FINALIZED DRAFT

AUTOMOTIVE INDUSTRY STANDARD

Constructional and Functional Requirements for Insulated Vehicles

Date of Hosting on website: ………………. 2021
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CHECK LIST FORPREPARING AUTOMOTIVE INDUSTRY STANDARD

AIS-164: Constructional and Functional Requirements for Insulated Vehicles

SR. NO.	PARTICULARS	REMARKS
1	Indicate details of the base reference standard. (eg. UN Regulation / EC Directive/UNGTR etc.)	ATP document on international carriage of perishable food
2	Add an explanatory note indicating differences between the above standard and the draft, if any.	NA
3	Specify details of technical specifications to be submitted at the time of type approval relevant to the requirements of this standard covered.	YES, to be submitted as per Annex
4	Are the details of Worst Case Criteria covered?	-
5	Are the performance requirements covered?	YES
6	Is there a need to specify dimensional requirements?	NO
7	If yes, are they covered?	NA
8	Is there a need to specify COP requirements? If yes, are they covered?	NO
9	Is there a need to specify type approval, and routine test separately, as in the case of some of the Indian Standards? If yes, are they covered?	NO
10	If the standard is for a part/component or sub-system; i) AIS-037 or ISI marking scheme be implemented for this part? ii) Are there any requirements to be covered for this part when fitted on the vehicle? If yes, has a separate standard been prepared?	NO
11	If the standard is intended for replacing or revising an already notified standard, are transitory provisions for re-certification of already certified parts/vehicles by comparing the previous test result, certain additional test, etc. required? If yes, are they included?	NO

12	Include details of any other international or foreign national standards which could be considered as alternate standard.	NA
13	Are the details of accuracy and least counts of test equipment/meters required to be specified? If yes, have they been included?	NO
14	What are the test equipments for establishing compliance?	Temperature measurement instruments
15	If possible, identify such facilities available in India.	ARAI, ICAT, CIRT,VRDE
16	Are there any points on which special comments or information is to be invited from members? If yes, are they identified?	NO
17	Does the scope of standard clearly identify vehicle categories?	YES
18	Has the clarity of definitions been examined?	YES

INTRODUCTION

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the Ministry of Surface Transport (MOST) has constituted a permanent Automotive Industry Standard Committee (AISC) vide order No.RT-11028/11/97-MVL dated September 15, 1997. The standards prepared by AISC will be approved by the permanent CMVR Technical Standing Committee (CMVR-TSC). After approval, the Automotive Research Association of India, (ARAI), Pune, being the secretariat of the AIS Committee, has published this standard. For better dissemination of this information ARAI may publish this document on their Website.

Ministry desired to formulate a separate AIS on Vehicles for the carriage of perishable foodstuff by considering the importance and urgency posed by Ministry of Agriculture. Based on this, subject was discussed in 56th meeting of CMVR TSC and 63rd meeting of AISC where in it was decided to formulate an AIS on Vehicles for the carriage of perishable foodstuff (Insulated Vehicles). A panel was formulated. Accordingly, ARAI have carried out some background work to prepare a draft standard based on international reference of ATP agreement, 2020. This standard will be applicable for N category of vehicle. Every original manufacturer or second stage manufacturer of such vehicles shall meet all the requirements laid down in CMVR for that respective category. Accordingly, different test applicability matrix for chassis level approval and fully built vehicle level approval would be addressed in the standard.

Subsequently panel meetings were held where all necessary details were deliberated with the participation from various stake holders, OEMs, Test Agencies and Reefer van manufacturers.

The AISC panel and the Automotive Industry Standards Committee (AISC) responsible for preparation of this standard are given in Annex-XI and Annex-XII respectively.

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1.0 **SCOPE:**

1.1 This standard specifies the constructional and functional requirements for insulated vehicle (refrigerated/ heated/ refrigerated and heated) of category N for the carriage of perishable foodstuff.

1.2 This standard mainly covers the constructional and functional requirements necessary for roadworthiness of above vehicles.

1.3 Vehicles covered under this Standard shall comply with the requirements as notified under CMVR 1989, as amended from time to time.

2.0 **REFERENCE:**

2.1 Agreement on the international carriage of perishable foodstuff and on the special equipment to be used for such carriage (ATP) which is under working party on transport of perishable food (WP 11)

3.0 **DEFINITION**

For the purpose of this standard, the following definitions shall apply.

3.1 **"Approval of a Vehicle"** the approval of an insulated vehicle with regard to its special function for the carriage of perishable foodstuff.

3.2 **"Insulated Vehicle"** means a vehicle of which the body is built with rigid insulating walls, doors, floor and roof, by which heat exchanges between the inside and outside of the body can be limited.

3.3 **'Self contained refrigeration system'** which means the entire system from condenser to evaporator is build in the cabinet. The condenser can be located on top, bottom or even side or back of commercial collar but evaporator is always on top of the unit. Most of the time this type is preferred.

3.4 **'Non self contained system'** is also called as remote condensing system where in condenser oil, compressor, receiver tank and other components are assembled on a common base.

4.0 **CLASSIFICATION OF INSULATED VEHICLE & GENERAL REQUIREMENTS**

Note: Body – Wagons, lorries, trailers, semi-trailer, containers and other similar equipment.

4.1 **"Insulated equipment"** means the **e**quipment of which the body is built with rigid insulating walls, doors, floor and roof, by which heat exchanges between the inside and outside of the body can be so limited that the overall coefficient of heat transfer (K coefficient) is such that the equipment is assignable to one or other of the following two categories:

4.1.1 IN = Normally insulated equipment specified by a ‘K coefficient’ equal to or less than 0.70 W/m2.K;

4.1.2 IR = Heavily insulated equipment specified by a ‘K coefficient’ equal to or less than 0.40 W/m2.K and by sidewalls with a thickness of at least 45 mm for transport equipment of a width greater than 2.50 m.

4.1.3 ‘Food grade material’ for the construction of interior of the insulated container may be used for safe transportation of Food Stuff. Guidelines given in below table may be followed. **Guidelines as given in Table 1 is to be followed for food grade material which is to be used in Insulated Vehicles.**

Table 1

S.No	**Material**	**Ref standard**	**Reference Grade**
1	Stainless Steel	IS:15997-2012/ IS 5522-2014	1) IS 15997 having SS grades N1 (J4), N2 (204Cu) and N3 (JSL AUS). 2) IS 5522 having SS grades 304, 302 and 430
2	Aluminium	ISO-209-1	Alloy:- 1050, 3003, 5005, 5754, 5083 and 6082- for making skin of Refrigerated Containers Van
3	Composites	-	Thermo plastics etc
4	Polymers	-	IS-10171-Guides suitability for plastic packaging
5	Coating for interior cladding	-	For interior cladding painting if required.

4.1.4 Insulated container with length more than 20 feet and used for intercity application , may be equipped with the secondary door in addition to the rear opening door to avoid the unwanted heat loss because of the opening of the rear door all the times

4.2 **“Refrigerated equipment”** means insulated equipment which, using a source of cold (natural ice, with or without the addition of salt; eutectic plates; dry ice, with or without sublimation control; liquefied gases, with or without evaporation control, etc.) other than a mechanical or "absorption" unit, is capable, with a mean outside temperature of + 30 °C, of lowering the temperature inside the empty body to, and thereafter maintaining it:

4.2.1 At + 7 °C maximum in the case of class A;

4.2.2 At - 10 °C maximum in the case of class B;

4.2.3 At - 20 °C maximum in the case of class C;

4.2.4 At 0 °C maximum in the case of class D.

4.2.5 If such equipment includes one or more compartments, receptacles or tanks for the refrigerant, the said compartments, receptacles or tanks shall:

4.2.6 be capable of being filled or refilled from the outside; and

4.2.7 have a capacity in conformity with the provisions of Annexure III Clause no. 1.1.3 of this standard.

4.2.8 The K coefficient of refrigerated equipment of classes B and C shall in every case be equal to or less than 0.40 W/m2.K.

4.3 **“Mechanically refrigerated equipment”** means insulated equipment either fitted with its own refrigerating appliance, or served jointly with other units of transport equipment by such an appliance (fitted with either a mechanical compressor, or an "absorption" device, etc.). The appliance shall be capable, with a mean outside temperature of + 30 °C, of lowering the temperature Ti inside the empty body to, and thereafter maintaining it continuously in the following manner at:

4.3.1 In the case of classes A, B and C, any desired practically constant inside temperature Ti in conformity with the standards defined below for the three classes:

4.3.2 **Class A**. Mechanically refrigerated equipment fitted with a refrigerating appliance such that Ti may be chosen between + 12 °C and 0 °C inclusive

4.3.3 Class B. Mechanically refrigerated equipment fitted with a refrigerating appliance such that Ti may be chosen between + 12 °C and - 10 °C inclusive

4.3.4 Class C. Mechanically refrigerated equipment fitted with a refrigerating appliance such that Ti may be chosen between + 12 °C and - 20 °C inclusive.

4.3.5 In the case of classes D, E and F a fixed practically constant inside temperature Ti in conformity with the standards defined below for the three classes:

4.3.5.1 **Class D**. Mechanically refrigerated equipment fitted with a refrigerating appliance such that Ti is equal to or less than 0 °C

4.3.5.2 **Class E.** Mechanically refrigerated equipment fitted with a refrigerating appliance such that Ti is equal to or less than - 10 °C

4.3.5.3 **Class F.** Mechanically refrigerated equipment fitted with a refrigerating appliance such that Ti is equal to or less than - 20 °C. The K coefficient of equipment of classes B, C, E and F shall in every case be equal to or less than 0.40 W/m2.K

4.4 **"Heated equipment" means i**nsulated equipment, which is capable of raising the inside temperature of the empty body to, and thereafter maintaining it for not less than 12 hours without renewal of supply at, a practically constant value of not less than + 12 °C when the mean outside temperature, is as indicated below:

4.4.1 -10 °C in the case of class A heated equipment;

4.4.2 -20 °C in the case of class B heated equipment;

4.4.3 -30° C in the case of class C heated equipment;

4.4.4 -40° C in the case of class D heated equipment

4.4.5 Heat producing appliances shall have a capacity in conformity with the provisions of Annexure III , clause numbers 1.3.1 to 1.3.5 of this standard,

4.4.6 The K coefficient of equipment of classes B, C and D shall in every case be equal to or less than 0.40 W/m2.K.

4.5 **"Mechanically refrigerated and heated equipment"** means insulated equipment either fitted with its own refrigerating appliance, or served jointly with other units of transport equipment by such an appliance (fitted with either a mechanical compressor, or an 'absorption' device, etc.), and heating (fitted with electric heaters, etc.) or refrigerating-heating units capable both of lowering the temperature Ti inside the empty body and thereafter maintaining it continuously, and of raising the temperature and thereafter maintaining it for not less than 12 hours without renewal of supply at a practically constant value, as indicated below.

4.5.1 Class A: Ti may be chosen between + 12 °C and 0 °C inclusive at a mean outside temperature between -10 ºC and +30 ºC.

4.5.2 Class B: Ti may be chosen between + 12 °C and 0 °C inclusive at a mean outside temperature between -20 ºC and +30 ºC

4.5.3 Class C: Ti may be chosen between + 12 °C and 0 °C inclusive at a mean outside temperature between -30 ºC and +30 ºC.

4.5.4 Class D: Ti may be chosen between + 12 °C and 0 °C inclusive at a mean outside temperature between -40 ºC and +30 ºC.

4.5.5 Class E: Ti may be chosen between + 12 °C and -10 °C inclusive at a mean outside temperature between -10 ºC and +30 ºC.

4.5.6 Class F: Ti may be chosen between + 12 °C and -10 °C inclusive at a mean outside temperature between -20 ºC and +30 ºC.

4.5.7 Class G: Ti may be chosen between + 12 °C and -10 °C inclusive at a mean outside temperature between -30 ºC and +30 ºC.

4.5.8 Class H: Ti may be chosen between + 12 °C and -10 °C inclusive at a mean outside temperature between -40 ºC and +30 ºC.

4.5.9 Class I: Ti may be chosen between + 12 °C and -20 °C inclusive at a mean outside temperature between -10 ºC and +30 ºC.

4.5.10 Class J: Ti may be chosen between + 12 °C and -20 °C inclusive at a mean outside temperature between -20 ºC and +30 ºC.

4.5.11 Class K: Ti may be chosen between + 12 °C and -20 °C inclusive at a mean outside temperature between -30 ºC and +30 ºC.

4.5.12 Class L: Ti may be chosen between + 12 °C and -20 °C inclusive at a mean outside temperature between -40 ºC and +30 ºC

4.5.13 The K coefficient of equipment of classes B, C, D, E, F, G, H, I, J, K and L shall in every case be equal to or less than 0.40 $W/m^2.K$.

4.5.14 Heat producing or refrigerating-heating appliances when in heating mode shall have a capacity in conformity with the provisions of Annexure III, clause Nos. 1.4.1 to 1.4.5 of this standard.

5.0 SPECIFIC REQUIREMENTS

5.1 Insulated Vehicle shall comply with the requirements of CMVR, as amended from time to time. In addition, insulated vehicle shall meet following requirements.

5.1.1 The certificate of compliance shall be carried with insulated vehicle during carriage and be produced whenever so required by the road authorities. However, if a certification plate of compliance, as given in Annexure I, is fixed to the insulation vehicle, the certification plate of compliance shall be recognized as equivalent to a certificate of compliance. A certification plate of compliance may be fixed to the insulated vehicle only when a valid certificate of compliance is available.

5.1.2 The insulated bodies of ‘insulated’, ‘refrigerated’, ‘mechanically refrigerated’, ‘heated’ or ‘mechanically refrigerated and heated’ transport equipment and their thermal appliances shall each bear a durable manufacturer’s plate firmly affixed by the manufacturer in a conspicuous and readily accessible position on a part not subject to replacement in use. It shall be able to be checked easily and without the use of tools. For insulated bodies, the manufacturer’s plate shall be on the outside of the body. The manufacturer's plate shall show clearly and indelibly at least the following particulars

5.1.2.1 Country of manufacture

5.1.2.2 Name of manufacturer or company

5.1.2.3 Model name

5.1.2.4 Serial number

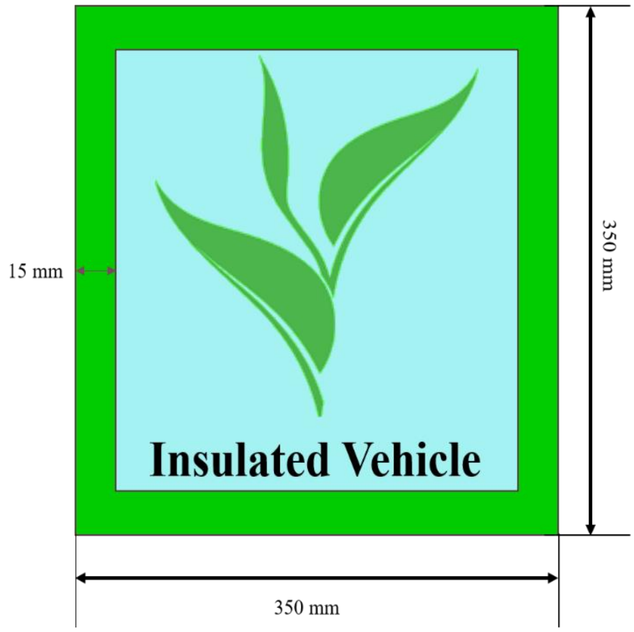
5.1.2.5 Month and year of manufacture

5.2 Insignia Location

The 'Insulated Vehicle Insignia' shall be either of square or circular in shape with dimension of 350 x 350 mm or 350 mm diameter and a back drop of ice blue- colour with the symbol and border in green colour.

The template drawn to 1:2 scale is shown in Figure 1. This shall be provided on the outer surface of the insulated vehicle in a visible location on the front and the rear.

In case, if it is not possible to accommodate insignia of size 350 x 350 mm or 350 mm diameter, size can be reduced to 200 x 200 mm or 200 mm diameter.



5.3 Methods and Procedures for Measuring and Checking the Insulating Capacity and the Efficiency of the Cooling or Heating Appliances of Special Equipment for the Carriage of Perishable Foodstuffs Shall be as given in Annexure II

5.4 Procedure for measurement of Effectiveness of thermal appliances of equipment is given in Annexure III

5.5 Procedure for measuring the effective refrigerating capacity wo of a unit when the evaporator is free from frost is given in Annexure IV

5.6 Procedure for measuring the capacity of mechanical multi-temperature refrigeration units and dimensioning multi-compartment equipment is given in Annexure V

5.7 Guideline for Selection of equipment and temperature conditions to be observed for the carriage of quick (deep) frozen and frozen food stuff shall be as per Annexure VI

5.8 Guideline for Monitoring of air temperature for transport of quick frozen perishable foodstuff shall be as per Annexure VII

5.9 Guideline for Selection of equipment and temperature conditions to be observed for the carriage of chilled foodstuff shall be as per Annexure VIII

5.10 Every Insulated Vehicle manufacturer of body builder shall submit Technical information to the testing agency as given in Annexure IX

5.11 After verification of insulated Vehicle with provisions laid down in this standard, every testing agency shall issue a report as given in Annexure X

ANNEXURE I

DETAILS OF LOCATION OF INSULATED VEHICLE IDENTIFICATION NUMBER AND CODE FOR MONTH AND YEAR OF MANUFACTURE

Name of the Insulated Vehicle Manufacturer & Address :	
Name of the basic model :	
Name of variants, if any :	
Place of embossing or etching the insulated vehicle identification number (Supporting details by drawing or pictures may be provided if necessary)	
Position of the code for month of production in the insulated vehicle identification number	
Position of the code for year of production in the insulated vehicle identification number	
Height of the insulated vehicle identification number - Min. 7 mm	
Illustrative example	

Code for month and year of production			
Code for month of production:		**Code for year of production:**	
Month	**Code**	**Year**	**Code**
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Example:

Subject	Manufacture digit			Year		Month	Serial no of vehicle		
example	1	2	3	4	5	6	7	8	9
Remark	Can be WMI letter if available			As per declaration above table		As per declaration above table	As per manufacture production vehicle per year		

Note:

1. Wherever possible number shall be marked on a single line. The use of the letters I, O and Q and dashes, asterisks and other special signs, is not permitted.

2. The minimum height of the letters and numerals shall be 7 mm for characters marked.

3. It is advised that insulated vehicle manufacturer may take reference of AIS-065 while deciding insulated vehicle identification number.

ANNEXURE II

METHODS AND PROCEDURES FOR MEASURING AND CHECKING THE INSULATING CAPACITY AND THE EFFICIENCY OF THE COOLING OR HEATING APPLIANCES OF SPECIAL EQUIPMENT FOR THE CARRIAGE OF PERISHABLE FOODSTUFFS

1.0 DEFINITIONS AND GENERAL PRINCIPLES

1.1 K coefficient. The overall heat transfer coefficient (K coefficient) of the special equipment is defined by the following formula:

$$K = \frac{W}{S \, \Delta T}$$

where W is either the heating power or the cooling capacity, as the case may be, required to maintain a constant absolute temperature difference ΔT between the mean inside temperature Ti and the mean outside temperature Te, during continuous operation, when the mean outside temperature Te is constant for a body of mean surface area S

1.2 The mean surface area S of the body is the geometric mean of the inside surface area Si and the outside surface area Se of the body:

$$S = \sqrt{S_i \cdot S_e}$$

In determining the two surface areas Si and Se, structural peculiarities and surface irregularities of the body, such as chamfers, wheel-arches and similar features, shall be taken into account and shall be noted under the appropriate heading in test reports; however, if the body is covered with corrugated sheet metal the area considered shall be that of the plane surface occupied, not that of the developed corrugated surface.

For calculating the mean surface area of the body of a refrigerated vehicle, the testing agency shall select one of the following method

Method A: The manufacturer shall provide drawing and calculation of the inside and outside surfaces

The surface areas Se and Si are determined taking into consideration the projected surface areas of specific design features of the irregularities of its surface such as curves, corrugations, wheel boxes, etc.

Method B : The manufacturer shall provide drawings and the testing agencies shall use the calculations according to the case and ~~formulate~~ formulae below

Si= (((WExLE)+(WExWe)+(WexLe))x2)

Se= (((WExLE)+(WExWe)+(WexLe))x2)

Where

WI is the Y axis of the internal surface area

LI is the X axis of the internal surface area

Wi is the Z axis of the internal surface area

WE is the ~~X~~ Y axis of the external surface area

LE is the X axis of the external surface area

We is the Z axis of the external surface area

Using the most appropriate formula for the Y axis of the internal surface area

WI= (WIa x a + WIb x (b+c/2) + WIc x c/2)/ (a+b+c)

WI= (WIa x a/2 + WIb x (a/2+b/2) + WIc x b/2)/ (a+b)

WI= ((WIb x b) + (WIbxc)-((WIb-WIc)xc)+(2x((WIb-WIa)xa)))/(a+b+c)

Where

WIa is the internal width at the floor or between the wheel arches

WIb is the internal width at the height of the vertical edge from the floor or above the wheel arches

WIc is the internal width along the roof

a is the height of the vertical edge from the floor

b is either the height between the bottom of the vertical edge and the roof or between the top of the wheelarch and the top of the vertical edge from the floor

c is the height between the roof and point b

Along with the two formulae for the X and Z axes of the internal surface:

LI= ((LIa x a) + (LIb+LIc)/2 x b+ (LIc X c)/ (a+b+c)

Where

LIa is the internal length along the floor

LIb is the internal length above the wheel arches

LIc is the internal length along the roof

a is the height between LIa and LIb

b is the height between LIb and LIc

c is the height between LIc and the roof

Wi= (Wi back + Wi front)/2

Where

Wi back is the width at the bulkhead

Wi front is the width at the door end

The external surface area is calculated using the formulae below

WE= WI + declared mean thickness

LE = LI + declared mean thickness

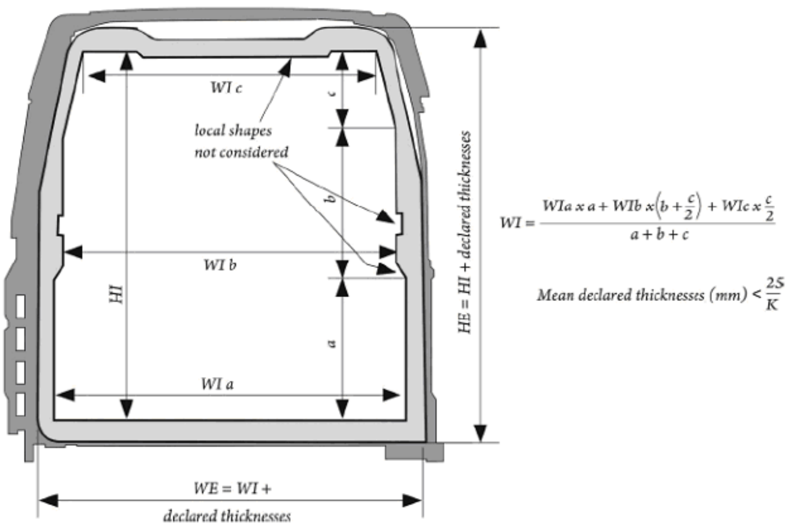
We = Wi + declared mean thickness

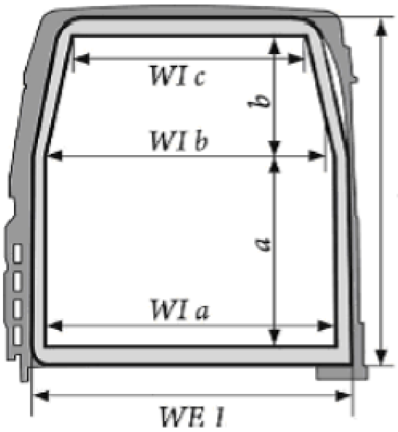
We = Wi + we = wi + declared mean thickness

The K value shall then be calculated based on the internal surface area, taking the insulation thickness nill. From this K value, the average insulation thinckness is calculated from the assumption that λ for the insulation has a value of 0.025 W/m.K or as per actual raw material of the insulation.

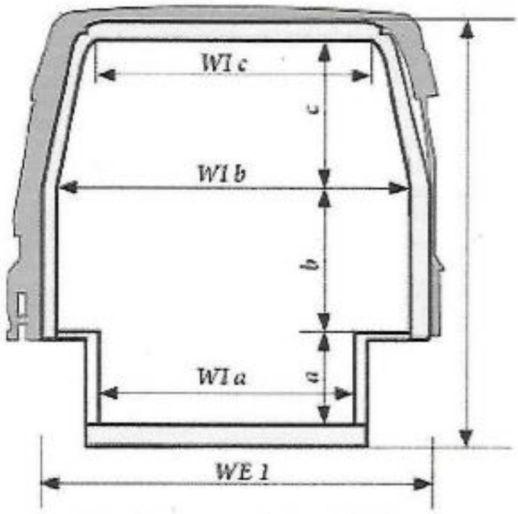
$$D= Si \times \Delta T \times \lambda/W$$

Once the thickness of the insulation has been estimated, the external surface area is calculated and the mean surface area is determined. The final K value is derived from successive iteration.





$$WI = \frac{WIa \times \frac{a}{2} + WIb\left(\frac{a}{2}+\frac{b}{2}\right) + WIc\left(\frac{b}{2}\right)}{a+b}$$



WE = WI + mean declared thicknesses

$$WI = \frac{((WIb \times b)+(WIb \times c)-((WIb-WIc) \times c)+(WIb \times a)+(2 \times ((WIb-WIa) \times a)))}{(a+b+c)}$$

Key

WIa is the internal width between the wheel arches

WIb is the internal width above the wheel arches

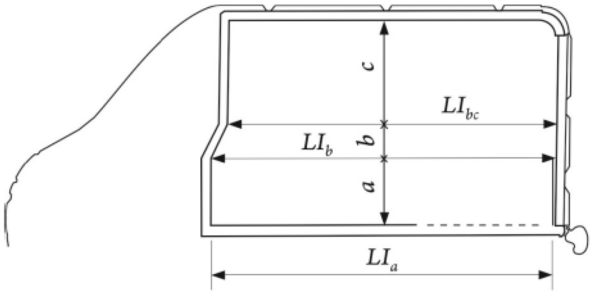
WIc is the internal width of the roof

a is the internal height of the wheel arches

b is the internal height above the wheel arches

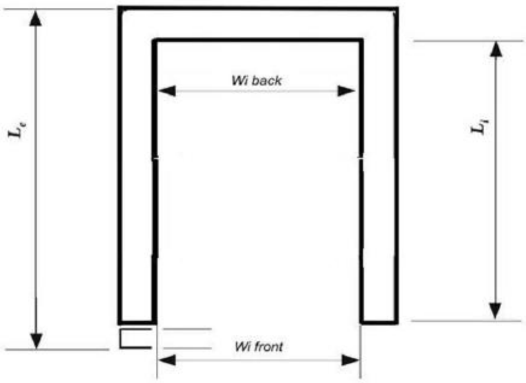
c is the internal height above the wheel arches where the side wall width ends.

Method C : If neither of the above is acceptable to the expert, the internal surface shall be measured according to the figure and formulae in method B.



$$LI = \frac{(LI_a \ x \ a) + \left(LI_b + LI_c\right)/2 \ x \ b + (LI_c \ x \ c)}{a + b + c}$$

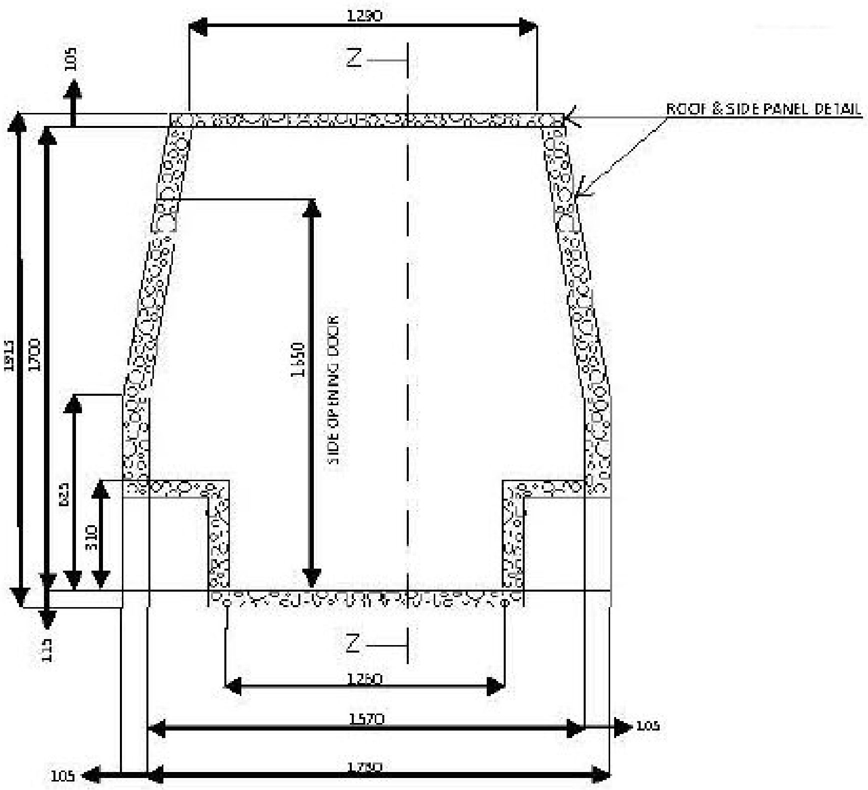
$$LE = LI + mean\ declared\ thicknesses$$

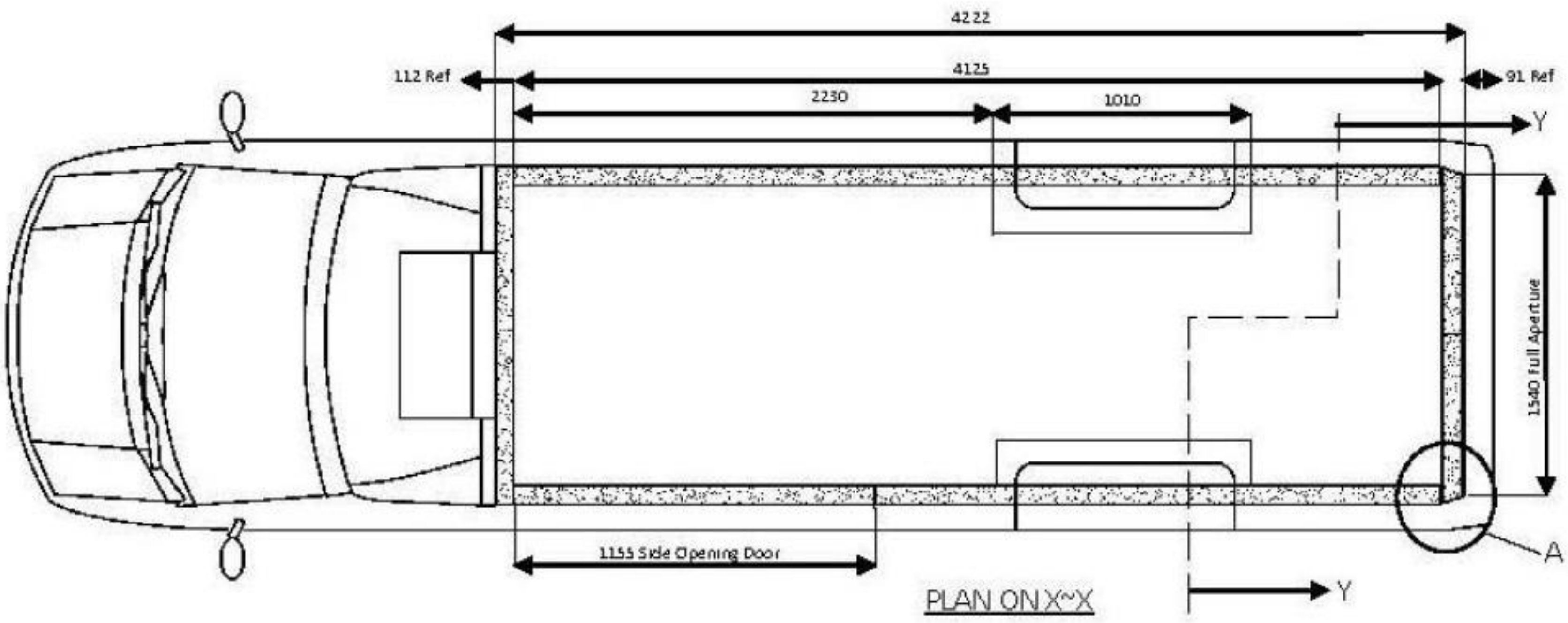


$$Wi = \frac{(Wi\ back + Wi\ front)}{2}$$

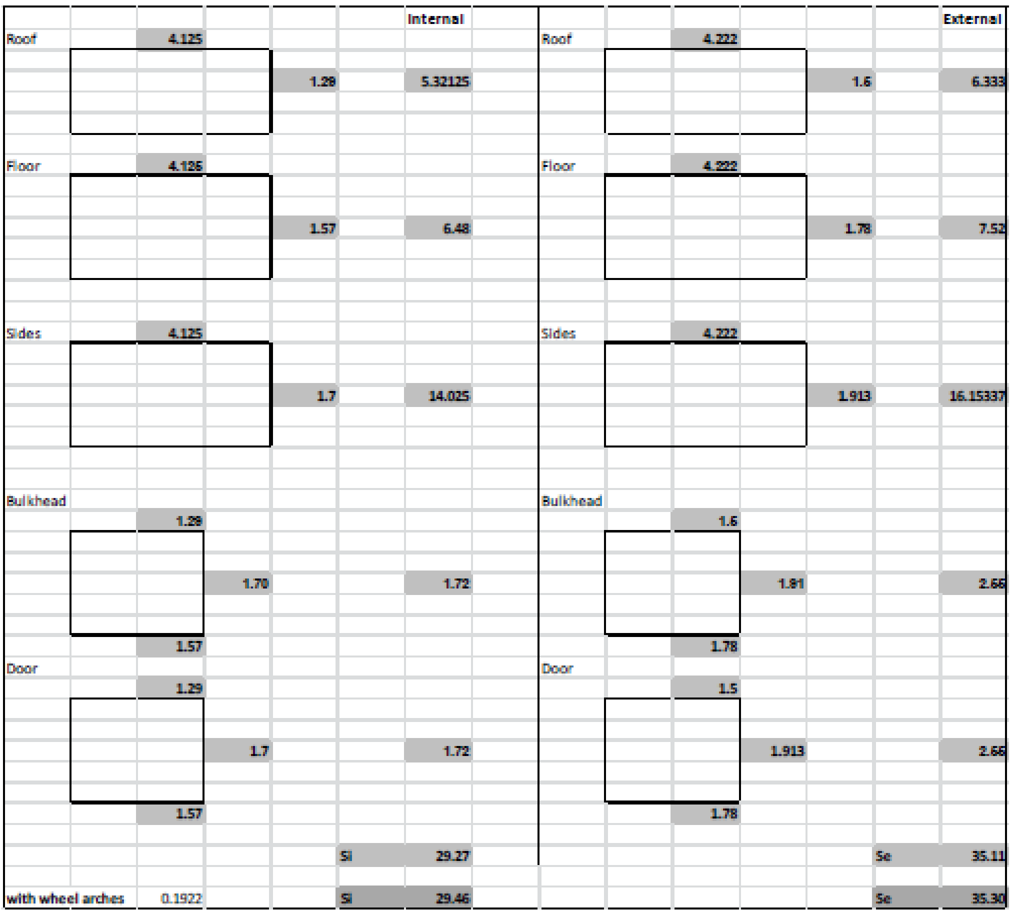
We = Wi + mean declared thickness

Examples

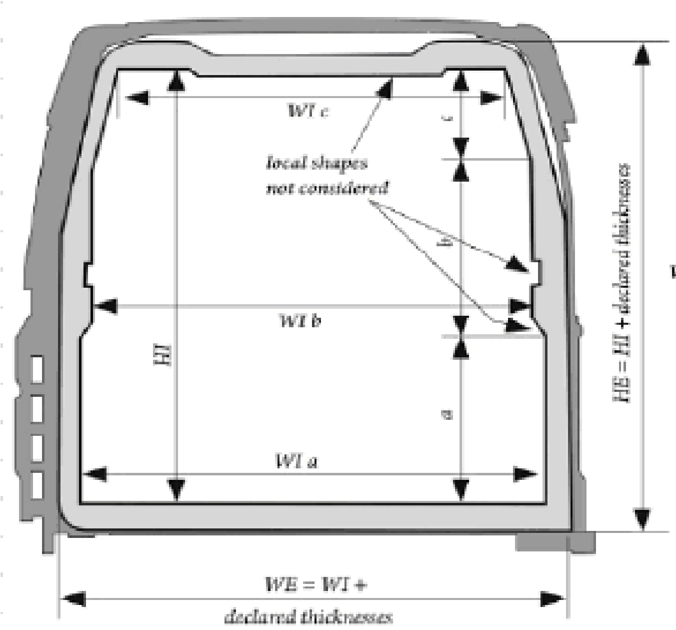

1290
Z
Z
105
ROOF & SIDE PANEL DETAIL
1815
1700
1650
SIDE OPENING DOOR
625
310
115
1250
1570
105
105
1780


4222
112 Ref
4125
91 Ref
2230
1010
Y
1540 Full Aperture
A
1155 Side Opening Door
PLAN ON X~X
Y

	Method A



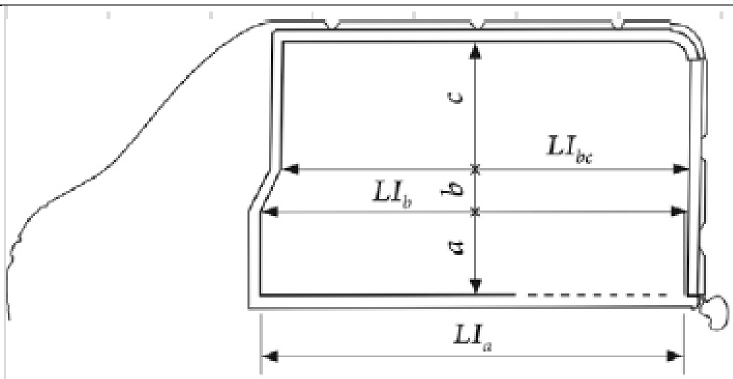
	Method B (Excluding wheel arches)



$$WI = \frac{WIa \times a + WIb \times \left(b + \frac{c}{2}\right) + WIc \times \frac{c}{2}}{a + b + c}$$

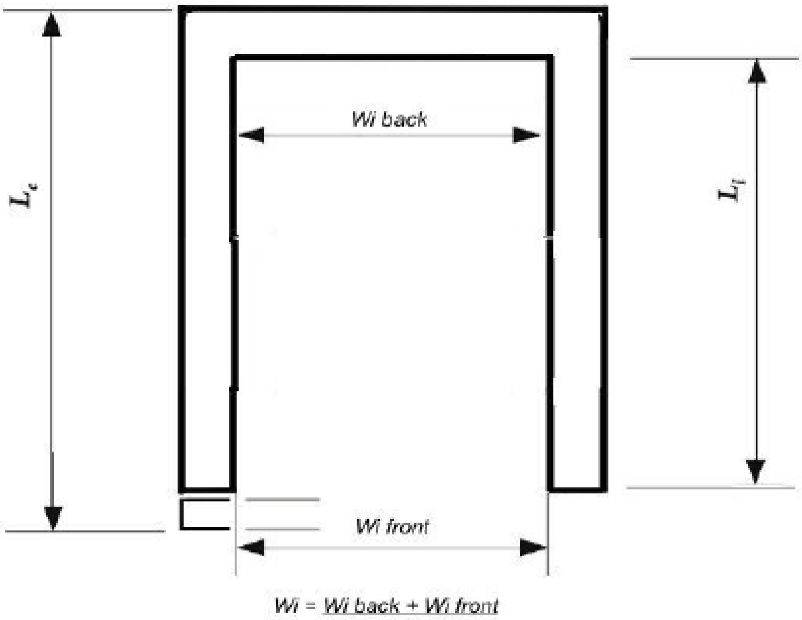
$$\text{Mean declared thicknesses (mm)} < \frac{25}{K}$$

Wia	1.57
Wib	1.57
Wic	1.29
a	0.31
b	0.315
c	1.075
WI	**1.481471**
Declared Thickness	0.22
WE	**1.701471**



$$LI = \frac{(LI_a \times a) + \left(LI_b + LI_c\right)/2 \times b + (LI_c \times c)}{a + b + c}$$

Lia	4.125
Lib	4.125
Lic	4.125
a	0.31
b	0.315
c	1.075
Ll	**4.125**
Declared Thickness	0.203
LE	**4.328**



Wiback	1.57
Wifront	1.57
Wi	**1.57**
Declared Thickness	0.21
We	**1.78**

	Method C (Excluding wheel arches)															
	WIa	1.57		LIa	4.125		WIb	1.57								
	WIb	1.57		LIb	4.125		WIF	1.57								
	WIc	1.29		LIc	4.125											
	a	0.31		a	0.31											
	b	0.315		b	0.315											
	c	1.075		c	1.075											
									Si	Se	S	W	Delta T	K	Lambda	D
	WI	1.481471		LI	4.125		WI	1.57	29.37			300	25	0.409	0.025	0.0612
	WE	1.6039		LE	4.2474		We	1.6924	29.37	33.43	31.34	300	25	0.383	0.025	0.0653
	WE	1.6120		LE	4.2556		We	1.7006	29.37	33.68	31.45	300	25	0.382	0.025	0.0655
	WE	1.6125		LE	4.2560		We	1.7010	29.37	33.69	31.46	300	25	0.381	0.025	0.0655

Temperature measuring points

1.3 In the case of parallelepipedic bodies, the mean inside temperature of the body (Ti) is the arithmetic mean of the temperatures measured 10 cm from the walls (OR nearest contact surface (e.g. phased changed material(PCM) cartridge in case wherein PCM cartridge is mounted on the walls) at the following 12 points:

(a) The eight inside corners of the body; and

(b) The centres of the four inside faces having the largest area.

If the body is not parallelepipedic, the 12 points of measurements shall be distributed as satisfactorily as possible having regard to the shape of the body

1.4 In the case of parallelepipedic bodies, the mean outside temperature of the body (Te) is the arithmetic mean of the temperatures measured 10 cm from the walls(OR nearest contact surface (e.g. phased changed material(PCM) cartridge in case wherein PCM cartridge is mounted on the walls) at the following 12 points

(a) The eight outside corners of the body; and

(b) The centres of the four outside faces having the largest area

If the body is not parallelepipedic, the 12 points of measurement shall be distributed as satisfactorily as possible having regard to the shape of the body

1.5 The mean temperature of the walls of the body is the arithmetic mean of the mean outside temperature of the body and the mean inside temperature of the body:

$$\frac{T_e + T_i}{2}$$

1.6 Temperature measuring instruments protected against radiation shall be placed inside and outside the body at the points specified in paragraphs 1.3 and 1.4 of this Annexure.

Steady state period and duration of test

1.7 The mean outside temperatures and the mean inside temperatures of the body, taken over a steady period of not less than 12 hours, shall not vary by more than ± ~~3K~~ 1°C, and these temperatures shall not vary by more than ± ~~1.0K~~ 1°C during the preceding 6 hours.

The difference between the heating power or cooling capacity measured over two periods of not less than 3 hours at the start and at the end of the steady state period, and separated by at least 6 hours, shall be less than 3 %.

The mean values of the temperatures and heating or cooling capacity over at least the last 6 hours of the steady state period will be used in K coefficient calculation.

The mean inside and outside temperatures at the beginning and the end of the calculation period of at least 6 hours shall not differ by more than 1°C.

2.0 **INSULATING CAPACITY OF EQUIPMENT**

Procedures for measuring the K coefficient

2.1 Equipment other than liquid-foodstuffs tanks

2.1.1 The K coefficient shall be measured in continuous operation either by the internal cooling method or by the internal heating method. In either case, the empty body shall be placed in an insulated chamber

Test method

2.1.2 Where the internal cooling method is used, one or more heat exchangers shall be placed inside the body. The surface area of these exchangers shall be such that, if a fluid at a temperature not lower than 0 °C passes through them, the mean inside temperature of the body remains below + 10 °C when continuous operation has been established. Where the internal heating method is used, electrical heating appliances (resistors, etc.) shall be used. The heat exchangers or electrical heating appliances shall be fitted with fans having a delivery rate sufficient to obtain 40 to 70 air charges per hour related to the empty volume of the tested body, and the air distribution around all inside surfaces of the tested body shall be sufficient to ensure that the maximum difference between the temperatures of any 2 of the 12 points specified in paragraph 1.3 of this Annexure does not exceed 2 K when continuous operation has been established.

2.1.3 Heat quantity: The heat dissipated by the electrical resistance fan heaters shall not exceed a flow of 1W/cm2 and the heater units shall be protected by a casing of low emissivity.

The electrical energy consumption shall be determined with an accuracy of ±0.5%.

Test procedure

2.1.4 Whatever the method employed, the mean temperature of the insulated chamber shall throughout the test be kept uniform, and constant in compliance with paragraph 1.7 of this Annexure, to within 1°C, at a level such that the temperature difference between the inside of the body and the insulated chamber is 25 °C ± 1°C the average temperature of the walls of the body being maintained at + 20 °C ± 1°C

2.1.5 During the test, whether by the internal cooling method or by the internal heating method, the mass of air in the chamber shall be made to circulate continuously so that the speed of movement of the air 10 cm from the walls is maintained at between l and 2 metres/second

2.1.6 The appliances for generating and distributing cold or heat and for measuring the quantity of cold or heat exchanged and the heat equivalent of the air-circulating fans shall be started up. Electrical cable losses between the heat input measuring instrument and the tested body shall be established by a measurement or calculation and subtracted from the total heat input measured

2.1.7 When continuous operation has been established, the maximum difference between the temperatures at the warmest and at the coldest points on the outside of the body shall not exceed 2 K.

2.1.8 The mean outside temperature and the mean inside temperature of the body shall each be read not less than four times per hour.

2.2 Liquid-foodstuffs tanks

2.2.1 The method described below applies only to single-compartment or multiple-compartment tank equipment intended solely for the carriage of liquid foodstuffs such as milk. Each compartment of such tanks shall have at least one manhole and one discharge-pipe connecting socket; where there are several compartments they shall be separated from one another by non-insulated vertical partitions.

2.2.2 K coefficients shall be measured in continuous operation by internal heating of the empty tank in an insulated chamber.

Test method

2.2.3 An electrical heating appliance (resistors, etc.) shall be placed inside the tank. If the tank has several compartments, an electrical heating appliance shall be placed in each compartment. The electrical heating appliances shall be fitted with fans with a delivery rate sufficient to ensure that the difference between the maximum temperature and the minimum temperature inside each compartment does not exceed 3 K when continuous operation has been established. If the tank comprises several compartments, the difference between the mean temperature in the coldest compartment and the mean temperature in the warmest compartment shall not exceed 2 K, the temperatures being measured as specified in paragraph 2.2.4 of this Annexure.

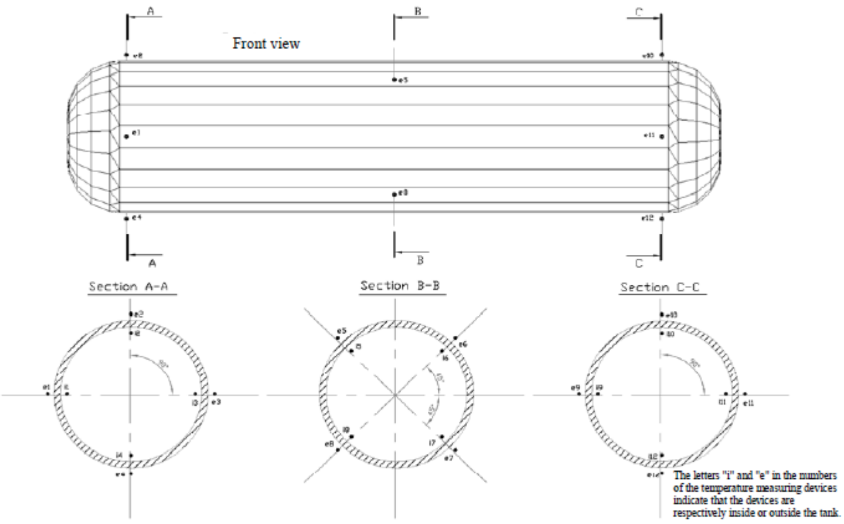
2.2.4 Temperature measuring instruments protected against radiation shall be placed inside and outside the tank 10 cm from the walls, as follows:

(a) If the tank has only one compartment, measurements shall be made at a minimum of 12 points positioned as follows:

The four extremities of two diameters at right angles to one another, one horizontal and the other vertical, near each of the two ends of the tank;

The four extremities of two diameters at right angles to one another, inclined at an angle of 45° to the horizontal, in the axial plane of the tank;

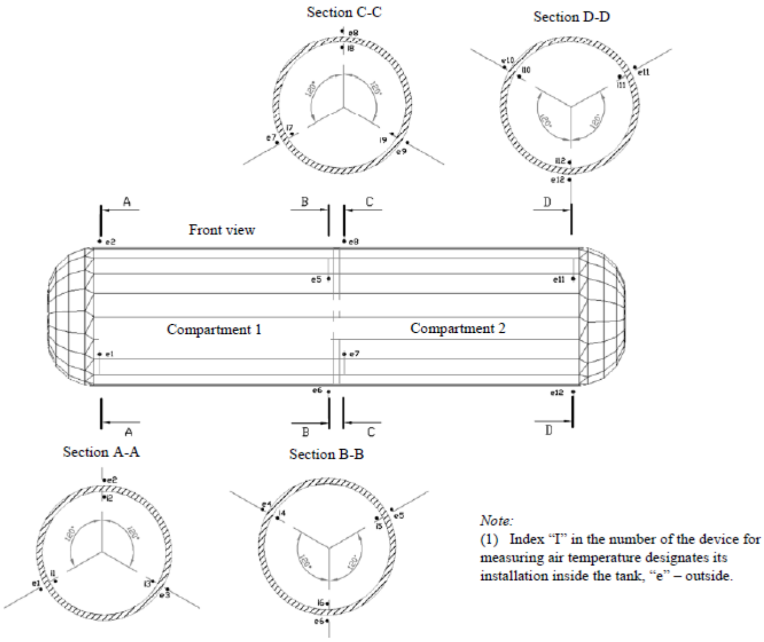
The layout of the placement of air temperature measuring devices inside and outside tanks with one compartment is shown below



(b) If the tank has two compartments, the measurements shall be made at least at the following points:

Near the end of the first compartment and near the partition with the second compartment, at the extremities of three radiuses forming 120° angles, one of the radiuses being directed vertically upwards.

The layout of the placement of air temperature measuring devices inside and outside tanks with two compartment is shown below



(c) If the tank has several compartments, the points of measurement shall be as follows

for each of the two end compartments, at least the following:

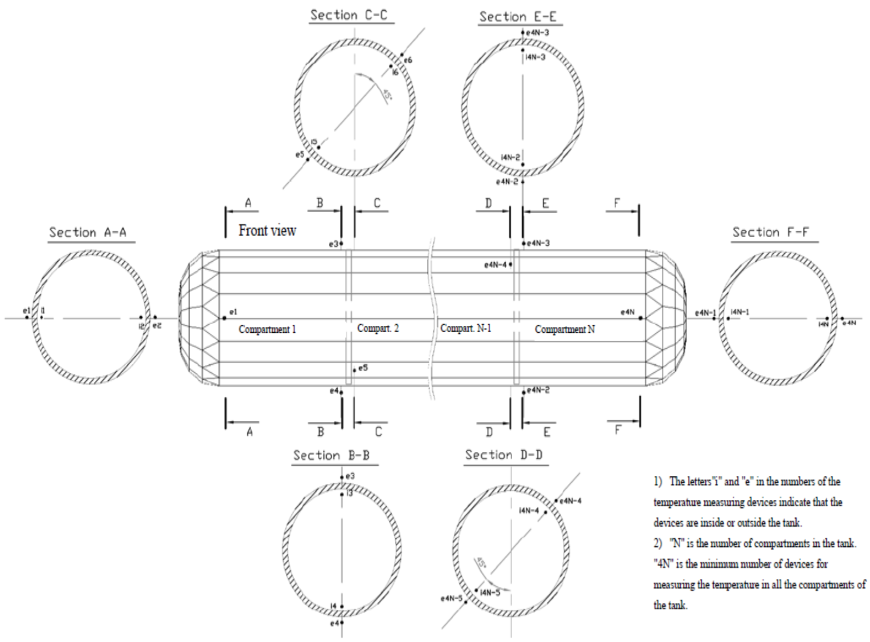
The extremities of a horizontal diameter near the end and the extremities of a vertical diameter near the partition;

and for each of the other compartments, at least the following

The extremities of a diameter inclined at an angle of 45° to the horizontal near one of the partitions and the extremities of a diameter perpendicular to the first and near the other partition.

(d) The mean inside temperature and the mean outside temperature of the tank shall respectively be the arithmetic mean of all the measurements taken inside and all the measurements taken outside the tank. In the case of tanks having at least two compartments, the mean inside temperature of each compartment shall be the arithmetic mean of the measurements made in the compartment, and the number of those measurements in each compartment shall be no less than four and the total number of measurements in all compartments of the tank shall be no less than twelve.

The layout of the placement of air temperature measuring devices inside and outside tanks with three compartmets is shown below



Test procedure

2.2.5 Throughout the test, the mean temperature of the insulated chamber shall be kept uniform, and constant in compliance with paragraph 1.7 of this Annexure, at a level such that the difference in temperature between the inside of the tank and that of the insulated chamber is not less than 25 °C ± 1°C with the average temperature of the tank walls being maintained at + 20 °C ± 1°C

2.2.6 The mass of air in the chamber shall be made to circulate continuously so that the speed of movement of the air 10 cm from the walls is maintained at between l and 2 metres/second.

2.2.7 The appliances for heating and circulating the air and for measuring the quantity of heat exchanged and the heat equivalent of the air-circulating fans shall be started up

2.2.8 When continuous operation has been established, the maximum difference between the temperatures at the warmest and at the coldest points on the outside of the tank shall not exceed 2 K.

2.2.9 The mean outside temperature and the mean inside temperature of the tank shall each be read not less than four times per hour

2.3 Provisions common to all types of insulated equipment

2.3.1 Verification of the K coefficient

Where the purpose of the tests is not to determine the K coefficient but simply to verify that it is below a certain limit, the tests carried out as described in paragraphs 2.1.1 to 2.2.9 of this Annexure may be stopped as soon as the measurements made show that the K coefficient meets the requirements

2.3.2 Accuracy of measurements of the K coefficient

Testing agencies shall be provided with the equipment and instruments necessary to ensure that the K coefficient is determined with a maximum margin of error of ± 10% when using the method of internal cooling and ± 5% when using the method of internal heating.

ANNEXURE III

EFFECTIVENESS OF THERMAL APPLIANCES OF EQUIPMENT

1.0 Procedures for determining the efficiency of thermal appliances of equipment

1.1 Refrigerated equipment

1.1.1 The empty equipment shall be placed in an insulated chamber whose mean temperature shall be kept uniform, and constant to within ± 0.5 °C, at + 30 °C. The mass of air in the chamber shall be made to circulate as described in paragraph 2.1.5 of Annexure II.

1.1.2 Temperature measuring instruments protected against radiation shall be placed inside and outside the body at the points specified in paragraphs 1.3 and 1.4 of Annexure II

Test procedure

1.1.3 (a) In the case of equipment other than equipment with fixed eutectic plates, and equipment fitted with liquefied gas systems, the maximum weight of refrigerant specified by the manufacturer or which can normally be accommodated shall be loaded into the spaces provided when the mean inside temperature of the body has reached the mean outside temperature of the body (+30 °C). Doors, hatches and other openings shall be closed and the inside ventilation appliances (if any) of the equipment shall be started up at maximum capacity. In addition, in the case of new equipment, a heating appliance with a heating capacity equal to 35% of the heat exchanged through the walls in continuous operation shall be started up inside the body when the temperature prescribed for the class to which the equipment is presumed to belong has been reached. No additional refrigerant shall be loaded during the test

(b) In the case of equipment with fixed eutectic plates, the test shall comprise a preliminary phase of freezing of the eutectic solution. For this purpose, when the mean inside temperature of the body and the temperature of the plates have reached the mean outside temperature (+ 30 °C), the plate-cooling appliance shall be put into operation for 18 consecutive hours after closure of the doors and hatches. If the plate- cooling appliance includes a cyclically- operating mechanism, the total duration of operation of the appliance shall be 24 hours. In the case of new equipment, as soon as the cooling appliance is stopped, a heating appliance with a heating capacity equal to 35% of the heat exchanged through the walls in continuous operation shall be started up inside the body when the temperature prescribed for the class to which the equipment is presumed to belong has been reached. The solution shall not be subjected to any re-freezing operation during the test;

(c) In the case of equipment fitted with liquefied gas systems, the following test procedure shall be used: when the mean inside temperature of the body has reached the mean outside temperature (+ 30 °C), the receptacles for the liquefied gas shall be filled to the level prescribed by the manufacturer. Then the doors, hatches and other openings shall be closed as in normal operation and the inside ventilation appliances (if any) of the equipment shall be started up at maximum capacity. The thermostat shall be set at a temperature not more than 2 degrees below the limit temperature of the presumed class of the equipment. Cooling of the body then shall be commenced. During the cooling of the body the refrigerant consumed is simultaneously replaced. This replacement shall be effected:

either for a time corresponding to the interval between the commencement of cooling and the moment when the temperature prescribed for the class to which the equipment is presumed to belong is reached for the first time; or

for a duration of three hours counting from the commencement of cooling, whichever is shorter

Beyond this period, no additional refrigerant shall be loaded during the test

In the case of new equipment, a heating appliance with a heating capacity equal to 35% of the heat exchanged through the walls in continuous operation shall be started up inside the body when the class temperature has been reached

Provisions common to all types of refrigerated equipment

1.1.4 The mean outside temperature and the mean inside temperature of the body shall each be read at least every 30 minutes

1.1.5 The test shall be continued for 12 hours after the mean inside temperature of the body has reached the lower limit prescribed for the class to which the equipment is presumed to belong (A = +7 °C; B = -10 °C; C = -20 °C; D = 0 °C) or, in the case of equipment with fixed eutectic plates, after stoppage of the cooling appliance.

Criterion of satisfaction

1.1.6 The test shall be deemed satisfactory if the mean inside temperature of the body does not exceed the aforesaid lower limit during the aforesaid period of 12 hours.

1.2 Mechanically refrigerated equipment

Test method

1.2.1 The test shall be carried out in the conditions described in paragraphs 1.1.1 and 1.1.2 of this Annexure.

Test procedure

1.2.2 When the mean inside temperature of the body reaches the outside temperature (+ 30 °C), the doors, hatches and other openings shall be closed and the refrigerating appliance and the inside ventilating appliances (if any) shall be started up at maximum capacity. In addition, in the case of new equipment, a heating appliance with a heating capacity equal to 35% of the heat exchanged through the walls in continuous operation shall be started up inside the body when the temperature prescribed for the class to which the equipment is presumed to belong has been reached.

1.2.3 The mean outside temperature and the mean inside temperature of the body shall each be read at least every 30 minutes

1.2.4 The test shall be continued for 12 hours after the mean inside temperature of the body has reached:

either the lower limit prescribed for the class to which the equipment is presumed to belong in the case of classes A, B and C (A = 0 °C; B = -10 °C; C = -20 °C); or

a level not lower than the upper limit prescribed for the class to which the equipment is presumed to belong in the case of classes D, E, and F (D = 0 °C; E = -10 °C; F = -20 °C).

Criterion of satisfaction

1.2.5 The test shall be deemed satisfactory if the refrigerating appliance is able to maintain the prescribed temperature conditions during the said 12-hour periods, with any automatic defrosting of the refrigerating unit not being taken into account

1.2.6 If the refrigerating appliance with all its accessories has undergone separately, to the satisfaction of the Testing Agency, a test to determine its effective refrigerating capacity at the prescribed reference temperatures, the transport equipment may be accepted as mechanically refrigerated equipment without undergoing an efficiency test if the effective refrigerating capacity of the appliance in continuous operation exceeds the heat loss through the walls for the class under consideration, multiplied by the factor 1.75

The proposed provision concerning the use of a multiplier factor of 1.75 when determnining the refrigerating capacity of the appliance to be installed on a body, it is to be applicable whether or not the body was fixed with an appliance when the K coefficient was measured. If during the insulation test the body was not equipped with an appliance does not exceed the class limits, in order to allow for the variation that might occur with equipment of different lengths or types.

1.2.7 If the mechanically refrigerating unit is replaced by a unit of a different type, the Testing Agency may

(a) require the equipment to undergo the determinations and verifications prescribed in paragraphs 1.2.1 to 1.2.4; or

(b) satisfy itself that the effective refrigerating capacity of the new mechanically refrigerating unit is, at the temperature prescribed for equipment of the class concerned, at least equal to that of the unit replaced; or

(c) satisfy itself that the effective refrigerating capacity of the new mechanically refrigerating unit meets the requirements of paragraph 1.2.6.

1.3 Heated equipment

Test method

1.3.1 The empty equipment shall be placed in an insulated chamber whose temperature shall be kept uniform and constant at as low a level as possible. The atmosphere of the chamber shall be made to circulate as described in paragraph 2.1.5 of Annexure II.

1.3.2 Temperature measuring instruments protected against radiation shall be placed inside and outside the body at the points specified in paragraphs 1.3 and 1.4 of Annexure II.

Test procedure

1.3.3 Doors, hatches and other openings shall be closed and the heating equipment and the inside ventilating appliances (if any) shall be started up at maximum capacity.

1.3.4 The mean outside temperature and the mean inside temperature of the body shall each be read at least every 30 minutes.

1.3.5 The test shall be continued for 12 hours after the difference between the mean inside temperature and the mean outside temperature of the body has reached the level corresponding to the conditions prescribed for the class to which the equipment is presumed to belong. In the case of new equipment, the above temperature difference shall be increased by 35 per cent.

Criterion of satisfaction

1.3.6 The test shall be deemed satisfactory if the heating appliance is able to maintain the prescribed temperature difference during the 12 hours aforesaid.

1.4 Mechanically refrigerated and heated equipment

Test method

1.4.1 The test shall be carried out in two stages. The efficiency of the refrigeration unit of the refrigerating or refrigerating-heating appliance is determined in the first stage and that of the heating appliance is determined in the second stage

1.4.2 In the first stage, the test shall be carried out in the conditions described in paragraphs 1.1.1 and 1.1.2 of this Annexure; in the second stage, it shall be carried out in the conditions described in paragraphs 1.3.1 and 1.3.2 of this Annexure

Test procedure

1.4.3 The basic requirements for the test procedure for the first stage are described in paragraphs 1.2.2 and 1.2.3 of this Annexure; those for the second stage are described in paragraphs 1.3.3 and 1.3.4 of this Annexure

1.4.4 The second stage of the test may be initiated immediately after the end of the first stage, without the measuring equipment being dismantled

1.4.5 In each stage, the test shall be continued for 12 hours after

(a) in the first stage, the mean inside temperature of the body has reached the lower limit prescribed for the class to which the equipment is presumed to belong;

(b) in the second stage, the difference between the mean inside temperature of the body and the mean outside temperature of the body has reached the level corresponding to the conditions prescribed for the class to which the equipment is presumed to belong. In the case of new equipment, the above temperature difference shall be increased by

35 per cent.

Criterion of satisfaction

1.4.6 The results of the test shall be deemed satisfactory if:

(a) in the first stage, the refrigerating or refrigerating-heating appliance is able to maintain the prescribed temperature conditions during the said 12-hour period, with any automatic defrosting of the refrigerating or refrigerating-heating unit not being taken into account;

(b) in the second stage, the heating appliance is able to maintain the prescribed temperature difference during the said 12-hour period.

1.4.7 If the refrigerating unit of the refrigerating or refrigerating-heating appliance with all its accessories has undergone separately, to the satisfaction of the Testing Agency, a test to determine its effective refrigerating capacity at the prescribed reference temperatures, the transport equipment may be accepted as having passed the first stage of the test without undergoing an efficiency test if the effective refrigerating capacity of the appliance in continuous operation exceeds the heat loss through the walls for the class under consideration, multiplied by the factor 1.75.

1.4.8 If the mechanically refrigerating unit of the refrigerating or refrigerating-heating appliance is replaced by a unit of a different type, the Testing Agency may

(a) require the equipment to undergo the determinations and verifications for the first stage of testing prescribed in paragraphs 1.4.1 to 1.4.5 of this Annexure; or

(b) satisfy itself that the effective refrigerating capacity of the new mechanically refrigerating unit is, at the temperature prescribed for equipment of the class concerned, at least equal to that of the unit replaced; or

(c) satisfy itself that the effective refrigerating capacity of the new mechanically refrigerating unit meets the requirements of paragraph 1.4.7 of this Annexure.

ANNEXURE IV

PROCEDURE FOR MEASURING THE EFFECTIVE REFRIGERATING CAPACITY W_O OF A UNIT WHEN THE EVAPORATOR IS FREE FROM FROST

0.0 This Annexure is optional in case of fully built vehicle is manufactured by OE manufacturer. OE manufacturer may declare refrigeration capacity.

1.0 General principles

1.1 When attached to either a calorimeter box or the insulated body of a unit of transport equipment, and operating continuously, this capacity is:

$$Wo = Wj + U.\,\Delta T$$

where U is the heat leakage of the calorimeter box or insulated body, Watts/°C.

Δ T is the difference between the mean inside temperature Ti and the mean outside temperature Te of the calorimeter or insulated body (K),

Wj is the heat dissipated by the fan heater unit to maintain each temperature difference in equilibrium

1.2 Test method

1.2.1 The refrigeration unit is either fitted to a calorimeter box or the insulated body of a unit of transport equipment

In each case, the heat leakage is measured at a single mean wall temperature prior to the capacity test. An arithmetical correction factor, based upon the experience of the testing agency, is made to take into account the average temperature of the walls at each thermal equilibrium during the determination of the effective refrigerating capacity.

It is preferable to use a calibrated calorimeter box to obtain maximum accuracy.

Measurements and procedure shall be as described in paragraphs 1.1 to 2.1.8 of Annexure II; however, it is sufficient to measure U the heat leakage only, the value of this coefficient being defined by the following relationship:

$$U = \frac{W}{\Delta T_m}$$

W is the heating power (in Watts) dissipated by the internal heater and fans;

ΔTm is the difference between the mean internal temperature Ti and the mean external temperature Te

U is the heat flow per degree of difference between the air temperature inside and outside the calorimeter box or unit of transport equipment measured with the refrigeration unit fitted.

The calorimeter box or unit of transport equipment is placed in a test chamber. If a calorimeter box is used, U.ΔT should be not more than 35% of the total heat flow Wo.

The calorimeter box or unit of transport equipment shall be heavily insulated

The U factor of a calorimeter box is usually measured without the regrigeration unit fitted to the aperture. In the case of a unit of transport equipment, measureemnt of U may be made with or without the refrigeration unit fitted to the insulated body, in the absence of a refrigeration unit an insulated panel is fitted to the aperture.

1.2.2 Instrumentation

Test agency shall be equipped with instruments to measure the U value to an accuracy of ± 5%. Heat transfer through air leakage should not exceed 5% of the total heat transfer through the calorimeter box or through the insulated body of the unit of transport equipment. The refrigerating capacity shall be determined with an accuracy of ± 5%.

The instrumentation of the calorimeter box or unit of transport equipment shall conform to paragraphs 1.3 and 1.4 of Annexure II. The following are to be measured:

(a) Air temperatures: At least four thermometers uniformly distributed at the inlet to the evaporator;

At least four thermometers uniformly distributed at the outlet to the evaporator;

At least four thermometers uniformly distributed at the air inlet(s) to the refrigeration unit;

The thermometers shall be protected against radiation

The accuracy of the temperature measuring system shall be ± 1°C

(b) Energy consumption: Instruments shall be provided to measure the electrical energy or fuel consumption of the refrigeration unit

The electrical energy and fuel consumption shall be determined with an accuracy of ±0.5%;

(c) Speed of rotation: Instruments shall be provided to measure the speed of rotation of the compressors and circulating fans or to allow these speeds to be calculated where direct measurement is impractical.

The speed of rotation shall be measured to an accuracy of ±1%;

(c) Pressure: High precision pressure gauges (accurate to ± 1%) shall be fitted to the condenser and evaporator and to the compressor inlet when the evaporator is fitted with a pressure regulator.

1.2.3 Test conditions

(i) The average air temperature at the inlet(s) to the refrigeration unit shall be maintained at 30 °C ± 1°C

The maximum difference between the temperatures at the warmest and at the coldest points shall not exceed 2 K

(ii) Inside the calorimeter box or the insulated body of the unit of transport equipment (at the air inlet to the evaporator): there shall be three levels of temperature between -25 °C and +12 °C depending on the characteristics of the unit, one temperature level being at the minimum prescribed for the class requested by the manufacturer with a tolerance of ± 1 K

The mean inside temperature shall be maintained within a tolerance of ± ± 1°C. During the measurement of refrigerating capacity, the heat dissipated within the calorimeter box or the insulated body of the unit of transport equipment shall be maintained at a constant level with a tolerance of ± 1%

When presenting a refrigeration unit for test, the manufacturer shall supply

- Documents describing the unit to be tested;

- A technical document outlining the parameters that are most important to the functioning of the unit and specifying their allowable range;

- The characteristics of the equipment series tested; and

- A statement as to which prime mover(s) shall be used during testing.

1.3 Test procedure

1.3.1 The test shall be divided into two major parts, the cooling phase and the measurement of the effective refrigerating capacity at three increasing temperature levels.

(a) Cooling phase; the initial temperature of the calorimeter box or transport equipment shall be 30 ºC ± 1°C It shall then be lowered to the following temperatures: -25 ºC for -20 ºC class, -13 ºC for -10 ºC class or -2 ºC for 0 ºC class;

(b) Measurement of effective refrigerating capacity, at each internal temperature level.

A first test to be carried out, for at least four hours at each level of temperature, under control of the thermostat (of the refrigeration unit) to stabilize the heat transfer between the interior and exterior of the calorimeter box or unit of transport equipment.

A second test shall be carried out without the thermostat in operation in order to determine the maximum refrigerating capacity, with the heating power of the internal heater producing an equilibrium condition at each temperature level as prescribed in paragraph 1.2.3

The duration of the second test shall be not less than four hours

Before changing from one temperature level to another, the box or unit shall be manually defrosted.

If the refrigeration unit can be operated by more than one form of energy, the tests shall be repeated accordingly.

If the compressor is driven by the vehicle engine, the test shall be carried out at both the minimum speed and at the nominal speed of rotation of the compressor as specified by the manufacturer.

If the compressor is driven by the vehicle motion, the test shall be carried out at the nominal speed of rotation of the compressor as specified by the manufacturer.

1.3.2 The same procedure shall be followed for the enthalpy method described below, but in this case the heat power dissipated by the evaporator fans at each temperature level shall also be measured.

This method may, alternatively, be used to test reference equipment. In this case, the effective refrigerating capacity is measured by multiplying the mass flow (m) of the refrigerant liquid by the difference in enthalpy between the refrigerant vapour leaving the unit (ho) and the liquid at the inlet to the unit (hi).

To obtain the effective refrigerating capacity, the heat generated by the evaporator fans (Wf) is deducted. It is difficult to measure Wf if the evaporator fans are driven by an external motor, in this particular case the enthalpy method is not recommended. When the fans are driven by internal electric motors, the electrical power is measured by appropriate instruments with an accuracy of ± 3%, with refrigerant flow measurement being accurate to ± 3%.

The heat balance is given by the formula:

$$Wo = (ho - hi)\,m - Wf.$$

An electric heater is placed inside the equipment in order to obtain the thermal equilibrium

1.3.3 Precautions

As the tests for effective refrigerating capacity are carried out with the thermostat of the refrigeration unit disconnected, the following precautions shall be observed:

If the equipment has a hot gas injection system, it shall be inoperative during the test;

With automatic controls of the refrigeration unit which unload individual cylinders (to tune the capacity of the refrigeration unit to motor output) the test shall be carried out with the number of cylinders appropriate for the temperature.

1.3.4 Checks

The following should be verified and the methods used indicated on the test report:

(i) the defrosting system and the thermostat are functioning correctly;

(ii) the rate of air circulation shall be measured using an existing standard;

If the air circulation of a refrigeration unit's evaporator fans is to be measured, methods capable of measuring the total delivery volume shall be used. Use of one of the relevant existing standards, i.e. ISO 5801: 2008, AMCA 210-99 and AMCA 210-07 is recommended;

(iii) the refrigerant used for tests is that specified by the manufacturer

1.4 Test result

1.4.1 The refrigeration capacity for ATP purposes is that relating to the mean temperature at the inlet(s) of the evaporator. The temperature measuring instruments shall be protected against radiation.

ANNEXURE V

PROCEDURE FOR MEASURING THE CAPACITY OF MECHANICAL MULTI-TEMPERATURE REFRIGERATION UNITS AND DIMENSIONING MULTI-COMPARTMENT EQUIPMENT

1.0 **Definitions**

(a) Multi-compartment equipment: Equipment with two or more insulated compartments for maintaining a different temperature in each compartment;

(b) Multi-temperature mechanical refrigeration unit: Mechanical refrigeration unit with compressor and common suction inlet, condenser and two or more evaporators set at different temperatures in the various compartments of multi-compartment equipment;

(c) Host unit: Refrigeration unit with or without an integral evaporator;

(d) Unconditioned compartment: a compartment considered to have no evaporator or for which the evaporator is inactive for the purposes of dimensioning calculations and certification;

(e) Multi-temperature operation: Operation of a multi-temperature mechanical refrigeration unit with two or more evaporators operating at different temperatures in multi-compartment equipment;

(f) Nominal refrigerating capacity: Maximum refrigerating capacity of the refrigeration unit in mono-temperature operation with two or three evaporators operating simultaneously at the same temperature;

(g) Individual refrigerating capacity (Pind-evap): The maximum refrigerating capacity of each evaporator in solo operation with the host unit;

(h) Effective refrigerating capacity (Peff-frozen-evap): The refrigerating capacity available to the lowest temperature evaporator when two or more evaporators are each operating in multi-temperature mode, as prescribed in paragraph 2.4.5.

2.0 **Test procedure for multi-temperature mechanical refrigeration units**

2.1 General procedure

The test procedure shall be as defined in section 4 of this Annexure.

The host unit shall be tested in combination with different evaporators. Each evaporator shall be tested on a separate calorimeter, if applicable.

The nominal refrigerating capacity of the host unit in mono-temperature operation, as prescribed in paragraph 2.2 of this Annexure, shall be measured with a single combination of two or three evaporators including the smallest and largest.

The individual refrigerating capacity shall be measured for all evaporators, each in mono-temperature operation with the host unit, as prescribed in paragraph 2.3 of this Annexure.

This test shall be conducted with two or three evaporators including the smallest, the largest and, if necessary, a mid-sized evaporator.

If the multi-temperature unit can be operated with more than two evaporators:

a) The host unit shall be tested with a combination of three evaporators: the smallest, the largest and a mid-sized evaporator.

b) In addition, on demand of the manufacturer, the host unit can be tested optionally with a combination of two evaporators: the largest and smallest.

The tests are done in independent mode and stand by.

2.2 Determination of the nominal refrigerating capacity of the host unit

The nominal refrigerating capacity of the host unit in mono-temperature operation shall be measured with a single combination of two or three evaporators operating simultaneously at the same temperature. This test shall be conducted at -20°C and at 0°C.

The air inlet temperature of the host unit shall be +30°C.

The nominal refrigerating capacity at -10°C shall be calculated by linear interpolation from the capacities at -20°C and 0°C.

2.3 Determination of the individual refrigerating capacity of each evaporator

The individual refrigerating capacity of each evaporator shall be measured in solo operation with the host unit. The test shall be conducted at -20°C and 0°C. The air inlet temperature of the refrigeration unit shall be +30°C.

The individual refrigerating capacity at -10°C shall be calculated by linear interpolation from the capacities at 0°C and -20°C.

2.3.1 Test of the remaining effective refrigerating capacities of a set of evaporators in multi-temperature operation at a reference heat load

The remaining effective refrigerating capacity shall be measured for each tested evaporator at -20°C with the other evaporator(s) operating under control of a thermostat set at 0 °C with a reference heat load of 20% of the individual refrigerating capacity at -20 °C of the evaporator in question. The air inlet temperature of the host unit shall be +30 °C.

For multi-temperature refrigeration units with more than one compressor such as cascade systems or units with two-stage compression systems, where the refrigerating capacities can be simultaneously maintained in the frozen and chilled compartments, the measurement of the effective refrigerating capacity, shall be done at one additional heat load.

2.4 **Dimensioning and certification of refrigerated multi-temperature equipment**

2.4.1 General procedure

The refrigerating capacity demand of multi-temperature equipment shall be based on the refrigerating capacity demand of mono-temperature equipment as defined in this Annexure.

For multi-compartment equipment, a K coefficient less than or equal to 0.40 $W/m^2.K$ for the outer body as a whole shall be approved in accordance with subsections 2 to 2.2 of Annexure II.

The insulation capacities of the outer body walls shall be calculated using the K coefficient of the body approved in accordance with this Agreement. The insulation capacities of the internal dividing walls shall be calculated using the K coefficients in the table in paragraph 2.4.7 of this Annexure.

For issuance of an type approval certificate:

- The nominal refrigerating capacity of the multi-temperature refrigeration unit shall be at least equal to the heat loss through the outer body walls of the equipment as a whole multiplied by the factor 1.75 as specified in paragraph 1.2.6 of Annexure III.

- In each compartment, the calculated remaining effective refrigerating capacity at the lowest temperature of each evaporator in multi-temperature operation shall be greater than or equal to the maximum refrigeration demand of the compartment in the most unfavourable conditions, as prescribed in paragraphs 2.4.5 and 2.4.6 of this Annexure, multiplied by the factor 1.75 as specified in paragraph 1.2.6 of this Annexure III.

2.4.2 Conformity of the entire body

The outer body shall have a K value $K \leq 0.40\ W/m^2.K$.

The internal surface of the body shall not vary by more than 20 %.

The equipment shall conform to:

$$P_{nominal} > 1.75 * K_{body} * S_{body} * \Delta T$$

Where:

Pnominal is the nominal refrigerating capacity of the multi-temperature refrigeration unit,

Kbody is the K value of the outer body,

Sbody is the geometric mean surface area of the full body,

ΔT is the difference in temperature between outside and inside the body.

2.4.3 Determination of the refrigerating demand of chilled evaporators

With the bulkheads in given positions, the refrigerating capacity demand of each chilled evaporator is calculated as follows:

$$P_{chilled\ demand} = (S_{chilled\text{-}comp} - \Sigma S_{bulk}) * K_{body} * \Delta T_{ext} + \Sigma (S_{bulk} * K_{bulk} * \Delta T_{int})$$

Where:

Kbody is the K value given by an ATP test report for the outer body,

Schilled-comp is the surface of the chilled compartment for the given positions of the bulkheads,

Sbulk are the surfaces of the bulkheads,

Kbulk are the K values of the bulkheads given by the table in paragraph 2.4.7,

ΔText is the difference in temperatures between the chilled compartment and +30°C outside the body,

ΔTint is the difference in temperatures between the chilled compartment and other compartments. For unconditioned compartments a temperature of +20°C shall be used for calculations.

2.4.4 Determination of the refrigerating demand of frozen compartments

With the bulkheads in given positions, the refrigerating capacity demand of each frozen compartment is calculated as follows:

Pfrozen demand = (Sfrozen-comp – ΣSbulk) * Kbody* ΔText + Σ (Sbulk * Kbulk* ΔTint)

Where:

Kbody is the K value given by an ATP test report for the outer body,

Sfrozen-comp is the surface of the frozen compartment for the given positions of the bulkheads,

Sbulk are the surfaces of the bulkheads,

Kbulk are the K values of the bulkheads given by the table in paragraph 2.4.7,

ΔText is the difference in temperatures between the frozen compartment and +30 °C outside the body,

ΔTint is the difference in temperatures between the frozen compartment and other compartments. For insulated compartments a temperature of +20°C shall be used for calculations.

2.4.5 Determination of the effective refrigerating capacity of frozen evaporators

The effective refrigerating capacity, in given positions of the bulkheads, is calculated as follows:

Peff-frozen-evap = Pind-frozen-evap * [1 - Σ (Peff-chilled-evap / Pind-chilled-evap)]

Where:

Peff-frozen-evap is the effective refrigerating capacity of the frozen evaporator with a given configuration,

Pind-frozen-evap is the individual refrigeration capacity of the frozen evaporator at -20 °C,

Peff-chilled-evap is the effective refrigeration capacity of each chilled evaporator in the given configuration as defined in paragraph 2.4.6,

Pind-chilled-evap is the individual refrigerating capacity at -20 °C for each chilled evaporator.

This calculation method is only approved for multi-temperature mechanical refrigeration units with a single one-stage compressor. For multi-temperature refrigeration units with more than one compressor such as cascade systems or units with two-stage compression systems, where the refrigerating capacities can be simultaneously maintained in the frozen and the chilled compartments, this calculation method shall not be used, because it will lead to an underestimation of the effective refrigerating capacities. For this equipment, the effective refrigerating capacities shall be interpolated between the effective refrigerating capacities measured with two different heat loads given in the tests reports as prescribed in 2.3.1 of this Annexure.

2.4.6 Conformity declaration

The equipment is declared in conformity in multi-temperature operation if, for each position of the bulkheads, and each distribution of temperature in the compartments:

Peff-frozen-evap ≥ 1.75 * Pfrozen demand

Peff-chilled-evap ≥ 1.75 * Pchilled demand

Where:

Peff-frozen-evap is the effective refrigeration capacity of the considered frozen evaporator at the class temperature of the compartment in the given configuration,

Peff-chilled-evap is the effective refrigeration capacity of the considered chilled evaporator at the class temperature of the compartment in the given configuration,

Pfrozen demand is the refrigerating demand of the considered compartment at the class temperature of the compartment in the given configuration as calculated according to 2.4.4,

Pchilled demand is the refrigerating demand of the considered compartment at the class temperature of the compartment in the given configuration as calculated according 2.4.3.

It shall be considered that all the positions of the bulkheads have been dimensioned if the wall positions from the smallest to the largest compartment sizes are checked by iterative methods whereby no input step change in surface area is greater than 20 %.

2.4.7 Internal dividing walls

Thermal losses through internal dividing walls shall be calculated using the K coefficients in the following table.

	K coefficient-[W/m^2.K]		Minimum foam thickness [mm]
	Fixed	Removable	
Longitudinal-alu floor	2.0	3.0	25
Longitudinal –GRP floor	1.5	2.0	25
Transversal-alu floor	2.0	3.2	40
Transversal-GRP floor	1.5	2.6	40

K coefficients of movable dividing walls include a safety margin for specific ageing and unavoidable thermal leakages.

For specific designs with additional heat transfer caused by additional thermal bridges compared to a standard design, the partition K coefficient shall be increased.

2.4.8 The requirements of Annexure V shall not apply to equipment produced before the entry into force of the requirements and having undergone equivalent tests as multi-temperature equipment. Equipment produced before the entry into force of this section may be operated in international transport but may only be transferred from one country to another with the agreement of the competent authorities of the countries concerned.

ANNEXURE VI

SELECTION OF EQUIPMENT AND TEMPERATURE CONDITIONS TO BE OBSERVED FOR THE CARRIAGE OF QUICK (DEEP)-FROZEN AND FROZEN FOODSTUFFS

1.0 For the carriage of the following quick (deep)-frozen and frozen foodstuffs, the transport equipment has to be selected and used in such a way that during carriage the highest temperature of the foodstuffs at any point of the load does not exceed the indicated temperature.

By that means the equipment used for the transport of quick-frozen foodstuffs shall be fitted with the device referred to in Annexure 4. If however one should proceed to the verification of the temperature of the foodstuff, this shall be done according to the procedure laid down in Annexure 5 to this standard.

2.0 Accordingly, the temperature of the foodstuffs at any point in the load must be at or below the indicated value on loading, during carriage and on unloading.

3.0 Where it is necessary to open the equipment, e.g. to carry out inspections, it is essential to ensure that the foodstuffs are not exposed to procedures or conditions contrary to the objectives of this annex and those of the International Convention on the Harmonization of Frontier Controls of Goods.

4.0 During certain operations, such as defrosting the evaporator of mechanically refrigerated equipment, a brief rise of the temperature of the surface of the foodstuffs of not more than 3 °C in a part of the load, e.g. near the evaporator, above the appropriate temperature may be permitted.

Ice cream	-20 °C
Frozen or quick (deep)-frozen fish, fish products, molluscs and crustaceans and all other quick (deep)-frozen foodstuffs	-18 °C
All other frozen foodstuffs (except butter)	-12 °C
Butter	-10 °C
Deep-frozen and frozen foodstuffs mentioned below to be immediately further processed at destination: (6)	
Butter	
Concentrated fruit juice	

(1) The deep-frozen and frozen foodstuffs listed, when intended for immediate further processing at destination, may be permitted gradually to rise in temperature during carriage so as to arrive at their destination at temperatures no higher than those specified by the sender and indicated in the transport contract. This temperature should not be higher than the maximum temperature authorized for the same foodstuff when refrigerated as mentioned in Annexure VIII of this standard. The transport document shall state the name of the foodstuff, whether it is deep-frozen or frozen and that it is immediately to be further processed at destination. This carriage shall be undertaken with approved equipment without use of a thermal appliance to increase the temperature of the foodstuffs.

ANNEXURE VII

MONITORING OF AIR TEMPERATURE FOR TRANSPORT OF QUICK-FROZEN PERISHABLE FOODSTUFFS

1.0 The transport equipment shall be fitted with an instrument capable of measuring and recording air temperatures and storing the data obtained (hereinafter referred to as the instrument) to monitor the air temperatures to which quick-frozen foodstuffs intended for human consumption are subjected.

2.0 The instrument shall be verified in accordance with EN 13486 (Temperature recorders and thermometers for the transport, storage and distribution of chilled, frozen, deep-frozen/quick-frozen food and ice cream – Periodic verification) by an accredited body and the documentation shall be available for the approval of competent authorities.

3.0 The instrument shall comply with standard EN 12830 (Temperature recorders for the transport, storage and distribution of chilled, frozen, deep-frozen/quick-frozen food and ice cream – Tests, performance, suitability).

4.0 Temperature recordings obtained in this manner must be dated and stored by the operator for at least one year or longer, according to the nature of the food.

5.0 Minimum requirements for measuring instrument

5.1 The measuring instrument must measure air temperature in transport equipment with an accuracy of at least ± 1 °C

5.2 The measuring instrument must allow for measuring air temperature and recording/logging the measured value of the air temperature

5.2.1 At least once every 5 minutes if the duration of the journey does not exceed 24 hours

5.2.2 At least once every 15 minutes if the duration of the journey is between 24 hours and 7 days

5.2.3 At least once every 60 minutes if the duration of the journey exceeds 7 days

5.3 The recording instrument should make it possible to determine whether the instrument or its components for the measurement and recording and storage of the values of air temperature have shut down during the carriage of quick-frozen perishable foodstuffs

5.4 Where it is possible, the measuring instruments should be place inside the body of the transport equipment in the area with the highest air temperature in accordance with the para 2 of Annexure VI.

5.4.1 In the case of upper cold air distribution systems, near (to the left or right of) the bottom of the doorway furthest away from the refrigeration unit.

5.4.2 In the case of lower cold air distribution system, in the middle of the portion above the doorway furthest away from the refrigeration unit.

5.5 The instrument shall be adequately protected to avoid damage caused by moving parts of equipment or contact with cargo items during loading and unloading or shifting or partial or complete collapse of stacks of cargo during carriage.

No means of protection of the instruments (e.g. protective housing or placement of the measuring instrument in a protective housing in a recess in a wall of the transport equipment, if any) should affect the accuracy of the air temperature measurements inside the transport equipment.

ANNEXURE VIII

SELECTION OF EQUIPMENT AND TEMPERATURE CONDITIONS TO BE OBSERVED FOR THE CARRIAGE OF CHILLED FOODSTUFFS

1 For the carriage of the following chilled foodstuffs, the transport equipment has to be selected and used in such a way that during carriage the highest temperature of the foodstuffs at any point of the load does not exceed the indicated temperature.

2 Accordingly, the temperature of the foodstuffs at any point in the load must not exceed the temperature as indicated below on loading, during carriage and on unloading.

3 Where it is necessary to open the equipment, e.g. to carry out inspections, it is essential to ensure that the foodstuffs are not exposed to procedures or conditions contrary to the objectives of this Annex and those of the International Convention on the Harmonization of Frontier Controls of Goods

4 The temperature control of foodstuffs specified in this Annex should be such as not to cause freezing at any point of the load.

Raw milk(1)	+ 6 °C
Red meat(2) and large game (other than red offal)	+ 7 °C
Meat products, (3) pasteurized milk, butter, fresh dairy products (yoghurt, kefir, cream and fresh cheese(4)), ready cooked foodstuffs (meat, fish, vegetables), ready to eat prepared raw vegetables and vegetable products5, concentrated fruit juice and fish products(3) not listed below	Either at + 6 °C or at temperature indicated on the label and/or on the transport documents
Game (other than large game), poultry2 and rabbits	+ 4 °C
Red offal(2)	+ 3 °C
Minced meat(2)	Either at +2 °C or at temperature indicated on the label and/or on the transport documents
VII Untreated fish, molluscs and crustaceans (6)	On melting ice or at temperature of melting ice

Note:- (1) When milk is collected from the farm for immediate processing, the temperature may rise during carriage to +10 °C.

(2) Any preparations thereof.

(3) Except for products fully treated by salting, smoking, drying or sterilization.

(4) "Fresh cheese" means a non-ripened (non-matured) cheese which is ready for consumption shortly after manufacturing and which has a limited conservation period.

(5) Raw vegetables which have been diced, sliced or otherwise size reduced, but excluding those which have only been washed, peeled or simply cut in half.

(6) Except for live fish, live molluscs and live crustaceans

ANNEXURE IX

TECHNICAL INFORMATION TO BE SUBMITTED BY VEHICLE MANUFACTURER/ RETROFITTER

Specifications of the equipment (equipment other than tanks for the carriage of liquid foodstuff

Sr. No.	Content	Description
1.1	Name	
1.2	Address	
2.0	Type of equipment:[2]	
2.1	Make	
2.2	Unladen Weight	
2.3	Carrying capacity[3] (kg)	
3.0	Body:	
3.1	Make	
3.2	Type	
3.3	Identification number	
3.4	Built by	
3.6	Submitted by	
3.7	Date of construction	
4.0	Principal dimensions:	
4.1	Outside length (m)	
4.2	Width (m)	
4.3	Height (m)	
4.4	Inside Length (m)	
4.5	Width (m)	
4.6	Height m)	
4.7	Total floor area of body (m^2)	
4.8	Usable internal volume of body (m^3)	
4.9	Total inside surface area S_1 of body (m^2)	
4.10	Total outside surface area, S_e of body (m^2)	
4.11	Mean surface area $S = \sqrt{Si.Se}$ (m^2)	
5.0	Specifications of the body walls[4]	

5.1	Top	
5.2	Bottom	
5.3	Sides	
6.0	Structural peculiarities of body[5]	
6.1	Number,) of doors	
6.2	Positions) of vents	
6.3	And dimensions) of ice-loading apertures	
7.0	Accessories[6], if fitted	
8.0	K coefficient (W/m^2.K)	

(1) Delete as necessary
(2) Wagon, lorry, trailer, semi-trailer, container, etc.
(3) State source of information.
(4) Nature and thickness of materials constituting the body walls, from the interior to the exterior, mode of construction, etc.
(5) If there are surface irregularities, show how Si and Se were determined. 6 Meat bars, flettner fans, etc.
(6) Meat bars, flettner fans, etc.

Specifications of tanks for the carriage of liquid foodstuffs

Sr. No.	Content	Description
1.0	Name	
1.1	Address	
2.0	Type of tank[2]	
2.1	Make	
2.3	Serial number	
2.5	Unladen Weight 3	
2.6	Carrying capacity[3] (kg)	
3.0	Tank	
3.1	Make	
3.2	Type	
3.3	Identification number	
3.4	Built by	
3.5	Submitted by	
3.6	Date of construction	

3.7	Principal dimensions:	
3.8	Outside Length of cylinder (m)	
3.9	Major axis (m)	
3.10	Minor axis (m)	
3.11	Inside Length of cylinder (m)	
3.12	Major axis (m)	
3.13	Minor axis (m)	
3.14	Usable internal volume (m^3)	
3.15	Internal volume of each compartment (m^3)	
3.16	Total inside surface area Si of tank (m^2)	
3.17	Inside surface area of each compartment S_{i1} (m^2)	
3.18	Total outside surface area Se of tank (m^2)	
3.19	Mean surface area of tank $S = \sqrt{Si.Se}$ (m^2)	
4.0	Specifications of the tank walls [4]	
5.0	Structural peculiarities of the tank [5]	
5.1	Number, dimensions and description of manholes	
5.2	Description of manhole covers	
5.3	Number, dimensions and description of discharge piping	
5.4	Number and description of tank cradles	
6.0	Accessories, if fitted [6]	

(1) Delete as necessary
(2) Wagon, lorry, trailer, semi-trailer, container, etc.
(3) State source of information.
(4) Nature and thickness of materials constituting the tank walls, from the interior to the exterior, mode of construction, etc.
(5) If there are surface irregularities, show how Si and Se were determined.
(6) Meat bars, flettner fans, etc.

ANNEXURE X

TEST REPORT FORMAT

Test Report No…………..

1.0	**Testing Agency**		
1.1	Name		
1.2	Address		
2.0	**Refrigeration unit presented by**		
2.1	Name		
2.1	Address		
3.0	Technical specifications of the unit		
3.1	Date of manufacture		
3.2	Make		
3.4	Type		
3.5	Sr. No.		
3.6	Category (1)		
3.6.1	Self-contained/not self-contained		
3.6.2	Removable/not removable		
3.6.3	Single unit/assembled components		
3.6.4	Description		
4.0	**Compressor**		
4.1	Make		
4.2	Type		
4.3	Number of cylinders		
4.4	Cubic Capacity		
4.5	Nominal speed of rotation(RPM)		
4.6	Methods of drive(1)		
4.6.1	Electric motor/ Separate internal combustion engine/ Vehicle engine/ Vehicle motion		
4.7	Compressor drive motor (1)(2)		
4.7.1	Electrical		
4.7.2	Make		

4.7.3	Type			
4.7.4	Power (W) at RPM (Specify both parameters)			
4.7.5	Supply voltage (V)			
4.7.6	Supply Frequency (Hz)			
4.8	Internal Combustion Engine			
4.8.1	Make			
4.8.2	Type			
4.8.3	Number of cylinders			
4.8.4	Cubic capacity			
4.8.5	Power (W) at RPM (Specify both parameters)			
4.8.6	Fuel			
4.9	Hydraulic motor			
4.9.1	Make			
4.9.2	Type			
4.9.3	Method of drive			
4.10	Alternator			
4.10.1	Make			
4.10.2	Type			
4.10.3	Method of drive			
4.11	Speed of rotation			
4.11.1	Nominal speed given by manufacturer(RPM)			
4.11.2	Minimum Speed (RPM)			
4.12	Refrigerant fluid			
4.13	Heat Exchanger			
		Condenser	Evaporator	
4.13.1	Make-type			
4.13.2	Number of tubes			
4.13.3	Fan pitch (mm) (2)			
4.13.5	Tube : nature and diameter (mm) (2)			

4.13.6	Exchange surface area (m^2) (2)			
4.13.7	Frontal area (m^2)			
4.13.8	Fans			
4.13.8.1	Number			
4.13.8.2	Number of blades per fan			
4.13.8.3	Diameter (mm)			
4.13.8.4	Nominal power (W) (2) (3)			
4.13.8.5	Total nominal power at pressure ------ Pa (m^3h) (2)			
4.13.8.6	Method of drive			
4.14	Expansion valve			
4.14.1	Make			
4.14.2	Model			
4.14.3	Adjustable(1)			
4.14.4	Not adjustable(1)			
4.15	Defrosting device			
4.16	Automatic device			

Results of measurement and refrigerating performance

(Mean temperature of the air to the inlet (s) of the refrigeration unit------ °C)

Speed of rotation										
	Fans (3)	Alternator(3)	compressor(3)	Power of internal fan heater	Power absorbed by the unit cooler fan (4)	Fuel of electrical power consumption	Mean temperature around the body	Internal temperature		Effective refrigerating capacity
								Mean	Inlet to evaporato	
	rpm	rpm	rpm	W	W	W or l/hr	°C	°C	°C	W

Nominal										
Minimal										

5.0	**Test method and results**		
5.1	Test method[(1)]		
5.1.1	Heat balance method/ enthalpy difference method		
5.2	In calorimeter box of mean surface area (m^2)		
5.2.1	Measured value of the U-coefficient of box fitted with refrigerated unit (W/°C) at a mean wall temperature of (°C) (Specify both parameters		
5.3	In an item of transport equipment		
5.3.1	Measured value of the U-coefficient of an item of transport equipment fitted with refrigerated unit (W/°C) at a mean wall temperature of (°C) (Specify both parameters		
5.4	Method employed for the correction of the U-coefficient of the body as a function of the means wall temperature of the body.		

5.5	Maximum errors of determination of:		
5.5.1	U-coefficient of the body		
5.5.2	Refrigerated capacity of body		
6.0	Checks		
6.1	Temperature regulator		
6.1.1	Setting (°C)		
6.1.2	Differential (°C)		
6.2	Functioning of the defrosting device (1)		
6.2.1	Satisfactory / Unsatisfactory		
6.3	Air flow volume leaving the evaporator (m^3/h) at pressure of (Pa)		
6.4	Existence of a means of supplying heat to the evaporator for setting the thermostat between 0 and 12°C (1): Yes/No		
7.0	Remark		

(1) Delete where applicable
(2) Value indicated by the manufacture
(3) Where applicable
(4) Enthalpy difference method only

Date	Test report prepared By	Verified By	Authorised By

ANNEXURE XI

Panel Composition

Chairperson	**Organization**
Mr. A. A. Badusha	ARAI
Members	**Representing**
Dr. A. V. Marathe	ARAI
Mr. Vikram Tandon	ARAI
Mr. Kamalesh B. Patil	ARAI
Mr. Sujit Chinchwade	ARAI
Mr. Pratik Nayak	ARAI
Ms. Vijayanta Ahuja	iCAT
Mr. S. N. Dhole	CIRT
Mr. Mangesh Pathak	CIRT
Mr. Uday Harite	ACMA
Mr. P. S. Gowrishankar	SIAM (Tata Motors Ltd.)
Mr. Sharad S. Bhole	SIAM (Tata Motors Ltd.)
Ms. Namrata Deb	SIAM(Tata Motors Ltd)
Mr. V. G. Kulkarni	SIAM (Mahindra Truck & Bus Div.)
Mr. Arun Jalali	SIAM(Mahindra)
Mr. Rajkumar Diwedi	SIAM (Maruti Suzuki)
Ms. Buvaneswari	SIAM(Maruti Suzuki)
Mr. Utsav Sherekar	SIAM(Maruti Suzuki)
Mr. Srikanth Nalluri	SIAM(Maruti Suzuki)
Mr. Faustino	SIAM(Ashok Leyland Ltd.)
Ms. Suchismita Chaterjee	SIAM(Ashok Leyland)

Mr. S. Ravishankar	SIAM(Ashok Leyland)
Mr. Prabhakar Chaurasia	AutoApps Engg. Soln. Pvt Ltd.
Mr. Pankaj Mehta	Carrier Transicold
Mr. Joshua R. Dsouza	Carrier Transicold
Mr. Dhanesh Subhash Patil	Nandan GSE Pvt Ltd
Mr. Hirdesh Singh Thakur	Pinnacle Industries
Mr. Swapnil Tambe	Pinnacle Industries
Col. Mahesh Mathur	Sub Zero Insulation Technologies
Mr. Deep Khira	Sub Zero Insulation Technologies
Mr. V. P. Vargheese	Suraksha Transport Systems India

ANNEXURE XII

COMMITTEE COMPOSITION

Automotive Industry Standards Committee

Chairperson	
Dr. Reji Mathai	Director, The Automotive Research Association of India, Pune
Members	**Representing**
Representative from	Ministry of Road Transport and Highways (Dept. of Road Transport and Highways), New Delhi
Representative from	Ministry of Heavy Industries and Public Enterprises (Department of Heavy Industry), New Delhi
Shri S. M. Ahuja	Office of the Development Commissioner, MSME, Ministry of Micro, Small and Medium Enterprises, New Delhi
Shri Shrikant R. Marathe	Former Chairman, AISC
Shri R.R. Singh	Bureau of Indian Standards, New Delhi
Director	Central Institute of Road Transport, Pune
Director	Global Automotive Research Centre
Director	International Centre for Automotive Technology, Manesar
Director	Indian Institute of Petroleum, Dehra Dun
Director	Vehicles Research and Development Establishment, Ahmednagar
Director	Indian Rubber Manufacturers Research Association
Representatives from	Society of Indian Automobile Manufacturers
Shri R. P. Vasudevan	Tractor Manufacturers Association, New Delhi
Shri Uday Harite	Automotive Components Manufacturers Association of India, New Delhi
Shri K. V. Krishnamurthy	Indian Construction Equipment Manufactures' Association (ICEMA), New Delhi
Member Secretary	
Shri Vikram Tandon	The Automotive Research Association of India, Pune