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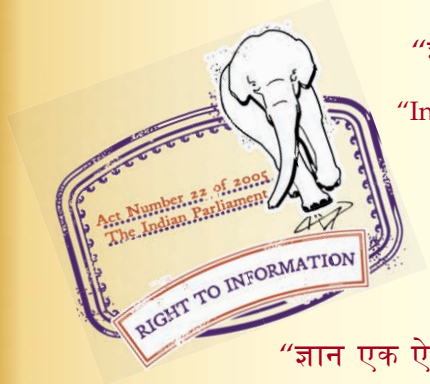

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IS : 659-1964
(Reaffirmed 2012)

Indian Standard

SAFETY CODE FOR AIR CONDITIONING

(Revised)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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SAFETY CODE FOR AIR CONDITIONING

(Revised)

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Indian Standard

SAFETY CODE FOR AIR CONDITIONING

(Revised)

0. FOREWORD

0.1 This Indian Standard (Revised) was adopted by the Indian Standards Institution on 22 October 1964, after the draft finalized by the Refrigeration and Air Conditioning Sectional Committee had been approved by the Building Division Council.

0.2 The Indian Standard Safety Code fot Air Conditioning was first issued in 1955. This code covered the safe design, construction, installation, operation and inspection of air conditioning equipment and systems including methods of natural ventilation and mechanical ventilation of buildings, factories and industrial establishments. While reviewing the code in the light of the experience gained during its usage, the Sectional Committee, responsible for the preparation of this code, agreed with the view that the requirements specified for dry bulb and wet bulb relationship could not be realized by mere ventilation or evaporative cooling systems usually adopted in factories and consequently would impose heavy restriction on factories. The outside wet bulb temperatures in various parts of India remain far beyond those specified and, therefore, refrigeration would have to be employed to bring down the temperatures and where necessary humidities in enclosures. In the light of this finding, the Committee has decided that this code should be revised so as to limit the code only to air conditioning systems by deleting all provisions pertaining to mechanical ventilation, evaporative cooling systems, etc, and issue a separate code of practice dealing with industrial ventilation*. While making the necessary modifications, the table dealing with minimum air requirements has been enlarged to include a number of other amenities and also the design conditions for comfort air conditioning have been specifically given for guidance.

0.3 In the formulation of this standard, due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to renting it to the practices in the field in this country.

*Since issued as IS : 3103 -1963 Code of practice for industrial ventilation.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This code covers the safe design, construction, installation, operation, and inspection of air conditioning equipment, inside design conditions, mechanical equipment and refrigerant piping, duct work for air, electric wiring and fire protection.

1.1.1 The requirements set forth in this code are intended to serve as minimum requirements, and are not to be construed as limiting good practice or preventing progress in the field of air conditioning.

2. TERMINOLOGY

2.0 For the purpose of this code, the following definitions shall apply.

2.1 Air Conditioning — The process of treating air so as to control simultaneously its temperature, humidity, cleanliness and distribution to meet the requirements of the conditioned space.

2.2 Positive Ventilation — The introduction of outside air by means of a fan or blower or any other mechanical device. The amount of positive ventilation can always be easily measured, because it is exclusively what is drawn by the mechanical device from outside.

2.3 Re-circulated Air — Air which is returned to the plant from the conditioned space but which is not re-treated.

2.4 Re-heating — The process by which air, which has been cooled down in order to condense out part of the moisture it contains, is heated again in order to raise its temperature to a suitable level.

2.5 Return Air — The air which is returned from the conditioned space to the plant for re-treatment.

2.6 Supply and Return Air Grilles — The fittings which are fixed at the openings through which air is delivered into and returned from the air conditioned enclosure by an air conditioning plant or unit.

2.7 Temperature, Dry Bulb — The temperature read by a thermometer placed in such a way that errors due to radiation are eliminated.

*Rules for rounding off numerical values (*revised).*

2.8 Temperature, Wet Bulb — The steady temperature finally read on a thermometer having its bulb covered with gauze or muslin moistened with distilled water in an air stream of not less than 4.5 metres per second.

3. VENTILATION

3.1 Only positive ventilation methods shall be adopted for ventilation of air conditioned enclosures.

3.2 Minimum Ventilation for Human Occupancy — The total minimum outside fresh air introduced into an enclosure by an air conditioning plant or unit by the method specified in **3.1** shall be related to the number of occupants in the enclosure at any time, whether they are smokers or non-smokers and to the cubic contents of the enclosed space in the manner specified in Table 1.

3.2.1 Table 1 should be used only when the contamination of the air in the conditioned enclosure results solely from respiratory and other physiological activities of occupants or due to their smoking.

3.2.2 In hospital operation theatres no re-circulated air shall be used, and all air in circulation shall be drawn from outside. The refrigerant used shall be such as not to form any explosive with the common anaesthetics used in medical surgery.

3.3 Determination of Available Volume of Positive Ventilation — In air conditioned enclosures, the volume of positive ventilation shall be measured by appropriate instruments, such as a properly calibrated 'Anemo-meter', velocity meter, Pitot tube, etc, which primarily measure the average velocity of air in the outside air intake duct. The average velocity of air multiplied by the air of the duct cross-section gives the volume of outside air drawn by the air conditioning plant. This is the volume of positive ventilation supplied.

NOTE — If sufficient positive ventilation is supplied to a closed enclosure, it will prevent infiltration of air due to higher pressure inside. However, there is possibility of positive ventilation and infiltration co-existing if the former is not sufficient to maintain adequate ever-pressure inside.

3.4 When means are adopted, such as by use of activated carbon, in a system of air conditioning where re-circulation of air is used to absorb body odours and other contaminating gases or vapours due to human occupancy, relaxation may be made in the rate of ventilation laid down under 3.2. The extent of relaxation shall depend upon the efficiency of the means adopted to restore the treated air to a condition equivalent to fresh air.

4. INSIDE DESIGN CONDITIONS

4.1 For air conditioning systems other than comfort air conditioning, design conditions as required by the processes involved may be adopted.

TABLE 1 MINIMUM FRESH AIR REQUIREMENTS

(Clauses 3.2 *and* 3.2.1)

SL No.	APPLICATION	SMOKING	m^3/min PER PERSON		m^3/min PER m^2 OF FLOOR AREA
			Recommended	Minimum	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Apartments	Some	0.56	0.28	—
ii)	Banking space	Occasional	0.28	0.21	—
iii)	Board rooms	Very heavy	1.40	0.56	—
iv)	Department stores	None	0.21	0.14	0.015
v)	Directors' rooms	Very heavy	1.40	0.84	—
vi)	Drug stores*	Considerable	0.28	0.21	—
vii)	Factories†	None	0.28	0.21	0.03
viii)	Oarages	—	—	—	0.30
ix)	Hospitals:				
	a) Operating rooms (all fresh air)	None			0.60
	b) Private rooms	None	0.84	0.70	0.10
	c) Wards	None	0.56	0.28	—
x)	Hotel rooms	Heavy	0.84	0.70	0.10
xi)	Kitchens:				
	a) Restaurant	–	–	—	1.20
	b) Residence	–	—	–	0.60
xii)	Laboratories*	Some	0.56	0.42	—
xiii)	Meeting rooms	Very heavy	1.40	0.84	0.38
xiv)	Office:				
	a) General	Some	0.42	0.28	—
	b) Private	None	0.70	0.42	0.08
	c) Private	Considerable	0.84	0.70	0.08
XV)	Restaurants:				
	a) Cafeteria*	Considerable	0.34	0.28	—
	b) Dining room*	Considerable	0.42	0.34	—
xvi)	Retail shop	None	0.28	0.21	—
xvii)	Theatre†	None	0.21	0.14	—
xviii)	Theatre†	Some	0.42	0.28	—
xix)	Tollets† (exhaust)	–	—	—	0.60

*In case exhaust air required is more than fresh air specified, then fresh air requirements will take exhaust considerations into account.

†May be governed by local bye-laws.

4.1.1 For comfort air conditioning dry bulb and wet bulb temperatures may be adopted as given in Table 2 for summer and in Table 3 for winter.

TABLE 2 INSIDE DESIGN CONDITIONS FOR SUMMER

OPTIMUM CONDITIONS		MAXIMUM CONDITIONS	
Dry Bulb Temp °C	Wet Bulb Temp °C	Dry Bulb Temp °C	Wet Bulb Temp °C
23.3	19.4	25.9	21.8
23.9	18.4	26.1	21.6
24 4	17.6	26.7	20.9
25.0	16.8	27.2	20.1
25.6	16.0	27.8	19.4
26.1	15.2	28.3	18.8
		28.9	18.1
		29.4	17.5

TABLE 3 INSIDE DESIGN CONDITIONS FOR WINTER

OPTIMUM CONDITIONS		MAXIMUM CONDITIONS	
Dry Bulb Temp °C	Wet Bulb Temp °C	Dry Bulb Temp °C	Wet Bulb Temp °C
21.4	17.8	18.3	15.0
21.7	17.3	18.9	13.4
22.2	16.4	19.4	12.0
22.8	15.3	19.7	10.8
23.3	14.4		
23.6	13.4		

4.2 Adequate movement of air shall always be provided in an air conditioned enclosure, but velocities in excess of 30 m per minute in the zone between floor level and the 1.5 m level should generally be avoided; in the case of comfort air conditioning 15 m/min shall be the permissible limit of air movement in this zone except in the vicinity of a supply or return air grille.

5. MECHANICAL EQUIPMENTS

5.1 The design and installation of compressors, condensers, evaporators, piping and other apparatus forming a part of the refrigerating system of an air conditioning installation shall conform to the requirements of IS : 660 -1963*.

5.2 Where steam is used for heating or re-heating air for air conditioning by direct contact with a heating coil, the pressure of steam used shall not exceed 3.5 kg/cm^2.

5.3 Any heating coils used in an air conditioning system shall withstand a hydrostatic pressure five times the working pressure of steam for a period of one minute without failure or leakage.

5.4 All boilers used in producing steam for heating purposes shall satisfy the requirements of the Indian Boilers Act and other Central or State Acts and regulations in the matter of the use of boilers.

5.5 No machinery with moving parts shall be placed inside an operation theatre.

6. DUCT WORK

6.1 All metal duct work shall conform to the requirements of IS : 655 - 1963†.

7. ELECTRICAL WIRING INCLUDING FIRE PRECAUTIONS

7.1 Conformity with Indian Electricity Act, Rules and Standards — All electrical work in connection with the wiring and installation of electrical equipment shall be carried out in accordance with the provisions of Indian Electricity Act and Rules thereunder and shall also comply with the provisions of IS : 732-1963‡ and IS : 2274-1963§, as applicable.

7.2 Where conduits are used for carrying insulated electrical conductors and when such conduits pass from a non-air conditioned area into an air conditioned area or into a fan chamber or duct, a junction box shall be installed or other means shall be adopted to break the continuity of such conduit at the point of entry or just outside, and the conduit should be sealed round the conductors to prevent air being carried from one area into the other through the conduit and thereby giving rise not only to

*Safety code for mechanical refrigeration *(revised)*

†Specification for metal air ducts *(revised)*.

‡Code of practice for electrical wiring installations (system voltage not exceeding 650 volts) *(revised)*.

§Code of practice for electrical wiring installations (system voltage exceeding 650 volts).

leakage and inefficiency but also to the risk of condensation of moisture inside the conduits. The same method applies equally to other types of wiring, like wood sheathing or ducts which allow air to pass through around the conductors.

7.3 In case of air conditioning plants where re-heating is used, a safety device shall be incorporated in the installation to cut off automatically the source of heating, such as steam or electricity by means of a thermostat or some other device, as soon as the temperature of the room reaches a pre-determined high level not exceeding 44°C, unless a higher temperature is required for an industrial process carried on in the air conditioned enclosure.

7.4 In cases of air conditioning plants where heating or re-heating by means of an electric heater designed to operate in an air current is used, a safety device shall be incorporated in the installation to cut off the supply of electricity to the heating device whenever there is failure of the air current in which the heater is required to operate. Serious harm , and sometimes fires may be caused by negligence in this respect.

7.4.1 The surface temperature of all electric heaters used in an air conditioned enclosure should be limited, preferably to 400°C, and in a case it shall not exceed 538°C, when measured in still air.

7.5 Air conditioning of enclosures where extremely combustible articles, such as cinematograph films, explosives, etc, are stored, shall be governed by appropriate State regulations in this respect where, such regulations exist. Normally, such enclosure should not be air conditioned by a plant or unit which also air conditions other enclosures meant for human occupancy. If this is unavoidable, effective means, such as automatic shutters shall be adopted to close tightly all duct communications between such enclosure and the other enclosures and the air conditioning plant itself, as soon as temperatures reach a dangerously high level due to fire or other causes. Fire dampers arc customarily held open by fusible links.

7.5.1 In particular, a projection room attached to a cinema theatre shall be isolated automatically, in the manner indicated under **7.5**, from the auditorium.

7.6 Very special care shall be taken in the case of film storage rooms to prevent explosions. State regulations, generally, lay down the maximum allowable amount of films which may be stored in an enclosure of a given size.

BUREAU OF INDIAN STANDARDS

Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones: 323 0131, 323 3375, 323 9402
Fax : 91 11 3234062, 91 11 3239399, 91 11 3239382

Telegrams : Manaksanstha
(Common to all Offices)

	Telephone
Central Laboratory:	
Plot No. 20/9, Site IV, Sahibabad Industrial Area, SAHIBABAD 201010	8-77 00 32
Regional Offices:	
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	323 76 17
*Eastern : 1/14 CIT Scheme VII M, V.I.P. Road, Manikto|a, CALCUTTA 700054	337 86 62
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43
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†Sales Office is at Novelty Chambers, Grant Road, MUMBAI 400007 — 309 65 28
‡Sales Office is at 'F' Block, Unity Building, Narashimaraja Square, BANGALORE 560002 — 222 39 71

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