

EDU[**CAD**]TION **STUDY GUIDE**

How to Choose the Right Material for Your Design

Chapter 3, Lesson 2

SendCutSend

Understanding Project Requirements

- Before choosing a material, start by understanding the project's goals, environment, and functional constraints.
- These factors will directly influence the mechanical, chemical, and physical properties needed for your design.
- In this lesson's example, the designer is building two motorcycle components: a front fork and a chain tensioner. Each has different performance needs, which will affect material choice (see Figures 1.1 and 1.2).



Figure 1.1



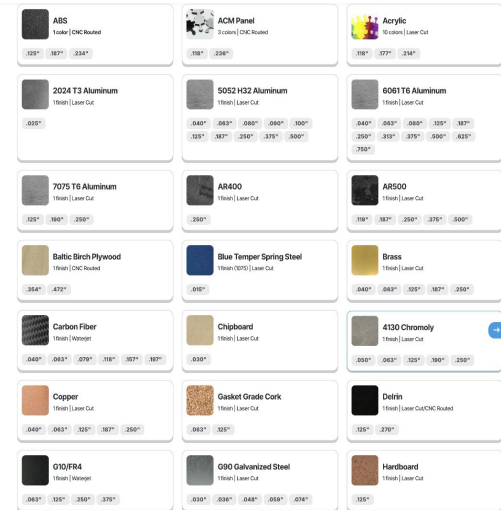
Figure 1.2

1. Material Characteristics

- Different applications require different properties. Consider the following factors:

- Corrosion Resistance:** For outdoor or harsh environments (like motorcycles exposed to road salt), use materials such as stainless steel or aluminum. Avoid mild steel to prevent rust.
- Wear Resistance:** Components like a chain tensioner experience friction and must resist wear. In this example, stainless steel may outperform aluminum.
- Chemical Resistance:** Consider exposure to oils, fuels, or chemicals. In this example, chemical exposure is minimal, so multiple materials may be acceptable.

Note: To review the characteristics and specifications of different materials, visit the SendCutSend Material Guidelines: <https://sendcutsend.com/materials/>



2. Machinability and Formability

- Once you've narrowed down material options, evaluate how easy they are to work with. Some alloys are easier to machine or form than others, for example from this lesson:
- **Aluminum** (6000 series) machines easily but cannot be bent effectively, eliminating it for parts that require forming.
- **Stainless steel** may be harder to machine but offers durability and flexibility in forming. This step helps eliminate unsuitable materials and refine your list further.

3. Cost Considerations

- Material costs can vary widely depending on your budget, production volume, and sourcing options.
- **Stainless steel** is typically more expensive than **aluminum** but may be worth the cost for longevity or corrosion resistance.
- Always weigh the performance benefit versus material expense to make the best choice for your design scale and purpose.

4. Tolerances and Manufacturing Precision

- Every material behaves differently during machining.
- Softer materials like aluminum may deform under high-pressure cuts, making it difficult to maintain tight tolerances.
- Harder materials like stainless steel hold dimensions better but may require slower machining and specialized tooling.
- Keep in mind that tighter tolerances directly increase production costs.

5. Surface Finish and Aesthetic Goals

- If your component is customer-facing, surface finish becomes an important design factor.
- For example, aluminum can be anodized for a sleek, durable appearance, while stainless steel offers a polished aesthetic right out of machining. Consider both the functional and visual impact of the final material finish.

6. Weight and Performance

- Weight directly affects performance and efficiency.
- For instance, in this lesson, in automotive design, lighter materials such as aluminum are often preferred because they reduce weight, improving both speed and handling..
- However, some parts may require the strength and rigidity of heavier materials. Balancing strength-to-weight ratio is key in performance-oriented designs.

7. Lead Time and Availability

- Even the best material is useless if you can't get it in time. Some alloys or specialty grades have long lead times or limited suppliers.
- For small-scale or custom projects, prioritize readily available materials that meet most of your design needs without causing production delays.

Summary

Material selection bridges design intent with manufacturing reality. By understanding how each property affects performance and cost, you can make informed decisions that ensure functionality, manufacturability, and long-term reliability.

Learn more at <https://sendcutsend.com/education/>