**CELLULOSE NITRATE**

# Table of Contents

**Page**

**1.0 SCOPE** ..... 2
1.1 Hazards ..... 2
1.2 Changes ..... 2
**2.0 LOSS PREVENTION RECOMMENDATIONS** ..... 2
2.1 Construction and Location ..... 2
2.2 Occupancy ..... 3
2.2.1 General ..... 3
2.2.2 Process Areas ..... 4
2.3 Protection ..... 4
2.3.1 Phlegmatized Cellulose Nitrate Fibers. Solvent and Water Base ..... 4
2.3.2 Cellulose Nitrate Rolls or Sheets ..... 5
2.4 Ignition Source Control ..... 5
2.5 Electrical ..... 5
2.6 Training ..... 5
**3.0 SUPPORT FOR RECOMMENDATIONS** ..... 5
3.1 Phlegmatized Cellulose Nitrate Fibers ..... 6
3.2 Cellulose Nitrate Rolls ..... 6
3.3 Other Cellulose Nitrate Applications ..... 6
**4.0 REFERENCES** ..... 6
4.1 FM ..... 6
4.2 NFPA Standards ..... 6
**APPENDIX A GLOSSARY OF TERMS** ..... 7
**APPENDIX B DOCUMENT REVISION HISTORY** ..... 7

## List of Figures

Fig. 2.1.1. Location and construction of stabilized cellulose nitrate storage areas ..... 3

## List of Tables

Table 2.1.1.1. Construction and Space Separation of Detached Storage Areas ..... 2
Table 2.3.1.2.2. Ceiling Sprinkler Protection for Solid-Piled and Palletized Storage Arrangements ..... 4

©2026 Factory Mutual Insurance Company. All rights reserved. No part of this document may be reproduced, stored in a retrieval system, or transmitted, in whole or in part, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission of Factory Mutual Insurance Company.

## 1.0 SCOPE

This data sheet provides guidance for the storage and use of cellulose nitrate (also known as nitrocellulose or pyroxylin) in the following forms and applications:

A. Wetted or phlegmatized cellulose nitrate materials classified as Division 4.1 flammable solids.

B. Cellulose nitrate in roll or sheet form, classified as 4.1 flammable solid, used in applications such as lateral flow assays (LFAs), diagnostic test strips and specialized filtration devices.

This data sheet does not apply to the following materials:

- Cellulose nitrate products with nitrogen content greater than 12.6%. For these products, follow the guidance in Data Sheet 7-28, *Energetic Materials*.
- Cellulose nitrate motion picture films. Guidance for storage and protection of these materials is provided in NFPA 40.

### 1.1 Hazards

Cellulose nitrate is an extremely flammable and potentially explosive material. Its hazards vary based on nitrogen content and whether it is stored wet/phlegmatized (stabilized) or dry (highly reactive). Because the material contains enough oxygen within its molecular structure, it can sustain combustion without air. Once ignited, it burns rapidly and intensely.

As the stabilizing liquid (water or alcohol) evaporates, cellulose nitrate becomes increasingly unstable. Dry cellulose nitrate is sensitive to heat, friction, impact, and static discharge, and can transition from rapid burning to detonation under the right conditions.

### 1.2 Changes

**October 2026.** This document has been completely revised. Significant changes include the following:

A. Revised the scope to clarify the applicability of the standard to various cellulose nitrate products, specifically stabilized forms and nitrogen content.

B. Updated storage, use, and protection guidance for stabilized cellulose nitrate products classified as Division 4.1 flammable solids.

C. Developed protection guidance for cellulose nitrate rolls or sheet forms.

D. Removed Appendix C, and incorporated updated cellulose nitrate hazard information into Section 3.

## 2.0 LOSS PREVENTION RECOMMENDATIONS

### 2.1 Construction and Location

2.1.1 Construct storage areas with noncombustible materials. Locate cellulose nitrate storage areas according to Figure 2.1.1.

2.1.1.1 Locate detached storage areas in low value buildings according to Table 2.1.1.1

*Table 2.1.1.1. Construction and Space Separation of Detached Storage Areas*

| *Separation Distance to Main Building [Note 1] ft (m)* | *Construction Type of Exposed Wall (A)* |
|---|---|
| 50 (15) | Any |
| 25 (7.6) | Noncombustible |
| 5 (1.5) | 2-hour (FR [Note 2]) |

Note 1. Lower separation distances determined by calculation are tolerable, considering actual storage quantities that can produce heat fluxes lower than 66.6 BTU/min/ft$^2$ (12.6 kW/m$^2$).
Note 2. Fire ratings are per ASTM E119 ratings or local code equivalent, and construction materials are noncombustible.

2.1.1.2 Provide cutoff or attached storage walls (B), exposing the main building, with a noncombustible two-hour fire rating per ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, or local code equivalent.

©2026 Factory Mutual Insurance Company. All rights reserved.

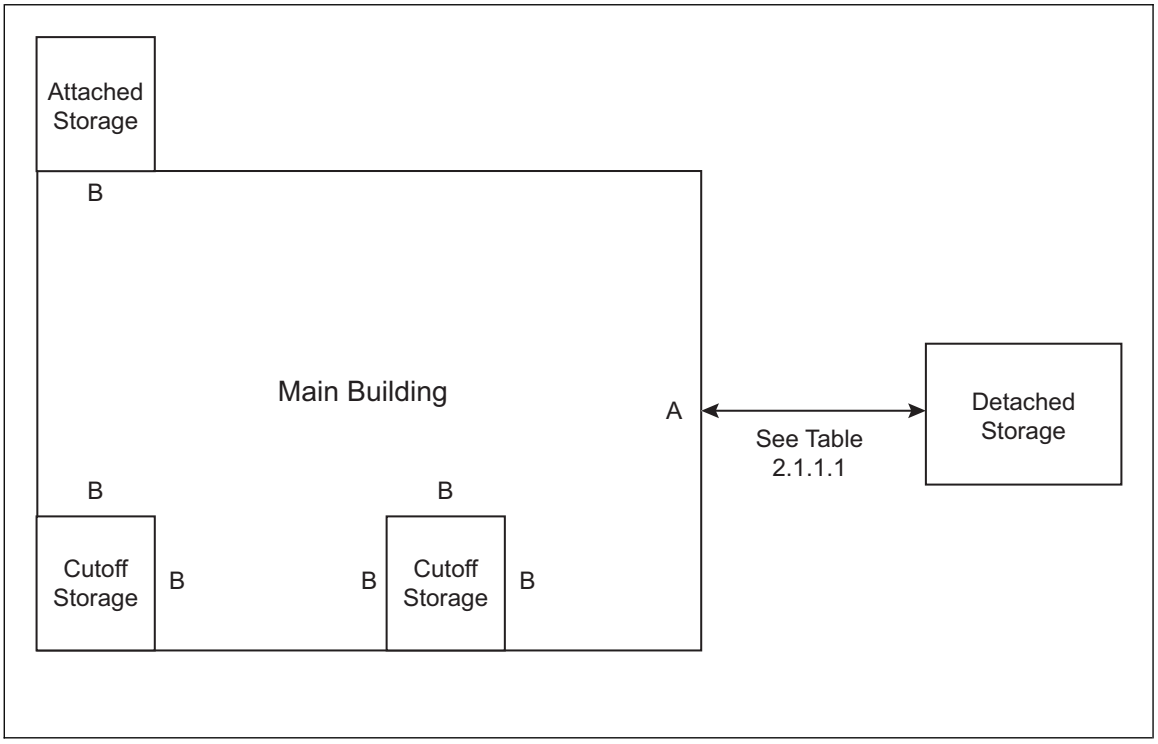



*Fig. 2.1.1. Location and construction of stabilized cellulose nitrate storage areas*

## 2.2 Occupancy

### 2.2.1 General

2.2.1.1 Store cellulose nitrate fibers and powders only in their stabilized form and packaging approved for transportation. Do not open drums or containers in the storage areas.

2.2.1.2 Ensure cellulose nitrate containers are carefully and cautiously transported, avoiding impacts, shock and friction.

2.2.1.3 Store cellulose nitrate products in a cool, dry and well-ventilated area at temperatures below 77°F (25°C). Protect materials from direct sunlight, heat sources, and any conditions that may promote temperature increases or moisture accumulation.

2.2.1.4 Ensure only compatible materials are located in the storage area. Do not store combustible materials or ignitable liquids in the area, as they can create potential ignition sources.

2.2.1.5 Maintain storage areas clean. Immediately clean any cellulose nitrate spills, and remove leaking or broken containers following specific safe disposal procedures and Section 2.2.1.10.

2.2.1.6 Implement a first-in, first-out stock rotation program to ensure the oldest inventory is consumed first. Identify and prioritize opened or partially used containers before unopened containers are placed into service. Ensure materials are stored and used within manufacturer’s shelf-life recommendations.

2.2.1.7 Conduct regular inspections to confirm the wetting agent remains uniformly distributed, and that materials have not dried out. Ensure containers are tightly resealed after inspection.

2.2.1.8 Use the entire contents of a package as soon as practical after opening. If the material cannot be fully consumed immediately, ensure it is thoroughly wetted with the appropriate water or solvent, and reseal the drum tightly to maintain safe moisture levels.

2.2.1.9 Use only non sparking tools (e.g., copper, brass, wood) when opening drums and handling materials. Do not use plastic tools, as they may generate static electricity. Handle all containers carefully, and avoid any actions that could cause friction, impact or shock.

©2026 Factory Mutual Insurance Company. All rights reserved.

2.2.1.10 Develop and implement written procedures that provide clear, detailed guidance for the safe cleanup of cellulose nitrate spills and the management of cellulose nitrate waste. Ensure procedures include, but are not limited to, the following:

A. Always maintain cellulose nitrate waste in a wet condition.

B. Promptly wet down and clean any spilled cellulose nitrate, ensuring all residue is fully saturated with water before collection.

C. Collect all wet sweepings in a covered, metal waste container; and keep the contents continuously wetted with water.

D. After emptying cellulose nitrate waste drums, wipe the interior surfaces clean, re-cover and seal the containers. Place used rags in an approved, covered waste can and wet them thoroughly.

E. Do not accumulate cellulose nitrate waste. Whenever possible, dispose of it daily in accordance with local hazardous waste regulations.

F. If daily disposal cannot be performed, store cellulose nitrate waste only in designated containers and locations. Periodically inspect stored waste to confirm it remains fully wetted, and add water as necessary.

### 2.2.2 Process Areas

2.2.2.1 Do not store cellulose nitrate in process or manufacturing areas. Provide protection according to Section 2.3.1.1

2.2.2.2 Limit the quantity of cellulose nitrate brought into dispensing or processing areas. Do not exceed what is required for a shift supply with no more than eight drums or two pallets.

## 2.3 Protection

### 2.3.1 Phlegmatized Cellulose Nitrate Fibers. Solvent and Water Base

#### 2.3.1.1 Process or Dispensing Areas

2.3.1.1.1 Protect areas where cellulose nitrate is used or dispensed with a sprinkler system designed with a 0.3 gpm/ft$^2$ (12 mm/min) density over a demand area of 6,000 ft$^2$ (560 m$^2$) and 60 minutes of water duration. Ensure a hose stream of 500 gpm (1900 L/min) is included in the design.

2.3.1.1.2 If the cellulose nitrate is wetted with alcohol, provide ventilation according to Data Sheet 7-32, Ignitable Liquids Operations.

#### 2.3.1.2 Storage Areas

2.3.1.2.1 Store cellulose nitrate in separate rooms used only for that purpose, according to Section 2.1.1. Ensure materials and drums are only stored in an upright position.

2.3.1.2.2 Provide ceiling sprinkler protection for solid-piled or palletized storage arrangements using a wet or deluge system, according to Table 2.3.1.2.2. Ensure the storage height does not exceed two-levels high for cardboard boxes and three-levels high for fiber drums, provided they are strapped.

*Table 2.3.1.2.2. Ceiling Sprinkler Protection for Solid-Piled and Palletized Storage Arrangements*

| *Maximum Ceiling Height ft (m)* | *Sprinkler System Type* | *Response, Nominal Temperature, Rating, Orientation* | *Density gpm/ft$^2$ (mm/min)* | *Demand Area* | *Duration min* |
|---|---|---|---|---|---|
| 30 (9.1) | Wet | QR/Low/Any | 0.6 (24) | Entire area [Note 1] | 60 |
| | Deluge | - | | | |

Note 1. Large rooms may need to be divided or split into smaller rooms/partitions. The size will depend on the available water supply.

2.3.1.2.3 Protect rack storage with in-rack sprinkler systems according to the protection scheme for Class 3 oxidizers in Data Sheet 7-80, *Organic Peroxides and Oxidizing Materials* and the following:

©2026 Factory Mutual Insurance Company. All rights reserved.

A. Metal horizontal and vertical rack barriers arrangement can also be used.

B. Locate the thermal element of the in-rack sprinkler no more than 9 in. (225 mm) vertically below the underside of the horizontal barrier.

C. Limit the rack arrangements to single and double row racks, with a maximum storage height of 15 ft (4.5 m).

D. Include a hose demand allowance of 250 gpm (950 L/min) for manual intervention. Provide the combined water demand (in-rack and hose demand) for at least one hour.

### 2.3.2 Cellulose Nitrate Rolls or Sheets

2.3.2.1 Store cellulose nitrate rolls or sheets in separate rooms used only for that purpose, according to Section 2.1.1. Ensure no combustible materials or ignitable liquids are stored in the area.

2.3.2.2 Protect storage areas containing cellulose nitrate rolls or sheets in accordance with Table 2.3.1.2.2. Design and arrange the storage so that water from fire protection systems can be applied directly over the stored materials, ensuring uniform wetting and penetration to all levels, including the lowest levels.

2.3.2.3 Protect storage areas with finished nitrocellulose membrane products according to Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities* using an Uncartoned Expanded Plastic (UEP) commodity.

### 2.4 Ignition Source Control

2.4.1 Provide bonding and grounding in accordance with Data Sheet 5-8, *Static Electricity*. Connect bonding wires before transferring operations of cellulose nitrate to prevent spark generation.

### 2.5 Electrical

2.5.1 Ensure all electrical equipment used in areas where cellulose nitrate is stored or used is rated in accordance with NFPA 70 (*National Electric Code*), Article 500 and appropriate sub articles, or the international equivalent. Area classification and equipment selection should consider the wetting medium of the cellulose nitrate, as well as the potential for accumulation of cellulose nitrate dust. Refer to Data Sheet 5-1, *Electrical Equipment in Hazardous Locations*, for additional details regarding area classification and equipment selection.

### 2.6 Training

2.6.1 Ensure employees are trained in the fire hazards, preventive, and protective practices involving the storage and use of cellulose nitrate.

## 3.0 SUPPORT FOR RECOMMENDATIONS

Cellulose nitrate (also known as nitrocellulose) is a highly versatile material with numerous applications in everyday life. Its physical form can vary widely, ranging from white fibrous solids to thin sheets or viscous liquids, depending on its formulation and degree of nitration. Owing to its rapid drying and excellent film forming properties, nitrocellulose is widely used in the manufacture of lacquers and coatings, explosives (such as smokeless gunpowder and propellants), specialized printing inks, adhesives, resins and certain plastics, including pyroxylin.

Despite its usefulness, cellulose nitrate is an extremely flammable and potentially explosive substance. Its hazard level depends largely on its nitrogen content and its physical state—whether it is stored in a wet/phlegmatized (stabilized) form, or as a dry material, which is significantly more reactive. Nitrocellulose becomes increasingly energetic and potentially explosive at higher nitrogen contents, typically above approximately 12.6%.

Dry nitrocellulose ignites easily and can burn violently or explosively. For this reason, it should never be stored for any significant period in a dry, fibrous state. Unstabilized material decomposes gradually even at relatively low temperatures, producing large volumes of toxic and flammable gases accompanied by rapid heat generation.

The molecular structure of non explosive grades of nitrocellulose (e.g., $C_{12}H_{17}(ONO_2)_3O_7$ or $C_{12}H_{16}(ONO_2)_4O_6$), incorporated both a fuel component (the carbon hydrogen cellulose backbone) and an

©2026 Factory Mutual Insurance Company. All rights reserved.

oxidizing component (the nitrate groups). Due to its self oxidizing nature, nitrocellulose can sustain combustion even in the absence of air. Once ignited, it burns rapidly and with great intensity.

### 3.1 Phlegmatized Cellulose Nitrate Fibers

Phlegmatized (wet) cellulose nitrate fibers are a white, pulp-like material or amorphous powder that is maintained in a wetted state using water, alcohol or other organic solvents with a flash point not lower than 30°F (–1°C). Typical solvent or alcohol concentrations range from 20–30%, with water content of approximately 20–25%. Maintaining nitrocellulose in this wetted form provides a more stable condition that inhibits decomposition and reduces the risk of explosion. However, it still constitutes a serious fire hazard.

### 3.2 Cellulose Nitrate Rolls

In biomedical and pharmaceutical manufacturing, cellulose nitrate, commonly referred to as nitrocellulose or mixed cellulose ester (MCE), is frequently supplied in roll form for manual assembly processes, including lateral flow assays, diagnostic test strips, and specialized filtration devices. Typical nitrocellulose content in these products ranges from approximately 70% to 100%. In most pharmaceutical and diagnostic roll materials, the composition is not 100% nitrocellulose unless specifically formulated for high-performance protein-binding applications. Instead, most products consist of a blend of cellulose nitrate and cellulose acetate. The addition of cellulose acetate enhances mechanical strength and flexibility while reducing the inherent brittleness of pure nitrocellulose.

This material possesses a serious fire hazard and is a Class 4.1 flammable solid.

### 3.3 Other Cellulose Nitrate Applications

The storage and use of dry, solid cellulose nitrate (pyroxylin) have been largely discontinued because of the development of better substitutes. It is likely to be found only in rare instances, such as the storage of old motion picture films or imported table tennis balls. Since its use is so rare, publication of recommended practices for this material has been discontinued.

Cellulose nitrate may also be in solution form as a lacquer, with low flash point organic solvents. Unless the cellulose nitrate is more concentrated than in normal commercial lacquers, it may be treated as an ordinary ignitable liquid with the hazards based on the flash point.

While cellulose nitrate is no longer used as a film base, stocks of old films may be encountered in archival storage. Its commercial use for plastics in the form of lacquers, enamels, playing cards, combs, buttons, fountain pens, eyeglass frames, drafting instruments, etc., continues.

## 4.0 REFERENCES

### 4.1 FM

Data Sheet 5-1, *Electrical Equipment in Hazardous (Classified) Locations*
Data Sheet 5-8, *Static Electricity*
Data Sheet 7-28, *Energetic Materials*
Data Sheet 7-32, Ignitable Liquid Operations
Data Sheet 7-80, *Organic Peroxides and Oxidizing Materials*
Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*

### 4.2 NFPA Standards

NFPA 40, *Standard for Storage and Handling of Cellulose Nitrate Motion Film*

## APPENDIX A GLOSSARY OF TERMS

**Approved:** References to “Approved” in this data sheet mean the product and services have satisfied the criteria to be FM Approved. Refer to the *Approval Guide* for a complete listing of products and services that are FM Approved.

©2026 Factory Mutual Insurance Company. All rights reserved.

## APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

**October 2026.** This document has been completely revised. Significant changes include the following:

A. Revised the scope to clarify the applicability of the standard to various cellulose nitrate products, specifically stabilized forms and nitrogen content.

B. Updated storage, use, and protection guidance for stabilized cellulose nitrate products classified as Division 4.1 flammable solids.

C. Developed protection guidance for cellulose nitrate rolls or sheet forms.

D. Removed Appendix C, and incorporated updated cellulose nitrate hazard information into Section 3.

**April 2025.** Interim revision. Reaffirmed to be technically correct.

**May 2000.** This revision of the document has been reorganized to provide a consistent format.

**June 1999.** This document was restructured and data sheet and NFPA references were updated.

**1990.** The information in this document was reaffirmed.

**1975.** This document was updated from information provided in the “Handbook of Industrial Loss Prevention”.

©2026 Factory Mutual Insurance Company. All rights reserved.