Dawn Michele Bellis
Secretary, Standards Council

10 September 2021*

To: Interested Parties

Subject:

Standards Council Decision (Final):	**D#21-12**
Standards Council Agenda Item:	**SC#21-8-35-d**
Date of Decision:	26 August 2021
TIA No. 1527 to NFPA 484, *Standard for Combustible Metals*, 2019 and 2022 Editions	

Dear Interested Parties:

At its meeting of August 24-26, 2021, the Standards Council considered an appeal on the above referenced matter. The Council's Final decision is now available and is attached herewith.

Sincerely,

Dawn Michele Bellis
Secretary, NFPA Standards Council

cc: S. Everett, S. Gallagher, L. Moreno
Members, TC on Combustible Metals and Metal Dusts (CMD-CMM)
Members, CC on Combustible Dusts (CMD-AAC)
Members, NFPA Standards Council (AAD-AAA)
Individuals Providing Appeal Commentary

*NOTE: Participants in NFPA's standards development process should know that limited review of this decision may be sought from the NFPA Board of Directors. For the rules describing the available review and the method for petitioning the Board for review, please consult section 1-7 of the Regulations Governing the Development of NFPA Standards and the NFPA Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council. Notice of the intent to file such a petition must be submitted to the Clerk of the Board of Directors within 15 calendar days of the publication date of this Decision.

Standards Council Decision (Final):	**D#21-12**
Standards Council Agenda Item:	**SC#21-8-35-d**
Date of Decision:	26 August 2021
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SUMMARY OF ACTION (for convenience only; not part of official decision): The Standards Council voted to uphold a jointly filed appeal requesting the Council to overturn the Correlating Committee ballot results and issue TIA No. 1527 on NFPA 484, *Standard for Combustible Metals,* 2019 and 2022 editions.

DECISION:

At its meeting of August 24-26, 2021, the Standards Council considered an appeal from co-appellants Samuel Rodgers of Honeywell, and Walter Frank of Frank Risk Solutions, Inc. The appellants request that the Standards Council overturn the Correlating Committee ballot results and issue TIA No. 1527 on the 2019 and 2022 editions of NFPA 484. Specifically, the appeal requests that the Standards Council issue TIA No. 1527 which seeks to revise various paragraphs throughout the standard.

As background, TIA No. 1527 was balloted through the Technical Committee on Combustible Metals and Metal Dusts (TC) and the Correlating Committee on Combustible Dusts (CC) in accordance with the *Regulations Governing the Development of NFPA Standards (Regs)* to determine whether the necessary three-fourths majority support was achieved on technical merit, correlation and emergency nature for recommendation of issuance. The TIA achieved the necessary support of the TC on both technical merit and emergency nature, and on correlation by the CC, but failed to achieve the necessary support of the CC on emergency nature.

When a TIA fails to achieve the recommendation of the responsible committees, the resulting recommendation of the standards development process is to not issue the TIA.

On appeal, the Council accords great respect and deference to the NFPA standards development process. In conducting its review, the Council will overturn the results of that process only where a clear and substantial basis for doing so is demonstrated. There is such a basis demonstrated in this matter.

This TIA was developed by a Task Group at the April 2018 direction of Standards Council (see SC# 18-4-26). The Task Group was charged with resolving conflict among multiple NFPA standards as it pertained to the use of zone electrical classifications for combustible dusts. Council notes that this TIA failed by two votes on emergency nature by the Correlating Committee but had support on correlation, and support from the Technical Committee on both technical and emergency nature. This is one TIA of a series developed by the Task Group to ensure consistency and reduce confusion among NFPA standards.

The Council has reviewed the entire record concerning this matter and has considered all the arguments put forth in this appeal. In this case, based upon all information presented, the Council finds sufficient basis to issue TIA No. 1527. Accordingly, the Council has voted to uphold the appeal. The effect of this action is that the text of TIA No. 1527 will be included in NFPA 484, *Standard for Combustible Metals*, 2019 and 2022 editions.

Tentative Interim Amendment

NFPA® 484

Standard for Combustible Metals

2019 Edition

Reference: Various paragraphs
TIA 19-1
(SC 21-8-35 / TIA Log #1527)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 484, *Standard for Combustible Metals*, 2019 edition. The TIA was processed by the Technical Committee on Combustible Metals and Metal Dusts, and the Correlating Committee on Combustible Dusts, and was issued by the Standards Council on August 26, 2021, with an effective date of September 15, 2021.

1. Add a new 1.1.2.2 and associated Annex material to read as follows; and renumber existing paragraph accordingly:

1.1.2.2* This standard shall apply to the storage or use of ignitible fibers/flyings, specifically with regard to fire hazards.

A.1.1.2.2 Ignitible fibers/flyings, as defined in *NFPA 70* and NFPA 499, do not present a flash-fire hazard or explosion hazard and are not included in the definition of combustible dust in this standard. Ignitible fibers/flyings present a fire hazard, so locations are classified differently and the electrical installation includes additional restrictions compared to combustible fibers/flyings. Ignitible metal fibers/flyings would be anticipated to be identified as a combustible metal in accordance with Chapter 5.

2. Add a new reference to Section 2.4 as follows:

2.4 References for Extracts in Mandatory Sections.

NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2021 edition.

3. Revise 3.3.10, and associated Annex A.3.3.10 to read as follows:

3.3.10* Combustible Dust. A finely divided combustible particulate solid, including combustible fibers/flyings, that presents a flash-fire hazard or explosion hazard when suspended in air or the process-specific oxidizing medium over a range of concentrations. [**652,** 2019]

A.3.3.10 Combustible Dust. The term *combustible dust* when used in this standard includes powders, fines, fibers, flyings, etc. Combustible fibers/flyings are specifically mentioned because, while the hazard is the same, *NFPA 70* and NFPA 499 treat combustible dust and combustible fibers/flyings separately in regards to establishing hazardous (classified) locations and specifying the electrical installation. Ignitible fibers/flyings, as defined in *NFPA 70* and NFPA 499, do not present a flash-fire or explosion hazard and are not included in the definition of combustible dust in this standard. Ignitible fibers/flyings present a fire hazard, so locations are classified differently and the electrical installation includes additional restrictions compared to combustible fibers/flyings. [**652,** 2019]

This definition also includes consideration of a process-specific oxidizing medium other than air. A larger particle size material might not present a hazard in air, yet could present a hazard in an atmosphere with increased oxygen concentration. Similarly, a combustible metal might still present a hazard in an atmosphere typically considered inert, such as CO_2 or nitrogen. [**652,** 2019]

Dusts traditionally were defined as material 420 μm or smaller (i.e., capable of passing through a U.S. No. 40 standard sieve). For consistency with other standards, 500 μm (i.e., capable of passing through a U.S. No. 35 standard sieve) is now considered an appropriate size criterion. Particle surface area-to-volume ratio is a key factor in determining the rate of combustion. Combustible particulate solids with the smallest ~~a minimum~~ dimension more than 500 μm generally have a surface-to-volume ratio that is too small to pose a deflagration hazard. ~~Flat platelet-shaped particles, flakes, or fibers~~ Fibers/flyings with lengths that are large compared to their diameter or thickness usually do not pass through a 500 μm sieve, yet could still pose a deflagration hazard. Many particulates accumulate electrostatic charge in handling, causing them to attract each other, forming agglomerates. Often, agglomerates behave as if they were larger particles, yet when they are dispersed they present a significant hazard. Therefore, it can be inferred that any particulate that has the smallest ~~a minimum~~ dimension less than or equal to 500 μm could behave as a combustible dust if suspended in air or the process-specific oxidizer. If the smallest ~~minimum~~ dimension of the particulate is greater than 500 μm, it is unlikely that the material would be a combustible dust, as determined by test. The determination of whether a sample of combustible material presents a flash-fire or explosion hazard could be based on a screening test methodology such as provided in the ASTM E1226, *Standard Test Method for Explosibility of Dust Clouds*. Alternatively, ~~and~~ a standardized test method such as ASTM E1515, *Standard Test Method for Minimum Explosible Concentration of Combustible Dusts*, could be used to determine dust explosibility. Chapter 5 of NFPA 652 has additional information on testing requirements. ~~[**654**, 2017]~~ [**652,** 2019]

There is some possibility that a sample will result … ~~[**654**, 2017]~~ [**652,** 2019]

This possibility for false positives ahs been know … ~~[**654**, 2017]~~ [**652,** 2019]

NFPA 68 also recognized this problem and addresses … ~~[**654**, 2017]~~ [**652,** 2019]

A dust deflagration has the following four requirement:

(1) Combustible dust

…

~~[**654**, 2017]~~ [**652,** 2019]

If the deflagration is confined and produces a pressure … ~~[**654**, 2017]~~ [**652,** 2019]

Evaluation of the hazard of a combustible dust should be …

(1) MEC

…

~~[**654**, 2017]~~ [**652,** 2019]

…It is important to keep in mind that as a particulate … ~~[**654**, 2017]~~ [**652,** 2019]

4. *In section 3.3 add new definition for Combustible Fibers/Flying and associated Annex material to read as follows:*

3.3.x* Combustible Fibers/Flyings. Fibers/flyings, where any dimension is greater than 500 μm in nominal size, which can form an explosible mixture when suspended in air at standard atmospheric pressure and temperature. [**499,** 2021]

A.3.3.x Combustible Fibers/Flyings. Section 500.5 of NFPA 70 defines a Class III location. Combustible fibers/flyings can be similar in physical form to ignitible fibers/flyings and protected using the same electrical equipment installation methods. Examples of fibers/flyings include flat platelet-shaped particulate, such as metal flake, and fibrous particulate, such as particle board core material. If the smallest dimension of a combustible material is greater than 500 μm, it is unlikely that the material would be combustible fibers/flyings, as determined by test. Finely divided solids with lengths that are large compared to their diameter or thickness usually do not pass through a 500 μm sieve, yet when tested could potentially be determined to be explosible. [**499,** 2021]

The typical test methods for evaluating an explosible mixture are ASTM E1226, Standard Test Method for Explosibility of Dust Clouds, ISO 6184-1, Explosion protection systems — Part 1: Determination of explosion indices of combustible dusts in air, or ISO/IEC/UL 80079-20-2, Explosive atmospheres — Part 20-2: Material characteristics — Combustible dusts test methods, for procedures for determining the explosibility of dusts. A material that is found to not present an explosible mixture could still be an ignitible fiber/flying, as defined in 3.3.4.2. Historically, the explosibility condition has been described as presenting a flash fire or explosion hazard. It could be understood that the potential hazard due to the formation of an explosible mixture when suspended in air at standard atmospheric pressure and temperature would include ignition. [**499,** 2021]

While this standard includes larger yet still hazardous materials as a subset of combustible dust, *NFPA 70* addresses them separately for purposes of defining the appropriate electrical classification. Although the hazard is the same when dispersed in a cloud, the electrical installation to prevent ingress of combustible fibers/flyings is different.

5. *In section 3.3 add new definition for Ignitible Fibers/Flyings, and associated Annex material to read as follows:*

3.3.y* Ignitible Fibers/Flyings. Fibers/flyings where any dimension is greater than 500 μm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499,** 2021]

A.3.3.y Ignitible Fibers/Flyings. Section 500.5 of *NFPA 70* defines a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. [**499,** 2021]

The zone classification system does not address ignitible fibers/flyings. Where these are present, the user should consider installation in accordance with Article 503 of *NFPA 70.* [**499,** 2021]

6. Revise 3.3.11.1 and associated Annex material to read as follows:

3.3.11.1*Combustible Metal Dust.* A combustible particulate metal, including combustible fibers/flyings, that presents a fire or explosion hazard when suspended in air or the process-specific oxidizing medium over a range of concentrations, regardless of particle size or shape.

A.3.3.11.1 Combustible Metal Dust. Dust from some processes can contain various amounts or concentrations of organic material. The burning characteristics from the mixture as determined from testing are used to distinguish between a combustible metal dust and a combustible dust.

Dusts traditionally have been defined as a material 420 microns or smaller (capable of passing through a U.S. No. 40 standard sieve). For consistency with other standards, 500 microns (capable of passing through a U.S. No. 35 standard sieve) is now considered an appropriate size criterion. Particle surface area to volume ratio is a key factor in determining the rate of combustion. Combustible particulate solids with a minimum dimension more than 500 microns generally have a surface to volume ratio that is too small to pose a deflagration hazard. Flat platelet-shaped particles, flakes, or fibers with lengths that are large compared to their diameter usually do not pass through a 500 micron sieve yet could still pose a deflagration hazard. Many particulates accumulate electrostatic charge in handling, causing them to attract each other, forming agglomerates. Often, agglomerates behave as if they were larger particles, yet when they are dispersed they present a significant hazard. Consequently, it can be inferred that any particle that has a minimum dimension of less than 500 microns could behave as a combustible dust if suspended in air.

The determination of whether a sample of material is a combustible, explosible, dust should be based on a screening test methodology such as that provided in the draft ASTM E1226, *Test Method for Pressure and Rate of Pressure Rise for Combustible Dusts*. Alternatively, a standardized test method such as ASTM E1515, *Standard Test Method for Minimum Explosible Concentration of Combustible Dusts*, can be used to determine dust explosibility.

There is some possibility that a sample will result in a false positive in the 20 Liter sphere when tested by the ASTM E1226 screening test or ASTM E1515 test. This is due to the high energy ignition source over-driving the test. When the lowest ignition energy allowed by either method still results in a positive result, the owner/operator can elect to determine whether the sample is a combustible dust with screening tests performed in a larger scale (≥1 m3) enclosure, which is less susceptible to over-driving and thus will provide more realistic results.

This possibility for false positives has been known for quite some time and is attributed to over-driven conditions that exist in the 20 liter chamber due to the use of strong pyrotechnic igniters. For that reason, the reference method for explosibility testing is based on 1 m3 chamber, and the 20 L chamber test method is calibrated to produce results comparable to those from 1 m3 chamber for most dusts. In fact, the U.S. standard for 20 L testing (ASTM E1226) states, "The objective of this test method is to develop data that can be correlated to those from the 1 m3 chamber ...." ASTM E1226 further states, "Because a number of factors (concentration, uniformity of dispersion, turbulence of ignition, sample age, etc.) can affect the test results, the test vessel to be used for routine work must be standardized using dust samples whose *KSt* and *P*max parameters are known in the 1 m3 chamber." NFPA 68 also recognizes this problem and addresses it, stating "the 20 L test apparatus is designed to simulate results of the 1 m3 chamber; however, the igniter discharge makes it problematic to determine *KSt* values less than 50 bar-m/sec. Where the material is expected to yield *KSt* values less than 50 bar-m/sec, testing in a 1 m3 chamber might yield lower values."

Any time a combustible dust is processed or handled, a potential for deflagration exists. The degree of hazard varies, depending on the type of combustible dust and the processing methods used.

A dust deflagration has the following four requirements:

(1) Combustible dust
(2) Dust dispersion in air or other oxidant
(3) Sufficient concentration at or exceeding the minimum explosible concentration (MEC)
(4) Sufficiently powerful ignition source such as an electrostatic discharge, an electric current arc, a glowing ember, a hot surface, welding slag, frictional heat, or a flame

If the deflagration is confined and produces a pressure sufficient to rupture the confining enclosure, the event is, by definition, an *explosion*.

Evaluation of the hazard of a combustible dust should be determined by the means of actual test data. Each situation should be evaluated and applicable tests selected. The following

~~list represents the factors that are sometimes used in determining~~
~~the deflagration hazard of a dust:~~
~~(1) MEC~~
~~(2) Minimum ignition energy (MIE)~~
~~(3) Particle size distribution~~
~~(4) Moisture content as received and as tested~~
~~(5) Maximum explosion pressure at optimum concentration~~
~~(6) Maximum rate of pressure rise at optimum concentration~~
~~(7) *KSt* (normalized rate of pressure rise) as defined in ASTM E1226-2010~~
~~(8) Layer ignition temperature~~
~~(9) Dust cloud ignition temperature~~
~~(10) Limiting oxidant concentration (LOC) to prevent ignition~~
~~(11) Electrical volume resistivity~~
~~(12) Charge relaxation time~~
~~(13) Chargeability~~
~~It is important to keep in mind that as particulate is processed, handled, or transported the particle size generally decreases due to particle attrition. Consequently, it is often necessary to evaluate the explosibility of the particulate at multiple points along the process. Where process conditions dictate the use of oxidizing media other than air (nominally taken as 21 percent oxygen and 79 percent nitrogen), certain of the above tests should be conducted in the appropriate process specific medium.~~

7. Revise 9.7.1.1 to read as follows:

9.7.1.1 Vigorous sweeping or blowing down with compressed air produces dust clouds and shall be permitted only where the following requirements are met:
(1) Electrical equipment not suitable for Class II, Division Group E or Zone Group IIIC locations and other sources of ignition shall be shut down or removed from the area.
(2) Compressed air shall not exceed a gauge pressure of 206 kPa (30 psi) unless otherwise determined to be safe by a documented hazard analysis.

8. Revise section 10.8 and associated Annex material to read as follows:

10.8 Electrical Area Classification.
~~**10.8.1*** The classification criteria in *NFPA 70* shall be applied whenever combustible metal particulate meets the definition of combustible metal dust in this standard, notwithstanding the definition of combustible dust in *NFPA 70*.~~
10.8.1~~.1~~* The identification of the possible presence and extent of ~~Class II~~ combustible dust hazardous (classified) locations shall be made based on the criteria in ~~Article 500.5(C)~~ Article 500 or 506 of *NFPA 70*.

A.10.8.1 ~~The definition of combustible dust in Article 500 of *NFPA 70* limits particle size and conflicts with the definition of combustible metal dust in this standard. Combustible metal dust should be considered Class II, Group E regardless of particle size. *(See NFPA 497 and NFPA 499 for information on electrical area classification.)*~~ Housekeeping can reduce or eliminate the electrical area classification for a location where combustible metal dust is present. Electrical equipment upgrades to meet Article 500 of *NFPA 70* can be costly and users might better focus on preventing fugitive dust from escaping equipment and accumulations to minimize the extent of the hazardous (classified) areas.

10.8.~~1.1.1~~2 All areas designated as hazardous (classified) locations shall be documented, and such documentation shall be maintained and preserved for access at the facility.
10.8.~~1.2~~3 Electrical equipment and wiring within ~~Class II~~ combustible dust locations shall comply with ~~Article 500.5(C) of *NFPA 70*~~.
10.8.~~1.3~~4* Preventive maintenance programs for electrical equipment and wiring in ~~Class II~~ combustible dust locations shall include provisions to verify that dusttight electrical enclosures are not experiencing significant dust ingress.

A.10.8.~~1.3~~4 Finding combustible metal dust or powder within electrical equipment and components should warrant more frequent inspection and cleaning.

~~**10.8.1.4*** Zone classification for dusts in accordance with Article 506 of *NFPA 70* shall not be permitted.~~

~~**A.10.8.1.4** NFPA 499 provides guidance for zone classification to clarify that combustible metal dust is Group IIIC, regardless of particle size. However, this clarification has not yet progressed through the *NFPA 70* revision cycle.~~
10.8.~~1.~~5 Flashlights and other portable electrical equipment shall be identified for the locations where they are used.

9. Revise 16.6.2.2.2 to read as follows:

16.6.2.2.2* Wet solvent milling areas or other areas where combustible or flammable liquids are present shall be classified, where applicable, in accordance with Article 500, 505, or 506 of *NFPA 70* with the exception of control equipment meeting the requirements of NFPA 496.

10. Add new material to the end of Annex A.3.3.12 to read as follows:

A.3.3.12 Combustible Particulate Solid. …

For purposes of determining appropriate electrical installation requirements for combustible particulate solids, NFPA 499 has defined three material subgroups that can warrant establishing hazardous (classified) locations. Combustible dusts, per NFPA 499, are materials with a particle size less than 500 µm that can propagate a deflagration when suspended in a cloud, as determined by test. Combustible fibers/flyings are larger than 500 µm in at least one dimension, yet can still propagate a deflagration in a cloud. Both of these first two subgroups present flash-fire or explosion hazards when suspended in a cloud, as well as fire hazards when in a layer. Ignitible fibers/flyings are larger than 500 µm in at least one dimension, but either are too large or too agglomerated to suspend in the typical test or do not propagate a deflagration in a cloud. Ignitible fibers/flyings do not present a flash-fire or explosion hazard, yet still present a fire hazard when in a layer. All three of these subgroups defined in NFPA 499 are included in the term *combustible particulate solid* as defined and used in NFPA 652. Combustible fibers/flyings as defined in NFPA 499 are included in the term *combustible dust* as used and defined in NFPA 652. [**652,** 2019]

NFPA 70 provides different installation requirements for each of these three material subgroups. Materials smaller than 500 µm require more stringent dust exclusion designs (i.e., Class II or Zone Group IIIB) than materials larger than 500 µm (i.e., Class III or Zone Group IIIA). The exception to this is combustible metals, where both combustible metal dust and combustible metal fibers/flyings require Class II or Zone Group IIIC installations. Ignitible fibers/flyings additionally require lower maximum surface temperatures than combustible fibers/flyings for certain electrical equipment subject to overload conditions. When a hazardous (classified) location is established to address the presence of more than one of the three subgroups, the more stringent electrical installation requirements should be applied. [**652,** 2019]

11. Revise Annex A.10.9.2 to read as follows:

A.10.9.2 Diesel-powered front-end loaders suitable for use in hazardous (classified) locations have not been commercially available. The following provisions can be used to reduce the fire hazard from diesel-powered front-end loaders used in ~~Class II~~ combustible dust ~~hazardous~~ areas, as defined in Articles 500 and 506 of *NFPA 70*:

(1) Only essential electrical equipment should be used, and

…

(6) Loaders should never be parked or left unattended in the dust explosion hazard or dust fire hazard area.

12. Revise Annex A.15.7 item (3) to read as follows:

A.15.7 Section 15.7 applies to operations where metals or metal alloys are subjected to processing or finishing operations. The operations can include, but are not limited to, grinding, buffing, polishing, sawing, and machining of solids. Media blasting operations include, but are not limited to, abrading, etching, applying an anchor pattern, wheel blast, centrifugal wheel blast, sand blast, grit blast, air blast, airless blast, siphon blast, suction blast, abrasive shot blast, peening, and shot peening of solids.

…

The control of ignition sources is paramount in maintaining a fire-free environment. The following measures provide guidance for controlling ignition sources:

(1) Open flames and smoking should be prohibited.

(2) Cutting and welding in the vicinity of fines, dust, and flammable lubricants should be prohibited.

(3) Electrical equipment, wiring, and lighting in the area should comply with Article 500 or 506 of *NFPA 70.* ~~be explosion proof, conforming to National Electrical Manufacturers Association (NEMA) rating class II, Group E, as defined in *Guide for Classification of All Types of Insulated Wire and Cable.*~~

(4) Blowers and exhaust fans …

(11) Dust-handling equipment …

*13. Add a new citation to **J.1.2.9 (2019 edition)** and **J.1.2.10 (2022 edition)** as follows:*

J.1.2.9 (2019 ed) **J.1.2.10** (2022 ed) **ISO Publications. …**

ISO/IEC 80079-20-2, *Explosive atmospheres — Part 20-2: Material characteristics — Combustible dusts test methods*, 2016.

14. Delete J.1.2.10 entirely and renumber subsequent paragraphs accordingly as follows:

~~**J.1.2.10 NEMA Publications. …**~~

~~*Guide for Classification of All Types of Insulated Wire and Cable,* 2001.~~

~~J.1.2.11~~ J.1.2.10 U.S. Bureau of Mines Publications. …

~~J.1.2.12~~ J.1.2.11 U.S. Government Publications. …

~~J.1.2.123~~J.1.2.12 Other Publications. …

15. Add a new citation to J.3 as follows:

J.3 References for Extracts in Informational Sections.

NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2021 edition.

Issue Date: August 26, 2021

Effective Date: September 15, 2021

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

Tentative Interim Amendment

NFPA® 484

Standard for Combustible Metals

2022 Edition

Reference: Various paragraphs
TIA 22-1
(SC 21-8-35 / TIA Log #1527)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Add a new 1.1.2.2 and associated Annex material to read as follows; and renumber existing paragraph accordingly:

1.1.2.2* This standard shall apply to the storage or use of ignitible fibers/flyings, specifically with regard to fire hazards.

A.1.1.2.2 Ignitible fibers/flyings, as defined in *NFPA 70* and NFPA 499, do not present a flash-fire hazard or explosion hazard and are not included in the definition of combustible dust in this standard. Ignitible fibers/flyings present a fire hazard, so locations are classified differently and the electrical installation includes additional restrictions compared to combustible fibers/flyings. Ignitible metal fibers/flyings would be anticipated to be identified as a combustible metal in accordance with Chapter 5.

2. Add a new reference to Section 2.4 as follows:

2.4 References for Extracts in Mandatory Sections.

NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2021 edition.

3. Revise 3.3.12 and associated Annex A.3.3.12 to read as follows:

3.3.12* Combustible Dust. A finely divided combustible particulate solid, including combustible fibers/flyings, that presents a flash-fire hazard or explosion hazard when suspended in air or the process-specific oxidizing medium over a range of concentrations. [**652,** 2019]

A.3.3.12 Combustible Dust. The term *combustible dust* when used in this standard includes powders, fines, fibers, flyings, etc. Combustible fibers/flyings are specifically mentioned because, while the hazard is the same, *NFPA 70* and NFPA 499 treat combustible dust and combustible fibers/flyings separately in regards to establishing hazardous (classified) locations and specifying the electrical installation. Ignitible fibers/flyings, as defined in *NFPA 70* and NFPA 499, do not present a flash-fire or explosion hazard and are not included in the definition of combustible dust in this standard. Ignitible fibers/flyings present a fire hazard, so locations are classified differently and the electrical installation includes additional restrictions compared to combustible fibers/flyings. [**652,** 2019]

This definition also includes consideration of a process-specific oxidizing medium other than air. A larger particle size material might not present a hazard in air, yet could present a hazard in an atmosphere with increased oxygen concentration. Similarly, a combustible metal might still present a hazard in an atmosphere typically considered inert, such as CO_2 or nitrogen. [**652,** 2019]

Dusts traditionally were defined as material 420 µm or smaller (i.e., capable of passing through a U.S. No. 40 standard sieve). For consistency with other standards, 500 µm (i.e., capable of passing through a U.S. No. 35 standard sieve) is now considered an appropriate size criterion. Particle surface area-to-volume ratio is a key factor in determining the rate of combustion. Combustible particulate solids with the smallest ~~a minimum~~ dimension more than 500 µm generally have a surface-to-volume ratio that is too small to pose a deflagration hazard. ~~Flat platelet-shaped particles, flakes, or fibers~~

Fibers/flyings with lengths that are large compared to their diameter or thickness usually do not pass through a 500 μm sieve, yet could still pose a deflagration hazard. Many particulates accumulate electrostatic charge in handling, causing them to attract each other, forming agglomerates. Often, agglomerates behave as if they were larger particles, yet when they are dispersed they present a significant hazard. Therefore, it can be inferred that any particulate that has the smallest ~~a minimum~~ dimension less than or equal to 500 μm could behave as a combustible dust if suspended in air or the process-specific oxidizer. If the smallest ~~minimum~~ dimension of the particulate is greater than 500 μm, it is unlikely that the material would be a combustible dust, as determined by test. The determination of whether a sample of combustible material presents a flash-fire or explosion hazard could be based on a screening test methodology such as provided in the ASTM E1226, *Standard Test Method for Explosibility of Dust Clouds*. Alternatively, a standardized test method such as ASTM E1515, *Standard Test Method for Minimum Explosible Concentration of Combustible Dusts*, could be used to determine dust explosibility. Chapter 5 of NFPA 652 has additional information on testing requirements. [**652**, 2019]

There is some possibility that a sample will result … [**652**, 2019]

It is important to keep in mind that as a particulate … [**652,** 2019]

4. *In section 3.3 add new definition for Combustible Fibers/Flying and associated Annex material to read as follows:*

3.3.x* Combustible Fibers/Flyings. Fibers/flyings, where any dimension is greater than 500 μm in nominal size, which can form an explosible mixture when suspended in air at standard atmospheric pressure and temperature. [**499,** 2021]

A.3.3.x Combustible Fibers/Flyings. Section 500.5 of NFPA 70 defines a Class III location. Combustible fibers/flyings can be similar in physical form to ignitible fibers/flyings and protected using the same electrical equipment installation methods. Examples of fibers/flyings include flat platelet-shaped particulate, such as metal flake, and fibrous particulate, such as particle board core material. If the smallest dimension of a combustible material is greater than 500 μm, it is unlikely that the material would be combustible fibers/flyings, as determined by test. Finely divided solids with lengths that are large compared to their diameter or thickness usually do not pass through a 500 μm sieve, yet when tested could potentially be determined to be explosible. [**499,** 2021]

The typical test methods for evaluating an explosible mixture are ASTM E1226, Standard Test Method for Explosibility of Dust Clouds, ISO 6184-1, Explosion protection systems — Part 1: Determination of explosion indices of combustible dusts in air, or ISO/IEC/UL 80079-20-2, Explosive atmospheres — Part 20-2: Material characteristics — Combustible dusts test methods, for procedures for determining the explosibility of dusts. A material that is found to not present an explosible mixture could still be an ignitible fiber/flying, as defined in 3.3.4.2. Historically, the explosibility condition has been described as presenting a flash fire or explosion hazard. It could be understood that the potential hazard due to the formation of an explosible mixture when suspended in air at standard atmospheric pressure and temperature would include ignition. [**499,** 2021]

While this standard includes larger yet still hazardous materials as a subset of combustible dust, *NFPA 70* addresses them separately for purposes of defining the appropriate electrical classification. Although the hazard is the same when dispersed in a cloud, the electrical installation to prevent ingress of combustible fibers/flyings is different.

5. *In section 3.3 add new definition for Ignitible Fibers/Flyings, and associated Annex material to read as follows:*

3.3.y* Ignitible Fibers/Flyings. Fibers/flyings where any dimension is greater than 500 μm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499,** 2021]

A.3.3.y Ignitible Fibers/Flyings. Section 500.5 of *NFPA 70* defines a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. [**499,** 2021]

The zone classification system does not address ignitible fibers/flyings. Where these are present, the user should consider installation in accordance with Article 503 of *NFPA 70.* [**499,** 2021]

6. *Revise 3.3.13.1 and associated Annex material to read as follows:*

3.3.13.1* *Combustible Metal Dust.* A combustible particulate metal, including combustible fibers/flyings, that presents a fire or explosion hazard when suspended in air or the process-specific oxidizing medium over a range of concentrations~~, regardless of particle size or shape~~.

A.3.3.13.1* Combustible Metal Dust. Dust from some processes can contain various amounts or concentrations of organic material. The burning characteristics from the mixture as determined from testing are used to distinguish between a combustible metal dust and a combustible dust.

Dusts traditionally have been defined as a material 420 microns or smaller (capable of passing through a U.S. No. 40 standard sieve). For consistency with other standards, 500 microns (capable of passing through a U.S. No. 35 standard sieve) is now considered an appropriate size criterion. Particle surface area to volume ratio is a key factor in determining the rate of combustion. Combustible particulate solids with a minimum dimension more than 500 microns generally have a surface to volume ratio that is too small to pose a deflagration hazard. Flat platelet-shaped particles, flakes, or fibers with lengths that are large compared to their diameter usually do not pass through a 500 micron sieve yet could still pose a deflagration hazard. Many particulates accumulate electrostatic charge in handling, causing them to attract each other, forming agglomerates. Often, agglomerates behave as if they were larger particles, yet when they are dispersed they present a significant hazard. Consequently, it can be inferred that any particle that has a minimum dimension of less than 500 microns could behave as a combustible dust if suspended in air.

The determination of whether a sample of material is a combustible, explosible, dust should be based on a screening test methodology such as that provided in the draft ASTM E1226, *Test Method for Pressure and Rate of Pressure Rise for Combustible Dusts*. Alternatively, a standardized test method such as ASTM E1515, *Standard Test Method for Minimum Explosible Concentration of Combustible Dusts*, can be used to determine dust explosibility.

There is some possibility that a sample will result in a false positive in the 20 Liter sphere when tested by the ASTM E1226 screening test or ASTM E1515 test. This is due to the high energy ignition source over-driving the test. When the lowest ignition energy allowed by either method still results in a positive result, the owner/operator can elect to determine whether the sample is a combustible dust with screening tests performed in a larger scale (≥1 m3) enclosure, which is less susceptible to over-driving and thus will provide more realistic results.

This possibility for false positives has been known for quite some time and is attributed to over-driven conditions that exist in the 20 liter chamber due to the use of strong pyrotechnic igniters. For that reason, the reference method for explosibility testing is based on 1 m3 chamber, and the 20 L chamber test method is calibrated to produce results comparable to those from 1 m3 chamber for most dusts. In fact, the U.S. standard for 20 L testing (ASTM E1226) states, "The objective of this test method is to develop data that can be correlated to those from the 1 m3 chamber ...." ASTM E1226 further states, "Because a number of factors (concentration, uniformity of dispersion, turbulence of ignition, sample age, etc.) can affect the test results, the test vessel to be used for routine work must be standardized using dust samples whose *KSt* and *P*max parameters are known in the 1 m3 chamber." NFPA 68 also recognizes this problem and addresses it, stating "the 20 L test apparatus is designed to simulate results of the 1 m3 chamber; however, the igniter discharge makes it problematic to determine *KSt* values less than 50 bar-m/sec. Where the material is expected to yield *KSt* values less than 50 bar-m/sec, testing in a 1 m3 chamber might yield lower values."

Any time a combustible dust is processed or handled, a potential for deflagration exists. The degree of hazard varies, depending on the type of combustible dust and the processing methods used.

A dust deflagration has the following four requirements:

(1) Combustible dust
(2) Dust dispersion in air or other oxidant
(3) Sufficient concentration at or exceeding the minimum explosible concentration (MEC)
(4) Sufficiently powerful ignition source such as an electrostatic discharge, an electric current arc, a glowing ember, a hot surface, welding slag, frictional heat, or a flame

If the deflagration is confined and produces a pressure sufficient to rupture the confining enclosure, the event is, by definition, an *explosion*.

Evaluation of the hazard of a combustible dust should be determined by the means of actual test data. Each situation should be evaluated and applicable tests selected. The following list represents the factors that are sometimes used in determining the deflagration hazard of a dust:

(1) MEC
(2) Minimum ignition energy (MIE)
(3) Particle size distribution
(4) Moisture content as received and as tested
(5) Maximum explosion pressure at optimum concentration
(6) Maximum rate of pressure rise at optimum concentration
(7) *KSt* (normalized rate of pressure rise) as defined in ASTM E1226-2010
(8) Layer ignition temperature
(9) Dust cloud ignition temperature
(10) Limiting oxidant concentration (LOC) to prevent ignition
(11) Electrical volume resistivity
(12) Charge relaxation time

~~(13) Chargeability~~
~~It is important to keep in mind that as particulate is processed, handled, or transported the particle size generally decreases due to particle attrition. Consequently, it is often necessary to evaluate the explosibility of the particulate at multiple points along the process. Where process conditions dictate the use of oxidizing media other than air (nominally taken as 21 percent oxygen and 79 percent nitrogen), certain of the above tests should be conducted in the appropriate process specific medium.~~

7. Revise 11.7.1.1 to read as follows:

11.7.1.1 Vigorous sweeping or blowing down with compressed air produces dust clouds and shall be permitted only where the following requirements are met:
(1) Electrical equipment not suitable for Class II, Division Group E or Zone Group IIIC locations and other sources of ignition shall be shut down or removed from the area.
(2) Compressed air shall not exceed a gauge pressure of 206 kPa (30 psi) unless otherwise determined to be safe by a documented hazard analysis.

8. Revise section 12.4 and associated Annex material to read as follows:

12.4 Electrical Area Classification.
~~**12.4.1*** The classification criteria in *NFPA 70* shall be applied whenever combustible metal particulate meets the definition of combustible metal dust in this standard, notwithstanding the definition of combustible dust in *NFPA 70*.~~
12.4.1~~.1~~* The identification of the possible presence and extent of ~~Class II~~ combustible dust hazardous (classified) locations shall be made based on the criteria in ~~Article 500.5(C)~~ Article 500 or 506 of *NFPA 70*.
A.12.4.1 ~~The definition of combustible dust in Article 500 of *NFPA 70* limits particle size and conflicts with the definition of combustible metal dust in this standard. Combustible metal dust should be considered Class II, Group E regardless of particle size. *(See NFPA 497 and NFPA 499 for information on electrical area classification.)*~~ Housekeeping can reduce or eliminate the electrical area classification for a location where combustible metal dust is present. Electrical equipment upgrades to meet Article 500 of *NFPA 70* can be costly and users might better focus on preventing fugitive dust from escaping equipment and accumulations to minimize the extent of the hazardous (classified) areas.
12.4.~~1.1.1~~2 All areas designated as hazardous (classified) locations shall be documented, and such documentation shall be maintained and preserved for access at the facility.
12.4.~~1.2~~3 Electrical equipment and wiring within ~~Class II~~ combustible dust locations shall comply with ~~Article 500.5(C) of~~ *NFPA 70*.
12.4.~~1.3~~4* Preventive maintenance programs for electrical equipment and wiring in ~~Class II~~ combustible dust locations shall include provisions to verify that dusttight electrical enclosures are not experiencing significant dust ingress.
A.12.4.~~1.3~~4 Finding combustible metal dust or powder within electrical equipment and components should warrant more frequent inspection and cleaning.
~~**12.4.1.4*** Zone classification for dusts in accordance with Article 506 of *NFPA 70* shall not be permitted.~~
~~**A.12.4.1.4** NFPA 499 provides guidance for zone classification to clarify that combustible metal dust is Group IIIC, regardless of particle size. However, this clarification has not yet progressed through the *NFPA 70* revision cycle.~~

9. Revise 18.6.2.2.2 to read as follows:

18.6.2.2.2* Wet solvent milling areas or other areas where combustible or flammable liquids are present shall be classified, where applicable, in accordance with Article 500, 505, or 506 of *NFPA 70* with the exception of control equipment meeting the requirements of NFPA 496.

10. Add new material to the end of Annex A.3.3.14 to read as follows:

A.3.3.14 Combustible Particulate Solid. …
For purposes of determining appropriate electrical installation requirements for combustible particulate solids, NFPA 499 has defined three material subgroups that can warrant establishing hazardous (classified) locations. Combustible dusts, per NFPA 499, are materials with a particle size less than 500 μm that can propagate a deflagration when suspended in a cloud, as determined by test. Combustible fibers/flyings are larger than 500 μm in at least one dimension, yet can still propagate a deflagration in a cloud. Both of these first two subgroups present flash-fire or explosion hazards when suspended in a cloud, as well as fire hazards when in a layer. Ignitible fibers/flyings are larger than 500 μm in at least one dimension, but either are too large or too agglomerated to suspend in the typical test or do not propagate a deflagration in a cloud. Ignitible fibers/flyings do not present a flash-fire or explosion hazard, yet still present a fire hazard when in a layer. All three of these subgroups defined in NFPA 499 are included in the term *combustible particulate solid* as defined and used in NFPA 652. Combustible fibers/flyings as defined in NFPA 499 are included in the term *combustible dust* as used and defined in NFPA 652. [**652,** 2019]

NFPA 70 provides different installation requirements for each of these three material subgroups. Materials smaller than 500 µm require more stringent dust exclusion designs (i.e., Class II or Zone Group IIIB) than materials larger than 500 µm (i.e., Class III or Zone Group IIIA). The exception to this is combustible metals, where both combustible metal dust and combustible metal fibers/flyings require Class II or Zone Group IIIC installations. Ignitible fibers/flyings additionally require lower maximum surface temperatures than combustible fibers/flyings for certain electrical equipment subject to overload conditions. When a hazardous (classified) location is established to address the presence of more than one of the three subgroups, the more stringent electrical installation requirements should be applied. [**652,** 2019]

11. Revise Annex A.17.7 item (3) to read as follows:

A.17.7 Section 17.7 applies to operations where metals or metal alloys are subjected to processing or finishing operations. The operations can include, but are not limited to, grinding, buffing, polishing, sawing, and machining of solids. Media blasting operations include, but are not limited to, abrading, etching, applying an anchor pattern, wheel blast, centrifugal wheel blast, sand blast, grit blast, air blast, airless blast, siphon blast, suction blast, abrasive shot blast, peening, and shot peening of solids.

…

The control of ignition sources is paramount in maintaining a fire-free environment. The following measures provide guidance for controlling ignition sources:

(1) Open flames and smoking should be prohibited.
(2) Cutting and welding in the vicinity of fines, dust, and flammable lubricants should be prohibited.
(3) Electrical equipment, wiring, and lighting in the area should comply with Article 500 or 506 of *NFPA 70*.
(4) Blowers and exhaust fans …
(11) Dust-handling equipment …

12. Add a new citation to J.1.2.10 as follows:

J.1.2.10 ISO Publications. …

ISO/IEC 80079-20-2, *Explosive atmospheres — Part 20-2: Material characteristics — Combustible dusts test methods*, 2016.

13. Add a new citation to J.3 as follows:

J.3 References for Extracts in Informational Sections.

NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2021 edition.

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