Tentative Interim Amendment

NFPA 654

Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids

2006 Edition

Reference: 6.1, 6.2.3, and 11.2.3
TIA 06-1
(SC 11-3-15/TIA Log #1020)

Pursuant to Section 5 of the NFPA Regulations Governing Committee Projects, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2006 edition. The TIA was processed by the Technical Committee on Handling and Conveying of Dusts, Vapors, and Gases, and was issued by the Standards Council on March 1, 2011, with an effective date of March 21, 2011.

A Tentative Interim Amendment is tentative because it has not been processed through the entire standards-making procedures. It is interim because it is effective only between editions of the standard. A TIA automatically becomes a proposal of the proponent for the next edition of the standard; as such, it then is subject to all of the procedures of the standards-making process.

1. Revise 6.1 to read as follows:

6.1 General. The provisions of this section shall apply to the overall design of systems that handle combustible particulate solids.

6.1.1* Those portions of the process and facility where a dust deflagration hazard exists shall be protected from the effects of dust deflagrations in accordance with Sections 6.2, 6.3, and 6.4 and Chapter 7.

6.1.1.1 Those portions of the process and facility where dust accumulations exist shall be evaluated to determine if a dust deflagration hazard exists, unless the dust layer depth is 1/64 in. (0.4 mm) or less or the underlying surface colors are readily discernible.

6.1.1.2 The layer depth criterion of 1/32 in. (0.8 mm) shall be permitted to be increased according to equation 6.1.1.2 for materials with bulk density less than 75 lb/ft^3 (1200 kg/m^3).

$$\text{Layer Depth Criterion (in)} = \frac{(1/32\text{ in})(75\text{ lb/ft}^3)}{\text{Bulk Density (lb/ft}^3)} \qquad \text{Eqn 6.6.1.1.2}$$

6.1.1.3* A dust deflagration hazard shall be deemed to exist where dust clouds of a hazardous concentration exist or where any of the following conditions exist:

(1) For buildings or rooms with footprint areas smaller than 20,000 ft^2 (1860 m^2)
  (a) the area of dust accumulations exceeding the layer depth criterion is greater than 5% of the footprint area, or
  (b) the total volume of dust accumulations is greater than the layer depth criterion multiplied by 5% of the footprint area.
(2) For buildings or rooms with footprint areas greater than or equal to 20,000 ft^2 (1860 m^2)
  (a) the area of dust accumulations exceeding the layer depth criterion is greater than 1000 ft^2 (93 m^2), or
  (b) the total volume of dust accumulations is greater than the layer depth criterion multiplied by 1000 ft^2 (93 m^2).

6.1.1.4 Dust accumulation amounts shall reflect the conditions that exist just prior to routinely scheduled cleaning in accordance with Chapter 8.

6.1.1.5 An explosion hazard shall be deemed to exist in enclosed process equipment where all of the following conditions are possible:

(1) Combustible dust is present in sufficient quantity to cause enclosure rupture if suspended and ignited.
(2) A means of suspending the dust is present.

6.1.2 through 6.1.6 *are unchanged from existing standard.*

6.1.7 Personnel exposed to a dust deflagration hazard shall be protected in accordance with 11.2.3.

2. Revise 6.2.3 to read as follows:

6.2.3 Use of Separation.

6.2.3.1* Separation shall be permitted to be used to limit the fire or dust explosion hazardous area, that separation area shall be free of dust to the extent that dust accumulations on any surfaces do not exceed 1/64 in. (0.4 mm) or surface colors are readily discernible. The required separation distance between the hazardous area identified in 6.1.1.3 and surrounding exposures shall be determined by the following:

(1) Engineering evaluation that addresses the properties of the materials
(2) Type of operation
(3) Amount of material likely to be present outside the process equipment
(4) Building design
(5) Nature of surrounding exposures

6.2.3.2 In no case shall the distance be less than 30 ft (9 m).

6.2.3.3 When separation is used, housekeeping, fixed dust collection systems employed at points of release, and compartmentation shall be permitted to be used to limit the extent of the hazardous area.

3. Change reference in 6.4.1 from 6.2.3.1 to 6.1.1.3 as follows:

6.4.1* If a room or building contains a dust explosion hazard as specified in 6.1.1.3 that is external to protected equipment, such areas shall be provided with deflagration venting to a safe outside location.

4. Change reference in 6.5 from 6.2.3.1 to 6.1.1.3 as follows:

6.5* Relief Valves. Relief valves shall not be vented to a dust hazard area, as specified by 6.1.1.3.

5. Add a new 11.2.3 to read as follows:

11.2.3 Operating and maintenance procedures shall address personal protective equipment (PPE) including flame-resistant garments in accordance with the workplace hazard assessment required by NFPA 2113.

6. Add a new A.6.1.1.3 for new 6.1.1.3 as follows:

A.6.1.1.3 The dust accumulation is a product of the actual layer depth and the total area of accumulation. The limitation in 6.1.1.3 is expressed as a product of the Layer Depth Criterion and a percentage of the footprint area of the room or building. Within a single room or building, areas of significant dust accumulation could be contiguous or separated. When they are separated, the separate accumulations are combined and compared to the permissible dust accumulation. The Layer Depth Criterion can be increased for a specific dust when the bulk density is known.

For rooms or buildings where dust accumulations are limited to a small area, one way to determine if the actual dust accumulation is sufficient to result in a dust deflagration hazard is to ratio the actual dust accumulation to the permissible dust accumulation. If the ratio exceeds 1, then a dust deflagration hazard exists in the subject building or room.

Surfaces where dust could settle include floors, beam flanges, piping, ductwork, equipment, suspended ceilings, light fixtures and walls. Particular attention should be given to dust adhering to walls and vertical surfaces as it can be easily dislodged.

When determining the total volume of dust accumulations, accumulation areas where the actual thickness is less than 1/64 in. (0.4 mm) can be excluded.

Example 1: A single floor accumulation area in a small portion of a 25 ft. by 40 ft. room. The dust has a bulk density of 75 lb/ft^3.

Layer Depth Criterion = 1/32 inch
Room footprint area = 1000 ft^2
Actual accumulation area = 20 ft^2
Average layer depth in accumulation area = 1/16 inch

$$Ratio = \frac{20\,ft^2 \bullet \left(1/16\right) inch}{0.05 \bullet 1000\,ft^2 \bullet \left(1/32\right) inch} = \frac{1.3\,ft^2 \cdot inch}{1.6\,ft^2 \cdot inch} \le 1$$

Since the ratio is less than or equal to 1, a dust deflagration hazard does not exist in the room. When the actual accumulation area is less than 5% of the room footprint, the layer thickness can be greater without resulting in a dust deflagration hazard.

Example 2: A single floor accumulation area in a portion of a 25 ft. by 40 ft. room. The dust has a bulk density of 30 lb/ft^3. First adjust the Layer Depth Criterion for the reduced bulk density.

$$LayerDepthCriterion = \frac{\left(1/32\right) inch \bullet 75\, lb/ft^3}{30\, lb/ft^3} = 0.078 inch \cong \left(1/16\right) inch$$

Room footprint area = 1000 ft^2
Actual accumulation area = 100 ft^2
Average layer depth in accumulation area = 1/32 inch

$$Ratio = \frac{100\,ft^2 \bullet \left(1/32\right) inch}{0.05 \bullet 1000\,ft^2 \bullet 0.078 inch} = \frac{3.1\,ft^2 \cdot inch}{3.9\,ft^2 \cdot inch} \le 1$$

Since the ratio is less than or equal to 1, a dust deflagration hazard does not exist in the room. A dust with a bulk density less than the basis 75 lb/ft^3 can accumulate to 1/32 in. layer depth in more than 5% of the room footprint area and still not present a dust deflagration hazard.

Example 3: Multiple floor level and elevated accumulation areas with different layer depths for each area. The room is 100 ft by 100 ft. For rooms less than 20,000 ft^2, the limitation is based on a maximum of 5% of the footprint area. The dust has a bulk density of 30 lb/ft^3. First adjust the Layer Depth Criterion for the reduced bulk density.

$$LayerDepthCriterion = \frac{\left(1/32\right) inch \bullet 75\, lb/ft^3}{30\, lb/ft^3} = 0.078 inch \cong \left(1/16\right) inch$$

Room footprint area = 10000 ft^2

Table A.6.1.1.3 Multiple Accumulation Areas for Example 4

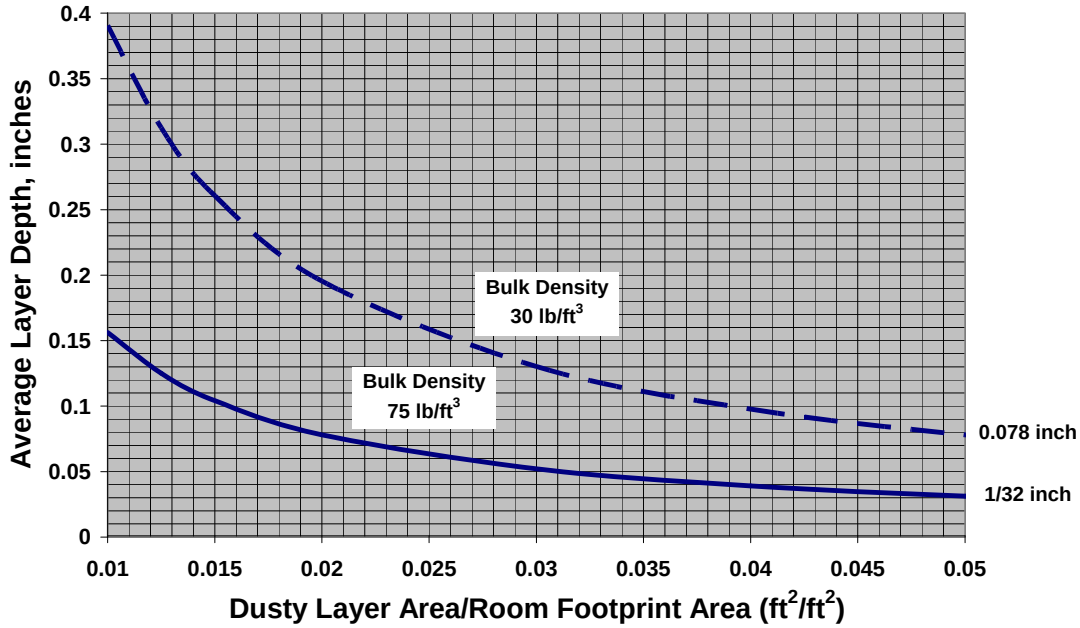
Accumulation Location	Accumulation Area	Average Layer Depth	Accumulation
Floor	50 ft^2	1/16 inch	3.1 ft^2-inch
Beam Surfaces	500 ft^2	1/32 inch	15.6 ft^2-inch
Equipment Surfaces	100 ft^2	1/8 inch	12.5 ft^2-inch

$$Ratio = \frac{50\,ft^2 \bullet \left(1/16\right) inch + 500\,ft^2 \bullet \left(1/32\right) inch + 100\,ft^2 \bullet \left(1/8\right) inch}{0.05 \bullet 10000\,ft^2 \bullet 0.078 inch} = \frac{31\,ft^2 \cdot inch}{39\,ft^2 \cdot inch} \le 1$$

Since the ratio is less than or equal to 1, a dust deflagration hazard does not exist in the room. There could be many more separated accumulation areas than listed in Table A.6.1.1.3 and all significant areas should be included. Note that areas where dust layers are less than 1/64 in. would not be included.

When there is a single accumulation area or the actual layer depth is the same over all accumulation areas, Figure A.6.1.1.3 indicates the actual layer depth which results in a dust deflagration hazard.

Figure A.6.1.1.1 Dust Deflagration Hazard Limitation - Average Layer Depth with Reduced Accumulation Area for Buildings or Rooms less than 20,000 ft^2



The following table provides guidance for evaluating isolated accumulations of dust in a building larger than 20,000 ft^2. These types of accumulations commonly occur due to leaks in equipment and machining operations. The table lists various areas of accumulation and the corresponding layer depth criterion. It assumes a bulk density of 75 lb/ft^3 and a rectangular shaped accumulation. The layer depth can be adjusted for bulk density.

Dust Accumulation Area	Layer Depth Criterion
1000 ft^2	1/32 inches
100 ft^2	0.3 inches
50 ft^2	0.6 inches
25 ft^2	1.3 inches
16 ft^2	2.0 inches
9 ft^2	3.5 inches
4 ft^2	7.8 inches
2 ft^2	15.7 inches

Example 4: Machining operation resulting in piles of dust accumulations. The machining operation is located in a 10 ft × 10 ft area in a 100 ft × 100 ft room. Between periodic housekeeping, the machining operation results in three 12 in. × 12 in. × 16 inch high piles of dust with a bulk density of 40 lb/ft^3 and a uniform dust layer thickness throughout the room of less than 1/64 in.

Room footprint area = 10,000 ft^2
Actual accumulation area = 100 ft^2

1. Determine adjusted layer depth criterion
   Layer depth criterion = ((1/32) in.*75 lb/ft^3)/40 lb/ft^3 = 0.059 in.

2. Determine the allowable volume of dust
   Allowable volume of dust = 0.05 *10,000 ft^2 * (0.059 in) * 1 ft/12 in. = 2.46 ft^3

3. Determine the actual volume of dust
   The layer of dust less than 1/64 in. does not need to be factored into the calculation.

   Volume of dust per pile = (12 in. × 12 in. × 16 in.) * 1 ft^3/1728 $in.^3$ = 1.33 ft^3

   Total volume of dust = 3 * 1.33 lb = 4 ft^3

The total volume of dust exceeds the allowable volume of dust; therefore a dust deflagration hazard exists.

Example 5: Processing operation with several areas of accumulation. The building area is 350 ft × 150 ft. There are 3 accumulation areas:

1. 15 ft × 100 ft mezzanine with ½ in. dust accumulation
2. 50 ft × 150 ft area with 1/8 in. dust accumulation at east end
3. 15 ft × 10 ft area with 1-½ in. average depth at west end

The dust has bulk density of 2 lbs/ ft^2.

Room footprint area = 350 ft × 150 ft = 52,500 ft^2 (Note: the mezzanine area does not increase the room footprint area)

1. Determine adjusted layer depth criterion
   Layer depth criterion = ((1/32) in.*75 lb/ft^3)/2 lb/ft^3 = 1.17 in.

2. Determine the allowable volume of dust. This is limited to 1000 ft^2 because the total room footprint exceeds 20,000 ft^2.
   Allowable volume of dust = 1000 ft^2 * (1.17 in.) * 1 ft/12 in. = 97.5 ft^3

3. Determine the actual volume of dust
   Volume of mezzanine dust = 1500 ft^2 * ½ in. *1 ft/12 $in.^2$ = 62.5 ft^3
   Volume of east end dust = 7500 ft^2 * 1/8 in. * 1 ft/12 $in.^2$ = 78.13 ft^3
   Volume of east west dust = 150 ft^2 * 1.5 in. * 1 ft/12 $in.^2$ = 18.75 ft^3

4. Total volume of dust = 62.5 + 78.13 + 18.75 = 159.4 ft^3

The total volume of dust exceeds the allowable volume of dust; therefore, a dust deflagration hazard exists.

Issue Date: March 1, 2011

Effective Date: March 21, 2011

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/codelist**)**

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