TECHNotes

Published by Buehler, a division of Illinois Tool Works

Volume 9, Issue 2

Reducing Cutting Time on the AbrasiMet® L Pro Abrasive Cutter

Introduction:

The AbrasiMet L Pro automatic abrasive cutter is a high performance 14in cut off saw, designed to be intuitive, advanced, and reliable. Combine with Buehler's abrasive vising solutions and abrasive wheels for a complete cutting solution providing optimal sample quality and reduced processing time.

In this article we review some of the challenges inherent to abrasive cutting and how the AbrasiMet L Pro can provide the solutions to overcoming them to ensure your cutting process is optimized.

Abrasive cutting is the most common technique employed for sectioning metals for metallurgical purposes. The methods date back to the early 1930's when the first abrasive cutters and blades became commonly available. There have been considerable advancements in cutting machines over the years, and while blade choices have increased, blade construction is very similar today as it was 100 years ago. Although the number of choices can complicate choosing the best blade for a given application, the right machine can adjust the cutting process to optimize blade performance whichever blade you choose.

Advancements in machine design can be of great utility in assisting operators with optimizing blade choice and feed rate to ensure blade life is maximized, cutting time is reduced, and quality of the cut surface is maintained. Buehler's AbrasiMet L Pro (as well as the larger AbrasiMet XL Pro) are capable of adjustments to accomplish these goals even when the optimal blade type and feed rate setting are unknown. These machines have been engineered with specific features including Variable SmartCut, Cut Start Detect, and Planar Cut (a Minimum Area of Contact feature) that can remove the guesswork from determining ideal cutting parameters. In addition, these machines are designed with advanced capabilities such as user-defined programmed methods (for immediate method recall to ensure the same cutting process is used for a given part) and the Quick-Lock Nut for rapid blade loading to expedite the cutting setup process considerably.

We explain these features below to better explain how they work and their value.

Variable SmartCut

A feature that allows the operator to control the machine power. In Variable SmartCut the user can set the amount of current drawn during cutting, effectively allowing the user to control maximum motor power output. Properly used, this adjusts the feed rate automatically based on resistance to cutting. Cutting rate is reduced when cutting through large cross-sections or abrasion-resistant induction-hardened zones. Feed rate is then increased where less resistance to cutting is encountered such as thin areas or the softer core of a case-hardened part. This enables Variable SmartCut to find the fastest cutting time without compromising surface finish nor causing excessive blade wear. This eliminates the guesswork of which feed rate to set to cut a given part.

Serial Cutting

Serial Cutting enables the user to set up multiple cuts through the sample in one cutting program. This is commonly employed for cutting engine cam and crankshafts. Serial cutting allows the operator to perform other tasks while all of the necessary cuts on a part are done automatically. When used in conjunction with Cut Start Detect (see below) the time when the cutting blade is not engaged in cutting (such as when advancing toward the cut area) is largely eliminated.

Cut Start Detect

Cut Start Detect is blade sensing technology that determines when a cutting blade is actively cutting. During the period when the blade is not cutting through the sample, blade movement is increased to advance to the next cut location rapidly. Upon encountering the part, blade movement is reduced to the optimal feed rate determined by Variable SmartCut. Once the cut is complete, feed rate is again increased until the next cut begins.

Optimize the Cutting Process

Automotive Drivetrain Components

As stated above, one of the most common applications for serial cutting is removal of counterweights from crankshafts, which can be automated with the AbrasiMet L Pro. Users can easily realize significant time savings by implementing Cut Start Detect (CSD) and Variable SmartCut (VSC). In the present example, we have 4 cuts programmed (Figure x.) to remove two counterweights from a crankshaft. The cut through the crank is 50mm, however the blade travel (cut depth) must be set to ~140mm to clear the vices and counterweights as the blade travels to each successive cut location. This results in 90mm (~65%) of the cut length does not involve cutting the material. At 0.3mm/s feed rate, appropriate for cutting through the shaft center, this translates into 300 additional seconds, or 5 minutes, per cut that is virtually eliminated by CSD. In the present case of 4 cuts to remove 2 counterweights, CSD removes 20 minutes cut time from the process.

Figure 1. *Crankshaft in the AbrasiMet L Pro ready for cutting.*

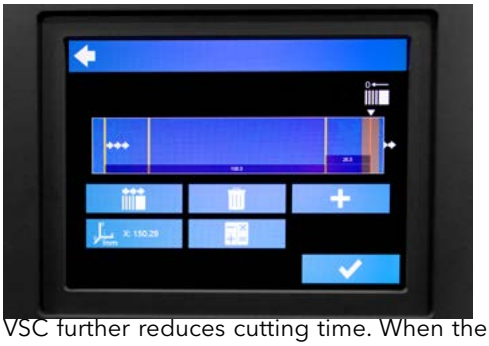

Figure 2. *Serial Cut Programming to automatically cut the four locations.*

VSC further reduces cutting time. When the cut begins there is very little material in contact with the blade and cutting can proceed rapidly, however feed rate must be reduced on entering the thicker area of the shaft to prevent burning. Ordinarily one would need to set a feed rate appropriate for cutting the center of the shaft, however with VSC we can set a feed rate considerably higher and allow the machine to reduce the rate as needed based on resistance to cutting at any given time. This allows the blade to cut quickly when entering and exiting the shaft and more slowly through the center. In this example, the center of the shaft cannot be cut faster than 0.3mm/s without inducing thermal damage, however we can cut more quickly in smaller cross-sectional areas. Cutting at a constant 0.3mm/s would take 167 seconds, or 2.8 minutes per cut. With VSC engaged, we can set a feed rate of 1mm/s and save over 20 seconds per cut, or an additional 1.5 minutes from the four cuts along the shaft.

For this part, we see that engaging CSD and VSC together removes approximately 21 minutes from the cut time. What would conventionally take 31 minutes cutting time is reduced to about 10 minutes. The improvement in efficiency is magnified the more times such a cutting process is undertaken daily, potentially saving hundreds of minutes of operator time and expediting materials analysis and quality assessment.

Crankshaft counterweights are sometimes sectioned again after removal from the shaft. For larger shafts, cutting in this orientation results in a significant amount of material in contact with the blade during the cut. In such cases, coolant at the cut surface is limited and may result in burning the cut surface and/or uneven blade wear if conventional "chop" type (Z axis or vertical) cutting is employed. Minimum Area of Contact (MAC) techniques are useful to resolve this common issue. The idea behind MAC is to limit the amount of sample material in contact with the cutting surface of the blade at a given time. This has been achieved in different ways with different machines. In the case of the AbrasiMet L Pro, Planar mode serves as the Minimum Area of Contact function. Using this cutting mode, the blade traverses in vertical steps through the part, lowering a preselected distance with each traverse. While this mode of cutting may increase cutting time relative to other more aggressive techniques, it does not require operator attendance and ensures that only a small amount of material is in contact with the blade at any time. It also allows ample coolant flow into the cutting plane, resulting in excellent cut quality. Achieving the same quality from a single cut would require significantly slower feed rate and operator attention to ensure quality. For heavy cutting of large cross-section areas, Minimum Area of Contact cutting is the ideal technique to ensure integrity of the cut surface.

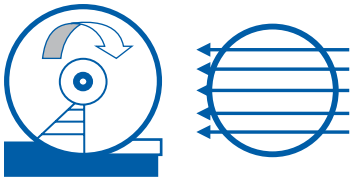

Figure 3. *Planar Mode cutting characteristics*

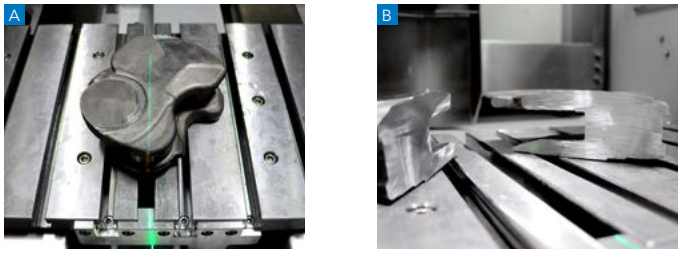

Figure 4*. Using Plane Mode to section the counterweight.*

In another example, drive axles with constant velocity joint bearing race are cross sectioned to inspect the induction hardening process. It is often desirable to cut these longitudinally, down the shaft, and through the "tulip". Sectioning is further complicated by the tendency for these parts to "grab" the blade as it enters the hardened zone. The shaft can be cut at a higher rate than the area where the shaft joins the housing. Use of VSC allows the operator to set a relatively high feed rate for cutting the shaft. As the blade enters the heat-treated section VSC reduces the feed rate automatically to optimize quality of the cut surface. Use of MAC cutting here also reduces the potential for the part to close on the blade due to release of internal stress as it is cut.

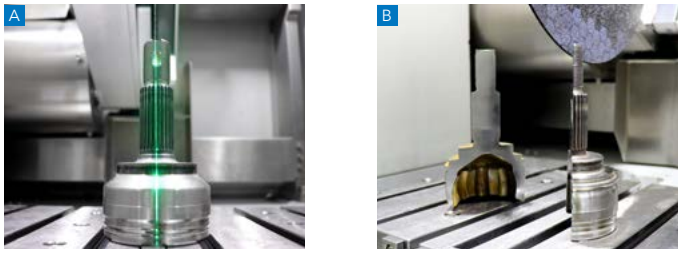

Figure 5. *AbrasiMet L Pro Variable Smart-Cut can automatically adjust feed rate to cut more quickly along the shaft and reduce cutting rate as needed through the bearing race.*

Reducing Setup Time

While Variable SmartCut and Cut Start Detect are useful tools to ensure faster cutting time, the abrasive blade must be changed when it becomes small enough that practical cutting is no longer feasible. For high-volume cutting, changing to a new blade will potentially occur dozens of times per day or shift and can amount to considerable time. The Buehler Quick-Lock Nut reduces blade change time and effort significantly requiring no tools -- only hand loosening and tightening. Removing the nut and blade takes seconds with a fast, counter-clockwise turn of the Quick-Lock Nut. After placing the new blade and flange on the arbor, thread the Quick-Lock Nut clockwise until snug. The nut automatically tightens during cutting to secure the blade yet can be readily loosened with hand strength when removing. A few minutes time savings changing blades can translate into 30 to 60 minutes of additional productivity per day. This also does not account for eliminating the time spent locating, using, and re-storing tools needed for removing conventional nuts nor the increased potential for injury when conventional nuts are broken free causing the wench to move suddenly.

The programming capability of this machine ensures certainty

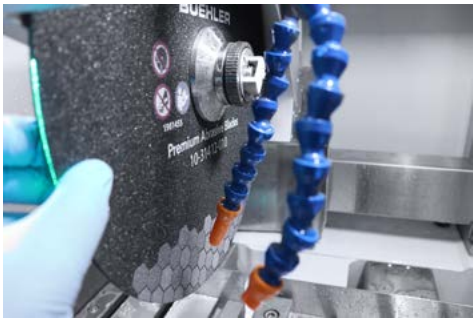

Figure 6. Quick-Lock Nut makes changing blades a snap.

and reproducibility, further reducing setup time. All cutting processes with the AbrasiMet L Pro can be readily saved and locked using a passcode so you can ensure that your parameters and process are consistent day to day, user to user. Recall of programs takes just seconds, then simply align the laser on the first cut and start the cut. Save as many programs as are necessary for your cutting needs.

Pairing the AbrasiMet L Pro with the Right Blades

Abrasive blades consist of abrasive grains mixed with bond material comprised of resin or a mix of resin and rubber. The strength of bond material, or its ability to "hold" abrasive grains during sectioning, varies depending on intended application. For highly abrasion-resistant materials such as hardened steel or refractory metals, bond strength of the blade is relatively soft, meaning abrasive grains readily break free from the bond during cutting. The soft bond is necessary as abrasion-resistant materials wear down sharp cutting edges from the abrasive quickly. A soft bond ensures fresh abrasive is continuously exposed for cutting.

For less abrasion-resistant materials such as copper and aluminum alloys, blades with higher bond strength are employed. Cutting these materials does not wear abrasive as quickly as hard steel, meaning the strong hold provides extended blade life.

The cutting abrasive in abrasive blades are generally alumina or silicon carbide. Alumina is an excellent general-purpose abrasive and is used in blades designed for cutting ferrous metals, copper, aluminum and polymers. Silicon carbide is harder than alumina and cuts abrasion-resistant refractory metals more efficiently. For this reason, silicon carbide is the abrasive used in blades intended for cutting titanium alloys.

Size of abrasive grains used in cutting blades affects cut performance. Larger abrasive grains lend themselves to more free cutting blades, other factors being equal this translates into faster cutting (higher feed rates), greater blade wear and somewhat coarser surface finish. Smaller abrasive grains contribute to lower feed rate, reduced blade wear and somewhat smoother surface finish.
Selection of abrasive blades is often a compromise of blade characteristics depending on the criteria important to the user. When cutting at high volume (such as hundreds of cuts per day) performance of the blade becomes more critical. If an abrasive blade wears too quickly there is considerable expense in blades consumed and operator time repeatedly changing to a new blade. If a blade wears too slowly, cutting time will increase, leading to loss of efficiency or worse, OR a burned cut surface that requires extended grinding time to remove the additional damage. It can be challenging to determine the best blade option to cut different materials while ensuring optimal sample integrity and process efficiency.

In our **catalog**, we provide a blade selection guide depending on the type of material being cut. Each blade is optimized for its specific material using the ideal combination of bond material strength and abrasive material and size.

Trust the AbrasiMet L Pro to Bring Your Process to New Heights

The AbrasiMet L Pro has been developed to maximize cutting efficiency. The cutting process is then further optimized using Buehler Premium Abrasive Blades to ensure minimum cutting time, extended blade life, and superior quality of the cut surface.

Equipment Used in TechNote

Consumables Used in TechNote

AbrasiMet® L Pro Abrasive Cutter

Abrasive Vises

For a complete listing of Buehler Equipment and

Premium Abrasive Blades

Cool 3 Cutting Fluid

Consumables, please refer to **Buehler's Product Catalog** or **www.Buehler.com**

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