**Submitter:** Warde Comeaux, Global Fire Protection Consulting, Inc.

**Recommendation:**

Add a new section and renumber definition as follows:

Catwalk. A catwalk is a walkway used to access storage within the racks and/or shelving and is a working platform. Catwalks are independent of the building structure and are a component of the storage system.

**Substantiation:**

Catwalks are used in several storage occupancies, such as parts storage, records storage, retail storage, etc. The catwalk system does not fit into the definition of a story, floor, or mezzanine as the construction is usually upended metal grating, wood or sheet set. The definition is needed for clarification.

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**Submitter:** Karin Rountree, Ampco Safety Tools

**Recommendation:**

Anywhere ignition sources are a concern, please include as a requirement. Non-Sparking Tools are required where hazardous, combustible or flammable gases, liquids, dusts, or residues are present.

**Substantiation:**

Ordinary hand tools are usually made of steel and if struck, scraped, or dropped, can cause sparks which can be disastrous in an explosive environment. Non-Sparking Tools eliminate this hazard, however; standards regarding their application are incomplete, inconsistent and in some cases inaccurate.

We feel prevention is one of the most effective means of ensuring safety. If we can prevent an accident and safe someone’s life and business, if we can implement standards and codes to educate and inform before an accident happens, then we should make the necessary standards and codes to solve the problem.

The standards and recommended practices developed by NFPA are designed to improve overall safety and protection of property and personnel. Implementing a Non-Sparking Tools requirement wherever an ignition source is concern would reduce the risk of fire and explosion where hazardous conditions are present.

Non-Sparking Tools are recommended by Safety Engineers and Insurance Companies and meet OSHA and EPA requirements where hazardous, combustible or flammable gases, liquids, dusts and residues are present. Non-Sparking Tools should be be used when storing, processing, handling hazardous materials as well as maintenance and repair operations within hazardous environments. All it takes is just one spark to cause an explosion.
Submitter: Marcelo M. Hirschler, GBH International

Recommendation:
Revise text to read as follows:

1.1.1 This standard shall apply to the indoor and outdoor storage of materials representing the broad range of combustibles, including plastics, forest products, rubber tires, scrap tires, baled cotton, and roll paper.

1.1.2 Storage configurations included in the scope of this standard shall include palletized storage, solid-piled storage, and storage in bin boxes, on shelves, or on racks.

1.1.3 Outside storage configurations of forest products included in the scope of this standard shall include stacked storage, piles, and cold decks.

1.1.4 Unsprinklered buildings containing baled cotton storage.

1.1.5 Unsprinklered buildings containing certain rack storage arrangements protected by high-expansion foam systems in accordance with this standard.

1.1.6 This standard shall not apply to the following:

1.1.6.1 Unsprinklered buildings, except as indicated in 1.1.4 and 1.1.5, the following:

(a) Buildings containing baled cotton storage

(b) Certain rack storage arrangements protected by high-expansion foam systems in accordance with this standard.

1.1.6.2 Storage of commodities that, with their packaging and storage aids, would be classified as noncombustible

1.1.6.3 Unpackaged bulk materials such as grain, coal, or similar commodities but excluding wood chips and sawdust, which are addressed in Section 11.6

1.1.6.4 Inside or outside storage of commodities covered by other NFPA standards, except where specifically mentioned herein (e.g., pyroxylin plastics)

1.1.6.5 Storage of high-hazard materials covered by other NFPA standards, except where specifically mentioned herein

1.1.6.6 Storage on plastic shelves on racks

1.1.6.7* Miscellaneous tire storage

1.1.6.8 Forest products stored on piers, wharves, and raised platforms, as addressed in NFPA 307, Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves

Substantiation:
This makes a more positive statement regarding the application of the standard rather than the double negative in the present edition.
Submitter: Marcelo M. Hirschler, GBH International

Recommendation:
Revise text to read as follows:
Chapter 6 Protection of Palletized, Solid Pile, Bin Box, and On-Shelf Storage

6.1* Application. Chapter 6 of this document shall apply to the indoor storage of normal combustibles (Class I through Class IV) and plastics that are stored palletized, solid-piled, in bin boxes, or on shelves. It shall also apply to the storage of densely-packed cotton bales.

A.6.1 Storage should be separated by aisles so that piles are not more than 15.2 m (50 ft) wide or 7.6 m (25 ft) wide if they abut a wall. Main and cross aisles should be located opposite window or door openings in exterior walls. This design is of particular importance in buildings where few exterior openings exist. Aisle width should be not less than 2.4 m (8 ft). In judging the adequacy of existing sprinkler protection, aisle spacing and frequency should be given consideration. Densely-packed cotton bales are difficult to ignite and do not burn easily.

Substantiation:
The text in this proposal corrects information contained in Annex D of this standard and which is based on historical records, and not on the use of efficient densely-packed modern cotton bales. In order to counteract some historical anecdotal information, such as that contained in Annex D of this standard, regarding the combustibility characteristics of densely-packed cotton bales, flammability research was conducted, including the following experiments and results, with details contained towards the end of the substantiation:

(1) Standard cotton fibre "passed" the Department of Transportation spontaneous combustion test: the cotton did not exceed the oven temperature and was not classified as self-heating.

(2) Cotton within densely-packed cotton bales did not cause sustained smoldering propagation: an electric heater placed within the bale was unable to cause sustained smoldering propagation, due to the lack of oxygen inside the densely-packed bale.

(3) Cotton within densely-packed cotton bales was exposed to ignition from a cigarette and a match and performed very well: no propagating combustion with either.

(4) Cotton within densely-packed cotton bales was exposed to ignition from the gas burner source in ASTM E 1590 (also known as California Technical Bulletin 129; 12 L/min of propane gas for 180 seconds) and passed all the criteria of CA TB 129: mass loss of less than 1.36 kg (3 pounds), heat release rate less than 100 kW and total heat release of less than 2 MJ in the first 10 minutes of test.

In consequence, the US Department of Transportation (US Coast Guard), the United Nations and the International Maritime Organization have all removed the listing of baled cotton from the list of hazardous materials, and from the list of flammable solids, provided the cotton bales are the type of bales listed above.
Recommendation:

Revise and add definitions as follows:

3.3.24* Flameover. A fire that spreads rapidly over the exposed linty surface of cotton bales. The condition where unburned fuel (pyrolysate) from the originating fire has accumulated in the ceiling layer to a sufficient concentration (i.e., at or above the lower flammable limit) that it ignites and burns; can occur without ignition and prior to the ignition of other fuels separate from the origin. (NFPA 921)

3.3.25* Flashover. A stage in the development of a contained fire in which all exposed surfaces reach ignition temperatures more or less simultaneously and fire spreads rapidly throughout the space. (NFPA 555)

A 3.3.24 The term flameover is often used to describe the condition where flames propagate through or across the ceiling layer only and do not involve the surfaces of target fuels. Flameover generally precedes flashover but may not always result in flashover conditions throughout a compartment, particularly where there is a large volume or high ceiling involved or there is limited fuel present. At the time of flashover, the compartment door becomes a restriction to the amount of air available for combustion inside the compartment, and the majority of the pyrolys products will burn outside the compartment. Flameover or rollover generally occurs prior to flashover but may not always result in flashover. (See also flashover)

A 3.3.25 Flashover occurs when the surface temperatures of combustible contents rise, producing pyrolys gases, and the room heat flux becomes sufficient to heat all such gases to their ignition temperatures. Also, renumber definitions that follow 3.3.24.

Substantiation:

The term flameover is a term used extensively in the fire investigations profession and is defined properly in NFPA 921, Guide for Fire and Explosion Investigations. It refers to a concept of what happens before flashover, when all gaseous and vapor layers are burning. The term flashover should be defined here in NFPA 230 also, so that it can be contrasted with flameover. The old, anecdotal, information regarding cotton is incorrect and misleading and is not really associated with the concept of flameover.

In the whole set of NFPA documents, including all codes and standards, the term flameover is used in 3 documents: NFPA 230, NFPA 921 and NFPA 255. In NFPA 921 there is a definition (as shown in this proposal, and recognized as the official NFPA definition), as well as references in the sections on fire science and building design, that are consistent with the definition. In NFPA 255 (Steiner tunnel test for flame spread and smoke developed indices) there is a discussion in the Annex on mounting methods, stating the following:

“D-7.8 The materials described in this section, (i.e., those that drip, melt, delaminate, draw away from the fire, or need artificial support) present unique problems and necessitate careful interpretation of the test results. Some of these materials that are assigned a low FSI based on this test method can exhibit an increasing propensity for generating flameover conditions during room fire tests with increasing area of material exposure and increasing intensity of fire exposure. The result, therefore, might not be indicative of their performance if evaluated under large-scale test procedures. Alternative means of testing might be necessary to fully evaluate some of these materials."

Again, this clearly reflects the concept of flameover from NFPA 921.

The outmoded concept of “flameover” for cotton contained in NFPA 230 is a holdover from previous documents (NFPA 231E, Recommended Practice for the Storage of Baled Cotton) and is incorrect. The term is used (beyond the definition) in D.1.3.1 (twice), in D.3.3.4, in D.4.2.3 and in D.7.1 (twice). The uses of the term need to be reviewed and revised as appropriate. I have submitted companion proposals to that effect, which eliminate the term and replace it by a better description of the concept in all 6 occurrences.
Revise text to read as follows:

D.1.3.1 Cotton fiber, unless stored as densely-packed cotton bales, is readily ignitable and burns freely and, when stored in relatively large quantities, poses special fire control problems not generally encountered in other common commodities.

Densely-packed cotton bales are difficult to ignite and do not burn easily. Cotton fiber is compressed to various densities in baled form for transport, storage, and handling and is largely covered by industry-accepted packaging materials, and bound by The bales are bound by wire bands, polyester plastic strapping or cold rolled high tensile steel strapping, and covered with fully-coated or strip coated woven polypropylene, polyethylene film or burlap, steel, synthetic or wire bands, or wire. Uncovered The bale surfaces normally are ragged in appearance due to the loose fibrous material not confined by the binding or wrapping. Frequently In the past, this ragged appearance was also in further aggravated by sampling, which exposes additional fibrous material and could contribute to the rapid spread of fire.

This is no longer an issue, as current cotton industry standards (for example by the Joint Cotton Industry Bale Packaging Committee) require bales to be fully covered and sample holes to be patched thereby minimizing the presence of exposed cotton.

Bale storage The storage of cotton bales that are not densely-packed cotton bales, in relatively large quantities can pose severe fire control problems due to the potential for flameover surface flammability and the large area of involvement that could overcome even a well designed and supplied sprinkler system. Therefore, this annex takes into consideration limits on the number of bales, other than densely-packed cotton bales, per building or fire division and the size of storage blocks.

Where the bales are tiered or piled in buildings or outdoors, the loose surface fibers are easily ignited in the presence of an ignition source and the fire can spread rapidly over the entire mass or body of the material. This happening commonly is called flameover. Fire then can burrow into the bale interiors making detection and extinguishment difficult, particularly in large mass storage. A quick, hot fire then can ensue and spread beyond the control of ordinary extinguishing methods. However, it has been shown (Wakelyn and Hughes, 2002) that flameover will not occur with densely-packed cotton bales.

In properly arranged storage and with adequate automatic sprinkler protection, fire normally is confined to the pile of origin, although an aisle fire can be expected to involve more than one tier or pile. Sprinklers usually operate beyond the confines of the fire and wet down bales immediately adjacent to the burning pile.

If adequate sprinkler protection is lacking, if tiers or piles are too large or high, if aisle separation is not properly maintained, or if the loosely packed bales are otherwise improperly arranged, damage to the section, building, or area of involvement will be more severe, if not totally destructive.

D.3.3.4 Where a 4.6-m (15-ft) cross aisle is provided after every fourth or fifth tiered block, each storage block can be increased to 800 bales of compressed cotton and 400 bales of flat uncompressed cotton. This provision does not apply to densely-packed cotton bales, which have low ignition potential. The purpose of this alternate method of tiered storage is to encourage wider cross aisles at least intermittently, without reducing the recommended storage capacity, as an aid in reducing the flameover fire potential for rapid surface flammability. Because of the increase in block sizes, however, it is recommended that the authority having jurisdiction be consulted prior to practicing this method.

D.4.2.3 Recommended water supplies contemplate successful sprinkler operation when installed. However, because of the flameover fire potential for rapid surface flammability and inherent unfavorable features of cotton warehouse of loose cotton fibers, there should be an adequate water supply available for fire department use.

D.7 Information on Fighting Fires in Baled Cotton.

D.7.1 Introduction. The information contained in this section is a summary of knowledge gained over the years by cotton warehouse personnel, fire fighters, and insurance authorities in fighting fires in the Cotton Belt.

A baled cotton fire on a baled cotton, other than densely packed cotton bales, has peculiarities that should be understood and respected if a large loss is to be avoided with minimum danger to personnel. Automatic sprinklers, if properly designed and supplied, can be expected to control a baled cotton fire where storage methods outlined in this standard are followed, but extinguishment should not be expected.

The primary rule for any fire is always to call the responding fire department first. Fighting fires of any type is a profession and, even where a well-trained private fire organization is available, professional aid should be effected as soon as possible, and plant personnel should not be unduly exposed to the peril.

The myriad of small fibers that make up a cotton bale, unless it is a densely-packed cotton bale, especially a naked cotton bale or one wrapped in burlap, and cover its surface offer a highly vulnerable source of ignition as well as the potential for a rapid flame spread above the stored material, also known as flameover. A flameover Such rapid flame spread is usually followed by a slower flame spread at the surface, then tenacious burrowing into the pile between bales and penetration of the interiors of individual bales. High-density bales are less vulnerable to a burrowing fire, but the possibility of
such a fire should not be ignored.

**Substantiation:**

The term flameover is a term used extensively in the fire investigations profession and is defined properly in NFPA 921, Guide for Fire and Explosion Investigations. It refers to a concept of what happens before flashover, when all gaseous and vapor layers are burning. The term flashover should be defined here in NFPA 230 also, so that it can be contrasted with flameover. The old, anecdotal, information regarding cotton is incorrect and misleading and is not really associated with the concept of flameover. The definitions of flameover from NFPA 230 and NFPA 921 and of flashover follow:

3.3.24 Flameover. A fire that spreads rapidly over the exposed linty surface of cotton bales. (NFPA 230)

1.3.56 The condition where unburned fuel (pyrolysate) from the originating fire has accumulated in the ceiling layer to a sufficient concentration (i.e., at or above the lower flammable limit) that it ignites and burns; can occur without ignition and prior to the ignition of other fuels separate from the origin. (NFPA 921)

3.3.25 Flashover. A stage in the development of a contained fire in which all exposed surfaces reach ignition temperatures more or less simultaneously and fire spreads rapidly throughout the space. (NFPA 555)

In the whole set of NFPA documents, including all codes and standards, the term flameover is used in 3 documents: NFPA 230, NFPA 921 and NFPA 255. In NFPA 921 there is a definition (as shown in this proposal, and recognized as the official NFPA definition), as well as references in the sections on fire science and building design, that are consistent with the definition. In NFPA 255 (Steiner tunnel test for flame spread and smoke developed indices) there is a discussion in the Annex on mounting methods, stating the following:

“D-7.8 The materials described in this section, (i.e., those that drip, melt, delaminate, draw away from the fire, or need artificial support) present unique problems and necessitate careful interpretation of the test results. Some of these materials that are assigned a low FSI based on this test method can exhibit an increasing propensity for generating flameover conditions during room fire tests with increasing area of material exposure and increasing intensity of fire exposure. The result, therefore, might not be indicative of their performance if evaluated under large-scale test procedures. Alternative means of testing might be necessary to fully evaluate some of these materials.”

Again, this clearly reflects the concept of flameover from NFPA 921.

The outmoded concept of “flameover” for cotton contained in NFPA 230 is a holdover from previous documents (NFPA 231E, Recommended Practice for the Storage of Baled Cotton) and is incorrect. The term is used (beyond the definition) in D.1.3.1 (twice), in D.3.3.4, in D.4.2.3 and in D.7.1 (twice). The uses of the term need to be reviewed and revised as appropriate. I have submitted companion proposals to that effect.

The revisions shown here also address the concept of “densely-packed cotton bales” and to “flat” bales of cotton discussed elsewhere in the proposals.

230- Log #7
(A.3.3.4)

**Submitter:** Marcelo M. Hirschler, GBH International

**Recommendation:**

Delete the lines referencing “Gin, flat” and “Modified gin, flat” bales.

**Substantiation:**

Flat bales of cotton are no longer in use and the use of the terms in the table causes confusion and is misleading. The references to flat bales are also present in D.3.2.1 and D.3.3.4, and a companion proposal recommends revisions to these sections, to eliminate the terms and replace them by references to uncompressed cotton bales.
Submittal: Marcelo M. Hirschler, GBH International

Recommendation:
Revise text to read as follows:

D.3.2.1 Storage blocks, tiered or untiered, or in racks, should be limited to 700 bales of compressed cotton or 350 bales of flat uncompressed cotton (unless the bales are densely-packed cotton bales). (See D.3.3.4 for a permitted variation and also Table A.3.3.4 for typical cotton bale types and approximate sizes.)

D.3.3.4 Where a 4.6-m (15-ft) cross aisle is provided after every fourth or fifth tiered block, each storage block can be increased to 800 bales of compressed cotton and 400 bales of flat uncompressed cotton. This provision does not apply to densely-packed cotton bales, which have low ignition potential. The purpose of this alternate method of tiered storage is to encourage wider cross aisles at least intermittently, without reducing the recommended storage capacity, as an aid in reducing the flameover fire potential for rapid surface flammability. Because of the increase in block sizes, however, it is recommended that the authority having jurisdiction be consulted prior to practicing this method.

Substantiation:
Flat bales of cotton are no longer in use and the use of the terms in the table causes confusion and is misleading. The references to flat bales, which have been proposed to be eliminated from the table in A.3.3.4 (by a companion proposal) should also be eliminated from D.3.2.1 and D.3.3.4, and replaced by references to uncompressed cotton bales.

This proposal also includes language referencing "densely-packed cotton bales" and “flameover” discussed in other proposals.

Submittal: Marcelo M. Hirschler, GBH International

Recommendation:
Completely revise Annex D to incorporate an up-to-date understanding of the appropriate guidelines needed for cotton storage.

Substantiation:
Beyond the proposals made for revision of Annex D, further changes to update this annex would be of use to the reader. However, detailed proposals will be made only at the comment stage once proper language is drafted, which will incorporate all needed changes.
Submitter: Marcelo M. Hirschler, GBH International

Recommendation:
Revise text to read as follows:
Annex D Protection of Baled Cotton History of Guidelines
This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.
D.1 Introduction.
D.1.1 Origin. In the early 1900s, a group of marine underwriters formulated regulations to reduce the frequency of excessive fire loss in baled cotton facilities. In 1916, following a joint conference with the cotton industry, guidelines were established under the title Specifications and Standards (also known as Marine Standards). From 1947 through 1969, the sponsorship was through the Cotton Warehouse and Inspection Service (dissolved in 1969). In 1967, interested insurance rating bureaus were added as sponsors, and, in 1969, to prevent conflicts with various rating bureau schedules, the word Standards was replaced with Recommended Good Practices. However, since 1939, the booklet was commonly referred to as the Blue Book.
Numerous revisions were made over the years to keep current, the last made in 1973. Early in 1978, the committee for the Blue Book requested that the NFPA consider a standard on baled cotton storage and handling based on the Blue Book recommended practices. The NFPA Correlating Committee for Storage expanded the scope to include all fibers in baled form, which were covered in NFPA 44, Storage of Combustible Fibers, which was withdrawn many years ago. Little data was found on fire experience for baled fibers other than cotton, and that data was largely empirical in nature.
Therefrom, the former NFPA 231E, Recommended Practice for the Storage of Baled Cotton, was developed by consensus of a test group formed in 1978 that was made up of the cotton warehousing, cotton processing, and insurance industries, under the auspices of the Technical Committee on General Storage. The recommendations were limited to cotton fiber in baled form with the intent to convert to a standard as field experience became available to further substantiate its content.
In the 1990s, experimental work by the US Department of Agriculture, and others (Wakelyn and Hughes, 2002), investigated the flammability of cotton bales with a packing density of at least 360 kg/m2 (22 lb/ft²). The research showed that such cotton bales (densely-packed cotton bales) did not undergo self-heating nor spontaneous combustion and that the likelihood of sustained smoldering combustion internal to the cotton bale, creating a delayed fire hazard, was extremely low. The same research also showed that, when the cotton bales were exposed to smoldering cigarettes, matches and open flames (including the gas burner ignition source used for the mattress tests ASTM E 1590 and California Technical Bulletin 129), the probability of initiating flaming combustion was at such a low level as not to qualify the densely-packed cotton bales as flammable solids. These investigations resulted in harmonization between the U.S. Department of Transportation (49CFR172.102, note 137), the United Nations Recommendations on the Transport of Dangerous Goods, the International Maritime Organization (the International Maritime Dangerous Goods Code) and the International Civil Aviation Organization’s Technical Instructions, with the removal of the flammable solid designation from densely-packed cotton bales, complying with ISO 8115, “Cotton Bales - Dimensions and Density” and the exemption of such cotton bales from the Hazardous Materials Regulations.
With the merger of a number of general storage standards in 1999, the information was edited and is now included in this annex as guidance for the user.
D.1.2 Scope.
D.1.2.1 This annex provides fire protection guidance for the storage of baled cotton, other than densely-packed cotton bales, in buildings and in yards. Storage of densely-packed cotton bales should be treated the same way as storage of normal combustibles (see Chapter 6).
Add to a new section G1.2.4 (ISO Publication) a reference to ISO 8115, “Cotton Bales - Dimensions and Density”.
Add to a new section G1.2.5 (California Publication) a reference to CA TB 129, “CA Technical Bulletin 129 Flammability Test Procedure for Mattresses for Use in Public Buildings”

Substantiation:

Include 230_L11_S.doc