

COMBUSTIBLE DUST

A photograph capturing a massive industrial explosion. A large, bright orange and yellow fireball dominates the left side of the frame, with a thick plume of white smoke and debris rising from the base of the explosion. In the center, a dark, rectangular industrial structure, possibly a silo or storage tank, stands amidst the chaos. The background is a hazy, overcast sky.

AN EXPLOSIVE ISSUE

NFPA 654

NFPA 654- 2006

What is NFPA 654-

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

Why is it Important

- In 1997 Expanded to include all industries not otherwise included in previous editions
- Referenced “heavily”
 - OSHA- SHIB Combustible Dust In Industry: Preventing and Mitigating the Effects of Fire and Explosions issued July 2005
 - Chemical Safety Board Report Investigation Report Combustible Dust Hazard Study- November 2006
 - OSHA National Emphasis Program on Combustible Dust- Reissued March 2008

NFPA 654- 2006

Latest Version Issued 2006

Retro Active Portion of NFPA 654-2006

1. Management of change program-
2. Housekeeping requirements strengthened-
3. Written operating procedures, training (initial and refresher) and housekeeping procedures-
4. Written maintenance procedures and Inspection, testing, and maintenance of fire protection and explosion protection systems-

NFPA 654

In Cycle for voting at NFPA June 2010 Association Meeting

Cycle of Document

1. NFPA issues notice of document entering cycle and requests proposals from public and develop committee proposals
2. NFPA Technical Committee (TC) (654) meets to discuss proposals and issues document- Report on Proposals (ROP) detailing committee actions and request comments
3. Anyone can review ROP and submit comments
4. NFPA TC meets to discuss comments and published report detailing action in Report on Comments (ROC)
5. Public reviews ROC and notifies NFPA if they want to make a Notice of Intent to Make a Motion (NITMAM) at annual meeting
6. Document is presented at Association meeting and motions are acted upon and document and motions are voted on by NFPA members

NFPA 654 NITMAM

- American Forest and Paper Association
 - Six Proposals
 - New “Theoretical” Equations – Main Concern
 - Not Substantiated or validated in Practice or peer review
 - Issues with Entrainment factor
 - Too Complex
 - Impractical and Unenforceable per OSHA representative
 - New Simple equation is a 40% reduction from 2006 version without substantiation

NFPA 654 NITMAM

- American Forest and Paper Association
 - Six Proposals -Continued
 - Others
 - Recycled air - Industrial Hygiene exposure limit or 1% MEC
 - Elimination of abort gates in return air
 - Four Proposals – John Cholin
 - Use of Deflagration hazard vs Dust Fire hazard

Existing 654

- **6.2.3 Use of Separation.**

6.2.3.1* When separation is used to limit the fire or dust explosion hazardous area, the hazardous area shall include areas where dust accumulations exceed 1/32 in. (0.8 mm) or areas where dust clouds of a hazardous concentration exist, unless otherwise permitted by 6.2.3.3.

6.2.3.2 The requirements of 6.2.3.1 shall not apply to dust accumulations with a bulk density less than 75 lb/ft³ (1200 kg/m³), where the allowable thickness can be prorated upward by the following equation:

$$\textit{Allowable thickness (in.)} = \frac{(1/32)(75)}{\textit{bulk density (lb/ft}^3\text{)}}$$

New “Simplified” Calculations

NFPA 654 ROC

$$M_{basic-exp} = 0.004 \cdot A_{floor} \cdot H$$

$$M_{basic-fire} = 0.02 \cdot A_{floor}$$

- $M_{Basic-exp}$ Threshold Dust mass Explosion Exposure (kg)
- $M_{Basic-fire}$ Threshold Dust mass Fire Hazard (kg)
- A_{floor} Enclosure floor area (m²) Limit 2000 m²
- H Height of enclosure (m) Limit 12 m

Establishing a Dust Explosion Hazard

NFPA 654 ROC

$$M_{\text{exp}} = \left[\frac{P_{es}}{DLF} \right] \cdot \left[\frac{C_w}{P_{\text{max}}} \right] \cdot \frac{A_{\text{floor}} \cdot H}{\eta_D}$$

- M_{exp} Threshold Dust mass Explosion Exposure (kg)
- C_w Worst Case Dust Concentration (kg/m³)
- P_{Max} Max pressure (Bar g) developed in ASTM E1226
- A_{floor} Enclosure floor area (m²)
- N_D Entrainment Factor
- H Height of enclosure (m)
- P_{es} Weakest Structural member not intended to fail (bar g)
- DLF Dynamic Load Factor

Establishing a Dust Fire Hazard

NFPA 654 ROC

$$M_{fire} = 0.05 \cdot c_w \cdot \left[\frac{P_{initial}}{P_{initial} + P_{max}} \right] \cdot \frac{A_{floor} \cdot D}{\eta_D}$$

- M_{Fire} Threshold Dust mass personnel fire Exposure
- C_w Worst Case Dust Concentration (kg/m³)
- P_{Max} Max pressure (Bar g) developed in ASTM E1226
- A_{floor} Enclosure floor area (m²)
- N_D Entrainment Factor
- D Height of person (m)
- $P_{Initial}$ 1 bar absolute

NFPA 2113
Standard on
Selection, Care, Use, and Maintenance of Flame-Resistant
Garments for Protection of Industrial Personnel Against
Flash Fire
2007 Edition

- **A.5.2** Employees should be required to wear flame-resistant garments in facilities or areas where any of the following materials or conditions are present:
 - (4) Combustible dust (components present in the material where particle size is less than 75 microns, required ignition energy is less than 100 mJ, and moisture content is less than 10 percent), where such dust is present in normal operation

Example

- ROC - Annex D
 - Area 1000 m²
 - Height 9.5 m
 - P_{es} .036 bar (75 lb/ft²)
 - P_{max} 7 bar
 - C_w .60kg/m³
 - DLF 1.5
 - N_d .25
- Basic
 - ROC
 - M_{basic exp} = 38kg
 - M_{basic fire} = 20 kg
- Calculated
 - ROC
 - Exp = 76 kg
 - Fire = 30 kg

Example - Coal

- ROC - Annex D
 - Area 1000 m²
 - Height 9.5 m
 - Pes .036 bar (75 lb/ft²)
 - Pmax 7 bar
 - Cw .60kg/m³
 - DLF 1.5
 - Nd .25
- ROC - Coal
 - Area 217 m²
 - Height 3.2m
 - Pes .036 bar (75 lb/ft²)
 - Pmax 6.3 bar
 - Cw .42kg/m³
 - DLF 1.5
 - Nd .25

Example - Coal

- Basic
 - ROC
 - $M_{\text{basic exp}} = 3 \text{ kg}$
 - $M_{\text{basic fire}} = 4 \text{ kg}$
- Calculated
 - ROC
 - Exp = 4 kg
 - Fire = 5 kg

Summary

New Equations have promise as specific characteristics are taken into consideration

However-

1. Equations introduced in ROC and very limited time for peer review and verification
2. Equations are complex and appear not to be valid for small areas with a dust characteristics of coal
3. Indication that the new version of NFPA 654 will be utilized/referenced extensively by OSHA in proposed rulemaking- it needs to be right.
4. The EEI Loss Control and Fire Protection Task Force voted at its April 19-21, 2010 meeting to support the proposed NITMAM to return to committee for further study

Summary - continued

The EEI Loss Control and Fire Protection Task Force is requesting:

1. The EEI Occupational Safety and Health Committee and EEI make it's members aware of the June 7-10, NFPA Association Meeting and that a member of the EEI Loss Control and Fire Protection Task Force be allowed to stand and support the AFPA motions on behalf of the EEI.
2. EEI members who have employees who are NFPA members present at the NFPA Association Meeting, support motions endorsed by the EEI.

