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Industrial Machinery Standards:

NFPA 79 for North America in comparison to IEC / EN 60204-1 for Europe

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Introduction

Every year, European manufacturers export thousands of electrical products to the North America and Canada. Sometimes these products are unwittingly non-compliant simply because European manufacturers are unfamiliar with the equipment rules that apply in the individual US states or that are required by specific Authorities Having Jurisdiction (AHJs) and the Occupational Safety and Health Administration (OSHA).

Building a compliance programme that accommodates the wide variety of requirements from different US institutions is complex and sometimes confusing. A manufacturers lack of understanding of local and national US laws and their implementation, can lead to some requirements being overlooked which can delay product entry at port – eating into the sales calendar; or a simple non-compliance that could have been resolved with a design 'tweek' before release, being missed – and the equipment later needs to be recalled or modified as a result.

To help manufacturers of machinery and equipment make sense of the requirements, and reduce the risk of delays through non-conformity and their associated costs, this paper will highlight some of the key differences between the IEC / EN 60204-1:2006 Safety of Machinery Standard and NFPA 79 the Electrical Standard for Industrial Machinery in the North America. Although both Standards seem similar, there are significant differences between them that manufacturers need to consider when preparing machinery for North America.

Background to the NFPA 79 - Electrical Standard for Industrial Machinery

The National Fire Protection Association (NFPA) was founded in 1896 and is the issuing body of a comprehensive set of regulations for fire protection – having developed and published more than 300 codes and Standards.

For manufacturers of industrial equipment and machinery, the National Electrical Code (NEC) also known as NFPA 70, and NFPA 79 the Electrical Standard for Industrial Machinery are the most important compliance considerations for electrical, mechanical and plant engineering.

The NEC is the Standard for the development of public and private building installations that connect to the supply of electricity.

The Code is updated every three years and has a high legal status. Each new issue must come from individual federal states and local bodies – and these are officially adopted as requirements.

But be aware, in different states, different issues of the Code apply. Some are using the current version, some the previous one and some the one before that. Its worth checking with your distributors which version of the Code locally applies when trying to plan your compliance activities. You can also check the NEMA Trade Association site – which carries a useful territorial map

(http://www.nema.org/stds/fieldreps/NECadoption/implement.cfm)

Additionally, in some larger cities local variations to the NEC apply. The local Building Codes supplement or amend the NEC and should be considered according to your distribution destinations.

NFPA 79 verses EN 60204-1

Despite certain similarities between the two Standards, it is important for European Manufacturers to understand the difference. For example, a machine built in accordance with NFPA 79 and supported by appropriate CE Marking documentation could theoretically be placed on the market in Europe. However a machine built in accordance to EN 60204-1, would not be compliant with NFPA 79, and could not be installed in North America. This is because the requirements of NFPA 79 are significantly more detailed than those of EN 60204-1.

Definition of Industrial Machinery

Their terminology of what constitutes an industrial machine differs significantly between the two documents. NFPA 79 specifies particular types of equipment and processes. In Chapter 3, section 3.3.56 'Industrial Machinery' (Machine) is defined as:

> " A power-driven machine (or group of machines working together in a coordinated manner), not portable by hand while working, that is used to process material by cutting; forming; pressure; electrical, thermal, or optical techniques; lamination; or a combination of these processes. Machine can include associated equipment used to transfer material or tooling, including fixtures to assemble/disassemble, to inspect or test, or to package. [The associated electrical equipment, including the logic controller(s) and associated software or logic together with the machine actuators and sensors, are considered as part of the industrial machine.]"

In section 3.35, EN60204-1 gives a more general definition of 'Machine' and 'Machinery' as:

> "assembly of linked parts or components, at least one of which moves, with the appropriate machine actuators, control and power circuits, joined together for specific application, in particular for the processing, treatment, moving or packaging of material."
>
> "The term 'machinery' also covers an assembly of machines which, in order to achieve the same end, are arranged and controlled so that they function as an integral whole."

So equipment that does not fall under this category of 'Machine' in the EU may do so in North America and will need to be assessed accordingly.

NB. A device or a small machine is covered in the normal case of a product standard and not by the NFPA 79. Examples include: UL 775 - Graphics Arts Equipment, UL 1740 - Industrial Robots; UL 73 - Motor-operated appliances.

Voltage Differences

The differences in scope of each document highlight the different applicable voltages between the Standards:

Paragraph 1.1 of the NFPA 79 defines its Scope:

> "1.1.1 The provisions of this standard shall apply to the electrical/electronic equipment, apparatus, or systems of industrial machines operating from a nominal voltage of 600 volts or less, and commencing at the point of connection of the supply to the electrical equipment of the machine."

Whilst Paragraph 1 of the EN60204-1 defines its scope as:

> "… applies to the application of electrical, electronic or programmable electronic equipment and systems to machines not portable by hand while working, including a group of machines working together in a co-ordinated manner…"

And adds:

> "…is applicable to electrical equipment or parts of electrical equipment that operate with nominal supply voltages not exceeding 1000 V for alternating current (AC) and not exceeding 1500 V for direct current (DC) with nominal supply frequencies not exceeding 200Hz"

Terminology

As you would expect, both documents use a great deal of common terminology when describing machinery (such as 'actuator', 'ambient temperature' and 'barrier' and so on - though each with a slightly different definition – but similar enough to find a degree parity between the two Standards), but interestingly NFPA 79 also specifies definitions for words key to the implementation and understanding of the requirements, whereas EN 60204-1 doesn't.

In Chapter 3 of NFPA 79, compliance terminology is specifically addressed:

> "3.2.1 Approved Acceptable to the Authority Having Jurisdiction.
>
> 3.2.2 Authority Having Jurisdiction An organisation, 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 Labelled Equipment or materials to which has been attached a label, symbol or other identifying mark of an organisation that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labelled equipment or materials, and by whose labelling 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 organisation that is acceptable to the authority having jurisdiction and concerned with the evaluation of products or services, that maintains periodic inspection of production listed equipment or materials or periodic inspection of services,

whose listing states that either the equipment, material or services 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."

Related compliance terminology is defined and explored for European requirements in the Machinery Directive – regional legislation that governs the build and use of machinery in the EU.

Technical Documentation

Chapter 17 of NFPA 79 specifies more detailed technical documentation requirements for Machinery than European manufacturers would be familiar with under EN 60204-1

NFPA 79	EN 60204-1
1) Clear, comprehensive description of the equipment, installation and mounting, and the connection to the electrical supply(ies)	1) A main document (parts list or list of documents)
2) Electrical supply circuit(s) requirements	2) Electrical supply(ies) requirements
3) Overview (block) diagram(s) where appropriate	3) Information on the physical environment (for example, lighting, vibration, atmospheric contaminants) where appropriate
4) Schematic diagram(s)	4) Overview (block) diagram(s) where appropriate
5) Information (where appropriate) on the following: a) programming b) sequence of operation(s) c) frequency of inspection d) frequency and method of functional testing e) adjustment, maintenance and repair f)interconnection diagram g) Panel layouts h) Instruction and service manuals i) Physical environment (e.g lighting, vibration, noise levels, atmospheric contaminants)	5) circuit diagram(s)

NFPA 79	EN 60204-1
6) A description (including interconnection diagrams) of the safeguards, interacting functions, and interlocking of guards with potentially hazardous motions	6) Information (as applicable) on: Programming as necessary for use of the equipment Sequence of operation(s) Frequency of inspection Frequency and method of functional testing Guidance on the adjustment, maintenance, particularly of the protective devices and circuits Recommended spare parts list and; List of tools supplied
7) A description of the safeguarding means and methods provided where the primary safeguards are overridden (e.g. manual programming, program verification)	7) A description (including interconnection diagrams) of the safeguards, interlocking functions, and interlocking of guards against hazards, particularly for machines operating in a coordinated manner
8) Information for safety lockout procedure	8) A description of the safeguarding and of the means provided where it is necessary to suspend the safeguarding (for example for setting or maintenance)
9) Explanation of unique terms	9) Instructions on the procedures for securing the machine for safe maintenance
10) Parts List and recommended spare parts list	10) Information on handling, transportation and storage
11) Maintenance instructions and adjustment procedures	11) Information regarding load currents, peak starting currents and permitted voltage drops; as applicable
12) Reference information (where appropriate) on the following: a) Lubrication diagram b) Pneumatic diagram c) Hydraulic diagram d) Miscellaneous system diagrams (e.g. coolant, refrigerant	12) information on the residual risks due to the protection measures adopted, indication of whether ant particular training is required and specification of any necessary personal protective equipment

Cabling Requirements

The requirements for machine cabling differ between the two Standards largely due to the differences in grid currents and the colour coding of wiring. For example, in Europe the grounded neutral conductor cable is blue whereas in the US it is white or grey. The PE conductor (grounding conductor) in Europe is green and yellow in North America it can either be green or green and yellow.

Machines carrying EU colour coded cabling will be non-complaint in North America, so manufactures will need to source appropriate NA cable instead. Additionally particular connectors may be required.

Operating Conditions

The standards share similar parameters for operating conditions, but again the North American requirements are more detailed.

NFPA 79	EN 60204-1
4.3 Electrical Supply	
4.3.1 Alternating Current (AC) Supplies Voltage Frequency Harmonics Voltage unbalance Voltage impulses Voltage interruption Voltage Dips	
4.3.3 Direct Current (DC) Supplies from Batteries Voltage Voltage Interruption	
4.3.4 Direct Current (DC) Supplies from converting equipment Voltage Voltage interruption Ripple (Peak to Peak)	
4.4 Physical Environment General EMC Ambient operating temperature Relative Humidity Altitude	4.4.1General 4.42 EMC 4.4.3 Ambient temperature 4.4.4 Humidity 4.4.5 Altitude 4.4.6 Contaminants

NFPA 79	EN 60204-1
Contaminants Non-ionizing radiation Vibration, shock and bump	4.4.7 ionizing and non-ionizing radiation 4.4.8 vibration, shock and bump
4.5 Transportation and storage	4.5 Transportation and storage
4.6 Provisions for handling	4.6 Provisions for handling
4.7 Installation & Operating Conditions	4.7 Installation
4.8 Available fault current	

Application of the Standards

How the Standards are applied in each territory is essentially the same:

- Both are used by manufacturers during the design phase as reference when 'designing for compliance' for a target territory
- Both would be used as a reference source locally by specifiers looking to purchase geographically compliant equipment
- In the relevant territory, each would be used by field inspectors, assessing and certifying equipment on site – alongside other applicable Standards such as the ANSI-UL 508A Standard for Industrial Control Panels – Cabinets, or ANSI UL 1740 Standard for Robots and Robotic Equipment.
- Test and certification houses will use the Standards as the basis of their assessment programmes before a product is released for sale.
- In North America, Authorities Having Jurisdiction (AHJs), will use NPFA 79 as part of their enforcement activities to check equipment on site – but this is often refined further by local interpretation of the Standard and the application of additional local laws on site.

In the EU, the emphasis is largely on compliance with relevant Directives, rather than specific Standards. Whilst proving you can meet the requirements of an applicable Standard can be used as evidence of conformity with a particular Directive, other considerations such as labelling, Marking, a Declaration of Conformity, the generation of a technical file and in some cases risk assessment also need to be considered.

Conclusions

Just as the European and Asian territories have a mixture of requirements for importers in specific regions - so too does North America.

The NFPA 79 Committee is working towards harmonising the Standard with IEC /EN 60204-1 and whilst this process is ongoing, Manufacturers should continue to check the requirements state to state to ensure that they have appropriate proofs of compliance in place to prevent impeded market access.

However, even harmonisation won't remove all of the subtle complexities of US market compliance. Certain cities and states will continue to have variant requirements which their Authorities Having Jurisdiction will continue to enforce – and therefore will still need to be met – but there is no easy solution to this and each project should be met on a case by case basis.

Manufacturers exporting to the US should to seek advice on their regional obligations from their distributors, the local authorities in their target states and their partner certification bodies, as early in the build cycle as possible, to ensure all of the requirements are planned for to avoid expensive delays and potentially product re-designs.

Tips for US Machine Compliance

- Check to see if your machine falls under the North American regulations
- Check with your partner certification body as to the requirements for your target states and build provision for compliance with these into your compliance schedule (treat them as you would national deviations within the EU)
- You can ask your local distributors who the Authorities Having Jurisdiction (AHJs) are in your target states and contact them to check what they accept.
- Find as many states with common regulations as you can, and focus on exporting to these initially until you are able to accommodate variations in your product designs for the other territories.
- If you are building custom equipment for a particular site, obtain as much information as you can about the site environment, the equipment that yours will be connected to and the local requirements of the AHJs.

- Check your technical documentation carefully to make sure it complies with NFPA 79. The requirements for North America are more specific than European requirements.
- Invest in a copy of the NFPA 79 Standard as a source of reference.

Glossary

AHJ	Authority Having Jurisdiction - local authority, gives the operator the authorization for the connection of electrical equipment.
ANSI	American National Standards Institute - Standards writing body (e.g. ANSI / NFPA 79 or ANSI / UL 73).
ASME	American Society of Mechanical Engineers - Standards writing body
CEC	Canadian Electrical Code or California Energy Commission – depending on the geographical location concerned.
CSA	Canadian Standards Association - Standards writing body
ESA	Electrical Safety Authority - responsible for electrical safety in Ontario, Canada.
ETL	A Certification Mark for North America - is awarded by Nationally Recognised Test Laboratory (NRTL) Intertek to demonstrate complete compliance with appropriate product Standards.
FCC	The Federal Communications Commission is an independent authority. It sets up the communication radio, television, satellite and cable (EMC). It checks devices for compatibility with their own and other standards
NEC	National Electrical Code, NFPA 70.
NEMA	National Electrical Manufacturers Association - standards body, such as classification of enclosures (NEMA type), similar to IP protection
NFPA	National Fire Protection Association - issues Standards such as NFPA 79 "Electrical Standard for Industrial Machinery" (similar to EN 60204).
NRTL	National Recognized Testing Laboratory - an OSHA accredited laboratory for test and certification the electrical equipment and able to issue certification Marks (e.g. ETL)

OSHA Occupational Safety & Health Administration, the US Accrediting body and part of the US Department of Labour (Comparable to the Health & Safety Executive in the UK)

SCC Standards Council of Canada - including the accredited testing laboratories in Canada.

UL Underwriters Laboratory - Standards writing body.

How Intertek can help with US territory compliance

- We are a Nationally Recognised Test Laboratory (NRTL) able to test and certify (with the ETL Mark) products for North America to demonstrate compliance.
- We can offer field labelling and on-site machine inspections
- As recognised and accredited experts in machine technology, we can provide technical interpretations on Standards and 'engineering judgements' on custom equipment that requires assessment but that falls outside the scope of current Standards.
- Our experts work with US city, state and national requirements every day and can provide guidance on what your obligations are in a particular territory.
- As an EU Notified Body and a US Nationally Recognised Test Laboratory (NRTL) we can provide gap analysis of your existing certifications and approvals to highlight what else you need to do.
- We are a test and Certification Body within the IEC CB scheme and can provide you with a range of testing and CB test certificates for market access
- We have an international network of over 100 test laboratories, so we can provide services to you, close to the point of manufacture.

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Source documents

NFPA 79 Electrical Standard for Industrial machinery 2007 Edition

BE EN 60204-1 2006 Safety of machinery – electrical equipment of machines Part 1: general requirements

For more information on specific testing and certification information, please contact Intertek at 1-800-WORLDLAB, email icenter@intertek.com, or visit our website at www.intertek.com.