

Metal fabrication

For other uses, see [Fabricator \(disambiguation\)](#).

Metal fabrication is the building of metal structures



A set of six-axis welding robots

by cutting, bending, and assembling processes. It is a value added process that involves the construction of machines and structures from various raw materials. A fab shop will bid on a job, usually based on the engineering drawings, and if awarded the contract will build the product. Large fab shops will employ a multitude of value added processes in one plant or facility including welding, cutting, forming and machining. These large fab shops offer additional value to their customers by limiting the need for purchasing personnel to locate multiple vendors for different services. Metal fabrication jobs usually start with shop drawings including precise measurements then move to the fabrication stage and finally to the installation of the final project. Fabrication shops are employed by contractors, OEMs and VARs. Typical projects include loose parts, structural frames for buildings and heavy equipment, and stairs and hand railings for buildings.

1 Processes

- *Cutting* is done by sawing, shearing, or chiseling (all with manual and powered variants); torching with hand-held torches (such as oxy-fuel torches or plasma torches); and via numerical control (CNC) cutters (using a laser, mill bits, torch, or water jet).
- *Bending* is done by hammering (manual or powered) or via press brakes and similar tools. Modern metal fabricators use press brakes to either coin or air-

bend metal sheet into form. CNC-controlled back-gauges use **hard stops** to position cut parts in order to place bend lines in the correct position. Off-line programming software now makes programming the CNC-controlled press brakes seamless and very efficient.

- *Assembling* (joining of the pieces) is done by welding, binding with adhesives, riveting, threaded fasteners, or even yet more bending in the form of a crimped seam. Structural steel and sheet metal are the usual starting materials for fabrication, along with the welding wire, flux, and fasteners that will join the cut pieces. As with other manufacturing processes, both human labor and automation are commonly used. The product resulting from fabrication may be called a fabrication. Shops that specialize in this type of metal work are called *fab shops*. The end products of other common types of metalworking, such as machining, metal stamping, forging, and casting, may be similar in shape and function, but those processes are not classified as fabrication.

2 Overlap

Fabrication comprises or overlaps with various metal-working specialties:

- Fabrication shops and machine shops have overlapping capabilities, but fabrication shops generally concentrate on metal preparation and assembly as described above. By comparison, machine shops also cut metal, but they are more concerned with the machining of parts on machine tools. Firms that encompass both fab work and machining are also common.
- **Blacksmithing** has always involved fabrication, although it was not always called by that name.
- The products produced by welders, which are often referred to as weldments, are an example of fabrication.
- Boilermakers originally specialized in boilers, leading to their trade's name, but the term as used today has a broader meaning.
- Similarly, millwrights originally specialized in setting up grain mills and saw mills, but today they may be called upon for a broad range of fabrication work.

- **Ironworkers**, also known as **steel erectors**, also engage in fabrication. Often the fabrications for structural work begin as prefabricated segments in a fab shop, then are moved to the site by **truck**, **rail**, or **barge**, and finally are installed by erectors.

3 Raw materials

Standard raw materials used by metal fabricators are;

- plate metal
- formed and **expanded metal**
 - tube stock,
- welding wire/welding rod
- casting

4 Cutting and burning

The raw material has to be cut to size. This is done with a variety of tools.

The most common way to cut material is by **Shearing** (**metalworking**);

Special **band saws** designed for cutting metal have hardened blades and a feed mechanism for even cutting. Abrasive cut-off saws, also known as chop saws, are similar to miter saws but with a steel cutting abrasive disk. **Cutting torches** can cut very large sections of steel *with little effort*.

Burn tables are CNC cutting torches, usually natural gas powered. Plasma and **laser cutting tables**, and **Water jet cutters**, are also common. Plate steel is loaded on a table and the parts are cut out as programmed. The support table is made of a grid of bars that can be replaced. Some very expensive burn tables also include CNC punch capability, with a carousel of different punches and taps. Fabrication of structural steel by **plasma and laser cutting** introduces robots to move the cutting head in three dimensions around the material to be cut.

5 Forming

Forming is a process of material deformation. Forming is typically applied to metals. To define the process, a raw material piece is formed by applying force to an object. The force must be great enough to change the shape of the object from its initial shape. The process of forming can be controlled with the use of tools such as punches or dies. Machinery can also be used to regulate force magnitude and direction. An example of machine based forming can also combine forming and welding to produce lengths of

fabricated sheeting, most commonly seen in the form of linear grating (used principally for water drainage) - (see **example**).^[1]

Proper design and use of tools with machinery creates a repeatable form which can be used to create products for many industries, including jewelry, aerospace, automotive, construction, civil and architectural, etc.

6 Machining

Machining is the process of removing unwanted material from the block of metal to get the desire shape. Machining is a trade, in and of itself, although Fab shops will generally entail a limited machining capability including; metal lathes, mills, **magnetic based drills**, along with other portable metal working tools.

7 Welding

Main article: [welding](#)

Welding is the main focus of steel fabrication. The formed and machined parts will be assembled and tack welded into place then re-checked for accuracy. A **fixture** may be used to locate parts for welding if multiple weldments have been ordered.

The welder then completes welding as per the engineering drawings if welding is detailed, or as per his/her own judgement if no welding details are provided.

Special precautions may be needed to prevent warping of the weldment due to heat. These may include re-designing the weldment to use less weld, welding in a staggered fashion, using a stout fixture, covering the weldment in sand during cooling, and straightening operations after welding.

Straightening of warped steel weldments is done with an Oxy-acetylene torch and is somewhat of an art. Heat is selectively applied to the steel in a slow, linear sweep. The steel will have a net contraction, upon cooling, in the direction of the sweep. A highly skilled welder can remove significant warpage using this technique.

Steel weldments are occasionally **annealed** in a low temperature oven to relieve **residual stresses**. Such weldments, particularly those employed for engine blocks, may be line-bored after heat treatment.

8 Final assembly

After the weldment has cooled it is generally sand blasted, primed and painted. Any additional manufacturing specified by the customer is then completed. The finished

product is then inspected and shipped.

9 Specialities

Many fabrication shops have speciality processes which they develop or invest in, based on their customers needs and their expertise:

- casting
- chipping
- powder coating
- powder metallurgy
- welding

10 See also

- Interchangeable parts
- Manufacturing engineering
- PEB

11 References

[1] *paigestainless.com.au* <http://www.paigestainless.com.au/linear-surface-water-drainage/>. Retrieved 20 February 2016. Missing or empty |title= (help)

- Sheetmetalworld – Sheet Metal Fabrication tutorials

12 Text and image sources, contributors, and licenses

12.1 Text

- **Metal fabrication** *Source:* https://en.wikipedia.org/wiki/Metal_fabrication?oldid=738146068 *Contributors:* Ram-Man, Thesteve, Michael Hardy, Ixfd64, Warofdreams, Mirv, Mushroom, Mendel, R. fiend, Antandrus, Rdsmith4, Neutrality, Vsmith, Smalljim, Duk, Kjkolb, Atlant, Andrew Gray, Bart133, Oleg Alexandrov, Gmaxwell, Damicatz, BD2412, MC MasterChef, Tdowling, Graibeard, Nihiltres, GünniX, DVdm, Bgwhite, Gwernol, Ytrottier, NawlinWiki, Bmdavll, Vicarious, SmackBot, Slashme, Gilliam, Quidam65, Anwar saadat, Rsedlacek, JDCMAN, Stormraven, Stonesmart, Dr Greg, Tcleary, Wizard191, JMK, Martinericbailey, Casper2k3, Neelix, Cydebot, Kozuch, Epbr123, Mr pand, Nick Number, I already forgot, Porqin, EdJogg, ForrestVoight, Toastydeath, WordSurd, MER-C, Bongwarrior, Theroadslong, Glrx, R'n'B, CommonsDelinker, Dividing, Inwind, Andy Dingley, Phe-bot, Caltas, Torchwoodwho, ClueBot, Mild Bill Hiccup, Three-quarter-ten, Rick.neff, Addbot, Cst17, Tide rolls, Mercurybds, Yobot, Jim1138, Materialschemist, SME2009, Killerhistory, Vrenator, Rami radwan, RA0808, TeeTylerToe, K6ka, Joe Campbell - WEIT, Bamyers99, Peterh5322, Coolnights, Sonia Sevilla, Dougienicoll, TYelliot, ClueBot NG, JBF Engineering Co., Lforsche, Jack Greenmaven, Nick.maddalena, Widr, MerIwBot, Christopherjillys, Mcgarbear, BG19bot, Aeroplanepics0112, Sheetmetal01, Rockcrawling, MadGuy7023, Wywin, The Anonymouse, Tentinator, Clay.reiser, Kbaysden, Prof cam, Gronk Oz, RSmith at S-Bond, RachOKC, Joel Galloway, Lolcat175, Uncle Fig 25, Finepunchfab, Leecarey83 and Anonymous: 143

12.2 Images

- **File:Commons-logo.svg** *Source:* <https://upload.wikimedia.org/wikipedia/en/4/4a/Commons-logo.svg> *License:* CC-BY-SA-3.0 *Contributors:* ? *Original artist:* ?
- **File:FANUC_6-axis_welding_robots.jpg** *Source:* https://upload.wikimedia.org/wikipedia/en/9/9b/FANUC_6-axis_welding_robots.jpg *License:* CC-BY-3.0 *Contributors:* ? *Original artist:* ?
- **File:Question_book-new.svg** *Source:* https://upload.wikimedia.org/wikipedia/en/9/99/Question_book-new.svg *License:* Cc-by-sa-3.0 *Contributors:*
Created from scratch in Adobe Illustrator. Based on Image:Question book.png created by User:Equazcion *Original artist:* Tkgd2007

12.3 Content license

- Creative Commons Attribution-Share Alike 3.0