Ministry of Defence
Defence R&D Organisation

STEC PAMPHLET - 7

SAFETY FOR ELECTRICAL INSTALLATIONS AND APPARATUS FOR BUILDINGS AND AREAS CONTAINING MILITARY EXPLOSIVES

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PREFACE

This pamphlet prescribes the requirements for electrical installations like power supply/distribution, lighting, heating, lightning and electro-static protection, electrical and electronic apparatus, and air-conditioning in buildings or areas containing or likely to contain Military Explosives/Ammunition. The Pamphlet has been revised incorporating, amendments to the relevant paras as per Panel recommendations made from time to time.

These regulations do not apply to administrative buildings, residential or other personnel accommodation, workshops, not containing explosives, within an enclosed explosives area. The electrical installations in such buildings should, however, comply with Departmental Regulations, which should ensure that there is no danger to other buildings containing explosives within the explosives area.

It is hoped that users will find this revised STEC Pamphlet 2025 simpler, easier to understand and implement, thereby promoting the safe storage and transportation of military explosive. This publication supersedes STEC Pamphlet, 2017 on the subject.

SECTION-1

CATEGORIES OF EXPLOSIVES BUILDINGS

Scope

1. These regulations govern electrical installations in buildings containing military explosives and prescribe minimum requirements of safety and are applicable to the following areas:-

    a) All the explosives and ammunition storage buildings located within or outside an enclosed explosives area.
    b) Explosives and filling factories under Ministry of Defence.
    c) Ammunition workshops, explosives laboratories, breakdown laboratories and ammunition proof establishments under Ministry of Defence.

2. These regulations should be read in conjunction with all the relevant departmental specifications and codes of practice/specifications listed in Appendix 'A'

Categories of Buildings and Standards of Installations, Equipment & Apparatus

3. All buildings containing explosives are divided into three categories according to the nature of explosives which are stored or handled in the building. Electrical installations, equipment & apparatus are accorded the same category as the building in which they are installed or used:-

    a) Category A: This category comprise explosives store-houses, laboratories or process buildings in which explosives may give rise to flammable vapour in the building but not explosives dust. It is sub-divided into three zones as per BIS specifications IS: 5572-2009 (reaffirmed June -2014)which recognize the different degree of probabilities with which the explosives concentrations of flammable vapours may arise in terms of both the frequency of occurrence and probable duration of existence on each occasion. The recommendations on the type of installation to be provided zone wise are covered in BIS specification IS: 5571-2009 (reaffirmed June -2014) and summarized below:-

        i. Category A, Zone O: Zone in which the flammable atmosphere is continuously present or is present for long periods. In such situations, no electrical fittings/ equipments should be installed. Zone O areas are generally encountered in petro-chemical industries. If installation of electrical equipments is considered absolutely essential, the recommendations lay down in IS/IEC 60079: Part 11:2006 (Reaffirmed 2013) should be used. For explosives like nitro-glycerine

which has the property to sublime, it is recommended that either Dust-Tight or pressurized electrical equipment may be used.

ii. Category A, Zone 1: Zone in which the flammable atmosphere is likely to occur in normal operation. Electrical equipment which is certified as flame-proof (FLP) with type of protection's' (IS/IEC 60079: Part 1:2007 (reaffirmed 2012)) is recommended. For FLP enclosures of electrical apparatus, gases and vapours are subdivided according to their Maximum Experimental Safe Gap (MESG) determined by means of an experimental vessel. Alternatively, for intrinsically safe electrical apparatus, gases and vapours are subdivided according to ratio of their Minimum Ignition Current (MIC) to that of laboratory methane (IS: 5571-2009 (reaffirmed June -2014)). Based on MESG or MIC ratio, gases/vapours are subdivided into three subdivisions, namely Subdivision 'A' (Benzene, kerosene, ethyl acetate, ethanol, etc.) and subdivision 'C' (Hydrogen, Acetylene, Carbon disulphide, etc.) All lighting fittings should be FLP.

iii. Category A, Zone 2: Zone in which the flammable atmosphere is not likely to occur in normal operation and if occurs it will exist only for a short time. Electrical fittings/equipment, which are suitable for category A Zone 1 are permitted. Alternatively, increased safety fittings/ equipment with type of protection 'e' corresponding to IS/IEC 60079 : Part 7 :2006 (reaffirmed 2013) or non-sparking electrical equipment with type of protection 'n' ornon-sparking electrical fittings for Zone 2can be used.

b) Category B: This category comprises magazines, laboratories or process buildings in which there may be exposed explosives or explosives dust but not flammable vapour. It is sub-divided into two zones which recognize the differing degree of probability of incidence and amounts of dust which may be present. Electrical fitting equipments used have to comply with the following standards:-

(i) Category B, Zone Z: Zone in which the exposed explosives give rise to an atmosphere of explosive dust. Electrical equipment which is certified to be Dust-tight is permitted. The electrical fittings should be Dust-Tight.

(ii) Category B, Zone Y: Zone in which the incidence and amount of dust produced by the exposed explosives may be considered insignificant. Dust is accumulative in nature and depends on the frequency and extent of exposure. For example whilst a single operation may be thought to produce insignificant

quantity of dust, repeated operations may produce significant amount which may accumulate and enter unprotected enclosures of electrical equipment. In the absence of effective housekeeping standards, Zone Y area may thus degenerate to Zone Z area. It is therefore recommended that for Zone Y area also, electrical installations and equipments are to comply with Zone Z specifications.

c) Category C: This category comprises explosives buildings in which the explosives are not exposed and do not give rise to flammable vapours or explosives dust. For buildings in this category all electrical installations, equipment and apparatus should comply with requirements, of Totally Enclosed (TE) electrical fittings as stipulated in STEC Specification given at Appendix 'B'.

4. Corridors and verandas of category A, B and C buildings could be provided with TE lighting fitting.

5. The standard of electrical equipment of vehicles and mechanical handling equipment should comply with the standards specified for the electrical installation in the building in which it is being used (see para 45).

Design Considerations

6. Permanent electrical installations for the purpose of providing lighting, air-conditioning and power constitute an approved integral feature in the construction of the buildings designed for the manufacture, filling, assembly and storage of explosives and ammunition. If defective in design, erection or operations of such installations are liable to constitute serious risks and therefore special considerations must be given to their design, construction, erection and maintenance. These are given as under:-

a) In all cases, installations must be designed and installed to ensure that any over-heating or sparking whether in normal use or under fault condition is confined within the approved housing of wiring system and electrical items concerned.

b) The circuits for all installations must be provided with excess current and earth leakage protection necessary to isolate the circuit concerned as quickly as possible in the event of a fault developing.

c) There may be restrictions on the use of certain materials in the construction and equipment of buildings designed to contain explosives. Enquiries should be

made from the Service Headquarters concerned before proceeding with the installation or alteration of electrical equipment in such buildings. As a guide the restrictions apply to conditions where certain exposed explosives may be found, examples are exclusion of lead when picrates are exposed and copper where azides may be exposed. In building where ammonium nitrate is handled, all iron and steel fittings used in the electrical installation must be effectively protected against corrosion.

Temperature Limitations

7. The surface temperature of any electrical equipment or installation is not to exceed the following limits:-

a) Categories A and B buildings- 100^0 C

b) Category C building - 120^0 C

Any apparatus or component which may produce excessive temperatures under abnormal conditions of operation should preferably be fitted with a thermal device to disconnect the appropriate circuit before the maximum safe temperature is exceeded. In the case of vehicles, lifting appliances and other apparatus, any portion of which is capable of developing a surface temperature exceeding the limit prescribed above should be suitably screened to ensure that all exposed surfaces are maintained below these limits.

Approving /Certifying Authority for Different Categories of Installations

8. All electrical installations, equipment and apparatus such as Flame-Proof (FLP), Dust-Tight (DT) and Totally Enclosed (TE) shall be certified by the Director, Central Institution of Mining and Fuel Research (CIMFR), Dhanbad, as suitable for use in explosives buildings.

SECTION-II

THE SUPPLY OF ELECTRICITY, ITS CONTROL AND WIRING SYSTEMS

Power Supply

9. The electricity supply to the building containing explosives may be either direct or alternating with a voltage to earth not exceeding 250 volts. On this basis a 500 volts 3 wire D.C. System or a 440 volts 3-phase 50 cycles, 4-wire A.C. system may be employed provided the mid-wire or neutral conductor is connected to earth in accordance with the Indian Electricity Act and Rules.

Siting of Electrical Distribution Installations

10. The design and siting of the electrical distribution system and buildings, in which the equipment is housed, are to ensure that there is no risk of damage to any building or stacks containing explosives.

(a) The manned generating stations and sub-stations (including mobile and semi- mobile generators) should be located at PIQD or a minimum distance of 45 meters whichever is more from any building containing explosives. The purpose is to protect the buildings containing explosives from explosion/fire occurring within the electrical installations.

(b) The electrical substations should be enclosed in a structure of 34 cm brick and should be in the shadow of traverse as far as possible.

(c) Unmanned electrical substations serving only one building should be situated beyond traverse or beyond 45 m in case of untraversed explosive building.

(d) If serving a group of buildings, unmanned electrical substations should be provided a distance of SIQD from the nearest explosive building or 45m whichever is larger.

(e) Low and medium voltage switch houses and feeder pillars are to be sited not less than 10m from any building containing explosives.

(f) Solar power plants in explosive areas should be located beyond a distance of 45m from any explosive building. These solar plants should be on vacant grounds and no rooftop solar panel should be allowed for explosive building.

(g) Secondary storage batteries as per IS 16270 (2014): “Secondary cells and batteries for solar photovoltaic applications- general requirements and methods of test” for solar power plants can be installed in explosive areas with 34 cm brick wall as fire screen around the batteries and observing 45 m distance from the explosive buildings for solar power plants.

(h)

11. If low and medium voltage electrical apparatus is provided with an effective containment (by means of 34cm brick wall or equivalent) relative to the explosives, including overhead containment then the minimum distances required by sub Para 10(a) may be reduced to that required by sub Para 10 (b)

12. If the generating station and sub stations are to be protected from an explosion in the explosives buildings, these should be sited at process inside quantity distances from the nearest explosive block building. Main generating stations should preferably be located at outside quantity distance from any explosives building.

13. When in an electrical station or substation or in switch houses within an enclosed explosives area, fuel oil in sufficient quantity is held, drains must be provided to lead oil leakage into a single filled sump of an adequate size to contain all leakage. Further a fire break of at least 2 meters must be maintained around the sump. This should be observed in addition to the requirements given in IS: 3034-1993(Reaffirmed 2012).

Distribution

14. Electrical distribution in an area containing explosives may be underground cables or overhead lines. Cables laid underground are preferred and should be adopted wherever practicable. For maintenance reasons cables should not be laid below buildings but no other restriction is imposed on their location. All feeder cables should be paper insulated lead sheathed double steel armoured or PVC insulated similarly armoured and must terminate outside the buildings. The installation of cables must comply with departmental specifications and IS: 1255-1983(Reaffirmed 2016).

15. Where the distribution is by overhead line, the conductors are to run throughout the route and be terminated at not less than 15m from any building containing explosives, and the remaining distance completed by underground cable.

16. A surge protective device is to be fitted at the junction of the overhead line and the underground cable between conductors and earth.

17. The fixing of supports for overhead lines to buildings containing explosives is prohibited. The siting of poles or other forms of support of overhead lines or street lighting columns should ensure that in the event of failure of a support of conductor, they cannot fall on a building containing explosives.

18. The requirements of paras 14-17 also apply to fire alarms and telecommunications systems with the added requirement that fire alarm points and emergency call boxes are not to be sited where they are likely to be put out of action by an explosion in an adjacent building.

Plans of Underground Cables

19. Explosive establishments are to hold up to date plans showing the position and size of all underground cables, including the location of all joints in cables, cable pits, etc. within the explosive area.

Wiring Systems

20. The electrical systems within buildings and underground sites are to comply with the code of practice for electrical wiring installations IS: 732-1989(Reaffirmed 2015).

21. The following wiring systems are permitted in categories A, B and C buildings subject to the specific requirements given in paras 22 to 24:-

    a) Screwed metal conduit systems enclosing PVC cables.

    b) Mineral insulated copper aluminium covered cables.

    c) PVC insulated multi-cored, wire armoured cables.

    d) Paper insulated, lead covered steel wire armoured cables.

Additionally, an approved non-metallic conduit system enclosing PVC cables may be used in Category 'C' buildings only i.e. totally Enclosed standard.

Conduits

22. Metal conduit is to comply with the following requirements:-

    a) Metal conduits may be solid drawn/ERW or butt welded and screwed and are to be galvanized or hot zinc dipped or stove enamelled as a protection from corrosion, conforming to IS : 9537 (Part 1)-1980 (Reaffirmed 2015) for buildings requiring FLP installation. A welded steel screwed conduit to specification IS: 9537 (Part 2)-1981(Reaffirmed 2013) may be used in buildings requiring DT and TE installations.

    b) Metal conduit is to be screwed tight into all fittings and apparatus, with the minimum of thread exposed and is to be visible throughout the installation. Conduit unions only are to be used and running couplers are prohibited.

    c) In categories A and B installations, conduit boxes are to be fixed independently of the conduit and their fixing holes are to be external to the enclosure.

    d) In category B installations, conduit threads are to be sealed with approved material and solid backed distance saddles only are to be used (Hollow saddles with a stable inert material are considered to be solid saddles).

    e) Flexible conduits should not be used in hazardous locations involving gas, vapour, liquid or dust laden atmosphere, as large quantities of dust are likely to enter the

flexible conduits and dust-tight enclosures to which the flexible conduits obtained with the imported machinery may be permitted during the warranty period only with periodical cleaning. These are to be duly replaced by approved type after the expiry of warranty period.

23. Non-metallic conduits may be used under the following conditions installations:-

a) Rigid PVC conduit systems are to comply with IS: 9537 (Part 3)-1983(Reaffirmed 2013).

b) Approved systems are to be of totally enclosed pattern.

c) Additional protection against mechanical damage is to be enclosed throughout the system.

d) A separate and adequately rated earth conductor is to be enclosed throughout the system.

e) Where slip joints or sliding couplers are used, joints should be made using a suitable adhesive.

f) Non-metallic conduit is not suitable for communicating or alarm system wiring.

Cables

24. Cables used in explosives buildings should meet the following requirements:-

a) In all conduit systems, single strand conductor cables are prohibited. Cables are to be PVC insulated 1100 volts grade and should comply with IS: 694-1990(Reaffirmed 2015). Minimum cross sectional area of a copper conductor is to be not less than 1 square millimetre and that of aluminium 1.5 square millimetres.

b) Mineral insulated copper-cover (MICC) cables heavy duty 1100 volts class either bare or with a PVC over sheath, conforming to IS 1554 (Part 1)-1988(Reaffirmed 2015) may be used. The use of 1100 volts class cables will, to a large extent, diminish the need for limitations of use because of low electrical impulse strength. In categories A and B installations only flame proof, DT unions and glands are to be used. MICC cables are not to be connected directly to apparatus subject to oscillation or vibration to avoid cracking of the sheath by fatigue of the metal.

c) Multicore PVC insulated, wire armoured and PVC sheathed cables to IS: 694-1990(Reaffirmed 2015) may be used in situations where severe condensation is likely to occur. Additional protection against mechanical damage is to be provided where necessary.

d) Flexible cables can be used where cables leads terminate on the machinery which is in motion or in the state of vibration with suitable compression glands.

Overhead Power Lines

25. National grid overhead systems and associated network and sub-stations are normally not permitted in or to pass over an explosives area or buildings and should be sited at a safe distance from the perimeter of such area.

26. Although the breaking of an overhead conductor is a rare occurrence, the operation of circuit protection devices cannot be accepted as a total safeguard. Minimum distance must be determined to ensure safety in such an event.

27. The physical safe distance 'D' may be of roughly determined by reference to the length of span 'S' and the height of the line insulators on the pylon or supporting structure 'H' as follows

$$D = \frac{S}{2} - H$$

This assumes that should a break occur in the overhead line, natural coiling of the broken line will occur and restrict the swing in a direction normal to the line axis to less than half the span distance.

28. The electrical safe distances from the foot of an earthed pylon or the earthed network of a substation is determined by the requirement that in the event of maximum short circuit current to earth the potential above true earth appearing at the explosives area perimeter fence must not exceed 4 volts.

29. Distance between an explosives building and public supply overhead power line operating at 3.3 KV or above should be public traffic route distance i.e. 2/3 OQD subject to a minimum of 60 meters. However, in respect of internal power line inside the Defence unit these can be sited at 1/2 OQD at the discretion of Service HQ. The distance to particularly important line like national super grid line (400KV above) should be 1 to 1.5 times the inhabited building distance subject to a minimum of 120m.

30. In special cases, guard wires should be provided for places where electric wires cross over pathways or pass close to the explosives buildings. Wherever possible, the public supply and explosives area distribution overhead power lines should not cross roads and railways.

Control of Electrical Supply Circuits

31. The supply of electricity to a building or underground site containing explosives is to be controlled by one or more master switches outside the building or underground sites. Master switches should be in close proximity to each other, identified and capable of isolating every conductor entering the building or underground site including the neutral of switches/starters, etc. If installed inside the building, these should conform to the category of installations. If DT fittings are not available, FLP fittings can be used in lieu.

32. All circuits are to be provided with protection against overload and earth leakage.

33. All final sub-circuits are to be controlled by switches ensuring complete isolation of each conductor from the supply. Lighting circuits may be controlled by switches within the building or underground site provided they conform to categories of installations.

34. Where large power supplies are concerned, the provision of remote control sub station feeder switch-gear may be considered as an alternative to the installation of large external master switches. The remote control should be of a suitably protected push button or rotary switch type with pilot lamp ON/OFF indication and should be sited at a clearly visible position outside the building or underground site concerned. In any case switches shall be provided within a fire proof plant room to isolate every conductor entering all areas or rooms containing explosives.

35. Over current protection may be given by automatic circuit breakers complying with IS: 3842 (Part 1)-1967(Reaffirmed 2011).

36. Electrical apparatus located in categories B and C buildings containing explosives but in the immediate vicinity or in an adjacent and separate plant room should only meet the minimum TE standard.

37. Electrical apparatus adjacent to or within the immediate vicinity of category ‘A’ building should be Flame-Proof if the hazard area extends outside the building, otherwise the apparatus is required to meet the minimum TE standard.

SECTION-III

ELECTRICAL EQUIPMENT

Lighting Fittings and Fans

38. Lighting fittings should be in accordance with category of installation. Electric lamps may be of the filament or fluorescent types. Only lamps of approved wattage as shown on the design drawings of an installation are to be used. The use of lamps of higher wattage is prohibited. Keys for access to lighting fittings should be held in the office of the engineer responsible for maintenance of the installation and issued only to personnel authorized by him. Similarly where keys are used to gain access to parts of a conduit installation these should be retained in the office of the engineer responsible for maintenance of the installation and issued only to personnel authorized by him. Before opening any lighting fitting or any part of the conduit system, the circuit serving it should be isolated from the supply and should remain so until all work has been completed.

39. Where fluorescent or electric discharge lighting is installed, a bimetal thermally operated cut-out device is to be included in the enclosure containing the choke and other components liable to overheating. The cut-out is to be set to prevent the temperature of the enclosure exceeding 100^0 C in category 'A' and 'B' building and exceeding 120^0C in category 'C' buildings, and is not to be of the automatic resetting type. In the case of new installations, the control equipment including the choke and ancillary apparatus should be outside the building wherever reasonably practicable and so make the provision of cut-out unnecessary. Chokes and other ancillaries if fitted inside the explosive buildings should also be in accordance with the category of installation.

40. Unprotected fans are not to be fitted in explosive buildings where explosive dust and flammable vapours are present. As an alternative, air-conditioning or forced ventilation may be resorted to in lieu.

Mains operated Portable Equipment

41. Portable mains operated lights with flexible leads are not normally permitted inside buildings containing explosive and plug sockets must not be provided for such fittings; however, where the use of such lights is essential they should be supplied at a voltage not exceeding 25 V through a flexible cable in which cores are collectively screened by a copper earth screen and protected by an outer neoprene sheath. The supply should be taken from a double wound transformer incorporating an earth screen between primary and secondary windings or alternatively winding should be mounted on separate limbs. A separate core shall be provided in each cable and the earth continuity conductor shall be bonded at both ends. Such lights will not be used in magazines.

Battery Operated Portable Equipment

42. Portable flood lights of an approved battery operated type may be used only in C buildings.

43. Self-contained hand or head lamps and torches may be used in explosives buildings provided they comply with the following requirements:-

a) For category 'A' installation all external parts if constructed of aluminum alloy shall be free from frictional sparking hazard. The same is applicable for category 'B' and 'C' installations.

b) Dry batteries are preferred but if wet batteries are used, either lead acid or alkaline, the electrolyte is to be in gel form and un-spill able. It must be established that they do not leak if dropped or otherwise improperly used. Batteries must not be changed or charged in buildings containing explosives. The type of hand lamps which may be charged without breaking any seals is to be preferred.

c) In areas where regulations require that non-ferrous tools are to be used, hand lamps and torches must also comply with this requirement.

d) Every lamp or torch shall be type-tested by the approving/certifying authority depending on the building category.

44. Lighting systems or equipment containing batteries are not to be left unattended inside explosives buildings.

Battery Operated Vehicles and Lifting Appliances

45. The normal action of lead acid batteries involves the evolution of hydrogen gas and introduces the possibility of explosion if a concentration of gas occurs in a battery container. The rate of evolution of gas depends on the ampere hour capacity of the battery and the number of cells. It increases with the age of the positive plates, the temperature of the electrolyte and its density. Battery containers are, therefore, required to ventilate so as to ensure that the concentration of hydrogen cannot amount to 4 percent, which is the lower limit of flammability of a mixture of hydrogen and air. Similar precautions are also necessary with alkaline batteries. In addition the following design features are recommended:-

a) Traction batteries of the lead acid type in categories A and B installations should have all interconnections duplicated and solidly burned or welded to guard against the production of sparks in the event of damage.

b) Traction batteries of the alkaline type are permitted with single interconnections with terminal nuts fitted each cell. All terminal nuts are to be fitted with a locking device.

c) The lids of all battery containers should be lined with a non-flammable non-hygroscopic insulating material. Means are to be provided for locking the cover in the closed position.

d) When ventilation is essential ventilation louvers or screens for battery enclosures should be so designed as to avoid restriction of ventilation by external means and also preclude objects from accidentally entering the enclosure. All ventilation openings should have a nominal width of aperture of 425 □m and should be protected from mechanical damage. A plug and socket should be provided to facilitate battery recharging.

e) The battery plug and socket shall be interlocked with a switch to prevent removal and insertion while socket contacts are live or so secured to prevent removal by unauthorized persons.

f) An emergency main isolator should be provided between each battery and its plug socket connection unless specific approval is obtained for alternative means of protection. This isolator may serve the purpose of sub-Para 'e' above.

g) The flexible cable to the battery plug should be VR, PCP or PVC-insulated and served, metal screened and PCP-sheathed overall. Screening vehicles may be omitted provided extra mechanical protection is given to the cable.

h) Double pole wiring should be used throughout.

i) Circuit breakers of approved type should be provided to protect the main and auxiliary power circuits.

j) Cable glands for wiring on flame-proof or dust-tight vehicles should be of the flame-proof type.

k) The metallic enclosures of all electrical equipment should be bonded to the framework of the vehicle.

l) The use of solid state electrical control is preferred. Where control resistances are fitted, they should be housed in the correct Category enclosures.

m) A safety dead man's pedal hand or seat.

46. Batteries are inspected and where necessary tested to determine the rate of hydrogen evolution under departmental arrangement installations are to be certified by the certifying and approving authority-Director CIMFR Dhanbad.

47. Battery operated vehicles and lifting appliance are permitted along-side stocks of explosives in the open an along-side all buildings containing explosives.

48. Certified and approved battery operated vehicles and lifting appliances are permitted inside the explosives storehouses and laboratory in which work is carried out under "Magazine Conditions" (excepting those classified for magazine storage), provided to exposed explosives are present whilst the vehicle or lifting appliances are present.

49. Battery operated vehicle and lifting appliances are not permitted inside buildings where explosives are stored under Magazine conditions.

Provision of Unprotected Lighting Fittings and Ceiling Fans

50. In case of laboratories where naked flames, muffle furnaces and hot plates are used for analysis and testing of explosives, provision of ceiling fans and unprotected lighting fittings could be considered on merits. Likewise requirement of protected electrical fittings and fans for ammunition workshops and certain process buildings could also be examined and considered on merits.

However, in case of laboratories where no muffle furnaces and naked flames are used normal regulations should apply.

Exhaust Fans and Motors

51. All equipment, appliances fitted in explosives buildings should conform to category of the building in which they are installed. Depending upon the particular type of risk i.e. flammable vapour or explosives dust appropriate motors i.e. FLP, DT or TE should be employed. Modified FLP motors conforming to BIS specification could be used for category A & B areas where flammable vapours and explosives dust environment prevail.

Public Telephone/Telegraphic Trunk Lines

52. Public telephone/telegraphic trunk lines should be sited beyond Process inside Quantity Distance from explosives buildings. Overhead lines serving telephones, fire alarm points or call boxes must not be carried nearer than 15 meters to a building containing explosives, the remaining distance being completed by underground cable. All wiring for telephones bells or loud speakers within buildings containing explosives must be totally enclosed in conduit. Personal communication equipment (e.g. Cellular Phones) shall not be taken into explosive buildings. Notices prohibiting the entry of non-approved Personal Communication Equipment shall be displayed at the entrance(s) of explosive buildings, or areas.

Alarm System

53. These system must not be installed in buildings containing explosives except with the specific approval of Service HQ. Where considered necessary provision should be made externally to the building for the complete isolation of all conductors entering the building.

Telephone/Intercoms and Bells

54. When telephones, bells and intercoms are approved for installation in explosives buildings they must conform to the category of installation. Where flame-proof and dust tight equipment are required, any equipment certified as intrinsically safe by Director, CIMFR, Dhanbad for use in a flammable concentration of petroleum vapour can be accepted as an alternative. This equipment can be located on the veranda/lobby of the explosive buildings.

Loud Speakers

55. When service HQ approves the installation of loud speakers within a building containing explosives requiring a dust-tight installation, the speech transformer and its connection (if any) must be enclosed in a dust-tight enclosure provided with a conduit outlet. Where no speech transformer is incorporated the speech coil circuits and all wiring circuits within the building must be of low impedance (3 to 15 ohms) and dust-tight. Loud speakers certified by the approving authority (CIMFR) as intrinsically safe for use in a flammable concentration of petroleum vapour may be installed in buildings requiring flame-proof, dust-tight or totally enclosed installations. For loud speaker circuits, provision must be made outside the explosive storehouse or explosives area for isolating all wiring passing into the building.

Electrical Heating

56. Electrical heating systems and appliances may be installed in explosives buildings of any category subject to prior approval of Service HQ. Heating appliances and systems must be rigorously tested to ensure safe working temperature conditions before acceptance.

57. All heating appliances and systems must be fixed and permanently installed. Portable heaters are not permissible in buildings containing explosives.

58. Only low temperature heaters are to be used which have a maximum designed surface temperature not exceeding 100ºC in categories A and B buildings and 120ºC in category C buildings. A thermally operated cut out of the non-automatic resetting type must be fitted to all heaters and heater banks inside buildings to prevent the surface temperature exceeding the above limits.

59. In all heating appliances used for heating explosives, an additional thermostatic regulator with a maximum control temperature limit not exceeding 100ºC is to be fitted. The temperature indicating control knob or wheel is to be positively locked to the control spindle to avoid setting errors. Duplicate indicator lights are required for appliances of this type.

60. Air recirculation systems are normally not permitted in categories A and B buildings or in heating appliances containing exposed explosives. If these are inescapable process requirements, flame traps are to be fitted to both intake and exhaust ducts and the heater banks are to be so constructed as to prevent propagation of fire or explosion into the building. Fresh air bleed from an uncontaminated source is to be employed to ensure a minimum of 2 air changes per hour within the appliances or building.

61. Electrode type boilers which are normally to be located at Storage Inside Quantity Distance can be located on the outer half of the traverse or outside the building or inside the explosives buildings in a separate room/cubicle with adequate wall thickness and RCC roof.

Tools and Appliances

62. No electrically operated tool is to be used in an explosives building unless approved by the Service Headquarters.

Electric Soldering Iron

The soldering Iron used for soldering operating in an explosive building should meet the following stipulations:-

(a) Soldering should be carried out only at a designated place, in a separate cubicle, which is away from the bulk ammunition handled in the bldg. No other work on explosives should be undertaken in the cubicle.

(b) Since it is not practicable to restrict the surface temperature, the size and rating of the iron should be as small as practicable consistent with the task to be carried out.

(c) The flexible cable fitted to the iron should comply with the requirements of paragraph 24.d of STEC Pamphlet No.7 (viz. flexible leads should be with suitable compression glands).

(d) Each electric iron should be connected to separate wall mounted socket outlet which will insure complete isolation. It should be provided with pilot lamp indication.

(e) The bench top should be of incombustible material and a suitable fire-proof storage space is to be provided to accommodate the hot iron.

Hearing Aids

63. Electric hearing aids certified as intrinsically safe in the Hydrogen class may be worn in buildings containing exposed explosives, subject to the approval of Service HQ. Hearing aids are to be secured against dropping and properly maintained. The battery is not to be exposed and precautions are to be taken to prevent the inadvertent opening of its container.

Electronic Equipment

64. The design and manufacturing methods of electronic apparatus and instruments do not generally comply with the requirements of categories of installations and recourse must be made to pressurization ventilation or other techniques if they are to be employed in explosives building:-

a) Pressurization is the process by which ingress of an external flammable atmosphere (Category A) or explosives dust (category B) into an enclosure is prevented. This is achieved successfully by feeding clean air or inert gas, with or without dynamic flow into the enclosure at a pressure above that of the surrounding atmosphere.

b) The pressures involved are usually very low about 3-6 kPa (0.4-0.8 psi) because higher pressures might affect the light construction materials of electronic enclosures, thus giving rise to distortion and mal-functioning. Further safety of the system depends upon the continuance of the pressure inside the enclosure. Pressure monitoring devices should be used, either to cut off the electrical supply to the apparatus or to give an alarm that a dangerous situation has arisen

Electrical/Electronic Balance

65. Electrical balances to be used in an explosives building should meet the following requirements:-

a) The display unit and power supply should be housed in FLP/DT enclosure.

b) All power supplies should be routed through approved type of zener barrier device.

c) All zener barriers should be earthed at a point.

Closed Circuit TV Systems (CCTV)

66. Where closed circuit TV system is required to be provided in explosives buildings of any category to monitor process operations, it should be of an approved design. The following safety requirements are to be complied with for installation of CCTV system:-

a) The camera is mounted externally to the explosives area with a window provided for viewing the area required.

b) When the camera is required to be sited in the explosives area it should comply with the appropriate enclosure standard required or alternatively is pressurized or continuously purged with a clean air giving a small positive pressure of 3-6 kPa (0.4-0.8 psi).

c) For category A and B installations, camera head together with its remote operated pan and tilt mechanisms, should be housed inside an enclosure in the form of an hemisphere or any convenient shape or blister of fire and chemical resistant transparent material.

d) Monitors, control and ancillary equipment are to be sited outside the explosives buildings.

X-ray Equipment

67. X-ray of rocket propellant grains and other shaped explosives charges for defect investigation studies is carried out as a routine for the quality assurance checks in ordnance factories. Where X-ray equipment is required for the inspection of ammunition, the following stipulations should be complied with:-

(a) Radiography should be confined to category-C areas as a general rule. Where, however, it is essential that such equipment is used in a higher risk area, advice and approval must be obtained from the appropriate Service HQ.
(b) All control equipment is to be sited outside the explosives buildings.
(c) The X-ray head is to be of the industrial type with the appropriate enclosure for the category concerned or alternatively to be pressurized.
(d) Portable X-ray equipment is not general suitable for use in explosives buildings.

Laser Fencing System

68. Laser Fencing System (LFS) with LASER power up-to 1W complying AERB safety guidelines "AERB/SG/IS-7— Safety in design and application of LASER" can be used at perimeter of Explosive areas.

Barrier Devices

69. A barrier device has been defined as a unit comprising an electrical network when fitted at the interface between a safe and a dangerous area, ensures that the energy passing from the safe area to the danger area cannot exceed a definite value which is known to be safe even if severe faults occur within the safe area.

70. While designing a barrier device, the worst possible fault namely unrestricted application of power mains to the barrier is taken into consideration. The most common type of barrier device comprises a simple network of resistors and zener diodes with a fuze. The network is designed to have negligible distortion effect on normal instrument signal, but if there is a rise in voltage on the barrier input, terminals up to the avalanche voltage of the zener diodes the diodes become conductive and clamp the voltage to a safe value. The current and the voltage in the danger area is then determined by the series of resistance of the barrier and the zener potential under the fault conditions.

71. A fuse is incorporated in the barrier device to protect the zener diodes since an excessive potential across the input terminals (i.e. on the safe area side) may operate the diodes at powers in excess of their long term rating. The thermal characteristics of the fuse and the

diodes are to be such that regardless of the magnitude of the fault condition, the fuze ruptures before the diodes are damaged.

72. Barrier device should be mounted in a safe area preferably as close as possible to the dangerous area. Where this is not possible, the barrier should be mounted in a flame-proof or dust-tight enclosure and the circuits to it from the safe area should comply with appropriate requirements.

73. It is essential that electrical and physical characteristics and maximum lengths of external cables from the barrier device to apparatus in the dangerous area shall be specified by the certifying authority when these are likely to affect the intrinsic safety of any circuit.

74. Particular attention must be paid do the method of earthing barrier devices to avoid adverse effects on the intrinsic safety of the system.

75. Equipment connected to safe area terminals of the barrier device must not be supplied from or contain a source of potential exceeding 360 volts peak (250 V r.m.s.) with respect to earth. Mains powered equipment must be isolated from the mains supply by a double wound transformer, the primary of which is protected by fuses. This isolating transformer must contain an earthed copper foil screen between primary and secondary windings.

76. The following precautions should be taken for maintenance and testing:-

(a) The cables to the dangerous area must be disconnected from the barrier device before any tests are carried out on the barrier itself.
(b) When wiring within the safe area is subjected to high voltage insulation tests, the barrier unit should be disconnected at the safe area terminals before the test is begun as such a test may rupture the fuses within the barrier.
(c) An annual test should include examination for signs of corrosion, tightness of terminal connections and measurement of earth connection resistance (earth loop impedance not to exceed 1 Ohm). If malfunctioning of the barriers is suspected or they may have been subjected to excessive voltages, then the barriers should be removed from their mountings and checked according to production tests on the appropriate manufacturer’s barrier drawing.

Electro Explosives Devices (EED)

77. Electro-explosives devices (EED) also called as electrically initiated/ignited explosives device (EIED) is one in which an action is dependent on a fuel ignited by an electrical discharge. EEDs are engine starting cartridges explosives bolts, rocket motors, hot gas power supplies and parachute ejection cartridges. Also it can be an electric initiator of explosives contained therein. EEDs are used extensively in weapon systems to activate control and arming devices and to initiate explosives trains.

78. Spurious initiation of EED is likely in the radio frequency and electromagnetic environment. Induced voltages and currents are set up in the leads of the EEDs under the following conditions:-

Frequency Range	**Type of Modulation**	**Power Range**	**Distance**
HE	AM	0.5 to 1 KW	3 m to 1600 m
VHF	AM/FM	1.5 W to 50 W	1.5 m to 320 m

A safety factor of 20 decibels below the no fire threshold is safe from electromagnetic hazards for EED.

79. Radio/Radar installations in the vicinity of EEDs should be sited on the following guidelines:-

(a) The electrically operated ammunition will not be stored within 45 m of any radio/radar transmitter. In such situations, all EEDs or ammunition containing EEDs should be adequately shielded against stray electro-magnetic fields at all times by proper design and packaging. EED or ammunition containing EED is to be considered fully shielded if they are totally enclosed in metal containers with either soldered on lids or lids which are tight fittings so as to made good electrical contact with the containers. Metal skins ammunition into which EED are fitted are considered to be fully shielded provided proper metal protective covers are fitted over EED. In the same manner EED or ammunition containing EED, are considered fully screened when they are completely enclosed in metal foil arranged so as to make good electrical contact all round. The foil must be protected against damage during storage and handling.

(b) Radio and radar transmitter station should not be sited within the OQD of the explosives. If the siting is an operational necessity the consequent risk of damage should be kept in view. Some protection could be afforded to the installations within the OQD by providing an effective traverse adjacent to them where this can be done without interfering with their operations.

(c) Mobile VHF and UHF radio sets of power output less than 7 watts may be used outside danger buildings within explosives areas without restriction.

(d) Fixed VHF and UHF radio sets of power output less than 25 watts may be used at ranges down to 8 meters from danger buildings provided:-

i. For explosive devices containing wire bridge fuze heads as initiating components in system where the stores are not contained in metal containers any exposed firing leads are twisted together, preferably screened and provided with non-shorting protective covers.
ii. For explosives containing composition type of igniters where the initiating components are not contained within metal containers or in screened assemblies or where the initiators have to be handled as separate items their leads are shorted.

80. Conditions for using EEDs and minimum safe distance between radio frequency sources and EEDs are given at Appendix 'C'. For further details, reference may be made to the STEC Publication -"Hazards from electro-magnetic radiation to ammunition containing Electro-Explosives Devices".

Air conditioning and Humidity Control

81. Air-conditioning in its true sense, constitutes simultaneous control of temperature humidity, purity and distribution of air in an enclosed conditioned space. It comprises of basic refrigeration system and air-handling equipment for circulation of treated air.

82. The installation of air-conditioning in explosives process/storage buildings poses serious hazard as the control used are electrically operated with electric make and break contacts. During operation the sparking at the contacts is inevitable and therefore the controls should never be located in flammable dust laden explosives atmosphere.

83. Location and selection of the proper type of air-conditioning system for used in explosives areas should ensure safety from inherent fire hazards. Air conditioning plant room or even the weather maker room should, therefore, not be located inside the air-conditioned explosives buildings.

84. In case of category A and B buildings the air-conditioning system shall be of chilled water type. For category C buildings this system is preferred over the direct expansion system but is not essential. The plant room shall be located beyond the traverse or at PIQD in case of the traversed buildings and the weather- maker room shall be near to or even attached to the conditioned building. When attached the wall separating the weather- maker room for the explosives building shall be a strong wall of appropriate thickness.

85. In case of category B and C building wherein small quantities of explosives are handled/ stored, the air-conditioning system could be of direct expansion type. The plant room (including the weather maker room) could be attached to the conditioned building with an appropriate RCC partition wall in between.

86. When a group of buildings are to be air-conditioned chilled water system shall be used. The plant room shall be located outside the traverse or at PIQD in case of untraversed buildings. Each building shall be served by its own weather-maker unit attached to the building itself.

87. In case of building with several bays/rooms to be air-conditioned, safety demands that the individual bays/rooms to be separately served by the air-conditioned plant to eliminate the risk of fire spreading from one room to another through the air ducts. Where this is practically not feasible, grouping of bays/rooms could be resorted to with provisions of automatic fire dampers to prevent propagation of fire through the ducts.

88. Use of room (i.e. window) and package air conditioners is to be normally discouraged. In very exceptional cases, package type air conditioner housed in a separate room and using air ducts could be provided in case of category 'C' buildings, with prior concurrence of STEC.

89. All electrical items like motors, equipment, controls, wiring etc. used inside the weather-maker room should be of the same category/specification as adopted for the items in the conditioned building.

90. Air-conditioning plant working with ammonia as refrigerant should NOT be used for air-conditioning of explosives buildings. Use of central type air-conditioning plants working on direct expansion or chilled water system, instead, is recommended.

91 The blower unit of the air-conditioning plant should be made from non-ferrous material and should not be belt-driven from the motor to avoid any possibility of static charge generation. Reliable earthing should be provided.

92. Ducts for supply and return air should be constructed from substantial gauge metal and should be preferably circular to avoid dust accumulation. These should be straight with least number of bends exposed to view to facilitate inspection, replacement, etc. All air ducts its insulation, fitments and accessories shall be made from the non-combustible materials only.

93. Fire dampers should be used inside the air ducts to block the flow of air and prevent fire propagation through them. Used of automatic fire dampers actuated by a low melting alloy is to be preferred.

94. For humidification purposes, water spray humidifier having pumped and spray nozzle combination is recommended for use with air-conditioning plants. Use of steam and other types of humidification apparatus/equipment is NOT recommended.

95. Dehumidification by excessive cooling by air-conditioning plants and subsequent reheating of air with hot water or low pressure steam coils is recommended. Use of electric strip heaters for reheating is discouraged. Reducing relative humidity by heating alone is not recommended. Chemical dehumidifiers should be critically examined from safety angle before their installation in explosive buildings.

96. For further details, STEC pamphlet No.8 on Air- conditioning and Humidity Control in Explosives Areas should be consulted.

SECTION-IV

LIGHTNING PROTECTION, EARTHING AND STATIC ELECTRICITY

Lightning Protection

97. Lightning protection is to be provided for buildings in accordance with IS Code of Practice IS 62305: Part 1 to Part 4. Lightning protection must be provided for buildings containing explosives where net weight of explosives exceeds 250kg for permanent storages and 500kg for temporary storages.

98. Of the various lightning protection systems in vogue, none can be guaranteed to give immunity from damage by lightning discharges. The suspended air termination network is preferable to obtain maximum protection.

99. The system with a 30-degree zone of protection gives 90 percent probability of immunity from lightning discharges as against 75 percent probability for the 45 degree zone. The 30 degree figure should therefore be used for buildings of high risk, i.e. buildings containing explosives sensitive to electrical induction, or thermal or mechanical shock or where the consequences of an ignition may be very serious.

100. The spacing of horizontal conductors is a matter of judgment according to the risks involved. A spacing of 3m may be considered necessary where a building has penetrable roofs, the explosives store is sensitive to shock and the consequences of ignition are serious, whereas with a thick reinforced concrete roof on a category C building containing stable explosives with only a slight or not so serious explosive effect, the maximum spacing of up to 10m may be permissible.

101. Underground sites and structures may be protected by either an air termination or surface network, but in all cases it is considered essential that services and major metal work entering the structure should be bonded together and connected to the lightning protective system at the entrance.

102. The earth terminations of each system are required to be interconnected by a ring conductor which should be preferably buried. It is permissible, because of the need for bonding other objects to it to leave it exposed on the wall of the building, but in this case the interconnection is no longer part of the earthing network and will not form part of the testing of earth termination. The connections to the down conductors on the building which it interconnects should, therefore, be fixed and permanent.

103. The need to bond metal in and on a building often causes difficulties. In many cases in explosives buildings the need for bonding may arise from anti-static considerations rather than from the need only for lightning protection. The main danger from structural metal in a building which is not part of the lightning protective system is damage or fire due to side flashing. This can be avoided by isolation, by distance or by bonding. The need to bond reinforced concrete structures, especially roofs should not normally be in doubt since bonding will not only prevent rupture or spelling but will give additional protection over its total area. Reinforced concrete roofs should have connections solidly to the nearest down conductors or roof tapes.

104. Small ventilators, door frames, hinges and similar items may be left unbounded unless they are in close proximity to down conductors. The bonding of metal window frames its only generally considered essential, where their configuration can give rise to side flashing that is where their position in relation to roof or down conductors is such as to offer an alternative earth path for the lightning discharge.

105. Electric supply lines to buildings containing explosives are to be terminated at not less than 15m from the buildings, the remaining distances being completed by underground cables. This length of 15m underground cable cannot give protection to the building from lightning discharges carried through the cable from overhead supply lines due to considerable voltage building up by repeated reflections which need as much as 150m of underground cable for the originating surge to die off. To overcome this a surge protective device (lightning arrester) of the appropriate type conforming to IS: 15086 (Part 1) : 2001 (reaffirmed 2011)should be provided at points where overhead lines leading to explosives buildings are connected to underground service cables.

Making Safe Explosive Facilities

106. The various precautions are suggested to ensure enhanced safety to personnel working in different explosive facilities during storms and lightning.

a) Process Facilities:-

i. Stop work.
ii. DO NOT deliberately earth explosive assemblies but ensure that they are at least 500mm from the walls of the facility.
iii. Close windows, doors and vents, if possible.

iv. Switch off electricity from outside.
v. Evacuate to a safe location.

b) Storage facilities:-

i. Stop work.
ii. DO NOT deliberately earth explosive assemblies. Close doors and vents.
iii. Switch off electricity from outside.
iv. Evacuate to a safe location.

Earthing

107. A common system of earthing and bonding will be employed for all metallic enclosures of electrical wiring and equipment major metal work in the structure of building and lightning and electro-static protection systems. The metallic sheath and armouring of the main supply cables metallic pipes including those of compressed air and steam system rails of guides entering the building will be bonded to the earthing system at the point of entry or exit outside the structure of the building and will also be earthed at a point 75m away from the building. In underground installation extra earthing is required at intervals not exceeding 75m along the access roadway or shaft underground.

108. Earthing of direct current systems shall conform to the following:-

a) The wire systems in which the voltage exceeds 250 volts shall have a point of the system connected with earth.

b) The connection shall be made at the generating station or sub-station and the insulation of the system shall be maintained throughout all other parts.

c) The connection shall always be maintained except when it is interrupted by means of a switch link for the purpose of testing or locating a fault.

d) A fuse or circuit breaker may be inserted in the earth connection in parallel with a resistance of suitable value to reduce to safe limits any current flowing to earth.

e) An ammeter shall be permanently inserted in the earth connection and the current to earth shall be recorded daily.

109. Earthing of alternating current systems shall conform to the following:-

a) Any medium or low voltage AC system in which the voltage exceeds 125 volts shall have a point of the system connected with earth; this means each distinct system from which a supply is given.

b) The connection shall be made at a generating station, sub station or transformer and the insulation of the system shall be maintained throughout all other parts.

c) The connection shall always be maintained except when it is interrupted by means of a switch or link for the purpose of testing or locating a fault.

d) No resistance impedance fuse or circuit breaker shall be inserted in the earth connection.

e) The current passing to earth shall be ascertained and recorded quarterly.

f) The point to be connected to earth will generally be the neutral point of the star connected system. The midpoint of one phase of delta connected system may be connected to earth when the working conditions are suitable. Delta or star connection system, in which the voltage does not exceed 125 volts, need not be earthed.

110. Safety requirements under short circuit and heavy current fault conditions will normally be met by over-current protection with fuses or circuit breakers in the main or sub-circuits. In buildings and structures containing explosives, and especially those having conducting and anti-static floors, it is considered that earth leakage systems should be employed because of their greater sensitivity in earth fault protection. The type to be installed, either voltage or current operated, or combination of both, and their position in the circuits, sensitivity and time of operation must be determined according to the circumstances of the installation.

111. Concerning earth leakage circuit breakers (ELCB) in general, current operated core balance relays with sensitivity in the range 20/25mA operating at less than 50ms are suitable for most explosives buildings. With installations where conducting or anti-static floors are used, earth leakage relays with a sensitivity as high as 1.25mA to 5mA operating at less than 100ms have been applied successfully in order to reduce the possibility of shock on the person handling explosive. Also where direct isolation of particular circuits may be hazardous undesirable or impracticable such as a firing circuit or a lightning system, the earth leakage relay can be arranged to give a warning only that hazardous conditions has developed.

112. There are three types of electrical systems viz., lightning protection, power and lighting and static which are provided in an explosives building. These electrical systems are provided with individual systems of earthing. Common grounding is always desirable as it would equalize the various groundings in or about a protected structure to minimize the possibilities of a side flash from one grounding system to another. Combined earthing of LP, lighting, power supply and dissipation of static charges could be permitted depending upon the actual site conditions.

Static Electricity

113. Adequate precautions must be taken to prevent the accumulation of static electrical charges. Thorough bonding must be carried out in order to earth all anti-static and conducting materials and all plants and equipment. Where drive or conveyor belts are fitted they are to be of a material of sufficient conductivity to assist in draining away static charges.

Electric Spark Sensitive Explosives

114. The classification of initiating and other compositions based on sensitiveness to electric spark and corresponding degree of precaution in their handling are as under:-

a)	Comparatively insensitive	If the ignition energy is greater than 0.45 joule- first degree precautions sufficient.
b)	Sensitive	If the ignition energy is in the range of 0.001 joule to 0.45 joule intermediate precautions required.
c)	Very sensitive	If the ignition energy is less than 0.001 joule- Full second degree precautions required.

FIREST DEGREE PRECAUTIONS require the earthing of all large objects, the use of antistatic conducting conveyor belts and antistatic or conducting components for pneumatic equipment.

FULL SECOND DEGREE PRECAUTIONS requires the use of floors, conducting bench tops, foot wear and containers, a minimum relative humidity (normally 65%) and outer clothing not prone to electrification.

INTERMEDIATE PRECAUTIONS As regards intermediate precautions, in addition to first degree precautions, relaxation of some of the second degree precautions can only be decided upon after consideration of the properties of the particular composition and the way it is handled. However, some guidelines can be given. For example, if a composition is ignited at 0.45 Joule and not at 0.045 Joule i.e. it is in the upper energy range of the intermediate class, then it will be wise to avoid large potential differences on medium sized items of the equipment. Thus, if material poured from one portable sized container to another, electrical contact between them and earth should be made before hand. If a composition has ignition energy greater than 0.001 Joule, then conducting floors and bench tops will not be necessary. If the ignition energy is in the range of 0.001 Joule to 0.045 Joule, i.e. in the lower energy range of the intermediate class, then items of highly insulating materials may be considered but should not be used if they have surface areas greater than 100cm2 e.g. outer garments, screens and plastic bags. In this energy range, the minimum relative humidity required for second degree precautions is not necessary, and may not be desirable.

A warning notice should be displayed on buildings in which anti-static precautions are necessary. A list of explosives which require maximum anti-static precautions to be taken when they are exposed or handled is given as Appendix 'D'.

115. The basic difference between conducting and anti-static flooring is its electric resistivity and the requirements are:-

Conducting grade	-	Resistance of floor surface to earth must be less than 50 $x10^3$ ohms.
Anti-static grade	-	Resistance of floor surface to earth must be between50 x 10^3 and 2 x 10^6 ohms.

when measured with a wet electrode in accordance with the following method:-

a) The surface of the floor is to be clean and dry. The application of fuller's earth followed by wiping with distilled water is suitable method of cleaning.

b) Tests shall be carried out with an insulation tester having an open circuit voltage of 500 volts D.C. If explosives are present, an intrinsically safe and certified instrument must be employed. The instrument used shall not dissipate more than 3 watt in the flooring and the time of test shall not be longer than is necessary for obtaining a stable reading.

c) The electrode system shall consist of a smooth flat metal foil, a layer of rubber and a weight having an area of $25cm^2$. The metal foil shall be of tin or tin on lead approximately 0.025 mm thick and shall be backed by a layer of rubber approximately 6 mm thick and having hardness not greater than 60 degree BS. The weight to rest on the rubber layer is to be approximately 0.91 kg.

d) The floor surface over an area equal to the area of the metal foil shall be wetted with a wetting agent (such as Tee pole or similar detergent). The electrode shall be place on the floor and the electrical resistance measured between the electrode and known earth connection.

e) Tests are to be carried out between each square meter of the floor and the known earth connection.

116. Installation of conducting and anti-static flooring is to be on a sub floor which should be protected by an effective damp proof membrane. Bonding strips are to be laid on the sub floor in the form of a grid under the flooring material. The spacing of the grid shall ensure that at least 2 earth paths are available to each tile or roll of flooring and the grid shall be connected to the electrical path of the building in 2 positions preferably at diametrically or diagonally opposite points of the floor. The grid material should either be brass or copper, or stainless steel of minimum thickness 0.1 mm. Where a non-electrically conducting adhesive is used, great care is to be taken to prevent the adhesive impairing the conductance between the bonding strips and the under surface of the flooring material.

117. Since the first principle of anti-static precaution is to prevent ignition of explosive situations where maximum antistatic precautions are required conducting flooring should be used. In areas where there may be a high degree of risk to personnel from electric shock such as research and testing laboratories and missile test areas it may be desirable to use anti static flooring as an additional precaution to the basic requirements given above.

118. The use of a personnel test meter for monitoring persons entering buildings fitted with conducting or antistatic flooring is recommended. The test system needs to ensure that the total resistance of personnel wearing conductive foot-wear on a conducting flooring to earth should not exceed 10^6 ohms and that the total resistance of a personnel wearing anti-static footwear on an anti-static floor should not exceed 10 x 10^6 ohms. Where stores or compositions are segregated for investigation because of suspected micro joule sensitivity or damage then these must be examined under conducting conditions, i.e. with maximum personnel to earth resistance of 10^6ohms. Personnel test meters are to be maintained in accordance with the operating instructions.

119. The method of siting of personnel test meter is important. Test meters should always be placed at the entrance of the building i.e. veranda/lobby and the earth electrode should be connected to the earthed grid of the conducting or anti-static floor of the building. The use of brass earth plates as foot electrodes is not recommended as this does not check the actual conditions within the building.

SECTION-V

PERIODIC INSPECTION AND TESTING OF CATEGORIES OFINSTALLATIONS

Inspection

120. Electrical installation is to be periodically examined for signs of mechanical failure such as corrosion of conduit or conduit fittings and apparatus or damage to components due to overheating.

121. All terminals of flexible cables should be examined for tightness and signs of strand breakage. The metal braiding or armouring should be examined for fraying or other damage.

122. Conducting and anti-static floors should be examined for excessive wear or mechanical damage.

123. Lightning protection installations should be inspected and all clamps, bonds and joints in the conductor examined for tightness or signs of corrosion. Conductors should be examined for mechanical damage and security of fixing.

Safety Equipment for Testing

124. No test is to be made on an installation in an explosives building without prior permission of the Head of the establishment and unless the safety officer authorized to act on behalf of the head of the establishment, has first checked that it is safe for testing. The safety officer is to remain in attendance throughout to ensure that adequate safety precautions are taken.

125. Instruments which are certified as intrinsically safe should be used for testing installations within explosives building.

126. Care is to be exercised when making line-earth or neutral earth loop tests to ensure that no hazard can arise if the earthing circuit under test is defective.

127. Opportunity should be taken when a building is free from explosives to carry out testing.

128. If for any reason it is considered necessary to test with explosives stores in the building, special permission is to be obtained from the Service HQ. The safety officer is to remain in attendance and ensure that the following safety precautions are taken:

a) The distance between explosives (stacked or otherwise) and electrical conductors and equipment is kept to a maximum during the testing and on no account should this distance be less than 0.5 m. This is particularly relevant where wiring runs overhead.

b) Testing points for connecting instruments are to be well removed from ammunition or explosives and should preferably be outside a room or building. No unsealed or exposed explosive is permitted within the area under test.

c) The installation is to be under observation during testing and fire fighting equipment is to be immediately available.

d) All the process activities in the room should be discontinued while testing is in progress.

e) On completion of testing shorting resistors should be used to discharge any residual capacitance charge and a period of 30 seconds is to be allowed before disconnecting test equipment.

f) Immediately following testing all test equipment is to be removed from the explosives building.

Testing

129. The resistance of the earth continuity conductor should be tested before other tests are conducted. Resistance measured between the main switch and any part of the earth continuity conductor should not exceed 0.5 ohm.

130. The insulation resistance of electrical installations between conductors and between conductors and earth when tested should not be less than 1 mega ohms.

131. The resistance between the surface of a conducting floor and earth is to be tested with 500 volts insulation tester using a wetted electrode. The maximum resistance between any part of the floor surface and earth should not exceed 50×10^3 ohms.

132. The resistance between the surface of an anti-static floor and earth is to be tested in the same way as a conducting floor. The resistance between any part of the floor surface and earth should not be greater than 2 mega ohms or less than 50×10^3 ohms.

133. The testing of lightning protection installation requires that on initial testing and after any modification:

a) The resistance to earth of each earth termination should not exceed the product given by 10 ohms times the number of earth termination provided.

b) The resistance to earth of the installation with all electrodes and bonding of other service connected is not to exceed 10 ohms when measured at accessible random points approximately equidistance from all earth electrodes.

134. Communication fire alarms and intruder alarm systems are to be tested periodically to ensure satisfactory and safe operation.

Frequency of Testing and Inspection

135. All electrical installations in explosives buildings should be inspected for any visible signs of damage or depreciation at least annually. Shorter periods between inspection may be considered necessary in areas where there is a severe explosion risk i.e. when containing explosives and explosives stores listed in A corrosive or where plants and installations may be subject to mechanical damage or vandalism.

136. All fixed electrical installations within the enclosed explosives area are to be electrically tested not less frequently than recommended in the following schedule:-

Category of Buildings		**Test Requirements**		
		Insulation Resistance	**Earth Continuity**	**Other Tests as per Indian Electricity Act and Rules**
Category 'A'	Min	6 Months	6 Months	6 Months
	Max	1 Year	1 Year	1 Year
Category 'B'	Min	6 Months	1 Year	1 Year
	Max	2 Year	2 Year	2 Year
Category 'C'	Min	1 Year	1 Year	2 Year
	Max	3 Year	4 Year	4 Year
Other buildings within the enclosed explosives area	Min	2 Year	2 Year	4 Year
	Max	5 Year	5 Year	5 Year

NOTE:1. Where circuit are protected by current operated core balance earth leakage devices the above minimum period may be extended to twice the minimum period after the initial period.

2. Where 2 successive periodic tests give results greater than 2 mega ohms for insulation resistance and less than 0.25 ohm for other electrical tests the period

between the test nos. 1, 2 and 3 may be extended by 6 months at each periodic test until the maximum permitted period is achieved.

137. Flexible cables used with electrical appliances in buildings containing explosives are to be inspected and tested at least once a month.

138. Conducting and anti-static floors are to be tested on installation and subsequently at intervals of 3 and 9 months. Thereafter the tests should be made at intervals not exceeding 12 months. The authority competent to inspect and certify the conducting floor is MES in case of Services, R&D and DGI Organisation and in the case of DGOF; it is the responsibility of the local maintenance engineer of the concerned factory.

139. In buildings where there is a high static hazard these tests should be made at more frequent intervals.

140. Protected electrical installations like flame-proof / dust-tight lighting fitting and motors may require change of gaskets, washers, glands and other joints after these have been installed in explosives dust laden and flammable corrosive vapours locations, after some time. When opened for maintenance purposes, the accessories like gaskets, washers, glands, etc. should invariably be replaced by exactly matching types. For this purpose it is desirable to keep a stock of such items. This aspect may be kept in view while procuring these fitments.

14. Inspection and testing record should be maintained in a register and shown to Audit Officer at the time of inspection.

APPENDIX-'A'

LIST OF RELATED REGULATIONS, INDIAN STANDARDS AND CODES OF PRACTICE

1.	Indian Electricity Rules, 1956 and Indian Electricity Act, 1910 with amendments issued from time to time.	
2.	IS/IEC 60079 : Part 1 :2007 (reaffirmed 2012)	Explosive atmospheres Part 1: Equipment protection by Flameproof enclosures."d"
3.	IS:3034-1993(reaffirmed 2012)	Fire safety of industrial buildings: Electrical generating and distributing stations-code of practice.
4.	IS:1255-1983(reaffirmed 2016)	Code of practice for Installation and maintenance of paper insulated power cables.
5.	IS:9537(Part1)1981(reaffirmed 2015) Amended in 1995	Conduits for electrical installation: Part 1-General requirements.
6.	IS: 732-1989(reaffirmed 2015)	Code of practice for electrical wiring installations.
7.	IS: 694-1990(reaffirmed 2015)	PVC insulated cables for working voltages upto and including 1100 V.
8.	IS:9537(Part2)1981(reaffirmed 2015) Amended in 1984, 1990, 2002	Conduits for electrical installations: Part 2-Rigid? Steel conduits.
9.	IS:1554(Part1)1988(reaffirmed 2015) third revision	PVC insulated (heavy duty) electric cables: Part-1 for working voltages up to and including 1100V
10.	IS:9537(Part3)1983(reaffirmed 2013) Amended in 2002, 2011	Conduits for electrical installations: Part 3-Rigid Non-metallic conduits for insulating materials.
11.	IS:3842(Part1)1988(reaffirmed 2011)	Application guide for electrical relays or A C systems: Part 1 over current relays for feeders and Transformers.
12.	IS 62305 : Part 1 to Part 4	Protection against lightning
13.	IS 15086 (Part 1) : 2001 (reaffirmed 2011)	Surge arresters : Part 1 Non linear resistor type gapped surged arrestor for a.c. system
14.	IS/IEC 60079 : Part 0 : 2011	Explosive atmospheres Part 0 General requirements (second revision)
15.	IS:5572-2009 (reaffirmed June - 2014)	Classification of hazardous areas (other than mines) Areas having flammable gases and vapours for electric installations

16.	IS/IEC 60079 : Part 0 : 2011	Explosive atmospheres Part 0 General requirements (second revision)
17.	IS IEC 60079 : Part 2 : 2007(reaffirmed 2014)	Explosive protection by pressurized enclosure “p”
18.	IS/IEC 60079:PART-11: 2006 (reaffirmed 2013)	Explosive atmospheres: Part 11 Equipment protection by intrinsic safety.
19.	IS:7689-1989(reaffirmed 2015)	Guide for control of undesirable static electricity.
20.	IS:3043-1987(reaffirmed 2016) Amended in 2006, 2010	Code of practice for earthing.
21.	IS:8374-1977(reaffirmed 2017)	Bitumen mastic, anti-static and electrically conducting grade.
22.	IS:5571-2009 (reaffirmed June - 2014)	Guide for selection and installation of electrical equipment for hazardous areas (other than mines).
23.	IS/IEC 60079 : Part 7 :2006 (reaffirmed 2013)	Explosive atmospheres: Part 7 Equipment protection by increased safety “e”.
24.	IS/IEC 60079-15 : Part 15 :2010	Explosive atmospheres Part 15 Equipment protection by type of protection
25.	IS:418:2004(reaffirmed 2014)	Tungsten Filament Lamp for domestic and similar general lighting
26.	IS:9900-1981 (Part – 1) to (Part –IV) (reaffirmed 2012)	Pressure mercury vapours lamps or tubular fluorescent lamps.
27.	IS: 1258:2005 (reaffirmed 2015)	Bayonet lamp holders.
28.	IS: 4218: Part 1: 2001 (Reaffirmed 2013)	ISO General purpose Metric Screw Threads-Part 1 : Basic and Design Profile.

APPENDIX-'B'

STEC SPECIFICATION FOR TOTALLY-ENCLOSED LIGHTING FITTINGS

In Explosives storage buildings and Process Buildings with no flammable vapour/gas or flammable/explosives dust risk the use of totally enclosed lighting fittings which are mechanically sound and weather and insect proof would be adequate. For this Purpose:-

(i) The body of the fittings should be sufficiently strong to withstand any damage likely to be met within the course of normal usage.

(ii) It should be a completely closed fitting to prevent entry of extraneous material but need not necessarily be airtight.

This standard is intended to cover the use of totally-enclosed fittings for incandescent and mercury vapour lamps and tubular fluorescent fittings.

1. Scope:

This standard covers lighting fittings of totally-enclosed construction intended for use in Explosives Building without flammable gas/vapour and flammable/explosives dust risks.

2. Terminology

2.0 For the purpose of the standard, the following definitions shall apply:

2.1 Totally-enclosed –A fitting protected by mechanically sound enclosure weather-proof and insect-proof, without opening for ventilation but not necessarily air-tight.

2.2 Lighting Fitting –Apparatus which distributes, filters or transforms the light given by one or more lamps, and which includes all the items necessary for supporting, fixing, connecting and protecting these lamps and, if necessary, the auxiliaries for their operation. A simple lamp holder however, does not constitute a lighting fitting.

2.3 Rated Voltage –The nominal mains voltage for which the lighting fitting is designed.

2.4 Rated Wattage –The total rated wattage of the lamp for which the lighting fitting is designed.

2.5 Routine Test –Test carried by the manufacturer on each fitting to check requirements which are likely to vary during production.

2.6 Type Test –Tests carried out at the Testing Section to prove conformity with the specification. These are intended to prove the general qualities and design of a given type of lighting fittings.

2.7 Weather-Proof –Applied to apparatus to denote that the live parts are enclosed by a cover or covers so constructed as to exclude rain, snow and external splashing.

3. General Requirements:

3.1 Totally enclosed lighting fittings shall comply with the requirements of this assembled including the attachment of cable or conduit, the assembly shall be mechanically sound and the fitting weather-proof and insect-proof. They shall be constructed from such materials and have such finishes that no undue deterioration occurs during normal life.

4. Material and Construction:

4.1 The body of the fitting shall be cast iron, aluminium alloy or other suitable metal. The metallic retaining ring for the glass shall be of cast iron or mild steel or any other suitable material of adequate thickness. They shall be free from cracks, blow-holes and other flaws. The strength and rigidity of the enclosure shall be such that there will be no subsequent twisting or warping due to any nominal inequality of the surface on which it is mounted.

4.1.1 The gaskets shall be of homogeneous material throughout and shall be without a joint, thoroughly compressed, reasonably free from air holes and all other imperfections. The gasketed ring shall be made of any suitable material which shall not deteriorate in normal use.

4.1.2 Control Gear –Where control gear for discharge lamps is accommodated within the street lighting luminaries' enclosure, the design, construction and workmanship shall conform to General Safety Requirements for Electric Light Fittings.

4.2 Joints-The surface of the joints and glass shall be flat and free from any unevenness and inequalities.

4.3 Lamps-Fitting made to the Specification shall accommodate TUNGSTEN filament lamps of the appropriate voltage complying with IS : 418-2004 specification for Tungsten filament general service electric lamps, mercury vapour discharge lamps in accordance with IS: 9900-1981(Part 1) to (Part 4)(Reaffirmed 2012) High Pressure mercury vapour lamps or tubular fluorescent lamps.

4.4 Lamp Holders –The lamp holders shall be of metal / alloy or porcelain and they shall comply with the relevant Indian Standard (see IS: 1258 –2005, specifications for Bayonet lamp holders).

4.5 Glass and Plastic Enclosures:

4.5.1 Where glass or plastic enclosures are used, these parts should be firmly held yet easily replaceable. They should be well sealed by the use of suitable gaskets but readily accessible for cleaning and maintenance. They should be resiliently mounted free from stress and so secured that in the case of plastic warping is minimized.

4.5.2 Plastic enclosures shall be made sufficiently large to obviate over-heating when used with the largest lamp recommended by the manufacturer under the worst possible weather conditions.

4.5.3 Glass or plastic enclosures shall be capable of withstanding thermal shock due to rain and stresses due to other causes in normal operation when the street lighting luminaries is equipped with each of the light sources for which it is designed.

4.6 Provision for Reflectors –Provision may be made on well-glass fittings for the attachment of reflectors if required. If provided the material and finish of reflectors shall comply with the relevant Indian Standards Specification.

4.7 Provision for guard-The lighting fittings shall be provided with guard. Bars in such guards shall be of metal and, when in round sections, shall have the following minimum dimensions:-

Diameter of Basket		**Diameter of Bar**
Above (mm)	**Up to and including (mm)**	**(mm)**
	75	3
75	100	4
100		5

In the case of bars other than round in section they shall have a minimum cross-sectional area of 20 mm^2. At points where bars cross, they shall be firmly fixed, for example, by welding.

The dimensions of openings in such guards shall be as follows:

	Max.
Up to 60 W	40 mm x 50 mm
Above 60 W and up to 200 W	50 mm x 70 mm
Above 200 W	60 mm x 100 m

Variation from the maximum on the lower side shall not exceed 10%.

The minimum distance of the protective bars from the glass shall be:-
External diameter of the body in the case of well-glasses and maximum dimensions in case of

bulkhead glasses:

Up to 100 mm	7 mm
Above 100 mm	10 mm

Note: In lighting fittings with glass windows, it shall be not less than 5 mm.

The wire guards shall be so fixed to the main part of the lighting fittings that the use of special tools shall be essential to remove them.

4.8 Finish –The fittings shall have a neat finish and the metal parts shall be either stove enamel painted or otherwise treated to render them dust-proof.

5. Provision for Earthing

An earthing terminal shall be provided to enable the fitting to be earthed. The earthing terminal shall have screw thread corresponding to M6 (See IS:4218:Part 1:2001) Specification for Dimensions for Screw threads for General Purposes Diameter range 0.25 to 39 mm (Revised).

6. Warning Inscription

The totally-enclosed fitting shall carry an inscription warning against opening the enclosure unless circuit is isolated elsewhere or the fitting shall be so designed that access to the lamp inside cannot be obtained unless the circuit is rendered dead.

7. Temperature Rise

7.1 The temperature rise at any part of the external surface of the fitting shall not exceed 50^0C in the case of incandescent and 40ºC for tubular fluorescent and mercury vapour lamps when measured in an ambient temperature of 50ºC. In other words the maximum temperature on the surface at such ambient temperature shall not exceed 100ºC for incandescent and 90ºC for tubular fluorescent and mercury vapour lamps.

7.2.1 If the fittings are designed to include an external reflector, the temperature rise shall comply with this requirement either with or without the reflector.

8. Marking

8.1 Each fitting shall be permanently marked either by raised lettering or cast integrally with, or by a plate attached by reverting to the body of the fitting in a manner which will not impair the totally enclosed enclosure, to indicate the following particulars:

(a) Manufacturer's name and / or Trade Mark
(b) Country of Manufacture.
(c) Model and type designation (i.e. T.E.)
(d) Rated wattage

(e) Max. Rated voltage.
(f) Temperature range letter i.e. Max. Temp rise 50º C/40º C in Max. Amb. 50º C.

8.2 **Marking of Earth Connection** –The earthing terminal shall b marked in legible and indelible manner or adjacent to the terminal.

9. Tests:

9.1 Routine Test-The following shall constitute routine tests:-

(a) Insulation Resistance (Dry) –The test-resistance should be measured by the application of 500 V DC for one minute between:-

(i) Live parts of different polarity inside the fitting and
(ii) Live parts and external metal parts of the fitting. The insulation resistance shall not be less than 5 mega ohms.

(b) High Voltage Test –1000 V RMS is applied between the parts mentioned at (a) (i) and (ii) above and the fitting examined to see whether it can withstand the above voltage without any puncture or arcing.

9.1.1 Certificates of the above route tests shall be forwarded by the manufacturer to the Testing Authority along with the sample under test.

9.1.2 **Type Test:**

(a) Weather Proofness –Artificial rain is applied at an angle of 45ºto the fitting for an hour. Entry of water within the interior of the lighting fitting shall be taken as non compliance with the definition of weather proofness.

(b) Test for temperature rise-The test shall be carried out in a rectangular draught proof enclosure with the lamp when giving the greatest rise in temperature. Thermo couples are used to record the temperature by measurement of the EMF developed. The thermocouple may be attached to the surface so as to get a good thermal contact with the minimum of disturbance of the thermal conditions. Attachment may be by mechanical means, soldering, adhesive or by thermocouple holders suitable for the well-glass or bulk-head fittings.

(c) Thermal shockproof test for cover glass –The purpose of the test is to examine whether the cover glass could stand sudden variations in surface temperature for example by falling rain or splashing water when it is operating, without developing cracks. The test consists of heating the cover glass in an oven to attain a steady temperature of 100ºC (maximum permissible surface temperature) and plunging it in cold water and examining for any cracks or defects.

Weather Proofness Test:

(i) An artificial rain shall be applied at an angle of approximately 45º to the vertical to the fitting as mounted in service. The rain shall be applied for one hour at an approximate rate of 3mm per minute. The rate of rainfall shall be measured by the rise of water in a small straight sides pan placed horizontally and completely within the area covered by the rain.

(ii) The water shall not come into contact with the enclosed electrical equipment and the interior of the fitting.

(iii) Immediately afterwards the insulation resistance of the fitting shall be measured in accordance with 9.1a and the measured value shall be not less than 2 mega ohms.

APPENDIX-'C'

DISTANCE OF RADIO FREQUENCY SOURCES FROM ELECTRO-EXPLOSVIES DEVICES

	Conditions of using EEDs	**Omni-directional Aerials**		**Differential Aerials**	
Sl. No.		**Mean power (Kilo watts)**	**Min. Distance (Metre)**	**Mean Power (Kilo watts)**	**Min. Distance (Metre)**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
1.	Flying, taxing parked or internally housed aircraft fitted with explosives items	0.25 1	15 30	0.25 0.5	30 60
2.	Loading on to aircraft fully assembled explosives items containing properly connected EEDs. No transmission from aircraft being Loaded.	4 16 64	60 120 240	0.75 1 2	90 120 240
3.	Transporting, but not handling prepared items containing properly connected EEDs	256	480	4 16 64	480 960 1920
4.	Testing EEDs in vicinity of or on aircraft. The Following precautions are to be observed. a. NO transmission from aircraft under test. b. No transmission from adjacent aircraft within 30 m and/or for adjacent aircraft with directional aerials, the aerials of which are pointed to avoid illumination of the aircraft under test c. For aircraft and ground radio equipments beyond 30m from aircraft and (5), as Appropriate, are to be observed.	0.25 1 4 16 64 256	30 60 120 240 430 960	0.25 0.5 0.75 1 2 8 32	60 120 180 240 480 960 1920
5.	Explosives laboratories, explosives preparation rooms and missile preparation buildings & Blasting operations. The following precautions are to be observed: a. No radio frequency transmitter to be sited inside the safety distances given in cols. (3) & (5) as appropriate without prior evaluation. b. No rhombic aerial to be sited without prior Evaluation.	0.25 1 4 16 64 256	60 120 240 480 960 1920	0.25 0.5 0.75 1 4 16	120 240 360 480 960 1920

APPENDIX-D

LIST OF EXPLOSIVES AND EXPLOSIVES STORES REQUIRING ANTI-STATIC PRECAUTIONS

The following list of explosives requires anti-static precautions to be taken when exposed and handled:-

(1) All initiatory compositions with spark sensitivity of less than 0.001J.

(2) All EEDs which may be initiated below an energy level of 0.001 J.

(3) Pyrotechnic compositions:-

(a) Delay composition (gasless) based on Boron as fuel and Lead and Barium peroxides, Chromium, Bismuth and Molybdenum trioxides as oxidant: SR 54, SR 56, SR 57, SR 61, SR 75, SR 79, SR 87, SR 89, SR 90 and SR 92.

(b) Igniters and primary compositions based either on Zirconium as fuel with Molybdenum or Chromium trioxide as oxidant or Aluminium and/or Magnesium as fuel with Cupric oxide and Tungsten trioxide as oxidant: SR 45, SR 46, SR 47, SR 70 and SR 72.

(c) Flame compositions based on Titanium as fuel: SR 697, SR 698 and SR 699.

TYPES OF LIGHTING PROTECTION FOR EXPLOSIVES AND NON-EXPLOSIVES BUILDINGS IN EXPLOSIVES AREA

Explosives and Non-Explosives Buildings in Storages Depots				Explosives and Non-Explosives Buildings in Explosives and filling Factories and Ammunition Workshops of the Navy				
Explosives Storage Buildings and Amn. WKPs/Explosives Labs of Army and Air Force		Non-Explosives Storages Buildings & Offices in Explosives Areas where being provided		Nitro-glycerine & Initiatory Explosives Manufacturing Bldgs	Process Buildings other than those under Column (5) and Explosives Storage Buildings of the Factories and Amn. Workshops of the Navy			Non-Explosives Storage Buildings and Offices in Explosives Areas
Small Structures	All Other Structures	Large Structures	Small Structure		Requiring FLP or DT Fittings	Requiring DP Fittings	Requiring TE Fittings	
Pole Type (on the basis of 30^0 zone of protection)	Integrally mounted systems. Spacing of horizontal conductors – 7.5m. Height of finials –0.3m. Notes: 1. Finials may be dispensed with on grounds of camouflage in the case of Forward Areas. 2. For Ammunition workshops of the Navy see under explosives filing factories.	Integrally mounted systems with horizontal conductors 18m apart. Finials up to 0.3m high may be provided if necessary at the discretion of the engineers.	Pole Type (on the basis of 45^0 zone of protection)	Suspended type of air termination network with protective angle of 45^0 within the space bounded by the conductors but only 30^0 outside space	Integrally mounted systems with horizontal conductors spaced 3m apart and with finials 1.5m high at intersection points.	Integrally mounted systems. Spacing of horizontal conductors – 5m. Height of finials-1.5m	Integrally mounted systems. Spacing of horizontal conductors – 7.5m. Height of finials – 0.3m.	Same as for storage depots.

GLOSSARY

Air Termination Network: The part of lightning protection system that is intended to intercept lightning discharges.

Category 'A' Buildings: Buildings containing or likely to contain explosives which may produce flammable vapours but not explosives dust.

Category 'B' buildings: Buildings containing or likely to contain exposed explosives or explosives, which may give rise to explosives dust, but not flammable vapour.

Category 'C' buildings: Buildings containing or likely to contain explosives which do not give rise to flammable vapours or explosives dust.

Down conductor: A conductor which connects the air termination network with the earth termination network.

Earth Termination Network: The part of the lightning protection system which is intended to discharge lightning currents into the general mass of earth. All parts below the lowest test joint in a down conductor are included in this term.

Electro-Explosives Device: A one shot explosives or pyrotechnic device caused to function by the application of electrical energy.

Flame-Proof (Ex d): A type of electrical fitting which will withstand an internal explosion of the flammable gas or vapour which may enter or which may originate inside the enclosure without suffering damage and which prevents the transmission of the explosion to the flammable atmosphere surrounding the enclosure.

Dust-Tight: A type of electrical fitting which when used in a dust-laden atmosphere does not permit the entry of any dust.

Increased Safety: A type of electrical fitting in which measures are applied so as to prevent, with a higher degree of security, the possibility of excessive temperatures and the occurrence of arcs and sparks in the interior and on the external parts of electrical apparatus which does not produce them in normal service.

Pressurised apparatus: A type of electrical fitting in which the entry of a surrounding atmosphere into the enclosure of the electrical fitting is prevented by maintaining, inside the enclosure, a protective gas at a higher pressure than that of the surrounding atmosphere. The overpressure is maintained either with or without a continuous flow of protective gas.

Non-Sparking: A type of electrical fitting in which in normal operation, it is not capable of igniting a surrounding explosives atmosphere and a fault capable of causing ignition is not likely to occur.

Totally Enclosed: A type of electrical fitting which is protected by mechanically sound enclosure, weather-proof and insect-proof without opening for ventilation but not necessarily air-tight.

Floor, antistatic: A floor which is sufficiently electrically conductive to disperse charges of static electricity, but has sufficient electrical resistance to minimize the danger from electric shock.

Intrinsically safe circuits -

Referred to flammable gas or vapour: A circuit in which neither spark nor thermal effect produced in the test condition prescribed in IS:5780-1980 is capable of causing ignition of a given flammable atmosphere.

Referred to explosives: Circuits which, when connected into an explosives train or system normally initiated by an EED, remain incapable of initiating such a device when the circuit is energized from the intended power source.

Intrinsically safe electrical apparatus/equipment -

Referred to flammable gas or vapour: Electrical equipment consisting of an assembly of electrical components, circuits or parts of circuits usually within a single enclosure in which all the circuits are intrinsically safe.

Referred to explosives: Electrical equipment when connected into an operated in conjunction with an explosive train or system normally initiated by an EED, is incapable of causing the device to function.

Type of Protection N:

Zone of Protection: The zone considered to be protected by a complete air-termination network of a lightning protection system.

Index of Protection: IP

Refer to the BIS Standards for IP number in glossary.

Quantity Distance (QD): This is the minimum permissible distance to be observed from explosives stocks to other explosives to prevent direct propagation and to ensure minimum practicable risk to life and property should an explosion occur.

Storage inside Quantity Distance (SIQD): This is the minimum permissible distance between any two stacks / buildings used for storage of explosives inside the enclosed explosives area.

Process inside Quantity Distance (PIQD): This is the minimum permissible distance to be observed between an explosives building / stack and process building production line inside the enclosed explosives area.

Outside Quantity Distance (OQD): This is the minimum permissible distance between an explosives building / stack to utilities/ places used by the general public outside the enclosed explosives area.