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Close tolerances and automated material handling characterize today's sawing.


Rohbi America

Cutting it with saws

Rohbi America

Sawing is often considered a roughing operation compared to drilling, milling and turning. Though true at one time, that is not always the case today. Sawing machines have improved substantially from the days when a tape measure and chalk were used to mark the cut and ±0.250" "looked about right."

In addition, sawing is a material-handling-intensive process. The metalcutting portion of the operation is usually short compared to the time spent loading and unloading workpieces. Some recent sawing innovations have reduced this noncutting time and, as a result, enhanced productivity.

This article looks at five enhancements that allow more accurate, higher-throughput sawing operations to be performed.

High-Volume Work

For high-volume production work involving ferrous or nonferrous materials with small cross sections—less than 4"—stand-alone sawing machines automate the material-handling function and cut to extremely close tolerances. One manufacturer of these machines, Rohbi America LLC, Columbus, Ind., offers production machines that handle stock up to 20' long.

These saws operate at 200 to 4,000 rpm, depending upon the material being cut. Cycle times can be as short as 3 to 4 seconds for nonferrous materials and 20 seconds for tool steel. Cutoff-length tolerances are from ±0.0008" for single pieces and ±0.002" to ±0.003" for bundled materials, depending on the model.

For example, one Rohbi system can cut a length of a single steel extrusion within ±0.0008" at a rate of 400 pieces per hour. The production rate for 0.23"-thick, bundled-and-clamped, round stainless steel stock can be 8,400 pieces per hour, within ±0.0011".

The accuracy and precision of this type of production saw are largely a result of the cutting tools and the jaws. Its carbide or HSS saw blades are highly polished on both sides. The blades have a 0.001" taper, which prevents material buildup, and produce a 0.020" kerf. Blades measure 4" to 10" in diameter and have relatively large bores—22mm or 32mm.

Form jaws hold the workpieces to ensure squareness. Air-over-oil pressure accumulators generate the clamping force that ensures workpiece rigidity during sawing. Additionally, the saw incorporates a high-precision, grinder-type spindle. The sawing process requires flood coolant appropriate for the material being cut.

Automated material handling is largely responsible for these saws' increased production capacities. Automatic, angular loading, horizontal-chain loading, magazine loading and belt loading also enhance productivity levels, while bundling the stock prior to cutting serves as a productivity multiplier, too.

Cutting Off

Watkins Manufacturing Inc., Cincinnati, offers self-contained, motorized rotary saw cutting (RSC) attachments that mount on screw machines and other types of turning machines. They replace single-point cutoff tools in some high-volume turning applications.

In RSC, the workpiece and the saw rotate simultaneously so the saw cuts a convex shape that reduces the chip load. The most desirable cutting dynamics occur when the blade and the work rotate in opposite directions at the point of cut. In climb cutting, the saw and workpiece rotate in the same direction. In RSC, each tooth makes a small cut, resulting in the formation of small chips.

Increased feed rates per workpiece revolution—1.5 to 4 times that of sin-

Watkins Manufacturing

Watkins Manufacturing offers self-contained, motorized rotary saw cutting attachments. In RSC, the workpiece and the saw rotate simultaneously. The narrow blade minimizes kerf, which averages 50 to 75 percent less than a conventional cutoff tool.

gle-point tooling—reduce cutoff times and increase the number of pieces cut per hour.

A low cutting pressure allows the saw to cut completely through material, which eliminates the cutoff nib and reduces burrs. Saw and part deflection are negligible, and the saw acts as a guide to eject cut parts. Saw material and surface treatment, diameter, thickness, number of teeth and tooth angle depend on the application.

TiN- and TiCN-coated carbide and HSS saws are available. Carbide saws cut cleaner, resulting in better surface finishes with fewer burrs or no nib. Saw diameters—2½" to 6"—depend on the distance to the cut, DOC and tool zone configuration. Kerf averages 0.045", which is 50 to 75 percent less than what a conventional cutoff tool produces.

Coarse-tooth configurations—90 teeth on a 4"-dia. saw—is better for cutting 0.75"-dia. or larger workpieces and workpieces with holes. Fine-tooth configurations—130 or more teeth on a 4"-dia. saw—are best for workpieces with small diameters, cutting to center and thin-walled tubing.

The number of cuts per grind is influenced by tool alignment, geometry, rotational speed (sfm) of the workpiece, feed per revolution of the workpiece, coolant delivery, vibration and material variation. With RSC, tool and workpiece deflection are negligible; surface flatness and squareness are typically within 0.002". Due to light cutting pressures, length, flatness and squareness can be held to close tolerances, repeatable within tenths.

RSC requires a heavy flow of coolant delivered to the point at which the saw enters the material. The coolant must flow equally to both sides of the saw to promote even tooth wear and to flush away chips. When cutting ferrous metals with HSS saws, an oil-based coolant with active sulfur prevents galling at temperatures below 350° F. Water-soluble coolants are appropriate for use with carbide saws or when cutting aluminum or brass.

Ultra-Precise Sawing

For ultra-precise sawing, Manufacturing Technology Inc., Ventura, Calif., offers bridge-type machines. These precision sawing machines apply diamond, CBN and carbide blades to cut and slot aluminum, stainless steels, titanium, tool steels, graphite, bronze, composites and green ceramics.

Saw blades vary in thickness and diameter and can be mounted on a common arbor to generate different slot widths and depths in a single operation. Blade diameters are as small as 0.5" and go up to 6", while blade thicknesses vary from 0.001" to 1.0".

A massive, cast-iron frame and granite-mounted X- and Y-axis slides ensure rigidity, dampen vibration and maximize dimensional stability. The machine's CNC and AC servo system control X, Y and Z table motions and spindle velocity, and ensure easy setups and high performance at speeds that range from zero to 14,000 rpm. Preloaded, high-precision, antifriction linear bearings for axes travel ensure reliability. Indexing accuracy, straightness and spindle cartridge accuracies are measured and quantified in microns. Slide movements are as small as 0.1 microns—4 millionths of an inch.

For ganged (multiple-blade) arbor assemblies, the carbide arbors can accommodate up to 200 saw blades while maintaining slot width and pitch tolerances to ±0.00010". The number of teeth per blade can vary from 12 to 220, and blade tolerances are extremely stable. The standard tolerance for a saw blade OD is +0.015"/-0.000", while gang-saw blades are matched within ±0.00025". Blade thicknesses for standards are held within ±0.00010" and parallelism is held to 0.000020".

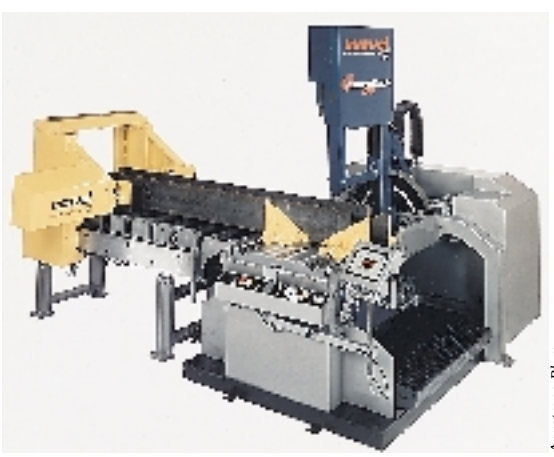
Chilled, recirculating coolants with flow and temperature-control monitoring are also part of the system. Permanent magnets, CNC electromagnetic chucks or vacuum chucks hold the workpiece.

These machines are laser-calibrated. Options include online spindle-vibration monitoring, robotics and active vision systems.

CNC Cold Sawing

Another example of programmable saw cutting is the automatic CNC circular cold saw manufactured by Scotchman Industries Inc., Philip, S.D. The machine cuts 300 to 500 pieces per hour, depending on the type of stock—ferrous or nonferrous—and the stock-bundling arrangement. This can translate into thousands of parts per 8-hour shift. These saws can cut solid stock up to 2" in diameter and bundled stock up to 3.5" in diameter. The standard tolerance on length is ±0.040".

Operators use the CNC to set cutting speeds and feeds. The speed ranges are from 18 to 88 rpm or 44 to 140 rpm. The machines' variable-speed drives allow for infinite speed adjustment within the specified range. The CNC capabilities extend to the material-handling functions as well, controlling the length of stock and up to four cuts per length. These



Armstrong-Blum

Armstrong-Blum's TouchTech 60 bandsawing machine is equipped with Windows NT-based controls that let operators select preprogrammed settings and customize or fine-tune cutting parameters via a touch screen.

CNC units can retain up to 100,000 cutting programs by part numbers.

The cold saws' notch-ground, HSS blades can be treated with either black oxide or coated with TiN for optimal cutting. These saws come standard with mist-coolant units; flood-coolant capability is optional.

During a cutting cycle, bundle loaders and automatic rollers feed the stock into the sawing machine. The material comes to rest at predetermined stops.

The rollers hold the parts in place while pneumatic vise clamps respond to proximity sensors and clamp the workpiece in place for cutting. Then, part unloaders transfer cut stock away from the cutting zone.

Vertical Tilt-Frame

For those cutting larger-diameter stock, a vertical tilt-frame bandsaw may be in order. Vertical tilt-frame saws, like those manufactured by Armstrong-Blum Manufacturing Co., Mount Prospect, Ill., cut up to 60° (±0.10°) left and right miters (parallelograms and trapezoids) and include CNC capabilities with automated material handling.

Equipped with a Windows NT-based control, operators can select preprogrammed settings and customize or fine-tune cutting parameters, via a touch screen, to meet production demands. The control software includes a database of feeds and speeds for various materials, which can be edited for specific applications, as well as a library database for storing cutting parameters for parts by part number. With the controls located at the front of the machine and in-line with the blade, the operator can see both the in-feed and discharge sides of the machine.

Saw cuts are made in the presence of flood or mist coolant. The standard tolerance is ±0.005" and ±0.10°, using either a HSS or carbide blade. Vertical blades provide consistent cutting (feed) pressures during cutting, which extends blade life.

Workholding is accomplished with variable-pressure, hydraulic vises that exert up to 1,500 psi on the workpiece material. Additionally, T-slots in the worktable allow for various workholding methods for securing oversized or asymmetrical parts, which are difficult to fit in the vise jaws.

The design of the vertical tilt-frame saw facilitates material loading on the worktable. A hydraulic bar feeder uses a shuttle stroke to feed stock up to 8' long into the cutting zone in a straight line.

The following companies contributed to this article:

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