

Australian Standard[®]

**AIR CONDITIONING
AND VENTILATION IN SHIPS**

**CABINS AND
LIVING SPACES OF
MERCHANT SHIPS**

The following scientific, industrial and governmental organizations and departments were officially represented on the committee entrusted with the preparation of this standard:

American Bureau of Shipping
Australian Chamber of Shipping
Australian Shipbuilders Association
Australian Shipbuilding Board
Australian Shipping Commission
Bureau Veritas
Commonwealth Scientific and Industrial Research Organization
Department of Defence
Department of Industry and Commerce
Department of Transport
Designers and Manufacturers of Marine Air Conditioning Systems
Institute of Marine Engineers
Lloyds Register of Shipping
Royal Institute of Naval Architects

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PREFACE

This standard was prepared by the Association's Committee on Shipbuilding Details at the request of the Whyalla Shipbuilding and Engineering Works.

The standard has been based on Swedish Standard VIS 376, Air Conditioning in Cabins—Conditions and Calculation Fundamentals, with suitable changes for Australian conditions. Assistance was obtained from CSIRO Division of Mechanical Engineering in regard to conditions applying in Australia ports and acceptable conditions of comfort. The air condition charts given in Appendix A were made available from a CSIRO Division of Mechanical Engineering Technical Report (in press) by Wooldridge M., and Kaschmeider D., entitled 'Climatic Data for Several Australian Locations for Use in Air Conditioning Design'.

The standard specifies the design conditions for vessels operating generally on the Australian coast in terms of overall summer conditions, and zoned winter conditions. Recommendations are also given in regard to the summer conditions for ships operating in restricted geographical locations.

The standard is intended to apply to new ships, and to ships that are to be extensively modified or converted.

Users of the standard should note that while observing the requirements of this standard, they should at the same time ensure compliance with such statutory and classification society requirements, rules and regulations as are applicable to the individual ships concerned.

For requirements for air conditioning and ventilation of machinery control rooms of merchant ships, reference should be made to AS 1925.

This standard requires reference to—

- AS 1150 Artificial Illumination in Ships.
- AS 1806 Seawater Temperatures for Cooling of Ships Machinery

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STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard Specification

for

**AIR CONDITIONING AND VENTILATION IN SHIPS—
CABINS AND LIVING SPACES OF MERCHANT SHIPS**

1 SCOPE. This standard specifies the design conditions for the air conditioning of cabins and living spaces of merchant ships operating on the Australian coast, and also in all global waters except arctic and antarctic waters in winter, and provides data and suitable methods of calculation for use in designing to meet these conditions.

The 'cabins and living spaces' referred to in this standard are intended to include the following:

- Cabins
- Saloons and mess rooms
- Smoke rooms and recreation room
- Day rooms
- Games room and gymnasium
- Hospital and first aid rooms
- Radio office
- Other offices
- Pantry.

Appropriate requirements are specified for other spaces which may be ventilated from the air conditioning system, or which may affect the operation of the system.

The standard also includes recommendations for the design of air conditioning systems for ships operating in restricted geographical locations on the Australian coast, e.g. ports and adjacent waters. These are given in Appendix A.

2 DESIGN CONDITIONS.

2.1 Summer. The design conditions for summer shall be as follows:

- (a) *High enthalpy condition—*
Outside: 35°C dry bulb and 30°C wet bulb
Inside: 29°C dry bulb with a wet bulb temperature less than 24°C.
- (b) *Low enthalpy condition—*
Outside: 35°C dry bulb and 22°C wet bulb
Inside: 24°C dry bulb with a wet bulb temperature less than 19°C.

The system shall be designed to meet both sets of conditions.

2.2 Winter.

2.2.1 Zones. For winter the ship shall be air conditioned for the operating zones specified by the purchaser, as follows:

Zone A—Ships primarily operating in tropical waters

Zone B—Ships primarily operating on the Australian coast or in similar temperature zones

Zone C—Ships operating in all waters except arctic and antarctic waters in winter.

2.2.2 Conditions. The design conditions shall be as follows:

(a) *Outside—*

Zone A: Heating not required

Zone B: -1°C

Zone C: -15°C

(b) *Inside—*

All Zones: 22°C .

3 CALCULATION OF HEAT GAIN AND HEAT LOSS.

3.1 Summer Conditions. The calculation for summer conditions shall be based on the heat gain from the following sources:

(a) Transmission (see Clause 4)

(b) Solar Heat Gain (see Clause 5)

(c) Heat from Persons and Food (see Clause 6)

(d) Heat Gain from Lighting and Appliances (see Clause 7)

(e) Heat Gain from Other Sources (see Clause 8).

3.2 Winter Conditions. The calculation for winter conditions shall be based on the transmission (see Clause 4). Any solar heat gain, heat gain from persons and food, lighting and appliances, or other heat sources, shall not be included.

4 TRANSMISSION.

4.1 Method of Calculation. The following formula should be used for calculating the transmission loss or gain:

$$P_t = \Delta t_o [(A_v \times h_v) + (A_g \times h_g)]$$

where

P_t = transmission loss or gain, in watts

Δt_o = temperature difference to adjoining space (see Clause 2 for external spaces, and Clause 4.2 for internal spaces), in degrees Celsius

A_v = surface exclusive of any glass surface, in square metres

h_v = heat transfer coefficient for the surface, in watts per square metre kelvin ($\text{W}/\text{m}^2\cdot\text{K}$)

A_g = free glass surface, in square metres

h_g = heat transfer coefficient for glass surface, in watts per square metre kelvin ($\text{W}/\text{m}^2\cdot\text{K}$).

TABLE 1
TEMPERATURE DIFFERENCES TO ADJOINING INTERNAL SPACES

Surface against adjoining space	degrees Celsius			
	High enthalpy summer $t_a - t_i$ °C	Low enthalpy summer $t_a - t_i$ °C	Zone C winter $t_i - t_a$ °C	Zone B winter $t_i - t_a$ °C
<i>Group 1</i>				
Deck above hot tanks	41	41	17	11
Deck and bulkhead against boiler room	26	31	17	11
Deck and bulkhead against engine room or non-air-conditioned galley	16	21	17	11
Deck and bulkhead against cargo space or equivalent large spaces (ventilated with outside air)	11	16	37	23
Deck and bulkhead against laundry or like size spaces (ventilated with outside air)	11	16	17	11
<i>Group 2*</i>				
Deck and bulkhead against common sanitary spaces and like (ventilated with outside air and heated)	6	8	0	0
Deck and bulkhead against private sanitary spaces and like (ventilated by exhaust of conditioned air from cabins) —				
(a) with any part against exposed outlet surface	2	2.4	3	2
(b) not exposed	1	1.2	0	0
Bulkhead against alley way (ventilated by exhaust of conditioned air from cabins) —	3	3.6	6	4
(a) adjoining engine room or boiler room or like	2	2.4	8	5
(b) not adjoining engine room or boiler room or like				

* Adjoining spaces referred to in Group 2 with surfaces exposed to outside or cold or warm spaces are assumed to have these surfaces insulated in the same way as air-conditioned spaces.

LEGEND:

t_a = temperature in adjoining space; t_i = temperature in the air-conditioned space.

4.2 Temperature Differences to Adjoining Internal Spaces. Unless otherwise advised by the purchaser, the values given in Table 1 shall be used as the temperature difference between adjoining air-conditioned and non-air conditioned internal spaces.

4.3 Insulation. Insulation shall be provided for all surfaces exposed to outside conditions or adjoining warm or cold spaces. Increased insulation shall be provided for surfaces adjoining hot pipes, boilers, etc.

The maximum heat transfer coefficients for surfaces commonly involved in air conditioning calculations are given in Table 2. Allowance shall be made for any deviations advised by the purchaser.

TABLE 2
MAXIMUM HEAT TRANSFER COEFFICIENTS

Surface	Maximum heat transfer coefficient W/m ² .K
Glass windows, single pane	4.7
Glass windows, double pane	3.5
Deck and bulkhead against alleyway, sanitary space, etc (Table 1, Group 2)	2.3
Ship's side, outer bulkhead or weather deck with sun awning	0.9
Deck and bulkhead against engine room, cargo space or other non-air-conditioned spaces	0.8
Deck and bulkhead against boiler room or near boiler in engine room	0.7
Deck against open air or weather deck without sun awning and deck above hot tanks	0.6

4.4 Heat Transfer Coefficient. The following formula should be used for calculating the heat transfer coefficient:

$$\frac{1}{h} = \sum \left(\frac{1}{a} \right) + \frac{\sum \left(\frac{d}{\lambda} + M_L + M_b \right)}{\mu}$$

where

- h = heat transfer coefficient, in watts per square metre kelvin (W/m².K)
- a = heat transfer coefficient for surface to air
 - = 80 W/m².K for surfaces exposed to wind ($\approx$ 20 m/s), outside
 - = 8 W/m².K for surfaces not exposed to wind ($\approx$ 0.5 m/s), inside
- d = thickness of material, in metres
- λ = thermal conductivity, in watts per metre kelvin (W/m.K)
- M_L = thermal resistance in air layer, in square metre kelvins per watt (m².K/W)
- M_b = contact resistance between different layers of material, in square metre kelvins per watt (m².K/W)
- μ = correction factor for steel frame
 - = 1.2 for insulation according to Fig. 1
 - = 1.45 for insulation according to Fig. 2.

NOTE: Figs 1 and 2 are intended to be typical examples. Factor μ must be derived for other types of construction.

Practical values of thermal conductivity for commonly used materials are given in Appendix A.

For thermal resistance of a non-ventilated air layer, see Table 3.

The contact heat resistance between different layers of material is normally taken as 0.09 m².K/W for common types of construction.

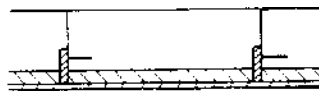


Fig. 1. PLAIN INSULATION OF UNIFORM THICKNESS

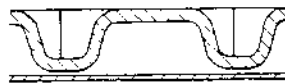


Fig. 2. CORRUGATED INSULATION OF UNIFORM THICKNESS

TABLE 3
THERMAL RESISTANCE OF NON-VENTILATED AIR LAYER

Boundary surfaces of air layer	Air thickness mm	Thermal resistance m ² .K/W
Non-metallic material	5	0.10
	10	0.13
	20	0.17
	50	0.17
One surface of aluminium foil	5	0.17
	10	0.30
	20	0.43
	50	0.47
Both surfaces of aluminium foil	5	0.17
	10	0.34
	20	0.47
	50	0.52

4.5 Measurement of Transmission Surfaces. Height shall be measured from steel deck to steel deck. Length shall be measured from steel bulkhead to steel bulkhead where applicable, otherwise to the centre of the partition.

5 SOLAR HEAT GAIN. The following formula should be used for calculating solar heat gain:

$$P_s = A_v \times h \times \Delta t_r + A_g \times G_s$$