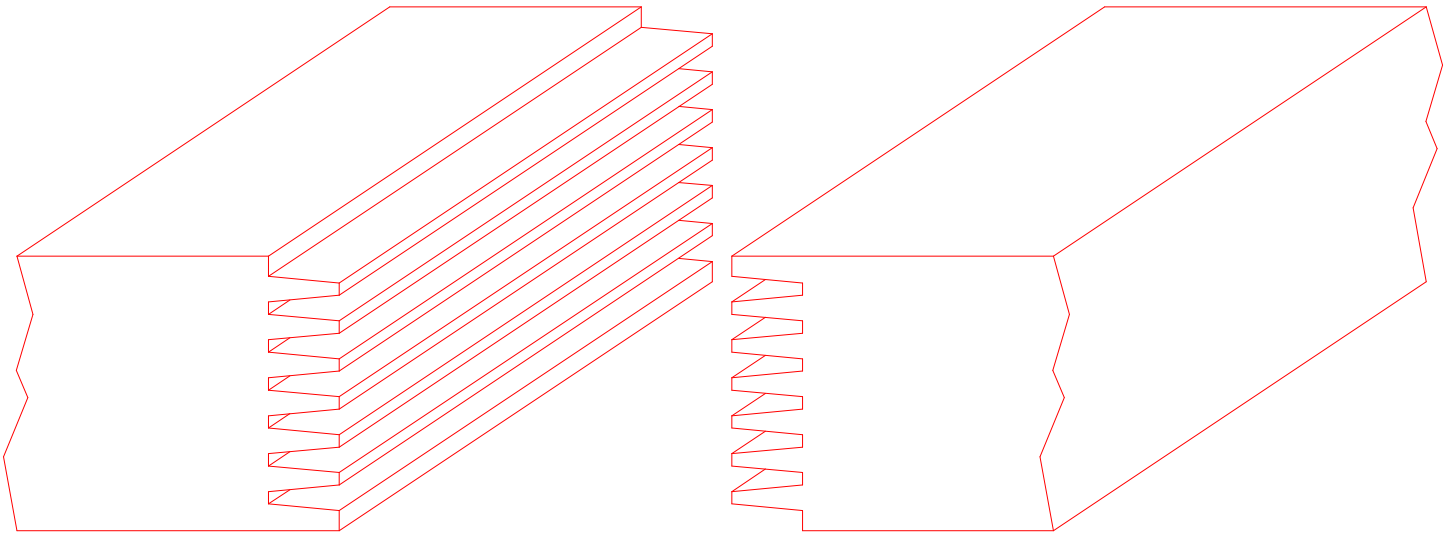
BULLETIN 700 H

Wisconsin Knife Works, Inc.

FINGERJOINT HEADS AND CUTTERS

SETUP AND MAINTENANCE



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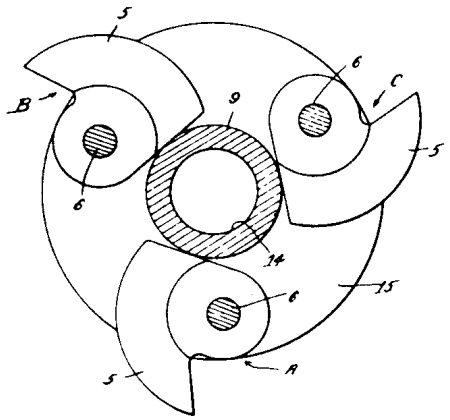
THE PATENT

Wisconsin Knife Works was founded in 1926 in Clinton, Wisconsin and immediately found a major role in the manufacture of cutterheads and knives for the woodworking industry. On June 25, 1929; the company obtained United States Patent number 1,718,325 for the Lock-Joint Grooving Head... known today as the fingerjoint head.



This product met with great success, particularly in the automobile industry. Both the automobile bodies, and the steering wheels were made up of short pieces of wood that had been fingerjointed together. Even now, WKW still provides the BG 600 two-wing solid cutters for use in authentic automobile restorations.

Fingerjointing has evolved since 1929. Joints have become shorter and stronger, but the cost and diminishing supplies of wood tell us that it still makes good sense to make longer pieces from short ones whenever possible.

The WKW style of fingerjoint cutter has been copied by several companies but the basic design has remained unchanged for the most part since 1926. Whereas tolerances and machining precision have improved greatly over the years, the basic principle of the WKW style cutter (sometimes referred to as the "circle- bit") is the same. Fingerjointing requires that the profile being cut is both consistent and close-fitting. The "circle-bit" cutters allow a very precision cut, and at the same time, give the user the ability to sharpen the cutters easily and set up to cut the exact pattern time after time. Brazed or solid "wing type" fingerjoint cutters may at first appear to be cheaper, but they offer much shorter life due to the inability to be resharpened as many times as the WKW style cutter. In addition, the accuracy of WKW cutters is seldom equalled by other cutters.

WKW fingerjoint heads and cutters may be used on a variety of machinery, from a heavy duty spindle shaper (that has been equipped with a cut-off saw) to a double end tenoner, however the most common application is on a Fingerjoint system. Modern fingerjoint systems usually come complete with stock handling and feeding systems, as well as all assembly and gluing apparatus.

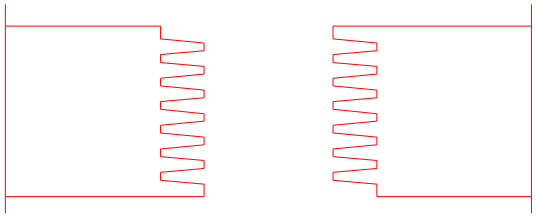
Traditionally, most fingerjoint cutters have been made from M-2 High Speed Tool Steel, as most fingerjointing has been in softwoods. Some species of hardwoods may be successfully jointed using High Speed Steel (HSS) cutters, but very abrasive woods may require the use of **WKW OPTI** cutters, **WKW Carbide** cutters or another variety of WKW cutter.

In addition to the abrasion and corrosion problems that abrasive woods cause, the increasing use of man-made wood products has necessitated specially designed cutters. Composite materials consisting of wood fiber and glue usually require WKW Carbide fingerjoint cutters .

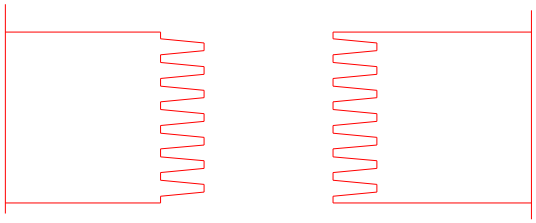
TYPES OF FINGERJOINTS

Modern fingerjoints come in many configurations. Structural joints such as those found on fingerjointed laminated beams may be over one inch in length. Joints for non-structural applications may be as short as four millimeters (.157"). Thick and thin cutters are combined to produce the specific joint type. The most common joint types are shown below. See section on head assembly for more information.

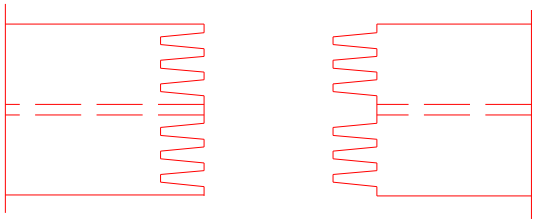
REVERSIBLE



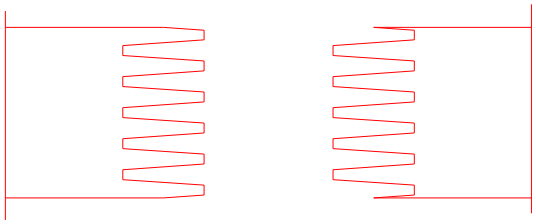
MALE-FEMALE (END MATCH)



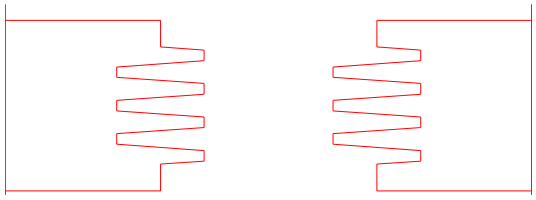
RE-SAW



SCARF (FEATHER JOINT)



HALF-SHOULDER STOCK FINGERJOINT



CUTTERS

JOINT LENGTH	THICK CUTTER	THIN CUTTER	CUTTER RADIUS	TIP THICKNESS THIN	TIP THICKNESS THICK	TIP INDEX	MATERIAL
4mm	BG-1280	BG-1281	1-1/2"	.040	.250	.110	HSS
5mm	BG-1258	BG-1259	1-1/2"	.042	.250	.118	HSS
.250	BG-1137	BG-1138	1-1/2"	.045	.250	.138	HSS
.300	BG-899	BG-900	1-1/2	.045	.250	.153	HSS
.300	BG-903	BG-904	1-7/8	.049	.254	.152	HSS
.375	BG-919	BG-920	1-1/2	.045	.250	.169	HSS
.375	BG-1079	BG-1080	1-7/8	.049	.254	.168	HSS
.500	BG-564	BG-565	1-7/8	.093	.343	.2655	HSS
.500	BG-854	BG-855	1-7/8	.030	.343	.152	HSS
.625	BG-737	BG-738	1-7/8	.062	.343	.214	HSS
.625	BG-1204	BG-1205	1-1/2	.044	.250	.1685	HSS
.987*	BG-824*	BG-825*	1-7/8	.031	.343	.239	HSS
1.113*	BG-741*	BG-742*	2-1/8	.030	.343	.264	HSS
1.113*	BG-751*	BG-752*	2-3/8	.031	.283	.265	HSS

* Note: Cutters marked * are used for producing joints for structural applications, and are used with spacer plates between the individual cutters. Please contact a WKW engineer for more specifics regarding these cutters.

CUSTOM CUTTERS AND PATTERNS

In addition to the stock cutters listed above, WKW has designed and manufactured scores of other fingerjoint configurations. WKW has pioneered the fingerjointing of engineered lumber products such as LVL (laminated veneer lumber),and other manmade wood products. Exotic hardwoods and very abrasive woods have also been successfully fingerjointed using WKW tooling. WKW's **OPTI** and **Carbide** cutters often are the solution.

OPTI fingerjoint cutters are a specially treated cutter designed primarily for natural woods. The extremely hard cutting surface of the **OPTI** cutters generally produces run times from 50 percent longer to several times longer than conventional High Speed Steel cutters. Produced using a patented process, **OPTI** cutters have been used at several of the largest fingerjointing facilities in the United States.

WKW **Carbide** fingerjoint cutters are often the solution to fingerjointing very abrasive natural woods as well as manmade and engineered lumber products containing glues. Plywoods and other laminated materials that were once impossible to fingerjoint have now been successfully fingerjointed. Again, WKW was the innovator .

Whether your needs are for a specific fingerjoint profile, or for a cutterhead designed to fit your machine, or for a cutter material to machine a particularly hard or abrasive wood product, WKW has the technical support that you need. Give us a call.

HEAD SETUP AND ASSEMBLY

Which type of joint shown on page 4 you should use depends on several factors. The vast majority of fingerjointing for mouldings, door and window parts, and general recovery of short pieces is done using a **reversible joint.** A single head with one thick cutter per bolt could be used to cut both sides of a reversible joint, however, production fingerjointing usually requires both a left and a right head.

The **end match,** or male-female joint, is a less common joint, but is used in cases where the fingerjointed stock will be moulded or shaped on both sides as in the case of fingerjointed chair backs. Two separate heads would be required for an end match joint, since one head would have thick cutters on both the bottom and the top of the stack, and the other head would have all thin cutters.

The **re-saw joint** utilizes a thick center cutter to leave a thick shoulder to allow for splitting the stock into two thinner pieces.

The number of cutters that will be required to cut a particular thickness of material can usually be calculated in the following manner. Please refer to the chart on page 5 for cutter specifications.

EXAMPLE

How many cutters (per bolt) will I need using BG 919 and BG 920 cutters to cut a reversible joint on 1-1/2 inch thick stock?

SOLUTION **(Stock thickness) minus (tip thickness of thick cutter) then, divided by tip index. Round to the next number.**

OR **1.500 minus .250 equals 1.250. Then, divide 1.250 by .169.**

The answer obtained using the formula above is 7.4, and when rounded up, you would get 8. This means that the number of thin cutters needed per bolt would be 8. In other words, when cutting a reversible joint in 1-1/2 inch stock, using BG 919 and BG 920 cutters, you would need 8 thin and 1 thick cutter per bolt.

Note: The above formula may be used in most cases, however when in doubt, please call WKW for an exact pattern layout .

Balance of the fingerjoint head is extremely critical to a good fingerjoint. Even a very slight amount of imbalance or improper setup may produce a joint that will fail. All cutter stacks should be assembled so that they will keep the head in dynamic balance during operation. The best way to ensure cutterhead balance is to weigh each stack of cutters, and then install stacks that weigh the same **across** from each other. If there is more than one tenth of a gram difference between stacks that will be installed across from each other, the heavier stack should be lightened by grinding material off the flat area on the back of the cutter.

HEAD SETUP AND ASSEMBLY-(CON'T)

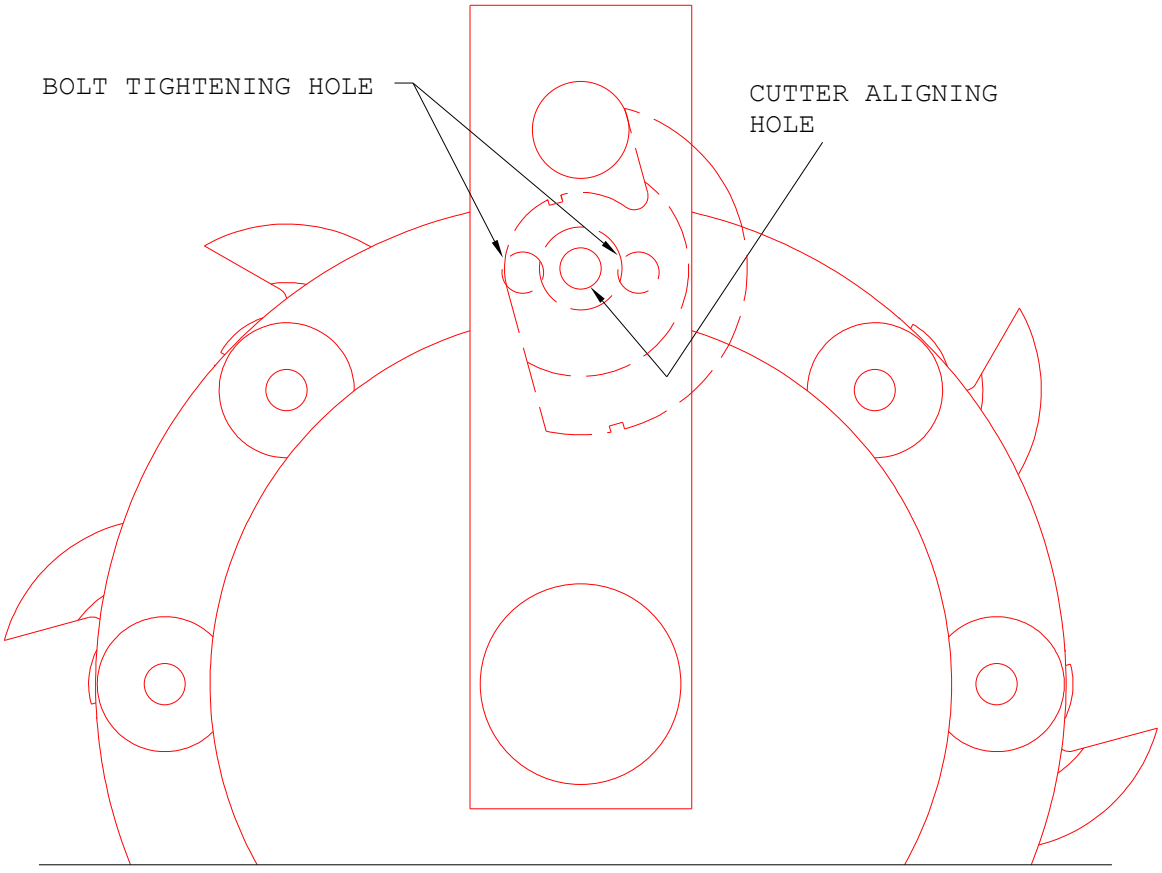
Balance of cutter bolts is just as important as the cutter balance. If you are replacing bolts or reassembling a cutterhead, bolts that are straight across from each other must be balanced to within **one tenth of a gram.** Be certain to use care when pressing bolts in or removing them from the head. Always use an arbor press, and be sure that both the bolts and the head are completely free from dirt or debris. Bolts that are worn or scored must be replaced.

The set up fixture is perhaps one of the most important tools for guaranteeing a good joint. Once the fixture is mounted securely in a vise, carefully slide the cutterhead onto the arbor. Note that there are three locating holes for the "L" pin. Locate the "L" pin into the side hole that will hold the cutters **away** from the locating post. (The center hole should not be used for loosening or tightening the nuts.)

Loosen the nut, and relocate the "L" pin to the **center** hole. Rotate each cutter in that stack up to the locating post so that all cutters are flush with the post. You may want to check with a feeler gage no more than .002 thick to be sure that all cutters are rotated completely to the post. Snug the nut up by hand, and continue the same procedure until all stacks have been re-set to the post and **hand** tightened. Never use a wrench to loosen or tighten the nuts with the "L" pin in the center hole.

After the cutters have been relocated away from the post (by placing the "L" pin in one of the side holes) use a torque wrench, and begin to tighten the bolts in a diagonal or alternating pattern. Torque each stack in 50 foot pound increments until you have attained 250 foot pounds. On WKW laminated beam fingerjoint heads equipped with 1-1/8" diameter bolts, torque to 450 foot pounds.

WKW also offers 6- 8- and 10-post set up fixtures. Call for information.



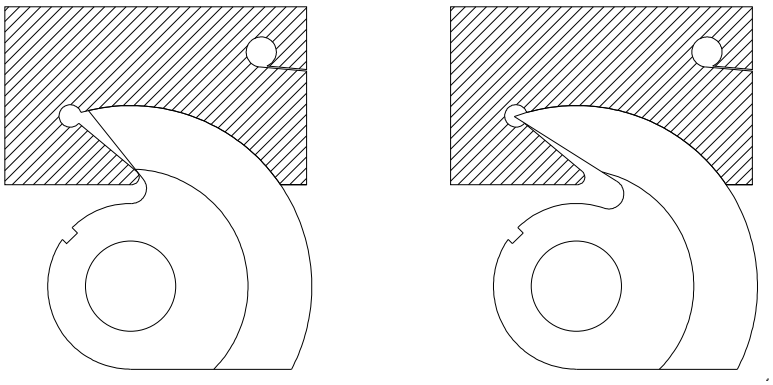
GRINDING THE CUTTERS

Grinding the cutters correctly is a very important factor in obtaining a good fingerjoint. The cutters must always be ground so that the face bevel of the cutter matches the grinding template as shown in the figure below . If the cutters are ground to the incorrect face bevel the joint will not fit correctly. (See section on TROUBLESHOOTING.)

The grinding wheel you select will have a great influence on cutter performance. A 60 grit wheel at 1700 RPM will usually give excellent results on **HSS** and **OPTI** cutters. Depending upon your own grinding technique, you may have better success with a 120 to 150 grit wheel. Dress the wheel so that it will produce a smooth radius at the gullet of the cutter. A cutter gullet that is not smooth may be subject to breakage or may cause chip buildup. Always be sure to wear eye protection as well as proper breathing apparatus.

Once the head is mounted on the tool grinder, mark the faces of the cutters with a felt marker. This will indicate whether you are making full contact with all cutters in a stack. Be sure to remove only .001 or less in each pass, and always be sure to grind enough to remove all of the wear and any chipped areas. Allow the wheel to "spark out" after the wear line is removed or after every .006 is removed from the cutters if you will be grinding more than .006. Never let the last cutter in a stack go past the center of the grinding wheel. Be sure to feed at a slow steady rate, and only advance the wheel into the cutters while the wheel is in contact with the cutters.A micro finish of 50 will give the best results. After grinding, it is good procedure to reset the cutters to the fixture.

NOTE: Extra care should be used when grinding **OPTI** fingerjoint cutters. The extra hard surface may chip if too much material is ground off per pass. Careful grinding will produce an extremely durable and sharp surface.



Always check the bevel of the cutters against the **grinding template** as shown above. Cutters ground too blunt (left) or too sharp (right) will produce a weak joint.(See TROUBLESHOOTING section on following page.)

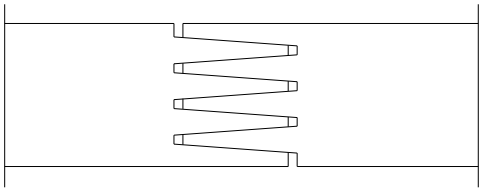
Grinding Template Part Numbers

Cutter Radius	Part Number
1 1/4	T981
1 1/2	T684
1 7/8	T683
2 1/8	T685
2 3/8	T686
45deg MTP	T1370

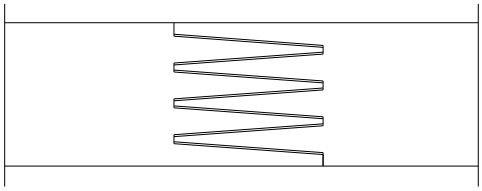
TROUBLESHOOTING

Even if you have correctly setup the head using the setup fixture, you may still have a poorly- fitting joint.Two major causes of a poorly- fitting fingerjoint are **improper finger length** (incorrect setup of the cutoff saw) and **improper cutter bevel** (see preceeding page). Following are common joint problems that are caused by either the cutoff saw or by improper bevel on the cutters. Always call WKW if you have problems.

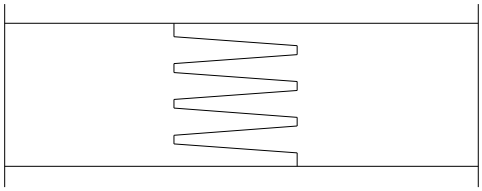
FINGERS TRIMMED TOO SHORT



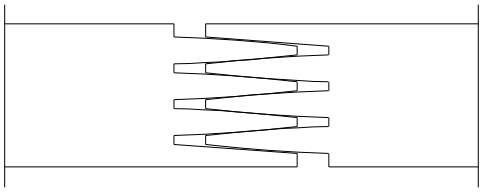
FINGERS TRIMMED TOO LONG



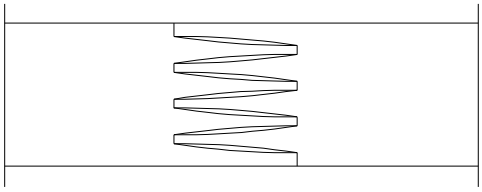
FINGERS TRIMMED CORRECTLY



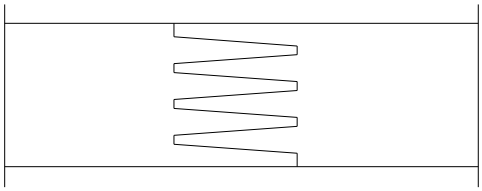
CUTTERS GROUND TOO BLUNT



CUTTERS GROUND TOO SHARP



CUTTERS GROUND CORRECTLY



FEED RATES

RPM of the head and FPM (feet per minute) of the stock both combine to give the measurement known as KMPI (knife marks per inch). Too many KMPI will burn or glaze the wood; leading to premature dulling of the cutters and possibly failure of the glued joint. On the other hand, too few KMPI can lead to too rough a finish or tearout. The knowledgeable operator can fine tune the KMPI to achieve the best quality cut and the longest run times between sharpenings.

One of the best indicators of a proper feed rate is **chip size**. The presence of fine sawdust indicates that there are too many KMPI, and chip load is too small to effectively cool the cutters. The ideal chip should be well-formed and have the appearance of a shaving rather than sawdust.

Generally, good fingerjoints may be produced using a feed rate that yields around 30 to 60 KMPI. However it is recommended that one experiment a bit to find the best speed for local conditions.

The formula to compute KMPI is: $\frac{\text{RPM X Number of bolts}}{\text{12 X FPM}}$

How many KMPI are produced with a 10 bolt head at 3600 RPM and 75 FPM?

SOLUTION $\frac{\text{3600 X 10}}{\text{12 X 75}}$

The answer would be 40 KMPI...right in the range that works well in many cases...but remember ... experiment yourself to find out the optimum feed rate for your wood species and location.

TERMINOLOGY

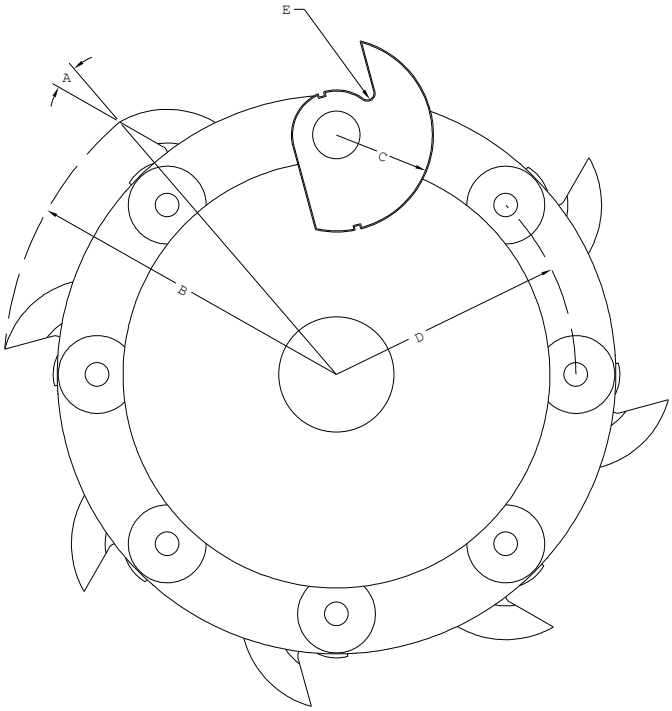
A - Cutting angle or hook angle.

B - Maximum swing circle.

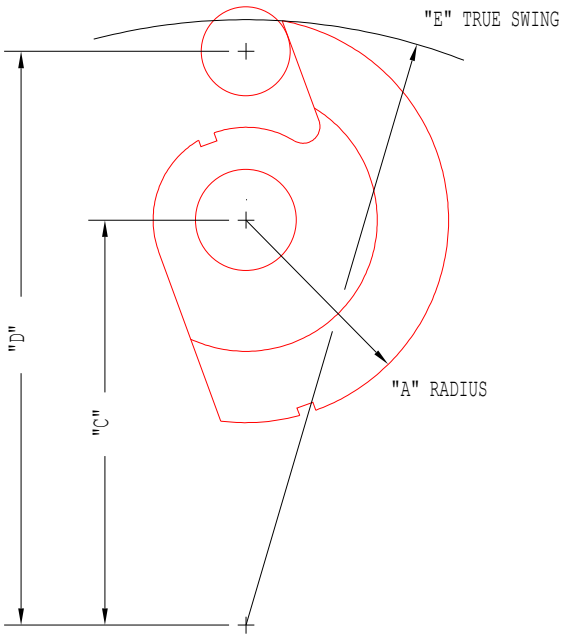
C - Cutter radius.

D - Bolt circle.

E - Cutter gullet.



COMMON DIMENSIONS



9" SWING

"A"	"B"	"C"	"D"	"E"
1 1/2	20deg	3.000	4.250	8.927
1 7/8	21deg 7'	2.625	4.094	8.963
2 1/8	15deg 50'	2.375	3.875	8.974

10 1/2" SWING

"A"	"B"	"C"	"D"	"E"
1 1/2	20deg	3.750	5.000	10.422
1 7/8	20deg 28'	3.375	4.848	10.459
2 1/8	15deg 4'	3.125	4.662	10.469

HEAD MAINTENANCE AND CARE

The spindles on your machine must be free from runout and wear. For your cutterhead to produce the optimum fingerjoint, the spindle size should be no more that .0005 less than the nominal size. Runout in your spindle will also prevent your cutterhead from performing properly.

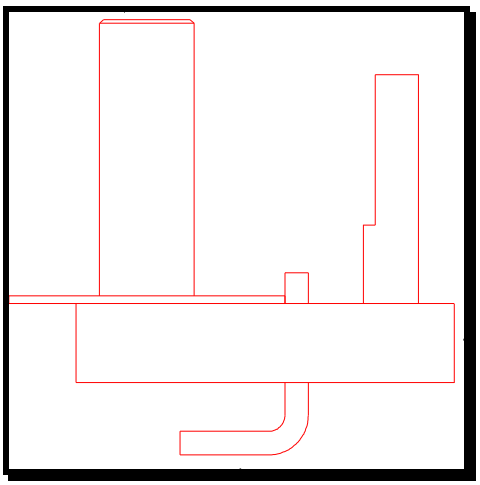
Straight Bore heads are usually equipped with self-centering cones or collets. Always be certain that the collet seat in the head is clean and free from dirt or debris. In addition, the collet must be free from wear, burrs or score marks. Torque the spindle nut according to the machine manufacturer's suggested torque.

Hydro-Lock heads rely on grease pressure and are equipped with a filler and a release valve. The following steps should be observed.

1. Place the head in the desired location on the spindle. Never pressurize a head when it is not on a spindle or when your spindle is .001 inch or more under the nominal diameter. Damage to the head could result.
2. Connect the grease gun to the filler nipple. Always use the WKW recommended grease gun. A regular gun will not pressurize the head to a high enough pressure.
3. Loosen the screw valve on the gauge block, and pump until grease flows out the release valve. This will remove any air pockets inside the head.
4. Tighten the screw in the release valve on the head and pressurize to 300 to 350 bar (4350 to 5075 PSI). Tighten the screw valve on the gauge block and loosen the grease release valve on the gun. Remove the grease gun.
5. If there is no pressure loss within two minutes, install and tighten the lock ring. You may proceed if you have read and understand the information provided by the machine manufacturer. Never operate a Hydro-Lock cutterhead without a lock ring.
6. Always be sure to check for any pressure loss each morning, after each shift change, or after the machine has been idle for more than eight hours.
7. If cleaning the head with a heated solution, always be sure that pressure release fitting is left open to prevent sleeve damage.

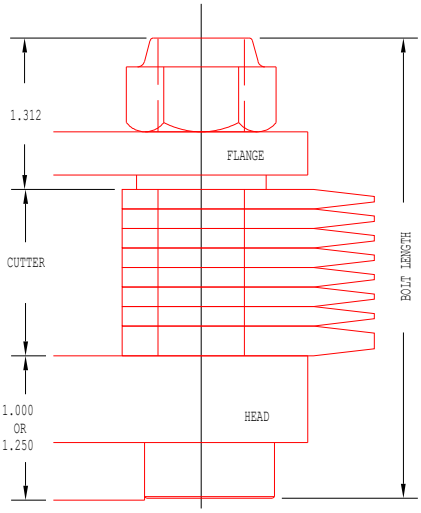
SET UP FIXTURES

Swing Circle	Cutter Radius	Bore	Single Post	6 Post	8 Post	10 Post
9”	1 1/2	1 1/2	36442	TF1818-B	TF1834-B	------
9”	1 1/2	1 13/16	36446	TF1818-A	TF1834-A	------
9”	1 7/8	1 1/2	TF1344-B	TF1963-B	------	------
9”	1 7/8	1 13/16	TF1344-A	TF1963-A	------	------
9”	2 1/8	1 1/2	TF1598-B	------	------	------
9”	2 1/8	1 13/16	TF1598-A	------	------	------
10 1/2”	1 1/2	1 1/2	36440	TF1965-B	TF1966-B	TF1967-B
10 1/2”	1 1/2	1 13/16	36444	TF1965-A	36448	36450
10 1/2”	1 7/8	1 1/2	TF1968-B	TF1969-B	TF1886-B	------
10 1/2”	1 7/8	1 13/16	TF1968-A	TF1969-A	TF1886-A	------
10 1/2”	2 1/8	1 1/2	TF1970-B	TF1971-B	------	------
10 1/2”	2 1/8	1 13/16	TF1970-A	TF1971-A	------	------



FINGER JOINT BOLTS

Over All Length	Right Hand Threads	Left Hand Threads
4 3/4	DC503-J	DC591-C
4 1/2	DC503-H	DC591
4 1/4	DC503-G	DC591-G
4	DC503-F	DC591-A
3 3/4	DC503-E	DC591-F
3 1/2	DC503-D	DC591-B
NUT	NB207	NB207-C
1/8 Washer	W405	
C’Washer	W329-A	



Wisconsin Knife

LOCKING COLLARS

Bore	Pin Distance	LOCK COLLAR
1 1/2	2.56	SE1624-A
1 13/16	3.14 (45°)	SE1590
1 13/16	2.56	SE1646
1 13/16	3.14(55°)	SE1628
50mm		SE1648
2 1/2		SE1687

Works offers a complete line of industrial woodworking tooling including the following:

υ Moulder and Planer Knives υ
υ Custom and Stock Cutterheads υ
υCarbide and High Speed Steel Router Bits υ
υ Saw Blades and Dado Sets υ

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