

BULETINUL INSTITUTULUI POLITEHNIC DIN IAȘI  
Publicat de  
Universitatea Tehnică „Gheorghe Asachi” din Iași  
Volumul 71 (75), Numărul 4, 2025  
Secția  
CONSTRUCȚII DE MAȘINI  
DOI: 10.2478/bipcm-2025-0033

## STUDY ON TEMPERATURE SHOCK TESTS PERFORMED ON CHARGING CABLES FOR ELECTRIC VEHICLES

BY

ELENA-ROXANA COSĂU and VIOREL GOANȚĂ\*

“Gheorghe Asachi” Technical University of Iași,  
Faculty of Mechanical Engineering, Iași, Romania

Received: July 7, 2025

Accepted for publication: August 11, 2025

**Abstract.** The cables used for electric vehicle charging are subjected to various stresses and interventions during operation or storage. It is taken into account that these cables are stored in a certain form, usually coiled, after which they are unwound, stretched and, while being subjected to an electromagnetic field, are in the open air. This can mean high or low temperatures and various other environmental actions. During handling and actual electrical charging, various situations arise in which shock loads may occur. One reason would be the stress caused by shock traction by the user. Another cause can be the fall of foreign bodies during the electric charging operation. There can also be an accidental passage over the cable with the car wheel. If all these shock stresses are superimposed and with high temperatures, these cables can be taken out of use. In this paper, the results of shock tests of two types of cables, at high temperatures, are presented.

**Keywords:** shock test, Charpy impact, charging cables, temperature.

---

\*Corresponding author; *e-mail*: viorel.goanta@academic.tuiasi.ro

© 2025 Elena-Roxana Cosău and Viorel Goanță

This is an open access article licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0).

## 1. Study context

Electric cables used in charging electric vehicles must operate reliably in diverse and often demanding environments. One key aspect of ensuring their performance lies in their ability to resist various forms of mechanical and thermal stress (Bernstein, 1994). The polymeric materials used in cable insulation, particularly those based on PVC, are engineered to absorb shocks and withstand mechanical impacts without suffering visible damage or internal failure. These materials provide adequate structural rigidity, reducing the likelihood of unwanted deformation or displacement during use. PVC, a commonly used polymer in cable sheathing, is chemically stable and maintains its physical characteristics over extended periods. As a viscoelastic material, it can slowly deform when subjected to continuous loading – a process referred to as time-dependent strain or creep (Yiyan, 2017). Compared to other thermoplastics such as polyethylene or polypropylene, PVC demonstrates a significantly lower tendency toward this type of deformation, due to its molecular structure, which limits the mobility of its chains in non-crystalline regions. This property enhances its suitability for components that must retain dimensional accuracy under long-term loading conditions. When exposed to constant mechanical pressure at ambient temperature, this behaviour becomes evident as a slow, irreversible shape change known as cold flow – a factor that must be considered during product design in construction and industrial contexts.

EV charging cables typically consist of multiple layers: conductive copper strands, internal and external sheaths made from polymeric compounds, and reinforcement elements like textile fibres. These components may be subjected to damage from repeated bending, stretching, twisting, or impacts, particularly during day-to-day handling. While standard power cables installed in stationary settings experience limited mechanical fluctuation, those used in mobile charging systems are exposed to more dynamic forces. Outdoor cables, for instance, endure environmental challenges such as temperature variation, wind, and ice accumulation. In contrast, EV cables encounter stress primarily due to repeated user interaction - including bending, pulling, and torsion during plug-in and unplugging operations. Because the mechanical performance of these cables directly influences the efficiency and safety of the charging process, the materials and construction must meet higher durability requirements than traditional cables. The growing demand for electric vehicles also places increased emphasis on developing robust, long-lasting charging infrastructure. As such, systematic mechanical testing plays an essential role in validating the physical resilience of these cables under real-world conditions (Linshu *et al.*, 2019). The aim of mechanical testing procedures is to evaluate how these cables respond to repeated stress factors - such as twisting, compression, abrasion, and external impact - all of which can contribute to

gradual material degradation. Standards have been established to guide these evaluations (Chahoe and Chengyu, 2013), including:

- IEC 60811-202, 2012, which refers to measuring the thickness of the PVC protection of cables;
- IEC 60502-1, 2021, in which various specifications are given for power cables with extruded insulation;
- IEC 60332-1-2, 2025 in which the fire resistance is evaluated for both electrical cables and optical fibres;
- IEC 62893-1, 2020 which provides certain requirements for cables used in testing electric vehicles with voltages up to 0.6/1kV;
- EN 50520:2020/A1:2021, 2021 is a standard that establishes the performance of cables used for charging electric vehicles;
- EN 60811-100, 2012, is a European standard that describes the general testing conditions for polymeric materials.

Despite the presence of standardized testing protocols, there remains a lack of detailed experimental studies focused specifically on EV cable durability. Previous research has explored charging infrastructure and cable technologies in general terms. For example, Singh *et al.*, 2024 addressed various aspects of charging systems and international compatibility, yet did not delve into the relationship between material choices and failure modes. Other studies, such as those by Lin *et al.*, 2021, have utilized computational simulations to evaluate cable response under load but often overlook the cable's true geometry, such as spiral layouts. Later, Lin *et al.*, 2025, examined practical test setups and observed recurring issues related to clamping efficiency, slippage, and localized failure. In response to these limitations, Xiao *et al.*, 2020, introduced a redesigned fixture system with improved stability, validated through simulation, although mechanical constraints remained due to the spring configuration. Complementary efforts include fatigue assessments performed on reinforced elastomeric composites by Stevens *et al.*, 2018, where thermal imaging was used to monitor damage progression. Meanwhile, Jingle Jabha *et al.*, 2016, proposed an acoustic sensing method to detect early-stage defects in conductive materials, demonstrating that significant elongation can occur prior to failure.

Other researchers have concentrated on the behaviour of conductive elements and polymers at elevated temperatures. For instance, tensile tests conducted on metal wires at high thermal loads have provided insight into how mechanical properties degrade with temperature (Kuzmanov *et al.*, 2020; Anderson *et al.*, 2025; Du *et al.*, 2018; Zhang *et al.*, 2024). Some models, such as those proposed by Anderson *et al.*, 2025, have enabled more accurate predictions of thermal effects on material performance. Investigations into cyclic thermal stress, like those reported by Rickman *et al.*, 2021, highlight the long-term impact of repeated heating and cooling on structural integrity. Zichuan *et al.*, 2020 focused on performance degradation in high-risk

environments, such as nuclear facilities, where thermal shock plays a major role.

In the present work, mechanical impact testing was performed on two types of EV charging cables to assess the response of the complete system – including conductor, polymeric insulation, and textile reinforcements – under dynamic loading. While isolated mechanical or thermal stresses can compromise cable performance, their combined action poses a more significant risk of failure. As previously noted, more extensive studies are needed to understand how electric vehicle charging cables behave under different loads, environmental actions, combined effects, etc. When designing such cables, in addition to the economic aspect, one must take into account both the electrical and mechanical characteristics as well as the properties that these cables must satisfy in order to ensure use with a certain frequency (Guo *et al.*, 2020; Zhao *et al.*, 2024; Li *et al.*, 2022).

## 2. Materials and equipment

In the shock tests that will be presented below, cables taken from the final charging system (including the charging plugs) were used. Cables from the same company were used but were to be supplied for two different types of vehicles. Under these conditions, we had cables with an outer diameter of 16 mm and 12 mm. These cables were classified as having class 6 flexibility in relation to the provisions of the IEC 60228, 2023 standard. The cable with an outer diameter of 16 mm (blue), in addition to the outer sheath, contains six inner cables (each consisting of a sheath and copper conductors) and a textile wire placed in a central position (Fig. 1a). The cable with an outer diameter of 12 mm (yellow) also had six inner cables, their diameter being smaller than the previous cable, and the corresponding textile wire (Fig. 1b). The PVC part representing the outer insulation is made of PVC type TM2 while the sheath of the inner conductors is made of PVC type TI2, according to the provisions of the DIN VDE 0281 Part 1 + HD 21.1 standard. The copper wires, which constitute the electrically conductive part, have a specific mass of 72kg/m.



(a) Sample with cu  $\varnothing = 16$  mm

(b) Sample with cu  $\varnothing = 12$  mm

Fig. 1 – Samples used in shock testing.  $\varnothing$  is the diameter of the cable.

The properties of the materials that make up the cable assembly described above are presented in Table 1. Four types of materials are present here, namely, the outer sheath of the assembly, the inner conductor sheath, copper and textile thread. We mention that both types of cables (with outer diameters of 16 mm and 12 mm) had the same types of materials. The following characteristics are presented in Table 1: the longitudinal modulus of elasticity (Young's modulus), Poisson's ratio, the yield strength and the tangent modulus, taken from the straight line that simulates the characteristic stress-strain curve, after the yield zone.

**Table 1**  
*Material characteristics used for components*

<b>Material</b>	<b>Poisson ratio</b>	<b>Young modulus [MPa]</b>	<b>Yield limit [MPa]</b>	<b>Tangent modulus [MPa]</b>
Copper	0.34	110000	150	1150
PVC outer	0.42	1100	4	0
PVC inner	0.42	1100	2.5	0
Textile thread	0.39	3500	50	0

From Fig. 2 it can be seen that the cables inside are arranged in a strand around the textile thread. Cosău *et al.*, 2025, showed, through finite element analysis, that part of the energy received from the outside through the tensile test is dissipated through internal friction between the cables, and between them and the outer sheath. We expect that such energy dissipation will also occur during shock testing, proportional to the friction area between the surfaces in contact.



Fig. 2 – Twisting the cables inside the outer sheath.



Fig. 3 – Charpy pendulum hammer.

The equipment used was the Charpy pendulum hammer type device, with a maximum load of over 300 daN, Fig. 3.

It is noted that although the device is designed to deliver a maximum energy of 300 daN, by raising the pendulum hammer to a higher height on the toothed sector, it can deliver a higher energy. This was also the case for the 16 mm diameter cable loads as it did not break at a delivered energy of 300 daN.

## 2. How to perform the tests and clamp them in the jaws

The samples made of cables were clamped in the jaws of the testing device, as shown in Fig. 4a. As can be seen from Fig. 4b, the sample broke in the area of impact with the pendulum hammer and not in the jaws. Under these conditions, we can consider that the tests were valid.

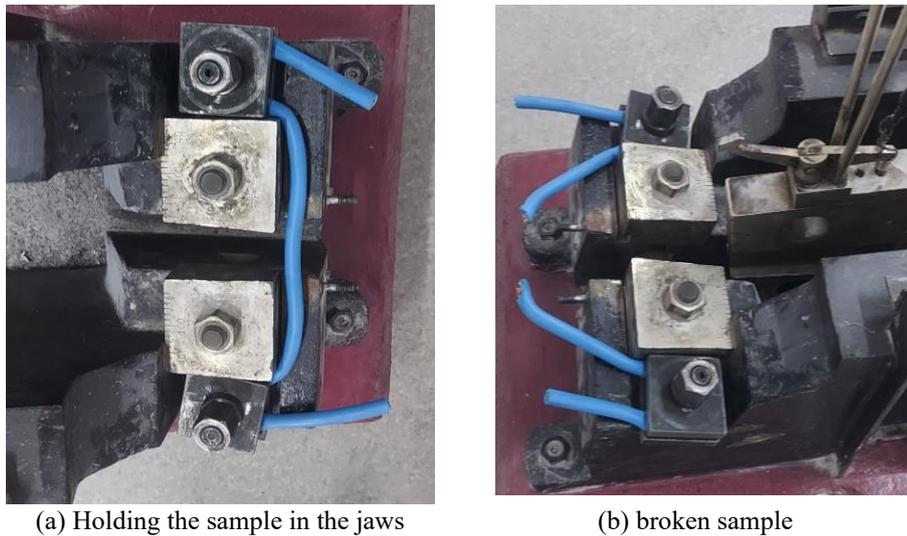


Fig. 4 – How to hold and break the samples.

The maximum energy of the pendulum specified in the standard for the Charpy test is 300 Joules. The energy released by friction (determined by the free fall of the hammer) was 45 Joules. The total energy, released to the sample and lost by friction, was read on the graduated scale shown in Fig. 5. It should be noted that the energy of 300 Joules was not sufficient to break the 16 mm diameter cable, Fig. 6. Under these conditions, the pendulum was raised three steps higher, Fig. 3, to provide the necessary energy. Under these conditions, the maximum energy to which the pendulum was raised was empirically calculated to be 364 Joules. Corrective calculations were made for the new energy and the measurement scale was adapted so as to correctly measure the energy released to the sample by breaking.



Fig. 5 – How to read energy on the graduated scale.



Fig. 6 – Unbroken sample with maximum energy of 300 J.

Heating was carried out using a blower which allowed the temperature to be raised to 110°C. Instantaneous temperature reading was carried out using a digital thermometer, Fig. 7.



Fig. 7 – Heating mode and temperature reading.

It is mentioned that the heating and the temperature reading were also carried out during the test so that the cable temperature taken for drawing the graphs below was the real one, from the moment of impact. We also mention that the heating with the blower, before the impact, was carried out 2-3 degrees more than the one read at the moment of impact. This was done so that at the moment of impact the temperature was the desired one. Fig. 8 shows some temperature measurements during heating.



Fig. 8 – How to take temperature readings when heating cables.

The failure mode of the specimens with an outer diameter of 12 mm is shown in Fig. 9. It is found that the specimens break in the area of impact with the pendulum hammer (central area) and not in the clamping area, which makes the test performed valid.



Fig. 9 – Breaking mode of samples with outer diameter of 12 mm.

The breaking mode of the cables with an outer diameter of 16 mm can be seen in Fig. 10. Here too, it can be seen that the breaking occurred in the impact zone. We recall that the impact energy required to break the cable with a diameter of 16 mm was greater than 300 J and 364 J, respectively, obtained by raising the hammer to a height higher than that indicated for obtaining the energy of 300 J.

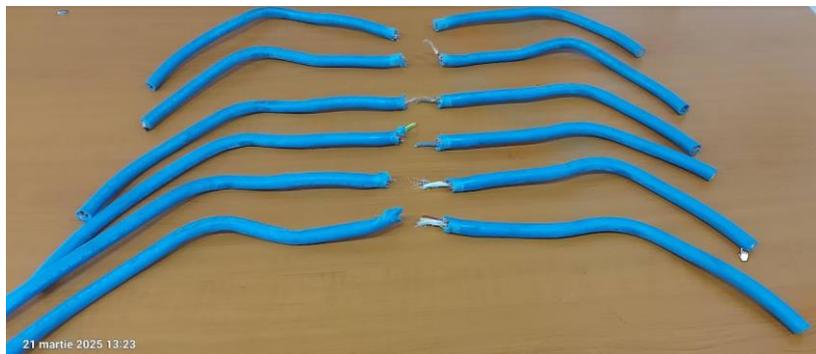


Fig. 10 – Breaking mode of samples with outer diameter of 16 mm.

#### 4. Results obtained and discussions

Following the tests, the breaking energies were determined, under the conditions in which the cables were heated to certain temperatures, in the central part, where the impact zone was. It is mentioned that the temperatures were measured in the central area, right at the moment of impact.

Fig. 11 shows the variation of the energy given to the sample at the moment of impact in relation to the cable temperature in the impact zone, for the cable with a diameter of 12 mm. It is found that the breaking energy decreases with increasing temperature.

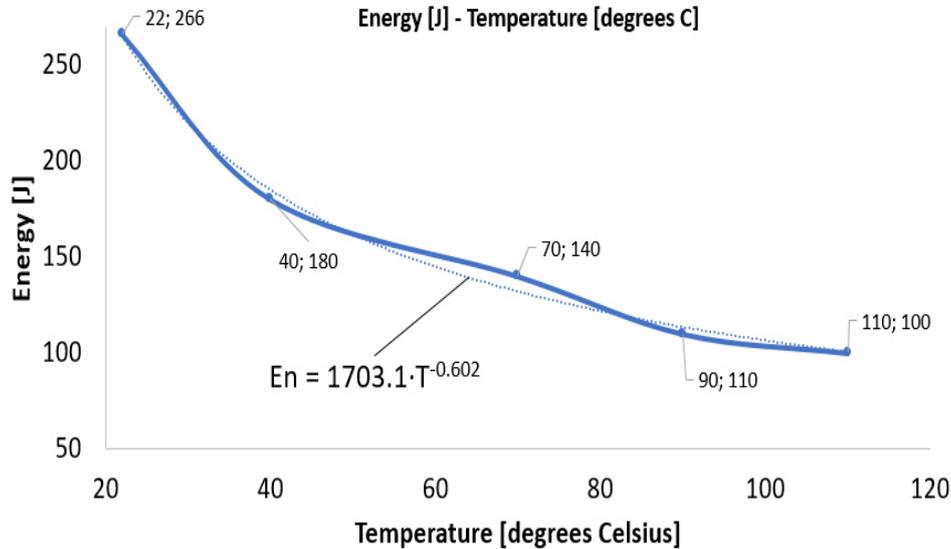


Fig. 11 – Variation of energy released with temperature; sample Ø12mm.

In the temperature range, 22°C – 110°C, it is possible to assign a negative exponential law of energy variation with respect to temperature, as follows:

$$E_n = 1703.1 \cdot T^{-0.602} \quad (1)$$

where:

- $E_n$  is the breaking energy supplied to the sample upon impact;
- $T$  is the temperature in the central area of the sample which is also the impact area.

For the sample with an outer diameter of 16 mm, the variation of energy in relation to the temperature in the impact area is given in Fig. 12. For this sample too, the decrease of the impact energy in relation to the increase of the temperature in the impact area of the pendulum hammer is observed.

In the temperature range, 22°C – 110°C, the negative exponential law of variation of energy in relation to the temperature, which can be assigned for the cable with an outer diameter of 16 mm is:

$$E_n = 1039.4 \cdot T^{-0.42} \quad (2)$$

where:

- $E_n$  is the fracture energy supplied to the sample upon impact;
- $T$  is the temperature in the central area of the sample which is also the impact area.

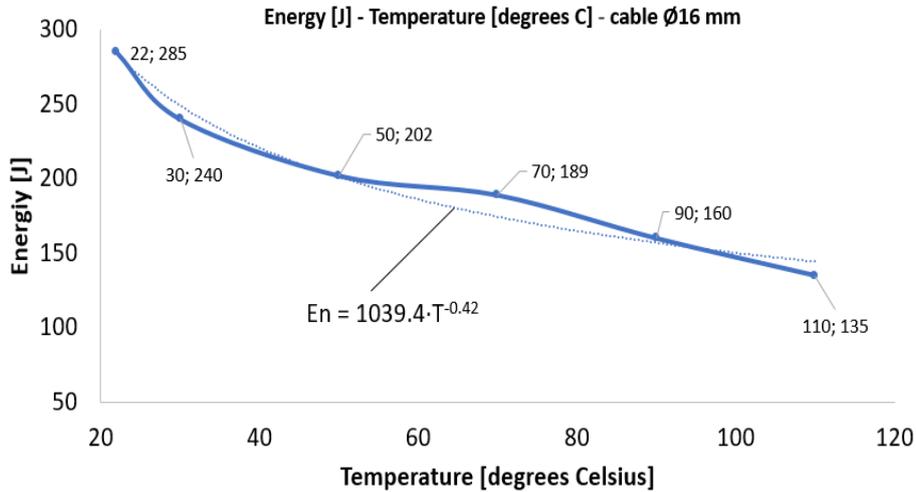


Fig. 12 – Variation of energy released with temperature; sample Ø16mm.

For comparison, in Fig. 13 the two previous variations, the impact energy in relation to the temperature, for the two cables with diameters of 12 mm and 16 mm, have been plotted.

It is found that, for a certain temperature, the energy required to break the cable with an outer diameter of 16 mm is greater than the energy required to break the cable with a diameter of 12 mm. Table 2 presents, for 4 common temperatures, the energies provided for breaking as well as the ratio between them.

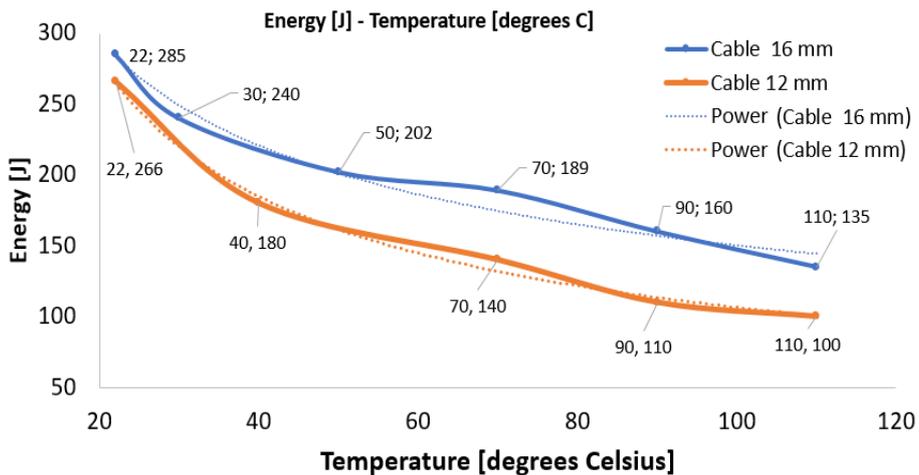


Fig. 13 – Variation of energy released with respect to temperature; sample Ø16mm versus sample Ø12mm.

**Table 2**  
*The energies supplied for breaking the two cables*

	Temperature [degrees Celsius]				Energy ratio
	20	70	90	110	
	Energy [J]				
Cable with Ø=16 mm	285	189	160	135	<b>1,297</b>
Cable with Ø=12 mm	266	140	110	100	
Energy ratio: Ø=16 mm/ Ø=12 mm	1,07	1,32	1,45	1,35	

Using the data from Table 2, the variation in Fig. 14 was plotted. Beyond the fact that the energies released for breaking the 16 mm diameter sample are higher for any temperature, Fig. 14 shows that the ratio between the breaking energies:  $E_{n\text{Ø}16\text{mm}}/E_{n\text{Ø}12\text{mm}}$  increases up to a temperature of 90 degrees Celsius after which a decrease occurs. It is possible that the decrease also occurs after a temperature of 11 degrees Celsius. The explanation lies in the fact that, by applying excessive heating, PVC-type materials degrade sharply, under these conditions no longer providing high resistance even at larger cross-sectional sizes.

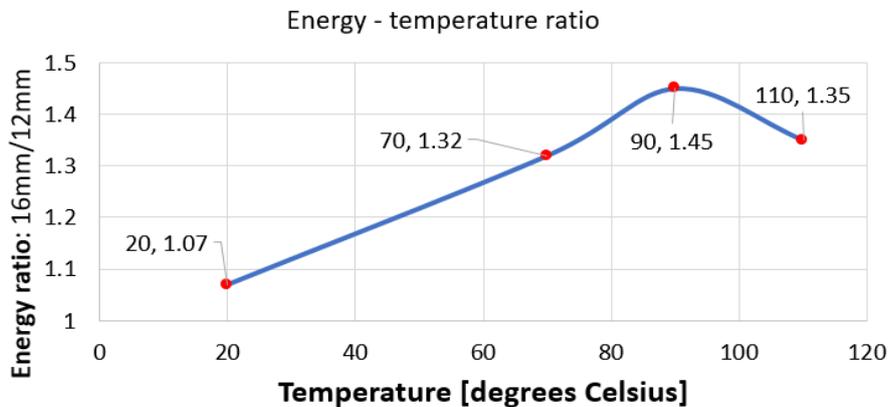


Fig. 14 – Variation of energy ratio,  $E_{n\text{Ø}16\text{mm}}/E_{n\text{Ø}12\text{mm}}$ , with temperature.

## 5. Conclusions

The present paper presents the shock test method for cables with outer diameters of 12 mm and 16 mm, at different temperatures.

The clamping in the jaws of the testing device was carried out based on clips and screws. This type of clamping did not affect the breaking mode of the

samples. They broke in the central part, in the impact zone with the pendulum hammer, which led to the validation of the tests.

It is noted that for the cable with an outer diameter of 16 mm, the energy of 300 J at which the testing machine usually operates was not sufficient for the complete breaking of the cross-section. Under these conditions, two types of additional calculations were used to determine both the initial energy of the hammer and the energy read on the corresponding ruler. All samples broke in the impact zone, with significant plastic deformations. As can be seen from Fig. 9 and Fig. 10, these deformations are greater the higher the working temperature. Note: in Figs. 9 and 10, the samples are placed from higher energy (lower temperature) to lower energy (higher temperature).

It is found that, for both samples, the energy required to break the samples decreases as the temperature in the impact zone increases. Regarding the ratio between the energies supplied to the two types of samples at the same temperature, it varies, increasing from a lower temperature to a higher temperature, up to a temperature of 90 degrees Celsius. After this temperature value, this ratio begins to decrease. Fig. 13 shows a more pronounced decrease in energy with respect to temperature for the 12mm cable. This can be attributed to the fact that, in the 16mm cable, the friction between the inner cables and between them and the outer sheath is greater, given that the contact surface is also larger.

## REFERENCES

- Anderson P., Bror Person B., *Performance of Cables Subjected to Elevated Temperatures*, Brandforsk Project 625-001, Available online: [https://publications.iafss.org/publications/fss/8/1121/view/fss\\_8-1121.pdf](https://publications.iafss.org/publications/fss/8/1121/view/fss_8-1121.pdf) (accessed on 18 March 2025).
- Bernstein B.S., *Cable Testing: Can we do better?*, IEEE Electr. Insul. Mag. 1994, **10**, 33-38.
- Chaohe T., Chengyu L., *Standardization analysis of electric vehicle charging cable*, Electr. Ind. 2013, **11**, 60-63.
- Cosau E.R., Goanta V., Blanari I., Alkisswani L., Samara F., *Determination of Tensile Characteristics and Electrical Resistance Variation of Cables Used for Charging Electric Vehicles*, Polymers 2025, **17**, 1317, <https://doi.org/10.3390/polym17101317>.
- Du Y., Peng J.Z., Yuen J., Liew R., Li G.Q., *Mechanical properties of high tensile steel cables at elevated temperatures*, Constr. Build. Mater. 2018, **182**, 52-56.
- EN 50520:2020/A1:2021, *Cover Plates and Cover Tapes for the Protection and Location Warning of Buried Cables or Buried Conduits in Underground Installations*, EU Technical Committee–CLC/TC 213–Cable Management Systems, European Committee for Electrotechnical Standardization: Brussels, Belgium, 2021.

- EN 60811-10, *Electric and Optical Fibre Cables–Test Methods for Non-Metallic Materials–Part 100: General*, EU Technical Committee–CLC/TC 20–Electric Cables, European Committee for Electrotechnical Standardization: Brussels, Belgium, 2012.
- Guo Z., Dai C., Qin, J., Zhou C., Li J., Yu W., Liu F., Yang D., Huang C. Li L. et al., *Research on mechanical properties of high-performance cable-in-conduit conductors with different design*, Supercond. Sci. Technol. 2020, **33**, 4.
- IEC 60228:2023; *Conductors of Insulated Cables*, International Electrotechnical Commission: Geneva, Switzerland, 2023.
- IEC 60502-1, *Power Cables with Extruded Insulation and Their Accessories for Rated Voltages from 1 kV ( $U_m = 1,2$  kV) up to 30 kV ( $U_m = 36$  kV) – Part 1, Cables for Rated Voltages of 1 kV ( $U_m = 1,2$  kV) and 3 kV ( $U_m = 3,6$  kV)*, IEC Technical Committee 20: Electric Cables. International Electrotechnical Commission: Geneva, Switzerland, 2021.
- IEC 60811-202:2012, *Electric and Optical Fibre Cables–Test Methods for Non-Metallic Materials–Part 202, General Tests–Measurement of Thickness of Non-Metallic Sheath*, IEC Technical Committee 20: Electric Cables. International Electrotechnical Commission: Geneva, Switzerland, 2012.
- IEC 60332-1-2, *Tests on Electric and Optical Fibre Cables Under Fire Conditions–Part 1-2: Test for Vertical Flame Propagation for a Single Insulated Wire or Cable*, International Electrotechnical Commission: Geneva, Switzerland, 2025.
- IEC 62893-1, *Charging Cables for Electric Vehicles for Rated Voltages up to and Including 0.6/1 kV–Part 1: General Requirements*, EC Technical Committee 20: Electric Cables, International Electrotechnical Commission: Geneva, Switzerland, 2020.
- Jingle Jabha D.F., Selvi K., Joselin R., *Determination of Tensile Strength and Dielectric Strength in XLPE Power Cables Using Acoustic Emission Technique*, Non-Destr. Eval. 2016, **22**, 162-168.
- Kuzmanov N., Borisov B., Muhtarov I., *Tensile testing of Inconel 600 wire at high temperatures*, IOP Conf. Ser. Mater. Sci. Eng. 2020, **878**, 012057.
- Li P. Zhao X., Qiu J., Qian J., Zhu Z., Zhang Z., Meng L., *Experimental and Numerical Investigation into the Stability Behaviour of Cable-Stiffened Steel Columns*, Materials 2022, **15**, 8813.
- Lin L., Xiao Zhiyong X., Guiping L., *Finite Element Modeling and Simulation of Mechanical Properties of DC Charging Cables for Electric Vehicles*, In Proceedings of IncoME-V & CEPE Net, 2021, Springer: Cham, Switzerland.
- Lin L., Xiao Zhiyong X., Guiping L., *Mechanical Performance Test and Analysis of DC Charging Cable for Electric Vehicle*, E3S Web Conf. 2020, 185, 01070, Polymers 2025, **17**, 1317 15 of 15.
- Linshu L., Jie Y., Hu Yongle H., *FEM and Simulation of bending of DC charging cable of electric vehicle*, Wire Cable 2019, **2**, 12–21.
- Rickman S.L., Furst B., Johnson K.L., *Thermal Testing and Analysis Techniques for Wires and Wire Bundles*, J. Phys. Conf. 2021, **2116**, 01207.
- Singh A., Vishnuram P., Alagarsamy S., Bajaj M., Blazek V., Damaj I., Rathore R.S., Al-Wesabi F.N., Othman K., *Electric vehicle charging technologies*,

- infrastructure expansion, grid integration strategies, and their role in promoting sustainable*, Alex. Eng. J. 2024, **105**, 300-330.
- Stevens A., Bilotti E., Peijs T., Busfield C.J., *Development of a novel fatigue test method for cord-rubber composites*. Polym. Test. 2018, **71**, 238–247.
- Xiao Z., Lu G., Zhong Z., *Design and Research of New-Type Clamping Fixture Based on Tensile Test of Wire and Cable Materials*, In Advances in Asset Management and Condition Monitoring. Smart Innovation, Systems and Technologies; Ball, A., Gelman, L., Rao, B., Eds., 2020, Springer: Berlin/Heidelberg, Germany, p. 166.
- Yiyan C., *Simulation of tensile mechanical behavior of high strength composite cable*, Mater. Dev. Appl. 2017, **32**, 47-52.
- Zhang Z., Xu Y., Huang Y., Wei Chen W.W., Ni Y., Ye J., Jiang J., *Experiment study on the mechanical properties and constitutive model of grade 1960 steel wires under and after elevated temperatures*, J. Build. Eng. 2024, **82**, 108318.
- Zhao Y., Hu J., Song S., Zhang T., Li P., Xiong G., *Global Stability Behavior of Pre-Cast Cable-Stiffened Steel Columns*, Buildings 2024, **14**, 248.
- Zichuan G., Chao D., Jinggang Q., Chao Z., Jiangang L., *Research on mechanical properties of high-performance cable-in-conduit conductors with different design*, Supercond.Sci.Technol. 2020, **33**, 4, 045002, Published: Feb 17, 2020, DOI: 10.1088/1361-6668/ab6ec4.

## STUDIUL PRIVIND TESTELE DE ȘOC LA TEMPERATURĂ, EFECTUATE PE CABLURI DE ÎNCĂRCARE PENTRU VEHICULE ELECTRICE

(Rezumat)

Cablurile utilizate pentru încărcarea vehiculelor electrice sunt supuse la diverse solicitări și intervenții în timpul funcționării sau depozitării. Se are în vedere faptul că aceste cabluri sunt depozitate într-o anumită formă, de obicei circulară, după care sunt derulate, întinse și, supuse fiind unui câmp electromagnetic, se află sub acțiunea factorilor de mediu. Aceasta poate însemna temperaturi ridicate sau scăzute și diverse alte acțiuni ale mediului. Totodată, pot apărea și solicitări de șoc din diverse motive. Un motiv ar fi solicitarea cauzată de tracțiunea bruscă de către utilizator. O altă cauză poate fi căderea unor corpuri străine în timpul operațiunii de încărcare electrică. Poate exista și o trecere accidentală peste cablu cu roata mașinii. Dacă toate aceste solicitări de șoc sunt suprapuse și cu temperaturi ridicate, aceste cabluri pot fi scoase din uz. În această lucrare sunt prezentate rezultatele testelor de șoc la două tipuri de cabluri, la temperaturi ridicate.