TROUBLE SHOOTING FOR TURNING

Trouble \ Solution (Factors)			Insert Grade Selection: Select a harder grade	Insert Grade Selection: Select a tougher grade	Insert Grade Selection: Select a grade with better thermal shock resistance	Insert Grade Selection: Select a grade with better adhesion resistance	Cutting Conditions: Cutting speed (Up ↗ / Down ↘)	Cutting Conditions: Feed (Up ↗ / Down ↘)	Cutting Conditions: Depth of cut (Up ↗ / Down ↘)	Cutting Conditions: Coolant: Do not use water-soluble cutting	Cutting Conditions: Coolant: Determine dry or wet cutting	Style and Design of the Tool: Select chip breaker (Up ↗ / Down ↘)	Style and Design of the Tool: Rake (Up ↗ / Down ↘)	Style and Design of the Tool: Corner radius (Up ↗ / Down ↘)	Style and Design of the Tool: Lead angle (Up ↗ / Down ↘)	Style and Design of the Tool: Honing strengthens the cutting edge (Up ↗ / Down ↘)	Style and Design of the Tool: Class of insert	Style and Design of the Tool: Improve tool holder rigidity	Machine, Installation of Tool: Increase clamping rigidity of the tool and workpiece	Machine, Installation of Tool: Decrease holder overhang	Machine, Installation of Tool: Decrease power and machine backlash
Deterioration of Tool Life	Insert wear quickly generated	Improper tool grade	a																		
		Improper cutting edge geometry										a	↗ a	↗ a	↗ a	a ↘					
		Improper cutting speed					a ↘	↗ a			a Wet										
	Chipping or fracturing of cutting edge	Improper tool grade		a																	
		Improper cutting conditions						a ↘	a ↘												
		Lack of cutting edge strength.										a		↗ a		↗ a					
		Thermal crack occurs			a		a ↘	a ↘	a ↘	a	a Dry										
		Build-up edge occurs				a	↗ a	↗ a		a	a Wet										
		Lack of rigidity																a	a	a	a
Out of Tolerance	Dimensions are not constant	Poor insert accuracy															a				
		Large cutting resistance and cutting edge flank										a	a	a ↘	a ↘	a ↘		a	a	a	a
	Necessary to adjust often because of over-size	Improper tool grade	a																		
		Improper cutting conditions					a ↘	↗ a													
Deterioration of Surface Finish	Poor finished surface	Welding occurs					↗ a			a	a Wet										
		Improper cutting edge geometry										a		↗ a							
		Chattering					a ↘	a ↘	a ↘									a	a	a	a
Generation of Heat	Workpiece over heating can cause poor accuracy and short life of insert	Improper cutting conditions					a ↘	a ↘	a ↘												
		Improper cutting edge geometry										a	↗ a			a ↘					

Trouble		Solution / Factors	Insert Grade Selection: Select a harder grade	Insert Grade Selection: Select a tougher grade	Insert Grade Selection: Select a grade with better thermal shock resistance	Insert Grade Selection: Select a grade with better adhesion resistance	Cutting Conditions: Cutting speed (Up ↗ / Down ↘)	Cutting Conditions: Feed (Up ↗ / Down ↘)	Cutting Conditions: Depth of cut (Up ↗ / Down ↘)	Cutting Conditions: Coolant: Do not use water-soluble cutting	Cutting Conditions: Coolant: Determine dry or wet cutting	Style and Design of the Tool: Select chip breaker	Style and Design of the Tool: Rake (Up ↗ / Down ↘)	Style and Design of the Tool: Corner radius (Up ↗ / Down ↘)	Style and Design of the Tool: Lead angle (Up ↗ / Down ↘)	Style and Design of the Tool: Honing strengthens the cutting edge	Style and Design of the Tool: Class of insert	Style and Design of the Tool: Improve tool holder rigidity	Machine, Installation of Tool: Increase clamping rigidity of the tool and workpiece	Machine, Installation of Tool: Decrease holder overhang	Machine, Installation of Tool: Decrease power and machine backlash
Burrs, Chipping etc.	Burrs (steel, aluminium)	Notch wear	a																		
		Improper cutting conditions					a ↘	↗ a			a Wet										
		Improper cutting edge geometry										a	↗ a	a ↘	a ↘	a ↘					
	Workpiece chipping (cast iron)	Improper cutting conditions						a ↘	a ↘												
		Improper cutting edge geometry										a	↗ a	↗ a	↗ a	a ↘					
		Vibration occurs																a	a	a	a
	Burrs (mild steel)	Improper tool grade				a															
		Improper cutting conditions					↗ a			a	a Wet										
		Improper cutting edge geometry										a	↗ a			a ↘					
		Vibration occurs																a	a	a	a
Poor Chip Dispersal	long chips	Improper cutting conditions					a ↘	↗ a	↗ a		a Wet										
		Large chip control range										a									
		Improper cutting edge geometry												a ↘	a ↘						
	Chips are short and scattered	Improper cutting conditions						a ↘	a ↘		a Dry										
		Small chip control range										a									
		Improper cutting edge geometry												↗ a	↗ a						

TROUBLE SHOOTING FOR FACE MILLING

Trouble \ Solution / Factors			Insert Grade Selection				Cutting Conditions						Style and Design of the Tool										Machine, Installation of Tool		
			Select a harder grade	Select a tougher grade	Select a grade with better thermal shock resistance	Select a grade with better adhesion resistance	Cutting speed	Feed	Depth of cut	Engage angle	Coolant: Do not use water-soluble cutting fluid	Coolant: Determine dry or wet cutting	Rake	Corner angle	Honing strengthens the cutting edge	Cutter diameter	Number of teeth	Wider chip pocket	Use of a wiper insert	Improve run-out accuracy	Cutter rigidity	Increase clamping rigidity of the tool and workpiece	Decrease overhang	Decrease power and machine backlash
							Up ↗ / Down ↘			↗ Up			Up ↗ / Down ↘				↗ Smaller / Larger							
Deterioration of Tool Life	Insert wear quickly generated	Improper tool grade	a																					
		Improper cutting edge geometry											↗a	↗a	a↘					a				
		Improper cutting speed					a↘					a Wet												
	Chipping or fracturing of cutting edge	Improper tool grade		a																				
		Improper cutting conditions						a↘	a↘															
		Lack of cutting edge strength.													↗a									
		Thermal crack occurs			a		a↘	a↘	a↘		a	a Dry												
		Build-up edge occurs				a	↗a	↗a			a	a Wet												
		Lack of rigidity																			a	a	a	a
Deterioration of Surface Finish	Poor finished surface	Improper cutting conditions	a				a↘	a↘	a↘															
		Welding occurs				a	↗a				a	a Wet	↗a		a↘									
		Poor run-out accuracy																	a	a				
		Chattering					a↘	a↘	a↘	↗a			↗a		a↘		a↘				a	a	a	a
	Not parallel or irregular surface	Workpiece bending						a↘	a↘				↗a	a↘	a↘		a↘					a		
		Tool clearance																			a	a	a	a
		Large back force											↗a	a↘	a↘		a↘							
Burr, Workpiece Chipping	Burrs, chipping	Chip thickness is too large					↗a	a↘	a↘															
		Cutter diameter is too large								↗a						a↘								
		Low sharpness											↗a		a↘									
		A large corner angle												a↘										
	Workpiece edge chipping	Improper cutting conditions						a↘	a↘															
		Low sharpness											↗a		a↘									
		A small corner angle												↗a										
		Chattering					a↘	a↘	a↘	↗a			↗a		a↘		a↘				a	a	a	a
Chip Control	Poor chip dispersal, chip jamming and chip packing	Welding occurs					↗a																	
		Chip thickness is too thin					↗a	↗a																
		Cutter diameter is too small														a↘								
		Poor chip disposal									a	a Wet					a↘	a						

TROUBLE SHOOTING FOR END MILLING

Trouble		Solution / Factors	Insert Grade Selection	Cutting Conditions									Style and Design of the Tool						Machine, Installation of Tool					
											Coolant													
			Coated tool	Cutting speed	Feed	Depth of cut	Pick feed	Down cut	Use air blow	Increase coolant quantity	Do not use water-soluble cutting	Determine dry or wet cutting	Helix angle	Insert number	Concavity angle of end cutting edge	Tool diameter	Cutter rigidity	Wider chip pocket	Shorten tool overhang	Increase tool installation accuracy	Increase spindle collet run-out accuracy	Collet inspection and exchange	Increase chuck clamping power	Increase work clamping rigidity
				Up ↗ / Down ↘			↘ Down						Up ↗ / Down ↘		Larger / Smaller									
Deterioration of Tool Life	Large peripheral cutting edge wear	Non-coated end mill is used	a																					
		A small number of cutting edges												a ↗										
		Improper cutting conditions		a ↘							a													
		Up cut milling is used						Down Cut																
	Severe chipping	Improper cutting conditions																						
		Fragile cutting edge															a							
		Insufficient clamping force																				a	a	
		Low clamping rigidity																	a	a	a	a	a	a
	Breakage during cutting	Improper cutting conditions				a ↘																		
		Low end mill rigidity														a ↗	a							
		Overhang longer than necessary				a ↘													a					
		Chip jamming								a								a						
Deterioration of Surface Finish	Vibration during cutting	Improper cutting conditions		a ↘	a ↘																			
		Low end mill rigidity											a ↗	a ↗		a ↗	a							
		Low clamping rigidity																	a	a	a	a	a	a
	Poor surface finish on walls	Large cutting edge wear	a																					
		Improper cutting conditions		a ↘		a ↘																		
		Chip packing.							a	a		a Wet												
	Poor surface finish on faces	The end cutting edge does not have a concave angle			a ↘	a ↘									a ↗									
		Large pick feed					a ↘																	
	Out of vertical	Large cutting edge wear	a																					
		Improper cutting conditions			a ↘	a ↘																		
		Lack of end mill rigidty											a ↗	a ↗		a ↗	a							
	Poor dimensional accuracy	Improper cutting conditions		a ↘	a ↘	a ↘																		
		Low clamping rigidity																	a	a	a	a	a	a
Burrs, Chipping, etc.	Burr or chipping occurs	Improper cutting conditions			a ↘	a ↘																		
		Large helix angle											a ↘											
	Quick bur formation	Notch wear	a																					
		Improper cutting conditions		a ↘	↗ a																			
Poor Chip Dispersal	Chip packing	Metal removal too large			a ↘	a ↘																		
		Lack of chip pocket												a ↘				a						

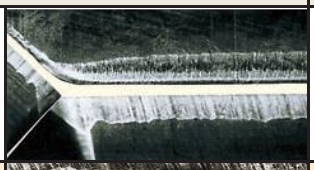
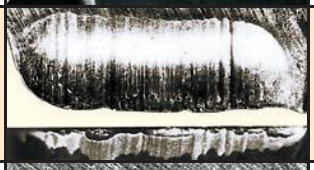
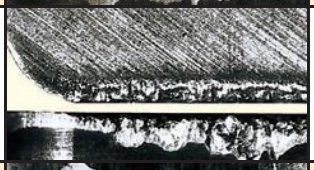
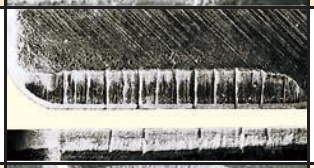
TROUBLE SHOOTING FOR DRILLING

Trouble	Factors	Solution: Cutting Conditions — Cutting speed (Up ↗ / Down ↘)	Feed (Up ↗ / Down ↘)	Lower feed at initial cutting	Lower feed when breaking through	Step feed	Increase accuracy of prep-hole and depth	Coolant: Increase oil ratio	Coolant: Increase volume	Coolant: Increase coolant pressure	Style and Design of the Tool: Chisel width (Up ↗ / Down ↘)	Honing width (Up ↗ / Down ↘)	Core thickness (Up ↗ / Down ↘)	Shorten flute length	Decrease lip height	Use internal coolant type drill	Change to a drill with X type thinning	Machine, Installation of Tool: Increase tool installation accuracy	Shorten tool overhang	Flat workpiece face	Increase work clamping rigidity	Reduce machine backlash and increase rigidity
Deterioration of Tool Life	Drill breakage	Lack of drill rigidity											a	a								
		Improper cutting conditions	a ↘																			
		Large deflection of the tool holder																a				a
		Workpiece face is inclined																		a		
	Large wear at the peripheral cutting edge and along the land	Improper cutting conditions	a ↘																			
		An increase in temperature at the cutting point						a	a							a						
		Poor run-out accuracy																a				
	Chipping of the peripheral cutting edge	Improper cutting conditions		a ↘			a															
		Large deflection of the tool holder																a				a
		chattering, vibration										a ↘							a		a	a
	Chisel edge chipping	The chisel edge width is too wide									a ↘											
		Poor entry			a																	
		Chattering, vibration										a ↘							a		a	a
Deterioration of Hole Accuracy	Hole diameter increases	Lack of drill rigidity											a	a								
		Improper drill geometry													a							
	Hole diameter becomes smaller	An increase in temperature at the cutting point						a	a							a						
		Improper cutting conditions	a ↘																			
		Improper drill geometry													a							
	Poor straightness	Lack of drill rigidity											a	a								
		Large deflection of the tool holder																a				a
		Poor guiding properties						a														
	Poor hole positioning accuracy, roundness and surface finish	Lack of drill rigidity											a	a								
		Poor entry															a					
		Improper cutting conditions			a																	
		Large deflection of the tool holder																a				a
Burrs	Burrs at the hole exit	Improper drill geometry										a ↘										
		Improper cutting conditions				a																
Poor Chip Dispersal	Long chips	Improper cutting conditions		a ↗				a														
		Poor chip disposal								a	a		a ↘			a						
	Chip jamming	Improper cutting conditions	a ↘	a ↘				a														
		Poor chip disposal								a	a		a ↘			a						

TECHNICAL DATA

TOOL WEAR AND DAMAGE

CAUSES AND COUNTERMEASURES

Tool Damage Form		Cause	Countermeasure
Flank Wear		• Tool grade is too soft. • Cutting speed is too high. • Flank angle is too small. • Feed rate is extremely low.	• Tool grade with high wear resistance. • Lower cutting speed. • Increase flank angle. • Increase feed rate.
Crater Wear		• Tool grade is too soft. • Cutting speed is too high. • Feed rate is too high.	• Tool grade with high wear resistance. • Lower cutting speed. • Lower feed rate.
Chipping		• Tool grade is too hard. • Feed rate is too high. • Lack of cutting edge strength. • Lack of shank or holder rigidity.	• Tool grade with high toughness. • Lower feed rate. • Increase honing. (Round honing is to be changed to chamfer honing.) • Use large shank size.
Fracture		• Tool grade is too hard. • Feed rate is too high. • Lack of cutting edge strength. • Lack of shank or holder rigidity.	• Tool grade with high toughness. • Lower feed rate. • Increase honing. (Round honing is to be changed to chamfer honing.) • Use large shank size.
Plastic Deformation		• Tool grade is too soft. • Cutting speed is too high. • Depth of cut and feed rate are too large. • Cutting temperature is high.	• Tool grade with high wear resistance. • Lower cutting speed. • Decrease depth of cut and feed rate. • Tool grade with high thermal conductivity.
Welding		• Cutting speed is low. • Poor sharpness. • Unsuitable grade.	• Increase cutting speed. (For JIS S45C, cutting speed 80m/min.) • Increase rake angle. • Tool grade with low affinity. (Coated grade, cermet grade)
Thermal Cracks		• Expansion or shrinkage due to cutting heat. • Tool grade is too hard. *Especially in milling.	• Dry cutting. (For wet cutting, flood workpiece with cutting fluid) • Tool grade with high toughness.
Notching		• Hard surfaces such as uncut surfaces, chilled parts and machining hardened layer. • Friction caused by jagged shape chips. (Caused by small vibration)	• Tool grade with high wear resistance. • Increase rake angle to improve sharpness.
Flaking		• Cutting edge welding and adhesion. • Poor chip disposal.	• Increase rake angle to improve sharpness. • Enlarge chip pocket.
Flank Wear Fracture *Damage for polycrystallines		• Damage due to the lack of strength of a curved cutting edge.	• Increase honing. • Tool grade with high toughness.
Crater Wear Fracture *Damage for polycrystallines		• Tool grade is too soft. • Cutting resistance is too high and causes high cutting heat.	• Decrease honing. • Tool grade with high wear resistance.