

**RULES
FOR THE CLASSIFICATION
AND CONSTRUCTION
OF SHIPS
(Rev.2020)**



INTERMARITIME CERTIFICATION SERVICES (ICS Class)

Chapter 12 Refrigerating Plants

Section			subject to the pressure of refrigerant), 9.1.3, 9.2.1.
1. General	1.2	Definitions and explanations	
2. General technical requirements	1.2.1	Definitions and explanations relating to the general terminology of the Rules are given in the <i>General Regulations for the Supervision</i> .	
3. Refrigerating plant spaces			
4. Machinery	1.2.2	For the purpose of the present Chapter the following explanations have been adopted: Refrigerating machinery space is a space containing mechanical and other types of equipment intended for cold production. Refrigerated spaces are cargo holds and spaces provided with equipment capable of maintaining the reduced temperatures and intended for the carriage of refrigerated and frozen cargoes.	
5. Heat exchangers, pressure vessels and cooling arrangements			
6. Fittings and piping			
7. Indicating and measuring instruments and automatic devices			
8. Insulation	1.3	Scope of supervision and technical documentation	
9. Tests			
10. Spare parts	1.3.1	General provisions covering the procedure of classification, supervision during construction and classification surveys, as well as the amount of documents for the refrigerating plant which should be submitted to <i>ICS Class</i> for consideration and approval are specified in the <i>General Regulations for the Supervision</i> and in <i>Ch 1, Section 5</i> . The technical documents for compressors and pumps to the extent which should be submitted to ICS for consideration are specified in <i>Ch 9, rule 1.2.3</i> and for heat exchangers and pressure vessels, as determined in <i>Ch 10, rule 1.3.4.1</i> .	

SECTION 1

General

1.1 Application

1.1.1	The present Chapter applies to marine refrigerating plants and their equipment.		
1.1.2	Classed refrigerating plants are to comply with all requirements of this Chapter.	1.3.2	The machinery and apparatus which are to be manufactured under the supervision of <i>ICS Class</i> are:
1.1.3	Un-classed refrigerating plants are to comply with all requirements of this Chapter specified in 1.3.2.1, 1.3.2.2, 1.3.2.5 (only for apparatus and vessels subject to the pressure of refrigerant), 1.3.2.6 (only for the refrigerating systems), 1.3.2.7 (only the automatic protection systems are concerned), 1.3.4.2, 1.3.4.3, 1.3.4.5, 1.3.4.7 (only for protection systems), 1.3.4.8, 2.1.2, 2.2.2, 3.1.1, 3.1.3 to 3.1.7, 3.2.1 to 3.2.5, 3.3.4, 3.3.8, 3.3.10, 3.4.3, 3.5, 4.1.2, 4.1.5, 5.1.1, 5.1.2, 5.1.4, 5.2.1, 6.1.1, 6.1.2, 6.2.3, 6.2.5, 6.2.6, 7.1.2, 7.2.3, 7.2.4.3, 7.2.8, 9.1.2 (only for equipment	.1	Refrigerant compressors
		.2	Refrigerant pumps.
		.3	Liquid secondary refrigerant pumps.
		.4	Cooling water pumps.
		.5	Heat exchangers and other apparatus and pressure vessels of refrigerant, liquid secondary refrigerant or cooling water.
		.6	Pipes and fittings intended for work at a pressure of 1,0 MPa.
		.7	Devices of automatic control, indication and protection systems, as well as instruments for measuring and recording the temperature in the refrigerated spaces.

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1.3.3 The parts of machinery and apparatus mentioned in 1.3.2 are subject to technical supervision of *ICS Class* during manufacture to ensure that the provisions of *Chs 13 and 14*, as well as particular requirements of technical documents approved by *ICS Class* are complied with. The parts of machinery under 1.3.2.1 - 1.3.2.4 are listed in *Ch 9 Table 1.2.4* and the parts of apparatus indicated in 1.3.2.5 are given in *Ch 10, Table 1.3.3*.

- 1.3.4 In the process of ship's construction the following is to be supervised by *ICS Class*:
- .1 Manufactures and testing of the relevant items of the refrigerating plant at the workshop
 - .2 Mounting of machinery, heat exchangers and pressure vessels.
 - .3 Mounting of refrigerant systems.
 - .4 Mounting of secondary refrigerant, cooled air and cooling water systems.
 - .5 Mounting of the main and emergency ventilation systems.
 - .6 Fitting of insulation of the cooling spaces and freezing chambers, apparatus, pressure vessels and refrigerating pipes.
 - .7 Installation of control, indication, alarm and protection systems of the refrigerating plant
 - .8 Testing of the refrigerating plant.

SECTION 2

General technical requirements

2.1 General provisions

- 2.1.1 The machinery and other units of the refrigerating plant shall remain operative under the environmental conditions specified in *Ch 7, Subs 1.6*.
- 2.1.2 The machinery and equipment of the refrigerating plant are to be installed and secured on board the ship in accordance with the requirements of *Ch 7, rules 1.13.1, 1.13.4, 1.13.6 and 1.13.7*.

2.2 Refrigerants and design pressure

2.2.1 The refrigerants are subdivided into three groups as follows:

- I. Non - flammable refrigerants.
- II. Toxic and flammable refrigerants having low flammable level at the volume concentration of the refrigerant vapor in air of 3,5 per cent and over.
- III. Explosive or flammable refrigerants having low flammable level at the volume concentration of the refrigerant vapors in air of less than 3,5 per cent.

The refrigerants included in Group III may be permitted by *ICS Class* only for the refrigerant systems of ships carrying the liquefied gases in bulk with the cargo used as a refrigerant.

NOTE: Considering restrictive international legislation, it is recommended not to use refrigerants R12 and R502 (see *Table 2.2.2*) in any new refrigerating plant.

2.2.2 In strength calculations of the items operating under refrigerant pressure the design pressure shall be taken not less than the excessive pressure of the saturated vapours of the refrigerant at temperature + 50° C in accordance with *Table 2.2.2*.

For the refrigerant equipment working under the pressure of refrigerants with low critical temperatures (below + 50° C) the design pressure is subject to special consideration by *ICS Class*.

The refrigerating plant components working under pressure are to be calculated for compliance with hydraulic test pressure (see 9.1.2). The stresses involved shall not exceed 0,9 times the yield stress of material.

Table 2.2.2 Design pressures of refrigerants

Refrigerant group	Symbol	Chemical formula	Design pressure <i>p</i> , MPa
I	R12	CF ₂ Cl ₂	1,2
	R22	CHF ₂ Cl	2,0
	R502 (R22 + R115)	CHF ₂ Cl + C ₂ F ₅ Cl (azeotropic mixture)	2,0
II	R717	NH ₃ (ammonia)	2,0
III	R290	C ₃ H ₈ (propane)	1,6
	R1270	C ₃ H ₆ (propylene)	2,0

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- 2.3 Number and capacity of the refrigerating equipment**
- 2.3.1 The refrigerating plant is to provide effective maintenance of the temperatures in refrigerated spaces as may be required for the cargo carried, depending upon its type and conditions of navigation area, as well as cold treatment of cargo.
- 2.3.2 The refrigerating plant of ships of unrestricted service is to provide maintenance of required temperatures in the refrigerated cargo spaces with the main equipment at work supplying cold to all consumers under the following environmental conditions:
- Sea water temperature not below + 30° C.
 - Ambient air temperature not below + 40° C.
- The design environmental conditions of the refrigerating plants of fishing vessels and special purpose ships which, in addition to the refrigerating plants of the cargo spaces are equipped with other refrigerating facilities are subject to special consideration by *ICS Class*.
- 2.3.3 Capacity of main equipment of the refrigerating plant is to be sufficient to maintain the required temperatures in refrigerated spaces when working 24 hours a day and to supply cold to other consumers. The main equipment shall comprise at least two similar condensers and, where intermediate secondary refrigerant or cascade and stage cycles are used, two similar evaporators, intercascade heat exchangers and intermediate pressure vessels.
- 2.3.4 Capacity of the refrigerating plant designed also for cooling non-precooled cargoes with all the machinery running, including the standby unit, shall be sufficient to reduce the cargo temperature to the required temperature as quickly as necessary for the preservation of that cargo.
- 2.3.5 Standby equipment of a compressor refrigerating plant shall comprise one compressor with a drive motor, one condenser, control systems and all fittings necessary for independent operation of all components of this equipment.
- Capacity of the standby equipment shall be such as to supply cold to all consumers with one of the main compressors or condensers inoperative.
- 2.3.6 For fishing vessels and special purpose ships which, in addition to the refrigerating plants of the cargo spaces, are equipped with other refrigerating facilities (e.g., freezing, cooling and ice making), provision of the standby equipment is subject to special consideration by *ICS Class*.
- 2.3.7 Freezing and cooling facilities shall provide freezing (cooling) of cargo as quickly as may be required for the intended cargo. Where cooling or freezing apparatus with a capacity in excess of 10 tons per 24 hours are provided, at least two such apparatus must be installed with total capacity equal to the required one.
- 2.3.8 Pipe systems between apparatus and machinery shall be joined in such a way as to provide operation of the refrigerating units at various combinations of apparatus, machinery and facilities necessary for their independent operation. The apparatus shall be fitted with the connections for suction and delivery pipes providing the transfer of the refrigerant and its discharge from the apparatus.
- 2.3.9 The distribution of cooling grids is to provide uniform cooling of the space concerned. The grids are to be arranged in not less than two independent sections, with means permitting shut-off of each section. The use of cooling grids with direct expansion of a Group II refrigerant is not permitted.
- 2.3.10 When pumping for liquid refrigerant circulation is used, at least two circulating pumps are to be fitted, one of which is to be a standby pump. If the refrigerant system is so designed that it can work properly without pumps, the standby pump need not be installed provided the refrigerant system capacity meets the requirements of 2.3.1 and the freezing chambers or units capacity is not reduced in excess of 20 per cent.

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- 2.3.11 The liquid secondary refrigerant system serving a single group of cold consumers shall comprise at least two circulating pumps, one of which being standby. .4 Materials used for the manufacture of parts of equipment working at temperatures below - 50° C are subject to special consideration by *ICS Class*.
- 2.3.12 In case of two or more groups of cold consumers with separate liquid secondary refrigerant systems (differing in temperatures), each group is to have at least one circulating pump; a common standby pump may be admitted provided it has adequate capacity and pressure head. Cooling water supply to the refrigerating plant is to be provided from at least two circulating pumps, one of which is to be used for standby purpose. Any of sea water pumps with adequate capacity and pressure head may be accepted as standby means. 2.4.2 Parts of machinery and apparatus exposed to the action of corrosive agents are to be made of materials with adequate corrosion resistance or be protected by corrosion-resisting coating. Assemblies and parts of machinery and apparatus made of materials differing in electrolytic potential are to be protected against galvanic corrosion.
- 2.3.13 Cooling water shall be supplied from at least two sea connections. Where it is intended to use sea connections of general service, proper structural arrangements are to be provided for adequate supply of cooling water from each sea connection under normal service conditions of the ship. 2.4.3 Steel piping of refrigerant, liquid secondary refrigerant and connecting parts of these pipes made of steel other than stainless steel are to be galvanized on the outside or treated in some other way ensuring equivalent antirust protection. Surfaces in contact with refrigerant or liquid secondary refrigerant are not to be galvanized. In manufacturing pipes the requirements of 2.4.1 and 2.4.2 are to be taken into consideration.
- 2.4 Materials**
- 2.4.1 Quality and main characteristics of materials used for the manufacture of parts, assemblies and securing items of the refrigerating equipment subject to the dynamic loads, excessive pressure, variable and low temperatures are to comply with requirements of *Ch 13*. The choice of materials depends on the working temperature and physical and chemical properties of the refrigerant:
- .1 Materials used for the manufacture of parts of equipment exposed to the refrigerants and their solutions, lubricating oils, cooling and cooled media shall be inert and resistant to their action.
- .2 Materials used for the manufacture of parts of equipment working at low temperatures shall not be subject to structural irreversible modifications and shall maintain adequate strength at the temperatures concerned.
- .3 Material used for the manufacture of parts and assemblies of the refrigerating equipment working at temperatures not below - 50° C are to comply with the requirements of *Ch 13, Subs 3.5* and *Ch 2, Subs 1.2*.
- 2.5 Electrical equipment**
- 2.5.1 Electrical equipment of refrigerating plants and automatic devices, as well as the lighting of refrigerating machinery, refrigerated spaces and refrigerant storerooms are to comply with the pertaining requirements of *Ch 11*.
- 2.5.2 Driving motors of compressors, pumps and fans are to meet the requirements of *Ch 10, Sections 5* and *10*

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SECTION 3

Refrigerating plant spaces

3.1 Refrigerating machinery spaces

3.1.1 The refrigerating machinery spaces are to meet the requirements of *Ch 7, rules 1.11.1 and 1.11.2*, as well as the requirements of this Chapter.

Refrigerating equipment working with Group II and Group III refrigerants is to be arranged in isolated gastight compartments.

Drainage of the refrigerating machinery space is to be provided as required in *Ch 8, rule 2.4.10*.

3.1.2 The machinery, apparatus and piping are to be so arranged in the refrigerating machinery space as to permit easy access for maintenance and to enable the parts to be renewed, if necessary, without dismantling the machinery and apparatus from foundations. Care should be taken that the machinery, apparatus and other equipment be placed not less than 100 mm apart from bulkheads and other vertical surfaces.

3.1.3 The refrigerating machinery space is to have two exits located as far apart as practicable, with the doors opening outwards. Where the refrigerating machinery space is situated above or below the open deck, each escape route is to be fitted with steel ladders as widely separated from each other as possible and leading to the spaces which give access to the open deck.

Compartments of automated refrigerating machinery working with Group I refrigerant, where continuous watch is not required, need not be provided with a second means of escape.

3.1.4 The means of escape from spaces of refrigerating machinery working with Group II and Group III refrigerants are not to lead into accommodation, public and service spaces or spaces in communication therewith. One of the means of escape is to lead to the open deck.

Where the escape routes pass through corridors and casing, these are to be fitted with supply and exhaust ventilation, forced

air supply being obligatory. The starting arrangements of the ventilation are to be available both inside and outside the refrigerating machinery space and placed in the immediate proximity to the exit.

3.1.5 Exits from spaces housing refrigerating machinery working with Group II and Group III refrigerants are to be provided with water-screen arrangements. The starting means of water screens are to be available from the outside of the space, placed in immediate proximity to the exit.

In the machinery space there shall be one fire hydrant of the water fire main system and a hose.

3.1.6 The refrigerating machinery space shall have an independent ventilation system ensuring 10 air changes per hour.

3.1.7 In addition to the main ventilation system required in 3.1.6, each refrigerating machinery space is to be fitted with emergency ventilation system of a capacity sufficient for:

.1 30 air changes per hour for spaces of refrigerating machinery working with Group II and Group III refrigerants

.2 20 air changes per hour for spaces of refrigerating machinery working with Group I refrigerant

Depending on density of the refrigerant, exhaust ventilation is to be provided from the uppermost or lowest parts of the space.

When calculating the emergency ventilation system, the capacity of the main ventilators may be included, provided these are operable with the emergency ones, should the switchboard of the refrigerating units be de-energized.

3.2 Refrigerant storerooms

3.2.1 Refrigerant storerooms are to be separated from other spaces. Their location in the ship and the construction of boundaries, as well as refrigerant storage cylinders for the refrigerating plants should be chosen in compliance with requirements of *Ch 6, Subs 2.2 and 2.3*.

The spaces intended for storage of the refrigerant are to be gastight.

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When storing small amounts of Group I refrigerant the departure is allowed from the abovementioned requirements on agreement with *ICS Class*.

3.2.2 The refrigerant storage cylinders are to be secured in place in such a way that they will not shift in adverse weather conditions. Non-metallic pads are to be placed between the steel plating and the storage cylinders, as well as between storage cylinders proper.

3.2.3 The refrigerant storerooms shall be provided with an independent ventilation system.

3.2.4 Storage cylinders containing compressed gases other than the refrigerant gas are not permitted to be stowed in spaces of refrigerant storage, nor should combustible materials be used for the outfit of these spaces.

3.2.5 Storage of refrigerant in fixed receivers is permitted on condition that the receivers and spaces they are arranged in comply with the requirements stated in 3.1.5, 3.1.7, 5.1.1, 5.1.2, 5.1.4, 6.2.5 and 6.2.6. Provision shall be made for sucking off Group II refrigerant from the service piping of each receiver after complete filling of the system or periodical replenishing.

Service piping of receivers designed for refrigerant storage is not to pass through accommodation and service spaces.

3.3 Refrigerated cargo spaces

3.3.1 Cooling apparatus, grids, mechanisms, devices, as well as piping and air ducts arranged in the refrigerated cargo spaces are to be efficiently secured and protected from being damaged by cargo.

3.3.2 Where the air cooling system is used, the air coolers may be located either in separate spaces or in the same spaces as the cargo cooled. When arranged in the refrigerated cargo spaces, the air coolers are to be provided with condensate tray. For the refrigerated spaces with the ambient air temperature being negative the condensate trays are to be provided with the heating system.

The use of air coolers with direct expansion of Group II refrigerant is not permitted.

3.3.3 Where the air cooling system is adopted, the air coolers are to be made accessible with the cargo space being entirely loaded with refrigerated cargo. Alternatively, access to the air coolers shall be provided from adjacent non-cooled spaces. The access opening of the air cooler space is to be as large as to permit the fan impeller and electric motor to be carried through, if necessary.

3.3.4 In places where air ducts pass through watertight bulkheads, sluice valves are to be fitted. The sluice valves are to be designed as strong as the bulkhead. The sluice valves are to be operable from positions above the bulkhead deck.

3.3.5 Appropriate ventilation system capable of supplying uncontaminated atmospheric air (cooled or heated, if necessary) into the spaces of refrigerated cargoes requiring adequate air exchange during carriage shall be provided.

3.3.6 Each air inlet and outlet is to have an arrangement to permit being closed airtight.

3.3.7 Air ducts passing through refrigerated cargo and other spaces are to be airtight and efficiently insulated.

3.3.8 Where air cooling of the cargo holds of unclassified refrigerating plants is effected through direct expansion of Group II refrigerant in the air coolers, provision is to be made for an independent ventilation system to serve each hold or a group of them.

3.3.9 The refrigerated spaces are to be fitted with tele-thermometric arrangements. In the absence of these arrangements the refrigerated spaces are to be fitted with not less than two thermometric tubes of not less than 50 mm diameter. The portions of thermometric tubes that pass through non-cooled spaces are to be carefully insulated.

3.3.10 Drainage of refrigerated spaces is to conform to the requirements stated in *Ch 8, Subs 2.7*.

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3.3.11 The arrangement of piping in refrigerated compartments shall comply with the requirements of *Ch 8, rule 1.6.4*.

3.4 Freezing and cooling chambers

3.4.1 The arrangement of air coolers and fans in freezing chambers is to comply with requirements of *rules 3.3.1 and 3.3.3*.

3.4.2 Spaces containing the refrigerating units are to be equipped with proper devices permitting to check the operation of freezing and cooling apparatus using direct expansion of refrigerant.

3.4.3 If direct expansion of Group II refrigerant is used in the systems of the freezing chamber, emergency exhaust ventilation is required and the space of the chamber is to be gastight.

3.4.4 Valves and fittings of the piping carried inside the freezing chamber are to be located in the portion of the piping outside the chamber.

3.5 Spaces containing process equipment

3.5.1 The arrangement of machinery, apparatus and refrigerant pressure vessels in spaces other than the refrigerating machinery spaces will require special consideration by *ICS Class* in each case.

3.5.2 Spaces containing the process equipment in connection with direct expansion of Group II refrigerant are to be provided with a fire hydrant and hose of the water fire main system.

3.5.3 Spaces containing the process equipment are to have independent ventilation. In addition to the ventilation at work in the spaces of process equipment where direct expansion of refrigerant is used, there should be provided an emergency ventilation system. The number of air changes per hour determined for the main and emergency ventilation systems is to comply with requirements of *3.1.6 and 3.1.7*.

3.5.4 In spaces containing the process equipment using direct expansion of Group II and Group

III refrigerants there shall be two exits, as it is specified in *rules 3.1.3 and 3.1.4*.

When using Group II refrigerant, the exits are to be fitted with arrangements capable of producing water screens. The cut-in device of the screens shall be placed from the outside of the space in immediate proximity to the exit.

SECTION 4

Machinery

4.1 Compressors

4.1.1 Compressors are to comply with the requirements specified in this Chapter and also with those of *Ch 9, rules 5.1.3 and 5.1.4.1*.

4.1.2 Parts of compressors exposed to the action of dynamic loads and excessive pressures are to be calculated for strength having in view the design pressures in compliance with *2.2.2*.

4.1.3 The refrigerant suction and delivery sides of the compressor are to have stop valves from the automatic valves.

4.1.4 Cavities in compressors reserved for refrigerant, lubricating oil and cooling water are to have drain arrangements, where necessary.

4.1.5 A pressure relief valve or some other self operating safety device is to be fitted in the delivery line of the intermediate and final compression stages of compressor between the delivery cavity and the stop valve, the discharge being led to the suction side of the compressor in case of excessive pressure rise. Discharging capacity of the safety devices is to be not less than the maximum volumetric capacity of the compressor stage protected. The pressure rise shall not exceed 10 per cent of the lifting pressure, with the valve being open. No shut-off devices are permitted in the refrigerant gas relief line. The possibility of the refrigerant discharge into the atmosphere is subject to special consideration by *ICS Class* in each case.

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4.2 Pumps

4.2.1 Pumps are to comply with requirements set out in *Ch 9, Subs 5.2*.

4.3 Fans

4.3.1 Fans are to comply with requirements set out in *Ch 9, Subs 5.3*.

of these valves is to provide the full discharging capacity.

ICS Class may require that the safety valves are also fitted in other apparatus if this is deemed expedient.

No shut-off valves are permitted between the heat exchanger or pressure vessel and the safety device.

The use of safety devices with one safety valve or safety devices of other types is subject to special consideration by *ICS Class*.

SECTION 5

Heat exchangers, pressure vessels and cooling arrangements

5.1.3

Heat exchangers and pressure vessels are to have suitable facilities for removing water, air, lubricating oil and liquid secondary refrigerant.

5.1 Heat exchangers and pressure vessels

5.1.1 Heat exchangers and pressure vessel as regards materials, scantlings of components and provision with fittings, are to comply with the relevant requirements of *Ch 10, Section 6* (except for *6.3.1, 6.3.3, 6.4.1, 6.4.2.3* and *6.4.2.4*) and also with the requirements of this Part of the Rules.

5.1.4

Heat exchangers and pressure vessels with Group II and Group III refrigerants are to have suitable facilities for emergency dumping of the latter.

The rated time of refrigerant dumping shall be not more than 2 min with refrigerant in heat exchangers or pressure vessels under constant excessive pressure assumed equal to the design pressure according to 2.2.2.

5.1.2 "Shell and tube" heat exchangers and pressure vessels with the volume of the refrigerant space of 50 dm³ and over are to be fitted with safety devices having the discharging capacity so designed that the pressure will not rise in excess of 10 per cent of the design pressure, with the valve being completely open. The design discharging capacity *G*, in kg/s, is to be not less than determined by the formula:

5.2 Air coolers

5.2.1

Where direct expansion of refrigerant is used, the coils of air coolers are to have welded or soldered connections. Flanged connections between the coil sections and pipes are permitted only when this is proved necessary; all flanged connections are to be arranged in readily accessible places to enable inspection for tightness.

$$G = \frac{qS}{r} \quad (5.1.2)$$

where:

q = specific intensity of the heat flow from the space during fire, kW/m² (assumed to be 10 kW/m² in all cases);

S = area of the outer surface of pressure vessel (heat exchanger), m²;

r = specific heat of the refrigerant vaporization under opening pressure of the safety valve, kJ/kg.

5.2.2

Where a single air cooler is used, its evaporator is to be arranged in not less than two sections, each of which is to be capable of being disconnected, if necessary

The safety devices shall consist of two safety valves and a change-over device so constructed that both or one of these valves will, in any case, communicate with the heat exchanger or pressure vessel involved. Each

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SECTION 6

Fittings and piping

6.1 Fittings and safety valves

6.1.1 The refrigerating plants are to be provided with shut-off, regulating and safety devices designed for a pressure of not less than **1,25 p**, where *p* is the design pressure as given in 2.2.2.

As rule, valves and fittings are to be made of steel. The use of other types of materials is subject to special consideration by *ICS Class*. The integral shut-off valves and fittings made of grey cast iron which are intended for the inlet and outlet cavities of the refrigerant compressors, as well as the valves and fittings made of spherical graphite cast iron may be permitted when using Group I and Group II refrigerants at ambient temperatures not below - 40° C.

6.1.2 The safety valve springs are to ensure the valve blowing up at a pressure exceeding the design pressure as given in 2.2.2 by not more than 10 per cent.

6.2 Piping

6.2.1 The piping of refrigerant, liquid secondary refrigerant and cooling water systems is to comply with respective requirements set out in *Ch 8, Subs 1.3* (except for 1.3.6, and refrigerant piping, 1.3.6 and 1.3.7), and is also to meet the requirements of this Chapter. In this case the piping of refrigerants of Group II and Group III, as well as liquid pipes of Group I refrigerant belong to Class I piping in accordance with *Ch 8, Table 1.2.2*.

6.2.2 The piping of refrigerant and liquid secondary refrigerant is to be made of seamless pipes. The piping of the liquid secondary refrigerant is to be made of steel pipes. The joining of steel pipes carrying the refrigerant is, as a rule, to be made by welding and, where copper pipes are concerned, by welding or brazing. Where pipes are joined with fittings, machinery, heat exchangers and pressure vessels, detachable connections may be admitted.

6.2.3 The refrigerant delivery piping of the compressors and refrigerant pumps is to be fitted with non-return valves. These valves need not be used for compressors working with Group I refrigerant and having no discharge facilities.

6.2.4 Refrigerant driers for moisture absorption are to be fitted on the liquid piping carrying the refrigerant slightly soluble in water. They are to be fitted together with gauze filters in the liquid lines to the regulators or structurally connected with them.

6.2.5 The pipes from safety valves (except for those in 4.1.5) are to be led overboard below the waterline corresponding to the minimum draught of the ship. These pipes are to be provided with refrigerant leak detectors and non-return valves fitted immediately in proximity to the ship's side.

It is permitted to discharge Group I refrigerant to the open air at a position safe for persons.

6.2.6 The pipes for refrigerant dumping from heat exchangers and pressure vessels in emergency are to terminate into a header located outside the refrigerating machinery space, but near the access thereto. Each dumping pipe is to be fitted with shut-off valves located near the header and refrigerant leak detectors placed after each valve. These valves are to be protected from opening by unauthorized persons and must be so constructed as to be convenient for sealing when closed. The common main of the emergency dumping header is to have a check valve and is to be led overboard below the waterline corresponding to the minimum draught of the ship. To permit clearing of the common main, steam or compressed air connections are to be provided.

The inner diameters of the refrigerant emergency dumping pipes of separate heat exchangers and pressure vessels are to be not less than the diameter of the relief valve determined as required in 5.1.2. The cross-sectional area of the dumping main is to be not less than the total cross-sectional area of three largest dumping pipes communicating with the main.

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6.2.7	For pipes led overboard in a place below the waterline according to 6.2.5 and 6.2.6, the minimum pipe wall thickness in all cases is to be not less than that specified in <i>Ch 8, Table 1.3.4.3 column 3</i>	.4	Inadmissible rise of refrigerant discharge temperature (intended for the refrigerating plants working with Group II and Group III refrigerants, as well as for the automated refrigerating plants with unattended operation).
		.5	Inadmissible axial rotor displacement of centrifugal compressor
		.6	Inadmissible temperature rise in sliding bearings of centrifugal compressors.
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SECTION 7			
Indicating and measuring instruments and automatic devices			
7.1	Indicating and measuring instruments		
7.1.1	The compressors and apparatus of the refrigerating plants are to be fitted with suitable devices to permit the working parameters being monitored. Besides, the arrangement should provide for the possibility of installing additional indicating and measuring instruments required when testing the plant.	.1	Maintaining a constant level of refrigerant liquid necessary for proper work of the evaporator, or constant temperature of vapor superheating.
		.2	Stopping the delivery of liquid refrigerant into evaporators and any type of intermediate vessels, in case of compressor shut-down.
		.3	Stopping the compressor, should the level of refrigerant liquid rise inadmissibly.
7.1.2	Indicating and measuring instruments are to be placed in readily accessible and visible positions. The scales are to bear clear marks indicating the minimum admissible values of the parameters controlled. Indicating and measuring instruments are to be checked and accepted by Organizations which are recognized by <i>ICS Class</i> .	7.2.5	Plants incorporating “shell and tube” type evaporators are to be fitted with automatic devices capable of:
		.1	Stopping the compressor, should the circulation of the liquid secondary refrigerant inside the evaporator be impeded, or cutting off this evaporator from the refrigerant system
		.2	Stopping the compressor, should the temperature of secondary refrigerant drop inadmissibly.
7.2	Automatic devices		
7.2.1	Automatic systems, as well as the elements and components constituting these systems are to comply with the requirements of <i>Ch 15</i> .	7.2.6	The refrigerating plants are to be provided with signal devices which shall give general warnings at the refrigerating plant control station after the operation of the protective devices specified in 7.2.3 - 7.2.5. Provision is to be made at the local control station for decoding the above signals.
7.2.2	Where automatic control of the refrigerating plant is used, facilities for manual operation are also to be available. Manual operation need not be provided if two automation devices operating in parallel are fitted.	7.2.7	In addition to the requirements of <i>rule 7.2.6</i> , for automated refrigerating plants without personnel at the control it shall be provided:
7.2.3	The refrigerant compressors are to be provided with automatic devices capable of stopping the compressors in case of:	.1	An indication of the working condition of the devices (on-off), as well as of the mean temperature of the refrigerated spaces
.1	Inadmissible drop of suction pressure	.2	Prevention alarm of deviation of the temperature of the refrigerated spaces from
.2	Inadmissible rise of discharge pressure		
.3	Inadmissible drop of lubricating oil pressure		

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the permissible values, according to the prescribed values for the kind of cargo

- 7.2.8 The automated refrigerating plants with unattended operation and the refrigerating plants working with Group II refrigerant are to be provided with gas detection panels which actuate alarms at the refrigerating plant control station in case of the refrigerant leak. The location of air sampling is subject to special consideration by *ICS Class*.

SECTION 8

Insulation

8.1 Insulation of the refrigerated spaces

- 8.1.1 All steelwork of ship's hull inside the refrigerated cargo spaces is to be efficiently insulated.
- 8.1.2 The insulating materials adopted for refrigerated cargo spaces are to have adequate resistance to adverse biological factors and are to be of the type that does give off any odour.
- 8.1.3 The surfaces of the bulkheads and the inner bottom plating in way of fuel tanks are to be coated with oil-resistant and inodorous material. The coating is to be applied before the insulation of these surfaces is arranged.
- 8.1.4 Care should be taken to prevent the insulation from infiltration with water, or, alternatively, suitable means for drying it during service, as well as protective measures against damage by rodents, are to be provided.
- 8.1.5 The insulation of refrigerated cargo spaces is to be covered with suitable lining or other protective coating. In places where insulation linings may be crushed by cargo, they are to be suitably protected.
- 8.1.6 The insulation in freezing chambers is to comply with requirements of 3.3.7; 8.1.4 and 8.1.5.

8.2 Insulation of piping

- 8.2.1 Where pipes are carried through bulkheads and decks, no direct contact with the surfaces they pierce is permitted to prevent heat exchange.
- 8.2.2 Provision is to be made for protecting the insulation of piping from dampness.
- 8.2.3 The insulating materials used for piping are to be non-combustible in accordance with *Ch 6, rule 2.1.1.1*. This requirement does not apply to insulation of piping arranged within the refrigerated cargo spaces and refrigerated storerooms.
- 8.2.4 Vapour barriers and adhesives used in conjunction with insulation, as well as insulation of pipe fittings need not satisfy the requirements of *Ch 6, rule 2.1.1.1* provided they are kept to the minimum quantity and their exposed surfaces have low flame spread characteristics.

SECTION 9

Tests

9.1 Tests at maker's works

- 9.1.1 Tests of the refrigerating plant components listed in this Chapter are to be carried out in the presence of a Surveyor to *ICS Class*.
- 9.1.2 Hydraulic tests for strength of the components working under the refrigerant pressure are to be carried out at a test pressure of not less than **1,5 p** in accordance with *rule 2.2.2*, with the exception of reciprocating compressor crankcases which are to be subjected to a test pressure of not less than the design pressure. Components working under the pressure of liquid secondary refrigerant or water are to be tested at a hydraulic pressure of 1,5 times the working pressure, but not less than 0,4 Mpa.
- 9.1.3 Pneumatic leak tests of the components working under the refrigerant pressure are to be carried out at a test pressure of not less than the design pressure assumed according to 2.2.2, with the exception of reciprocating compressor crankcases for which the test pressure is to be not less than 0,8 times the design pressure.

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9.1.4 Group I refrigerant equipment working under a pressure below the atmospheric pressure is to be subjected to vacuum-tight tests with a residual pressure of not more than 0,8 kPa.

9.1.5 Fittings in assembly and automatic devices provided with shut-off facilities, in addition to the above-mentioned tests, shall be subjected to a leak test by pneumatic pressure equal to the design pressure in accordance with 2.2.2.

9.1.6 The machinery and equipment specified in *rule 1.3.2* after assembling are to be tested in accordance with the requirements of *Ch 9, Subs 1.4*.

9.2 Testing on board ship

9.2.1 After the refrigerating plant has been completely assembled on board, the entire refrigerant system is to be subjected to pneumatic leak tests at a test pressure of **1,0 p** in accordance with 2.2.2.

9.2.2 Pneumatic tests on board may be carried out with dry air (if oil is not present in the system), carbon dioxide, nitrogen or other inert gas. Oxygen, carbon dioxide, halocarbon refrigerants or any combustible mixture or gas is not to be used in ammonia systems.

9.2.3 Upon leak testing the refrigerant system is to be dried. The system is also to be subjected to the vacuum-tight tests at a residual pressure of not more than 1,0 kPa. Carbon dioxide is not to be used for leak tests of an existing ammonia system.

9.2.4 After the system has been filled with refrigerant all joints and fittings are to be checked for leaks.

9.2.5 All pipes of liquid secondary refrigerant and cooling water systems together with pertaining fittings are to be subjected to leak tests under operating conditions.

9.2.6 To check the fulfilment of the requirements of *Subsection 2.3* the refrigerating plant is to be subjected to the refrigerating capacity tests

SECTION 10

Spare parts

10.1 General requirements

10.1.1 Each refrigerating plant is to be provided with spare parts carried on board to an extent that is not less than required in this Section.

10.1.2 The spare parts are to be secured in accessible positions marked and protected against corrosion in an effective way.

10.2 Minimum required spare parts

10.2.1 Compressors, pumps and internal combustion engines driving the compressors are to be supplied with spares according to the provisions of *Ch 7, Sect 5*. Electric motors of compressors, pumps and fans are to be supplied with spare parts according to provisions of *Ch 11, Section 21*.

10.2.2 Apart from the requirements of *10.2.1*, the refrigerating plants are to be supplied with spare parts in accordance with *Table 10.2.2*.

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Table 10.2.2 Spare parts for the refrigerating plant

Nos	Spare parts	Quantity
1	Compressor piston with connecting rod complete, of each size used. Shaft seal ¹ for compressor of each size used.	1
2	Liner of compressor cylinder of each size used.	1
3	Blades of rotary compressor of each size used. Fan impeller with shaft for refrigerated spaces and freezing chambers of each size used.	1
4	Refrigerant expansion valve of each size used. Assorted cocks, valves and fittings of each size used.	1 set for 1 compressor
5	Gaskets and packing of each size used. Thermometers, pressure gauges and vacuum gauges of each size used. Safety valve springs of each size used.	1
6	Leak detector. Hydrometer (only where the liquid secondary refrigerant is used).	1
7		1
8		1
9		1
10		2
11		1
12		1

¹ To be provided as spare parts are rapidly wearing parts of seals only if it is permitted by the seal design.