NFPA 79
ELECTRICAL STANDARD
FOR INDUSTRIAL MACHINERY

2012 EDITION

WHITE PAPER

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MEETING THE NEW NFPA 79 2012 CABLE REQUIREMENTS

NFPA-79 is the section of the National Electrical Code (NEC) that focuses on electrical wiring standards used with industrial machinery. 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 machine’s electrical and electronic elements operating at 600V or less.

In 2007, NFPA-79 underwent significant revisions in order to harmonize it with IEC-60204, its European counterpart. 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 conductor or multi-conductor AWM shall not be permitted, unless the completed assembly was listed prior for such use. Many industry participants considered this change an unrealistic requirement, and it was soon realized that further clarification was necessary. With the release of NFPA-79 2012, the use of AWM is now permitted as long as certain requirements are met as specified in the NFPA-79 electrical standard. That said, the acceptability of AWM requires a thorough review of the standard because the allowance is not automatic. If the new requirements are not followed, or are deemed noncompliant by the inspection authority, serious repercussions could occur.

PROPER CABLE SELECTION SHOULD NOT 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 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 builder, 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, insuring proper cable selection becomes 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 many manufacturers use low-cost materials not up to code with thin insulation to provide a lucrative cable price for the end user. In the long run, these substandard cables end up being replaced at the end user’s facility. 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 remain unresolved and the fallout from this recall is ongoing. Machine manufacturers are generally given two options when their products fail in an end user’s facility: 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 circuits, lighting and control circuits, programmable input/output controllers and motor circuits. When AWM was omitted in the 2007 NFPA-79 code, this prohibited its use in industrial machines. No longer was the use of AWM allowed; if used anyway, an unanticipated onsite inspection could result in a shutdown. Overseas equipment manufacturers who were supplying AWM with their machines as part of a “complete package” for installation in U.S. factories were no longer permitted to do so. AWM was omitted for several reasons from NFPA-79:

- 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,
providing virtually no mechanical protection where the slightest abrasion will expose the conductor and create hazardous conditions.

To permit inclusion of AWM as an allowable option for cabling in NFPA-79 2012, the above concerns had to be addressed and resolved to the satisfaction of all standard committee members. This required much in-depth analysis of which requirements would be mandated in the standard to insure there would be no safety concerns. NFPA-79 2012 section 12.9 covers the requirements when using AWM, and the following summarizes the vitally important points of this section:

- 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 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 appear on the cable jacket, for example:

**Correct Print Legend Example:**
LAPP KABEL OLFLEX® 490P P/N 401603 16 AWG (1,5MM²)/3C
AWM 20234 600V 80C

**Incorrect Print Legend Example:**
Average Joe Cable P/N 123456 16 AWG (1,5MM²)/3C
AWM

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

When the 2007 AWM ban was in effect, cables used in machinery could only be marked on the jacket surface with a UL Listed marking symbol instead of the Recognized Cable Component (RU) 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 New York State may not be acceptable in New York City and vice-versa. Now that AWM is permitted per 2012 NFPA-79, the UL Recognized component symbol can appear on the cable jacket without fear of rejection by inspectors.
CONSIDERATIONS REGARDING EXPOSED CABLE

Another key section in the 2012 NFPA 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 the surface and structural members of the machinery. This section permits cable to be installed without using conduit or raceways, thereby enabling fast and tool-free installation. During installation, 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 savings over traditional installation methods requiring conduit or special mounting hardware.

Certain UL Listed cables meet Exposed Run (-ER) requirements, which provide an additional level of protection for these types of applications. Cables meeting -ER requirements are subjected to the same crush and impact tests as armored type or Metal Clad (MC) cables, allowing 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 — is well known in the industry for its high standard regarding superior flexibility, oil resistance, flame retardancy and overall ruggedness. When cable is UL dual-rated with both cable approvals, customers are able to use one cable to meet a variety of application requirements.

For applications where the cables required on a machine are not addressed in 2012 NFPA-79, Section 1.4 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 stranded criteria referenced in the NFPA standard. Not all UL Listed cables meet NFPA requirements, especially lower-priced commodity and rigid 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 required for an installation. To ignore cable-specific requirements or consider them unimportant can be a very costly mistake, and could even cause a hazardous or life-threatening condition. With regard to industrial machine manufacturing and installation, the NFPA has taken a major step in addressing these critical issues by publishing its latest document, the 2012 edition of NFPA-79.

By allowing the use of specific AWM, machine manufacturers, installers, contractors, end users and others are insured that the correct cables will be used and provided with the machine. It is also crucial to remember that inspectors, or the authority having jurisdiction in the area, are the only qualified individuals that can make the final decision regarding the correct cable requirements for an installation. We at Lapp USA can provide an opinion as to our interpretation of NEC regulations, but remember that is strictly what it is, an opinion. We do not have jurisdictional authority to provide a determination, but we can offer product solutions.

Lapp UL Listed Products Conforming to NFPA 79 2012

<table>
<thead>
<tr>
<th>Product</th>
<th>Application</th>
<th>Key Features</th>
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<tbody>
<tr>
<td>ÖLFLEX® TRAY II</td>
<td>Stationary Control</td>
<td>Tray rated for extended runs, no need for conduit. Highly flexible for ease of installation, save time and money, highly oil and chemical resistant. MTW all sizes</td>
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<tr>
<td>Shielded &amp; Unshielded</td>
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<tr>
<td>ÖLFLEX® TC 600</td>
<td>Stationary Control</td>
<td>Economical version of ÖLFLEX® TRAY II. MTW sizes 14 AWG and larger</td>
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<tr>
<td>ÖLFLEX® CONTROL TM</td>
<td>Stationary Control</td>
<td>Flexible and Oil resistant Tray and Machine Cable. MTW all sizes</td>
</tr>
<tr>
<td>ÖLFLEX® FORTIS</td>
<td>Stationary Control</td>
<td>Oil Resistant, Tri-rated Cable for use in Tray and Passes -40ºC Cold Impact</td>
</tr>
<tr>
<td>ÖLFLEX® 190</td>
<td>Stationary Control</td>
<td>All advantages of 190 cable plus MTW rating</td>
</tr>
<tr>
<td>Shielded &amp; Unshielded</td>
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<tr>
<td>ÖLFLEX® Auto I</td>
<td>Stationary Control</td>
<td>Available in Blue and Red conductors to differentiate DC and AC Control Circuits. MTW sizes 16 &amp; 18 AWG</td>
</tr>
<tr>
<td>ÖLFLEX® -FD 879</td>
<td>Continuous Flex Control</td>
<td>Designed for Continuous Flex Cable Tracks or Chains, Highly Oil and Chemical Resistant with UL MTW</td>
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</tr>
<tr>
<td>ÖLFLEX® VFD Slim</td>
<td>Stationary VFD Cable</td>
<td>Reduced diameter, flexible VFD cable with “Lapp Surge Guard” with UL and CSA TC Approval. MTW all sizes</td>
</tr>
<tr>
<td>ÖLFLEX® VFD XL</td>
<td>Stationary VFD Cable</td>
<td>Oil Resistant, VFD Cable for Control and Precision</td>
</tr>
<tr>
<td>ÖLFLEX® with Signal</td>
<td>Stationary VFD Cable</td>
<td>First CSA TC Servo cable in USA, contains a pair for brake. MTW all sizes</td>
</tr>
<tr>
<td>ÖLFLEX® SYMMETRICAL</td>
<td>Stationary VFD Cable</td>
<td>Large AWG VFD Cables for use in Tray with Industrial Size Motors.</td>
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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 insuring that all electrical, physical, and environmental parameters are in compliance.

2. **Who controls the cables that are being installed in the field?**
   National Electrical Code regulations cited by the authority having jurisdiction in the area 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 building – yes. If you are not sure of the final destination of the machine it 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 as 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 the NFPA-79 a law?**
   No, this document is only a standard used by the machinery industry in the USA as the bench mark in safety compliance.

6. **What about FD products?**
   Depending on specific flexing applications there are different types of material blends that meet the NFPA79 requirements and will hold up well in this type environment.

7. **Is the industry going to become standardized with the 2012 edition of the NFPA-79?**
   In the long run yes, due much in part to issues surrounding liability and safety. In short no one will purchase a machine that does not comply that 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 approval?**
    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) acts as the sponsor of the National Electrical Code. The NFPA itself has no power, nor does it undertake, to police or enforce compliance with the contents of the National Electrical Code. The NFPA also does not list, certify, test or inspect products, designs, or 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 uses in the interest of life and property protection. These include both use in law and for regulatory purposes and use in private self-regulation and standardization activities as insurance underwriting, building and facilities construction and management and product testing and certification.

(UL) – Underwriters Laboratories Inc. (UL) is an independent, not-for-profit product-safety testing and certification organization. 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. 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, an 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 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 the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specific purpose.

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.