Description

Image

Image caption

(1) Robofil 300 WireCut © Graibeard at Wikimedia Commons (CC BY 2.0) (2) Wire EDM © SMC Contract Manufacturing (3) Wire EDM © SMC Contract Manufacturing

The process

ELECTRICAL DISCHARGE WIRE CUTTING (EDWC) uses a continuously spooled conductive wire (usually brass) as an electrode. A power supply generates rapid electric pulses that create a discharge between the workpiece and wire electrode. The discharge causes the melting, and probably the vaporization, of a minute piece of material, slowly eating into the work piece. Any electrical conductive material can be machined irrespective of hardness. The wire is positioned relative to the workpiece by numerical control. On some machines the wire can be tilted to create tapered parts. An advantage of this process is that no mechanical stresses are created in the workpiece because the wire does not make contact with it.

Process schematic

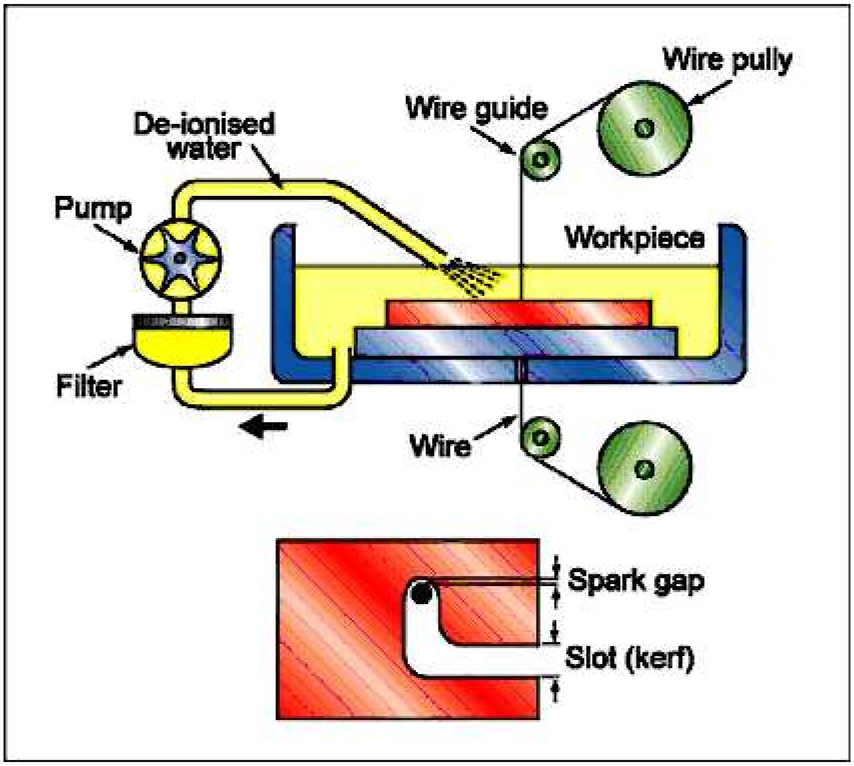

Figure caption

Electro-discharge wire cutting.

Tradenames

Spark erosion; Wire EDM or WEDM.

Material compatibility

Metals - ferrous	✓
Metals - non-ferrous	✓

Shape

Circular prismatic	✓
Non-circular prismatic	✓
Flat sheet	✓
Dished sheet	✓

Economic compatibility

Relative tooling cost	low			
Relative equipment cost	high			
Labor intensity	high			
Economic batch size (units)	1	-	1e3	

Physical and quality attributes

Mass range	0.022	-	66.1	lb
Range of section thickness	9.84	-	1.97e3	mil
Tolerance	0.197	-	7.87	mil
Roughness	0.00394	-	0.157	mil
Surface roughness (A=v. smooth)	A			
Cutting speed	0.00315	-	0.0252	in/s
Minimum cut width	1.97	-	11.8	mil

Process characteristics

Primary shaping processes	✗
Machining processes	✓
Cutting processes	✓
Discrete	✓
Prototyping	✓

Supporting information

Design guidelines

Electrical discharge wire cutting is very precise, but it is slow. It is particularly attractive when limited numbers of parts are to be made from very hard, conducting materials: molds, dies etc. But it has other uses such as the machining of metal foams (fast by EDM and difficult to cut without surface damage by other methods) and low volume production of thin-walled parts in light metals and steels. A high quality surface finish and high precision are achieved by successive lower power "skims", gradually removing less material on each cut; four skims gives a mirror finish. The heat generated by the sparks creates a narrow heat-affected zone. The process is limited to 2D shapes

Technical notes

EDM works by electric breakdown: the enormous potential gradient between tool and work-piece pulls electrons free from molecules of the dielectric, and accelerates them into projectiles, kicking more electrons from molecules as they pass, thereby creating a cascade. The resulting plasma, with temperatures of around 10,000C blasts a tiny nugget of metal from the surface. When the pulse ends, the blast stops. EDM is particularly used to cut Stellite, Inconel, Hastelloy, Nitralloy, Waspaloy, Nimonic, Udimet, tool steels, tungsten carbide and titanium alloys. The angle of the wire or bed can be adjusted to create angled faces or tapered parts.

Typical uses

Cutting and shaping of metals and conducting ceramics that are difficult to shape in any other way: dies for molding, stamping, extrusion and forging; making tool fixtures; aircraft and medical parts, cutting of metal foams and honeycombs.

The economics

There are no tooling costs as the wire creates the required profile. However, the slow rate of cutting (measured in a few mm/min) limits its use to small batch sizes. The process can be fully automated with low labor costs, giving an overall cost of about $50/hour. Typical machining times are 1 to 6 hours. A high degree of numerical control and automation are possible, making the EDWC economic for low production runs

The environment

The process poses no great environmental problems.

Links

MaterialUniverse

Reference