ROUTER SELECTION GUIDE

The selection guide on pages 2 - 12 is a place to start making a bit selection or a place to check your current bit selection. You should try several tools and more than one tool geometry before you settle on the best tool for you specific router, set-up, fixturing and other environmental conditions.

How To Order – Onsrud Cutter products are sold solely through industrial distribution. You may place an order through the authorized distributor in you market area. Should you wish the name of that distributor, please call Onsrud Cutter.

Guarantee – Onsrud Cutter products are guaranteed against defects in material and quality of manufacture when used in the proper manner. Onsrud Cutter will repair or replace tools, which have been authorized for return, if upon inspection such tools are found to be defective due to material or manufacture.

Router Laboratory – Customers, as a routine, send us panels (2' x 2') with router and feed specifications several weeks prior to the start of a new run. (We are able to duplicate most production environments in the Router Laboratory.) Armed with material, router type, spindle speed, feed rate, set up and type of cut to be made, Onsrud Cutter can make a specific tool recommendation for test and evaluation in your operational environment. Should you have difficult-to-cut material or should you wish to verify your current tool selection, call the Onsrud Cutter Engineering Department and arrange for a Router Laboratory test.

GENERAL GUIDELINES FOR TOOL MATERIAL AND GEOMETRY

TOOL MATERIALS

Solid Carbide Use for fibrous or abrasive plastics.

Carbide Tipped Use for general plastic cutting applications.

High Speed Steel Use for optimum surface finish.

TOOL GEOMETRY

Straight Flute Use for plastic hand feed applications.

Spiral Flute Use for plastic automatic feed applications.

FLUTE GEOMETRY

Single Flute Use for faster feed rates in softer materials.

Double Flute Use for better finish in harder materials.

Upcut Spiral Use for grooving or slotting, for upward chip evacuation and best finish on bottom side of piece part.

Downcut Spiral Use for downward chip flow, better hold down in fixture and best finish on top side of piece part.

Up/Down Spiral Use for double laminated material and best finish on top and bottom side of piece part.

Technical Data

TOOL SELECTION

TOOL MATERIAL

- Solid Carbide: Primarily used in CNC operations. Material provides best rigidity and long tool life.
- Carbide Tipped: Incorporates the wear resistance of carbide and the toughness of a HSS body-mainly hand held.
- HSS: Primarily used in hand routing. Material provides a tough body and sharper cutting edge. Good in CNC.

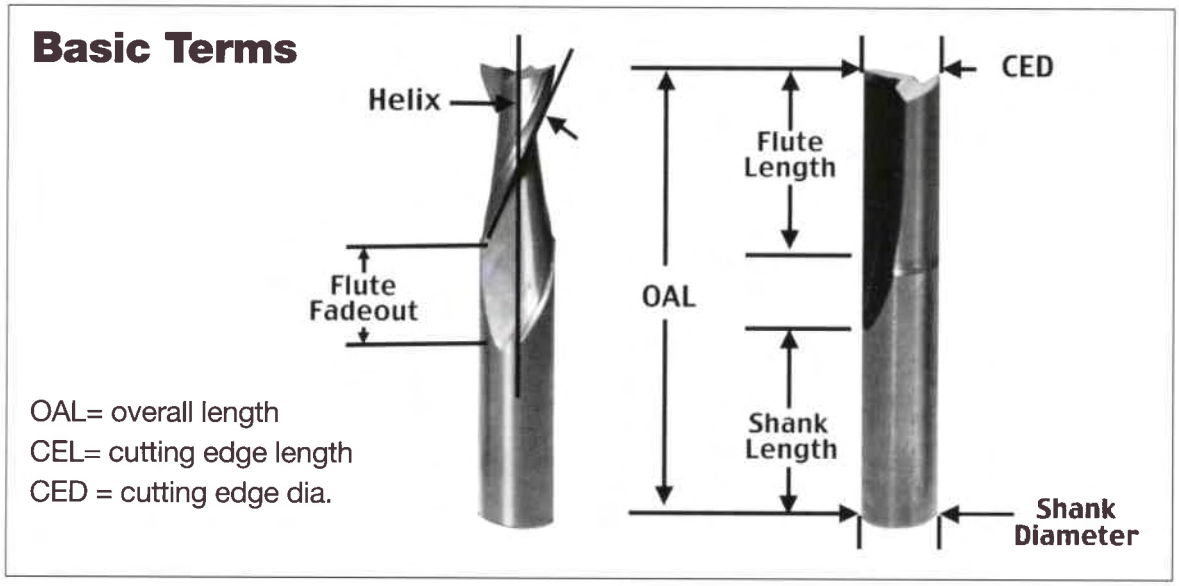
FLUTE GEOMETRY

- Straight flute: Offers a neutral cutting action - highest force
- Upcut flute: Provides the best surface finish and allows for good chip extraction. May cause part lifting if vacuum or fixturing is not sufficient.
- Downcut flute: Provides a downward force which helps eliminate part lifting. Chip rewelding MAY occur if there is no space below the part for chip expansion.
- Compression: Used for laminated materials, produces a good top and bottom finish on the part.

NUMBER OF FLUTES

- Single Flute: Allows for larger chiploads in softer materials
- Double Flute: Allows for better part finish in harder materials.
- Multiple Flutes: Allows for an even better part finish in harder materials.

Note: As the number of cutting edges increase, your feed rate should increase to prevent burning and premature tool dulling.



OPTIMIZING SPEED AND FEEDS

1. Start off using the recommended chipload and RPM for the material you are cutting.
2. Increase the feedrate until the part finish starts to decrease or you risk moving the part off the vacuum. Decrease the feed by 10%.
3. Next decrease your RPM by a set increment until your surface finish deteriorates again. Once this happens increase your RPM until the finish is acceptable.
4. You have now optimized your speed and feed by taking the largest chip possible.

Note: This should be done in the first sheet of material to prevent tool dulling due to excessive heat.

TOOL HEAT

If a feed rate is too low, heat will be generated causing the cutting edge to break down and dull quickly. To check this, run a nest of parts and stop the spindle. When the spindle has stopped rotating, carefully feel the tool's temperature. It should be at or near room temperature. If the tool is hot, review "Optimizing Speed and Feeds".

Technical Data

FIXTURING METHODS

FLOW THROUGH VACUUM

This style uses LDF (Low Density Fiberboard) or MDF (Medium Density Fiberboard) as a sacrificial surface for sheet material to be cut on. The porous nature of LDF or MDF allows vacuum to pass through allowing the material to be held in place for machining. As parts are cut out of the sheet material, vacuum loss starts to occur from the slot produced by the cutting tool. This can lead to part lifting or movement especially in small parts. Cutter diameter will also influence part movement. A 1/2 diameter tool will exert 25% more lateral pressure than a 3/8 diameter tool.

When cutting small parts in sheet material, one may want to consider tab or skin cutting to prevent part movement.

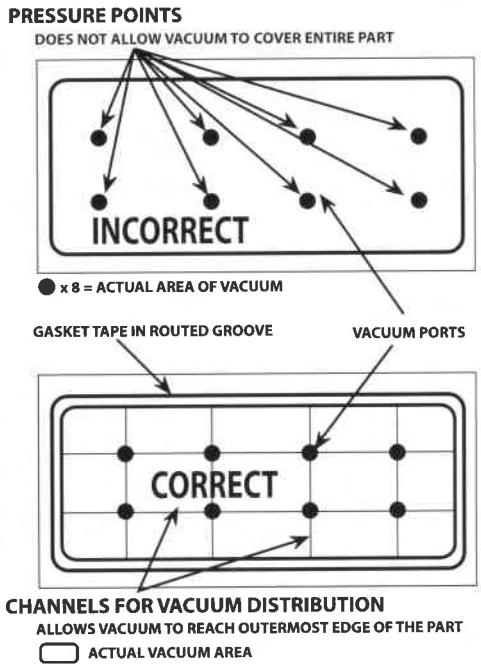
DEDICATED SPOILBOARD

Dedicated spoilboards are used for reoccurring production runs where optimal cycle times are needed. This work holding method creates vacuum chambers in the sacrificial board specifically to the shape of the parts being cut. This elimination of vacuum loss relates to improved cycle times and part finish.

STEPS TO CREATE A DEDICATED SPOILBOARD:

1. Surface both sides of your MDF board
2. Lay out the part pattern on the MDF and determine quantity that will fit.
3. Cut the part profile into the MDF board using a larger diameter tool than would normally cut the part. Make your slot depth 1 to 1.5 times the cutter diameter.
4. A gasket groove must be cut next inside the part profile to create a vacuum seal. The groove should be 1/2 the gasket material thickness to allow for proper compression.
5. A grid pattern must then be cut inside the gasket groove to distribute the vacuum evenly through out the vacuum area.
6. Drill holes through out the pattern in the intersections of the vacuum grid until there is no resistance on your vacuum gage on the machine table.
7. Seal the board using rubberized coatings, polyurethane sealers or a sanding sealer to prevent vacuum from passing through the board in unwanted areas.
8. Apply the gasket tape.

Proper Spoilboard Techniques



This operations sounds time consuming. It will be for your first board. Once you become familiar making these fixtures, you will make up for it in your cycle time reductions and part finish. A lot of headaches and problems can be resolved by using the proper work holding.

RAISED SPOILBOARD

This is generally used where secondary operations are needed and the spoilboard will interfere with the secondary tool.
Raised spoilboards are another type of fixturing that works well for routing parts such as circles from squares where the scrap or off-fall is of such a size to be potentially harmful to the tool and or operator when it is cut free. A raised spoilboard should make sure the off-fall would not interfere with the first and second tool and that the off-fall would be free and clear of the tool path.

SURFACING SPOILBOARDS

When creating new fixtures or using a new MDF sheet, the spoilboard must be surfaced to level the board to the machine table. This consists using a large diameter cutter (OC 91-100 series) to quickly level the entire surface.

The following benefits will be achieved by surfacing your spoilboard:

- Leveling material to get consistent cuts.
- Remove grooves caused by routing.
- Reduce vacuum loss due to clogged pores at the material surface due to dust and chips.
- Preventing material warpage caused by humidity in summer time.

Technical Data

COLLETING

COLLET LIFE SPAN

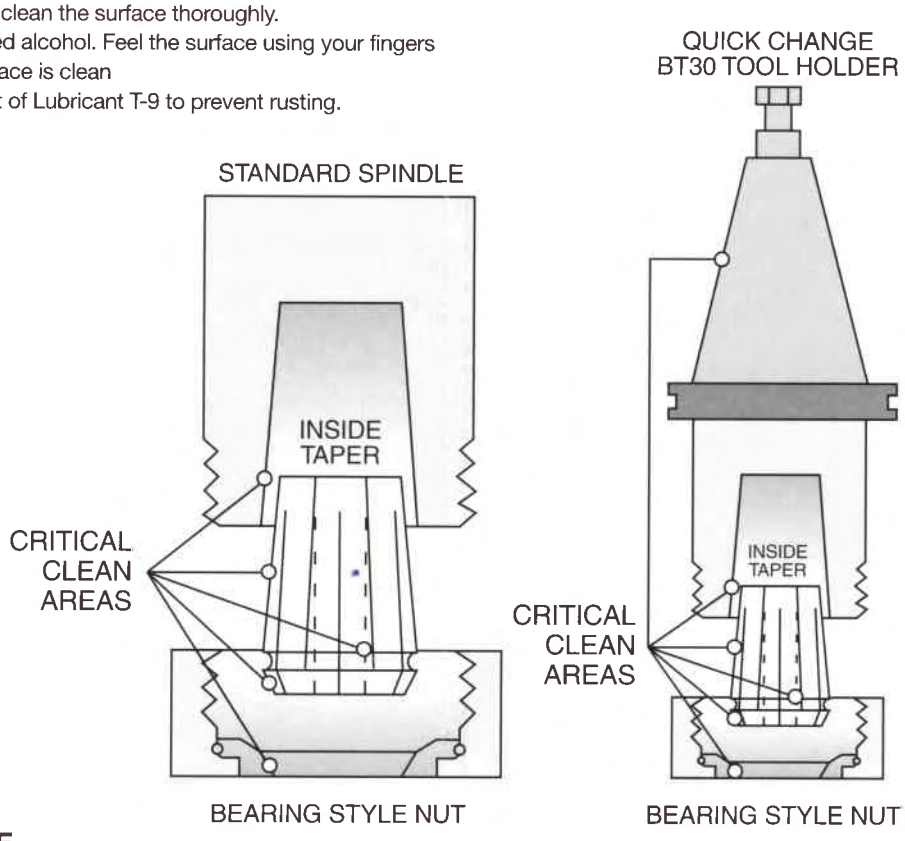
Collets have a life span of 3 months if used 8 hours a day. Replacing the collets will ensure your operation runs consistently and prevents tool breakage. When inserting a tool into the collet make sure the flute fadeout does not enter the collet. This will cause run out and potentially lead to tool breakage. To ensure proper clamping the tool shank should fill, at the minimum, 80% of the depth of the collet. If this can not be achieved, use a collet life plug to ensure a proper clamping effect.

COLLET MAINTENANCE

Cleaning is an essential part of collet maintenance. As material is cut it causes the collet, tool holder, collet nut and spindle to become dirty. This causes your tool to cut in an elliptical fashion which will decrease tool life and cause inconsistency in your operation. Collets, tool holder, and collet nut should be cleaned daily using the Rust Free solvent and a brass brush (OC series 33-21 and 33-10). Refer to the critical areas diagram to see which surfaces must be clean.

CLEANING INSTRUCTIONS

1. Spray the cleaner on the surface and allow it to soak for a minute
2. Use a brass brush to clean the surface thoroughly.
3. Rinse off using distilled alcohol. Feel the surface using your fingers to make sure the surface is clean
4. Apply a small amount of Lubricant T-9 to prevent rusting.



TOOL BREAKAGE

If a condition arises where multiple tools should break, follow these steps to solve your problem:

1. Are you using the proper tool for the job?
2. Make sure your collets and tool holders are clean and the tool is colleted properly.
3. Check your speed and feed (is your tool hot?)
4. Is your depth of cut too excessive for the material you're cutting?
5. Do you have any part movement?
6. Do you have ample part hold down?
7. Stop running parts and check with your distributor or Onsrud's Technical Support.

If you have to contact your distributor or Technical Support, have the following information:

1. Machine being used.
2. Material being cut.
3. Part number of tool along with the batch number which is below the part number.
4. Speed / Feed / Depth of cut.
5. Where did the tool break (flute, shank, or in the collet)?
6. How long did the tool work before it broke?
7. Have you done this operation in the past using this tool?

SW Soft Wood Cutting Data

APPLICATION	GOOD	BETTER	BEST
Single Pass	82-200	60-100	52-200/57-200
Roughing	52-700	60-000	60-850
Finishing		52-200/57-200	60-200

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter

Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
10-00	1 x D	.004-.006	.004-.006	.005-.007				.007-.009		.008-.010												
15-00	2											.017-.019										
37-50/60	1/2 CED					.001-.003		.002-.004		.003-.005		.003-.005			.005-.007		.007-.009					
37-80	1 x D																.004-.006			.004-.006*		.004-.006**
40-50	1 1/2											.003-.005										
40-000	1 x D			.002-.004	.002-.004	.003-.005		.004-.006	.004-.006	.005-.007												
40-100	1 x D			.005-.007		.005-.007	.005-.007	.006-.008	.006-.008	.007-.009		.008-.010			.010-.012							
52-200/ 57-200	1 x D			.006-.008	.006-.008	.006-.008	.006-.008	.007-.009	.007-.009	.008-.010	.008-.010	.009-.011	.009-.011	.010-.012	.011-.013							
52-400/ 57-400	1 x D				.006-.008	.006-.008		.007-.009	.007-.009	.008-.010		.009-.011										
52-900	1 x D							.007-.009		.008-.010		.009-.011										
56-200	1 x D			.004-.006	.004-.006	.005-.007	.005-.007	.006-.008	.006-.008	.007-.009		.008-.010			.010-.012							
57-800	1 x D							.007-.009		.008-.010		.009-.011										
60-000 (LH)	1 x D									.013-.015		.015-.017		.017-.019	.019-.021							
60-000 (HH)	1 x D									.016-.018		.018-.020		.020-.022	.022-.024							
60-090	1 x D													.005-.007								
60-100	1 x D			.011-.013		.013-.015		.015-.017		.017-.019		.019-.021		.021-.023								
60-100DE	1 x D							.018-.020		.020-.022		.022-.024		.024-.026	.026-.028							
60-100E	1 x D									.017-.019		.019-.021										
60-100C	1 x D									.024-.026		.026-.028		.028-.030	.030-.032							
60-200	1 x D							.005-.007		.006-.008		.007-.009			.008-.010							
60-300	1 x D									.024-.026		.026-.028		.028-.030	.030-.032							
60-350	1 x D									.017-.019		.019-.021			.021-.023							
60-500/ 500M	1 x D											.015-.017		.017-.019	.019-.021							
60-600	1 x D											.019-.021			.023-.025							
60-700	1 x D											.019-.021		.021-.023	.023-.025							
60-800	1 x D									.017-.019		.019-.021		.021-.023	.023-.025							
60-900	1 x D									.017-.019		.018-.020										
60-950	1 x D									.024-.026		.026-.028										
61-000	1 x D			.008-.010	.008-.010	.009-.011	.009-.011	.010-.012	.010-.012	.011-.013	.011-.013	.012-.014										
61-200	1 x D			.008-.010				.010-.012	.010-.012	.011-.013		.012-.014										
64-000/ 65-000	1 x D	.001-.003		.002-.004		.003-.006		.004-.006		.005-.007												
77-100 (DE)	1 x D			.003-.005																		
77-100 (3E)	1 x D							.005-.007														

* = 16,000 RPM
** = 15,000 RPM

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

HW Hard Wood Cutting Data

APPLICATION	GOOD	BETTER	BEST
Single Pass	52-700	52-200/57-200	60-300/60-350
Roughing	52-700	60-000	60-850
Finishing		60-300/60-350	60-200

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter																						
Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
12-00	1 x D			.002-.004	.002-.004		.003-.005	.003-.005		.004-.006	.005-.007	.005-.007				.010-.012						
37-50/60	1/2 CED					.002-.004		.002-.004		.002-.004		.003-.005			.005-.007		.007-.009					
37-80	1 x D																.004-.006			.004-.006*		.004-.006**
40-50	1 1/2											.003-.005										
40-000	1 x D			.006-.008	.006-.008	.007-.009		.008-.010	.008-.010	.009-.007		.010-.012										
40-100	1 x D			.004-.006		.005-.007	.005-.007	.005-.007	.006-.008	.006-.008		.007-.009			.009-.011							
48-000	1 x D					.004-.006		.005-.007	.005-.007	.005-.007		.006-.008		.007-.009	.008-.010	.009-.011	.010-.012	.011-.013	.012-.014	.013-.015	.014-.016	.015-.017
52-200/ 57-200	1 x D			.003-.005	.003-.005	.004-.006	.004-.006	.005-.007	.005-.007	.006-.008	.006-.008	.007-.009	.007-.008	.008-.010	.009-.011							
52-400/ 57-400	1 x D				.004-.006	.004-.006		.005-.007	.005-.007	.006-.008		.007-.009										
52-900	1 x D							.006-.008		.007-.009		.007-.009										
56-200	1 x D			.003-.005	.003-.005	.004-.006	.004-.006	.005-.007	.005-.007	.006-.008		.007-.009			.009-.011							
57-900	1 x D							.005-.007		.006-.008		.007-.009										
60-000 (LH)	1 x D									.013-.015		.014-.016		.016-.018	.017-.019							
60-000 (HH)	1 x D									.015-.017		.017-.019		.019-.021	.021-.023							
60-090	1 x D													.005-.007								
60-100	1 x D			.010-.012		.012-.014		.014-.016		.016-.018		.018-.020		.020-.022	.022-.024							
60-100DE	1 x D							.014-.016		.016-.018		.018-.020		.020-.022	.022-.024							
60-100SE	1 x D									.016-.018		.018-.020										
60-100C	1 x D									.019-.021		.021-.023		.023-.025	.025-.027							
60-500/ 500M	1 x D											.013-.015		.015-.017	.016-.018							
60-600	1 x D											.018-.020			.022-.024							
60-700	1 x D											.018-.020		.020-.022	.022-.024							
60-800	1 x D									.017-.019		.019-.021		.021-.023	.023-.025							
60-900	1 x D									.015-.017		.017-.019			.019-.021							
60-950	1 x D									.019-.021		.021-.023										
61-200	1 x D			.007-.009				.009-.011	.009-.011	.010-.012												
64-000/ 65-900	1 x D	.001-.003		.002-.004		.003-.005		.004-.006		.005-.007												
77-100 (DE)	1 x D			.003-.005																		
77-100 (3E)	1 x D							.005-.007														

* = 16,000 RPM
** = 15,000 RPM

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

MDF Cutting Data

APPLICATION	GOOD	BETTER	BEST
Single Pass	52-200/57-200	60-300/60-350	60-100
Roughing		60-000	60-850
Finishing		60-300/60-350	60-200

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter																					
Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
13-50	1 x D											.013-.015			.016-.018							
37-50/60	1/2 DED					.001-.003		.001-.003		.002-.004		.003-.005			.005-.007		.007-.009					
37-80	1 x D																.004-.006			.004-.006*		.004-.006**
40-50	1 1/2											.003-.005										
47-80	1 x D															.004-.006			.004-.006	.004-.006		
48-000	1 x D					.004-.006		.005-.007	.005-.007	.005-.007		.006-.008		.006-.008	.007-.009	.008-.010	.009-.011					
48-700	1 x D							.005-.007		.005-.007		.006-.008		.006-.008	.007-.009		.009-.011					
52-200/ 57-200	1 x D			.005-.007	.005-.007	.006-.008	.006-.008	.006-.008	.006-.008	.007-.009	.007-.009	.008-.010	.008-.010	.009-.011	.009-.011							
52-400/ 57-400	1 x D				.003-.005	.004-.006		.005-.007	.005-.007	.006-.008		.008-.010	.009-.011	.010-.012	.011-.013	.012-.014						
52-600	1 x D							.006-.008		.007-.009		.008-.010										
56-200	1 x D			.003-.005	.003-.005	.004-.006	.004-.006	.005-.007	.005-.007	.006-.008		.007-.009			.009-.011							
57-600	1 x D							.006-.008		.007-.009		.008-.010										
60-000 (LH)	1 x D									.012-.014		.013-.015		.014-.016	.016-.018							
60-000 (HH)	1 x D									.017-.019		.018-.020		.020-.022	.023-.025							
60-090	1 x D													.004-.006								
60-100	1 x D			.010-.012		.010-.012		.013-.015		.014-.016		.016-.018		.017-.019	.019-.021							
60-1000E	1 x D							.013-.015		.014-.016		.016-.018		.018-.020	.019-.021							
60-1003E	1 x D									.014-.016		.016-.018			.018-.020							
60-100C	1 x D									.017-.019		.018-.020		.020-.022	.023-.025							
60-200	1 x D							.004-.006		.005-.007		.005-.007			.006-.008							
60-300	1 x D									.017-.019		.018-.020		.020-.022	.023-.025							
60-350	1 x D									.014-.016		.016-.018		.017-.019	.019-.021							
60-500/ 500M	1 x D											.014-.016		.016-.018	.018-.020							
60-600	1 x D											.020-.022		.022-.024	.024-.026							
60-700	1 x D											.020-.022		.022-.024	.024-.026							
60-800	1 x D									.017-.019		.019-.021		.021-.023	.023-.025							
60-900	1 x D									.017-.019		.019-.021										
60-950	1 x D									.017-.019		.018-.020										
61-200	1 x D			.007-.009		.008-.010		.009-.011	.009-.011	.010-.012		.011-.013										
62-200	1 x D			.010-.012		.011-.013		.012-.014	.012-.014	.013-.015		.014-.016										
64-200/ 65-200	1 x D	.001-.003		.002-.004		.003-.005		.004-.006		.005-.007												
68-100	1 x D									.008-.010		.012-.014		.015-.017	.018-.020							
77-100 (DE)	1 x D			.003-.005																		
77-100 (3E)	1 x D							.005-.007														

* = 18,000 RPM
** = 15,000 RPM

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

Soft Plywood Cutting Data

APPLICATION	GOOD	BETTER	BEST
Single Pass	60-300/60-350	60-100	60-100C
Roughing	60-800	60-000	60-850
Finishing		60-300/60-350	60-200

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter																			
Series	Cut	1/16	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2	2
13-50	1 x D										.016-.018			.018-.020						
37-50/60	1/2 CED				.001-.003		.002-.004		.002-.004		.003-.005			.004-.006		.006-.008				
37-80	1 x D															.004-.006			.004-.006*	.004-.006**
40-50	1 1/2										.003-.005									
48-000	1 x D				.005-.007		.005-.007	.006-.008	.006-.008		.007-.009		.008-.010	.009-.011	.010-.012	.011-.013	.012-.014	.013 - .015		
48-700	1 x D						.005-.007				.007-.009			.009-.011		.011-.013				
56-200	1 x D		.003-.005	.003-.005	.004-.006	.004-.006	.005-.007	.005-.007	.006-.008		.007-.009			.009-.011						
60-000 (LH)	1 x D								.014-.016		.016-.018		.018-.020	.020-.022						
60-000 (HH)	1 x D								.017-.019		.019-.021		.021-.023	.023-.025						
60-090	1 x D												.003-.005							
60-100	1 x D		.013-.015		.014-.016		.015-.017		.016-.018		.018-.020		.020-.022	.022-.024						
60-100DE	1 x D						.017-.019		.019-.021		.021-.023		.023-.025	.025-.027						
60-100SE	1 x D								.020-.022		.022-.024			.024-026						
60-100C	1 x D								.022-.024		.024-.026		.026-.028	.028-.030						
60-300	1 x D								.022-.024		.024-.026		.026-.028	.028-.030						
60-350	1 x D								.020-.022		.022-.024		.024-.026	.026-.028						
60-500/ 500M	1 x D										.021-.023		.023-.025	.025-.027						
60-600	1 x D										.028-.030		.030-.032	.032-.034						
60-700	1 x D										.028-.030		.030-.032	.032-.034						
60-800	1 x D								.017-.019		.019-.021		.021-.023	.023-.025						
60-900	1 x D								.017-.019		.019-.021									
60-950	1 x D								.022-.024		.024-.026									
61-200	1 x D		.006-.008		.007-.009		.008-.010	.008-.010	.009-.011		.010-.012									
64-000/ 65-000	1 x D	.001-.003	.002-.004		.003-.005		.004-.006		.005-.007											
68-100									.010-.012		.012-.014		.017-.019	.018-.020						

* = 16,000 RPM
** = 15,000 RPM

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

Hard Plywood Cutting Data

APPLICATION	GOOD	BETTER	BEST
Single Pass	60-300/60-350	60-100	60-100C
Roughing	60-800	60-000	60-850
Finishing		60-300/60-350	60-200

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter

Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
13-50	1 x D											.016-.018			.018-.020							
37-50/60	1/2 CED					.001-.003		.001-.003		.002-.004		.003-.005			.005-.007		.007-.009					
37-80	1 x D																.004-.006			.004-.006*		.004-.006**
40-50	1 1/2											.003-.005										
48-000	1 x D					.004-.006		.005-.007	.005-.007	.006-.008		.007-.009		.008-.010	.009-.011	.010-.012	.011-.013	.012-.014	.013-.015			
48-700	1 x D							.005-.007				.007-.009			.009-.011		.011-.013					
56-200	1 x D			.003-.005	.003-.005	.004-.006	.004-.006	.005-.007	.005-.007	.006-.008		.007-.009			.009-.011							
60-000 (LH)	1 x D									.014-.016		.016-.018		.018-.020	.020-.022							
60-000 (HH)	1 x D									.017-.019		.019-.021		.021-.023	.023-.025							
60-090	1 x D													.003-.005								
60-100	1 x D			.012-.018		.012-.018		.014-.016		.016-.018		.018-.020		.020-.022	.022-.024							
60-100DE	1 x D							.014-.016		.016-.018		.018-.020		.020-.022	.022-.024							
60-100SE	1 x D									.020-.022		.022-.024			.026-.028							
60-100C	1 x D									.019-.021		.021-.023		.023-.025	.025-.027							
60-300	1 x D									.019-.021		.021-.023		.023-.025	.025-.027							
60-350	1 x D									.018-.020		.020-.022		.022-.025	.024-.026							
60-500/ 500M	1 x D											.039-.041		.043-.045	.047-.049							
60-600	1 x D											.027-.029		.030-.032	.032-.034							
60-700	1 x D											.027-.029		.029-.031	.032-.034							
60-800	1 x D									.017-.019		.019-.021		.021-.023	.023-.025							
60-900	1 x D									.017-.019		.019-.021										
60-950	1 x D									.019-.021		.021-.023										
61-200	1 x D			.005-.007				.007-.009	.007-.009	.008-.010		.009-.011										
64-000/ 65-000	1 x D	.001-.003		.002-.004		.003-.005		.004-.006		.005-.007												
68-100	1 x D									.010-.012		.012-.014		.017-.019	.018-.020							

* = 16,000 RPM
** = 15,000 RPM

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

LW | Laminated Chipboard Cutting Data

APPLICATION	GOOD	BETTER	BEST
Single Pass	60-100	60-100MW	60-100C
Roughing			60-850

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter																
Series	Cut	1/8	3/16	7/32	1/4	5/16	3/8	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2	2
13-50	1 x D							.017-.019			.019-.021						
37-80	1 x D												.004-.006			.004-.006*	.004-.006**
48-000	1 x D		.005-.007	.005-.007	.006-.008	.006-.008	.007-.009	.008-.010		.009-.011	.010-.012	.011-.013	.012-.014	.013-.015	.014-.016		
60-100	1 x D	.013-.015	.014-.016		.015-.017		.016-.018	.018-.020		.019-.021	.021-.023						
60-100 (DE)	1 x D				.017-.019		.019-.021	.021-.023		.025-.027	.027-.029						
60-100 (3E)	1 x D						.020-.022	.022-.024			.024-.026						
60-100C	1 x D						.022-.024	.024-.026		.026-.028	.028-.030						
60-500/500M	1 x D							.021-.023		.023-.025	.025-.027						
60-600	1 x D							.028-.030		.030-.032	.032-.034						
68-100	1 x D						.008-.010	.012-.014		.016-.018	.019-.021						

* = 16,000 RPM
** = 15,000 RPM

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

LW Laminated Plywood Cutting Data

APPLICATION	GOOD	BETTER	BEST
Single Pass	60-100	60-100MW	60-100C
Roughing			60-850

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter

Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
13-50	1 x D											.014-.016			.018-.020							
37-80	1 x D																.004-.006			.004-.006*		.004-.006**
48-000	1 x D					.004-.006	.005-.007	.005-.007	.006-.008	.006-.008		.007-.009		.009-.011	.010-.012	.011-.013	.012-.014	.013-.015	.014-.016			
60-100	1 x D			.013-.015		.014-.016		.015-.017		.016-.018		.018-.020		.019-.021	.021-.023							
60-100DE	1 x D							.015-.017		.016-.018		.018-.020		.019-.021	.021-.023							
60-1003E	1 x D									.018-.020		.020-.022			.022-.024							
60-100C	1 x D									.019-.021		.021-.023		.023-.025	.025-.027							
60-500/ 500M	1 x D											.019-.021		.021-.023	.023-.025							
60-600	1 x D											.027-.029		.030-.032	.032-.034							
68-100	1 x D									.008-.010		.012-.014		.016-.018	.019-.021							
77-100 (DE)	1 x D			.003-.005																		
77-100 (3E)	1 x D							.005-.007														

* = 16,000 RPM
** = 15,000 RPM

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

Soft Plastic Cutting Data

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

1/2" DIAMETER TOOL

APPLICATION	GOOD	BETTER	BEST
Single Pass	61-000P	65-000	63-750
Roughing			60-000
Finishing			60-200

1/2" DIAMETER TOOL

APPLICATION	GOOD	BETTER	BEST
Single Pass	56-600	52-700	52-600
Roughing		82-100	60-000
Finishing			60-200

CHIP LOAD PER TOOTH

Cutting Edge Diameter

Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
10-00	1 x D	.002 - .004		.004 - .006		.006 - .008		.006 - .008		.007 - .009		.008 - .010										
38-50/ 38-60	1 x D			.001 - .003		.002 - .004		.003 - .005		.004 - .006		.005 - .007		.006 - .008	.007 - .009							
52-200B/BL	1 x D	.002 - .004		.002 - .004		.004 - .006		.004 - .006		.004 - .006		.006 - .008		.010 - .012	.012 - .014							
52-400	1 x D			.002 - .004		.003 - .005		.004 - .008		.005 - .007		.006 - .008		.007 - .009								
52-600	1 x D							.008 - .010		.010 - .012		.012 - .014		.014 - .016	.016 - .018							
52-700	1 x D											.012 - .014		.014 - .016	.016 - .018							
56-430	1 x D			.006 - .008		.006 - .008		.007 - .009		.008 - .010		.009 - .011										
56-600	1 x D			.004 - .006		.006 - .008		.008 - .010		.010 - .012		.012 - .014										
57-600	1 x D							.008 - .010		.010 - .012		.012 - .014		.014 - .016	.016 - .018							
60-000	1 x D									.004 - .006		.006 - .008		.008 - .012	.012 - .016							
60-200	1 x D							.004 - .006		.004 - .006		.006 - .010			.012 - .016							
60-900	1 x D									.004 - .006		.006 - .008										
61-000P	1 x D			.004 - .006		.006 - .008		.008 - .012		.014 - .018		.018 - .022										
61-400	1 x D			.017 - .019		.017 - .019		.018 - .020		.019 - .021		.020 - .021										
62-750	1 x D			.004 - .006		.006 - .008		.008 - .012		.008 - .012		.010 - .014										
62-850	1 x D			.004 - .006		.006 - .008		.008 - .012		.008 - .012		.010 - .014										
63-500	1 x D	.002 - .004		.004 - .006		.005 - .007		.006 - .008		.007 - .009												
63-750	1 x D	.002 - .004		.004 - .006		.006 - .008		.008 - .012		.008 - .012		.010 - .014										
63-850	1 x D	.002 - .004		.004 - .006		.006 - .008		.008 - .012		.008 - .012		.010 - .014										
64-000/ 65-000	1 x D	.002 - .004		.004 - .006		.006 - .008		.008 - .012		.008 - .012												
77-100 (DE)	1 x D			.005 - .007																		
77-100 (SE)	1 x D							.008 - .010														

* = 12,500 RPM

NOTE: To eliminate rewelding increase the feedrate or change to a single edge tool
If using a downcut spiral and chip rewelding occurs, cut a slot in your spoilboard to allow the chips a place to expand
Incorrect chiploads can lead to knife marks occurring

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

Hard Plastic Cutting Data

1/2" DIAMETER TOOL

APPLICATION	GOOD	BETTER	BEST
Single Pass	65-000	63-700	56-000P
Roughing			60-000
Finishing			60-200

1/2" DIAMETER TOOL

APPLICATION	GOOD	BETTER	BEST
Single Pass	52-700	52-600	56-000P
Roughing		82-100	60-000
Finishing		60-200	75-000

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter

Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
52-200B/BL	1 x D	.002 - .004		.002 - .004		.004 - .006		.004 - .006		.004 - .006		.006 - .008		.008 - .010	.010 - .012							
52-600	1 x D							.006 - .008		.008 - .010		.010 - .012		.012 - .014	.014 - .016							
56-000P	1 x D			.002 - .004		.004 - .006		.004 - .006		.006 - .008		.008 - .010										
56-430	1 x D			.005 - .007		.005 - .007		.006 - .008		.007 - .009		.008 - .010										
56-450	1 x D					.005 - .007		.006 - .008		.007 - .009		.008 - .010										
56-600	1 x D			.003 - .005		.005 - .007		.007 - .009		.009- .011		.011 - .013										
57-600	1 x D							.006 - .008		.008 - .010		.010 - .012		.012 - .014	.014 - .016							
60-000	1 x D									.004 - .006		.006 - .008		.008 - .012	.012 - .016							
60-200	1 x D							.004 - .006		.004 - .006		.006 - .010			.012 - .016							
60-900	1 x D									.004 - .006		.006 - .008										
61-000P	1 x D			.003 - .005		.005 - .007		.007 - .011		.013 - .017		.017 - .021										
61-400	1 x D			.014 - .016		.014 - .016		.015 - .017		.016 - .018		.017 - .019										
62-700	1 x D			.006 - .008		.008 - .010		.010 - .012		.010 - .012		.012 - .016										
62-750	1 x D			.004 - .006		.006 - .008		.008 - .012		.008 - .012		.010 - .014										
62-800	1 x D			.006 - .008		.008 - .010		.010 - .012		.010 - .012		.012 - .016										
62-850	1 x D			.004 - .006		.006 - .008		.008 - .012		.008 - .012		.010 - .014										
63-500	1 x D	.002 - .004		.003 - .005		.003 - .005		.004 - .006		.005 - .007												
63-700	1 x D	.002 - .004		.006 - .008		.008 - .010		.010 - .012		.010 - .012		.012 - .016										
63-750	1 x D	.002 - .004		.004 - .006		.006 - .008		.008 - .012		.008 - .012		.010 - .014										
63-800	1 x D	.002 - .004		.006 - .008		.008 - .010		.010 - .012		.010 - .012		.012 - .016										
63-850	1 x D	.002 - .004		.004 - .006		.006 - .008		.008 - .012		.008 - .012		.010 - .014										
64-000/ 65-000	1 x D	.002 - .004		.006 - .008		.008 - .010		.010 - .012		.010 - .012												
77-000	1 x D	.002 - .004		.002 - .004		.006 - .008		.008 - .012														
77-100 (DE)	1 x D			.005 - .007																		
77-100 (3E)	1 x D							.008 - .010														

NOTE: When chip rewelding occurs while cutting soft plastic, increase feedrate or go to a single edge tool. Incorrect chiploads can result in cratering

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

Composite Cutting Data

APPLICATION	GOOD	BETTER	BEST
Finishing			55-000/58-000
Honeycomb	67-300	32-000	30-300
G10/G11 Fiberglass	56-000P	67-000	54-300/55-300
Fiberglass	67-000	67-400	67-200
Phenolic	53-000	56-000P	67-200
Single Pass	56-000P	67-250	68-000

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

		Cutting Edge Diameter																				
Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
48-000	1 x D			.006 - .008		.006 - .008		.007 - .009	.007 - .009	.008 - .010		.009 - .011		.010 - .012	.011 - .013		.012 - .014		.013 - .015	.014 - .016	.015 - .017	.016 - .018
48-000DE	1 x D			.002 - .004		.002 - .004		.003 - .005	.003 - .005	.004 - .006		.005 - .007		.006 - .008	.007 - .009		.008 - .010		.009 - .011	.010 - .012	.011 - .013	.012 - .014
52-000	1 x D			.003 - .005		.003 - .005		.004 - .006		.006 - .008		.010 - .012										
54-000 / 59-000	1 x D			.002 - .004		.002 - .004		.002 - .004		.003 - .006		.005 - .010										
54-300	1 x D									.007 - .009		.008 - .010										
55-000 / 58-000	1 x D			.002 - .004		.002 - .004		.002 - .004		.003 - .006		.007 - .009										
55-300	1 x D									.007 - .009		.008 - .010										
56-000P	1 x D			.002 - .004		.002 - .004		.004 - .006		.004 - .006		.004 - .006										
56-450	1 x D					.002 - .005		.003 - .005	.003 - .006	.004 - .006		.005 - .007										
57-000	1 x D			.003 - .005		.003 - .005		.004 - .006		.006 - .008		.010 - .012										
63-000	1 x D			.003 - .005		.003 - .005		.003 - .005	.004 - .006			.005 - .007										
67-000	1 x D							.004 - .006		.004 - .006		.004 - .006										
67-200	1 x D									.002 - .010		.002 - .010										
67-250	1 x D			.002 - .004				.004 - .006		.004 - .006												
67-300	1 x D							.004 - .006		.006 - .008		.010 - .012										
67-400	1 x D			.002 - .004				.004 - .006		.004 - .006		.004 - .006										
67-500	1 x D			.001 - .003		.001 - .003		.002 - .004	.002 - .004	.003 - .005		.004 - .006										
67-600	1 x D			.002 - .004		.002 - .004		.003 - .005	.003 - .005	.004 - .006		.005 - .007										
68-000	1 x D							.004 - .006		.004 - .006		.004 - .006			.008 - .010							
68-200	1 x D							.0005 - .001		.001 - .002		.001 - .002										

* = 10,000 RPM

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

Aluminum Cutting Data

APPLICATION	GOOD	BETTER	BEST
BLOCK			
Single Pass	63-600	52-000	81-200
Roughing	40-000	52-000	81-200
Finishing		81-200	66-300
Slotting	63-600	52-000	81-200
Profile/Shape			52-200B
SHEET			
Single Pass	40-000	65-000	63-600
EXTRUSION			
Single Pass		81-100	81-000

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter

Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
16-00**	1 x D											.004 - .006					
40-000*	1 x D			.005 - .007		.005 - .007		.006 - .008	.006 - .008	.007 - .009		.008 - .010					
40-100	1 x D			.001 - .003		.001 - .003		.002 - .004	.002 - .004	.003 - .005		.004 - .008			.006 - .008		
52-000	1 x D			.003 - .005		.003 - .005		.004 - .006		.006 - .008		.010 - .012					
52-200B/BL	1 x D	.002 - .004		.003 - .005		.003 - .005		.004 - .006		.006 - .008		.010 - .012		.012 - .014	.014 - .016		
57-000*	1 x D			.003 - .005		.003 - .005		.004 - .006		.006 - .008		.010 - .012					
61-000	1 x D			.001 - .003		.002 - .005		.002 - .005		.003 - .007		.007 - .009					
62-600	1 x D	.002 - .004		.002 - .004		.003 - .006		.003 - .006	.003 - .006	.004 - .008		.008 - .010					
63-000	1 x D			.006 - .008		.006 - .008		.007 - .009	.007 - .009	.008 - .010		.009 - .011					
63-600	1 x D	.002 - .004		.002 - .004		.003 - .006		.003 - .006	.003 - .006	.004 - .008		.008 - .010					
63-900	1 x D	.002 - .004		.002 - .004		.003 - .006		.003 - .006	.003 - .006	.004 - .008		.008 - .010					
64-000/ 65-000	1 x D	.002 - .004		.002 - .004		.003 - .006		.003 - .006		.004 - .008							
77-100(DE)				.002 - .004													
77-100(3E)								.003 - .005									
81-100	1 x D								.002 - .005	.003 - .008		.003 - .008					

* 16,000 RPM

** Aluminum Extrusion or Aluminum UAD Doors/Windows

NOTE: When cutting soft aluminum a squirt of cutting fluid every now and then will help to eliminate chip rewelding and improve surface finish

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

Specialty Tool Chiploads

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Material: Foam

Cutting Edge Diameter																					
Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
12-00	1 x D			.0005 - .002		.0005 - .002		.001 - .003	.001 - .003	.002 - .004		.003 - .005		.004 - .006	.005 - .007		.006 - .008		.007 - .009			
13-50	1"											.015 - .017			.017 - .019							
40-550	1 x D											.004 - .006										
48-300	1 x D			.002 - .004		.002 - .004		.003 - .005	.003 - .005	.004 - .006		.005 - .007		.006 - .008	.007 - .009		.010					.010 - .012
52-550	1 x D			.002 - .004		.002 - .004		.004 - .006	.004 - .006	.004 - .006												

Material: Wood

Cutting Edge Diameter																						
Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
37-00/ 37-20	Varies							.004-.006														
37-50	1/2 CED					.003 - .006		.003 - .006		.003 - .006												
37-60	1/2 CED									.004 - .006		.004 - .006			.006 - .008		.008 - .010					
37-80	Varies																.001 - .003		.001 - .003			.001 - .003

Material: Plastic

Cutting Edge Diameter																						
Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
37-00/ 37-20	Varies							.004-.006														
37-50*	1 x D					.003 - .006		.003 - .006		.003 - .006												
37-60*	1 x D									.004 - .006		.004 - .006			.006 - .008		.008 - .010					
37-80	Varies																.001 - .003		.001 - .003			.001 - .003
66-000	1 x D							.004 - .008		.004 - .008		.004 - .008										
66-200	1 x D							.004 - .006		.006 - .008												
66-300	1 x D			.002 - .004				.004 - .006		.006 - .008		.006 - .008										
66-350	1 x D			.002 - .004				.004 - .006		.006 - .008		.006 - .008										
75-000	1 x D									.001 - .002		.0005 - .002			.001 - .002		.001 - .002					
77-000	1 x D	.002 - .004		.002 - .004		.006 - .008		.008 - .012														

Material: Aluminum

Cutting Edge Diameter																						
Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
37-00/ 37-20	Varies							.004-.006														
37-80	Varies																.001 - .003		.001 - .003			.001 - .003
66-200	1 x D							.004 - .006		.006 - .008												
66-300	1 x D			.002 - .004				.004 - .006		.006 - .008		.006 - .008										
66-350	1 x D			.002 - .004				.004 - .006		.006 - .008		.006 - .008										
77-025	1 x D	.002 - .004		.002 - .004		.003 - .006		.003 - .006														

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS: IPM = Inches Per Minute
IPR = Inches Per Revolution

Solid Surface Cutting Data

DEPTH OF CUT: 1 x D Use recommended chip load
2 x D Reduce chip load by 25%
3 x D Reduce chip load by 50%

CHIP LOAD PER TOOTH

Cutting Edge Diameter																	
Series	Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
37-50	1 x D					.003 - .006		.003 - .006		.003 - .006							
37-60	1 x D									.004 - .006		.004 - .006			.006 - .008		.008 - .010
52-000	1 x D			.003 - .006		.003 - .006		.004 - .006		.008 - .010		.012 - .014					
52-200B/BL	1 x D	.002 - .004		.002 - .004		.002 - .004		.004 - .006		.004 - .006		.006 - .008		.008 - .010	.010 - .012		
52-400	1 x D			.002 - .004		.002 - .004		.003 - .005		.004 - .006		.005 - .007					
52-600	1 x D							.004 - .006		.006 - .008		.008 - .010		.008 - .010	.010 - .012		
56-000P	1 x D			.002 - .004		.002 - .004		.004 - .006		.006 - .008		.008 - .010					
56-450	1 x D			.002 - .004		.002 - .004		.003 - .005		.004 - .006		.005 - .007					
57-000	1 x D			.002 - .004		.002 - .004		.003 - .005		.004 - .006		.005 - .007					
57-200	1 x D			.002 - .004		.002 - .004		.003 - .005		.004 - .006		.005 - .007		.006 - .008	.007 - .009		
57-400	1 x D			.002 - .004		.002 - .004		.003 - .005		.004 - .006		.005 - .007		.006 - .008	.007 - .009		
57-600	1 x D							.004 - .006		.006 - .008		.008 - .010		.008 - .010	.010 - .012		
60-200	1 x D							.002 - .004		.002 - .006		.002 - .006		.004 - .008			
62-700	1 x D			.002 - .004		.004 - .006		.006 - .010		.006 - .010		.010 - .012					
62-750	1 x D			.002 - .004		.004 - .006		.006 - .010		.006 - .010		.010 - .012					
62-800	1 x D			.002 - .004		.004 - .006		.006 - .010		.006 - .010		.010 - .012					
62-850	1 x D			.002 - .004		.004 - .006		.006 - .010		.006 - .010		.010 - .012					
63-700	1 x D	.002 - .003		.002 - .004		.004 - .006		.006 - .010		.006 - .010		.010 - .012					
63-750	1 x D	.002 - .003		.002 - .004		.004 - .006		.006 - .010		.006 - .010		.010 - .012					
63-800	1 x D	.002 - .003		.002 - .004		.004 - .006		.006 - .010		.006 - .010		.010 - .012					
63-850	1 x D	.002 - .003		.002 - .004		.004 - .006		.006 - .010		.006 - .010		.010 - .012					
64-000/ 65-000	1 x D	.002 - .004		.006 - .008		.008 - .010	.010 - .012	.010 - .012		.010 - .012							
66-000	1 x D							.002 - .004		.003 - .005		.004 - .006					

FORMULAS: Chip Load = Feed Rate / (RPM x # of cutting edges)
Feed Rate (IPM) = RPM x # of cutting edges x chip load
Speed (RPM) = Feed Rate / (# of cutting edges x chip load)

DEFINITIONS:
IPM = Inches Per Minute
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Drilling Cutting Data

Drill Diameter																	
Series		SFM	3	1/8	3/16	5	6	1/4	5/16	8	3/8	7/16	1/2	5/8	3/4	7/8	1
67-800	Composites	230		.001 - .003	.001 - .003			.002 - .004	.002 - .004		.003 - .005	.003 - .005	.003 - .005				
68-900	Composites	230		0.001				0.0015			0.0015		0.0015				
70-500	Plastic	200		.019 - .021				.021 - .023			.023 - .025		.025 - .027	.027 - .029	.029 - .031	.031 - .033	.033 - .035
72-000*	Wood		.009 - .011			.011 - .013	.013 - .015			.015 - .017							
86-000	Kevlar	230		0.0005	0.0005			0.001	0.001		0.001	0.001	0.001				
86-100	Composites	165		0.001				0.0015			0.0015		0.0015				

* Gang drills run at 4,500 RPM and 150 IPM

FORMULAS: RPM = (3.82 x SFM) / tool dia.
Feedrate (IPM) = RPM x IPR

DEFINITIONS:
IPM = Inches Per Minute
IPR = Inches Per Revolution

RESHARPENING MODIFICATIONS

DISTRIBUTOR _____

DISTRIBUTOR NUMBER _____

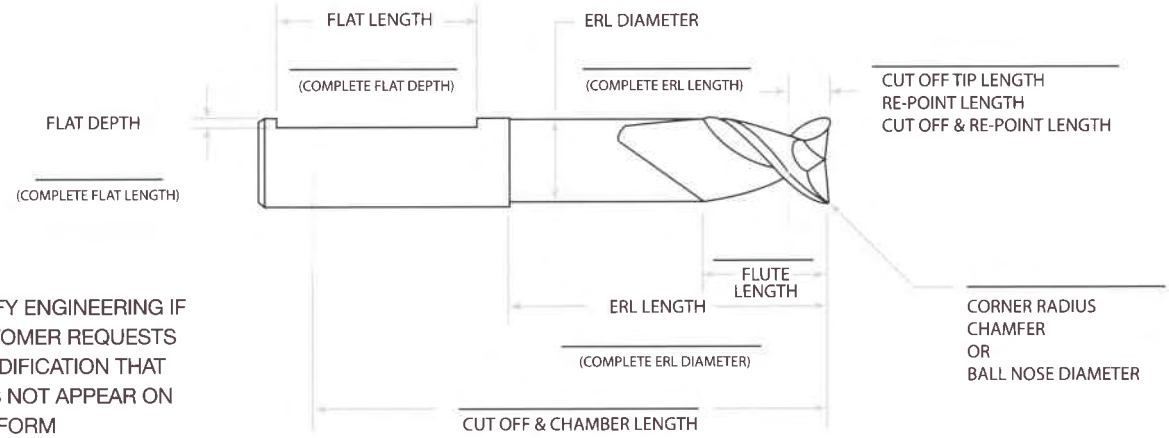
DISTRIBUTOR PO NUMBER _____

DATE _____

TOOL TO BE MODIFIED (PART NUMBER) _____

QUANTITY _____

SALES ORDER NUMBER _____



NOTE: NOTIFY ENGINEERING IF CUSTOMER REQUESTS A MODIFICATION THAT DOES NOT APPEAR ON THIS FORM

INSIDE SALES SIGNATURE _____ DATE & TIME _____

OPERATOR SIGNATURE _____ DATE & TIME _____

INSPECTION SIGNATURE _____ DATE & TIME _____

NOTES: _____

_____

_____

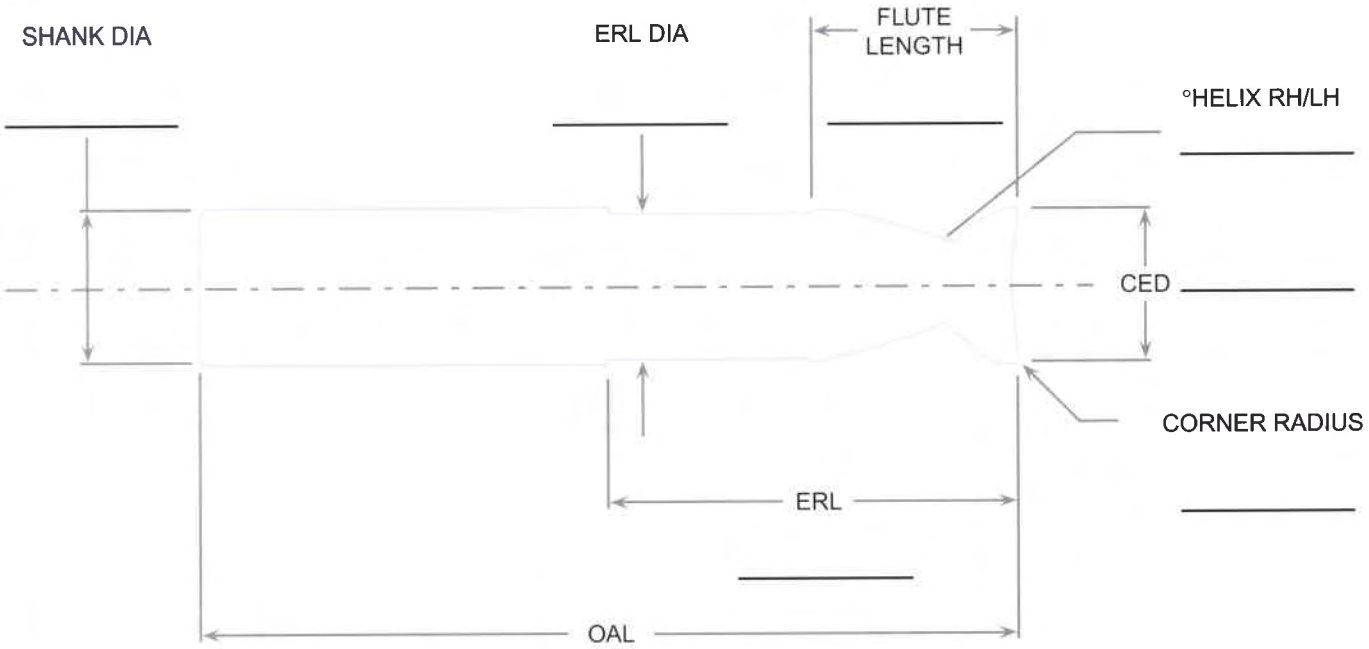
Tool Modification Instructions

- Complete form
- Fax to Onsrud with purchase order number.
- Orders must be received before 2:30 PM (Central time) in order to ship the following day.
- You will receive a confirmation fax

TOOL MODIFICATION

Part Number	Description
BALLNOSE	RADIUS: _____
RADIUS	DIAMETER: _____
CHAMFER	CUT OFF AND CHAMFER
CUT-REPOINT	CUT OFF TIP AND REPOINT
CUT-TIP	CUT OFF TIP UNDER 1/8
*ERL/SPNBCK	CEL RQD: _____ DIA: _____
FLAT	FLATS ON SHANK
REPOINT-1/8	REPOINT LESS THAN 1/8"

- Note: ERL price is based on one inch length. Actual ERL length = ERL length - CEL


SHANK DIA
ERL DIA
FLUTE LENGTH
°HELIX RH/LH
CED
CORNER RADIUS
ERL
OAL