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GUIDE FOR CONSTRUCTION AND USE OF ROOMS OR BUILDINGS PROTECTED BY PRESSURIZATION, FOR INSTALLATION OF ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES

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0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 23 August 1984, after the draft finalized by the Electrical Apparatus for Explosive Atmospheres Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard is one of a series of standards on pressurized enclosures. The requirements of pressurized enclosures with no internal source of flammable gas or vapour are covered in IS : 7389 (Part 1)-1976*.

0.3 The object of this guide is to lay down the principles of protection of electrical apparatus by pressurization, adapting them to suit in the case of rooms or buildings containing electrical apparatus and protected by internal over-pressure against the ingress of the potentially explosive external atmosphere.

0.4 In the preparation of this guide, assistance has been derived from IEC Publication 79-13 (1982) Electrical apparatus for explosive gas atmospheres: Part 13 Construction and use of rooms or buildings protected by pressurization, issued by International Electrotechnical Commission.

1. SCOPE

1.1 This guide defines the conditions in which an electrical apparatus liable to cause an ignition may be used in a room or building situated where flammable gases or vapours may be present, the ingress of these gases or vapours into the room being prevented by maintaining inside it a protective gas at a higher pressure than that of the outside atmosphere.

*Specification for pressurized enclosures of electrical equipment for use in hazardous areas : Part 1 Pressurized enclosures with no internal source of flammable gas or vapour (*first revision*).

1.2 This guide includes recommendations for the construction, equipping and operation of rooms or buildings and their associated parts, such as inlet and exhaust ducts for the protective gas, and auxiliary control devices necessary for the satisfactory production and maintenance of the overpressure.

1.3 This guide also recommends the tests necessary to show that the installation conforms to these recommendations and the marking to be placed on the rooms or buildings.

1.4 This guide concerns only rooms and buildings in the interior of which there is no internal release (actual or potential) of flammable gases and vapours.

2. TERMINOLOGY

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

2.1 **Room or Building** — An enclosure (or enclosures) provided with doors, cable ducts, conduits, etc, containing electrical apparatus and of sufficient size to permit the entry of a person who may be expected to work or remain inside the enclosure for a prolonged period.

NOTE — Throughout the rest of this guide, the term 'room' is employed without distinction to designate rooms or buildings.

2.2 **Opening** — Any aperture, door, window or non-airtight fixed panel.

2.3 **Protective Gas** — The gas used to maintain an overpressure within the room, or to purge air in these circumstances.

2.4 **Pressurization** — A type of protection by which the ingress of an explosive atmosphere into a room is prevented by maintaining therein a protective gas at a pressure greater than that of the surrounding atmosphere.

2.5 **Pressurized Room** — A room in which the protective gas is maintained at a pressure greater than that of the surrounding atmosphere.

2.6 **Pressurization with Leakage Compensation** — A method in which the supply of protective gas is sufficient to maintain the overpressure in the room, with a flow corresponding to the inevitable leakages from the room and its associated ducts, all the exit openings being closed.

2.7 **Pressurization with Circulation of Protective Gas** — A method in which the internal overpressure is maintained within the room and its associated ducts, a continuous and intentional flow of protective gas passing through these, through apertures of controlled section.

2.8 Purging — The operation of passing a quantity of protective gas through a room and its associated ducts in order to reduce any concentration of flammable gas or vapour within to a safe level.

3. CLASSIFICATION OF THE INTERIOR OF THE ROOM

3.1 The different hazardous zones given in IS : 5572 (Part 1)-1978* enables to drive, the classification of the zone, where the room is situated.

3.2 It is considered that the interior of a room should receive, in the absence of pressurization, a classification based on the most hazardous area into which the room has at least one direct opening.

3.3 Pressurization of the room after purging, permits the use of electrical equipment, which is not otherwise suitably protected for the area classification.

NOTE — The atmospheres inside a room which is partially situated in a hazardous zone, but all of whose openings lead into non-hazardous zones, is considered as non-hazardous.

4. PRINCIPLES OF CONSTRUCTION OF ROOMS

4.1 Protective Gas Ducts and Their Connections

4.1.1 The materials used for protective gas ducts and their connections should have chemical and physical resistance suitable for their intended use.

4.1.2 The ducts and connections shall be capable of withstanding 1.5 times, the maximum overpressure specified for normal service, with a minimum of 200 Pa. Appropriate safety devices shall be installed if there is a possibility of overpressures occurring during service capable of causing dangerous deformation of ducts or connections.

4.1.3 The position, dimensions and number of supply ducts shall be sufficient to ensure effective purging. The number of ducts shall be chosen in relation to the design and arrangement of the apparatus to be protected.

4.1.4 The supply ducts should be considered as forming part of the room. In particular, where they pass through a hazardous area, it is desirable that they be pressurized with respect to the surrounding atmosphere. However, if the mechanical integrity and sealing of the ducts can be guaranteed, then it is permissible for the pressure within the ducts to be lower than that of the surrounding atmosphere.

*Classification of hazardous areas (other than mines) for electrical installaions: Part 1 Areas having flammable gases and vapours (*first revision*).

4.2 Entry of Ducts for Electrical and Gas Service

4.2.1 The entry of cables or electrical conduits and other services (protective gas, water, etc) directly into the room should be so effected that the necessary overpressure can be maintained and entry of flammable substances precluded.

4.2.2 Where exhaust apertures open into a hazardous zone, it is recommended to provide them with automatic closing valves or flaps to prevent, as far as practicable, the ingress of the external explosive atmosphere in case of failure of pressurization.

5. PROTECTIVE MEASURES

5.0 Protective measures shall be adopted to prevent the electrical apparatus installed in a pressurized room from giving rise to an explosion at the moment of switching on, or in the case of failure of pressurization. These measures should be determined by the characteristics of the electrical apparatus, by the environmental conditions, and by the use of safety devices to monitor the inside atmosphere, or to actuate an alarm or possibly switch the power supplies off automatically. Such measures are given in **5.1** to **5.3** and also summarized in Table 1.

5.1 Energizing — During initial start-up, or after shutdown and whatever the classification of the hazardous area, it is necessary, before energizing any electrical apparatus in the room which is not suitably protected for the classification of the area:

a) Either to ensure that internal atmosphere is not hazardous (*see* Note 1) or to proceed with prior purging of sufficient duration that the internal atmosphere may be considered non-hazardous (*see* Note 2), and

b) To pressurize the room.

NOTE 1 — An atmosphere is considered non-hazardous when, at all points in the room, the enclosures and associated ducts, the concentration of flammble gases or vapours is below 25 percent of the lower explosive limit. The place of measurement shall be judiciously chosen to determine the highest concentration of gas.

NOTE 2 — Generally, the volume of protective gas required for purging is estimated as at least five times the internal volume of the room and its associated ducts.

5.2 Failure of Pressurization

5.2.1 *First Case* — The atmosphere in the room, considered as non-hazardous when pressurized, is classified Zone 1 in the absence of pressurization, according to 3 (exceptional case).

TABLE 1 SUMMARY OF PROTECTIVE MEASURES TO BE TAKEN IN THE EVENT OF FAILURE OF PRESSURIZATION SYSTEM

(*Clause* 5.0)

Classification of the Interior of the Room*	Electrical Equipment Installed		
	Equipment Suitable for Zone 1	Equipment Suitable for Use in Zone 2	Equipment not Protected for any Hazardous Areas
(1)	(2)	(3)	(4)
Zone 1	No action necessary	a) Suitable alarm (visible or audible or both), b) Immediate action to restore pressurization, and c) Programmed disconnection of Power supplies if the pressurization cannot be restored for an extended period or if the concentration of flammable gas is rising to a dangerous level.	a) Suitable alarm (visible or audible or both), b) Immediate action to restore pressurization, and c) Automatic interruption of the power supplies as rapidly as practicable within a prescribed delay time having regard to the needs of a programmed shutdown.
Zone 2	No action necessary	No action necessary	a) Suitable alarm (visible or audible or both), b) Immediate action to restore pressurization, and c) Programmed disconnection of power supplies if the pressurization can not be restored for an extended period or if the concentration of flammable gas is rising to a dangerous level.

*For classification in the event of absence of pressurization see IS : 5572 (Part 1) 1978 Classification of hazardous areas (other than mines) for electrical installations : Part 1 areas having flammable gases and vapours (*first revision*)'.

5.2.1.1 If any electrical apparatus installed in the room is not suitable for a hazardous area, the following provisions should be made:

a) Suitable alarm (visible or audible or both) indicating absence of pressurization,

b) Immediate action to restore pressurization, and

c) Automatic interruption of the power supplies as rapidly as practicable within a prescribed delay time having regard to the needs of a programmed shutdown.

In determining the delay time, account shall be taken of the precautions adopted to prevent the ingress of dangerous gas mixtures, and the probable effects of gas diffusion, convection and breathing of the room. This delay may also be prolonged to facilitate a programmed shutdown of the apparatus in the interest of safety provided that it is verified that the atmosphere immediately outside the room is not dangerous.

5.2.1.2 If any electrical apparatus installed in the room is appropriate for Zone 2, the following provisions shall be made:

a) Suitable alarm (visible or audible or both) indicating absence of pressurization,

b) Immediate action to restore pressurization, and

c) Programmed disconnection of power supplies if pressurization cannot be restored for an extended period or if the concentration of flammable gas is rising to a dangerous level.

5.2.2 *Second Case* — The atmosphere in the room, considered as non-hazardous when pressurized, is classified Zone 2 in the absence of pressurization according to 3 (most frequent case).

5.2.2.1 If any electrical apparatus installed in the room is not suitable for a hazardous area, the following provisions should be made:

a) Suitable alarm (visible or audible or both) indicating absence of pressurization,

b) Immediate action to restore pressurization, and

c) Programmed disconnection of power supplies if pressurization cannot be restored for an extended period or if the concentration of flammable gas is rising to a dangerous level.

5.3 Other Protective Measure

5.3.1 Whatever protective measure are adopted, the complementary provisions given in **5.3.1.1** to **5.3.1.4** should be made.

5.3.1.1 All electrical apparatus which is to be energized in the absence of pressurization, particularly that which assures pressurization, lighting and essential telecommunication should be suitable for use in the zone corresponding to its position; in the case where this apparatus is inside the room, it is necessary to take into account the zone corresponding to the classification of the inside of the room (*see* 3).

NOTE — These provisions permit lighting and essential telecommunication installations to remain in service, even in the event of danger.

5.3.1.2 The visible or audible alarm shall be so located as to be immediately percieved by the responsible personnel who shall take the necessary action.

5.3.1.3 For monitoring the satisfactory functioning of the pressurization, either a pressure monitoring device or a flow monitoring device or both should be used.

NOTE — Electrical interlock on the fan motors is not suitable to indicate failure of pressurization. They do not give an indication in the event of, for example, the fan belt slipping, the fan becoming loose on the shaft or reverse rotation of fan.

5.3.1.4 In certain circumstances, such as the necessity of keeping electrical apparatus in operation, it may be advisable to provide two sources of protective gas so that each one can take over from the other in case of a breakdown of one source. Each source should be independently capable of maintaining the necessary overpressure.

6. VALUES OF OVERPRESSURE AND OF PROTECTIVE GAS FLOW

6.1 The pressurization system shall be capable of ensuring a sufficient outward protective gas speed through the openings of the room when all these openings are open at the same time. The velocity should be greater than that of external air currents but should not lead to so great a pressure in the room as to make it difficult to open and close the doors.

NOTE — Where doors, windows and openings are provided with interlocks, these are to be closed when checking this requirement.

6.2 A minimum overpressure of 25 Pa (0·25 m bar) with respect to the outer atmosphere should be maintained at all points inside the room and its associated ducts at which leaks are liable to occur, all doors and windows being closed.

6.3 If there is any air-consuming equipment inside the pressurized room, the flow through the pressurization system should be capable of covering all needs; if not, the extra air required should be supplied by a separate system.

NOTE 1 — The pressurization system may also include heating, ventilating and air-conditioning devices over and above the equipments necessary to fulfil the requirements of **6.1** to **6.3**.

NOTE 2 — The design of a pressurized room will also need to consider :

a) the number of persons expected to stay in the room in order to ensure the necessary renewal of the air; and

b) the type of apparatus to be installed in the room and their need for cooling air, if any.

7. PROTECTIVE GAS SUPPLY

7.1 The protective gas should not, by virtue of any chemical products or impurities which it may contain, produce deleterious effects or introduce a risk of reduced safety.

NOTE — The protective gas may also be used for other purposes, such as for cooling the apparatus.

8. VERIFICATION AND TESTS

8.1 Before putting a pressurized room into service, the technical documentation should be examined and if necessary, a test shall be carried out.

8.2 In particular, it should be assured that:

a) the construction of the installation and the protective measures are such that purging can be effected, and

b) the minimum over pressure (*see* **6.2**) can be maintained at the minimum flow rate of the pressurization system with all the openings closed, in normal working conditions.

9. MARKING

9.1 All doors from the pressurized room should be clearly marked on the outside, by the following notice or an equivalent:

'WARNING — PRESSURIZED ROOM — CLOSE THIS DOOR'.

9.2 Inside the room, the following information should be displayed:

Minimum required overpressure, or corresponding rate of flow of protective gas.

9.3 Rules to be observed for the installation in question:

a) When switching on:

In accordance with **5.1**, a notice should be displayed close to the switch of the pressurization fan and to the general circuit-breaker for the room, with the following or equivalent wording:

'WARNING — The pressurization fan should be allowed to run for *t* minutes before switching on the installation, unless it has been checked that the atmosphere in the room is not hazardous.'

NOTE — *t* is the time required for purging at minimum flow rate.

b) In case of pressurization failure:

In accordance with **5.2**, a detailed list should be given indicating the apparatus to be switched off, the delays, if any, allowed for each operation, and any other measures to be taken particularly in the event of pressurization failure.