Table 29-1: UL-Marking at Cables & Wires and its intended use

(UL) or (UL) UL Listing Mark for listed cables & wires

UL Listed Cables and Wires covered by this category are intended for use as fixed wiring for three general building types: residential, commercial and industrial. Listed wire and cable must not only comply with the applicable individual UL standards but also with requirements indicated under specific Articles of the National Electical Code.

The National Electrical Code defines specific end use application and where a particular Listed wire or cable is installed. Listed cables and wires are applicable for factory wired equipment (such as electrical devices, equipment, appliances, as well as machines) as well as for local field wiring purpose (see NEC & NFPA 79).

Typical type designations of Listed cables, wires and flexibel cords:
MTW, TC, PLTC, CM, CL2, THHN, THWN; SO, SOO, ST, STO, SJT, SJTO.

Some Lapp Kabel multi listed/ multi approved products:
ÖLFLEX® TRAY II, ÖLFLEX® VFD TC; ÖLFLEX® CONTROL TM/ÖLFLEX® CONTROL M; ÖLFLEX® AUTO-X; Multi-Standard SC 2.1; Multi-Standard SC 2.2, UNITRONIC® BUS, UNITRONIC® 300. More details see table T29-4.

Approval mark at the product:
(UL) = UL Listing mark.

UL Recognition Mark for AWM cables and wires

Appliance Wiring Material better known under the abbreviation of “AWM“ covers wire and cable intended for use as factory installed components of a complete equipment, such as elctrical devices, appliances. In control panels or industrial machines only if as a part of a listed assembly (NFPA 79 Edition 2007).

Appliance Wiring Material is not intended for use in direct separate installation in the field. Wire or cable indicating a UL AWM style marking is intended for applications that are unique to each individual style sheet. The usage statement of an individual style sheet will indicate specific end use limitations of the AWM wire or cable.

If a Manufacturer desires to obtain NRTL listing for their new piece of equipment they must submit their design to the NRTL. The entire listing process will move much more quickly and easily if all internal components used within the equipment design are UL listed or UL recognized.

If the internal components are not UL listed or UL recognized then the Listing process will take much longer and cost more as the individual components now must be tested for compliance. AWM can also be used externally to interconnect the Listed Components such as the data assembly that connects a computer to a printer (see www.ul.com).

Note:
Multinorm cables and wires. Metric- (mm^2) and AWG/MCM-conductor sizes of multinorm cables and wires often do have special conductor strands, so one of both of the conductor sizes is typically (slightly) oversized regarding its nominal cross section. This may occur a particular wiring problem when clamping range of the terminal is strictly limited to one uniqe gage size.

Futher informations to that subject:
Table T 11 Conductor resistance and conductor make-up (metric)
Table T 16 Anglo-American Units
Table T 13 Power Ampacity to cables & wires NFPA 70 (National Electrical Code)
NFPA 79 Electrical Standard of Industrial Machinery

How to get Lapp UL-approval certificates online quick and easy

This link: http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm allows every internet user a direct access to UL’s Online Certification Directory. Insert “**U. I. Lapp**” or “**Lapp USA**” into the field “company name” and you will get all Lapp approvals under its individual file numbers/Control Category Numbers (CCN).

Table 29-2: NFPA – Use of Cables and Wires for Industrial Machinery in the USA

NFPA 79 is the section of the National Electric Code (NEC®) that focuses on the electrical wiring standards used with industrial machinery. NFPA 79 applies to the electrical equipment used within a wide variety of machines, as well as groups of machines working together in a coordinated manner. Examples of industrial machinery include, among others: machine tools, injection molding machines, woodworking equipment, assembling machinery, material handling machinery – in general machines to process and to transfer material. This is clearly differentiated from e.g. equipment for 'people transfers'.

The scope of NFPA 79 includes all electrical and electronic elements of the machinery operating at 600V or less. In 2006, the NFPA 79 code underwent significant revisions. The main goal of the revision was to further harmonize NFPA 79 with its European counterpart, IEC/EN 60204. This involved reorganizing the NFPA 79 chapter structure to follow IEC/EN 60204 while adopting state-of-the-art safety standards. As of January 2007, one of the major changes in the NFPA 79 is the cable selections required under section 12.2.7.3. This section states that (Note: ...within the scope of NFPA 79) single conductor or multi-conductor AWM (Note: ...nowadays still widely spread) shall not be permitted, unless the completed assembly has been listed prior for such use. (Note: ...'complete assembly' often refers to elektrical subsystems, described by an UL-standard, e.g. Industrial Control Panels in acc. with UL-508A) Machine Tool Wire (MTW) is one of the wire and cable permissible options. Wiring inbetween a group of machines often makes Tray Cables (TC) become the best economical solution in compliance with NFPA 79.

Today, with ever increasing concerns of liability issues it is more important than ever to meet regulatory requirements and proper cable selection for industrial machinery. Especially with present day global supply access, the tightening of NFPA79 requires much more attention to cable selection to ensure performance reliability.

We strive to keep our customers aware of breaking industry changes. In a tight cooperation with our colleagues from Lapps manufacturing- and sales center at Florham Park, New Jersey www.lappusa.com Lapp offers a variety of product solutions that are UL Listed and conform to the
NFPA 79, 2007 Edition. E.g. ÖLFLEX® CONTROL M, ÖLFLEX® CONTROL TM, ÖLFLEX® TRAY II.

Please find further information at: www.lappkabel.com => SERVICE => knowledge Center => NFPA 79

The diagram illustrates key NEC® and NFPA regulatory codes for an industrial plant manufacturing floor. Each code calls out permissible cables. 'NEC®' is a registered trademark of the National Fire Protection Association.

Table 29-3: NFPA – Use of Cables and Wires for Industrial Machinery in the USA

General requirements regarding design, manufacturing and usage of Industrial Machinery in USA
Machinery may accepted as being safe if they are desigend, manufactured and tested according federal law issued by the Occupational Safety and Health Administration (OSHA: www.osha.gov) as well as to local (State-, County-, City-) laws and safety has been testified and certified by a Nationally Recognized Testing Laboratory (NRTL). A NRTL listing or -labeling mark at the machine is required as the "visual proof" to local inspectors (Authorities having Jurisdiction) as being tested and certified.

NFPA 79 Electrical Standard for Industrial Machinery Edition 2007
The National Fire Protection Assosiation (www.nfpa.org) is authorised issuer of that important Electrical Standard for Industrial Machinery.

NFPA 79 Edition 2007 quasi is the US-American counterpart to the International Standard IEC 60204-1 = European Standard EN 60204-1, regarding safety of machinery. NFPA 79, Chapter 12 covers requirements regarding use of cables & wires for machines.

Conductors, cables and cords shall be listed Type AWM shall be permissible, when part of a listed assembly suitable for the intended application.

Herewith some general requirements:
- Conductors of motor supply cables shall have an ampacity not less than 125% of the motor full-load current rating.
- Minimum conductor size for power circuits is 14AWG.
- Minimum conductor size for lightning and control circuits is 18AWG
- Minimum conductor size for electronic-programmable control circuits (inputs/outputs) is 24AWG.
- The combined cross-sectional area of all conductors and cables shall not exceed 50% of the interior cross-sectional area of the raceway, conduit or wireway.
- Conductors and cables shall not be subject of mechanical, chemical and thermal effects based damages.

A common method of protection is wiring inside of raceways, wireways and conduits along its entire run. Cables on cable trays must have a "cable tray rating". In industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation, TC cable having additional approval for "open wiring" is allowed to be used from tray to a peace of equipment without the use of conduits [NEC® <NFPA 70> 2008, Article 336.10(6)].

In Fall 2003 the requirement of marking "open wiring" of TC cables have been changed into marking "Exposed Run (-ER)" by decision of the UL Standards Technical Panel for power cables. Use of TC cables having "open wiring" or "exposed run"-approvals, such as Lapp Kabel ÖLFLEX® CONTROL M+TM, ÖLFLEX® TRAY II, ÖLFLEX® VFD CT, ÖLFLEX® AUTO X, ÖLFLEX® AUTO I, UNITRONIC® 300 cables, allows much more faster and cost-saving installations.

NFPA 79 reffers in specific aspects to the National Electrical Code (NEC, USA). Chapter 1.4.1. Wiring between component machines of an industrial manufacturing system shall be covered by NFPA 70 (NEC). Especially if machinery wiring is attached to the building. In such cases it have to be done by an adequate wiring method described by relevant articles of the NEC.

NEC (National Electrical Code) Handbook Edition
NEC® <NFPA 70> 2008
This code covers the standard NFPA 70. The Handbook Edition offers additional informations given by tables, grafics, pictures, comments e.t.c. The NEC Handbook as well as NFPA 79 Standard is available via NFPAs webside: www.nfpa.org

UL 508-A Moreover:
Industrial Control Panels can be designed, manufactured and labeled under UL 508-A Standard (www.ul.com).

Table 29-4: Survey of respective products in this catalogue ('Listed')

Lapp cables with UL listing	Listed type	Rated voltage in V	Rated Temperature in °C	Material
Multi-Standard SC 2.1	MTW	600	90	PVC
Multi-Standard SC 2.2	MTW	600	90	PVC
ÖLFLEX® SOLAR XL multi	USE-2, RWU90	600	90	Cross linked Co-Polymer
ÖLFLEX® CONTROL M	MTW, TC-ER, WTTC	600, 1000	90	Special-TPE-compound
ÖLFLEX® FORTIS	MTW, TC-ER, WTTC	600, 1000	90	Special-PVC-compound
ÖLFLEX® CONTROL TM	MTW, TC-ER, WTTC	600, 1000	90	Special-PVC-compound
ÖLFLEX® CONTROL TM CY	MTW, TC-ER, WTTC	600, 1000	90	Special-PVC-compound
ÖLFLEX® Tray II	MTW, TC-ER or DP-1, WTTC	600, 1000	90	Special-PVC-compound
ÖLFLEX® Tray II CY	MTW, TC-ER or DP-1, WTTC	600, 1000	90	Special-PVC-compound
ÖLFLEX® VFD with Signal	MTW, TC-ER or DP-1, WTTC	600, 1000	90, 105	Special-PVC-compound
ÖLFLEX® CHAIN 879	MTW	600	90	PVC Oil res. II
ÖLFLEX® CHAIN 879 CY	MTW	600	90	PVC Oil res. II
UNITRONIC® 300	CMG, PLTC, Open Wiring, Oil Res 1	300	105	PVC
UNITRONIC® 300 CY	CMG, PLTC, Open Wiring, Oil Res 1	300	105	PVC
UNITRONIC® FD P plus	CMX	250	75	PUR
UNITRONIC® FD CP plus	CMX	250	75	PUR
UNITRONIC® FD CP (TP) plus	CMX	250	75	PUR
UNITRONIC® BUS IBS A	CMX	250	70	PVC
UNITRONIC® BUS IBS P COMBI	CMX	250	75	PUR
UNITRONIC® BUS IBS FD P	CMX	250	70	PUR
UNITRONIC® BUS IBS FD P COMBI	CMX	450	70	PUR
UNITRONIC® BUS IBS Yv	CMX	250	75	PVC
UNITRONIC® BUS IBS Yv Combi	CMX	250	75	PVC
UNITRONIC® BUS LD	CMX	250	70	PVC
UNITRONIC® BUS LD FD P	CMX	250	75	PUR
UNITRONIC® BUS PB A	CMX	250	75	PVC
UNITRONIC® BUS PB FC	CMG	100	60	PVC
UNITRONIC® BUS PB 7-W FC	CMX	250	75	PVC
UNITRONIC® BUS PB H FC	CMX	100	75	FRNC
UNITRONIC® BUS PB P FC	CMX	100	75	PUR
UNITRONIC® BUS PB FD P	CMX	250	70	PUR
UNITRONIC® BUS PB TORSION	CMX	300	75	PUR
UNITRONIC® BUS PB FESTOON	CMG	600	75	PVC
UNITRONIC® BUS PB FRNC FC	CMG	250	60	PUR
UNITRONIC® BUS PB FD FRNC FC	CMG	250	60	PUR
UNITRONIC® BUS PA (BU)	CMX	100	75	PVC
UNITRONIC® BUS PA (BK)	CMX	100	75	PVC
UNITRONIC® BUS PA FC	CMG	100	75	PVC
UNITRONIC® BUS FF 3 (YE)	CMG/PLTC	300	105	PVC
UNITRONIC® BUS FF 3 ARM	CMG/PLTC	300	105	PVC
UNITRONIC® BUS FF 2	CMG	300	105	PVC
UNITRONIC® BUS CC	CM/PLTC	300	75	PVC
UNITRONIC® BUS CAN	CMX	250	75	PVC
UNITRONIC® BUS CAN FD P	CMX	250	70	PUR
UNITRONIC® BUS ASI (PVC)	CMG	300	80	PVC
UNITRONIC® BUS SAFETY	CMX	250	75	Compound
UNITRONIC® BUS DN THICK FRNC	CMG	300	80	TPE FRNC
UNITRONIC® BUS DN THIN FRNC	CMG	300	80	TPE FRNC
UNITRONIC® BUS DN THICK Y	CMG	300	80	PVC
UNITRONIC® BUS DN THIN Y	CMG	300	80	PVC
UNITRONIC® BUS DN THICK Y ECO	CMG	300	80	PVC
UNITRONIC® BUS DN ECO THIN Y ECO	CMG	300	80	PVC
UNITRONIC® BUS DN THICK FD P	CMX	300	80	PUR
UNITRONIC® BUS DN THIN FD Y	CMX	300	80	PUR
UNITRONIC® BUS DN THICK FD Y	CMG	300	80	PVC
UNITRONIC® BUS DN THIN FD P	CMG	300	80	PVC
ETHERLINE® Y UL/CSA CAT.5e	CMX	125	75	PVC
ETHERLINE® Y FC UL/CSA CAT	CMG	600	75	PVC
ETHERLINE® YY CAT.5e UL/CSA	CMG	125	70	PVC
ETHERLINE® Y FLEX FC UL/CSA CAT.5	CMG	600	70	PVC
ETHERLINE® FD P FC UL/CSA CAT.5	CMX	300	75	PUR

Table 29-5: Survey of respective products in this catalogue ('AWM')

Lapp cables with AWM-Style	Style number	Rated voltage in V	Rated temperature in °C	Material
Multi-Standard SC 2.1	1015	600	105	PVC
Multi-Standard SC 2.2	10269	1000	105	PVC
Multi-Standard SC 1	1007, 1569	300	105	PVC
ÖLFLEX® 150 CY QUATTRO	2587, 21098	600	90	PVC
ÖLFLEX® 150 CY QUATTRO CCC	2587, 21098	600	90	PVC
ÖLFLEX® 150 QUATTRO	2587, 21098	600	90	PVC
ÖLFLEX® 150 QUATTRO CCC	2587, 21098	600	90	PVC
ÖLFLEX® 191	2587, 21098	600	90	PVC
ÖLFLEX® 191 CY	2587, 21098	600	90	PVC
ÖLFLEX® 491 CP	20234	600	80	PUR compound
ÖLFLEX® 491 P	20234	600	80	PUR compound
ÖLFLEX® CONTROL M	20886	1000	105	Special-TPE compound
ÖLFLEX® FORTIS	20886	1000	105	Special-TPE-compound
ÖLFLEX® CONTROL TM	20886	1000	105	Special-PVC-compound
ÖLFLEX® CONTROL TM CY	20886	1000	105	Special-PVC-compound
ÖLFLEX® CHAIN 879	20886	1000	90	PVC Oil res. II
ÖLFLEX® CHAIN 879 CY	20886	1000	90	PVC Oil res. II
ÖLFLEX® FD 891	2587, 21098	600	90	PVC
ÖLFLEX® FD 891 CP	20234	600	80	PUR-compound
ÖLFLEX® FD 891 CY	2587, 21098	600	90	PVC-compound
ÖLFLEX® FD 891 P	20234	600	80	PVC-compound
ÖLFLEX® FD 90	10107	600	90	PVC-compound
ÖLFLEX® FD 90 CY	10107	600	90	PVC-compound, DESINA®-conform
ÖLFLEX® TORSION FRNC	21288	1000	80	Special compound halogen-free
ÖLFLEX® HEAT 180 MS	4476/3529	600	150	Silicone-rubber
ÖLFLEX® HEAT 180 C MS	4476/3529	600	150	Silicone-rubber
ÖLFLEX® ROBOT F1	20940	up to & incl. 1.5 mm^2: 600 V up from 2.5 mm^2: 1000	80	PUR-compound
ÖLFLEX® SERVO 709 CY	20886	1000	90	PVC-compound
ÖLFLEX® SERVO 9YSLCY-JB	2570, 20886	1000	80	PVC
ÖLFLEX® SERVO 9YSLCYK-JB	2570, 20886	1000	80	PVC
ÖLFLEX® SERVO FD 790 CP	wihout control pairs: 20234 including control pairs: 20235	Power cores: 600 Control cores: 300	80	PUR-compound, DESINA®-conform
ÖLFLEX® SERVO FD 795 CP	wihout control pairs: 20234 including control pairs: 20235	Power cores: 600 Control cores: 300	80	PUR-compound, DESINA®-conform
ÖLFLEX® SERVO FD 795 P	wihout control pairs: 20234 including control pairs: 20235	Power cores: 600 Control cores: 300	80	PUR-compound, DESINA®-conform
SERVO cables acc. to INDRAMAT Standard INK	Power cables: 20234 Signal cables: 20236	Power cables: 600/1000 Signal cables: 300	80	PUR
SERVO cables acc. to Lenze Standard	Resolver- + Encoder-cables: 2464, 21165 Motor cables: 2570, 20940	Resolver- + Encoder-Signal cables: 300 Motor cables: 600	80	PUR
SERVO cables acc. to SEW Standard	2587	600	80	PVC-compound, DESINA®-conform
SERVO cables acc. to Siemens Standard 6FX 5008	Power cables: 2570 Signal cables: 2502	Power cables: 1000 Signal cables: 30	80	PVC-compound, DESINA®-conform
SERVO cables acc. to Siemens Standard 6FX 7008	20234	1000	80	PVC-compound, DESINA®-conform
SERVO cables acc. to Siemens Standard 6FX 8008	Power cables: 20234 Signal cables: 20236	Power cables: 1000 Signal cables: 30	80	PUR
SERVO cables acc. to Siemens Standard FX 8PLUS	Power cables: 21223 Signal cables: 20236	Power cables: 1000 Signal cables: 30	80	PUR
UNITRONIC® 300	2464	300	105	PVC
UNITRONIC® 300 CY	2464	300	105	PVC
UNITRONIC® LiYCY A	2464	300	80	Special-PVC
UNITRONIC® LiYCY(TP) A	2464	300	80	Special-PVC
UNITRONIC® LiYY A	2464	300	80	Special-PVC
UNITRONIC® BUS CC FD P FRNC	20233	300	80	PUR-compound
UNITRONIC® BUS ASI (TPE)	2103	300	105	TPE