# 12 Dielectric Oil and Flushing for Ram EDM

## Dielectric Oil

Ram EDM uses oil for its dielectric fluid. Dielectric oil performs three important functions for ram EDM, see Figure 12:1.

1. The oil forms a dielectric barrier for the spark between the workpiece and the electrode.

2. The fluid cools the eroded particles between the workpiece and the electrode.

3. The pressurized oil flushes out the eroded gap particles and removes the particles from the oil by causing the oil to pass through a filter system.

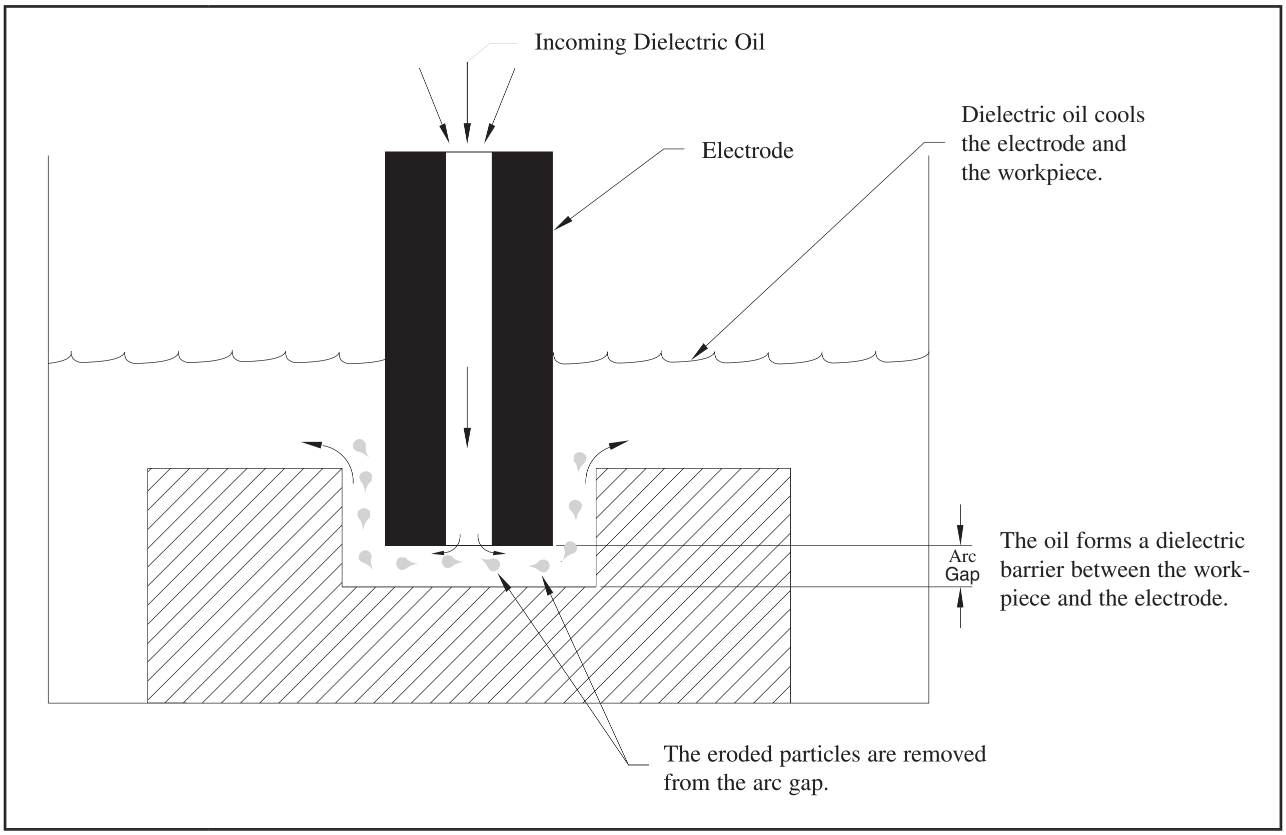


**Figure 12:1**

**Functions of the Dielectric Oil**

Various manufacturers produce many types of dielectric oil. The best way to determine the type of oil needed for a particular machine is to ask the machine manufacturer for its recommendations. It is important to get oil which is specifically produced for ram EDM.

## Coolant System

EDM creates sparks in the gap with sufficient energy to melt the material. The resulting heat is transferred into the oil. Oil loses its efficiency when it reaches 100° F (38° C). Controlling this heat is essential to ensure accuracy and efficient cutting. Therefore, it is best to have a coolant system to maintain a proper temperature.

## Flash Point

Oil will ignite at certain temperatures. The ignition temperature is called "flash point." This is especially important when doing heavy cutting, because the oil may get so hot that it reaches its flash point. Even though some oils have a flash point of 200° F (93° C) and higher, it is unsafe to use oil over 165° F (74° C). Precautions need to be taken to prevent the oil from reaching its flash point. Some machines are equipped with a fire suppression system that is controlled by an infrared scanner.

## Flushing

### A. Proper Flushing

The most important factor in EDM is to have proper flushing. There is an old saying among EDMers: "There are three rules for successful EDMing: flushing, flushing, and flushing."

Flushing is important because eroded particles must be removed from the gap for efficient cutting. Flushing also brings fresh dielectric oil into the gap and cools the electrode and the workpiece. The deeper the cavity, the greater the difficulty for proper flushing.

Improper flushing causes erratic cutting. This in turn increases machining time. Under certain machining conditions, the eroded particles attach themselves to the workpiece. This prevents the electrode from cutting efficiently. It is then necessary to remove the attached particles by cleaning the workpiece.

The danger of arcing in the gap also exists when the eroded particles have not been sufficiently removed. Arcing occurs when a portion of the cavity contains too many eroded particles and the electric current passes through the accumulated particles. This arcing causes an unwanted cavity or cavities which can destroy the workpiece. Arcing is most likely to occur during the finishing operation because of the small gap that is required for finishing. New power supplies have been developed to reduce this danger.

### B. Volume, Not Pressure

Proper flushing depends on the volume of oil being flushed into the gap, rather than the flushing pressure. High flushing pressure can also cause excessive electrode wear by making the eroded particles bounce around in the cavity. Generally, the ideal flushing pressure is between 3 to 5 psi. (.2 to .33 bars).

Efficient flushing requires a balance between volume and pressure. Roughing operations, where there is a much larger arc gap, require high volume and low pressure for the proper oil flow. Finishing operations, where there is a small arc gap, requires higher pressure to ensure proper oil flow.

Often flushing is not a problem in a roughing cut because there is a sufficient gap for the coolant to flow. Flushing problems usually occur during finishing operations. The smaller gap makes it more difficult to achieve the proper oil flow to remove the eroded particles.

**C. Types of Flushing**

There are four types of flushing: pressure, suction, external, and pulse flushing. Each job needs to be evaluated to choose the best flushing method.

**1. Pressure Flushing**

Pressure flushing, also called injection flushing, is the most common and preferred method for flushing. One great advantage of pressure flushing is that the operator can visually see the amount of oil that is being used for flushing. With pressure gauges, this method of flushing is simple to learn and use.

**a. Pressure Flushing Through the Electrode**

Pressure flushing may be performed in two ways: through the electrode (Figure 12:2) or through the workpiece.

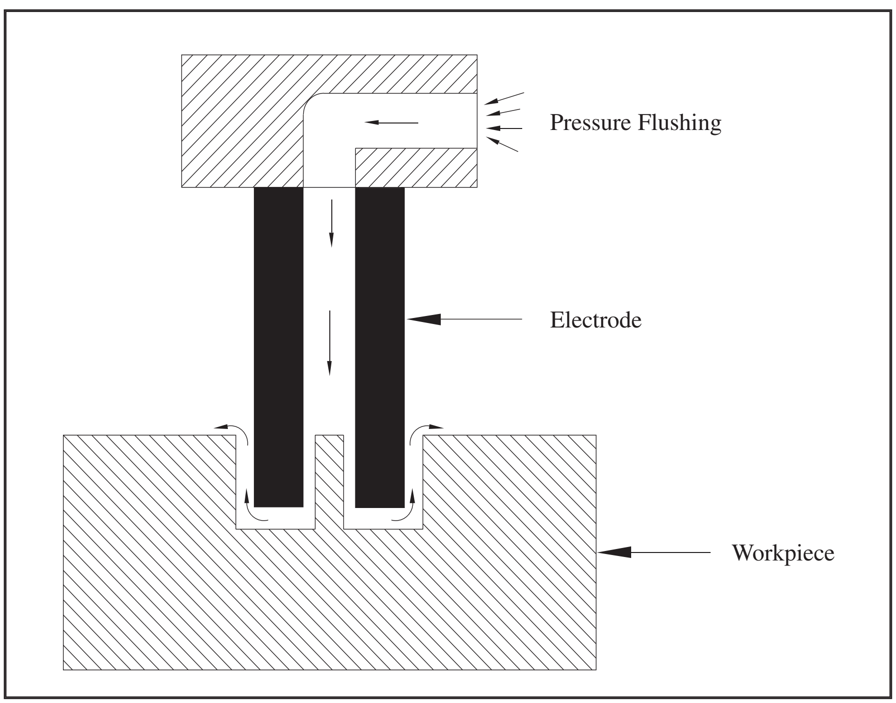


**Figure 12:2**

**Pressure Flushing Through the Electrode**

With pressure flushing, there is the danger of a secondary discharge. Since electricity takes the path of least resistance, secondary discharge machining can occur as the eroded particles pass between the walls of the electrode and the workpiece, as presented in Figure 12:3. This secondary discharge can cause side wall tapering. Suction flushing can prevent side wall tapering.

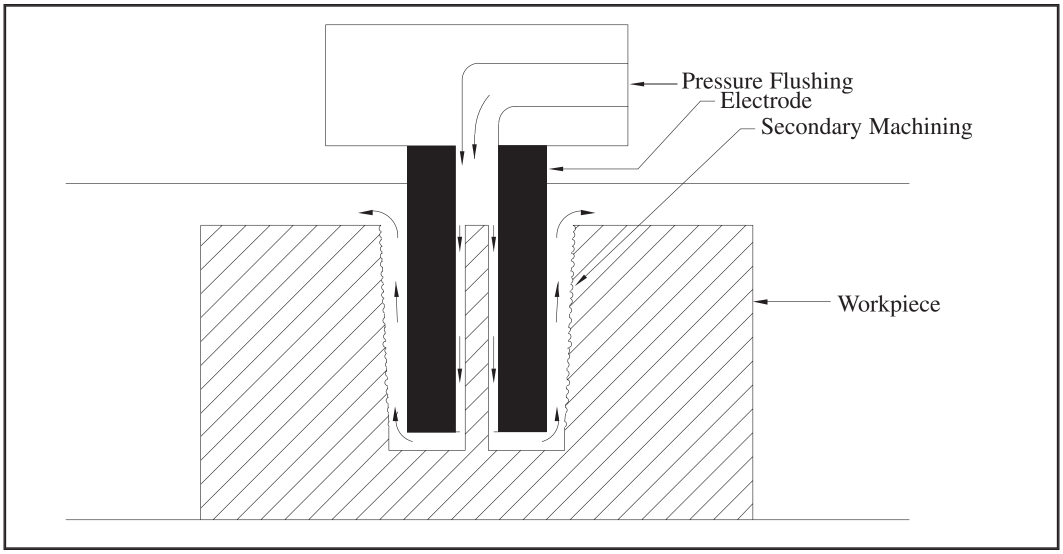


**Figure 12:3**

**Pressure Flushing May Cause Secondary Machining**

**b. Pressure Flushing Through the Workpiece**

Pressure flushing can also be done by forcing the dielectric fluid through a workpiece mounted over a flushing pot. See Figure 12:4. This method eliminates the need for holes in the electrode.

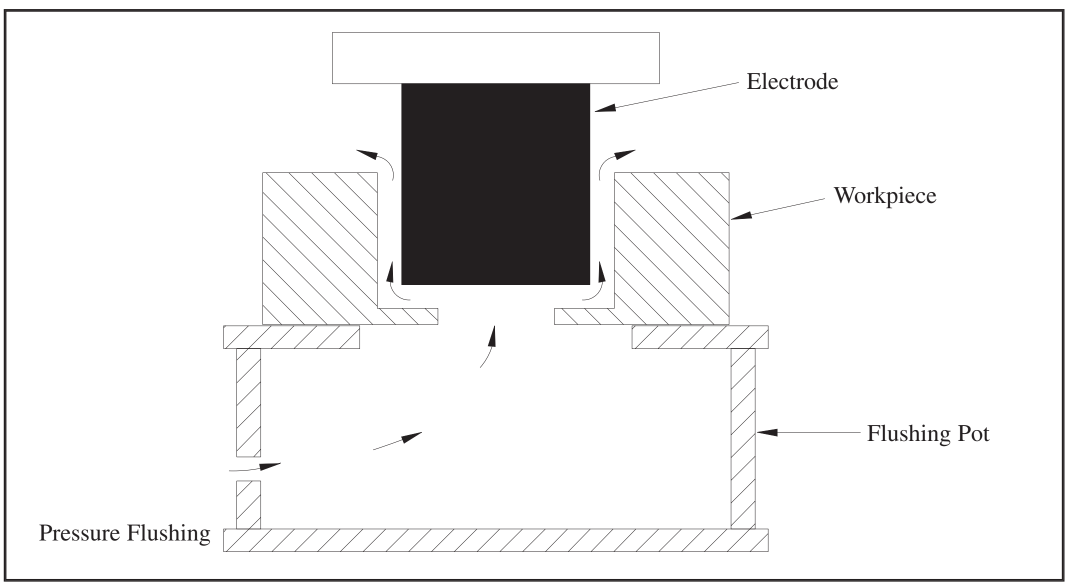


**Figure 12:4**

**Pressure Flushing Through the Workpiece**

**2. Suction Flushing**

Suction or vacuum flushing can be used to remove eroded gap particles. Suction flushing can be done through the electrode as in Figure 12:5, or through the workpiece, as in Figure 12:6.

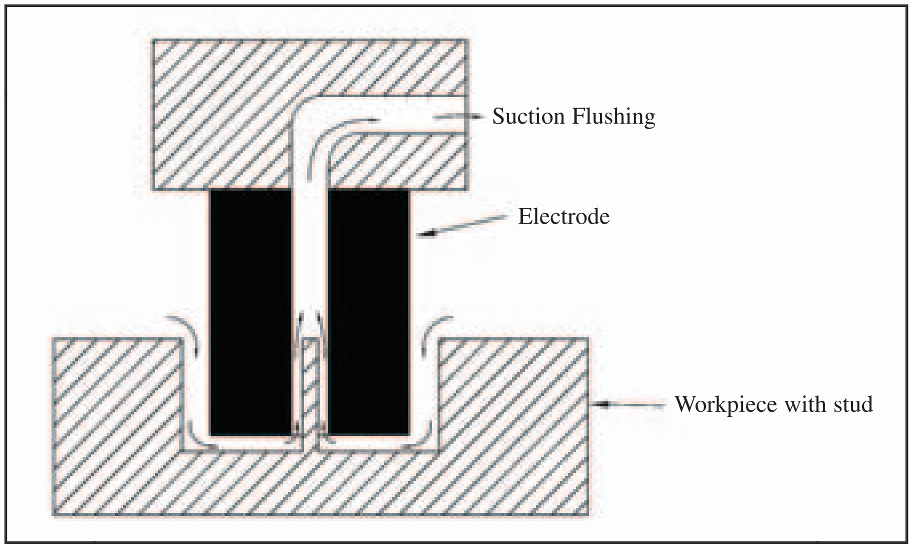


**Figure 12:5**

**Suction Flushing Through the Electrode**

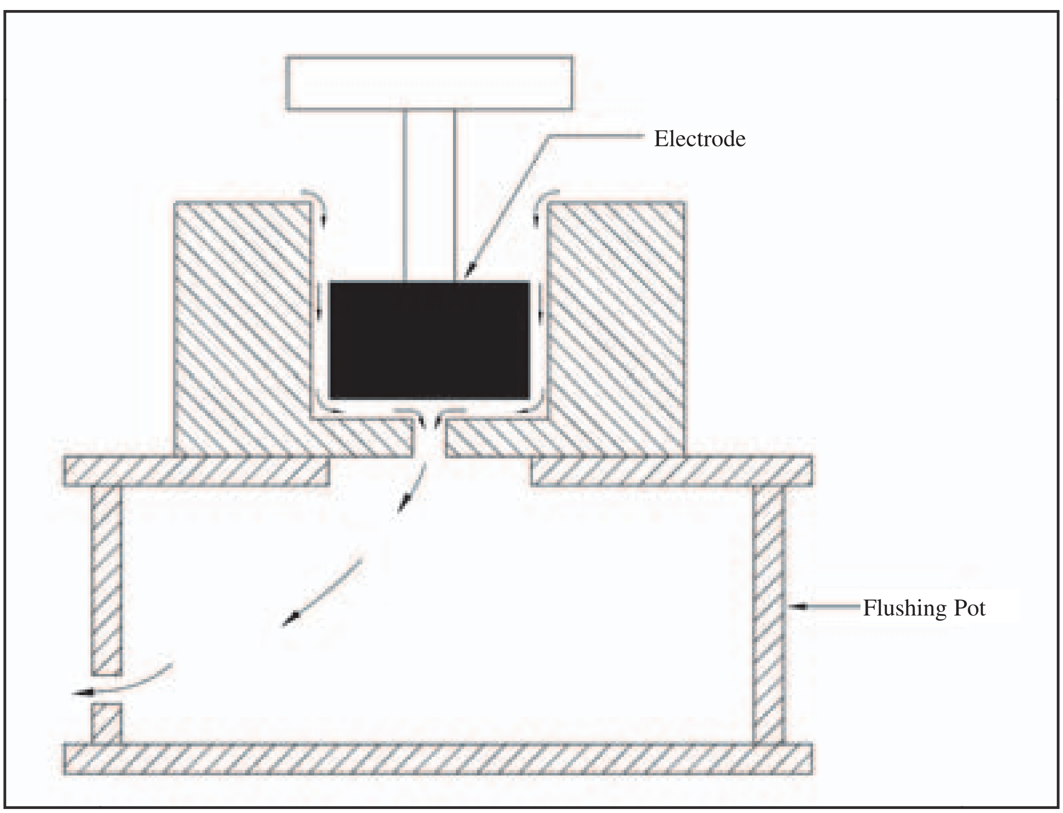


**Figure 12:6**

**Suction Flushing Through the Workpiece**

Suction flushing minimizes secondary discharge and wall tapering. Suction flushing sucks oil from the worktank, not from the clean filtered oil as in pressure flushing. For suction cutting, efficient cutting is best accomplished when the work tank oil is clean.

A disadvantage of suction flushing is that there is no visible oil stream as with pressure flushing. Also, gauge readings are not always reliable regarding the actual flushing pressure in the gap.

A danger of suction flushing is that gases may not be sufficiently removed, this can cause the electrode to explode. In addition, the created vacuum can be so great that the electrode can be pulled from its mount, or the workpiece pulled from the magnetic chuck.

**3. Combined Pressure and Suction Flushing**

Pressure and suction flushing can be combined. They are often used for molds with complex shapes. This combination method allows gases and eroded particles in convex shapes to leave the area and permit circulation for proper machining.

**4. Jet Flushing**

Jet or side flushing is done by tubes or flushing nozzles which direct the dielectric fluid into the gap, as shown in Figure 12:7. Pulse flushing is usually used along with jet flushing.

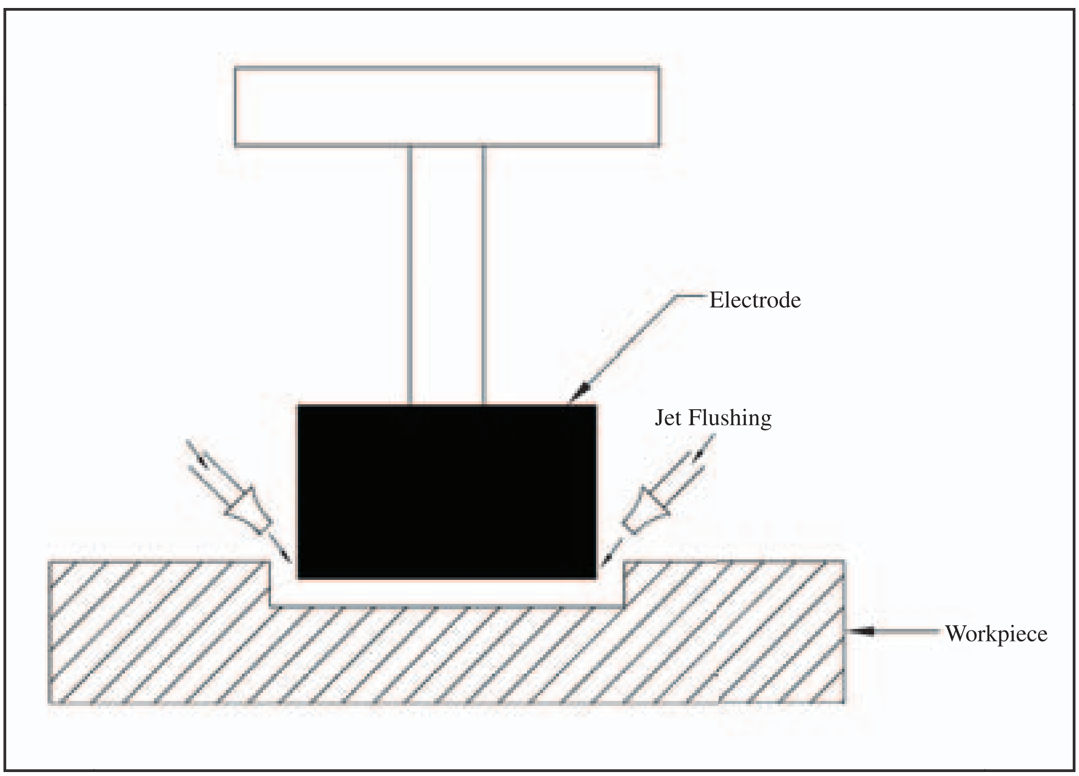


**Figure 12:7**

**Jet Flushing Using Multiple Flushing Nozzles**

**5. Pulse Flushing**

Three types of pulse flushing are:

a. Vertical flushing: the electrode moves up and down.

b. Rotary flushing: the electrode rotates.

c. Orbiting flushing: the electrode orbits.

**a. Vertical Flushing**

In vertical flushing, the electrode moves up and down in the cavity. This up and down motion causes a pumping action which draws in fresh dielectric oil. Many machines are now equipped with jump control which causes the electrode to jump rapidly in and out of the cavity which aids in flushing out the eroded particles. See Figure 12:8.

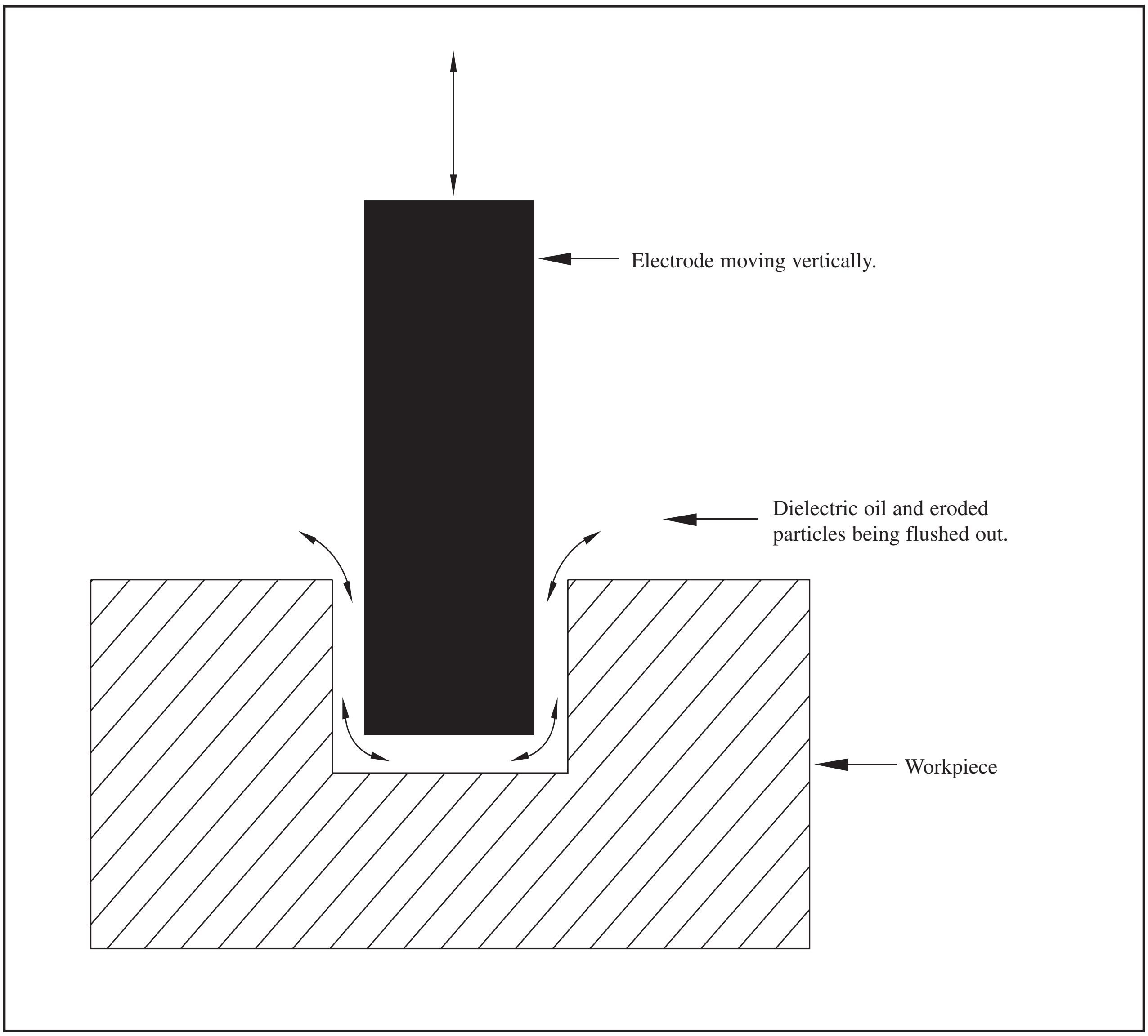


**Figure 12:8**

**Vertical Flushing: The Electrode Moves Up and Down**

Since many of the new machines have rapid pulse or high speed jump machining, thin ribs can be easily EDMed as shown in Figure 12:9.

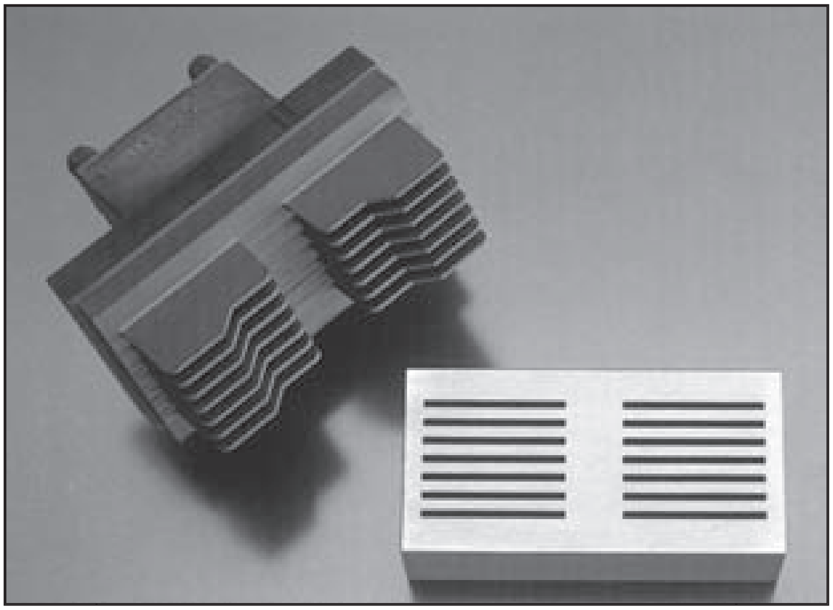

**Figure 12:9** Courtesy Makino

**Pulse Machining With Thin Electrodes**

**b. Rotary Flushing**

In rotary flushing, the electrode rotates in the cavity as in Figure 12:10. Rotating the electrode aids in flushing out the EDM particles from the cavity.

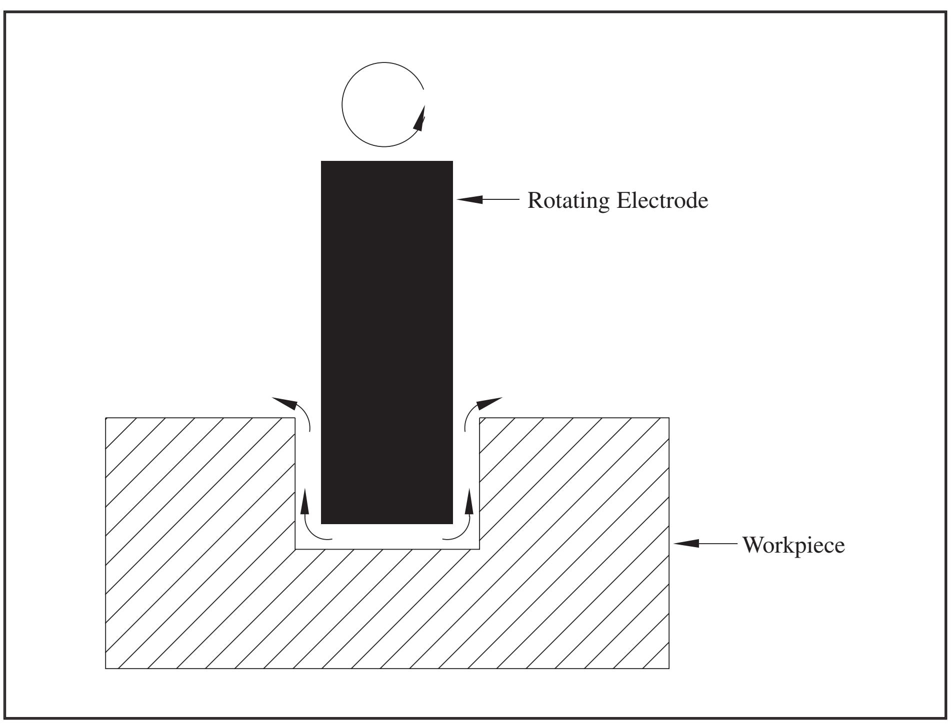


**Figure 12:10**

**Rotary Flushing: The Electrode Rotates**

For small round electrodes, manufacturers make multiple cavities in these electrodes to aid in flushing. This is a very efficient method of producing holes without a stud. See Figure 12:11.

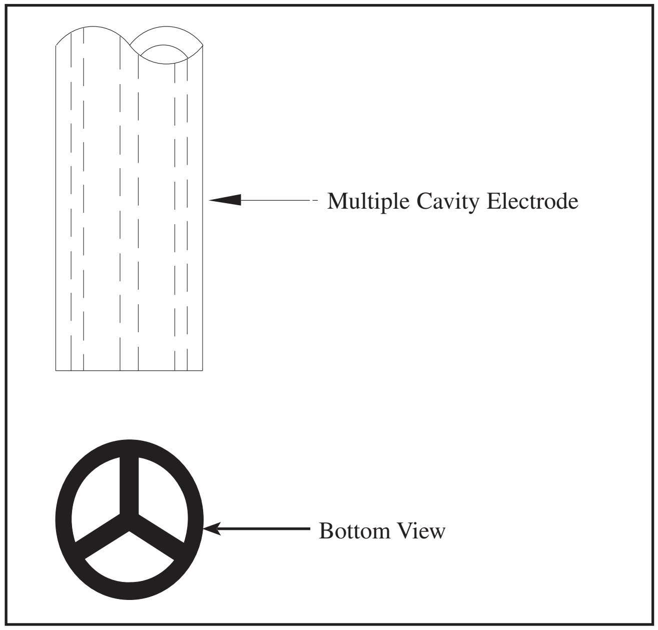


**Figure 12:11**

**Electrode With Multiple Cavities for Rotary EDMing**

c. Orbiting Flushing

Orbiting an electrode in a cavity allows the electrode to mechanically force the eroded particle from the cavity, as pictured in Figure 12:12.

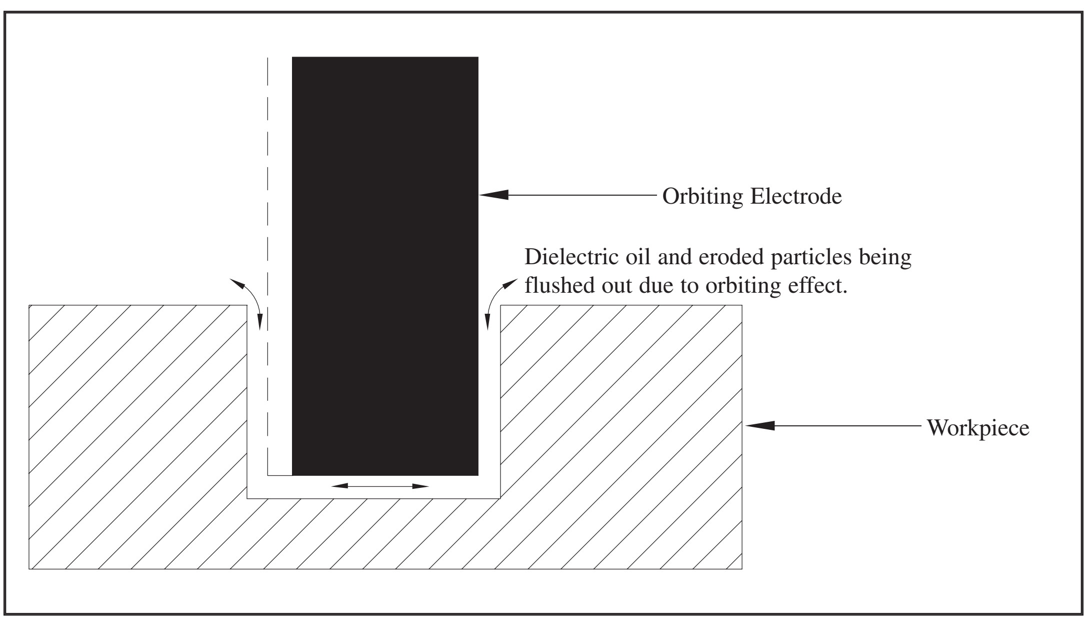


**Figure 12:12**

**Orbiting Flushing: The Electrode Orbits in the Workpiece**

Orbiting flushing is the most efficient method for cutting. Furthermore, if the orbiting is larger than the radius of the flushing holes in the electrode, it will produce no studs.

## Filtration System

In order to insure proper cutting, a filtration system needs to be maintained that adequately removes the eroded particles from the dielectric oil. Improperly filtered oil will send oil with eroded particles into the gap which will hinder effective cutting.

## The Challenge of New Procedures

Reducing costs should always be on the minds of manufacturers. One of the best ways to reduce costs is to understand the process and search for new procedures. The next chapter will examine ways to reduce costs.