VÉDELEM TUDOMÁNY
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COMPARISON OF THE HUNGARIAN AND INTERNATIONAL STANDARDS FOR ELECTRIC CAR CHARGING STATIONS

Abstract

Electric vehicles are becoming more and more importance, which also poses a number of problems. The installation of the chargers for electric vehicles is currently a new technology, so to this day there is, no coherent installation and operating code in the European Union or worldwide. To understand the problem, the authors will review and compare the Hungarian and international regulations. The regulations differ in that they place a different emphasis on each area of operation.

Keywords: electric car, charger, regulations, comparison

ELEKTROMOS AUTÓTÖLTŐ ÁLLOMÁSOK HAZAI ÉS NEMZETKÖZI ELŐÍRÁSAINAK ÖSSZEHASONLÍTÁSA

Absztrakt

Az elektromos járművek elterjedésével problémát jelent, hogy az elektromos járművek töltésére szolgáló berendezések telepítése jelenleg még annyira újszerűnek számít, hogy nem alakult ki sem az EU-ban sem a világon egységes telepítési és üzemeltetési szabályzat. A probléma megismerése érdekében, a szerzők áttekintik, majd összehasonlítják a hazai és nemzetközi szabályzatokat. A szabályzatok abban különböznek, hogy más és más hangsúlyt fektetnek az egyes üzemeltetési területekre.

Kulcsszavak: elektromos autó, töltő, előírások, összehasonlítás

1. INTRODUCTION

Researches on firefighting and fire prevention in case of electric cars is incomplete in Hungary. Publications in the topic focus on the generation of transformer fires [1] and the fire safety testing of electric vehicles [2]. In addition, papers on safety firefighting intervention [3] [4] only mention this topic but do not analyse it in detail. Examinations in the topic of the fire prevention in case of smart buildings [5] [6]. Firefighting against electric cars may appears in the investigation of the decision making of the firefighters, but the topic is not explained in detail here either [7] [8]. It is important to deal with issue, because inefficient firefighting can result in serious costs [9] [10]. This is especially true in case of underground interventions [11].

International standards and regulations

The standard for charging electric vehicles was first established in 2001 by the International Electrotechnical Commission (IEC) and the International Organization for Standardization (ISO). Hungarian standards are also based on these. The related standards are presented in Table 1.

Table 1 – Standards in connection with electric vehicles. Source: [12]

Standards	IEC	Title
MSZ EN 61851-1:2012	IEC 61851-1:2010	Electric vehicle conductive charging system - Part 1: General requirements
MSZ EN 61851-21:2002	IEC 61851-21:2001	Electric vehicle conductive charging system - Part 21-1 Electric vehicle on-board charger EMC requirements for conductive connection to AC/DC supply
MSZ EN 61851-22:2002	IEC 61851-22:2001	Electric Vehicle Conductive Charging System - Part 22: AC Electric Vehicle Charging Statio
MSZ EN 61851-23:2014	IEC 61851-23:2014	Electric vehicle conductive charging system - Part 23: DC electric vehicle charging station
MSZ EN 61851-24:2014	IEC 61851-24:2014	Corrigendum 1 - Electric vehicle conductive charging system - Part 24: Digital communication between a d.c.

		EV charging station and an electric vehicle for control of d.c. charging
MSZ EN 62196-1:2015	IEC 62196-1:2014, módosítva	Plugs, socket-outlets, vehicle connectors and vehicle inlets. Conductive charging of electric vehicles. Part 1: General requirements (IEC 62196-1:2014, modified
MSZ EN 62196-2:2013 Withdrawn!	IEC 62196-2:2011 Withdrawn	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories
MSZ EN 62196-2:2012/ A11:2013 Withdrawn!	-	Plugs, socket-outlets, vehicle connectors and vehicle inlets. Conductive charging of electric vehicles. Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessorie
MSZ EN 62196-2:2012/ A12:2015 Withdrawn!	-	Plugs, socket-outlets, vehicle connectors and vehicle inlets. Conductive charging of electric vehicles. Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories
MSZ EN 62196-3:2015	IEC 62196-3:2014	Plugs, socket-outlets, vehicle connectors and vehicle inlets. Conductive charging of electric vehicles. Part 3: Dimensional compatibility and interchangeability requirements for d.c. and a.c./d.c. pin and contact-tube vehicle couplers (IEC 62196-3:2014)

2. PRESENTATION OF CHARGING STATIONS AND REGULATIONS

In this paper, we present two global companies and a Hungarian charging station and the regulations along which they operate. The three stations: RISCAuthority and Fire Protection Association (United Kingdom), Fire Safety Regulations of Changi Airport Group (Singapore) and the Fire Safety Regulations of Arena Mall (Budapest, Hungary).

2.1. United Kingdom

The rules applied in the United Kingdom are presented according to the RISCAuthority and Fire Protection Association - RC59 Fire safety when charging electric vehicles. It was published in 2012. The purpose of this guidelines is to provide practical guidance to insurers and their customers on the risk of fire in case of charging electric vehicles. The concept of vehicles includes electric cars, vans and motorcycles. These are presented with in a separate chapter. [13]

The suggested fire protection measures are the followings in this issue:

- An automatic fire alarm system shall be provided at the place of the charger. It is designed, installed and maintained by an engineer accredited by the UKAS (United Kingdom Accreditation Service). The installation must be carried out in accordance with the standard BS 5839-1 Fire Alarm System for Buildings.
- The automatic fire alarm system shall be continuously monitored by an on-site or off-site remote monitoring centre that is accredited by the UKAS. These BS 5979 Remote Monitoring Centres operate in accordance with the standard for receiving fire and security alarms.
- Periodic maintenance of chargers shall be performed by an appropriate engineer in accordance with BS 5839-1 standard.
- The installation of the automatic fire alarm system should be carried out in such a way that the power supply to the charging stations can be disconnected in case of fire alarm.
- At commercial buildings, where vehicles are being charged without supervision, it is recommended to install built-in automatic fire extinguishers on the fire section, where the charging process takes place.
- The most effective extinguisher for a given application should be selected after a risk assessment. The efficiency of the extinguisher should be considered with the health and environmental effects. The primary extinguishing agent is dust, carbon dioxide and other gases [13].

2.2. Changi Airport Group – Singapore

It is also worth examining the fire regulations of Changi Airport, which is a facility with very strict safety standards. Airports are large and extended, so a fire can spread quickly and it can also have characterized by high fire load.

The main measures presented by the standard are the followings: [14]

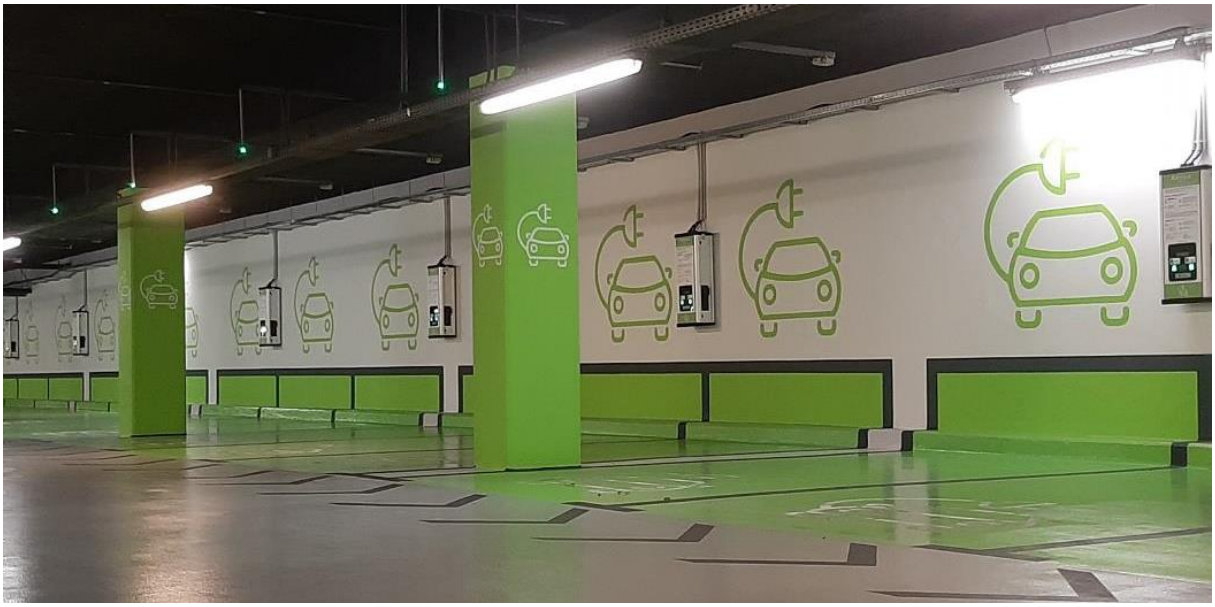
- Charging equipment shall be treated as electrical equipment or parts of them. These devices must also accomplish with national standards, regulations and legislation.
- The electric vehicle must be connected to the charger in the way that the power transmission should be safe during the application.
- Only the pre-connected cable should be used.
- An adapter between the socket on the charger and the plug of the vehicle can only be used if it is a product of the manufacturer of the vehicle or the charger.
- Chargers must be capable of charging electric vehicles without the use of an external ventilation system.
- An emergency switch must be installed for the disconnection. It can be operated in case event of an electric shock, fire or explosion. The device must be designed to prevent accidental operation and must be suitable for outdoor use or bad environmental conditions.
- The charging cable must be flexible and have the mechanical characteristics for cables required by IEC 60245-6 such as bad environmental conditions, exposure to chemicals and oil, UV radiation, abrasion, physical exposure and fire.
- Chargers should only be used to charge batteries for their intended purpose.

It is forbidden to modify the chargers and it is also forbidden to charge vehicles which are not suitable for this type of charging. [14]

2.3. Arena Mall - Budapest

The solutions used in Hungary are presented on the basis of an example. This is the instruction of the Arena Mall "Fire Protection Instructions for Electric Car Chargers" located at 9. Kerepesi Street, Budapest.

The document is an official part of the Fire Protection Regulations for the shopping centre and it also covers the area of charging stations on the parking level of the building. [15]



Picture 1 – Charging stations at the Arena Mall. Source: [15]

In case of fire, the following actions must be taken:

- In case of a fire in the parking zone, the power supply must be cut off using the switches in the dispatch centre.
- De-energization is mandatory for electric devices in case of fire. This activity is performed by the person who is responsible for the maintenance, after a decision by the security service.
- After the de-energization all switchgear used for disconnection must be secured against reconnection.

- It is very important to use types ABC, BC, or C fire extinguishers during the intervention. The use of water or wrong fire extinguishers may result electric shocks or death. The suitable fire extinguishers are available in the shopping mall.
- After the successful firefighting, the condition of the reconnection of the equipment is a joint permission from the maintenance company and the Disaster Management. In case of an incorrect signal, personal conviction is sufficient for the reconnection.
- All fires must be reported to the appropriate Disaster Management Branch Office [15].

3. COMPARATIVE ANALYSIS

3.1. Comparison of rules and practices

Based on the type of action, we have set up categories that allow the comparison:

- legislative background
- electric network connection
- requirements for fire alarm systems
- preventive measures and processes
- charging rules
- what to do in case of fire
- information about the firefighting

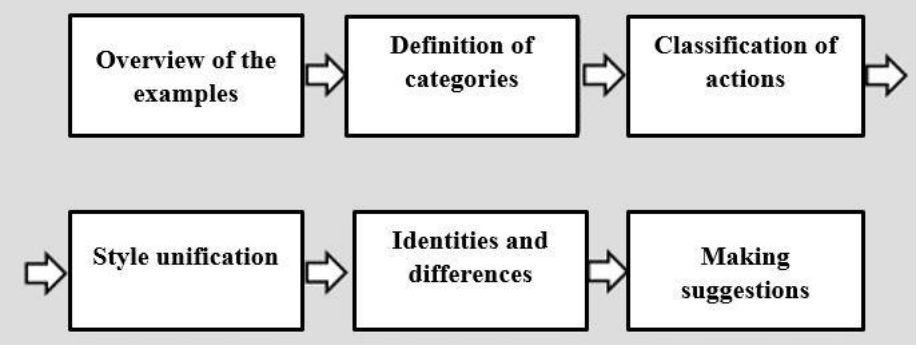
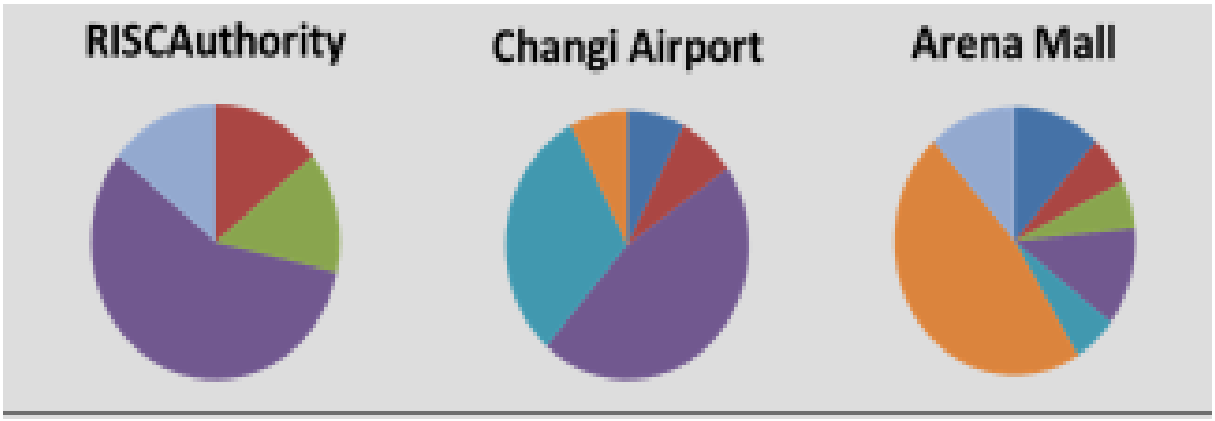


Figure 1 - Processes of analysis. Created by the Authors.

From our analysis, it can be concluded that each solution focuses on other categories of measures, but there are also some common findings. In all three cases, it appears that an electric solution must be selected so that the chargers can be disconnected from the mains in case of fire, and this should not affect the fire alarm. A common feature of the Arena Mall and the RISCAuthority is that an automatic fire alarm system must be installed at the site of the chargers, and the actions also make a recommendation for the firefighting. Both RISCAuthority and Changi Airport Group outline the more serious measures and processes that need to be taken to prevent a fire. These include the action plans and risk assessment, training of the staff, maintaining equipment and displaying information signs. In case of Arena Mall and Changi Airport Group, standards and legislation must be met. All three recommendations detail and highlight one topic the most. The Arena Mall sets out the measures to be taken in case of fire, with RISCAuthority setting out the importance of accreditations, with particular emphasis on preventive measures and processes. According to the Changi Airport Group, the presence of the regulations for the charging process is very important. The three presented recommendations present the most important topics, so they can be used to easily prepare company proposals for the Fire Protection Regulations. This can be found in Chapter 5.

The comparison is also illustrated in a graph according to the different categories.



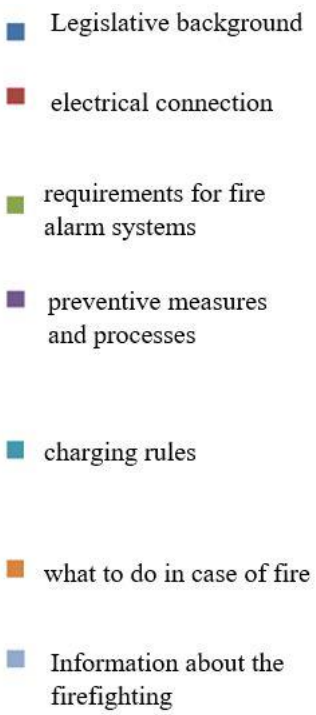


Figure 2 - The comparison in a graph according to the different categories. Created by the Authors.

4. SUGGESTIONS FOR FIRE PROTECTION REGULATIONS

Important criteria for electric car chargers

- During installation, the relevant electrical standards and regulations must be met, the manufacturer's specifications and instructions must be corresponded in all cases.
- Chargers must be used in accordance with the electrical equipment and the relevant requirements must also be observed.

- The following standards must be met: MSZ EN 61851-1:2012; MSZ EN 61851-21:2002; MSZ EN 61851-22; MSZ EN 61851-23:2014; MSZ EN 61851-24:2014; MSZ HD 60364-7-722:2012; MSZ HD 60364-7-722:2016 (see Table1).

***The following requirements must be met in the context of electrical chargera and electrical network*:**

- The supply of the charger must be implemented in such a way that it can be disconnected from the electric network of the building.
- The de-energization must be carried out by operating the main fire protection switch located at the charging stations. In addition, an emergency switch must be installed in a conspicuous place, which can be operated in case of electric shock, fire or explosion.
- The power supply to the automatic fire alarm system must be independent of the power supply to the charging stations.

Measures in connection with the fire prevention:

- An automatic fire alarm system must be in install at the site of the charger and must be constantly monitored.
- Impact protection of charging stations must be provided by impact protectors.
- A risk assessment must be carried out before the use of the charger, after that an emergency plan must be prepared. An emergency action plan should also be developed.
- People acting in case of fire must be trained in the safe charging process and they should be familiar with the location of the charging equipment. They have to know how to de-energize and the measures to be taken in case of an emergency.
- Ignoring the components of the electric vehicles and the charger, no flammable material can be stored in the affected area.
- Only an undamaged cable or adapter can be used during the charging!
- It must be checked regularly that the chargers are undamaged and that the instructions on it are readable. Chargers must be regularly maintained. in the event of any failure, the charger must not be used and must be notified to the user (with appropriate indications).

In case of fire, the following measures must be taken

- The manual call point must be operated. This starts the fire alarm and the fire protection equipment.
- De-energization shall be performed by using on-site fire protection switches.

- The switching devices used for disconnection must be secured against reconnection.
- People should start the firefighting with the available fire extinguishers, if it can be started safely.
- The professional firefighters must be informed of the measures taken so far, the condition of the charging equipment and to give them the Fire Alert Plan and its annexes.
- If necessary, the evacuation of the building shall be carried out in accordance with the provisions of the Fire Alert Plan.
- After the successful firefighting, the condition of the reconnection of the equipment is a joint permission from the maintenance company and the Disaster Management
- All fires must be reported to the appropriate Disaster Management Branch Office.

REFERENCES

[1] Sándor Barnabás - Nagy Rudolf: Transzformátortüzek kialakulásának és tulajdonságainak vizsgálata. *Védelem Tudomány* III. 4. (2018), pp. 73-91.

[2] Szabó Viktória - Molnár Kristóf – Nagy Rudolf: Elektromos járművek tűzbiztonságának vizsgálata. *Védelem Tudomány* III. 2. (2018), pp. 77-112.

[3] Pántya Péter: A katasztrófavédelem beavatkozó hatékonyságának fejlesztése a tűzoltósági területen. *Hadmérnök*, XIII. „KÖFOP” (2018), pp. 109-144.

[4] Bodnár László - Bérczi László: Beavatkozói biztonság vizsgálata a nagy kiterjedésű erdőtüzek kapcsán. *Műszaki Katonai Közlöny*, XXVIII. 4. (2018), pp. 102-110

[5] Érces Gergő –Vass Gyula: Okos épületek, okos városok tűzvédelmének alapjai I. *Védelem Tudomány*, VI. 1. (2021), pp. 1-21.

[6] Érces Gergő - Bérczi László - Rácz Sándor: The effects of the actively used reactive and passive fire protection systems established by innovative fire protection methods for whole life-cycle of buildings. *Műszaki Katonai Közlöny*, XXVIII. 4. (2018), pp. 47-58.

[7] Restás Ágoston: *Decision making on the spot*. In: Grześkowiak, Ł Wojciech et. al: Proceedings of the 8th International Scientific Conference Wood and Fire Safety

Zilina, Slovakia: EDIS Zilina University Publishers (2016), pp. 277-286.

[8] Rácz Sándor - Pántya Péter: *Nagy alapterületű létesítmények tűzoltásához szükséges erők eszközök riasztásának döntéstámogatása*. In: Restás Ágoston - Urbán Anett (szerk.): Katasztrófavédelem 2015.Budapest: BM Országos Katasztrófavédelmi Főigazgatóság, 2015. pp. 135-139.

[9] Bodnár László: Case study of "Hortobagy" and "Kunfeherto" fires, Hungary: disaster in costs of their elimination's view. *Ecoterra: Journal of Environmental Research and Protection*, XIV. 1. (2017), pp. 40-46.

[10] Restás Ágoston: *Measuring the efficiency by mixing the costs and the effectiveness of extinguishing materials and aerial firefighting*. In: Lenka, BLINOVÁ; et, al: Management of Environment 2016. Bratislava, Slovakia: Slovak Society of Environmental Technology. 2017. pp. 118-124.

[11] Érces Gergő - Komjáthy László: Mérnöki módszerek szerepe a felszíni alatti vasútvonalak tűzvédelmi helyzetének alakulásában. *Hadmérnök*, XIII. 4. (2018), pp. 190-198.

[12] Magyar Szabványügyi Testület: www.mszt.hu download: 02.30.2021.

[13] RISCAuthority - Risk Control: Fire safety when charging electric vehicles, 2012.

[14] Airport Emergency Service - Changi Airport Group Fire Safety Manual, 2019.

[15] Arena Mall Elektromos autótöltőkre vonatkozó tűzvédelmi utasítás, 2019.

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