Fire and overheating risks of electric vehicle charging stations

Dr Laurent Tribut

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Specific risks induced by Charging station

Overheating induced by high power supply for long period >20KW during hours (high thermal rated components preferred)

Surge and power transfer should be monitored to avoid battery overload (communication and monitoring devices preferred)

Potential grounding issue induced by insulation failure and component deterioration (type B residual current device preferred to prevent dangerous leakage currents)

Specific risks induced by Charging station

Flame spread should be avoided in confined area (non propagating cables and cable management systems preferred)

Fire load can become significant in car parks where one car requires on charging station (distancing and ventilation need to be adapted)

Vandalism and cable degradation may induce insulation failure (IK10 and reinforced cable preferred)

Different electrical ratings and charging modes*

Protection level

Smart Wallbox

Parking EVlink AC

Parking EVlink DC

Low

Mode 1

<3,7KW

Direct connection
of the vehicle to the grid

- Non-dedicated power socket (domestic socket)
- Simple cable
- Risk of overheating
- Prohibited in the United States

Acceptable

Mode 2

3,7-7,4 KW

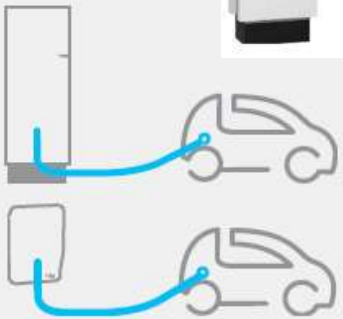
Direct connection
of the vehicle to the grid

- Non-dedicated power socket
- Cable with communicating charge monitoring device

High

Mode 3

11- 22 KW



Direct connection
of the vehicle to the grid

- Dedicated power socket incorporating charge monitoring
- Dedicated cable (attached to the charging station or not)

Mode 4

> 22 KW

Indirect connection
of the vehicle to the grid
via an external charger

- Direct-current external charger incorporating charge monitoring
- Dedicated attached cable

*According to IEC 61851 definition

A world of standards*…

Standards for Electrical Installations of EVSE		
IEC	**UL**	**SAE**
60364-7-722	NEC	

Charging station related standards		
IEC	**UL**	**SAE**
61851	2594	J2293
	2231	
	2202	

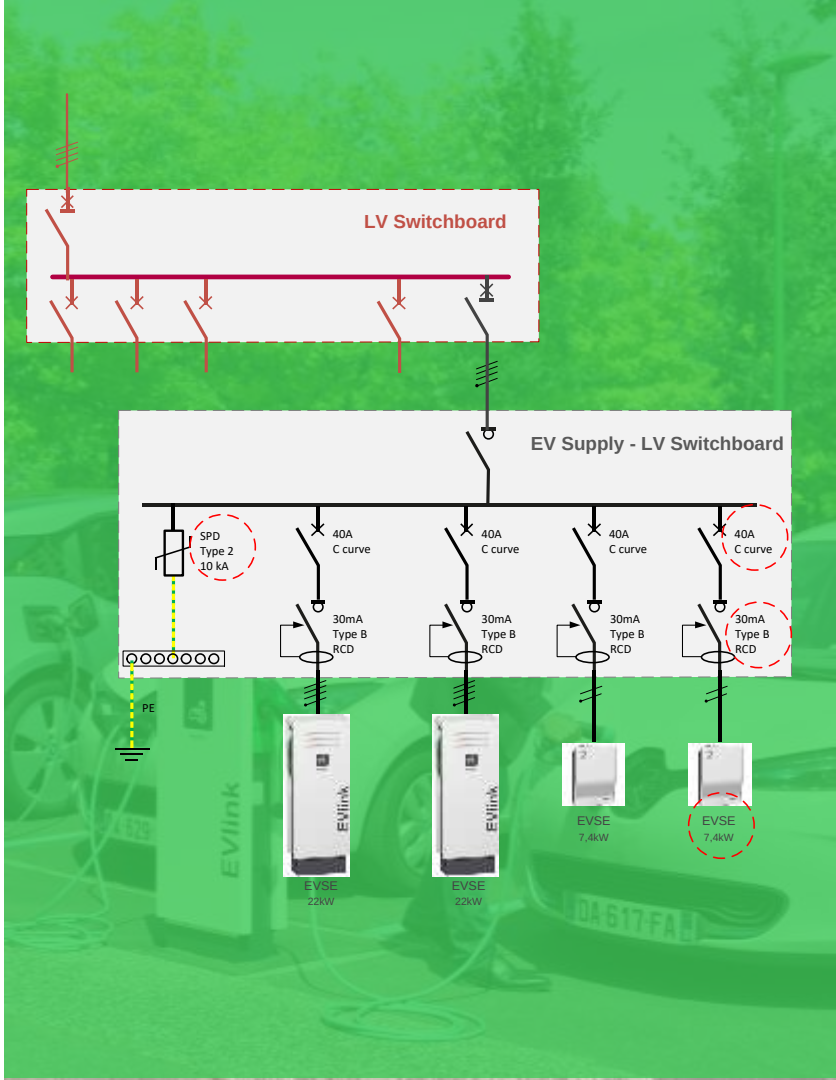
Charging plug and sockets related standards		
IEC	**UL**	**SAE**
62196	2251	J1772

* Non exhaustive list

Mother standard for safety of EV Charging: IEC 60364-7-722

To ensure safety of the overall EV charging installation

- Protection against **short-circuit** and **overload**
- Protection against **electric shocks**
- Protection against **overvoltages**
- Compliance of components to the relevant safety standards (Charging station, plugs, Vehicle connector, circuit-breaker, residual current device, surge protection…)



IEC - Fire and overheating requirements

Glow wire test

Ball pressure test

Enclosure (IEC 61851-1)

- **Glow wire flammability index: 650°C** (IEC TS 61439-1 clause 10.2.3.2)
- Temperature rise: comply with TS 61439-7

Plug and sockets (IEC 62196-1)

- **Glow wire flammability index: 650°C to 850°C**
- **Ball pressure: 80 to 125°C**
- **Test 1h at 110°C: no sealing compound flowing**
- **Touch temperature 60 to 85°C at In**

➡ Target: avoid the fire ignition induced by the charging station

UL - Fire and overheating requirements

UL94 test

UL 723 Steiner tunnel

ASTM E162 “radiant panel”

Enclosure (UL2594 and 2202)

- **UL94: 5V for permanent equipment**
- **Rating < 200 in UL723 or ASTM E162**

If enclosure has a projected surface > 0,93m² or one dimension > 1,83m

- **Touch temperature 60 to 95°C at In**

Plugs, receptacles and couplers (UL2251)

- **No hard rubber as insulating material**
- **UL94: min HB rating in association with HAI and HWI for internal barrier or enclosures (minimum thickness 0,71mm, 2cm3, 3cm)**
- **or other standards requirements for components (if any)**
- **Special HB marking in Canada**
- **Temperature rise max 50°C**
- **RTI: min 100°C**

➡ Target: avoid the fire propagation from internal or external sources

Conclusion

- Several standards apply on EV charging station and plug/sockets and the relevant safety measures for electrical installation.
- IEC and UL requirements are different, but each of them constitutes an “ecosystem” with installation requirements, product standards and horizontal standards which has proven to be safe.
- The concept of flammability is different in Europe and USA (fire ignition form the EV charging station vs fire propagation from internal/external sources)
- IEC requirements should be achievable with recycle materials

Thank you very much for your attention
Do you have some questions?