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Tung TECH

Tungaloy Technical Articles

MillLine

DOFEED for
TUNGALOY

Efficient High-Feed Milling

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Tungaloy's DoFeed has transformed the manufacturers' way of thinking about milling. These flexible and versatile tools offer much more advantages than any other milling tool: dramatically reduced cycle time and cost, long tool life, and high quality of finished parts.

Also, the tools are easy on machines and applicable for various materials. No wonder DoFeed is one of the most popular milling tools in Tungaloy's full product line.

In today's hypercompetitive machining market, cycle time plays a major role in productivity and often determines the profitability of a given job.

Simply increasing the speed or revolutions per minute (RPM) may appear to decrease the cycle time. However, reduction in cycle time would be converted to time to change inserts since the increased speed or RPM shortens tool life, which increases the tool cost at the same time.

"DoFeed is the solution for this problem. The tool works at elevated feed rates with modest speed or RPM and provides reduced cycle time as well as extended tool life"



CHIP THINNING - THE KEY TO REDUCE CUTTING FORCE:

DoFeed's mechanism is based on the "chip thinning" principle. Chip thinning depends on the lead angle of a milling cutter. A cutter with a 90° lead angle has no benefit of chip thinning as 0.2 mm/t of feed per tooth only delivers the same 0.2 mm of chip thickness (Fig. 1). In case of a cutter with a 45° lead angle, 0.25 mm/t of feed per tooth creates 0.178 mm of chip thickness (Fig. 2), which allows the feed to be increased, resulting in reduced cycle time. As for DoFeed, 1.27 mm/t of feed per tooth provides chip thickness of only 0.178 mm (Fig. 3) and cycle time is often decreased by 50% or more.

Low cutting force is also an advantage of DoFeed. The lead angle on a cutter decides the direction of cutting force. A 90° cutter (Fig. 1) will produce cutting force that acts perpendicular to the spindle, putting incredible pressure on the tool. As for a 45° cutter (Fig. 2), cutting force goes toward the spindle at 45° angle. With DoFeed, cutting force is almost parallel and directed back to the spindle due to its acute lead angle (Fig. 3), which means less pressure to the spindle.

Thus, DoFeed is suitable for long-reach applications, too, such as hole-making. Combined with the capability of ramping, the feature allows DoFeed to operate helical interpolation; the tool moves in circular motion to X and Y axes while simultaneously moving downward to Z axis.

Fig. 1 - 90° cutter

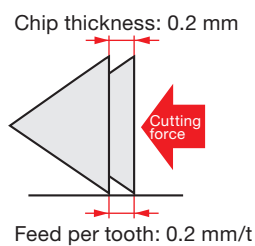


Fig. 2 - 45° cutter

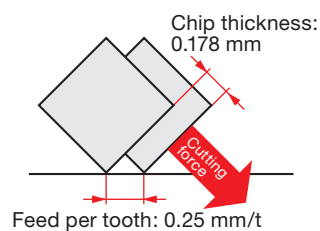
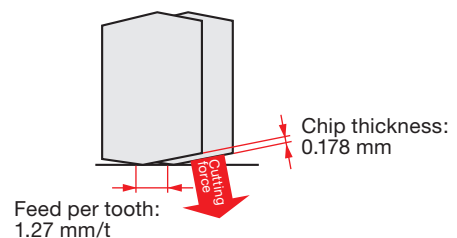


Fig. 3 - DoFeed (15° - 17°)



High-feed milling is the most suitable and fast face milling operation when it comes to machining large parts. However, customers usually have to make an additional finishing pass to clean up the rough surface generated.

“The series now includes wiper inserts that deliver outstanding quality of surface finish with no reduction in feed rate. As a result, DoFeed wiper inserts drastically improve efficiency in the overall machining process”



Because DoFeed cutters can machine multiple hole diameters and produce counter bore and countersink in the same operation, there is no need to change tools and purchase multiple tools. As a result, significant time and cost saving will be achieved.

CLOSE TO NET SHAPE:

“DoFeed provides high metal removal rate even with small depth of cut, which makes workpiece materials closer to the desired shape in one operation and minimizes or even eliminates the number of finishing processes”

This characteristic is ideal for 3D machining.

Most 3D machining begins with a block of material and the material is gradually removed until the desired configuration is obtained. This method is subtractive manufacturing, which is opposite to additive manufacturing.

An example of additive manufacturing is 3D printing. While a 3D printer places thin layers upon layers, DoFeed removes thin layers of material one by one. In both cases, thin layers help produce the shape close to the final structure.

FOR A WIDE RANGE OF MATERIAL:

Another advantage is that DoFeed is applicable for various materials. The series is an excellent choice for tool steel like molds, and even suitable for superalloys, such as titanium, Inconel, and others. Those materials are always difficult to machine since many of them need to be “sheared.” Whereas negative inserts tend to push the material and cause work hardening, DoFeed’s inserts with very positive cutting edges, especially the ML geometry, easily shear the material and no work hardening occurs.

For example, titanium is commonly used for aerospace parts due to its resiliency; a titanium part deflects in response to stress and returns to the original shape. This characteristic works well for aerospace parts, but cutting titanium is problematic because of its tendency to “push back.” The strength of DoFeed is effective in this case since its positive inserts prevent the titanium’s push-back and deliver smooth machining.

“DoFeed is an innovative tool series for high-feed milling even for Exotic Materials that helps customers save time for operations and cost on tools which were major issues of conventional milling. The series enjoys good reputations in the market as the advantages of the tools contribute to efficient machining and maximization of productivity in a wide variety of applications”



CASE STORY: AEROSPACE INDUSTRY

Workpiece: End fitting

Material: Ti-6Al-4V

Cutter: EXN03R025M25.0-05

Insert: LNMU0303ZER-ML AH130

Cutting condition:

$V_c = 40 \text{ m/min (131.2 sfm)}$

$f_z = 0.707 \text{ mm/t (0.028 ipt)}$

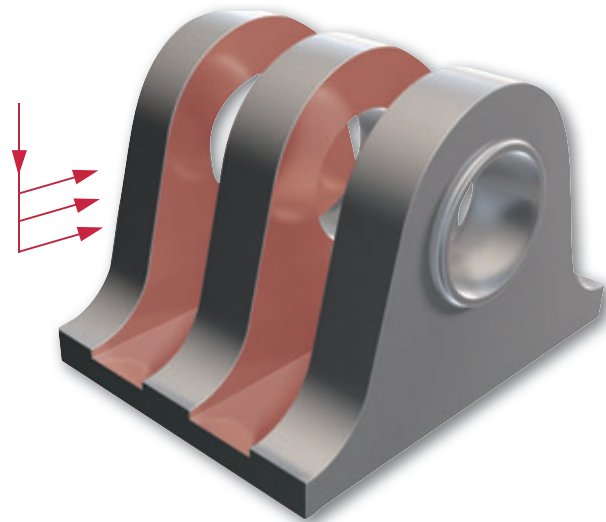
$V_f = 1800 \text{ mm/min (70.866 ipm)}$

$a_p = 0.8 \text{ mm (0.031")}$

$a_e = 5 - 25 \text{ mm}$

Machine: Horizontal M/C

Coolant: Wet



Result: DoFeed prevents chip welding and peeling-off of coating, which provides long tool life. The number of the parts DoFeed machines is 2.5 times more than the competitor due to sharp ML chipbreaker and tough AH130 grade.

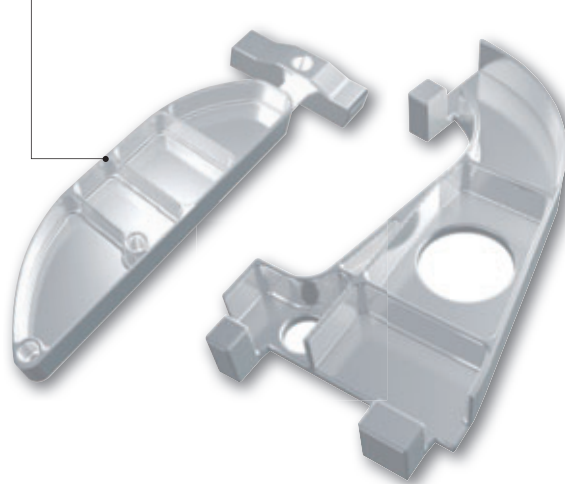
“DoFeed provides high productivity in machining of titanium at high feed and speed because of close-pitch design of the cutter body. In addition, ML chipbreaker's low cutting force prevents chattering”

TYPICAL PARTS:

• Die & Mold



• Aerospace Parts



• Impeller

