

A I S

Generation Corporation



CHOOSING A MATERIAL **FOR SHEET METAL PARTS**

This guide explores the factors that affect the performance of sheet metal parts and helps you determine how to choose the right metal material for your custom steel parts.

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FACTORS TO BE CONSIDERED WHEN CHOOSING A MATERIAL FOR SHEET METAL PARTS.

Not all sheet metal parts are created equal. Depending on the final application, the metal material must be chosen carefully to ensure it meets the desired performance and fabrication requirements. Picking the wrong material can cause part or product failure, low yield, high cost, poor performance or a number of safety concerns (imagine a structural part failing due to improper selection of a material and you have an idea of the potential concerns). The selection process can be complex due to the sheer number of factors involved, but we will summarize the most crucial aspects.

The most critical factors you must consider when selecting a material for sheet metal parts are:

- ✓ Applications of Sheet Metal
- ✓ Sheet Metal Types
- ✓ Material Properties
- ✓ Ease of Manufacture
- ✓ Cost



 Fig. 1: Sheet Metal Materials

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Applications of Sheet Metal

Sheet Metal Types

Material Properties

Ease of Manufacture

Cost

Finishing

Implication of selecting improper materials

TYPES OF SHEET METAL USED IN FABRICATION

There are many types of sheet metal, all with different properties that make them suitable for different applications. Each has its benefits and drawbacks that must be considered when you select a material for a project.

We will explore the type of **sheet metal materials** used at Komaspac and give examples of real-life uses for each of them.

MILD OR LOW CARBON STEEL

Mild steel is by far the most commonly used material for **sheet metal fabrication**. The relative strength, combined with its ease of fabrication and relatively low cost compared to stainless or aluminum, means that it can be used to create a wide variety of custom steel parts such as construction or automotive body panels.



Mild Steel Pros

- + Inexpensive
- + Easy to work with
- + High weldability
- + Versatile
- + Strong for its weight
- + Can support a variety of surface finishes

Mild Steel Cons

- Not suitable for high-finish polishing
- Needs protection from rust
(additional processing and cost)

Stainless Steel

Stainless steel is an alloy containing chromium, providing good corrosion resistance and improved strength. It is non-magnetic and non-sparking, making it ideal for medical instruments, outdoor applications, and a host of other applications in which these materials can be exposed to corrosive chemicals or needs a relatively higher hardness compared to mild steel.



 Fig. 2 Mill Finish – Stainless Steel

Stainless Steel Pros

- + Easy to work with
- + Suitable for high-finish polishing
- + Durable
- + Easy to clean and sterilize
- + High levels of built-in corrosion resistance

Mild Steel Cons

- More expensive than mild steel (average of three to five times the cost depending on the grade of stainless steel)
- Welding can be more cumbersome (requires specialized equipment)

Galvanized Steel

Galvanization bonds a layer of zinc to the surface of the steel. This serves as a cost-effective way to provide high corrosion resistance built-in to the material, which reduces the potential for rusting prior to fabrication and the need to additional surface finishing. This makes it perfect for things like fencing and other outdoor frameworks that are exposed to the weather.

Galvanized Steel Pro

- + Easy to manufacture and maintain
- + Cost-effective corrosion protection
- + Durable

Galvanized Steel Cons

- Joints or cuts can corrode over time where the processing (laser cuts or bending in the case of sheet metal fabrication) has compromised the galvanized protective layer



 Fig. 3 Cold Galvanized Steel

Aluminum

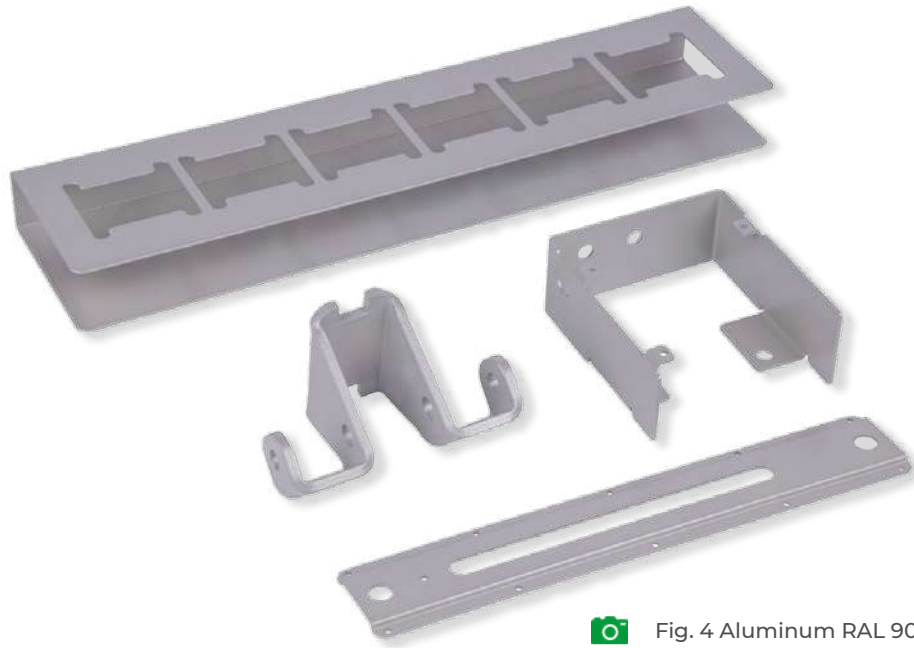


 Fig. 4 Aluminum RAL 9006

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Aluminum has many wonderful qualities, such as its high resistance to rust. It is one-third of the weight of steel and can be equally as strong in some settings.

In other applications, this material may not be able to handle the same stresses as steel, so you might want to contact our representatives at Komaspec to help you decide if aluminum is suitable for your application or not.

Aluminum Pros

- + High strength to weight ratio
(ideal for applications requiring weight reduction)
- + Truly corrosion resistant
- + Durable
- + Aesthetically attractive with only minor polishing

Aluminum Cons

- More expensive than carbon steels
- Significantly lower tensile and yield strength than steel
- Can require additional hardening processes after processing

SPRING STEEL

Spring steel is a very resilient material containing manganese and high concentrations of carbon. It is designed to bend or flex under load and return to its original shape when removed. This makes it an excellent choice for making latching mechanisms, drive belts, and of course - springs.

Spring Steel Pros

- + High yield strength
- + High tensile and fatigue strength
- + Easily formed and shaped

Spring Steel Cons

- Potential to lose shape over time

For more info about each of the sheet metal materials Komaspac offers, including specific physical properties and surface finishing options, you can refer to the [sheet metal material selection on our site](#).



MECHANICAL FACTORS IMPORTANT TO MATERIAL SELECTION

Understanding the mechanical properties and their effect is critical to selecting the best raw material for the job. There are many physical qualities, and each one has a different purpose. Some of the most essential mechanical factors to consider in the selection process include:

- ✓ Strength
- ✓ Ductility
- ✓ Corrosion Resistance
- ✓ Ease of Manufacture

Strength

Material Strength is often the most widely used metric in determining material suitability. It measures how much load a part can withstand before bending from its original shape (also known as plastic deformation). There are two ways of looking at the strength of a material, and each may give a different outcome:

Strength by cost

Metal enclosures or tanks require high strength and low cost, so low-carbon (mild) steel would generally be considered the ideal material.

Strength by weight

The material must still be strong when building airplanes, but overall weight is also essential. In this example, aluminum is the better choice.

Specific Strength = The Ratio of Strength to Density

Interestingly, in a comparison of aluminum, carbon steel, and stainless steel, the aluminum alloy has the highest specific strength ([ASM Material Data Sheet](#)), despite having the lowest tensile strength.

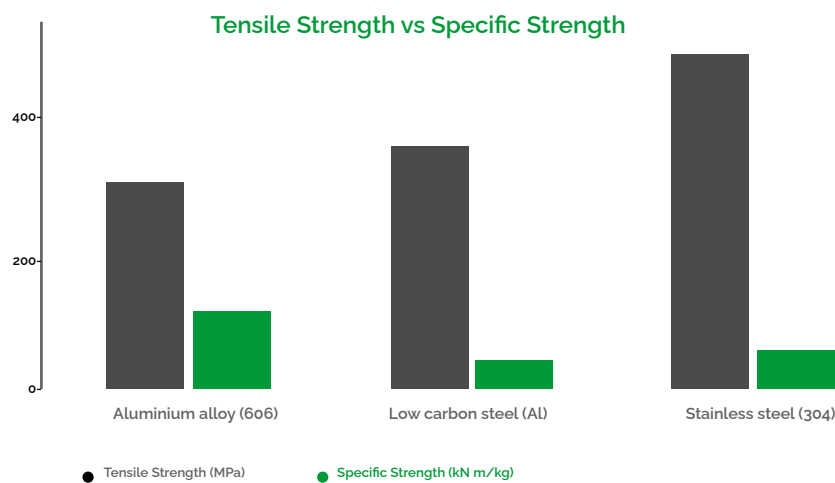


Fig. 5 Tensile Strength vs. Specific Strength

DUCTILITY

Also referred to as formability, this is the ability of a material to be easily stretched without cracking or breaking. This commonly occurs when a tight radius is formed during a metal stamping or folding process.

A simple way to visualize ductility is to compare it to a spring—the greater the elasticity of a material, the better its ductility. This flexibility can be increased using a metal-forming process called annealing.

Corrosion Resistance

Corrosion, or rust, is the chemical reaction between the iron in a material and the oxygen in its surroundings, whether air or water. Good corrosion resistance (**Metals - Corrosion Resistance to Aggressive Fluids**) is a crucial factor in material selection; it can weaken steel in a surprisingly short period if the conditions are right.

Corrosion From Aggressive Fluids

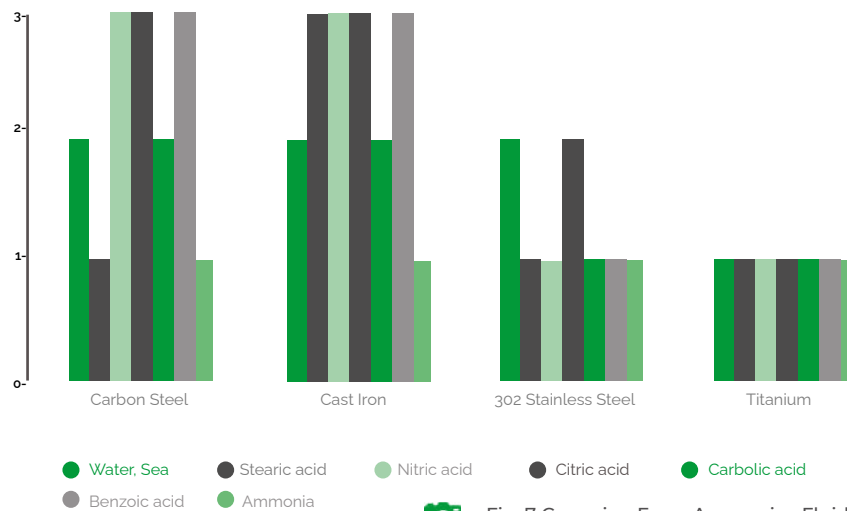


Fig. 7 Corrosion From Aggressive Fluids

The two main factors that help reduce corrosion are:

1.

Choosing a secondary finishing process such as painting or galvanizing

2.

Choosing the right material for the job in the first place

WHAT IS THE BEST MATERIAL FOR CORROSION RESISTANCE?

✓ Stainless Steel

Contains chromium which forms a thin film of chromium oxide on the surface of the stainless steel, which protects the steel from corrosion. Stainless steel can become discolored or can rust if there is long term exposure to the elements / high salt concentrations, but the resistance is greatly superior to mild steels. Bimetal corrosion is a risk and must be considered when mating with other parts or fasteners.

✓ Aluminum

A lightweight alternative to steel, aluminum is a naturally non-reactive metal. This means that it will not corrode in the presence of air or water. Aluminum can be somewhat vulnerable to corrosion when in contact with concrete, and there is the risk of bimetal corrosion. These can be overcome through anodizing or painting.

✓ Modified Mild Steel

Using galvanized mild steel could be a great alternative if cost is a factor. The Zinc coating gives a layer of protection, but be aware that when these sheets are cut, the edges are exposed and lead to rust.

✓ Mild Steels

Mild carbon steels without secondary finishing will rust rapidly in the presence of moisture or salt – unprotected steel sheet can begin rusting even before fabrication, which can often lead to the need for deburring or chemical treatment to remove rust before surface finishing. Rust can in some cases be so severe as to impact the final part appearance even after painting (parts can appear "mottled" or with a blotched surface).

Ease of Manufacture for Sheet Metal Parts

Sheet metal parts fabrication is a process that involves cutting, bending, and joining sheets of metal to create different configurations of custom steel parts. Each material has its own specific advantages and disadvantages that should be considered in the fabrication process. This, in turn, can affect cost.

✓ Laser Cutting

Laser cutting is a precise and reliable method for cutting different metals. This makes the process a great option for many businesses in the automotive industry, for example, where precision and speed are necessities. Lasers are especially attractive for cutting thicker materials and complex cut-outs since the cuts are very clean.

The exception to this is shiny materials such as aluminum and copper. Plastic films can reduce the impact, but this option should be assessed and discussed before the design process.

✓ Bending

There are two factors that have an impact on bendability:

1. Material Choice

Aluminum is commonly considered a good choice where **sheet metal bending** is required. However, even within the same material, there can be differences between the grades. For example, if ductility is important, the 6000 series aluminum is best avoided.

2. Product Design Considerations

Tight bend radii and low tolerances can make sheet metal parts more difficult to produce, which adds unnecessary cost. For more about bend design, read our article on **sheet metal design guidelines**.

 Fig. 8 Metal Bending at Komacut





Fig. 9 Robotic Welding at Komacut

WELDABILITY

Welding is one of the most common methods for joining and manufacturing metal components. It uses a high-powered and highly controlled electric arc to heat the base metals to the point they melt. They then solidify almost as one piece. The weldability of sheet metal will depend on the filler metal, the process used, and the material makeup of the sheet.

COST INVOLVED IN SHEET METAL PARTS FABRICATION

The cost of sheet metal parts fabrication begins with the raw material. Costlier materials such as aluminum, stainless steel, and copper can provide superior performance compared to cheaper materials such as steel and galvanized steel. Still, they come with a higher price tag.

In some cases, cheaper material may be suitable for the job and still provide adequate performance at a lower cost. For example, aluminum may be too expensive for a part that requires lightweight and corrosion resistance, so galvanized steel may be the better choice.

Ultimately, the choice of material will depend on the performance requirements and the cost constraints of the project. The table below shows a rough outline of how much each material costs. We can see that while aluminum is twice as expensive as steel per kg, stainless steel is nearly five times more costly. A material such as titanium is much more expensive again and is used sparingly in products such as jet engines where the extra strength it provides is crucial.

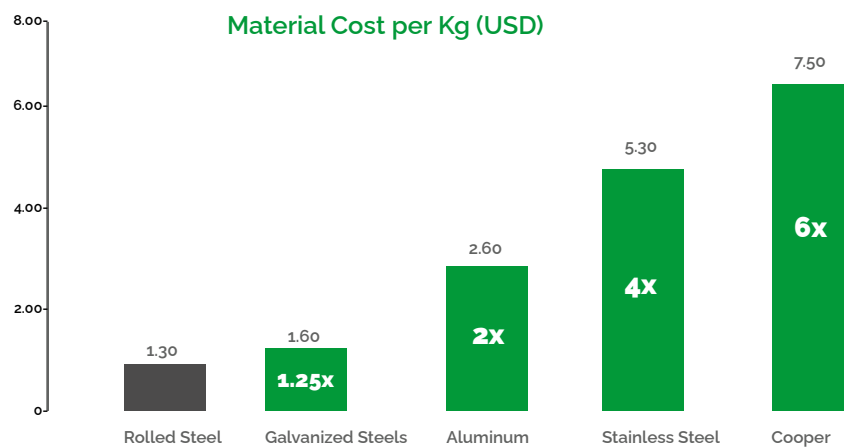


Fig. 10 Material Cost Per Kg (USD)

The difficulty in comparing material costs

When considering which sheet metal material to buy for a project, there are several things to consider. You have to weigh the cost against the design and performance goals of the project. Not all sheet metal is created equal in strength, weight, and appearance.

The cost of sheet metal material is proportionate to volume. While aluminum is twice as expensive as steel, it has a much lower density, meaning the volume per dollar may even out.

For example, aluminum is not as strong as stainless steel. Therefore, thinner material could be used for a stainless-steel tank or vessel compared to an aluminum one.

Implications of Using the Wrong Sheet Metal Material

Using the wrong material for sheet metal parts can have severe implications for the quality and performance of the part. Many materials have unique properties that can affect their strength, durability, and other characteristics.

In addition, using the wrong material could lead to corrosion, which could cause further damage to the part or system. Using stainless steel would negate the need for paint, plating, or another coating.

Finally, using the wrong material could cause costly delays in production as the part needs to be re-made or re-designed. The manufacturing processes to be used can affect and increase the overall cost of the final product in a more significant way than the cost of the raw material itself.

Cost Increase of Custom Steel Parts

Custom designs significantly impact the price of steel sheet metal parts. Since custom designs require more intricate processes and skills to manufacture, the cost of labor and materials will increase.

Custom metal parts fabrication often requires

additional processes, such as welding, cutting, and bending, which will also increase the cost of the parts. They may require the use of specialized tools and equipment to construct correctly. This adds to the overall cost of the steel sheet metal parts and contributes to a higher price for custom designs.

Choosing the Correct Finish for Sheet Metal Parts

Different materials have different properties when it comes to **surface finishing**, so the desired finish will determine the best material choice. For example, some materials may be better suited for painting or powder coating, while others may be better suited for plating.

The application of the product often determines the

finishing requirements. Some reasons for wanting an enhanced surface finish include:

- ✓ Aesthetics
- ✓ Hygiene
- ✓ Durability

Aesthetics

Polishing is a common technique used to create a high-quality look that is pleasing to the eye. The process involves progressively removing all surface imperfections to give it a shiny finish.

Materials suitable for polishing:

- ✓ Copper
- ✓ Stainless steel
- ✓ Aluminum

Stainless steel can be brought to a mirror finish and is very durable; aluminum is less durable and can take longer to reach the same finish. It is not possible to create a durable polished surface on mild steel.



 Fig. 11 Surface Finishing



HYGIENE

Sheet metal parts are often used in both the food industry and medical settings. The material chosen must be resistant to the build-up of bacteria and other contaminants.

For example, stainless steel is a popular choice for sheet metal products because it is non-porous and resistant to corrosion. This eliminates the need for potentially toxic paints and other coatings. Additionally, stainless steel can be easily cleaned and sterilized using various chemical and thermal means, making it an ideal choice for food-grade products and medical instrumentation.



DURABILITY

Especially important in hygienic environments, the durability of a material affects how well it can withstand harsh environments without needing to be repaired or replaced. Durability is the main factor that affects the material's resilience to dents, scratches, and bending.

Stainless steel is a great option if the part needs to resist scratching and be easy to repair. When scratched, it does not cause possible contamination with aluminum oxide. Aluminum, along with copper, will resist scratches and deformation very poorly.

Mild steel is another durable material, but the paints and coating needed should be considered as they can often lead to the same problems with contamination.

Material finishing requirements will help determine the best material choice for the particular part. For more about different types of finishing, [read this guide](#).

APPLICATIONS OF SHEET METAL PARTS FABRICATION

Analyzing the application's needs is crucial to determining which material properties to prioritize when selecting a sheet metal. Since any material selection is going to be a compromise between various factors such as weight, strength, cost, appearance, etc. their relative importance to the part's performance in the end application is crucial.

As an example, for an aeronautics application, weight would be the most important factor, much more important relatively than a part used for industrial machinery. In this case, aluminum or titanium grades would be prioritized absolutely due to the need to minimize part weight. For a structural part, yield or tensile strength might be significantly more important than cost or weight, as part failure would be a serious safety issue.

When analyzing application needs, it's best to create a simple selection matrix by ranking the following factors in importance from 1 to 5 (or writing the minimum requirement in the case of quantifiable factors like tensile strength) and then seeing how this corresponds with material performance:



1. Weight to Strength



2. Tensile Strength



3. Yield Strength



4. Ductility



5. Durability



6. Cost



CONCLUSION

Choosing the right material for sheet metal parts is a critical decision that should be taken carefully. Factors such as cost, strength, corrosion resistance, and durability must be considered to ensure a suitable material is chosen for the product.

It is important to consult with experienced professionals when selecting the right material, as they can provide valuable advice and guidance. With the right material, sheet metal parts can be manufactured to be more efficient, more robust, and longer lasting. For more information on what material is best for your sheet metal parts, get in touch with Komaspac for expert advice.