

NFPA
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POWERED INDUSTRIAL TRUCKS 1978



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

NFPA 505 — 1978

1978 Edition of NFPA 505

This document was prepared by the Committee on Industrial Trucks and this present edition was adopted by the Association on May 18, 1978, at its Annual Meeting in Anaheim, California. It was released by the Standards Council for publication on June 6, 1978.

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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 3 and 4 (formerly Parts A and B) "Maintenance of Industrial Trucks" and "Operation of Industrial Trucks" were originally adopted in 1952 and published by the NFPA under the designation NFPA 505B and 505C, respectively. Revisions were made in 1955, 1957, 1963, 1965, 1966, 1967, 1968, 1969, 1971, 1972, 1973, and 1975. 1971 was the first edition to be approved by ANSI.

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Fire Safety Standard for Powered Industrial Trucks

Including Type Designations, Areas of Use, Maintenance and Operation

NFPA 505 — 1978

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A. For information on referenced publications see Appendix B.

Chapter 1 Type Designations and Areas of Use

1-1 Scope. This standard applies to fork trucks, tractors, platform lift trucks, motorized hand trucks and other specialized industrial trucks powered by electric motors or internal combustion engines. This standard does not apply to compressed air or nonflammable compressed gas-operated industrial trucks, to farm vehicles, or to automotive vehicles for highway use.

1-2 General.

1-2.1 Design and installation of the LP-Gas fuel systems on LP-Gas and dual-fuel powered industrial trucks shall be in accordance with the applicable provisions of the *Standard for the Storage and Handling of Liquefied Petroleum Gas*, NFPA 58 (ANSI).

1-2.2 Approved powered industrial trucks as used in this standard are those trucks listed for the use intended, by a nationally recognized testing laboratory. Trucks shall bear a label or some other identifying mark to that effect authorized by such laboratory. The word "listed" as used herein is defined inside the back cover of this standard.

To prevent confusion all testing laboratories shall use the same type designations to identify the various types of industrial trucks.

1-3* Type Designations. For the purpose of this standard there are thirteen different type designations of industrial trucks or tractors as follows:

(a) The *type D* units are diesel powered units having minimal acceptable safeguards against inherent fire hazards.

(b) The *type DS* units are diesel powered units that, in addition to all the requirements for the type D units, are provided with additional safeguards to the exhaust, fuel and electrical systems.

(c) The *type DY* units are diesel powered units that have all the safeguards of the type DS units and, in addition, do not have any electrical equipment, including ignition. They are equipped with temperature limitation features.

(d) The *type E* units are electrically powered units having minimum acceptable safeguards against inherent fire and electrical shock hazards.

(e) The *type ES* units are electrically powered units that, in addition to all of the requirements for the type E units, are provided with additional safeguards to the electrical system to prevent emission of hazardous sparks and to limit surface temperatures.

(f) The *type EE* units are electrically powered units that have, in addition to all of the requirements for the types E and ES units, the electric motors and all other electrical equipment completely enclosed.

(g) The *type EX* units are electrically powered units that differ from the types E, ES or EE units in that the electrical fittings and equipment are so designed, constructed and assembled that the units may be used in atmospheres containing specifically named flammable vapors, dusts, and, under certain conditions, fibers. Type EX units are specifically tested and classified for use in Class I, Group D or for Class II, Group G locations as defined in the *National Electrical Code*, NFPA 70 (ANSI).

(h) The *type G* units are gasoline powered units having minimum acceptable safeguards against inherent fire hazards.

(i) The *type GS* units are gasoline powered units that, in addition to all the requirements for the type G units, are provided with additional safeguards to the exhaust, fuel and electrical systems.

(j) The *type LP* units are liquefied petroleum gas powered units having minimum acceptable safeguards against inherent fire hazards.

(k) The *type LPS* units are liquefied petroleum gas powered units that, in addition to the requirements for the type LP units, are provided with additional safeguards to the exhaust, fuel and electrical systems.

(l) The *type G/LP* units operate on either gasoline or liquefied petroleum gas having minimum acceptable safeguards against inherent fire hazards.

(m) The *type GS/LPS* units operate on either gasoline or liquefied petroleum gas and, in addition to all requirements for the *type G/LP* units, are provided with additional safeguards to the exhaust, fuel and electrical systems.

1-4 The authority having jurisdiction shall determine the hazard classification of any particular location. The location shall have been classified prior to the consideration of industrial trucks being used therein and the type of industrial truck required shall be as provided in Section 1-7 of this standard for such location.

1-5 Several areas of any one plant or building may have different hazard classifications. The authority having jurisdiction shall limit the use of industrial trucks in classified areas in a plant or building in accordance with the hazard classification of such areas. The responsibility for enforcement of restricted use in such areas shall rest on management.

1-6 The industrial trucks specified in Section 1-7 are the minimum types required. Industrial trucks having greater safeguards may be used if desired.

1-7 Specific Areas of Use.

NOTE: Table 1-7 provides a summary of industrial truck types for specific areas of use and was developed from information contained in this section.

References in parentheses in the following subsection headings in this section are to the corresponding classification as used in the *National Electrical Code*, NFPA 70 (ANSI), for the convenience of people familiar with those classifications.

1-7.1 Areas Containing Certain Flammable Gases or Vapors Where Power-Operated Industrial Trucks Shall Not Be Used (Class I, Groups A, B and C, Division 1). Power-operated industrial trucks shall not be used in locations containing gases or vapors of the following chemicals:

acetaldehyde	ethylene oxide
acetylene	ethylenimine
acrolein (inhibited)	hydrogen
allyl alcohol	hydrogen sulfide
butadiene	manufactured gases containing more than 30% hydrogen (by volume)
n-butyraldehyde	morpholine
carbon monoxide	2-nitropropane
crotonaldehyde	propylene oxide
cyclopropane	tetrahydrofuran
diethyl ether	unsymmetrical dimethyl hydrazine (UDMH 1, 1-dimethyl hydrazine)
diethylamine	
epichlorohydrin	
ethylene	

Table 1-7 – Summary Table on Use of Powered Industrial Trucks as Described in Chapter 1 of this Standard

Locations	Diesel-Powered			Electric-Powered				Gasoline-Powered		LP-Gas-Powered		Dual-Fuel		Text Par.
	D	DS	DY	E	ES	EE	EX	G	GS	LP	LPS	G/LP	GS/LPS	Reference
Class I														
Division 1														
Group A														1-7.1
Group B														1-7.1
Group C														1-7.1
Group D							A							1-7.2
Class I														
Division 2														
Group A		X	X		X	X	X		X		X		X	1-7.9
Group B		X	X		X	X	X		X		X		X	1-7.9
Group C		X	X		X	X	X		X		X		X	1-7.9
Group D		*	A		*	A	A		*		*		*	1-7.3
Class II														
Division 1														
Group E							*							1-7.4
Group F							*							1-7.4
Group G							A							1-7.5
Class II														
Division 2														
Group E		X	X		X	X	X		X		X		X	1-7.9
Group F		X	X		X	X	X		X		X		X	1-7.9
Group G		*	A		*	A	A		*		*		*	1-7.6
Class III														
Division 1			A			A	A							1-7.7
Class III														
Division 2		A	A	*	A	A	A		A		A		A	1-7.8

Key To Table Symbols

- A = Type truck authorized in location described.
- * = Type truck authorized in location described with approval of the authority having jurisdiction.
- X = Type truck authorized to be determined by the authority having jurisdiction.
- Blank spaces = Type truck not authorized in location described.

NOTE: For a listing of chemicals of which mixtures of their vapors in air are classified as Class I, Group A, B and C, see Table 500-2 of the *National Electrical Code*, NFPA 70 (ANSI).

1-7.2 Areas Where Vapors of Flammable Liquids and Some Gases Exist Under Normal Operating Conditions (Class I, Group D, Division 1).

1-7.2.1 Approved power-operated industrial trucks designated as type EX and classified for Class I, Group D locations shall be used in locations containing gases or vapors of such flammable liquids or gases as:

acetic acid (glacial)	methane (natural gas)
acetone	methanol (methyl alcohol)
acrylonitrile	3-methyl-1-butanol (isoamyl alcohol)
ammonia	methyl ethyl ketone
benzene	methyl isobutyl ketone
butane	2-methyl-1-propanol (isobutyl alcohol)
1-butanol (butyl alcohol)	2-methyl-2-propanol (tertiary butyl alcohol)
2-butanol (secondary butyl alcohol)	petroleum naphtha
n-butyl acetate	pyridine
isobutyl acetate	octanes
sec-butyl alcohol	pentanes
di-isobutylene	1-pentanol (amyl alcohol)
ethane	propane
ethanol (ethyl alcohol)	1-propanol (propyl alcohol)
ethyl acetate	2-propanol (isopropyl alcohol)
ethyl acrylate (inhibited)	propylene
ethylene diamine (anhydrous)	styrene
ethylene dichloride	toluene
gasoline	vinyl acetate
heptanes	vinyl chloride
hexanes	xylenes
isoprene	
isopropyl ether	
mesityl oxide	

in quantities sufficient to produce explosive or ignitable mixtures and where such concentrations of these gases or vapors exist continuously, intermittently or periodically under normal operating conditions or might exist frequently because of repair, maintenance operations, leakage, breakdowns or faulty operation of equipment.

NOTE: For a listing of chemicals of which mixtures of their vapors in air are classified as Class I, Group D, see Table 500-2 of the *National Electrical Code*, NFPA 70 (ANSI).

1-7.2.2 Class I, Group D, Division 1 includes locations where volatile flammable liquids or liquefied flammable gases are transferred from one container to another; interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used; locations containing open tanks or vats of volatile flammable liquids; drying rooms or compartments for the evaporation of flammable solvents; locations containing fat and oil extraction apparatus using volatile flammable solvents; portions of cleaning and dyeing plants where hazardous liquids are used; gas generator rooms and other portions of gas manufacturing plants where flammable gas may escape; inadequately ventilated pump rooms for flammable gas or for volatile flammable liquids; the interiors of refrigerators and freezers in which volatile flammable materials are stored in open, lightly stoppered, or easily ruptured containers; and all other locations where hazardous concentrations of flammable vapors or gases are likely to occur in the course of normal operations.

1-7.3 Areas Where Volatile Flammable Liquids and Their Vapors or Flammable Gases Are Normally Confined (Class I, Group D, Division 2).

1-7.3.1 Approved power-operated industrial trucks designated as types DY, EE or EX (classified for Class I, Group D locations) shall be used in locations where volatile flammable liquids or flammable gases are handled, processed or used, but in which these liquids, vapors or gases will normally be confined within closed containers or closed systems from which they might escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; also in locations in which hazardous concentrations of gases or vapors are normally prevented by positive mechanical ventilation but which might become hazardous through failure or abnormal operation of the ventilating equipment; or in locations which are adjacent to Class I, Division 1 locations, and to which hazardous concentrations of gases or vapors 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.

1-7.3.2 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 types DS, ES, GS, LPS, or GS/LPS may be used if permitted for such locations by the authority having jurisdiction.

1-7.3.3 The classification Class I, Group D, Division 2 includes locations where volatile flammable liquids or flammable gases or vapors are used, but which, in the judgment of the authority having jurisdiction, would become hazardous only in case of an accident or of some unusual operating condition. The quantity of flammable material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors that should receive consideration in determining whether or not the DS, DY, ES, EE, GS, LPS, or GS/LPS type truck possesses sufficient safeguards for the location.

1-7.4 Areas Containing Metal Dusts, Carbon Black, Coke or Coal Dust (Class II, Groups E and F, Division 1).

1-7.4.1 Power-operated industrial trucks shall not be used in locations containing hazardous concentrations of metal dust, including aluminum, magnesium, and their commercial alloys, other metals of similar characteristics, or in locations containing carbon black, coal or coke dust.

Exception: Approved power-operated industrial trucks designated as type EX may be used in such locations, subject to special investigation of both the truck and specific area of use by the authority having jurisdiction.

1-7.4.2 In atmospheres where dust of magnesium, aluminum or aluminum bronze might be present, fuses, switches, motor controllers and circuit breakers of trucks shall have enclosures specifically approved for such locations.

1-7.5 Areas Containing Combustible Dusts in Suspension Other Than Those Specified in 1-7.4 (Class II, Group G, Division 1).

1-7.5.1 Approved power-operated industrial trucks designated as EX (classified for Class II, Group G locations) shall be used in locations in which combustible dust is or may be in suspension continuously, intermittently or periodically under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures, or where mechanical failure or abnormal operation of machinery or equipment might cause such mixtures to be produced.

1-7.5.2 The classification Class II, Group G, Division 1 includes the working areas of grain handling and storage plants, rooms containing grinders or pulverizers, cleaners, graders, scalpers, open conveyors or sprouts, open bins or hoppers, mixers or blenders, automatic or hopper scales, packing machinery, elevator heads and

boots, stock distributors, dust and stock collectors (except all-metal collectors vented to the outside), and all similar dust producing machinery and equipment in grain processing plants, starch plants, sugar pulverizing plants, malting plants, wood flour plants, hay grinding plants, and other occupancies of similar nature where combustible dust might, under normal operating conditions, be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

1-7.6 Areas Where Combustible Dusts Are Present But Not Normally in Suspension in the Atmosphere (Class II, Group G, Division 2).

1-7.6.1 Approved power-operated industrial trucks designated as type DY, EE or EX (classified for Class II, Group G locations) shall be used in locations in which combustible dust is not normally in suspension in the air or is not likely to be thrown into suspension by the normal operation of equipment or apparatus in quantities sufficient to produce explosive or ignitable mixtures but where deposits or accumulations of such dust might be ignited by arcs or sparks originating in the truck.

1-7.6.2 In locations where dangerous concentrations of suspended dust would not be likely, approved power-operated industrial trucks designated as types DS, ES, GS, LPS, or GS/LPS may be used if permitted for such location by the authority having jurisdiction. These locations would include rooms and areas containing only closed spouting and conveyors, closed bins or hoppers, or machines and equipment from which appreciable quantities of dust would escape only under abnormal operating conditions; rooms or areas into which explosive or ignitable concentrations of suspended dust might be communicated only under abnormal operating conditions; rooms or areas where the formation of explosive or ignitable concentrations of suspended dust is prevented by the operation of effective dust control equipment; warehouses and shipping rooms where dust producing materials are stored or handled only in bags or containers and other similar locations.

1-7.7 Areas Where Ignitable Fibers Are Processed (Class III, Division 1).

1-7.7.1 Approved power-operated industrial trucks designated as types DY, EE or EX shall be used in locations which are classified because of the presence of easily ignitable fibers or flyings but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.

1-7.7.2 Locations where easily ignitable fibers or flyings are found usually include some parts of rayon, cotton, and other textile mills; combustible fiber manufacturing and processing plants; cotton gins and cotton-seed mills; flax processing plants; clothing manufacturing plants; wood working plants (except wood flour plants); and establishments and industries involving similar processes or conditions.

Wood flour plants shall be considered as being in the type of locations defined in 1-7.5.2.

1-7.8 Areas Where Ignitable Fibers Are Stored (Class III, Division 2).

1-7.8.1 Approved power-operated industrial trucks designated as types DS, DY, ES, EE, EX, GS, LPS, or GS/LPS shall be used in locations where easily ignitable fibers are stored or handled, including outside storage, but are not being processed or manufactured. Industrial trucks designated as type E, which have been previously used in these locations, may be continued in use with the approval of the authority having jurisdiction.

1-7.8.2 Easily ignitable fibers and 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.

1-7.9 Hazardous Areas Not Otherwise Classified. The authority having jurisdiction shall determine what types of approved power-operated industrial truck, if any, shall be used on an engineering survey of the property and an evaluation of the fire and explosion hazards.

1-7.10 Piers and Wharves.

1-7.10.1 When determined that the location on piers and wharves for handling general cargo is not hazardous, any approved power-operated industrial truck designated as type D, E, G, LP, or G/LP may be used, or trucks which conform to the requirements for these types may be used.

1-7.10.2 Where an area of a pier or wharf is determined to be hazardous, only approved power-operated industrial trucks specified for such locations in the preceding subsections shall be used.

1-7.11 General Inside and Outside Storage.

1-7.11.1 When determined that the location for general storage in warehouses or general outside storage is not hazardous,

any approved power-operated industrial truck designated as type D, E, G, LP, or G/LP may be used or trucks which conform to the requirements for these types may be used.

1-7.11.2 Where the location for general storage in warehouses or general outside storage is determined to be hazardous, only approved power-operated industrial trucks specified for such locations in the preceding subsections shall be used.

1-7.12 General Industrial or Commercial Properties.

1-7.12.1 When determined that the locations on general industrial or commercial properties for handling or processing materials (storage being incidental to handling and processing), or both, is not hazardous, any approved power-operated industrial truck designated as type D, E, G, LP, or G/LP may be used, or trucks which conform to the requirements for these types may be used.

1-7.12.2 Where the location on general industrial or commercial properties for handling or processing materials, or both, is determined to be hazardous, only approved power-operated industrial trucks specified for such locations in the preceding subsections shall be used.

1-7.13 Converted Industrial Trucks.

1-7.13.1 Power-operated industrial trucks that have been originally approved or which conform to the requirements for type G for the use of gasoline for fuel, when converted to the use of liquefied petroleum gas fuel in accordance with Chapter 3, may be used in those locations where G or LP trucks have been specified in the preceding subsections.

1-7.13.2 Power-operated industrial trucks that have been originally approved, or which conform to the requirement for type G for the use of gasoline for fuel, when converted to the use of dual fuels in accordance with Chapter 3, may be used in those locations where G or LP type trucks have been specified in the preceding subsections.

1-7.13.3 Power-operated industrial trucks that have been originally approved, or which conform to the requirements for type LP for the use of liquefied petroleum gas for fuel, when converted to the use of dual fuels in accordance with Chapter 3, may be used in those locations where G or LP type trucks have been specified in the preceding subsections.

1-7.13.4 Power-operated industrial trucks that have been originally approved, or which conform to the requirements for type LP for the use of liquefied petroleum gas for fuel, when converted to the use of gasoline for fuel in accordance with Chapter 3, may be used in those locations where G type trucks have been specified in the preceding subsections.

1-7.13.5 Power-operated industrial trucks that have been originally approved, or which conform to the requirements for type G/LP for the use of dual fuels, when converted to the use solely of gasoline for fuel in accordance with Chapter 3, may be used in those locations where G type trucks have been specified in the preceding subsections.

1-7.13.6 Power-operated industrial trucks that have been originally approved, or which conform to the requirements for type G/LP for the use of dual fuels, when converted to the use solely of liquefied petroleum gas for fuel in accordance with Chapter 3, may be used in those locations where LP type trucks have been specified in the preceding subsections.

1-7.13.7 Power-operated industrial trucks originally designated GS, LPS or GS/LPS shall not be converted to the use of other fuels.

1-7.13.8 Power-operated industrial trucks originally approved or which conform to the requirements for type G, LP or G/LP shall not be converted to type GS, LPS, or GS/LPS.

Chapter 2 Dual-Fuel Trucks

2-1 General. A dual-fuel truck is defined as a truck equipped to be operated on either gasoline or LPG without further modification.

2-2 Requirements.

2-2.1 Those parts of the fuel system which come into contact with gasoline shall meet the requirements for liquid fuel — *Standard for Internal Combustion Engine-Powered Industrial Trucks, ANSI/UL 558.* (See *Appendixes A and B.*)

2-2.2 Those parts of the fuel system which come into contact with LPG fuel shall meet the requirements for LPG fuel — *Standard for Internal Combustion Engine-Powered Industrial Trucks, ANSI/UL 558,* or *Standard for the Storage and Handling of Liquefied Petroleum Gas, NFPA 58 (ANSI).* (See *Appendixes A and B.*)

2-2.3 Those parts of the fuel system which come into contact with both gasoline and LPG fuel shall be compatible with both types of fuel.

2-2.4 Fuel Changeover. Means shall be provided for fuel changeover which meet the following conditions:

(a) Which provides three-way selector means or device for selection of each of the two fuels plus a position where both fuels are shut off.

(b) Which prevents operation of both fuels at one time — except for that fuel remaining in the common fuel system components at the time of changeover.

(c) The shutoff means for gasoline shall be located between the fuel pump and the carburetor. The fuel line between the shutoff means and the fuel pump shall be kept as short as possible for the installation in question.

(d) The shutoff means for LPG fuel shall be located between the fuel container and the vaporizer. The fuel line between the shutoff means and the vaporizer shall be kept as short as possible.

(e) The means provided to effect a changeover in the type of fuel to be consumed shall be located within the enclosed engine compartment of the vehicle.

(f) When switching from LPG to liquid fuel, care shall be taken to ascertain there is no spillage of liquid fuel.¹

2-2.5 Automatic shutoff shall be provided in the LPG system at some point ahead of the inlet of the first-stage regulator, designed to prevent flow of LPG when the ignition is off and the engine not running or if the engine should stop. This device shall permit the back flow of LPG from the vaporizer in the event of a pressure build-up in the vaporizer. The device shall be of a type designed for use with LP-Gas at a working pressure of not less than 250 pounds per square inch gage.

2-2.6 The gasoline tank shall be provided with a self-closing type fill and vent fitting provided with a means to lock it in the closed position in order to prevent accidental opening.

2-3 The truck designations (*see Section 1-3*) as shown on the nameplate and the type markers (*see Figure 5-4.2.2*) shall not be painted over so as to obscure their content.

¹The purpose of this requirement is to ensure the carburetor float system is functioning properly after a period of disuse.

Chapter 3 Converted Trucks

3-1* Industrial trucks originally approved and classified by type designation (*see 1-7.13*):

(a) For the use of gasoline for fuel may be converted to liquefied petroleum gas as a fuel:

(b) For the use of gasoline or liquefied petroleum gas for fuel may be converted to dual fuels:

(c) For the use of liquefied petroleum gas for fuel or dual fuels may be converted to gasoline only as a fuel:

(d) For the use of dual fuels may be converted to liquefied petroleum gas only as a fuel:

Provided that in each of the above conversions the complete conversion results in a truck which embodies the features specified for the particular fuel to be used.

3-2 Conversion Requirements.

3-2.1 A truck designated G, LP or G/LP when converted to another of these designations shall conform to the requirements for the designation selected in accordance with ANSI/UL 558.

3-2.2 Conversion kits for use on trucks having type designation G, LP or G/LP shall conform to the requirements for the type designation selected in accordance with ANSI/UL 558, and may be approved by a nationally recognized testing laboratory.

(a) The content of the kit shall be as set forth in 3-2.3.

(b) The installation of the kit shall conform to the features set forth in 3-2.3.

When a conversion kit approved by a nationally recognized testing laboratory is used, a copy of the report shall be supplied to the authority having jurisdiction, upon request.

3-2.3 Kits for conversion of G, LP and G/LP trucks shall include:

(a) Step by step installation instructions with pictorial illustration (if necessary) for clarity.

(b) All parts required to complete the installation, including:

- (1) Functional components,
- (2) Mounting brackets and hardware,
- (3) Connecting wires, hoses and fittings,
- (4) Sealants, if required.

(c) A durable, corrosion resistant plate indicating the type designation of the converted truck, for permanent mounting on the truck.

(d) A metal nameplate attached to the LP-tank mounting identifying the fuel container assembly to be used.

(e) If the conversion is from LP to gasoline or dual fuels and the truck was not equipped with a gasoline fuel tank, a tank should be included in the kit along with the necessary mounting and connection hardware and installation instructions.

(f) If the conversion is from gasoline to LP, instructions for removal or deactivation of the present components including gasoline tank(s).

(g) Instructions covering checks and tests to be performed after the conversion and prior to putting the truck into service.

3-2.3.1 When a conversion kit is installed, all original identification of approval and type designation shall be removed or obliterated and the plate specified in 3-2.3(c) shall be installed in lieu thereof.

Chapter 4 Maintenance of Industrial Trucks

4-1 General. It is essential that the fire safety built into power-operated industrial trucks be maintained; any power-operated industrial truck not in safe operating condition shall be removed from service.

4-2 Precautions.

4-2.1 Repairs shall not be made in Class I, II and III locations.

4-2.2 Repairs to the fuel and ignition systems of industrial trucks which involve fire hazards shall be conducted only in locations designated for such repairs.

4-2.3 Repairs to the electrical system of battery-powered industrial trucks shall be performed only after the battery has been disconnected.

4-3 All parts of any industrial truck requiring replacement shall be replaced only with parts providing the same degree of fire safety as those used in the original design.

4-4 Water mufflers shall be filled daily or as frequently as is necessary to prevent depletion of the supply of water below 75 percent of the filled capacity. Vehicles with mufflers having screens or other parts that may become clogged shall not be operated while such screens or parts are clogged. Any vehicle that emits hazardous sparks or flames from the exhaust system shall immediately be removed from service, and not returned to service until the cause for the emission of such sparks and flames has been eliminated.

4-5 When the temperature of any part of any truck is found to be in excess of its normal operating temperature and which creates a hazardous condition, the vehicle shall be removed from service and not returned to service until the cause for such overheating has been eliminated.

4-6 Industrial trucks shall be kept in a clean condition, reasonably free of lint, excess oil, and grease. Noncombustible agents are preferred for cleaning trucks. Flammable liquids — i.e., having a

flash point below 100° F (37.8° C) — shall not be used. Combustible liquids — i.e., having a flash point at or above 100° F (37.8° C) — may be used. Precautions regarding toxicity, ventilation, and fire hazard shall be consonant with the agent or solvent used.

4-7 When antifreeze is required in the engine cooling system only glycol base material shall be used.

4-8 The truck designations (*see Section 1-3*) as shown on the nameplate and the type markers (*see 5-4.2*) shall not be painted over so as to obscure their content.

Chapter 5 Fueling, Recharging and Marking of Industrial Trucks

5-1 Fuel Handling and Storage.

5-1.1 Liquid Fuels (such as Gasoline and Diesel Fuel).

5-1.1.1 The storage and handling of liquid fuels shall be in accordance with the *Flammable and Combustible Liquids Code*, NFPA 30 (ANSI).

5-1.1.2 Trucks using liquid fuels shall be refueled only at locations designated for that purpose and from approved dispensing pumps. Safe outdoor locations are preferable to those indoors. The *Flammable and Combustible Liquids Code*, NFPA 30 (ANSI) (see 7-4.1.2), outlines recommendations for arranging safe indoor fueling facilities.

5-1.1.3 Engines shall be stopped and operator off the truck during refueling.

5-1.1.4 Emergency refueling shall be from approved safety cans. Safety cans shall be inspected regularly for damage to closures and for leaks; faulty cans shall be replaced.

5-1.1.5 Spillage of fuel or overfilling the vehicle fuel tank shall be avoided.

5-1.1.6 Smoking shall be prohibited in the refueling area.

5-1.2 Liquefied Petroleum Gas Fuel.

5-1.2.1 The storage and handling of liquefied petroleum gas (LP-Gas) shall be in accordance with the *Standard for Storage and Handling of Liquefied Petroleum Gases*, NFPA 58 (ANSI).

5-1.2.2 Filling of fuel containers which are permanently mounted on trucks and the filling of removable DOT type LP-Gas containers shall be done at locations designated for that purpose and in accordance with the *Standard for Storage and Handling of Liquefied Petroleum Gases*, NFPA 58 (ANSI).

5-1.2.3 LP-Gas containers shall not be dropped, thrown, rolled or dragged.

5-1.2.4 LP-Gas containers shall not be overfilled.

5-1.2.5 The engine shall be stopped and operator off the truck during refueling.

5-1.2.6 Trained and designated personnel shall refill or exchange LP-Gas containers.

5-1.2.7 A soap solution shall be used to check for leaks. A match or open flame shall not be used.

5-1.2.8 Removable LP-Gas containers shall not be exchanged and LP-Gas powered vehicles shall not be parked near sources of heat, open flames, or similar sources of ignition, or near open pits, underground entrances, elevator shafts or other similar areas unless such areas are adequately ventilated to prevent accumulations of LP-Gas.

5-1.2.9 Trucks equipped with permanently mounted LP-Gas containers shall be refueled outdoors.

5-1.2.10 The exchange of removable LP-Gas containers is preferably done outdoors, but may be done indoors. Means shall be provided in the fuel system to minimize the escape of fuel when the containers are exchanged. This shall be accomplished by:

(a) Closing the valve on the LP-Gas container, and

(b) Using an approved automatic quick-closing coupling (a type which closes in both directions, when uncoupled) in the fuel line. Where such an automatic quick-closing coupling is not used the fuel line shall be emptied by allowing the engine to run until the fuel in the line is consumed.

5-1.2.11 Removable LP-Gas containers shall be securely mounted to prevent jarring loose, slipping, or rotating, and shall be so positioned that the safety pressure relief valve opening is always in contact with the vapor space (top) of the container. This is accomplished by an indexing pin and container clamp(s) which, when the container is properly installed, positions the container.

5-1.2.12 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.

5-1.2.13 All LP-Gas containers shall be examined before refilling for the following defects or damage:

- (a) Dents, scrapes, and gouges of the pressure vessel,
- (b) Damage to the various valves and liquid level gage,
- (c) Debris in the relief valve,

- (d) Damage to or loss of relief valve cap,
- (e) Indications of leakage at valves or threaded connections,
- (f) Deterioration damage or loss of flexible seals in the filling or servicing connections.

Where examination reveals physical damage such as dents, scrapes or gouges (item a) which materially weaken the structure of the LP-Gas container, rendering it unsafe for use, it shall be removed from service.

Where examination reveals damages listed above (items b through f) other than physical damage to the container, appropriate repairs shall be made before the container is refilled.

5-1.2.14 Smoking shall be prohibited in the container refilling area for either portable or permanently mounted containers and in the exchange area when exchanging LP-Gas containers.

5-1.2.15 The service valve of the fuel container shall be closed whenever vehicles are parked overnight or stored for protracted periods of time indoors.

5-2 Dual-Fuel.

5-2.1 When operating a dual-fuel truck on LPG, the gasoline level in the liquid fuel tank shall be checked daily. The truck shall not be operated unless the gasoline fuel tank is at least $\frac{1}{4}$ full.¹

5-2.2 When operating a dual-fuel truck on LPG fuel the provisions of 5-1.2 shall be followed.

5-2.3 When operating a dual-fuel truck on liquid fuel the provisions of 5-1.1 shall be followed.

5-3 Changing and Charging Storage Batteries.

5-3.1 This section shall apply to batteries used on electric trucks. The two types of batteries in common use are (a) lead and (b) nickel-iron. They contain corrosive chemical solutions, either acid or alkali, and therefore present a chemical hazard. On charge, they give off hydrogen and oxygen which, in certain concentrations, are explosive.

5-3.2 Battery charging installations shall be located in areas designated for that purpose; such areas shall be kept free of extraneous combustible materials. Facilities shall be provided: for

¹The purpose in requiring the maintenance of at least $\frac{1}{4}$ full tank of gasoline is to provide a sufficient amount of liquid fuel to maintain a vapor saturation in the tank above the normally explosive level. The amount of fuel in the tank may be determined using the normal fuel gage provided on the vehicle.

flushing spilled electrolyte; for fire protection; for protecting charging apparatus from damage by trucks; and for adequate ventilation for dispersal of fumes from gassing batteries. Where on-board chargers are used, charging shall be accomplished at locations designated for that purpose, taking into account the electrical requirements of the charger and facilities for fire protection.

Exception: Flushing facilities are not required if charging is accomplished without removing battery from the vehicle.

5-3.3 When handling acid concentrates greater than 50 percent acid (above 1.400 specific gravity) an eye wash fountain shall be provided.

5-3.4 A conveyor, overhead hoist, or equivalent material handling equipment shall be provided for handling batteries.

5-3.5 Chain hoists shall be equipped with load-chain containers. When 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. A properly insulated spreader bar shall be used with any overhead hoist.

5-3.6 Reinstalled batteries shall be positioned properly and secured in the truck.

5-3.7 A carboy tilter or siphon shall be provided when acid in carboys is used. When diluting concentrated sulfuric acid to make up electrolyte ALWAYS add the acid to the water and not the water to the acid. Battery maintenance personnel shall wear protective clothing such as eye protection, long sleeves and gloves.

Exception: Removal and replacement of batteries does not require the use of protective clothing.

5-3.8 Electrical installations shall conform to the *National Electrical Code*, NFPA 70 (ANSI), and any local ordinances.

5-3.9 Trained and authorized personnel shall change or charge batteries.

5-3.10 Trucks shall be properly positioned and brake applied before attempting to change or charge batteries.

5-3.11 When charging batteries, the vent caps shall be kept in place to avoid electrolyte spray. Care shall be taken to assure that vent caps are functioning. The battery (or compartment) cover(s) shall be open to dissipate heat and gas.

5-3.12 Smoking shall be prohibited in the charging area.

5-3.13 Precautions shall be taken to prevent open flames, sparks, or electric arcs in battery charging areas.

5-3.14 Tools and other metallic objects shall be kept away from the top of uncovered batteries.

5-4 Use of Trucks in Classified Areas.

5-4.1 Industrial trucks shall not be used in classified areas except as specified in Chapter 1 of this standard.

5-4.2 Markings of Types DS, DY, ES, EE, EX, GS, LPS, GS/LPS Industrial Trucks and Their Areas of Use.

5-4.2.1 The use of proper equipment in classified areas is essential for the safety and protection of employees and property. Approved trucks, listed by a nationally recognized testing laboratory for use in such areas, shall be clearly identified. To facilitate identification by both operators and supervisory personnel, a uniform system of marking has been developed as described herein.

5-4.2.2 Durable markers indicating the designation of the type of truck for use in classified areas shall be applied to each side of the vehicle in a visible but protected location. These markers shall be distinctive in shape as indicated in Figure 5-4.2.2.

5-4.2.3 Entrances to classified areas where industrial trucks are intended to be used shall be posted with durable markers as shown in Figure 5-4.2.3.

5-5 Safe Operating Rules. This standard primarily concerns powered industrial trucks' fire safety. For safe operating rules, see the *American National Standard Safety Code for Powered Industrial Trucks, Low Lift and High Lift Trucks*, ANSI B56.1.