“Reel” Facts
And
Optimum Cut Technology

Introduction

Foley United, a division of Foley Belsaw Company in Minneapolis, Minnesota, has been manufacturing grinders and accessories for the Turf Industry since 1934. Foley United moved to a new facility in River Falls, Wisconsin in 1992 that was designed specifically for the manufacturing of sharpening equipment. Investments have been made in the newest and most advanced manufacturing technology, allowing Foley United to better serve the Turf Industry.

EVOLUTION OF U.S. GRINDERS

- **Manual Upright Single Blade Grinders**
- **Introduction of first Tabletop Style - 1972**
- **Upright Spin/Relief Grinders**
- **Introduction of first "Automated" & "Enclosed" grinder in 1993.**
- **Tabletop Spin/Relief Grinders**

SEMINAR SUBJECTS COVERED

A. **MAINTENANCE OBJECTIVES**

B. **TECHNOLOGICAL CHANGES AND CUTTING UNIT BACKGROUND**

C. **CUTTING UNIT PERFORMANCE**

1. **ADJUSTMENTS**
2. **BACKLAPPING**
3. **BEDKNIFE FACING**
4. **GRINDING**
   - a) **Reel Grinding**
     - **-Single Blade Grinding**
     - **- Spin Grinding**
     - **- Relief Grinding**
   - b) **Bedknife Grinding**

D. **ROTARY BLADE GRINDING**

E. **HOLE CUTTER SHARPENING**

TECHNICIAN & SUPERINTENDENT QUALITY OBJECTIVES

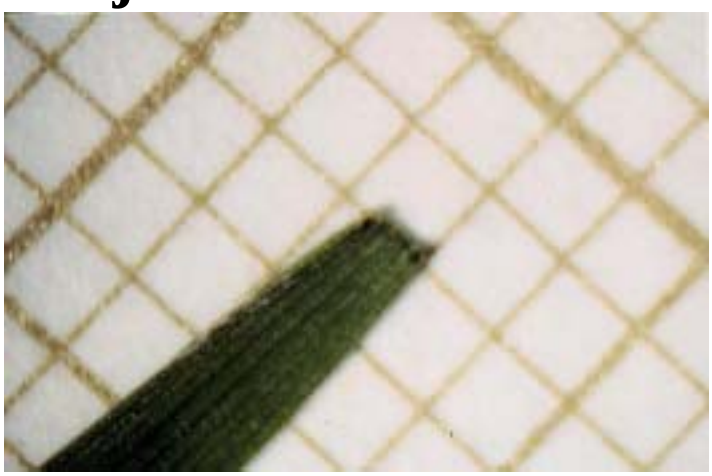
- ***You would like to have your cutting units provide the best quality of cut possible 100% of the time!***
- ***You would like to visually attain the best possible "after-cut appearance" that the cutting units can provide!***
    - Do you want to maintain the optimum engineered cutting unit performance?
    - Do you want the most efficient methods to achieve the best quality of cut?

BY MAINTAINING YOUR QUALITY OBJECTIVES, YOU CAN ALSO MINIMIZE COSTS FOR :

- Labor
- Fuel
- Chemicals
- Equipment Replacement
- Equipment Repair

QUALITY OF CUT OBJECTIVES

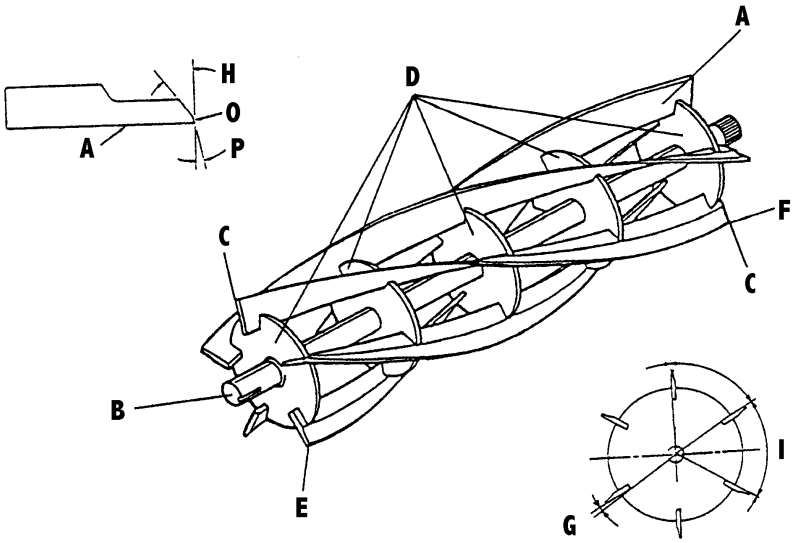
These two photos illustrate what you would like to minimize, as studies have shown the cutting process will always damage the turf to a certain degree. This type of damage can happen whether the reel is sharp or dull, but will always be most prevalent with dull and/or misadjusted reels.



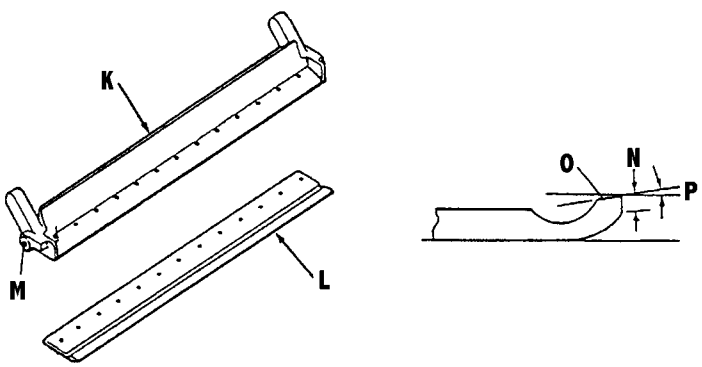
This clip will be your ultimate objective for cut quality where the grass tip is not frayed or torn.

REEL TECHNOLOGY & DESIGN

When looking at the basic concept of reel design, very little has changed regarding the reel and bedknife shape, or configuration.



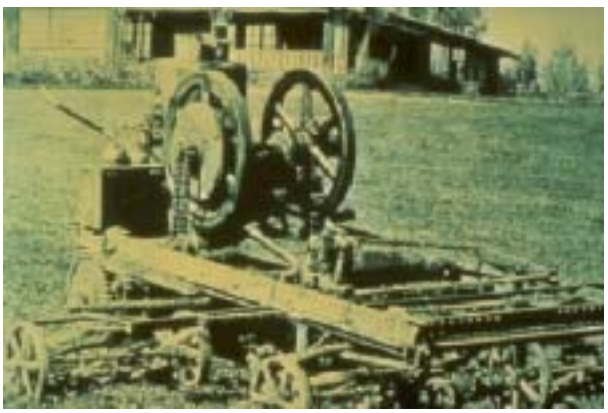
A = Reel Blade B = Reel Shaft C = Helix D = Spiders
E = Leading Edge F = Run-out G = Rake Angle H = Relief Angle



K = Bedknive Backing L = Bedknive M = Hinge / Pivot Point
N = Front-Face O = Cutting surface P = Top Angle

REEL TECHNOLOGY & DESIGN

What has changed, however, is the technology that drives the cutting units, and the factors that will determine quality of cut, cutting efficiency, and productivity.

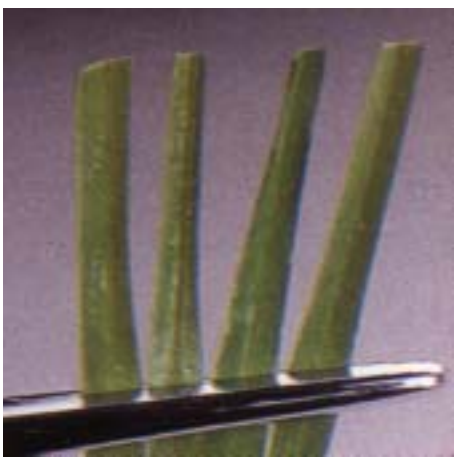


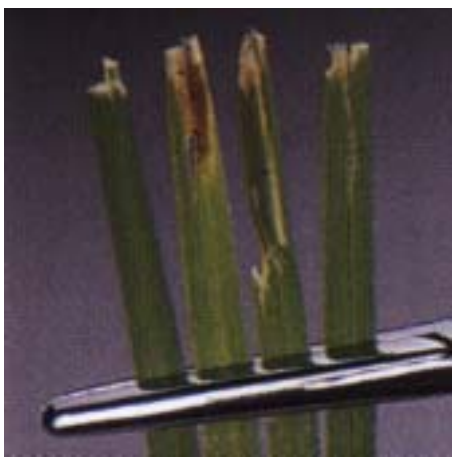
WHY DO WE USE A REEL TYPE CUTTING UNIT?

CUTTING UNIT BACKGROUND

ADVANTAGES OF A REEL TYPE MOWER

1) You get the BEST "quality of cut possible!





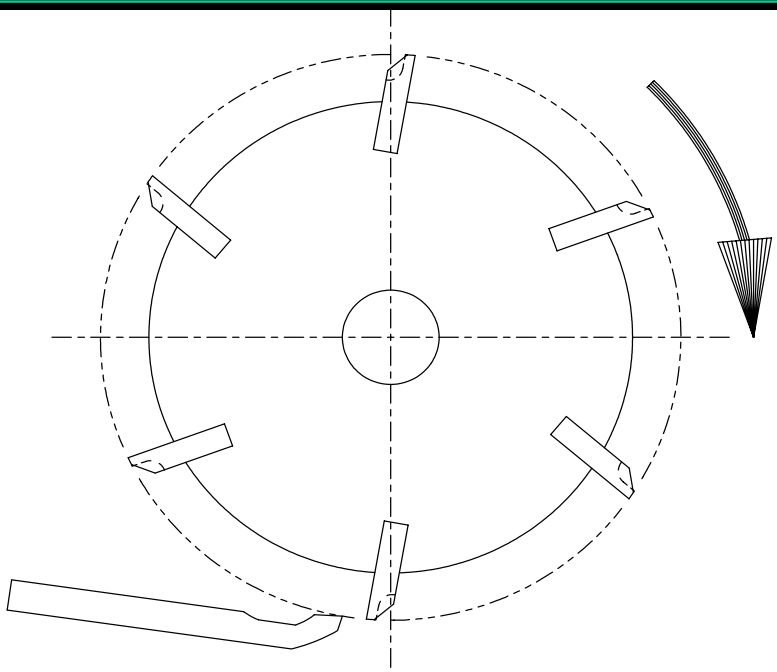
2) You can get an exact height of cut.

DISADVANTAGES OF A REEL TYPE UNIT

1) Costs

2) Maintenance

REEL CUTTING UNIT



A REEL CUTTING UNIT HAS TWO WORKING PARTS:

1) **BEDKNIFE**
2) **REEL BLADE LEADING EDGE**

The Bedknife has TWO functions:

a) ***It pushes against the blade of grass and stands the grass up in a vertical position.***

b) ***THEN, the bedknife edge acts as half of a scissors.***

The Reel Blade has TWO functions:

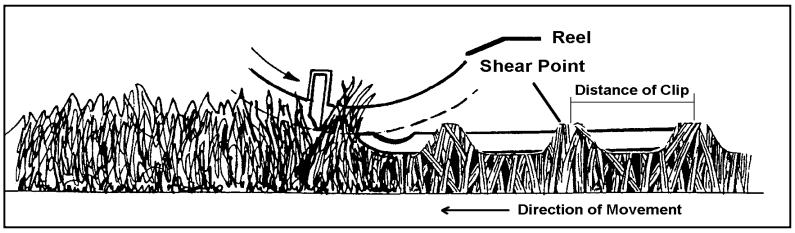
a) ***The reel blade rotates across the edge of the bedknife acting as the second half of the scissors.***

b) ***The reel blade gathers the grass and discharges the clippings***

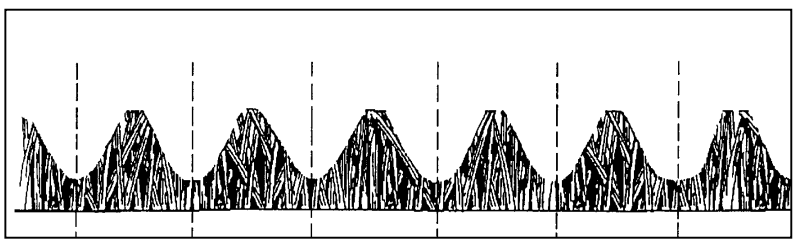
CLIP RATE

CLIP RATE IS DETERMINED BY:

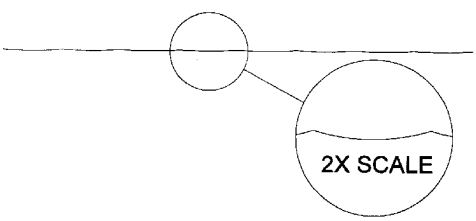
- ***The number of blades in the reel.***
- ***The RPM of the reel.***
- ***The forward travel speed of the traction unit.***



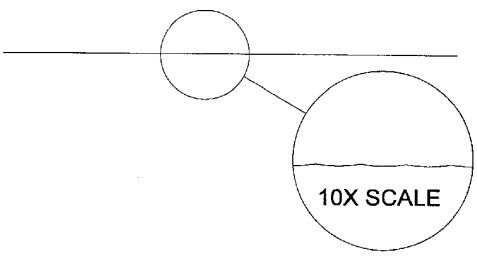
As the reel rotates, the front edge of the reel travels along a "BLADE PATH" and gathers the grass in a clump as illustrated above. The end result of this cutting action leaves 20-30% of grass mass that is not cut at the "shear" point. Different diameter reels will have their own unique "blade path", thus a unique surface clip based on blade count, reel diameter, RPM, and mow speed.



This picture illustrates why a "double-cut" will yield more grass in a basket as "Peak Points" are clipped the second time around. This will increase a stimp meter reading as the playing surface is made more smooth and the cut more level.



To mow roughs, the top surface can be wavy. Therefore, a 5-bladed reel at lower RPM is acceptable and a close up view might look like this picture at 2X.

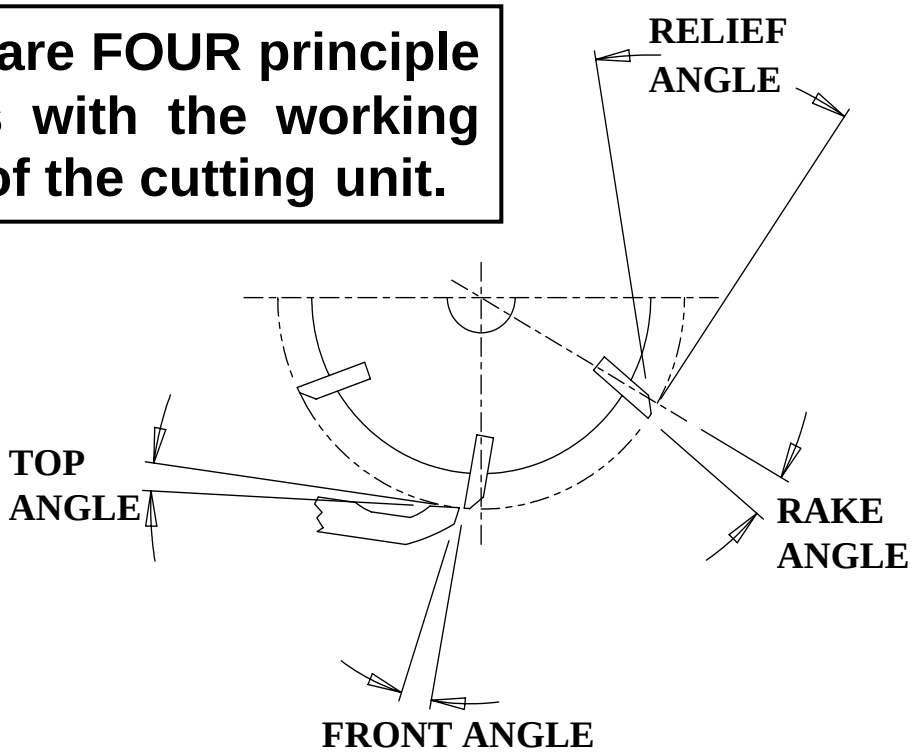


To mow greens, the desired surface is smooth and an 11-bladed reel at a high RPM is best. A closer view at 10X illustrates a flatter surface is achieved for putting purposes.

REEL DESIGN

- *The desire for tighter clip rates and smoother surfaces has evolved, and the technology of the traction unit and drive components have changed in order to meet this demand.*
- *Now, most ALL manufacturers use hydraulically driven units and reel design plays a significant role in the overall optimum efficiency of the machine.*

There are FOUR principle angles with the working parts of the cutting unit.



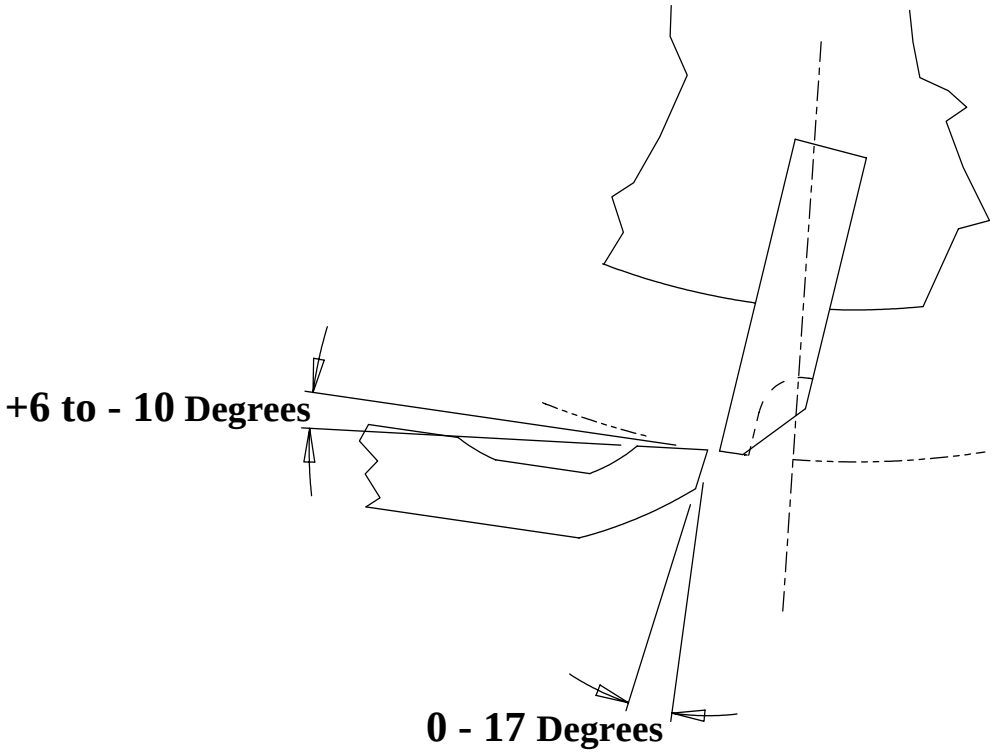
The BEDKNIFE is associated with two angles:

1) TOP FACE ANGLE
2) FRONT FACE ANGLE

The REEL BLADE is associated with two angles:

1) RELIEF ANGLE
2) RAKE ANGLE

BEDKNIFE ANGLES



All bedknife angles are based on the bottom surface of the bedknife. These values are industry averages - for the correct angles of specific models, refer to the mower manufacturers specifications.

- **The "TOP" angle of the bedknife serves two purposes:**
  1) **It reduces the amount of surface area that exist as the reel blade sweeps across its cutting edge.**
  2) **It allows for the cut grass to be ejected from the cutting unit, optimizing dispersion and minimizing clumping.**

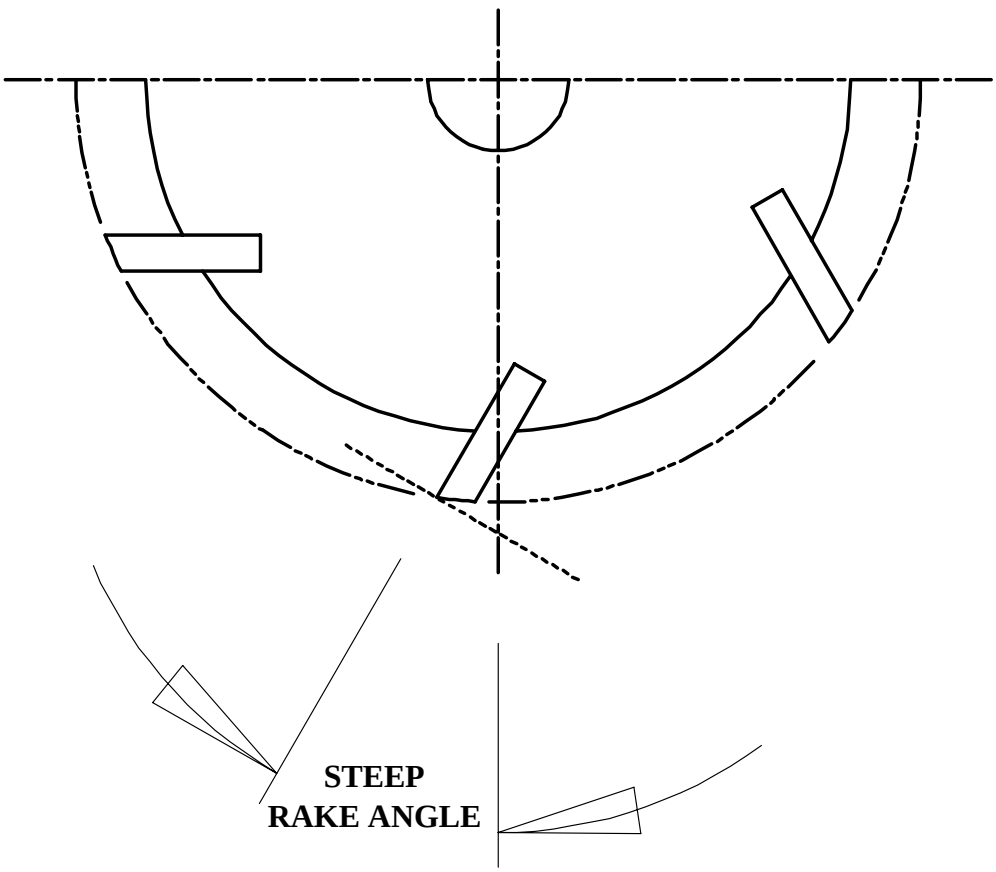
- **The "FRONT" angle of the bedknife serves one purpose:**

  This angle assures that the front edge will stand the grass up in a vertical position, rather than pushing the grass over prior to the reel blade making its pass over the cutting edge. This will contribute to a more even cut with minimal stragglers.

RAKE ANGLE

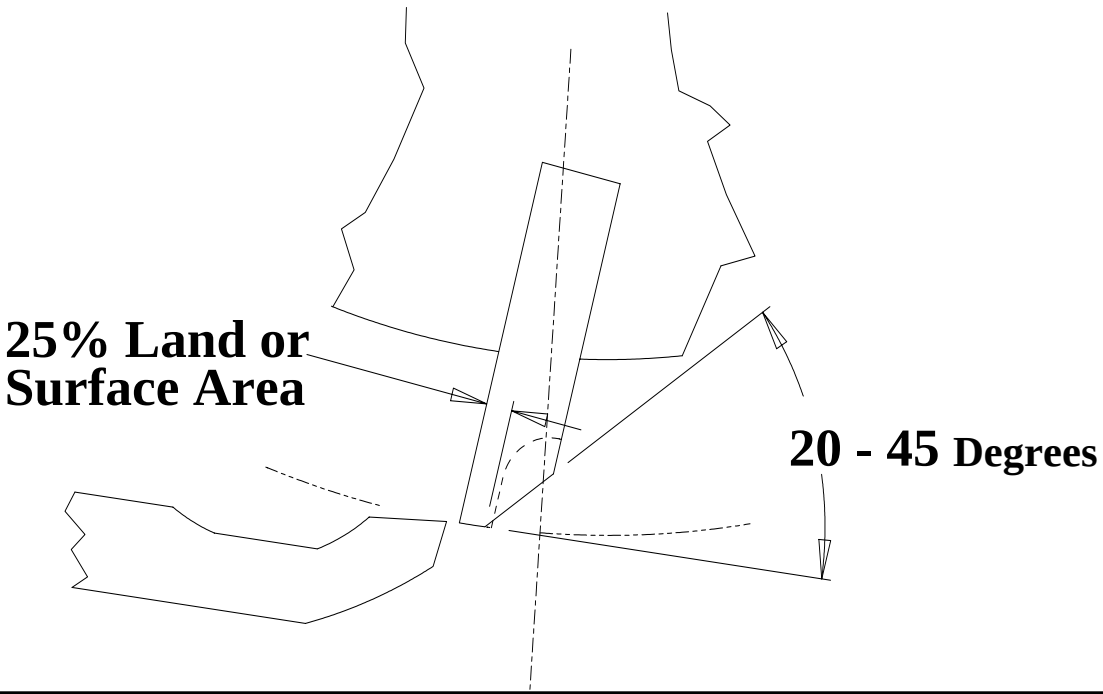
The rake angle is fixed at the manufacturer and cannot be revised. This angle varies from one manufacturer to another and can vary depending on cutting unit application.

The reel RAKE ANGLE is created by the slot in the spider which locates the blade on an angle. The angle ensures that the front cutting edge is always forward of the blade body, which in turn cuts, not pushes the grass.



A closer inspection of a spun ground reel will illustrate that the ground surface is at an angle with the blade body. This visual angle should not be confused with "relief", as relief will always require a secondary grind process. Note the angle of the blade face in relation to cutting path of the reel blade and the blade body. The entire blade face surface will pass over the cutting edge of the bedknife.

REEL BLADE ANGLES



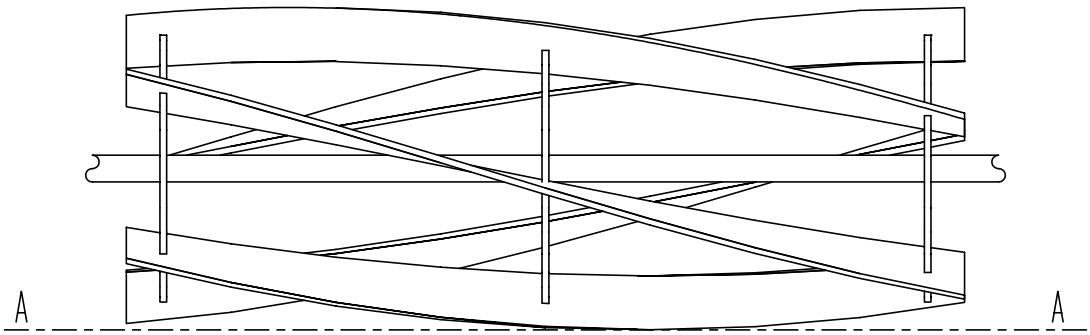
Reel blades have a back "RELIEF ANGLE" where approximately 75% of the blade is removed. The OEM reel blade configuration has two basic process designs :

1) **FAIRWAY/ROUGH** mowers have a much thicker blade design and a "**GROUND-IN-RELIEF**" is produced at the factory to maximize efficiency.

2) **GREENS/TEE** mowers have a thinner blade design, which utilizes a "**MILLED-IN-RELIEF"** manufacturing process. Recently, some OEM'S have "ground-in" additional relief on these milled blades for optimum cutting unit performance.

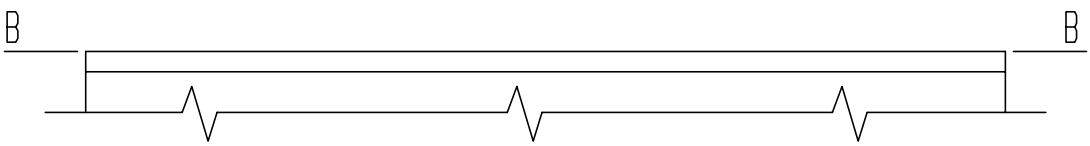
These "relief angle" values and percentage of back blade removal are approximations. For the correct angles and percentages for your specific mowing unit, refer to the mower manufacturers specifications.

OEM CUTTING UNIT CONFIGURATION



REEL IS CYLINDRICAL IN TWO PLANES

1) **ALL reel blades are on the same cutting circle.**
2) **The reel diameter is equal from end to end.**

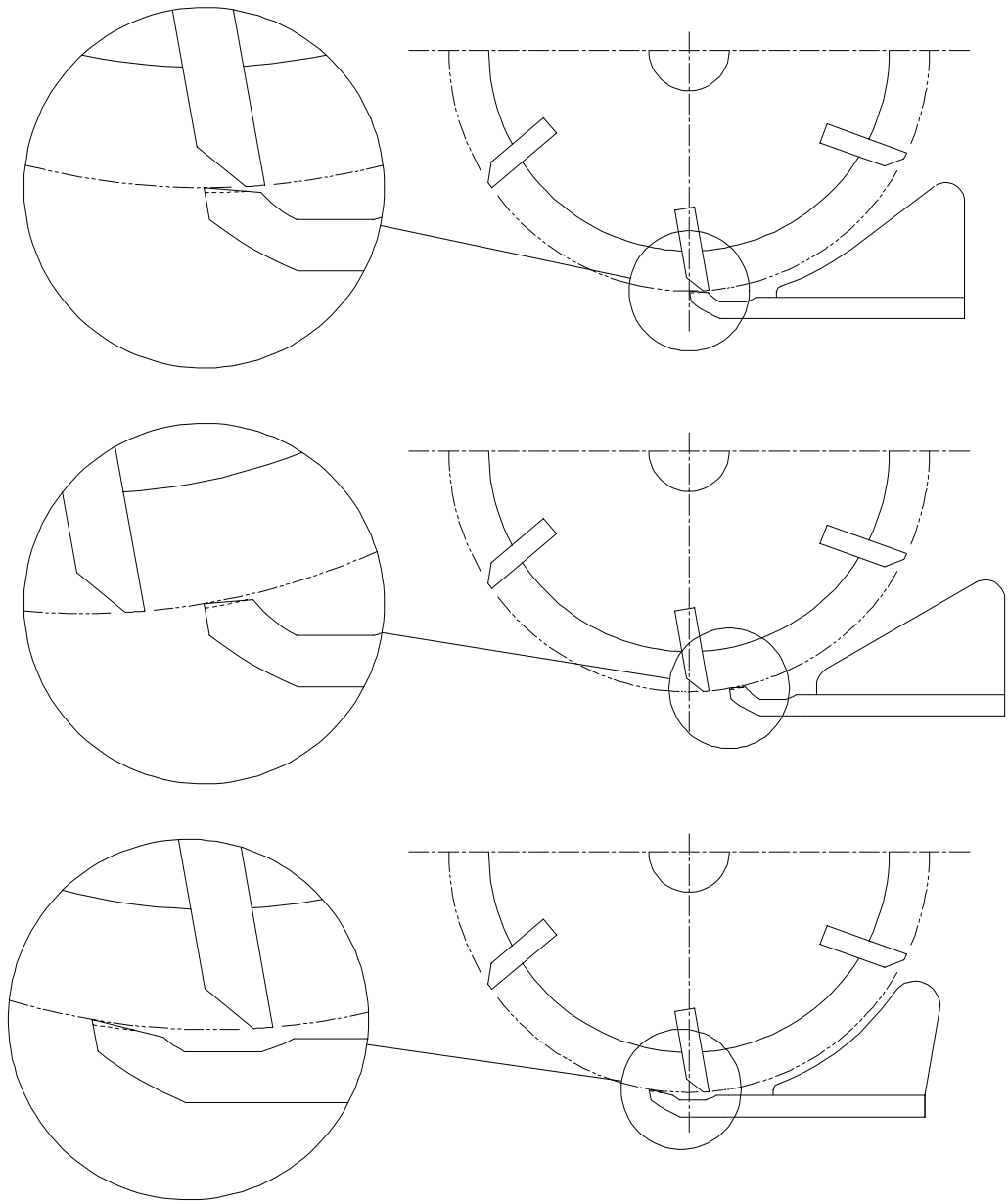


BEDKNIFE IS STRAIGHT AND TRUE

OPTIMUM "QUALITY OF CUT" AND CUTTING UNIT PERFORMANCE IS ACHIEVED WHEN THE CIRCULARITY OF REEL SURFACE "A-A" IS STRAIGHT AND PARALLEL WITH BEDKNIFE SURFACE "B-B".

Total tolerance between reel and bedknife can only be +.002/-.001 to provide a quality reel to bedknife clearance that does not require backlapping.

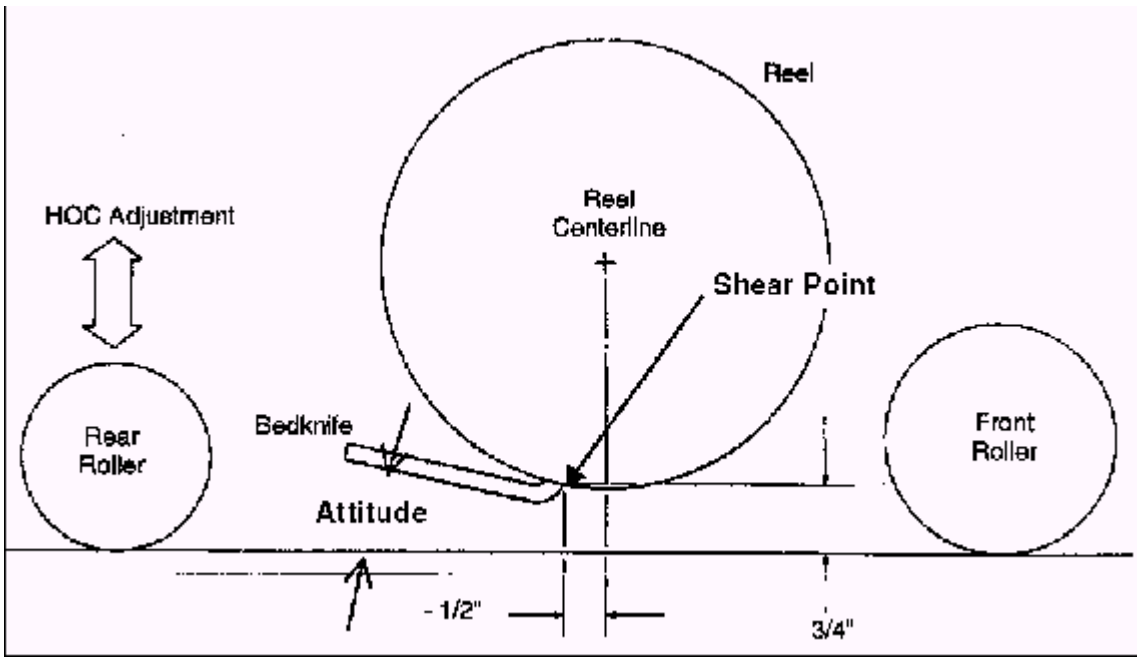
REEL AND BEDKNIFE RELATIONSHIP



The bedknife position has a specific wear pattern as the reel blade sweeps over the bedknife, and the wear angle depends on the position and attitude of the knife. The pictures above illustrate the three primary positions of the bedknife cutting edge in relation to the centreline of the reel: even, behind or forward of the centreline.

A very small angle (flat attitude) can have most or all of the bedknife riding on the turf. This can influence after cut appearance if the bedbar contacts the ground at lower heights of cut. It will normally be an advantage to have the front cutting edge of the bedknife closer to the turf than the back to prevent "ruffling" of the turf after it has been cut and passed over by the bedbar.

REEL AND BEDKNIFE RELATIONSHIP



WHAT EXACTLY IS "ATTITUDE'? The cutting unit "attitude" is the angle between the bottom of the bedknife and the ground under the cutting unit. As the bedknife attitude is changed, it is important to note that the reel to bedknife shear point changes relative to the center line of the reel. This can change the after cut appearance of the grass. The result may be better or worse depending on several factors.

HOW DO YOU CHANGE "ATTITUDE"? Bedknife attitude is adjusted by changing the height of the front, rear, or both rollers. A height of cut change is NOT necessarily part of a change to the bedknife attitude.

HOW CAN "ATTITUDE" EFFECT MY CUT? A large angle is also referred to as an aggressive bedknife attitude. There is a limit on how much of a forward angle to which the bedbar can be positioned. If the rear roller is positioned too high, the reel position can become low enough in relation to the cutting edge where it can give a poor quality of cut.

CUTTING UNIT PERFORMANCE

WHAT HAPPENS WHEN WE PUT THE CUTTING UNITS INTO OPERATION?

THE PERFECT WORLD

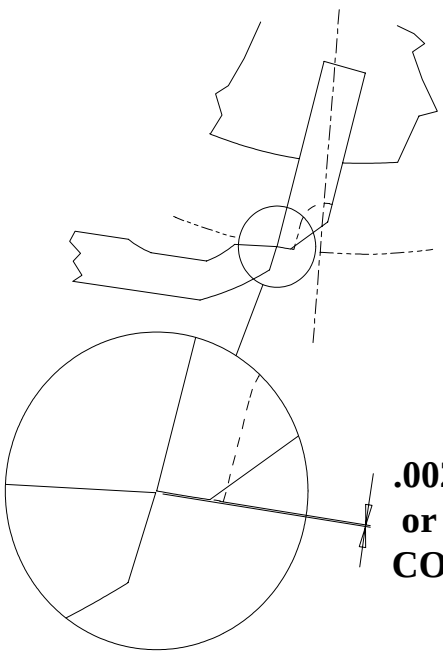
1) The reel and bedknife have specific angles designed for optimum performance.

2) The reel is perfectly cylindrical in two planes; all the reel blades are on the same cutting circle and the diameter of the reel is equal end to end.

3) The bedknife is perfectly straight.

4) The OEM has a specific location of the bedknife relative to the centerline of the reel.

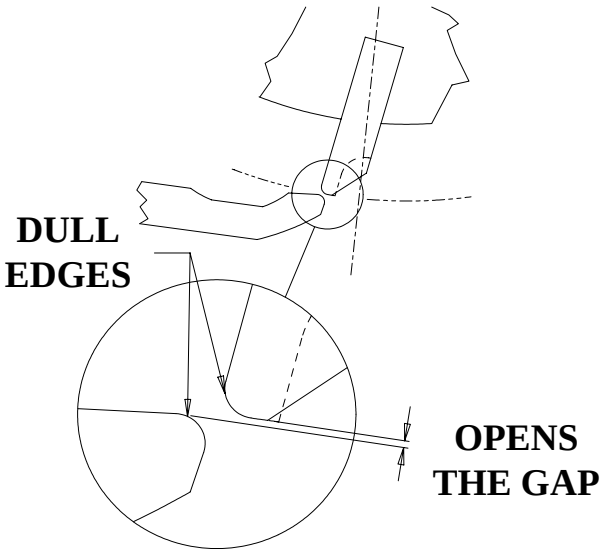
5) There is a specific reel to bedknife setting that each OEM recommends on their cutting system designs. It is not necessary to have any or much metal contact to maintain a good cut quality, as heavy contact will hinder good mechanical operations.



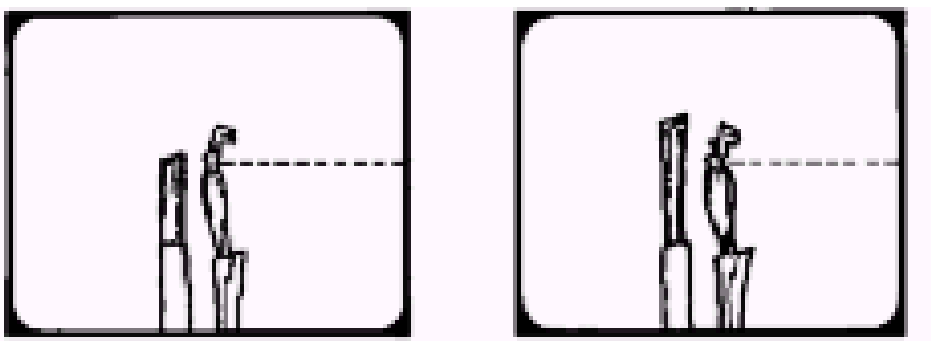
DETERIORATING CUT QUALITY

Extended use with no preventive maintenance can cause the reel blade and bedknife to become rounded and dull as shown on the right. Many things contribute to the dulling process, and all these factors will contribute to a deteriorating cut quality:

- **Sand**
- **Chemicals**
- **Rust from Moisture**
- **Dirt**
- **Foreign Objects**
- **Grass itself**



A dull reel and bedknife will not only create a poor aftercut appearance, but will stunt the re-growth of the grass.



Effect of sharp versus dull cut on growth rate on two nearly identical blades of Bluegrass (sketched from actual time–lapse photos).

CUTTING UNIT DULLING CURVE

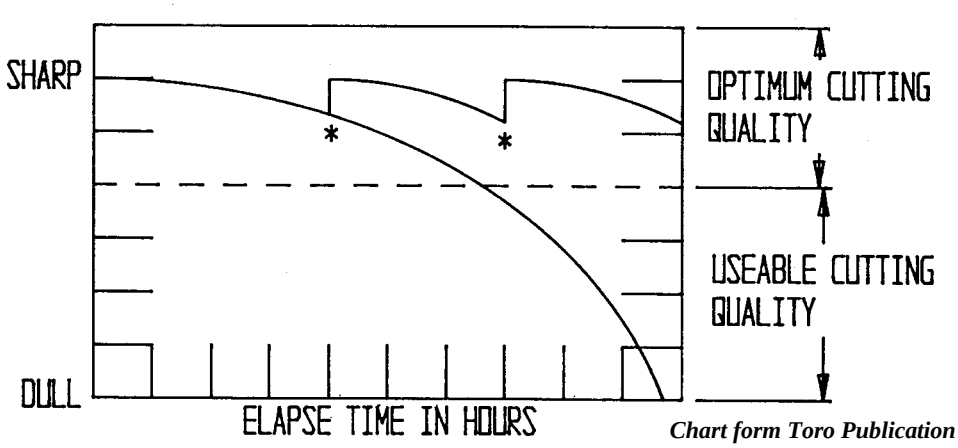


Chart form Toro Publication

Note that you want to take corrective action prior to dropping out of the "OPTIMUM CUTTING QUALITY" range.

THREE WAYS TO RETAIN A BETTER QUALITY OF CUT:

- **ADJUSTMENT**
- **BACKLAPPING**
- **GRINDING / Facing Bedknives**

****There are appropriate times to perform each of these maintenance practices. Proper judgement will optimize cut quality and maximize cutting unit efficiency.**

WHAT ROLE DOES THE OEM DESIGN PLAY IN THE EFFECTIVENESS OR FREQUENCY OF EACH OF THESE PRACTICES?

ADJUSTMENT

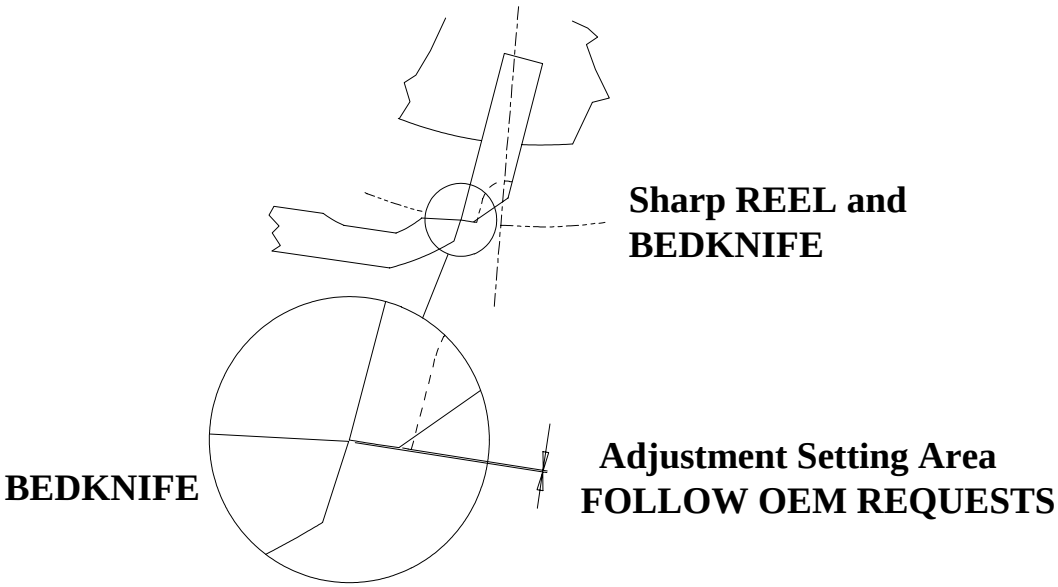
Adjustments should be done daily to ensure proper cutting unit performance. Daily minor adjustments are better for the equipment than major adjustments done when the cutting unit is not mowing properly.

Before making the adjustments, also remember the basics: Reels will adjust EASIER, FASTER, and MORE POSITIVE when the reel and bedknife are sharp and GROUND at the PROPER ANGLES . ***(Excerpt from Textron)***

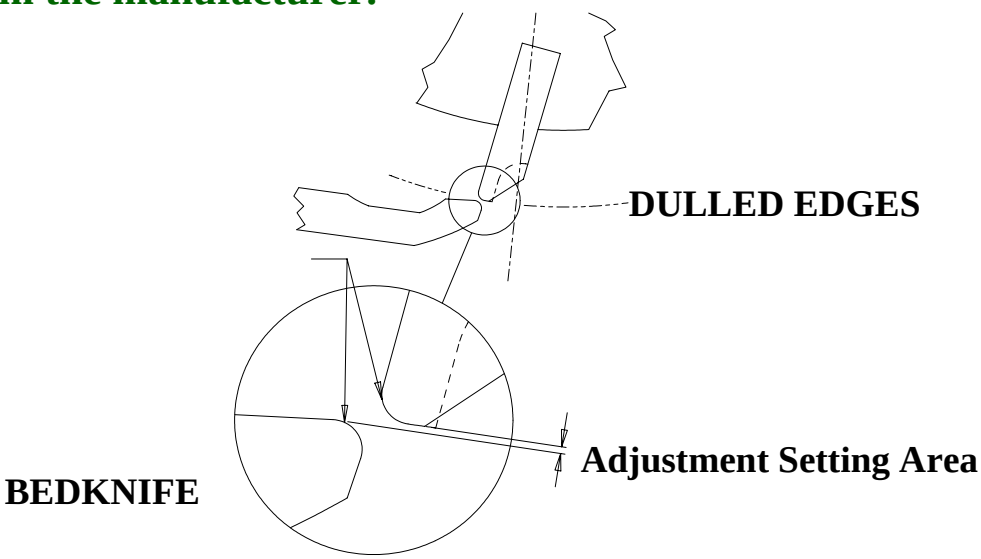
LIGHT CONTACT between the bedknife and reel will help promote a self-sharpening action. ***(Excerpt from a Toro)***

Over adjustment of the reel to bedknife can cause the reel to climb over the bedknife and may cause what is called rifling. Rifling of the bedknife will lead to streaking, an uneven cut, or even a complete failure of the cutting unit.

DULLING PROCESS



These diagrams illustrate what happens when blades and bedknives begin to dull. The edges of the reel and bedknife are sharp from the manufacturer.



A microscopic review of the reel and bedknife reveals that it takes only SIX to TEN HOURS of operation for a crisp sharp edge to begin to round off. This can result in a widening of the gap between the cutting edges when the machine is through cutting for the day.

REEL DESIGN AND THE ADJUSTMENT PROCESS

There are two standard adjustment practices and reel design plays a role in the overall optimum efficiency of the traction and cutting systems:

1) SETTING WITH A .001 - .003” GAP

2) SETTING WITH LIGHT CONTACT

HORSEPOWER STUDY: John Deere conducted a horsepower requirement study with two spun ground reel configurations. One was “spun ground” only, and the other was spun ground and “RELIEFED”: The results showed that whether making reel to bedknife contact or not, the overall increase of horsepower required to rotate a non-reliefed reel was greater.

SETTING WITH A GAP AND NO RELIEF:

.002" Gap 16% more horsepower per cutting unit with “NO” relief

.005" Gap 17.5% more horsepower per cutting unit with “NO” relief

SET WITH CONTACT AND NO RELIEF:

Touch (contact) 294% more horsepower per cutting unit with “NO” relief

"HORSEPOWER" AND THE ADJUSTMENT PROCESS

REQUIRED HORSEPOWER & REEL ROTATION

- **.002" to .005" GAP**
  - **OEM Relief** — **.75 hp per cutting unit**
  - **"NO" Relief** — **.87 hp per cutting unit**

REQUIRED HORSEPOWER & REEL ROTATION

- **CONTACT**
  - **OEM Relief** — **.88 hp per cutting unit**
  - **"NO" Relief** — **2.59 hp per cutting unit**

Note that a "reliefed" reel with contact requires little more horsepower than a "non-reliefed" reel with no contact.

Cutting units are manufactured to minimize the strain on the reel and traction drive systems. By simply re-grinding to OEM specifications, you lower the stress on the mechanical systems by a minimum of 16-18%, and a significant percentage more if and/or when the reel and bedknife makes operational contact.

“NO CONTACT” AND THE ADJUSTMENT PROCESS

SETTING WITH A GAP: This clearance is normally determined one of two ways:

1) FEELER GAUGE: When using the feeler gauge, start your adjustment on the leading edge of the reel where there is a slight drag on the gauge between the reel blade and bedknife. Alternate sides on the outer ends of the reel until the adjustment clearance is equal on both sides. The end result should be equal clearance along the entire length of the reel. Do not spin the reel while making the gauge checks and make your checks along the same reel blade.

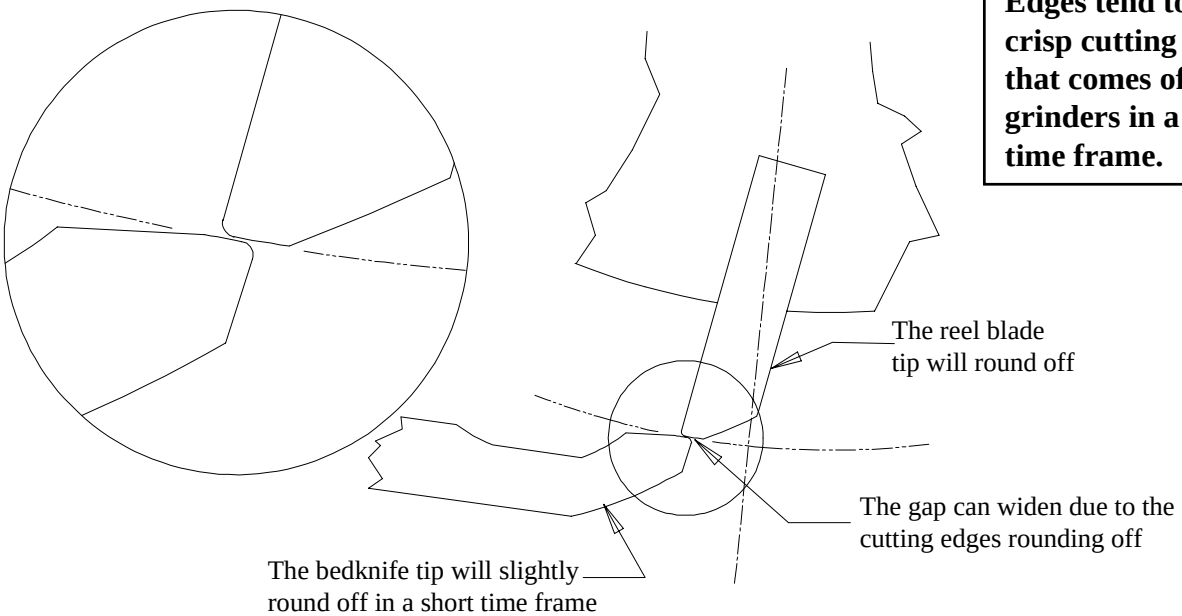
2) NEWSPAPER: If using newspaper, check the clearance by inserting it in the reel parallel to the top surface of the bedknife. Slowly rotate the blade so it passes over the top of the paper. If the reel has been set correctly, the paper will be pinched and will show a heavy crease mark.

Another common practice of using newspaper is to use two pieces; one will be folded while the other is cut, which will provide a desired gap. If no mark is made on the second piece of paper, the clearance is too large and will result in a poorer cut and will contribute to a quicker dulling process.

"LIGHT CONTACT" AND THE ADJUSTMENT PROCESS

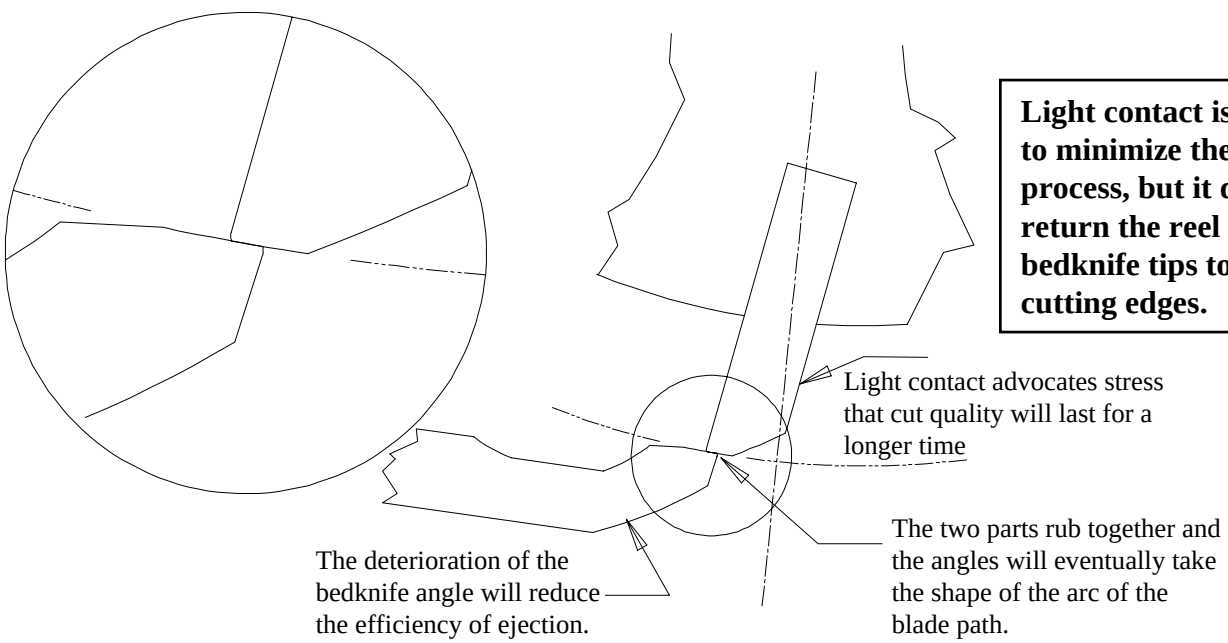
If making light metal to metal contact during operation, the reliefed area of the reel blades minimize the amount of metal contact between the reel and the bedknife.

Edges tend to lose their crisp cutting corners that comes off the grinders in a very short time frame.



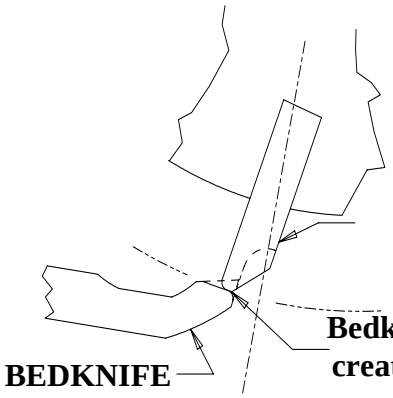
You will never attain the sharpness that comes off a grinder through adjustments, but advocates of the light contact process indicate that the rubbing of the two parts will allow for adjustments to be more effective for a longer time frame.

Light contact is thought to minimize the dulling process, but it does not return the reel blade or bedknife tips to crisp cutting edges.



REEL DESIGN AND THE ADJUSTMENT PROCESS

REMEMBER - The bench setting clearance between the reel and bedknife may be different than when the cutting units are on the ground and in operation. There are two causes for this:



1) When the cutting units are dropped on the turf, the ground can push the bedknife up, closing the gap between the two parts. An example of seeing how the ground pressure can play a role in your gap is demonstrated by setting the reel with a slight gap on the bench. By simply pushing on the bedknife with your hand, you can produce contact. This is more critical at lower heights of cut where ground pressure has a greater impact on the bedknife and is more common with bedknife to reel adjustment features.

2) Metal expands when heated up, so as the reel rotates, the increased friction that is generated between the reel and bedknife could play a role in closing this gap as well. This will most commonly occur in dry cutting conditions.

CUTTING UNIT EFFICIENCY

The OEM specification for cutting unit design includes a "relief" in the reel blade. This design reduces the surface area when the two cutting parts are brought closer together from adjusting - and it will:

- **Reduce friction when in operation, whether contact is made or not.**
- **Reduce the stress on the hydraulic system and minimize the potential for premature hydraulic problems.**
- **Minimize the stress on the engine, and maximize the horsepower for the traction unit.**

***** For proper adjustment clearance, refer to your OEM guidelines.**

WHY FOLLOW OEM RECOMMENDATIONS FOR YOUR ADJUSTMENT PRACTICE

How many people will set their reels on fairway mowers, trim mowers, and greens mowers the same way regardless of the brand and OEM recommendations?

EVERY MANUFACTURER HAS SPECIFIC ENGINEERING PARAMETERS AND DESIGN CRITERIA THAT WILL BE UNIQUE TO THEIR CUTTING SYSTEM. WHEN YOU CHANGE THE PROPERTIES OF ONE CRITERIA, IT CAN BE POSSIBLE TO ADVERSELY EFFECT THE ENTIRE SYSTEM.

MATERIAL SELECTIONS – The type of steel and the properties of the metal are chosen for specific heat treating processes and will vary from each manufacturer.

ROCKWELL HARDNESSES – There are Rockwell hardness differences between the manufacturers for reel and bedknife hardness, and the cutting unit applications that they are used for.

RAKE ANGLES & BEDKNIFE POSITIONS – Studies are conducted to determine the optimum geometry for all the components of the reel, bedknife and frame.

BEDKNIFE & REEL BLADE ANGLES: Varied reel and bedknife angles are chosen for optimum performance purposes and are related to the systems that make the cutting units and the drive units function at their best.

LONGEVITY OF CUT: Studies are implemented to determine the best design and the best process to stay sharp and stay on cut for the longest possible time frame. This is done while attempting to reduce the effort that is required to maintain high quality of cut standards.

These are only a few of a number of important criteria that are tested and reviewed when the OEM defines the adjustment and maintenance recommendations for their machines.

WHY FOLLOW OEM RECOMMENDATIONS

BELOW IS AN EXAMPLE OF HOW ONE SPECIFIC ADJUSTMENT PRACTICE WAS STUDIED AND WHY A RECOMMENDATION FOR LIGHT CONTACT ON THEIR EQUIPMENT IS THE PREFERRED SETTING:

Iowa State Study - Four Parameters:

	Visual Quality	Mowing Injury	Chlorophyll Content	Ethylene Production
SHARP with "LIGHT" Contact	**8.68**	**0.83**	**17.46**	**0.541**
SHARP with "NO" Contact	**8.20**	**1.85**	**15.73**	**0.593**
DULL with "LIGHT" Contact	**8.41**	**1.28**	**17.12**	**0.603**
DULL with "NO" Contact	**8.07**	**2.35**	**16.34**	**0.669**

Figure 1

Figure 2

Figure 3

Figure 4

The clean cut strands of grass pictured above are more indicative of results from properly maintained and sharp reels versus more tearing of the grass tissue with dull and poorly maintained reels

Pictures in figures 1, 2, 3, and 4 can be found in all four plots with the sharpness and adjustment settings that are described above, but the clean cut in Figure 1 was most prevalent in the sharp with light contact plot.

Figure 2 shows a clip of grass where the surface tissue of the grass was peeled, but the grass was not cut.

Figure 3 shows where the blade of grass was not clipped completely, but rather pulled apart.

Figure 4 represents the worst tissue damage where it was pulled apart and there is little cutting action that occurred. This was most prevalent in the dull and no contact plot.

WHY FOLLOW OEM RECOMMENDATIONS? "ONE SHOE" DOES NOT FIT ALL

While setting the cutting units with light contact may work best for one manufacturing design criteria and process, it does not mean that overall efficiency and results will be the same for the engineering criteria of a different manufacturer.

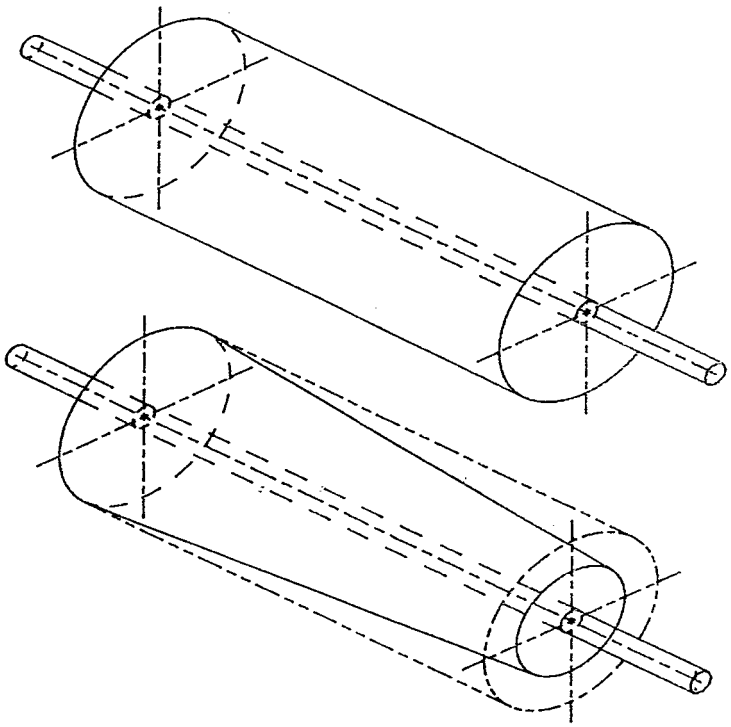
The manufacturers who advocate clearance have engineered and designed their product where cut quality and the longevity of producing a high quality of cut is best when a .001" to .002" gap is set for their cutting units. Anything more than this recommended gap setting can have adverse effects to cut quality and longevity, and anything tighter is not the optimal setting.

These same manufacturers understand that when the cutting units are on the turf and put into operation, it is possible to have light operational contact. If this occurs with their preferred setting, it is acceptable providing reel specifications are adhered to.

The rake angle, the bedknife position relative to center line, the hardness of the cutting parts, the frame and bearing designs, roller designs, weights of the cutting units, designed horsepower ratios for traction and reel drive systems, cutting unit down pressure, etc. will all play a role in the recommended adjustment practices.

These observations are not to imply that these cutting units will not function outside of the design parameters that are engineered into the system, but rest assured that you will minimize potential issues by following OEM guidelines.

ADJUSTMENT & OPERATIONAL WEAR



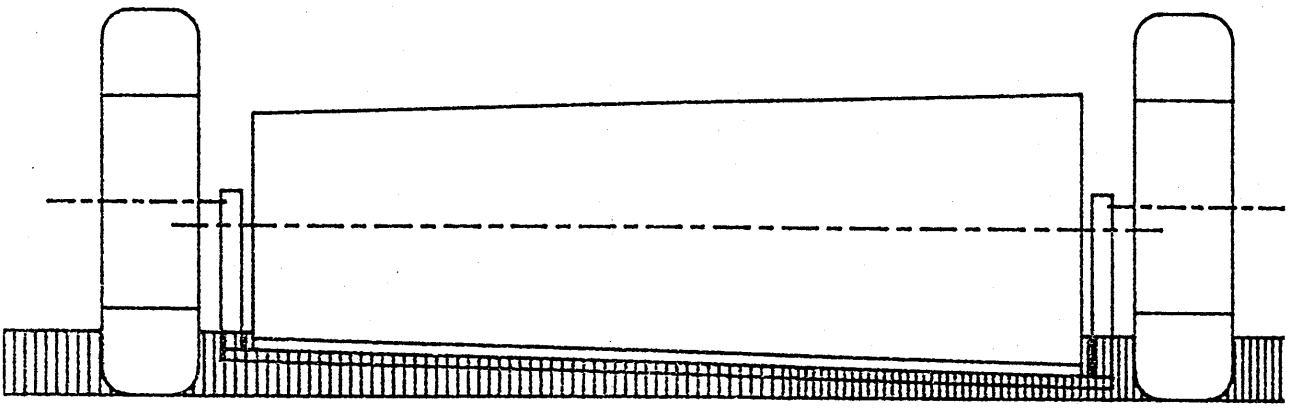
Even reels that are properly adjusted can start to lose their cylindrical shapes and become coned or tapered. As the "relief" wears away through the season and more surface of the reel blade passes the bedknife, the adjustments may accentuate inaccurate wear patterns.

WHY IS THIS IMPORTANT? The phenomena of “coning” can not only effect the blade path of the reel as it gathers grass over the bedknife, but it can introduce unwanted loads and twists into the cutting unit assembly. This can lead to faster wear on the bearings, shorten the life of the bedknife/bedbar assembly, and can increase torque on the frame of the reel.

WHAT EFFECT DOES TAPER HAVE ON ADJUSTMENTS? The taper can load the bearings of the reel as well as the bedbar shoe. This could effect the adjusted clearance that was set prior to the reels being dropped on the turf and put into operation.

All reels eventually become tapered with use. If the reel is not adjusted or ground to a cylinder shape again, a mismatch in the height of cut between adjacent reels can result.. *Excerpt from a Toro Publication*

“AFTERCUT APPEARANCE” AND A TAPERED REEL



This picture illustrates what happens
when a reel becomes cone shaped.

Care must be taken if twisting the bedknife or adjusting rollers to compensate for a tapered reel. You may be able to set equal heights of cut on a tri-plex or five-gang drive unit, but varying blade paths from one reel to another, and changes in the bedknife attitudes of each reel from end to end can alter the aftercut appearance of the turf.

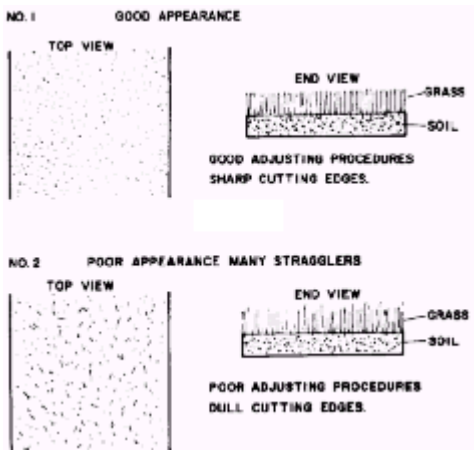
.010 of an inch difference in set-up with your reels, either in height from end to end, or from one cutting unit to another can produce a visible mismatch on putting greens.

THE REEL MUST BE GROUND BACK TO THE OEM CYLINDER SPECS IN ORDER TO ATTAIN THE OPTIMUM ENGINEERED CUTTING PERFORMANCE.

“AFTERCUT APPEARANCE” AND REEL RELATED ISSUES

A few reel related issues that do not involve sharpness:

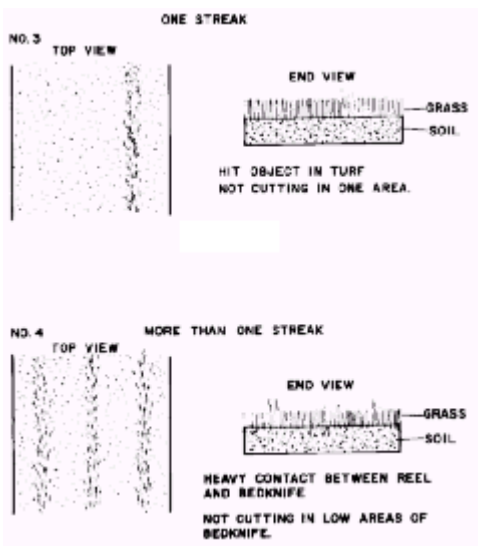
1) Clip rate incorrect for height of cut application
2) Cutting unit counterbalance or down pressure
3) Cutting unit alignment and ground following
4) Reel and roller bearings
5) Bedknife parallel to reel
6) Bedknife attitude
7) Rollers parallel to the reel



The first pattern illustrates good adjustment procedures and properly maintained cutting edges.

The second pattern shows many stragglers. This can be caused by:

· Incorrect bedknife to reel adjustment
· Dull cutting edges
· Mowing outside of the optimum clip rate
· Not using preparation devices – i.e.. set-up plate
· Inconsistent turf texture and density
· Using the wrong type of roller



The third pattern illustrates a single streak. This can be caused by:

· Rifled or uneven wear on bedknife
· Damaged area on bedknife from hitting an object(s)
· Loose bedknife screws
· Bent reel blade

The fourth pattern shows multiple streaks. This can be caused by heavy contact between the bedknife and reel, resulting in a “rifled” or wavy bedknife.

BACKLAPPING

- **It is recommended that backlapping be done on a regular schedule. It is more of a preventive maintenance procedure as you attempt to maintain high quality of cut standards.**

- **While backlapping will hone the edge, it should never be used to sharpen extremely dull or out of shape reels.**

OEM TECHNOLOGY

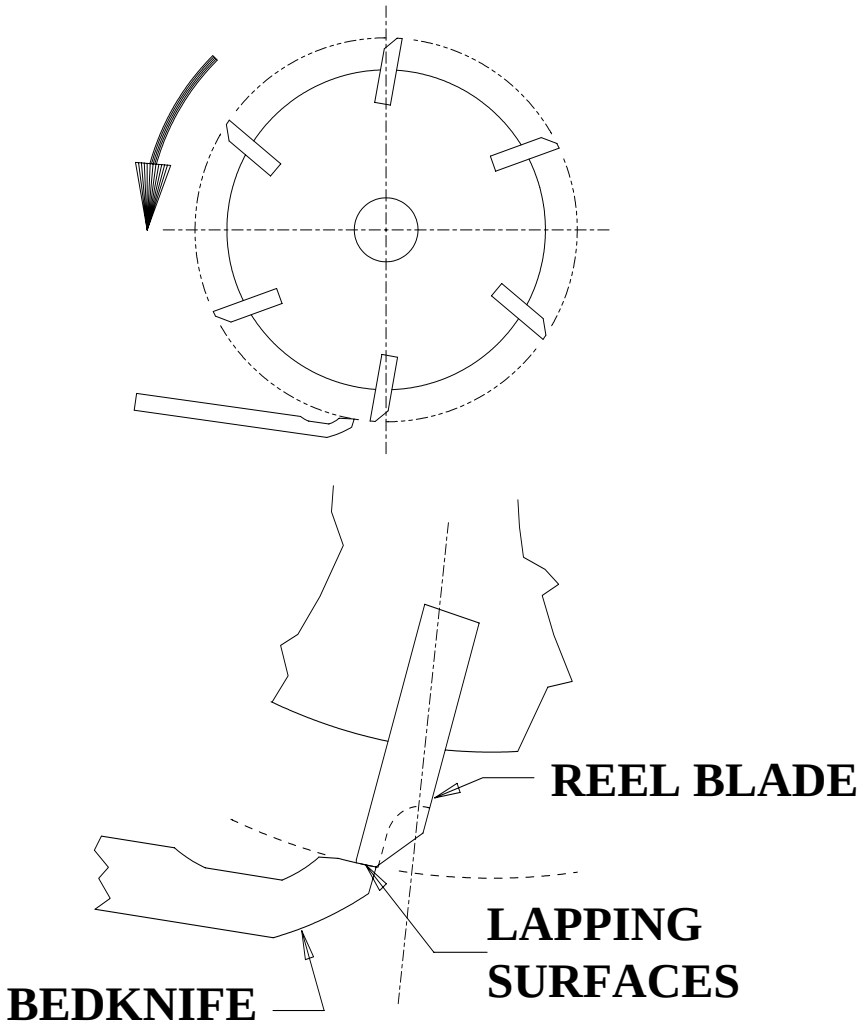
Most traction units are now manufactured with a backlapping mode on the machine. This allows for the capability to backlap and recondition the cutting units while they are still attached to the tractor.

If it takes more than 3 to 5 minutes to backlap reels, you will most likely need to grind the cutting units, because:

1) **The edges have rounded off severely enough where lapping will be ineffective in generating an edge**

2) **The OEM "relief" on the reel blades has worn away and lapping is not a viable option.**

BACKLAPPING

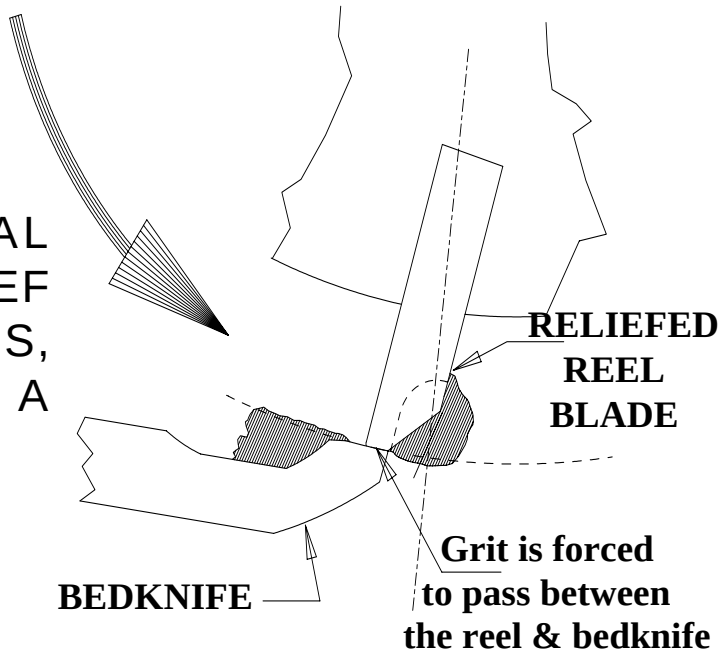


The correct procedure for backlapping will be to make light contact between the reel and the bedknife. The grit of the compound will pass between the top part of the bedknife that lies in the blade path and the surface width of the reel blade. This can be effective in bringing the cutting edges back to "square". When the cutting edges are rounded off too much, it will take much longer to remove enough metal to get to a "square" edge, and there can be greater wear on the bedknife.

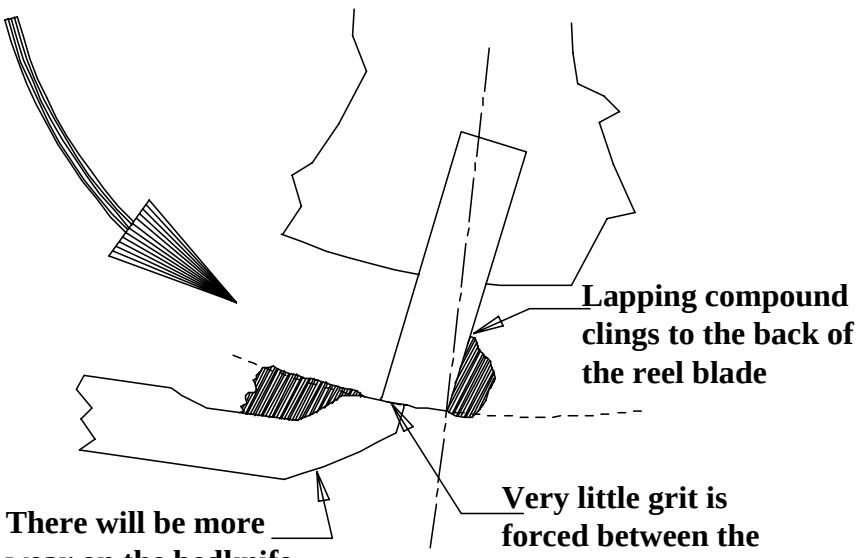
THE THINNER THE LAPPING SURFACE AREA OF THE REEL BLADE, THE LESS TIME IT WILL TAKE TO BACKLAP.

REEL DESIGN AND THE BACKLAPPING PROCESS

WITHOUT THE ORIGINAL REEL DESIGN WITH RELIEF ON THE REEL BLADES, BACKLAPPING IS NOT A REASONABLE OPTION.



REASON: The relief area on the reel blade provides a landing area for the lapping compound to adhere to. This enables the grit to be suspended on the reliefed area and is pushed between the reel and the bedknife, thus "effectively" removing metal.



On a flat ground or worn reel, there is so much surface area and metal to remove on the reel blade that it makes the lapping process ineffective and time consuming. This will also cause excess wear to the bedknife and will induce more stress time on the drive systems.

The most amount of metal that can be expected to be removed using an 80 grit compound is less than .005.

THE BACKLAPPING PROCESS AND COMPONENT WEAR

FACT or MYTH

BACKLAPPING WILL RUIN BEARINGS

FACT: Manufacturers choose bearings for specific applications, and the reel is typically designed for bearing loads to withstand ten times the loading which may occur for the lapping process.

> **Example: A tapered roller reel bearing used for a 5” to 7” diameter reel is capable of working under a radial load that ranges from 1,200 lbs. to 1,700 lbs. The load deflection for a bedknife to pass the compound grit during the lapping process is less than 100 lbs., substantially below the load ratings of the reel bearings.**

FACT: Heavy reel to grinding wheel impact that occurs during the grinding process induces more load on the reel bearings than lapping ever will.

FACT: If excessive water pressure is used to clean the compound off the reel, it is possible to push grit into the bearing housing area and potentially cause premature damage. Many newer reel designs have multi-lip seals to protect the bearing area from debris so this is not as big an issue as it was in the past.

FACT: If lapping a reel where relief does not exist (or a reel that has been spun ground only), there can be excessive wear on the bedknife.

FACT: When lapping, it is best to keep the grit evenly dispersed across the length of the reel. This will prevent compound from building up on one side of the reel and actively removing more metal in certain spots.

THE BACKLAPPING PROCESS AND CUT QUALITY

Four factors that effect whether backlapping will prove to be an effective practice:

1. How dull was the reel when you made the decision to lap? Remember, lapping is a preventive maintenance process. If you have let the reel go too long between lapping, then cut quality can suffer.

2. How much relief was left on the reel blade? The efficiency of the lap process will decrease as the season progresses, and if the relief has worn away, lapping will be less effective in generating an edge.

3. How long did you backlap? If you did not lap long enough to effectively put an edge on, then cut quality can suffer.

4. What is your backlapping procedure? If you do not stay with the reel for a brief period and keep the grit evenly dispersed, the quality and effectiveness of the process may not match expectations.

FACT: Cut quality will be best when freshly ground reels are put on the turf surface. When the dulling process begins, you can expect to maintain high quality of cut standards if reels are lapped on a timely basis.

FACING BEDKNIVES

Facing bedknives can be an effective method to improve your cut quality. Following are some quick facts about this maintenance process:

- Facing should not be conducted on certain bedknives because of a special hardening coat that is applied in some manufacturing processes. You should consult your OEM for their recommendation on bedknife facing.

- Try to be consistent on each bedknife when using a file or a facing tool for this practice. By doing so you can avoid gouging the bedknife front face, and the cut quality will be more consistent the entire length of the reel.

- Facing bedkives has nothing to do with your adjustment practices. This facing process can be effective in improving cut quality for units with “light operational contact” or “no contact”.

- Care must be taken so bedknives are not ground back too far during the life of a bedknife. If the front cutting edge is ground back too far in relation to the centerline of the reel, the attitude of the bedknife can be effected enough to change the geometry of the shear point and the intended optimum cutting unit position. This will be especially true when the reel diameter gets smaller due to grinding and wear.

REEL GRINDING (RESHAPING THE REEL)

THERE ARE THREE PRIMARY OBJECTIVES WHEN MAKING THE EFFORT AND TAKING THE TIME TO GRIND YOUR CUTTING UNITS:

PRIMARY GRINDING OBJECTIVES

- Grind to produce a sharp edge.
- Grind to remove any "cone-shape" that has developed through use.
- Grind the specified "relief" as originally designed from the OEM.

THESE THREE OBJECTIVES FOR REEL GRINDING CAN BRING YOUR REEL BACK TO "OEM - FACTORY NEW" CONDITION.

When Is It Time To Grind

Reel grinding should be done when the adjustment and backlapping procedures are no longer effective, and the grass is not cut cleanly. By checking the cutting edges of the reel blades and bedknife, you can visibly see if the relief is gone, and you can physically inspect them to see how rounded off and dulled the edges are. There are some "general" time frames that can be estimated for grind intervals and they are as follows:

8" - 10" Diameter ROUGH MOWER reels: Should be backlapped "as needed"; if estimated use totals 15-20 hours of cutting per week, this will yield a need to grind approximately every 400-500 hours, or once every six to eight months.

5" - 7" Diameter FAIRWAY/TRIM reels: Should be backlapped "as needed"; if estimated use totals 20-30 hours of cutting per week, this will yield a need to grind approximately every 375-425 hours, or once every four to six months.

5" Diameter GREENS & TEE MOWER reels: Should be backlapped "as needed"; if estimated use is five to seven times per week, averaging 15-25 hours of cutting time, this will yield a need to grind approximately every 200-250 hours, or once every three to four months.

Excerpts from Textron publication

The grind intervals noted above are strictly estimates. The need to grind will depend on course conditions, top-dressing practices, adjustment and backlapping/non-backlapping practices, and ultimately, the judgment of desired cut quality.

REEL GRINDING

Prior to grinding a reel, the mowing unit must be prepared. This preparation is very important and should be performed when using "Manual" single blade grinders or "Spin" grinders.

ALWAYS INSPECT:

- *REEL BEARINGS* - **They must be in good condition and properly adjusted to assure that the reel assembly spins true to the reel axis. There should be zero end-play, and no movement up and down with the reel. Most OEM's have a spec for bearing pre-load, which is the amount of force it takes to turn the reel.**
- *ROLLER BEARINGS* - **Front and Rear rollers must be checked, because movement of the reel while grinding will have an effect on the quality of the grind. In the field, the condition of the rollers will effect the overall performance of the cutting unit.**
- *GEAR CASE SEALS* - **Replace if applicable.**

ALWAYS DO:

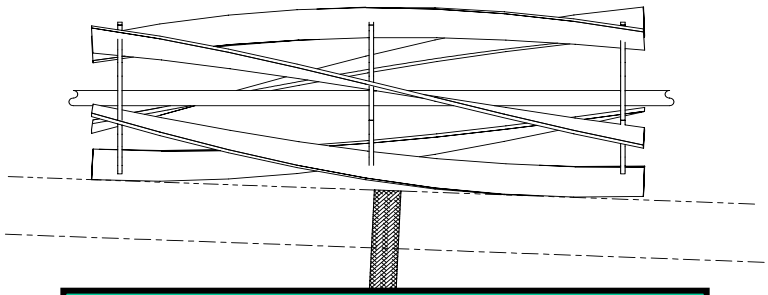
- **Thoroughly clean the reel, removing grass and debris off the blades and bearing areas.**
- **Verify that the reel spins freely in the frame with no “sticking” spots.**
- **Inspect the reel for bent and broken blades. When trying to straighten out severely bent blades, avoid having to heat the blades if possible. Be careful that the blades do not crack, and/or pull away from the weld in the spiders.**

Reels should be ground in-frame and go through the inspection listed above. This not only minimizes the effort needed to prep the reel for grinding, but the reel winds up being ground in the same bearing position within the frame as it will be when in operation.

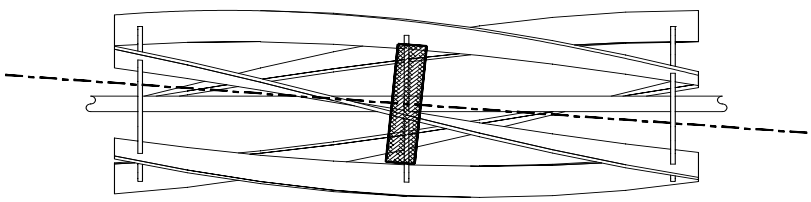
GRINDER TO REEL ALIGNMENT

Quality Control - Removing Taper in Reels

To CYLINDRICALLY grind the reel, the reel must be ACCURATELY ALIGNED in both a HORIZONTAL and VERTICAL plane.

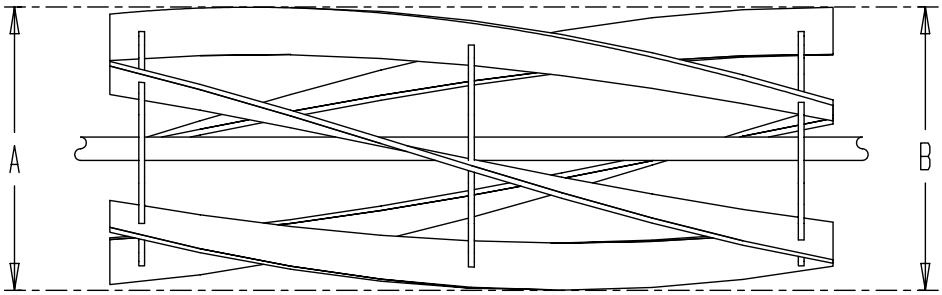


Horizontal Alignment

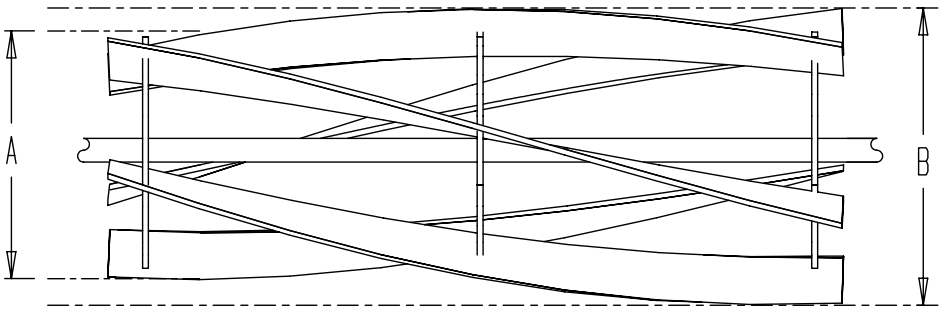


Vertical Alignment

On some reels, the window of adjustment allowing for taper is relatively small. Taking time to properly grind a true cylinder will minimize the potential for problems, including adjustment issues, quality of cut issues, or “aftercut” appearance issues.



If diameters A and B are equal, the reel is CYLINDRICAL.



If diameters A and B are not equal, the reel is CONICAL.

NOTE : Always correct a conical shaped reel by grinding.

These diagrams illustrate how most reels become cone shaped after they are used for a season. Due to the helical shape of the reel blade, natural abrasion, and reel adjustment, cone shaping occurs. In order for this problem to be corrected, the center shaft of the reel must be aligned, so that it is parallel to the grinding wheel. If this is not done, the chances of taking the complete cone shape out of a reel is improbable.

TWO KEY ELEMENTS PRIOR TO GRINDING

- **Reel prep work assuring quality condition of bearings, etc. as specified under "Always Check" & "Always Do".**
- **Proper Alignment that will allow for an OEM "Cylindrical" grind.**

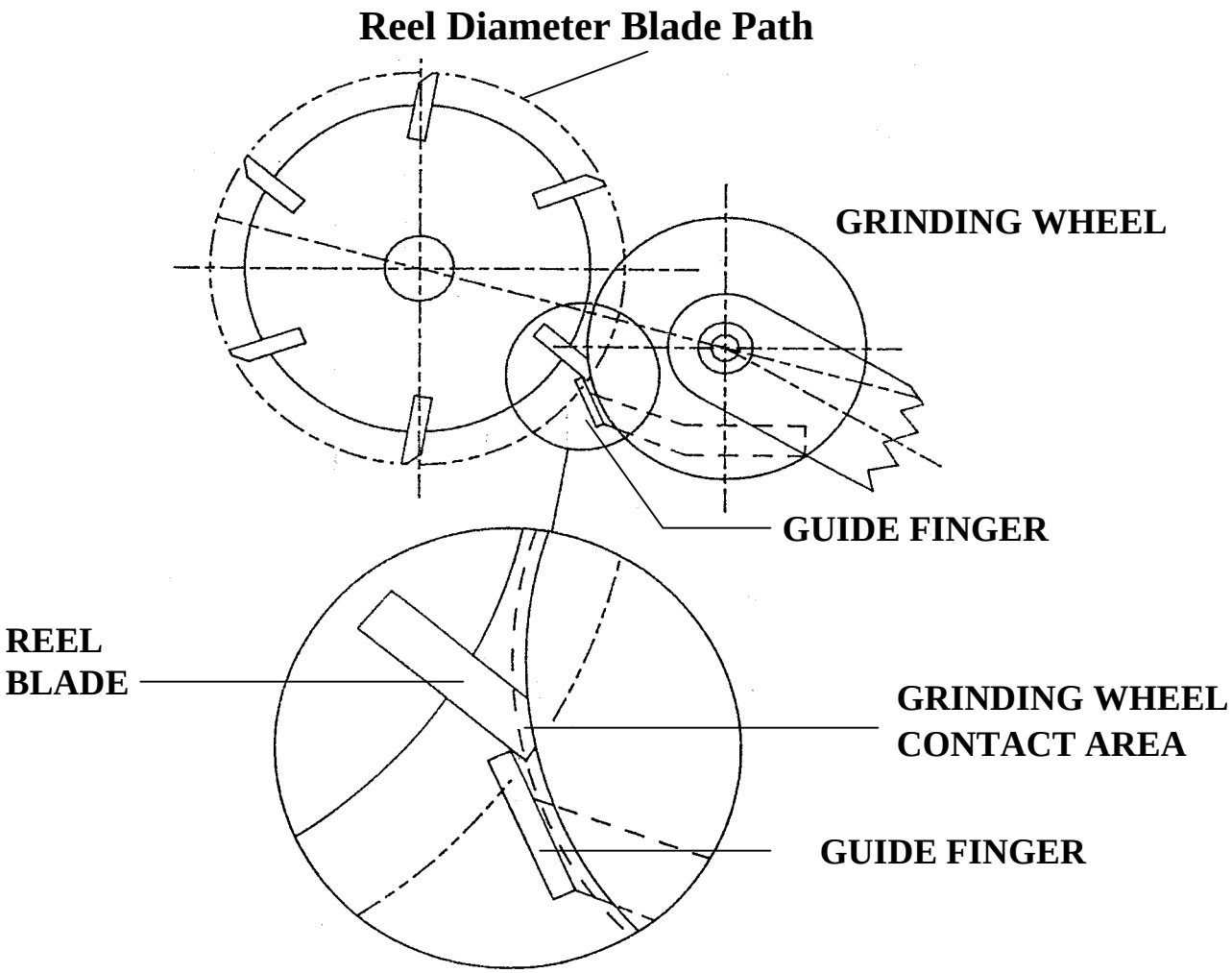
THREE FORMS OF GRINDING

» ***SINGLE BLADE*** **- Grinds one blade at a time to a sharp edge.**

» ***SPIN GRINDING*** **- Rotates the reel and puts ALL reel blades on the same cutting circle.**

» ***RELIEF GRINDING*** **- The secondary grind process for spin or single blade grinding.**

SINGLE BLADE GRINDING



These pictures demonstrate how a reel is set up on a single blade grinder to achieve the desired angle on the edge of the blade. The grinding wheel turns and the reel does not as each reel blade is ground separately. The height of the grinding wheel will dictate the angle on the reel blade, as the reel blade rests on the guide finger.

NOTE: By raising the grinding head position, you will get less of a relief angle, and by lowering the grinding head, you will get more of a relief angle. Adjusting the grinding stone position up or down will allow the operator to match the OEM "relief" specification

These pictures illustrate various angles that can be put on the end of a reel blade.

Figure 1: This is a normal angle ground on a single blade grinder and is called a **"FULL RELIEF"** angle

Figure 2: Shows the preferred edge found on most new cutting units. It also shows an **"AVERAGE RELIEF"** angle.

Figure 3: Shows what a blade will look like after a season of wear.

Figure 4: Shows a flat grind or what a blade looks like after it has been spun ground.

Figure 1

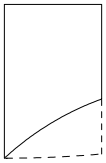


Figure 2

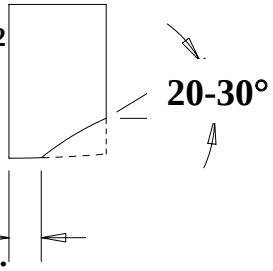


Figure 3

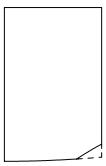


Figure 4

An optional method of single blade grinding which requires a much higher skill level is to make the initial grind a near flat grind, but making sure you are grinding from front to back with an approximately 3-5 degree back relief angle as illustrated below.

Figure 5: Shows an initial near flat grind, but care being taken to go toward the back edge at a 3-5 degree angle.

Figure 5

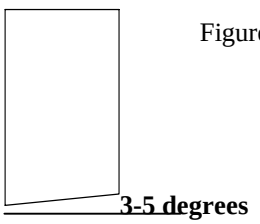


Figure 6

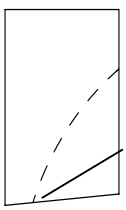


Figure 6: The dashed line on the reel blade illustrates the "milled-in" relief area of a greens or tee mower. The solid line shows the secondary relief that can be attained by lowering the grinding head after grinding to a sharp edge with the near flat grind as illustrated in figure 5.

This method of grinding will establish a sharp edge with fewer passes, and when establishing the secondary relief angle, you can save some of the life of the blade.

IT IS VERY IMPORTANT TO A QUALITY GRIND THAT A STAGGERED GRINDING METHOD IS USED TO ACHIEVE A UNIFORM BLADE HEIGHT.

SPIN GRINDING

SPIN GRINDING A REEL ACCOMPLISHES TWO THINGS:

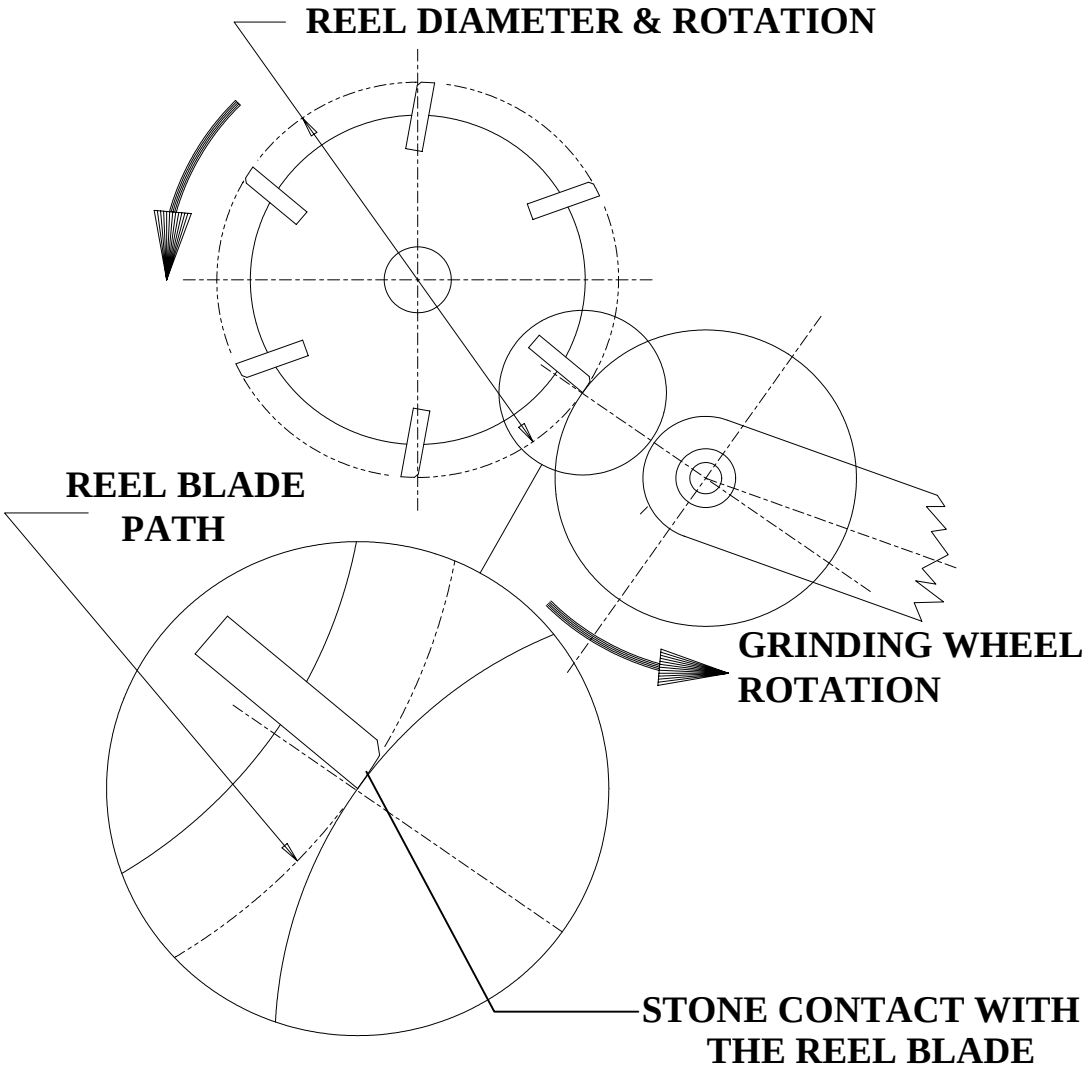
- ***Sharpens the front leading edge***
- ***Brings all of the reel blades on the same cutting circle***

While Spin grinding serves the purpose of generating a sharp edge, it is only 1/3 the formula in re-shaping the reel to the optimum OEM design. Some general statements which apply to spin grinding:

1) Try to always travel off the reel and then come back onto the reel to change directions. Reversing directions on the reel will remove more material on the ends during the delay, possibly making for a less-uniform grind.

2) Spin grinding DOES NOT ensure grinding the reel to a cylindrical shape from end to end. Properly aligned reels will have all reel blades on the same cutting circle and will have an equal diameter at each end.

3) The outside diameter of each reel blade is an arc in relationship to the cutting circle and blade path of the reel. The spin grinding process produces similar shaped blades regardless of grinder types and traverse designs.



This picture shows how the edge of a reel blade is ground on spin grinders to achieve a sharp edge. Note that both the reel and the grinding wheel rotate in the same direction, causing opposite directional contact at the grind point. This will yield a better grind performance in producing a sharp edge.

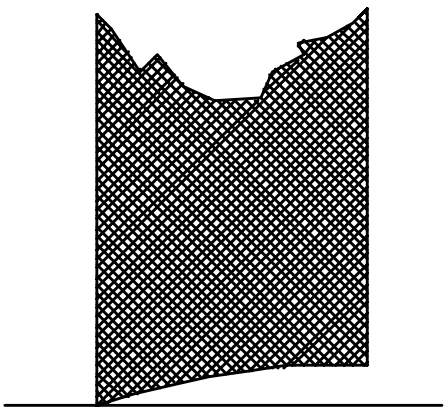
SPIN SPEED : *SPIN SPEED is determined by the diameter of the reel and the number of reel blades. There is an optimum "spin speed" for every reel where the operator can aggressively grind, yet get a smooth grind.*

The SPIN GRINDING Process and RESULTS

Grinding head traverse designs: There are basically three primary traverse designs in the field:

- Spring loaded dual infeed handwheel system with a grinding wheel driven on a live shaft.
- Rigid dual infeed handwheel system with a grinding wheel driven on a live shaft.
- Single point infeed systems with a rigid mount for the grinding wheel on a carriage.

Testing has shown that each of these spin grinding traverse systems will spin grind a reel with the shape of the ground land surface area having a similar tip shape, and a slight deviation from the front cutting edge to the back of the reel blade. The spring loaded live shaft produced the greatest amount of deviation, while sparking out produced the least amount.



A concave grind as illustrated above does not occur with any grinding traverse system that was tested.

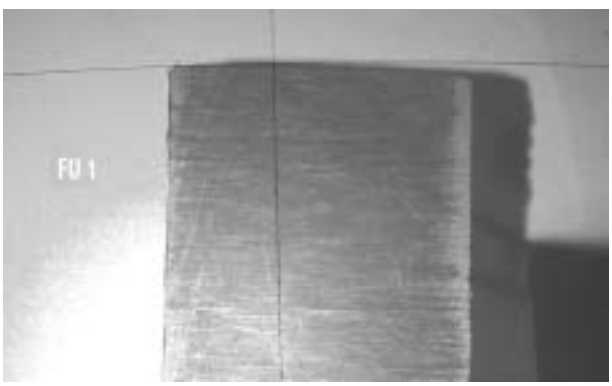


PHOTO # 1

FOLEY UNITED ground reel: The deviation from the front cutting edge to the rear of the reel blade is .0073” in relation to the cutting path of the reel blade.

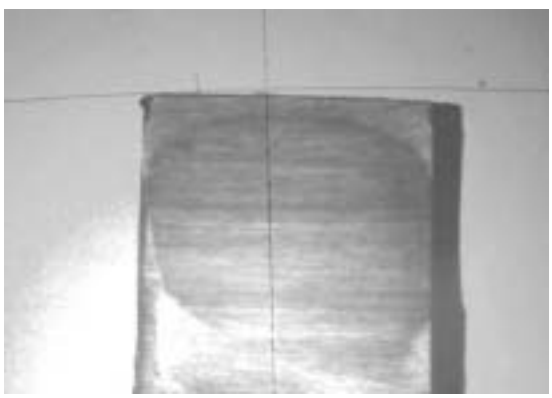


PHOTO # 2

EXPRESS DUAL ground reel: The deviation from the front cutting edge to the rear of the reel blade is .0085” in relation to the cutting path of the reel blade.

SPIN GRINDING and DESIRED RESULTS

PHOTO # 3

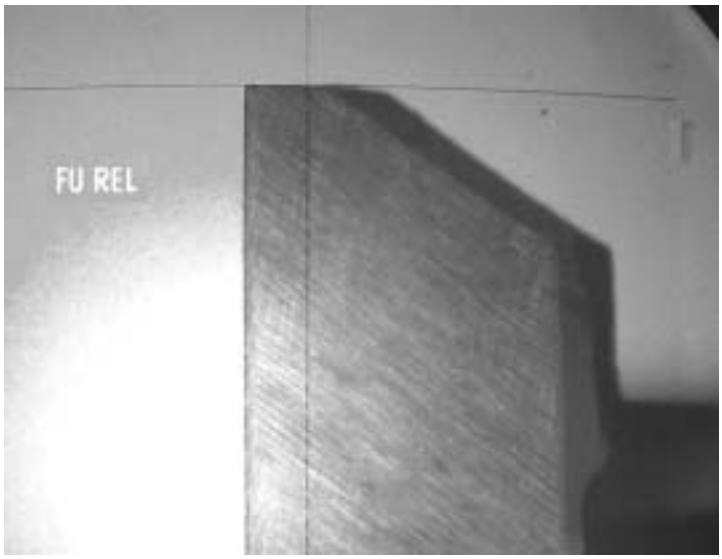


Photo # 3 above is an aftermarket Foley United grind. The reel was spun ground to a sharp edge and the secondary relief was reground in. This shape is one of the primary objectives when taking the time to grind.

PHOTO # 4

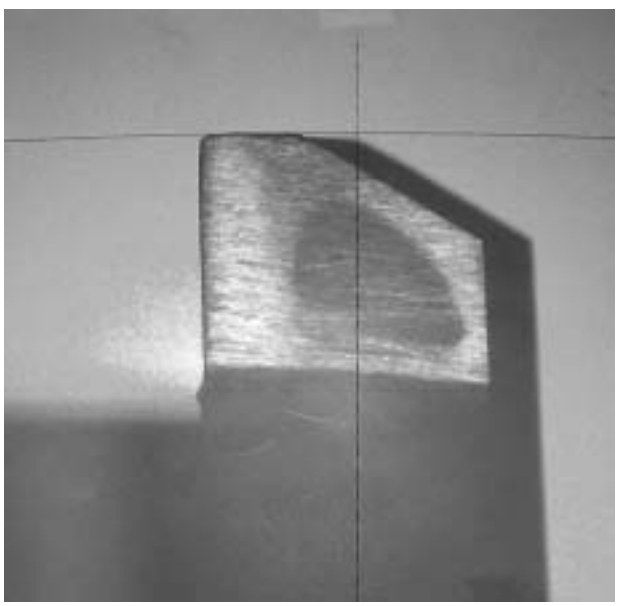
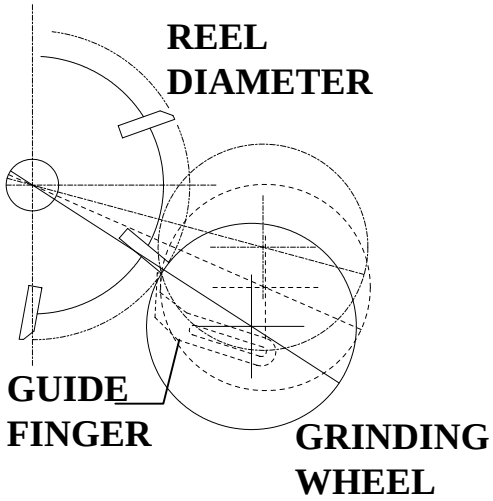


Photo # 4 above is a NEW OEM DESIGNED blade as it looks from the manufacturer. The relief portion of the reel reduces friction and stress on the hydraulic, engine and drive systems, and will reduce the grind frequency through the course of a season.

“RELIEF” GRINDING ON A SPIN GRINDER

RELIEF GRINDING ON AN “UPRIGHT” STYLE SPIN GRINDER

This picture illustrates that the grinding stone feeds from the front of the grinder. By repositioning a grinding wheel at different heights with a “guide finger”, you can relief grind the back edge of a reel blade. Lowering the grinding head allows the reel blade to drop deeper between the stone and the finger, providing a steeper relief angle. By raising the grinding head, the reel blade will rest in a flatter position as it is trapped between the stone and the finger, thus providing less of a relief angle.



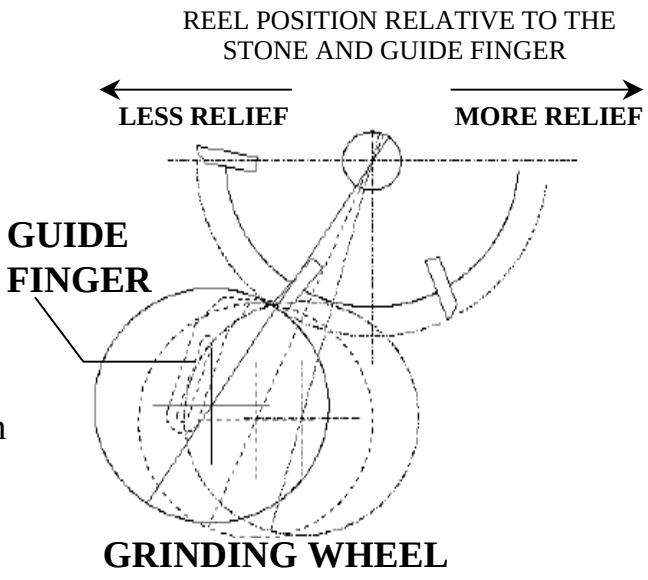
GENERAL RULES - Whether you are using an “UPRIGHT” or “TABLETOP” spin grinder – it is preferable to:

1) **CHECK FOR STONE CLEARANCE WITH FRONT ROLLER.**
2) **CHECK FOR STONE CLEARANCE WITH THE BLADE ABOVE THE ONE YOU ARE RELIEFING.**
3) **CHECK YOUR RELIEF ANGLE.**
4) **CHECK STONE AND FINGER CLEARANCE WITH THE SIDE FRAME OF THE REEL.**
5) **SPIN GRIND FIRST TO REMOVE TAPER.**

RELIEF GRINDING ON A “TABLETOP” STYLE SPIN GRINDER

This picture shows that the grinding head will feed up from the bottom of a “tabletop” style reel grinder. The relief angle can be changed one of two ways:

1) Repositioning the reel on the machine in a horizontal plane.
2) Repositioning the guide finger in relation to the grinding stone.



“RELIEF” GRINDING & EFFECTS

What effect does the “relief” have on the strength and integrity of the reel blade?

When following OEM specifications, reducing the blade thickness at the tip of the reel blade will have an insignificant impact on the strength and integrity of the reel blade itself.

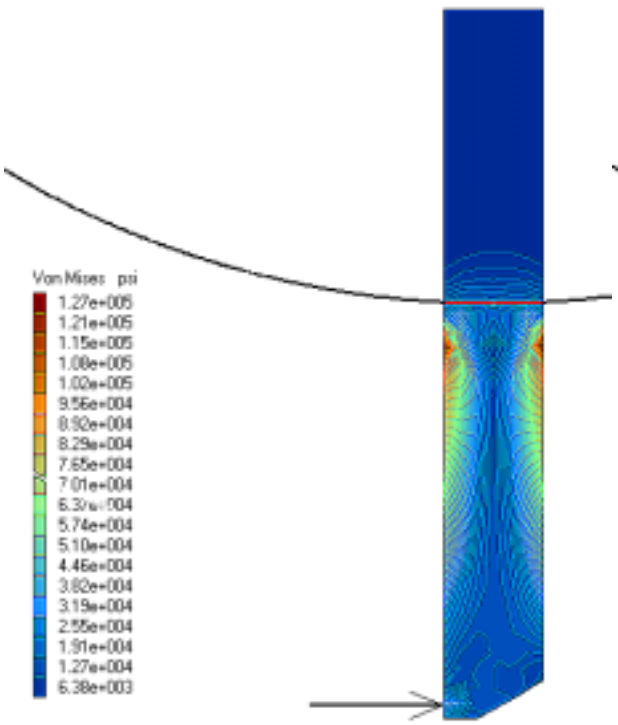


FIGURE 1: Reliefed Reel Blade

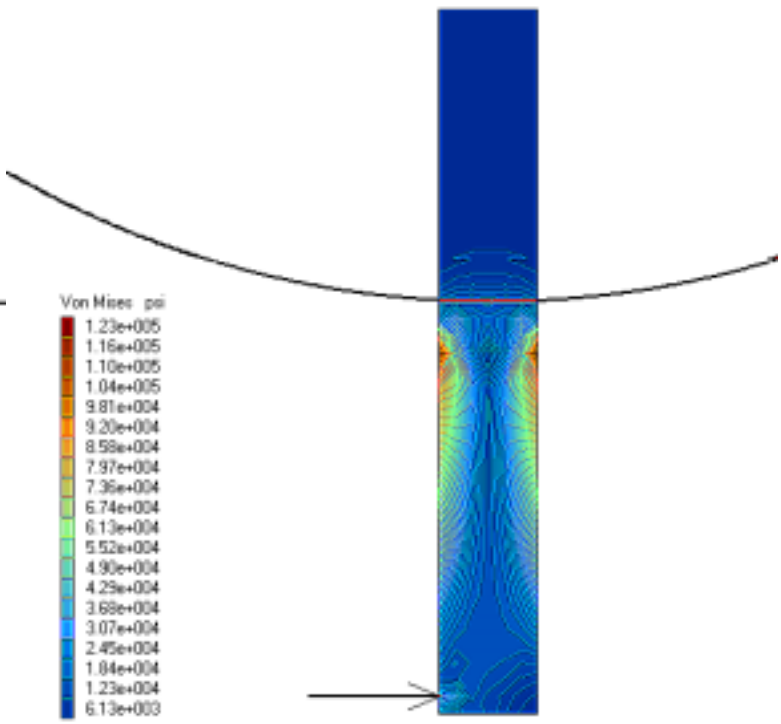


FIGURE 2: Flat Ground Reel Blade

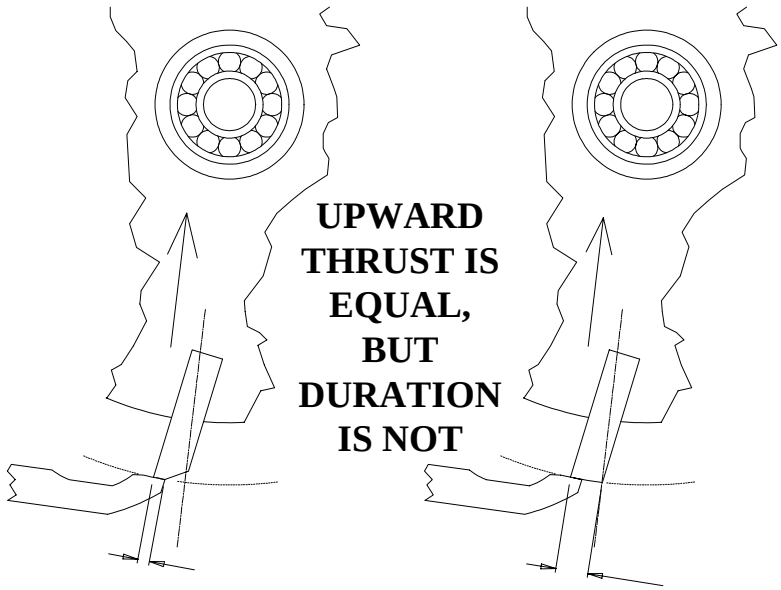
A stress analysis comparing the impact of a piece of solid debris on a reel blade reveals that the stress area effected does not reach the rear two thirds of the blade. The test illustrations above shows that the greatest stress is produced up the reel blade toward the spider. The tighter lines and lighter colors indicate the greatest points of stress.

If you grind the relief out to a “point” where there is no flat land area, you will weaken the cutting edge and make it more susceptible to damage. However, when grinding the reel to an OEM shape with the specified land area and the proper relief angle, the damage that occurs between reliefed and flat ground reel blades will be similar in severity.

“RELIEF” GRINDING & EFFECTS

What effect does the “relief” have on the wear of bearings?

Reducing the blade thickness by ¾ has been said to reduce the torque required to turn the reel by a factor of 16 and as a result, the vertical thrust on the reel bearings also increases by a factor of 16.



¼ surface area generates less duration with interference

The wider the surface area, the greater the duration

Reality is that the vertical thrust applied to the bearings is a function of what passes through the reel and bedkife gap (ie. grass, lapping compound) or is a function of interference (ie. light contact). There is no change in the amount of upward force when comparing a reliefed reel to a spun only reel, but the duration that the force is applied is greatly reduced with relief on the reel blade. This is illustrated by the reduction of horsepower needed to rotate a reliefed reel when grass is passed between the two parts (assuming the gap or light contact comparison is the same).

What effect does “relief” have on the dulling process of the reel and bedknife?

It has been thought that the added vertical thrust initially described above causes the bearings to oval over time, resulting in a fine vibration that will round off the edges of the reel and bedknife.

Reality is that the vertical load rating for reel bearings is significantly lower than what they are rated for in their use. If damage to the bearings is occurring where they become oval shaped, you can correctly assume that the relief on the reel blade has nothing to do with the bearing wear. Bearing failure is typically a function of lubrication, or lack thereof, and life.

BEDKNIFE GRINDING

Every time you grind the reel, you <u>should</u> also grind the bedknife. If you do not, the reel to bedknife clearance may vary from one end of the reel to the other, and thus could effect the "quality of cut".

TWO BEDKNIFE GRINDING OPTIONS:

1) **Regrinding a used bedknife.**

2) **Replacing the bedknife and grinding the "new" bedknife.**

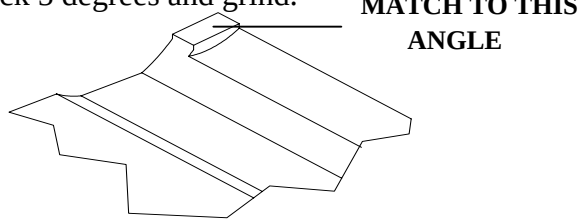
GRINDING A USED BEDKNIFE

Preparation for grinding a used bedknife:

- Use a wire brush or pressure washer to clean the bedknife & bedbar assembly.
- Inspect the bedknife/bedbar assembly to assure that it is straight and true by using a high quality straight edge. A warped bedbar will greatly reduce bedknife life.
- Establish the correct angles according to the OEM specification.

The methods to do this are:

1) **Correct or Best Method -** Establish the recommended angle from the bottom of the bedknife
2) **2nd Choice -** Match the old angle on end of the bedknife. See illustration.
3) **3rd Choice -** Find worn surface, tip back 5 degrees and grind.



GRINDING A NEW BEDKNIFE

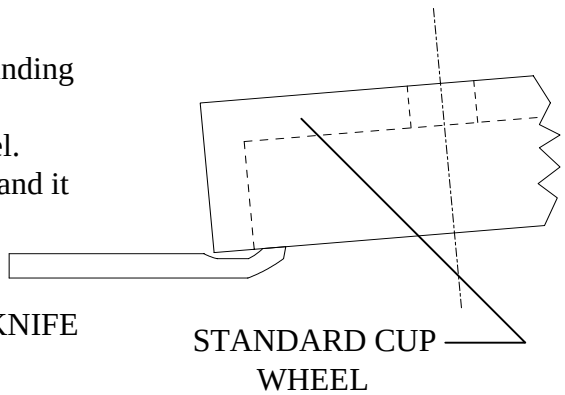
Replace the bedknife when it is worn to the point where it can no longer be reground with a correct relief on the top surface. All "new" bedknives should be ground because the torque of the bedknife mounting screws will distort the bedknife when installed onto the bedbar.

- Remove the old bedknife from the bedbar. Use a wire brush or pressure washer to clean the bedknife & bedbar assembly.
- Inspect the bedbar for flatness and distortion by using a high quality straight edge. If it has been damaged or cracked- replace it. In some cases, it is feasible to grind the bedbar surface straight and true.
- Install the new bedknife per mowing unit manufacturer's recommendation. This is normally done by applying an anti-seize lubricant to the screw threads, and installing the bedbar screws with a torque wrench. Tighten the screws from the center holes in the bedknife first and work out toward each end. This will prevent the bedknife from distorting from torque on the bedbar.
- Grind the minimum amount necessary on the bedknife until the knife is at the correct angle and the cutting edge is straight the entire length of the knife.

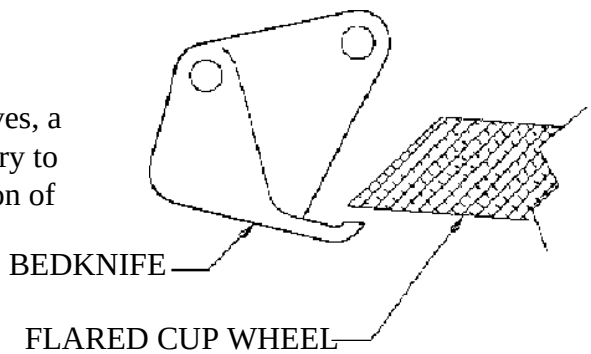
KEY ELEMENTS OF AN EFFECTIVE QUALITY BEDKNIFE GRIND

* **Control heat buildup so it never exceeds a comfortable touch. If your grinder does not have a flood coolant system, take a bucket of water and a rag (sponge,etc.), and rub the wet rag across the bedknife with each pass to keep it cool.**
* **Always pass off the ends of the bedknife for a uniform grind.**
* **Never remove an excessive amount of material with one in-feed of the grinding wheel. This could reduce the temper of the metal of the bedknife.**
* **Sparking out will result in the most uniform grind possible.**

This picture shows the position of a standard cup grinding wheel when in use. Note that the full surface of the bedknife is covered by the face of the grinding wheel. There may be some cases where this is not possible and it will be important to dress the grinding stone.



This picture shows that on some bedknives, a special flared cup wheel may be necessary to avoid hitting the “ears”, or casting portion of the bedbar.



Dressing the grinding wheel is important to the quality of grind. A grinding wheel which is loaded will cause excessive heat build up and can cause an irregular grind. The best dressing method is a diamond dresser rigidly mounted in relation to the grinding wheel. Other methods which can be used are hand held diamond dressers and hand held dressing bricks. Hand held dressers are difficult to use and makes it more difficult to achieve an accurate wheel dressing.

ROTARY BLADE GRINDING

PRIOR TO GRINDING PROCEDURES

Follow these instructions, to correctly sharpen Rotary Lawn Mower Blades.

1. *CLEANING:* ***A*** rotary mower blade which has a buildup of dirt and dried grass clippings can not be properly sharpened or balanced.

To clean your blade follow these steps:

1. Put on safety glasses
2. Scrape off the heavy grass buildup with a flat scraper.
3. Use a wire wheel on a bench grinder or a wire brush by hand to finish cleaning.

2. INSPECT THE BLADE: If the blade is bent, twisted, or cracked, it must be replaced. A blade can be checked for cracks by performing a ring test. If you put the blade on a small horizontal steel pin and then tap it with a hammer it should ring. If it is cracked, generally it will not ring and should be replaced. Do not attempt to straighten or repair a bent, cracked or twisted blade. The use of such a blade could present a serious safety risk.

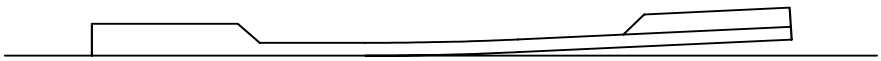
3. *GRINDING:* With the motor off, match the cutting edge whenever possible. On most rotary blade grinders this can be accomplished by either raising or lowering the stone in relation to the base that the blade rests on, or there is a stationary stone with an adjustable blade guide. The cutting edge angle should be approximately 30 (thirty) degrees. If it is not, adjust the blade guide and/or the depth control until the desired bevel is achieved.

NEVER overheat the blade during grinding. You can quench the blade in water to keep it cool.

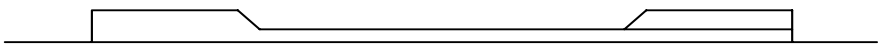
ALWAYS balance the blade. You can do this as you are grinding for less correction at the end.

Grind the same area of the blade as the manufacturer had ground when new.

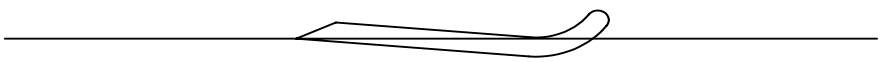
ROTARY BLADE DAMAGE



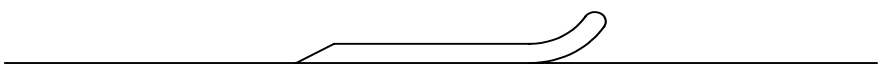
Warped Blade: This should be replaced as it can cause vibration and significant premature damage to the spindle assembly.



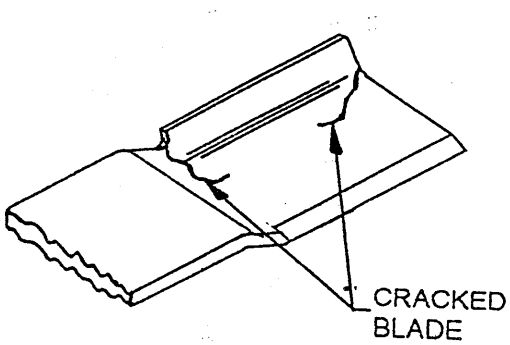
Straight Blade: This is the correct condition.



Twisted Blade: View the end of the blade and make sure that there is no twist. This can cause damage to the spindle assembly and will negatively effect the dispersion of the grass clippings.

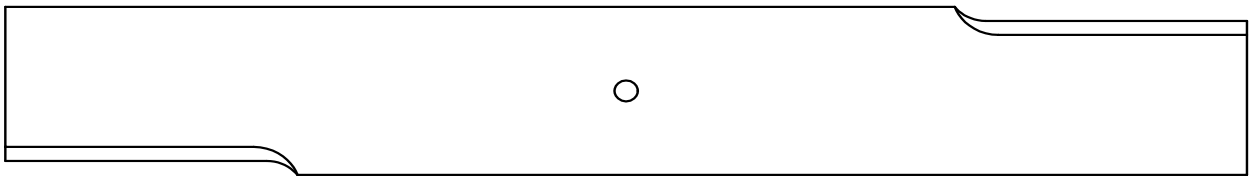


The end view inspection of the blade reveals that the blade is not damaged/twisted and "lifting capacity" of the blade will be correct.

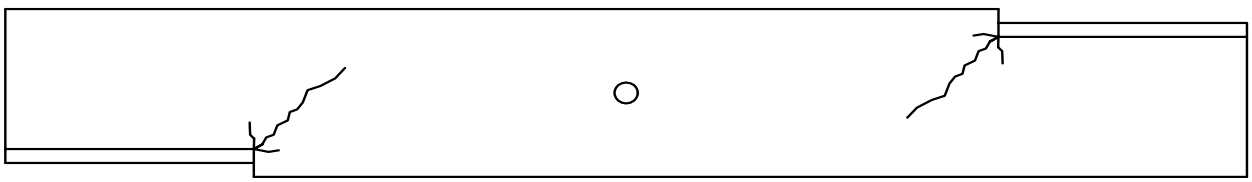


Beware of cracks that are in the blade

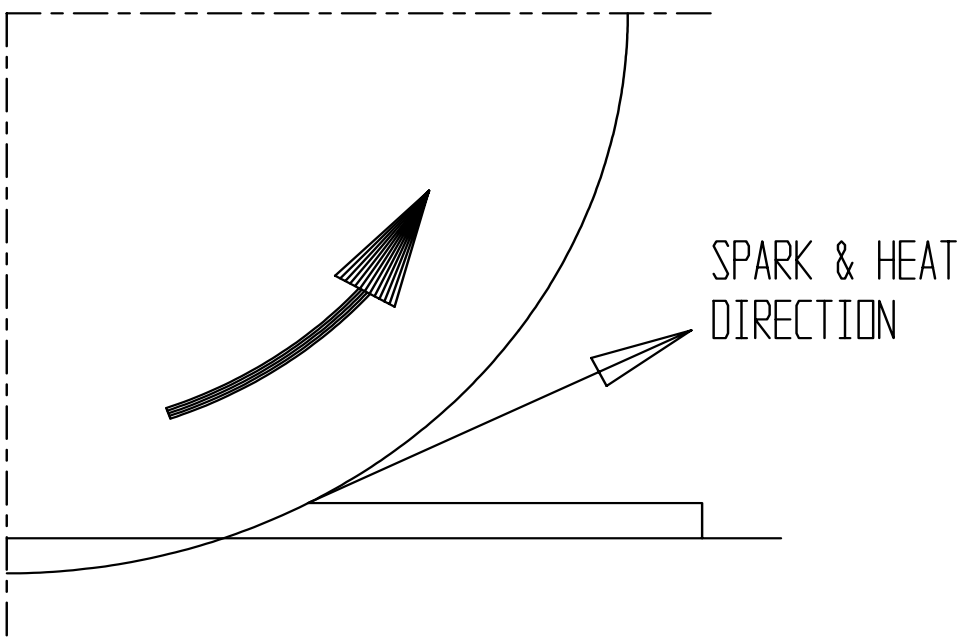
PROPER GRINDING TECHNIQUES



Grind at an angle with the blade being careful not to generate a step grind as illustrated below



A step grind in which the cutting edge is ground at a perpendicular angle can create stress points, making the blade tip area more susceptible to cracking. A "hook" grind can have this same effect where if the tip hit something hard, it is more prone to cracking and/or breaking off.



You would like to have the rotation of the grinding wheel to send the sparks away from the cutting edge of the rotary blade. This can help minimize the heat build up that occurs at the very tip, preventing it from losing the hardness, or temper, of the blade.

HOLE CUTTER SHARPENING

Cutting a hole with a dull cutter will tear the root system rather than cleanly cutting the root system. Torn roots will cause brown rings or halo effects on the greens. The way to avoid and/or correct this problem is to keep the hole cutter blade sharp so it is cutting and not tearing.

Hole cutting is done with a cutter of one of three general types:

- **3 Scallop Cup Cutter**
- **4 Scallop Cup Cutter**
- **Straight Bottom Cup Cutter**

There are three primary methods to keep the cutter blade sharp:

1. **<u>Hand Filing</u>: Hand filing is time consuming and inaccurate. Additionally, because of the time required, it is not often done on a regular basis.**

2. **<u>Blade Replacement</u>: A good method, but due to the cost of replacement blades, there is a strong tendency to use blades after they have dulled for an extended time.**

3. **<u>Use of a Hole Cutter Sharpener</u>: There are cutter sharpeners with the proper designs that can sharpen 3 Scallop, 4 Scallop, and straight hole cutters.**

SHARPENING WITH A HOLE CUTTER SHARPENER

1. Clean inside and outside surface of the hole cutter shell.
2. Examine the tips on the hole cutter shell, if any tips are bent, they must be realigned straight with the outside diameter of the shell.

   NOTE: The tip surface is hardened, so be careful not to break tip while straightening.
3. Draw a line down the center of each lobe, approximately 4" long with a black grease pencil or marker. Number each line in order.
4. With the motor OFF insert the shell into the hole in the grinder. Line up the #1 line with the pointer on the machine base. Make sure the plunger stop plate engages the cup plunger and pushes it back away from the grinding disc.
5. Push shell against the grinding disc and back off approximately 1/4".
6. Turn ON the motor and grind lobe #1 in short, light and smooth strokes.

NOTE: The entire hole cutter cutting edge is hardened. When grinding aggressively on the cutting edge, it causes heat buildup. Excess heat buildup causes a softening of the metal and permits a burr to roll over to the outside diameter of the cup. Take quick grinding strokes to minimize heat buildup. Excessive and/or rapid stock removal in one pass creates excessive heat and can also soften the hardened shell.

7. Rotate to the #2 line and remove an equal amount of material as in previous steps.
8. Rotate to the #3 line and remove an equal amount of material as in previous steps.
9. Rotate to the #4 line, if applicable, and remove an equal amount of material as in previous steps.
10. Turn motor off, check to see if all the tips have been completely re-ground and that an equal amount was ground off each lobe. Regrind if required repeating Steps 6-9.

NOTE #1: Watch the spark pattern for full grinding disc contact. This will help in grinding each lobe equally.

NOTE #2: After grinding a few shells, you'll develop a feel for how much metal is being removed and it will become easier to grind each lobe equally.

NOTE #3: If the metal edge turns color after grinding, remove less metal on each stroke to remedy this problem.

NOTE #4: Keep a sharp edge on the shell by sharpening more often. This will lessen the amount of material needed to be removed during each sharpening. This would also help the problem of burning metal and grinding too much in one pass.

GRINDING IMPORTANCE AND REVIEW

What role does having a grinder play at a golf course?

There is a direct relationship of having dull versus sharp reels and the aftercut appearance of the turf. If you are trying to raise the aesthetic standards at your course, cut quality will make a difference.

You have quality control of the cutting units that are put on the turf and this provides the flexibility to grind when you want to.

There is a reduction of downtime due to waiting on reels to get back from an outside source.

What kind of justification is there for investing in a grinder or upgrading to newer technology?

If purchasing a grinder for the first time, it is important to look at your overall budget and the number of cutting units you are responsible for. There are many makes and models with varied prices so even if you have few reels (i.e. less than 20), there are machines that will make the most of limited investment dollars. Simply make sure your purchase today will provide the flexibility to meet the demands of tomorrow.

This is a purchase that will be capable of re-conditioning every cutting head you have no matter what the make is. When put in perspective as a purchase compared to greens and fairway mowers, this is a long-term investment and will cover ten to twenty years. When you own your grinders, you can control cut quality on demand by having the ability to grind whenever you want.

If using manual machines, a “spin” grinder will free up the technician, allowing them to perform other tasks while the machine does the work. This will not only improve the quality of the grind, but will eliminate the need to backlap after the grind process (only if you have also ground your bedknife.

The auto-index relief systems that are now available on a few of the “Spin’ grinders will reduce the labor involved in what was once a very time consuming process. The “hands-free” relief process can increase the overall life of your traction and cutting unit systems, will make the adjustment process more effective for a longer time frame, and will reduce the grind frequency. The newer technology of these types of grinding machines allow for more flexibility to do quick touch-up spin grinds when wanted and allows for factory relief when the operator feels that time permits.

DEFINED TIME: MANAGING QUALITY AND EFFICIENCY

If you had a technician that changed the oil in your fairway or greens traction units, but neglected to change the oil filters because they were hard to get to and would take extra time to perform the task, what would be the reaction?

The machines will still run with the new oil and a dirty filter, and in all likelihood it will run just fine. What are the long-term ramifications of continuing this type of maintenance practice?

> At some point, you should take the extra time that it may take to change the filter, because with such a large investment and the need for a reliable machine, you minimize your long-term potential for failure of the system.

There is a practical grinding analogy that can be drawn to this scenario. If you are spin grinding only without taking the time to occasionally re-install the relief, you will stress your working systems by a minimum of an additional 16%, 100% of the time.

What does this mean when determining what works for you?

There has been the OEM approach to grinding, and an alternative "spin" only approach. It is not necessary to limit the tools of one particular process to your practice, as a combination of these two practices may work best with varying course conditions and grass types.

All "spin" grinders on the market provide the option to pull the reel off of the machine when the "spin" process is completed. With this in mind, ALL of these same suppliers offer a relief capability of some sort to utilize whenever you desire.

For those who do not want to backlap, don't. Touch-up "spin" grinds are fine, but you should re-install the relief whenever you feel you have the time to do so.

For those who want to backlap, you must have relief. Make sure that the lapping process is timely, and remember it is most effective when keeping the grit in suspension.

For those who want to face bedknives, simply take care that you do not remove the edge too far back, or remove the hardening coat that may be applied to certain knifes.

A well thought out schedule for grinding units will allow for an efficient, quality controlled grind process, as most facilities should not be in a race to see how fast they can make their investment cut grass. There will always be cases where time will not permit returning to specs, but minimizing potential problems and maximizing cutting unit investments should play a role in your overall maintenance plans.

We are committed to:

Providing superior customer support, training, and service.

Manufacturing the highest quality products at an unequaled value.

Setting the industry standard by investing in technological product innovation.

Manufacturing products specifically designed to maintain original equipment manufacturers' specifications.

Interacting with and supporting all original equipment manufacturers.