PART 7 Refrigerating Installations

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CHAPTER 1 General

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SECTION 1 General

1.1 Scope

1.1.1 The requirements of this chapter apply to the machinery and hull equipment of the refrigerating installation serving the cargo of ocean-going ships over 500 tons gross tonnage.

1.1.2 The committee will give consideration to ships engaged on voyages of short duration, to installations of small capacity, or to other special circumstances. In such cases, the class notation may include a service limitation or other restriction.

1.1.3 At owners responsibility safety requirements of these rules also apply to refrigerating installations not subject to classification, provision refrigerating installations and air conditioning refrigerating installations. In this respect, upon special application the Society may check the design, undertake all necessary surveys, attend pressure tests and issue certificates for components important for safety.

1.2 Definitions

1.2.1 Refrigerating installations on seagoing ships include:

- Cargo refrigerating installations for the refrigeration of insulated cargo holds, and
- Container refrigerating installations for the refrigeration of insulated containers.

It is assumed that the refrigerating installations are permanently installed and form part of the ship's equipment.

1.2.2 Ships for the transport of refrigerated liquefied gases are also subject to the provisions of the Code for the construction and equipment of ships carrying Liquefied Gases in Bulk.

1.3 Classification of refrigerating installations

1.3.1 The following Class notations will be assigned to refrigerating installations, when they meet the relevant requirements of the Rules or other requirements deemed equivalent by the Society:

(1) RMC for installations which have been built and installed under the Society's Surveyors supervision in accordance with these Rules.

(2) RMC for installations which have not been built and installed under the Society's Surveyors supervision but have been found satisfactory after a Special Survey.

(3) In general, notations of (1) and (2) will be followed by the minimum temperatures in the refrigerated chambers to be maintained with maximum sea temperature.

(4) When an installation is provided with any additional equipment to suit the carriage of special cargoes or quick freezers for the catch in fishing vessels, appropriate descriptive notes will be added to the notations mentioned in (1) and (2), e.g.

- Equipped for the carriage of fruit.
- Equipped for quick freezers.
- Equipped for the carriage of insulated containers.

1.3.2 New installations intended for classification are to be constructed under the Special Survey of LHR surveyors in accordance with the requirements of this chapter.

1.3.3 For periodical surveys of refrigerating installations, reference should be made to Part 7, Chapter 2 of the Rules.

1.4 Documents for approval

1.4.1 Following information and plans are to be submitted to the Society in triplicate

(1) A description of the refrigerating installations providing all the information necessary for the classification of refrigerating installations.

(2) A calculation of the cooling load.

(3) A general arrangement plan of the refrigerating installation with details of the ventilation of the refrigerating machinery spaces, and the refrigerated spaces or container holds including air ducts and temperature measuring equipment.

(4) Diagrams showing the layout of refrigerant, brine and cooling water pipelines.

(5) Drawings of all vessels and equipment under refrigerant pressure, e.g. condensers, evaporators and oil separators etc. as well as brine tanks and air coolers, together with details of the materials used.

(6) Drawings and design calculations of the crankshaft or rotors of the compressors together with a longitudinal and transverse section of the general arrangement of the compressor for information.

(7) Insulation drawings.

(8) Drawings of the bilge pumping and drainage facilities in refrigerated and air cooler spaces.

(9) Drawings and descriptions of electrical temperature-monitoring and automatic control systems.

1.4.2 Where the ship's machinery is not built under the supervision of LHR or of another recognized Classification Society, plans of the power supply plant have also to be submitted together with the documents relating to the refrigerating installation.

1.4.3 Re-submission of drawings of installation components for which the drawings have already been approved by the Society is not required.

1.5 Tests of equipment

1.5.1 The selection and testing of materials is subject to the requirements included in Part 2, Rules for Materials.

SECTION 2 System Design

2.1 Definition of a refrigerating unit

2.1.1 A refrigerating unit is considered to comprise a compressor, its driving motor and one gas condenser. Where a secondary refrigerant is employed the unit is also to include a brine cooler. It is usual for the compressor and the condenser to be permanently connected to the installation with all necessary piping, fittings and electrical equipment. Alternative arrangements to the above will be given consideration in relation to the number of units in the installation and related factors.

2.1.2 Two or more compressors driven by a single motor, or having only one condenser or brine cooler, are to be regarded as one unit.

2.2 Number of refrigerating units

2.2.1 At least two complete refrigerating units are to be installed for each refrigerating installation or autonomous group thereof.

2.2.2 Where only two refrigerating units are installed, each compressor must be capable of working with each condenser and, where applicable, with each brine cooling evaporator.

2.3 Refrigerating capacity

2.3.1 The refrigerating capacity of the installation is to be rated in such a way that, should any particular refrigerating unit fail, the temperature upon which the cooling load calculation is based and which is certified in the Refrigerating Installation Certificate, can be maintained.

2.3.2 For refrigerating installations comprising a large number of refrigerant compressors or refrigerating units, the number of compressors or units to be provided as stand-by capacity will be subject to special consideration.

2.4 Plant rating

2.4.1 Unless other values are agreed by the Society, the calculation of the required refrigerating capacity is to be based on a seawater temperature of at least 32°C and on an ambient air temperature of at least 40°C with 55% relative humidity.

2.5 Power supply

2.5.1 At least two generating sets must be available for supplying power to refrigerating installations. The capacity of the generators is to be such that, in addition to other requirements:

(1) When all the generators are in operation, the total installed electrical load of the refrigerating installation can be satisfied.
(2) In the event of the failure or shutdown of any one generator, all refrigerating machinery, with the exception of the stand-by sets, can be operated at full load.

2.6 Automation

2.6.1 Automated refrigerating installations are to be so equipped that they can also be operated manually.
(1) Input units and actuating devices are to be type-tested; see also Part 8.

2.6.2 Steps must be taken to prevent the temperature in the inlet ducts from falling below the minimum permitted level.

2.6.3 For the following faults alarm systems are to be installed which actuate an alarm at a position which is constantly manned:
(1) Temperature of return air or air in space above maximum permitted level. A temperature instrument on the bridge may be accepted as an alternative.
(2) Failure of circulating fans.
(3) Permitted level exceeded in bilges or bilge wells of refrigerated spaces.
(4) Suction pressure of refrigerant below permitted level.
(5) Condensation pressure of refrigerant above permitted level.
(6) Lubricating oil pressure below required level.

2.6.4 In the event of the faults specified in 2.6.3(4), (5) and (6) the installation must switch off automatically.

SECTION 3 Refrigerants

3.1 Accepted refrigerants

3.1.1 Normally incombustible refrigerants without significant hazard to human health may be used, such as:

Difluorodichioromethane	(R 12)	CCl_2F_2
Difluoromonochloromethane	(R 22)	$CHClF_2$
Azeotrope of R 22 and R 115	(R 502)	$CHClF_2$/ $CClF_2$-CF_3

3.1.2 In view of phasing out of the production of the refrigerants R 12 and R 502 by the year 1997 due to restrictions of national or international legislation, it is recommended that these refrigerants should not be used in any new installation. As NH_3 (R 717) is among the alternatives the Society is prepared to give special consideration to relevant proposals.

3.2 Design pressures

3.2.1 The maximum working pressure of refrigerants in each of the High Pressure (HP) and Low Pressure (LP) parts of the refrigeration unit is to be taken as the saturation vapor pressure of the refrigerant at 56°C and 44°C approximately (see also 3.2.2).

3.2.2 Design pressures (DR) applicable to the four refrigerants mentioned in 3.1 are as follows:

Table 1.3.1: Design pressures, DR

Refrigerant	High-pressure side (HP)	Low-pressure side (LP)
NH_3	24 bar	17,5 bar
R 12	14 bar	10,5 bar
R 22	22,5 bar	17 bar
R 502	23,5 bar	18 bar

For other refrigerants, the allowable working pressure is to be agreed with the Society.

3.2.3 Within the meaning of these Rules, the low-pressure side of the plant includes all parts exposed to the evaporation pressure of the refrigerant. However, these parts are also subject to the design pressure for the high-pressure side if (e.g. for hot gas defrosting) a switch-over of the system can subject them to high pressure.

Medium-pressure vessels of two-stage plants form part of the high-pressure side.

3.3 Use of Ammonia as a refrigerant (IACS UR M57)

3.3.1 Ammonia refrigerating machinery shall be installed in dedicated gastight compartments. Except for small compartments, at least two access doors are to be provided.

3.3.2 Compartments containing ammonia machinery (including process vessels) are to be fitted with:

(a) a negative ventilation system independent of ventilation systems serving other ship spaces and having a capacity not less than 30 changes per hour based upon the total volume of the space; other suitable arrangements which ensure an equivalent effectiveness may be considered;
(b) a fixed ammonia detector system with alarms inside and outside the compartment;
(c) water screens above all access doors, operable manually from outside the compartment;
(d) an independent bilge system.

3.3.3 At least two sets of breathing apparatus and protective clothing are to be available.

3.3.4 Ammonia piping is not to pass through accommodation spaces.

3.3.5 In case of ammonia plants of fishing vessels under 55 m in length or other ammonia plants with a quantity of ammonia not greater than 25 kg said plants are allowed to be located in the machinery space.

The area where the ammonia machinery is installed is to be served by a hood with a negative ventilation system, so as not to permit any leakage of ammonia from dissipating into other areas in the space.

A water spray system is to be provided for the said area.

In addition previous items 3.3.2(b), 3.3.3 and 3.3.4 apply.

SECTION 4 Refrigerating Equipment

4.1 Refrigerating machinery spaces

4.1.1 Definition

For the purpose of these Rules, refrigerating machinery spaces are service spaces separated by bulkheads from other spaces and housing the refrigerating machinery and its accessory equipment.

4.1.2 Installation of refrigerating machinery

Whether or not it is located in special refrigerating machinery spaces, refrigerating machinery is to be installed in such a way as to leave sufficient room for operation, maintenance and repair.

4.1.3 Disposition and equipment

(1) Irrespective of the nature of the refrigerant used, the doors of refrigerating machinery spaces must not be connected with accommodation or with passageways giving access to accommodation.

(2) Refrigerating machines operated with ammonia and where the weight of the charge exceeds 25 kg, are to be installed in refrigerating machinery spaces separated by gastight divisions from other ship's spaces and service rooms.

(3) Where refrigerating machinery is operated with ammonia, devices for generating water screens are to be provided above the access doors to the refrigerating machinery spaces. These devices must be capable of being actuated from outside the refrigerating machinery space. The actuating mechanism should not be located in the immediate vicinity of the access doors.

Where, in addition, water sprinklers are installed in the refrigerating machinery spaces themselves, these are to be permanently installed and must likewise be capable of being actuated from outside.

The spray nozzles of sprinkler systems are to be appropriately distributed within the refrigerating machinery space. Allowance is to be made for electrical machines and equipment. The spray nozzles are to be capable of projecting a spray of fine water droplets over as large an area as possible.

(4) Where this is made necessary by local circumstances or by the refrigerant used, e.g. ammonia, refrigerating machinery spaces are to be provided with emergency exits.

(5) Provision must be made for the bilge pumping or drainage of refrigerating machinery spaces. Where installations are operated with ammonia, the refrigerating machinery spaces may not be drained into the open wells or bilges of other spaces.

(6) The electrical equipment of refrigerating machinery spaces is subject to the requirements of Part 6 of the Rules.

4.1.4 Ventilation

(1) Refrigerating machinery spaces must have a suitably arranged, mechanical ventilation system. Where refrigerants referred to in 3.1.1 are used, the minimum requirement is that the exhaust air should be conducted into the open air separately from the ducts serving other spaces. The air intake duct may not be connected to the ventilation system serving the accommodation.

(2) Where ammonia is used, the ventilation system may not be connected to the ventilation system serving other spaces of the ship.

(3) The rating of mechanical fans is subject to the following criteria:

(a) Refrigerating machinery spaces where refrigerants referred to in 3.1.1 are used, are to be equipped with mechanical means of ventilation enabling the air to be changed at least 30 times every hour.

(b) Where the refrigerant used is ammonia, the minimum flow rate of the mechanical fans serving the refrigerating machinery spaces is to be calculated by applying the formula:

$$Q = 60 \cdot \sqrt[3]{W^2}\,, \qquad m^3/h$$

where:

W = weight of the refrigerant charge in the installation, kg

In any event, the number of air changes per hour may not be less than 40. Where installations operated on ammonia are equipped with an effective water sprinkler system in the refrigerating machinery space, the minimum flow-rate of the fans specified above may be reduced by 20%.

(4) The fans specified in (3) are also required for insulated refrigerating machinery spaces. In these spaces, however, they are to be switched on only when access to the spaces is required.

(5) Exhaust air ducts of fans serving refrigerating machinery spaces are to be made gastight inside the ship. The exhaust air must be conveyed in such a way as to prevent the leakage of gas into other ship's spaces.

(6) Fans serving refrigerating machinery spaces must also be capable of being switched on and off from outside the space in question. The switches are to be clearly marked.

4.2 Compressors

4.2.1 General

(1) Where the compressors are electrically driven, the motors and other items of electrical plant must comply with Part 6 of the Rules.

(2) Other compressor drives (diesel engine, turbines) must comply with the relevant sections of Part 5 of the Rules.

(3) All compressor components subject to the refrigerant pressure are to be designed to withstand the design pressure for High Pressure side listed in Table 1.3.1.

(4) Crankshafts or rotors of compressors are to be designed to withstand all relevant stresses for an unlimited period. Drawings together with the design calculations and evidence of the functional reliability are to be submitted for consideration.

(5) Compressors and their driving units are to be designed for the operating conditions referred to in Part 5, Chapter 1, SECTION 3.

4.2.2 Material testing

(1) Refrigerant compressors and compressor parts are to be subjected to material testing in accordance with Parts 1 and 2.

(2) Material tests are to be performed on the crankshafts of reciprocating compressors and the rotors of screw compressors with a calculated journal diameter of more than 50 mm. Works Certificates are sufficient for journal diameters of 50 mm. Finished shafts and rotors are to be subjected to magnetic particle testing.

(3) The Society reserves the right to extend material testing to other important components.

4.2.3 Equipment

(1) Provisions have to be made to ensure that the compressor drive switches off automatically should the maximum allowable working pressure be exceeded.

(2) Compressors are to be equipped with devices such as pressure relief valves, rupture discs, etc. which, if the maximum allowable working pressure is exceeded, will equalize the pressures on the discharge and suction sides. Semi-hermetic compressors in automatic installations will be specially considered.

(3) Pressure gauges and thermometers are to be fitted in accordance with 4.8.2(1) and 4.8.2(2).

4.2.4 Testing

After completion, refrigerant compressors are to be subjected to a trial run without refrigerant at the manufacturer's works and to the pressure and tightness tests specified in 6.1.

4.3 Pressure vessels etc.

4.3.1 Pressure vessels and apparatuses under refrigerant pressure

(1) General:

Pressure vessels and apparatuses under refrigerant pressure must comply with Part 5, Chapter 7 of the Rules.

(2) Material testing:

The materials of components under refrigerant pressure must be tested in accordance with Part 2 of the Rules.

(3) Safety devices:

(a) Pressure vessels and apparatuses which contain liquid refrigerant and which can be shut off are to be fitted with a safety valve. For the design of safety valves, see 4.8.1.

(b) Filters and driers need not be fitted with safety valves provided that the refrigerant inlets and outlets cannot inadvertently be closed at the same time.

(4) Pressure and tightness tests:

After completion, pressure vessels and apparatuses under refrigerant pressure are to be subjected to the pressure and tightness tests specified in 6.1.

4.3.2 Brine tanks

(1) General

(a) Brine systems must be equipped with air pipes which cannot be closed off and with brine compensating tanks.

(b) Brine tanks which can be shut off must be protected against excessive pressure rises due to the thermal expansion of the brine by the provision of safety valves or by a mechanism for interlocking the shutoff devices in the open position.

(c) Brine tanks may not be galvanized on the side in contact with the brine.

(2) Testing

Brine tanks are to be subjected in the manufacturer's works to the hydraulic pressure and tightness tests specified in 6.1. Material tests and pneumatic tightness tests may in general be dispensed with.

4.3.3 Air coolers

(1) General

(a) Where necessary, air coolers are to be fitted with suitable means for defrosting. Provision is to be made for heating the drains. In automatic plants, the heating equipment is to be controlled by the defrosting program.

(b) Depending on the type of air circulation system employed, the air coolers are to be subdivided by shutoffs in such a way that, even after the breakdown of one air cooler section, the cooling of the refrigerated space or containers concerned can be maintained. The subdivision can be dispensed with where an air cooler is provided for each stack of containers or for each container.

(c) Air coolers are to be provided with drip trays and adequate drains.

(2) Material testing:
Materials for air coolers using direct evaporation must be subjected to the tests specified in Part 2 of the Rules.

(3) Pressure and tightness tests:
Air coolers are to be subjected in the manufacturer's works to the pressure and tightness tests specified in 6.1. In the case of air coolers for indirect evaporation, the pneumatic tightness test may be dispensed with.

4.4 Piping and accessories

4.4.1 Refrigerant pipes

(1) General
- (a) Refrigerant pipes are to be designed in accordance with Part 5, Chapter 8 of the Rules.
- (b) When installing refrigerant pipes, care is to be taken to provide all pipes whose working temperatures are below the normal ambient temperatures with insulation in accordance with 4.7.1. These pipes are to be protected externally against corrosion. Unless some other form of corrosion protection has been demonstrated to the Society to be equally effective, steel pipes are to be galvanized on the outside.
- (c) At points where they are supported or pass through decks or bulkheads, the refrigerant pipes mentioned in (b) may not come directly into contact with steel members of the ship's structure.
- (d) Where necessary, refrigerant pipes between compressors and condensers are to be protected against being inadvertently touched.

(2) Material testing:
Materials for refrigerant pipes must be tested in accordance with the Part 2 of the Rules.

(3) Tightness tests:
After installation all refrigerant pipes are to be subjected to the tightness test specified in 6.1.

4.4.2 Brine pipes

(1) General:
- (a) Brine pipes must comply with the requirements set out in Part 5, Chapter 8 of the Rules. They may not be galvanized on the inside, but must be protected against corrosion on the outside.
- (b) In general, use is to be made of thick-walled pipes in accordance with Part 5, Chapter 8, Table 8.3.1, Sea water pipes.
- (c) In the case of brines being used whose neutrality during subsequent operation is suitably ensured, the use of externally galvanized brine pipes with the minimum wall thicknesses specified in Part 5, Chapter 8, Table 8.3.1, Pipes in general, may be permitted. This also applies to non-galvanized pipes which are uninsulated and which can be externally inspected and maintained at all times.
- (d) Where brine pipes pass through inaccessible spaces, their wall thicknesses are required to comply with Part 5, Chapter 8, Table 8.3.1, Bilge pipes through ballast tanks. The pipes and their insulation are to be installed in such a way that they are protected against damage.
- (e) At points where they are supported or pass through decks or bulkheads, brine pipes may not come directly into contact with steel members of the ship's structure.

(2) Testing:
After being installed but prior to the application of the insulation, brine pipes are to be subjected to the hydraulic pressure and tightness tests specified in 6.1. Material tests and pneumatic tightness tests may general be dispensed with.

4.4.3 Refrigerant valves and fittings

(1) General
Refrigerant valves and fittings must comply with the requirements set out in Part 5, Chapter 8 of the Rules. Automatic control valves are to be arranged or fitted with by-passes so that the installation can also be operated by hand.

4.4.4 Brine valves and fittings
(1) General:
Brine valves and fittings must comply with the requirements set out in Part 5, Chapter 8 of the Rules. The requirements specified in 4.4.2(1)(a) are also applicable.
(2) Testing:
After being installed but prior to the application of the insulation, brine valves and fittings are to be subjected to the hydraulic pressure and tightness tests specified in 6.1. Material tests and pneumatic tightness tests may generally be dispensed with.

4.5 Fans and pumps

4.5.1 Fans
Motors driving all fans of refrigerated holds must comply with Part 6 of the Rules for Electrical Installations.

4.5.2 Refrigerant circulating pumps
(1) At least two mutually independent pumps are to be installed, one of which is to act as a stand-by.
(2) Motors driving refrigerant circulating pumps must comply with the Part 6 of the Rules.
(3) Refrigerant circulating pumps are to be subjected in the manufacturer's works to a performance test and to the pressure and tightness tests specified in 6.1.

4.5.3 Brine pumps
(1) At least two mutually independent pumps are to be installed, one of which is to act as a stand-by. These pumps must be of a well-established design.
(2) Motors driving brine pumps must comply with Part 6 of the Rules.
(3) Brine pumps are to be subjected in the manufacturer's works to a performance test and to the hydraulic pressure and tightness tests specified in 6.1. A pneumatic tightness test is not required.

4.5.4 Cooling water pumps
The requirements set out in 4.5.3 are applicable in an analogous manner. Regarding the possible deletion of the stand-by pumps, see 4.6.2.

4.6 Sea Water Circulation System

4.6.1 General
Pipes, valves and fittings must comply with Part 5, Chapter 8 of the Rules.

4.6.2 Reserve cooling water supply.
Where the reserve cooling water supply system of the refrigerating installation is connected to the cooling water system of the main propulsion plant, the stand-by cooling water pump specified in 4.5.4 may be dispensed with provided that the stand-by cooling water pump of the main propulsion plant is capable of adequate supply of cooling water to the refrigerating installation without adversely affecting the operation of the main propulsion plant.

4.6.3 Dock operation
Provisions should be made so that where necessary, the refrigerating installation can also be operated while the ship is docked.

4.6.4 Suction lines

Each cooling water pump must be equipped with its own suction line and must be able to draw from at least two sea chests. Seawater filters are to be fitted and so arranged that they can be cleaned without interrupting the cooling water supply.

4.6.5 Cooling water pipes in cargo holds

Where cooling water pipes have to be laid through cargo holds or refrigerated cargo holds to the refrigerating machinery spaces, they normally are to be installed in pipe tunnels. Where cooling water pipes pass through double bottom tanks, their wall thickness is required to comply with Part 5, Chapter 8, Table 8.3.1, Bilge pipes through tanks.

4.6.6 Testing

After being installed, cooling water pipes, valves and fittings are to be subjected to the pressure and tightness tests specified in 6.1.

4.7 Insulation of Refrigerating Equipment

4.7.1 Cold insulation

(1) All pressure vessels, apparatuses, pipes, valves and fittings whose operating temperatures may lie below the ambient temperature at the points where they are installed are to be provided with cold insulation when necessary.

(2) Before being insulated, the items concerned are to be protected against corrosion.

(3) Cold insulation is to be at least sufficiently thick to prevent the formation of condensation water on its surface at a maximum relative humidity of 90%.

(4) The insulation is to be free from discontinuities and its final layer must be given a vapor tight coating.

(5) Insulation is to be protected at points where there is a danger of damage.

4.7.2 Heat insulation

(1) For insulation used to prevent accidental touching and fitted to pressure pipes between refrigerant compressor and condenser and to oil separators on the pressure side, see 4.4.1(d).

(2) To avoid premature refrigerant condensation, hot gas defrosting pipes are to be insulated over their entire length.

(3) Components requiring insulation are to be protected against corrosion.

4.8 Safety Equipment and Instrumentation

4.8.1 Safety equipment

(1) General

(a) Provisions are to be made to ensure that if the maximum allowable working pressure according to 3.2.2. is exceeded, the compressor drive switches off automatically; see also 4.2.3(1).

(b) Pressure vessels and apparatuses which can be isolated and which contain liquefied refrigerants must be equipped with a safety valve; see also 4.3.1(3).

(c) Provision must be made for the safe blow-off of refrigerants directly into the open air.

(2) Safety valves and rupture discs

(a) Safety valves exposed to refrigerant pressure are subject to the requirements set out in 4.4.3. The provisions of 4.4.3 are applicable in an analogous manner to safety valves under brine pressure.

(b) Safety valves are to be set to the maximum allowable working pressure and secured to prevent the setting from being altered inadvertently.

(c) Fitting a rupture disc in front of a safety valve is permitted only where, between the rupture disc and the safety valve, no uncontrolled pressure build-up can occur which, in the event of a sudden pressure surge, would not allow either the safety valve or the rupture disc to respond. The space between the rupture disc and the safety valve cone must therefore be fitted with an alarm pressure gauge or equivalent device. Instead of this a free outlet duct may also be used, provided that it traverses oil-filled sight glasses or the like which reveal any leakage through the rupture disc. A screen for the retention of broken fragments is to be fitted behind the rupture disc.

(d) Where rupture discs are used, the Society requires evidence that the bursting pressure does not exceed the maximum allowable working pressure. A 10% margin of tolerance is permitted.

4.8.2 Monitoring equipment

(1) Pressure gauges:
The suction and pressure pipes of refrigerant compressors, intermediate stage pressure vessels and pressurized brine pipes are to be fitted with pressure gauges. Refrigerant pressure gauges are required to have pressure and temperature scales for the refrigerant concerned. The maximum allowable working pressure is to be indicated by a red line.

(2) Thermometers:
Brine delivery and return pipes, condenser cooling water inlet and outlet pipes and pressure and suction pipes of compressors are to be fitted with thermometers.
For the number and disposition of thermometers in refrigerated cargo holds and in the air duct systems of refrigerated containers, see SECTION 7.

(3) Liquid level indicators:
Direct indicators such as sight glasses for liquid refrigerants used in plants operated with ammonia are to be so designed that they can be shut off. The use of tubular glasses is not permitted.

SECTION 5 Refrigerated Cargo Spaces

5.1 Construction

5.1.1 Each individual refrigerated cargo chamber is to be constructed of steel or other approved equivalent materials and separated from other compartments by water-tight walls. However, the wall between 2 refrigerated spaces intended to contain the cargoes of different natures and having mutual taint is to be built gas-tight so that the taste or odor will not be adversely affected during the ripening process.

5.1.2 Oil tanks are, as far as practicable, not to be located adjacent to the refrigerated cargo chambers. Tank top and bulkheads of oil tanks which are adjacent to the refrigerated cargo chambers are to be completely welded gas-tight.

5.1.3 Manholes in double bottoms or in oil tank tops are to be surrounded by oil-tight coatings of 100 mm height.

5.1.4 The clear widths of manholes and companion way hatches of cargo or air cooler spaces are not to be less than 600 x 600 mm. Hinged covers of companion ways are to be secured against unintended shutting and are to be capable of being opened from both sides.

5.1.5 An escape passage is to be led to the open from each cargo or air cooler space. For this purpose at least one door is to be provided for each space, which can also be opened from both sides.

5.1.6 Brine or refrigerant pipe penetrations through watertight bulkheads and decks must be of an approved design. The pipes may not come into direct contact with bulkheads, the ship's structure or other metallic structural members. The fire resistance of the bulkheads and decks may not be impaired.

5.1.7 Air ducts of refrigerated holds are to be fitted with fire flaps. Where the cargo makes this necessary, each refrigerated hold is to be provided with separately installed air intake and exhaust ducts.

5.1.8 Refrigerated spaces are to be provided with drains and/or bilge pumping facilities. In this connection, see Part 5 of the Rules.

5.1.9 For scuppers on the bulkhead deck, see Part 3, Chapter 16, SECTION 3 of the Rules.

5.1.10 Circulating fans and air-coolers installed in refrigerated or air-cooler spaces must be accessible at all times. It must be possible to change fan impellers and drive motors even when the cargo spaces are fully loaded.

5.1.11 Provision is to be made for heating the spaces when necessary.

5.2 Insulation

5.2.1 The internal surfaces of the walls, ceilings and floors of refrigerated chambers are to be thoroughly insulated. Bilges are to be separated from the insulation of the tank top and the ship's sides in a gas-tight construction. Partition walls, bulkheads or decks between refrigerated chambers operating at the same temperature need not to be insulated. However, the structural parts of the hull which may act as heat conductors, such as decks, partition walls and pillars are to be effectively insulated over a length of not less than 1 m into the refrigerated chambers. Metallic fittings through the insulation which may form a heat conducting bridge are to be avoided as far as possible.

5.2.2 Insulation is to be permanently secured. Where insulation in the form of slabs is used, the edges of the slabs are to abut tightly against each other, and where the slabs are laid in several layers the joints are to be staggered.

5.2.3 The insulation at manhole covers, bilge suctions and wells must be removable.

5.2.4 If timber is used in refrigerated cargo spaces, this is to be impregnated with, if possible odorless, media to prevent rotting and fire.

5.2.5 Insulating materials shall be odorless and, at least, self-extinguishing. They must be approved by the Society and should not if possible absorb moisture.

5.2.6 Removable insulation is recommended for tank tops.

5.2.7 At hatches, and for about 500 mm beyond, the deck insulation in lower holds is to be provided with a special protective covering. The same also applies to shaft tunnels.

5.2.8 Unless suitable deck material or aluminium gratings are provided as top covering, the insulation of the decks of refrigerated spaces is to be protected by battens measuring at least 50 mm by 50 mm in cross-section. The batons may take the form of removable gratings. Thinner battens may be used in refrigerated spaces in which the cargo carried is invariably suspended.

5.2.9 The insulation of the bulkheads of refrigerated spaces and of air ducts is to be suitably protected against damage. This protection is to be so designed that the cooling air is able to circulate freely.

5.2.10 Wherever appropriate, the above requirements apply in an analogous manner to systems of air ducts for the connection of refrigerated containers.

5.3 Testing

5.3.1 The equipment and insulation of refrigerated spaces is to be tested under the supervision of the Society. Compliance with the prescribed heat transfer values is to be demonstrated by performing the refrigeration test specified in 6.2.2.

SECTION 6 Testing

6.1 Pressure tests for refrigerating equipment

6.1.1 General

(1) All pressure tests are to be performed in the presence of a Surveyor. They are to be carried out initially during supervision of construction at the manufacturer's works or, in the case of a survey for the assignment of class, on board ship.

(2) For repeat tests, see Part 2 of this Part.

(3) As a rule, pneumatic tightness tests are to be performed after the hydraulic pressure tests.

(4) Exceptionally, the Society may, on application, waive the hydraulic pressure test provided that a pneumatic pressure test is performed at the test pressure specified for the hydraulic test. Such a test is to be conducted in accordance with the accident prevention regulations and requires the agreement of the competent national Authority.

(5) In refrigerating installations which have already been charged with refrigerant, pneumatic pressure tests may be performed only with nitrogen or carbon dioxide if Group refrigerants referred to in 3.1.1 are used or only with nitrogen if the refrigerant is ammonia. The use of other gases requires the agreement of the Society.

6.1.2 Test pressures

(1) Components under refrigerant pressure:
The test pressures to be used are specified in Table 1.6.1. According to the refrigerant used, HP is to be substituted by the design pressure on the high-pressure side and LP by the design pressure on the low-pressure side in accordance with Table 1.3.1 in 3.2.2.

(2) Components under cooling water or brine pressure:
The test pressures shown in Table 1.6.2 are to be applied.

Table 1.6.1: Test Pressure for Components under Refrigerant Pressure

Test	Item to be tested	Test pressure, bar (1)	
		hydraulic	pneumatic
Prior to installation	Compressor (high-pressure side)	1,5 x HP	1 x HP
	Compressor (low-pressure side)	1,5 x LP	1 x LP
	Compressors with integrally cast cylinders and crankcase	1,5 x HP	1 x HP
	Motor compressors, assembled	-	2 x HP
	Refrigerant circulating pumps	1,5 x HP	1 x HP
	High-pressure vessels and apparatuses	1,5 x HP	1 x HP
	Low-pressure vessels and apparatuses	1,5 x LP	1 x LP
Prior to start-up	Refrigerant valves on fittings (except automatic control valves)	1,5 x HP	1 x HP
	Complete installations : High-pressure side	-	1 x HP
	Low-pressure side	-	1 x LP

NOTE:

1. Where the low-pressure side of the installation can be subjected by operational switching to the pressure of the high-pressure side (e.g. for defrosting with hot gas), the vessels and equipment involved are to be designed and tested at the pressures prescribed for the high-pressure side.

Table 1.6.2: Test Pressure for Components under Cooling Water or Brine Pressure

Test	Item to be tested	Hydraulic test pressure (1)
Prior to installation	Cooling water spaces of machines and equipment, cooling water pumps	1,5 pe,per, minimum 4 bar
	Vessels and equipment on the pressure side of brine pumps, brine pumps	1,5 pe,per, minimum 4 bar
	Vessels and equipment on the suction side of brine pumps	1,5 pe,per, minimum pe,per + 0,2 bar
	Cooling water lines, valves and fittings	1,5 pe,per, minimum 4 bar
	Brine pipelines, valves and fittings (prior to insulation)	1,5 pe,per, minimum 4 bar

NOTE:

1. $p_{e,per}$ = maximum allowable working pressure, bar.

6.2 Tests after installation

6.2.1 Operational tests

The refrigerating installation is to be subjected to the following tests:

(1) All compressors, pumps, fans etc. are to be run simultaneously and demonstrated in operation, to the Society's Surveyor in all the anticipated speed ranges. It is to be ascertained that no unacceptable vibrations occur.

(2) To test their functional efficiency, all compressors are to be operated both individually and together at various speeds of rotation and at different evaporation temperatures. During the test they are to be connected to the condensers and evaporators for all combinations possible in service.

(3) The condensers are to be operated first with the normal cooling water pump and then with the stand-by cooling water pump. Operation of the cooling water supply when in dock, in accordance with 4.6.3, is to be demonstrated.

(4) Brine pumps are to be tested.

(5) Circulating fans are to be operated at their specified service speeds - or with the prescribed blade settings in the case of variable-pitch fans - and the delivery rates measured. It is to be demonstrated to the Society that the requisite rate of air renewal and uniform space ventilation are achieved.

(6) The working of the defrosting devices or the air-coolers is to be demonstrated.

6.2.2 Refrigeration test for cargo refrigerating installations

(1) A refrigeration test is to be performed to demonstrate to the Society that the degree of thermal insulation of the refrigerated spaces and the available refrigerating capacity of the refrigerating installation complies with the requirements set out in 2.3 and 2.4. The refrigeration test is to be performed in the form of a heat balance test. The required proof of performance is deemed to have been supplied if the evaluation of the test by the Society shows that the maximum permitted heat transfer coefficient determined by the Society with regard to the refrigerating installation capacity has not been exceeded.

(2) Before commencing the heat balance test, a detailed test schedule is to be submitted to the Society for approval. Relevant LHR requirements are available upon request.

(3) After the balance test, the following documents are to be submitted to the Society's Head Office:

(a) A diagrammatic drawing of the ship and the refrigerated holds showing the points of temperature measurement.

(b) A report on the execution of the test including all the measured data and copies of the recorded temperature charts.

(c) The ship's draught, fore and aft.

6.2.3 Refrigeration test for container refrigerating installations

(1) The Society may accept as an adequate shipboard trial an operational test analogous to that described in 6.2.1, subject to sufficient steady-state times for adjustments, provided that the following conditions are satisfied:

(a) For the supply of cooling air to the containers exclusive use is made of air ducting systems in accordance with 5.1.1.(1) which have been satisfactorily tested in the manufacturer's works, as prescribed in 5.3.2.

(b) The manufacturer demonstrates by calculation the ample capacity of the refrigerating installation, and the values applied in this operation conform to the Society's experience with comparable installations.

(c) An adequate number of containers is made available for the operational test.

(2) If one of the conditions specified in 6.2.3(1) is not fulfilled, the refrigeration test is to be performed in a manner analogous to that described in 6.2.2, once for at least one empty container hold and once with a sufficient number of containers connected.

(3) The documents specified in 6.2.2(3)(b) and (c) are to be submitted.

SECTION 7 Monitoring of Temperature in Refrigerated Spaces

7.1 General

7.1.1 Suitably distributed and easily accessible thermometers are to be placed in each refrigerated space. At least one thermometer each is required before and after each air-cooler.

7.1.2 Based on spaces of normal geometry and on the useful capacities shown, the following numbers of thermometers are to be fitted as a minimum:

for space capacities up to approximately	300 m^3 :	2 thermometers
for space capacities up to approximately	800 m^3 :	3 thermometers
for space capacities over	800 m^3 :	4 thermometers.

In determining the number of thermometers required, each individual refrigerated space is to be considered separately, even where several spaces are served by a single air-cooler and the intermediate decks are not insulated.

7.1.3 In container refrigerating installations, each container is to be fitted with one thermometer each at the inlet and return connections of the air ducting system. Where cooling is applied by a common supply duct to one stack of containers, the individual thermometers for the supply air may be replaced by one thermometer to each stack, placed in the supply duct close to the air cooler.

7.1.4 Calibrated thermometers are to be used which give a reading of the accuracy required by the cargo.

7.1.5 Where thermometer tubes are fitted, these are required to have an inside diameter of at least 50 mm. If the thermometer tubes are to be operated from the free deck, screw connections and tubes are to be insulated from the deck plating. Where they pass through other spaces, the tubes are to be effectively insulated. They are to be arranged so that water cannot enter them.

7.2 Electrical temperature monitoring equipment

7.2.1 The design and type of enclosure of all appliances and other system components must be compatible with the mechanical and climatic conditions relating to their particular operating environments. So that they can be used in refrigerated cargo, mobile temperature sensors may be used in refrigerated holds. They are then to be fitted with connecting leads of sufficient length. The sensors are to be protected against mechanical damage.

7.2.2 Where temperatures are not monitored locally, electrical devices are to be fitted which comply both with the following requirements and with Part 6 of the Rules.

7.2.3 At least two mutually independent temperature measuring systems with separate power supply are to be installed. The number of measuring points (sensors) in refrigerated spaces depends on the location and size of each space. The requirements set out in 7.1.1 and 7.1.2 or in 7.1.3 are to be complied with as a minimum.

7.2.4 The measuring points in each refrigerated space are to be equally allocated to at least two mutually independent temperature measuring systems.

7.2.5 In air ducting systems for container refrigeration, the measuring points in the delivery and return air ducts are to be coupled to separate indicating instruments, unless provision is made for local measurement of at least the delivery air temperatures.

7.2.6 The measuring range of the systems must cover the entire anticipated temperature range plus an additional ±5°C. Temperatures above or below the measuring range are not to have any harmful effect on the systems.

7.2.7 The accuracy of the temperature measurement and reading must be compatible with the requirements imposed by the sensitivity of the cargo with regard to temperature fluctuations. In the absence of special requirements, the following values are to be applied:
Maximum total error:
(1) for fruit cargo 0,15°C (in range from +10°C to +15°C)
(2) for deep-frozen cargo 0,5°C
Exceptions are subject to the Society's special approval. For analog measurements, the scale calibration must be at least 10 mm/K for fruit cargo and at least 2,5 mm/°C for deep-frozen cargo. The temperature measurement may not be influenced by the duration of the duty cycle of the sensor. Changes in the resistance of the measuring leads due to temperature fluctuations between 0°C and +40°C along the wire and/or fluctuations of ± 20% in the measuring voltage are not to cause the aforementioned total errors to be exceeded.

7.2.8 Wires and their installation must comply with Part 6 of the Rules. Water-proof distribution and junction boxes must be used.

7.2.9 Each temperature measuring system must be provided with its own power supply. The power supply systems are to be electrically independent of each other and of the shipboard supply system.

7.2.10 Where temperature measuring systems are supplied by their own power sources or via converters from the ship's network, provision must be made for simple switching to a stand-by power

source or to a stand-by converter. The mains unit of a temperature measuring system is not subject to these requirements (see 8.1.1).

7.2.11 The system and its individual components are to be subjected to a test in the manufacturer's works under the supervision of the Society. The Society may recognize this as a type-test for other installations of the same design.

SECTION 8 Spare Parts and Protective Equipment

8.1 Spare parts

8.1.1 It is recommended that adequate spare parts together with the tools necessary for maintenance or repair are available. The maintenance of the spares is the responsibility of the owner.

8.2 Equipment for personnel protection

8.2.1 The provision of gas masks, respirators, protective clothing etc. is subject to the accident prevention regulations in force.

CHAPTER 2 Periodical Surveys

CONTENTS

SECTION 1 General

1.1 Scope

1.1.1 The requirements of this Chapter apply to the machinery and hull equipment of refrigerating installations.

1.2 Mandatory periodical surveys

1.2.1 For the retention of the classed assigned, refrigerated cargo installations are to be surveyed by a surveyor of the Society as specified in SECTION 2 and SECTION 3.

1.3 Loading port surveys

1.3.1 At the request of the Owner or his representatives, a non-mandatory loading port survey may be carried out in accordance with requirements of SECTION 4, and a relevant certificate to be issued recording, in addition to other details, the temperatures in the various refrigerated holds and chambers at the time of the survey.

1.4 Surveys of non-classed refrigerating installations

1.4.1 It is Owner's responsibility to assure that all components of non-classed refrigerating installations are maintained in good condition and are periodically surveyed and tested as required for classed installations. Upon application the Society will undertake to carry out these surveys, attend the pressure tests and issue relevant certificates.

SECTION 2 Annual surveys

2.1 General

2.1.1 The annual survey of a classed refrigerated cargo installation should not normally require any opening out of the machinery, or dismantling of the insulating arrangements.

2.1.2 If any defects are observed, or if there are indications of deficiency in the installation affecting classification, or the temperature notation assigned, the surveyors may recommend the opening out of suspected items.

2.1.3 The surveyors may, as a result of their survey, recommend urgent or deferred repair or renewal of defective items, to place the refrigerated installation in good and efficient condition.

2.2 Examination of the installation

2.2.1 Whenever practicable, the entire refrigerating machinery is to be examined under working condition on the ship's arrival at the port of discharge before the refrigerated cargo is unloaded. Log books or other records are to be examined to ascertain that if any part of appliances show abnormal working condition in the past and if necessary steps are to be taken in order to determine the possible cause of the deficiencies recorded and to deal with them.

2.2.2 Cargo chambers are to be examined throughout to check that insulation linings, fastenings as well as sheathings on decks, tank tops and tunnel tops are free from damages and are airtight. Where the insulation deficiency is known or suspected, the removal or boring of the insulation may be

required by the surveyor in order to determine fullness and dryness, test holes are to be properly closed thereafter.

2.2.3 Air trunks and casing for air ducts and coolers, and fastenings and supports for ducts, grids and meat rails, etc. are to be examined as far as practicable for damage or deterioration.

2.2.4 Hatch covers and seals, doors and frames of cargo or cooler spaces, covers of bilges and manholes, air-refreshing ducts and their closing appliances as well as thermometer tubes with their connections and fastenings are to be examined to see that they are in good condition and are airtight.

2.2.5 Bilges are to be cleaned and suction pipes, suction roses, sounding pipes as well as liquid sealed traps and non-return valves for chamber drainage are examined to ascertain that all sounding and drainage devices are in efficient working condition.

2.2.6 Cooling grids, air cooler coils and air cooler drip pans with drainage are to be examined to ascertain that they are clean and in good working order.

2.2.7 Brine coils and grids and brine return tanks, together with valves and fittings are to be examined under working condition.

2.2.8 Primary refrigerant cooler coils and cooling grids together with valves and fittings are to be examined under working condition.

2.2.9 Shells of shell-and-tube and double-pipe type condensers and evaporators, separators, receivers, filters, driers, coil terminals of coil-in casing type condensers and evaporators and other pressure vessels as well as primary refrigerant gas and liquid pipes, brine piping, headers condensor cooling water piping and valves are to be examined externally as far as practicable.

2.2.10 Thermometers concerned are to be examined. The surveyor may request one or more thermometers to be calibrated by a competent person.

2.2.11 A general examination is to be made of refrigerant compressors, condenser cooling water pumps, brine and primary refrigerant circulating pumps, air circulating fans together with their motors, control gear and cables and the insulation resistance measured. The results of insulation resistance are measured. The acceptable insulation resistance measured is to be as shown in Part 6.
The results of insulation measurement carried out by a competent person may be acceptable at the discretion of the Surveyor.

2.2.12 The generating plant supplying electric power to the refrigerating machinery is to be examined generally with a view to ascertaining that the plant is being efficiently maintained. In the case of ships not classed with the Society, the Surveyor is to ascertain that regular examinations of the generating plant continue to be held by the Classification Society concerned.

SECTION 3 Special surveys

3.1 General

3.1.1 A special survey is normally to be carried out at 5 yearly intervals. If a Special Survey is carried out at its due date and it is inconvenient for owners to complete all the requirements of such a survey at one time, the Special Survey may be commenced at the 4th Annual Survey after Classification Survey

or previous Special Survey and be progressed during the succeeding year with a view to completion by the 5th anniversary date.

3.2 First special survey

3.2.1 In addition to the requirements for Annual Survey as detailed in SECTION 2, the examinations required by 3.2.2 to 3.2.8 are to be carried out.

3.2.2 All refrigerant together with their prime movers are to be opened up for examination. Relief devices, suction filters and lubricating arrangements are also to be examined.

3.2.3 Water and covers of shell-and-tube and double-pipe type condensors are to be removed for examination of tubes, tube plates and covers.

3.2.4 Condenser cooling water pumps, including the reserve pump which may be used for other services, as well as brine and primary refrigerant circulating pumps are to be examined under working condition and if deemed necessary by the Surveyor, these pumps may be opened up for examination.

3.2.5 Brine coils and grids are to be hydraulically tested for tightness to a pressure of 1,5 times the working pressure or 0,4MPa (4Kgf/cm^2), whichever is the greater.

3.2.6 Primary refrigerant cooler coilers and cooling grids together with valves and fittings, gas condensers, evaporators and receivers are to be leak tested for tightness when under the refrigerant pressure prevailing the system with the refrigerating machinery at rest and the regulating valves opened sufficiently to obtain and approximate balance of pressure throughout the system.

3.2.7 The Surveyor is to satisfy himself that all pressure relief valves and safety discs throughout the refrigerating machinery and appliances are in good order.

3.2.8 At exposed places a different amount of the insulation of refrigerant and brine pipes is to be removed and pipes examined, if deemed necessary by the Surveyor.

3.3 Subsequent Special Survey

3.3.1 A subsequent Special Survey is to be held approximately five years from the date of the previous Special Survey.

3.3.2 In addition to the requirements for first Special Survey as detailed, paragraphs 3.3.3 to 3.3.6 are to be complied with.

3.3.3 Coils of coil-in-casing condensers and evaporators are to be removed for examination and pressure tested to a pressure as specified in Part 7, Chapter 1, SECTION 6 or their relief valve setting pressure, whichever is the smaller to prove tight. Where it is impracticable to remove the coils they may be examined from inspection holes and pressure tested in place.

3.3.4 Shell-and-tube condensers and evaporators are to have end covers removed and are to be pressure tested under the same pressure as that required in 3.3.3.

3.3.5 Where brine or water is used for sub-cooling the primary refrigerant liquid in heat exchangers of the shell-and-tube type, the heat exchangers are to be examined and pressure tested in the same manner as that required for condensers. Double-pipe type heat exchangers are to be examined as far as practicable with the refrigerant gas piping under the same pressure as that required for condensers. Other types of heat exchangers using brine or water are to be examined and pressure tested at the discretion of the Surveyor according to the design of such equipment.

3.3.6 Primary refrigerant cooling grids or air cooler coils in the refrigerant chamber are to be pressure tested in place under a pressure as specified in Part 7, Chapter 1, SECTION 6.

3.4 Continuous Survey

3.4.1 At the request of the Owner, the Committee will give consideration to the Special Survey requirements, as detailed in 3.2 and 3.3 being carried out on a Continuous Survey basis. This will normally require that one fifth of the refrigerating machinery and arrangements, insulated holds and chambers is surveyed annually. When it has been agreed that the complete survey of the refrigerating installation may be carried out employing the Continuous Survey procedure, the various items of machinery should be opened out for survey in rotation, so far as practicable, to ensure that the interval between consecutive examinations of each item will not normally exceed five years.

SECTION 4 Loading port survey requirements

4.1 General

4.1.1 When a loading port certificate is required by the Owner or his representative, a survey as detailed in 4.2 is to be carried out at the loading port. The certificate is not in respect of the cargo to be loaded or the manner in which it is to be stowed.

4.1.2 In the case of ships engaged on voyages of less than two months duration, a Loading Port Certificate is to be considered as valid for two months, provided cargoes carried out are such nature as not to damage the insulation or appliances in refrigerated chambers, nor to be affected by taint or mould refrigerated cargoes loaded during that period.

4.1.3 If the ship loads at more than one port, one survey only at the first loading port is required, provided that it includes the examination of all refrigerated chambers which are to be used for refrigerated cargo during the voyage, and general cargo is not subsequently carried in any of the chambers prior to loading the refrigerated cargo.

4.1.4 If there is no Surveyor of the Society available at the loading port, or if none is obtainable from a port within a reasonable distance, the Society is to accept the report of survey held at the loading port by a reliable Surveyor appointed by the Society. If no such Surveyor is available, a report signed by two competent engineers of the ship is to be accepted.

4.2 Survey requirements

4.2.1 Refrigerated chambers are to be examined in any empty state to ascertain that they are cleaned and free of odour that may adversely affect the cargo to be loaded.

4.2.2 Brine or other refrigerant pipe grids, cooler coils and connections are to be examined to ascertain that they are free from leakage.

4.2.3 Wood sheathings and cargo battens are to be examined to ascertain that they are well fitted in position.

4.2.4 Insulation and linings are to be examined to ascertain that no damage has been sustained prior to the loading of the refrigerated cargo.

4.2.5 Scuppers and bilge suctions draining refrigerated chambers are to be examined to ascertain that they are in good working order, and that liquid sealed traps are primed.

4.2.6 The refrigerating machinery is to be examined under working conditions, and temperatures in the refrigerated chambers are to be noted.

4.2.7 Where any repair is deemed necessary by the Surveyor, it is to be carried out immediately to his satisfaction before the new cargo is loaded. Any indication of defective insulation not considered to warrant immediate attention is to be noted and specially reported.