TÜRK LOYDU

CARRIAGE of REFRIGERATED CONTAINERS on SHIPS JANUARY 2025

This latest edition incorporates all rule changes. The latest revisions are shown with a vertical line. The section title is framed if the section is revised completely. Changes after the publication of the rule are written in red colour.

Unless otherwise specified, these Rules apply to ships for which the date of contract for construction as defined in IACS PR 29 is on or after 1st of January 2025. New rules or amendments entering into force after the date of contract for construction are to be applied if required by those rules. See Rule Change Notices on **TL** website for details.

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SECTION 1

CARRIAGE of REFRIGERATED CONTAINERS on SHIPS

A. Scope

1. These Guidelines apply to container ships with the Class Notation **RCP x/y** (Refrigerated Container Stowage Positions).

2. The requirements are additional to those of Chapter 1 – Hull, Sections 1 to 22. They apply to the stowage of refrigerated containers both on deck and in container holds.

3. These guidelines imply that the container refrigeration units carried on board are fully functional at ambient temperatures up to 50 °C.

4. It is assumed that the refrigerated containers are generally at their predetermined carrying temperature at the time the containers are taken on board.

B. Class Notation, Certificate Records

This Class Notation will be affixed to the Character of Classification for the machinery and will be assigned upon approval of the design and satisfactory testing upon completion.

The Class Notation **RCP** is supplemented by two figures the first of which stands for the number of certified refrigerated container stowage positions and the second figure for the percentage of containers carrying fruit / chilled cargoes.

For example; ..... RCP 480/30

means, that the ship is designed for the simultaneous carriage of 480 refrigerated containers arranged on deck and/or in container holds, thereof a maximum of 30% may be loaded with fruit / chilled cargoes.

The designated number of refrigerated containers is related to FEU (forty foot equivalent units). Details concerning container size, stowage positions and special conditions will be stipulated in the annex to the Certificate of Class.

C. Novel Arrangements and Design

1. Arrangements differing in design from those which have already been proved suitable in service on board ships are subject to **TL**'s approval. Such plants/arrangements may require special requirements in terms of documentation to be submitted for approval and scope of testing.

2. In case this Class Notation is applied for ships other than container ships it will be given special consideration.

D. Documents for Approval

The following additional documents are to be submitted to **TL** for approval:

1. General arrangement plan showing all refrigerated container stowage positions for designated container sizes for information.

2. Cargo hold and weather deck ventilation system showing the air ducting and the air distribution system, details of air inlets and outlets including type, size and location, details of mechanical ventilation fans including duty point at design conditions, details showing the means provided against water ingress.

3. Diagrammatic plan of cooling water systems used for container refrigeration units equipped with water-cooled condensers.

4. Calculation of electric power demand (see Chapter 5- Electric, Section 3, A.) covering all refrigerated containers and the necessary fans for the container holds according to E. 4.

5. Details concerning power supply for container sockets and fans for the container hold including monitoring and alarms.

6. Access arrangement plan detailing access to container holds and containers for monitoring/repair (See E.3).

7. Test Procedure for trials including inspection and testing (See F) for information.

E. Technical Requirements

1. Heat dissipation from container holds by means of air ventilation systems

1.1 General criteria

Container hold ventilation systems are to be determined by the size and type of refrigerated containers and the type of cargo envisaged to be carried.

Unless otherwise agreed, the capacity of supply air is to be calculated for unrestricted service range of the vessel at following conditions:

- ambient air condition : 35ºC, RH%70
- max.air temperature in container holds: 45ºC
- max. seawater temperature:: 32ºC

1.1.1 Air supply to container holds designed for the carriage of refrigerated containers using air-cooled condensers

The following values for supply air may be used as a guidance:

3100 m³/h per 20 ft refrigerated container
4500 m³/h per 40ft refrigerated container

Alternatively, the supply air capacity to container holds may be calculated by applying the formula given below. A simultaneous factor shall not be applied.

$$V_{\text{supply air}} = (P_{el.cont.} + Q_{\text{resp}} + P_{\text{fans}}) \cdot \frac{V_{\text{air}}}{h_{45} - h_{35}}$$

= calculated supply air capacity per container stowage position in container hold [m³/s]

$P_{el.cont.}$ = power demand per refrigerated container depending on cargo mix, see Fig. A.1 and A.2 [kW]

Q_{resp} = respiration heat of fruit cargoes per container [kW]

P_{fans} = power demand of cargo hold supply air fans per container [kW]

V_{air} = specific volume of air at inlet condition [m³/kg]

h_{45}-h_{35} = enthalpy difference [kJ/kg]

An example of calculation supply air capacities to cargo holds is given in Annex B.

1.1.2 Air supply to container holds designed for the carriage of refrigerated containers using water-cooled condensers

The calculation of air supply to container holds shall be based on the following heat emission values:

– 1,5 kW per 20' refrigerated container
– 2,1 kW per 40' refrigerated container

Unless otherwise agreed, at least 8% of the container refrigeration units shall be considered to operate without water cooling.

The following values for air supply may be used as a guidance:

– 460 m3/h per 20' refrigerated container
– 700 m3/h per 40' refrigerated container

1.2 Air ducting and air distribution

1.2.1 Air ducting and air distribution systems are to be so designed as to ensure heat dissipation from the refrigerated containers regardless of the loaded condition. Hot spots are to be avoided.

1.2.2 Dedicated supply air ducts and fans shall be arranged for each container stack. In case of the outermost stacks, one supply air duct and fan may serve supply air to the outermost two or three stacks. The number of refrigerated containers served by one supply air fan shall not exceed 16.

For the design case specified in 1.1.2 (water cooled condencers), the container hold ventilation system may be reduced to two air ducts with fans and with supply air outlets arranged in the lower part of the container hold.

1.2.3 Supply air in container holds shall be directed to the lower part (1/3 height) of each container refrigeration unit. For the design case specified in 1.1.2

(water cooled condencers) air distribution individual to each container need not be provided.

1.2.4 Where container holds are designed for the simultaneous stowage of 8,5' and 9,5' containers the supply air outlets in holds are to be provided with adjustable openings to direct supply air to the lower part of the container refrigeration units independent of the stowage pattern.

1.2.5 Consideration is to be given to minimise the air flow resistance between container refrigeration units and exhaust air outlets of container holds. Restrictions of air flow caused by walkways etc. shall be kept to a minimum.

1.2.6 Arrangements to permit rapid shutdown and closure of the ventilation system shall be provided for each cargo hold in case of fire.

1.3 Air inlets and outlets on deck

1.3.1 Air inlets and air outlets of cargo hold ventilation systems are to be arranged such that heat dissipation from container holds is ensured even in heavy weather. Where supply air inlets are required to be provided with weather-tight closures in accordance with **ILLC 66/88**, suitable means shall be provided against water ingress such as water traps or droplet separators. Alternative arrangements may be agreed with **TL**, e.g. arrangements in locations protected against green water.

1.3.2 The positions of air inlets and air outlets are to be such as to prevent short-circuiting of air. Heat ingress from the deck stowed containers into the cargo hold as well as the effect of warm exhaust air on deck stowed containers shall be considered.

1.3.3 The total cross sectional area of exhaust air outlets is to be designed such that the air velocity does not exceed 10 m/s. Air velocities up to 13 m/s may be accepted in case suitable arrangements are provided for access doors to container holds to allow safe handling under any excess pressure condition inside container holds, e.g. by means of air locks or other suitable arrangements.

1.4 Supply air fans for container holds

1.4.1 Supply air fans shall be capable of being operated simultaneously with the weather-tight covers at the exhaust air outlets on one side closed, i.e. starboard or port side.

1.4.2 Supply air fan motors shall be capable of being replaced with the ship in any loaded condition.

1.4.3 At least one spare supply air fan motor of each type shall be kept available on board.

1.5 Heat dissipation from refrigerated containers stowed on deck

1.5.1 Heat dissipation by means of natural air convection is considered sufficient for the first and the second tier stowed on deck.

1.5.2 Stowage positions for refrigerated containers arranged on the third tier will be given special consideration.

2. Heat dissipation by means of cooling water systems

2.1 Cooling water systems intended for refrigerated containers equipped with water-cooled condensers

2.1.1 Cooling water pipes, valves and fittings are to meet the Machinery Rules according to Chapter 4, Section 16.

2.1.2 Cooling water systems including temperature control systems shall be so designed that specified temperatures at condenser inlets can be maintained under all operating conditions.

2.1.3 The total rating shall be covered by at least two cooling water pumps each designed for 100% rating and two heat exchangers each designed for a capacity of at least 60% rating.

2.1.4 Shut-off valves are to be provided at the cooling water inlets and outlets of each container hold.

2.1.5 Automatic vents and manual test valves are to be provided at the highest point of cooling water outlet pipes arranged in each container hold. Drains from vents shall be led to the container hold bilge via drain pipes.

2.1.6 Means are to be provided to ensure continuous cooling water flow in the piping systems at part loaded condition, e.g. by suitable by-pass arrangements or speed-variable cooling water pumps.

2.1.7 An expansion tank with automatic replenishing of cooling water from a storage tank is to be provided. Expansion tanks shall be fitted with vents, drains, level indicators as well as low level alarms.

3. Access arrangements

3.1 Access to containers for monitoring / repairs

3.1.1 Suitable access shall be provided to refrigerated containers stowed on deck and in container holds to allow monitoring and repairs including compressor replacement. A minimum width of 600 mm is considered sufficient.

3.1.2 In cargo holds, walkways shall be arranged in front of the container refrigeration units to allow easy monitoring.

3.1.3 On deck, safe means of access shall be provided for refrigerated containers stowed in any elevated tier, e.g. by means of lashing bridges, fixed or mobile platforms.

3.2 Access to container holds

3.2.1 Means shall be provided to allow personnel safe access to container holds taking into consideration the effect of over pressure in container holds. Relief devices or air locks may be required.

4. Electric power supply for refrigerated container sockets and cargo hold fans

In addition to the requirements of Chapter 5 - Electrical Installations and ISO 1496-2 – Electrical aspects of thermal containers, the following is to be complied with:

4.1 Refrigerated container sockets and the fans for corresponding cargo holds shall be considered as secondary essential equipment.

4.2 The power demand for refrigerated containers shall be calculated based on a cargo mix as per Fig. A.3 and A.4.

The percentage in fruit /chilled cargo containers should not be less than 20 % and shall in any case be agreed between ship owner and shipyard. Electrical components provided within sub-distribution systems may be designed for different power demand per FEU/TEU.

In exceptional cases the power demand may be calculated on the basis of ship owner's experiences with specific trades and cargo pattern.

The power demand for the cargo hold ventilation shall be calculated separately.

4.3 If any one of the generators is out of order,the remaining generators shall supply at least seagoing conditions and all certified refrigerated container sockets including cargo hold fans.

4.4 The rating of all generators shall be sufficient to supply the container sockets and the cargo hold fans in addition to the consumers needed under manoeuvring conditions.

4.5 A simultaneous factor for group supply cables for container sockets and for accessory transformers may be agreed in individual cases.

4.6 Sub-distribution boards for container sockets shall be supplied independent of each other to minimise the influence of the cargo in case of a failure.

The number of container sockets connected to one final circuit shall not exceed 10.

4.7 Sub-distribution boards for cargo hold fans shall be supplied independent of each other to minimise the influence of the cargo in case of a failure.

4.8 The electric power supply to refrigerated container sockets should be galvanically isolated from

the ship mains to avoid any influence in case of insulation faults.

4.9 Gradual restarting of refrigerated containers should be possible after blackout dependent on the available electric power and at a central location.

5. Indications, monitoring and alarms

5.1 The power supply to distribution boards for refrigerated containers and cargo hold fans shall be indicated locally**.**

5.2 Ships designed for more than 150 refrigerated container stowage positions shall be equipped with a remote condition monitoring system which is to conform to a recognised standard, e.g. ISO 10368.

5.3 A failure of power supply for refrigerated container circuits and for cargo hold fans shall be alarmed. A common alarm for each distribution board is considered sufficient.

5.4 All alarms shall be displayed locally and in a control station. The alarms shall be integrated within the general ships alarm system. Alarms shall give an audible and visual warning.

F. Testing

Measurements and tests shall be carried out in the presence of the Surveyor.

1. Testing of air duct systems

1.1 Prefabricated air ducts shall be individually tested at the manufacturer's to the following extent:

1.1.1 Measurement of air capacity at the inlet openings.

1.1.2 Measurement of air distribution at the air outlets. The maximum deviation of air flow at each outlet shall be ± 10% of the rated flow..

1.2 Air ducts which form an integral part of the ships hull shall be tested in place. For scope of testing, see 1.1.

2. Inspection and testing on completion

2.1 Measurement of air capacities at all cargo hold exhaust air openings, while respective fans used for the carriage of refrigerated containers run simultaneously. The maximum air velocity measured at the face of the louvers shall be in line with the requirements set out in E.1.3.3. An allowance of maximum 10% may be accepted.

2.2 Verification of unrestricted function of hold ventilation systems with exhaust air outlets closed on one side (starboard or portside), see E.1.4.1.

2.3 Alarm systems described in E.5.3 – E.5.4 with consideration given to electric supply arrangements shall be tested with regard to correct function.

2.4 Cooling water piping systems are to be subjected to a tightness test under operational conditions. Cooling water flow rate at inlet to each refrigerated container stowage position shall be verified by the attending Surveyor.

2.5 Access arrangements shall be verified by the attending Surveyor.

ANNEX A

POWER DEMAND – DIAGRAMS

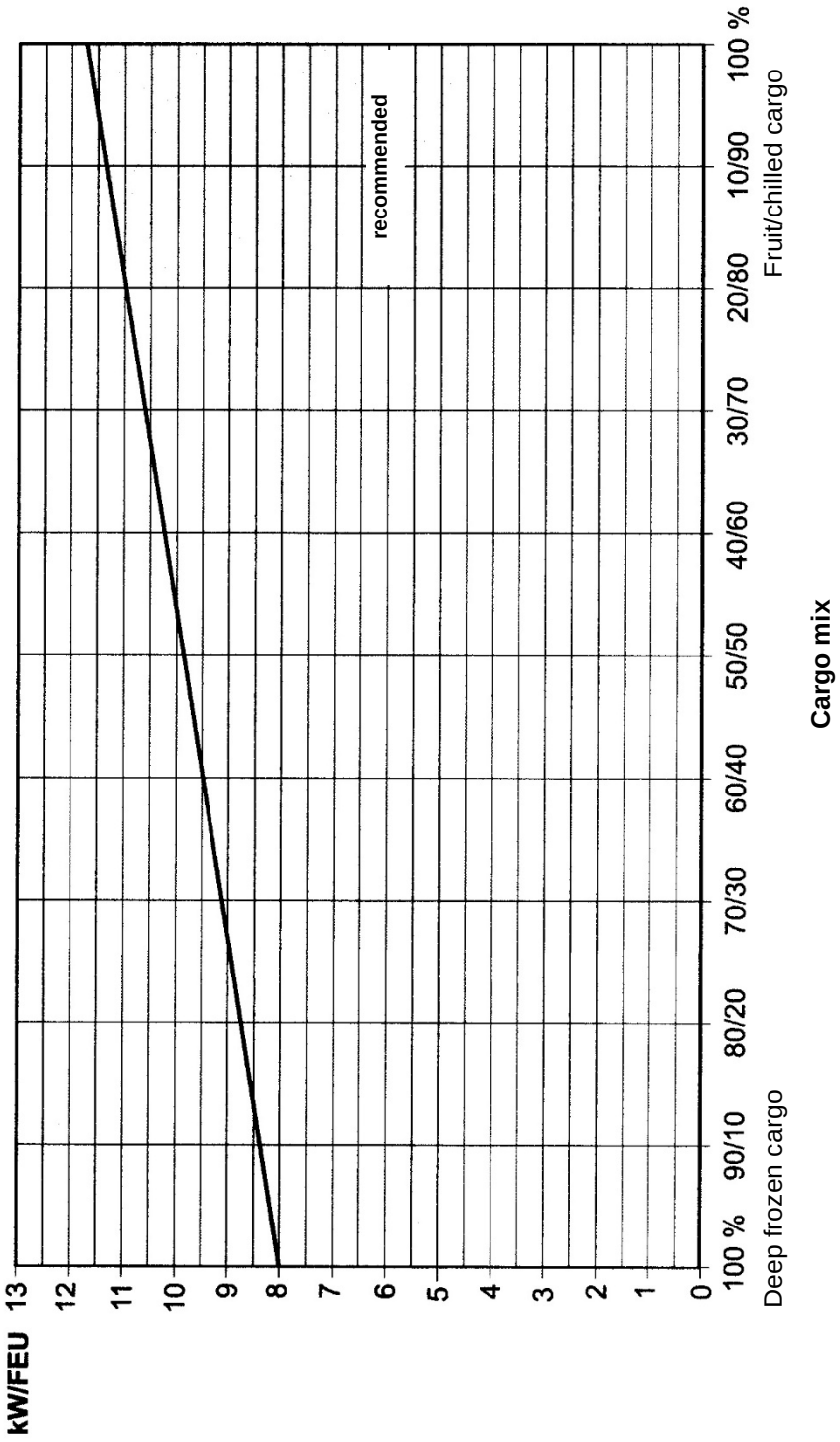

Fig. A.1 Power Demand 40' Reefer Container
Determination of Cargo Hold Ventilation System

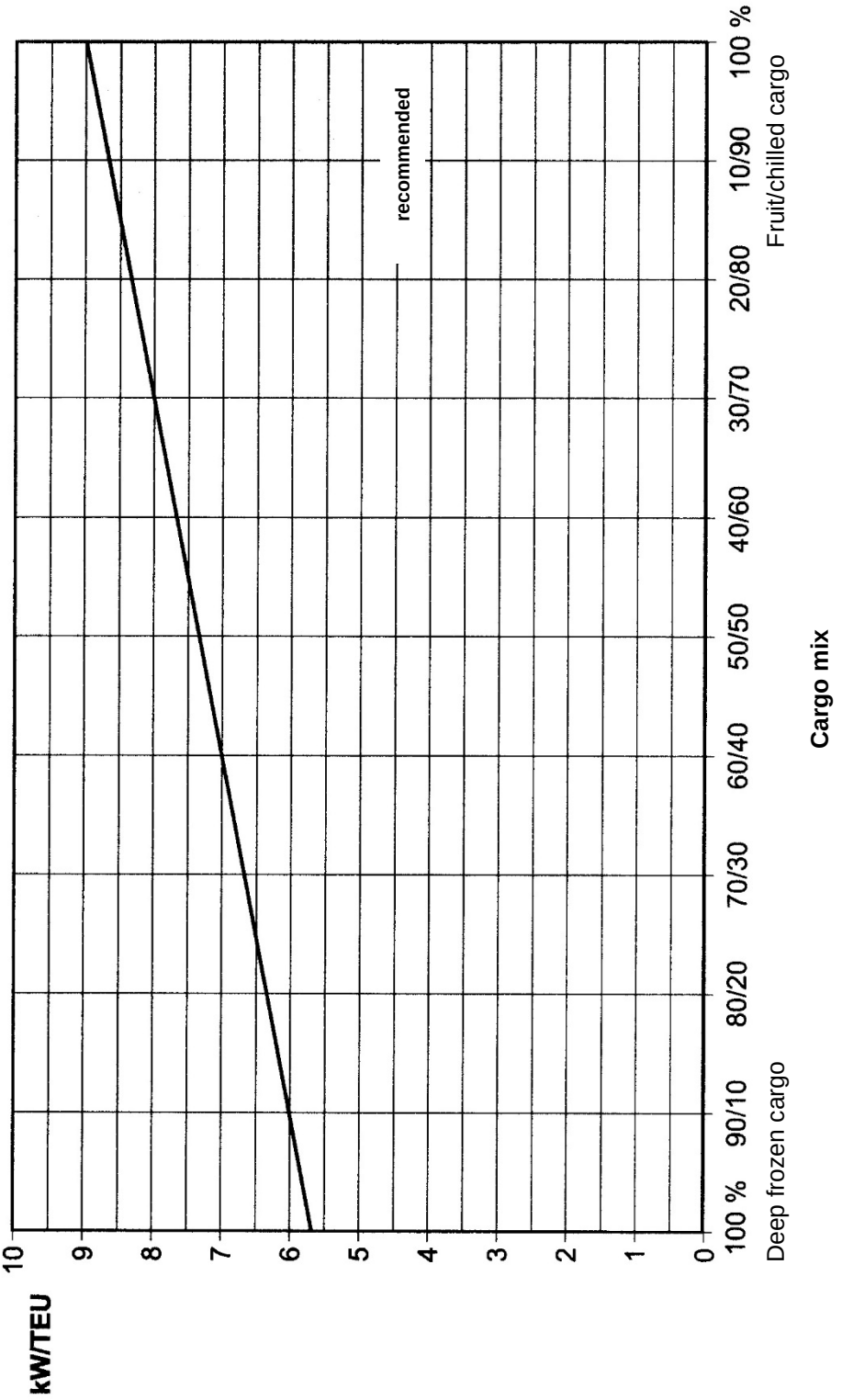

Fig. A.2 Power Demand 20' Reefer Container
Determination of Cargo Hold Ventilation System

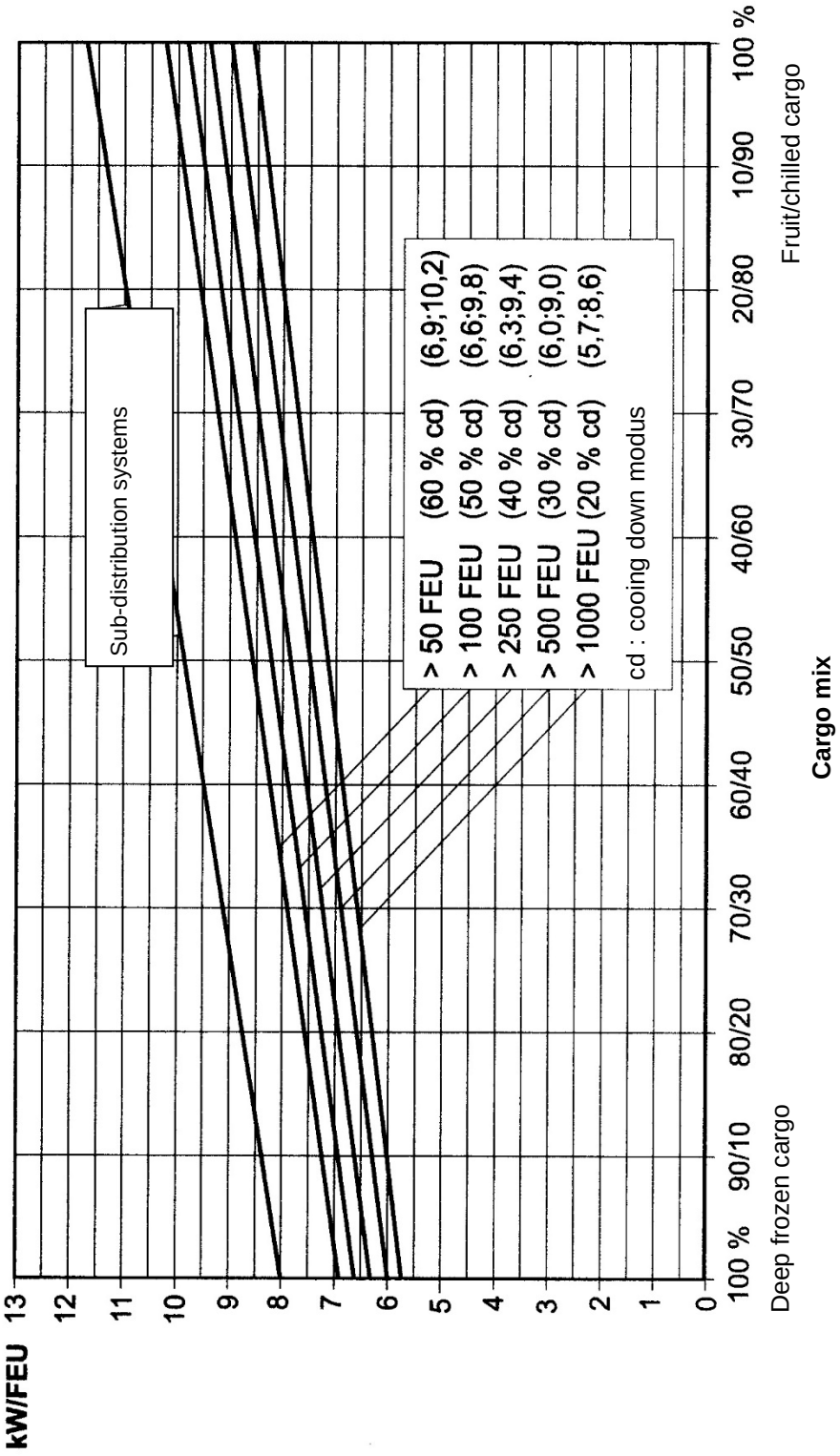

Fig. A.3 Power Demand 40' Reefer Container
Determination of Generator Power and Sub-Distribution System

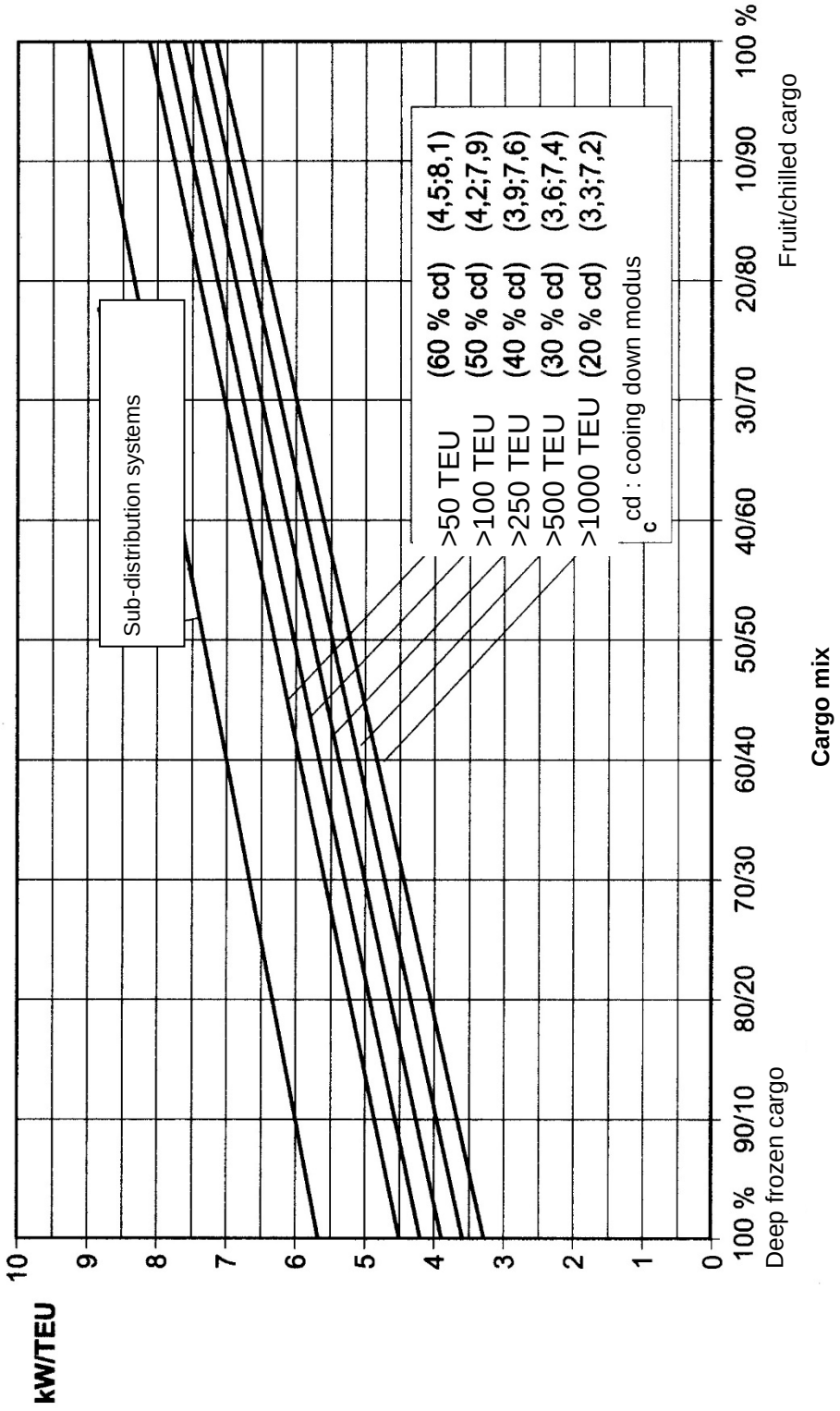

Fig. A.4 Power Demand 20' Reefer Container
Determination of Generator Power and Sub-Distribution System

ANNEX B
EXAMPLE FOR THE CALCULATION OF AIR SUPPLY TO CONTAINER HOLDS

$$V_{\text{supply air}} = (P_{el.cont.} + Q_{\text{resp}} + P_{\text{fans}}) \cdot \frac{V_{\text{air}}}{h_{45} - h_{35}}$$

V_{air}	=	m^3/h	required supply air capacity per 40' container
$P_{el.cont.}$	=	11,0 kW	cargo mix 20% deep frozen / 80% fruits (Fig. A.1)
Q_{resp}	=	1,5 kW	64 W/t, in case of bananas
P_{fans}	=	1,4 kW	based on 4500 m^3/h, 700 Pa, η_{fan} = %75 η_M = %85
V_{air}	=	0,92 m^3/kg	specific volume of air at inlet condition
h_{45}-h_{35}	=	10,3 kJ/kg	enthalpy - difference of exhaust air and inlet air

$$V_{\text{air}} = (11{,}0 + 1{,}5 + 1{,}4) \cdot \frac{0{,}92}{10{,}3} = 1{,}24 \ \frac{m^3}{sn} \cong 4470 \ \frac{m^3}{h} \quad \text{per FEU}$$