

# NFPA 79 ELECTRICAL STANDARD FOR INDUSTRIAL MACHINERY

2015 EDITION

WHITE PAPER

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## THE INDUSTRIAL MACHINERY STANDARD: NFPA 79

NFPA 79 is the U.S. Electrical Standard for Industrial Machinery and is referenced by the National Electrical Code under Article 670. Specifically, NFPA 79 applies to the electrical equipment used within a wide variety of machines — and groups of machines — working together in a coordinated manner. Some examples of industrial machinery include machine tools, injection molding machines, woodworking equipment, assembling machinery, material handling machinery and inspection and testing machines. NFPA 79 encompasses all of the machines' electrical and electronic elements operating at 600V or less.

With the new NFPA 79 2015 edition, the primary focus is mainly one of overall safety and promoting further harmonization with its European counterpart Standard IEC 60204-1. These new changes were driven primarily by the machine manufacturers' global necessity to ensure that their products were safety-compliant at both the domestic and international levels.

In 2007, NFPA 79 underwent significant revisions to approach harmonization with IEC-60204. This involved reorganizing the NFPA 79 chapter structure to follow IEC-60204 and to agree with less restrictive, more progressive requirements without sacrificing equipment safety. One of the major changes in the 2007 update involved cable selection options required under section 12.2.7.3., which indicated that single- or multi-conductor AWM was not be permitted unless the completed assembly was listed prior for such use. Many industry participants considered this change unrealistic, and it was soon realized that further modification was necessary. With the release of NFPA 79 2012, AWM was permitted as long as certain requirements were met as specified within the standard. That being said, the acceptability of AWM required a thorough review of the standard because the allowance was not automatic. If the requirements were not followed, or deemed noncompliant by the inspection authority, serious repercussions could occur.

## PROPER CABLE SELECTION SHOULD NEVER BE AN AFTERTHOUGHT

Perhaps one of the most overlooked items regarding the installation of equipment and machines in an industrial or commercial setting is selection of the proper cable. This could be due to expenses surrounding the original purchase price of machines, equipment, and mounting hardware (conduits, trays, raceways), plus labor costs necessary to complete the installation. Intentional or not, cable selection seems to be given a secondary degree of attention in the installation process. Unfortunately, this can prove to be very costly to the building contractor, machine fabricator, manufacturing occupant, and all others involved in the process. Today, with the ever-increasing prevalence of lawsuits and insurance liability issues, proper cable specification is more important than ever.

## END USERS SHOULD UNDERSTAND FOREIGN CABLE AND WIRING DIFFERENCES

Many overseas suppliers now provide machinery for use in manufacturing facilities in the United States. As there are different codes and regulatory requirements that affect machine electrical installations both in the U.S. and overseas, ensuring proper cable selection has become increasingly more involved. In addition, overseas manufacturers sometimes include European or Asian cables along with their machines, further complicating the cable selection issue. These foreign wiring methods do not apply in the U.S. and can cause many problems for both the installer and end user. Another issue is that manufacturers may use low-cost materials with thin insulation to provide a lucrative cable price for the end user. In the long run, these substandard cables must be replaced. As an example, one of the largest U.S. companies listed on the Fortune 10 had 2.5 million units recalled due to faulty cables. The cables contained materials that were very fragile, which subsequently caused fires resulting in several million dollars in liability and damage. Five years later, many issues remained unresolved and the fallout from this recall is ongoing. Machine manufacturers are generally given two options when their products fail in end use: Take the machine back and replace it with a new one (recall), or replace the faulty cables and be billed for the material and labor.

## WHY AWM WAS BANNED IN 2007, ALLOWED IN 2012

Wire and cable for industrial machines and electrical/electronic equipment can be used in a wide range of applications, including power, lighting, control, programmable input/output controllers, and motor circuits. When AWM was omitted in the NFPA 79 2007 standard, its use was prohibited in industrial machines. No longer was the use of AWM allowed; if used, an unanticipated on-site inspection could result in a shutdown. Overseas equipment manufacturers who were previously supplying AWM with their machines as part of the "complete package" for installation in U.S. factories were no longer permitted to do so. AWM was omitted for several reasons from the NFPA 79 2007:


- AWM was being incorrectly used during installation of industrial machinery as part of the building infrastructure.
- The National Electrical Code does not recognize AWM as an acceptable method for wiring installation.
- The flame rating of AWM can vary greatly; under specific conditions, certain types of AWM will catch and spread fire.
- Minimum insulation wall thickness of AWM can vary greatly, where under certain conditions, the slightest abrasive action may expose the conductor and create a hazardous condition.

Inclusion of AWM remains an allowable option for cabling in NFPA 79 2015. Requirements for using AWM are clearly specified under section 12.9.2. The following provides a summary of the vitally important points when using AWM for compliance with the NFPA 79 2015 standard:

- Acceptance of AWM is not automatically permitted.
- AWM must be identified for use with the approved equipment.
- AWM must be used per the machine manufacturer's instructions.
- The AWM legend shall include the cable manufacturer's name or trademark, AWM Style number, voltage rating (unless prohibited), wire gauge, temperature rating, and flame resistance.
- Field installation information must be provided with the machine's technical documentation.

Specific information must be marked on the cable jacket, for example:



**Correct Print Legend Example:**

LAPP KABEL ÖLFLEX® 490P P/N 401603 16 AWG (1.5MM<sup>2</sup>)/3C  
 AWM 20234 600V 80C VW-1

**Incorrect Print Legend Example:**

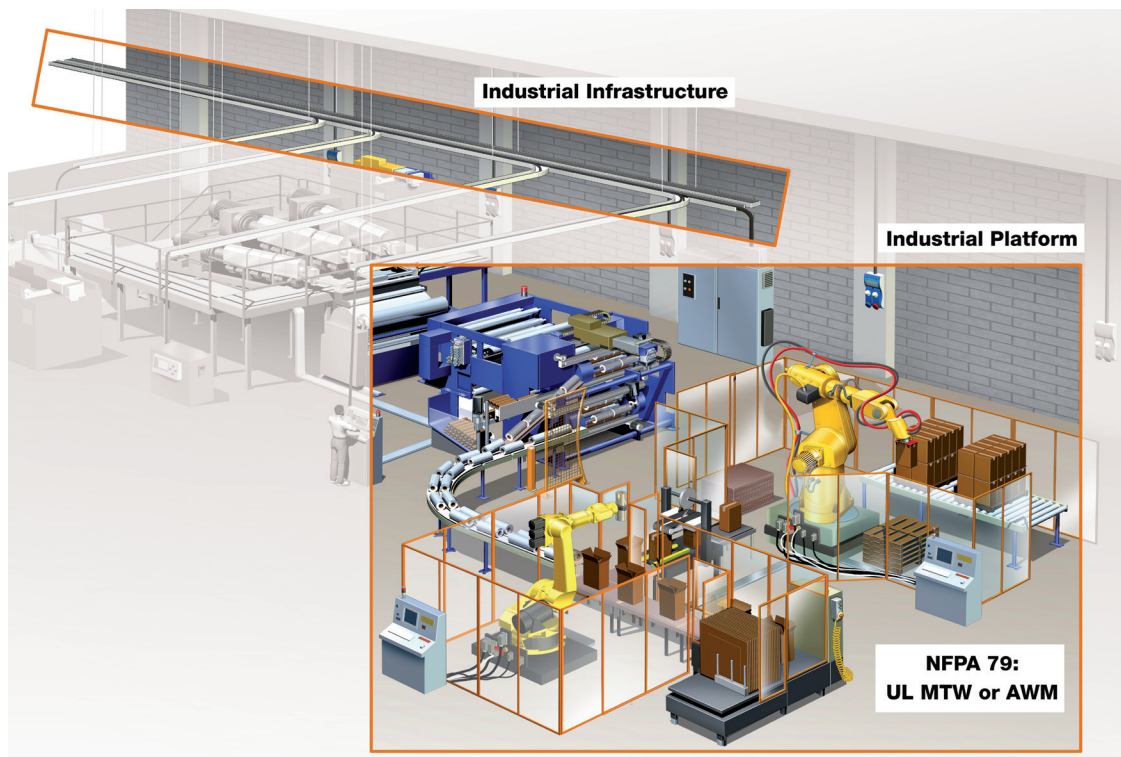
Average Joe Cable P/N 123456 16 AWG (1.5MM<sup>2</sup>)/3C  AWM

Including the detailed AWM information on the cable jacket fulfills the NFPA 79 2015 standard marking requirements and provides clearly visible information for inspection. These stringent marking requirements put an end to potentially fraudulent approvals, while also easing safety concerns.

When the NFPA 79 2007 AWM ban was in effect, cables used in machinery could only be marked on the jacket surface with a UL Listed  symbol instead of the Recognized Cable Component  logo more commonly known as AWM (Appliance Wiring Material). It's also important to remember that the final decision of local inspectors is based on their interpretation of NEC code regulations. They would not knowingly permit a non-listed product for use in an installation. When an inspector shuts down a facility, no further installation work is permitted and all progress is left at a standstill. Further, interpretation of the NEC code can vary greatly among inspectors. For example, what is considered acceptable in the state of New York may not be acceptable in New York City and vice-versa. As allowance for AWM remains per NFPA 79 2015, the UL Recognized component symbol can appear on the cable jacket surface without fear of rejection by inspectors.

**CONSIDERATIONS REGARDING EXPOSED CABLE**

Another key section in NFPA 79 2015 is 13.1.6.1, which indicates that exposed cables installed along the structure of the equipment or system, or in the machinery chassis, are permitted. Exposed cables must be installed to closely follow



**Diagram 1.** Communication Cables, Tray Cables, and Exposed Run, etc. — NEC Articles 336, 392, 501



the surface and structural members of the machinery. Section 13.1.6.1 permits cable to be installed without using conduit or raceways, enabling an economical, expedient, and tool-free installation. During installation, the cable is also permitted to be dressed along the existing machine structures without the use of any special hardware. The time and labor saved during machine installation results in a huge cost saving over traditional installation methods requiring conduit or special mounting and routing hardware.

Certain UL Listed cables meet Exposed Run (-ER) requirements, which provide an additional level of protection for Section 13.1.6.1 types of applications. Cables meeting -ER requirements are subjected to the same crush and impact tests as armored type or Metal Clad (MC) cables. The -ER permits cables to leave the machine area and enter into a cable tray without conduit. (See Diagram 1) UL Listed MTW cable — also permitted under NFPA 79 2015 — is well known in the industry for its high standard regarding superior flexibility, oil resistance, flame retardancy, and overall ruggedness. When a cable is UL dual-rated with both UL Listed and AWM approvals, customers can then use one cable to meet a variety of application requirements.

For applications where the cables required on a machine are not addressed in NFPA 79 2015, Section 1.5 allows machine builders to follow NEC Article 670. For example, in communication applications, UL Type CMG is allowed under NEC Article 800, but it must meet the stranding criteria referenced in the NFPA 79 2015 standard. Not all UL Listed cables meet NFPA requirements, especially the lower-priced commodity and more rigid generic types of products.

## CONCLUSION

In summary, it is of utmost importance to pay as much attention to the cables that will be used in equipment and machines as all the other costs associated with an installation. To ignore cable-specific requirements or consider them unimportant can be a very costly mistake, and ultimately result in a hazardous or life-threatening situation. With regard to industrial machine manufacturing and installation, the NFPA continues to promote safety to life and property through publication of the 2015 edition of NFPA 79.

By allowing the use of specific AWM, machine manufacturers, installers, contractors, end users and others are ensured that the correct cables will be used and provided with the machine. It is also crucial to remember that inspectors or the local Authority Having Jurisdiction (AHJ) are the only qualified individuals that can provide final determination concerning correct cable installation requirements. While Lapp USA can offer its opinion concerning NEC regulations, we are not an AHJ and are prohibited from providing any final determination.

## Lapp UL Listed Products Conforming to NFPA 79 2015

Product	Application	Key Features
ÖLFLEX® TRAY II Shielded & Unshielded	Stationary Control	Tray rated for extended runs, no need for conduit. Highly flexible for ease of installation, saving time and money. Highly oil and chemical resistant. MTW all sizes.
ÖLFLEX® TC 600	Stationary Control	Economical version of ÖLFLEX® TRAY II. MTW sizes 14 AWG and larger.
ÖLFLEX® CONTROL TM	Stationary Control	Flexible and oil resistant tray and machine cable. MTW all sizes.
ÖLFLEX® FORTIS	Stationary Control	Oil resistant, tri-rated cable for use in tray. Passes -40°C Cold Impact.
ÖLFLEX® 190 Shielded & Unshielded	Stationary Control	Highly flexible for ease of routing. Extremely oil resistant. MTW rating.
ÖLFLEX® AUTO-I	Stationary Control	Flexible tray cable with colored conductors for DC or AC control wiring.
ÖLFLEX® FD AUTO-X	Continuous Flex Control	Heavy duty continuous flex control cable.
ÖLFLEX® VFD SLIM	Stationary VFD Cable	Reduced-diameter VFD cable with a semiconductive insulation layer to withstand nonlinear power distortions.
ÖLFLEX® VFD with Signal	Stationary VFD Cable	Based on ÖLFLEX® VFD SLIM with pair for brake or temperature.
ÖLFLEX® FD VFD	Continuous Flex VFD Cable	Continuous flex VFD cable for moderate track applications.
ÖLFLEX® VFD 2XL	Stationary VFD Cable	Both 600V and 2000V TC-ER rating. Extended performance with an XLPE (plus) insulation and a phthalate-free jacket.
ÖLFLEX® VFD 2XL with Signal	Stationary VFD Cable	Based on ÖLFLEX® VFD 2XL with pair for brake or temperature.

## FREQUENTLY ASKED QUESTIONS

**1. Does UL dictate what cables are being installed out in the field?**

No, they control the construction and testing requirements of the cables which ensures that all electrical, physical, and environmental parameters are in compliance.

**2. Who controls the cables that are being installed in the field?**

The National Electrical Code regulations are cited by the local Authority Having Jurisdiction, which is generally the local electrical inspector.

**3. Does a machine have to meet NFPA 79?**

Depending upon your application and whether your product is being installed in a building – yes. If you are not sure of the final destination of the machine it is advisable to comply with NFPA 79 for purposes of compliance and safety and also to avoid any unnecessary litigation.

**4. If the cable is UL Listed is it allowable for use on a machine?**

No, not necessarily. There are machines that use Listed cordage incorrectly, since these cable types are only intended for temporary applications. Even if your cables have a UL Listing, the minimum stranding count required by NFPA 79 must be met.

**5. Is NFPA 79 a law?**

No, this document is only a standard used by the machinery industry in the U.S. as the benchmark in safety compliance.

**6. What about FD products?**

Depending on specific flexing applications there are different types of material blends that meet the NFPA 79 requirements and will hold up well in this type of environment.

**7. Is the industry going to become standardized with the 2015 edition of NFPA 79?**

In the long run yes, due much in part to issues surrounding liability and safety. In short, nobody will purchase a machine that does not comply with NFPA 79 2015, as doing so could possibly expose them to liability.

**8. If my cable is MTW, can it be run into building infrastructure?**

No, it has to be dual marked with another UL Listing such as “TC” which indicates the cable complies with a very high flammability rating. MTW requirements mandate that a cable only meet a minimal type of flame test, VW-1.

**9. Can the cable be left exposed when going from the machine to the cable tray?**

No, unless the cable has an Exposed Run approval such as TC-ER (according to UL 1277).

**10. Are MTW cables required to be oil resistant?**

Yes, all MTW cable must meet the requirements of the Oil Res I test due to the demanding requirements that are associated with industrial machine environments. In those applications requiring more severe exposure, the Oil Res II test is also a permitted option for cable manufacturers which provides extra durability.

**11. What is unique about the MTW Listing?**

MTW requires that the cable be flexible and yet have a high degree of mechanical durability so it can maintain performance under the challenging conditions surrounding the everyday use of an industrial machine.

## REGULATORY DEFINITIONS

**NFPA** – The National Fire Protection Association (NFPA) has no power, nor does it undertake to police or enforce compliance with the contents of the National Electrical Code. The NFPA does not list, certify, test, or inspect products or design installations for compliance with the NEC. The NFPA also makes no guarantee or warranty as to the accuracy or completeness of any of the information published in the National Electrical code.

**NEC** – The National Electrical Code (NEC) is considered purely advisory as far as the NFPA is concerned. It is made available for a wide variety of both public and private sector uses in the interest of life and property protection. These include for use both in law and regulatory purposes and in private self-regulation and standardization activities such as insurance underwriting, building and facilities construction, and product testing and certification.

**UL** – Underwriters Laboratories Inc. UL is an independent organization providing safety-related certification, testing, inspection, and training services. There are no laws specifying that a UL Mark must be used. However, in the U.S. there are many municipalities that have laws, codes, or regulations which require a product to be tested by a Nationally Recognized Testing Laboratory (NRTL). UL does not, however, maintain a list of the jurisdictions having such regulations.

**Authority Having Jurisdiction (AHJ)** – The organization, office, or individual responsible for approving equipment, materials, and installation or a procedure.

**Listed** – Equipment, materials, or services included in a list published by an organization that is acceptable to the Authority Having Jurisdiction for product evaluation and periodic inspection. Listing states that the equipment, material, or service either meets appropriate designated standards or has been tested and found suitable for a specific purpose.

**Labeled** – Equipment or materials that have been labeled with the identifying mark of an organization which is acceptable to the Authority Having Jurisdiction for product evaluation and periodic inspection of production of labeled equipment or materials. Labeled items indicate manufacturer compliance with appropriate standards or performance in a specified manner.



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