



# A Complete Guide to Aerospace Metal Fabrication

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**MANOR**

TOOL & MANUFACTURING COMPANY

## A Complete Guide to Aerospace Metal Fabrication

The aerospace industry has long depended on metal fabrication to produce reliable, precise components. The industry requires highly complex parts that are often not possible to build using traditional or simple methods. Components must meet very tight tolerances, retain dimensional stability, and withstand extreme temperatures and pressures. Additionally, they must add as little weight to the final aircraft as possible.

This eBook is a guide on how industrial metal fabrication works, the common materials used, and how this key process serves the aerospace industry. We will also explain what to look for in the right metal fabricator in order to receive the most fitting parts for the job.



## What You Need to Know About Metal Fabrication

Metal fabrication is the process by which new components are created from cutting, bending, and assembling raw or stock metal. Commonly employed materials include aluminum, steel, stainless steel, copper, brass, and titanium. Every metal fabrication process comprises three major steps: design, fabrication, and installation. The resulting components of metal fabrication are found in everyday items such as computers, smartphones, tools, and cars, as well as high-performance, mission-critical applications the likes of aircraft.

Here are some of the common types of metal fabrication techniques that are used to create high-precision aerospace parts:

- **Cutting:** Cutting is any process that splits a workpiece into smaller pieces. There are many types of cutting methods available, including sawing, laser cutting, waterjet cutting, and plasma arc cutting. If needed, fabricators can use die cutting to cut workpieces on a die.
- **Drawing:** In both hot (heated) and cold (room temperature) drawing, a die uses tensile force to stretch sheet metal into a thinner shape. Deep drawing occurs when the end product has a hollow interior, with a depth equal to or greater than its diameter.
- **Forging:** In forging, fabricators apply compressive force—either with a hammer or die—to strike the metal workpiece and form it into a desired shape.
- **Punching:** A punch creates holes or indentations in sheet metal. These features can be aesthetic, functional, or both.

## What You Need to Know About Metal Fabrication

- **Milling:** Milling is a machining technique that uses cutting tools to shave off excess material from a workpiece. Computer numerical control (CNC) milling is the most common type of machining because its automated, computerized nature produces highly repeatable, precise results.

Metal fabrication offers the aerospace industry a level of precision, repeatability, and versatility that is vital to daily operations. Experienced metal fabricators have the appropriate machinery, resources, and expertise to produce aerospace parts with tight tolerances, the right finish, and high-quality materials. They can advise on the best fabrication techniques for your project while making sure to stay within your budget and timeline.



## Commonly Used Materials & Their Properties

Materials are selected according to their inherent properties and ability to achieve the end goals of an application. Strength, corrosion resistance, and resilience amidst harsh environmental conditions, for instance, are essential properties for aerospace requirements. To select the right material for a given setting, it is important to understand the distinctions and unique features of each one. As a general rule of thumb, it is always best to consult with your fabricator—they will help you to choose materials that fit your needs and may even save costs.

### ALUMINUM

Aluminum comes in different grades depending on the alloying elements added to the metal. Aluminum 6061 is one of the strongest and least costly types of aluminum alloy. Its excellent strength-to-weight ratio and better corrosion resistance compared to steel make this grade an attractive material option for aerospace components

- **Aluminum 6061 T6:** This is a specific type of aluminum 6061 that is heat-treatable, formable, and weldable. The “T6” refers to the way it was tempered—heat-treated—and the version of heat treatment. T6 means the material has been heated to over 900 °F, then quenched, cooled, and artificially aged. As a result, 6061 T6 has enhanced corrosion resistance, yield strength, and durability than ordinary aluminum 6061.
- **Aluminum 6061 T651:** This grade has also been heat-treated to enhance its corrosion resistance and strength. 6061 T651 has a slightly dull surface finish suitable for interior and exterior aircraft applications.

## Commonly Used Materials & Their Properties

Unlike aluminum 6061, aluminum 5052 is not heat-treatable. However, it is extremely versatile and excellent for bending fabrication techniques. Its excellent corrosion resistance and vibration resistance make it ideal for aerospace applications. In particular, aluminum 5052 H32 is a strain-hardened grade with good strength and fatigue resistance.

Aluminum 7050 exhibits better corrosion resistance, toughness, and exfoliation resistance than other 7000-series alloys. These qualities make it ideal for aerospace fuselages, bulkheads, and wings.

### STAINLESS STEEL

Stainless steel is another valuable material option for aerospace components because of its durability and corrosion resistance. Stainless steel 15-5 PH is a martensitic grade often found in aerospace structural parts, gears, and valves. Stainless steel 304 is the most common type of stainless steel. This austenitic grade is highly formable and corrosion-resistant, ideal for a wide range of aerospace applications. The second most popular type of stainless steel is 316L, an austenitic grade that offers better corrosion resistance than 304.

### CARBON STEEL

Carbon steel 4140 is a low-carbon steel that is frequently used in aircraft engines and turbines, due to its toughness, torsional strength, and fatigue resistance.

## Commonly Used Materials & Their Properties

### NICKEL

Nickel Inconel 718 is a nickel-chromium alloy typically used in rocket and aircraft engines.

As of 2022, nickel and steel prices have risen significantly, so it is important to partner with a metal fabricator that knows what grades to purchase and where to source it responsibly.



## Aerospace Applications Served

Within the aerospace industry, there are numerous specialized applications that metal fabrication processes serve. Some examples include:

- Landing and braking components
- Exterior and interior sensors
- Motion control/actuation systems
- Interior aircraft parts
- Flight-critical safety components
- Faraday cages

By no means is this an exhaustive list—check with your metal fabricator to see if they have the capabilities to bring your specific part to reality. In the next section, we cover some of the questions you should be asking in order to better qualify a metal fabricator.



## What to Look for in an Aerospace Metal Fabricator

Looking for a metal fabricator that can serve your specific needs is vital. To find the ideal aerospace metal fabricator, ask yourself the following questions:

### DO THEY HAVE THE RIGHT CERTIFICATIONS AND UPHOLD KEY INDUSTRY STANDARDS?

Look for an ISO 9001:2015-certified company, as this ensures that their internal processes and systems have been evaluated and confirmed to provide high-quality products and services. They also should be able to produce components reliably and accurately according to your deadlines while meeting the strict requirements established by the Federal Aviation Administration (FAA). Ask the potential fabricator what measures they have in place in order to deliver your parts on time.

### CAN THEY FABRICATE AND INSPECT COMPLEX JOBS IN-HOUSE?

Not every metal fabricator can handle the complex jobs required and requested by the aerospace industry. It is best to partner with a metal fabricator with ample machinery and expertise to perform all services in-house. This reduces the risk of miscommunication, inconsistent product quality, and stretched lead times that tend to come with outsourcing. The company should also have in-house testing and quality control capabilities to take the project from beginning to end, always with form and function at the top of mind.

[Manor Tool](#) has the in-house quality and inspection equipment necessary to perform thorough reviews of every part we produce. We continually invest in the latest advanced QC equipment to further make good on our goal of quality.

## What to Look for in an Aerospace Metal Fabricator

### WHAT LEVEL OF COMMUNICATION AND TRANSPARENCY DOES THE COMPANY PROVIDE THROUGHOUT THE FABRICATION PROCESS?

Transparency and regular communication are excellent ways to establish trust and loyalty between all involved. A great metal fabricator will keep you updated along every step of the process, providing estimated timelines for specific deliverables, troubleshooting support, and guidance from design to delivery. They should also be quick to respond to requests and questions via email, phone, or any other method you specify a preference for.

Manor Tool maintains constant communication with our clients. We understand that metal fabrication is a complicated business, so we strive to answer logistical and engineering questions as soon as they arise. In fact, questions come up throughout the quoting, fabrication, and shipping process. We are committed to being a valuable resource for our customers whenever they have questions or concerns.



## What to Look for in an Aerospace Metal Fabricator

### WHAT SUPPORT SERVICES DOES THE FABRICATOR OFFER FROM START TO FINISH?

An ideal metal fabricator can offer support from the initial stages—i.e. design and prototyping—to post-production finishing processes.

Manor Tool assists customers from prototyping to post-production. Our [finite element analysis](#) tools can perform part simulations to determine whether clients should choose a metal stamping or metal fabrication service for their project. From there, we take their design through prototyping, fabrication, finishing, inspection, and delivery, providing support at every stage.



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## Why Choose Manor Tool for Aerospace Metal Fabrication Services?

Since 1959, [Manor Tool](#) has been providing professional metal fabrication [services](#), including deep draw stamping, punching, forming, and bending. Our customers regularly send us their existing dies so that we can help them solve the quality and pricing issues that they currently face. With our 30-press facility, we can accommodate low to high production volumes of highly precise aerospace parts.

Our longstanding relationships with aerospace clients mean that we are familiar with the strict industry and government standards that fabricated components must meet. As an ISO 9001:2015 certified company, Manor Tool is committed to the highest standards for quality and customer service.

[Contact us](#) to learn more about our aerospace metal fabrication services, or [request a quote](#) to start your project.



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## About Us

Manor Tool & Manufacturing Company began as a tool and die shop in 1959, and has grown to become a first class metal stamping company, specializing in punching, bending, forming and deep drawn stampings. Manor can produce your low volume needs in the prototype stage and produce your high volume needs that require progressive tooling.

We produce your prototypes and short run stampings or fabricated parts with a turret and press brakes, while concentrating on hard tooling when the quantities are justified.

In addition to building new tooling for your parts, we can run your dies in our 32 Press facility. Many of our customers send us their existing dies from another stamping supplier in order to solve problems of quality or delivery at competitive prices.

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