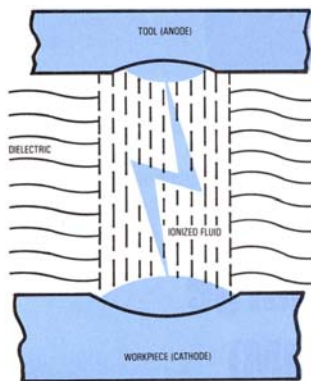


ELECTRICAL DISCHARGE MACHINING (Cutting Metal to Precise Shapes using Electricity)

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Principles of EDM

Electrical Discharge Machining (EDM) is a controlled metal-removal process that is used to remove metal by means of electric spark erosion. In this process an electric spark is used as the cutting tool to cut (erode) the workpiece to produce the finished part to the desired shape. The metal-removal process is performed by applying a pulsating (ON/OFF) electrical charge of high-frequency current through the electrode to the workpiece. This removes (erodes) very tiny pieces of metal from the workpiece at a controlled rate.



EDM Process

EDM spark erosion is the same as having an electrical short that burns a small hole in a piece of metal it contacts. With the EDM process both the workpiece material and the electrode material must be conductors of electricity.

The EDM process can be used in two different ways:

1. A preshaped or formed electrode (tool), usually made from graphite or copper, is shaped to the form of the cavity it is to reproduce. The formed electrode is fed vertically down and the reverse shape of the electrode is eroded (burned) into the solid workpiece.
2. A continuous-travelling vertical-wire electrode, the diameter of a small needle or less, is controlled by the computer to follow a programmed path to erode or cut a narrow slot through the workpiece to produce the required shape.

Conventional EDM

In the EDM process an electric spark is used to cut the workpiece, which takes the shape opposite to that of the cutting tool or electrode. The electrode and the workpiece are both

submerged in a dielectric fluid, which is generally light lubricating oil. A servomechanism maintains a space of about the thickness of a human hair between the electrode and the work, preventing them from contacting each other.

In EDM ram or sinker machining, a relatively soft graphite or metallic electrode can be used to cut hardened steel, or even carbide. The EDM process produces a cavity slightly larger than the electrode because of the overcut.

Wire-Cut EDM

The wire-cut EDM is a discharge machine that uses CNC movement to produce the desired contour or shape. It does not require a special shaped electrode, instead it uses a continuous-traveling vertical wire under tension as the electrode. The electrode in wire-cut EDM is about as thick as a small diameter needle whose path is controlled by the machine computer to produce the shape required.

Dielectric Fluids - Conventional EDM

During the EDM process the workpiece and the electrode are submerged in the dielectric oil, which is an electrical insulator that helps to control the arc discharge. The dielectric oil, that provides a means of flushing, is pumped through the arc gap. This removes suspended particles of workpiece material and electrode from the work cavity.

Flushing

One of the most important factors in a successful EDM operation is the removal of the metal particles (chips) from the working gap. Flushing these particles out of the gap between the workpiece to prevent them from forming bridges that cause short circuits.

Flushing Ram Type EDM

Flushing is the most important function in any electrical discharge machining operation. Flushing is the process of introducing clean filtered dielectric fluid into the spark gap. Flushing applied incorrectly can result in erratic cutting and poor machining conditions.

There are a number of flushing methods used to remove the metal particles efficiently while assisting in the machining process. Too much fluid pressure will remove the chips before they can assist in the cutting action, resulting in slower metal removal. Too little pressure will not remove the chips quickly enough and may result in short-circuiting the erosion process

Wire EDM Dielectric Fluids

The dielectric fluid must be circulated under constant pressure to flush (wash) away the metal particles and assist in the machining or erosion process. If red sparks occur during the

cutting operation, the water supply is inadequate. To overcome this problem, increase the flow of water until blue sparks appear.

The Servo Mechanism

Both wire and vertical EDM machines are equipped with a servo control mechanism that automatically maintains a constant gap of about the thickness of a human hair between the electrode and the workpiece. It is important for both machine types that there is no physical contact between the electrode and the workpiece, otherwise arcing could damage the workpiece and break the wire. The servomechanism advances the electrode into the workpiece as the operation progresses and senses the work-wire spacing and controls it to maintain the proper arc gap which is essential to a successful machining operation.

Advantages of EDM

Conventional EDM machines can be programmed for vertical machining, orbital, vectorial, directional, helical, conical, rotational, spin and indexing machining cycles. This versatility gives Electrical Discharge Machines many advantages over conventional machine tools.

- Any material that is electrically conductive can be cut using the EDM process.
- Hardened workpieces can be machined eliminating the deformation caused by heat treatment.
- **X**, **Y**, and **Z** axes movements allow for the programming of complex profiles using simple electrodes.
- Complex dies sections and molds can be produced accurately, faster, and at lower costs.
- The EDM process is burr-free.
- Thin fragile sections such as webs or fins can be easily machined without deforming the part.