Why Aluminum Wires Are Not A Good Choice to Use in Our Projects Electrical Wiring Systems

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Abstract

Construction projects in Kurdistan have made great progress. With these advances, electrical systems in projects are an important part of construction projects. Proper supervision and implementation of projects depends on the expertise of supervisors, the level of project implementation, the level of awareness of employers, and the type of material that we are going to use it in our project. In this publication, as an experienced electrical engineer, I have explained how unsafe the use of aluminum wire for electricity distribution systems in households and construction projects are. Based on some research and in my view, a large part of the fires in the projects are due to the low level of implementation of the electrical system of the projects. Although the level of safety implementation and how to respond to any unwanted situation is an important part of preventing damage, but preventing disasters is more important than the method of emergency. Therefore, the reasons for not using aluminum wire in the electricity distribution system of our homes and projects are presented. This is due to the poor use of this type of wire for the safety of the projects, especially during the long life of the projects. Some of the causes of fires are electrical short circuits in the projects and some of these short circuits are caused by the use of aluminum wires.

INTRODUCTION

In each project, selecting using material is an important part of the project related to its quality and safety. In electrical section for each project your electrical wiring is an important aspect of your project. And it goes without saying that having a reliable electrical wiring system that lights up and powers up your project safely should be one of your top priorities. When it comes to the materials that are used for wiring, available are plenty of options, including aluminum, copper, silver and more, with each material having its own set of advantages and disadvantages.

Over the past few decades, aluminum has been a popular choice for project owner and homeowners in many countries due to its relatively affordable cost but not anymore. After a couple of decades of use by project owner and homeowners and electricians, inherent weaknesses were discovered in the material, that aluminum wire oxidizes more easily than copper wire, and the compound formed by oxidation – aluminum oxide – is less conductive than copper oxide. Over time, oxidation can deteriorate connections and present an increased fire hazard (Aluminum Wiring | Issues, Replacement Costs, and More | Square One, n.d.).

If you go back to the 1960s and 1970s, you will see that most of electrical projects used aluminum wire because aluminum was more economical than copper wiring at that time. In contrast, in Kurdistan, there is more effort than ever to use aluminum wire in projects, since the cost of aluminum wire is currently lower than that of copper wire. It took about a more than a decade or so to discover the inferior properties of aluminum for wiring Higher Electrical Resistance, Warping, Expansion, Oxidation, Galvanic Corrosion, and Excessive Vibration (The Dangers of Aluminum Wiring and How to Detect Them, 2020). Generally, aluminum wiring is still used today, and there's nothing inherently unsafe about it. The service wires coming into homes consists of aluminum wiring, and there are plenty of aluminum 380-volt circuits in use today. That stuff is all fine. The stuff that could be unsafe, the stuff that had

problems, was a specific alloy used during a specific time, and that's what this research is about. in this research when I refer to aluminum wiring, I'm referring to aluminum branch circuit conductors installed in branch circuit conductors" means wires that feed 10- and 20-amp circuits in houses. It's the wire that connects to outlets, switches, lights, and the like. That stuff had a lot of problems.

The problem with aluminum wiring is that it expands and contracts at a high rate, which can lead to lose connections. Connections between aluminum and copper can also cause oxidation, resistance, heat, increased expansion.

Motivation

The motivation behind this research is to find the most appropriate way to use electrical wires in our homes and projects to make a better and safer project and avoid fire disasters due to electrical short circuits.

Problem Statement

The existence of fires in construction projects in Kurdistan is a big problem and is repeated daily. Our purpose in this study is to present one of the factors that cause fires that are related to the materials used in the electricity distribution system of our homes and projects. The reason we will present in this study is the use of aluminum wire instead of copper wire in our pro electrical distribution systems.

Objectives

Explain the risks of using aluminum wire in our projects.

Explain the reasons for this risk.

Raising the awareness of project owners and project supervisors to choose the appropriate tools to carry out projects.

Scope

The main focus of this research is based on my research to show the differences in materials used in the electrical wiring systems of projects. The phenomenon of using aluminum wire in projects is another reason for this.

Significant

Understanding the differences and identifying the reasons for not using aluminum wire in the electricity distribution system of the projects are important to reduce the risk to the projects and reduce the phenomenon of scorches and fires in construction projects.

What is aluminum wiring?

Globally, although no longer in use, aluminum wire was previously thought to be a secure and cost-effective substitute for copper. The preferred wiring is copper wire. However, copper was so costly for a spell between about 1965 and 1974 that everyone was seeking for ways to save money while wiring a home. And presto! The solution was aluminum wiring. Nevertheless, it didn't take long (about 10 years) to realize that aluminum wire tended to degrade more quickly than copper. In fact, because of the electrical connections that cause the wire to overheat, major fire hazards might be present in outlets, light switches, or fixtures if they are overlooked (*Aluminum Wiring | Issues, Replacement Costs, and More | Square One*, n.d.)

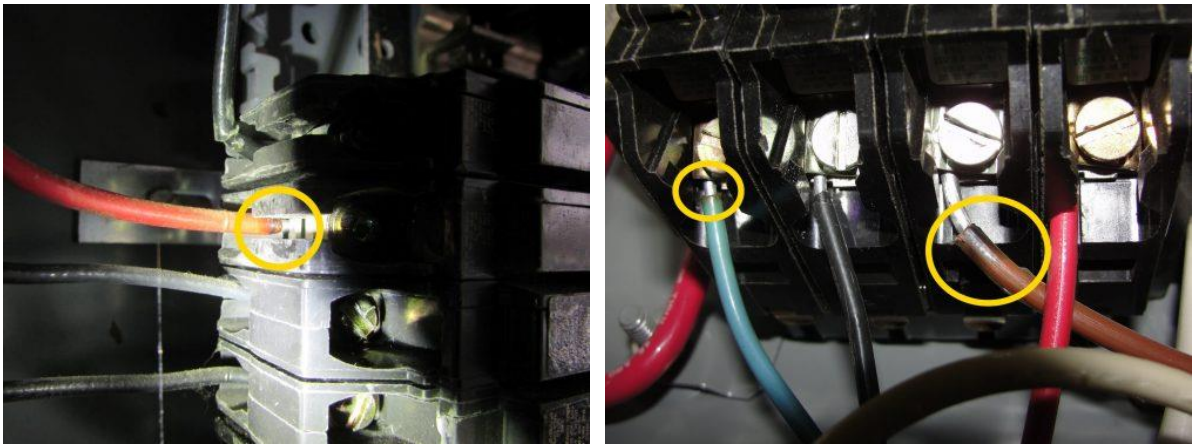
What functions do aluminum wires have?

Although aluminum wiring functions in the same way as copper wiring, there is a serious issue that has rendered aluminum obsolete for use in residential wiring. The connections in this wiring are where the major risk lies. Electrical cables and connectors heat up and expand when power flows through them. This form of wire has problems, including the fact that it extends three times as much as copper does. In other words, its rate of thermal expansion is substantially larger. The wires and connectors cool and contract when the power is switched off. After enough stretching and shrinking, a hole will ultimately form, exposing the wire to the atmosphere. The connecting point becomes even as a result of the oxidization that follows (*Aluminum Wiring | Issues, Replacement Costs, and More | Square One*, n.d.).

What owners of construction projects need to know

Although aluminum wire is used in many projects, we have found that using this material in the electricity distribution system in construction projects and houses is not a good thing. This rejection is due to several reasons. The problem with aluminum wiring is that it expands and contracts at a high rate, which can lead to loss of connections. Connections between aluminum and copper can also cause oxidation, resistance, heat, and increased expansion.

Here is some scorched wiring shown in picture (1) these constitute fire hazard conditions.

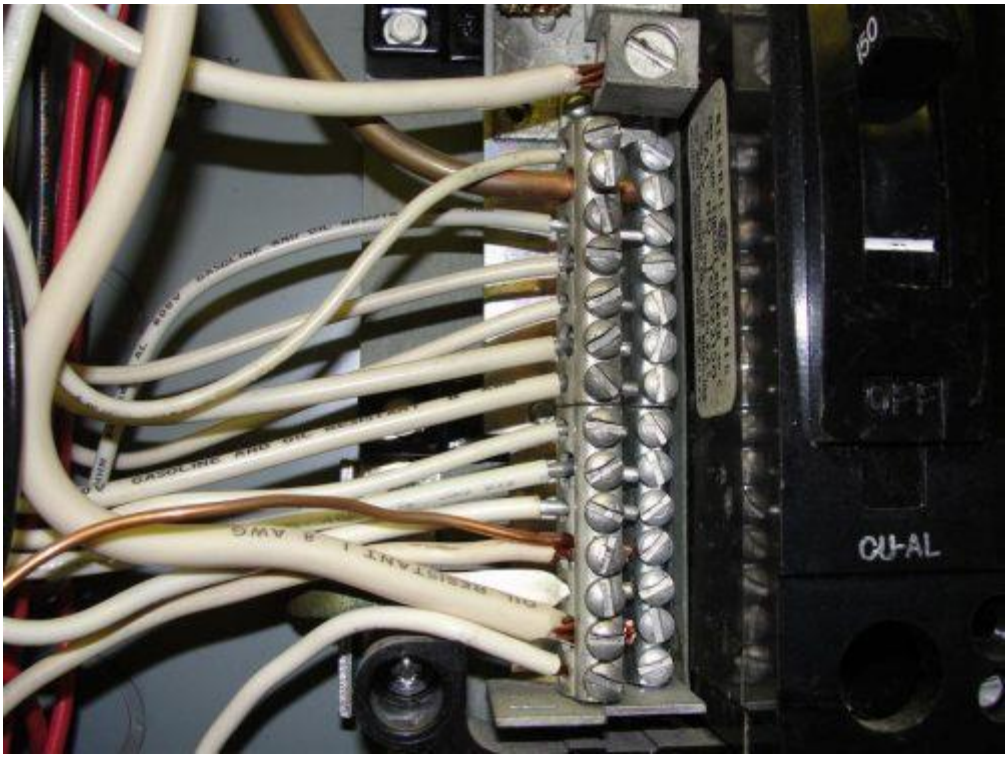


Picture (1) Images for some scorched wiring

If each of us inspects our house, we can find aluminum wiring during our home inspections. Researchers estimate that almost all our homes have scorched wires in the panel, but he can't comment on the rest of the wiring.

How to identify aluminum wiring?

The easiest and most obvious place to find aluminum wiring is inside the main electric panel. The pictures below show a mix of aluminum and copper wiring inside the panels.



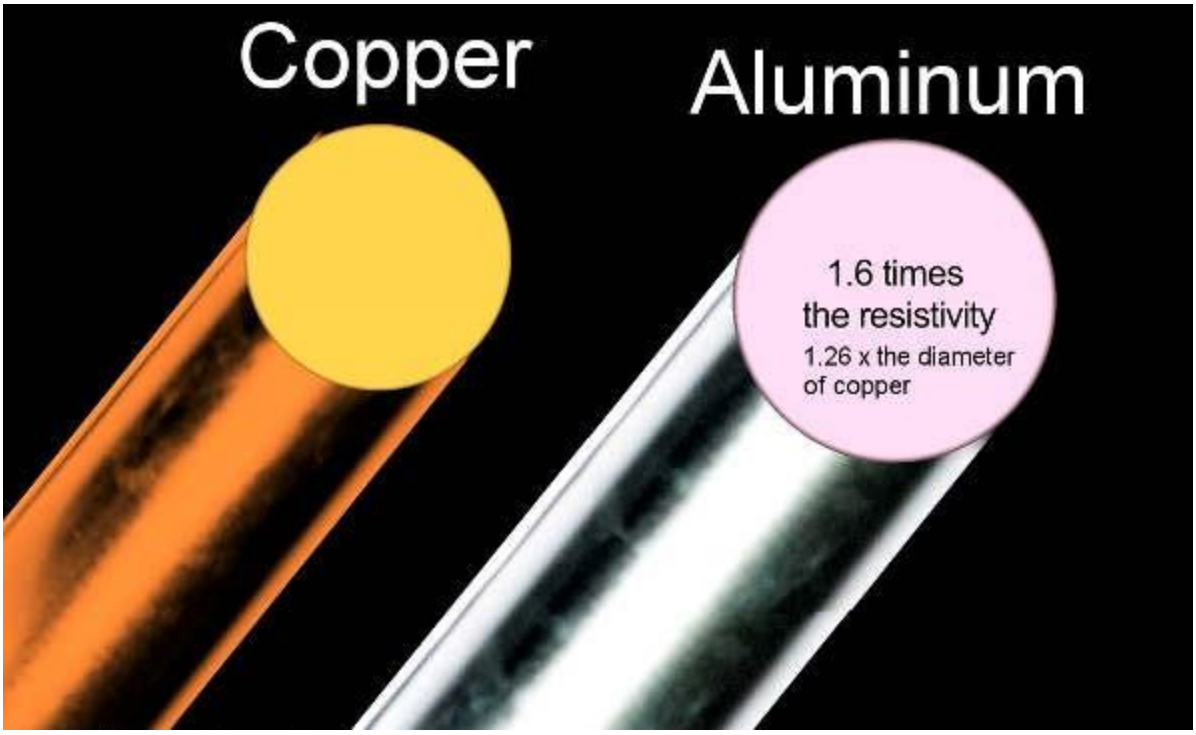
Picture (2) Image for main panel that have a mix of aluminum

and copper wiring inside of the panel

Reasons motivating the non-use of aluminum wires in electrical distribution systems

1. Higher Electrical Resistance

If we compare aluminum and copper with each other aluminum has a higher electrical resistance. In a case like that, we can see that for the same amount of current to flow through the aluminum wire, a larger size of wire is needed. As a consequence, these wires will generate more heat due to the resistance. In a situation like that, this can cause warping of the aluminum wire and let off the insulations, creating a potential fire hazard.



Picture (3) Higher Electrical Resistance for Aluminum and Copper

Higher electrical resistance is one of the reasons why we should avoid using such materials to protect our projects and lives. Using larger-sized wires and causing more heat production and causing fires.

2. Warping

When we come to warping, one of the things that are wrong with aluminum wiring is aluminum softer than copper wiring. When we want to talk about the condition of each aluminum and Couper, we can see that aluminum wiring is much softer than copper wiring, which makes it more prone to damage during installation and more likely to break, fray, or deform over time. Due to its high sensitivity to compression, aluminum wires can easily warp with repeated use.

Warped wires lead to loss of connections (which causes the wiring to become exposed to air) and increased electrical resistance at the deformation point. As this increased resistance continually occurs, fire hazards can develop from the buildup of excessive heat (The Dangers of Aluminum Wiring and How to Detect Them, 2020).

3. Expansion

If we want to talk about expansion, when heated, aluminum expands much more than copper does. That is another disadvantage of using aluminum wiring in our hose or projects. In aluminum, this extra expansion and contraction gradually cause loose connection points. In a case like that and a loose connection, the wire is exposed to air. Exposed wiring is susceptible to oxidation and corrosion, which can further impede electrical flow to outlets, leading again to heat. Aluminum wiring has a higher rate of expansion than copper wiring. This constant distension can cause the aluminum wire to fail (Aluminum House Wiring Problems - How to Identify and Resolve Them, 2021).

4. Oxidation

Another problem with aluminum is oxidation. In general, all metals rust, including aluminum and copper. In any metal, exposure to oxygen is the are causes deterioration of the outer surface of the wire, a process like that called oxidation. Having this issue in using aluminum creates potential connecting problems because this will lead to overheating. Higher temperatures mean more likely fires.

5. Excessive Vibration

Excessive vibration is another problem when someone is using aluminum wiring in their electrical system installation. Electrical current vibrates as it passes through wiring. This vibration is more intense with aluminum wiring than with copper wiring, and can gradually cause connections to loosen. We all know the dangers of having loose electrical connections.

6. Galvanic Corrosion

When connected with another metal, the majority of metals experience some type of galvanic corrosion in the presence of moisture and electric current. These most frequently occurs when utilizing the wrong receptacles or conductors with aluminum wiring, such as when a homeowner or previous resident replaced outdated outlets with new outlets made for use with copper wiring. Galvanic corrosion causes material loss, increased electrical resistance, and yet another run-in with our nemesis, the fire hazard.

In general, these six factors are the main reasons why we should avoid using aluminum wire in our home electricity distribution systems and construction projects. In real live, when home owner needs to buy electricity wiring for his or her home the seller or the electrician will probably tell you it's perfectly fine to buy and use aluminum wire in your house. They will tell you, using this type of wire has never been a problem, and there's nothing to worry about. If you go back to your previous work and see you've heard this story many times. Through this article I would like to clarify how important we should avoid this opinion and not use this type of wire in the electricity distribution system of our construction projects.

Cause and effect of wiring fire in household

Based on what we explained, we can find out that most of the cause and effect of wiring fire in the household is using aluminum wiring for the electrical system and outdating wiring in our household. When bad wiring system and outdated wiring often cause electrical fires. If a home is over 20 years old, and aluminum wiring is used in our household it may not have the wiring capacity to handle the increased amounts of electrical appliances in today's average home, such as computers, wide-screen televisions, and video and gaming players, microwaves and air conditioners. While breakers should be triggered when circuits get overloaded by too much electricity, outdated breaker boxes and mostly when wired in aluminum often have worn connectors that do not work, causing the system to overload and start an electrical fire.

Conclusion

Over the years, copper and aluminum wiring in homes has occasionally been blended. If not all the appropriate aluminum-to-copper connectors are employed, this can represent a serious risk. Gaps may form as a result of the varying rates of expansion and contraction, raising major fire safety concerns. The primary purpose of this publication is to encourage project owners, electricians, and supervising engineers to avoid using aluminum wiring for the electrical system in their projects. The safety and longevity of our projects depend on the way they are implemented and the materials we select and use in our projects.

Citation

1. Aluminum Wiring | Issues, Replacement Costs, and More | Square One. (n.d.). Retrieved July 4, 2022, from https://www.squareone.ca/resource-centres/getting-to-know-your-home/aluminum-wiring#:~:text=Aluminum%20wire%20oxidizes%20more%20easily
2. The Dangers of Aluminum Wiring and How to Detect Them. (2020, March 26). Penna Electric. https://pennaelectric.com/aluminum-wiring-dangers-detection/
3. Aluminum House Wiring Problems - How to Identify and Resolve Them. (2021, November 17). Premium Electric Ltd - Abbotsford Electricians 604-308-6195. https://www.premium-electric.ca/blog/common-aluminum-wiring-problems/
4. Square One Insurance Services. (2022, May 11). *Getting to know aluminum wiring*. https://www.squareone.ca/resource-centres/getting-to-know-your-home/aluminum-wiring#:%7E:text=Aluminum%20wire%20oxidizes%20more%20easily,present%20an%20increased%20fire%20hazard.
5. Licensing. (n.d.). Edisontechcenter.org. Retrieved July 4, 2022, from https://edisontechcenter.org/licensing.html