

NFPA 480

Standard for the Storage, Handling, and Processing of Magnesium Solids and Powders

1998 Edition



National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 480

Standard for the

Storage, Handling, and Processing of Magnesium Solids and Powders

1998 Edition

This edition of NFPA 480, *Standard for the Storage, Handling, and Processing of Magnesium Solids and Powders*, was prepared by the Technical Committee on Combustible Metals and Metal Dusts and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 18–21, 1998, in Cincinnati, OH. It was issued by the Standards Council on July 16, 1998, with an effective date of August 5, 1998, and supersedes all previous edition.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

This edition of NFPA 480 was approved as an American National Standard on August 6, 1998.

Origin and Development of NFPA 480

This standard was begun in 1946, tentatively adopted in 1950, and adopted by the National Fire Protection Association in May 1951. Revisions were adopted by the Association in 1952, 1954, 1957, 1959, 1961, and 1967. The 1967 edition was reconfirmed in 1974.

The 1974 edition was completely revised in 1980, primarily to comply with the NFPA *Manual of Style*. Minor technical amendments were made at that time. This complete revision of the 1974 edition was acted on by the Association at its 1981 Fall Meeting, and the revision was designated the 1982 edition.

The 1987 edition was a reconfirmation of the 1982 edition. The only changes made were minor editorial improvements and redesignation of the standard as NFPA 480.

For the 1993 edition, the Committee completely revised the standard to update the requirements for safe handling of magnesium solids and powders as well to update the fire and dust explosion prevention measures for both. The Committee incorporated the requirements for safe handling of magnesium powder that were previously found in the 1987 edition of NFPA 651, *Standard for the Manufacture of Aluminum and Magnesium Powder* (retitled *Standard for the Machining and Finishing of Aluminum and the Production and Handling of Aluminum Powders* in 1998). The Committee revision also incorporated editorial and style revisions to comply with the NFPA *Manual of Style* and to assist in making the document more usable, adoptable, and enforceable.

The 1998 revision incorporates amendments to the entire document. Key changes have been made to Section 4-2 to consolidate requirements applicable to all dust collectors; to paragraph 7-1.2 to add requirements for vacuum cleaning systems; and to Chapter 9 to incorporate fire prevention concepts and fire protection methods developed for other combustible metals.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on safeguards against fire and explosion in the manufacturing, processing, handling, and storage of combustible metals, powders, and dusts.

Contents

Chapter 1 General	480- 4	Chapter 6 In-Plant Conveying of Magnesium Powder	480- 8
1-1 Scope	480- 4	6-1 Containers.....	480- 8
1-2 Purpose	480- 4	6-2 Pneumatic Conveying	480- 8
1-3 Equivalent Protection	480- 4	6-3 Ductwork for Conveying Systems	480- 8
1-4 Definitions	480- 4	6-4 Fan Construction and Arrangement.....	480- 9
Chapter 2 Location and Construction of Magnesium Powder Production Plants	480- 4	6-5 Dust Collectors	480- 9
2-1 Location.....	480- 4	Chapter 7 Prevention of Fugitive Dust Accumulations	480- 9
2-2 Security.....	480- 5	7-1 General	480- 9
2-3 Building Construction.....	480- 5	7-2 Cleaning Frequency.....	480- 9
2-4 Doors and Windows	480- 5	Chapter 8 Storage of Magnesium Solids	480- 9
2-5 Grounding of Equipment.....	480- 5	8-1 Storage of Pigs, Ingots, and Billets	480- 9
2-6 Electrical Power.....	480- 5	8-2 Storage of Heavy Castings	480-10
Chapter 3 Magnesium Mill and Foundry Operations	480- 5	8-3 Storage of Light Castings.....	480-10
3-1 Melting and Casting Operations	480- 5	8-4 Storage in Racks or Bins	480-10
3-2 Heat Treating	480- 6	8-5 Storage of Scrap Magnesium	480-10
Chapter 4 Machining, Finishing, and Fabrication of Magnesium	480- 6	8-6 Storage of Magnesium Powder	480-11
4-1 Machining	480- 6	8-7 Storage of Other Magnesium Products.....	480-11
4-2 Dust Collection	480- 6	Chapter 9 Fire Prevention and Fire Protection	480-11
4-3 Cleaning.....	480- 7	9-1 Fire Prevention.....	480-11
4-4 Electrical Equipment	480- 7	9-2 General Fire Protection.....	480-12
4-5 Grounding of Equipment.....	480- 7	9-3 Extinguishing Agents and Application Techniques.....	480-12
4-6 Safety Precautions	480- 7	Chapter 10 Referenced Publications	480-12
4-7 Drawing, Spinning, and Stamping.....	480- 7	Appendix A Explanatory Material	480-13
Chapter 5 Magnesium Powder—Machinery and Operations	480- 8	Appendix B Supplementary Information on Magnesium	480-16
5-1 General Precautions	480- 8	Appendix C Explosibility of Magnesium Dust	480-18
5-2 Requirements for Machinery	480- 8	Appendix D Referenced Publications	480-22
5-3 Start-Up Operations	480- 8	Index	480-22
5-4 Charging and Discharging	480- 8		
5-5 Packaging and Storage	480- 8		

NFPA 480

Standard for the

Storage, Handling, and Processing of
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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 Appendix A.

Information on referenced publications can be found in Chapter 10 and Appendix D.

Chapter 1 General

1-1 Scope.

1-1.1 This standard shall apply to the storage, handling, and processing of magnesium solids at magnesium foundries, processing plants, and commercial storage facilities.

1-1.2 This standard shall also apply to the storage, handling, processing, and manufacture of magnesium powder.

1-1.3 This standard shall not apply to the primary production of magnesium.

1-1.4* This standard shall not apply to the transportation of magnesium in any form on public highways, waterways, or by air or rail.

1-1.5 The requirements of NFPA 650, *Standard for Pneumatic Conveying Systems for Handling Combustible Particulate Solids*, shall not apply to magnesium.

1-2 Purpose. The purpose of this standard is to minimize the occurrence of and resulting damage from fire and explosion hazards in the storage, handling, processing, and manufacture of magnesium solids and powders.

1-3 Equivalent Protection.

1-3.1 Existing plants, equipment, structures, and installations that do not comply strictly with the requirements of this standard shall be considered to be in compliance if it can be shown that an equivalent level of protection has been provided, or that no specific hazard shall be created or continue to exist through noncompliance.

1-3.2 This standard shall not be intended to prevent the use of systems, methods, or devices that provide equivalent protection from fire and explosion. NFPA 69, *Standard on Explosion Prevention Systems*, shall be referenced where considering the use of optional systems.

1-4 Definitions. For the purpose of this standard, the terms below shall be defined as follows.

Approved.* Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Fire-Resistive. Meeting the requirements for Type I or Type II construction, as described in NFPA 220, *Standard on Types of Building Construction*.

Heavy Casting. Castings greater than 25 lb (11.3 kg) with walls of large cross-sectional weights [at least $\frac{1}{4}$ in. (6.4 mm)]. Castings less than 25 lb (11.3 kg) are considered light castings.

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.

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 identified standards or has been tested and found suitable for a specified purpose.

Magnesium. Refers to either pure metal or alloys having the generally recognized properties of magnesium marketed under different trade names and designations.

Magnesium Powder. Refers to magnesium metal in the form of a chip, granule, flake, or finely divided particle. Any such magnesium metal that is less than $\frac{1}{8}$ in. (3.2 mm) in two dimensions or less than $\frac{1}{20}$ in. (1.3 mm) in single dimension (e.g., magnesium ribbon) will be considered a powder.

Magnesium Powder Production Plant. Facilities or buildings whose primary product is bulk magnesium powder. Facilities or buildings in which powder is produced incidental to operations will not be considered a powder production plant.

Noncombustible. In the form used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. (Materials reported as noncombustible, when tested in accordance with ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, shall be considered noncombustible materials.)

Shall. Indicates a mandatory requirement.

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

Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

Swarf. Finely divided metal particles produced by sawing and cutting operations.

Chapter 2 Location and Construction of Magnesium
Powder Production Plants

2-1 Location.

2-1.1 Magnesium powder production plants shall be located on a site large enough so that the buildings in which powder is manufactured shall be at least 300 ft (91.5 m) from public roads and from any occupied structure, such as public buildings, dwellings, and business or manufacturing establish-

ments, other than those buildings that are a part of the magnesium powder production plant.

2-1.2 Different production operations shall be located in separate but not adjoining buildings that are located at least 50 ft (15 m) from each other.

Exception: Two buildings less than 50 ft (15 m) apart shall be permitted if the facing wall of the exposed building shall be capable of resisting a blast pressure of 2.0 psig (13.8 kPa gauge) and shall be nonload-bearing, noncombustible, and without openings.

2-1.3 Separate buildings shall be required where different operations, such as but not limited to atomization, grinding, crushing, screening, blending, or packaging are performed.

Exception: More than one operation within the same building shall be permitted if the design provides equivalent protection.

2-2 Security.

2-2.1 This section shall be applied to new and existing facilities. The intent of this section shall be to restrict access by the general public to those facilities and to establish adequate exit facilities for personnel.

2-2.2 The powder production plant shall be surrounded by strong fencing at least 6 ft (1.8 m) high with suitable entrance gates, or otherwise shall be rendered inaccessible.

2-2.3 Security measures taken shall be in accordance with NFPA 101®, *Life Safety Code*®.

2-3 Building Construction.

2-3.1 All buildings used for the manufacture, packing, or loading for shipment of magnesium powders shall be single story, without basements, constructed of noncombustible materials throughout, and shall have nonload-bearing walls. The buildings shall be designed so that all internal surfaces are readily accessible to facilitate cleaning.

Exception: Other construction types shall be permitted if equivalent protection can be demonstrated.

2-3.2 All walls or areas that are not of monolithic construction and where dust can be produced, shall have all masonry joints thoroughly slushed with mortar and troweled smooth so as to leave no interior or exterior voids where magnesium powder can infiltrate and accumulate.

2-3.3 Floors shall be noncombustible hard surface and non-slip, installed with a minimum number of joints in which powder can collect. The requirements of this subsection shall also apply to elevated platforms, balconies, floors, or gratings. (See Appendix B.)

2-3.4 Roofs of buildings that house dust-producing operations shall be supported on girders or structural members designed to minimize surfaces on which dust can collect.

2-3.5 Roof decks shall be watertight.

2-4 Doors and Windows.

2-4.1 All exits shall conform with NFPA 101, *Life Safety Code*.

2-4.2 All doors in fire-rated partitions shall be approved, self-closing fire doors, installed in accordance with NFPA 80, *Standard for Fire Doors and Fire Windows*.

2-4.3* Windows shall be held in place by friction latches and installed so that they open outward.

2-5* Grounding of Equipment. All process equipment and all building steel shall be securely grounded by permanent ground wires to prevent accumulation of static electricity.

2-6 Electrical Power.

2-6.1 All electrical equipment and wiring shall be installed in accordance with NFPA 70, *National Electrical Code*®.

2-6.2* All parts of manufacturing buildings shall be classified.

2-6.3 Buildings shall be provided with emergency lighting systems in accordance with NFPA 101, *Life Safety Code*. The emergency lighting shall be energized automatically upon loss of electrical power to the buildings.

Exception: Buildings of less than 200 ft² (19 m²) not normally occupied shall not be required to have emergency lighting systems.

Chapter 3 Magnesium Mill and Foundry Operations

3-1* Melting and Casting Operations.

3-1.1 Buildings used for the melting and casting of magnesium shall be noncombustible. Melt rooms shall provide access to facilitate fire control. Floors shall be of noncombustible construction and be kept clean and free of moisture and standing water.

3-1.2* All solid metal shall be thoroughly dried by preheating and shall be at a temperature not less than 250°F (121°C) throughout when coming into contact with molten magnesium.

3-1.3 Fuel supply lines to melting pots and preheating installations shall have remote fuel shutoffs and combustion safety controls in accordance with NFPA 86, *Standard for Ovens and Furnaces*, or equivalent.

3-1.4* Prevention of Molten Magnesium Contact with Foreign Materials.

3-1.4.1 Areas of furnaces that can come into contact with molten magnesium in the event of a runout shall be kept dry and free of iron oxide.

3-1.4.2 Crucible interiors and covers shall be maintained free of iron oxide scale, which could fall into the molten metal.

3-1.4.3 Molten magnesium systems shall overflow or relieve to secondary containments designed to handle 110 percent of the largest expected failure and shall be provided with the means to prevent contact with incompatible materials.

3-1.4.4 Melting pots and crucibles shall be inspected regularly. Pots and crucibles that show evidence of possible failure or that allow molten metal to contact iron oxide, concrete, or other incompatible materials shall be repaired or discarded.

3-1.5 Ladles, skimmers, and sludge pans shall be thoroughly dried and preheated before contacting molten metal.

3-1.6 Extreme care shall be exercised in pouring magnesium castings to avoid spillage. All molds shall be thoroughly preheated before pouring.

3-1.7 Operators in melting and casting areas shall wear flame-resistant clothing, high foundry shoes, and face protection. Clothing worn where molten magnesium is present shall have no exposed pockets or cuffs that could trap and retain magnesium.

3-2* Heat Treating.

3-2.1 A standard procedure for checking the uniformity of temperatures at various points within heat-treating furnaces shall be established. Furnaces shall be checked prior to use and at regular intervals during use to identify undesirable hot spots.

3-2.2* Gas- or oil-fired furnaces shall be provided with combustion safety controls.

3-2.3 All furnaces shall have two sets of temperature controls operating independently. One shall maintain the desired operating temperature; the other, operating as a high-temperature limit control, shall cut off fuel or power to the heat-treating furnace at a temperature slightly above the desired operating temperature.

3-2.4 Magnesium parts to be put in a heat-treating furnace shall be free of magnesium turnings, chips, and swarf.

3-2.5 Combustible spacers on pallets shall not be used in a heat-treating furnace.

3-2.6* Aluminum parts, sheets, or separators shall not be included in a furnace load of magnesium.

3-2.7 There shall be strict adherence to the heat-treating temperature cycle recommended by the alloy manufacturer.

3-2.8* Molten salt baths containing nitrates or nitrites shall not be used for heat-treating magnesium alloys.

3-2.9* Magnesium and aluminum metals shall be segregated and easily identified to avoid the possibility of accidental immersion of magnesium alloys in salt baths used for aluminum.

3-2.10* Furnaces used to heat magnesium or magnesium alloys shall be inspected and cleaned as necessary to remove any accumulation of loose iron oxide scale.

Chapter 4 Machining, Finishing, and Fabrication of Magnesium

4-1* Machining.

4-1.1 Cutting tools shall not be allowed to ride on the metal without cutting, as frictional heat can ignite any fine metal that is scraped off. For the same reason, the tool shall be backed off as soon as the cut is finished. Cutting tools shall be kept sharp and ground with sufficient rake clearance to minimize rubbing on the end and sides of the tool.

4-1.2* When drilling deep holes (depth greater than 5 times drill diameter) in magnesium, high-helix drills (45 degrees) shall be used to prevent packing of the chips produced.

4-1.3 Relief shall be maintained on tools used in grooving and parting operations, since the tool tends to rub the sides of the groove as it cuts. Side relief shall be 5 degrees; end relief shall be from 10 degrees to 20 degrees.

4-1.4 If lubrication is needed, as in tapping or extremely fine grooving, a high-flash point mineral oil shall be used. Water, water-soluble oils, and oils containing more than 0.2 percent fatty acids shall not be used, as they can generate flammable hydrogen gas.

Exception: Special formulated coolant fluids (water-oil emulsions) that specifically inhibit the formation of hydrogen gas shall be permitted.

4-1.5 Where compressed air is used as a coolant, special precautions shall be taken to keep the air dry.

4-1.6 All machines shall be provided with a pan or tray to catch chips or turnings. The pan or tray shall be installed so that it can be readily withdrawn from the machine in case of fire. It shall be readily accessible for chip removal and for application of extinguishing agent to control a fire.

4-1.6.1 During magnesium machining operations, chips shall be removed from the point of generation by continuous or batch removal. Accumulation at the point of generation shall not exceed 3 lb (1.4 kg) dry weight. All chips shall be stored in covered noncombustible containers and removed to a storage area in accordance with Chapter 8.

4-1.6.2 In case of a fire in the chips, the pan or tray shall be immediately withdrawn from the machine, but shall not be picked up or carried away until the fire has been extinguished.

4-2 Dust Collection.

4-2.1 Dust shall be collected by means of suitable hoods or enclosures at each operation. Hoods and enclosures shall be connected either to a wet-type collector or to a cyclone collector and blower located outdoors.

4-2.2 The dust collection system shall be designed and installed so that the dust is collected upstream of the fan.

4-2.3 The use of dry media-type collectors shall be prohibited.

4-2.4 Wet-Type Dust Collectors.

4-2.4.1* Where wet-type dust collectors are used, the unit shall be designed so that the dust collected is converted to sludge without contact, in the dry state, with any high-speed moving parts.

4-2.4.2* Wet-type dust collectors shall be restricted to a dust-loading of no more than 5 grains/ft³ (175 grains/m³) of inlet air on standard configuration collectors.

4-2.4.3 Wet-type dust collectors shall be designed so that the hydrogen being generated from the magnesium contacting the water shall be vented at all times.

4-2.4.4 Means of venting to avoid accumulation of hydrogen shall be maintained. Each chamber of the collector shall be vented to dissipate the hydrogen.

4-2.4.5 Sludge level build-up in the sludge tank of the wet-type dust collector shall not exceed 5 percent of the tank water capacity as measured by volume. Sludge shall be removed from the collector whenever the collector is to remain inoperative for a period of 24 hours or more.

4-2.4.6 Wet-type dust collectors shall incorporate the use of positive venting of the sludge tank at all times during shutdown by means of an auxiliary blower that is energized when the main exhaust fan is turned off. The auxiliary fan volume shall not be less than 10 percent of the exhaust fan volume.

4-2.4.7 Down-draft bench configuration separators shall maintain no less than 300 ft/min (90 m/min) average work-surface capture velocity at each work station. Work-surface