

NFPA[®]

505

**Fire Safety Standard for
Powered Industrial Trucks
Including Type Designations,
Areas of Use, Conversions,
Maintenance, and Operations**

2018



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NFPA® 505

Fire Safety Standard for

Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations

2018 Edition

This edition of NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, was prepared by the Technical Committee on Industrial Trucks. It was issued by the Standards Council on July 28, 2017, with an effective date of August 18, 2017, and supersedes all previous editions.

This edition of NFPA 505 was approved as an American National Standard on August 18, 2017.

Origin and Development of NFPA 505

Chapter 1 (formerly Part A) of this standard was originally designated as NFPA 505A and was first adopted by the Association in 1951. Chapters 8 and 9 (formerly Parts A and B), “Maintenance of Industrial Trucks” and “Fuel Recharging, Marking, and Operation of Industrial Trucks,” were originally adopted in 1952 and published by NFPA under the designations NFPA 505B and 505C, *Standards for the Maintenance and Safe Operation of Industrial Trucks*. In 1955, the three documents were combined into one standard, NFPA 505. Revisions were made in 1955, 1957, 1963, 1965, 1966, 1967, 1968, 1969, 1971, 1972, 1973, 1975, 1978, 1982, and 1987. The 1971 edition was the first edition to be approved by ANSI.

In the 1992 edition, Group F was added to the list of classified locations to correlate with *NFPA 70®*, *National Electrical Code®*.

In the 1996 edition, changes were made to the types of trucks listed for operation in Class I, Division 2 locations, and a new Type DX designation was added. Also, a new section on compressed natural gas (CNG) was added, and related changes to the chapters on dual-fuel trucks and converted trucks were made.

The 1999 edition was revised to make the entire document more user-friendly and to facilitate its use with *NFPA 70*.

The 2002 edition was editorially reorganized to conform to the *Manual of Style for NFPA Technical Committee Documents* and to further clarify specific use areas for industrial trucks.

Changes to the 2006 edition were primarily editorial reviews that clarified requirements and provided additional information on hazardous areas and their classifications.

The 2011 edition saw an expansion of applicability to address fuel cell systems and conversions. The material on the electric hazard classifications was revised to incorporate the Class I, Zone concept, and other language was updated to the 2008 edition of *NFPA 70*.

The 2013 edition expanded the requirements for hydrogen-powered fuel cell systems for powered industrial trucks. Additional requirements and updated reference materials and standards were given for the use of these vehicles.

The 2018 edition was updated with current references. For this document revision cycle, the document scope was not revised to address other industrial trucks.

Technical Committee on Industrial Trucks

David B. Wechsler, *Chair*

Consultant, TX [U]

Rep. American Chemistry Council

Lewis C. Barbe, World Safety Organization, MN [SE]

Curtis A. Bender, Tennant Company, MI [M]

Rep. American Association of Cleaning Equipment
Manufacturers

Chris Burch, FM Global, RI [I]

Rudy Fiers, U.S. Department of Labor, MD [E]

Jack D. Fry, Los Angeles Fire Department, CA [E]

John M. Jacovetty, BASF Corporation, SC [U]

Christopher P. James, UL LLC, NC [RT]

Steven L. McDermitt, Crown Equipment Corporation, OH [M]

John M. Mertens, Fyrsafe Engineering, Inc., IL [U]

Angelo Bruno Miretti, Miretti SPA, Italy [M]

Suzanne Smyth, Exponent, Inc., IL [SE]

Kenneth R. Van Hook, Mitsubishi Caterpillar Forklift America Inc.,
TX [M]

Rep. Industrial Truck Association

Alternates

Frank Burg, Accident Prevention Corporation, IL [SE]

(Alt. to Lewis C. Barbe)

Todd M. Hetrick, Exponent, Inc., IL [SE]

(Alt. to Suzanne Smyth)

Becky Ann Martin, BASF Corporation, PA [U]

(Alt. to John M. Jacovetty)

Eric Nette, NFPA Staff Liaison

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Committee Scope: This Committee shall have primary responsibility for documents on the safe use, maintenance, and operation of industrial trucks and other material-handling equipment to minimize fire hazards.

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NFPA 505

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Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations

2018 Edition

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex C. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex C.

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard shall apply to fork trucks, tractors, platform lift trucks, motorized hand trucks, and other specialized industrial trucks powered by electric motors or internal combustion engines.

1.1.2 This standard shall not apply to compressed air-operated or nonflammable compressed gas-operated industrial trucks, farm vehicles, or automotive vehicles for highway use.

1.2 Purpose. (Reserved)

1.3 Application.

1.3.1 The design and installation of the compressed natural gas (CNG) fuel systems on CNG-powered and dual fuel-powered (gasoline and CNG) industrial trucks shall be in accordance with the applicable provisions of NFPA 52.

1.3.2 The design and installation of the LP-Gas fuel systems on LP-Gas-powered and dual fuel-powered (gasoline and LP-Gas) industrial trucks shall be in accordance with the applicable provisions of NFPA 58.

1.3.3 The design and installation of compressed gaseous hydrogen (CGH) fuel systems for fuel cell system-powered electric industrial trucks shall be in accordance with ANSI/UL 2267.

1.3.4 The approved powered industrial trucks addressed in this standard are trucks that are listed by a testing laboratory for the use intended and shall be tested and labeled in accordance with ANSI/UL 558 or ANSI/UL 583.

1.3.5 Fuel cell power systems shall be listed by a testing laboratory for the use intended and shall be tested and labeled in accordance with ANSI/UL 2267.

1.4 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.4.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.4.2* The system, method, or device shall be approved or be suitable for the intended purpose by the authority having jurisdiction.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 2, *Hydrogen Technologies Code*, 2016 edition.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2017 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2015 edition.

NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*, 2015 edition.

NFPA 52, *Vehicular Natural Gas Fuel Systems Code*, 2016 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2017 edition.

NFPA 70®, *National Electrical Code*®, 2017 edition.

2.3 Other Publications.

2.3.1 ITSDF Publications. Industrial Truck Standards Development Foundation, 1750 K Street NW, Suite 460, Washington, DC 20006.

ANSI/ITSDF B56.1, *Safety Standard for Low-Lift and High-Lift Trucks*, 2012.

▲ **2.3.2 UL Publications.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 558, *Standard for Safety Industrial Trucks, Internal Combustion Engine-Powered*, 10th edition, 2012.

ANSI/UL 583, *Standard for Safety Electric-Battery-Powered Industrial Trucks*, 10th edition, 2012.

ANSI/UL 2267, *Standard for Fuel Cell Power Systems for Installation in Industrial Electric Trucks*, 2nd edition, 2013.

2.3.3 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections. (Reserved)

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational

note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Dual-Fuel Truck. A truck that is equipped to be operated using either gasoline or LP-Gas or to be operated using either gasoline or compressed natural gas without further modification.

3.3.2* Type Designation. A system for identifying types of powered industrial trucks for operation in nonclassified and classified areas.

3.3.2.1 Type Designation CGH. A compressed hydrogen powered unit utilizing a fuel cell that has minimum acceptable safeguards against inherent fire and electrical shock hazards.

3.3.2.2 Type Designation CN. A compressed natural gas-powered unit that has minimum acceptable safeguards against inherent fire hazards.

3.3.2.3 Type Designation CNS. A compressed natural gas-powered unit that, in addition to meeting the requirements for Type CN units, is provided with additional safeguards to the exhaust, fuel, and electric systems.

3.3.2.4 Type Designation D. A diesel-powered unit that has minimum acceptable safeguards against inherent fire hazards.

3.3.2.5 Type Designation DS. A diesel-powered unit that, in addition to meeting all the requirements for Type D units, is provided with additional safeguards to the exhaust, fuel, and electric systems.

3.3.2.6* Type Designation DX. A diesel-powered unit in which the diesel engine and the electric fittings and equipment are so designed, constructed, and assembled that the unit can be used in atmospheres that contain specifically named flammable vapors, dusts, and, under certain conditions, fibers.

3.3.2.7 Type Designation DY. A diesel-powered unit that has all the safeguards of Type DS units and, in addition, any electric equipment is completely enclosed and equipped with temperature-limitation features.

3.3.2.8 Type Designation E. An electrically powered unit that has minimum acceptable safeguards against inherent fire and electrical shock hazards.

3.3.2.9 Type Designation EE. An electrically powered unit that, in addition to meeting all the requirements for Type E and ES units, has its electric motors and all other electric equipment completely enclosed.

3.3.2.10 Type Designation ES. An electrically powered unit that, in addition to meeting all the requirements for Type E units, is provided with additional safeguards to the electric system to prevent the emission of hazardous sparks and to limit surface temperatures.

3.3.2.11* Type Designation EX. An electrically powered unit in which the electric fittings and equipment are so designed, constructed, and assembled that the unit can be used in atmospheres containing specifically named flammable vapors, dusts, and, under certain conditions, fibers.

3.3.2.12 Type Designation G. A gasoline-powered unit that has minimum acceptable safeguards against inherent fire hazards.

3.3.2.13 Type Designation G/CN. A unit that operates on either gasoline or compressed natural gas that has minimum acceptable safeguards against inherent fire hazards.

3.3.2.14 Type Designation G/LP. A unit that operates on either gasoline or liquefied petroleum gas and that has minimum acceptable safeguards against inherent fire hazards.

3.3.2.15 Type Designation GS. A gasoline-powered unit that, in addition to meeting all the requirements for Type G units, is provided with additional safeguards to the exhaust, fuel, and electric systems.

3.3.2.16 Type Designation GS/CNS. A unit that operates on either gasoline or compressed natural gas and, in addition to meeting all the requirements for Type G/CN units, is provided with additional safeguards to the exhaust, fuel, and electric systems.

3.3.2.17 Type Designation GS/LPS. A unit that operates on either gasoline or liquefied petroleum gas and, in addition to meeting all the requirements for the Type G/LP units, is provided with additional safeguards to the exhaust, fuel, and electric systems.

3.3.2.18 Type Designation LP. An LP-Gas-powered unit that has minimum acceptable safeguards against inherent fire hazards.

3.3.2.19 Type Designation LPS. An LP-Gas-powered unit that, in addition to meeting the requirements for Type LP units, is provided with additional safeguards to the exhaust, fuel, and electric systems.

Chapter 4 Hazardous (Classified) Locations

4.1 General.

4.1.1 Locations shall be classified in accordance with *NFPA 70*. (See Annex B.)

4.1.2 The location shall be classified prior to considering the use of industrial trucks therein, and the type of industrial truck required shall be as specified in Sections 4.2 through 4.6 for the given location.

4.1.3 Different areas of any single plant or building shall be permitted to be classified differently.

4.1.4 The authority having jurisdiction shall limit the use of industrial trucks in hazardous (classified) areas according to the hazard classification assessment made of each area.

4.1.5 The management shall be responsible for the enforcement of restricted use in such areas.

4.1.6 The industrial trucks specified in Sections 4.2 through 4.6 shall be the minimum types required.

4.1.7 Industrial trucks with safeguards greater than those specified in Sections 4.2 through 4.6 shall be permitted to be used.

4.2 Summary for Hazardous (Classified) Location of Use. Table 4.2(a) and Table 4.2(b) shall be used as appropriate as a reference for industrial truck types for specific areas of use and are based on the information contained in Sections 4.3 through 4.6.

4.3* Class I Areas.

4.3.1 Division 1.

4.3.1.1 Groups A, B, and C. Power-operated industrial trucks shall not be permitted to be used in Class I, Division 1, Groups A, B, or C locations unless listed or approved as being suitable for use in hazardous (classified) locations.

4.3.1.2 Group D. Power-operated industrial trucks designated as Type DX or Type EX, and listed or approved power-operated industrial trucks determined to be suitable for the hazardous (classified) location, shall be permitted to be used.

4.3.2 Division 2.

4.3.2.1 Group A. Power-operated industrial trucks designated as Type DY, DX, EE, or EX, when approved for use in the hazardous (classified) location, and listed or approved power-operated industrial trucks determined to be suitable for the hazardous (classified) location, shall be permitted to be used.

4.3.2.2 Groups B and C. Power-operated industrial trucks designated as Type CNS, DS, DY, DX, ES, EE, EX, GS, LPS, GS/CNS, or GS/LPS, when approved for use in the hazardous (classified) location, and power-operated industrial trucks listed or approved as being suitable for the hazardous (classified) location, shall be permitted to be used.

4.3.2.3 Group D. Power-operated industrial trucks designated as Type CNS, DS, ES, GS, LPS, GS/CNS, or GS/LPS, when approved for use in the hazardous (classified) location, power-operated industrial trucks designated as Type DY, DX, EE, or EX, and power-operated industrial trucks listed or approved as being suitable for use in the hazardous (classified) locations, shall be permitted to be used.

4.4 Class II Areas.

4.4.1 Division 1.

4.4.1.1* Group E. Power-operated industrial trucks designated as Type DX or EX, when approved for use in the hazardous (classified) location, and power-operated industrial trucks listed or approved as being suitable for use in the hazardous (classified) locations, shall be permitted to be used.

4.4.1.2 Groups F and G. Power-operated industrial trucks designated as Type DX or EX, and power-operated industrial trucks listed or approved as being suitable for use in the hazardous (classified) locations, shall be permitted to be used.

4.4.2 Division 2.

4.4.2.1 Group E. Power-operated industrial trucks designated as Type DX or EX, when approved for use in the hazardous (classified) location, and power-operated industrial trucks

Table 4.2(a) Division Summary Table on Use of Powered Industrial Trucks

Locations*	CGH Powered Trucks	CNG- Powered Trucks		Diesel-Powered Trucks				Electrically Powered Trucks				Gasoline- Powered Trucks		LP-Gas- Powered Trucks		Dual Fuel-Powered Trucks				Text Ref.
	CGH	CN	CNS	D	DS	DY	DX	E	ES	EE	EX	G	GS	LP	LPS	G/ CN	GS/ CNS	G/ LP	GS/ LPS	
<i>Class I,</i> <i>Division 1</i>																				
Group A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3.1.1
Group B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3.1.1
Group C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.3.1.1
Group D	NA	NA	NA	NA	NA	NA	A	NA	NA	NA	A	NA	NA	NA	NA	NA	NA	NA	NA	4.3.1.2
<i>Class I,</i> <i>Division 2</i>																				
Group A	NA	NA	NA	NA	NA	K	K	NA	NA	K	K	NA	NA	NA	NA	NA	NA	NA	NA	4.3.2.1
Group B	NA	NA	K	NA	K	K	K	NA	K	K	K	NA	K	NA	K	NA	K	NA	K	4.3.2.2
Group C	NA	NA	K	NA	K	K	K	NA	K	K	K	NA	K	NA	K	NA	K	NA	K	4.3.2.2
Group D	NA	NA	J	NA	J	A	A	NA	J	A	A	NA	J	NA	J	NA	J	NA	J	4.3.2.3
<i>Class II,</i> <i>Division 1</i>																				
Group E	NA	NA	NA	NA	NA	NA	J	NA	NA	NA	J	NA	NA	NA	NA	NA	NA	NA	NA	4.4.1.1
Group F	NA	NA	NA	NA	NA	NA	A	NA	NA	NA	A	NA	NA	NA	NA	NA	NA	NA	NA	4.4.1.2
Group G	NA	NA	NA	NA	NA	NA	A	NA	NA	NA	A	NA	NA	NA	NA	NA	NA	NA	NA	4.4.1.2
<i>Class II,</i> <i>Division 2</i>																				
Group E	NA	NA	NA	NA	NA	NA	J	NA	NA	NA	J	NA	NA	NA	NA	NA	NA	NA	NA	4.4.2.1
Group F	NA	NA	J	NA	J	A	A	NA	J	A	A	NA	J	NA	J	NA	J	NA	J	4.4.2.2
Group G	NA	NA	J	NA	J	A	A	NA	J	A	A	NA	J	NA	J	NA	J	NA	J	4.4.2.2
<i>Class III,</i> <i>Division 1</i>																				
Group E	NA	NA	J	NA	J	A	A	NA	J	A	A	NA	J	NA	J	NA	J	NA	J	4.5.1
<i>Class III,</i> <i>Division 2</i>																				
Group E	J	NA	A	NA	A	A	A	J	A	A	A	NA	A	NA	A	NA	A	NA	A	4.5.2
<i>Unclassified</i> <i>(Ordinary)</i>	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	4.1.1

Notes:

(1) A = Type truck authorized for location described.

(2) J = Type truck authorized for location described with approval of the authority having jurisdiction.

(3) K = Type truck authorized to be determined by the authority having jurisdiction.

(4) NA = Type truck not authorized in location described unless listed or approved as being suitable for use in the hazardous (classified) location.

*The references to class, division, and group in the headings in 4.3.1.1 through 4.5.2 correspond to classifications that are in accordance with NFPA 70 and are provided for the convenience of the user.

listed as being suitable for use in the hazardous (classified) locations, shall be permitted to be used.

4.4.2.2 Groups F and G. Power-operated industrial trucks designated as Type CNS, DS, ES, GS, LPS, GS/CNS, or GS/LPS, when approved for use in the hazardous (classified) location, power-operated industrial trucks designated as Type DY, DX, EE, or EX, and power-operated industrial trucks listed as being suitable for use in the hazardous (classified) locations, shall be permitted to be used.

4.5 Class III Areas.

4.5.1 Division 1. Power-operated industrial trucks designated as Type DX or EX, when approved for use in the hazardous (classified) location, power-operated industrial trucks designated as Type DY, DX, EE, or EX, and power-operated industrial trucks listed as being suitable for use in the hazardous (classified) locations, shall be permitted to be used.

4.5.2 Division 2. Power-operated industrial trucks designated as Type E, when approved for use in the hazardous (classified)

location, power-operated industrial trucks designated as Type CNS, DS, DY, DX, ES, EE, EX, GS, LPS, GS/CNS, or GS/LPS, and power-operated industrial trucks listed as being suitable for use in the hazardous (classified) location, shall be permitted to be used.

4.6 Class I, Zone Areas.

4.6.1 Class I, Zone 1.

4.6.1.1 Groups IIC and IIB. Power-operated industrial trucks shall not be permitted to be used in Class I, Zone 1, Group IIC, or IIB locations, unless listed or approved as being suitable for use in the hazardous (classified) locations.

4.6.1.2 Group IIA. Power-operated industrial trucks designated as Type DX or EX, and power-operated industrial trucks suitable for use in the hazardous (classified) location, shall be permitted to be used.

Table 4.2(b) Zone Summary Table on Use of Powered Industrial Trucks

Locations*	CGH Powered Trucks	CNG- Powered Trucks		Diesel-Powered Trucks				Electrically Powered Trucks				Gasoline- Powered Trucks		LP-Gas- Powered Trucks		Dual Fuel-Powered Trucks				Text Ref.
	CGH	CN	CNS	D	DS	DY	DX	E	ES	EE	EX	G	GS	LP	LPS	G/ CN	GS/ CNS	G/ LP	GS/ LPS	
<i>Class I, Zone 1</i>																				
Group IIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6.1.1
Group IIB	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.6.1.1
Group IIA	NA	NA	NA	NA	NA	NA	A	NA	NA	NA	A	NA	NA	NA	NA	NA	NA	NA	NA	4.6.1.2
<i>Class I, Zone 2</i>																				
Group IIC	NA	NA	NA	NA	NA	K	K	NA	NA	K	K	NA	NA	NA	NA	NA	NA	NA	NA	4.6.2.1
Group IIB	NA	NA	K	NA	K	K	K	NA	K	K	K	NA	K	NA	K	NA	K	NA	K	4.6.2.1
Group IIA	NA	NA	J	NA	J	A	A	NA	J	A	A	NA	J	NA	J	NA	J	NA	J	4.6.2.2
<i>Unclassified</i>	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	4.1.1

Notes:

(1) A = Type truck authorized for location described.

(2) J = Type truck authorized for location described with approval of the authority having jurisdiction.

(3) K = Type truck authorized to be determined by the authority having jurisdiction.

(4) NA = Type truck not authorized in location described unless listed or approved as being suitable for use in the hazardous (classified) location.

*The references to zone, and group in the headings in 4.3.1.1 through 4.5.2 correspond to classifications that are in accordance with *NFPA 70* and are provided for the convenience of the user.**4.6.2 Class I, Zone 2.**

4.6.2.1 Group IIC and IIB. Power-operated industrial trucks designated as Type CNS, DS, DY, DX, ES, EE, EX, GS, LPS, GS/CNS, or GS/LPS, when approved for use in the hazardous (classified) location, and power-operated industrial trucks suitable for the hazardous (classified) location, shall be permitted to be used.

4.6.2.2 Group IIA. Power-operated industrial trucks designated as Type CNS, DS, ES, GS, LPS, GS/CNS, or GS/LPS, when approved for use in the hazardous (classified) location; power-operated industrial trucks designated as Type DY, DX, EE, or EX; and power-operated industrial trucks suitable for use in the hazardous (classified) locations, shall be permitted to be used.

Chapter 5 Other Locations

5.1 Storage of Flammable Liquids in Sealed Containers or Liquefied or Compressed Flammable Gases in Containers. In locations used for the storage of flammable liquids in sealed containers, or liquefied or compressed flammable gases in containers, approved power-operated industrial trucks designated as Type CNS, Type DS, Type ES, Type GS, Type LPS, or Type GS/CNS, and Type GS/LPS, Type DX, Type DY, Type EE, and Type EX shall be permitted to be used.

5.2 Areas Presenting Potential Hazards Not Addressed in Chapter 4. The authority having jurisdiction shall determine which types of approved power-operated industrial trucks shall be used following an engineering survey of the property and an evaluation of the fire and explosion hazards.

5.3 Piers and Wharves. Where it is determined that the location on piers and wharves used for handling general cargo is not hazardous, approved power-operated industrial trucks designated as Type CGH, Type CN, Type D, Type E, Type G, Type LP, Type G/CN, or Type G/LP, or trucks that conform to the requirements for these types, shall be permitted to be used.

5.4 General Inside and Outside Storage. Where it is determined that the location for general storage in warehouses or general outside storage is not hazardous, any power-operated industrial truck designated as Type CGH, Type CN, Type D, Type E, Type G, Type LP, Type G/CN, or Type G/LP shall be permitted to be used, or trucks that conform to the requirements for the specified types shall be permitted to be used.

5.5 General Industrial or Commercial Properties. Where it is determined that the location on a general industrial or commercial property used for handling and/or processing materials (with storage being incidental to handling and processing) is not hazardous, any approved power-operated industrial truck designated as Type CGH, Type CN, Type D, Type E, Type G, Type LP, Type G/CN, or Type G/LP shall be permitted to be used, or trucks that conform to the requirements for the specified types shall be permitted to be used.

Chapter 6 Dual-Fuel Trucks

6.1 General. A dual-fuel truck shall be a truck that is **equipped** to be operated using either gasoline or LP-Gas or to be operated using either gasoline or CNG without further modification.

6.2 Requirements.

6.2.1 Fuel system parts that come into contact with gasoline shall meet the requirements for liquid fuel in ANSI/UL 558.

6.2.2 Fuel system parts that come into contact with CNG fuel shall meet the requirements for CNG fuel in NFPA 52.

6.2.3 Fuel system parts that come into contact with LPG fuel shall meet the requirements for LPG fuel in ANSI/UL 558.

6.2.4 Fuel system parts that come into contact with gasoline and LPG fuel or with gasoline and CNG fuel shall be compatible with both fuels.

Chapter 7 Conversion of Trucks

7.1* Truck Conversion Requirements.

7.1.1 Power-operated industrial trucks for ordinary (nonhazardous) locations shall be permitted to be converted to an alternative fuel and/or power system in accordance with the requirements in Chapter 6.

7.1.2 A truck designated as Type E, Type ES, or Type EE that is converted to another of those designations shall conform to the requirements for the new designation in accordance with ANSI/UL 583.

7.1.3 A truck designated as Type G, Type LP, or Type G/LP that is converted to another of those designations shall conform to the requirements for the new designation in accordance with ANSI/UL 558.

7.1.4 A truck conversion that impacts the stability or the center of gravity of the truck shall be in accordance with the requirements of ANSI/ITSDF B56.1 or the original equipment manufacturer.

7.1.5 The conversion of trucks approved for, or that conform to the requirements for, hazardous locations shall be in accordance with the requirements of ANSI/UL 558 or ANSI/UL 583 and shall be certified by a nationally recognized testing laboratory (NRTL).

7.2 Conversion Kit Requirements.

7.2.1 Conversion kits for use on trucks designated as Type CN, Type G, Type LP, Type G/CN, or Type G/LP shall conform to the requirements for the type designation in accordance with ANSI/UL 558.

7.2.2 Conversion kits for converting a Type E truck to a fuel cell-powered electric industrial truck shall conform to the applicable requirements of ANSI/UL 583 and ANSI/UL 2267.

7.2.3 The conversion kit shall include the items specified in 7.2.8.

7.2.4 The installation of the kit shall be in accordance with 7.2.8.

7.2.5 A copy of the listing report shall be supplied to the authority having jurisdiction upon request.

7.2.6 Conversion kits shall be approved by a testing laboratory.

7.2.7 When a conversion kit is installed, all original identification of approval or listing and type designation shall not be removed, and the plate specified in 7.2.8(3) shall be installed.

7.2.8* Conversion kits shall comply with 7.1.4 and include the following:

- (1) Step-by-step installation instructions with illustrations, including deactivation and removal of existing components and the tests or checks required prior to returning the truck to service
- (2) All parts necessary to complete the installation
- (3) A durable, corrosion-resistant plate, indicating the converted type designation of the truck, for permanent mounting adjacent to the manufacturer's nameplate on the truck
- (4) A durable, corrosion-resistant nameplate attached to the LPG-tank mounting that identifies the fuel container

assembly to be used in situations where the conversion is to LPG and a removable fuel tank is to be used

- (5) A durable, corrosion-resistant nameplate attached to the CGH module compliant to the marking requirements of ANSI/UL 2267 where the conversion is to CGH and a removable CGH module is used

7.2.9 Reserved.

Chapter 8 Maintenance of Industrial Trucks

8.1 General.

8.1.1 The fire safety built into power-operated industrial trucks shall be maintained in accordance with the instructions and training material provided by the manufacturer.

8.1.2 Any power-operated industrial truck that is not in safe operating condition shall be removed from service.

8.2 Precautions.

8.2.1 Repairs shall not be made in Class I, Class II, and Class III locations.

8.2.2 Repairs to the fuel and ignition systems of industrial trucks that involve fire hazards shall be conducted only in locations designated for such repairs.

8.2.3 Repairs to the electrical system of battery-powered industrial trucks shall be performed only after the battery has been disconnected.

8.3* Replacement Parts. All parts of any industrial truck that need replacement shall be replaced only with parts that provide the same degree of fire safety as those used in the original design.

8.4 Mufflers.

8.4.1 Water mufflers shall be filled and maintained to prevent depletion of the supply of water below 75 percent of filled capacity.

8.4.2 Vehicles with mufflers having screens or other parts that can become clogged shall not be operated while such screens or parts are clogged.

8.4.3 Any vehicle that emits hazardous sparks or flames from the exhaust system shall be removed from service immediately and shall not be returned to service until the cause for the emission of such sparks and flames has been eliminated.

8.5 Operating Temperature. Where the temperature of any part of any truck is found to be in excess of its normal operating temperature and creates a hazardous condition, the vehicle shall be removed from service and shall not be returned to service until the cause for such overheating has been eliminated.

8.6 Fire Prevention.

8.6.1 Industrial trucks shall be kept clean and reasonably free of lint, excess oil, and grease.

8.6.2 Noncombustible agents shall be used for cleaning trucks.

8.6.3 Flammable liquids [those having flash points below 100°F (37.8°C)] shall not be used.

8.6.4 Combustible liquids [those having flash points at or above 100°F (37.8°C)] shall be permitted to be used.

8.6.5 Precautions regarding toxicity, ventilation, and fire hazard shall be appropriate for the agent or solvent used.

8.7 Antifreeze. Where antifreeze is used in the engine-cooling system, only glycol-based material shall be used.

8.8 Nameplate Visibility. The truck type designations (*see* 3.3.2), as shown on the nameplate and the type marker (*see* 9.5.1), shall not be obscured.

Chapter 9 Fuel Recharging, Marking, and Operation of Industrial Trucks

9.1 Fuel Handling and Storage.

9.1.1 Liquid Fuels.

9.1.1.1 The storage and handling of liquid fuels shall be in accordance with NFPA 30 or NFPA 30A, as applicable.

9.1.1.2* Trucks using liquid fuels shall be refueled only at locations designated for such purpose and shall be refueled from approved dispensing pumps.

9.1.1.3 The engine shall be stopped and the operator shall not be on or inside the truck during refueling.

9.1.1.4 Emergency refueling shall be from approved safety cans. Safety cans shall be inspected regularly for leaks and for damage to closures.

9.1.1.5 Faulty cans shall be replaced.

9.1.1.6 Smoking or open flames shall be prohibited in the refueling area.

9.1.2 Liquefied Petroleum Gas Fuel.

9.1.2.1 The storage and handling of liquefied petroleum gas (LP-Gas) shall be in accordance with NFPA 58.

9.1.2.2 Fuel containers that are permanently mounted on trucks and removable U.S. Department of Transportation (DOT)-type LP-Gas containers shall be filled at locations designated for such purpose and in accordance with NFPA 58.

9.1.2.3 LP-Gas containers shall not be dropped, thrown, rolled, or dragged.

9.1.2.4 LP-Gas containers shall not be overfilled.

9.1.2.5 The engine shall be stopped and the operator shall not be on or inside the truck during refueling.

9.1.2.6 Trained and designated personnel shall refill or exchange LP-Gas containers.

9.1.2.7 A soap solution shall be used to check for leaks.

9.1.2.7.1 A match or open flame shall not be used.

9.1.2.8 Removable LP-Gas containers shall not be exchanged near, and LP-Gas-powered vehicles shall not be parked near, sources of heat or open flame or similar sources of ignition or near open pits, underground entrances, elevator shafts, or other similar areas unless ventilated in accordance with NFPA 30.

9.1.2.9 Refueling of trucks with permanently mounted LP-Gas containers shall be done in accordance with NFPA 58.

9.1.2.10 Refueling of trucks with exchangeable or removable LP-Gas cylinders shall have the LP-Gas cylinder removed prior to refueling. Refueling shall be done in accordance with NFPA 58.

9.1.2.11 Removable LP-Gas containers shall be mounted securely to prevent them from jarring loose, slipping, or rotating and shall be positioned so that the safety pressure relief valve opening is always in contact with the vapor space (top) of the container.

9.1.2.11.1 Proper mounting shall be accomplished by using a positioning pin that engages the cylinder, or an equivalent means, and a container clamp(s) that positions the container where the container is properly installed.

9.1.2.11.2 A container and its fittings shall not extend beyond the plan form of the industrial truck.

9.1.2.12 All reserve LP-Gas containers shall be stored and transported with the service valve closed. Safety relief valves shall have direct communication with the vapor space of the container at all times.

9.1.2.13 All LP-Gas containers shall be examined before refilling for the following defects or damage:

- (1) Dents, scrapes, and gouges of the pressure vessel
- (2) Damage to the various valves and liquid level gauge
- (3) Debris in the relief valve
- (4) Damage to or loss of the relief valve cap
- (5) Indications of leakage at the valves or threaded connections
- (6) Deterioration, damage, or loss of flexible seals in the filling or servicing connections

9.1.2.13.1 Where examination reveals physical damage, such as dents, scrapes, or gouges [*see* 9.1.2.13(1)], that materially weaken the structure of the LP-Gas container and render it unsafe for use, it shall be removed from service.

9.1.2.13.2 Where examination reveals damage as specified in 9.1.2.13(2) through 9.1.2.13(6), other than physical damage to the container, appropriate repairs shall be made before the container is refilled.

9.1.2.14 Smoking shall be prohibited in the container refilling area for either portable or permanently mounted containers and in the exchange area during the exchange of LP-Gas containers.

9.1.2.15 The service valve of the fuel container shall be closed whenever vehicles are parked overnight or stored indoors for a protracted time.

9.1.3 Compressed Natural Gas and Gaseous Hydrogen Fuel.

9.1.3.1 The compression, storage, handling, and dispensing of compressed natural gas (CNG) shall be located and conducted in accordance with NFPA 52.

9.1.3.2 The compression, storage, handling, and dispensing of compressed hydrogen gas (CGH) shall be located and conducted in accordance with NFPA 2.

9.1.3.3 While refueling CNG, the engine shall be stopped and the operator shall not be in the normal operating position.

9.1.3.4 While refueling CGH, the operator shall not be in the normal operating position.

9.1.3.5 Smoking and open flames shall be prohibited in the refueling area.

9.1.3.6 Each fuel supply container shall be mounted in a location that minimizes damage from collision.

9.1.3.6.1 A container and its fittings shall not extend beyond the plan form of the industrial truck.

9.1.3.6.2 Containers, valves, and hose and fittings shall be protected from physical damage using the vehicle structure, valve protectors, or suitable guards in accordance with NFPA 52 for Type CNG trucks and NFPA 2 for Type CGH trucks.

9.1.3.7 The refueling receptacle on a truck shall be supported firmly and shall incorporate a means to prevent the entry of dust, water, and other foreign material.

9.1.3.7.1 Where the means of protection used seals the system pressure, the system shall be capable of being depressurized before removal.

9.1.3.8 The transfer of CNG or CGH into the fuel supply container of a truck shall be performed by a person who has performed the transfer operation for at least three full cycles under supervision and who has competence in initiating emergency procedures.

9.1.3.8.1 The individual shall be responsible for verifying the working pressure and for ensuring that the container is retested according to the required schedule.

9.1.3.9 A match or open flame shall not be used to check for leaks in CNG or CGH fuel systems.

9.1.3.10 Containers and their appurtenances, piping systems, compression equipment, controls, devices, and pressure relief valves shall be maintained in proper operating condition.

9.1.3.10.1 Pressure relief devices shall be maintained in operating condition.

9.1.3.10.2* Pressure relief devices shall not be plugged.

9.1.3.10.3 Only qualified personnel shall be permitted to service pressure relief devices.

9.1.3.10.4 Only assemblies or original manufacturer's parts shall be used in the repair of pressure relief devices.

9.1.3.10.5 Assemblies or parts that have been proved by suitable testing shall be permitted to be used in the repair of pressure relief devices.

9.1.3.11 CNG-powered or CGH fuel cell system-powered trucks shall not be parked near sources of heat or open flame or similar sources of ignition.

9.1.3.12 For Type CNG trucks, the service valve of the fuel container shall be closed whenever vehicles are parked overnight or stored indoors for a protracted time.

9.2 Dual Fuel.

9.2.1* Where operating a dual-fuel truck on CNG or LP-Gas, the gasoline level in the liquid fuel tank shall be checked daily.

9.2.1.1 The truck shall not be operated unless the gasoline fuel tank is at least one-quarter full.

9.2.2 Where operating a dual-fuel truck on CNG fuel, the provisions of 9.1.3 shall apply.

9.2.3 Where operating a dual-fuel truck on LP-Gas, the provisions of 9.1.2 shall apply.

9.2.4 Where operating a dual-fuel truck on liquid fuels, the provisions of 9.1.1 shall apply.

9.3 Changing and Charging Storage Batteries.

9.3.1* Section 9.3 shall apply to batteries used on electric trucks.

9.3.2 Battery-charging installations shall be located in areas designated for such purpose. The areas shall be kept free of extraneous combustible materials.

9.3.2.1 Facilities shall be provided for the following:

- (1) Flushing spilled electrolyte
- (2) Fire protection
- (3) Protection of charging apparatus against damage by trucks
- (4) Adequate ventilation for dispersal of fumes from gassing batteries

9.3.2.2 Where onboard chargers are used, charging shall be accomplished at locations designated for such purpose, taking into account the electrical requirements of the charger and facilities for fire protection.

9.3.2.3 Flushing facilities shall not be required if charging is accomplished without removing the battery from the vehicle.

9.3.3 Where handling acid concentrates that contain greater than 50 percent acid (above 1.400 specific gravity), an eyewash fountain shall be provided.

9.3.4 A conveyor, an overhead hoist, or equivalent material-handling equipment shall be provided for handling batteries.

9.3.5 Chain hoists shall be equipped with load-chain containers.

9.3.5.1 Where a hand hoist is used, uncovered batteries shall be covered with a sheet of plywood or other nonconducting material to prevent the hand chain from shorting on cell connectors or terminals.

9.3.5.2 A properly insulated spreader bar shall be used with any overhead hoist.

9.3.6 Reinstalled batteries or new batteries shall be equivalent to or shall be rated higher than the battery type marked on the truck. Reinstalled batteries shall be positioned properly and secured in the truck.

9.3.7 A carboy tilter or siphon shall be provided where acid in carboys is used.

9.3.7.1 Where concentrated sulfuric acid is diluted to make up electrolyte, the acid shall always be added to the water.

9.3.7.2 Water shall never be added to acid.

9.3.7.3 Battery maintenance personnel shall wear protective clothing such as eye protection, long sleeves, and gloves.

9.3.7.4 Removal and replacement of batteries shall not require the use of protective clothing.

9.3.8 Electric installations shall be in accordance with *NFPA 70* and any local ordinances.

9.3.9 Trained and authorized personnel shall change or charge batteries.

9.3.10 Trucks shall be positioned properly and brakes shall be applied before personnel attempt to change or charge batteries.

9.3.11 When batteries are being charged, the vent caps shall be kept in place to avoid electrolyte spray.

9.3.11.1 Care shall be taken to ensure that vent caps are functioning.

9.3.11.2 The battery or compartment cover(s) shall be open to dissipate heat and gas.

9.3.12 Smoking shall be prohibited in the charging area.

9.3.13 Precautions shall be taken to prevent open flames, sparks, or electric arcs in battery-charging areas.

9.3.14 Tools and other metal objects shall be kept away from the tops of uncovered batteries.

9.4 Changing Type CGH Battery Replacement Modules.

9.4.1 Section 9.4 shall apply to fuel cell system modules used to replace batteries in Type E trucks and replaceable fuel cell system modules in Type CGH trucks.

9.4.2 Chain hoists shall be equipped with load-chain containers.

9.4.2.1 A properly constructed spreader bar or other appropriate lifting device shall be used with an overhead hoist.

9.4.2.2 Spreader bars shall be insulated where exposed electrical connections can contact the lifting device.

9.4.3 Reinstalled Type CGH modules shall comply with the requirements of 7.1.4.

9.4.4 Removal or replacement of batteries or other stored energy devices on Type CGH modules shall not require the use of protective clothing.

9.4.5 Trained and authorized personnel shall change Type CGH modules.

9.4.6 Smoking shall be prohibited in the Type CGH area.

9.4.7 Precautions shall be taken to prevent open flames, sparks, or electric arcs in the area.

9.5 Marking and Labeling.

9.5.1 Types CNS, DS, DY, DX, ES, EE, EX, GS, LPS, GS/CNS, and GS/LPS Industrial Trucks.

9.5.1.1 Proper equipment shall be used in classified areas for the safety and protection of employees and property.

9.5.1.1.1 Approved trucks that are listed by a testing laboratory for use in such areas shall be clearly identified.

9.5.1.1.2 To facilitate identification by operators and supervisory personnel, a uniform system of marking as described in 9.5.1.2 and 9.5.2.1 shall be used.

9.5.1.2 Durable markers indicating the type designation of trucks used in classified areas shall be applied to each side of the vehicle in a visible but protected location.

9.5.1.2.1 The markers shall be distinctive in shape as shown in Figure 9.5.1.2.1.

9.5.1.2.2 The markers for Types LPS, GS, DS, ES, CNS, GS/LPS, and GS/CNS shall be 4 in. (102 mm) squares.

9.5.1.2.3 The width of markers for other type designations shall be 5 in. (127 mm).

9.5.1.2.4 The markers shall consist of black borders and lettering on a yellow background.

9.5.2 Marking Areas of Use.

9.5.2.1 Entrances to classified areas where industrial trucks are to be used shall be posted with durable markers as shown in Figure 9.5.2.1.

9.5.2.2 The minimum width of the sign shall be 11 in. (279 mm).

9.5.2.3 The minimum height of the sign shall be 16 in. (406 mm).

9.5.2.4 The word “Caution” shall be printed on the sign in yellow letters on a black background.

9.5.2.5 The body of the sign shall consist of black letters on a yellow background.

9.5.2.6 A marker(s) identical to that used on the side of the truck shall be installed on the sign. (See Figure 9.5.1.2.1.)

9.6 Safe Operating Rules.

9.6.1 Powered industrial truck operation shall be in accordance with applicable sections of ANSI/ITSDF B56.1.

9.6.2 Prior to each shift of operations, the operator of an industrial truck shall perform an inspection for safe operation, including a visual check of the general condition of the truck and a check for the presence of easily ignited combustible materials such as accumulated debris and oily rags.

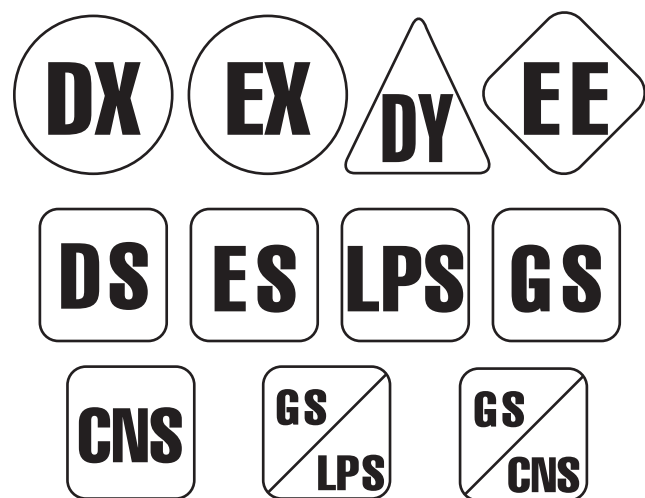


FIGURE 9.5.1.2.1 Markers Used to Identify Types of Industrial Trucks.

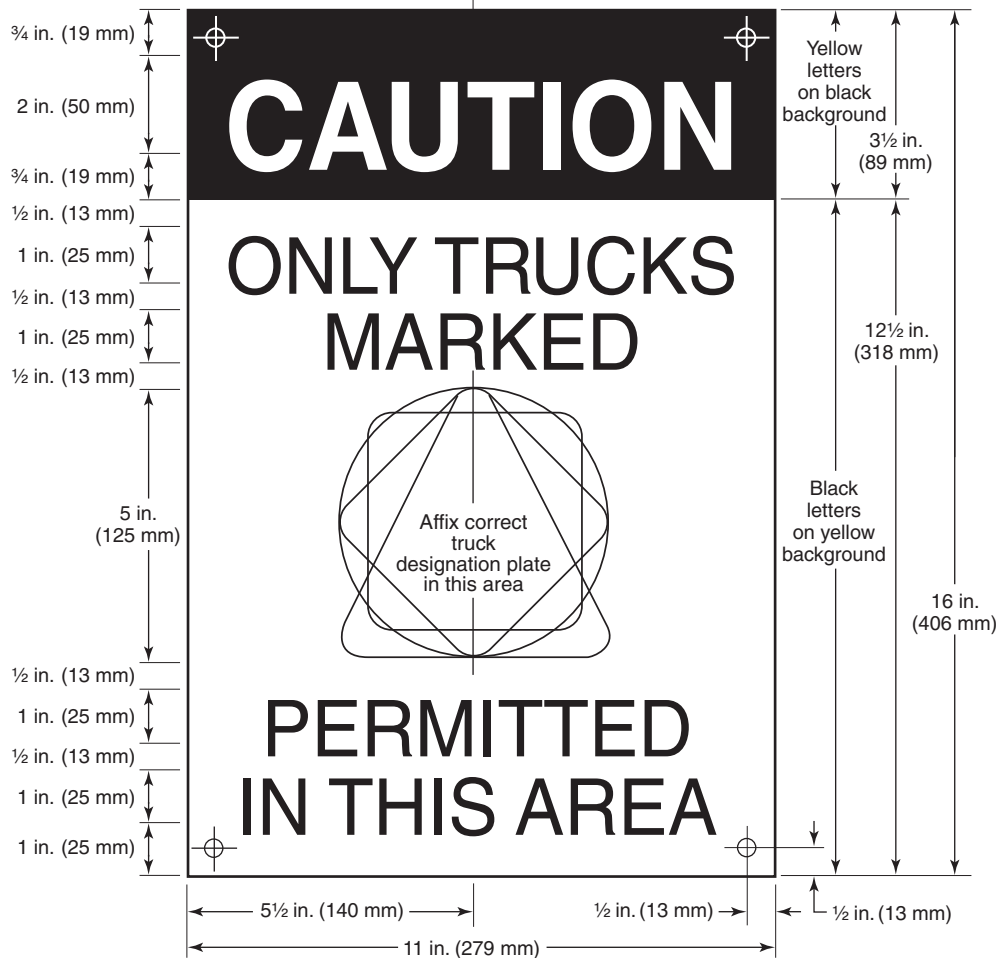


FIGURE 9.5.2.1 Building Sign for Posting at Entrance to Hazardous Areas.

9.7 Operating Procedures and Training.

9.7.1 There shall be a written operating procedure plan and operator training relevant to the location of use and type of truck.

9.7.2 The procedure shall include, as a minimum, the following:

- (1) Operation limited to trained personnel
- (2) Cautions where checking or filling tank
- (3) Action for suspected leak
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- (6) Hazardous location classifications and markings
- (7) Industrial truck designations and markings

Chapter 10 Portable Fire Extinguishers

10.1* General Requirements.

10.1.1 Where the authority having jurisdiction or end user requires an industrial truck to be equipped with a portable

extinguisher, the location of the extinguisher on the truck shall be in accordance with the truck manufacturer's recommendations.

10.1.2 Industrial trucks shall be equipped with portable extinguishers only if truck operators have been trained in the safe operation and use of portable extinguishers.

10.1.3 The type of extinguisher used on a truck shall be in accordance with the hazard classification guidance provided in NFPA 10.

10.2 Maintenance.

10.2.1 Extinguishers shall be maintained in accordance with NFPA 10, and records shall be kept in accordance with such requirements.

10.2.2 Recharging procedures shall follow the requirements of NFPA 10.

10.2.3 Extinguishers that are out of service for maintenance or recharge shall be replaced with extinguishers that have the same agent, rating, and operating procedure.

10.3 Hydrostatic Testing. Extinguisher shells and appurtenant devices, such as nozzles, hose, and pressure cartridges, shall be hydrostatically tested in accordance with NFPA 10.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.4.2 NFPA 70 defines suitability in 500.8(A).

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase “authority having jurisdiction,” or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.2 Type Designation. Specific standards that cover the types of industrial trucks defined in Section 3.3 have been published by Underwriters Laboratories Inc. and are identified as ANSI/UL 558 and ANSI/UL 583. ANSI/UL 558 covers Types D, DS, DY, G, GS, LP, LPS, G/LP, and GS/LPS; ANSI/UL 583 covers Types CGH, E, EE, ES, and EX.

Standards for Types CN, CNS, G/CN, and GS/CNS trucks are not in published form; however, information regarding the requirements for these type designations is available from Underwriters Laboratories Inc.

The examination of powered industrial trucks by Underwriters Laboratories Inc. relates to fire hazards only for Types D, DS, DY, G, GS, LP, LPS, G/LP, and GS/LPS industrial trucks that are powered by internal combustion engines; to fire and electrical shock hazards only for Types CGH, E, ES, and EE battery-powered industrial trucks; and to fire, electric shock, and explosion hazards for Type EX trucks that are suitable for use in Class I, Group D, or Class II, Group G, hazardous locations. Trucks that have been examined and classified as meet-

ing the respective Underwriters Laboratories standards for Type EX trucks can be found in the UL *Hazardous Locations Equipment Directory*. Other trucks that have been examined and classified as meeting the respective Underwriters Laboratories standards for a particular area of use are identified in the UL Online Certification Directory at <http://www.ul.com/database>.

A.3.3.2.6 Type Designation DX. Such units are specifically tested and classified for use in Class I, Group D locations or for Class II, Group F or Group G locations as defined in NFPA 70.

A.3.3.2.11 Type Designation EX. Such units are specifically tested and classified for use in Class I, Group D locations or for Class II, Group F or Group G locations as defined in NFPA 70.

A.4.3 NFPA 51B and NFPA 30 provide for dealing with special conditions, such as that which may be required for an infrequent or temporary condition in which equipment not otherwise suitable can be used in a hazardous (classified) location when that hazardous (classified) location is tested initially and routinely monitored and found to be free of concentrations of flammable gases, vapors, combustible gases, combustible liquids, or combustible dusts. This action is accomplished under an administrative control, such as a safe/hot/work permit, subject to approval by the authority having jurisdiction.

A.4.4.1.1 Approval for use in Class II, Division 1, Group E locations should consider specifically approved enclosures for truck fuses, switches, motor controllers, and circuit breakers.

A.7.1 Section 7.1 provides that responsibility for the acceptance of an industrial truck that has been converted rests entirely with the inspection authority having jurisdiction. The responsibility for determining whether a truck has been properly converted is that of the authority having jurisdiction because it is impractical to ship each converted truck back to the testing laboratory to be reexamined or retested. It is also impractical for the laboratory to send a representative into the field to examine or test every converted truck.

Authorities having jurisdiction are not always expert in recognizing the criteria that constitute a proper conversion. Installation directions furnished with conversion equipment, “Listed by Report,” specify in detail how to perform the conversion so that it meets the requirements of NFPA 58 for trucks using liquefied petroleum gas, NFPA 52 for trucks using compressed natural gas, and NFPA 2 for trucks using compressed hydrogen gas. The detailed instructions supply the authority having jurisdiction with the necessary information to determine whether a truck has been properly converted.

A.7.2.8 The conversion of vehicles should consider the functional components such as gasoline tanks, mounting brackets for new hardware, wires, hose, fittings, and sealant. The instructions should also detail the safe deactivation of components.

A.8.3 The requirement of Section 8.3 applies particularly to trucks approved for use in hazardous (classified) locations. Industrial trucks equipped with “white” non-marking, or non-marring, tires can generate static electrical charges, which can pose an ignition hazard when used in hazardous (classified) locations.

A.9.1.1.2 Safe outdoor locations for refueling are recommended over indoor locations. NFPA 30 includes requirements for arranging indoor fueling facilities. NFPA 30A includes requirements for arranging outdoor fueling facilities.

Spillage of fuel or overfilling of the vehicle fuel tank should be avoided.

A.9.1.3.10.2 Care should be exercised to avoid plugging caused by paint or other dirt accumulation in pressure relief device channels or other parts of the container that can interfere with the functioning of the device.

A.9.2.1 The liquid fuel tank is required to be at least one-quarter full of gasoline at all times to provide a sufficient quantity of liquid fuel to maintain a vapor saturation in the tank above the normally explosive level. The quantity of fuel in the tank can be determined using the fuel gauge provided on the vehicle.

A.9.3.1 The two types of batteries commonly used are lead and nickel-iron. They contain corrosive chemical solutions, either acid or alkali, and, therefore, present a chemical hazard. While being charged, they give off hydrogen and oxygen, which, in certain concentrations, are explosive.

A.10.1 Situations exist where portable extinguishers, mounted safely and accessibly on industrial trucks, are recommended or required by local or state agencies or the end user. However, it should be noted that it is possible to encounter opposition to the provision of an extinguisher on an industrial truck. Opposition can be associated with factors such as operator training issues, size and rating of the extinguisher, access and visibility of the extinguisher(s) on the truck, and protection from damage to the extinguisher itself (mounting).

Space allowance for only small extinguishers (1-A:10-B:C) can provide a false sense of security, because such extinguishers have limited capability. NFPA 10 does not provide specific guidance for the installation of portable extinguishers for all industrial trucks specified in the scope of NFPA 505.

Annex B Definitions for Locations for Electrical Installations

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

Δ B.1 Electrical Hazard Locations. The following terms are defined in *NFPA 70* (2017 edition) for hazardous area (users are advised to refer to the current edition of *NFPA 70*):

Class I Locations. Class I locations are those in which flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I locations shall include those specified in B.1(1) and B.1(2). [70:500.5(B)]

(1) Class I, Division 1. A Class I, Division 1 location is a location

(a) In which ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors can exist under normal operating conditions, or

(b) In which ignitable concentrations of such flammable gases or flammable liquid-produced vapors or combustible liquids above their flash points may exist frequently because of repair or maintenance operations or because of leakage, or

(c) In which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors and might also cause simultaneous failure of electrical equipment in such a way as to directly cause the electrical equipment to become a source of ignition. [70:500.5(B)(1)]

(2) Class I, Division 2. A Class I, Division 2 location is a location

(a) In which volatile flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems or in case of abnormal operation of equipment, or

(b) In which ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operation of the ventilating equipment, or

(c) That is adjacent to a Class I, Division 1 location, and to which ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors above their flash points might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided. [70:500.5(B)(2)]

Class II Locations. Class II locations are those that are hazardous because of the presence of combustible dust. Class II locations shall include those specified in (3) and (4). [70:500.5(C)]

(3) Class II, Division 1. A Class II, Division 1 location is a location

(a) In which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures, or

(b) Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electrical equipment, through operation of protection devices, or from other causes, or

(c) In which Group E combustible dusts may be present in quantities sufficient to be hazardous. [70:500.5(C)(1)]

(4) Class II, Division 2. A Class II, Division 2 location is a location

(a) In which combustible dust due to abnormal operations may be present in the air in quantities sufficient to produce explosive or ignitable mixtures; or

(b) Where combustible dust accumulations are present but are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but could as a result of infrequent malfunctioning of handling or processing equipment become suspended in the air; or

(c) In which combustible dust accumulations on, in, or in the vicinity of the electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment, or could be ignitable by abnormal operation or failure of electrical equipment. [70:500.5(C)(2)]

Class III Locations. Class III locations are those that are hazardous because of the presence of easily ignitable fibers or where materials producing combustible flyings are handled, manufactured, or used, but in which such fibers/flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures. Class III locations shall include those specified in (5) and (6). [70:500.5(D)]

(5) Class III, Division 1. A Class III, Division 1 location is a location in which easily ignitable fibers/flyings are handled, manufactured, or used.

Informational Note No. 1: Such locations usually include some parts of rayon, cotton, and other textile mills; combustible fibers/flyings manufacturing and processing plants; cotton gins and cotton-seed mills; flax-processing plants; clothing manufacturing plants; woodworking plants; and establishments and industries involving similar hazardous processes or conditions.

Informational Note No. 2: Easily ignitable fibers/flyings include rayon, cotton (including cotton linters and cotton waste), sisal or henequen,istle, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, and other materials of similar nature. [70:500.5(D)(1)]

(6) Class III, Division 2. A Class III, Division 2 location is a location in which easily ignitable fibers/flyings are stored or handled other than in the process of manufacture. [70:500.5(D)(2)]

B.2 Material Groups. For purposes of testing, approval, and area classification, various air mixtures (not oxygen-enriched) shall be grouped in accordance with B.2.1 and B.2.2.

Exception: Equipment identified for a specific gas, vapor, or dust.

Informational Note: This grouping is based on the characteristics of the materials. Facilities are available for testing and identifying equipment for use in the various atmospheric groups. [70:500.6]

Unclassified Locations. Locations determined to be neither Class I, Division 1; Class I, Division 2; Class I, Zone 0; Class I, Zone 1; Class I, Zone 2; Class II, Division 1; Class II, Division 2; Class III, Division 1; Class III, Division 2; Zone 20; Zone 21; Zone 22; or any combination thereof. [70:500.2]

B.2.1 Class I Group Classifications. Class I groups shall be according to B.2.1(1) through B.2.1(4).

Informational Note No. 1: Informational Note Nos. 2 and 3 apply to B.2.1.

Informational Note No. 2: The explosion characteristics of air mixtures of gases or vapors vary with the specific material involved. For Class I locations, Groups A, B, C, and D, the classification involves determinations of maximum explosion pres-

sure and maximum safe clearance between parts of a clamped joint in an enclosure. It is necessary, therefore, that equipment be identified not only for class but also for the specific group of the gas or vapor that will be present.

Informational Note No. 3: Certain chemical atmospheres may have characteristics that require safeguards beyond those required for any of the Class I groups. Carbon disulfide is one of these chemicals because of its low ignition temperature (90°C) and the small joint clearance permitted to arrest its flame. [70:500.6(A)]

(1) Group A. Acetylene. [497:3.3.5.1.1]

(2) Group B. Flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value less than or equal to 0.45 mm or a minimum igniting current ratio (MIC ratio) less than or equal to 0.40. [497:3.3.5.1.2]

(3) Group C. Flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.45 mm and less than or equal to 0.75 mm, or a minimum igniting current ratio (MIC ratio) greater than 0.40 and less than or equal to 0.80. [497:3.3.5.1.3]

(4) Group D. Flammable gas, flammable liquid produced vapor, or combustible liquid produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.75 mm or a minimum igniting current ratio (MIC ratio) greater than 0.80. [497:3.3.5.1.4]

B.2.2 Class II Group Classifications. Class II groups shall be in accordance with B.2.2(1) through B.2.2(3). [70:500.6(B)]

(1) Group E. Atmospheres containing combustible metal dusts, including aluminum, magnesium, and their commercial alloys, or other combustible dusts whose particle size, abrasiveness, and conductivity present similar hazards in the use of electrical equipment. [499:3.3.4.1]

(2) Group F. Atmospheres containing combustible carbonaceous dusts that have more than 8 percent total entrapped volatiles (see ASTM D3175, *Standard Test Method for Volatile Matter in the Analysis Sample for Coal and Coke, for coal and coke dusts*) or that have been sensitized by other materials so that they present an explosion hazard. Coal, carbon black, charcoal, and coke dusts are examples of carbonaceous dusts. [499:3.3.4.2]

(3) Group G. Atmospheres containing combustible dusts not included in Group E or F, including flour, grain, wood, plastic, and chemicals. [70:500.6(B)(3)]

B.2.3 Class I, Zone 0, 1, and 2 Locations. Class I, Zone 0, 1, and 2 locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I, Zone 0, 1, and 2 locations shall include those specified in B.2.3(1), B.2.3(2), and B.2.3(3). [70:505.5(B)]

(1) Class I, Zone 0. A Class I, Zone 0 location is a location in which

(a) Ignitable concentrations of flammable gases or vapors are present continuously, or

(b) Ignitable concentrations of flammable gases or vapors are present for long periods of time. [70:505.5(B)(1)]

(2) **Class I, Zone 1.** A Class I, Zone 1 location is a location

(a) In which ignitable concentrations of flammable gases or vapors are likely to exist under normal operating conditions; or

(b) In which ignitable concentrations of flammable gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or

(c) In which equipment is operated or processes are carried on, of such a nature that equipment breakdown or faulty operations could result in the release of ignitable concentrations of flammable gases or vapors and also cause simultaneous failure of electrical equipment in a mode to cause the electrical equipment to become a source of ignition; or

(d) That is adjacent to a Class I, Zone 0 location from which ignitable concentrations of vapors could be communicated, unless communication is prevented by adequate positive pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided. [70:505.5(B)(2)]

(3) **Class I, Zone 2.** A Class I, Zone 2 location is a location

(a) In which ignitable concentrations of flammable gases or vapors are not likely to occur in normal operation and, if they do occur, will exist only for a short period; or

(b) In which volatile flammable liquids, flammable gases, or flammable vapors are handled, processed, or used but in which the liquids, gases, or vapors normally are confined within closed containers of closed systems from which they can escape only as a result of accidental rupture or breakdown of the containers or system, or as a result of the abnormal operation of the equipment with which the liquids or gases are handled, processed, or used; or

(c) In which ignitable concentrations of flammable gases or vapors normally are prevented by positive mechanical ventilation but which may become hazardous as a result of failure or abnormal operation of the ventilation equipment; or

(d) That is adjacent to a Class I, Zone 1 location, from which ignitable concentrations of flammable gases or vapors could be communicated, unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided. [70:505.5(B)(3)]

(4) Class I, Zone 0, 1, and 2, groups are as follows in (a) through (c): [70:505.6]

(a) **Group IIC.** Atmospheres containing acetylene, hydrogen, or flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value less than or equal to 0.50 mm or minimum igniting current ratio (MIC ratio) less than or equal to 0.45. [497:3.3.5.2.1]

Informational Note: Group IIC is equivalent to a combination of Class I, Group A, and Class I, Group B, as described in B.2.1(1) and B.2.1(2).

(b) **Group IIB.** Atmospheres containing acetaldehyde, ethylene, or flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor mixed with air that may burn or explode, having either maximum experimental safe gap (MESG) values greater than 0.50 mm and less than or equal to 0.90 mm or minimum igniting current ratio (MIC ratio) greater than 0.45 and less than or equal to 0.80. [497:3.3.5.2.2]

Informational Note: Group IIB is equivalent to Class I, Group C, as described in B.2.1(3).

(c) **Group IIA.** Atmospheres containing acetone, ammonia, ethyl alcohol, gasoline, methane, propane, or flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.90 mm or minimum igniting current ratio (MIC ratio) greater than 0.80. [497:3.3.5.2.3]

Informational Note: Group IIA is equivalent to Class I, Group D as described in B.2.1(4).

Annex C Informational References

C.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

C.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 2, *Hydrogen Technologies Code*, 2016 edition.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2017 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2015 edition.

NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*, 2015 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2014 edition.

NFPA 52, *Vehicular Natural Gas Fuel Systems Code*, 2016 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2017 edition.

NFPA 70®, *National Electrical Code®*, 2017 edition.

C.1.2 Other Publications.

C.1.2.1 ASTM Publication. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D3175, *Standard Test Method for Volatile Matter in the Analysis Sample of Coal and Coke*, 2011.

C.1.2.2 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 558, *Standard for Safety Industrial Trucks, Internal Combustion Engine-Powered*, 10th edition, 2012.

ANSI/UL 583, *Standard for Safety Electric-Battery-Powered Industrial Trucks*, 10th edition, 2012.

Hazardous Locations Equipment Directory, 2011.

C.2 Informational References. (Reserved)

C.3 References for Extracts in Informational Sections.

NFPA 70®, *National Electrical Code®*, 2017 edition.

NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2017 edition.

NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2017 edition.

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