Appendix B
Fire Protection Considerations for Venting in Industrial and Storage Buildings

B.1 SCOPE

B1.1 This appendix covers venting requirements in industrial buildings. Provisions contained herein shall be applicable to factory and storage facilities requiring large floor areas without dividing walls and enclosures.

B1.2 This appendix shall not apply to ventilation designed for personnel comfort, commercial cooking operation, regulating odor or humidity in toilet and bathing facilities, to regulate cooling equipment.

B1.3 This appendix shall apply to fire and smoke of two criteria (a) Fire or smoke layer that does not enhance the burning rate. (b) Deflagration

B2 VENTING OF FIRE AND SMOKE THAT DOES NOT ENHANCE THE BURNING RATE

B2.1 Precise venting shall be based on fire dynamics and needs detail calculation, considering variables like rate of combustion, composition of the combustion product, shape, size and packaging of the combustible materials as well the size, height and disposition of the stacks of materials are involved with it.

B2.2 Vent system designs shall be computed by calculating the vent area required to achieve a mass rate of flow through the vent that equals the mass rate of smoke production.

B2.3 Venting devices are to be so designed and installed that they operate automatically at the earliest sign of fire or smoke.

B2.4 The smoke and fire venting system shall be so designed and installed as to keep the temperature of the combustion product as low as possible, preferably below $150^{O}C$.

B2.5 To achieve full efficiency in vents total area of all vents must be more than the inlet area for cold air. Ideally the inlets should be as close to the floor level as possible.

B2.6 The area of unit vent shall not exceed $2d^2$, where d is the design depth of the smoke layer. For vents with length to width ratio more than two, the width shall not exceed the design depth of the smoke layer.

B2.7 The center-to-center spacing of vents within a curtained area shall not exceed 2.8 H, where H is the ceiling height. For different shape of the roof the ceiling height can be calculated as per provision of NFPA 204.

B2.8 The spacing of vents shall be such that the horizontal distance from any point on a wall or draft curtain to the center of the nearest vent, within a curtained area does not exceed 1.4 H.

B2.9 The total vent area per curtained area shall be sized to meet the design objectives and the performance objectives relative to the design fire or smoke, determined in accordance with NFPA 204.

B2.10 The design of venting for sprinkled building shall be based on performance analysis acceptable to the authority having jurisdiction, demonstrating that the established objectives are met.

B2.11 Smoke and heat venting systems and mechanical exhaust systems shall be inspected and maintained in accordance with NFPA 204.

B2.12 Venting systems are complement to fire extinguishing system. Where automatic sprinklers are installed as fire extinguishing system, the sprinklers shall operate before the vent system comes into operation.

B2.13 In industrial buildings exterior wall windows alone shall not be accepted as satisfactory means of venting, but may be reckoned as additional means of venting when located close to the eaves and are provided with ordinary glass or movable section arranged for both manual and automatic operation.

B2.14 Vents shall be automatic in operation unless where designed specifically for both manual and automatic operation.

B2.15 Release mechanism of vent closure shall be simple in operation and shall not be dependent on electric power.

B2.16 The automatic operation of vents can be achieved by actuation of fusible links or other heat or smoke detectors or by interlacing with the operation of sprinkler system or any other automatic fire extinguishing system covering the area. The vents can be so designed as to open by counterweights utilizing the force of gravity or spring loaded level following its release.

B2.17 When vents and automatic sprinklers where installed together, sprinkler shall go into operation first before vents open, in order to avoid delay in sprinkler operation.

B2.18 Materials used in hinges, hatches and other related parts in vents shall be noncorrosive in nature for long trouble free operation.

B2.19 Vents shall be properly sited, at the highest point in each area to be covered.

B2.20 If possible, vents shall be sited right on top of the probable risk area to be protected to ensure free and speedy removal of smoke and other combustion product.

B2.21 Minimum vent opening shall not be less than 1250 mm in any direction.

B2.22 Vent spacing shall be designed considering the fact that higher number of smaller vents is better than smaller number of large vents.

B 3. DEFLAGRATION VENTING

B3.1 Deflagration is the propagation of a fire or smoke at a velocity less than the sound wave. When this velocity of combustion increased beyond sound velocity then the combustion is said to be detonated and explosion occurred with the rupture of an enclosure or a container due to the increase of internal pressure from a deflagration.

B3.2 The design of deflagration vents and vents closures necessitates consideration of many variables, only some of which have been investigated in depth. No Venting recommendations are currently available for fast-burning gases with fundamental burning velocities greater than 1.3 times that of propane, such as hydrogen. Recommendations are unavailable and no venting data have been generated that addresses condition that fast-burning gas deflagrations. The user is cautioned that fast-burning gas deflagrations can readily undergo transition to detonation.

B3.3 Deflagration venting is provided for enclosures to minimize structural damage to the enclosure itself and to reduce the probability of damage to the other structures.

B3.4 Venting shall be sufficient to prevent the maximum pressure that develops within the enclosure from exceeding enclosure strength.

B3.5 The vent area shall be distributed as symmetrically and as evenly as possible.

B3.6 The need for deflagration vents can be eliminated by the application of explosion prevention techniques described in NFPA 69.

B3.7 The vent closure shall be designed to function as rapid as is practical. The mass of the closure shall be as low as possible to reduce the effects of inertia. The total mass of the moveable part of the vent closure assembly shall not be exceeded 12.2kg/m^2.

B3.8 When an enclosure is subdivided into compartments by walls, partitions, floors, or ceilings, then each compartment that contains a deflagration hazard should be provided with its own vent closure(s).

B3.9 It is possible to isolate hazardous operations and equipment outside of buildings with a pressure resisting wall which will reduce risk of structural damage. Such operations and equipment may be housed in a single storey building having appropriate venting facilities and a device to absorb explosion shock from blowing through the duct back to the building.

B3.10 Sometimes it may not be possible to house hazardous operations and equipment outside of the building, in which case the separation from other parts and equipment shall be achieved by pressure resisting walls and such units shall be ventilated outdoors. If suitable vents are integrated, external walls may be of heavy construction or of heavy panel which may be blown off easily.

B3.11 Unobstructed vent opening is the most effective pressure release vent structures.

B3.12 Explosion relief vents may be provided with open or unobstructed vents, louvers, roof vents, hanger type doors, building doors, windows, roof or wall panels or marble/fixed sash. Any or more than one of these may be adopted depending on individual situations and requirements.

B3.13 Roof vents covered with weather hoods shall be as light as possible and attached lightly, so that it is easily blown off as and when an explosion occurs.

B3.14 Doors and windows used as explosion vents shall be so fixed as to open outward. Doors shall be fitted with friction, spring or magnetic, latches that function automatically at the slight increase in internal pressure.

B3.15 Placed at the top or bottom, the hinged or projected movable sash shall be equipped with latch or friction device to prevent accidental opening due to wind action or intrusion. Such latches or locks shall be well maintained.

B3.16 Venting shall be so planned as to prevent injury to inmates and damage to enclosure. In populated locations, substantial ducts or diverts shall be provided to channelize the blast towards a pre-determined direction.

B3.17 If explosion are probable within the duct, they shall be equipped with diaphragm to rupture at predetermined locations. The duct system shall not be physically connected to more than one collector.

B3.18 Skylight with moveable sash that opens outward or fixed sash having panes of glass or plastic that blow out readily under pressure from within can be used to supplement wall vents or windows, provided their resistance to opening or displacement may be kept as low as possible consistent with structural requirement of the building.

B3.19 For equivalent explosion pressure release, larger closed vents will be required compared to open vents.

B3.20 As far as possible hazardous areas shall be segregated be means of fire walls or party walls to prevent spread of fire.

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