之 2 和第 8 条之 4 所规定的应变须知就足够了，不必进行另一次集合演习。

3.3 在从事短程国际航行的船舶上，如在离港后不举行旅客集合演习者，则应请旅客注意第 8 条之 2 和 4 所规定的应变须知。

3.4 每次弃船演习应包括：

- .1 使用第 6 条之 4.2 所规定的报警系统，召集旅客和船员至集合地点，并确保他们了解应变部署表中规定的弃船命令；
- .2 向集合地点汇报，并准备执行应变部署表所述的任务；
- .3 查看旅客和船员穿着是否合适；
- .4 查看是否正确地穿好救生衣；
- .5 在完成任何必要的降落准备工作后，至少降下一艘救生艇；
- .6 起动并运转救生艇发动机；
- .7 运转降落救生筏所用的吊筏架。

3.5 不同的救生艇应在可行的范围内按第 3.4.5 段的要求，在逐次演习中降下。

3.6 演习应尽可能按实际应变情况进行。

3.7 每只救生艇至少每 3 个月在一次弃船演习中要载着经指定的操作船员降入水中开动。对于从事短程国际航行的船舶，如果由于港口泊位的安排和营运格局不允许救生艇在某一舷降下水者，主管机关可准许救生艇不在该舷降下水。但无论如何，所有这些救生艇应至少每 3 个月下降一次并每年降下水一次。

3.8 除兼作救助艇的救生艇外，救助艇应在合理和可行的范围内，每个月载指派的艇上艇员后降下水并在水上进行操纵。在一切情况下，应至少每 3 个月按此要求进行一次。

3.9 如救生艇与救助艇的降下水演习是在船舶前进航行中进行者，因为涉及危险，该项演习应在有遮蔽的水域并在有此项演习经验的驾驶员监督下进行演习。

3.10 在每次弃船演习时，应试验集合与弃船所用的应急照明系统。

#### 4 船上训练与授课

4.1 应尽可能快地，但不迟于船员上船后两星期内，进行船舶救生设备（包括救生艇筏属具）用法的船上训练。但无论如何，如船员是定期安排轮流派上船者，应在不迟于第一次上船后两星期内，进行此项训练。

4.2 应进行讲授船舶救生设备的用法和海上救生须知方面的课程，其间隔期与演习间隔期相同。每一课程内容可以是关于船舶救生设备系统中各个不同部分的，但在任一个2个月周期内，课程内容应包括全部船舶救生属具与设备。每个船员均应听课，课程应包括但没有必要仅限于：

- .1 船舶气胀式救生筏的操作与使用；
- .2 低温保护问题，低温急救护理和其他合适的急救程序；
- .3 在恶劣气候和恶劣海况中，船舶救生设备使用所需要的其他专门课程。

4.3 在每艘装设吊筏架降落救生筏的船舶上，应在不超过4个月的间隔期，举行此项设备用法的船上训练。每当可行时，此项训练应包括充气与降下救生筏。这只救生筏可以是训练专用救生筏，而不是船舶救生设备的组成部分；这只专用救生筏应加显著标记。

#### 5 记录

举行应变演习的日期、弃船演习与消防演习的细节、其他救生设备演习以及海上训练应记载于主管机关可能规定的航海日志。若在指定时间未举行全部应变集合、演习或训练项目时，则应在航海日志内记述其原因和已举行的集合、演习或训练项目的范围。

### 第19条

#### 使用准备状态、维护保养与检查

1 本条适用于一切船舶。1986年7月1日以前建造的船舶应在可行范围内符合本条之3和本条之6.2的要求。

#### 2 使用准备状态

在船舶离港前及在整个航行时间内，一切救生设备应处于可用状态，并准备立即使用。

#### 3 维护保养

3.1 应备有符合第5.2条要求的救生设备船上维护保养须知，并按须知进行维护保养。

3.2 主管机关可以同意用列在第52条要求中的船上计划维护保养表来代替本条之3.1所规定的须知。

#### 4 吊艇索的保养

应将降落所用的吊艇索的两索端掉转,间隔不超过30个月,由于吊艇索变质而有必要时,或在不超过5年的间隔期中,应予换新,取其较早者。

#### 5 备件与修理设备

救生设备及其易损或易耗而必须定期更换的部件应配有备件与修理设备。

#### 6 每周检查

每周应进行下列的试验和检查:

- .1 一切救生艇筏、救助艇及降落设备应进行外观检查,以确使立即可用;
- .2 只要环境温度在启动发动机所规定的最低温度以上,一切救生艇和救助艇的发动机应进行正车和倒车运转,总时间不少于3min。对于1986年7月1日以前建造的船舶,作为特例,主管机关可不坚持此项要求;
- .3 应试验通用紧急报警系统。

#### 7 月度检查

每月应使用第52条之1所规定的检查表检查救生设备(包括救生属具),确使完整无缺并处于可用状态。检查报告应载入航海日志。

#### 8 气胀式救生筏、气胀式救生衣与充气式救助艇的检修

##### 8.1 每只气胀式救生筏与每件气胀式救生衣应加检修;

- .1 间隔期限不得超过12个月,但无论如何,凡外观正常和合情合理者,主管机关可展期到17个月;
- .2 在认可的检修站进行检修,该检修站是胜任检修该筏的,备有正规的检修器具,并仅雇用受过正规训练的人员\*。

8.2 一切充气式救助艇的修理和维护保养,应按照制造商的说明书进行。可以在船上进行应急修理,但无论如何,应在认可检修站完成其永久性修理。

#### 9 液压脱开装置的定期检修

液压脱开装置应加检修;

- .1 间隔期限不得超过12个月,但无论如何,凡外观正常和合情合理者,主管机关可展期到17个月;

\* 参阅海事组织所通过的决议A.333(LX)所制定的“气胀式救生筏检修站的认可条件建议书”。

- .2 在认可的检修站进行检修, 该检修站是胜任检修该装置的, 备有正规检修器具, 并仅雇用受过正规训练的人员。

### 第 II 节 客船 (附加要求)

#### 第 20 条

#### 救生艇筏与救助艇

##### 1 救生艇筏

##### 1.1 从事非短程国际航行的客船应配备:

- .1 符合第 4 2 条、第 4 3 条或第 4 4 条要求的救生艇, 其在每舷的总容量应为不少于船上人员总数的 50%。主管机关可准以相等总容量的救生筏来代替救生艇, 但是, 船舶每舷应配备足够容纳不少于船上人员总数 37.5% 的救生艇。该救生艇应符合第 3 9 条或第 4 0 条要求, 而且应使用相等地分布在船舶每舷的降落设备; 并且
- .2 另外, 总容量应为船上人员总数至少 25% 的符合第 3 9 条或第 4 0 条要求的救生艇。这些救生艇应使用至少 1 台设在每舷的降落设备, 该设备可以是按本条之 1.1.1 要求装设的设备, 或是能在两舷均可使用的等效认可设备。但无论如何, 这些救生艇的存放没有必要符合第 1 3 条之 5 的要求。

##### 1.2 从事短程国际航行而且符合第 II-1 章第 6 条之 5 规定的分舱特种标准的客船应配备:

- .1 在可行范围内, 相等地分布在船舶每舷的符合第 4 2、4 3 或 4 4 条要求的救生艇总容量应为船上人员总数至少 30%, 而且符合第 3 9 条或第 4 0 条要求的救生艇总容量连同救生艇容量的救生艇筏应为船上人员总人数。这些救生艇应使用相等地分布在船舶每舷的降落设备, 并且
- .2 另外, 符合第 3 9 或 4 0 条要求的救生艇总容量应为船上人员总数至少 25%。这些救生艇应使用至少 1 台设在每舷的降落设备, 该设备可以是按本条之 1.2.1 要求装设的设备, 或是能在两舷均可使用的等效认可设备。但这些救生艇的存放没有必要符合第 1 3 条之 5 的要求。

##### 1.3 从事短程国际航行而且不符合第 II-1 章第 6 条之 5 规定的分舱特种标准的客船, 应按本条之 1.1 要求配备救生艇筏。



1.4 为船上人员总数弃船所需要配备的一切救生艇筏在载足全部乘员及属具后，应能在从发出弃船信号后30min内，全部降落水中。

1.5 为代替满足本条之1.1、1.2或1.3的要求，500总吨以下的客船，凡船上人员总数少于200人者，可遵照下列要求：

- .1 船舶每舷所配备的符合第39条或第40条要求的救生筏总容量应能容纳船上人员总数。
- .2 除非1.5.1段所要求的救生筏是能迅速地转移到任何一舷降落的，否则，应配备附加救生筏，使每舷的总容量为船上人员总数150%。
- .3 如本条之2.2所要求的救助艇亦是符合第42、43或44条要求的救生艇，则可计入本条之1.5.1段所要求的总容量，但是船舶任何一舷的总容量至少是船上人员总数的150%。
- .4 在任何一只救生艇筏掉失或不能使用时，每舷可供使用的救生艇筏应能足够容纳船上的所有人员。

## 2 救助艇

2.1 500总吨及500总吨以上的客船应在船舶每舷至少配备1艘符合第47条要求的救助艇。

2.2 500总吨以下的客船应至少配备一艘符合第47条要求的救助艇。

2.3 倘若救生艇也符合救助艇的要求，则可同意将此救生艇当作救助艇。

## 3 救生筏的集结

3.1 客船应配备足够数量的救生艇及救助艇，确使为了够船上全体人员弃船时使用而需要每艘救生艇或救助艇配备的救生筏不多于6只。

3.2 从事短程国际航行而且符合第II-1章第6条之5规定的分舱特种标准的客船应配备足够数量的救生艇及救助艇，确使为了够船上全体人员弃船时使用而需要每艘救生艇或救助艇配备的救生筏不多于9只。

## 第21条

### 个人救生设备

#### 1 救生圈

1.1 一艘客船应配备符合第7条之1和第31条要求的救生圈，其数量应不少于下表所规定的数量：

船 长(m)	最少救生圈数
60 以下	8
60 至 120 以下	12
120 至 180 以下	18
180 至 240 以下	24
240 及 240 以上	30

1.2 不论第7条之1.3如何规定，长度为60m以下的客船应配备不少于6个设以自亮浮灯的救生圈。

## 2 救生衣

除第7条之2规定的救生衣外，每艘客船应配备供不少于船上人员总数5%用的救生衣。这些救生衣应存放在甲板上或集合地点显而易见的地方。

## 3 救生衣浮灯

3.1 本款适用于一切客船，本款应不迟于1991年7月1日适用于1986年7月1日以前建造的客船。

3.2 在从事国际航行而非短程国际航行的客船上，每件救生衣应设有一盏符合第3.2条之3要求的浮灯。

## 4 保温救生服与保温用具

4.1 本款适用于一切客船。本款应不迟于1991年7月1日适用于1986年7月1日以前建造的客船。

4.2 客船应为每艘船上的救生艇配备至少3件符合第3.3条要求的保温救生服，此外，应为容纳在救生艇中而没有配备保温救生服的每一个人配备1件符合第3.4条要求的保温用具。在下列情况下，没有必要配备这些保温救生服与保温用具：

- .1 容纳在全封闭或部分封闭救生艇中的人员；或
- .2 如船舶一直在温暖气候航区航行，主管机关认为保温用具为不必要者。

4.3 4.2.1段的规定还应适用于配备在1986年7月1日以前建造的船舶上不符合第42、43或44条要求的全封闭或部分封闭救生艇。

## 第22条

### 救生艇筏与救助艇的登乘布置

1 在客船上，救生艇筏登乘布置的设计，应适于：

- .1 所有从存放处直接登乘并降落，或者从登乘甲板登乘并降落（但从两处登乘并降落）的救生艇；

.2 从存放处一个紧邻的位置登乘并降落的或从按第13条之5的要求在降落前移至的位置登乘并降落的吊架降落救生筏。

2 救助艇的布置应为，救助艇可在存放处直接登乘，并在救助艇定员船员载足的情况下直接降落。尽管有1.1段的要求，如救助艇也是救生艇，并且其他救生艇为从登乘甲板登乘及降落者，其安排则应为，救助艇也能从登乘甲板登乘并降落。

### 第23条

#### 救生筏的存放

在客船上，每一救生筏存放时，其艙缆应固定地系连在船上并设有符合第38条之6要求的漂浮脱开装置，使救生筏在船舶沉没时，在可行的情况下能漂浮脱开，如为气胀式，还能自动充气。

### 第24条

#### 集 合 站

除符合第11条要求外，每艘客船应设有旅客集合站，该站应：

- .1 设在登乘站附近，并可使旅客易于到达登乘站，与登乘站设在同一处者除外；
- .2 有集结和指挥旅客用宽敞场地。

### 第25条

#### 演 习

- 1 本条适用于一切客船。
- 2 客船每周应举行一次弃船演习和消防演习。

### 第三节 货船（附加要求）

### 第26条

#### 救生艇筏与救助艇

#### 1 救生艇筏

##### 1.1 货船应配备：

- .1 船舶每舷一艘或多艘符合第44条要求的救生艇，其总容量应能容纳船上人员总数。但是，主管机关可准许在有利气候条件下和在适宜航区内营运的货船（除油船、化学品液货船和气体运输船外）配备符

合第43条要求的救生艇,但营运航区的界限要注明在货船安全设备证书内;并且

- .2 另外,一只或多只符合第39或40条要求并能在船舶任何一舷降落下水的救生筏,其总容量应能容纳船上人员总数。如该救生筏或多只救生筏为不能容易地移到船舶任何一舷以降落下水者,则每舷所有的总容量应能容纳船上人员总数。

1.2 为代替满足1.1段的要求,货船可配备:

- .1 一艘或多艘符合第44条要求而能在船尾自由下降降落下水的救生艇,其总容量应能容纳船上人员总数;并且
- .2 另外,船舶每舷一只或多只符合第39或40条要求的救生筏,总容量应能容纳船上人员总数。至少在船舶一舷的救生筏应使用降落装置。

1.3 除油船、化学品液货船和气体运输船外,长度为85m以下的货船可按照下列要求,来代替满足1.1或1.2段的要求:

- .1 船舶每舷配备一只或多只符合第39或40条要求的救生筏,其总容量应能容纳船上人员总数。
- .2 除非1.3.1段所规定的救生筏能迅速地转移到任何一舷降落下水,否则应配备附加救生筏使每舷可用的总容量能容纳船上人员总数的150%。
- .3 如本条之2所规定的救助艇亦是符合第43或44条要求的救生艇,则该艇可列入1.3.1段所规定的总容量,但船舶每舷可用的总容量至少是船上人员总数的150%。
- .4 在万一任何一艘救生艇筏掉失或不能使用的情况下,每舷可供使用的救生艇筏应能容纳船上人员总数。

1.4 凡救生艇筏存放地点距船艏或船艉超过100m的货船,除配备1.1.2和1.2.2段所规定的救生筏外,尚应配备1只救生筏,在合理和可行范围内,尽量靠前或靠后放置,或1只尽量靠前和另一只尽量靠后放置。不管第29条如何要求,此一只或多只救生筏可按能用人力脱解的方式系牢,并不必是能用认可降落设备降落的形式。

1.5 除第15条之1.1所提到的救生艇筏外,为船上人员总数弃船所需要配备的一切救生艇筏在载足全部人员及属具后,应能在从发出弃船信号后10min内,全部降落水中。

1.6 运载散发有毒蒸气或毒气的货物\*的液体化学品船和气体运输船,应配备符合第4.5条要求的救生艇,来代替符合第4.3或4.4条要求的救生艇。

1.7 油船、化学品液货船和气体运输船装载闪点不超过60°C(闭杯试验)的货物者应配备符合第4.6条要求的救生艇,来代替符合第4.3或4.4条要求的救生艇。

## 2 救助艇

货船应至少配备1艘符合第4.7条要求的救助艇。若救生艇亦符合救助艇的要求,可以同意将此艇作为救助艇。

3 1986年7月1日以前建造的货船,除其救生艇外,应不迟于1991年7月1日配备:

- 1 一只或多只救生筏,总容量应能容纳船上人员总数。这只或多只救生筏应采用能与下沉中船舶自动脱开的制牢救生筏的绑扎方法或等效设施;
- 2 凡救生艇筏存放地点距船艏或船艉超过100 m者,除配备3.1段规定的救生筏外,1只救生筏在合理和可行范围内,尽量靠前或后放置,或一只尽量靠前,另一只尽量靠后,不管3.1段如何要求,此救生筏可按能用人力脱解的方式系牢。

## 第27条

### 个人救生设备

#### 1 救生圈

1.1 货船应配备符合第7条之1和第3.1条要求的救生圈,其数量应不少于下表所规定的数量:

船 长(m)	最少救生圈数
100 以下	8
100 至 150 以下	10
150 至 200 以下	12
200 及 200 以上	14

\* 参阅海上安全委员会决议MSC.4(48)所通过的国际散装危险化学品船建造与设备规则第十七章中和海上安全委员会决议MSC.5(48)所通过的国际液化气体船建造与设备规则第十九章中紧急逃脱需加呼吸保护的产品。

1.2 第7条之1.3所规定配在油船上的救生圈用自亮浮灯，应是电池型。

## 2 救生衣浮灯

2.1 本款适用于一切货船。本款应不迟于1991年7月1日适用于1968年7月1日以前建造的货船。

2.2 在货船上，每件救生衣应设有一盏符合第3.2条之3要求的浮灯。

## 3 保温救生服与保温用具

3.1 本款适用于一切货船。本款应不迟于1991年7月1日适用于1986年7月1日以前建造的货船。

3.2 货船应为船上每艘救生艇至少配备3件符合第3.3条要求的保温救生服，或如主管机关认为必须和可行时，则为船上每人配备1件符合第3.3条要求的保温救生服；但是，船舶除应配备第3.8条之5.1.24、第41条之8.31和第47条之2.2.13所规定的保温用具外，尚应为船上未配有浸水服的人员配备符合第3.4条要求的保温器材。如该船符合下列要求，则没有必要配备这些浸水服和保温器材：

- .1 船舶每舷配有全封闭救生艇，其总容量能容纳船上人员总数；或
- .2 配有能在该船舶艇自由下降降落下水的全封闭救生艇，总容量能容纳船上人员总数，而且是能从存放地方直接登上和降落下水的救生艇，同时船舶每舷救生筏总容量能容纳船上人员总数；或
- .3 经常从事温暖航区航行，主管机关认为浸水服为不必要者。

3.3 符合第2.6条之1.3要求的货船，应为船上每个人配备符合第3.3条要求的保温救生服，除非该船：

- .1 配有吊筏架降落救生筏；或
- .2 配有使用能在船舶两舷均可利用的等效设备的救生筏，且为不需先进入水中再登筏者；
- .3 经常从事温暖气候航区航行，主管机关认为浸水服为不必要者。

3.4 可用本条所规定的浸水服来满足第7条之3的要求。

3.5 1986年7月1日以前建造的货船所配备的本条3.2.1和3.2.2段所指的全封闭救生艇，不必符合第4.4条的要求。

## 第28条

### 救生艇筏的登乘和降落布置

1 货船救生艇筏的登乘布置应设计为，救生艇可从存放处直接登乘和降落，吊架降落救生筏可从存放处旁一紧邻位置或按第1.3条之5的规定将救生筏于降放前移至的位置登乘和降落。

2 总吨为 20,000 吨及 20,000 吨以上的货船, 其救生艇应能在大船于静水中以 5 节速度前进时降放, 必要时可利用艇锚缆。

### 第 29 条

#### 救生筏的存放

在货船上, 除第 26 条之 1.4 所要求的救生筏外, 每只救生筏存放时, 其锚缆应固定地系连在船上, 并设有符合第 38 条之 6 要求的漂浮脱开装置, 使救生筏在船舶沉没时, 能漂浮脱开, 如其为气胀式, 还能自动充气。

### C 部分 救生设备要求

#### 第 I 节 通 则

### 第 30 条

#### 救生设备一般要求

1 2.7 段适用于一切船舶。 2.7 段应不迟于 1991 年 7 月 1 日适用于在 1986 年 7 月 1 日以前建造的船舶。

2 除另有明文规定或主管机关经考虑船舶所经常从事的特殊航程, 认为其它要求为宜者外, 本节所规定的一切救生设备应:

- . 1 以恰当的工艺和材料制成;
- . 2 在 - 30 °C 至 + 65 °C 的空气温度范围内存放而不致损坏;
- . 3 如其在使用中, 可能浸没在海水中, 则在 - 1 °C 至 + 30 °C 的海水温度范围内使用;
- . 4 凡适用者, 皆防腐烂, 耐腐蚀, 并不受海水、原油或霉菌侵袭的过度影响;
- . 5 如暴露于日光下, 有抗变质力;
- . 6 在一切有助于探测的部位具有鲜明易见的颜色;
- . 7 在有助于探测的位置装贴逆向反光材料, 并与海事组织的建议相一致\*;
- . 8 如必须在风浪中使用, 则能在该环境中令人满意地工作。

3 主管机关应确定会老化变质救生设备的可用期限。 这类救生设备应标明确定其寿命的方法或必须更换的日期。

\* 参阅海事组织所通过的决议 A. 274 (VII) 所制定的“救生设备逆向反光带建议”。

## 第 II 节 个人救生设备

### 第 31 条

#### 救生圈

#### 1 救生圈技术规格

每只救生圈：

- .1 应具有不大于 800 mm 的外径及不少于 400 mm 的内径；
- .2 应采用自然浮力材料制成；它的浮力应不得依靠灯心草、软木刨片或软木粒、任何其它松散的粒状材料或任何依靠充气的空气室；
- .3 应能在淡水中支承不少于 14.5 kg 的铁块达 24 h 之久；
- .4 应具有不少于 2.5 kg 的质量；
- .5 应在被火完全包围 2 s 后，不至燃烧或继续熔化；
- .6 其构造，应能经受从最轻载航海水线以上至存放位置的高度或 3.0 m（取其大者）处投落水而不致损害救生圈或其附件的操作性能；
- .7 如救生圈为用来操动为自发烟雾信号及自亮浮灯所配备的迅速抛投装置者，应具有足以操动此项迅速抛投装置的质量或 4 kg，取其大者；
- .8 应设有直径不小于 9.5 mm 及长度不少于救生圈体外直径 4 倍的把手索 1 根。把手索应绕救生圈的周围，制牢在四个等距点，形成四个相等的索环。

#### 2 救生圈自亮浮灯

第 7 条之 1.3 所规定的自亮浮灯应：

- .1 不致被水所熄灭；
- .2 能向上半球的所有方向，不论是连续发出发光强度不小于 2 cd 的亮光，或是发出至少相称的发光强度，每分钟不少于 50 闪速率的闪光（放出闪光）；
- .3 配有使用至少 2 h 并能满足 2.2 段要求的能源；
- .4 能经受 1.6 段所要求的投落试验。

#### 3 救生圈自发烟雾信号

第 7 条之 1.3 所规定的自发烟雾信号应：

- .1 在平静水面漂浮时，均速喷出鲜明易见颜色的烟雾不少于 15 min；
- .2 在信号喷出烟雾的整个期间中，不会爆炸般地点燃，或不喷出任何火焰；



- .3 在海浪中, 不致淹没;
- .4 当完全浸没在水下时, 继续喷出烟雾至少 10s;
- .5 能经受 1.6 段所要求的投落试验。

#### 4 可浮救生索

第 7 条之 1.2 所规定的可浮救生索应:

- .1 不打纽结;
- .2 具有不小于 8 mm 的直径;
- .3 具有不少于 5 KN 的破断强度。

### 第 32 条

#### 救生衣

##### 1 救生衣的一般要求

1.1 救生衣应在被火完全包围 2 s 后, 不至燃烧或继续熔化。

1.2 每件救生衣的结构应:

- .1 经示范后, 在无帮助情况下一个人能在 1 min 内正确地穿好救生衣;
- .2 能反穿或显然只能以一种穿法穿用, 并尽可能不至被错误地穿着;
- .3 穿着舒适;
- .4 任由穿着者从至少 4.5 m 高度跳入水中不致受伤, 而且救生衣不移位也不损坏。

1.3 每件救生衣在平静淡水中, 应具有足够的浮力与稳性:

- .1 将筋疲力尽或失去知觉人员的嘴部托出水面不低于 120 mm, 其身体向后倾斜与垂向成不少于 20° 并不大于 50° 的角度;
- .2 将水中失去知觉人员从任何姿势转成为嘴部高出水面的姿势, 不超过 5 s。

1.4 救生衣应具有足够的浮力, 在浸入淡水中 24 h 后, 不得降低 5% 以上。

1.5 救生衣应使穿着的人员可作短距离的游泳, 并登上救生艇筏。

1.6 每件救生衣应备有用细索系牢的哨笛。

##### 2 气胀式救生衣

依靠充气作浮力的救生衣应具有不少于两个独立充气室, 而且符合本条 1 款的要求, 并应:

- .1 浸水后自动充气, 配有用单一人工动作充气的装置, 并能用嘴来充气;

- .2 在万一任何一个空气室失去浮力时，仍能符合 1.2、1.3 和 1.5 段的要求；
- .3 使用自动机械装置充气后，仍符合 1.4 段的要求。

### 3 救生衣浮灯

#### 3.1 每个救生衣浮灯应：

- .1 具有不小于 0.75 *cd* 的发光强度；
- .2 具有能提供 0.75 *cd* 发光强度至少达 8 h 的能源；
- .3 当系在救生衣时，可在上半球的可行最大球缺上看到亮光。

#### 3.2 如 3.1 段所指的浮灯是闪光灯，该灯还应：

- .1 配有手动操作开关；
- .2 不得装设聚光的透镜或弧形反射器；
- .3 以每分钟不少于 50 闪的速率闪光，其有效发光强度至少为 75 *cd*。

## 第 33 条

### 保温救生服

#### 1 保温救生服的一般要求

##### 1.1 保温救生服应采用防水材料制成，并应：

- .1 在无帮助情况下，能在 2 分钟内将它拆包并穿好，如保温救生服必须连同救生衣一起穿着，则考虑到任何有关联的衣服\*和救生衣；
- .2 在被火完全包围 2 s 后，不至燃烧或继续熔化；
- .3 遮盖除脸部以外整个身体，双手也应遮盖，配有永久性附连的手套者除外；
- .4 备有尽量排除或减少保温救生服腿部内面自由空气的布置；
- .5 从不少于 4.5 m 高度跳进水中后，不至有过分的水进入保温救生服。

##### 1.2 保温救生服亦符合第 32 条要求者，则可归类为救生衣。

##### 1.3 保温救生服应使穿着保温救生服（如保温救生服必须连同救生衣一起穿着，则加穿救生衣）的人员能：

- .1 爬上并爬下长度至少为 5 m 的垂直梯子；
- .2 在弃船时，执行正常的任务；

\* 参考本组织以决议 A . (Ⅷ) 通过的“关于救生设备试验的建议”的 3.1.3.1 段。

- . 3 从不少于 4.5m 高度跳入水中, 保温救生服不损坏或不移位, 或人员不受伤; 并且
  - . 4 在水中作短距离游泳并登上救生艇筏。
- 1.4 具有浮力而且设计为不须加穿救生衣的浸水服应设有符合第 32 条之 6 要求的浮灯及第 32 条之 1.6 所规定的笛哨。
- 1.5 如保温救生服必须连同救生衣一起穿着, 救生衣应穿在保温救生服外面。穿着保温救生服的人员应能在无帮助的情况下穿上救生衣。

## 2 保温救生服的热性能要求

### 2.1 非自然保温材料制成的保温救生服:

- . 1 应标明必须连同保暖衣服一起穿着的须知;
- . 2 其构造应为: 在穿着者连同保暖衣服一起穿着时, 或如保温救生服必须连同救生衣一起穿着, 则加穿救生衣后, 从 4.5m 高度跳入水中一次后, 保温救生服能继续提供足够的热保护, 确使穿着者在平静流通水中, 水温为 5℃, 历时 1 小时后, 体温降低不超过 2℃。

2.2 自然保温材料制成的保温救生服, 在穿着者在单独穿着保温救生服, 或如保温救生服必须连同救生衣一起穿着, 则加穿救生衣后, 从 4.5m 高度跳入水中一次后, 应能继续提供足够的热保护, 确使穿着者在平静流通水中, 水温为 0℃与 2℃之间, 历时 6 h 后, 体温降低不超过 2℃。

2.3 保温救生服应可使两手受到包裹的穿着者, 浸在 5℃水中, 历时 1 h 后, 可拿起铅笔并写字。

### 3 浮力要求

穿着符合第 32 条要求的保温救生服, 或保温救生服与救生衣一起穿着的人员, 应在淡水中, 在不超过 5 s 内, 从脸部朝下姿势翻转成脸部朝上姿势。

## 第 34 条

### 保温用具

1 保温用具应采用导热率于大于 0.25 W/(m·K) 的防水材料制成, 并且其结构在用来包裹人员时, 应减少被包裹者体温的对流性和蒸发性热损失。

### 2 保温用具:

- . 1 应包裹穿着救生衣人员除面部以外的整个身体, 双手也应包裹, 除配有永久性附连的手套者外;

- . 2 应能在救生艇筏或救助艇中，在无人帮助的情况下将它拆包并容易穿着；
  - . 3 如保温用具妨碍游泳，应可使穿着者在2分钟内在水中把它脱掉。
- 3 保暖用具在气温-30℃至+20℃范围内，功能应正常。

### 第Ⅲ节 视觉信号

#### 第35条

##### 火箭降落伞火焰信号

- 1 火箭降落伞火焰信号应：
- . 1 装在防水外壳内；
  - . 2 在外壳上，印有清楚阐明火箭降落伞火焰信号用法的简明须知或图解；
  - . 3 具有整体的点燃装置；
  - . 4 设计成：在按制造厂的操作须知使用时，人员握持外壳而不致感到不舒适。
- 2 当垂直发射时，火箭应达到不少于300m的高度，在其弹道顶点处，或在接近其弹道顶点处，火箭应射出降落伞火焰，该火焰应：
- . 1 发出明亮红光；
  - . 2 燃烧均匀，平均发光强度不少于30,000 cd；
  - . 3 具有不小于40s的燃烧时间；
  - . 4 具有不大于5m/s的降落速度；
  - . 5 在燃烧时不烧损降落伞或附件。

#### 第36条

##### 手持火焰信号

- 1 手持火焰信号应：
- . 1 装在防水外壳内；
  - . 2 在外壳上，印有清楚阐明手持火焰信号用法的简明须知或图解；
  - . 3 具有自备的点燃装置；
  - . 4 设计成：在按制造厂的操作须知使用时，人员握持外壳而不致感到不舒适，燃烧中的或未熄灭的渣滓不致危害救生艇筏。
- 2 手持火焰信号应：
- . 1 发出明亮红光；

- .2 燃烧均匀, 平均发光强度不少于 15,000 *cd*;
- .3 具有不小于 1 *min* 的燃烧时间;
- .4 浸入 100*mm* 深的水下, 历时 10 秒钟后, 仍继续燃烧。

### 第 37 条

#### 可浮发烟信号

- 1 可浮发烟信号应:
  - .1 装在防水外壳内;
  - .2 在按制造厂的操作须知使用时, 不会爆炸般地点燃;
  - .3 在外壳上, 印有清楚阐明可浮发烟信号用法的简明须知或图解。
- 2 可浮发烟信号应:
  - .1 在平静水面漂浮时, 匀速地喷出鲜明易见颜色的烟雾; 持续时期不少于 3 *min*;
  - .2 在整个喷出烟雾期间, 不喷出任何火焰;
  - .3 在海浪中, 不致淹没;
  - .4 在浸入 100*mm* 水深下, 历时 10*s* 后, 仍继续喷出烟雾。

### 第 IV 节 救生艇筏

#### 第 38 条

#### 救生筏的一般要求

##### 1 救生筏的构造

- 1.1 每只救生筏的构造, 应能经受在一切海况下暴露漂浮达 30 天。
- 1.2 救生筏的构造应为从 18*m* 高度投落下水后, 救生筏及其属具能符合使用要求。如救生筏必须存放在最轻载航海水线以上超过 18*m* 高度的地方, 则该救生筏应是曾从至少该高度处进行过满意的投落试验的型式。
- 1.3 在顶篷撑起和未撑起的情况下, 漂浮的救生筏应能经受从筏底以上至少 4.5*m* 的高度反复多次跳登。
- 1.4 救生筏及其舫装件的构造应使救生筏在载足全部乘员及属具并放下 1 只海锚后, 在平静水中, 能被拖带, 航速达 3 节。
- 1.5 救生筏应设有保护乘员免受暴露的顶篷, 该顶篷在救生筏降落中和到水面时自动撑起。该顶篷应符合下列要求:
  - .1 顶篷应采用以空气间隙隔开的双层材料或其它等效设施来防热及御寒。应设有防止水分聚集在空气间隙内的设施;

- .2 顶篷内面的颜色应不致使乘员感到不舒适;
- .3 每个进口处应有鲜明的标志, 并设有有效的可调整关闭装置, 在筏内外两面均能容易而迅速地开启该装置, 以利于通空气且可防止海水、风和冷气的侵入。容纳 8 人以上的救生筏应设有不少于两个正相对面的进口处;
- .4 即使当进口处关闭时, 顶篷无论何时都应通入足够乘员需要的空气;
- .5 顶篷应设有不少于一个的瞭望窗;
- .6 顶篷应设有收集雨水的设施;
- .7 坐在顶篷下面各处的乘员, 应有足够的头上空间。

## 2 救生筏的最小乘员定额与质量

- 2.1 按第 39 条之 3 或第 40 条之 3 的要求算出的乘员定额少于 6 人的救生筏, 概不得认可。
- 2.2 除必须使用符合第 48 条要求的认可降落设备降落的救生筏及不要求是便携式的救生筏外, 其他救生筏的容器及其属具的总质量不得超过 185kg。

## 3 救生筏舫装件

- 3.1 救生筏应沿筏体外围及内侧牢固地装设链环状把手索。
- 3.2 救生筏应设有把第 6 条之 2.1 所要求的手提式无线电设备所配的天线适宜地安装和制牢在操作地点的装置。
- 3.3 救生筏应设一根有效的船缆, 其长度应不少于从存放处到最轻载航海水线的距离的 2 倍或 15m, 取其长者。

## 4 吊筏架降落救生筏

- 4.1 除符合上述要求外, 使用认可降落设备的救生筏应:
  - .1 当救生筏载足全部乘员及属具后, 能经受碰撞速度不小于 3.5m/s 之碰撞船舷的水平撞击力, 并再从不小于 3m 高度投落下水后, 不得有影响其性能的损坏;
  - .2 设置在登乘期间能可靠地将救生筏贴紧并系留在登乘甲板的装置。
- 4.2 每只客船的吊筏架降落救生筏的布置应使救生筏的全部乘员能迅速地登上救生筏。
- 4.3 每只货船的吊筏架降落救生筏的布置应使救生筏的全部乘员能在发出登筏指示的时间起不超过 3min 内登上救生筏。

## 5 属具

5.1 每只救生筏的正常属具应包括：

- .1 系有不少于 30m 长浮索的可浮救生环一个；
- .2 装有可浮柄的非折叠式小刀 1 把，系以短绳并存放在顶篷外面靠近舷缆与救生筏系连处的袋子内。另外，乘员定额为 13 人或 13 人以上的救生筏应加配一把不必是非折叠式的小刀；
- .3 乘员定额不超过 12 人的救生筏配可浮水瓢 1 只。乘员定额为 13 人或 13 人以上的救生筏配可浮水瓢 2 只；
- .4 海绵 2 块；
- .5 海锚 2 只，每只配有耐冲击锚索及收锚索各 1 根，一只备用，另一只固定地系于救生筏上，其系固方法应使海锚在救生筏充气或到水面时，总是使救生筏以非常稳定的方式顶风。每只海锚及其锚索和收锚索应具有足以适于一切海况的强度。海锚收锚索的每端都应设有旋转环，并应是不可能在其支索之间外转的一种类型；
- .6 可浮手划桨 2 只；
- .7 开罐头刀 3 把。带特殊开罐头叶片的安全小刀可满足本要求；
- .8 急救药包 1 套，置于使用后可再盖紧的水密箱内；
- .9 哨笛或等效的音响号具 1 只；
- .10 符合第 35 条要求的火箭降落伞火焰信号 4 支；
- .11 符合第 36 条要求的手持火焰信号 6 支；
- .12 符合第 37 条要求的可浮发烟信号 2 个；
- .13 适于摩氏通信的防水手电筒 1 只，连同备用电池 1 副及备用灯泡 1 只，装在同一水密容器内；
- .14 有效的雷达反射器 1 具；
- .15 日光信号镜 1 面，连同与船舶和飞机通信用法须知；
- .16 印在防水硬纸上，或装在水密容器内的第五章第十六条所指的救生信号图解说明表 1 张；
- .17 钓鱼用具 1 套；
- .18 总数为救生筏额定乘员每个人不少于 10,000 KJ 的口粮，口粮应保存于气密包装内并收存于水密容器内；
- .19 水密容器数个，内装总数为救生筏额定乘员每个人 1.5l 的淡水，其中每个人所需的 0.5l 可用 2 天内能生产等量淡水的海水除盐器来代替；
- .20 不锈饮料量杯 1 个；

- .21 救生筏额定乘员每个人配防晕船药6片和清洁袋一个;
- .22 救生须知;
- .23 紧急行动须知;
- .24 足供10%救生筏额定乘员用的符合第34条要求的保温器材或2件,取其大者。

5.2 在根据5.1段配备的救生筏上,第39条之7.3.5和第40条之7.7所要求的标志应是以印刷体大写罗马字母标明的“SOLAS.A.PACK”字样。

5.3 从事短程国际航行的客船,如主管机关在考虑到航程性质与时间后认为5.1段所规定的全部项目不都是必要时,主管机关可准许这些船上所载的救生筏配备5.1.1至5.1.6段、5.1.8段、5.1.9段、5.1.13至5.1.16段和5.1.21至5.1.24段所规定的属具以及5.1.10至5.1.12段所规定的属具的半数。在这些救生筏上,第39条之7.3.5和第40条之7.7所要求的标志应是以印刷体大写罗马字母标明的“SOLAS.A.PACK”字样。

5.4 属具,凡适宜者,应收存在容器内,如容器不是救生筏的整体部分或固定地附于救生筏上的,则容器应存放并制牢在救生筏内,并能在水面漂浮至少30 min,不至损坏其内存属具。

## 6 救生筏漂浮脱开装置

### 6.1 艏缆系统

救生筏艏缆系统应在船舶与救生筏之间起连接作用,其布置应确使救生筏在脱开时(气胀式救生筏则在充气时)不至被下沉中的船舶拖没。

### 6.2 薄弱环

如漂浮脱开装置使用薄弱环者,薄弱环应:

- .1 不至被从救生筏容器内拉艏缆所需的力拉断;
- .2 在适用时有足够强度使救生筏充气;
- .3 在张力为 $2.2 \pm 0.4$  KN时断开。

### 6.3 静水压力脱开装置

漂浮脱开装置中使用静水压力脱开装置者,该脱开装置:

- .1 应采用兼容的材料制成,以防止该装置发生故障。不得接受在静水压力脱开装置的部件上镀锌或其它形式的金属镀层;
- .2 在水深不超过4 m处,应自动脱开救生筏;
- .3 应设有防止水分在该装置处在正常位置时聚积在静水压力室内的泄水器;



- .4 其结构, 当海浪拍击时, 应不至脱开;
- .5 在其外部应耐久地标明其型号与出厂号;
- .6 应附有证件或产品铭牌, 说明其制造日期、型号与出厂号;
- .7 每件连接舢缆系统的部件的强度应不小于对舢缆所要求的强度。

### 第 39 条

#### 气胀式救生筏

1 气胀式救生筏应符合第 38 条的要求, 此外, 应符合本条的要求。

#### 2 气胀式救生筏的构造

2.1 主浮力舱应分成不少于 2 个的独立隔舱, 每个隔舱通过各自的止回充气阀充气。浮力舱的安排应是在任一隔舱万一损坏或充气失效时, 未损伤的隔舱应能支持该筏的额定乘员而且救生筏整个周围都是正的干舷。每个乘员的质量以 75 kg 计并且都坐在规定的座位上。

2.2 救生筏的筏底应为水密, 并应充分绝缘以御寒冷, 不论是:

- .1 采用一个或几个隔舱(这个或这几个隔舱能由乘员充气或自动充气, 并能由乘员泄气并再充气的方法; 或
- .2 采用不依靠充气的其它等效设施。

2.3 救生筏应使用无毒气体充气, 环境温度为 18°C 至 20°C 之间时在 1 min 内, 环境温度为 -30°C 时在 3 min 内, 完全充足。充气后, 救生筏载足全部乘员和属具后应保持其形状不变。

2.4 每个充气隔舱应能经受至少等于 3 倍工作压力的超压, 并应不论使用安全阀或限制供气方法, 均能防止其压力超过 2 倍工作压力。应设有安装 10.1.2 段所要求的充气泵或充气器的设备, 用以保持工作压力。

#### 3 气胀式救生筏的乘员定额

气胀式救生筏的乘员定额应等于下列各数中较小者:

- .1 充气后, 其主浮胎(不包括篷柱以及横座位在内, 如设有时)的容量以  $m^3$  计时除以 0.096 后所得的最大整数; 或
- .2 救生筏的内水平横剖面面积(可包括一个或多个横座位在内, 如设有时)量至浮胎的最内边, 以  $m^2$  计时除以 0.372 后所得的最大整数; 或
- .3 可足够舒适地坐下并有足够的头上空间而且不致妨碍任何救生筏属具操作的人数; 这些人全部穿着救生衣, 每个人的质量以 75 kg 计。

#### 4 进入气胀式救生筏的通道

4.1 至少一个进口处应设有半刚性登筏跳板以使人员能从海面登入救生筏，跳板的布置要防止一旦跳板损坏，使救生筏明显泄气。设有一个以上的进口处的吊筏架降落救生筏应在拉近索与登乘设施对面的进口处设有登筏跳板。

4.2 未设有登筏跳板的进口处应备有登筏梯，其最下一级踏板应位于救生筏的最轻水线以下不小于0.4m处。

4.3 救生筏内面应有有助于水中的人员把自己从登筏梯拉进救生筏的设施。

#### 5 气胀式救生筏的稳性

5.1 每只气胀式救生筏的构造在充气胀满并且顶篷撑到最高位置而漂浮时，在风浪中应当稳定。

5.2 救生筏处于翻覆位置的稳性应为，在风浪中及在平静水面上，均能由1个人扶正。

5.3 救生筏载足全部乘员和属具后的稳性，应为能在平静水面被拖带，航速达到3节。

#### 6 气胀式救生筏舾装件

6.1 除第38条之6所要求的薄弱环节外，舾缆系统包括其系连于救生筏上设施的破断强度，救生筏的乘员定额为9人或9人以上者，应不小于10.0kN；其它救生筏应不小于7.5kN。救生筏应能由一个人充气。

6.2 救生筏顶篷的顶部应装设一盏人工控制灯，在晴朗天气的黑夜，距离至少2海里处可看到灯光，使用时间不少于12h。如是闪光灯，该灯在12h使用时间的初始2h内的闪光速率，每分钟应不少于50闪。该灯应由海水电池或化学干电池供电，并应在救生筏充气时自动发光。该电池应为不因其存放所在救生筏内的潮湿或湿气而变质的类型。

6.3 救生筏内面应装设一盏人工控制灯，该灯应能连续使用至少12h。应在救生筏充气时自动发光，并有足够光强以供阅读救生和属具用法须知。

#### 7 气胀式救生筏的容器

7.1 气胀式救生筏应装在容器内，该容器：

- 1 其结构在所能遇到的海上各种条件下，能经久耐用；
- 2 有充裕的自然浮力，当装有救生筏及其属具时，船舶如沉没，能从内部拉舾缆并拉动充气装置；
- 3 应是切合实际地水密，容器底部泄水孔除外。

7.2 救生筏在其容器内的包装方法，应确使救生筏从容器破裂脱开后，在水面充气时，尽可能地处于正浮位置。

7.3 容器上应标明：

- .1 制造厂名或商标；
- .2 出厂号码；
- .3 认可机关名称和乘员定额；
- .4 SOLAS
- .5 内装应急袋的型号；
- .6 最近一次检修日期；
- .7 舱缆长度；
- .8 水线以上最大许可存放高度（根据跌落试验高度和舱缆长度）；
- .9 降落须知。

8 气胀式救生筏上的标志

救生筏上应标明：

- .1 制造厂名或商标；
- .2 出厂号码；
- .3 制造日期（年月）；
- .4 认可机关名称；
- .5 最近一次检修的检修站名称和地点；
- .6 每个进口处上面写明乘员定额，字高不小于100mm，字色与救生筏颜色有明显的差异。

9 吊筏架降落气胀式救生筏

9.1 除上述的要求外，使用认可降落设备的救生筏，当悬挂在吊筏钩或吊筏索时，应能受下列负荷：

- .1 在环境温度和稳定的救生筏温度为 $20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ 而且不使用所有安全阀的情况下，全部乘员和属具质量的4倍。 及
- .2 在环境温度和稳定的救生筏温度为 $-30^{\circ}\text{C}$ 而且使用所有安全阀的情况下，全部乘员和属具质量的1.1倍。

9.2 必须使用降落设备降落的救生筏的刚性容器，应加以制牢，以防止该容器或其部件在所装的救生筏充气 and 降落下水过程中及以后，坠落下海。

10 气胀式救生筏的附加属具

10.1 除第38条之5所要求的属具外，每只气胀式救生筏应配备：

- . 1 修补浮力分隔舱破洞的修补工具一套；
- . 2 充气泵或充气器 1 具。

10.2 第 38 条之 5.1.2 所要求的小刀应是安全小刀。

#### 第 40 条

##### 刚性救生筏

- 1 刚性救生筏应符合第 38 条的要求，此外，应符合本条的要求。
- 2 刚性救生筏的构造
  - 2.1 救生筏的浮力应由认可的自然浮力材料提供，置于尽可能靠近救生筏的周围处。浮力材料应是阻燃的，或用阻燃的复盖加以保护。
  - 2.2 救生筏的筏底应能防止海水进入，并应有效地支持乘员离开水面并御寒。
- 3 刚性救生筏的乘员定额

每只刚性救生筏的乘员定额应等于下列各数中较小者：

  - . 1 浮力材料以  $m^3$  计的体积乘一个系数，系数为 1 减去浮力材料比重，除以 0.096 所得的最大整数；或
  - . 2 救生筏筏底的水平横剖面面积，以  $m^2$  计时，除以 0.372 所得到的最大整数；或
  - . 3 可足够舒适地坐下并有足够的头上空间而且不致妨碍救生筏任何属具操作的人数，这些人员全部穿着救生衣，每个人的质量以 75 kg 计。
- 4 进入刚性救生筏的通道
  - 4.1 至少有一个进口处应设有刚性登筏跳板以便人员能从海面登上救生筏。设有一个以上进口处的吊筏架降落救生筏应在拉近与登乘设备对面的进口处设有登筏跳板。
  - 4.2 未设有登筏跳板的进口处应设有登筏梯，其最下一级踏板应位于救生筏的最轻水线以下不小于 0.4 m 处。
  - 4.3 救生筏内应有有助于水中的人员把自己从登筏梯拉进救生筏的设施。
- 5 刚性救生筏的稳性
  - 5.1 除救生筏以任何一面漂浮时都能安全使用者外，救生筏的强度与稳性应为能自行扶正，或在风浪中及平静水面上，均能由一人扶正。
  - 5.2 救生筏载足全部乘员和属具后的稳性，应为能在平静水面被拖带，航速达到 3 节。

## 6 刚性救生筏舾装件

6.1 救生筏应设有一根有效的艏缆。除第38条之6所要求的薄弱环外，艏缆系统包括其系连于救生筏上设施的破断强度，救生筏的乘员定额为9人或9人以上者，应不小于10.0 kN；其它救生筏应不小于7.5 kN。

6.2 救生筏顶篷的顶部应装设一盏人工控制灯，在晴朗天气的黑夜，距离至少2海里处可看到灯光，使用时间不少于12 h。如是闪光灯，该灯在12 h使用时间的初始2 h的闪光速率，每分钟应不少于50闪。该灯应由海水电池或化学干电池供电，并应在救生筏顶篷撑起时自动发光。该电池应为不因其存放所在救生筏的潮湿或湿气而变质的类型。

6.3 救生筏内面应装设一盏人工控制灯，能连续使用至少12 h。该灯应在顶篷撑起时自动发光，并有足够光强以供阅读救生和属具用法须知。

## 7 刚性救生筏上的标志

救生筏上应标明：

- .1 所从属的船舶名称和船籍港；
- .2 制造厂名或商标；
- .3 出厂号码；
- .4 认可机关的名称；
- .5 每个进口处上面写明乘员定额，字高不小于100mm，字色与救生筏颜色有显著的差异；
- .6 SOLAS；
- .7 内装应急袋的型号；
- .8 艏缆长度；
- .9 水线以上最大许可存放高度（投落试验高度）；
- .10 降落须知。

## 8 吊筏架降落刚性救生筏

除上述的要求外，使用认可降落设备的刚性救生筏，当悬挂在吊筏钩或吊筏索时，应能承受全部乘员和属具质量的4倍。

### 第41条

#### 救生艇的一般要求

##### 1 救生艇的构造

1.1 一切救生艇均应建造恰当，其形状及尺度比例应使其在海浪中具有充裕的稳性，并在载足全部乘员及属具后，具有足够的干舷。一切救生艇应有刚性艇体，

而且当在平静水面处于正浮位置，并载足全部乘员及属具时，以及在水线以下任何部位破孔，假设没有掉失浮力材料及其它损伤时，能保持正稳性。

1.2 一切救生艇应具有足够的强度，

- .1 使其在载足全部乘员及属具后能安全降落水中；
- .2 当船舶在平静水中以5节航速前进时，能降落水中并被拖带。

1.3 艇体及刚性顶盖应是阻燃的或不燃的。

1.4 横座板、长凳或尽可能置于艇内低处的固定椅上面应设有座位，其构造应能支承其乘员人数，每个人的体重以100 kg计，其座位按2.2.2段的要求提供。

1.5 每艘救生艇应具有足够强度使其经受下列负荷，在卸去负荷后无剩余变形，

- .1 对于金属艇体的救生艇，救生艇载足全部乘员及属具后的总质量的1.25倍；或
- .2 对于其它救生艇，救生艇载足全部乘员及属具后的总质量的2倍。

1.6 每艘救生艇应具有足够的强度，使其在载足全部乘员和属具以及处在一定位置的滑梯或护舷材（如适用）时，能经受碰撞速度至少3.5 m/s的船舷水平撞击力，并能经受从至少3 m高度投落下水。

1.7 从超过50%艇底面积的艇底表面到封闭盖或顶篷内面的垂直距离应：

- .1 对于乘员定额为9人或9人以下的救生艇，不少于1.3 m；
- .2 对于乘员定额为24人或24人以上的救生艇，不少于1.7 m；
- .3 对于乘员定额为9人至24人的救生艇，不少于以线性内插法确定的介于1.3 m与1.7 m之间长度的距离。

## 2 救生艇的乘员定额

2.1 容纳人数超过150人的救生艇，概不得予以认可。

2.2 救生艇的乘员定额应等于下列各数中的较小者：

- .1 以正常姿势坐着时不致妨碍推进装置或任何救生艇属具操作的人数，每个人的平均质量为75 kg，全部穿着救生衣；或
- .2 按照图1要求的座位设置所能提供的座位的数目。倘若搁脚板已固定，有足够腿部活动空间而且上下座位之间垂直距离不少于350 mm，则各座位形状可以交搭如图所示。

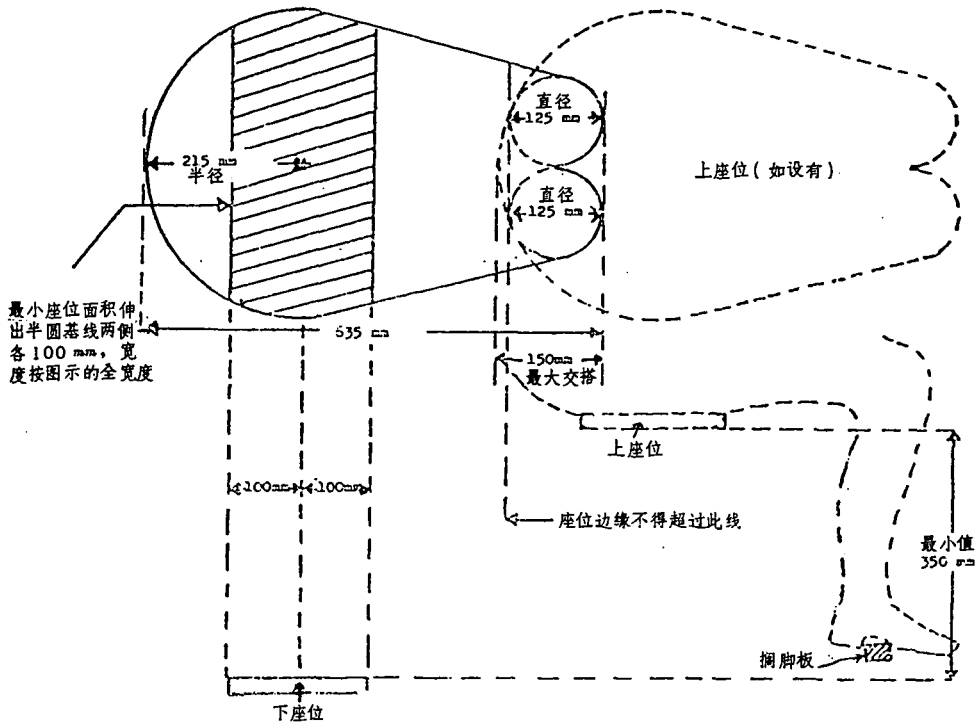


图 1

2.3 应在救生艇内明确地标出每个座位位置。

### 3 进入救生艇

3.1 每艘客船救生艇的布置, 应使其全部乘员能迅速登艇, 而且能迅速离艇。

3.2 每艘货船救生艇的布置, 应使其全部乘员在从发出登艇指示时间起不超过 3 min 登艇完毕。尚应可能迅速离艇。

3.3 救生艇应备有在救生艇任何一舷均可使用的登乘梯, 以便水中人员能够登艇。该梯子的最下一级踏板应位于救生艇轻水线以下不小于 0.4 m 处。

3.4 救生艇的布置, 应能把失去自助能力的人员从海上或者从所躺的担架上抬进救生艇。

3.5 人员可能行走的所有表面应有防滑层。

### 4 救生艇浮力

一切救生艇应具有自然浮力, 或应设有必须不受海水、原油或石油产品不利影响的自然浮力材料, 当艇内浸水和破漏通海时, 仍足以将满载一切属具的救生艇浮起。每个救生艇额定乘员应配备相等于 280 N 浮力的附加自然浮力材料。除非

是上述要求的浮力材料以外的浮力材料，否则浮力材料不得设置在救生艇的艇体外面。

### 5 救生艇干舷和稳性

当50%乘员定额的乘员以正常姿势坐在艇中心线一侧时，一切救生艇的干舷应至少为救生艇长度的1.5%，或100 mm，取其大者，干舷是从水线量至救生艇可能变成浸水状态的最低开口处。

### 6 救生艇推进装置

6.1 每艘救生艇应由压燃式发动机驱动。其燃料的闪点为43℃或43℃以下（闭杯试验）的发动机，概不得供任何救生艇使用。

6.2 发动机应既可设有手起动系统，也可使用两个独立的可再次充电的电源的起动系统。尚应配备任何必要的起动辅助设施。除主管机关考虑到配备救生艇的船舶所经常从事的特殊航行，认为另一种最低温度较为适宜外，发动机起动装置和辅助设施在环境温度-15℃中，应在发动机起动操作程序开始后2min内起动发动机。发动机的罩壳、横座板或其它障碍物均不得妨碍起动装置。

6.3 发动机应能在离水的救生艇冷起动后运转不少于5min。

6.4 当救生艇艇内浸水浸到曲轴中心线处时，发动机应仍能运转。

6.5 螺旋桨轴系的布置应可使螺旋桨从发动机脱开。应设有救生艇正车和倒车装置。

6.6 废气管的布置应防止水进入处在正常运转状态的发动机。

6.7 一切救生艇的设计应充分考虑在水中人员的安全和漂流物损坏推进系统的可能性。

6.8 当载足全部乘员和属具，并且所有发动机驱动的辅助装置均运转时，救生艇在平静水中前进航速应至少为6节，而当拖带1只载足全部乘员和属具或其相等负载的25人救生筏时，救生艇在平静水中前进的航速应至少为2节。应配备适用于船舶营运航区预期温度范围内的燃料，而且应足够供满载的救生艇以6节的航速运转不少于24h。

6.9 救生艇发动机、传动装置和发动机的附件，应采用阻燃罩壳或其它提供类似保护的适当装置加以围蔽。这些装置尚应保护人员不至意外地接触到发热和转动的部件，并保护发动机免于暴露在风雨和海浪中。应装设减低发动机噪声的适宜装置。起动装置电池应设有围绕电池底部和各侧面形成水密围壁的箱子。电池箱应有紧密的并装有必要通气孔的顶盖。



6.10 救生艇发动机和附件的设计，应限制电磁波的发射，使发动机运转时不致干扰在救生艇内使用的无线电救生设备的运转。

6.11 所有起动发动机用的电池、无线电用的电池和探照灯用的电池都应配备有再充电的设备。无线电用的电池应不得用作起动发动机的动力。应装有从船舶电源供电的救生艇电池再充电设施，电源电压不超过55 V，并可在救生艇登乘位置断开。

6.12 应备有起动和操作发动机的防水须知，并张贴在发动机起动控制器附近明显处。

## 7 救生艇舾装件

7.1 一切救生艇应在靠近艇体内最低点处装设至少1个的排水阀，该排水阀在救生艇不在水面时自动开启，使水从艇体内排出，并且在救生艇在水面时自动关闭，以防防水浸入。每个排水阀应配有1只盖闭排水阀的盖子或塞子，以短绳、链条或其它适宜方法系于救生艇上。排水阀应位于救生艇内容易到达之处，并且其位置应明显标示。

7.2 一切救生艇应装有舵和舵柄。当加设舵轮或其它遥控操舵机械装置时，舵柄应在万一操舵机械发生故障时仍能控制舵叶。舵应固定地附连在救生艇上。舵柄应固定地安装或连接在舵柱上，但如救生艇设有遥控操舵机械装置，舵柄可以是可拆装式，并可靠地存放在舵柱附近。舵和舵柄的布置，应不致因脱开机械装置的操作或螺旋桨的运转而遭到损坏。

7.3 除在舵和螺旋桨附近部位外，应沿救生艇外面装设链环状可浮救生索。

7.4 翻覆时不能自行扶正的救生艇，应在艇体底部装设供人员攀附救生艇的适宜扶手。扶手固连在救生艇的方式，应在受到足以把扶手从救生艇上打掉的冲击力时，打掉扶手而不损坏救生艇。

7.5 一切救生艇应设置的水密柜或舱室，足供贮存本条第8款所要求的细小属具、水和口粮。应备有贮存所收集到雨水的设施。

7.6 每艘必须用单根或多根吊艇索降落的救生艇应设置符合下列要求的脱开机械装置：

- 1 该装置的布置应能同时脱开所有吊艇钩；
- 2 该装置应具有下列两种脱开能力：
  - 2.1 正常脱开能力，当救生艇浮在水面或吊艇钩无负荷时，它总会把救生艇脱开；

2.2 受载脱开能力，在吊艇钩有负荷时它总会把救生艇脱开。此脱开的布置应使救生艇在有任何负荷的情况下，从漂浮在水面上救生艇的受载情况到等于救生艇载足全部乘员及属具后总质量的1.1倍的负荷情况，都能脱开。此种脱开能力要得到足够的保护，使在意外和过早使用时不会脱开。

.3 脱开控制手柄应有明显标志，标志颜色与手柄周围颜色有明显的差异。

.4 该装置的设计应取安全系数等于6，按所选用材料的极限强度计算，假设救生艇质量是相等分布在两吊艇索的。

7.7 每艘救生艇应装设脱开装置，使能脱开拉紧的前舷缆。

7.8 每艘救生艇应设有固定设置的地线接头和把第6条之2.1所要求的手持式无线电设备所配的天线适宜地安装和制牢在操作地点的装置。

7.9 用于顺船舷降落下水的救生艇应设置便于救生艇降落和防止损坏所必不可少的滑梯和护舷材。

7.10 顶篷或封闭盖的顶部应装设一盏人工控制灯，该灯在晴朗天气的黑夜，在距离至少2海里处可看到灯光，使用时间不少于12 h。如是闪光灯者，该灯在12 h使用时间的初始2 h的闪光速率，每分钟应不少于50闪。

7.11 救生艇内应装设一盏灯或一个光源，提供照明不少于12 h，使人能阅读救生须知和属具用法须知；但不准使用燃油灯作此用途。

7.12 除另有说明外，每艘救生艇应配备有效的舀水设施或自动的舀水设施。

7.13 每艘救生艇的布置应为能在控制与操舵位置提供足够的向前、向后和向两舷的视域，以便安全地降放和操纵救生艇。

## 8 救生艇属具

除带钩艇篙应散置，以供撑开救生艇外，一切本款或本章各处所要求的各项救生艇属具应采用绑扎的方式、贮存在柜内或舱室内的方式、贮存在托架内或类似的支架装置的方式或其它适宜的方式系牢于救生艇内。属具的系缚方式应不致妨碍任何弃船步骤。各项救生艇属具应尽可能小巧轻便并应包装合适而紧凑。除另有说明者外，每艘救生艇的正常属具应包括：

.1 足够的数量的可浮桨，以供在平静海面划桨前进。所配备的每支桨应配齐桨架、桨叉或等效装置。桨架或桨叉应以短绳或链条系于艇上；

.2 带钩艇篙2支；

.3 可浮水瓢1只，水桶2只；

- . 4 救生手册 1 本；
- . 5 内装涂有发光剂或具有适宜照明装置的有效罗经的罗经柜一具，在全封闭救生艇，该罗经柜应固定地设置在操舵位置；在任何其它救生艇，该罗经柜应配有适当的支架装置；
- . 6 适当尺度的海锚 1 只，配有浸湿时还可用手紧握的耐冲击锚索和收锚索各 1 根。海锚、锚索和收锚索的强度在一切海况中，均应是适用的；
- . 7 有效的艏缆 2 根，其长度不小于从救生艇存放位置到最轻载航海水线距离的 2 倍或 15m，取其长者。1 根附连在第 41 条之 7.7 所要求的脱开装置的艏缆应设置在救生艇的前端，而另一根艏缆应系固于救生艇艇艏或艇艏附近，以备使用；
- . 8 太平斧 2 把，救生艇每端各 1 把；
- . 9 水密容器数个，内装总数为救生艇额定乘员每个人 3 l 的淡水，其中每个人 1 l 的淡水可用 2 天内能生产等量淡水的水除盐器来代替；
- . 10 附有短绳的不锈钢勺 1 个；
- . 11 不锈钢饮料量杯 1 个；
- . 12 总数为救生艇额定乘员每个人不少于 10,000 kJ 的口粮，口粮应保存于气密包装内并收存在水密容器内；
- . 13 符合第 35 条要求的火箭降落伞火焰信号 4 支；
- . 14 符合第 36 条要求的手持火焰信号 6 支；
- . 15 符合第 37 条要求的可浮发烟信号 2 个；
- . 16 适于摩氏通信的防水手电筒 1 只，连同备用电池 1 副及备用灯泡 1 只，装在水密容器内；
- . 17 日光信号镜 1 面，连同与船舶和飞机通信用法须知；
- . 18 印在防水硬纸上，或装在水密容器内的第五章第十六条所规定的救生信号图解说明表 1 张；
- . 19 哨笛或等效的音响号具 1 只；
- . 20 急救药包一套，置于使用后可盖紧的水密箱内；
- . 21 每个人配防晕船药 6 剂和清洁袋 1 个；
- . 22 以短绳系于艇上的水手刀 1 把；
- . 23 开罐头刀 3 把；
- . 24 系有长度不小于 30 m 浮索的可浮救生环 2 个；

- .25 手摇泵 1 具；
- .26 钓鱼用具 1 套；
- .27 足够数量的发动机和其附件的小调整用工具；
- .28 适用扑灭油类火灾的手持灭火器 1 具；
- .29 探照灯 1 具，可在黑夜对距离 180m 处宽度为 18 m 的浅色物体有效照明总共达 6 小时，并至少能连续使用不少于 3 h；
- .30 有效的雷达反射器 1 具；
- .31 足供不少于救生艇额定乘员 10% 用的符合第 3.4 条要求的保温器材或 2 件，取其大者；
- .32 如主管机关在考虑该船所从事的航程性质与时间认为 8.12 和 8.26 段所规定的属具为不必要者，主管机关可准予免配。

## 9 救生艇标记

- 9.1 在救生艇上应以经久的显明字迹标明其尺度和乘员定额。
- 9.2 救生艇所从属的船舶名称及船籍港应以粗体罗马字母标明于艇艏两侧。
- 9.3 识别救生艇所从属船舶和救生艇号码措施的标志方法，应使在空中可看清。

## 第 4.2 条

### 部分封闭救生艇

- 1 部分封闭救生艇应符合第 4.1 条的要求，另外，应符合本条的要求。
- 2 每艘部分封闭救生艇应装设有效的舀水设施或是自动的自舀水设施。
- 3 部分封闭救生艇应装设固定附连的从艇艏延伸不少于 20% 的该救生艇长度和从该救生艇最后端延伸不少于 20% 的该救生艇长度的刚性顶盖。该救生艇应设固定附连的可折式顶篷，可折式顶篷连同刚性顶盖形成一个能挡风雨的遮蔽把该救生艇乘员完全罩住，使其免受风吹雨打。顶篷的布置：
  - .1 应设有合适的刚性型材或条板，以便撑起顶篷；
  - .2 应能由不多于 2 个人即可容易地撑起顶篷；
  - .3 顶篷应采用空气间隙隔开的不少于两层的材料或其它等效设施来隔热，以保护乘员不受寒热的侵害。应设有防止水分聚集在空气间隙内的设施；
  - .4 顶篷外面应是鲜明易见的颜色，顶篷内面的颜色要不致使乘员感到不舒适；

- .5 顶篷内面及两舷应有进口处，进口处设有有效的可调整关闭装置，在内外两面均能容易而迅速地开启和关闭该装置，既可通空气又可防止海水、风和冷气的侵入；应设有把进口处牢固地固定在开启和关闭位置的设施；
  - .6 进口处关闭后，顶篷应无论何时仍有足供乘员所需的空气进入；
  - .7 顶篷应有收集雨水的设备；
  - .8 万一救生艇翻覆时，乘员应能逃出。
- 4 救生艇内面应有鲜明易见颜色。
- 5 第6条之2.2所要求的无线电报设备应安装在足以容纳该项设备和使用人员的舱室内。如救生艇的构造提供满足主管机关要求的遮蔽处所者，则不要求安装在独立舱室。

### 第 43 条

#### 自行扶正部分封闭救生艇

- 1 自行扶正部分封闭救生艇应符合第41条的要求，另外，尚应符合本条的要求。
- 2 封闭盖
- 2.1 应装设固定附连的从该救生艇艇艏延伸不少于20%救生艇长度的并从该救生艇最后端延伸不少于20%救生艇长度的刚性顶盖。
- 2.2 这两个顶盖应形成两个遮盖。如遮盖具有舱壁者，则应有足够尺寸的开口，以使每个穿着保温救生服或保暖衣服和救生衣的人员容易进入。遮盖的内高度应足够供人员容易地进入设在救生艇艇艏和艇艉的座位。
- 2.3 刚性顶盖的布置应包括窗口或半透明板，使足够的日光射进在开口或顶篷关闭后的救生艇内部，以使没有必要采用人工光。
- 2.4 刚性顶盖应装有扶手供在救生艇外部活动的人员安全抓用手用。
- 2.5 救生艇开敞部分应装设固定附连的可折式顶篷，其布置应：
- .1 能由不多于2个人在不超过2 min以内即可容易地撑起的顶篷；
  - .2 顶篷应采用空气间隙隔开的不少于两层材料或其它等效办法来绝热，为乘员御寒。
- 2.6 刚性顶盖和顶篷所形成的遮盖的布置应做到：
- .1 在任一乘员不离开遮盖的情况下，应能完成降落和回收操作；

- 2 在两端和每舷均应设有进口处，进口处设有在内外两面均能迅速开启和关闭的有效可调整关闭装置，以便既能通空气又可防止海水、风和冷气侵入；应设有把进口牢固地固定在开启和关闭位置的设施；
- 3 顶篷撑起和关闭所有进口后，应仍有足供乘员所需的空气进入；
- 4 应设有收集雨水的设施；
- 5 刚性顶盖和顶篷外面和救生艇被顶篷覆盖部分的内面应有鲜明易见的颜色。遮盖内面的颜色应不致使乘员感到不舒适。
- 6 应能划动救生艇。

### 3 翻覆与扶正

3.1 每个标明的座位处应设有1根安全带。安全带的设计应在救生艇处于翻覆位置时能将质量为100kg的人员牢固地缚在原处。

3.2 救生艇的稳性在装载全部或部分乘员及属具，而且全部乘员都用安全带缚牢后，应是自然或自动地自行扶正的。

### 4 推进装置

4.1 应在舵工位置控制发动机和传动装置。

4.2 发动机及发动机装置应能在翻覆过程中任何位置运转，并在救生艇转回到正浮后仍继续运转，或在翻覆后，能自动停车，并在救生艇转回到正浮状态而且水已从救生艇泄出后易于再起。燃油及润滑油系统的设计要做到在翻覆过程中，能防止从发动机流失燃油或流失超过250ml的润滑油。

4.3 空气冷却式发动机应设有从救生艇外面吸进冷气并把它排出救生艇外面的空气管系统。应设有手动调节风门，使可从救生艇内面吸进冷气并把它排到救生艇内面。

### 5 结构与护舷材

5.1 不管第41条之1.6如何规定，自行扶正部分封闭救生艇的结构与护舷材，应保证救生艇在载足全部乘员及属具后以不小于3.5m/s的碰撞速度碰撞船舷时，提供免受由于救生艇碰撞而产生的有害加速度的影响的保护装置。

5.2 救生艇应为自动的自舀水型。

## 第 44 条

### 全封闭救生艇

1 全封闭救生艇应符合第41条的要求，另外，尚应符合本条的要求。

#### 2 封闭盖

每艘全封闭救生艇应设有完全罩住救生艇的刚性水密封闭盖。封闭盖的布置：

- 1 应保护乘员，使其不受冷、热的侵害；
- 2 应采用通道盖提供进入救生艇的通道，通道盖可关闭以使救生艇水密；

- 3 通道盖应位于任何乘员在无须离开围蔽区域的情况下，能完成降落和回收操作的地方；
- 4 在内外两面应均能开启和关闭通道盖，并设有可靠地把通道盖夹住在开启位置的设施；
- 5 使能划动救生艇；
- 6 当救生艇处于翻覆位置、通道盖关闭且无显著漏水时，封闭盖应能支持救生艇（包括全部属具、机械和全部乘员）的全部质量；
- 7 封闭盖的两舷应设有窗口或半透明板，使足够的日光射进进口盖关闭后的救生艇内部，以使没有必要采用人工光；
- 8 封闭盖外面应是鲜明的颜色，而内面的颜色不致使乘员感到不舒适；
- 9 应设有扶手供在救生艇外部活动的人员安全抓手用，并帮助登艇和离艇；
- 10 人员应能从进口处无须跨过横座板或其它障碍物而到达他们的座位；
- 11 应保护乘员免受救生艇发动机可能造成的危险的负大气压的影响。

### 3 翻覆与扶正

3.1 每个标明的座位处应设有1根安全带。安全带的设计应在救生艇处于翻覆位置时能将质量为100kg的人员牢固地缚在原处。

3.2 救生艇在稳性上做到当救生艇在装载全部或部分乘员及属具、所有进口处和开口都是关闭成水密而且全部乘员都用安全带缚牢时，能自然或自动地自行扶正。

3.3 救生艇应在救生艇处于第41条之1.1所规定的损坏情况时，能支持其全部乘员及属具，并且其稳性在万一翻覆时，应使救生艇自动地处于为乘员提供在水面上逃出的位置。

3.4 一切发动机排气管、空气管和其它开口，在设计上做到应在救生艇翻覆和扶正时，使水不至进入发动机。

### 4 推进装置

4.1 应在舵工位置控制发动机和传动装置。

4.2 发动机及发动机装置应能在翻覆过程中任何位置运转并在救生艇转回到正浮后仍继续运转，或在翻覆后能自动停车并在救生艇转回到正浮时易于再起。燃油及润滑油系统在设计上做到在翻覆过程中，能防止从发动机流失燃油或流失超过250ml的润滑油。

4.3 空气冷却式发动机应设有从救生艇外面吸进冷气并把它排出救生艇外面的空气管系统。应设有手动调节风门，使可从救生艇内面吸进冷气并把它排到救生艇内面。

## 5 结构与护舷材

不管第 41 条之 1.6 如何规定, 全封闭救生艇的结构与护舷材, 应保证救生艇在载足全部乘员及属具后以不小于 3.5m/s 的碰撞速度碰撞船舷时, 提供免受由于救生艇碰撞而产生的有害加速度的影响的保护装置。

## 6 自由降落救生艇

用于自由下降的救生艇, 在构造上要做到使救生艇能提供免受在载足全部乘员及属具后, 至少从最大设计的水线以上存放处高度降落下水所产生的有害加速度的影响的保护装置; 该水线是最轻载的船舶在不利的纵倾达 10° 的情况下和向任何一舷横倾达 20° 的水线。

### 第 45 条

#### 具有独立供气系统的救生艇

除应符合第 41 条和第 44 条的要求外, 具有独立供气系统的救生艇在布置上要做到当救生艇在一切进口处和开口均关闭的情况下航行时, 救生艇内空气保持安全和适宜于呼吸, 而且发动机正常运转时间不少于 10min。在此期间, 救生艇内大气压应不得降到艇外大气压以下, 也不得超过艇外大气压 20mbar 以上。该系统应有视觉指示器, 无论何时均可指示送风压力。

### 第 46 条

#### 耐火救生艇

1 除符合第 41 条、第 44 条和第 45 条的要求外, 耐火救生艇在水面时, 应能保护其额定乘员经受持续油火包围该救生艇不少于 8 min。

## 2 喷水系统

装有喷水防火系统的救生艇, 应符合下列要求:

- 1 应使用自吸式马达泵从海里抽水为该系统供水。该系统应可“开”和“关”洒到救生艇外面的水流;
- 2 海水吸入口在布置上应做到能防止从海面吸入易燃液体;
- 3 该系统在布置上应做到能用淡水冲洗, 并完全排清积水。



## 第 V 节 救助艇

### 第 47 条

#### 救助艇

#### 1 一般要求

1.1 除本条所规定者外，所有救助艇应符合第 41 条之 1 至第 41 条之 7.4 以及第 41 条之 7.6、第 41 条之 7.7、第 41 条之 7.9、第 41 条之 7.12 和第 41 条之 9 的要求。

1.2 救助艇可以是刚性或充气结构，或两者的混合结构，并且：

- . 1 其长度应不小于 3.8m，不大于 8.5m；
- . 2 应至少能乘载 5 个坐下的人员和 1 个躺下的人员。

1.3 刚性与充气混合结构的救助艇，应符合本条中合适的要求，使主管机关感到满意。

1.4 除具有足够舷弧的救助艇外，救助艇应设有延伸不少于 15 % 该艇长度的艇艏盖。

1.5 救助艇应能以航速达到 6 节进行操纵，并保持此航速至少 4h。

1.6 救助艇应在海浪中具有充分的机动性和操纵性，使能从水中拯救人员，集结救生筏能以至少 2 节航速拖带船舶所配备的载足全部乘员及属具或相当重量的最大救生筏。

1.7 救助艇应装设舷内发动机或舷外发动机。如装设舷外发动机，舵与舵柄可以是该机的组成部分。不管第 41 条之 6.1 如何要求，救助艇可以装设具有认可燃油系统的汽油驱动舷外发动机，但燃油柜要加特殊的防火和防爆炸保护。

1.8 拖带装置应永久地安装在救助艇上，其强度应足够集结或拖带 1.6 段所要求的救生筏。

1.9 救助艇应设有贮存细小属具的防风雨贮存处。

#### 2 救助艇属具

2.1 除带钩艇篙应不加固定以供撑开救助艇外，各项救助艇属具应通过采用索具，通过贮存在柜内或舱室内、贮存在托盘或类似支架装置内，或通过采取其它适宜办法，固定在救助艇内。属具的系缚方式应不致妨碍任何降落和收回作业。一切救助艇属具应尽可能小巧轻便，并应包装合适而紧凑。

## 2.2 每艘救助艇通常的属具应包括：

- 1 足够数量的可浮桨或手划桨，以供在平静海面划桨前进。每支桨应配齐桨架、桨叉或等效装置。桨架或桨叉应以短绳或链条系于艇上；
- 2 可浮水瓢 1 只；
- 3 内装有涂有发光剂或具有适宜照明装置的有效罗经的罗经柜 1 具；
- 4 海锚 1 个和收锚绳 1 条，配有足够强度的锚索，其长度不少于 10m；
- 5 足够长度和强度的艏缆 1 根，附连在符合第 41 条之 7.7 要求的脱开装置，并设置在救助艇的前端；
- 6 长度不少于 50m 的可浮索 1 根，具有足够拖带 1.6 段的要求救生筏的强度；
- 7 适于摩氏通信的防水手电筒 1 只，连同备用电池 1 副及备用灯泡 1 只，装在水密容器内；
- 8 哨笛或等效的音响号具 1 只；
- 9 急救药包 1 套，置于使用后可盖紧的水密箱内；
- 10 系有长度不小于 30 m 浮索的可浮救生环 2 个；
- 11 探照灯 1 具，可在黑夜对距离 180m 处宽度为 18m 的浅色物体有效照明总共达 6 h，并至少能连续使用不少于 3 h；
- 12 一个有效的雷达反射器；
- 13 足供 10 % 救助艇额定乘员用的符合第 34 条要求的保温器材或 2 件，取其大者。

## 2.3 除 2.2 段所要求的属具外，每艘刚性救助艇通常的属具应包括：

- 1 带钩艇篙 1 支；
- 2 水桶 1 只；
- 3 小刀或太平斧 1 把。

## 2.4 除 2.2 段所要求的属具外，每艘充气式救助艇通常的属具应包括：

- 1 可浮安全小刀 1 把；
- 2 海绵 2 块；
- 3 有效的手动充气器或充气泵 1 具；
- 4 装在适当容器内的修补破洞的修补工具 1 套；
- 5 安全艇篙 1 支。

## 3 充气式救助艇的附加要求

### 3.1 第 41 条之 1.3 和第 41 条之 1.5 的要求不适用于充气式救助艇。

- 3.2 充气式救助艇在构造上要做到当充气式救生艇被悬挂在吊艇钩或吊艇索时:
- . 1 其强度和刚性应足使救助艇载足全部乘员和属具后能降落和收回;
  - . 2 其强度在环境温度为  $20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ , 不使用所有安全阀的情况下, 应足够经受其全部乘员及属具质量 4 倍的负荷;
  - . 3 其强度在环境温度为  $-30^{\circ}\text{C}$ , 使用所有安全阀的情况下, 应足够经受其全部乘员及属具质量 1.1 倍的负荷。
- 3.3 充气式救助艇的构造, 应能经受下列暴露:
- . 1 在海上当存放在船舶开敞甲板时;
  - . 2 在一切海况下漂浮达 30d。
- 3.4 除第 41 条之 9 的要求外, 充气式救助艇应标明其出厂号码、制造厂名或商标和制造日期。
- 3.5 充气式救助艇的浮力应或者由至少有 5 个约为等体积的独立隔舱分隔的单胎, 或者 2 个均不得超过 60 % 总体积的独立胎提供。浮力胎的布置在任一隔舱万一损坏时, 未损伤的隔舱应仍能支持该救助艇的额定乘员而且救助艇整个周围都是正的干舷, 每个乘员质量以 75 kg 计, 而且坐在规定的座位上。
- 3.6 成为充气式救助艇边界的浮力胎充气后应为每个救助艇额定乘员提供不少于  $0.17 \text{ m}^3$  的体积。
- 3.7 每个浮力舱应设有一个供人力充气用的止回阀和放气设备。尚应设有 1 个安全释放阀, 除主管机关认为此阀为不必要者外。
- 3.8 充气式救助艇的艇底下面和外面易受伤害部位, 应加设主管机关满意的防擦板条。
- 3.9 凡装有艇底板者, 该艇底板应不得嵌入超过救助艇总长的 20 %。
- 3.10 应设有合适的加强片以便系牢艇艏缆和艇艉缆以及艇内外两面的链环状把手索。
- 3.11 无论何时, 充气式救助艇均应维持满充气状态。

## 第 VI 节 降落与登乘设备

### 第 48 条

#### 降落与登乘设备

##### 1 一般要求

- 1.1 每具降落设备连同一切降落和回收索具的布置, 应能在纵倾达到  $10^{\circ}$  并向任一舷横倾达到  $20^{\circ}$  时, 在下列情况下安全降落它所配属的满配备的救生艇筏或救助艇:

- 1 按第 22 条或第 28 条所要求, 登上全部乘员后;
- 2 不载人员的救生艇筏或救助艇。

1.2 不管 1.1 段如何规定, 按经有关的 1978 年议定书修改后的 1973 年国际防止船舶造成污染公约和海事组织的建议 \* (如果适用) 计算的最后横倾角超过  $20^{\circ}$  的油船、化学品液货船和气体运输船上所配备的救生艇降落设备应能在该船舶处于最后横倾角的情况下, 在较低舷进行操作。

1.3 降落设备不得依靠除重力或不依赖船舶动力的任何储存机械动力以外的任何方式来降落其所配属的处于满载、满配备状态和轻载状态的救生艇筏或救助艇。

1.4 降落机械装置的布置应可由 1 个人自船舶甲板上某一位置, 或自救生艇筏或救助艇内面某一位置, 来开动; 在甲板上操作降落机械装置的人员应能看到救生艇筏。

1.5 每具降落设备的构造, 应仅需要最少的日常维护量。一初需要船员进行定期维护的部件, 应容易接近和容易维护。

1.6 降落设备的绞车制动器的强度, 应足以经受:

- 1 试验负荷不少于 1.5 倍最大工作负荷的静负荷试验;
- 2 试验负荷不少于 1.1 倍最大工作负荷在最大下降速度时的动负荷试验。

1.7 降落设备及其附属设备的强度, 除绞车制动器外, 应足以经受试验时不少于最大工作负荷 2.2 倍的静力试验负荷。

1.8 设计构件和一切滑车、吊艇索、眼板、链环、紧固件和其它一切用作连接降落设备的配件所用的安全系数应大于根据规定的最大工作负荷和结构所选用材料的极限强度而取用的最小安全系数。适用于一切吊艇架和构件的最小安全系数应为 4.5, 适用于吊艇索、吊艇链、链环和滑车的最小安全系数应为 6。

1.9 每具降落设备应在结冰情况下在可行范围内保持有效。

1.10 救生艇降落设备应能收回载有艇员的救生艇。

1.11 降落设备的布置, 应能使人员按第 38 条之 4.2、第 38 条之 4.3、第 41 条之 3.1 和第 41 条之 3.2 的要求安全地登上救生艇筏。

## 2 使用吊艇索和绞车的降落设备

2.1 吊艇索应是防旋转及耐腐蚀的钢丝绳。

2.2 除设置有效的补偿装置者外, 对于多卷筒绞车, 吊艇索的布置应使在降落时, 以相同的速率从各卷筒卷出, 并在吊起时, 以相同的速率均匀地卷到各卷筒上。

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\* 参阅海上安全委员会以决议 MSC.4(48) 通过的《国际散装运输危险化学品船舶构造和设备规则》和海上安全委员会以决议 MSC.5(48) 通过的《国际散装运输液化气体船舶构造和设备规则》关于破损稳性的要求。

2.3 每具救助艇降落设备应装设动力驱动的绞车马达，该马达的功率能从中吊起载足全部乘员及属具的救助艇。

2.4 应设有收回每艘救生艇筏和救助艇的有效的手动装置。在救生艇筏和救助艇下降时，或使用动力吊起时，绞车的转动部分应不使手动装置手柄或手轮旋转。

2.5 凡使用动力收回吊艇架吊臂者，应装设安全装置，在吊艇架吊臂回到原位限制器之前要自动地切断动力，以防止吊艇索或吊艇架受到过度应力，除马达的设计是能防止此过度应力者外。

2.6 救生艇筏或救助艇降落下水的速度，应不小于由下列公式得出的速度：

$$S = 0.4 + (0.02 \times H)$$

式中 S = 下降速度（以 m/s 计）

并且 H = 从吊艇架顶部到最轻载航海水线的距离（以 m 计）。

2.7 经过考虑救生艇筏或救助艇的设计、乘员的防止过度力的保护装置以及把在急刹车过程中的惯性力考虑进去的降落装置强度后，主管机关应制定出最大下降速度。降落设备应同时采取其他某些措施，以确保不得超过此速度。

2.8 每具救助艇降落设备应能以不少于 0.3m/s 的速度吊起载足全部救助艇乘员及属具的救助艇。

2.9 每具降落设备应设有制动器，使载足全部乘员及属具的救生艇筏或救助艇在降落中能刹住并可靠地系留住，凡有必要者，制动带应加防水和防油的保护。

2.10 手控制动器的布置，应始终处于制动状态，除非操作者或操作者操作的机械装置把制动控制器保持在“脱开”的位置上。

### 3 漂浮脱开降落

凡需要降落设备的救生艇筏也设计为漂浮脱开者，救生艇筏从其存放地点漂浮脱开应是自动的。

### 4 自由下降降落

除符合本条之 1 中适用的要求外，每具使用斜面的自由下降降落设备尚应符合下列要求：

- 1 该降落设备的布置应使救生艇筏的乘员在降落过程中不至感受到过度力。
- 2 该降落设备应是具有足够斜角和长度的刚性结构，保证救生艇筏有效地离开船舶。
- 3 该降落设备应加有效防腐保护，而且其构造在救生艇筏降落过程中应防止发生摩擦火花或碰击火花。

## 5 撤离滑梯降落和登乘

除符合本条之 1 适用的要求外，每具撤离滑梯降落设备尚应符合下列要求：

- 1 撤离滑梯应能由 1 个人在登乘位置展开；
- 2 撤离滑梯应能在强风和海浪中使用。

## 6 救生筏降落设备

除关于利用重力旋出降落设备，在存放地点登乘，并收回满载的救生筏者外，每具救生筏降落设备应符合 1 和 2 段的要求。该降落设备的布置，应防止在降落过程中过早脱开，并使救生筏在水面时脱开。

## 7 登乘梯

7.1 为确保从甲板到登乘梯顶部，或从登乘梯顶部到甲板的安全过渡，应设有扶手。

### 7.2 登乘梯的踏板：

- 1 应采用没有节疤或其它凹凸不平外形的硬质木制成，而且加工平滑并无锐利棱边和毛刺，或采用其它等效性质的适用材料制成；
- 2 应具有有效的防滑表面，可以采用纵向槽纹，也可以敷铺认可的防滑覆盖物；
- 3 其长度应不少于 480mm，宽度应不少于 115mm，并且厚度应不少于 25mm，不把任何防滑表面或覆盖计算在内；
- 4 间距应相等，间隔不少于 300mm，也不大于 380mm，并且其系固方法要使其保持水平状态。

7.3 登乘梯每边的边绳应由两根裸露的白棕绳组成，其周长不小于 65mm。每根边绳在顶端踏板之下应为整根而无接头。可以采用其它材料，但尺度、破断应力、风化性能、伸缩性能和紧握性能均须至少相当于白棕绳的性能。所有绳端均应扎牢以防松散。

## 第 V II 节 其它救生设备

### 第 49 条

#### 抛绳设备

1 每具抛绳设备应：

- 1 能相当准确地将绳抛射出；
- 2 包括不少于 4 个抛绳体，每个能在无风天气中将绳抛射至少 230m 远；
- 3 包括不少于 4 根抛射绳，每根抛射绳具有破断张力不少于 2KN；

- 4 备有简要说明书或图解阐明抛绳设备的用法。
- 2 手枪发射的火箭，或火箭与抛射绳组成整体的组件，应装在防水的外壳内。此外，对于手枪发射的火箭、抛射绳和火箭以及引燃器材应贮存在抗风雨的容器内。

### 第 50 条

#### 通用紧急报警系统

通用紧急报警系统应以船舶号笛或汽笛，并另加以由船舶主电源及第 II - 1 章第 42 条或第 II - 1 章第 43 条所要求的应急电源（如果适合）供电的电动铃或小型振膜电警笛或其它等效警报系统，发出由 7 个或 7 个以上的短声继以一长声组成的通用紧急报警信号。除了鸣响船舶号笛外，该系统应能自船舶驾驶室和其它要害位置进行操作。全船所有起居处所及正常船员工作处所均应能听到该系统的报警。

### 第 V Ⅲ 节 其他

#### 第 51 条

##### 训练手册

训练手册可分成若干分册，此手册应包括关于船上所配备的救生设备和最佳救生方法的须知和资料，用易懂措词（凡有可能者加以图解）进行说明。这些资料的任何部分都可以用听 - 视辅助教材形式来代替。下列各项应加详细解释：

- 1 救生衣与保温救生服的穿着法（如果适用）；
- 2 在指定地点集合；
- 3 救生艇筏和救助艇的登乘、降落、和离开；
- 4 在救生艇筏内降落的方法；
- 5 从降落设备上脱开；
- 6 降落区域内防护方法与防护设备的用法（如果适用）；
- 7 降落区域的照明；
- 8 一切救生属具的用法；
- 9 一切探测装备的用法；
- 10 （用图解说明）无线电救生设备的用法；
- 11 海锚的用法；
- 12 发动机及其附件的用法；
- 13 救生艇筏和救助艇的回收（包括存放和制牢）；
- 14 暴露的危险和穿用保暖衣服的必要性的；

- 15 为救生而最佳使用救生艇筏设备；
- 16 拯救的方法，包括直升飞机救助装置（吊绳、吊篮和吊担架）、连裤救生圈、海岸救生工具和船舶抛绳设备的用法；
- 17 应变部署表与应变部署指令所列出的所有职责；
- 18 救生设备应急修理须知。

### 第 52 条

#### 船上维护保养须知

救生设备的船上维护保养须知应是易懂的，凡有可能者应加以图解说明，并且如果适用，每种设备应包括下列各项：

- 1 进行第 19 条之 7 所要求的检验时所用的核对表；
- 2 维护保养与修理须知；
- 3 定期维护保养计划；
- 4 润滑点示意图，并注明建议用的润滑剂；
- 5 可替换部件一览表；
- 6 备件来源一览表；
- 7 检验和维护保养记录簿。

### 第 53 条

#### 应变部署表与应变须知

- 1 应变部署表应写明第 50 条所规定的通用紧急报警信号的细则，并应规定发出警报时船员和旅客必须采取的行动。应变部署表尚应写明弃船命令将如何发出。
- 2 应变部署表应写明分派给各种船员的任务，包括：
  - 1 船上水密门、防火门、阀门、流水孔、船舷小窗、天窗、舷窗和其它类似开口的关闭；
  - 2 救生艇筏和其它救生设备的装备；
  - 3 救生艇筏的准备工作和降落；
  - 4 其它救生设备的一般准备工作；
  - 5 集合旅客；
  - 6 通信设备的用法；
  - 7 指定处理火灾的消防队人员的配备；
  - 8 指定有关使用消防设备及装置方面的专门任务。



3 应变部署表应指明那些驾驶员负责保证维护救生设备使其处于完好状态，并立即可用。

4 应变部署表应指明关键人员受伤后的替换者，要考虑到不同应变情况要求不同的行动。

5 应变部署表应指明在应变时，指定给船员的与旅客有关的各项任务。

这些任务应包括：

- 1 向旅客告警；
- 2 查看旅客是否适当地穿好衣服，以及是否正确地穿好救生衣；
- 3 召集旅客于各集合地点；
- 4 维持通道及梯道上的秩序，并一般地控制旅客的动向；
- 5 保证把毛毯送到救生艇筏上。

6 应变部署表应在船舶出航以前制定。在应变部署表制定后，如船员有所变动而必须更改应变部署表时，船长应修订该表，或者制定新表。

7 客船用应变部署表的格式应经认可。

#### 第四部分

#### 第四章

#### 无线电报与无线电话

#### 第二条

#### 名词与定义

增加下列新款：

“九. ‘应急无线电示位标’系指用于移动业务的电台，其发射的电波旨在便于搜寻和救助作业。”

增加下列新条：

#### “第十四条甲

#### 救生艇筏应急无线电示位标

一. 第 III 章第 6 条之 2.3 要求在救生艇筏上配备的救生艇筏应急无线电示位标应发射能使航空器测定救生艇筏位置的电波，并可发射用于报警目的的电波。

二. 救生艇筏应急无线电示位标应至少能在 121.5 兆赫和 243.0 兆赫频率上，交替发射或同时发射符合国际民用航空组织有关标准和推荐惯例的信号。

三. 救生艇筏应急无线电示位标应:

- (一) 颜色显而易见, 其设计应能使非熟练人员使用, 其构造应易于试验和维修。在考虑到试验装置的情况下, 电池在 12 个月内应无须更换;
- (二) 水密, 能够飘浮, 而且能从高度至少为 20m 处投入水中而不致损坏;
- (三) 只能手工启动和停止;
- (四) 便于携带, 重量轻而且结构紧密;
- (五) 设有表明正在发射信号的指示器;
- (六) 其能源来自系装置组成部分的并具有使装置工作 48 小时之足够容量的电池。发射可为间歇性的。在决定工作循环时, 应考虑到进行适当引航的可能性、避免频率拥挤的必要性以及符合国际民用航空组织要求的必要性; 和
- (七) 经过试验, 如果必要, 在不超过 12 个月的时间内更换其能源。

第十四条乙

应急无线电示位标的定期检验和试验

按照第 III 章第 6 条之 2.3 配备的应急无线电示位标应在不超过 12 个月的时间内进行检查和试验, 如果必要, 更换其能源。但是, 在适当和合理的情况下, 主管机关可把此时间延长至 17 个月。

第十四条丙

救生艇筏用双向无线电设备

- 一. 第 III 章第 6 条之 2.4 所要求的设备的设计应能使非熟练人员在紧急情况下使用。
- 二. 设备应便于携带, 并能用于船上通信。
- 三. 设备应符合无线电规则中有关用于海上移动业务的船上通信设备的要求, 并应在无线电规则所规定的和主管机关所要求的那些频道上工作。如果设备正在甚高频波段内进行工作, 应采取措施防止能在甚高频 16 频道上进行工作的设备误选该频道。
- 四. 设备应使用具有足够容量的电池, 在收发为 1:9 的情况下, 应能保证工作 4 小时。
- 五. 当船舶在海上时, 设备应保持处于良好状态, 而且在必要时, 应将电池充足电或者换新。”

## 第五部分

### 第 VII 章

#### 危险货物的装运

第 VII 章的现行条文用下文代替：

#### A 部分 包装或固体散装形式的危险货物的装运

##### 第 1 条

##### 适用范围

- 1 除另有明文规定外，本节适用于现行条款所适用的一切船舶以及小于 500 总吨货船装运的包装或固体散装形式的、按本部分第 2 条分类的危险货物（以下简称危险货物）。
- 2 本部分的规定不适用于船用物料和设备。
- 3 除非符合本部分的规定，禁止装运危险货物。
- 4 为补充本部分的规定，各缔约国政府应颁布或促使颁布关于危险货物安全包装及积载的细则，该细则应包括与其他货物有关的必要预防措施\*。

##### 第 2 条

##### 分类

危险货物应分为如下类别：

- 1 类 爆炸品
- 2 类 压缩、液化或加压溶解的气体
- 3 类 易燃液体
- 4 类(1) 易燃固体
- 4 类(2) 易于自燃的物质
- 4 类(3) 遇水发生易燃气体的物质
- 5 类(1) 氧化剂
- 5 类(2) 有机过氧化物

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\* 参阅本组织以决议 A.81(IV) 通过的《国际海上危险货物规则》，以及本组织以决议 A.434(XI) 通过并已由海上安全委员会修正或可能修正的《固体散装货物安全实施规则》附录 B 的有关部分和有关章节。

- 6类(1) 有毒的(毒性的)物质
- 6类(2) 感染性物质
- 7类 放射性物质
- 8类 腐蚀性物质
- 9类 杂类危险物质(即经验已证明或可能证明按其危险性质必须应用本部分规定的任何其他物质)。

### 第3条

#### 包 装

- 1 危险货物的包装应是:
  - .1 坚固而完好;
  - .2 包装的内表面可能与货物相接触者,应不致受所装货物的严重影响;
  - .3 能经受得住装卸及海运的一般危险。
- 2 如包装液体容器按常例采用具有吸收性或减震性的材料时,此种材料应为:
  - .1 能减少此液体可能引起的危险;
  - .2 其布置应能防止移动,并确保该容器保持围衬状态;
  - .3 如为合理与可能,应具有足够的数量,以便在容器万一破裂时能吸收液体。
- 3 装盛危险液体的容器,应在灌注温度下留有正常装运过程中最高温度所需的足够膨胀空隙。
- 4 压缩气体的盛瓶或容器,应为构造合适、经过试验、维护良好以及正确充灌者。
- 5 除非已经采用适当的措施以消除任何危险性,曾用于装运危险货物的未清洗的空容器,应按本部分关于灌装容器的规定处理。

### 第4条

#### 标记、标志和标志牌

- 1 盛装危险货物的包装件,应以正确的学名(不应单独使用商品名称)加以耐久标记。
- 2 危险货物包装件应根据需要,加上明显的标志或签条板或标志牌,以表明所装盛的货物的危险性质。

3 在危险货物包装件上标学名、贴标志或加签条板或固定标志牌的方法，应使包装件上的内容在海中浸没至少3个月后依然可以辨认。在考虑采用合适的标记、标志和标志牌时，应考虑到所用材料的耐久性和包装件的表面。

4 危险货物包装件应照此加以标记和标志，但是：

.1 危险程度低或包装数量有限的危险货物包装件\*，或

.2 特殊情况许可时，用标志或标志牌识别的成组堆放和装卸的包装件\*；

可以免除标志要求。

### 第5条

#### 单据

1 在有关海运危险货物的所有单据中，货物名称应使用正确学名（不应单独使用商品名称）并按本部分第2条所列类别加以正确说明。

2 由托运人预备的托运单据，应包括或附有经签署的证明书或声明书，注明所交运的货物业已按情况需要正确地作了包装、标记、标志或加上了标志牌，并处于合适的装运状态。

3 每一艘装运危险货物的船舶，须具有按照本部分第2条的分类规定载明船上所装危险货物及其位置的特殊清单或舱单。标明所有危险货物的类别并注明其在船上位置的详细配载图，可以代替此特殊清单或舱单。

### 第6条

#### 堆装要求

1 危险货物应按其性质安全地和适当地予以堆装。性质互不相容的货物，应彼此分开。

2 具有严重危险性的爆炸品（弹药除外），应堆装于在航行中须保持严密封闭的火药库内。这类爆炸品应与雷管分开。装运爆炸品的任何舱室内的电气设备及电缆，其设计与使用应能使火灾或爆炸的危险减至最小程度。

3 会产生危险气体的包装形式的危险货物，应堆装于机械通风的处所或甲板上。会产生危险气体的散装固体危险货物，应堆装于通风良好的处所。

4 装运易燃液体或易燃气体的船舶，在有必要防止火灾或爆炸的处所，应采取特殊的预防措施。

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\* 参考《国际海上危险货物规则》中所订的特殊免除。

5 在未经采取足够的预防措施以减小火灾发生的可能性以前，不得装运易于自热或自燃的物质。

### 第7条

#### 客船上的爆炸品

- 1 在客船上仅可装运如下爆炸品：
  - .1 安全弹药和安全引信；
  - .2 总净重不超过10 kg的少量爆炸品；
  - .3 船舶或飞机使用的遇险信号，其总重量不超过1000 kg者；
  - .4 不致发生猛烈爆炸的花炮，但装运统舱无床位旅客的船舶除外。
- 2 虽在本条第1款有所规定，但在具有经主管机关认可的特殊安全措施的客船上，可载运额外数量或其他类型的爆炸品。

#### B部分 散装运输危险化学品船舶的构造和设备

### 第8条

#### 定义

除另有明文规定外，在本部分中：

- 1 “国际散装化学品规则”系指本组织海安会决议MSC.4(48)通过的《国际散装运输危险化学品船舶构造和设备规则》，此规则可能由本组织进行修正，但此项修正应为根据现行公约第八条对附则（第一章除外）的修正程序实施并已得到通过、生效和执行者。
- 2 “化学品液货船”系指建造或改建用于运输《国际散装化学品规则》第十七章所列的任何液体产品的货船。
- 3 在第9条内，“建造的船舶”系指安放龙骨或处于相应建造阶段的船舶。
- 4 “处于相应建造阶段”是指在这样的阶段：
  - .1 可认为某一具体船舶建造开始；
  - .2 该船业已开始的装配量至少为5.0吨或为所有结构材料估算重量的1%，以较小者为准。

### 第 9 条

#### 化学品液货船的适用范围

1 除另有明文规定外，本节适用于 1986 年 7 月 1 日或以后建造的化学品液货船，包括小于 500 总吨者。此类化学品液货船除符合本公约任何其他可适用的要求外，也应符合本部分的要求。

2 任何化学品液货船，不论其建造日期如何，当进行修理、改装、改建以及与之有关的装时，至少应继续符合该船原先适用的要求。这种船舶如系在 1986 年 7 月 1 日之前建造者，一般应至少达到该船在进行修理、改装、改建或舾装之前，已经履行该日期及以后建造船舶要求的同等程度。重大的修理、改装、改建以及与之有关的舾装，在主管机关认为合理和可行的范围内，应满足对 1986 年 7 月 1 日或以后建造船舶的要求。

3 不论其建造日期如何，当船舶改建成化学品液货船时，应作为在该船改建开始之日建造的化学品液货船处理。

### 第 10 条

#### 化学品液货船的要求

1 化学品液货船应符合国际散装化学品规则的要求，并且除了符合本公约附则第一章第八、九、十条的规定以外，还要根据该规则进行检验及发证。在本条范围内，该规则的要求作为法定要求处理。

2 持有根据本条之 1 要求所发证书的化学品液货船，应受本公约附则第一章第十九条所确定的监督。为此，此项证书应被作为根据附则第一章第十二条或第十三条要求而颁发的证书处理。

#### C 部分 散装运输液化气体船舶的构造和设备

### 第 11 条

#### 定义

除另有明文规定外，在本部分中：

1 国际液化气体船舶规则系指本组织海安会决议 MSC.5(48)通过的国际散装运输液化气体船舶的构造和设备规则，此规则可能由本组织进行修正，但此项修正应为根据现行公约第八条对附则（第一章除外）的修正程序实施并已得到通过、生效和执行者。

- 2 “气体运输船”系指建造或改建用于运输国际气体运输船舶规则第十九章所列的任何散装液化气体或其他物质。
- 3 在第12条内，“建造的船舶”系指安放龙骨或处于相应建造阶段的船舶。
- 4 “处于相应建造阶段”是指这样的阶段：
  - .1 可认为某一具体船舶建造开始；
  - .2 该船业已开始的装配量至少为50吨或为所有结构材料估算重量的1%，以较小者为准。

### 第12条

#### 气体运输船舶的适用范围

- 1 除另有明文规定外，本部分适用于1986年7月1日或以后建造的气体运输船舶，包括小于500总吨者。此类气体运输船舶除符合本公约任何其他可适用的要求外，还应符合本部分的要求。
- 2 任何气体运输船，不论其建造日期如何，当进行修理、改装、改建以及与之有关的舾装时，至少应继续符合该船原先适用的要求。这种船舶如系在1986年7月1日之前建造者，一般应至少达到该船在进行修理、改装、改建或舾装之前，已经履行该日期及以后建造船舶要求的同等程度。重大的修理、改装、改建以及与之有关的舾装，在主管机关认为合理和可行的范围内，应满足对1986年7月1日或以后建造船舶的要求。
- 3 不论其建造日期如何，当船舶改建成气体运输船时，应作为在该船改建开始之日建造的气体运输船处理。

### 第13条

#### 气体运输船的要求

- 1 气体运输船应符合国际气体运输船规则的要求，并且除了符合本公约附则第一章第八、九和十条的规定以外，还要根据该规则进行检验及发证。在本条范围内，该规则的要求作为法定要求处理。
- 2 持有根据本条之1要求所发证书的气体运输船，应按照第一章第十九条的要求营运。因此，这样的证书应作为按照第一章第十二条或第一章第十三条的要求而颁发的证书看待。



决议 MSC.4(48)<sup>1</sup>通过国际散装运输危险化学品船舶构造和设备规则  
(国际散化规则)海上安全委员会,

忆及大会通过决议 A.490(XII) 授权它在经修订的散装运输危险化学品船舶构造和设备规则与由决议 A.328(IX)通过的散装运输液化气体船舶构造和设备规则相一致后通过散装运输危险化学品船舶构造和设备规则,

注意到它根据决议 MSC.6(48)特别通过了1974年国际海上人命安全公约(1974年安全公约)第VII章的修正案,以便把国际散装运输危险化学品船舶构造和设备规则(国际散化规则)的规定放入该公约中成为强制性的规定,

审议了所建议的国际散化规则的文本:

1. 通过国际散化规则,其文本见本决议的附件;
2. 注意到,根据经决议 MSC.6(48)修正的1974年安全公约第VII章B部分的规定,国际散化规则的修正案必须按照该公约第八条的规定来通过、生效和实施;
3. 进一步注意到,在经1978年议定书修订的1973年国际防止船舶造成海洋污染公约的附则II生效之前,要对国际散化规则进行修正,以便把防止污染方面的问题也包括进去;
4. 请秘书长把上述国际散化规则的修正条款分发给所有有关国家,修正条款把新货品均放入第17章中;并建议在这些修正条款生效之前,应由符合修正条款规定的化学品液货船来运输这些新货品;
5. 还请秘书长把本决议连同国际散化规则的文本一同分发给本组织的所有成员国和所有那些虽然并非本组织成员国,但却是1974年安全公约的缔约方的政府。

\* \* \*

<sup>1</sup> Resolution published for information by the Secretariat of the United Nations — Résolution publiée pour information par le Secrétariat de l'Organisation des Nations Unies.

## 附 件

### 国际散装运输危险化学品船舶构造和设备规则

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## 前 言

1 本规则的目的是要对在海上安全散装运输本规则第 17 章所列危险液态化学品提供一个国际标准；它对从事这种运输的船舶（不论吨位多少）以及它们所应

装载的设备的设计和构造标准作出了规定，以便最大程度地减少所运货品的特性对船舶、船员和环境造成的危险。

2 它的基本原理是船型与本规则所列货品的危险性的相互关系。每一这种货品都有一个或多个危险特性，它们包括可燃性、毒性、腐蚀性和反应性。

3 在制定本规则的整个过程中，人们都认识到它必须以完善的造船学和工程学的原理，以对规则所列的各种货品的最为正确的认识作为基础；认识到化学品液货船的设计工艺不仅是复杂的，而且是在不断发展的，因此本规则也不应当是永久不变的。由于这些原因，本组织要考虑到经验和技术发展这两者，定期地对规则进行审核。

4 对新货品的要求及其装载条件，在本组织的海上安全委员会通过后，但在根据 1974 年国际海上人命安全公约第八条的规定在适当的修正案生效之前，作为一种临时性的建议书分发下去。

5 规则的主要内容是船舶的设计和和设备。为了确保能安全地运输这些货品，要对整个系统作出鉴定。本组织正在进一步检查或将要进一步检查有关安全运输这些货品这个问题的其它重要方面，如培训、操作、交通控制和港口装卸等。

6 国际船级社协会和国际电工委员会所做的有关工作对规则的制定有很大的帮助。

7 有关化学品液货船营运要求的规则第 16 章着重讲了有关营运问题的其它章节的条款，提到了化学品液货船的营运所特有的一些其它重要安全特点。

8 本规则的编排与海上安全委员会第四十八届会议通过的国际散装运输液化气体船构造和设备规则（国际气体船规则）是一致的。正如国际气体船规则所规定的那样，气体船也可载运本规则中的散装液态化学品。

## 第 1 章 总则

### 1.1 适用范围

1.1.1 本规则适用于各种尺寸的（包括不足 500 总吨的在内）从事运载散装液体危险化学品货物的船舶，但是运载石油或下列类似的易燃产品的船舶不包括在内：

- 1 具有重大火灾危险性的货品，其危险超过石油产品和类似的易燃产品；
- 2 具有除易燃性之外还有其它重大危险性的货品或虽然没有易燃性但有其它重大危险性的货品。

目前本规则限于第 17 章最低要求一览表所示的液体货物。 凡经审查决定不列入本规则范围内的货品，见第 18 章。

1.1.2 在本规则中的液体是在温度为 37.8℃ 时，其蒸气压力不超过 2.8 巴的液体。

1.1.3 对于建议散装运输的但未列入第 17 章或第 18 章之中的产品，主管机关以及与此类运输有关的港口当局在考虑散装化学品危险性估价准则之后，应对初步适于运载的状况作出规定。 并应把考虑将某种产品列入本规则的情况通知本组织。

1.1.4 除另有明文规定外，本规则适用于在 1986 年 7 月 1 日或以后安放龙骨或处于如下阶段的船舶：

- .1 能识别为该船舶的建造开始；
- .2 船舶已开始组装了至少 50 吨或所有结构材料估计重量的 1%，取其小者。

1.1.5 不管何时建造的船舶，在 1986 年 7 月 1 日或以后被改建成化学液货船时，应作为在此改建开始之日建造的化学液货船对待。

1.1.6 引用本规则某一段时，该标题下的所有分段的规定均应适用。

## 1.2 危险性

本规则涉及到的产品的危险性包括：

1.2.1 由化学品的闪点、沸点、可燃性范围和自燃温度确定的火灾危险性。

1.2.2 健康危险性是由：

- .1 在处于气体或具有蒸气压力的蒸气状态下，对皮肤的或对眼、鼻、喉和肺的粘膜所产生的刺激或有毒效应确定；或者
- .2 在液体状态下，对皮肤的刺激效应确定；或者
- .3 由毒性效应确定，确定时要考虑到以下值：口服致死剂量 50：在口服时，使 50% 的受试验者死亡的剂量；  
皮肤致死剂量 50：施用于皮肤时，使 50% 的受试验者死亡的剂量；  
致死浓度 50：在吸入时，使 50% 的受试验者死亡的浓度。

1.2.3 水污染危险性是由对人的毒害性、水溶性、挥发性、气味或滋味以及相对密度来确定。

1.2.4 空气污染危险性是由下述情况确定：

- .1 紧急情况暴露限度 (E.E.L.) 或致死浓度 50；

- .2 蒸气压；
  - .3 在水中的可溶性；
  - .4 液体的相对密度；
  - .5 蒸气的相对密度。
- 1.2.5 反应性危险性是由对下列物质的反应性确定：
- .1 其他化学品；或
  - .2 水；或
  - .3 化学品本身（包括聚合作用）。

### 1.3 定义

除另有明文规定外，下列定义适用（附加定义被列入各个章节之中）：

- 1.3.1 起居处所为公共处所、走廊、盥洗室、住舱、办公室、医院、电影院、娱乐室、理发室、无炊具的配膳室以及类似处所。公共处所为作为大厅、餐室、休息室及类似的永久性围蔽处所的那些起居处所。
- 1.3.2.1 主管机关指船旗国政府。
- 1.3.2.2 港口当局指船舶装货或卸货的所在港国家的有权当局。
- 1.3.3 沸点是指货品的蒸气压力等于大气压力时的温度。
- 1.3.4 船宽 (D) 系指船舶最大宽度，金属船壳在船中量至肋骨的型线；其他材料船壳在船中量至船壳外部表面。船宽 (E) 应用 m 为单位衡量。
- 1.3.5 货物区域系指船上包括液货舱、污水舱、货泵舱（含泵舱在内）、隔离空舱、邻近液货舱的压载水处所或空位，及船中上述处所之上整个长度和宽度之内的甲板区域在内的那个部分。
- 1.3.6 货泵舱是装有用于装卸本规则涉及到的产品的泵及其属具的处所。
- 1.3.7 货物服务处所系指货物区域内用作工作间、物料间和存放货物装卸设备而且面积在 2 m<sup>2</sup> 以上的储藏室的处所。
- 1.3.8 液货舱是设计装盛货物的包壳。
- 1.3.9 化学品液货船系指为运输第 7 章所列的任何散装液体产品而建造或采纳用的货船。
- 1.3.10 隔离空舱为两相邻钢质舱壁或甲板之间的隔离处所。此处所可以是空位或压载处所。
- 1.3.11 控制站是里面有船舶无线电、主航行设备或应急电源的处所或者是火灾记录设备或火灾控制设备的集中控制处所。这些设备不包括能非常有效地放置于货物区域的专用火灾控制设备。



1.3.12 可燃性界限是限定燃油氧化剂混合状态的条件，在这种条件下，在给定试验设备里采用足够强的外部点燃源仅仅能够产生可燃性。

1.3.13 闪点是货品释放出的可燃蒸气足以点燃时的摄氏温度。本规则所列数值是由认可的闪点装置确定的“闭杯试验”。

1.3.14 货舱处所为船舶的结构围蔽而成的用作独立的液货舱的处所。

1.3.15 独立的系指管系或透气系统（举例）根本不与另一系统连接并且没有可与其它系统进行潜在连接的手段。

1.3.16 长度(L)系指从龙骨顶部量起的最小型深85%处之水线总长度的96%，或指在该水线处从船艏往最前端至舵杆轴线处的长度，如果这一长度更长一些的话。对于斜龙骨的船舶，测量长度的水线应与设计水线相平行。长度(l)应当用m来表示。

1.3.17 A类机器处所应包括如下设施的处所和通往这些处所的通道，

- .1 用于主推进的内燃机，或
- .2 总输出功率不小于375kW用于主推进之外的其他用途的内燃机，或
- .3 任何燃油锅炉或油燃料装置。

1.3.18 机器处所为所有A类机器处所和装有推进机、锅炉、油燃料装置、蒸气机、内燃机、发电机和主要电器机械、加油站、冷藏机、稳定机、通风及空调机器的所有其它处所以及类似处所；以及通向此类处所的通道。

1.3.19 燃油装置是为燃油锅炉输送燃油的准备设备，或者是为内燃机输送加热燃油的准备设备，它包括处理油压超过1.8巴的所有油压泵、滤清器及加热器。

1.3.20 组织系指国际海事组织(IMO)。

1.3.21 处所的浸水率系指在该处所之内，假设被水占据的容积与总容积的比率。

1.3.22 泵舱系指位于货物区域，装有泵及用于装卸压载及燃油的辅助设备的处所。

1.3.23 相对密度系指某一体积货品的质量与相等体积水的质量之比。

1.3.24 分隔系指例如一货物管系或货物透气系统不与另一货物管系或货物透气系统相连接。此分隔可以用设计或操作方法取得。操作方法不得在货舱内使用，应由下列型式中的一种构成：

- .1 移动阀槽或阀并切断管端；
- .2 布置两个串联的双环法兰，在该两个双环法兰之间有探测向管内渗漏的装置。

1.3.25 服务处所系指作为走廊、具有炊具的配膳室、物料间、邮件舱和贵重物品保管室、储藏室、不构成机器处所组成部分的工作间及通往此类处所通道。

1.3.26 1974年公约系指1974年国际海上人命安全公约。

1.3.27 1983年公约修正条款系指由1983年6月17日本组织第48届海安会的决议MSC.6(48)通过的1974年公约的修正案。

1.3.28 蒸气密度或蒸气相对密度系指某一体积的蒸气或气体(不含空气)的质量与相等体积空气在相同压力和温度下的质量之比。

1.3.29 蒸气压力系指在一特定温度用绝对巴表示的在液体之上饱和蒸气的平衡压力。

1.3.30 空位系指在液货舱外部的货物区域内除货物处所、压载处所、燃油舱、液货泵舱、泵舱或人员作一般使用的任何处所之外的围蔽处所。

#### 1.4 等效

1.4.1 凡本规则要求船上应装设或配备某一专门属具、材料、装置、器具、设备或其型式，或本规则要求应采取某一特别措施，或应符合某一程序或布置，主管机关可准许在该船上装设或配备任何其他的属具材料、装置、器具、设备或其型式，或采取其它措施、程序或布置，但须通过试验或其他方法认定这些代替的属具、材料、装置、器具、设备或其型式，或任何其他的专门措施、程序或布置，至少与本规则所要求者具有同等效能。主管机关不得允许用操作办法或程序来取代由本规则阐明的某一专门属具、材料、装置、器具、设备或其型式，除非本规则明文规定允许此类代替。

1.4.2 当主管机关准许采取代替某一材料、装置、器具、设备或其型式，或措施、程序或布置，或新颖设计或应用，应将其细节连同所作的证据报告交送海协组织以便使本组织将这些文件转知1974年海上人命安全公约的其他缔约国政府，以供其官员参考。

#### 1.5 检验与发证

##### 1.5.1 检验程序

1.5.1.1 凡是事关各规则之规定的执行和这种执行的免除，船舶的检验应由主管部门的官员来进行。但是主管机关可以把这种检验委托给为此目的而指定的验船师或由它认可的机构。

1.5.1.2 指定验船师或认可检验机构的主管机关至少应当授与任何被指定的验船师或被认可的机构以下权力：

- .1 要求对船舶进行修理；和

。2 如果有关的港口国当局\*提出要求的话, 进行检验。

主管机关应将授与被指定验船师或被认可机构的权力的具体责任和条件通知本组织, 以便分发给各缔约国政府。

1.5.1.3 当一被指定的验船师或被认可的机构得出的结论为该船或其设备的条件根本不符合证书的细目或者因此船舶不适宜继续航行, 否则会给船舶或船上人员带来危险时, 该验船师或机构应立即确保采取纠正措施并及时通知主管机关。如果不采取这种纠正措施的话, 便应撤回有关证书, 立即通知主管机关, 如果该船是在另一缔约国政府的港口之中的话, 也应立即通知有关的港口国当局。

1.5.1.4 在任何情况下, 主管机关要保证检验的完整性和有效性, 确保履行这一职责所必须的安排。

#### 1.5.2 检验要求

1.5.2.1 化学品液货船的构造、设备、属具、布置和材料(但不包括“货船安全结构证书”、“货船安全无线电报证书”或“货船安全无线电话证书”的颁发所需检查的那些项目)应受到下列检验:

- 。1 初期检验。 该检验在船舶投入营运之前或在第一次得到“国际散装运输危险化学品合格证书”之前进行, 只要该船是本规则所适用的检验应包括对构造、设备、属具、布置和材料的全面检查。 初期检验要确保构造、设备、属具、布置和材料完全符合本规则的适用的规定。
- 。2 定期检验。 该检验的间隔期由主管机关决定, 但不得超过5年。 定期检验要确保构造、设备、属具、布置和材料均符合本规则的适用的规定。
- 。3 中期检验。 该检验在“国际散装运输危险化学品合格证书”的有效期内至少进行一次。如果在任何一段证书有效期内只进行了一次中期检验的话, 检验应在证书有效期的中间日期之前和之后的6个月内进行。中期检验应确保安全设备、其它设备及有关的泵系和管系符合本规则的适用的规定, 并处于良好工作状态。 这种检验应在国际散装运输危险化学品合格证书中进行背书。

\* “港口国当局”的含义载于1974年安全公约1978年议定书第十九条的第八章。

- 4 强制性年度检验。 该检验应在国际散装运输危险化学品合格证书颁发一周年之日的之前或之后的三个月内进行。 年度检验应包括一全面检查，以确保构造、设备、属具和材料在所有方面均适合该船预期的营运。 这种检验应在国际散装运输危险化学品安全证书中进行背书。
- 5 补充检验。 该检验可以是全面的，也可以是部分的，视情况而定。 在根据 1.5.3.3 进行的调查后提出要求时，或在进行了重要修理或更新时，应进行该检验。 这种检验要确保已有效地进行了必要的修理和更新；此种修理或更新的材料和工艺是令人满意的；船舶适合于继续航行，不会给船舶或船上人员带来危险。

### 1.5.3 检验后状况的保持

1.5.3.1 船舶及其设备的状况要保持符合本规则的规定，以确保船舶始终适合继续航行，不会给船舶或船上人员带来危险。

1.5.3.2 在完成了 1.5.2 中的任何船舶检验后，非经主管机关批准经检验过的构造、设备、属具、布置和材料不得有任何改变，除非这种改变是直接的替代。

1.5.3.3 每当船舶发生了事故，或出现了缺陷，而这种事故或缺陷影响了船舱的安全，影响了其救生设备或其它设备的有效性或完整性时，该船的船长或船东应尽早向负责颁发有关证书的主管机关、被指定的验船师或被认可的机构提交报告；主管机关、被指定的验船师或被认可的机构应进行调查来决定 1.5.2.5 所说的检验是否必要。 如果该船是在另一缔约国政府的港口内的话，船长或船东也应立即向有关的港口国当局报告。被指定的验船师或经认可的机构应确保提交了这种报告。

### 1.5.4 国际合格证书的颁发

1.5.4.1 在对符合本规则有关要求的化学品液货船进行了初期或定期检验后，应颁发一份名为国际散装运输危险化学品合格证书的证书，其标准格式列在附件中。

1.5.4.2 按本节规定颁发的证书应放在船上，以供随时检查。

### 1.5.5 由另一政府颁发或背书国际合格证书

1.5.5.1 在另一缔约国政府的请求下，一缔约国政府可要悬挂另一缔约国国旗的船舶接受检验。 如果它认为该船是符合本规则的要求的，可向该船颁发，或命令向其颁发证书，如有必要，可根据本规则对船上的证书进行背书或命令对其进行背书。 在这样颁发的证书中，要有一声明说它是根据船旗国政府的要求颁发的。

### 1.5.6 国际合格证书的持续时间和有效性

1.5.6.1 国际散装运输危险化学品合格证书的持续时间由主管机关决定，但从初期检验或从定期检验之日算起不得超过5年。

1.5.6.2 不得允许把证书的这5年持续时间加以延长。

1.5.6.3 在下列情况下，证书停止有效：

- 1 在1.5.2中规定的时间内没有进行检验。
- 2 船舶更换船旗国。只有当颁发新证书的政府完全确认船舶是符合1.5.3.1和1.5.3.2的要求时才能颁发新证书。当这种更换是在缔约国政府之间进行时，该船原先的船旗国政府，如果在更换进行后的12个月内收到请求的话，应尽快把更换船旗国前该船所持有的证书的副本和（如果有的话）有关检验报告的副本尽快转给主管机关。

## 第2章 船舶抗沉性\*及货舱位置\*

### 2.1 通则

2.1.1 适用于本规则的船舶，在由某种外力引起的假设船体破损之后，应能经受进水的通常效应。此外，为了保护船舶及环境，某种类型船舶的液货舱应受保护，以防对船舶因与例如码头或拖轮接触而产生的微小破损而引起的渗漏，并且采取保护措施以防因碰撞或搁浅引起的破损，即置货舱于距舱壳板之内规定的最小距离。假设的破损及货舱与船壳的接近程度都取决于要装运货物的危险程度。

2.1.2 适用于本规则的船舶应按照下列标准之一设计：

- 1 1型船舶是用于运输第17章中对环境或安全有非常严重危险的货物的化学品船，它需用最大的预防措施来消除其漏逸。
- 2 2型船舶是用于运输第17章中对环境或安全有可感知的严重危险的货物的化学品船，它需用重大的预防措施来消除其漏逸。
- 3 3型船舶是用于运输第17章中对环境或安全有足够的严重危险货物的化学品船，它需用一中等程度的围护来增加破舱条件下的抗沉能力。

\* 参看“统一应用散装化学品规则及气体运输船规则的抗沉性要求指南”。

因此，1型船舶是用于运输被看作是具有最大全面危险的货品的化学品船，2型和3型船舶是用于运输危险性相继减少的货品的化学品船。相应地，1型船应能经受得住最严重的破损标准，其货舱应置于船壳板后最大的规定距离上。

2.1.3 各个货品要求的船型在第17章“c”栏中表示出来。

2.1.4 如果一艘船用于装运一种以上第17章表列货品，则破舱标准应与有最严格船型要求的那种货品相一致。但是，各个货舱位置的要求是对于装运各种货品的船型的要求。

## 2.2 干舷与完整稳性

2.2.1 适用于本规则的船舶可以指定生效的国际载重线公约允许的最小干舷。但是与干舷指定有关的吃水不可大于本规则另外要求的最大吃水。

2.2.2 船舶在所有海上运输状态的稳性应达到为主管机关所接受的标准。

2.2.3 当计算可耗液体的自由液面效应来确定装载状况时，对每一型式的液体应假设至少一对横向舱或单个中舱有一自由液面并且要计算的舱或组合舱为自由液面效应最大的舱。未破损舱室的自由液面效应应使用主管机关可接受的方法进行计算。

2.2.4 固体压载一般不应使用于货物区域的双层底舱。但是，当在此类处所出于稳性考虑的原因不可避免使用固体压载的设置时，那么其分布应根据需要控制，以确保因底部破损造成的冲击负荷不会直接传递到货舱结构。

2.2.5 应为船长提供一本《装载与稳性资料》手册。手册应包括典型营运和压载状态、估算其他装载状态的规定以及船舶抗沉能力的总结等详细资料。此外，该手册应包含足够资料使船长能用安全而且适航的方式装载并操纵船舶。

## 2.3 干舷甲板以下船舷的排放水

2.3.1 为自干舷甲板以下的处所或自设有风雨密门在干舷甲板上的上层建筑及甲板室内的处所引过船壳进行排放的阀门的设置与控制应满足生效的国际载重线公约有关规则的要求，但是阀门的选择应局限于：

- 1 带有能自干舷甲板上关闭阀门的确定手段的一个自动止回阀；或
- 2 当自夏季载重线至排放管船内端的垂直距离超过0.01L时，两个没有确定关闭手段的自动止回阀。但船内的阀在营运状态下总是能够得到检查才行；

2.3.2 在本章内，“夏季载重水线”及“干舷甲板”与生效的国际载重线公约所规定的意思相同。

2.3.3 在 2.3.1.1 和 2.3.1.2 中提到的自动止回阀应为主管机关可接受的型式，应能完全有效地防止水进入船内，并考虑到 2.9 中抗沉要求中的下沉、纵倾和横倾。

## 2.4 装载状态

应根据呈送主管机关的有关所有预期装载状态及吃水与纵倾的变化的装载资料，对破舱抗沉能力进行调查。当化学品船不装载本规则所涉及的货品或仅装载规则涉及货品的残余物时，不必考虑压载状况。

## 2.5 破损假设

### 2.5.1 假设破损的最大程度应为：

#### .1 舷侧破损：

##### .1.1 纵向范围：

$1/3L^{2/3}$  或 14.5m, 取小者

##### .1.2 横向范围（自船舷内直角量至夏季载重水线水准上的中心线）：

$B/5$  或 11.5m, 取小者

##### .1.3 垂直范围：（从中心线上船底壳板的型线量起）

向上没有限制

#### .2 底部破损：

自船艏垂线  $0.3L$  处量起

船舶任何其他部位

##### .2.1 纵向范围：

$1/3L^{2/3}$  或

14.5m, 取小者

$1/3L^{2/3}$  或 5m, 取小者

##### .2.2 横向范围：

$B/6$  或 10.0m, 取小者

$B/6$  或 5m, 取小者

##### .2.3 垂直范围：

$B/15$  或 6m,

取小者，量自中线船底壳板的型线

（见 2.6.2）

$B/15$  或 6m, 取小者，量自中线船底壳板的型线（见 2.6.2）

### 2.5.2 其他破损

- .1 若任何破损范围虽小于在 2.5.1 内规定的最大破损，却会引起更严重的状态的话，则此类破损应予以考虑。
- .2 对于 1 型和 2 型船舶，如若在货物区域的局部船侧破损以直角从船壳量起向船内延伸达 760mm 的话，应考虑这种破损。当 2.8.1 的适用的分段也要求横向舱壁的话，还要另外假设横向舱壁的破损。

## 2.6 液货舱位置

### 2.6.1 液货舱应位于下述船内距离

- .1 1 型船舶：量自舷侧壳板时不小于 2.5.1.1.2 规定的横向破损范围，量自中心线上底壳板的型线时不小于 2.5.1.2.3 规定的垂直破损范围，但量自船壳板时都不得小于 760mm。
- .2 2 型船舶：量自中心线上底壳板的型线时不得小于 2.5.1.2.3 规定的垂直破损范围，量自船壳板时不得小于 760mm。
- .3 3 型船舶：无要求。

2.6.2 除 1 型船舶外，安装于液货舱的吸水井可以突出到 2.5.1.2.3 规定的底部破损的垂直范围，但此类吸水井应尽量小并且在内底板以下突出部分不应超过双层底高度的 25 % 或 350mm，取小者。若无双层底时，在底部破损上限以下独立液货舱的吸水井的突出部分应不超过 350mm。根据本段要求设置的吸水井在计算受破损影响舱室时可以忽略不计。

## 2.7 浸水假设

2.7.1 2.9 的要求应通过计算来证实，计算中应考虑船舶的设计特性，破损舱室的布置、形状及所载物体，液体的分配、相对密度及自由液面的效应，以及所有装载状态的吃水和纵倾。

2.7.2 假设受破损处所的渗透率如下：

处 所	渗透率
用作贮藏室	0.60
居住占据处所	0.95
机器占用处所	0.85
空位	0.95
用于装消耗液体	0 至 0.95 *
用于装其他液体	0 至 0.95 *

\* 部分充装舱室的渗透率与该舱室装载液体量应该是一致的。



2.7.3 只要破损穿透装载液体的液货舱，则应假设货品完全从该舱流失并由达到最后平衡平面高度的盐水代替。

2.7.4 在2.5.1中规定的最大破损范围之内每一水密分隔和被认为在2.8.1段所述位置已遭受破损的每一水密分隔应被假设为进水。当小于最大破损范围的破损被认为是符合2.5.2时，则应假设只有在此类较小破损的范围内的水密分隔或水密分隔的组合是进水的。

2.7.5 船舶的设计应以有效的布置使不对称浸水减小到最小的程度。

2.7.6 如若装有诸如阀门或横通调平管之类的机械辅助设备的平衡装置的话，该装置不应被当成用作减小横倾角或为了达到2.9的要求来取得最小剩余稳性范围的；在需要使用平衡的所有阶段，均应保持足够的剩余稳性。用大截面导管连接的处所应被视为正常。

2.7.7 若管子、导管、通道或隧道位于2.5规定的假设破损渗透范围之内，布置应为累进进水不能延伸到每种破损状态假设要进水的舱室之外的舱室。

2.7.8 直接在舷侧破损之上的任何上层建筑的浮力应不考虑。然而超出破损范围之外的上层建筑未进水部分也可以考虑，但是，

- .1 它们必须由水密分隔与破损处所分开，并且关于这些完整处所的要求必须满足；及
- .2 这些分隔上的开口要能用遥控操作滑动水密门进行关闭，并且在2.9中要求的最小剩余稳性之内，未保护的开口不被浸没；但是能关闭成风雨密的其他任何开口的浸没是允许的。

## 2.8 破舱标准

2.8.1 在2.7所述的进水假设情况下，船舶应能经受2.5所述的破损。进水假设的程度由船型依下列标准决定：

- .1 应假设1型船舶在其长度范围内任何部位上受到破损；
- .2 应假设长度大于150m的2型船舶在其长度范围内任何部位上经受破损；
- .3 应假设长度为150m或以下的2型船舶在其长度范围内除艏机型机舱两边的界舱壁之外经受破损；
- .4 应假设长度大于225m的3型船舶在其长度范围内经受破损；
- .5 应假设船长为125m或以上但小于225m的3型船舶在其长度范围内除艏机型机舱两边的界舱壁之外经受破损；

- .6 应假设船长小于125m的3型船舶在其长度范围内除艉机型机舱破损之外经受破损。但主管机关应考虑机舱进水的抗沉能力。

2.8.2 对于不是在所有方面满足2.8.1.3及2.8.1.6适当要求的小型2型及3型船舶,只有当采取了能保持同样安全程度的替代措施时,主管机关才可考虑特别免除。替代措施的性质必须获准及得到清楚地阐述并为港口国当局所能得到。任何此类免除必须在1.5.4提及的国际适合证书上作适当记录。

### 2.9 抗沉要求

2.9.1 适用于本规则的船舶应能按2.8的标准,在稳定平衡的状况下经受住2.5所说的假设破损,并应能对下述标准感到满意。

2.9.2 在任何进水阶段:

- .1 考虑到下沉、横倾和纵倾,水线应低于经此能发生累积进水或向下进水的任何开口。此类开口应包括空气管和以风雨密门或舱口盖关闭的开口,可以不包括那些用水密人孔盖和水密甲板舱口盖关闭的开口、保持甲板高度整体性的小型水密液货舱舱口盖、遥控操作的水密滑门和非开口型舷窗;
- .2 由于不对称进水引起的横倾最大角度不应超过 $25^{\circ}$ ,但是若无甲板浸没发生,则此角度可增加到 $30^{\circ}$ ;
- .3 在进水中间阶段期间的剩余稳性应为主管机关所满意。但决不允许很大地低于2.9.3的要求。

2.9.3 在进水后的最后均衡情况下:

- .1 复原力臂曲线超过平衡位置处应有一个 $20^{\circ}$ 的最小范围,以及在 $20^{\circ}$ 范围内至少有一个0.1m的最大剩余复原力臂;在此范围内该曲线下的面积应不小于 $0.0175\text{m/rad}$ 。在此范围内未保护的开口不应浸没,除非有关处所假定要进水。在这个范围内,2.9.2.1所列的任何开口及能水密关闭的其他开口可以允许浸没;
- .2 应急电源能够运行。

## 第3章 船舶布置

### 3.1 货物分隔

3.1.1 除本规则另外规定者外,应该用隔离舱、空位、货物泵舱、泵舱、空舱柜、燃油舱或其他类似处所,把盛有本规则所适用的货物或剩余货物的舱室与起居处所、服务处所、机器处所、饮用水和生活消耗贮藏室分隔开。

3.1.2 与其他货物起危险反应的货物应：

- .1 用隔离舱、空位、货物泵舱、泵舱、空舱或盛有互相相容的物货舱与此类其他货物分隔；
- .2 有独立的不通过盛有此类货物的其他液货舱的泵系和管系，除非它们是被包围在一隧道内的；
- .3 有分开的液货舱室透气系统。

3.1.3 液货管系不应通过任何起居处所、服务处所或货物泵舱或泵舱之外的机器处所。

3.1.4 适用本规则的货物不应装载于艏尖舱或艉尖舱。

3.2 起居、服务和机器处所以及控制站

3.2.1 起居住所或服务处所或控制站不得设置在符合1983年安全公约修正条款第II-2章第56条的货物泵舱壁龛或泵舱壁龛之上部位以外的货物区域；液货舱或污水舱不应设置在任何住舱的前端之后。

3.2.2 为了防护危害性蒸气的危险，应充分考虑与货物管系和货舱透气系统相关的居住处所、服务处所和机器处所的空气入口和开口的位置。

3.2.3 起居处所、服务处所、机器处所和控制站的入口、进气口和开口不应面向货物区域。它们应安置于不面向货物区域的端舱壁和/或离上层建筑或甲板室面朝货物区域一端至少为船长的4%但不少于3m的上层建筑或甲板室的舷外侧。但本距离不必超过5m。在上述范围之内不得有门，但主管机关可允许不通往起居处所、服务处所和控制站的那些处所（如货物控制站和储藏室）有门。如果装有这种门的话，该处所的边界的绝热要达到“A-60”标准。移动机器用的螺栓板可在上述范围内安装。只要操舵室的门和窗子在设计上能确保对操舵室进行快速和有效的气密和蒸气密，便能设在上述的范围之内。面向货物区域和上层建筑以及甲板室在上述范围之内之侧部上的窗子和舷窗应当是固定式的（不能打开的）。甲板上的第一排舷窗应装有钢质或相等材料的里盖。

3.3 货物泵舱

3.3.1 货物泵舱的布置应确保：

- .1 在任何时候从扶梯平台或从舱底地板能不受约束地通行；及
- .2 穿着人身保护设备的人能不受约束地达到货物装卸所必需的一切阀门。

3.3.2 应装有能用救生绳把受伤人员吊出来的永久性装置，并避免受任何凸出物的阻碍。

3.3.3 所有扶梯和平台上都应设有栏杆。

3.3.4 正常的出入口扶梯不应垂直设置，应在适当的间隔设平台。\*

3.3.5 在货物泵舱内应有处理货泵和阀门的放泄物或其可能的泄漏的装置。为货物泵舱服务的舱底管系应能从货物泵舱之外操作。应设有一个或几个污水舱用以储存污染的舱底水或洗舱水。还应备有带有标准联接器的通岸接头或其他设备，以便把污液移注到岸上的污液柜去。

3.3.6 泵的排出压力表应装在货物泵舱之外。

3.3.7 由穿过舱壁或甲板的轴驱动机器时，应有用有效润滑的气密封或能确保永久气封的其他措施布置于舱壁或甲板处。

#### 3.4 货物区域处所的通入

3.4.1 在货物区域内隔离舱、压载舱、液货舱和其他处所的通道应直接通到开敞甲板并且能确保上述舱室的完全检验。双层底处所的通道可以通过泵舱、隔离深舱、管隧或类似舱室，但必须对通风方面予以考虑。

3.4.2 通过水平开口、舱口或人孔，其尺寸应足够能让携带呼吸器及防护衣的人员上下扶梯而毫无阻碍，并且还须提供一净开口以便从处所底部把受伤人员提升起来。该净开口最小尺寸不得小于60mm×600mm。

3.4.3 对于通过垂直开口或人孔提供以处所长度和宽度为通道的出入口，最小净开口不得小于600mm×800mm，离底板的高度不大于600mm，除非设有格栅或其他立足点。

3.4.4 如果通过此类开口或搬移受伤人员的能力能够证明为主管机关所满意，则主管机关在特殊情况下可以批准较小的尺寸。

#### 3.5 舱底及压载布置

3.5.1 泵、压载管路、透气管及为永久压载舱服务的类似设备必须独立于为液货舱服务的类似设备和货舱本身。紧接液货舱的永久压载舱的排放装置应在机器处所和起居处所的外面。充注装置可设置在机器处所内，但此类装置应确保从舱顶部充注并设置止回阀。

3.5.2 可从甲板水平上用为永久压载舱服务的泵将压载水注入液货舱，但注入管线与液货舱或管系要没有永久联接，而且要装有止回阀。

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\* 参考由决议A.330(IX)修正的《安全出入大液货舱以及在大液货舱内安全工作》的建议(决议A.272(VIII))。

3.5.3 用于货物系舱、泵舱、空位、污水舱、双层底舱及类似处所的舱底水泵装置应完全位于货物区域，但由双层舱壁将其与装有货物或货物残物的液货舱相隔开的空位、双层底液货舱和压载水舱不在此例。

### 3.6 泵和管系的识别

对于泵、阀门及管路区别符号应有规定，以鉴别其用途及其服务的液货舱。

### 3.7 船艙或船艙装载和卸载装置

3.7.1 经主管机关批准可设置货物管系以允许船艙或船艙装卸。便携式装置不准使用。

3.7.2 船艙装卸管路不得用于转注要求装载在1型船舶的货品。除非由主管机关特别批准，船艙装卸管路不得用于驳运要求符合15.12.1规定的散发有毒的蒸汽的货物。

3.7.3 除5.1的要求以外，下列规定也适用：

- 1 货舱区域以外的管路的设置在开敞甲板上应至少在船内760 mm。  
此类管路必须清楚好认并且在其与货物区域之内货物管系联接处设置一个停止阀门。在这一位置，当不使用时，管路可以用可移短管和盲板法兰进行分隔。
- 2 岸接头应装置一个停止阀门和一个盲板法兰。
- 3 管子必须全透对接焊，并且进行了完全的射线探伤。在管路中，法兰接头只准在货物区域内及在岸接头上使用。
- 4 应在3.7.3.1中规定的接头处装置防溅板及带有清除泄放设施的足够容量的收集盘。
- 5 管路应为自我泄放到货物区域并且最好泄入货舱。泄放管路替代装置可以由主管机关批准。
- 6 应设装置以使此类管路在使用后得到清洗并且在不使用时保持气体安全。与清洗相连的透气管应位于货物区域。管路的有关接头应设有停止阀门及盲板法兰。

3.7.4 通向居住、服务和机器处所及控制站的入口、空气入口及开口不应面对船艙装卸装置的货物岸接头位置。它们必须位于上层建筑或甲板室舷侧离面对船艙装卸装置的货物岸接头位置的室端距离至少为船长(L)的4%但不得小于3 m。

然而此距离不必超过5 m。面对岸接头位置并且在上层建筑或甲板室在上述距离之内的舷窗应为固定（非开启）式舷窗。另外，在船艙装卸装置使用期间在有关的上层建筑或甲板室舷侧上的所有的门、舷窗及其他开口都处于关闭状态。当为小型

船舶时，若不可能满足3.2.3和本节时，则主管机关可以批准对上述要求放松条件。

3.7.5 通向未列入3.7.4的围闭处所的空气管及其他开口应遮屏以防来自破开的软管或接头的任何飞溅。

3.7.6 逃生通路不应终止在3.7.7要求的围板之内或超出围板3 m的距离之内。

3.7.7 应设置适当高度的连续围板以使溢漏被保持在甲板上并使其与起居和服务区域隔开。

3.7.8 在3.7.7要求的围板之内或在超出围板3 m距离之内的任何电气设备应符合第10章的要求。

3.7.9 艙艙装卸区域的消防布置应符合11.3.16的规定。

3.7.10 若有必要，应在货物控制站与货物岸接头位置之间提供联络手段，并应证明这些手段是安全的。应设置适当的设施自货物岸接头位置来遥控切断货物泵。

#### 第4章 货物围护

##### 4.1 定义

4.1.1 独立液货舱系指不与船体结构相邻或不是其组成部分的载货容器。建造和安装独立液货舱是为了在所有可能的时刻消除（或至少最大地减少）因相邻船体结构的应力或移动所造成的应力。独立液货舱对船体结构的完整性不是不可少的。

4.1.2 整体液货舱系指这样一种载货容器：该容器是船壳的一个组成部分；它可能受到与邻近船体结构所受到的应力在负荷方面相等，在方式方面相同的应力；它通常是船体结构完整性所不可缺少的。

4.1.3 重力液货舱系指在舱顶设计压力不大于0.7巴的液货舱。重力液货舱可以是独立或整体液货舱重力液货舱的建造和试验应符合主管机关的标准并考虑到货物运输温度和相对密度。

4.1.4 压力液货舱系指设计压力大于0.7巴的舱。压力液货舱应为独立液货舱，并构造应使按主管机关标准应用压力容器设计标准成为可能。

##### 4.2 各种货品的舱型要求

各种货品的舱型安装和设计的要求都在第17章“d”栏列出。

## 第5章 货物移注

## 5.1 管系尺寸\*

5.1.1 按 5.1.4 规定的条件, 管子的壁厚(t)应不小于:

$$t = \frac{t_0 + b + c}{1 - \frac{a}{100}} \text{ (mm)}$$

式中:

$t_0$  = 理论厚度

$$t_0 = PD / (20 K e + P) \text{ (mm)}$$

其中:

P = 5.1.5 中的设计压力 (巴)

D = 外径 (mm)

K = 5.1.5 中的许用应力 (N/mm<sup>2</sup>)

e = 有效系数; 对于无缝管和由经认可的焊管厂商所交货的、被主管机关看作是等同于无缝管的纵向或螺旋式焊接的管子, e 等于 1.0。对于其它管子, e 的值由主管机关根据制造工艺和试验程序来确定。

b = 弯曲公差 (mm)。b 值的选取应使仅由于内部压力造成的、弯曲部位的计算应力不超过许用应力。当没有给出此理由时, b 应不小于:

$$b = \frac{D t_0}{2.5 r} \text{ (mm)}$$

其中:

r = 弯曲的平均半径 (mm)

c = 腐蚀公差 (mm)。如果有腐蚀或侵蚀, 则管子的壁厚应超过其他设计要求的需要量。

a = 厚度的负制造公差 (%)。

5.1.2 考虑到该系统上任何释放阀的最高设定压力, 在 5.1.1 中  $t_0$  的公式中设计压力 P 是该系统在工作中可以受到的最大测量压力。

5.1.3 未受释放阀保护的或已隔离于释放阀的管路或管系的部件, 应被设计至少为下列的最大值:

.1 对于可能有一些液体的管系或部件, 于 45 °C 时的饱和蒸气压力;

\* 参考已出版的《国际船级社协会 (IACS) 的会员及联系会员的规则》。

- .2 有关泵的排放安全阀的设定压力；
- .3 当不装设泵排放安全阀时，有关泵的出口的最大可能的总和水头压力。

5.1.4 设计压力不应小于10巴。只有开口端管的设定压力可小于10巴，但不应小于5巴。

5.1.5 对于管路，5.1.1中求  $t_0$  值的公式要考虑的许用应力低于下列之值：

$$\frac{R_m}{A} \text{ or } \frac{R_e}{B}$$

式中：

$R_m$  = 在环境温度下最小规定抗拉强度 (N/mm<sup>2</sup>)

$R_e$  = 在环境温度下最小规定屈服应力。如果应力—张力曲线没有表明规定屈服应力的话，0.2%的屈服点便适用了。

A和B的值应至少为：

A = 2.7 和 B = 1.8

5.1.6.1 最小厚度应符合经认可的标准。\*

5.1.6.2 当需用机械强度来防止因管子和管内物的重量以及来自支撑、船舶倾斜或其他原因的叠加负荷所引起的管子的损坏、塌坍、过度下陷或弯曲时，壁厚应超过5.1.1所要求的厚度，或者，若这样做不可能或会引起过度局部应力的话，则用其他设计方法来减少、防止或消除这些负荷。

5.1.6.3 法兰、阀门和其他设备应为主管机关所接受的标准型式，同时要考虑5.1.2规定的设计压力。

5.1.6.4 对于不符合标准型的法兰，法兰及有关螺栓的尺寸应为主管机关所满意。

## 5.2 管系制造与连接细则

5.2.1 本节要求适用于液货舱的内外管路。然而，主管机关可以接受对端口开口的管子及对货舱内的管子放松要求，但为其他货舱服务的货物管子除外。

5.2.2 货物管路应由焊接连接，下述情况除外：

- .1 到中断阀的认可接头和膨胀接头；
- .2 由主管机关特别认可的其他例外的情况。

5.2.3 可以考虑下列管长而且无法兰的直接连接：

- .1 在所有设施中可以使用在根部全透对接焊接。

\* 本章中所说的经认可的标准是指由主管机关认可的船级社所制定和使用的标准。



- .2 尺寸为主管机关所满意的带有套袖及有关焊接物的滑动焊接接头只能使用于外径为50mm或以下的管子。当裂隙腐蚀会发生时则不应使用这一型式的连接。
- .3 主管机关可接受的螺栓接头只能用于外径为25mm或以下的辅助管路和仪表设备管路。

5.2.4 为应付管系的扩张,要在管系中设置膨胀圈或膨胀弯管。

- .1 伸缩风箱可以由主管机关在每一情况下进行特殊考虑。
- .2 滑动连接不应使用。

5.2.5 焊接、焊后热处理及无损探伤应按认可的标准进行。

### 5.3 法兰连接件

5.3.1 法兰应为焊接颈、套装或插口焊接型。但插口焊接型法兰在公称尺寸大于50mm时不得使用。

5.3.2 法兰的型式制造和试验应符合主管机关接受的标准。

### 5.4 管系试验要求

5.4.1 本段试验要求适用于货舱内外的管路。对于货舱内的管路及端部开口的管路,主管机关可以放松这些要求。

5.4.2 安装完毕之后,每一货物管路系统应承受至少1.5倍设计压力的静水压力试验。然而,当管系或部分系统完全制造好并装配了所有的配件时,静水压力试验的进行可以先于船舶上的安装。船上焊接的接头应以1.5倍设计压力进行静水压力试验。

5.4.3 在船上安装完毕之后,每一管系都应进行泄漏试验,其压力视使用方法而定。

### 5.5 管系布置

5.5.1 货物管路不应安装在货物围护处所的舷边与船壳之间的甲板之下,除非保持破损保护(见2.6)要求的间隙;但是,当管子的破损不会引起货物的释放时,若保持检验要求的间隙,此距离可以减少。

5.5.2 位于主甲板以下的物货管路,可以从其所服务的液货舱穿过液货舱壁或穿过纵向或横向相邻的液货舱、压载舱、空液货舱或泵舱的共同舱壁,但是在其所服务的液货舱内的管路要装有能在露天甲板上操作的截止阀,并且当管路受损时要确保货物的相容性。作为一个例外,当液货舱与货物泵舱相邻时,能在露天甲板上操作的截止阀可位于货物泵舱一侧的液货舱壁上。然而,主管机关也可接受安装在货舱外面的全封闭液力操纵阀,但是该阀门应:

- .1 在设计上能排除渗漏危险；
- .2 安装在其服务的液货舱舱壁上；
- .3 适当地保护，以防机械损伤；
- .4 距船壳的距离按破损保护要求；
- .5 能在露天甲板上操作。

5.5.3 在一个泵服务于两个或更多个液货舱的任何货泵舱内时，在每一舱的管路上应装设一个截止阀。

5.5.4 安装在管隧内的货物管路也应满足5.5.1和5.5.2的要求。管隧应满足有关结构、位置和通风等所有液货舱要求以及防止电气危险要求。在管路失效时应确保货物的相容性。该隧道除通向露天甲板和货物泵舱或泵舱外不得设有任何开口。

5.5.5 穿过舱壁的管路应布置成能防止在舱壁产生过度的应力，不得使用以螺栓通过舱壁固定起来的法兰。

## 5.6 货物移注控制系统

5.6.1 为适当控制货物，货物移注控制系统应该：

- .1 在每一液货舱充注和排出管上可以人工操作而且位于液货舱贯穿件附近提供一个截止阀；若用独立深井泵来排放液货舱的货物，则在该舱的排放管路上不要求设置截止阀；
- .2 在每个货物软管接头处提供一个截止阀；
- .3 对所有货物泵和类似设备提供遥控截断装置。

5.6.2 移注或运载本规则中的货物所需要的控制装置（不包括本规则在其它地方已经讲过的货物泵舱中的控制装置）不应设置在露天甲板之下。

5.6.3 对于某些货品，第17章的表格的“m”栏中列出其附加的货物移注控制要求。

## 5.7 船舶货物软管

5.7.1 用于移注气体和液体货物的软管应与货物相容并且适合于货物温度。

5.7.2 承受液货舱压或泵的排放压力的软管的设计，其爆破压力应不小于在货物移注期间软管将经受的最大压力的5倍。

5.7.3 每一新型的备有端部设备的货物软管应进行原型试验，其压力不小于其规定的最大工作压力的5倍。在原型试验期间的软管温度应达到要求的最高营运温度。原型试验的软管不得用于货物输送。以后在投入营运之前，所生产的每一段新软管都应在环境温度下进行静水试验，其压力不小于规定最大工作压力的1.5倍，但不必大

于其爆破压力的五分之二。软管应印有或另外标上其最大工作压力和其最大和/或最小管运温度(如果要在非环境温度下工作的话)。规定的最大工作压力应不小于10巴。

## 第6章 构造材料

### 6.1 通则

6.1.1 货舱建造所用的材料,连同相联的管路、泵、阀门、透气管及其接合材料,应适合于所载货物的装载温度和压力,并经主管机关同意。钢是作为构造的正常材料。

6.1.2 在选用结构材料时,应视需要注意下列性能:

- .1 在操作温度下的缺口韧性;
- .2 货物的腐蚀作用;
- .3 货物与结构材料之间产生危险反应的可能性;
- .4 覆盖层的适宜性。

### 6.2 材料的特别要求

6.2.1 对于某些货品,第17章一览表中“k”栏中所标的材料需执行,6.2.2

6.2.3和6.2.4中的特殊规定。

6.2.2 下列结构材料不得应用于第17章“k”栏中提到的可能与货品或其蒸气接触的货舱、管路、泵、装置及其他设备:

- N1 铝、铜、铜合金、锌、镀锌钢或汞。
- N2 铜、铜合金、锌或镀锌钢。
- N3 铝、镁、锌、镀锌钢或锂。
- N4 铜和铜轴承合金。
- N5 铝或铜或铜铝任一合金。
- N6 铜、银、汞镁和形成乙炔的其他金属及其合金。
- N7 铜和大于1%铜含量的铜轴承合金。
- N8 铝、锌,镀锌钢或汞。

6.2.3 在电器装置内通常使用的材料例如铜、铝、绝缘应尽量采用密封来保护,以防与第17章“k”栏以Z标出的货品蒸气接触。

6.2.4 可以与某些货品或其蒸气接触的下列结构材料可以用于货舱、管路、阀门、装置或其他设备。在第17章“k”栏中所列符号如下:

- Y1 铝、不锈钢或有适当保护的衬套或镀层的钢。

- Y2 铝或不锈钢用于98%或以上纯度的货物。
- Y3 特殊抗酸不锈钢用于小于98%浓度的货物。
- Y4 固体奥氏不锈钢。
- Y5 不锈钢或有适当保护衬套或镀层的钢。

6.2.5 熔点低于925℃的结构材料，如铝及其合金，不得用作在船上装运闪点不超过60℃(闭杯试验)的货物的外部管路，除非第17章“k”栏有规定。与货舱连接的短的外部管路，如果设有防火绝缘，主管机关可以允许使用。

## 第7章 货物温度控制

### 7.1 通则

7.1.1 任何货物加热或冷却系统的建造、设置和试验应使主管机关满意。用于建造温度控制系统的材料应适合于将装运的产品。

7.1.2 加热或冷却介质应被认可用于特种货物的装运。应对加热旋管或通道的表面温度给予考虑，以避免货物局部过热或过冷引起的危险反应。(另见15.1.3.6.)

7.1.3 加热或冷却系统应设阀门使每一货舱隔离于该系统，并且允许人工节流流量。

7.1.4 在加热或冷却系统中，除空舱情况外，在任何其他情况下，应有设施来保证在管系中保持的压力高于舱内货物作用于管系的最大压力。

7.1.5 应备有测量货物温度的设备。

- .1 当第17章表“h”栏中所示的各种物质要求用限制式或封闭式仪表装置时，测量货物温度的设施应分别为限制式或封闭式的。
- .2 限制式的温度测量装置应符合13.1.1.2中对限制式仪表装置的定义，例如可携式温度应降放在限制式表管之内。
- .3 封闭式温度测量装置符合13.1.1.3中对封闭式仪表装置的定义，例如：感应器装在舱内的遥控读数的温度计。
- .4 当过热或过冷可导致危险状态时，应设置可监视货物温度的报警系统。(另见16.6中的操作要求。)

7.1.6 当第17章“m”栏中列出的15.12、15.12.1或15.12.3的货品加热或冷却时，加热或冷却介质所应在内运行的回路：

- .1 应独立于其他船舶服务(另一货物加热或冷却除外)，并不进入机器处所；
- .2 在装运有毒货品的货舱之外；

- .3 在介质再循环到船舶其他营运业务处所或进入机器处之前取样, 检查有无货物存在。取样设备应位于货物舱区域内, 并能探测任何被加热或被冷却的有毒货物的存在。如使用本方法, 管路回路必须进行测试, 不仅在加热或冷却有毒品货品开始之时, 而且在已装运不加热或不冷却的有毒货物之后第一次使用管路之时。

## 7.2 附加要求

对于某些货品, 第15章中包括的附加要求在第17章“m”栏中列出。

## 第8章 货舱透气系统

### 8.1 通则

8.1.1 所有货舱应设置适合于所装运货物的透气系统。货舱透气系统的设计应减小货物蒸气在甲板集聚、进入起居、服务和机器处所及控制站, 对于可燃蒸气, 减小其进入任何有点火源的处所的可能性。他们也必须设计成减少向甲板喷射的可能性。透气出口的布置应防止水进入货舱, 并且同时应使蒸气以不受阻气流形式向上排放。

8.1.2 应有设施确保任何舱室的液体压力不超过该舱的试验压力。为此目的, 适当的高位报警、溢流控制系统或调节阀及仪表和货舱充注程序都可以接受。当限制货舱过压设施中包含一个自动关闭阀时, 该阀应满足15.19的要求。

8.1.3 对于装设封闭式或限制式计量仪的舱室, 应规定透气系统的尺寸, 允许设有防火网(如设有时), 以在设计速率装载时货舱不致超压。特别是在饱和和货物气体以最大装载速率通过透气系统排放时, 货舱蒸气空间与大气压的压力差不应超过0.2巴, 或对于独立舱来说, 不超过货舱的最大工作压力。

8.1.4 任何装设在透气系统排放开口的防火网应易于到达和取出, 以便清洁。

8.1.5 应有适当的设施, 以排空透气管路。

8.1.6 透气管系如与抗腐蚀材料建成的货舱相连接, 或者与按本规则要求加有覆盖层或涂层用来装载特殊货物的货舱相连接, 则透气管系也要同样加有覆盖层或涂层, 或者用抗腐蚀材料制成。

### 8.2 货舱透气系统的形式\*

8.2.1 开式透气系统系指在正常操作中, 对货物蒸气进出货舱的自由流, 除摩擦和如装有防火网时而产生的损失外, 无任何限制的系统。此系统仅可用于闪点在

\* 请注意1974年安全公约1983年修正条款的第II-2/59条。

60 °C以上（闭杯试验）无明显吸入健康危害的货物。开式透气系统可以由每个货舱的独立透气管组成，或者这些独立透气管会合于一个或几个集管箱内，并适当注意货物的分隔问题。但在任何情况下，在独立透气管上或集管箱上均不应设关闭阀。

8.2.2 控制式透气系统指每舱均有压力/真空泄放阀以限制货舱中压力和真空的系统，并应用于不准采用开式透气方式的货物。控制式透气系统可以由每个货舱的独立透气管组成，或者这些独立透气管在压力一侧可以会合于一个或几个集管箱内，并适当注意货物的分隔问题。在任何情况下，在压力/真空泄放阀的上面或下面均不应装设关闭阀，但在某些操作条件下，可采取对压力/真空泄放阀加装旁通的装置。

1. 透气管出口在露天甲板上的高度应不小于4m，如透气管装设在高步桥4m以内，其高度应在前、后步桥之上不小于4m。
2. 如果装设主管机关认可型的高速透气管引导蒸气/空气混合体以出口至少为30m/s的速度向上自由喷射时，甲板或纵向步桥之上的高度可分别减小到3m。
3. 透气管出口的布置还应离开居住、服务和机器处所及有火源处所的最近空气入口或开口至少10m之外。易燃蒸气的出口应设有易于更新和有效的防火网或认可型的安全顶部。对于恶劣天气时货物蒸气冻结或结冰引起装置阻塞的可能性，在设计压力/真空阀、防火网及透气顶部时应予适当注意。

8.2.3 在8.2.1和8.2.2内对于透气管路内使用的关闭阀的规定，应延伸到所有其他切断设施（包括双孔盲板和盲板法兰）。

### 8.3 个别货物的透气要求

个别货物的透气要求列在第17章“e”栏中及“m”栏的附加要求中。

## 第9章 环境控制

### 9.1 通则

9.1.1 货舱内蒸气处所及某些情况下的货舱周围的处所可以要求有特别控制的大气。

9.1.2 有以下四种不同型式的货舱控制：

1. 惰性法——用不助燃的或不与货物反应的气体或蒸气，对货舱和有关管系及第15章规定的货舱周围的处所进行充注并维持此状态，

- .2 填料法——用分隔货物与空气接触的液体、气体或蒸气对货舱和有关管系进行充注并维持此状态。
- .3 干燥法——用在大气压下露点为 $-40^{\circ}\text{C}$ 或以下的干燥气体或蒸气来充注货舱及有关管系，并维持此状态。
- .4 通风法——强行或自然。

#### 9.1.3 当货舱要求用惰性法或填料法时：

- .1 除非岸上的供应随时可利用，应携带足够的惰性气体以供货舱充注或卸货时使用，或在船上就地制造。另外船上应有足够的惰性气体来补偿运输中的正常损耗。
- .2 船上惰性气体系统在围护系统内任何时候都必须能够保持至少为0.07巴的表压力。另外，惰性气体系统不得将货舱压力提高到超出货舱释放阀的调定值。
- .3 当使用填料法时，如上述.1和.2两段对惰性气体的要求，对提供填料介质要作类似的布置。
- .4 为确保维持正确的气压，应提供设施来监控包含一个气体垫的液面空间。
- .5 用于易燃货物的惰性和/或填料的装置应能在接纳惰性介质时尽量减少静电荷的产生。

9.1.4 当使用干燥法并且以干氮作介质时，提供干燥剂的类似安排要求同9.1.3的要求。在所有进入货舱的空气进口用干燥剂作为干燥介质时，在考虑了一日温度范围及预期的湿度后，在航行期内应携带足够的介质。

#### 9.2 各种货品的环境控制要求

某些货品环境控制的要求形式列在第17章表中的“f”栏内。

## 第10章 电气装置

### 10.1 通则

10.1.1 本章规定适用于装载其本身或其与其它物质反应后可燃或对电器设备有腐蚀性的货物的船舶，并且与《安全公约1983年修正条款第II-1章第D部分的电气要求一起联用。

10.1.2.1 电器设备应能尽量减少易燃货物发生火灾和爆炸的危险。考虑到10.1.4的要求，符合本章要求的电器装置，用于8.2.2.3的要求时不应被看作是火源。

10.1.2.2 当特种货物有可能对通常在电器设备中应用的材料造成损坏时，对于选择用作导体、绝缘、金属部件等的材料的特别特性应给予适当的考虑。只要有必要，这些部件应设防护，以防可能与气体或蒸气接触。

10.1.3 主管机关应采取适当措施，以确保执行及应用本章有关电气装置的条文的统一性。\*

10.1.4 电器设备和线路不得安装于在10.2中列出的危险部位，除非在10.2.3中列出的例外许可对营运目的是必要时才行。

10.1.5 本节允许安装于危险处所的电器设备应使主管机关满意，并且由主管机关承认的有关当局发证，证明可在易燃环境中工作，如第17章“g”栏所示。

10.1.6 第17章“g”栏中缺少温度级和设备组的资料，系指现在尚无数据。这不得与表示某些物质不燃的(NF)符号相混淆。作为指导参考，如果一物质的闪点达到60℃时(闭杯试验)，则给出指示。对于加热货的运输，可能要订出装运条件，并且应用10.2.2的要求。

## 10.2 危险部位和设备及线路的类型

10.2.1 本节的限制不排除在包括货物管系在内的所有危险部位使用本身安全的系统和回路。特别建议将本身安全的系统和回路用于测量、监视、控制和通信目的。

### 10.2.2 闪点超过60℃的货物(闭杯试验)

- .1 对于第17章“m”栏内无规定的这一类货物，仅仅货舱和货物管系为危险部位。适当地考虑了货品的化学和物理特性之后，对特定货物或明确规定范围的货物，在例外环境下，主管机关可以允许采用浸没的货泵马达和其有关的电缆。为了在可燃气体空气混合状态时防止连通马达和电缆及在低液位状态时切断马达和电缆，应作好布置。这一种关闭应在货物控制站由一报警显示。
- .2 当电气设备位于货物泵舱内时，应适当考虑使用设备的类型，确保在正常营运状态下不产生电弧或火花和热点，或者使用合格的安全型装置。
- .3 当货物加热到其闪点15℃之内时，货物泵舱应被视为危险区域，如此加热的货物货舱开口3m之内的区域及通向货物泵舱的入口或通风开口3m之内的区域都应视为危险区域。在这类部位中装设的电气设备应为核证安全型的设备。

\* 参阅国际电器技术委员会出版的建议，尤其是出版物92-502。



. 4 当货物加热到高于其闪点时, 10.2.3 的要求适用。

10.2.3 对于闪点不超过 60 °C (闭杯试验) 的货物, 第 17 章 “m” 栏中无要求时, 危险区域的位置见下文。另外, 除本身安全的系统和回路之外, 在危险部位允许采用的电气装置如下:

. 1 货舱及货物管系:

不允许设置额外的电气设备。

. 2 完整舱邻近的、上方的或下方的空舱:

- . 2.1 连续电缆。此类电缆应设置在气密接头的厚钢管内。在此类处所内不得设置膨胀弯管。
- . 2.2 电测深装置或记录装置和外加电流阴极保护系统的阳极或电极。这些装置应设置在气密围蔽处所内; 对有关电缆按 10.2.3.2.1 进行保护。

. 3 包括独立货舱在内的货舱空间:

- . 3.1 无任何附加保护的连续电缆。
- . 3.2 有加压外壳或防火焰型照明装置。照明系统应在至少两个支回路间分割开来。所有开关和保护装置都应切断所有的极或相, 并且应布置在无危险部位。
- . 3.3 电测深装置或记录装置和外加电流阴极保护系统的阳极或电极。这些装置应设置在气密围蔽处所内。

. 4 货物泵舱及位于货物区域内的泵舱:

- . 4.1 有加压外壳或防火焰型照明装置。照明系统应在至少两个支回路间分割开来。所有开关和保护装置都应切断所有的极或相, 并且应布置在无危险部位。
- . 4.2 应该由气密舱壁或甲板来把用来驱动货物泵及任何有关辅助泵的电动马达和这些处所分隔开来。保持对中的弹性联轴或保持联接的其他设施应安装于被驱动的设备及其马达之间的轴系上, 另外, 为轴系穿过舱壁或甲板时, 填料函压盖的设置应使主管机关满意。此类电马达应设置在有正压通风的舱室内。
- . 4.3 防火总报警声响指示器。

- . 5 开敞甲板区或开敞甲板半围蔽处所, 在任何货舱出口、气体或蒸气出口、货管法兰、货物阀门或货物泵舱入口及透气开口 3 m 之内, 在所有货舱和货舱舱室之上的开敞甲板之上货物区域, 包括货物区

域内的全部压载舱和隔离空舱，至舱舶的全宽，加上前后 3 m 及至甲板上方 2.4 m 的高度：

- .5.1 合格的安全型设备，适合在开敞甲板上使用；
- .5.2 连续电缆。
- .6 装有含货物的管路的封闭或半封闭处所，紧连货舱上方的封闭或半封闭处所（例如在甲板之间）或在货舱舱壁之上并且与其在一个剖面上有舱壁；紧接货物泵舱上方或者与货舱相连的垂直隔离空舱之上的封闭或半封闭处所，具有气密甲板分隔或良好通风者除外；以及货物软管舱室：
  - .6.1 合格的安全型照明装置。照明系统应至少在两条分线路之间分开。所有开关及保护装置都应切断所有的极或相并且都应布置于非危险部位。
  - .6.2 连续电缆。
- .7 有一个通向上述任何危险部位的直接开口的封闭或半封闭处所应设有符合开口通向处所或区域要求的电气设备。

### 10.3 接地

独立的货柜应与船壳进行电气连接。所有的垫圈货物管的接头和软管连接都应进行电气连接。

### 10.4 各种货品的电气要求

各种货品的电气要求在第 17 章“g”栏内示出。

## 第 11 章 防火与灭火

### 11.1 适用范围

11.1.1 1974 年国际海上人命安全公约 1983 年修正条款第 II-2 章对油轮的要求应对本规则所涉及的船舶适用，不管其吨位如何，包括小于 500 总吨的船舶，除非：

- .1 第 60、61、62 和 63 条不适用；
- .2 第 56 条之 2（即：主要货物控制站位置的要求）不必适用；
- .3 第 4 条（适用于货船）和第 7 条应适用，因为它们适合 2,000 总吨位及以上的油轮；
- .4 11.3 的规定应适用而替代第 61 条；及
- .5 11.2 的规定应适用而替代第 63 条。

11.1.2 尽管有11.1.1的规定要求,仅装载苛性碳酸钾溶液、磷酸或苛性钠溶液的船舶,如满足安全公约1983年修正条款第II-2章第C部分的要求,就不必满足该章第D部分的要求,除了第53条不必适用这类船舶并且以下的11.2和11.3不必应用以外。

## 11.2 货物泵舱

11.2.1 任何船舶的货物泵舱应设置如下固定灭火系统:

- 1 安全公约1983年修正条款第II-2章第5条之1和2规定的二氧化碳系统。应于控制处标明此系统仅用于灭火而不适用于惰性法的目的,因为存在有静电起火的危险。安全公约1983年修正条款第II-2章第5条之1.6要求的报警在可燃货物蒸气/空气混合气体中的使用应确保安全。根据本要求,应设置适合于机器处所使用的灭火系统。在各种情况下,应携带充足的自由气体,其气体量应等于货物泵舱总容积的45%;或
- 2 安全公约1983年修正条款第II-2章第5条之1和3规定的卤化烃系统。应于控制处标明此系统仅用于灭火而不适用于惰性法的目的,因为存在有静电起火的危险。安全公约1983年修正条款第II-2章第5条之1.6要求的报警在可燃货物蒸气/空气混合气体中的使用应确保安全。根据本要求,应设置适合于机器处所使用的灭火系统,但是基于货物泵舱的容积,使用如下最小设计量:

卤化烃 1301	7 %
卤化烃 1211	5.5 %
卤化烃 2402	0.3 kg/m <sup>3</sup>

11.2.2 用于专门装载有限种类货物的船舶的货物泵舱,应得到主管机关批准的适当灭火系统的保护。

11.2.3 如果可以向主管机关证明要装载的货物不适宜采用二氧化碳或卤化烃进行灭火,则可对货物泵舱提供一个固定压力喷水系统或者高倍泡沫系统的灭火系统。国际散装危险化学品适航证书,应反映出此条件的要求。

## 11.3 货物区域\*

11.3.1 根据11.3.2至11.3.12的要求,每一条都应装置固定甲板泡沫系统。

\* 参见对化学液货轮泡沫系统计算方法提出指南的工作文件MSC/Circ.314,该文件可在应用本规则灭火剂的要求时加以使用。

11.3.2 仅应提供一种泡沫浓缩物，所以该浓缩物应对要装载的最大可能种类数的货物有效。对于其他用泡沫不奏效或者与之不相容的货物，则要设置为主管机关所满意的附加装置。一般的蛋白泡沫不得使用。

11.3.3 提供泡沫的装置应能输送泡沫到整个货舱甲板区域，也能输入任何货舱舱室，假设其甲板断裂。

11.3.4 甲板泡沫系统的操作应该简单、迅速。系统主控站应适当地位于货物区域之外，邻近起居处所，便于在受保护区域内万一失火时随时进入和操作。

11.3.5 泡沫溶液的供应率不应小于下列的最大者：

- .1 货舱甲板面积  $2\ell/m^2/min$ ，货舱甲板面积系指船舶最大宽度乘以货舱处所总纵向范围；
- .2 具有最大水平剖面面积的单舱的这种剖面面积  $20\ell/m^2/min$ ；
- .3 最大泡沫炮保护的面积  $10\ell/m^2/min$ ，这个面积在该泡沫炮之前但不得小于  $1,250\ell/min$ 。对小于 4,000 总吨的船舶，的最小能力应获主管机关认可。

11.3.6 当使用 11.3.5.1、11.3.5.2 和 11.3.5.3 中规定的最大溶液速率时，应提供足够的泡沫浓缩物以确保至少能在 30min 内一直产生泡沫。

11.3.7 应通过泡沫炮和泡沫发生器提供来自固定泡沫系统的泡沫。11.3.5.1 或 11.3.5.2 要求的泡沫速率，至少 50% 应通过每个泡沫炮输出。任何泡沫炮提供泡沫的能力应至少能为由该泡沫炮保护的甲板区域提供每平方米  $10\ell/min$  的泡沫溶液。这种能力应不小于  $1,250\ell/min$ 。对于小于 4,000 总吨的船舶，泡沫炮的最小能力应为主管机关所满意。

11.3.8 自泡沫炮至该泡沫炮所保护区的最远边缘的距离应不大于泡沫炮在平静空气中射程的 75%。

11.3.9 泡沫发生器的泡沫炮和软管连接应位于艙楼前部或面对货舱区域的起居处所的左、右舷。

11.3.10 发生器应在消防作业中具有操作的灵活性，并且应覆盖泡沫炮屏障区域。任一发生器的容量应不小于  $400\ell/min$ ，而且发生器在静空气状态的射程应不小于 15m。装设的泡沫发生器数量应不少于 4 个。泡沫主出口的数量和位置应该是至少有两个发生器的泡沫可以喷向货舱甲板区域的任何部位。

11.3.11 在泡沫总管及与甲板泡沫系统连为一体的消防总管上，应设置阀门，使之位于每一泡沫炮前部，以隔断破损的总管节段。

11.3.12 按其要求的输出量来操作甲板泡沫系统，应允许在所要求的消防总管的压力下同时使用所要求的最低数量的水喷口。

11.3.13 用于装载有限货物种类的船舶，应由使主管机关满意的替代设施进行保护，其对有关货品的效应相同于对甲板泡沫系统所要求的对一般易燃货物的效应。

11.3.14 应配备适于所装货品的手提式灭火设备并保持良好操作状态。

11.3.15 当装载易燃货物时，所有点火源应排除在 10.2 涉及到的危险部位之外。

11.3.16 装有船艏或船艙装卸装置的船舶应额外设置一个符合 11.3.7 要求的泡沫炮及一个符合 11.3.10 要求的发生器。附加泡沫炮应位于保护船艏或船艙装卸装置的位置。货物区域前后的货物管线应由上述发生器保护。

#### 11.4 特殊要求

被认为适合于某些产品的灭火介质列在第 17 章“j”栏内，以供参考。

### 第 12 章 货物区域的机械通风

对本规则所适用的船舶，用本章的要求替代安全公约 1983 年修正条款第 II-2 章第 59 条之 3 的要求。

#### 12.1 装卸货物过程中经常进入的处所

12.1.1 货物泵舱和包括货物装卸设备的其他围蔽处所以及在在里面在货物上进行工作的类似处所应装设机械通风系统，并使得能从此类处所外部进行控制。

12.1.2 应作出在进入舱室和操作设备之前应对此类处所进行通风的规定，并且要求进行此类通风的警告牌应放置在舱室之外。

12.1.3 机械通风的进口和出口应布置成确保足够的空气流经这些处所，以避免有毒蒸气和/或可燃蒸气（考虑其蒸气密度）集聚并且为提供安全工作环境确保足够的氧气，但不管怎样，基于处所的总容积，通风系统应具有每小时不小于 30 次的空气交换能力。对于某些货品，对货物泵舱的增加的通风率阐述于 15.17 之中。

12.1.4 通风系统应为永久的并且一般应为排出型的。应可以从花铁板上和上抽放。在装有驱动货物泵马达的舱室内通风应为正压型。

12.1.5 来自货物区域内处所的通风排气管道应向上排放，其位置距离通风进口和起居、服务和机器处所和控制台站的开口以及货物区外部的其他处所的开口在水平方向上应至少 10m。

12.1.6 通风进口的布置应减小来自任何通风排气口的危险蒸气再循环的可能性。

12.1.7 通风管道不得穿过机器处所、起居处所、服务处所或其他类似处所。

12.1.8 如果装运易燃货品，驱动风扇的电动马达应装置在通风筒的外部。在第10章内提到的危险区域中的通风机和风扇筒中的扇体应为防火花结构，其规定如下：

- .1 非金属结构的叶轮和罩壳，要考虑减少静电作用；
- .2 非亚铁材料的叶轮和罩壳；
- .3 奥氏（不锈）钢叶轮和罩壳；
- .4 亚铁叶轮和罩壳设计顶齿间隙不小于13mm。铝合金或锰合金的固定或转动部件和亚铁的固定或转动部件的任何组合应被认为有火花危险，在这些处所不得使用。

12.1.9 本章所要求的船上每一种扇型应具备有足够的备件。

12.1.10 应在通风筒外部开口处设置不小于13mm平方的网筛保护屏障。

## 12.2 经常进入的泵舱及其他封闭处所

在12.1.1中未包括的经常进入的泵舱和其他围蔽处所应设置机械通风系统，并能从此类处所外部操作，而且符合12.1.3的要求，但基于处所的总容量，每小时空气交换次数不得少于20次。在进入之前应规定对此类处所进行通风。

## 12.3 不经常进入的处所

双层底、隔离空舱、箱型龙骨、管道、货舱及货物可能集聚的其他处所应能通风以确保在必须进入处所时环境是安全的。当对此类处所不设有永久通风系统时，应具备有认可型的便携式机械通风装置。当由于处所布置必要时，例如在货舱，这种通风的必要通道应永久设置。对于永久装置，应提供每小时8次的空气交换，对便携式系统则为每小时16次的空气交换。风机或风扇应离开人员出入口，并且应符合12.1.8的规定。

## 第13章 测量仪器

### 13.1 测量

13.1.1 货舱应装设下列型式之一的测量设备：

- .1 开敞式设备——该设备利用货舱上的开口，仪表可露置于货物或其蒸气中。例如液面测量孔。
- .2 限制式设备——该设备穿入货舱，当使用时，允许少量货物蒸气或液体暴露于大气。当不使用时，这种设备是完全封闭的。其设计应保证在打开这种设备时，舱内物质（液体或喷雾）不会危险地溢出。

- .3 封闭式设备——该设备穿入货舱，它是封闭系统的一部分，能防止舱内物质泄出。例如浮式系统、电子探测器、磁性探测器和安全观察玻璃等。或者用不穿过货舱外壳而与货舱独立的间接式设备。例如货物的磅称、管子流量计等。

13.1.2 测量仪器应独立于15.19所要求的设备。

13.1.3 只有在下列情况下才允许用开敞式测量和限制式测量：

- .1 本规则允许开敞式透气时，或
- .2 在操作仪表之前可采取措施以释放货舱压力。

13.1.4 对各种货品的测量方式见第17章表中的“h”栏。

### 13.2 蒸气探测

13.2.1 载运有毒和/或易燃货物的船舶，至少应备有两种设计和经核准用来测试该种特殊蒸气的仪器。如果这种仪器不能兼用于试验毒性浓度和易燃浓度，则应备有两套分开的仪器。

13.2.2 蒸气探测仪器可以是可携型的或固定型的。若装有一个固定系统，则至少还要备有一种可携型仪器。

13.2.3 当对某些货品的有毒蒸气没有适用的探测设备时（如第17章的“i”栏所示），则主管机关可以免除对该船舶的要求，但在国际适合证书上应有适当的记录。当批准这一免除时，主管机关应认识到增加呼吸空气供应的必要性，并且在国际适合证书上应记载以使注意14.2.4和16.4.2.2的规定。

13.2.4 对各种货品的蒸气探测要求见第17章表中的“i”栏。

## 第14章 人员保护

### 14.1 保护设备

14.1.1 为保护从事装卸作业的船员，船上应有适宜的保护设备，包括大围裙、带有长袖的特别手套、适用的鞋袜、用抗化学性材料制成的连衣裤工作服以及带有紧密的护目镜和/或面罩等。用于保护人身的衣服和设备应围罩人全身的皮肤，使人体全部受到保护。

14.1.2 工作服和保护设备应保存于容易取用的地方，并放在专门的储存柜内。这些设备不准存放在起居处所内，新的、没有用过的设备及经彻底洗净后没有用过的设备除外。如果与生活处所（例如舱室、过道、餐厅、浴室等）适当地隔离，主管机关也可批准在起居处所内的此类设备的储存室。

14.1.3 在一切可能对人员产生危险的作业中，应使用保护设备。

## 14.2 安全设备

14.2.1 装载第17章表中“m”栏里列出的15.12、15.12.1或15.12.3规定的货物的船舶，在船上应有足够数量的（但不少于3整套）安全设备，每套设备允许人员进入充满瓦斯的舱室并在内工作至少20min。此类设备应为安全公约1983年修正条款第II.2/17条所要求的设备之补充。

14.2.2 一整套安全设备应包括：

- .1 独立式空气呼吸器一具（不使用储存的氧气）；
- .2 保护衣服、鞋、手套和紧密的护目镜；
- .3 带有腰带的不受所载货物影响的防火救生绳；
- .4 防爆灯。

14.2.3 对于14.2.1要求的安全设备，所有船舶都应携带下列要求的一种：

- .1 为每具呼吸器配备一套满注备用空气瓶；
- .2 一台能供应所需纯度的高压空气的特殊空气压缩机；
- .3 能为足够的备用呼吸具气瓶充注的充气复式接头；或
- .4 超过安全公约1983年修正条款第II-2/17条的要求时，船上每具呼吸具配备的满注备用气瓶装至少相当于6,000ℓ自由空气的压缩空气。

14.2.4 装载执行15.18要求的货物或第17章“i”栏所列的货物的船舶的货物泵舱，当要求有毒蒸气探测设备而无适用设备时，应有：

- .1 适合14.2.1所要求的呼吸器使用的有软管接头的低压管系。该系统应有充足的高压气量，并通过减压装置来提供足够低压的空气量以供两个人在瓦斯危险处所至少工作一小时而不用呼吸器的气瓶。应采取措施用适于提供所要求纯度的高压气量的空气压缩机对固定空气瓶和呼吸具气瓶再充气；或
- .2 等量的备用瓶装空气，以替代低压空气管。

14.2.5 应至少有一套14.2.2所要求的安全设备，在泵舱附近易于到达的地方，存放于明显标示的储藏间内。其他几套安全设备也应放在适当的有明显标示的和易于到达的地方。

14.2.6 呼吸器应由负责的驾驶员每个月至少检查一次并把检查记录在船舶航海日志里。该设备应由专门检验人员每年检查和试验一次。

14.2.7 适用于从货物泵舱等处所吊出受伤人员的担架，应放置在易于取用的地方。



14.2.8 从事装运某些货物的船舶应配备适当的足够船上每一人员在应急逃生而用的呼吸和眼睛保护装置,受下列要求限制:

- .1 只有当一个过滤器适合船舶可装运的所有指明的货物时,过滤式呼吸保护器才能被接受;
- .2 独立式呼吸器一般应至少能使用 15min;
- .3 应急逃生呼吸保护装置不得用于消防或装卸货物的目的,并应打上相应的标志。

本节要求适用的各种货物在第 17 章“1”栏内表示。

14.2.9 船上应有医药急救设备,包括输氧设备和对所载货物的消毒药品。

14.2.10 在甲板上方便的地方,应有适当标明的消除沾染的淋浴和洗眼设备。淋浴和洗眼设备在所有环境下都应能操作。

## 第 15 章 特殊要求

第 17 章表中的“m”栏中有具体指示时,本章的要求适用。这些要求是本规则一般要求的补充。

### 15.1 丙酮氰醇

丙酮氰醇须用无机酸加以稳定,以防分解。制造厂应提供稳定证书,证书上须载明:

- .1 所加稳定剂的名称与数量;
- .2 稳定剂加入日期与有效期;
- .3 改变稳定剂有效期的任何温度界限;
- .4 航程超过稳定剂有效期时应采取的行动。

### 15.2 93%或93%以下的硝酸铵溶液

15.2.1 硝酸铵溶液应至少含有7%的水分。该溶液在以十份水与一份溶液稀释时,酸度(pH)应在5.0和7.0之间。溶液中所含的氯化物离子和铁离子均不超过10 ppm并不得含有其他杂质。

15.2.2 装载硝酸铵溶液的货舱和设备,应独立于装载其他货物或可燃货品的货舱和设备。不得使用那些可能在使用中或在有故障时会将可燃货物(如滑油)释放至货物中的设备。货舱不得用于海水压载。

15.2.3 除主管机关另有认可外,硝酸铵溶液不得装运在以前装过其他货物的货舱里,但货舱及其设备经清洗至主管机关满意者除外。

15.2.4 货舱加热系统中热交换介质的温度不能超过160°C。该加热系统应设有控制装置,使散装货物的平均温度保持在140°C。应设有145°C和150°C的高温报警装置和125°C的低温报警装置。在热交换介质的温度超过160°C时,也应报警。温度报警装置及其控制器应位于驾驶室内。

15.2.5 如果散装货物的温度达到145°C,应取货物试样,并以十份蒸馏水或软水和一份试样加以稀释,其酸度(pH)应以具有精确量程的试纸或试棒确定之。酸度(pH)应每隔2-4小时测量一次。一旦酸度(pH)低于4.2,应将氨气注入货物,直到酸度(pH)达到5.0为止。

15.2.6 应设有能将氨气注入货物的固定装置。该装置的控制装置应位于驾驶室内。为此,船上每1,000吨硝酸铵溶液应备300kg氨。

15.2.7 货泵应为离心深潜式或离心水封式泵。

15.2.8 透气管系应设有经认可的风雨帽盖,以防障碍物阻塞。此种帽盖应能予以检查和清洗。

15.2.9 凡是与硝酸铵溶液接触过的货舱、管系和设备,只有在内外彻底清除所有硝酸铵的痕迹后,方可进行热加工。

### 15.3 二硫化碳

15.3.1 货舱在装载、卸载和移载时,应采取措施以使舱内保持一层水衬垫。此外,在移载时,在货舱空档内应保持一个惰性气体的衬垫。

15.3.2 所有开口应在甲板以上的货舱顶上。

15.3.3 装载管路端头应接近液货舱底。

15.3.4 备有标准的空档开口,以便应急测深。

15.3.5 货物管系和透气管路应独立于其他货物的管系和透气管路。

15.3.6 泵可以用来卸货,但这种泵应为深潜式或液压驱动的半潜式泵。驱动深潜式泵的装置不应产生点燃二硫化碳的火源,并且不得采用温度可能超过80°C的设备。

15.3.7 如果采用卸货泵,要把它放入一个从舱顶伸到近于舱底某点的圆柱形井状围栏内。在打算把泵取出之前,除非证明该货舱内已无瓦斯之外,井状围栏内应形成一层水衬垫。

15.3.8 如果货物系统设计的压力和温度适合需要,则水或惰性气体的位移法可以用来卸货。

15.3.9 安全释放阀应以不锈钢制成。

15.3.10 由于二硫化碳的低着火温度和需用较小的间隙来阻止火焰的传播，所以在10.2.3中所述的危险位置只许设有固有的安全系统的回路。

#### 15.4 乙醚

15.4.1 除非舱内充有惰性气体，船舶在航行中对货舱周围的留空处所应能自然通风。如果设置机械通风系统，所有鼓风机应为无火花型结构。机械通风设备不得置于货舱周围的留空处所内。

15.4.2 压力释放阀的调节，对于重力货舱不得小于0.2巴。

15.4.3 如果货物系统的设计压力适合需要，则惰性气体的位移法可以用来对压力货舱进行卸货。

15.4.4 为防止发生火灾，在货物区域内应采取措施，以免有任何火源和/或产生热度。

15.4.5 泵可以用来卸货，但这种泵的设计型式须能避免对泵轴压盖产生液体压力，或者采用液压驱动的潜式泵，并适用于这种货物。

15.4.6 货舱在装载、卸载和移载时，应采取措施以使舱内保持惰性气体垫。

#### 15.5 60%以上但不超过70%的过氧化氢溶液

15.5.1 过氧化氢溶液只能用专用船载运，并不得载运其他货物。

15.5.2 货舱及其设备应以纯铝(99.5%)或全不锈钢(304L、316、316L或316Ti)制成，并按经认可的程序纯化。甲板上不得采用铝制管系。所有非金属材料制造的容器系统，既不能同过氧化氢起化学反应，也不能有助于分解。

15.5.3 泵舱不得用于货物过驳操作。

15.5.4 货舱应与燃油舱或装有易燃或可燃材料的任何其他处所用隔离空舱加以隔开。

15.5.5 拟载过氧化氢的货舱不得用于海水压载。

15.5.6 货舱的顶上和底部应设置感温器。驾驶室内应设有温度遥测读出器并能连续监控。如果舱内温度超过35℃，驾驶室内应发出声光报警。

15.5.7 于货舱邻接的留空处所内应设有固定式氧气监控器(或瓦斯取样管路)，以探测货物是否泄漏到这些处所内。驾驶室内也应设有遥测读出器、连续监控(如果采用瓦斯取样管路，则以间歇取样为好)以及类似感温器所需的声光报警装置。在这些留空处所内，如果氧气浓度超过容量的30%，应发出声光警报。应设两个可携式氧气监控器作为备用装置。

15.5.8 为防止发生不能控制的分解情况，应设置货物投弃系统，以便将分解货物排到船外。如果货物温升在5小时内以每小时超过2℃，或者在舱内温度超过40℃时，该货物应予以投弃。

15.5.9 货舱的通风系统，对于正常通风，应设有压力/真空安全阀，对于应急通风，应设有安全膜或类似装置，以防货舱压力迅速升高以致引起无法控制的分解。安全膜的尺寸应根据货舱设计压力、货舱大小和预期的分解率确定。

15.5.10 应设有固定式喷水系统，以便稀释并洗掉溢漏在甲板上的任何浓缩的过氧化氢溶液。喷水器所覆盖的区域应包括支管/软管接头和载运过氧化氢溶液的专用货舱的顶部。最小应用率应符合下列标准：

- .1 货品应在溢漏5min之内把其原来的浓度稀释到35%。
- .2 溢漏率和估计溢漏的大小应根据预计的最大装卸率、货舱注满或管系/软管故障时停止货物流通所需的时间以及从货物控制站或驾驶室启动稀释水喷洒装置所需的时间而定。

15.5.11 过氧化氢溶液应予以稳定，以防分解。制造厂应提供稳定证书，证书应存放在船上，上面载明：

- .1 所加稳定剂的名称与数量；
- .2 稳定剂加入日期与有效期；
- .3 改变稳定剂有效期的任何温度界限；
- .4 一旦航程时间超过稳定剂有效期时应采取的行动。

15.5.12 只能载运那些在25℃时具有每年1%的最小分解率的过氧化氢溶液。托运人用以说明货品符合本标准的证书应送交船长并保存于船上。制造厂应派技术代表上船监控装货操作，所派代表应有能力检验过氧化物的稳定性。技术代表应向船长证明，货物是在稳定状况下装载的。

15.5.13 涉及货物装载操作的每一个船员，均应配备能抵抗过氧化氢溶液的防护衣。防护衣应包括不燃的工作服、适宜的手套、靴子和眼睛保护装置。

## 15.6 内燃机燃油（含有烷基铅的）防爆化合物

15.6.1 用于这些货物的货舱，除了用于运输制造内燃机燃油的含有烷基铅的防爆化合物货品之外，不得用于运输任何其他货物。

15.6.2 如果货泵舱按15.18的规定置于甲板平面上，则通风装置应符合15.17的要求。

15.6.3 用于运输这些货物的货舱非经主管机关认可不得进入。

15.6.4 在允许人员进入货泵舱或货舱周围的留空处所之前，应进行空气分析，以测定含铅量是否合格。

### 15.7 磷（黄色或白色）

15.7.1 必须使磷在装载、运输和卸载的任何时候都处于最小深度为 760 mm 的水层之下。在卸载作业中，应设有装置以保证水能占据已卸去的磷的体积。从磷舱排出的水，只能回到岸上装置中去。

15.7.2 货舱的设计和试验，在设计的同时，并考虑到磷的深度、比重和装卸方法，应至少经受高出货舱顶 2.4 m 的水头。

15.7.3 货舱的设计，应尽量减少液体磷与其水层之间的交界面积。

15.7.4 在水层上面应至少保持 1% 的空档。空档应充以惰性气体，或以两个不同高度的具有通风帽的立管进行自然通风，立管高出甲板至少为 6 m，高出泵舱顶至少为 2 m。

15.7.5 货舱的所有开口都要位于舱顶上，其附属零件应使用能抵抗五氧化二磷的材料制成。

15.7.6 磷应在温度不应超过 60 °C 的条件下装卸。

15.7.7 货舱加热装置应设在货舱之外，并有适当的温度控制方法以保证磷的温度不超过 60 °C。应装有高温报警器。

15.7.8 在所有货舱周围的留空处所内，均应设有主管机关认可的水淋系统。当磷逸出时，该系统能自动开启。

15.7.9 15.7.8 所述的留空处所，应备有有效的机械通风装置，倘遇紧急情况能够迅速封闭。

15.7.10 磷的装载和卸载，应由船上中央系统予以控制，该系统除装有高液位报警器外，应能保证货舱不会溢流，而且当遇有紧急情况时，装卸作业能够从船上或岸上予以迅速停止。

15.7.11 在货物装卸中，甲板上要备有与水源连接的水龙带，并保持在整个作业中有水流通，以保证任何磷的漏逸可以立刻用水洗去。

15.7.12 船上到岸上装卸货的管子接头应经主管机关认可。

### 15.8 环氧丙烷

15.8.1 依照本节规定运输的环氧丙烷，必须不含有乙炔。

15.8.2 凡装过上述三种已知能与下列任何货品起催化聚合作用的货物之一的货舱，除非该舱业经适当清洗，否则不得装运环氧丙烷：

- 1 无机酸（如硫酸、盐酸、硝酸）；

- .2 羧酸和酞(如甲酸、醋酸);
- .3 卤代羧酸(如氯醋酸);
- .4 磺酸(如苯磺酸);
- .5 苛性碱(如氢氧化钠、氢氧化钾);
- .6 氨及氨溶液;
- .7 胺及胺溶液;
- .8 氧化物质。

15.8.3 货舱在装运环氧丙烷之前,应彻底地有效地予以清洗,以便清除货舱及其管道工程上前次所装货物的所有痕迹,但前次所装货物是环氧丙烷者例外。在非不锈钢建造的钢舱内有氨气时应予特别注意。

15.8.4 在任何情况下,应以适当的试验或检验来检查货舱及其管道工程的清洗程序是否有效,以确定不存在酸或碱材料痕迹,因为这些残留痕迹在装进环氧丙烷时可能会引起危险的情况。

15.8.5 在货舱里,每当首次装载环氧丙烷之前,应进去加以检查,以保证没有污染、严重的铁锈沉积物和明显的结构缺陷。当货舱连续运输环氧丙烷时,则上述检验的间隔应不超过两年。

15.8.6 载运环氧丙烷的货舱应以钢或不锈钢制成。主管机关可以接受适当的货舱涂层,并在国际散装运输危险化学品合格证书上注明。

15.8.7 装过环氧丙烷的货舱,只要货舱及有关管道系统经过彻底清洗以后,仍可装运其他货物。

15.8.8 所有阀门、法兰、配件和附属设备,其型式必须适用于环氧丙烷,应由钢或不锈钢或其它经主管机关允许的材料制成。所有材料的化学成分,应在制造之前提交主管机关认可。阀门的阀盘或阀盘面、阀座和其它摩擦部件应用含铬不少于11%的不锈钢制成。

15.8.9 所有填料应用不会同环氧丙烷起反应,不会溶解在环氧丙烷里,也不会降低环氧丙烷的自然温度的材料制成,这种材料还应耐火和具有适当的机械性能。接触货物的表面应为聚四氟乙烯(PTFE)或由于其惰性而具有相同安全程度的材料制成。主管机关可以接受具有聚四氟乙烯填料或类似氟化聚合物的螺旋缠绕不锈钢材料。

15.8.10 如果使用绝缘和填料,其材料应不会同环氧丙烷起反应,不会溶解在环氧丙烷里,也不会降低环氧丙烷的自然温度。

15.8.11 下列材料一般认为不适宜用于环氧丙烷容器系统上的填料、衬垫和类似用途，若要使用，须在主管机关批准之前作试验：

- .1 氯丁橡胶或天然橡胶（如果与环氧丙烷接触）；
- .2 石棉或与石棉混合使用的粘接料；
- .3 含有镁氧化物的材料，如矿渣绒。

15.8.12 在货物液体和蒸气管路中，禁止使用螺纹连接。

15.8.13 装载和卸载的管路应伸到离舱底或任何聚液的井状围栏的底部100毫米之内。

15.8.14 装载环氧丙烷货舱的容器系统应设有阀门控制的蒸气回路接头。

15.8.15 货舱在装卸环氧丙烷时不要向外通风。如在货舱装载时必须将蒸气回送到岸上，则连接环氧丙烷容器系统的蒸气回路装置应同所有的其它容器系统分离。

15.8.16 在卸载作业期间，货舱内的压力必须保持在0.07巴以上。

15.8.17 装载环氧丙烷的货舱，其透气管系应与装载其它产品的货舱分开。应设有在不打开货舱的情况下能够取样的设施。

15.8.18 卸下货物时只可使用深井泵、液压操纵半潜式泵或惰性气体位移法。每一货泵的布置，应保证在关闭或阻塞泵的排放管路时不致产生很大的热量。

15.8.19 装卸环氧丙烷的软管上应标明“环氧丙烷装卸专用”。

15.8.20 相邻于整体重力货舱的货舱、留空处所和其他封闭处所，应装载能相容的货物（15.8.2列举的货物为不相容货物的例子）或充满适当的惰性气体。设有独立货舱的任何封闭处所应充以惰性气体。充有惰性气体的处所和货舱应能监控环氧丙烷和氧气。可移式取样设备应符合要求。这些处所内的氧气成分应保持在2%以下。

15.8.21 当货泵或管系存有环氧丙烷时，则在任何情况下禁止空气进入其内。

15.8.22 在拆开岸上管路之前，液体和蒸气管路内的压力应通过装于装载端管上的适当阀门予以泄放。这些管路内的液体和蒸气不准排入大气。

15.8.23 环氧丙烷可以装载在压力货舱或独立重力货舱或整体重力货舱内。货舱的设计应能经受在货物装载、运输和卸载中预计会遇到的最大压力。

15.8.24 设计压力小于0.6巴的货舱，需要有一个冷却系统来保持环氧丙烷低于其标准温度。此标准温度系指环氧丙烷在压力释放阀调定值时相应于环氧丙烷的蒸气压力时的温度。

15.8.25 如果船舶营运于有限航区或从事有限航行，主管机关可以放弃设计压力小于0.6巴的货舱的制冷要求，但可以考虑该货舱在此情况下的任何绝缘措施。允许上述运输的航区和每年次数应在国际散装运输危险化学品合格证书的载运条件中加以标明。

15.8.26 任何冷却系统应保持液体温度低于抑制压力的沸点温度。至少应备有两整套冷却装置，按货舱内温度的变化自动调节。每套要配齐正常作业所必需的辅助设备，其控制系统还要能够人工操作。应设有报警器，用来指示温度控制失灵。每个冷却系统的能力应足以使液体货物的温度保持在该系统的标准温度以下。

15.8.27 另一种办法是包括三个冷却装置，其中任何两个应足以使液体温度保持在标准温度以下。

15.8.28 仅用单壁同环氧丙烷隔开的冷却介质应为不与环氧丙烷起反应的介质。

15.8.29 禁止使用需要压缩环氧丙烷的冷却系统。

15.8.30 压力释放阀的调定，对压力舱来说，应不小于0.2巴，不大于7.0巴。

15.8.31 用于装载环氧丙烷货舱的管系，应与所有其他货舱（包括空舱）和所有货物压缩器的管系分开（见1.3.24的规定）。若所装货舱的管系并非独立的（见1.3.15的规定），则以可移短管件、阀件或其它管段来达到所需的管系独立，并在这些位置上安装盲断法兰。所需的独立适用于所有液体和蒸气管系、液体和蒸气透气管路以及任何其它可能的连接，例如公用惰性气体供给管路等。

15.8.32 只有按照主管机关认可的货物装卸计划，才可运输环氧丙烷。每一拟定的装载布置应在单独的货物装卸计划上标明。货物装卸计划应标明需要符合上述管系分开要求的整个货物管系和盲断法兰的安装位置。船上应保存每一经认可的货物装卸计划的副本一份。应签署国际散装运输危险化学品合格证书，其中包括经认可的货物装卸计划。

15.8.33 在每次装载环氧丙烷之前，应从主管机关认可的主管机构那里获得证明业已达到所需管系分开的证书，并存于船上。盲断法兰和管路法兰之间的每一连接应设置金属线，并由主管人员密封，以保证盲断法兰不被无意移动。

15.8.34.1 货舱在标准温度（R）下所装液体不得超过98%。

15.8.34.2 货舱所载的最大容积（ $V_L$ ）应为：

$$V_L = 0.98 V \frac{P_R}{P_L}$$



式中:  $V$  = 货舱容积

$P_R$  = 货物在标准温度时的相对密度

$P_L$  = 货物在装载温度和压力下的相对密度

$R$  = 货物在压力释放阀开启压力下相应于蒸气压力的标准温度。

15.8.34.3 对于可能适用的每一装载温度和最大的标准温度, 每一货舱最大许可的充注极限应在主管机关认可的表上标明。该表的副本应由船长长期保存在船上。

15.8.35 货物应在适宜的氮气保护层之下载运。应装有自动制氮系统, 以便在由于环境情况或制冷系统的不正确操作而致使货品温度下降时, 能够防止货舱压力低于0.07巴。船上应能获得充足的氮气, 以便满足压力自动控制的要求。用于保护层的氮应为工业用的纯度为99.9%的氮气。在此方面, 通过降压阀与货舱连接的一排氮气瓶可满足“自动”一词的要求。

15.8.36 在装载前后应测试货舱的蒸气空间, 以证实其含氧量为2%或以下。

15.8.37 在进行装卸作业的区域, 应设有喷水灭火系统, 其能力和布置应能有效地覆盖环氧丙烷装载支管、有关货物装卸的露天甲板管道和货舱圆顶的周围区域。当每分钟出水率为10  $\ell/m^2$  时, 管路和喷嘴的布置应对所保护的全部区域均匀地分布。该喷水灭火系统应能进行就地和遥控人工操作, 而且其布置应保证能把任何泄漏的货物冲洗掉。此外, 如果大气温度许可, 应装一条给喷嘴以压力的水龙软管, 以便在进行装卸作业时可以使用。

15.8.38 在货物装卸时所使用的每个货物软管接头上, 都要备有一个能遥控的控制关闭速率的关闭阀。

### 15.9 50%或50%以下的氯酸钠溶液

15.9.1 装过本货品的液货舱及其附属设备, 只要经过彻底的清洗, 仍可装运其它货物。

15.9.2 本货品一旦发生泄漏, 所有泄漏的液体应立即彻底地冲洗掉, 不得延迟。为使火灾危险减至最小, 因此, 不许让泄漏物变干。

### 15.10 液态硫

15.10.1 在一切载运情况下, 应使货舱通风, 使全部货舱蒸气空间内保持硫化氢的浓度低于其爆炸下限的一半, 即体积在1.85%之下。

15.10.2 如果使用机械通风系统来使货舱内保持气体低浓度, 应装有一个报警系统, 在机械通风失效时报警。

15.10.3 通风系统的设计和布置, 应能排除硫在该系统内的积存。

15.10.4 在货舱邻近的留空处所的开口，其设计和装置应能防止进入水、硫或货物蒸气。

15.10.5 应装有能对留空处所内的蒸气取样和进行分析的连接件。

15.10.6 应备有货物温度控制装置，以保证硫的温度不超过155℃。

#### 15.11 酸

15.11.1 船壳板不得作为装载矿物酸的货舱的界限板。

15.11.2 主管机关可以考虑用抗腐蚀材料来对钢的货舱和有关管系加衬里的建议。衬里的弹性应不低于起支撑作用的界限板的弹性。

15.11.3 除非完全用抗腐蚀材料建成，或者装有经认可的衬里，否则应考虑到货舱板厚度受到的货物的腐蚀。

15.11.4 装卸支管接头的法兰盘处应设有可移动的防护罩，以防货物喷出的危险，此外，还应备有滴盘，以防货物滴漏到甲板上。

15.11.5 装载这种物质时，由于其产生氢的危险，所以电气设备应符合10.2.3.1、10.2.3.2、10.2.3.3、10.2.3.4、10.2.3.6和10.2.3.7的规定。应采用适于在氢气和空气的混合气体中使用的经认可的安全型设备，而且其处所内不得有其他火源。

15.11.6 受本节约束的货物，除遵守3.1.1的分隔要求外，尚须与燃油舱分隔。

15.11.7 应备有适当的仪器，以探测货物漏逸到邻近处所。

15.11.8 货泵舱的舱底泵装置及其放泄装置应用抗腐蚀材料制成。

#### 15.12 有毒货品

15.12.1 货舱透气系统的排出口位置应为：

- .1 风雨甲板以上高度为  $B/3$  或 6 m，取其大者；或者，对于甲板货舱，以出入步桥为基准；
- .2 如设在步桥 6 m 之内，则须在前后步桥以上不少于 6 m；及
- .3 离开任何居住和服务处所的任何开口或空气入口 15 m；
- .4 适用时，透气管高度可减至甲板或前后步桥以上 3 m 处，但应设置经主管机关认可型式的高速透气阀，该阀应使蒸气/空气混合物以至少 30 m/s 的出口速度垂直向上无阻挡地喷出去。

15.12.2 货舱透气系统应备有一个接头，用以连接把蒸气回送到岸上设备的管路。

### 15.12.3 货品应该

- .1 不装载在燃油舱的邻接舱内;
- .2 具有分开的管系, 及
- .3 具有与装载无毒货品的货舱分开的货舱透气系统。(亦见3.7.2)。

### 15.12.4 货舱安全阀开启压力最小应为0.2巴。

### 15.13 需要制止自行反应的货物

15.13.1 某些货物, 如第17章“m”栏中所列举的, 由于它们所具的化学性质, 在一定湿度条件下暴露于空气或与催化剂接触时, 具有化学聚合的趋向。要减轻这种趋向, 可在液体货物内加入少量阻化剂, 或者控制货舱环境。

15.13.2 装载这种货物的船舶, 其设计应在货舱和货物装卸系统内消除一切可能起催化作用或可能破坏阻化剂的任何结构材料或污染物。

15.13.3 应注意使这些货物在全部航程时间内保证受到抑制, 以防化学聚合。装载这种货物的船舶应有制造厂的抑制证书, 证书上载明:

- .1 所加阻化剂的名称和数量;
- .2 阻化剂加入的日期及其有效期;
- .3 改变阻化剂有效期的任何温度界限;
- .4 一旦航程超过阻化剂有效期时应采取的行动。

15.13.4 在船上使用排除空气作为防止货物自行反应的方法, 应符合9.1.3的要求。

15.13.5 透气系统的设计应能消除由于化学聚合物增多而造成的阻塞。透气设备的型式应能定期检查其功用是否适当。

15.13.6 货物通常以熔化状态载运时, 其结晶或凝固可能导致货舱容量中此部分的阻化剂消失, 随后的重新溶化可能产生无其他物质的液体囊, 并带来聚合的危险。为防止上述现象, 应注意保证该货物在货舱的任何部分和任何时候不会产生全部或局部的结晶或凝固现象。任何所需的加热装置应保证货舱内的任何部分不使货物过分加热到可能产生危险的聚合反应的程度。若蒸气盘的温度可能导致过分加热时, 应采用间接低温加热系统。

### 15.14 在37.8℃时蒸气压力超过1.013标准巴的货物

15.14.1 第17章表中“m”栏内的本节所述的货物, 除非该货物系统的设计能承受货物在45℃时的蒸气压力, 否则应设有机机械制冷系统。如该货物系统的设计能承受货物在45℃时的蒸气压力并毋须设有制冷系统时, 则应在国际适航证书的载运情况上作出标志, 以指明货舱所需的安全阀开启压力。

15.14.2 机械制冷系统在货舱设计压力下应能保持液体温度低于沸点温度。

15.14.3 倘若船舶在有限季节里营运于有限航区或从事有限航程，主管机关可以同意放弃关于制冷系统的要求。这种同意（包括载运区域的限制和季节及航程的限制）应包括在国际散装运输危险化学品证书的运载条件之中。

15.14.4 应备有在装载作业中把逐出的气体送回岸上的管子接头。

15.14.5 每个货舱应备有一个压力表，指示货物上面蒸气空间的压力。

15.14.6 货物如需冷却，每个货舱应在舱顶和舱底设有温度计。

15.14.7.1 货舱在标准温度下所装液体不得超过98%。

15.14.7.2 货舱装载的最大货物体积（ $V_L$ ）应为：

$$V_L = 0.98 v \frac{P_R}{P_L}$$

式中：  $v$  = 货舱容积

$P_R$  = 货物在标准温度下的密度

$P_L$  = 货物在装载温度下的密度

$R$  = 货物在压力安全阀开启压力下相应于货物蒸气压力的标准温度。

15.14.7.3 对于可能适用的每一装载温度和最大标准温度下，每一货舱最大许可的充注极限应在主管机关认可的表上予以指明。该表副本应由船长长期保存在船上。

#### 15.15 点燃温度低、可燃性范围宽的货物

对于载运上述货物的船舶，10.2.3.5 规定的距离要求应至少增至4.5 m。

#### 15.16 货物污染

15.16.1 如第17章“m”栏适用于本节，则碱性或酸性材料（如苛性钠或硫酸）不得污染货物。

15.16.2 如第17章“m”栏适用于本节，水不得污染货物。此外，亦应符合下列要求：

- .1 装有货物的货舱，其压力/真空安全阀的进气口应至少位于风雨甲板以上2 m的高度。
- .2 第7章所需的货物温度控制系统内不得用水或蒸气作为热量传递的介质。
- .3 除非永久性压载舱或水舱是空舱和干舱，否则其邻近货舱概不得装运货物。

- 4 货物不得载运在这样的舱内，即这种货舱相邻于污液舱或容纳压载水或污液或可能以危险方式起反应的其它含水货物的货舱。用于上述货舱的泵、管子或透气管路，应同用于装货货舱的类似设备分开。污液舱的管路或压载管路不得穿过装货货舱，但有管隧者除外。

#### 15.17 增加的通风要求

12.1.3所述的通风系统对于某些货品来说，根据处所的总容积，其最小能力至少为每小时换气4.5次。通风系统的排气通道应远离居住处所的开口、通风系统的进口、工作区域或其他类似处所至少10 m之外，并至少高出货舱用板4 m以上。

#### 15.18 特种货物泵舱的要求

对于某些货品，货物泵舱应置于甲板平面上，或将货泵置于货舱内。主管机关对低于甲板的货物泵舱应予特别考虑。

#### 15.19 溢流控制

15.19.1 如第17章表中的“m”栏具体提及时，本节中的要求将适用，并且是测量仪器要求的补充。

15.19.2 任何安全装载的关键系统万一出现动力故障时，应向有关操作人员报警。

15.19.3 任何安全装载的关键系统万一不能工作时，装载作业应立刻停止。

15.19.4 液位报警器应在装载之前予以试验。

15.19.5 15.19.6所需的高液位报警器系统应同15.19.7所需的溢流控制系统分开，并与13.1所需的设备分开。

15.19.6 货舱应设置符合15.19.1到15.19.5规定的并能示明货舱内液位达到正常满载情况的声光高液位报警器。

15.19.7 本节所需的货舱溢流控制系统应为：

- 1 当货舱正常装载程序制止货舱液位超过正常满载情况失灵时能开始工作。
- 2 给船舶操作人员发出货舱溢流的声光报警。
- 3 设有相继关闭岸泵和/或阀门以及相继关闭船上阀门的一致信号。信号以及泵和阀的关闭可由操作人员决定。只有在得到主管机关和有关港口主管机关的特别认可后，才能允许使用船上的自动关闭阀。

15.19.8 货舱装载率 (LR) 应不超过:

$$LR = \frac{3600U}{t} (m^3 / h)$$

式中: U = 操作信号液位时的留空容积 (m<sup>3</sup>),

t = 从发出信号到完全停止货物流入货舱所需的时间 (s), 此时间为相继操作的每一步 (如操作人员对信号的响应、停泵和关闭阀门等) 所需时间的总和。

亦应考虑管路系统的设计压力。

## 第 16 章 操作要求\*

### 16.1 每舱允许最大装货量

16.1.1 要求装载在 1 型船内的货物数量, 任一货舱不得超过 1,250 m<sup>3</sup>。

16.1.2 要求装载在 2 型船内的货物数量, 任一货舱不得超过 3,000 m<sup>3</sup>。

16.1.3 考虑到货物可能达到的最高温度, 在环境温度下载运液体的货舱, 在装货时应使得可以避免在航行期间液体涨满。

### 16.2 货物资料

16.2.1 本规则所适用的每艘船上应备有本规则, 或已编入本规则要求的国家条例。

16.2.2 需要散装的任何货物, 应在运输文件上以正确的技术名称记明。如果货物是混合物, 应有标明构成货品整个危害的主要危险因素的分析。倘若可能, 应有一份完整的分析。此分析应经制造厂或经主管机关可接受的独立专家核证。

16.2.3 船上应备有给出货物安全运载所需数据的资料, 并向一切有关人员开放。上述资料应包括存放在易于到达之处的货物堆装计划, 并列明船上的包括所载的每一危险化学品的所有货物:

- .1 详细说明货物安全装运所需的物理和化学性能 (包括反应性);
- .2 万一溢出或漏出时应采取的行动;
- .3 预防身体意外接触的措施;
- .4 消防措施和灭火手段;
- .5 货物驳运、货舱清洗、除气和压载的程序;
- .6 那些按照 15.1、15.5.11 或 15.13.3 需要稳定或阻化的货物, 如果没有提供在这些条中所要求的证书, 则应拒绝装货。

\* 亦应注意包括在国际航运公会油船安全守则 (化学品) 内的操作指南。

16.2.4 如不能得到货物安全运输所需的充分资料，该货物应予拒装。

16.2.5 凡能放出看不见的剧毒蒸气的货物，除非在货物中放入看得见的添加剂，否则一概不能运输。

### 16.3 人员训练\*

16.3.1 所有人员对于使用保护设备应经过充分的训练，并应经过与他们的职务相适应的、在应急情况下采取必需的操作程序的基本训练。

16.3.2 参加货物操作的人员，应在装卸程序方面经过适当的训练。

16.3.3 高级船员应进行关于应急程序的训练，以便处理泄漏、溢出或货物火灾等问题，并对他们中间足够多的人员教授和训练所载货物的主要急救方法。

### 16.4 货舱开口及其进入

16.4.1 会产生易燃和/或有毒蒸气的货物在装卸和载运时，或这种货物卸载后在进行压载时，或在装载或卸下货物时，货舱盖应总是保持关闭。对于任何有危害性的货物，其货舱盖、气垫和观察孔、货舱清洗出入盖只准在必要时开启。

16.4.2 人员不得进入货舱、货舱周围的留空处所、货物装卸处所或其它封闭处所，除非：

- .1 该舱室已排除了有毒蒸气，并且不缺乏氧气，或
- .2 人员穿戴了呼吸器具和其它必要的保护设备，并且全部工作是在一位负责的高级船员密切监视下进行的。

16.4.3 仅有易燃危险的处所，应在一位负责的高级船员密切监视下，人员才可进入。

### 16.5 货物试样的堆装

16.5.1 须保存在船上的试样应堆装在位于装货区域内的指定处所内，或在特殊情况下，装在主管机关认可的其它处所内。

16.5.2 堆装处所应为：

- .1 容器隔开，以防在海上时瓶子移动，
- .2 所用材料完全能抵抗拟载的各种液体的腐蚀，
- .3 设有适当的通风装置。

16.5.3 相互起危险反应的试样，不能相互紧靠堆装。

16.5.4 试样保留在船上的时间不能超过必要的时间。

\* 参考1978年海员培训、发证和值班标准国际公约的规定，特别参考该公约附件第五章规则V/2的“化学品船的船长、高级船员和一般船员的训练与考核的强制性最低要求”，以及1978年国际海员培训和发证会议决议11的规定。

## 16.6 不得暴露于过热状态下的货物

16.6.1 如由于货舱或附属管路内的货物受到局部过分加热后，该货物可能产生危险的反应，诸如聚合、分解、热不稳定性或放出气体等，上述货物应与温度会高于其初始反应温度的其它货品适当分隔（见7.1.5.4）。

16.6.2 装运上述货品的货舱，其加热盘管应能盲断或以等效设施关紧。

16.6.3 热敏感货品不能载运在未经绝缘的甲板货舱内。

## 16.7 附加操作要求

本规则在下列条款内包括附加操作要求：

3.1.1	15.3.1	15.8.22
3.1.2.1	15.3.7	15.8.28
3.1.2.2	15.3.8	15.8.29
3.1.4	15.4.6	15.8.31
3.5.2	15.5	15.8.32
3.7.4	15.6.1	15.8.33
	15.6.3	15.8.34.1
	15.6.4	15.8.34.2
7.1.2	15.7.1	15.8.34.3
7.1.6.3	15.7.6	15.8.35
9.1.4	15.7.11	15.8.36
9.2	15.8.1	15.8.37
11.3.2	15.8.2	15.9
11.4	15.8.3	15.10.1
12.1.2	15.8.4	15.11.4
12.2	15.8.5	15.11.6
13.2.1	15.8.7	15.12.3.1
13.2.2	15.8.15	15.13
13.2.3	15.8.16	15.14.7.1
13.2.4	15.8.17	15.14.7.2
Ch.14	15.8.19	15.14.7.3
15.1	15.8.20	15.16
	15.8.21	15.19.8

## 第17章 最低要求一览表

### 注 释

货品名称 (a 栏)	货品名称并不都跟修改过的散装化学品规则中所列的相同， (决议A.212(VII)通过)(说明见化学品索引)。
联合国编号 (b 栏)	联合国危险品运输专家委员会所提的建议案里有关每一货品的编号。所列的联合国编号仅供参考。
船型 (c 栏)	1 = 船型 1 (2.1.2) 2 = 船型 2 (2.1.2) 3 = 船型 3 (2.1.2)



舱型 ( d 栏)	1 = 独立货舱 (4.1.1)    G = 重力液货舱 (4.1.3) 2 = 整体货舱 (4.1.2)    P = 压力液货舱 (4.1.4)
货舱通风 ( e 栏)	Open: 开式通风 Cont: 控制通风 SR: 安全释放阀
货舱环境控制 * ( f 栏)	Inert: 惰性控制 (9.1.2.1) Liq: 液体或气体 (9.1.2.2) Dry: 干燥 (9.1.2.3) Vent: 自然或强制 (9.1.2.4)
电气设备 ( g 栏)	T1 至 T6: 温度等级 ** IIA、IIB 或 IIC: 设备分类 ** NF: 不燃货品 (10.1.6) Yes: 闪点超过 60 °C (闭杯试验) (10.1.6)
测量 ( h 栏)	O: 开敞式测量 (13.1.1.1) R: 限制式测量 (13.1.1.2) C: 封闭式测量 (13.1.1.3) I: 间接式测量 (13.1.1.3)
蒸气探测 * ( i 栏)	F: 可燃蒸气 T: 有毒蒸气
防火 * ( j 栏)	A: 抗乙醇泡沫 B: 普通泡沫, 包括所有非抗乙醇泡沫, 其中包括氟化蛋白质和水膜泡沫 (AFFF) C: 喷水 D: 干粉 No: 在本规则中无特殊要求

\* “No” 表示无要求。

\*\* 温度等级和设备分类见国际电工委员会出版物 79 (第 1 篇附录 D, 第 4、8 和 12 篇)。空白即目前无数据。

制造材料	N: 见 6.2.2
( k 栏 )	Z: 见 6.2.3
	Y: 见 6.2.4
	空白表示对制造材料无特殊要求
防毒面具及眼睛防护*	E: 见 14.2.8
( l 栏 )	

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\* “No”表示无要求。

a	货品名称	b	联合国编号	c	船型	d	舱型	e	货舱通风	f	货舱环境控制	k 电气设备		h	测量	i	蒸气探测	j	防火	k	制造材料	l	防毒面具及眼睛防护	m	特殊要求
												类	级												
	乙醇		2189	3	2C		2C	Cont.	No		No	T1	IIA	No	R	F	A	VI, Z	E					15.11.2 to 15.11.4, 15.11.6 to 15.11.8	
	醋酐		1715	2	2C		2C	Cont.	No		No	T2	IIA	No	R	F-T	A	VI	E					15.11.2 to 15.11.4, 15.11.6 to 15.11.8	
	丙酮氰化氢		1541	2	2C		2C	Cont.	No		No	T1	IIA	Yes	C	T	A	VI	E					15.1, 15.12, 15.17, 15.18, 15.19, 16.6	
	乙醇		1648	2	2C		2C	Cont.	No		No	T2	IIA	No	R	F-T	A		No					15.12	
	丙烯酰胺溶液 50% 或以下			2	2C		2C	Open	No		No	NF		C	No	No	No		No					15.12.3, 15.13, 15.16.1, 15.19.6, 16.6.1	
	丙烯酸		2218	3	2C		2C	Cont.	No		No	T2	IIA	No	R	F-T	A	VI	No					15.13, 16.6.1	
	丙烯酸		1093	2	2C		2C	Cont.	No		No	T1	IIB	No	C	F-T	A	N3, Z	E					15.12, 15.13, 15.17, 15.19	
	乙二醇		2203	3	2C		2C	Cont.	No		No		IIB	Yes	R	T	A		No						
	烷基苯磺酸		2584 2586	3	2C		2C	Open	No		No			Yes	O	No	B		No						
	烯丙醇		1098	2	2C		2C	Cont.	No		No	T2	IIB	No	C	F-T	A		E					15.12, 15.17, 15.19	
	烯丙基氯		1100	2	2C		2C	Cont.	No		No	T2	IIA	No	C	F-T	A		E					15.12, 15.17, 15.19	
	2-(2-氨基乙氧基)乙醇			3	2C		2C	Open	No		No			Yes	O	No	ACD	N2	No					15.19.6	

货品名称	联合国编号	船型	舱型	货舱通风	货舱环境控制	电气设备		测量	蒸气探测	防火	制造材料	防毒面具及眼睛防护	特殊要求
						级	类						
乙氧基乙醇液		3	2C	Open	No	T2	IIA	Yes	O	No	A	NI	No
N-氨基呱嗪	2015	3	2C	Cont.	No			Yes	R	T	A, C, D	R2	No
氨水 28% 或以下	2672	3	2C	Cont.	No		NP		R	T	C	R4	E <sup>2</sup> / <sub>2</sub>
硝酸溶液 93% 或以下	2426	2	1C	Open	No		NP		O	No	No	Y6	No
苯胺	1547	2	2C	Cont.	No	T1	IIA	Yes	C	T	A		No
苯和含 10% 或以上苯的混合物	1114	3	2C	Cont.	No	T1	IIA	No	R	F-T	B		No
苯磺酰氨	2225	3	2C	Cont.	No			Yes	R	T	B, D	NI	No
苯基氨	1738	2	2C	Cont.	No	T1	IIA	Yes	C	T	B		E
正丁醇	2348	2	2C	Cont.	No	T2	IIIB	No	R	F-T	A		No
正丁胺	1125 1214	2	2C	Cont.	No			No	R	F-T	A	NI	E
正丁基醚	1149	3	2C	Cont.	Inert	T4	IIIB	No	R	F-T	A, D		No

a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备		h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	m 特殊要求
						级	闪点高于60°C						
丁基/癸基/十六烷基-基烷 甲基丙烯酸混合物		3 2C	2C	Cont.	No			R	No	A,C D		No	15.13, 16.6.1, 16.6.2
甲基丙烯酸丁酯	2227	3 2C	2C	Cont.	No	IIA	No	R F-T	F-T	A,D		No	15.13, 16.6.1, 16.6.2
正丁醇	1129	3 2C	2C	Cont.	No	IIA	No	D F-T	F-T	A		No	15.16.1
樟脑油	1130	3 2C	2C	Cont.	No	IIA	No	O F	F	B		No	
酚油		2 2C	2C	Cont.	No		Yes	C F-T	F-T	A		No	15.12, 15.19
二硫化碳	1131	2 1C	1C	Cont.	Pod + Inert	T5	IIIC	No C	F-T	C		E	15.3, 15.12, 15.15, 15.19
四氯化碳	1846	3 2C	2C	Cont.	No	NF		C T	No 2	No 2		E	15.12, 15.17, 15.19.6
樟如坚果油 (未处理)		3 2C	2C	Cont.	No		Yes	R T	T	B		No	
氢氧化钾溶液	1816	3 2C	2C	Open	No	NF		O No	No	No	NB	No	
甲基丙烯酸癸甘酯		3 2C	2C	Open	No		Yes	O No	No	A,C D		No	15.13, 16.6.1, 16.6.2
氯苯	1134	3 2C	2C	Cont.	No	T1	IIA	No R	F-T	B		No	
氯仿	1888	3 2C	2C	Cont.	No	NF		R T	T	No		E	15.12

a	b	c	d	e	f	g		h	i	j	k	l	m
货品名称	联合国编号	船型	舱型	货舱通风	货舱环境控制	电气等级	电气类	测量	蒸气探测	防火	制造材料	防毒面具及眼睛防护	特殊要求
粗氯乙醇		2	ZC	Cont.	No		IIA No C		F-T A	A		No	15.12, 15.19
2-或3-氯丙酸	2511	3	ZC	Open	No		Yes O		No A	A	Y1	No	15.11.2 to 15.11.4, 15.11.6 to 15.11.8
氯磺酸	1754	1	ZC	Cont.	No		MF	C T	T	No		E	15.11.2 to 15.11.8, 15.12, 15.16.2, 15.19
(邻-、间-、对-) 氯甲苯	2238	3	ZC	Cont.	No			No R	F-T B,C			No	
煤焦石脑油	2553	3	ZC	Cont.	No	T3	IIA No R		F-T A,D			No	
杂酚油		3	ZC	Open	No	T2	IIA Yes O		No B,D			No	15.19.6
甲氧甲酚异体混合物	2076	3	ZC	Open	No	T1	IIA Yes O		No B			No	
巴豆醛	1143	2	ZC	Cont.	No	T3	IIIB No R		F-T A	A		E	15.12, 15.16.1, 15.17
环己酮	1915	3	ZC	Cont.	No	T2	IIA No R		F-T A	A	H5	No	
环己胺	2357	3	ZC	Cont.	No	T3	IIA No R		F-T A,D	H1		No	
丙烯酸癸酯		3	ZC	Open	No	T3	IIA Yes O		No A,C	H2		No	15.13, 16.6.1, 16.6.2
二丁基胺	2248	3	ZC	Cont.	No	T2	IIA No R		F-T B,D	H4		No	

a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备		h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	o 特殊要求	
						等级	闪点高于60C							
邻二氯苯	1591	3	2C	Cont.	No	T1	IIA	Yes	R	T	B, D	NS	No	
1, 1-二氯乙烷	2362	3	2C	Cont.	No	T2	IIA	No	R	F-T	B		E	
二氯乙醚	1916	2	2C	Cont.	No	T2	IIA	No	R	F-T	A	NS	No	
2, 2-二氯乙醚	2490	2	2C	Cont.	No			Yes	R	T	B, C	NS	No	15.12, 15.17, 15.19
2, 4-双氯酚醇	2021	3	2C	Cont.	Dry			Yes	R	T	B, C	NS	No	15.19.6
1, 2-二氯丙烷	1279	2	2C	Cont.	No	T1	IIA	No	R	F-T	B	Z	No	15.12
1, 3-二氯丙烷		2	2C	Cont.	No	T1	IIA	No	R	F-T	B		No	15.12
二氯丙烯/二氯丙烷混合物		2	2C	Cont.	No			No	C	F-T	B, C		E	15.12, 15.17, 15.18, 15.19
1, 3-二氯丙烯	2047	2	2C	Cont.	No	T2	IIA	No	C	F-T	B		E	15.12, 15.17, 15.18, 15.19
2, 2-丙酸		3	2C	Cont.	Dry			Yes	R	No	A	NS	No	15.11.2, 15.11.4, 15.11.6, 15.11.8
二乙醇胺		3	2C	Open	No	T1	IIA	Yes	O	No	A	NS	No	

a	b	c	d	e	f	g		h	i	j	k	l	m
货品名称	联合国编号	船型	舱型	货舱通风	货舱环境控制	电气设备	类	测量	蒸气探测	防火	制造材料	防毒面具及眼睛防护	特殊要求
二乙基胺	1154	3	2C	Cont.	No	T2	IIA	No	R	F-T	A	E	15.12
二乙撑三胺	2079	3	2C	Open	No	T2	IIA	Yes	O	No	A	No	
二乙基乙醇胺	2686	3	2C	Cont.	No	T2	IIA	No	R	F-T	A, D	No	
二乙基醚	1155	2	1C	Cont.	Inerted	T4	IIB	No	C	F-T	A	E	15.4, 15.14, 15.15, 15.19
焦磷酸	1902	3	2C	Open	No			Yes	D	No	B, C, D	No	
硫酸二乙基	1594	2	2C	Cont.	No			Yes	C	T	A, D	No	15.19.6
二异丁胺	2361	2	2C	Cont.	No			No	R	F-T	B, D	No	15.12.3, 15.19.6
二异丙醇胺		3	2C	Open	No	T2	IIA	Yes	O	No	A	No	
二异丙胺	1158	2	2C	Cont.	No	T2	IIA	No	C	F-T	A	E	15.12, 15.19
水二甲胺 45%或以下	1160	3	2C	Cont.	No	T2	IIA	No	R	F-T	C, D	E	15.12
水二甲胺 45%以上, 但 55%以下	1160	2	2C	Cont.	No			No	C	F-T	A, C, D	E	15.12, 15.17, 15.19



a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备		h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	m 特殊要求
						类	级						
水二甲胺55%以上 65%以下	1160	2	2C	Cont.	No			C	F-T	A, C,D	N1	E	15.12, 15.14, 15.17, 15.19
N,N-二甲基环己胺	2264	2	2C	Cont.	No			R	F-T	A,C	N1	No	15.12, 15.17, 15.19.6
二甲基乙醇胺	2031	3	2C	Cont.	No	T3	IIA	R	F-T	A,D	N2	No	
二甲基甲酰胺	2265	3	2C	Cont.	No	T2	IIA	R	F-T	A,D		No	
1,4-二恶烷	1165	2	2C	Cont.	No	T4	IIIB	C	F-T	A		No	15.12, 15.19
二苯基甲烷二异氰酸酯	2489	2	2C	Cont.	Dry			No <sup>y</sup> C	Y	C <sup>y</sup> , D <sup>y</sup>	N5	No	15.12, 15.16.2, 15.17, 15.19.6
二正丙胺	2283	3	2C	Cont.	No			No	F-T	A	N2	No	15.12.3, 15.19.6
十二基二苯基 氧化二磷酸酯溶液		3	2C	Open	No		HF	O	No	No		No	
甲基丙烯酸十二酯		3	2C	Open	No			Yes O	No	A,C		No	15.13
甲基丙烯酸十二-十五酯 混合物		3	2C	Open	No			Yes O	No	A,C D		No	15.13, 16.6.1, 16.6.2
表氯醇	2023	2	2C	Cont.	No		IIIB	C	F-T	A		E	15.12, 15.17, 15.19

货品名称	联合国编号	船型	舱型	e 货舱通风	f 货舱环境控制	R 电气设备		h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	特殊要求
						级	闪点高于60°C						
丙烯酸乙酯	1917	2	2C	Cont.	No	T2	IIB	No	R	F-T	A	E	15.13, 16.6.1, 16.6.2
N-甲基丁胺		3	2C	Cont.	No			No	R	F-T	A	No	15.12.3, 15.19.6
N-乙基环己胺		3	2C	Cont.	No			No	R	F-T	A, C	No	15.19.6
乙醇胺	1135	2	2C	Cont.	No	T2	IIA	No	C	F-T	D	E	15.12, 15.17, 15.19
乙醇胺		3	2C	Open	No		IIB	Yes	O	No	A	No	
乙二胺	1604	2	2C	Cont.	No	T2	IIA	No	R	F-T	A	No	
二溴化乙烯 15A	1605	2	2C	Cont.	No		MF		C	T	No	E	15.12, 15.19.6
二氯化乙烯	1184	2	2C	Cont.	No	T2	IIA	No	R	F-T	B	No	15.19
2-乙基丙基丙烯酸		3	2C	Open	No	T3	IIB	Yes	O	No	A	No	15.13, 16.6.1, 16.6.2
2-乙基丙基胺	2276	2	2C	Cont.	No			No	R	F-T	A	No	15.12
乙叉降冰片烯		3	2C	Cont.	No			No	R	F-T	B, C, D	No	15.12.1, 15.16.1, 15.19.6
甲基丙烯酸乙酯	2277	3	2C	Cont.	No		IIA	No	R	F-T	B, D	No	15.13, 16.6.1, 16.6.2

a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备			h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	m 特殊要求
						级	类	闪点高于60°C						
2-乙基-3-丙基丙烯醛		J	2C	Cont.	No	IIA	No	P-T	A	No				
甲醛溶液 45%或以下	1198 <sup>d</sup>	J	2C	Cont.	No	T2	No	P-T	A	E <sup>d</sup>		15.16.1		
甲酸	1779	J	2C	Cont.	No	T1	No	T	A	E	T2/Y3	15.11.2 to 15.11.4, 15.11.6 to 15.11.8		
糠醛	1199	J	2C	Cont.	No	T2	No	P-T	A	No		15.16.1		
戊二醛溶液 50%或以下		J	2C	Open	No	NF		O	No	No		15.16.1		
巴戟二胺溶液	1783	J	2C	Cont.	No		Yes	R	T	No	N2	15.19.6		
六甲撑胺	2493	Z	2C	Cont.	No		No	R	P-T	A, C	N1			
盐酸	1788	J	4C	Cont.	No	NF		R	T	No		15.11		
过氧化氢溶液 60%以上, 70%以下		Z	2C	Cont.	No	NF		C	No	No		15.5, 15.19.6		
丙烯酸 2-羟乙酯		Z	2C	Cont.	No		Yes	C	T	A		15.12, 15.13, 15.19.6, 16.6.1, 16.6.2		
丙烯酸异丁酯	2527	Z	2C	Cont.	No	T2	No	R	P-T	A		15.13, 16.6.1, 16.6.2		

a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备		h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	m 特殊要求
						等级	闪点高于60°C						
异丁醛	2045 3 2C			Cont.	No	T3	IIA	No	F-T	A		No	15.16.1
异佛尔酮二胺	2289 3 2C			Cont.	No			Yes	T	A	H2	No	
异佛尔酮二异氰酸酯	2290 3 2C			Cont.	Dry			Yes	T	C <sup>5</sup> ,D,H5		No	15.12, 15.16.2, 15.17, 15.19.6
异戊间二烯	1218 3 2C			Cont.	No	T3	IIIB	No	F <sup>+</sup>	B		No	15.13, 15.14, 16.6.1, 16.6.2
异丙胺	1221 2 2C			Cont.	No	T2	IIA	No	F-T	C,D,H2		E	15.12, 15.14, 15.19
异丙醚	1159 3 2C			Cont.	Inert			No	F	A		No	15.4.6, 15.13.3, 15.19.6
异戊醛	2058 3 2C			Cont.	Inert	T3	IIIB	No	F-T	A		No	15.4.6, 15.16.1
马来酐	2215 3 2C			Cont.	No			Yes	No	A <sup>3</sup> /C		No	
异丙又丙酮	1229 3 2C			Cont.	No	T2	IIIB	No	F-T	A		No	15.19.6
异丁烯酸	2331 3 2C			Cont.	No			Yes	T	A	VI	No	15.13, 16.6.1
丙烯酸甲酯	1919 2 2C			Cont.	No	T1	IIIB	No	F-T	B		E	15.13, 16.6.1, 16.6.2
甲胺溶液 4.2%或以下	1235 2 2C			Cont.	No			C	F-T	A,C,H1 D		E	15.12, 15.17, 15.19

a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备			h 测量	i 蒸气探测	j 防火	k 制造材料	l 特殊要求
						R	类	级					
						R	类	级	R	类	级		
						R	类	级	R	类	级		
2-甲基 6-乙基苯胺		J	2C	Open	No			Yes	D	No	B, C, D		
甲叉二氧	1593	J	2C	Cont.	No	T1	IIA	Yes	R	T	No		
2-甲基 5-乙基吡啶	2300	J	2C	Open	No		IIA	Yes	O	No	D	M4	
甲磺甲脂	1243	Z	2C	Cont.	No			No	R	F-T	A		E 15.12, 15.14, 15.19
2-甲基-2-羟基-丁炔-(3)		J	2C	Cont.	No			No	R	F-T	A, C, D	M6	E 15.19.6
异丁烯酸甲脂	1247	Z	2C	Cont.	No	T2	IIA	No	R	F-T	B		E 15.13, 16.6.1, 16.6.2
2-甲基吡啶	2313	Z	2C	Cont.	No			No	C	F	A, C	M4	E 15.12.3, 15.19.6
α-甲基苯乙烯	2303	J	2C	Cont.	No	T1	IIB	No	R	F-T	D		E 15.13, 16.6.1, 16.6.2
一乙醇胺	2491	J	2C	Dpen	No	T2	IIA	Yes	O	F-T	A	M2	
一乙醇胺		Z	1C	Cont.	No	T2	IIA	No	C	F-T	C, D	M2	E 15.12, 15.14
一乙醇胺溶液72%或以下	2270	Z	2C	Cont.	No			No	C	F-T	A, C	M1	E 15.12, 15.14, 15.17, 15.19

a 货品名称	h 联合国编号	d 船型	e 货舱通风	f 货舱环境控制	g 电气设备		h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	m 特殊要求
					级	类						
一异丙醇胺		3 2G	Open	No	T2	IIA	Yes	F-T	A	N2	No	
一硝基苯	1662	2 2G	Cont.	No	T1	IIA	Yes	T	D		No	15.12, 15.17, 15.18, 15.19
吗啡	2034	3 2G	Cont.	No	T2	IIA	No	F	A	N2, Z	No	
内造机燃料抗暴化合物	1649	2 1G	Cont.	No	T4	IIA	No	F-T	B, C		£	15.6, 15.12, 15.18, 15.19
苯 (熔化的)	2304	3 2G	Cont.	No	T1	IIA	Yes	No	A, D		No	
硝基70及以上	2031, 2032	2 2G	Cont.	No	NF		C	T	No		£	15.11, 15.19
硝基70以下	2031	2 2G	Cont.	No	NF		R	T	No		£	15.11, 15.19
邻硝基苯	1578	2 2G	Cont.	No			Yes	C	B, C, D		No	15.12, 15.17, 15.18, 15.19
邻一硝基苯 (熔化的)	1663	2 2G	Cont.	No			Yes	C	A, C, D		No	15.12, 15.19, 6
1-或2-硝基丙烷	2608	3 2G	Cont.	No	T2	IIB	No	R	F-T	A	No	
(邻-及对-) 硝基甲苯	1664	2 2G	Cont.	No		IIIB	Yes	C	T	B	No	15.12, 15.17, 15.19

a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备 等级	h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼瞳防护	m 特殊要求
发烟硫酸	1831	2	2C	Cont.	No	MF	C	T	No		E	15.11.2 to 15.11.8, 15.12.1, 15.16.2, 15.17, 15.19
仲醛	1264	3	2C	Cont.	No	T3 IIB	R	F	A		No	
五氟乙烷	1669	3	2C	Cont.	No	MF	R	T	No		No	15.12, 15.17
1,3-戊二烯		3	2C	Cont.	No		No	R	F-T		No	15.13, 16.6
酚	2312	2	2C	Cont.	No	T1 IIIA	Yes	C	T		No	15.12, 15.19
磷酸	1805	3	2C	Open	No	MF	O	No	No		No	15.11.1 to 15.11.4, 15.11.6 to 15.11.8
磷(黄或白色的)	2447	1	1C	Cont. (vent or inert)	Per + inert		No <sup>b</sup>	C	No		E	15.7, 15.19
酞酐	2214	3	2C	Cont.	No	T1 IIIA	Yes	R	No		No	
多乙撑多胺	2734/2735	3	2C	Open	No		Yes	O	No	A	No	
多甲撑多苯基异氰酸酯	2206/2207	2	2C	Cont.	Dry		No <sup>b</sup>	C	T <sup>b</sup>	M5	No	15.12, 15.16.2, 15.19.6
正丙醇胺		3	2C	Open	No		Yes	O	No	A, D	No	
小丙基丁内脂		2	2C	Cont.	No	IIIA	Yes	R	T	A	No	

a	b	c	d	e	f	g		h	i	j	k	l	m
货品名称	联合国编号	船型	舱型	货舱通风	货舱环境控制	电气设备	电气设备	测量	蒸气探测	防火	制造材料	防毒面具及眼睛防护	特殊要求
						级	类						
丙醛	1275	3	2C	Cont.	No		No	R	F-T	A		E	15.16.1, 15.17
丙酸	1848	3	2C	Cont.	No	T1	IIA	R	F	A	Y1	E	15.11.2 to 15.11.4, 15.11.6 to 15.11.8
丙酸酐	2496	3	2C	Cont.	No	T2	IIA	R	T	A	Y1	No	
丙醇	2404	2	1C	Cont.	No	T1	IIB	C	F-T	A,D		E	15.12, 15.17, 15.18, 15.19
正丙胺	1277	2	2C	Cont.	Inert	T2	IIA	C	F-T	C,D	N2	E	15.12, 15.19
氧化丙烯	1280	2	2C	Cont.	Inert	T2	IIB	C	F-T	A,C	Z	No	15.8, 15.12.1, 15.14, 15.15, 15.19
吡啶	1282	3	2C	Cont.	No	T1	IIA	R	F	A	N4	No	
氢氧化钠 15%或以下/ 氢氧化钠溶液		3	2C	Open	No	N7		O	No	No	N1	No	
氯酸钠溶液 50%或以下		3	2C	Open	No	N7		O	No	No		No	15.9, 15.16.1, 15.19.6
重铬酸钠溶液 70%或以下		2	2C	Open	No	N7		C	No	No	N2	No	15.12.3, 15.19
氢硫酸钠溶液 45%或以下		3	2C	Cont.	Vent. per pac (gse)	N7		R	T	No		No	15.16.1



a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备			h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	m 特殊要求
						等级	类别	闪点高于 60°C						
氢氧化钠溶液	1824	3	2C	Open	No	HF		O	No	No	HB	No		
次氯酸钠溶液 15% 或以下		3	2C	Cont.	No	HF		R	No	No	H5	No	15.16.1	
2-萘酚萘苯半噻唑溶液		3	2C	Open	No	HF		O	No	No	H1	No		
苯乙烯单体	2055	3	2C	Cont.	No	TI IIA	No	O	F	B	N4, Z	No	15.13, 16.6.1, 16.6.2	
液态硫	2448	3	3C	Open	Vent or pack (800)	T3	Yes	O	F-T	No		No	15.10	
苯胺	1830	3	2C	Open	No	HF		O	No	No		No	15.11, 15.16.2	
苯酚	1832	3	2C	Open	No	HF		O	No	No		No	15.11, 15.16.2	
四氢乙烷	1702	3	2C	Cont.	No	HF		R	T	No		No	15.12, 15.17	
四氢乙烷五胺	2320	3	2C	Open	No		Yes	O	No	A	H1	No		
四氢呋喃	2056	3	2C	Cont.	No	T3	Yes	R	F-T	A, D		No		
甲苯二胺	1709	2	2C	Cont.	No		Yes	C	T	B, C, D	H1	E	15.12, 15.17, 15.19	

a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备		h 测 量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	m 特殊要求
						级	类						
						T1	IIA	Yes	C	F-T	C <sup>1</sup> , D, M6	E	15.12, 15.16.2, 15.17, 15.19
								Yes	C	T	A, C	No	15.12, 15.17, 15.19
								Yes	R	T	C	No	15.19.6
						NF			R	T	No	No	15.12.1
						T2	IIA	Yes	R	T	No	No	15.12, 15.16.1, 15.17
								Yes	C	T	B, C, D	No	15.12, 15.17, 15.19
							IIA	Yes	O	No	A	No	
						T2	IIA	No	R	F-T	B	E	15.12
						T2	IIA	Yes	O	No	A	No	
								Yes	R	No	A, C, Y1	No	15.11.2 to 15.11.8
								Yes	O	No	A, C	No	15.19.6
甲苯二异氰酸酯	2078	2	2C	Cont.	Dry	T1	IIA	Yes	C	F-T	C <sup>1</sup> , D, M6	E	15.12, 15.16.2, 15.17, 15.19
邻甲苯胺	1708	2	2C	Cont.	No			Yes	C	T	A, C	No	15.12, 15.17, 15.19
1,2,4-三氯苯	2321	3	2C	Cont.	No			Yes	R	T	C	No	15.19.6
1,1,2-三氯甲烷		3	2C	Cont.	No	NF			R	T	No	No	15.12.1
三氯乙烯	1710	3	2C	Cont.	No	T2	IIA	Yes	R	T	No	No	15.12, 15.16.1, 15.17
1,2,3-三氯丙烷		2	2C	Cont.	No			Yes	C	T	B, C, D	No	15.12, 15.17, 15.19
三乙醇胺		3	2C	Open	No		IIA	Yes	O	No	A	No	
三乙醇	1296	2	2C	Cont.	No	T2	IIA	No	R	F-T	B	E	15.12
三甲基胺	2259	3	2C	Open	No	T2	IIA	Yes	O	No	A	No	
三甲基乙酸		3	2C	Cont.	No			Yes	R	No	A, C, Y1	No	15.11.2 to 15.11.8
三甲苄基二胺 (2,2,4-和2,4,4-异构体)	2327	3	2C	Open	No			Yes	O	No	A, C	No	15.19.6

a 货品名称	b 联合国编号	c 船型	d 舱型	e 货舱通风	f 货舱环境控制	g 电气设备		h 测量	i 蒸气探测	j 防火	k 制造材料	l 防毒面具及眼睛防护	m 特殊要求
						类	级						
三甲基乙撑二异氰酸酯 (2,2,4,4-和2,4,4-异体)	2328	2	2C	Cont.	Dry		Yes	C	T	A,C <sup>4</sup>		No	15.12, 15.16.2, 15.17, 15.19.2
磷酸三甲酯	2329	3	2C	Cont.	No		No	R	F-T	A,D		No	15.12.1, 15.16.2, 15.19.6
亚磷酸三硝基甲苯, 含有 1%或更多邻位异构物	2574 <sup>4</sup>	2	2C	Cont.	No	T2	IIA	Yes	C	Mf	B	No	15.12.3, 15.19
尿素铵溶液 (含氨水)		3	2C	Cont.	No		MF	R	T	A	M4	No	
正戊醇	2058	3	2C	Cont.	Inert <sup>3</sup>	T3	IIIB	No	R	F-T	A	No	15.4.6, 15.16.1
酞酸乙酯	1301	3	2C	Cont.	No	T2	IIA	No	O	F	A	No	15.13, 16.6.1, 16.6.2
乙烷基乙醚	1302	2	1C	Cont.	Inert <sup>3</sup>	T3	IIIB	No	C	F-T	A	E	15.4, 15.13, 15.14, 15.19, 16.6.1, 16.6.2
二氯乙烯	1303	2	2C	Cont.	Inert <sup>3</sup>	T2	IIA	No	R	F-T	B	E	15.13, 15.14, 16.6.1, 16.6.2
新癸乙烯酯		3	2C	Open	No		Yes	O	No	B		No	15.13, 15.16.1, 16.6.1, 16.6.2
乙烷基甲苯	2618	3	2C	Cont.	No		IIA	No	R	F	D	No	15.13, 16.6.1, 16.6.2
二甲苯酚	2261	3	2C	Open	No		IIA	Yes	O	No	B	No	

- a 适用于28%或28%以下但不低于10%的氨水。
- b 如所载货品含有闪点不超过60°C的可燃溶剂,则应设有特殊电气系统和可燃蒸气探测器。
- c 水虽然适用于熄灭含有本脚注适用的化学品的露天火灾,但不许用来污染含有那些化学品的封闭货舱,否则会引起有害蒸气产生的危险。
- d 联合国编号1198仅适用于闪点低于60°C。
- e 适用于45%或45%以下但不低于5%的甲醛溶液。
- f 适用于不低于10%的氢氯酸。
- g 由于具有引起爆炸的可能性,所以不能采用干粉。
- h 联合国编号2023为红色发烟硝酸的编号。
- i 联合国编号取决于物质的沸点。
- j 标有联合国编号的物质含有3%以上的邻位异构物。
- k 黄磷或白磷在其自然温度以上的温度下运输,因此闪点不适用。电气设备的  
要求可相似于闪点为60°C以上物质的设备要求。
- l 液态硫闪点在60°C以上,但是电气设备应经核证,能够在所产生的气体中安全使用。

### 第18章

#### 不适用本规则的化学品名单\*

1 下面是不列入本规则范围内的一些货品的名单。该名单对考虑散装运输那些危险性尚未判定的货品,可作为指导性资料。

2 本章所列货品即使超出本规则的范围,主管机关也应注意其安全运输可能需要的若干安全措施的实际情况。主管机关应适当地规定合理的安全要求。

3 下面所列货品,待1973/78年国际船舶防污染公约生效时,可能需要予以重新考虑。

第18章	联合国编号
丙酮	1090
工业醋酸戊酯	1104

\* 货品名称同各种版本的散装化学品规则(决议A.212(VII))所给定的名称不一定一致。

<u>第 18 章</u>	<u>联合国编号</u>
醋酸正戊酯	1104
醋酸仲戊酯	1104
正戊醇	1105
仲戊醇	1105
叔戊醇	1105
初级戊醇	1105
特戊烯	—
苜醇	—
醋酸正丁酯	1123
醋酸仲丁酯	1123
正丁醇	1120
仲丁醇	1120
叔丁醇	1120
苯二甲酸丁基苜酯	—
丁二醇	—
γ-丁内酯	—
烷基水杨酸钙	—
枯烯	1918
环己烷	1145
环己醇	—
对伞花烃	2046
正癸醇	—
双丙酮醇	1148
酞酸二丁酯	—
双茂	2048
二乙基苯	2049
二甘醇	—
二甘醇乙醚	—
二甘醇—丁醚	—
二甘醇—醚醋酸酯	—

<u>第 18 章</u>	<u>联合国编号</u>
二甘醇一乙基醚	—
二甘醇一乙基醚醋酸盐	—
二甘醇一甲基醚	—
二甘醇一甲基醚醋酸盐	—
二异丁烯	2050
二异丁基甲酮	1157
二异丁基酞酸盐	—
二异辛基酞酸盐	—
二辛基酞酸盐	—
酞酸二辛酯	—
二戊烯	2052
二苯醚	—
二丙二醇	—
二丙二醇一甲基醚	—
十二烷醇	—
十二烷苯	—
十二烷酚	—
2-乙氧基乙醇	1171
2-乙氧基乙酯醋酸	1172
醋酸乙酯	1173
乙酰乙酸乙酯	—
乙醇	1170
乙苯	1175
乙基环己烷	—
乙烯碳酸盐	—
乙撑二醇	—
乙二醇甲基丁基醚	—
乙二醇一丁基醚	2369
乙二醇一丁基醚醋酸盐	—
乙二醇一甲基醚	1188

第 18 章	联合国编号
乙二醇—甲基醚醋酸盐	1189
乙二醇—苯醚	—
2-乙基巴酸	—
甲酰胺	—
糠醇	2874
甘油	—
正庚烷	1206
庚醇, 所有异构物	—
庚烯, 混合异构物	2278
正己烷	1208
乙醇-1	2282
1-己烯	2370
己烯乙二醇	—
醋酸异戊酯	1104
异戊醇	1105
醋酸异丁酯	1213
异丁醇	1212
甲酸异丁酯	2393
异癸醇	—
异戊烷	1265
异戊烯	—
异佛尔酮	—
醋酸异丙酯	1220
异丙醇	1219
乳酸	—
胶乳	—
醋酸甲酯	1231
甲醇	1230
甲基·戊基醋酸盐	1233
甲基·戊基醇	2053

<u>第 18 章</u>	<u>联合国编号</u>
甲基·戊基甲酮	1110
甲基·特丁基醚	2398
甲基·乙基甲酮	1193
甲基·异丁基甲酮	1245
2-甲基-1-戊烯	-
正甲基-2-吡咯烷酮	-
糖蜜	-
石脑油溶剂	1256
壬烷	1920
壬醇	-
壬酚	-
辛烷	1262
辛醇, 所有异构物	-
石蜡	-
正戊烷	1265
正戊烯	1108
凡士林	-
石脑油	1255
全氯乙烯	1897
苯烯	2368
聚丙烯醇	-
正醋酸丙酯	1276
正丙醇	1274
丙二醇	-
丙二醇-乙基醚	-
丙二醇-甲基醚	-
丙烯四聚物	2850
丙烯三聚物	2057
环砜烷	-
妥尔油	-



<u>第 18 章</u>	<u>联合国编号</u>
四氢化萘	—
甲苯	1294
磷酸三丁酯	—
1,1,1-三氯乙烷	2831
十三醇	—
三乙苯	—
三甘醇	—
三异丙醇胺	—
1,2,4-三甲基苯	—
三丙二醇	—
三丙二醇一甲基醚	—
三甲苯基磷酸盐 (< 1% 邻位异构物)	—
三二甲苯基磷酸盐	—
松节油	1299
尿素、硝酸铵溶液	—
尿素、磷酸铵溶液	—
石油溶剂	1300
酒类	—
二甲苯类	1307

## 第 19 章

### 从事海上焚烧液态化学品废弃物船舶的要求

#### 19.1 通则

19.1.1 从第 1 章到第 16 章, 凡有关之处和经本章的规定补充或修改之处, 皆适用于焚烧装置船舶。

19.1.2 倘若合理,主管机关或港口主管机关或者二者应要求提供关于所需焚烧废物的成分和危害的资料,并在认为散装运输这些废物太危险时,可以禁运这些废物。\*

19.1.3 下列增加的定义适用:

1. 焚烧装置处所指仅设有焚烧装置及其附属设施的气密处所。
2. 焚烧装置鼓风机处所指设有向焚烧装置燃烧器供给燃烧空气的鼓风机处所。
3. 废物倾倒入公约系指1972年海上倾倒入废物和其他物质的防污染公约。
4. 货品区域系指1.3.5规定的船上部分,但不包括焚烧装置及其化学品废物管系。

19.1.4 在按照1.5.2.1.2和1.5.2.1.3规定进行定期和中间检验时,应检查所有货舱和货物管系的腐蚀情况,并确定剩余材料厚度。如已运输强腐蚀性废物,则应每年检查货舱和货物管系的腐蚀情况,并在检查期间确定剩余材料的厚度。

## 19.2 船舶抗沉性及货舱位置

19.2.1 本章所指的船舶应符合2型船舶标准,货舱位置应符合2型船舶的要求。

19.2.2 2型船舶可以运输含有可能要求1型船舶标准运输的物质的废物混合物,但目的仅仅是为了焚烧而已。

## 19.3 船舶布置

19.3.1 液态化学品废物不得装在与燃油舱相邻的舱内,除非那些舱内的燃油仅仅用于焚烧之用。

19.3.2 凡可能含有19.3.3所述以外液体的舱和泵,并且这些舱和泵须用于焚烧过程或用于清洗货物管子和货舱的,均可位于货舱的相邻之处,并应位于货物区域内。3.1要求所适用的舱和设备,其范围如同适用于货舱一样。

19.3.3 倘若需要在预热或维持焚烧过程中,直接供油给焚烧装置燃烧器的燃油舱和燃油泵可以置于货物区域之外,但所用燃油的闪点要高于60°C(闭杯试验)(见19.5.3)。

\* 焚烧和倾倒入废物的环境方面见废物倾倒入公约的规定。一般说来,对于焚烧废物,需要得到该公约缔约方(即装货港所在国)的有关主管机构的许可。如装货港所在国家不是该公约的缔约方,则主管机关应签发许可证。

19.3.4 凡经用于清洗货物管子和货舱以及用于泵舱排放的液体,应装在货物区域内的污水水舱内,其处理应符合废物倾倒公约所附的技术指导。货舱可以用作污水水舱。用于处理污染的清洗流体的泵应设在货物区域内。

19.3.5 倘若需要,可无须符合3.2.1的规定,起居处所、服务处所、控制站和A类以外的机器处所可允许位于货物区域的前方,但须设有主管机关满意的等效的安全标准和适当的灭火装置安排。

19.3.6 起居处所、服务处所、控制站或A类以外的机器处所如按19.3.5位于货物区域的前方,依此类推,3.2.3中的要求也应适用。即:从位于货物区域前方的舱室的后端起测出规定的距离。

19.3.7 焚烧装置应位于货物区域的外周界线之外。主管机关可以考虑替代安排,但应达到同等程度的安全要求。

19.3.8 应考虑到燃烧气体对驾驶室的良好视野的影响以及对起居处所、服务处所和机器处所的进气口和开口以及甲板工作区域和通道等处的影响。

19.3.9 应从开敞甲板进入焚烧装置的处所。然而焚烧装置控制室和鼓风机处所可从焚烧装置处所进入,但这些处所应另有从开敞甲板进入的出入口。焚烧装置处所的出入口应设有自闭式气密门。

#### 19.4 货物容器及焚烧装置标准

19.4.1 整体式重力货柜可以用于装载危险的废物。

19.4.2 焚烧装置(包括燃烧器)的设计和制造应能达到主管机关可以接受的安全标准。<sup>\*</sup>对于制造材料,应符合6.1的要求。

19.4.3 焚烧装置(包括支撑件和其他固定件)应设计成能承受在0℃至30℃范围内最不利的静止倾角,并考虑到由于船舶运动而引起的动负荷。

19.4.4 应有适当的砖层和绝热材料,以保证任何温升不致损害焚烧装置结构的强度,或损害所属辅机和仪表的作用,并且不致有害于工作人员的安全。

19.4.5 应设有能测量炉子外表面温度的装置。应设有报警装置,以便当温度超过主管机关认可的温度而应停止焚烧时能发出警报。

#### 19.5 货物移注

19.5.1 5.1中的要求适用,但货物管系应尽实际可能设在货物区域内,并且通往焚烧装置的货物管系应:

- 1 至少设在货物区域之内760mm,

<sup>\*</sup> 亦应符合倾倒公约中所规定的海上操纵焚烧废弃物及其他物质的标准。

- .2 如设在货物区域之外, 则应位于开敞甲板之上;
- .3 清楚地标明, 和
- .4 设计成易于排放和清洗。

19.5.2 货物管系和操纵的布置, 应为在正常装卸货物时能防止把拟将焚烧的废弃物排至舷外。

19.5.3 燃油和货物管系可以连接在燃烧器的前面, 但应要装三向旋塞, 并应在焚烧装置处所的内侧给燃油管子设置两个截止回阀。

19.5.4 应在控制站和驾驶室内设置遥控关闭装置, 以便切断焚烧的废弃物和燃油的供给。 停止阀应位于货物区域内。 若停止阀为遥控式的, 则应设有就地人工操作的装置, 或者设置独立的人工操作阀。

19.5.5 装货支管连接的法兰应设有可移式护罩, 以防止发生货物喷出的危险。亦应设置滴盘。

## 19.6 制造材料

19.6.1 6.2节——对于材料的特殊要求, 由下列条文代替:

- .1 铝、铜、铜合金、锌、镀锌钢或水银不得用于货舱、管路、阀件、附件和其他可能接触液态废弃物或其蒸气的设备。
- .2 熔点低于925 °C的制造材料(如铝和铝合金等), 不得用于涉及拟载闪点不超过60°C(闭杯试验)废弃物船舶的货物操作的外界管系。连接货舱的短的外界管子, 如它们设有耐火绝缘, 则主管机关可以允许使用。
- .3 在确定货物系统尺寸时, 应考虑到废弃物的腐蚀性。

## 19.7 货舱透气系统

19.7.1 对于控制透气系统的要求, 第8章和第15章的15.12节中除8.2.1和15.12.3以外均适用。

## 19.8 货舱环境控制

19.8.1 当再循环滴水管路不能终止在货舱底部附近时, 当具有闪点不超过60°C(闭杯试验)的废弃物被循环至此时, 该货舱应进行惰性处理。

19.8.2 当使用采用闪点不超过60°C(闭杯试验)液体的洗舱机时, 货舱应进行惰性保护。

19.8.3 惰性舱内大气中的含氧量, 在舱的任何部分均不得超过容量的8%。

19.8.4 应设声光报警器,以便在惰性货舱的蒸气空间中的压力低于0.07巴时发出警报。

### 19.9 电气设备

19.9.1 对于焚烧装置处所、焚烧装置鼓风机处所以及能直接进入这些处所的相邻处所,其照明系统、电话和播音系统以及一般报警系统应为获准的安全型。

19.9.2 须装在19.9.1所述处所的所有其他的电气设备,均应为获准的安全型,但符合下列条件者例外:

- .1 保证处所在启动非获准的安全型设备之前应有适当的通风。在上述设备的风机和开关装置之间应设有联锁装置,以保证符合此要求。
- .2 非获准安全型的设备,在19.11.2.1和19.11.3.1所规定的压力一旦失压时应能自动断开。主管机关可允许这些设备在断开之前有一合理的迟延时间。
- .3 非获准安全型的设备应至少符合IP55\*或等效的防护要求。

### 19.10 防火与灭火

19.10.1 焚烧装置处所应设有符合国际海上人命安全公约1983年修正条款第II-2/8条或第II-2/9条的固定式的泡沫灭火系统,该系统可以接至甲板泡沫灭火系统。

### 19.11 货物区域及焚烧装置位置的机械通风

19.11.1 对于货物泵舱,15.17段——增加通风的要求——应适用。

19.11.2 焚烧炉处所的通风系统应为固定的、通常为正压型的,并与所有其他供气系统分开。

- .1 空气压力对于炉内压力来说始终是正压的(见19.9.2.2)。
- .2 根据焚烧炉处所的总容积,其最小的通风量应为每小时换气4.5次。

燃烧室在维修期间应考虑其通风要求。

19.11.3 焚烧炉鼓风机处所的通风系统应为固定的、通常为正压型的,并与其他供气系统分开。

- .1 空气压力对于炉内压力来说始终是正压的(见19.9.2.2)。
- .2 根据焚烧炉鼓风机处所的总容积,其最小通风量应为每小时换气20次。

\* 参见国际电工委员会出版的建议,尤其是出版物44。

19.12 仪表和溢流控制

19.12.1 应设置13.1.1.3所述的封闭式测量装置和15.19所需的溢流控制系统。

19.12.2 应设置13.2所述的有毒和可燃货品的蒸气探测器。

19.13 工作人员的保护

19.13.1 应备有14.2所述的安全设备,其中包括14.2.8所述的船上每人的防毒面具和眼睛的保护。

附 录

国际散装运输危险化学品适航证书的标准格式

国际散装运输危险化学品适航证书

( 公 章 )

按国际散装运输危险化学品船舶构造和设备规则

颁 发

( 决议MSC.4(48) )

根据.....政府授权,

( 国家全名 )

由.....

( 经主管机关承认的能胜任的个人或组织的正式全名 )

船 名	识别号码或字母	登 记 港	总 吨 位	船 型 ( 规则的第2.1.2段)

安放龙骨或船舶处于相应建造阶段的日期或(对于改装船舶)化学品船开始改装之日;

.....

证书应以签发国家的官方语文印制。 若所用语文既不是英文又不是法文,则文本应包括一份前述语文之一的翻译文本。

本船也应完全符合该规则的下列修正条款:

.....  
.....

本船免除符合该规则的下列要求:

.....  
.....

兹证明:

- 1 .1 本船已按该规则 1.5 节的要求检验;
  - .2 检验表明该船的构造和设备符合该规则的有关要求;
  - \* .3 本船是也符合第 19 章补充要求和修改要求的焚烧炉船舶。
- 2 本船适于散装运输下列货品, 但应符合该规则所有有关的操作要求<sup>2</sup>。

货    品	运输情况 ( 舱号等 )
* 下接经签署和注明日期的附件 1。 本表所指航号应与经签署和注明日期的货舱计划附件 2 一致。 对于焚烧船来说, 各产品名称应以“液态化学品废弃物”代替。	

- 3 按照 \* 1.4 和 \* 2.8.2 规定, 该规则的要求应对本船在下列方面作出修改:

\* 不适合者删去。

## 4 本船装载时必须:

\*.1 符合经盖章并说明日期为.....的获准装载手册中规定的装载条件, 而且此手册应经主管机关所承认的组织的负责官员签署;

\*.2 遵守本证书所附的装载限定。

在需要不按上述要求装船时, 则将证明所拟装载条件的必要计算提供给发证主管机关, 该机关可以书面批准所建议的装载条件.\*\*

本证书有效期限至.....止。

19 .....发于.....

( 发证地点 )

签名人声明, 本人由所述政府正式授权颁发本证书。

.....  
( 发证官员签名和/或发证主管机构印  
记 )

## 证书末尾的注解:

- 1/ “船型”: 任何填入本栏的内容, 均必须与所有有关的建议有关, 例如: 填入“2型”, 即为该规则所述的所有方面的2型。
- 2/ 第2节: 仅列该规则第17章所列货品或由主管机关按该规则1.1.3业经鉴定过的货品。关于后面的“新”的货品, 应注意所述的任何临时的特殊要求。应注意, 对于焚烧船来说, 各种货品的名称应以“液态化学品废弃物”代替。

\* 不适合者删去。

\*\* 本文如经适当签署和盖印后可以附于证书后, 而不必合并到证书里。



法定年度检验的签署

兹证明，经按照国际散装运输危险化学品船舶构造和设备规则第1.5.2.1.4段的要求进行法定年度检验，本船符合国际散装化学品规则的有关要求。

签字：.....  
(经正式授权的官员签字)

地点：.....

日期：.....

(如适用，主管机构的公章或钢印)

签字：.....  
(经正式授权的官员签字)

地点：.....

日期：.....

(如适用，主管机构的公章或钢印)

签字：.....  
(经正式授权的官员签字)

地点：.....

日期：.....

(如适用，主管机构的公章或钢印)

签字：.....  
(经正式授权的官员签字)

地点：.....

日期：.....

(如适用，主管机构的公章或钢印)

注：在符合1.5.2.1.3段和1.5.2.1.4段规定的情况下，可用中期检验代替法定年度检验。

### 中 期 检 验

兹证明经按国际散装运输危险化学品船舶构造和设备规则的1.5.2.1.3段的要求进行中间检验，本船符合规则中的有关要求。

签字: .....

( 经正式授权的官员签字 )

地点: .....

日期: .....

( 主管机关公章或钢印 )

签字: .....

( 经正式授权的官员签字 )

地点: .....

日期: .....

( 主管机关公章或钢印 )

#### 国际散装运输危险化学品适航证书附件 I

第 3 节所列货品清单及其运载条件之续。

货品名称	运载条件 ( 舱号等 )

日期: .....

( 发证日期 )

.....

颁发证书官员签字和/或颁发

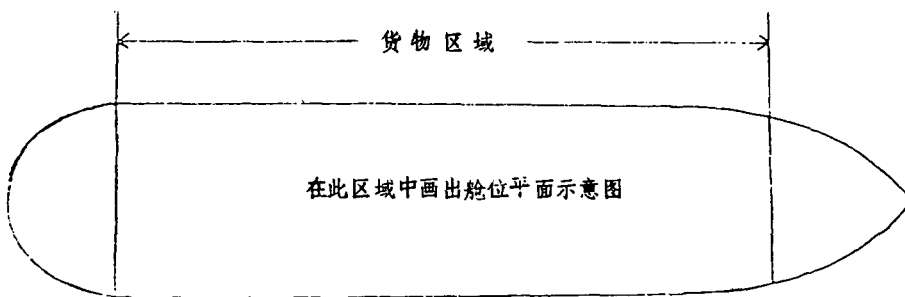
主管机关印章

国际散装运输危险化学品适航证书附件2

舱位平面图 ( 样本 )

船名: .....

识别数码或字母: .....



日期: .....

( 发证日期 )

.....  
颁发证书官员签字和/或发证主  
管机关印章

决议 MSC.5(48)<sup>1</sup>通过国际散装运输液化气体船舶构造和设备规则  
(IGC 规则)

海上安全委员会，

回顾了决议 A328(IX)，在该决议中，大会授权海委会对散装运输液化气体船舶构造和设备规则进行必要的修改，

注意到在决议 MSC.6(48) 中，大会通过了对 1974 年国际海上人命安全公约 (1974 SOLAS 公约) 第 VII 章的修正案，使国际散装运输液化气体船舶构造和设备规则 (IGC 规则) 根据该公约为法定的规则，

审议了建议的 IGC 规则的文本：

- 1 通过 IGC 规则，该规则的文本为本决议的附件；
- 2 注意到按经决议 MSC.6(48) 修正的 1974 SOLAS 公约第 VII 章 C 部分，IGC 规则的修正案将根据该公约第八条通过、生效及执行；
- 3 要求秘书长将上述通过了的 IGC 规则的修正条款 (包括第 19 章内规定的新货品)，通知各有关政府，建议在这些修正条款生效之前，这些新货品应由符合修正条款规定的液化气体船装运；
- 4 进一步要求秘书长将本决议条款的副本连同 IGC 规则的文本转发给本组织所有成员国以及不是本组织成员国的所有 1974 SOLAS 公约缔约国的政府。

\* \* \*

<sup>1</sup> Resolution published for information by the Secretariat of the United Nations — Résolution publiée pour information par le Secrétariat de l'Organisation des Nations Unies.

## 附 件

## 国际散装运输液化气体船舶构造和设备规则

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序言

1 本规则的目的在于为海上运输本规则第19章所列的散装液化气体和某些其它物质提供一个国际标准,在考虑到有关货品性质的情况下,规定了这类运输船

船的设计和建造标准以及船上所应装配的设备,以便使其对船舶、船员及环境所造成的危险减至最少。

2 基本原理是船舶的型式与本规则所包括货品的危险性有关。每一货品可以有一个或多个危险特性,包括易燃性、毒性、腐蚀性及反应性。由于货品在低温下或压力条件下运输还可能引起另外的危险性。

3 严重的碰撞或搁浅可能导致货舱破损,造成货品不可控制地释放。此项释放可能引起货品的蒸发和扩散,并在某些情况下可能导致船体的脆性断裂。本规则根据现有的知识和技术要求尽可能减少这种危险性。

4 制订本规则的过程中,认识到必须以良好的造船和工程原则以及对各种货品的危险性有彻底的了解为基础;且进一步认识到液化气体船舶的设计建造不仅是一门复杂的技术,而且正在迅速发展之中;故本规则不应保持不变;因此,本组织将在考虑到经验和技术进一步发展的情况下对本规则进行定期的复审。

5 对新货品及其运输条件的要求,在国际海事组织海安会通过后,将根据 1974 年国际海上人命安全公约第八条的规定,在适当的修正案生效之前,暂作建议案进行通告。

6 本规则主要涉及船舶设计和设备。为了确保货品的安全运输,必须对整个系统进行鉴定。保证货品安全运输的其它方面,例如训练、操作、交通控制和港口装卸等,本组织正在作或将作更进一步研究。

7 本规则的制订得到国际船级社协会(IACS)的大力支持,并对 IACS 关于液化气体船舶统一要求的第 4、5 和 6 章作了充分考虑。

8 本规则第 10 章的制订得到了国际电工技术委员会(IEC)的大力支持。

9 本规则第 18 章处理了液化气体运输船舶的操作问题,它突出了其它章节中属于操作性质的条款,并提到了液化气体安全操作的其它重要方面。

10 本规则的编排与海安会在其第四十八届会议上通过的国际散装运输危险化学品船舶构造和设备规则(IBC)相一致。

## 第 1 章 总则

### 1.1 适用范围

1.1.1 本规则适用于不论吨位大小(包括 500 吨以下)凡散装运输温度在 37.8℃ 时蒸气绝对压力超过 2.8 bar 的液化气体和第 19 章所列的其它货品的船舶。

1.1.2 除非另有明文规定,本规则适用于在1986年7月1日或以后安放龙骨或处于相当阶段的船舶;相当阶段系指:

- .1 可认为某一具体船舶建造开始;
- .2 该船业已开始的装配量至少为50吨或为所有结构材料估算重量的1%,以较小者为准。

1.1.3 不论何时建造的船舶,凡在1986年7月1日或以后改建成气体运输船舶应该作为气体运输船舶,并把改建日期作为建造日期。

1.1.4.1 当液货舱装有按本规则要求具有1G型船舶的货品时,位于2.6.1.1所属的保护区域内的液舱不应装载具有闪点(闭杯闪点试验)60℃或小于60℃的易燃液体,也不应装载第19章所列的易燃货品。

1.1.4.2 同样地,当液货舱装有按本规则要求具有2G/2PG型船舶的货品时,位于2.6.1.2所述的保护区域内的液舱不应装载上面所述的易燃液体。

1.1.4.3 对液货舱装有按本规则要求1G或2G/2PG型船舶的货品时,在每一种情况下,上述限制只适用于货舱纵向范围以内的保护区域。

1.1.4.4 如果液货舱装有按本规则要求具有1G或2G/2PG型船舶的货品时,且其数量仅限于供冷却、循环或作燃料用时,则在这些保护区域内可以装载上述易燃液体和货品。

1.1.5 除1.1.7.1内要求者外,当船舶拟装载本规则所包括的货品或国际散装运输危险化学品构造和设备规则(IBC)(国际海事组织大会授权、根据大会决议A.490(XII)召开的海安会已通过并可能被组织修订)所包括的货品,则该船舶应按所装运货品的情况,符合两个规则的要求。

1.1.6 如果拟装载的货品可认为是属于本规则的范围但在现有的第19章中尚未给出者,则主管机关及有关这类货品装载的港口主管机关应根据本规则的原则建立适当的基本装载条件,并应将这些条件通知本组织。

1.1.7.1 当船舶设计和建造成用来装载下列货品时,应该首先满足本规则的下列要求:

- .1 本规则第19章中专门列出的货品;
- .2 既在本规则又在国际散装化学品规则中列出的一种或几种货品,这些货品在第19章表中“a”栏用(\*)作了标记。

1.1.7.2 若船舶拟专门装载1.1.7.1.2中指明的一种或几种货品,应该采用经修正的国际散装化学品规则的要求。

1.1.8 符合国际气体运输规则的船舶应在 1.5 中给出的国际散装运输液化气体适装证书中注明。如符合本规则的修正案,按情况需要,也应在国际散装运输液化气体适装证书中注明。

## 1.2 危险性

本规则中所考虑的气体的危险性包括火灾、毒性、腐蚀性、反应性、低温及低压。

## 1.3 定义

除另有明文规定外,下列定义适用于本规则。其它的定义则在第 4 章中给出。

1.3.1 “起居处所”系指用作公共处所、走廊、盥洗室、住室、办公室、医务室、电影院、娱乐室、理发室、没有炊事用具的配膳室以及类似处所。公共处所系指居住处所中作大厅、餐厅、休息室及类似用途的固定围蔽处所。

1.3.2 “‘A’级分隔”系指 1983 年 SOLAS 修正条款第 II-2/3.3 条中所定义的分隔。

1.3.3.1 “主管机关”系指船旗国政府。

1.3.3.2 “港口主管机关”系指船舶装卸货物港所在国的主管机关。

1.3.4 “沸点”系指货品呈现蒸气压力等于大气压力时的温度。

1.3.5 “宽度(B)”系指船舶的最大宽度,金属船在船中部量至肋骨型线,其它材料船在船中部量至船体外表面。宽度(B)应以米计。

1.3.6 “货物区域”系指船上设有货物围护系统、货泵舱和压缩机舱的区域,并包括上述区域在船舶整个船宽和船长范围的甲板面积。最后一个货舱后面或最前一个货舱前面的隔离舱、压载舱或空舱(如设有时)不应算作货物区域。

1.3.7 “货物围护系统”系指用来围护货物的装置,包括主屏壁和次屏壁(如设有时)以及附属的绝热层和壁间处所,如果需要支持这些构件,还包括邻接结构。若次屏壁是船体结构的一部分,它可以是货舱的边界。

1.3.8 “货物控制室”系指用来控制货物装卸作业并符合 3.4 要求的处所。

1.3.9 “货物”系指符合本规则的船舶散装运输的第 19 章一览表所列的货品。

1.3.10 “货物服务处所”系指货物区域内面积大于 2 m<sup>2</sup> 用作车间、橱柜及储藏室的处所,以及供货物装卸设备用的处所。

1.3.11 “液货舱”系指设计来作为装载货物的主要容器的液密壳枋,包括不论有无绝热层或次屏壁(或两者)的所有这类容器。

1.3.12 “隔离舱”系指两个相邻钢质舱壁或甲板之间的隔离处所。该处所可为空舱或压载舱。

1.3.13 “控制站”系指设有船舶无线电台、主要导航设备或应急电源的处所，或指火警记录器或失火控制设备集中的处所，但不包括很可能设置在货物区域内的失火控制设备。

1.3.14 “易燃货品”系指第19章“f”栏中标有“F”的货品。

1.3.15 “可燃限度”系指对燃料氧化剂混合物状态的限制，它在外加一足够强的着火源后于给定的试验仪器中正好能形成可燃的条件。

1.3.16 “气体运输船”系指建造或改建成用来散装运输任何液化气体或第19章表中所列其它货品的货船。

1.3.17 “气体危险处所或区域”系指：

- .1 货物区域中未装置或未配备认可的设备以确保其空气在任何时候均处于气体安全状态的处所；
- .2 货物区域以外含有液体或气体货品的任何管路通过（或在其中终止）的围蔽处所，但安装了认可型装置能防止货品蒸气渗入该处所内空气之中的处所除外；
- .3 货物围护系统和货物管系；
- .4.1 要求装次屏壁的货物围护系统中装载货物的货舱；
- .4.2 不要求装次屏壁的货物围护系统中装载货物的货舱；
- .5 用单一钢质气密边界与上面.4.1所述的货物相分隔的处所；
- .6 货泵舱和货物压缩机舱；
- .7 离液货舱出口、气体或蒸气出口、液货管法兰或液货阀或通到货泵舱和货物压缩机舱的入口或通风口3 m范围以内开敞甲板上的区域（或开敞甲板上的半围蔽处所）；
- .8 货物区域内上方的开敞甲板、开敞甲板上货物区域前后3 m及离露天甲板2.4 m高度范围以内的处所；
- .9 离货物围护系统外表面（该表面是露天的）2.4 m以内的处所；
- .10 内部设有含货品管路的围蔽或半围蔽处所。但含有符合13.6.5要求的气体监测设备的处所，或利用蒸发气体作为燃料并符合第16章要求的处所，在此不认为是气体危险处所；
- .11 供货物软管用的处所；或
- .12 向任一危险处所或区域直接开口的围蔽处所或半围蔽处所。

1.3.18 “气体安全处所”系指货物危险区域以外的处所。

1.3.19 “货舱”系指由船舶结构围蔽、内部设有货物围护系统的处所。

1.3.20 “独立”系指不以任何方式和其它系统相连接的管路系统或透气系统，并且没有任何设施可以用来和其它系统作潜在的连接。

1.3.21 “绝热处所”系指全部或部分地被绝热材料填充的处所，它可能是（或不是）屏壁间处所。

1.3.22 “屏壁间处所”系指主屏壁和次屏壁之间的处所，不论是全部还是部分地被绝热材料或其它材料填充。

1.3.23 “长度（L）”系指从龙骨顶量至最小型深85%处水线总长的96%，或在此水线上由艏柱前缘量至舵杆轴线的长度，取其中较大者。对设计有龙骨倾斜的船舶，量取长度的水线应与设计水线平行。长度（L）应以米计。

1.3.24 “A类机器处所”系指装有下列设施的处所以及通往这些处所的围壁通道：

- .1 主推进用的内燃机；
- .2 作其它用途的合计总输出功率不小于373 kW的内燃机；或
- .3 任何燃油锅炉或燃油装置。

1.3.25 “机器处所”系指一切A类机器处所和一切其它包括推进机械、锅炉、燃油装置、蒸气机和内燃机、发电机和主要电动机、加油站、冷藏机、减摇装置、通风机和空气调节机的处所，以及类似处所；连同通往这些处所的围壁通道。

1.3.26 “MARVS”系指液货舱内释放阀设定的最大许用值。

1.3.27 “燃油装置”系指准备为燃油锅炉输送燃油或准备为内燃机输送加热燃油的设备，并包括用于处理压力超过1.8 bar油类的任何油压泵、过滤器及加热器。

1.3.28 “组织”系指国际海事组织（IMO）。

1.3.29 “渗透率”系指某一处所假定被水侵占的容积与该处所总容积之比。

1.3.30.1 “主屏壁”系指货物围护系统具有两层界面时用来装货的内层构件。

1.3.30.2 “次屏壁”系指货物围护系统中的液密外层构件，用来对液货通过主屏壁可能产生的泄漏提供暂时的保护并防止船体结构的温度下降至不安全的程度。次屏壁的类型在第4章中有更完整的定义。

1.3.31 “相对密度”系指某一货品的质量与等体积淡水的质量之比。

1.3.32 “隔离”系指不和另一货物管系或货物透气系统相连接的货物管系或货物透气系统。这种隔离可以通过设计或操作方法予以实现。操作方法不应在液货舱内使用，它应采用下列型式之一：

- .1 拆去短管或阀门，并且盲断管端；

.2 装设两个串接的盲通两用法兰,并具有检测的设施。此项型式亦可用在类似处所,以及通往这些处所的围壁通道内。

1.3.33 “服务处所”系指用作厨房、装有炊事用具的配膳室、厨柜、邮件及贵重物品室、储藏室、构成机器处所部分以外的车间以及类似处所,包括通往这些处所的围壁通道。

1.3.34 “1974 SOLAS 公约”系指1974年国际海上人命安全公约。

1.3.35 “SOLAS 1983 修正条款”系指1983年6月17日国际海事组织下属的海安会第四十八届会议以决议 MSC.6(48)通过的1974年 SOLAS 公约的修正条款。

1.3.36 “液舱盖”系指用来保护突出在露天甲板上使货物围护系统免受损伤的结构或用来保证甲板结构连续性和完整性的结构。

1.3.37 “液舱气室”系指液货舱向上延伸的部分。如货物围护系统在甲板下方,则液舱气室突出露天甲板或液舱盖。

1.3.38 “毒性货品”系指第19章表中“f”栏内标有“T”的货品。

1.3.39 “蒸汽压力”系指在规定温度下液体上方饱和蒸汽的平衡压力,以 bar (绝对值)计。

1.3.40 “空舱”系指货物围护系统外方货物区域内的围蔽处所,但不包括货舱、压载舱、燃油舱、货泵舱、压缩机舱或人员正常使用的任何处所。

#### 1.4 等效

1.4.1 对本规则要求船上所应装设或配备的专门装置、材料、设备和器具,及其项目或型式,或要求作出的任何特殊规定,或要求符合的任何程序或布置,主管机关可允许在该船上装设或配备任何其它的装置、材料、设备和器具及其项目或型式,或作任何其它的规定、程序或布置,但须通过试验或其它方法经主管机关认定这些装置、材料、设备和器具及其项目或型式,或特定的规定、程序或布置至少与本规则所要求者具有同等效能。然而,主管机关不准许采用改变本规则规定的特定装置、材料、设备和器具及其项目或型式的操作方法或程序。

1.4.2 当主管机关准许采用的替代装置、材料,设备和器具及其项目或型式,或规定、程序或布置时,它应将其细节连同验证报告提交国际海事组织,以便国际海事组织能将其转知1974年 SOLAS 公约其它缔约国政府,供其官员参考。

#### 1.5 检验与发证

##### 1.5.1 检验程序

1.5.1.1 船舶的检验,包括本规则条文的实施及免除的准许,应由主管机关的官员进行。然而,主管机关也可委托指定的验船师或认可的机构进行。

1.5.1.2 指定验船师或认可机构去执行检验的主管机关至少应对指定的验船师或认可机构授权进行:

- .1 要求修理船舶;
- .2 在有关国家的港口当局\*的要求下执行检验。

主管机关应通知海事组织关于指定验船师和认可机构的特定职责和权力范围,并发给缔约国政府。

1.5.1.3 当指定的验船师或认可机构确认船舶或设备的状态实质上与证书所载情况不符,或船舶不宜作对船舶或船上人员没有危险的出海航行时,该验船师或机构应确保能立即采取正确措施并应及时通知主管机关。如果未能采取此类措施,应撤销有关证书,并立即通知主管机关;同时假使船舶处于另一缔约国的港口,也应立即通知有关国家港口当局。

1.5.1.4 在任何情况下,主管机关应保证检验的完整性和有效性,并应作出必要的安排以保证满足这一要求。

#### 1.5.2 检验要求

1.5.2.1 液化气体船舶的结构、设备、附件、装置和材料(不包括货船结构安全证书、货船安全设备证书和货船安全无线电报证书或货船安全电话证书已涉及的有关项目)应接受下列检验:

- .1 在船舶投入营运之前或第一次颁发国际散装运输液化气体适装证书之前的初次检验。此项检验应包括对本规则有关的船舶结构、设备、附件、装置和材料进行一次全面的检查,这项检验应保证结构、设备、附件、装置和材料完全符合本规则的可适用的规定。
- .2 按主管机关规定的周期(不超过五年)进行定期检验。此项检验应保证结构、设备、附件、装置和材料完全符合本规则的可适用的规定。
- .3 在国际散装运输液化气体适装证书的有效期限内至少有一次中间检验。如在证书有效期限内只进行一次这样的中间检验时,则此检验不应在该证书有效期限一半日期的6个月之前或6个月之后进行。

\* 国家港口当局的含义和1974年SOLAS公约及其1978年议定书的第1章第1.9条相同。



中间检验应保证安全设备、其它设备及有关的泵和管路系统符合本规则的可适用的规定，并处于良好的工作状态。这类检验应在国际散装运输液化气体适装证书上签证。

- .4 在国际散装运输液化气体适装证书周年之日3个月前或后以内进行一次法定年度检验。此项检验应包括一次全面的检查以保证结构、设备、附件、装置和材料在各方面都保持船舶营运时所需要的良好状态。此项检验应在国际散装运输液化气体适装证书上签证。
- .5 按1.5.3.3规定的要求进行了研究后有要求时，或作了一次重大的修理或更新后，应根据情况进行一次全面的或部分的额外的检验。这种检验应保证这类修理或更新是有效地进行的，并且这类修理或更新的材料和工艺质量是良好的；还应使船舶适于海上航行而对船舶或船上人员无危险。

### 1.5.3 检验后状态的保持

1.5.3.1 应保持船舶及其设备的状态使之符合本规则的规定，并保证船舶仍能适于海上航行而对船舶或船上人员无危险。

1.5.3.2 按1.5.2规定在任何一次检验完成后，未经主管机关的批准，不应该在结构、设备、附件、装置及材料上有任何变动，但直接替换者除外。

1.5.3.3 如船上发生任何事故或发现任一缺陷，只要它们对船舶的安全性或救生设备（或其它设备）的完整性或有效性有影响时，船长或船东应尽快报告主管机关、负责颁发证书的指定验船师或认可机构，他们应着手调查研究以决定按1.5.2.5要求的检验是否必要。若船舶处在另一缔约国政府的港口，则船长或船东应立即报告该国家港口当局，指定验船师或认可机构应证实是否已经作了这样的报告。

### 1.5.4 证书的颁发

1.5.4.1 对符合本规则有关规定的液化气体船舶进行了初次检验或定期检验后应颁发一份国际散装运输液化气体适装证书，其示范格式在附录中列出。

1.5.4.2 按本节规定颁发的证书应存放在船上以便随时进行检查。

1.5.4.3 船舶按1.1.5规定进行设计和建造时，应按本节要求以及国际散装化学品规则的1.5节要求颁发国际适装证书。

### 1.5.5 由另一国政府签署或颁发证书

1.5.5.1 应另一国政府的要求，缔约国政府可对挂其它国家国旗的船舶进行检验，如果认为符合本规则要求，可对其颁发或授权颁发证书，并根据情况也可按本

规则要求对该船的证书签署或授权签署。这样颁发的证书应包含一份声明,表示该证书的颁发是应船旗国政府的要求而进行的。

#### 1.5.6 证书的期限及有效期

1.5.6.1 国际散装运输液化气体适装证书颁发的周期由主管机关规定,从初步检验或定期检验起不应超过5年。

1.5.6.2 证书的展期不得超过5年。

1.5.6.3 证书应停止生效:

- .1 如在1.5.2规定的期限内未进行检验;
- .2 当船舶换挂另一国家的国旗时,只有当颁发新证书的政府认为该船完全符合1.5.3.1和1.5.3.2的要求,才能颁发新证书。当船舶换挂国旗是在两个缔约国政府之间进行时,如在换挂国旗的关系发生之后12个月内提出要求,原船旗国政府应尽早向主管机关转交该船在换挂国旗之前所具有的证书副本,如可行,还应包括有关的检验报告副本。

## 第2章 船舶抗沉能力\*与液货舱位置

### 2.1 通则

2.1.1 受本规则约束的船舶应能承受在外力作用下船体遭受假定破损后的正常进水影响。此外,为了保护船舶及周围环境,若遇诸如和码头或拖船相接触而引起船体较小损伤,液货舱应加保护防止穿透,并提供在碰撞或搁浅时免遭破损的措施,此项措施可把液货舱布置在舷内离船体外板有一规定最小距离之处。所假定的破损和液舱与船体外板间的距离取决于所装货品所具有的危险程度。

2.1.2 受本规则约束的船舶应按下列标准之一设计:

- .1 1G型船舶系指拟运载第19章所列货品的气体运输船,它要求采取最有效的保护措施预防此类货物的逸泄。
- .2 2G型船舶系指拟运载第19章所列货品的气体运输船,它要求采取有效的保护措施预防此类货物的逸泄。
- .3 2PG型船舶系指长度为150 m及150 m以下拟运载第19章所列货品的气体运输船,它要求采取重大保护措施预防这类货物的逸泄,且货品装载在独立的针对MARVS至少为7 bar及货物围护系

\* 参见关于散装化学品规则和气体运输船舶规则的抗沉要求统一应用准则。

统设计温度为 $-55^{\circ}\text{C}$ 或以上而设计的C型舱(见4.2.4.4)中。应注意到这类船舶的长度,如超过150 m应认为是2G型船舶。

- .4 3G型船舶系指拟运载第19章所列货品的气体运输船,它要求采取中等保护措施预防这类货物的逸泄。

这就是说,1G型船舶是用来运载具有最大危险性货品的气体运输船,2G/2PG以及3G型船舶运载货品的危险程度则逐渐减小。因此,1G型船舶应能承受最严重的破损标准,而其液货舱应位于舷内离船体外极具有最大规定距离的外所。

2.1.3 个别货品要求的船型表示在第19章表的“c”栏中。

2.1.4 如果拟运载不止一种第19章所列的货品,其破损标准应按最严格船型要求的货品来确定。但对个别液货舱位置的要求,即系按与拟运载各货品有关船型的要求。

## 2.2 干舷和完整稳性

2.2.1 受本规则约束的船舶可按现行的国际载重线公约勘定最小干舷。然而,勘定干舷所决定的吃水不应该大于本规则其它条款所允许的最大吃水。

2.2.2 船舶在所有航海条件及装卸货物期间的稳性应该达到主管机关认可的标准。

2.2.3 在对装载状态计算消耗液体自由液面的影响时,应对每种液体假定:至少一对横向液舱或一个中心液舱有自由液面,且须考虑进去的液舱(或组合液舱)应该是自由液面影响最大的舱室。在未破损舱室内的自由液面影响应采用主管机关认可的方法计算。

2.2.4 货物区域内的双层底处所中一般不应采用固体压载。然而,如因考虑到稳性,在这些处所中装设固体压载成为不可避免时,则其分布应由需要决定,以保证船底破损引起的冲击荷重不会直接传递到液货舱结构。

2.2.5 应向船长提供一本装载和稳性资料手册,其内容包括典型营运状态、装载、卸载以压载操作的细节,估算其它装载状态的规定,以及船舶抗沉能力小结。此外,手册还应包括能使船长采用安全和适航方式装载货物和操作该船的足够资料。

## 2.3 干舷甲板以下的舷侧排水孔

2.3.1 从干舷甲板以下处所或从装有水密门的干舷甲板上的上层建筑和甲板室内通过外板排水阀门的装设及控制,应符合现行国际载重线公约的有关规定,但是阀门选择应限于:

- .1 具有主动关闭设备(从干舷甲板上方操作)的自动止回阀一只;或

- .2 如从夏季载重水线至排水管舷内端的垂直距离超过 $0.01L$ ，无主动关闭设备的自动止回阀二只，但是舷内阀在营运条件下受始终能接近供检查。

2.3.2 本节范围内，“夏季载重水线”和“干舷甲板”的含义和现行的国际载重水线公约的定义相同。

2.3.3 2.3.1.1和2.3.1.2所述的自动止回阀应为主管机关认可的型式，应能在考虑了2.9的抗沉要求所述的下沉、纵倾和横倾后，完全有效地防止水进入船内。

#### 2.4 装载状态

破损抗沉能力应根据提交给主管机关的装载资料针对所有预计的装载状态以及吃水和纵倾的变化进行研究。抗沉要求不必适用于船舶处在压载状态\*的情况，但要求留在船上的货物仅供冷却、循环或作燃料用。

#### 2.5 破损范围假定

2.5.1 假定的最大破损范围应该是：

- .1 舷侧破损： $2/3$
- .1.1 纵向范围： $1/3L$  或  $14.5\text{ m}$ ，取小者。
- .1.2 横向范围： $B/5$  或  $11.5\text{ m}$ ，取小者。  
从舷侧向舷内沿夏季载重水线垂直于纵中剖面方向量取。
- .1.3 垂向范围：向上无限制。  
在中心线处自船底外板型线量起。
- .2 船底破损  
距艏垂线 $0.3L$  船舶的其它部分。  
范围内。
- .2.1 纵向范围： $1/3L^{2/3}$  或  $14.5\text{ m}$ ， $1/3L^{2/3}$  或  $5\text{ m}$ ，取小者。  
取小者。

\* 在估算压载状态时，甲板上的小型独立清洗舱的货物不必考虑在内。

2.2 横向范围:

$B/6$  或 10 m,  $B/6$  或 5 m, 取小者。

取小者。

2.3 垂向范围:

$B/15$  或 2 m,  $B/15$  或 2 m, 取小者, 在中

取小者, 在中心线上自 心线上自船底外板型线量起

船底外板型线量起 (见 2.6.3)。

(见 2.6.3)。

2.5.2 其它破损:

- 1 如果破损范围虽小于 2.5.1 所规定的最大值, 但却导致更严重情况的任何破损应该加以考虑。
- 2 货物区域内任何部位的局部舷侧破损, 若其范围为船体外板向舷内扩展到 760 mm, 则应加以考虑, 且当 2.8.1 可适用的部分也要求满足时, 应假定横舱壁受到破损。

2.6 液货舱布置

2.6.1 液货舱应布置在舷内下列距离处:

- 1 1 G 型船舶: 离船侧外板不小于 2.5.1.1.2 规定的横向破损范围, 在中心线上离船底外板型线不小于 2.5.1.2.3 规定的垂向破损范围以及任何部位离船体外板不小于 760 mm。
- 2 2G/2PG 型船舶: 在中心线上离船底外板型线不小于 2.5.1.2.3 规定的垂向破损范围, 以及任何部位离外板不小于 760 mm。

2.6.2 就液货舱布置而言, 如采用薄膜液舱或半薄膜液舱, 船底破损的垂向范围应量到内底, 其它舱量至液货舱底。采用薄膜液舱或半薄膜液舱时, 舷侧破损的横向范围应量到纵舱壁, 其它舱量至液货舱舷侧 (见图 2.1)。对内部绝热液舱, 破损范围应量至液舱支持板。

2.6.3 除 1 G 型船舶外, 液货舱内的吸水井可以突入 2.5.1.2.3 规定的船底垂向破损范围内, 但要求此项井尽可能小, 且内底板以下的突出部分不超过双层底高的 25% 或 350 mm (取小者)。如果没有双层底, 船底破损上限以下的突出部分不应超过 350 mm。在确定受破损影响的舱室时, 按本款设置的吸水井可予忽略。

## 2.7 浸水假定

2.7.1 2.9的要求应该用计算予以证实,计算中须考虑船舶的设计特征;破损舱室的布置、结构外形及所装内容;液体的分布、相对密度和自由液面影响;以及所有装载状态下的吃水及纵倾。

2.7.2 假定破损处所的渗透率应取下列值:

处 所	渗 透 率
物料贮放处所	0.60
起居处所	0.95
机器处所	0.85
空 舱	0.95
供装消耗液体用	0-0.95*
供其它液体用	0-0.95*

2.7.3 凡遇破损穿透装有液体舱室的情况,应假定所装货物完全从该舱流失,并由海水替代直至最终平衡水线面的液面高度。

2.7.4 如果水密横舱壁之间的破损假定为2.8.1.4, .5和.6中所规定的范围,则横舱壁之间的距离至少应等于2.5.1.1.1规定的纵向破损范围才认为有效。如果横舱壁之间的距离小于上述值,则在此破损范围内的这类舱壁中的一个或多个,在确定浸水舱室时应假定为不存在。再则如果水密舱壁界限是在2.5所要求的垂向或水平向穿透范围内,则任何限制边舱或双层底舱的横舱壁部分应假定为破损。如果横舱壁上有长度超过3 m的台阶或壁凹位于假定的破损穿透范围内,则该横舱壁应假定为破损。在本款范围内,艏尖舱舱壁形成的台阶及艏尖舱舱顶不应作为台阶。

2.7.5 船舶的设计应通过有效的布置使不对称浸水减至最小。

2.7.6 凡要求采用机械手段的平衡装置(例如阀或横通调平管,如装有时)不应认为可用于减小横倾角或达到最小剩余稳性范围以满足2.9.1的要求,且如采用平衡装置的话,在所有阶段均应保持足够的剩余稳性。用大截面导管连通的处所可认为是互通处所。

2.7.7 如果管路、导管、围井或隧道位于2.5规定的假定破损穿透范围内,其布置应使在每一破损情况下延续进水不会扩展到假定进水舱室以外的其它舱室。

\* 部分装满舱室的渗透率应和该舱室所装载的液体量相一致。

2.7.8 直接位于舷侧破损上方的上层建筑，其浮力应不加考虑。然而，破损范围以外上层建筑的不浸水部分可以考虑进去，只要：

- .1 它们用水密分舱和破损处所隔离，且这些完整处所满足2.9.1.2.1的要求；
- .2 这些分隔内的开口能用远距离控制的水密滑门关闭，且在2.9.1要求的最小剩余稳性范围内，不加保护的开口不被浸没；但允许能风雨密关闭的其它开口浸没。

## 2.8 破损标准

2.8.1 船舶应能按照下列标准，依据2.7按船型确定的浸水假定范围，承受2.5所示的破损：

- .1 1 G型船应假定在其长度内任何部位经受破损；
- .2 长度超过150m的2 G型船应假定在其长度内任何部位经受破损；
- .3 长度为150m或不足150m的2 G型船应假定在其长度内任何部位经受破损，但不包括作为艏部机舱边界的舱壁；
- .4 2 P G型船应假定在其长度内任何部位经受破损，但不包括间距超过2.5.1.1.1规定的纵向破损范围的横向舱壁；
- .5 长度为125m或超过125m的3 G型船应假定在其长度内任何部位经受破损，但不包括间距超过2.5.1.1.1规定的纵向破损范围的横向舱壁；
- .6 长度不足125m的3 G型船应假定在其长度内任何部位经受破损，但不包括间距超过2.5.1.1.1规定的纵向破损范围的横向舱壁，且不包括位于艏部的机舱破损。但是承受机舱浸水的抗沉能力应由主管机关考虑。

2.8.2 若是小型的且不是一切方面都满足2.8.1.3，.4和.6相应要求的2 G/2 P G型船和3 G型船，可由主管机关考虑对其作特殊免除，但要求采取可保持同等安全程度的替代措施。此替代措施的性质应经认可并清楚地加以说明，并随时可向港口主管机关提交。任何此项免除应在1.5.4所述的国际散装运输液化气体适装证书中适当地注明。

## 2.9 抗沉要求

受本规则约束的船舶应按2.8所提供的破损标准，在2.5规定的假定破损范围内仍能在稳定条件下抗沉，并应满足下列标准：

2.9.1 在浸水的任何阶段：

- .1 计及下沉、横倾和纵倾后的水线应该位于可能发生延续浸水的任何开口下缘以下。 这类开口应包括空气管和用风雨密门或舱口盖关闭的开口，但不包括用水密人孔盖关闭的开口、甲板平齐的水密舱口、保持甲板高度完整性的小型水密舱口盖、远距离控制的水密滑门以及非开启型的舷窗；
- .2 不对称浸水引起的最大横倾角应不超过  $30^\circ$ ；及
- .3 浸水中间阶段的剩余稳性应得到主管机关的同意。 然而，无论如何不应比 2.9.2.1 所要求的值小很多。

2.9.2 处于浸水后的最终平衡阶段：

- .1 复原力臂曲线超过平衡位置应有一个  $20^\circ$  的最小范围，且在  $20^\circ$  范围内至少有一个 0.1m 的最大剩余复原力臂；此范围内该曲线下的面积应不小于 0.0175m 弧度。 在此范围内不加保护的开口不应浸没，除非有关处所假定是浸水的。 在这个范围内，2.9.1.1 所列的任一开口和能水密关闭的其它开口可以允许浸没；
- .2 供给应急电源。

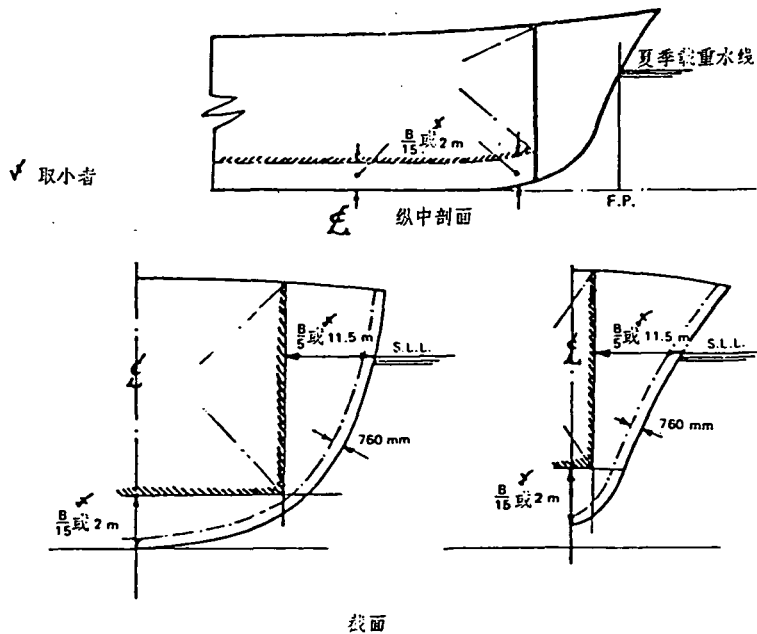


图 2.1 - 2.6 规定的液舱布置要求



### 第 3 章 船舶布置

#### 3.1 货物区域的分隔

3.1.1 货舱应与机舱、锅炉舱、起居处所、服务处所、控制站、锚链舱、饮用水和生活用水舱以及储物舱分隔开。货舱应位于 A 类机器处所（主管机关认为船舶安全或航行所必需者除外）的前面。

3.1.2 如货物系装载在不要求有次屏壁的货物围护系统中，货舱和 3.1.1 所述处所之间，或货舱和其下面的处所或其舷外一侧的处所之间，可以用隔离舱、燃油舱或全焊接结构形成 A-60 级分隔的单层水密舱壁予以隔开。如果相邻处所中没有着火源或火灾危险，则气密的 A-0 级分隔亦可同意。

3.1.3 凡货物装载在要求有次屏壁的货物围护系统中，货舱和 3.1.1 所述处所之间，或货舱和其下面或其舷外一侧含有着火源或火灾危险的处所之间，应该用隔离舱或燃油舱予以隔开。如果相邻处所中没有着火源或火灾危险，可以用气密的单层 A-0 级分隔予以隔开。

3.1.4 如货物装载在要求有次屏壁的货物围护系统中：

- .1 温度低于 -10℃ 者，货舱应以双层底同海水相分隔 及
- .2 温度低于 -55℃ 者，船舶也应设有一道形成边舱的纵舱壁。

3.1.5 可能含有货物或货物蒸气的管路系统应：

- .1 与其它管系相隔离，但为了与货物净化、气体清除或隋化作业有关而需相互连接者除外。在此情况下，应采取预防措施确保货物或货物蒸气不致通过连通管而进入其它管系；
- .2 除第 16 章中规定的以外，上述管路系统不应通过任何起居处所、服务处所或控制站，或通过机器处所（但货泵舱或货物压缩机舱除外）；
- .3 除安装在竖向围壁通道或等效装置内的管路用来通过货物围护系统上方的空舱处所，以及除供排水、通风或净化用的管路可以横穿隔离舱外，上述管路系统应从开敞甲板直接通至货物围护系统；
- .4 除按 3.8 规定的艏艙装卸装置、按 3.1.6 的应急货物抛弃管路系统和按第 16 章的规定以外，上述管路系统应位于开敞甲板上方的货物区域内；及
- .5 除在航行中不承受内部压力的横向接岸管路或应急货物抛弃管路系统外，上述管路系统应位于 2.6.1 所规定的横向液舱位置以内。

3.1.6 货物应急抛弃管路系统应按情况需要符合 3.1.5 要求并可从起居处所、服务处所、控制站或机器处所的后部外面经过，但不应穿过这些处所。如果货物应

急抛弃管路系统是永久性装设的，则应在货物区内为管路提供一适当的切断设施。

3.1.7 应设有装置以密封露天甲板上货物围护系统的开口。

### 3.2 起居、服务及机器处所和控制站

3.2.1 任何起居处所、服务处所或控制站都不应布置在货物区域内。起居处所、服务处所或控制站，其面向货物区域舱壁的位置应避免气体通过要求设置次屏壁的货物围护系统船上的某一破损甲板或舱壁而从货舱进入这些处所。

3.2.2 为了防止危险蒸气的侵袭，相当于货物管系、货物通风系统及机器处所中从燃气装置排出废气的位置，应适当考虑起居处所、服务处所、机器处所和控制站的空气进口及开口。

3.2.3 穿过气密门或其它型式门的通道不应该从气体安全处所通到气体危险处所，但当起居处所位于艙部时通过3.6.1所允许的空气闸通到货物区前面服务处所的通道除外。

3.2.4 起居处所、服务处所和控制站的进口、空气进口及开口不应面向货物区。它们应设置在不面向货物区的端壁上，或设置在舱室的舷外侧（或两侧）上，后者离面向货物区舱室端的距离至少为船长的4%（但不少于3 m）。然而，这个距离不必超过5 m。面向货物区和在上述距离范围内的舱室两侧上的窗和舷窗应是固定（非开启）型。驾驶室的窗可以是非固定型的，其门可位于上述范围内，但它们的设计要确保驾驶室能达到迅速而有效的气密和蒸气密。对于专门用来装载既不燃烧又无毒性的危险货物，主管机关可准许放宽上述要求。

3.2.5 上层连续甲板以下壳板上的舷窗及第一层上层建筑上的舷窗应该是固定（非开启）型的。

3.2.6 通到起居处所、服务处所和控制站的所有空气进口及开口应该安装关闭设备。对于毒性气体，这些进口及开口应能在处所内部进行操作。

### 3.3 货泵舱及货物压缩机舱

3.3.1.1 除非主管机关另有特别许可，货泵舱和货物压缩机舱应位于露天甲板上方，并在货物区域内。按照1983年修正的SOLAS公约第II-2章第58条的规定，货物压缩机舱应作为防火用的货泵舱。

3.3.1.2 当货泵舱和货物压缩机舱允许设置在最后面货舱的后端（或最前面货舱的前端）的露天甲板上方（或下方）时，1.3.6所定义的货物区域的限制应扩展到包括货泵舱和货物压缩机舱的整个船宽和船深范围以及这些处所上方的甲板面积。

3.3.1.3 如货物区域的限制范围按 3.3.1.2 扩展, 则把货泵舱和货物压缩机舱同起居处所、服务处所、控制站和 A 类机器处所隔开的舱壁位置, 应布置成能避免气体通过甲板或舱壁的单一破损而进入这些处所。

3.3.2 当货泵和压缩机靠通过舱壁或甲板的轴驱动时, 在舱壁或甲板处应安装具有高效润滑或其它能确保永久性气密的密封装置。

3.3.3 货泵舱或货物压缩机舱的布置应确保能让穿有防护服或携带呼吸器的人员安全无阻地出入, 并在受伤时能把昏迷人员救出。所有在货物装卸时必需的阀门对穿有防护服的人员来说应该是易于接近的。应配备适当装置以适当处理货泵舱和压缩机舱的排水问题。

### 3.4 货物控制室

3.4.1 任一货物控制室应位于露天甲板上方, 并可设在货物区域内, 货物控制室可以设在起居处所、服务处所或控制站内, 但要满足下列条件:

- .1 货物控制室是一气体安全处所; 且
  - .2.1 如果进口符合 3.2.4 的要求, 控制室可以有通到上述处所的通道;
  - .2.2 如果进口不符合 3.2.4 的要求, 控制室不应有通到上述处所的通道, 且与这些处所的边界绝热应达到“ A - 60”级完整性。

3.4.2 如果货物控制室设计成气体安全处所, 其仪表应尽可能采用非直接读出系统, 且在任何情况下应设计成能防止气体逃逸至该处所的大气中。如果气体探测器是按 13.6.5 安装的, 则其在货物控制室内的设置应不违反气体安全处所的要求。

3.4.3 如果装载可燃货物船舶的货物控制室是气体危险处所, 则应排除着火源。应考虑任何电气设备的安全特性。

### 3.5 进入货物区域各处所的通道

3.5.1 至少对船体内层结构的一侧在任何固定结构或装置不移去的情况下应能进行目视检查。如果这一目视检查只能在内壳的外面一侧进行(不论与 3.5.2, 4.7.7 或 4.10.16 所要求的检验是否联合进行), 内壳不应是燃油舱的边界壁。

3.5.2 应对货舱内绝热一侧进行检查。如果当液舱处于营运温度时, 绝热系统的完整性能靠货舱边界外侧的检查加以验证, 则不必要求检查货舱内绝热一侧。

3.5.3 货舱、空舱、认为有气体危险的其它处所以及液货舱的布置应允许穿着防护服、携带呼吸器的人员进入并检查该处所, 并在发生工伤事故时允许把昏迷人员从该处所中救出, 还应满足下列条件:

- .1 通道的设置:
  - .1.1 应直接从开敞甲板通至液货舱;

- 1.2 应通过水平开口、舱口或人孔，它们的尺寸应足够能让携带呼吸器的人员无妨碍地上下梯道，并且还应提供一净开口以便把受伤的人员从处所的底部提升上来，该净开口的最小尺寸应不小于 600 mm × 600 mm；及
- 1.3 应通过垂向开口或人孔（供该处所的整个长宽范围使用），这类开孔的最小净尺寸应为 600 mm × 800 mm，离底板的高度不大于 600 mm，但设有格栅或其它的立足点除外。
- 2 如果通过这些开口或搬移一个受伤人员的能力可以使主管机关认为满意，则 3.5.3.1.2 和 1.3 所述的尺度可以减少。
- 3 3.5.3.1.2 和 1.3 的要求不适用于 1.3.17.5 所述的处所。这类处所只应设有从开敞露天甲板通达的直接通道或间接通道，不包括围蔽的气体安全处所。

3.5.4 从开敞露天甲板到气体安全处所的通道应设置在高出露天甲板至少 2.4 m 的气体安全区域内，除非该通道采用了按 3.6 规定的空气闸。

### 3.6 空气闸

3.6.1 空气闸只允许设在开敞露天甲板上的气体危险区域和气体安全处所之间，空气闸应有两扇实质上气密的钢门，它们之间的距离至少为 1.5 m 但不大于 2.5 m。

3.6.2 此类门应是自闭式的，不设任何门背扣装置。

3.6.3 应给空气闸两侧配备声光报警系统，以指示是否有不止一扇门从关闭位置开启。

3.6.4 在装载可燃货品的船上，受空气闸保护处所内的非认可安全型电气设备，当该处所发生过压损耗时应能切断电路（亦见 10.2.5.4）。供操纵、锚泊和系泊设备用以及供应急消防泵用的非认可型安全电气设备，不应该位于受空气闸保护的处所内。

3.6.5 空气闸处所应该从某一气体安全处所进行机械通风，且对开敞露天甲板上的气体危险区域应保持过压。

3.6.6 应对空气闸处所进行货物蒸气监督。

3.6.7 按照现行国际载重线公约的要求，门栏的高度应不小于 300 mm。

### 3.7 舱底水、压载和燃油布置

3.7.1.1 如货物装载在不要求设有次屏壁的货物围护系统中，货舱应配备适当的、不与机舱相连接的排水装置。应有检测任何泄漏的设施。

3.7.1.2 若有次屏壁，应有适当的排水装置用来处理通过相邻船体结构漏进货舱（或绝热舱）的污水。吸口不应通到机舱内的泵上。应有检测此项泄露的设施。

3.7.2 屏壁间处所应设有适合于在液货舱泄漏或破裂时处理液货的排泄系统。

3.7.3 若为内层绝热舱，屏壁间处所和次屏壁与内层船体（或独立液舱结构）之间的处所不要求设置检测泄漏的设施和排水装置，因为这些处所全部充满了符合4.9.7.2要求的绝热材料。

3.7.4 压载处所、燃油舱和气体安全处所可以连接到机舱内的泵上。箱形龙骨可以和机舱内的泵相连接，但其连接管应直接通到泵上。且从泵中排出的水应直接排至舷外，而从箱形龙骨通出的管路和气体安全处所管路相连接的管路上，不应有任何阀或分配阀箱。泵的出口不应通向机器处所。

### 3.8 艙或艙装卸装置

3.8.1 可安装供艙或艙装卸货物用的货物管系，但应经主管机关的批准和满足本节要求。

3.8.1.1 通过起居处所、服务处所或控制站的艙或艙装卸管路不应用来输送要求1G型船的货品。艙或艙装卸管路不应用来输送1.3.38规定的毒性货品，除非获得了主管机关的特殊认可。

3.8.2 不应允许采用便携式装置。

3.8.3 除第5章要求外，下列规定适用于货物管系和有关的管路设备：

- .1 在货物区域以外的货物管系和有关的管路设备应为全焊接连接。货物区域外的管路应在开敞甲板上敷设，且在舷内至少760 mm，但横过船宽的接岸管路除外。此类管路应明显地加以识别，且在货物区域内与货物管系的连接点上应配有截止阀。在此连接点位置上，当不再使用时，应能用一可拆除的短管和盲板法兰予以隔离。
- .2 此管路应是全焊透对接焊接，且不论其管径大小和设计温度多少，应经全部射线探伤。管路上的法兰接头只允许设在货物区域内及设在通岸管接头处。
- .3 应配有装置能让此类管路在使用后洗净和除气。当不再使用时，短管应拆去，管端应用盲板法兰堵住。与清洗用途连在一起的通风管路应设在货物区域内。

3.8.4 起居处所、服务处所、机器处所和控制站的进口、空气进口及开口不应面向艙或艙装卸装置的通岸接头处。它们应位于上层建筑或甲板室的舷外侧，离

开的距离至少为船长的4%，但离面向艏或艉装卸装置的货物通岸管接头处的舱室端的距离不小于3 m。然而，这个距离不必超过5 m。面向通岸接头处及上述距离范围内的上层建筑或甲板室两侧的舷窗应该是固定（非开启）型。此外，在艏或艉装置使用期间，相应上层建筑或甲板室两侧的所有门、舷门及其它开口应保持关闭状态。如为符合3.2.4的小船，且本款要求不可能达到，则主管机关可准许放宽上述要求。

3.8.5 通到离货物通岸管接头处10 m范围内处所的甲板开口和空气进口，在艏或艉装卸装置使用期间应保持关闭状态。

3.8.6 离货物通岸管接头处3 m范围内的电气设备应该符合第10章的要求。

3.8.7 供艏或艉装卸区域用的消防设备应符合11.3.1.3和11.4.7的要求。

3.8.8 应提供货物控制站和通岸管接头处之间的通信装置，必要时应为认可的安全型。

#### 第4章 货物围护系统

##### 4.1 通则

4.1.1 主管机关应该采取适当步骤确保在实施和应用本章规定\*中的一致性。

4.1.2 除1.3中的定义以外，本章给出的定义在整个规则中适用。

##### 4.2 定义

###### 4.2.1 整体液舱

4.2.1.1 整体液舱构成船体结构的一部分，并且以相同方式与船体相邻结构受到同样载荷的影响。

4.2.1.2 4.2.6中所定的设计蒸气压力 $P_0$ 通常不应超过0.25 bar。如果船体构件尺寸有适当增加， $P_0$ 亦可相应增加到某一较大数值，但应小于0.7 bar。

4.2.1.3 如果货物沸点不低于-10℃，则可用整体液舱来装载这些货物。经过主管机关的特殊考虑，也可采用较低温度。

###### 4.2.2 薄膜液舱

4.2.2.1 薄膜液舱是非自身支持的舱，它由邻接的船体结构通过绝热层支持的一层薄膜所组成。薄膜的设计方式应使热膨胀和其它膨胀（或收缩）得到补偿，免受过大的薄膜应力。

\* 应参考国际船级社协会（IACS）会员社及联系会员社所发表的规范，特别是IACS的统一要求NOS.G1和G2。

4.2.2.2 设计蒸气压力  $P_0$  通常不应超过 0.25 bar。如果船体结构尺寸有适当增加，并且对支持的绝热层强度作了适当考虑， $P_0$  可相应增加到某一较高值，但应低于 0.7 bar。

4.2.2.3 薄膜液舱的定义并不排斥这些设计，例如应用非金属薄膜或用包括或合并于绝热层中的薄膜。但是这些设计应经主管机关特殊考虑。薄膜厚度，在任何情况下，一般应不超过 10mm。

#### 4.2.3 半薄膜液舱

4.2.3.1 半薄膜液舱是装载状态下非自身支持的舱，它包含有一薄层，其中一部分由相邻船体结构通过绝热层支持，而且与上述支持部分相连接的这一薄层的圆形部分也应设计成能承受热膨胀和其它膨胀（或收缩）。

4.2.3.2 设计蒸气压力通常不应超过 0.25 bar。然而，如果船体构件有适当增加，并且对支持的绝热层强度作了适当考虑， $P_0$  可相应增加到某一较高数值，但应低于 0.7 bar。

#### 4.2.4 独立液舱

4.2.4.1 独立液舱是自身支持的，它不构成船体结构的一部分，及对船体强度不是主要的。独立液舱共有三类，分别在 4.2.4.2 至 4.2.4.4 中叙述。

4.2.4.2 A 型独立液舱，其设计主要应用经典的船舶结构分析程序的承认的标准\*，如果这类液舱主要是由平面构成（重力液舱），则其设计蒸气压力  $P_0$  应该低于 0.7 bar。

4.2.4.3 B 型独立液舱，其设计应用模型试验，精确分析手段和分析方法确定应力大小，疲劳寿命和裂纹扩展特性。如果这类液舱主要由平面构成（重力液舱），则其设计蒸气压力  $P_0$  应低于 0.7 bar。

4.2.4.4 C 型独立液舱（亦称压力容器），它是符合压力容器标准的液舱，其设计蒸气压力不小于：

$$P_0 = 2 + AC(\rho_r)^{1.5}$$

$$\text{式中：} \quad A = 0.0185 \left( \frac{\sigma_m}{\Delta \sigma_A} \right)^2$$

其中：

$\sigma_m$  = 设计第一类薄膜应力

$\Delta \sigma_A$  = 许用薄膜动应力（全幅，当概率范围为  $Q = 10^{-8}$  时）

= 55 N/mm<sup>2</sup> ，对铁素体/马氏体钢

= 25 N/mm<sup>2</sup> ，对铝合金（5083-0）

\* 第 4、5 和 6 章承认的标准是指主管机关承认的船级社所制订和保留的标准。

$C =$  特征液舱的尺度, 取下列值中的最大值:

$$h; 0.75b; \text{ or } 0.45l$$

其中:

$h =$  液舱高度 (沿船舶垂向量取) (m)

$b =$  液舱宽度 (沿船舶横向量取) (m)

$l =$  液舱长度 (沿船舶纵向量取) (m)

$\rho_r =$  设计温度下货物的相对密度 (淡水,  $\rho_r = 1$ )。

但是, 主管机关根据液舱的形状及其支承装置和连接件, 可把满足本分段标准的液舱归属 A 型或 B 型。

#### 4.2.5 内部绝热液舱

4.2.5.1 内部绝热液舱为非自身支持, 由适合于货物围护系统的绝热材料所组成, 受到邻接的内层船体结构或独立液舱的支持。绝热层的内表面与货物直接接触。

4.2.5.2 两类内部绝热液舱是:

- 1 1型液舱, 系指舱内的绝热层或绝热层和一层或多层衬里组合绝热层只起到主屏壁的作用。必要时, 内层船体或独立液舱结构应起到次屏壁作用。
- 2 2型液舱, 系指舱内绝热层或绝热层和一层或多层衬里组合绝热层能同时起到主屏壁和次屏壁的作用, 而且这些屏壁可以清楚地识别。

“衬里”一词系指一层薄的非自身支持的金属、非金属或复合材料构成内层绝热液舱的一部分, 使提高抗断能力或其它机械性能。衬里不同于薄膜, 因为它不单独作为液体屏壁。

4.2.5.3 内层绝热液舱应该采用合适的材料建造, 使货物围护系统能按 4.4.7 所要求的模型试验和精确的分析方法进行设计。

4.2.5.4 设计蒸气压力  $P_0$ 。通常不应超过 0.25 bar。如果货物围护系统的设计用于较高蒸气压力时,  $P_0$  值可以提高; 但若内层绝热液舱是由内层船体结构支持, 则  $P_0$  不应超过 0.7 bar。假如内层绝热液舱受到独立液舱结构的适当支持, 则主管机关可以接受大于 0.7 bar 的设计蒸气压力。

#### 4.2.6 设计蒸气压力

4.2.6.1 设计蒸气压力  $P_0$  是液舱顶部的最大表压力, 它在液舱设计中已被使用。

4.2.6.2 对于没有温度控制以及货物压力只是由环境温度支配的液货舱,  $P_0$  不应该低于货物处于温度 45 °C 时的蒸气表压力。然而, 对于限制航区运行或在限制期限内航行的船舶, 主管机关可以接受一个较低的温度值, 且在这种情况下, 可以



把液舱中的任一绝热层考虑进去。相反，对于一直运行在较高环境温度区域的船舶可以要求一个较高的温度值。

4.2.6.3 包括 4.2.6.2 在内的所有情况下， $P_0$  不应低于释放阀设定的最大许用值 MARVS。

4.2.6.4 经主管机关特别考虑，并符合 4.2.1 到 4.2.5 对各类液舱所规定的限制条件，在港内条件下，如果动力荷重得到减少，可以允许采用比  $P_0$  高的蒸气压压力。

#### 4.2.7 设计温度

供选择材料用的设计温度是在液舱内货物可以载运的最低温度。应有使主管机关满意的措施确保液舱或货物温度不下降到设计温度以下。

### 4.3 设计载荷

#### 4.3.1 一般要求

4.3.1.1 液舱连同其支持构件以及其它附件的设计，应考虑下列载荷的适当组合：

内部压力

外部压力

船舶运动引起的动载荷

热载荷

晃动载荷

船舶挠曲引起的载荷

在支持构件部位的液舱和货物重量以及相应的反作用力

绝热层重量

作用在塔架和其它连接附件处的载荷。

这些载荷的范围应根据液舱的型式加以考虑，并在下列各款中作详细的说明。

4.3.1.2 应计及 4.10 所述相应于压力试验时的载荷。

4.3.1.3 应计及 4.2.6.4 所述在港内条件下蒸气压力的增加。

4.3.1.4 液舱的设计应考虑最不利的横倾从  $0^\circ$  到  $30^\circ$ ，并不超过 4.5.1 所规定的许用应力。

#### 4.3.2 内部压力

4.3.2.1 设计蒸气压压力  $P_0$  引起的内部压头  $h_{eq}$  (bar 表压) 和 4.3.2.2 所述的液体压力  $h_{gd}$ ，不包括液体晃动的影响，应按下式计算：

$$h_{eq} = P_0 + (h_{gd})_{max} \quad (\text{bar})$$

等效的计算方法也可以采用。

4.3.2.2 内部液体压力是指由于 4.3.4.1 所述的船舶运动引起货物重心加速度所产生的压力。由重力和动加速度联合作用引起的内部压头  $h_{gd}$  应按下式计算:

$$h_{gd} = a_{\beta} z_{\beta} \frac{\rho}{1.02 \times 10^4} \text{ (bar)}$$

式中:

$a_{\beta}$  = 由重力或动载荷在任意方向  $\beta$  上引起的无因次加速度 (相对于重力加速度) (见图 4.1)。

$z_{\beta}$  = 须决定压力的点以上的最大液柱高度 (m), 在  $\beta$  方向上量自液舱壳体 (见图 4.2)。不作为液货舱总体积一部分的舱顶小气室, 在确定  $z_{\beta}$  时可不予考虑。

$\rho$  = 设计温度下的货物最大密度 ( $\text{kg}/\text{m}^3$ )

应该考虑给出  $h_{gd}$  最大值的  $(h_{gd})_{\max}$  方向。如需要考虑三个方向的加速度, 应采用椭圆替代图 4.1 中的椭圆。上述公式仅适用于注满的液舱。

#### 4.3.3 外部压力

外部设计压力载荷, 应根据最小内部压力 (最大真空度) 和液舱的任何部分可能同时承受的最大外部压力之间的差值予以确定。

#### 4.3.4 船舶运动引起的动载荷

4.3.4.1 动载荷的确定应计及船舶在其使用寿命期间所经受的船舶运动的长期分布, 包括不规则海况中的纵荡、横荡、垂荡、横摇、纵摇和艏摇等的影响 (通常取为相当于  $10^8$  次波遇)。由于采取必要的减速和船艏方向的变化, 可以考虑减少动载荷, 如果这种考虑是已作为船体强度评定的一个组成部分。

4.3.4.2 为防止塑性变形和屈曲的设计, 动载荷应取船舶使用寿命期间 (通常取为相当于  $10^{-8}$  的概率范围) 可能遇到的最大载荷。加速度分量的指导公式见 4.12。

4.3.4.3 如要考虑疲劳的设计, 动载谱应根据船舶使用寿命期间的长期分布计算加以确定 (通常取为相当于  $10^8$  次波遇)。若采用简化的动载谱来估算疲劳寿命, 则这些动载谱应经主管机关特别考虑。

4.3.4.4 为了裂纹扩展估算的实际应用, 可以采用十五天为一期的简化载荷分布图, 这类载荷分布取自图 4.3。

4.3.4.5 限制航区的船舶可给予特别考虑。

4.3.4.6 作用在液舱上的加速度应在其重心上加以估算, 它包括下列分量:

垂向加速度: 垂荡, 纵摇及可能还有横摇引起的运动加速度 (垂直于船舶基线);

横向加速度：横荡，艏摇和横摇的运动加速度；以及横摇的重力分量；

纵向加速度：纵荡和纵倾的运动加速度；以及纵摇的重力分量。

#### 4.3.5 晃动载荷

4.3.5.1 对于拟作部分注满的液舱，应考虑由于4.3.4.6所述任何一种运动引起的重大晃动载荷所造成的危险性。

4.3.5.2 如发现具有重大的晃动诱发载荷的危险性，则应要求做专门的试验和计算。

#### 4.3.6 热载荷

4.3.6.1 对拟载运货物温度低于-55℃的液舱，应考虑冷却期间的瞬时热载荷。

4.3.6.2 如设计的支持设施以及运行温度可能引起重大热应力时，对于这类液舱应考虑固定热载荷。

#### 4.3.7 支持构件上的载荷

作用在支持构件上的载荷，见4.6规定。

### 4.4 结构分析

#### 4.4.1 整体液舱

整体液舱的结构分析应按照承认的标准。液舱界限的结构尺寸，计及4.3.2规定的内压力，至少应满足深舱的要求，但最终的结构尺寸应不小于这些标准的要求。

#### 4.4.2 薄膜液舱

4.4.2.1 对薄膜液舱，应该考虑所有静、动载荷的影响，以确定薄膜及相联的绝热层对塑性变形和疲劳的适应性。

4.4.2.2 在给出认可以前，通常应对既有主屏壁又有次屏壁，包括角隅和接头在内的模型进行试验，以验证这些结构能承受静、动和热载荷引起的组合应变。试验条件应该代表货物围护系统在其使用寿命中可能遇到的最严重运行条件。材料试验应确保时效不妨碍材料发挥它预期的功能。

4.4.2.3 为了进行4.4.2.2所述的试验，应该对船舶和货物围护系统的具体运动、加速度和响应作一完整的分析，除非这些数据是从相似船舶中获得的。

4.4.2.4 应该特别注意薄膜的可能破坏，这些破坏是由于屏壁间的超压、液货舱的真空、液货晃动的影响及船体振动的影响而引起。

4.4.2.5 计及4.3.2所述的内部压力的船体的结构分析，应使主管机关满意。然而，应特别注意对船体挠曲以及它们与薄膜和相联的绝热层的一致性。内层船壳

板厚度，在考虑了 4.3.2 所述的内部压力后，应至少满足承认的标准对深舱的要求。薄膜、薄膜支持构件材料和绝热层的许用应力应根据每一具体情况加以确定。

#### 4.4.3 半薄膜液舱

计及 4.3.2 所述内部压力的结构分析，应按对薄膜液舱或独立液舱的要求（如适合时）进行。

#### 4.4.4 A 型独立液舱

4.4.4.1 计及 4.3.2 所述内部压力的结构分析，应使主管机关满意。液货舱板厚，计及 4.3.2 所述内部压力以及 4.5.2 所要求的腐蚀余量，应至少满足承认的标准对深舱的要求。

4.4.4.2 在承认的标准中没有包括的某些部件诸如在支持构件处的结构，其应力在尽可能考虑 4.3 所述的载荷和支持构件处的船舶挠曲后，应按直接计算法确定。

#### 4.4.5 B 型独立液舱

对这类液舱适用下列情况：

- .1 动、静载荷的影响应用来决定结构对下列内容的适应性：
  - 塑性变形
  - 屈曲
  - 疲劳破坏
  - 裂纹扩展。

按照 4.3.4 有限元分析法或类似的方法、断裂力学分析法或其它相当的分析方法进行统计波浪载荷的分析。

- .2 应采用三维分析法评定船体上的应力程度。这种分析模型应包括带有支持构件的液货舱，键固系统以及船体的其它适当部分。
- .3 对在不规则波浪上具体船舶的加速度和运动，以及船舶及其液货舱对这些力和运动的响应，应作一完整的分析。除非这些数据是从相似船舶获得的。
- .4 屈曲分析应考虑最大的建造公差。
- .5 如主管机关认为有必要，为了确定应力集中系数和结构构件的疲劳寿命，可要求做模型试验。
- .6 疲劳载荷的积累效应应符合：

$$\sum \frac{n_i}{N_i} + \frac{10^3}{N_j} \leq C_w$$

式中:

- $n_1$  = 船舶寿命期间每一应力级上的应力循环次数
- $N_1$  = 按照韦勒 (S - N) 曲线, 相应应力级达到断裂时的循环次数
- $N_j$  = 加载和卸载的疲劳载荷达到断裂时的循环次数
- $c_w$  = 应小于或等于 0.5; 对取用大于 0.5 的值, 主管机关可给予特别的考虑, 但不应小于 1.0, 此种情况均取决于建立韦勒 (S - N) 曲线时所用的试验方法和数据。

#### 4.4.6 C型独立液舱

##### 4.4.6.1 根据内部压力确定的结构尺寸应该按如下计算:

- .1 承受内压包括法兰在内的受压容器, 其受压部件的厚度和形状, 应按主管机关可接受的标准予以确定。在所有情况下, 这些计算按照一般认可的受压容器设计原理。受压容器中受压部件的开口应按主管机关可接受的标准进行加强。
- .2 在上述计算中应考虑 4.3.2 所述的液体设计压力。
- .3 按 4.10.9 规定进行检查和无损探伤, 在计算中的焊接效率, 应按 4.4.6.1.1 规定取 0.95。若考虑了其它因素, 例如所使用的材料、接头型式、焊接程序以及载荷型式等, 焊接效率可以增大到 1.0。对于处理受压容器, 主管机关可以接受局部无损探伤, 但应不少于 4.10.9.2.2 的规定, 这些规定取决于这些因素, 例如采用的材料、设计温度、制造材料的零韧性转变温度、接头型式和焊接程序等, 但此时焊缝效率在任何情况下, 应不大于 0.85。对于特殊材料, 上述效率应予减小, 根据焊接接头规定的机械性能而定。

##### 4.4.6.2 屈曲标准应如下:

- .1 承受外压和使受压缩应力的其它载荷的受压容器, 其厚度和形状应符合主管机关可接受的标准, 在所有情况下, 均应按照可接受的一般受压容器屈曲理论进行这些计算, 并应充分考虑到理论和实际屈曲应力值之间的差别, 这些差别是由于板边不对准, 以及在规定的弧长 (或弦长) 范围内有椭圆度或失圆度等引起。
- .2 用来验算受压容器屈曲的计算压力  $P_e$  应不小于下式给出的值:

$$P_e = P_1 + P_2 + P_3 + P_4 \quad (\text{bar})$$

式中：

$P_1 =$  真空释放阀的设定压力。对不配备真空释放阀的容器， $P_1$  应作特别考虑，但一般应取不小于 0.25 bar。

$P_2 =$  容纳受压容器或部分受压容器的完全封闭处所的压力释放阀设定压力，其它部位  $P_2 = 0$ 。

$P_3 =$  由绝热层的重量和收缩、壳体重量（包括腐蚀余量）及受压容器可能受到的其它载荷等作用在壳体上的压缩力。这些压力包括（但不限于）气室的重量、塔架和管路的重量、部分注满条件下货品的效应以及加速度和船体的挠曲。此外，还应考虑外部压力或内部压力或两者的局部影响。

$P_4 =$  露天甲板上受压容器或部分受压容器的水柱引起的外部压力；其它部位  $P_4 = 0$ 。

#### 4.4.6.3 关于静、动载荷应该按以下规定进行分析：

- .1 受压容器的结构尺寸应该按 4.4.6.1 和 .2 的规定。
- .2 在支持构件处及壳体支持连接件处应进行载荷和应力计算。如适用，应采用 4.3 中的载荷。支持构件处的应力应符合主管机关可接受的标准。在特殊情况下，主管机关可要求作疲劳分析。
- .3 如主管机关要求，应特别考虑第二类应力和热应力。

4.4.6.4 对受压容器，按 4.4.6.1 计算得到的厚度，或 4.4.6.2 所要求的厚度加上腐蚀余量（如有时），应看作为最小值，不应有负公差。

4.4.6.5 加工成形后的受压容器，其壳体和封头的最小厚度，包括腐蚀裕度，对碳锰钢和镍钢应不小于 5 mm；对奥氏体钢 3 mm；铝合金 7 mm。

#### 4.4.7 内层绝热液舱

4.4.7.1 应考虑所有静、动载荷的影响以确定液舱对下列因素的适用性：

疲劳破坏

从自由表面和支持表面的裂纹扩展

压缩、拉伸和剪切强度。

应该采用按 4.3.4 的统计波浪载荷分析法、有限元分析法或其它类似方法，以及断裂力学分析法或其它等效方法进行分析。

4.4.7.2.1 应该特别注意抗裂和内层船体或独立液舱结构的挠曲及其绝热材料的一致性。应进行三维结构分析使主管机关满意。这个分析是为了评定内层船体或独立液舱结构（或两者）的应力级和变形，分析时应考虑到 4.3.2 所述的内部压力。

如压载水舱邻接于构成内层绝热液舱支持构件的内层船体, 则其分析应考虑到压载水在船舶运动影响下而引起的动载荷。

4.4.7.2.2 内层绝热液舱和内层船体结构或独立液舱结构的许用应力及其相关的挠曲, 应按每一具体情况予以确定。

4.4.7.2.3 内层船体的板厚或独立液舱的板厚, 在考虑了4.3.2所述的内部压力后, 应至少符合承认的标准要求。平面结构液舱至少应符合对深舱的承认的标准要求。

4.4.7.3 船舶、货物和任何压载对某一具体船舶在不规则波浪上的加速度和运动的响应, 应作一完整的分析, 并使主管机关满意, 除非这些数据是取自类似船舶的。

4.4.7.4.1 为了确认设计原理, 包括结构元件在内的复合模型的原型试验应在静、动载荷和热载荷联合作用下进行。

4.4.7.4.2 试验条件应代表货物围护系统在船舶使用寿命期间所经受的最严重情况, 包括热循环。为此, 根据每年19个来回航次, 至少应考虑400次热循环。如预计每年超过19个来回航次, 将要求更高的热循环次数。这400次热循环可分成20个完整循环(货物温度达45℃)及380个部分循环(货物温度达到压载状态航行时预计到达的温度)。

4.4.7.4.3 模型应能代表实际构造, 包括角隅、接头、泵座、管路贯通件及其它关键性区域, 并应考虑材料性能、工艺和质量控制方面的任何变化。

4.4.7.4.4 应该进行拉伸和疲劳的联合试验, 以评定内层船体或独立液舱结构有穿透性裂纹扩展时绝热材料的裂纹动态。在这些试验中, 如可行, 裂纹区域应经受压载水的最大静水压力。

4.4.7.5 疲劳载荷的影响应按4.4.5.6的规定或等效方法予以确定。

4.4.7.6 对于内部绝热液舱, 修补程序应在绝热材料和内层船体或独立液舱结构的原型试验期间制订出来。

## 4.5 许用应力和腐蚀余量

### 4.5.1 许用应力

4.5.1.1 对于独立液舱, 许用应力通常应是承认的标准对船体结构所给的许用应力。

4.5.1.2 对薄膜液舱, 应参考4.4.2.5的要求。

4.5.1.3 对主要由平面结构组成的A型独立液舱, 其主要构件和次要构件(加强材、强肋骨、纵桁、纵材)的应力, 如按经典分析方法计算, 对碳锰钢和铝合金应不超过 $R_m/2.66$ 或 $R_e/1.33$ 的较低值, 其中的 $R_m$ 和 $R_e$ 见4.5.1.7的定义。然

而，如对主要构件进行了详细计算，4.5.1.8中的相当应力  $\sigma_c$  可比上述数值增加至主管机关可接受的应力；计算时应考虑到弯曲、剪切、轴向和扭转变形以及由于双层底和液货舱底的挠曲而引起的船体/液货舱的相互作用力。

4.5.1.4 对主要由回转体结构组成的B型独立液舱，其许用应力应不超过。

$$\begin{aligned} \sigma_m &\leq f \\ \sigma_L &\leq 1.5 f \\ \sigma_b &\leq 1.5 F \\ \sigma_L + \sigma_b &\leq 1.5 F \\ \sigma_m + \sigma_b &\leq 1.5 F \end{aligned}$$

式中：

$\sigma_m$  = 相当第一类薄膜总应力

$\sigma_L$  = 相当第一类薄膜局部应力

$\sigma_b$  = 相当第一类弯曲应力

$f = \frac{R_m}{A}$  或  $\frac{R_e}{B}$ ，取其小者

$F = \frac{R_m}{C}$  或  $\frac{R_e}{D}$ ，取其小者

$R_m$  和  $R_e$  见4.5.1.7的定义。 $\sigma_m$ 、 $\sigma_L$  和  $\sigma_b$  见4.13应力分类定义。

A, B, C 和 D 值应在国际散装运输液化气体适装证书上注明，至少应不少于下列最小值：

	镍钢和碳锰钢	奥氏体	铝合金
A	3	3.5	4
B	2	1.6	1.5
C	3	3	3
D	1.5	1.5	1.5

4.5.1.5 对主要由平面结构组成的B型液舱，主管机关可要求满足额外的或其它应力标准。

4.5.1.6 对C型独立液舱，按4.4.6.1.1计算中所采用的最大许用薄膜应力应取下列较小者：

$$\frac{R_m}{A} \text{ 或 } \frac{R_e}{B}$$



式中:

$R_m$  和  $R_e$  见 4.5.1.7 定义。

(A 和 B 值应在 1.5 所提供的国际散装运输液化气体适装证书中注明, 且至少应有 4.5.1.4 表中所给的最小值。

4.5.1.7 下列定义适用于 4.5.1.3, 4.5.1.4 和 4.5.1.6:

• 1  $R_e$  = 室温下屈服应力下限值 (N/mm<sup>2</sup>)。如应力-应变曲线上无明显的屈服应力, 可采用 0.2% 的条件屈服应力。

$R_m$  = 室温下抗拉强度下限值 (N/mm<sup>2</sup>)。

对铝合金焊接件, 应采用退火状态下的  $R_e$  和  $R_m$  的相应值。

• 2 上述性能应和材料的机械性能下限值相一致, 包括制造状态的焊接金属。经主管机关的特殊考虑, 可在低温下提高屈服应力和抗拉强度。定作材料性能依据的温度应该在 1.5 提供的国际散装运输液化气体证书中注明。

4.5.1.8 相当应力  $\sigma_c$  (von Mises, Huber) 应按下式确定:

$$\sigma_c = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau_{xy}^2}$$

式中:

$\sigma_y$  = x 方向的总正应力

$\sigma_x$  = y 方向的总正应力

$\tau_{xy}$  = x-y 平面内的总剪应力。

4.5.1.9 当静应力和动应力进行分别计算, 且除非有其它计算方法证明恰当时, 则总应力可按下式计算:

$$\sigma_x = \sigma_{x.st} \pm \sqrt{\Sigma(\sigma_{x.dyn})^2}$$

$$\sigma_y = \sigma_{y.st} \pm \sqrt{\Sigma(\sigma_{y.dyn})^2}$$

$$\tau_{xy} = \tau_{xy.st} \pm \sqrt{\Sigma(\tau_{xy.dyn})^2}$$

式中:

$\sigma_{x.st}$ ,  $\sigma_{y.st}$  和  $\tau_{xy.st}$  = 静应力

$\sigma_{x.dyn}$ ,  $\sigma_{y.dyn}$  和  $\tau_{xy.dyn}$  = 动应力

都从加速度分量和因挠曲和扭转引起的船体应变分量中单独确定。

4.5.1.10 对内层绝热液舱，应参考 4.4.7.2 的要求。

4.5.1.11 使用第 6 章规定外的材料的许用应力，每种情况均应征得主管机关的批准。

4.5.1.12 应力可能更会被疲劳分析、裂纹扩展分析和屈曲标准所限制。

#### 4.5.2 腐蚀余量

4.5.2.1 一般在结构分析的厚度中，不应再有任何腐蚀余量要求。然而，如果在液货舱周围无环境控制，如隋性化，或货物是带腐蚀性的，则主管机关可要求加适当的腐蚀余量。

4.5.2.2 如果受压容器内所装货物是非腐蚀性的及外表面由隋性气保护，或由具有认可型蒸气屏适当的绝热层保护，则受压容器一般不要求加腐蚀余量。油漆或其它薄的涂层不能看作是保护层。如果采用了具有认可型抗腐蚀性能的特殊合金，不应要求有任何腐蚀余量。假如上述条件不满足，按 4.4.6 算得的结构尺寸应适当增加。

#### 4.6 支持构件

4.6.1 货物液舱应由船体支持，使在受到静、动载荷作用下能防止液舱本体的移动，但允许液舱在温度变化和船体挠曲时可以收缩和膨胀，而不引起船体和液舱的过大应力。

4.6.2 设计具有支持构件的液舱应适应横倾 30°，不超出 4.5.1 规定的许用应力。

4.6.3 支持构件的设计应考虑由于转动和移动的影响而可能引起的最大合成加速度。在给定向上的这个加速度可按图 4.1 予以确定。“加速度椭圆”的半轴应按 4.3.4.2 确定。

4.6.4 应设置适当的支持构件以承受作用在液舱上的碰撞力（此力相当于  $\frac{1}{2}$  液舱和货物重量的向前冲力，以及  $\frac{1}{2}$  液舱和货物重量的向后冲力），使不产生可能危及液舱结构的变形。

4.6.5 4.6.2 和 4.6.4 所述的载荷不需相互组合，也不需和波浪诱发载荷相组合。

4.6.6 对独立液舱，如适合，也对薄膜液舱或半薄膜液舱，应采取措施用键固定液舱，防止 4.6.3 所述的转动影响。

4.6.7 独立液舱应设置防浮装置。此防浮装置应能承受某一货舱进水至船舶夏季载重吃水时由一个空液舱引起的向上力，不致产生可能危及船体结构的塑性变形。

#### 4.7 次屏壁

4.7.1 如在大气压力下货物温度低于 $-10^{\circ}\text{C}$ ，应按4.7.3要求设立次屏壁，作为液货可能从主屏壁泄漏出来的临时围护设施。

4.7.2 如在大气压力下货物温度不低于 $-55^{\circ}\text{C}$ ，则船体结构可作为次屏壁。在这种情况下：

- .1 船体材料应按4.9.2的要求，适合于在大气压力下货物的温度；及
- .2 该设计应使此温度不会造成不能接受的船体应力。

4.7.3 与液舱型式有关的次屏壁通常应按下表设置。对于不同于4.2所定义的基本液舱型式的液舱，次屏壁要求应根据每一具体情况由主管机关确定。

大气压力下的 货物温度	$-10^{\circ}\text{C}$ 及以上	$-10^{\circ}\text{C}$ 至 $-55^{\circ}\text{C}$	$-55^{\circ}\text{C}$ 以下
基本液舱型式	不要求次屏壁	船体可作为次屏壁	单独设立次屏壁(如需要时)
整体 薄膜 半薄膜 独立液舱 A型 B型 C型 内层绝热液舱 1型 2型		通常不许可的液舱型式 <sup>1</sup> 完整的次屏壁 完整的次屏壁 <sup>2</sup>  完整的次屏壁 部分的次屏壁 不要求次屏壁  完整的次屏壁 结合成一体的次屏壁	

4.7.4 次屏壁的设计应为：

- .1 在考虑了4.3.4.4所述的载荷谱后，能容纳预计泄漏的液货达15天，但对于有不同要求的特别航程除外；
- .2 按4.8.2所指的主屏壁出现泄漏时，应能防止船体结构的温度下降到不安全的程度；以及
- .3 主屏壁的破坏机理不会引起次屏壁的破坏，反之亦然。

<sup>1/</sup> 按4.2.1.3规定，如允许在大气压力下的货物温度低于 $-10^{\circ}\text{C}$ ，通常应要求完整的次屏壁。

<sup>2/</sup> 如半薄膜液舱在各方面均能适合于B型独立液舱的要求（支持方式除外），主管机关经特别考虑后可同意设立部分的次屏壁。

4.7.5 次屏壁应能在船舶横倾角 $30^{\circ}$ 时完成它的功效。

4.7.6.1 如要求设置部分次屏壁时,其设置范围应根据主屏壁主要泄漏的初始探测,按4.3.4.4所述的载荷谱所造成的破坏范围内相对应的货物泄漏量加以确定。可适当计及液体蒸发、泄漏率、泵容量及其它有关因素。在所有情况下,液货舱处的内底应设有防止液货的保护设施。

4.7.6.2 次屏壁范围以外的处所,应设有类似防溅屏障的设施,以使液货挡回流入主屏壁和次屏壁之间的处所,并使船体结构温度保持在安全程度上。

4.7.7 应能对次屏壁的有效性作定期检查,检查方法可以采用压力真空试验、外表检查或主管机关认为适当的其它方法。所采用的方法应提交主管机关审批。

#### 4.8 绝热

4.8.1 如果运载的货品温度在 $-10^{\circ}\text{C}$ 以下,则应设置适当的绝热层以确保船体温度不会下降到第6章对有关钢级规定的最小许用工作温度以下,详见4.9,此时的液货舱处在设计温度下,其环境温度空气为 $5^{\circ}\text{C}$ (海水为 $0^{\circ}\text{C}$ )。这些条件一般可适用于环球航区。但对运行在限制航区的船舶,主管机关可允许采用较高的环境温度值。相反,对偶尔或有规律地运行在冬季月份可能遇到较低温度的纬度区域的船舶,主管机关可规定低的环境温度。设计中所选用的环境温度应在1.5所述的国际散装运输液化气体适装证书中注明。

4.8.2 如果要求设置完整的或部分的次屏壁,则应按4.8.1的假设进行计算,以校核船体的温度不会下降到第6章对有关钢级规定的最小许用工作温度以下,详见4.9。完整或部分的次屏壁应假定处于大气压力下的货物温度。

4.8.3 按4.8.1和4.8.2要求进行的计算应假定空气和水是静止的,除4.8.4所允许的以外,加热的方式均不足以相信。如为4.8.2所述的情况,泄漏货物蒸发产生的冷却效应在热传导分析中应加以考虑。对于连接内外层壳体的构件,确定钢材级别时可取平均温度。

4.8.4 在4.8.1和4.8.2所述的情况中以及对于空气为 $5^{\circ}\text{C}$ 和海水为 $0^{\circ}\text{C}$ 的这种环境温度条件,可以采用认可的方法对船体横向结构材料加热,以确保这些材料的温度不下降到最小值的允许值以下。如果规定了较低的环境温度,亦可以采用认可的方法对船体纵向构件材料加热,但这些材料如不加热也能保持适合于空气为 $5^{\circ}\text{C}$ 和海水为 $0^{\circ}\text{C}$ 的温度条件。这些加热方式应满足下列要求:

- 1 应有足够的热量用来使船体结构温度在4.8.1和4.8.2所述的条件下仍能高出最小的许用温度;

- .2 加热系统应布置成当该系统的任一部分失效时, 备用加热可保持不低于100%理论热载荷,
- .3 加热系统应被认为是一个主要的辅助设备,
- .4 加热系统的设计和构造应使主管机关满意。

4.8.5 在确定绝热层厚度时, 应适当注意可接受的蒸发量以及船上的再生液化装置、主推进机械或其他温度控制系统。

#### 4.9 材料

4.9.1 船体外板和甲板板以及所附连的加强材应符合承认的标准, 除非由于低温货物的影响在设计条件下的材料设计温度处在 $-5^{\circ}\text{C}$ 以下, 此时材料应按表6.5的规定, 假定周围海水和空气的温度分别为 $0^{\circ}\text{C}$ 和 $5^{\circ}\text{C}$ 。在设计条件下, 应假定完整的和部分的次屏壁是处于大气压力下的货物温度状态, 对于没有设置次屏壁的液舱, 应假定主屏壁是处于货物温度状态。

4.9.2 构成次屏壁的船体材料应符合表6.2的要求, 不构成船体结构一部分但用在次屏壁中的金属材料应根据情况按表6.2或6.3的规定(如适用时)。构成次屏壁的绝热材料应符合4.9.7的要求。若次屏壁是由甲板或舷侧外板构成, 则表6.2所要求的材料级别应不同程度地延伸到邻接的甲板或舷侧外板上(如适用时)。

4.9.3 液货舱结构中采用的材料应按6.1, 6.2或6.3的规定。

4.9.4 非4.9.1, 4.9.2和4.9.3所述的材料用于建造遵守因货物而减低温度以及不构成次屏壁的船舶, 对4.8确定的温度应按表6.5的规定。这些包括内底板、纵舱壁板、横舱壁板、肋板、深桁材、水平桁材以及所有附连的加强构件。

4.9.5 绝热材料应适合于其相邻结构可能施加的载荷。

4.9.6 如可行, 由于位置或环境条件的关系, 绝热材料应有适当的阻火和防火焰传播的性能, 并应有足够的保护水汽渗透和防止机械损伤的措施。

4.9.7.1 用作绝热的材料, 应对下列性能作试验(如适用时), 以确保它们适合于预定的用途:

- .1 与货物的一致性
- .2 在货物中的可溶性
- .3 货物的吸收作用
- .4 收缩量
- .5 时效
- .6 孤立气泡率

- .7 密度
- .8 机械性能
- .9 热膨胀
- .10 磨耗性
- .11 粘结力
- .12 热传导性
- .13 抗振
- .14 阻火和防火焰传播。

4.9.7.2 除满足上述要求以外，构成4.2.5所述的货物围护一部分的绝热材料，应在模拟时效和热循环后，对下列性能进行试验，以确保它们适合于预定的用途：

- .1 粘接（粘附和粘结强度）
- .2 货物压力的耐压能力
- .3 疲劳和裂纹扩展性能
- .4 货物组成物和其他添加剂与预计在正常工作下要和绝热层相接触的一致性
- .5 如适用时，应计及有水和水压力存在时绝热性能的影响
- .6 气体拒吸性。

4.9.7.3 上述性能，如适用时，应在营运中预计出现的最高温度和最低设计温度以下5°C之间的范围内进行试验，但不低于-196°C。

4.9.8 绝热材料的加工制造、贮存、装卸、安装、质量控制以及有害的露于阳光下的控制，应使主管机关满意。

4.9.9 当采用粉末或粒状绝热材料时，其布置应能防止振动而使材料压实，这种设计应结合措施确保材料有足够的浮力以保持所需的热传导性，同时也能防止围护系统中压力不适当的增加。

#### 4.10 构造和试验

4.10.1.1 独立液舱壳体的所有焊接接头应为对接焊、全焊透型。对于气室和壳体的连接，主管机关可以批准采用全焊透T型焊接。除气室上的小贯穿件外，喷嘴焊缝一般也应设计成全焊透焊。

4.10.1.2 C型独立液舱的焊接接头细节应该满足以下要求：

- .1 受压容器的所有纵向或周向接头应为对接、全焊透、双面V型坡口或单面V型坡口型。全焊透的对接焊缝应该采用双面焊或加垫环焊。如果采用

垫环，则在焊后垫环应予除去，除非主管机关对很小的处理受压容器予以专门批准。采用其他的边缘坡口形式，根据主管机关对电焊认可试验结果亦可同意。

2. 受压容器立体和气室，以及气室及其相联附件之间的连接接头，其斜坡口应该按主管机关可接受的受压容器标准进行设计。连接容器的喷嘴、气室或其他贯通件以及所有连接法兰至容器或喷嘴的所有焊缝应在容器壁（或喷嘴壁）的全厚度范围内都是全焊透焊缝，对小直径喷嘴经主管机关专门批准除外。

4.10.2 工艺质量应使主管机关满意。除C型独立液舱外，液舱的焊缝的检查和无损探伤试验应该按6.3.7的要求进行。

4.10.3 对薄膜液舱、质量保证措施、焊接程序考核、设计细节、材料、构造、部件的检验和生产试验应符合在原型试验程序时制订的标准。

4.10.4 本节对独立液舱或薄膜液舱的有关要求亦适用于半薄膜液舱（如适合时）。

4.10.5.1 对内层绝热液舱，为了保证材料的均匀性，质量控制程序（包括环境控制、应用程序、角隅、贯通件及其他设计细节、材料技术规格、安装及部件的生产试验）均应符合进行原型试验时制订的标准。

4.10.5.2 质量控制技术规定（包括构造缺陷的最大许用尺度、制造和安装中的试验和检查以及每一阶段取样试验等）应该使主管机关满意。

4.10.6 整体液舱应做水压或空气压力试验，使主管机关满意。一般这种试验应尽实际可行使其应力接近设计应力，并使液舱顶的压力至少相当于MARVS。

4.10.7 装有薄膜液舱或半薄膜液舱的船舶，隔离舱和正常情况下装载液体并邻接于支持薄膜的船体结构的所有处所，应按承认的标准进行水压或空气压力试验。此外，支持薄膜的其他货舱结构应做密性试验。管隧和正常情况下装载液体的其他舱室不必做水压试验。

4.10.8.1 装有内层绝热液舱（其内层船体是支持结构）的船舶，所有内层船体结构在考虑了释放阀的最大值MARVS后，应按承认的标准进行水压或空气压力试验。

4.10.8.2 装有内部绝热液舱（其独立液舱是支持结构）的船舶，独立液舱应按4.10.10.1规定进行试验。

4.10.8.3 对于内层绝热液舱（其内层船体结构或某一独立液舱结构作次屏壁用），这些结构的密性试验应该采用使主管机关满意的工艺进行。

4.10.8.4 这些试验应在构成内层绝热舱的材料敷上以前进行。

4.10.9 对C型独立液舱，应进行如下检查和无损探伤试验：

- .1 制造和工艺质量——关于制造和工艺质量的公差，例如偏离实际形状的局部失圆度，焊接接头的对中以及不同厚度板的削斜，应符合主管机关承认的标准。这些公差还应与4.4.6.2所述的屈曲分析相关。
- .2 无损探伤试验——就焊接接头的无损探伤试验的完成和范围而言，无损探伤试验的范围应该是全部或部分按照主管机关可接受的标准，但所作的控制应不少于如下规定：

.2.1 按4.4.6.1.3规定进行全部无损探伤试验：

射线检查：

对接焊缝100%，及

表面裂纹检查：

所有焊缝10%；

开孔和喷嘴等的加强环100%。

如主管机关专门许可，可以接受采用部分超声波检查替代部分射线检查。此外，主管机关可要求对开孔和喷嘴周围的电焊或加强环等进行全部超声波检查。

.2.2 按4.4.6.1.3规定进行部分无损探伤试验：

射线检查：

对接焊缝：全部焊缝交叉接头，以及至少选取均匀分布焊缝全长的10%。

表面裂纹检查：

开孔和喷嘴等的加强环100%。

超声波检查：

主管机关可根据每一具体情况给予考虑。

4.10.10 对每个独立液舱应该进行下列水压或空气压力试验：

- .1 对A型独立液舱，这种试验应使其应力尽实际可行接近设计应力，并且在液舱顶的压力至少相当于MARVS。当进行空气压力试验时，其试验条件应尽实际可行模拟履舱及其支持构件的实际载荷条件。



- .2 对B型独立液舱,应按4.10.10.1对A型独立液舱要求那样进行试验。此外,试验条件下在主要构件中的最大第一类薄膜应力或最大弯曲应力,应不超过材料(制造状态)在试验温度下屈服强度的90%。为确保满足这个条件,当计算表明此应力超过材料屈服强度的75%时,其原型试验应采用应变仪或其他适当设备加以监视。
- .3 C型独立液舱应该进行下列试验:
  - .3.1 每一受压容器在制造完成以后,应该做水压力试验,试验时的压力应使在液舱顶面测得的压力不小于 $1.5P_0$ ,但在任何一点所算得的第一类薄膜应力应不超过材料屈服应力的90%。 $P_0$ 的定义见4.2.6。为了确保满足此条件,如计算表明这个应力会超过屈服强度的75%时,原型试验应在简单圆筒形和球形受压容器以外的受压容器中采用应变仪或其他适当设备加以监视。
  - .3.2 试验所采用的水温,应至少比制成材料的零韧性转变温度高出 $30^{\circ}\text{C}$ 。
  - .3.3 每25mm厚度,压力应保持2小时,任何情况下不得少于2小时。
  - .3.4 如货物受压容器需要,并经主管机关专门认可,可在4.10.10.1, .2和.3所述的条件下进行空气压力试验。
  - .3.5 主管机关根据工作温度,可对采用较高许用应力液舱的试验给予特别考虑。但是4.10.10.1的要求应该完全满足。
  - .3.6 完工和装配后,每一受压容器及其有关的附件应该进行适当的密性试验。
  - .3.7 液货舱以外的受压容器气压试验应由主管机关针对各种情况予以考虑。这些试验只有对以下这些容器才允许:这些容器如此设计(或支持)致使它们不能安全地注满水,或者这些容器不能干燥,并且在使用中不允许留下试验介质的痕迹。
- 4.10.11 所有液舱应进行密性试验,此试验可以和4.10.10所述的压力试验一起进行或单独进行。
- 4.10.12 关于次屏壁的检验要求应该由主管机关根据每一情况加以确定。
- 4.10.13 在装有B型独立液舱的船上,至少应测量一个液舱及其支持构件,以便确认其应力的程度,除非某种尺度船舶的设计和布置得到了实际规模试验的经验。对C型独立液舱,可以根据它们的形状及其支持构件和附件的布置,要求作类似的测量。

4.10.14 应验证货物围护系统的全部性能在初始冷却以及货物装卸时是否符合设计参数。用于验证设计参数的部件和设备的性能记录应予以保存，并可供主管机关使用。

4.10.15 如果按4.8.4规定装有加热装置，则应对其所需的热量输出或热量分配予以试验。

4.10.16 船体应在第一次满载航行时对冷点进行检查。

4.10.17 内层绝热液舱的绝热材料应作额外的检查，以验证它们在船舶第三次满载航行后的表面情况是否符合要求。但此类额外检查应在船舶建成后或内层绝热液舱经大修后船舶运行的头6个月内进行。

4.10.18 对C型独立液舱，作受压力容器标记所使用的方法应使不致于产生无法接受的局部应力。

#### 4.11 C型独立液舱的应力消除

4.11.1 对碳和碳锰钢制的C型独立液舱，如设计温度低于 $-10^{\circ}\text{C}$ 以下，应进行焊后热处理。其他各种情况的焊后热处理和不使用上述材料的焊后热处理应使主管机关满意。热处理的温度和保温时间应征得主管机关的同意。

4.11.2 碳钢或碳锰钢制的大型受压力容器进行热处理有困难时，在经主管机关批准并遵守下列条件的情况下，可以用充压机械法应力消除过程替代热处理。

- 1 焊接受压容器的复杂部件，例如带喷嘴的贮槽或气室连同其相邻的壳板，在被焊接到受压容器的较大部件以前，应进行热处理。
- 2 板厚应不超过主管机关可接受的标准所规定的值。
- 3 为了确定在机械法应力消除时的最大第一类薄膜应力而进行的详细分析，应表明此应力非常接近（但不超过）材料屈服应力的90%。主管机关为了验证计算结果，可以要求应力消除充压时作应变测量。
- 4 机械法应力消除程序，应预先提交主管机关审批。

#### 4.12 加速度分量的指导公式

下列公式作为计算加速度分量的指导，此加速度相应于在北大西洋上概率级为 $10^{-8}$ 的船舶运动，适用于超过50m长的船舶。

4.3.4.6所述的垂向加速度

$$a_z = \pm a_0 \sqrt{1 + (5.3 - \frac{45}{L_0})^2 (\frac{x}{L_0} + 0.05)^2 (\frac{0.6}{C_B})^{1.5}}$$

## 4.3.4.6 所述的横向加速度

$$a_y = \pm a_0 \sqrt{0.6 + 2.5 \left(\frac{x}{L_0} + 0.05\right)^2 + K(1 + 0.6 \frac{z}{B})^2}$$

## 4.3.4.6 所述的纵向加速度

$$a_x = \pm a_0 \sqrt{0.06 + A^2 - 0.25 A}$$

式中:

$$A = \left(0.7 - \frac{L_0}{1200} + \frac{z}{L_0}\right) \left(\frac{0.6}{C_B}\right)$$

而

$L_0$  = 承认的标准规定用来确定结构尺寸的船长(m)

$C_B$  = 方形系数

$B$  = 船舶最大型宽(m)

$x$  = 从船中到装货液舱重心之间的纵向距离(m); 船中以前的  $x$  为正值, 其后为负值

$z$  = 从船舶的实际水线到装货液舱重心之间的垂向距离(m); 水线以上为正值, 水线以下为负值。

$$a_0 = 0.2 \frac{V}{\sqrt{L_0}} + \frac{34 - \frac{600}{L_0}}{L_0} \quad \text{其中 } V \text{ 为服务航速 (节)}$$

$K$  = 一般为 1。对于特殊的装载情况和船型,  $K$  值可按下列公式确定:

$K = 13GM/B$ , 其中  $K \geq 1.0$  和  $GM$  = 静稳心高度(m)

$a_x, a_y$  和  $a_z$  为相应方向上的最大无因次加速度值 (即为相对于重力加速度的值), 为了便于计算, 可认为是分别作用的。  $a_z$  不包括重力分量,  $a_y$  包括因横摇在横方向上的重力引起的分量,  $a_x$  包括因纵摇在纵方向上的重力引起的分量。

## 4.13 应力分类

为了评定 4.5.1.4 所述的应力, 本节将应力进行分类如下:

- 4.13.1 正应力系指垂直于参考平面的应力分量。
- 4.13.2 薄膜应力系指正应力分量, 它在所考虑的截面厚度范围内均匀分布且等于平均值。
- 4.13.3 弯曲应力系指扣除薄膜应力后, 在所考虑的截面厚度范围内变化的应力。
- 4.13.4 剪切应力系指作用在参考平面内的应力分量。
- 4.13.5 第一类应力系指由外加载荷所产生的应力, 它是平衡外力和外力矩所需要的。第一类应力的基本特性为它不是自身限制的。明显超过屈服强度的第一类应力将导致破坏或至少严重变形。

4.13.6 第一类总体薄膜应力系指一种第一类薄膜应力，它在结构中的分配不会由于屈服而引起载荷再分配。

4.13.7 在由压力或其他机械载荷产生的而且与第一类应力或不连续效应有关的薄膜应力，把载荷传递到结构的其他部位过程中产生过度的扭曲时，出现第一类局部薄膜应力。这些应力即使具有某些第二类应力的特性，亦应归入第一类局部应力。如果满足下列条件，可以认为应力区域是局部的：

$$S_1 \leq 0.5 \sqrt{Rt} \quad \text{及} \\ S_2 \geq 2.5 \sqrt{Rt}$$

式中：

$S_1$  = 在子午线方向上相当应力超过  $1.1f$  的距离

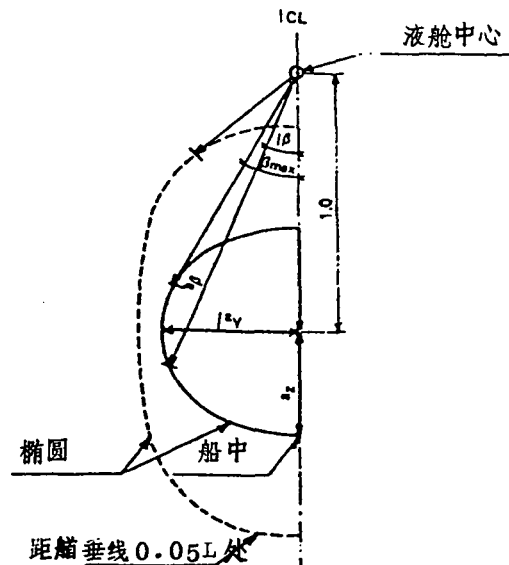
$S_2$  = 在子午线方向上到超过第一类总体薄膜应力极限的另一区域的距离

$R$  = 容器的平均半径

$t$  = 容器在第一类总体薄膜应力超过极限部位的壁厚

$f$  = 第一类总体薄膜的许用应力。

4.13.8 第二类应力是由邻近部分的结构或结构自身约束产生的正应力或剪应力。第二类应力的基本特性是，它是自身限制的。局部屈服或较小的扭曲能满足这类应力产生的条件。



$a_\beta$  = 在任意方向  $\beta$  上的合成加速度 ( 静的和动的 )

$a_y$  = 加速度的横向分量

$a_z$  = 加速度的垂向分量

图 4.1 - 加速度椭圆

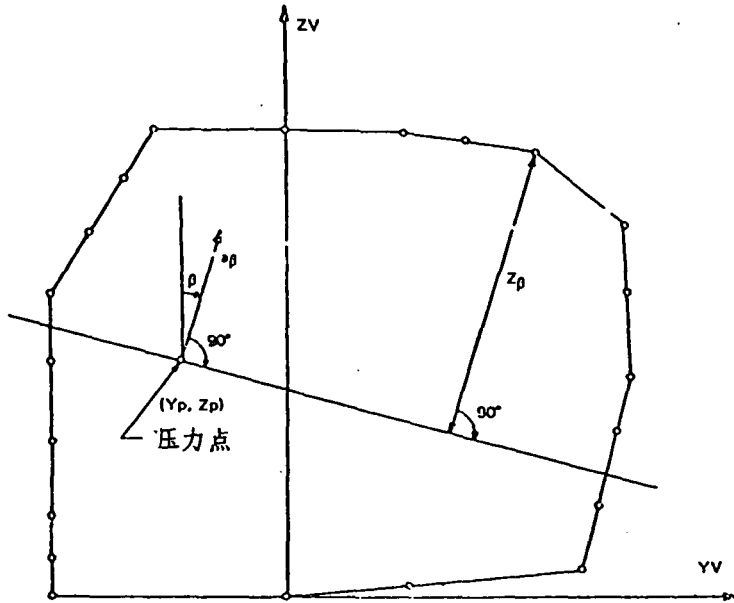
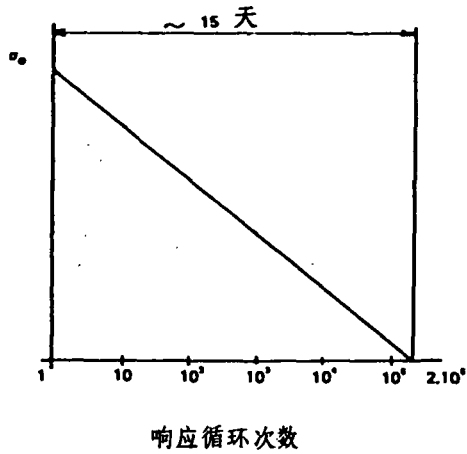


图 4.2- 内部压头的确定



$\sigma_0$  = 船舶使用寿命中可能出现的最大应力

响应循环次数比例尺以对数计； $2 \times 10^6$  值作为估算例子。

图 4.3- 简化的载荷分布

## 第5章 处理受压容器和液体、蒸气与处理压力管路系统

### 5.1 通则

5.1.1 主管机关在执行和应用本章的规定中应采取适当步骤确保一致性\*。

5.1.2 如主管机关要求,第4章对C型独立液舱的要求亦可适用于处理受压容器。第4章中使用的“受压容器”一词包括C型独立液舱和处理受压容器。

### 5.2 货物和处理管路

#### 5.2.1 通则

5.2.1.1 本节要求适用于包括蒸气管系及安全阀透气管或类似管路在内的货品和处理管系。不含货物的仪表管路可免除这些要求。

5.2.1.2 应采用支管、环形管、弯头、机械膨胀接头(例如波纹管、滑动接头和球状接头或类似的适当部件),以保护管路、管系部件和液货舱免受由于热膨胀引起的过大应力的影响和船体与液货舱移动的影响。如管路中采用机械膨胀接头,应尽量减少其使用数量;如管路位于液货舱外面,应采用波纹管型。

5.2.1.3 如需要时,低温管路应与其相邻的船体结构进行热隔离,以防船体的温度降低到船体材料的设计温度以下。如液体管路需经常拆卸或预计可能有液体泄漏(例如通岸接头和泵密封等),则应对其下方的船体部分提供保护措施。

5.2.1.4 如液舱或管路采用热绝缘和船体结构相隔离,则管路和液舱两者均采取电气接地措施。所有具有填料的管接头和软管接头应进行电气联结。

5.2.1.5 应配备适当装置以使在拆开货物软管前卸除压力,并在脱开货物软管之前把液货从货物的装、卸交叉联箱和货物软管放到液货舱或其他适当位置。

5.2.1.6 在充满液体条件下可以切断的所有管路或部件应装有释放阀。

5.2.1.7 从货物管系由释放阀排出的液货应回至液货舱内;或者,如设有能检测和处理可能流进透气系统中的任何液货设备,则也可回至透气桅。货泵上的释放阀的排出应回至泵的吸口。

#### 5.2.2 按内压力确定的尺寸

5.2.2.1 按5.2.4所述的条件,管壁厚度应不小于:

$$t = \frac{t_0 + b + c}{1 - \frac{a}{100}} \quad (\text{mm})$$

\* 应参考IACS会员社和联系会员社所发表的规则,特别应参考IACS的统一要求No G3。

式中:

$t_0$  = 理论计算厚度

$$t_0 = PD / (20Ke + P) \quad (\text{mm})$$

其中:

$P$  = 5.2.3 中所述的设计压力 (bar)

$D$  = 外径 (mm)

$K$  = 5.2.4 中所述的许用应力 ( $\text{N}/\text{mm}^2$ )

$e$  = 效率系数; 对无缝钢管, 以及由认可制造厂供应的纵向焊接或螺旋焊接的管子, 其焊缝按承认的标准经无损探伤检查认为等效于无缝钢管者, 则此系数为 1.0; 其他情况的效率系数, 根据制造方法可由主管机关确定。

$b$  = 弯曲减薄值 (mm)。  $b$  值应选取得能使在弯头中仅由内压力引起的计算应力不超过许用应力。 如未作过此种正确的计算, 则  $b$  值应为:

$$b = \frac{Dt_0}{2.5r} \quad (\text{mm})$$

式中:

$r$  = 平均弯曲半径 (mm)

$c$  = 腐蚀余量 (mm)。 如预计有腐蚀或侵蚀, 则管壁厚度应比其设计要求的值有所增加。 增加的量应和预计的管子寿命相一致。

$a$  = 厚度制造负公差 (%)。

### 5.2.3 预计压力

5.2.3.1 5.2.2.1 的  $t_0$  公式中, 其设计压力  $P$  是指此系统在营运中可能承受的最大压力。

5.2.3.2 对管子、管系和部件应适当地采用下列设计条件中的较大者:

- .1 对可能和释放阀隔离并可能含有某种液体的蒸气管系或零部件, 应为 45°C 时的饱和蒸气压, 如经主管机关同意可以取用较高或较低值 (见 4.2.6.2);
- .2 对可能和释放阀隔离并在任何时候只含有蒸气的管系或部件, 应为 45°C 时的过热蒸气压, 如经主管机关同意可以取用较高或较低值 (见 4.2.6.2), 但都假定系统中饱和蒸气的初始状态系处于该系统的工作压力和工作温度;

- .3 液货舱和货物处理系统释放阀最大许用设定值 MARVS;
- .4 相关泵或压缩机的释放阀开启压力;
- .5 货物管路系统在卸货或装货时的最大总压头;
- .6 管路系统上释放阀的开启压力。

5.2.3.3 设计压力应不小于 10 bar,但对有开口端的管路应小于 5 bar。

#### 5.2.4 许用应力

5.2.4.1 5.2.2.1 公式中需考虑的管子许用应力,应取下列应力的较低值:

$$\frac{R_m}{A} \text{ 或 } \frac{R_c}{B}$$

式中:

$R_m$  = 室温时,材料抗拉强度下限值 ( $N/mm^2$ )

$R_c$  = 室温时,材料屈服应力下限值 ( $N/mm^2$ )。如果应力应变曲线没有明显的屈服应力,则取用 0.2% 条件屈服应力。

A 和 B 值应在 1.5 规定的国际散装运输液化气体适装证书上予以注明, A 值至少为 2.7, B 值至少为 1.8。

5.2.4.2 最小壁厚应符合承认的标准。

5.2.4.3 如果机械强度有这种需要,以防止管子的损坏、破损、过度下垂或失稳,而且这些问题是由支持构件、船舶挠度或其他原因参与的累计载荷引起的,则此时的管壁厚度应比 5.2.2 所要求的值有所增加。如果这样做不现实或会引起过大的局部应力时,这些载荷应予减少,或用其他设计方法加以防止或消除。

5.2.4.4 法兰、阀件和其他附件,计及 5.2.2 所规定的设计压力,应为主管机关可接受的标准。用于蒸气管的波形膨胀接头,主管机关可以接受较低的设计压力。

5.2.4.5 对于不符合标准的法兰,法兰和螺栓的规格应使主管机关满意。

#### 5.2.5 应力分析

当设计温度为  $-110^\circ C$  或更低时,对于管系的每一支路,计及管子的重量〔包括加速度载荷(如大时)〕、内部压力、热收缩、船舶中拱中垂引起的载荷等所产生的所有应力,应向主管机关提交一份完整的应力分析。当温度高于  $-110^\circ C$  时,主管机关可要求的应力分析内容为诸如管系的设计或刚度、及材料选择等。在任何情况下,即使没有提交计算书,但热应力都应予以考虑。这些分析可按主管机关可接受的实施规则进行。



## 5.2.6 材料

5.2.6.1 管路系统中所用材料的选择和试验, 计及最低的设计温度后, 应符合第6章的要求。但是开口端透气管的材料质量可允许有所放宽, 条件为压力释放阀设定值时的货物温度为 $-55^{\circ}\text{C}$ 或高于 $-55^{\circ}\text{C}$ , 以及不会出现液货排至透气管。在同样温度下, 对液货舱内的开口端管路(薄膜舱和半薄膜舱内的排出管和所有管路除外), 可允许有类似的放宽。

5.2.6.2 熔点在 $925^{\circ}\text{C}$ 以下的材料不应用于液货舱外的管子, 但与液货舱连接的短管除外, 此时应设置防火绝缘。

## 5.3 管路部件的型式试验

5.3.1 每一类管路部件应进行型式试验。

5.3.2.1 拟使用于工作温度 $-55^{\circ}\text{C}$ 以下的各种尺寸和类型的阀件, 应在最低设计温度(或更低)和不低于阀件设计压力下进行密性试验。试验期间应确认阀件的良好操作性能。

5.3.2.2 对拟用在液货舱外货物管路上的每种波纹膨胀接头, 如需要时, 对拟设置在液货舱内的波纹膨胀接头, 应进行下列型式试验:

- .1 不处于压缩状态下的波纹接头类型单件, 应经受不小于五倍设计压力的压力试验而不破坏。试验时间不少于五分钟。
- .2 带有所有附件(例如法兰、牵条、关节件等)的型式膨胀接头应在制造厂推荐的最大位移条件下经受两倍设计压力的压力试验而不产生永久变形。主管机关根据所采用的材料, 可要求在最低设计温度下进行这种试验。
- .3 对完整的膨胀接头应进行循环试验(热运动), 它在压力、温度、轴向运动、旋转运动和横向运动的条件下应能满意地承受至少和在实际营运中遇到的一样多的循环次数。当该试验与营运温度下的试验(至少)一样严重时, 在允许的环境温度下进行试验。
- .4 对完整的膨胀管接头应在无内压力下进行循环疲劳试验(船舶变形), 通过模拟相当于在一段补偿管段中的波纹接头运动予以完成, 要求在不高于5周/秒的频率下其交变次数至少为 $2 \times 10^6$ 次。这一试验只有当由于管路布置实际上会经受船舶变形载荷时才要求进行。
- .5 如能提供完整的文件并确认膨胀接头能适应承受预计的工作条件, 则主管机关可以免除进行本款所述的试验。当最大的内部表压力

超过1.0bar时,此类文件应包括足够的试验资料以证明所用设计方法的合理性,特别应参考设计方案和试验结果之间的相互关系。

#### 5.4 管路制造和接合细节

5.4.1 本节要求适合于液货舱内、外的管子。然而主管机关可接受放松对液货舱内的管路和开口端管路的要求。

5.4.2 可考虑采用下列管段直接连接(不用法兰):

- .1 根部完全焊透的对接焊接头在各种情况下均可以采用。当设计温度低于 $-10^{\circ}\text{C}$ 时,对接焊应为双面焊或等效于双面焊的对接接头。这可采用在第一道焊道上加垫环、焊接材料嵌补或惰性气体封底等办法来达到。当设计压力超过10bar及设计温度为 $-10^{\circ}\text{C}$ 或 $-10^{\circ}\text{C}$ 以下时,垫环应除去。
- .2 套装式焊接接头及其焊接(具有使主管机关满意的尺寸)只能用在外径为小于或等于50mm和设计温度不低于 $-55^{\circ}\text{C}$ 有开口端的管路上。
- .3 主管机关能接受的螺纹联接只能用在外径为小于或等于25mm的辅助管路或仪表管路。

5.4.3.1 法兰接头中的法兰应为整体、套装焊接或插入焊接法兰。

5.4.3.2 法兰的型式、制造和试验应符合主管机关能接受的标准。除开口端的管路外,所有管路应特别遵守下列限制:

- .1 设计温度低于 $-55^{\circ}\text{C}$ ,只能采用整体法兰。
- .2 设计温度低于 $-10^{\circ}\text{C}$ ,公称尺寸超过100mm的管路不应采用套装焊接法兰;公称尺寸超过50mm的管路不应采用插入焊接法兰。

5.4.4 上述5.4.2和.3以外的管路连接,主管机关可针对每一具体情况接受何种型式的管路接头。

5.4.5 应设置波纹接头和膨胀接头以允许管路膨胀:

- .1 如果需要,波纹接头应防止冰冻。
- .2 除位于液货舱内者外,不应采用套装接头。

5.4.6 焊接、焊后热处理和无损探伤试验:

- .1 焊接应按6.3要求进行。
- .2 对碳钢、碳锰钢和低合金钢管子的所有对接焊缝,要求进行热处理。主管机关对壁厚小于10mm的管子,根据有关管系的设计温度和压力可免除消除热应力的要求。

- .3 除在焊接前和焊接期间进行正常控制以及对完工焊缝进行目视检查以外,为了证明焊接已按本段的要求正确进行,必须要求进行下列试验:
  - .3.1 对工作温度低于 $-10^{\circ}\text{C}$ 及内径大于75mm或壁厚大于10mm的管系,对焊接接头要求进行100%的射线检查。
  - .3.2 对于其他管子的对接焊接头,主管机关根据其用途、位置和材料,决定是否应进行局部射线检查或其他无损探伤检查。一般至少应有10%的管子对接焊的接头进行射线检查。

### 5.5 管路试验

5.5.1 本节要求适用于液货舱内、外的管路。但主管机关对液货舱内的管路和开口端管路可接受放宽这些要求。

5.5.2 所有货物及处理管路装配后,应进行至少1.5倍设计压力的水压试验。当管系或管系的部件完全制造完毕并已装配了所有附件后,水压试验可在装船之前进行。在船上焊接的接头应进行至少为1.5倍设计压力的水压试验。如果管路中不允许有水并且管路系统在投入使用之前不能进行干燥,采用其他试验流体或试验方法的建议应提交主管机关审批。

5.5.3 每一货物管路和处理管路系统在船上组装以后,应使用空气、卤化物或其他适当的介质进行密性试验,其压力取决于所采用的泄漏检测方式。

5.5.4 所有管路系统(包括阀、附件及操作货物或蒸气用的设备)应在不晚于第一次装货作业的正常工作状态下进行试验。

### 5.6 货物系统阀件要求

5.6.1 每一货物管路系统和液货舱应设置如下阀件(如适用时):

- .1 MARVS不超过0.7bar(表压)的液货舱,除安全阀和液面测量装置以外的所有液体和蒸气连接接头,应设有截止阀,其位置尽可能接近液货舱。这些阀可以远距离控制,但应能就地手工操作并完全围蔽。在船上应设有一个或多个应急的遥控截止阀,用来截止船和岸之间的液货和蒸气货物的输送。这些阀可根据船舶设计要求进行布置,可以是5.6.3所要求的同一阀件,且应满足5.6.4的要求。
- .2 MARVS超过0.7bar(表压)的液货舱,除安全阀和液面测量装置以外的所有液体和蒸气连接接头,应设置一手工操作的截止阀和

一遥控的应急截止阀。这些阀应尽可能靠近液舱。如管径不超过50mm,释流阀可用来代替应急的截止阀。假如此阀符合5.6.4的要求,并能就地手工操作和对管路提供完全围蔽,那么可单独采用一个阀代替两个分离阀。

- .3 如果5.6.1.1和.2要求的应急截止阀是由5.6.4要求的应急截止系统关闭,则货泵和压缩机应能实现自动关闭。

5.6.2 供仪器或测量装置用的液货舱连接接头不必设置释流阀或应急截止阀,但这些装置的结构应能使液舱内货物外流不超过1.5mm直径圆孔所通过的流量。

5.6.3 在使用中的每一货物软管连接接头处,应设置一个遥控的应急截止阀。在输送作业中不使用的连接接头可用盲板法兰代替阀。

5.6.4 所有要求应急截止阀的控制系统应布置得使其所有这些阀件可以位于至少两个远离的地方用简单的控制进行操作,其中的一个位置应是13.1.3所要求的控制位置或货物控制室。控制系统也应设有能在98°C和104°C之间熔化的易熔元件,可以在失火中使应急关闭阀关闭。这些易熔元件的位置应包括液舱气室和装货站。应急截止阀应为动力故障关闭型,以及能就地进行手动关闭。液货管路中的应急截止阀,在所有的作业条件下,应能在30秒钟的动作时间内完全关闭,关于这些阀关闭的时间及其操作特性资料,应保存在船上,关闭时间应可核实,并能重现。这些阀的关闭应是平稳的。

5.6.5 释流阀应在制造厂规定的蒸气或液体的关闭额定流量下能实现自动关闭。包括附件、阀和由释流阀保护的辅助设备在内的管路应具有比释流阀的额定关闭流量较大的容量。释流阀可以设计成具有不超过1.0mm直径圆孔面积的旁通,以便使截止阀关闭后的压力平衡。

## 5.7 船舶的货物软管

5.7.1 用于输送货物的液体软管和蒸气软管应与货物具有一致性,且与其货物温度相适应。

5.7.2 承受液舱压力或泵或蒸气压缩机排出压力的软管应按爆破压力设计,此压力应不小于软管在输送货物时所承受最大压力的5倍。

5.7.3 配有端部附件的每一新型软管,应在不小于5倍规定的最大工作压力下进行原型试验,原型试验时的软管温度应是拟定的极限工作温度。供原型试验用的软管不应再用作货物运输。每一段新制成的软管,在使用前,应在环境温度下进行水压试验,其试验压力值不低于规定工作压力的1.5倍,也不大于爆破压力的

五分之二。软管上应用模板喷刷或其他方法标记出规定的最大工作压力，如果不是在环境温度工作条件下使用，则还应标记出它的最大或最小工作温度或两者都标出。规定的最大工作压力应不小于10bar（表压）。

### 5.8 货物输送方法

5.8.1 如果货物是靠货泵输送的，而货泵在液舱处于营运时不能接近进行修理，则至少应设置两个独立的设施把货物从每一液舱输出，此种设计应能在一台货泵或一种输送设施发生故障时不至于妨碍其他货泵或另一输送设施的使用。

5.8.2 靠气体增压输送货物的过程，应消除在这种输送过程中释放阀的开启。气体增压可以作为一种输送货物的设施，但液货舱的安全系数在货物输送作业的条件下不会减少。

### 5.9 蒸气回路连接器

应设置蒸气回路管子至岸上装置相连接的接头。

## 第6章 结构材料

### 6.1 通则

6.1.1 主管机关应采取适当的步骤以保证执行和实施本章规定\*的一致性。

6.1.2 本章规定适用于建造液货舱、货物处理受压容器、为货物装卸和货物处理管系、次屏壁及与物品运输有关的相邻船体结构所用的板材、型材、管材、锻件、铸件和焊接件。对于轧制材料、锻件和铸件的要求，见6.2和表6.1至6.5的规定。对于焊接件要求，见6.3的规定。

6.1.3 有关的制造、试验、检验以及文件应符合承认的标准的规定和本规则规定的要求。

6.1.4.1 除主管机关另有规定外，验收试验应包括V型缺口韧性试验。V型缺口所规定的要求系为三个全尺寸（10mm×10mm）试样的最小平均冲击值和单个试样的最小单一冲击值。V型缺口的尺寸和误差应根据承认的标准。对小于

\* 应参考国际船级社协会（IACS）会员社及联系会员社所发表的规范，特别是IACS的统一要求 No. W1。

5.0 mm 尺寸试样的试验和要求应根据公认的标准。小尺寸试样的最小平均值规定如下:

V 型缺口试 样尺寸	3 个试样的 最小平均冲击值
10 × 10 mm	E
10 × 7.5 mm	<del>5</del> E
10 × 5.0 mm	<del>2.5</del> E

式中: E = 表 6.1 至 6.4 所规定的冲击值 ( J )。

3 个试样中允许有 1 个试样的值小于规定的平均值, 但不得小于规定平均值的 70 %。

6.1.4.2 在所有情况下, 材料厚度所许可的最大尺寸的却贝试样应截取得使其试样尽可能位于表面和厚度中心之间的中点处, 并使缺口长度方向垂直于表面 (见图 6.1)。当一组 3 个 V 型缺口试样的平均值达不到规定的要求, 或者不止一个试样的值低于所要求的平均值, 或者当一个试样的值低于单个所许可的最低值时, 则可从原先取样的材料上再取 3 个试样进行附加试验, 同时将所得结果与以往求出的结果组成一个新的平均值。如果这个新的平均值符合要求, 而且个别结果低于所要求的值不超过两个以及单个试样的结果低于所要求的值不超过一个, 则此件或这批材料可以接受。其他型式的韧性试验, 诸如落锤试验可由主管机关自行决定, 此次试验可作为附加试验或替代 V 型缺口试验。

6.1.5 抗拉强度、屈服应力和延伸率应达到主管机关满意的程度。对于具有有限屈服点的碳锰钢和其他材料, 应考虑限制屈服与拉伸之间的比例。

6.1.6 作为材料验收, 试验弯曲试验可不作, 但对焊接试验则要求作弯曲试验。

6.1.7 具有供选择化学成分或机械性能的材料可由主管机关认可。

6.1.8 如规定或要求作焊后热处理, 母材性能应在热处理情况下按照本章适用的表列内容进行确定, 而且焊缝性能应在热处理情况下按照 6.3 的规定确定。如果采用焊后热处理, 试验要求可由主管机关酌情修改。

6.1.9 如本章参照 A, B, D, E, AH, DH 和 EH 船体结构用各种钢级, 这些钢级应根据承认的标准为船体结构用的各种钢级。

## 6.2 材料要求

结构材料的要求见下表:

表 6.1: 用于设计温度不低于 0 °C 的液货舱和处理受压力容器所用的板材、管材 (无缝和焊接)、型材和锻件。

表 6.2: 用于设计温度低于 0℃ 至 -55℃ 的液货舱、次屏壁和处理受压力容器所用的板材、型材和锻件。

表 6.3: 用于设计温度低于 -55℃ 至 -165℃ 的液货舱、次屏壁和处理受压力容器所用的板材、型材和锻件。

表 6.4: 用于设计温度低于 0℃ 至 -165℃ 的液货舱和处理管系所用的管材 (无缝和焊接)、锻件和铸件。

表 6.5: 4.9.1 和 4.9.4 所要求的船体结构用板材和型材。

表 6.1

用于设计温度不低于 0℃ 的液货舱和处理受压力容器所用的板材、管材 (无缝和焊接) 1/ 型材和锻件	
<u>化学成分和热处理</u>	
碳锰钢, 全镇静。	
厚度超过 20mm 的细精粒钢	
经主管机关同意增加少量的合金元素	
应经主管机关认可的化学成分限度	
正火或淬火和回火 2/	
<u>抗拉和韧性 (冲击) 试验的要求</u>	
<u>板材</u>	按件试验
<u>型材和锻材</u>	按批试验
<u>拉伸性能</u>	屈服应力下限值不超过 410 N/mm <sup>2</sup> 3/
<u>V - 缺口试验</u>	
<u>板材</u>	横向试样。最小平均冲击功(E) 41 J
<u>型材和锻材</u>	纵向试样。最大平均冲击功(E) 41 J
<u>试验温度</u>	厚度 t ( mm )      试验温度(°C)
	t ≤ 20                      0
	20 < t ≤ 40                -20

注:

1/ 对于无缝管和附件应当采用正常的施工做法。使用纵向和螺旋焊接管应经主管机关的特别认可。

2/ 可以采用控制轧制程序替代正火或淬火和回火, 但须经主管机关的特别认可。

3/ 对屈服应力下限值超过 410 N/mm<sup>2</sup> 的材料, 可提请主管机关予以特别认可。对于这些材料的焊缝硬度和热影响区域, 应予以特别注意。

表 6.2

用于设计温度低于 0℃ 至 -55℃ 的液货舱、次屏壁和处理受压力容器所用的板材、型材和锻件 <sup>1/</sup>					
最大厚度为 25 mm <sup>2/</sup>					
<u>化学成分和热处理</u>					
<u>碳锰钢</u> , 全镇静。 铝处理细晶粒钢					
化学成分 (炉前分析)					
C	Mn	Si	S	P	
0.16%max. <sup>[3]</sup>	0.70-1.60%	0.10-0.50%	0.035%max.	0.035%max.	
选择性添加料: 合金和晶粒细化元素一般应按照下列要求:					
Ni	Cr	Mo	Cu	Nb	V
0.80%max.	0.25%max.	0.08%max.	0.35%max.	0.05%max.	0.10%max.
正火或淬火和回火 <sup>4/</sup>					
<u>抗拉和韧性 (冲击) 试验要求</u>					
<u>板材</u>	按件试验				
<u>型材</u>	按批试验				
<u>V 型缺口试验</u>	试验温度比设计温度低 5℃, 或为 -20℃, 取其小者。				
<u>板材</u>	横向试样。 最小平均冲击功 <sup>(5)</sup> 27 J				
<u>型材和锻件<sup>1/</sup></u>	纵向试样。 最小平均冲击功 <sup>(5)</sup> 41 J				

注:

- <sup>1/</sup> 对锻件的 V 型缺口和化学要求可由主管机关予以特殊考虑。  
<sup>2/</sup> 对材料厚度超过 25mm 者, V 型缺口试验应按下列要求进行:

材料厚度 (mm)	试验温度 (℃)
25 < t ≤ 30	比设计温度低 10°, 或为 -20°, 取其小者
30 < t ≤ 35	比设计温度低 15°, 或为 -20°, 取其小者
35 < t ≤ 40	比设计温度低 20°

冲击功应按照表内所列试样的适用型式。 对材料厚度超过 40mm 者, V 型缺口值应予以特殊考虑。

用于液舱和液舱部件的材料, 如焊接后经热应力完全消除处理者可在比设计温度低 5℃ 或在 -20℃ (取其小者) 时进行试验。



对经热应力消除处理的加强构件和其他附件，其试验温度应与邻近液舱的壳体厚度所要求的温度相同。

- 3/ 经主管机关特别同意，碳含量最大可增加至0.18%，但设计温度不得低于-40℃。
- 4/ 可以采用控制轧制程序替代正火或淬火和回火，但须经主管机关特别认可。

**指南：**

对厚度超过25mm的材料，试验温度为-60℃或以下者，可能有必要采用表6.3所列的钢材或经特殊处理的钢材。

表 6.3

用于设计温度低于-55℃至-165℃ <sup>2/</sup> 的液货舱、次屏壁和处理受压容器所用的板材、型材和锻件 <sup>1/</sup> 最大厚度为25mm <sup>3/</sup>		
最小设计温度(℃)	化学成分 <sup>4/</sup> 和热处理	冲击试验温度(℃)
- 60	1.5%镍钢-正火	- 65
- 65	2.25%镍钢-正火或正火和回火 <sup>5/</sup>	- 70
- 90	3.5%镍钢-正火或正火和回火 <sup>5/</sup>	- 95
- 105	5%镍钢-正火或正火和回火 <sup>5/ 6/</sup>	- 110
- 165	9%镍钢-二次正火和回火或淬火和回火	- 196
- 165	奥氏体不锈钢，诸如型号304, 304L, 316, 316L, 321和347等经溶态处理 <sup>7/</sup>	- 196
- 165	铝合金，诸如型号5083经退火	无要求
- 165	奥氏体铁-镍合金(36%镍)按同意的热处理	无要求

抗拉和韧性 (冲击) 试验的要求:

板材                      按件试验

型材和锻件              按批试验

V型缺口试验

板材                      横向试样。最小平均冲击功(E) 27 J

型材和锻件              纵向试样。最小平均冲击功(E) 41 J

注:

- 1/ 对应用至极限范围的锻件所要求的冲击试验, 须经主管机关特别考虑。
- 2/ 对设计温度低于  $-165^{\circ}\text{C}$  的要求应经主管机关特别同意。
- 3/ 对 1.5% Ni, 2.25% Ni, 3.5% Ni 和 5% Ni 的材料, 如厚度超过 25 mm, 冲击试验应按下列要求进行:

材料厚度 ( mm )	试验温度( $^{\circ}\text{C}$ )
$25 < t \leq 30$	比设计温度低 $10^{\circ}$
$30 < t \leq 35$	比设计温度低 $15^{\circ}$
$35 < t \leq 40$	比设计温度低 $20^{\circ}$

任何情况下试验温度均不可超过上述表列的数值。

冲击功应按照表内所列试样的适用型式。 对材料厚度超过 40 mm, 试样冲击功应予以特殊考虑。

对 9% 镍、奥氏体不锈钢和铝合金, 用厚度超过 25 mm 的材料, 可按主管机关的指示办理。

- 4/ 化学成分极限范围应经主管机关认可。
- 5/ 经淬火和回火的钢材如取用较低的最小设计温度可经主管机关特别同意。
- 6/ 经主管机关特别同意, 特别热处理过的 5% 镍钢, 诸如经三次热处理的 5% 镍钢可用在  $-165^{\circ}\text{C}$  的温度条件, 但应在  $-196^{\circ}\text{C}$  下进行冲击试验。
- 7/ 经主管机关同意, 可以免做冲击试验。

表 6.4

用于设计温度低于 0 °C 至 -165 °C <sup>3/</sup> 的液货舱和处理管系所用的管材 (无缝和焊接) <sup>1/</sup> 、锻件 <sup>2/</sup> 和铸件 <sup>2/</sup> 最大厚度为 25 mm			
最小设计温度 (°C)	化学成分 <sup>5/</sup> 和热处理	冲击试验	
		试验温度 (°C)	最小平均冲击功 (MJ)
- 55	碳锰钢, 全镇静细晶粒, 正火或按同意的方 <sup>6/</sup>	4	27
- 65	2.25% 镍钢, 正火或正火和回火 <sup>6/</sup>	-70	34
- 90	3.5% 镍钢, 正火或正火和回火 <sup>6/</sup>	-95	34
- 165	9% 镍钢 <sup>7/</sup> , 二次正火和回火或淬火和回火	-196	41
	奥氏体不锈钢, 诸如型号 304, 304L, 316, 316L, 321 和 347, 经溶态处理 <sup>8/</sup>	-196	41
	铝合金, 诸如 5083 型, 退火		无要求
抗拉和韧性 (冲击) 试验要求 按批试验 冲击试验——纵向试样			

## 注:

- 1/ 如使用纵向或螺旋焊接的管子, 则应经主管机关特别认可。
- 2/ 对于锻件和铸件的要求可经主管机关的特别考虑。
- 3/ 对设计温度低于 -165 °C 的要求应经主管机关特别同意。
- 4/ 试验温度应比设计温度低 5 °C 或为 -20°C, 取其小者。
- 5/ 化学成分的范围应经主管机关认可。
- 6/ 对淬火和回火的材料可提请主管机关特别同意采用较低的设计温度。
- 7/ 化学成分不适用于铸件。
- 8/ 经主管机关同意, 冲击试验可予免做。

表 6.5

4.9.1 和 4.9.4 所要求的船体结构用板材和型材							
船体结构最低 设计温度 (°C)	根据 6.1.9 规定的各种钢级的最大厚度 (mm)						
	A	B	D	E	AH	DH	EH
0 及以上 <sup>1/</sup> - 5 及以上 <sup>2/</sup>	常例做法						
至 - 5	15	25	30	50	25	45	50
至 - 10	×	20	25	50	20	40	50
至 - 20	×	×	20	50	×	30	50
至 - 30	×	×	×	40	×	20	40
低于 - 30	按表 6.2 规定 但表 6.2 内及该表脚注 <sup>3/</sup> 中所指的 厚度范围不适用						

注:

“×”系指不使用的钢级。

<sup>1/</sup> 系指 4.9.4 范围内适用。

<sup>2/</sup> 系指 4.9.1 范围内适用。

6.3 焊接和无损探伤检查6.3.1 通则

本节要求一般适用于碳、碳锰钢、镍合金和不锈钢，向时作为验收其他材料试验的基础。主管机关可自行决定对不锈钢和铝合金焊接件免做冲击试验以及其他任何材料可特别要求加做其他试验。

6.3.2 焊接材料

除经主管机关另行同意外，对拟用作焊接液货舱的焊接材料应根据承认的标准规定。所有焊接材料应要求作溶敷金属试验和对接焊缝试验，主管机关另行同意者除外。抗拉和 V 型缺口冲击试验所得的结果应符合承认的标准规定。溶敷金属的化学成分应作记录供查验和认可。

6.3.3 液货舱和处理受压容器的焊接程序试验

6.3.3.1 对所有液货舱和处理受压容器的对接焊缝，要求作焊接程序试验，而且其试件应代表：

每种母材

每种焊接材料和每种焊接方法  
每种焊接位置。

对板材的对接焊缝，其试件应截取得使轧制方向平行于焊接方向。每一种焊接程序试验所认可的材料厚度范围应按照承认的标准规定。射线或超声波探伤检查可由制造厂或主管机关选择决定。拟作填角焊用的焊接材料的焊接程序试验应按照承认的标准。在这种情况下，应选择具有满意冲击性能的焊接材料。

6.3.3.2 对液货舱和处理受压容器所作的下列焊接程序试验应在每一试件上进行：

- .1 十字焊接拉伸试验。
- .2 横向弯曲试验由主管机关自行选择，可为正弯、反弯或侧弯。如果母材和焊接金属具有不同的强度级，则纵向弯曲试验可替代横向弯曲试验。
- .3 一组3个V型缺口冲击试样，一般在下列位置上截取，如图6.1所示：

焊缝的中心线  
熔合线 ( F.L. )  
距熔合线 1 mm  
距熔合线 3 mm  
距熔合线 5 mm

- .4 主管机关可要求作宏观断面、微观断面和硬度测定检验。

#### 6.3.4 试验要求

6.3.4.1 拉伸试验：一般来说，抗拉强度不应低于相应母材规定的最小抗拉强度。如果焊缝金属的抗拉强度低于母材金属的抗拉强度，则主管机关可要求横向焊缝抗拉强度应不低于对焊缝金属所规定的最小抗拉强度。在每一情况下，裂缝位置应作出报告备查。

6.3.4.2 弯曲试验：除主管机关另有特殊要求或另经许可者外，弯心直径为4倍试样厚度的180°弯曲试验时不得断裂。

6.3.4.3 V型缺口冲击试验：却贝试验应在对被连接母材所规定的温度下进行。焊接金属冲击试验结果应表明最小平均冲击功(E)不得低于27 J。小尺寸试样的焊缝金属要求和单个冲击功应根据6.1.4规定。熔合线和热影响区冲击试验的结果应表明最小平均冲击功符合母材的横向或纵向要求（视何者适合而定），而且对

小尺寸试样，最小平均冲击功应按照 6.1.4 规定。如果材料的厚度不可能截取大尺寸试样或是标准小尺寸试样，则其试验程序和验收标准应根据认可标准的规定。

#### 6.3.5 管路的焊接程序试验

对管路应进行焊接程序试验。试验的具体要求应与 6.3.3 对液货舱规定的要求相类似。除非主管机关另行同意，试验要求应根据 6.3.4 的规定。

#### 6.3.6 成品焊接试验

6.3.6.1 除整体液舱和薄膜液舱外的所有液货舱和处理受压容器，一般应对每 50 M 的对接焊缝接头进行成品焊接试验并应代表每一焊接位置。对次屏壁应进行如主屏壁所要求的同样型式的成品焊接试验。但经主管机关许可，试验数量可以减少。除 6.3.6.2, .3 和 .4 所规定的试验以外，对液货舱或次屏壁的其他试验可由主管机关自行决定。

6.3.6.2 对 A 型和 B 型独立液舱和半薄膜液舱的成品试验应包括下列试验：

- .1 弯曲试验，如要求作程序试验，每 50 M 焊缝应作一组 3 个 V 型缺口试验。V 型缺口试验应使缺口交替位于焊缝中心和热影响区(根据程序试验考核的结果选定最关键的位置)。对于奥氏体不锈钢，所有缺口应位于焊缝中心处。
- .2 试验要求与 6.3.4 所适用的试验要求相同，但如冲击试验不符合冲击功的要求，经主管机关特别考虑，通过落锤试验，仍能予以验收。在此情况下，对每套不合格的却贝试件，应选两个试样作落锤试验。这两个试样应处在与却贝试验同样的温度下进行落锤试验得出“不破断”特性。

6.3.6.3 对 C 型独立液舱和处理受压容器，除 6.3.6.1 规定的那些试验外，尚要求作横向焊缝拉伸试验。各种试验要求见 6.3.4，但对未达到规定冲击功要求的冲击试验只要经主管机关特殊考虑，通过落锤试验仍可予以接受。在这种情况下，对每套不合格的却贝试件，应取两个试样作落锤试验，并应处在却贝试验同样的温度下进行试验得出“不断裂”的特性。

6.3.6.4 整体液舱和薄膜液舱的成品试验应根据承认的标准规定。

#### 6.3.7 无损探伤检查

6.3.7.1 对 A 型独立液舱和半薄膜液舱如设计温度为  $-20^{\circ}\text{C}$  或以下时，以及对 B 型独立液舱不论温度如何，其液货舱壳板的所有全焊透对接焊缝应作 100% 射线检查。

6.3.7.1.1 如设计温度高于  $-20^{\circ}\text{C}$ ，在交叉点处的所有全焊透对接焊缝和至少 10% 的其余液舱结构的全焊透焊缝应作射线检查。

6.3.7.1.2 在每一情况下，如经主管机关考虑有必要时，其余的液舱结构焊缝，包括扶强材以及其他配件和连接件的焊缝应采用磁粉或着色进行检查。

6.3.7.1.3 所有特别焊缝检查程序和验收标准应根据承认的标准规定。主管机关可接受经认可的超声波检查程序替代射线检查，但也可要求选择一定的位置用射线透视作补充检查。此外，主管机关除可要求采用正常射线检查外，还可要求采用超声波探伤检查。

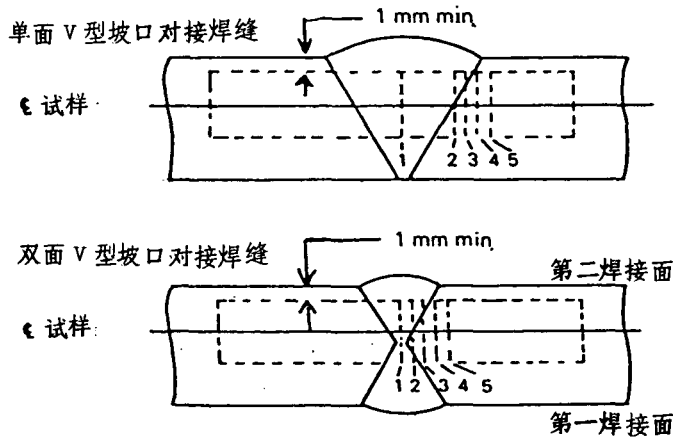
6.3.7.2 C型独立液舱和处理受压容器的检查应按4.10.9的规定进行。

6.3.7.3 对整体和薄膜液，特殊焊缝检查程序和验收标准应根据承认的标准规定。

6.3.7.4 内层壳体或支撑内部绝热液舱的独立液舱结构的检查和无损探伤检查应考虑计及4.4.7规定的设计准则。检查和无损探伤检查的计划应使主管机关的满意。

6.3.7.5 管路的检查应按照第5章的规定。

6.3.7.6 如主管机关认为有必要，主屏壁应作射线检查。如船体的外壳作为次屏壁的一部分，所有舷侧顶外板的对接缝和舷侧外板上的所有对接缝的交叉点应作射线检查。



缺口位置：

1. 位于焊缝中心
2. 位于熔合线上
3. 在 HAZ 位置，距熔合线 1 mm
4. 在 HAZ 位置，距熔合线 3 mm
5. 在 HAZ 位置，距熔合线 5 mm

HAZ = 热影响区

材料厚度所许可的最大尺寸的却贝试样应截取得使试件的中心位置尽可能接近材料厚度表面和中心之间的中点处。 在所有情况下, 从材料的表面至试样边的距离应为 1 mm 或以上。 此外对双面 V 形坡口对接焊缝, 试样尚应在接近于第二个焊接面处截取。

图 6.1——焊接试样的定向

## 第 7 章 货物压力/温度控制

### 7.1 通则

7.1.1 除非全部货舱系统设计成能在环境设计温度上限条件下承受货物的最大蒸气表压力, 否则应设有下列一种或一种以上的系统以保持货舱压力低于释放阀设定的最大许用值 MARVS (以下同)。 但本节另有规定者除外:

- .1 用机械制冷方式调节液货舱内压力的系统;
- .2 遵照第 1 6 章将蒸发气体作为燃料供船上使用或供废热系统使用的系统。 此系统在任何时间都可使用, 包括船舶在港或在航行期间, 但要设置一种处理过剩能量的装置, 诸如蒸气排泄系统, 并应征得主管机关的同意;
- .3 使物品加温和增大压力的系统, 绝热层或液货舱设计压力或两者均应足以在所涉及的操作时间和温度提供适当的余量。 在每一情况下, 此系统应为主管机关可以接受;
- .4 主管机关可接受的其他系统;
- .5 除上述系统以外, 主管机关可允许船舶在海上航行时某些货物通过排放其蒸气至大气压来予以控制。 经港口当局同意, 泊港时也可用此方法。

7.1.2 7.1.1 所要求的系统, 其结构、安装和试验应使主管机关满意。 结构的材料应适合所承运的货物。 对正常营运的船舶, 环境温度的上限应为:

海水 32 °C

空气 45 °C

对营运于特别热或冷的航区的船舶, 主管机关应对这些设计温度作适当增减。

7.1.3 对第 1 7 章规定的某些很危险性的货物, 不论是否设有处理蒸发气体的系统, 货物围护系统应于环境设计温度上限范围内能承受货物的最大蒸气压力。



## 7.2 制冷系统

7.2.1 制冷系统应包括一台或多台在环境设计温度上限的范围内能保持所要求的货物压力/温度的机组。除非设有另一种能控制货物压力/温度的设施能使主管机关满意,否则应设有至少能提供相等于所要的最大单个机组容量的一台(或几台)备用机组。备用机组应包括带有驱动电动机的压缩机、控制系统以及任何必需的附件等,以便能独立于正常工作机组运行。除非用于该机组的正常热交换器的容量至少能超过最大要求容量的25%,否则应设有备用热交换器,但不要求有独立管路系统。

7.2.2.1 如果同时载运两种或两种以上能起危险化学反应的冷冻货物时,则对制冷系统应予特别考虑,以避免货物混在一起的可能性。如载运这类货物,应对每种货物设置独立的制冷系统,每一制冷系统应按7.2.1规定备有备用机组。但是,如果利用间接或组合系统进行冷却,而且热交换器的泄漏不致在任何可以设想的情况下造成货物的相混,则不必设置单独使用的制冷机组。

7.2.2.2 如载运两种或多种在运输条件下不会相互溶解的冷冻货物,但它们的蒸气压力能在液货混合情况下相加者,则应对制冷系统特别考虑,以避免货物相混的可能性。

7.2.3 如果制冷系统要求用冷却水,则应由专为此而设的泵或泵组提供足够的冷却水。这台泵或这些泵至少应具有两个海水吸入管路,如有可能,应引自左舷和右舷的海水箱。应配备一台具有足够容量的备用泵,此泵可作其他用途,只要这些用途不妨碍制冷这一项主要工作。

7.2.4 制冷系统可按下列方式之一进行布置:

- .1 一个直接系统将气货压缩、冷凝和输回液货舱。对第17章规定的某些货物不得采用;
- .2 一个间接系统将货物或气货用载冷剂冷却或冷凝,但不需要压缩;
- .3 一个组合系统将气货压缩,在货物/载冷剂热交换器内冷凝并输回液货舱。对第17章规定的某些货物不得使用。

7.2.5 所有制冷剂和载冷剂必须相互相容,并与可能接触的货物相容。热交换可在远离液货舱处进行或是通过设置在液货舱里面或外边的冷却盘管进行。

## 第8章 液货舱的透气系统

### 8.1 通则

所有液货舱应设有适合于货物围护系统设计和所载运货物的压力释放系统。可能承受超过其设计能力的货物处所,屏壁间处所以及货物管路也应设有适当的压力

释放系统。此系统应与透气管路系统连接，其设计应使货物蒸气积聚在甲板上或进入居住处所、服务处所、控制站和机器处所或可能造成危险的其他处所的可能性减少至最低限度。第7章所规定的压力控制系统应独立于压力释放阀。

## 8.2 压力释放系统

8.2.1 容积超过20m<sup>3</sup>的每一液货舱至少应设置两只容量大致相等的压力释放阀，其设计和构造应适合于规定的用途。容积未超过20m<sup>3</sup>的液货舱可设置单个释放阀。

8.2.2 屏壁间处所应设有使主管机关满意的压力释放装置。

8.2.3 压力释放阀的开启压力应不大于在设计液舱中已采用的蒸气压力。

8.2.4 压力释放阀应连接在甲板以上部分的液货舱最高部位。工作温度低于0℃的液货舱上的压力释放阀，其布置应防止在关闭时形成结冰造成阀失灵。承受低环境温度液货舱上的压力释放阀的构造和布置应给予适当考虑。

8.2.5 压力释放阀应进行原型试验以保证阀具有所要求的排量。每一阀应经试验以保证在规定的设定压力下开启，开启压力的偏差，在0至1.5bar时不超过±10%，在1.5至3.0bar时不超过±6%，在3.0bar及以上时不超过±3%。压力释放阀应由主管机关认可的主管当局进行校核和铅封，此项工作应作出记录（包括阀的调整压力），保留在船上。

8.2.6 如液货舱允许有一个以上释放阀设定值时，可采用下列方法完成：

- .1 安装两只或更多只经正确调整和铅封阀以及提供必要时可把不用的阀与液货舱隔离的设施，或
- .2 安装释放阀，其设定值可通过插入预先认可的设定环或替换弹簧或用其他类似设施来变更，不要求作压力试验来核实新设定的压力。所有其他阀的调整应铅封。

8.2.7 变更8.2.6规定的设定压力应在船长的监督下根据主管机关认可的规程以及船舶操作手册的规定进行。设定压力值的变更应记录在航行日志内并在货物控制室（如没有时）内贴上标记，并在每一释放阀上标明设定压力。

8.2.8 在液货舱和释放阀之间不应设有为便于维修而设的截止阀或其他隔离设施，除非设有所有下列装置：

- .1 防止有一个以上压力释放阀同时失效的合适装置；
- .2 能自动和明显地表明某个释放阀失效的装置；

- .3 压力释放阀排量应是这样：如果一只阀不能工作时，其余的各阀具有8.5所要求的联合排量。但是，如果船上备有一只保养良好的备用阀，上述排量可由所有释放阀来承担。

8.2.9 装在液货舱上的每一压力释放阀应与透气系统相连接，此系统的构造应把排放的气体引向上方，且其布置应使水或雪能进入排气系统的可能性减少至最低限度。透气管出口的高度应不低于露天甲板以上  $B/3$  或 6m，取其大者，并高出工作区域和纵向步桥 6m。

8.2.10 液货舱压力释放阀排气管出口的布置离最近的通向居住处所、服务处所和控制站或其他气体安全处所的空气吸入口或开口的距离至少等于  $B$  或 25m，取其小者。对长度小于 90m 的船舶，经主管机关同意可以取较小者。连接至货物围护系统的所有其他排气管出口的布置离最近的通向居住处所的服务处所和控制站，或其他气体安全处所的空气吸入口或开口的距离至少应为 10m。

8.2.11 其他各章未涉及的所有其他货物排气管出口应按 8.2.9 和 8.2.10 的规定布置。

8.2.12 如果同时载运的几种货物，其相互间能起危险反应，则应对每一种载运的货物设置单独的压力释放系统。

8.2.13 在排气管路系统中，应设有从易于积聚液体的地方排泄液体的设施。压力释放阀和管路的布置应在任何情况下也不会使液体积聚在压力释放阀内或附近。

8.2.14 在排气管出口处应设置适当的防护网罩，以免异物进入。

8.2.15 所有排气管路的设计和布置应确保不因管子的温度变化或船舶的运动而受到损坏。

8.2.16 按 8.5 规定要求确定排量时，应计及压力释放阀排气管路中的背压。

8.2.17 压力释放阀在液货舱上的位置应使船舶处于横倾  $15^\circ$  及  $0.015L$  纵倾 ( $L$  的定义见 1.3.23) 的条件下依然保持蒸气状态。

### 8.3 用于液位控制的其他压力释放系统

8.3.1 如按 15.1.4.2 的要求，应对每一液舱增设一个压力释放系统以防止在 8.5 所述播及火灾的情况下在系统释放的任何时间内不使液体满舱。此压力释放系统应包括如下：

- .1 一只或几只释放阀设定的压力相当于 15.1.4.2 所规定的温度时液货舱的蒸气表压力；和

- .2 一个越控装置，必要时以阻止其正常工作。此装置应包括易熔元件，设计在 98°C 到 104°C 之间下熔化，且使 8.3.1.1 规定的释放阀可以作用。易熔元件应特别位于释放阀的附近。一旦在系统电源发生故障时此系统可以产生作用。该越控装置应不依赖于船上的任何动力源。

8.3.2 增设的压力释放系统的总释放量在 8.3.1.1 所述的压力下应不低于下列公式之值：

$$Q' = FC' A^{0.82} \quad (\text{m}^3/\text{s})$$

式中：

$Q'$  = 在 273 K 和 1.013 bar 标准状态下所要求的最小空气排放率。

$$C' = \frac{12.4}{(L + \rho_r m) D} \sqrt{\frac{Z \cdot T'}{M}}$$

式中：

$\rho_r$  = 在释压条件下，液态货品的相对密度

( $\rho_r = 1.0$ ，淡水)；

$m = -di/d\rho_r$  = 在释压条件下，液态热含的递减相对于液态密度 (kJ/kg) 的增加。对设定压力不大于 2.0 bar，可使用表 8.1 所列之值。对于未列入表内的货品和较高的设定压力， $m$  值应根据货品本身的热动力资料进行计算；

$i$  = 液体的热含 (kJ/kg)；

$T'$  = 在释压状态，亦即增设的压力释放系统设定压力下，以 K 表示的温度；

$F, A, L, D, Z$  和  $M$  见 8.5.2 的定义。

8.3.3 如符合 8.3.1.1 规定而要求改变本节中所设置的释放阀的设定压力，则应按照 8.2.6 和 8.2.7 的规定办理。

8.3.4 8.3.1.1 所述的释放阀可与 8.2 所述的压力释放阀相同，但是设定压力和释放量应符合本节要求。

8.3.5 这类压力释放阀的排气可导致 8.2.9 所述的透气系统。如果安装单独的透气系统，则应按照 8.2.9 至 8.2.15 的要求。

表 8.1-系数 m

货 品	$m = -di/d\rho_x$ (kJ/kg)
氨	3400
丁二烯	1800
丁烷	2000
丁烯	1900
乙烷	2100
乙烯	1500
甲烷	2300
甲基氯	816
氮	400
丙烷	2000
丙烯	1600
丙烯氧化物	1550
乙烯基氯	900

表内所列之值可适用于设定压力不大于 2.0bar。

#### 8.4 真空保护系统

8.4.1 凡设计能承受最大外部压力差超过 0.25bar 并能承受在最大卸货速率下, 无蒸气返回液货舱而可能达到的最大外部压力差的液货舱或采用货物冷冻系统时, 均不需要真空保护系统。

8.4.2 凡设计能承受最大外部压力差不超过 0.25bar 的液货舱, 或不能承受在最大的卸货速率下, 无蒸气返回液货舱而可能达到的最大外部压力差的液货舱或采用货物冷冻系统, 或采用送蒸气气体给机械处所, 则应设置:

- 1 两天独立的压力开关, 用于在充分低于液货舱最大设计外部压力差的情况下, 用适当方式作顺序报警和顺序停止从液货舱抽取液体货物或蒸气以及停止冷冻设备(如设有时); 或
- 2 真空释放阀, 具有至少等于最大单舱卸货速度的气流量, 调整在足够低于货舱最大外部设计压差的情况下开启; 或
- 3 主管机关可接受的其他真空释放系统。

8.4.3 遵照第 17 章的要求, 真空释放阀应允许惰性气体、货物蒸气或空气进入液货舱, 且其布置应尽量减少水或雪进入液货舱的可能性。如许可货物蒸气进入, 则应由货物蒸气管路以外的途径进入。

8.4.4 真空保护系统应能进行试验, 以保证其在规定的压力下起作用。

#### 8.5 阀的大小

压力释放阀对每个液货舱应具有一个组合释放量, 它应能释放下列两者中的大者而液货舱内压力的升高不超过 MARVS 值的 20%;

- .1 液货舱惰化气体系统的最大能量, 如果液货舱惰化气体系统的可达到的最大工作压力超过液货舱 MARVS 值, 或
- .2 播及火灾时产生的蒸气量按下列公式进行计算:

$$Q = FGA0.82 \quad (\text{m}^3/\text{S})$$

式中:

Q = 在 273 K 和 1.013 bar 标准状态下, 所要求的空气最小排出率。

F = 不同类型液货舱的火灾播及系数:

F = 1.0 对于甲板上无绝热层的液货舱

F = 0.5 对于甲板上的液货舱, 绝热层经主管机关认可。(此项认可根据使用认可的防火材料、绝热层的热传导和处于火灾情况下的稳定性);

F = 0.5 对于安装在货舱中非绝热的独立液货舱;

F = 0.2 对于在货舱内的绝热的独立液货舱(或在绝热货舱内的非绝热的独立液货舱);

F = 0.1 对于在惰化货舱内的绝热的独立液货舱(或在惰化的绝热货舱内的非绝热的独立液货舱);

F = 0.1 对于薄膜和半薄膜液货舱

对于部分突出于露天甲板的独立液货舱, 其火灾播及系数应根据甲板上和甲板下的表面积决定。

G = 气体系数

$$G = \frac{12.4}{LD} \sqrt{\frac{Z \cdot T}{H}}$$

式中:

T = 在释放状态下的温度 K, 即压力释放阀设定压力的 120%。

L = 在释放状态下, 货物的气化热 (kJ/kg)。

D = 常数, 根据比热 k 决定, 见表 8.2; 如 k 值不知, 则 D 应取 0.606。

常数 D 也可用下列公式算得:

$$D = \sqrt{k \left( \frac{2}{k+1} \right)^{\frac{k+1}{k-1}}}$$

Z = 在释放状态下气体的压缩性系数; 如此系数未知, 则取 Z = 1.0。

M = 货品的分子量。

A = 不同类型液货舱外表面面积 (  $m^2$  ) :

对回转型液货舱壳体:

A = 外表面面积;

对非回转型液货舱壳体:

A = 外表面面积减去底表面的投影面积;

对由一组受压容器组成的液货舱:

— 船体结构绝热:

A = 货舱的外表面面积减去其投影的面积;

— 液货舱结构绝热:

A = 一组受压容器的外表面面积 ( 不包括绝热层 ) 减去投影底面积,  
见图 8.1。

表 8.2 常数 D

k	D	k	D
1.00	0.606	1.52	0.704
1.02	0.611	1.54	0.707
1.04	0.615	1.56	0.710
1.06	0.620	1.58	0.713
1.08	0.624	1.60	0.716
1.10	0.628	1.62	0.719
1.12	0.633	1.64	0.722
1.14	0.637	1.66	0.725
1.16	0.641	1.68	0.728
1.18	0.645	1.70	0.731
1.20	0.649	1.72	0.734
1.22	0.652	1.74	0.736
1.24	0.656	1.76	0.739
1.26	0.660	1.78	0.742
1.28	0.664	1.80	0.745
1.30	0.667	1.82	0.747
1.32	0.671	1.84	0.750
1.34	0.674	1.86	0.752
1.36	0.677	1.88	0.755
1.38	0.681	1.90	0.758
1.40	0.685	1.92	0.760
1.42	0.688	1.94	0.763
1.44	0.691	1.96	0.765
1.46	0.695	1.98	0.767
1.48	0.698	2.00	0.770
1.50	0.701	2.02	0.772
		2.20	0.792

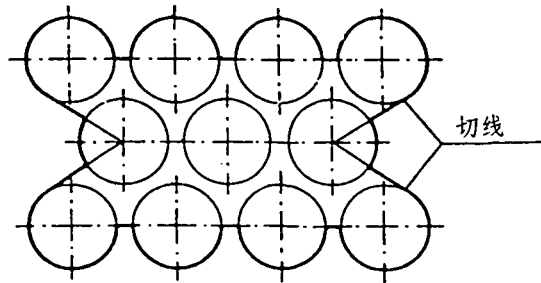


图 8.1

## 第 9 章 环境控制

### 9.1 液货舱和货物管路系统内的环境控制

9.1.1 应装有一个管路系统，使每个液货舱能安全清除气体，且能在气体清除状态安全地用货物气体扫除空气。此系统的布置应使在清除气体或扫除空气后留下气体或空气死角的可能性减少至最低限度。

9.1.2 为了合适地监测扫除空气和清除气体的进程，应对每个液货舱设置足够数量的采样点。气体采样连接装置应在主甲板上装设阀门并加盖板。

9.1.3 对可燃气体，应利用惰化介质作为中间步骤，在清除气体作业的每个阶段减少可燃气体混合物存在于液货舱的可能性。此外，此系统应能使液货舱在灌注液货或气货前，用惰化介质扫除空气，不允许有可燃混合气在任何时候存在于液货舱内。

9.1.4 可能含有货物的管路系统应能按 9.1.1 和 9.1.3 的规定清除气体和扫除空气。

9.1.5 用于这些作业程序的惰性气体可由岸上或船上供给。

### 9.2 液货舱内的环境控制（除 C 型独立液舱以外的货物保护系统）

9.2.1 供可燃气体用的附有要求全部设次屏壁的货物围护系统的屏壁间处所和货舱处所，应用适当的干燥惰性气体予以惰化，并用船上惰性气体发生系统进行补充或用船上能充分供应正常消耗至少达 30 天的储存量来维持惰化。

9.2.2.1 供可燃气体用的附有要求部分设次屏壁的货物围护系统的屏壁间处所和货舱处所，应用适当的干燥惰性气体予以惰化，并用船上惰性气体发生系统进行补充或用船上能充分供应正常消耗至少达 30 天的储存量来维持惰化。

9.2.2.2 或者，遵照第 17 章规定的限制，主管机关可允许对 9.2.2.1 所述的处所用干燥的空气充填，但船上应保存一定的惰性气体储存量或设有惰性气体发



生系统足以惰化最大的这些处所；同时这些处所的形状和有关的气体检测系统连同惰化设施的能力能迅速地探知液货舱的任何泄漏，以及能在危险条件形成之前完成惰化作用。 应设有能产生足够数量、适当质量和能满足预期需要的干燥空气设备。

9.2.3 对非可燃性气体，9.2.1和9.2.2.1所述的处所可用适当的干燥空气或惰性气体来维持。

9.2.4 如属内层绝热的液舱，屏壁间处所不要求设有环境控制装置；位于次屏壁与内层船体之间的处所，以及位于次屏壁与符合4.9.7.2规定的全部充填绝热材料的独立液舱结构之间的处所，也不要求设有环境控制装置。

### 9.3 C型独立液舱周围处所的环境控制

冷冻液货舱周围处所未设置次屏壁者应灌注合适的干燥惰性气体或干燥的空气，并用船上惰性气体发生系统、船上储存的惰性气体或合适的干燥空气设备提供的干燥空气来补充和维持这种状态。

### 9.4 惰化

9.4.1 惰化系指加进相容气体制造一个不可燃的环境。 这些气体可装在储存容器内或在船上制造或由岸上供给。 惰性气体在化学性质上和操作上，应在所有要惰化处所内可能产生的温度下，与处所的结构材料和货物相容。 应考虑到气体的露点。

9.4.2 如储存惰性气体还用作灭火，则应装在独立的容器内，且不应用于货物的用途。

9.4.3 当惰性气体在0°C以下储存时，无论是液态或是气态，其储存和供应系统的设计应使在船舶结构上施加的温度不下降至极限值之下。

9.4.4 应设有适于所载运货物的装置，以防止货物蒸气倒回至惰性气体系统中。

9.4.5 此装置应使每个惰化的处所能予以隔离，并设有必要的控制和释放阀等，用来控制这些处所的压力。

### 9.5 船上惰性气体的生产

9.5.1 遵照第17章的特殊要求，此设备应能产生含氧量在任何时候不大于5%（容积）的惰性气体。 遵照第17章的要求，此设备的惰性气体出口处须设置一能连续显示含氧读数的仪表及一个设定含氧量在5%（容积）报警的报警器。 此外，如惰性气体采用船上的空气分馏法制取，此法涉及用于连续施放的液态氮冷剂的储存，送入储存器的液化气体应予监测微量氧以避免为惰化而施放惰性气体时可能有初先高富氧气体。

9.5.2 惰性气体系统应具有与货物围护系统相适应的压力控制和监测装置。应设有一种主管机关可接受的安装在货物区域能防止货物气体回流的设施。

9.5.3 安装惰性气体发生装置的处所不应有进入起居处所、服务处所或控制站的直接通道，但可位于机舱处所内。如果这种设备安装在机器处所或液货舱区域以外的其他处所，则应按9.5.2要求在货物区域内的惰性气体总管上装有两个止回阀或等效设施。惰性气体管路不得通过起居处所、服务处所或控制站。

9.5.4 产生惰性气体的火焰燃烧设备不得位于货物区域内，对于采用催化燃烧法的惰性气体发生装置的安装位置可给予特殊考虑。

## 第10章 电气设备

### 10.1 通则

10.1.1 本章规定适用于载运易燃货品的船舶，应与 SOLAS 1983 修正条款第 II-1 章的第 D 部分一起实施。

10.1.2 配备的电气设备应使易燃货品燃烧和爆炸的危险减少到最低程度。符合本章规定的电气设备不必当作第 3 章范围内的着火源来看待。

10.1.3 主管机关应采取适当的措施以保证本章关于电气设备规定的实施和执行的一致性。\*

10.1.4 当允许存在 10.2 内所列的例外时，电气设备或电缆，除了在操作上是必要的以外，不得安装或敷设在危险处所或危险区域。

10.1.5 如电气设备按 10.1.4 规定安装在危险处所或危险区域应使主管机关认为满意，并经主管机关认可的有关机关核准方可在易燃大气中操作。

### 10.2 设备的类型

合格安全型设备可以按照下列规定安装在气体危险处所和气体危险区域：

#### 10.2.1 气体危险处所和区域——通则

本质安全型电气设备和电缆可安装和敷设在 1.3.17 所规定的所有气体危险处所和区域内。

#### 10.2.2 货物围护系统

潜水货泵电动机及其输送电缆可以装设在货物围护系统内。应设有装置以能在低液位时自动关闭电动机。这可用检测泵排出低压力、电动机低电流或低液位

\* 可参考国际电工委员会出版的建议，特别是出版物 92 - 502。

的方法实现。此种关闭动作应在货物控制站报警。货泵电动机应能在除气操作期间切断其电源。

### 10.2.3 货舱和某些其它处所

10.2.3.1 如货物装载在要求次屏壁货物围护系统内的货舱中,则此货舱内可敷设潜水货泵电动机的输电电缆。

10.2.3.2 如货物装载在不要求次屏壁货物围护系统内的货舱中以及1.3.17.5所述的处所中,则此货舱内可按下列要求装设:

- .1 路过电缆敷设;
- .2 隔爆型的或通风、充气型的照明设备。照明系统至少应有两个分路供电。所有的开关和保护装置应能中断所有的电极或相位,并应装设在气体安全区域;和
- .3 电测深仪或测程仪以及外加电流阴极保护系统的阳极或电极。这些装置应安装在气密的外壳内;

下列仅可装设在1.3.17.5所述的处所内:

- .4 为货物或压载系统阀门操纵所用的防火电动机;并且
- .5 隔爆型通用音响报警指示器。

### 10.2.4 货泵舱和货物压缩机舱

10.2.4.1 照明设备应具有通风、充气型外壳或应为隔爆型。照明系统至少应有两个分路供电。所有的开关和保护装置应能中断所有的电极或相位,并应安装在气体安全处所内。

10.2.4.2 驱动货泵或货物压缩机的电动机应以气密舱壁或甲板使之与这些处所隔开。应对被驱动设备及其电动机之间的传动轴设置弹性联轴节或其他保持对中的措施,此外,在传动轴通过气密舱壁或甲板处,应设有合适的密封装置。此项电动机及其附属设备应安装在符合第12章的舱室内。

10.2.4.3 如因操作上的或结构上的要求而不可能符合10.2.4.2所述的规定,可安装下列合格安全型的电动机:

- .1 具有防爆外壳的增加安全型;和
- .2 通风、充气型。

10.2.4.4 通用音响报警指示器应具有防爆罩壳。

### 10.2.5 露天甲板上的区域以及货舱以外的处所

10.2.5.1 露天甲板上的区域或露天甲板上的非围闭处所,距任何液货舱出口、气体或蒸气出口、货物管法兰、货物阀门或通向货泵舱和货物压缩机舱的通风口或

入口的 3m 范围内；在货物区域上方露天甲板的区域内和距露天甲板上货物区域前后各 3 m 以及甲板以上高度达 2.4m 的范围内；距货物围护系统的露天外表面 2.4m 内的区域，可安装下列设备：

- . 1 合格安全型设备；和
- . 2 敷设路过电缆。

10.2.5.2 在含有货品管系的围闭或半围闭处所内以及放置货物软管的舱室中，可装设下列设备：

- . 1 防爆型或具有通风、充气型的照明设备。照明系统至少应有两个分路供电。所有的开关和保护装置应能中断所有的极或相位并应装设在气体安全处所内；和
- . 2 敷设路过电缆。

10.2.5.3 对具有直接开口通向任何气体危险处所或区域的围闭或半围闭处所，应安装符合对开口通往的处所或区域的要求的电气设备。

10.2.5.4 用空气闸保护的处所内安装的电气设备应为合格安全型，除非其布置系按 3.6.4 要求的措施可以使其停止通电者。

## 第 11 章 防火和灭火

### 11.1 防火安全要求

11.1.1 不论船舶吨位的大小（包括小于 500 总吨的船舶），SOLAS 1983 年修正条款第 II-2 章对油船的要求应适用于本规则范围内的船舶，但：

- . 1 第 5 6 条之 4 不适用；
- . 2 第 4 条适用于货船部分，第 7 条按其适用于 2,000 总吨及 2,000 总吨以上油船的情况，均应适用；
- . 3 SOLAS 1983 年修正条款第 II-2 章有关油船的条款不适用，并以本规则的各章、节替代如下：

SOLAS 条文	本规则置换条文
17	11.6
56.1 和 56.2	第 3 章
60、61、62	11.3 和 11.4
63	11.5

11.1.2 除在第10和16章中另有规定外,所有着火源应从可能存在可燃性蒸气的处所内排除。

11.1.3 本节规定与第3章一起适用。

11.1.4 为了灭火,在最后面货舱的末端或在最前面货舱的前端处的隔离舱、压载舱或空舱上方的任何露天甲板区域应包括在货物区域内。

## 11.2 消防总管设备

11.2.1 凡装运受本规则约束的货品的一切船舶,不论吨位大小,应符合 SOLAS 1983年修正条款第 II-2/4 和 II-2/7 条的要求,但当消防泵和消防总管用作如 11.3.3 所许可的水雾系统的一部分时,所要求的消防泵排量、消防总管和供水管的直径则不受第 4.2.1 和 4.4.1 条的限制。此外,第 4.4.2 条的要求,在表压力至少为 5.0 bar 时应得到满足。

11.2.2 水灭火系统的布置应至少使两股水柱能射到货舱区域内甲板的任何部位和甲板上方的货物围护系统和液舱盖板部分。应布置必要数目的消火栓以满足上述要求并符合 SOLAS 1983年修正条款第 II-2/4.5.1 和 II-2/4.8 条的要求。消防栓所配备的消防水带的长度不应超过 33m。

11.2.3 应在任何管道交叉处和船艏前部的消防总管或主管上安装截止阀,并在货物区甲板上的消防栓之间不大于 40m 的间隔内装设截止阀,以便隔断总管的损坏管段。

11.2.4 作灭火用的所有水枪应为认可的两用型,既可形成水雾也可形成水柱。灭火系统中所有的管子、阀门、水枪以及其他附件应能耐海水腐蚀,为此,可使用镀锌管;此外尚应耐火焰影响。

11.2.5 如船舶机舱无人值班,则应设有装置使至少有一台消防泵能在驾驶台内或货物区外其他控制站进行遥控启动并与消防总管相连接。

## 11.3 水雾系统

11.3.1 在载运可燃性或毒性货品或载运两者的船上,应安装供冷却、防火和保护船员用的水雾系统,其覆盖范围包括:

- .1 露天的液货舱气室和液货舱的任何露天部分;
- .2 甲板上储存可燃货品或毒品的露天容器;
- .3 液体和蒸气货物的装卸总管及其控制阀区域,以及主要控制阀所在的任何其他区域以及至少等于防滴盘面积的其它区域;和
- .4 所有面向货物区的通常有人管理的上层建筑和甲板室的限界面、货物压缩机舱、货泵舱、有高度失火危险物品的储藏室及货物控制室。

未存放有高度失火危险物品或设备的无人管理的艙楼界面则不要  
求水雾保护。

11.3.2 此水雾系统应能覆盖11.3.1所提及的所有区域，其均匀分布的水雾对水平投影面的喷射量至少为每分钟10升/m<sup>2</sup>，对垂直面至少为每分钟4升/m<sup>2</sup>。对水平面或垂直面无明显区别的结构，水雾系统的排量应取下列二者的较大之值：

- .1 水平投影面乘以每分钟10升/m<sup>2</sup>；或
- .2 实际表面乘以每分钟4升/m<sup>2</sup>。

在垂直面上，保护较低区域的喷嘴间距可以计入预计从高处流下的水量。为了隔断损坏部分，在喷雾总管上应每隔一段距离安装截止阀。或者把系统分成可以进行独立操作的两个或多个区段，但须将必需的控制装置一起安装在货物区后部。保护11.3.1.1和.2所述的任何区域的区段应能覆盖包括这个区域的整个横向液舱群。

11.3.3 水雾泵的排量应足以同时向所有区域输送所需要的水量，或者如系统分成几个区段时，其布置和排量应能同时向任一区段和11.3.1.3和.4所述的表面供水。或者可利用主消防泵作此用途，但是，其总的排量应增加水雾系统所需要的水量。不论何种情况，在货物区以外的消防总管和水雾总管之间应设有通过截止阀的连接管。

11.3.4 通常作其他用途的水泵可用来向水雾总管供水，但需经主管机关认可。

11.3.5 水雾系统中所有的管子、阀门、喷嘴以及其他设备应能耐海水的腐蚀，为此，可使用镀锌管，此外还应能耐火焰的影响。

#### 11.4 化学干粉灭火系统

11.4.1 凡拟载运可燃货物的船舶应安装固定式化学干粉灭火系统，以便对货物区甲板和如适用时对艙部或艙部货物装卸区进行灭火。本系统和化学干粉应适合作灭火用途并使主管机关满意。

11.4.2 本系统应至少能用两条手持软管或组合型干粉喷射器/手持软管把干粉输送至甲板上方露天货物区的任何部分，包括甲板上方的货品管系。本系统应利用专供此种用途的惰性气体（例如氮）来驱动，且应将惰性气体储存在邻近干粉容器的受压容器内。

11.4.3 用于货物区的这种系统应至少包括两个独立自给式化学干粉装置，连同配套的控制装置、受压介质固定式管系、干粉喷射器或手持软管，对载货容积小于1,000 m<sup>3</sup>的船舶，经主管机关同意允许只安装一台这种装置。应设有干粉喷射

器，其布置应能保护货物装卸的集合管区，且能就地或遥控地起动和喷射。如果干粉喷射器能从单一位置传送必要的干粉量至所有要求的区域，则干粉喷射器不要求能遥控瞄准。所有的手持软管和干粉喷射器应能在软管盘架处或干粉喷射器处起动。至少应有一条手持软管或一台干粉喷射器置于货物区的后部。

11.4.4 具有两个或多个干粉喷射器、手持软管或其组合型的灭火装置应在干粉容器处设有总管并引出独立的分管，除非设有经主管机关认可的其他合适的装置能保证正常工作者可以例外。如装置上附有两根或多根管子，其布置应使任何或所有的干粉喷射器和手持软管能在额定排量下同时或顺序地工作。

11.4.5 干粉喷射器的排量应不低于  $10 \text{ kg/s}$ 。手持软管应为不能扭曲的，并应设有一枝能开/关的喷枪，其喷射率不低于  $3.5 \text{ kg/s}$ 。最大的排射率应只需要一个人操作即可。手持软管的长度应不超过  $33 \text{ m}$ 。如在干粉容器和手持软管或干粉喷射器之间设置固定管，则管子长度应不超过当管子被持续或间断使用时，能把干粉维持在流动状态，同时当系统关闭时，仍能清除干粉的长度。手持软管和喷枪应为防风雨型结构或储存在防风雨的室内或盖板内，且应易于取用。

11.4.6 每一容器内应储存足量的化学干粉以能向每一干粉装置所附的全部干粉喷射器和手持软管至少提供喷射  $45 \text{ s}$  所需的干粉。固定式干粉喷射器覆盖范围应符合下列要求：

固定式干粉喷射器排量 ( $\text{kg/s}$ )	10	25	45
最大覆盖范围的距离 (m)	10	30	40

应考虑手持软管喷射的最大覆盖有效距离须等于软管本身长度。如被保护区域显然高出干粉喷射器或手持软管盘架，则应予以特别考虑。

11.4.7 对设有艙或艙装卸设备的船舶应提供附加的化学干粉装置，至少具备符合 11.4.1 至 11.4.6 要求的一个干粉喷射器和一条手持软管。此种附加装置的位置应能保护艙或艙装卸设备。货物区域前或后的货物管道区应由手持软管来保护。

## 11.5 气体危险围蔽处所

11.5.1 可能出现可燃液体或蒸气渗漏而通常要进入的围蔽处所，例如货物压缩机舱或货泵舱应设有能扑灭这些处所内火灾的固定装置。另外，这一系统或另一个固定式系统应能对发生过火灾的处所进行惰化以保证火灾不再发生。就设计而言，该处所的边界应假设为完整无损的。除非慎重考虑到静电的危险性，否则应避免使用二氧化碳和蒸气灭火系统。

11.5.2 应提供关闭通达此项处所的通风口和其他开口的装置，必要时，也应在该处所内提供声音报警信号，以便在惰化/灭火介质进入该处所前使人员能紧急撤离该处所。

### 11.6 消防人员的装备

11.6.1 凡载有可燃性货品的每一船舶应配备如下符合 SOLAS 1983 年修正条款第 II-2/17 条要求的消防人员的装备：

<u>货物总容积</u>	<u>装备的数量 (套)</u>
2,000m <sup>3</sup> 以下	2
2,000m <sup>3</sup> 至 5,000m <sup>3</sup>	4
5,000m <sup>3</sup> 以上	5

11.6.2 有关安全设备的附加要求，见第 14 章。

11.6.3 作为消防人员装备一部分的任何呼吸器应为自给式空气呼吸器，其容量至少为 1,200 升自由空气。

## 第 12 章 货物区内的机械通风

本章要求替代 SOLAS 1983 年修正条款第 II-2/59.3 条。

### 12.1 货物正常装卸作业期间要求进入的处所

12.1.1 电动机舱、货物压缩机舱、货泵舱、具有货物装卸设备的其它围闭处所以及进行货物装卸操作的类似处所应设置可在处所外部进行控制的机械通风系统。在进入此类舱室并操作设备前，应采取措施使这些处所通风，且应在舱室外面张贴需要进行通风的警告标志。

12.1.2 机械通风进出口的布置应确保有足够的空气流通于处所之间，以免易燃的或有毒蒸气的聚集，并保证有一个安全的工作环境，但在任何情况下，通风系统的容量根据处所总容积计算，每小时应不少于 30 次空气交换；而作为例外，气体安全货物控制室可以为每小时换气 8 次。

12.1.3 通风系统应为固定型的。如为负压型，可允许从处所的上部或下部抽风，或从上下部同时抽风，这取决于所装运货品蒸气的浓度。

12.1.4 对装设驱动货物压缩机或泵的电动机舱，装有惰性气体发生器的机器处所以外的处所，被认为是气体安全处所的货物控制室以及在货物区内的其他气体安全处所，其通风系统均应为正压型的。



12.1.5 对货物压缩机舱和泵舱以及被认为是气体危险处所的货物控制室，其通风系统均应为负压型。

12.1.6 气体危险处所的排气通向管应向上排放，其排放位置应距居住处所、服务处所和控制站以及其他气体安全处所的通风进口和开口在水平方向至少10m。

12.1.7 通风进口的布置应尽量减少任何通风排气口排出的危险蒸气再循环的可能性。

12.1.8 气体危险处所的通风管应不通过居住处所、服务处所和机器处所或控制站，但第16章所允许者可例外。

12.1.9 如拟载运易燃货品，驱动风机的电动机应置放在通风管外面，风机不应在通风处所或与该处所相联系的通风系统中引起蒸气点火源。用于气体危险处所的风机和风机管道（仅限于风机处）应是非火花型结构，具体限定如下：

- .1 非金属材料的叶轮或罩壳，应对消除静电予以适当注意；
- .2 非铁材料的叶轮和罩壳；
- .3 奥氏体不锈钢叶轮和罩壳；和
- .4 叶梢间隙不小于13mm的铁质叶轮和罩壳。

铝或镁合金制造的固定或转动部件和铁质的固定或转动部件的任何组合，不论叶梢间隙是多大，都被认为有产生火花的危险，故不应用在这些处所内。

12.1.10 本章所述船上的每一种风机都应设有备件。

12.1.11 应在通风管的外侧开口处设置不超过13mm网孔的保护网。

## 12.2 通常不进入的处所

货舱、屏壁间处所、空舱、隔离舱、装有货物管系的处所和可能积聚货物蒸气的其他处所应能进行通风以便在必要进入这些处所时确保有一个安全的环境。如对这些处所未设固定式的通风系统，则应提供认可型移动式机械通风装置。必要时，根据这些供通风用的处所（例如货舱和屏壁间处所）布置的情况，应安装必要的固定式的管道。风机或鼓风机应远离人员出入口，且应符合12.1.9的规定。

## 第13章 测试设备（仪表、气体探测）

### 13.1 通则

13.1.1 每个液货舱应设有指示货物液面、压力和温度的装置。压力计和温度指示器应根据本章所评述的要求安装在液体和蒸气管系内，货物冷藏装置内以及惰性气体系统内。

13.1.2 如要求装设次屏壁，应配备固定式测试设备，以便在主屏壁任一位置的液密失效时或液货在任一位置与次屏壁接触时能探测出来。这种测试设备应包含按13.6规定的适当的气体检测装置。然而，这种测试设备不要求能定出液货在主屏壁上漏穿的区域或液货与次屏壁接触的范围。

13.1.3 如果船舶装卸货是通过远距离控制的阀和泵进行的，则与给定的一个液货舱有关的所有控制器和指示器都应集中在一个控制位置。

13.1.4 测试设备应经试验，以保证在工作条件下的可靠性，并应定期复校。测试设备的试验程序和复校间隔时间应经主管机关认可。

### 13.2 液货舱液位指示器

13.2.1 每一液货舱应至少设置一个液位测量装置，它应设计成在压力低于液货舱释放阀设定的最大许用值的情况下温度在货物操作温度范围内进行动作。如仅设置一个液位仪，则其布置应使在液货舱营运的状态下，仍能进行必要的维修保养工作。

13.2.2 除按第19章表中“g”栏对特种货物的特殊要求外，液货舱液位仪可为下述类型：

- . 1 间接装置，用秤重或管式流量计测定货物量；
- . 2 密闭装置，不穿透液货舱，例如使用放射性同位素或超声波装置；
- . 3 密闭装置，穿透液货舱，但形成密闭系统的一部分并防止货物逸出，例如浮式系统、电子探头、磁性探头和气泡管式指示器等。如果密闭式测量装置不直接安装在液货舱上，则应在尽可能接近液货舱处设置一只关闭阀；和
- . 4 限制装置，例如固定管式和滑动管式液位仪，该仪器穿透液货舱且在使用时许可少量的货物蒸气或液体逸向大气。当这些装置不使用时，应保持完全关闭。装置的设计和安装应保证在打开该装置时不致发生危险性的货物逸出。这种测量装置的设计应使最大开口的直径不超过1.5mm或取等效面积，除非这种装置配备一个过流阀。

13.2.3 对具有设计蒸气压力不超过0.7bar的液货舱，主管机关可允许具有适当保护盖和内部液位表尺，并且位于液位上方的观测孔可作为测量的辅助手段。

13.2.4 不应装设玻璃管式液位仪。主管机关可以允许甲板液舱装设类似安装在高压锅炉上并设有释流阀的增强型玻璃管式液位仪，但须遵照第17章的规定。

### 13.3 溢流控制

13.3.1 除第13.3.2的规定以外，每一液货舱应设置一台独立于其他液位指示器的高液位报警器，并在动作时会发出声光报警信号。独立于高液位报警器以外的另一液位传感器应能自动启动一只关闭阀，使既能避免装卸管系中液体压力过高又能防止液舱充满液体。5.6.4所述的应急关闭阀可供此用途。如为此用途使用另一只阀，应在船上备有5.6.4所述的相同的使用说明。在装货期间，凡使用这些阀可能造成在装卸系统内形成一个潜在的突然过压时，主管机关和港口主管当局可同意使用替代安排，如限制装货率等。

13.3.2 如液货舱属于下述两者情况之一时，则不必设置高液位报警器和液货舱充注自动关闭装置：

- . 1 具有容积不超过200m<sup>3</sup>的受压液舱；或
- . 2 设计成能在进行装货操作时承受最大可能的压力，且此项压力低于液货舱释放阀的开始释放压力。

13.3.3 液面报警器的电路（如有时）应能在装货之前进行试验。

### 13.4 压力表

13.4.1 每一液货舱的蒸气处所应配备一只压力表，它应与13.1.3所要求的货物控制位置内的指示器相结合。此外，尚应在驾驶台内设置高压报警器，如要求作真空保护，还应设置低压报警器。在指示器上应注明最大和最小的许用压力。在达到设定压力之前，应发出警报。对设有释放压力阀的液货舱，根据8.2.6规定，它们可设定在不止一个压力值上，并应对每一设定压力配备高压报警器。

13.4.2 在每一货泵排放管路和每个液体和蒸气货物总管处应至少配置一只压力表。

13.4.3 应配备现场能读出的总管压力表，以指示出截止阀和通岸连接软管之间的压力。

13.4.4 未设与大气相连开口的货舱和屏壁间处所应配备压力表。

### 13.5 温度指示仪

13.5.1 每一液货舱应至少设有两个仪表以指示货物温度，一个置放在液货舱底部，另一只靠近液货舱的顶部，但低于许可的最高液面。温度指示仪应有标志表明经主管机关认可的液货舱的最低温度。

13.5.2 如果货物在温度低于-55℃下于具有次屏壁的货物围护系统内装运，在绝热层或邻近货物围护系统的船体结构上应配备温度指示仪。此指示仪应定期

显示读数，并且如实用时，还应在当温度接近于船体钢材适合的最低温度时发出声响报警信号。

13.5.3 如货物在低于 $-55^{\circ}\text{C}$ 的温度下装运，液货舱的边界如与货物围护系统的设计相适应，应配备如下温度指示仪：

- . 1 足够数目的温度指示仪使不产生不合要求的温度差。
- . 2 可在一个液舱上设置超过13.5.3.1所要求数量的指示仪以核实初始冷却的过程是否合格。这些指示仪可为暂时的也可为永久性的。当建造成批同型船舶时，第二批和以后各批的船舶不需符合本款的规定。

13.5.4 温度指示仪的数目和位置应使主管机关满意。

### 13.6 气体探测要求

13.6.1 应根据第19章表中“f”栏的要求提供主管机关可以接受的并适合于所载运气体的气体探测设备。

13.6.2 每台探测装置在确定固定取样点的位置时，应适当考虑拟载运货品的蒸气密度以及由于舱室清洗或通风所造成的稀释物。

13.6.3 从取样点引出的管子不应通过气体安全处所，除13.6.5许可的以外。

13.6.4 凡按本节要求的气体探测设备的声光报警器，应设在驾驶台、13.1.3所要求的货物控制位置以及气体探测器读出位置。

13.6.5 气体探测设备可安装在13.1.3所要求的货物控制位置、驾驶台或其他合适的位置。如果此设备安装在气体安全处所，应满足下述条件：

- . 1 气体取样管应具有关闭阀或等效装置以防止与气体危险区相互连通；  
以及
- . 2 从探测器排出的气体应在安全位置排向大气。

13.6.6 气体探测设备应设计成使其易于试验，并应对其进行定期的试验和校准。船上应有为此用途的适当设备和试验用气体。如果可能，应为这种设备设置固定式连接器。

13.6.7 应为下述各处所安装固定气体探测系统和声光报警器：

- . 1 货泵舱；
- . 2 货物压缩机舱；
- . 3 货物装卸机械用的电动机舱；
- . 4 货物控制室（指定为气体安全处所者除外）；

- 5 货物区内可能积聚蒸气的其他围蔽处所，包括货舱和除C型以外的独立液舱的屏壁间处所；
- 6 按第16章所要求的通风罩和气体管道；以及
- 7 空气闸。

13.6.8 气体探测设备应能在不超过30分钟时间间隔内依次从每个取样点抽样和分析，但对于13.6.7.6所述的通风罩和气体管道内的气体探测，则应连续抽样。不应设置通向探测设备的公用取样管。

13.6.9 如货品是有毒的或既有毒并易燃的，则除第19章表中“h”栏内所列参照17.9的以外，主管机关可准予使用可携式设备替代固定式装置用作毒气检测，但这种设备的使用应在人员进入13.6.7所述的处所之前以及人员停留在这些处所期间的每30分钟以内。

13.6.10 对13.6.7所述的处所，当蒸气浓度达到可燃下限的30%时，易燃物品的报警器应该触发。

13.6.11 如属易燃货品，当采用货物围护系统而不采用独立液舱时，货舱和屏壁间处所应设有能测量气体浓度按容积从0%至100%的固定装置气体探测系统。配有声光报警的探测设备应能依次从每个取样点取样和探测，其间隔时间不超过30分钟。如蒸气浓度达到相当于在空气中的可燃下限30%或根据特殊货物围护系统经主管机关认可的其他限度时，报警器应触发。不应设置通向探测设备的公用取样管。

13.6.12 如属毒性气体，货舱和屏壁间处所应设有固定装置的管系以便从处所中获取气体样品。对这些处所的气体应采用固定式或可携式设备在每个样品点抽样和分析；其时间间隔应不超过4小时，且在任何情况下，至少在人员进入处所之前及人员停留在这些处所期间的每30分钟以内，均应取样。

13.6.13 每一船舶应至少配备两套经主管机关认可并适合于所载运货品的可携式气体探测设备。

13.6.14 应安装一台测量惰性大气中含氧量的适当仪器。

#### 第14章 人员保护

##### 14.1 保护设备

为了保护从事装卸操作的船员，应在考虑到货品特性的情况下，对人员提供包括眼保护在内的适当的保护设备。

## 14.2 安全设备

14.2.1 除11.6.1所要求的消防人员的装备以外,尚应对每一个允许进入充满气体处所内工作的人员提供足量的不少于两整套的安全设备。

14.2.2 一整套的安全设备应包括:

- . 1 一套不采用储存氧的自给式空气呼吸器,其容量至少为1,200升自由空气;
- . 2 防护服、长靴、手套和贴肉的防护目镜;
- . 3 配有腰带的钢芯援救绳;及
- . 4 防爆灯。

14.2.3 应供应足量的压缩空气,包括:

- . 1 按14.2.1的要求,每一呼吸器配备一套充满空气的气瓶;适用于供应所要求纯度的高压空气的特种空气压缩机;和能对14.2.1所要求的呼吸器的足够多备用呼吸器空气瓶进行充气的充气阀箱;或
- . 2 按14.2.1所要求的每一呼吸器提供空气总容量至少为6,000升的充满空气的备用气瓶。

14.2.4 作为替代措施,主管机关可接受一种适用于14.2.1所要求的呼吸器的具有软管接头的低压空气管路系统。该系统应提供足量的高压空气,通过减压装置供应低压空气以便能使两个人在气体危险处所工作至少1小时而不需要动用呼吸器的气瓶。应有设施为使适宜于供应所要求纯度的高压空气的特种空气压缩机向固定空气气瓶和呼吸器气瓶再充气。

14.2.5 14.1所要求的保护设备和14.2.1所要求的安全设备应保存在合适的具有明显标志的位于易于到达地点的柜内。

14.2.6 应由负责工作人员对压缩空气设备进行每月至少1次的检查,并将检查结果记录在航行日志内,且此项设备应至少每年由专家检查和试验1次。

## 14.3 急救设备

14.3.1 应在易于抵达之处放置适合于从甲板以下处所提起一个受伤人员的担架一副。

14.3.2 应在船上配备医药急救设备,包括氧气复苏设备和所承运货品的解毒剂(如备有时)。

#### 14.4 对各种货品的人员保护要求

14.4.1 14.4规定适用于船舶载运第19章表中“h”栏所列的货品。

14.4.2 应为船上每一人员提供适宜于应急逃生之用的呼吸防毒面具和眼保护设备，但需考虑下列情况：

- .1.1 过滤器型呼吸防毒面具，只是在该过滤器适合于船舶核准载运的所有指定货物的情况下才予接受；
- .1.2 自给式呼吸器通常应至少能持续工作15分钟；
- .2 应急逃生呼吸防毒面具不应作灭火或货物装卸用，并应对此作出标志；
- .3 两套额外的呼吸防毒面具和眼保护设备应永久性地存放在驾驶台。

14.4.3 应在甲板上的方便之处设有经适当标志的除污染喷头和眼冲洗设备，这些设备应在所有环境条件下均可使用。

14.4.4 如船舶载货容积为2,000m<sup>3</sup>及以上时，除按11.6.1和14.2.1所要求配备的设备以外，尚应配备两整套安全设备。对本款所要求的每一自给式空气呼吸器应至少设置三套备用充满空气的气瓶。

14.4.5 为防止人员受到主要货物释放的影响，应在居住区域内提供一个安全处所，其设计和设备应征得主管机关的同意。

14.4.6 对于高度危险的货品，货物控制室应只能是气体安全型的。

### 第15章 液货舱的充装极限

#### 15.1 通则

15.1.1 除15.1.3所许可者以外，液货舱内充装的液体在基准温度下不得超过液舱容积的98%。

15.1.2 液货舱应装载的最大容积系按下列公式来确定：

$$v_L = 0.98 v \frac{\rho_R}{\rho_L}$$

式中：

- $v_L$  = 液货舱可装载的最大容积
- $v$  = 液舱容积
- $\rho_R$  = 在基准温度下货物的相对密度
- $\rho_L$  = 装载温度和装载压力下的货物相对密度。

15.1.3 考虑到液舱的形状、压力释放阀的布置、液位和温度测量仪的精度以及压力释放阀在设定压力下与货物蒸气压力相应的温度和装载温度之间的差异，主管机关可允许在基准温度下的装载限额大于15.1.1和15.1.2所规定的98%，但是仍应保持8.2.17中所规定的条件。

15.1.4 仅在本章范围内，“基准温度”系指：

- . 1 当未配备有第7章所述的货物蒸气压力/温度控制器时，在压力释放阀设定的压力下与货物蒸气压力相应的温度；
- . 2 当配备有第7章所述的货物蒸气压力/温度控制器时，装货终止时、运输期间或卸货时的温度，视何者温度最高而定。如果当货物于达到8.2所要求的释放阀设定压力下与货物蒸气压力相应的温度之前，此种基准温度将会导致液舱注满液体的话，则应再安装1只符合8.3要求的压力释放阀。

## 15.2 向船长提供的资料

针对可能载运的每种物品，可能采用的每种装货温度以及可适用的最高基准温度，每个液货舱应指明最大许可的充装极限，并列成表格提供给主管当局予以认可。压力释放阀，包括8.3所要求的那些阀上业已设定的压力也应列在表上。此表的副本应由船长负责永久保存在船上。

## 第16章 用货物作燃料

### 16.1 通则

16.1.1 甲烷（液态天然气）是唯一的货种，其蒸气或蒸发出的气体可供主推进机处所和锅炉舱内使用，但在这些处所或舱室中只可供锅炉、惰性气体发生器和内燃机使用。

16.1.2 本章的规定并不排除这些蒸气或蒸发出的气体在其他位置作其他用途使用，诸如货物再液化和制造惰性气体，但是这些其他位置和作其他用途需经主管机关特殊考虑。

### 16.2 气体燃料供应

16.2.1 气体燃料管不应通过居住处所、服务处所或控制站。气体燃料管可通过或延伸至另外一些处所，但需满足下列要求之一：

- . 1 气体燃料管应为气体燃料储存在内管中的双层管系结构。在同心管之间的空间应用惰性气体增压使其压力大于燃料压力。应安装适当的报警器以指示管子之间压力的降低；



- .2 气体燃料管应安装在机械抽风式通风管或管道内。在管子或管道内外壁之间的空气空间应安装机械通风设备，其功率至少能供每小时换气30次。通风系统的布置应使压力维持低于大气的压力。鼓风机应置放在通风管或管道外面。通风出口应位于决不会点燃易燃气体/空气混合物的地方。通风入口的布置应不致使气体或气体/空气混合物被吸入到系统中去。当供应管内有气体时应在作业中始终保持通风。根据16.2.9的规定，应设有连续气体检测器以示明气体的泄漏并切断向机器处所供应气体燃料。管道鼓风机的布置应在所要求的空气流动不能实现和维持的情况下能切断给机器处所供应气体燃料。

16.2.2 如发生气体泄漏，只有在查出泄漏之处并予以修复后才能供应气体燃料。内容大意如此的说明书应张贴在机器处所显著的地方。

16.2.3 供气体燃料管用的双层壁管系或管道应在按16.2.4所要求的通风箱或通风罩处终止。

16.2.4 对法兰、阀门等和在气体利用装置上的气体燃料管（不围蔽在双层壁管路系统或通风管道中）占用的地方，诸如锅炉、柴油机、燃气轮机等应设有通风箱或通风罩。如果这种通风箱或通风罩不是由16.2.1.2所规定的、供管道用的抽风机来驱动，则应装备抽风系统并应按照16.2.9的规定设有连续的气体探测装置以检测泄漏并停止向机器处所供应气体燃料。抽风机的布置应在抽风不起作用以致不能实现所要求的空气流动的情况下切断向机器处所供应气体燃料。通风箱或通风罩的安装或架设应能使通风空气扫过气体利用装置且在箱或罩的顶部予以排出。

16.2.5 空气通风系统所需要的补偿空气和从通风系统排出的空气应从安全位置进出。

16.2.6 每台气体利用装置应配备1套3个自动阀。其中两个阀应串接在通向消耗设备的气体燃料管路上。另一个阀则应安装在两个串接阀门之间部分气体燃料管路的排气管路上，且应排向开敞大气的安全处所。这些阀门应布置成当必需的鼓风失效、锅炉燃烧器熄火、气体燃料供应管压力不正常或驱动介质控制阀门失效时能导致自动关闭两个串接气体燃料阀并自动打开排气阀。或者，两个串接阀中的一只阀的功能与通气管路上的阀的功能能结合成一只阀体，其布置应是：如发生上述情况之一时，能切断气体流向气体利用装置并打开排气口。

16.2.7 应在机器处所的外面装设能在机器处所内予以关闭的气体燃料主阀。阀的布置应为当检测出气体泄漏或是导管或通风罩发生通风失效或是发生双层壁气体燃料管失压时，阀门能自动关闭。

16.2.8 应采取措施对机器处所内的气体燃料管系进行惰化和气体清除。

16.2.9 按照16.2.1和16.2.4的要求所安装的气体探测系统在燃烧下限的30%时应能报警,并在气体浓度达到燃烧下限的60%之前停止向机器处所供应气体燃料。

16.2.10 气体燃料系统的所有细节应提交给主管机关认可。

## 第17章 特殊要求

### 17.1 通则

凡引用第19章表中“h”栏的特殊要求时,适用本章的规定。这些特殊要求是对本规则一般要求的补充。

### 17.2 结构材料

在正常作业时可能与货物接触的材料应能抗气体的腐蚀作用。另外,供液货舱及附属的管路、阀门、附件以及其他地方用的下列结构材料不应用于第19章表中“h”栏所列的货品:

- .1 汞、铜与铜基轴承合金及锌;
- .2 铜、银、汞、镁和其他形成乙炔化合物的金属;
- .3 铝和铝基轴承合金;
- .4 铜、铜合金、锌或镀锌钢;
- .5 铝或铜或其任一种的合金;
- .6 铜和含铜量大于1%的铜基轴承合金。

### 17.3 独立液舱

17.3.1 货品只应在独立液舱中载运。

17.3.2 货品在C型独立液舱中载运,并适用7.1.3的规定。液货舱的设计压力应考虑任何气垫压力或蒸气排放卸载压力。

### 17.4 制冷系统

17.4.1 只应采用7.2.4.2所述的间接系统。

17.4.2 对于装运容易发生危险的过氧化物货品的船舶,再冷凝的货物不允许形成非抑制液体的滞积囊。这可采取下述任一方法来实现:

- .1 采用7.2.4.2所述的液货舱内部具有冷凝器的间接系统;或
- .2 分别采用7.2.4.1所述的直接系统或7.2.4.3所述的综合系统,或是采用7.2.4.2所述的液货舱外部具有冷凝器的间接系统,同时把这种冷凝系统设计成能避免在任何地方积聚和滞留液体。如不可能,则应在这一地点的前段添加抑制性液体。

17.4.3 如果船舶在连续装运17.4.2所规定的货品当中插入一次压载航行,则在压载航行前应除去所有未加抑制的液体。如果在连续装运这种货物之间装运第二种货物,则在装载第二种货物前应彻底地排泄和清洗再液化系统。清洗应使用惰性气体或(如相容时)第二种货物的蒸气进行。应采取实际步骤确保在货物系统中不积聚聚合物或过氧化物。

#### 17.5 甲板货物管

对直径超过75mm的货物管上所有对接焊接头均要求作100%的射线照相检验。

#### 17.6 排除蒸气处所的空气

装货前应排除液货舱及其附属管中的空气,然后用下述方法对空气进行清除:

- .1 引入惰性气体以保持正压力。惰性气体的储存或生产量应足以满足正常的操作要求以及释放阀的泄漏。惰性气体中的含氧量在任何时候不得超过容积的0.2%;或
- .2 控制货物的温度使在所有时间内都保持正压力。

#### 17.7 湿度控制

对于不易燃而可能变成腐蚀性或与水起危险反应的气体,要求进行湿度控制以确保液货舱在装货前是干燥的,同时在卸货期间应引入干燥空气或货物蒸气以防出现负压力。在本条范围内,干燥空气系指在大气压力下应有-45°C或更低的露点。

#### 17.8 抑制

应注意确保货物充分抑制以防止在整个航行期间起聚合作用。船上应持有制造商提供的证书,说明:

- .1 所添加的抑制剂的名称和数量;
- .2 添加剂加入的日期和正常情况下预计的有效期;
- .3 影响抑制剂的任何温度限制;
- .4 航行周期超过抑制剂有效期时应采取的措施。

#### 17.9 固定安装的有毒气体检测器

17.9.1 气体取样管路不应引入或穿过气体安全处所。如蒸气浓度达到阀门限值,应触发13.6.7所述的报警器。

17.9.2 不允许使用按13.6.9规定的可携式设备作为替代装置。

#### 17.10 透气出口处的防火网

如载运本节所述的某种货物,液货舱的透气出口处应配备能易于更换和有效的防火网或认可型的安全罩。在设计防火网和安全罩时,应适当注意这些装置在恶

劣气候条件下由于货物蒸气的凝结或结冰而引起阻塞的可能性。取出防火网后应装上普通的保护网。

#### 17.11 每个液舱最大的许可载货量

如载运本节所述的货物时，任何一个液舱的载货量不应超过 $3,000\text{m}^3$ 。

#### 17.12 电动潜水货泵

在易燃液体装货前、运输中和卸货期间，配备有电动潜水电动机泵的液货舱内的蒸气处所应充惰化气体至正压力。

#### 17.13 氮

因为高浓度的氮在有限空间内可能会引起燃烧，因此除开敞甲板区域以外，应适用第10章对可燃货品的规定。决不能把液态氮溅入含有空气的液舱内，因为这样在舱内会引起静电荷而造成着火的风险。当氮在 $-20^\circ\text{C}$ 以上温度载运时（蒸气压力为表压 $1.9\text{ bar}$ ），为了使应力腐蚀裂缝的危险性减至最低限度，在液态氮引入之前，受压容器内以及碳锰钢材料制成的管子内蒸气空间中的含氧量应减至可能的最低值。在 $-33^\circ\text{C}$ 下作业的液舱冷凝系统可能会受到影响，除非它们业经作了热应力消除。

#### 17.14 氧

##### 17.14.1 货物围护系统

17.14.1.1 每一液舱载货的容积应不超过 $600\text{ m}^3$ ，而所有液货舱的载货的总容积应不超过 $1,200\text{m}^3$ 。

17.14.1.2 液舱的设计蒸气压力应不低于表压 $13.5\text{ bar}$ （并参见7.1.3和17.3.2）。

17.14.1.3 液舱突出在上甲板上方的部分应设有保护措施，以防计及全部被火焰包围时的热辐射。

17.14.1.4 每一液舱应配备两只安全释放阀。应在液货舱和安全释放阀之间安装适当材料制成的安全片。安全片的裂破压力应比安全释放阀的开启压力低 $1\text{ bar}$ ，开启压力应设定等于液舱的设计蒸气压力，但不低于 $13.5\text{ bar}$ （表压）。安全片与释放阀之间的处所应通过一个过流阀连接到压力表和气体检测系统上。应采取使这一空间保持在正常作业时达到或接近大气压力。

17.14.1.5 压力释放阀出口的布置应能使船上以及周围环境的危险性减少至最低限度。释放阀的渗漏应引至吸收装置，以尽可能降低气体浓度。释放阀排放管布置在船舶的前端在甲板平面向舷外排放，同时应设一用机械联锁的、能选择左、右舷的装置，以确保有一条排放管总是开着的。

17.14.1.6 主管机关和港口当局可要求氯气在规定的最大压力下以冷冻状态装运。

#### 17.14.2 货物管系

17.14.2.1 货物的排卸应利用岸上的压缩氯蒸气、干燥空气或另一种认可的气体或全潜泵。液舱内蒸气处所的压力在排放期间应不超过 10.5 bar 表压。主管机关应不允许使用船上配置的货物排放压缩机。

17.14.2.2 货物泵系的设计表压力应不小于 21 bar 表压。货管的内径应不超过 100mm。补偿管子的热力运动的方式只同意用管子弯头。使用法兰接头的数目应减至最少,如要使用,法兰应为槽舌结合的焊接形式。

17.14.2.3 货物管系的释放阀应排放至吸收装置(并参见 8.2.16)。

#### 17.14.3 材料

17.14.3.1 液货舱和货物管系应由适用于货物和 -40 °C 温度的钢材制成,即使打算采用更高的运输温度,也应如此。

17.14.3.2 液货舱应作热应力消除。机械性应力消除不允许作为等效方法。

#### 17.14.4 仪表——安全装置

17.14.4.1 船舶应设有与货物管系和货舱相连接的氯气吸收装置。吸收装置应至少能按合理的吸收率来中和至少为全部货物容量的 2%。

17.14.4.2 在液货舱除气期间,不应将蒸气排向大气。

17.14.4.3 应配备能检测氯浓度(体积含量)至少为 1ppm 的气体探测系统。

吸气点应布置在:

- .1 接近货物货舱的底部;
- .2 安全释放阀的管子内;
- .3 气体吸收装置的出口处;
- .4 居住、服务和机器处所及控制站的通风系统的进口处;
- .5 货物区前端、中部和后端的甲板上(只要求用于货物装卸和除气操作时)。

气体探测系统应配备声光报警器,设定点为 5ppm。

17.14.4.4 每一液货舱应装备一个高压报警器,能在表压等于 10.5 bar 时发出音响报警信号。

#### 17.14.5 人员保护

除第 14 章所述的要求外,尚应满足下列要求:

- .1 14.4.5 所要求的围蔽处所应能从开敞甲板和居住处所方便而迅速地进入,且能迅速地作气密关闭。从甲板和居住舱室的其余地方

进入该围蔽处所应通过空气闸。该处所应设计成能容纳船上的全部船员并应能提供维持不少于4小时的未受污染的空气源。14.4.3所要求的消毒淋浴设备之一应设置在该处所靠近空气闸的部位。

.2 应配备一台压缩机和必要设备以注满空气瓶。

.3 17.14.5.1所述的处所内应配备一套氧气理疗设备。

#### 17.14.6 液货舱的充装极限

17.14.6.1 如拟载运氨气,则15.1.4.2的要求不适用。

17.14.6.2 装货后,液货舱蒸气处所内气体中氨容积含量应大于80%。

#### 17.15 乙醚、乙氧基乙烯

17.15.1 乙醚及乙氧基乙烯货物只准用深井泵或由液压操纵的潜水泵排放。这些泵的类型应设计成能避免液压施加在轴填料盖上。

17.15.2 如货物系统是按预计压力设计的,惰性气体置换法可用来排放C型独立液舱的货物。

#### 17.16 环氧乙烷

17.16.1 载运环氧乙烷时,适用17.20的要求,同时应满足本节给出的附加和修改要求。

17.16.2 甲板液舱不应用作载运环氧乙烷。

17.16.3 416和442型不锈钢以及铸铁不应用于环氧乙烷货物围护系统和管系。

17.16.4 装货前,各液舱应进行彻底而有效的清洁以清除舱内及附属管路中前次所装货物的痕迹,除非刚刚装过的货物是环氧乙烷、氧化丙烯或是这些货物的混合物。用不锈钢以外的钢质液舱装氨时,应特别予以注意。

17.16.5 环氧乙烷只准用深井泵或惰性气体置换法排放。泵的布置应符合17.20.6.3规定。

17.16.6 环氧乙烷只准以冷冻状态载运并保持温度低于30℃。

17.16.7 压力释放阀应设定在表压不低于5.5bar。最大设定压力应经主管机关专门批准。

17.16.8 17.20.15所要求的氮气保护衬垫应能使液货舱蒸气处所的氮浓度在任何时候不少于45%(按容积计)。

17.16.9 在装货前及在液货舱内装有环氧乙烷的液体或蒸气的任何时间内,液货舱应用氮气惰化。

17.16.10 17.20.17和11.3所要求的水雾系统在火灾延至货物围护系统的情况下应能自动操作。

17.16.11 应提供一投弃货物的装置，以便在不可控制的自身反应时可将环氧乙烷应急排放。

#### 17.17 异丙胺、乙胺

应配备如 1.3.32 所规定的隔离管路系统。

#### 17.18 甲基乙炔-丙二烯混合物

17.18.1 甲基乙炔-丙二烯混合物应适当地进行稳定处理以便运输。另外，对混合物，在冷冻时应规定其温度和压力的上限。

17.18.2 可予接受的、稳定处理后的成分样例为：

##### .1 成分 1

- .1.1 最大的甲基乙炔对丙二烯摩尔比为 3:1；
- .1.2 摩尔百分浓度为 65 的甲基乙炔和丙二烯的最大化合浓度；
- .1.3 摩尔百分浓度为 24 的丙烷、丁烷和异丁烷的最低化合浓度，其中至少  $1/3$ （以摩尔为单位）为丁烷和  $1/3$  为丙烷；以及
- .1.4 摩尔百分浓度为 10 的丙烯和丁烯的最大化合浓度。

##### .2 成分 2

- .2.1 摩尔百分浓度为 30 的甲基乙炔和丙二烯的最高化合浓度；
- .2.2 摩尔百分浓度为 20 的甲基乙炔的最高浓度；
- .2.3 摩尔百分浓度为 20 的丙烯的最高浓度；
- .2.4 摩尔百分浓度为 45 的丙烯的最高浓度；
- .2.5 摩尔百分浓度为 2 的丁二烯和丁烯的最高化合浓度；
- .2.6 摩尔百分浓度为 4 的饱和的 C<sub>4</sub> 碳氢化合物的最低浓度；以及
- .2.7 摩尔百分浓度为 25 的丙烷最低浓度。

17.18.3 只要混合物的稳定性经过验证达到主管机关满意的程度也可接受其他化合成分。

17.18.4 载运甲基乙炔-丙烯混合物的船舶最好具有按 7.2.4.2 规定的直接制冷系统。或者，对未设有直接制冷系统的船舶可使用直接蒸气压缩冷冻，但应受到与化合成分有关的压力和温度的限制。对于 17.18.2 所给出的成分样例，应具有下列特点：

- .1 一台蒸气压缩机，其在运行期间温度的升高不应超过 60 °C，压力增加不应高出 17.5 bar 表压力，同时在继续运行期间，不允许蒸气在压缩机内停滞。

- .2 压缩机每一级的排放管或往复压缩机同一级中的每一气缸引出的排放管应具有：
  - .2.1 两只温度激动的关闭开关，设定在 60 °C 或 60 °C 以下动作；
  - .2.2 一只压力激动的关闭开关，设定在 17.5 bar 或 17.5 bar 表压以下动作；及
  - .2.3 一只安全释放阀，设定在 18.0 bar 或 18.0 bar 表压以下释放。
- .3 17.18.4.2.3 所要求的释放阀应引至满足 8.2.9，8.2.10，8.2.13 和 8.2.14 要求的某一桅处排气，且不应释放入压缩机的吸入管内。
- .4 一台报警器，当一高压开关或高温开关动作时，该报警器应在货物控制站和驾驶台内发出警报。

17.18.5 准备装载甲基乙炔-丙二烯混合物的液舱管系，包括货物冷冻系统，应与其他液舱的管系和冷冻系统相独立（如 1.3.20 规定）或隔离（如 1.3.32 规定）。此种隔离适用于所有液体和蒸气排气管路及其他诸如公用惰性气体供应管这样的连接接头。

#### 17.19 氮

结构和附属设备（诸如绝缘）的材料应能承受高浓度氧的作用，它是由于在货物部分系统的低温使氧冷凝和浓缩所造成的。对这些可能发生冷凝情况的区域，其通风应给予特别考虑以避免形成富氧大气层。

#### 17.20 氧化丙烯和含有按重量计不超过 30 % 环氧乙烷的环氧乙烷/氧化丙烯的混合物

17.20.1 根据本节规定所运输的货品应为不存在乙炔者。

17.20.2.1 除非液货舱经适当的清洁，否则这些货品不应装运在曾经储存过已知有催化聚合作用的上述三种货物之一的液舱内，例如：

- .1 无水氨和氨气溶液；
- .2 胺及胺溶液；
- .3 氧化物物质（例如氮）。

17.20.2.2 装货前，各液舱应进行彻底而有效的清洁，以清除舱内附属管路中过去装货物的痕迹，除非刚刚装过氧化丙烯或环氧乙烷-氧化丙烯混合物。对在不锈钢以外的钢质液舱中装氨时，应特别予以注意。



17.20.2.3 在所有的情况下，对液舱及其附属的管路清洗方法的有效性应通过适当的试验或检验方法进行校核，以查明当存在上述货品时，不致遗留下可能会引起危险情况的酸性或碱性物质的痕迹。

17.20.2.4 在每次初次装载上述货品之前，应进入液舱进行检查，以确保无污染、无大量铁锈沉淀及明显的结构缺陷。如这些液货舱继续装运上述货品，则进行此种检查的间隔期应不超过两年。

17.20.2.5 载运上述货品的液舱应为钢质或不锈钢的结构。

17.20.2.6 装运过上述货品的液舱，在对液舱及其附属的管路用冲洗或吹洗进行彻底的清洁后可用作载运其他货物。

17.20.3.1 所有的阀、法兰、配件和辅助设备应为与上述货品相适用的一种型式，且应为钢或不锈钢或其他为主管机关接受的材料所建造。建造前，所用材料的化学成分应提交给主管机关认可。阀盘或阀盘面、阀基座和阀中其他易磨损的部件应由含铬量不低于11%的不锈钢制成。

17.20.3.2 衬垫应由不与上述货品起反应、不溶于上述货品、不降低上述货品的自然温度且能耐火和具有合适的机械性能的材料制成。面向货物的表面应为聚四氟乙烯（PTFE）或其惰性达到类似安全程度的材料。含有聚四氟乙烯（PTFE）或类似氟化聚合物作填料的螺旋卷绕的不锈钢可以被主管机关所接受。

17.20.3.3 如需使用绝缘和垫料，应为不与上述货品起反应、不溶于上述货品或是不降低上述货品自然温度的材料。

17.20.3.4 通常发现，下列材料用作上述货品围护系统中的衬垫、垫料、和类似用途时，其效果是不好的，应在主管机关认可以前进行试验：

- .1 氯丁橡胶或天然橡胶（如与上述货品接触时）；
- .2 石棉或用于石棉的粘合剂；
- .3 含有镁氧化物的材料（例如矿棉）。

17.20.4 装卸管路应延伸至液舱底或任何集液槽底部100mm的范围内。

17.20.5.1 货品的装卸方式应使液舱不致向大气排气。如果液舱装货期间，利用岸上回收蒸气法，则与货品相连接的货物围护系统的蒸气回收系统应与所有其他围护系统分开。

17.20.5.2 在卸货作业时，液货舱的压力应保持在0.07bar表压以上。

17.20.5.3 货物只可由深井泵、液压操作的潜水泵或惰性气体置换法来排卸。每一货泵的布置应能确保当泵的排卸管被截止或被阻塞时，此项货品不会显著发热。

17.20.6 载运上述货品的液舱的透气系统应与载运其他货品的液舱透气系统分开。应设置能对液舱内容进行取样而不必开启液舱与大气相通的设施。

17.20.7 运输上述货品所用的货物软管应标明“限于运输氧化烯货品”。

17.20.8 对上述货品的货舱应进行监测。A和B型独立液舱周围的货舱也应惰化并对氧进行监测。这些处所的氧含量应保持在2%以下。可携式取样设备应是合格的。

17.20.9 拆开通岸管路前，液体和蒸气管路中的压力应通过安装在装货集管上的适当的阀进行释放。从这些管路出来的液体和蒸气不应排向大气。

17.20.10 液货舱应按在货物装载、运输或卸载过程中可能遇到的最大压力进行设计。

17.20.11 对载运氧化丙烯具有设计蒸气压力低于0.6bar的液舱和对载运环氧乙烷氧化丙烯混合物具有设计蒸汽压力低于1.2bar的液舱，应设有一个冷却系统，以保持货物在基准温度以下。有关基准温度参阅15.1.4.1。

17.20.12 压力释放阀的设定值应不小于0.2bar表压，而且对C型独立液舱，如载运氧化丙烯时不大于7.0bar表压，而载运环氧乙烷-氧化丙烯混合物时，则大于5.3bar表压。

17.20.13.1 装载上述货品的液舱管系应与所有其他液舱（包括空液舱）的管系以及与所有货物压缩机全部隔开。如果装载上述货品的液舱管系并不按1.3.20规定是独立的话，则所要求管系的分隔应通过拆去短管、阀门、或其他管段并在这些位置安装盲板法兰予以实现。这样要求的分隔同样也适用于所有液体和蒸气管路、液体和蒸气透气管路以及任何其他可能的连接接头（诸如公用气体供应管路等）。

17.20.13.2 上述货品只能按经主管机关认可的货物装卸图运输。拟定的每一装货布置应在单独的装卸图上表明。货物装卸图上应标明全部货物管路系统和为满足上述管路隔离要求安装盲板法兰的位置。每一份经认可的货物装卸图的副本应保存在船上。国际散装运输液化气体适装证书的背签中应包括认可的货物装卸图。

17.20.13.3 装载上述货品前，应从港口当局认可的负责人员处取得证实业已达到所要求的管系分隔的证书并携带在船上。在盲板法兰和管路法兰之间的每一连接接头应由负责人员装上金属丝并加以铅封以保证不致由于疏忽而拆去盲板法兰。

17.20.14 每一液舱的最大许可充装极限应按可能采用的每一装货温度和适用的最大基准温度指明在提交给主管机关认可的表格上。此表的副本应由船长永久性地保存在船上。

17.20.15 应在适当的氮气保护垫下载运货物。应安装一氮气自动补充系统,以防万一由于环境条件或冷冻系统的误动作造成货品温度下降时液舱压力不致下降到低于0.07 bar表压以下。在船上应备有足量的氮气以满足自动压力控制的需要。应采用商业纯度的氮气(按容积计99.9%)作为气垫。一组通过减压阀连接到液货舱的氮气瓶可以满足本文提出的“自动”一词义的含义。

17.20.16 液货舱蒸气处所应在装货前和装货后作试验,以保证按容积计的含氧量为2%或以下。

17.20.17 应设有足够容量的水雾系统以有效地覆盖装货总管及与货品装卸有关的露天甲板管系和液货舱气室周围的区域。管系和喷嘴的布置应使水雾的均匀分布率为每分钟10升/m<sup>2</sup>。水雾系统应能既可就地手控操作又可远距离手控操作,同时其布置应确保任何溢出的货物能被冲洗干净。另外,若大气温度许可时,应在装卸作业期间,将一条具有压力的输水软管连到水枪以便随时使用。

#### 17.21 氯乙烯

如添加抑制剂能预防氯乙烯的聚合作用,则17.8的规定是适用的。如未曾添加抑制剂或是抑制剂添加量不足,则17.6规定所要使用的任何惰性气体内含氧量应不超过0.1%。在开始装货之前,从液舱和管系内取出的惰性气体样品应加以分析。如载运氯乙烯,液舱内始终应保持正压力,甚至在连续装运之间的压载航行时也应如此。

### 第18章 操作要求

#### 18.1 货物资料

18.1.1 船上应备有资料且供所有有关方面使用,主要内容为货物安全运输提供必要的资料。此类资料应针对每种被运输的货品,其具体项目如下:

- .1 一份为货物安全围护所必需的物理和化学性能的详细说明书;
- .2 发生溢出或泄漏事故时需要采取的措施;
- .3 防备人员偶而接触的防范措施;
- .4 灭火程序和灭火剂;
- .5 货物运输、气体清除、压载、清洗液舱和交换货物的程序;
- .6 安全装卸特种货物所需的特殊设备;
- .7 内层船壳钢最低温度;
- .8 应急措施。

18.1.2 如未提供17.8所要求的证书,则应拒绝装运需作抑制的货品。

18.1.3 遵照本规则的每条船上应保存有本规则的副本或结合本规则条款的国家规则。

## 18.2 相容性

18.2.1 船长应弄清楚所装载的每一货品的数量和特性系在 1.5 所规定的国际散装运输液化气体适装证书和 2.2.5 所规定的装载和稳性手册所述范围之内，同时如证书第 3 节有所要求，则船长还应核实这些货品已列入国际散装运输液化气体适装证书之中。

18.2.2 如货物系混装时，应注意避免可能发生的危险性化学反应。就下述情况而言，这点特别重要：

- 1 同一液舱内连续装货之间所要求的液舱清洗程序；以及
- 2 同时载运几种在混装时会起化学反应的货物。只有整个货物系统包括但并不限于货物管路、液舱、透气系统和冷藏系统，按 1.3.3 2 规定的加以分隔时才许可进行混装。

## 18.3 人员培训\*

18.3.1 对货物操作人员应在操作程序方面进行适当训练。

18.3.2 所有人员对使用船上备有的保护设备应进行充分训练并进行与他们的职务相适应的、在紧急情况下采取必要操作程序的基本训练。

18.3.3 高级船员应进行应急程序的训练以处理泄漏、溢出或是货物发生火灾的情况，并对其中足够数量的人员讲授和训练适于所载货物的主要急救方法。

## 18.4 进入处所

18.4.1 人员不得进入可能有气体聚集的液货舱、货舱、空舱、货物装卸处所或其他围闭处所，除非：

- 1 在上述处所大气中的气体含量用固定式或可携式设备确定具有足够的氧气而且不存在有毒大气；或
- 2 人员配带有呼吸器和其他必需的保护设备，且全部操作是在高级船员严密监督下进行的。

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\* 参阅 1978 年国际海员培训、发证及值班标准公约，特别是该公约附则第 V 章第 V/3 条“散装液化气体船船长、高级及普通船员培训及资历的法定最低要求”，以及 1978 年国际海员培训与发证会议决议 12 的内容。

18.4.2 人员进入装有可燃货品的船上的任一气体危险处所不得引入任何潜在的着火源，除非业已核准该处所已清除过气体并一直保持着那种状况。

18.4.3.1 对内部绝热液舱，如在其相邻液舱进行热工工作，应采取专门的防火措施。为此目的，应考虑绝热材料吸收气体的特性和把已吸收的气体除掉的特性。

18.4.3.2 对内部绝热液舱，应根据 4.4.7.6 所规定的程序进行修理。

## 18.5 低温下装运货物

18.5.1 如货物在低温下装运时，应注意下列事项：

- .1 与货物围护系统相配套的加垫设备的操作方式应能确保温度不致下降到低于船壳结构材料的设计温度；
- .2 装载方式应确保任何液舱、管系或其他附属设备中不致发生令人不满意的温度梯度；以及
- .3 当液舱的温度逐渐从环境温度或接近环境温度向下冷却时，应严格遵守为特定液舱、管系和附属设备所规定的冷却程序。

## 18.6 防护设备

应使人员意识到货物处理过程中可能涉及的危险性，同时在指导其在货物装卸过程中小心操作并使用 14.1 所规定的合适防护设备。

## 18.7 系统和控制

在货物装卸作业开始前，应试验和检验与货物运输有关的货物应急关闭系统和报警系统。在运输作业前也应试验和/或检验主要的货物装卸控制设备。

## 18.8 货物运输作业

18.8.1 在运输开始前，船上人员与岸上负责设备人员应共同讨论包括应急措施在内的货物运输作业要求，并在整个运输作业过程中保持通信联系。

18.8.2 13.3.1 所述的阀的关闭时间（即指从激发关闭信号至阀全部关闭为止的时间）应不大于下列公式之值：

$$\frac{3600 U}{LR} \quad (s)$$

式中：U = 作业信号液位上方空挡容积 (m<sup>3</sup>)

L R = 经商定的船、岸运输工具之间最大装货率 (m<sup>3</sup>/h)。

考虑到装货软管或吊臂以及船和岸之间有关的管系系统，装货率应调整在当阀关闭时把急冲压力限定在可以接受的标准上。

### 18.9 附加的操作要求

在本规则下述条文中可查明附加的操作要求：

3.8.4, 3.8.5, 7.1.1.5, 8.2.5, 8.2.7, 9.4.2, 12.1.1, 12.1.10, 13.1.4, 14.2.5, 14.2.6, 14.3.1, 15.1, 15.2, 16.2.2, 17.4.2, 17.6, 17.7, 17.12, 17.13, 17.14, 17.15, 17.16, 17.17, 17.18, 17.20.

## 第19章 最低要求一览表

### 最低要求一览表的注释

联合国编号	第19章表内所列的联合国编号系供参考之用。
蒸气检测要求 (f 栏)	F —— 易燃性蒸气检测 T —— 毒性蒸气检测 O —— 氧气分析器 F+T —— 易燃和毒性蒸气检测
仪表——许可的类型 (g 栏)	I —— 13.2.2.1 和 .2 所述的间接或封闭型 C —— 13.2.2.1, .2 和 .3 所述的间接或封闭型 R —— 13.2.2.1, .2, .3 和 .4 所述的间接、封闭或限制型
致冷剂气体	无毒和不易燃的气体，诸如： (1028) 二氯二氟甲烷 (1029) 二氯一氟甲烷 (1958) 二氯四氟乙烷 (1018) 一氯二氟甲烷 (1021) 一氯四氟乙烷 (1022) 一氯三氟甲烷

除另有明文规定外，气体混合物中所含的乙炔低于总量的5%可予运输，不再有比其主要组成成分更进一步的要求。

a	b	c	d	e	f	g	h
货品名称	中国国名	包装要求	是否危险品	是否易燃	是否有毒	是否腐蚀性	特殊要求
乙醚	1089	2G/ 2PG	-	Inert	F+T	C	14.4.3, 14.4.4, 17.4.1, 17.6.1
氨(无水的)	1005	2G/ 2PG	-	-	T	C	14.4.2, 14.4.3, 14.4.4, 17.2.1, 17.13
丁二烯	1010	2G/ 2PG	-	-	F	R	17.2.2, 17.4.2, 17.4.3, 17.6, 17.8
丁烷	1011	2G/ 2PG	-	-	F	R	
丁烷/丙烷混合物	1011/ 1978	2G/ 2PG	-	-	F	R	
丁烯	1012	2G/ 2PG	-	-	F	R	
氯	1017	1G	Yes	Dry	T	L	14.4, 17.3.2, 17.4.1, 17.5, 17.7, 17.9, 17.14
乙醚*	1155	2G/ 2PG	-	Inert	F+T	C	14.4.2, 14.4.3, 17.2.6, 17.3.1, 17.6.1, 17.10, 17.11, 17.15
二甲苯胺	1032	2G/ 2PG	-	-	F+T	C	14.4.2, 14.4.3, 14.4.4, 17.2.1
乙烷	1961	2G	-	-	F	R	
氯乙烷	1037	2G/ 2PG	-	-	F+T	R	
乙 烯	1038	2G	-	-	F	R	
环氧乙烷	1040	1G	Yes	Inert	F+T	C	14.4.2, 14.4.3, 14.4.4, 14.4.6, 17.2.2, 17.3.2, 17.4.1, 17.5, 17.6.1, 17.16
环氧乙烷/氧化丙烯混合物, 但环氧乙烷的含量按重量计不超过30%	2983	2G/ 2PG	-	Inert	F+T	C	14.4.3, 17.3.1, 17.4.1, 17.6.1, 17.10, 17.11, 17.20

\* 此货品也包括在IBC规则内。

a	b	c	d	e	f	g	h
货品名称	申请国名称	标志要求	是否有害于健康	是否有害于环境	是否有害于水生生物	是否有害于大气	特殊要求
异戊间二烯*	1218	2C/ 2PC	-	-	F	R	16.4.3, 17.8, 17.10, 17.12
异丙烷	1221	2C/ 2PC	-	-	F+T	C	16.4.2, 16.4.3, 17.2.4, 17.10, 17.11, 17.12, 17.17
甲烷 (液态天然气)	1972	2C	-	-	F	C	
甲基乙炔-丙二烯 混合物	1060	2C/ 2PC	-	-	F	R	17.18
溴甲烷	1062	1C	Yes	-	F+T	C	16.4, 17.2.3, 17.3.2, 17.4.1, 17.5, 17.9
氟甲烷	1063	2C/ 2PC	-	-	F+T	C	17.2.3
乙烷*	1036	2C/ 2PC	-	-	F+T	C	16.4.2, 16.4.3, 16.4.4, 17.2.1, 17.3.1, 17.10, 17.11, 17.12, 17.17
氟	2040	3C	-	-	0	C	17.19
丙烷	1978	2C/ 2PC	-	-	F	R	
丙烯	1077	2C/ 2PC	-	-	F	R	
氧化丙烯	1280	2C/ 2PC	-	Inert	F+T	C	16.4.3, 17.3.1, 17.4.1, 17.6.1, 17.10, 17.11, 17.20
致冷气体 (见注解)	-	3C	-	-	-	R	
二氧化氮	1079	1C	Yes	017	T	C	16.4, 17.2.2, 17.4.1, 17.5, 17.7, 17.9
氟乙烯	1086	2C/ 2PC	-	-	F+T	C	16.4.2, 16.4.3, 17.2.2, 17.3.1, 17.3.2, 17.5, 17.21
乙氧基乙烯*	1302	2C/ 2PC	-	Inert	F+T	C	16.4.2, 16.4.3, 17.2.2, 17.3.1, 17.6.1, 17.8, 17.10, 17.11, 17.15
亚乙烯基*	1303	2C/ 2PC	-	Inert	F+T	R	16.4.2, 16.4.3, 17.2.3, 17.4.1, 17.8, 17.10, 17.11

\* 该货品也包括在 IUC 规则内。



附 录

国际散装运输液化气体适装证书的标准格式

国际散装运输液化气体适装证书

( 公章 )

根据国际散装运输液化  
气体船舶构造和设备规则的规定发证

( 决议 MSC.5(48) )

经.....政府授权，由.....

( 国家的正式全名 )

( 主管机关授权的组织或人员 )

发给。

船 名	船舶编号或 呼号	船籍港	货容量	船舶类别 ( 本规则 则 2.1 节 1/ )

安放龙骨或相应建造阶段的日期或如属改建船舶，则为改建成气体运输船的开始日期。

.....

船舶亦完全符合本规则下列修正案的要求。

.....  
.....

船舶免除本规则的下列规定。

.....  
.....

兹证明：

- 1 .1 此船业已根据本规则 1.5 的规定进行了检验；
- .2 检验查明船舶的结构、设备、附件、装置和材料及其状况在各方面均为合格，且该船符合本规则的有关条款。

本证书应以发证国家的官方语文书写。 如所用语文既非英文又非法文，则应包括英文或法文的译文。

2 下列设计参数业已采用:

.1 环境空气温度.....°C 2/

.2 环境水温.....°C 2/

.3

液舱型式及舱号 及舱号	应力系数 2/				材料 2/	MARVS
	A	B	C	D		
货物管系						

注意: 本表所列液舱编号注明在附页 2 经签署并注有日期的液舱图上。

.4 液货舱材料的机械性能是在.....°C 2/时确定的。

3 该船适于散装运输下列货品, 但须符合本规则所有有关操作规定: 5/

货 品	运载条件 ( 舱号等 )

若表内填不上, 则续写在额外经签署并注有日期的附页 1 上。本表所列的舱号注明在附页 2 经签署并注有日期的液舱图上。

4 按照 1.4/2.8.2 \* 的规定, 对该船用下述方式修改了本规则的规定:

5 该船的装载必须符合:

- \* .1 认可的装货手册中所提供的装载条件, 该手册应由主管机关的负责官员或主管机关承认的机构 盖上印记、记录日期.....并签字;

\* 按需要删去。

\* .2 本证书所附的装载限制。

如果要求该船的装载不按照上述规定，则应向发证的主管机关递送能论证所建议装载条件的必要的计算书，该主管机关可以书面授权采用建议的装载条件。\*  
本证书有效至.....

19...年...月...日颁发于.....

( 发证地点 )

.....

( 经正式授权核发证书的官员签字 )

( 发证单位的公章或钢印 )

填写完证书时的注释：

- 1/ “船舶类别”：填入此栏的船型必须与所有有关建议内容相关，例如，填入“2G型”是指完全符合本规则规定的2G型。
- 2/ 第2.1和2.2段：应填入为符合本规则4.8.1规定的经主管机关接受或要求的环境温度。
- 3/ 第2.3段：应填入为符合本规则4.5.1.4和4.5.1.6规定的经主管机关接受或要求的应力系数和材料。
- 4/ 第2.4段：应填入为符合4.5.1.7规定的经主管机关接受的温度。
- 5/ 第3段：只有本规则第19章所列的货品或根据本规则1.1.6经主管机关评定的货品才可列在表内。对后一种“新”货品而言，应注上暂行的特殊要求。

法定年度检验的签署

兹证明在根据国际散装运输液化气体船舶构造和设备规则1.5.2.1.4要求的法定年度检验中，查明该船符合规则的有关规定。

签字:.....

( 授权官员签字 )

地点:.....

日期:.....

( 发证机关的公章或钢印 )

签字:.....

( 授权官员签字 )

\* 按需要删去。

[\*\*] 这段文字如不包括在证书中，则可附于该证书，但应适当加以签字并盖上印记。

地点:.....

日期:.....

(发证机关的公章或钢印)

签字:.....

(授权官员签字)

地点:.....

日期:.....

(发证机关的公章或钢印)

签字:.....

(授权官员签字)

地点:.....

日期:.....

(发证机关的公章或钢印)

注: 如果符合 1.5.2.1.3 和 1.5.2.1.4 的有关规定, 则期间检验可以替代法定的年度检验。

#### 期间检验的签署

兹证明业已按国际散装运输液化气体船舶构造和设备规则 1.5.2.1.3 进行了期间检验, 检验查明该船符合本规则的有关规定。

签字:.....

(授权官员签字)

地点:.....

日期:.....

(发证机关的公章或钢印)

签字:.....

(授权官员签字)

地点:.....

日期:.....

(发证机关的公章或钢印)

国际散装运输液化气体适装证书的附页 1

第 3 节规定的货品清单续表及运载条件。

货 品	运载条件 ( 舱号等 )

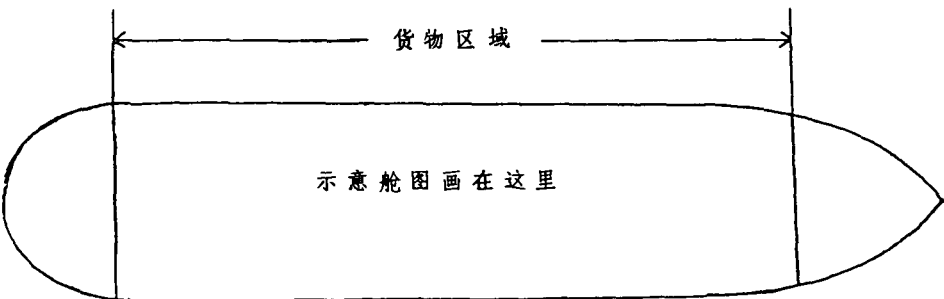
日期 .....  
( 与证书同 )

.....  
发证官员签字和 / 或发证当局盖章

国际散装运输液化气体适装证书附页 2

液舱图 ( 样式 )

船名: .....  
船舶编号或呼号: .....



日期 .....  
( 与证书同 )

.....  
发证官员签字和 / 或发证当局盖章

No. 18961. INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA,  
1974. CONCLUDED AT LONDON ON 1 NOVEMBER 1974<sup>1</sup>

AMENDMENTS to the above-mentioned Convention

The amendments were adopted on 17 June 1983 by resolution MSC.6(48) of the Maritime Safety Committee of the International Maritime Organization, in accordance with article VIII(b)(iv) of the Convention.

They came into force for all Parties to the Convention on 1 July 1986, i.e., six months after the date on which they were deemed to have been accepted (1 January 1986 as determined by the Maritime Safety Committee), no objection having been notified to the Secretary-General of the International Maritime Organization by any Contracting Government prior to that date, in accordance with article VIII of the said Convention.

*RESOLUTION MSC.6(48)*<sup>2</sup>  
*adopted on 17 June 1983*

ADOPTION OF AMENDMENTS TO THE INTERNATIONAL CONVENTION  
FOR THE SAFETY OF LIFE AT SEA, 1974<sup>3</sup>

The Maritime Safety Committee,

Noting article VIII(b) of the International Convention for the Safety of Life at Sea, 1974,<sup>3</sup> hereafter referred to as "the Convention", concerning the procedure for amending the Annex to the Convention, other than the provisions of chapter I thereof,

Noting further the functions which the Convention confers upon the Maritime Safety Committee for the consideration and adoption of amendments to the Convention,

Having considered at its forty-eighth session amendments to the Convention proposed and circulated in accordance with article VIII(b)(i) thereof,

1. Adopts in accordance with article VIII(b)(iv) of the Convention amendments to chapters II-1, II-2, III, IV and VII of the Convention, the texts of which are given in the Annex to the present resolution;

2. Determines in accordance with article VIII(b)(vi)(2)(bb) of the Convention that the amendments to chapters II-1, II-2, III, IV and VII shall be deemed to have been accepted on 1 January 1986 unless prior to this date more than one third of Contracting Governments to the Convention or Contracting Governments the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet, have notified their objections to the amendments;

3. Invites Contracting Governments to note that in accordance with article VIII(b)(vii)(2) of the Convention the amendments to chapters II-1, II-2, III, IV and VII shall enter into force on 1 July 1986 upon their acceptance in accordance with paragraph 2 above;

<sup>1</sup> United Nations, *Treaty Series*, vol. 1184, p. 2 (authentic Chinese and English texts), vol. 1185, p. 3 (authentic French, Russian and Spanish texts), vol. 1300, No. A-18961 (rectification of authentic English, French, Russian and Spanish texts) and vol. 1331, p. 400 (rectification of authentic Chinese text), and annex A in volumes 1198, 1208, 1226, 1266, 1286, 1300, 1323, 1355, 1370, 1371, 1372, 1391, 1402, 1406, 1408, 1419 and 1428.

<sup>2</sup> Resolution published for information by the Secretariat of the United Nations.

<sup>3</sup> United Nations, *Treaty Series*, vol. 1184, p. 2 (authentic Chinese and English texts), and vol. 1185, p. 3 (authentic French, Russian and Spanish texts).

4. Requests the Secretary-General in conformity with article VIII(b)(v) of the Convention to transmit certified copies of the present resolution and the texts of the amendments contained in the Annex to all Contracting Governments to the International Convention for the Safety of Life at Sea, 1974;

5. Further requests the Secretary-General to transmit copies of the resolution and its Annex to Members of the Organization which are not Contracting Governments to the Convention.

## 1983 AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974

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Amendment to Regulation 41. Main source of electrical power and lighting systems	Amendment to Regulation 32. Ventilation systems
Amendment to Regulation 42. Emergency source of electrical power in passenger ships	Replacement of Regulation 36. Fixed fire detection and fire alarm systems, automatic sprinkler, fire detection and fire alarm systems
Amendment to Regulation 43. Emergency source of electrical power in cargo ships	Amendment to Regulation 37. Protection of special category spaces
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- Replacement of Regulation 56. Location and separation of spaces
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## PART 3

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Addition of new Regulation 14-2. Periodic inspection and testing of emergency position-indicating radio beacons

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## PART 1

## CHAPTER II-1. CONSTRUCTION — SUBDIVISION AND STABILITY, MACHINERY AND ELECTRICAL INSTALLATIONS

Chapter II-1 of the Convention is replaced by the text of chapter II-1 annexed to resolution MSC.I(XLV),<sup>1</sup> further amended as follows:

*Regulation 1. APPLICATION*

In paragraph I.1, line 3, delete "1 September 1984" and insert "1 July 1986".

In paragraph 1.3.2, line 2, delete "1 September 1984" and insert "1 July 1986".

Replace the whole of paragraph 2 by:

"Unless expressly provided otherwise, for ships constructed before 1 July 1986 the Administration shall ensure that the requirements which are applicable under chapter II-1 of the International Convention for the Safety of Life at Sea, 1974, as amended by resolution MSC.I(XLV), are complied with."

Delete the footnote.

In paragraph 3, lines 4 and 9, delete "1 September 1984" and insert "1 July 1986".

Delete paragraph 5 and renumber paragraph 6 as paragraph 5.

*Regulation 3. DEFINITIONS RELATING TO PARTS C, D AND E*

In paragraph I8, delete "fiire" and insert "fire".

Amend paragraph 19 as follows:

"'Chemical tanker' is a cargo ship constructed or adapted and used for the carriage in bulk of any liquid product listed in either:

<sup>1</sup> See p. 353 of this volume.

- .1 Chapter 17 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk<sup>1</sup> adopted by the Maritime Safety Committee by resolution MSC.4(48), hereinafter referred to as 'the International Bulk Chemical Code', as may be amended by the Organization; or
- .2 Chapter VI of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk adopted by the Assembly of the Organization by resolution A.212(VII),<sup>2</sup> hereinafter referred to as 'the Bulk Chemical Code', as has been or may be amended by the Organization;
- whichever is applicable."

Amend paragraph 20 to read:

"Gas carrier' is a cargo ship constructed or adapted and used for the carriage in bulk of any liquefied gas or other products listed in either:

- .1 Chapter 19 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk<sup>3</sup> adopted by the Maritime Safety Committee by resolution MSC.5(48) hereinafter referred to as 'the International Gas Carrier Code', as may be amended by the Organization; or
- .2 Chapter XIX of the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk adopted by the Assembly of the Organization by resolution A.328(IX),<sup>4</sup> hereinafter referred to as 'the Gas Carrier Code', as has been or may be amended by the Organization;
- whichever is applicable."

*Regulation 4. FLOODABLE LENGTH IN PASSENGER SHIPS*

Paragraph 1, line 3, delete "and" and insert "and".

*Regulation 5. PERMEABILITY IN PASSENGER SHIPS*

Amend paragraph 4.1 to read:

"4.1. In the case of special subdivision required in regulation 6.5, the uniform average permeability throughout the portion of the ship forward of or abaft the machinery space shall be 95-35 b/v where:

- b = the volume of the spaces below the margin line and above the tops of floors, inner bottom, or peak tanks, as the case may be, which are appropriated to and used as cargo spaces, coal or oil fuel bunkers, storerooms, baggage and mail rooms, chain lockers and fresh water tanks, forward of or abaft the machinery space; and
- v = the whole volume of the portion of the ship below the margin line forward of or abaft the machinery space."

*Regulation 6. PERMISSIBLE LENGTH OF COMPARTMENTS IN PASSENGER SHIPS*

Paragraph 2.2, line 2, delete "seervice" and insert "service".

Replace the heading of section 5 by "Special subdivision standards for ships complying with regulation III/20.1.2."

Insert new paragraphs 5.3 and 5.4 as follows:

"5.3 The special provisions regarding permeability given in regulation 5.4 shall be employed when calculating the floodable length curves.

<sup>1</sup> See p. 353 of this volume.

<sup>2</sup> *Resolutions and Other Decisions, Intergovernmental Maritime Consultative Organization Assembly, Seventh Session, 5-15 October 1971*, p. 33.

<sup>3</sup> See p. 421 of this volume.

<sup>4</sup> *Resolutions and Other Decisions, Intergovernmental Maritime Consultative Organization Assembly, Ninth Session, 3-14 November 1975*, p. 90.

5.4 Where the Administration is satisfied that, having regard to the nature and conditions of the intended voyages compliance with the other provisions of this chapter and of chapter II-2 is sufficient, the requirements of this paragraph need not be complied with.”

*Regulation 41. MAIN SOURCE OF ELECTRICAL POWER AND LIGHTING SYSTEMS*

Paragraph 1.3, line 3, insert “of rotation” after “direction”.

*Regulation 42. EMERGENCY SOURCE OF ELECTRICAL POWER IN PASSENGER SHIPS*

Amend sub-paragraph 2.1.1 to read:

“1 At every muster and embarkation station and over the sides as required by regulations III/11.4 and III/15.7”.

Insert new sub-paragraph 2.1.2 to read:

“2 In alleyways, stairways and exits giving access to the muster and embarkation stations, as required by regulation III/11.5”.

Renumber sub-paragraphs 2.1.2 to 2.1.7 to read 2.1.3 to 2.1.8.

Paragraph 2.3.4, line 2, delete “manual fire alarms” and insert “manually operated call points”.

*Regulation 43. EMERGENCY SOURCE OF ELECTRICAL POWER IN CARGO SHIPS*

Paragraph 1.3, line 10, delete “sppace” and insert “space”.

Amend paragraph 2.1 to read:

“2.1 For a period of 3 h, emergency lighting at every muster and embarkation station and over the sides as required by regulations III/11.4 and III/15.7.”

Paragraph 2.4.4, line 2, delete “manual fire alarms” and insert “manually operated call points”.

*Regulation 49. CONTROL OF PROPULSION MACHINERY FROM THE NAVIGATING BRIDGE*

Paragraph 3, line 6, delete “the machinery space” and insert “the main machinery space”; delete “the machinery control room” and insert “the main machinery control room”.

Paragraph 5, line 3, insert “of the propeller” after “thrust”.

Paragraph 6.1, line 1, delete “in case” and insert “in the case”.

Paragraph 6.2, line 1, delete “in case” and insert “in the case”.

## PART 2

CHAPTER II-2. CONSTRUCTION — FIRE PROTECTION, FIRE DETECTION,  
AND FIRE EXTINCTION

Chapter II-2 of the Convention is replaced by the text of chapter II-2 annexed to resolution MSC.1(XLV), further amended as follows:

*Regulation 1. APPLICATION*

In paragraph 1.1, line 3, delete "1 September 1984" and insert "1 July 1986".

In paragraph 1.3.2, line 2, delete "1 September 1984" and insert "1 July 1986".

Replace the whole of paragraph 2 by:

"Unless expressly provided otherwise, for ships constructed before 1 July 1986 the Administration shall ensure that the requirements which are applicable under chapter II-2 of the International Convention for the Safety of Life at Sea, 1974, as amended by resolution MSC.1(XLV), are complied with."

In paragraph 3, lines 4 and 9, delete "1 September 1984" and insert "1 July 1986".

Delete the footnote.

*Regulation 3. DEFINITIONS*

In paragraph 12, correct "main and specie rooms" to read "'mail and specie rooms'".

Paragraph 30, amend to:

"'Chemical tanker' is a tanker constructed or adapted and used for the carriage in bulk of any liquid product of a flammable nature listed in either:

- .1 Chapter 17 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk adopted by the Maritime Safety Committee by resolution MSC.4(48), hereinafter referred to as 'the International Bulk Chemical Code', as may be amended by the Organization; or
- .2 Chapter VI of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk adopted by the Assembly of the Organization by resolution A.212(VII), hereinafter referred to as 'the Bulk Chemical Code', as has been or may be amended by the Organization;

whichever is applicable."

Paragraph 31, amend to:

"'Gas carrier' is a tanker constructed or adapted and used for the carriage in bulk of any liquefied gas or other products of a flammable nature listed in either:

- .1 Chapter 19 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk adopted by the Maritime Safety Committee by resolution MSC.5(48), hereinafter referred to as 'the International Gas Carrier Code', as may be amended by the Organization; or
- .2 Chapter XIX of the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk adopted by the Assembly of the Organization by resolution A.328(IX), hereinafter referred to as 'the Gas Carrier Code', as has been or may be amended by the Organization;

whichever is applicable."

Add an additional paragraph to read:

"32. 'Cargo area' is that part of the ship that contains cargo tanks, slop tanks and cargo pump rooms including pump rooms, cofferdams, ballast and void spaces adjacent to cargo tanks and also deck areas throughout the entire length and breadth of the part of the ship over the above-mentioned spaces."

*Regulation 4. FIRE PUMPS, FIRE MAINS, HYDRANTS AND HOSES*

In paragraph 3.3.2.6, line 3, delete “room” and insert “station”.

*Regulation 5. FIXED GAS FIRE-EXTINGUISHING SYSTEMS*

In paragraph 2.2, line 2, delete “quantity” and insert “volume”.

In paragraph 2.2, line 3, delete “quantities” and insert “volumes”.

*Regulation 6. FIRE EXTINGUISHERS*

In paragraph 7, line 2, delete “providceed” and insert “provided”.

*Regulation 7. FIRE-EXTINGUISHING ARRANGEMENTS IN MACHINERY SPACES*

In paragraph 1.2, lines 1 and 2, delete “air foam equipment” and insert “foam applicator unit”.

*Regulation 11. SPECIAL ARRANGEMENTS IN MACHINERY SPACES*

In the first line of paragraph 8, amend “An approved automatic fire detection and alarm system” to read “A fixed fire detection and alarm system”.

*Regulation 12. AUTOMATIC SPRINKLER, FIRE DETECTION AND FIRE ALARM SYSTEMS*

In paragraph 3, correct “sppaced” to read “spaced”.

*Regulation 13. FIXED FIRE DETECTION AND FIRE ALARM SYSTEMS*

In paragraph 2.1, lines 1, 2, 3 and 5, delete “Manual” and insert “Manually operated”.

*Regulation 14. FIXED FIRE DETECTION AND FIRE ALARM SYSTEMS*

FOR PERIODICALLY UNATTENDED MACHINERY SPACES

In paragraph 1, line 1, amend to read “A fixed fire detection and fire alarm system of an approved type in accordance with the”.

*Regulation 15. ARRANGEMENTS FOR OIL FUEL, LUBRICATING OIL  
AND OTHER FLAMMABLE OILS*

Insert a new paragraph 6 to read:

“6. *Prohibition of carriage of flammable oils in forepeak tanks*

Oil fuel, lubricating oil and other flammable oils shall not be carried in forepeak tanks”.

*Regulation 20. FIRE CONTROL PLANS*

Paragraph 1, lines 14 and 15, delete “national language” and insert “official language of the flag State”.

*Regulation 26. FIRE INTEGRITY OF BULKHEADS AND DECKS IN SHIPS  
CARRYING MORE THAN 36 PASSENGERS*

Paragraph 2.2, line 1, delete “for the purpose of” and insert “For”; line 10, delete “number”.

Paragraph 2.2(1), line 4, delete “fire control and recording stations” and insert “fire control rooms and fire-recording stations”.

Paragraph 2.2(5), line 3, delete “Air space” and insert “Air spaces”.

Table 26.2, line 5, delete “space” and insert “spaces”.

*Regulation 27. FIRE INTEGRITY OF BULKHEADS AND DECKS IN SHIPS  
CARRYING NOT MORE THAN 36 PASSENGERS*

Paragraph 2.2(1), line 4, delete "stations" and insert "rooms".

In table 27.1, line 2, column 4; line 3, column 4; line 4, column 4; line 4, column 5, replace B-0<sup>c</sup> by A-0<sup>a</sup>; A-0<sup>a</sup>, B-0<sup>c</sup>.

Paragraph 4, line 4, delete "this chapter" and insert "this part".

*Regulation 32. VENTILATION SYSTEMS*

Paragraph 1.4.3.1, line 1, delete "restricted" and insert "low".

Replace Regulation 36 by:

*Regulation 36. FIXED FIRE DETECTION AND FIRE ALARM SYSTEMS;  
AUTOMATIC SPRINKLER, FIRE DETECTION AND FIRE ALARM SYSTEMS*

In any ship to which this part applies, there shall be installed throughout each separate zone, whether vertical or horizontal, in all accommodation and service spaces and, where it is considered necessary by the Administration, in control stations, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc., either:

- .1 A fixed fire detection and fire alarm system of an approved type and complying with the requirements of regulation 13 and so installed and arranged as to detect the presence of fire in such spaces; or
- .2 An automatic sprinkler, fire detection and fire alarm system of an approved type and complying with the requirements of regulation 12 and so installed and arranged as to protect such spaces and in addition a fixed fire detection and fire alarm system of an approved type complying with the requirements of regulation 13 so installed and arranged as to provide smoke detection in corridors, stairways and escape routes within accommodation spaces."

*Regulation 37. PROTECTION OF SPECIAL CATEGORY SPACES*

Amend the text of paragraph 1.4.1 to read:

"1.4.1. An efficient patrol system shall be maintained in special category spaces. In any such space in which the patrol is not maintained by a continuous fire watch at all times during the voyage there shall be provided a fixed fire detection and fire alarm system of an approved type complying with the requirements of regulation 13. The fixed fire detection system shall be capable of rapidly detecting the onset of fire. The spacing and location of detectors shall be tested to the satisfaction of the Administration taking into account the effects of ventilation and other relevant factors."

Amend the text of paragraph 2.2.1 to read:

"2.2.1. On any deck or platform, if fitted, on which vehicles are carried and on which explosive vapours might be expected to accumulate, except platforms with openings of sufficient size permitting penetration of petrol gases downwards, equipment which may constitute a source of ignition of flammable vapours and, in particular, electrical equipment and wiring, shall be installed at least 450 mm above the deck or platform. Electrical equipment installed at more than 450 mm above the deck or platform shall be of a type so enclosed and protected as to prevent the escape of sparks. However, if the Administration is satisfied that the installation of electrical equipment and wiring at less than 450 mm above the deck or platform is necessary for the safe operation of the ship, such electrical equipment and wiring may be installed provided that it is of a type approved for use in an explosive petrol and air mixture."

*Regulation 40. FIRE PATROLS, DETECTION, ALARMS AND PUBLIC ADDRESS SYSTEMS*

Amend paragraphs 1 and 2 to read:

“1. Manually operated call points complying with the requirements of regulation 13 shall be installed”.

“2. A fixed fire detection and fire alarm system of an approved type shall be provided”.

*Regulation 42. STRUCTURE*

In paragraph 1, second line, amend “deck” to read “decks”.

*Regulation 49. RESTRICTED USE OF COMBUSTIBLE MATERIALS*

Amend the text of paragraph 3 to read:

“Primary deck coverings, if applied within accommodation and service spaces and control stations, shall be of approved material which will not readily ignite, or give rise to toxic or explosive hazards at elevated temperatures.\*\*”

*Regulation 51. ARRANGEMENTS FOR GASEOUS FUEL FOR DOMESTIC PURPOSES*

Delete comma and insert “for the” after “arrangements”.

*Regulation 52. FIXED FIRE DETECTION AND FIRE ALARM SYSTEMS;  
AUTOMATIC SPRINKLER, FIRE DETECTION AND FIRE ALARM SYSTEMS*

Amend the first three paragraphs to read:

“1. In ships in which method IC is adopted, a fixed fire detection and fire alarm system of an approved type complying with the requirements of regulation 13 shall be so installed and arranged as to provide smoke detection and manually operated call points in all corridors, stairways and escape routes within accommodation spaces.

2. In ships in which method IIC is adopted, an automatic sprinkler, fire detection and fire alarm system of an approved type complying with the relevant requirements of regulation 12 shall be so installed and arranged as to protect accommodation spaces, galleys and other service spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc. In addition, a fixed fire detection and fire alarm system of an approved type complying with the requirements of regulation 13 shall be so installed and arranged as to provide smoke detection and manually operated call points in all corridors, stairways and escape routes within accommodation spaces.

3. In ships in which method IIIC is adopted, a fixed fire detection and fire alarm system of an approved type complying with the requirements of regulation 13 shall be so installed and arranged as to detect the presence of fire in all accommodation spaces and service spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc.”

Delete paragraph 4.

*Regulation 53. FIRE PROTECTION ARRANGEMENTS IN CARGO SPACES*

In paragraph 1.3, line 4, delete “by” and insert “with”.

Amend the first sentence of paragraph 2.1 to read: “There shall be provided a fixed fire detection and fire alarm system of an approved type.”

Replace paragraph 2.4.2 by the following:

“2. Above a height of 450 mm from the deck and from each platform for vehicles, if fitted, except platforms with openings of sufficient size permitting penetration of petrol gases downwards, electrical equipment of a type so enclosed and protected as to prevent the escape of sparks shall be permitted as an alternative on condition

that the ventilating system is so designed and operated as to provide continuous ventilation of the cargo spaces at the rate of at least 10 air changes per hour whenever vehicles are on board.”

*Regulation 54. SPECIAL REQUIREMENTS FOR SHIPS CARRYING DANGEROUS GOODS*

In table 54.2, note *f*, amend “. . . in addition to those enumerated . . .” to read “. . . in addition to meeting the requirements enumerated . . .”.

Amend the first sentence in paragraph 2.3 to read: “A fixed fire detection and fire alarm system of an approved type shall be fitted to all enclosed cargo spaces including closed vehicle deck spaces.”

*Regulation 55. APPLICATION*

Amend paragraph 2 to read:

“Where liquid cargoes other than those referred to in paragraph 1 or liquefied gases which introduce additional fire hazards are intended to be carried, additional safety measures shall be required to the satisfaction of the Administration, having due regard to the provisions of the International Bulk Chemical Code, the Bulk Chemical Code, the International Gas Carrier Code and the Gas Carrier Code, as appropriate.”

Amend paragraph 6 to read:

“Chemical tankers and gas carriers shall comply with the requirements of this part, except where alternative and supplementary arrangements are provided to the satisfaction of the Administration, having due regard to the provisions of the International Bulk Chemical Code, the Bulk Chemical Code, the International Gas Carrier Code and the Gas Carrier Code, as appropriate.”

*Regulation 56. LOCATION AND SEPARATION OF SPACES*

Replace the text of the whole regulation by:

“1. Machinery spaces shall be positioned aft of cargo tanks and slop tanks; they shall also be situated aft of cargo pump rooms and cofferdams, but not necessarily aft of the oil fuel bunker tanks. Any machinery space shall be isolated from cargo tanks and slop tanks by cofferdams, cargo pump rooms, oil fuel bunker tanks or permanent ballast tanks. Pump rooms containing pumps and their accessories for ballasting those spaces situated adjacent to cargo tanks and slop tanks and pumps for oil fuel transfer shall be considered as equivalent to a cargo pump room within the context of this regulation, provided that such pump rooms have the same safety standard as that required for cargo pump rooms. However, the lower portion of the pump room may be recessed into machinery spaces of category A to accommodate pumps, provided that the deck head of the recess is in general not more than one third of the moulded depth above the keel, except that in the case of ships of not more than 25,000 tonnes deadweight, where it can be demonstrated that for reasons of access and satisfactory piping arrangements this is impracticable, the Administration may permit a recess in excess of such height, but not exceeding one half of the moulded depth above the keel.

2. Accommodation spaces, main cargo control stations, control stations and service spaces (excluding isolated cargo handling gear lockers) shall be positioned aft of all cargo tanks, slop tanks, cargo pump rooms and cofferdams which isolate cargo or slop tanks from machinery spaces but not necessarily aft of the oil fuel bunker tanks. A recess provided in accordance with paragraph 1 need not be taken into account when the position of these spaces is being determined.

3. However, where deemed necessary, accommodation spaces, control stations, machinery spaces other than those of category A, and service spaces may be permitted forward of the cargo area, provided they are isolated from the cargo tanks and slop tanks by



cofferdams, cargo pump rooms, oil fuel bunker tanks or permanent ballast tanks and subject to an equivalent standard of safety and appropriate availability of fire-extinguishing arrangements being provided to the satisfaction of the Administration. In addition, where deemed necessary for the safety or navigation of the ship, the Administration may permit machinery spaces containing internal combustion machinery not being main propulsion machinery having an output greater than 375 kW to be located forward of the cargo area provided the arrangements are in accordance with the provisions of this paragraph.

4. In combination carriers only:

- .1 The slop tanks are to be surrounded by cofferdams except where the boundaries of the slop tanks where slop may be carried on dry cargo voyages are the hull, main cargo deck, cargo pump room bulkhead or oil fuel bunker tank. These cofferdams shall not be open to a double bottom, pipe tunnel, pump room or other enclosed space. Means shall be provided for filling the cofferdams with water and for draining them. Where the boundary of a slop tank is the cargo pump room bulkhead the pump room shall not be open to the double bottom, pipe tunnel or other enclosed space, however, openings provided with gastight bolted covers may be permitted.
- .2 Means shall be provided for isolating the piping connecting the pump room with the slop tanks referred to in paragraph 4.1. The means of isolation shall consist of a valve followed by a spectacle flange or a spool piece with appropriate blank flanges. This arrangement shall be located adjacent to the slop tanks, but where this is unreasonable or impracticable it may be located within the pump room directly after the piping penetrates the bulkhead. A separate pumping and piping arrangement shall be provided for discharging the contents of the slop tanks directly over the open deck when the ship is in the dry cargo mode.
- .3 Hatches and tank cleaning openings to slop tanks shall only be permitted on the open deck and shall be fitted with closing arrangements. Except where they consist of bolted plates with bolts at watertight spacing, these closing arrangements shall be provided with locking arrangements which shall be under the control of the responsible ship's officer.
- .4 Where cargo wing tanks are provided, cargo oil lines below deck shall be installed inside these tanks. However, the Administration may permit cargo oil lines to be placed in special ducts which shall be capable of being adequately cleaned and ventilated and be to the satisfaction of the Administration. Where cargo wing tanks are not provided cargo oil lines below deck shall be placed in special ducts.

5. Where the fitting of a navigation position above the cargo area is shown to be necessary, it shall be for navigation purposes only and it shall be separated from the cargo tank deck by means of an open space with a height of at least 2 m. The fire protection of such a navigation position shall in addition be as required for control spaces in regulation 58.1 and 58.2 and other provisions, as applicable, of this part.

6. Means shall be provided to keep deck spills away from the accommodation and service areas. This may be accomplished by provision of a permanent continuous coaming of a suitable height extending from side to side. Special consideration shall be given to the arrangements associated with stern loading.

7. Exterior boundaries of superstructures and deckhouses enclosing accommodation and including any overhanging decks which support such accommodation, shall be insulated to 'A-60' standard for the whole of the portions which face the cargo area and for 3 m aft of the front boundary. In the case of the sides of those superstructures and deckhouses, such insulation shall be carried as high as is deemed necessary by the Administration.

8.I. Entrances, air inlets and openings to accommodation spaces, service spaces and control stations shall not face the cargo area. They shall be located on the transverse

bulkhead not facing the cargo area or on the outboard side of the superstructure or deckhouse at a distance of at least 4% of the length of the ship but not less than 3 m from the end of the superstructure or deckhouse facing the cargo area. This distance, however, need not exceed 5 m.

8.2. No doors shall be fitted within the limits specified in paragraph 8.1 except that doors to spaces not having access to accommodation spaces, service spaces and control stations may be permitted by the Administration. Such spaces may be cargo control stations, provision rooms and store-rooms. Where such doors are fitted to spaces located aft of the cargo area, the boundaries of the space shall be insulated to 'A-60' standard, with the exception of the boundary facing the cargo area. Bolted plates for removal of machinery may be fitted within the limits specified in paragraph 8.1. Wheelhouse doors and wheelhouse windows may be located within the limits specified in paragraph 8.1 so long as they are designed to ensure that the wheelhouse can be made rapidly and efficiently gas and vapour tight.

8.3. Windows and sidescuttles facing the cargo area and on the sides of the superstructures and deckhouses within the limits specified in paragraph 8.1 shall be of the fixed (non-opening) type. Such windows and sidescuttles in the first tier on the main deck shall be fitted with inside covers of steel or other equivalent material."

*Regulation 58. FIRE INTEGRITY OF BULKHEADS AND DECKS*

In table 1, note <sup>b</sup>, line 1, delete "b" and insert "b".

Paragraph 4, line 4, delete "these Requirements" and insert "this part".

*Regulation 59. VENTING, PURGING, GAS FREEING AND VENTILATION*

Paragraph 2, line 16, delete "gas" and insert "vapour"; line 18, delete "gas" and insert "vapour"; lines 16, 17 and 18, "When. . . level." forms part of paragraph 2 and must be moved to that paragraph's margin.

Amend paragraph 3.3 as follows:

In the third sentence, amend "referred to in Regulation 56.1" to read "referred to in regulation 56.4".

In the fourth sentence, amend "cargo tank area" to read "cargo area".

*Regulation 61. FIXED DECK FOAM SYSTEMS*

In paragraph 1, amend "cargo tank area" to read "cargo tanks deck area".

In paragraph 2, amend "cargo tank area" to read "cargo area" in the second sentence.

In paragraph 3.1, amend "cargo deck area" to read "cargo tanks deck area".

In paragraph 7 in the first and second sentence, amend "cargo deck" to read "cargo tank deck".

In paragraph 8, third line, amend "400 ℓ" to read "400 ℓ/min". In the fourth sentence amend "any cargo tank deck area" to read "any part of the cargo tanks deck area".

*Regulation 62. INERT GAS SYSTEMS*

In paragraph 1, delete "non flammable" and insert "non flammable".

In paragraph 9.1, lines 2 and 3, delete "19.2" and insert "19.3" and "19.4" respectively.

In paragraph 10.2, amend "cargo tank area" to read "cargo area".

Replace paragraph 14.1 by:

"14.1 One or more pressure vacuum breaking devices shall be provided to prevent the cargo tanks from being subject to:

.1 A positive pressure in excess of the test pressure of the cargo tank if the cargo were to be loaded at the maximum rated capacity and all other outlets are left shut; and

- .2 A negative pressure in excess of 700 mm water gauge if cargo were to be discharged at the maximum rated capacity of the cargo pumps and the inert gas blowers were to fail.

Such devices shall be installed on the inert gas main unless they are installed in the venting system required by regulation 59.1.1 or on individual cargo tanks.”

In paragraph 20.1, amend the last line to read “10.2, 10.7, 10.9, 11.3, 11.4, 12, 13.1, 13.2, 13.4.2, 14.2 and 19.8;”

In paragraph 20.2, amend the last line to read “12, 13.1, 13.2 and 14.2.”

## PART 3

### CHAPTER III

The existing text of chapter III is replaced by the following:

#### LIFE-SAVING APPLIANCES AND ARRANGEMENTS

##### PART A. GENERAL

###### *Regulation 1. APPLICATION*

1. Unless expressly provided otherwise, this chapter shall apply to ships the keels of which are laid or which are at a similar stage of construction on or after 1 July 1986.

2. For the purpose of this chapter the term “a similar stage of construction” means the stage at which:

- .1 Construction identifiable with a specific ship begins; and
- .2 Assembly of that ship has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less.

3. For the purpose of this chapter:

- .1 The expression “ships constructed” means “ships the keels of which are laid or which are at a similar stage of construction”.
- .2 The expression “all ships” means “ships constructed before, on or after 1 July 1986”; the expressions “all passenger ships” and “all cargo ships” shall be construed accordingly.
- .3 A cargo ship, whenever built, which is converted to a passenger ship shall be treated as a passenger ship constructed on the date on which such a conversion commences.

4. For ships constructed before 1 July 1986, the Administration shall:

- .1 Ensure that, subject to the provisions of [paragraphs] 4.2 and 4.3, the requirements which are applicable under chapter III of the International Convention for the Safety of Life at Sea, 1974, in force prior to 1 July 1986 to new or existing ships as prescribed by that chapter are complied with;
- .2 Consider the life-saving appliances and arrangements in ships which do not comply with the requirements referred to in paragraph 4.1, with a view to securing, so far as this is reasonable and practicable and as early as possible, substantial compliance with those requirements;
- .3 Ensure that when life-saving appliances or arrangements on such ships are replaced or such ships undergo repairs, alterations or modifications of a major character which involve replacement of, or any addition to, their existing life-saving appliances or arrangements, such life-saving appliances or arrangements, in so far as is reasonable and practicable, comply with the requirements of this chapter. However, if a survival craft is replaced without replacing its launching appliance, or vice versa, the survival craft or launching appliance may be of the same type as that replaced;

- .4 Approve the life-saving appliances to be provided in compliance with paragraph 6. The Administration may permit those life-saving appliances provided on board ships prior to 1 July 1991 not to comply fully with the requirements of this chapter as long as they remain in a satisfactory condition;
- .5 Except as provided for survival craft and launching appliances referred to in paragraph 4.3, ensure that life-saving appliances replaced or installed on or after 1 July 1991 are evaluated, tested and approved in accordance with the requirements of regulations 4 and 5.
  - 5. With respect to ships constructed before 1 July 1986 the requirements of regulations 8, 9, 10, 18 and 25 and, to the extent prescribed therein, regulation 19 shall apply.
  - 6. With respect to ships constructed before 1 July 1986 the requirements of regulations 6.2.3, 6.2.4, 21.3, 21.4, 26.3, 27.2, 27.3 and 30.2.7 shall apply not later than 1 July 1991.

#### *Regulation 2. EXEMPTIONS*

1. The Administration may, if it considers that the sheltered nature and conditions of the voyage are such as to render the application of any specific requirements of this chapter unreasonable or unnecessary, exempt from those requirements individual ships or classes of ships which, in the course of their voyage, do not proceed more than 20 miles from the nearest land.

2. In the case of passenger ships which are employed in special trades for the carriage of large numbers of special trade passengers, such as the pilgrim trade, the Administration, if satisfied that it is impracticable to enforce compliance with the requirements of this chapter, may exempt such ships from those requirements, provided that such ships comply fully with the provisions of:

- .1 The rules annexed to the Special Trade Passenger Ships Agreement, 1971;<sup>1</sup> and
- .2 The rules annexed to the Protocol on Space Requirements for Special Trade Passenger Ships, 1973.<sup>2</sup>

#### *Regulation 3. DEFINITIONS*

For the purpose of this chapter, unless expressly provided otherwise:

1. Certified person is a person who holds a certificate of proficiency in survival craft issued under the authority of, or recognized as valid by, the Administration in accordance with the requirements of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers,<sup>3</sup> in force; or a person who holds a certificate issued or recognized by the Administration of a State not a Party to that Convention for the same purpose as the convention certificate.

2. Detection is the determination of the location of survivors or survival craft.

3. Embarkation ladder is the ladder provided at survival craft embarkation stations to permit safe access to survival craft after launching.

4. Float-free launching is that method of launching a survival craft whereby the craft is automatically released from a sinking ship and is ready for use.

5. Free-fall launching is that method of launching a survival craft whereby the craft with its complement of persons and equipment on board is released and allowed to fall into the sea without any restraining apparatus.

6. Immersion suit is a protective suit which reduces the body heat-loss of a person wearing it in cold water.

<sup>1</sup> United Nations, *Treaty Series*, vol. 910, p. 61.

<sup>2</sup> United Nations, *Treaty Series*, vol. 1046, p. 317.

<sup>3</sup> *Ibid.*, vol. 1361, p. 2 (authentic Chinese and English texts), and vol. 1362, p. 2 (authentic French, Russian and Spanish texts).

7. Inflatable appliance is an appliance which depends upon non-rigid, gas filled chambers for buoyancy and which is normally kept uninflated until ready for use.

8. Inflated appliance is an appliance which depends upon non-rigid, gas filled chambers for buoyancy and which is kept inflated and ready for use at all times.

9. Launching appliance or arrangement is a means of transferring a survival craft or rescue boat from its stowed position safely to the water.

10. Length is 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or the length from the fore-side of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel the waterline on which this is measured shall be parallel to the designed waterline.

11. Moulded depth

.1 The moulded depth is the vertical distance measured from the top of the keel to the top of the freeboard deck beam at side. In wood and composite ships the distance is measured from the lower edge of the keel rabbet. Where the form at the lower part of the midship section is of a hollow character, or where thick garboards are fitted, the distance is measured from the point where the line of the flat of the bottom continued inwards cuts the side of the keel.

.2 In ships having rounded gunwales, the moulded depth shall be measured to the point of intersection of the moulded lines of the deck and side shell plating, the lines extending as though the gunwale were of angular design.

.3 Where the freeboard deck is stepped and the raised part of the deck extends over the point at which the moulded depth is to be determined, the moulded depth shall be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

12. Novel life-saving appliance or arrangement is a life-saving appliance or arrangement which embodies new features not fully covered by the provisions of this chapter but which provides an equal or higher standard of safety.

13. Rescue boat is a boat designed to rescue persons in distress and to marshal survival craft.

14. Retrieval is the safe recovery of survivors.

15. Retro-reflective material is a material which reflects in the opposite direction a beam of light directed on it.

16. Short international voyage is an international voyage in the course of which a ship is not more than 200 miles from a port or place in which the passengers and crew could be placed in safety. Neither the distance between the last port of call in the country in which the voyage begins and the final port of destination nor the return voyage shall exceed 600 miles. The final port of destination is the last port of call in the scheduled voyage at which the ship commences its return voyage to the country in which the voyage began.

17. Survival craft is a craft capable of sustaining the lives of persons in distress from the time of abandoning the ship.

18. Thermal protective aid is a bag or suit made of waterproof material with low thermal conductivity.

#### *Regulation 4. EVALUATION, TESTING AND APPROVAL OF LIFE-SAVING APPLIANCES AND ARRANGEMENTS*

1. Except as provided in paragraphs 5 and 6, life-saving appliances and arrangements required by this chapter shall be approved by the Administration.

2. Before giving approval to life-saving appliances and arrangements, the Administration shall ensure that such life-saving appliances and arrangements:

- .1 Are tested, to confirm that they comply with the requirements of this chapter, in accordance with the recommendations of the Organization;\* or
- .2 Have successfully undergone, to the satisfaction of the Administration, tests which are substantially equivalent to those specified in those recommendations.
  3. Before giving approval to novel life-saving appliances or arrangements, the Administration shall ensure that such appliances or arrangements:
    - .1 Provide safety standards at least equivalent to the requirements of this chapter and have been evaluated and tested in accordance with the recommendations of the Organization;\*\* or
    - .2 Have successfully undergone, to the satisfaction of the Administration, evaluation and tests which are substantially equivalent to those recommendations.
  4. Procedures adopted by the Administration for approval shall also include the conditions whereby approval would continue or would be withdrawn.
  5. Before accepting life-saving appliances and arrangements that have not been previously approved by the Administration, the Administration shall be satisfied that life-saving appliances and arrangements comply with the requirements of this chapter.
  6. Life-saving appliances required by this chapter for which detailed specifications are not included in part C shall be to the satisfaction of the Administration.

#### *Regulation 5. PRODUCTION TESTS*

The Administration shall require life-saving appliances to be subjected to such production tests as are necessary to ensure that the life-saving appliances are manufactured to the same standard as the approved prototype.

### PART B. SHIP REQUIREMENTS

#### SECTION I. PASSENGER SHIPS AND CARGO SHIPS

#### *Regulation 6. COMMUNICATIONS*

1. Paragraphs 2.3 and 2.4 apply to all ships. With respect to ships constructed before 1 July 1986, paragraphs 2.3 and 2.4 shall apply not later than 1 July 1991.
  2. *Radio life-saving appliances*
    - 2.1. *Portable radio apparatus for survival craft*
      - 2.1.1. A portable radio apparatus for survival craft complying with the requirements of regulation IV/14 shall be provided. The portable radio apparatus shall be stowed in a protected and easily accessible position ready to be moved to any survival craft in an emergency, except that in the case of a ship with lifeboats stowed in widely separated positions fore and aft, the portable radio apparatus shall be stowed in the vicinity of the lifeboats which are furthest away from the ship's main transmitter.
      - 2.1.2. The requirements of paragraph 2.1.1 need not be complied with if a radio installation complying with the requirements of regulation IV/13 is fitted in a lifeboat on each side of the ship or in the stern-launched lifeboat referred to in regulation 26.1.2.1.

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\* Reference is made to the "Recommendation on testing of life-saving appliances" to be submitted to the Assembly of the Organization at its thirteenth session for adoption.

\*\* Reference is made to the "Code of practice for the evaluation, testing and acceptance of prototype novel life-saving appliances and arrangements" to be submitted to the Assembly of the Organization at its thirteenth session for adoption.

2.1.3. On ships engaged on voyages of such duration that in the opinion of the Administration portable radio apparatus for survival craft is unnecessary, the Administration may allow such equipment to be dispensed with.

2.2. *Radiotelegraph installation for lifeboats*

On passenger ships engaged on international voyages which are not short international voyages:

- .1 Where the total number of persons on board is more than 199 but less than 1,500, a radiotelegraph installation complying with the requirements of regulation IV/13 shall be fitted in at least one of the lifeboats required by regulation 20.1.1.1;
- .2 Where the total number of persons on board is 1,500 or more, at least one lifeboat on each side shall be so fitted.

2.3. *Survival craft emergency position-indicating radio beacons*

One manually activated emergency position-indicating radio beacon complying with the requirements of regulation IV/14-1 shall be carried on each side of the ship. They shall be so stowed that they can be rapidly placed in any survival craft other than the liferaft or liferafts required by regulation 26.1.4.

2.4. *Two-way radiotelephone apparatus*

2.4.1. Two-way radiotelephone apparatus complying with the requirements of regulation IV/14-3 shall be provided for communication between survival craft, between survival craft and ship and between ship and rescue boat. An apparatus need not be provided for every survival craft; however, at least three apparatus shall be provided on each ship. This requirement may be complied with by other apparatus used on board provided such apparatus is not incompatible with the appropriate requirements of regulation IV/14-3.

2.4.2. For ships constructed before 1 July 1986 such apparatus need only comply with the frequency requirements of regulation IV/14-3.

3. *Distress flares*

Not less than 12 rocket parachute flares, complying with the requirements of regulation 35, shall be carried and be stowed on or near the navigating bridge.

4. *On-board communications and alarm systems*

4.1. An emergency means comprised of either fixed or portable equipment or both shall be provided for two-way communications between emergency control stations, muster and embarkation stations and strategic positions on board.

4.2. A general emergency alarm system complying with the requirements of regulation 50 shall be provided and shall be used for summoning passengers and crew to muster stations and to initiate the actions included in the muster list. The system shall be supplemented by either a public address system or other suitable means of communication.

*Regulation 7. PERSONAL LIFE-SAVING APPLIANCES*

1. *Lifebuoys*

1.1. Lifebuoys complying with the requirements of regulation 31.1 shall be:

- .1 So distributed as to be readily available on both sides of the ship and as far as practicable on all open decks extending to the ship's side; at least one shall be placed in the vicinity of the stern;
- .2 So stowed as to be capable of being rapidly cast loose, and not permanently secured in any way.

1.2. At least one lifebuoy on each side of the ship shall be fitted with a buoyant lifeline complying with the requirements of regulation 31.4 equal in length to not less than twice the height at which it is stowed above the waterline in the lightest seagoing condition, or 30 m, whichever is the greater.

1.3. Not less than one half of the total number of lifebuoys shall be provided with self-igniting lights complying with the requirements of regulation 31.2; not less than two of these shall also be provided with self-activating smoke signals complying with the requirements of regulation 31.3 and be capable of quick release from the navigating bridge; lifebuoys with lights and those with lights and smoke signals shall be equally distributed on both sides of the ship and shall not be the lifebuoys provided with lifelines in compliance with the requirements of paragraph 1.2.

1.4. Each lifebuoy shall be marked in block capitals of the Roman alphabet with the name and port of registry of the ship on which it is carried.

#### 2. *Lifejackets*

2.1. A lifejacket complying with the requirements of regulation 32.1 or 32.2 shall be provided for every person on board the ship and, in addition:

- .1 A number of lifejackets suitable for children equal to at least 10% of the number of passengers on board shall be provided or such greater number as may be required to provide a lifejacket for each child;
- .2 A sufficient number of lifejackets shall be carried for persons on watch and for use at remotely located survival craft stations.

2.2. Lifejackets shall be so placed as to be readily accessible and their position shall be plainly indicated. Where, due to the particular arrangements of the ship, the lifejackets provided in compliance with the requirements of paragraph 2.1 may become inaccessible, alternative provisions shall be made to the satisfaction of the Administration which may include an increase in the number of lifejackets to be carried.

#### 3. *Immersion suits*

3.1. An immersion suit, of an appropriate size, complying with the requirements of regulation 33 shall be provided for every person assigned to crew the rescue boat.

### *Regulation 8. MUSTER LIST AND EMERGENCY INSTRUCTIONS*

1. This regulation applies to all ships.

2. Clear instructions to be followed in the event of an emergency shall be provided for every person on board.

3. Muster lists complying with the requirements of regulation 53 shall be exhibited in conspicuous places throughout the ship including the navigating bridge, engine-room and crew accommodation spaces.

4. Illustrations and instructions in appropriate languages shall be posted in passenger cabins and be conspicuously displayed at muster stations and other passenger spaces to inform passengers of:

- .1 Their muster station;
- .2 The essential actions they must take in an emergency;
- .3 The method of donning lifejackets.

### *Regulation 9. OPERATING INSTRUCTIONS*

1. This regulation applies to all ships.

2. Posters or signs shall be provided on or in the vicinity of survival craft and their launching controls and shall:

- .1 Illustrate the purpose of controls and the procedures for operating the appliance and give relevant instructions or warnings;
- .2 Be easily seen under emergency lighting conditions;
- .3 Use symbols in accordance with the recommendations of the Organization.



*Regulation 10. MANNING OF SURVIVAL CRAFT AND SUPERVISION*

1. This regulation applies to all ships.
2. There shall be a sufficient number of trained persons on board for mustering and assisting untrained persons.
3. There shall be a sufficient number of crew members, who may be deck officers or certificated persons, on board for operating the survival craft and launching arrangements required for abandonment by the total number of persons on board.
4. A deck officer or certificated person shall be placed in charge of each survival craft to be used. However, the Administration, having due regard to the nature of the voyage, the number of persons on board and the characteristics of the ship, may permit persons practised in the handling and operation of liferafts to be placed in charge of liferafts in lieu of persons qualified as above. A second-in-command shall also be nominated in the case of lifeboats.
5. The person in charge of the survival craft shall have a list of the survival craft crew and shall see that the crew under his command are acquainted with their duties. In lifeboats the second-in-command shall also have a list of the lifeboat crew.
6. Every lifeboat required to carry a radiotelegraph installation complying with the requirements of regulation 6.2.2 shall have a person assigned who is capable of operating the equipment.
7. Every motorized survival craft shall have a person assigned who is capable of operating the engine and carrying out minor adjustments.
8. The master shall ensure the equitable distribution of persons referred to in paragraphs 2, 3 and 4 among the ship's survival craft.

*Regulation 11. SURVIVAL CRAFT MUSTER AND EMBARKATION ARRANGEMENTS*

1. Lifeboats and liferafts for which approved launching appliances are required shall be stowed as close to accommodation and service spaces as possible.
2. Muster stations shall be provided close to the embarkation stations. Each muster station shall have sufficient space to accommodate all persons assigned to muster at that station.
3. Muster and embarkation stations shall be readily accessible from accommodation and work areas.
4. Muster and embarkation stations shall be adequately illuminated by lighting supplied from the emergency source of electrical power required by regulation II-1/42 or II-1/43, as appropriate.
5. Alleyways, stairways and exits giving access to the muster and embarkation stations shall be lighted. Such lighting shall be capable of being supplied by the emergency source of electrical power required by regulation II-1/42 or II-1/43, as appropriate.
6. Davit-launched survival craft muster and embarkation stations shall be so arranged as to enable stretcher cases to be placed in survival craft.
7. An embarkation ladder complying with the requirements of regulation 48.7 extending, in a single length, from the deck to the waterline in the lightest seagoing condition under unfavourable conditions of trim and with the ship listed not less than 15° either way shall be provided at each launching station or at every two adjacent launching stations. However, the Administration may permit such ladders to be replaced by approved devices to afford access to the survival craft when waterborne, provided that there shall be at least one embarkation ladder on each side of the ship. Other means of embarkation may be permitted for the liferafts required by regulation 26.1.4.
8. Where necessary, means shall be provided for bringing the davit-launched survival craft against the ship's side and holding them alongside so that persons can be safely embarked.

*Regulation 12. LAUNCHING STATIONS*

Launching stations shall be in such positions as to ensure safe launching having particular regard to clearance from the propeller and steeply overhanging portions of the hull and so that, as far as possible, survival craft, except survival craft specially designed for free-fall launching, can be launched down the straight side of the ship. If positioned forward, they shall be located abaft the collision bulkhead in a sheltered position and, in this respect, the Administration shall give special consideration to the strength of the launching appliance.

*Regulation 13. STOWAGE OF SURVIVAL CRAFT*

1. Each survival craft shall be stowed:

- .1 So that neither the survival craft nor its stowage arrangements will interfere with the operation of any other survival craft or rescue boat at any other launching station;
- .2 As near the water surface as is safe and practicable and, in the case of a survival craft other than a liferaft intended for throw-overboard launching, in such a position that the survival craft in the embarkation position is not less than 2 m above the waterline with the ship in the fully loaded condition under unfavourable conditions of trim and listed up to 20° either way, or to the angle at which the ship's weatherdeck edge becomes submerged, whichever is less;
- .3 In a state of continuous readiness so that two crew members can carry out preparations for embarkation and launching in less than 5 min;
- .4 Fully equipped as required by this chapter;
- .5 As far as practicable, in a secure and sheltered position and protected from damage by fire and explosion.

2. Lifeboats for lowering down the ship's side shall be stowed as far forward of the propeller as practicable. On cargo ships of 80 m in length and upwards but less than 120 m in length, each lifeboat shall be so stowed that the after end of the lifeboat is not less than the length of the lifeboat forward of the propeller. On cargo ships of 120 m in length and upwards and passenger ships of 80 m in length and upwards, each lifeboat shall be so stowed that the after end of the lifeboat is not less than 1.5 times the length of the lifeboat forward of the propeller. Where appropriate, the ship shall be so arranged that lifeboats, in their stowed positions, are protected from damage by heavy seas.

3. Lifeboats shall be stowed attached to launching appliances.

4. In addition to meeting the requirements of regulations 23 and 29, liferafts shall be so stowed as to permit manual release from their securing arrangements.

5. Davit-launched liferafts shall be stowed within reach of the lifting hooks, unless some means of transfer is provided which is not rendered inoperable within the limits of trim and list prescribed in paragraph 1.2 or by ship motion or power failure.

6. Liferafts intended for throw-overboard launching shall be so stowed as to be readily transferable for launching on either side of the ship unless liferafts, of the aggregate capacity required by regulation 26.1 to be capable of being launched on either side, are stowed on each side of the ship.

*Regulation 14. STOWAGE OF RESCUE BOATS*

Rescue boats shall be stowed:

- .1 In a state of continuous readiness for launching in not more than 5 min;
- .2 In a position suitable for launching and recovery;
- .3 So that neither the rescue boat nor its stowage arrangements will interfere with the operation of any survival craft at any other launching station;
- .4 If it is also a lifeboat, in compliance with the requirements of regulation 13.

*Regulation 15. SURVIVAL CRAFT LAUNCHING AND RECOVERY ARRANGEMENTS*

1. Launching appliances complying with the requirements of regulation 48 shall be provided for all survival craft except:

.1 Survival craft which are boarded from a position on deck which is less than 4.5 m above the waterline in the lightest seagoing condition and which either:

.1.1 Have a mass of not more than 185 kg; or

.1.2 Are stowed for launching directly from the stowed position under unfavourable conditions of trim of up to 10° and with the ship listed not less than 20° either way;

.2 Survival craft having a mass of not more than 185 kg and which are carried in excess of the survival craft for 200% of the total number of persons on board the ship.

2. Each lifeboat shall be provided with an appliance which is capable of launching and recovering the lifeboat.

3. Launching and recovery arrangements shall be such that the appliance operator on the ship is able to observe the survival craft at all times during launching and for lifeboats during recovery.

4. Only one type of release mechanism shall be used for similar survival craft carried on board the ship.

5. Preparation and handling of survival craft at any one launching station shall not interfere with the prompt preparation and handling of any other survival craft or rescue boat at any other station.

6. Falls, where used, shall be long enough for the survival craft to reach the water with the ship in its lightest seagoing condition, under unfavourable conditions of trim and with the ship listed not less than 20° either way.

7. During preparation and launching, the survival craft, its launching appliance, and the area of water into which it is to be launched shall be adequately illuminated by lighting supplied from the emergency source of electrical power required by regulation II-1/42 or II-1/43, as appropriate.

8. Means shall be available to prevent any discharge of water on to survival craft during abandonment.

9. If there is a danger of the survival craft being damaged by the ship's stabilizer wings, means shall be available, powered by an emergency source of energy, to bring the stabilizer wings inboard; indicators operated by an emergency source of energy shall be available on the navigating bridge to show the position of the stabilizer wings.

10. If lifeboats complying with the requirements of regulation 42 or 43 are carried, a davit span shall be provided, fitted with not less than two lifelines of sufficient length to reach the water with the ship in its lightest seagoing condition, under unfavourable conditions of trim and with the ship listed not less than 20° either way.

*Regulation 16. RESCUE BOAT EMBARKATION, LAUNCHING AND RECOVERY ARRANGEMENTS*

1. The rescue boat embarkation and launching arrangements shall be such that the rescue boat can be boarded and launched in the shortest possible time.

2. If the rescue boat is one of the ship's survival craft, the embarkation arrangements and launching station shall comply with the requirements of regulations 11 and 12.

3. Launching arrangements shall comply with the requirements of regulation 15. However, all rescue boats shall be capable of being launched, where necessary utilizing painters, with the ship making headway at speeds up to 5 knots in calm water.

4. Rapid recovery of the rescue boat shall be possible when loaded with its full complement of persons and equipment. If the rescue boat is also a lifeboat, rapid recovery shall be

possible when loaded with its lifeboat equipment and the approved rescue boat complement of at least six persons.

*Regulation 17. LINE-THROWING APPLIANCES*

A line-throwing appliance complying with the requirements of regulation 49 shall be provided.

*Regulation 18. ABANDON SHIP TRAINING AND DRILLS*

1. This regulation applies to all ships.

2. *Manuals*

A training manual complying with the requirements of regulation 51 shall be provided in each crew messroom and recreation room or in each crew cabin.

3. *Practice musters and drills*

3.1. Each member of the crew shall participate in at least one abandon ship drill and one fire drill every month. The drills of the crew shall take place within 24 h of the ship leaving a port if more than 25% of the crew have not participated in abandon ship and fire drills on board that particular ship in the previous month. The Administration may accept other arrangements that are at least equivalent for those classes of ship for which this is impracticable.

3.2. On a ship engaged on an international voyage which is not a short international voyage, musters of the passengers shall take place within 24 h after their embarkation. Passengers shall be instructed in the use of the lifejackets and the action to take in an emergency. If only a small number of passengers embark at a port after the muster has been held it shall be sufficient, instead of holding another muster, to draw the attention of these passengers to the emergency instructions required by regulations 8.2 and 8.4.

3.3. On a ship engaged on a short international voyage, if a muster of the passengers is not held on departure, the attention of the passengers shall be drawn to the emergency instructions required by regulations 8.2 and 8.4.

3.4. Each abandon ship drill shall include:

- .1 Summoning of passengers and crew to muster stations with the alarm required by regulation 6.4.2 and ensuring that they are made aware of the order to abandon ship specified in the muster list;
- .2 Reporting to stations and preparing for the duties described in the muster list;
- .3 Checking that passengers and crew are suitably dressed;
- .4 Checking that lifejackets are correctly donned;
- .5 Lowering of at least one lifeboat after any necessary preparation for launching;
- .6 Starting and operating the lifeboat engine;
- .7 Operation of davits used for launching liferafts.

3.5. Different lifeboats shall, as far as practicable, be lowered in compliance with the requirements of paragraph 3.4.5 at successive drills.

3.6. Drills shall, as far as practicable, be conducted as if there were an actual emergency.

3.7. Each lifeboat shall be launched with its assigned operating crew aboard and manoeuvred in the water at least once every 3 months during an abandon ship drill. The Administration may allow ships operating on short international voyages not to launch the lifeboats on one side if their berthing arrangements in port and their trading patterns do not permit launching of lifeboats on that side. However, all such lifeboats shall be lowered at least once every 3 months and launched at least annually.

3.8. As far as is reasonable and practicable, rescue boats other than lifeboats which are also rescue boats, shall be launched each month with their assigned crew aboard and

manoeuvred in the water. In all cases this requirement shall be complied with at least once every 3 months.

3.9. If lifeboat and rescue boat launching drills are carried out with the ship making headway, such drills shall, because of the dangers involved, be practised in sheltered waters only and under the supervision of an officer experienced in such drills.

3.10. Emergency lighting for mustering and abandonment shall be tested at each abandon ship drill.

#### 4. *On-board training and instructions*

4.1. On-board training in the use of the ship's life-saving appliances, including survival craft equipment, shall be given as soon as possible but not later than 2 weeks after a crew member joins the ship. However, if the crew member is on a regularly scheduled rotating assignment to the ship, such training shall be given not later than 2 weeks after the time of first joining the ship.

4.2. Instructions in the use of the ship's life-saving appliances and in survival at sea shall be given at the same interval as the drills. Individual instruction may cover different parts of the ship's life-saving system, but all the ship's life-saving equipment and appliances shall be covered within any period of 2 months. Each member of the crew shall be given instructions which shall include but not necessarily be limited to:

- .1 Operation and use of the ship's inflatable liferafts;
- .2 Problems of hypothermia, first-aid treatment for hypothermia and other appropriate first-aid procedures;
- .3 Special instructions necessary for use of the ship's life-saving appliances in severe weather and severe sea conditions.

4.3. On-board training in the use of davit-launched liferafts shall take place at intervals of not more than 4 months on every ship fitted with such appliances. Whenever practicable this shall include the inflation and lowering of a liferaft. This liferaft may be a special liferaft intended for training purposes only, which is not part of the ship's life-saving equipment; such a special liferaft shall be conspicuously marked.

#### 5. *Records*

The date when musters are held, details of abandon ship drills and fire drills, drills of other life-saving appliances and on-board training shall be recorded in such log-book as may be prescribed by the Administration. If a full muster, drill or training session is not held at the appointed time, an entry shall be made in the log-book stating the circumstances and the extent of the muster, drill or training session held.

#### *Regulation 19. OPERATIONAL READINESS, MAINTENANCE AND INSPECTIONS*

1. This regulation applies to all ships. The requirements of paragraphs 3 and 6.2 shall be complied with, as far as is practicable, on ships constructed before 1 July 1986.

##### 2. *Operational readiness*

Before the ship leaves port and at all times during the voyage, all life-saving appliances shall be in working order and ready for immediate use.

##### 3. *Maintenance*

3.1. Instructions for on-board maintenance of life-saving appliances complying with the requirements of regulation 52 shall be provided and maintenance shall be carried out accordingly.

3.2. The Administration may accept, in lieu of the instructions required by paragraph 3.1, a shipboard planned maintenance programme which includes the requirements of regulation 52.

#### 4. *Maintenance of falls*

Falls used in launching shall be turned end for end at intervals of not more than 30 months and be renewed when necessary due to deterioration of the falls or at intervals of not more than 5 years, whichever is the earlier.

#### 5. *Spares and repair equipment*

Spares and repair equipment shall be provided for life-saving appliances and their components which are subject to excessive wear or consumption and need to be replaced regularly.

#### 6. *Weekly inspection*

The following tests and inspections shall be carried out weekly:

- .1 All survival craft, rescue boats and launching appliances shall be visually inspected to ensure that they are ready for use;
- .2 All engines in lifeboats and rescue boats shall be run ahead and astern for a total period of not less than 3 min provided the ambient temperature is above the minimum temperature required for starting the engine. In special cases the Administration may waive this requirement for ships constructed before 1 July 1986;
- .3 The general emergency alarm system shall be tested.

#### 7. *Monthly inspections*

Inspection of the life-saving appliances, including lifeboat equipment, shall be carried out monthly using the checklist required by regulation 52.1 to ensure that they are complete and in good order. A report of the inspection shall be entered in the log-book.

#### 8. *Servicing of inflatable liferafts, inflatable lifejackets and inflated rescue boats*

8.1. Every inflatable liferaft and inflatable lifejacket shall be serviced:

- .1 At intervals not exceeding 12 months. However, in cases where it appears proper and reasonable, the Administration may extend this period to 17 months;
- .2 At an approved servicing station which is competent to service them, maintains proper servicing facilities and uses only properly trained personnel.\*

8.2. All repairs and maintenance of inflated rescue boats shall be carried out in accordance with the manufacturer's instructions. Emergency repairs may be carried out on board the ship; however, permanent repairs shall be effected at an approved servicing station.

#### 9. *Periodic servicing of hydrostatic release units*

Hydrostatic release units shall be serviced:

- .1 At intervals not exceeding 12 months. However, in cases where it appears proper and reasonable, the Administration may extend this period to 17 months;
- .2 At a servicing station which is competent to service them, maintains proper servicing facilities and uses only properly trained personnel.

### SECTION 11. PASSENGER SHIPS (ADDITIONAL REQUIREMENTS)

#### *Regulation 20. SURVIVAL CRAFT AND RESCUE BOATS*

##### 1. *Survival craft*

1.1. Passenger ships engaged on international voyages which are not short international voyages shall carry:

\* Reference is made to the "Recommendation on the conditions for the approval of servicing stations for inflatable liferafts" adopted by the Organization by resolution A.333 (IX).<sup>1</sup>

<sup>1</sup> *Resolutions and Other Decisions, Intergovernmental Maritime Consultative Organization Assembly, Ninth Session, 3-14 November 1975, p. 195.*

- .1 Lifeboats complying with the requirements of regulation 42, 43, or 44 on each side of such aggregate capacity as will accommodate not less than 50% of the total number of persons on board. The Administration may permit the substitution of lifeboats by liferafts of equivalent total capacity provided that there shall never be less than sufficient lifeboats on each side of the ship to accommodate 37.5% of the total number of persons on board. The liferafts shall comply with the requirements of regulation 39 or 40 and shall be served by launching appliances equally distributed on each side of the ship; and
- .2 In addition, liferafts complying with the requirements of regulation 39 or 40 of such aggregate capacity as will accommodate at least 25% of the total number of persons on board. These liferafts shall be served by at least one launching appliance on each side which may be those provided in compliance with the requirements of paragraph 1.1.1 or equivalent approved appliances capable of being used on both sides. However, stowage of these liferafts need not comply with the requirements of regulation 13.5.
  - 1.2. Passenger ships engaged on short international voyages and complying with the special standards of subdivision prescribed by regulation 11-1/6.5 shall carry:
    - .1 Lifeboats complying with the requirements of regulation 42, 43 or 44 equally distributed, as far as practicable, on each side of the ship and of such aggregate capacity as will accommodate at least 30% of the total number of persons on board and liferafts complying with requirements of regulation 39 or 40 of such aggregate capacity that, together with the lifeboat capacity, the survival craft will accommodate the total number of persons on board. The liferafts shall be served by launching appliances equally distributed on each side of the ship; and
    - .2 In addition, liferafts complying with the requirements of regulation 39 or 40 of such aggregate capacity as will accommodate at least 25% of the total number of persons on board. These liferafts shall be served by at least one launching appliance on each side which may be those provided in compliance with the requirements of paragraph 1.2.1 or equivalent approved appliances capable of being used on both sides. However, stowage of these liferafts need not comply with the requirements of regulation 13.5.
      - 1.3. Passenger ships engaged on short international voyages and not complying with the special standard of subdivision prescribed by regulation 11-1/6.5, shall carry survival craft complying with the requirements of paragraph 1.1.
      - 1.4. All survival craft required to provide for abandonment by the total number of persons on board shall be capable of being launched with their full complement of persons and equipment within a period of 30 min from the time the abandon ship signal is given.
      - 1.5. In lieu of meeting the requirements of paragraph 1.1, 1.2 or 1.3, passenger ships of less than 500 tons gross tonnage where the total number of persons on board is less than 200, may comply with the following:
        - .1 They shall carry on each side of the ship, liferafts complying with the requirements of regulation 39 or 40 and of such aggregate capacity as will accommodate the total number of persons on board.
        - .2 Unless the liferafts required by paragraph 1.5.1 can be readily transferred for launching on either side of the ship, additional liferafts shall be provided so that the total capacity available on each side will accommodate 150% of the total number of persons on board.
        - .3 If the rescue boat required by paragraph 2.2 is also a lifeboat complying with the requirements of regulation 42, 43 or 44, it may be included in the aggregate capacity required by paragraph 1.5.1, provided that the total capacity available on either side of the ship is at least 150% of the total number of persons on board.
        - .4 In the event of any one survival craft being lost or rendered unserviceable, there shall be sufficient survival craft available for use on each side to accommodate the total number of persons on board.

## 2. *Rescue boats*

2.1. Passenger ships of 500 tons gross tonnage and over shall carry at least one rescue boat complying with the requirements of regulation 47 on each side of the ship.

2.2. Passenger ships of less than 500 tons gross tonnage shall carry at least one rescue boat complying with the requirements of regulation 47.

2.3. A lifeboat may be accepted as a rescue boat provided it also complies with the requirements for a rescue boat.

## 3. *Marshalling of liferafts*

3.1. The number of lifeboats and rescue boats that are carried on passenger ships shall be sufficient to ensure that in providing for abandonment by the total number of persons on board not more than six liferafts need be marshalled by each lifeboat or rescue boat.

3.2. The number of lifeboats and rescue boats that are carried on passenger ships engaged on short international voyages and complying with the special standards of subdivision prescribed by regulation II-1/6.5 shall be sufficient to ensure that in providing for abandonment by the total number of persons on board not more than nine liferafts need be marshalled by each lifeboat or rescue boat.

## *Regulation 21. PERSONAL LIFE-SAVING APPLIANCES*

### 1. *Lifebuoys*

1.1. A passenger ship shall carry not less than the number of lifebuoys complying with the requirements of regulations 7.1 and 31 prescribed in the following table:

<i>Length of ship in metres</i>	<i>Minimum number of lifebuoys</i>
Under 60 .....	8
60 and under 120 .....	12
120 and under 180 .....	18
180 and under 240 .....	24
240 and over .....	30

1.2. Notwithstanding regulation 7.1.3, passenger ships of under 60 m in length shall carry not less than six lifebuoys provided with self-igniting lights.

### 2. *Lifejackets*

In addition to the lifejackets required by regulation 7.2, every passenger ship shall carry lifejackets for not less than 5% of the total number of persons on board. These lifejackets shall be stowed in conspicuous places on deck or at muster stations.

### 3. *Lifejacket lights*

3.1. This paragraph applies to all passenger ships. With respect to passenger ships constructed before 1 July 1986, the requirements of this paragraph shall apply not later than 1 July 1991.

3.2. On passenger ships engaged on international voyages which are not short international voyages each lifejacket shall be fitted with a light complying with the requirements of regulation 32.3.

### 4. *Immersion suits and thermal protective aids*

4.1. This paragraph applies to all passenger ships. With respect to passenger ships constructed before 1 July 1986, the requirements of this paragraph shall apply not later than 1 July 1991.

4.2. Passenger ships shall carry for each lifeboat on the ship at least three immersion suits complying with the requirements of regulation 33 and, in addition, a thermal protective aid complying with the requirements of regulation 34 for every person to be accommodated in



the lifeboat and not provided with an immersion suit. These immersion suits and thermal protective aids need not be carried:

- .1 For persons to be accommodated in totally or partially enclosed lifeboats; or
- .2 If the ship is constantly engaged on voyages in warm climates where, in the opinion of the Administration, thermal protective aids are unnecessary.

4.3. The provisions of paragraph 4.2.1 also apply to totally or partially enclosed lifeboats not complying with the requirements of regulation 42, 43 or 44, provided they are carried on ships constructed before 1 July 1986.

*Regulation 22. SURVIVAL CRAFT AND RESCUE BOAT EMBARKATION ARRANGEMENTS*

1. On passenger ships, survival craft embarkation arrangements shall be designed for:
  - .1 All lifeboats to be boarded and launched either directly from the stowed position or from an embarkation deck but not both;
  - .2 Davit-launched liferafts to be boarded and launched from a position immediately adjacent to the stowed position or from a position to which, in compliance with the requirements of regulation 13.5, the liferaft is transferred prior to launching.
2. Rescue boat arrangements shall be such that the rescue boat can be boarded and launched directly from the stowed position with the number of persons assigned to crew the rescue boat on board. Notwithstanding the requirements of paragraph 1.1, if the rescue boat is also a lifeboat and the other lifeboats are boarded and launched from an embarkation deck, the arrangements shall be such that the rescue boat can also be boarded and launched from the embarkation deck.

*Regulation 23. STOWAGE OF LIFERAFTS*

On passenger ships, every liferaft shall be stowed with its painter permanently attached to the ship and with a float-free arrangement complying with the requirements of regulation 38.6 so that, as far as practicable, the liferaft floats free and, if inflatable, inflates automatically when the ship sinks.

*Regulation 24. MUSTER STATIONS*

Every passenger ship shall, in addition to complying with the requirements of regulation 11, have passenger muster stations which shall:

- .1 Be in the vicinity of, and permit ready access for the passengers to, the embarkation stations unless in the same location;
- .2 Have ample room for marshalling and instruction of the passengers.

*Regulation 25. DRILLS*

1. This regulation applies to all passenger ships.
2. On passenger ships, an abandon ship drill and fire drill shall take place weekly.

SECTION III. CARGO SHIPS (ADDITIONAL REQUIREMENTS)

*Regulation 26. SURVIVAL CRAFT AND RESCUE BOATS*

1. *Survival craft*
  - 1.1. Cargo ships shall carry:
    - .1 One or more lifeboats complying with the requirements of regulation 44 of such aggregate capacity on each side of the ship as will accommodate the total number of persons on board. The Administration may, however, permit cargo ships (except oil tankers, chemical tankers and gas carriers) operating under favourable climatic conditions and in suitable

areas, to carry lifeboats complying with the requirements of regulation 43, provided the limits of the trade area are specified in the Cargo Ship Safety Equipment Certificate; and

2. In addition, a liferaft or liferafts, complying with the requirements of regulation 39 or 40, capable of being launched on either side of the ship and of such aggregate capacity as will accommodate the total number of persons on board. If the liferaft or liferafts cannot be readily transferred for launching on either side of the ship, the total capacity available on each side shall be sufficient to accommodate the total number of persons on board.

1.2. In lieu of meeting the requirements of paragraph 1.1, cargo ships may carry:

1. One or more lifeboats, complying with the requirements of regulation 44, capable of being free fall launched over the stern of the ship of such aggregate capacity as will accommodate the total number of persons on board; and
2. In addition, one or more liferafts complying with the requirements of regulation 39 or 40, on each side of the ship, of such aggregate capacity as will accommodate the total number of persons on board. The liferafts on at least one side of the ship shall be served by launching appliances.

1.3. In lieu of meeting the requirements of paragraph 1.1 or 1.2, cargo ships of less than 85 m in length other than oil tankers, chemical tankers and gas carriers, may comply with the following:

1. They shall carry on each side of the ship, one or more liferafts complying with the requirements of regulation 39 or 40 and of such aggregate capacity as will accommodate the total number of persons on board.
2. Unless the liferafts required by paragraph 1.3.1 can be readily transferred for launching on either side of the ship, additional liferafts shall be provided so that the total capacity available on each side will accommodate 150% of the total number of persons on board.
3. If the rescue boat required by paragraph 2 is also a lifeboat complying with the requirements of regulation 43 or 44, it may be included in the aggregate capacity required by paragraph 1.3.1, provided that the total capacity available on either side of the ship is at least 150% of the total number of persons on board.
4. In the event of any one survival craft being lost or rendered unserviceable, there shall be sufficient survival craft available for use on each side to accommodate the total number of persons on board.

1.4. Cargo ships where the survival craft are stowed in a position which is more than 100m from the stem or stern shall carry, in addition to the liferafts required by paragraphs 1.1.2 and 1.2.2, a liferaft stowed as far forward or aft, or one as far forward and another as far aft, as is reasonable and practicable. Notwithstanding the requirements of regulation 29, such liferaft or liferafts may be securely fastened so as to permit manual release and need not be of the type which can be launched from an approved launching device.

1.5. With the exception of the survival craft referred to in regulation 15.1.1, all survival craft required to provide for abandonment by the total number of persons on board shall be capable of being launched with their full complement of persons and equipment within a period of 10 min from the time the abandon ship signal is given.

1.6. Chemical tankers and gas carriers carrying cargoes emitting toxic vapours or gases\* shall carry, in lieu of lifeboats complying with the requirements of regulation 43 or 44, lifeboats complying with the requirements of regulation 45.

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\* Reference is made to products for which emergency escape respiratory protection is required in chapter 17 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) adopted by the Maritime Safety Committee by resolution MSC.4(48) and in chapter 19 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) adopted by the Maritime Safety Committee by resolution MSC.5(48).

1.7. Oil tankers, chemical tankers and gas carriers carrying cargoes having a flashpoint not exceeding 60° C (closed cup test) shall carry, in lieu of lifeboats complying with the requirements of regulation 43 or 44, lifeboats complying with the requirements of regulation 46.

## 2. *Rescue boats*

Cargo ships shall carry at least one rescue boat complying with the requirements of regulation 47. A lifeboat may be accepted as a rescue boat, provided that it also complies with the requirements for a rescue boat.

3. In addition to their lifeboats, cargo ships constructed before 1 July 1986 shall carry not later than 1 July 1991:

- .1 One or more liferafts of such aggregate capacity as will accommodate the total number of persons on board. The liferaft or liferafts shall be equipped with a lashing or an equivalent means of securing the liferaft which will automatically release it from a sinking ship;
- .2 Where the survival craft are stowed in a position which is more than 100 m from the stem or stern, in addition to the liferafts required by paragraph 3.1, a liferaft stowed as far forward or aft, or one as far forward and another as far aft, as is reasonable and practicable. Notwithstanding the requirements of paragraph 3.1, such liferaft or liferafts may be securely fastened so as to permit manual release.

## *Regulation 27. PERSONAL LIFE-SAVING APPLIANCES*

### 1. *Lifebuoys*

1.1. Cargo ships shall carry not less than the number of lifebuoys complying with the requirements of regulations 7.1 and 31 prescribed in the following table:

<i>Length of ship in metres</i>	<i>Minimum number of lifebuoys</i>
Under 100 .....	8
100 and under 150 .....	10
150 and under 200 .....	12
200 and over .....	14

1.2. Self-igniting lights for lifebuoys on tankers required by regulation 7.1.3 shall be of an electric battery type.

### 2. *Lifejacket lights*

2.1. This paragraph applies to all cargo ships. With respect to cargo ships constructed before 1 July 1986, this paragraph shall apply not later than 1 July 1991.

2.2. On cargo ships, each lifejacket shall be fitted with a light complying with the requirements of regulation 32.3.

### 3. *Immersion suits and thermal protective aids*

3.1. This paragraph applies to all cargo ships. With respect to cargo ships constructed before 1 July 1986, this paragraph shall apply not later than 1 July 1991.

3.2. Cargo ships shall carry for each lifeboat on the ship at least three immersion suits complying with the requirements of regulation 33 or, if the Administration considers it necessary and practicable, one immersion suit complying with the requirements of regulation 33 for every person on board the ship; however, the ship shall carry in addition to the thermal protective aids required by regulations 38.5.1.24, 41.8.31 and 47.2.2.13, thermal protective aids complying with the requirements of regulation 34 for persons on board not provided with immersion suits. These immersion suits and thermal protective aids need not be required if the ship:

- .1 Has totally enclosed lifeboats on each side of the ship of such aggregate capacity as will accommodate the total number of persons on board; or

.2 Has totally enclosed lifeboats capable of being launched by free-fall over the stern of the ship of such aggregate capacity as will accommodate the total number of persons on board and which are boarded and launched directly from the stowed position, together with life-rafts on each side of the ship of such aggregate capacity as will accommodate the total number of persons on board; or

.3 Is constantly engaged on voyages in warm climates where, in the opinion of the Administration, immersion suits are unnecessary.

3.3. Cargo ships complying with the requirements of regulation 26.1.3 shall carry immersion suits complying with the requirements of regulation 33 for every person on board unless the ship:

.1 Has davit-launched liferafts; or

.2 Has liferafts served by equivalent approved appliances capable of being used on both sides of the ship and which do not require entry into the water to board the liferaft; or

.3 Is constantly engaged on voyages in warm climates where, in the opinion of the Administration, immersion suits are unnecessary.

3.4. The immersion suits required by this regulation may be used to comply with the requirements of regulation 7.3.

3.5 The totally enclosed lifeboats referred to in paragraphs 3.2.1 and 3.2.2 carried on cargo ships constructed before 1 July 1986 need not comply with the requirements of regulation 44.

*Regulation 28. SURVIVAL CRAFT EMBARKATION AND LAUNCHING ARRANGEMENTS*

1. Cargo ship survival craft embarkation arrangements shall be so designed that lifeboats can be boarded and launched directly from the stowed position and davit-launched liferafts can be boarded and launched from a position immediately adjacent to the stowed position or from a position to which the liferaft is transferred prior to launching in compliance with the requirements of regulation 13.5.

2. On cargo ships of 20,000 tons gross tonnage and upwards, lifeboats shall be capable of being launched, where necessary utilizing painters, with the ship making headway at speeds up to 5 knots in calm water.

*Regulation 29. STOWAGE OF LIFERAFTS*

On cargo ships, every liferaft, other than those required by regulation 26.1.4, shall be stowed with its painter permanently attached to the ship and with a float-free arrangement complying with the requirements of regulation 38.6 so that the liferaft floats free and, if inflatable, inflates automatically when the ship sinks.

PART C. LIFE-SAVING APPLIANCE REQUIREMENTS

SECTION I. GENERAL

*Regulation 30. GENERAL REQUIREMENTS FOR LIFE-SAVING APPLIANCES*

1. Paragraph 2.7 applies to all ships. With respect to ships constructed before 1 July 1986, paragraph 2.7 shall apply not later than 1 July 1991.

2. Unless expressly provided otherwise or unless, in the opinion of the Administration having regard to the particular voyages on which the ship is constantly engaged, other requirements are appropriate, all life-saving appliances prescribed in this part shall:

.1 Be constructed with proper workmanship and materials;

.2 Not be damaged in stowage throughout the air temperature range  $-30^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$ ;

- .3 If they are likely to be immersed in seawater during their use, operate throughout the seawater temperature range  $-1^{\circ}\text{C}$  to  $+30^{\circ}\text{C}$ ;
- .4 Where applicable, be rot-proof, corrosion-resistant, and not be unduly affected by seawater, oil or fungal attack;
- .5 Where exposed to sunlight, be resistant to deterioration;
- .6 Be of a highly visible colour on all parts where this will assist detection;
- .7 Be fitted with retro-reflective material where it will assist in detection and in accordance with the recommendations of the Organization\*;
- .8 If they are to be used in a seaway, be capable of satisfactory operation in that environment.

3. The Administration shall determine the period of acceptability of life-saving appliances which are subject to deterioration with age. Such life-saving appliances shall be marked with a means for determining their age or the date by which they must be replaced.

## SECTION II. PERSONAL LIFE-SAVING APPLIANCES

### *Regulation 31. LIFEBUOYS*

#### *1. Lifebuoy specification*

Every lifebuoy shall:

- .1 Have an outer diameter of not more than 800 mm and an inner diameter of not less than 400 mm;
- .2 Be constructed of inherently buoyant material; it shall not depend upon rushes, cork shavings or granulated cork, any other loose granulated material or any air compartment which depends on inflation for buoyancy;
- .3 Be capable of supporting not less than 14.5 kg of iron in fresh water for a period of 24 hr;
- .4 Have a mass of not less than 2.5 kg;
- .5 Not sustain burning or continue melting after being totally enveloped in fire for a period of 2 s;
- .6 Be constructed to withstand a drop into the water from the height at which it is stowed above the waterline in the lightest seagoing condition or 30 m, whichever is the greater, without impairing either its operating capability or that of its attached components;
- .7 If it is intended to operate the quick-release arrangement provided for the self-activated smoke signals and self-igniting lights, have a mass sufficient to operate the quick-release arrangement or 4 kg, whichever is the greater;
- .8 Be fitted with a grabline not less than 9.5 mm in diameter and not less than 4 times the outside diameter of the body of the buoy in length. The grabline shall be secured at four equidistant points around the circumference of the buoy to form four equal loops.

#### *2. Lifebuoy self-igniting lights*

Self-igniting lights required by regulation 7.1.3 shall:

- .1 Be such that they cannot be extinguished by water;
- .2 Be capable of either burning continuously with a luminous intensity of not less than 2 cd in all directions of the upper hemisphere or flashing (discharge flashing) at a rate of not less than 50 flashes per minute with at least the corresponding effective luminous intensity;

\* Reference is made to the "Recommendation on retro-reflective tapes on life-saving appliances" adopted by the Organization in resolution A.274(VIII).<sup>1</sup>

<sup>1</sup> *Resolutions and Other Decisions, Intergovernmental Maritime Consultative Organization Assembly, Eighth Session, 13-23 November 1973, p. 96.*

.3 Be provided with a source of energy capable of meeting the requirement of paragraph 2.2 for a period of at least 2 hr;

.4 Be capable of withstanding the drop test required by paragraph 1.6.

### 3. *Lifebuoy self-activating smoke signals*

Self-activating smoke signals required by regulation 7.1.3 shall:

.1 Emit smoke of a highly visible colour at a uniform rate for a period of at least 15 min when floating in calm water;

.2 Not ignite explosively or emit any flame during the entire smoke emission time of the signal;

.3 Not be swamped in a seaway;

.4 Continue to emit smoke when fully submerged in water for a period of at least 10 s;

.5 Be capable of withstanding the drop test required by paragraph 1.6.

### 4. *Buoyant lifelines*

Buoyant lifelines required by regulation 7.1.2 shall:

.1 Be non-kinking;

.2 Have a diameter of not less than 8 mm;

.3 Have a breaking strength of not less than 5 kN.

## Regulation 32. LIFEJACKETS

### 1. *General requirements for lifejackets*

1.1. A lifejacket shall not sustain burning or continue melting after being totally enveloped in a fire for a period of 2 s.

1.2. A lifejacket shall be so constructed that:

.1 After demonstration, a person can correctly don it within a period of 1 min without assistance;

.2 It is capable of being worn inside-out or is clearly capable of being worn in only one way and, as far as possible, cannot be donned incorrectly;

.3 It is comfortable to wear;

.4 It allows the wearer to jump from a height of at least 4.5 m into the water without injury and without dislodging or damaging the lifejacket.

1.3. A lifejacket shall have sufficient buoyancy and stability in calm fresh water to:

.1 Lift the mouth of an exhausted or unconscious person not less than 120 mm clear of the water with the body inclined backwards at an angle of not less than 20° and not more than 50° from the vertical position;

.2 Turn the body of an unconscious person in the water from any position to one where the mouth is clear of the water in not more than 5 s.

1.4. A lifejacket shall have buoyancy which is not reduced by more than 5% after 24 h submersion in fresh water.

1.5. A lifejacket shall allow the person wearing it to swim a short distance and to board a survival craft.

1.6. Each lifejacket shall be fitted with a whistle firmly secured by a cord.

### 2. *Inflatable lifejackets*

A lifejacket which depends on inflation for buoyancy shall have not less than two separate compartments and comply with the requirements of paragraph 1 and shall:

.1 Inflate automatically on immersion, be provided with a device to permit inflation by a single manual motion and be capable of being inflated by mouth;

- .2 In the event of loss of buoyancy in any one compartment be capable of complying with the requirements of paragraphs 1.2, 1.3 and 1.5;
- .3 Comply with the requirements of paragraph 1.4 after inflation by means of the automatic mechanism.
  3. *Lifejacket lights*
    - 3.1. Each lifejacket light shall:
      - .1 Have a luminous intensity of not less than 0.75 cd;
      - .2 Have a source of energy capable of providing a luminous intensity of 0.75 cd for a period of at least 8 h;
      - .3 Be visible over as great a segment of the upper hemisphere as is practicable when attached to a lifejacket.
        - 3.2. If the light referred to in paragraph 3.1 is a flashing light it shall, in addition:
          - .1 Be provided with a manually operated switch;
          - .2 Not be fitted with a lens or curved reflector to concentrate the beam;
          - .3 Flash at a rate of not less than 50 flashes per minute with an effective luminous intensity of at least 0.75 cd.

#### *Regulation 33. IMMERSION SUITS*

##### *1. General requirements for immersion suits*

1.1. The immersion suit shall be constructed with waterproof materials such that:

- .1 It can be unpacked and donned without assistance within 2 min, taking into account any associated clothing\*, and a lifejacket if the immersion suit is to be worn in conjunction with a lifejacket;
- .2 It will not sustain burning or continue melting after being totally enveloped in a fire for a period of 2 s;
- .3 It will cover the whole body with the exception of the face. Hands shall also be covered unless permanently attached gloves are provided;
- .4 It is provided with arrangements to minimize or reduce free air in the legs of the suit;
- .5 Following a jump from a height of not less than 4.5 m into the water there is no undue ingress of water into the suit.

1.2. An immersion suit which also complies with the requirements of regulation 32 may be classified as a lifejacket.

1.3. An immersion suit shall permit the person wearing it, and also wearing a lifejacket if the immersion suit is to be worn in conjunction with a lifejacket, to:

- .1 Climb up and down a vertical ladder at least 5 m in length;
- .2 Perform normal duties during abandonment;
- .3 Jump from a height of not less than 4.5 m into the water without damaging or dislodging the immersion suit, or being injured; and
- .4 Swim a short distance through the water and board a survival craft.

1.4. An immersion suit which has buoyancy and is designed to be worn without a lifejacket shall be fitted with a light complying with the requirements of regulation 32.3 and the whistle prescribed by regulation 32.1.6.

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\* Reference is made to paragraph 3.1.3.1 of the "Recommendation on testing of life-saving appliances" to be submitted to the Assembly of the Organization at its thirteenth session for adoption.

1.5. If the immersion suit is to be worn in conjunction with a lifejacket, the lifejacket shall be worn over the immersion suit. A person wearing such an immersion suit shall be able to don a lifejacket without assistance.

2. *Thermal performance requirements for immersion suits*

- 2.1. An immersion suit made of material which has no inherent insulation shall be:
- .1 Marked with instructions that it must be worn in conjunction with warm clothing;
  - .2 So constructed that, when worn in conjunction with warm clothing, and with a lifejacket if the immersion suit is to be worn with a lifejacket, the immersion suit continues to provide sufficient thermal protection, following one jump by the wearer into the water from a height of 4.5 m, to ensure that when it is worn for a period of 1 h in calm circulating water at a temperature of 5° C, the wearer's body core temperature does not fall more than 2° C.
- 2.2. An immersion suit made of material with inherent insulation, when worn either on its own or with a lifejacket, if the immersion suit is to be worn in conjunction with a lifejacket, shall provide the wearer with sufficient thermal insulation, following one jump into the water from a height of 4.5 m, to ensure that the wearer's body core temperature does not fall more than 2° C after a period of 6 h immersion in calm circulating water at a temperature of between 0° C and 2° C.
- 2.3. The immersion suit shall permit the person wearing it with hands covered to pick up a pencil and write after being immersed in water at 5° C for a period of 1 h.

3. *Buoyancy requirements*

A person in fresh water wearing either an immersion suit complying with the requirements of regulation 32, or an immersion suit with a lifejacket, shall be able to turn from a face-down to a face-up position in not more than 5 s.

*Regulation 34. THERMAL PROTECTIVE AIDS*

1. A thermal protective aid shall be made of waterproof material having a thermal conductivity of not more than 0.25 W/(m-K) and shall be so constructed that, when used to enclose a person, it shall reduce both the convective and evaporative heat loss from the wearer's body.
2. The thermal protective aid shall:
  - .1 Cover the whole body of a person wearing a lifejacket with the exception of the face. Hands shall also be covered unless permanently attached gloves are provided;
  - .2 Be capable of being unpacked and easily donned without assistance in a survival craft or rescue boat;
  - .3 Permit the wearer to remove it in the water in not more than 2 min, if it impairs ability to swim.
3. The thermal protective aid shall function properly throughout an air temperature range -30° C to +120° C.

SECTION III. VISUAL SIGNALS

*Regulation 35. ROCKET PARACHUTE FLARES*

1. The rocket parachute flare shall:
  - .1 Be contained in a water-resistant casing;
  - .2 Have brief instructions or diagrams clearly illustrating the use of the rocket parachute flare printed on its casing;
  - .3 Have integral means of ignition;



- .4 Be so designed as not to cause discomfort to the person holding the casing when used in accordance with the manufacturer's operating instructions.
2. The rocket shall, when fired vertically, reach an altitude of not less than 300 m. At or near the top of its trajectory, the rocket shall eject a parachute flare, which shall:
  - .1 Burn with a bright red colour;
  - .2 Burn uniformly with an average luminous intensity of not less than 30,000 cd;
  - .3 Have a burning period of not less than 40 s;
  - .4 Have a rate of descent of not more than 5 m/s;
  - .5 Not damage its parachute or attachments while burning.

*Regulation 36. HAND FLARES*

1. The hand flare shall:
  - .1 Be contained in a water-resistant casing;
  - .2 Have brief instructions or diagrams clearly illustrating the use of the hand flare printed on its casing;
  - .3 Have a self-contained means of ignition;
  - .4 Be so designed as not to cause discomfort to the person holding the casing and not endanger the survival craft by burning or glowing residues when used in accordance with the manufacturer's operating instructions.
2. The hand flare shall:
  - .1 Burn with a bright red colour;
  - .2 Burn uniformly with an average luminous intensity of not less than 15,000 cd;
  - .3 Have a burning period of not less than 1 min;
  - .4 Continue to burn after having been immersed for a period of 10 s under 100 mm of water.

*Regulation 37. BUOYANT SMOKE SIGNALS*

1. The buoyant smoke signal shall:
  - .1 Be contained in a water-resistant casing;
  - .2 Not ignite explosively when used in accordance with the manufacturer's operating instructions;
  - .3 Have brief instructions or diagrams clearly illustrating the use of the buoyant smoke signal printed on its casing.
2. The buoyant smoke signal shall:
  - .1 Emit smoke of a highly visible colour at a uniform rate for a period of not less than 3 min when floating in calm water;
  - .2 Not emit any flame during the entire smoke emission time;
  - .3 Not be swamped in a seaway;
  - .4 Continue to emit smoke when submerged in water for a period of 10 s under 100 mm of water.

SECTION IV. SURVIVAL CRAFT

*Regulation 38. GENERAL REQUIREMENTS FOR LIFERAFTS*

1. *Construction of liferafts*
  - 1.1. Every liferaft shall be so constructed as to be capable of withstanding exposure for 30 days afloat in all sea conditions.

1.2. The liferaft shall be so constructed that when it is dropped into the water from a height of 18 m, the liferaft and its equipment will operate satisfactorily. If the liferaft is to be stowed at a height of more than 18 m above the waterline in the lightest seagoing condition, it shall be of a type which has been satisfactorily drop-tested from at least that height.

1.3. The floating liferaft shall be capable of withstanding repeated jumps on to it from a height of at least 4.5 m above its floor both with and without the canopy erected.

1.4. The liferaft and its fittings shall be so constructed as to enable it to be towed at a speed of 3 knots in calm water when loaded with its full complement of persons and equipment and with one of its sea-anchors streamed.

1.5. The liferaft shall have a canopy to protect the occupants from exposure which is automatically set in place when the liferaft is launched and waterborne. The canopy shall comply with the following:

- .1 It shall provide insulation against heat and cold by means of either two layers of material separated by an air gap or other equally efficient means. Means shall be provided to prevent accumulation of water in the air gap;
- .2 Its interior shall be of a colour that does not cause discomfort to the occupants;
- .3 Each entrance shall be clearly indicated and be provided with efficient adjustable closing arrangements which can be easily and quickly opened from inside and outside the liferaft so as to permit ventilation but exclude seawater, wind and cold. Liferafts accommodating more than eight persons shall have at least two diametrically opposite entrances;
- .4 It shall admit sufficient air for the occupants at all times, even with the entrances closed;
- .5 It shall be provided with at least one viewing port;
- .6 It shall be provided with means for collecting rain water;
- .7 It shall have sufficient headroom for sitting occupants under all parts of the canopy.

### 2. *Minimum carrying capacity and mass of liferafts*

2.1. No liferaft shall be approved which has a carrying capacity of less than six persons calculated in accordance with the requirements of regulation 39.3 or 40.3, as appropriate.

2.2. Unless the liferaft is to be launched by an approved launching appliance complying with the requirements of regulation 48 and is not required to be portable, the total mass of the liferaft, its container and its equipment shall not be more than 185 kg.

### 3. *Liferaft fittings*

3.1. Lifelines shall be securely becketed around the inside and outside of the liferaft.

3.2. The liferaft shall be provided with arrangements for adequately siting and securing in the operating position the antenna provided with the portable radio apparatus required by regulation 6.2.1.

3.3. The liferaft shall be fitted with an efficient painter of length equal to not less than twice the distance from the stowed position to the waterline in the lightest seagoing condition or 15 m whichever is the greater.

### 4. *Davit-launched liferafts*

4.1. In addition to the above requirements, a liferaft for use with an approved launching appliance shall:

- .1 When the liferaft is loaded with its full complement of persons and equipment, be capable of withstanding a lateral impact against the ship's side at an impact velocity of not less than 3.5 m/s and also a drop into the water from a height of not less than 3 m without damage that will affect its function;
- .2 Be provided with means for bringing the liferaft alongside the embarkation deck and holding it securely during embarkation.

4.2. Every passenger ship davit-launched liferaft shall be so arranged that it can be rapidly boarded by its full complement of persons.

4.3. Every cargo ship davit-launched liferaft shall be so arranged that it can be boarded by its full complement of persons in not more than 3 min from the time the instruction to board is given.

#### 5. *Equipment*

5.1. The normal equipment of every liferaft shall consist of:

- .1 One buoyant rescue quoit, attached to not less than 30 m of buoyant line;
- .2 One knife of the non-folding type having a buoyant handle and lanyard attached and stowed in a pocket on the exterior of the canopy near the point at which the painter is attached to the liferaft. In addition, a liferaft which is permitted to accommodate 13 persons or more shall be provided with a second knife which need not be of the non-folding type;
- .3 For a liferaft which is permitted to accommodate not more than 12 persons, one buoyant bailer. For a liferaft which is permitted to accommodate 13 persons or more, two buoyant bailers;
- .4 Two sponges;
- .5 Two sea-anchors each with a shock-resistant hawser and tripping line, one being spare and the other permanently attached to the liferaft in such a way that when the liferaft inflates or is waterborne it will cause the liferaft to lie oriented to the wind in the most stable manner. The strength of each sea-anchor and its hawser and tripping line shall be adequate for all sea conditions. The sea-anchors shall be fitted with a swivel at each end of the line and shall be of a type which is unlikely to turn inside-out between its shroud lines;
- .6 Two buoyant paddles;
- .7 Three tin openers. Safety knives containing special tin-opener blades are satisfactory for this requirement;
- .8 One first-aid outfit in a waterproof case capable of being closed tightly after use;
- .9 One whistle or equivalent sound signal;
- .10 Four rocket parachute flares complying with the requirements of regulation 35;
- .11 Six hand flares complying with the requirements of regulation 36;
- .12 Two buoyant smoke signals complying with the requirements of regulation 37;
- .13 One waterproof electric torch suitable for Morse signalling together with one spare set of batteries and one spare bulb in a waterproof container;
- .14 An efficient radar reflector;
- .15 One daylight signalling mirror with instructions on its use for signalling to ships and aircraft;
- .16 One copy of the life-saving signals referred to in regulation V/16 on a waterproof card or in a waterproof container;
- .17 One set of fishing tackle;
- .18 A food ration totalling not less than 10,000 kJ for each person the liferaft is permitted to accommodate; these rations shall be kept in airtight packaging and be stowed in a watertight container;
- .19 Watertight receptacles containing a total of 1.5 ℓ of fresh water for each person the liferaft is permitted to accommodate, of which 0.5 ℓ per person may be replaced by a desalting apparatus capable of producing an equal amount of fresh water in 2 days;
- .20 One rustproof graduated drinking vessel;

- .21 Six doses of anti-seasickness medicine and one seasickness bag for each person the liferaft is permitted to accommodate;
- .22 Instructions on how to survive;
- .23 Instructions for immediate action;
- .24 Thermal protective aids complying with the requirements of regulation 34 sufficient for 10% of the number of persons the liferaft is permitted to accommodate or two, whichever is the greater.

5.2. The marking required by regulations 39.7.3.5 and 40.7.7 on liferafts equipped in accordance with paragraph 5.1 shall be "SOLAS A PACK" in block capitals of the Roman alphabet.

5.3. In the case of passenger ships engaged on short international voyages of such a nature and duration that, in the opinion of the Administration, not all the items specified in paragraph 5.1 are necessary, the Administration may allow the liferafts carried on any such ships to be provided with the equipment specified in paragraphs 5.1.1 to 5.1.6 inclusive, 5.1.8, 5.1.9, 5.1.13 to 5.1.16 inclusive and 5.1.21 to 5.1.24 inclusive and one half of the equipment specified in paragraphs 5.1.10 to 5.1.12 inclusive. The marking required by regulations 39.7.3.5 and 40.7.7 on such liferafts shall be "SOLAS B PACK" in block capitals of the Roman alphabet.

5.4. Where appropriate the equipment shall be stowed in a container which, if it is not an integral part of, or permanently attached to, the liferaft, shall be stowed and secured inside the liferaft and be capable of floating in water for at least 30 min without damage to its contents.

#### 6. *Float-free arrangements for liferafts*

##### 6.1. *Painter system*

The liferaft painter system shall provide a connection between the ship and the liferaft and shall be so arranged as to ensure that the liferaft when released and, in the case of an inflatable liferaft, inflated is not dragged under by the sinking ship.

##### 6.2. *Weak link*

If a weak link is used in the float-free arrangement, it shall:

- .1 Not be broken by the force required to pull the painter from the liferaft container;
- .2 If applicable, be of sufficient strength to permit the inflation of the liferaft;
- .3 Break under a strain of  $2.2 \pm 0.4$  kN.

##### 6.3. *Hydrostatic release units*

If a hydrostatic release unit is used in the float-free arrangements, it shall:

- .1 Be constructed of compatible materials so as to prevent malfunction of the unit. Galvanizing or other forms of metallic coating on parts of the hydrostatic release unit shall not be accepted;
- .2 Automatically release the liferaft at a depth of not more than 4 m;
- .3 Have drains to prevent the accumulation of water in the hydrostatic chamber when the unit is in its normal position;
- .4 Be so constructed as to prevent release when seas wash over the unit;
- .5 Be permanently marked on its exterior with its type and serial number;
- .6 Be provided with a document or identification plate stating the date of manufacture, type and serial number;
- .7 Be such that each part connected to the painter system has a strength of not less than that required for the painter.

#### *Regulation 39. INFLATABLE LIFERAFTS*

1. Inflatable liferafts shall comply with the requirements of regulation 38 and, in addition, shall comply with the requirements of this regulation.

## 2. *Construction of inflatable liferafts*

2.1. The main buoyancy chamber shall be divided into not less than two separate compartments, each inflated through a non-return inflation valve on each compartment. The buoyancy chambers shall be so arranged that, in the event of any one of the compartments being damaged or failing to inflate, the intact compartments shall be able to support, with positive freeboard over the liferaft's entire periphery, the number of persons which the liferaft is permitted to accommodate, each having a mass of 75 kg and seated in their normal positions.

2.2. The floor of the liferaft shall be waterproof and shall be capable of being sufficiently insulated against cold either:

- .1 By means of one or more compartments that the occupants can inflate, or which inflate automatically and can be deflated and reinflated by the occupants; or
- .2 By other equally efficient means not dependent on inflation.

2.3. The liferaft shall be inflated with a non-toxic gas. Inflation shall be completed within a period of 1 min at an ambient temperature of between 18° C and 20° C and within a period of 3 min at an ambient temperature of -30° C. After inflation the liferaft shall maintain its form when loaded with its full complement of persons and equipment.

2.4. Each inflatable compartment shall be capable of withstanding a pressure equal to at least 3 times the working pressure and shall be prevented from reaching a pressure exceeding twice the working pressure either by means of relief valves or by a limited gas supply. Means shall be provided for fitting the topping-up pump or bellows required by paragraph 10.1.2 so that the working pressure can be maintained.

## 3. *Carrying capacity of inflatable liferafts*

The number of persons which a liferaft shall be permitted to accommodate shall be equal to the lesser of:

- .1 The greatest whole number obtained by dividing by 0.096 the volume, measured in cubic metres, of the main buoyancy tubes (which for this purpose shall include neither the arches nor the thwarts if fitted) when inflated; or
- .2 The greatest whole number obtained by dividing by 0.372 the inner horizontal cross-sectional area of the liferaft measured in square metres (which for this purpose may include the thwart or thwarts, if fitted) measured to the innermost edge of the buoyancy tubes; or
- .3 The number of persons having an average mass of 75 kg, all wearing lifejackets, that can be seated with sufficient comfort and headroom without interfering with the operation of any of the liferaft's equipment.

## 4. *Access into inflatable liferafts*

4.1. At least one entrance shall be fitted with a semi-rigid boarding ramp to enable persons to board the liferaft from the sea so arranged as to prevent significant deflation of the liferaft if the ramp is damaged. In the case of a davit-launched liferaft having more than one entrance, the boarding ramp shall be fitted at the entrance opposite the bowsing lines and embarkation facilities.

4.2. Entrances not provided with a boarding ramp shall have a boarding ladder, the lowest step of which shall be situated not less than 0.4 m below the liferaft's light waterline.

4.3. There shall be means inside the liferaft to assist persons to pull themselves into the liferaft from the ladder.

## 5. *Stability of inflatable liferafts*

5.1. Every inflatable liferaft shall be so constructed that, when fully inflated and floating with the canopy uppermost, it is stable in a seaway.

5.2. The stability of the liferaft when in the inverted position shall be such that it can be righted in a seaway and in calm water by one person.

5.3. The stability of the liferaft when loaded with its full complement of persons and equipment shall be such that it can be towed at speeds of up to 3 knots in calm water.

#### 6. *Inflatable liferaft fittings*

6.1. The breaking strength of the painter system including its means of attachment to the liferaft, except the weak link required by regulation 38.6, shall be not less than 10.0 kN for a liferaft permitted to accommodate nine persons or more, and not less than 7.5 kN for any other liferaft. The liferaft shall be capable of being inflated by one person.

6.2. A manually controlled lamp visible on a dark night with a clear atmosphere at a distance of at least 2 miles for a period of not less than 12 h shall be fitted to the top of the liferaft canopy. If the light is a flashing light it shall flash at a rate of not less than 50 flashes per minute for the first 2 h of operation of the 12 h operating period. The lamp shall be powered by a sea-activated cell or a dry chemical cell and shall light automatically when the liferaft inflates. The cell shall be of a type that does not deteriorate due to damp or humidity in the stowed liferaft.

6.3. A manually controlled lamp shall be fitted inside the liferaft capable of continuous operation for a period of at least 12 h. It shall light automatically when the liferaft inflates and be of sufficient intensity to enable reading of survival and equipment instructions.

#### 7. *Containers for inflatable liferafts*

7.1. The liferaft shall be packed in a container that is:

- .1 So constructed as to withstand hard wear under conditions encountered at sea;
- .2 Of sufficient inherent buoyancy, when packed with the liferaft and its equipment, to pull the painter from within and to operate the inflation mechanism should the ship sink;
- .3 As far as practicable watertight, except for drain holes in the container bottom.

7.2. The liferaft shall be packed in its container in such a way as to ensure, as far as possible, that the waterborne liferaft inflates in an upright position on breaking free from its container.

7.3. The container shall be marked with:

- .1 Maker's name or trade mark;
- .2 Serial number;
- .3 Name of approved authority and the number of persons it is permitted to carry;
- .4 SOLAS;
- .5 Type of emergency pack enclosed;
- .6 Date when last serviced;
- .7 Length of painter;
- .8 Maximum permitted height of stowage above waterline (depending on drop-test height and length of painter);
- .9 Launching instructions.

#### 8. *Markings on inflatable liferafts*

The liferaft shall be marked with:

- .1 Maker's name or trade mark;
- .2 Serial number;
- .3 Date of manufacture (month and year);
- .4 Name of approving authority;

- .5 Name and place of servicing station where it was last serviced;
- .6 Number of persons it is permitted to accommodate over each entrance in characters not less than 100mm in height of a colour contrasting with that of the liferaft.

9. *Davit-launched inflatable liferafts*

9.1. In addition to complying with the above requirements, a liferaft for use with an approved launching appliance shall, when suspended from its lifting hook or bridle, withstand a load of:

- .1 4 times the mass of its full complement of persons and equipment, at an ambient temperature and a stabilized liferaft temperature of  $20 \pm 3^{\circ}$  C with all relief valves inoperative; and
- .2 1.1 times the mass of its full complement of persons and equipment at an ambient temperature and a stabilized liferaft temperature of  $-30^{\circ}$  C with all relief valves operative.

9.2. Rigid containers for liferafts to be launched by a launching appliance shall be so secured that the container or parts of it are prevented from falling into the sea during and after inflation and launching of the contained liferaft.

10. *Additional equipment for inflatable liferafts*

10.1. In addition to the equipment required by regulation 38.5, every inflatable liferaft shall be provided with:

- .1 One repair outfit for repairing punctures in buoyancy compartments;
  - .2 One topping-up pump or bellows.
- 10.2. The knives required by regulation 38.5.1.2 shall be safety knives.

*Regulation 40. RIGID LIFERAFTS*

1. Rigid liferafts shall comply with the requirements of regulation 38 and, in addition, shall comply with the requirements of this regulation.

2. *Construction of rigid liferafts*

2.1. The buoyancy of the liferaft shall be provided by approved inherently buoyant material placed as near as possible to the periphery of the liferaft. The buoyant material shall be fire-retardant or be protected by a fire-retardant covering.

2.2. The floor of the liferaft shall prevent the ingress of water and shall effectively support the occupants out of the water and insulate them from cold.

3. *Carrying capacity of rigid liferafts*

The number of persons which a liferaft shall be permitted to accommodate shall be equal to the lesser of:

- .1 The greatest whole number obtained by dividing by 0.096 the volume, measured in cubic metres, of the buoyancy material multiplied by a factor of 1 minus the specific gravity of that material; or
- .2 The greatest whole number obtained by dividing by 0.372 the horizontal cross-sectional area of the floor of the liferaft measured in square metres; or
- .3 The number of persons having an average mass of 75 kg, all wearing lifejackets, that can be seated with sufficient comfort and headroom without interfering with the operation of any of the liferaft's equipment.

4. *Access into rigid liferafts*

4.1. At least one entrance shall be fitted with a rigid boarding ramp to enable persons to board the liferaft from the sea. In the case of a davit-launched liferaft having more than one entrance, the boarding ramp shall be fitted at the entrance opposite to the bowsing and embarkation facilities.

4.2. Entrances not provided with a boarding ramp shall have a boarding ladder, the lowest step of which shall be situated not less than 0.4 m below the liferaft's light waterline.

4.3. There shall be means inside the liferaft to assist persons to pull themselves into the liferaft from the ladder.

#### 5. *Stability of rigid liferafts*

5.1. Unless the liferaft is capable of operating safely whichever way up it is floating, its strength and stability shall be such that it is either self-righting or can be readily righted in a seaway and in calm water by one person.

5.2. The stability of a liferaft when loaded with its full complement of persons and equipment shall be such that it can be towed at speeds of up to 3 knots in calm water.

#### 6. *Rigid liferaft fittings*

6.1. The liferaft shall be fitted with an efficient painter. The breaking strength of the painter system, including its means of attachment to the liferaft, except the weak link required by regulation 38.6, shall be not less than 10.0 kN for liferafts permitted to accommodate nine persons or more, and not less than 7.5 kN for any other liferaft.

6.2. A manually controlled lamp visible on a dark night with a clear atmosphere at a distance of at least 2 miles for a period of not less than 12 h shall be fitted to the top of the liferaft canopy. If the light is a flashing light it shall flash at a rate of not less than 50 flashes per minute for the first 2 h of operation of the 12 h operating period. The lamp shall be powered by a sea-activated cell or a dry chemical cell and shall light automatically when the liferaft canopy is set in place. The cell shall be of a type that does not deteriorate due to damp or humidity in the stowed liferaft.

6.3. A manually controlled lamp shall be fitted inside the liferaft, capable of continuous operation for a period of at least 12 h. It shall light automatically when the canopy is set in place and be of sufficient intensity to enable reading of survival and equipment instructions.

#### 7. *Markings on liferafts*

The liferaft shall be marked with:

- .1 Name and port of registry of the ship to which it belongs;
- .2 Maker's name or trade mark;
- .3 Serial number;
- .4 Name of approving authority;
- .5 Number of persons it is permitted to accommodate over each entrance in characters not less than 100 mm in height of a colour contrasting with that of the liferaft;
- .6 SOLAS;
- .7 Type of emergency pack enclosed;
- .8 Length of painter;
- .9 Maximum permitted height of stowage above waterline (drop-test height);
- .10 Launching instructions.

#### 8. *Davit-launched rigid liferafts*

In addition to the above requirements, a rigid liferaft for use with an approved launching appliance shall, when suspended from its lifting hook or bridle, withstand a load of 4 times the mass of its full complement of persons and equipment.



*Regulation 41. GENERAL REQUIREMENTS FOR LIFEBOATS**1. Construction of lifeboats*

1.1. All lifeboats shall be properly constructed and shall be of such form and proportions that they have ample stability in a seaway and sufficient freeboard when loaded with their full complement of persons and equipment. All lifeboats shall have rigid hulls and shall be capable of maintaining positive stability when in an upright position in calm water and loaded with their full complement of persons and equipment and holed in any one location below the waterline, assuming no loss of buoyancy material and no other damage.

1.2. All lifeboats shall be of sufficient strength to:

- .1 Enable them to be safely lowered into the water when loaded with their full complement of persons and equipment; and
- .2 Be capable of being launched and towed when the ship is making headway at a speed of 5 knots in calm water.

1.3. Hulls and rigid covers shall be fire-retardant or non-combustible.

1.4. Seating shall be provided on thwarts, benches or fixed chairs fitted as low as practicable in the lifeboat and constructed so as to be capable of supporting the number of persons each weighing 100 kg for which spaces are provided in compliance with the requirements of paragraph 2.2.2.

1.5. Each lifeboat shall be of sufficient strength to withstand a load, without residual deflection on removal of that load:

- .1 In the case of boats with metal hulls, 1.25 times the total mass of the lifeboat when loaded with its full complement of persons and equipment; or
- .2 In the case of other boats, twice the total mass of the lifeboat when loaded with its full complement of persons and equipment.

1.6. Each lifeboat shall be of sufficient strength to withstand, when loaded with its full complement of persons and equipment and with, where applicable, skates or fenders in position, a lateral impact against the ship's side at an impact velocity of at least 3.5 m/s and also a drop into the water from a height of at least 3 m.

1.7. The vertical distance between the floor surface and the interior of the enclosure or canopy over 50% of the floor area shall be:

- .1 Not less than 1.3 m for a lifeboat permitted to accommodate nine persons or less;
- .2 Not less than 1.7 m for a lifeboat permitted to accommodate 24 persons or more;
- .3 Not less than the distance as determined by linear interpolation between 1.3 m and 1.7 m for a lifeboat permitted to accommodate between nine and 24 persons.

*2. Carrying capacity of lifeboats*

2.1. No lifeboat shall be approved to accommodate more than 150 persons.

2.2. The number of persons which a lifeboat shall be permitted to accommodate shall be equal to the lesser of:

- .1 The number of persons having an average mass of 75 kg, all wearing lifejackets, that can be seated in a normal position without interfering with the means of propulsion or the operation of any of the lifeboat's equipment; or
- .2 The number of spaces that can be provided on the seating arrangements in accordance with Figure 1. The shapes may be overlapped as shown, provided footrests are fitted and there is sufficient room for legs and the vertical separation between the upper and lower seat is not less than 350 mm.

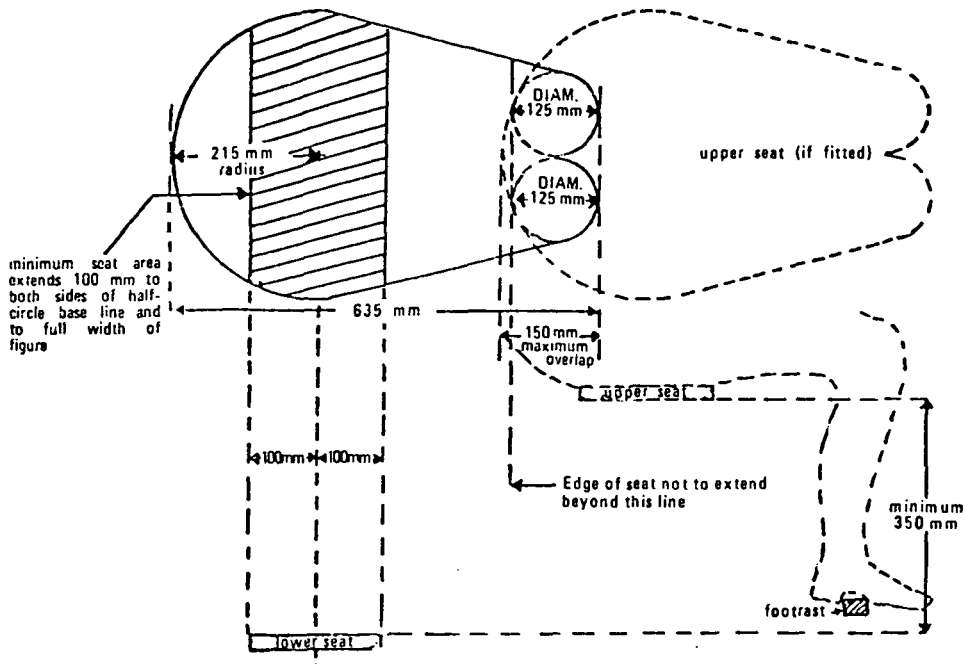


FIGURE 1

2.3. Each seating position shall be clearly indicated in the lifeboat.

### 3. Access into lifeboats

3.1. Every passenger ship lifeboat shall be so arranged that it can be rapidly boarded by its full complement of persons. Rapid disembarkation shall also be possible.

3.2. Every cargo ship lifeboat shall be so arranged that it can be boarded by its full complement of persons in not more than 3 min from the time the instruction to board is given. Rapid disembarkation shall also be possible.

3.3. Lifeboats shall have a boarding ladder that can be used on either side of the lifeboat to enable persons in the water to board the lifeboat. The lowest step of the ladder shall be not less than 0.4 m below the lifeboat's light waterline.

3.4. The lifeboat shall be so arranged that helpless people can be brought on board either from the sea or on stretchers.

3.5. All surfaces on which persons might walk shall have a non-skid finish.

### 4. Lifeboat buoyancy

All lifeboats shall have inherent buoyancy or shall be fitted with inherently buoyant material which shall not be adversely affected by seawater, oil or oil products, sufficient to float the lifeboat with all its equipment on board when flooded and open to the sea. Additional inherently buoyant material, equal to 280 N of buoyant force per person, shall be provided for the number of persons the lifeboat is permitted to accommodate. Buoyant material, unless in addition to that required above, shall not be installed external to the hull of the lifeboat.

### 5. Lifeboat freeboard and stability

All lifeboats, when loaded with 50% of the number of persons the lifeboat is permitted to accommodate seated in their normal positions to one side of the centreline, shall have a free-

board, measured from the waterline to the lowest opening through which the lifeboat may become flooded, of at least 1.5% of the lifeboat's length or 100 mm, whichever is the greater.

#### 6. *Lifeboat propulsion*

6.1. Every lifeboat shall be powered by a compression ignition engine. No engine shall be used for any lifeboat if its fuel has a flashpoint of 43° C or less (closed cup test).

6.2. The engine shall be provided with either a manual starting system, or a power starting system with two independent rechargeable energy sources. Any necessary starting aids shall also be provided. The engine starting systems and starting aids shall start the engine at an ambient temperature of -15° C within 2 min of commencing the start procedure unless, in the opinion of the Administration having regard to the particular voyages in which the ship carrying the lifeboat is constantly engaged, a different temperature is appropriate. The starting systems shall not be impeded by the engine casing, thwarts or other obstructions.

6.3. The engine shall be capable of operating for not less than 5 min after starting from cold with the lifeboat out of the water.

6.4. The engine shall be capable of operating when the lifeboat is flooded up to the centreline of the crank shaft.

6.5. The propeller shafting shall be so arranged that the propeller can be disengaged from the engine. Provision shall be made for ahead and astern propulsion of the lifeboat.

6.6. The exhaust pipe shall be so arranged as to prevent water from entering the engine in normal operation.

6.7. All lifeboats shall be designed with due regard to the safety of persons in the water and to the possibility of damage to the propulsion system by floating debris.

6.8. The speed of a lifeboat when proceeding ahead in calm water, when loaded with its full complement of persons and equipment and with all engine-powered auxiliary equipment in operation, shall be at least 6 knots and at least 2 knots when towing a 25-person liferaft loaded with its full complement of persons and equipment or its equivalent. Sufficient fuel, suitable for use throughout the temperature range expected in the area in which the ship operates, shall be provided to run the fully loaded lifeboat at 6 knots for a period of not less than 24 h.

6.9. The lifeboat engine, transmission and engine accessories shall be enclosed in a fire-retardant casing or other suitable arrangements providing similar protection. Such arrangements shall also protect persons from coming into accidental contact with hot or moving parts and protect the engine from exposure to weather and sea. Adequate means shall be provided to reduce the engine noise. Starter batteries shall be provided with casings which form a watertight enclosure around the bottom and sides of the batteries. The battery casings shall have a tight fitting top which provides for necessary gas venting.

6.10. The lifeboat engine and accessories shall be designed to limit electromagnetic emissions so that engine operation does not interfere with the operation of radio life-saving appliances used in the lifeboat.

6.11. Means shall be provided for recharging all engine-starting, radio and searchlight batteries. Radio batteries shall not be used to provide power for engine starting. Means shall be provided for recharging lifeboat batteries from the ship's power supply at a supply voltage not exceeding 55 V which can be disconnected at the lifeboat embarkation station.

6.12. Water-resistant instructions for starting and operating the engine shall be provided and mounted in a conspicuous place near the engine starting controls.

#### 7. *Lifeboat fittings*

7.1. All lifeboats shall be provided with at least one drain valve fitted near the lowest point in the hull, which shall automatically open to drain water from the hull when the lifeboat is not waterborne and shall automatically close to prevent entry of water when the lifeboat is waterborne. Each drain valve shall be provided with a cap or plug to close the valve, which

shall be attached to the lifeboat by a lanyard, a chain, or other suitable means. Drain valves shall be readily accessible from inside the lifeboat and their position shall be clearly indicated.

7.2. All lifeboats shall be provided with a rudder and tiller. When a wheel or other remote steering mechanism is also provided the tiller shall be capable of controlling the rudder in case of failure of the steering mechanism. The rudder shall be permanently attached to the lifeboat. The tiller shall be permanently installed on, or linked to, the rudder stock; however, if the lifeboat has a remote steering mechanism, the tiller may be removable and securely stowed near the rudder stock. The rudder and tiller shall be so arranged as not to be damaged by operation of the release mechanism or the propeller.

7.3. Except in the vicinity of the rudder and propeller, a buoyant lifeline shall be becketed around the outside of the lifeboat.

7.4. Lifeboats which are not self-righting when capsized shall have suitable handholds on the underside of the hull to enable persons to cling to the lifeboat. The handholds shall be fastened to the lifeboat in such a way that, when subjected to an impact sufficient to cause them to break away from the lifeboat, they break away without damaging the lifeboat.

7.5. All lifeboats shall be fitted with sufficient watertight lockers or compartments to provide for the storage of the small items of equipment, water and provisions required by paragraph 8. Means shall be provided for the storage of collected rainwater.

7.6. Every lifeboat to be launched by a fall or falls shall be fitted with a release mechanism complying with the following requirements:

- .1 The mechanism shall be so arranged that all hooks are released simultaneously.
- .2 The mechanism shall have two release capabilities as follows:
  - .2.1 A normal release capability which will release the lifeboat when it is waterborne or when there is no load on the hooks;
  - .2.2 An on-load release capability which will release the lifeboat with a load on the hooks. This release shall be so arranged as to release the lifeboat under any conditions of loading from no-load with the lifeboat waterborne to a load of 1.1 times the total mass of the lifeboat when loaded with its full complement of persons and equipment. This release capability shall be adequately protected against accidental or premature use;
- .3 The release control shall be clearly marked in a colour that contrasts with its surroundings;
- .4 The mechanism shall be designed with a factor of safety of 6 based on the ultimate strength of the materials used, assuming the mass of the lifeboat is equally distributed between the falls.

7.7. Every lifeboat shall be fitted with a release device to enable the forward painter to be released when under tension.

7.8. Every lifeboat shall be provided with a permanently installed earth connection and arrangements for adequately siting and securing in the operating position the antenna provided with the portable radio apparatus required by regulation 6.2.1.

7.9. Lifeboats intended for launching down the side of a ship shall have skates and fenders as necessary to facilitate launching and prevent damage to the lifeboat.

7.10. A manually controlled lamp visible on a dark night with a clear atmosphere at a distance of at least 2 miles for a period of not less than 12 h shall be fitted to the top of the cover or enclosure. If the light is a flashing light, it shall initially flash at a rate of not less than 50 flashes per minute over the first 2 h of operation of the 12 h operating period.

7.11. A lamp or source of light shall be fitted inside the lifeboat to provide illumination for not less than 12 h to enable reading of survival and equipment instructions; however, oil lamps shall not be permitted for this purpose.

7.12. Unless expressly provided otherwise, every lifeboat shall be provided with effective means of bailing or be automatically self-bailing.

7.13. Every lifeboat shall be so arranged that an adequate view forward, aft and to both sides is provided from the control and steering position for safe launching and manoeuvring.

#### 8. *Lifeboat equipment*

All items of lifeboat equipment, whether required by this paragraph or elsewhere in this chapter, with the exception of boat-hooks which shall be kept free for fending off purposes, shall be secured within the lifeboat by lashings, storage in lockers or compartments, storage in brackets or similar mounting arrangements or other suitable means. The equipment shall be secured in such a manner as not to interfere with any abandonment procedures. All items of lifeboat equipment shall be as small and of as little mass as possible and shall be packed in a suitable and compact form. Except where otherwise stated, the normal equipment of every lifeboat shall consist of:

- .1 Sufficient buoyant oars to make headway in calm seas. Thole pins, crutches or equivalent arrangements shall be provided for each oar provided. Thole pins or crutches shall be attached to the boat by lanyards or chains;
- .2 Two boat-hooks;
- .3 A buoyant bailer and two buckets;
- .4 A survival manual;
- .5 A binnacle containing an efficient compass which is luminous or provided with suitable means of illumination. In a totally enclosed lifeboat, the binnacle shall be permanently fitted at the steering position; in any other lifeboat, it shall be provided with suitable mounting arrangements;
- .6 A sea-anchor of adequate size fitted with a shock-resistant hawser and a tripping line which provides a firm hand grip when wet. The strength of the sea-anchor, hawser and tripping line shall be adequate for all sea conditions;
- .7 Two efficient painters of a length equal to not less than twice the distance from the stowage position of the lifeboat to the waterline in the lightest seagoing condition or 15 m, whichever is the greater. One painter attached to the release device required by regulation 41.7.7 shall be placed at the forward end of the lifeboat and the other shall be firmly secured at or near the bow of the lifeboat ready for use;
- .8 Two hatchets, one at each end of the lifeboat;
- .9 Watertight receptacles containing a total of 3 l of fresh water for each person the lifeboat is permitted to accommodate, of which 1 l per person may be replaced by a de-salting apparatus capable of producing an equal amount of fresh water in 2 days;
- .10 A rustproof dipper with lanyard;
- .11 A rustproof graduated drinking vessel;
- .12 A food ration totalling not less than 10,000 kJ for each person the lifeboat is permitted to accommodate; these rations shall be kept in airtight packaging and be stowed in a watertight container;
- .13 Four rocket parachute flares complying with the requirements of regulation 35;
- .14 Six hand flares complying with the requirements of regulation 36;
- .15 Two buoyant smoke signals complying with the requirements of regulation 37;
- .16 One waterproof electric torch suitable for Morse signalling together with one spare set of batteries and one spare bulb in a waterproof container;
- .17 One daylight signalling mirror with instructions for its use for signalling to ships and aircraft;
- .18 One copy of the life-saving signals prescribed by regulation V/16 on a waterproof card or in a waterproof container;
- .19 One whistle or equivalent sound signal;

- .20 A first-aid outfit in a waterproof case capable of being closed tightly after use;
- .21 Six doses of anti-seasickness medicine and one seasickness bag for each person;
- .22 A jack-knife to be kept attached to the boat by a lanyard;
- .23 Three tin openers;
- .24 Two buoyant rescue quoits, attached to not less than 30 m of buoyant line;
- .25 A manual pump;
- .26 One set of fishing tackle;
- .27 Sufficient tools for minor adjustments to the engine and its accessories;
- .28 Portable fire-extinguishing equipment suitable for extinguishing oil fires;
- .29 A searchlight capable of effectively illuminating a light-coloured object at night having a width of 18 m at a distance of 180 m for a total period of 6 h and of working for not less than 3 h continuously;
- .30 An efficient radar reflector;
- .31 Thermal protective aids complying with the requirements of regulation 34 sufficient for 10% of the number of persons the lifeboat is permitted to accommodate or two, whichever is the greater.
- .32 In the case of ships engaged on voyages of such a nature and duration that, in the opinion of the Administration, the items specified in paragraphs 8.12 and 8.26 are unnecessary, the Administration may allow these items to be dispensed with.

#### 9. *Lifeboat markings*

9.1. The dimensions of the lifeboat and the number of persons which it is permitted to accommodate shall be marked on it in clear permanent characters.

9.2. The name and port of registry of the ship to which the lifeboat belongs shall be marked on each side of the lifeboat's bow in block capitals of the Roman alphabet.

9.3. Means of identifying the ship to which the lifeboat belongs and the number of the lifeboat shall be marked in such a way that they are visible from above.

#### *Regulation 42. PARTIALLY ENCLOSED LIFEBOATS*

1. Partially enclosed lifeboats shall comply with the requirements of regulation 41 and in addition shall comply with the requirements of this regulation.

2. Every partially enclosed lifeboat shall be provided with effective means of bailing or be automatically self-bailing.

3. Partially enclosed lifeboats shall be provided with permanently attached rigid covers extending over not less than 20% of the length of the lifeboat from the stem and not less than 20% of the length of the lifeboat from the aftermost part of the lifeboat. The lifeboat shall be fitted with a permanently attached foldable canopy which together with the rigid covers completely encloses the occupants of the lifeboat in a weatherproof shelter and protects them from exposure. The canopy shall be so arranged that:

- .1 It is provided with adequate rigid sections or battens to permit erection of the canopy;
- .2 It can be easily erected by not more than two persons;
- .3 It is insulated to protect the occupants against heat and cold by means of not less than two layers of material separated by an air gap or other equally efficient means; means shall be provided to prevent accumulation of water in the air gap;
- .4 Its exterior is of a highly visible colour and its interior is of a colour which does not cause discomfort to the occupants;
- .5 It has entrances at both ends and on each side, provided with efficient adjustable closing arrangements which can be easily and quickly opened and closed from inside or outside so

as to permit ventilation but exclude seawater, wind and cold; means shall be provided for holding the entrances securely in the open and closed position;

- .6 With the entrances closed, it admits sufficient air for the occupants at all times;
- .7 It has means for collecting rainwater;
- .8 The occupants can escape in the event of the lifeboat capsizing.

4. The interior of the lifeboat shall be of a highly visible colour.

5. The radiotelegraph installation required by regulation 6.2.2 shall be installed in a cabin large enough to accommodate both the equipment and the person using it. No separate cabin is required if the construction of the lifeboat provides a sheltered space to the satisfaction of the Administration.

*Regulation 43. SELF-RIGHTING PARTIALLY ENCLOSED LIFEBOATS*

1. Self-righting partially enclosed lifeboats shall comply with the requirements of regulation 41 and in addition shall comply with the requirements of this regulation.

2. *Enclosure*

2.1. Permanently attached rigid covers shall be provided extending over not less than 20% of the length of the lifeboat from the stem and not less than 20% of the length of the lifeboat from the aftermost part of the lifeboat.

2.2. The rigid covers shall form two shelters. If the shelters have bulkheads they shall have openings of sufficient size to permit easy access by persons each wearing an immersion suit or warm clothes and a lifejacket. The interior height of the shelters shall be sufficient to permit persons easy access to their seats in the bow and stern of the lifeboat.

2.3. The rigid covers shall be so arranged that they include windows or translucent panels to admit sufficient daylight to the inside of the lifeboat with the openings or canopies closed so as to make artificial light unnecessary.

2.4. The rigid covers shall have railings to provide a secure handhold for persons moving about the exterior of the lifeboat.

2.5. Open parts of the lifeboat shall be fitted with a permanently attached foldable canopy so arranged that:

- .1 It can be easily erected by not more than two persons in not more than 2 min;
- .2 It is insulated to protect the occupants against cold by means of not less than two layers of material separated by an air gap or other equally efficient means.

2.6. The enclosure formed by the rigid covers and canopy shall be so arranged:

- .1 As to allow launching and recovery operations to be performed without any occupant having to leave the enclosure;
- .2 That it has entrances at both ends and on each side, provided with efficient adjustable closing arrangements which can be easily and quickly opened and closed from inside or outside so as to permit ventilation but exclude seawater, wind and cold; means shall be provided for holding the entrances securely in the open and in the closed position;
- .3 That with the canopy erected and all entrances closed, sufficient air is admitted for the occupants at all times;
- .4 That it has means for collecting rainwater;
- .5 That the exterior of the rigid covers and canopy and the interior of that part of the lifeboat covered by the canopy is of a highly visible colour. The interior of the shelters shall be of a colour which does not cause discomfort to the occupants;
- .6 That it is possible to row the lifeboat.

### 3. *Capsizing and re-righting*

3.1. A safety belt shall be fitted at each indicated seating position. The safety belt shall be so designed as to hold a person of a mass of 100 kg securely in place when the lifeboat is in a capsized position.

3.2. The stability of the lifeboat shall be such that it is inherently or automatically self-righting when loaded with its full or a partial complement of persons and equipment and the persons are secured with safety belts.

### 4. *Propulsion*

4.1. The engine and transmission shall be controlled from the helmsman's position.

4.2. The engine and engine installation shall be capable of running in any position during capsize and continue to run after the lifeboat returns to the upright or shall automatically stop on capsizing and be easily restarted after the lifeboat returns to the upright and the water has been drained from the lifeboat. The design of the fuel and lubricating systems shall prevent the loss of fuel and the loss of more than 250 ml of lubricating oil from the engine during capsize.

4.3. Air-cooled engines shall have a duct system to take in cooling air from, and exhaust it to, the outside of the lifeboat. Manually operated dampers shall be provided to enable cooling air to be taken in from, and exhausted to, the interior of the lifeboat.

### 5. *Construction and fendering*

5.1. Notwithstanding regulation 41.1.6, a self-righting partially enclosed lifeboat shall be so constructed and fendered as to ensure that the lifeboat renders protection against harmful accelerations resulting from an impact of the lifeboat, when loaded with its full complement of persons and equipment, against the ship's side at an impact velocity of not less than 3.5 m/s.

5.2. The lifeboat shall be automatically self-bailing.

#### *Regulation 44. TOTALLY ENCLOSED LIFEBOATS*

1. Totally enclosed lifeboats shall comply with the requirements of regulation 41 and in addition shall comply with the requirements of this regulation.

#### 2. *Enclosure*

Every totally enclosed lifeboat shall be provided with a rigid watertight enclosure which completely encloses the lifeboat. The enclosure shall be so arranged that:

- .1 It protects the occupants against heat and cold;
- .2 Access to the lifeboat is provided by hatches which can be closed to make the lifeboat watertight;
- .3 Hatches are positioned so as to allow launching and recovery operations to be performed without any occupant having to leave the enclosure;
- .4 Access hatches are capable of being opened and closed from both inside and outside and are equipped with means to hold them securely in open positions;
- .5 It is possible to row the lifeboat;
- .6 It is capable, when the lifeboat is in the capsized position with the hatches closed and without significant leakage, of supporting the entire mass of the lifeboat, including all equipment, machinery and its full complement of persons;
- .7 It includes windows or translucent panels on both sides which admit sufficient daylight to the inside of the lifeboat with the hatches closed to make artificial light unnecessary;
- .8 Its exterior is of a highly visible colour and its interior of a colour which does not cause discomfort to the occupants;



- .9 Handrails provide a secure handhold for persons moving about the exterior of the lifeboat, and aid embarkation and disembarkation;
- .10 Persons have access to their seats from an entrance without having to climb over thwarts or other obstructions;
- .11 The occupants are protected from the effects of dangerous subatmospheric pressures which might be created by the lifeboat's engine.

### 3. *Capsizing and re-righting*

3.1. A safety belt shall be fitted at each indicated seating position. The safety belt shall be designed to hold a person of a mass of 100 kg securely in place when the lifeboat is in a capsized position.

3.2. The stability of the lifeboat shall be such that it is inherently or automatically self-righting when loaded with its full or a partial complement of persons and equipment and all entrances and openings are closed watertight and the persons are secured with safety belts.

3.3. The lifeboat shall be capable of supporting its full complement of persons and equipment when the lifeboat is in the damaged condition prescribed in regulation 41.1.1 and its stability shall be such that in the event of capsizing, it will automatically attain a position that will provide an above-water escape for its occupants.

3.4. The design of all engine exhaust pipes, air ducts and other openings shall be such that water is excluded from the engine when the lifeboat capsizes and re-rights.

### 4. *Propulsion*

4.1. The engine and transmission shall be controlled from the helmsman's position.

4.2. The engine and engine installation shall be capable of running in any position during capsize and continue to run after the lifeboat returns to the upright or shall automatically stop on capsizing and be easily restarted after the lifeboat returns to the upright. The design of the fuel and lubricating systems shall prevent the loss of fuel and the loss of more than 250 ml of lubricating oil from the engine during capsize.

4.3. Air cooled engines shall have a duct system to take in cooling air from, and exhaust it to, the outside of the lifeboat. Manually operated dampers shall be provided to enable cooling air to be taken in from, and exhausted to, the interior of the lifeboat.

### 5. *Construction and fendering*

Notwithstanding regulation 41.1.6, a totally enclosed lifeboat shall be so constructed and fendered as to ensure that the lifeboat renders protection against harmful accelerations resulting from an impact of the lifeboat, when loaded with its full complement of persons and equipment, against the ship's side at an impact velocity of not less than 3.5 m/s.

### 6. *Free-fall lifeboats*

A lifeboat arranged for free-fall launching shall be so constructed that it is capable of rendering protection against harmful accelerations resulting from being launched, when loaded with its full complement of persons and equipment, from at least the maximum height at which it is designed to be stowed above the waterline with the ship in its lightest seagoing condition, under unfavourable conditions of trim of up to 10° and with the ship listed not less than 20° either way.

### *Regulation 45. LIFEBOATS WITH A SELF-CONTAINED AIR SUPPORT SYSTEM*

In addition to complying with the requirements of regulations 41 and 44, a lifeboat with a self-contained air support system shall be so arranged that, when proceeding with all entrances and openings closed, the air in the lifeboat remains safe and breathable and the engine runs normally for a period of not less than 10 min. During this period the atmospheric pressure inside the lifeboat shall never fall below the outside atmospheric pressure nor shall it exceed it by

more than 20 mbar. The system shall have visual indicators to indicate the pressure of the air supply at all times.

*Regulation 46. FIRE-PROTECTED LIFEBOATS*

1. In addition to complying with the requirements of regulations 41, 44 and 45, a fire-protected lifeboat when waterborne shall be capable of protecting the number of persons it is permitted to accommodate when subjected to a continuous oil fire that envelops the lifeboat for a period of not less than 8 min.

2. *Water spray system*

A lifeboat which has a water spray fire-protection system shall comply with the following:

- .1 Water for the system shall be drawn from the sea by a self-priming motor pump. It shall be possible to turn "on" and turn "off" the flow of water over the exterior of the lifeboat;
- .2 The seawater intake shall be so arranged as to prevent the intake of flammable liquids from the sea surface;
- .3 The system shall be arranged for flushing with fresh water and allowing complete drainage.

SECTION V. RESCUE BOATS

*Regulation 47. RESCUE BOATS*

1. *General requirements*

1.1. Except as provided by this regulation, all rescue boats shall comply with the requirements of regulations 41.1 to 41.7.4 inclusive and 41.7.6, 41.7.7, 41.7.9, 41.7.12 and 41.9.

1.2. Rescue boats may be either of rigid or inflated construction or a combination of both and shall:

- .1 Be not less than 3.8m and not more than 8.5m in length;
- .2 Be capable of carrying at least five seated persons and a person lying down.

1.3. Rescue boats which are a combination of rigid and inflated construction shall comply with the appropriate requirements of this regulation to the satisfaction of the Administration.

1.4. Unless the rescue boat has adequate sheer, it shall be provided with a bow cover extending for not less than 15% of its length.

1.5. Rescue boats shall be capable of manoeuvring at speeds up to 6 knots and maintaining that speed for a period of at least 4 h.

1.6. Rescue boats shall have sufficient mobility and manoeuvrability in a seaway to enable persons to be retrieved from the water, marshal liferafts and tow the largest liferaft carried on the ship when loaded with its full complement of persons and equipment or its equivalent at a speed of at least 2 knots.

1.7. A rescue boat shall be fitted with an inboard engine or outboard motor. If it is fitted with an outboard motor, the rudder and tiller may form part of the engine. Notwithstanding the requirements of regulation 41.6.1, petrol-driven outboard engines with an approved fuel system may be fitted in rescue boats provided the fuel tanks are specially protected against fire and explosion.

1.8. Arrangements for towing shall be permanently fitted in rescue boats and shall be sufficiently strong to marshal or tow liferafts as required by paragraph 1.6.

1.9. Rescue boats shall be fitted with weathertight stowage for small items of equipment.

2. *Rescue boat equipment*

2.1. All items of rescue boat equipment, with the exception of boat-hooks which shall be kept free for fending off purposes, shall be secured within the rescue boat by lashings, storage

in lockers or compartments, storage in brackets or similar mounting arrangements, or other suitable means. The equipment shall be secured in such a manner as not to interfere with any launching or recovery procedures. All items of rescue boat equipment shall be as small and of as little mass as possible and shall be packed in suitable and compact form.

2.2. The normal equipment of every rescue boat shall consist of:

- .1 Sufficient buoyant oars or paddles to make headway in calm seas. Thole pins, crutches or equivalent arrangements shall be provided for each oar. Thole pins or crutches shall be attached to the boat by lanyards or chains;
- .2 A buoyant bailer;
- .3 A binnacle containing an efficient compass which is luminous or provided with suitable means of illumination;
- .4 A sea-anchor and tripping line with a hawser of adequate strength not less than 10 m in length;
- .5 A painter of sufficient length and strength, attached to the release device complying with the requirements of regulation 41.7.7 and placed at the forward end of the rescue boat;
- .6 One buoyant line, not less than 50 m in length, of sufficient strength to tow a liferaft as required by paragraph 1.6;
- .7 One waterproof electric torch suitable for Morse signalling, together with one spare set of batteries and one spare bulb in a waterproof container;
- .8 One whistle or equivalent sound signal;
- .9 A first-aid outfit in a waterproof case capable of being closed tightly after use;
- .10 Two buoyant rescue quoits, attached to not less than 30 m of buoyant line;
- .11 A searchlight capable of effectively illuminating a light-coloured object at night having a width of 18 m at a distance of 180 m for a total period of 6 h and of working for at least 3 h continuously;
- .12 An efficient radar reflector.
- .13 Thermal protective aids complying with the requirements of regulation 34 sufficient for 10% of the number of persons the rescue boat is permitted to accommodate or two, whichever is the greater.

2.3. In addition to the equipment required by paragraph 2.2, the normal equipment of every rigid rescue boat shall include:

- .1 A boat-hook;
- .2 A bucket;
- .3 A knife or hatchet.

2.4. In addition to the equipment required by paragraph 2.2 the normal equipment of every inflated rescue boat shall consist of:

- .1 A buoyant safety knife;
- .2 Two sponges;
- .3 An efficient manually operated bellows or pump;
- .4 A repair kit in a suitable container for repairing punctures;
- .5 A safety boat-hook.

### 3. *Additional requirements for inflated rescue boats*

3.1. The requirements or regulations 41.1.3 and 41.1.5 do not apply to inflated rescue boats.

3.2. An inflated rescue boat shall be constructed in such a way that, when suspended by its bridle or lifting hook:

- .1 It is of sufficient strength and rigidity to enable it to be lowered and recovered with its full complement of persons and equipment;
  - .2 It is of sufficient strength to withstand a load of 4 times the mass of its full complement of persons and equipment at an ambient temperature of  $20 \pm 3^\circ\text{C}$  with all relief valves inoperative;
  - .3 It is of sufficient strength to withstand a load of 1.1 times the mass of its full complement of persons and equipment at an ambient temperature of  $-30^\circ\text{C}$ , with all relief valves operative.
- 3.3. Inflated rescue boats shall be so constructed as to be capable of withstanding exposure:
- .1 When stowed on an open deck on a ship at sea;
  - .2 For 30 days afloat in all sea conditions.
- 3.4. In addition to complying with the requirements of regulation 41.9, inflated rescue boats shall be marked with a serial number, the maker's name or trade mark and the date of manufacture.
- 3.5. The buoyancy of an inflated rescue boat shall be provided by either a single tube subdivided into at least five separate compartments of approximately equal volume or two separate tubes neither exceeding 60% of the total volume. The buoyancy tubes shall be so arranged that, in the event of any one of the compartments being damaged, the intact compartments shall be able to support the number of persons which the rescue boat is permitted to accommodate, each having a mass of 75 kg, when seated in their normal positions with positive freeboard over the rescue boat's entire periphery.
- 3.6. The buoyancy tubes forming the boundary of the inflated rescue boat shall on inflation provide a volume of not less than  $0.17\text{ m}^3$  for each person the rescue boat is permitted to accommodate.
- 3.7. Each buoyancy compartment shall be fitted with a non-return valve for manual inflation and means for deflation. A safety relief valve shall also be fitted unless the Administration is satisfied that such an appliance is unnecessary.
- 3.8. Underneath the bottom and on vulnerable places on the outside of the inflated rescue boat, rubbing strips shall be provided to the satisfaction of the Administration.
- 3.9. Where a transom is fitted it shall not be inset by more than 20% of the overall length of the rescue boat.
- 3.10. Suitable patches shall be provided for securing the painters fore and aft and the becketed lifelines inside and outside the boat.
- 3.11. The inflated rescue boat shall be maintained at all times in a fully inflated condition.

#### SECTION VI. LAUNCHING AND EMBARKATION APPLIANCES

##### *Regulation 48.* LAUNCHING AND EMBARKATION APPLIANCES

###### 1. *General requirements*

- 1.1. Each launching appliance together with all its lowering and recovery gear shall be so arranged that the fully equipped survival craft or rescue boat it serves can be safely lowered against a trim of up to  $10^\circ$  and a list of up to  $20^\circ$  either way:
- .1 When boarded, as required by regulation 22 or 28, by its full complement of persons;
  - .2 Without persons in the survival craft or rescue boat.
- 1.2. Notwithstanding the requirements of paragraph 1.1, lifeboat launching appliances for oil tankers, chemical tankers and gas carriers with a final angle of heel greater than  $20^\circ$  cal-

culated in accordance with the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the 1978 Protocol related thereto<sup>1</sup> and the recommendations of the Organization\*, as applicable, shall be capable of operating at the final angle of heel on the lower side of the ship.

1.3. A launching appliance shall not depend on any means other than gravity or stored mechanical power which is independent of the ship's power supplies to launch the survival craft or rescue boat it serves in the fully loaded and equipped condition and also in the light condition.

1.4. A launching mechanism shall be so arranged that it may be actuated by one person from a position on the ship's deck, and from a position within the survival craft or rescue boat; the survival craft shall be visible to the person on deck operating the launching mechanism.

1.5. Each launching appliance shall be so constructed that a minimum amount of routine maintenance is necessary. All parts requiring regular maintenance by the ship's crew shall be readily accessible and easily maintained.

1.6. The winch brakes of a launching appliance shall be of sufficient strength to withstand:

- .1 A static test with a proof load of not less than 1.5 times the maximum working load; and
- .2 A dynamic test with a proof load of not less than 1.1 times the maximum working load at maximum lowering speed.

1.7. The launching appliance and its attachments other than winch brakes shall be of sufficient strength to withstand a static proof load on test of not less than 2.2 times the maximum working load.

1.8. Structural members and all blocks, falls, padeyes, links, fastenings and all other fittings used in connection with launching equipment shall be designed with not less than a minimum factor of safety on the basis of the maximum working load assigned and the ultimate strength of the material used for construction. A minimum factor of safety of 4.5 shall be applied to all davit and winch structural members, and a minimum factor of safety of 6 shall be applied to falls, suspension chains, links and blocks.

1.9. Each launching appliance shall, as far as practicable, remain effective under conditions of icing.

1.10. A lifeboat launching appliance shall be capable of recovering the lifeboat with its crew.

1.11. The arrangements of the launching appliance shall be such as to enable safe boarding of the survival craft in accordance with the requirements of regulations 38.4.2, 38.4.3, 41.3.1 and 41.3.2.

## 2. *Launching appliances using falls and a winch*

2.1. Falls shall be of rotation-resistant and corrosion-resistant steel wire rope.

2.2. In the case of a multiple drum winch, unless an efficient compensatory device is fitted, the falls shall be so arranged as to wind off the drums at the same rate when lowering, and to wind on to the drums evenly at the same rate when hoisting.

2.3. Every rescue boat launching appliance shall be fitted with a powered winch motor of such capacity that the rescue boat can be raised from the water with its full complement of persons and equipment.

\* Reference is made to the damage stability requirements of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) adopted by the Maritime Safety Committee by resolution MSC.4(48) and the International Code for the Construction and Equipment of Ships carrying Liquefied Gases in Bulk (IGC Code) adopted by the Maritime Safety Committee by resolution MSC.5(48).

<sup>1</sup> United Nations, *Treaty Series*, vol. 1340, p. 61 (authentic English and Russian texts), and vol. 1341, p. 3 (authentic French and Spanish texts).

2.4. An efficient hand gear shall be provided for recovery of each survival craft and rescue boat. Hand gear handles or wheels shall not be rotated by moving parts of the winch when the survival craft or rescue boat is being lowered or when it is being hoisted by power.

2.5. Where davit arms are recovered by power, safety devices shall be fitted which will automatically cut off the power before the davit arms reach the stops in order to avoid over-stressing the falls or davits, unless the motor is designed to prevent such over-stressing.

2.6. The speed at which the survival craft or rescue boat is lowered into the water shall be not less than that obtained from the formula:

$$S = 0.4 + (0.02 \times H)$$

where S = speed of lowering in metres per second

and H = height in metres from davit head to the waterline at the lightest seagoing condition.

2.7. The maximum lowering speed shall be established by the Administration having regard to the design of the survival craft or rescue boat, the protection of its occupants from excessive forces, and the strength of the launching arrangements taking into account inertia forces during an emergency stop. Means shall be incorporated in the appliance to ensure that this speed is not exceeded.

2.8. Every rescue boat launching appliance shall be capable of hoisting the rescue boat when loaded with its full rescue boat complement of persons and equipment at a rate of not less than 0.3 m/s.

2.9. Every launching appliance shall be fitted with brakes capable of stopping the descent of the survival craft or rescue boat and holding it securely when loaded with its full complement of persons and equipment; brake pads shall, where necessary, be protected from water and oil.

2.10. Manual brakes shall be so arranged that the brake is always applied unless the operator, or a mechanism activated by the operator, holds the brake control in the "off" position.

### 3. *Float-free launching*

Where a survival craft requires a launching appliance and is also designed to float free, the float-free release of the survival craft from its stowed position shall be automatic.

### 4. *Free-fall launching*

Every free-fall launching appliance using an inclined plane shall, in addition to complying with the applicable requirements of paragraph 1, also comply with the following requirements:

- .1 The launching appliance shall be so arranged that excessive forces are not experienced by the occupants of the survival craft during launching.
- .2 The launching appliance shall be a rigid structure with a ramp angle and length sufficient to ensure that the survival craft effectively clears the ship.
- .3 The launching appliance shall be efficiently protected against corrosion and be so constructed as to prevent incendive friction or impact sparking during the launching of the survival craft.

### 5. *Evacuation-slide launching and embarkation*

Every evacuation-slide launching appliance shall, in addition to complying with the applicable requirements of paragraph 1, also comply with the following requirements:

- .1 The evacuation slide shall be capable of being deployed by one person at the embarkation station.
- .2 The evacuation slide shall be capable of being used in high winds and in a seaway.

#### 6. *Liferaft launching appliances*

Every liferaft launching appliance shall comply with the requirements of paragraphs 1 and 2, except with regard to use of gravity for turning out the appliance, embarkation in the stowed position and recovery of the loaded liferaft. The launching appliance shall be so arranged as to prevent premature release during lowering and shall release the liferaft when waterborne.

#### 7. *Embarkation ladders*

7.1. Handholds shall be provided to ensure a safe passage from the deck to the head of the ladder and vice versa.

7.2. The steps of the ladder shall be:

- .1 Made of hardwood, free from knots or other irregularities, smoothly machined and free from sharp edges and splinters, or of suitable material of equivalent properties;
- .2 Provided with an efficient non-slip surface either by longitudinal grooving or by the application of an approved non-slip coating;
- .3 Not less than 480 mm long, 115 mm wide and 25 mm in depth, excluding any non-slip surface or coating;
- .4 Equally spaced not less than 300 mm or more than 380 mm apart and secured in such a manner that they will remain horizontal.

7.3. The side ropes of the ladder shall consist of two uncovered manila ropes not less than 65 mm in circumference on each side. Each rope shall be continuous with no joints below the top step. Other materials may be used provided the dimensions, breaking strain, weathering, stretching and gripping properties are at least equivalent to those of manila rope. All rope ends shall be secured to prevent unravelling.

### SECTION VII. OTHER LIFE-SAVING APPLIANCES

#### *Regulation 49. LINE-THROWING APPLIANCES*

1. Every line-throwing appliance shall:

- .1 Be capable of throwing a line with reasonable accuracy;
- .2 Include not less than four projectiles each capable of carrying the line at least 230 m in calm weather;
- .3 Include not less than four lines each having a breaking strength of not less than 2 kN;
- .4 Have brief instructions or diagrams clearly illustrating the use of the line-throwing appliance.

2. The rocket, in the case of a pistol fired rocket, or the assembly, in the case of an integral rocket and line, shall be contained in a water-resistant casing. In addition, in the case of a pistol-fired rocket, the line and rockets together with the means of ignition shall be stowed in a container which provides protection from the weather.

#### *Regulation 50. GENERAL EMERGENCY ALARM SYSTEM*

The general emergency alarm system shall be capable of sounding the general emergency alarm signal consisting of seven or more short blasts followed by one long blast on the ship's whistle or siren and additionally on an electrically operated bell or klaxon or other equivalent warning system, which shall be powered from the ship's main supply and the emergency source of electrical power required by regulation II-1/42 or II-1/43, as appropriate. The system shall be capable of operation from the navigating bridge and, except for the ship's whistle, also from other strategic points. The system shall be audible throughout all the accommodation and normal crew working spaces.

## SECTION VIII. MISCELLANEOUS

*Regulation 51. TRAINING MANUAL*

The training manual, which may comprise several volumes, shall contain instructions and information, in easily understood terms illustrated wherever possible, on the life-saving appliances provided in the ship and on the best methods of survival. Any part of such information may be provided in the form of audio-visual aids in lieu of the manual. The following shall be explained in detail:

- .1 Donning of lifejackets and immersion suits, as appropriate;
- .2 Muster at the assigned stations;
- .3 Boarding, launching, and clearing the survival craft and rescue boats;
- .4 Method of launching from within the survival craft;
- .5 Release from launching appliances;
- .6 Methods and use of devices for protection in launching areas, where appropriate;
- .7 Illumination in launching areas;
- .8 Use of all survival equipment;
- .9 Use of all detection equipment;
- .10 With the assistance of illustrations, the use of radio life-saving appliances;
- .11 Use of drogues;
- .12 Use of engine and accessories;
- .13 Recovery of survival craft and rescue boats including stowage and securing;
- .14 Hazards of exposure and the need for warm clothing;
- .15 Best use of the survival craft facilities in order to survive;
- .16 Methods of retrieval, including the use of helicopter rescue gear (slings, baskets, stretchers), breeches-buoy and shore life-saving apparatus and ship's line-throwing apparatus;
- .17 All other functions contained in the muster list and emergency instructions;
- .18 Instructions for emergency repair of the life-saving appliances.

*Regulation 52. INSTRUCTIONS FOR ON-BOARD MAINTENANCE*

Instructions for on-board maintenance of life-saving appliances shall be easily understood, illustrated wherever possible, and, as appropriate, shall include the following for each appliance:

- .1 A checklist for use when carrying out the inspections required by regulation 19.7;
- .2 Maintenance and repair instructions;
- .3 Schedule of periodic maintenance;
- .4 Diagram of lubrication points with the recommended lubricants;
- .5 List of replaceable parts;
- .6 List of sources of spare parts;
- .7 Log for records of inspections and maintenance.

*Regulation 53. MUSTER LIST AND EMERGENCY INSTRUCTIONS*

1. The muster list shall specify details of the general emergency alarm signal prescribed by regulation 50 and also action to be taken by crew and passengers when this alarm is sounded. The muster list shall also specify how the order to abandon ship will be given.



2. The muster list shall show the duties assigned to the different members of the crew including:

- .1 Closing of the watertight doors, fire doors, valves, scuppers, sidescuttles, skylights, port-holes and other similar openings in the ship;
- .2 Equipping of the survival craft and other life-saving appliances;
- .3 Preparation and launching of survival craft;
- .4 General preparations of other life-saving appliances;
- .5 Muster of passengers;
- .6 Use of communication equipment;
- .7 Manning of fire parties assigned to deal with fires;
- .8 Special duties assigned in respect of the use of fire-fighting equipment and installations.

3. The muster list shall specify which officers are assigned to ensure that life-saving and fire appliances are maintained in good condition and are ready for immediate use.

4. The muster list shall specify substitutes for key persons who may become disabled, taking into account that different emergencies may call for different actions.

5. The muster list shall show the duties assigned to members of the crew in relation to passengers in case of emergency. These duties shall include:

- .1 Warning the passengers;
- .2 Seeing that they are suitably clad and have donned their lifejackets correctly;
- .3 Assembling passengers at muster stations;
- .4 Keeping order in the passageways and on the stairways and generally controlling the movements of the passengers;
- .5 Ensuring that a supply of blankets is taken to the survival craft.

6. The muster list shall be prepared before the ship proceeds to sea. After the muster list has been prepared, if any change takes place in the crew which necessitates an alteration in the muster list, the master shall either revise the list or prepare a new list.

7. The format of the muster list used on passenger ships shall be approved.

## PART 4

### CHAPTER IV. RADIOTELEGRAPHY AND RADIOTELEPHONY

#### *Regulation 2. TERMS AND DEFINITIONS*

The following new sub-paragraph is added:

“(i) ‘Emergency position-indicating radio beacon’ means a station in the mobile service the emissions of which are intended to facilitate search and rescue operations.”

The following new regulations are added:

#### *“Regulation 14-1. SURVIVAL CRAFT EMERGENCY POSITION-INDICATING RADIO BEACONS*

(a) Survival craft emergency position-indicating radio beacons required by regulation III/6.2.3 to be carried in survival craft shall provide transmissions to enable aircraft to locate the survival craft and may also provide transmissions for alerting purposes.

(b) Survival craft emergency position-indicating radio beacons shall, at least, be capable of transmitting alternately or simultaneously signals complying with the relevant standards and recommended practices of the International Civil Aviation Organization (ICAO) on the frequencies 121.5 MHz and 243.0 MHz.

- (c) Survival craft emergency position-indicating radio beacons shall:
- (i) Be of a highly visible colour, so designed that they can be used by an unskilled person and so constructed that they may be easily tested and maintained. Batteries shall not require replacement at intervals of less than 12 months, taking into account testing arrangements;
  - (ii) Be watertight, capable of floating and being dropped into the water without damage from a height of at least 20 m;
  - (iii) Be capable only of manual activation and de-activation;
  - (iv) Be portable, lightweight, and compact;
  - (v) Be provided with an indication that signals are being emitted;
  - (vi) Derive their energy supply from a battery forming an integral part of the device and having sufficient capacity to operate the apparatus for a period of 48 h. The transmission may be intermittent. Determination of the duty cycle should take into account the probability of homing being properly carried out, the need to avoid congestion on the frequencies and the need to comply with the requirements of the International Civil Aviation Organization (ICAO); and
  - (vii) Be tested and, if necessary, have their source of energy replaced at intervals not exceeding 12 months.

*Regulation 14-2. PERIODIC INSPECTION AND TESTING OF EMERGENCY POSITION-INDICATING RADIO BEACONS*

Emergency position-indicating radio beacons provided in accordance with regulation III/6.2.3 shall at intervals not exceeding 12 months be inspected, tested and, if necessary, have their source of energy replaced. However, in cases where it appears proper and reasonable, the Administration may extend this period to 17 months.

*Regulation 14-3. TWO-WAY RADIOTELEPHONE APPARATUS FOR SURVIVAL CRAFT*

(a) The apparatus required by regulation III/6.2.4 shall be so designed that it can be used in an emergency by an unskilled person.

(b) The apparatus shall be portable and capable of being used for on-board communications.

(c) The apparatus shall conform to the requirements laid down in the relevant Radio Regulations for equipment used in the maritime mobile service for on-board communications and shall be capable of operation on those channels specified by the Radio Regulations and as required by the Administration. If the apparatus is operating in the VHF band, precautions shall be taken to prevent the inadvertent selection of VHF channel 16 on equipment capable of being operated on that frequency.

(d) The apparatus shall be operated from a battery of adequate capacity to ensure 4 h operation with a duty cycle of 1 : 9.

(e) While at sea, the equipment shall be maintained in satisfactory condition, and, whenever necessary, the battery shall be brought to the fully charged condition or replaced.”

## PART 5

## CHAPTER VII. CARRIAGE OF DANGEROUS GOODS

The existing text of chapter VII is replaced by the following:

PART A. CARRIAGE OF DANGEROUS GOODS IN PACKAGED FORM  
OR IN SOLID FORM IN BULK*Regulation 1. APPLICATION*

1. Unless expressly provided otherwise, this part applies to dangerous goods classified under regulation 2 which are carried in packaged form or in solid form in bulk (hereinafter referred to as “dangerous goods”), in all ships to which the present regulations apply and in cargo ships of less than 500 tons gross tonnage.
2. The provisions of this part do not apply to ships’ stores and equipment.
3. The carriage of dangerous goods is prohibited except in accordance with the provisions of this part.
4. To supplement the provisions of this part, each Contracting Government shall issue, or cause to be issued, detailed instructions on safe packaging and stowage of dangerous goods which shall include the precautions necessary in relation to other cargo.\*

*Regulation 2. CLASSIFICATION*

Dangerous goods shall be divided into the following classes:

- Class 1. Explosives
- Class 2. Gases: compressed, liquefied or dissolved under pressure
- Class 3. Flammable\*\* liquids
- Class 4.1. Flammable\*\* solids
- Class 4.2. Substances liable to spontaneous combustion
- Class 4.3. Substances which, in contact with water, emit flammable gases
- Class 5.1. Oxidizing substances
- Class 5.2. Organic peroxides
- Class 6.1. Poisonous (toxic) substances
- Class 6.2. Infectious substances
- Class 7. Radioactive materials
- Class 8. Corrosives
- Class 9. Miscellaneous dangerous substances, that is any other substance which experience has shown, or may show, to be of such a dangerous character that the provisions of this part shall apply to it.

\* Reference is made to the International Maritime Dangerous Goods Code (IMDG Code) adopted by the Organization by resolution A.81(IV),<sup>1</sup> and to the relevant sections and the related parts of Appendix B of the Code of Safe Practice for Solid Bulk Cargoes (BC Code) adopted by the Organization by resolution A.434(XI),<sup>2</sup> as have been or may be amended by the Maritime Safety Committee.

<sup>1</sup> *Resolutions and Other Decisions, Intergovernmental Maritime Consultative Organization Assembly, Fourth Session, 15-28 September 1965*, p. 18.

<sup>2</sup> *Ibid.*, *Eleventh Session, 5-15 November 1979*, p. 156.

\*\* “Flammable” has the same meaning as “inflammable”.

*Regulation 3. PACKAGING*

1. The packaging of dangerous goods shall be:
  - .1 Well made and in good condition;
  - .2 Of such a character that any interior surface with which the contents may come in contact is not dangerously affected by the substance being conveyed; and
  - .3 Capable of withstanding the ordinary risks of handling and carriage by sea.
    2. Where the use of absorbent or cushioning material is customary in the packaging of liquids in receptacles, that material shall be:
      - .1 Capable of minimizing the dangers to which the liquid may give rise;
      - .2 So disposed as to prevent movement and ensure that the receptacle remains surrounded; and
      - .3 Where reasonably possible, of sufficient quantity to absorb the liquid in the event of breakage of the receptacle.
    3. Receptacles containing dangerous liquids shall have an ullage at the filling temperature sufficient to allow for the highest temperature during the course of normal carriage.
    4. Cylinders or receptacles for gases under pressure shall be adequately constructed, tested, maintained and correctly filled.
    5. Empty uncleaned receptacles which have been used previously for the carriage of dangerous goods shall be subject to the provisions of this part for filled receptacles, unless adequate measures have been taken to nullify any hazard.

*Regulation 4. MARKING, LABELLING AND PLACARDING*

1. Packages containing dangerous goods shall be durably marked with the correct technical name; trade names alone shall not be used.
2. Packages containing dangerous goods shall be provided with distinctive labels or stencils of the labels, or placards, as appropriate, so as to make clear the dangerous properties of the goods contained therein.
3. The method of marking the correct technical name and of affixing labels or applying stencils of labels, or of affixing placards on packages containing dangerous goods, shall be such that this information will still be identifiable on packages surviving at least three months' immersion in the sea. In considering suitable marking, labelling and placarding methods, account shall be taken of the durability of the materials used and of the surface of the package.
4. Packages containing dangerous goods shall be so marked and labelled except that:
  - .1 Packages containing dangerous goods of a low degree of hazard or packed in limited quantities\*; or
  - .2 When special circumstances permit, packages that are stowed and handled in units that are identified by labels or placards\*;may be exempted from labelling requirements.

*Regulation 5. DOCUMENTS*

1. In all documents relating to the carriage of dangerous goods by sea where the goods are named, the correct technical name of the goods shall be used (trade names alone shall not be used) and the correct description given in accordance with the classification set out in regulation 2.

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\* Reference is made to the specific exemptions provided for in the International Maritime Dangerous Goods Code (IMDG Code).

2. The shipping documents prepared by the shipper shall include, or be accompanied by, a signed certificate or declaration that the shipment offered for carriage is properly packaged and marked, labelled or placarded, as appropriate, and in proper condition for carriage.

3. Each ship carrying dangerous goods shall have a special list or manifest setting forth, in accordance with the classification set out in regulation 2, the dangerous goods on board and the location thereof. A detailed stowage plan which identifies by class and sets out the location of all dangerous goods on board may be used in place of such special list or manifest.

#### *Regulation 6. STOWAGE REQUIREMENTS*

1. Dangerous goods shall be stowed safely and appropriately in accordance with the nature of the goods. Incompatible goods shall be segregated from one another.

2. Explosives (except ammunition) which present a serious risk shall be stowed in a magazine which shall be kept securely closed while at sea. Such explosives shall be segregated from detonators. Electrical apparatus and cables in any compartment in which explosives are carried shall be so designed and used as to minimize the risk of fire or explosion.

3. Dangerous goods in packaged form which give off dangerous vapours shall be stowed in a mechanically ventilated space or on deck. Dangerous goods in solid form in bulk which give off dangerous vapours shall be stowed in a well ventilated space.

4. In ships carrying flammable liquids or gases, special precautions shall be taken where necessary against fire or explosion.

5. Substances which are liable to spontaneous heating or combustion shall not be carried unless adequate precautions have been taken to minimize the likelihood of the outbreak of fire.

#### *Regulation 7. EXPLOSIVES IN PASSENGER SHIPS*

1. In passenger ships the following explosives only may be carried:

- .1 Safety cartridges and safety fuses;
- .2 Small quantities of explosives not exceeding 10 kg total net mass;
- .3 Distress signals for use in ships or aircraft, if the total mass of such signals does not exceed 1,000 kg;
- .4 Except in ships carrying unberthed passengers, fireworks which are unlikely to explode violently.

2. Notwithstanding the provisions of paragraph 1, additional quantities or types of explosives may be carried in passenger ships in which special safety measures approved by the Administration are taken.

### **PART B. CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING DANGEROUS LIQUID CHEMICALS IN BULK**

#### *Regulation 8. DEFINITIONS*

For the purpose of this part, unless expressly provided otherwise:

1. "International Bulk Chemical Code" means the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk adopted by the Maritime Safety Committee of the Organization by resolution MSC.4(48), as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the Annex other than chapter I.

2. "Chemical tanker" means a cargo ship constructed or adapted and used for the carriage in bulk of any liquid product listed in chapter 17 of the International Bulk Chemical Code.

3. For the purpose of regulation 9, "ship constructed" means a ship the keel of which is laid or which is at a similar stage of construction.

4. "At a similar stage of construction" means the stage at which:

- .1 Construction identifiable with a specific ship begins; and
- .2 Assembly of that ship has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less.

*Regulation 9. APPLICATION TO CHEMICAL TANKERS*

1. Unless expressly provided otherwise, this part applies to chemical tankers constructed on or after 1 July 1986 including those of less than 500 tons gross tonnage. Such tankers shall comply with the requirements of this part in addition to any other applicable requirements of the present regulations.

2. Any chemical tanker, irrespective of the date of construction, which undergoes repairs, alterations, modifications and outfitting related thereto shall continue to comply with at least the requirements previously applicable to the ship. Such a ship, if constructed before 1 July 1986, shall, as a rule, comply with the requirements for a ship constructed on or after that date to at least the same extent as before undergoing such repairs, alterations, modifications or outfitting. Repairs, alterations and modifications of a major character, and outfitting related thereto, shall meet the requirements for a ship constructed on or after 1 July 1986 in so far as the Administration deems reasonable and practicable.

3. A ship, irrespective of the date of construction, which is converted to a chemical tanker shall be treated as a chemical tanker constructed on the date on which such conversion commenced.

*Regulation 10. REQUIREMENTS FOR CHEMICAL TANKERS*

1. A chemical tanker shall comply with the requirements of the International Bulk Chemical Code and shall, in addition to the requirements of regulations I/8, I/9, and I/10, as applicable, be surveyed and certified as provided for in that Code. For the purpose of this regulation, the requirements of the Code shall be treated as mandatory.

2. A chemical tanker holding a certificate issued pursuant to the provisions of paragraph 1 shall be subject to the control established in regulation I/19. For this purpose such certificate shall be treated as a certificate issued under Regulation I/12 and I/13.

**PART C. CONSTRUCTION AND EQUIPMENT OF SHIPS  
CARRYING LIQUEFIED GASES IN BULK**

*Regulation 11. DEFINITIONS*

For the purpose of this part, unless expressly provided otherwise:

1. "International Gas Carrier Code" means the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk as adopted by the Maritime Safety Committee of the Organization by resolution MSC.5(48), as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the Annex other than chapter I.

2. "Gas carrier" means a cargo ship constructed or adapted and used for the carriage in bulk of any liquefied gas or other product listed in chapter 19 of the International Gas Carrier Code.

3. For the purpose of regulation 12, "ship constructed" means a ship the keel of which is laid or which is at a similar stage of construction.

4. "At a similar stage of construction" means the stage at which:

- .1 Construction identifiable with a specific ship begins; and
- .2 Assembly of that ship has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less.

*Regulation 12. APPLICATION TO GAS CARRIERS*

1. Unless expressly provided otherwise, this part applies to gas carriers constructed on or after 1 July 1986 including those of less than 500 tons gross tonnage. Such gas carriers shall comply with the requirements of this part in addition to any other applicable requirements of the present regulations.

2. Any gas carrier, irrespective of the date of construction, which undergoes repairs, alterations, modifications and outfitting related thereto shall continue to comply with at least the requirements previously applicable to the ship. Such a ship if constructed before 1 July 1986 shall, as a rule, comply with the requirements for a ship constructed on or after that date to at least the same extent as before undergoing such repairs, alterations, modifications or outfitting. Repairs, alterations and modifications of a major character, and outfitting related thereto, shall meet the requirements for a ship constructed on or after 1 July 1986 in so far as the Administration deems reasonable and practicable.

3. A ship, irrespective of the date of construction, which is converted to a gas carrier shall be treated as a gas carrier constructed on the date on which such conversion commenced.

*Regulation 13. REQUIREMENTS FOR GAS CARRIERS*

1. A gas carrier shall comply with the requirements of the International Gas Carrier Code and shall, in addition to the requirements of regulations I/8, I/9 and I/10, as applicable, be surveyed and certified as provided for in that Code. For the purpose of this regulation, the requirements of the Code shall be treated as mandatory.

2. A gas carrier holding a certificate issued pursuant to the provisions of paragraph 1 shall be subject to the control established in regulation I/19. For this purpose such certificate shall be treated as a certificate issued under regulation I/12 or I/13.

*RESOLUTION MSC.4(48)<sup>1</sup>  
adopted on 17 June 1983*

**ADOPTION OF THE INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING DANGEROUS CHEMICALS IN BULK (IBC CODE)**

The Maritime Safety Committee,

Recalling resolution A.490 (XII) by which the Assembly authorized it to adopt the revised Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk when harmonized with the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk as adopted by resolution A.328(IX),

Noting resolution MSC.6(48) by which it adopts, *inter alia*, amendments to chapter VII of the International Convention for the Safety of Life at Sea, 1974 (SOLAS Convention), to

<sup>1</sup> Resolution published for information by the Secretariat of the United Nations.

make the provisions of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) mandatory under that Convention,

Having considered the text of the proposed IBC Code:

1. Adopts the IBC Code, the text of which is given in the Annex to the present resolution;
2. Notes that under part B of chapter VII of the 1974 SOLAS Convention as amended by resolution MSC.6(48), amendments to the IBC Code shall be adopted, brought into force and take effect in accordance with the provisions of article VIII of that Convention;
3. Further notes that the IBC Code will require amendments to cover pollution prevention aspects prior to the entry into force of Annex II of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto;<sup>1</sup>
4. Requests the Secretary-General to circulate to all Governments concerned amendments to the IBC Code adopted as above which comprise the inclusion in chapter 17 of new products, recommending that, pending the entry into force of those amendments, these new products should be carried by chemical tankers in compliance with the provisions of the amendments;
5. Further requests the Secretary-General to transmit a copy of the present resolution together with the text of the IBC Code to all Members of the Organization and to all Contracting Governments to the 1974 SOLAS Convention which are not Members of the Organization.

## A N N E X

### INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING DANGEROUS CHEMICALS IN BULK

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<sup>1</sup> United Nations, *Treaty Series*, vol. 1340, p. 61 (authentic English and Russian texts), and vol. 1341, p. 3 (authentic French and Spanish texts).



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## PREAMBLE

1. The purpose of this Code is to provide an international standard for the safe carriage by sea in bulk of dangerous liquid chemicals listed in chapter 17 of the Code by prescribing the design and construction standards of ships regardless of 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 one of ship types related to the hazards of the products covered by the Code. Each of the products may have one or more hazard properties which include flammability, toxicity, corrosivity and reactivity.

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 Organization will periodically review the Code taking into account both experience and technical development.

4. Requirements for new products and their conditions of carriage will be circulated as recommendations, on an interim basis, when adopted by the Maritime Safety Committee of the Organization, prior to the entry into force of the appropriate amendments, under the terms of article VIII of the International Convention for the Safety of Life at Sea, 1974.

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. The development of the Code has been greatly assisted by relevant work of the International Association of Classification Societies (IACS) and of the International Electrotechnical Commission (IEC).

7. Chapter 16 of the Code, dealing with operational requirements of chemical tankers, highlights the regulations in other chapters that are operational in nature and mentions those other important safety features that are peculiar to chemical tanker operation.

8. The layout of the Code is in line with the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) adopted by the Maritime Safety Committee at its forty-eighth session. Gas carriers may also carry in bulk liquid chemicals covered by this Code as dealt with in the IGC Code.

*Chapter 1. GENERAL**1.1. Application*

1.1.1. The Code applies to ships regardless of size, including those of less than 500 tons gross tonnage, engaged in the carriage of bulk cargoes of dangerous liquid chemical substances, other than petroleum or similar flammable products as follows:

- .1 Products having significant fire hazards in excess of those of petroleum products and similar flammable products;
- .2 Products having significant hazards in addition to or other than flammability.

The Code is at present limited to the liquids shown in the summary of minimum requirements in chapter 17. Products that have been reviewed and determined not to come within the scope of the Code are found in chapter 18.

1.1.2. Liquids covered by the Code are those having a vapour pressure not exceeding 2.8 bar at a temperature of 37.8°C.

1.1.3. For a product proposed for carriage in bulk, but not listed in chapter 17 or 18, the Administration and port Administrations involved in such carriage should prescribe the pre-

liminary suitable conditions for the carriage, having regard to the criteria for hazard evaluation of bulk chemicals. The Organization should be notified of the conditions for consideration for inclusion of the product in the Code.

1.1.4. Unless expressly provided otherwise the Code applies to ships the keels of which are laid or which are at a stage at which:

- .1 Construction identifiable with the ship begins; and
- .2 Assembly has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less;

on or after 1 July 1986.

1.1.5. A ship, irrespective of the date of construction, which is converted to a chemical tanker on or after 1 July 1986, should be treated as a chemical tanker constructed on the date on which such conversion commences.

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

## 1.2. Hazards

Hazards of products covered by the Code include:

1.2.1. Fire hazard defined by flashpoint, boiling point, flammability limits and autoignition temperature of the chemical.

1.2.2. Health hazard defined by:

- .1 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
- .2 Irritational effects on the skin in the liquid state; or
- .3 Toxic effect, taking into account values of:

LD 50 oral: a dose which is lethal to 50% of the test subjects when administered orally;

LD 50 skin: a dose which is lethal to 50% of the test subjects when administered to the skin;

LC 50: the concentration which is lethal by inhalation to 50% of the test subjects.

1.2.3. Water pollution hazard defined by human toxicity, water solubility, volatility, odour or taste, and relative density.

1.2.4. Air pollution hazard defined by:

- .1 Emergency exposure limit (E.E.L.) or LC 50;
- .2 Vapour pressure;
- .3 Solubility in water;
- .4 Relative density of liquid;
- .5 Vapour density.

1.2.5. Reactivity hazard defined by reactivity with:

- .1 Other products; or
- .2 Water; or
- .3 The product itself (including polymerization).

## 1.3 Definitions

The following definitions apply unless expressly provided otherwise. (Additional definitions are given in individual chapters.)

1.3.1. Accommodation spaces are those spaces used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, barber shops, pantries containing no cooking appliances and similar spaces. Public spaces are those portions of the

accommodation spaces which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

1.3.2.1. Administration means the Government of the State whose flag the ship is entitled to fly.

1.3.2.2. Port Administration means the appropriate authority of the country in the port of which the ship is loading or unloading.

1.3.3. Boiling point is the temperature at which a product exhibits a vapour pressure equal to the atmospheric pressure.

1.3.4. Breadth (B) means the maximum breadth of the ship, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material. The breadth (B) should be measured in metres.

1.3.5. Cargo area is that part of the ship that contains cargo tanks, slop tanks, cargo pump rooms including pump rooms, cofferdams, ballast or void spaces adjacent to cargo tanks and also deck areas throughout the entire length and breadth of the part of the ship over the above-mentioned spaces. Where independent tanks are installed in hold spaces, cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forwardmost hold space are excluded from the cargo area.

1.3.6. Cargo pump room is a space containing pumps and their accessories for the handling of products covered by the Code.

1.3.7. Cargo service spaces are spaces within the cargo area used for workshops, lockers and store-rooms of more than 2 m<sup>2</sup> in area, used for cargo handling equipment.

1.3.8. Cargo tank is the envelope designed to contain the cargo.

1.3.9. Chemical tanker is a cargo ship constructed or adapted and used for the carriage in bulk of any liquid product listed in chapter 17.

1.3.10. Cofferdam is the isolating space between two adjacent steel bulkheads or decks. This space may be a void space or a ballast space.

1.3.11. Control stations are those spaces in which ship's radio or main navigating equipment or the emergency source of power is located or where the fire-recording or fire-control equipment is centralized. This does not include special fire-control equipment which can be most practically located in the cargo area.

1.3.12. Flammability limits are the conditions defining the state of fuel-oxidant mixture at which application of an adequately strong external ignition source is only just capable of producing flammability in a given test apparatus.

1.3.13. Flashpoint is the temperature in degrees Celsius at which a product will give off enough flammable vapour to be ignited. Values given in the Code are "closed cup test" determined by an approved flashpoint apparatus.

1.3.14. Hold space is the space enclosed by the ship's structure in which an independent cargo tank is situated.

1.3.15. 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.

1.3.16. Length (L) means 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel, the waterline on which this length is measured should be parallel to the designed waterline. The length (L) should be measured in metres.

1.3.17. Machinery spaces of category A are those spaces and trunks to such spaces which contain:

.1 Internal combustion machinery used for main propulsion; or

- .2 Internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or
- .3 Any oil-fired boiler or oil fuel unit.

1.3.18. Machinery spaces are all machinery spaces of category A and all other spaces containing propelling machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air-conditioning machinery, and similar spaces, and trunks to such spaces.

1.3.19. Oil fuel unit is the equipment used for the preparation of oil fuel for delivery to an oil-fired boiler, or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a pressure of more than 1.8 bar gauge.

1.3.20. Organization is the International Maritime Organization (IMO).

1.3.21. Permeability of a space means the ratio of the volume within that space which is assumed to be occupied by water to the total volume of that space.

1.3.22. Pump room is a space, located in the cargo area, containing pumps and their accessories for the handling of ballast and oil fuel.

1.3.23. Relative density of liquid is the ratio of the mass of a volume of a product to the mass of an equal volume of fresh water. For a product of limited solubility, the relative density indicates whether it floats on water or sinks.

1.3.24. 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:

- .1 Removing spool pieces or valves and blanking the pipe ends;
- .2 Arrangement of two spectacle flanges in series with provisions for detecting leakage into the pipe between the two spectacle flanges.

1.3.25. Service spaces are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, store-rooms, workshops other than those forming part of the machinery spaces and similar spaces and trunks to such spaces.

1.3.26. 1974 SOLAS Convention means the International Convention for the Safety of Life at Sea, 1974.

1.3.27. 1983 SOLAS amendments means the amendments to the 1974 SOLAS Convention adopted by the Maritime Safety Committee of the Organization at its forty-eighth session on 17 June 1983 by resolution MSC.6(48).

1.3.28. Vapour density or the relative density of vapour is the ratio of the mass of a volume of vapour or gas (with no air present) to the mass of an equal volume of air at the same pressure and temperature. Vapour density below or above 1 indicates whether the vapour or gas is lighter or heavier than air.

1.3.29. Vapour pressure is the equilibrium pressure of the saturated vapour above the liquid expressed in bars absolute at a specified temperature.

1.3.30. Void space is an enclosed space in the cargo area external to a cargo tank, other than a hold space, ballast space, oil fuel tank, cargo pump room, pump room, or any space in normal use by personnel.

#### 1.4. *Equivalents*

1.4.1. Where the Code requires that a particular fitting, material, appliance, apparatus, item of equipment or type thereof should be fitted or carried in a ship, or that any particular provision should be made, or any procedure or arrangement should be complied with, the Administration may allow any other fitting, material, appliance, apparatus, item of equipment or type thereof to be fitted or carried, or any other provision, procedure or arrangement to be

made in that ship, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance, apparatus, item of equipment or type thereof or that any particular provision, procedure or arrangement is at least as effective as that required by the Code. However, the Administration may not allow operational methods or procedures to be made an alternative to a particular fitting, material, appliance, apparatus, item of equipment, or type thereof, which are prescribed by the Code, unless such substitution is specifically allowed by the Code.

1.4.2. 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 thereafter, it should communicate to the Organization the particulars thereof together with a report on the evidence submitted so that the Organization may circulate the same to other Contracting Governments to the 1974 SOLAS Convention for the information of their officers.

### 1.5. *Surveys and certification*

#### 1.5.1. *Survey procedure*

1.5.1.1. The survey of ships, so far as regards the enforcement of the provisions of the regulations and granting of exemptions therefrom, should be carried out by officers of the Administration. The Administration may, however, entrust the surveys either to surveyors nominated for the purpose or to organizations recognized by it.

1.5.1.2. The Administration nominating surveyors or recognizing organizations to conduct surveys should, as a minimum, empower any nominated surveyor or recognized organization to:

- .1 Require repairs to a ship; and
- .2 Carry out surveys if requested by the port State authority\* concerned.

The Administration should notify the Organization of the specific responsibilities and conditions of the authority delegated to nominated surveyors or recognized organizations for circulation to the Contracting Governments.

1.5.1.3. When a nominated surveyor or recognized organization determines that the condition of the ship or its equipment does not correspond substantially with the particulars of the certificate or is such that the ship is not fit to proceed to sea without danger to the ship, or persons on board, such surveyor or organization should immediately ensure that corrective action is taken and should in due course notify the Administration. If such corrective action is not taken the relevant certificate should be withdrawn and the Administration should be notified immediately; and, if the ship is in a port of another Contracting Government, the port State authority concerned should also be notified immediately.

1.5.1.4. In every case, the Administration should guarantee the completeness and efficiency of the survey, and should undertake to ensure the necessary arrangements to satisfy this obligation.

#### 1.5.2. *Survey requirements*

1.5.2.1. 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 International 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

\* Port State authority has the meaning as presented in chapter I, regulation 19 of the 1978 Protocol to the 1974 SOLAS Convention.

- 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 5 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 International 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 6 months prior to, nor later than 6 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 on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.
  - .4 A mandatory annual survey within 3 months before or after the anniversary date of the International 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 International Certificate of Fitness for the Carriage 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 1.5.3.3, 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.

#### 1.5.3. *Maintenance of conditions after survey*

1.5.3.1. The condition 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.

1.5.3.2. After any survey of the ship under 1.5.2 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.

1.5.3.3. 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 lifesaving appliances or other equipment, the master or owner of the ship should report 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 1.5.2.5, is necessary. If the ship is in a port of another Contracting Government, the master or owner should also report immediately to the port State authority concerned and the nominated surveyor or recognized organization should ascertain that such a report has been made.

#### 1.5.4. *Issue of International Certificate of Fitness*

1.5.4.1. A certificate called an International 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 which complies with the relevant requirements of the Code.

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

1.5.5. *Issue or endorsement of International Certificate of Fitness by another Government*

1.5.5.1. A Contracting Government may, at the request of the Government of another State, cause a ship entitled to fly the flag of the other State 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 board 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 whose flag the ship is entitled to fly.

1.5.6. *Duration and validity of the International Certificate of Fitness*

1.5.6.1. An International 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 5 years from the date of the initial survey or the periodical survey.

1.5.6.2. No extension of the 5 year period of the certificate should be permitted.

1.5.6.3. The certificate should cease to be valid:

- .1 If the surveys are not carried out within the period specified by 1.5.2;
- .2 Upon transfer of the ship to the flag of another State. 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 1.5.3.1 and 1.5.3.2. Where a transfer occurs between Contracting Governments, the Government of the State whose flag the ship was formerly entitled to fly should, 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.

*Chapter 2. SHIP SURVIVAL CAPABILITY\* AND LOCATION OF CARGO TANKS*

2.1. *General*

2.1.1. Ships subject to the Code should survive the normal effects of flooding following assumed hull damage caused by some external force. In addition, to safeguard the ship and the environment, the cargo tanks of certain types of ships should be protected from penetration in the case of minor damage to the ship resulting, for example, from contact with a jetty or tug, and given a measure of protection from damage in the case of collision or stranding, by locating them at specified minimum distances inboard from the ship's shell plating. Both the damage to be assumed and the proximity of the cargo tanks to the ship's shell should be dependent upon the degree of hazard presented by the products to be carried.

2.1.2. Ships subject to the Code should be designed to one of the following standards:

- .1 A type 1 ship is a chemical tanker intended to transport chapter 17 products with very severe environmental and safety hazards which require maximum preventive measures to preclude an escape of such cargo.
- .2 A type 2 ship is a chemical tanker intended to transport chapter 17 products with appreciably severe environmental and safety hazards which require significant preventive measures to preclude an escape of such cargo.
- .3 A type 3 ship is a chemical tanker intended to transport chapter 17 products with sufficiently severe environmental and safety hazards which require a moderate degree of containment to increase survival capability in a damaged condition.

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\* Reference is made to the Guidelines for the Uniform Application of the Survival Requirements of the Bulk Chemical Code and the Gas Carrier Code.



Thus a type 1 ship is a chemical tanker intended for the transportation of products considered to present the greatest overall hazard and type 2 and type 3 for products of progressively lesser hazards. Accordingly, a type 1 ship should survive the most severe standard of damage and its cargo tanks should be located at the maximum prescribed distance inboard from the shell plating.

2.1.3. The ship type required for individual products is indicated in column "c" in the table of chapter 17.

2.1.4. If a ship is intended to carry more than one product listed in chapter 17, the standard of damage should correspond to that product having the most stringent ship type requirement. The requirements for the location of individual cargo tanks, however, are those for ship types related to the respective products intended to be carried.

## 2.2. *Freeboard and intact stability*

2.2.1. Ships subject to the Code may be assigned the minimum freeboard permitted by the International Convention on Load Lines<sup>1</sup> in force. However, the draught associated with the assignment should not be greater than the maximum draught otherwise permitted by this Code.

2.2.2. The stability of the ship in all seagoing conditions should be to a standard which is acceptable to the Administration.

2.2.3. When calculating the effect of free surfaces of consumable liquids for loading conditions it should be assumed that, for each type of liquid, at least one transverse pair or a single centre tank has a free surface and the tank or combination of tanks to be taken into account should be those where the effect of free surfaces is the greatest. The free surface effect in undamaged compartments should be calculated by a method acceptable to the Administration.

2.2.4. Solid ballast should not normally be used in double bottom spaces in the cargo area. Where, however, because of stability considerations, the fitting of solid ballast in such spaces becomes unavoidable, then its disposition should be governed by the need to ensure that the impact loads resulting from bottom damage are not directly transmitted to the cargo tank structure.

2.2.5. The master of the ship should be supplied with a Loading and Stability Information booklet. This booklet should contain details of typical service and ballast conditions, provisions for evaluating other conditions of loading and a summary of the ship's survival capabilities. In addition, the booklet should contain sufficient information to enable the master to load and operate the ship in a safe and seaworthy manner.

## 2.3. *Shipside discharges below the freeboard deck*

2.3.1. The provision and control of valves fitted to discharges led through the shell from spaces below the freeboard deck or from within the superstructures and deckhouses on the freeboard deck fitted with weathertight doors should comply with the requirements of the relevant regulation of the International Convention on Load Lines in force, except that the choice of valves should be limited to:

- .1 One automatic non-return valve with a positive means of closing from above the freeboard deck; or
- .2 Where the vertical distance from the summer load waterline to the inboard end of the discharge pipe exceeds 0.01 L, two automatic non-return valves without positive means of closing, provided that the inboard valve is always accessible for examination under service conditions.

2.3.2. For the purpose of this chapter "summer load waterline" and "freeboard deck", have the meanings as defined in the International Convention on Load Lines in force.

<sup>1</sup> United Nations, *Treaty Series*, vol. 640, p. 133.

2.3.3. The automatic non-return valves referred to in 2.3.1.1 and 2.3.1.2 should be of a type acceptable to the Administration and should be fully effective in preventing admission of water into the ship, taking into account the sinkage, trim and heel in survival requirements in 2.9.

#### 2.4. *Conditions of loading*

Damage survival capability should be investigated on the basis of loading information submitted to the Administration for all anticipated conditions of loading and variations in draught and trim. Ballast conditions where the chemical tanker is not carrying products covered by the Code, or is carrying only residues of such products, need not be considered.

#### 2.5. *Damage assumptions*

2.5.1. The assumed maximum extent of damage should be:

##### .1 Side damage:

.1.1 Longitudinal extent:  $1/3L^{2/3}$  or 14.5 m, whichever is less

.1.2 Transverse extent:  $B/5$  or 11.5 m, whichever is less

Measured inboard from the ship's side at right angles to the centreline at the level of the summer load line

.1.3 Vertical extent: upwards without limit

From the moulded line of the bottom shell plating at centreline

##### .2 Bottom damage:

For 0.3L from the forward perpendicular of the ship

Any other part of the ship

.2.1 Longitudinal extent:  $1/3L^{2/3}$  or 14.5 m, whichever is less

$1/3L^{2/3}$  or 5 m, whichever is less

.2.2 Transverse extent:  $B/6$  or 10 m, whichever is less

$B/6$  or 5 m, whichever is less

.2.3 Vertical extent:  $B/15$  or 6 m, whichever is less measured from the moulded line of the bottom shell plating at centreline (see 2.6.2).

$B/15$  or 6 m, whichever is less measured from the moulded line of the bottom shell plating at centreline (see 2.6.2).

##### 2.5.2. Other damage:

.1 If any damage of a lesser extent than the maximum damage specified in 2.5.1 would result in a more severe condition, such damage should be considered.

.2 For type 1 and type 2 ships, local side damage anywhere in the cargo area extending inboard 760 mm measured normal to the hull shell should be considered and transverse bulkheads should be additionally assumed damaged when also required by the applicable subparagraphs of 2.8.1.

#### 2.6. *Location of cargo tanks*

2.6.1. Cargo tanks should be located at the following distances inboard:

.1 Type 1 ships: from the side shell plating not less than the transverse extent of damage specified in 2.5.1.1.2 and from the moulded line of the bottom shell plating at centreline not less than the vertical extent of damage specified in 2.5.1.2.3 and nowhere less than 760 mm from the shell plating.

- .2 Type 2 ships: from the moulded line of the bottom shell plating at centreline not less than the vertical extent of damage specified in 2.5.1.2.3 and nowhere less than 760 mm from the shell plating.
- .3 Type 3 ships: no requirement.

2.6.2. Except for type 1 ships, suction wells installed in cargo tanks may protrude into the vertical extent of bottom damage specified in 2.5.1.2.3 provided that such wells are as small as practicable and the protrusion below the inner bottom plating does not exceed 25% of the depth of the double bottom or 350 mm, whichever is less. Where there is no double bottom, the protrusion of the suction well of independent tanks below the upper limit of bottom damage should not exceed 350 mm. Suction wells installed in accordance with this paragraph may be ignored in determining the compartments affected by damage.

### 2.7. Flooding assumptions

2.7.1. The requirements of 2.9 should be confirmed by calculations which take into consideration the design characteristics of the ship; the arrangements, configuration and contents of the damaged compartments; the distribution, relative densities and the free surface effects of liquids; and the draught and trim for all conditions of loading.

2.7.2. The permeabilities of spaces assumed to be damaged should be as follows:

<i>Spaces</i>	<i>Permeabilities</i>
Appropriated to stores .....	0.60
Occupied by accommodation .....	0.95
Occupied by machinery .....	0.85
Voids .....	0.95
Intended for consumable liquids .....	0 to 0.95*
Intended for other liquids .....	0 to 0.95*

\* The permeability of partially filled compartments should be consistent with the amount of liquid carried in the compartment.

2.7.3. Wherever damage penetrates a tank containing liquids it should be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.

2.7.4. Every watertight division within the maximum extent of damage defined in 2.5.1 and considered to have sustained damage in positions given in 2.8.1 should be assumed to be penetrated. Where damage less than the maximum is being considered in accordance with 2.5.2, only watertight divisions or combinations of watertight divisions within the envelope of such lesser damage should be assumed to be penetrated.

2.7.5. The ship should be so designed as to keep unsymmetrical flooding to the minimum consistent with efficient arrangements.

2.7.6. Equalization arrangements requiring mechanical aids such as valves or cross-levelling pipes, if fitted, should not be considered for the purpose of reducing an angle of heel or attaining the minimum range of residual stability to meet the requirements of 2.9 and sufficient residual stability should be maintained during all stages where equalization is used. Spaces which are linked by ducts of large cross-sectional [areas] may be considered to be common.

2.7.7. If pipes, ducts, trunks or tunnels are situated within the assumed extent of damage penetration, as defined in 2.5, arrangements should be such that progressive flooding cannot thereby extend to compartments other than those assumed to be flooded for each case of damage.

2.7.8. The buoyancy of any superstructure directly above the side damage should be disregarded. The unflooded parts of superstructures beyond the extent of damage, however, may be taken into consideration provided that:

- .1 They are separated from the damaged space by watertight divisions and the requirements of 2.9.3 in respect of these intact spaces are complied with; and
- .2 Openings in such divisions are capable of being closed by remotely operated sliding watertight doors and unprotected openings are not immersed within the minimum range of residual stability required in 2.9; however the immersion of any other openings capable of being closed weathertight may be permitted.

#### 2.8. *Standard of damage*

2.8.1. Ships should be capable of surviving the damage indicated in 2.5 with the flooding assumptions in 2.7 to the extent determined by the ship's type according to the following standards:

- .1 A type 1 ship should be assumed to sustain damage anywhere in its length;
- .2 A type 2 ship of more than 150 m in length should be assumed to sustain damage anywhere in its length;
- .3 A type 2 ship of 150 m in length or less should be assumed to sustain damage anywhere in its length except involving either of the bulkheads bounding a machinery space located aft;
- .4 A type 3 ship of more than 225 m in length should be assumed to sustain damage anywhere in its length;
- .5 A type 3 ship of 125m in length or more but not exceeding 225 m in length should be assumed to sustain damage anywhere in its length except involving either of the bulkheads bounding a machinery space located aft;
- .6 A type 3 ship below 125 m in length should be assumed to sustain damage anywhere in its length except involving damage to the machinery space when located aft. However, the ability to survive the flooding of the machinery space should be considered by the Administration.

2.8.2. In the case of small type 2 and type 3 ships which do not comply in all respects with the appropriate requirements of 2.8.1.3 and 2.8.1.6, special dispensations may only be considered by the Administration provided that alternative measures can be taken which maintain the same degree of safety. The nature of the alternative measures should be approved and clearly stated and be available to the port Administration. Any such dispensation should be duly noted on the International Certificate of Fitness referred to in 1.5.4.

#### 2.9. *Survival requirements*

2.9.1. Ships subject to the Code should be capable of surviving the assumed damage specified in 2.5 to the standard provided in 2.8 in a condition of stable equilibrium and should satisfy the following criteria.

2.9.2. In any stage of flooding:

- .1 The waterline, taking into account sinkage, heel and trim, should be below the lower edge of any opening through which progressive flooding or downflooding may take place. Such openings should include air pipes and openings which are closed by means of watertight doors or hatch covers and may exclude those openings closed by means of watertight man-hole covers and watertight flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors, and sidescuttles of the non-opening type;
- .2 The maximum angle of heel due to unsymmetrical flooding should not exceed 25°, except that this angle may be increased up to 30° if no deck immersion occurs;
- .3 The residual stability during intermediate stages of flooding should be to the satisfaction of the Administration. However, it should never be significantly less than that required by 2.9.3.

2.9.3. At final equilibrium after flooding:

- .1 The righting lever curve should have a minimum range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 0,1 m within the 20° range; the area under the curve within this range should not be less than 0.0175 m/rad. Unprotected openings should not be immersed within this range unless the space concerned is assumed to be flooded. Within this range, the immersion of any of the openings listed in 2.9.2.1 and other openings capable of being closed weathertight may be permitted; and
- .2 The emergency source of power should be capable of operating.

### Chapter 3. SHIP ARRANGEMENTS

#### 3.1. Cargo segregation

3.1.1. Unless expressly provided otherwise, tanks containing cargo or residues of cargo subject to the Code should be segregated from accommodation, service and machinery spaces and from drinking water and stores for human consumption by means of a cofferdam, void space, cargo pump room, pump room, empty tank, oil fuel tank or other similar space.

3.1.2. Cargoes which react in a hazardous manner with other cargoes should:

- .1 Be segregated from such other cargoes by means of a cofferdam, void space, cargo pump room, pump room, empty tank, or tank containing a mutually compatible cargo;
- .2 Have separate pumping and piping systems which should not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and
- .3 Have separate tank venting systems.

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

3.1.4. Cargoes subject to the Code should not be carried in either the fore or aft peak tank.

#### 3.2. Accommodation, service and machinery spaces and control stations

3.2.1. No accommodation or service spaces or control stations should be located within the cargo area except over a cargo pump room recess or pump room recess that complies with regulation II-2/56 of the 1983 SOLAS amendments and no cargo or slop tank should be aft of the forward end of any accommodation.

3.2.2. 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, service and machinery spaces and control stations in relation to cargo piping and cargo vent systems.

3.2.3. Entrances, air inlets and openings to accommodation, service and machinery spaces and control stations should not face the cargo area. They should be located on the end bulkhead not facing the cargo area and/or on the outboard side of the superstructure or deckhouse at a distance of at least 4% of the length (L) of the ship but not less than 3 m from the end of the superstructure or deckhouse facing the cargo area. This distance, however, need not exceed 5 m. No doors should be permitted within the limits mentioned above, except that doors to those spaces not having access to accommodation and service spaces and control stations, such as cargo control stations and store-rooms may be permitted by the Administration. Where such doors are fitted, the boundaries of the space should be insulated to "A-60" standard. Bolted plates for removal of machinery may be fitted within the limits specified above. Wheelhouse doors and wheelhouse windows may be located within the limits specified above so long as they are so designed that a rapid and efficient gas and vapour tightening of the wheelhouse can be ensured. Windows and sidescuttles facing the cargo area and on the sides of the superstructures and deckhouses within the limits specified above should be of the fixed (non-

opening) type. Such sidescuttles in the first tier on the main deck should be fitted with inside covers of steel or equivalent material.

### 3.3. *Cargo pump rooms*

3.3.1. Cargo pump rooms should be so arranged as to ensure:

- .1 Unrestricted passage at all times from any ladder platform and from the floor; and
- .2 Unrestricted access to all valves necessary for cargo handling for a person wearing the required personnel protective equipment.

3.3.2. Permanent arrangements should be made for hoisting an injured person with a rescue line while avoiding any projecting obstacles.

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

3.3.4. Normal access ladders should not be fitted vertical and should incorporate platforms at suitable intervals.\*

3.3.5. Means should be provided 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 liquids to on-shore reception facilities.

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

3.3.7. Where machinery is driven by shafting passing through a bulkhead or deck, gas-tight seals with efficient lubrication or other means of ensuring the permanence of the gas seal should be fitted in way of the bulkhead or deck.

### 3.4. *Access to spaces in the cargo area*

3.4.1. Access to cofferdams, ballast tanks, cargo tanks and other spaces in the cargo area should be direct from the open deck and such as to ensure their complete inspection. Access to double bottom spaces may be through a cargo pump room, pump room, deep cofferdam, pipe tunnel or similar compartments, subject to consideration of ventilation aspects.

3.4.2. For access through horizontal openings, hatches or manholes, the dimensions should be sufficient to allow a person wearing a self-contained air breathing apparatus and protective equipment 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 by 600 mm.

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

3.4.4. Smaller dimensions may be approved by the Administration in special circumstances, if the ability to traverse such openings or to remove an injured person can be proved to the satisfaction of the Administration.

### 3.5. *Bilge and ballast arrangements*

3.5.1. Pumps, ballast lines, vent lines and other similar equipment serving permanent ballast tanks should be independent of similar equipment serving cargo tanks and of cargo

\* Reference is made to the Recommendation on Safe Access to and Working in Large Tanks (resolution A.272(VIII))<sup>1</sup> as amended by resolution A.330(IX).<sup>2</sup>

<sup>1</sup> *Resolutions and Other Decisions, Intergovernmental Maritime Consultative Organization Assembly, Eighth Session, 13-23 November 1973, p. 92.*

<sup>2</sup> *Ibid., Ninth Session, 3-14 November 1975, p. 192.*

tanks themselves. Discharge arrangements for permanent ballast tanks sited immediately adjacent to cargo tanks should be outside machinery spaces and accommodation spaces. Filling arrangements may be in the machinery spaces provided that such arrangements ensure filling from tank deck level and non-return valves are fitted.

3.5.2. 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.

3.5.3. 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 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.

### 3.6. *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.

### 3.7. *Bow or stern loading and unloading arrangements*

3.7.1. Subject to the approval of the Administration, cargo piping may be fitted to permit bow or stern loading and unloading. Portable arrangements should not be permitted.

3.7.2. Bow or stern loading and unloading lines should not be used for the transfer of products required to be carried in type 1 ships. Bow and stern loading and unloading lines should not be used for the transfer of cargoes emitting toxic vapours required to comply with 15.12.1, unless specifically approved by the Administration.

3.7.3. In addition to 5.1, the following provisions apply:

- .1 The piping outside the cargo area should be fitted at least 760 mm inboard on the open deck. Such piping should be clearly identified and fitted with a shutoff valve at its connection to the cargo piping system within the cargo area. At this location, it should also be capable of being separated by means of a removable spool piece and blank flanges when not in use.
- .2 The shore connection should be fitted with a shutoff valve and a blank flange.
- .3 The piping should be full penetration butt welded, and fully radiographed. Flange connections in the piping should only be permitted within the cargo area and at the shore connection.
- .4 Spray shields should be provided at the connections specified in .1 as well as collecting trays of sufficient capacity with means for the disposal of drainage.
- .5 The piping should be self-draining to the cargo area and preferably into a cargo tank. Alternative arrangements for draining the piping may be accepted by the Administration.
- .6 Arrangements should be made to allow such piping to be purged after use and maintained gas-safe when not in use. The vent pipes connected with the purge should be located in the cargo area. The relevant connections to the piping should be provided with a shutoff valve and blank flange.

3.7.4. Entrances, air inlets and openings to accommodation, service and machinery spaces and control stations should not face the cargo shore connection location of bow or stern loading and unloading arrangements. They should be located on the outboard side of the superstructure or deckhouse at a distance of at least 4% of the length of the ship but not less than 3 m from the end of the house facing the cargo shore connection location of the bow or stern loading and unloading arrangements. This distance, however, need not exceed 5 m. Side-scuttles facing the shore connection location and on the sides of the superstructure or deckhouse within the distance mentioned above should be of the fixed (nonopening) type. In addition, during the use of the bow or stern loading and unloading arrangements, all doors, ports and other openings on the corresponding superstructure or deckhouse side should be

kept closed. Where, in the case of small ships, compliance with 3.2.3 and this paragraph is not possible, the Administration may approve relaxations from the above requirements.

3.7.5. Air pipes and other openings to enclosed spaces not listed in 3.7.4 should be shielded from any spray which may come from a burst hose or connection.

3.7.6. Escape routes should not terminate within the coamings required by 3.7.7 or within a distance of 3 m beyond the coamings.

3.7.7. Continuous coamings of suitable height should be fitted to keep any spills on deck and away from the accommodation and service areas.

3.7.8. Electrical equipment within the coamings required by 3.7.7 or within a distance of 3 m beyond the coamings should be in accordance with the requirements of chapter 10.

3.7.9. Fire-fighting arrangements for the bow or stern loading and unloading areas should be in accordance with 11.3.16.

3.7.10. Means of communication between the cargo control station and the cargo shore connection location should be provided and certified safe, if necessary. Provision should be made for the remote shutdown of cargo pumps from the cargo shore connection location.

#### Chapter 4. CARGO CONTAINMENT

##### 4.1. Definitions

4.1.1. Independent tank means a cargo containment envelope which is not contiguous with, or 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 structural completeness of the ship's hull.

4.1.2. Integral tank means a cargo containment envelope which forms part of the ship's hull and which may be stressed in the same manner and by the same loads which stress the contiguous hull structure and which is normally essential to the structural completeness of the ship's hull.

4.1.3. Gravity tank means a tank having a design pressure not greater than 0.7 bar gauge at the top of the tank. A gravity tank may be independent or integral. A gravity tank should be constructed and tested according to the standards of the Administration taking account of the temperature of carriage and relative density of the cargo.

4.1.4. Pressure tank means a tank having a design pressure greater than 0.7 bar gauge. A pressure tank should be an independent tank and should be of a configuration permitting the application of pressure vessel design criteria according to the standards of the Administration.

##### 4.2. Tank type requirements for individual products

Requirements for both installation and design of tank types for individual products are shown in column "d" in the table of chapter 17.

#### Chapter 5. CARGO TRANSFER

##### 5.1. Piping scantlings\*

5.1.1. Subject to the conditions stated in 5.1.4 the wall thickness (t) of pipes should not be less than:

$$t = \frac{t_0 + b + c}{1 - \frac{a}{100}} \text{ (mm)}$$

\* Reference is also made to the published Rules of the Members and Associate Members of the International Association of Classification Societies (IACS).



where:  $t_0$  = theoretical thickness

$$t_0 = PD/(20 Ke + P) \text{ (mm)}$$

with

P = design pressure (bar) referred to in 5.1.2

D = outside diameter (mm)

K = allowable stress (N/mm<sup>2</sup>) referred to in 5.1.5

e = efficiency factor; equal to 1.0 for seamless pipes and for longitudinally or spirally welded pipes, delivered by manufacturers approved for making welded pipes which are considered by the Administration as equivalent to seamless pipes. In other cases the e value is to be determined by the Administration depending on the manufacturing process and testing procedure.

b = allowance for bending (mm). The value of b should be chosen so that the calculated stress in the bend, due to internal pressure only, does not exceed the allowable stress. Where such justification is not given, b should be not less than:

$$b = \frac{Dt_0}{2.5r} \text{ (mm)}$$

with

r = mean radius of the bend (mm).

c = corrosion allowance (mm). If corrosion or erosion is expected, the wall thickness of piping should be increased over that required by the other design requirements.

a = negative manufacturing tolerance for thickness (%).

5.1.2. The design pressure P in the formula for  $t_0$  in 5.1.1 is the maximum gauge pressure to which the system may be subjected in service, taking into account the highest set pressure on any relief valve on the system.

5.1.3. Piping and piping system components which are not protected by a relief valve, or which may be isolated from their relief valve, should be designed for at least the greatest of:

- .1 For piping systems or components which may contain some liquid, the saturated vapour pressure at 45°C;
- .2 The pressure setting of the associated pump discharge relief valve;
- .3 The maximum possible total pressure head at the outlet of the associated pumps when a pump discharge relief valve is not installed.

5.1.4. The design pressure should not be less than 10 bar gauge except for open-ended lines where it should be not less than 5 bar gauge.

5.1.5. For pipes, the allowable stress to be considered in the formula for  $t_0$  in 5.1.1 is the lower of the following values:

$$\frac{R_m}{A} \text{ or } \frac{R_e}{B}$$

where:  $R_m$  = specified minimum tensile strength at ambient temperature (N/mm<sup>2</sup>)

$R_e$  = specified minimum yield stress at ambient temperature (N/mm<sup>2</sup>). If the stress-strain curve does not show a defined yield stress, the 0.2% proof stress applies.

A and B should have values of at least A = 2.7 and B = 1.8.

5.1.6.1. The minimum wall thickness should be in accordance with Recognized Standards.\*

\* Recognized Standards for the purpose of this chapter are standards laid down and maintained by a classification society recognized by the Administration.

5.1.6.2. Where necessary for mechanical strength to prevent damage, collapse, excessive sag or buckling of pipes due to weight of pipes and content and to superimposed loads from supports, ship deflection or other causes, the wall thickness should be increased over that required by 5.1.1 or, if this is impracticable or would cause excessive local stresses, these loads should be reduced, protected against or eliminated by other design methods.

5.1.6.3. Flanges, valves and other fittings should be to a standard acceptable to the Administration, taking into account the design pressure defined under 5.1.2.

5.1.6.4. For flanges not complying with a standard the dimensions of flanges and associated bolts should be to the satisfaction of the Administration.

#### 5.2. *Piping fabrication and joining details*

5.2.1. The requirements of this section apply to piping inside and outside the cargo tanks. However, the Administration may accept relaxations from these requirements for open-ended piping and for piping inside cargo tanks except for cargo piping serving other cargo tanks.

5.2.2. Cargo piping should be joined by welding except:

- .1 For approved connections to shutoff valves and expansion joints; and
- .2 For other exceptional cases specifically approved by the Administration.

5.2.3. The following direct connections of pipe lengths, without flanges, may be considered:

- .1 Butt welded joints with complete penetration at the root may be used in all applications.
- .2 Slip-on welded joints with sleeves and related welding having dimensions satisfactory to the Administration should only be used for pipes with an external diameter of 50 mm or less. This type of joint should not be used when crevice corrosion is expected to occur.
- .3 Screwed connections acceptable to the Administration should only be used for accessory lines and instrumentation lines with external diameters of 25 mm or less.

5.2.4. Expansion of piping should normally be allowed for by the provision of expansion loops or bends in the piping system.

- .1 Bellows may be specially considered by the Administration in each case.
- .2 Slip joints should not be used.

5.2.5. Welding, post weld heat treatment and non-destructive testing should be performed in accordance with Recognized Standards.

#### 5.3. *Flange connections*

5.3.1. Flanges should be of the welded neck, slip-on or socket welded type. However, socket welded type flanges should not be used in nominal size above 50 mm.

5.3.2. Flanges should comply with standards acceptable to the Administration as to their type, manufacture and test.

#### 5.4. *Test requirements for piping*

5.4.1. The test requirements of this section apply to piping inside and outside cargo tanks. However, the Administration may accept relaxations from these requirements for piping inside cargo tanks and open-ended piping.

5.4.2. After assembly, each cargo piping system should be subject to a hydrostatic test to at least 1.5 times the design pressure. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the hydrostatic test may be conducted prior to installation aboard the ship. Joints welded on board should be hydrostatically tested to at least 1.5 times the design pressure.

5.4.3. After assembly on board, each cargo piping system should be tested for leaks to a pressure depending on the method applied.

### 5.5. *Piping arrangements*

5.5.1. 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 2.6) 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.

5.5.2. Cargo piping, located below the main deck, may run from the tank it serves and penetrate tank bulkheads or boundaries common to longitudinally or transversally adjacent cargo tanks, ballast tanks, empty tanks, pump rooms or cargo pump rooms provided that inside the tank it serves it is 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 cargo pump room, the stop valve operable from the weather deck may be situated on the tank bulkhead on the cargo pump room side. As an exception, where a cargo tank is adjacent to a cargo 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:

- .1 Designed to preclude the risk of leakage;
- .2 Fitted on the bulkhead of the cargo tank which it serves;
- .3 Suitably protected against mechanical damage;
- .4 Fitted at a distance from the shell, as required for damage protection; and
- .5 Operable from the weather deck.

5.5.3. 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.

5.5.4. Cargo piping installed in pipe tunnels should also comply with the requirements of 5.5.1 and 5.5.2. 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.

5.5.5. Cargo piping passing through bulkheads should be so arranged as to preclude excessive stresses at the bulkhead and should not utilize flanges bolted through the bulkhead.

### 5.6. *Cargo transfer control systems*

5.6.1. For the purpose of adequately controlling the cargo, cargo transfer systems should be provided with:

- .1 One stop valve capable of being manually operated on each tank filling and discharge line, located near the tank penetration; if an individual deepwell pump is used to discharge the contents of a cargo tank, a stop valve is not required on the discharge line of that tank;
- .2 One stop valve at each cargo hose connection;
- .3 Remote shutdown devices for all cargo pumps and similar equipment.

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

5.6.3. For certain products additional cargo transfer control requirements are shown in column "m" in the table of chapter 17.

### 5.7. *Ship's cargo hoses*

5.7.1. Liquid and vapour hoses used for cargo transfer should be compatible with the cargo and suitable for the cargo temperature.

5.7.2. Hoses subject to tank pressure or the discharge pressure of pumps should be designed for a bursting pressure not less than 5 times the maximum pressure the hose will be subjected to during cargo transfer.

5.7.3. Each new type of cargo hose, complete with end fittings, should be prototype tested to a pressure not less than 5 times its specified maximum working pressure. The hose temperature during this prototype test should be the intended extreme service temperature. Hoses used for prototype testing should not be used for cargo service. Thereafter, before being placed in service, each new length of cargo hose produced should be hydrostatically tested at ambient temperature to a pressure not less than 1.5 times its specified maximum working pressure but not more than two-fifths of its bursting pressure. The hose should be stencilled or otherwise marked with its specified maximum working pressure and, if used in other than ambient temperature services, its maximum and minimum service temperature as applicable. The specified maximum working pressure should not be less than 10 bar gauge.

## Chapter 6. MATERIALS OF CONSTRUCTION

### 6.1. General

6.1.1. Structural materials used for tank construction, together with associated piping, pumps, valves, vents and their jointing materials, should be suitable at the 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.

6.1.2. Where applicable the following should be taken into account in selecting the material of construction:

- .1 Notch ductility at the operating temperature;
- .2 Corrosive effect of the cargo;
- .3 Possibility of hazardous reactions between the cargo and the material of construction; and
- .4 Suitability of linings.

### 6.2. Special requirements for materials

6.2.1. For certain products special requirements apply in respect of materials indicated by symbols in column "k" in the table of chapter 17, as stipulated in 6.2.2, 6.2.3 and 6.2.4.

6.2.2. The following materials of construction should not be used for tanks, pipelines, valves, fittings and other equipment, which may come into contact with the products or their vapour where referred to in column "k" in the table of chapter 17:

N1 Aluminium, copper, copper alloys, zinc, galvanized steel and mercury.

N2 Copper, copper alloys, zinc and galvanized steel.

N3 Aluminium, magnesium, zinc, galvanized steel and lithium.

N4 Copper and copper-bearing alloys.

N5 Aluminium, copper and alloys of either.

N6 Copper, silver, mercury, magnesium and other acetylide-forming metals and their alloys.

N7 Copper and copper-bearing alloys with greater than 1% copper.

N8 Aluminium, zinc, galvanized steel and mercury.

6.2.3. Materials normally used in electrical apparatus, such as copper, aluminium and insulation, should as far as practicable be protected, e.g. by encapsulation, to prevent contact with vapours of products where referred to by Z in column "k" in the table of chapter 17.

6.2.4. The following materials of construction which may come into contact with certain products or their vapour should be used for tanks, pipelines, valves, fittings and other equipment, where referred to in column "k" in the table of chapter 17 as follows:

- Y1 Steel covered with a suitable protective lining or coating, aluminium or stainless steel.
- Y2 Aluminium or stainless steel for product concentrations of 98% or more.
- Y3 Special acid-resistant stainless steel for product concentrations of less than 98%.
- Y4 Solid austenitic stainless steel.
- Y5 Steel covered with suitable protective lining or coating or stainless steel.

6.2.5. Materials of construction having a melting point below 925°C, e.g. aluminium and its alloys, should not be used for external piping involved in cargo handling operations on ships intended for the carriage of products with flashpoints not exceeding 60°C (closed cup test) unless so specified in column "k" in the table of chapter 17. Short lengths of external pipes connected to cargo tanks may be permitted by the Administration if they are provided with fire-resistant insulation.

### Chapter 7. CARGO TEMPERATURE CONTROL

#### 7.1. General

7.1.1. When provided, any 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 product intended to be carried.

7.1.2. Heating or cooling media should be of a type 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 or overcooling of cargo. (See also 15.13.6.)

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

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

7.1.5. Means should be provided for measuring the cargo temperature.

- .1 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 "h" in the table of chapter 17.
- .2 A restricted temperature measuring device is subject to the definition for a restricted gauging device in 13.1.1.2, e.g. a portable thermometer lowered inside a gauge tube of the restricted type.
- .3 A closed temperature measuring device is subject to the definition for closed gauging device in 13.1.1.3, e.g. a remote-reading thermometer of which the sensor is installed in the tank.
- .4 When overheating or overcooling could result in a dangerous condition, an alarm system which monitors the cargo temperature should be provided. (See also operational requirements in 16.6.)

7.1.6. When products for which 15.12, 15.12.1 or 15.12.3 are listed in column "m" in the table of chapter 17 are being heated or cooled, the heating or cooling medium should operate in a circuit:

- .1 Which is independent of other ships' services, except for another cargo heating or cooling system, and which does not enter the machinery space; or
- .2 Which is external to the tank carrying toxic products; or
- .3 Where the medium is sampled to check for the presence of cargo before it is recirculated to other services of the ship or into the machinery space. The sampling equipment should be

located within the cargo area and be capable of detecting the presence of any toxic cargo being heated or cooled. Where this method is used, 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.

#### 7.2. *Additional requirements*

For certain products, additional requirements contained in chapter 15 are shown in column "m" in the table of chapter 17.

### Chapter 8. CARGO TANK VENT SYSTEMS

#### 8.1. *General*

8.1.1. All cargo tanks should be provided with a venting system appropriate to the cargo being carried. Tank vent systems should be designed so as to minimize the possibility of cargo vapour accumulating about the decks, entering accommodation, service and machinery spaces and control stations and, in the case of flammable vapours, any spaces containing sources of ignition. They should also be designed to minimize possible spraying on to 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.

8.1.2. Provision should be made to ensure that the liquid head in any tank does not exceed the test head of that tank. Suitable high-level alarms, overflow control systems or spill valves, together with gauging and tank filling procedures may be accepted for this purpose. Where the means of limiting cargo tank overpressure includes an automatic closing valve, the valve should comply with the appropriate provisions of 15.19.

8.1.3. 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 overpressurizing 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 bar or, for independent tanks, the maximum working pressure of the tank.

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

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

8.1.6. Tank vent piping connected to cargo tanks of corrosion resistant material, or to tanks 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.

#### 8.2. *Types of tank vent systems\**

8.2.1. Open tank venting system means a system which offers no restriction except for friction losses and flame screens if fitted, to the free flow of cargo vapours to and from the cargo tanks during normal operations and should only be used for those cargoes having a flash-point above 60°C (closed cup test) 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 to cargo segregation. However, in no case should shutoff valves be fitted either to the individual vents or to the header.

8.2.2. Controlled tank venting system means a system in which pressure/vacuum relief valves are fitted to each tank to limit the pressure or vacuum in the tank to 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

\* Attention is drawn to regulation II-2/59 of the 1983 amendments to the 1974 SOLAS Convention.

be combined into a common header or headers with due regard to 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.

- .1 The heights of vent outlets 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.
- .2 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.
- .3 The vent outlets should also be arranged at a distance of at least 10 m from the nearest air intake or openings to accommodation, service and machinery 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 pressure/vacuum 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.

8.2.3. Reference in 8.2.1 and 8.2.2 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.

#### 8.3. *Venting requirements for individual products*

Venting requirements for individual products are shown in column "e" and additional requirements in column "m" in the table of chapter 17.

### Chapter 9. ENVIRONMENTAL CONTROL

#### 9.1. *General*

9.1.1. Vapour spaces within cargo tanks and, in some cases, spaces surrounding cargo tanks may require to have specially controlled atmospheres.

9.1.2. There are four different types of control for cargo tanks, as follows:

- .1 Inerting—by filling the cargo tank and associated piping systems and, where specified in chapter 15, the spaces surrounding the cargo tanks, with a gas or vapour which will not support combustion and which will not react with the cargo, and maintaining that condition.
- .2 Padding—by filling the cargo tank and associated piping systems with a liquid, gas or vapour which separates the cargo from the air, and maintaining that condition.
- .3 Drying—by filling the cargo tank and associated piping systems with moisture-free gas or vapour with a dewpoint of  $-40^{\circ}\text{C}$  or below at atmospheric pressure, and maintaining that condition.
- .4 Ventilation—forced or natural.

9.1.3. Where inerting or padding of cargo tanks is required:

- .1 An adequate supply of inert gas for use in filling and discharging the cargo tanks 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.
- .2 The inert gas system on board the ship should be able to maintain a pressure of at least 0.07 bar gauge 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.
- .3 Where padding is used, similar arrangements for supply of the padding medium should be made as required for inert gas in .1 and .2.

- .4 Means should be provided for monitoring ullage spaces containing a gas blanket to ensure that the correct atmosphere is being maintained.
- .5 Inerting or padding arrangements or both, where used with flammable cargoes, should be such as to minimize the creation of static electricity during the admission of the inerting medium.

9.1.4. Where drying is used and dry nitrogen is used as the medium, similar arrangements for supply of the drying agent should be made to those required in 9.1.3. Where drying agents are used as the drying medium on all air inlets to the tank, sufficient medium should be carried for the duration of the voyage, taking into consideration the diurnal temperature range and the expected humidity.

#### 9.2. *Environmental control requirements for individual products*

The required types of environmental control for certain products are shown in column "f" in the table of chapter 17.

### Chapter 10. ELECTRICAL INSTALLATIONS

#### 10.1. *General*

10.1.1. The provisions of this chapter are applicable to ships carrying cargoes which are inherently, or due to their reaction with other substances, flammable or corrosive to the electrical equipment, and should be applied in conjunction with applicable electrical requirements of part D, chapter II-1 of the 1983 SOLAS amendments.

10.1.2.1. Electrical installations should be such as to minimize the risk of fire and explosion from flammable products. Electrical installations complying with this chapter should not be considered a source of ignition for the purposes of 8.2.2.3, having regard to 10.1.4.

10.1.2.2. Where the specific cargo is liable to damage the materials normally used in electrical apparatus, due consideration should be given to the particular characteristics of the materials chosen for conductors, insulation, metal parts, etc. As far as necessary, these components should be protected to prevent contact with gases or vapours liable to be encountered.

10.1.3. The Administration should take appropriate steps to ensure uniformity in the implementation and the application of the provisions of this chapter in respect of electrical installations.\*

10.1.4. Electrical equipment and wiring should not be installed in the hazardous locations referred to in 10.2, unless essential for operational purposes, when the exceptions listed in 10.2.3 are permitted.

10.1.5. Where electrical equipment is installed in hazardous locations, as permitted in this chapter, it should be to the satisfaction of the Administration and certified by the relevant authorities recognized by the Administration for operation in the flammable atmosphere concerned, as indicated in column "g" in the table of chapter 17.

10.1.6. Absence of information on temperature class and apparatus group in column "g" in the table of chapter 17 means that data are not currently available, and this should not be confused with the non-flammable (NF) notation describing some substances. For guidance, indication is given if the flashpoint of a substance is in excess of 60°C (closed cup test). In the case of heated cargo, carriage conditions might need to be established and the requirements of 10.2.2 applied.

#### 10.2. *Hazardous locations and types of equipment and wiring*

10.2.1. The restrictions in this section do not preclude the use of intrinsically safe systems and circuits in all hazardous locations including cargo piping. It is particularly recom-

\* Reference is made to the Recommendations published by the International Electrotechnical Commission and in particular to Publication 92-502.



mended that intrinsically safe systems and circuits are used for measurement, monitoring, control and communication purposes.

10.2.2. Cargoes with a flashpoint exceeding 60°C (closed cup test):

- .1 Cargo tanks and cargo piping are the only hazardous locations for such cargoes which have no qualification in column "m" in the table of chapter 17. Submerged cargo pump motors and their associated cables may, in exceptional circumstances for a specific cargo or for a clearly defined range of cargoes, be permitted by the Administration, due consideration having been given to the chemical and physical characteristics of the products. Arrangements should be made to prevent the energizing of motors and cables in flammable gas air mixtures and to de-energize the motors and cables in the event of low liquid level. Such a shutdown should be indicated by an alarm at the cargo control station.
- .2 Where electrical equipment is located in a cargo pump room, due consideration should be given to the use of types of apparatus which ensure the absence of arcs or sparks and hot spots during normal operation, or which are of a certified safe type.
- .3 Where the cargo is heated to within 15°C of its flashpoint value, the cargo pump room should be considered as a hazardous area as well as areas within 3 m of openings from tanks where the cargo is so heated, and within 3 m of the entrance or ventilation openings to cargo pump rooms. Electrical equipment installed within these locations should be of a certified safe type.
- .4 Where the cargo is heated above its flashpoint value, the requirements of 10.2.3 are applicable.

10.2.3. For cargoes with a flashpoint not exceeding 60°C (closed cup test) without qualification in column "m" in the table of chapter 17, the hazardous locations are given below. In addition to intrinsically safe systems and circuits, the only electrical installations permitted in hazardous locations are the following:

- .1 Cargo tanks and cargo piping: No additional electrical equipment is permitted.
- .2 Void spaces adjacent to, above or below integral tanks:
  - .2.1 Through runs of cables. Such cables should be installed in heavy gauge steel pipes with gastight joints. Expansion bends should not be fitted in such spaces.
  - .2.2 Electrical depth sounding or log devices and impressed current cathodic protection system anodes or electrodes. These devices should be housed in gastight enclosures; associated cables should be protected as referred to in 10.2.3.2.1.
- .3 Hold spaces containing independent cargo tanks:
  - .3.1 Through runs of cables without any additional protection.
  - .3.2 Lighting fittings with pressurized enclosure or of the flameproof type. The lighting system should be divided between at least two branch circuits. All switches and protective devices should interrupt all poles or phases and should be located in a non-hazardous location.
  - .3.3 Electrical depth sounding or log devices and impressed current cathodic protection system anodes or electrodes. These devices should be housed in gastight enclosures.
- .4 Cargo pump rooms and pump rooms in the cargo area:
  - .4.1 Lighting fittings with pressurized enclosures or of the flameproof type. The lighting system should be divided between at least two branch circuits. All switches and all protective devices should interrupt all poles or phases and should be located in a non-hazardous location.
  - .4.2 Electrical motors for driving cargo pumps and any associated auxiliary pumps should be separated from these spaces by a gastight bulkhead or deck. Flexible couplings, or other means of maintaining alignment, should be fitted to the shafts between the driven equipment and its motors, and in addition, glands should be provided to the satisfaction of the Administration where the shafts pass through the

bulkhead or deck. Such electrical motors should be located in a compartment having positive pressure ventilation.

- .4.3 Flameproof general alarm audible indicator.
- .5 Zones on open deck, or semi-enclosed spaces on open deck, within 3 m of any cargo tank outlet, gas or vapour outlet, cargo pipe flange, cargo valve or entrance and ventilation opening to cargo pump rooms; cargo area on open deck over all cargo tanks and cargo tank holds, including all ballast tanks and cofferdams within the cargo area, to the full width of the ship, plus 3 m fore and aft and up to a height of 2.4 m above the deck:
  - .5.1 Equipment of a certified safe type, adequate for open deck use;
  - .5.2 Through runs of cables.
- .6 Enclosed or semi-enclosed spaces in which pipes containing cargoes are located; enclosed or semi-enclosed spaces immediately above cargo tanks (e.g. between decks) or having bulkheads above and in line with cargo tank bulkheads; enclosed or semi-enclosed spaces immediately above cargo pump rooms or above vertical cofferdams adjoining cargo tanks, unless separated by a gastight deck and suitably ventilated; and compartments for cargo hoses:
  - .6.1 Lighting fittings of a certified safe type. The lighting system should be divided between at least two branch circuits. All switches and protective devices should interrupt all poles or phases and should be located in a non-hazardous location.
  - .6.2 Through runs of cables.
- .7 Enclosed or semi-enclosed spaces having a direct opening into any hazardous location referred to above should have electrical installations complying with the requirements for the space or zone into which the opening leads.

### 10.3. *Bonding*

Independent cargo tanks should be electrically bonded to the hull. All gasketed cargo pipe joints and hose connections should be electrically bonded.

### 10.4. *Electrical requirements for individual products*

Electrical requirements for individual products are shown in column "g" in the table of chapter 17.

## Chapter 11. FIRE PROTECTION AND FIRE EXTINCTION

### 11.1. *Application*

11.1.1. The requirements for tankers in chapter II-2 of the 1983 SOLAS amendments should apply to ships covered by the Code, irrespective of tonnage, including ships of less than 500 tons gross tonnage, except that:

- .1 Regulations 60, 61, 62 and 63 should not apply;
- .2 Regulation 56.2, i.e. the requirements for location of the main cargo control station, need not apply;
- .3 Regulation 4, as applicable to cargo ships, and regulation 7 should apply as they would apply to tankers of 2,000 tons gross tonnage and over;
- .4 The provisions of 11.3 should apply in lieu of regulation 61; and
- .5 The provisions of 11.2 should apply in lieu of regulation 63.

11.1.2. Notwithstanding the provisions of 11.1.1, 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 1983 SOLAS amendments, provided that they comply with part C of that chapter, except that regulation 53 need not apply to such ships and 11.2 and 11.3 hereunder need not apply.

## 11.2. *Cargo pump rooms*

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

- .1 A carbon dioxide system as specified in regulation II-2/5.1 and .2 of the 1983 SOLAS amendments. 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 1983 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. 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 pump room in all cases; or
- .2 A halogenated hydrocarbon system as specified in regulation II-2/5.1 and .3 of the 1983 SOLAS amendments. 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 1983 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/m <sup>3</sup>

11.2.2. Cargo pump rooms of ships which are dedicated to the carriage of a restricted number of cargoes should be protected by an appropriate fire-extinguishing system approved by the Administration.

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

## 11.3. *Cargo area\**

11.3.1. Every ship should be provided with a fixed deck foam system in accordance with the requirements of 11.3.2 to 11.3.12.

11.3.2. 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. Basic protein foams should not be used.

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

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

\* Reference is made to MSC/Circ. 314 which provides guidance for calculating the capacity of foam systems for chemical tankers and may be used in applying the requirements for extinguishing media of the Code.

11.3.5. The rate of supply of foam solution should be not less than the greatest of the following:

- .1 2 ℓ/min per square metre of the cargo tanks deck area, where cargo tanks deck area means the maximum breadth of the ship times the total longitudinal extent of the cargo tank spaces;
- .2 20 ℓ/min per square metre of the horizontal sectional area of the single tank having the largest such area;
- .3 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 tonnes deadweight, the minimum capacity of the monitor should be to the satisfaction of the Administration.

11.3.6. Sufficient foam concentrate should be supplied to ensure at least 30 min of foam generation when using the highest of the solution rates stipulated in 11.3.5.1, 11.3.5.2 and 11.3.5.3.

11.3.7. 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 11.3.5.1 or 11.3.5.2 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 entirely forward of the monitor. Such capacity should be not less than 1,250 ℓ/min. For ships of less than 4,000 tonnes deadweight, the minimum capacity of the monitor should be to the satisfaction of the Administration.

11.3.8. 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.

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

11.3.10. Applicators should be provided for flexibility of action during fire-fighting 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 tanks deck area.

11.3.11. 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.

11.3.12. 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.

11.3.13. Ships which are dedicated to the carriage of a restricted number of cargoes should be protected by alternative provisions to the satisfaction of the Administration when they are just as effective for the products concerned as the deck foam system required for the generality of flammable cargoes.

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

11.3.15. Where flammable cargoes are to be carried all sources of ignition should be excluded from hazardous locations referred to in 10.2.

11.3.16. Ships fitted with bow or stern loading and unloading arrangements should be provided with one additional foam monitor meeting the requirements of 11.3.7 and one additional applicator meeting the requirements of 11.3.10. The additional monitor should be located to protect the bow or stern loading and unloading arrangements. The area of the cargo line forward or aft of the cargo area should be protected by the above-mentioned applicator.

#### 11.4. *Special requirements*

Fire-extinguishing media considered to be suitable for certain products are listed for information in column "j" in the table of chapter 17.

### *Chapter 12. MECHANICAL VENTILATION IN THE CARGO AREA*

For ships to which the Code applies, the requirements of this chapter replace the requirements of regulation II-2/59.3 of the 1983 SOLAS amendments.

#### 12.1. *Spaces normally entered during cargo handling operations*

12.1.1. Cargo pump rooms and other enclosed spaces which contain cargo handling equipment and similar spaces in which work is performed on the cargo should be fitted with mechanical ventilation systems, capable of being controlled from outside such spaces.

12.1.2. Provision should be made to ventilate such spaces prior to entering the compartment and operating the equipment and a warning notice requiring the use of such ventilation should be placed outside the compartment.

12.1.3. Mechanical ventilation inlets and outlets should be arranged to ensure sufficient air movement through the space to avoid the accumulation of toxic or flammable vapours or both (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 pump rooms are prescribed in 15.17.

12.1.4. 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.

12.1.5. Ventilation exhaust ducts from spaces within the cargo area should discharge upwards in locations at least 10 m in the horizontal direction from ventilation intakes and openings to accommodation, service and machinery spaces and control stations and other spaces outside the cargo area.

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

12.1.7. Ventilation ducts should not be led through accommodation, service and machinery spaces or other similar spaces.

12.1.8. Electric motors driving fans should be placed outside the ventilation ducts if the carriage of flammable products is intended. Ventilation fans and fan ducts, in way of fans only, for hazardous locations referred to in chapter 10 should be of nonsparking construction defined as:

- .1 Impellers and housing of nonmetallic construction, due regard being paid to the elimination of static electricity;
- .2 Impellers and housing of nonferrous materials;
- .3 Impellers and housing of austenitic stainless steel; and
- .4 Ferrous impellers and housing with not less than 13 mm design tip clearance.

Any combination of an aluminium or magnesium alloy fixed or rotating component and a ferrous fixed or rotating component, regardless of tip clearance, is considered a sparking hazard and should not be used in these places.

12.1.9. Sufficient spare parts should be carried for each type of fan on board, required by this chapter.

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

### 12.2. *Pump rooms and other enclosed spaces normally entered*

Pump rooms and other enclosed spaces normally entered, which are not covered by 12.1.1, should be fitted with mechanical ventilation systems, capable of being controlled from outside such spaces and complying with the requirements of 12.1.3, except that the capacity should not be less than 20 changes of air per hour, based upon the total volume of the space. Provision should be made to ventilate such spaces prior to entering.

### 12.3. *Spaces not normally entered*

Double bottoms, cofferdams, duct keels, pipe tunnels, hold spaces and other spaces where cargo may accumulate, should be capable of being ventilated to ensure a safe environment when entry into the spaces is necessary. Where a permanent ventilation system is not provided for such spaces, approved means of portable mechanical ventilation should be provided. Where necessary owing to the arrangement of spaces, for instance hold spaces, essential ducting for such ventilation should be permanently installed. For permanent installations, the capacity of eight air changes per hour should be provided and for portable systems the capacity of 16 air changes per hour. Fans or blowers should be clear of personnel access openings, and should comply with 12.1.8.

## Chapter 13. INSTRUMENTATION

### 13.1. *Gauging*

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

- .1 Open device, which makes use of an opening in the tanks and may expose the gauger to the cargo or its vapour. An example of this is the ullage opening.
- .2 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.
- .3 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. Alternatively an indirect device which does not penetrate the tank shell and which is independent of the tank may be used. Examples are weighing of cargo, pipe flow meter.

13.1.2. Gauging devices should be independent of the equipment required under 15.19.

13.1.3. Open gauging and restricted gauging should be allowed only where:

- .1 Open venting is allowed by the Code; or
- .2 Means are provided for relieving tank pressure before the gauge is operated.

13.1.4. Types of gauging for individual products are shown in column "h" in the table of chapter 17.

### 13.2. *Vapour detection*

13.2.1. Ships carrying toxic or flammable products or both 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.

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

13.2.3. When toxic vapour detection equipment is not available for some products which require such detection, as indicated in column "i" in the table of chapter 17, the Administration may exempt the ship from the requirement, provided an appropriate entry is made on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk. When

granting such an exemption, the Administration should recognize the necessity for additional breathing air supply and an entry should be made on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk drawing attention to the provisions of 14.2.4 and 16.4.2.2.

13.2.4. Vapour detection requirements for individual products are shown in column "i" in the table of chapter 17.

#### Chapter 14. PERSONNEL PROTECTION

##### 14.1. *Protective equipment*

14.1.1. 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 or face shields or both. The protective clothing and equipment should cover all skin so that no part of the body is unprotected.

14.1.2. 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, dining rooms, bathrooms, etc.

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

##### 14.2. *Safety equipment*

14.2.1. Ships carrying cargoes for which 15.12, 15.12.1 or 15.12.3 is listed in column "m" in the table of chapter 17 should have on board sufficient but not less than three complete sets of safety equipment each permitting personnel to enter a gas-filled compartment and perform work there for at least 20 min. Such equipment should be in addition to that required by regulation II-2/17 of the 1983 SOLAS amendments.

14.2.2. One complete set of safety equipment should consist of:

- .1 One self-contained air-breathing apparatus (not using stored oxygen);
- .2 Protective clothing, boots, gloves and tight-fitting goggles;
- .3 Fireproof lifeline with belt resistant to the cargoes carried; and
- .4 Explosion-proof lamp.

14.2.3. For the safety equipment required in 14.2.1, all ships should carry the following, either:

- .1 One set of fully charged spare air bottles for each breathing apparatus;
- .2 A special air compressor suitable for the supply of high-pressure air of the required purity;
- .3 A charging manifold capable of dealing with sufficient spare breathing apparatus air bottles for the breathing apparatus; or
- .4 Fully charged spare air bottles with a total free air capacity of at least 6,000 l for each breathing apparatus on board in excess of the requirements of regulation II-2/17 of the 1983 SOLAS amendments.

14.2.4. A cargo pump room of ships carrying cargoes which are subject to the requirements of 15.18 or cargoes for which in column "j" in the table of chapter 17 toxic vapour detection equipment is required but is not available should have either:

- .1 A low-pressure line system with hose connections suitable for use with the breathing apparatus required by 14.2.1. This system should provide sufficient high-pressure air capacity

to supply, through pressure reduction devices, enough low-pressure air to enable two men to work in a gas-dangerous space for at least 1 h without using the air bottles of the breathing apparatus. Means should be provided for recharging the fixed air bottles and breathing apparatus air bottles from a special air compressor suitable for the supply of high-pressure air of the required purity; or

.2 An equivalent quantity of spare bottled air in lieu of the low-pressure air line.

14.2.5. At least one set of safety equipment as required by 14.2.2 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 suitable, clearly marked, easily accessible, places.

14.2.6. The breathing apparatus should be inspected at least once a month by a responsible officer, and the inspection recorded in the ship's log-book. The equipment should be inspected and tested by an expert at least once a year.

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

14.2.8. Ships intended for the carriage of certain cargoes should be provided with suitable respiratory and eye protection sufficient for every person on board for emergency escape purposes, subject to the following:

- .1 Filter-type respiratory protection should be accepted only when one filter is suitable for all designated cargoes that the ship is certified to carry;
- .2 Self-contained breathing apparatus should have normally at least a duration of service of 15 min;
- .3 Emergency escape respiratory protection should not be used for firefighting or cargo handling purposes and should be marked to that effect.

Individual cargoes to which the provisions of this paragraph apply are indicated in column "I" in the table of chapter 17.

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

14.2.10. 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.

### Chapter 15. SPECIAL REQUIREMENTS

The provisions of this chapter are applicable where specific reference is made in column "m" in the table of chapter 17. These requirements are additional to the general requirements of the Code.

#### 15.1. Acetone cyanohydrin

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

- .1 Name and amount of stabilizer added;
- .2 Date stabilizer was added and duration of effectiveness;
- .3 Any temperature limitations qualifying the stabilizer's effective lifetime;
- .4 The action to be taken should the length of voyage exceed the effective lifetime of the stabilizer.



15.2. *Ammonium nitrate solution, 93% or less*

15.2.1. The ammonium nitrate solution should contain at least 7% by weight of water. The acidity (pH) of the cargo when diluted with ten 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.

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

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

15.2.4. 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.

15.2.5. If the bulk mean cargo temperature reaches 145°C, a cargo sample should be diluted with ten parts of distilled or demineralized water to one part of cargo by weight and the acidity (pH) should be determined by means of a narrow range indicator paper or stick. Acidity (pH) measurements should then be taken every 24 h. If the acidity (pH) is found to be below 4.2, ammonia gas should be injected into the cargo until the acidity (pH) of 5.0 is reached.

15.2.6. 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 tonnes of ammonium nitrate solution should be available on board.

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

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

15.2.9. 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.

15.3. *Carbon disulphide*

15.3.1. Provision 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.

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

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

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

15.3.5. Cargo piping and vent lines should be independent of piping and vent lines used for other cargo.

15.3.6. Pumps may be used for discharging cargo, provided they are of the deepwell or hydraulically driven 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.

15.3.7. 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 water pad should be formed in this well before attempting pump removal unless the tank has been certified as gas-free.

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

15.3.9. Safety relief valves should be of stainless steel construction.

15.3.10. Because of its low ignition temperature and close clearances required to arrest its flame propagation, only intrinsically safe systems and circuits are permitted in the hazardous locations described in 10.2.3.

#### 15.4. *Diethyl ether*

15.4.1. 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 nonsparking construction. Mechanical ventilation equipment should not be located in the void spaces surrounding the cargo tanks.

15.4.2. Pressure relief valve settings should not be less than 0.2 bar gauge for gravity tanks.

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

15.4.4. In view of the fire hazard, provision should be made to avoid any ignition source or heat generation or both in the cargo area.

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

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

#### 15.5. *Hydrogen peroxide solutions over 60% but not over 70%*

15.5.1. Hydrogen peroxide solutions should be carried in dedicated ships only and no other cargoes should be carried.

15.5.2. Cargo tanks and associated equipment should be either pure aluminium (99.5%) or solid stainless steel (304L, 316, 316L or 316Ti), 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.

15.5.3. Pump rooms should not be used for cargo transfer operations.

15.5.4. Cargo tanks should be separated by cofferdams from oil fuel tanks or any other space containing flammable or combustible materials.

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

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

15.5.7. 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 be activated if the oxygen concentration in these void spaces exceeds 30% by volume. Two portable oxygen monitors should also be available as back-up systems.

15.5.8. 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 per hour over a 5 h period or when the temperature in the tank exceeds 40°C.

15.5.9. 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.

15.5.10. A fixed water-spray system should be provided for diluting and washing away any concentrated hydrogen peroxide 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 solutions. The minimum application rate should satisfy the following criteria:

- .1 The product should be diluted from the original concentration to 35% by weight within 5 min of the spill.
- .2 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 overflow 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.

15.5.11. Hydrogen peroxide solutions should be stabilized to prevent decomposition. A certificate of stabilization should be provided by the manufacturer, and kept on board, specifying:

- .1 Name and amount of stabilizer added;
- .2 Date stabilizer was added and duration of effectiveness;
- .3 Any temperature limitations qualifying the stabilizer's effective lifetime;
- .4 The action to be taken should the length of voyage exceed the effective lifetime of the stabilizer.

15.5.12. Only those hydrogen peroxide solutions which have a maximum decomposition rate of 1% 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 peroxide. He should certify to the master that the cargo has been loaded in a stable condition.

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

#### 15.6. *Motor fuel anti-knock compounds (containing lead alkyls)*

15.6.1. 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.

15.6.2. If a cargo pump room is located on deck level according to 15.18, the ventilation arrangements should be in compliance with 15.17.

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

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

### 15.7. *Phosphorus, yellow or white*

15.7.1. 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.

15.7.2. 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, relative density and method of loading and discharge of the phosphorus.

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

15.7.4. 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.

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

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

15.7.7. 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.

15.7.8. 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.

15.7.9. Void spaces referred to in 15.7.8 should be provided with effective means of mechanical ventilation which should be capable of being sealed off quickly in an emergency.

15.7.10. 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.

15.7.11. 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.

15.7.12. Ship-to-shore loading and discharge connections should be of a type approved by the Administration.

### 15.8. *Propylene oxide*

15.8.1. Propylene oxide transported under the provisions of this section should be acetylene-free.

15.8.2. Unless cargo tanks are properly cleaned, propylene oxide should not be carried in tanks which have contained as one of the three previous cargoes any product known to catalyse polymerization, such as:

- .1 Mineral acids (e.g. sulphuric, hydrochloric, nitric);
- .2 Carboxylic acids and anhydrides (e.g. formic, acetic);
- .3 Halogenated carboxylic acids (e.g. chloroacetic);
- .4 Sulphonic acids (e.g. benzene sulphonic);
- .5 Caustic alkalis (e.g. sodium hydroxide, potassium hydroxide);
- .6 Ammonia and ammonia solutions;
- .7 Amines and amine solutions;
- .8 Oxidizing substances.

15.8.3. Before carrying propylene oxide, tanks should be thoroughly and effectively cleaned to remove all traces of previous cargoes from tanks and associated pipework, except where the immediate prior cargo has been propylene oxide. Particular care should be taken in the case of ammonia in tanks made of steel other than stainless steel.

15.8.4. 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 materials remain that might create a hazardous situation in the presence of propylene oxide.

15.8.5. Tanks should be entered and inspected prior to each initial loading of propylene oxide to ensure freedom from contamination, heavy rust deposits and visible structural defects. When cargo tanks are in continuous propylene oxide service, such inspections should be performed at intervals of not more than 2 years.

15.8.6. Tanks for the carriage of propylene oxide should be of steel or stainless steel construction. Suitable tank coatings may be accepted as such by the Administration and noted on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.

15.8.7. Tanks which have contained propylene oxide may be used for other cargoes after thorough cleaning of tanks and associated pipework systems by washing or purging.

15.8.8. All valves, flanges, fittings and accessory equipment should be of a type suitable for use with propylene oxide 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.

15.8.9. Gaskets should be constructed of materials which do not react with, dissolve in, or lower the autoignition temperature of propylene oxide 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.

15.8.10. Insulation and packing, if used, should be of a material which does not react with, dissolve in, or lower the autoignition temperature of propylene oxide.

15.8.11. The following materials are generally found unsatisfactory for gaskets, packing and similar uses in propylene oxide containment systems and would require testing before being approved by the Administration:

- .1 Neoprene or natural rubber, if it comes into contact with propylene oxide;
- .2 Asbestos, or binders used with asbestos;
- .3 Materials containing oxides of magnesium, such as mineral wools.

15.8.12. Threaded joints should not be permitted in the cargo liquid and vapour lines.

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

15.8.14. The containment system for a tank containing propylene oxide should have a valved vapour return connection.

15.8.15. Propylene oxide 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 propylene oxide containment system should be independent of all other containment systems.

15.8.16. During discharging operations, the pressure in the cargo tank should be maintained above 0.07 bar gauge.

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

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

15.8.19. Cargo hoses used for transfer of propylene oxide should be marked "FOR PROPYLENE OXIDE TRANSFER ONLY".

15.8.20. Cargo tanks, void spaces and other enclosed spaces, adjacent to an integral gravity cargo tank, should either contain a compatible cargo (those cargoes specified in 15.8.2 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 propylene oxide and oxygen. Portable sampling equipment is satisfactory. The oxygen content of these spaces should be maintained below 2%.

15.8.21. In no case should air be allowed to enter the cargo pump or piping system while propylene oxide is contained within the system.

15.8.22. 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.

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

15.8.24. Cargo tanks with a design pressure less than 0.6 bar gauge should have a cooling system to maintain the propylene oxide below the reference temperature. Reference temperature (R) means, in the case of propylene oxide, the temperature corresponding to the vapour pressure of the propylene oxide at the set pressure of the pressure relief valve.

15.8.25. The refrigeration requirement for tanks with a design pressure less than 0.6 bar gauge may be waived by the Administration if the ship is operating in restricted areas or in 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 carriage on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.

15.8.26. 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 (R).

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

15.8.28. Cooling media which are separated from propylene oxide by a single wall only should be nonreactive with the propylene oxide.

15.8.29. Cooling systems requiring compression of propylene oxide should not be used.

15.8.30. Pressure relief valve settings should not be less than 0.2 bar gauge, or greater than 7.0 bar gauge, for pressure tanks.

15.8.31. The piping system for tanks to be loaded with propylene oxide should be separate (as defined in 1.3.24) from piping systems for all other tanks, including empty tanks. If the

pipng system for the tanks to be loaded is not independent (as defined in 1.3.15), 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.

15.8.32. Propylene oxide 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 International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk should be endorsed to include reference to the approved cargo handling plans.

15.8.33. Before each loading of propylene oxide, certification verifying that the required piping separation has been achieved should be obtained from a responsible person acceptable to the port Administration and should be 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.

15.8.34.1. No cargo tanks should be more than 98% liquid full at the reference temperature (R).

15.8.34.2. The maximum volume ( $V_L$ ) of cargo to be loaded in a tank should be:

$$V_L = 0.98 V \frac{\rho_R}{\rho_L}$$

where: V = volume of the tank

$\rho_R$  = relative density of cargo at the reference temperature (R)

$\rho_L$  = relative density of cargo at the loading temperature

R = reference temperature corresponding to the vapor pressure of the cargo at the set pressure of the pressure relief valve.

15.8.34.3. 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.

15.8.35. 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 bar 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.

15.8.36. 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.

15.8.37. 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/min per square metre. 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. 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.

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

15.9. *Sodium chlorate solution, 50% or less*

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

15.9.2. 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.

15.10. *Sulphur liquid*

15.10.1. Cargo tank ventilation should be provided to maintain the concentration of hydrogen sulphide 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.

15.10.2. 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.

15.10.3. Ventilation systems should be so designed and arranged as to preclude depositing of sulphur within the system.

15.10.4. Openings to void spaces adjacent to cargo tanks should be so designed and fitted as to prevent the entry of water, sulphur or cargo vapour.

15.10.5. Connections should be provided to permit sampling and analysing of vapour in void spaces.

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

15.11. *Acids*

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

15.11.2. Proposals for lining 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.

15.11.3. 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.

15.11.4. 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 also be provided to guard against leakage on to the deck.

15.11.5. Because of the danger of evolution of hydrogen when these substances are being carried, the electrical arrangements should comply with 10.2.3.1, 10.2.3.2, 10.2.3.3, 10.2.3.4, 10.2.3.6 and 10.2.3.7. The certified safe type equipment should be suitable for use in hydrogen-air mixtures. Other sources of ignition should not be permitted in such spaces.

15.11.6. Substances subjected to the requirements of this section should be segregated from oil fuel tanks, in addition to the segregation requirements in 3.1.1.

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

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

15.12. *Toxic products*

15.12.1. Exhaust openings of tank vent systems should be located:

- .1 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;
- .2 Not less than 6 m above the fore and aft gangway, if fitted within 6 m of the gangway; and



- .3 15 m from any opening or air intake to any accommodation and service spaces;
- .4 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.

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

15.12.3. Products should:

- .1 Not be stowed adjacent to oil fuel tanks;
- .2 Have separate piping systems; and
- .3 Have tank vent systems separate from tanks containing nontoxic products.

(See also 3.7.2.)

15.12.4. Cargo tank relief valve settings should be a minimum of 0.2 bar gauge.

15.13. *Cargoes inhibited against self-reaction*

15.13.1. Certain cargoes, with a reference in column "m" in the table of chapter 17, by the nature of their chemical make-up tend to polymerize under certain conditions of temperature, exposure to air or contact with a catalyst. Mitigation of this tendency is carried out by introducing small amounts of chemical inhibitors into the liquid cargo or controlling the cargo tank environment.

15.13.2. 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.

15.13.3. Care should be taken to ensure that these cargoes are sufficiently inhibited to prevent polymerization at all times during the voyage. Ships carrying such cargoes should be provided with a certificate of inhibition from the manufacturer, and kept during the voyage, specifying:

- .1 Name and amount of inhibitor added;
- .2 Date inhibitor was added and duration of effectiveness;
- .3 Any temperature limitations qualifying the inhibitor's effective lifetime;
- .4 The action to be taken should the length of voyage exceed the effective lifetime of the inhibitor.

15.13.4. Ships using the exclusion of air as the method of preventing self-reaction of the cargo should comply with 9.1.3.

15.13.5. 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.

15.13.6. 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.

15.14. *Cargoes with a vapour pressure greater than 1.013 bar absolute at 37.8° C*

15.14.1. For a cargo referenced in column "m" in the table of chapter 17 to this section, a mechanical refrigeration system should be provided unless the cargo system is designed to with-

stand the vapour pressure of the cargo at 45°C. Where the cargo system is designed to withstand the vapour pressure of the cargo at 45°C, and no refrigeration system is provided, a notation should be made in the conditions of carriage on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk to indicate the required relief valve setting for the tanks.

15.14.2. A mechanical refrigeration system should maintain the liquid temperature below the boiling temperature at the cargo tank design pressure.

15.14.3. When ships operate in restricted areas and at restricted times of the year, or on voyages of limited duration, the Administration involved may agree to waive requirements for a refrigeration system. A notation of any such agreement, listing geographic area restrictions and times of the year, or voyage duration limitations, should be included in the conditions of carriage on the International Certificate for the Carriage of Dangerous Chemicals in Bulk.

15.14.4. Connections should be provided for returning expelled gases to shore during loading.

15.14.5. Each tank should be provided with a pressure gauge which indicates the pressure in the vapour space above the cargo.

15.14.6. Where the cargo needs to be cooled, the thermometers should be provided at the top and bottom of each tank.

15.14.7.1. No cargo tanks should be more than 98% liquid full at the reference temperature (R).

15.14.7.2. The maximum volume ( $V_L$ ) of cargo to be loaded in a tank should be:

$$V_L = 0.98 V \frac{\rho_R}{\rho_L}$$

where  $V$  = volume of the tank

$\rho_R$  = relative density of cargo at the reference temperature (R)

$\rho_L$  = relative density of cargo at the loading temperature

R = reference temperature corresponding to the vapour pressure of the cargo at the set pressure of the pressure relief valve.

15.14.7.3. 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 approved by the Administration. A copy of the list should be permanently kept on board by the master.

#### 15.15. *Cargoes with low ignition temperature and wide flammability range*

For ships carrying such cargoes, the distance requirements of 10.2.3.5 should be increased to at least 4.5 m.

#### 15.16. *Cargo contamination*

15.16.1. Where column "m" in the table of chapter 17 refers to this section, alkaline or acidic materials, such as caustic soda or sulphuric acid, should not be allowed to contaminate the cargo.

15.16.2. Where column "m" in the table of chapter 17 refers to this section, water should not be allowed to contaminate this cargo. In addition, the following provisions apply:

- .1 Air inlets to pressure/vacuum relief valves of tanks containing the cargo should be situated at least 2 m above the weather deck.
- .2 Water or steam should not be used as the heat transfer media in a cargo temperature control system required by chapter 7.
- .3 The cargo should not be carried in cargo tanks adjacent to permanent ballast or water tanks unless the tanks are empty and dry.

- .4 The cargo should not be carried in tanks adjacent to slop tanks or 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 the cargo. Pipelines from slop tanks or ballast lines should not pass through tanks containing the cargo unless encased in a tunnel.

15.17. *Increased ventilation requirements*

For certain products, the ventilation system as described in 12.1.3 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, work areas or other similar spaces, and intakes to ventilation systems, and at least 4 m above the tank deck.

15.18. *Special cargo pump room requirements*

For certain products, the cargo pump room should be located on the deck level or cargo pumps should be located in the cargo tank. The Administration may give special consideration to cargo pump rooms below deck.

15.19. *Overflow control*

15.19.1. The provisions of this section are applicable where specific reference is made in column "m" in the table of chapter 17, and are in addition to the requirements for gauging devices.

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

15.19.3. Loading operations should be terminated at once in the event of any system essential for safe loading becoming inoperative.

15.19.4. Level alarms should be capable of being tested prior to loading.

15.19.5. The high-level alarm system required under 15.19.6 should be independent of the overflow control system required by 15.19.7 and should be independent of the equipment required by 13.1.

15.19.6. Cargo tanks should be fitted with a visual and audible high-level alarm which complies with 15.19.1 to 15.19.5 and which indicates when the liquid level in the cargo tank approaches the normal full condition.

15.19.7. A tank overflow control system required by this section should:

- .1 Come into operation when the normal tank loading procedures fail to stop the tank liquid level exceeding the normal full condition;
- .2 Give a visual and audible tank overflow alarm to the ship's operator; and
- .3 Provide an agreed signal for sequential shutdown of onshore pumps or valves or both and of the ship's valves. The signal, as well as the pump and valve shutdown, may be dependent on operator's intervention. The use of shipboard automatic closing valves should be permitted only when specific approval has been obtained from the Administration and the port Administrations concerned.

15.19.8. The loading rate (LR) of the tank should not exceed:

$$LR = \frac{3600 U}{t} \text{ (m}^3\text{/h)}$$

where U = ullage volume (m<sup>3</sup>) at operating signal level;

t = time (s) needed from the initiating signal to fully stopping the cargo flow into the tank, being the sum of times needed for each step in sequential operations such as operator's responses to signals, stopping pumps and closing valves;

and should also take into account the pipeline system design pressure.

*Chapter 16. OPERATIONAL REQUIREMENTS\**

16.1. *Maximum allowable quantity of cargo per tank*

16.1.1. The quantity of a cargo required to be carried in a type 1 ship should not exceed 1,250 m<sup>3</sup> in any one tank.

16.1.2. The quantity of a cargo required to be carried in a type 2 ship should not exceed 3,000 m<sup>3</sup> in any one tank.

16.1.3. 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.

16.2. *Cargo information*

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

16.2.2. Any cargo offered for bulk shipment should be indicated in the shipping documents by the correct technical name. Where the cargo is a mixture, an analysis indicating the dangerous components contributing significantly to the total hazard of the product should be provided, or a complete analysis if this is available. Such an analysis should be certified by the manufacturer or by an independent expert acceptable to the Administration.

16.2.3. 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:

- .1 A full description of the physical and chemical properties, including reactivity necessary for the safe containment of the cargo;
- .2 Action to be taken in the event of spills or leaks;
- .3 Counter-measures against accidental personal contact;
- .4 Fire-fighting procedures and fire-fighting media;
- .5 Procedures for cargo transfer, tank cleaning, gas-freeing and ballasting;
- .6 For those cargoes required to be stabilized or inhibited in accordance with 15.1, 15.5.11 or 15.13.3, the cargo should be refused if the certificate required by these paragraphs is not supplied.

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

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

16.3. *Personnel training\*\**

16.3.1. 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.

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\* Attention is also drawn to the operation guidelines contained in the ICS Tanker Safety Guide (Chemicals).

\*\* Reference is made to the provisions of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978<sup>1</sup> and in particular to the "Mandatory minimum requirements for the training and qualifications of masters, officers and ratings of chemical tankers" — regulation V/2, chapter V of the Annex to that Convention and to resolution 11 of the International Conference on Training and Certification of Seafarers, 1978.

<sup>1</sup> United Nations, *Treaty Series*, vol. 1361, p. 2 (authentic Chinese and English texts), and vol. 1362, p. 2 (authentic French, Russian and Spanish texts).

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

16.3.3. 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.

16.4. *Opening of and entry into cargo tanks*

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

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

- .1 The compartment is free of toxic vapours and not deficient in oxygen; or
- .2 Personnel wear breathing apparatus and other necessary protective equipment, and the entire operation is under the close supervision of a responsible officer.

16.4.3. 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.

16.5. *Stowage of cargo samples*

16.5.1. Samples which have to be kept on board should be stowed in a designated space situated in the cargo area or, exceptionally, elsewhere, subject to the approval of the Administration.

16.5.2. The stowage space should be:

- .1 Cell-divided in order to avoid shifting of the bottles at sea;
- .2 Made of material fully resistant to the different liquids intended to be stowed; and
- .3 Equipped with adequate ventilation arrangements.

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

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

16.6. *Cargoes not to be exposed to excessive heat*

16.6.1. Where the possibility exists of a dangerous reaction of a 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, such cargo should be loaded and carried adequately segregated from other products whose temperature is sufficiently high to initiate a reaction of such cargo (see 7.1.5.4).

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

16.6.3. Heat-sensitive products should not be carried in deck tanks which are not insulated.

16.7. *Additional operational requirements*

The code contains additional operational requirements in:

3.1.1	15.3.8	15.8.28
3.1.2.1	15.4.6	15.8.29
3.1.2.2	15.5	15.8.31
3.1.4	15.6.1	15.8.32
3.5.2	15.6.3	15.8.33
3.7.4	15.6.4	15.8.34.1
7.1.2	15.7.1	15.8.34.2
7.1.6.3	15.7.6	15.8.34.3
9.1.4	15.7.11	15.8.35
9.2	15.8.1	15.8.36
11.3.2	15.8.2	15.8.37
11.4	15.8.3	15.9
12.1.2	15.8.4	15.10.1
12.2	15.8.5	15.11.4
13.2.1	15.8.7	15.11.6
13.2.2	15.8.15	15.12.3.1
13.2.3	15.8.16	15.13
13.2.4	15.8.17	15.14.7.1
Ch.14	15.8.19	15.14.7.2
15.1	15.8.20	15.14.7.3
15.3.1	15.8.21	15.16
15.3.7	15.8.22	15.19.8

### Chapter 17. SUMMARY OF MINIMUM REQUIREMENTS

#### *Explanatory notes*

Product name (column a)	The product names are not always identical with those given in the Bulk Chemical Code, as amended (adopted by resolution A.212 (VII)). (For explanation see index of chemicals.)
UN number (column b)	The number relating to each product shown in the recommendations proposed by the United Nations Committee of Experts on the Transport of Dangerous Goods. UN numbers, where available, are given for information only.
Ship type (column c)	1 = ship type 1 (2.1.1) 2 = ship type 2 (2.1.2) 3 = ship type 3 (2.1.2)
Tank type (column d)	1 = independent tank (4.1.1) 2 = integral tank (4.1.2) G = gravity tank (4.1.3) P = pressure tank (4.1.4)
Tank vents (column e)	Open: open venting Cont: controlled venting SR: safety relief valve

Tank environmental control* (column f)	Inert: inerting (9.1.2.1) Pad: liquid or gas (9.1.2.2) Dry: drying (9.1.2.3) Vent: natural or forced (9.1.2.4)
Electrical equipment (column g)	T1 to T6: temperature classes** IIA, IIB or IIC: apparatus groups** NF: nonflammable product (10.1.6) Yes: flashpoint exceeding 60°C (closed cup test) (10.1.6)
Gauging (column h)	O: open gauging (13.1.1.1) R: restricted gauging (13.1.1.2) C: closed gauging (13.1.1.3) I: indirect gauging (13.1.1.3)
Vapour detection* (column i)	F: flammable vapours T: toxic vapours
Fire protection (column j)	A: alcohol-resistant foam B: regular foam, encompasses all foams that are not of an alcohol-resistant type, including fluoroprotein and aqueous-film-forming foam (AFFF) C: water-spray D: dry chemical No: no special requirements under this Code
Materials of construction (column k)	N: see 6.2.2 Z: see 6.2.3 Y: see 6.2.4. A blank indicates no special guidance given for materials of construction
Respiratory and eye protection* (column l)	E: see 14.2.8

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\* "No" indicates nil requirements.

\*\* Temperature classes and apparatus groups as defined in International Electrotechnical Commission Publication 79 (Part 1, Appendix D, Parts 4, 8 and 12). A blank indicates that data are currently not available.

Product name	a	b	c	d	e	f	g		h	i	j	k	l	m
							Class	Group						
		UN number	Ship type	Tank type	Tank vents	environmental control	Electrical Equipment	Flash-point >60° C	Causing detection	Vapour detection	Fire protection	Materials of construction	Respiratory and eye protection	Special requirements
Acetic acid		2789	3	2G	Cont.	No	T1 I1A	No	R	F	A	Y1,Z	E	15.11.2 to 15.11.4, 15.11.6 to 15.11.8
Acetic anhydride		1715	2	2G	Cont.	No	T2 I1A	No	R	F-T	A	Y1	E	15.11.2 to 15.11.4, 15.11.6 to 15.11.8
Acetone cyanohydrin		1541	2	2G	Cont.	No	T1 I1A	Yes	C	T	A	Y1	E	15.1, 15.12, 15.17, 15.18, 15.19, 16.6
Acetonitrile		1648	2	2G	Cont.	No	T2 I1A	No	R	F-T	A		No	15.12
Acrylamide solution, 50% or less			2	2G	Open	No	NF		C	No	No		No	15.12.3, 15.13, 15.16.1, 15.19.6, 16.6.1
Acrylic acid		2218	3	2G	Cont.	No	T2 I1A	No	R	F-T	A	Y1	No	15.13, 16.6.1
Acrylonitrile		1093	2	2G	Cont.	No	T1 I1B	No	C	F-T	A	N3,Z	E	15.12, 15.13, 15.17, 15.19
Adiponitrile		2205	3	2G	Cont.	No	I1B	Yes	R	T	A		No	
Alkyl benzene sulphonic acid		2584												
Allyl alcohol		2586	3	2G	Open	No		Yes	O	No	B		No	
Allyl chloride		1098	2	2G	Cont.	No	T2 I1B	No	C	F-T	A		E	15.12, 15.17, 15.19
2-(2-Aminoethoxy)-ethanol		1100	2	2G	Cont.	No	T2 I1A	No	C	F-T	A		E	15.12, 15.17, 15.19
Aminoethyl ethanolamine		3	2G	Open	No	No		Yes	O	No	A,C,D	N2	No	15.19.6
Aminoethyl ethanolamine		3	2G	Open	No	No	T2 I1A	Yes	O	No	A	N1	No	
N-Aminoethyl piperazine		2815	3	2G	Cont.	No		Yes	R	T	A,C,D	N2	No	15.19.6
Ammonia aqueous, 28% or less		2672	3	2G	Cont.	No	NF		R	T	C	N4	Ea	
Ammonium nitrate solution, 93% or less		2426	2	1G	Open	No	NF		O	No	No	Y4	No	15.2, 15.11.4, 15.11.6, 15.18, 15.19.6
Aniline		1547	2	2G	Cont.	No	T1 I1A	Yes	C	T	A		No	15.12, 15.17, 15.19
Benzene and mixtures having 10% benzene content or more		1114	3	2G	Cont.	No	T1 I1A	No	R	F-T	B		No	15.12.1, 15.17





a Product name	b UN number	c Ship type	d Tank type	e Tank vents	f Tank environ- mental control	g Electrical Equipment		h Flash- point > 60°C	i Gauging detection	j Vapour protection	k Fire protection	l Materials of construction	m Respiratory and eye protection	n Special requirements
						Class	Group							
Crotonaldehyde	1143	2	2G	Cont.	No	T3	I1B	No	R	F-T	A		E	15.12, 15.16.1, 15.17
Cyclohexanone	1915	3	2G	Cont.	No	T2	I1A	No	R	F-T	A	N5	No	
Cyclohexylamine	2357	3	2G	Cont.	No	T3	I1A	No	R	F-T	A,D	N1	No	
Decyl acrylate		3	2G	Open	No	T3	I1A	Yes	O	No	A,C,D	N2	No	15.13, 16.6.1, 16.6.2
Dibutylamine	2248	3	2G	Cont.	No	T2	I1A	No	R	F-T	B,D	N4	No	
o-Dichlorobenzene	1591	3	2G	Cont.	No	T1	I1A	Yes	R	T	B,D	N5	No	
1,1-Dichloroethane	2362	3	2G	Cont.	No	T2	I1A	No	R	F-T	B		E	
Dichloroethyl ether	1916	2	2G	Cont.	No	T2	I1A	No	R	F-T	A	N5	No	
2,2-Dichloroisopropyl ether	2490	2	2G	Cont.	No	T2	I1A	Yes	R	T	B,C,D	N5	No	15.12, 15.17, 15.19
2,4-Dichlorophenol	2021	3	2G	Cont.	Dry			Yes	R	T	B,C,D	N1	No	15.19.6
1,2-Dichloropropane	1279	2	2G	Cont.	No	T1	I1A	No	R	F-T	B	Z	No	15.12
1,3-Dichloropropane		2	2G	Cont.	No	T1	I1A	No	R	F-T	B		No	15.12
Dichloropropene/Di-chloropropane mix- tures		2	2G	Cont.	No			No	C	F-T	B,C,D		E	15.12, 15.17, 15.18, 15.19
1,3-Dichloropropene	2047	2	2G	Cont.	No	T2	I1A	No	C	F-T	B		E	15.12, 15.17, 15.18, 15.19
2,2-Dichloropropionic acid		3	2G	Cont.	Dry			Yes	R	No	A	Y5	No	15.11.2, 15.11.4, 15.11.6, 15.11.8
Diethanolamine		3	2G	Open	No	T1	I1A	Yes	O	No	A	N2	No	
Diethylamine	1154	3	2G	Cont.	No	T2	I1A	No	R	F-T	A	N1	E	15.12
Diethylenetriamine	2079	3	2G	Open	No	T2	I1A	Yes	O	No	A	N2	No	
Diethyl ethanolamine	2686	3	2G	Cont.	No	T2	I1A	No	R	F-T	A,D	N1	No	
Diethyl ether	1155	2	1G	Cont.	Inert	T4	I1B	No	C	F-T	A	N7	E	15.4, 15.14, 15.15, 15.19
Di-(2-ethylhexyl) phos- phoric acid	1902	3	2G	Open	No			Yes	O	No	B,C,D	N2	No	
Diethyl sulphate	1594	2	2G	Cont.	No			Yes	C	T	A,D	N3	No	15.19.6
Diisobutylamine	2361	2	2G	Cont.	No			No	R	F-T	B,D	N1	No	15.12.3, 15.19.6
Diisopropanolamine		3	2G	Open	No	T2	I1A	Yes	O	No	A	N2	No	

Diisopropylamine	1158	2	2G	Cont.	No	T2	I1A	No	C	F-T	A	N2	E	15.12, 15.19
Dimethylamine aqueous, 45% or less	1160	3	2G	Cont.	No	T2	I1A	No	R	F-T	C,D	N1	E	15.12
Dimethylamine aqueous greater than 45% but not greater than 55%	1160	2	2G	Cont.	No			No	C	F-T	A,C,D	N1	E	15.12, 15.17, 15.19
Dimethylamine aqueous greater than 55% but not greater than 65%	1160	2	2G	Cont.	No			No	C	F-T	A,C,D	N1	E	15.12, 15.14, 15.17, 15.19
<i>N,N</i> -Dimethylcyclohexylamine	2264	2	2G	Cont.	No			No	R	F-T	A,C	N1	No	15.12, 15.17, 15.19.6
Dimethylethanolamine	2051	3	2G	Cont.	No	T3	I1A	No	R	F-T	A,D	N2	No	
Dimethylformamide	2265	3	2G	Cont.	No	T2	I1A	No	R	F-T	A,D		No	15.12, 15.19
1,4-Dioxane	1165	2	2G	Cont.	No	T4	I1B	No	C	F-T	A	N5	No	15.12, 15.16.2, 15.17, 15.19.6
Diphenylmethane diisocyanate	2489	2	2G	Cont.	Dry			No <sup>b</sup>	C	T <sup>b</sup>	C,D		No	15.12, 15.16.2, 15.17, 15.19.6
<i>Di-n</i> -propylamine	2383	3	2G	Cont.	No			No	R	F-T	A	N2	No	15.12.3, 15.19.6
Dodecyl diphenyl oxide disulphonate solution		3	2G	Open	No		NF		O	No	No		No	
Dodecyl methacrylate		3	2G	Open	No			Yes	O	No	A,C		No	15.13
Dodecyl-Pentadecyl methacrylate mixture		3	2G	Open	No			Yes	O	No	A,C,D		No	15.13, 16.6.1, 16.6.2
Epichlorohydrin	2023	2	2G	Cont.	No		I1B	No	C	F-T	A		E	15.12, 15.17, 15.19
Ethyl acrylate	1917	2	2G	Cont.	No	T2	I1B	No	R	F-T	A		E	15.13, 16.6.1, 16.6.2
<i>N</i> -Ethylbutylamine		3	2G	Cont.	No			No	R	F-T	A	N1	No	15.12.3, 15.19.6
<i>N</i> -Ethylcyclohexylamine		3	2G	Cont.	No			No	R	F-T	A,C	N1	No	15.19.6
Ethylene chlorohydrin	1135	2	2G	Cont.	No	T2	I1A	No	C	F-T	D		E	15.12, 15.17, 15.19
Ethylene cyanohydrin		3	2G	Open	No		I1B	Yes	O	No	A		No	
Ethylenediamine	1604	2	2G	Cont.	No	T2	I1A	No	R	F-T	A	N2	No	
Ethylene dibromide	1605	2	2G	Cont.	No		NF		C	T	No		E	15.12, 15.19.6
Ethylene dichloride	1184	2	2G	Cont.	No	T2	I1A	No	R	F-T	B	N4	No	15.19
2-Ethylhexyl acrylate		3	2G	Open	No	T3	I1B	Yes	O	No	A		No	15.13, 16.6.1, 16.6.2
2-Ethylhexylamine	2276	2	2G	Cont.	No			No	R	F-T	A	N2	No	15.12
Ethylidene norbornene		3	2G	Cont.	No			No	R	F-T	B,C,D	N4	No	15.12.1, 15.16.1, 15.19.6

a Product name	b UN number	c Ship type	d Tank type	e Tank venti- lation	f Tank environ- mental control	g Electrical Equipment		h Flash- point >60°C	i Vapour detection	j Fire protection	k Materials of construction	l Respiratory and eye protection	m Special requirements
						Class	Group						
Ethyl methacrylate	2277	3	2G	Cont.	No	11A	No	R	F-T	B,D		No	15.13, 16.6.1, 16.6.2
2-Ethyl-3-propylacrolein		3	2G	Cont.	No	11A	No	R	F-T	A		No	
Formaldehyde solutions, 45% or less	1198 <sup>d</sup>	3	2G	Cont.	No	T2	No	R	F-T	A		Ee	15.16.1
Formic acid	1779	3	2G	Cont.	No	T1	No	R	T	A	Y2/Y3	E	15.11.2 to 15.11.4, 15.11.6 to 15.11.8
Furfural	1199	3	2G	Cont.	No	T2	No	R	F-T	A		No	15.16.1
Glutaraldehyde solutions, 50% or less		3	2G	Open	No	NF		O	No	No		No	15.16.1
Hexamethylenediamine solutions	1783	3	2G	Cont.	No		Yes	R	T	A	N2	No	15.19.6
Hexamethylenimine	2493	2	2G	Cont.	No		No	R	F-T	A,C	N1	No	
Hydrochloric acid	1789	3	1G	Cont.	No	NF		R	T	No		Ef	15.11
Hydrogen peroxide solutions over 60% but not over 70%		2	2G	Cont.	No	NF		C	No	No		No	15.5, 15.19.6
2-Hydroxyethyl acrylate		2	2G	Cont.	No		Yes	C	T	A		No	15.12, 15.13, 15.19.6, 16.6.1, 16.6.2
Isobutyl acrylate	2527	2	2G	Cont.	No	T2	No	R	F-T	A		No	15.13, 16.6.1, 16.6.2
Isobutyraldehyde	2045	3	2G	Cont.	No	T3	No	O	F-T	A		No	15.16.1
Isophorone diamine	2289	3	2G	Cont.	No		Yes	R	T	A	N2	No	
Isophorone diisocyanate	2290	3	2G	Cont.	Dry		Yes	C	T	C,D	N5	No	15.12, 15.16.2, 15.17, 15.19.6
Isoprene	1218	3	2G	Cont.	No	T3	No	R	F	B		No	15.13, 15.14, 16.6.1, 16.6.2
Isopropylamine	1221	2	2G	Cont.	No	T2	No	C	F-T	C,D	N2	E	15.12, 15.14, 15.19
Isopropyl ether	1159	3	2G	Cont.	Inert		No	R	F	A		No	15.4.6, 15.13.3, 15.19.6
Isovaleraldehyde	2058	3	2G	Cont.	Inert	T3	No	R	F-T	A		No	15.4.6, 15.16.1
Maleic anhydride	2215	3	2G	Cont.	No		Yes	R	No	A <sup>6</sup> ,C		No	
Mesityl oxide	1229	3	2G	Cont.	No	T2	No	R	F-T	A		No	15.19.6

Methacrylic acid	2531	3	2G	Cont.	No															No	15.13, 16.6.1
Methyl acrylate	1919	2	2G	Cont.	No	T1	11B	No	R	R	F-T	A	B							E	15.13, 16.6.1, 16.6.2
Methylamine solutions, 42% or less	1235	2	2G	Cont.	No			No	C	C	F-T	A,C,D								E	15.12, 15.17, 15.19
2-Methyl-6-ethyl aniline		3	2G	Open	No			No	O	O	No	B,C,D								No	
Methylene chloride	1593	3	2G	Cont.	No	T1	11A	No	R	R	T	No								No	
2-Methyl-5-ethylpyridine	2300	3	2G	Open	No			No	O	O	No	D								No	
Methyl formate	1243	2	2G	Cont.	No			No	R	R	F-T	A								E	15.12, 15.14, 15.19
2-Methyl-2-hydroxy-3-butene		3	2G	Cont.	No			No	R	R	F-T	A,C,D								No	15.19.6
Methyl methacrylate	1247	2	2G	Cont.	No	T2	11A	No	R	R	F-T	B								No	15.13, 16.6.1, 16.6.2
2-Methylpyridine	2313	2	2G	Cont.	No			No	C	C	F	A,C								No	15.12.3, 15.19.6
<i>o</i> -Methylstyrene	2303	3	2G	Cont.	No	T1	11B	No	R	R	F-T	D								No	15.13, 16.6.1, 16.6.2
Monoethanolamine	2491	3	2G	Open	No	T2	11A	Yes	O	O	F-T	A								No	
Monoethylamine		2	1G	Cont.	No	T2	11A	No	C	C	F-T	C,D								E	15.12, 15.14
Monoethylamine solutions, 72% or less	2270	2	2G	Cont.	No			No	C	C	F-T	A,C								E	15.2, 15.14, 15.17, 15.19
Monoisopropanolamine		3	2G	Open	No	T2	11A	Yes	O	O	F-T	A								No	
Mononitrobenzene	1662	2	2G	Cont.	No	T1	11A	Yes	C	C	T	D								No	15.12, 15.17, 15.18, 15.19
Morpholine	2054	3	2G	Cont.	No	T2	11A	No	R	R	F	A								No	
Motor fuel anti-knock compounds	1649	2	1G	Cont.	No	T4	11A	No	C	C	F-T	B,C								E	15.6, 15.12, 15.18, 15.19
Naphthalene, molten	2304	3	2G	Cont.	No	T1	11A	Yes	R	R	No	A,D								No	
Nitric acid, 70% and over	2031 2032 <sup>h</sup>	2	2G	Cont.	No			No	NF	NF	T	No								E	15.11, 15.19
Nitric acid, less than 70%	2031	2	2G	Cont.	No			No	NF	NF	T	No								E	15.11 15.19
<i>o</i> -Nitrochlorobenzene	1578	2	2G	Cont.	No			No	C	C	T	B,C,D								No	15.12, 15.17, 15.18, 15.19
<i>o</i> -Nitrophenol, molten	1663	2	2G	Cont.	No			No	C	C	T	A,C,D								No	15.12, 15.19.6
1- or 2-Nitropropane	2608	3	2G	Cont.	No	T2	11B	No	R	R	F-T	A								No	
( <i>o</i> - and <i>p</i> -)Nitrotoluene	1664	2	2G	Cont.	No			No	C	C	T	B								No	15.12, 15.17, 15.19
Oleum	1831	2	2G	Cont.	No			No	NF	NF	T	No								E	15.11.2 to 15.11.8, 15.12.1, 15.16.2, 15.17, 15.19
Paraldehyde	1264	3	2G	Cont.	No	T3	11B	No	R	R	F	A								No	

a Product name	b UN number	c Ship type	d Tank type	e Tank vents	f Tank environ- mental control	g Electrical Equipment		h Flash- point >60°C	i Gauging detection	j Vapour detection	k Fire protection	l Materials of construction	m Respiratory and eye protection	Special requirements
						Class	Group							
Pentachloroethane	1669	3	2G	Cont.	No	NF		R	T	No	No	No	No	15.12, 15.17
1,3-Pentadiene		3	2G	Cont.	No		No	R	F-T	B	No	No	No	15.13, 16.6
Phenol	2312	2	2G	Cont.	No	T1	I1A	Yes	C	T	A	No	No	15.12, 15.19
Phosphoric acid	1805	3	2G	Open	No	NF		O	No	No	No	No	No	15.11.1 to 15.11.4, 15.11.6 to 15.11.8
Phosphorus, yellow or white	2447	1	1G	Cont.	Pad+ (vent or Inert)		No <sup>k</sup>	C	No	C	C	E	E	15.7, 15.19
Phthalic anhydride	2214	3	2G	Cont.	No	T1	I1A	Yes	R	No	D	No	No	
	2734 <sup>i</sup>													
Polyethylene polyamines	2735	3	2G	Open	No		Yes	O	No	A	N2	No	No	
Polymethylene polypho- nyl isocyanate	2206 <sup>i</sup> 2207	2	2G	Cont.	Dry		No <sup>b</sup>	C	T <sup>b</sup>	C,D	N5	No	No	15.12, 15.16.2, 15.19.6
n-Propanolamine		3	2G	Open	No		Yes	O	No	A,D	N2	No	No	
β-Propiolactone		2	2G	Cont.	No	I1A	Yes	R	T	A		No	No	
Propionaldehyde	1275	3	2G	Cont.	No		No	R	F-T	A		E	E	15.16.1, 15.17
Propionic Acid	1848	3	2G	Cont.	No	T1	I1A	No	R	F	A	Y1	E	15.11.2 to 15.11.4, 15.11.6 to 15.11.8
Propionic anhydride	2496	3	2G	Cont.	No	T2	I1A	Yes	R	T	A	Y1	No	
Propionitrile	2404	2	1G	Cont.	No	T1	I1B	No	C	F-T	A,D		E	15.12, 15.17, 15.18, 15.19
n-Propylamine	1277	2	2G	Cont.	Inert	T2	I1A	No	C	F-T	C,D	N2	E	15.12, 15.19
Propylene oxide	1280	2	2G	Cont.	Inert	T2	I1B	No	C	F-T	A,C	Z	No	15.8, 15.12.1, 15.14, 15.15, 15.19
Pyridine	1282	3	2G	Cont.	No	T1	I1A	No	R	F	A	N4	No	
Sodium borohydride, 15% or less/Sodium hydroxide solution		3	2G	Open	No	NF		O	No	No	No	NI	No	
Sodium chlorate solu- tions, 50% or less		3	2G	Open	No	NF		O	No	No	No	No	No	15.9, 15.16.1, 15.19.6

Sodium dichromate solution, 70% or less	2	2G	Open	No	NF	C	No	No	N2	No	15.12.3, 15.19
Sodium hydrosulphide solution, 45% or less	3	2G	Cont.	Vent or pad (gas)	NF	R	T	No		No	15.16.1
Sodium hydroxide solution	3	2G	Open	No	NF	O	No	No	N8	No	
Sodium hypochlorite solution, 15% or less	3	2G	Cont.	No	NF	R	No	No	N5	No	15.16.1
Sodium-2-mercaptobenzothiazol solution	3	2G	Open	No	NF	O	No	No	N1	No	
Styrene monomer	2055	3	2G	Cont.	T1	No	O	F	N4,Z	No	15.13, 16.6.1, 16.6.2
Sulphur, liquid	2448	3	1G	Open	T3	Yes <sup>1</sup>	O	F-T		No	15.10
Sulphuric acid	1830	3	2G	Open	NF		O	No		No	15.11., 15.16.2
Sulphuric acid, spent	1832	3	2G	Open	NF		O	No		No	15.11, 15.16.2
Tetrachloroethane	1702	3	2G	Cont.	NF		R	T		No	15.12, 15.17
Tetraethylenepentamine	2320	3	2G	Open		Yes	O	No	N1	No	
Tetrahydrofuran	2056	3	2G	Cont.	T3	No	R	F-T		No	
Toluenediamine	1709	2	2G	Cont.		Yes	C	T	N1	E	15.12, 15.17, 15.19
Toluene diisocyanate	2078	2	2G	Cont.	T1	Yes	C	F-T	N4	E	15.12, 15.16.2, 15.17, 15.19
<i>o</i> -Toluidine	1708	2	2G	Cont.		Yes	C	T		No	15.12, 15.17, 15.19
1,2,4-Trichlorobenzene	2321	3	2G	Cont.		Yes	R	T		No	15.19.6
1,1,2-Trichloroethane		3	2G	Cont.		Yes	R	T		No	15.12.1
Trichloroethylene	1710	3	2G	Cont.		Yes	R	T		No	15.12, 15.16.1, 15.17
1,2,3-Trichloropropane		2	2G	Cont.	T2	Yes	C	T		No	15.12, 15.17, 15.19
Triethanolamine		3	2G	Open		Yes	O	No	N1	No	
Triethylamine	1296	2	2G	Cont.	T2	No	R	F-T	N2	E	15.12
Triethylenetetramine	2259	3	2G	Open	T2	Yes	O	No	N1	No	
Trimethylacetic acid		3	2G	Cont.		Yes	R	No	Y1	No	15.11.2 to 15.11.8
Trimethylhexamethylene diamine (2,2,4- and 2,4,4- isomers)	2327	3	2G	Open		Yes	O	No	N1	No	15.19.6

a Product name	b UN number	c Ship type	d Tank type	e Tank vents	f Tank environ- mental control	g Electrical Equipment			h Flash- point > 60° C	i Yapour detection	j Fire protection	k Materials of construction	l Respiratory and eye protection	m Special requirements
						Class	Group	Division						
Trimethylhexamethylene diisocyanate (2,2,4- and 2,4,4-isomers)	2328	2	2G	Cont.	Dry		Yes	C	T	A, C <sup>c</sup>		No	15.12, 15.16.2, 15.17, 15.19.2	
Trimethyl phosphite	2329	3	2G	Cont.	No		No	R	F-T	A, D		No	15.12.1, 15.16.2, 15.19.6	
Triethyl phosphate, containing 1% or more ortho-isomer	2574j	2	2G	Cont.	No	T2	11A	Yes	C	No	B	No	15.12.3, 15.19	
Urea, ammonium solution, containing aqua ammonia		3	2G	Cont.	No	NF		R	T	A	N4	No		
n-Valeraldehyde	2058	3	2G	Cont.	Inert	T3	11B	No	R	F-T	A	No	15.4.6, 15.16.1	
Vinyl acetate	1301	3	2G	Cont.	No	T2	11A	No	O	F	A	No	15.13, 16.6.1, 16.6.2	
Vinyl ethyl ether	1302	2	1G	Cont.	Inert	T3	11B	No	C	F-T	A	E	15.4, 15.13, 15.14, 15.19, 16.6.1, 16.6.2	
Vinylidene chloride	1303	2	2G	Cont.	Inert	T2	11A	No	R	F-T	B	E	15.13, 15.14, 16.6.1, 16.6.2	
Vinyl neodecanoate		3	2G	Open	No			Yes	O	No	B	No	15.13, 15.16.1, 16.6.1, 16.6.2	
Vinyl toluene	2618	3	2G	Cont.	No	11A		No	R	F	D	No	15.13, 16.6.1, 16.6.2	
Xylenols	2261	3	2G	Open	No	11A		Yes	O	No	B	No		

<sup>a</sup> Applies to ammonia, aqueous, 28% or less, but not below 10%.

<sup>b</sup> If the product to be carried contains flammable solvents such that the flashpoint does not exceed 60° C, then special electrical systems and a flammable vapour detector should be provided.

<sup>c</sup> Although water is suitable for extinguishing open-air fires involving chemicals to which this footnote applies, water should not be allowed to contaminate closed tanks containing these chemicals because of the risk of hazardous gas generation.

<sup>d</sup> UN number 1198 only applies if flashpoint is below 60° C.

<sup>e</sup> Applies to formaldehyde solutions, 45% or less, but not below 5%.

<sup>f</sup> Applies to hydrochloric acid not below 10%.

<sup>g</sup> Dry chemical cannot be used because of the possibility of an explosion.

<sup>h</sup> UN number 2032 assigned to red fuming nitric acid.

<sup>i</sup> UN number depends on boiling point of substance.

<sup>j</sup> UN number assigned to this substance containing more than 3% of ortho-isomer.

<sup>k</sup> Phosphorus, yellow or white, is carried above its autoignition temperature and therefore flashpoint is not appropriate. Electrical equipment requirements may be similar to those for substances with a flashpoint above 60° C.

<sup>l</sup> Sulphur, liquid, has a flashpoint above 60° C, however electrical equipment should be certified safe for the gases evolved.



Chapter 18. LIST OF CHEMICALS TO WHICH THE CODE DOES NOT APPLY\*

1. The following are products which are not considered to come within the scope of the Code. This list may be used as a guide in considering bulk carriage of products whose hazards have not yet been evaluated.

2. Although the products listed in this chapter fall outside the scope of the Code, the attention of Administrations is drawn to the fact that some safety precautions may be needed for their safe transportation. Accordingly Administrations should prescribe appropriate safety requirements.

3. The products listed below may be subject to reconsideration upon the coming into force of the International Convention for the Prevention of Pollution from Ships, 1973/78.

Chapter 18	UN number	Chapter 18	UN number
Acetone	1090	Diisooctyl phthalate	—
Amylacetate, commercial	1104	2,2-Dimethyloctanoic acid	—
<i>n</i> -Amyl acetate	1104	Dioctyl phthalate	—
<i>sec</i> -Amyl acetate	1104	Dipentene	2052
<i>n</i> -Amyl alcohol	1105	Diphenyl ether	—
<i>sec</i> -Amyl alcohol	1105	Dipropylene glycol	—
<i>tert</i> -Amyl alcohol	1105	Dipropylene glycol monomethyl ether	—
Amyl alcohol, primary	1105	Dodecyl alcohol	—
<i>tert</i> -Amylenes	—	Dodecylbenzene	—
Benzyl alcohol	—	Dodecylphenol	—
<i>n</i> -Butyl acetate	1123	2-Ethoxyethanol	1171
<i>sec</i> -Butyl acetate	1123	2-Ethoxyethyl acetate	1172
<i>n</i> -Butyl alcohol	1120	Ethyl acetate	1173
<i>sec</i> -Butyl alcohol	1120	Ethyl acetoacetate	—
<i>tert</i> -Butyl alcohol	1120	Ethyl alcohol	1170
Butyl benzyl phthalate	—	Ethylbenzene	1175
Butylene glycol	—	Ethylcyclohexane	—
$\gamma$ -Butyrolactone	—	Ethylene carbonate	—
Calcium alkyl salicylate	—	Ethylene glycol	—
Cumene	1918	Ethylene glycol methyl butyl ether	—
Cyclohexane	1145	Ethylene glycol monobutyl ether	2369
Cyclohexanol	—	Ethylene glycol monobutyl ether acetate	—
<i>p</i> -Cymene	2046	Ethylene glycol monomethyl ether	1188
<i>n</i> -Decyl alcohol	—	Ethylene glycol monomethyl ether acetate	1189
Diacetone alcohol	1148	Ethylene glycol monophenyl ether	—
Dibutyl phthalate	—	2-Ethylhexanoic acid	—
Dicyclopentadiene	2048	Formamide	—
Diethylbenzene	2049	Furfuryl alcohol	2874
Diethylene glycol	—	Glycerine	—
Diethylene glycol diethyl ether	—	<i>n</i> -Heptane	1206
Diethylene glycol monobutyl ether	—	Heptanol, all isomers	—
Diethylene glycol monobutyl ether acetate	—	Heptene, mixed isomers	2278
Diethylene glycol monoethyl ether	—	<i>n</i> -Hexane	1208
Diethylene glycol monoethyl ether acetate	—	Hexan-1-ol	2282
Diethylene glycol monomethyl ether	—	1-Hexene	2370
Diethylene glycol monomethyl ether acetate	—	Hexylene glycol	—
Diisobutylene	2050	Isoamyl acetate	1104
Diisobutyl ketone	1157	Isoamyl alcohol	1105
Diisobutyl phthalate	—	Isobutyl acetate	1213
		Isobutyl alcohol	1212

\* The product names are not always identical with the names given in the various editions of the Bulk Chemical Code (resolution A.212 (VII)).

<i>Chapter 18</i>	<i>UN number</i>	<i>Chapter 18</i>	<i>UN number</i>
Isobutyl formate .....	2393	Perchloroethylene .....	1897
Isodecyl alcohol .....	—	Pinene .....	2368
Isopentane .....	1265	Polypropylene glycols .....	—
Isopentene .....	2371	<i>n</i> -Propyl acetate .....	1276
Isophorone .....	—	<i>n</i> -Propyl alcohol .....	1274
Isopropyl acetate .....	1220	Propylene glycol .....	—
Isopropyl alcohol .....	1219	Propylene glycol monoethyl ether .....	—
Lactic acid .....	—	Propylene glycol monomethyl ether .....	—
Latex .....	—	Propylene tetramer .....	2850
Methyl acetate .....	1231	Propylene trimer .....	2057
Methyl alcohol .....	1230	Sulpholane .....	—
Methylamyl acetate .....	1233	Tall oil .....	—
Methylamyl alcohol .....	2053	Tetrahydronaphthalene .....	—
Methyl amyl ketone .....	1110	Toluene .....	1294
Methyl <i>tert</i> -butyl ether .....	2398	Tributyl phosphate .....	—
Methyl ethyl ketone .....	1193	1,1,1-Trichloroethane .....	2831
Methyl isobutyl ketone .....	1245	Tridecanol .....	—
2-Methyl-1-pentene .....	—	Triethylbenzene .....	—
<i>N</i> -Methyl-2-pyrrolidone .....	—	Triethylene glycol .....	—
Molasses .....	—	Triisopropanolamine .....	—
Naphtha solvent .....	1256	1,2,4-Trimethylbenzene .....	—
Nonane .....	1920	Tripropylene glycol .....	—
Nonyl alcohol .....	—	Tripropylene glycol monomethyl ether .....	—
Nonylphenol .....	—	Tritolyl phosphate (?1% ortho-isomer) .....	—
Octane .....	1262	Trixylenyl phosphate .....	—
Octanol, all isomers .....	—	Turpentine .....	1299
Paraffin wax .....	—	Urea, ammonium nitrate solutions .....	—
<i>n</i> -Pentane .....	1265	Urea, ammonium phosphate solutions .....	—
<i>n</i> -Pentene .....	1108	White spirit .....	1300
Petrolatum .....	—	Wines .....	—
Petroleum naphtha .....	1255	Xylenes .....	1307

**Chapter 19. REQUIREMENTS FOR SHIPS ENGAGED IN THE INCINERATION AT SEA  
OF LIQUID CHEMICAL WASTE**

**19.1. General**

19.1.1. Chapters 1 to 16 apply to incinerator ships, as relevant, and as supplemented or modified by the provisions of this chapter.

19.1.2. Information on the composition and the hazards of the waste to be incinerated should be made available to the Administration or port Administration, or both, as appropriate, which may prohibit carriage of those wastes deemed to be too hazardous to be carried in bulk.\*

19.1.3. The following additional definitions apply:

- .1 Incinerator space is a gastight space containing solely the incinerator and its associated auxiliaries.
- .2 Incinerator blower space is a space containing the blowers which supply combustion air to the incinerator burners.

\* The environmental aspects of incineration and dumping of wastes are regulated by the Dumping Convention. In general, for incineration of waste, a permit from the appropriate authority of the Contracting Party to the Convention, where the loading port is situated, is required. Where the loading port is situated in a State not being a Contracting Party to the Convention, the Administration should issue a permit.

.3 Dumping Convention means the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter at Sea, 1972.<sup>1</sup>

.4 Cargo area is that part of the ship defined by 1.3.5, excluding incinerators and chemical waste piping leading to the incinerators.

19.1.4. During the periodical and intermediate surveys required under 1.5.2.1.2 and .3, all cargo tanks and the cargo piping system should be inspected for corrosion and the remaining thickness of material should be determined. Where severely corrosive wastes have been carried, inspections of cargo tanks and the cargo piping system for corrosion should be held annually and the remaining thickness of materials determined during those inspections.

19.2. *Ship survival capability and location of cargo tanks*

19.2.1. Ships subject to this chapter should comply with type 2 ship standards and with the requirements for location of cargo tanks in type 2 ships.

19.2.2. Waste mixtures containing substances which would require a type 1 ship standard may be carried in type 2 ships if solely for the purpose of incineration.

19.3. *Ship arrangements*

19.3.1. Liquid chemical wastes should not be stowed adjacent to oil fuel tanks except those tanks containing oil fuel to be used exclusively for incineration.

19.3.2. Tanks and pumps, other than those described in 19.3.3, which may contain liquids and which are to be used for the incineration process or for washing cargo pipes and cargo tanks may be located adjacent to cargo tanks and should be located within the cargo area. The provisions of 3.1 should apply to such tanks and equipment to the same extent as they apply to cargo tanks.

19.3.3. Where necessary, oil fuel tanks and fuel pumps directly feeding the incinerator burners during the process of pre-heating or supporting incineration may be located outside the cargo area provided the oil fuel used has a flashpoint above 60°C (closed cup test). (See also 19.5.3.)

19.3.4. Liquids which have been used for cleaning cargo pipes and cargo tanks as well as for pumproom drainage should be stored in a slop tank in the cargo area, for disposal in conformity with the technical guidelines annexed to the Dumping Convention. A cargo tank may be used as a slop tank. Pumps used for handling contaminated cleaning fluids should be located in the cargo area.

19.3.5. Where necessary, compliance with 3.2.1 need not be required in so far as accommodation spaces, service spaces, control stations and machinery spaces other than those of category A may be permitted forward of the cargo area, subject to an equivalent standard of safety and appropriate fire-extinguishing arrangements being provided to the satisfaction of the Administration.

19.3.6. If accommodation spaces, service spaces, control stations or machinery spaces other than those of category A are located forward of the cargo area in accordance with 19.3.5, the requirements of 3.2.3 should be applied by analogy; i.e. the specified distances should be measured from the after end of a house located forward of the cargo area.

19.3.7. The incinerator should be located outside the external perimeter of the cargo area. Alternative arrangements may, however, be considered by the Administration, provided an equivalent degree of safety is achieved.

19.3.8. The effect which combustion gases may have on adequate vision from the navigating bridge, on air intakes and openings into accommodation, service and machinery spaces, and on deck working areas and passageways should be considered.

<sup>1</sup> United Nations, *Treaty Series*, vol. 1046, p. 120.

19.3.9. Access to the incinerator space should be from the open deck. However, the incinerator control room and incinerator blower space may have direct access to the incinerator space provided that these spaces have an additional access from the open deck. Access openings of the incinerator space should be fitted with self-closing gastight doors.

19.4. *Cargo containment and incinerator standards*

19.4.1. Integral gravity tanks may be used for hazardous wastes.

19.4.2. The incinerator including burners should be designed and constructed to safety standards acceptable to the Administration\*. For materials of construction the provisions of 6.1 apply.

19.4.3. The steel structure of the incinerator including supports and other fixtures should be designed for the most unfavourable static angle of heel within the range of 0° to 30°, taking into account the dynamic loads due to the ship's motion.

19.4.4. Suitable bricklining and insulation should be provided to ensure that any temperature rise will not impair the strength of the incinerator structure or the functioning of the associated auxiliaries and instruments and will not adversely affect personnel safety.

19.4.5. Means should be provided for measuring the temperature on the outside furnace surfaces. Means for alarms should be provided to indicate when the temperature approved by the Administration is exceeded and the process of incineration has to be stopped.

19.5. *Cargo transfer*

19.5.1. The requirements of 5.1 apply, except that cargo piping should as far as practicable be fitted in the cargo area and that cargo piping leading to the incinerator should:

- .1 Be fitted at least 760 mm inboard;
- .2 If outside the cargo area, be on the open deck;
- .3 Be clearly marked; and
- .4 Be so designed as to allow draining and purging.

19.5.2. Arrangements of the cargo piping and controls should be such as to preclude the discharge overboard of wastes intended to be incinerated during normal cargo handling operations.

19.5.3. Oil fuel and cargo piping systems may be connected in front of the burners, provided that three-way cocks are installed and the oil fuel pipes are fitted with two screw-down non-return valves inside the incinerator space.

19.5.4. Remote shutdown devices to cut out the supply of waste and fuel for incineration should be fitted at the control station and on the navigating bridge. Shutoff valves should be located in the cargo area. Where shutoff valves are remotely controlled, provision for local manual operation should be made, or a separate manually operated valve should be fitted.

19.5.5. Flanges of the loading manifold connections should be provided with shields, which may be portable, to guard against the danger of the cargo being sprayed. Drip trays should also be provided.

19.6. *Materials of construction*

19.6.1. Section 6.2—special requirements for materials—is replaced by the following:

- .1 Aluminium, copper, copper alloys, zinc, galvanized steel or mercury should not be used for cargo tanks, pipelines, valves, fittings and other equipment which may come into contact with the liquid wastes or their vapour.
- .2 Materials of construction having a melting point below 925°C; e.g. aluminium and its alloys, should not be used for external piping involved in cargo handling operations on

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\* The standards set out by the Dumping Convention for the control of incineration of wastes and other matter at sea should also be observed.

ships intended for the carriage of wastes with a flashpoint not exceeding 60° C (closed cup test). Short lengths of external pipes connected to cargo tanks may be permitted by the Administration if they are provided with fire-resistant insulation.

- .3 In determining the scantlings of the cargo system the corrosivity of the waste should be taken into account.

19.7. *Tank vent systems*

19.7.1. The provisions for controlled venting systems—chapter 8 and section 15.12 apply, except 8.2.1 and 15.12.3.

19.8. *Cargo tank environmental control*

19.8.1. When the recirculating drop line does not terminate near the bottom of the cargo tank, the tank should be inerted whenever wastes having a flashpoint not exceeding 60° C (closed cup test) are being recirculated to it.

19.8.2. When washing machines using liquids having a flashpoint not exceeding 60° C (closed cup test) are employed, the cargo tank should be inerted.

19.8.3. The oxygen content of the atmosphere in an inerted tank should not exceed 8% by volume in any part of the tank.

19.8.4. An audible and visual alarm should be provided to indicate when the pressure in the vapour space of an inerted cargo tank is less than 0.07 bar gauge.

19.9. *Electrical installation*

19.9.1. In incinerator spaces, incinerator blower spaces, and adjacent spaces having direct access thereto, the lighting systems, telephone and public address systems and general alarm systems should be of the certified safe type.

19.9.2. All other electrical installations which are fitted in the spaces referred to in 19.9.1 should be of the certified safe type unless the following conditions are complied with:

- .1 It is assured that the spaces are adequately ventilated prior to activating installations not of a certified safe type. Interlocks should be provided between fans and the switch gear of such installations to ensure compliance with this requirement.
- .2 Installations not of a certified safe type should be automatically switched off in case of loss of the pressure required by 19.11.2.1 and 19.11.3.1. A reasonable time delay may be permitted by the Administration before these installations are switched off.
- .3 Installations not of a certified safe type should comply as a minimum with IP 55\* or equivalent protection.

19.10. *Fire protection and fire extinguishing*

19.10.1. The incinerator space should be provided with a fixed foam fire-extinguishing system complying with regulation II-2/8 or II-2/9 of the 1983 SOLAS amendments. This system may be connected to the deck foam fire-extinguishing system.

19.11. *Mechanical ventilation in the cargo area and in the incinerator location*

19.11.1. For cargo pump rooms the provisions of 15.17—increased ventilation requirements—apply.

19.11.2. The ventilation system of the incinerator space should be permanent, normally of the positive pressure type and independent of all other air supply systems.

- .1 The air pressure should always be positive to the pressure within the furnace (see also 19.9.2.2).

\* Reference is made to the Recommendations published by the International Electrotechnical Commission and in particular to Publication 44.

- .2 A minimum capacity of 45 changes of air per hour should be provided based upon the total volume of the incinerator space.  
Consideration should be given to venting requirements during maintenance of burners.
- 19.11.3. The ventilation system of the incinerator blower space should be permanent, normally of the positive pressure type and independent of other air supply systems.
- .1 The air pressure should always be positive to the pressure within the furnace (see also 19.9.2.2).
- .2 A minimum capacity of 20 changes of air per hour should be provided based upon the total volume of the incinerator blower space.
- 19.12. *Instrumentation and overflow control*
- 19.12.1. Closed gauging devices described in 13.1.1.3 should be fitted and overflow control systems required in 15.19 should be provided.
- 19.12.2. Vapour detection instruments for toxic and flammable products described in 13.2 should be fitted.
- 19.13. *Personnel protection*
- 19.13.1. The safety equipment described in 14.2, including respiratory and eye protection for every person on board described in 14.2.8, should be provided.

APPENDIX. MODEL FORM OF INTERNATIONAL CERTIFICATE OF FITNESS  
FOR THE CARRIAGE OF DANGEROUS CHEMICALS IN BULK

*INTERNATIONAL CERTIFICATE OF FITNESS FOR THE CARRIAGE  
OF DANGEROUS CHEMICALS IN BULK*

(OFFICIAL SEAL)

ISSUED UNDER THE PROVISIONS OF THE  
INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT  
OF SHIPS CARRYING DANGEROUS CHEMICALS IN BULK

(resolution MSC.4 (48))

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)*

<i>Name of ship</i>	<i>Distinctive number or letters</i>	<i>Port of registry</i>	<i>Gross tonnage</i>	<i>Ship type (Code paragraph 2.1.2)<sup>1</sup></i>

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:

.....

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.

The ship also complies fully with the following amendments to the Code: .....

The ship is exempted from compliance with the following provisions of the Code: .....

This is to certify:

1.
  - .1 That the ship has been surveyed in accordance with the provisions of section 1.5 of the Code;
  - .2 That the survey showed that the construction and equipment of the ship complied with the relevant provisions of the Code;
  - \*.3 That the ship is an incinerator ship complying also with the supplementary and modified requirements of chapter 19;
2. 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.<sup>2</sup>

Products	Conditions of carriage (tank numbers etc.)
<p>* Continued on attachment 1, additional signed and dated sheets.                      Tank numbers referred to in this list are identified on attachment 2, signed and dated tank plan.                      For incinerator ships enter "liquid chemical waste" in lieu of individual products.</p>	

3. That, in accordance with \*1.4 and \*2.8.2, the provisions of the Code are modified in respect of the ship in the following manner:

\* Delete as appropriate.

## 4. That the ship must be loaded:

- \*.1 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;
- \*.2 In accordance with the loading limitations 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 .....

Issued at ..... I9....  
(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*

<sup>1</sup> "Ship type". Any entry under this column must relate to all relevant recommendations, e.g. an entry "type 2" should mean type 2 in all respects prescribed by the Code.

<sup>2</sup> Paragraph 2. Only products listed in chapter 17 of the Code, or which have been evaluated by the Administration in accordance with I.1.3 of the Code, should be listed. In respect of the latter "new" products, any special requirements provisionally prescribed should be noted. It should be noted that for incinerator ships "liquid chemical waste" is to be entered in lieu of the individual product names.

## ENDORSEMENT FOR MANDATORY ANNUAL SURVEYS

This is to certify that at a mandatory annual survey required by 1.5.2.1.4 of the International 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.

Signed: .....  
(signature of authorized official)

Place: .....

Date: .....

(seal or stamp of the Authority, as appropriate)

\* Delete as appropriate.

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



*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

NOTE. An intermediate survey may take the place of a mandatory annual survey where the relevant provisions of 1.5.2.1.3 and 1.5.2.1.4 are complied with.

#### ENDORSEMENT FOR INTERMEDIATE SURVEYS

This is to certify that at an intermediate survey required by 1.5.2.1.3 of the International 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.

*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

*Attachment 1 to the International 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)

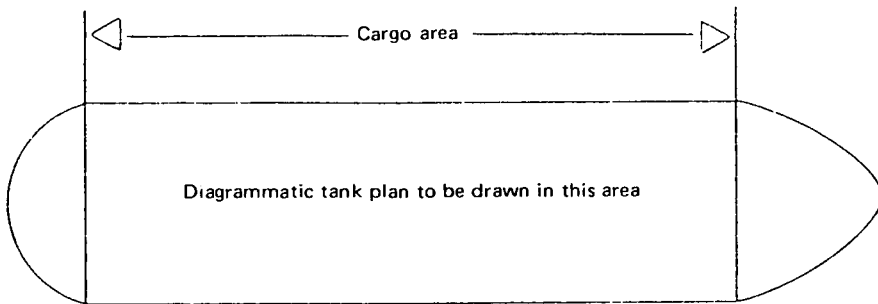
.....  
(signature of official issuing the certificate  
and/or seal of issuing authority)

*Attachment 2 to the International Certificate of Fitness  
for the Carriage of Dangerous Chemicals*

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)

**RESOLUTION MSC.5(48)<sup>1</sup>**  
*adopted 17 June 1983*

**ADOPTION OF THE INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING LIQUEFIED GASES IN BULK (IGC CODE)**

The Maritime Safety Committee,

Recalling resolution A.328(IX) by which the Assembly authorized the Maritime Safety Committee to amend the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk as may be necessary,

Noting resolution MSC.6(48) by which it adopts, *inter alia*, amendments to chapter VII of the International Convention for the Safety of Life at Sea, 1974 (1974 SOLAS Convention), to make the provisions of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) mandatory under that Convention,

<sup>1</sup> Resolution published for information by the Secretariat of the United Nations.

Having considered the text of the proposed IGC Code:

1. Adopts the IGC Code, the text of which is given in the Annex to the present resolution;
2. Notes that under part C of chapter VII of the 1974 SOLAS Convention as amended by resolution MSC.6(48), amendments to the IGC Code shall be adopted, brought into force and take effect in accordance with the provisions of article VIII of that Convention;
3. Requests the Secretary-General to circulate to all Governments concerned amendments to the IGC Code adopted as above which comprise the inclusion in chapter 19 of new products, recommending that, pending the entry into force of those amendments, these new products should be carried by gas carriers in compliance with the provisions of the amendments;
4. Further requests the Secretary-General to transmit a copy of the present resolution together with the text of the IGC Code to all Members of the Organization and to all Contracting Governments to the 1974 SOLAS Convention which are not Members of the Organization.

## A N N E X

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## PREAMBLE

1. The purpose of this Code is to provide an international standard for the safe carriage by sea in bulk of liquefied gases and certain other substances listed in chapter 19 of the Code, by prescribing the design and construction standards of ships 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 one of ship types related to the hazards of the products covered by the Code. Each of the products may have one or more hazard properties which include flammability, toxicity, corrosivity and reactivity. A further possible hazard may arise due to the products being transported under cryogenic or pressure conditions.

3. Severe collisions or strandings could lead to cargo tank damage and result in uncontrolled release of the product. Such release could result in evaporation and dispersion of the product and, in some cases, could cause brittle fracture of the ship's hull. The requirements in the Code are intended to minimize this risk as far as is practicable, based upon present knowledge and technology.

4. 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 gas carrier design technology is not only a complex technology but is rapidly evolving and that the Code should not remain static. Therefore the Organization will periodically review the Code taking into account both experience and future development.

5. Requirements for new products and their conditions of carriage will be circulated as recommendations, on an interim basis, when adopted by the Maritime Safety Committee of the Organization, prior to the entry into force of the appropriate amendments, under the terms of article VIII of the International Convention for the Safety of Life at Sea, 1974.

6. 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.

7. The development of the Code has been greatly assisted by the work of the International Association of Classification Societies (IACS) and full account has been taken of the IACS Unified Requirements for Liquefied Gas Tankers in chapters 4, 5 and 6.

8. The development of chapter 10 has been greatly assisted by the relevant work of the International Electrotechnical Commission (IEC).

9. Chapter 18 of the Code dealing with operation of liquefied gas carriers highlights the regulations in other chapters that are operational in nature and mentions those other important safety features that are peculiar to gas carrier operation.

10. The layout of the Code is in line with the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) adopted by the Maritime Safety Committee at its forty-eighth session.

*Chapter 1. GENERAL**1.1. Application*

1.1.1. The Code applies to ships regardless of their size, including those of less than 500 tons gross tonnage, engaged in carriage of liquefied gases having a vapour pressure exceeding 2.8 bar absolute at a temperature of 37.8°C, and other products as shown in chapter 19, when carried in bulk.

1.1.2. Unless expressly provided otherwise, the Code applies to ships the keels of which are laid or which are at a stage at which:

- .1 Construction identifiable with the ship begins; and
- .2 Assembly of that ship has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less;

on or after 1 July 1986.

1.1.3. A ship, irrespective of the date of construction, which is converted to a gas carrier on or after 1 July 1986 should be treated as a gas carrier constructed on the date on which such conversion commences.

1.1.4.1. When cargo tanks contain products for which the Code requires a type 1G ship, neither flammable liquids having a flashpoint of 60°C (closed cup test) or less nor flammable products listed in chapter 19 should be carried in tanks located within the protective zones described in 2.6.1.1.

1.1.4.2. Similarly, when cargo tanks contain products for which the Code requires a type 2G/2PG ship, the above-mentioned flammable liquids should not be carried in tanks located within the protective zones described in 2.6.1.2.

1.1.4.3. In each case the restriction applies to the protective zones within the longitudinal extent of the hold spaces for the cargo tanks loaded with products for which the Code requires a type 1G or 2G/2PG ship.

1.1.4.4. The above-mentioned flammable liquids and products may be carried within these protective zones when the quantity retained in the cargo tanks of products for which the Code requires a type 1G or 2G/2PG ship is solely used for cooling, circulation or fuelling purposes.

1.1.5. Except as provided in 1.1.7.1, when it is intended to carry products covered by this Code and products covered by the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk adopted by the Maritime Safety Committee under the authority of the Assembly of the Organization conferred by resolution A.490(XII), as may be amended by the Organization (IBC Code), the ship should comply with the requirements of both Codes appropriate to the products carried.

1.1.6. Where it is proposed to carry products which may be considered to come within the scope of the Code but are not at present designated in chapter 19, the Administrations and the port Administrations involved in such carriage should establish preliminary suitable conditions of carriage based on the principles of the Code and notify the Organization of such conditions.

1.1.7.1. The requirements of this Code should take precedence when a ship is designed and constructed for the carriage of the following products:

- .1 Those listed exclusively in chapter 19 of this Code; and
- .2 One or more of the products which are listed both in this Code and in the International Bulk Chemical Code. These products are marked with an asterisk (\*) in column "a" in the table of chapter 19.

1.1.7.2. When a ship is intended exclusively to carry one or more of the products noted in 1.1.7.1.2, the requirements of the International Bulk Chemical Code as amended should apply.

1.1.8. Compliance of the ship with the requirements of the International Gas Carrier Code should be shown in the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk provided for in 1.5. Compliance with the amendments to the Code, as appropriate, should also be indicated in the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk.

## 1.2. *Hazards*

Hazards of gases considered in this Code include fire, toxicity, corrosivity, reactivity, low temperature and pressure.

## 1.3. *Definitions*

Except where expressly provided otherwise, the following definitions apply to the Code. Additional definitions are given in chapter 4.

1.3.1. "Accommodation spaces" are those spaces used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, barber shops, pantries containing no cooking appliances and similar spaces. Public spaces are those portions of the accommodation which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

1.3.2. "'A' class divisions" means divisions as defined in regulation 11-2/3.3 of the 1983 SOLAS amendments.

1.3.3.1. "Administration" means the Government of the State whose flag the ship is entitled to fly.

1.3.3.2. "Port Administration" means the appropriate authority of the country in the port of which the ship is loading or unloading.

1.3.4. "Boiling point" is the temperature at which a product exhibits a vapour pressure equal to the atmospheric pressure.

1.3.5. "Breadth (B)" means the maximum breadth of the ship, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material. The breadth (B) should be measured in metres.

1.3.6. "Cargo area" is that part of the ship which contains the cargo containment system and cargo pump and compressor rooms and includes deck areas over the full length and breadth of the part of the ship over the above-mentioned spaces. Where fitted, the cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forwardmost hold space are excluded from the cargo area.

1.3.7. "Cargo containment system" is the arrangement for containment of cargo including, where fitted, a primary and secondary barrier, associated insulation and any intervening spaces, and adjacent structure if necessary for the support of these elements. If the secondary barrier is part of the hull structure it may be a boundary of the hold space.

1.3.8. "Cargo control room" is a space used in the control of cargo handling operations and complying with the requirements of 3.4.

1.3.9. "Cargoes" are products listed in chapter 19 carried in bulk by ships subject to the Code.

1.3.10. "Cargo service spaces" are spaces within the cargo area used for workshops, lockers and store-rooms of more than 2 m<sup>2</sup> in area, used for cargo handling equipment.

1.3.11. "Cargo tank" is the liquid-tight shell designed to be the primary container of the cargo and includes all such containers whether or not associated with insulation or secondary barriers or both.

1.3.12. "Cofferdam" is the isolating space between two adjacent steel bulkheads or decks. This space may be a void space or a ballast space.

1.3.13. "Control stations" are those spaces in which ships' radio or main navigating equipment or the emergency source of power is located or where the fire-recording or fire-control equipment is centralized. This does not include special fire-control equipment which can be most practically located in the cargo area.

1.3.14. "Flammable products" are those identified by an "F" in column "f" in the table of chapter 19.



1.3.15. "Flammability limits" are the conditions defining the state of fuel-oxidant mixture at which application of an adequately strong external ignition source is only just capable of producing flammability in a given test apparatus.

1.3.16. "Gas carrier" is a cargo ship constructed or adapted and used for the carriage in bulk of any liquefied gas or other products listed in the table of chapter 19.

1.3.17. "Gas-dangerous space or zone" is:

- .1 A space in the cargo area which is not arranged or equipped in an approved manner to ensure that its atmosphere is at all times maintained in a gas-safe condition;
- .2 An enclosed space outside the cargo area through which any piping containing liquid or gaseous products passes, or within which such piping terminates, unless approved arrangements are installed to prevent any escape of product vapour into the atmosphere of that space;
- .3 A cargo containment system and cargo piping;
- .4.1 A hold space where cargo is carried in a cargo containment system requiring a secondary barrier;
- .4.2 A hold space where cargo is carried in a cargo containment system not requiring a secondary barrier;
- .5 A space separated from a hold space described in .4.1 by a single gas-tight steel boundary;
- .6 A cargo pump room and cargo compressor room;
- .7 A zone on the open deck, or semi-enclosed space on the open deck, within 3 m of any cargo tank outlet, gas or vapour outlet, cargo pipe flange or cargo valve or of entrances and ventilation openings to cargo pump rooms and cargo compressor rooms;
- .8 The open deck over the cargo area and 3 m forward and aft of the cargo area on the open deck up to a height of 2.4 m above the weather deck;
- .9 A zone within 2.4 m of the outer surface of a cargo containment system where such surface is exposed to the weather;
- .10 An enclosed or semi-enclosed space in which pipes containing products are located. A space which contains gas detection equipment complying with 13.6.5 and a space utilizing boil-off gas as fuel and complying with chapter 16 are not considered gas-dangerous spaces in this context;
- .11 A compartment for cargo hoses; or
- .12 An enclosed or semi-enclosed space having a direct opening into any gas-dangerous space or zone.

1.3.18. "Gas-safe space" is a space other than a gas-dangerous space.

1.3.19. "Hold space" is the space enclosed by the ship's structure in which a cargo containment system is situated.

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

1.3.21. "Insulation space" is the space, which may or may not be an interbarrier space, occupied wholly or in part by insulation.

1.3.22. "Interbarrier space" is the space between a primary and a secondary barrier, whether or not completely or partially occupied by insulation or other material.

1.3.23. "Length (L)" means 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel, the waterline on which this length is measured should be parallel to the designed waterline. The length (L) should be measured in metres.

1.3.24. "Machinery spaces of category A" are those spaces and trunks to such spaces which contain:

- .1 Internal combustion machinery used for main propulsion; or
- .2 Internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or
- .3 Any oil-fired boiler or oil fuel unit.

1.3.25. "Machinery spaces" are all machinery spaces of category A and all other spaces containing propelling machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air-conditioning machinery, and similar spaces; and trunks to such spaces.

1.3.26. "MARVS" is the maximum allowable relief valve setting of a cargo tank.

1.3.27. "Oil fuel unit" is the equipment used for the preparation of oil fuel for delivery to an oil-fired boiler, or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a pressure of more than 1.8 bar gauge.

1.3.28. "Organization" is the International Maritime Organization (IMO).

1.3.29. "Permeability" of a space means the ratio of the volume within that space which is assumed to be occupied by water to the total volume of that space.

1.3.30.1. "Primary barrier" is the inner element designed to contain the cargo when the cargo containment system includes two boundaries.

1.3.30.2. "Secondary barrier" is the liquid-resisting outer element of a cargo containment system designed to afford temporary containment of any envisaged leakage of liquid cargo through the primary barrier and to prevent the lowering of the temperature of the ship's structure to an unsafe level. Types of secondary barrier are more fully defined in chapter 4.

1.3.31. "Relative density" is the ratio of the mass of a volume of a product to the mass of an equal volume of fresh water.

1.3.32. "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:

- .1 Removing spool pieces or valves and blanking the pipe ends;
- .2 Arrangement of two spectacle flanges in series with provisions for detecting leakage into the pipe between the two spectacle flanges.

1.3.33. "Service spaces" are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, storerooms, workshops other than those forming part of the machinery spaces and similar spaces and trunks to such spaces.

1.3.34. "1974 SOLAS Convention" means the International Convention for the Safety of Life at Sea, 1974.

1.3.35. "1983 SOLAS amendments" means amendments to the 1974 SOLAS Convention adopted by the Maritime Safety Committee of the Organization at its forty-eighth session on 17 June 1983 by resolution MSC.6(48).

1.3.36. "Tank cover" is the protective structure intended to protect the cargo containment system against damage where it protrudes through the weather deck or to ensure the continuity and integrity of the deck structure.

1.3.37. "Tank dome" is the upward extension of a portion of a cargo tank. In the case of below-deck cargo containment systems the tank dome protrudes through the weather deck or through a tank cover.

1.3.38. "Toxic products" are those identified by a "T" in column "f" in the table of chapter 19.

1.3.39. "Vapour pressure" is the equilibrium pressure of the saturated vapour above the liquid expressed in bars absolute at a specified temperature.

1.3.40. "Void space" is an enclosed space in the cargo area external to a cargo containment system, other than a hold space, ballast space, fuel oil tank, cargo pump or compressor room, or any space in normal use by personnel.

#### 1.4. *Equivalents*

1.4.1. Where the Code requires that a particular fitting, material, appliance, apparatus, item of equipment or type thereof should be fitted or carried in a ship, or that any particular provision should be made, or any procedure or arrangement should be complied with, the Administration may allow any other fitting, material, appliance, apparatus, item of equipment or type thereof to be fitted or carried, or any other provision, procedure or arrangement to be made in that ship, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance, apparatus, item of equipment or type thereof or that any particular provision, procedure or arrangement is at least as effective as that required by the Code. However, the Administration may not allow operational methods or procedures to be made an alternative to a particular fitting, material, appliance, apparatus, item of equipment, or type thereof which is prescribed by the Code.

1.4.2. When the Administration so allows any fitting, material, appliance, apparatus, item of equipment, or type thereof, or provision, procedure or arrangement to be substituted, it should communicate to the Organization the particulars thereof together with a report on the evidence submitted, so that the Organization may circulate the same to other Contracting Governments to the 1974 SOLAS Convention for the information of their officers.

#### 1.5. *Surveys and certification*

##### 1.5.1. *Survey procedure*

1.5.1.1. The survey of ships, so far as regards the enforcement of the provisions of the regulations and the granting of exemptions therefrom, should be carried out by officers of the Administration. The Administration may, however, entrust the surveys either to surveyors nominated for the purpose or to organizations recognized by it.

1.5.1.2. The Administration nominating surveyors or recognizing organizations to conduct surveys should, as a minimum, empower any nominated surveyor or recognized organization to:

- .1 Require repairs to a ship; and
- .2 Carry out surveys if requested by the port State authority\* concerned.

The Administration should notify the Organization of the specific responsibilities and conditions of the authority delegated to nominated surveyors or recognized organizations for circulation to the Contracting Governments.

1.5.1.3. When a nominated surveyor or recognized organization determines that the condition of the ship or its equipment does not correspond substantially with the particulars of the certificate or is such that the ship is not fit to proceed to sea without danger to the ship, or persons on board, such surveyor or organization should immediately ensure that corrective action is taken and should in due course notify the Administration. If such corrective action is not taken the relevant certificate should be withdrawn and the Administration should be notified immediately; and, if the ship is in a port of another Contracting Government, the port State authority concerned should also be notified immediately.

1.5.1.4. In every case, the Administration should guarantee the completeness and efficiency of the survey, and should undertake to ensure the necessary arrangements to satisfy this obligation.

\* Port State authority has the meaning as presented in chapter 1, regulation 19 of the 1978 Protocol<sup>1</sup> to the 1974 SOLAS Convention.

<sup>1</sup> United Nations, *Treaty Series*, vol. 1226, p. 213.

### 1.5.2. *Survey requirements*

1.5.2.1. 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 is issued) of a gas carrier should be subjected to the following surveys:

- .1 An initial survey before the ship is put in service or before the International Certificate of Fitness for the Carriage of Liquefied Gases 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 5 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 International Certificate of Fitness for the Carriage of Liquefied Gases 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 6 months prior to, nor later than 6 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 on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk.
- .4 A mandatory annual survey within 3 months before or after the anniversary date of the International Certificate of Fitness for the Carriage of Liquefied Gases 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 International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk.
- .5 An additional survey, either general or partial according to the circumstances, should be made when required after an investigation prescribed in 1.5.3.3, 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.

### 1.5.3. *Maintenance of conditions after survey*

1.5.3.1. The condition 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.

1.5.3.2. After any survey of the ship under 1.5.2 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.

1.5.3.3. 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 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 1.5.2.5, is necessary. If the ship is in a port of another Contracting Government, the master or owner should also report immediately to the port State authority con-

cerned and the nominated surveyor or recognized organization should ascertain that such a report has been made.

1.5.4. *Issue of certificate*

1.5.4.1. A certificate called an International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk, the model form of which is set out in the appendix, should be issued after an initial or periodical survey to a gas carrier which complies with the relevant requirements of the Code.

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

1.5.4.3. When a ship is designed and constructed under the provisions of 1.1.5, International Certificates of Fitness should be issued in accordance with the requirements of this section and with the requirements of section 1.5 of the International Bulk Chemical Code.

1.5.5. *Issue or endorsement of certificate by another Government*

1.5.5.1. A Contracting Government may, at the request of another Government, cause a ship entitled to fly the flag of the other State 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 board 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 whose flag the ship is entitled to fly.

1.5.6. *Duration and validity of the certificate*

1.5.6.1. An International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk should be issued for a period specified by the Administration which should not exceed 5 years from the date of the initial survey or the periodical survey.

1.5.6.2. No extension of the 5 year period of the certificate should be permitted.

1.5.6.3. The certificate should cease to be valid:

- .1 If the surveys are not carried out within the period specified by 1.5.2;
- .2 Upon transfer of the ship to the flag of another State. 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 1.5.3.1 and 1.5.3.2. Where a transfer occurs between Contracting Governments, the Government of the State whose flag the ship was formerly entitled to fly should, 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.

## Chapter 2. SHIP SURVIVAL CAPABILITY\* AND LOCATION OF CARGO TANKS

### 2.1. General

2.1.1. Ships subject to the Code should survive the normal effects of flooding following assumed hull damage caused by some external force. In addition, to safeguard the ship and the environment, the cargo tanks should be protected from penetration in the case of minor damage to the ship resulting, for example, from contact with a jetty or tug, and given a measure of protection from damage in the case of collision or stranding, by locating them at specified minimum distances inboard from the ship's shell plating. Both the damage to be assumed and the proximity of the tanks to the ship's shell should be dependent upon the degree of hazard presented by the product to be carried.

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\* Reference is made to the Guidelines for Uniform Application of the Survival Requirements of the Bulk Chemical Code and the Gas Carrier Code.

2.1.2. Ships subject to the Code should be designed to one of the following standards:

- .1 A type 1G ship is a gas carrier intended to transport products indicated in chapter 19 which require maximum preventive measures to preclude the escape of such cargo.
- .2 A type 2G ship is a gas carrier intended to transport products indicated in chapter 19 which require significant preventive measures to preclude the escape of such cargo.
- .3 A type 2PG ship is a gas carrier of 150 m in length or less intended to transport products indicated in chapter 19 which require significant preventive measures to preclude escape of such cargo, and where the products are carried in independent type C tanks designed (see 4.2.4.4) for a MARVS of at least 7 bar gauge and a cargo containment system design temperature of  $-55^{\circ}\text{C}$  or above. Note that a ship of this description but over 150 m in length is to be considered a type 2G ship.
- .4 A type 3G ship is a gas carrier intended to carry products indicated in chapter 19 which require moderate preventive measures to preclude the escape of such cargo.

Thus a type 1G ship is a gas carrier intended for the transportation of products considered to present the greatest overall hazard and types 2G/2PG and type 3G for products of progressively lesser hazards. Accordingly, a type 1G ship should survive the most severe standard of damage and its cargo tanks should be located at the maximum prescribed distance inboard from the shell plating.

2.1.3. The ship type required for individual products is indicated in column "c" in the table of chapter 19.

2.1.4. If a ship is intended to carry more than one product listed in chapter 19, the standard of damage should correspond to that product having the most stringent ship type requirement. The requirements for the location of individual cargo tanks, however, are those for ship types related to the respective products intended to be carried.

## 2.2. *Freeboard and intact stability*

2.2.1. Ships subject to the Code may be assigned the minimum freeboard permitted by the International Convention on Load Lines in force. However, the draught associated with the assignment should not be greater than the maximum draught otherwise permitted by this Code.

2.2.2. The stability of the ship in all seagoing conditions and during loading and unloading cargo should be to a standard which is acceptable to the Administration.

2.2.3. When calculating the effect of free surfaces of consumable liquids for loading conditions it should be assumed that, for each type of liquid, at least one transverse pair or a single centre tank has a free surface and the tank or combination of tanks to be taken into account should be those where the effect of free surfaces is the greatest. The free surface effect in undamaged compartments should be calculated by a method acceptable to the Administration.

2.2.4. Solid ballast should not normally be used in double bottom spaces in the cargo area. Where, however, because of stability considerations, the fitting of solid ballast in such spaces becomes unavoidable, then its disposition should be governed by the need to ensure that the impact loads resulting from bottom damage are not directly transmitted to the cargo tank structure.

2.2.5. The master of the ship should be supplied with a Loading and Stability Information booklet. This booklet should contain details of typical service conditions, loading, unloading and ballasting operations, provisions for evaluating other conditions of loading and a summary of the ship's survival capabilities. In addition, the booklet should contain sufficient information to enable the master to load and operate the ship in a safe and seaworthy manner.

## 2.3. *Shipside discharges below the freeboard deck*

2.3.1. The provision and control of valves fitted to discharges led through the shell from spaces below the freeboard deck or from within the superstructures and deekhouses on the

freeboard deck fitted with weathertight doors should comply with the requirements of the relevant regulation of the International Convention on Load Lines in force, except that the choice of valves should be limited to:

- .1 One automatic non-return valve with a positive means of closing from above the freeboard deck; or
- .2 Where the vertical distance from the summer load waterline to the inboard end of the discharge pipe exceeds  $0.01L$ , two automatic non-return valves without positive means of closing, provided that the inboard valve is always accessible for examination under service conditions.

2.3.2. For the purpose of this chapter "summer load waterline" and "freeboard deck", have the meanings defined in the International Convention on Load Lines in force.

2.3.3. The automatic non-return valves referred to in 2.3.1.1 and 2.3.1.2 should be of a type acceptable to the Administration and should be fully effective in preventing admission of water into the ship, taking into account the sinkage, trim and heel in survival requirements in 2.9.

#### 2.4. *Conditions of loading*

Damage survival capability should be investigated on the basis of loading information submitted to the Administration for all anticipated conditions of loading and variations in draught and trim. The survival requirements need not be applied to the ship when in the ballast condition\*, provided that any cargo retained on board is solely used for cooling, circulation or fuelling purposes.

#### 2.5. *Damage assumptions*

2.5.1. The assumed maximum extent of damage should be:

- .1 Side damage:
  - .1.1 Longitudinal extent:  $1/3L^{2/3}$  or 14.5 m, whichever is less
  - .1.2 Transverse extent:  $B/5$  or 11.5 m, whichever is less  
measured inboard from the ship's side at right angles to the centreline at the level of the summer load line
  - .1.3 Vertical extent: Upwards without limit  
from the moulded line of the bottom shell plating at centreline
- .2 Bottom damage:
 

For  $0.3L$  from the forward perpendicular of the ship

  - .2.1 Longitudinal extent:  $1/3L^{2/3}$  or 14.5 m, whichever is less
  - .2.2 Transverse extent:  $B/6$  or 10 m, whichever is less
  - .2.3 Vertical extent:  $B/15$  or 2 m, whichever is less measured from the moulded line of the bottom shell plating at centreline (see 2.6.3)

Any other part of the ship

  - .2.1 Longitudinal extent:  $1/3L^{2/3}$  or 5 m, whichever is less
  - .2.2 Transverse extent:  $B/6$  or 5 m, whichever is less
  - .2.3 Vertical extent:  $B/15$  or 2 m, whichever is less measured from the moulded line of the bottom shell plating at centreline (see 2.6.3)

#### 2.5.2. *Other damage:*

- .1 If any damage of a lesser extent than the maximum damage specified in 2.5.1 would result in a more severe condition, such damage should be assumed.

\* The cargo content of small independent purge tanks on deck need not be taken into account when assessing the ballast condition.

- .2 Local side damage anywhere in the cargo area extending inboard 760 mm measured normal to the hull shell should be considered and transverse bulkheads should be assumed damaged when also required by the applicable subparagraphs of 2.8.1.

#### 2.6. Location of cargo tanks

2.6.1. Cargo tanks should be located at the following distances inboard:

- .1 Type 1G ships: from the side shell plating not less than the transverse extent of damage specified in 2.5.1.1.2 and from the moulded line of the bottom shell plating at centreline not less than the vertical extent of damage specified in 2.5.1.2.3 and nowhere less than 760 mm from the shell plating.
- .2 Types 2G/2PG and 3G ships: from the moulded line of the bottom shell plating at centreline not less than the vertical extent of damage specified in 2.5.1.2.3 and nowhere less than 760 mm from the shell plating.

2.6.2. For the purpose of tank location, the vertical extent of bottom damage should be measured to the inner bottom when membrane or semi-membrane tanks are used, otherwise to the bottom of the cargo tanks. The transverse extent of side damage should be measured to the longitudinal bulkhead when membrane or semi-membrane tanks are used, otherwise to the side of the cargo tanks (see figure 2.1). For internal insulation tanks the extent of damage should be measured to the supporting tank plating.

2.6.3. Except for type 1G ships, suction wells installed in cargo tanks may protrude into the vertical extent of bottom damage specified in 2.5.1.2.3 provided that such wells are as small as practicable and the protrusion below the inner bottom plating does not exceed 25% of the depth of the double bottom or 350 mm, whichever is less. Where there is no double bottom, the protrusion below the upper limit of bottom damage should not exceed 350 mm. Suction wells installed in accordance with this paragraph may be ignored in determining the compartments affected by damage.

#### 2.7. Flooding assumptions

2.7.1. The requirements of 2.9 should be confirmed by calculations which take into consideration the design characteristics of the ship; the arrangements, configuration and contents of the damaged compartments; the distribution, relative densities and the free surface effects of liquids; and the draught and trim for all conditions of loading.

2.7.2. The permeabilities of spaces assumed to be damaged should be as follows:

<i>Spaces</i>	<i>Permeabilities</i>
Appropriated to stores . . . . .	0.60
Occupied by accommodation . . . . .	0.95
Occupied by machinery . . . . .	0.85
Voids . . . . .	0.95
Intended for consumable liquids . . . . .	0 to 0.95*
Intended for other liquids . . . . .	0 to 0.95*

\* The permeability of partially filled compartments should be consistent with the amount of liquid carried in the compartment.

2.7.3. Wherever damage penetrates a tank containing liquids, it should be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.

2.7.4. Where the damage between transverse watertight bulkheads is envisaged as specified in 2.8.1.4, .5, and .6, transverse bulkheads should be spaced at least at a distance equal to the longitudinal extent of damage specified in 2.5.1.1.1 in order to be considered effective. Where transverse bulkheads are spaced at a lesser distance, one or more of these bulkheads within such extent of damage should be assumed as nonexistent for the purpose of determining flooded compartments. Further, any portion of a transverse bulkhead bounding side compartments or double bottom compartments should be assumed damaged if the watertight bulkhead boundaries are within the extent of vertical or horizontal penetration required by 2.5.



Also, any transverse bulkhead should be assumed damaged if it contains a step or recess of more than 3 m in length located within the extent of penetration of assumed damage. The step formed by the after peak bulkhead and after peak tank top should not be regarded as a step for the purpose of this paragraph.

2.7.5. The ship should be so designed as to keep unsymmetrical flooding to the minimum consistent with efficient arrangements.

2.7.6. Equalization arrangements requiring mechanical aids such as valves or cross-levelling pipes, if fitted, should not be considered for the purpose of reducing an angle of heel or attaining the minimum range of residual stability to meet the requirements of 2.9.1 and sufficient residual stability should be maintained during all stages where equalization is used. Spaces which are linked by ducts of large cross-sectional area may be considered to be common.

2.7.7. If pipes, ducts, trunks or tunnels are situated within the assumed extent of damage penetration, as defined in 2.5, arrangements should be such that progressive flooding cannot thereby extend to compartments other than those assumed to be flooded for each case of damage.

2.7.8. The buoyancy of any superstructure directly above the side damage should be disregarded. The unflooded parts of superstructures beyond the extent of damage, however, may be taken into consideration provided that:

- .1 They are separated from the damaged space by watertight divisions and the requirements of 2.9.1.2.1 in respect of these intact spaces are complied with; and
- .2 Openings in such divisions are capable of being closed by remotely operated sliding watertight doors and unprotected openings are not immersed within the minimum range of residual stability required in 2.9.1; however the immersion of any other openings capable of being closed weathertight may be permitted.

## 2.8. *Standard of damage*

2.8.1. Ships should be capable of surviving the damage indicated in 2.5 with the flooding assumptions in 2.7 to the extent determined by the ship's type according to the following standards:

- .1 A type 1G ship should be assumed to sustain damage anywhere in its length;
- .2 A type 2G ship of more than 150 m in length should be assumed to sustain damage anywhere in its length;
- .3 A type 2G ship of 150 m in length or less should be assumed to sustain damage anywhere in its length except involving either of the bulkheads bounding a machinery space located aft;
- .4 A type 2PG ship should be assumed to sustain damage anywhere in its length except involving transverse bulkheads spaced further apart than the longitudinal extent of damage as specified in 2.5.1.1.1;
- .5 A type 3G ship of 125 m in length or more should be assumed to sustain damage anywhere in its length except involving transverse bulkheads spaced further apart than the longitudinal extent of damage specified in 2.5.1.1.1;
- .6 A type 3G ship less than 125 m in length should be assumed to sustain damage anywhere in its length except involving transverse bulkheads spaced further apart than the longitudinal extent of damage specified in 2.5.1.1.1 and except damage involving the machinery space when located aft. However, the ability to survive the flooding of the machinery space should be considered by the Administration.

2.8.2. In the case of small type 2G/2PG and 3G ships which do not comply in all respects with the appropriate requirements of 2.8.1.3, .4, and .6, special dispensations may only be considered by the Administration provided that alternative measures can be taken which maintain the same degree of safety. The nature of the alternative measures should be approved and clearly stated and be available to the port Administration. Any such dispensation should be duly noted on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk referred to in 1.5.4.

### 2.9. Survival requirements

Ships subject to the Code should be capable of surviving the assumed damage specified in 2.5 to the standard provided in 2.8 in a condition of stable equilibrium and should satisfy the following criteria.

#### 2.9.1. In any stage of flooding:

- .1 The waterline, taking into account sinkage, heel and trim, should be below the lower edge of any opening through which progressive flooding or downflooding may take place. Such openings should include air pipes and openings which are closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight man-hole covers and watertight flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors, and sidescuttles of the non-opening type;
- .2 The maximum angle of heel due to unsymmetrical flooding should not exceed 30°; and
- .3 The residual stability during intermediate stages of flooding should be to the satisfaction of the Administration. However, it should never be significantly less than that required by 2.9.2.1.

#### 2.9.2. At final equilibrium after flooding:

- .1 The righting lever curve should have a minimum range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 0.1 m within the 20° range; the area under the curve within this range should not be less than 0.0175 m/rad. Unprotected openings should not be immersed within this range unless the space concerned is assumed to be flooded. Within this range, the immersion of any of the openings listed in 2.9.1.1 and other openings capable of being closed weathertight may be permitted; and
- .2 The emergency source of power should be capable of operating.

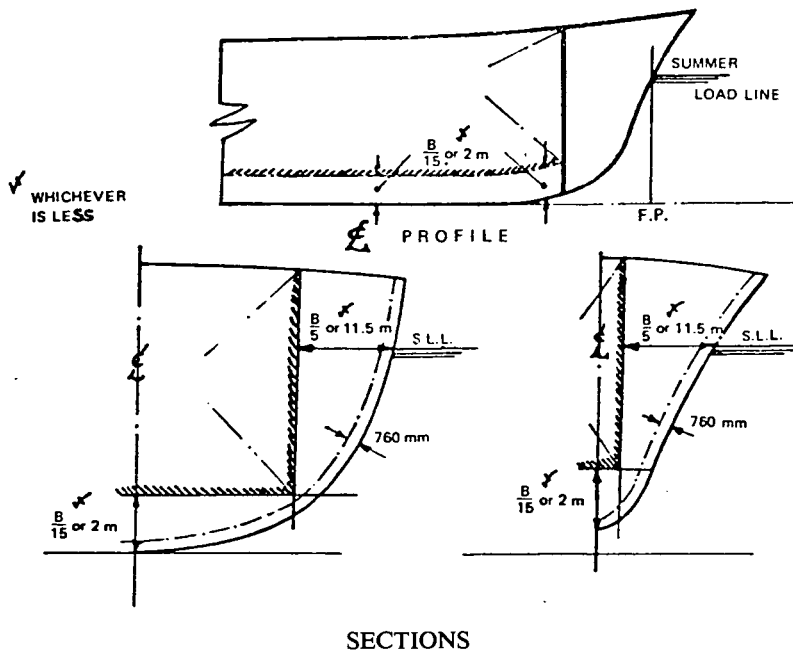


FIGURE 2.1. TANK LOCATION REQUIREMENTS AS SET OUT IN 2.6.

### Chapter 3. SHIP ARRANGEMENTS

#### 3.1. Segregation of the cargo area

3.1.1. Hold spaces should be segregated from machinery and boiler spaces, accommodation spaces, service spaces and control stations, chain lockers, drinking and domestic water tanks and from stores. Hold spaces should be located forward of machinery spaces of category A, other than those deemed necessary by the Administration for the safety or navigation of the ship.

3.1.2. Where cargo is carried in a cargo containment system not requiring a secondary barrier, segregation of hold spaces from spaces referred to in 3.1.1 or spaces either below or outboard of the hold spaces may be effected by cofferdams, fuel oil tanks or a single gastight bulkhead of all-welded construction forming an A-60 class division. A gastight A-0 class division is satisfactory if there is no source of ignition or fire hazard in the adjoining spaces.

3.1.3. Where cargo is carried in a cargo containment system requiring a secondary barrier, segregation of hold spaces from spaces referred to in 3.1.1 or spaces either below or outboard of the hold spaces which contain a source of ignition or fire hazard should be effected by cofferdams or fuel oil tanks. If there is no source of ignition or fire hazard in the adjoining space, segregation may be by a single A-0 class division which is gastight.

3.1.4. When cargo is carried in a cargo containment system requiring a secondary barrier:

- .1 At temperatures below  $-10^{\circ}\text{C}$ , hold spaces should be segregated from the sea by a double bottom; and
- .2 At temperatures below  $-55^{\circ}\text{C}$ , the ship should also have a longitudinal bulkhead forming side tanks.

3.1.5. Any piping system which may contain cargo or cargo vapour should:

- .1 Be segregated from other piping systems, except where interconnections are required for cargo-related operations such as purging, gas-freeing or inerting. In such cases, precautions should be taken to ensure that cargo or cargo vapour cannot enter such other piping systems through the inter-connections;
- .2 Except as provided in chapter 16, not pass through any accommodation space, service space or control station or through a machinery space other than a cargo pump room or cargo compressor space;
- .3 Be connected into the cargo containment system directly from the open deck except that pipes installed in a vertical trunkway or equivalent may be used to traverse void spaces above a cargo containment system and except that pipes for drainage, venting or purging may traverse cofferdams;
- .4 Except for bow or stern loading and unloading arrangements in accordance with 3.8 and emergency cargo jettisoning piping systems in accordance with 3.1.6, and except in accordance with chapter 16, be located in the cargo area above the open deck; and
- .5 Except for thwartship shore connection piping not subject to internal pressure at sea or emergency cargo jettisoning piping systems, be located inboard of the transverse tank location requirements of 2.6.1.

3.1.6. Any emergency cargo jettisoning piping system should comply with 3.1.5 as appropriate and may be led aft externally to accommodation spaces, service spaces or control stations or machinery spaces, but should not pass through them. If an emergency cargo jettisoning piping system is permanently installed a suitable means of isolation from the cargo piping should be provided within the cargo area.

3.1.7. Arrangements should be made for sealing the weather decks in way of openings for cargo containment systems.

### 3.2. *Accommodation, service and machinery spaces and control stations*

3.2.1. No accommodation space, service space or control station should be located within the cargo area. The bulkhead of accommodation spaces, service spaces or control stations which face the cargo area should be so located as to avoid the entry of gas from the hold space to such spaces through a single failure of a deck or bulkhead on a ship having a containment system requiring a secondary barrier.

3.2.2. 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, service and machinery spaces and control stations in relation to cargo piping, cargo vent systems and machinery space exhausts from gas burning arrangements.

3.2.3. Access through doors, gastight or otherwise, should not be permitted from a gas-safe space to a gas-dangerous space, except for access to service spaces forward of the cargo area through air-locks as permitted by 3.6.1 when accommodation spaces are aft.

3.2.4. Entrances, air inlets and openings to accommodation spaces, service spaces and control stations should not face the cargo area. They should be located on the end bulkhead not facing the cargo area or on the outboard side of the house or on both at a distance of at least 4% of the length of the ship but not less than 3 m from the end of the house facing the cargo area. This distance, however, need not exceed 5 m. Windows and sidescuttles facing the cargo area and on the sides of the houses within the distance mentioned above should be of the fixed (non-opening) type. Wheelhouse windows may be non-fixed and wheelhouse doors may be located within the above limits so long as they are so designed that a rapid and efficient gas and vapour tightening of the wheelhouse can be ensured. For ships dedicated to the carriage of cargoes which have neither flammable nor toxic hazards, the Administration may approve relaxations from the above requirements.

3.2.5. Sidescuttles in the shell below the uppermost continuous deck and in the first tier of the superstructure are to be of the fixed (non-opening) type.

3.2.6. All air intakes and openings into the accommodation spaces, service spaces and control stations should be fitted with closing devices. For toxic gases they are to be operated from inside the space.

### 3.3. *Cargo pump rooms and cargo compressor rooms*

3.3.1.1. Cargo pump rooms and cargo compressor rooms should be situated above the weather deck and located within the cargo area unless specially approved by the Administration. Cargo compressor rooms should be treated as cargo pump rooms for the purpose of fire protection according to regulation 11-2/58 of the 1983 SOLAS amendments.

3.3.1.2. When cargo pump rooms and cargo compressor rooms are permitted to be fitted above or below the weather deck at the after end of the aftermost hold space or at the forward end of the forwardmost hold space, the limits of the cargo area as defined in 1.3.6 should be extended to include the cargo pump rooms and cargo compressor rooms for the full breadth and depth of the ship and deck areas above those spaces.

3.3.1.3. Where the limits of the cargo area are extended by 3.3.1.2, the bulkhead which separates the cargo pump rooms and cargo compressor rooms from accommodation and service spaces, control stations and machinery spaces of category A should be so located as to avoid the entry of gas to these spaces through a single failure of a deck or bulkhead.

3.3.2. Where pumps and compressors are driven by shafting passing through a bulk head or deck, gastight seals with efficient lubrication or other means of ensuring the permanence of the gas seal should be fitted in way of the bulkhead or deck.

3.3.3. Arrangements of cargo pump rooms and cargo compressor rooms should be such as to ensure safe unrestricted access for personnel wearing protective clothing and breathing apparatus, and in the event of injury to allow unconscious personnel to be removed. All valves necessary for cargo handling should be readily accessible to personnel wearing protective

clothing. Suitable arrangements should be made to deal with drainage of pump and compressor rooms.

#### 3.4. *Cargo control rooms*

3.4.1. Any cargo control room should be above the weather deck and may be located in the cargo area. The cargo control room may be located within the accommodation spaces, service spaces or control stations provided the following conditions are complied with:

- .1 The cargo control room is a gas-safe space; and
- .2.1 If the entrance complies with 3.2.4, the control room may have access to the spaces described above;
- .2.2 If the entrance does not comply with 3.2.4, the control room should have no access to the spaces described above and the boundaries to such spaces should be insulated to "A-60" class integrity.

3.4.2. If the cargo control room is designed to be a gas-safe space, instrumentation should, as far as possible, be by indirect reading systems and should in any case be designed to prevent any escape of gas into the atmosphere of that space. Location of the gas detector within the cargo control room will not violate the gas-safe space if installed in accordance with 13.6.5.

3.4.3. If the cargo control room for ships carrying flammable cargoes is a gas-dangerous space, sources of ignition should be excluded. Consideration should be paid to the safety characteristics of any electrical installations.

#### 3.5. *Access to spaces in the cargo area*

3.5.1. Visual inspection should be possible of at least one side of the inner hull structure without the removal of any fixed structure or fitting. If such a visual inspection, whether combined with those inspections required in 3.5.2, 4.7.7 or 4.10.16 or not, is only possible at the outer face of the inner hull, the inner hull should not be a fuel-oil tank boundary wall.

3.5.2. Inspection of one side of any insulation in hold spaces should be possible. If the integrity of the insulation system can be verified by inspection of the outside of the hold space boundary when tanks are at service temperature, inspection of one side of the insulation in the hold space need not be required.

3.5.3. Arrangements for hold spaces, void spaces and other spaces that could be considered gas-dangerous and cargo tanks should be such as to allow entry and inspection of any such space by personnel wearing protective clothing and breathing apparatus and in the event of injury to allow unconscious personnel to be removed from the space and should comply with the following:

- .1 Access should be provided:
  - .1.1 To cargo tanks direct from the open deck;
  - .1.2 Through horizontal openings, hatches or manholes, the dimensions of which 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 by 600 mm; and
  - .1.3 Through vertical openings, or manholes providing passage through the length and breadth of the space, the minimum clear opening of which should be not less than 600 mm by 800 mm at a height of not more than 600 mm from the bottom plating unless gratings or other footholds are provided.
- .2 The dimensions referred to in 3.5.3.1.2 and .1.3 may be decreased if the ability to traverse such openings or to remove an injured person can be proved to the satisfaction of the Administration.

.3 The requirements of 3.5.3.1.2 and .1.3 do not apply to spaces described in 1.3.17.5. Such spaces should be provided only with direct or indirect access from the open weather deck, not including an enclosed gas-safe space.

3.5.4. Access from the open weather deck to gas-safe spaces should be located in a gas-safe zone at least 2.4 m above the weather deck unless the access is by means of an air-lock in accordance with 3.6.

### 3.6. *Air-locks*

3.6.1. An air-lock should only be permitted between a gas-dangerous zone on the open weather deck and a gas-safe space and should consist of two steel doors substantially gas-tight spaced at least 1.5 m but not more than 2.5 m apart.

3.6.2. The doors should be self-closing and without any holding back arrangements.

3.6.3. An audible and visual alarm system to give a warning on both sides of the air-lock should be provided to indicate if more than one door is moved from the closed position.

3.6.4. In ships carrying flammable products, electrical equipment which is not of the certified safe type in spaces protected by air-locks should be de-energized upon loss of overpressure in the space (see also 10.2.5.4). Electrical equipment which is not of the certified safe type for manoeuvring, anchoring and mooring equipment as well as the emergency fire pumps should not be located in spaces to be protected by air-locks.

3.6.5. The air-lock space should be mechanically ventilated from a gas-safe space and maintained at an overpressure to the gas-dangerous zone on the open weather deck.

3.6.6. The air-lock space should be monitored for cargo vapour.

3.6.7. Subject to the requirements of the International Convention on Load Lines in force, the door sill should not be less than 300 mm in height.

### 3.7. *Bilge, ballast and fuel oil arrangements*

3.7.1.1. Where cargo is carried in a cargo containment system not requiring a secondary barrier, hold spaces should be provided with suitable drainage arrangements not connected with the machinery space. Means of detecting any leakage should be provided.

3.7.1.2. Where there is a secondary barrier, suitable drainage arrangements for dealing with any leakage into the hold or insulation spaces through adjacent ship structure should be provided. The suction should not be led to pumps inside the machinery space. Means of detecting such leakage should be provided.

3.7.2. The interbarrier space should be provided with a drainage system suitable for handling liquid cargo in the event of cargo tank leakage or rupture. Such arrangements should provide for the return of leakage to the cargo tanks.

3.7.3. In case of internal insulation tanks, means of detecting leakage and drainage arrangements are not required for interbarrier spaces and spaces between the secondary barrier and the inner hull or independent tank structure which are completely filled by insulation material complying with 4.9.7.2.

3.7.4. Ballast spaces, fuel oil tanks and gas-safe spaces may be connected to pumps in the machinery spaces. Duct keels may be connected to pumps in the machinery spaces, provided the connections are led directly to the pumps and the discharge from the pumps led directly overboard with no valves or manifolds in either line which could connect the line from the duct keel to lines serving gas-safe spaces. Pump vents should not be open to machinery spaces.

### 3.8. *Bow or stern loading and unloading arrangements*

3.8.1. Subject to the approval of the Administration and to the requirements of this section, cargo piping may be arranged to permit bow or stern loading and unloading.

3.8.1.1. Bow or stern loading and unloading lines which are led past accommodation spaces, service spaces or control stations should not be used for the transfer of products requir-

ing a type 1G ship. Bow or stern loading and unloading lines should not be used for the transfer of toxic products as specified in 1.3.38 unless specifically approved by the Administration.

3.8.2. Portable arrangements should not be permitted.

3.8.3. In addition to the requirements of chapter 5 the following provisions apply to cargo piping and related piping equipment:

- .1 Cargo piping and related piping equipment outside the cargo area should have only welded connections. The piping outside the cargo area should run on the open deck and should be at least 760 mm inboard except for thwartships shore connection piping. Such piping should be clearly identified and fitted with a shutoff valve at its connection to the cargo piping system within the cargo area. At this location, it should also be capable of being separated by means of a removable spool piece and blank flanges when not in use.
- .2 The piping is to be full penetration butt welded, and fully radiographed regardless of pipe diameter and design temperature. Flange connections in the piping are only permitted within the cargo area and at the shore connection.
- .3 Arrangements should be made to allow such piping to be purged and gas-freed after use. When not in use, the spool pieces should be removed and the pipe ends be blank-flanged. The vent pipes connected with the purge should be located in the cargo area.

3.8.4. Entrances, air inlets and openings to accommodation spaces, service spaces, machinery spaces and control stations should not face the cargo shore connection location of bow or stern loading and unloading arrangements. They should be located on the outboard side of the superstructure or deckhouse at a distance of at least 4% of the length of the ship but not less than 3 m from the end of the house facing the cargo shore connection location of the bow or stern loading and unloading arrangements. This distance, however, need not exceed 5 m. Side-scuttles facing the shore connection location and on the sides of the superstructure or deckhouse within the distance mentioned above should be of the fixed (non-opening) type. In addition, during the use of the bow or stern loading and unloading arrangements, all doors, ports and other openings on the corresponding superstructure or deckhouse side should be kept closed. Where, in the case of small ships, compliance with 3.2.4 and this paragraph is not possible, the Administration may approve relaxations from the above requirements.

3.8.5. Deck openings and air inlets to spaces within distances of 10 m from the cargo shore connection location should be kept closed during the use of bow or stern loading or unloading arrangements.

3.8.6. Electrical equipment within a zone of 3 m from the cargo shore connection location should be in accordance with chapter 10.

3.8.7. Fire-fighting arrangements for the bow or stern loading and unloading areas should be in accordance with 11.3.1.3 and 11.4.7.

3.8.8. Means of communication between the cargo control station and the shore connection location should be provided and if necessary certified safe.

#### *Chapter 4. CARGO CONTAINMENT*

##### *4.1. General*

4.1.1. Administrations should take appropriate steps to ensure uniformity in the implementation and application of the provisions of this chapter\*.

4.1.2. In addition to the definitions in 1.3, the definitions given in this chapter apply throughout the Code.

\* Reference is made to the published Rules of members and associate members of the International Association of Classification Societies and in particular to IACS Unified Requirements Nos. G1 and G2.

## 4.2. Definitions

### 4.2.1. Integral tanks

4.2.1.1. Integral tanks form a structural part of the ship's hull and are influenced in the same manner and by the same loads which stress the adjacent hull structure.

4.2.1.2. The design vapour pressure  $P_o$  as defined in 4.2.6 should not normally exceed 0.25 bar. If, however, the hull scantlings are increased accordingly,  $P_o$  may be increased to a higher value but less than 0.7 bar.

4.2.1.3. Integral tanks may be used for products provided the boiling point of the cargo is not below  $-10^{\circ}\text{C}$ . A lower temperature may be accepted by the Administration subject to special consideration.

### 4.2.2. Membrane tanks

4.2.2.1. Membrane tanks are non-self-supporting tanks which consist of a thin layer (membrane) supported through insulation by the adjacent hull structure. The membrane is designed in such a way that thermal and other expansion or contraction is compensated for without undue stressing of the membrane.

4.2.2.2. The design vapour pressure  $P_o$  should not normally exceed 0.25 bar. If, however, the hull scantlings are increased accordingly and consideration is given, where appropriate, to the strength of the supporting insulation,  $P_o$  may be increased to a higher value but less than 0.7 bar.

4.2.2.3. The definition of membrane tanks does not exclude designs such as those in which non-metallic membranes are used or in which membranes are included or incorporated in insulation. Such designs require, however, special consideration by the Administration. In any case the thickness of the membranes should normally not exceed 10 mm.

### 4.2.3. Semi-membrane tanks

4.2.3.1. Semi-membrane tanks are non-self-supporting tanks in the loaded condition and consist of a layer, parts of which are supported through insulation by the adjacent hull structure, whereas the rounded parts of this layer connecting the above-mentioned supported parts are designed also to accommodate the thermal and other expansion or contraction.

4.2.3.2. The design vapour pressure  $P_o$  should not normally exceed 0.25 bar. If, however, the hull scantlings are increased accordingly, and consideration is given, where appropriate, to the strength of the supporting insulation,  $P_o$  may be increased to a higher value but less than 0.7 bar.

### 4.2.4. Independent tanks

4.2.4.1. Independent tanks are self-supporting; they do not form part of the ship's hull and are not essential to the hull strength. There are three categories of independent tanks referred to in 4.2.4.2 to 4.2.4.4.

4.2.4.2. Type A independent tanks are tanks which are designed primarily using Recognized Standards\* of classical ship-structural analysis procedures. Where such tanks are primarily constructed of plane surfaces (gravity tanks), the design vapour pressure  $P_o$  should be less than 0.7 bar.

4.2.4.3. Type B independent tanks are tanks which are designed using model tests, refined analytical tools and analysis methods to determine stress levels, fatigue life and crack propagation characteristics. Where such tanks are primarily constructed of plane surfaces (gravity tanks) the design vapour pressure  $P_o$  should be less than 0.7 bar.

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\* Recognized Standards for the purpose of chapters 4, 5 and 6 are standards laid down and maintained by a classification society recognized by the Administration.



4.2.4.4. Type C independent tanks (also referred to as pressure vessels) are tanks meeting pressure vessel criteria and having a design vapour pressure not less than:

$$P_o = 2 + AC (p_r)^{1.5} \quad (\text{bar})$$

$$\text{where: } A = 0.0185 \left( \frac{\sigma_m}{\Delta\sigma_A} \right)^2$$

with

$\sigma_m$  = design primary membrane stress

$\Delta\sigma_A$  = allowable dynamic membrane stress (double amplitude at probability level  $Q = 10^{-8}$ )

55 N/mm<sup>2</sup> for ferritic/martensitic steel

25 N/mm<sup>2</sup> for aluminium alloy (5083-0)

C = a characteristic tank dimension to be taken as the greatest of the following:

$$h; 0.75b; \text{ or } 0.45\ell$$

with

h = height of tank (dimension in ship's vertical direction) (m)

b = width of tank (dimension in ship's transverse direction) (m)

$\ell$  = length of tank (dimension in ship's longitudinal direction) (m)

$\rho_r$  = the relative density of the cargo ( $\rho_r = 1$  for fresh water) at the design temperature.

However, the Administration may allocate a tank complying with the criterion of this subparagraph to type A or type B, dependent on the configuration of the tank and the arrangement of its supports and attachments.

#### 4.2.5. Internal insulation tanks

4.2.5.1. Internal insulation tanks are non-self-supporting and consist of thermal insulation materials which contribute to the cargo containment and are supported by the structure of the adjacent inner hull or of an independent tank. The inner surface of the insulation is exposed to the cargo.

4.2.5.2. The two categories of internal insulation tanks are:

- .1 Type 1 tanks which are tanks in which the insulation or a combination of the insulation and one or more liners functions only as the primary barrier. The inner hull or an independent tank structure should function as the secondary barrier when required.
- .2 Type 2 tanks which are tanks in which the insulation or a combination of the insulation and one or more liners functions as both the primary and the secondary barrier and where these barriers are clearly distinguishable.

The term "liner" means a thin, non-self-supporting, metallic, nonmetallic or composite material which forms part of an internal insulation tank in order to enhance its fracture resistance or other mechanical properties. A liner differs from a membrane in that it is not intended to function alone as a liquid barrier.

4.2.5.3. Internal insulation tanks should be of suitable materials enabling the cargo containment system to be designed using model tests and refined analytical methods as required in 4.4.7.

4.2.5.4. The design vapour pressure  $P_o$  should not normally exceed 0.25 bar. If, however, the cargo containment system is designed for a higher vapour pressure,  $P_o$  may be increased to such higher value, but not exceeding 0.7 bar if the internal insulation tanks are supported by the inner hull structure. However, a design vapour pressure of more than 0.7 bar may be accepted by the Administration provided the internal insulation tanks are supported by suitable independent tank structures.

#### 4.2.6. *Design vapour pressure*

4.2.6.1. The design vapour pressure  $P_o$  is the maximum gauge pressure at the top of the tank which has been used in the design of the tank.

4.2.6.2. For cargo tanks where there is no temperature control and where the pressure of the cargo is dictated only by the ambient temperature,  $P_o$  should not be less than the gauge vapour pressure of the cargo at a temperature of 45°C. However, lesser values of this temperature may be accepted 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. Conversely, higher values of this temperature may be required for ships permanently operating in areas of high ambient temperature.

4.2.6.3. In all cases, including 4.2.6.2,  $P_o$  should not be less than MARVS.

4.2.6.4. Subject to special consideration by the Administration and to the limitations given in 4.2.1 to 4.2.5 for the various tank types, a vapour pressure higher than  $P_o$  may be accepted in harbour conditions, where dynamic loads are reduced.

#### 4.2.7. *Design temperature*

The design temperature for selection of materials is the minimum temperature at which cargo may be loaded or transported in the cargo tanks. Provision to the satisfaction of the Administration should be made to ensure that the tank or cargo temperature cannot be lowered below the design temperature.

### 4.3. *Design loads*

#### 4.3.1. *General*

4.3.1.1. Tanks together with their supports and other fixtures should be designed taking into account proper combinations of the following loads:

Internal pressure,  
 External pressure,  
 Dynamic loads due to the motions of the ship,  
 Thermal loads,  
 Sloshing loads,  
 Loads corresponding to ship deflection,  
 Tank and cargo weight with the corresponding reactions in way of supports,  
 Insulation weight,  
 Loads in way of towers and other attachments.

The extent to which these loads should be considered depends on the type of tank, and is more fully detailed in the following paragraphs.

4.3.1.2. Account should be taken of the loads corresponding to the pressure test referred to in 4.10.

4.3.1.3. Account should be taken of an increase of vapour pressure in harbour conditions referred to in 4.2.6.4.

4.3.1.4. The tanks should be designed for the most unfavourable static heel angle within the range 0° to 30° without exceeding allowable stresses given in 4.5.1.

#### 4.3.2. *Internal pressure*

4.3.2.1. The internal pressure head  $h_{eq}$  in bars gauge resulting from the design vapour pressure  $P_o$  and the liquid pressure  $h_{gd}$  defined in 4.3.2.2, but not including effects of liquid sloshing, should be calculated as follows:

$$h_{eq} = P_o + (h_{gd})_{max} \quad (\text{bar})$$

Equivalent calculation procedures may be applied.

4.3.2.2. The internal liquid pressures are those created by the resulting acceleration of the centre of gravity of the cargo due to the motions of the ship referred to in 4.3.4.1. The value

of internal pressure head  $h_{gd}$  resulting from combined effects of gravity and dynamic accelerations should be calculated as follows:

$$h_{gd} = a_{\beta} Z_{\beta} \frac{\rho}{1.02 \times 10^4} \quad (\text{bar})$$

where:  $a_{\beta}$  = dimensionless acceleration (i.e. relative to the acceleration of gravity), resulting from gravitational and dynamic loads, in an arbitrary direction  $\beta$  (see figure 4.1).

$Z_{\beta}$  = largest liquid height (m) above the point where the pressure is to be determined measured from the tank shell in the  $\beta$  direction (see figure 4.2). Small tank domes not considered to be part of the accepted total volume of the cargo tank need not be considered when determining  $Z_{\beta}$ .

$\rho$  = maximum cargo density ( $\text{kg}/\text{m}^3$ ) at the design temperature.

The direction which gives the maximum value ( $h_{gd}$ ) of  $h_{gd}$  should be considered. Where acceleration in three directions needs to be considered, an ellipsoid should be used instead of the ellipse in figure 4.1. The above formula applies only to full tanks.

#### 4.3.3. External pressure

External design pressure loads should be based on the difference between the minimum internal pressure (maximum vacuum) and the maximum external pressure to which any portion of the tank may be subjected simultaneously.

#### 4.3.4. Dynamic loads due to ship motions

4.3.4.1. The determination of dynamic loads should take account of the long-term distribution of ship motions, including the effects of surge, sway, heave, roll, pitch and yaw on irregular seas which the ship will experience during its operating life (normally taken to correspond to  $10^8$  wave encounters). Account may be taken of reduction in dynamic loads due to necessary speed reduction and variation of heading when this consideration has also formed part of the hull strength assessment.

4.3.4.2. For design against plastic deformation and buckling the dynamic loads should be taken as the most probable largest loads the ship will encounter during its operating life (normally taken to correspond to a probability level of  $10^{-8}$ ). Guidance formulae for acceleration components are given in 4.12.

4.3.4.3. When design against fatigue is to be considered, the dynamic spectrum should be determined by long-term distribution calculation based on the operating life of the ship (normally taken to correspond to  $10^8$  wave encounters). If simplified dynamic loading spectra are used for the estimation of the fatigue life, those should be specially considered by the Administration.

4.3.4.4. For practical application of crack propagation estimates, simplified load distribution over a period of 15 days may be used. Such distributions may be obtained as indicated in figure 4.3.

4.3.4.5. Slips for restricted service may be given special consideration.

4.3.4.6. The accelerations acting on tanks are estimated at their centre of gravity and include the following components:

Vertical acceleration: motion accelerations of heave, pitch and, possibly, roll (normal to the ship base);

Transverse acceleration: motion accelerations of sway, yaw and roll; and gravity component of roll;

Longitudinal acceleration: motion accelerations of surge and pitch; and gravity component of pitch.

#### 4.3.5. *Sloshing loads*

4.3.5.1. When partial filling is contemplated, the risk of significant loads due to sloshing induced by any of the ship motions referred to in 4.3.4.6 should be considered.

4.3.5.2. When risk of significant sloshing-induced loads is found to be present, special tests and calculations should be required.

#### 4.3.6. *Thermal loads*

4.3.6.1. Transient thermal loads during cooling down periods should be considered for tanks intended for cargo temperatures below  $-55^{\circ}\text{C}$ .

4.3.6.2. Stationary thermal loads should be considered for tanks where design supporting arrangement and operating temperature may give rise to significant thermal stresses.

#### 4.3.7. *Loads on supports*

The loads on supports are covered by 4.6.

### 4.4. *Structural analyses*

#### 4.4.1. *Integral tanks*

The structural analysis of integral tanks should be in accordance with Recognized Standards. The tank boundary scantlings should meet at least the requirements for deep tanks taking into account the internal pressure as indicated in 4.3.2, but the resulting scantlings should not be less than normally required by such standards.

#### 4.4.2. *Membrane tanks*

4.4.2.1. For membrane tanks, the effects of all static and dynamic loads should be considered to determine the suitability of the membrane and of the associated insulation with respect to plastic deformation and fatigue.

4.4.2.2. Before approval is given, a model of both the primary and secondary barriers, including corners and joints, should normally be tested to verify that they will withstand the expected combined strains due to static, dynamic and thermal loads. Test conditions should represent the most extreme service conditions the cargo containment system will see in its life. Material tests should ensure that ageing is not liable to prevent the materials from carrying out their intended function.

4.4.2.3. For the purpose of the test referred to in 4.4.2.2, a complete analysis of the particular motions, accelerations and response of ships and cargo containment systems should be performed, unless these data are available from similar ships.

4.4.2.4. Special attention should be paid to the possible collapse of the membrane due to an overpressure in the interbarrier space, to a possible vacuum in the cargo tank, to the sloshing effects and to hull vibration effects.

4.4.2.5. A structural analysis of the hull should be to the satisfaction of the Administration, taking into account the internal pressure as indicated in 4.3.2. Special attention, however, should be paid to deflections of the hull and their compatibility with the membrane and associated insulation. Inner hull plating thickness should meet at least the requirements of Recognized Standards for deep tanks taking into account the internal pressure as indicated in 4.3.2. The allowable stress for the membrane, membrane-supporting material and insulation should be determined in each particular case.

#### 4.4.3. *Semi-membrane tanks*

A structural analysis should be performed in accordance with the requirements for membrane tanks or independent tanks as appropriate, taking into account the internal pressure as indicated in 4.3.2.

#### 4.4.4. *Type A independent tanks*

4.4.4.1. A structural analysis should be performed to the satisfaction of the Administration taking into account the internal pressure as indicated in 4.3.2. The cargo tank plating

thickness should meet at least the requirements of Recognized Standards for deep tanks taking into account the internal pressure as indicated in 4.3.2 and any corrosion allowance required by 4.5.2.

4.4.4.2. For parts such as structure in way of supports not otherwise covered by Recognized Standards, stresses should be determined by direct calculations, taking into account the loads referred to in 4.3 as far as applicable, and the ship deflection in way of supports.

4.4.5. *Type B independent tanks*

For tanks of this type the following applies:

- .1 The effects of all dynamic and static loads should be used to determine the suitability of the structure with respect to:
  - Plastic deformation,
  - Buckling,
  - Fatigue failure,
  - Crack propagation.

Statistical wave load analyses in accordance with 4.3.4, finite element analyses or similar methods and fracture mechanics analyses or an equivalent approach, should be carried out.

- .2 A three-dimensional analysis should be carried out to evaluate the stress levels contributed by the ship's hull. The model for this analysis should include the cargo tank with its supporting and keying system as well as a reasonable part of the hull.
- .3 A complete analysis of the particular ship accelerations and motions in irregular waves and of the response of the ship and its cargo tanks to these forces and motions should be performed unless these data are available from similar ships.
- .4 A buckling analysis should consider the maximum construction tolerances.
- .5 Where deemed necessary by the Administration, model tests may be required to determine stress concentration factors and fatigue life of structural elements.
- .6 The cumulative effect of the fatigue load should comply with:

$$\sum \frac{n_i}{N_i} + \frac{10^3}{N_j} \leq C_w$$

where:  $n_i$  = number of stress cycles at each stress level during the life of the ship  
 $N_i$  = number of cycles to fracture for the respective stress level according to the Wöhler (S-N) curve  
 $N_j$  = number of cycles to fracture for the fatigue loads due to loading and unloading  
 $C_w$  = should be less than or equal to 0.5, except that the Administration may give special consideration to the use of a value greater than 0.5 but not greater than 1.0, dependent on the test procedure and data used to establish the Wöhler (S-N) curve.

4.4.6. *Type C independent tanks*

4.4.6.1. Scantlings based on internal pressure should be calculated as follows:

- .1 The thickness and form of pressure-containing parts of pressure vessels under internal pressure, including flanges, should be determined according to a standard acceptable to the Administration. These calculations in all cases should be based on generally accepted pressure vessel design theory. Openings in pressure-containing parts of pressure vessels should be reinforced in accordance with a standard acceptable to the Administration.
- .2 The design liquid pressure defined in 4.3.2 should be taken into account in the above calculations.

- .3 The welded joint efficiency factor to be used in the calculation according to 4.4.6.1.1 should be 0.95 when the inspection and the non-destructive testing referred to in 4.10.9 are carried out. This figure may be increased up to 1.0 when account is taken of other considerations, such as the material used, type of joints, welding procedure and type of loading. For process pressure vessels the Administration may accept partial non-destructive examinations, but not less than those of 4.10.9.2.2 depending on such factors as the material used, the design temperature, the nil ductility transition temperature of the material as fabricated, the type of joint and welding procedure, but in this case an efficiency factor of not more than 0.85 should be adopted. For special materials, the above-mentioned factors should be reduced depending on the specified mechanical properties of the welded joint.

4.4.6.2. Buckling criteria should be as follows:

- .1 The thickness and form of pressure vessels subject to external pressure and other loads causing compressive stresses should be to a standard acceptable to the Administration. These calculations in all cases should be based on generally accepted pressure vessel buckling theory and should adequately account for the difference in theoretical and actual buckling stress as a result of plate edge misalignment, ovality and deviation from true circular form over a specified arc or chord length.
- .2 The design external pressure  $P_e$  used for verifying the buckling of the pressure vessels should not be less than that given by:

$$P_e = P_1 + P_2 + P_3 + P_4 \quad (\text{bar})$$

where:  $P_1$  = setting value of vacuum relief valves. For vessels not fitted with vacuum relief valves  $P_1$  should be specially considered, but should not in general be taken as less than 0.25 bar.

$P_2$  = the set pressure of the pressure relief valves for completely closed spaces containing pressure vessels or parts of pressure vessels; elsewhere  $P_2 = 0$ .

$P_3$  = compressive actions in the shell due to the weight and contraction of insulation, weight of shell, including corrosion allowance, and other miscellaneous external pressure loads to which the pressure vessel may be subjected. These include, but are not limited to, weight of domes, weight of towers and piping, effect of product in the partially filled condition, accelerations and hull deflection. In addition the local effect of external or internal pressure or both should be taken into account.

$P_4$  = external pressure due to head of water for pressure vessels or part of pressure vessels on exposed decks; elsewhere  $P_4 = 0$ .

4.4.6.3. Stress analysis in respect of static and dynamic loads should be performed as follows:

- .1 Pressure vessel scantlings should be determined in accordance with 4.4.6.1 and .2.
- .2 Calculations of the loads and stresses in way of the supports and the shell attachment of the support should be made. Loads referred to in 4.3 should be used, as applicable. Stresses in way of the supports should be to a standard acceptable to the Administration. In special cases a fatigue analysis may be required by the Administration.
- .3 If required by the Administration, secondary stresses and thermal stresses should be specially considered.

4.4.6.4. For pressure vessels, the thickness calculated according to 4.4.6.1 or the thickness required by 4.4.6.2 plus the corrosion allowance, if any, should be considered as a minimum without any negative tolerance.

4.4.6.5. For pressure vessels, the minimum thickness of shell and heads including corrosion allowance, after forming, should not be less than 5 mm for carbon-manganese steels and nickel steels, 3 mm for austenitic steels or 7 mm for aluminium alloys.

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4.4.7. *Internal insulation tanks*

4.4.7.1. The effects of all static and dynamic loads should be considered to determine the suitability of the tank with respect to:

Fatigue failure,

Crack propagation from both free and supported surfaces,

Adhesive and cohesive strength,

Compressive, tensile and shear strength.

Statistical wave load analysis in accordance with 4.3.4, finite element analysis or similar methods and fracture mechanics analysis or an equivalent approach should be carried out.

4.4.7.2.1. Special attention should be given to crack resistance and to deflections of the inner hull or independent tank structure and their compatibility with the insulation materials. A three-dimensional structural analysis should be carried out to the satisfaction of the Administration. This analysis is to evaluate the stress levels and deformations contributed either by the inner hull or by the independent tank structure or both and should also take into account the internal pressure as indicated in 4.3.2. Where water ballast spaces are adjacent to the inner hull forming the supporting structure of the internal insulation tank, the analysis should take account of the dynamic loads caused by water ballast under the influence of ship motions.

4.4.7.2.2. The allowable stresses and associated deflections for the internal insulation tank and the inner hull structure or independent tank structure should be determined in each particular case.

4.4.7.2.3. Thicknesses of plating of the inner hull or of an independent tank should at least comply with the requirements of Recognized Standards, taking into account the internal pressure as indicated in 4.3.2. Tanks constructed of plane surfaces should at least comply with Recognized Standards for deep tanks.

4.4.7.3. A complete analysis of the response of ship, cargo and any ballast to accelerations and motions in irregular waves of the particular ship should be performed to the satisfaction of the Administration unless such analysis is available for a similar ship.

4.4.7.4.1. In order to confirm the design principles, prototype testing of composite models including structural elements should be carried out under combined effects of static, dynamic and thermal loads.

4.4.7.4.2. Test conditions should represent the most extreme service conditions the cargo containment system will be exposed to during the lifetime of the ship, including thermal cycles. For this purpose, 400 thermal cycles are considered to be a minimum, based upon 19 round voyages per year; where more than 19 round voyages per year are expected, a higher number of thermal cycles will be required. These 400 thermal cycles may be divided into 20 full cycles (cargo temperature to 45°C) and 380 partial cycles (cargo temperature to that temperature expected to be reached in the ballast voyage).

4.4.7.4.3. Models should be representative of the actual construction including corners, joints, pump mounts, piping penetrations and other critical areas, and should take into account variations in any material properties, workmanship and quality control.

4.4.7.4.4. Combined tension and fatigue tests should be carried out to evaluate crack behaviour of the insulation material in the case where a through crack develops in the inner hull or independent tank structure. In these tests, where applicable the crack area should be subjected to the maximum hydrostatic pressure of the ballast water.

4.4.7.5. The effects of fatigue loading should be determined in accordance with 4.4.5.6 or by an equivalent method.

4.4.7.6. For internal insulation tanks, repair procedures should be developed during the prototype testing programme for both the insulation material and the inner hull or the independent tank structure.

4.5. *Allowable stresses and corrosion allowances*

4.5.1. *Allowable stresses*

4.5.1.1. For integral tanks, allowable stresses should normally be those given for hull structure in Recognized Standards.

4.5.1.2. For membrane tanks, reference is made to the requirements of 4.4.2.5.

4.5.1.3. For type A independent tanks primarily constructed of plane surfaces, the stresses for primary and secondary members (stiffeners, web frames, stringers, girders) when calculated by classical analysis procedures should not exceed the lower of  $R_m/2.66$  or  $R_e/1.33$  for carbon-manganese steels and aluminium alloys, where  $R_m$  and  $R_e$  are defined in 4.5.1.7. However, if detailed calculations are carried out for the primary members, the equivalent stress  $C$  as defined in 4.5.1.8 may be increased over that indicated above to a stress acceptable to the Administration; calculations should take into account the effects of bending, shear, axial and torsional deformation as well as the hull/cargo tank interaction forces due to the deflection of the double bottom and cargo tank bottoms.

4.5.1.4. For type B independent tanks, primarily constructed of bodies of revolution, the allowable stresses should not exceed:

$$\begin{aligned}\sigma_m &\leq f \\ \sigma_L &\leq 1.5 f \\ \sigma_b &\leq 1.5 F \\ \sigma_L + \sigma_b &\leq 1.5 F \\ \sigma_m + \sigma_b &\leq 1.5 F\end{aligned}$$

where:  $\sigma_m$  = equivalent primary general membrane stress

$\sigma_L$  = equivalent primary local membrane stress

$\sigma_b$  = equivalent primary bending stress

$f$  = the lesser of  $\frac{R_m}{A}$  or  $\frac{R_e}{B}$

$F$  = the lesser of  $\frac{R_m}{C}$  or  $\frac{R_e}{D}$

with  $R_m$  and  $R_e$  as defined in 4.5.1.7. With regard to the stresses  $\sigma_m$ ,  $\sigma_L$  and  $\sigma_b$  see also the definition of stress categories in 4.13. The values of A, B, C and D should be shown on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk and should have at least the following minimum values:

	<i>Nickel steels and carbon-manganese steels</i>	<i>Austenitic steels</i>	<i>Aluminum alloys</i>
A	3	3.5	4
B	2	1.6	1.5
C	3	3	3
D	1.5	1.5	1.5

4.5.1.5. For type B independent tanks, primarily constructed of plane surfaces, the Administration may require compliance with additional or other stress criteria.



4.5.1.6. For type C independent tanks the maximum allowable membrane stress to be used in calculation according to 4.4.6.1.1 should be the lower of:

$$\frac{R_m}{A} \text{ or } \frac{R_e}{B}$$

where:  $R_m$  and  $R_e$  are as defined in 4.5.1.7.

The values of A and B should be shown on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk provided for in 1.5, and should have at least the minimum values indicated in the table of 4.5.1.4.

4.5.1.7. For the purpose of 4.5.1.3, 4.5.1.4 and 4.5.1.6 the following apply:

1.  $R_e$  = specified minimum yield stress at room temperature (N/mm<sup>2</sup>). If the stress-strain curve does not show a defined yield stress, the 0.2% proof stress applies.  
 $R_m$  = specified minimum tensile strength at room temperature (N/mm<sup>2</sup>).

For welded connections in aluminium alloys the respective values of  $R_e$  or  $R_m$  in annealed conditions should be used.

2. The above properties should correspond to the minimum specified mechanical properties of the material, including the weld metal in the as-fabricated condition. Subject to special consideration by the Administration, account may be taken of enhanced yield stress and tensile strength at low temperature. The temperature on which the material properties are based should be shown on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk provided for in 1.5.

4.5.1.8. The equivalent stress  $\sigma_C$  (von Mises, Huber) should be determined by:

$$\sigma_C = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}^2}$$

where:  $\sigma_x$  = total normal stress in x-direction

$\sigma_y$  = total normal stress in y-direction

$\tau_{xy}$  = total shear stress in x-y plane.

4.5.1.9. When the static and dynamic stresses are calculated separately and unless other methods of calculation are justified, the total stresses should be calculated according to:

$$\sigma_x = \sigma_{x.st} \pm \sqrt{\sum (\sigma_{x.dyn})^2}$$

$$\sigma_y = \sigma_{y.st} \pm \sqrt{\sum (\sigma_{y.dyn})^2}$$

$$\tau_{xy} = \tau_{xy.st} \pm \sqrt{\sum (\tau_{xy.dyn})^2}$$

where:  $\sigma_{x.st}$ ,  $\sigma_{y.st}$  and  $\tau_{xy.st}$  = static stresses

$\sigma_{x.dyn}$ ,  $\sigma_{y.dyn}$  and  $\tau_{xy.dyn}$  = dynamic stresses

all determined separately from acceleration components and hull strain components due to deflection and torsion.

4.5.1.10. For internal insulation tanks, reference is made to the requirement of 4.4.7.2.

4.5.1.11. Allowable stresses for materials other than those covered by chapter 6 should be subject to approval by the Administration in each case.

4.5.1.12. Stresses may be further limited by fatigue analysis, crack propagation analysis and buckling criteria.

#### 4.5.2. *Corrosion allowances*

4.5.2.1. No corrosion allowance should generally be required in addition to the thickness resulting from the structural analysis. However, where there is no environmental control around the cargo tank, such as inerting, or where the cargo is of a corrosive nature, the Administration may require a suitable corrosion allowance.

4.5.2.2. For pressure vessels no corrosion allowance is generally required if the contents of the pressure vessel are non-corrosive and the external surface is protected by inert atmosphere or by an appropriate insulation with an approved vapour barrier. Paint or other thin coatings should not be credited as protection. Where special alloys are used with acceptable corrosion resistance, no corrosion allowance should be required. If the above conditions are not satisfied, the scantlings calculated according to 4.4.6 should be increased as appropriate.

#### 4.6. *Supports*

4.6.1. Cargo tanks should be supported by the hull in a manner which will prevent bodily movement of the tank under static and dynamic loads while allowing contraction and expansion of the tank under temperature variations and hull deflections without undue stressing of the tank and of the hull.

4.6.2. The tanks with supports should also be designed for a static angle of heel of 30° without exceeding allowable stresses given in 4.5.1.

4.6.3. The supports should be calculated for the most probable largest resulting acceleration, taking into account rotational as well as translational effects. This acceleration in a given direction may be determined as shown in figure 4.1. The half axes of the "acceleration ellipse" should be determined according to 4.3.4.2.

4.6.4. Suitable supports should be provided to withstand a collision force acting on the tank corresponding to one half the weight of the tank and cargo in the forward direction and one quarter the weight of the tank and cargo in the aft direction without deformation likely to endanger the tank structure.

4.6.5. The loads mentioned in 4.6.2 and 4.6.4 need not be combined with each other or with wave-induced loads.

4.6.6. For independent tanks and, where appropriate, for membrane and semi-membrane tanks, provision should be made to key the tanks against the rotational effects referred to in 4.6.3.

4.6.7. Antiflotation arrangements should be provided for independent tanks. The antiflotation arrangements should be suitable to withstand an upward force caused by an empty tank in a hold space flooded to the summer load draught of the ship, without plastic deformation likely to endanger the hull structure.

#### 4.7. *Secondary barrier*

4.7.1. Where the cargo temperature at atmospheric pressure is below  $-10^{\circ}\text{C}$ , a secondary barrier should be provided when required by 4.7.3 to act as a temporary containment for any envisaged leakage of liquid cargo through the primary barrier.

4.7.2. Where the cargo temperature at atmospheric pressure is not below  $-55^{\circ}\text{C}$ , the hull structure may act as a secondary barrier. In such a case:

- .1 The hull material should be suitable for the cargo temperature at atmospheric pressure as required by 4.9.2; and
- .2 The design should be such that this temperature will not result in unacceptable hull stresses.

4.7.3. Secondary barriers in relation to tank types should normally be provided in accordance with the following table. For tanks which differ from the basic tank types as defined

in 4.2 the secondary barrier requirements should be decided by the Administration in each case.

<i>Cargo temperature at atmospheric pressure</i>	<i>-10° C and above</i>	<i>Below -10° C down to -55° C</i>	<i>Below -55° C</i>
<i>Basic tank type</i>	<i>No secondary barrier required</i>	<i>Hull may act as secondary barrier</i>	<i>Separate secondary barrier where required</i>
Integral		Tank type not normally allowed <sup>(1)</sup>	
Membrane		Complete secondary barrier	
Semi-membrane		Complete secondary barrier <sup>(2)</sup>	
Independent			
Type A		Complete secondary barrier	
Type B		Partial secondary barrier	
Type C		No secondary barrier required	
Internal insulation			
Type 1		Complete secondary barrier	
Type 2		Complete secondary barrier is incorporated	

(1) A complete secondary barrier should normally be required if cargoes with a temperature at atmospheric pressure below -10°C are permitted in accordance with 4.2.1.3.

(2) In the case of semi-membrane tanks which comply in all respects with the requirements applicable to type B independent tanks, except for the manner of support, the Administration may, after special consideration, accept a partial secondary barrier.

4.7.4. The secondary barrier should be so designed that:

- .1 It is capable of containing any envisaged leakage of liquid cargo for a period of 15 days, unless different requirements apply for particular voyages, taking into account the load spectrum referred to in 4.3.4.4;
- .2 It will prevent lowering of the temperature of the ship structure to an unsafe level in the case of leakage of the primary barrier as indicated in 4.8.2; and
- .3 The mechanism of failure for the primary barrier does not also cause the failure of the secondary barrier and vice versa.

4.7.5. The secondary barrier should fulfil its functions at a static angle of heel of 30°.

4.7.6.1. Where a partial secondary barrier is required, its extent should be determined on the basis of cargo leakage corresponding to the extent of failure resulting from the load spectrum referred to in 4.3.4.4 after the initial detection of a primary leak. Due account may be taken of liquid evaporation, rate of leakage, pumping capacity and other relevant factors. In all cases, however, the inner bottom in way of cargo tanks should be protected against liquid cargo.

4.7.6.2. Clear of the partial secondary barrier, provision such as a spray shield should be made to deflect any liquid cargo down into the space between the primary and secondary barriers and to keep the temperature of the hull structure to a safe level.

4.7.7. The secondary barrier should be capable of being periodically checked for its effectiveness, by means of a pressure/vacuum test, a visual inspection or another suitable method acceptable to the Administration. The method should be submitted to the Administration for approval.

#### 4.8. *Insulation*

4.8.1. Where a product is carried at a temperature below  $-10^{\circ}\text{C}$  suitable insulation should be provided to ensure that the temperature of the hull structure does not fall below the minimum allowable service temperature given in chapter 6 for the grade of steel concerned, as detailed in 4.9, when the cargo tanks are at their design temperature and the ambient temperatures are  $5^{\circ}\text{C}$  for air and  $0^{\circ}\text{C}$  for seawater. These conditions may generally be used for world-wide service. However, higher values of the ambient temperatures may be accepted by the Administration for ships operated in restricted areas. Conversely, lesser values of the ambient temperatures may be fixed by the Administration for ships trading occasionally or regularly to areas in latitudes where such lower temperatures are expected during the winter months. The ambient temperatures used in the design should be shown on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk as provided for in 1.5.

4.8.2. Where a complete or partial secondary barrier is required, calculations should be made with the assumptions in 4.8.1 to check that the temperature of the hull structure does not fall below the minimum allowable service temperature given in chapter 6 for the grade of steel concerned, as detailed in 4.9. The complete or partial secondary barrier should be assumed to be at the cargo temperature at atmospheric pressure.

4.8.3. Calculations required by 4.8.1 and 4.8.2 should be made assuming still air and still water, and except as permitted by 4.8.4, no credit should be given for means of heating. In the case referred to in 4.8.2, the cooling effect of the rising boil-off vapour from the leaked cargo should be considered in the heat transmission studies. For members connecting inner and outer hulls, the mean temperature may be taken for determining the steel grade.

4.8.4. In all cases referred to in 4.8.1 and 4.8.2 and for ambient temperature conditions of  $5^{\circ}\text{C}$  for air and  $0^{\circ}\text{C}$  for seawater, approved means of heating transverse hull structural material may be used to ensure that the temperatures of this material do not fall below the minimum allowable values. If lower ambient temperatures are specified, approved means of heating may also be used for longitudinal hull structural material, provided this material remains suitable for the temperature conditions of  $5^{\circ}\text{C}$  for air and  $0^{\circ}\text{C}$  for seawater without heating. Such means of heating should comply with the following requirements:

- .1 Sufficient heat should be available to maintain the hull structure above the minimum allowable temperature in the conditions referred to in 4.8.1 and 4.8.2;
- .2 The heating system should be so arranged that, in the event of a failure in any part of the system, stand-by heating could be maintained equal to not less than 100% of the theoretical heat load;
- .3 The heating system should be considered as an essential auxiliary; and
- .4 The design and construction of the heating system should be to the satisfaction of the Administration.

4.8.5. In determining the insulation thickness, due regard should be paid to the amount of acceptable boil-off in association with the reliquefaction plant on board, main propulsion machinery or other temperature control system.

#### 4.9. *Materials*

4.9.1. The shell and deck plating of the ship and all stiffeners attached thereto should be in accordance with Recognized Standards, unless the calculated temperature of the material in the design condition is below  $-5^{\circ}\text{C}$  due to the effect of the low temperature cargo, in which case the material should be in accordance with table 6.5 assuming the ambient sea and air temperature of  $0^{\circ}\text{C}$  and  $5^{\circ}\text{C}$  respectively. In the design condition, the complete or partial secondary barrier should be assumed to be at the cargo temperature at atmospheric pressure and for tanks without secondary barriers, the primary barrier should be assumed to be at the cargo temperature.

4.9.2. Hull material forming the secondary barrier should be in accordance with table 6.2. Metallic materials used in secondary barriers not forming part of the hull structure should be in accordance with table 6.2 or 6.3 as applicable. Insulation materials forming a secondary barrier should comply with the requirements of 4.9.7. Where the secondary barrier is formed by the deck or side shell plating, the material grade required by table 6.2 should be carried into the adjacent deck or side shell plating, where applicable, to a suitable extent.

4.9.3. Materials used in the construction of cargo tanks should be in accordance with table 6.1, 6.2 or 6.3.

4.9.4. Materials other than those referred to in 4.9.1, 4.9.2 and 4.9.3 used in the construction of the ship which are subject to reduced temperature due to the cargo and which do not form part of the secondary barrier should be in accordance with table 6.5 for temperatures as determined by 4.8. This includes inner bottom plating, longitudinal bulkhead plating, transverse bulkhead plating, floors, webs, stringers and all attached stiffening members.

4.9.5. The insulation materials should be suitable for loads which may be imposed on them by the adjacent structure.

4.9.6. Where applicable, due to location or environmental conditions, insulation materials should have suitable properties of resistance to fire and flame spread and should be adequately protected against penetration of water vapour and mechanical damage.

4.9.7.1. Materials used for thermal insulation should be tested for the following properties as applicable, to ensure that they are adequate for the intended service:

- .1 Compatibility with the cargo,
- .2 Solubility in the cargo,
- .3 Absorption of the cargo,
- .4 Shrinkage,
- .5 Ageing,
- .6 Closed cell content,
- .7 Density,
- .8 Mechanical properties,
- .9 Thermal expansion,
- .10 Abrasion,
- .11 Cohesion,
- .12 Thermal conductivity,
- .13 Resistance to vibrations,
- .14 Resistance to fire and flame spread.

4.9.7.2. In addition to meeting the above requirements, insulation materials which form part of the cargo containment as defined in 4.2.5 should be tested for the following properties after simulation of ageing and thermal cycling to ensure that they are adequate for the intended service:

- .1 Bonding (adhesive and cohesive strength),
- .2 Resistance to cargo pressure,
- .3 Fatigue and crack propagation properties,
- .4 Compatibility with cargo constituents and any other agent expected to be in contact with the insulation in normal service,
- .5 Where applicable the influence of presence of water and water pressure on the insulation properties should be taken into account,
- .6 Gas de-absorbing.

4.9.7.3. The above properties, where applicable, should be tested for the range between the expected maximum temperature in service and 5°C below the minimum design temperature, but not lower than -196°C.

4.9.8. The procedure for fabrication, storage, handling, erection, quality control and control against harmful exposure to sunlight of insulation materials should be to the satisfaction of the Administration.

4.9.9. Where powder or granulated insulation is used, the arrangements should be such as to prevent compacting of the material due to vibrations. The design should incorporate means to ensure that the material remains sufficiently buoyant to maintain the required thermal conductivity and also prevent any undue increase of pressure on the containment system.

#### 4.10. *Construction and testing*

4.10.1.1. All welded joints of the shells of independent tanks should be of the butt weld, full penetration type. For dome-to-shell connections, the Administration may approve tee welds of the full penetration type. Except for small penetrations on domes, nozzle welds are also generally to be designed with full penetration.

4.10.1.2. Welding joint details for type C independent tanks should be as follows:

- .1 All longitudinal and circumferential joints of pressure vessels should be of butt welded, full penetration, double vee or single vee type. Full penetration butt welds should be obtained by double welding or by the use of backing rings. If used, backing rings should be removed, unless specifically approved by the Administration for very small process pressure vessels. Other edge preparations may be allowed by the Administration depending on the results of the tests carried out at the approval of the welding procedure.
- .2 The bevel preparation of the joints between the pressure vessel body and domes and between domes and relevant fittings should be designed according to a standard for pressure vessels acceptable to the Administration. All welds connecting nozzles, domes or other penetrations of the vessel and all welds connecting flanges to the vessel or nozzles should be full penetration welds extending through the entire thickness of the vessel wall or nozzle wall, unless specially approved by the Administration for small nozzle diameters.

4.10.2. Workmanship should be to the satisfaction of the Administration. Inspection and non-destructive testing of welds for tanks other than type C independent tanks should be in accordance with the requirements of 6.3.7.

4.10.3. For membrane tanks, quality assurance measures, weld procedure qualification, design details, materials, construction, inspection and production testing of components, should be to standards developed during the prototype testing programme.

4.10.4. For semi-membrane tanks the relevant requirements in this section for independent tanks or for membrane tanks should be applied as appropriate.

4.10.5.1. For internal insulation tanks, in order to ensure uniform quality of the material, quality control procedures including environmental control, application procedure qualification, corners, penetrations and other design details, materials specification, installation and production testing of components should be to standards developed during the prototype test programme.

4.10.5.2. A quality control specification including maximum permissible size of constructional defects, tests and inspections during the fabrication, installation and also sampling tests at each of these stages should be to the satisfaction of the Administration.

4.10.6. Integral tanks should be hydrostatically or hydropneumatically tested to the satisfaction of the Administration. The test in general should be so performed that the stresses approximate, as far as practicable, to the design stresses and that the pressure at the top of the tank corresponds at least to the MARVS.

4.10.7. In ships fitted with membrane or semi-membrane tanks, cofferdams and all spaces which may normally contain liquid and are adjacent to the hull structure supporting the membrane should be hydrostatically or hydropneumatically tested in accordance with Recognized Standards. In addition, any other hold structure supporting the membrane should be tested for tightness. Pipe tunnels and other compartments which do not normally contain liquid need not be hydrostatically tested.

4.10.8.1. In ships fitted with internal insulation tanks where the inner hull is the supporting structure, all inner hull structure should be hydrostatically or hydropneumatically tested in accordance with Recognized Standards, taking into account the MARVS.

4.10.8.2. In ships fitted with internal insulation tanks where independent tanks are the supporting structure, the independent tanks should be tested in accordance with 4.10.10.1.

4.10.8.3. For internal insulation tanks where the inner hull structure or an independent tank structure acts as a secondary barrier, a tightness test of those structures should be carried out using techniques to the satisfaction of the Administration.

4.10.8.4. These tests should be performed before the application of the materials which will form the internal insulation tank.

4.10.9. For type C independent tanks, inspection and non-destructive testing should be as follows:

- .1 Manufacture and workmanship: The tolerances relating to manufacture and workmanship such as local out-of-roundness deviations from the true form, welded joints alignment and tapering of plates having different thicknesses, should comply with standards acceptable to the Administration. The tolerances should also be related to the buckling analysis referred to in 4.2.6.2.
- .2 Non-destructive testing: As far as completion and extension of non-destructive testing of welded joints are concerned, the extent of non-destructive testing should be total or partial according to standards acceptable to the Administration, but the controls to be carried out should not be less than the following:
  - .2.1 Total non-destructive testing referred to in 4.4.6.1.3:

Radiography:

    - Butt welds 100%; and

Surface crack detection:

    - All welds 10%;
    - Reinforcement rings around holes, nozzles, etc. 100%.

As an alternative, ultrasonic testing may be accepted as a partial substitute for the radiographic testing, if specially allowed by the Administration. In addition, the Administration may require total ultrasonic testing on welding or reinforcement rings around holes, nozzles, etc.
  - .2.2 Partial non-destructive testing referred to in 4.4.6.1.3:

Radiography:

    - Butt welds: all welded crossing joints and at least 10% of the full length at selected positions uniformly distributed; and

Surface crack detection:

    - Reinforcement rings around holes, nozzles, etc. 100%

Ultrasonic testing:

    - As may be required by the Administration in each instance.

4.10.10. Each independent tank should be subjected to a hydrostatic or hydropneumatic test as follows:

- .1 For type A independent tanks, this test should be so performed that the stresses approximate, as far as practicable, to the design stresses and that the pressure at the top of the tank corresponds at least to the MARVS. When a hydropneumatic test is performed, the conditions should simulate, as far as practicable, the actual loading of the tank and of its supports.
- .2 For type B independent tanks, the test should be performed as required in 4.10.10.1 for type A independent tanks. In addition, the maximum primary membrane stress or maximum bending stress in primary members under test conditions should not exceed 90% of the yield strength of the material (as fabricated) at the test temperature. To ensure that this condition is satisfied, when calculations indicate that this stress exceeds 75% of the yield strength, the prototype test should be monitored by the use of strain gauges or other suitable equipment.
- .3 Type C independent tanks should be tested as follows:
  - .3.1 Each pressure vessel, when completely manufactured, should be subjected to a hydrostatic test at a pressure measured at the top of the tanks, of not less than  $1.5 P_o$ , but in no case during the pressure test should the calculated primary membrane stress at any point exceed 90% of the yield stress of the material. The definition of  $P_o$  is given in 4.2.6. To ensure that this condition is satisfied where calculations indicate that this stress will exceed 0.75 times the yield strength, the prototype test should be monitored by the use of strain gauges or other suitable equipment in pressure vessels other than simple cylindrical and spherical pressure vessels.
  - .3.2 The temperature of the water used for the test should be at least 30° C above the nil ductility transition temperature of the material as fabricated.
  - .3.3 The pressure should be held for 2 h per 25 mm of thickness but in no case less than 2 h.
  - .3.4 Where necessary for cargo pressure vessels, and with the specific approval of the Administration, a hydropneumatic test may be carried out under the conditions prescribed in 4.10.10.3.1, .2 and .3.
  - .3.5 Special consideration may be given by the Administration to the testing of tanks in which higher allowable stresses are used, depending on service temperature. However, the requirements of 4.10.10.3.1 should be fully complied with.
  - .3.6 After completion and assembly, each pressure vessel and its related fittings should be subjected to an adequate tightness test.
  - .3.7 Pneumatic testing of pressure vessels other than cargo tanks should be considered on an individual case basis by the Administration. Such testing should be permitted only for those vessels which are so designed or supported that they cannot be safely filled with water, or for those vessels which cannot be dried and are to be used in a service where traces of the testing medium cannot be tolerated.

4.10.11. All tanks should be subjected to a tightness test which may be performed in combination with the pressure test referred to in 4.10.10 or separately.

4.10.12. Requirements with respect to inspection of secondary barriers should be decided by the Administration in each case.

4.10.13. In ships fitted with type B independent tanks, at least one tank and its support should be instrumented to confirm stress levels unless the design and arrangement for the size of ship involved are supported by full-scale experience. Similar instrumentation may be required by the Administration for type C independent tanks dependent on their configuration and on the arrangement of their supports and attachments.

4.10.14. The overall performance of the cargo containment system should be verified for compliance with the design parameters during the initial cool-down, loading and discharging



of the cargo. Records of the performance of the components and equipment essential to verify the design parameters should be maintained and be available to the Administration.

4.10.15. Heating arrangements, if fitted in accordance with 4.8.4, should be tested for required heat output and heat distribution.

4.10.16. The hull should be inspected for cold spots following the first loaded voyage.

4.10.17. The insulation materials of internal insulation tanks should be subjected to additional inspection in order to verify their surface conditions after the third loaded voyage of the ship, but not later than the first 6 months of the ship's service after building or a major repair work is undertaken on the internal insulation tanks.

4.10.18. For type C independent tanks, the required marking of the pressure vessel should be achieved by a method which does not cause unacceptable local stress rises.

#### 4.11. *Stress relieving for type C independent tanks*

4.11.1. For type C independent tanks of carbon and carbon-manganese steel, post-weld heat treatment should be performed after welding if the design temperature is below  $-10^{\circ}\text{C}$ . Post-weld heat treatment in all other cases and for materials other than those mentioned above should be to the satisfaction of the Administration. The soaking temperature and holding time should be to the satisfaction of the Administration.

4.11.2. In the case of large cargo pressure vessels of carbon or carbon-manganese steel for which it is difficult to perform the heat treatment, mechanical stress relieving by pressurizing may be carried out as an alternative to the heat treatment with the approval of the Administration and subject to the following conditions:

- .1 Complicated welded pressure vessel parts such as sumps or domes with nozzles, with adjacent shell plates should be heat treated before they are welded to larger parts of the pressure vessel.
- .2 The plate thicknesses should not exceed those given by a standard acceptable to the Administration.
- .3 The performance of a detailed stress analysis to ascertain that the maximum primary membrane stress during the mechanical stress relieving closely approaches, but does not exceed, 90% of the yield stress of the material. Strain measurements during the stress relief pressurization may be required by the Administration for verifying the calculations.
- .4 The procedure for mechanical stress relieving should be submitted beforehand to the Administration for approval.

#### 4.12. *Guidance formulae for acceleration components*

The following formulae are given as guidance for the components of acceleration due to ship's motions corresponding to a probability level of  $10^{-8}$  in the North Atlantic and apply to ships with a length exceeding 50 m.

Vertical acceleration as defined in 4.3.4.6

$$a_z = \pm a_0 \sqrt{1 + \left(5.3 - \frac{45^2}{L_0}\right) \left(\frac{x}{L_0} + 0.05\right)^2 \left(\frac{0.6}{C_B}\right)^{1.5}}$$

Transverse acceleration as defined in 4.3.4.6

$$a_y = \pm a_0 \sqrt{0.6 + 2.5 \left(\frac{x}{L_0} + 0.05\right)^2 + K \left(1 + 0.6 K \frac{z}{B}\right)^2}$$

Longitudinal acceleration as defined in 4.3.4.6

$$a_x = \pm a_0 \sqrt{0.06 + A^2 - 0.25 A}$$

with:

$$A = \left(0.7 - \frac{L_o}{1200} + 5 \frac{z}{L_o}\right) \left(\frac{0.6}{C_B}\right)$$

where:  $L_o$  = length of the ship for determination of scantlings as defined in Recognized Standards (m)

$C_B$  = block coefficient

$B$  = greatest moulded breadth of the ship (m)

$x$  = longitudinal distance (m) from amidships to the centre of gravity of the tank with contents;  $x$  is positive forward of amidships, negative aft of amidships

$z$  = vertical distance (m) from the ship's actual waterline to the centre of gravity of tank with contents;  $z$  is positive above and negative below the waterline.

$$a_o = 0.2 \frac{V}{\sqrt{L_o}} + \frac{34 - \frac{600}{L_o}}{L_o}$$

where:  $V$  = service speed (knots)

$K = 1$  in general. For particular loading conditions and hull forms determination of  $K$  according to the formula below may be necessary.

$K = 13GM/B$ , where  $K \geq 1.0$  and  $GM$  = metacentric height (m)

$a_x, a_y$   
and  $a_z$  = maximum dimensionless accelerations (i.e. relative to the acceleration of gravity) in the respective directions and they are considered as acting separately for calculation purposes.  $a_z$  does not include the component due to the static weight,  $a_y$  includes the component due to the static weight in the transverse direction due to rolling and  $a_x$  includes the component due to the static weight in the longitudinal direction due to pitching.

#### 4.13. Stress categories

For the purpose of stress evaluation referred to in 4.5.1.4, stress categories are defined in this section.

4.13.1. Normal stress is the component of stress normal to the plane of reference.

4.13.2. Membrane stress is the component of normal stress which is uniformly distributed and equal to the average value of the stress across the thickness of the section under consideration.

4.13.3. Bending stress is the variable stress across the thickness of the section under consideration, after the subtraction of the membrane stress.

4.13.4. Shear stress is the component of the stress acting in the plane of reference.

4.13.5. Primary stress is a stress produced by the imposed loading and which is necessary to balance the external forces and moments. The basic characteristic of a primary stress is that it is not self-limiting. Primary stresses which considerably exceed the yield strength will result in failure or at least in gross deformations.

4.13.6. Primary general membrane stress is a primary membrane stress which is so distributed in the structure that no redistribution of load occurs as a result of yielding.

4.13.7. Primary local membrane stress arises where a membrane stress produced by pressure or other mechanical loading and associated with a primary or a discontinuity effect produces excessive distortion in the transfer of loads for other portions of the structure. Such a

stress is classified as a primary local membrane stress although it has some characteristics of a secondary stress. A stress region may be considered as local if:

$$S_1 \leq 0.5 \sqrt{Rt} \quad \text{and}$$

$$S_2 \geq 2.5 \sqrt{Rt}$$

where:  $S_1$  = distance in the meridional direction over which the equivalent stress exceeds 1.1  $f$

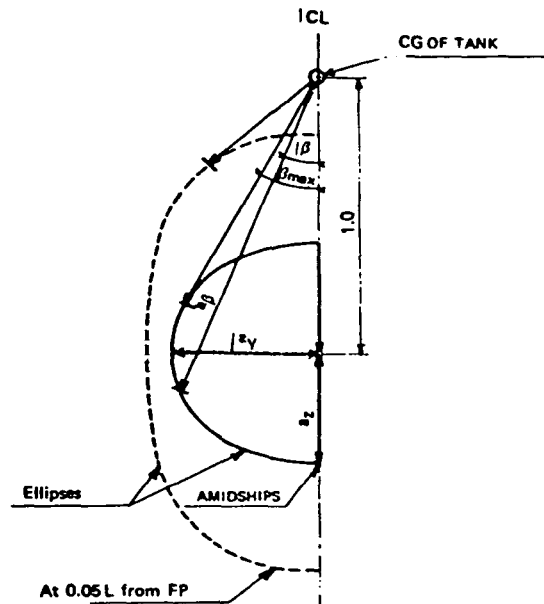
$S_2$  = distance in the meridional direction to another region where the limits for primary general membrane stress are exceeded

$R$  = mean radius of the vessel

$t$  = wall thickness of the vessel at the location where the primary general membrane stress limit is exceeded

$f$  = allowable primary general membrane stress.

4.13.8. Secondary stress is a normal stress or shear stress developed by constraints of adjacent parts or by self-constraint of a structure. The basic characteristic of a secondary stress is that it is self-limiting. Local yielding and minor distortions can satisfy the conditions which cause the stress to occur.



$a_\beta$  = resulting acceleration (static and dynamic) in arbitrary direction  $\beta$

$a_y$  = transverse component of acceleration

$a_z$  = vertical component of acceleration

FIGURE 4.1. ACCELERATION ELLIPSE

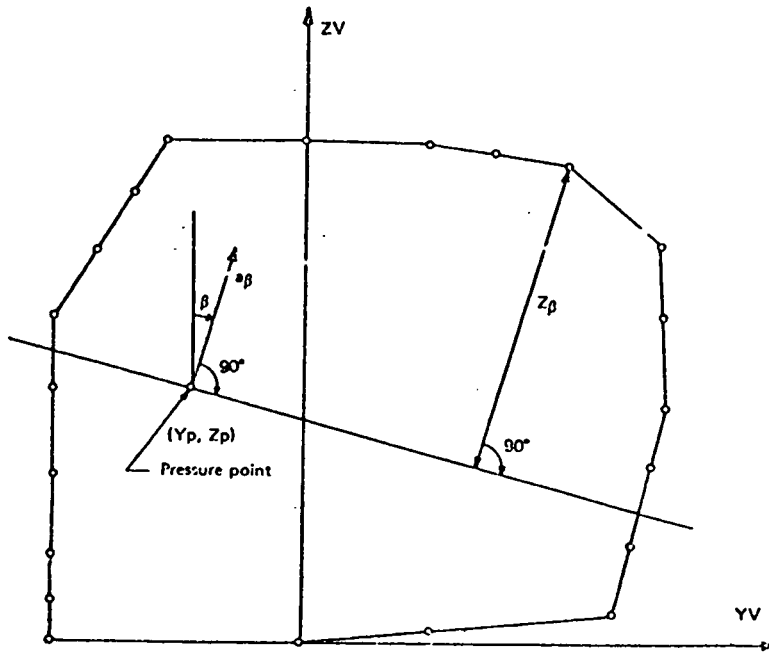
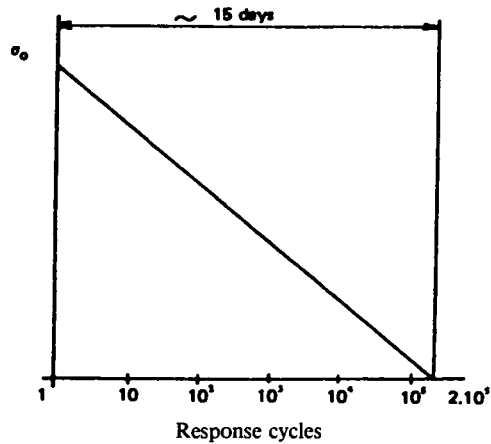


FIGURE 4.2. DETERMINATION OF INTERNAL PRESSURE HEADS



$\sigma_0$  = most probable maximum stress over the life of the ship  
 Response cycle scale is logarithmic; the value of  $2.10^6$  is given as an example of estimate.

FIGURE 4.3. SIMPLIFIED LOAD DISTRIBUTION

*Chapter 5. PROCESS PRESSURE VESSELS AND LIQUID,  
VAPOUR, AND PRESSURE PIPING SYSTEMS*

5.1. *General*

5.1.1. Administrations should take appropriate steps to ensure uniformity in the implementation and application of the provisions of this chapter.\*

5.1.2. The requirements for type C independent tanks in chapter 4 may also apply to process pressure vessels if required by the Administration. If so required the term "pressure vessels" as used in chapter 4 covers both type C independent tanks and process pressure vessels.

5.2. *Cargo and process piping*

5.2.1. *General*

5.2.1.1. The requirements of this section apply to product and process piping including vapour piping and vent lines of safety valves or similar piping. Instrument piping not containing cargo is exempt from these requirements.

5.2.1.2. Provision should be made by the use of offsets, loops, bends, mechanical expansion joints such as bellows, slip joints and ball joints or similar suitable means to protect the piping, piping system components and cargo tanks from excessive stresses due to thermal movement and from movements of the tank and hull structure. Where mechanical expansion joints are used in piping they should be held to a minimum and, where located outside cargo tanks, should be of the bellows type.

5.2.1.3. Low-temperature piping should be thermally isolated from the adjacent hull structure, where necessary, to prevent the temperature of the hull from falling below the design temperature of the hull material. Where liquid piping is dismantled regularly, or where liquid leakage may be anticipated, such as at shore connections and at pump seals, protection for the hull beneath should be provided.

5.2.1.4. Where tanks or piping are separated from the ship's structure by thermal isolation, provision should be made for electrically bonding both the piping and the tanks. All gasketed pipe joints and hose connections should be electrically bonded.

5.2.1.5. Suitable means should be provided to relieve the pressure and remove liquid contents from cargo loading and discharging crossover headers and cargo hoses to the cargo tanks or other suitable location, prior to disconnecting the cargo hoses.

5.2.1.6. All pipelines or components which may be isolated in a liquid full condition should be provided with relief valves.

5.2.1.7. Relief valves discharging liquid cargo from the cargo piping system should discharge into the cargo tanks; alternatively they may discharge to the cargo vent mast if means are provided to detect and dispose of any liquid cargo which may flow into the vent system. Relief valves on cargo pumps should discharge to the pump suction.

5.2.2. *Scantlings based on internal pressure*

5.2.2.1. Subject to the conditions stated in 5.2.4, the wall thickness of pipes should not be less than:

$$t = \frac{t_o + b + c}{1 - \frac{a}{100}} \text{ (mm)}$$

\* Reference is made to the published Rules of members and associate members of the International Association of Classification Societies and in particular to IACS Unified Requirement No. G3.

where:  $t_o$  = theoretical thickness

$$t_o = PD/(20 Ke + P) \text{ (mm)}$$

with:

P = design pressure (bar) referred to in 5.2.3

D = outside diameter (mm)

K = allowable stress (N/mm<sup>2</sup>) referred to in 5.2.4

e = efficiency factor [equals] 1.0 for seamless pipes and for longitudinally or spirally welded pipes, delivered by approved manufacturers of welded pipes, which are considered equivalent to seamless pipes when non-destructive testing on welds is carried out in accordance with Recognized Standards. In other cases an efficiency factor value depending on the manufacturing process may be determined by the Administration.

b = allowance for bending (mm). The value of b should be chosen so that the calculated stress in the bend, due to internal pressure only, does not exceed the allowable stress. Where such justification is not given, b should be:

$$b = \frac{Dt_o}{2.5r} \text{ (mm)}$$

with:

r = mean radius of the bend (mm)

c = corrosion allowance (mm). If corrosion or erosion is expected, the wall thickness of the piping should be increased over that required by other design requirements. This allowance should be consistent with the expected life of the piping.

a = negative manufacturing tolerance for thickness (%).

### 5.2.3. Design pressure

5.2.3.1. The design pressure P in the formula for  $t_o$  in 5.2.2.1 is the maximum gauge pressure to which the system may be subjected in service.

5.2.3.2. The greater of the following design conditions should be used for piping, piping system and components as appropriate:

- .1 For vapour piping systems or components which may be separated from their relief valves and which may contain some liquid: the saturated vapour pressure at 45°C, or higher or lower if agreed upon by the Administration (see 4.2.6.2);
- .2 For systems or components which may be separated from their relief valves and which contain only vapour at all times: the superheated vapour pressure at 45°C or higher or lower if agreed upon by the Administration (see 4.2.6.2), assuming an initial condition of saturated vapour in the system at the system operating pressure and temperature; or
- .3 The MARVS of the cargo tanks and cargo processing systems; or
- .4 The pressure setting of the associated pump or compressor discharge relief valve; or
- .5 The maximum total discharge or loading head of the cargo piping system; or
- .6 The relief valve setting on a pipeline system.

5.2.3.3. The design pressure should not be less than 10 bar gauge except for open ended lines where it should be not less than 5 bar gauge.

#### 5.2.4. *Permissible stresses*

5.2.4.1. For pipes, the permissible stress to be considered in the formula for  $t$  in 5.2.2.1 is the lower of the following values:

$$\frac{R_m}{A} \text{ or } \frac{R_e}{B}$$

where:  $R_m$  = specified minimum tensile strength at room temperature (N/mm<sup>2</sup>)

$R_e$  = specified minimum yield stress at room temperature (N/mm<sup>2</sup>). If the stress-strain curve does not show a defined yield stress, the 0.2% proof stress applies.

The values of A and B should be shown on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk as provided for in 1.5 and have values of at least A = 2.7 and B = 1.8.

5.2.4.2. The minimum wall thickness should be in accordance with Recognized Standards.

5.2.4.3. Where necessary for mechanical strength to prevent damage, collapse, excessive sag or buckling of pipes due to superimposed loads from supports, ship deflection or other causes, the wall thickness should be increased over that required by 5.2.2, or, if this is impracticable or would cause excessive local stresses, these loads should be reduced, protected against or eliminated by other design methods.

5.2.4.4. Flanges, valves and other fittings should be to a standard acceptable to the Administration, taking into account the design pressure defined in 5.2.2. For bellows expansion joints used in vapour service, a lower minimum design pressure may be accepted by the Administration.

5.2.4.5. For flanges not complying with a standard, the dimensions of flanges and related bolts should be to the satisfaction of the Administration.

#### 5.2.5. *Stress analysis*

When the design temperature is  $-110^{\circ}\text{C}$  or lower, a complete stress analysis, taking into account all the stresses due to weight of pipes, including acceleration loads if significant, internal pressure, thermal contraction and loads induced by hog and sag of the ship for each branch of the piping system should be submitted to the Administration. For temperatures of above  $-110^{\circ}\text{C}$ , a stress analysis may be required by the Administration in relation to such matters as the design or stiffness of the piping system and the choice of materials. In any case, consideration should be given to thermal stresses, even though calculations are not submitted. The analysis may be carried out according to a code of practice acceptable to the Administration.

#### 5.2.6. *Materials*

5.2.6.1. The choice and testing of materials used in piping systems should comply with the requirements of chapter 6 taking into account the minimum design temperature. However, some relaxation may be permitted in the quality of material of open ended vent piping, provided the temperature of the cargo at the pressure relief valve setting is  $-55^{\circ}\text{C}$  or greater and provided no liquid discharge to the vent piping can occur. Similar relaxations may be permitted under the same temperature conditions to open ended piping inside cargo tanks, excluding discharge piping and all piping inside membrane and semi-membrane tanks.

5.2.6.2. Materials having a melting point below  $925^{\circ}\text{C}$  should not be used for piping outside the cargo tanks except for short lengths of pipes attached to the cargo tanks, in which case fire-resisting insulation should be provided.

### 5.3. *Type tests on piping components*

5.3.1. Each type of piping component should be subject to type tests.

5.3.2.1. Each size and type of valve intended to be used at a working temperature below  $-55^{\circ}\text{C}$  should be subjected to a tightness test to the minimum design temperature or lower, and to a pressure not lower than the design pressure of the valve. During the test the satisfactory operation of the valve should be ascertained.

5.3.2.2. The following type tests should be performed on each type of expansion bellows intended for use on cargo piping outside the cargo tank and, where required, on those expansion bellows installed within the cargo tanks:

- .1 A type element of the bellows, not precompressed, should be pressure tested at not less than 5 times the design pressure without bursting. The duration of the test should not be less than 5 min.
- .2 A pressure test should be performed on a type expansion joint complete with all the accessories such as flanges, stays and articulations, at twice the design pressure at the extreme displacement conditions recommended by the manufacturer without permanent deformation. Depending on the materials used, the Administration may require the test to be at the minimum design temperature.
- .3 A cyclic test (thermal movements) should be performed on a complete expansion joint, which is to successfully withstand at least as many cycles, under the conditions of pressure, temperature, axial movement, rotational movement and transverse movement, as it will encounter in actual service. Testing at ambient temperature is permitted, when this testing is at least as severe as testing at the service temperature.
- .4 A cyclic fatigue test (ship deformation) should be performed on a complete expansion joint, without internal pressure, by simulating the bellows movement corresponding to a compensated pipe length, for at least 2,000,000 cycles at a frequency not higher than 5 cycles/s. This test is only required when, due to the piping arrangement, ship deformation loads are actually experienced.
- .5 The Administration may waive performance of the tests referred to in this paragraph provided that complete documentation is supplied to establish the suitability of the expansion joints to withstand the expected working conditions. When the maximum internal pressure exceeds 1.0 bar gauge this documentation is to include sufficient test data to justify the design method used, with particular reference to correlation between calculation and test results.

### 5.4. *Piping fabrication and joining details*

5.4.1. The requirements of this section apply to piping inside and outside the cargo tanks. However, the Administration may accept relaxations from these requirements for piping inside cargo tanks and open ended piping.

5.4.2. The following direct connection of pipe lengths, without flanges, may be considered:

- .1 Butt welded joints with complete penetration at the root may be used in all applications. For design temperatures below  $-10^{\circ}\text{C}$ , butt welds should be either double welded or equivalent to a double welded butt joint. This may be accomplished by use of a backing ring, consumable insert or inert gas back-up on the first pass. For design pressures in excess of 10 bar and design temperatures of  $-10^{\circ}\text{C}$  or lower, backing rings should be removed.
- .2 Slip-on welded joints with sleeves and related welding, having dimensions satisfactory to the Administration, should only be used for open ended lines with external diameter of 50 mm or less and design temperatures not lower than  $-55^{\circ}\text{C}$ .
- .3 Screwed couplings acceptable to the Administration should only be used for accessory lines and instrumentation lines with external diameters of 25 mm or less.



5.4.3.1. Flanges in flange connections should be of the welded neck, slip-on or socket welded type.

5.4.3.2. Flanges should comply with standards acceptable to the Administration as to their type, manufacture and test. In particular, for all piping except open ended, the following restrictions apply:

- .1 For design temperatures lower than  $-55^{\circ}\text{C}$ , only welded neck flanges should be used.
- .2 For design temperatures lower than  $-10^{\circ}\text{C}$ , slip-on flanges should not be used in nominal sizes above 100 mm and socket welded flanges should not be used in nominal sizes above 50 mm.

5.4.4. Piping connections, other than those mentioned in 5.4.2 and .3, may be accepted by the Administration in each case.

5.4.5. Bellows and expansion joints should be provided to allow for expansion of piping.

- .1 If necessary, bellows should be protected against icing.
- .2 Slip joints should not be used except within the cargo tanks.

5.4.6. Welding, post-weld heat treatments and non-destructive testing.

- .1 Welding should be carried out in accordance with 6.3.
- .2 Post-weld heat treatments should be required for all butt welds of pipes made with carbon, carbon-manganese and low alloy steels. The Administration may waive the requirement for thermal stress relieving of pipes having wall thickness less than 10 mm in relation to the design temperature and pressure of the piping system concerned.
- .3 In addition to normal controls before and during the welding and to the visual inspection of the finished welds, as necessary for proving that the welding has been carried out correctly and according to the requirements of this paragraph, the following tests should be required:
  - .3.1 100% radiographic inspection of butt welded joints for piping systems with service temperatures lower than  $-10^{\circ}\text{C}$  and with inside diameters of more than 75 mm or wall thicknesses greater than 10 mm.
  - .3.2 For other butt welded joints of pipes, spot radiographic tests or other non-destructive tests should be carried out at the discretion of the Administration depending upon service, position and materials. In general, at least 10% of butt welded joints of pipes should be radiographed.

### 5.5. *Testing of piping*

5.5.1. The requirements of this section apply to piping inside and outside the cargo tanks. However, the Administration may accept relaxations from these requirements for piping inside cargo tanks and open ended piping.

5.5.2. After assembly, all cargo and process piping should be subjected to a hydrostatic test to at least 1.5 times the design pressure. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the hydrostatic test may be conducted prior to installation aboard ship. Joints welded on board should be hydrostatically tested to at least 1.5 times the design pressure. Where water cannot be tolerated and the piping cannot be dried prior to putting the system into service, proposals for alternative testing fluids or testing means should be submitted to the Administration for approval.

5.5.3. After assembly on board, each cargo and process piping system should be subjected to a leak test using air, halides, or other suitable medium to a pressure depending on the leak detection method applied.

5.5.4. All piping systems including valves, fittings and associated equipment for handling cargo or vapours should be tested under normal operating conditions not later than at the first loading operation.

### 5.6. *Cargo system valving requirements*

5.6.1. Every cargo piping system and cargo tank should be provided with the following valves, as applicable:

- .1 For cargo tanks with a MARVS not exceeding 0.7 bar gauge, all liquid and vapour connections, except safety relief valves and liquid level gauging devices, should have shutoff valves located as close to the tank as practicable. These valves may be remotely controlled but should be capable of local manual operation and provide full closure. One or more remotely controlled emergency shutdown valves should be provided on the ship for shutting down liquid and vapour cargo transfer between ship and shore. Such valves may be arranged to suit the ship's design and may be the same valve as required in 5.6.3 and should comply with the requirements of 5.6.4.
- .2 For cargo tanks with a MARVS exceeding 0.7 bar gauge, all liquid and vapour connections, except safety relief valves and liquid level gauging devices, should be equipped with a manually operated stop valve and a remotely controlled emergency shutdown valve. These valves should be located as close to the tank as practicable. Where the pipe size does not exceed 50 mm in diameter, excess flow valves may be used in lieu of the emergency shutdown valve. A single valve may be substituted for the two separate valves provided the valve complies with the requirements of 5.6.4, is capable of local manual operation and provides full closure of the line.
- .3 Cargo pumps and compressors should be arranged to shutdown automatically if the emergency shutdown valves required by 5.6.1.1 and .2 are closed by the emergency shutdown system required by 5.6.4.

5.6.2. Cargo tank connections for gauging or measuring devices need not be equipped with excess flow or emergency shutdown valves provided that the devices are so constructed that the outward flow of tank contents cannot exceed that passed by a 1.5 mm diameter circular hole.

5.6.3. One remotely operated emergency shutdown valve should be provided at each cargo hose connection in use. Connections not used in transfer operations may be blinded with blank flanges in lieu of valves.

5.6.4. The control system for all required emergency shutdown valves should be so arranged that all such valves may be operated by single controls situated in at least two remote locations on the ship. One of these locations should be the control position required by 13.1.3 or cargo control room. The control system should also be provided with fusible elements designed to melt at temperatures between 98°C and 104°C which will cause the emergency shutdown valves to close in the event of fire. Locations for such fusible elements should include the tank domes and loading stations. Emergency shutdown valves should be of the fail-closed (closed on loss of power) type and be capable of local manual closing operation. Emergency shutdown valves in liquid piping should fully close under all service conditions within 30 s of actuation. Information about the closing time of the valves and their operating characteristics should be available on board and the closing time should be verifiable and reproducible. Such valves should close smoothly.

5.6.5. Excess flow valves should close automatically at the rated closing flow of vapour or liquid as specified by the manufacturer. The piping including fittings, valves, and appurtenances protected by an excess flow valve, should have a greater capacity than the rated closing flow of the excess flow valve. Excess flow valves may be designed with a bypass not exceeding an area of 1.0 mm diameter circular opening to allow equalization of pressure, after an operating shutdown.

### 5.7. *Ship's cargo hoses*

5.7.1. Liquid and vapour hoses used for cargo transfer should be compatible with the cargo and suitable for the cargo temperature.

5.7.2. Hoses subject to tank pressure, or the discharge pressure of pumps or vapour compressors, should be designed for a bursting pressure not less than 5 times the maximum pressure the hose will be subjected to during cargo transfer.

5.7.3. Each new type of cargo hose, complete with end fittings, should be prototype tested to a pressure not less than 5 times its specified maximum working pressure. The hose temperature during this prototype test should be the intended extreme service temperature. Hoses used for prototype testing should not be used for cargo service. Thereafter, before being placed in service, each new length of cargo hose produced should be hydrostatically tested at ambient temperature to a pressure not less than 1.5 times its specified maximum working pressure nor more than two fifths its bursting pressure. The hose should be stencilled or otherwise marked with its specified maximum working pressure and, if used in other than ambient temperature services, its maximum or minimum service temperature or both. The specified maximum working pressure should not be less than 10 bar gauge.

#### 5.8. *Cargo transfer methods*

5.8.1. Where cargo transfer is by means of cargo pumps not accessible for repair with the tanks in service, at least two separate means should be provided to transfer cargo from each cargo tank and the design should be such that failure of one cargo pump, or means of transfer, will not prevent the cargo transfer by another pump or pumps, or other cargo transfer means.

5.8.2. The procedure for transfer of cargo by gas pressurization should preclude lifting of the relief valves during such transfer. Gas pressurization may be accepted as a means of transfer of cargo for those tanks so designed that the design factor of safety is not reduced under the conditions prevailing during the cargo transfer operation.

#### 5.9. *Vapour return connections*

Connections for vapour return lines to the shore installations should be provided.

### Chapter 6. MATERIALS OF CONSTRUCTION

#### 6.1. *General*

6.1.1. Administrations should take appropriate steps to ensure uniformity in the implementation and application of the provisions of this chapter.\*

6.1.2. This chapter gives the requirements for plates, sections, pipes, forgings, castings and weldments used in the construction of cargo tanks, cargo process pressure vessels, cargo and process piping, secondary barriers and contiguous hull structures associated with the transportation of the products. The requirements for rolled materials, forgings and castings are given in 6.2 and tables 6.1 to 6.5. The requirements for weldments are given in 6.3.

6.1.3. The manufacture, testing, inspection and documentation should be in accordance with Recognized Standards and the specific requirements given in this Code.

6.1.4.1. Acceptance tests should include Charpy V-notch toughness tests unless otherwise specified by the Administration. The specified Charpy V-notch requirements are minimum average energy values for three full size (10 mm × 10 mm) specimens and minimum single energy values for individual specimens. Dimensions and tolerances of Charpy V-notch specimens should be in accordance with Recognized Standards. The testing and requirements

\* Reference is made to the published Rules of members and associate members of the International Association of Classification Societies and in particular to IACS Unified Requirement No. W1.

for specimens smaller than 5.0 mm size should be in accordance with Recognized Standards. Minimum average values for subsized specimens should be:

<i>Charpy V-notch specimen size</i>	<i>Minimum energy average of three specimens</i>
10 × 10 mm .....	E
10 × 7.5 mm .....	5/6 E
10 × 5.0 mm .....	2/3 E

where: E = the energy values (J) specified in tables 6.1 to 6.4.

Only one individual value may be below the specified average value provided it is not less than 70% of that value.

6.1.4.2. In all cases, the largest size Charpy specimens possible for the material thickness should be machined with the specimens located as near as practicable to a point midway between the surface and the centre of the thickness and the length of the notch perpendicular to the surface (see figure 6.1). If the average value of the three initial Charpy V-notch specimens fails to meet the stated requirements, or the value for more than one specimen is below the required average value, or when the value for one specimen is below the minimum value permitted for a single specimen, three additional specimens from the same material may be tested and the results combined with those previously obtained to form a new average. If this new average complies with the requirements and if no more than two individual results are lower than the required average and no more than one result is lower than the required value for a single specimen, the piece or batch may be accepted. At the discretion of the Administration other types of toughness tests, such as a drop weight test, may be used. This may be in addition to or in lieu of the Charpy V-notch test.

6.1.5. Tensile strength, yield stress and elongation should be to the satisfaction of the Administration. For carbon-manganese steel and other materials with definitive yield points, consideration should be given to the limitation of the yield to tensile ratio.

6.1.6. The bend test may be omitted as a material acceptance test, but is required for weld tests.

6.1.7. Materials with alternative chemical composition or mechanical properties may be accepted by the Administration.

6.1.8. Where post-weld heat treatment is specified or required, the properties of the base material should be determined in the heat treated condition in accordance with the applicable table of this chapter and the weld properties should be determined in the heat treated condition in accordance with 6.3. In cases where a post-weld heat treatment is applied, the test requirements may be modified at the discretion of the Administration.

6.1.9. Where reference is made in this chapter to A, B, D, E, AH, DH and EH hull structural steels, these steel grades are hull structural steels according to Recognized Standards.

## 6.2. *Material requirements*

The requirements for materials of construction are shown in the tables as follows:

Table 6.1. Plates, pipes (seamless and welded), sections and forgings for cargo tanks and process pressure vessels for design temperatures not lower than 0°C.

Table 6.2. Plates, sections and forgings for cargo tanks, secondary barriers and process pressure vessels for design temperatures below 0°C and down to -55°C.

Table 6.3. Plates, sections and forgings for cargo tanks, secondary barriers and process pressure vessels for design temperatures below -55°C and down to -165°C.

Table 6.4. Pipes (seamless and welded), forgings and castings for cargo process piping for design temperatures below 0°C and down to -165°C.

Table 6.5. Plates and sections for hull structures required by 4.9.1 and 4.9.4.

TABLE 6.1. PLATES, PIPES (SEAMLESS AND WELDED),<sup>(1)</sup> SECTIONS AND FORGINGS FOR CARGO TANKS AND PROCESS PRESSURE VESSELS FOR DESIGN TEMPERATURES NOT LOWER THAN 0° C

*Chemical composition and heat treatment*

Carbon-manganese steel: Fully killed

Fine grain steel where thickness exceeds 20 mm

Small additions of alloying elements by agreement with the Administration

Composition limits to be approved by the Administration

Normalized, or quenched and tempered<sup>(2)</sup>

*Tensile and toughness (impact) test requirements*

Plates: Each "piece" to be tested

Sections and forgings: Batch test

Tensile properties: Specified minimum yield stress not to exceed 410 N/mm<sup>(2),(3)</sup>

Charpy V-notch test

Plates: Transverse test pieces. Minimum average energy value (E) 27 J

Sections and forgings: Longitudinal test pieces. Minimum average energy value (E) 41 J

Test temperature: Thickness t (mm) Test temperature (° C)

t ≤ 20 0

20 < t ≤ 40 -20

NOTES

<sup>(1)</sup> For seamless pipes and fittings normal practice applies. The use of longitudinally and spirally welded pipes should be specially approved by the Administration.

<sup>(2)</sup> A controlled rolling procedure may be used as an alternative to normalizing or quenching and tempering, subject to special approval by the Administration.

<sup>(3)</sup> Materials with specified minimum yield stress exceeding 410 N/mm<sup>2</sup> may be specially approved by the Administration. For these materials, particular attention should be given to the hardness of the weld and heat affected zone.

TABLE 6.2. PLATES, SECTIONS AND FORGINGS<sup>(1)</sup> FOR CARGO TANKS, SECONDARY BARRIERS AND PROCESS PRESSURE VESSELS FOR DESIGN TEMPERATURES BELOW 0° C AND DOWN TO -55° C

*Maximum thickness 25 mm<sup>(2)</sup>*

*Chemical composition and heat treatment*

Carbon-manganese steel: Fully killed. Aluminium treated fine grain steel.

Chemical composition (ladle analysis):

C	Mn	Si	S	P
0.16% max. <sup>(3)</sup>	0.70-1.60%	0.10-0.50%	0.035% max.	0.035% max.

Optional additions: Alloys and grain refining elements may be generally in accordance with the following:

Ni	Cr	Mo	Cu	Nb	V
0.80% max.	0.25% max.	0.08% max.	0.35% max.	0.05% max.	0.10% max.

Normalized or quenched and tempered<sup>(4)</sup>

*Tensile and toughness (impact) test requirements*

Plates: Each "piece" to be tested

Sections: Batch test

Charpy V-notch test: Test temperatures 5° C below the design temperature or -20° C whichever is lower

Plates: Transverse test pieces. Minimum average energy value (E) 27 J

Sections and forgings:<sup>(1)</sup> Longitudinal test pieces. Minimum average energy value (E) 41 J

## NOTES

- (1) The Charpy V-notch and chemistry requirements for forgings may be specially considered by the Administration.  
 (2) For material thickness of more than 25 mm, Charpy V-notch tests should be conducted as follows:

Material thickness (mm)	Test temperature (°C)
25 < t ≤ 30	10° below design temperature or whichever is lower –20° whichever is lower
30 < t ≤ 35	15° below design temperature or –20° whichever is lower
35 < t ≤ 40	20° below design temperature

The impact energy value should be in accordance with the table for the applicable type of test specimen. For material thickness of more than 40 mm, the Charpy V-notch values should be specially considered.

Materials for tanks and parts of tanks which are completely thermally stress relieved after welding may be tested at a temperature 5°C below design temperature or –20°C whichever is lower.

For thermally stress relieved reinforcements and other fittings, the test temperature should be the same as that required for the adjacent tank-shell thickness.

(3) By special agreement with the Administration, the carbon content may be increased to 0.18% maximum provided the design temperature is not lower than –40°C.

(4) A controlled rolling procedure may be used as an alternative to normalizing or quenching and tempering, subject to special approval by the Administration.

*Guidance:* For materials exceeding 25 mm in thickness for which the test temperature is –60°C or lower, the application of specially treated steels or steels in accordance with table 6.3 may be necessary.

TABLE 6.3. PLATES, SECTIONS AND FORGINGS<sup>(1)</sup> FOR CARGO TANKS, SECONDARY BARRIERS AND PROCESS PRESSURE VESSELS FOR DESIGN TEMPERATURES BELOW 55°C AND DOWN TO –165°C<sup>(2)</sup>

*Maximum thickness 25 mm<sup>(3)</sup>*

Minimum design temp. (°C)	Chemical composition <sup>(4)</sup> and heat treatment	Impact test temp. (°C)
–60	1.5% nickel steel — normalized	–65
–65	2.25% nickel steel — normalized or normalized and tempered <sup>(5)</sup>	–70
–90	3.5% nickel steel — normalized or normalized and tempered <sup>(5)</sup>	–95
–105	5% nickel steel — normalized or normalized and tempered <sup>(5),(6)</sup>	–110
–165	9% nickel steel — double normalized and tempered or quenched and tempered	–196
–165	Austenitic steels, such as types 304, 304L, 316, 316L, 321 and 347 solution treated <sup>(7)</sup>	–196
–165	Aluminium alloys; such as type 5083 annealed	Not required
–165	Austenitic Fe-Ni alloy (36% nickel) Heat treatment as agreed	Not required

*Tensile and toughness (impact) test requirements*

Plates: Each “piece” to be tested

Sections and forgings: Batch test

*Charpy V-notch test*

Plates: Transverse test pieces. Minimum average energy value (E) 27 J

Sections and forgings: Longitudinal test pieces. Minimum average energy value (E) 41 J

## NOTES

(1) The impact test required for forgings used in critical applications should be subject to special consideration by the Administration.

(2) The requirements for design temperatures below –165°C should be specially agreed with the Administration.

(3) For materials 1.5% Ni, 2.25% Ni, 3.5% Ni and 5% Ni, with thicknesses greater than 25 mm, the impact tests should be conducted as follows:

Material thickness (mm)	Test temperature (°C)
25 < t ≤ 30	10° below design temperature
30 < t ≤ 35	15° below design temperature
35 < t ≤ 40	20° below design temperature

In no case should the test temperature be above that indicated in the table.

The energy value should be in accordance with the table for the applicable type of test specimen. For material thickness of more than 40 mm, the Charpy V-notch values should be specially considered.

For 9% Ni, austenitic stainless steels and aluminium alloys, thicknesses greater than 25 mm may be used at the discretion of the Administration.

(4) The chemical composition limits should be approved by the Administration.

(5) A lower minimum design temperature for quenched and tempered steels may be specially agreed with the Administration.

(6) A specially heat treated 5% nickel steel, for example triple heat treated 5% nickel steel, may be used down to -165° C upon special agreement with the Administration, provided that the impact tests are carried out at -196° C.

(7) The impact test may be omitted subject to agreement with the Administration.

TABLE 6.4. PIPES (SEAMLESS AND WELDED),<sup>(1)</sup> FORGINGS<sup>(2)</sup> AND CASTINGS<sup>(2)</sup> FOR CARGO AND PROCESS PIPING FOR DESIGN TEMPERATURES BELOW 0° C AND DOWN TO -165° C<sup>(3)</sup>

		Impact test	
		Test temp. (°C)	Minimum average energy (E) (J)
Minimum design temp. (°C)	Chemical composition <sup>(5)</sup> and heat treatment		
-55	Carbon-manganese steel. Fully killed fine grain. Normalized or as agreed <sup>(6)</sup>	(4)	27
-65	2.25% nickel steel. Normalized or normalized and tempered <sup>(6)</sup>	-70	34
-90	3.5% nickel steel. Normalized or normalized and tempered <sup>(6)</sup>	-95	34
-165	9% nickel steel. <sup>(7)</sup> Double normalized and tempered or quenched and tempered	-196	41
	Austenitic steels, such as types 304, 304L, 316, 316L, 321 and 347. Solution treated <sup>(8)</sup>	-196	41
	Aluminium alloys, such as type 5083 annealed		Not required

#### Tensile and toughness (impact) test requirements

Each batch to be tested

Impact test: Longitudinal test pieces

#### NOTES

(1) The use of longitudinally or spirally welded pipes should be specially approved by the Administration.

(2) The requirements for forgings and castings may be subject to special consideration by the Administration.

(3) The requirements for design temperatures below -165° C should be specially agreed with the Administration.

(4) The test temperature should be 5° C below the design temperature or -20° C whichever is lower.

(5) The composition limits should be approved by the Administration.

(6) A lower design temperature may be specially agreed with the Administration for quenched and tempered materials.

(7) This chemical composition is not suitable for castings.

(8) Impact tests may be omitted subject to agreement with the Administration.

TABLE 6.5. PLATES AND SECTIONS FOR HULL STRUCTURES  
REQUIRED BY 4.9.1 AND 4.9.4

Minimum design temperature of hull structure (° C)	Maximum thickness (mm) for steel grades in accordance with 6.1.9						
	A	B	D	E	AH	DH	EH
0 and above <sup>(1)</sup> -5 and above <sup>(2)</sup>	Normal practice						
Down to -5	15	25	30	50	25	45	50
Down to -10	x	20	25	50	20	40	50
Down to -20	x	x	20	50	x	30	50
Down to -30	x	x	x	40	x	20	40
Below -30	In accordance with table 6.2 except that the thickness limitation given in table 6.2 and in footnote 2 of that table does not apply.						

## NOTES

"x" means steel grade not to be used.

(1) For the purpose of 4.9.4

(2) For the purpose of 4.9.1

### 6.3. *Welding and non-destructive testing*

#### 6.3.1. *General*

The requirements of this section are those generally employed for carbon, carbon-manganese, nickel alloy and stainless steels, and may form the basis for acceptance testing of other material. At the discretion of the Administration, impact testing of stainless steel and aluminium alloy weldments may be omitted and other tests may be specially required for any material.

#### 6.3.2. *Welding consumables*

Welding consumables intended for welding of cargo tanks should be in accordance with Recognized Standards unless otherwise agreed with the Administration. Deposited weld metal tests and butt weld tests should be required for all welding consumables, unless otherwise specially agreed with the Administration. The results obtained from tensile and Charpy V-notch impact tests should be in accordance with Recognized Standards. The chemical composition of the deposited weld metal should be recorded for information and approval.

#### 6.3.3. *Welding procedure tests for cargo tanks and process pressure vessels*

6.3.3.1. Welding procedure tests for cargo tanks and process pressure vessels are required for all butt welds and the test assemblies should be representative of:

- Each base material,
- Each type of consumable and welding process,
- Each welding position.

For butt welds in plates, the test assemblies should be so prepared that the rolling direction is parallel to the direction of welding. The range of thickness qualified by each welding procedure test should be in accordance with Recognized Standards. Radiographic or ultrasonic testing may be performed at the option of the fabricator or the Administration. Procedure tests for consumables intended for fillet welding should be in accordance with Recognized Standards. In such cases consumables should be selected which exhibit satisfactory impact properties.



6.3.3.2. The following welding procedure tests for cargo tanks and process pressure vessels should be made from each test assembly:

- .1 Cross-weld tensile tests.
- .2 Transverse bend tests which may be face, root or side bends at the discretion of the Administration. However, longitudinal bend tests may be required in lieu of transverse bend tests in cases where the base material and weld metal have different strength levels.
- .3 One set of three Charpy V-notch impacts, generally at each of the following locations, as shown in figure 6.1:
  - Centreline of the welds,
  - Fusion line (F.L.),
  - 1 mm from the F.L.,
  - 3 mm from the F.L.,
  - 5 mm from the F.L.
- .4 Macrosection, microsection and hardness survey may also be required by the Administration.

#### 6.3.4. *Test requirements*

6.3.4.1. Tensile tests: Generally, tensile strength should not be less than the specified minimum tensile strength for the appropriate parent materials. The Administration may also require that the transverse weld tensile strength should not be less than the specified minimum tensile strength for the weld metal, where the weld metal has a lower tensile strength than that of the parent metal. In every case, the position of fracture is to be reported for information.

6.3.4.2. Bend tests: No fracture is acceptable after a 180° bend over a former of a diameter 4 times the thickness of the test pieces, unless otherwise specially required by or agreed with the Administration.

6.3.4.3. Charpy V-notch impact tests: Charpy tests should be conducted at the temperature prescribed for the base material being joined. The results of weld metal impact tests, minimum average energy (E), should be no less than 27 J. The weld metal requirements for subsize specimens and single energy values should be in accordance with 6.1.4. The results of fusion line and heat affected zone impact tests should show a minimum average energy (E) in accordance with the transverse or longitudinal requirements of the base material, whichever is applicable, and for subsize specimens, the minimum average energy (E) should be in accordance with 6.1.4. If the material thickness does not permit machining either full-size or standard subsize specimens, the testing procedure and acceptance standards should be in accordance with Recognized Standards.

#### 6.3.5. *Welding procedure tests for piping*

Welding procedure tests for piping should be carried out and should be similar to those detailed for cargo tanks in 6.3.3. Unless otherwise specially agreed with the Administration, the test requirements should be in accordance with 6.3.4.

#### 6.3.6. *Production weld tests*

6.3.6.1. For all cargo tanks and process pressure vessels except integral and membrane tanks, production weld tests should generally be performed for approximately each 50 m of butt weld joints and should be representative of each welding position. For secondary barriers, the same type production tests as required for primary tanks should be performed except that the number of tests may be reduced subject to agreement with the Administration. Tests, other than those specified in 6.3.6.2, .3 and .4, may be required for cargo tanks or secondary barriers at the discretion of the Administration.

6.3.6.2. The production tests for types A and B independent tanks and semi-membrane tanks should include the following tests:

- .1 Bend tests, and where required for procedure tests one set of three Charpy V-notch tests should be made for each 50 m of weld. The Charpy V-notch tests should be made with specimens having the notch alternately located in the centre of the weld and in the heat affected zone (most critical location based on procedure qualification results). For austenitic stainless steel, all notches should be in the centre of the weld.
- .2 The test requirements are the same as the applicable test requirements listed in 6.3.4 except that impact tests that do not meet the prescribed energy requirements may still be accepted, upon special consideration by the Administration, by passing a drop weight test. In such cases, two drop weight specimens should be tested for each set of Charpy specimens that failed and both must show "no break" performance at the temperature at which the Charpy tests were conducted.

6.3.6.3. In addition to those tests listed in 6.3.6.1 for type C independent tanks and process pressure vessels, transverse weld tensile tests are required. The test requirements are listed in 6.3.4 except that impact tests that do not meet the prescribed energy requirements may still be accepted upon special consideration by the Administration, by passing a drop weight test. In such cases, two drop weight specimens should be tested for each set of Charpy specimens that failed, and both must show "no break" performance at the temperature at which the Charpy tests were conducted.

6.3.6.4. Production tests for integral and membrane tanks should be in accordance with Recognized Standards.

#### 6.3.7. *Non-destructive testing*

6.3.7.1. For type A independent tanks and semi-membrane tanks where the design temperature is  $-20^{\circ}\text{C}$  or less, and for type B independent tanks regardless of temperature, all full penetration butt welds of the shell plating of cargo tanks should be subjected to 100% radiographic inspection.

6.3.7.1.1. Where the design temperature is higher than  $-20^{\circ}\text{C}$ , all full penetration butt welds in way of intersections and at least 10% of the remaining full penetration welds of tank structures should be subjected to radiographic inspection.

6.3.7.1.2. In each case the remaining tank structure including the welding of stiffeners and other fittings and attachments should be examined by magnetic particle or dye penetrant methods as considered necessary by the Administration.

6.3.7.1.3. All test procedures and acceptance standards should be in accordance with Recognized Standards. The Administration may accept an approved ultrasonic test procedure in lieu of radiographic inspection, but may in addition require supplementary inspection by radiography at selected locations. Further, the Administration may require ultrasonic testing in addition to normal radiographic inspection.

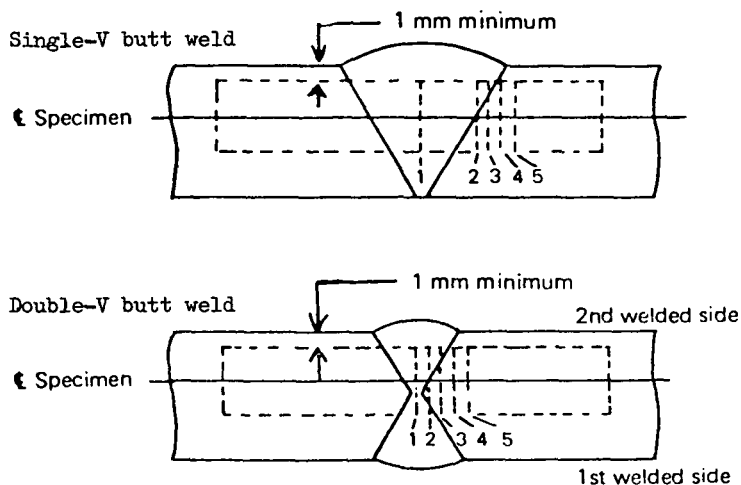
6.3.7.2. Inspection of type C independent tanks and process pressure vessels should be carried out in accordance with 4.10.9.

6.3.7.3. For integral and membrane tanks, special weld inspection procedures and acceptance criteria should be in accordance with Recognized Standards.

6.3.7.4. The inspection and non-destructive testing of the inner hull or the independent tank structures supporting internal insulation tanks should take into account the design criteria given in 4.4.7. The schedule for inspection and non-destructive testing should be to the satisfaction of the Administration.

6.3.7.5. Inspection of piping should be carried out in accordance with the requirements of chapter 5.

6.3.7.6. The secondary barrier should be radiographed as considered necessary by the Administration. Where the outer shell of the hull is part of the secondary barrier, all sheer strake butts and the intersections of all butts and seams in the side shell should be tested by radiography.



*Notch location:*

1. Centre of weld
2. On fusion line
3. In HAZ, 1 mm from fusion line
4. In HAZ, 3 mm from fusion line
5. In HAZ, 5 mm from fusion line

HAZ = heat affected zone

The largest size Charpy specimens possible for the material thickness should be machined with the centre of the specimens located as near as practicable to a point midway between the surface and the centre of the thickness. In all cases, the distance from the surface of the material to the edge of the specimen should be approximately one mm or greater. In addition for double-V butt welds, specimens should be machined closer to the surface of the second welded side.

FIGURE 6.1. ORIENTATION OF WELD TEST SPECIMEN

## Chapter 7. CARGO PRESSURE/TEMPERATURE CONTROL

### 7.1 General

7.1.1. Unless the entire cargo system is designed to withstand the full gauge vapour pressure of the cargo under conditions of the upper ambient design temperatures, maintenance of the cargo tank pressure below the MARVS should be provided by one or more of the following means, except as otherwise provided in this section:

- .1 A system which regulates the pressure in the cargo tanks by the use of mechanical refrigeration;
- .2 A system whereby the boil-off vapours are utilized as fuel for shipboard use or waste heat system subject to the provisions of chapter 16. This system may be used at all times, including while in port and while manoeuvring, provided that a means of disposing of excess energy is provided, such as a steam dump system, that is satisfactory to the Administration;
- .3 A system allowing the product to warm up and increase in pressure. The insulation or cargo tank design pressure or both should be adequate to provide for a suitable margin for the operating time and temperatures involved. The system should be acceptable to the Administration in each case;
- .4 Other systems acceptable to the Administration;
- .5 In addition to the above means, the Administration may permit certain cargoes to be controlled by venting cargo vapours to the atmosphere at sea. This may also be permitted in port with the permission of the port Administration.

7.1.2. The systems required by 7.1.1 should be constructed, fitted and tested to the satisfaction of the Administration. Materials used in their construction should be suitable for use with the cargoes to be carried. For normal service, the upper ambient design temperature should be:

Sea 32° C

Air 45° C.

For service in especially hot or cold zones these design temperatures should be increased or reduced, as appropriate, by the Administration.

7.1.3. For certain highly dangerous cargoes specified in chapter 17, the cargo containment system should be capable of withstanding the full vapour pressure of the cargo under conditions of the upper ambient design temperatures irrespective of any system provided for dealing with boil-off gas.

### 7.2. Refrigeration systems

7.2.1. A refrigeration system should consist of one or more units capable of maintaining the required cargo pressure/temperature under conditions of the upper ambient design temperatures. Unless an alternative means of controlling the cargo pressure/temperature is provided to the satisfaction of the Administration, a stand-by unit (or units) affording spare capacity at least equal to the largest required single unit should be provided. A stand-by unit should consist of a compressor with its driving motor, control system and any necessary fittings to permit operation independently of the normal service units. A stand-by heat exchanger should be provided unless the normal heat exchanger for the unit has an excess capacity of at least 25% of the largest required capacity. Separate piping systems are not required.

7.2.2.1. Where two or more refrigerated cargoes which may react chemically in a dangerous manner are carried simultaneously, special consideration should be given to the refrigeration systems to avoid the possibility of mixing cargoes. For the carriage of such cargoes, separate refrigeration systems, each complete with a stand-by unit as specified in 7.2.1, should be provided for each cargo. However, where cooling is provided by an indirect or

combined system and leakage in the heat exchangers cannot cause mixing of the cargoes under any envisaged condition, separate refrigeration units need not be fitted.

7.2.2.2. Where two or more refrigerated cargoes are not mutually soluble under the conditions of carriage, so that their vapour pressures would be additive on mixing, special consideration should be given to the refrigeration systems to avoid the possibility of mixing cargoes.

7.2.3. Where cooling water is required in refrigeration systems, an adequate supply should be provided by a pump or pumps used exclusively for this purpose. This pump or these pumps should have at least two sea suction lines, where practicable leading from sea-chests, one port and one starboard. A spare pump of adequate capacity should be provided, which may be a pump used for other services so long as its use for cooling would not interfere with any other essential service.

7.2.4. The refrigeration system may be arranged in one of the following ways:

- .1 A direct system where evaporated cargo is compressed, condensed and returned to cargo tanks. For certain cargoes specified in chapter 17 this system should not be used;
- .2 An indirect system where cargo or evaporated cargo is cooled or condensed by refrigerant without being compressed;
- .3 A combined system where evaporated cargo is compressed and condensed in a cargo/refrigerant heat exchanger and returned to the cargo tanks. For certain cargoes specified in chapter 17 this system should not be used.

7.2.5. All primary and secondary refrigerants must be compatible with each other and with the cargo with which they come into contact. The heat exchange may take place either remotely from the cargo tank or by cooling coils fitted inside or outside the cargo tank.

## Chapter 8. CARGO TANK VENT SYSTEMS

### 8.1. *General*

All cargo tanks should be provided with a pressure relief system appropriate to the design of the cargo containment system and the cargo being carried. Hold spaces, interbarrier spaces and cargo piping which may be subject to pressures beyond their design capabilities should also be provided with a suitable pressure relief system. The pressure relief system should be connected to a vent piping system so designed as to minimize the possibility of cargo vapour accumulating on the decks, or entering accommodation spaces, service spaces, control stations and machinery spaces, or other spaces where it may create a dangerous condition. Pressure control systems specified by chapter 7 should be independent of the pressure relief valves.

### 8.2. *Pressure relief systems*

8.2.1. Each cargo tank with a volume exceeding 20 m<sup>3</sup> should be fitted with at least two pressure relief valves of approximately equal capacity, suitably designed and constructed for the prescribed service. For cargo tanks with a volume not exceeding 20 m<sup>3</sup>, a single relief valve may be fitted.

8.2.2. Interbarrier spaces should be provided with pressure relief devices to the satisfaction of the Administration.

8.2.3. The setting of the pressure relief valves should not be higher than the vapour pressure which has been used in the design of the tank.

8.2.4. Pressure relief valves should be connected to the highest part of the cargo tank above deck level. Pressure relief valves on cargo tanks with a design temperature below 0°C should be arranged to prevent their becoming inoperative due to ice formation when they are closed. Due consideration should be given to the construction and arrangement of pressure relief valves on cargo tanks subject to low ambient temperatures.

8.2.5. Pressure relief valves should be prototype tested to ensure that the valves have the capacity required. Each valve should be tested to ensure that it opens at the prescribed pressure setting with an allowance not exceeding  $\pm 10\%$  for 0 to 1.5 bar,  $\pm 6\%$  for 1.5 to 3.0 bar,  $\pm 3\%$  for 3.0 bar and above. Pressure relief valves should be set and sealed by a competent authority acceptable to the Administration and a record of this action, including the values of set pressure, should be retained aboard the ship.

8.2.6. In the case of cargo tanks permitted to have more than one relief valve setting this may be accomplished by:

- .1 Installing two or more properly set and sealed valves and providing means as necessary for isolating the valves not in use from the cargo tank; or
- .2 Installing relief valves whose settings may be changed by the insertion of previously approved spacer pieces or alternative springs or by other similar means not requiring pressure testing to verify the new set pressure. All other valve adjustments should be sealed.

8.2.7. The changing of the set pressure under the provisions of 8.2.6 should be carried out under the supervision of the master in accordance with procedures approved by the Administration and specified in the ship's operating manual. Changes in set pressures should be recorded in the ship's log and a sign posted in the cargo control room, if provided, and at each relief valve, stating the set pressure.

8.2.8. Stop valves or other means of blanking off pipes between tanks and pressure relief valves to facilitate maintenance should not be fitted unless all the following arrangements are provided:

- .1 Suitable arrangements to prevent more than one pressure relief valve being out of service at the same time;
- .2 A device which automatically and in a clearly visible way indicates which one of the pressure relief valves is out of service; and
- .3 Pressure relief valve capacities such that if one valve is out of service the remaining valves have the combined relieving capacity required by 8.5. However, this capacity may be provided by the combined capacity of all valves, if a suitably maintained valve is carried on board.

8.2.9. Each pressure relief valve installed on a cargo tank should be connected to a venting system, which should be so constructed that the discharge of gas will be directed upwards and so arranged as to minimize the possibility of water or snow entering the vent system. The height of vent exits should be not less than  $B/3$  or 6 m, whichever is greater, above the weather deck and 6 m above the working area and the fore and aft gangway.

8.2.10. Cargo tank pressure relief valve vent exits should be arranged at a distance at least equal to  $B$  or 25 m, whichever is less, from the nearest air intake or opening to accommodation spaces, service spaces and control stations, or other gas-safe spaces. For ships less than 90 m in length, smaller distances may be permitted by the Administration. All other vent exits connected to the cargo containment system should be arranged at a distance of at least 10 m from the nearest air intake or opening to accommodation spaces, service spaces and control stations, or other gas-safe spaces.

8.2.11. All other cargo vent exits not dealt with in other chapters should be arranged in accordance with 8.2.9 and 8.2.10.

8.2.12. If cargoes which react in a hazardous manner with each other are carried simultaneously, a separate pressure relief system should be fitted for each cargo carried.

8.2.13. In the vent piping system, means for draining liquid from places where it may accumulate should be provided. The pressure relief valves and piping should be so arranged that liquid can under no circumstances accumulate in or near the pressure relief valves.

8.2.14. Suitable protection screens should be fitted on vent outlets to prevent the ingress of foreign objects.

8.2.15. All vent piping should be so designed and arranged that it will not be damaged by temperature variations to which it may be exposed, or by the ship's motions.

8.2.16. The back pressure in the vent lines from the pressure relief valves should be taken into account in determining the flow capacity required by 8.5.

8.2.17. Pressure relief valves should be positioned on the cargo tank so that they will remain in the vapour phase under conditions of 15° list and 0.015 L trim, where L is as defined in 1.3.23.

### 8.3. *Additional pressure relieving system for liquid level control*

8.3.1. Where required by 15.1.4.2, an additional pressure relieving system to prevent the tank from becoming liquid full at any time during relief under the fire exposure conditions referred to in 8.5 should be fitted to each tank. This pressure relieving system should consist of:

- .1 One or more relief valves set at a pressure corresponding to the gauge vapour pressure of the cargo at the reference temperature defined in 15.1.4.2; and
- .2 An override arrangement, whenever necessary, to prevent its normal operation. This arrangement should include fusible elements designed to melt at temperatures between 98°C and 104°C and to cause relief valves specified in 8.3.1.1 to become operable. The fusible elements should be located, in particular, in the vicinity of relief valves. The system should become operable upon loss of system power if provided. The override arrangement should not be dependent on any source of ship's power.

8.3.2. The total relieving capacity of the additional pressure relieving system at the pressure mentioned in 8.3.1.1 should not be less than:

$$Q' = FG' A^{0.82} \text{ (m}^3\text{/s)}$$

where:  $Q'$  = minimum required rate of discharge of air at standard conditions of 273 K and 1.013 bar.

$$G' = \frac{12.4}{(L + \rho_r m) D} \sqrt{\frac{Z \cdot T'}{M}}$$

with:

$\rho_r$  = relative density of liquid phase of product at relieving conditions ( $\rho_r = 1.0$  for fresh water);

$m = -di/d_{\rho_r}$  = gradient of decrease of liquid phase enthalpy against increase of liquid phase density (kJ/kg) at relieving conditions. For set pressures not higher than 2.0 bar the values in table 8.1 may be used. For products not listed in the table and for higher set pressures, the value of  $m$  should be calculated on the basis of the thermodynamic data of the product itself;

$i$  = enthalpy of liquid (kJ/kg);

$T'$  = temperature in kelvins (K) at relieving conditions, i.e. at the pressure at which the additional pressure relieving system is set;

F, A, L, D, Z and M are defined in 8.5.2.

8.3.3. Compliance with 8.3.1.1 requires changing of the setting of the relief valves provided for in this section. This should be accomplished in accordance with the provisions of 8.2.6 and 8.2.7.

8.3.4. Relief valves mentioned under 8.3.1.1 above may be the same as the pressure relief valves mentioned in 8.2, provided the setting pressure and the relieving capacity are in compliance with the requirements of this section.

8.3.5. The exhaust of such pressure relief valves may be led to the venting system referred to in 8.2.9. If separate venting arrangements are fitted these should be in accordance with the requirements of 8.2.9 to 8.2.15.

TABLE 8.1. FACTOR M

Product	$m = -di/d_{pr}$ (kJ/kg)
Ammonia, anhydrous	3400
Butadiene	1800
Butane	2000
Butylenes	1900
Ethane	2100
Ethylene	1500
Methane	2300
Methyl chloride	816
Nitrogen	400
Propane	2000
Propylene	1600
Propylene oxide	1550
Vinyl chloride	900

The values in this table may be used for set pressures not higher than 2.0 bar.

#### 8.4. Vacuum protection systems

8.4.1. Cargo tanks designed to withstand a maximum external pressure differential exceeding 0.25 bar and capable of withstanding the maximum external pressure differential which can be attained at maximum discharge rates with no vapour return into the cargo tanks, or by operation of a cargo refrigeration system, need no vacuum relief protection.

8.4.2. Cargo tanks designed to withstand a maximum external pressure differential not exceeding 0.25 bar, or tanks which cannot withstand the maximum external pressure differential that can be attained at maximum discharge rates with no vapour return into the cargo tanks, or by operation of a cargo refrigeration system, or by sending boil-off vapour to the machinery spaces, should be fitted with:

- .1 Two independent pressure switches to sequentially alarm and subsequently stop all suction of cargo liquid or vapour from the cargo tank, and refrigeration equipment if fitted, by suitable means at a pressure sufficiently below the maximum external designed pressure differential of the cargo tank; or
- .2 Vacuum relief valves with a gas flow capacity at least equal to the maximum cargo discharge rate per cargo tank, set to open at a pressure sufficiently below the external design differential pressure of the cargo tank; or
- .3 Other vacuum relief systems acceptable to the Administration.

8.4.3. Subject to the requirements of chapter 17, the vacuum relief valves should admit an inert gas, cargo vapour or air to the cargo tank and should be arranged to minimize the possibility of the entrance of water or snow. If cargo vapour is admitted, it should be from a source other than the cargo vapour lines.

8.4.4. The vacuum protection system should be capable of being tested to ensure that it operates at the prescribed pressure.

#### 8.5. Size of valves

Pressure relief valves should have a combined relieving capacity for each cargo tank to discharge the greater of the following with not more than a 20% rise in cargo tank pressure above the MARVS:

- .1 The maximum capacity of the cargo tank inerting system if the maximum attainable working pressure of the cargo tank inerting system exceeds the MARVS of the cargo tanks; or



2 Vapours generated under fire exposure computed using the following formula:

$$Q = FGA^{0.82} \text{ (m}^3\text{/s)}$$

where: Q = minimum required rate of discharge of air at standard conditions of 273 K and 1.013 bar.

F = fire exposure factor for different cargo tank types:

F = 1.0 for tanks without insulation located on deck;

F = 0.5 for tanks above the deck when insulation is approved by the Administration. (Approval will be based on the use of an approved fire-proofing material, the thermal conductance of insulation, and its stability under fire exposure);

F = 0.5 for uninsulated independent tanks installed in holds;

F = 0.2 for insulated independent tanks in holds (or uninsulated independent tanks in insulated holds);

F = 0.1 for insulated independent tanks in inerted holds (or uninsulated independent tanks in inerted, insulated holds);

F = 0.1 for membrane and semi-membrane tanks.

For independent tanks partly protruding through the open deck, the fire exposure factor should be determined on the basis of the surface areas above and below deck.

G = gas factor

$$G' = \frac{12.4}{LD} \sqrt{\frac{Z \cdot T}{M}}$$

with:

T = temperature in kelvins (K) at relieving conditions, i.e. 120% of the pressure at which the pressure relief valve is set.

L = latent heat of the material being vaporized at relieving conditions, in kJ/kg

D = constant based on relation of specific heats k, shown in table 8.2; if k is not known, D = 0.606 should be used. The constant D may also be calculated by the following formula:

$$D = \sqrt{k \left( \frac{2}{k+1} \right) \frac{k+1}{k-1}}$$

Z = compressibility factor of the gas at relieving conditions; if not known, Z = 1.0 should be used.

M = molecular mass of the product

A = external surface area of the tank (m<sup>2</sup>) for different tank types:

For body-of-revolution type tanks:

A = external surface area;

For other than body-of-revolution type tanks:

A = external surface area less the projected bottom surface area;

For tanks consisting of an array of pressure vessel tanks:

— Insulation on the ship's structure:

A = external surface area of the hold less its projected area;

— Insulation on the tank structure:

A = external surface area of the array of pressure vessels excluding insulation, less the projected bottom area as shown in figure 8.1.

TABLE 8.2. CONSTANT D

<i>k</i>	<i>D</i>	<i>k</i>	<i>D</i>
1.00	0.606	1.52	0.704
1.02	0.611	1.54	0.707
1.04	0.615	1.56	0.710
1.06	0.620	1.58	0.713
1.08	0.624	1.60	0.716
1.10	0.628	1.62	0.719
1.12	0.633	1.64	0.722
1.14	0.637	1.66	0.725
1.16	0.641	1.68	0.728
1.18	0.645	1.70	0.731
1.20	0.649	1.72	0.734
1.22	0.652	1.74	0.736
1.24	0.656	1.76	0.739
1.26	0.660	1.78	0.742
1.28	0.664	1.80	0.745
1.30	0.667	1.82	0.747
1.32	0.671	1.84	0.750
1.34	0.674	1.86	0.752
1.36	0.677	1.88	0.755
1.38	0.681	1.90	0.758
1.40	0.685	1.92	0.760
1.42	0.688	1.94	0.763
1.44	0.691	1.96	0.765
1.46	0.695	1.98	0.767
1.48	0.698	2.00	0.770
1.50	0.701	2.02	0.772
		2.20	0.792

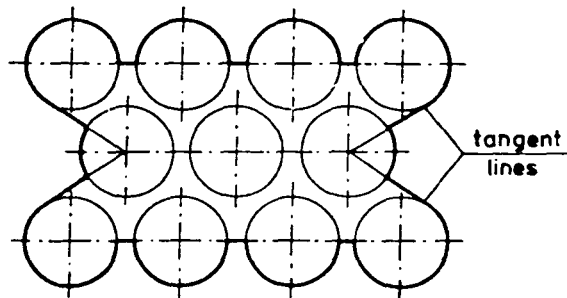


FIGURE 8.1

### Chapter 9. ENVIRONMENTAL CONTROL

#### 9.1. *Environmental control within cargo tanks and cargo piping systems*

9.1.1. A piping system should be provided to enable each cargo tank to be safely gas-freed, and to be safely purged with cargo gas from a gas-free condition. The system should be arranged to minimize the possibility of pockets of gas or air remaining after gas-freeing or purging.

9.1.2. A sufficient number of gas sampling points should be provided for each cargo tank in order to adequately monitor the progress of purging and gas-freeing. Gas sampling connections should be valved and capped above the main deck.

9.1.3. For flammable gases, the system should be arranged to minimize the possibility of a flammable mixture existing in the cargo tank during any part of the gas-freeing operation by utilizing an inerting medium as an intermediate step. In addition, the system should enable the cargo tank to be purged with an inerting medium prior to filling with cargo vapour or liquid, without permitting a flammable mixture to exist at any time within the cargo tank.

9.1.4. Piping systems which may contain cargo should be capable of being gas-freed and purged as provided in 9.1.1 and 9.1.3.

9.1.5. Inert gas utilized in these procedures may be provided from the shore or from the ship.

#### 9.2. *Environmental control within the hold spaces (cargo containment systems other than type C independent tanks)*

9.2.1. Interbarrier and hold spaces associated with cargo containment systems for flammable gases requiring full secondary barriers should be inerted with a suitable dry inert gas and kept inerted with make-up gas provided by a shipboard inert gas generation system, or by shipboard storage which should be sufficient for normal consumption for at least 30 days.

9.2.2.1. Interbarrier and hold spaces associated with cargo containment systems for flammable gases requiring partial secondary barriers should be inerted with suitable dry inert gas and kept inerted with make-up gas provided by a shipboard inert gas generation system or by shipboard storage which should be sufficient for normal consumption for at least 30 days.

9.2.2.2. Alternatively, subject to the restrictions specified in chapter 17, the Administration may allow the spaces referred to in 9.2.2.1 to be filled with dry air provided that the ship maintains a stored charge of inert gas or is fitted with an inert gas generation system sufficient to inert the largest of these spaces; and provided that the configuration of the spaces and the relevant vapour detection systems, together with the capability of the inerting arrangements, ensure that any leakage from the cargo tanks will be rapidly detected and inerting effected before a dangerous condition can develop. Equipment for the provision of sufficient dry air of suitable quality to satisfy the expected demand should be provided.

9.2.3. For non-flammable gases, the spaces referred to in 9.2.1 and 9.2.2.1 may be maintained with a suitable dry air or inert atmosphere.

9.2.4. In case of internal insulation tanks, environmental control arrangements are not required for interbarrier spaces and spaces between the secondary barrier and the inner hull or independent tank structures completely filled with insulation materials complying with 4.9.7.2.

#### 9.3. *Environmental control of spaces surrounding type C independent tanks*

Spaces surrounding refrigerated cargo tanks not having secondary barriers should be filled with suitable dry inert gas or dry air and be maintained in this condition with make-up inert gas provided by a shipboard inert gas generation system, shipboard storage of inert gas, or dry air provided by suitable air drying equipment.

#### 9.4. *Inerting*

9.4.1. Inerting refers to the process of providing a non-combustible environment by the addition of compatible gases, which may be carried in storage vessels or produced on board the ship or supplied from the shore. The inert gases should be compatible chemically and operationally, at all temperatures likely to occur within the spaces to be inerted, with the materials of construction of the spaces and the cargo. The dew points of the gases should be taken into consideration.

9.4.2. Where inert gas is also stored for fire-fighting purposes, it should be carried in separate containers and should not be used for cargo services.

9.4.3. Where inert gas is stored at temperatures below 0°C, either as a liquid or as a vapour, the storage and supply system should be so designed that the temperature of the ship's structure is not reduced below the limiting values imposed on it.

9.4.4. Arrangements suitable for the cargo carried should be provided to prevent the backflow of cargo vapour into the inert gas system.

9.4.5. The arrangements should be such that each space being inerted can be isolated and the necessary controls and relief valves etc. should be provided for controlling pressure in these spaces.

#### 9.5. *Inert gas production on board*

9.5.1. The equipment should be capable of producing inert gas with an oxygen content at no time greater than 5% by volume subject to the special requirements of chapter 17. A continuous-reading oxygen content meter should be fitted to the inert gas supply from the equipment and should be fitted with an alarm set at a maximum of 5% oxygen content by volume subject to the requirements of chapter 17. Additionally, where inert gas is made by an on-board process of fractional distillation of air which involves the storage of the cryogenic liquefied nitrogen for subsequent release, the liquefied gas entering the storage vessel should be monitored for traces of oxygen to avoid possible initial high oxygen enrichment of the gas when released for inerting purposes.

9.5.2. An inert gas system should have pressure controls and monitoring arrangements appropriate to the cargo containment system. A means acceptable to the Administration, located in the cargo area, of preventing the backflow of cargo gas should be provided.

9.5.3. Spaces containing inert gas generating plants should have no direct access to accommodation spaces, service spaces or control stations, but may be located in machinery spaces. If such plants are located in machinery spaces or other spaces outside the cargo tank area, two non-return valves or equivalent devices should be fitted in the inert gas main in the cargo area as required in 9.5.2. Inert gas piping should not pass through accommodation spaces, service spaces or control stations.

9.5.4. Flame burning equipment for generating inert gas should not be located within the cargo area. Special consideration may be given to the location of inert gas generating equipment using the catalytic combustion process.

### Chapter 10. ELECTRICAL INSTALLATIONS

#### 10.1. *General*

10.1.1. The provisions of this chapter are applicable to ships carrying flammable products and should be applied in conjunction with part D of chapter 11-1 of the 1983 SOLAS amendments.

10.1.2. Electrical installations should be such as to minimize the risk of fire and explosion from flammable products. Electrical installations complying with this chapter need not be considered as a source of ignition for the purposes of chapter 3.

10.1.3. Administrations should take appropriate steps to ensure uniformity in the implementation and application of the provisions of this chapter in respect of electrical installations.\*

10.1.4. Electrical equipment or wiring should not be installed in gas-dangerous spaces or zones unless essential for operational purposes, when the exceptions listed in 10.2 are permitted.

10.1.5. Where electrical equipment is installed in gas-dangerous spaces or zones as provided in 10.1.4, it should be to the satisfaction of the Administration and approved by the relevant authorities recognized by the Administration for operation in the flammable atmosphere concerned.

#### 10.2. *Types of equipment*

Certified safe type equipment may be fitted in gas-dangerous spaces and zones in accordance with the following provisions:

##### 10.2.1. *Gas-dangerous spaces and zones, general*

Intrinsically safe electrical equipment and wiring may be fitted in all gas-dangerous spaces and zones as defined in 1.3.17.

##### 10.2.2. *Cargo containment systems*

Submerged cargo pump motors and their supply cables may be fitted in cargo containment systems. Arrangements should be made to automatically shut down the motors in the event of low liquid level. This may be accomplished by sensing low pump discharge pressure, low motor current, or low liquid level. This shutdown should be alarmed at the cargo control station. Cargo pump motors should be capable of being isolated from their electrical supply during gas-freeing operations.

##### 10.2.3. *Hold spaces and certain other spaces*

10.2.3.1. In hold spaces where cargo is carried in a cargo containment system requiring a secondary barrier, supply cables for submerged cargo pump motors may be installed.

10.2.3.2. In hold spaces where cargo is carried in a cargo containment system not requiring a secondary barrier and in spaces described in 1.3.17.5, the following may be installed:

- .1 Through runs of cables;
- .2 Lighting fittings with pressurized enclosures or of the flameproof type. The lighting system should be divided between at least two branch circuits. All switches and protective devices should interrupt all poles or phases and be located in a gas-safe space; and
- .3 Electrical depth sounding or log devices and impressed current cathodic protection system anodes or electrodes. These devices should be housed in gas-tight enclosures; and only in spaces described in 1.3.17.5:
- .4 Flameproof motors for valve operation for cargo or ballast systems; and
- .5 Flameproof general alarm audible indicators.

##### 10.2.4. *Cargo pump and cargo compressor rooms*

10.2.4.1. Lighting fittings should have pressurized enclosures or should be of the flameproof type. The lighting system should be divided between at least two branch circuits. All switches and protective devices should interrupt all poles or phases and be located in a gas-safe space.

10.2.4.2. Electric motors for driving cargo pumps or cargo compressors should be separated from these spaces by a gastight bulkhead or deck. Flexible couplings or other means of maintaining alignment should be fitted to the shafts between the driven equipment and its motors and, in addition, suitable glands should be provided where the shafts pass through the

\* Reference is made to the Recommendations published by the International Electrotechnical Commission and in particular to Publication 92-502.

gastight bulkhead or deck. Such electric motors and associated equipment should be located in a compartment complying with chapter 12.

10.2.4.3. Where operational or structural requirements are such as to make it impossible to comply with the method described in 10.2.4.2, motors of the following certified safe types may be installed:

- .1 Increased safety type with flameproof enclosure; and
- .2 Pressurized type.

10.2.4.4. General alarm audible indicators should have flameproof enclosures.

10.2.5. *Zones on open decks, spaces other than hold spaces*

10.2.5.1. In zones on open decks or non-enclosed spaces on the open deck, within 3 m of any cargo tank outlet, gas or vapour outlet, cargo pipe flange, cargo valves or entrances and ventilation openings to cargo pump rooms and cargo compressor rooms; in zones on the open deck over the cargo area and 3 m forward and aft of the cargo area on the open deck and up to a height of 2.4 m above the deck; in zones within 2.4 m of the outer surface of a cargo containment system where such surface is exposed to the weather the following may be installed:

- .1 Certified safe type equipment; and
- .2 Through runs of cables.

10.2.5.2. In enclosed or semi-enclosed spaces in which pipes containing cargo products are located and in compartments for cargo hoses the following may be installed:

- .1 Lighting fittings with pressurized enclosures, or of the flameproof type. The lighting system should be divided between at least two branch circuits. All switches and protective devices should interrupt all poles or phases and be located in a gas-safe space; and
- .2 Through runs of cables.

10.2.5.3. In enclosed or semi-enclosed spaces having a direct opening into any gas-dangerous space or zone there should be installed electrical installations complying with the requirements for the space or zone to which the opening leads.

10.2.5.4. Electrical equipment within spaces protected by air-locks should be of the certified safe type unless arranged to be de-energized by measures required by 3.6.4.

## *Chapter 11. FIRE PROTECTION AND FIRE EXTINCTION*

### *11.1. Fire safety requirements*

11.1.1. The requirements for tankers in chapter II-2 of the 1983 SOLAS amendments should apply to ships covered by the Code, irrespective of tonnage including ships of less than 500 tons gross tonnage, except that:

- .1 Regulation 56.4 does not apply;
- .2 Regulation 4 as applicable to cargo ships and regulation 7 should apply as they would apply to tankers of 2,000 tons gross tonnage and over;
- .3 The following regulations of chapter II-2 of the 1983 SOLAS amendments related to tankers do not apply and are replaced by chapters and sections of the Code as detailed below:

<i>Regulation</i>	<i>Replaced by</i>
17	11.6
56.1 and 56.2	Chapter 3
60, 61, 62	11.3 and 11.4
63	11.5

11.1.2. All sources of ignition should be excluded from spaces where flammable vapour may be present except as otherwise provided in chapters 10 and 16.

11.1.3. The provisions of this section apply in conjunction with chapter 3.

11.1.4. For the purposes of fire fighting, any open deck areas above cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forward-most hold space should be included in the cargo area.

#### 11.2. *Fire water main equipment*

11.2.1. All ships, irrespective of size, carrying products which are subject to this Code should comply with the requirements of regulations II-2/4 and II-2/7 of the 1983 SOLAS amendments, except that the required fire pump capacity and fire main and water service pipe diameter should not be limited by the provisions of regulations 4.2.1 and 4.4.1 when the fire pump and fire main are used as part of the water spray system as permitted by 11.3.3. In addition, the requirements of regulation 4.4.2 should be met at a pressure of at least 5.0 bar gauge.

11.2.2. The arrangements should be such that at least two jets of water can reach any part of the deck in the cargo area and those portions of the cargo containment system and tank covers above the deck. The necessary number of fire hydrants should be located to satisfy the above arrangements and to comply with the requirements of regulations II-2/4.5.1 and II-2/4.8 of the 1983 SOLAS amendments, with hose lengths not exceeding 33 m.

11.2.3. Stop valves should be fitted in any crossover provided and in the fire main or mains at the poop front and at intervals of not more than 40 m between hydrants on the deck in the cargo area for the purpose of isolating damaged sections of the main.

11.2.4. All water nozzles provided for fire-fighting use should be of an approved dual-purpose type capable of producing either a spray or a jet. All pipes, valves, nozzles and other fittings in the fire-fighting systems should be resistant to corrosion by seawater, for which purpose galvanized pipe, for example, may be used, and to the effect of fire.

11.2.5. Where the ship's engine-room is unattended, arrangements should be made to start and connect to the fire main at least one fire pump by remote control from the navigating bridge or other control station outside the cargo area.

#### 11.3. *Water spray system*

11.3.1. On ships carrying flammable or toxic products or both, a water spray system for cooling, fire prevention and crew protection should be installed to cover:

- .1 Exposed cargo tank domes and any exposed parts of cargo tanks;
- .2 Exposed on-deck storage vessels for flammable or toxic products;
- .3 Cargo liquid and vapour discharge and loading manifolds and the area of their control valves and any other areas where essential control valves are situated and which should be at least equal to the area of the drip trays provided; and
- .4 Boundaries of superstructures and deckhouses normally manned, cargo compressor rooms, cargo pump rooms, store-rooms containing high fire risk items and cargo control rooms, all facing the cargo area. Boundaries of unmanned forecastle structures not containing high fire risk items or equipment do not require water spray protection.

11.3.2. The system should be capable of covering all areas mentioned in 11.3.1 with a uniformly distributed water spray of at least 10 ℓ/m<sup>2</sup> per minute for horizontal projected surfaces and 4 ℓ/m<sup>2</sup> per minute for vertical surfaces. For structures having no clearly defined horizontal or vertical surfaces, the capacity of the water spray system should be the greater of the following:

- .1 Projected horizontal surface multiplied by 10 ℓ/m<sup>2</sup> per minute; or
- .2 Actual surface multiplied by 4 ℓ/m<sup>2</sup> per minute.

On vertical surfaces, spacing of nozzles protecting lower areas may take account of anticipated rundown from higher areas. Stop valves should be fitted at intervals in the spray main for the purpose of isolating damaged sections. Alternatively, the system may be divided into two or more sections which may be operated independently provided the necessary controls are located together, aft of the cargo area. A section protecting any area included in 11.3.1.1 and .2 should cover the whole of the athwartship tank grouping which includes that area.

11.3.3. The capacity of the water spray pumps should be sufficient to deliver the required amount of water to all areas simultaneously or where the system is divided into sections, the arrangements and capacity should be such as to supply water simultaneously to any one section and to the surfaces specified in 11.3.1.3 and .4. Alternatively, the main fire pumps may be used for this service provided that their total capacity is increased by the amount needed for the spray system. In either case, a connection, through a stop valve, should be made between the fire main and water spray main outside the cargo area.

11.3.4. Subject to the approval of the Administration, water pumps normally used for other services may be arranged to supply the water spray main.

11.3.5. All pipes, valves, nozzles and other fittings in the water spray systems should be resistant to corrosion by seawater, for which purpose galvanized pipe, for example, may be used, and to the effect of fire.

#### 11.4. *Dry chemical powder fire-extinguishing systems*

11.4.1. Ships in which the carriage of flammable products is intended should be fitted with fixed dry chemical powder type extinguishing systems for the purpose of fighting fire on the deck in the cargo area and bow or stern cargo handling areas if applicable. The system and the dry chemical powder should be adequate for this purpose and satisfactory to the Administration.

11.4.2. The system should be capable of delivering powder from at least two hand hose lines or combination monitor/hand hose lines to any part of the above-deck exposed cargo area including above-deck product piping. The system should be activated by an inert gas such as nitrogen, used exclusively for this purpose and stored in pressure vessels adjacent to the powder containers.

11.4.3. The system for use in the cargo area should consist of at least two independent self-contained dry chemical powder units with associated controls, pressurizing medium fixed piping, monitors or hand hose lines. For ships with a cargo capacity of less than 1,000 m<sup>3</sup> only one such unit need be fitted, subject to approval by the Administration. A monitor should be provided and so arranged as to protect the cargo loading and discharge manifold areas and be capable of actuation and discharge locally and remotely. The monitor is not required to be remotely aimed if it can deliver the necessary powder to all required areas of coverage from a single position. All hand hose lines and monitors should be capable of actuation at the hose storage reel or monitor. At least one hand hose line or monitor should be situated at the after end of the cargo area.

11.4.4. A fire-extinguishing unit having two or more monitors, hand hose lines, or combinations thereof, should have independent pipes with a manifold at the powder container, unless a suitable alternative means is provided to ensure proper performance as approved by the Administration. Where two or more pipes are attached to a unit the arrangement should be such that any or all of the monitors and hand hose lines should be capable of simultaneous or sequential operation at their rated capacities.

11.4.5. The capacity of a monitor should be not less than 10 kg/s. Hand hose lines should be non-kinkable and be fitted with a nozzle capable of on/off operation and discharge at a rate not less than 3.5 kg/s. The maximum discharge rate should be such as to allow operation by one man. The length of a hand hose line should not exceed 33 m. Where fixed piping is provided between the powder container and a hand hose line or monitor, the length of piping should not exceed that length which is capable of maintaining the powder in a fluidized state



during sustained or intermittent use, and which can be purged of powder when the system is shut down. Hand hose lines and nozzles should be of weather-resistant construction or stored in weather-resistant housing or covers and be readily accessible.

11.4.6. A sufficient quantity of dry chemical powder should be stored in each container to provide a minimum 45 seconds discharge time for all monitors and hand hose lines attached to each powder unit. Coverage from fixed monitors should be in accordance with the following requirements:

Capacity of fixed monitors (kg/s) each	10	25	45
Maximum distance of coverage (m)	10	30	40

Hand hose lines should be considered to have a maximum effective distance of coverage equal to the length of hose. Special consideration should be given where areas to be protected are substantially higher than the monitor or hand hose reel locations.

11.4.7. Ships fitted with bow or stern loading and discharge arrangements should be provided with an additional dry chemical powder unit complete with at least one monitor and one hand hose line complying with the requirements of 11.4.1 to 11.4.6. This additional unit should be located to protect the bow or stern loading and discharge arrangements. The area of the cargo line forward or aft of the cargo area should be protected by hand hose lines.

#### 11.5. *Gas-dangerous enclosed spaces*

11.5.1. Enclosed spaces normally entered where flammable liquid or vapour leakage may occur, such as cargo compressor and pump rooms, should be provided with a fixed installation which is capable of extinguishing a fire within the space. Additionally, this system or another fixed system should be capable of inerting the space following a fire to ensure that the fire does not recur. For purposes of design, the boundaries of the space should be assumed to remain intact. Carbon dioxide and steam smothering systems should be avoided unless due consideration is given to the danger of static electricity.

11.5.2. Provision should be made for closure of ventilation and any other openings into the space and, where necessary, for an audible warning signal to be sounded within the space for the emergency escape of personnel before admission of the inerting/extinguishing medium.

#### 11.6. *Firemen's outfits*

11.6.1. Every ship carrying flammable products should carry firemen's outfits complying with the requirements of regulation II-2/17 of the 1983 SOLAS amendments as follows:

<i>Total cargo capacity</i>	<i>Number of outfits</i>
Below 2,000 m <sup>3</sup>	2
Between 2,000 m <sup>3</sup> and 5,000 m <sup>3</sup>	4
Above 5,000 m <sup>3</sup>	5

11.6.2. Additional requirements for safety equipment are given in chapter 14.

11.6.3. Any breathing apparatus required as part of a fireman's outfit should be a self-contained air-breathing apparatus having a capacity of at least 1,200 l of free air.

### *Chapter 12. MECHANICAL VENTILATION IN THE CARGO AREA*

The requirements of this chapter replace regulation II-2/59.3 of the 1983 SOLAS amendments.

#### 12.1. *Spaces required to be entered during normal cargo handling operations*

12.1.1. Electric motor rooms, cargo compressor and pump rooms, other enclosed spaces which contain cargo handling equipment and similar spaces in which cargo handling operations are performed should be fitted with mechanical ventilation systems capable of being controlled from outside such spaces. Provision should be made to ventilate such spaces prior to en-

tering the compartment and operating the equipment and a warning notice requiring the use of such ventilation should be placed outside the compartment.

12.1.2. Mechanical ventilation inlets and outlets should be arranged to ensure sufficient air movement through the space to avoid the accumulation of flammable or toxic vapours and to ensure 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. As an exception, gas-safe cargo control rooms may have eight changes of air per hour.

12.1.3. Ventilation systems should be fixed and, if of the negative pressure type, permit extraction from either the upper or the lower parts of the spaces, or from both the upper and the lower parts, depending on the density of the vapours of the products carried.

12.1.4. In rooms housing electric motors driving cargo compressors or pumps, spaces except machinery spaces containing inert gas generators, cargo control rooms if considered as gas-safe spaces and other gas-safe spaces within the cargo area, the ventilation should be of the positive pressure type.

12.1.5. In cargo compressor and pump rooms and in cargo control rooms if considered gas-dangerous, the ventilation should be of the negative pressure type.

12.1.6. 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 spaces, service spaces and control stations and other gas-safe spaces.

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

12.1.8. Ventilation ducts from gas-dangerous spaces should not be led through accommodation, service and machinery spaces or control stations, except as allowed in chapter 16.

12.1.9. Electric motors driving fans should be placed outside the ventilation ducts if the carriage of flammable products is intended. Ventilation fans should not produce a source of vapour ignition in either the ventilated space or the ventilation system associated with the space. Ventilation fans and fan ducts, in way of fans only, for gas-dangerous spaces should be of nonsparking construction defined as:

- .1 Impellers or housing of nonmetallic construction, due regard being paid to the elimination of static electricity;
- .2 Impellers and housing of nonferrous materials;
- .3 Impellers and housing of austenitic stainless steel; and
- .4 Ferrous impellers and housing with not less than 13 mm design tip clearance.

Any combination of an aluminium or magnesium alloy fixed or rotating component and a ferrous fixed or rotating component, regardless of tip clearance, is considered a sparking hazard and should not be used in these places.

12.1.10. Spare parts should be carried for each type of fan on board referred to in this chapter.

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

## 12.2. *Spaces not normally entered*

Hold spaces, interbarrier spaces, void spaces, cofferdams, spaces containing cargo piping and other spaces where cargo vapours may accumulate should be capable of being ventilated to ensure a safe environment when entry into the spaces is necessary. Where a permanent ventilation system is not provided for such spaces, approved means of portable mechanical ventilation should be provided. Where necessary owing to the arrangement of spaces, such as hold spaces and interbarrier spaces, essential ducting for such ventilation should be permanently installed. Fans or blowers should be clear of personnel access openings, and should comply with 12.1.9.

*Chapter 13. INSTRUMENTATION (GAUGING, GAS DETECTION)**13.1. General*

13.1.1. Each cargo tank should be provided with means for indicating level, pressure and temperature of the cargo. Pressure gauges and temperature indicating devices should be installed in the liquid and vapour piping systems, in cargo refrigerating installations and in the inert gas systems as detailed in this chapter.

13.1.2. Where a secondary barrier is required, permanently installed instrumentation should be provided to detect when the primary barrier fails to be liquid-tight at any location or when liquid cargo is in contact with the secondary barrier at any location. This instrumentation should consist of appropriate gas detecting devices according to 13.6. However, the instrumentation need not be capable of locating the area where liquid cargo leaks through the primary barrier or where liquid cargo is in contact with the secondary barrier.

13.1.3. If the loading and unloading of the ship is performed by means of remotely controlled valves and pumps, all controls and indicators associated with a given cargo tank should be concentrated in one control position.

13.1.4. Instruments should be tested to ensure reliability in the working conditions and recalibrated at regular intervals. Test procedures for instruments and the intervals between recalibration should be approved by the Administration.

*13.2. Level indicators for cargo tanks*

13.2.1. Each cargo tank should be fitted with at least one liquid level gauging device, designed to operate at pressures not less than the MARVS of the cargo tank and at temperatures within the cargo operating temperature range. Where only one liquid level gauge is fitted it should be so arranged that any necessary maintenance can be carried out while the cargo tank is in service.

13.2.2. Cargo tank liquid level gauges may be of the following types subject to any special requirement for particular cargoes shown in column "g" in the table of chapter 19:

- 1 Indirect devices, which determine the amount of cargo by means such as weighing or pipe flow meters;
- 2 Closed devices, which do not penetrate the cargo tank, such as devices using radioisotopes or ultrasonic devices;
- 3 Closed devices, which penetrate the cargo tank, but which form part of a closed system and keep the cargo from being released, such as float type systems, electronic probes, magnetic probes and bubble tube indicators. If a closed gauging device is not mounted directly on the tank it should be provided with a shutoff valve located as close as possible to the tank; and
- 4 Restricted devices, which penetrate the tank and when in use permit a small quantity of cargo vapour or liquid to escape to the atmosphere, such as fixed tube and slip tube gauges. When not in use, the devices should be kept completely closed. The design and installation should ensure that no dangerous escape of cargo can take place when opening the device. Such gauging devices should be so designed that the maximum opening does not exceed 1.5 mm diameter or equivalent area, unless the device is provided with an excess flow valve.

13.2.3. Sighting ports with a suitable protective cover and situated above the liquid level with an internal scale may be allowed by the Administration as a secondary means of gauging for cargo tanks having a design vapour pressure not higher than 0.7 bar.

13.2.4. Tubular gauge glasses should not be fitted. Gauge glasses of the robust type as fitted on high-pressure boilers and fitted with excess flow valves may be allowed by the Administration for deck tanks, subject to any provisions of chapter 17.

### 13.3. *Overflow control*

13.3.1. Except as provided in 13.3.2, each cargo tank should be fitted with a high liquid level alarm operating independently of other liquid level indicators and giving an audible and visual warning when activated. Another sensor operating independently of the high liquid level alarm should automatically actuate a shutoff valve in a manner which will both avoid excessive liquid pressure in the loading line and prevent the tank from becoming liquid full. The emergency shutdown valve referred to in 5.6.4 may be used for this purpose. If another valve is used for this purpose, the same information as referred to in 5.6.4 should be available on board. During loading, whenever the use of these valves may possibly create a potential excess pressure surge in the loading system, the Administration and the port Administration may agree to alternative arrangements such as limiting the loading rate, etc.

13.3.2. A high liquid level alarm and automatic shutoff of cargo tank filling need not be required when the cargo tank:

- .1 Is a pressure tank with a volume not more than 200 m<sup>3</sup>; or
- .2 Is designed to withstand the maximum possible pressure during the loading operation and such pressure is below that of the start-to-discharge pressure of the cargo tank relief valve.

13.3.3. Electrical circuits, if any, of level alarms should be capable of being tested prior to loading.

### 13.4. *Pressure gauges*

13.4.1. The vapour space of each cargo tank should be provided with a pressure gauge which should incorporate an indicator in the control position required by 13.1.3. In addition, a high-pressure alarm and, if vacuum protection is required, a low-pressure alarm, should be provided on the navigating bridge. Maximum and minimum allowable pressures should be marked on the indicators. The alarms should be activated before the set pressures are reached. For cargo tanks fitted with pressure relief valves, which can be set at more than one set pressure in accordance with 8.2.6, high-pressure alarms should be provided for each set pressure.

13.4.2. Each cargo pump discharge line and each liquid and vapour cargo manifold should be provided with at least one pressure gauge.

13.4.3. Local-reading manifold pressure gauges should be provided to indicate the pressure between stop valves and hose connections to the shore.

13.4.4. Hold spaces and interbarrier spaces without open connection to the atmosphere should be provided with pressure gauges.

### 13.5. *Temperature indicating devices*

13.5.1. Each cargo tank should be provided with at least two devices for indicating cargo temperatures, one placed at the bottom of the cargo tank and the second near the top of the tank, below the highest allowable liquid level. The temperature indicating devices should be marked to show the lowest temperature for which the cargo tank has been approved by the Administration.

13.5.2. When a cargo is carried in a cargo containment system with a secondary barrier at a temperature lower than  $-55^{\circ}\text{C}$ , temperature indicating devices should be provided within the insulation or on the hull structure adjacent to cargo containment systems. The devices should give readings at regular intervals and, where applicable, audible warning of temperatures approaching the lowest for which the hull steel is suitable.

13.5.3. If cargo is to be carried at temperatures lower than  $-55^{\circ}\text{C}$ , the cargo tank boundaries, if appropriate for the design of the cargo containment system, should be fitted with temperature indicating devices as follows:

- .1 A sufficient number of devices to establish that an unsatisfactory temperature gradient does not occur.

.2 On one tank a number of devices in excess of those required in 13.5.3.1 in order to verify that the initial cool down procedure is satisfactory. These devices may be either temporary or permanent. When a series of similar ships is built, the second and successive ships need not comply with the requirements of this subparagraph.

13.5.4. The number and position of temperature indicating devices should be to the satisfaction of the Administration.

### 13.6. *Gas detection requirements*

13.6.1. Gas detection equipment acceptable to the Administration and suitable for the gases to be carried should be provided in accordance with column "P" in the table of chapter 19.

13.6.2. In every installation, the positions of fixed sampling heads should be determined with due regard to the density of the vapours of the products intended to be carried and the dilution resulting from compartment purging or ventilation.

13.6.3. Pipe runs from sampling heads should not be led through gas-safe spaces except as permitted by 13.6.5.

13.6.4. Audible and visual alarms from the gas detection equipment, if required by this section, should be located on the navigating bridge, in the control position required by 13.1.3, and at the gas detector readout location.

13.6.5. Gas detection equipment may be located in the control position required by 13.1.3, on the navigating bridge or at other suitable locations. When such equipment is located in a gas-safe space the following conditions should be met:

- .1 Gas-sampling lines should have shutoff valves or an equivalent arrangement to prevent cross-communication with gas-dangerous spaces; and
- .2 Exhaust gas from the detector should be discharged to the atmosphere in a safe location.

13.6.6. Gas detection equipment should be so designed that it may readily be tested. Testing and calibration should be carried out at regular intervals. Suitable equipment and span gas for this purpose should be carried on board. Where practicable, permanent connections for such equipment should be fitted.

13.6.7. A permanently installed system of gas detection and audible and visual alarms should be provided for:

- .1 Cargo pump rooms;
- .2 Cargo compressor rooms;
- .3 Motor rooms for cargo handling machinery;
- .4 Cargo control rooms unless designated as gas-safe;
- .5 Other enclosed spaces in the cargo area where vapour may accumulate including hold spaces and interbarrier spaces for independent tanks other than type C;
- .6 Ventilation hoods and gas ducts where required by chapter 16; and
- .7 Air-locks.

13.6.8. The gas detection equipment should be capable of sampling and analysing from each sampling head location sequentially at intervals not exceeding 30 min, except that in the case of gas detection for the ventilation hoods and gas ducts referred to in 13.6.7.6 sampling should be continuous. Common sampling lines to the detection equipment should not be fitted.

13.6.9. In the case of products which are toxic or both toxic and flammable, the Administration, except when column "h" in the table of chapter 19 refers to 17.9, may authorize the use of portable equipment for detection of toxic products as an alternative to a permanently installed system, if such equipment is used before personnel enter the spaces listed in 13.6.7 and at 30 min intervals while they remain therein.

13.6.10. For the spaces listed in 13.6.7, alarms should be activated for flammable products when the vapour concentration reaches 30% of the lower flammable limit.

13.6.11. In the case of flammable products, where cargo containment systems other than independent tanks are used, hold spaces and interbarrier spaces should be provided with a permanently installed gas detection system capable of measuring gas concentrations of 0 to 100% by volume. The detection equipment, equipped with audible and visual alarms, should be capable of sampling and detecting from each sampling head location sequentially at intervals not exceeding 30 min. Alarms should be activated when the vapour concentration reaches the equivalent of 30% of the lower flammable limit in air or such other limit as may be approved by the Administration in the light of particular cargo containment arrangements. Common sampling lines to the detection equipment should not be fitted.

13.6.12. In the case of toxic gases, hold spaces and interbarrier spaces should be provided with a permanently installed piping system for obtaining gas samples from the spaces. Gas from these spaces should be sampled and analysed from each sampling head location by means of fixed or portable equipment at intervals not exceeding 4 h and in any event before personnel enter the space and at 30 min intervals while they remain therein.

13.6.13. Every ship should be provided with at least two sets of portable gas detection equipment acceptable to the Administration and suitable for the products to be carried.

13.6.14. A suitable instrument for the measurement of oxygen levels in inert atmospheres should be provided.

#### Chapter 14. PERSONNEL PROTECTION

##### 14.1. Protective equipment

Suitable protective equipment including eye protection should be provided for protection of crew members engaged in loading and discharging operations, taking into account the character of the products.

##### 14.2. Safety equipment

14.2.1. Sufficient, but not less than two complete sets of safety equipment in addition to the firemen's outfits required by 11.6.1 each permitting personnel to enter and work in a gas-filled space, should be provided.

14.2.2. One complete set of safety equipment should consist of:

- .1 One self-contained air-breathing apparatus not using stored oxygen, having a capacity of at least 1,200 l of free air;
- .2 Protective clothing, boots, gloves and tight-fitting goggles;
- .3 Steel-cored rescue line with belt; and
- .4 Explosion-proof lamp.

14.2.3. An adequate supply of compressed air should be provided and should consist either of:

- .1 One set of fully charged air bottles for each breathing apparatus required by 14.2.1;  
A special air compressor suitable for the supply of high-pressure air of the required purity; and  
A charging manifold capable of dealing with sufficient spare breathing apparatus air bottles for the breathing apparatus required by 14.2.1; or
- .2 Fully charged spare air bottles with a total free air capacity of at least 6,000 l for each breathing apparatus required by 14.2.1.

14.2.4. Alternatively, the Administration may accept a low-pressure air line system with hose connection suitable for use with the breathing apparatus required by 14.2.1. This system should provide sufficient high-pressure air capacity to supply, through pressure reduction devices, enough low-pressure air to enable two men to work in a gas-dangerous space for at

least 1 h without using the air bottles of the breathing apparatus. Means should be provided for recharging the fixed air bottles and the breathing apparatus air bottles from a special air compressor suitable for the supply of high-pressure air of the required purity.

14.2.5. Protective equipment required in 14.1 and safety equipment required in 14.2.1 should be kept in suitable, clearly marked lockers located in readily accessible places.

14.2.6. The compressed air equipment should be inspected at least once a month by a responsible officer and the inspection recorded in the ship's log-book, and inspected and tested by an expert at least once a year.

#### 14.3. *First-aid equipment*

14.3.1. A stretcher which is suitable for hoisting an injured person from spaces below deck should be kept in a readily accessible location.

14.3.2. Medical first-aid equipment including oxygen resuscitation equipment and antidotes, if available, for products carried should be provided on board.

#### 14.4. *Personnel protection requirements for individual products*

14.4.1. Provisions of 14.4 are applicable to ships carrying products for which those paragraphs are listed in column "h" in the table of chapter 19.

14.4.2. Respiratory and eye protection suitable for emergency escape purposes should be provided for every person on board subject to the following:

- .1.1 Filter type respiratory protection should be accepted, only when one filter is suitable for all designated cargoes that the ship is certified to carry;
- .1.2 Self-contained breathing apparatus should normally have a duration of service of at least 15 min;
- .2 Emergency escape respiratory protection should not be used for fire-fighting or cargo handling purposes and should be marked to that effect;
- .3 Two additional sets of the above respiratory and eye protection should be permanently located in the navigating bridge.

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

14.4.4. In ships of a cargo capacity of 2,000 m<sup>3</sup> and over, two complete sets of safety equipment should be provided in addition to the equipment required by 11.6.1 and 14.2.1. At least three spare charged air bottles should be provided for each self-contained air breathing apparatus required in this paragraph.

14.4.5. Personnel should be protected against the effects of a major cargo release by the provision of a space within the accommodation area designed and equipped to the satisfaction of the Administration.

14.4.6. For certain highly dangerous products, cargo control rooms should be of the gas-safe type only.

### Chapter 15. FILLING LIMITS FOR CARGO TANKS

#### 15.1. *General*

15.1.1. No cargo tanks should be more than 98% liquid full at the reference temperature, except as permitted by 15.1.3.

15.1.2. The maximum volume to which a cargo tank should be loaded is determined by the following formula:

$$V_L = 0.98 V \frac{\rho_R}{\rho_L}$$

where:  $V_L$  = maximum volume to which the tank may be loaded

$V$  = volume of the tank

$\rho_R$  = relative density of cargo at the reference temperature

$\rho_L$  = relative density of cargo at the loading temperature and pressure.

15.1.3. The Administration may allow a higher filling limit than the limit of 98% specified in 15.1.1 and 15.1.2 at the reference temperature, taking into account the shape of the tank, arrangements of pressure relief valves, accuracy of level and temperature gauging and the difference between the loading temperature and the temperature corresponding to the vapour pressure of the cargo at the set pressure of the pressure relief valves, provided the conditions specified in 8.2.17 are maintained.

15.1.4. For the purpose of this chapter only, "reference temperature" means:

- .1 The temperature corresponding to the vapour pressure of the cargo at the set pressure of the pressure relief valves when no cargo vapour pressure/temperature control as referred to in chapter 7 is provided;
- .2 The temperature of the cargo upon termination of loading, during transport, or at unloading, whichever is the greatest, when a cargo vapour pressure/temperature control as referred to in chapter 7 is provided. If this reference temperature would result in the cargo tank becoming liquid full before the cargo reaches a temperature corresponding to the vapour pressure of the cargo at the set pressure of the relief valves required in 8.2, an additional pressure relief valve complying with 8.3 should be fitted.

#### 15.2. *Information to be provided to the master*

The maximum allowable tank filling limits for each cargo tank should be indicated for each product which may be carried, for each loading temperature which may be applied and for the applicable maximum reference temperature, on a list to be approved by the Administration. Pressures at which the pressure relief valves, including those valves required by 8.3, have been set should also be stated on the list. A copy of the list should be permanently kept on board by the master.

### Chapter 16. USE OF CARGO AS FUEL

#### 16.1. *General*

16.1.1. Methane (LNG) is the only cargo whose vapour or boil-off gas may be utilized in main propelling machinery spaces and boiler rooms and in such spaces or rooms may be utilized only in boilers, inert gas generators, and combustion engines.

16.1.2. The provisions of this chapter do not preclude the use of vapour or boil-off gas for other services in other locations, such as cargo reliquefaction and inert gas generation, provided that such other services and locations are specially considered by the Administration.

#### 16.2. *Gas fuel supply*

16.2.1. Gas fuel lines should not pass through accommodation spaces, service spaces or control stations. Gas lines may pass through or extend into other spaces provided they fulfil one of the following:

- .1 The gas fuel line should be a double wall piping system with the gas fuel contained in the inner pipe. The space between the concentric pipes should be pressurized with inert gas at a pressure greater than the fuel pressure. Suitable alarms should be provided to indicate a loss of pressure between the pipes; or



.2 The gas fuel lines should be installed in a mechanically exhaust-ventilated pipe or duct. The air space between the outer and inner walls of piping or ducts should be equipped with mechanical ventilation having a capacity of at least 30 air changes per hour. The ventilation system should be arranged to maintain a pressure less than the atmospheric pressure. The fan motors should be placed outside the ventilated pipe or duct. The ventilation outlet should be placed in a position where no flammable gas-air mixture may be ignited. The ventilation inlet should be so arranged that gas or gas-air mixture will not be drawn into the system. The ventilation should always be in operation when there is gas in the supply pipeline. Continuous gas detection should be provided to indicate leaks and to shut down the gas fuel supply to the machinery space in accordance with 16.2.9. The exhaust fan for this duct should be so arranged that the gas fuel supply to the machinery space will be cut off if the required air flow is not established and maintained.

16.2.2. If a gas leak occurs, the gas fuel supply should not be operated until the leak has been found and repaired. Instructions to this effect should be placed in a prominent position in the machinery space.

16.2.3. The double wall piping system or the ventilated duct provided for the gas fuel lines should terminate at the ventilation hood or casing required by 16.2.4.

16.2.4. A ventilation hood or casing should be provided for the areas occupied by flanges, valves, etc., and for the gas fuel piping, which is not enclosed in the double wall piping system or ventilated duct, at gas utilization units, such as boilers, diesel engines and gas turbines. If this ventilation hood or casing is not served by the exhaust ventilation fan serving a duct as specified in 16.2.1.2, then it should be equipped with an exhaust ventilation system and continuous gas detection should be provided to indicate leaks and to shut down the gas fuel supply to the machinery space in accordance with 16.2.9. The exhaust fan should be so arranged that the gas fuel supply to the machinery space will be cut off if the exhaust ventilation is not functioning so as to produce the required air flow. The hood or casing should be installed or mounted to permit the ventilating air to sweep across the gas utilization unit and be exhausted at the top of the hood or casing.

16.2.5. Make-up air for the required ventilation air system and air discharges from the ventilation system shall be taken from and led to a safe location.

16.2.6. Each gas utilization unit should be provided with a set of three automatic valves. Two of these valves should be in series in the gas fuel pipe to the consuming equipment. The other valve should be in a pipe that vents, to a safe location in the open air, that portion of the gas fuel piping that is between the two valves in series. These valves should be so arranged that failure of necessary forced draft, loss of flame on boiler burners, abnormal pressure in the gas fuel supply line, or failure of the valve control actuating medium will cause the two gas fuel valves which are in series to close automatically and cause the vent valve to open automatically. Alternatively, the function of one of the valves in series and of the valve in the vent line can be incorporated into one valve body so arranged that when one of the above conditions occurs, flow to the gas utilization unit will be blocked and the vent opened.

16.2.7. A master gas fuel valve that can be closed from within the machinery space should be provided outside the machinery space. The valve should be so arranged as to close automatically if leakage of gas is detected, or loss of ventilation for the duct or casing or loss of pressurization of the double wall gas fuel piping occurs.

16.2.8. Provision should be made for inerting and gas-freeing that portion of the gas fuel piping system located in the machinery space.

16.2.9. Gas detection systems provided in accordance with the requirements of 16.2.1 and 16.2.4 should alarm at 30% of the lower flammability limit and shut down the gas fuel supply to the machinery space before the gas concentration reaches 60% of the lower flammability limit.

16.2.10. All details of the gas fuel system should be submitted to the Administration for approval.

## Chapter 17. SPECIAL REQUIREMENTS

### 17.1. *General*

The provisions of this chapter are applicable where reference is made in column "h" in the table of chapter 19. These are requirements additional to the general requirements of the Code.

### 17.2. *Materials of construction*

Materials which may be exposed to cargo during normal operations should be resistant to the corrosive action of the gases. In addition, the following materials of construction for cargo tanks, and associated pipelines, valves, fittings and other items of equipment should not be used for certain products as specified in column "h" in the table of chapter 19:

- .1 Mercury, copper and copper-bearing alloys, and zinc;
- .2 Copper, silver, mercury, magnesium and other acetylide-forming metals;
- .3 Aluminium and aluminium-bearing alloys;
- .4 Copper, copper alloys, zinc and galvanized steel;
- .5 Aluminium, copper and alloys of either;
- .6 Copper and copper-bearing alloys with greater than 1% copper.

### 17.3. *Independent tanks*

17.3.1. Products should be carried in independent tanks only.

17.3.2. Products should be carried in type C independent tanks and the provisions of 7.1.3 apply. The design pressure of the cargo tank should take into account any padding pressure or vapour discharge unloading pressure.

### 17.4. *Refrigeration systems*

17.4.1. Only the indirect system described in 7.2.4.2 should be used.

17.4.2. For a ship engaged in the carriage of products which readily form dangerous peroxides, recondensed cargo should not be allowed to form stagnant pockets of uninhibited liquid. This may be achieved either by:

- .1 Using the indirect system described in 7.2.4.2 with the condenser inside the cargo tank; or
- .2 Using the direct system or combined system described in 7.2.4.1 and .3 respectively, or the indirect system described in 7.2.4.2 with the condenser outside the cargo tank, and designing the condensate system to avoid any places in which liquid could collect and be retained. Where this is impossible inhibited liquid should be added upstream of such a place.

17.4.3. If the ship is to carry consecutively products as specified in 17.4.2 with a ballast passage between, all uninhibited liquid should be removed prior to the ballast voyage. If a second cargo is to be carried between such consecutive cargoes, the reliquefaction system should be thoroughly drained and purged before loading the second cargo. Purging should be carried out using either inert gas or vapour from the second cargo, if compatible. Practical steps should be taken to ensure that polymers or peroxides do not accumulate in the cargo system.

### 17.5. *Deck cargo piping*

One hundred per cent radiography of all butt welded joints in cargo piping exceeding 75 mm in diameter is required.

### 17.6. *Exclusion of air from vapour spaces*

Air should be removed from the cargo tanks and associated piping before loading and then subsequently excluded by:

- .1 Introducing inert gas to maintain a positive pressure. Storage or production capacity of the inert gas should be sufficient to meet normal operating requirements and relief valve

leakage. The oxygen content of inert gas should at no time be greater than 0.2% by volume; or

- .2 Control of cargo temperatures such that a positive pressure is maintained at all times.

#### 17.7. *Moisture control*

For gases which are non-flammable and may become corrosive or react dangerously with water, moisture control should be provided to ensure that cargo tanks are dry before loading and that during discharge, dry air or cargo vapour is introduced to prevent negative pressures. For the purposes of this paragraph, dry air is air which has a dew point of  $-45^{\circ}\text{C}$  or below at atmospheric pressure.

#### 17.8. *Inhibition*

Care should be taken to ensure that the cargo is sufficiently inhibited to prevent polymerization at all times during the voyage. Ships should be provided with a certificate from the manufacturer stating:

- .1 Name and amount of inhibitor added;
- .2 Date inhibitor was added and the normally expected duration of its effectiveness;
- .3 Any temperature limitations affecting the inhibitor;
- .4 The action to be taken should the length of the voyage exceed the effective lifetime of the inhibitors.

#### 17.9. *Permanently installed toxic gas detectors*

17.9.1. Gas sampling lines should not be led into or through gas-safe spaces. Alarms referred to in 13.6.7 should be activated when the vapour concentration reaches the threshold limiting value.

17.9.2. The alternative of using portable equipment in accordance with 13.6.9 should not be permitted.

#### 17.10. *Flame screens on vent outlets*

Cargo tank vent outlets should be provided with readily renewable and effective flame screens or safety heads of an approved type when carrying a cargo referenced to this section. Due attention should be paid in the design of 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. Ordinary protection screens should be fitted after removal of the flame screens.

#### 17.11. *Maximum allowable quantity of cargo per tank*

When carrying a cargo referenced to this section, the quantity of the cargo should not exceed  $3,000\text{ m}^3$  in any one tank.

#### 17.12. *Submerged electric cargo pumps*

The vapour space of cargo tanks equipped with submerged electric motor pumps should be inerted to a positive pressure prior to loading, during carriage and during unloading of flammable liquids.

#### 17.13. *Ammonia*

Because high concentrations of ammonia in confined spaces can be flammable, the provisions of chapter 10 for flammable products should be applied except in zones on the open deck. Liquid ammonia should never be sprayed into a tank containing air as there is a risk of creating a static electrical charge which could cause ignition. To minimize the risk of stress corrosion cracking occurring when ammonia is carried at a temperature above  $-20^{\circ}\text{C}$  (vapour pressure 1.9 bar), the oxygen content of the vapour space in pressure vessels and in pipelines made of carbon-manganese steel (and other steels which require special consideration) should be reduced to the minimum practicable before liquid ammonia is introduced. The condensate

system of tanks operating at  $-33^{\circ}\text{C}$  may be affected unless they have been thermally stress relieved.

#### 17.14. Chlorine

##### 17.14.1. Cargo containment system

17.14.1.1. The capacity of each tank should not exceed  $600\text{ m}^3$  and the total capacity of all cargo tanks should not exceed  $1,200\text{ m}^3$ .

17.14.1.2. The tank design vapour pressure should not be less than 13.5 bar (see also 7.1.3 and 17.3.2).

17.14.1.3. Parts of tanks protruding above the upper deck should be provided with protection against thermal radiation taking into account total engulfment by fire.

17.14.1.4. Each tank should be provided with two pressure relief valves. A bursting disc of appropriate material should be installed between the tank and the pressure relief valves. The rupture pressure of the bursting disc should be 1 bar lower than the opening pressure of the pressure relief valve, which should be set at the design vapour pressure of the tank but not less than 13.5 bar gauge. The space between the bursting disc and the relief valve should be connected through an excess flow valve to a pressure gauge and a gas detection system. Provision should be made to keep this space at or near the atmospheric pressure during normal operation.

17.14.1.5. Outlets from pressure relief valves should be arranged in such a way as to minimize the hazards on board the ship as well as to the environment. Leakage from the relief valves should be led through the absorption plant to reduce the gas concentration as far as possible. The relief valve exhaust line should be arranged at the forward end of the ship to discharge outboard at deck level with an arrangement to select either port or starboard side, with a mechanical interlock to ensure that one line is always open.

17.14.1.6. The Administration and the port Administration may require that chlorine is carried in [a] refrigerated state at a specified maximum pressure.

##### 17.14.2. Cargo piping systems

17.14.2.1. Cargo discharge should be performed by means of compressed chlorine vapour from shore, dry air or another acceptable gas or fully submerged pumps. The pressure in the vapour space of the tank during discharging should not exceed 10.5 bar gauge. Cargo discharge compressors on board ships should not be accepted by the Administration.

17.14.2.2. The design pressure of the cargo piping system should be not less than 21 bar gauge. The internal diameter of the cargo pipes should not exceed 100 mm. Only pipe bends should be accepted for compensation of pipeline thermal movement. The use of flanged joints should be restricted to a minimum, and when used the flanges should be of the welding neck type with tongue and groove.

17.14.2.3. Relief valves of the cargo piping system should discharge to the absorption plant (see also 8.2.16).

##### 17.14.3. Materials

17.14.3.1. The cargo tanks and cargo piping systems are to be made of steel suitable for the cargo and for a temperature of  $-40^{\circ}\text{C}$ , even if a higher transport temperature is intended to be used.

17.14.3.2. The tanks should be thermally stress relieved. Mechanical stress relief should not be accepted as an equivalent.

##### 17.14.4. Instrumentation — safety devices

17.14.4.1. The ship should be provided with a chlorine absorbing plant with connections to the cargo piping system and the cargo tanks. The absorbing plant should be capable of neutralizing at least 2% of the total cargo capacity at a reasonable absorption rate.

17.14.4.2. During the gas-freeing of cargo tanks, vapours should not be discharged to the atmosphere.

17.14.4.3. A gas detecting system should be provided capable of monitoring chlorine concentrations of at least 1 ppm by volume. Suction points should be located:

- .1 Near the bottom of the cargo hold spaces;
- .2 In the pipes from the safety relief valves;
- .3 At the outlet from the gas absorbing plant;
- .4 At the inlet to the ventilation systems for the accommodation, service and machinery spaces and control stations;
- .5 On deck at the forward end, in the middle and at the after end of the cargo area. (Only required to be used during cargo handling and gas-freeing operations.)

The gas detection system should be provided with an audible and visual alarm with a set point of 5 ppm.

17.14.4.4. Each cargo tank should be fitted with a high-pressure alarm giving an audible alarm at a pressure equal to 10.5 bar gauge.

#### 17.14.5. *Personnel protection*

In addition to the requirements given in chapter 14 the following requirements should be met:

- .1 The enclosed space required by 14.4.5 should be easily and quickly accessible from the open deck and from accommodation spaces and should be capable of being rapidly closed gastight. Access to this space from the deck and from the remainder of the accommodation spaces should be by means of an air-lock. The space should be so designed as to accommodate the entire crew of the ship and be provided with a source of uncontaminated air for a period of not less than 4 h. One of the decontamination showers required by 14.4.3 should be located near the air-lock to the space.
- .2 A compressor and the necessary equipment for filling the air bottles should be provided.
- .3 One set of oxygen therapy equipment should be carried in the space referred to in 17.14.5.1.

#### 17.14.6. *Filling limits for cargo tanks*

17.14.6.1. The requirements of 15.1.4.2 do not apply when it is intended to carry chlorine.

17.14.6.2. The chlorine content of the gas in the vapour space of the cargo tank after loading should be greater than 80% by volume.

#### 17.15. *Diethyl ether and vinyl ethyl ether*

17.15.1. The cargo should be discharged only by deepwell pumps or by hydraulically operated submerged pumps. These pumps should be of a type designed to avoid liquid pressure against the shaft gland.

17.15.2. Inert gas displacement may be used for discharging cargo from type C independent tanks provided the cargo system is designed for the expected pressure.

#### 17.16. *Ethylene oxide*

17.16.1. For the carriage of ethylene oxide the requirements of 17.20 apply, with the additions and modifications as given in this section.

17.16.2. Deck tanks should not be used for the carriage of ethylene oxide.

17.16.3. Stainless steels types 416 and 442 as well as cast iron should not be used in ethylene oxide cargo containment and piping systems.

17.16.4. Before loading, tanks should be thoroughly and effectively cleaned to remove all traces of previous cargoes from tanks and associated pipework, except where the immediate

prior cargo has been ethylene oxide, propylene oxide or mixtures of these products. Particular care should be taken in the case of ammonia in tanks made of steel other than stainless steel.

17.16.5. Ethylene oxide should be discharged only by deepwell pumps or inert gas displacement. The arrangement of pumps should comply with 17.20.6.3.

17.16.6. Ethylene oxide should be carried refrigerated only and maintained at temperatures of less than 30°C.

17.16.7. Pressure relief valves should be set at a pressure of not less than 5.5 bar gauge. The maximum set pressure should be specially approved by the Administration.

17.16.8. The protective padding of nitrogen gas as required by 17.20.15 should be such that the nitrogen concentration in the vapour space of the cargo tank will at no time be less than 45% by volume.

17.16.9. Before loading and at all times when the cargo tank contains ethylene oxide liquid or vapour, the cargo tank should be inerted with nitrogen.

17.16.10. The water spray system required by paragraph 17.20.17 and that required by 11.3 should operate automatically in a fire involving the cargo containment system.

17.16.11. A jettisoning arrangement should be provided to allow the emergency discharge of ethylene oxide in the event of uncontrollable self-reaction.

17.17. *Isopropylamine and monoethylamine*

Separate piping systems should be provided as defined in 1.3.32.

17.18. *Methyl acetylene-propadiene mixtures*

17.18.1. Methyl acetylene-propadiene mixtures should be suitably stabilized for transport. Additionally, upper limits of temperature and pressure during the refrigeration should be specified for the mixtures.

17.18.2. Examples of acceptable, stabilized compositions are:

.1 Composition 1

.1.1 Maximum methyl acetylene to propadiene molar ratio of 3 to 1;

.1.2 Maximum combined concentration of methyl acetylene and propadiene of 65 mol per cent;

.1.3 Minimum combined concentration of propane, butane, and isobutane of 24 mol per cent, of which at least one third (on a molar basis) must be butanes and one third propane; and

.1.4 Maximum combined concentration of propylene and butadiene of 10 mol per cent.

.2 Composition 2

.2.1 Maximum methyl acetylene and propadiene combined concentration of 30 mol per cent;

.2.2 Maximum methyl acetylene concentration of 20 mol per cent;

.2.3 Maximum propadiene concentration of 20 mol per cent;

.2.4 Maximum propylene concentration of 45 mol per cent;

.2.5 Maximum butadiene and butylenes combined concentration of 2 mol per cent;

.2.6 Minimum saturated C<sub>4</sub> hydrocarbon concentration of 4 mol per cent; and

.2.7 Minimum propane concentration of 25 mol per cent.

17.18.3. Other compositions may be accepted provided the stability of the mixture is demonstrated to the satisfaction of the Administration.

17.18.4. A ship carrying methyl acetylene-propadiene mixtures should preferably have an indirect refrigeration system as specified in 7.2.4.2. Alternatively, a ship not provided with indirect refrigeration may utilize direct vapour compression refrigeration subject to pressure and temperature limitations depending on the composition. For the example compositions given in 17.18.2, the following features should be provided:

- .1 A vapour compressor that does not raise the temperature and pressure of the vapour above 60° C and 17.5 bar gauge during its operation, and that does not allow vapour to stagnate in the compressor while it continues to run.
- .2 Discharge piping from each compressor stage or each cylinder in the same stage of a reciprocating compressor should have:
  - .2.1 Two temperature-actuated shutdown switches set to operate at 60° C or less;
  - .2.2 A pressure-actuated shutdown switch set to operate at 17.5 bar gauge or less; and
  - .2.3 A safety relief valve set to relieve at 18.0 bar gauge or less.
- .3 The relief valve required by 17.18.4.2.3 should vent to a mast meeting the requirements of 8.2.9, 8.2.10, 8.2.13 and 8.2.14 and should not relieve into the compressor suction line.
- .4 An alarm that sounds in the cargo control position and in the navigating bridge when a high-pressure switch, or a high-temperature switch operates.

17.18.5. The piping system, including the cargo refrigeration system, for tanks to be loaded with methyl acetylene-propadiene mixtures should be either independent (as defined in 1.3.20) or separate (as defined in 1.3.32) from piping and refrigeration systems for other tanks. This segregation applies to all liquid and vapour vent lines and any other possible connections, such as common inert gas supply lines.

#### 17.19. Nitrogen

Materials of construction and ancillary equipment such as insulation should be resistant to the effects of high oxygen concentrations caused by condensation and enrichment at the low temperatures attained in parts of the cargo system. Due consideration should be given to ventilation in such areas where condensation might occur to avoid the stratification of oxygen-enriched atmosphere.

#### 17.20. Propylene oxide and mixtures of ethylene oxide-propylene oxide with ethylene oxide content of not more than 30% by weight

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

17.20.2.1. 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 product known to catalyse polymerization, such as:

- .1 Anhydrous ammonia and ammonia solutions;
- .2 Amines and amine solutions;
- .3 Oxidizing substances (e.g. chlorine).

17.20.2.2. Before loading, tanks should be thoroughly and effectively cleaned to remove all traces of previous cargoes from tanks and associated pipework, except where the immediate 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.

17.20.2.3. 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 materials remain that might create a hazardous situation in the presence of these products.

17.20.2.4. Tanks should be entered and inspected prior to each initial loading of these products to ensure freedom from contamination, heavy rust deposits and any visible structural defects. When cargo tanks are in continuous service for these products, such inspections should be performed at intervals of not more than 2 years.

17.20.2.5. Tanks for the carriage of these products should be of steel or stainless steel construction.

17.20.2.6. Tanks which have contained these products may be used for other cargoes after thorough cleaning of tanks and associated pipework systems by washing or purging.

17.20.3.1. All valves, flanges, fittings and accessory equipment should be of a type suitable for use with these 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.

17.20.3.2. 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.

17.20.3.3. 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.

17.20.3.4. 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:

- .1 Neoprene or natural rubber if it comes into contact with the products;
- .2 Asbestos or binders used with asbestos;
- .3 Materials containing oxides of magnesium, such as mineral wools.

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

17.20.5.1. 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.

17.20.5.2. During discharging operations, the pressure in the cargo tank should be maintained above 0.07 bar gauge.

17.20.5.3. The cargo should 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.

17.20.6. 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.

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

17.20.8. Hold spaces should be monitored for these products. Hold spaces surrounding type A and B independent tanks should also be inerted and monitored for oxygen. The oxygen content of these spaces should be maintained below 2%. Portable sampling equipment is satisfactory.

17.20.9. 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.

17.20.10. Tanks should be designed for the maximum pressure expected to be encountered during loading, carriage or unloading of cargo.



17.20.11. Tanks for the carriage of propylene oxide with a design vapour pressure of less than 0.6 bar and tanks for the carriage of ethylene oxide-propylene oxide mixtures with a design vapour pressure of less than 1.2 bar should have a cooling system to maintain the cargo below the reference temperature. For reference temperature see 15.1.4.1.

17.20.12. Pressure relief valve settings should not be less than 0.2 bar gauge and for type C independent cargo tanks not greater than 7.0 bar gauge for the carriage of propylene oxide and not greater than 5.3 bar gauge for the carriage of ethylene oxide-propylene oxide mixtures.

17.20.13.1. The piping system for tanks to be loaded with these products should be completely separate from piping systems for all other tanks, including empty tanks, and from all cargo compressors. If the piping system for the tanks to be loaded with the product is not independent as defined in 1.3.20 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.

17.20.13.2. The products should 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 kept on board the ship. The International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk should be endorsed to include reference to the approved cargo handling plans.

17.20.13.3. Before loading the product, 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 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.

17.20.14. 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.

17.20.15. 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 bar gauge in the event of product temperature fall due to ambient conditions or malfunctioning of refrigeration system. 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.

17.20.16. 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.

17.20.17. 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<sup>2</sup> per minute. 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. 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.

### 17.21. *Vinyl chloride*

In cases where polymerization of vinyl chloride is prevented by addition of an inhibitor, 17.8 is applicable. In cases where no or insufficient inhibitor has been added, any inert gas used for the purposes of 17.6 should contain not more oxygen than 0.1%. Before loading is started, inert gas samples from the tanks and piping should be analysed. When vinyl chloride is carried, a positive pressure should always be maintained in the tanks, also during ballast voyages between successive carriages.

## Chapter 18. OPERATING REQUIREMENTS

### 18.1. *Cargo information*

18.1.1. Information should be on board and available to all concerned, giving the necessary data for the safe carriage of cargo. Such information should include for each product carried:

- .1 A full description of the physical and chemical properties necessary for the safe containment of the cargo;
- .2 Action to be taken in the event of spills or leaks;
- .3 Counter-measures against accidental personal contact;
- .4 Fire-fighting procedures and fire-fighting media;
- .5 Procedures for cargo transfer, gas-freeing, ballasting, tank cleaning and changing cargoes;
- .6 Special equipment needed for the safe handling of the particular cargo;
- .7 Minimum inner hull steel temperatures; and
- .8 Emergency procedures.

18.1.2. Products required to be inhibited should be refused if the certificate required by 17.8 is not supplied.

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

### 18.2. *Compatibility*

18.2.1. The master should ascertain that the quantity and character of each product to be loaded are within the limits indicated in the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk provided for in 1.5 and in the Loading and Stability Information booklet provided for in 2.2.5 and that products are listed in the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk if so required under section 3 of the Certificate.

18.2.2. Care should be taken to avoid dangerous chemical reactions if cargoes are mixed. This is of particular significance in respect of:

- .1 Tank cleaning procedures required between successive cargoes in the same tank; and
- .2 Simultaneous carriage of cargoes which react when mixed. This should be permitted only if the complete cargo systems including, but not limited to, cargo pipework, tanks, vent systems and refrigeration systems are separated as defined in 1.3.32.

### 18.3. *Personnel training\**

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

\* Reference is made to the provisions of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978,<sup>1</sup> and in particular to the "Mandatory minimum requirements for the training and qualifications of masters, officers and ratings of liquefied gas tankers" — regulation V/3, chapter V of the Annex to that Convention and to resolution 12 of the International Conference on Training and Certification of Seafarers, 1978.

<sup>1</sup> United Nations, *Treaty Series*, vol. 1361, p. 2 (authentic Chinese and English texts), and vol. 1362, p. 2 (authentic French, Russian and Spanish texts).

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

18.3.3. 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 the cargoes carried.

#### 18.4. *Entry into spaces*

18.4.1. Personnel should not enter cargo tanks, hold spaces, void spaces, cargo handling spaces or other enclosed spaces where gas may accumulate, unless:

- .1 The gas content of the atmosphere in such space is determined by means of fixed or portable equipment to ensure oxygen sufficiency and the absence of toxic atmosphere; or
- .2 Personnel wear breathing apparatus and other necessary protective equipment and the entire operation is under the close supervision of a responsible officer.

18.4.2. Personnel entering any space designated as gas-dangerous on a ship carrying flammable products should not introduce any potential source of ignition into the space unless it has been certified gas-free and is maintained in that condition.

18.4.3.1. For internal insulation tanks, special fire precautions should be taken in the event of hot work carried out in the vicinity of the tanks. For this purpose, gas absorbing and de-absorbing characteristics of the insulation material should be taken into account.

18.4.3.2. For internal insulation tanks, repairs should be carried out in accordance with the procedures provided for in paragraph 4.4.7.6.

#### 18.5. *Carriage of cargo at low temperature*

18.5.1. When carrying cargoes at low temperatures:

- .1 If provided, the heating arrangements associated with cargo containment systems should be operated in such a manner as to ensure that the temperature does not fall below that for which the material of the hull structure is designed;
- .2 Loading should be carried out in such a manner as to ensure that unsatisfactory temperature gradients do not occur in any cargo tank, piping, or other ancillary equipment; and
- .3 When cooling down tanks from temperatures at or near ambient, the cool-down procedure laid down for that particular tank, piping and ancillary equipment should be followed closely.

#### 18.6. *Protective equipment*

Personnel should be made aware of the hazards associated with the cargo being handled and should be instructed to act with care and use the appropriate protective equipment as mentioned in 14.1 during cargo handling.

#### 18.7. *Systems and controls*

Cargo emergency shutdown and alarm systems involved in cargo transfer should be tested and checked before cargo handling operations begin. Essential cargo handling controls should also be tested and checked prior to transfer operations.

#### 18.8. *Cargo transfer operations*

18.8.1. Transfer operations including emergency procedures should be discussed between ship personnel and the persons responsible at the shore facility prior to commencement and communications maintained throughout the transfer operations.

18.8.2. The closing time of the valve referred to in 13.3.1 (i.e. time from shutdown signal initiation to complete valve closure) should not be greater than:

$$\frac{3600 U}{LR} \quad (\text{s})$$

where: U = ullage volume at operating signal level (m<sup>3</sup>)

LR = maximum loading rate agreed between ship and shore facility (m<sup>3</sup>/h).

The loading rate should be adjusted to limit surge pressure on valve closure to an acceptable level taking into account the loading hose or arm, the ship and the shore piping systems where relevant.

#### 18.9. *Additional operating requirements*

Additional operating requirements will be found in the following paragraphs of the Code: 3.8.4, 3.8.5, 7.1.1.5, 8.2.5, 8.2.7, 9.4.2, 12.1.1, 12.1.10, 13.1.4, 14.2.5, 14.2.6, 14.3.1, 15.1, 15.2, 16.2.2, 17.4.2, 17.6, 17.7, 17.12, 17.13, 17.14, 17.15, 17.16, 17.17, 17.18, 17.20.

### Chapter 19. SUMMARY OF MINIMUM REQUIREMENTS

#### *Explanatory notes to the summary of minimum requirements*

UN Numbers	The UN numbers as listed in the table of chapter 19 are intended for information only.
Vapour detection required (column f)	F: Flammable vapour detection T: Toxic vapour detection O: Oxygen analyser F + T: Flammable and toxic vapour detection
Gauging: types permitted (column g)	I: Indirect or closed, as described in 13.2.2.1 and .2 C: Indirect, or closed, as described in 13.2.2.1, .2 and .3 R: Indirect, closed or restricted, as described in 13.2.2.1, .2, .3 and .4
Refrigerant gases	Non-toxic and non-flammable gases such as: Dichlorodifluoromethane (1028) Dichloromonofluoromethane (1029) Dichlorotetrafluoroethane (1958) Monochlorodifluoromethane (1018) Monochlorotetrafluoroethane (1021) Monochlorotrifluoromethane (1022)

Unless otherwise specified, gas mixtures containing less than 5% total acetylenes may be transported with no further requirements than those provided for the major components.

<i>a</i> Product name	<i>b</i> UN number	<i>c</i> Ship type	<i>d</i> Independent tank type C required	<i>e</i> Control of vapour space within cargo tanks	<i>f</i> Vapour detection	<i>g</i> Gauging	<i>h</i> Special requirements
Acetaldehyde	1089	2G/2PG	-	Inert	F + T	C	14.4.3, 14.4.4, 17.4.1, 17.6.1
Amonia, anhydrous	1005	2G/2PG	-	-	T	C	14.4.2, 14.4.3, 14.4.4, 17.2.1, 17.13
Buradiene	1010	2G/2PG	-	-	F	R	17.2.2, 17.4.2, 17.4.3, 17.6, 17.8
Burane	1011	2G/2PG	-	-	F	R	
Burane-propane mixtures	1011/1978	2G/2PG	-	-	F	R	
Burylenes	1012	2G/2PG	-	-	F	R	
Chlorine	1017	1G	Yes	Dry	T	I	14.4, 17.3.2, 17.4.1, 17.5, 17.7, 17.9, 17.14
Diethyl ether*	1155	2G/2PG	-	Inert	F + T	C	14.4.2, 14.4.3, 17.2.6, 17.3.1, 17.6.1, 17.10, 17.11, 17.15
Dimethylamine	1032	2G/2PG	-	-	F + T	C	14.4.2, 14.4.3, 14.4.4, 17.2.1
Ethane	1961	2G	-	-	F	R	
Ethyl chloride	1037	2G/2PG	-	-	F + T	R	
Ethylene	1038	2G	-	-	F	R	
Ethylene oxide	1040	1G	Yes	Inert	F + T	C	14.4.2, 14.4.3, 14.4.4, 14.4.6, 17.2.2, 17.3.2, 17.4.1, 17.5, 17.6.1, 17.16
Ethylene oxide-propylene oxide mixtures with ethylene oxide content of not more than 30% by weight	2983	2G/2PG	-	Inert	F + T	C	14.4.3, 17.3.1, 17.4.1, 17.6.1, 17.10, 17.11, 17.20
Isoprene*	1218	2G/2PG	-	-	F	R	14.4.3, 17.8, 17.10, 17.12
Isopropylamine*	1221	2G/2PG	-	-	F + T	C	14.4.2, 14.4.3, 17.2.4, 17.10, 17.11, 17.12, 17.17
Methane (LNG)	1972	2G	-	-	F	C	
Methyl acrylene-propadiene mixtures	1060	2G/2PG	-	-	F	R	17.18
Methyl bromide	1062	1G	Yes	-	F + T	C	14.4, 17.2.3, 17.3.2, 17.4.1, 17.5, 17.9
Methyl chloride	1063	2G/2PG	-	-	F + T	C	17.2.3
Monoethylamine*	1036	2G/2PG	-	-	F + T	C	14.4.2, 14.4.3, 14.4.4, 17.2.1, 17.3.1, 17.10, 17.11, 17.12, 17.17

<i>a</i> Product name	<i>b</i> UN number	<i>c</i> Ship type	<i>d</i> Independent tank type C required	<i>e</i> Control of vapour space within cargo tanks	<i>f</i> Vapour detection	<i>g</i> Caulking	<i>h</i> Special requirements
Nitrogen .....	2040	3G	—	—	O	C	17.19
Propane .....	1978	2G/2PG	—	—	F	R	
Propylene .....	1077	2G/2PG	—	—	F	R	
Propylene oxide* .....	1280	2G/2PG	—	Inert	F + T	C	14.4.3, 17.3.1, 17.4.1, 17.6.1, 17.10, 17.11, 17.20
Refrigerant gases (see notes) .....	—	3G	—	—	—	R	
Sulphur dioxide .....	1079	1G	Yes	Dry	T	C	14.4, 17.3.2, 17.4.1, 17.5, 17.7, 17.9
Vinyl chloride .....	1086	2G/2PG	—	—	F + T	C	14.4.2, 14.4.3, 17.2.2, 17.2.3, 17.3.1, 17.6, 17.21
Vinyl ethyl ether* .....	1302	2G/2PG	—	Inert	F + T	C	14.4.2, 14.4.3, 17.2.2, 17.3.1, 17.6.1, 17.8, 17.10, 17.11, 17.15
Vinylidene chloride* .....	1303	2G/2PG	—	Inert	F + T	R	14.4.2, 14.4.3, 17.2.5, 17.6.1, 17.8, 17.10, 17.11

\* This cargo is covered also by the IBC Code.

APPENDIX. MODEL FORM OF INTERNATIONAL CERTIFICATE OF FITNESS  
FOR THE CARRIAGE OF LIQUEFIED GASES IN BULK

*INTERNATIONAL CERTIFICATE OF FITNESS FOR THE CARRIAGE  
OF LIQUEFIED GASES IN BULK*

(OFFICIAL SEAL)

ISSUED UNDER THE PROVISIONS OF THE

INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT  
OF SHIPS CARRYING LIQUEFIED GASES IN BULK

(resolution MSC.5(48))

under the authority of the Government of .....  
(full official designation of country)

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

<i>Name of ship</i>	<i>Distinctive number or letters</i>	<i>Port of registry</i>	<i>Cargo capacity (m<sup>3</sup>)</i>	<i>Ship type (section 2.1 of the Code)<sup>(1)</sup></i>
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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 a gas carrier was commenced:

.....

The ship also complies fully with the following amendments to the Code: .....

The ship is exempted from compliance with the following provisions of the Code: .....

This is to certify:

- I. .1 That the ship has been surveyed in accordance with the provisions of section 1.5 of the Code;
- .2 That the survey showed that the structure, equipment, fittings, arrangements and materials of the ship and the conditions thereof are in all respects satisfactory and that the ship complies with the relevant provisions of the Code.

<sup>(1)</sup> 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.

2. That the following design criteria have been used:

- .1 Ambient air temperature ..... °C<sup>(2)</sup>
- .2 Ambient water temperature ..... °C<sup>(2)</sup>
- .3 \_\_\_\_\_

Tank type and number	Stress factors <sup>(3)</sup>				Materials <sup>(3)</sup>	MARVS
	A	B	C	D		

Cargo piping

N.B. Tank numbers referred to in this list are identified on attachment 2, signed and dated tank plan.

- .4 Mechanical properties of the cargo tank material were determined at ..... °C<sup>(4)</sup> .....
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:<sup>(5)</sup>

Products	Conditions of carriage (tank numbers, etc.)
Continued on attachment 1, additional signed and dated sheets. Tank numbers referred to in this list are identified on attachment 2, signed and dated tank plan.	

4. That in accordance with sections 1.4/2.8.2\* 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:

\*.1 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;

\*.2 In accordance with the loading limitations 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 .....

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

..... 19 .....  
(date of issue) (signature of authorized official  
issuing the Certificate)

(seal or stamp of issuing Authority, as appropriate)

*Notes on completion of certificate:*

(1) "Ship type": Any entry under this column must be related to all relevant recommendations, e.g. an entry "type 2G" should mean type 2G in all respects prescribed by the Code.

(2) Paragraphs 2.1 and 2.2: The ambient temperatures accepted or required by the Administration for the purposes of 4.8.1 of the Code to be inserted.

(3) Paragraph 2.3: Stress factors and materials as accepted or required by the Administration for the purposes of 4.5.1.4 and 4.5.1.6 of the Code to be inserted.

(4) Paragraph 2.4: Temperature accepted by the Administration for the purposes of 4.5.1.7 to be inserted.

(5) Paragraph 3: Only products listed in chapter 19 of the Code or which have been evaluated by the Administration in accordance with paragraph 1.1.6 of the Code should be listed. In respect of the latter "new" products, any special requirements provisionally prescribed should be noted.

## ENDORSEMENT FOR MANDATORY ANNUAL SURVEYS

This is to certify that at a mandatory annual survey required by 1.5.2.1.4 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, the ship was found to comply with the relevant provisions of the Code.

Signed: .....  
(signature of authorized official)

Place: .....

Date: .....

(seal or stamp of the Authority, as appropriate)

\* Delete as appropriate.

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

*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

**NOTE:** An intermediate survey may take the place of a mandatory annual survey where the relevant provisions of 1.5.2.1.3 and 1.5.2.1.4 are complied with.

#### ENDORSEMENT FOR MANDATORY ANNUAL SURVEYS

This is to certify that at an intermediate survey required by 1.5.2.1.3 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, the ship was found to comply with the relevant provisions of the Code.

*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

*Signed:* .....  
(signature of authorized official)

*Place:* .....

*Date:* .....

(seal or stamp of the Authority, as appropriate)

*Attachment 1 to the International Certificate of Fitness  
for the Carriage of Liquefied Gases in Bulk*

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

<i>Products</i>	<i>Conditions of carriage (tank numbers, etc.)</i>

Date .....

*(as for certificate)*

.....

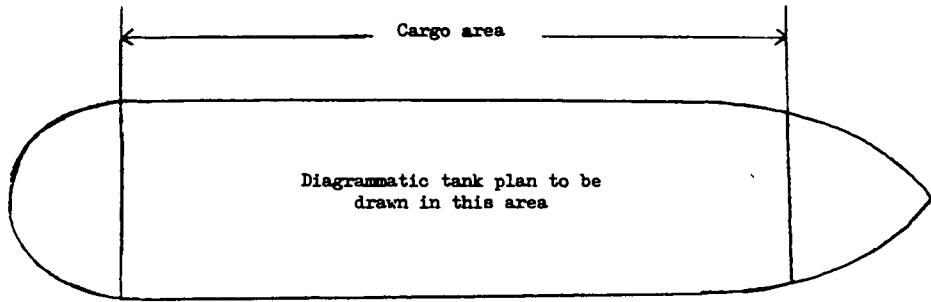
*(signature of official issuing the certificate  
and/or seal or issuing authority)*

*Attachment 2 to the International Certificate of Fitness  
for the Carriage of Liquefied Gases 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 or issuing authority)

*Authentic texts of the Amendments: Chinese, English, French, Russian and Spanish.*

*Certified statement was registered by the International Maritime Organization on 17 July 1986.*

*(For the authentic Chinese text, see this volume. For the authentic French and Russian texts, see volume 1432. For the authentic Spanish text, see volume 1433.)*

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