ACECO PRECISION WOOD TOOLING

Wood Tooling Catalog & Technical Manual

AceCo Precision Manufacturing
Order / Technical Service
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ORDERING INFORMATION:

F.O.B. Point	All shipments are F.O.B. Boise, Idaho USA unless quoted otherwise.
Terms of Payment	Net 30 days. A service charge of 1.5% per month (18% per annum) will apply on the unpaid amount of any accounts 30 days past due.
Discounts	Quantity discounts are available upon request.
Prices	Prices are quoted in U.S. dollars and subject to change without notice.
Specifications	Product specifications are subject to change without notice.
Delivery	AceCo maintains an inventory level on many items displayed in this catalog. Contact the factory for a delivery date on custom tooling and high volume requirements.

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4419 Federal Way Boise, Idaho USA 83716

AceCo Quality

Finger Joint Cutters & Tooling

C40 Finger Joint System

Moulder & Planer Heads

Hydraulic Cartridges & Custom Tooling

Finger Joint Technical

Moulder & Planer Technical

General Technical Information

COMMITMENT TO QUALITY

AceCo is driven by a dedication to quality in every aspect of our business, from further educating our skilled work force to investing in the most advanced tools and CNC (computer numerical control) machines. This dedication to quality results in AceCo tooling that will save you maintenance time and replacement tooling money.

All AceCo tooling is made from only the highest grades of hardened alloy steel in order to handle the daily abuse of an industrial millwork operation. It would be cheaper and easier to use softer materials, cast or injection molded tools like many other manufacturers, but we decided long ago never to compromise our quality. As a result, our tooling lasts longer and performs better.

PRECISION MACHINING AND BALANCING

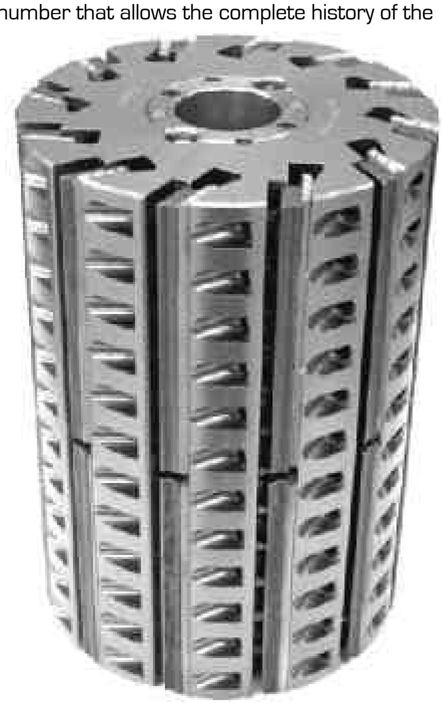
AceCo has invested heavily in advanced CNC milling, turning, and grinding machinery that allows us to achieve accurate repeatability and precise tolerances of ± .0001 of an inch (.0025mm).

The FINITE FINISH on our cutters improves flatness beyond industry tolerances, yielding better cutter compression for more consistent and accurate wood joints. All of this adds up to an unmatched ability to provide the highest quality tooling available for your woodworking needs.

Every AceCo cutter head is dynamically balanced to ISO Grade 1.0, far exceeding industry standards, for performance. This precision balancing improves wood surface finish, extends cutter life, and reduces vibration, noise, and bearing wear.

INSPECTION, SPC & TRACEABILITY

Advanced inspection methods and Statistical Process Control (SPC) procedures insure that we produce only the very best tooling. SPC procedures control complicated manufacturing processes and help effectively manage our production procedures. Documented standard operating procedures assure consistent parts every time. Traceability of all AceCo products includes information about the raw material vendor and chemistry, sampling, heat treatment reports, machinists that worked on the specific parts, and documented measurement reports. The last step in the finish process is to stencil the parts with a serial number that allows the complete history of the part to be revisited.



WORLD CLASS SERVICE & SUPPORT

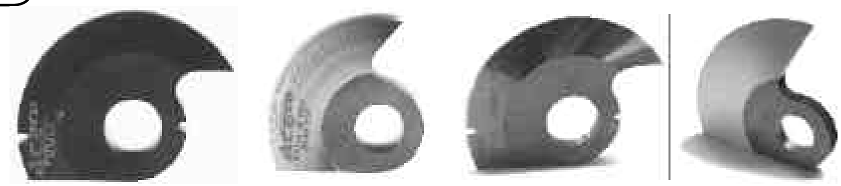
High quality goes beyond our fine tooling. We pride ourselves on unmatched customer service and superior technical support. We meet your specific requirements with quick response and express delivery. Our engineering department can resolve many of your production and product quality problems. From common joint remedies to ways of increasing production, AceCo has the answers to help your operation succeed.

OUR GUARANTEE

All of our products are guaranteed against defects in material and workmanship under normal use and service for a period of one year from the date of purchase. AceCo Precision Manufacturing also guarantees our products to meet standards and tolerances as noted or specified per customer order. This warranty applies to all AceCo products when used in a normal industrial environment. Any tampering, misuse, or neglect will make this warranty null and void. AceCo's liability under this warranty is limited to repair of the product and/or replacement of parts and is given to purchasers in lieu of all other remedies, including incidental and consequential damages. There are no express warranties other than those specified herein. There are no warranties that extend beyond the description on the face hereof. No warranties, including but not limited to warranty of merchantability, shall be implied. AceCo will obligate itself only for normal freight charges in cases of prepaid warranty shipments; special freight rates are not included.

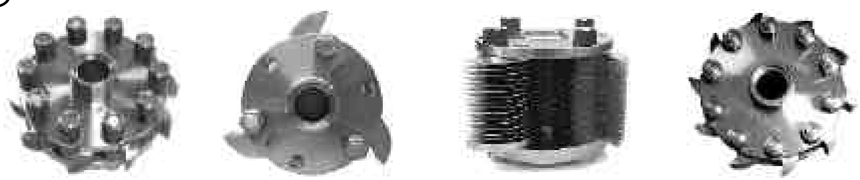
Finger Joint Cutters

- Finite Finish
- M2 HS Steel
- Solid Carbide
- Micro-Joints
- Structural
- Custom



Finger Joint Heads

- Ace-Loc Hydraulic
- Collet Style
- Class II
- Custom



C40 Finger Joint System

- C40 Plate Cutters
- Finite Finish
- M2 HS Steel
- Ace-Loc Hydraulic

Moulder Heads

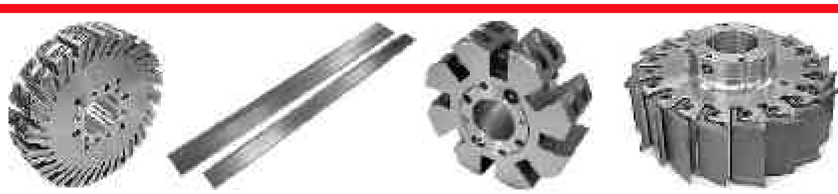
- Ace-Loc Hydraulic
- Straight Bore
- Corrugated
- Flatback
- Custom

Shear Cut Moulder Heads

- Ace-Loc Hydraulic
- Straight Bore
- Corrugated
- Flatback
- Custom

Planer Heads

- Ace-Loc Hydraulic
- Straight Bore
- L and LV Styles
- Side Heads
- Taper Bore
- Custom



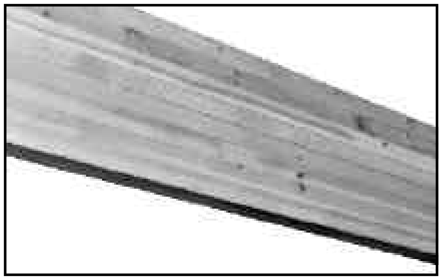
Hydraulic Cartridges

- Ace-Loc Hydraulic
- Welded
- Type A
- Type B
- Custom

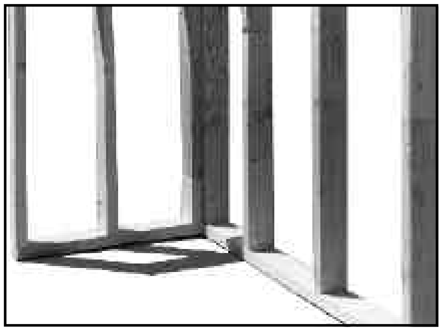
Custom Tooling

- Tenon Heads
- Expandable Arbors
- Hydraulics
- Specialty Cartridges

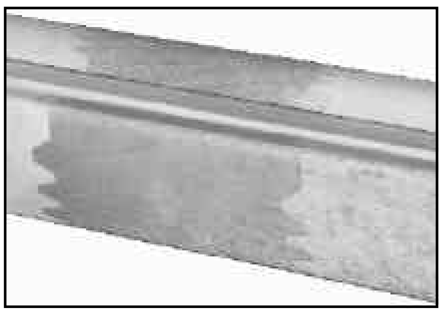
USES OF FINGER JOINTING



Structural
Because of their exceptional strength, finger joints are utilized in a multitude of load bearing applications including laminated beams, I-beams, and a variety of other structural components.

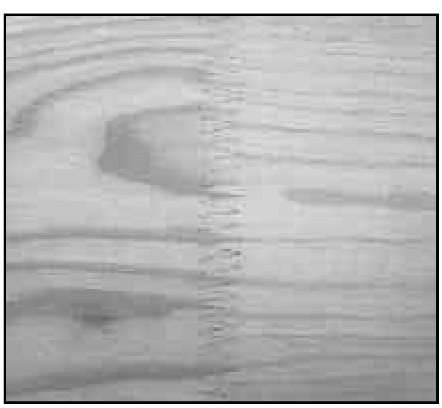


Sub-Structural
Typical applications for finger jointed sub-structural lumber include pallets, dimensional construction lumber (i.e. 2x4, 4x4, etc.), overhead door parts and furniture.



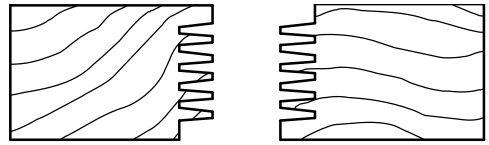
Non-Structural
Non-structural finger jointed products consist of door and window mouldings, doorjambs, cores, casings, interior trims, and shelving material. These operations benefit from the recovery of scrap lumber and from the upgraded clear lumber produced.

Specialty
Finger jointing keeps growing in the specialty wood products market as hundreds of specialty manufacturers realize the great financial returns possible from finger jointing. Specialty finger jointed products include curtain rods, tooth pick and pencil stock, cutting boards, toys, round top windows, floor material, as well as many other products.

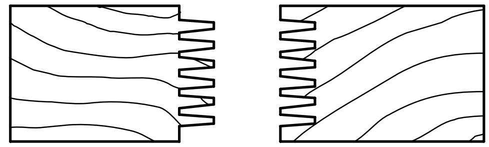


Vertical
Common in Europe and Asia, vertical finger joints are used in a variety of wood products - most commonly in furniture and components. With the introduction of the C40 finger joint system, AceCo can now offer a precision vertical tooling option.

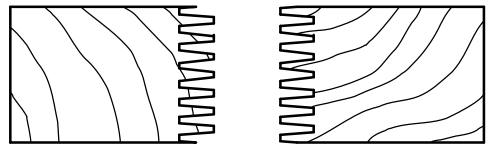
TYPES OF FINGER JOINTS



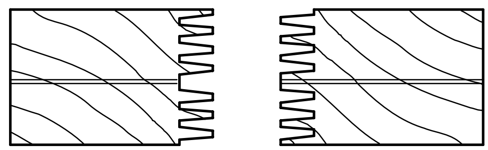
Reverse



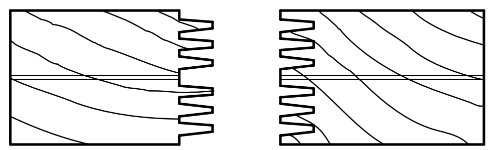
Male - Female



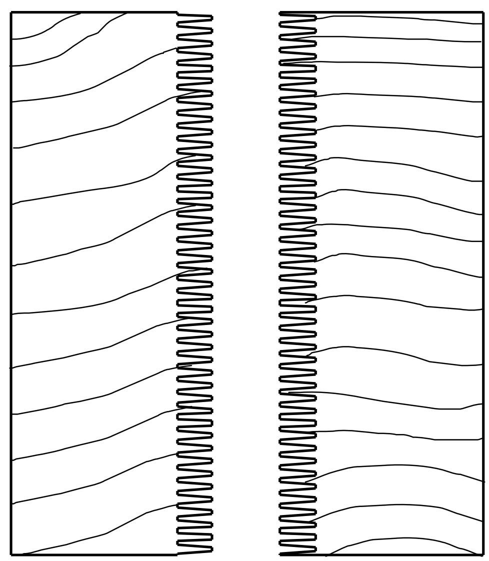
Feather



Reverse Resaw



Male - Female Resaw

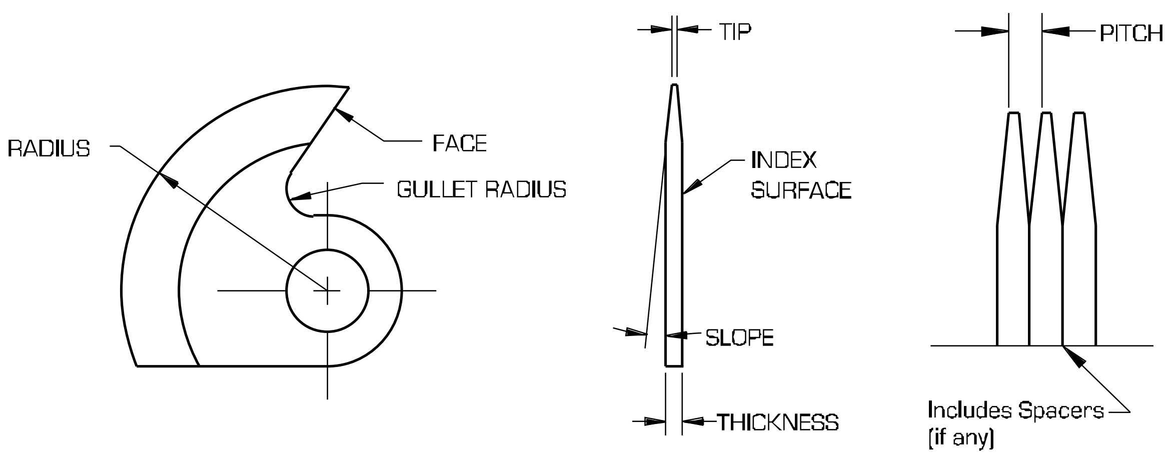


Vertical

FINGER JOINT CUTTERS

AceCo finger joint cutters are the ultimate in quality and cutting precision. Our cutters are manufactured using American Iron and Steel Institute (AISI) rolled and billet stock M2 tool steel, hardened and ground to specific dimensional tolerances of ±.0001 of an inch (.0025 mm). We do not cast or injection mold our cutters. Using advanced statistical process control and inspection procedures, our skilled workforce produces the most uniform, high-quality cutters on the market today.

AceCo maintains a large volume of standard production cutters that can be shipped overnight if needed. We also have the capability of producing custom cutters to meet your specific requirements. Some of the innovations pioneered by AceCo include micro joints that save lumber, special cutter treatments that reduce downtime, and our new C40 Vertical Finger Joint System.

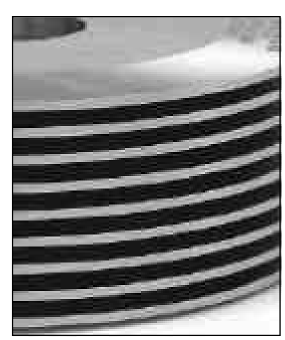


FINITE FINISH™

Thickness accuracy and flatness are the key elements that guarantee cutter stacks will meet finger joint tolerance expectations. Through research and process evolution, AceCo has developed FINITE FINISH™ - a process that achieves new levels of flatness and accuracy far exceeding current industry standards.

Thickness Accuracy

FINITE FINISH™ guarantees thickness accuracy tolerances to be held to under ± .0001" (one ten thousandth of an inch or ±.0025mm), which is at least twice as accurate as other manufacturer's cutters. FINITE FINISH™ eliminates many of the tolerance accumulation problems associated with stacked cutters and ensures that all cutters follow the same tracking plane.



Flatness

FINITE FINISH™ produces cutters so flat they actually adhere to each other. When two AceCo cutter faces are pressed together with a slight twisting motion, essentially all the air between them is compressed out, and a vacuum is formed. This physical law can only be obtained with flatness tolerances below .00005" (50 millionths of an inch) (±.0012mm). FINITE FINISH™ also improves the remaining physical dimensions of the cutters, because the FINITE FINISH™ surfaces are used in subsequent processes as critical location surfaces.

FINITE FINISH™ cutters compress better, have tighter tolerances, and produce more consistently accurate wood joints.

FINGER JOINT CUTTERS (HSS) - STANDARD

AceCo Part #	Joint Length	Cutter Thickness	Cutter Radius	Cutter Tip	Remarks	Hook Gauge #
C16-237 C16-238	4mm (.157") 4mm (.157")	.100 (2.54mm) .302 (7.67mm)	1.500 (38.10mm) 1.500 (38.10mm)	.038 (.96mm) .240 (6.10mm)	Extended Life Extended Life	G17-018 G17-018
C16-249 C16-250	4.5mm (.177") 4.5mm (.177")	.1210 (3.07mm) .3270 (8.31mm)	1.500 (38.10mm) 1.500 (38.10mm)	.044 (.96mm) .250 (6.10mm)	Extended Life Extended Life	G17-018 G17-018
C16-217 C16-218	5mm (.197") 5mm (.197")	.125 (3.18mm) .331 (8.41mm)	1.500 (38.10mm) 1.500 (38.10mm)	.044 (1.12mm) .250 (6.35mm)	Extended Life Extended Life	G17-018 G17-018
C16-235 C16-236	5mm (.197") 5mm (.197")	.125 (3.18mm) .331 (8.41mm)	1.500 (38.10mm) 1.500 (38.10mm)	.044 (1.12mm) .250 (6.35mm)	E. L./No Back Notch E. L./No Back Notch	G17-018 G17-018
C16-104 C16-105	1/4" (6.35mm) 1/4" (6.35mm)	.139 (3.53mm) .344 (8.74mm)	1.500 (38.10mm) 1.500 (38.10mm)	.047 (1.19mm) .252 (6.40mm)	Extended Life Extended Life	G17-018 G17-018
C16-150 C16-151	1/4" (6.35mm) 1/4" (6.35mm)	.125 (3.18mm) .200 (5.08mm)	1.250 (31.75mm) 1.250 (31.75mm)	.045 (1.14mm) .120 (3.05mm)	9/16" Bolt Hole 9/16" Bolt Hole	G17-024 G17-024
C16-048 C16-049	3/8" (9.53mm) 3/8" (9.53mm)	.1685 (4.28mm) .3735 (9.49mm)	1.500 (38.10mm) 1.500 (38.10mm)	.046 (1.17mm) .251 (6.38mm)	Extended Life Extended Life	G17-018 G17-018
C16-052 C16-053	3/8" (9.53mm) 3/8" (9.53mm)	.1775 (4.51mm) .355 (9.02mm)	1.875 (47.63mm) 1.875 (47.63mm)	.063 (1.60mm) .2405 (6.11mm)		G17-026 G17-026
C16-154 C16-155	10mm (.394") 10mm (.394")	.140 (3.56mm) .2825 (7.18mm)	1.250 (31.75mm) 1.250 (31.75mm)	.045 (1.14mm) .1875 (4.76mm)	9/16" Bolt Hole 9/16" Bolt Hole	G17-024 G17-024
C16-168 C16-169	10mm (.394") 10mm (.394")	.1496 (3.80mm) .3135 (7.96mm)	1.250 (31.75mm) 1.250 (31.75mm)	.0236 (.60mm) .1875 (4.76mm)	9/16" Bolt Hole 9/16" Bolt Hole	G17-024 G17-024
C16-090 C16-091	1/2" (12.70mm) 1/2" (12.70mm)	.1516 (3.85mm) .4642 (11.79mm)	1.875 (47.63mm) 1.875 (47.63mm)	.030 (.76mm) .3426 (8.70mm)		G17-026 G17-026
C16-190 C16-191	.585" (14.86mm) .585" (14.86mm)	.1685 (4.28mm) .3746 (9.51mm)	1.500 (38.10mm) 1.500 (38.10mm)	.044 (1.12mm) .250 (6.35mm)	1/8" Gullet 1/8" Gullet	G17-019 G17-019
C16-159 C16-179	5/8" (15.88mm) 5/8" (15.88mm)	.185 (4.70mm) .316 (8.03mm)	1.875 (47.63mm) 1.875 (47.63mm)	.029 (.74mm) .160 (4.06mm)		G17-028 G17-028
C16-032 C16-033	11/16" (17.46mm) 11/16" (17.46mm)	.214 (5.44mm) .495 (12.57mm)	1.875 (47.63mm) 1.875 (47.63mm)	.062 (1.57mm) .343 (8.71mm)		G17-020 G17-020
C16-028 C16-029	.987" (25.07mm) .987" (25.07mm)	.2225 (5.65mm) .5515 (14.00mm)	1.875 (47.63mm) 1.875 (47.63mm)	.031 (.79mm) .360 (9.14mm)	Spacers Required Spacers Required	G17-021 G17-021
C16-007 C16-008	1.113" (28.27mm) 1.113" (28.27mm)	.248 (6.30mm) .560 (14.22mm)	2.125 (53.98mm) 2.125 (53.98mm)	.030 (.76mm) .342 (8.69mm)	Spacers Required Spacers Required	G17-022 G17-022
C16-016 C16-017	1.113" (28.27mm) 1.113" (28.27mm)	.243 (6.17mm) .494 (12.55mm)	2.375 (60.33mm) 2.375 (60.33mm)	.032 (.81mm) .283 (7.19mm)	Spacers Required Spacers Required	G17-023 G17-023
C16-139 C16-107	1.113" (28.27mm) 1.113" (28.27mm)	.2635 (6.69mm) .576 (14.63mm)	2.125 (53.98mm) 2.125 (53.98mm)	.030 (.76mm) .342 (8.69mm)		G17-022 G17-022

In order to process orders efficiently, please have the following information available when ordering:
Part number or Joint length, Radius of Cutter, Lumber Size, Joint Size

Note:
- Cutters are shown with their mating thin and thick pairs.
- Joint length can vary due to radial runout of tooling and/or spindle.
- A sample cutter may be required in some cases to provide an exact match. AceCo can provide customers with a joint layout drawing and material savings data for analysis.

FINGER JOINT CUTTERS (HSS) - CUSTOM

AceCo has over 300 finger joint cutters on print. If your finger jointing needs go beyond our standard line of stocked M2 cutters, please request a quote on custom M2 HSS cutters, carbide cutters, or treated cutters.

SPECIALTY FINGER JOINT CUTTERS

CARBIDE FINGER JOINT CUTTERS

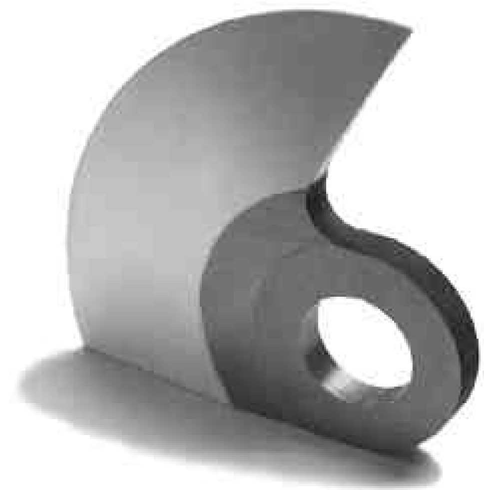
The demand to salvage wood with high hardness and abrasive characteristics is escalating. AceCo's solid carbide cutters make finger jointing these materials economically feasible. The carbide option enables wood processors to salvage materials such as:

- Laminated Veneer Lumber (LVL)
- Lumber with high silicon content
- Plywood and composite materials
- Exotic hardwoods
- Materials with abrasive glue lines

AceCo's solid carbide cutters also increase production, because resharpening rates can be dramatically decreased. Increased production and cutter life depend primarily on the type of material and profile being cut. AceCo's carbide finger joint cutters are designed for materials that cannot feasibly be processed with standard high speed steel cutters.

Solid carbide cutters offer significantly longer life over carbide tipped cutters, since they can be resharpened many more times to take advantage of the full radius. This provides almost 2" of usable life on most cutters.

CUTTER TREATMENTS



Treated cutters are used to cut tough materials or to increase cutter life between sharpenings. Our treatments offer a low cost way to increase machine uptime, machine production, and your plant's net profits. Production time between sharpenings can be increased up to 50% depending on the application. These treatments are offered in all of the AceCo standard cutter styles, as well as any custom cutter you may need. After extensive analysis, we have discovered that some treatments work far better in a particular cutting operation than others. Therefore, AceCo offers a variety of treatments suited for your specific material and cutting application.

DiaMax*

The DiaMax Cutter Treatment is a diamond coating that increases edge life and performance of the cutter between sharpenings. Depending on the density of the wood, DiaMax can substantially increase output per sharpening. DiaMax coating has a lubricating characteristic that decreases pitch buildup. DiaMax does not affect the metallurgical properties of M2 steel, therefore it can be applied to all cutter sizes.

DuraMax*

The DuraMax Cutter Treatment dramatically increases cutter life between resharpenings in high-abrasion applications. Testing shows up to a 50% reduction in wear over conventional cutters. The DuraMax treatment is a proprietary process that hardens only the outer surface of the steel cutting edge (72 Rc), which allows the cutter to hold a sharp edge longer while still offering a flexible inner core to reduce breakage. This process also reduces oxidation and pitch buildup on the cutters. Please note that this treatment is not recommended on cutters with one of the following: a gullet radius of less than 1/4", a tip of less than .030", or a joint length of 5/8" or longer. Brittleness may be enhanced with this treatment.

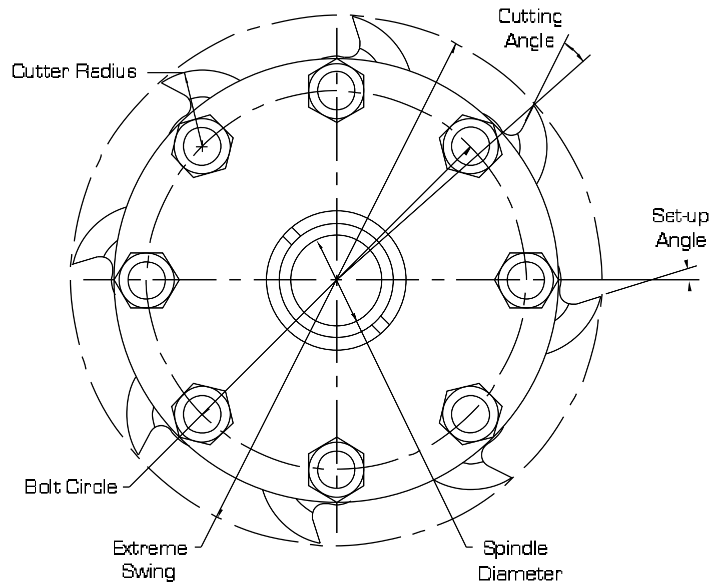
StressMax*

The StressMax treatment is used in applications when cutters are in "high stress" cuts, or rough, interrupted cuts. The StressMax treatment works well for cutters that cut joints over 1/2" in length. The StressMax Cutter Treatment changes the cutter's molecular arrangement to improve the grain structure of the cutting edge.

*These treatments are accomplished after final grind and may affect flatness in critical applications.

FINGER JOINT HEADS

All AceCo finger joint heads are precision machined from hardened alloy steel to resist the daily abuse of an industrial millwork operation. AceCo's heads are known to run smoother and to last longer than any other finger joint head made. From 2 to 20 bolts, AceCo offers the widest selection of standard and custom finger joint heads to fit most finger joint machines.



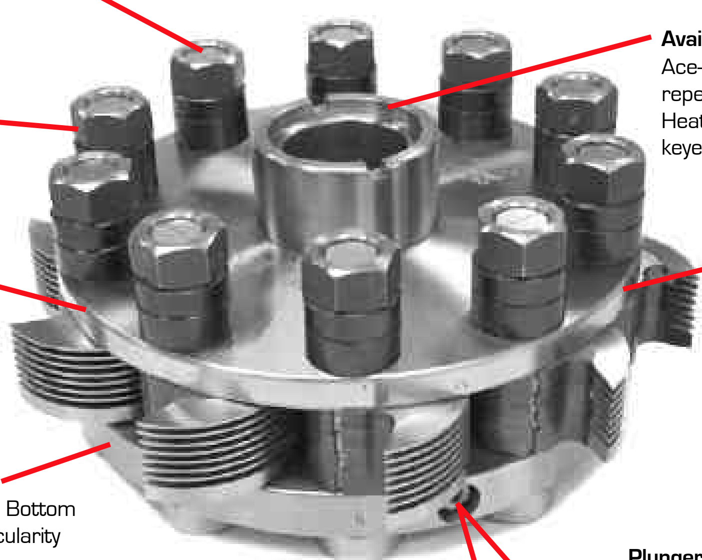
Finger Joint Head Features:

Hardened Steel Bolts
High Strength

Hardened Steel Nuts
Grade 8 - High Strength

High Tensile Alloy Steel
4150 Heat-treated steel for maximum durability and performance

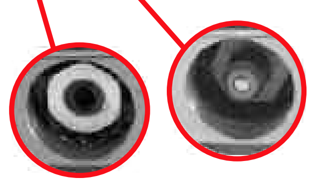
Class II Option
.0005" Bore to Bottom Plate Perpendicularity



Available Hydraulic Centering
Ace-Loc hydraulic sleeves ensure repeatability, accuracy, and balance. Heat-treated sleeves are available for keyed spindles.

7200 RPM Balancing
Precision balanced on a computer-aided, dynamic balancer to ISO Grade G-1.0, far beyond industry standards

Plunger Style Grease Zerks
This style fitting uses a plunger rather than a ball to seal the back pressure flow - no more leaks from dirt and grit under the check ball



Finger Joint Head Ordering Options

To order a Finger Joint Head, please specify the following:

Description	AceCo Standard Options *
# of Bolts	4 6 8 10
Extreme Swing * *	9.0" 10.5"
Cutter Radius	1.50" 1.875" 2.125"
Rotation	Clockwise or Counterclockwise
Spindle Diameter	1.50" 1.813" 50mm
Spindle Type	Keyed or Keyless
Centering	Ace-Loc Hydraulic or Collet Style

Please Note: * Other options are possible - contact us for anything not shown
* * Extreme swing can limit # of bolts possible

Ace-Loc Heads

The Ace-Loc finger joint head represents the most accurate advancement in hydraulic, self-centering cutter heads. Ace-Loc finger joint heads offer longer cutter life, more accurate cuts, and quicker tool changes. Ace-Loc finger joint heads are a necessity for cutting joints of 1/4" or less in length.

Collet Heads

AceCo collet heads are less accurate than hydraulically centered heads. However, they offer an economical and reliable alternative for many applications.

Custom Application Heads

Please contact our engineering staff for applications not covered by our standard product line, 1-800-359-7012.

AceCo CLASS II Premium Heads

Finger joint cutting accuracy has evolved with the introduction of Finite Finish™ and other dimensional tolerance improvements to AceCo finger joint cutters.

These technological advances required that we hold the tolerances of our finger joint heads to the same exacting standards as our cutters. If the head is not as accurate as the cutters, then the full benefit of precision cutters is not realized.

Therefore, we have introduced our CLASS II premium heads for these exacting wood machining requirements. CLASS II heads have the most accurate relationship of the bottom plate cutter face to the spindle bore, with perpendicularity held to ±.0005" (five ten thousands of an inch or ±.0125 mm). The CLASS II premium perpendicularity dimension is twice as accurate as a stock AceCo finger joint head, and four times as accurate as accepted industry standards.

As the perpendicularity accuracy improves, the finger joint cutters run behind one another on a more precise plane, which allows for more uniform chip load and tool pressure. Because all the finger joint cutters in a CLASS II head are working together precisely, you will experience less tool wear, longer run times, and an overall better joint. If you want the ultimate technology and accuracy for your finger joint wood machining, then call us and inquire about AceCo CLASS II premium heads.

Ace System - 1™

If you are thinking of finger jointing on a small scale, AceCo has what you need. The patented Ace System-1™ finger joint head with long life cutters can be mounted on any standard shaper with a sliding table. *

Quality finger jointing requires precise squaring of board ends and length adjustment capability. The Ace System-1™ provides a unique combination of standard finger joint cutters and trim knives. With one simple adjustment, the Ace System-1™ allows for fine tuning of the straight knives simultaneously, without removing the head from the shaper. With convenient, fast, and accurate setup, this AceCo innovation makes quality joints possible. These heads are also available with shear-cut trim knives for improved board end surface finish, longer knife life, and reduced chip loading that requires less horsepower.

Note:
- Maximum spindle diameter = 1-1/4"
- Maximum board height = 2"
- Maximum joint length = 7/16"

*Your machine will require adaptation to adequately hold the board (without operator participation) and the addition of appropriate protection guarding.

AceCo FINGER JOINT HEAD MAINTENANCE PROGRAM

CMM Inspection

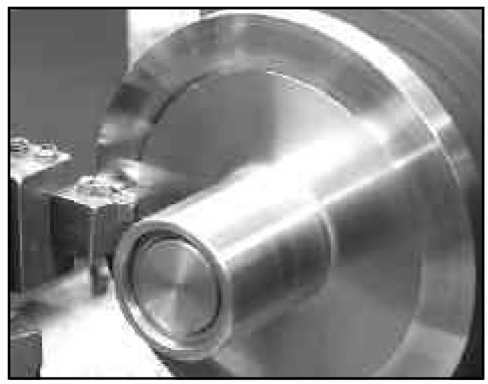
AceCo recommends all finger joint heads be inspected once a year to maintain peak performance of the tooling. Just like a high-performance automobile, our tooling should be "tuned-up" on a regular basis to ensure long life and optimum performance.

The AceCo Finger Joint Head Maintenance Program provides a complete "tune-up" service for all AceCo finger joint heads and includes:

- Full inspection of the head both visually and with the assistance of a computer-aided Coordinate Measuring Machine (CMM).
- Complete verification of all geometry including radial run-out, bolt circle to bore concentricity, bolt to bolt spacing, bottom head plate to bore perpendicularity, collet face perpendicularity to bore, and balance.
- Fully documented report from the CMM with the head serial number attached. Each time the head is re-measured, a comparison will be done with the last report to identify any changes (all new AceCo finger joint heads are inspected before leaving the factory).
- Recutting the face of the bottom plate, regrinding the top plate, balance and reassemble (only performed if head is out of specification).
- Precision balanced on a computer-aided, dynamic balancer to ISO Grade G-1.0.

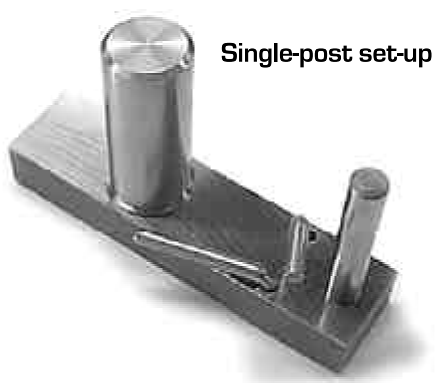
The turn-around time for the inspection is three to four days after we receive the head at AceCo. The heads must be shipped to our factory with the cutters removed. If additional work is needed that goes beyond the scope of the standard program, AceCo will issue a quote before any work is performed.

Balancing



Recutting knife face

FINGER JOINT TOOLING ACCESSORIES



Single-post set-up stands

Multi-post set-up stands

FINGER JOINT TOOLING ACCESSORIES

Safety Lock Collars

Part#	Spindle Size	Top or Bottom
C20-008-1	1.5"	Bottom
C20-012-1	1.5"	Top
C20-008-2	1.813"	Bottom
C20-012-2	1.813"	Top
C20-021	50mm	Top

Safety Lock Collars act as a retaining device and prevent accidental spinning of the cutter head, which can damage the spindle and/or head if hydraulic pressure is not properly maintained. We strongly recommend lock collar use with all hydraulically centered Ace-Loc heads.

Hook Gauges

Hook Gauges play a crucial role in maintaining cutter performance. AceCo Hook Gauges provide a template for measuring proper hook angle and cutter face length.

An improperly sharpened cutter can adversely change joint geometry. As shown on page 40, the relationship of the cutter face to the cutter radius affects the geometry of the joint profile. The cutter face length must be maintained to ensure proper joint length and to prevent the gullet area from doing any cutting. AceCo hook gauges have a scribe mark indicating the minimum cutter face length for that particular cutter, so the cutter face will not gradually decrease in length as the cutter is resharpened throughout its life.

HOOK GAUGES Part #	
G17-018	Refer to FJ cutter chart on page 7 for correct Hook Gauge.
G17-019	
G17-020	
G17-021	
G17-022	
G17-023	
G17-024	
G17-026	
G17-028	

The AceCo hook gauge is a precise instrument that will guarantee a properly resharpened cutter every time. Hook gauges are made of softer steel than that of the cutter; therefore, the gauge will wear and could be bent if mishandled or dropped. Under normal industrial conditions, replace hook gauges every six months.

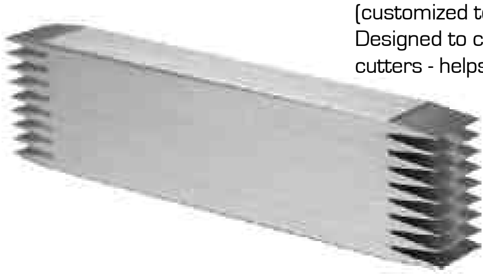
Pull-Up Tool

By inserting it in the back notch of the cutter, the T-02 Pull-up Tool is used to rotate the finger joint cutter forward against the alignment post of the setup stand. Using other tools to pry against the alignment post or against the cutters could damage the tooling and/or setup stand.

Pull-Up Tool
Part # T-02

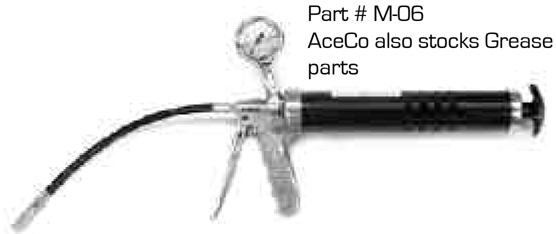
Brass Head Cleaners

(customized to your joint layout)
Designed to clean out fiber buildup in between cutters - helps maximize performance



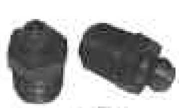
High Pressure Grease Gun (600 BAR)

Part # M-06
AceCo also stocks Grease Gun rebuild kits and parts



Grease Zerks

Part # GFS1/8NPTZ



Pressure Relief Valves

Part # GFS1/8NPTR

Zerk & Relief Valve Installation Socket

Modified deep well socket (11mm hex) for installing grease fittings
Part # T14-005

Collets

(1.25", 1.5" & 1 13/16", 50mm ONLY)

FINGER JOINT TOOLING ACCESSORIES

Bolts

Part#	Diameter	Length	Threads
B30-004-1	3/4"	3.5"	16
B30-004-2	3/4"	4"	16
B30-004-3	3/4"	4.5"	16
B30-004-5	3/4"	6"	16
B30-004-6	3/4"	8"	16
B30-007-1	9/16"	3.5"	18
B30-007-2	9/16"	4"	18
B30-007-6	9/16"	8"	18
B30-011-2	3/4"	4"	16 (LH)

Hardened Washers

Part#	Size (ID)	Thickness
W11-003-1	3/4"	1/8"
W11-003-2	3/4"	1/4"
W11-003-3	3/4"	3/8"
W11-003-4	3/4"	1/2"
W11-003-5	3/4"	3/4"
W11-004-1	9/16"	1/16"
W11-004-2	9/16"	1/8"
W11-004-3	9/16"	3/16"
W11-004-4	9/16"	1/4"
W11-004-5	9/16"	3/8"
W11-004-6	9/16"	1/2"
W11-004-7	9/16"	3/4"
W11-004-8	9/16"	1"

Nuts

Part#	Size	Grade	Threads
N10-006	9/16"	9	18
N10-007	3/4"	8	16
N10-011	3/4"	8	16 (LH)

Hardened Index Spacers

("Doughnut" style)
STANDARD = .0003" tolerance
PRECISION = .0001" tolerance
(same thickness tolerance as all AceCo FJ Cutters)

"DOG BONE" Hardened Index Spacers

.0001" tolerance/ .015" to .030" thickness
A precision alternative to "Disk" or "Pie" spacers, providing the accuracy of .0001" as compared to approx .0007" tolerance for Disk spacers (Patents Pending)

Shim Stock Spacers

("Doughnut" style)
Standard thickness, under .040"

Mast Lock Hardened Index Spacers

.0001" tolerance - For use on difficult set-ups requiring precision spacers, such as staggered knife head set-ups or three bolt heads. Helps eliminate knife rollback on tall stack configurations. (Patents Pending)

Offset "DOG BONE" Hardened Index Spacers

.0001" tolerance - For use on a staggered knife head set-up to help eliminate knife rollback on taller stack configurations. Thickness is equivalent to the cutter used. (Patents Pending)

"DISK" Style 4 to 10-Bolt Spacers

Standard thickness, under .040"

RADIUS EDGE FINGER JOINT GRINDING WHEEL

AceCo offers custom grinding wheels specifically designed for resharpening finger joint cutters. This unique, radius-edge grinding wheel features a body of aluminum and a rim of Cubic Boron Nitride (CBN), also known by its trade name Borazon™.

This CBN wheel incorporates a radius edge that reforms the gullet each time you grind the face. Maintaining the gullet profile reduces fracture stresses (stress risers), which helps reduce cutter breakage. The wheel removes just enough material to clean the cutting edge without leaving a heavy burr, which can cause deformed or loose-fitting joints.

Compared to other grinding wheel materials like Aluminum Oxide, CBN offers significant advantages including:

- Self-Sharpening: CBN will load and dull only to a point, when it then breaks down and exposes new crystals. Once it is initially dressed, CBN never requires resharpening like other wheels.
- CBN Longevity: Because it is second only to diamond in terms of hardness, CBN remains sharp even after grinding High Speed Tool Steel.

- Cool Cutting Action: CBN is a thermal conductor, so it conducts heat away from the steel being ground. Comparatively, Aluminum Oxide is a thermal insulator that causes heat build-up in the steel and substantially decreased tool life.
- Less Metal Fatigue: Grinding operations have normal heating and cooling cycles that cause surface tension on the work piece. If the temperature extremes are far apart, minute fissures in the steel result and can cause the cutting edge to rupture. CBN absorbs heat generated from the grinding process, so the work piece does not expand or contract to produce fissures.
- Higher Quality Cut: CBN particles remove a more uniform chip from the work piece. The result is a very keen cutting edge that produces a better surface finish on the wood. A sharp cutting edge also helps reduce tool pressure resulting in increased tool life.

AceCo CBN Grinding Wheels (available from stock)

Part#	Diameter	Grit	Bore	Radius
CB80-R-5.5-1/8	5.5"	80	20mm	1/8"
CB80-R-5.5-1/4	5.5"	80	20mm	1/4"
CB120-R-5.5-1/8	5.5"	120	20mm	1/8"
CB120-R-5.5-1/4	5.5"	80	20mm	1/4"
CB80-R-6-1/8	6"	80	1 ¼"	1/8"
CB80-R-6-1/4	6"	80	1 ¼"	1/4"
CB120-R-6-1/8	6"	120	1 ¼"	1/8"
CB120-R-6-1/4	6"	80	1 ¼"	1/4"
CB80-R-8-1/8	8"	80	1 ¼"	1/8"
CB80-R-8-1/4	8"	80	1 ¼"	1/4"
CB120-R-8-1/8	8"	120	1 ¼"	1/8"
CB120-R-8-1/4	8"	80	1 ¼"	1/4"

WOOD CUTTING LUBRICANT

Clear Lube from Technichem is a mineral oil-based, mist-applied lubricant that enhances cutter life and performance by reducing heat and residue build-up. **Clear Lube** also aids in machine and tool clean up. Most of the fluid is used up during the application process; however, if any fluid needs to be disposed of, simply take it to any facility that recycles motor oil.

HEAD AND CUTTER CLEANING SOLUTION

Designed especially for the lumber industry and sawmills, **Blade Clean** from Technichem is a cold or hot tank cleaner that removes the baked on pitch and gum from the tooling. It is water-based and can be diluted as much as 5 to 1 with water. Always dispose of in accordance with Federal, State, and Local regulations.

WARNING: Do not use abrasives, such as sand blasting, to remove pitch. Abrasive cleaning methods will wear metal surfaces and change clearances between parts. We only recommend **Blade Clean** Solution.

C40 VERTICAL FINGER JOINT SYSTEM

Designed specifically for vertical-style finger joint machines, the innovative AceCo C40 system represents a significant leap forward in vertical finger jointing technology. AceCo has utilized all of our advanced capabilities to design a vertical system that offers:

- **High Precision Cutting**
- **Ease of use**
- **Versatility**
- **Economical Operation**
- **Longer Cutter Life**

The C40 System is designed to accommodate smaller cutting circles (extreme swing), while maintaining the tight tooling tolerances AceCo is known for. The C40 system combines the advantages of hydraulic centering with the convenience of drop-on plates.

Multiple Set-up Options:

- **Standard**
- **Staggered**
- **Spiral**

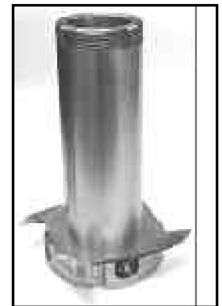
C40 Plate Cutter Advantages

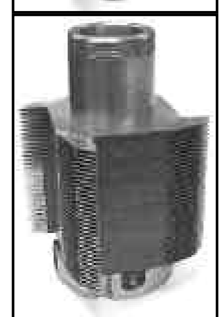
FINITE FINISH™ Flatness and Thickness
The C40 plate cutters are precision ground using our FINITE FINISH™ process to ensure thickness accuracy tolerance of ± .0001" and flatness accuracy of ± .00005", which eliminates tolerance accumulation problems associated with other vertical tooling.

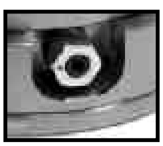
Better Cutting Circle Retention
As the C40 cutters are resharpened, the change in cutting circle is less than conventional vertical tooling. This helps ensure that joint quality is not compromised over the life of the cutter.

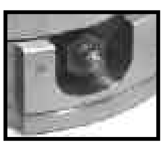
Longer Usable Cutter Tip
The C40 plate cutter offers a usable cutter length of .640", which is nearly twice as much as the .375" length for most conventional vertical tooling.

Easy, Economical Cutter Replacement
If a cutter needs to be replaced, the C40 plates can easily be interchanged one by one. Because cutters can be replaced as individual plates, cost is much lower than some other vertical systems.









Hydraulic Sleeve - Expands against both the spindle and the cutters simultaneously. This expansion against the cutters prevents the cutter plates from rolling back out of alignment or from slipping against the sleeve.

Easy Assembly - Simply drop cutter plates one by one onto an unenergized sleeve and then tighten top nut - no need to torque because hydraulic sleeve “grabs” cutter plates.

Quick Setup - Setup bar is easily attached and cutter plates are all aligned simultaneously. Only one side needs to be aligned, because of cutter plate design. The assembly is then energized on the grinder spindle for resharpening.

MOULDER HEADS

AceCo's precision moulder heads represent the finest tooling available for your moulding operation. We provide our customers with high-quality tooling, superior technical support, and competitive pricing. All AceCo moulder heads are designed on computer aided equipment and machined on fully automated, precision CNC equipment.

Moulder Head Features:

Hydraulic Centering
Ace-Loc hydraulic sleeves ensure repeatability, accuracy, and balance. Heat-treated sleeves are available for keyed spindles

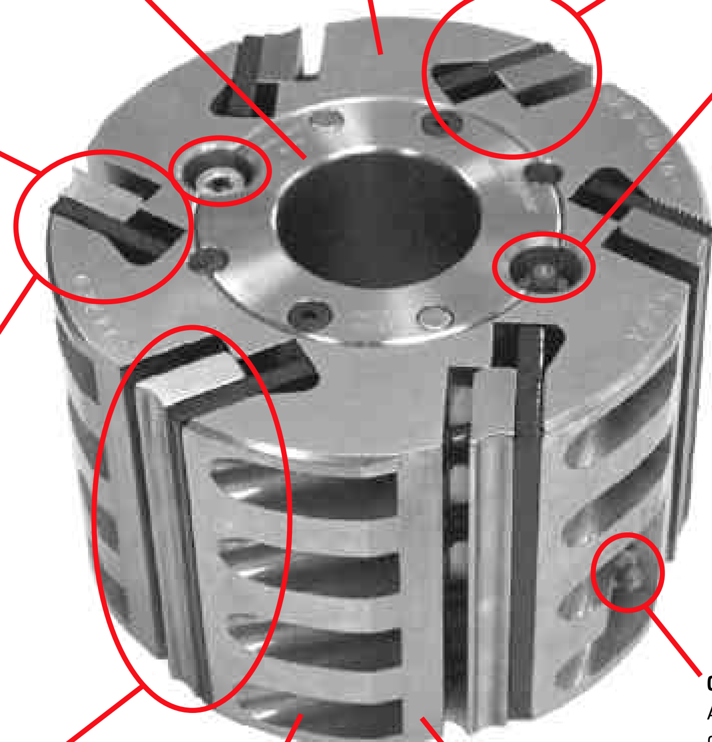
7200 RPM Balancing
Precision balanced on a computer-aided, dynamic balancer to ISO Grade G - 1.0, far beyond industry standards

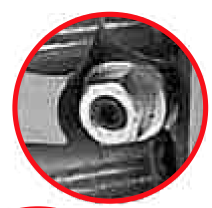
Knife Pocket Options
16 - 60° Corrugated or Flat Back

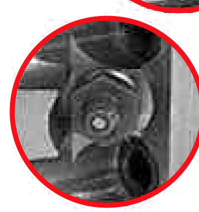
Standard Cutting Angles
12° or 20° standard angles to handle hard or softwood

Deeper Knife Pockets
Allows for use of larger knife steel

Plunger Style Grease Zerks
This style fitting uses a plunger rather than a ball to seal the back pressure flow - no more leaks from dirt and grit under the check ball







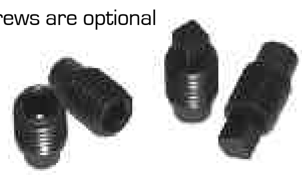
Wider Knife Pockets
Pocket width can accommodate up to 10mm thick knife steel

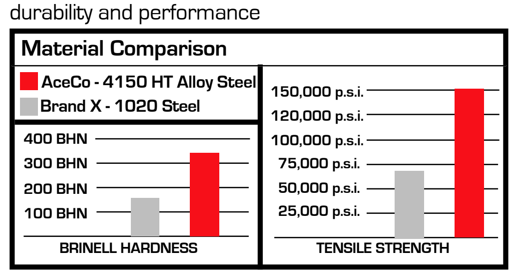
Outside Diameter Grease Zerks
Additional fittings, on the outside diameter of all standard heads, provide better access when sides of head are restricted

Hardened Radius Gibs
Heat-treated all the way through to resist screw wear; radius design provides better chip flow

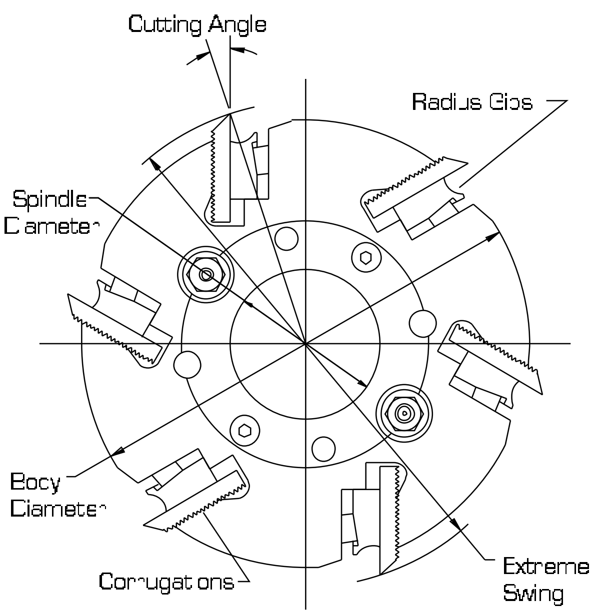
High Tensile Alloy Steel
4150 Heat-treated steel for maximum durability and performance

Allen Head Gib Screws
Square head screws are optional

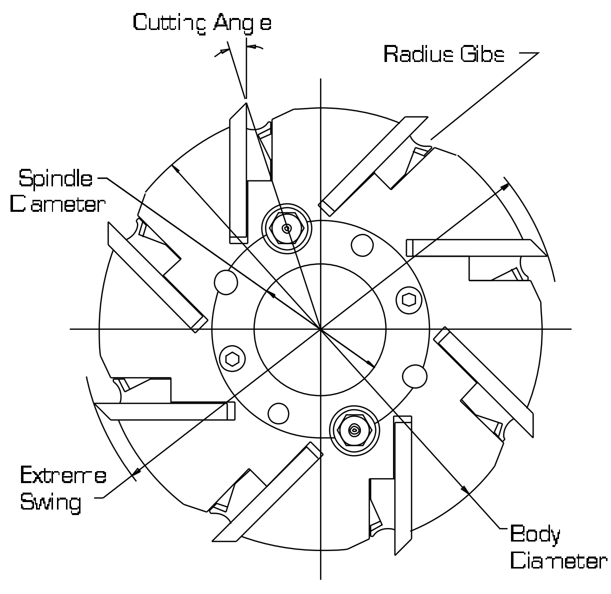




CORRUGATED MOULDER HEAD TERMINOLOGY



FLAT BACK MOULDER HEAD TERMINOLOGY



Moulder Head Ordering Options

To order a Moulder Head, please specify the following:

Description	AceCo Standard Options *		
Body Diameter	150mm	163mm	195mm
# of Knife Pockets * *	4 6	8	10 12
Body Width	60mm 76mm 100mm 130mm 150mm 180mm 230mm 260mm 310mm		
Pocket Style	Corrugated (16-60°) or Flat back		
Gib Screws	Allen Head * * *		
Cutting Angle	12° or 20°		
Spindle Diameter	40mm 50mm 1.813" 2.125"		
Spindle Type	Keyed or Keyless		
Centering	Ace-Loc Hydraulic or Straight Bore		

Please Note:
* Other options are possible - contact us for anything not shown here
* * Body size can limit # of knives possible
* * * Square head screws are available at an additional charge

SHEAR CUT MOULDER HEADS

Moulder heads with shear angle knife-edges provide better surface finish, especially on end grain. The shearing action reduces chip loading, which in turn reduces horsepower requirements and noise levels. The reduced chip loading also results in longer knife sharpness and life. AceCo Shear Cut Heads are available in a variety of shear angles and cutting angles and either right or left hand orientation.

Shear Cut Moulder Head Features

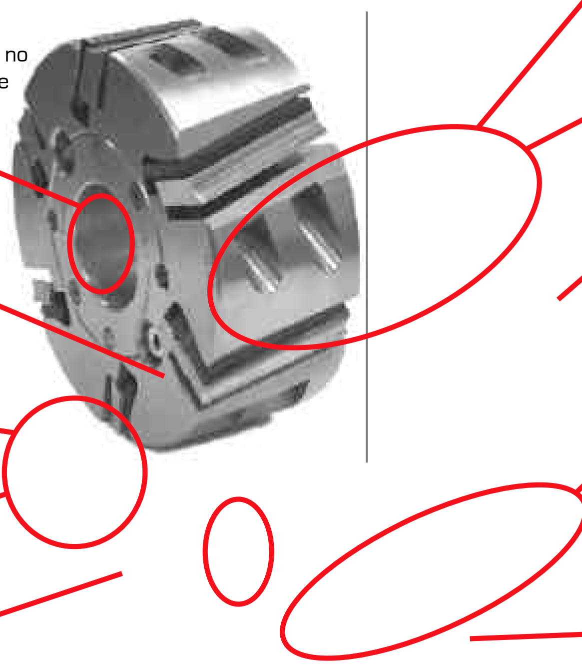
Plunger Style Grease Zerks
This style fitting uses a plunger rather than a ball to seal back pressure flow - no more leaks from dirt and grit under the check ball

Hydraulic Centering
Ace-Loc hydraulic sleeves ensure repeatability, accuracy, and balance - heat-treated sleeves available for keyed spindles

Wide Knife Pockets
Pocket width can accommodate up to .375" thick knife steel

Knife Pocket Options
16 - 60° Corrugated or Flat Back

High Tensile Alloy Steel
4150 Heat-treated steel for maximum durability and performance



Shear Angles
10° Shear Angle standard

Cutting Angles
18° Cutting Angle standard

7200 RPM Balancing
Precision balanced on a computer-aided, dynamic balancer to ISO Grade G-1.0, far beyond industry standards

Hardened Radius Gibs
Heat-treated all the way through to resist screw wear; radius design provides better chip flow

Allen Head Gib Screws
Square head screws are optional

Shear Knife Sharpening Guide

Refer to page 61 for proper resharpening of shear heads.
Part # G12-006

Shear Cut Head Ordering Options

To order a Shear Cut Head, please specify the following:

Description	AceCo Standard Options *					
Shear Direction	Left Hand or Right Hand					
Body Diameter	**150mm**		**163mm**		**195mm**	
# of Knife Pockets **	4	6	6	8	8	10
Body Widths	150mm	60mm 76mm 100mm 130mm	130mm 150mm	60mm 76mm 100mm	100mm 130mm 150mm	60mm 76mm
Pocket Style	Corrugated (16-60°) or Flat back					
Gib Screws	Allen Head ***					
Cutting Angle	18°					
Shear Angle	10°					
Spindle Diameter	40mm 50mm 1.813" 2.125"					
Spindle Type	Keyed or Keyless					
Centering	Ace-Loc Hydraulic or Straight Bore					

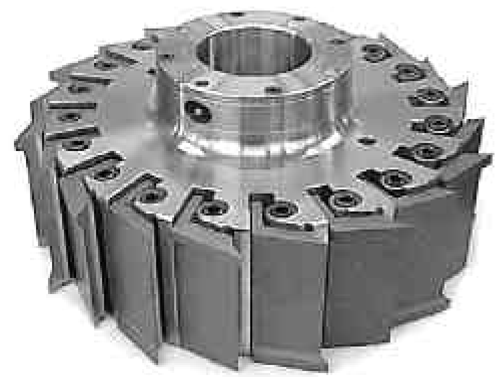
Please Note: * Other options are possible - contact us for anything not shown here
** Body size can limit # of knives possible
*** Square head screws are available at an additional charge

PLANER HEADS

AceCo manufactures a full line of precision planer and side heads. These include L-V style heads as well as straight knife heads. AceCo can manufacture planer heads to your specifications.

Planer Head Features:

Choice of Pocket Style
Straight Knife (16-60° Corrugated or Flat Back)
L-V Type Knife (16-90° Corrugations)
L Type Knife (16-90° Corrugations)



7200 RPM Balancing
Precision balanced on a computer-aided, dynamic balancer to ISO Grade G - 1.0, far beyond industry standards

Choice of Cutting Angles
On Straight Knife Heads only

Hardened Radius Gibs
Heat-treated all the way through to resist screw wear; radius design provides better chip flow

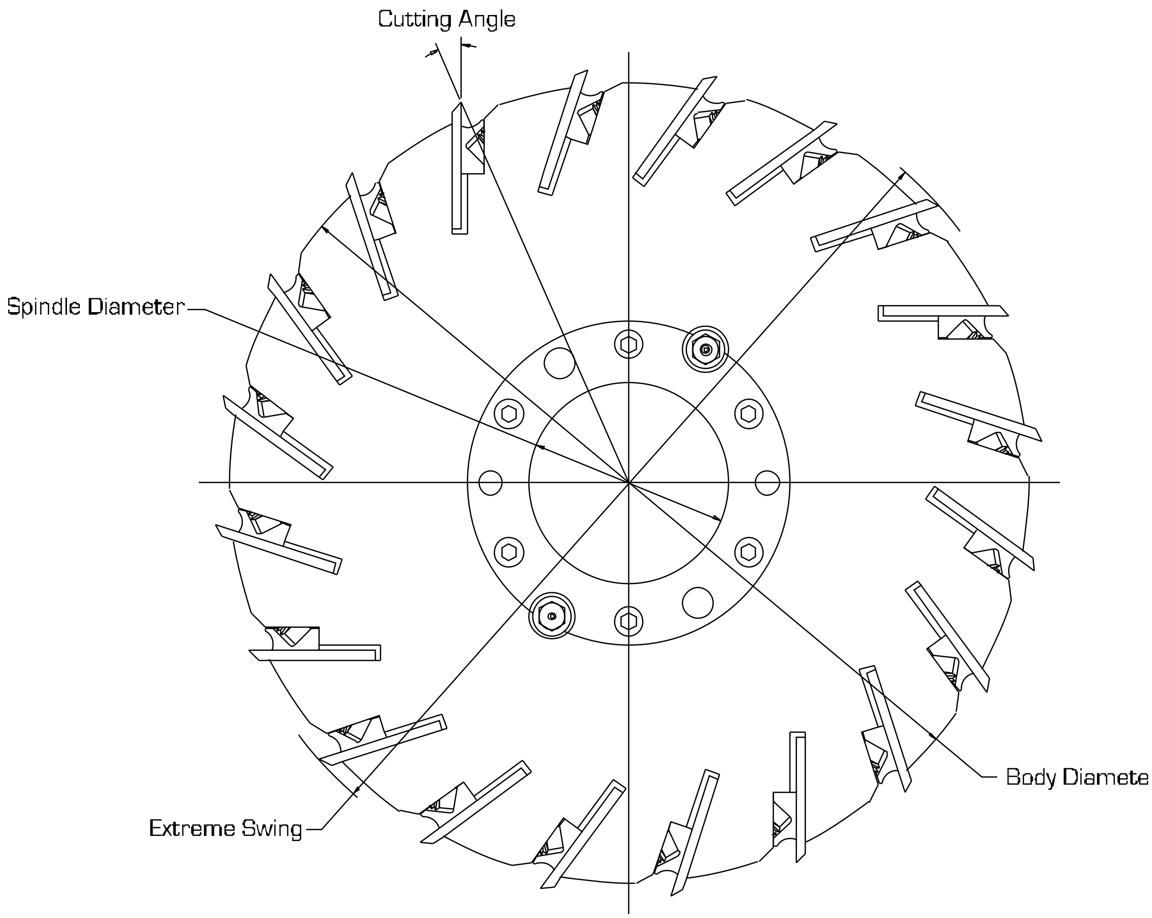
High Tensile Alloy Steel
4150 Heat-treated steel for maximum durability and performance

Allen Head Gib Screws
Standard gib screws are allen head -
square or spline head screws are optional

Plunger Style Grease Zerks
This style fitting uses a plunger rather than a ball to seal the back pressure flow - no more leaks from dirt and grit under the check ball

Choice of Centering
Ace-Loc Hydraulic or Taper Bore centering
(heat-treated sleeves available for keyed spindles)

PLANER HEAD TERMINOLOGY



Planer Head Ordering Information

To order a Planer Head, please specify the following:

Description	AceCo Standard Options *
Body Diameter	From 6" to 13.5"
# of Knife Pockets * *	From 4 up to 24
Cutting Width	60mm and up
Pocket Style	Corrugated (16-60°) Flat back L Type L-V Type
Cutting Angle	From 10° to 30°
Spindle Diameter	Wide range available
Spindle Type	Keyed or Keyless

Please Note: * Other options are possible - contact us for anything not shown here
* * Body size can limit # of knives possible

MOULDER & PLANER TOOLING ACCESSORIES

Moulder Safety Lock Collars

Part#	Spindle Size
C20-050-1	40mm
C20-050-2	1.813"
C20-050-3	50mm
C20-050-4	2.125"

Gib Screws

Part#	Type	Threads
S34-003	1/4" Square head	M12 x 1.75
S34-005	3/8" Square head	9/16" - 18
S34-006	6mm Allen head	M12 x 1.75
S34-008	1/4" Square head	3/8" - 16

Square Head Gibs Screws

Socket Head Gibs Screws

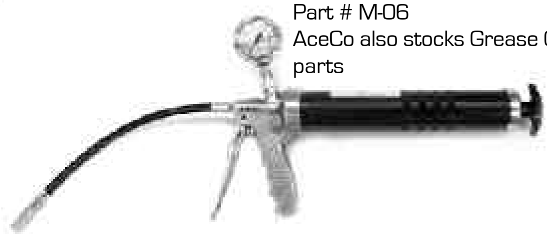
Hardened Steel Gibs

Gibs

Part#	Angle	Available Sizes
G11-002	33°	60mm,76mm,100mm,130mm,150mm
G11-006	26°	60mm,76mm,100mm,130mm,150mm
G11-007	10°	60mm,76mm,100mm,130mm,150mm
G11-014	18°	60mm,76mm,100mm,130mm,150mm
G11-022	42°	60mm,76mm,100mm,130mm,150mm

High Pressure Grease Gun (600 BAR)

Part # M-06
AceCo also stocks Grease Gun rebuild kits and parts



Zerk & Relief Valve Installation Socket

Modified deep well socket (11mm hex) for installing grease fittings.
Part # T14-005

Grease Zerks

Part # GFS1/8NPTZ

Pressure Relief Valve

Part # GFS1/8NPTR

MOULDER & PLANER TOOLING ACCESSORIES

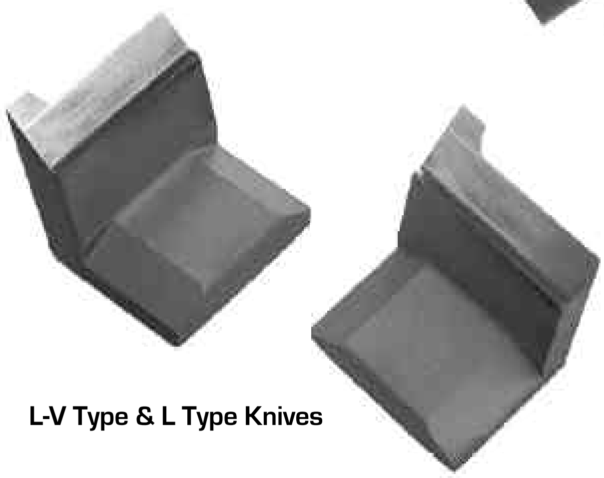
Knife Steel

Corrugated or flat back knives are available in **M2, T1, or D2** tool steel. Our knives will provide the extra strength and long life needed for your wood working applications. Bars from 25" to 39" long and 1/8" to 3/8" thick are available in widths from 1-1/4" to 3".

M2 - HSS, one of the best materials available for high feed rates, and long runs.
Hardness: 63 Rc.

D2, has excellent grinding properties, and is lower priced than M2.
However, run times are up to 50% less than M2. Hardness: 57 Rc.

T1 - HSS, excellent for long runs and abrasive applications such as glue lines. Up to 30% longer life than M2.
Hardness: 63 Rc.



L-V Type & L Type Knives

L-V Knife Holders

WOOD CUTTING LUBRICANT

Clear Lube from Technichem is a mineral oil-based, mist-applied lubricant that enhances cutter life and performance by reducing heat and residue build-up. **Clear Lube** also aids in machine and tool clean up. Most of the fluid is used up during the application process; however, if any fluid needs to be disposed of, simply take it to any facility that recycles motor oil.

HEAD AND CUTTER CLEANING SOLUTION

Designed especially for the lumber industry and sawmills, **Blade Clean** from Technichem is a cold or hot tank cleaner that removes the baked on pitch and gum from the tooling. It is water-based and can be diluted as much as 5 to 1 with water. Always dispose of in accordance with Federal, State, and Local regulations.

WARNING: Do not use abrasives, such as sand blasting, to remove pitch. Abrasive cleaning methods will wear metal surfaces and change clearances between parts. We only recommend **Blade Clean** Solution.

TENON HEADS

Our standard line of Ace-Loc tenon heads are offered in a variety of configurations to meet your exact requirements. We can deliver heads from 1/2" to 12" wide.

Our unique carbide saw-style heads deliver the finest finish possible without tear-out or chipping. Because of the spiral design, a shear cutting action produces smooth cuts through any type of solid or composite material.

AceCo is not limited to stock head styles and take-it-or-leave-it standardization. Different operations and materials require unique specifications to allow for optimum cutting and maximized production. Custom heads can be produced to fit the exact requirements you need for almost any application.

The following information is required to process your tenon head orders more efficiently:

- Outside diameter / Cutting Circle
- Spindle size
- Cutting Width
- Type of Centering
- Depth of Cut

CUSTOM TOOLING CAPABILITIES

Top Lock
Patented hydraulic cartridge built for Mereen Johnson for use on their double end tenoner with automatic tool changer

Tapered Hydraulic Adapter
Built for Progressive Mill Supply for use on their ProEdge-Tec fully automatic cutter head grinder

Expanding Gang Rip Saw Arbor
Built for Mereen Johnson

Log Notching Head
Custom built for E and J Company for use in the log home industry

HYDRAULIC CARTRIDGES

Hydraulic Cartridges are used where precision centering, quality finish, and maximum versatility are required.

One cartridge can be used in many different pieces of tooling, which makes your operation run smoothly and economically.

Ace-Loc cartridges are commonly used with wing-body tools, gang rip saw collars, and for upgrading old profile heads to hydraulic-centering.

Hydraulic Cartridge Features:

High Tensile Alloy Steel
4150 Heat-treated steel for maximum durability and performance

Precision Hydraulic Centering
Ace-Loc hydraulic sleeves ensure repeatability, accuracy, and balance (heat-treated sleeves available for keyed spindles)

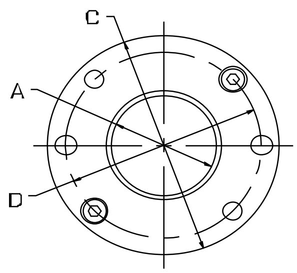
Plunger Style Grease Zerks
This style fitting uses a plunger rather than a ball to seal the back pressure flow - no more leaks from dirt and grit under the check ball

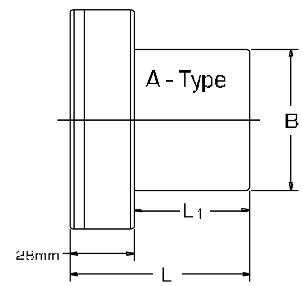
Standard or Custom Length
Cartridges are available in a variety of standard usable lengths, as well as any custom length you may need

Sleeve Style
AceCo can provide either welded or mechanically sealed sleeves (contact us to find out which one may be better for your application)

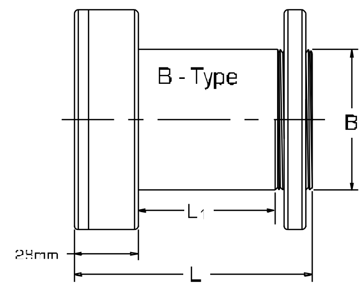
Types
Non-threaded (A-type) and threaded (B-type) cartridges available

HYDRAULIC CARTRIDGES





A = Spindle Diameter (I.D.)
B = Cartridge Diameter (O.D.)
C = Flange Diameter (standard)
D = Bolt Circle
L = Total Length
L_1 = Usable Length



Hydraulic Cartridge Ordering Options

To order a Hydraulic Cartridge, please specify the following:

Description	AceCo Options *
Spindle Diameter	30mm and up
Cartridge Diameter	40mm and up
Flange Diameter	Various
Cartridge Type	A-type (non-threaded) or B-type (threaded)
Usable Length	Wide variety available
Sleeve Style	Ace-Loc (Mechanically Sealed) or Welded

Please Note: * Other options are possible - contact us for anything not shown here

Ace-Loc SAW COLLARS

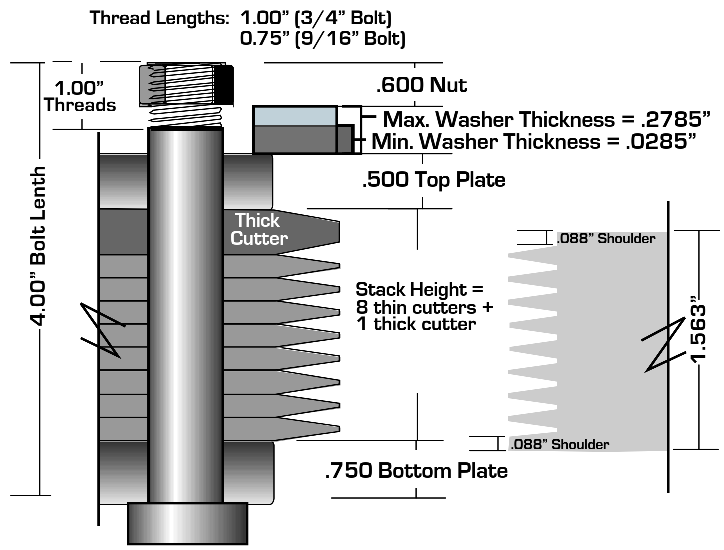
AceCo manufactures a diverse line of custom, hydraulically centered, precision saw collars for your rip saw operation. We can custom design collars to meet your exact requirements. With our quick response and automated CNC equipment, AceCo can deliver your tooling in weeks, not months. Please call for details and additional information.

FINGER JOINT CUTTER STACK DIMENSIONING

Determining correct stack dimensions is an essential first step in starting to finger joint. The following example will lead you through the steps required to calculate how many cutters are needed, what size shoulder will be cut, and what size washers should be used. If you are unsure how to calculate number of cutters or shoulder size for your particular application, please contact AceCo for technical support.

EXAMPLE ASSUMPTIONS: Ace-Loc Hydraulic Head with

- 4" bolt length
- Reverse type joint using C16-048 (thin) and C16-049 (thick) cutters
- No spacers required
- 1.563" Board Height



STEP 1. Determine the number of cutters needed to cut a reverse joint for a 1.563" board height.

Divide Board Height by the Thin Cutter Index Thickness (see page 7 for index thickness)

Example: 1.563" ÷ 0.1685" = 9.27
For a reverse joint, round down to 9 to get the number of thin cutters.* Then add the one thick cutter.

= 9 THIN CUTTERS + 1 THICK SHOULDER CUTTER

This answer needs to be verified in STEP 2

STEP 2. Verify that the number of cutters determined in STEP 1 will cut a proper shoulder - if not, reduce number of thin cutters and recalculate.

Use this formula to calculate shoulder height (with our answer from STEP 1):

$$\frac{\{\text{Board Height} - [\#\text{ of thin cutters} \times (\text{thin cutter thickness} + \text{spacer})]\} - \{[(\text{thin cutter thickness} + \text{spacer}) - (2 \times \text{thin cutter tip})] \div 2\}}{2}$$

Example: $\frac{\{1.563 - [9 \times (0.1685 + 0)]\} - \{[(0.1685 + 0) - (2 \times .046)] \div 2\}}{2} = \frac{.00825}{2} =$ **.004" Shoulder**

So, 9 thin cutters and 1 thick cutter result in a shoulder of only .004", much too small; thus, the number of thin cutters needs to be reduced to 8 and the shoulder recalculated:

Recalculate: $\frac{\{1.563 - [8 \times (0.1685 + 0)]\} - \{[(0.1685 + 0) - (2 \times .046)] \div 2\}}{2} = \frac{.1768}{2} =$ **.088" Shoulder**

.088" shoulder is a good size, so our original answer in STEP 1 needs to be changed to:
8 THIN CUTTERS + 1 THICK SHOULDER CUTTER

STEP 3. Determine what size washer should be used.

Stack height is the sum of all of the cutter thicknesses on one bolt (pages 7 & 8).
Assuming cutter stack has 8 thin cutters and one thick:

Stack Height = (8 x .1685) + (1 x .3735) = 1.7215"

Minimum Washer Thickness = Bolt Length - [(bottom plate thickness) + (top plate thickness) + (stack height) + (thread length)]

Example: 4 - [(.750) + (.500) + (1.7215) + (1.00)] = 4 - 3.9715 = **.0285"**

Maximum Washer Thickness = Minimum Washer Thickness + .250" = .0285 + .250 = **.2785"**

Based on the example, it would be suggested to **use a 1/8" or 1/4" washer** (all washers come in 1/8" increments)

FINGER JOINTING CUTTING CONDITIONS

Cutting conditions that determine the rate of material removal are cutting speed, feed rate, and depth of cut.

- **Cutting Speed**: The speed at which the cutter passes through the wood.
- **Feed Rate**: The speed at which the wood is fed through the cutter head.
- **Depth of Cut:** The amount of wood removed when each cutter passes through.

Cutting conditions and the type of material to be cut determine the power required to make the cut. Cutting conditions and tool life are related.

Optimum cutting speed and feed rate should be used if longer tool life is expected. Tool life is influenced mainly by cutting speed, then by feed rate, and lastly by the depth of cut. The appropriate cutting speed is a relationship derived from relative hardness, properties of the material doing the cutting, and the material being cut.

Most commercial finger jointer machines use specified head sizes and fixed RPM, therefore cutting speeds are set.

CUTTING SPEED

These formulas are helpful in establishing cutting speed for materials that are not typical.

Cutting Speed Formula - English

V = Cutting Speed (surface feet per minute) π = 3.1416 D = Dia. (extreme swing of cutter head in inches) N = Spindle Speed (R.P.M.)	$V = \frac{\pi DN}{12}$

Examples: Commercial finger joint machines - English

D = 10.5" N = 3,600 R.P.M.	$V = \frac{3.1416 \times 10.5'' \times 3{,}600}{12} = 9896$ ft/min.

D = 9" N = 3,600 R.P.M.	$V = \frac{3.1416 \times 9'' \times 3{,}600}{12} = 8482$ ft/min.

Cutting Speed Formula - Metric

V = Cutting Speed (surface meters per minute) π = 3.1416 D = Dia. (extreme swing of cutter head in mm) N = Spindle Speed (R.P.M.)	$V = \frac{\pi DN}{1000}$

Examples: Commercial finger joint machines - Metric

D = 250mm N = 6,000 R.P.M.	$V = \frac{3.1416 \times 250 \times 6{,}000}{1000} = 4712$ M/min.

D = 180mm N = 6,000 R.P.M.	$V = \frac{3.1416 \times 160 \times 6{,}000}{1000} = 3016$ M/min.

D = 160mm N = 6,000 R.P.M.	$V = \frac{3.1416 \times 180 \times 6{,}000}{1000} = 3393$ M/min.

FINGER JOINT KNIFE MARKS PER INCH (CHIP LOAD)

(Based on 3,600 R.P.M.)

Feed Rate	Number of Bolts							Lug Spacing		
Feet/Min.	2	4	6	8	10	12	14	6"	9"	12"
								Lugs per Minute		
11.3	53.3 (.019")							22.5	15.0	11.25
15.0	40.0 (.025")	80.0 (.013")						30	20	15
18.8	32.0 (.031")	64.0 (.016")						37.5	25	18.75
22.5		53.3 (.019")						45	30	22.5
26.3		45.6 (.022")	68.4 (.015")					52.6	35	26.3
30.0		40.0 (.025")	60.0 (.017")					60	40	30
33.8		35.5 (.028")	53.3 (.019")	71.0 (.014")				67.6	45	33.8
37.5		32.0 (.031")	48.0 (.021")	64.0 (.016")				75	50	37.5
41.3		29.0 (.034")	43.6 (.022")	58.1 (.017")				82.6	55	41.3
45.0		26.7 (.038")	40.0 (.025")	53.3 (.019")	66.7 (.015")			90	60	45
48.8			36.9 (.027")	49.2 (.020")	61.4 (.016")			97.6	65	48.8
52.5			34.3 (.029")	45.7 (.022")	57.1 (.018")	68.6 (.015")		105	70	52.5
56.3			32.0 (.031")	42.6 (.023")	53.3 (.019")	63.9 (.016")		112.6	75	56.3
60.0			30.0 (.033")	40.0 (.025")	50.0 (.020")	60.0 (.017")	70.0 (.014")	120	80	60
67.5			26.7 (.038")	35.6 (.028")	44.4 (.023")	53.3 (.019")	62.2 (.016")		90	67.5
75.0				32.0 (.032")	40.0 (.025")	48.0 (.021")	56.0 (.018")		100	75
82.5				29.0 (.034")	36.4 (.028")	43.6 (.023")	50.9 (.020")		110	82.5
90.0				26.7 (.038")	33.3 (.030")	40.0 (.025")	46.7 (.021")		120	90
97.5					30.8 (.033")	36.9 (.027")	43.0 (.023")			97.5
105.0					28.6 (.035")	34.3 (.029")	40.0 (.025")			105
112.5					26.7 (.038")	32.0 (.031")	37.3 (.027")			112.5
120.0						30.0 (.033")	35.0 (.029")			120

Note: The above chart shows Marks per Inch (M.P.I.) and chip load, with the figures in parenthesis indicating chip load. The chart shows ideal average ranges. Some long joints and certain species of wood will require a different M.P.I. or feed rate. 45 to 65 M.P.I. is ideal for most conditions.

$$\text{M.P.I.} = \frac{\text{R.P.M x Number of Bolts}}{\text{12 x Feed Rate in Feet/Min.}}$$

$$\text{Feed Rate in Feet/Min.} = \frac{\text{Lugs per Minute x Distance Between Lugs (in.)}}{12}$$

FINGER JOINT KNIFE MARKS PER MILLIMETER (CHIP LOAD)

(Based on 6,000 R.P.M.)

Feed Rate	Number of Bolts							Bar Spacing	
Meter/Min.	2	4	6	8	10	12	14	200mm	223mm
4	3.0 (0.33)							20.0	17.9
6	2.0 (0.50)							30.0	26.9
8	1.5 (0.67)	3.0 (0.33)						40.0	35.9
10	1.2 (0.83)	2.4 (0.42)	3.6 (0.28)					50.0	44.8
12		2.0 (0.50)	3.0 (0.33)					60.0	53.8
14		1.7 (0.58)	2.6 (0.39)	3.4 (0.29)				70.0	62.8
16		1.5 (0.67)	2.3 (0.44)	3.0 (0.33)				80.0	71.7
18		1.3 (0.75)	2.0 (0.50)	2.7 (0.38)	3.3 (0.30)			90.0	80.7
20			1.8 (0.56)	2.4 (0.42)	3.0 (0.33)			100.0	89.7
22			1.6 (0.61)	2.2 (0.46)	2.7 (0.37)	3.3 (0.31)		110.0	98.7
24			1.5 (0.67)	2.0 (0.50)	2.5 (0.40)	3.0 (0.33)	3.5 (0.29)	120.0	107.6
26			1.4 (0.72)	1.8 (0.54)	2.3 (0.43)	2.8 (0.36)	3.2 (0.31)	130.0	116.6
28				1.7 (0.58)	2.1 (0.47)	2.6 (0.39)	3.0 (0.33)	140.0	125.6
30				1.6 (0.63)	2.0 (0.50)	2.4 (0.42)	2.8 (0.36)	150.0	134.5
32				1.5 (0.67)	1.9 (0.53)	2.3 (0.44)	2.6 (0.38)	160.0	143.5
34				1.4 (0.71)	1.8 (0.57)	2.1 (0.47)	2.5 (0.40)	170.0	152.5
36					1.7 (0.60)	2.0 (0.50)	2.3 (0.43)	180.0	161.4
38					1.6 (0.63)	1.9 (0.53)	2.2 (0.45)	190.0	170.4
40					1.5 (0.67)	1.8 (0.56)	2.1 (0.48)	200.0	179.4
42						1.7 (0.58)	2.0 (0.50)	210.0	188.3
44						1.6 (0.61)	1.9 (0.52)	220.0	197.3
46							1.8 (0.55)	230.0	206.3
48							1.8 (0.57)	240.0	215.2
50							1.7 (0.60)	250.0	224.2

Note: The above chart shows Marks per Millimeter (M.P.mm.) and chip load, with the figures in parenthesis indicating chip load. The chart shows ideal average ranges. Some long joints and certain species of wood will require a different M.P.mm. or feed rate. 1.8 to 2.6 M.P.mm. is ideal for most conditions.

$$\text{M.P.mm} = \frac{\text{R.P.M x Number of Bolts}}{\text{1000 x Feed Rate in Meters/Min.}}$$

$$\text{Feed Rate in Meters/Min.} = \frac{\text{Feed Bars per Minute x Distance Between Bars in Millimeters}}{1000}$$

CHIP LOAD

Chip load is defined as the amount of material removed by each cutting tooth or edge with each revolution of the spindle. By calculating chip load per cutter, we can determine how hard the cutters are working within the cutter head and provide a benchmark on the range of force that is applied from each cutter to the lumber itself.

As chip load increases, tool pressure and heat will increase. Both of these factors increase the rate of wear on the cutting face of the cutter, thus reducing the operating time between sharpenings. Increased chip load will also contribute to excessive tear-out because of the elevated tool pressure.

As chip load decreases, tool pressure and heat will decrease. If chip load is reduced too much, the cutters will just rub rather than cut an efficient chip. This excessive friction dulls the cutting edge prematurely and could possibly burn the wood enough to "seal" the wood from glue penetration. This rubbing still requires significant horsepower, but the chip load to horsepower ratio is inefficient.

To calculate chip load per cutter use the following formula:

$$\textbf{Chip Load (English)} = \frac{\text{Feed Rate (Feet per minute) x 12}}{\text{Number of Cutters x R.P.M.}}$$

$$\textbf{Chip Load (Metric)} = \frac{\text{Feed Rate (Meters per minute) x 1000}}{\text{Numbers of Cutters x R.P.M.}}$$

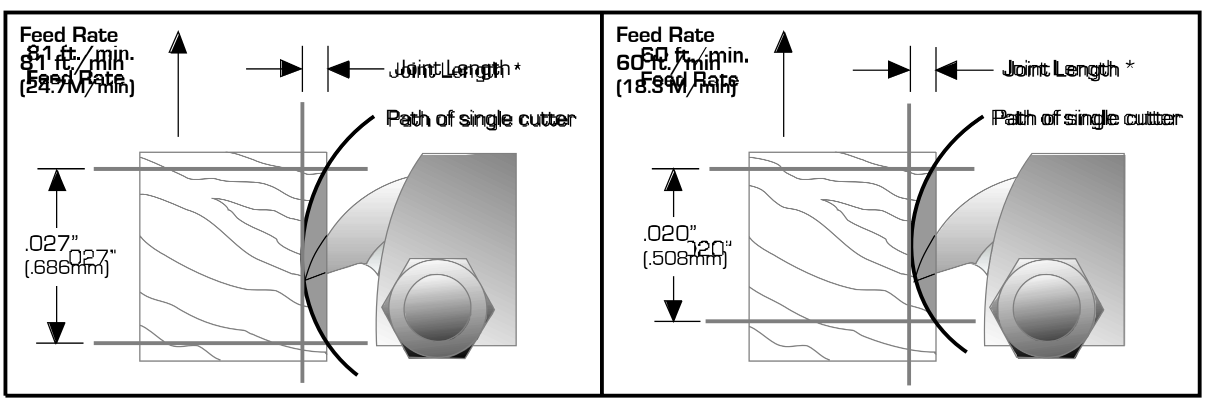
Chip loads can be compared to one another only if the joint length and geometry are the same. The same chip load will remove a greater area of wood for a longer joint than for a shorter joint. The figure below illustrate the effect feed rate has on chip load. Feed rate must be adjusted to achieve the recommended chip load range.

Recommended chip load range = .015" to .021" (0.38mm to 0.53mm) for optimum tool life.

Some chip loads can be as small as .015" (0.38mm) without producing any burning of wood, dulling of cutters, or tear-out. Generally, this is common for machines with small cutting circles or low cutting speeds.

Chip Load Comparison

(Assumptions: 10 Cutters, 3600 RPM)



Too fast of a feed rate results in too large of a Chip Load

Adjusted feed rate results in proper Chip Load

Packet style finger joint machines use somewhat different feed rates for cutting through lumber. A packet style machine will have several boards stacked together and clamped as they are machined by the tooling. Therefore, the finger joint cutters are generally in solid wood longer than a chain fed machine (one piece at a time). Feed rates on packet machines are generally higher, so the heat build-up in the tooling is kept to a minimum. However, higher feed rates decrease the Marks Per Inch which will increase the cutting pressure by increasing the Chip Load. A typical feed rate for a packet machine ranges between 25 to 35 Marks Per Inch (0.98 to 1.38 Marks Per Millimeter), which results in a chip load ranging from .0285" to .040" (0.72 mm to 1.02mm).

MATERIAL REMOVAL RATE

Definition of MRR: Volume of material removed by each cutter expressed in cubic inches per minute.

MRR is a measurement that can be used to compare the total work load of different cutters or heads that cut different joint lengths and geometry. This method examines the total volume removed by a cutter, unlike the Chip Load calculation which only allows comparison if the joint length and geometry are the same. The MRR can be used to "fine tune" the productivity of a machine and the quality of the joint given the machine and tooling variables. This method is considered superior to either the Marks Per Inch or Chip Load calculations.

MRR FOR ALL THIN CUTTERS =

Joint Length x [Thin Cutter Tip Thickness + (Thin Cutter Index - Thin Tip Thickness) / 2] x Feed Rate in Inches Per Minute x Number of Thin Cutters

MRR FOR THICK CUTTER =

Joint Length x [Shoulder Thickness + (Thick Cutter Index - Thick Tip Thickness) / 4] x Feed Rate in Inches Per Minute x Number of Thick Cutters

TOTAL MRR = MRR FOR ALL THIN CUTTERS + MRR FOR THICK CUTTER

MRR Example - ENGLISH

Assumption: Reverse joint in two inch material. Cutters are C16-048 for the thin cutter and C16-049 for the thick shoulder cutter. The wood joint will have eleven thin cutters and one thick cutter cutting a .056" shoulder thickness.

Joint Length	= .375 (3/8")	Shoulder Thickness	= .056"
C16-048 Tip	= .046"	C16-049 Tip	= .251"
C16-048 Index	= .1685"	C16-049 Index	= .3735"

Feed Rate = 50 Feet Per Minute = 600 Inches Per Minute

MRR FOR ALL THIN CUTTERS = .375 x [.046 + (.1685 - .046) / 2] x 600 x 11 = 265.44
MRR FOR THICK CUTTER = .375 x [.056 + (.3735 - .251) / 4] x 600 x 1 = 19.49

= 265.44 + 19.49

TOTAL MRR = 284.93 Cubic Inches Per Minute

MRR Example - METRIC

Assumption: Reverse joint in two inch material. Cutters are C16-048 for the thin cutter and C16-049 for the thick shoulder cutter. The wood joint will have eleven thin cutters and one thick cutter cutting a 1.4mm shoulder thickness.

Joint Length	= 9.5mm	Shoulder Thickness	= 1.4mm
C16-048 Tip	= 1.2mm	C16-049 Tip	= 6.4mm
C16-048 Index	= 4.3mm	C16-049 Index	= 9.5mm

Feed Rate = 15.2 Meters Per Minute = 1520 Centimeters Per Minute

$$\text{MRR FOR ALL THIN CUTTERS} = \frac{9.5 \times [1.2 + (4.3 - 1.2) / 2] \times 1520 \times 11}{100} = 4368$$

$$\text{MRR FOR THICK CUTTER} = \frac{9.5 \times [1.4 + (9.5 - 6.4) / 4] \times 1520 \times 1}{100} = 314$$

= 4368 + 314

TOTAL MRR = 4682 Cubic Centimeters Per Minute

MRR RANGE Vs. HORSEPOWER REQUIREMENT GUIDELINES

These guidelines identify MRR and horsepower for different joint lengths and wood types, given the following assumptions:

1.562" Board Height 10.5" Cutting Circle 3600 RPM 2.5" Board Width

JOINT LENGTH		Softwood Low	Softwood High	Medium Density Low	Medium Density High	Hardwood Low	Hardwood High
4mm 10-bolt	MRR Range	110	128	110	128	110	128
	HP Required	5	6	9	10	16	19
4.5mm 10-bolt	MRR Range	122	142	122	142	122	142
	HP Required	6	6	9	11	16	19
5mm 10-bolt	MRR Range	134	156	134	156	134	156
	HP Required	6	7	10	12	19	22
1/4" 10-bolt	MRR Range	170	198	170	198	170	198
	HP Required	9	10	14	16	27	31
3/8" 10-bolt	MRR Range	242	282	242	282	242	282
	HP Required	11	13	18	21	35	40
7/16" to 5/8" 10-bolt	MRR Range	374	435	374	435	374	435
	HP Required	17	19	28	32	54	62
11/16" to .987" 8-bolt	MRR Range	429	511	429	511	429	511
	HP Required	19	23	32	38	62	74
1.113" 6-bolt	MRR Range	381	439	381	439	381	439
	HP Required	22	25	37	42	65	75

Wood Type Examples:

Softwoods: Pine, Fir, Spruce, Hemlock, Cedar, Redwood, Basswood

Medium Density: Alder, Myrtlewood, Western Larch, Poplar

Hardwoods: Walnut, Maple, Oak, Birch, Beech, Mahogany

Please Note:

- Horsepower requirements may be more or less if the MRR is not kept within the appropriate range.
- For different board heights or joints lengths not listed, please call AceCo for technical support.

FINGER JOINT TOOLING MAINTENANCE

Maintaining your AceCo finger joint tooling is critical to the success of your finger joint operation. This section provides the necessary information needed to keep your AceCo tooling performing at its peak and includes step-by-step procedures for:

- **Preparing a Finger Joint Head**
- **Balancing Cutter Stacks**
- **Setting up the Head Using a Single or Multi-post Stand**
- **Properly Torquing the Head**
- **Aligning the Grinding Machine**
- **Sharpening Finger Joint Cutters**
- **Proper Grinding Wheel Use**
- **Maintaining Cutting Angle and Gullet**

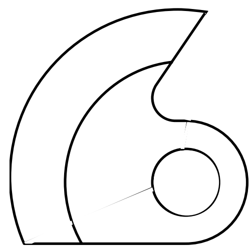
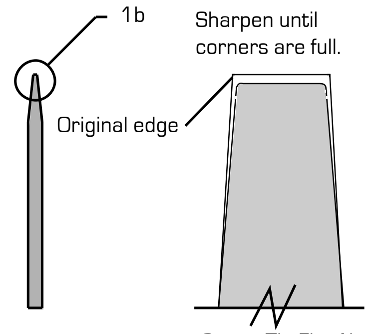


Fig. 1a



Cutter Tip Fig. 1b

How often you perform these procedures is dependent on many different factors. In particular, resharpening rates are influenced by many factors including feed rate, spindle RPM, species of lumber being finger jointed, type of machine used and types of joints being cut. Joint length also determines when the tooling needs to be resharpened. As shown on page 43, joint length increases as the cutter edge dulls. If the measured joint length is more than 20% longer than the specified length, the tooling needs to be resharpened. Other common signs of dull cutters include excessive tear-out, rip-out, or joints that splinter excessively.

Recommended intervals for the maintenance procedures are:

- Sharpen Cutters: Every 1 to 3 shifts, or as needed depending on conditions
- Align Grinding Machine: Once every ten uses
- Balance Cutter Stacks: Once a month, or every 5 postings
- Post on Setup Stand: After every 5 resharpenings, or when the cutters are 0.025 inches away from the alignment post
- Torque Head: Every time the head is loosened or disassembled

AceCo also recommends that you maintain a logbook for keeping records of all maintenance performed on the cutters and heads.

The steps listed below are in order, however all the steps may not be performed every time. For example, if you have recently balanced and posted your cutters, you may only need to perform Steps 1 and 6.

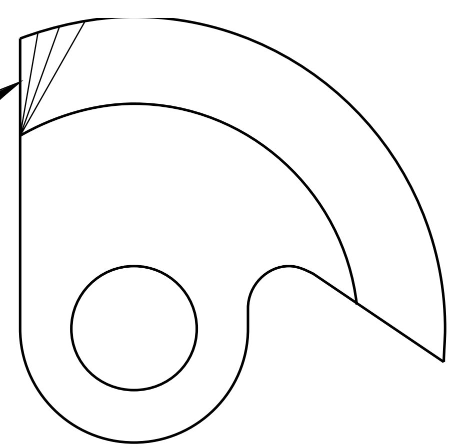
STEP 1 - PREPARE FINGER JOINT HEADS

If head is new, clean all cutter mating surfaces on the index and around the cutter bolt hole, and then proceed to balancing cutters. If head has been used, clean tooling using Technichem **Blade Clean**. For tooling that is relatively clean, proceed to posting on the set-up stand. For heavy pitch buildup, use medium grade Scotch-Brite and WD40 to clean. It may be necessary to remove the cutters from the head and clean thoroughly if there is excessive pitch buildup, rust or corrosion present. Never use abrasives to clean cutters or the cutter head.

STEP 2 - BALANCE CUTTER STACKS

Balancing is critical to the smooth performance of your finger joint head. In order to maintain an equal balance, cutter stacks must be cross-balanced. This means the stack of cutters, along with any washers or spacers, that are 180 degrees from each other must be weighed and balanced equally to within one-tenth (0.1) of a gram. If one stack is heavier, carefully grind a small amount off the back of the cutter only, as shown.

Typical industrial usage requires cutter stacks to be balanced once a month.



STEP 3 - SET UP CUTTERS IN THE HEAD

After the cutters have been resharpened 5 times (0.025" steel removal), the head must be reset to the correct cutting angle and cutting circle. This recommendation assumes that you are removing .005" of material during each grind. This will give a consistent joint length and minimize finger joint machine adjustments during production.

Using a Single Post Set-up Stand:
proceed to page 35 if using a multi-post set-up stand

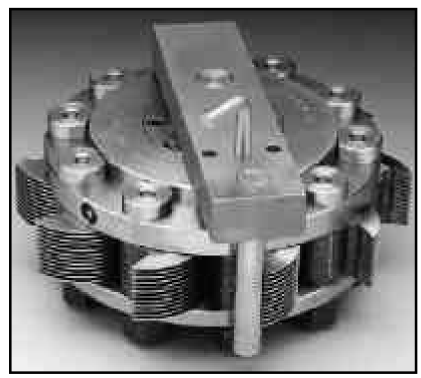
Single post set-up stands offer a simple, economical way to properly align the cutters within the head.

1. Secure the base portion of your set-up stand into a large vise so that the alignment holes are easily accessible with the L-pin.

2. Carefully slide the head onto the center post of the set-up stand.

3. Slip the torquing L-pin into the hole-offset, adjacent to the center hole and push up through the bottom of the set-up stand and into the locating hole in the bolt head.

4. Loosen all the nuts in a crisscross pattern to reduce excessive bolt stress, and to prevent the top plate from warping. Single-post set-up stands come with two L-pins; one should be used for torquing and the other only for indexing the cutters in the center hole.



5. Pull the torquing L-pin out of the torquing position. Reposition the head body by rotating it slightly forward to allow the alignment L-pin to fit into the bolt head hole.

6. The head is now ready to be setup for the correct cutting alignment. When setting up a collet style head, always use collets on the set-up stand spindle post to increase the accuracy of the setup.

7. Pull forward the first stack of cutters. Hold all cutters tightly against the setup post so that a .002" feeler gauge cannot pass between the cutter faces and the setup post.

8. Apply thread lubricant to the threads (Anti-Seize or equivalent).

9. Hand tighten the nut while holding the cutters in their forward position. This will keep the cutters from rotating out of alignment while setting up the other stacks.

10. Remove the torquing L-pin and slowly roll the head body away from the alignment post. Be careful not to knock any cutters out of position.

11. Lift the head up and rotate it to the next stack of cutters to be setup.

12. Repeat this procedure until all cutter stacks are in their proper alignment position. Note that every time the cutter head is reset, it must be resharpened afterward to maintain a constant cutting circle. To eliminate the lift and rotate procedure previously mentioned, multiple alignment post setup stands are available (see picture of ten-post set-up stand on page 35).

13. The nuts must be tightened to the correct torque setting using the same set-up stand and a heavy duty torque wrench.

14. Special care must be taken in torquing finger joint nuts - see page 36 for details.

STEP 3 - SET UP CUTTERS IN THE HEAD

Using a Multi-post Set-up Stand

Multi-post stands offer an easier and quicker way to set-up the head. Multi-post stands come with a stationary posting positioning pin which is pressed into the stand and a moveable torquing positioning pin that fits into the offset hole.

1. Secure the set-up stand by bolting to a bench or stand.
2. Place the torquing pin in the correct offset hole depending on the rotation of the head. For clockwise rotating heads, the pin will be placed counterclockwise of the center pin. For counter-clockwise rotating heads, the pin will be placed clockwise of the center pin.
3. Roll the cutters back for easy clearance and carefully slide the head onto the center post of the set-up stand.
4. Slip the bolt onto the offset torquing positioning pin adjacent to the center hole.
5. Loosen all the nuts in a crisscross pattern to reduce excessive bolt stress, and to prevent the top plate from warping. Never use a torque wrench for loosening nuts, only use a breaker bar.
6. Lift the head and rotate to slip the bolt onto the center posting pin.
7. The head is now ready to be setup for the correct cutting alignment. When setting up a collet style head, always use collets on the set-up stand spindle post to increase the accuracy of the setup.
8. Pull forward the first stack of cutters. Hold all cutters tightly against the setup post so that a .002" feeler gauge cannot pass between the cutter faces and the setup post.
9. Apply thread lubricant to the threads (Anti-Seize or equivalent).
10. Hand tighten the nut while holding the cutters in their forward position. This will keep the cutters from rotating out of alignment while setting up the other stacks.
11. Repeat steps 8, 9 and 10 on each cutter stack until all bolts have been hand tightened and secured enough so cutters do not shift or roll out of position. Every time the cutter head is reset, it must be resharpened afterward to maintain a constant cutting circle.
12. Lift the head up and rotate back to slip the bolt onto the torquing pin.
13. The head is now ready for the Torquing procedure - see page 36.

STEP 4 - TORQUE HEAD

Once the cutters are setup, you need to secure the top plate against the cutter stacks with AceCo hardened washers and nuts. This is a simple process; however, a few critical steps must be followed to ensure safe operation of your cutter head.

1. Once the cutter stacks are all setup, slowly rotate the head away from the alignment post into the off-center torquing position:
   - Single post Set-up Stand: re-insert the torquing L-pin into the off-center hole and into the bolt head.
   - Multi-post Set-up stand: insert the bolt head into the positioning torque pin

2. AceCo highly recommends using a metal base thread lubricant (Anti-Seize or equiv.) before torquing the nut down - do not use oil. The use of thread lubricant will dramatically increase the clamping force (as much as four times) on the cutters for the same amount of torque. Less torque can then be used and less head distortion will result. It is important not to allow any lubricants or debris to come in contact with the mating surfaces of the cutters or the top and bottom plates of the cutter head. Lubricants or other debris on these critical surfaces will allow the cutter stack to roll out of alignment. Always apply the Anti-Seize after the top plate is installed - this will prevent any excess lubricant from lodging itself between the top of the cutter stack and the underside of the top plate.

3. At this point, the nuts should all be hand tight. Inspect the bolt threads; if more than 1/8" is sticking up through the nut, you should use an additional or thicker hardened washer to take up the excessive space. This will guarantee a firm hold and prevent any thread damage. Always try to use washers that allow all the threads in the nut to be utilized. The threads of the bolt should exit the nut. Always put washers under the nut on the outside of the top plate. The top plate will give more surface area for holding cutter stacks in place.

4. When torquing, you must tighten the nuts in a crisscross pattern to ensure level tension is maintained on the top plate. First, tighten one nut (#1 position) to 50 foot-pounds (68 Nm), then tighten the nut directly across from it (#2 position) to the same 50 foot-pounds (68 Nm).

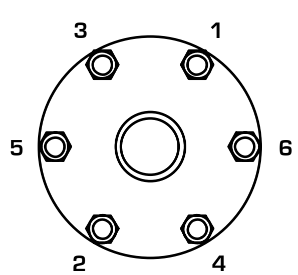
5. Next, tighten the remaining nuts; following the number order of the chart until all nuts have been torqued to the same 50 foot-pounds (68 Nm).

6. Complete the same torque sequence and tighten the nuts to 100 foot-pounds (136 Nm). If counter-clockwise rotating heads have problems with cutters pulling away from alignment post when torqued to the first 50 lbs. increment, then only torque to 15 lbs. increments until 50 lbs. is reached. AceCo offers left-handed bolts if problem persists.

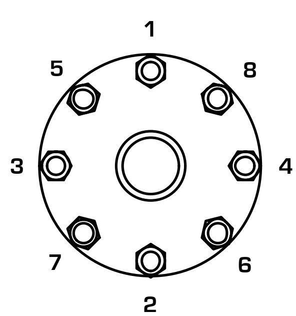
7. Repeat this step while increasing torque in 50 foot-pound (68 Nm) increments each time, until the ideal range is reached. For 3/4" bolts, a minimum of 150 foot-pounds (204 Nm) is required, as a general rule. Tool pressure and stack height variations may require more torque. For 9/16" bolts, 100 foot-pounds (136 Nm) is generally required. Over or under tightening can result in bolt and/or cutter damage. Next, the cutter heads will need to be resharpened (see pages 37 through 40). Call AceCo for assistance if torque value is uncertain.

NOTES:
- Always have your torque wrench calibrated at least once every year.
- Never use a torque wrench to break loose a tightened nut.
- When loosening nuts to replace or repost cutters, loosen in gradual increments using the same sequence as torquing.
- Always use a breaker bar to loosen the nuts.

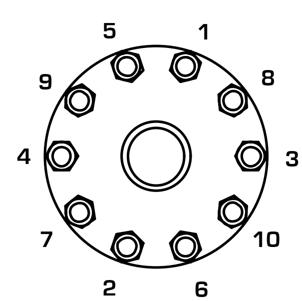
Centrifugal force can also influence the torque needed. The amount of torque required to keep a stack of cutters from rotating will increase as the Surface Feet Per Minute (SFPM) of the cutting circle increases. For instance, the normal operations of a 10-1/2" or 9" cutting circle rotating at 3,600 RPM will have a SFPM of 9,896 ft./min. and 8,482 ft./min., respectively. If a larger diameter head or higher RPM is used, then an excessive amount of centrifugal force could roll the stack of cutters. Most cutter stacks will actually roll forward since the central mass of the cutter is set back in the head and will spin away from the center of the rotating axis. Even spindle motors with slower start-ups ("Soft Start") will ultimately roll stacks if the eventual RPM or SFPM is too high. We recommend a SFPM of no higher than 11,000 ft./min. This can be calculated using the Cutting Speed formula on page 28 of this manual. Higher SFPM values will require disc spacers in between the cutters to assist the friction between cutters; however, when spacers are added between cutters, the effective cutter index is increased and joint length is also increased.



6 BOLT



8 BOLT

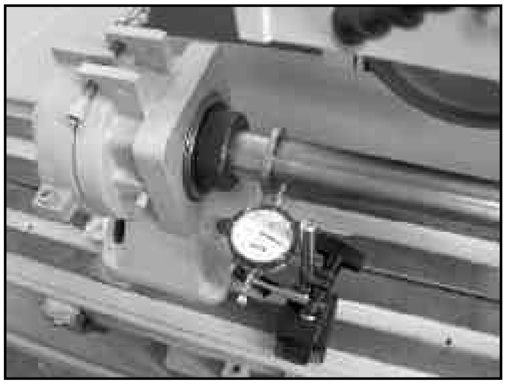


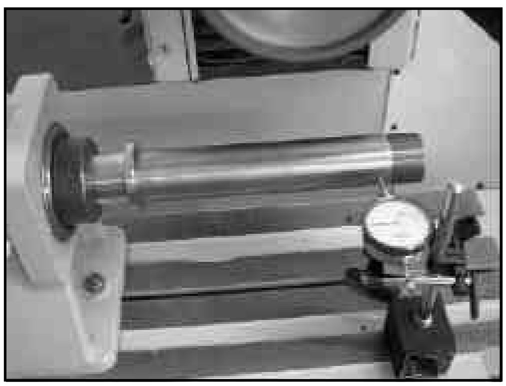
10 BOLT

STEP 5 - ALIGN GRINDING MACHINE

It is important to maintain grinding machine alignment to ensure properly ground finger joint heads. The following alignment steps and checks should be repeated on a regular basis to ensure that the finger joint heads are ground consistently shift after shift. The tight tolerances that AceCo holds in the manufacture of finger joint tooling can be compromised if your grinder tolerances are not maintained.

Use a magnetic base dial indicator (.001") for the following tolerance checks.



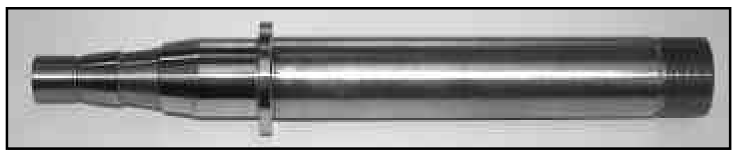


Grinder Work Head: Run-out Alignment

1. Check the run-out on the arbor end nearest the workhead base first, zero the indicator, then rotate the arbor one full turn (360 degrees) - it should be within +/-.001".

2. Repeat the measurement on the other end of the arbor - again it should also be within +/-.001".

3. If run-out is more than +/-.003", most likely the tapered mating surfaces are dirty or have burrs or scratches. Remove the arbor from the workhead; clean the male taper of the arbor and check for any burrs. If burrs are found, use an India stone to lightly smooth out the taper surface.
   Repeat the cleaning process on the female taper of the workhead.



4. Do a final cleaning of both surfaces with WD-40 and a clean rag.

5. Carefully reinstall the arbor.

6. Repeat the run-out inspection (1 & 2) with the dial indicator.

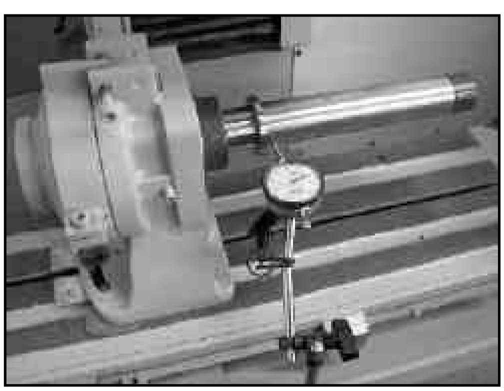
7. If manual cleaning is not enough to correct run-out, professional grinding may be required to get the mating surface back into tolerance, or the arbor should be replaced.

Grinder Work Head: Vertical Alignment

1. Mount the dial indicator mag base to a stationary position on the machine, so the table can pass freely.

2. Align the dial indicator needle on the side of the arbor.

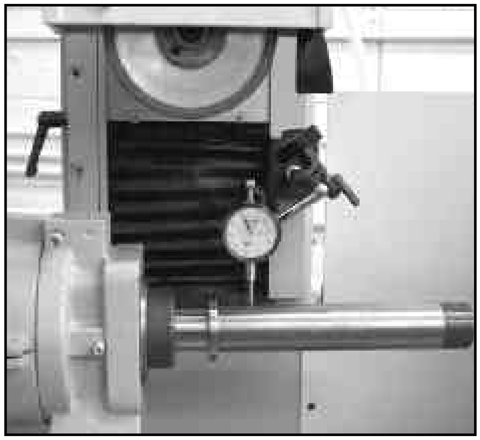
3. Pass the arbor across the stationary indicator - the reading should be no more than +/- .003" over a 6" length of the arbor.

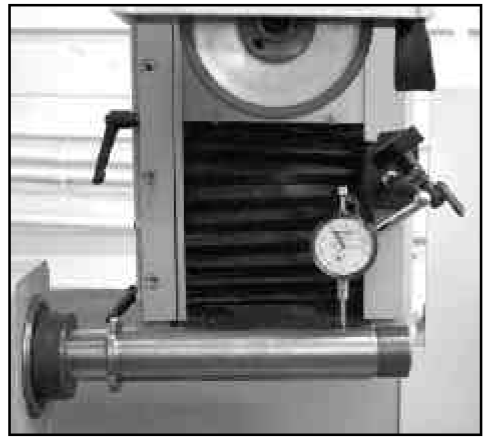


4. If found to be out of alignment, workhead bolts must be loosened and the work head shifted into alignment on the table.

5. Repeat this measurement with the indicator and repeat the fine adjustment process until the arbor is within the +/-.003" tolerance.

Grinder Work Head: Horizontal Alignment



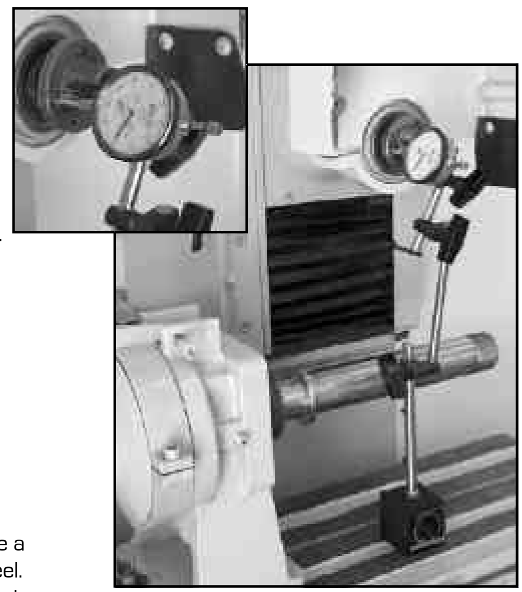


1. Similar to the Vertical Alignment procedure, the dial indicator needle is aligned on the top of the arbor and mounted to a stationary position so the arbor can pass freely.

2. Pass the arbor across the stationary indicator - this reading should also be within +/- .003" over a 6" length of the arbor.

3. If found to be out of alignment, the top half of the work head must be shimmed into alignment. If shims are added, you will need to re-check vertical alignment.

4. Repeat the alignment measurement with the indicator and continue the fine shimming adjustment process until the arbor is within the +/-.003" tolerance.



Grinding Wheel Alignment: Check Run-out of Wheel Spindle

1. Mark a starting point on the flat surface of the spindle collar (wheel sits flush against this surface).

2. Align the dial indicator with the starting point and rotate the spindle 360 degrees. This run-out should be within +/-.001".

3. If spindle run-out is out of tolerance:
   - Spindle collar may need to be faced
   - Spindle may be bent
   - Spindle bearings may be worn

Grinding Wheel Alignment: Lead Adjustment

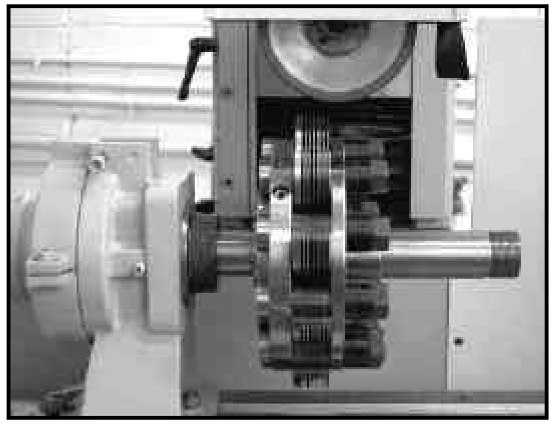
1. The grinding wheel must be adjusted to have a lead of .003" - .005" on the front of the wheel. This will prevent the trailing edge of the wheel from causing a double grind on the knife face.

2. Mount the dial indicator on the grinding table and zero indicator on the trailing side of the spindle collar with enough clearance for the indicator needle to pass below the wheel mounting shaft of the spindle.

3. Carefully slide the table and take the indicator reading on the opposite side of the spindle collar. The lead side should be at +.003" to +.005" of the trailing side.

4. To adjust lead, the headstock bolts need to be loosened in order to move the whole headstock. Retighten bolts when correct lead is obtained. It may take several attempts to get the correct lead adjustment.

STEP 6 - SHARPEN CUTTER HEADS



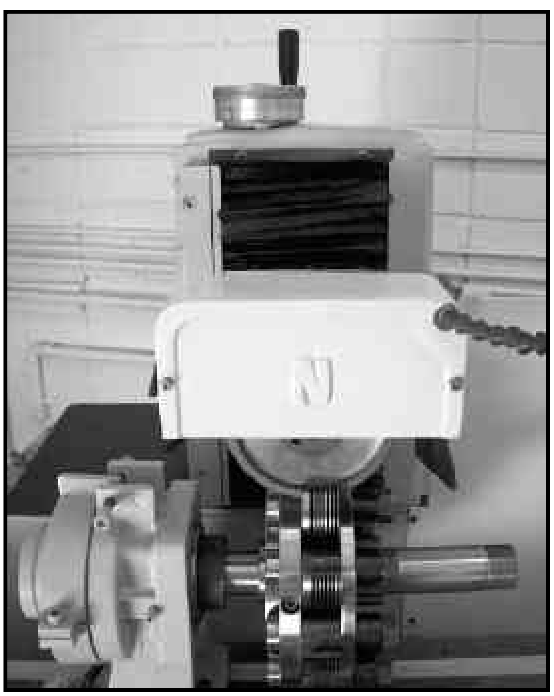
The most common method for sharpening finger joint cutters is described below. Most finger joint cutters will last approximately 1 to 3 shifts (28,000 to 90,000 joints cut for 10-bolt heads). The cutters can be sharpened while torqued tight in the cutter head by using an arbor and a common tool grinder or side head grinder.

When grinding heads, the indexing should always be done using the most accurate surface area of the head. These surfaces are the outside diameter of the head of the bolt or the inside diameter of the indexing hole in the head of the bolt. Indexing on these surfaces eliminates the accumulated tolerances and clearances from the bolt diameter, cutter bolt hole diameter, cutter radius, cutter face, and the grinder indexing plate.

Cutter Head Alignment Procedures on Grinding Machine

1. Mount the cutter head on the work head arbor as close to the work head mast as possible for the best rigidity.
2. Secure head to the arbor:
   - For hydraulic heads, pump up to specification stamped on the head
   - For collet heads, use proper spacers, collets, washer and locking nut

3. Using a felt tip marker, color each knife face of each stack - this enables you to see how flush your grinding is.



4. Select a stack of cutters as a starting point. Only one stack of cutters can be sharpened at a time.
5. Adjust headstock (usually on the rear of the machine).
6. Set the index pin on the work head.
7. Align the cutters with the grinding wheel by rotating the spindle and head to line up the wheel to the face of the cutters. Fine-tune the alignment with the VERTICAL (Z) head stock adjustment (located on top of the machine) and the HORIZONTAL (X) head stock adjustment.
8. Grinding wheel should be perfectly aligned with the properly posted cutters, giving a very accurate starting point to maintain proper hook angle. Note that only the face of the cutter is to be ground for sharpening.

Cutter Head Grinding Procedures

1. Perform set-up pass by dusting cutters (only remove 0.0005” of material, 2 to 3 passes on first stack).

2. Inspect the cutters and see if the ink from the marker was removed uniformly across each knife in the whole stack. If not, make required alignment adjustments and perform 2 to 3 more passes with no more than 0.0005” of material removal.

3. Once the grind is uniform, use the hook gauge to ensure a good starting point.

4. Leave the adjustments set at this point and zero mag base indicator on the rear of the machine.

5. Grind each cutter stack on the head at this zero point.

6. Inspect each cutter for grind uniformity. Any mistakes made during the posting process will now be apparent. If .005” of material removal will not clean up the stack, the head should be removed and re-posted.

7. If the entire stack looks uniform, you are now ready to grind the head - .003” to .005” of total material will be removed from each knife in the grinding process. The material is removed over a total of 4 passes.

8. First pass: adjust the wheel to remove .0015” of material. For the most accurate adjustments use a mag base indicator.

9. Check with hook gauge*. Adjust if needed.

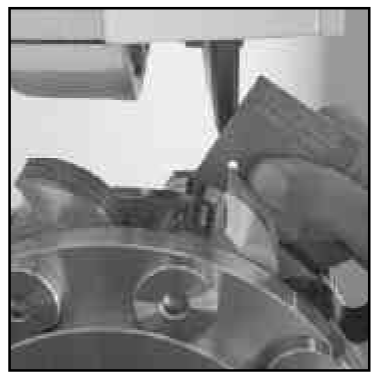
10. Second pass: repeat, removing .0015” of material.

11. Check with hook gauge*. Adjust if needed.

12. Third pass: adjust wheel to remove .0010” of material.

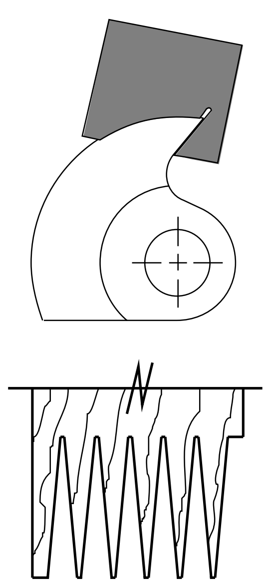
13. Forth (final) pass: adjust wheel to remove .0005” of material.

14. Inspect the entire cutting edge of the face of the cutter under 10x or 20x magnification to ensure that the corners are full and the edges are sharp. Don’t remove any burrs on the cutter face by buffing, stoning, or filing. This will dull the cutting edge and produce a ragged joint.

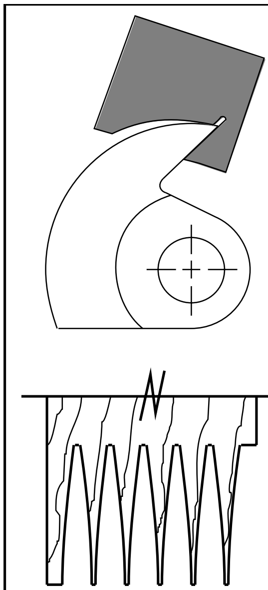


This example is only a guideline. Each grinding machine, grinding wheel and cutter stack is different. Create the best procedure for your conditions and document the procedure for repeatability.

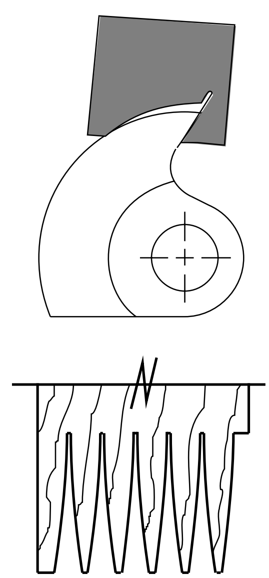
*Note: If hook angle is different from first cutter in stack to the last cutter in the stack; this indicates too much wheel pressure, which is causing wheel deflection. Reduce the amount of material removal per pass.



Correctly resharpened finger joint cutter.



Too sharp of hook angle will cut concave fingers.



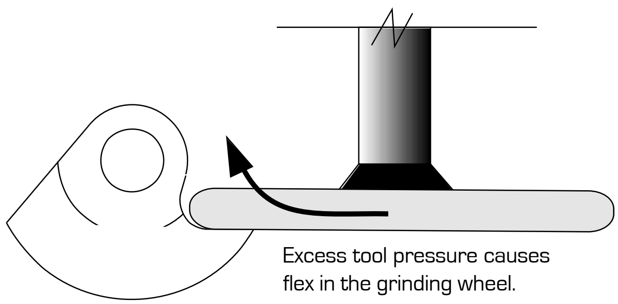
A blunt hook angle will cut convex fingers.

GRINDING WHEEL INFORMATION

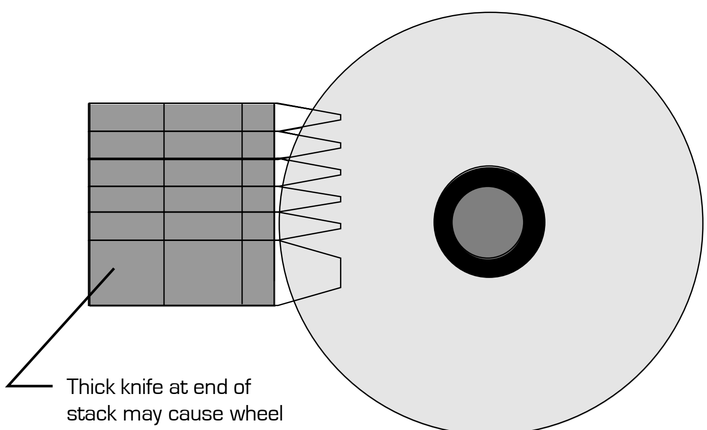
Fine-grit CBN wheels (60-120) and slow traverse speeds across the cutters will produce a light burr. This burr will be removed in the first few minutes of production, leaving a keen edge. However, coarse grinding wheels and heavy feed rates can cause a heavy burr that is not readily removed during the first minutes of production. This affects the geometry or joint profile for up to an hour of production and can cause gaps on one side of all fingers.

A 4" - 8", 80 to 120-grit CBN (Borazon) wheel works best when grinding M2-steel finger joint cutters.

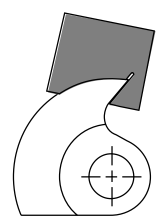
Grinding Wheel Flex



Excess tool pressure causes flex in the grinding wheel.



Thick knife at end of stack may cause wheel flex, resulting in an uneven grind.



The hook gauge is an inspection tool. Never grind on the hook gauge so it will clear the gullet radius. Always grind the cutter to fit the gauge.

Grinding Wheel Safety

1. Never exceed the recommended RPM of the grinding wheel manufacturer.
2. Always allow a newly mounted grinding wheel to run for a moment at the operating speed before you use it. Sometimes grinding wheels will fly apart if they are damaged.
3. Always have the safety shield on the grinder before starting it. If damaged wheels fly apart, the shield will divert much of the stone down.
4. Never stand in line with the wheel when the grinder is turned on. Grinding wheels will throw pieces of stone in a lineal direction if they happen to break apart.
5. Always use safety glasses when grinding.
6. Always turn the coolant off first so the grinding wheel will "throw" it off. If coolant settles on the wheel, it can cause an imbalance.
7. Always make sure the arbor hole of the grinding wheel and the arbor are the same size for a tight fit. A loose fitting wheel will not be centered and will vibrate if its circumference is not centered to the arbor. Failure to do this check could result in serious injury.
8. Never grind material for which the wheel was not designed.

CUTTING ANGLE

Definition: The angle at which the cutter face enters the wood at the start of the cutting process.

POSITION A: Angle too steep

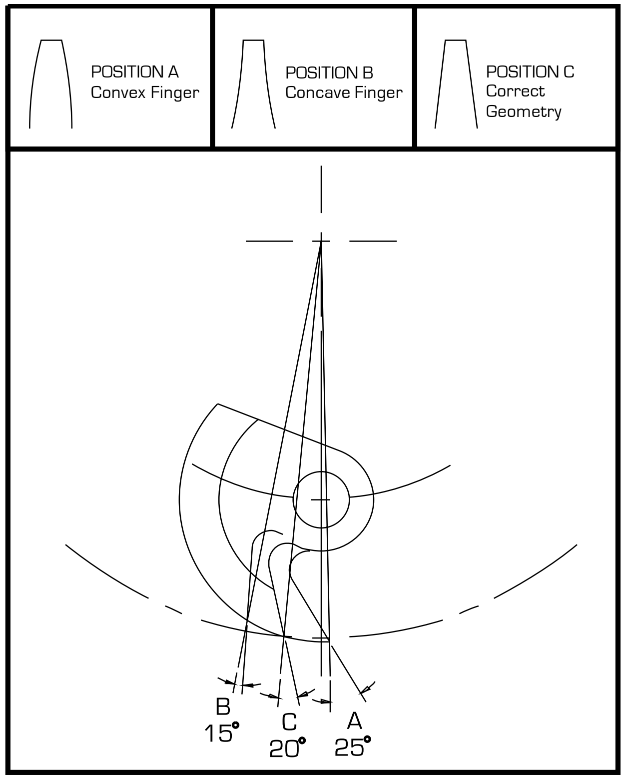
- Insufficient back clearance causes cutters to rub instead of cut, resulting in dulling from heat.
- Diameter of cutting circle increased causing cutters to cut excessively into lugs or to interfere with housing.
- Geometry of joint will change resulting in convex fingers or joint length inconsistency.

POSITION B: Angle too shallow

- Insufficient shear cut causes increased tool pressure and tool wear.
- Diameter of cutting circle is decreased leaving cutters unsupported by lugs when exiting wood and causing tear-out.
- Geometry of joint will change resulting in concave fingers or joint length inconsistency.

POSITION C: Correct cutting angle

- Accomplished by using:
  - -Setup Stand (page 34)
  - -Hook Gauge (page 40)



PROPER GULLET GRINDING

Proper grinding of finger joint cutters can help reduce breakage and extend cutter life. Breakage occurs in finger joint cutters for various reasons:

- When lumber hold-downs do not work properly and the lumber gets drawn into the tooling
- When foreign objects are fed through the system
- When cutters are not sharpened properly

The finger joint cutter in Figure 1 has the gullet area identified. Most AceCo cutters have a 1/4" gullet radius designed to disperse cutting pressures and eliminate a stress concentration at one point. Compared to other manufacturers, AceCo cutters have a larger gullet radius that reduces cutter breakage. The gullet radius, when properly maintained, also acts as a chip breaker and provides better chip flow.

Typically, as cutters are sharpened with a standard wheel, the cutting face is sharpened back, and the gullet produced at the factory is unintentionally ground to an acute angle. Figure 2 shows the grind lines that develop over the life cycle of a cutter that has not been ground properly. This improper grinding of the gullet will result in cutter breakage.

The concentration of force is then brought to one point which makes the cutter more susceptible to breakage. Sharp corners allow fiber buildup and compaction which can negatively affect cutting, balance, and cutter clean-out. To eliminate this problem, a rework operation needs to be done to return the gullet back to its original shape.

The CBN radius edge grinding wheel accomplishes face sharpening and gullet maintenance in a one-step operation. This procedure will keep the gullet radius formed throughout the life of the cutter. The picture on page 14 shows how the radius edge grinding wheel forms and maintains the gullet, whether starting with new or reworked cutters.

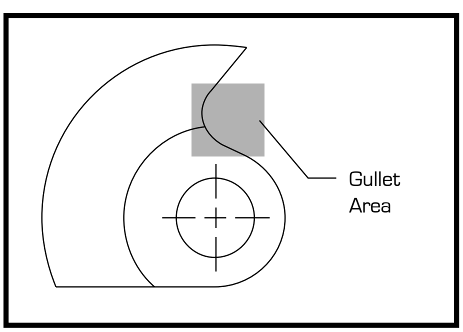


Figure 1

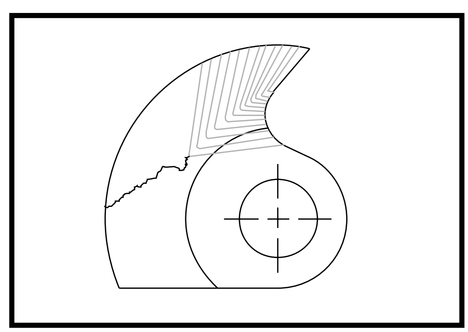
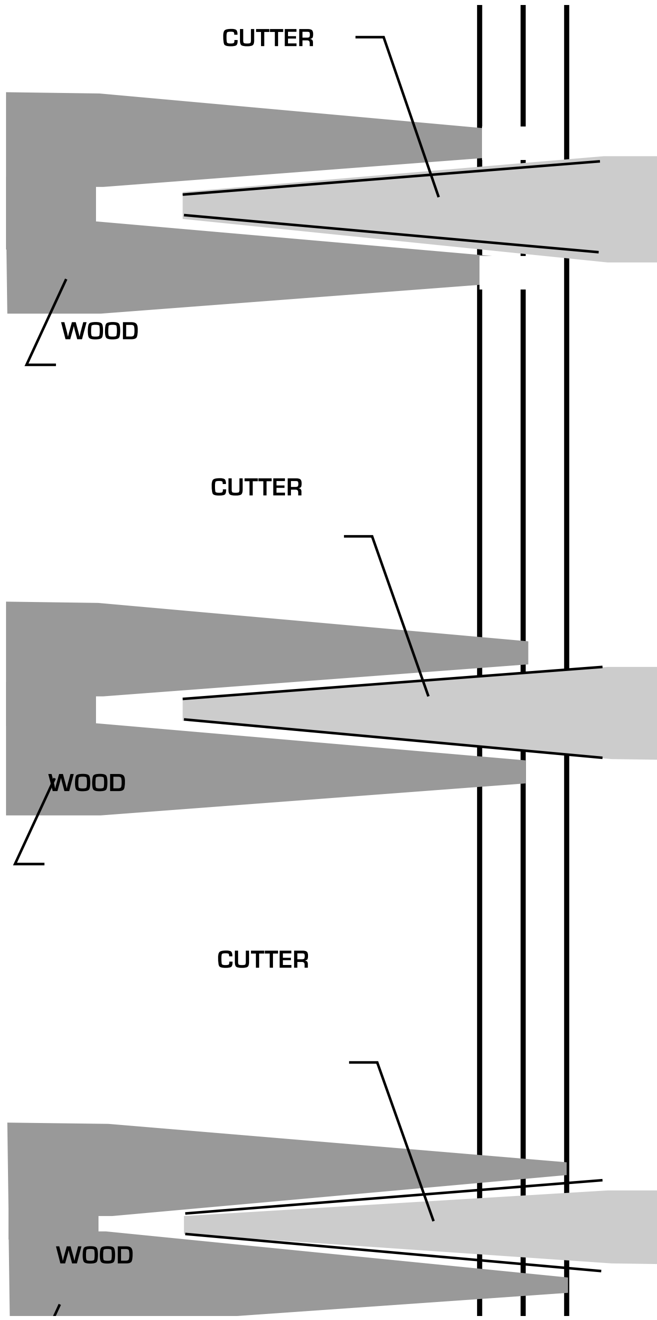


Figure 2

JOINT LENGTH ADJUSTMENT

There are three stages of cutter edge wear that require joint length to be adjusted.



1st STAGE
Sharpening creates a burr on the cutter edge. This burr cuts a wider interior tip. The exterior tip must be wider to match, so the joint is shortened. Do not attempt to deburr cutting edge as dulling of cutters will result.

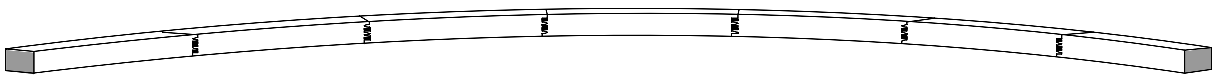
2nd STAGE
The edge smooths out as the burr wears off and interior tip width is reduced. Joint is lengthened to match the thinner exterior tip. This stage is the majority of run time.

3rd STAGE
The cutter edge dulls. Interior tip is thinner, so the joint is lengthened again to get thinner exterior tip. This stage indicates cutters need to be resharpened.

Length adjustment is normally accomplished with a trim saw.

FINGER JOINT TROUBLE-SHOOTING

PROBLEM #1 - Pressed board has bend to thin side



Possible Cause Board end is not perpendicular, so trim saw won't "cleanup" the end. If the trim saw doesn't cut perpendicular, then the boards will develop a bend when pressed together. This problem worsens when too much pressure is used in the press assembly.
Cure Adjust chop saws to cut perpendicular.

Possible Cause Boards have moved during cut so board ends are not being trimmed perpendicular.
Cures
1. Too much tool pressure during cut. Reduce cutting pressure by either: sharpening tooling, slowing feed rate, increasing RPMs, or increasing number of cutting teeth.
2. Check air bag for leaks or twists which would affect hold down pressure.
3. Board height varies too much and shorter boards do not get adequate hold down pressure. Sort boards closer to the same height dimensions.
4. Replace worn bedrail inserts, which may be allowing board movement.

Possible Cause Lugs are misaligned and not square to bedrails.
Cure Square lugs to bedrails. Square lugs in front of drive motor. May need to check the drive and tail sprockets.

Possible Cause Centerline of board is beyond the centerline of the anvil and ram of the press. More pressure is asserted on one side of the board than the other.
Cure Adjust anvil and ram closer to centerline of board width. Always have anvil and ram slightly to the outside of centerline of the board to avoid accidents if board comes apart in press.

Possible Cause Press assembly has indexing fence on the opposite side of the lug side of board. Boards have been profiled and trimmed while indexing on the lug side. The indexing fence in the press should always be on the lug side of the board.
Cure Move press assembly to opposite side of scarfer unit.

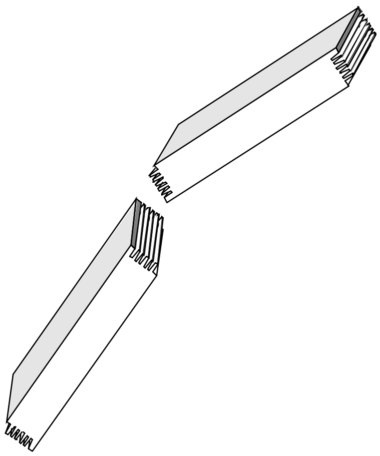
PROBLEM #2 - Pressed board has bend to wide side

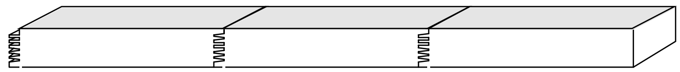
Possible Cause Trim saws have too much lead, thus, cutting a concave board end.
Cure Adjust lead of saw blade to no more than .004".

Possible Cause Long board sections have too much bow.
Cure May have to cut the longer board sections and finger joint again.

Possible Cause Trim saws are tilted from top or bottom causing an unsquare board end to be cut.
Cure Square saw blades from top to bottom with bedrails (flying cut-off saw may also need adjustment).

FINGER JOINT TROUBLE-SHOOTING - Continued





PROBLEM #3 - Pressed board falls apart

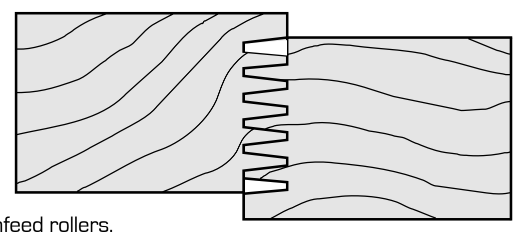
Possible Cause Too little pressure used in press assembly.
Cure Use load meter to adjust assembly pressure to 400 to 500 lbs. per square inch for the cross section of the end of the board. Less pressure than this will leave too much of a glue line and won't allow glue into the wood fiber. Adequate pressure is also needed to ensure contact on the sides of the fingers. More pressure will be needed for joints longer than 5/8".

Possible Cause Glue penetration into wood is not adequate.
Cure Moisture content of wood is too high (i.e. above 15%). Dry and reduce moisture content.

Possible Cause Temperature is too cold to allow glue to coagulate and form a reliable bond. Chalking of glue is evidence of this condition.
Cure Keep boards and surrounding work area above freezing temperatures.

PROBLEM #4 - Pressed board has misaligned joints (joints jumped a tooth)

Possible Cause Shoulder of finger joint is too thin and is being forced in between fingers.
Cure Always set the thickness of the shoulder of the finger joint to be larger than the tip thickness of the thin finger joint cutter.



Possible Cause Infeed roller bearings are worn out.
Cure Replace roller bearings.

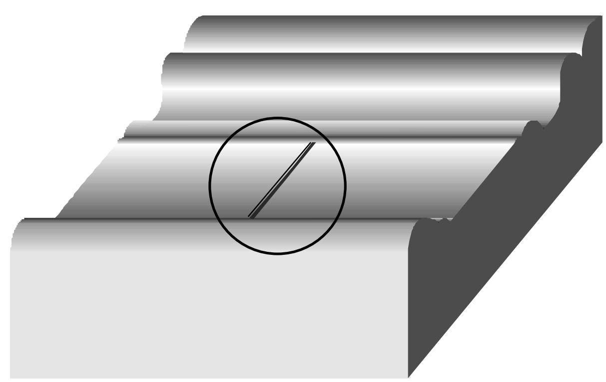
Possible Cause Too much thickness variation in the boards.
Cure Sort boards for closer height dimensions.

Possible Cause Boards are being crowded together before being held down by infeed rollers.
Cure Adjust feeder assembly, so boards are under the infeed rollers before crowding begins.

Possible Cause Crowder roller feed table is not flat, which allows boards to bounce and misalign before final crowding.
Cure Replace or resurface infeed support table.

PROBLEM #5 - Pressed board separates at joints after the moulding operation

Cause Too much pressure is being used in the press assembly. Once the moulder cuts into the board, it relieves over-stressed fibers, and the fibers separate from the glue line.



Cure Check the total force being applied to the boards in the assembly press by using a load meter. The load meter reading should be between 400 to 500 lbs. per square inch for the cross section of the end of the board. For example, a 2x4 has eight square inches of cross section and would require 3,200 to 4,000 Lbs. of force. Pressure will vary somewhat with finger joint length.

To calculate the total force of the press:

1. Determine the diameter of the cylinder of the press and the Pounds per Square Inch (P.S.I.) of the hydraulic line leading into the cylinder. Put these figures into the formula:
   $(3.1416 \times D^2 \div 4) \times$ (P.S.I. of hydraulic line to cylinder) = Z
   where D = Diameter of hydraulic cylinder
2. The answer, Z, is then divided by the square inches of the cross section of the board. This will yield the force in pounds per square inch of the board cross section and should range between the 400 to 500 Lbs. per square inch as stated above.

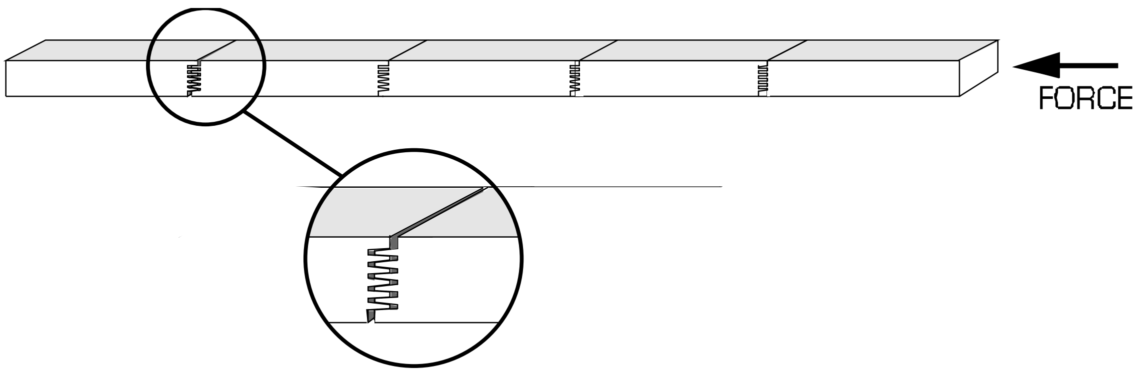
Note: This force is at the front of the pressure cylinder. As this force travels down the board, some will be lost due to the length of the board, number of joints, board height/width, and joint length.

FINGER JOINT TROUBLE-SHOOTING - Continued

PROBLEM #6 - Some joints in board are not pressed together (may occur at end furthest from press cylinder)

Cause Insufficient force used to close joints due to: length of board, joint length, wood species, or board height/width. As these factors absorb more of the total force, less and less pressure is applied at the end of the board. For example, as board width increases, more force is required to close the joints furthest from the press.

Cure Calculate needed force required and adjust P.S.I. to hydraulic cylinder. Always check with the machine manufacturer to verify the maximum allowable pressure for your machine. Never exceed this recommended pressure.
Note: A load meter can identify the total force. When using a load meter, always place it at the board end away from the hydraulic cylinder to record the lowest pressure. Always place a piece of metal on each side of the load meter donut to prevent it from being crushed into the wood and to ensure a more accurate reading of the force.

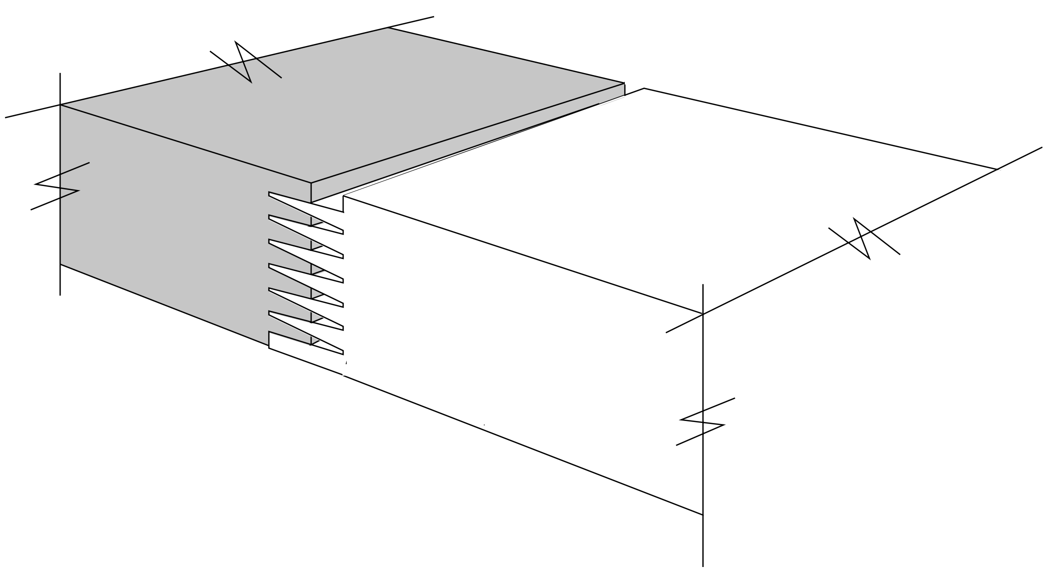


PROBLEM #7 - Joint open on one side (board has varying tip thickness from one side to the other)

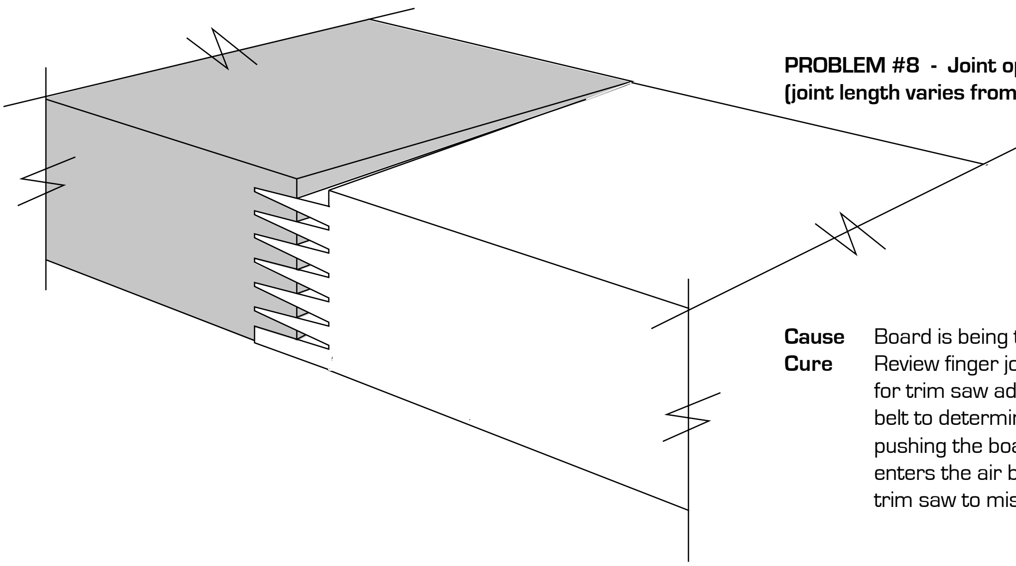
Possible Cause Excessive tool pressure, which causes board movement while cutting.
Cure Calculate Chip Load, Cutting Speed, and MRR, as shown on pages 28-32, and verify that all are within acceptable range. If not, make the appropriate changes to reduce tool pressure.

Possible Cause Board is moving during cutting process because of worn bed rails, low air bag pressure, or a twisted air bag. As a result, board end is not square to machine spindle.
Cure Contact machine manufacturer for replacement or rebuild parts.

Possible Cause Board end is too unsquare to trim.
Cure Sort boards to eliminate scrap.



FINGER JOINT TROUBLE-SHOOTING - Continued



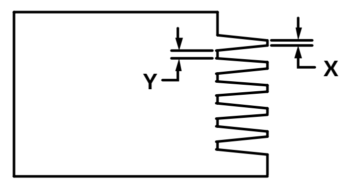
PROBLEM #8 - Joint open across one board end (joint length varies from one side to the other)

Cause Board is being trimmed unevenly.

Cure Review finger joint machine operation manual for trim saw adjustment. Check the transfer belt to determine if belt is moving too fast and pushing the board away from the lug before it enters the air bag section. This will cause the trim saw to miss the board end.

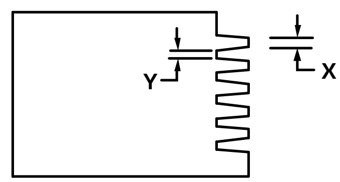
PROBLEM #9 - Joint fingers too short or too long

In this figure, the fingers are too long. Dimension X is smaller than Y. The fingers must be shortened by increasing the amount of wood the trim saw removes.



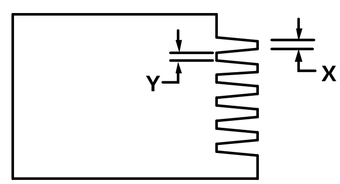
X < Y

In this figure, the fingers are too short. Dimension X is larger than Y. The fingers must be lengthened by reducing the amount of wood the trim saw removes.

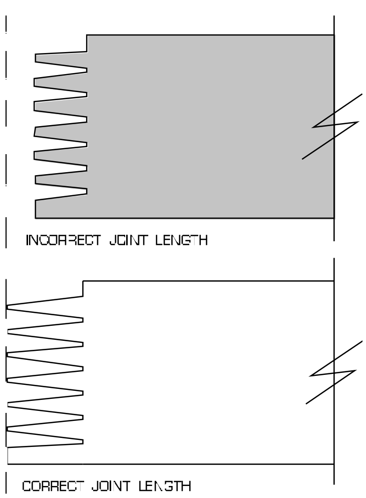


X > Y

A good finger joint will have no gaps, allowing very little room for excess glue. This is accomplished when dimension X = Y.



X = Y



PROBLEM #10 - Joint Length Shorter Than Normal

Possible Cause Excessive radial run-out at the top of the cutter stacks.
Cure Check spindle for excessive run-out or warped spindle.

Possible Cause Excessive radial run-out at the bottom of the cutter stacks.
Cure Have the head's bottom cutter face checked by AceCo for bore perpendicularity.

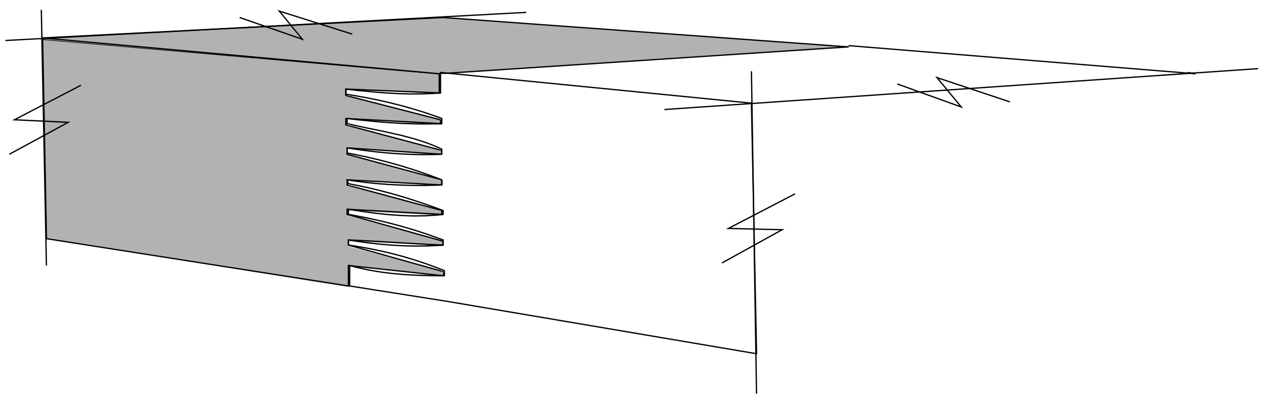
Possible Cause Excessive radial run-out at the spindle, caused by bad bearings.
Cure Contact machine manufacturer.

FINGER JOINT TROUBLE-SHOOTING - Continued

PROBLEM #11 - Joint Fingers Have Concave Gap on Side

Possible Cause Cutters were not resharpened according to hook gauge. Cutters have too sharp of a hook angle.
Cure Grind the cutters to match the hook gauge (see page 40).

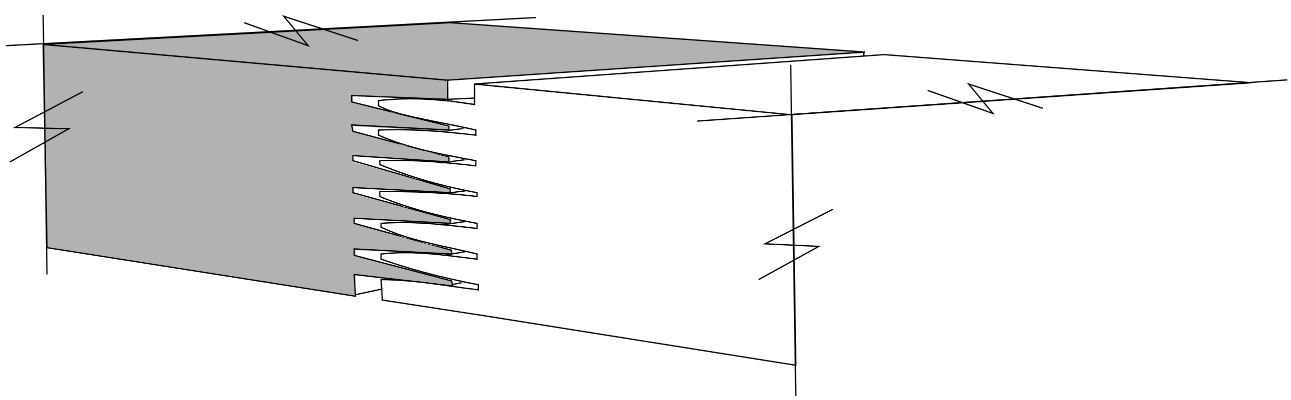
Possible Cause Cutter stack moved during setup and rotated too far forward for the correct set-up angle.
Cure Reset the head on a set-up stand and check alignment of cutter stack to alignment post. Check set-up stand for damage or excessive wear.



PROBLEM #12 - Joint Fingers Have Convex Gap on Side

Possible Cause Cutters were not resharpened according to hook gauge. Cutters have too blunt of a hook angle.
Cure Grind the cutters to match the hook gauge (see page 40).

Possible Cause Cutter stack was not pulled up to the alignment post of the set-up stand.
Cure Set cutter stacks against the alignment post of the set-up stand and re-torque the bolts.



TEAR OUT

Tear-out is defined as excessive splintering and chipping of the wood surface that the tooling is exiting.

Conditions That Cause Tear-out:

Dull Cutters: Sometimes tear-out can be eliminated by simply resharpening your cutters more often and verifying that your grinding procedures are correct.

Too High of Feed Rate: Tear-out can occur if your feed rate is too high. To see if this is a problem, you need to calculate the number of knife "Marks per Inch" (see page 29).

Gullet Radius: An improperly maintained gullet radius can prevent wood chips from flowing clear of the stack of cutters. Compacted fiber builds up until the tips of the wood joint are ripped out because of a lack of clearance. A properly formed gullet radius acts as a chip breaker.

Grain Orientation: Direction of wood grain can reduce or accentuate tear-out (see graphic below).

Bad Lugs: Lack of proper backing support can cause tear-out. Lugs will not function properly if they are excessively worn or rounded on the supporting edge. The brush system in front of the hold-downs should not run on the lugs themselves, or it will cause excessive wear and rounding of the supporting corner on the lug face. Lugs that are out of adjustment can also contribute to tear-out. The finger joint cutters should just touch the lug.

Species of Wood: The type of lumber and grain structure can further add to tear-out. Materials that splinter and clog the finger joint head quickly (e.g. Hemlock Fir) will produce excessive tear-out.

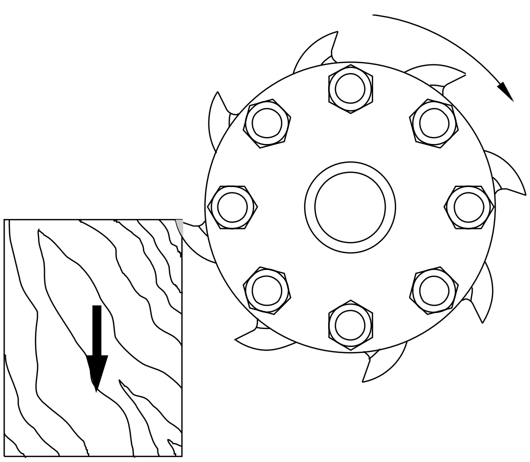
Cutting Angle: Proper cutting angle is critical in producing a good joint. If cutters are sharpened without using a proper hook gauge, tear-out can occur. Using a blunt cutting angle (under 18°) can cause tear-out due to excessive tool pressure. Also, using an improper or damaged set-up stand to set-up your heads can cause tear-out. Double-check your set-up and sharpening procedures to be sure this is not a problem.

Moisture Content: Dry lumber will promote tear-out. We recommend moisture content to be between 8% and 15%.

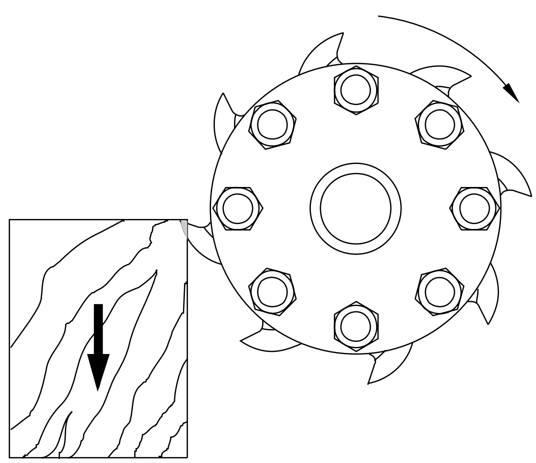
Excess Radial Run-out: Tendency of the head and cutters to fluctuate up and down as they rotate is known as radial run-out. This is caused by component inaccuracy, tolerance buildup, worn spindles, or imprecise systems used to attach the head to the spindle.

Joint Length: The amount of tear-out decreases directly as the tip and shoulder sizes decrease. Switching to a shorter joint can greatly reduce tear-out.

Saws: Chop and trim saws often cause tear-out (see page 50). It is important that the proper saws are used and that sharpness is maintained. This will prevent tear-out on the exit side of the board which is caused by excessive saw tooth pressure.

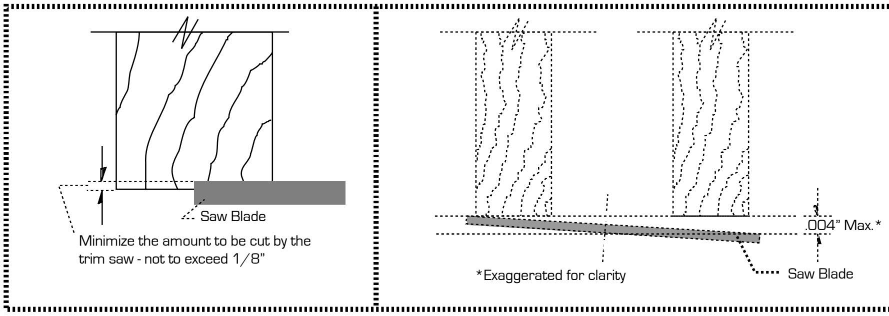


This grain orientation will cause tear-out.



This grain orientation will reduce tear-out.

TRIM SAWS



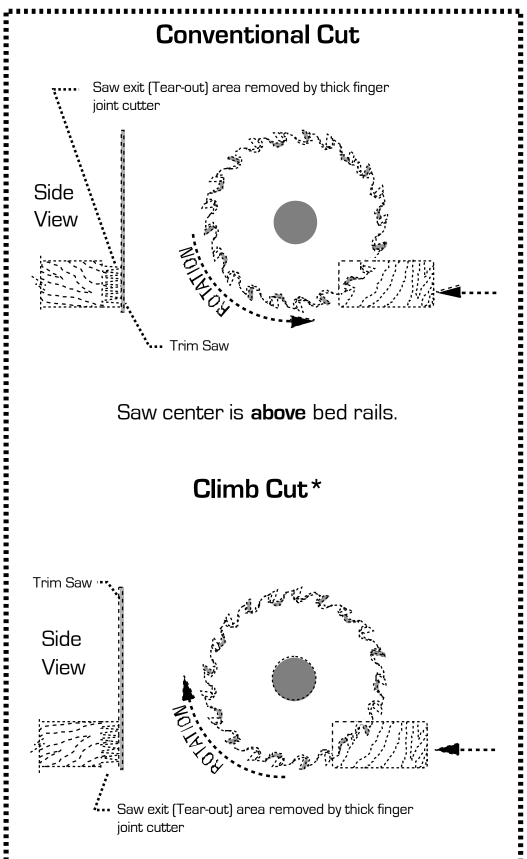
Trim Saws perform precision squaring of the board end and precision trimming of finger joint depth. Trim saw blades should have directional left or right-hand teeth (9 and 1 pattern suggested) with the finish side toward the board. Like chop saws, dull and improper trim saws will cause fiber separation. The kerf of the trim saw should always be less than the saw blade thickness, while not exceeding the thickness that is required to clean up and square the boards. In other words, there should never be a board end slice left over after trimming.

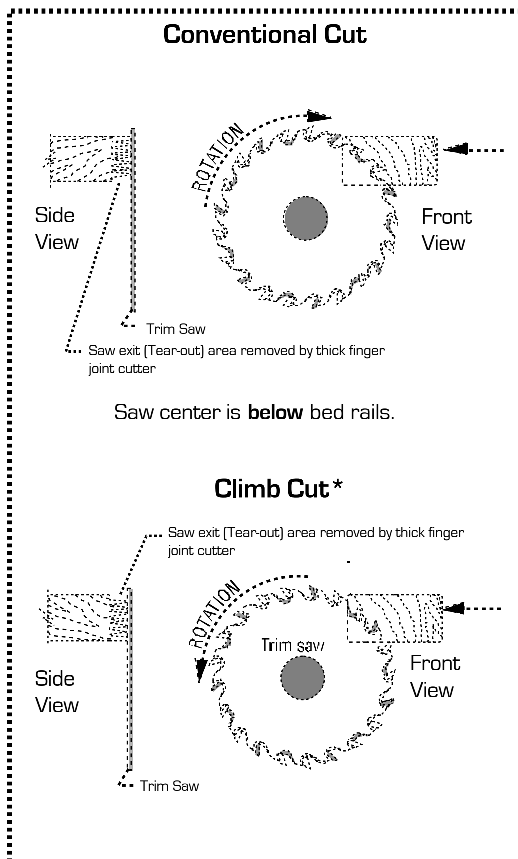
How much wood is being trimmed off the board? To find out, let the board go through the trim saw, pull it out and then send it through the same saw again. The distance between the scribed bed rail marks is the amount being trimmed off by the saw.

For proper squaring, the trim saw needs to be perpendicular, both vertically and horizontally, to the board with a lead of no more than .004". A bit of lead is desirable, or the saw will double-cut the board, causing bowed stock at the assembly press. Conversely, too much lead will produce open-concave board ends, which will also bow when pressed in the assembly. If the trim saw motor bracket doesn't have its own mechanism for adjusting lead, then simply shim under the bracket itself to obtain the correct lead.

Rotation of the trim saw blade can reduce tear-out. The blade should enter the board surfaces where tear-out is least desired and exit the board where quality is least impacted. The following figures show tear-out minimized on "reverse" type joints by configuring rotation and saw exit in areas that are removed with the thick finger joint cutter. By design, the tear-out is cleaned-up by the thick finger joint cutter.

Saw tips should exit no more than 1/8" through board in order to keep more teeth in the cut, reducing tool pressure and tear-out from the saw.

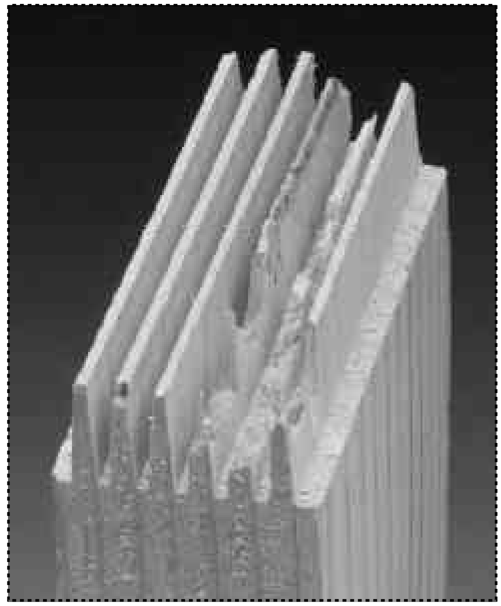




*Hold down pressure on the board must be adequate to keep the board from pulling away from the lug during a climb cut.

RIP-OUT

Rip-out is defined as the removal of fingers in the center of the profiled board and the jamming or embedding of this material between stacked cutters. In turn, this clogged material produces more rip-out by prohibiting the clean cutting of adjacent fingers.



Conditions That Cause “Rip-out”

Species of wood: Materials that splinter and clog up finger joint heads quickly (i.e. Hemlock fir) will experience rip-out, because the wood has erratic grain structure with different degrees of strength.

Moisture content: Extremely dry lumber will promote rip-out. We recommend that finger jointed lumber remain above 8% moisture content.

Cutter tip thickness: Tips thinner than .030” tend to cause rip-out. One cure for this problem is to setup your finger joint cutters in a staggered profile. The quickest way to try this cure is to rollback every other cutter out of the cutting circle, so they will do no cutting. On the next stack of cutters behind the first ones, roll back the opposite cutters from the first stack. In effect, this will make a 10-bolt head cut like a 5-bolt head. AceCo can provide spacers in place of the rolled back cutters, if this is a problem. Keep in mind, you will need to slow your feed rate by 50%, because you have 50% of the normal amount of cutters. Another potential cure for this situation is to mount a brass head cleaner on the machine shaper. (See Page 12)

Gullet Radius: An improperly maintained gullet radius can prevent wood chips from flowing clear of the stack of cutters. Compacted fiber builds up until the tips of the wood joint are ripped out because of a lack of clearance. A properly formed gullet radius acts as a chip breaker.

MEASURING JOINT LENGTH

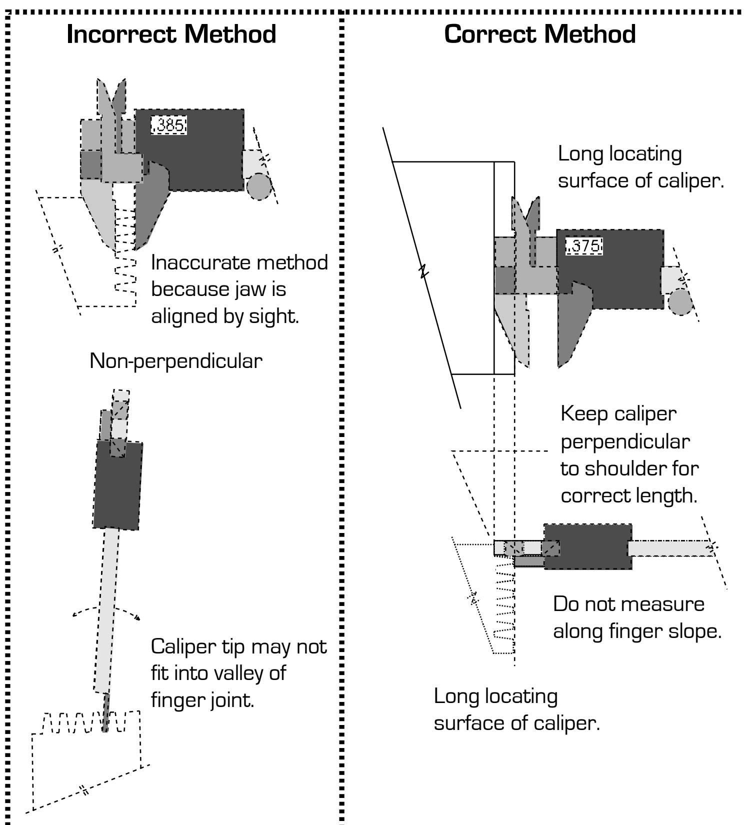
Periodically, joint length measurements must be taken from the finger-jointed boards produced. Joint length measurements are used for:

Machine setup - Trim saws: Each end must have the same length to prevent end gaps as the boards are pressed together.

True Joint Length: Resharpened tooling will produce a shorter finger than the nominal design length. This is caused by burrs on the cutter face which are removed during the first few hours of production.

Dull Tooling: As the tooling dulls, joint length increases. When a determined length is reached, the tooling needs to be resharpened.

The graphic illustrates correct and incorrect methods for measuring the length of a finger joint. Please note that the correct method uses longer surfaces of the digital caliper for location. By locating on these long surfaces, joint lengths have better repeatability, to within .003”.



JOINT SAVINGS ANALYSIS

The following is a method to evaluate your savings by shortening your joint length. The lumber saved from this conversion will usually pay for the tooling in just a few months time. AceCo offers cutters that can produce joints as small as 1/4", 4mm, and 5mm. To find out how much you can save simply follow the example below, then fill out the Joint Savings Analysis Work Sheet.

Assumptions used in the example:
(1) Joint Conversion from 3/8" to 1/4"
(2) Board Size is 6/4 (1.562" height x 3" width)
(3) 80 joints per minute average for two 8-hour shifts

Example:

Step 1: Calculate lineal feet of lumber saved.

1. 3/8" - 1/4" = 1/8" or .125"
2. .125 x 80 joints per minute x 60 minutes = 600 lineal inches saved per hour.
3. 600 lineal inches saved per hour x 16 hours (2 shifts) = 9,600 lineal inches saved per day.
4. 9,600" ÷ 12"/ft. = 800 lineal feet saved per day.
5. Assign cost per lineal foot x amount of lineal feet saved per day = Cost Savings per lineal foot per day. Assume: $.30 cost per foot x 800 lineal feet saved = **$240.00 saved per day.**

Step 2: Calculate board feet of lumber saved.

1. 9,600 lineal inches saved x 1.562" board height x 3" board width = 44,985 cubic inches saved.
2. 44,985 cubic inches ÷ 144 (the volume of inches in one board foot) = 312 board feet saved per day.
3. Assigned cost for 1,000 board feet ÷ 1,000 board feet = savings per board foot per day.
4. Example of $900.00 ÷ 1,000 board feet = $.90 per board foot.
5. $.90 x 312 board feet saved = **$280.80 worth of lumber saved per day.**

Joint Savings Analysis Work Sheet:

Step 1:

A. Current joint length = ____________________

B. Joint length converting to = ______________

C. A - B = _______________________________ lumber saved per joint.

D. Average number of joints ran per minute = __________________________

E. C x D x 60 minutes per hour = ____________________________________ lineal inches saved per hour

F. Number of hours of operation per day = ____________________________

G. E x F = _______________________________ lineal inches saved per day

H. G ÷ 12 = _____________________________ lineal feet saved per day

I. Cost of lineal foot of lumber = $____________

J. **I x H = $_______________________________ of cost savings per lineal foot per day.**

Step 2:

K. Board height = ________________________

L. Board width = _________________________

M. G x K x L = ____________________________ cubic inches saved per day.

N. M ÷ 144 (volume of one board foot) = _______________________________ board feet saved per day.

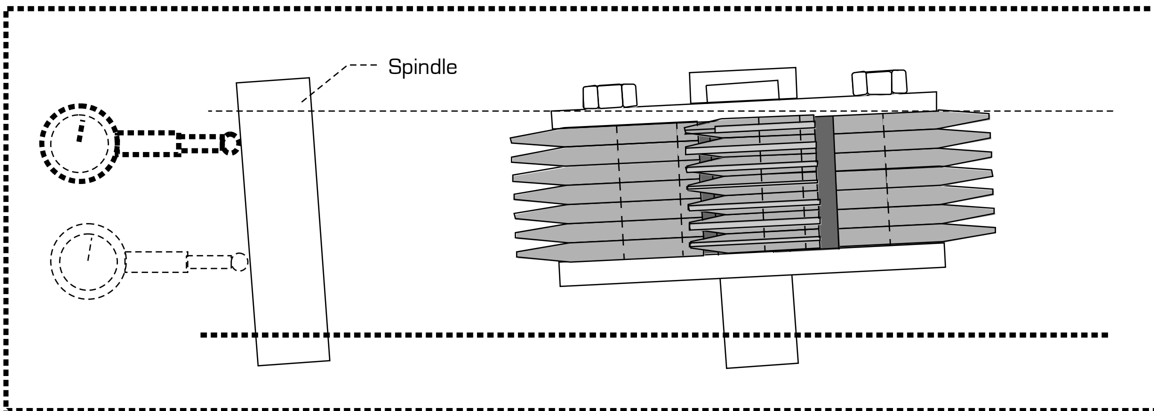
O. Cost of 1,000 board feet = $ ______________

P. O ÷ 1,000 board feet = $ __________________ savings per board foot per day.

Q. **P x N = $______________________________ worth of lumber saved per day.**

SPINDLE PERPENDICULARITY AND CROSSLINING

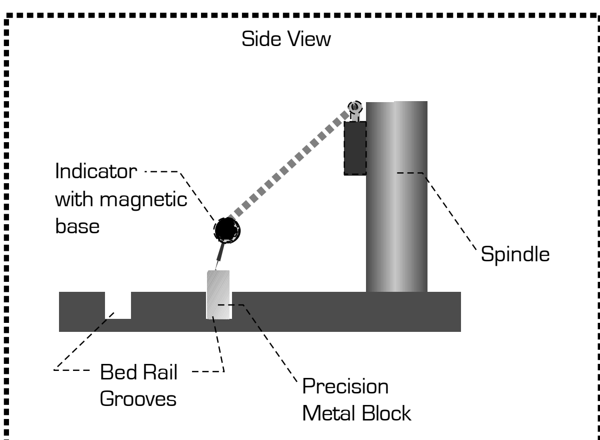
AceCo would like to state that we are tooling manufacturers and not machine manufacturers; however, the best tooling in the world won't perform correctly unless the finger joint machine is also perfectly tuned. Therefore, one of the most important aspects of the machine is the spindle and its perpendicularity to the bed rail grooves. As shown below, a non-perpendicular shaft will not be found by simply indicating on the spindle itself. If the shaft is running true, then the indicator will show little or no run-out, even though the spindle may be tilted in relation to the bed rail grooves.

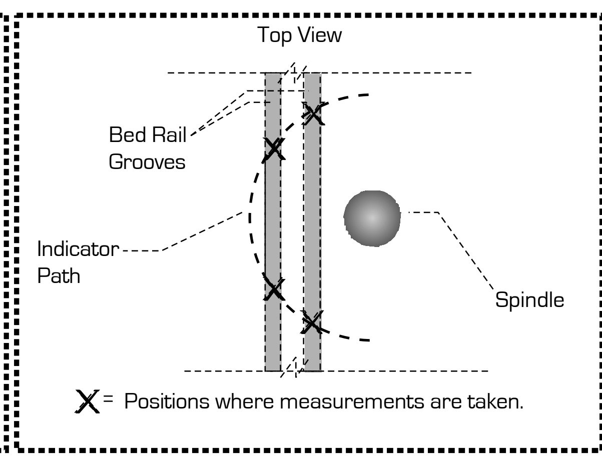


If a spindle is not perpendicular to the bed rail grooves, the finger joint head will "plow" through the wood and produce a joint that needs to be shortened in order to fit together. The finger joint cutters will also be galled on the sides, because there will be little or no side clearance between the wood and the cutters.

Crosslining is a procedure to check the perpendicularity of the spindle to the bed rail grooves. This procedure utilizes a dial indicator with a magnetic base attached to the spindle and then swung across the bed rail grooves at four different positions. Measurements are taken at all four positions and verified to within .003" of each other. Do not take measurements on the bed rails themselves, as they may be worn.

Remove the bed rail inserts and any spacers that may be under the inserts that were used to level them. Clean out the bed rail grooves and insert a 1" x 1" x 1/2" metal block into the grooves. Swing the indicator to each of the four locations shown below and let the dial indicator "read" off the block at each point. The variance between the four measurements should not exceed .003", as stated above. This variance may need to be smaller for short joints (i.e. 1/4", 4mm, 5mm joints), as they require more accurate spindle perpendicularity. Adjustments should be made at the spindle motor mounting bracket on the machine.





TILTED HEAD SYNDROME

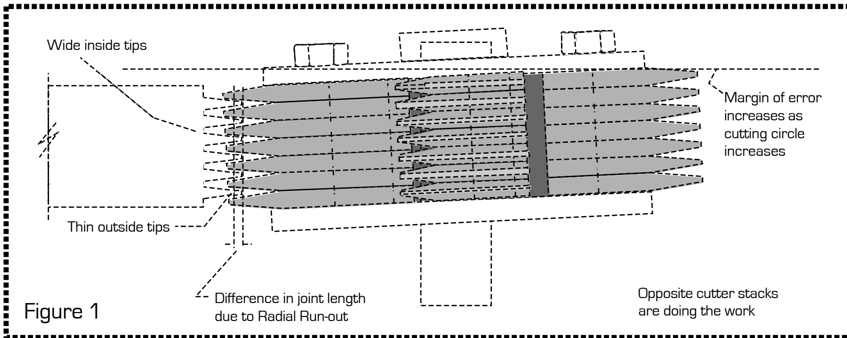


Figure 1

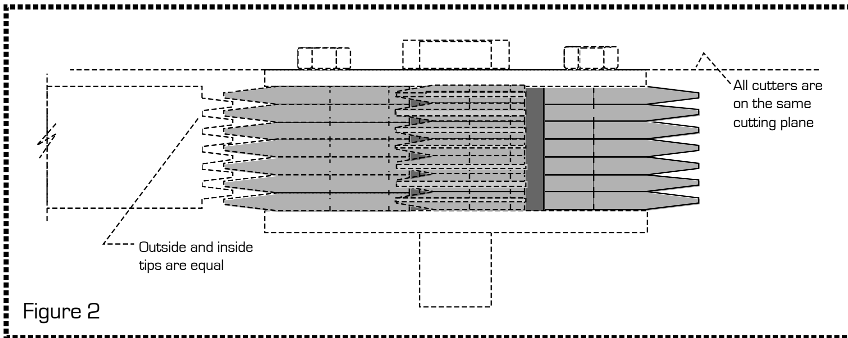


Figure 2

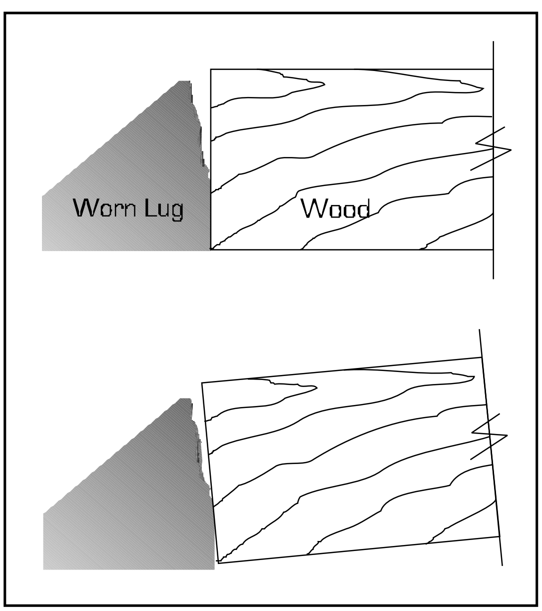
Tilted Head Syndrome is a problem where, even though the spindle is perpendicular to the bed rail grooves, the head is not perpendicular to the spindle, as shown in Figure 1. This problem usually results from the head not properly locating on the spindle due to nicks or burrs on the collets (centering cones) or the collet faces of the head itself. Tilted Head Syndrome can be detected by placing a mag-base dial indicator securely to the machine so that the indicator tip can ride on the top of the cutter stacks at the tip of the cutters. With the spindle motor locked out, rotate the spindle one revolution and read the variance between the cutter stacks.

If the variance between the tops of the stacks of cutters is more than .003", then the head is likely tilted, as shown in Figure 1.

The high and low readings on the cutter stacks are usually opposite of each other, but the readings will not necessarily remain on the same cutter stacks for collet-type heads. If the spindle nut is loosened and the head is rotated 180°, the high and low readings will move to different stacks. This tilted condition makes the cutters act like they have wider pitch than they actually do, which, in turn, produces joints with thinner tips that need to be shortened to make the joint fit together. However, when the joint is shortened, the tip of the wood finger becomes thicker, producing more of a butt joint within the finger joint. The result is a finger joint with reduced strength.

The finger joint head will also have only a few opposite stacks cutting while the rest of the stacks are missing the wood. This increases the chip load for the cutters that are doing the work and decreases the time between sharpenings. It is possible for a 10-bolt collet head to cut like a 4-bolt head, because all the cutters are not precisely following the same plane. Additional tear-out on the back of the boards will result because of the increased tool pressure.

The Ace-Loc hydraulically-centered finger joint head was designed to eliminate this misalignment. Hydraulically-centered finger joint heads "grab" the entire surface area of the spindle, thus increasing the perpendicularity of the finger joint head to the spindle as shown in Figure 2. Joint lengths are maintained better, because all the cutter stacks cut evenly, reducing the chip load on each individual stack. Additional benefits include reduced tear-out and extended cutter life.



WORN LUGS

Worn lugs allow boards to move as they are being cut by the finger joint head and will produce a joint much like that of the "Tilted Head Syndrome." See the illustration to the left.

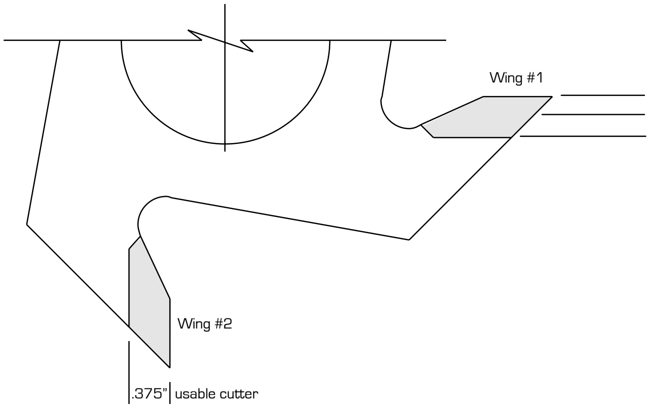
Never allow alignment brushes to ride over the lugs and make contact. This will eventually wear the lugs down.

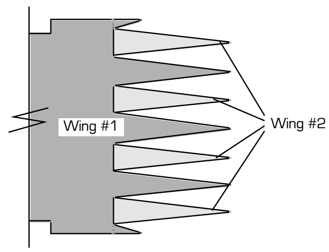
If the mating surface of the lug is worn so that less than half of the height of the back of the board is supported, then the board will move during the cutting process. Examining the bottom of the board can identify this. Bed rail scribe marks that are deeper on the front of the board and less on the lug side of the board indicate that this problem is happening.

FINGER JOINT TOOLING COMPARISON

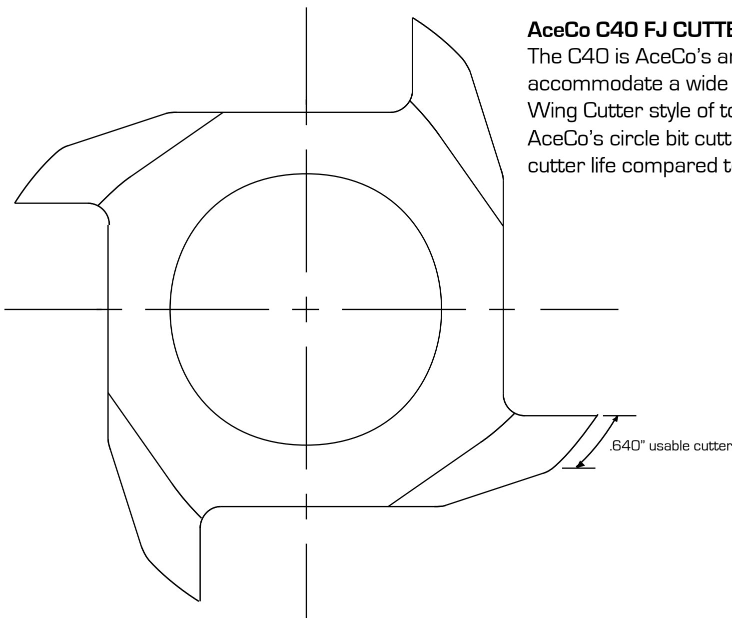
WING CUTTERS

The cutting circle is quickly reduced as the cutter is resharpened. Machine adjustments are required to continue to produce an acceptable joint. The short life cycle and inconsistency of joint quality are major disadvantages of solid wing cutters.



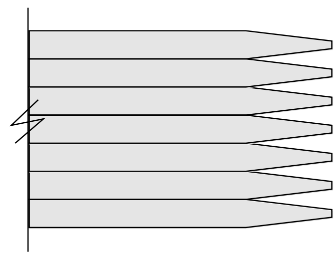


View of typical wing cutters; showing alternating cutting sequence of each wing.



AceCo C40 FJ CUTTERS

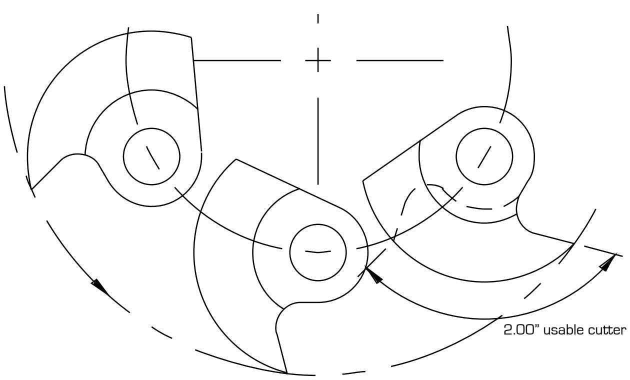
The C40 is AceCo's answer to vertical fingerjointing. The C40 is designed to accommodate a wide range of equipment that has previously been dominated by Wing Cutter style of tooling. The C40 incorporates the precision tolerances of AceCo's circle bit cutters and maximizes cutting circle life by giving .640" of usable cutter life compared to .375" provided by wing cutters.

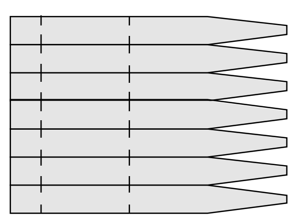


View of AceCo C40 tooling shows advantages of individual cutters. Finite Finish™ ensures flatness of .00005", which produces a superior joint.

AceCo CIRCLE BIT FJ CUTTERS

The cutting circle is maintained after each sharpening by rotating the cutter to the same, exact position. The precision tolerances provide the most accurate joint quality and consistency possible.





View of AceCo tooling shows advantages of individual cutters. Finite Finish™ ensures flatness of .00005", which produces a superior joint.

MOULDER HEAD KNIFES PER INCH - M.P.I.

Based on 3,600 and 6,000 RPM

Feed Rate Feet per Minute	Number of Knives 1		2		4		6		8		10		12	
15	20	33.3	40											
20	15	25	30	50										
25	12	20	24	40	48									
30	10	16.7	20	33.3	40									
35	8.6	14.3	17.1	28.6	34.3		51.4							
40	7.5	12.5	15	25	30	50	45							
45	6.7	11.1	13.3	22.2	26.7	44.4	40							
50	6	10	12	20	24	40	36		48					
60	5	8.3	10	16.7	20	33.3	30	50	40		50			
70		7.1	8.6	14.3	17.1	28.6	25.7	42.9	34.3		42.6		51.4	
80		6.3	7.5	12.5	15	25	22.5	37.5	30	50	37.5		45	
90		5.6	6.7	11.1	13.3	22.2	20	33.3	26.7	44.4	33.3		40	
100		5	6	10	12	20	18	30	24	40	30	50	36	
110			5.5	9.1	10.9	18.2	16.4	27.3	21.8	36.4	27.3	45.5	32.7	
120			5	8.3	10	16.7	15	25	20	33.3	25	41.6	30	50
130				7.7	9.2	15.4	13.8	23.1	18.5	30.8	23.1	38.5	27.7	46.2
140				7.1	8.6	14.3	12.9	21.4	17.1	28.6	21.4	35.7	25.7	42.9
150				6.7	8	13.3	12	20	16	26.7	20	33.3	24	40
160				6.3	7.5	12.5	11.3	18.8	15	25	18.8	31.3	22.5	37.5
170				5.9	7.1	11.8	10.6	17.6	14.1	23.5	17.6	29.4	21.2	35.3
180				5.6	6.7	11.1	10	16.7	13.3	22.2	16.7	27.8	20	33.3
190				5.3	6.3	10.5	9.5	15.8	12.6	21.1	15.8	26.3	18.9	31.6
200				5	6	10	9	15	12	20	15	25	18	30
220					5.5	9.1	8.2	13.6	10.9	18.2	13.6	22.7	16.4	27.3
240					5	8.3	7.5	12.5	10	16.7	12.5	20.8	15	25
260						7.7	6.9	11.5	9.2	15.4	11.5	19.2	13.8	23.1
280						7.1	6.4	10.7	8.6	14.3	10.7	17.9	12.9	21.4
300						6.7	6	10	8	13.3	10	16.7	12	20
325						6.2	5.5	9.2	7.4	12.3	9.2	15.4	11.1	18.5
350						5.7	5.1	8.6	6.9	11.4	8.6	14.3	10.3	17.1
375						5.3		8	6.4	10.7	8	13.3	9.6	16
400						5		7.5	6	10	7.5	12.5	9	15
425								7.1	5.6	9.4	7.1	11.8	8.5	14.1
450								6.7	5.3	8.9	6.7	11.1	8	13.3
475								6.3	5.1	8.4	6.3	10.5	7.6	12.6
500								6		8	6	10	7.2	12
550								5.5		7.3	5.5	9.1	6.5	10.9
600								5		6.7	5	8.3	6	10
700										5.7		7.1	5.1	8.6

Note: The chart illustrates average, ideal conditions. Some species of wood will require a different M.P.I. or feed rate. When knives are not jointed, use the single knife column. See page 60 for Jointing information.

$$\text{M.P.I.} = \frac{\text{R.P.M. x Number of Knives}}{\text{12 x Feed rate in Feet/Min.}}$$

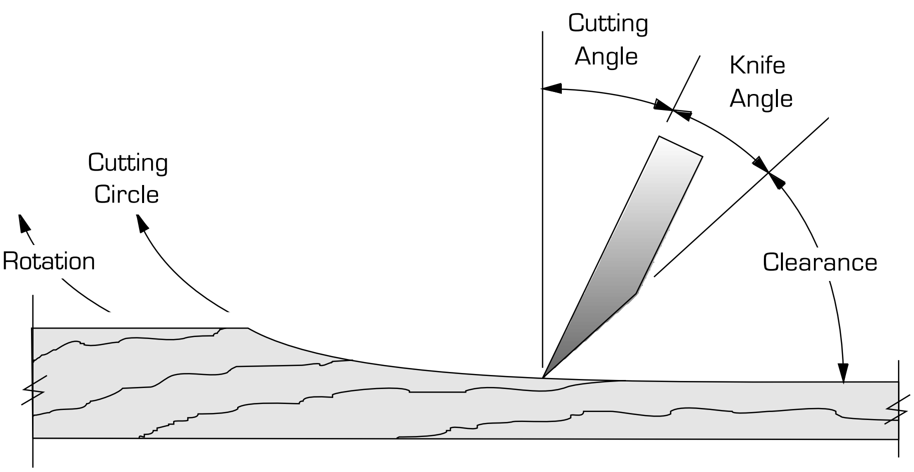
GEOMETRY OF ANGLES

Cutting angle (hook angle) + Knife angle + Clearance angle = 90 degrees

As cutting angle is increased, the knife enters the wood at more of a shear angle, which reduces tool pressure.

As knife angle is increased, cutting edge is strengthened, for longer life, but cutting edge won't be as sharp and will not produce as good of a finish.

As clearance angle is increased, there is less drag produced against the wood. This results in less heat for the wood and the knife.



If the cutting angle were held constant, you would want to decrease the knife angle (sharper knife angle) for softer woods and increase the knife angle for harder woods. If the knife angle is increased, knife life can be prolonged in exchange for a lower quality surface finish.

If the knife angle were held constant, you would want to increase cutting angle (more shearing action) for woods with a higher moisture content.

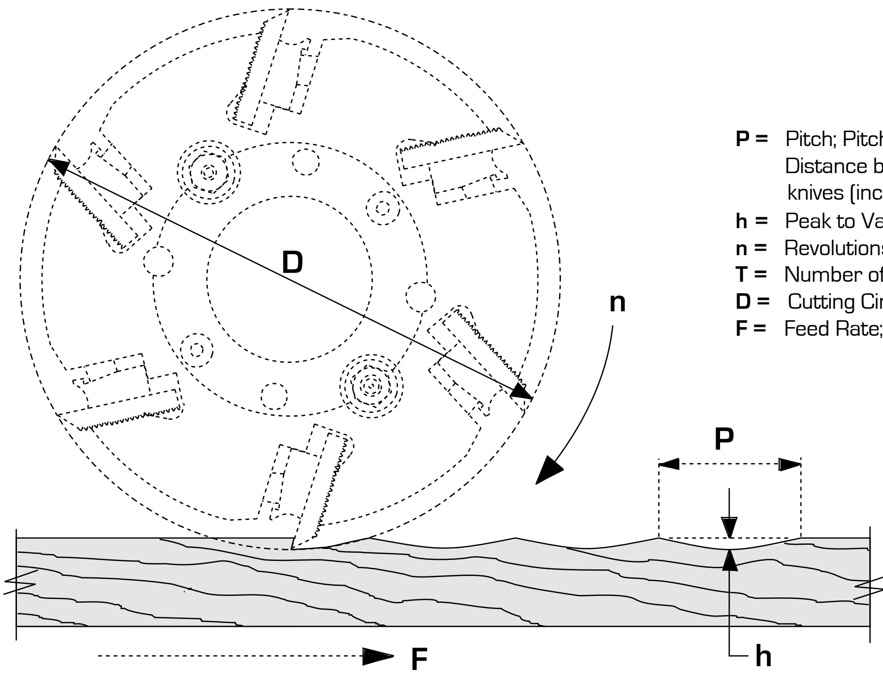
RECOMMENDED CUTTING ANGLES

M.C. - Moisture Content

Species of Wood	Green 12% M.C. or higher	Air Dried	Kiln Dried 7% M.C. or lower
Ash	25°	20°	15°
Basswood	20°	15°	10°
Beech	25°	25°	15°
Birch	25°	20°	15°
Cedar	30°	25°	20°
Cypress	30°	25°	20°
Douglas Fir	25°	20°	15°
Gum	25°	20°	15°
Hemlock	30°	25°	20°
Hickory	13°	11°	10°
Mahogany	25°	20°	15°
Maple	25°	20°	15°
Oak	25°	20°	15°
Pine, Yellow	25°	20°	15°
Pine, White	30°	25°	20°
Poplar	25°	20°	15°
Redwood	30°	25°	20°
Spruce	30°	25°	20°
Walnut	25°	20°	15°

SURFACE FINISH

Decreasing the feed rate, increasing the number of knives, or increasing the cutter head speed can reduce the distance between pitch marks. The quality of the surface finish will be improved with a shorter pitch mark. Shorter pitch marks can also reduce tool pressure and increase the time between sharpenings. However, if tool pressure is reduced beyond recommended levels, the chip load per knife will be inadequate for proper cutting, and the knives will prematurely dull. Wave height can be reduced by increasing the radius of the cutter head or by decreasing the feed per knife.



P = Pitch; Pitch Mark; Feed per Knife: Distance between engagement of successive knives (inches)
h = Peak to Valley Depth; Wave Height (inches)
n = Revolutions per Minute of the Cutter head (R.P.M.)
T = Number of Jointed Knives in Cutter head
D = Cutting Circle Diameter; Extreme Swing (inches)
F = Feed Rate; Feed Speed of Work piece (feet/min)

$$P = \frac{12F}{Tn} \qquad h = \frac{P^2}{4D} \qquad M.P.I. = \frac{1}{P}$$

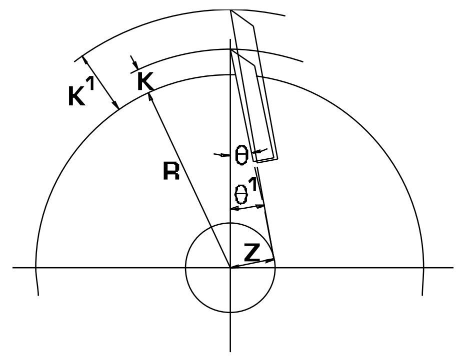
Guidelines:	High Quality (Furniture)	Avg. Quality (Moulding)	Lower Quality (Const. Lumber)
Pitch	Less than .070" (1.78mm)	.070" to .134" (1.78mm to 3.40mm)	Above .134" (3.40mm)
M.P.I.	More than 14.3	14.3 to 7.5	Less than 7.5
Peak to Valley	Less than .0002" (.005mm)	.0002" to .0007" (.005mm to .018mm)	Above .0007" (.018mm)

Assuming moulder head diameter at 163mm (6.417").

MOULDER HEAD CUTTING ANGLES

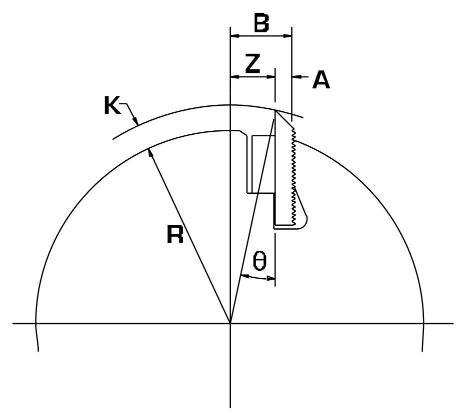
How to determine moulder head cutting angles when the knife protrudes at different distances from the head.

K = Distance knife protrudes from the head
R = Radius of body
O = Cutting angle



Corrugated Knives		Smooth Back Knives	
Knife	Dim "A"**	Knife	Dim "A"
1/4"	.218	1/8"	.125
5/16"	.280	5/32"	.156
3/8"	.343	3/16"	.188
		1/4"	.250
		5/16"	.313
		3/8"	.375

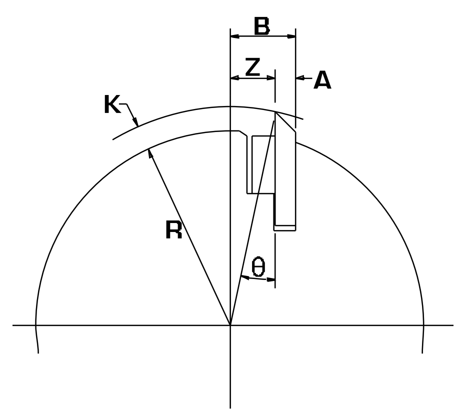
**Note: Dimension "A" is the knife thickness minus the depth of the corrugations.



Corrugated Heads

Dimension "B"
Measure back of pocket to parallel centerline or use the following schedule for AceCo std. heads:
(Assuming K=.375")

Description	Cutting Angle	Body Radius	Dim "B"
150mm - 4 Knife	20°	2.953	1.418
150mm - 4 Knife	12°	2.953	.858
150mm - 6 Knife	20°	2.953	1.418
150mm - 6 Knife	12°	2.953	.858
163mm - 8 Knife	20°	3.209	1.506
163mm - 8 Knife	12°	3.209	.902
195mm - 10 Knife	20°	3.839	1.721
195mm - 10 Knife	12°	3.839	1.012



Note: Flat Back Heads - Measure from the back of the pocket to parallel with the centerline. Cutting angles decrease as knives are extended out of the cutter head.

$Z = B - A$

$\sin \theta = \dfrac{Z}{R + K}$

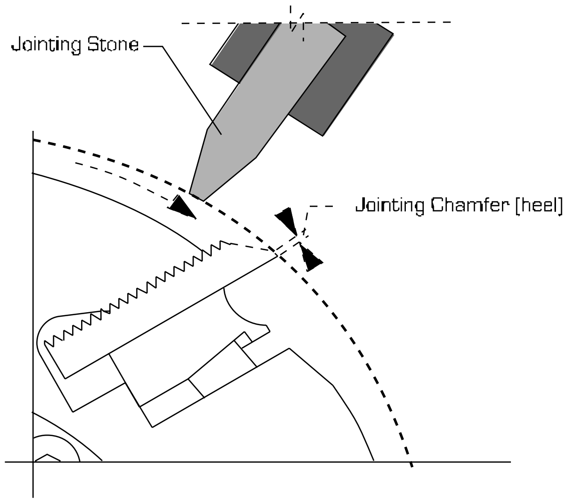
Sample: 150mm corrugated head, 6 knife, 20° C.A., 5/16" knife, K = 20mm (.787"), R = 75mm (2.953)

A = .280
B = 1.418
Z = (1.418-.280) = 1.138

$\sin \theta = \dfrac{1.138}{2.953 + .787} = .30428$

Look in trig tables
θ = 17°43'

WARNING: DO NOT EXTEND KNIFE BEYOND THE BOTTOM OF THE GIB, INJURY OR MACHINE DAMAGE COULD RESULT.



JOINTING

To ensure a uniform cutting circle for all knives in a head, the knives should be jointed on a moulding spindle. A mounted jointing stone hones each knife-edge as the head spins at actual cutting speed. This brings all cutting surfaces to an exact radius, while compensating for any tolerance accumulation or imbalance.

The jointing process can be repeated several times. However, the chamfer or heel produced on the tip must not exceed the following recommendations:

Maximum Chamfer:

Softwoods:	**.020" (0.51mm)**
Hardwoods:	**.028" (0.71mm)**

Jointing improves the quality of finish by ensuring that knife cuts are of an even height. A properly jointed knife will also cut cleanly, causing minimal damage to wood cells and preventing a glazed finish.

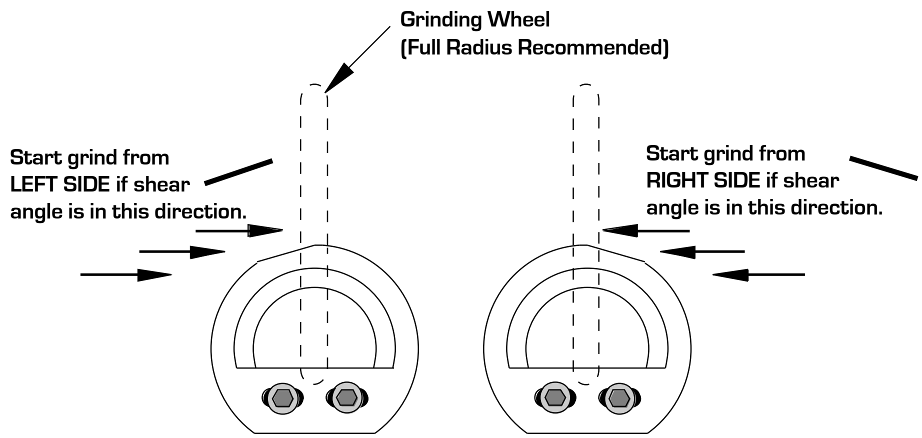
The knives can only be jointed a few times before they must be properly resharpened. The frequency of jointing, before grinding, is related to the amount of heel you leave on the knife. Knives that are jointed in an unbalanced or inaccurately centered manner will have uneven tip (heel) removal, as shown in Figure C (page 65). The larger heel will eventually result in decreased tool life, increased sharpening, and potentially poor surface finish. Figure D (page 65) shows the increased tip life of jointed knives from precision-centered and balanced cutter heads.

MOULDER AND PLANER HEAD GIB SCREW TIGHTENING

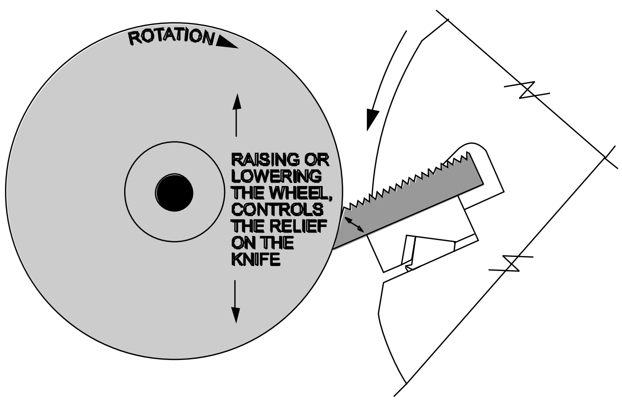
Always use a torque wrench to tighten gib screws in moulder and planer heads. Tighten gib screws starting with the center screw first and torque to **30 - 35 Ft. Lbs.** to eliminate distortion. The threads of the gib screws should be coated with thread lubricant to increase the clamping force. Moulder knives should be cleaned, inspected, and balanced to within one tenth of a gram in order to reduce vibration, increase spindle bearing life, and provide better surface finish.

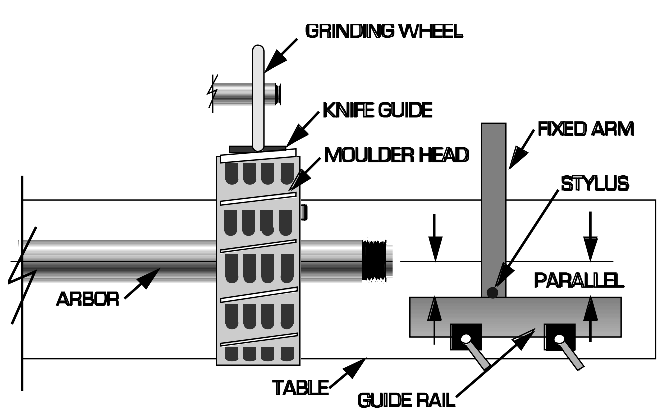
SHEAR HEAD RESHARPENING - Using the Shear Knife Grinding Guide

The AceCo shear knife grinding guide simplifies the sharpening of shear-cut moulder heads by providing a precise cutting edge on heads with shear angles up to 15°. The guide can be used on both left and right hand shear-cut heads to create a consistent grind on the entire knife. The guide easily mounts on most grinders, is symmetrical front to back, and adjusts from side to side.



The shear guide allows for a smooth transition to be made as the grinding wheel moves across the knife surface. The direction of the guide and grind pass correlate directly to the angle direction of the knife. At the right front corner of the grinder, a guide rail and stylus provide the straight line reference. This rail must be parallel with the arbor of the machine or the moulder head will cut a taper. The knife relief angle is achieved by moving the center height of the grinding wheel in relationship to the center height of the moulder head. By increasing this distance, the angle will increase and vice-versa. When setting up the shear guide, the center of the guide must be aligned with the center of the grinding wheel. It is recommended that the guide be as close to the wheel as possible, without actually touching, to ensure a rigid set-up and to reduce chatter.





HYDRAULIC TOOLING INFORMATION

A. General Ace-Loc Head Guidelines

1. Safety lock collars are required. Lock collars prevent the cutter heads from accidentally slipping when hydraulic pressure is not maintained. They also retain the cutter head if a lock nut is not used.

2. Obey minimum and maximum operating pressures, which are engraved on all heads. O-ring and/or sleeve damage could occur if the maximum pressure is exceeded.

3. Never attempt to pressurize any hydraulically-centered cutter head that is not on a spindle. Damage to the sleeve will result.

4. Never leave unpressurized cutter heads on unattended machines. The machine could be turned on by mistake, resulting in damaged spindles or sleeves, and possible operator injury.

5. Machine spindles must be in good condition for hydraulically-centered cutter heads to perform correctly. They must be clean, dry, and free of any grease or oil. Do not spray the spindle with any cleaning solvent or oil, as it could drain down into the spindle bearing and contaminate it. Always wipe the spindle clean.

6. Total clearance between the spindle and the bore of the head cannot exceed .003" (.076mm) for keyless shafts. For keyed shafts (1-1/2" and less) clearance cannot exceed .002" (.050mm). AceCo factory bore sizes are 1.8130" - 1.8135" for the 1-13/16" spindle size and 1.5005" - 1.5010" for the 1-1/2" spindle size.

7. Never use a cutter head with a sleeve designed for keyless spindles on a spindle that has a keyway. The Ace-Loc sleeve could be permanently deformed and would have to be replaced. However, a sleeve designed for a keyed spindle may be used on a keyless spindle.

8. Always check the hydraulic pressure each day before starting the machine. Pressure can be monitored using the grease gun's pressure gauge. Hydraulic pressure will change due to temperature variations.

9. To maintain balance and accuracy, all debris such as sawdust and pitch must be removed from the cutter head.

10. It is important to clean cutter heads in a non-corrosive cleaning solution such as **Blade Clean** or equivalent. If you are unsure about your cleaning solution, obtain an O-ring from AceCo. Test your cleaning solution by soaking the O-ring for a few days and then inspecting for deterioration. Recommended cleaning solution temperature should not exceed 140° Fahrenheit (60.0 degrees Celsius).

11. To release the hydraulic pressure in the Ace-Loc sleeve, loosen the allen screw on the pressure relief fitting, located directly opposite the zerk fitting. The allen screw will release grease from within the Ace-Loc. Always retighten the allen screw before attempting to re-pressurize the cutter head. (Do not completely remove the allen screw from the relief fitting, as check ball may be lost)

12. In the event that you need to replace the grease fittings in your cutter head, only use AceCo approved, high-pressure grease fittings. Other fittings may not work properly with our tapered fittings.

13. Do not use graphite-based grease. Graphite under high pressure will damage the O-rings.

14. When cleaning Ace-Loc heads, always close the pressure release valve so cleaning solvent will not enter the system.

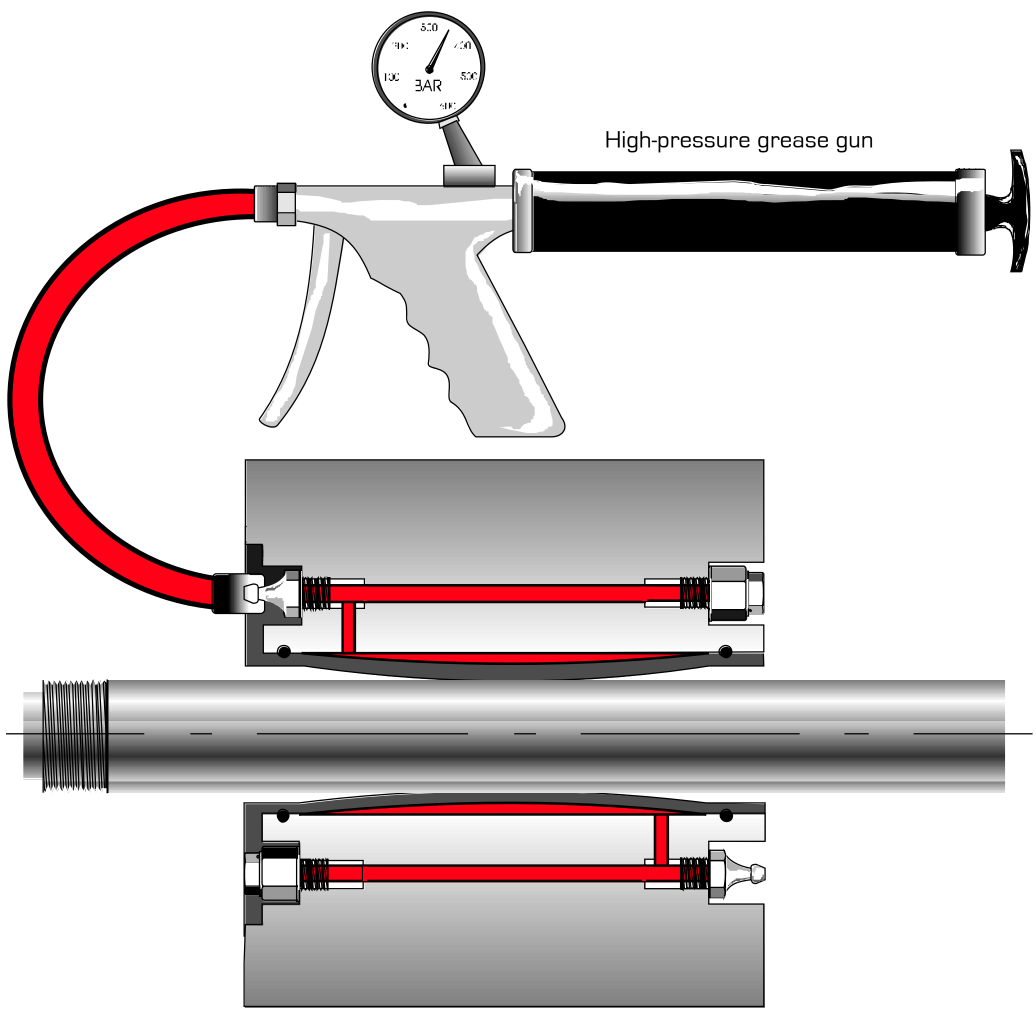
HYDRAULIC TOOLING INFORMATION

B. Grease Gun Technical Information

1. A special grease gun, available from AceCo, is required to pressurize an Ace-Loc sleeve. Please read and understand the operating and maintenance instructions before using grease gun.

2. To ensure that no contaminants are pumped into the cutter head, always wipe clean the hydraulic connector and grease fitting before connecting the grease gun to the cutter head.

3. Always use high temperature lithium-based grease in grease gun. Do not use graphite-based grease. Graphite under high pressure will damage the O-rings.



Cross section of Ace-Loc Sleeve

Cross Section exaggerated for clarity.
Sleeve bore to spindle diameterical clearance = .002" to .003"

BALANCE

Balance has a dynamic effect on performance-related considerations such as surface quality and tool life.

Imbalance is the result of an uneven distribution of weight on a rotational shaft. This can be caused by an off center alignment hole in the cutter head body; inaccurate or inconsistent weights of the machined head body, elements of the head or cutters; actual metal imperfections such as porosity or pockets; and changes caused by sharpening, cutter replacements, or uneven pitch or fiber build up.

All AceCo head bodies are balanced to 7200 RPM and to International Standards Organization (ISO) quality grade G - 1.0. All of the components on a cutter head body are weighed to 0.1 gram on a digital scale, and equally weighted elements are cross-balanced at assembly. Finger joint stacks are cross-balanced to within a total of 0.1 gram (page 33). Technicians in the mill should follow these guidelines when replacing or reassembling components.

An imbalance of 1 gram on a 10-1/2" extreme swing finger joint head, turning at 3,600 RPM, causes a centrifugal imbalance force of 4.25 lbs. This force can be calculated using the following formula:

Centrifugal Force =	Mass x Radius x Speed^2
W =	Weight in grams of unbalance
N =	Spindle Speed (RPM)
R =	Radius in inches from rotational center to unbalance concentration. Typically at the cutter peripheral or extreme swing divided by 2.

The formula is simplified to:

$$\text{Force} = \frac{W \times N^2 \times R \times .624}{10{,}000{,}000}$$

Example:

W =	1 gram
N =	3,600 RPM
R =	5.25 inches

Therefore:

$$\frac{1 \times 3{,}600^2 \times 5.25 \times .624}{10{,}000{,}000} = 4.25 \text{ lbs.}$$

As you can see, a small imbalance results in a significant rotational force that can cause vibrations, spindle bearing failure, unequal knife loading, and poor surface finish.

As speed is increased, the rotational imbalance forces increase exponentially. When the speed doubles, the imbalance force quadruples. A cutter head that is acceptable at 3,600 RPM may not be at 6,000 RPM. Similar to improper centering, imbalance can cause the center of rotation of a cutter body to be displaced, resulting in an out-of-round condition. This puts an unequal workload on the cutters and causes a loss of multiple knife finish and premature dulling.

The utopian way to balance the cutter head and knife assembly would be on the actual machine it is used on at actual running speeds. The next best method would be to balance the cutter head and knife assembly on a dynamic balancing machine prior to mounting. The most common method is to carefully cross-balance the assembled elements and cutters on a pre-balanced cutter head body (all AceCo heads are pre-balanced prior to shipping).

PRECISION CENTERING

Inaccurate centering can be caused by an off-center alignment hole in the cutter head body; or inaccurate joining of the cutter head body to the spindle shaft; or cutter head body imbalance. All of these conditions result in an out-of-round or eccentric tip path. Ace-Loc hydraulic centering can help eliminate problems associated with inaccurate joining of the head to the spindle.

Figures A and C show that the problems associated with inaccurate centering. Figures B and D show the benefits of a properly centered head.

Fig. A

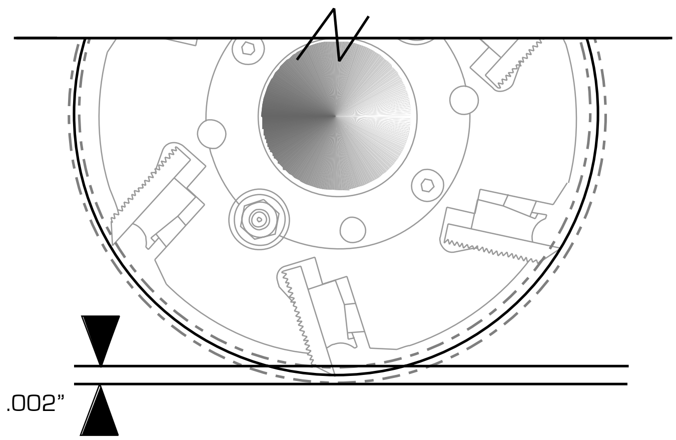


Figure A illustrates the knife path of an off-centered or unbalanced cutter head prior to jointing. Notice that the outside knives make heavier cuts while the inside knives make lighter cuts. This causes premature dulling of outside knives, as well as a poorer quality surface finish.

Fig. C

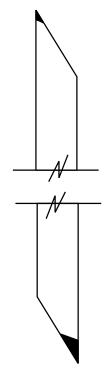


Figure C illustrates the knife depth of an off-centered or unbalanced cutter head. To equalize the knife depth the black tip area shown would be removed in the jointing process.

Fig. B

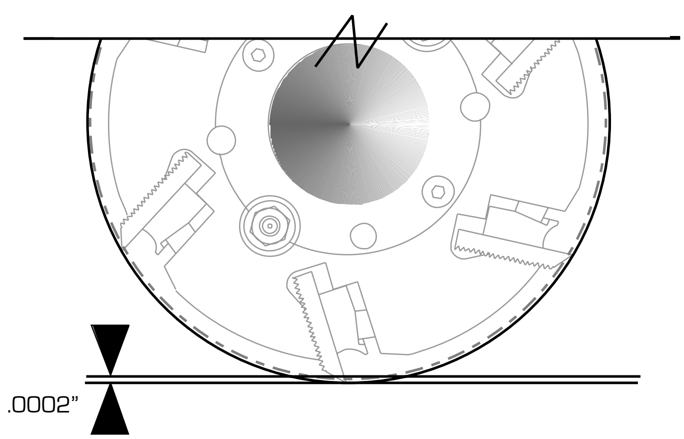


Figure B illustrates how an Ace-Loc hydrualically-centered head can improve the centering accuracy by 10 times over conventional tooling.

Fig. D

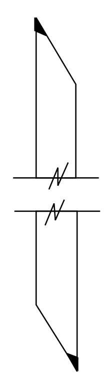


Figure D illustrates the knife depth of a balanced head with equal amounts of knife tip being removed in the jointing process.

CONVERSION CHART

Length

1 meter	=	39.37 inches or 3.28 feet or 1.094 yards
1 millimeter	=	.0394 inches
1 kilometer	=	3,281 feet or .6214 miles
1 inch	=	2.54 centimeters or 25.4 millimeters
1 foot	=	.3048 meters or 30.48 centimeters

Area

1 meter^2	=	10.76 feet^2 or 1,550 inches^2 or 10,000 cm^2
1 centimeter^2	=	.155 inches^2 or 100 millimeters^2

Volume

1 meter^3	=	1,000 liters or 35.31 feet^3
1 centimeter^3	=	.06102 inches^3
1 gallon	=	.1337 feet^3 or 3.785 liters
1 quart	=	946.4 centimeters^3 or .9463 liters
1 ounce (fluid)	=	.02957 liters

Weight

1 gram	=	.0022 pounds or 980.7 dynes or .0353 ounces
1 ounce	=	28.35 grams
1 kilogram	=	2.205 pounds
1 gal. of water	=	8.337 pounds
1 ton (short)	=	2,000 pounds or .89287 ton (long) or .9078 ton (metric)
1 pound	=	453.59 grams or .4536 kilograms or 16 ounces

Temperature

Fahrenheit	=	(Celsius x 9/5) + 32
Celsius	=	(Fahrenheit -32) x 5/9
Kelvin	=	Celsius + 273.18

Pressure

1 lb/inch^2	=	144 lb/foot^2 or 703.1 kg/m^2 or .073 kg/cm^2
1 kg/cm^2	=	14.22 lb/in^2 or .9678 atmospheres
1 kg/m^2	=	.2048 lb/foot^2 or 98.067 dynes/cm^2
1 bar	=	14.5 lb/in^2 or .9869 atmospheres
1 atmosphere	=	14.7 lb/in^2 or 1.033 kg/cm^2

Torque

1 Foot-pound	=	1.356 Nm (Joule)
1 In-lb	=	.113 Nm
1 Nm (Joule)	=	.738 Foot-pound

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Edition VII