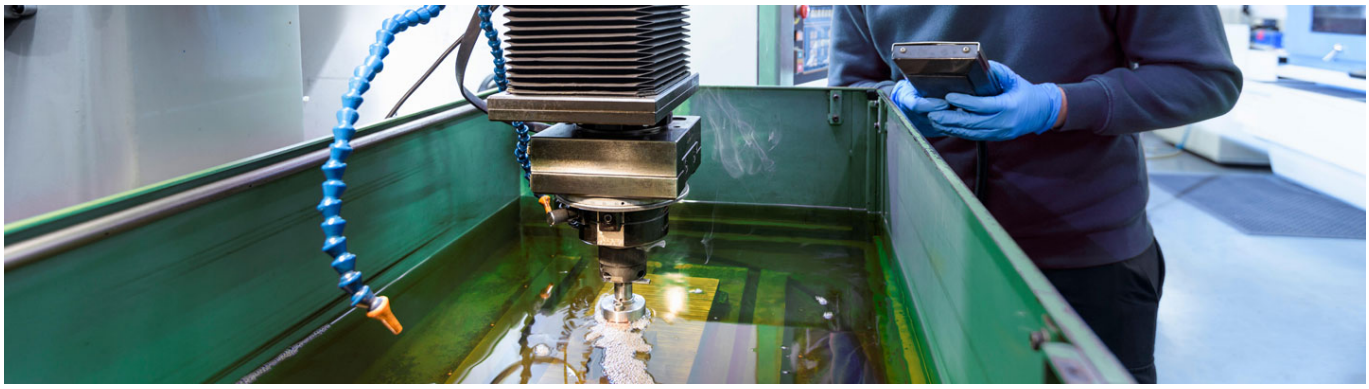

Machining

Beyond the CNC: What Is Electrical Discharge Machining?

Kip Hanson | Apr 23, 2019

Many of today's turbine blades, stents and optical mirror finishing parts are being made using EDM processes. Here's what you need to know about zapping your materials free from their raw form.

It's electric. It's fascinating. And it's making a real impact in manufacturing. Zion Market Research ***pegs*** the electrical discharge machining industry at roughly $4.6 billion in 2017—and expects it to grow to nearly $8 billion by 2024.

A rising number of CNC turning and milling shops are using EDM to create part features that are otherwise impossible to machine. These components are primarily found in the ***aerospace*** and ***medical*** industries. Today's automotive industry is generally not using EDM except in some tooling applications.

EDM does mean adoption of new machining practices. It's not "traditional" CNC machinery. There are graphite and copper electrodes to understand and manage, a need for the proper ***work holding*** and application-specific software.

None of it is particularly difficult to do, but like any new technology, it requires some initial investment as well as an open mind. The good news for job shops is that EDM opens doors that might otherwise remain closed.

What Is Electrical Discharge Machining and How Does It Work?

Electrical discharge machining uses electrical energy to "erode" workpiece material. It generates a series of high-frequency sparks between an electrically conductive workpiece and an electrode made of copper, brass, graphite or tungsten, and alloys from each of them.

As the spark jumps from the electrode to the workpiece, it carries away microscopic bits of material that are then flushed away by a dielectric fluid. The fluid is generally deionized water or a specialized non-conductive oil. Extremely fine finishes are possible, as well as accuracies best measured in microns.

There are three distinct types of EDM: Wire EDM, also called "WEDM," EDM hole drills, and conventional, or "sinker," EDM. They all rely on the same principle of high-energy erosion and are all available with up to five axes of motion—but you can get more axes with a rotary attachment.

All three are able to machine everything from aluminum to carbide, provided the material is

conductive. One key difference, however, is the electrode, which can be thought of as a cutting tool.

What Is Wire EDM?

WEDM uses a spool of copper or brass alloy wire that is continuously fed through the workpiece. Think of it as a highly accurate bandsaw.

Typical wire diameters range from .004 inches to .012 inches, although wires down to .0006 inches are available. WEDM is widely used in the tool and die industry, and for cutting small slots and similarly difficult features in medical components.

What Is EDM Hole Drilling?

EDM hole drilling, or "hole poppers," relies on a tubular electrode with dielectric fluid flowing through its center and back out similar to a coolant-fed drill bit.

As Evan Syverson, additive and HSM business manager at Sodick Inc. points out, EDM ***hole drills*** are the primary method for producing diffuser holes in ***jet engine blade and vane details***.

What Is Sinker EDM?

The electrodes used with sinker EDM (typically graphite or copper) are often machined in a mirror or reverse image of the workpiece shape, although round, square and other shapes are also used. As with EDM hole drilling, the electrode can be made to rotate, orbit or plunge into and out of the workpiece, increasing metal removal rates while generating a variety of unique geometries.

Whatever the technology, experts such as Eric Ostini, EDM product manager for GF Machining Solutions, and his peers are quick to point out the three most important things about EDM: flushing, flushing and flushing. That's because, without efficient flushing, a short circuit occurs, followed by decreased productivity, poor part quality and possibly damage to the electrode.

When Is EDM Needed?

Where can you use EDM in your shop? Brian Pfluger, EDM product line manager for Makino Inc., says that as workpiece materials become harder to machine by conventional means, the EDM process becomes more attractive and productive. Examples include the increase in length-to-diameter ratios and anywhere extremely small cutting tools are needed.

EDM offers some advantages over milling and turning. Because EDM is a noncontact process, it's possible to machine extremely small, thin-walled, honeycombed or tall workpieces without worry of deflection.

There are no burrs with EDM. Sharp internal corners with radii down to 0.001 inches are possible. Expensive materials such as gold or platinum can be machined with virtually no material loss to chips. And holding a couple of "tenths" is a relative cakewalk with EDM, even in nasty, high-nickel alloys, such as Rene 41 and L-605 where there is little need to worry over rapid tool wear.

EDM Getting Smarter

As with most CNC machine tools, EDM equipment is becoming more intelligent, making unattended or lightly attended machining that much easier to achieve. All are designed to make equipment easier to operate, more accurate and better able to run with no one around.

For instance, at ***IMTS 2018***, attendees saw new 5-axis hole drills with capabilities for automated electrode feeding and intelligent detection from Sodick.

Other EDM makers such as GF Machining Solutions made a big push in the ***Industry 4.0*** direction, including software that provides remote monitoring as well as virtual service and support. Some of its new WEDM machines were equipped with automated slug management and power generation for "smarter" erosion.

Makino introduced several new features including the ATHENA voice-command function, a wire tensioning system for enhanced wire stability and a new WEDM with one-micron precision.

Aerospace manufacturers use EDM to produce the shaped holes in turbine blades. Medical companies use it to slice up stents, cut clips and machine the teeth on tiny alligator clips. Gear makers use it to produce one-off sprockets. Optical component manufacturers make mirror finishes with it.

The list goes on.

What Kind of Tooling Do You Use with EDM?

Despite its extensive capabilities, EDM is no more difficult to operate than any other CNC machine. EDM machines have the same X, Y and Z axes. Many EDM systems have conversational controls similar to ***lathes*** and ***machining centers***, while others support the use of ***G-code***, canned cycles and offline programming software.

The ***vises*** and clamps used to grip workpieces are also similar to what's used everywhere else in the shop, but they are usually made of 400-series stainless steel rather than tool steel and cast iron.

EDM machining processes are significantly different, though, with emphasis placed on flushing, orbiting strategies, slug retention and the number of skim passes. But it's nothing that any skilled machinist can't wrap his or her brain around quickly.

Have you worked with EDM? Is it difficult? Tell the truth in the metalworking forum. [registration required]