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**Review Article**

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# Engineering use and Aluminium Alloys Properties

***Ziadoon Husein Abdulhusein***
*Materials Engineering Innovative Technologies in Metallurgy*

**Abstract:** Aluminium alloys are widely used in the fields of electric module packaging, electronic technology, automotive body structure, wind, and solar energy management, due to the advantages of high specific strength, high processability, predominantly anti-erosion, increased conductivity, eco-friendly nature, and recoverability. The objective of the study is to review the previous papers on aluminium usages, application, and workability parameters. The methodology adopted for the study is to use the structure literature review technique, and the time period selected for the study is 2020–2021 from the Scopus database. The findings of the study concluded that there are various types of aluminium alloys that has been used by the previous researchers, and only 6061 is least explored aluminium alloy among all of them. The future scope of the study is to investigate using distinct activating fluxes for raising penetration & to understand consequences on mechanical components & rust behaviour of TIG-welded aluminium metal welds.

**Keywords:** Aluminium Alloy; steel; and Heat sensitivity.

## INTRODUCTION

An aluminum alloy (or aluminum alloy; see spelling differences) is an alloy in which aluminum (Al) is the predominant metal. The typical alloying elements are copper, magnesium, manganese, silicon, tin, nickel and zinc. There are two principal classifications, namely casting alloys and wrought alloys, both of which are further subdivided into the categories heat-treatable and non-heat-treatable. About 85% of aluminum is used for wrought products, for example rolled plate, foils and extrusions. Cast aluminium alloys yield cost-effective products due to the low melting point, although they generally have lower tensile strengths than wrought alloys. The most important cast aluminium alloy system is Al–Si, where the high levels of silicon (4–13%) contribute to give good casting characteristics. Aluminium alloys are widely used in engineering structures and components where light weight or corrosion resistance is required. Alloys composed mostly of aluminium have been very important in aerospace manufacturing since the introduction of metal-skinned aircraft. Aluminium–magnesium alloys are both lighter than other aluminium alloys and much less flammable than other alloys that contain a very high percentage of magnesium.

## LITERATURE REVIEW OF STUDY

### 1. Engineering Use and Aluminum Alloys Properties

Aluminium alloys with a wide range of properties are used in engineering structures. Alloy systems are classified by a number system (ANSI) or by names indicating their main alloying constituents (DIN and ISO). Selecting the right alloy for a given application entails consideration of its tensile strength, density, ductility, formability, workability, weldability, and corrosion resistance, to name a few. Aluminium alloys are used extensively in aircraft due to their high strength-to-weight ratio. Pure aluminium metal is much too soft for such uses, and it does not have the high tensile strength that is needed for building airplanes and helicopters.

### 1.1. Aluminum Alloys versus Types of Steel

Aluminium alloys typically have an elastic modulus of about 70 GPa, which is about one-third of the elastic modulus of steel alloys. Therefore, for a given load, a component or unit made of an aluminium alloy will experience a greater deformation in the elastic regime than a steel part of identical size and shape. With completely new metal products, the design choices are often governed by the choice of manufacturing technology. Extrusions are particularly important in this regard, owing to the ease with which aluminium alloys, particularly the Al-Mg-Si series, can be extruded to form complex profiles.

In general, stiffer and lighter designs can be achieved with aluminium alloy than is feasible with steels. For instance, consider the bending of a thin-walled tube: the second moment of area is inversely related to the stress in the tube wall, i.e. stresses are lower for larger values. The second moment of area is proportional to the cube of the radius times the wall thickness, thus increasing the radius (and weight) by 26% will lead to a halving of the wall stress. For this reason, bicycle frames made of aluminium alloys make use of larger tube diameters than steel or titanium in order to yield the desired stiffness and strength. In automotive engineering, cars made of aluminium alloys employ space frames made of extruded profiles to





***Corresponding Author:** Ziadoon Husein Abdulhusein

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ensure rigidity. This represents a radical change from the common approach for current steel car design, which depend on the body shells for stiffness, known as unibody design.

Aluminium alloys are widely used in automotive engines, particularly in cylinder blocks and crankcases due to the weight savings that are possible. Since aluminium alloys are susceptible to warping at elevated temperatures, the cooling system of such engines is critical. Manufacturing techniques and metallurgical advancements have also been instrumental for the successful application in automotive engines. In the 1960s, the aluminium cylinder heads of the Corvair earned a reputation for failure and stripping of threads, which is not seen in current aluminium cylinder heads.

An important structural limitation of aluminium alloys is their lower fatigue strength compared to steel. In controlled laboratory conditions, steels display a fatigue limit, which is the stress amplitude below which no failures occur – the metal does not continue to weaken with extended stress cycles. Aluminium alloys do not have this lower fatigue limit and will continue to weaken with continued stress cycles. Aluminium alloys are therefore sparsely used in parts that require high fatigue strength in the high cycle regime (more than 107 stress cycles).

**1.2 Heat Sensitivity Considerations**

Often, the metal's sensitivity to heat must also be considered. Even a relatively routine workshop procedure involving heating is complicated by the fact that aluminium, unlike steel, will melt without first glowing red. Forming operations where a blow torch is used can reverse or remove the effects of heat treatment. No visual signs reveal how the material is internally damaged. Much like welding heat treated, high strength link chain, all strength is now lost by heat of the torch.

Aluminium is subject to internal stresses and strains. Sometimes years later, improperly welded aluminium bicycle frames may gradually twist out of alignment from the stresses of the welding process. Thus, the aerospace industry avoids heat altogether by joining parts with rivets of like metal composition, other fasteners, or adhesives.

Stresses in overheated aluminium can be relieved by heat-treating the parts in an oven and gradually cooling it—in effect annealing the stresses. Yet these parts may still become distorted, so that heat-treating of welded bicycle frames, for instance, can result in a significant fraction becoming misaligned. If the misalignment is not too severe, the cooled parts may be bent into alignment. If the frame is properly designed for rigidity (see above), that bending will require enormous force.

Aluminium's intolerance to high temperatures has not precluded its use in rocketry; even for use in constructing combustion chambers where gases can reach 3500 K. The Agena upper stage engine used a regeneratively cooled aluminium design for some parts of the nozzle, including the thermally critical throat region; in fact the extremely high thermal conductivity of aluminium prevented the throat from reaching the melting point even under massive heat flux, resulting in a reliable, lightweight component.

## DISCUSSION AND CONCLUSION

The properties of aluminum and its alloys which give rise to their widespread usage, with particular emphasis on manufacturability, recyclability, and corrosion resistance, are briefly described in this report. The designation system by which alloys are classified is also described. It is one of the lightest metals on earth: it is nearly 3 times lighter than iron but in addition, it is quite powerful, exceptionally flexible and rust-resistant since its surface is constantly covered in a very thin and very powerful layer of chromium film. It does not magnetise, it has an excellent electricity conductor and creates alloys with almost the other metals. Aluminium delivers a rare mixture of properties that are valuable. It's just one of the lightest metals on earth: it is nearly 3 times lighter than iron but is still quite powerful, exceptionally flexible, and rust-resistant since its surface is coated in a very thin yet very powerful layer of chromium film. It will not magnetize, fantastic electricity conductor and types of alloys with almost the other metals.

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