Spark Erosion

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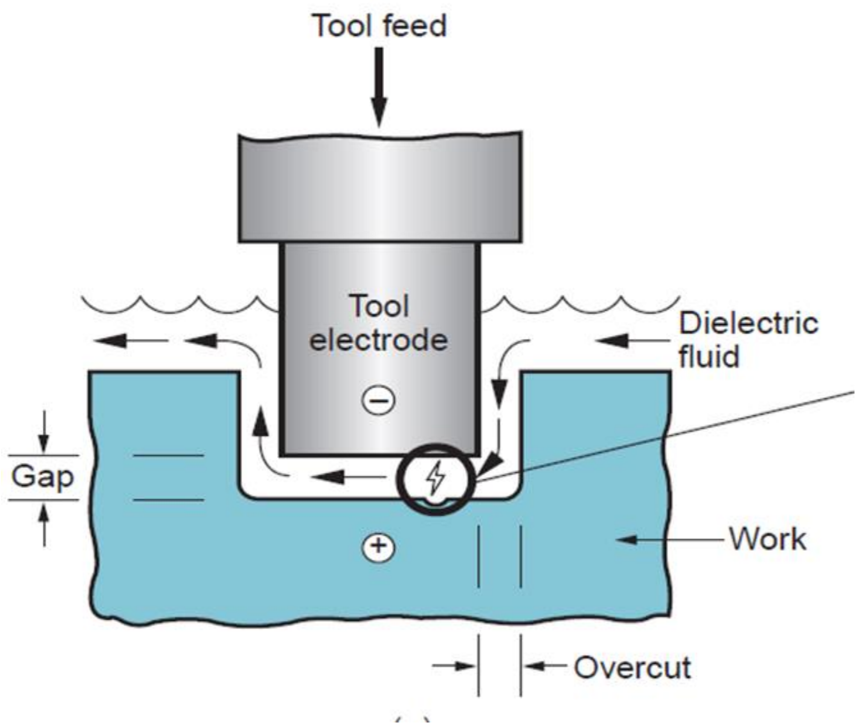
Spark Erosion

Spark erosion is a type of metal removal process based on the principle metals being erosion by an interrupted discharge of electric spark between the working anode and the tool cathode. Fundamentally, the effect is being understood by breaking down of electrode material accompanying any form of electric discharge. Discharge is usually through liquid.

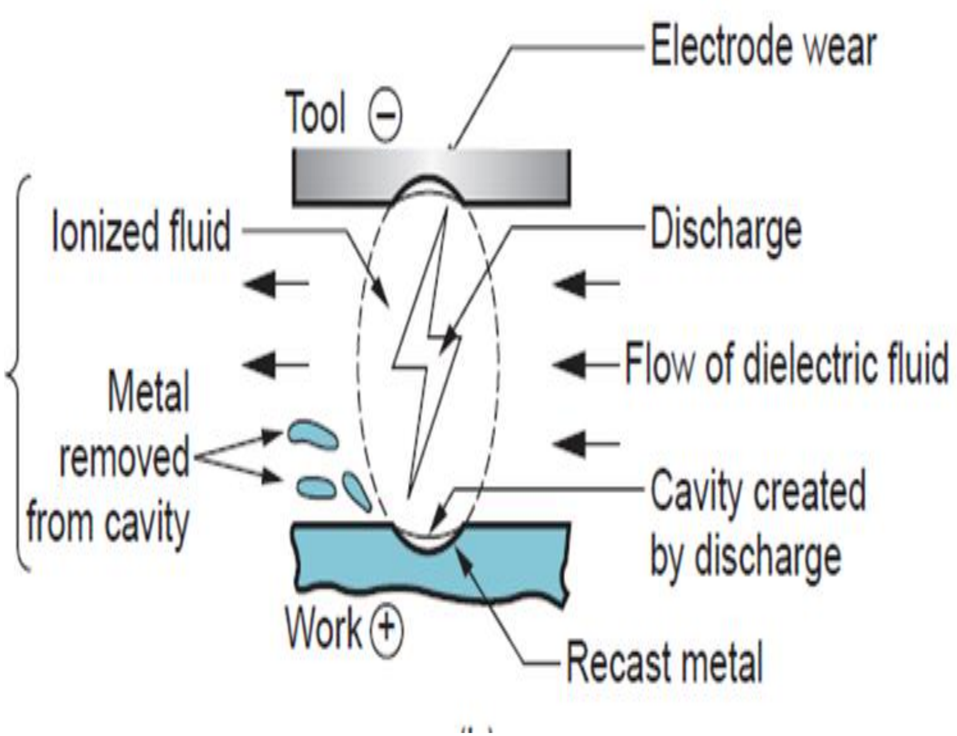
A necessary condition for producing discharge is ionization of the dielectric, i.e., splitting up of it’s molecules into electrons and ions.

The main components are the power supply, the dielectric medium, the workpiece and the tool, and the servo control.



Working principle of Spark Erosion

- The tool and workpiece are electrically connected to dc electric power. The workpiece is connected to the +ve terminal. It becomes the anode. The tool is the cathode.
- A gap, known as a ‘the gap of spark’ which ranges between 0.005 to 0.05mm and in that range maintains between workpiece and tool.
- When a suitable voltage in the range of 50 to 450V is supplied, the dielectric breaks down and electrons are emitted from cathode, and the gap is ionized.
- The small ionized fluid column is formed owing to the formation of an avalanche of electrons in the spark gap where the process ionization would collision take place.



The Electrode (Tool) and dielectric

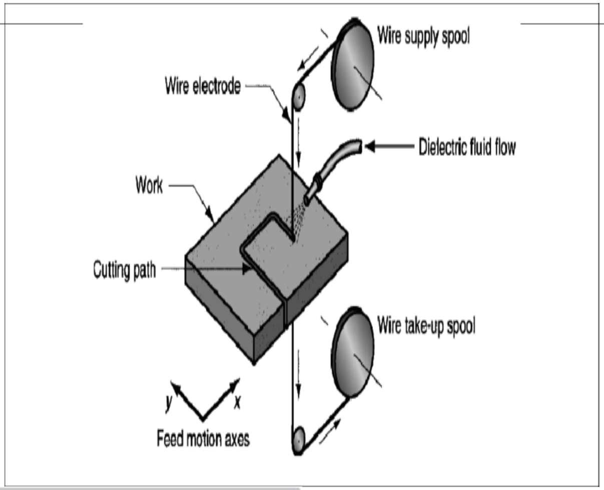
Electrodes are made of graphite, copper, brass, copper tungsten, silver tungsten, and other materials. The selection depends on the type of power supply circuit available on the EDM machine, the type of work material that is to be machined, and whether roughing or finishing is to be done. Graphite is preferred for many applications because of its melting characteristics.

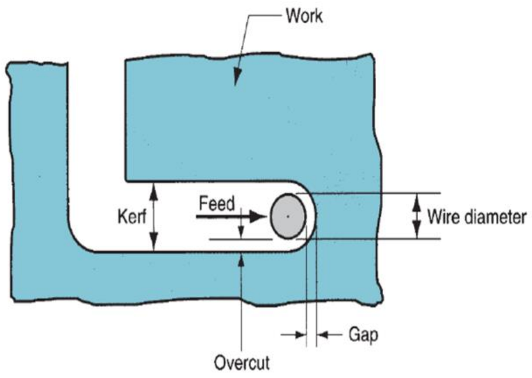
In fact, graphite does not melt. It vaporizes at very high temperatures, and the cavity created by the spark is generally smaller than for most other EDM electrode materials. Consequently, a high ratio of work material removed to tool wear is usually obtained with graphite tools.

Dielectric fluids used in EDM include hydrocarbon oils, kerosene, and distilled or deionized water. The dielectric fluid serves as an insulator in the gap except when ionization occurs in the presence of a spark. Its other functions are to flush debris out of the gap and remove heat from tool and workpart.

Types of Spark Erosion

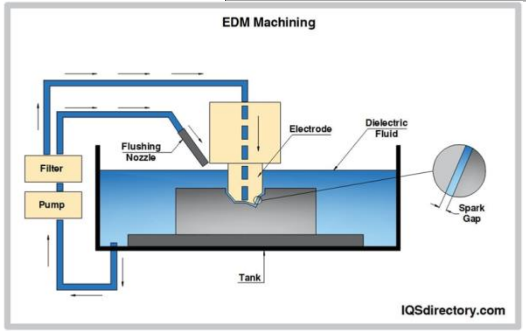
1-Wire EDM (WEDM), a thin, electrically conductive wire is used as the electrode. While the workpiece is immersed in dielectric fluid, the wire is continuously fed through it. When an electrical discharge happens between a wire and a workpiece, the material is eroded, and the desired shape is produced.



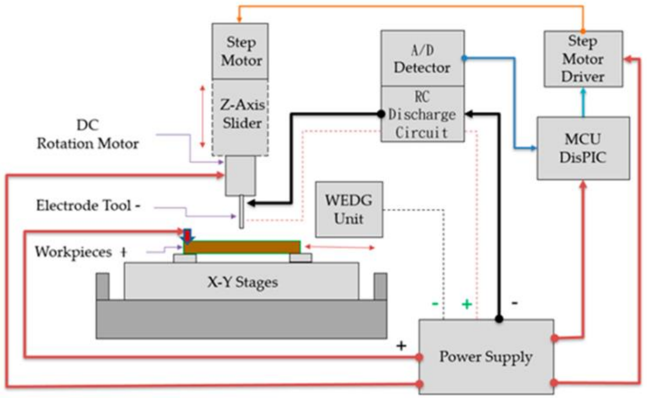


2-Sinker EDM:

the electrode sinks into the raw material



3-EDM Drilling: very precise holes can be made in tough materials

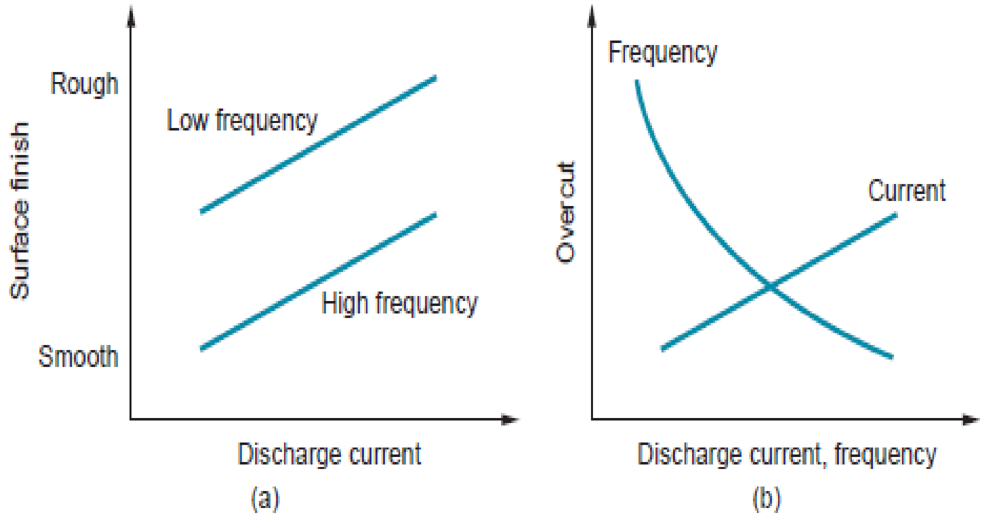


Process Parameters

Two important process parameters in EDM are discharge current and frequency of discharges. As either of these parameters is increased, metal removal rate increases.

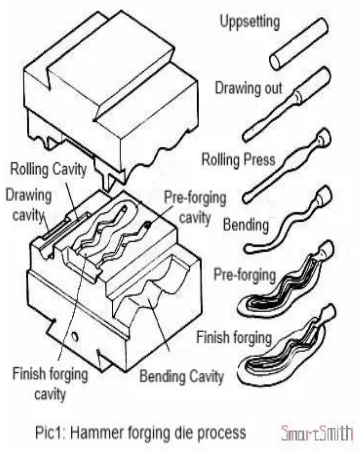
Surface roughness is also affected by current and frequency. The best surface finish is obtained in EDM by operating at high frequencies and low discharge currents.

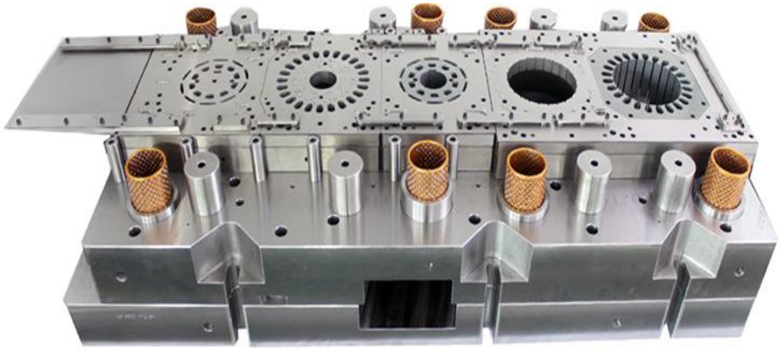
As the electrode tool penetrates into the work, overcutting occurs.. Overcut is a function of current and frequency, and can amount to several hundredths of a millimeter



Applications

1. Applications include both tool fabrication and parts production.
2. The EDM provides an advantage for making stamping tools, wire drawing and extrusion dies and forging and also headers.
3. It’s great for manufacturing exotic materials that being used in aerospace industry, refractory metals, hard carbides and hardenable steels.
4. Workpieces like copper parts which is delicate, for fitting into the vacuum tubes can be produced by this method. The workpiece, in this case, is fragile to withstand the cutting tool load during conventional machining.





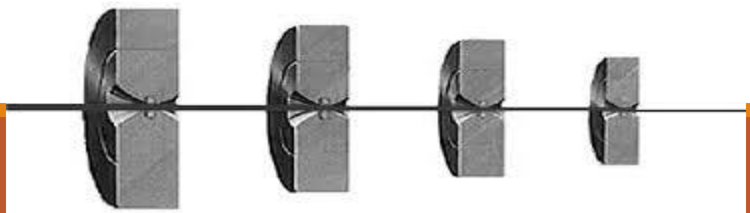


Figure: Difficult internal parts made by EDM process

Advantages:

1. The process can be applied to all electrically conducting metals and alloys irrespective of their melting points, hardness, toughness or brittleness.
2. Any complicated shape that can be made on the tool can be reproduced on the workpiece.
3. Time of machining is less than conventional machining processes.
4. EDM can be employed for the extremely hardened workpiece. Hence, the distortion of the workpiece arising out of the heat treatment process can be eliminated.
5. No mechanical stress is present in the process. It is due to the fact that the physical contact between the tool and the workpiece is eliminated. Thus, fragile and slender workpieces can be machined without distortion.
6. Hard and corrosion-resistant surfaces, essentially needed for die making, can be developed.

Disadvantages:

1. Profile machining of complex contours is not possible at required tolerances.
2. Machining heats the workpiece considerably and hence causes a change in surface and metallurgical properties.
3. Excessive tool wear.
4. High specific power consumption.

Thank you