# Counterfeit and non-compliant cables in the ICT industry.

Athens, 9.10.2015

Ing. Yannis Katris, RCDD

Uptime Institute Accredited Tier Designer Certified Data Centre Design Professional





The Data Centre Industry Association

## What ?

	UTP cat. 5							
Cod Produs	Denumire	Material	Manta	Nr. fire	Diametru fir	Metri / rola	Pret / metru (Pretul nu include TVA)	Cumpara
ARC-UTP5E	Cablu UTP cat. 5e / Arcnet	Cupru / Aliaj (Al- Cu)	PVC	4 fire Cupru / 4 fire Aliaj (Al- Cu)	-	305 M	0,6300 Lei	30 🤹
EMT-UTP5E	Cablu UTP cat. 5e / Emtex	Cupru	PVC	8 fire Cupru	-	305 M	0,8000 Lei	30 🤹
FRE-UTP5E	Cablu UTP cat. 5e / Freenet	Cupru / Aliaj (Al- Cu)	PVC	4 fire Cupru / 4 fire Aliaj (Al- Cu)	-	305 M	0,3600 Lei	30 🤹
JETLAN5E+/UTP	Cablu UTP cat. 5e / General Cable	Cupru	PVC	8 fire Cupru	0,51 mm	305 M	0,9000 Lei	30 🤹
KTX-UTP5E	Cablu UTP cat. 5e / K-Tex	Aliaj (Al-Cu)	PVC	4 fire CCS / 4 fire CCA	0,43 mm	305 M	0,3400 Lei	30 🤹
Q5-UTP5E	Cablu UTP cat. 5e / Q5+	Cupru	PVC	8 fire Cupru	0,51 mm	305 M	0,8000 Lei	30 🤹

▶ CCA LAN CABLE CAT 5E FTP, SOLID, 305M, GRAY, NO TEST FLUKE PASS



REQUEST INFORMATION





Stoc:	1		
Dimensiune:	0m x 0mm x 0 mm		
Cod Produs:	FTPpatchCCAH		
Producător:	Hantol		
Rating Mediu:	Fără Rating		





## What is counterfeit / non compliant cabling?

- **Compliant**, as it relates to the electrical performance of a cable: has been tested by the manufacturer and found to meet the requirements of a particular standard.
- Verified: refers to the electrical performance of the cable. Often preceded by the term "third party".
- Listed: refers to the physical attributes of a cable (requirement by the NEC, USA; listing obtain from, e.g., UL)
- **Counterfeit**: If a cable or product falsely bears a manufacturer's name or brand that is descriptive of the product that was not produced by that manufacturer.
- Counterfeit mark: If a cable or a product bears an unauthorized certification mark (e.g. UL listed or ETL verified), then the cable is counterfeit as to the mark; essentially falsifying that they are compliant with safety and performance standards.

## **Counterfeit & Non-compliant cabling**

#### • Not a new problem.

- Demand for less expensive cabling.
- Difficult to quantify the market for counterfeit cables.
- A worldwide issue
- Looks like "Category" cabling but uses substandard conductors, insulation and/or jacketing.

#### • Warning signs:

- Very low price below market limits
- Unfamiliar brand or completely unmarked cable and packaging, anonymous, untraceable.
- No information on factory location or country of origin
- No approval marks or fake approval marks
- Reference to non-standard construction (e.g. "CCA")
- Supplied only through website or local distributors
- Completely unmarked cable and packaging, anonymous, untraceable.



## **Counterfeit cable issues**

- False claim of conformity to specifications and standards
- Incorrect polymers
- Extremely poor fire performance.
- Incorrect conductors
- False mark of origin
- False claims of test conformity
- False approvals paperwork
- False regulatory credentials
- Possible liability.





#### **Agencies and Associations to help**







#### BICSI and CCCA collaborate on international effort to stop counterfeit and non-compliant cables







## **Cabling standards**

- Standards define the "worst" acceptable performance to be met by components, links and channels. It is the "minimum" acceptable performance.
- Statement of requirements (**shall/should**). No explanation on how to achieve the requirements.
- The manufacturers develop products around the standards specifications.
- Interoperability of cabling products.
- Manufacturers can make cabling that are better than those standards in order to differentiate their products from competitors.
- Living documents. Technology moves on, so do the standards.
  Products always available before standards issued.
  - Manufacturers are part of the standards development group.



ISO/IEC 11801 EN 50173 ANSI/TIA-568-C.0

#### **Cabling standards**

Cabling standards: **voluntary** consensus standards; not written as laws or regulations.

**Regulatory requirements** (mandatory/must) are created by public authorities and so arise in the form of enforceable legislation or regulations. Application of a voluntary standard cited in a regulation becomes obligatory

Electrical transmission performance vs. safety standards.





#### **Requirements for a conductor**

#### Material conductance:

Material	Resistivity ρ [Ω·m]	Conductivity σ [S/m]
Silver	1,59 x 10 <sup>-8</sup>	6,301 x 10 <sup>7</sup>
Copper	1,68 x 10 <sup>-8</sup>	5,858 x 10 <sup>7</sup>
Copper, annealed	1,72 x 10 <sup>-8</sup>	5,800 x 10 <sup>7</sup>
Aluminum	2.82 x 10 <sup>-8</sup>	3,538 x 10 <sup>7</sup>
Iron	9.71 x 10 <sup>-8</sup>	1,000 x 10 <sup>7</sup>

The resistance of a wire is driven by the conductance of the material from which it is made.

Mechanical considerations:

✓ Ductility✓ Malleability

**Silver**: the best, but too expensive



#### **Solid conductor properties**

Table 1.2 Solid conductor properties

Property	Copper	Copper/Steel	High-Strength Alloys	Aluminum
Electrical conductivity	Sets the standard	Less than Copper	85% typical	61% typical
Ductility	Good	Good	Better than copper	Good
Solderability	Good	Good	Good	Special techniques
Corrosion resistance	Good	Good	Poor	Good
Oxidation resistance	Good	Good	Good	Poor
Weight	14.25 kg (31.42 lb)	13.06 kg (28.79 lb)	_	4.32 kg (9.52 lb)
Tensile strength	250 000 kPa (36,000 psi)	380 000 kPa (55,000 psi)	To 550 000 kPa (80,000 psi)	69 000 kPa (10,000 psi)
© 2009 BICSI®		1-3		TDMM, 12th edition





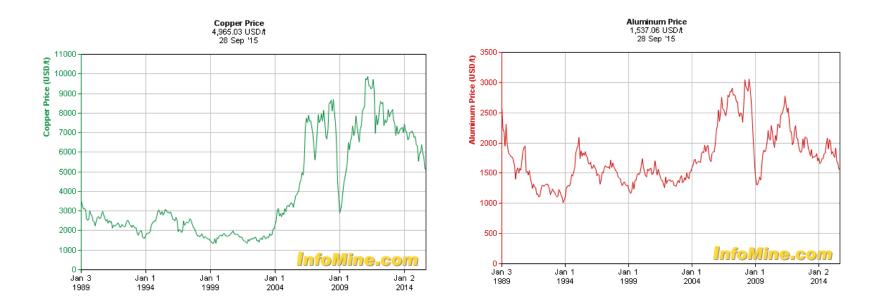


## **Cabling standards - "Category" cabling**

- The term "Category cabling" the performance of communications cabling systems.
- Defined in ISO/IEC 11801; EN 50173; ANSI/TIA-568 standards series.
- EN 50173 series requires cables conforming the EN 50288 series of standards "Multi-element metallic cables used in analogue and digital communication and control."
- EN 50288: pure copper conductors are required.
- The Telecommunications Industry Association's TIA 568C.2 specification (Section 5.3) requires compliance to ANSI/ICEA S-90-661-2006 and ANSI/ICEA S-102-732 which both include the following language: "Solid conductors shall consist of commercially pure, annealed, bare copper ..."



## Why counterfeit/non-compliant cables?



Steel price: 170 USD/MT on Monday September 28, 2015



## **Power distribution: Aluminium vs. Copper**

- If aluminum is to be used as a conductor:
  - roughly 60% larger conductor cross sections required due to the lower conductivity compared with copper.
  - aluminum is roughly 35% lighter than copper.
  - Above factors taken into account, if aluminum is used instead of copper, the raw material costs are reduced by 80%
- But:

stallation 02-2012. Sien

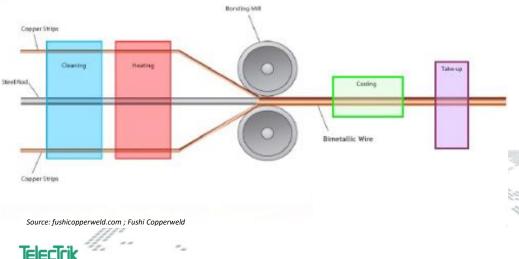
- More space required (not a matter with high-voltage lines)
- An aluminum cable is much stiffer than a copper one.
- Fire risk at (common-type) connection points (unsafe as building wire without conversion to special connections).



## Copper Clad Aluminium (CCA ... and CCS, CCAG)



The primary applications of this conductor revolve around **weight reduction requirements**. These applications include high-quality coils, such as the voice coils in headphones, or portable loudspeakers, **high frequency coaxial applications such as RF antennas or CATV distribution.** 



#### **Bimetallic conductors**

- Core of aluminum (CCA) or steel (CCS), clad in copper
- Thin layer of copper metallurgically bonded using heat and pressure
- Two materials permanently united and cannot be separated (mechanical process)
- Plated is not clad

## **Applications of CCS & CCA**

#### • CCS

#### – Utility

- Grounding
- Distribution
- Telecom
  - Drop Wire
  - CATV Drop Wire 7 Coaxial cable
- ✓ Invented in 1915
- ✓ Strands well, even at large gauges
- ✓ Very durable

#### • CCA

- Telecom
  - CATV Coaxial cable
  - Enameled magnet wire

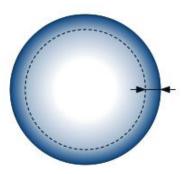
#### - Electronics

- Typically the aluminum core is 60%-80% of the conductor diameter with the remaining 20%-40% being a copper cladding surrounding the aluminum.
- ✓ Ability to draw to gauges as fine as 0,06 mm
- ✓ Light weight and flexible, <sup>1</sup>/<sub>3</sub> the weight of copper at equivalent length

## The skin effect

- ✓ Electric currents in a conductor try to move away from each other.
- ✓ This causes the current to flow on the surface where it is far away from itself as possible.
- ✓ This effect skin effect is seen at all frequencies.
- ✓ There is a formula for calculating the skin depth (it represents the depth at which the electric field in the conductor has reduced to approximately 30% of its surface value)
- ✓ Skin depth tends to decrease with the square root of the frequency.
  - Basically you can think that the conductor is getting smaller with frequency

Source: "CCA when is it OKAY?" - George Karanikolau, Madison Technologies, BICSI AU conference 2014





## Skin depth for copper

Frequency	Skin depth	
60 Hz	8,5 mm	←
10 kHz	0,66 mm	
100 kHz	0,21 mm	
1 MHz	0,066 mm	1
10 MHz	0,021 mm	ſ

Copper Clad conductors for CATV coaxial applications:

- Copper Clad Aluminium (CCA)
- Copper Clad Steel (CCS)



At power frequencies, copper conductors over ca. 20 mm in diameter are not fully used

At frequencies over 1 MHz, only a thin surface of the conductor, the "skin" is used; for high frequency transmission, only the surface is required to be of low resistance.

- Connector technology switched to crimp types, using alloys or compatible materials
- ✓ F-connectors; the centre conductor not connectorized
- ✓ Hermetic sealing of the connectors
- Baseband applications that carried LF or DC currents remained as solid copper conductors

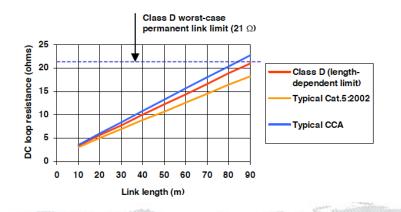
## **Copper Clad conductors for data cabling?**

- All standards for balanced cable demand solid copper conductors (tinned copper allowed for cords).
- CCA/CCS/CCx cables do not conform to the recognized International, European and American standards for structured cabling systems and cables.
- As non-standard products, they cannot claim any Category.
- CCA/CCS are not compliant to the standards, could possibly be counterfeit (possibly false statements regarding third party verification)



### **Copper Clad conductors for data cabling?**

- Skin effect → theoretically OK; the performance at the higher frequencies may be similar to standard cables.
- But what about performance at lower frequencies and for DC current ?

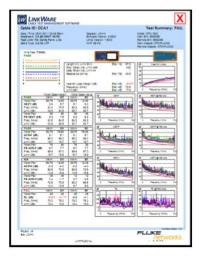


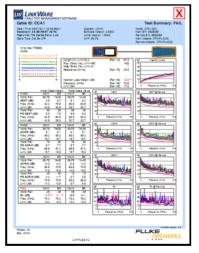
"If the resistance of CCA conductors is 40% above that of solid copper, permanent links can be expected to be non-compliant for lengths in excess of approximately 80 meters; ... Insertion loss/attenuation is also likely to be flagged... particularly at lower frequencies"

Source: FIA-IAN-002, Infrastructure Advisory Note; "The impact of Copper Clad Aluminium (and Steel) conductors within balanced pair cables (intended for use within implementations of generic cabling); Mike Gilmore, 3<sup>rd</sup> October 2011



#### "Category 5e" CCA test results





#### Insertion Loss FAIL by 9.9 dB!

Length (m), Limit 90.0	[Pair 12]	87.3
Prop. Delay (ns), Limit 498		423
Delay Skew (ns), Limit 44		1
Resistance (ohms)	[Pair 78]	43.5
Insertion Loss Margin (dB)	[Pair 45]	-9.9 F
Frequency (MHz)	[Pair 45]	72.8
Limit (dB)	[Pair 45]	17.6

Cable sheath length 90m Electrical length 87m (NVP)

Return Loss FAIL by 6.8dB!

The Return Loss failure was across all four

SR

45

-4.1 F

75.0

13.3

MAIN

45

-6.8 F

73.0

13.4

FAIL

pairs.

Worst Pair RL (dB)

Freq. (MHz)

Limit (dB)

# <section-header><section-header><complex-block>

#### Note the DC Loop Resistance!

Length (m), Limit 90.0 Prop. Delay (ns), Limit 498 Delay Skew (ns), Limit 44	[Pair 12]	87.3 423
Resistance (ohms)	[Pair 78]	43.5
Insertion Loss Margin (dB)	[Pair 45]	-9.9 F
Frequency (MHz)	[Pair 45]	72.8
Limit (dB)	[Pair 45]	17.6

The relevant TIA standard requires the DC resistance not 9.38 ohms/100m Result should not have exceeded 9.38 ohms

Bicsi

Source: John Kellow Consulting

#### Re-certifying the results to ISO/IEC 11801 Class F shows additional $\ensuremath{\mathsf{FAIL}}$ on ACR

FAIL	MAIN	SR	MAIN	SR
Worst Pair	36-78	12-45	36-78	12-45
ACR-N (dB)	-0.8 F	-4.4 F	-0.8	-4.4
Freq. (MHz)	82.5	73.5	82.5	73.5
Limit (dB)	15.3	17.2	15.3	17.2
Worst Pair	45	45	12	12
PS ACR-N (dB)	-0.1*F	-2.1 F	2.2	2.3
Freq. (MHz)	72.5	73.5	93.0	98.8
Limit (dB)	14.5	14.2	10.2	9.1

Source: John Kellow Consulting

Source: John Kellow Consulting

SR

45

-4.1

75.0

13.3

MAIN

45

-6.8

73.0

13.4

11111.

## **Copper Clad conductors for data cabling?**

#### CCA/CCS based cables

- Shorter cable runs
- Lower tensile strength →more fragile conductors → poor mechanical properties →can be damaged when pulled or broken wires during termination and/or operation; disconnections likely during MACs;
- Poor flexibility, lower bend radius than pure copper cables;
- Could exhibit oxidation of exposed aluminum at points of connection → may reduce lifetime; *IDC connectors?*
- Could produce higher than expected temperature rise when used for Power Over Ethernet (PoE) applications.



#### **Power over Ethernet**

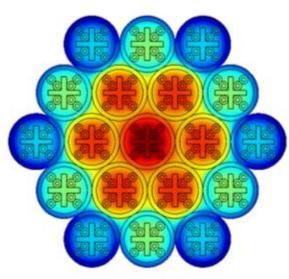
Both data (100Mb/s or 1Gb/s) and power (nominal 48 V DC) over a single Cat.5e (or higher) cable.

Туре	Standards	Maximum current	Number of energized pairs	Power at device	Standard retified
ΡοΕ	IEEE 802.3af (802.3at Type 1)	350 mA	2	13 W	2003
PoE+	IEEE 802.3at Type 2	600 mA	2	25.5 W	2009
PoE++	Proposed IEEE 802.3bt Type 3 Proposed IEEE 802.3bt Type 4	600 mA 960 mA	4	51 W 71 W	Expected 2016-17
Not PoE standards based	Cisco UPOE HDBaseT (www.hdbaset.org)	600 mA 1000 mA	4	60 W 71 W	Exists today - no official ratification

The cables must handle the 960 mA current and the 71 W of power.



#### PoE and the cabling system



Source: Nexans

Source: R&M web site (adapted)

#### **Concerns:**

- heat (resistive heating) and temperature rise in a cable bundle (restricted airflow); the main byproduct of PoE is heat → higher Insertion Loss/Attenuation → reach of the cabling link will be reduced; excessive heat could also compromise the cable integrity over the longterm.
- arcing in connectors when a plug is removed from the jack with live PoE (IEC 60512-9-3, IEC 60512-99-001)

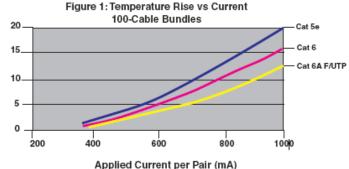


#### PoE and temperature rise in a cable bundle

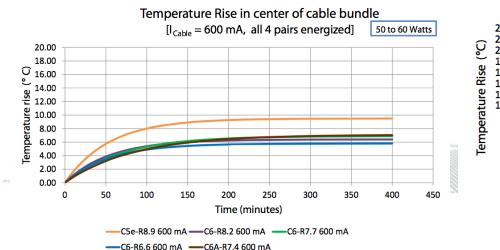
The PoE+ standard assumes a maximum DC pair loop resistance of 12,5  $\Omega$  for a 100 m Category 5e channel (this includes an allowance for temperature variations, connectors & cords). All of the developments of PoE both now and into the future are based around Standards Compliant Horizontal cabling.

Recommended maximum bundle size for a given cable type (*) to limit temperature rise to 15 °C or less				
Cable type	PoE/PoE+ maximum bundle size (2- pair, up to 600 mA)	PoE++/HDBase-T maximum bundle size (4-pair, up to 960 mA)		
Cat. 5e	Tested up to 100 cables	61		
Cat. 6	Tested up to 100 cables	72		
Cat. 6A	Tested up to 100 cables	Tested up to 100 cables		

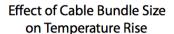
nmandad maximum hundla siza far a aiyan sahla tuna (\*) ta limit tamparatura risa ta 15.00 ar las

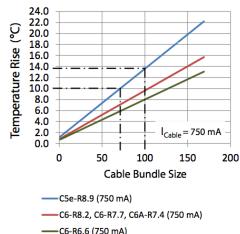


(\*) Source: Panduit









#### (TIA) TSB-184



## **Copper Clad conductors for PoE applications?**

**IEEE 802.3at** : "Type 2 operation requires Class D, or better, cabling as specified in ISO/IEC 11801:1995 with the additional requirement that channel DC loop resistance shall be 25  $\Omega$  or less. These requirements are also met by Category 5e or better cable"

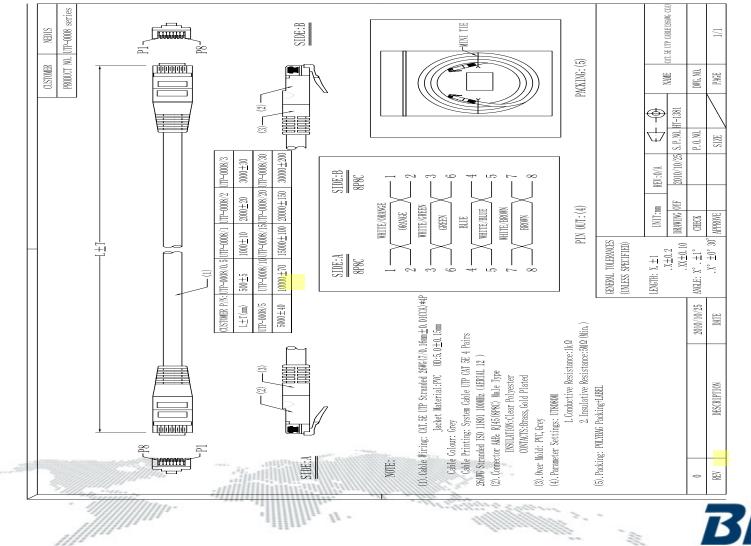
#### **CCA/CCS**: DC resistance (much) more than equivalent gauge poor copper $\rightarrow$ (much) more heat $\rightarrow$ initial temperature (probably) twice than pure copper cables $\rightarrow$ overheat $\rightarrow$ potential damage to the cable(s)

Higher DCR for CCA conductors results in increased voltage drops meaning that PoE devices may not operate properly due to insufficient power being supplied.

Resistance	Standard Cable	ССА	CCS
@ 100 m	9,38 Ω	24 Ω	75 Ω



#### Patch cords with CCA/CCS conductors?

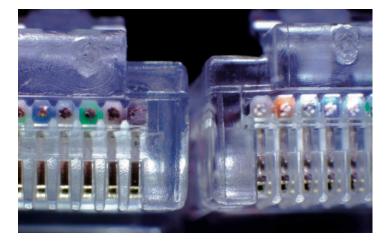


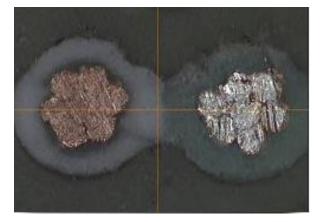
Bicsi

#### Patch cords with CCA/CCS conductors

Patch cord cable standards do permit the use of metal plated copper e.g. tinned copper; they do not permit the use of copper plated on any type of metal.

Most of these CCA/CCS patch cord products seems to work electrically, in the short term, any repeated flexing through repeated patching is probably going to result in mechanical failure.

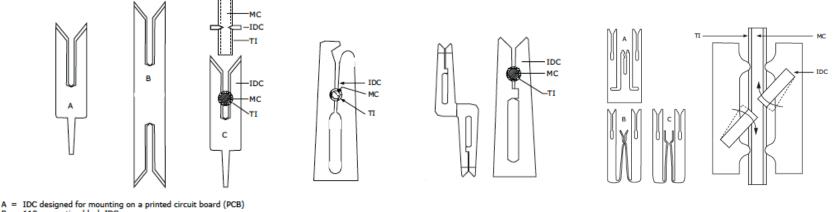




Source: Nexans web site



## What about IDC connectors and CCA/CCS conductors?



B = 110 connecting block IDC Conductor termination in IDC

IDC

Contact dovetail Metallic conductor

TI = Thermoplastic insulation

Source: BICSI TDMM 12th Ed.

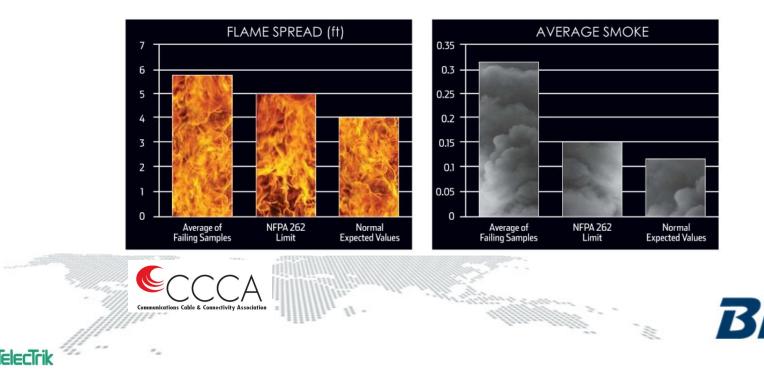
#### Have the connectors been designed for Aluminium presence in the connector?

Connectors using copper, brass, steel, tin and chrome will see the preferential corrosion of exposed Aluminium in electrolytic contact with these surfaces.



# If the conductors are counterfeit, how about the insulation & cable jacket?

- Flammability of plastic-insulated cables is a major safety issue.
- Cable can promote fire spread and cause toxic fumes.



## USA – Electrical & Fire codes for communications cablimg - NEC

- The most important "standards" and the only ones that are legally mandatory, in USA, are the local building and electrical codes, such as the US National Electrical Code (NEC).
- The NEC is developed by the National Fire Protection Association and covers all aspects of electrical and fire safety.
- All premises cabling must comply with building and electrical codes applicable in each area.



## **NEC Articles covering communications cabling**

Chapter	Article	Торіс
6	640	Sound systems
7	725	Remote-control, signaling and power limited circuits
7	760	Fire alarm signaling systems
7	770	Optical Fiber cables and raceways
7	780	"Smart House" wiring
8	800	Telecommunications circuits (Telephone and LAN)
8	810	Radio and TV equipment
8	820	CATV systems
8	830	Network-powered broadband systems







#### NEC, UL, and copper

- (USA) The National Electrical Code (Section 800.179) states that "Conductors in communications cables, other than in a coaxial cable, shall be copper."
- UL 444, Standard for Communications Cable (Section 5.1.1) states that "The conductors shall be solid or stranded, annealed, bare or metal-coated copper."
- UL444 compliance is a basic requirement for any communications cable to receive fire/safety ratings from Underwriters Laboratories or other nationally recognized test laboratories.



## (Counterfeit) communications cables with a counterfeit mark ?



## **EU: The Construction Product Regulation (CPR)**

#### **REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**

#### of 9 March 2011

laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

Fully applicable in all EU Member States in **July 2013** (governed by law) Purpose:

- Harmonised rules for the marketing of construction products in the EU.
- A **common technical language** (applied by the manufacturer, authorities, users), to assess the performance of construction products.
- Reliable information available to professionals, public authorities, and consumers so they can compare the performance of products from different manufacturers in different countries.
- Products have to be tested only once according to a harmonised European standard or European Assessment Document.



#### The CPR consists of four main elements:



"Conformité Européenne"

- A system of harmonised technical specifications
- An agreed upon **system of attestation of conformity** for each product family
- A framework of **notified bodies** (authorised, independent third party)
- The **CE-marking** of products

The **Declaration of Performance** (DoP – identification/intended use/essential characteristics – a manufacturer's mandatory requirement/<u>legal obligation</u>, **publicly available**) is a key part of the CPR.



## **CE** marking



The **CE marking** (the only sign visible on the product), signifies that products sold the European Economic Area are in **conformity** with its declared performance and that it has been **assessed to meet high safety, health, and environmental protection requirements.** 

- Businesses know that products bearing the CE marking can be traded in the EU without restriction.
- Consumers enjoy the same level of health, safety, and environmental protection throughout the entire European Economic Area.
- ✓ Not all products must have CE marking. It is compulsory only for most of the products covered by the New Approach Directives [New Approach Standardization in the Internal Market Directives of Regulations and Standards].
- $\checkmark$  It is forbidden to affix CE marking to other products.
- ✓ A CE marking does not indicate that a product have been approved as safe by the EU or by another authority.
- $\checkmark$  It does not indicate the origin of a product.
- ✓ CE marking exists, but CE certification doesn't.
- ✓ CE marking is a declaration by the manufacturer.



## The CPR and cables

**Extension** of the CPR to building cables (both metallic and optical). Announced in the Official Journal of the European Union on **10 July 2015**.

Cable performances included:

- reaction to fire
- resistance to fire
- release of dangerous substances
  - » The only requirement: Safety in case of fire

Cables included:

Power, control, and communications cables



# CE marking requirements of power, control and communications cables becomes mandatory

#### EN 50575:2014

*Power, control and communication cables. Cables for general applications in construction works subject to reaction to fire requirements* 

#### EN 13501-6:2014

*Fire classification of construction products and building elements. Classification using data from reaction to fire tests on electric cables* 

→ Defines seven basic **EuroClasses** (by reference to the measured results when cables are subject to a range of fire performance tests)

**EuroClasses A to F**; A: do not burn ... F: the only class which does not require involvement of a notified body (deemed to be flammable, no any test criteria)

#### EN 50399:2011

Common test methods for cables under fire conditions. Heat release and smoke production measurement on cables during flame spread test. Test apparatus, procedures, results

#### EN 60332-1-2:2004

Tests on electric and optical fibre cables under fire conditions. Test for vertical flame propagation for a single insulated wire or cable. Procedure for 1 kW pre-mixed flame

EN ISO 1716; EN 61304-2; EN 50267-2-3; EN 50174-1

## What, who is responsible, when

- What: Safety in case of fire.
- Who: Manufacturer: the person who (first) places the product on the market in the EU. The actual manufacturer, or an importer. Assumes the responsibility, must create and maintain the "technical library".

#### • When:

- Announced in the Official Journal of the EU: 10 July 2015
- From 1 December 2015 the standard (EN 50575:2014) becomes harmonised.
- A 12-month period for manufacturers & suppliers to establish CE marking of power, control and communications cables. <u>Coexistence period.</u> [may be extended to 36 months]
- Mandatory from 1 December 2016  $\rightarrow$  (CE) Marking to cables

All cables manufacturers who intend to sell cables for use in permanent installations in buildings in EU must obtain CE-marking for their products.



#### **CE mark – Who is responsible**

Manufacturers:



It is the manufacturer's responsibility to carry out the conformity assessment, to set up the technical file, to issue the EU declaration of conformity, and to affix the CE marking to a product. **Only then can this product be traded on the EEA market**.

## Importers & Distributors:



Importers and distributors help ensure that only products compliant with EU legislation and bearing the CE marking are placed on the extended Single Market of the EEA. As they are the intermediaries between manufacturers and traders, **they must have overall knowledge of the legal requirements and make sure that the products they distribute or import meet them.** If importers or distributors market the products under their own names, they take over the manufacturer's responsibilities.

EU countries have put in place this market surveillance system and share information about unsafe products.



# Counterfeit and non-compliant communications cables

- ✓ May be fire and smoke hazard. Don't play with fire.
- ✓ Not to specs, non-conforming, non-compliant.
- ✓ Low conductivity, high conductor resistance, shorter cable runs, dangerous for PoE.
- ✓ Incorrect materials.
- ✓ Incorrect marking false claims of test/approval.
- ✓ Oxidation & corrosion, possible IDC contact issues.
- ✓ Anonymous cable (no manufacturer marked).
- ✓ Untraceable cable.
- ✓ Importers setting specifications e.g. copper weight (0.35 mm Copper Conductors)
- ✓ Hard to install inflexible wire.
- Brittle Attempts to bend the wire when making connections will result in broken. wires that must be replaced.
- Difficult to strip the casing on counterfeit cabling is hard to remove from the interior wire strand.
- ✓ Significant problems for end users.
- ✓ Possible liability.

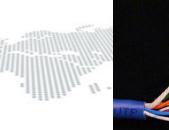
#### Will you take the risk?



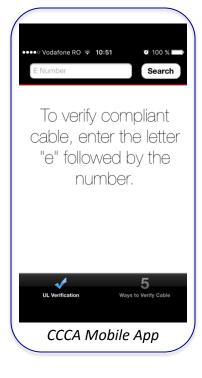


### How to avoid it

- Supplied only through website?
- Buy it from reliable sources, well-known brands.
- No information on factory location or country of origin?
- Are cable specifications and samples available?
- Include standards and specifications in orders
- Check marking and traceability
- Does it have the required approvals?
- If price is very cheap, be very suspicious
- Is the cable UL and/or ETL tested? CE marked ?
- Fake or illegitimate UL's ETL's ?
- Unfamiliar jacket construction ?
- Does the packing have a holographic UL sticker?
- Scrape it, look at the silver color at the conductor's end
- Weight it
- Burn it
- Use a magnet (!)









#### Ευχαριστώ!

yannis.katris@telectrik.ro



