Weinig Hydromat 2000 Moulder Manual

Safe Working Procedures, Setup & Troubleshooting Manual

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Safe Working Procedures, Setup & Troubleshooting Manual

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Prepared by: Hans Range

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Scope & Validity
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Regulatory Basis
This manual references (latest editions):

- **WorkSafeBC Occupational Health & Safety Regulation** — Part 10 *De-energization and Lockout*; Part 12 *Tools, Machinery & Equipment*. (https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation)
- **CSA Z460-20** *Control of Hazardous Energy — Lockout and Other Methods*.
- **CSA Z94.3** *Eye and Face Protectors*; **CSA Z94.2** *Hearing Protection Devices*.

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Revision History

Version	Date (YYYY-MM-DD)	Author / Editor	Audited by	Summary of Changes
1.0	2025-05-20	H. Range		Initial complete release

Section 1: Introduction

1.1 Overview of the Weinig Hydromat 2000

The Weinig Hydromat 2000 is a high-performance four-sided planing/moulding machine designed for wood processing applications. This robust machine features six cutter spindles (2 bottom, 2 top, and 2 side cutters) arranged to plane and mould all four sides of a workpiece in a single pass.

Key features include a fully enclosed hood for safety and noise reduction, digital readout's, servo motor systems for tool positioning, and an advanced feed system. The Hydromat 2000 can operate at feed speeds up to 100 m/min (approximately 330 ft/min) with a working width up to 300 mm, making it a top performer in Weinig's HighSpeed series.

1.2 Purpose and Scope

This manual is developed specifically for operators and maintenance personnel working with the Weinig Hydromat 2000 moulder. The purpose is to provide clear, detailed instructions covering safe operating procedures (see §2.1-2.5), comprehensive setup guidelines (see §3.1-3.6), effective jointing processes (see §5.1-5.4), finish optimization techniques (see §6.1-6.5), troubleshooting strategies (see §8.1-8.4), and thorough maintenance routines (see §9.1-9.4).

The scope of this document covers all necessary operational aspects, best practices for achieving optimal performance, and adherence to safety standards to ensure workplace safety and equipment longevity. Operators must familiarize themselves fully with this manual to confidently and safely perform their responsibilities.

1.3 Roles and Responsibilities

Operators/Technicians

- Adhere strictly to all safety guidelines and procedures outlined in this manual (see §2.1-2.5).
- Execute machine setup, operation, and basic maintenance, ensuring quality control of produced components.
- Perform routine checks, jointing procedures, and adjustments as required.
- Report issues promptly and maintain communication with maintenance personnel for issues beyond their scope.
- Participate in training and refresher courses as required to ensure proficiency.

All users of the Weinig Hydromat 2000 must read, understand, and apply the contents of this manual to ensure safe, effective, and efficient operations.

Section 2: Safety Procedures

2.1 Training and Familiarization

All operators must undergo thorough training on the Weinig Hydromat 2000 moulder. Training includes reviewing this manual, understanding machine operation, familiarization with control interfaces, safe handling procedures, and recognizing potential hazards. Regular refresher sessions are mandatory to ensure continuous adherence to safety protocols.

Only trained operators should run the Hydromat 2000. All personnel must read and understand the operator's manual and safety manual before using or servicing the machine. Weinig stresses that operators and maintenance staff be familiar with all safety warnings and correct operating procedures.

2.2 Lockout/Tagout (De-energization)

Before any servicing, or maintenance on the Hydromat 2000 you**must** follow all steps mandated by WorkSafeBC OHS Regulation Part 10 (§10.3 to §10.11):

1. **Isolate every energy source** — electrical, pneumatic, hydraulic, mechanical, gravitational.
2. **Apply personal locks and tags** at each isolation point. Locks are to be uniquely keyed to the individual performing the work (OHSR §10.7).
3. **Verify zero-energy state** by pressing the Start button after disconnecting to ensure no power is present. For pneumatic elements, close off the main air supply and bleed out the lines via an air hose.
4. **Wait for all motion to stop** — verify that all cutter heads have completely stopped rotating (they can coast for up to a minute due to inertia).
5. **Restore power only when** all guards are re-installed, tools removed, and every person who placed a lock has removed it (group lockout procedure; OHSR §10.8 & CSA Z460-20 §7.3).

Important: Never rely solely on the push-button stop; use the main disconnect to eliminate power, and test the start button after disconnecting to ensure no power is present.

2.3 Machine Guards and Safety Devices

Ensure that all safety guards and devices on the Hydromat 2000 are securely in place and operational before machine startup. The large soundproof hood is a primary safety guard – it should remain closed whenever wood is being processed.

Regularly inspect guards for damage or wear and report any issues immediately. Replace or repair any damaged or missing guards before running the machine. Never operate the machine if guards or safety interlocks are missing, damaged, or malfunctioning.

Likewise, ensure the chip exhaust system is functioning properly. A poor dust extraction can lead to dangerous buildup of chips around cutters or throw debris at the operator. It also results in a poorer finish if chips bounce against the fresh-cut surfaces.

2.4 Safe Operating Practices

- Wear appropriate personal protective equipment (PPE) at all times, including safety glasses, hearing protection, hardhat, and gloves.
- Maintain a clean, organized work area, free from debris, obstacles, and tripping hazards.
- Stay alert and focused; avoid distractions while operating or maintaining the machine.
- Immediately report any unusual noise, vibration, or operational irregularities.
- Keep hands and clothing away from moving parts and cutters at all times.
- Avoid loose clothing, jewelry, or long hair that could get caught in moving parts.
- Only feed lumber that is within the machine's capacity and free of metal or foreign objects (no nails, staples, or stone embedded).

2.5 Emergency Readiness

Familiarize yourself with the locations and functions of emergency stop (E-stop) buttons on the Hydromat 2000. The machine has mushroom E-stop buttons that instantly cut power to the motors. Test these periodically (at start of shift) to ensure they work.

In case of a jam or malfunction, hit the E-stop and wait for all motion to cease before approaching the machine. Keep the area around the moulder clear of obstructions and tripping hazards so that in an emergency, moving away from the machine is easy.

It's also good practice to have a fire extinguisher nearby. Although wood machining doesn't usually involve open flame, chips and electrical components could ignite if there's a severe issue. Promptly remove any accumulations of oil or grease-soaked wood dust, as these can be combustible.

Following these safety procedures will significantly reduce risks, ensuring a safer working environment and optimal machine performance.

Section 3: Machine Operation and Setup

3.1 Overview of Machine Operation

The Weinig Hydromat 2000 has 6 cutter spindles (bottom, top, and side cutters) arranged to plane and mould all four sides of a workpiece in a single pass. The machine processes wood at high speed through a series of cutterheads that shape the material to the desired profile and dimensions.

Key operational components include:

- Multiple spindles with rotating cutterheads
- Feed system with powered rollers
- Control elements (chipbreakers, pressure shoes, guides)
- Memory-positioning systems for setup parameter storage
- Comprehensive guards and safety systems

The machine operates by feeding lumber through a series of precisely positioned cutterheads, with each head performing a specific function in creating the final moulded product.

3.2 Startup Procedure

At the beginning of each shift, operators must complete the machine startup checklist:

1. **Perform safety inspection** - Check that all guards are in place and secured.
2. **Verify dust extraction** - Ensure the dust collection system is operational and properly connected.
3. **Inspect feed system** - Check all rollers and pressure elements for proper position and condition.
4. **Check cutterhead security** - Verify all cutterheads are properly pressurized to ~350 bar with the high-pressure grease gun.
5. **Start main power** - Turn on the main electrical disconnect and engage the control panel.
6. **Start dust collection** - Ensure dust extraction is running before starting cutterheads.
7. **Start cutterhead motors** - Power up cutterhead motors in sequence using spindle start/stop rockers (see §4.1, Row 5, Controls A-F), waiting for each to reach full speed.
8. **Start feed system** - Activate the feed system using Feed START/STOP rocker (see §4.1, Row 5-13) only after cutterheads are running at full speed.
9. **Test feed the first piece** - Run a test piece through the moulder and inspect the result.

3.3 Moulder Setup Procedure

Setting up the Hydromat 2000 for a specific profile requires careful attention to detail. Follow these sequential steps:

1. **Radius Markings on Cutterheads**
    - All cutterheads to be installed **must** have a *current radius* number written on them with a marker. This radius is the distance from the center of the head bore to the cutting knife edge.
    - This radius number, when entered into the moulder's DRO control (see §4.3 for DRO ranges and display modes), tells the machine how far the knife edge is from the bed/fence plate.
2. **Profiled Knives: Radius and Axial Numbers**
    - Cutterheads with profiled knives **must** have both a radius number and an axial number.
    - The axial number indicates the reference point on the knife's profile and determines the cutterhead's axial position relative to the bed/fence plate.
    - The radial number indicates the distance from spindle center to the edge of the knife, for profiled knives this will be the deepest/lowest point on the knife edge.
3. **Initial Setup: Entering Numbers and Unlocking Heads**
    - Enter the radius (and axial, if applicable) numbers at each relevant adjustment point.
    - Disengage the manual or pneumatic locking mechanisms on bottom and side heads before attempting movement.
    - When adjusting via crank or servo motor, monitor for any resistance which could indicate a fence contact or limit violation.
4. **Deciding Which Heads to Run**
    - For S4S (*Surfaced on Four Sides*) input material: The first bottom and top heads are typically not used unless significant thickness reduction is needed.
    - For rough-cut lumber: All six cutterheads are used, with the first bottom and top heads dressing the material to a suitable starting size.

- For textured or unplaned bottom surfaces: Both bottom heads should be removed, and special bedplate adjustments are required (see §3.3.5).

5. **Running Without Bottom Heads** When a textured or unplaned bottom surface is required, both bottom heads must be removed and the bedplate configuration must be modified:

    - **Shim Removal Required**

        - A 0.020" steel shim under the receiving bedplate (after 2nd bottom head) must be removed
        - This shim normally sets the 2nd bottom head's depth of cut, as the head is set relative to this plate
        - All other heads (top and sides) have this 0.020" offset accounted for in their positioning

    - **Removal Procedure**

        - Locate the bedplate clamp bolts (17 mm / 11/16") on the side of the receiving bedplate
        - Unlock these bolts to access the shim
        - **Critical:** When removing or reinstalling the shim, ensure all mating surfaces are pristinely clean
        - Even minute particles can significantly offset the bedplate and affect product finish

    - **Reassembly**

        - After shim removal, position the receiving bedplate with minimal gap relative to the bedplate just before the 2nd bottom head
        - Verify the bedplate is perfectly level and parallel
        - Retighten all clamp bolts securely

    ⚠ **Important:** The cleanliness of mating surfaces during this procedure directly affects product quality. Even small debris can cause significant bedplate misalignment.

3.4 Feed Roller Selection and Installation

Feed roller selection is based on the input material's characteristics:

1. **Roller Types**:

    - **Polyurethane (rubber) rollers**: Used for S4S (pre-surfaced) material to prevent marking the surface.
    - **Steel (toothed) feed rollers**: Used for rough input material to ensure positive grip.

2. **Installation Procedure**:

    - Raise the "Beam" to allow sufficient clearance.
    - **Safety Note:** The moulder remains **partially energized** because the "jog" button is needed to rotate the roller axles and access each set screw.
    - During partial energization (jog mode), keep all personnel clear of the feed system.
    - If you must place hands near pinch points, **apply full lockout/tagout** instead.
    - Ensure no lumber is in the infeed "hopper" or on the "bridge rolls" to prevent accidents.

3.5 Cutterhead Installation and Removal

Proper cutterhead installation and removal is critical for both safety and performance. For detailed control locations and DRO specifications, refer to §4.2 and §4.3.

Removing Cutterheads

1. **Verify full lockout/tagout** is in place before removing any cutterhead (see §2.2).
2. Depressurize the outboard hydro-lock bearings using a 3 mm hex key at the grease pressure relief port.
3. Use a hand crank to remove the nuts securing the outboard bearing assemblies.
4. Remove the safety collars that prevent cutterheads from spinning freely.
5. Depressurize the cutterheads using a 3 mm hex key at the grease pressure relief port.
6. Ensure the moulder spindle is clean before sliding the head off.
7. Mount the cutterhead removal bar onto the spindle end; keep a firm grip to prevent slipping.
8. Carefully transfer cutterheads to the storage/transfer cart.

Installing Cutterheads (Varies by Position)

Top Head Installation:

1. Select the appropriate cutter and place the removal bar into its bore, ensuring knife direction matches feed direction.
2. Mount the bar to the spindle end and gently slide the cutter into position.
3. Pressurize the cutterhead to ~350 bar with a high-pressure grease gun to secure it to the shaft.
4. Attach the safety collar in front of the cutterhead, aligning pins with corresponding holes.
5. Install the straight-knife jointer onto the dovetail in the cutting cavity.
6. Replace the outboard bearing, ensuring proper alignment with the key/keyway.

Bottom Head Installation:

1. Follow top-head steps with one key difference:**manually set** the bottom head height (radius).
2. Loosen the lower nuts that disengage the spindle radius lock.
3. Use a straightedge on the receiving bedplate, sliding it over the cutterhead center.
4. Turn the cutterhead with a crank (against cutting direction) to avoid damage.
5. Adjust the radius until the knife just barely touches the straightedge.
6. Always move ~0.100" below your target, then back up to negate backlash.
7. Tighten the lock nuts until the pneumatic lock re-engages.

Side Head Installation:

1. Ensure the spindle shaft is clean and properly lubricated.
2. Lower the cutterhead onto the shaft with knives pointing in the feed direction.
3. Provide at least 1/8" clearance from the bedplate if necessary.
4. Pressurize the cutterhead to ~350 bar using the grease gun.
5. Secure a safety collar over the cutterhead, aligning pins and tightening.
6. Reset the jointer's indexer and prepare the stone carrier.
7. Install and align the jointing stone with the cutterhead profile.

3.6 Setting Control Elements

Proper adjustment of control elements is crucial for quality cuts and machine performance. For complete control locations and specifications, refer to §4.2 (Table 4-2) and §4.4.

1. **Fence and First Bottom Depth of Cut (DOC)**
    - For S4S material: 1–2 mm (0.040–0.080 in) fence setting is typically sufficient
    - For rough input: 4–5 mm (0.160–0.200 in) is common
    - When adjusting the first bottom DOC, always move**below** the target, then **back up**
    - ~2 mm (0.080 in) is a standard setting for rough lumber
2. **Hold-Down and Control Elements** (see §4.4)
    - **Bottom hold-down rolls**: Set ~4 mm (0.160 in) below input thickness when using first bottom head
    - **Side hold-over wheels**: Adjust to keep input against the fence
    - **Side chip-breaker assembly**: Position ~4–5 mm (0.160–0.200 in) narrower than input width
    - **Top head chip-breakers**: Use gauge blocks to verify proper clearance; No more than 4 mm (0.160 in) throw
    - **Pressure shoes**: Set after each top head using gauge blocks or test pieces For specific control locations and adjustment methods, refer to §4.2.
3. **Final Checks**
    - Verify all adjustments, confirming cutterhead swing clearance
    - Ensure all nuts are tight and locks re-engaged
    - Perform a final hazard inspection before removing lockout
    - Clear all tools and debris from the cutting area
    - Confirm all guards are properly in place

Safety Note: If adjusting control elements requires reaching into the cutter area. Always verify proper lockout/tagout procedures are followed (see §2.2).

Section 4: Machine Controls & Interfaces

> **Scope:** This section details every control, display, and adjustment element required to run, set-up, and maintain the **Hydromat 2000**. Controls are grouped first by *operator position* (control pedestal) and then by *work-piece path* (from infeed to outfeed). All safety pre-conditions (feed OFF, spindles stopped, hood open, etc.) are stated inline.

4.1 Operator Control Pedestal

The pedestal is the machine's primary command station. From here the operator selects the operating mode, controls the feed, and energizes individual spindles. The layout is fixed **left-to-right, top-to-bottom** as shown in Table 4-1.

Table 4-1 — Pedestal Controls

Row	Pos.	Control	Form	Function
1 Safety & Mode	1	Emergency-Stop	Red mushroom	Cuts all power & motion immediately; twist to reset
	2	Work-Light Switch	Black/white rotary switch	Toggles hood & table lighting
	3	Fault Indicator	Red pilot lamp	Illuminates on PLC/drive fault or E-Stop; reset may be required
	4	Setup-Mode Lamp	Yellow pilot lamp	Lit when key in *SETUP* position
	5	Mode Selector	3-position switch	**AUTOMATIC / LIMITED / SETUP** operating envelope
	6	"Open-Up" Button	Grey momentary	Raises pressure beam & opens machine width for profile change
2 Side-Head RPM	7	Left Side-Head VFD	Black knob	Varies RPM; value shown on DRO 2
	8	Right Side-Head VFD	Black knob	Varies RPM; value shown on DRO 3
	9	Cancel Jog	Red push-button	Aborts any active spindle jog
3 Digital Read-outs (DRO)	DRO1	Feed Speed	3-digit LED	Actual feed rate
	DRO2	Near-Side RPM	4-digit LED	Spindle RPM
	DRO3	Fence-Side RPM	4-digit LED	Spindle RPM
4 Feed Override	10	Feed STOP	Red push-button	Stops feed rolls only (spindles stay running)
	11	Feed-Rate Pot	Black dial	0 – 100 % of programmed speed
5 Transport/Spindles	12	Jog FWD / REV	Black/white rocker	Inching feed, REV with machine off only
	13	Feed START/STOP	Green / red rocker	Engages or disengages feed rolls
	A–F	Spindle Start/Stop	Twin rocker pairs	Start (green) / stop (red) individual spindles – order ➔ 2-Btm, 2-Top, 1-Top, Near, Fence, 1-Btm

Typical Start-up Sequence (AUTOMATIC)

1. **Insert key** and turn to **AUTOMATIC**; confirm yellow *SETUP* lamp is **off**.
2. Release any E-Stop; confirm red pilot lamp is dark.
3. Start required spindles in sequence using spindle start/stop rockers (see §4.1, Table 4-1).
4. Jog feed briefly to ensure clamps and guides are clear.
5. Press **Feed START**; confirm DRO1 shows target feed speed (see §4.3).
6. Begin production run.

> ⚠ **Safety Note:** The *Feed STOP/START/JOG* controls (see §4.1, Table 4-1) are the only controls the infeed operator may use during production. All other pedestal actions require the lead operator or technician.

4.2 Infeed-to-Outfeed Adjustment Stations

With the hood open, 29 numbered stations govern depth, width, height, and axial position of every cutter head plus supporting control elements. Table 4-2 lists these stations **infeed** → **outfeed**.

Table 4-2 — Machine-Side Stations

Seq.	Station	Adjusts / Displays	Lock / Actuation
1	1st Bottom Bedplate Depth	Depth of cut – DRO	Hand crank
2	1st Bottom Hold-down Rolls	Roll height – set ~4 mm below input thickness	Pneumatic actuation with 19 mm (3/4 in) bolted clamps
3	Side Hold-over Rolls	Hold-over roll width – set ~4–5 mm narrower than input	19 mm (3/4 in) standoff nut
4	1st Bottom Height / Radius	Cutter circle height / radius – DRO	Pneumatic twin lock + crank
5	1st Bottom Axial	Axial shift	12 mm (1/2 in) hex key + standoff
6	Fence-Side Head Axial	Axial position	Handle lock + crank
7	Fence-Side Head Jointer Switch	Engage / disengage jointer	Red toggle switch
8	Fence-Side Bedplate Clearance	Bedplate clearance – hand-wheel	None
9	Fence-Side Head Radial	Cutter height / radius	Handle lock + crank
10	Near-Side Chip Breaker	Breaker elevation – knob	Pneumatic actuation, 17 mm (11/16 in) guide lock
11	Near-Side Bedplate Clearance	Bedplate clearance – hand-wheel	None
12	Near-Side Head Axial	Axial position – DRO	Pneumatic lock (black switch)
13	Near-Side Head Jointer Switch	Engage / disengage jointer	Red toggle switch
14	Near-Side Head Radial / Width	Absolute width or radius – DRO	Servo push-buttons + crank
15	Near-Side Head Pressure Shoe	Shoe advancement – hand-wheel	2 × 17 mm (11/16 in) bolts
16	Aux Panel #1	E-Stop / Jog / Feed Beam controls	Electrical push-buttons
17	1st Top Head Chip Breaker	Breaker elevation – knob	2 standoff nuts
18	1st Top Head Height / Radius	Cutter height / radius – DRO	Servo (feed lock) + crank
19	1st Top Head Axial	Axial position – DRO	Handle lock + crank
20	1st Top Head Pressure Shoes	Shoe height – dual knobs	Spring preload
21	Near-Side Axial Lock Switch	Locks / unlocks Seq 12 axial	Pneumatic toggle
22	1st Top Head Jointer Switch	Engage / disengage jointer	Black toggle switch
23	Aux Panel #2	E-Stop / Jog / Feed Beam controls	Electrical push-buttons
24	2nd Top Head Chip Breaker	Breaker elevation – knob	2 standoff nuts
25	2nd Top Head Height / Radius	Cutter height / radius – DRO	Servo (feed lock) + crank
26	2nd Top Head Axial	Axial position – DRO	Handle lock + crank
27	2nd Top Head Pressure Shoes	Shoe height – dual knobs	Spring preload
28	2nd Bottom Head Height/Radius	Cutter height / radius – DRO	Pneumatic twin lock + crank
29	2nd Bottom Head Axial	Axial position – DRO	Handle lock + crank

4.3 Digital Read-Outs (DRO) & Display Logic

Table 4-3 — Typical DRO Ranges & Labels

Label	Normal Range (Metric → Imperial)	Notes
FEED	3 – 100 m/min (10 – 330 ft/min)	Adjustable Row 4-11
RPM	4,000 – 8,000 rpm	Side-heads (variable)
WIDTH	75 – 300 mm (3 – 12 in)	Near-side radial control
THK	12 – 120 mm (0.47 – 4.72 in)	1st / 2nd Top heads
RADIUS	76 – 102 mm (3 – 4 in)	Displayed when dual-button pressed
AXIAL	±25 mm (±1 in)	All heads

Switching Display Modes: To switch between TARGET and RADIUS views, press and hold both servo push-buttons at a DRO station for more than 0.5 seconds.

Fault messages. `NOT IN POSITION` · `SERVO TIMEOUT` · `LIMIT SWITCH` · `ENCODER ERROR`

4.4 Manual & Pneumatic Adjustment Elements

Element	Location (Seq)	Nominal Setting	Locking Method	Purpose
1st Bottom Hold-down	Seq 2	Set ~4 mm below input thickness	19 mm (3/4") bolted	Maintains down-pressure before cut
Chip Breaker	1st Top (17) · 2nd Top (24) · Near-Side (10)	3-4 mm throw	2 standoff nuts / 17 mm	Clears chips ahead of cutter
Pressure Shoes (×2)	1st Top (20) · 2nd Top (27)	Set after each top head using gauge block	Spring preload only	Maintains down-pressure during cut
Bedplate Wheels	Fence 8 · Near 11	Set to match bedplate gap for side heads	None	Sets bedplate gap for side heads
Hold-over Rolls	Seq 3	4-5 mm narrower than input width	Standoff nut	Keeps material tight to fence

Tip. Keep side chip-breakers **4–5 mm (≈3⁄16 in)** narrower than the incoming board (see §3.6 *Setting Control Elements*).

4.5 Workflow References

Step-by-step instructions for common tasks are provided elsewhere in this manual. Refer to the sections below whenever you need to carry out a production change or adjustment:

Task	Refer to
Emergency Procedure	**§2.5 Emergency Readiness**
Normal start-up & shutdown	**§3.2 Startup Procedure**
Profile change & tool setup	**§3.3 Moulder Setup Procedure**
Setting bedplates, chip-breakers, pressure shoes	**§3.6 Setting Control Elements**
Thickness/width changes during production	**§7.5 Adjusting Product Dimensions During Operation**
Side head position adjustments	**§7.6 Side Head Position Adjustment**
Bottom head height adjustments	**§7.7 Bottom Head Height Adjustment**

Section 4 focuses solely on identifying and understanding the machine's controls. Follow the cross-referenced sections above for the procedural steps.

Section 5: Jointing Procedures

5.1 Understanding Jointing Importance

Jointing is a **light grinding or truing process** performed on the **cutting knives** while they remain mounted in the cutterhead. The purpose is to ensure **uniform knife projection** across all blades, remove minor defects or high spots in the cutting edges, and extend the time between full re-sharpening.

The process is critical for several reasons:

- **Uniform Knife Projection**: Ensures all knives share the cutting load equally, minimizing lines or chatter in the finished surface.
- **Removes Minor Nicks or High Spots**: Eliminates small defects on the cutting edges without requiring a full resharpen.
- **Extends Time Between Full Sharpenings**: Jointing removes minimal metal, allowing knives to stay in service longer.
- **Maintains Surface Quality**: Prevents one knife from cutting deeper than others, preserving consistent cutting accuracy.

On the Hydromat 2000, you will encounter **two types** of jointers:

1. **Slide Jointers** - Hand-operated jointers typically used for straight knives
2. **Pneumatic (Plunge) Jointers** - Air-activated jointers generally used for profile knives

5.2 Slide Jointers for Straight Knives

Slide jointers are hand-operated devices with specific features to perform precise jointing on straight-knife heads.

Design Features:

- Feature an **indexing button** on both the **front** and **back**
- When the operator slides the jointer fully forward or backward within the cutting cavity, it depresses these buttons
- Each button press **advances** the stone a few thousandths of an inch

Operation Procedure:

1. **Initial Index:** With the jointer control rod in hand push forward to depress the indexing button.
2. **Engage the Stone:**
    - Slide the jointer fully forward or backward to depress one of the index buttons.
    - This advances the stone slightly toward the knife edge.
3. **Jointing Motion:**
    - Move the jointer back and forth slowly while the cutterhead rotates.
    - Watch for uniform sparking across the entire knife edge.
    - Advance the stone in small increments as needed to eliminate visible lines, nicks, or irregular projections.
4. **Verification:**
    - After jointing, visual inspection should show a uniform "joint line" on each knife edge.
    - The finish quality of test pieces will improve after proper jointing.

For best practices and safety guidelines, refer to §5.4.

5.3 Pneumatic Jointers for Profile Knives

Profile knives have complex shapes that require pneumatic "plunge" jointers for effective truing:

Design Features:

- Air cylinder pushes a profiled stone onto the spinning cutterhead
- **Indexing knob** allows precise control of stone advancement
- Stone is shaped to match the complex profile of the cutter knives

Operation Procedure:

1. **Preparing the Stone (machine off, in setup mode):**
    - Reset the jointer's indexer by turning its knob clockwise until it stops.
    - Activate the jointer to ensure the stone profile matches the cutterhead profile.
    - Using the manual crank handle rotate the spindle to scrape-in the stone, observe a stone dust line across the profile to verify complete scrape-in
2. **Jointing Motion (machine on, feed stopped)**

  - Set spindle to lowest RPM
  - Activate the air cylinder to "plunge" the stone onto the spinning cutterhead.
  - The air pressure pushes the stone against the knives for a brief, controlled contact.
  - Each plunge joint automatically and incrementally advances the stone by turning the indexing knob counter-clockwise one notch.
  - You can do a more aggressive joint by indexing the knob once before or after the jointer activates, this will however increase the chance that the stone could break.

3. **Handling Nicked Knives:**

  - If a knife has a nick, the stone may develop a corresponding "bump"
  - This bump can repeatedly carve the same negative shape in future joints
  - To correct this:
    - Remove the stone from its carrier
    - Gently rub out the positive mark (bump) with a softer stone
    - Reinstall the stone with precision (don't scrape in) and perform a more aggressive plunge joint (increment the index knob an extra time before jointing)

Stone Modification:

- If a profiled stone starts to grab excessively during a plunge, reduce its frontal surface area
- Chamfer or bevel the stone's outer edges inward, leaving just a**narrow frontal land**
- This makes for smoother, more controlled jointing with less risk of stone breakage

5.4 Jointing Best Practices

For optimal results and safety when jointing cutterheads on the Hydromat 2000:

1. **Rotate Heads Slowly**

  - Keep the spindle at its**lowest safe RPM** for jointing (variable RPM available only to side heads)
  - This reduces friction and prevents the stone from "grabbing"

2. **Use Small Increments**

  - Make several light passes rather than one heavy cut
  - For pneumatic jointers, only rotate the indexing knob multiple notches when addressing significant blemishes

3. **Monitor Visual Indicators**

  - Watch for **uniform sparking** across all knife edges
  - If part of a knife doesn't spark, it's slightly lower than others and needs additional jointing
  - If there is no spark, very light sparking, or intermittent sparking, then the stone is probably loose and will need to be reset in it's carrier.

4. **Listen for Problems**

  - A stone "biting" or "grabbing" signals too much contact area or misalignment
  - Pause immediately to adjust or reshape the stone if abnormal sounds occur

5. **Follow Safety Protocols**

  - Ensure no hands or tools are near rotating components
  - For stone reshaping or other maintenance, engage**full lockout/tagout** first (see §2.2)
  - Always wear appropriate PPE, especially face shields during jointing operations

By following these jointing procedures, you can maintain sharp, evenly projecting knives, achieving consistent cut quality and minimizing unscheduled downtime for complete regrinds.

Section 6: Finish Optimization

6.1 Understanding Knife Marks per Inch (KMPI)

KMPI refers to how many cutting marks a single pass places on the wood per linear inch of travel. This measurement is a key factor in determining surface finish quality:

- **Definition:** Knife Marks per Inch (KMPI) indicates the density of knife cuts on the processed surface.
- **Relation to Finish Quality:** A higher KMPI typically yields a smoother surface, as the marks are more closely spaced and less noticeable.
- **Quality Considerations:**
    - **Very low** KMPI can show visible scalloping or an uneven appearance
    - **Excessively high** KMPI can lead to glazing (overly polished/burnished look), higher friction, and slower production
    - Finding the optimal balance is essential for efficient throughput and desired surface quality

6.2 Calculating and Adjusting KMPI

KMPI can be calculated and adjusted using the following formula and parameters:

Basic Formula for Knife Marks per Inch (KMPI) (in imperial units):

$$\mathrm{KMPI} = \frac{(\text{Number of Knives}) \times (\text{Spindle RPM})}{\text{Feed Rate in inches per minute}}$$

Key Variables:

1. **Number of Knives on the Cutterhead**
    - The Hydromat 2000 uses **6, 8, and 10 knife heads** depending on the application
    - More knives per head means more cuts per revolution, resulting in higher KMPI
2. **Spindle RPM**
    - On the Hydromat 2000, main spindles run at **6,000 RPM**
    - Side heads have variable-frequency drives (VFDs), allowing speeds from **4,000 up to 8,000 RPM** (see §4.1)
    - Higher spindle RPM creates more cuts per minute but increases friction, heat, and power demand
3. **Feed Speed**
    - Expressed in feet/min (FPM) or meters/min (m/min)
    - Slowing feed increases KMPI, promoting a smoother finish
    - Speeding feed decreases KMPI, boosting output but potentially reducing quality
    - For feed rate control locations, see §4.1

Example Calculation:

- Assume an 8-knife cutterhead at **6,000 RPM** and a **feed rate of 150 ft/min** (1,800 in/min):

$$\mathrm{KMPI} = \frac{8 \times 6000}{1800} = \frac{48,000}{1800} = 26.7 \text{ marks per inch}$$

For practical implementation and best practices, see §6.4.

6.3 Optimizing Finish Quality

According to the **Architectural Woodwork Institute (AWI)** guidelines, millwork quality can be categorized into three KMPI ranges:

1. **High KMPI (~20–30 marks/inch or more)**
    - **Industry Standard:** Meets or exceeds AWI highest-grade guidelines (20–25 KMPI)
    - **Advantages:** Achieves smoother finishes with minimal scallops
    - **Disadvantages:** Feed often must be slowed, or RPM increased—raising friction and risk of burnishing
    - **Applications:** High-end mouldings, furniture-grade surfaces, or finishing passes
2. **Medium KMPI (13–19 marks/inch)**
    - **Industry Standard:** Meets AWI medium-grade guidelines
    - **Advantages:** Balances production speed and finish quality

- **Disadvantages:** May not meet top AWI standards for premium applications
- **Applications:** Standard millwork, trim, or everyday mouldings

3. **Low KMPI (<12 marks/inch)**
    - **Industry Standard:** Falls below AWI premium recommendations
    - **Advantages:** Faster throughput, higher volume cutting, less friction and heat
    - **Disadvantages:** Noticeable knife marks or scallops—often requiring secondary sanding
    - **Applications:** Rough moulding, heavy stock removal, or utility pieces

6.4 Best Practices for Balancing KMPI and Production

To achieve the optimal balance between production efficiency and surface quality:

1. **Select the Right Variables for Your Application**
    - **Number of Knives:** For high-quality finish but moderate feed, use 8- or 10-knife heads
    - **Spindle RPM:** Increasing from 4,000 to 8,000 RPM doubles the effective cuts per minute
    - **Feed Rate:** The most direct control—slower feed raises KMPI, faster feed increases throughput
2. **Consider Other Factors Affecting Finish**
    - **Knife Sharpness & Geometry:** Dull or poorly ground knives cause tear-out regardless of KMPI
    - **Machine Condition:** Worn bearings or misaligned components create chatter that undermines finish
    - **Wood Species & Moisture Content:** Dense or figured woods often require higher KMPI
3. **Testing and Documentation**
    - **Start with Known Parameters:** Calculate baseline KMPI for typical operations
    - **Perform Test Cuts:** Run small test batches, adjusting until you find the ideal balance
    - **Log Your Settings:** Maintain records of feed speeds, knife configurations, and finish quality
    - **Sample Libraries:** Keep physical examples of different KMPI settings for reference

Practical Implementation:

- For AWI highest-grade finish (20-25 KMPI) with 8-knife heads at 6,000 RPM, target feed speeds of 200-240 ft/min
- For premium finishes with 10-knife heads, increase feed to maintain productivity while meeting quality standards
- For roughing or where secondary sanding will follow, use 6-knife heads at higher feeds to maximize throughput

6.5 Tool Lifetime and KMPI Considerations

The relationship between KMPI settings and tool life is critical for optimizing both production quality and maintenance costs:

1. **Impact of High KMPI on Tool Life**
    - Higher KMPI means more cuts per inch of material, increasing tool wear
    - Running at maximum RPM (8,000) generates more heat and friction
    - More knives per head (8-10) divides the cutting load but increases total knife maintenance
2. **Optimizing Tool Life**
    - Joint cutters every ~0.5 hours of run time or when finish quality deteriorates
    - Re-sharpen knives before they become too dull to avoid excessive power consumption and overheating
    - Monitor knife temperature during high-KMPI operations - excessive heat accelerates wear
3. **Balancing KMPI and Tool Longevity**
    - For rough cuts, use fewer knives (6) at moderate RPM to extend time between sharpening's
    - When high KMPI is required, increase feed rate rather than RPM when possible
    - Consider using more knives at lower RPM instead of fewer knives at higher RPM
4. **Maintenance Indicators**
    - Increased power draw indicates dulling knives
    - Rising cutter temperature suggests excessive friction
    - Deteriorating finish quality signals need for jointing or replacement
    - Unusual noise or vibration may indicate uneven knife wear

By understanding these relationships, operators can achieve optimal surface finish while maximizing tool life and minimizing maintenance costs.

Section 7: Safe Adjustment During Operation

In certain situations, operators may need to make **minor or careful adjustments** to the Hydromat 2000 under partial energization. If there is **any doubt about safety** or if a task is substantial or high-risk, **full lockout/tagout** is mandatory. The following guidelines cover procedures that may be performed safely with the machine partially energized.

7.1 Unjamming a Board

When a board jams in the Hydromat 2000, proper clearance techniques are essential for safety:

During Production (Energized Approach):

1. **Stop the feed system** immediately when a jam is detected.
2. **Open the hood** safely to access the jammed area.
3. **Back off control components** (chipbreakers, guides, etc.) as needed to free the board.
4. Use the **"jog"** function to carefully advance the jammed piece if needed.
5. Once the board can be safely moved or proceed through the machine, run it through normally.
6. **Reset control components** to their proper positions, using a fresh board to verify alignment if necessary.
7. **Close the hood** and resume normal operation.

For Severe Jams (Shutdown Approach):

1. **Power down fully** if the jam cannot be safely cleared with minimal adjustment.
2. **Back off necessary control components** to create clearance.
3. Use **"reverse"** jog to drive the jammed board backward.
4. Ensure the infeed area is clear to receive the jammed piece.
5. Reposition all components to their proper settings before restarting.
6. **Start the machine**, verify all settings, close the hood, and resume operation.

7.2 Lubricating the Bedplate

The Hydromat 2000 uses an automatic lubrication system for the bedplate, supplemented by manual lubrication when needed:

1. **Automatic Lubrication System**
    - Primary source of bedplate lubrication
    - Timer set to activate every 10 seconds during operation
    - Check reservoir level daily before startup
    - Use Plantoform or equivalent oil in the reservoir
    - Monitor oil flow to ensure proper distribution across bedplate
2. **Manual Supplemental Lubrication** When additional lubrication is needed during operation:
    - Stop the feed system while maintaining cutterhead rotation
    - Open the hood to access the bedplate area
    - Apply lubricant via spray bottle to bedplate, fence, and guiding surfaces as needed
    - Close the hood and resume feeding material
3. **Maintenance Requirements**
    - Check auto-lube reservoir level daily
    - Verify timer setting remains at 10 seconds
    - Inspect oil distribution lines for kinks or blockages
    - Clean oil ports if flow appears restricted
    - Monitor bedplate surface for dry spots indicating potential system issues

    Tip: If the bedplate appears dry despite the auto-lube system running, check the timer settings and reservoir level before resorting to manual lubrication.

7.3 Adjusting Control Components

Various control components may require minor adjustments during operation. For complete control locations and specifications, refer to §4.2-4.4.

Safety Requirements Before Any Adjustments:

- Always wear appropriate PPE, including face shield, when observing cutting operations
- Stop feed system before making visual inspections or adjustments
- Maintain proper distance from rotating components
- Never reach into the machine while cutterheads are rotating
- If adjustment requires reaching near cutters, perform full lockout/tagout (see §2.2)

Adjusting Shoe Throw

1. **Observe** the wood's passage under the pressure shoe while running.
2. **Stop the feed** using Feed STOP control (see §4.1, Row 4-10) before making adjustments.
3. To check pressure shoe tension:
    - Place your finger on the long standoff bolt that mounts the pressure shoe
    - Using jog control (see §4.1, Row 5-12), feed a single board under the shoe
    - Feel for a gentle "bump" or movement in the standoff bolt as the board passes
    - Proper tension feels like a light tap, not excessive resistance
4. Resume normal operation once satisfied with the adjustment.

Adjusting Chipbreaker Height

1. Monitor the chipbreaker's deflection when contacting the lumber.
2. **Stop the feed** and **stop the cutterhead**, disconnect the air line before adjusting if a board is under the chipbreaker.
3. Loosen the chipbreaker bolts, reposition to desired height, and tighten again.
4. **Don't forget to reconnect the air line** if it was disconnected.
5. Restart the cutterhead, jog a board under the chipbreaker, ensure proper throw, close the hood then resume operation.

Dialing In Side-Head Depth of Cut

1. **Stop the feed system completely** before making any visual inspection of cut depth.
2. Put on face shield before observing cutting action.
3. From a safe distance, observe the fence and near-side heads for proper cut depth.
4. If adjustment is needed:
    - Keep feed stopped and **stop** the fence-side cutterhead
    - Change the fence depth setting as required
    - Visually verify there is no collision risk between fence and cutterhead
    - If uncertain, shut down fully and manually rotate the head to check clearance
5. Restart the heads and resume production once confirmed safe.

Dialing In Bottom Depth of Cut

1. Observe how much material the top and bottom heads remove, watching for "skip" on the product.
2. **Eject any Material from the machine and Stop the feed** before adjusting the bedplate position.
3. Raise or lower the bedplate to correct any skip or uneven cutting.
4. Account for wood cup and hold-down roll positioning in your adjustments.
5. Resume operation after ensuring correct bedplate height.

7.4 Jointing During Operation

Jointing procedures can sometimes be performed safely during operation:

Jointing the Side Heads

1. **Stop the feed** system to prevent wood from entering during jointing.
2. Reduce the head speed to the **lowest setting** for safer jointing.
3. Engage the air switch for each side head's jointer **individually**.
4. Look and listen for correct contact/sparking between the stone and knives.
5. If needed, back off the stone and re-advance it for a more thorough joint.
6. Return to normal head speed and resume operation when complete.

Jointing the Top Heads

1. **Stop the feed system first** before any jointing operation.
2. This must be performed **With no material in the machine and with the feed stopped.**
3. Engage the top head jointer while observing for sparks to confirm proper contact.
4. Ensure sufficient stone exposure to achieve a proper joint without collision risk.
5. Once finished, secure the hood and resume normal production.

7.5 Adjusting Product Dimensions During Operation

In certain cases, it may be necessary to adjust the finished product thickness or width while the machine is energized but feed is OFF. The following procedures apply only if **no wood is in the machine** and **feed rolls are stopped**:

Adjusting Top Head Height (Thickness)

1. **Stop the feed** using Feed STOP control (see §4.1) and confirm there is no wood inside the machine.
2. Adjust the **1st and/or 2nd top head height** using either:
   - The **push-buttons** and **servo DRO station** (see §4.2, Stations 18 & 25)
   - The **manual crank** below the DRO housing
3. The DRO has multiple display modes:
   - **TARGET**: used during initial setup to define a TARGET position
   - **RADIUS**: displays the live radial position of the cutter
4. **Important:** After the initial setup, always adjust the **RADIUS** value rather than the **TARGET**. This ensures the DRO displays the true cutter position and avoids conflicting data.
5. To switch between modes, press and hold both servo push-buttons at the DRO station for more than 0.5 seconds. This cycles between **RADIUS** and **TARGET**.
6. When **moving downward**, always **overshoot the target by about 2.5 mm (0.100")** then **back upward** to the final position to eliminate backlash and ensure accurate positioning.

Adjusting Near-Side Cutterhead (Width)

1. Confirm feed is OFF and no workpieces are present in the cutter chamber.
2. Use the **servo buttons** at Station 14 or the **manual crank** to move the cutterhead **inward or outward**.
3. Use the dual-button toggle to switch the DRO between **TARGET** and **RADIUS** modes as needed.
4. Always adjust the **RADIUS** rather than the TARGET value after setup to maintain consistent and predictable final dimensions.
5. When reducing width (moving inward), no backlash compensation is needed. Only when increasing width (moving outward) should the cutter be moved past the TARGET and then brought back slightly to finalize.
6. If this adjustment is made **with the machine running** but feed OFF, only make **minor changes < 0.5 mm (0.020")** to prevent collision with the **hold-down wheel** above the side head.

Important: Always refer to DRO feedback for final position confirmation. For control locations and specifications, see §4.2 and §4.3.

7.6 Side Head Position Adjustment

Technicians may occasionally need to adjust the vertical (axial) position of the near-side or fence-side cutterheads after initial profile setup. These fine adjustments are typically done to correct alignment issues or to re-establish tool height. For complete control locations and DRO specifications, refer to §4.2 and §4.3.

Unlocking the Side Heads

- **Near-Side Head (Station 14)**:
    - Unlock the head using the **pneumatic release switch** mounted on the machine base near the cutter assembly (see §4.2, Station 21).
    - Adjust the head manually using the **crank handle**.
- **Fence-Side Head (Station 6)**:
    - Release the **mechanical lock handle** found directly below the cutterhead's DRO station.
    - Use the **manual crank** to reposition the cutterhead vertically.

Ensure the feed is OFF and the machine is clear of wood before beginning any such adjustments.

7.7 Bottom Head Height Adjustment

> **Scope:** Minor upward correction of the **1st** or **2nd bottom head** (see §4.2, Stations 4 & 28) when the knife edge has settled **below the bedplate** after several jointing cycles. Intended for deviations ≤ 0.08 mm (0.003 in). For initial setup and any larger correction apply **full lockout/tagout** and use the straight-edge method in §3.5.

Preconditions

- Feed rolls **STOPPED**; no wood in the machine
- Key switch in **LIMITED** mode (see §4.1, Row 1-5)

Procedure

1. **Verify** the machine is clear: **Press Feed STOP** (Row 4-10) and wait for feed rolls to halt
2. **Unlock** the bottom head: At Station **4** (1st bottom) *or* **28** (2nd bottom) **vent** the twin pneumatic clamp and back off each lock-nut ½ turn
3. **Bump** the head up: Turn the hand-crank **upwards** by *0.025 – 0.075 mm (0.001 – 0.003 in)*
4. **Re-engage** the lock: Re-pressurize the pneumatic clamp and tighten nuts. Confirm the DRO reflects the change

> ⚠ **Important:** For best accuracy whenever practical, shut down, apply **full lockout/tagout**, and reset the head with a straightedge per §3.5. Never adjust while stock is under the pressure beam.

7.8 Tasks Requiring Full Lockout/Tagout

Full LOTO must be applied (see §2.2) whenever performing **major** or **high-risk** tasks, including:

- Replacing or removing cutterheads, knives, or hydro-lock assemblies
- Reaching into hazardous areas where belts, spindles, or drive mechanisms might start unexpectedly
- When primary guards are removed
- Electrical/pneumatic maintenance on servo drives, motor wiring, air cylinders, etc.
- Any setup/adjustment that might cause a collision if attempted with power on
- Any procedure that conflicts with WorkSafeBC regulations or your facility's lockout/tagout policy

When in doubt, always lock out and tag out. Never compromise safety by attempting uncertain or complex work under partial power conditions.

Section 8: Troubleshooting

Even with proper setup, operators may encounter issues with cut quality or machine performance. This section provides guidance on identifying and resolving common problems.

8.1 Surface Quality Issues

Glazing (Excess Knife Marks per Inch)

Symptom: Very fine lines on the planed surface, creating a polished or "glazed" look.

- **Causes:**
    - Feed speed too slow relative to cutterhead speed (too many knife cuts per inch)
    - Using too many knives on the finish head
- **Solutions:**
    - Increase the feed rate using Feed-Rate Pot (see §4.1, Row 4-11), or reduce cutterhead RPM
    - For side heads, adjust RPM using VFD controls (see §4.1, Row 2)
    - Use fewer knives on the finishing head for multi-knife setups
    - Spreading out the knife marks helps eliminate glazing and improves finish

Burn Marks on Wood

Symptom: Scorching or darkened/burnished spots on the moulded profile.

- **Causes:**
    - Material pausing under a spinning cutter (friction heating)
    - Dull knives creating excessive friction
    - Knife with improper relief angle causing rubbing
- **Solutions:**
    - Maintain continuous, even feed without stops/starts mid-cut
    - Keep knives sharp and check relief angles are correct
    - Ensure feed system operates smoothly without stalling

Tear-Out

Symptom: Chips or chunks torn out, especially noticeable on end grain or figured wood.

- **Causes:**
    - Cutting against the grain direction
    - Dull knives or inadequate cutting angle
    - Excessive depth of cut for challenging grain
    - Feed rate too high relative to RPM (low KMPI)
- **Solutions:**
    - Orient stock so grain runs with cutter rotation when possible
    - Use higher cutterhead speed (for side heads, adjust at §4.1, Row 2)
    - Increase knife angle or use back-beveled knives for difficult grain
    - Take lighter passes by adjusting depth of cut (see §4.2, Stations 1 & 7)
    - Reduce feed rate or increase RPM to achieve higher KMPI (see §6.2)

Fuzzy or Raised Grain

Symptom: Fibers that stand up or appear "fuzzy," especially on softer woods.

- **Causes:**
    - Dull knives failing to cleanly sever wood fibers
    - Overly high feed speed with insufficient cutter speed
    - Wood with interlocked grain patterns
    - High moisture content in wood
- **Solutions:**
    - Sharpen or replace dull knives
    - Increase cutterhead RPM or reduce feed speed
    - Check wood moisture content - if too high, no immediate fix possible
    - Source drier material if moisture is the issue
    - Use higher hook angle for fibrous wood types

8.2 Dimensional Accuracy Issues

Skipping (Uncut Areas)

Symptom: Sections of the wood surface remain unplaned or partially untouched.

- **Causes:**
    - Previous cutterhead removed too much stock or stock thickness fluctuates
    - Bottom heads may be too low relative to the bedplate
    - Roughing heads not removing enough material for finishing head to engage
    - Inconsistent stock dimensions causing uneven cutterhead contact
    - Wood fragments jammed along fence, bedplate, or guides
- **Solutions:**
    - Verify each head's cutting depth using DRO displays (see §4.3)
    - For bottom heads, adjust at Stations 3 & 26 (see §4.2)
    - For top heads, use servo controls at Stations 16 & 23 (see §4.2)
    - Leave approximately 1/32" (0.8 mm) for the final cutter to clean up
    - Inspect stock thickness consistency before processing
    - Clean out any debris accumulation along guides and bedplates

Snipe (Indentations at Board Ends)

Symptom: A slight dip or deeper cut near the front or back ends of a workpiece.

- **Causes:**
    - Insufficient support as the board enters/exits cutterheads
    - Misalignment of rollers or bed plates
    - Incorrect infeed/outfeed table height
    - Cutterhead positioned too high or too low relative to bed/fence plate
    - Gaps in the feed system or end-to-end shock while board is partially in the moulder
- **Solutions:**
    - Adjust infeed/outfeed roller heights for uniform support
    - Ensure bed plates are level with no sagging
    - Set cutterhead position exactly on the same plane as bed/fence plate
    - Use auxiliary support for longer stock
    - For bottom head snipe:
        - **Tail-end snipe** indicates head is too **high** - lower slightly
        - **Leading-end snipe** indicates head is too **low** - raise slightly
    - For side head snipe:
        - Same leading/tail snipe logic applies (e.g., a fence-side radius proud of its fence will snipe the tail of the profile)
    - Ensure consistent feed pressure throughout the machine
    - When adjusting bottom heads to fix snipe:
        - Make only minor adjustments (0.025 – 0.075 mm / 0.001 – 0.003 in)
        - In most cases it's best to shut down, and use the straight-edge method (see §3.5)

Inconsistent Dimensions (Thickness or Width)

Symptom: Finished pieces vary in thickness/width beyond acceptable tolerances.

- **Causes:**
  - Calibration drift in spindle positioning
  - Improper feed roller, chipbreaker, or pressure shoe settings
  - Unclean or worn bed plates affecting consistent feeding
- **Solutions:**
  - Recalibrate spindles, table height, side guides
  - Ensure feed rollers apply even pressure
  - Clean and lubricate bed plates regularly

8.3 Feed and Machine Performance Issues

Feed System Slipping or Stalling

Symptom: Stock hesitates or stalls during processing, or feed rollers slip on material.

- **Causes:**
  - Incorrect roller pressure or dirty/worn rollers
  - Inadequate bed lubrication creating excessive friction
  - Excessive depth of cut overloading the feed motor
  - Control elements may be set too tight
  - Excessive pressure from chipbreakers or pressure shoes
- **Solutions:**
  - Clean feed rollers and set pressure correctly
  - Lubricate feed tables and bed plates adequately
  - Reduce cutting depth using appropriate station controls (see §4.2)
  - Check feed speed at DRO1 (see §4.1)
  - Adjust feed rate using Feed-Rate Pot (see §4.1)
  - Inspect control element settings at their respective stations (see §4.2)
  - Inspect drive belts, gears, chains for wear or slippage
  - Reduce pressure on chipbreakers and pressure shoes if excessive

Chatter (Ripples or Vibration Marks)

Symptom: A rippled or wavy texture on the surface, often in regular intervals.

- **Causes:**
  - Mechanical vibration or movement of the workpiece
  - Improperly set chipbreakers or pressure rollers
  - Out-of-balance cutterheads or worn bearings
- **Solutions:**
  - Tighten and adjust chipbreakers using Stations 15 & 22 (see §4.2)
  - Adjust pressure shoes at Stations 18 & 25 (see §4.2)
  - Verify cutterheads and knives are properly balanced
  - Slow feed speed using Feed-Rate Pot (see §4.1)
  - Inspect spindle bearings for wear or play

8.4 Noise and Vibration Problems

Tooling or Cutterhead Vibration/Noise

Symptom: Excessive vibration or rattling from the cutterheads, often accompanied by poor surface finish.

- **Causes:**
    - Unbalanced knives or cutterheads
    - Worn belts, bearings, or other drive components
    - Loose tooling or mountings
- **Solutions:**
    - Balance knives properly during installation
    - For side heads, check VFD settings (§4.1, Row 2)
    - Verify spindle start/stop function (§4.1, Row 5, Controls A-F)
    - Inspect and tension drive belts
    - Check spindle bearings, universal joints, and mounting hardware
    - Verify cutterhead hydro-lock pressure (~350 bar)

Unusual Motor Noises

Symptom: Whining, growling, or irregular sounds from motors or drive systems.

- **Causes:**
    - Bearing wear in motors or drive components
    - Misaligned belts or chains
    - Electrical problems affecting motor performance
- **Solutions:**
    - Inspect motor bearings and replace if worn
    - Check and correct belt/chain alignment
    - Verify electrical connections and motor loading
    - Monitor amperage draw during operation

Section 9: Maintenance and Lubrication

Proper maintenance is critical to keep the Hydromat 2000 running safely and efficiently. Regular cleaning and lubrication are essential for safe use and long machine life. This section provides detailed maintenance schedules and procedures.

9.1 Daily Maintenance

Before and after each operating shift, complete these essential maintenance tasks:

1. **Clean Wood Chips and Dust**
    - Remove chips and debris from around cutterheads, slideways, and feed works
    - Pay special attention to areas where chips can accumulate and affect operation
    - Use compressed air carefully, directed away from bearings and electronic components
2. **Verify Central Lubrication System**
    - Check that the automatic lubrication pump for the feed table/bedplates is functioning
    - Ensure oil reservoir is filled with the recommended lubricant (see §9.4)
    - Verify oil is reaching the table, maintaining a thin film for smooth feeding
3. **Check Cutterhead Clamping Pressure**
    - Verify all hydro-lock cutterheads are properly pressurized to ~350 bar
    - Use the high-pressure grease gun to check and adjust pressure as needed
    - Ensure outboard bearings remain securely locked
4. **Safety System Verification**
    - Test all E-stop buttons for proper function (see §4.1)
    - Verify the hood interlock switches are working correctly
    - Confirm that safety guards are intact and properly positioned
5. **Inspect Roller Condition**
    - Check feed rollers for wear, damage, or buildup
    - Ensure pressure rollers are clean and properly adjusted (see §4.4)
    - Look for any unusual conditions that may affect feeding
6. **Cutterhead Inspection**
    - Examine all knives for sharpness and condition
    - Re-sharpen or replace dull knives before they affect quality or cause overheating
    - Check for knife projection inconsistencies that may require jointing
7. **Listen for Unusual Noises**
    - During startup, listen for any abnormal sounds
    - Investigate any unusual noise or vibration immediately
    - Check for cutterhead balance, loose knives, damaged belts, or bearing issues

9.2 Weekly Maintenance

At weekly intervals or approximately every 40-50 operating hours, perform these more thorough maintenance procedures:

1. **Comprehensive Lubrication**
    - Grease all lubrication points fully, including:
        - Universal joints
        - Feed roller pivots
        - Dovetails and guideways
        - Cutterhead spindle bearings
        - Feed chain or belt drives
        - Bed elevation lead-screws
        - Pressure element pivot points
2. **Belt Tension Verification**
    - Inspect all cutterhead drive belts and feed drive belts
    - Adjust tension as needed, ensuring belts aren't too loose or too tight
    - Look for signs of wear or cracking that indicate replacement is needed
3. **Cooling System Check**
    - Ensure motor cooling fans are clean and operational
    - Verify electrical cabinet fans are free of dust and functioning properly
    - Clean any cooling vents or airways to maintain proper temperature
4. **Hydro-Lock System Check**
    - Inspect all hydraulic connections for leaks
    - Verify pressure gauge readings on hydro-lock system components
    - Check for any signs of tolerance loss, inadequate clamping

9.3 Monthly Maintenance

Monthly or after approximately 150-200 operating hours, conduct these more intensive maintenance procedures:

1. **Deep Clean and Inspection**
    - Remove access panels and thoroughly clean internal components
    - Inspect all bearing housings, drive components, and mechanical linkages
    - Look for signs of wear, misalignment, or potential failures
2. **Calibration Verification**
    - Check accuracy of digital readouts or mechanical gauges for thickness
    - Use gauge blocks or other measurement standards to verify settings
    - Recalibrate as necessary to maintain dimensional accuracy
3. **Electrical System Inspection**
    - Check for loose connections in control panels
    - Verify all limit switches and sensors are properly functioning
    - Inspect electrical cabinet filter and clean or replace as needed
4. **Pneumatic System Maintenance**
    - Change air filter elements
    - Check pneumatic cylinders for proper operation and seal condition
    - Verify air pressure settings throughout the system
5. **Major Lubrication Points Service**
    - Change oil in lubrication systems rather than just topping off
    - Grease all points to purge old grease and contaminants
    - Check condition of chains and apply proper chain lubricant
6. **Spindle and Gearbox Inspection**
    - Listen for any unusual noises that might indicate bearing wear
    - Check for excessive play or movement in spindles
    - Verify proper oil levels in gearboxes, changing oil if required by maintenance schedule

9.4 Lubrication Points and Schedule

Proper lubrication is essential for reliable operation and long component life. The table below outlines key lubrication points, recommended lubricants, and frequency:

Component	Lubricant Type	Frequency	Method	Notes
Feed Table/Bedplate	ISO VG 68 or equivalent	Daily	Auto system	Check reservoir level daily
Spindle Housings	Lithium grease EP-2	Weekly	Grease gun	2-3 pumps maximum
Universal Joints	EP-2 grease	Weekly	Grease gun	Until fresh grease appears
Feed Roller Pivots	EP-2 grease	Weekly	Grease gun	1-2 pumps per fitting
Dovetails/Guideways	EP-2 grease	Weekly	Grease gun	5-10 pumps per fitting
Elevation Screws	EP-2 grease	Weekly	Manual	Apply to lead screw threads
Hydro-Lock System	Special hydraulic grease	As needed	High-pressure gun	350 bar pressure
Chain Drives	Chain lubricant	Monthly	Spray/brush	Clean first, apply lightly
Gearboxes	S4 WE 220	6 months	Drain and fill	Check level monthly

Special Notes on Lubrication:

1. **Over-greasing** bearings can cause seal damage and overheating. Use only the specified amount.
2. **Contamination** is a leading cause of bearing failure. Keep grease fittings clean before attaching grease gun.
3. **Follow manufacturer's specifications** for lubricant types. Using incorrect lubricants can cause damage.
4. **Record all lubrication activities** in the maintenance log to ensure proper intervals are maintained.

Section 10: Appendices

10.1 Quick-Reference Checklists

> **Tip for printing:** Each checklist fits on one letter-sized sheet with 0.5 in margins.
> Use landscape orientation for the maintenance tables so operators can tick boxes easily.

10.1.1 Daily Pre-Operation Checklist

✔	Item	Target / Notes
☐	**Power isolated** overnight?	Main disconnects off, E-Stop out.
☐	**All guards intact** and secured	No broken latches or cracked panes.
☐	**Dust extraction** connected and operational	Test suction at each hood.
☐	**Cutterhead security**	Verify ~350 bar pressure on all heads.
☐	**Feed table lubrication**	Oil flow visible, reservoir above minimum.
☐	**Feed rollers** clean and in good condition	No buildup or damage visible.
☐	**Emergency stops** test pass	All E-stops functional when tested.
☐	**Cutter area clear** of tools, debris, cutoffs	Visually inspect before startup.
☐	**PPE available** and worn (glasses, ear protection, etc.)	See §2.4 for requirements

10.1.2 Setup Change Checklist

✔	Step	Reference
☐	Electrical **LOTO applied** and verified	§2.2
☐	Dust extraction system confirmed operational	§3.2
☐	Cutterheads marked with current radius numbers	§3.3
☐	Profiled knives marked with both radius and axial numbers	§3.3
☐	Outboard bearings depressurized before removal	§3.5
☐	Cutterheads depressurized before removal	§3.5
☐	Spindles cleaned and inspected before mounting new heads	§3.5
☐	New cutterheads installed with correct orientation	§3.5
☐	Outboard bearings correctly aligned and pressurized (~350 bar)	§3.5
☐	Radius and axial values entered at all adjustment points	§3.3
☐	Bottom head height manually set with straightedge	§3.5
☐	Appropriate feed rollers selected and installed	§3.4
☐	Feed roller pressure verified	§3.4
☐	First bottom depth of cut set (1-2 mm [0.040-0.080 in] S4S, 4-5 mm [0.160-0.200 in] rough)	§3.6
☐	Side hold-over rolls set ~4-5 mm (0.160-0.200 in) narrower than input	§3.6
☐	Bottom hold-down rolls set ~4 mm (0.160 in) below input thickness	§3.6
☐	Side chip-breaker assembly positioned correctly	§3.6
☐	Top head chip-breakers set with proper clearance (3-4 mm [0.120-0.160 in] throw)	§3.6
☐	Pressure shoes set after each top head using gauge blocks	§3.6
☐	All locking mechanisms re-engaged	§3.6
☐	Cutterhead swing clearance verified	§3.6
☐	Jointing performed on all new or adjusted heads	§5.4
☐	All tools removed from cutting area	§3.6
☐	Guards and hood properly secured	§3.6
☐	Test piece run and measured	§3.2
☐	Feed speed set appropriately for desired KMPI	§6.2

10.1.3 Daily Maintenance Checklist

✔	Task	Method / Quantity
☐	Clean chips from cutter area	Brush, vacuum, or low-pressure air
☐	Check lubrication reservoir level	Fill if below minimum mark
☐	Inspect feed rollers	Clean with appropriate solvent if needed
☐	Check cutterhead clamping pressure	High-pressure grease gun - 350 bar
☐	Verify dust extraction connections	Tighten if loose
☐	Check safety systems	Test E-stops and hood interlock
☐	Listen for unusual noises	Report any abnormalities immediately

10.1.4 Weekly Maintenance Checklist

✔	Task	Spec / Notes
☐	Grease universal joints	EP-2 until fresh grease appears
☐	Lubricate feed roller pivots	1-2 pumps EP-2 per fitting
☐	Grease dovetails and guideways	5-10 pumps EP-2 per fitting
☐	Check cutterhead knives	replace if dull
☐	Verify belt tension	Adjust if needed
☐	Clean cooling fans	Vacuum dust from motors and cabinet
☐	Check hydro-lock system	Inspect for leaks

10.1.5 Monthly / 150-200 Hour Maintenance

✔	Task	Spec
☐	Complete deep cleaning	Remove panels for access
☐	Check calibration accuracy	Use gauge blocks
☐	Inspect electrical connections	Tighten if loose
☐	Change air filter elements	Replace if dirty
☐	Service major lubrication points	Change oil, not just top-off
☐	Inspect spindles and gearboxes	Listen for unusual noises
☐	Check drives and bearings	Replace if worn

10.2 Glossary

Term	Definition
AWI	Architectural Woodwork Institute; organization that sets quality standards for architectural millwork.
Backlash	Mechanical play or looseness in adjustment systems that must be compensated for during setup.
Beam	Pressure beam above the material that holds workpieces down during machining; can be raised for setup and maintenance.
Chip-breaker	Component that controls chip formation and helps prevent tear-out; typically positioned just before the cutterhead.
DOC	Depth of Cut; amount of material removed by a cutting operation.
DRO	Digital Read-Out; electronic display showing machine settings (e.g., RPM, width, thickness, radius).
Feed Rate	Speed at which material travels through the machine, typically expressed in feet or meters per minute.
Glazing	Burnished or polished appearance on wood surfaces, often caused by excessive knife marks per inch.
Hold-down	Pressure elements that maintain downward force on the workpiece during machining.
Hydro-lock	Hydraulic system that secures cutterheads to spindle shafts using high-pressure oil.
Jog	Manual control mode allowing incremental movement of feed system or spindles for setup and adjustment.
Jointer/Jointing	Device or process used to true knife edges while mounted in the cutterhead.
KMPI	Knife Marks Per Inch; measure of surface quality based on density of knife cuts.
LOTO	Lockout/Tagout; safety procedure to ensure equipment is properly shut off and cannot start up during maintenance.
Outboard Bearing	Bearing assembly that supports the free end of a spindle to reduce deflection during cutting.
Pressure Shoe	Component that maintains downward pressure on the workpiece after it passes a cutterhead.
S4S	Surfaced Four Sides; lumber that has been planed smooth on all four sides.
Servo	Motorized actuator allowing precise positioning based on programmable input; used for head positioning.
Snipe	Unwanted deeper cut that occurs at the beginning or end of a workpiece.
Spindle	Rotating shaft that holds and drives the cutterhead.
TARGET	DRO display mode used during initial setup to define desired position.
Tear-out	Defect where wood fibers are torn rather than cleanly cut, leaving a rough surface.
VFD	Variable Frequency Drive; electronic control system that allows adjustment of motor speed.

10.3 Maintenance / Change-Log Form

Date	Technician	Action Performed	Details / Parts Used	Next Due (hrs / date)	Signature