WHAT IS METAL FABRICATION?

Defining an Industry

SOUTHERN FABRICATING

MACHINERY SALES

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Metal Fabricating Manufacturers, or “Fab Shops,” are a modern-day offshoot of the metalsmiths and blacksmiths that worked metals from as early as the Bronze Age. These blacksmiths and metalsmiths of yesterday honed their craft with hammers, chisels and melding their steels with fire to mold and shape sheet metal into everyday items from art to armor, weapons to pots, pans and tools. Today these “smiths” are simply known as “fabricators” and although their tools and methods have evolved the basic principle and process of metal fabricating has not.

These “Fab Shops” manufacture a wide variety of parts from sheet and plate metals and aluminum. Fab Shops cut, bend, fold, paint/coat, weld and assemble these materials into many products we use throughout your daily life from the stainless steel tables, sinks, appliances, and fixtures in a restaurant’s kitchen, to custom off-road parts and the signal control switch boxes at every lighted intersection in the world.

Although the term “fabrication” can be loosely applied to any type of manufacturing, it has become known as a reference to metal manufacturing and specifically sheet or plate metals manufacturing. It should also be noted that although there are many specialty fabricators such as Steel Service Centers, Structural Fabricators, Wire and Spring Manufacturers, Stamping Houses, Pipe and Tube Mills, Sign Shops, HVAC, and Roofing Fabricators using the specific methods and machinery described, this guide will focus on and assist with the understanding of the processes and machinery found in and around the general sheet metal fabrication shops today.

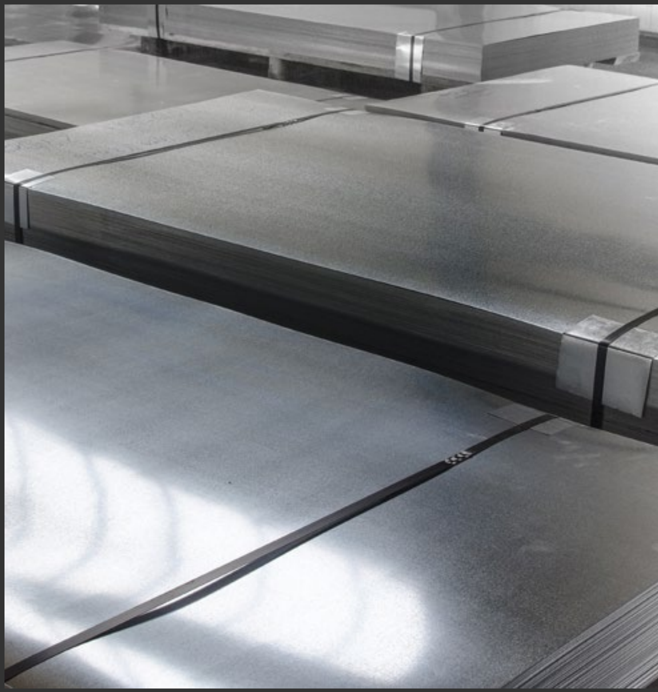
Materials Used in Metal Fabrication

In order to understand the fab shop of today, we must first gain an understanding of the materials they are working with on a daily basis. Although there are many, many grades of specific material mixtures that relate to everything from the materials "bend-ability" (malleability) to its "break-ability" (ductility) to its corrosion resistance (corrosivity) properties, we will focus on these materials in their most common and generic form.

Most Common Materials:
Steel, Stainless Steel, Aluminum

Steel is derived from a mixture of materials made mostly of iron. Steel is the most common material used in a fab shop as it is generally inexpensive, strong and easily worked and formed into the desired shapes. Steel is determined by two main types of manufacturing methods, cold rolled or hot rolled. This "rolling" process works very much like that of a baker's rolling pin flattening and spreading baking dough. By pressure and force the dough is thinned and widened. So is steel, just under much, much greater pressures.

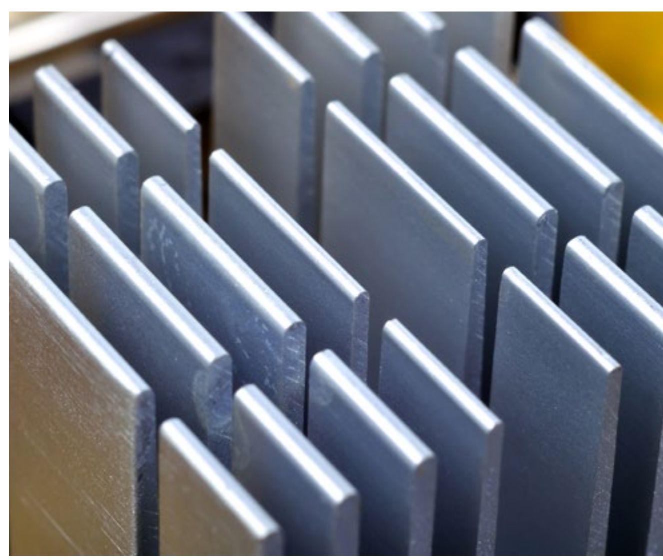
Cold Rolled Steel is found in thinner thicknesses, 11 gage (0.120" thick, but more on that later) and thinner. Whereas hot rolled steel is typically found in 10 gage and thicker metals. Cold rolled is the process used to finally "size" the material thickness and is done when the material is cold as opposed to just coming out of the furnace. Cold rolled steel often looks like it has a shiny or brushed finish as it inherits the polished finish of the hardened rolls the mill uses. Cold rolled steel is what you will usually see in coils and is more likely to be virgin mild steel (no recycled materials) with lower tensile strengths and thus better bending properties.



Hot Rolled Steel is steel that (10 gauge steel or thicker) includes plate and structural steels. The Hot Rolling process is what gives this steel its name and an easy way to identify Hot Rolled steel is its grayish or black scaly finish. Hot rolled steel is processed when the material is still extremely hot (cherry red) and thus the forces required to press and size the steel are greatly reduced. Hot rolled steel is most likely steel that is made from recycled which typically means it has inherited much harder properties and this it malleability is much tougher. Although there are many designations for both steels we are typically dealing with mild steel (MS) in cold rolled steels (CRS) and a designation of A-36 in hot rolled steels (HRS).

Stainless Steel is created by mixing in other materials into the steel mixture but most typical is chromium, zinc and nickel properties of which are very rust and corrosive resistant but also removes a great amount of malleability (bend-ability) and ductility (break-ability) from the steel requiring much greater forces in cutting and forming applications. Stainless steels are required where a material's exposure to elements in the atmosphere or in a process would corrode traditional steels quickly and thus weaken the structure or machinery in which it is employed on. Marine, piping and chemical tank applications are good examples of where stainless steel is required. It should also be noted that machinery rated to work standard steels at a given capacity will only have the ability to work with about 30% less capacity in stainless steel.

Aluminum is a specific material used when light weight is necessary in a fabricated product. Aluminum also has moderate non-corrosive properties for outdoor uses (although not generally good enough for marine use) and excellent heat absorption properties (which makes it great for electronic heat-sinks and radiators but bad for thermal cutting processes like plasma and laser). Examples of aluminum fabricated products are license plates, street signs, truck tool boxes and fuel tanks.



Designating Material Thicknesses in Steel and Stainless Steel

Cold & Hot Rolled Steel Sheets

Guage Number	Manufacturers' Standard Inches	Hot Rolled	Cold Rolled
3	.2391	± .009	N/A
4	.2242	± .009	N/A
5	.2092	± .009	N/A
6	.1943	± .009	N/A
7	.1793	± .008	N/A
8	.1644	± .008	N/A
9	.1495	± .008	N/A
10	.1345	± .008	± .006z
11	.1196	± .008	± .006
12	.1046	± .008	± .006
13	.0897	± .007	± .005
14	.0747	± .007	± .005
15	.0673	± .007	± .005
16	.0598	± .006	± .005
17	.0538	N/A	± .004
18	.0478	N/A	± .004
19	.0418	N/A	± .004
20	.0359	N/A	± .003
21	.0329	N/A	± .003
22	.0299	N/A	± .003
23	.0269	N/A	± .003
24	.0239	N/A	± .003
25	.0209	N/A	± .003
26	.0179	N/A	± .002
27	.0164	N/A	± .002
28	.0149	N/A	± .002
29	.0135	N/A	± .002
30	.0120	N/A	± .002

There are some odd habits that have developed over the years and throughout the trade of metal fabrication, including the system utilized to measure the thickness of the most common metals. When referring to steels and stainless steels it is common to refer to a "gauge" (also spelled gage) thickness but only up to 10 gauge (although the charts actually go down further) and then reference is typically made fractionally thereafter. These "gauges" of steel are references used for the thickness of steel and stainless steel but NEVER refer to aluminum thicknesses which are always referred to in decimal or fractional form (although charts exist giving them a "gauge" designation).

A phrase that includes: "Oh-Eighty" or "One Twenty-Five Thick" will always be a reference to aluminum. And although each gauge value represents a certain thickness of material it must be understood that it actually represents a "range" that is acceptable and varies between cold rolled and hot rolled steel. On the right is a chart showing the gages of steel and stainless steel as well as the allowable deviation tolerance from the nominal thickness.

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The Fabricating Process

A fab shop today starts with an order for fabricating a given component or assembly. In order to describe the process and follow a part through, the average fab shop we will use this common electrical enclosure as an example. If we look closely we can see that we have a box and lid made of a material we will assume to be Aluminum. It is coated or painted on the exterior and has some raised features, holes and countersinks for use of flush hardware. The processes that a fabrication job shop would need to go through in order to fabricate this party would be as follows:

1. Blanking
2. Shape Cutting
3. Forming
4. Assembly
5. Finishing

Steel sheets being rolled into tubes.

Each of the above processes is what is required to make the electrical box, however, each process has a myriad of options available such as the first part; blanking. Blanking of a part can be established by manually cutting (or shearing) a large sheet of material down to many smaller pieces for easier handling then notching the individual corners out of the part for later forming or can be incorporated directly into the 2nd process listed, shape cutting.

Because today's fab shops employ a wide variety of machinery this part would most likely be sent to a CNC turret punching machine for blanking and forming of features less than ½" tall. That would include forming the holes, knockouts, countersinks etc on this box (Click here for a video showing a punching machine in action). In the following pages, we will describe in detail the process of punching and the tools utilized, but for now, let's continue to follow the part through the shop.

In the second phase of manufacturing the part we need to form the main sides in order to form the box. This can be performed efficiently on one of two types of machinery, either a metal folder as shown pictured at right, (Click here for a video link showing a folder in action) or more likely (and much more common) a press brake such as the one shown below.

These machines will utilize a force of tonnage pressing the material between a forming punch and die in order to bend the sides of the part to the desired angle, in this case, a 90-degree bend, one side at a time. (Click here to watch press brake in action).

Once formed, the part is ready for the next step in the manufacturing process: assembly.

This particular part requires welding of the seams and then the addition of hardware for the cover to be attached and be easily removable for later servicing. In the case of this aluminum box, we will weld (more on that later) the corners using a robotic welder (Click here for a video of a robotic welder in action). Then we need to insert the hardware, in this case, hardened threaded nuts to allow for repeated removal and replacement of the cover of our electrical cabinet. For this process, we will use a hardware insertion press (Click here to watch a short video of the hardware press in action). The insert press uses a mass-produced hardened nut and through an application of high tonnage to the material around the nut squeezes the material to effectively "lock" the threaded nut in place.

The last stop for our electrical box is finishing. It is in this process that we may use a buffing wheel, hand grinder or various other tools to improve the finish and look of our fabricated box. Here we are also checking all the previous manufacturing methods for any errors or repairs that may be necessary prior to final finishing and delivery to our customer. Once our part checks out to be satisfactorily and is cleaned and ready, it is on to paint or rather powder coat which is a method of "painting" a part by actually baking on the paint in a much harder and more durable method than paint alone. In the photo at right panels are hung on a conveyor and electrostatically sprayed with dry, colored "powder". They are later put into an oven where the powder melts into a very durable hard coating adhering to the electrical boxes surface. Once this process is completed our electronic box is completed and ready for delivery to our customer.

Although this is a simplified example of manufacturing in a fabrication shop it is an example of the basic techniques that are or can be employed.

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