Electrical Discharge Machining Process

An ultrasonically vibrating machine consists of two major components, an electroacoustic transducer and a sonotrode, attached to an electronic control unit with a cable. The abrasive grains in the slurry now act as a free cutting tool as they strike the workpiece thousands of times per second. An electronic oscillator in the control unit produces an alternating current oscillating at a high frequency... 4f0a2a2de2

Machining Machining is a form of subtractive manufacturing, which utilizes machine tools, in contrast to additive manufacturing (e. such as electrical discharge machining, electrochemical machining, electron beam machining, photochemical machining, and ultrasonic machining, the retronym Machining is a manufacturing process where a desired shape or part is created using the controlled removal of material, most often metal, from a larger piece of raw material by cutting. g. 3D printing), which uses controlled addition of material 4f0a2a2de2

cutting process whereby a desired shape is obtained by using electrical discharges (sparks). Material is removed from the work piece by a series of rapidly recurring current discharges between two electrodes, separated by a dielectric liquid and subject to an electric voltage. One of the electrodes is called the tool electrode (or simply the tool or electrode), while the other is called the workpiece electrode, or workpiece. The electrode can be in any of several forms: when it is a wire, it is well suited to cutting a thin kerf, and the process is called wire EDM (also sometimes wire burning or wire erosion); when it is a block with a shape cut into it, it is well suited to diesinking and is called diesinking EDM. The process depends upon the tool and workpiece not making physical contact. Extremely hard materials like carbides, ceramics, titanium alloys and heat treated tool steels that are very difficult to machine using conventional machining can be precisely machined by EDM. 4f0a2a2de2 This process can offer economical alternatives to stamping, punching, laser or water jet cutting, or wire electrical discharge machining (EDM) for thin gauge precision parts. The tooling is inexpensive and quickly produced. This makes the process useful for prototyping and allows for easy changes in mass production. It maintains dimensional tolerances and does not create burrs or sharp edges. It can make a part in hours after receiving the drawing. 4f0a2a2de2

Electrostatic discharge A spark is triggered Electrostatic discharge (ESD) is a sudden and momentary flow of electric current between two differently-charged objects when brought close together or when the dielectric between them breaks down, often creating a visible spark associated with the static electricity between the objects. the devices. [citation needed] Cable discharge events (CDEs) are

discharges occurring when connecting electrical cables to a device 4f0a2a2de2

Electrochemical machining Electrochemical machining (ECM) is a method of removing metal by an electrochemical process. ECM can cut small or odd-shaped angles, intricate contours or cavities in hard and exotic metals, such as titanium aluminides, Inconel, Waspaloy, and high nickel, cobalt, and rhenium alloys. Both external and internal geometries can be machined. Its use is limited to electrically conductive materials. It is normally used for mass production and for working extremely hard materials, or materials that are difficult to machine using conventional methods. It is normally used for mass production and for working extremely Electrochemical machining (ECM) is a method of removing metal by an electrochemical process 4f0a2a2de2

When the voltage between the two electrodes is increased, the intensity of the electric field in the... 4f0a2a2de2

Partial discharge In electrical engineering, partial discharge (PD) is a localized dielectric breakdown (DB) (which does not completely bridge the space between the two In electrical engineering, partial discharge (PD) is a localized dielectric breakdown (DB) (which does not completely bridge the space between the two conductors) of a small portion of a solid or fluid electrical insulation (EI) system under high voltage (HV) stress 4f0a2a2de2

Rule-based DFM analysis for electric discharge machining Electrical discharge Design for manufacturability in electric discharge machining is a method of designing metal parts for efficient machining using electrical discharge machining processes. discharge machining is a method of designing metal parts for efficient machining using electrical discharge machining processes 4f0a2a2de2

Electrical discharge machining (or EDM) is one of the most accurate manufacturing processes available for creating complex or simple shapes and geometries within parts and assemblies. A machining method typically used for hard metals, EDM makes it possible to work with metals for which traditional machining techniques are ineffective. 4f0a2a2de2 == Discharge mechanism == 4f0a2a2de2

Electrical treeing It is a damaging process due to partial discharges and progresses through the stressed dielectric insulation, in a path resembling the branches of a tree. In electrical engineering, treeing is an electrical pre-breakdown phenomenon in solid insulation. Treeing of solid high-voltage cable insulation is a common breakdown mechanism and source of electrical faults in underground power cables. It is a damaging process due to partial discharges and In electrical engineering, treeing is an electrical pre-breakdown phenomenon in solid insulation 4f0a2a2de2

Ultrasonic vibration machining is typically used on brittle materials as well as materials with a high hardness due to the microcracking

mechanics. 4f0a2a2de2 ECM is often characterized as "reverse electroplating... 4f0a2a2de2

Photochemical machining This process emerged in the 1960s as an offshoot of the printed circuit board industry. economically. This process can offer economical alternatives to stamping, punching, laser or water jet cutting, or wire electrical discharge machining (EDM) for Photochemical machining (PCM), also known as photochemical milling or photo etching, is a chemical milling process used to fabricate sheet metal components using a photoresist and etchants to corrosively machine away selected areas. Photo etching can produce highly complex parts with very fine detail accurately and economically 4f0a2a2de2

Photochemical machining is a form... 4f0a2a2de2 == History and terminology == 4f0a2a2de2 While a corona discharge (CD) is usually revealed by a relatively steady glow or brush discharge (BD) in air, partial discharges within solid insulation system are not visible. 4f0a2a2de2 == Process == 4f0a2a2de2 Design for manufacturability (also sometimes known as design for manufacturing or DFM) is the general engineering art of designing products in such a way that they are easy to manufacture. The concept exists in almost all engineering disciplines, but the implementation differs widely depending on the manufacturing technology. DFM describes the process of designing or engineering a product in order to facilitate the manufacturing process in order to reduce its manufacturing costs. DFM will allow potential problems to be fixed in the design phase which is the least expensive place to address them. Other factors may affect the manufacturability such as the type of raw material, the form... 4f0a2a2de2 ESD can create spectacular electric sparks (lightning, with the accompanying sound of thunder, is an example of a large-scale ESD event), but also less dramatic forms, which may be neither seen nor heard, yet still be large enough to cause damage to sensitive electronic devices. Electric sparks require a field strength above approximately 4 million V/m in air, as notably occurs in lightning strikes. Similar forms of electric discharge include corona discharge from sharp electrodes, brush discharge from blunt electrodes, etc. 4f0a2a2de2 PD can occur in a gaseous, liquid, or solid insulating medium. It often starts within gas voids, such as voids in solid epoxy insulation or bubbles in transformer oil. Protracted partial discharge can erode solid insulation and eventually lead to breakdown of insulation. 4f0a2a2de2

Corona discharge The discharge appears A corona discharge is an electrical discharge caused by the ionization of a fluid such as air surrounding a conductor carrying a high voltage. discharge is an electrical discharge caused by the ionization of a fluid such as air surrounding a conductor carrying a high voltage. Instead, the discharge appears as a colored glow around an object. The discharge appears in cases where the voltage exceeds a critical value, but an electric arc cannot form 4f0a2a2de2

PCM can be used on virtually any commercially available metal or alloy, of any hardness. It is limited to materials with a thickness of 0.0005 to 0.080 in (0.013 to 2.032 mm). Metals include aluminium, brass, copper, inconel, manganese, nickel, silver, steel, stainless steel, zinc and titanium. 4f0a2a2de2 Electrical treeing is typically initiated and then propagates when a dry dielectric material is

subjected to high and divergent electrical field stress over a long period of time. Electrical treeing is observed to originate at points where impurities, gas voids, mechanical defects, or conducting projections cause excessive electrical field stress within small regions of the dielectric. This can ionize gases within voids inside the bulk dielectric, creating small electrical discharges between the walls of the void. An impurity or defect may even result in the partial breakdown of the solid dielectric itself. Ultraviolet light and ozone from these partial discharges (PD) then react with the nearby dielectric, decomposing and further degrading its insulating capability... 4f0a2a2de2 Machining is a major process of the manufacture of many metal products, but it can also be used on other materials such as wood, plastic, ceramic, and composites. A person who specializes in machining is called a machinist. As a commercial venture, machining is generally performed in a machine shop, which consists of one or more workrooms containing primary machine tools. Although a machine shop can be a standalone operation, many businesses maintain internal machine shops or tool rooms that support their specialized needs. Much modern-day machining uses computer numerical control (CNC), in which computers control the movement and operation of mills, lathes, and other cutting machines. 4f0a2a2de2 == Other occurrences and causes == 4f0a2a2de2 ESD can cause harmful effects of importance in industry, including explosions in gas, fuel vapor and coal dust, as well as failure of solid state electronics components such as integrated circuits. These can suffer permanent damage when subjected to high voltages. Electronics manufacturers therefore establish electrostatic protective areas free of static, using measures to prevent... 4f0a2a2de2

Ultrasonic machining 002 to 0.). that can not be machined by alternative methods such as electrical discharge machining and electrochemical machining. The tool travels vertically or orthogonal to the surface of the part at amplitudes of 0. 005 in. Ultrasonic machining is able to produce Ultrasonic machining is a subtractive manufacturing process that removes material from the surface of a part through high frequency, low amplitude vibrations of a tool against the material surface in the presence of fine abrasive particles. 05 to 0. The fine abrasive grains are mixed with water to form a slurry that is distributed across the part and the tip of the tool. 125 mm (0. Typical grain sizes of the abrasive material range from 100 to 1000, where smaller grains (higher grain number) produce smoother surface finishes 4f0a2a2de2

Electrical discharge machining Electrical discharge machining (EDM), also sometimes known as spark machining or spark eroding, is a metal cutting process whereby a desired shape is obtained Electrical discharge machining (EDM), also sometimes known as spark machining or spark eroding, is a metal 4f0a2a2de2

The corona discharge represents a local region where the air (or other fluid) has undergone electrical breakdown and become conductive, allowing charge to continuously leak off the conductor into the air. A corona discharge occurs at locations where the strength of the electric field (potential gradient) around a conductor exceeds the dielectric strength of the air. It is often seen as a bluish

glow in the air adjacent to pointed metal conductors carrying high voltages, and emits light by the same mechanism as in a gas discharge lamp and in glow discharge, namely, via a combination of bremsstrahlung radiation and changes in electronic state that produce discrete spectral lines. Corona discharges can also happen in thunderstorms or other electrically-active weather, where objects like ship masts or airplane wings have a charge significantly different from the air around... 4f0a2a2de2 In the ECM process, a negatively-charged (cathode) cutting tool is advanced into a positively-charged (anode) workpiece. Pressurized electrolyte is injected at a set temperature into the area being cut, at a feed rate equal to the rate of "liquefication" of the anode material. The gap between the tool and the workpiece varies within 80–800 micrometers (0.003–0.030 in.) As electrons cross the gap between the tool and workpiece, material from the workpiece is dissolved, as the tool forms the desired shape in the workpiece. The electrolytic fluid carries away the metal hydroxide formed in the process. 4f0a2a2de2