Success In Engraving ID Products, Nameplates and Signage

Purpose

Conventional engraving for signage can be performed by any one of four basic methods – all of which result in the removal of material from the surface of a workpiece. This paper outlines each of the three engraving methods, common materials and the technology available for increasing efficiency and quality of the end product.

Four Types of Equipment:

The pantograph is a manually operated machine that removes material using a rotating tool or diamond scribe. The tool is connected by levers to a stylus that is moved manually by the operator. The operator uses the stylus to trace a template of each letter. Because the tool follows the motion of the stylus, each letter must be precisely positioned to reflect the actual layout of the work. While pantographs are still used widely to engrave small plates at shopping mall stores like Things Remembered, they are generally considered an inefficient and outdated technology for industrial or 3D engraving. This is because the process requires and operator who is tied to the machine for the duration of the process. Not only is this costly in terms of labor, but the quality of the end product is dependant upon the skill and experience of an individual operator and may vary from shift to shift or part to part. Skilled pantograph operators are truly craftsmen of a dying art form. As a result, it is becoming increasingly hard for manufacturers to find qualified operators – and what they may save on the cost of equipment is usually offset by the cost of labor. Additionally, since the process is extremely taxing from a physical and ergonomic standpoint, employers are vulnerable to the added costs of workman's compensation or disability.

So, most engraving today is done with CNC (Computer Numeric Control) engravers and routers. The CNC engraver uses a rotating tool to remove material. The engraving is designed on computer software, converted to numeric commands for each axis of motion. These commands are sent to the machine and the spindle that spins the tool is moved by stepper motors or servo motors. While quality and repeatability are clear advantages for CNC routers, the process can also be performed by an unattended machine which lowers the cost of labor. Additionally, some CNC routers are multi-tasking industrial workhorses capable of engraving, milling, cutting, tapping and routing at a single work cell – throughout a 24/7/365 production schedule. This provides manufacturers with the flexibility to produce more complex engraved parts, the efficiency to increase throughput and the agility to take on new multi-phase projects.

Laser engravers are a type of CNC machine that use a focused laser beam, instead of a rotating tool, to remove material. While lasers rival CNC routers in terms of speed and quality, the type of cut that they produce generally doesn't appear "authentic". That's because lasers don't penetrate the workpiece as deep as rotary engraving and it lacks the look and feel of traditional engraving. Another drawback of laser engravers is that they often require special types of engraving material – so the substrates available as "blanks" are limited in color and texture and are more costly than those available for rotary CNC engraving.

Finally, there is stamping. With this process, a die is made for use with the stamping machine. Each die costs in the range of $2,000 to $3,000. For high volume production, say 20,000 parts, stamping is a logical choice because the stamping machine can produce a couple parts per second. But, for low volumes the cost of the dies cannot be justified. Another down side to this process is that the edge quality is far inferior to parts made on a CNC router. This is because the stamping machine removes material from the workpiece by pushing the die down through the material like a cookie cutter. The force created at the location of the cut bends and shears the substrate. With malleable materials like metal this can mean bending at the edge and with other more brittle substrates, chipped edges can result. Finally, unlike the multi-purpose CNC routers mentioned above, the stamping machines are limited to stamping. So if the end product requires a counter sunk hole or tapping, this would require another piece of equipment and a secondary operation – both at additional cost to the manufacturer.

Types of Material:

Engravers use a variety of mediums to produce signs and nameplates. While some engraving is done in more exotic materials like Dupont Corian (a synthetic resin stone), most engravers use brass, aluminum, and layered plastics.

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Metals

Solid brass and aluminum plates come in a variety of colored lacquers. Typically, these plates are very thin (about .025”) enabling the engraver to cut and size them for mounting on a plaque board or placing in a frame. Engraving in brass is usually done by removing the lacquered coating with a rotating tool in order to expose the shiny metal surface underneath. This process is called burnishing. Unlike deep engraving, which removes a considerable amount of metal, burnishing barely penetrates the surface of the material. Deep engraving (or milling) of metal is used primarily to make industrial molds and name plates.

Wood

Wood and is other common material used by engravers. Wood is a good material for rotary engraving, though it typically involves more processing time. That’s because after the image or text is cut, the engraved recesses often need to be stained or filled with paint to enhance legibility.

Plastics

Like brass and aluminum, engraving plastic is produced in thin sheets (typically 1/16” and 1/32” thick) which can be cut and trimmed to size, then mounted on a plaque board or placed in a decorative frame. The material is layered in a two-color sandwich usually composed of Acrylic or ABS. A rotary tool is used to remove the colored surface material to a depth of .003”-.015”. This exposes the core that contains the second color. Of all the materials available to an engraver, these co-extruded and micro-surfaced resins offer the greatest selection of color, texture, and finish. While some tend think of plastics as cheap looking plastic nameplates, new high tech, co-extruded and micro-surfaced resins can produce quality end products. Unlike lacquered metal, this new generation of engraving material is scratch resistant, it does not oxidize, some of it is durable enough to mount outdoors, and it comes in variety of finishes that effectively simulate stone and metal.

Features That Provide The Competitive Edge:

High-Speed Spindle

Most ID product and nameplate engraving is done with small engraving bits and endmills. These small tools must be run at high speeds. High-speed CNC engraving machines featuring 60,000 RPM spindles effectively evacuate chips from the cutting channel resulting in smooth surfaces and burr-free edges. This eliminates the need for the secondary de-burring operation, as well as the costs associated with it. The 60,000 RPM spindle is designed specifically for engraving and milling with small tools. Unlike conventional CNC spindles designed to run large tools, high frequency (high speed) spindles have smaller motors and produce less force. This helps to maximize tool life by minimizing the force that leads to tool breakage. Conventional CNC machines would have to be run at very low speeds in order to prevent the force of the spindle from breaking these small tools. As a result, cycle times are long and surface finish is inadequate for most engraving applications.

Probing

Probing saves time during job setup and ensures accuracy and repeatability. Probes available as an integrated component on some rotary CNC engravers can recognize irregular work-piece topography and compensates for it dynamically. They do this by taking measurements along the surface of a blank and feeding that data into the machining controller. The controller automatically adjusts for uneven surfaces or work piece position. Through this process, job setup times are reduced and piece/part rejection is minimized. With a 3D extension, the probe locates parts and material irregularities in the X, Y, and Z co-ordinates, finds centers of holes and bosses, pre-measures blanks before the machining starts, compensates for material variations, feeds data into ISO 9000 information chain for quality control, and even allows for the reverse engineering of many parts.

Oil-Free Coolant

While Probing can save valuable time at the front end of production, during set up, oil-free coolants like ethanol can save time at the back end. That’s because unlike oil leaves a residue on the completed product, ethanol simply evaporates. So, the secondary de-greasing operation can be eliminated – thereby reducing the cost of labor, the cost of consumables required for

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cleaning and, most importantly, minimizing total production time. Ethanol is a form of alcohol that results naturally through the sugar fermentation process and is environmentally friendly. It also happens to be an ideal coolant for high-speed, micro machining because a thinner-than-water viscosity allows the ethanol to quickly cover and cool more surface area on fast-moving micro tooling. The low evaporation point of ethanol makes it an efficient cooling solution and also eliminates the need for disposal and recycling, as well as their associated costs.

Note: Ethanol coolant should only be used for machining of non-ferrous materials and manufacturers can switch over to oil coolant when machining or engraving steel-based materials.

Integrated Workholding

Workholding for nameplate applications, like production runs of Metalphoto, can be problematic. Thin substrates are difficult to hold. This is particularly true if the manufacturer is using a conventional CNC to engrave or cut small parts with limited surface area, because the force of the spindle can literally "fling" the part across the machine bed once it is completely cut out. Many manufacturers actually resort to spray glue as a method of workholding. Not only is this messy, it can also lead to bending when the finished part is removed from the machine bed, it sometimes doesn't hold the part when it is completely cut out … and it results in a time consuming and costly secondary application to remove the glue form the completed parts.

Therefore, high-speed CNC engravers and routers are the logical choice for ID Product and Nameplate manufacturers. As mentioned above, these machines are designed exclusively for running small tools and inherently have smaller motors that produce less force. This low force enables innovative workholding technology. For example, some CNC manufacturers have developed vacuum tables that are integrated with the machine bed. So, thin stock, which could be secured only with great difficulties before, is now secured literally within seconds. Plastic foils as thin as 0.001", to 0.250" large aluminum sheets are secured quickly and held in place even when the parts are "cookie-cut" completely through the material.

A vacuum pump provides vacuum power for the system to work. A vacuum table features airflow-optimized vacuum ports, with recessed vacuum chambers, to provide superior vacuum distribution. A low cost gas-permeable substrate serves as a sacrificial vacuum diffuser, allowing the cutter to machine through the workpiece, without cutting into the table.

Automatic Tool Management

ID Product and Nameplate manufacturers considering various CNC machines for milling and engraving, need to consider their current processes and what their ideal process might be. In other words, they may currently be running only one or two shifts, but in a perfect world, an unattended overnight shift could be the secret to increased profitability. Even if a "lights-out" shift just isn't in the cards, a day shift where the CNC machine can run unattended allows the operator to tend to other business – thereby providing the manufacturer with more productivity from a single employee. So, choosing a CNC with the right kind of tool management is crucial.

In the world of machining with large tools, monitoring spindle load can be used as a means of detecting breakage. If there is a fluctuation or drop-off in the current, then the operator knows that the tool might be broken. Unfortunately, the benefits of this "Tool Detection" process are limited because it is used only as a means of checking tools and reporting possible breakage without systematically replacing the broken tool. So, the best that a manufacturer can hope for is that the machine will shut off and prevent additional damage to costly blanks. Still, production time is lost — and if the tool breakage occurs early in a "lights-out" overnight shift, it can significantly impact schedules and revenue. Furthermore, this method doesn't work when using micro tooling because the load involved is sometimes so small that the fluctuation in power usage doesn't even register.

CNCs with an Automatic Tool Management System are a better solution. The Automatic Tool Management System is made up of three separate components working in synergistically — the tool checker, the tool changer, and the software. The tool checker is a mechanical sensor that measures tool length and detects the broken tool. The tool changer is a rack or tray that has space for spare tools and sockets where the machine places broken tools before picking up a replacement. Operators can stock the rack with spare tools, thereby having a ready supply should tools break during "lights out" operation. The software is a macro program that can be set up to run a tool check after executing a number of lines of code. For example, a tool check

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macro can initiate a check after every 500 lines of code by employing an "if/then" statement such as, "Measure this tool; if the length is shorter than the parameter (listed in the software's tool database), then change the tool."

Wrapping It Up:

ID Product, Nameplate and Signage Manufactures who specialize in low production runs can gain efficiency, flexibility and an overall reduction in cost by using rotary-type CNC engravers and routers. Since most of these manufacturers use small tools, it is imperative that they select a CNC machine designed specifically for use with small tools. High-speed spindles are best suited for small tools and produce burr-free parts with superior surface and edge finishes. The low force of these spindles maximizes tool life and enables innovative workholding that speeds setup time, improves efficiency and makes secondary operations like de-greasing obsolete. Probing also makes setup more efficient and ensures accuracy and repeatability. Automatic Tool Management provides a reduction in cost by enabling unattended or lights-out production. CNC machines that deliver all of these features, working synergistically, provide manufacturers of ID Products, Nameplates and signage with a means to revolutionize their business.

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