Value add operations for sheet metal components

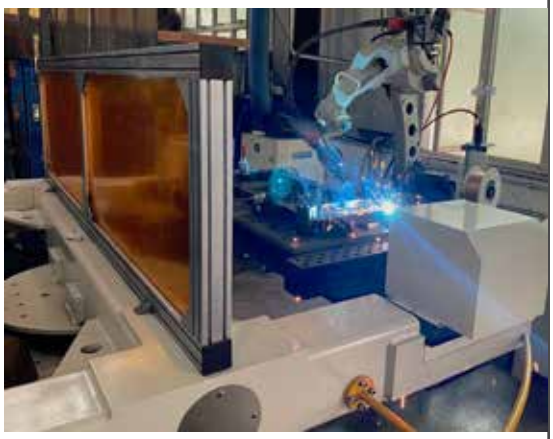
Some sheet metal fabricators offer additional value add services so they can deliver a complete part that is ready for use. Depending on your design and fabrication plans, you may want to look for a fabricator who can offer some of the additional services listed below. Another approach is to work with your fabricators preferred subcontractor for some of these services if they don't offer it themselves. Minimizing the number of companies involved in the manufacturing process can save you time, costs, and the trouble of shipping to multiple operators.

Prototyping

Prototyping is an important step before full on fabrication of your part. It gives you a "sample" to test and confirm it meets your requirements. A CAD designed part might look perfect, but the final fabricated part might not be as perfect. It also helps you improve or adjust the fabrication process if necessary. While the costs for a prototype might seem high, its an investment to help ensure quality and minimize the risk of a full production run of imperfect parts. You can perform any testing or certification processes on the prototype if required.

There are different ways for fabricators to produce a prototype – including some processes that allow for a prototype to be fabricated in a very short amount of time.

Welding



Welding is a common method for connecting two pieces of sheet metal. Opting for a weld vs something like a rivet tends to give you more flexibility in your design. Welding usually requires more time for surface preparation, grinding and polishing the weld, and allowing for a manual process. The heat can also cause some distortion or discoloration to certain materials.

Welding is a skilled trade. If a fabricator offers welding services, you'll want to ensure they have skilled journeymen with experience welding the kind of material and parts you're manufacturing.

Spot welding

Spot welding is also known as resistance spot welding (RSW). Heat is produced from the resistance of an electric current. The material become malleable and pressure is used to create a bond between the two parts. It's not possible to use this form of welding on all materials and is most common with low carbon steel. Spot welding tends to be a lower cost option and produces a strong joint but is a less desirable option if you need a perfectly finished joint or water-tightness.

Spot welding can be used on different materials with adjustments to factors like the current strength. Be sure your manufacturer has experience with the materials you are using. Also confirm their capacity to spot weld the necessary gauge for your part. The type of electrode tip they use for the weld can also affect the appearance, with the potential for indentations at the location of the spot weld. If this is important to the finished piece, confirm their ability to accommodate.

Riveting

Riveting is another common method for fastening two pieces of sheet metal. It is usually a fast process and allows some flexibility to combine different materials (keeping in mind issues like galvanic corrosion). We talk more about different types of rivets in Chapter 15. Rivets must be considered in your design with the correct tolerances for the hole location. You also must consider the space required for the riveting tool – which can also influence the type of rivet you use. Riveting will not be as strong as a weld so isn't suitable for joints that need to withstand force.

Confirm with your manufacturer the type of riveting tools they have and what type of rivets are available to use.

Drilling, tapping, reaming, and boring

Drilling uses a bit to create a hole in sheet metal. Fabricators need to consider the type and thickness of the material when determining the type of bit and overall process.
Tapping creates a threaded hole in your sheet metal so a fastener such as a bolt can be used without a nut. These are not meant as permanent joints like a weld. Your fabricator will need to use a tap and drill chart to determine the correct drill hole size.

Reaming is a cutting process used to smooth the edges of a hole. If reaming is a step in your fabrication process you need to design the hole slightly smaller than required so the material removed during reaming gives you the desired hole size. Good accuracy and finishes are possible with this technique.

Boring uses a lathe, milling machine, or boring mill with a single point to enlarge an existing hole.

Countersinking and counterboring

Countersinking and counterboring are very similar but have key differences that are important to understand. A key difference in the shape of the hole they create. A counterbore hole has a flat bottom while countersink holes have a conical shape to accommodate the typical shape of a screw. Counterbore holes are generally wider than the fastener/ bolt to accommodate for a washer and space for the driving tool. Counterbores set the top of the fastener below the part surface while countersinks can be below or flush with the surface.

Heat treating

Heat treating is a process to improve or change physical or mechanical properties of a part without changes to the shape. There are different processes that can be used depending on your needs and desired outcome, including:

Hardening increases the strength, but also increases brittleness. It's done by heating the part to the desired temperature and then quickly quenching it in oil, water, or a brine mixture.

Tempering is done after hardening to relieve some of the internal stresses that result in the brittleness. The part is heated to a lower temperature than when hardened and then allowed to cool. It does not require rapid cooling, so air cooling is often used. Higher temperatures during tempering result in a softer metal.

Annealing heats the metal and holds it at that temperature for a defined time before being cooled. The temperature, time it's held at that temperature, and speed of cooling are all dependant on material being used. The process helps relieve internal stresses, softens the material, improved ductility, and refines the grain.

Normalizing heats the metal to a temperature higher than that used for hardening or annealing and allowed to air cool. It is very common for parts that are subject to impact or external stresses to undergo a normalization step. The process relieves the internal stresses that occur due to processes like machining or welding.

Deburring

Burrs are a common imperfection resulting from some fabrication processes. They are essentially small, raised pieces of material along an edge. Processes like shearing, stamping, and folding will create mechanical burrs while operations that involve heat, like laser cutting, will produce thermal burrs.

The part design and use will determine how you instruct your fabricator to manage any burrs that form. For some parts, deburring may not be required. In other instances, simply removing the sharp edges is sufficient. On the other end of the spectrum, you can specify to your manufacturer that you want all the burs removed or rounded to a specific radius.

Fabricators may have wet or dry deburring machines depending on their shop. They can also use a variety of types, grades, and materials for the abrasive used for the deburring process. They should be able to help you choose the best deburring process factoring in the part size, material, and desired finishes.

Mechanical materials testing

Mechanical testing is used to test the properties of the material you're using to help ensure it's suitable for the part fabrication and use. By testing the material, you better understand its formability and the performance of the end part. It's also important to test the material properties from coil to coil as there can be variations that need to be adjusted for in the manufacturing process.

For some industries, precise testing is vital. An example is the automotive industry, where testing material for factors like consistent yield strength are essential to manufacturing parts that perform as they should. Mechanical testing can be done for elasticity, tensile strength, yield strength, elongation, hardness, fatigue limit, ductility, strain-hardening exponent, strain-rate effects, temperature effects, and hydrostatic pressure effects. The testing can include tension tests, plane-strain tension tests, compression tests, plane-strain compression tests, partial-width indentation tests, and torsion test.

Fasteners

You have several hardware options for fastening sheet metal parts. Your choice should be based on the design and take the type, material, tolerance, and placement into account. Chapter 15 includes details on how to choose the best fasteners for your part.

Metal finishing

Metal finishing adds a layer to your part to improve both appearance and functionality. An important consideration in metal finishing is galvanic corrosion which has a big impact on your material choices. Different types of metal finishing are discussed in Chapter 4 including powder coating, ecoating, zinc plating, Dacromet, anodizing, passivation, and galvanized dip.

Surface finishing

Surface finishes removes material from the part surface to improve appearance and function. We cover details of different surface finishing options in Chapter 8, including polishing, sand blasting, brushing, grinding, tumbling, and rumbling.