INTRODUCTION

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  - Abrasive Water Jet Machining
  - Chemical Machining
  - Electro-chemical Machining
  - Electro-chemical Grinding
  - Electrodischarge Machining
  - Laser Beam Machining
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Abrasive Grinding

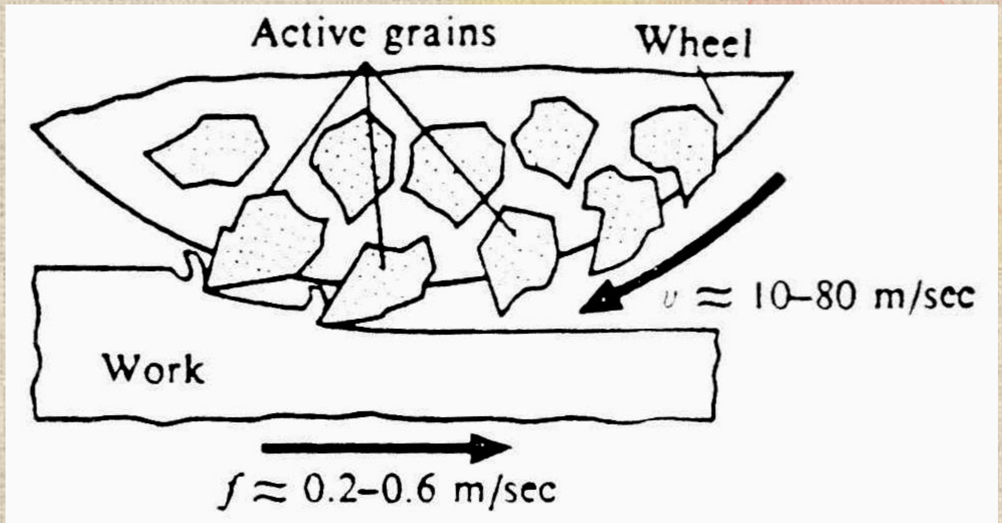
Can be viewed as multiple very small cutting edges

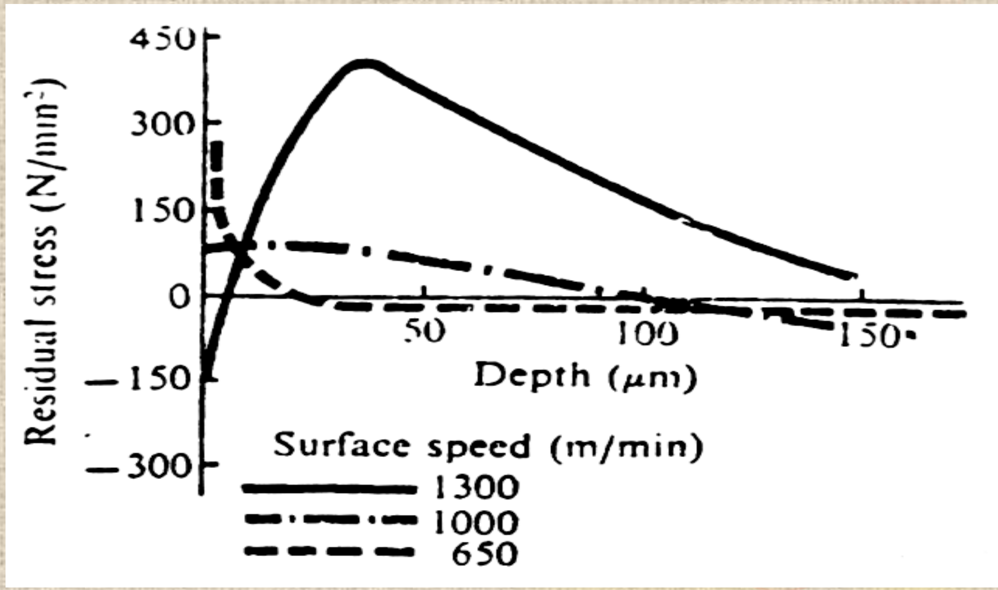
Results in a very fine finish

Can leave residual stresses

Slow, small material removal rates

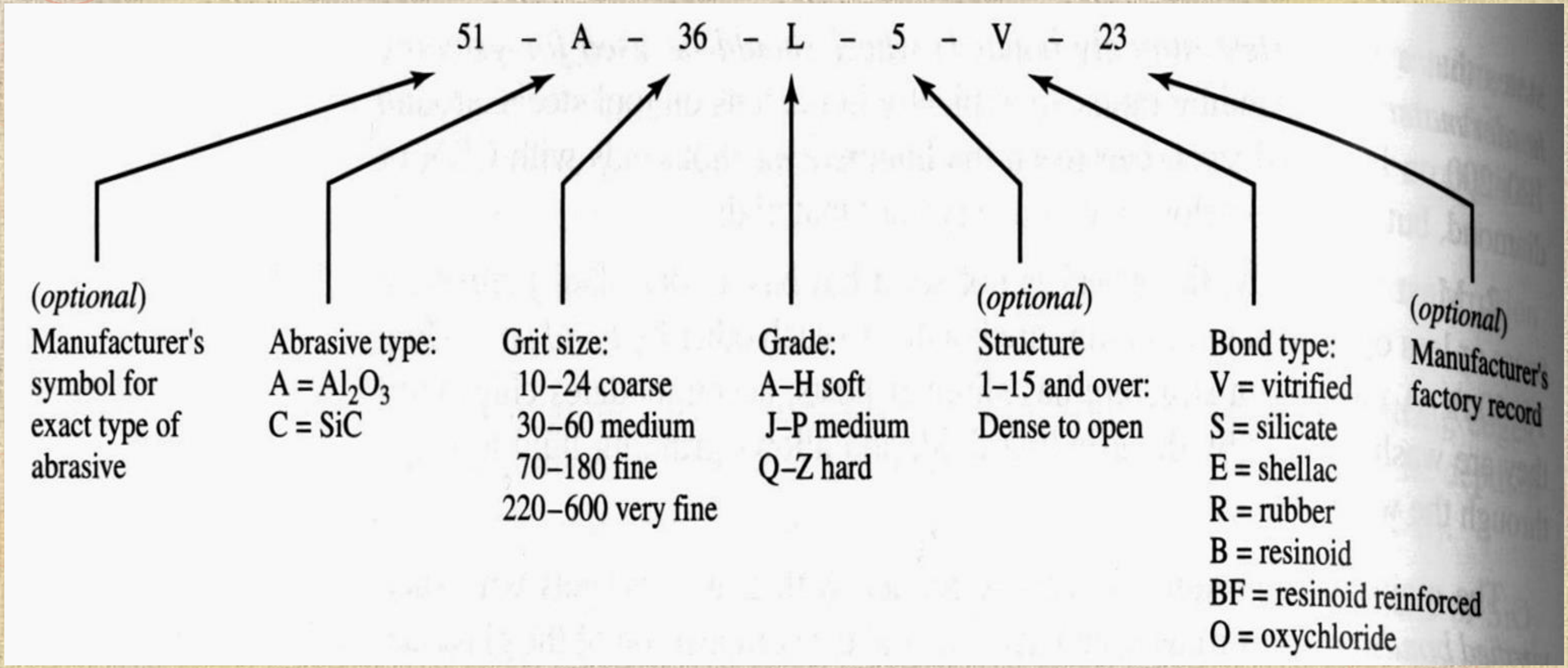
Sparking out





Standard Grinding Wheel Designation

- While this is specific to grinding, realize that there are similar standard designations in most industries
- Take the time to learn the standard designations early so that you can speak intelligibly with those within the industry.



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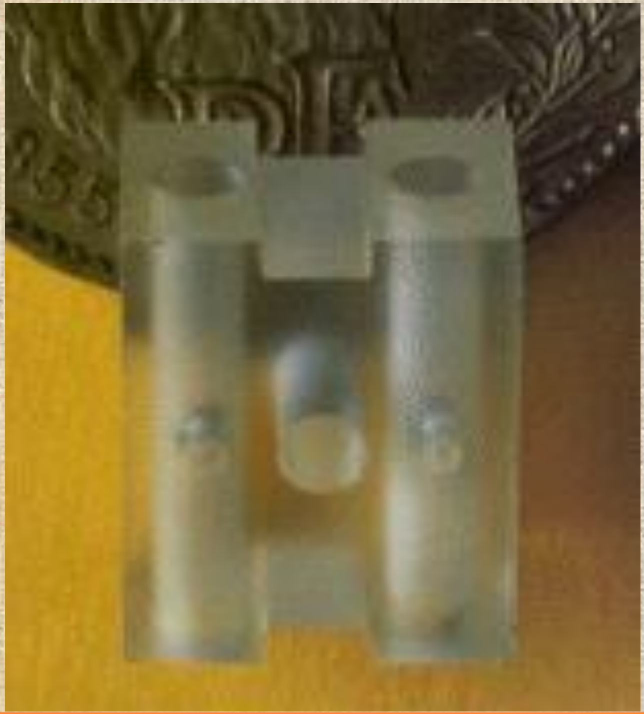
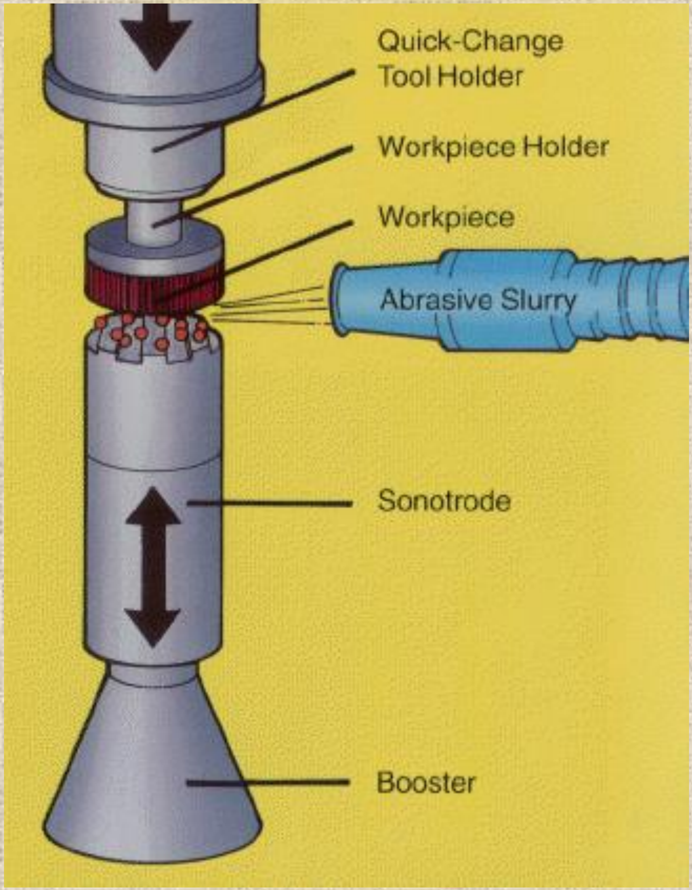
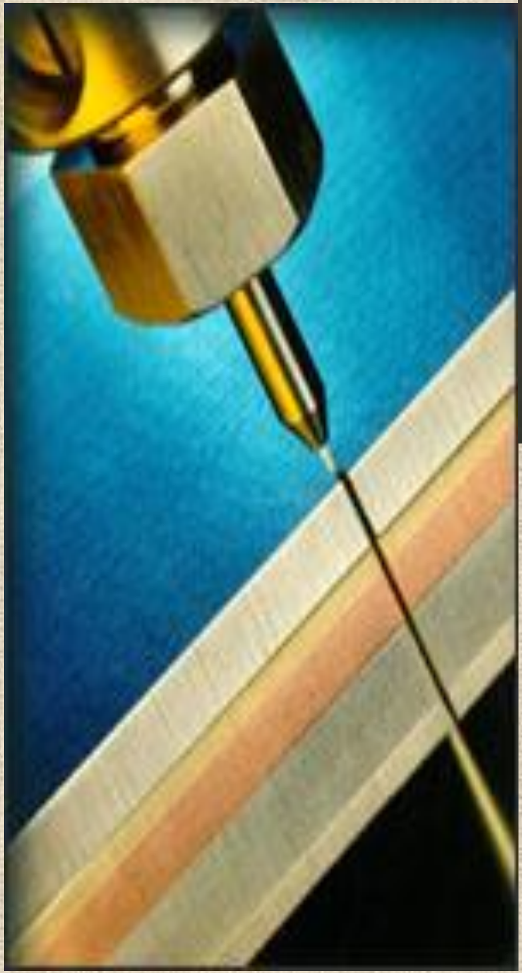
INTRODUCTION

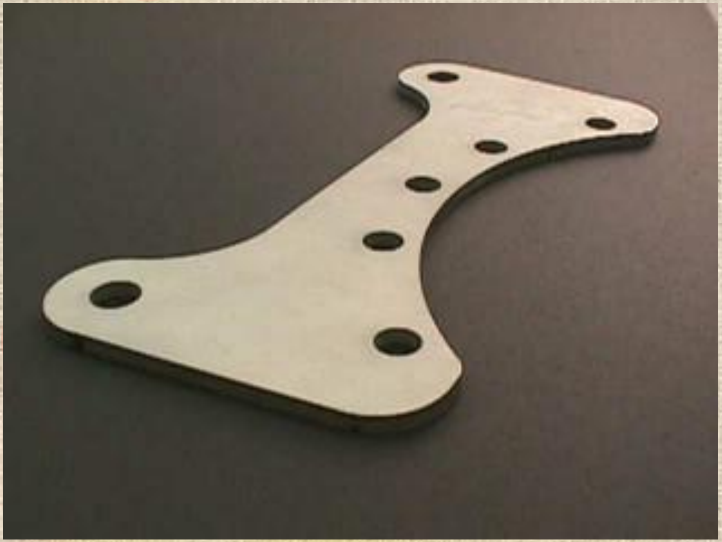
- Ultrasonic vibration (20,000 Hz) of very small amplitudes (0.04-0.08 mm) drive the form tool (sonotrode) of ductile material (usually soft steel)
- An abrasive slurry is flowed through the work area
- The workpiece is brittle in nature (i.e. glass)
- The workpiece is gradually eroded away.





Abrasive Water jet (AWJ) Cutting





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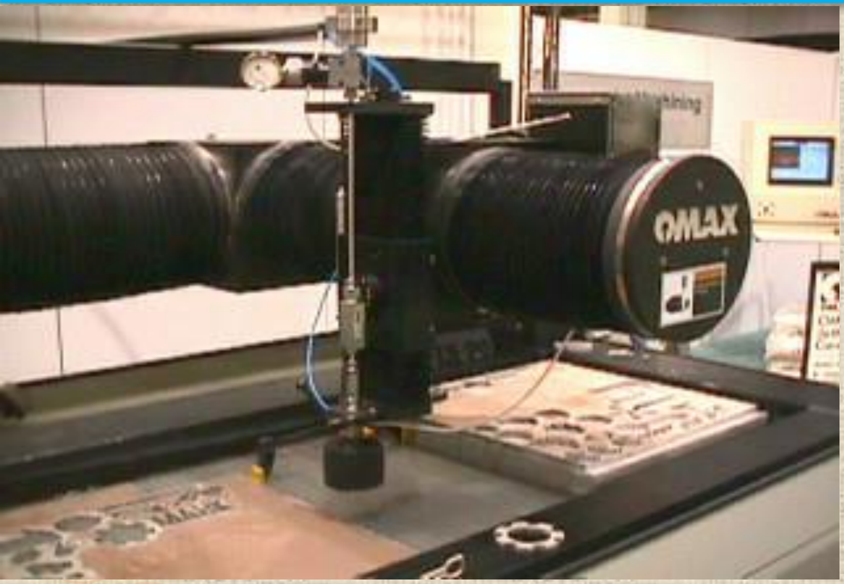
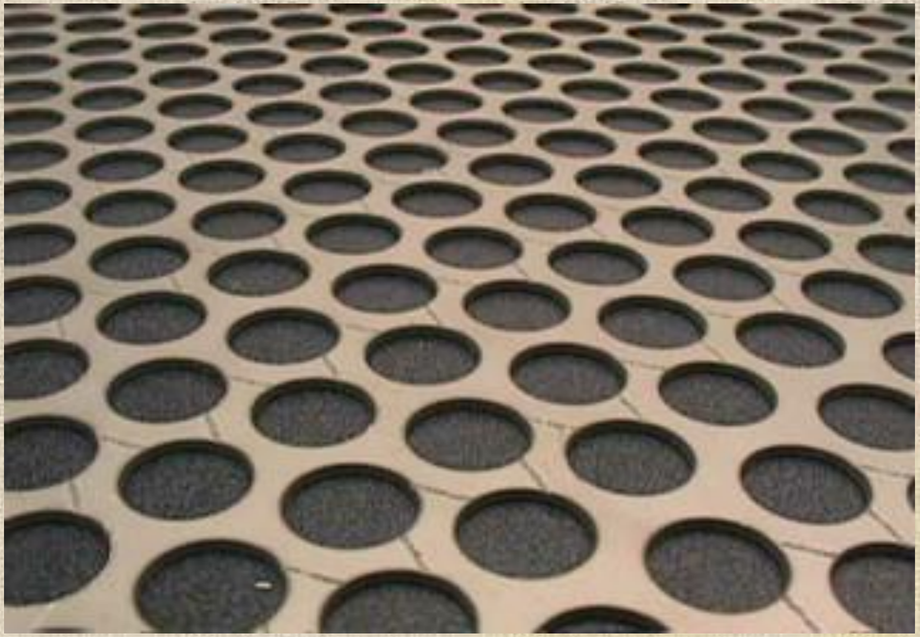
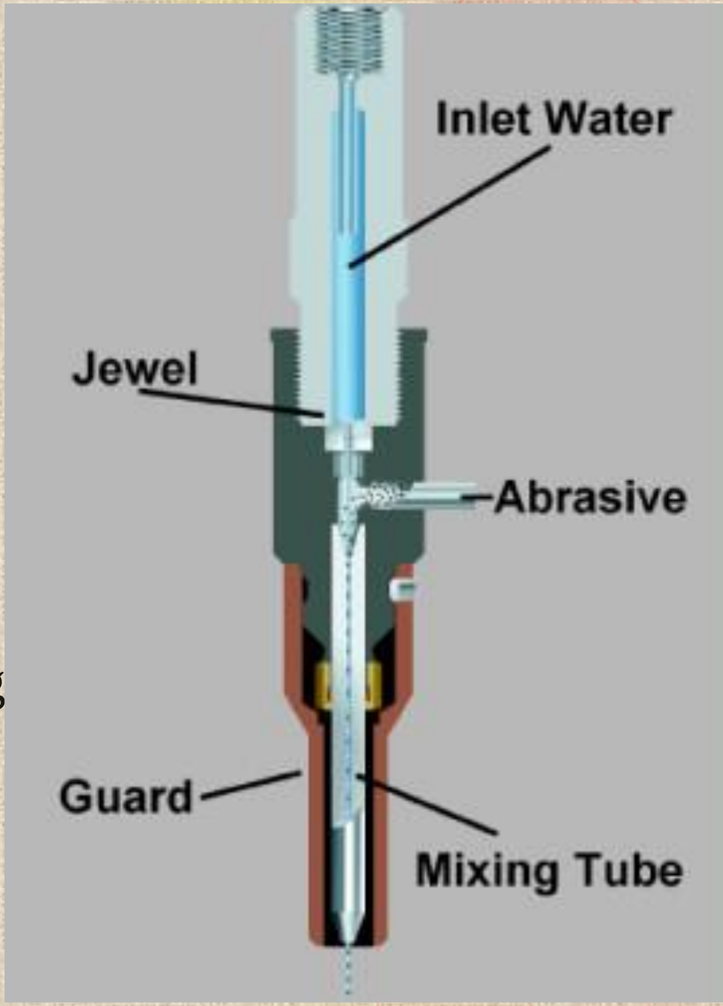




INTRODUCTION

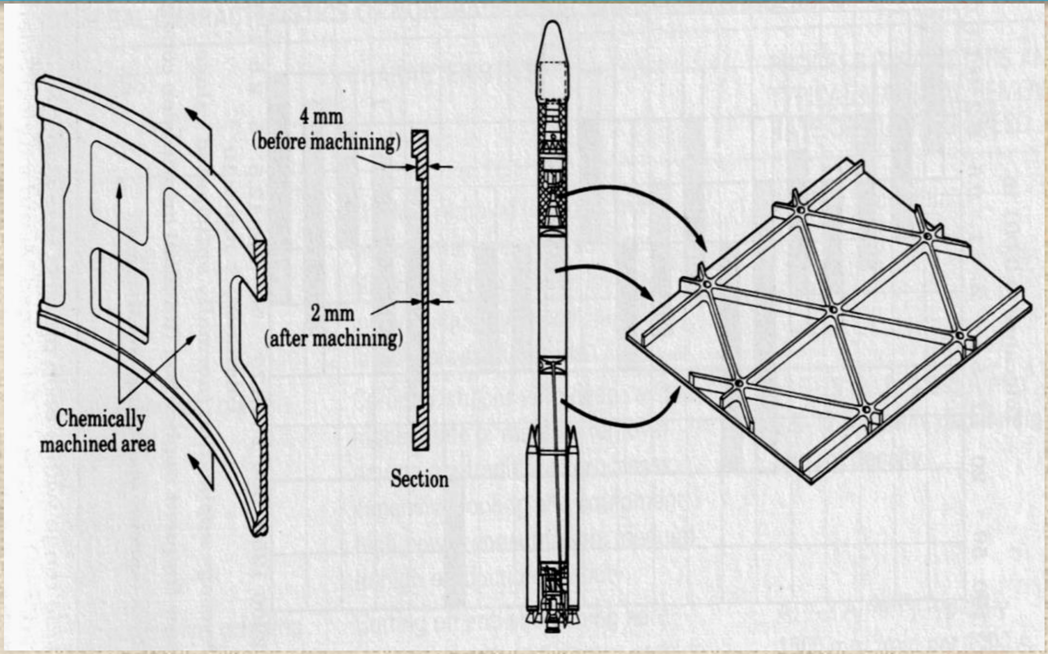
- High pressure water (20,000-60,000 psi)
- Educt abrasive into stream
- Can cut extremely thick parts (5-10 inches possible)
  - Thickness achievable is a function of speed
  - Twice as thick will take more than twice as long

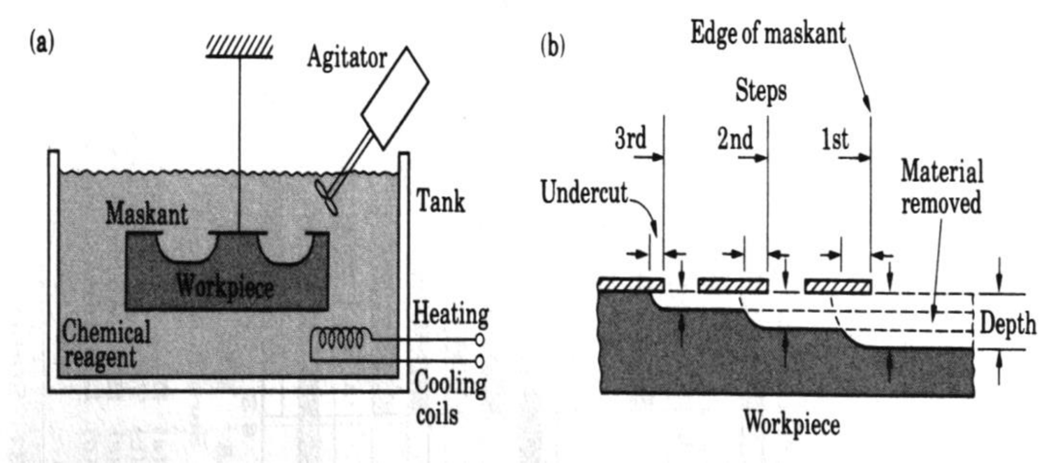


- Tight tolerances achievable
- Current machines 0.002” (older machines much less capable ~ 0.010”
- Jet will lag machine position, so controls must plan for it

Chemical Machining

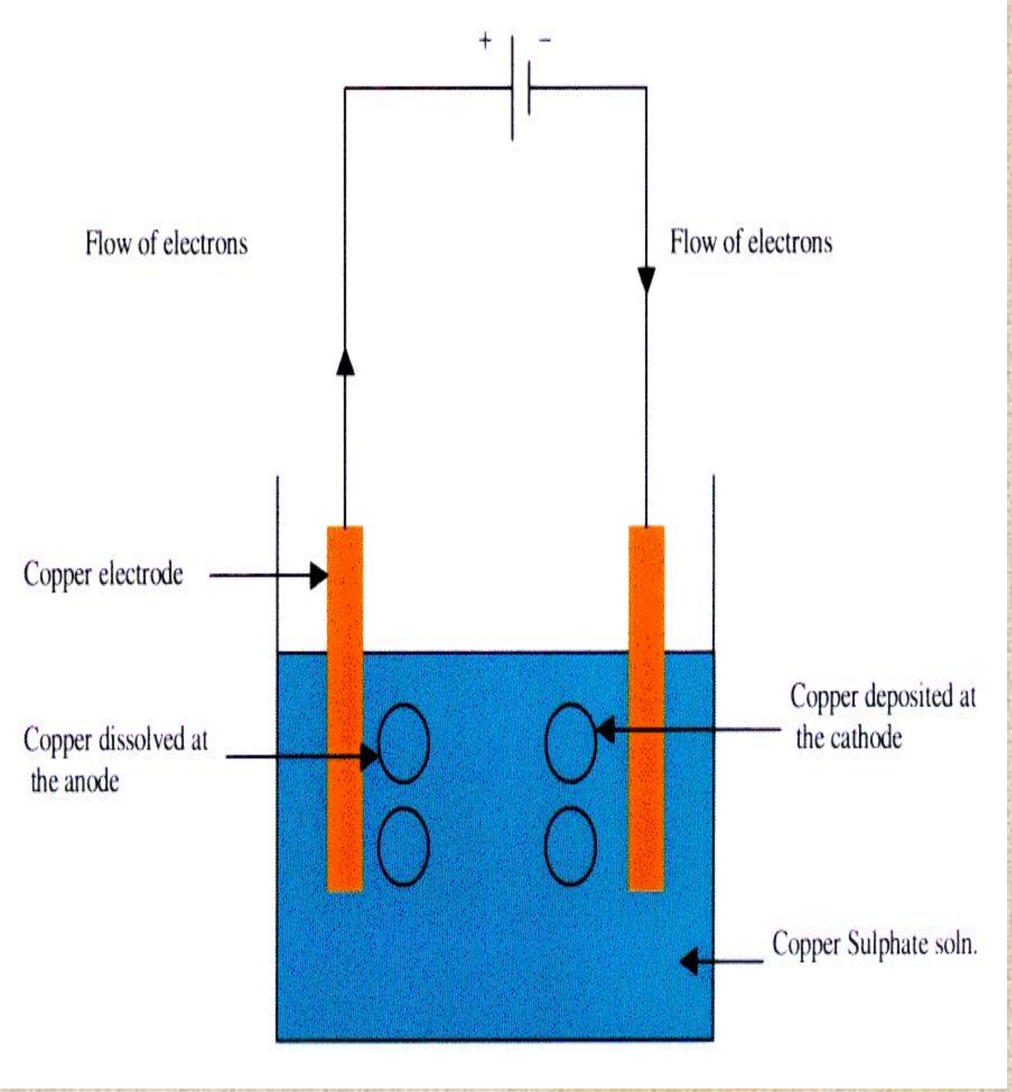
- Applications:
  - Aerospace industry
  - Engraving
  - Circuit boards
- A maskant is applied over areas you don't want to machine
  - Photochemical methods
  - Apply maskant to entire surface and use laser to cut
- Place the entire part in a chemical bath (acid or alkali depending upon the metal)
- Control temperature and time of exposure to control material removal





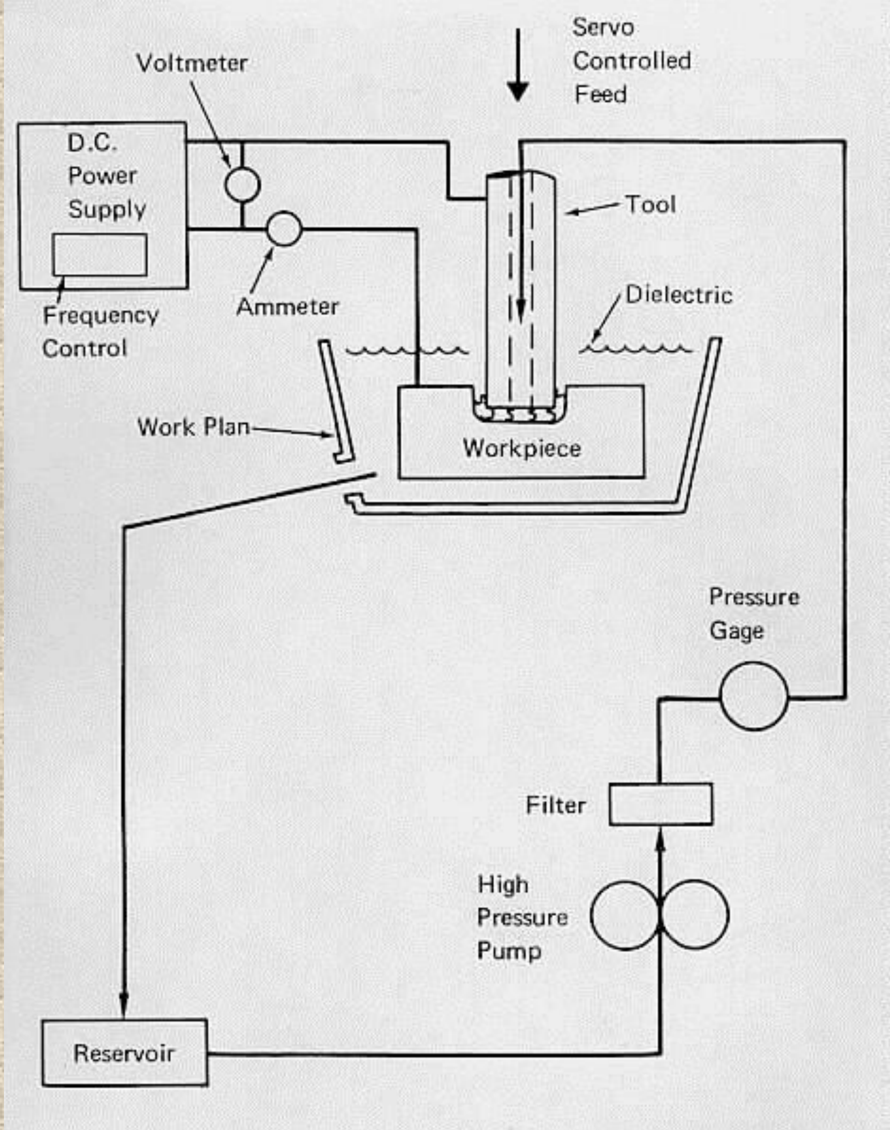
Electro-Chemical Machining (ECM)

- Works on the principle of electrolysis – accelerated chemilling
- Die is progressively lowered into workpiece as workpiece is dissociated into ions by electrolysis
- Electrolytic fluid flows around workpiece to remove ions and maintain electrical current path
- Low DC voltage, very High current (700 amps)



Electrode Discharge Machining (EDM)

- Direct Competitor of ECM – much more common than ECM
- The tool acts as a cathode (typically graphite) is immersed in a Dielectric fluid with conductive workpiece
- DC voltage (~300V) is applied. As voltage builds up over gap between workpiece and tool, eventually you get dielectric breakdown (sparking at around 12,000 deg F)
- The sparking erodes the workpiece in the shape of the tool
- The tool is progressively lowered by CNC as the workpiece erodes
- Cycle is repeated at 200,000-500,000 Hz
- Dielectric:
  - Cools tool and workpiece
  - Flushes out debris from work area



Schematic of EDM Machine.

Laser Beam Machining

- Lasers are high intensity focused light sources
  - CO_2
    - Most widely used
    - Generally more powerful that YAG lasers
    - Cutting operations commonly
  - Nd : YAG (Neodymium ions in an Yttrium Aluminum Garnet)
    - Less powerful
    - Etching/marking type operations more commonly
- Limited in depth of cut (focus of light)
- Would limit work piece to less than 1 inch (< ½” typically)