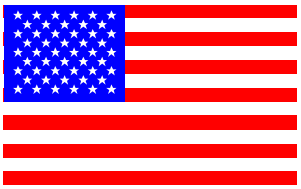
MANUAL

Key Knife Contact Information

If you have any questions, please consult an authorized Key Knife® representative at:



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Key Knife History

1986 - Bob Bayly and Tom Carpenter joined forces in Portland, OR to design and build a disposal knife for OSB plants. After a year of work, they chose to proceed with the development of a second concept upon the recommendation of Dudley Smith, who along with Bob's mother, Jane Bayly, were two of Key Knife's first financial supporters. The second concept marked the beginning of today's version of the Key Knife.

1987 - Bob and Tom hired Cecil Ostrander to build the first prototype of a chipper system utilizing steel knife stock "borrowed" from a friendly competitor. The first installation occurred at Mountain Fir Lumber of Dallas, OR in a Mobark chipper and ran for all of 30 seconds. Once they resolved the matters of hardness and radiuses, they hired their first employee, Norma Sherratt in June of 1988 and production got underway in Cecil's barn. The achievement of producing one box of knives/day was considered a great day. Only two machines could be operated at a time due to the lack of power to the shop and the grinder was in a lean-to heated by a wood stove where the coolant had to be defrosted every morning before start up.

1989 - The production shop was moved to a 3500 sq. ft. facility in Wilsonville, OR. During this time, the official name of the privately held organization was changed from Commercial Knife to Key Knife. $30,000 in sales for a month was considered record setting at the time. A former saw shop owner and supporter; Herb Frelich became the first production manager and the Chip-n-Saw concept was introduced in 1990. Neil Doherty was hired as the first field rep in January of 1991 and the first CNC machine purchased in 1992.

1993 - The manufacturing and office relocated from Wilsonville to a 20,000 sq. ft. building in Tigard, OR and the first High Recovery system was developed. In 1994, the first Blohm (a computerized grinding machine) was purchased, revolutionizing the knife production process. Two additional CNC machines and another Blohm were purchased in 1995.

1998 - The company relocated again, moving from Tigard to a newly built 50,000 + sq. ft. facility in Tualatin, OR with room for additional expansion. A fourth Blohm and a fourth CNC have since been added along with the establishment of a machine shop center for further expansion into in-house product development. Likewise, in-house production of additional Key Knife system components is taking place on a calculated basis as part of the organization's overall strategic plan.

2004-Key Knife had a record sale year, with sales increasing 26% over 2003. To meet the growing demand for Key Knife products 3 more CNC machines were added. A new R & D test center nicknamed the Big Beaver, was added to help with the theory and design of the next generation Key Knife chipping systems. To continue the growth Key Knife has developed innovative products for the Pulp mill, Particleboard, and OSB industries. The demand for Key Knife products and services has taken the company to new parts of the world, such as South America and Asia.

About this Manual

This manual has been designed to be a user-friendly reference guide for the use and operation of your High Recovery System. Included in the manual is information on the installation and operation of the System, in addition information and management tools. It is our hope that this manual becomes a useable tool for you and your mill. As always, your local Key Knife representative is always available to answer any questions that you may have.

Key Knife Patents

The Key Knife High Recovery Systems are protected under the following patents: 4850408, 5271442, 5511597, 5709255, 5816301 and 5819826.

Safety

The Key Knife conversion is designed to provide safe and dependable service, if operated according to the instructions and intended use, in the chipping of wood material. Any other use could be dangerous and is not recommended.

Be sure to read the entire System Manual before installing the Key Knife system. Failure to do so could result in personal injury or equipment damage.

Key Knives are extremely sharp! When handling the knives, use extreme caution and wear safety gloves.

Observe all equipment shutdown, lockout, and safety procedures as recommended by the equipment manufacturers, as well as your company policies and guidelines.

Key Knife Warranty Policy

Key Knife warrants that on the date of shipment to Buyer and for one year thereafter the Products will be free of defects in workmanship and material. If within one year from date of shipment of the Products, Buyer discovers that the Products are not as warranted above and promptly notifies Key Knife in writing thereof, Key Knife will, at Key Knife's option, repair or replace the item and any affected part of the Products, or refund the purchase price therefore. Buyer shall assume all responsibility and expense for removal and reinstallation in connection with the foregoing remedy. The same obligations and conditions shall extend to replacement items furnished by Key Knife hereunder. Buyer agrees to grant Key Knife access to the Products at all reasonable times in order for Key Knife to determine the existence of a claimed defect in the Products. Key Knife Product systems and accessories require installation by an Authorized Key Knife Representative. Installation by anyone other than an Authorized Key Knife Representative will void the terms of this warranty. This warranty does not cover defects due to misuse, abuse, or improper or inadequate installation, storage, service, modification or repair of the Products.

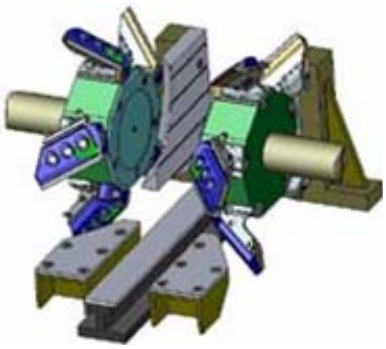
Chapter One

Introduction

Introduction

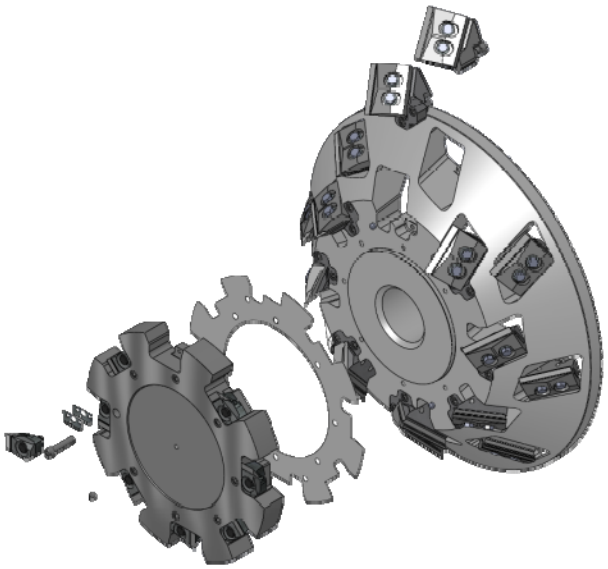
Congratulations on purchasing a Key Knife High Recovery System! You have chosen the finest wood chipping technology and equipment in the industry.

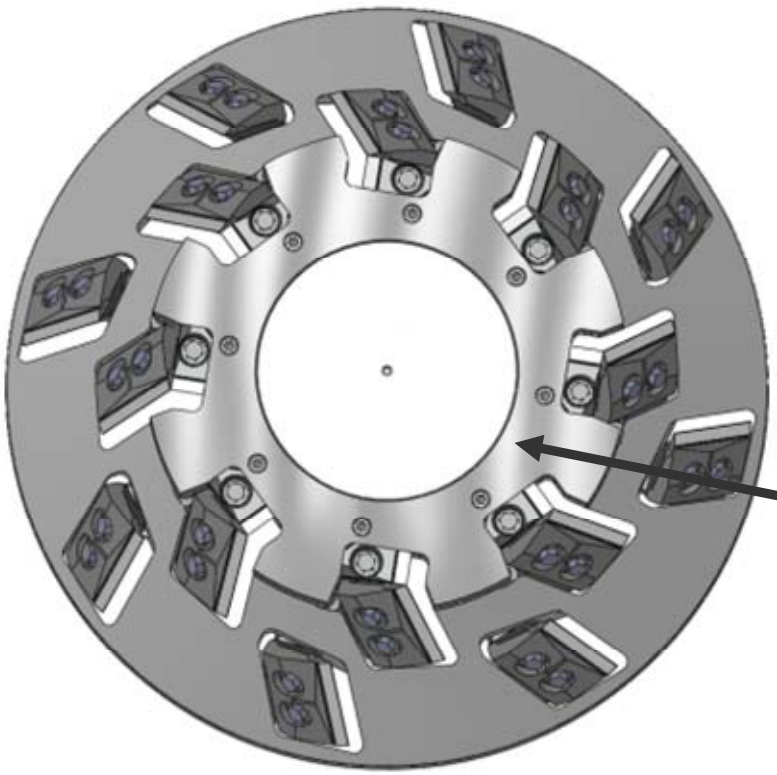
Key Knife developed the High Recovery XL conical chipping head product line for progressive mills that want to maximize the value of their wood products and improve the operating efficiencies tied directly to the process. The innovative High Recovery XL product line delivers unmatched gains in recovery, surface finish, chip quality, and production.



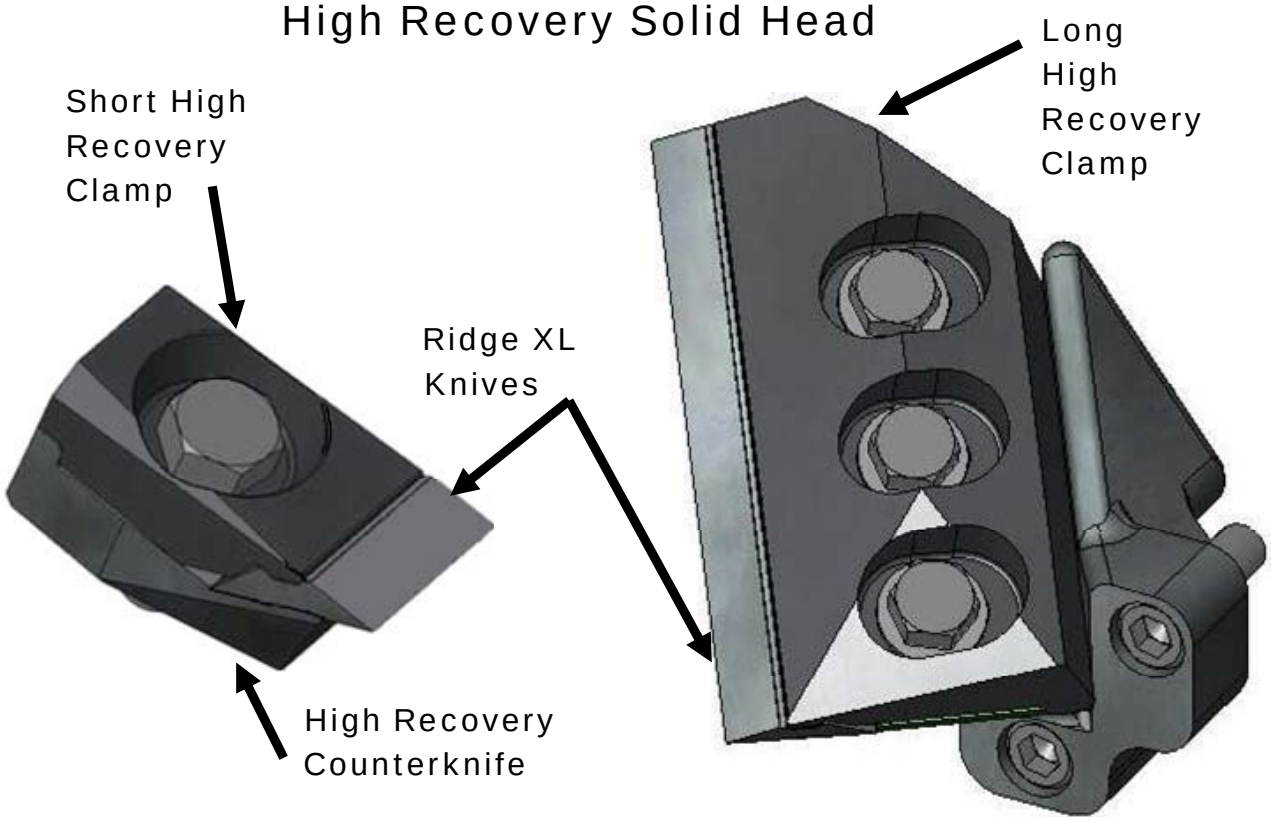
The knife is indexible and disposable, eliminating the need for grinding and babbitting. The innovative ridge design eliminates problematic packing, protects the counterknife from wear, and improves chip quality by providing chips a smooth transition from knife tip to counterknife.

The unique design of the Ridge Knife XL makes changing knives a quick and safe process.





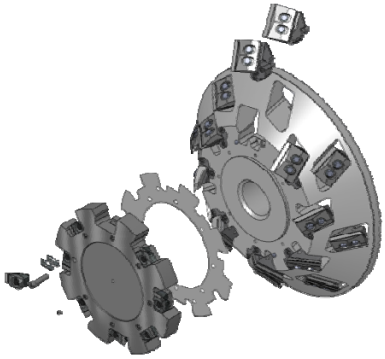
High Recovery Solid Head



Kit Solid Head

Dovetail Base Assembly

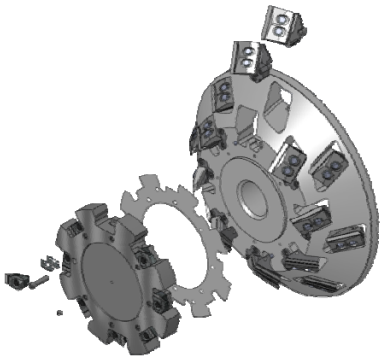
High Recovery Hub

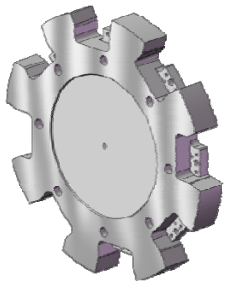


Feature	Advantages
A514 Steel	Mill proven durability and strength.

The High Recovery hub is the central component of the High Recovery Head. The hub mounts to the arbor in a variety of ways and base assemblies are bolted to the hub.

High Recovery Faceplate





Feature	Advantages
Industrial Chrome Plate	Plating increases wear resistance and the plate's operational life.

The faceplate is a component of the High Recovery Head and serves three purposes:

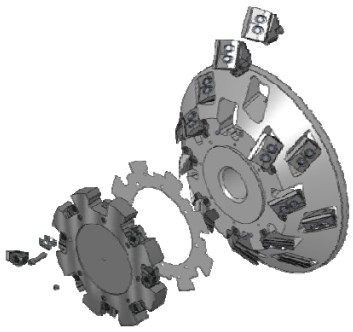
1. Seals the end of the head protecting mounting hardware (head to arbor)
2. Provides log control as needed (improved stability)
3. Provides positive lock to prevent the bases from loosening.

Dovetail Base

Feature	Advantages
A514 Steel	For supreme wear resistance.

The Dovetail Base is a component machined from a casting and used to position High Recovery cutting components on the head. The base is secured to the specially designed hub by a Gib that locks the base into place. The knife, counterknife, clamp and associated hardware are attached to the base.

High Recovery Control Plate



Feature	Advantages
Mild Steel	Available in a variety of thicknesses

The Control Plates are used with the High Recovery Solid Head Chipper System to adjust the limiting features of the faceplate. Control Plates are inserted between the faceplate and the hub.

The system is designed to run at your specified chip length with one control plate. Adding an additional control plate will reduce the target chip length, while removing a control plate will allow for a larger chip length.

High Recovery Counterknife

Short Counterknife

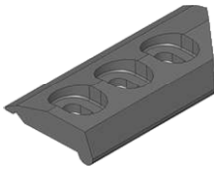
Feature	Advantages
Chipper Steel	Excellent wear resistance and durability
DC 60F Coating	Mill proven to provide twice the component life than traditional spray-on coatings.

Long Counterknife

Feature	Advantages
A514 Steel	Excellent wear resistance and durability
Nickel Plating	Adds significant corrosion resistance.

The High Recovery Counterknife supports the Ridge XL Knife in the head. The counterknife fits between the base and the knife. The face of the counterknife is designed to maintain chip formation and efficient chip flow.

High Recovery Clamp

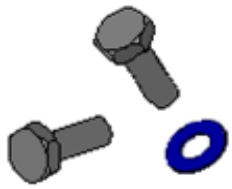


Feature	Advantages
4140 Steel	Durable Performance
Nickel Plate	Adds significant corrosion resistance.

The High Recovery Clamp provides optimum clamping force across the entire length of the knife.

High Recovery Chipping Systems have a clamp for both the long knife and the short knife. The long clamp may be designed as a Limiter to control log feeding in specific applications.

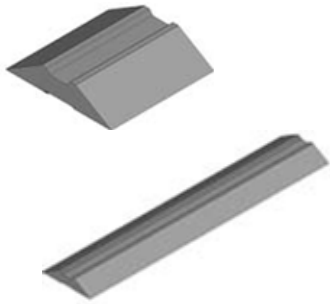
Fasteners



Feature	Advantages
Fasteners Grade 8	All mounting hardware is grade 8 for superior strength and durability
SAE Washers	Only SAE through hardened washers are used to assure strength and durability.

Key Knife uses only Grade 8 bolts and SAE Washers in your Key Knife High Recovery Head.

Ridge XL Knife



Feature	Advantages
Chipper Steel (A8)	Mill proven wear resistance with strength, durability and knife life
56~60 Rc	For maximum toughness and durability

The Ridge XL Knife is clamped at five points by the clamp and counterknife, significantly improving knife stability, for a precise and repeatable cut. This full surface contact minimizes knife twist and flutter, significantly improving knife stability. Through exceptional knife stability the High Recovery System with the Ridge XL Knife delivers improved finish, chip quality and knife life.

Chapter Two

Installation

High Recovery User Manual • Chapter Two

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Introduction

This chapter will introduce you to the proper installation of your new Key Knife High Recovery Head. Detailed instructions for installation can be found in Appendix G.

For a complete list of tools required for installation, see Appendix C.

For appropriate torque values, reference the table in Appendix D.

Some systems might have slightly different designs that require slight adjustments to the steps highlighted below and in Appendix G. Your Key Knife Representative is always available to provide you whatever assistance you desire.

Lubricants and Shim Stock:

Key Knife recommends the use of Nickel-Based Anti-Seize compounds, such as Locktite 771, to help prevent corrosion of components.

Key Knife recommends the use of thread locking compounds, such as Locktite 242, in certain applications.

Key Knife recommends the use of either Brass or Stainless Steel Shim Stock, when shims are required.

Installing High Recovery Solid Head System

1. Remove existing system.
   - Follow manufacturers procedures for safe removal.
   - Take care to properly secure the head, as removing bases will off balance the hub.
   - Thoroughly clean the hub / arbor mounting surfaces.
2. Install the hub onto the arbor.
   - As required.
   - Ensure the total hub run-out is within allowable tolerances (See Chapter 4).
3. Install the new bases.
4. Install secondary limiters.
   - As required.
5. Install the faceplate.
   - Ensure the total run-out of the faceplate is within allowable tolerances (See Chapter 4).
6. Install the clamps and counterknives for the short knives. Install the short knives.
7. Set the extension off the faceplate for all the short knives.
8. Install the counterknives for the long knives. Set the proper knife location.
9. Install the clamps for the long knives. Install the Knives.
10. Verify that the head lead and vertical an anvils are set correctly.
11. Start the machine and run for 4–12 hours.
12. Check the torque on all fasteners.

Chapter Three

Knife Change

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Introduction

The Ridge XL Knives are double-sided knives providing two cutting edges per knife. The procedure for rotating knives is exactly the same as for replacing knives.

It is highly recommended that a schedule of knife changes be establish and followed. Dull and damaged knives may cause excessive stress on the system and reduce the quality of the cants. By instituting a regular schedule for knife changes, you ensure your knives always maintain optimal performance. Additionally, you will not lose production time for an unscheduled mid-shift knife change.

During the knife change, remember to look for maintenance issues, such as worn or damaged components. See Chapter 5 for more details.

It is important to properly clean the pocket during a knife change. To provide superior results, your High Recovery System is designed with precise and exact tolerances. When debris is left in the pocket, the potential for the knife not locating on the keyway exists. With proper cleaning of the pocket, your High Recovery System will run safely and efficiently.

Warning. Key Knives are extremely sharp. When handling the knives, use extreme caution and always wear safety gloves. Eye and ear protection should be worn when operating tools and using compressed air during the knife change.

Knife Change Procedures

The following Sequence of Events highlights the steps for a knife change.

SEQ #	Task Description	Additional Information
010	Lock out the machine per mill standards.	Follow all safety lockout / tag out procedures recommended by mill, Key Knife and equipment manufacturer.
020	Loosen the Clamp Bolts on the Long Knife with an impact wrench and the 15/16" socket.	
030	Remove the Long Knife.	
040	Loosen the Clamp Bolts on the Short Knife with an impact wrench and the 15/16" socket.	


SEQ #050


SEQ #080

SEQ #	Task Description	Additional Information
050	Remove the Short Knife.	
060	Repeat SEQ #020 - 050 for all remaining bases.	
070	Clean all the counterknife and clamp surfaces thoroughly, blow away-loosened material.	
080	Clean all the knives that are to be rotated.	For knife change. Use a wire brush and compressed air.


SEQ #090


SEQ #100


SEQ #120 (a)


SEQ #120 (b)

SEQ #	Task Description	Additional Information
090	Position the short knife into place and torque the clamp bolt with the impact wrench and torque stick.	Ensure the knife is properly located on the key-way. DO NOT over torque the Bolts (Appendix D)
100	Position the long knife into place and tighten the clamp bolt with the impact wrench and torque stick.	Ensure the knife is properly located on the key-way. This will ensure the long knife is properly set back from the short knife at the knife junction. DO NOT over torque the Bolts (Appendix D)
110	Repeat SEQ #090 - 100 for remaining bases.	
120	Spot check the torque on the Clamp Bolts with the torque wrench and 15/16" socket.	Reference Torque Specifications (Appendix D)

Chapter Four

System Set-up and Theory

Theory

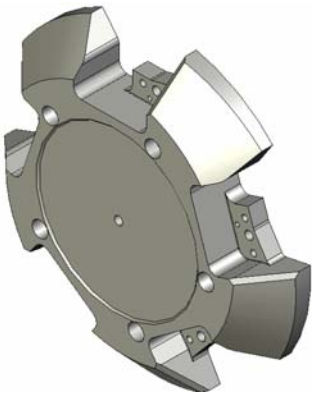
Key Knife's cutting edge Research and Development and expert knowledge of the sawmill industry has led to the development of the most advanced indexible knife equipment available to meet your exact needs.

We use the latest in testing equipment, Computer Simulated Finite Elements Analysis, and Laboratory Designed Validation Systems to develop new cutting edge High Recovery products that will add value to both your existing and future operations.

Because of our valuable research and testing, Key Knife has identified the most crucial elements to maximizing board finish; chip quality and recovery while increasing sawmill efficiencies and uptime. This chapter will share with you some of our findings.

Options

Limiter Faceplate Options

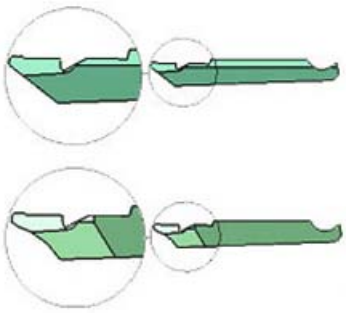


Based on specified operating parameters and chip length settings a custom helical surface is machined into the Faceplate. The helical surface matches the cutting contour of the knife, providing stable surface contact with the log/cant, limiting surging. Limiter Technology ensures smooth and consistent log/cant flow.

A limiting Faceplate is beneficial for mills that experience issues with their logs/cants surging. This is often a sign of infeed systems that have poor log control.

The various negative effects of surging include costly and hazardous damage to the saws, excessive fiber pull, and oversized chips.

Counterknife Options



Key Knife offers two counterknife options: Standard and Low Impact.

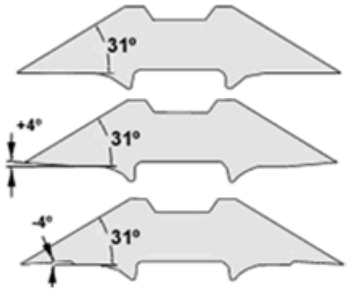
Standard: Helps to reduce oversized chips by providing a high impact area after the chip is formed.

Low Impact: Provides a smooth chip transition to reduce the potential of acceptable chips breaking up upon contact with the counterknife. Chips flow directly from the ridge of the knife through the low impact zone of the counterknife with minimal breakage.

Counterknives also come in different angles. These different angles change the orientation of the knife tip, which changes knife relief and attack angle, while using the same knife.

Knife Options

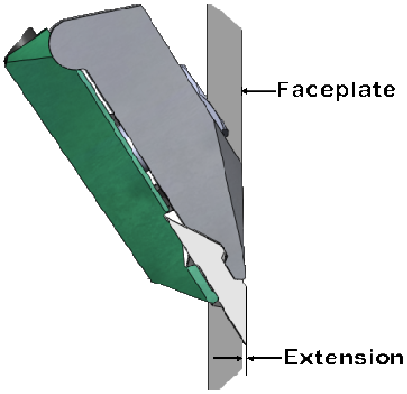
The Key Knife High Recovery System provides additional flexibility by simply changing the Ridge XL Knife. By changing the bottom grind on the knife, a 31-degree knife may have different attack angles. These customization features allow a mill to adapt to changes in the operating environment quickly and easily.



- Standard knife with angles of 29°, 31° and 33°
- Bottom ground knives to change attack angle by +2° and +4°
- Bottom ground knives to change attack angle by -2° and -4°

Machine Center Alignment

Short Knife Extension



Description: Extension is the position of the knife tip from the faceplate.

Function: Extension controls of the formation of the finish surface.

Measurement: Distance from knife tip to the faceplate, measured perpendicular to the faceplate.

Key Knife Customization Ability: The Push / Pull Bolt is used to adjust and secure the location of the short finishing knife. Tightening the push bolt raises the extension, while loosening the push bolt allows extension to be lowered.

Effects of Extension: Too high of an extension setting generally has the following results:

1. Increase fiber pull and know tear out
2. Decreased knife life.

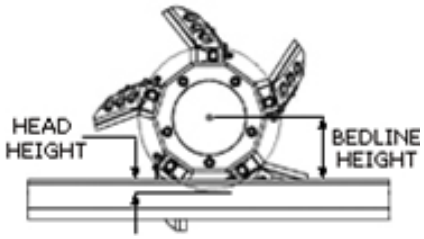
Head Lead

Description: The amount by which the lead knife point extends beyond the trailing knife point of the cutter head.

Function: Proper lead prevents back cutting.

Measurement: Distance from the lead knife point to the trailing knife point measured parallel to the center of the machine.

Head Position



Description: The relation of the Key Knife High Recovery head to the bedline (top of the Line Bar or Sharp chain)

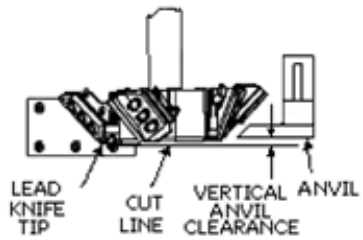
Function: The head position dictates the angle at which the knives will cut the wood. If the head is positioned too low the small knife never cuts parallel with the wood, which is the best possible knife position for superior finish.

Measurement: The distance between one-half of the cutting diameter and the bedline height.

Effects of Head Position: When the head is set to low, the knife will generally cut more against the grain of the lumber causing excessive fiber pull and knot tear. When the head position is set properly, a superior surface finish will be achieved. The direction of the cutting motion, though, requires good log control in the machine. If this control is not present, limiter clamps and secondary limiters can be installed.

Vertical Anvil Clearance

Description: The distance from the cut line off of the lead knife tip to the vertical anvil measured perpendicular to the anvil.



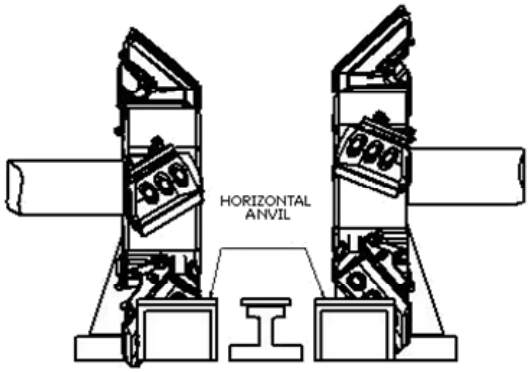
Function: Stabilizes the cant as it exits the conical head's cut zone.

Measurement: Distance from the anvil to the cut line extended off of the lead knife tip.

Effects of Anvil Clearance: A vertical anvil clearance set too tight will cause the cant to stick in the machine. If the clearance is too large, the cant will snipe and show uneven knife marks.

Horizontal Anvil

Description: The High Recovery Horizontal Anvil stabilizes the log as it enters the conical head's cut zone.

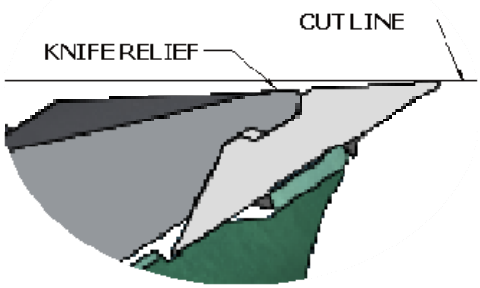


Function: Stabilizes the log as it enters the conical head's cut zone.

Measurement: Leveled both parallel and perpendicular to the center of the machine.

Effects of level anvils: Horizontal anvils that are not level can cause sniping and snatching on the cants.

Knife Relief



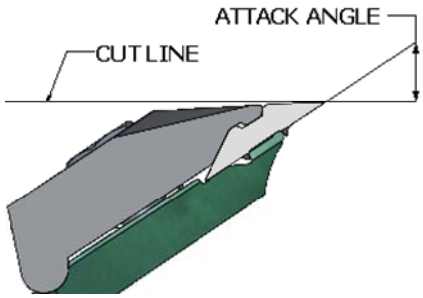
Description: The angle between the top of knife and the cut line or cut path of the head.

Function: The Knife Relief provides a clearance for the top of the knife. This clearance prevents heat generation and premature dulling of the knife.

Measurement: Angle between the top of knife and cutting plane.

Key Knife Customization Ability: The knife relief can be changed by simply replacing the counterknives.

Knife Attack Angle



Description: The angle from the bottom of the knife to the cutting plane of the head.

Function: Provides shearing forces to generate chip formation

Measurement: Angle from cutting plane to bottom of knife (keyway side).

Key Knife Customization Ability: Key Knife can affect the attack angle by changing the knife and counterknife combinations.

Summary

The combined affects of a properly aligned machine center will ensure the best operating efficiencies from your chipping heads. Allowing one or more of these variables to become out of alignment can negatively effect surface finish and / or chip quality.

It is, therefore, crucial that alignment of the machine center be included in the routine preventative maintenance program of your mill. Your local Key Knife representative is available to answer any questions you may have about optimizing the alignment of your machine center.

Target Operating Parameters

Knife Relief

Short Knife	Heavy Duty 0.009” – 0.015” 1°	Ridge XL 0.018” – 0.025” 2°
Long Knife	Measured 3/4" from knife junction 0.042” – 0.050” 4° (unless otherwise noted in system design prints)	

Knife Speed

Optimum for Finish (knife system)	6500 FPM
Optimum for Chip Quality (knife system)	5500 FPM
Optimum for Finish (saw system)	7500 FPM
Optimum for Chip Quality (saw system)	5500 FPM

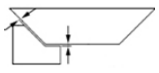
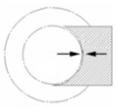
Head Position

	Knife System		Saw System		Edger	
Cut Diameter	**Range**	**Target**	**Range**	**Target**	**Range**	**Target**
12" - 20"	.75" - 1.5"	.75"	.75" - 1.5"	1"	.25" - 1"	.25"
20" - 24"	1" - 2"	1"	-	-	-	-
20" - 28"	-	-	1" - 3"	1.5"	1" - 2"	1"
24" - 32"	1" - 3"	2"	-	-	-	-

Lead

.001" per Inch of Cut Diameter (example 18" CD means .018" of lead)

Knife / Anvil Clearance in an Edger

Anvil	Target	Minimum	Maximum
Horizontal Anvil 	.040”	.030”	.060”
Vertical Anvil 	.015”	.010”	.020”

Vertical Anvil Clearance from knife tip

- Canter System:

Minimum clearance - Equal to 1/2 the extension setting
Example: an extension setting of 0.020” means anvil clearance is a minimum of 0.010”

Maximum clearance -Equal to the extension setting [+] 0.005"
Example: an extension setting of 0.020” means the anvil clearance is a maximum of 0.025”

- Curve application:

Minimum clearance - Equal to the extension setting
Example: an extension setting of 0.020” means the anvil clearance is a minimum of 0.020”.

Maximum clearance -Equal to twice the extension setting
Example: an extension setting of 0.020” means the anvil clearance is a maximum of 0.040”

Faceplate Runout - 0.010" maximum faceplate runout before replacing *

Hub Runout - 0.002" maximum runout *

Saw Plate Runout - 0.004" maximum runout *

Extension

Cut Diameter	Range	Target
12" - 24"	.010" - .015"	.015"
24" - 32"	.015" - .030"	.020"

*These parameters are targets or optimal performance and are not required tolerances.

Chapter Five

Maintenance

HR—Solid Head User Manual • Chapter Five

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Maintenance

Over time and heavy use, your High Recovery System will wear. Worn parts must be replaced as soon as possible to minimize the possibility of component failures. Proper daily knife changes and routine maintenance on the system will help ensure it runs optimally.

Section A. Daily Operations

The routine knife change is an opportune time for operators to note and report potential issues with the machine. Evidence of impact damage should always be noted and the appropriate actions taken to prevent further damage to the system.

Section B. Routine Preventive Maintenance

This section highlights the maintenance requirements for your High Recovery System to run efficiently and effectively. Because each mill has different operating conditions, this schedule is considered the minimum requirement. Your Key Knife Representative can work with you to develop a maintenance schedule that fits your mill's needs.

Appendix **E** includes examples of maintenance schedules that can be used to effectively manage your mill's maintenance program.

Weekly Maintenance

- Lubricate the Clamp Bolts with anti-seize.
- Thoroughly clean debris from the keyways between the clamps and counterknives.
- Visually inspect the counterknives and clamps for impact damage or wear. Change or rotate damaged components as needed.
- Note significant packing between the finishing knife and the long knife.

Monthly Maintenance or 35 MMBDFT, whichever comes first.

In addition to the weekly maintenance checklist, do the following:

- Visually inspect the counterknives and clamps for impact damage or wear. Change or rotate worn or damaged components as needed.
- Measure and note faceplate wear and run-out.
- Measure and adjust short Knife Extension and Run-out.
- Measure knife relief.
- Adjust long knife location, as needed.
- Check proper torque on counterknife cap screws.

Quarterly Maintenance or 100 MMBDFT, whichever comes first.

In addition to the monthly maintenance checklist, do the following:

- Remove all knives, clamps and counterknives from the head(s).
- Thoroughly clean all components.
- Ensure proper torque on Gib Bolts.
- Visually inspect bases for wear or impact damage. Change as needed.
- Determine if there is excessive play in the Sharp chain (as required)
- Measure / Confirm Head Lead.

- Measure and set Guidebar (Vertical Anvil) Clearance
- Measure and set the Horizontal Anvils.

Replace the system components, following the installation instructions found in Chapter 2 and Appendix **G**.

Section C. Component Wear

As stated in Chapter 1, your new Key Knife High Recovery Chipping System is designed for maximum durability and wear resistance. It also has a modular design, allowing for counterknife rotation, prolonging part life.

There is a critical balance that must be maintained when deciding when / if a component is ready to be changed out. Parts must be run up to or near their designed life. Changing too early will result in waste, which can outweigh savings from running a little longer. Changing too late can result in system failure.

The main components that must be watched are:

- Counterknife
- Bases
- Clamps

High Recovery Counterknife

The counterknife is probably the most important part in the system to monitor. It experiences some of the highest wear and stress in the entire system. Counterknives will wear differently from part to part, and system to system. It is important to learn to visually recognize when a counterknife needs to be replaced, since a precise measurement, is not practical or accurate.

There are several typical types of wear seen on counterknives, and some are more serious than others.

- Corner Wear
- Mounting Surface Wear
- Breakthrough Wear

Corner Wear: This is the most common type of wear. Chip Flow will eventually break through the hard surface at the knife junction, and begin to remove, and dish out the base metal. When one of the following conditions is present, it is time to change the part, or rotate it to the opposite head:

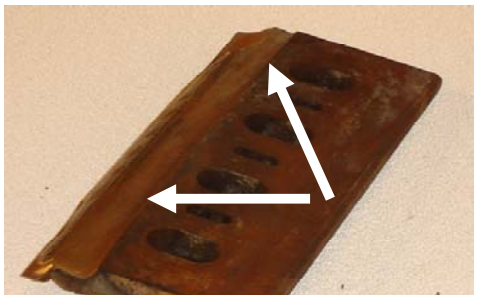
- The edge starts to bend
- The corner or edge chips
- The edge develops into a sharp point within ¼" of the corner for short counterknives or ½" of the corner for long counterknives

CAUTION: Rebuilding of Key Knife counterknives is not recommended. The counterknife is precision ground and has a very precise heat treatment. Simple rebuilding, or "re hard surfacing" erases the effects of these processes, and will result in a drastically weakened part.

Clockwise from top left – A short counterknife with an example of corner wear; long counterknife with an extreme example of corner wear; a long counterknife with a bent corner

Mounting Surface Wear: Although not common, this more serious type of wear deserves immediate attention. When chip flow gets between the holder and counterknife, and starts to erode this mounting surface, the counterknife needs to be replaced immediately. Failure to remove the component will jeopardize the safety of the system.

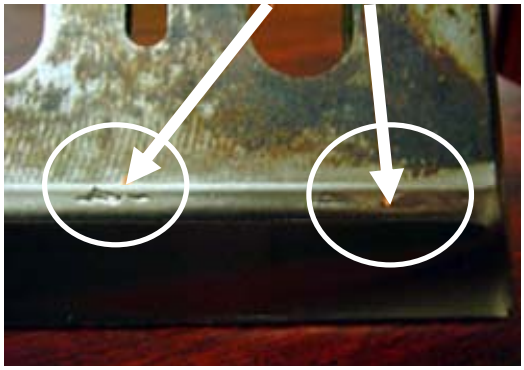
Close examination of the base to ensure it still has a flat mounting surface is also warranted.



Mounting Surface Wear

Breakthrough Wear: Occasionally, an item will impact the counterknife and cause cracking in the hard surface. This will appear in odd, random locations and the hard surface around the cracking will still be smooth.

This type of damage will not negatively affect the safety of the system, unless it is on the tip of the counterknife where the knife is supported.



Breakthrough Wear

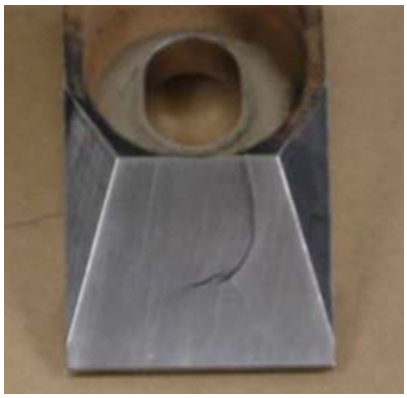
High Recovery Clamps

Clamps typically do not experience excessive wear from normal operation. Most damage will result from crashes in the machine center, and this is addressed in the Crash Recovery Section. Typical clamp wear to be aware of include:

- Normal Polishing Wear
- Cracks

Normal Polishing Wear: Clamps function to hold the knife in place, and in some cases to prevent cant surging, by limiting the advance of the cant. The clamps will often show polishing wear on the top surface as a result of this limiting action. This is normal and not a cause for concern. The clamp is not worn out unless there is evidence that the cant is surging or if the wear is negatively effecting knife clamping.

Cracks: Often cracks are caused by impact damage, which is addressed in the Crash Recovery section of this chapter. However, cracking along the nose of the clamp is always cause to replace the component. Always replace the clamp when cracks are found.



Section D. Operating in Frozen Wood

Operating in extreme cold weather presents many challenges in wood chipping applications. The durability of the Key Knife system has been proven to withstand the rigors of this extreme environment.

As the wood fibers freeze, the wood reacts differently. Often, a mill operating with frozen wood will see their pins and fines increase, in addition to a shift in their distribution towards thinner chips.

Contact your Key Knife representative with all questions regarding these conditions.

Section E. Parts Rotation

Unlike all other conical style chipper systems, Key Knife High Recovery Systems utilize a modular design. This allows for the rotation of wear parts for a longer part life.

When a counterknife is worn out from "corner wear", simply rotate the part to the other head. Clamps and bases cannot be rotated.

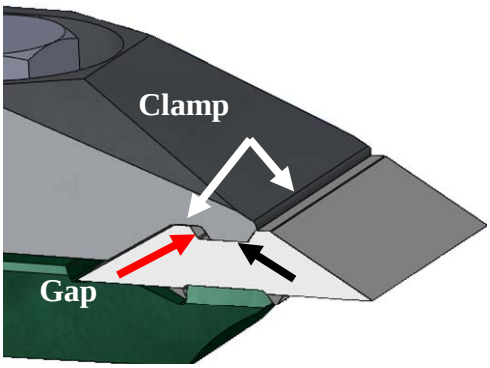
Because individual mills are different, your Key Knife Representative will be happy to assist you in developing a parts schedule that meets your needs and provides you with the most value.

Section F. System Crash Recovery

Although the Key Knife High Recovery Heads are extremely durable, it is not completely "bulletproof". Inadvertent crashes from foreign debris in the mill, is unfortunately a fact of life.

Fortunately, the advanced segmented design of your High Recovery System is of significant value when contaminants enter the system. Instead of having to replace the entire assembly, simply replacing the damaged parts saves time and money.

After a system crash simply follow these guidelines to get your operation up and running in a **safe** and **timely** manner.



1. Inspect all system components on the head where damage has occurred. Pay close attention to the components responsible for clamping the knife into place, as highlighted.
2. Replace all damaged components. (Reference Appendix G for instructions)
   - Always replace Clamp Bolts when changing clamps
   - Always replace Base Fasteners when changing bases.
3. Replace knives and continue operations.

Warning: -Bolts often sustain damage that is not readily visible. Hairline cracks are often common after a crash. If these fasteners are then put back into service, you risk another crash when they fail. Always replace bolts when the component they are holding is damaged.

Key Knife is committed to the welfare of your business. If you are unable to determine the exact cause of a crash, set the damaged parts aside and contact your Key Knife Representative who will be happy to assist you investigate the matter.

Section G. Spare Parts Inventory

Maintaining an adequate supply of spare parts is a proactive method of preventing against unneeded down time resulting from a crash.

Your Key Knife Representative will work with you to provide an Operations Model that will show your projected parts usage for the year as well as the recommended quantity of spare parts. From this analysis, you can establish a scheduled deliveries program with Key Knife to ensure you have the right parts in the right place at the right time.

Although each mill is different, and there is no standard spare parts list, Key Knife recommends that at least one full set of spare parts be maintained on site. Use this general rule of thumb, and the expert knowledge of your Key Knife Representative for establishing proper inventories for success.

Section H. Key Knife Services Overview

Key Knife services are not structured around typical maintenance programs. Instead our services focus on your operation as a whole and on the areas of your operation where we can add the most value.

Your Key Knife Representatives are knowledgeable and skilled in chipping application and chip theory. Most of our Account Managers have extensive backgrounds in the forest products industry and have seen and worked on just about every type of machine running in a mill today. This knowledge is utilized to provide you with the resources necessary to increase your mill's overall operating efficiency.

At no added cost, we provide scheduled deliveries, Operations Model Analysis, benchmark reporting, and frequent checkups of your operation. By taking advantage of these value adding service programs you will lower your purchasing costs, optimize inventory levels, and always receive the right products in the right place at the right time.

We also offer regularly scheduled maintenance programs to ensure your Key Knife system always performs at an optimum level. This extra level of service can be customized to meet the needs of your operation, including maintenance and optimization of individual machine centers, machine center performance analysis, mill staff training, inventory analysis, troubleshooting and providing solutions.

Contact your Key Knife Representative for more information on our Service Programs.

Chapter Six

Troubleshoot

Introduction

This chapter provides some commonly seen problems that occur in all chipping operations. Most issues arrive as a result of worn or damaged components or as a result of incorrect torque on critical knife clamping fasteners.

These troubleshooting tools are not meant to be all-inclusive. They are tools to assist you in your chipping-head operation. If you have tried unsuccessfully to fix a problem, or have any questions, call your local Key Knife Representative who will assist you to maximize the operation of your Key Knife System.

High Recovery Troubleshooting Matrix

Condition	Possible Cause	Corrective Action
Reduced knife life (unexplained)	Knife Flutter from reduced clamping force	Replace worn / damaged counterknives
		Ensure pockets are properly cleaned during knife change
		Ensure proper Clamp Bolt torque
	Excessive Rehoning on the knives	Follow Key Knife's recommended rehoning schedule
	Foreign debris, excessive bark, sand, dirt, etc on the logs	Excessive amounts of the listed materials will degrade knife life.
Chipped Knives	Foreign debris, excessive bark, sand, dirt, etc on the logs	Excessive amounts of the listed materials will degrade knife life.
Surging / Sticking	Inadequate feed control	Ensure the pressure rolls, etc are functioning properly
		Install Limiter clamps and / or secondary limiters
	Change in Chip Length settings	A change to a shorter chip length setting could cause surging
	Faceplate worn	Replace worn faceplate
	Horizontal Anvil set to high (sticking)	Properly set / align the horizontal anvil with the feed system
	Target size (sticking)	Ensure optimization software is running properly
Head Vibration	Unbalanced head caused by installation of one new base on hub	Replace bases in pairs

Condition	Possible Cause	Corrective Action
Back-cutting marks on the board	Improper Head Lead	Adjust the lead in the head to the appropriate setting
	Vertical Anvils are too loose	Ensure the anvils are level and set with the appropriate clearances
	Bearing End-Play	Ensure new, high-quality bearings are installed
Uneven cut marks on board finish	Inconsistent Knife Extension (run out)	Measure and adjust run out on the short knife
		Ensure proper procedures are used to set short knife extension
	High Knife	Measure and adjust run out on the short knife
		Ensure proper procedures are used to set short knife extension
	Extremely worn counterknives used with new counterknives on the same head	Ensure all counterknives have similar wear patterns
		Replace worn counterknives
Packing between knife and holder	Worn Counterknives	Replace worn or damaged counterknives
	Inadequate Clamp Bolt Torque	Ensure Clamp bolts are adequately torqued
	Knives not locating properly on the keyway(s)	Ensure the system is properly cleaned during knife changes
		Ensure proper procedures are used for changing knives
Snipe	Horizontal Anvils not set properly	Adjust anvil
	Vertical Anvils are too loose	Ensure the clearance on the vertical anvils is set properly
	Inadequate machine control	Add stabilizer clamps on the short knife
Snatching	Anvils	
	Loose Sharpchain	Ensure the Sharpchain has only the manufacturers recommended amount of play
	Horizontal Anvil not set properly (secondary breakdown)	
	Inadequate machine control	Add Limiter Clamps

Condition	Possible Cause	Corrective Action
Knot Pull	Dull Knives	Replace knives in the head
Fiber Pull	Dull Knives	Change knives on a regular schedule
	Log movement / vibration in the machine	Ensure the machine components are properly aligned
Tear out	Head is too low	
	Log diameter too large	
Pins and Fines	High Knife Speed	Reduce head speed
	Dull knives	Change to a low-impact counterknife on the long knife
	Standard counterknives	Change knives on a regular schedule
Overthicks	Slow knife speed	Increase head speed
	Counterknife not aggressive enough	Use a standard counterknife
		Change to knives with a thicker wedge / knife angle
Thin Chips	High Knife Speed	Reduce head speed
	Aggressive counterknife	Change to low impact counterknife on large knife
Uneven Target Size	Log Movement in the machine	Ensure the Sharpchain has only the manufacturers recommended amount of play
		Ensure the Horizontal and Vertical Anvils have a proper clearance
		Optimization of software
	Chipping Heads are not steady	Ensure the Bearings are adequately stable (End-Play)
		Ensure the ways are adequately stable

Anvil: A stationary (either vertical or horizontal) knife opposing the main knife assembly. The knife passes the anvil like scissors blades to cut the wood. Anvil is a sawmill term; also known as the cutter bar or bed knife to the Tree Industry.

Application: The task needing to be done with the wood, such as edging, canting, etc.

Assembly: All parts needed for a system setup (segment, clamp, holder, counterknife etc.) and the necessary hardware (bolts, screws, etc.) as a unit.

Babbitting: 1) The molten metal added to the bottom of a non-indexable knife after grinding to correct the height. 2) The process of adding babbitting to the knife.

Band Saw: A saw used as a canter or in primary recovery consisting of a continuous piece of flexible steel with teeth on one or both sides.

Bent Knife: 1)An old bent blade knife design used on conical saw heads 2) Key Knife updated the design by replacing the one knife with two smaller knives set at an angle. This term is now outdated, and the knife/knife systems should be referred to as High Recovery.

Board: A piece of lumber nominally less than 2" thick and 1 " or more wide.

Board Foot: The basic unit of measurement for lumber; equal to a 1 by 12 by 12-inch board. An 18 foot long 2 X4 would be 10 board feet, as would a 9 foot long 2X8.

Bottom Head: A cutting head/saw responsible for processing the bottom of a log.

Bow: A Flatwise deviation along the length of a piece of lumber measured at the point furthest from the optimal shape line. Bowing is the curving of the wood.

Butt: The bottom of the tree after being cut down; this end is wider and directly above the bottom-most cut on the tree (right above the stump).

Butt Log: The first log from the butt of the tree.

Camber: The curve or bend found in lumber not under stress.

Cant: 1) A log with two or more sides squared 2) A log that has gone through primary recovery and is destined for processing by other saws.

Canter: 1) Sawmill application, a) top and bottom already flat; sides are squared. b) all sides are squared 2) A cutting device to square two or more sides of a log.

Cards: Blocks of chips un-separated from each other.

Carriage: A track-mounted vehicle that carries the log through the head saw in a sawmill.

Chip: A small, thin wafer of wood cut at a precise angle to the grain with both side corrugated or striated as a result of being split from the parent wood (a log, slab, etc.) Chips are thicker and coarser than sawdust, and usually headed for a pulp mill.

Chip Accept: Any chip suitable for making pulp; not too wide or small like overs, fines, etc.

Chip 'N' Saw: A type of sawmill knife system; disk shaped segments are stacked to make a drum/barrel shaped head. Each segment has several knife pockets, and the knives are staggered along the head surface. (Note: Originally a brand name of one type of chipping head-rig, it has come to mean all such machines).

Chipper: A machine used solely for converting wood into chips.

Chipper-Canter: A machine that makes cants from logs using only chipping heads (no saws).

Chipping Head-rig: A machine that mills small logs simultaneously into lumber and chips; the outside is chipped away and the inside is sawn, usually into 2X4's.

Chute: A dry trough for moving logs from the logging area to a landing, body of water for rafting/ storage, or a mill. The trough may be wooden or gouged into the earth.

Circular Saw: A round saw with cutting teeth around the perimeter; it has been largely replaced in sawmills by band saws.

Clam Shell: Tilts the upper infeed portion of the gang upward to allow easy access to the saw guides.

Clamp: The clamp is placed on top of the knife, holding it in the knife pocket. It also provides a full length clamping force on the knife.

Clearance Angle: The angle between the ground bevel of the knife and a line tangent to the cutting circle at the knife cutting edge.

Coarse Grain: Wood grain with wide, conspicuous annual rings of less than four rings per inch.

Counterknife: An angled plate used in some knife assemblies to protect the knife assembly and aid in separating the wood. The counterknife is placed under the knife and braces it the knife pocket. Also known in the Tree Care industry as a gib.

Crook: Deviation along the edge of a piece of lumber from end to end, and measured at the point on the deviation furthest from the ideal line of cut.

Cup: Deviation along the face of a piece of lumber, measured at the point(s) not conforming to the ideal line of cut from end to end and edge to edge.

Curve Sawing: Applications performed on a curved log; generally the log remains stationary as the saws move around.

Cutter Head: Rotating planer piece that contains the knives/planers. See HUB.

Cutting Angle: The angle between the ground bevel of a knife and a line tangent to the cutting circle at the knife cutting edge.

Cutting Circle: The range of the knives on a cutting head in motion; diameter measured as the distance from the tip of one knife to the tip of the opposite knife

Cylinder: See CUTTER HEAD.

Depth of Cut: The thickness of material removed by a knife from the surface of a piece of lumber.

Dog: 1)A sawmill machine for gripping a log; for example, a dog holds a log in place prior to sawing. 2) Any device designed to bite into and hold something securely. 3) A spike designed to hold the chains on a log raft to the log.

Disk: A style of cutting heads shaped like a flat, narrow disk.

Drum: A style of cutting heads shaped like a cylinder. The head may be one piece, or made up of many segments stacked together .

Edger: 1) A sawmill application; cutting the sides off of tapered or misshapen boards. 2) A cutting device that performs this application.

Edging: Waste wood cut from misshapen lumber by an edger.

Extended Counterknife: A continuation of the counterknife designed to protect High Yield segments from chip flow wear.

Extension: See KNIFE EXTENSION.

Face: 1) A flat, rather than rounded, side of a cutting head, where the axle runs through. 2) The best looking side of a piece of lumber; the side from which the grade is determined.

Feed Speed: The rate lumber passes through a cutting assembly or assemblies. Usually measured in Feet Per Minute (FPM).

Feed Rolls: Any rolling piece of machinery, usually power driven, for moving wood up to and/or through a cutting machine at a specified speed.

Fines: Any chips very short in length, and/or less than 5.3 mm in cross-sectional measurement. Coarser than sawdust, but not big enough for accepts.

Fine Sawn: A term to describe surfaced lumber that has been passed through a saw to gain a textured face. Rougher than actual surfaced lumber, but smoother than unsurfaced lumber.

Gang: A machine designed to cut a cant into multiple boards. Usually a guided machine with multiple saw heads; to begin cutting, the cant is rotated, or the saws rotate around the cant.

Gang-saw: 1) A saw used in a gang to cut the cant into boards. 2) A number of saws on a common arbor.

Grain: A general term referring to the appearance, direction, and arrangement of wood fibers; examples include fine, coarse, spiral, vertical, and curly.

Gullet: The place on a cutting head between the cutting edge of the knife and the saw one head below; where any resulting chips/wood particles strike. This area of the cutting head wears out quickly.

Head: The entire body of the cutting assembly, hub/segments etc. and the knife assembly.

Head Rig: A carriage on rails that can transport a variety of saws/cutter heads.

Hood: In planers; part of the blower pipe that fits over the cutting head.

Holder: Is the support for the base for the counterknife, knife and clamp. It also provides a means to attach the assembly onto the hub.

Hub: The main body of a cutting assembly. The knife assemblies mount to special pockets on the hub, and as the hub turns on an axle, the knives spin to cut or chip the wood.(See HEAD). A hub can be called a cutting head, but the head can not be called a hub. Also called Rotor in the tree care industry; Segment or Drum in Chippers and Chip 'N' Saws.

Infeed: The end of the edger, gang, or planer where the wood enters the machine.

Kerf: The width of a saw cut; the amount of wood lost to sawdust after each pass of the saw (For example; 3/32 of an inch is considered narrow kerf).

Knife Extension: The amount a knife projects beyond the cutter head body/hub.

Lead Bar: See MAIN GUIDE.

Live Rolls: Powered rollers used to move lumber or cants in a sawmill.

Main Guide: A straight metal bar extending from the first bottom infeed roll to the inside saw head. The main guide directs lumber flow precisely in to the inside head.

Multi-spline: Sawmill application. A number of splines are cut into the bottom of a log to control it during processing.

OEM: Original Equipment Manufacturer.

Outfeed: Refers to the discharge end of the edger, gang, or planer.

Overs: Oversize and/or overly thick chips; any completely separated material over 76mm long and/or 10mm thick.

Pins: Very narrow chips; any material within the normal length range but less than 9.5mm and over 5.3mm wide. May also include very short chips.

Pocket: The location on a cutter machine hub where knife assemblies are mounted ('pockets' are cut into the hub).

Primary Breakdown: 1) Sawmill application; the whole log is round, cut off all sides. 2) The first processing the log experiences after being in log form.

Roll: A series of long large cylinders on individual axles mounted side by side lengthwise. Logs, lumber, and wood scraps can roll or be rolled (as in an electricity powered live roll) from one location to another.

Screening: Passing chips through a wire mesh or similar type screen in order to separate accepts from unacceptable chips.

Segment: A round, disk shaped foundation of metal that can be stacked with other segments to form the main body of a cutter head.

Setup: The preparation of a series of cutting assemblies designed to cut a specific size and pattern of lumber (planer, gang) prior to cutting a batch, including aligning and adjusting the equipment.

Shim: A thin piece of metal for filling spaces between machine parts, adjusting part extension, or bracing two pieces (i.e., filling the gap between a converted cutting head pocket and the new holder).

Side Head: A cutting assembly in a mill placed to process one side of a log.

Side Head Hold down Shoe: An adjustable metal bar positioned directly above the matcher plates at the side heads. The hold down shoe prevents lumber from moving vertically as it passes the side head knives.

Slab: A side of a log that has been cut off. See SLABBER

Slabber: Sawmill application; whole log is round, one side is cut off.

Snipe: When a log moves laterally in the machine, creating a tapered end.

Snatching: When a log jumps or surges as it goes along the mill line and does not feed through at an even rate.

Spline: A 'track' that can be sawn into the bottom of a log to make it easier to lead the log down the log line. The splines can be chipped off later.

Sweep: The curvature in a log, pole, or piling, classified as a defect.

System: A type of knife assembly used for certain applications, such as basic High Recovery, Chippers, or Chip 'N' Saw.

Tear-out: When wood splits or pulls out deeper than the knife depth of cut while being processed; resulting in a ragged, uneven surface.

Top Head Reman: Sawmill application; board is round on top or too thick; cut off top.

Torn Grain: An irregularity in the surface of a piece of wood or log.

Warp: Any variation from a true or plane surface. See CROOK, BOW, or CUP.

Wastewood: 1) Unusable wood such as ends, edges, scraps, etc. 2) The wood industry application for processing this type of waste and scrap wood into useable chips. The chippers used can be very large; free standing monoliths in sawmills, or very small; truck mounted portable chippers for arborists in the field.

Tool List

This appendix lists the tools required to install and operate a High Recovery System in your mill. Table One lists the tools needed to install your system and Table Two lists the tools needed during the daily operation of the system*.

To ensure fast and smooth knife changes, and change out of wear components, Key Knife recommends that two air-lines be available at the chipper to operate pneumatic tools.

Vendor names and part numbers are provided for your convenience only and do not represent any endorsement by Key Knife, Inc.

* Note that some of the tools needed for installing your High Recovery System can also be used during the daily operations of the system.

Item Description	Key Knife Order Number	Store Name	Order Number
Dial indicator with magnetic base		J&L INDUSTRIAL	MD2-41600E NOG-10100D
Wire brush		NAPA	SER 2310
Scraping Tool		GRAINGER	5LM13
Torque wrench, 3/4" drive, 300-600 ft/lbs		GRAINGER	1ARN1
Torque wrench, 1/2" drive, 50-250 ft/lbs		GRAINGER	4LY37
5/8" allen socket, 3/4" drive		GRAINGER	1AX70
Drive Adapter, 3/4" to 1/2"		NAPA	NHTNHP82
90-Degree Hex-Head Tool, 3/4" Drive, 5/8" Hex	29273		
Feeler Gauge Set		GRAINGER	1AC11
Ratchet, 1/2" Drive		GRAINGER	1AM19
Ball End Hex Key Set		GRAINGER	3A594
3/4" Ratcheting Wrench		GRAINGER	4AV15
1/2" Ratcheting Wrench		GRAINGER	4AU99
9/16" Ratcheting Wrench		GRAINGER	4AV10
Extension Bar	12559		
Brass Hammer		GRAINGER	4A105
Lock-tite 242		GRAINGER	24231
Anti-seize, Nickle Based		GRAINGER	4KM51
Hex Bit Set, 3/8" and 1/2" drive		* GRAINGER	1AF36
Socket Adapter, 1/2" to 3/8"		GRAINGER	1AH99
Socket, 1/2" drive (size as required for Faceplate Fasteners)		* GRAINGER	4JX08 5C893
3/8" T-Handle		GRAINGER	5MJ84
* The listed part numbers are for multiple-piece sets.			

Operation of High Recovery System

Item Description	Key Knife Order Number	Store Name	Order Number
Impact Wrench, 1/2" drive		GRAINGER	3Y495
Socket, 15/16", 1/2" drive	13138	GRAINGER	5MT08
Wire brush		NAPA	SER 2310
Torque wrench, 1/2" drive, 50-250 ft/lbs	27802	GRAINGER	4LY37
Torque Stick, 120 ft/lb	16568		

Torque Values

PART	DESCRIPTION	TOOL SIZE	FT-LB	Nm	Lubricate
Base	Cap Screw Socket 5/8-11 UNC	1/2 Allen	184 - 230	250 - 312	
Base Secondary	Cap Screw Socket 3/4-10 UNC	5/8 Allen	*300	*406	
Clamp	Hex Bolt 5/8-11 UNC	15/16 Socket	*120 - 160	*163 - 216	
Counterknife	Cap Screw Socket 1/4-20 UNC	3/16 Allen	11 - 14	15 - 19	
	Cap Screw Socket 3/8-16 UNC	5/16 Allen	39 - 49	53 - 66	
Faceplate	Cap Screw Socket 5/8-11 UNC	1/2 Allen	184 - 230	250 - 312	
	Set Screw Socket 5/8-11 UNC	1/2 Allen	184 - 230	250 - 312	
Spud	Cap Screw Socket 3/4-10 UNC	5/8 Allen	*300	*406	Loctite 2760 or 271

*** KK Special Torque Recommendation**

Key Knife High Recovery
Monthly Maintenance Schedule

Month:_____ Machine Center:_____

Task	Week 1	Week 2	Week 3	Week 4
Lubricate Clamp Bolts with Anti-Seize				
Thoroughly clean the keyways between the clamps and counterknives of debris.				
Visually inspect clamps and counterknives for impact damage or wear. Change or rotate as needed.				
Note significant packing between the finishing knife and the long knife.				
Measure and note faceplate wear and runout.				
Measure and adjust short Knife Extension and Runout.				
Measure knife relief.				
Adjust long knife location, as needed.				
Check proper torque on counterknife cap screws.				

Week 1 Notes:

Conducted By: _____

Week 2 Notes:

Conducted By: _____

Week 3 Notes:

Conducted By: _____

Week 4 Notes:

Conducted By: _____

Key Knife High Recovery
Quarterly Maintenance Schedule

Date: _____ Machine Center: _____

Conducted By: _____

Task	Yes	No	N/A
Remove all knives, clamps and counterknives from the head(s).			
Visually inspect counterknives and clamps for impact damage or wear.			
Visually inspect bases for wear or impact damage. Change as needed.			
Thoroughly clean all components.			
Replace or Rotate counterknives and clamps, as needed.			
Lubricate Clamp Bolts and Counterknife Cap Screws with Anti-Seize.			
Measure and note faceplate wear and runout.			
Measure and adjust short Knife Extension and Runout.			
Measure knife relief.			
Adjust long knife location, as needed.			
Determine if there is excessive play in the Sharpchain (as required)			
Measure / Confirm Head Lead.			
Measure and set Vertical Anvil Clearance			
Measure and set the Horizontal Anvils.			

Faceplate Runout:	Knife Runout:	Head Lead:
Knife Extension:	Knife Relief:	Vertical Anvil Clearance:

Notes:

LESSON PLAN

Basic Operator Training for the Key Knife High Recovery System

The following training checklist and testing materials are meant to serve as a tool for supervisors and shift leads to use in conducting new employee training, or refresher training on the Key Knife High Recovery System.

The training checklist should be used in conjunction with the content of this System Manual. Next to each topic is the chapter and section identification where the instructor can find the information to be taught.

Each item on the checklist is deemed critical knowledge for operators to safely and effectively operate your High Recovery System.

The test in section two is another tool Key Knife has provided for use by the instructors to ensure that the presented material has been understood and retained by the operator(s).

Revised: ____date_____

High Recovery Basic Operator Training Checklist

1. Review the High Recovery Components. Identify the name and purpose for the following items (Chapter 1):
    a. Base
    b. Counterknife
    c. Clamps
    d. Clamp Bolts
    e. Ridge XL Knife
2. Installing and Replacing Clamps and Counterknives (Appendix G "Install High Recovery Clamps and Counterknives")
    a. Review procedures for removing and installing components.
    b. Emphasize the proper seating of the counterknife to the back of the base.
    c. Emphasize the use of Anti-Seize on all fasteners.
    d. Emphasize the proper Torque Value for the Clamp Bolts
3. Knife Change (Chapter 3, Knife Change Procedures)
    a. Review the required tools to conduct a knife change.
    b. Review the procedures for removing and replacing Key Knives.
    c. Emphasize the proper cleaning of the keyway during the knife change.
    d. Emphasize proper knife location on the keyway(s).
    e. Rotating long knives to the opposite head (as required).
    f. Emphasize the proper Torque Value for the Clamp Bolts.
4. Measuring and Adjusting Short Knife Extension (Appendix G)
    a. Review the required tools.
    b. Emphasize the need to know the Faceplate Run-out and high spot before adjusting extension.
    c. Review the procedures (Appendix G).
    d. Review the allowable run-out for the short knives (Chapter 4, Operating Parameters).
5. Proper torque values (Appendix D)
    a. Clamp Bolts
    b. Counterknife Set Screws
    c. Base Bolts
6. Troubleshoot the system (Chapter 6)
    a. Review the Troubleshooting Matrix in Chapter 6.
    b. Review common board finish issues and corrections.
    c. Review common maintenance issues and corrections.
7. Procedures for inspecting and replacing components after a crash (Chapter 5).
    a. Review the critical areas to inspect on components.
    b. Review part replacement procedures (including fasteners).

Test: Basic Operator Training for the Key Knife High Recovery System

Multiple Choice

Q1 – Explain the importance of cleaning the counterknife thoroughly during a knife change.
(a) A dirty counterknife will decrease knife life.
(b) The knife will not locate on the keyway properly with excessive debris in the pocket.
(c) To increase component life.
(d) All of the above.
(e) None of the above.

Q2 –Give the proper torque value for the Base Bolts:
(a) 120 ft / lb
(b) 490 ft / lb
(c) 350 ft / lb
(d) All of the above.
(e) None of the above.

Q3 – The Counterknife should be replaced:
(a) When the corner has worn through the hard surface and starts to chip.
(b) Anytime the corner starts to bend.
(c) When the corner is sharp in the first ¼" of the short counterknife.
(d) All of the above.
(e) None of the above.

Q4 – After a crash, the clamp bolts should:
(a) Assumed to be fine and kept in the machine.
(b) Replaced only when the holder needs to be replaced.
(c) Replaced when the corresponding clamp and / or counterknife is replaced.
(d) All of the above.
(e) None of the above.

Q5 – When tightening Clamp Bolts with the impact wrench and torque stick during a knife change, you should always:
(a) Spot Check the load screws with the torque wrench to ensure proper torque.
(b) Check the torque on each Load Screw with the torque wrench.
(c) Assume the Load Screws are properly torqued.
(d) All of the above.
(e) None of the above.

Q6 –How far back from the short knife should the long knife be set?
(a) It does not matter.
(b) Approximately 0.020" behind the tip of the short knife.
(c) It must be flush with the tip of the short knife.
(d) All of the above
(e) None of the above

Q7 – The Clamps should be replaced:
(a) Whenever you feel like it
(b) When the surface becomes polished
(c) When cracks appear along the nose of the clamp
(d) All of the above
(e) None of the above

Q8 – A recent reduction in knife life can be explained by:
(a) Inconsistent knife extension off the faceplate (run-out)
(b) Foreign debris, excessive bark, sand, dirt, etc. on the logs
(c) Excessive rehoning of the knives
(d) Both (b) and (c)
(e) All of the above

Q9 – The Keyway on the Ridge XL Knife is designed to:
(a) Index the knives into place consistently
(b) Increase chip quality
(c) Reduce the cost of the knife
(d) All of the above
(e) None of the above

Q10 – The proper torque value for the Clamp Bolt is:
(a) 120 ft / lb
(b) 490 ft / lb
(c) 350 ft / lb
(d) All of the above
(e) None of the above

Practical Application Test

PA #1 – Demonstrate a knife change

PA #2 – Demonstrate setting the short knife extension

Answer Key

Multiple Choice

Q1 – Explain the importance of cleaning the counterknife thoroughly during a knife change.
(b) The knife will not locate on the keyway properly with excessive debris in the pocket

Q2 –Give the proper torque value for the Base Bolts:
(c) 350 ft / lb

Q3 – The Counterknife should be replaced:
(d) All of the above

Q4 – After a crash, the clamp bolts should:
(c) Replaced when the corresponding clamp and / or counterknife is replaced

Q5 – When tightening Clamp Bolts with the impact wrench and torque stick during a knife change, you should always:
(a) Spot Check the load screws with the torque wrench to ensure proper torque

Q6 –How far back from the short knife should the long knife be set?
(b) Approximately 0.020" behind the tip of the short knife.

Q7 – The Clamps should be replaced:
(c) When cracks appear along the nose of the clamp

Q8 – A recent reduction in knife life can be explained by:
(d) Both (b) and (c)

Q9 – The Keyway on the Ridge XL Knife is designed to:
(a) Index the knives into place consistently

Q10 – The proper torque value for the Clamp Bolt is:
(a) 120 ft / lb

Practical Application Test

PA #1 – Provide the trainee with the necessary tools to change the knives in the High Recovery System. Ensure the trainee properly follows the knife changing procedures as shown in Chapter 3. When the trainee has completed the procedures, check to ensure the knife junction is properly aligned and that the Clamp Bolts are properly torqued.

PA #2 – Provide the trainee with the necessary tools to measure and adjust short knife extension. Ensure the student properly follows the procedures as shown in Appendix **G**. When the trainee has completed the procedures, check to ensure the extension is properly set and runout is within the acceptable operating parameters (Chapter 4)

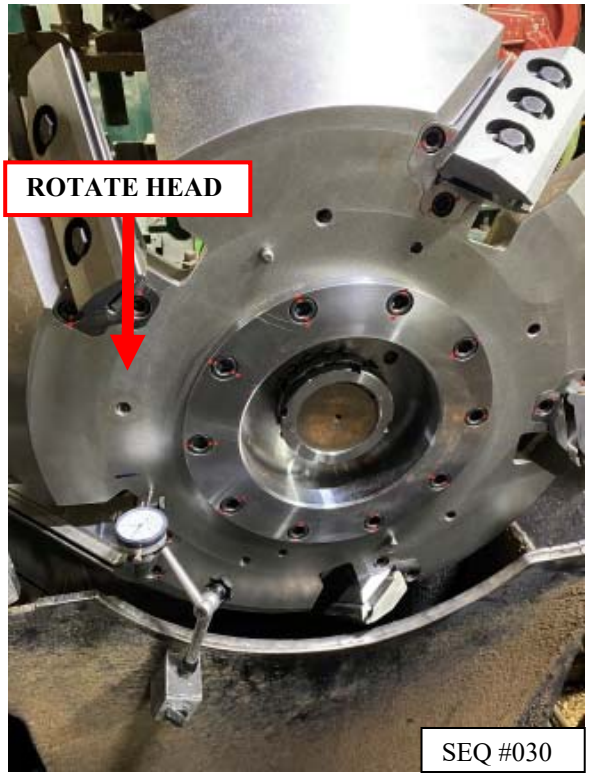
HIGH RECOVERY XL SOLID HEAD

Appendix G

SOE's

Table of Contents

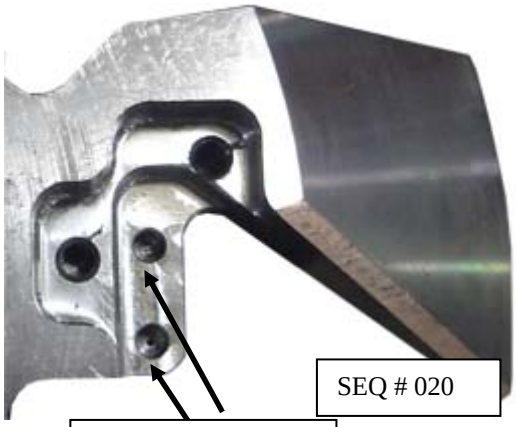
SEQ #010 & #020

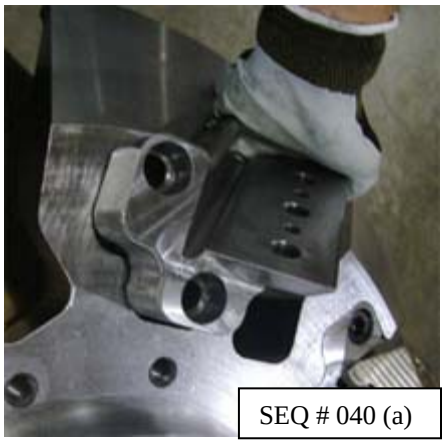


SEQ #030

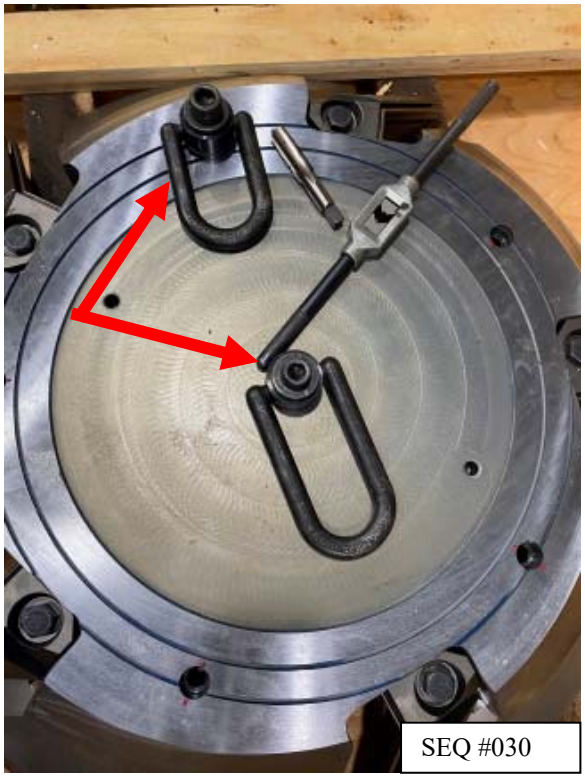
SEQ #	Task Description	Additional Information
010	Place the tip of the dial indicator half way between the outside edge of the hub and the outside radius of the faceplate bolt hole. The dial should be located adjacent to the short knife (approximate location if the bases are not installed).	Ensure the magnetic base mount is solidly attached to the frame or shroud. The dial indicator should be loaded about halfway.
020	Zero the dial indicator	Record the zero measurement on the hub with a Sharpie Pen.
030	Rotate the head until the dial indicator is directly adjacent to the tip of the next knife.	
040	Record the measurement on the hub.	

SEQ #	Task Description	Additional Information
050	Repeat steps 040 - 050 for the remaining knives.	Note and record any unusually high or low measurements discovered between the knives.
060	Note the variance between the high and low points on the hub.	See the Product line standard for acceptable hub variance.
080	Measure the runout of the arbor directly behind the hub to determine the arbor runout.	As Required. If the hub runout is excessive, check the arbor to determine if it is the arbor or the hub with the excessive movement.



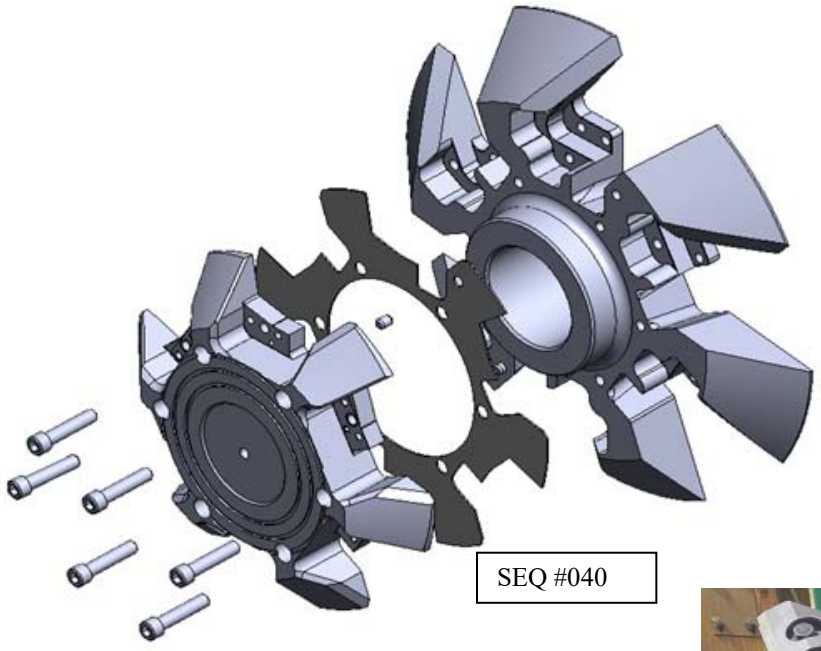


SEQ #	Task Description	Additional Information
010	Inventory on-hand bases and components. Remove jewelry from the bases, and inspect bases for burrs, etc on the mounting surfaces.	
020	Thoroughly clean the hub mounting surface, removing all grit and debris.	
030	Ensure the dowel pins are properly installed on the base.	
040	Install the base into place, ensuring the dowel pins line up with the appropriate holes.	Tap the base into position with a rubber mallet, as necessary.
050	Install and torque the socket head cap screws.	Use Anti-Seize on all fasteners. See Torque Specifications



SEQ #030

SEQ #	Task Description	Additional Information
010	Clean face of the hub and faceplate (if used) with a wire brush, scraper and compressed air.	
020	Remove any burrs from the hub or faceplate with an angle.	As Required.
030	Lift the faceplate using a lifting eye in one of the two threaded holes as shown.	

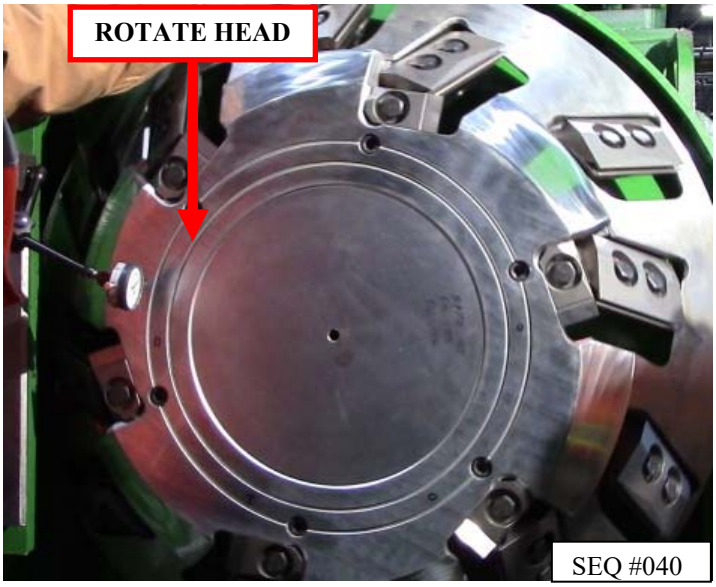


SEQ #040

SEQ #050

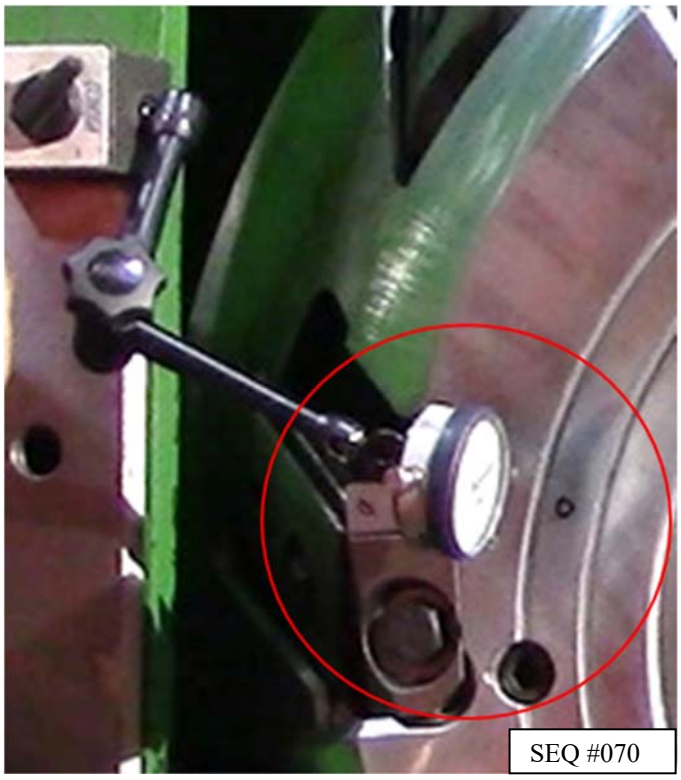
SEQ #	Task Description	Additional Information
040	Position the faceplate on the hub, using the dowel pin as a guide.	Include the required control plate between the hub and faceplate.
050	Torque the faceplate bolts with the torque wrench and appropriate socket, following a crisscross pattern.	Use Anti-seize on bolts. Reference Torque Specifications.
060	Utilizing the 0.002" feeler gauge ensure that the faceplate is snug against the hub.	


SEQ #020



SEQ #040

SEQ #	Task Description	Additional Information
010	Thoroughly clean the faceplate, removing dirt and debris.	
020	Place the tip of the dial indicator half way between the outside edge of the faceplate and the outside radius of the faceplate bolt hole.	The tip of the dial should be perpendicular to the faceplate and loaded about half-way. Ensure the magnetic base mount is solidly attached to the frame or shroud.
030	Zero the dial indicator adjacent to a short knife.	Record the zero measurement on the faceplate with a marker.
040	Rotate the head until the dial indicator is directly adjacent to the tip of the next knife.	


SEQ #070

SEQ #	Task Description	Additional Information
050	Record the measurement on the faceplate.	
060	Repeat steps 040 - 050 for the remaining knives.	Note and record any unusually high or low measurements discovered between the knives as well.
070	Rotate the hub backwards to the zero "0" mark on the faceplate and confirm the zero measurement.	If the zero knife does not confirm back at zero, start this SOE over from SEQ #030.
080	Note the variance between the high and low points on the faceplate.	See the Product line standard for faceplate variance.

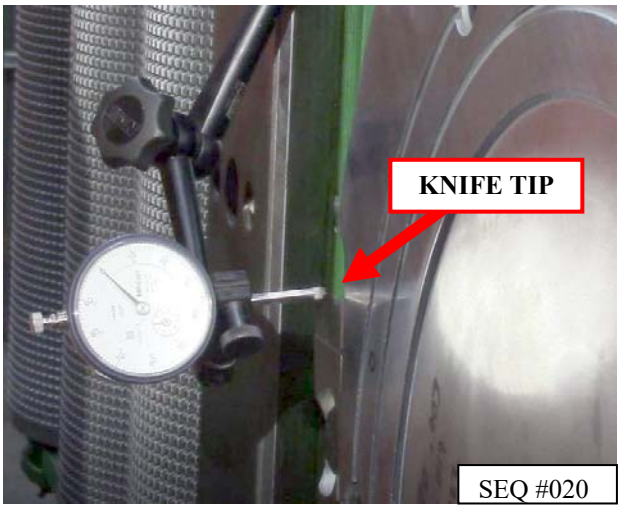
SEQ #020

SEQ #030

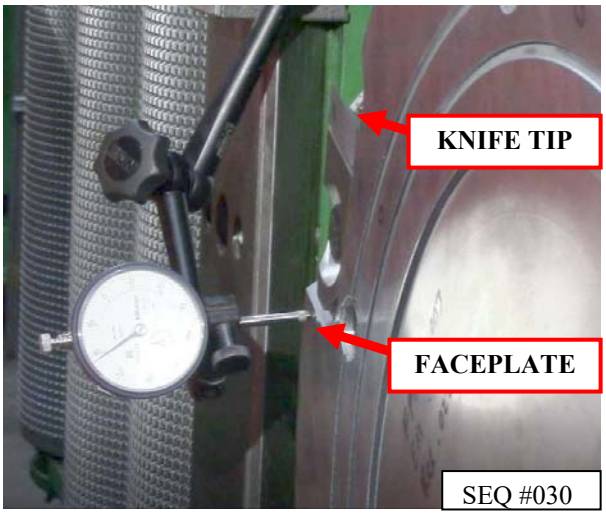
SEQ #040

SEQ #	Task Description	Additional Information
010	Thoroughly clean the hub and faceplate of dirt and burrs on the mounting surface.	
020	Place the appropriate control plates over the dowel pins on the short counterknife.	Reference the engineering prints for required control plates.
030	Set the short counterknife in place. Ensure it is seated flat to the faceplate and start a 5/8" clamp bolt.	Starting the clamp bolt ensures the control plates do not interfere with the bolt threads.
040	Insert and torque the counterknife Allen head cap screws with a 1/4" Allen Head wrench. Remove the clamp bolt.	Use Anti-Seize on the set screws Reference Torque Specification

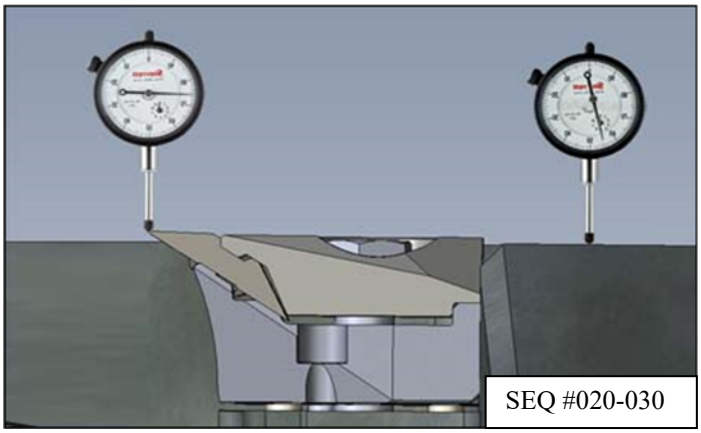
SEQ #	Task Description	Additional Information
050	Place the long counterknife into place on the base. Ensure that it sits flat and all the way to the back of the base.	
060	Insert and torque the counterknife Allen head cap screws with a 5/16" Allen Head wrench.	Use Anti-Seize on the set screws Reference Torque Specification
070	Install the clamps on both the short and long knives so that they are just tight enough to hold the clamp in place.	Use Anti-Seize on the clamp bolts



SEQ #020

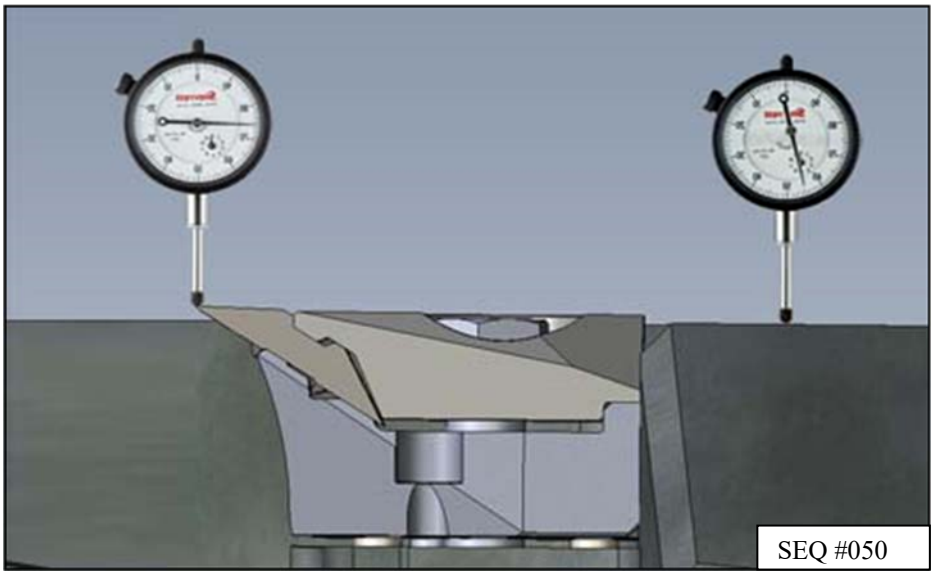


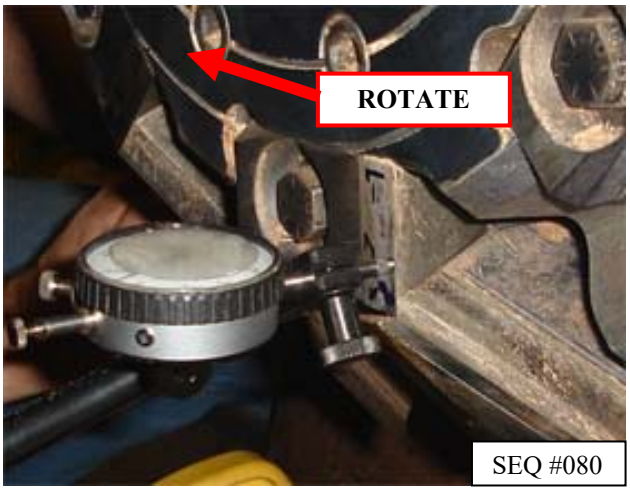
SEQ #030


SEQ #020-030


SEQ #040

SEQ #	Task Description	Additional Information
010	Determine the high point on the faceplate from the faceplate run-out measurement.	The knife closest to the high point on the faceplate will become the zero knife.
020	Zero the dial indicator on the tip of that knife closest to the faceplate high point from step 010.	See Product Line Standard for High Recovery Knife Extension. Note: the clamp bolt must be at full torque to accurately set knife extension.
030	Rotate the hub backwards and lower the dial tip down to the faceplate. Read the knife extension from the dial indicator.	
040	Add or remove shims from beneath the counterknife to achieve the required knife extension.	As Required. See "Install Solid Head Jewelry" SOE for procedures





SEQ #	Task Description	Additional Information
050	Check the knife extension again with the dial indicator to ensure the proper setting.	See steps #020-030
060	Mark the knife as the zero "0" knife once the required extension is attained.	
070	Re-Zero the dial indicator on the tip of the zero "0" knife.	Only load the dial about 0.020" for easiest operation.
080	Rotate the hub to the next knife and measure the knife height at the tip, in relation to the zero knife.	Mark the knife height on the knife with a sharpie pen.


SEQ #090


SEQ #100

SEQ #110

SEQ #	Task Description	Additional Information
090	Repeat SEQ #080 for the remaining knives.	If the zero knife does not confirm back at zero, then this procedure should be repeated.
100	Add or remove shims from the remaining counter-knives to achieve the required knife runout.	See Product Line Standard for High Recovery Knife Runout. See "Install Solid Head Jewelry" SOE for procedures
110	Set the dial indicator back on the zero knife and measure the runout following SEQ #070 - 100 to confirm results	
120	Repeat these procedures, until the runout is within specification	As Required.