



THE SOCIALIST REPUBLIC OF VIETNAM

QCVN 59: 2013/BGTVT

**NATIONAL TECHNICAL REGULATION
ON CARGO REFRIGERATING SYSTEMS**

HANOI 2013

Preamble

National Technical Regulation on Cargo Refrigerating Systems QCVN 59: 2013/BGTVT is compiled by Vietnam Register, verified by the Ministry of Science and Technology, promulgated by the Minister of Transport under Circular No. 06/2013/TT-BGTVT dated 2 May 2013.

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NATIONAL TECHNICAL REGULATION ON CARGO REFRIGERATING SYSTEMS

CONTENTS

	Page
I GENERAL	7
1.1 Application and Scope	7
1.2 References, Definitions and Explanations	7
II TECHNICAL REGULATIONS	10
Chapter 1 General	10
1.1 General.....	10
Chapter 2 Surveys	11
2.1 General.....	11
2.2 Registration Surveys	13
2.3 Registration Maintenance Surveys	15
Chapter 3 Refrigerating Machinery	18
3.1 General.....	18
3.2 Construction etc. of Refrigerating Machinery.....	19
3.3 Cooling Appliances in Refrigerated Chambers.....	22
3.4 Other Arrangements in Refrigerated Chambers	23
3.5 Refrigerating Machinery Compartments	23
Chapter 4 Special Requirements for Refrigerating Machinery using Ammonia as refrigerant.....	24
4.1 General.....	24
4.2 Design	24
4.3 Refrigerating Machinery	25
4.4 Refrigerating Machinery Compartment.....	25
4.5 Gas Expulsion System	26
4.6 Gas Detection and Alarm System.....	28
4.7 Electrical Equipment.....	29
4.8 Safety and Protective Equipment	29
Chapter 5 Refrigerated Chambers	30
5.1 Construction of Refrigerated Chambers	30

QCVN 59: 2013/BGTVT

5.2 Insulation and Insulation Materials	31
5.3 Temperature Measuring Arrangements.....	32
5.4 Drainage Arrangements	32
Chapter 6 Tests	34
6.1 Tests at the Manufacturer's Works.....	34
6.2 Tests during Construction	34
Chapter 7 Loading Port Surveys.....	36
7.1 General	36
III REGULATIONS ON MANAGEMENT	37
1.1 General	37
1.2 Regulations on technical supervisions	37
1.3 Certification	37
IV RESPONSIBILITIES OF ORGANIZATIONS, INDIVIDUALS	39
1.1 Responsibilities of ship owners and operators, agency of design, manufacturing, converting, renovating and repairing the systems.....	39
1.2 Responsibilities of Vietnam Register.....	39
1.3 Responsibilities of the Ministry of Transport.....	39
V IMPLEMENTATION	40

NATIONAL TECHNICAL REGULATION ON CARGO REFRIGERATING SYSTEMS

I GENERAL

1.1 Application and Scope

1.1.1 Application

- 1 This Regulation (hereinafter referred to as the Regulation) apply to the survey and manufacture of cargo refrigerating systems on sea-going ships which are surveyed and classed by Vietnam Register.
- 2 Relevant requirements in QCVN 21: 2010/BGTVT (National technical Regulation - Rules for the classification and construction of sea-going steel ships) are to be applied for cargo refrigerating systems except otherwise stipulated in this Regulation.
- 3 For the refrigerating machinery within the refrigerating installations specified in -1 above, the requirements in the Regulation apply to the refrigerating machinery using the primary refrigerants listed below. The surveys and constructions of the refrigerating machinery using primary refrigerants other than those listed below are to be as deemed appropriate by VR:

R22 : CHClF₂

R134a : CH₂FCF₃

R404A : R125/R143a/R134a (44/52/4 % wt) CHF₂CF₃/ CH₃CF₃/ CH₂FCF₃

R407C : R32/R125/R134a (23/25/52 % wt) CH₂F₂ / CHF₂CF₃ / CH₂FCF₃

R410A : R32/R125 (50/50 % wt) CH₂F₂ / CHF₂CF₃

R507A : R125/ R143a (50/50 % wt) CHF₂CF₃ / CH₃CF₃

R717 : NH₃

- 4 For refrigerating installations of ships with restricted area of service or those of small capacity, some of the requirements in the Regulation may be modified appropriately provided that VR considered it acceptable.
- 5 The survey and construction of controlled atmosphere systems specified in above -1 will be considered appropriate by VR.

1.1.2 Scope

This Regulation is to apply to organizations and individuals involving activities relating to cargo refrigerating systems and falling under the application as specified in 1.1.1 above, including Vietnam Register (hereinafter referred to as "VR"); ship owners; operators, designers, building yards, renovating and repairing yards of cargo refrigerating systems .

1.2 References, Definitions and Explanations

1.2.1 References

QCVN 59: 2013/BGTVT

- 1 QCVN 21: 2010/BGTVT, "National Technical Regulation - Rules for the classification and construction of sea-going steel ships" promulgated in accordance with Circular 12/2010/TT-BGTVT dated 21 April 2010.
- 2 Circular No.32/2011/TT-BGTVT dated 19 April 2011 of the Ministry of Transport stipulated on amendments and supplements to a number of articles of the Regulations on verification registration of ships in Vietnam, accompanying Decision No. 51/2005/QD-BGTVT dated 12 October 2005 of the Minister of Transport.

1.2.2 Definitions

The definitions of terms which appear in the Regulation are to be as specified in the following -1 to -7, unless otherwise specified elsewhere:

- 1 Refrigerating installations means refrigerating machinery, insulation for refrigerated chambers, other related appliances in refrigerated chambers, and controlled atmosphere systems to be registered.
- 2 Refrigerating machinery means a set of refrigerating units which compose refrigerating cycle, consisting of compressors, condensers, receivers, evaporators, coolers, piping and fittings, driving motors for the compressors and refrigerant pumps, automatic controllers, and electrical equipments.
- 3 Refrigerating units means in general such machinery as compressors, motors, condensers, evaporators, pumps, etc., necessary to operate refrigerating cycles among the refrigerating machinery
- 4 Brine is a general term for the secondary refrigerants which is cooled by the primary refrigerant and which is a thermal medium to cool the cargo.
- 5 Design pressures means the maximum pressure designed by the manufacturer. However, design pressures are not to be less than the values specified in Table 1.1 depending on the kind of the refrigerants.
- 6 Controlled atmosphere systems means such systems as to control and maintain the oxygen content at a low level in the cargo holds by introducing Nitrogen gas therein in order to extend the life of cargoes as subsidiary installations for cargo refrigerating installations.
- 7 Anniversary Date is the day corresponding to the expiry date of the Classification Certificate, excluding expiry date of the Classification Certificate.

Table 1.1 The Lowest Design Pressure

Refrigerant		R22	R134a	R404A	R407C	R410A	R507A	R717
Lowest Design Pressure (MPa)	High pressure side (1)	1.9	1.4	2.5	2.4	3.3	2.5	2.3
	Low pressure side (2)	1.5	1.1	2.0	1.9	2.6	2.0	1.8

Notes:

- (1) High Pressure side : The pressure part from the compressor delivery side to the expansion valve.

- (2) Low Pressure side : The pressure part from the expansion valve to the compressor suction valve. In case where a multistage compression system is adopted, the pressure part from the lower-stage delivery side to the higher-stage suction side is to be included.

II TECHNICAL REGULATIONS

CHAPTER 1 GENERAL

1.1 General

1.1.1 Equivalency

Cargo refrigerating systems which do not fully comply with the requirements of the Regulation may be accepted provided that they are deemed by VR to be equivalent to those specified in the Regulation.

1.1.2 Special Installations

The surveys and construction of refrigerating installations to which the requirements in this part can not be directly applied for a special reason are to be deemed appropriate at the discretion of VR.

CHAPTER 2 SURVEYS

2.1 General

2.1.1 Kinds of Surveys

1 Kinds of surveys are as follows:

- (1) Surveys for Registration (hereinafter referred to as Registration Surveys);
- (2) Surveys for registration maintenance (hereinafter referred to as Registration Maintenance Surveys):
 - (a) Special Surveys;
 - (b) Annual Surveys;
 - (c) Occasional Surveys.

2.1.2 Registration Surveys and Intervals of Registration Maintenance Surveys

1 Registration Surveys

(1) Registration Surveys during Construction

- (a) The presence of the Surveyor is required at the following stages of the work, except the case of thermal balance test specified in 6.2.6, the requirements may be modified having regard to the actual status of facilities, technical abilities and quality control at the works.
 - (i) When the tests of materials in accordance with the requirements in Part 7A, Section II of QCVN 21: 2010/BGTVT and other tests necessary for the approval or acceptance described in 3.1.3-4, 5.2.1-1 and 5.2.5 of the Regulation are carried out;
 - (ii) When materials are appropriated for parts, or when such parts are appropriated for the refrigerating installations concerned;
 - (iii) When finishing an important part is completed, and if necessary, at a proper time during the middle stage of construction;
 - (iv) When the tests specified in Chapter 6 are carried out.

(2) Registration Surveys not Built under the Survey

Refrigerating installations not Built under the Survey intended to be registered are to undergo the Registration Survey when an application for the survey is made.

2 Registration Maintenance Surveys are to be in accordance with the following:

- (1) Special Surveys are to be carried out at intervals specified in 1.1.3-1(3), Part 1B, Section II of QCVN 21: 2010/BGTVT;
- (2) Annual Surveys are to be carried out at intervals specified in 1.1.3-1(1), Part 1B, Section II of QCVN 21: 2010/BGTVT;
- (3) In addition to (1) and (2) above, an Occasional Survey is to be carried out independently of special surveys and annual surveys where:
 - (a) Main parts of the installations have been damaged, repaired or renewed;

QCVN 59: 2013/BGTVT

- (b) The installations are modified or altered; or
- (c) It is considered necessary by VR.

2.1.3 Special Surveys and Annual Surveys carried out in advance, etc.

1 Surveys carried out in advance

The requirements for Special Surveys and Annual Surveys carried out in advance are to be in accordance with the provisions specified in 1.1.4, Part 1B, Section II of QCVN 21: 2010/BGTVT.

2 Postponement of Special Surveys

The requirements for postponement of Special Surveys are to be in accordance with the provisions specified in 1.1.5(1) or 1.1.5(2), Part 1B, Section II of QCVN 21: 2010/BGTVT.

3 Partial Omission of Surveys

At Special Surveys, the Surveyor may omit the thorough examination for items examined in accordance with the requirements for the Special Survey at the previous Annual Survey or Occasional Survey at his discretion.

4 Modification of Surveys

At Special Surveys, the Surveyor may modify the requirements for cargo refrigerating installations specified in 2.3.1-1, taking into account the size, purpose, construction, history, results of the previous Survey and the present conditions of the installations.

5 Continuous Surveys

(1) For machinery and equipment approved to be applicable by VR, where they are examined in regular rotation to complete all the requirements of the special survey within 5 years and the intervals of consecutive surveys of each item do not exceed 5 years, the examination of them in special surveys may be properly modified at the discretion of the Surveyor;

(2) The survey in such way as specified in (1) above is referred to as a continuous survey.

2.1.4 Preparation for Surveys

- 1 All such preparations as required for the survey to be carried out as well as those which may be required by the Surveyor as necessary in accordance with the requirements in the Regulation are to be made by the applicant of the survey. The preparations are to include provisions of an easy and safe access, necessary facilities and necessary records for the execution of the survey. Inspection, measuring and test equipment, which Surveyors rely on to make decisions affecting classification are to be individually identified and calibrated to a standard deemed appropriate by VR. However, the Surveyor may accept simple measuring equipment (e.g. rulers, measuring tapes, weld gauges, micrometers) without individual identification or confirmation of calibration, provided they are of standard commercial design, properly maintained and periodically compared with other similar equipment or test pieces. The Surveyor may also accept equipment fitted on board a ship and used in examination of shipboard equipment (e.g. pressure, temperature or rpm gauges and meters) based either on calibration records or comparison of readings with multiple instruments.

- 2 The applicant for survey is to arrange a supervisor who is well conversant with the survey items intended for the preparation of the survey to provide the necessary assistance to the Surveyor according to his requests during the survey.
- 3 The survey may be suspended where necessary preparations have not been made, any appropriate attendant mentioned in the previous -2 is not present, or the Surveyor considers that the safety for execution of the survey is not ensured.
- 4 Where repairs are deemed necessary as a result of the survey, the Surveyor will notify his recommendations to the applicant of the survey. Upon this notification, the repair is to be made to the satisfaction of the Surveyor.
- 5 Where the replacement of equipments and spare parts etc. on the cargo refrigerating systems is necessary, such replacement is to comply with requirements for that existing cargo refrigerating systems. However, where such equipments are clearly specified or considered necessary by VR, VR may require the compliance of those with present Regulation. In addition, the replacing equipments are not to contain asbestos.

2.1.5 Ships Laid-up

- 1 Ships laid-up are not subject to Registration Maintenance Surveys. However, Occasional Surveys may be carried out at the request of the owners.
- 2 When ships laid-up are about to be re-entering service, the following surveys and surveys for specific matters which have been postponed due to being laid-up, if any, are to be carried out.
 - (1) If the due dates for Periodical Survey have not transpired while the ship was laid-up, then the extent of survey is to be equivalent to annual survey specified in 2.3.2.
 - (2) If the due dates for Periodical Surveys have transpired while the ship was laid-up, then these Periodical Surveys are, in principal, to be carried out. However, where two or more kinds of Periodical Surveys are due, only special survey may be carried out.

2.2 Registration Surveys

2.2.1 Registration Surveys during Construction

- 1 In a Registration survey during construction, the construction, materials, scantlings and workmanship of the refrigerating installation are to be examined in detail in order to ascertain that they meet the full requirements of each chapter concerned of the Regulation.
- 2 The refrigerating machinery used in the refrigerating installation intended to be registered with VR may be acceptable without their related tests by confirming the certificate issued by VR.
- 3 For the refrigerating installation intended to undergo a registration survey during construction, the following plans and information in triplicate are to be submitted to VR before the work is commenced:
 - (1) Specifications of the refrigerating installation (including particulars of refrigerating machinery units);
 - (2) Thermal calculation sheets;

QCVN 59: 2013/BGTVT

- (3) General arrangements of the refrigerating machinery (including detailed ventilating arrangements);
 - (4) Sectional assembly of refrigerant compressors and detailed plans (material to be indicated) of reciprocating compressor crankshafts, or rotors of screw type compressors, or rotors, discs and casings of turbo compressor, and plans of speed-increasing gear;
 - (5) Detailed plans of pressure vessels subject to the primary refrigerant pressure (condensers, receivers, evaporators (brine coolers), oil separators, surge tanks, inter coolers, etc.);
 - (6) Piping arrangements of primary and secondary refrigerants and cooling water (materials, diameter and thickness of pipes are to be indicated);
 - (7) Arrangements of refrigerated chambers (including ductings for air circulation and ventilation);
 - (8) Wiring diagram for the refrigerating installation and arrangements of electric appliances;
 - (9) Wiring diagram in refrigerated chambers (including details of construction of penetration of the insulation);
 - (10) Kind of insulation on all surfaces, physical properties, thickness and methods of attachment of the insulation and linings (including detailed construction and insulating methods of hatch covers, access doors, ventilating ducts, scupper and bilges);
 - (11) Drainage arrangements and defrosting arrangements in refrigerated chambers and spaces in which the air coolers are installed;
 - (12) Arrangements of thermometers or sensors in refrigerated chambers and air coolers, and the name of manufacturer and the type of the sensors are to be informed;
 - (13) Explanatory documents to show the function of automatic temperature controls;
 - (14) Heat balance tests and measuring plans (performance diagrams of compressors, fans, and their driving motors are to be submitted as well);
 - (15) Other documents considered necessary by VR.
- 4** Notwithstanding the requirements in -3, submission of some of the plans and documents specified in -3 may be omitted, in case where the refrigerating installation are intended to be constructed at the same manufacturer's work based on the plans and documents which have been approved by VR.

2.2.2 Registration Surveys not Built under the Survey

1 General

In an Registration Survey not built under the survey, the refrigerating installation is to be examined on their construction, materials, workmanship and actual conditions as required for the special survey corresponding to their age, in order to ascertain their effectiveness.

2 Tests

In the Registration Survey not built under the survey, operation tests and other various tests are to be carried out in accordance with the requirements in Chapter 6. However, the heat balance test may be replaced with other test or omitted where the Surveyor approves it.

- 3 When a refrigerating installation is intended to undergo the Registration Survey not built under the survey, plans and documents are to be submitted as may be required by the requirements in 2.2.1.

2.3 Registration Maintenance Surveys

2.3.1 Special Surveys

- 1 At a special survey, the examinations required by the following (1) to (18) are to be carried out:
- (1) An examination of the refrigerating installation log book is to be made to trace the operating condition of the installation during navigation.
 - (2) Insulation linings and their fastening are to be examined. Any indication of dampness or deterioration of the insulation is to be investigated.
 - (3) Air circulation ducts, hatch covers and their seal, access doors and their fastening, ventilating system and their closing means are to be examined. Care is to be given to the condition of penetrating parts where ducting or ventilating pipes pass through the deck plating.
 - (4) Bilge ways, wells, strainers, suction and sounding pipes, scupper pipes together with non-return valves and water sealed traps fitted to them are to be cleaned and examined. Air cooler defrosting arrangements and their drainage arrangements are also to be examined.
 - (5) Condition of air coolers cooling coils, cooling grids (including brine) in refrigerated chambers is to be examined.
 - (6) Shells of condensers, receivers, evaporators, separators, driers, filters and other pressure vessels exposed to the primary refrigerant pressure, and their connections and piping are, as far as possible, to be examined externally.
 - (7) Insulation on the surfaces of pressure vessels, pipe connections and piping is to be examined for dampness or deterioration.
 - (8) Reciprocating compressors with their lubricating system are to be opened up and examined. In the case of screwed-type compressors or compressors deemed appropriate by VR, the interval of opening up may be modified by VR, provided their working condition is found satisfactory.
 - (9) Condenser cooling water pumps, primary refrigerant pumps and brine pumps are to be opened up and examined.
 - (10) Insulated pipes carrying the refrigerant are to be examined both outside and inside the insulated chambers, removing the insulation to the extent necessary for checking their condition, especially of the locations in which pipes are connected by butt welding in place or screwed couplings.
 - (11) All pressure relief valves throughout the refrigerating plant are to be adjusted on their relieving pressures.
 - (12) All automatic controls, safety devices and alarms are to be tested for their satisfactory function.

QCVN 59: 2013/BGTVT

- (13) Randomly selected thermometers and apparatus used for measuring the temperature in the chambers and of air in suction and delivery main stream are to be checked for their accuracy. The Surveyor may at his discretion accept the checking records made by some reliable persons.
- (14) The insulation in refrigerated chambers is to be carefully examined, and bored where considered necessary in order to determine the integrity and dryness. These test holes are subsequently filled carefully.
- (15) Brine pipe system is to be tested to a pressure of 1.5 times the design pressure or 0.4 MPa whichever is the greater.
- (16) Pressure vessels are to be opened up for examination, and afterward pressure tested in accordance with the following procedures:
 - (a) The coils of gas condensers of the coil-in-casing type are to be examined and tested to a pressure of 1.5 times the high pressure side design pressure. Where it is impracticable to remove the coils they may be examined through inspection holes and tested in place.
 - (b) The coils of evaporators of the coil-in-casing type are to be examined and tested to a pressure of 1.5 times the low pressure side design pressure. Where it is impracticable to remove the coils, they may be examined through inspection holes and tested in place.
 - (c) Gas condensers of the shell-and-tube type and gas evaporators (brine coolers) of the shell-and-tube type in which the primary refrigerant is in the shell, are to have the water or brine end covers removed and the tube plates, tube ends and inside the end covers examined. Afterwards, the shells are to be tested to a pressure equal to the high pressure side design pressure.
 - (d) Gas evaporators (brine coolers) of the shell-and-tube type in which the brine is in the shell are to have the primary refrigerant end covers removed and the tube ends and inside the end covers examined. The shells are to be tested to a pressure of 1.5 times the design pressure or 0.4 MPa whichever is the greater. After refitting the end covers, the primary refrigerant side is to be tested to a pressure equal to the low pressure side design pressure.
 - (e) Primary refrigerant receivers are to be hydrostatically tested at the design pressure of the high pressure side. However, when the receivers are designed to use such primary refrigerant as R22, R134a, R404A, R407C, R410A or R507A, or when they are proved to have no harmful defects such as erosions or cracks on the inner surface of the vessels by means of ultrasonic test or other effective non-destructive examinations, the above mentioned pressure test may be omitted.
 - (f) For pressure vessels for the refrigerant of R22, R134a, R404A, R407C, R410A or R507A, pressure tests specified in (a) through (e) above may be omitted at the first Special Survey provided that the vessels are found to be in good order.
- (17) Current condition of the electrical equipment and electric cables are to be examined. It is to be ascertained that their insulation resistance is not less than 100,000 Ω between all insulated circuits and earth. When correct records are maintained, the above examination may be omitted at the discretion of the Surveyors;
- (18) Operation tests of the refrigerating installation are to be carried out.

2.3.2 Annual Surveys

- 1 At an annual survey, an external examination is to be carried out on the following items (1) to (5). Examination may also be made on the items which are prepared to be examined in detail or which are opened up by the Owners option. If any defects are observed at such examinations, the Surveyor may require open-up examinations of the suspected items.
 - (1) Items required in (1) through (7), and (13) in 2.3.1 are to be examined.
 - (2) Compressors, condenser cooling water pumps, primary refrigerant pumps, brine pumps, air circulation fans and their driving motors are to be examined externally.
 - (3) Water end covers of condenser(s) selected by the Surveyor are to be examined externally for corrosion through inspection holes or other suitable openings.
 - (4) Tests for insulation resistance are to be made on the motors and controls of compressors, pumps, fans, etc. and their wiring, and the resistance is to be not less than 100,000 Ω between insulated circuits and earth. However, when correct records are maintained, the above tests may be omitted at the discretion of the Surveyor.
 - (5) Random tests are to be made to ascertain that the automatic controls, safety devices and alarms are in good working condition.

2.3.3 Occasional Surveys

At an occasional survey, examinations or tests on items required are to be carried out in accordance with the requirements in 2.1.2-2(3), to the satisfaction of the Surveyor.

CHAPTER 3 REFRIGERATING MACHINERY

3.1 General

3.1.1 General

- 1 Refrigerating machinery are to be designed taking into account their purpose and service conditions.
- 2 All components of the refrigerating machinery are to be so constructed and arranged that they can be easily maintained and readily opened up for repair or renewal.
- 3 Where R717 is used as refrigerant, the refrigerating machinery are to comply with the requirements in this chapter and, in addition, they are to comply with the requirements in Chapter 4.
- 4 Primary refrigerant pipes for R22, R134a, R404A, R407C, R410A or R507A are to be classified into Group III specified in 12.1.3, Part 3, Section II of QCVN 21: 2010/BGTVT.
- 5 Pressure vessels for the refrigerant of R22, R134a, R404A, R407C, R410A or R507A are to be classified in accordance with the requirements in 10.1.3, Part 3, Section II of QCVN 21: 2010/BGTVT, according to the design pressure specified in 1.2(5) of the Regulation.
- 6 Refrigerating machinery are to be provided with the following equipment:
 - (1) Standard thermometer: 2 sets;
 - (2) Hydrometer: 1 set (in the case of brine-cooling);
 - (3) Refrigerant leakage detector: 1 set.

3.1.2 Capacity and Number of Refrigerating Machinery

- 1 At least two refrigerating units (in general consisting of one refrigerating compressor and its driving motor, one condenser, one evaporator, one pump and other accessories necessary to operate the unit independently) are to be provided and so arranged as to be readily interchanged with each other.
- 2 The refrigerating capacity of the installation is to be sufficient to maintain the temperatures of the refrigerated chambers specified in the descriptive note added the classification character with of any one unit suspended.

3.1.3 Materials and Welding

- 1 Materials used for the refrigerating machinery are to be suitable for the refrigerant used, the design pressure, the minimum working temperature, etc.
- 2 Materials used for the primary refrigerant pipes, valves and their fittings are to comply with the requirements in 12.1.4 to 12.1.6, Part 3, Section II of QCVN 21: 2010/BGTVT according to the classes of pipes specified in 3.1.1-4 and 4.2.1-1.
- 3 Materials used for the pressure vessels exposed to the refrigerant pressure (condensers, receivers and other pressure vessels) are to comply with the requirements in 10.2, Part 3, Section II of QCVN 21: 2010/BGTVT according to the classes of pressure vessels specified in 3.1.1-5 and 4.2.1-1.
- 4 Materials listed below are not to be used:

- (1) For parts exposed to fluorine-substituted hydrocarbons: aluminium alloys containing more than 2% of magnesium;
 - (2) For parts always exposed to water: aluminium of which purity is less than 99.7% (except corrosion protection treated materials).
- 5** The use of cast-iron valves is to be in accordance with the requirements in Table 3.1. Even when the use of cast-iron valves are allowed in that Table, such valves are not to be used where the design temperature is lower than 0 °C or higher than 220 °C. In this case, such valves may be used at temperatures down to -50 °C, even if the design temperature is lower than 0 °C, provided that they are used under a pressure up to 1/2.5 of the design pressure.
- 6** Refrigerating machinery using specific materials such as rubber hoses, plastic tubes, vinyl pipes, etc., or aluminum alloys is to be approved or accepted by VR, considering the refrigerant used or service conditions.
- 7** The welding for refrigerating machinery are to comply with the relevant requirements in Chapter 11, Part 3, Section II of QCVN 21: 2010/BGTVT.

Table 3.1 Service Limitation of Valves made of Iron Casting

Kind of valves	Materials	Application
Stop valves	Gray iron castings with specified tensile strength not exceeding 200 N/mm ² or equivalent thereto	Not to be used
	Gray iron castings other than those specified in above, Spheroidal graphite iron castings, Malleable iron castings or equivalent thereto	(1) May be used for design pressure not exceeding 1.6 MPa. (2) May be used for design pressure exceeding 1.6 MPa but not exceeding 2.6 MPa, provided nominal diameter does not exceed 100 mm and design temperature is 150 °C or below
Relief valves	Any iron casting	Not to be used
Automatic control valves	Gray iron castings with specified tensile strength not exceeding 200 N/mm ² or equivalent thereto	Not to be used
	Gray iron castings other than those specified in above or equivalent thereto	(1) May be used for design pressure not exceeding 1.6 MPa. (2) May be used for design pressure exceeding 1.6 MPa but not exceeding 2.6 MPa, provided nominal diameter does not exceed 100 mm and design temperature is 150 °C or below
	Spheroidal graphite iron castings, Malleable iron castings or equivalent thereto	Not to be used for design pressure exceeding 3.2 MPa

3.2 Construction etc. of Refrigerating Machinery

3.2.1 Refrigerant Compressors

QCVN 59: 2013/BGTVT

- 1 Compressor components subject to the refrigerant pressure (including crankcases in the case of reciprocating compressors) are to be so designed to withstand the design pressure for HP side. However, when a relief valve is fitted to the crankcase integral with compressor cylinder, the components mentioned above may be designed for the design pressure for the relief valve.
- 2 Where the compressor is lubricated by pressure oil, the compressor is to be stopped automatically when the oil pressure falls below a preset value.
- 3 The compressor is to be provided with an alarm or automatic cut off device which operates where condenser cooling water pressure falls below a predetermined value.

3.2.2 Driving Machines and Gearing

Prime movers and step-up gearing for compressors are to be in accordance with the relevant requirements in Part 3 and Part 4, Section II QCVN 21: 2010/BGTVT.

3.2.3 Pressure Vessels exposed to the Refrigerant Pressure

Design, construction and strength of pressure vessels exposed to the refrigerant pressure (condensers, receivers, and other pressure vessels) are to be in accordance with the requirements in 10.3 to 10.8, Part 3, Section II of QCVN 21: 2010/BGTVT (excluding those in 10.8.3).

3.2.4 Oil Separators

Suitable oil separators with drainage are to be provided to the discharge side of the compressor, except when a unit integrated with evaporator is provided to ensure oil recovery.

3.2.5 Filters

Suitable filters are to be provided in the refrigerant gas lines to the compressors and in the liquid lines to the automatic regulators. Filters may be omitted provided oil separators fitted have filtrating capability.

3.2.6 Refrigerating Driers

Driers are to be provided to the refrigerant pipes for R22, R134a, R404A, R407C, R410A or R507A. Driers are to be so arranged that they can be by-passed or changed over to a stand-by unit without interrupting the operation of the plant in case of failure. However, such arrangement is not required when the change over to the stand-by unit is ensured by a unit integrated with the evaporator.

3.2.7 Refrigerant Pumps

Where the primary and/or secondary refrigerants are circulated round the system by pumps, a stand-by pump(s) so arranged as to be easily interchangeable with pumps for normal operation is to be provided. Its capacity is not to be less than that of the largest pump for normal operation.

3.2.8 Condenser Cooling Water Pumps

- 1 At least two separate condenser cooling water pumps are to be provided and so arranged as to be interchangeable with each other. In this case, one of the pumps may be used for

other purposes, provided that it is of adequate capacity and its use on other services does not interfere with the supply of cooling water to the condenser.

- 2 Condenser cooling water is to be taken from at least two sea connections (suctions). One of the sea connections is to be provided on the port side and the other on the starboard side.

3.2.9 Piping Systems

- 1 Design, construction, strength, fabrication and outfitting of piping systems are to be in accordance with the requirements in 12.2 to 12.4 and 13.2 (excluding those in 13.2.1-6) Part 3, Section II of QCVN 21: 2010/BGTVT.
- 2 Pipes and pipe flange couplings are to be in accordance with the requirements for air in Table 3/12.8 Chapter 12, Part 3, Section II of QCVN 21: 2010/BGTVT.

3.2.10 Safety Devices against Excessive Pressure

- 1 A high pressure cut out switch and a relief valve are to be fitted between each compressor (except turbo compressors) and its delivery stop valve. The discharge from the relief valve is to be led to the open air or the low pressure side of the refrigerant system.
- 2 The refrigerant side of the condenser, the receiver, and parts containing liquid refrigerant, which may be isolated and exposed to a pressure exceeding their design pressure, are to be provided with relief valves or other suitable pressure relieving devices.
- 3 Pressure vessels used for low pressure side containing liquid refrigerants (including brine coolers and closed type brine tanks) and isolated by stop valves are to be provided with pressure relief valves or other suitable pressure relieving devices.
- 4 All pumps and piping systems which may be exposed to a pressure exceeding their design pressure are to be provided with relief valves or other suitable pressure relieving devices.
- 5 Where discharge from the relief valve on the high pressure side of the primary refrigerant is led to the low pressure side, the arrangement is to be made so that the operation of the relief valve is not affected by back pressure accumulation.
- 6 Where discharge from relief valves or other pressure relieving devices are led to the open air, the openings are to be located at safe places above the weather deck.
- 7 Pressure relieving devices are to be capable of preventing the pressure accumulation exceeding 1.1 times the design pressure of the parts to which the devices are fitted.

3.2.11 Automatic Control

Automatic control is to be in accordance with the requirements in 18.2 Part 3, Section II of QCVN 21: 2010/BGTVT.

3.2.12 Electrical Equipment

- 1 The electric power supply to the refrigerating installation is to be fed by at least two sets of generating units.
- 2 The capacity of the generating units mentioned above is to be such that in the event of any one generating unit being stopped the remaining generating units are capable of maintaining the temperature of the refrigerated chambers specified in the descriptive note added to the classification character.

QCVN 59: 2013/BGTVT

3 The construction of electrical equipment arranged in the refrigerating installation is to comply with the requirements in Chapter 1 và 2, Part 4, Section II of QCVN 21: 2010/BGTVT.

3.3 Cooling Appliances in Refrigerated Chambers

3.3.1 Cooling Grids

Brine cooling grids or direct expansion cooling grids in each refrigerated chamber are to be divided in at least two sections so arranged that each section can be shut off, where necessary.

3.3.2 Air Cooler

Cooling coils of each air cooler are to be arranged in not less than two sections, each of which can be shut off where necessary. Alternatively, at least two independent air coolers are to be provided.

3.3.3 Refrigerated Air Circulating Fans

Where circulation of air is dependent on a single fan and motor, access arrangements are to be such that the fan and motor can be readily removed for repair or renewal even when the chamber is loaded with refrigerated cargo. Where several fans and motors are installed and the chamber temperature can be maintained in an allowable range even if one unit is out of use, the above requirement is not applied.

3.3.4 Automatic Temperature Regulating Devices

Where automatic regulating devices for controlling the temperatures in the refrigerated chambers are provided, a manually operated regulating valve or system is to be provided as stand-by service. Alternatively, two sets of automatic regulating systems so arranged that each system can be readily operated by changing over may be provided.

3.3.5 Temperature Difference

In bulk refrigerated cargo ships, the temperature difference between the refrigerated chamber and the refrigerant is to be controlled so that the dehydration of cargo and frosting of the cooling appliances in each chamber can be minimized..

3.3.6 Galvanizing of Brine Tanks and Pipes

Internal surfaces of brine tanks and pipes exposed to brine are not to be galvanized. However, this requirement is not applied where brine tanks are closed type and they are provided with a ventilating pipe or pipes led to the open air in a location where no damage will arise from the gas discharged and their open ends are fitted with non corrosive metallic wire gauze diaphragms, or where the tanks are open type and the compartments in which they are situated are efficiently ventilated.

3.3.7 Corrosion Protection of Refrigerant Pipes in Refrigerated Chambers

External surfaces of primary refrigerant or brine pipes of steel within refrigerated chambers or embedded in insulation thereof are to be suitably protected from corrosion by galvanizing, coating of any corrosion protective paint or other methods. Where pipes are connected by screwed couplings or by welding, ungalvanized or uncoated portions of the pipes are to be coated with an efficient corrosion resisting material after pressure testing.

3.4 Other Arrangements in Refrigerated Chambers

3.4.1 Defrosting Arrangements

Where refrigerated chambers are operated below 0 °C, means for effectively defrosting air cooler coils in refrigerated chambers are to be provided.

3.4.2 Ventilating Arrangements in Refrigerated Chambers

Where chambers are intended for the carriage of refrigerated cargoes requiring controlled ventilation, air refreshing arrangements are to be provided. In this case, each chamber is to be provided with its own separate inlet and exhaust vent, and each vent is to be provided with an airtight closing appliance. The positions of the air inlet are to be selected to minimize the possibility of contaminated air entering into the chambers.

3.4.3 Heating Arrangements for Fruit Cargoes

Where it is intended to carry fruit cargoes which may be adversely affected by low temperatures into areas where the ambient temperature may become below the carrying temperature, arrangements for heating the chambers are to be provided.

3.5 Refrigerating Machinery Compartments

3.5.1 Condition of Refrigerating Machinery Compartments

Refrigerating machinery compartments are to be provided with efficient arrangements of drainage and ventilation, and separated by gastight bulkheads from the adjacent refrigerated chambers.

CHAPTER 4 SPECIAL REQUIREMENTS FOR REFRIGERATING MACHINERY USING AMMONIA AS REFRIGERANT

4.1 General

4.1.1 General

Refrigerating machinery using ammonia as refrigerant is to be of an indirect refrigerating system using brine, and to use R717 refrigerant as the primary refrigerant only.

4.1.2 Definition

- 1 The definitions of terms which appear in this chapter are to be as specified in the following (1) to (4), unless otherwise specified specially in other chapters:
 - (1) Gas means ammonia gas used as the refrigerant.
 - (2) Gas purging means the discharge of non-condensing gases from the condenser.
 - (3) Storage container means a vessel used for storing gas for replenishment.
 - (4) Gas expulsion system means the system for excluding gas quickly from a compartment, and consists of ventilation system, gas absorption system, water screening system, gas absorption water tanks, etc.

4.1.3 Drawings and Data

- 1 Drawings and data to be submitted in addition to those specified in other chapters, are generally as follows:
 - (1) Gas Detector Arrangement;
 - (2) General Arrangement of Refrigerating Machinery Compartment.

4.2 Design

4.2.1 General

- 1 Pressure vessels used in the refrigerating machinery are to be in accordance with the requirements of Group I specified in Chapter 10, Part 3, Section II of QCVN 21: 2010/BGTVT and the primary refrigerant pipes (hereinafter referred to as refrigerant pipes) are to be classified into Group I piping specified in Chapter 12, Part 3, Section II of QCVN 21: 2010/BGTVT.
- 2 Refrigerating machinery is to be provided with auxiliary receivers of adequate capacity so that repairs and maintenance may be carried out without discharging the gas to the atmosphere. However, the auxiliary receivers can be dispensed with, if at least the refrigerant in the receiver with the largest capacity can be stored in some other receiver.

4.2.2 Materials

- 1 Materials capable of highly corrosion (copper, zinc, cadmium, or their alloys) and materials containing mercury are to be not used at locations where ammonia comes in contact.
- 2 Nickel steel is not to be used in pressure vessels and piping systems.
- 3 Cast iron valves are not to be used in the refrigerant piping system.

- 4 Material for sea-water cooled condensers is to be selected considering the corrosion due to sea water.

4.3 Refrigerating Machinery

4.3.1 Refrigerant Compressors

Refrigerant compressors are to be provided with means for automatically stopping the compressor when the pressure on the high pressure side of the refrigerant piping system becomes excessively high. Also, an alarm system which generates visible and audible alarms when this means are in operation is to be installed in the refrigerating machinery compartment and monitoring position.

4.3.2 Piping Joints

Piping joints for the refrigerant piping system are to be butt welded as far as practicable.

4.3.3 Pressure Relieving Devices

The refrigerant gas discharged from a pressure relief valve is to be absorbed in water, except when leading the gas to the low pressure side.

4.3.4 Liquid Level Gauge

- 1 If liquid level gauges made of glass are used at locations where pressure exists permanently, they are to comply with the requirements given below:
- (1) Flat type glass is to be used in the liquid level gauge, and the construction is to be such that the gauge is adequately protected against external impacts.
 - (2) The construction of the stop valve for the liquid level gauge is to be such that the flow of liquid is automatically cut off if the glass breaks.

4.3.5 Gas Purging

Gas discharged from the purging valve is to be not discharged directly to the atmosphere, but absorbed in water.

4.3.6 Condenser

Independent piping for discharge of cooling sea water for the condenser is to be used. The piping is to be led directly overboard without passing through accommodation spaces.

4.4 Refrigerating Machinery Compartment

4.4.1 Construction and Arrangement

- 1 The compartment where the refrigerating machinery and storage vessels are installed (hereinafter referred to as refrigerating machinery compartment) is to be a special compartment isolated by gastight bulkheads and decks from all other compartments so that leaked ammonia does not enter other compartments. The refrigerating machinery compartment is to be provided with access doors which comply with the following requirements:
- (1) At least two access doors are to be provided in the refrigerating machinery compartment as far apart as possible from each other. At least one access door is to

QCVN 59: 2013/BGTVT

lead directly to the weather deck. However, if it is not possible to provide access door directly to the weather deck, then at least one access is to have air-lock type doors.

- (2) Access doors not leading to weather deck are to be of high tightly and self-closing type.
- (3) Access doors are to be capable of being operated easily and are to open outward.
- 2** The refrigerating machinery compartment is to be not adjacent to accommodation spaces, hospital room or control room.
- 3** Passages leading to the refrigerating machinery compartment are to comply with the following requirements:
 - (1) If a passage is adjacent to accommodation spaces, hospital room or control room, it is to be isolated by gastight bulkheads and decks.
 - (2) The passage is to be isolated from passages to accommodation spaces, and led directly to the weather deck.
- 4** Penetrations on gastight bulkheads and decks where cables and piping from the refrigerating machinery compartment pass through, are to be of gastight construction.
- 5** Drain pans of adequate size are to be provided at a position which is lower than the refrigerating machinery and storage vessels in the refrigerating machinery compartment so that liquid ammonia does not leak outside the compartment.
- 6** An independent drainage system is to be provided in the refrigerating machinery compartment so that the drainage of this compartment is not discharged into open bilge wells or bilge ways of other compartments.

4.5 Gas Expulsion System

4.5.1 General

A gas expulsion system consisting of ventilation system, gas absorption system, water screening system, and gas absorption water tanks is to be installed in the refrigerating machinery compartment so that the gas leaked out accidentally can be expelled quickly from the refrigerating machinery compartment.

4.5.2 Ventilation System

- 1** A mechanical ventilation system, which complies with the following requirements as a rule, is to be installed in the refrigerating machinery compartment so that this space can be ventilated all the time.
 - (1) The ventilation system is to have adequate capacity to ensure at least 30 air changes per hour in the refrigerating machinery compartment.
 - (2) The ventilation system is to be independent of other ventilation systems on board the ship, and is to be capable of being operated from outside the refrigerating machinery compartment.
 - (3) Exhaust outlets are to be installed at a horizontal distance of more than 10 m from the nearest air intake opening, openings of accommodation spaces, service spaces and control stations, and at a vertical distance of more than 4 m from the weather decks.

- (4) The air intake opening is to be provided at a low position and the exhaust opening is to be provided at a high position in the refrigerating machinery compartment so that the gas does not accumulate in the compartment and the exhaust ducts.
- (5) Exhaust fans and the exhaust ducts in which the fans are installed, are to be of a construction such that sparks are not generated according to any of the (a) to (c) mentioned below.
 - (a) Either the impeller or the casing, or both, are made of non-electrostatic, non-metallic materials.
 - (b) Non-ferrous metallic material is used in the impeller and the casing
 - (c) In case where ferrous material is used in the impeller and the casing, the tip clearance is greater than 13 mm. However, use of a combination of aluminium or magnesium alloy with ferrous materials has possibilities of generating sparks regardless of the tip clearance, therefore, such materials are not to be used in the refrigerating machinery compartment. As a rule, motors for driving the fans are to be of the exterior mount type.

2 Independent ventilation systems are to be installed in passages leading to the refrigerating machinery compartment. However, if the ventilation system specified in -1 above is provided with ducts so that it can be used for exhausting air in the passages, then an independent ventilation system need not be installed.

4.5.3 Gas Absorption System

1 A gas absorption system satisfying any of the requirements given below, capable of excluding leaked gases quickly from the refrigerating machinery compartment, and capable of being operated from outside the compartment, is to be installed.

(1) Scrubber

- (a) The scrubber is to be designed with an adequate processing capacity which restricts the gas concentration at the exhaust fan to well below 25 ppm, and absorbs ammonia in the largest receiver within 30 minutes.
- (b) The pump for the scrubber is to start automatically when the gas concentration in the refrigerating machinery compartment exceeds 300 ppm.

(2) Water sprinkler system

- (a) The quantity of sprinkled water is to be such that the leaked gas can be satisfactorily absorbed.
- (b) Nozzles are to be of type approved by VR. As a rule, nozzles are to be positioned so that their range covers all the refrigerating machinery in the compartment.
- (c) When the gas concentration in the refrigerating machinery compartment exceeds 300 ppm, the pump for sprinkling water is to start automatically.

4.5.4 All Water Screening System

All doors of the refrigerating machinery compartment are to be provided with water screening system which can be operated from outside the compartment.

4.5.5 Gas Absorption Water Tanks

QCVN 59: 2013/BGTVT

- 1** Gas absorption water tanks complying with the requirements given below, are to be installed at a position lower than the refrigerating machinery compartment so that the leaked liquid ammonia can be recovered quickly.
 - (1) The tank is to have such a capacity that the water which can absorb the refrigerant filled in at least one refrigerating machinery can be fully recovered.
 - (2) An automatic water supply system is to be installed in the tank so that the fully-filled condition of the tank is always maintained.
 - (3) Overflow from the tank is to be diluted or neutralized and then discharged overboard directly, without leading the discharge pipes through accommodation spaces.
 - (4) Means are to be provided in the tank to recover the drain of the liquid ammonia generated in the refrigerating machinery compartment. An appropriate drain cup is to be provided to prevent reverse flow of the gas from the tank.
 - (5) All the vent pipe of the tank is to be connected to the exhaust pipe of the ventilation system of 4.5.2.

4.6 Gas Detection and Alarm System

4.6.1 Installation Requirements

- 1** Gas detection and alarm systems are to be provided in the refrigerating machinery compartment complying with the following requirements:
 - (1) At least one gas detector complying with the requirements given below, is to be installed above each refrigerating machinery:
 - (a) The detectors are to activate an alarm when the gas concentration exceeds 25 ppm.
 - (b) When the gas concentration exceeds 300 ppm, the detector is to automatically stop the refrigerating machinery, automatically activate the gas expulsion, and activate the alarm.
 - (2) An adequate number of flammable gas detectors are to be provided so that when the gas concentration reaches up to 4.5%, the power supply to the electrical equipment in the refrigerating machinery compartment is cut off and the alarm systems are activated.
 - (3) The alarm systems are to generate visible and audible alarms near the doors, within and outside the refrigerating machinery compartment and at monitoring locations.
 - (4) A manually-operated transmitter for leakage warnings is to be provided, near the doors and outside the refrigerating machinery compartment.
- 2** Gas detection and alarm system complying with the following requirements are to be provided in passages leading to the refrigerating machinery compartment:
 - (1) The gas detectors are to activate the alarm system when the gas concentration exceeds 25 ppm.
 - (2) The alarm systems are to generate visible and audible alarms in the passage and near the doors of the refrigerating machinery compartment.
- 3** Detectors are to be capable of continuous detection and considered to be appropriate by VR.

4.7 Electrical Equipment

4.7.1 General

- 1 Electrical equipment in the refrigerating machinery compartment required to be operated in the event of leakage accidents, gas detection and alarm system, and emergency lights are to be of certified safety types for use in the flammable atmosphere concerned.
- 2 Electrical equipment in the refrigerating machinery compartment other than mentioned in - 1 above, are required to switch off automatically, by means of circuit breakers installed outside the refrigerating machinery compartment when the flammable gas detector specified in 4.6.1-1(2) activates.
- 3 If a water sprinkler system is installed in the refrigerating machinery compartment as the gas absorption system, all electrical machinery and equipment in the refrigerating machinery compartment are to be of the waterproof type.

4.8 Safety and Protective Equipment

4.8.1 General

- 1 As a rule, safety and protective equipment as given below are to be provided, and are to be stored at locations outside the refrigerating machinery compartment so that they can be easily retrieved in the event of leakage of the refrigerant. Storage locations are to be marked with signs so that they can be identified easily.
 - (1) Protective clothing (helmet, safety boots, gloves, etc.) (2 sets);
 - (2) Self-contained breathing apparatus (capable of functioning for at least 30 minutes) (2 sets);
 - (3) Protective goggles (2 sets);
 - (4) Eye washer (1 set);
 - (5) Boric acid;
 - (6) Emergency electric torch (2 sets);
 - (7) Electric insulation resistance meter (1 set).

CHAPTER 5 REFRIGERATED CHAMBERS

5.1 Construction of Refrigerated Chambers

5.1.1 Materials used for Refrigerated Chambers

Decks, floors and boundary bulkheads of refrigerated chambers are to be constructed of materials confirmed to be airtight. However, divisional bulkheads between refrigerated chambers, where the chambers concerned are intended for cargo which will not taint or adversely affect the cargo in any other chamber, may be constructed of appropriate materials subject to the approval of VR.

5.1.2 Airtightness of Closing Appliances

Closing appliances such as hatch covers, access doors, bilge and manhole covers forming part of the insulated envelope of independently refrigerated chambers, are to be made airtight. Where hatch covers or plugs are exposed to the ambient conditions, they are to be provided with a double seal.

5.1.3 Welding and Materials of Steelworks in Refrigerated Chambers

Special attention is to be paid to welding and materials of members which are directly welded to the main structural hull members, and structural discontinuities and/or defects in welded joint are to be avoided.

5.1.4 Coamings of Manholes, etc.

Tank top insulation in way of manholes and bilge hats is to be provided with a liquidtight coaming with a suitable height to prevent seepage into the insulation.

5.1.5 Penetration of Ventilation Ducts and Pipes through Decks, Bulkheads, etc.

- 1 Ventilation ducts are not to pass through the collision bulkheads below the freeboard deck. Ducts passing through the other watertight bulkheads are to be provided with an efficient closing appliance which can be operated from a position above the freeboard deck accessible at all times. In the operating position, an indicator is to be provided to show whether the duct is opened or closed.
- 2 Refrigerating pipes passing through bulkheads or decks of refrigerated chambers are not to be in direct contact with the steelwork. Airtightness of the bulkheads or decks is to be maintained. Where these pipes pass through deck plating or watertight bulkheads, the fittings and packing of the glands are to be both fireresisting and watertight.
- 3 Ventilators, air ducts or pipes passing through refrigerated chambers to other compartments are to be made airtight in way of penetrating parts of insulation, and they are to be effectively insulated in the refrigerated chamber.
- 4 Air pipes, sounding pipes, bilge suction pipes and other pipes led from the outside of refrigerated chambers and passing through refrigerated chambers are to be effectively insulated and special consideration is to be given to the arrangement of these pipe lines to prevent freezing of liquid in these pipes.

5.1.6 Insulating Linings, etc.

Insulation linings, bilge limbers and their covers, hatch covers and access doors to refrigerated chambers are to be constructed of water-vapour-resisting material or covered with such material.

5.1.7 Cargo Battens

Cargo battens are to be fitted and so arranged on all vertical walls of refrigerated chambers as to provide sufficient space for air circulation and prevent the cargo from coming to contact with the insulation or cooling grids. However, where the form of insulation lining, storage method of cargo, etc. are adequate, and need not provided battens, they may not be required.

5.1.8 Gratings

Gratings of suitable form and strength are to be provided on floors of refrigerated chambers so as to provide sufficient space between floors and cargo for free air circulation and prevent the floor insulation from mechanical damage by cargo handling. However, where the floor insulation lining meets the above requirements or cargoes to be loaded are suspended or supported on suitable pallets, gratings are not required.

5.2 Insulation and Insulation Materials

5.2.1 Insulation Materials

- 1 Insulation materials approved or accepted by VR are to be used.
- 2 If slab formed insulant is used, it is to have suitable strength. Where a binder is used to join slabs each other, it is to be odourless and not to absorb any of the odours from the cargo.

5.2.2 Protective Coatings

- 1 Steelworks to be insulated are to be thoroughly cleaned and coated with an anti-corrosive composition before they are insulated.
- 2 All steel bolts, nuts and other fixtures which support or secure insulation materials, joints, coverings, etc. are to be galvanized or protected against corrosion with suitable means.

5.2.3 Insulation

- 1 The thickness of insulation over all surfaces and the manner in which it is supported are to be in accordance with the approved specification and plans. The insulation is to be strongly fixed so as not to be loose. Where the insulation is of slab form, the joints are to be butted closely together and staggered. Unavoidable crevices are to be filled with suitable insulating material.
- 2 Structural members which extend into refrigerated chambers are to be effectively insulated over a sufficient length in the refrigerated chambers to prevent heat penetration into the chambers and super-cooling of each member at the place of penetration.

5.2.4 Removal of Insulation

- 1 The insulation of such places that easy access to bilges, bilge suction roses and tank manhole lids is required is to be of plug type and removable.

QCVN 59: 2013/BGTVT

- 2 The insulation in way of bilge suction pipes, air and sounding pipes and other pipe lines is to be removable to the extent necessary for access for inspection.

5.2.5 Insulation of Oil Tank Plating

Where the tank top and bulkhead of the oil storage tank form part of the refrigerated chamber walls, air space of sufficient width is to be provided between the tank plating and the insulation, or the surface of the tank plating is to be coated with an approved oil-proof and oil-tight composition of sufficient thickness, before the insulation is fitted. Where air space is provided between the tank plating and the insulation, free drainage of oil seepage to the gutter way and bilges is to be ensured. Furthermore, such air spaces are to be provided with ventilating pipes led to the open air, and corrosion resisting metallic wire gauze diaphragms are to be fitted at the outlet.

5.3 Temperature Measuring Arrangements

5.3.1 Number of Thermometers and Sensors

- 1 Two sets of thermometers are to be provided in each refrigerated chamber. At least two sensors are to be connected to each set of thermometer for each chamber.
- 2 Unless otherwise required, at least the following number of sensors are to be provided in each chamber, depending upon the volume of the chamber.
 - (1) Volume up to 300 m³: 4;
 - (2) Volume up to 600 m³: 5;
 - (3) Volume above 600 m³: 5 plus one for each 400 m³ or fraction thereof.
- 3 In addition to those specified in -2, one sensor is to be fitted in each main stream of air in the suction and delivery sides of each air cooler.

5.3.2 Electric Thermometers

- 1 Electric power supply to each instrument in refrigerated chambers is to be fed by a separate final sub-circuit.
- 2 Sensors connected to thermometers in refrigerated chambers are to be properly protected from mechanical damage.
- 3 The readings of thermometers in refrigerated chambers are to be accurate to the true temperature within ± 0.5 °C in the range of below 0 °C, and ± 0.3 °C in the range of 0 °C and above.

5.4 Drainage Arrangements

5.4.1 General

- 1 Drainage arrangements are to be in accordance with the relevant requirements in 13.5 Part 3, Section II of QCVN 21: 2010/BGTVT in addition to the requirements in this section.
- 2 All refrigerated chambers and air coolers are to have ample continuous drainage.
- 3 Compartments outside the refrigerated chambers are not to drain into the refrigerated chambers.

5.4.2 Non-return Valves and Sealed Traps in Scupper Pipes

- 1** Scupper pipes led from refrigerated chambers and air cooler trays are to be provided with non-return valves and liquid sealed traps. However, the pipes led from between deck chambers and air cooler trays above the tank top may be provided with only sealed traps.
- 2** Where scupper pipes from refrigerated chambers and air cooler trays are connected to a common header, each branch pipe is to be provided with a liquid sealed trap, and those from lower hold spaces are to be fitted, in addition, with non-return valves.
- 3** Where the chamber temperature contemplated is 0 °C or below, scupper pipes together with non-return valves and liquid sealed traps specified in -1 and -2 are, if necessary, to be well insulated.
- 4** Liquid sealed traps are to have an adequate depth and arranged so as to be accessible for cleaning and refilling with liquid.

CHAPTER 6 TESTS

6.1 Tests at the Manufacturer's Works

6.1.1 Pressure Tests and Leak Tests

- 1 Machinery components, pressure vessels and pressure piping exposed to a primary refrigerant pressure are to be subjected to hydrostatic tests to a pressure of 1.5 times the design pressure. After hydrostatic tests, they are to be leak tested to a pressure equal to the design pressure.
- 2 Machinery components, pressure vessels and pressure piping intended for use with brine are to be subjected to hydrostatic tests to a pressure of 1.5 times the design pressure or 0.4 MPa whichever is the greater.
- 3 In general, pressure tests are to be carried out with water or oil and leak tests are to be carried out with air or suitable inert gases or any inert gas with a small amount of the refrigerant added to it.

6.1.2 Performance Tests

- 1 Compressors, fans, primary refrigerant or brine pumps and their prime movers are to be tested for their performance.
- 2 Welded parts in pressure vessels and piping are to be tested in accordance with the relevant requirements in Chapter 11, Part 4, Section II of QCVN 21: 2010/BGTVT.
- 3 Electrical equipment is to be tested in accordance with the requirements in Chapter 2, Part 4, Section II of QCVN 21: 2010/BGTVT.

6.2 Tests during Construction

6.2.1 Leak Tests

- 1 The primary refrigerant system is to be leak tested after the piping arrangement is completed on board the ship, generally with inert gases or inert gases with a small amount of refrigerant added, to a pressure of 90% of the respective design pressures.
- 2 The brine system is to be leak tested after the piping arrangement is completed on board the ship to a pressure of 1.5 times the maximum working pressure of the brine pump or 0.4 MPa whichever is the greater.

6.2.2 Calibration of Thermometers

Thermometers are to be checked for accuracy at the freezing point of water, after they are set up on board the ship, and their accuracy is to comply with the required specification. The records of checking are to be submitted to the Surveyor.

6.2.3 Air Circulation Tests

Where air circulating fans are provided in refrigerated chambers, it is to be ascertained that the velocity of circulating air and the state of air circulation are satisfactory.

6.2.4 Functional Tests

Automatic control devices, safety devices and alarms are to be ascertained that they operate satisfactorily.

6.2.5 Tests under Operating Condition

All components of the refrigerating machinery are to be operated under full load condition as far as possible, and be proved that there is no defect on the installation, and changing over to stand-by units is smooth. This test may be carried out in the cooling down stage at the heat balance test specified in 6.2.6.

6.2.6 Heat Balance Tests

- 1 Heat balance tests are to be carried out in the way specified in the following (1) to (4), in order to measure the mean heat leakage from the insulation of refrigerated chambers:
 - (1) The chambers are to be cooled down step by step to a temperature lower than at least 20 °C from the atmospheric temperature. Further, cooling is to be continued until the chamber temperature can be maintained substantially constant without any adjustment of the output of the machinery or with regular on-off operation of the working compressors.
 - (2) After the stabilization stated above has been obtained, necessary measurements are to be taken once an hour for at least six hours, keeping the chamber temperature substantially constant.
 - (3) It is to be ascertained that the heat leakage obtained by this test is not more than the designed value calculated from the refrigerating capacity with reasonable redundancy, and the test was properly carried out. The measuring records are to be submitted to the Surveyor.
 - (4) Where the chamber temperature at the thermal balance test is higher than the specified temperature, the chamber is to be cooled down to the specified temperature and keep the condition for not less than two hours. During the period it is to be ascertained that the operation of the whole installation is smooth and satisfactory.

6.2.7 Defrosting Tests

The defrosting arrangement for air coolers are to be tested for satisfactory operation.

CHAPTER 7 LOADING PORT SURVEYS

7.1 General

7.1.1 General

- 1 At the request of the shipowner or his representative, the Surveyor may carry out Loading Port Surveys on a registered refrigerating installation at a loading port in accordance with the requirements in 7.1.2. On completion of the survey to the satisfaction of the Surveyor, Certificate on Loading Port Survey will be issued.
- 2 A Loading Port Survey may be carried out concurrently with other surveys of the refrigerating installations such as Annual Surveys.
- 3 If there is no Surveyor to VR at the loading port(s), VR will accept the report of a survey, except the case mentioned in -2, held at the loading port by a reliable competent person as considered appropriate by VR, provided that all requirements of Loading Port Surveys are fulfilled.

7.1.2 Items to be Examined

- 1 At the Loading Port Survey, the following items are to be confirmed or examined:
 - (1) The refrigerating installation is to be examined under working condition to confirm that it operates in good order, and the temperatures at that time in the refrigerated chambers are to be noted.
 - (2) The Surveyor is to ascertain that there is ample generating capacity available for the ship's essential services and maximum required power to the refrigerating installation, even when one generator is out of use. Where the electric power source is also used as the ship's main power supply, it is to be ascertained that the chamber temperature can be maintained at the specified value with the remaining generators used.
 - (3) The refrigerated chambers are to be examined in an empty state to ascertain that:
 - (a) They are clean and free from odour which may adversely affect the cargo to be loaded.
 - (b) Brine or refrigerant pipe grids, coils of air coolers and connections are free from leakage.
 - (c) Cargo battens, where fitted to the vertical walls, are in good order.
 - (d) Cargo gratings or dunnages are available as necessary for the floors or decks.
 - (e) There is no damage sustained to the insulation or its linings in the refrigerated cargo holds.
 - (f) All scuppers and bilge suctions for draining the refrigerated cargo holds are in good working order, and water sealed traps are provided.

III REGULATIONS ON MANAGEMENT

1.1 General

1.1.1 Additional class notation

- 1 If ship has refrigerating installations complying with requirements in this Regulation (excluding the installations referred to the following -2), an additional notation "RMC" is affixed to the characters of classification as specified in Chapter 2 Part 1A Section II QCVN 21: 2010/BGTVT.
- 2 If ship has refrigerating installations equipped with controlled atmosphere systems to be registered in accordance with the Regulation, an additional notation "RMC.CA" is affixed to the characters of classification as specified in Chapter 2 Part 1A QCVN 21: 2010/BGTVT.

1.1.2 Installation Notations

- 1 In General, Installation Characters will be followed by the minimum temperature(s) in the refrigerated chambers to be maintained with sea temperature maximum.
e.g.: -25 °C/ 32 °C for No. A, B and C Chambers and -15 °C/ 32 °C for No. D and E Chambers.
Note: -25 °C or -15 °C indicates the minimum chamber temperatures to be maintained and 32 °C is the maximum sea temperature.
- 2 When an installation is provided with any additional equipment to suit for carriage of special cargoes or quick freezers for the catch in fishing vessels, appropriate notations will be added to the Installation Character upon application of the Owner.
e.g.: Equipped for carriage of fruit;
Equipped with quick freezers.
- 3 When an installation is provided with the fixed N₂ generator as a part of controlled atmosphere system, the Installation Notation will be affixed as follows:
E.g.: Equipped with fixed N₂ generator.
- 4 When controlled atmosphere systems are installed for the certain holds only, appropriate notations will be affixed as follows.
E.g.: Equipped for No. F and G Holds.
- 5 When VR considers necessary to distinguish and special features or usage limitation of the installation, other appropriate notations than those described in -1 to -4 will be affixed to the Installation Character.

1.2 Regulations on technical supervisions

Cargo refrigerating systems are to be surveyed to the extent prescribed in Chapter 2 Section II of the Regulation.

1.3 Certification

1.3.1 Certificate

QCVN 59: 2013/BGTVT

If the system complies with this Regulation, that system will be issued a certificate of design approval or a classification certificate together with the ship depending on particular demand.

1.3.2 Procedure for certification

Procedure for certification is to be in accordance with Circular No. 32/2011/TT-BGTVT.

IV RESPONSIBILITIES OF ORGANIZATIONS, INDIVIDUALS

1.1 Responsibilities of ship owners and operators, agency of design, manufacturing, converting, renovating and repairing the systems

1.1.1 Ship owners and Operators

To implement all relevant requirements in this Regulation for the system in manufacturing, converting, renovating, operating in order to ascertain and maintain good technical condition of the systems.

1.1.2 Design company

- 1 To design the system in compliance with requirements of the Regulation.
- 2 To submit all required design documentation in accordance with requirements in the Regulation.

1.1.3 Yards of manufacturing, converting, renovating and repairing the systems

- 1 To be capable in terms of warehouse, manufacturing shop, building facilities etc. and competent manpower to meet requirement for new manufacture, conversions, renovations and repairs of the systems.
- 2 To comply with standards of quality, safety while manufacturing, converting, renovating and repairing the systems and to comply with approved design.
- 3 To undergo VR's supervision on the technical quality and safety of the systems.

1.2 Responsibilities of Vietnam Register

1.2.1 Design approval, technical supervision

To assign surveyors having competence and of sufficient standard to carry out the technical supervision during manufacture, conversions, renovations, repairs and operation of the systems in accordance with technical requirements specified in this Regulation.

1.2.2 To give instructions for implementation/application

To give instructions for the application of requirements of this Regulation to ship owners and operators, yards of manufacture, conversions, renovations and repair of the systems, inspection offices of Vietnam Register throughout the country.

1.2.3 To amend and supplement the Regulation

Based on the fact, Vietnam Register is to have responsibility to petition the Ministry of Transport for amendment, supplementation of the Regulation where necessary or on schedule specified in the Law of Standards and Technical Regulations.

1.3 Responsibilities of the Ministry of Transport

The Ministry of Transport (Science and Technology department) is responsible for verifying on the regular or random basis the implementation of this Regulation by relating organizations.

V IMPLEMENTATION

- 1.1** It is the responsibility of Vietnam Register to manage the survey system, technical supervision, classification and technical registration of cargo refrigerating systems on sea-going ships. It is also to include organizing the printing, dissemination and instructions for the application of this Regulation for organizations and individuals falling within the scope of this Regulation.
- 1.2** In case of inconsistency between the requirements in this Regulation and those in other rules, standards or technical regulations relating to cargo refrigerating systems, the requirements of this Regulation are to prevail over those of others.
- 1.3** In case the documents referred to in this Regulation are amended, supplemented or replaced, the latter is to prevail over the former.
- 1.4** This Regulation and its amendment are to apply to cargo refrigerating systems registered on or after effective date of this Regulation.