

**NFPA®**

# 79

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Electrical Standard for  
Industrial Machinery

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## NFPA® 79

### Electrical Standard for Industrial Machinery

#### 2021 Edition

This edition of NFPA 79, *Electrical Standard for Industrial Machinery*, was prepared by the Technical Committee on Electrical Equipment of Industrial Machinery and released by the Correlating Committee on National Electrical Code®. It was issued by the Standards Council on October 5, 2020, with an effective date of October 25, 2020, and supersedes all previous editions.

This edition of NFPA 79 was approved as an American National Standard on October 25, 2020.

#### Origin and Development of NFPA 79

This standard was first submitted at the 1961 NFPA Annual Meeting under the title *Electrical Standard for Machine Tools* and was tentatively adopted subject to comments. It was extensively revised and resubmitted at the 1962 NFPA Annual Meeting, where it was officially adopted. In 1965 a revised edition was adopted, reconfirmed in 1969, and in 1970, 1971, 1973, 1974, 1977, 1980, 1985, 1987, 1991, 1994, 1997, 2002 and 2007, revised editions were adopted.

In September 1941, the metalworking machine tool industry wrote its first electrical standard to make machine tools safer to operate, more productive, and less costly to maintain, and to improve the quality and performance of their electrical components. That particular standard served as an American “War Standard.”

To study the special electrical problems involved with machine tools, in 1941 the Electrical Section of the National Fire Protection Association sanctioned a Special Subcommittee on Wiring, Overcurrent Protection, and Control of Motor-Operated Machine Tools. This subcommittee, cooperating with machine tool builders, manufacturers of control equipment, and Underwriters Laboratories Inc., conducted tests and investigated the peculiar conditions involved with machine tools that might warrant exception to certain specific *National Electrical Code* requirements. This investigation resulted, on August 4, 1942, in a Tentative Interim Amendment and first appeared in a 1943 supplement to the 1940 edition of *NFPA 70®*, *National Electrical Code (NEC)*, as Article 670, “Machine Tools.” It remained essentially unchanged through the 1959 edition.

Meanwhile, manufacturers of other types of industrial equipment erroneously began to follow the specialized practices permitted by Article 670. Late in 1952, a Technical Subcommittee on Fundamentals of Electrically Operated Production Machinery and Material Handling and Processing Equipment for Fixed Locations was organized to attempt to group the special requirements of this broad field into one article. The extremely broad scope introduced so many problems that, in December 1956, this technical subcommittee was reorganized into an NFPA committee whose scope was limited to machine tools and whose objective was the preparation of this NFPA standard with corresponding revisions in Article 670 in the *National Electrical Code*.

Modern machine tool electrical equipment may vary from that of single-motor machines, such as drill presses, that perform simple, repetitive operations, to that of very large, multimotored automatic machines that involve highly complex electrical control systems, including electronic and solid-state devices and equipment. Generally these machines are specially designed, factory wired, and tested by the builder and then erected in the plant in which they will be used. Because of their importance to plant production and their usually high cost, they are customarily provided with many safeguards and other devices not often incorporated in the usual motor and control application as contemplated by the *National Electrical Code*.

Although these machines may be completely automatic, they are constantly attended, when operating, by highly skilled operators. The machine usually incorporates many special devices to protect the operator, protect the machine and building against fires of electrical origin, protect the machine and work in process against damage due to electrical failures, and protect against loss of



production due to failure of a machine component. To provide these safeguards, it may be preferable to deliberately sacrifice a motor or some other component, rather than to chance injury to the operator, the work, or the machine. It is because of such considerations that this standard varies from the basic concepts of motor protection as contained in the *National Electrical Code*.

As NFPA 79 evolved, it became apparent that certain classes of light industrial machinery (e.g., small drill presses, bench grinders, sanders) were not appropriately covered. The 1977 edition of the standard recognized this problem and purposely excluded tools powered by 2 hp or less.

Subsequent to publication of the 1977 standard, a light industrial machinery standard development activity was initiated by the Power Tool Institute. The 1985 edition of NFPA 79 reflects this activity, and appropriate requirements are now included in the standard.

In 1975, the Society of the Plastics Industry requested that this standard be enlarged in scope to include plastics machinery. A formal request was received by NFPA in September 1978, and, through the combined efforts of the NFPA 79 committee and representatives of the Society of the Plastics Industry, the scope was broadened to include such machinery in the 1980 edition.

In June 1981, the Joint Industrial Council (JIC) Board of Directors acknowledged the dated state of the electrical and electronic standards and requested that NFPA 79 incorporate into its standard the material and topics covered by the JIC electrical (EMP-1-67, EGP-1-67) and electronic (EL-1-71) standards with the intention that the JIC standards eventually would be declared superseded. The NFPA Standards Council approved the request with the stipulation that the material and topics incorporated from the JIC standards be limited to areas related to electrical shock and fire hazards. The 1985 edition reflected the incorporation of the appropriate material from the JIC electrical (EMP-1-67, EGP-1-67) standards not previously covered. The 1991, 1994, and 1997 editions included additional references to international standards and reflected the committee's efforts in harmonization.

The 2002 edition was a major rewrite and represented a significant and historic effort in harmonizing an existing NFPA standard with an existing IEC standard. Major changes for this edition included renumbering section and chapter numbers to align with IEC 60204-1. A new chapter was added to address testing.

The 2007 edition continued to be aligned with IEC 60204-1. Because so much electrical equipment today contains both electrical and electronic equipment, Chapter 11, Electronic Equipment, was deleted, and any sections that remained applicable were dispersed to the appropriate chapters. The deletion of Chapter 11 caused all chapters after Chapter 11 to be renumbered to one less than in previous editions. A new Chapter 19, entitled "Servo Drives and Motors," was added to the end of the standard. This new chapter addressed some of the user concerns that are arising as servo drives and servo motors are integrated into industrial machinery. Other changes include further defining of cables and cords, clarifying emergency stop functions, permitting system isolation equipment, clarifying short-circuit current markings, and refining requirements associated with software- and firmware-based control systems performing safety-related functions.

Changes to the 2012 edition continued to align the standard with IEC 60204-1. Due to the continued advancement and expansion of wireless and cableless technology, major changes for this edition included a revised definition for the term cableless control and a new definition for the term *cableless operator control station*, along with revisions to Chapter 9, which aligned with IEC 60204-1. The title of Chapter 6 was changed, to recognize that there are other hazards (such as arc flash and stored energy) besides electrical shock. New sections were added to Chapters 6 and 16 to recognize these hazards and correlate with *NFPA 70E*. Furthermore, the sections on the hazards from stored energy in Chapter 7 were moved to Chapter 6 for clarity and proper location of those rules in the document. To align with the *NEC*, the requirements in 7.2.10 were changed for selecting overcurrent devices for motors. Chapter 12 received a new section to address user concerns permitting the use of appliance wiring material (AWM) as special cables, with clarifications on determining suitability for use under specific conditions. An important addition of a 90°C (194°F) temperature column to the conductor ampacity table in Chapter 12 was included to correlate with the *NEC*.

Other changes included adding the definition for short-circuit current rating (SCCR), extracted from the *NEC*; revising the definition for equipment grounding conductor; and adding a new definition for safety-related function specific to industrial machines to harmonize with IEC and ISO standards. Further changes to Chapter 19 addressed some of the user concerns arising from servo drives and servo motors being more commonly used in industrial machinery. Finally, adding an American Wire Gauge (AWG) to the metric conductor cross-reference table in Annex I provided the user and enforcement officials a means to judge AWG versus metric wire sizes required by the standard.

As in previous editions, the 2015 edition aligned with IEC 60204-1, and the alignment was made more intuitive and informative. Parenthetical terms that aligned with IEC terms throughout the main body of the document without explanation reside in Annex J with further explanation for their use. Global changes of the editorial type were accepted to comply with the *Manual of Style for NFPA Technical Committee Documents*. Two definitions were added — *industrial control panel* and *overcurrent protective device, branch circuit*. Seven definitions were deleted — *cable trunking systems* (3.3.16), *duct* (3.3.33), *earth* (3.3.34), *positive opening operation* (of a contact element) (3.3.74), *protective bonding circuit* (3.3.77), *protective conductor* (3.3.78), and *subassembly* (3.3.98). The title of Section 6.6 was revised to Arc Flash Hazard Warning to clarify that the requirement is to warn qualified individuals of, not to protect them from, a potential arc flash hazard. This change aligned with the 2014 *NEC* revision



to 110.16, which added “or factory” to allow the required arc-flash warning label to be applied at the factory as well as in the field — a change that was more conducive to industrial machinery and industrial control panels.

The conditions for emergency stop on Category 1 and Category 0 were revised, as well as those for emergency switching off. Working space rules for enclosures that contain supply conductors were revised to clarify that 110.26 of the *NEC* applies, and an exhibit was added to Annex A to illustrate the requirement. The requirement for width of the working space was also revised to specify the opening into the control cabinet and to consider situations where there were devices involved with industrial machine control cabinets. Table 12.5.5(a) was revised to add 60 degree and 90 degree columns to correlate with the addition of a 90 degree column to 12.5.1 in the 2012 edition and in the *NEC*. Finally, language was revised to clarify the rules for separate supply sources; the standard to use for warning signs; how to calculate SCCR marking where there are multiple control panels; that overcurrent protection is required for servo drives; and that conveyors, conveying machines, and material handling machines are within the scope of NFPA 79.

In the 2018 edition, “600 volts” was replaced with “1000 volts” to align with the *NEC*. Three definitions were revised — *adjustable speed drive*, *liquidtight flexible metal conduit*, and *wet location*. Four definitions were added — *basic protection*, *effective ground-fault current path*, *fault protection*, and *machine supply circuit*. Four definitions were deleted — *attachment plug (plug cap) (plug)*, *receptacle*, *socket*, and *visible*. The title of Chapter 5 was revised to Disconnecting Means to clarify that Chapter 5 covers all the supply circuit conductor terminations on the machine.

The 2018 edition also revised Section 5.1 to remove “incoming” and add “machine” to align with the newly added definition. The main disconnecting means must be marked “main disconnecting means” if it supplies multiple disconnecting means on the machine. The machine supply circuit disconnecting means, by Exception No. 2 to 5.3.1.3, is permitted to be externally mounted up to 20 ft (6 m) away. Finally, language was revised to allow adjustable speed drives marked “suitable for output conductor protection” to have the rating of the short-circuit protective device (SCPD) determined by the drive’s rated input current.

A requirement was added to 7.8.1 to require a surge-protection device (SPD) to correlate with 670.6 of the *NEC*; the title of Chapter 8 for grounding added “bonding”; clarification was added on connection of the grounded conductor to the equipment grounding conductor; and clarification that all parts of effective ground-fault current path is capable of withstanding the highest thermal and mechanical stress that can be caused by fault currents. Further enhancements to Chapter 11 were added to clarify the peculiar working space condition of industrial machines and machine tools.

In the 2021 edition, the inconsistent use of text involving voltages has been resolved and the use of the term *safety related control systems* has been updated. In Chapter 3, terms extracted from *NFPA 70* have been updated and the definition of *safety circuit* has been revised. In Chapter 4, references to voltage dips have been revised, cable types for power conversion equipment have been removed, and electromagnetic compatibility (EMC) involving transients has been revised. Requirements involving supply circuit disconnecting means, access, operations, and markings in Chapter 5 have been enhanced; in 5.2.4, the term *isolation devices* has been replaced with *disconnecting means*.

Chapter 6 requirements on enclosure access and interlocking have been changed, and voltage limitations and rejection capabilities for attachment plugs in protective extra low voltage (PELV) systems have been revised. In Chapter 7, language requiring surge-protection devices (SPDs) has been updated. Control system grounding requirements in Chapter 8 have been updated, and the exception to 8.3.2 involving insulation monitoring for Class 2 circuits has been changed.

In Chapter 9, an exception has been added to 9.4.2.1. In Chapter 10, 10.7.1.3 has been revised, requiring emergency stop devices to be listed. Revisions to Chapter 15 deleted “in the machine area” in 15.2.2.1. In Chapter 19, Section 19.1 has been determined as redundant to 19.1.1 and 19.1.2 and was deleted. Duplicate material in the annexes has also been deleted, and A.9.2.5.4 added a reference to ISO 12100.

The technical committee for this standard reports to NFPA through the Correlating Committee of the National Electrical Code. The primary reason is to correlate this standard and *NFPA 70*, especially with respect to Article 670.



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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 minimizing the risk of electricity as a source of electric shock and as a potential ignition source of fires and explosions. It shall also be responsible for text to minimize the propagation of fire and explosions due to electrical installations.



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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 intended to minimize the potential hazard of electric shock and electrical fire hazards of industrial metalworking machine tools, woodworking machinery, plastics machinery and mass production equipment, not portable by hand. This Committee shall report to Correlating Committee of the National Electrical Code.



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2021 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. 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 should be sent to the technical committee responsible for the source document.

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

## Chapter 1 Administration

### 1.1\* Scope.

**1.1.1** The provisions of this standard shall apply to the electrical/electronic equipment, apparatus, or systems of industrial machines supplied from a nominal voltage of 1000 volts or less, and commencing at the point of connection of the supply circuit conductors to the electrical equipment of the machine.

**1.1.2\*** This standard does not include the additional requirements for machines intended for use in hazardous (classified) locations.

**1.2 Purpose.** This standard shall provide detailed information for the application of electrical/electronic equipment, apparatus, or systems supplied as part of industrial machines that will promote safety to life and property.

### 1.3 Application.

**1.3.1** This standard is not intended to be applied retroactively.

**1.3.2** When changes other than repairs are made to machines that do not comply with the provisions of this standard, the changes shall conform to the provisions of this standard.

**1.3.3** This standard shall not apply to the following:

- (1) Fixed or portable tools judged under the requirements of a testing laboratory acceptable to the authority having jurisdiction
- (2) Machines used in dwelling units

**1.4 Specific Provisions Other Than NFPA 79.** The size and overcurrent protection of the supply conductors to a machine shall be covered by Article 670 of NFPA 70. The wiring between component machines of an industrial manufacturing system shall be covered by NFPA 70.

*Exception:* Wiring of component machines of an industrial manufacturing system that is supplied by the manufacturer and is an integral part of the system, is adequately protected and supported, and meets the requirements of this standard.

**1.5\* Specific Provisions Not Made in Relation to NFPA 70.** On any point for which specific provisions are not made in this standard the provisions of NFPA 70 shall be observed.

**1.6 State of the Art.** This standard shall not limit or inhibit the advancement of the state of the art. Each type of machine has unique requirements that shall be accommodated to provide adequate safety.

## 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 70®, *National Electrical Code*®, 2020 edition.

NFPA 70E®, *Standard for Electrical Safety in the Workplace*®, 2021 edition.

### 2.3 Other Publications.

**2.3.1 ANSI Publications.** American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI Z535.4, *Product Safety Signs and Labels*, 2011, reaffirmed 2017.

**2.3.2 ASTM Publications.** ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM B8, *Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft*, 2011, reapproved 2017.

ASTM B174, *Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors*, 2017.

ASTM B286, *Standard Specification for Copper Conductors for Use in Hookup Wire for Electronic Equipment*, 2007, reapproved 2017.



**2.3.3 IEC Publications.** International Electrotechnical Commission, 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland.

IEC 60072-1, *Dimensions and output series for rotating electrical machines — Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080*, 1991.

IEC 60072-2, *Dimensions and output series for rotating electrical machines — Part 2: Frame numbers 355 to 1000 and flange numbers 1180 to 2360*, 1990.

**2.3.4 IEEE Publications.** IEEE, 3 Park Avenue, 17th Floor, New York, NY 10016-5997.

IEEE 315, *Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Letters)*, 1993.

**2.3.5 NEMA Publications.** National Electrical Manufacturers Association, 1300 North 17th Street, Suite 900, Arlington, VA 22209.

NEMA ICS 2, *Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts*, 2000, errata 2008.

NEMA MG-1, *Motors and Generators*, 2016.

NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*, 2014.

**Δ 2.3.6 UL Publications.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 50, *Enclosures for Electrical Equipment, Non-Environmental Considerations*, 2015.

UL 50E, *Enclosures for Electrical Equipment, Environmental Considerations*, 2015.

UL 508, *Industrial Control Equipment*, 2018.

UL 508A, *Industrial Control Panels*, 2018.

UL 870, *Wireways, Auxiliary Gutters, and Associated Fittings*, 2016.

UL 1063, *Machine-Tool Wires and Cables*, 2017, revised 2018.

UL 1581, *Electrical Wires, Cables, and Flexible Cords*, 2001, revised 2017.

**2.3.7 US Government Publications.** US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 29, Code of Federal Regulations, Part 1910.331–335, “Safety-Related Work Practices.”

### 2.3.8 Other Publications.

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

## 2.4 References for Extracts in Mandatory Sections.

NFPA 70®, *National Electrical Code®*, 2020 edition.

NFPA 70E®, *Standard for Electrical Safety in the Workplace®*, 2018 edition.

## 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 Accessible (as applied to equipment).** Admitting close approach; not guarded by locked doors, elevation, or other effective means. [70:100]

**3.3.2 Accessible, Readily (Readily Accessible).** Capable of being reached quickly for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, and so forth.

**3.3.3\* Actuator.** The part of the actuating system to which an external actuating force is applied.