

Services Guide

Machine Shops

**NOTE 1: This information is pulled from credible sources. This information is a guide. Any information used from this guide must be re-contextualized (no copying and pasting). Re-contextualize information incorporating SEO and business specifics.*

**NOTE 2: For MCP websites, stick to general information and avoid specifics.*

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1. MACHINE SHOPS OVERVIEW

1.1 General Information

<https://en.wikipedia.org/wiki/Machining>

https://en.wikipedia.org/wiki/Metal_fabrication

<http://www.craftsmanshipmuseum.com/Shoptools.htm>

https://www.studentscholarships.org/salary/406/tool_and_die_makers.php

- Machining includes any process in which a cutting tool is used to remove small chips of material from a workpiece to achieve a desired geometry. These processes are collectively known as subtractive manufacturing.
- A workpiece is often referred to as “the work.” The bulk of work is performed on metal, but plastics and composite materials are also machined.
- The machinist is a person who specializes in machining. Machinists use machine tools mounted on machinery, such as CNC machines, lathes, milling machines, and grinders, to produce precision metal parts.
- Toolmakers craft precision tools that are used to cut, shape, and form metal and other materials. They also produce jigs and fixtures—devices that hold metal while it is bored, stamped, or drilled—and gauges and other measuring devices.
- Die makers construct metal forms, called dies, that are used to shape metal in stamping and forging operations. They also make metal molds for die casting and for molding plastics, ceramics, and composite materials.

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- Machine shops are concerned with the machining of parts. They produce accurate metal parts exactly to the specifications provided in mechanical drawings. Firms that encompass both fabrication work and machining are common.
- Fabrication shops (sometimes called fab shops) generally concentrate on flat-metal preparation, cutting, bending and assembly. The resulting product may be called “a fabrication.”
- The main difference between fabrication shops and machine shops is the material being used (flat metal vs. bar stock/billet/purified metal) and the functionality of the machines (punch/form vs. subtractive manufacturing).

1.2 SEO

KEYWORDS (FIRST ROW - BEST, LAST ROW - LEAST)			
○ Metal Fabrication	○ Machine Shop	○ Machinist	○ Milling Machine
○ Rotary Broaching	○ Lathes	○ Best Router	○ Metal Fabrication
○ Welding	○ Machine Tools	○ CNC Machine Shop	○ Heat Treating
○ Precision Machining	○ Screw Machining	○ Gear Manufacturing	○ CAD File
○ 3 Axis, 5 Axis	○ Fabrication shop	○ Machine Turning	○ Field Machining

1.3 Equipment/Machine Tools

<http://www.craftsmanshipmuseum.com/Shoptools.htm><http://eng-services.ece.ubc.ca/fabrication/mechanical-fabrication/shop-request/>
http://www.globalspec.com/learnmore/part_fabrication_production/machine_shop_services/machine_shop_services
https://en.wikipedia.org/wiki/Grinding_machine
[https://en.wikipedia.org/wiki/Stamping_\(metalworking\)](https://en.wikipedia.org/wiki/Stamping_(metalworking))
https://en.wikipedia.org/wiki/Press_brake
https://en.wikipedia.org/wiki/Machine_tool
<http://eng-services.ece.ubc.ca/fabrication/mechanical-fabrication/shop-request/>
<http://multicam.ca/how-cnc-routers-work-and-the-difference-between-3-axis-and-5-axis-machines/>
<http://www.brighthubengineering.com/manufacturing-technology/40254-how-a-broaching-machine-works/>
https://en.wikipedia.org/wiki/Gear_shaper
[https://en.wikipedia.org/wiki/Planer_\(metalworking\)](https://en.wikipedia.org/wiki/Planer_(metalworking))

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https://books.google.ca/books?id=xw_KonwsWTEC&pg=PA23&lpg=PA23&dq=3+basic+types+of+saws+in+machine+shop?&source=bl&ots=YJbc_qf7Hm&sig=fm5TZY4G-GPioB6BylQTiP3VQ3w&hl=en&sa=X&ved=0ahUKEwjQ09OF_77PAhUF6IMKHRqJBrIQ6AEIPzAF#v=onepage&q=3%20basic%20types%20of%20saws%20in%20machine%20shop%3F&f=false
<http://www.thefabricator.com/article/sawing/band-saw-or-circular-cold-saw>
<http://www.wisegeek.com/what-is-a-shearing-machine.htm>
http://www.edmmachining.com/wire_edm.htm

Machine Tools

A machine tool is a machine for shaping or machining metal or other rigid materials, usually by cutting, boring, grinding, shearing, or other forms of deformation. The following is a list of just some of the machine tools commonly used in the machining/fabrication industry.

Equipment	Description
3-Axis CNC Routers	<ul style="list-style-type: none">○ These machines cut along 3 axes at the same time (front to back, left to right, up and down). Although 4-axis routers exist, 3 and 5 are most common.
5-Axis CNC Routers	<ul style="list-style-type: none">○ 5-axis routers have the ability to cut on five sides of a piece of material simultaneously, which expands the operator's capabilities and flexibility. Unlike their 3-axis counterparts, these machines are usually used to cut large 3-dimensional parts.
Broaching Machine	<ul style="list-style-type: none">○ The broach is a multi-edge toothed tool used to remove material. It is commonly used for circular or odd shapes in high volume.○ Broaching machines can be horizontal or vertical (verticals are typically the most popular, the majority of which are hydraulic).
Computer Numeric Controlled Machines (CNC) Computer-Aided Manufacturing (CAM)	<ul style="list-style-type: none">○ CNC machines cut metal the same way a machinist would, except instead of the machinist turning the handwheels, a program tells the machine how to move and the machine does the cutting. Can be a milling machine, lathe, router, welder, grinder, laser/waterjet cutter, or sheet metal stamping machine.○ Computer-aided design (CAD) software allows the user to create a design they want the router to cut.○ CAM software converts the design into a tool path code that the router can understand.
Coordinate Measuring	<ul style="list-style-type: none">○ A CMM is a device for measuring the physical geometrical characteristics of an object.

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Machine (CMM)	
CNC Router	<ul style="list-style-type: none">○ Computer-controlled cutting machine used to cut or hollow out a solid workpiece.
Drill Press	<ul style="list-style-type: none">○ These tools produce cylindrical holes of various sizes in hardened material.
Gear Shaper	<ul style="list-style-type: none">○ Shapers used for cutting the teeth of internal or external gears.
Grinder	<ul style="list-style-type: none">○ Grinders are power tools or machine tools used for grinding, which is a type of machining that uses an abrasive wheel to cut from the workpiece via shear deformation.○ Grinding is used to finish workpieces that must show high surface quality (e.g., low surface roughness).○ In most applications it tends to be a finishing operation.
Lathe	<ul style="list-style-type: none">○ A lathe is usually used to reduce the diameter of a part and to make parts that are round in cross-section. Used to shape and cut cylindrical parts. For turning, screw machining, swiss machining○ CNC lathes and machining centers can cut materials on many axes.
Milling Machine	<ul style="list-style-type: none">○ Milling is the process of refining surfaces and cutting down surfaces.○ A milling machine differs from a lathe in that the part does not turn rather it is mounted firmly in a vise or held to the mill table while a spinning cutting tool secured in the powered spindle is moved into the part.○ Milling machines are versatile devices that can perform many different cutting, shaping, boring, and forming operations. Types of milling include broaching and drilling.○ 2 basic forms: horizontal and vertical, which refers to the orientation of the main spindle.○ With the advent of CNC control, cooling systems, automatic tool changers, many milling machines are now called vertical machining centres (VMCs) and horizontal machining centres (HMCs).
Multitasking Machine	<ul style="list-style-type: none">○ MTMs are CNC machine tools with many axes that combine

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(MTM)	turning, milling, grinding, and material handling into one highly automated machine tool.
Planer	<ul style="list-style-type: none">○ Typically used to maintain and repair large stamping dies and plastic injection molds or to square larger blocks of metal.○ Similar to, but larger than a shaper. Mostly replaced by milling machines, broaching machines and grinding machines in modern shops.
Press Brake (fabrication)	<ul style="list-style-type: none">○ A press brake is a machine tool for bending sheet and plate material, most commonly sheet metal (fabrication). It forms predetermined bends by clamping the work piece between a matching punch and die.
Rotary Table	<ul style="list-style-type: none">○ A rotary table can be used in a drill press or on a milling machine to provide a 4th axis of movement called the “A” axis. Used in conjunction with a milling machine. 4 axes of movement theoretically allow just about any part to be made.
Saws	<ul style="list-style-type: none">○ 3 basic types of saw used in machining: power hacksaws (make sawing a mechanical operation, cut large sizes), power band saws (cuts straight lines, tight curves, smooth cuts in tough materials, bundle-cutting) and circular cold saws (high-speed cutting, high-quality finishes).
Screw Machine	<ul style="list-style-type: none">○ These machines are a form of turret lathe that produce large numbers of small identical parts such as bolts, studs, screws, handles and spindles.
Shaper	<ul style="list-style-type: none">○ A metalworking shaper is somewhat analogous to a metalworking planer. Uses linear relative motion between the workpiece and single-point cutting tool. Not used as much anymore in the industry.
Shear (fabrication)	<ul style="list-style-type: none">○ The majority of shearing machines cut sheet metal.○ Shearing machines also cut metal bars into more manageable lengths for use in other machines. Other machines are required to remove the burs or leftover material on the ends.
Stamping Press (fabrication)	<ul style="list-style-type: none">○ Stamping is usually done on sheet metal.○ The presses are used for punching, blanking, embossing, bending, flanging (creating a place to attach other pieces) and coining (creating fine details on a surface).

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Water Jet Cutter	<ul style="list-style-type: none">○ Water-jet cutting is used for many industrial applications because of its ability to precisely cut through materials. It is best suited for cutting shapes and designs out of 2D materials (i.e. sheets of metal and plastic).
Wire EDM (Electrical discharge machine)	<ul style="list-style-type: none">○ EDMs can easily machine complex parts and precision components out of hard conductive materials.

1.4 Hiring a Machine Shop

http://www.globalspec.com/learnmore/part_fabrication_production/machine_shop_services/machine_shop_services

Using Machine Shop Services

Machine shop services are contracted by manufacturers who do not have the ability to handle the work internally due to skill, capacity or budget constraints.

Typically, detailed part design drawings are submitted to the machine shop. The shop then buys the material, manufactures the part(s), and returns the finished part(s) to the manufacturer. Some machine shops will sub-contract work that they cannot do effectively, such as heat treating and plating.

Quotes (cost estimates) for orders or services are given to the customer after he or she provides the supplier with a description of the job requirements. Cost typically correlates to the time spent producing the product and the expense of the materials used (when purchased by the service company).

The location of the service provider is important to consider both for logistical reasons and expenses. Operations located farther away from the customer will have higher associated shipping costs. In addition, there may be additional logistical complications when dealing with suppliers from different countries.

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https://en.wikipedia.org/wiki/Just-in-time_manufacturing
<http://www.st-hubertmachineshop.com/en/repairs/>
<http://www.orbitalenergyservices.com/on-site-machining/>
https://en.wikipedia.org/wiki/Metal_fabrication
<http://www.havardmetal.com/>

1.5 Overview of General Services

Service	Description	Benefits
Design & Consultation	<ul style="list-style-type: none"> ○ Assistance from the concept level through to product realization ○ Turn-key manufacturing ○ CAD/CAM ○ Work from printed drawings, 2D or 3D CAD files ○ Produce in-house shop drawings 	<ul style="list-style-type: none"> ○ Cost-effective recommendations to help improve turnaround times, avoid waste, overproduction and over ordering ○
Prototype Development	<ul style="list-style-type: none"> ○ Design first generation parts through reverse engineering (studying a part to understand how to make it) ○ Pattern making and model making ○ Custom design research and development 	<ul style="list-style-type: none"> ○ Create specialized pieces for use in manufacturing ○ A way to duplicate worn, broken, obsolete, hard-to-find pieces
Machining Manufacturing	<ul style="list-style-type: none"> ○ Custom metal work/machine parts ○ Repair services ○ New parts: parts repaired or reproduced 	<ul style="list-style-type: none"> ○ Produce the exact piece you need ○ Handle large quantities or single runs ○ Fix heavy machinery components (gears, splines, rack and pinions, pistons, cylinders, etc.) ○ Intricate and complex details are possible ○ Precise control of surface finish ○ Extremely hard work pieces can be cut
Secondary Services: Treatments	<ul style="list-style-type: none"> ○ Some machine shops may have the capability to treat the finished parts after machining ○ Painting/Powder Coating 	<ul style="list-style-type: none"> ○ Enhances the look and durability of your metal ○ Decorative and/or protective finishes

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	<ul style="list-style-type: none">○ Anodizing○ Lapping/Polishing○ Black Oxide○ Heat Treating/Stress Relieving	<ul style="list-style-type: none">○ Provides corrosion resistance○ Heat treating is used to increase the strength of the metal, but can also be used to soften it for further machining
On-Site Machining	<ul style="list-style-type: none">○ Repairs can be made at customer's worksite○ Transportable machine tools and highly qualified technicians	<ul style="list-style-type: none">○ Avoid prolonged work stoppages○ Eliminates removal and shipping of equipment to a shop○ Prevents possible damage during shipment
Fabrication	<ul style="list-style-type: none">○ Building of metal structures by cutting, bending and assembly processes○ Welding	<ul style="list-style-type: none">○ Offers more flexibility in the types of products that can be produced and the types of service that can be rendered

2. MACHINING

2.1 Services/Terms

General:

- Machinists handle a wide range of parts and assemblies and serve a variety of industries including: agriculture, mining, hydroelectric, medical, pulp and paper, construction, oil and gas, scientific, environmental, fisheries, commercial printing, original equipment manufacturers and many more.
- Machine shops work with ultra-hard materials and hardened metals such as carbon steel, stainless steels, alloys (e.g. aluminum, brass, steel, etc.), aluminum, titanium, copper, bronze, plastics, graphite and carbide. Some shops may also work with stone, marble, granite, ceramics, glass, rubber and wood.
- Products produced for commercial and industrial applications include machine parts, custom tools, brackets, mounts, clamps, drums, knobs, spacers, pipeline rollers and more. The list is endless.
- Machine shops boast of their fine tolerances (the permissible limit or limits of variation in a physical dimension, measured value or physical property), competitive pricing, quick turnarounds, prototyping expertise, production run capabilities and the cosmetic appeal of their products.

<http://machining.ca/>

<http://machining.ca/profile/what-we-do/>

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http://www.innotool.com/?gclid=CLzw3_b7r88CFYYfhgodHcIEEQ
http://www.globalspec.com/learnmore/part_fabrication_production/machine_shop_services/machine_shop_services
https://en.wikipedia.org/wiki/Abrasive_jet_machining#Advantages_and_disadvantages
<http://americanmachinist.com/machining-cutting/cutting-tool-applications-chapter-10-boring-operations-and-machines>
[https://en.wikipedia.org/wiki/Broaching_\(metalworking\)](https://en.wikipedia.org/wiki/Broaching_(metalworking))
<https://en.wikipedia.org/wiki/Extrusion>
<http://www.andersonshumaker.com/services/forging.html>
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<http://www.investopedia.com/terms/j/jit.asp>
<http://metalcutting.com/core-capabilities/custom-metal-polishing-services/>
<http://www.lasermicronics.com/services/laser-cutting/advantages.htm>
<https://en.wikipedia.org/wiki/Millwright>
[https://en.wikipedia.org/wiki/Milling_\(machining\)](https://en.wikipedia.org/wiki/Milling_(machining))
<http://miragemachines.com/products/line-boring/line-boring/>
<http://www.themetalcasting.com/casting-process-advantages.html>
<http://americanmachinist.com/machining-cutting/cutting-tool-applications-chapter-11-reaming-and-tapping>
<http://www.datron.com/blog/thread-milling-vs-tapping/>
<http://the9000store.com/what-is-iso-9001.aspx>

Service/Product	Description	Benefits
Abrasive Jet Machining (AJM) Pencil Blasting	<ul style="list-style-type: none"> This machining process uses abrasive materials to polish, cut, and form parts. 	<ul style="list-style-type: none"> Cuts intricate shapes, forms specific edge shapes. Cuts heat-sensitive, brittle, thin or hard materials.

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Alloys	<ul style="list-style-type: none"> ○ Alloys are metal made by combining 2 or more metallic elements. 	<ul style="list-style-type: none"> ○ Compared to pure metals and other metals, alloys can be stronger, more resistant to damage and more versatile.
Anodizing	<ul style="list-style-type: none"> ○ Anodizing is a galvanic finishing process well suited to aluminum and its alloys. 	<ul style="list-style-type: none"> ○ Anodized finishes are hard-wearing and include corrosion-resistant properties on a wide variety of colors.
Automation	<ul style="list-style-type: none"> ○ Automation in the manufacturing industry is the process of integrating industrial machinery to perform tasks such as welding, material handling, packing, palletizing, dispensing, cutting, etc. 	<ul style="list-style-type: none"> ○ Repeatability ○ Quality control ○ Waste reduction ○ Increased productivity ○ Reduction of labor costs ○ Faster cycle times ○ Improved workplace safety
Black Oxide	<ul style="list-style-type: none"> ○ Black oxide is applied as an anti-corrosion treatment for a variety of steels. 	<ul style="list-style-type: none"> ○ Low cost visual appeal ○ Reduces glare ○ Improves adhesion for paint ○ No fumes
Boring	<ul style="list-style-type: none"> ○ This process involves the enlarging of existing holes in a workpiece. ○ This may be done on a lathe or a milling machine. ○ The work is in contact with a single point tool. 	<ul style="list-style-type: none"> ○ Will straighten the original hole ○ Brings hole to proper size and finish
Broaching	<ul style="list-style-type: none"> ○ Precision cutting for odd shapes like non-circular holes ○ Completes cutting in one stroke or cut. ○ Typical workpieces include small to medium-sized castings, forgings, screw machine parts, and stampings. 	<ul style="list-style-type: none"> ○ Broaching can be used to remove material between two adjacent drilled holes. For example, a round hole can be broached to a square or other shape. ○ Even though broaches can be expensive, broaching is usually favored over other processes when used for high-quantity

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		<p>production runs.</p> <ul style="list-style-type: none"> ○ Almost any material, from ferrous and nonferrous metals to plastic materials and wood are able to be cut through broaching, although softer metals are by far the most common material.
Casting	<ul style="list-style-type: none"> ○ This is a process where liquid metal is poured into a mold that contains a hollow cavity of the desired shape. 	<ul style="list-style-type: none"> ○ Low cost ○ Adaptable to the requirements of mass production, can be produced quickly ○ Certain light metal alloys can only be produced as castings ○ Design flexibility, high production rate, large and complex parts
CNC Machining	<ul style="list-style-type: none"> ○ CNC machining is a manufacturing process that utilizes specialized computer programs to instruct the automated design and production of high precision parts for a number of industries. CNC stands for computer numerical control. 	<ul style="list-style-type: none"> ○ Creates small or large volumes of identical precision parts quickly and efficiently
Cutter Grinding	<ul style="list-style-type: none"> ○ Sharpens milling cutters and tool bits 	<ul style="list-style-type: none"> ○ Quality control
Dies	<ul style="list-style-type: none"> ○ Dies are specialized tools used in manufacturing industries to cut or shape material, mostly through using a press. 	<ul style="list-style-type: none"> ○ Customized to the item they are used to create
Electrical Discharge Machining (EDM)	<ul style="list-style-type: none"> ○ EDM is a non-traditional method of removing metal by a series of rapidly reoccurring electric pulses which are discharged between an electrode and the work piece. 	<ul style="list-style-type: none"> ○ Provides the ability to create complex shapes at extremely close tolerances
Electroplating	<ul style="list-style-type: none"> ○ Coating a metal object by electrolytic deposition with chromium, silver or another metal. 	<ul style="list-style-type: none"> ○ Prolongs the life of parts ○ Changes surface qualities
Extrusion	<ul style="list-style-type: none"> ○ Extrusion is a process used to create objects of a fixed cross- 	<ul style="list-style-type: none"> ○ The extrusion process in metals may also increase the strength of

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	<p>sectional profile. Material is pushed through a die of the desired cross-section (think play doh sets).</p> <ul style="list-style-type: none"> ○ The products of extrusion are generally called "extrudates." ○ Aluminum is one of the most commonly extruded materials because of its impressive strength-to-weight ratio, rust resistance, and temperature resistance. 	<p>the material.</p> <ul style="list-style-type: none"> ○ Due to their strength, aluminum extrusions are perfectly suited for structural applications as well as many other functions in the construction and automotive industries. ○ These items are also simple to manufacture and are completely recyclable which makes them a cost effective and reusable solution.
Field Machining	<ul style="list-style-type: none"> ○ Portable machining service for machinery that cannot be shipped out for repair 	<ul style="list-style-type: none"> ○ Saves on the shipping of parts ○ Reduces work stoppage times
Fixture	<ul style="list-style-type: none"> ○ A fixture's primary purpose is to create a secure mounting point for a workpiece. ○ Holds work in a fixed location 	<ul style="list-style-type: none"> ○ Improves the economy of production by allowing smooth operation and quick transition from part to part. ○ Simplifies how workpieces are mounted and increases conformity across a production run
Forging	<ul style="list-style-type: none"> ○ Forging changes the size and shape (but not the volume) of a metal part. ○ Impression die forging (presses metal between 2 dies) ○ Cold forging (done as hot work at temps up to 2300 degrees F) ○ Open die forging (deforms/ hammers metal between multiple dies that do not enclose the material) ○ Seamless rolled ring forging (punches a hole then rolls/squeezes donut shape into a ring) 	<ul style="list-style-type: none"> ○ This process results in: metallurgical soundness and improved mechanical properties. Strength, toughness, and general durability, depending how the grain is placed. ○ Hammer forging can produce a wide variety of shapes and sizes and, if sufficiently reduced, can create a high degree of grain refinement at the same time. ○ Develops fiber strength and toughness in steel.

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Gear Manufacturing	<ul style="list-style-type: none">○ Gears can be manufactured by a variety of processes, including casting, forging, extrusion and blanking. Machining is applied to achieve the final dimensions, shape and surface finish in the gear.○ Common types of gears produced: spur, helical, worm, and bevel.	<ul style="list-style-type: none">○ Produces custom application gears for oil and gas, forestry, mining, pulp and paper industries and more.
Gun Drilling	<ul style="list-style-type: none">○ Gun drilling is a deep hole drilling process that uses a long, thin cutting tool with a unique head geometry to produce holes in metal.○ Deeper drilling than conventional machinery and tooling (such as twist drills)○ Uses high pressure coolant for clean chip exhaust, even at extreme depths	<ul style="list-style-type: none">○ A quick and efficient method of producing deep or shallow close tolerance holes with smooth surface finishes.○ Refined for maximum performance on modern, dedicated machinery.○ Used for firearms, diesel fuel components, medical tooling, plastic injection molds and more.
Grinding	<ul style="list-style-type: none">○ Process that uses an abrasive grinding stone or wheel to remove material from a workpiece	<ul style="list-style-type: none">○ Typically for polishing or cutting/shaping of harder materials.○ Grinding produces the correct surface finish, end features, parallelism and flatness to meet a variety of manufacturing needs.
Heat Treating/Stress Relieving	<ul style="list-style-type: none">○ Heat treating is a broad category of processes used to treat metals: annealing (reduces hardness), passivation (prevents corrosion), hardening, etc.).○ Stress relieving is used to alleviate residual stresses imposed during the stamping process. Done after rough machining but before final finishing.	<ul style="list-style-type: none">○ Helps create the desired hardness, tensile strength, ductility of the metal.○ Relieving reduces the risk of dimensional changes in the final product.

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Hobbing	<ul style="list-style-type: none"> ○ A milling process for gear cutting, cutting splines, sprockets. 	<ul style="list-style-type: none"> ○ Efficient, affordable way to produce high-quality toothed wheels. ○ Unlike milling, gashing or forming, hobbing creates an exact gear tooth profile. ○ Hobbing is surprisingly affordable.
Honing	<ul style="list-style-type: none"> ○ Honing is an abrasive machining process that produces a precision surface on the metal workpiece by scrubbing an abrasive stone against it along a controlled path. 	<ul style="list-style-type: none"> ○ Improves the geometric form and surface texture. ○ Finishing for cylinders, internal combustion engines, air bearing spindles and gears.
Metal Injection Molding (MIM)	<ul style="list-style-type: none"> ○ From high production to prototype tooling, this is a low cost, high volume manufacturing process that produces custom metal parts near to net shape. 	<ul style="list-style-type: none"> ○ Creates metal or ceramic parts which are stronger, denser and more capable of complex geometric shapes than most forged or die cast metal parts. ○ A relatively new invention in manufacturing. ○ Widely utilized for telecommunications, automotive, medical and dental instrumentation, industrial parts and more
ISO 9001:2008	<ul style="list-style-type: none"> ○ ISO9001 is an internationally recognized quality management system. ○ There are several different documents in the ISO 9000 family of standards, but ISO 9001-2008 is the only ISO standard that requires certification. ○ ISO 9001:2008 is the most recent standard and the "2008" references the year of latest revision. 	<ul style="list-style-type: none"> ○ Customers can feel confident that these high standards reflect the level of service and quality of product they will receive.
Jig	<ul style="list-style-type: none"> ○ A jig is a device that holds a piece of work and guides the tools 	<ul style="list-style-type: none"> ○ Jigs are a critical component to manufacturing quality products.

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	<ul style="list-style-type: none"> operating on it. Differs from a fixture in that a jig moves the workpiece while the tool remains stationary. 	<ul style="list-style-type: none"> Ergonomics – Redesign your jigs and fixtures to improve handling, ease of use, and worker comfort. On-Demand Production – Reduce or even eliminate inventory requirements by producing fixtures and jigs as needed.
Just-in-Time Delivery	<ul style="list-style-type: none"> An inventory strategy where companies receive goods only as they are needed. 	<ul style="list-style-type: none"> Reduces inventory costs (warehouse storage, less money spent on raw materials). Companies buy just what they need and no more.
Lapping/Polishing	<ul style="list-style-type: none"> Lapping and polishing processes use abrasive materials to smooth, polish and brighten metal surfaces. Associated with honing. 	<ul style="list-style-type: none"> Influences metal thickness, surface finish, part uniformity, flatness, camber (deviation of a side edge from a straight edge), and parallelism. Create highly polished part ends. Helps with tight length tolerances. Polishing improves the surface finishes and edge radii of metal parts.
Laser Machining	<ul style="list-style-type: none"> Laser machining is a material removal process accomplished by laser / material interaction. Low-distortion, hot cutting process using a CO2 	<ul style="list-style-type: none"> It is used to create precise cuts with easier work holding and reduced contamination (no solid cutting edge). Create clean cut edges without burr or dust formation. Produce extremely fine contours. Cuts various thicknesses in one operation.
Lights-Out	<ul style="list-style-type: none"> Minimal operator involvement, machine automation. 	<ul style="list-style-type: none"> Saves on labour costs. Quick turnaround.
Micro Machining	<ul style="list-style-type: none"> Micro machining involves precision machining of very small parts. 	<ul style="list-style-type: none"> Can create high-tech products. Commonly used for automotive,

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		medical fields: fuel injector nozzles, stents and catheters.
Millwright Service	<ul style="list-style-type: none"> ○ Installs, dismantles, repairs, reassembles and moves machinery in factories, power plants, construction sites. ○ * Related to machining, but not the same thing. 	<ul style="list-style-type: none"> ○ Prevents work stoppages. ○ Maintains expensive machinery.
Milling	<ul style="list-style-type: none"> ○ Process of using rotary cutters to remove materials. 	<ul style="list-style-type: none"> ○ Handles specialized manufacturing needs.
Portable Line Boring	<ul style="list-style-type: none"> ○ Portable line boring tools are lightweight and easy to set up while offering workshop precision on site. 	<ul style="list-style-type: none"> ○ Eliminates costly dismantling of equipment and production downtime. ○ Performs precision heavy duty line boring for stern tubes, rudder bores, hinge pins, gear boxes, turbines and many more applications.
Reaming	<ul style="list-style-type: none"> ○ A finishing operation performed with a multi-edge tool to smooth, enlarge or accurately size a previously drilled or bored hole. ○ A reamer is a precision finishing tool. 	<ul style="list-style-type: none"> ○ For use when superb hole quality and close dimensional tolerance is required.
Reverse Engineering	<ul style="list-style-type: none"> ○ Discovering the technological principles of a device, object or system through analysis of its structure, function and operation. ○ It often involves taking something apart and analyzing its workings in detail. 	<ul style="list-style-type: none"> ○ Creates obsolete replacement parts for clients.
Screw Machines/Machining	<ul style="list-style-type: none"> ○ A form of turret lathe usually having a hollow spindle through which a bar can be fed to be machined into bolts, studs, and other screws or any small repetition work (handles or spindles). 	<ul style="list-style-type: none"> ○ Improves part quality, reduces production time and cost and decreases time to market. ○ Value added component for manufacturers

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Swiss Machine/Machining	<ul style="list-style-type: none">○ Swiss-types machines are turning centers that handle small, complex precision parts.○ Swiss-type turning allows the part to move and the cutting tools remains stationary (unlike conventional lathes).	<ul style="list-style-type: none">○ Useful for markets where exceptional tolerances, difficult geometries and exotic metals and alloys are common, such as for medical devices and the aerospace industry.○ Screws and fasteners.
Tapping	<ul style="list-style-type: none">○ The process of cutting a thread inside a hole so that a cap screw or bolt can be threaded into the hole.	<ul style="list-style-type: none">○ High speed tapping centers with a rigid tap can thread holes much faster than it would take to thread mill the same holes.
Turning	<ul style="list-style-type: none">○ Turning is performed on a lathe, used to reduce the diameter of a part to a desired dimension.	<ul style="list-style-type: none">○ Creates precise pieces for various industries.
Water Jet Cutting	<ul style="list-style-type: none">○ Water jet cutting is a volume reduction process used to create new shapes and machine existing shapes.	<ul style="list-style-type: none">○ Hydro cutting offers manufacturers and fabricators an alternative to resource-intensive hot-cutting processes like laser and plasma cutting.○ Water jet cutters are capable of precisely cutting intricate shapes out of metal and plastics as well as some glass and ceramic materials.

3. FABRICATION

3.1 Services/Terms

https://en.wikipedia.org/wiki/Gas_metal_arc_welding
<http://www.wisegeek.com/what-are-the-advantages-of-tig-welding.htm>
<http://www.wisegeek.com/what-is-stick-welding.htm>
www.advantagefabricatedmetals.com/blanking-process.html
<http://www.iqsdirectory.com/industry/metal-cutting.htm>
https://en.wikipedia.org/wiki/Press_brake
<https://en.wikipedia.org/wiki/Rivet>
<http://www.conardcorp.com/advantages-of-photo-etching>

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https://en.wikipedia.org/wiki/Gas_metal_arc_welding

<http://www.custompartnet.com/wu/sheet-metal-shearing>

https://en.wikipedia.org/wiki/Gas_tungsten_arc_welding

http://www.metalcraft.ca/cnc_turret_punch_press_services.php

Metal fabricators are companies that process metals into usable products. Fabrication is a blanket term used in reference to a wide range of metalworking processes. Some of the most common fabrication processes include bending, welding, stamping, punching and many other forming processes.

Service/Product	Description	Benefits
Blanking/Piercing	<ul style="list-style-type: none">○ When a metal workpiece is removed from the primary metal strip or sheet using a punch and die.○ In blanking, the punched out piece is used and called a blank.○ In piercing the punched out piece becomes scrap.	<ul style="list-style-type: none">○ Assists Original Equipment Manufacturers (OEM) with production/assembly of products.
Metal Etching	<ul style="list-style-type: none">○ Metal etching, also referred to as metal engraving, is the process of creating grooves, fine lines or impressed designs on metal parts or sheets.○ Methods include mechanical, chemical machining or acid etching.	<ul style="list-style-type: none">○ Customization of metal products.○ Another way to produce a wide variety of precision metal parts.○ Precision metal etching can produce complex parts that would be either impossible or impractical to produce by stamping or laser cutting.○ Suitable for many alloys and gauges.
Metal Inert Gas (MIG) Welding	<ul style="list-style-type: none">○ A welding process in which an electric arc forms between a consumable wire electrode and the workpiece metal(s). This heats the workpiece(s), causing them to melt and join.○ Commonly used in the automobile industry.	<ul style="list-style-type: none">○ Metal is welded quickly.○ Ideal for soft metals like aluminum.○ Good for thin to medium thick metals and alloys.

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Metal Stamping	<ul style="list-style-type: none">○ Metal stamping is a method of metal forming which utilizes a press to force sheet metal into a tool or die. Many other metal forming processes like bending, drawing, blanking, and cutting can be incorporated into metal stamping.	<ul style="list-style-type: none">○ With a variety of different tools and dies, metal stamping can produce a very diverse range of metal products.○ The metal stamping process is perfect for quickly and efficiently manufacturing large quantities of products at low cost.○ Metal stamped parts are repeatable and can attain precision tolerances.
Perforated Metals	<ul style="list-style-type: none">○ Perforated metals are created when a pattern of holes is blanked out of sheet metal.	<ul style="list-style-type: none">○ Many different kinds of metals can be perforated including steel, aluminum, brass, and titanium, and these metals can serve a variety of purposes.○ Commonly used in structural, design, and filtration applications.○ Lightweight perforated metals like aluminum can be used as decorations.○ Perforated steel is frequently used for architectural support.
Press Brakes	<ul style="list-style-type: none">○ A press brake is a machine tool for bending sheet and plate material.○ It forms predetermined bends by clamping the work piece between a matching punch and die.○ Mechanical or hydraulic○ CNC press brakes are widely used.	<ul style="list-style-type: none">○ Assist in manufacturing, assembly.
Riveting	<ul style="list-style-type: none">○ Use of permanent mechanical fasteners in punched or drilled metal.	<ul style="list-style-type: none">○ Widely used in applications where light weight and high strength are critical, such as in aircrafts.
Shearing	<ul style="list-style-type: none">○ Shearing is also known as die cutting.○ Involves the application of force which causes material to fail and	<ul style="list-style-type: none">○ Commonly used to cut sheet stock into smaller pieces in preparation for other processes.

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	<p>separate into 2 parts.</p> <ul style="list-style-type: none"> ○ Can use a punch and die or upper and lower blades. 	
Shielded Metal Arc Welding (SMAW)/Arc Welding/Stick Welding	<ul style="list-style-type: none"> ○ Most popular of the arc welding processes. ○ Uses a fixed length electrode and an electric power source to join a variety of metals. 	<ul style="list-style-type: none"> ○ Versatile. ○ Can be done inside or outside. ○ Less sensitive to wind or drafts. ○ Ease of operation and low operating costs. ○ Used primarily for base metals like iron and steel in pipeline construction, automotive repair, steel building construction, industrial fabrication and more.
Gas Tungsten Arc Welding (TIG)	<ul style="list-style-type: none"> ○ TIG is an arc welding process that uses a non-consumable tungsten electrode to produce the arc. ○ Once the arc is formed between the workpiece and the electrode, a filler metal is fed into the arc to produce the weld. 	<ul style="list-style-type: none"> ○ Good for intricate curves, base metal designs on thinner gauge materials. ○ Kitchen sinks, tool boxes etc. ○ Produces clean welds with no slag. ○ The TIG welder is versatile as you can weld many different types of metals. The downside is that it is very slow.
Turret Punch	<ul style="list-style-type: none"> ○ A basic punch press is a type of machine that is used to punch holes in metal. ○ A CNC (computer numerical controlled) turret punch press has many more capabilities not available on the basic punch press. 	<ul style="list-style-type: none"> ○ Manufacture parts that require precision punches with high volume production.