

# Inspection of Electrical Cables Utilized in Residential and Commercial Construction in the Kurdistan Region

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## Abstract

Before installation, all cable parameters must be thoroughly tested to guarantee the dependability and safety of electrical installations in buildings. When assessing the efficacy of electrical cables, key characteristics like resistance, insulation quality, and cross-sectional area are vital. Electrical conduction efficiency is assessed by resistance testing, which also aids in locating any problems like excessive energy loss or overheating. To reduce the possibility of electrical malfunctions and shocks, insulation testing evaluates the robustness and security of the cable's insulating substance. Checking the cross-sectional area helps to prevent overheating and voltage drop problems by ensuring that cables are the right size to fit the expected electrical load. To ensure that safety regulations are followed, improve system dependability, and avert future malfunctions, these tests must be carried out prior to installation. By taking a proactive stance, the building's electrical infrastructure is kept safe and efficient while also ensuring the electrical system operates at peak efficiency.

**Keywords:** cable parameter, cable characteristics, cable resistance, insulator, and fire safety.

## 1. Introduction

Electric lines are essential to buildings and other modes of transportation, such as vehicles, trains, aircraft, and ships. The vast quantity of electrical cables that are installed in these kinds of products, along with the materials that are used in their production, have an effect on the environment. They significantly affect fire safety as well. These kinds of fires have the ability to significantly affect the surrounding area and have negative consequences on both the environment and safety. Energy saving and safety regulations often clash, requiring a careful balance between the two [1-3].

Since electrical cables were added to the category of building materials in the Kurdistan area, interest in their characteristics has grown. Since every structure has kilometers of installed electrical cables, they play a major role in both the building's fire safety and the load capacity of the electrical devices that its occupants utilize[4]. In addition to significantly raising their fire load, the numerous cables inserted may also make it easier for flames to

spread quickly in the event of a fire [5-6] and raise the possibility of fire toxicity . Although cables are a necessary component of modern life, they frequently create a risk of fire. They can be clearly separated according to the end-use application they serve by supplying signals and electricity to different receivers[7,8].

Because they are composed of insulation and sheaths composed of polymeric materials with different chemical structures, diameters, cross-sectional areas, and additives [9], cables are complicated objects that require careful compromise between them [10].

Electric shock, overload and short-circuit current, switching overvoltage, lightning, and various heat-related impacts, including fire, have become more prevalent due to the usage of electric cables [11]. Many studies have been conducted, both theoretically and empirically, on the insulator properties of electric wires and cables. A comprehensive study has been provided [10], which includes the following summary: "This review has emphasized the complex role of the conductor's diameter and cross-section area, specifically whether it is a heat source or heat sink, in the combustion, flame propagate, being burned, and annihilation[12-14].

We measured a cable's diameter, cross-sectional area, and ability to withstand heat generated by an electrical current flowing through it under normal load conditions and during a short circuit, all in a lab setting. We also calculated how long the process would take. and contrasted it with the cable industry's worldwide scientific significance[15-17].

both physical and electrical defense. For example, Prysmian Twin and Earth cable (XLPE) as well as many other common building cables, it's ideal for sheathing and insulation[18,19]. In the event that a conductor temperature greater than 70°C is needed, the cable selected for this application needs to be insulated using XLPE.This is due to the fact that XLPE has a maximum working temperature of 90°C, whereas PVC has a maximum working temperature of 70°C, which is precisely what is required for standing building wires. Higher currents can flow through conductors in cables with XLPE insulation[20,21]. Because XLPE is a thermoset material and PVC is a thermoplastic, it can withstand these temperatures. This indicates that XLPE's molecules are linked chemically to one another When it comes to severe environmental conditions, like humidity and dryness, XLPE is a superior cable insulator than PVC [21-23].

## 2. Collection of Data

Data collection entails obtaining information from a variety of sources, such as Erbil City construction companies, various cable and wire manufacturers' brands that are available on the market, and the different kinds of cables used for residential building electrical installations.

## 3. RESULTS AND DISCUSSION

Data from lab tests for every kind of cable used in building installation was analysed. To verify the outcome, we compared the results with actual data sheet values and looked into any failure values that did not match the cable's true table sheet values.

The test tables for several cable types used in the Kurdistan region are listed below. The tests primarily measure the conductor's resistance, overall diameter, and cross-section area.

### Routing Cable Test Result

According to standards, IEC 60227 BS EN 50525-2-31

| N<br>o | Type of test &<br>inspection | No | Type of cable                                            | Cable<br>specification<br>(in datasheet) | Cable<br>specification<br>(Test) | Test result |
|--------|------------------------------|----|----------------------------------------------------------|------------------------------------------|----------------------------------|-------------|
| 1      |                              | 1  | AL-RAWI CABLES<br>SINGLE 1.5 mm - 91.1<br>MADE IN JORDAN | 1.5 mm <sup>2</sup>                      | 1.43 mm <sup>2</sup>             | matching    |

|  |                    |   |                                                          |                     |                      |                 |
|--|--------------------|---|----------------------------------------------------------|---------------------|----------------------|-----------------|
|  | Cross-section test | 2 | AL-RAWI CABLES<br>SINGLE 2.5 mm - 91.1<br>MADE in JORDAN | 2.5 mm <sup>2</sup> | 2.12 mm <sup>2</sup> | Not<br>matching |
|  |                    | 3 | AL-RAWI CABLES<br>SINGLE 4 mm - 91.1<br>MADE in JORDAN   | 4 mm <sup>2</sup>   | 3.79 mm <sup>2</sup> | matching        |

Table-1-AL-RAWI Cable Single Cross-Section Test.

| No | Type of test & inspection                                   | No | Type of cable                                         | Cable specification (in datasheet) | Cable specification (Test) | Test result  |
|----|-------------------------------------------------------------|----|-------------------------------------------------------|------------------------------------|----------------------------|--------------|
| 2  | Conductor resistance test ( $\rho$ ) or Current rating test | 1  | AL-RAWI CABLES<br>SINGLE 1.5 mm - 91.1 MADE IN JORDAN | 12.1 $\Omega$ /Km                  | 14.4 $\Omega$ /Km          | matching     |
|    |                                                             | 2  | AL-RAWI CABLES<br>SINGLE 2.5 mm - 91.1 MADE IN JORDAN | 7.41 $\Omega$ /Km                  | 9.52 $\Omega$ /Km          | Not matching |
|    |                                                             | 3  | AL-RAWI CABLES<br>SINGLE 4 mm - 91.1 MADE IN JORDAN   | 4.61 $\Omega$ /Km                  | 5.75 $\Omega$ /Km          | matching     |

Table-2-AL-RAWI Cable Single Conductor resistance test ( $\rho$ ) or Current rating Test.

| No | Type of test & inspection       | No | Type of cable                                         | Cable specification (in datasheet) | Cable specification (Test) | Test result |
|----|---------------------------------|----|-------------------------------------------------------|------------------------------------|----------------------------|-------------|
| 3  | Measurement of overall diameter | 1  | AL-RAWI CABLES<br>SINGLE 1.5 mm - 91.1 MADE IN JORDAN | 3.05 mm                            | 3.1 mm                     | matching    |
|    |                                 | 2  | AL-RAWI CABLES<br>SINGLE 2.5 mm - 91.1 MADE IN JORDAN | 3.65 mm                            | 4 mm                       | matching    |
|    |                                 | 3  | AL-RAWI CABLES<br>SINGLE 4 mm -                       | 4.2 mm                             | 4.2 mm                     | matching    |

|  |  |  |                     |  |  |  |
|--|--|--|---------------------|--|--|--|
|  |  |  | 91.1 MADE IN JORDAN |  |  |  |
|--|--|--|---------------------|--|--|--|

Table-3-AL-RAWI Cable Single Measurement of overall diameter Test.

| No | Type of test & inspection  | No | Type of cable                                      | Cable specification (in datasheet) | Cable specification (Test) | Test result |
|----|----------------------------|----|----------------------------------------------------|------------------------------------|----------------------------|-------------|
| 4  | Insulation Resistance Test | 1  | AL-RAWI CABLES SINGLE 1.5 mm - 91.1 MADE IN JORDAN | R> Gega ohm                        | R> Gega ohm                | matching    |
|    |                            | 2  | AL-RAWI CABLES SINGLE 2.5 mm - 91.1 MADE IN JORDAN | R> Gega ohm                        | R> Gega ohm                | matching    |
|    |                            | 3  | AL-RAWI CABLES SINGLE 4 mm - 91.1 MADE IN JORDAN   | R> Gega ohm                        | R> Gega ohm                | Matching    |

Table-4- AL-RAWI Cable Single Insulation Resistance Test.

| No | Type of test & inspection | No | Type of cable                                                                                                                          | Cable specification (in datasheet) | Cable specification (Test) | Test result |
|----|---------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------|-------------|
| 1  | Cross-section test        | 1  | AYSAN KABLO 1X1.5mm <sup>2</sup> H07V R 450/750 V (N.23) TS IEC150900 1 2008 MADE IN TURKEY UR:202200649 (19:31:26) URT:2A08 8CA2 R304 | 1.5 mm <sup>2</sup>                | 1.37 mm <sup>2</sup>       | matching    |
|    |                           | 2  | AYSAN KABLO 1X2.5mm <sup>2</sup> H07V 450/750 V                                                                                        | 2.5 mm <sup>2</sup>                | 2.33 mm <sup>2</sup>       | matching    |
|    |                           | 3  | AYSAN KABLO 1X4 mm <sup>2</sup> H07V R (N.210) 450/750 V EN 50225                                                                      | 4 mm <sup>2</sup>                  | 3.8 mm <sup>2</sup>        | matching    |

Table-5- AYSAN KABLO Cable Single Cross-Section Test.

| No | Type of test & inspection                                   | No | Type of cable                                                                                                                          | Cable specification (in datasheet) | Cable specification (Test) | Test result  |
|----|-------------------------------------------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------|--------------|
|    | Conductor resistance test ( $\rho$ ) or Current rating test | 1  | AYSAN KABLO 1X1.5mm <sup>2</sup> H07V R 450/750 V (N.23) TS IEC150900 1 2008 MADE IN TURKEY UR:202200649 (19:31:26) URT:2A08 8CA2 R304 | 7.39_7.41 $\Omega$ /Km             | 16 $\Omega$ /Km            | NOT matching |

|  |  |   |                                                                   |                |           |              |
|--|--|---|-------------------------------------------------------------------|----------------|-----------|--------------|
|  |  | 2 | AYSAN KABLO 1X2.5mm <sup>2</sup> H07V 450/750 V                   | 7.91_7.98 Ω/Km | 8.4 Ω/Km  | matching     |
|  |  | 3 | AYSAN KABLO 1X4 mm <sup>2</sup> H07V R (N.210) 450/750 V EN 50225 | 4,61_ 4,70 /Km | 7.42 Ω/Km | NOT matching |

Table-6- AYSAN KABLO Cable Single Conductor resistance test (ρ) or Current rating Test.

| No | Type of test & inspection       | No | Type of cable                                                                                                                          | Cable specification (in datasheet) | Cable specification (Test) | Test result |
|----|---------------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------|-------------|
|    | Measurement of overall diameter | 1  | AYSAN KABLO 1X1.5mm <sup>2</sup> H07V R 450/750 V (N.23) TS IEC150900 1 2008 MADE IN TURKEY UR:202200649 (19:31:26) URT:2A08 8CA2 R304 | 2.92 mm                            | 3 mm                       | matching    |
|    |                                 | 2  | AYSAN KABLO 1X2.5mm <sup>2</sup> H07V 450/750 V                                                                                        | 3.6 mm                             | 3.2 mm                     | matching    |
|    |                                 | 3  | AYSAN KABLO 1X4 mm <sup>2</sup> H07V R (N.210) 450/750 V EN 50225                                                                      | 4.4 mm                             | 3.8 mm                     | matching    |

Table-7- AYSAN KABLO Cable Measurement of overall diameter Test.

| No | Type of test & inspection  | No | Type of cable                                                                                                                          | Cable specification (in datasheet) | Cable specification (Test) | Test result |
|----|----------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------|-------------|
|    | Insulation Resistance Test | 1  | AYSAN KABLO 1X1.5mm <sup>2</sup> H07V R 450/750 V (N.23) TS IEC150900 1 2008 MADE IN TURKEY UR:202200649 (19:31:26) URT:2A08 8CA2 R304 | R> Gega ohm                        | R> Gega ohm                | matching    |
|    |                            | 2  | AYSAN KABLO 1X2.5mm <sup>2</sup> H07V 450/750 V                                                                                        | R> Gega ohm                        | R> Gega ohm                | matching    |
|    |                            | 3  | AYSAN KABLO 1X4 mm <sup>2</sup> H07V R (N.210) 450/750 V EN 50225                                                                      | R> Gega ohm                        | R> Gega ohm                | matching    |

Table-8- AYSAN KABLO Cable Single Insulation Resistance Test.

According to standards, IEC 60228, IEC 60227-6, 60227-5, IEC 60502-1, BS6346

| No | Type of test & inspection | No | Type of cable                                                                                                                      | Cable specification (in datasheet) | Cable specification (Test) | Test result |
|----|---------------------------|----|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------|-------------|
| 1  | Cross-section area test   | 1  | SEVAL KABLO TSE 0.6/1KV N2XY-CU/XLPE/PVC TS IEC 60502-1 5G 10mm <sup>2</sup> 2023 CE Eca MPS NO 102245 2023 CE Eca MADE IN TURKIYE | 10 mm <sup>2</sup>                 | 9.8 mm <sup>2</sup>        | matching    |

|  |   |                                                                                                                                |                     |                      |          |
|--|---|--------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|----------|
|  | 2 | SEVAL KABLO TSE 0.6/1KV N2XY-CU/XLPE/PVC TS IEC 60502-1 5G 6mm <sup>2</sup> MPS NO 102247 2023 CE Eca MADE IN TURKIYE          | 6 mm <sup>2</sup>   | 5.9 mm <sup>2</sup>  | matching |
|  | 3 | SEVAL KABLO BASE C BS EN 5052 5-2-31 TSE HAR HO7V-R 450/750V 6491X 4mm <sup>2</sup> 2023 CE Eca MADE IN TURKIYE MPS NO:88925   | 4 mm <sup>2</sup>   | 3.85 mm <sup>2</sup> | matching |
|  | 4 | SEVAL KABLO BASEC BS EN 5052 5-2-31 TSE HAR HO1V-R 450/750V 5491X 2,5 mm <sup>2</sup> 2023 CE Ec3 MADE IN TURKIYE MPS NO:97414 | 2.5 mm <sup>2</sup> | 2.4 mm <sup>2</sup>  | matching |
|  | 5 | SEVAL KABLO BASEC BS EN 5052 5-2-31 TSE HAR HO7V-R 450/750V 6491X 1,5 mm <sup>2</sup> 2023 CE Ec3 MADE IN TURKIYE MPS NO:77423 | 1.5 mm <sup>2</sup> | 1.44 mm <sup>2</sup> | matching |

Table-9- SEVAL KABLO Cable Single Cross-Section area Test.

| No | Type of test & inspection                            | No | Type of cable                                                                                                                      | Cable specification (in datasheet) | Cable specification (Test) | Test result |
|----|------------------------------------------------------|----|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------|-------------|
| 2  | Conductor resistance test (R) or Current rating test | 1  | SEVAL KABLO TSE 0.6/1KV N2XY-CU/XLPE/PVC TS IEC 60502-1 5G 10mm <sup>2</sup> 2023 CE Eca MPS NO 102245 2023 CE Eca MADE IN TURKIYE | 1.84 $\Omega$ /Km                  | 1.9 $\Omega$ /Km           | matching    |
|    |                                                      | 2  | SEVAL KABLO TSE 0.6/1KV N2XY-CU/XLPE/PVC TS IEC 60502-1 5G 6mm <sup>2</sup> MPS NO 102247 2023 CE Eca MADE IN TURKIYE              | 3.8 $\Omega$ /Km                   | 3.8 $\Omega$ /Km           | matching    |
|    |                                                      | 3  | SEVAL KABLO BASE C BS EN 5052 5-2-31 TSE HAR HO7V-R 450/750V 6491X 4mm <sup>2</sup> 2023 CE Eca MADE IN TURKIYE MPS NO:88925       | 4.7 $\Omega$ /Km                   | 4.9 $\Omega$ /Km           | matching    |
|    |                                                      | 4  | SEVAL KABLO BASEC BS EN 5052 5-2-31 TSE HAR HO1V-R 450/750V 5491X 2,5 mm <sup>2</sup> 2023 CE Ec3 MADE IN TURKIYE MPS NO:97414     | 7.56 $\Omega$ /Km                  | 7.57 $\Omega$ /Km          | matching    |
|    |                                                      | 5  | SEVAL KABLO BASEC BS EN 5052 5-2-31 TSE HAR HO7V-R 450/750V 6491X 1,5 mm <sup>2</sup> 2023 CE Ec3 MADE IN TURKIYE MPS NO:77423     | 12.2 $\Omega$ /Km                  | 13.1 $\Omega$ /Km          | matching    |

Table-10- SEVAL KABLO Conductor resistance test ( $\rho$ ) or Current rating test

| No | Type of test & inspection       | No | Type of cable                                                                                                                      | Cable specification (in datasheet) | Cable specification (Test) | Test result |
|----|---------------------------------|----|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------|-------------|
| 3  | Measurement of overall diameter | 1  | SEVAL KABLO TSE 0.6/1KV N2XY-CU/XLPE/PVC TS IEC 60502-1 5G 10mm <sup>2</sup> 2023 CE Eca MPS NO 102245 2023 CE Eca MADE IN TURKIYE | 20.7 mm                            | 20.4 mm                    | matching    |
|    |                                 | 2  | SEVAL KABLO TSE 0.6/1KV N2XY-CU/XLPE/PVC TS IEC 60502-1 5G 6mm <sup>2</sup> MPS NO 102247 2023 CE Eca MADE IN TURKIYE              | 17.8 mm                            | 17.6 mm                    | matching    |
|    |                                 | 3  | SEVAL KABLO BASE C BS EN 5052 5-2-31 TSE HAR HO7V-R 450/750V 6491X 4mm <sup>2</sup> 2023 CE Eca MADE IN TURKIYE MPS NO:88925       | 4.5 mm                             | 4.5 mm                     | matching    |
|    |                                 | 4  | SEVAL KABLO BASEC BS EN 5052 5-2-31 TSE HAR HO1V-R 450/750V 5491X 2,5 mm <sup>2</sup> 2023 CE Ec3 MADE IN TURKIYE MPS NO:97414     | 3.6 mm                             | 3.6 mm                     | matching    |
|    |                                 | 5  | SEVAL KABLO BASEC BS EN 5052 5-2-31 TSE HAR HO7V-R 450/750V 6491X 1,5 mm <sup>2</sup> 2023 CE Ec3 MADE IN TURKIYE MPS NO:77423     | 3.3 mm                             | 3 mm                       | matching    |

Table-11- SEVAL KABLO Measurement of overall diameter

| No | Type of test & inspection  | No | Type of cable                                                                                                                      | Cable specification (in datasheet) | Cable specification (Test) | Test result |
|----|----------------------------|----|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------|-------------|
| 4  | Insulation Resistance Test | 1  | SEVAL KABLO TSE 0.6/1KV N2XY-CU/XLPE/PVC TS IEC 60502-1 5G 10mm <sup>2</sup> 2023 CE Eca MPS NO 102245 2023 CE Eca MADE IN TURKIYE | R> Gega ohm                        | R> Gega ohm                | matching    |
|    |                            | 2  | SEVAL KABLO TSE 0.6/1KV N2XY-CU/XLPE/PVC TS IEC 60502-1 5G 6mm <sup>2</sup> MPS NO 102247 2023 CE Eca MADE IN TURKIYE              | R> Gega ohm                        | R> Gega ohm                | matching    |
|    |                            | 3  | SEVAL KABLO BASE C BS EN 5052 5-2-31 TSE HAR HO7V-R 450/750V 6491X 4mm <sup>2</sup> 2023 CE Eca MADE IN TURKIYE MPS NO:88925       | R>Gega ohm                         | R> Gega ohm                | matching    |
|    |                            | 4  | SEVAL KABLO BASEC BS EN 5052 5-2-31 TSE HAR HO1V-R 450/750V 5491X 2,5 mm <sup>2</sup> 2023 CE Ec3 MADE IN TURKIYE MPS NO:97414     | R> Gega ohm                        | R> Gega ohm                | matching    |

|  |   |                                                                                                                                         |                |             |          |
|--|---|-----------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------|----------|
|  | 5 | SEVAL KABLO BASEC BS EN 5052 5-2-31<br>TSE HAR HO7V-R 450/750V 6491X 1,5 mm <sup>2</sup><br>2023 CE Ec3 MADE IN TURKIYE MPS<br>NO:77423 | R> Gega<br>ohm | R> Gega ohm | matching |
|--|---|-----------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------|----------|

Table-12- SEVAL KABLO Insulation Resistance Test.

#### 4. CONCLUSION

In order to achieve safety, this study suggests content analysis of testing cable parameters including conductor resistance, insulation resistance, cross-section, and conductor diameter. An assurance inspection ensures that there are no defects or damage to the cables. Faulty cables carry a serious risk of electrical fires or shocks. We can prevent potential dangers and ensure the safety of the building's occupants by inspecting cables beforehand to ensure they fulfil strict performance and safety standards. Testing ensures that the installation satisfies all safety and regulatory requirements by confirming that the cables fulfil these standards.

An electrical system that is both dependable and efficient benefits from thoroughly inspected cables. Testing ensures that cables will function as intended, lowering the possibility of unforeseen malfunctions or failures. Finding problems prior to installation helps save money on repairs and inconveniences down the road. If problems like insulation flaws or conductor damage are not fixed right away, they may cause malfunctions or performance problems.

Testing enables the quality of the used cables to be verified. Superior cables that have withstood stringent testing standards add to the electrical system's overall durability and efficacy. To sum up, testing electrical cables before to installation is a proactive step that improves safety, guarantees compliance, averts potential problems, and supports the electrical system's dependability and efficiency—all of which eventually save time and money.

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