TROUBLESHOOTING

ANSWERS TO COMMON MILLING PROBLEMS

Welcome to the Troubleshowoting Guide. In this section, end milling problems are addressed with potential solutions listed below. There can be many variables when encountering an issue and the charts listed below should narrow down your solution. These charts are not meant to be 100% accurate for your particular setup, as every application is different and may require a variety of adjustments. However, this information is a good start to determine your ideal conditions for your particular machining needs.

PROBLEM	CAUSE	SOLUTION
BREAKAGE	Too large cutting amount	Adjust to smaller cutting amount per teeth
	Too long flute length or long overall length	Hold shank deeper, use shorter end mill
	Too much wear	Regrind at earlier stage
	Workpiece rigidity	Ensure workpiece is secure and supported
	Speed too low	Increase the cutting speed (RPM's)
	Feed rate too high	Reduce FPT
	Heavy depth of cut	Reduce RDOC & ADOC
	Part entry	Reduce FPT on entry - implement radius in sweeping entrances - avoid 90º (perpendicular) entry
	Milling strategy	Review tool path and ensure there are no arbitrary moves, extreme angle of engagement increases & undesirable situations for the tool
	Tool overhang	Use shortest OAL, shortest LOC & reduce overhang from tool holder. Consider necked down tooling for long reach
	Tool runout	Check tool runout in holder/spindle. utilize collet, milling chuck or shrink fit holders if possible. Hand ground shank flats can be suspects
	Reconditioning	Improper regrind/reconditioning
	Poor chip evacuation	Reposition coolant lines, use air blasting
	Poor tool rigidity	Shorten LOC, place shank further up holder
BURR	Too much wear on primary relief	Regrind at earlier stage
	Incorrect conditions	Correct milling conditions
	Improper cutting angle	Change to correct cutting angle
	Tool wear	Replace or regrind tool
	Improper helix angle	Change to recommended helix angle
	Feed rate too high	Reduce feed rate
	Depth of cut too large	Reduce depth of cut
	Incorrect feed and speed rates	Correct cutting parameters
	Improper cutting parameters	Adjust feed and speed
BUILT UP EDGE	Chip welding	Utilize proper tool coating for material being cut
	Feed rate too low	Increase FPT
	Speed too low	Increase RPM's
	Coolant Strategy	Re-adjust coolant flow & check coolant mixture percentage
CHATTER/VIBRATION	Workpiece rigidity	Check that workpiece is secure and supported
	Tool holder rigidity	Use shortest holder possible and investigate for no tool slippage
	Lack of rigidity (machine)	Use better machine or change parameters
	Poor spindle rigidity	Use larger spindles or different tool
	Tool overhang	Use shortest length tool, shortest loc & reduce overhang from tool holder. Consider necked down tooling for long reach
	Tool run out	Check tool run out in holder/spindle. Utilize collet, milling chuck or shrink fit holders if possible. Hand ground shank flats can be suspects
	Speed too high	Lower the RPM's
	Feed rate too low	Increased FPT
	Angle of engagement violation	Use smaller tools generating corner radi in pockets - avoid tool diameters that match corner diameter/radius
	Too much surface contact	Utilize a lower flute count tool
	Chip Thinning	Utilize chip thinning adjustment
	Milling Strategy	Ensure you are climb milling unless the material has hard/abrasive outer skin then conventional milling is preferred for breakthrough
	Feed and speed too fast	Correct feed and speed
	Poor set up	Improve clamping rigidity
	Cut is too heavy	Decrease width and depth of cut
	Overhang of tool is too much	Hold shank deeper, use shorter end mill
	Lack of relief	Decrease relief angle, make margin: (touch primary with oil stone)
	Loose hold of workpiece	Hold workpiece tightly
	Cutting too deep	Decrease depth of cut
	Too long flute or overall length	Hold shank deeper, use shorter end mill or try down cut
	Cut too aggresive	Reduce width and/or depth of cut
CHIP COMPACTION	Insufficient chip room	Use tool with less flutes, increase helix
	Feed rate too high	Reduce FPT and increase RPM
	Heavy depth of cut	Reduce ADOC/RDOC in side milling & ADOC in slotting
	Coolant flush	Re-adjust coolant flow, air blast or "op stop" to clear chip build up
	Large chip size	Utilize chip breaker style tool to better manage chip size, adjust feed or speed
	Cut too heavy	Decrease width and depth-of-cut
	Not enough coolant	Use higher coolant pressure and reposition nozzle to point of cut or use air pressure; Increase volume of coolant
	Low cutting speed	Increase RPM or reduce feed rate
	Too great cutting amount	Adjust feed or speed
	Feed and/or speed too aggresive	Adjust feed or speed
DEFLECTION	Tool overhang	Use shortest length tool, shortest loc & reduce overhang from tool holder
	Milling strategy	Climb milling can help reduce the amount of deflection in some cases
	Too heavy of a RDOC	Reduce ADOC/RDOC in side milling & ADOC in slotting
	Feed rate too high	Decrease FPT
	End mill diameter	Increase diameter of end mill for higher strength-to-length ratio
	Increase number of flutes	Higher number of flutes = larger core diameter = increased strength

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DIMENSIONAL INACCURACIES (TAPERED WALL)	Coolant Strategy	Re-adjust coolant flow & check coolant mixture percentage
	Deflection	Refer to deflection section above
	Feed rate too high	Lower feed rate (clpt)
	RDOC too high	Reduce RDOC
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Cut is too heavy	Decrease width and depth of cut
	Lack of accuracy (machine & holder)	Repair machine or holder
	Rigidity is not enough (machine & holder)	Change machine or tool holder or change parameters
	Too few flutes	Use multiflute end mills, use end mill with higher rigidity
	Excessive cutting	Decrease depth and width of cut
	Lack of accuracy (machine and holder)	Repair machine or holder
	Not enough rigidity (machine)	Change machine or cutting conditions
	Loose/worn tool holder	Repair of replace
	Poor tool holder rigidity	Replace with shorter/more rigid tool holder
	Poor spindle rigidity	Use larger spindle or different tool
	Too tough condition	Change to easier condition
	Cut too aggresive	Reduce width and/or depth of cut
	Feed rate too heavy	Reduce feed rate
	Overhang of tool is too much	Hold shank deeper , use shorter end mill
EXCESSIVE CORNER WEAR	No Corner Radius	Implement corner radius on tool - adds strength & tool life
	Speed too high	Reduce RPM's
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Tool Overhang	Ensure you are using the shortest OAL/LOC possible. Utilize necked tooling for longer reach
POOR FINISH	Feed rate too high	Reduce FPT
	Speed too low	Increase RPM's
	Too light of a RDOC	Increase RDOC to stabilize tool in cut.
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Helix Angle	Change to tool with higher helix angle
	Need more Flutes	Choose end mill with higher number of flutes
	Recutting Chips	Redirect/evaluate coolant flush – or use less number of flutes
	Built Up Edge	Increase RPM, use higher helix tool
	Wear is too much	Regrind at earlier stage
	No end tooth concavity	Grind concave angle on bottom teeth
	Depth of cut too large	Reduce depth of cut
	Chip welding	Increase volume of coolant
	Chip biting	Cut less amount per pass
	Speed not aggresive enough	Increase RPM
	Cut too aggresive	Reduce width and/or depth of cut
	Tool overworn	Regrind/Recondition sooner
SHORT TOOL LIFE	Cutting friction is too much	Regrind at earlier stage
	Hard work material	Use Coatings (TiN, TiCN,TiAlN)
	Improper helix and relief angle	Change to correct helix angle and primary relief
	Poor coolant	Replace coolant or correct mixture
	Poor material condition	Use coated tool, clean material surface
WEAR	No Corner Radius	Implement corner radius on tool - adds strength & tool life
	Speed too high	Reduce RPM's, Decrease spindle speed, use another coolant
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Tool Overhang	Ensure you are using the shortest OAL/LOC possible. Utilize necked tooling for longer reach.
	Hard work material	Use higher grade tool material and coating
	Biting chips	Change feed and speed. Change chip size or clear chips with coolant or air pressure
	Improper feed and speed (too slow)	Increase feed and speed. Try down-cut
	Improper cutting angle	Change to correct cutting angle
	Too small primary relief angle	Change to larger relief angle
	Low feed rate	Increase feed rate
	Up milling (conventional)	Change to down milling (climb)
	Hard material	Use coated tool
	Poor chip evacuation	Reposition coolant lines, use air blasting
	Improper cutter helix	Change to recommended helix angle
	Poor coolant	Replace coolant or correct mixture
CHIPPING	Workpiece rigidity	Check workpiece is secure and supported - a common issue. Use better machine or tool holder or change parameters
	Tool holder rigidity	Use shortest holder possible and investigate for tool slippage. Use better machine or tool holder or change parameters. Clean or replace
	Lack of rigidity (tool)	Use shorter tool, hold shank deeper, try climb milling
	Feed rate too high	Reduce FPT
	Tool Heavy of a RDOC	Reduce RDOC
	Part Entry	Reduce FPT on entry – implement radius in or sweeping entrances - avoid 90º (perpendicular) entry
	Milling Strategy	Ensure you are climb milling unless the material has hard/abrasive outer skin then conventional milling technique is preferred for breakthrough
	Tool Overhang	Use shortest OAL, shortest LOC & reduce overhang from tool holder. Consider necked down tooling for long reach
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Tool Coating	Implement proper tool coating for material to be cut
	Edge prep	Ensure tool has proper edge prep
	Built Up Edge (BUE)	See BUE section for detailed explanation
	Feed too heavy on first cut	Reduce feed rate on first cut
	Tool cutting corner too sharp	Decrease primary relief and cutting angle, reduce radial width-of-cut
	Up milling (conventional)	Change to down milling (climb)
	Chattering	Redue RPM
	Low cutting speed	Inrease RPM
	Feed too aggresive	Reduce feed rate
	Cut too aggresive	Decrease width and/or depth of cut

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	Speed too high	Reduce RPM's, Decrease spindle speed, use another coolant
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	Hard work material	Use higher grade tool material and coating
	Biting chips	Change feed and speed. Change chip size or clear chips with coolant or air pressure
	Improper feed and speed (too slow)	Increase feed and speed. Try down-cut
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	Hard material	Use coated tool
	Poor chip evacuation	Reposition coolant lines, use air blasting
	Improper cutter helix	Change to recommended helix angle
	Poor coolant	Replace coolant or correct mixture
CHIPPING	Workpiece rigidity	Check workpiece is secure and supported - a common issue. Use better machine or tool holder or change parameters
	Tool holder rigidity	Use shortest holder possible and investigate for tool slippage. Use better machine, tool holder or change parameters. Remove from spindle, clean or replace
	Lack of rigidity (tool)	Use shorter tool, hold shank deeper, try climb milling
	Feed rate too high	Reduce FPT
	Tool Heavy of a RDOC	Reduce RDOC
	Part Entry	Reduce FPT on entry – implement radius in or sweeping entrances - avoid 90º (perpendicular) entry
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	Up milling (conventional)	Change to down milling (climb)
	Chattering	Redue RPM
	Low cutting speed	Inrease RPM
	Feed too aggresive	Reduce feed rate
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SURFACE TREATMENTS & COATINGS

SELECT ADVANCED SPECIALTY COATING

SELECTING YOUR COATING

Certain applications, materials or performances simply require the enhancement of a specialty coating and knowledge of the properties of the coatings available. Temperature, friction resistance, hardness, lubricity, toughness and cohesion of the resulting process must be examined prior to the selection.

SEE PAGES 42 - 44 FOR DETAILS

UNCOATED | TITANIUM NITRIDE | TITANIUM CARBON NITRIDE | TITANIUM ALUMINUM NITRIDE NANO | ALUMINUM TITANIUM NITRIDE NANO | ALUMINUM TITANIUM NITRIDE/ SILICON NITRIDE | ALUMINUM CHROMIUM NITRIDE NANO | ZIRCONIUM NITRIDE | TITANIUM DIBORIDE | AMORPHOUS DIAMOND & CVD