

# *Prototyping*

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The Aluminum  
Advantage



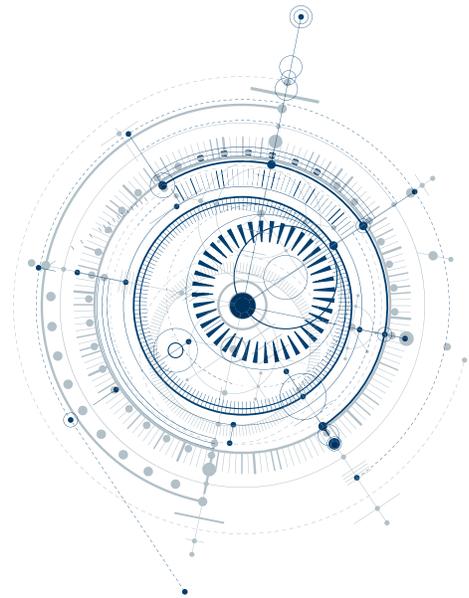
*Manufacturing precision partnerships.™*

# WHY PROTOTYPING IS AN IMPORTANT STEP IN MANUFACTURING

**REGARDLESS OF INDUSTRY OR THE ITEM THAT'S BEING MANUFACTURED, PROTOTYPING CAN BE AN IMPORTANT AND NECESSARY STEP IN THE DEVELOPMENT AND REFINEMENT OF A PART, NO MATTER HOW SIMPLE OR COMPLEX.**

The initial drawings or sketches of a part may ultimately turn out to be significantly different from the final real-world part and the situation where it will be used. However, when you prototype a component, you can assess a real, physical version of the product in advance and determine if it should be used, refined, or if a redesign is called for.

That's why prototyping is the best way to avoid problems and issues before they have a chance to occur.



**CONSIDER THIS SCENARIO** – your company produces fifty-thousand units of a part and later discovers that one of its components was defective in craftsmanship, causing it to fail. Recalls would follow, public apologies, and perhaps, possible legal recourse by the affected parties.

Whether you're a multinational company or a small, start-up business, a miscalculation or specification omission can have a disastrous effect that can cost a company thousands, even millions of dollars, and may even lead to bankruptcy.



# EVALUATION AND TESTING

**DETERMINING PROBLEMS IN THE ABSTRACT FROM SKETCHES OR DRAWINGS ARE, WELL, SKETCHY AT BEST.** The optimum way to achieve prototype success is technical drawings in file formats like PDF, DWG, and DXF. Prototype development from tight, accurate specifications allows everyone in the manufacturing pipeline to identify issues that they wouldn't be able to diagnose had skipped the prototype phase.

Evaluation is just the first phase. Testing follows, where researchers and developers have the opportunity to conduct qualitative assessments on the product before committing to full scale production. All in all, prototyping is critical to the well-being of a company, providing ways to save it substantial amounts of money and time.



# IDENTIFY POTENTIAL PROBLEMS AND CUTTING COSTS

**BY PROTOTYPING BEFORE INITIATING COMMERCIAL PRODUCTION ENABLES YOU TO EVALUATE THE MANUFACTURING PROCESS AND SEE IF ANYTHING NEEDS REVISION, IMPROVEMENT OR – HOPEFULLY NOT – A COMPLETE OVERHAUL.** This process will streamline operations, bring production costs to acceptable levels and occasionally, even reduce expenses.

The proactive management of manufacturing has a direct influence in the bottom line and profitability. During the review of production following prototyping, you may discover conditions that will cause problems in the final product. You may also notice some problems that may be inherent to your processing and previously gone undetected. In both instances, prototyping would have been a contributing influence on the discovery and subsequent correction of your issues. In every case, prototyping enables you to establish the best methods and means to manufacture your part or component.



# 5 KEYS TO CHOOSING THE RIGHT MATERIALS

**SELECTION OF THE IDEAL MATERIAL FOR YOUR PROTOTYPE WILL BE BASED ON A NUMBER OF FACTORS.** A prototype and its subsequent production part or component will fail if the most appropriate material isn't chosen. That's why materials selection is such an important consideration.

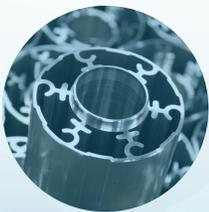
There are a number of factors to consider when coming to a decision about the material and centers on the properties of the materials. Here are several things that should be considered when making a determination of manufacturing materials:



**1) MATERIAL WEAR** - Wear can be a significant problem when the materials come in contact with each other. So, ensure that sufficient wear resistance is inherent in your choice. Plastic materials, while lightweight, may lack hardness and wear-ability, especially where constant contact occurs. Titanium, while durable, may prove useful for short prototyping, but can prove to be economically un-feasible when mass produced. A more ideal, and generally superior prototyping material is aluminum, which demonstrates superior wear resistance while offering a number of benefits unavailable in other materials.



**2) CORROSION RESISTANCE** - The importance of material selection in both prototyping and manufacturing engineering is critical when corrosive environments are involved. Metals like iron can be, depending on environmental conditions, heavily corrosion prone. Aluminum, on the other hand offers superior corrosion resistance, and can be coated in a variety of finishes and colors, adding to its performance characteristics and increasing product life.



**3) MECHANICAL PROPERTIES** - In developing a prototype for the production phase as well as the real-world performance of a component, the reliability of the material to withstand a specified load must be established. In order to predict the reliability of both of these requirements, the material must possess the required strength and stiffness in order to withstand a specific load.

# 5 KEYS TO CHOOSING THE RIGHT MATERIALS



**4) MANUFACTURING PROPERTIES** - Shape and tolerance play a large role in prototyping and the eventual outcome of the commercial manufacturing process. Extruded aluminum parts are a particularly well-suited solution, especially where structural integrity and extremely tight tolerances are required. Miniature aluminum extrusions – under 3.5 in. in diameter – can be manufactured with tolerances as tight as +/- .001' on one or more dimensions, depending on the shape. Parts made of plastic or manufactured on 3D printers by comparison are unable to be as precise and accurate.



**5) COST AND TIME** - Whether one-off, a limited number, or in larger quantities the cost of a prototype and the time required to create can be major factors in the selection of materials. When considering cost, creating a die for extruding a prototype part or component is relatively low, starting at around five-hundred dollars for a simple profile and increasing according to the complexity, tolerances, size and shape of the part to be extruded

When prototyping with aluminum, time is on your side. Extruding miniature aluminum prototypes in large quantities can be a relatively quick process, by comparison the effort required to create a similar prototype by 3D printing is both time consuming and expensive. Consider the fact that to manufacture a large number of prototypes in a timely manner, a single 3D printer is needed for each individual prototype of the requisite quantity. That means an order of 75 prototypes would require an equal number of 3D printers to produce the parts on a reasonable schedule, creating an astronomical cost for equipment. By the same token, if a prototype in the same quantity were to be manufactured sequentially on a single 3D printer, the process could take weeks, even months. An equally impractical situation.

# CUSTOMIZING ALUMINUM FOR PROTOTYPING

**WHEN COMPARED TO OTHER MATERIALS, ALUMINUM OFFERS A UNIQUE SELECTION OF ALLOYS.** They can be used to satisfy a wide variety of specifications, including material strength, formability, machining, extrudability and service finish. This versatility makes aluminum prototypes an ideal solution for a broad range of business sectors, including medical and healthcare as well as with institutions of higher learning. Among many, Minalex has worked in a variety of prototyping capacities with Dartmouth, Princeton and Penn State Universities.



# ALUMINUM: THE ENVIRONMENTALLY RESPONSIBLE CHOICE

**WHILE PROTOTYPING WITH ALUMINUM PROVIDES MANY GREAT ADVANTAGES, NONE IS MORE TOP OF MIND THESE DAYS THAN THE MATERIAL ITSELF, AND MOST IMPORTANTLY, ITS IMPACT ON THE ENVIRONMENT.** Fortunately, aluminum is unsurpassed for recycling and particularly with regards to its manufacturing waste recovery rate.

With an 85/15% part-to-waste recovery rate, extruding prototypes with aluminum reduces waste by more than three times the amount when compared to CNC milling, which can have a part-to-waste recovery rate as high as 50/50% and sometimes even higher.



# PROTOTYPING WITH ALUMINUM: A SEGWAY CASE STUDY

**PROTOTYPING OFFERS MANY ADVANTAGES IN THE MANUFACTURING CYCLE WHICH CAN BE ENJOYED IN THE DEVELOPMENT OF EVERYTHING FROM SIMPLE COMPONENTS TO THE MOST ADVANCED, DISRUPTIVE ADVANCEMENTS IN TECHNOLOGY.**

One such example of the latter is the two-wheeled, self-balancing transporter by Segway, Inc., which was brought to market in 2001 by its inventor, Dean Kamen. During the development of the company's first offering, the Segway HT, prototyping was an integral factor in the vehicle's successful introduction.

Minalex was contracted to prototype a key part of the Segway HT, the center tube. Almost 3.5" in diameter, the cylinder provides stability, connects to the handlebar, and contains a variety of electronics, wiring and components, which allow the operator to turn the Segway and maintain proper balance and, which affects acceleration and braking.

Matching the proper aluminum alloy to the performance needs of the single-person transporter, Minalex efficiently produced a staged run of 3,000 center tube prototypes, and the rest, as they say, is two-wheeled history.



# ONE FINAL ADVANTAGE: TOTAL SERVICE AND SUPPORT

## PROTOTYPING WITH ALUMINUM IS BOTH EFFECTIVE AND EFFICIENT, ESPECIALLY WHEN PARTNERING WITH A SINGLE SOURCE PROVIDER LIKE

**MINALEX.** Working together in the early stages of the process enables consultation and guidance in the adjustment of specifications, refinement of the component, and selection of the appropriate aluminum alloy.

Advanced planning and preparations also pave the way for any additional finishing your prototype may require, which may include precision cutting, deburring, tumbling. Selecting a provider who can provide a turnkey solution for your prototype is the best way to ensure a high-quality, on-spec prototype component at a fair price.



**BECAUSE YOU NEED MORE THAN A PART. YOU NEED A PARTNER.**

For more information about saving time and money by prototyping with aluminum or to request a quote, contact Minalex at **908.534.4044**.