Electric spindle technical guide

APPLICATION AND MATERIALS

Engraving or cutting plastic, plywood or fiberboard up to 0,25" thick, below 500 in/min feed rate, use spindles around 1.5 to 5HP up to 40,000rpm. Their small size and weight also make them highly maneuverable to suit small routers and robots with 5 axis or 3-D carving capabilities.

Cutting wood, plastic or aluminum using straight tools below 0.75" diameter at feed rates around 300 to 600 in/min, use spindles between 5 and 10HP, and speeds between 12,000 and 24,000rpm.

Heavy-duty demands including large profile tools over 1,0" diameter at high feed rates of 500 to 3000 inches/min in high-density materials: phenolic, hardwood or aluminium, use higher power spindles, 10 to 20 HP, and speeds from 9,000 to 18,000 rpm.

NOT SUITABLE	CAUTION	NORMAL APPLICATION

MATERIAL	FORM	Air	Fan	Compressed air	Liquid
Titanium and their alloys	Foil				
Nickle alloyed steel	Sheets				
Stailnless steel (S 300)	Sheets				
Stailnless steel (S 400)	Sheets				
Carbon alloyed steel	Sheets				
Mild steel	Sheets				
Stone,Marble, glass	Blocks				
Aluminium & Light alloys	All				
Phenolics, Fiberglass	Sheets & Molded				
Polycarbonate	Sheets				
Solid Hard woods	All				
Plywood & OSB	Sheets				
Solid soft woods	All				
Flexible plastic & PVC	Sheets & Pipes				
MDF	Sheets				

Particle board	Sheets				
Rigid Foam	Blocks & Molded				

SPEED AND FEED RATE

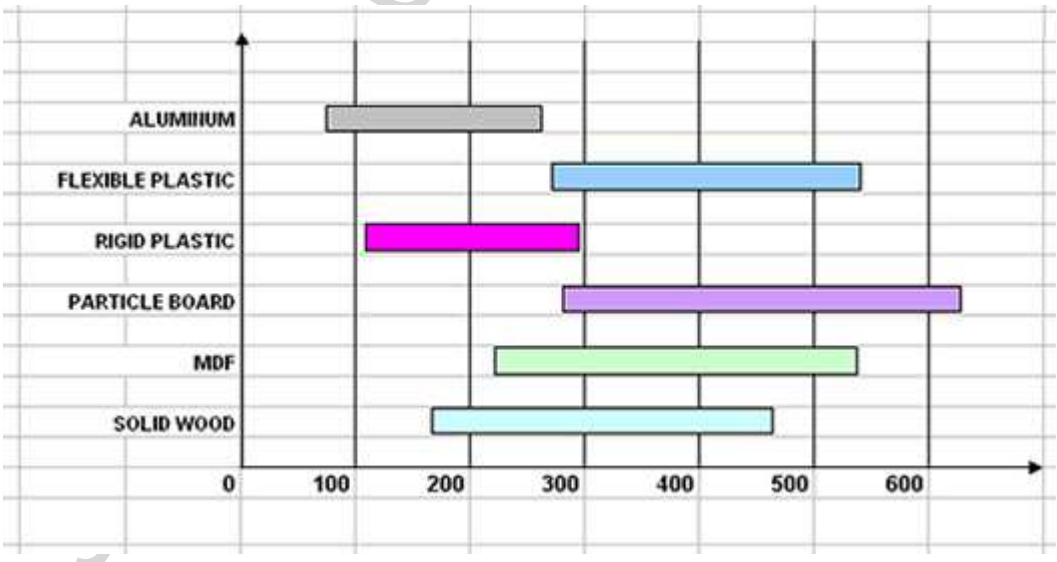
Incorrect spindle speed is a common error in CNC machining. Generally, each material and cuts has an ideal tool profile and cutting speed. Larger diameter tools require slower speeds.

Spindle speed and feed rate for a given cut must be balanced for best work quality, tool life and spindle life.

Speed is controlled by a FREQUENCY INVERTER connected to the electric spindle. All spindles are 3-phase, cycle with infinitely variable speed from 0 to maximum rpm by correctly programming your frequency inverter drive for each spindle.

MATERIAL	CHIP LOAD (inches)	
	Minimum	Average
Solid wood – hard	0.006	0.015
Solid wood - soft	0.008	0.020
Particle board	0.010	0.025
MDF	0.008	0.015
Rigid plastic	0.010	0.020
Flexible plastic	0.015	0.025
Aluminium	0.002	0.009

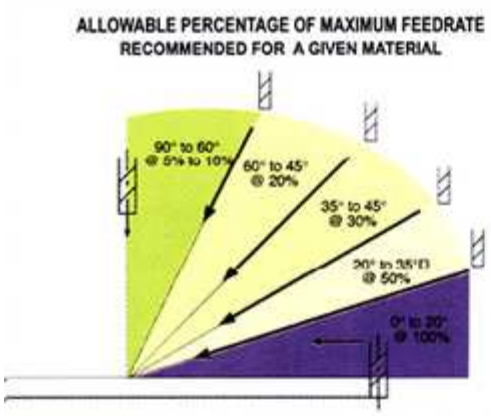
FEED RATE

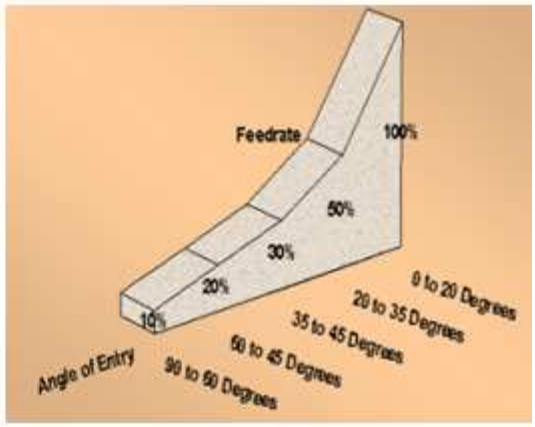


Formula = (feed speed in/min: RPM) / (Number of cutting edges) = chip load

Feed rate must be balanced with spindle speed. Changing one influences the other. Too slow feed rates decrease the tool life due to overheating and may leave bum marks on the workpiece. Heat builds in the tool when not enough material is removed to cool the cut interface. Often, determining the best feed rate can only come from trial and error. General feed rate chart for different materials is shown as a starting point. Your cutting tool suppliers can advise cutting data for various materials.

CUTTING ENTRY ANGLE





All electric spindles designed for routing applications are equipped by angular contact bearings capable to support high radial loads. During the normal cycle of work it is very important to mantein the axial load as low as possible and increase the bearings life.

Keep down-feed rates < 20% for the first 1 mm of depth. Ramp down to full cut depth at an angle less than about 20 degrees. This minimizes axial force.

Above all, avoid "crashes" of the spindle into the table, fixtures and workpiece.

TOOLING DIMENSIONS & DYNAMIC LIMITS

HSK TOOL HOLDERS

TAPER SIZE	CLAMP FORCE	SPEED (rpm)	TOOL DIAMETER (mm, max)	TOOL WEIGHT (kg, max)
HSK 63-B	18,000 N 4,050 lbf	6000 to 9000	300	12
		6000 to 9000	200	8
		6000 to 9000	130	5
		6000 to 9000	80	5
HSK 63-B	11,000 N 2,475 lbf	6000 to 9000	250	10
		9000 to 12000	170	7
		12000 to 15000	130	5
		15000 to 18000	80	5
HSK 63-F	11,000 N 2,475 lbf	6000 to 9000	250	10
		9000 to 12000	170	7
		12000 to 15000	130	5
		15000 to 18000	80	5
HSK 63-A	11,000 N 2,475 lbf	6000 to 9000	170	10
		9000 to 12000	140	7
		12000 to 15000	130	5
		15000 to 18000	80	5
HSK 63-B	6,800 N 1,530 lbf	6000 to 9000	160	5
		9000 to 12000	140	5
		12000 to 15000	120	3
		15000 to 18000	80	3
HSK 63-F	6,800 N 1,530 lbf	6000 to 9000	160	5
		9000 to 12000	140	5
		12000 to 15000	120	3
		15000 to 18000	80	3

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spindle repair and development

ISO TOOL HOLDERS

TAPER SIZE	CLAMP FORCE	SPEED (rpm)	TOOL DIA (mm, max)	TOOL WEIGHT (kg, max)	TOOL LENGTH (mm, max)
ISO 40	6,000 N 1,350 lbf	6000 to 9000	150	10	150
		9000 to 12000	130	7	150
		12000 to 15000	110	5	150
		15000 to 18000	80	5	125
ISO 30 Heavy Duty (FB3)	5,000 N 1,125 lbf	6000 to 9000	140	5	150
		9000 to 12000	130	5	150
		12000 to 15000	110	3	150
		15000 to 18000	80	3	125
ISO 30 Medium Duty (FP1)	3,500 N 785 lbf	6000 to 9000	140	4	125
		9000 to 12000	130	4	125
		12000 to 15000	110	2,5	100
		15000 to 18000	80	2,5	75
ISO 25	2100 N 475 lbf	6000 to 9000	120	3	
		9000 to 12000	90	2,5	
		12000 to 15000	60	2	
		15000 to 18000	30	1,5	
ISO 20	1800 N 405 lbf	6000 to 9000	60	2,5	
		9000 to 12000	40	2	
		12000 to 15000	30	1,5	
		15000 to 18000	20	1	
ISO 15	835 N 190 lbf	6000 to 9000	50	2	
		9000 to 12000	30	1,5	
		12000 to 15000	20	1	
		15000 to 18000	10	0,5	

ELECTRIC SPINDLE MAINTENANCE

CLEANING

Keep spindle housing, fans and airways clean to allow the cooling system to function correctly.

Keep tool tapers, shafts and collets (clamping groups) scrupulously clean.

Collet life is <700 hours. Minor contamination can cause tool misalignment, out of balance, tool slip and poor quality cuts. Tool slip leads operators to over tighten collet nuts (clamping groups) and damage threads.

COOL DOWN

Allow cooling system (fan, compressed air or liquid) and bearing pressurization (if fitted) to run for 10 minutes after stopping of the machine.

This minimizes condensation as well as contaminants being drawn into the bearing supports.

WARM UP

Do not apply load to a cold electric spindle. Run the spindle at half of the maximum speed available for 10 minutes or until the spindle bearing supports reach 37°C (human body temperature).

This allows bearings, supports and shaft to reach their designed dimensions. Applying load to a cold spindle will cause premature failure of bearings.

TOOLING

Use only balanced tools and tool holders. Rebalance all tools after each sharpening. Vibration from unbalanced tools can rapidly destroy bearings. The suggested balance grade is G1 (ANSI 1940/1).

Replace any worn, scratched or deformed tool holders and collets with new items to prevent tool slip (heat) and imbalance from run-out.

Keep tools sharp to reduce loads, heat and to maintain cut quality.

Monitor increases in current to the spindle to detect loss of tool sharpness.

Heat generated from tools can overheat bearing grease, evaporate its essential components and lessen bearing life. Maximum bearing temperature of bearing supports is 65°C. Excess heat will cause tool holders to jam in automatic tool change spindles. Be sure all spindle sensors operate correctly to avoid damage.

Note: The above informations are indicative. For further details on maintenance we suggest to look at the INSTRUCTION MANUAL of the electric spindle.