National Upholstery Workshop

Tool Selection

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The Upholstery Frame Workshop is sponsored by the Wood Education and Research Center at Princeton, West Virginia. It supports the hardwood forest industry in the states east of the Great Plains. Located in Princeton, West Virginia, www.fs.fed.us/werc

Statement

The work upon which this workshop is based was funded in whole or in part through a grant awarded by the Wood Education and Resource Center, Northeastern Area State and Private Forestry, U.S. Forest Service.

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Tool Materials

- HSS
- Carbide Tipped
- Solid Carbide
- PCD Diamond

Increasing Tool Life

Tougher
Harder
Tool Geometry:

- Tool geometry serves three main functions:
  1. Cutting the chips from the part
  2. Chip management from / to the cutting zone
  3. Produces a usable surface finish on the part
How Geometry Works in Wood

Wood Rout
- Best GP wood tool
- Slight chance of fraying
- Smooth finish

Rougher/Hogger
- Prevents large chips
- Lowest cutting force
- Fastest feed rates
- Scalloped finish

Chipbreaker/Finisher
- Prevents large chips
- Reduced cutting force
- Faster feed rates
- Smooth finish

Finisher
- High cutting force
- Ultra smooth finish
Tool Geometry:

- **Helix** is the angle that the flute twists around the body.
- It controls the chip flow:
  - For chip removal
  - For operator safety
  - For part stabilization
  - Better part edge finish
- It applies force to the parts and the fixtures.
- It applies shear to the part surfaces to make clean edges.
Up Cut Spiral Flute:
- Upcuts pull chips up and away from the cut path.
- Pulls the material into the base of hand routers
- Assist dust collection in removing chips from the cut.
Down Cut Spiral Flute:
- Down cuts push chips down and into the cut path.
- Shears the surfaces down.
- Makes clean dados-slots-mortise style cuts.
- Holds formed parts down to fixtures.
Wood Compression:

- For laminated wood products
- For Plywood
- Shears the chips towards the center of the material
- Many different styles for different production operations
- Mortise style allows for multiple use, profile and mortise cuts with same tool
Wood Chipbreaker/Finisher:

- Cuts with less pressures
- Leaves a rough finish
- Runs faster than standard spiral
- Production tool for many applications
- Good for light spindle loads on smaller or older CNC
- Upcuts, Downcuts & Compressions
Wood Rougher:
- Cuts with less pressures
- Leaves a “profile” finish
- Runs faster than standard spiral
- Production tool for many applications
- Upcuts and Downcuts
Methods of Tool Wear

- Friction
- Fatigue
- Hot Corrosion
- Structural Limits
Carbide Wear

• Solid Carbide bits are made of:
  – 4%-16% Cobalt (Co)
  – 80%-96% Tungsten Carbide (W)
  – Trace amounts of “Special Sauce”

• Cobalt acts as a binder or “glue” for the materials

• Cobalt is very reactive. It would much rather bond with other reactive substances than with carbide. This is called HOT CORROSION.
Chipload

CHIPLOAD = THICKNESS OF CHIP REMOVED

\[
\text{CHIPLOAD} = \frac{\text{FEED RATE}}{\text{RPM} \times \text{FLUTES}}
\]

- To INCREASE Chipload:
  - Increase FEED RATE
  - Decrease RPM
  - Use less FLUTES

- To DECREASE Chipload
  - Decrease FEED RATE
  - Increase RPM
  - Use more FLUTES
Reducing Heat

FACT: As chip size increases, the \(\frac{\text{VOLUME}}{\text{SURFACE AREA}}\) ratio increases.

FACT: The larger that ratio, the more heat a chip can store.

FACT: As chips are ejected, they carry any retained heat with them.

RESULT: Larger chips carry more heat from the cut and do not allow it to be transferred to the cutter.
Chipload and Edge Finish

A broad range of Chiploads (Feed Rates) will achieve an acceptable edge finish. Typical ranges are from .002” to over .060”
Calculating Cutting Parameters

**CHIP LOAD PER TOOTH**

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**Plywood Chip Load Chart**

- **60-000 series, 3/8” dia**

  **Chip Load = 0.019”**

  **Feed Rate = RPM x # Flutes x chip load**

  **Feed Rate = 18,000 x 3 x 0.019”**

  **Feed Rate = 1026 IPM**

**Formulas:**

- Chip Load = Feed Rate / (RPM x # cutting edges)
- Feed Rate (IPM) = RPM x # of cutting edges x chip load
- Speed (RPM) = Feed Rate / (# of cutting edges x chip load)
Reducing Tool Wear

• Pick the RIGHT TOOL FOR THE JOB!
• Increase Chipload
  – Increase (ACTUAL) Feed Rates
  – Decrease Spindle RPM
  – Decrease Flutes
• Why does increased chip size improve Tool Wear?
  – More work per revolution
  – Less heat
Additional Methods of Heat Reduction

• Avoid Dead Stops
  – Single Edge (SE) tools contact a part 300 times/sec
  – Double Edge (DE) tools contact a part 600 times/sec
  – Three Edge (3E) tools contact a part 900 times/sec

• Plunging
  – Ramping
  – Helical Ramp
  – Side Entry

• Coolant
  – Air
Achieving Maximum Feed Rates

• CONDITION OF THE MACHINE
  – Minimal Spindle Runout (Do you ever check this?)
  – Clean collets, collet nuts, tool holders, spindle taper
  – Good dust collection.
  – Servos and controller. Can the machine maintain high feed rates in a tight radius?

• FIXTURING
  – Must have the ability to hold parts rock solid
  – Properly made spoilboards that allow consistent part holding
  – Raised spoilboards that allow non-stop multi-pass machining
Achieving Maximum Feed Rates

• MATERIAL CONSISTENCY
  – Are materials multi-sourced or from a single vendor?
  – Does the wood vary?
  – Is the material crowned?

• OPERATOR SKILLS AND ABILITY
  – Willingness to change methods of procedure, programming, fixturing.
  – Accountability to adequately measure tool life and edge finish.
    • If the tool life increase by 25% or the edge finish improves by 15 µinches, do they know it? More importantly, do you know it?
  – Willingness and/or incentive to feed more parts across the machine to gain throughput.
  – Accountability & honest reporting of incidents
Keys to Success

- Select the tool for YOUR needs
- Apply best practices to programming
- Select realistic feeds & speeds
- Maintain your router religiously
- Select a tooling partner
Questions?

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