TC 20

International Standard 8058

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Air cargo equipment — Air mode insulated containers — Thermal efficiency requirements

Équipement pour le fret aérien — Conteneurs isothermes pour transport aérien — Caractéristiques de rendement thermique

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Air cargo equipment — Air mode insulated containers — Thermal efficiency requirements

0 Introduction

0.1 This International Standard specifies supplementary requirements for air cargo insulated containers of all sizes.

0.2 Nothing in this International Standard shall in any way cancel or reduce the status of the specifications which determine airworthiness, industry, ground handling or any other characteristics of the units.

0.3 This International Standard refers to the thermal efficiency of all insulated air cargo containers irrespective of their size and designation. It does not provide details concerning refrigerated or heated containers and/or the methods and equipment used to obtain the required thermal effect, such as cryogenic, gaseous or liquid fluids, or mechanical compressors.

0.4 In preparing this International Standard for compatibility and guidance purposes, the requirements of ISO 1496/2, *Series 1 freight containers — Specification and testing — Part 2 : Thermal containers*, have been taken into account as far as procedures for measuring the thermal efficiency are concerned.

1 Scope and field of application

1.1 This International Standard specifies the minimum operational requirements that will ensure that perishable cargoes in insulated standard airborne containers are kept in prime condition during the ground handling and air transportation cycle for a maximum period of 36 h.

1.2 The term "perishable cargo" refers, for example, to dairy produce, fruit, vegetables, flowers, frozen foods, meat, fish, etc., requiring maintenance of specific temperature ranges during door-to-door transportation involving air transport.

1.3 The overall temperature range for perishable commodities may be anywhere between + 20 °C (+ 68 °F) and − 25 °C (− 13 °F) during the transport cycle.

1.4 During this period of door-to-door transportation, the container may be subjected to outside ambient temperature with extremes of + 45 °C (+ 113 °F) and − 50 °C (− 58 °F) and a relative humidity of up to 100 %.

1.4.1 For design purposes, the container shall perform its protective function within an outside temperature variation, ΔT, within the range of temperature exposure extremes stated in 1.4, of 53 °C (95 °F) so as to allow for temperature drops and rises occurring between origin and destination in the air transport cycle.

2 Design considerations

2.1 In the design of the container, careful consideration shall be given to the contribution of conduction, convection, radiation and air leakage to the overall thermal efficiency of the unit. At the same time, an optimum balance between insulation, structure, cost and weight shall be a constant design goal.

2.2 Although no specific test is specified in clause 5 for thermal radiation, it is expected that consideration will be given to commonly encountered environments wherein radiant energy exchange can be minimized.

2.3 The container shall be free of sharp corners and/or crevices which might collect dirt, spillage or odours. No pockets shall exist in the cargo loading space that cannot be reached by conventional cleaning methods.

2.4 The construction shall be such that spillage collects during the transport cycle but runs off during flushing and/or washing. Adequate provision shall be made to ensure that cleaning water can satisfactorily drain from the inside of the container.

2.5 Materials used for the container structure, the interior surfaces and the insulation shall absorb neither moisture nor odours and shall not be functionally affected by daily washing.

2.5.1 Methods of washing shall include flushing using a pressure hose at 689 kPa (100 psig), 70 °C (158 °F) temperature and strong detergents. Washing may also be carried out by steam cleaning at 110 °C (230 °F).

2.5.2 When "washed", the container shall not require the use of odour-neutralizing chemicals.

2.5.3 The container shall withstand freezing temperatures while wet immediately following washing. All valves, seals, doors and controls shall remain operative.

3 Pressurization

3.1 General conditions

Containers shall be closed at differing terminal altitudes. The critical condition shall be that at sea level. Operationally, the container could be subjected to either internal positive or negative pressure. Careful attention to the design of equalization devices (if any) and all seals is important in the control of air leakage heat transfer.

3.2 Pressure equalization

Further to 3.1, if the design of door seals is not adequate to relieve pressure, a pressure equalization device should be installed for two-way equalization. This pressure relief device should be set to operate at 3,45 to 6,89 kPa (0.5 to 1.0 psig) pressure differentials.

4 Airtightness tests

4.1 The container shall be subjected to tests to determine the air leakage rate. These shall be carried out after completion of the applicable operational or limit load tests (if any) required in other specifications related to the specific container involved.

4.2 The temperature inside and outside the container shall be stabilized within 3 °C (5.4 °F) of each other and shall both be within the range of 15 to 25 °C (59 to 77 °F). The container shall be empty and in its normal operational condition with the access doors closed in the normal manner. Any drain openings shall be closed.

4.3 Air shall be introduced through an accurate metering device and a suitable manometer shall be connected to the container by a leakproof connection. The manometer shall not be part of the air supply system. The flow-measuring device shall be accurate to ± 3 % of the measured flow rate, and the manometer on the container shall be accurate to ± 5 %.

4.4 Air shall be admitted to the container to raise its internal pressure to 0,25 ± 0,01 kPa (0.036 ± 0.001 5 psig) and the air supply regulated to maintain this pressure.

4.4.1 The air leakage rate, expressed in standard atmospheric conditions, should be no more than the values given in table 1 (see annex A), i.e. 40 % of the internal volume per hour. If the measured air leakage is equal to or less than the values given in table 1, the heat transfer results determined in the thermal test (see clause 5) shall be reported without correction for air leakage.

4.4.2 If the measured air leakage exceeds these values, but is no more than the values given in table 2 (see annex A), then the U values measured in the thermal test shall be increased by the correction values given in table 3 (see annex A).

4.5 The air pressure shall be increased to between 3,45 and 6,89 kPa (0.5 to 1.0 psig) internal pressure. The pressure relief device, or door seal expulsion, shall operate within the positive differential range of 3,45 to 6,89 kPa (0.5 to 1.0 psig).

4.6 Upon completion of the tests described in 4.2 to 4.5, there shall be no permanent deformation and the container shall be fully operational. Closures, seals and pressure equalization device shall be intact and functional.

5 Thermal test

5.1 This test is performed to establish the overall heat transfer rate, or K factor, of the container. The container shall be tested in the exact configuration intended for use. Any options or component configuration alternatives shall be tested in a separate test and appropriately specified, when applicable, in the container performance data on the marking plate described in clause 6.

5.1.1 The heat leakage shall be expressed by the total heat transfer rate, U_θ, which is given by the formula

$$U_\theta = \frac{Q}{\theta_e - \theta_i}$$

where

U_θ is the total heat transfer rate, expressed in watts per degree Celsius[1)];

Q is the power dissipated or absorbed by the operation of internal heaters and fans or internal cooling units, in watts;

θ_e is the average outside temperature, in degrees Celsius, which shall be the arithmetic mean of the temperatures recorded at the end of each test interval (see 5.4.7) and measured 100 mm from the walls, at least at the 12 points specified in 5.3.2 and shown in figure 1 (see annex B);

θ_i is the average inside temperature, in degrees Celsius, which shall be the arithmetic mean of the temperatures recorded at the end of each test interval (see 5.4.7) and measured 100 mm from the walls, at least at the 12 points specified in 5.3.1 and shown in figure 2 (see annex B);

θ is the mean wall temperature, in degrees Celsius; by convention :

$$\theta = \frac{\theta_e + \theta_i}{2}$$

5.1.2 The coefficient of heat transfer, K, expressed in watts per square metre degree Celsius, is such that

$$K = \frac{U_\theta}{S}$$

where

U_θ is as defined in 5.1.1;

1) 1 W/°C = 0,556 W/°F = 0,860 kcal/(h·°C) = 1.895 Btu/(h·°F)

S is the mean surface area of the container, in square metres, which is the geometric mean of the inside surface area S_i and the outside surface area S_e; by convention :

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

If areas are corrugated, the projected area shall be used.

5.2 The test shall be performed under steady-state conditions using the internal heating method. All measuring systems shall be selected and calibrated to result in the following root-mean-square average accuracies :

Temperatures : ± 0,5 °C (± 0.9 °F)

Power : ± 2 % of the quantity measured

5.3 The temperatures shall be measured in accordance with 5.3.1 and 5.3.2.

5.3.1 The inside air temperature shall be measured 100 mm from the walls at least at the following 12 points (see annex B, figure 2) :

a) the eight inside corners of the container;

b) the centres of the side walls, floor and ceiling.

5.3.2 The outside air temperature shall be measured 100 mm from the walls at least at the following 12 points (see annex B, figure 1) :

a) the eight outside corners of the container;

b) the centres of the side walls, underside and roof.

5.4 Test data for determining the heat leakage of the container shall be taken after an appropriate soak period to stabilize the wall temperature for the continuous period of not less than 8 h during which the following conditions shall be satisfied.

5.4.1 The test shall be performed with a mean wall temperature chosen between 10 and 45 °C (50 and 113 °F), and a temperature difference between inside and outside of not less than 28 °C (50 °F).

NOTE — It should be noted that a standard mean wall temperature of 10 °C (50 °F) should be used for rating thermal containers because it allows a better determination of all factors involved in the in-service conditions in which the containers will be operated, and facilitates comparison of different containers by owners and users. It also eliminates misunderstanding in applying the total heat transfer rate values for different mean wall temperatures. Appropriate correction factors may be employed for the specific insulation material being used.

5.4.2 The maximum difference between the warmest and coldest points inside at any one time : 3 °C (5.4 °F).

5.4.3 The maximum difference between the warmest and coldest points outside at any one time : 3 °C (5.4 °F).

5.4.4 The maximum percentage difference between the lowest and the highest power dissipation values in watts shall not exceed 3 % of the lowest figure.

5.4.5 The maximum difference between any two average inside air temperatures, θ_i, at different times : 1,5 °C (2.7 °F).

5.4.6 The maximum difference between any two average ouside air temperatures, θ_e, at different times : 1,5 °C (2.7 °F).

5.4.7 All readings shall be recorded at intervals of not more than 30 min.

5.4.8 All temperature measuring instruments placed inside and outside the container shall be designed so as to render the effect of radiation negligible.

5.5 Calculate the total heat transfer rate, U_θ, in watts per degree Celsius, and the mean wall temperature, θ, in degrees Celsius

$$U_\theta = \frac{Q}{\theta_e - \theta_i}$$

and

$$\theta = \frac{\theta_e + \theta_i}{2}$$

where

Q is the power dissipated by the operation of internal heaters and fans, in watts, for the test period;

θ_e is the average outside air temperature, in degrees Celsius, during the test, as calculated from at least 17 sets of readings;

θ_i is the average inside air temperature, in degrees Celsius, during the test, as calculated from at least 17 sets of readings.

5.6 No test method shall result in frost build-up which could affect the test result in any way.

6 Markings

6.1 The markings required for handling shall include the following particulars :

a) the total heat transfer rate, U_θ, expressed in watts per degree Celsius;

b) the applicable mean wall temperature, θ, expressed in degrees Celsius.

6.2 The plate shall be 60 mm × 125 mm and permanently affixed to the container with black Gothic bold lettering 10 mm high with the following format :

Heat transfer rate ..... W/°C [Btu/(h·°F)]
Mean wall temperature..... °C (°F)

6.3 A sample perishable commodity capability should be indicated for guidance to the user. Suitable wording such as the following should be marked :

If the commodity temperature to be maintained is 0 °C (32 °F), the temperature within the container can be expected to vary ± x °C (x °F) within x h of transport at the indicated mean wall temperature (ambient).

Annex A

Air leakage rates and correction values

(This annex forms an integral part of the standard.)

Table 1 — 40 % of internal volume

Size of container	m^3	4,53	5,09	7,08	10,05	8,49 to 12,74	17,69	16,99	32,16
	ft^3	160	180	250	355	300 to 450	625	600	1 136
Typical units		LD-3	LD-1	LD-5	LD-9	Igloos	96 × 125	10 ft	20 ft
Air leakage rate	m^3/h	1,8	2	2,8	4	3,4 to 5	7,1	6,8	12,8
	ft^3/h	64	72	100	142	120 to 180	250	240	455

Table 2 — Maximum allowable during test 80 %

Size of container	m^3	4,53	5,09	7,08	10,05	8,49 to 12,74	17,69	16,99	32,16
	ft^3	160	180	250	355	300 to 450	625	600	1 136
Typical units		LD-3	LD-1	LD-5	LD-9	Igloos	96 × 125	10 ft	20 ft
Air leakage rate	m^3/h	3,6	4	5,6	8	6,8 to 10	14,2	13,6	25,6
	ft^3/h	128	144	200	284	240 to 360	500	480	910

Table 3 — Correction value 0,001 %

Size of container	m^3	4,53	5,09	7,08	10,05	8,49 to 12,74	17,69	16,99	32,16
	ft^3	160	180	250	355	300 to 450	625	600	1 136
Typical units		LD-3	LD-1	LD-5	LD-9	Igloos	96 × 125	10 ft	20 ft
Correction	W/°C	0,15	0,16	0,24	0,32	0,28 to 0,44	0,6	0,56	1,24

Annex B

Air temperature measurement points

(This annex forms an integral part of the standard.)

Dimensions in millimetres

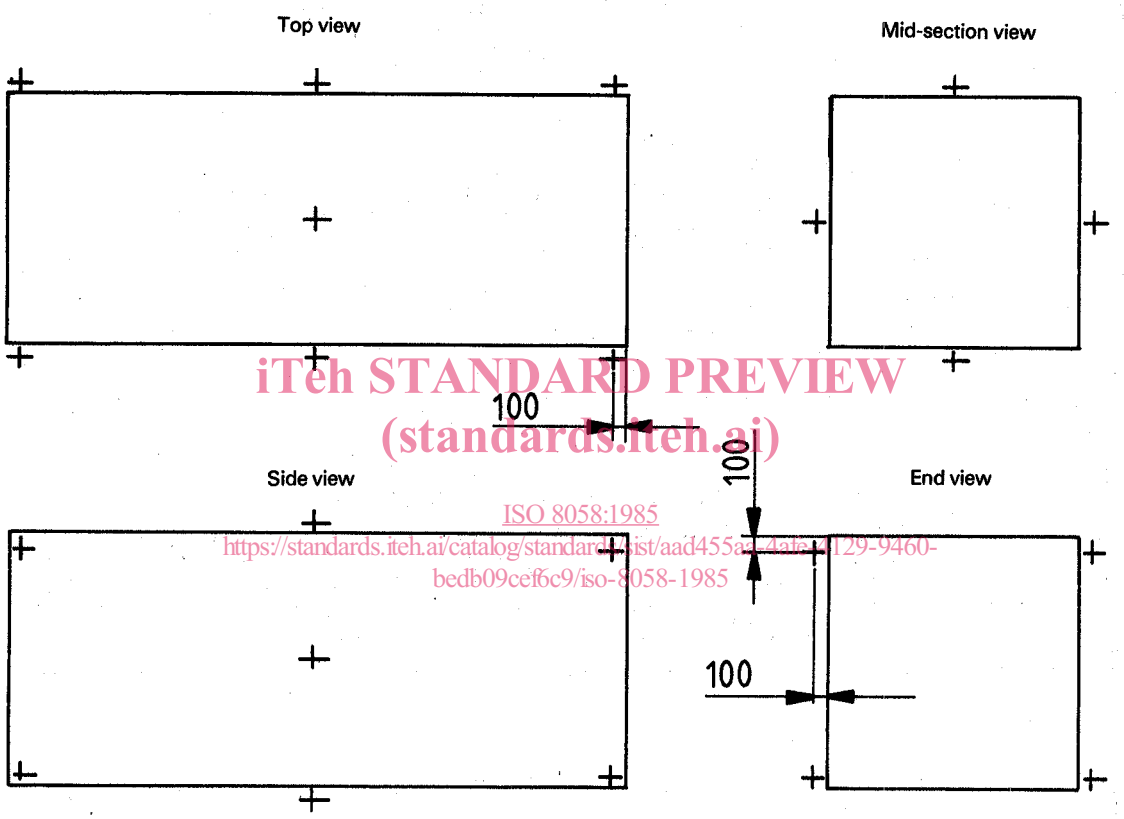

Figure 1 — Outside air temperature measurement points