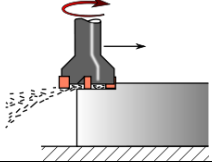
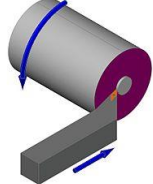
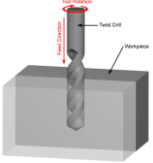
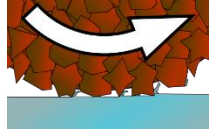
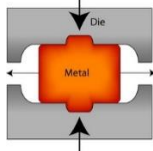
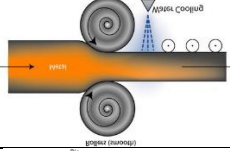
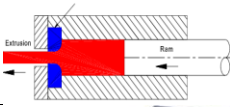
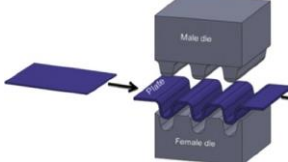
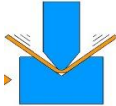
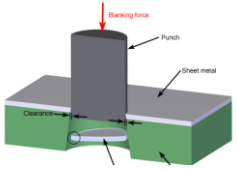
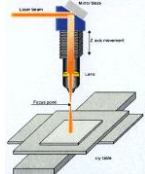
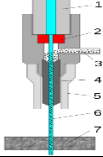
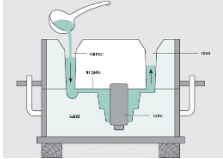
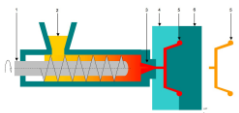
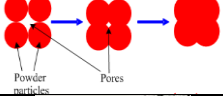

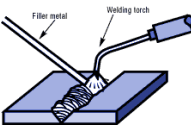

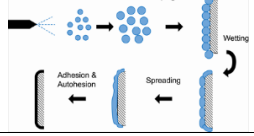
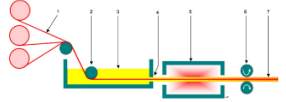


Summary of Manufacturing Processes

Ridiculously simple summary (aka ELI5) of the most used manufacturing processes.

| | | |
|--|--|---|
| <p>Machining (maquinagem)</p> | <p>Removes material (waste). A hard thing scratches a softer thing. The softer thing loses material as it is scratched and takes the shape we want. This is why it's preferred for softer materials: low carbon steels, aluminum, plastics, ... has to be done for each part individually so generally for 10-1000's/ units.</p> | |
| <p>Milling (fresagem)</p> | <p>Very versatile, allows smooth surfaces and good mechanical properties of material. The tool is called milling cutter (fresa) and the machine, milling machine (fresadora).</p> |  |
| <p>Turning (torneamento)</p> | <p>Same as milling but it's the part that rotates. Generally for revolution objects. The machine that does this is called lathe (torno).</p> |  |
| <p>Drilling (furação)</p> | <p>To make holes and threads.</p> |  |
| <p>Grinding (retificação)</p> | <p>For when you need excellent finishings or very strict tolerances. (that milling can't reach). The tool is called grinding wheel (mó).</p> |  |
| <p>Forming (conformação plástica)</p> | <p>Change of shape. No material is removed.</p> | |
| <p>Forging (forjamento)</p> | <p>Crushing. Material gets stronger. The machine is the press (prensa) and the tool, die (punção). If automated for 1000's of units because you need to make the die on purpose for the part.</p> |  |
| <p>Rolling (laminagem)</p> | <p>For long things with constant section (eg. ingots, beams, tubes)</p> |  |
| <p>Extrusion (extrusão)</p> | <p>For long things with constant section (eg. ingots, beams, tubes)</p> |  |
| <p>Stamping (estampagem/embutidura)</p> | <p>For plates. The machine is the press (prensa), the tool is the die (punção).</p> |  |
| <p>Bending (quinagem)</p> | <p>Mostly for plates, sometimes for beams. Bending machine does the bending (quinadora).</p> |  |
| <p>Cutting (Corte)</p> | <p>Cutting stuff.</p> | |

| | | |
|---|---|---|
| <p>Die cutting / shearing (Corte mecânico)</p> | <p>For thin plates (0.01-5mm). Punching machine (puncionadora). High speed – can cut several at the same time, but there needs to be a punch for that. Has the worst precision of the 3 types of cutting but is the fastest and cheapest.</p> |  |
| <p>Laser cutting (corte por laser)</p> | <p>For metallic plates (3-10mm). Cuts by melting the material, slowest speed. Can't cut reflective or ceramic materials (hard to melt). Has the highest precision of the 3.</p> |  |
| <p>Water jet cutting (corte por jato de água)</p> | <p>Thick plates (10-50mm). Intermediate cutting precision. For any material. It's like mechanical cutting where the punch is a thin water jet.</p> |  |
| <p>Casting (fundição)</p> | <p>Melt a metal and put it into a mold, generally made of sand. For parts with lots of details, hard to make in other ways, subject to low stresses, surface will be rough (due to the walls of the sand mold). For high number of parts, because you need to invest in the mold first. But after it's made, it can be used for thousands of parts.</p> |  |
| <p>Moulding (moldação)</p> | <p>Similar to casting, but for plastics. Put plastic material in mold. Injection molding, by blowing. Only worth it for large productions (thousands / millions) because it is necessary to invest in the mold, which is a very complex piece, needs many machining operations to be done and time to be designed.</p> |  |
| <p>Sintering (sinterização)</p> | <p>For ceramics. It's how all ceramic pieces are made. Ceramic powder is pressed (crushed) with the wanted shape, then baked (particles stick together).</p> |  |
| <p>Adhesives (adesivos, cola)</p> | <p>For joining parts with shear forces, never pulling. Increasingly used in airplanes, automobiles, composites. Result in low stress concentrations.</p> |  |
| <p>Welding, Brazing and Soldering (soldadura, brasagem e soldagem)</p> | <p>For metals. Bonding of two pieces by melting the material of the pieces or by melting external material. Joint strength and melting point of the metal that will be melted: Welding > Brazing > Soldering. (> 850 ° C, <850 ° C and <450 ° C respectively). MIG (uses noble gas to prevent oxidation) and MAG (using gas mixture) have the addition material to be drawn into the tool. TIG (see image), has addition material to be placed on the joint.</p> |  |
| <p>Additive Manufacturing (manufatura aditiva)</p> | <p>Currently mainly for plastics, parts with high complexity. Poor mechanical properties of the material.</p> |  |
| <p>Coating (revestimento)</p> | <p>Painting, spraying, chemical vapor deposition.</p> |  |
| <p>Pultrusion (pultrusão)</p> | <p>To manufacture parts in composites continuously. Yarns continuously coming out are dipped in the material (general / plastic) that will harden. Cut into pieces at the end.</p> |  |

Tool is the thing that touches the material. The machine that operates the tool is the machine tool (máquina ferramenta) Eg. Drilling machine uses a drill (broca), milling machine uses milling cutter (fresa).