





**ندوة خبراء
السلامة الكهربائية**
Electrical Safety Experts Symposium

Inspections of electrical installations in homes

Measurements are imperative

Mr. Benoît Dôme
ECI, Belgium

الرئيسي
Main Sponsor



الرئيسي الملائمي
Platinum Sponsor



الرعاة الذهبين
Golden Sponsor



الرعاة المشاركون
Co. Sponsors



منظم الحدث
Event Manager



الجهات المنظمة الرئيسية
Key Organizers



الجهات المساعدة
Supporting Organizations



Present situation

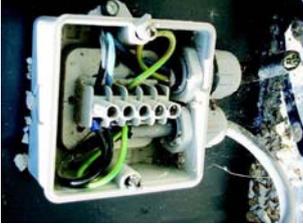
- Ageing housing stock
- Slow renovation rate
- Increasing use of electricity



**ندوة خبراء
السلامة الكهربائية**
Electrical Safety Experts Symposium

→ Danger!







Present situation



Periodic safety inspections = growing practice

But: visual inspections alone are not enough

Could give false feeling of safety

Measurements are imperative



When wires look like this, it's already too late!

Is it worth the effort and cost?



Electric defects = most common cause of fire

Overheated wires = one of the most common electric defects



Standardization bodies made wiring rules

Rules make no sense if they are not verified



Only for new dwellings?



Not only new, but also existing installations should be inspected



Picture: DocteurCosmos, Creative Commons



Picture: Brian Shaw, Creative Commons

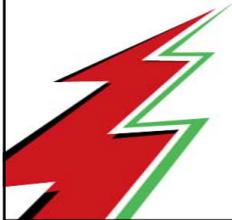
Which house is most likely to suffer from electrical safety issues?

Initial verification



Verifying if the requirements of all applicable prescriptions are met

- Full inspection of complete installations by qualified people
- Testing to prove the effectiveness of the installations

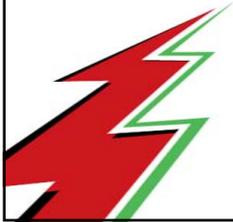


Periodic verification



Periodic verification is essential because:

- Electrical installations do wear (hardening of cable insulation, corrosion, loose contacts...)
- Number of electrical applications increases
- Safety awareness increases



Periodic verification



Periodic verification should consist of:

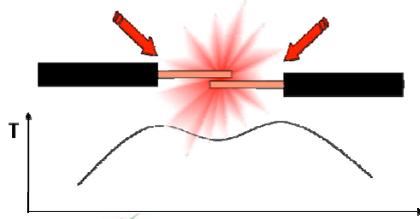
- Inspections: visual (naked eye, thermographic pictures), smell, touch, hearing
- Testing (e.g. resistance of cable insulation)



Risk of bad contact



Bad contact \rightarrow electrical resistance rises \rightarrow
heat generation \rightarrow fire risk



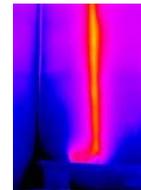
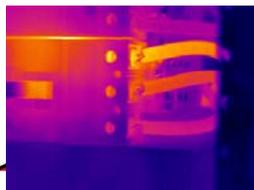
Bad contact of 0.5 ohm \rightarrow 1 ohm after
one week \rightarrow 10 ohm after one year

Verifying contacts



Thermography is a non-contact method for
visualizing temperature

It is a good method to search and find bad
contacts



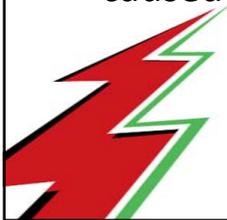
Risk of bad wiring



Two types of risks:

- Internal overheating due to inaptness to receive overloads or short circuits
- External exposure to fire: cable insulation containing excessive combustible material

UK: 3,000 out of 9,000 fires each year are caused by inadequate wiring



Risk of Al wiring

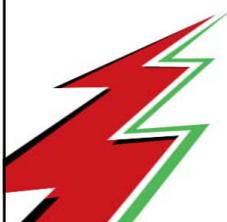


Aluminium wiring poses additional hazard



Bad connections or failing circuits → Al wires have a higher probability for overheating

Al wired homes have higher numbers of fire fatalities and injuries



When a periodic verification?



Generally accepted: every 10 years



10 year interval also in IEC 60364 standard

Unfortunately not mandatory in most countries

Ad hoc verifications: when?



When issues did occur

- Tripping of circuit breakers
- Burn marks on sockets, switches...
- ...



When modifications have been made

- Structural changes in the building
- Changes in electricity use
- Change of owner

What to verify?



Periodic verification will take into account:

- Adequacy of earthing
- Suitability of switchgear
- Serviceability of equipment: signs of overheating?
- The wiring system and its condition
- Presence of RCD's
- Presence of adequate circuit identification
- Presence of any wear, tear or damage
- Changes of use in premises

Test measurements



Test measurements to be carried out:

- Continuity of protective conductors
- Equipotential bonding
- Earth electrode resistance
- Earth fault loop impedance
- Correct operation of RCD's
- Correct operation of switches and isolators
- Condition of cables by measuring *insulation resistance*

Insulation quality tests



Measuring the insulation resistance of cables =
the most important test

Low insulation resistance → leakage current

Risk to shock individual if no RCD or if earth conductor is interrupted

A leakage current of 500 mA can generate enough heat to cause a fire



Insulation quality tests



Testing goes **quick and cost is low**

With 'insulation tester'

Initial verification when installation taken in use

- Reference measurement
- Revealing short circuits

During periodic verification, insulation tester reveals insulation failures



Insulation quality tests

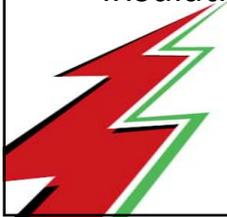


Tests made between active conductor and conductor connected to earthing

DC voltage is applied between them

→ Small current will flow

→ The higher this current, the more the insulation is deteriorated



Insulation quality tests

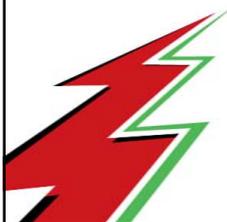


Minimal values of insulation resistance, according to IEC 60364-6:

Nominal circuit voltage V	Test voltage d.c. V	Insulation resistance MΩ
SELV and PELV	250	≥ 0,5
Up to and including 500 V, including FELV	500	≥ 1,0
Above 500 V	1000	≥ 1,0

But a reading $\leq 2 \text{ M}\Omega$ for individual circuit

→ Possibility of defective insulation



Main conclusions

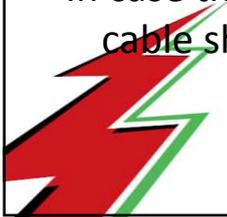


Periodic verification (every 10 years) of the electrical installation should be mandatory

Only inspection is not enough, test measurements are equally important

The insulation resistances should be tested

In case this resistance is not high enough, the cable should be replaced

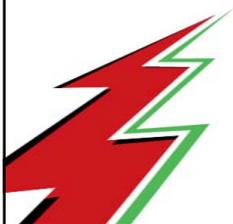


Other conclusions



Obsolete cables should be removed to reduce the potential fuel load in case of fire

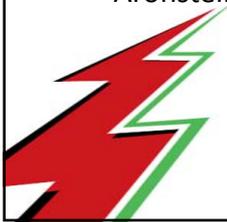
Aluminium wiring should be removed at the first sign of degradation (or even before)



Bibliography



1. IEC 60364-6, Low-voltage installations – Part 6: Verification
2. 'Towards improved electrical installations in European homes' - European Copper Institute
3. 'Overview of electrical safety in 11 countries' - European Copper Institute
4. US Fire Administration publications
5. ESFI (Electrical Safety Foundation International) publications
6. 'Reducing the fire hazard in aluminium-wired homes' - J. Aronstein, Ph.D.





THANK YOU

Mr. Benoît Dôme
ECI, Belgium

<p>الرئيسي Main Sponsor</p> 	<p>الرئيسي الملائمي Platinum Sponsor</p> 	<p>الرعاة الذهبية Golden Sponsor</p> 	<p>الرعاة الشركون Co-Sponsors</p> 
<p>منظم الحدث Event Manager</p> 	<p>الجهات المنظمة الرئيسية Key Organizers</p> 	<p>الجهات الداعمة Supporting Organizations</p> 	