Technical Resource

Machining Processes Overview

The Machine Age provided us with numerous products that we may take for granted today. One of the more common processes associated with the production of precision components manufactured from the 19th century through the present, is machining. As it relates to the prevention of corrosion – it is important to acknowledge that the machining process, or any process performed on metal, increases the propensity for a metal to rust or corrode.

Machining is generally a term that refers to a subtractive process – it "takes something away" from the metal to form desired shapes. Conventional (traditional) machining methods are defined as any process in which a cutting tool is used to remove pieces of the workpiece in order to achieve the desired design. Non-conventional machining processes may incorporate chemical, thermal or other technologies. Any of these processes leave the metal compromised and more susceptible to corrosion.

Conventional machining varies in the number of cutting edges as well as in how and what is moving. Machine shops may apply multiple machining processes in order to achieve the desired outcome. Some of the more common conventional machining processes are:

TURNING:
Turning rotates the workpiece on its axis and the cutting tool feeds into it, removing material. The most common example would be a lathe. Turning operations produce cylindrical shaped parts. Turning may also be used for other operations such as:

BORING:
Boring is the process of enlarging a hole that has already been drilled in order to achieve greater accuracy of the diameter of the hole. It may be performed on lathes (turning), milling machines and machines designed for boring.

FACING:
Facing is the process of cutting a flat surface onto the workpiece. In the turning operation, the face would be perpendicular to the axis of rotation of the workpiece.

GROOVING:
Cutting a groove on the workpiece is called grooving. With a turning operation, the groove would be perpendicular to the axis of the workpiece rotation.

THREAD CUTTING:
Threads may be cut into the workpiece in turning operations as well as during tapping.

MILLING:
Milling is a fast, rotating cutting tool that is cylindrical with the teeth on the perimeter. The workpiece is fed into the rotating tool following different paths to create the desired features. The versatility of milling is used to manufacture tooling such as three dimensional molds – it is used to make pockets, flat surfaces, contours and can also do drilling. There are a few types of milling operations that represent those most frequently encountered:

END MILLING:
The end milling cutting tool somewhat resembles a drill bit but unlike a drill bit, it is capable of cutting in all directions, not just in the direction of the axis of rotation. This enables this operation to produce complex shapes.

CHAMFER MILLING:
Chamfer milling produces a beveled edge that connects two surfaces. If the connecting edges are at right angles to one another, the chamfer would increase the angle of the resulting edges.

FACE MILLING:
Face milling is the process of milling flat surfaces that are at right angles to the axis of rotation of the cutter.

DRILLING:
With drilling operations, the rotating tool is fed into the stationary workpiece to make the hole. Drilling is primarily done on drill presses but sometimes on lathes and milling machines. Other operations that are associated with drilling are:

TAPPING:
A tap is used to create screw threads in a hole creating the female portion for the mating pair. A die is used to create threads on the associated male portion referred to as threading. Chasing is the term associated with using the same type of tool to clean up the cuts.

REAMING:
A reamer is a rotating tool that enlarges an existing hole. It increases accuracy, smooths and removes burrs.

COUNTERBORING:
This produces a flat bottom cylindrical enlargement of the existing hole. The bore has a thinner tip, called a pilot, which guides the bore so it may precisely follow the predetermined path of the previously drilled hole.

COUNTERSINKING:
Countersinking produces a conical expansion of the top of a hole. It is often used so that the top of a tapered screw head may rest flush with the surface.

ABRASIVE MACHINING:
This process uses tiny abrasive particles to act as a means of removing material and is generally used to improve the surface quality of the workpiece, although it may also be used to form features and shape. The more common types are:

GRINDING:
The abrasive grains are bonded into a rotating wheel that abrades the workpiece. The workpiece is fed into the cutting tool (rotating wheel) unless it is a cylindrical grinding machine in which case the workpiece is rotated and the cutting tool (abrasive) is feed into it.

HONING:
Honing is generally accomplished with a honing tool that is abrasive in nature. It is often used in a rotating motion to fine finish the interior surface of previously formed holes.

LAPPING:
This is the process of rubbing two surfaces together with an abrasive between them. This is often used to produce a finely smoothed surface.

ULTRASONIC MACHINING:
In this abrasive process, a tool oscillates at ultrasonic frequencies with an abrasive slurry between the tool and the workpiece.

ABRASIVE JET MACHINING:
Also known as micro-blasting, a high velocity gas propels abrasives to erode the unwanted material. There are many machining processes, including those that are difficult to categorize. Several of the unique processes are:

PLANING/SHAPING:
In planing, the workpiece moves against a stationary cutting tool. In shaping, the tool moves against a stationary workpiece. Each of these processes can be used to produce a plane or a sculpted surface. Both planing and shaping are quickly being replaced by milling.

BROACHING:
Broaching uses a cutting tool that resembles a course, heavy hair comb. In rotary broaching, the tool is spun like a drill bit and pressed into the workpiece. This may be accomplished on a lathe or screw machine, as well as on a broaching machine. In linear broaching, the cutting tool moves back and forth against the material like a saw. Broaching is used to produce odd shapes such as splines and keyways.

SAWING/SHEARING:
Sawing is the term to describe the removal of large pieces of material and separation through the use of a toothed cutting surface. Shearing is often used for cutting sheet metal and works with a scissor-type motion of the intersecting edges to do the cutting.

CUTTING FLUIDS:
In order to keep the cutting tool from becoming too hot and to provide lubrication, it is important to use to proper fluid. The cutting fluid not only acts as a lubricant and coolant, it helps move away the metal cuttings known as swarf.

NON-CONVENTIONAL and CONVENTIONAL MACHINING PROCESSES are increasingly difficult to separate. What is new today is not tomorrow and it becomes a matter of opinion. We already mentioned a few processes when discussing Abrasive Machining (Ultrasonic and Abrasive Jet) that certainly are non-traditional but there are many more. A few worth noting are:

Technical Resource

BURNING MACHINES:
Welding and burning machines use heat to melt and/or vaporize material. Laser cutting uses a narrow, high energy beam of light and provides high quality finishes with extreme precision. Oxy fuel, also known as gas cutting, employs fuel gases and oxygen to melt and cut. Plasma cutting utilizes an electrical arc to transform inert gas into plasma which reaches extremely high temperatures and may provide precise cuts.

EROSION MACHINING:
Erosion Machines use water or electricity to remove material by erosion. Water jet cutting uses high pressure water that carries abrasive particles to provide the cutting action. It is often used on materials that are sensitive to damage from heat that may be associated with other methods. Electrical discharge machining (EDM) uses electrical arc discharges to create micro-craters that combine to make precise cuts. It is generally used with ferrous alloys as it requires a conductive base material. Electro-Chemical Erosion (ECM) passes a high current electrical charge from the positively charged workpiece through an electrolyte solution to a negatively charged cutting tool. This causes molecules from the workpiece to dislodge into the electrolyte. This process is also limited to electrically conductive materials but applies minimal stress to the part formed.

CNC MACHINING:
Computer numerical control, or CNC machining, is a computer-aided technique that may be used in conjunction with machining equipment. It provides software programming that guides the machining process and may deliver great precision and a reduction in associated labor.

With the great care that is taken to produce finely finished precision parts it is equally as imperative to properly protect your investment from corrosion. Contact Armor Protective Packaging and let its more than 35 years' experience in the business of corrosion management solutions help you to protect your product and your reputation.