Setting the Standard With the World’s Most Valued Grinders.

GRINDING SEMINAR
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.
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INTRODUCTION

Foley United, a division of Foley-Belsaw Company of Minneapolis, Minnesota, has been manufacturing equipment for the turf industry since 1934. Foley United moved in 1992 to a new facility in River Falls, Wisconsin, designed specifically for the manufacturing of sharpening equipment. Our new modern facility includes some of the newest and best technology in manufacturing, dedicated to serving the industry. Foley United continues to grow today with the introduction of the newest and most innovative high value product in the industry.

SEMINAR SUBJECTS COVERED

A. CUTTING UNIT BACKGROUND

B. CUTTING UNIT PERFORMANCE

1. ADJUSTMENTS

2. BACKLAPPING

3. GRINDING

   a. REEL GRINDING
      - SINGLE BLADE GRINDING
      - SPIN GRINDING
      - RELIEF GRINDING ADVANTAGES
   b. BEDKNIFE GRINDING

C. ROTARY BLADE GRINDING

D. HOLE CUTTER SHARPENING
CUTTING UNIT BACKGROUND

ADVANTAGES AND DISADVANTAGES OF REEL CUTTING UNITS VERSUS ROTARY CUTTING UNITS.

There are advantages and disadvantages to the reel type cutting unit.

Two advantages are:
1) You get a cut that is exactly at the height you want.
2) You get the best quality of cut that is possible.

Disadvantages include:
1) The initial cost of the reel cutting unit.
2) The higher maintenance required on the reel cutting unit.
QUALITY OF CUT

BLADE OF GRASS CUT WITH SHARP REEL TYPE CUTTING UNIT (STRAIGHT/CLEAN)

BLADE OF GRASS CUT WITH A ROTARY TYPE CUTTING UNIT (RAGGED/SHREDDED)

These images illustrate the difference in the quality of cuts with a sharp reel type cutting unit and a rotary type cutting unit. The left side shows a blade of grass that was cut with a sharp reel cutting unit, leaving a straight clean cut. The right side demonstrates the type of cut you get with a dull reel cutting unit or a sharp rotary blade, the grass ends up torn, and not cut.
"A dull mower blade will shred grass blades, opening ports of entry for disease.

"Every time the grass is Cut, the root system is weakened to some degree. When the grass is Cut severely - more than 40 percent - the roots stop growing. The closer you cut, the longer it will take the roots to resume growing. Cut too close, and the roots may never grow again.

"Every time you mow the grass, you tear the plant (especially if the mower blade is not sharp) and create ports of entry for disease. "

"Finally, close cutting allows sunlight to both dry the soil and encourage weed seeds to germinate. "

"Mower height is critical to mowing with the least harm. Don't cut off any more than one third of the height of the grass. "

"Species vary considerably in how they should be mowed. Some must be cut short: In fact, putting greens of bentgrass, fine-leaved fescues, and bermudagrass will tolerate 1/4-inch mowing daily. If they're left to grow to 1 inch and mowed infrequently, hot weather can wipe them out. "

Excerpt from a Horticultural Publication
A reel cutting unit has two working parts: the bedknife and the reel blade leading edge. This diagram shows how these parts work.

The bedknife has two functions: 1) it pushes against the blade of grass and stands the grass up in a vertical position, and 2) the leading sharp edge acts as half of a scissors. The reel blade rotates across the bedknife performing the cutting action, as the second half of the scissors.
CLIP RATE

Clip rate is the rate at which the reel blade to bedknife scissors action occurs as the reel travels across the terrain.

Clip rate is determined by the number of blades in the reel and the RPM of the reel in relation to the forward travel speed of the cutting unit over the terrain.

Reel blade count varies from 4-11 blades. Reel RPM varies from 400-2200 RPM.

The application the mowing unit is used for determines the best clip rate. Example: To mow roughs, the top surface of the grass can be wavy. Therefore a 5 blade reel at lower RPM is acceptable and a close-up view of this grass might look as follows.

Another example: To mow a green for a tournament, the top surface of the grass should be very smooth. Therefore an 11 blade reel at high RPM is best. A close-up view of this grass might look as follows.

Generally speaking the type of mowing unit purchased is for a specific application and that application and mowing unit dictate the clip rate.
There are four principle angles when dealing with the reel and bed knife. The bed knife is associated with two angles: the top angle and front angle. The reel blade is also associated with two angles: the rake angle and the relief angle.
This diagram gives the range of angles that are found on the bedknife. The bedknife has two angles: the top and the front angle. The top angle, usually set at 3-10 degrees, is there to reduce metal contact, and it allows cut grass to be ejected from the cutting unit. This angle must be present for the bedknife to work properly. The front angle is normally set between 3-17 degrees and it assures that the front will stand the blade of grass up perpendicular. The front angle is available for a mechanic to file for resharpening.

These values are industry averages. For the correct angles for your specific mowing unit, refer to the mower manufactures specifications.
The reel rake angle is created by the slot in the spider which locates the blade on an angle: this ensures that the front cutting edge is always forward of the blade body, which in turn cuts, not pushes, the grass. The rake angle is fixed at the manufacturer and cannot be revised.
The reel back relief angle is machined, ground, or formed to remove approximately 67% of the blade to reduce metal contact and is usually at an angle of 20-45 degrees.

These values are industry averages. For the correct angles for your specific mowing unit, refer to the mower manufactures specifications.
On thicker bladed reels, a back grind of approximately 40 degrees is necessary.

The reel will now be backlapped to match the bedknife.

Usually, when a reel has been sharpened using the individual blade or straight line grind method, it is necessary to backlap the reel.

Excerpt from a Jacobsen Publication

Different Types of Reel Blades

It is important to understand that Toro reel mowers are designed and manufactured to optimize available power from the engine and hydraulic systems. To help do this, we put a "relief" on every reel blade to reduce the width of reel blade that contacts the bedknife. This has been proven to reduce power requirements, as well as allow the machine to operate more efficiently. This can be very important, depending on the terrain, type of grass and amount of grass being cut.

We have two different methods of manufacturing reel blades with a "relief". The reel blades are made from straight stock steel and then are either relief ground or the relief is milled in. Either way, there is a relief on the blade when it is manufactured.

Excerpt from a Toro Publication

John Deere recommends Relief Grinding the reels before spin grinding for these reasons:

- Reduced blade contact area, results in less friction, requiring less horsepower to drive the reel.
- Ensures longer wear life.
- Less time is required to backlap.
- Reduces pulling and tearing of the grass as the unit gets dull by use.
- Provides an area for backlapping compound to be trapped to more effectively backlap reels.
- Relief grinding removes metal from the trailing edge of the blade forming an angle (Relief Angle) to reduce the contact area of the cutting edges.
- Because of the relief grind it is possible, with backlapping, to true a reel (make it round) if a blade is .001” to .002” too high.

Excerpt from a John Deere Publication
The reel must be perfectly straight and the bedknife must be straight and flat in order for them to work properly, as illustrated.

Total tolerance between reel and bedknife can only be .002+/-0.001 to provide a quality reel to bedknife clearance that does not require backlapping.
The picture on this page depicts two ways the blade and bedknife relate to one another.

The top picture shows the rake angle coming into play, and how the leading edge makes contact with the bedknife.

The bottom picture illustrates that a .002 gap between the reel and the bedknife is the preferred setting. It is not necessary to have any or much metal contact. Heavy metal contact hinders good mechanical operations.
The reel and bedknife require sharpening only after long use, unless damage occurs. Incorrect adjustment of the bedknife by operators in the field is a frequent cause of shortened reel and knife life. Damage to the reel or bedknife by foreign material, or by misalignment of the unit as a result of severe impact with a solid object are other major causes of frequent grinding and shortened unit life. The book "Grinding Instructions for Jacobsen Reel Mowers", is available from our service department. This book, when used with the detailed instructions supplied with sharpening machinery, will provide you with the accurate information necessary for precise reel and bedknife grinding.

Reel mowers cut grass with a shearing action like a scissors. However, the metal to metal contact of a scissor's blades is not needed to cut grass. Blades of grass are estimated to average six or seven thousandths of an inch thick. A small clearance (.002), between the reel and the bedknife will result in a very clean cut. Metal to metal contact between reel and knife is not needed, and heavy contact between reel and bedknife can result in the waving of the reel blades and bedknife. This would necessitate grinding of both reel and bedknife.

Excerpt from a Jacobsen Publication

Bedknife to Reel Contact

There is a tendency to over tighten the bedknife to reel contact when quality of cut deteriorates. Remember, when setting up a cutting unit, that LIGHT CONTACT between the bedknife and reel will help promote a self-sharpening action. Once the reel and bedknife begin to get rounded edges, no amount of tightening will improve quality of cut, but it WILL increase horsepower requirements and can cause uneven wear, or "rifling" of the bedknife and reel. Once this has happened, backlapping will NOT correct the situation, the reel and bedknife must be sharpened.

Excerpt from a Toro Publication
CUTTING UNIT

PERFORMANCE
As shown on page 19, the cutting unit will become duller with time. This graph shows how the quality of the cut deteriorates over time, WITHOUT taking any corrective action.
Extended use without preventative maintenance can cause the reel blade and the bedknife to become rounded and dull, shown on this page. Without frequent adjusting this can also cause the gap between these two parts to become larger. Things other than cutting grass, can also contribute to this dulling such as: sand, dirt, chemicals, foreign objects and rust from moisture.
There are ways to retain a better quality of cut:

- **ADJUSTMENT**
- **BACKLAPPING**
- **GRINDING**

These should be used at appropriate times.
ADJUSTMENT

The adjustment should be between .001" - .003", and done daily to ensure proper cutting unit sharpness. Daily minor adjustments are better for the equipment than major adjustments done when the cutting unit is not mowing properly.

*LIGHT CONTACT between the bedknife and reel will help promote a self-sharpening action.*

Excerpt from a Toro Publication

Over adjustment of the reel to bedknife can cause the reel to climb over the bedknife and may rifle the bedknife. Rifling will lead to striping, an uneven cut, or even a complete failure of the cutting unit.
These diagrams illustrate what happens when blades and bedknives get dull and you adjust the reel to get it to cut. When the reel is adjusted, these two parts are brought together. This contact causes the metal on both parts to touch and the grass to be cut.
The adjustment process continues with wear on the reel and bedknife until more effective action must be taken, because the required quality of cut cannot be achieved through adjustment. At that point backlapping or grinding must be done.
Even reels that are not improperly or over-adjusted, can start to lose their cylindrical shapes and become coned. In addition to uneven cut, this phenomena can cause a multitude of problems for the cutting unit. It becomes hard to adjust, there is excessive wear on the beknives, there's faster wear on all bearings, and last but certainly not least, it increases the consumption of fuel. Coning is a natural reaction to adjusting the reel. To some extent it can be compensated for but it is very difficult to avoid coning of the reel.

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
This picture illustrates what happens when a reel becomes cone shaped. Notice how the left side is not even with the right side. This is the primary cause of an uneven cut.
BACKLAPPING

It is recommended that backlapping be done on a regular basis. Backlapping hones the edge and should never be used to sharpen extremely dull or out of shape reels. Backlapping does not replace grinding. Backlapping is used to maintain the sharp edge, not to establish a sharp edge.
BACKLAPPING

Backlapping is a method of removing metal by reversing the direction of the reel, adjusting it until metal contact is made, and applying lapping compound. Hydraulic units normally have a backlapping capability when still attached to tractor. All other units must be removed and set up on a lapping machine.

Reasons for Backlapping:

1. Maintain sharp leading edge.
2. Honing the cutting surface.
3. After grinding to remove the burr.
4. Grooved or serrated edge smoothing.
Lapping can bring back sharpness to a cutting edge and is demonstrated by this diagram. The entire top of the bedknife and the width of the reel blade are lapped.
This image illustrates how the lapping process works. First, the cutting unit is adjusted to make metal contact. The applied lapping compound clings to the relief area of the reel blade. As the reel turns, the lapping compound is forced between the top of the bedknife and the bottom of the reel blade. The grit in the compound then rubs the metal off both parts similar to emery cloth or sandpaper. Remember, lapping only hone the edges and should never be used as a replacement for grinding. The most amount of metal that can be expected to be removed using 80 grit lapping compound is probably less then .005.

_Lapping is not intended to be a reconditioning process to correct severely nicked or rounded blades, rifling or taper._

_Excerpt from a Toro Publication_
"ALL LAPPING COMPOUNDS ARE NOT CREATED EQUAL"

Foley-United holds a distinctive place in the history of lapping compounds. We manufactured the first gel based products, and have the only products to be patented. Finally, they have always been the premier, and most economical products in use. Others have tried to copy the unique features found in all Foley-United products, i.e., Diamonite and Razor Sharp, but none even come close to giving the results they do, and here are the reasons why:

"THE SUSPENSION AGENT"
In its conception every major polymer was tested, including Hydroxypropylcellulose, which is commonly used by other manufacturers, but they all come up short, lacking the characteristics needed to suspend abrasive grit properly. We therefore, had to custom blend a polymer that would give us the unique features we were looking for.

I. The polymer must permanently suspend the abrasive when not in use but lose its viscosity or thickness, and lubricity when actually backlapping. This feature increases its cutting efficiency, and allows prolonged storage with no separation.

II. The residue must be easily removed from the cutting unit when allowed to stand around for any time. To accomplish this we have added:

A. A Humectant that tends to draw and hold moisture from the air.
B. A wetting and re-wetting agent that resoftens any dried or hardened residue in a matter of minutes and allows the user to wash it off with garden hose pressure.

This feature is HIGHLY DESIRABLE BY ALL GOLF COURSE MECHANICS.

III. The molecular structure of our polymer gives it a spring action that literally self feeds the compound onto the blade of the reel, and creates a clinging action so that no compound is lost or spun off, during the lapping process. Because of this unique feature you apply a small amount initially, and then simply redistribute the compound from time to time reducing the amount needed by at least 50%. This feature alone makes Foley-United products the most economical lapping compound to use.

IV. A preservative has also been added to the gel allowing it to be stored for months and not decompose. It is still biodegradable and environmentally safe when used, and no harm will ever occur to grasses if our compound comes in contact with them.

V. Finally, these compounds can be frozen and thawed time and time again without causing any damage or reducing their efficiency.

"THE ABRASIVES"
There are two commonly used abrasives in the market today: aluminum oxide, which is the least effective, and slower cutting, and Silicon carbide which is more expensive, faster cutting and better suited for backlapping uses. There are also two forms of Silicon Carbide available: 1) Natural, which is normally dark brown or black in color and is generally not consistent enough to be used in commercial applications, but because it is very cheap, will be used where quality is not a concern or in noncommercial applications, and 2) Synthetic silicon carbide, which is made in electric furnaces by reacting silicon dioxide and carbon at very high temperatures creating a mass of synthetic silicon carbide, is the most desirable abrasive available. The mass created by this reaction has several layers of purity, from its center which is pure, having no carbon residue and is light green in color, to the outer perimeter which has not been totally reacted, leaving some carbon particles and is black in color.

Foley-United uses only synthetic silicon carbide in their lapping compounds to assure effective and consistent performance.

I. "Diamonite" lapping compound. This is the premier product on the market today. Light green in color because of the virgin, pure synthetic silicon carbide used, it's the coolest cutting, most durable, and longest lasting lapping compound available. Tests have shown that it can cut up to four times longer than lapping compounds using black silicon carbide. (This product is used by many of the elite golf courses in the U.S. and around the world.)

II. "Razor Sharp" lapping compound. This product is made from black synthetic (only) silicon carbide, but incorporates Foley United's exclusive polymer, making it the best of all the economical lapping compounds being sold.
REEL GRINDING
(RESHAPING THE REEL)

Grinding or Reshaping the reel can bring your reel back to factory new condition. Reel grinding should be part of your normal reel maintenance.
Reel Grinding

Prior to grinding a reel, the mowing unit must be prepared for grinding. This preparation includes:

- Roller bearing adjustment or replacement.
- Gear case seals inspection or replacement, if applicable
- Reel bearing adjustment or replacement.
- Thorough cleaning.
- Verification that the reel spins free in the frame.
- Inspection for bent and broken blades.
- Inspection for sprung or twisted frame.

The reel is precision ground at the factory when it is manufactured. The Bearing Mounts and reel frames are also precision manufactured at the manufacturer's plant. The reel manufacturers process controls and equipment are not available to the mechanic. Further, the mowing unit has changed through use and is no longer the same as when it was manufactured.

Therefore, the only accurate and effective method to regrind the reel is to grind it in frame with all the proper preparation as listed above.
GRINDER TO REEL ALIGNMENT

To avoid coning the reel or rifling the reel, the reel must be accurately aligned in both the horizontal and vertical planes.

Horizontal Alignment

Vertical Alignment

Most of the table top spin grinders do not have two plane adjustment capability.
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 cone shape out of a reel are highly improbable.
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. On single blade grinding the grinding wheel turns, the reel does not turn. Each reel blade is ground separately.
These pictures show the various angles that can be put on the end of the reel blade. Picture 1.--shows the normal angle ground on a single blade grinder and it is called a full relief angle. Picture 2.--shows the preferred edge found on most new equipment. It also shows how to finish grind. Picture 3.--shows what a blade would normally look like after a full season of wear. Picture 4.--shows a flat grind or what a blade looks like after is has been spun ground.

An optional method of grinding which requires a much higher skill level is to make a near flat grind which has an approximately 3-5 degrees back relief angle shown in picture 5. Then put a normal relief on the reel as shown dotted in picture 6.

The problem with this method is that it is extremely easy to put a reverse relief on the blade when attempting to install the 3-5 degree back relief. This yields a reel that will not cut.
Grind across blade #1.
The grinding should be done with light to moderate cuts as heavy grinding pressure will result in excessive heating of the blades. Also, the carriage should be traversed manually in **smooth and uniform speed** passes across the blade and without stopping. Hold the reel to the guide finger with your left hand and pull the grinding head assembly with your right hand. As soon as the grinding wheel contacts the reel, remove your left hand. The guide finger will keep the blade in place as the grinding head assembly is traversed across the reel. When it reaches the left side of the reel, the reel blade comes fully off the grinding wheel and partially off the guide finger. The reel blade will automatically pick up the same blade on the return stroke. The blade will be held to the finger in both directions by the rotation of the grinding wheel driving the blade upward against the finger. When you reach the right end of the blade, let the carriage come off the blade and gently against the travel stop.

Next, manually rotate the blade #2 and grind blade #2 and continue to grind all of the blades without changing the grinding wheel setting. If you have brought all of the blades to a sharp edge, advance the grinding wheel slightly and regrind the blades, in reverse order -- starting with the highest blade number and going down. Example: #5 then 4, 3, 2, 1. The reason for this is to get a better finish and to compensate for grinding wheel wear on the original grind. If the blade is not ground to a sharp edge, adjust the horizontal infeed wheel and grind another cycle. Grind the blades 2-3-4-5-1 as an example on the second cycle. Listed are two optional methods to stagger reel blades during grinding. The reel must be ground until you achieve a sharp edge. Again, always reverse order with a slight infeed after achieving a final sharp edge.

It is very important to a quality grind that a staggered grinding method is used to achieve a uniform blade height.

**GRINDING SEQUENCE**

1 3 5 7 2 4 6

2 4 6 1 3 5 7

3 5 7 2 4 6 1

**OR**

1 2 3 4 5 6 7

2 3 4 5 6 7 1

3 4 5 6 7 1 2
SPIN GRINDING

Spin grinding a reel is to sharpen the front leading edge and to bring all the reel blades on the same cutting circle.

Some general statements which apply to spin grinding are:

1. Always travel off the work and then come back onto the work to change directions. Do not reverse direction on the part. Reversing direction on the reel will remove more material during the delay, making for a non-uniform grind.

2. Rigidity of the grinder, grinding wheel and cutting unit to be ground is required for a quality grind.

3. Spin grinding grinds the reel to a cylindrical shape. The outside diameter of each blade is an arc.
This picture shows how the edge of the blade is ground on all spin grinders to achieve a ground edge. Note the reel rotation, the reel and grinding wheel rotate in the same direction causing opposite directional contact at the grind point. This yields the correct surface feet per minute for correct grinder performance.
This picture illustrates that by doing something as simple as positioning a grinding wheel at different heights with a relief finger, you can relief grind the edge of a reel blade on an individual blade. Many spin grinders do not allow you to do this.
On thicker bladed reels, a back grind of approximately 40 degrees is necessary.

The reel will now be backlapped to match the bedknife.

Usually, when a reel has been sharpened using the individual blade or straight line grind method, it is necessary to backlap the reel.

Excerpt from a Jacobsen Publication

**Different Types of Reel Blades**

It is important to understand that Toro reel mowers are designed and manufactured to optimize available power from the engine and hydraulic systems. To help do this, we put a "relief" on every reel blade to reduce the width of reel blade that contacts the bedknife. This has been proven to reduce power requirements, as well as allow the machine to operate more efficiently. This can be very important, depending on the terrain, type of grass and amount of grass being cut.

We have two different methods of manufacturing reel blades with a "relief". The reel blades are made from straight stock steel and then are either relief ground or the relief is milled in. Either way, there is a relief on the blade when it is manufactured.

Excerpt from a Toro Publication

**John Deere recommends Relief Grinding the reels before spin grinding for these reasons:**

- Reduced blade contact area, results in less friction, requiring less horsepower to drive the reel
- Ensures longer wear life.
- Less time is required to backlap.
- Reduces pulling and tearing of the grass as the unit gets dull by use.
- Provides an area for backlapping compound to be trapped to more effectively backlap reels.
- Relief grinding removes metal from the trailing edge of the blade forming an angle (Relief Angle) to reduce the contact area of the cutting edges.
- Because of the relief grind it is possible, with backlapping, to true a reel (make it round) if a blade is .001" to .002" too high.

Excerpt from a John Deere Publication
RELIEF GRINDING ADVANTAGES

1. OPTIMUM ENGINEERED CUTTING PERFORMANCE (FACTORY SPEC'S)

2. LESS POWER / FUEL CONSUMPTION

3. LESS HEAT BUILDUP AND EQUIPMENT WEAR

4. REDUCES HYDRAULIC MAINTENANCE

5. INCREASE BEDKNIFE LIFE

6. DECREASES FREQUENCY OF GRINDING TO RESHAPE THE REEL
BEDKNIFE GRINDING
BEDKNIFE GRINDING

Every time you grind the reel, you must grind the bedknife.

Two bedknife grinding options:
- Regrind a used bedknife
- Replace the bedknife and grind the new bedknife

REGRIND A USED BEDKNIFE

- The only preparation is to clean the used bedbar and bedknife.
  Use a wire brush and/or power washer. Do not use a hand held grinder.

- On a used bedknife you must establish the top face and front face angles.
  The methods are:

  Correct Method - establish the recommended angle from the bottom of the bedknife.
  2nd choice - match old angle on end of bedknife. See illustration.
  3rd choice - find worn surface, tip back 5 degrees and grind. This is the poorest method.

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.

- Remove the old bedknife from the bedbar. Clean the bedbar with a wire brush and/or power washer. Do not use a hand held grinder.

- Inspect the bedbar for flatness and distortion. If it has been damaged, replace it.

- Install the new bedknife per mowing unit manufacturer's recommendation.

- Grind the top face only matching the angle on the new bedknife. Grind the minimum necessary to true the knife.
The conditions of bedknives are demonstrated in these illustrations. The top one is new and sharp with both the top and front ground. Shown next is a used bedknife with a dull rounded front edge. A bedknife's life can be extended by a simple process of grinding. By grinding, both surfaces, the top and front leading edge, it is resharpened. This is the preferred method for life utilization of the bedknife.
This picture shows the relationship of the angles to the bedknife. It is essential that when a bedknife is ground, either new or used, the angles that are on the blade from the manufacturer are replaced. Never over relief grind a bedknife as it will reduce its life expectancy dramatically.
This picture shows the position of a cup grinding wheel when in use. Note that the whole surface of the bedknife is covered by the back part of the grinding wheel.

**BEDKNIFE GRINDING**

Key items in bedknife grinding:
* control heat buildup so it never exceeds a comfortable touch.
* always pass off ends.
* never take excessive material.
* spark out.
* remove burr with wood block.

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 achieve an accurate wheel dressing.
CORRECT ALIGNMENT

It is important to align the bedbar properly in the bedknife grinder to insure that the cutting edges will be in proper alignment with the mounting points of the bedbar. This assures, when the bedbar is installed in the cutting unit, that all of the designed bedbar adjustment is available for the life of the bedknife and that it can be properly mounted after grinding.

When using grinders that use centers in the mounting points for alignment, it is important to align those centers to that the cutting edges will be round in the proper position in relationship to the mounting points and the traverse of the grinding head. This requires a method of alignment prior to grinding to properly mount the bedbar in alignment with the traverse of the grinding head.

The bedbar can also be aligned by properly aligning the front and top surfaces of the bedknife prior to grinding. This can be done by indicating these surfaces with a dial indicator; a properly designed alignment gage, or by placing the unit on a prealigned surface in the grinder and touching the front edge of the bedknife to prealigned stops. Through this manner the cutting edges will automatically be aligned with the mounting points.

The illustrations on these two pages show the proper and improper alignment of the bedknife with the mounting points and the relationship of the bedbar with the reel.

After grinding, the bedbar is installed in cutting unit and located by the mounting points. The bedknife is now parallel with the reel blades.
New bedknives that are installed on bedbars are not necessarily straight and parallel with the mounting points. They must be ground to assure the correct straightness and parallelism.
Reel and bedknife grinding can be done successfully with manual, semi-automatic or full automatic grinders.

Your quality of grind will depend on:

--Type of grinder being used.

--Experience of person grinding.

--Desired quality of results.

Foley United makes equipment that can fulfill the expectations and needs of the user. Each product has the highest quality and value in the industry.
1. TOTALLY ENCLOSED CABINET
   Captures dust and provides operator protection

2. VACUUM PORTS
   Provides for connection of vacuum equipment to remove grinding dust during the grinding process.

3. VIEWING AREA
   Made of clear polycarbonate both protects the operator and offers maximum visibility to the working area.

4. GRINDING WHEEL
   A special formulation 1" x 8" diameter that allows very cool cutting at very aggressive rates.
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 it generally 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, adjust the blade guide (#3 on page 48) and the depth control knob (#1 on page 48) until the wheel surface is in contact with the rotary mower blade. Match to the cutting edge whenever possible. The cutting edge angle should be approximately 30 (thirty) degrees. If it is not, adjust the blade guide and the depth control until the desired bevel is achieved.

Do not overheat the blade during grinding. Quench the blade in water to keep it cool.

Balance the blade as you are grinding for less correction at the end.

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

NOTE: Because of the relationship of the grinding wheel to the grinder base during grinding, this grinder will give a slightly concave surface as illustrated at the right. This is normal and acceptable.
BLENDF GRIND

DO NOT STEP GRIND

Grinding away from the edge carries the heat away from the edge.

SPARK & HEAT DIRECTION
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
- 4 Scallop
- Straight.

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

1. Hand Filing.
2. Blade Replacement.
3. Use of a Hole Cutter Sharpener.

Hand Filing--
Hand filing is time consuming and inaccurate. Additionally, because of the time required, it is often not often done and the holes are cut with a dull cutter.

Blade Replacement--
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.

Use of a Hole Cutter Sharpener--
A hole cutter sharpener with the proper design will be able to sharpen 3 Scallop, 4 Scallop, and Straight hole cutters.

The correct method for sharpening is to lightly sharpen the cutter prior to use. By using this method, your cutter is always sharp and the stock removal from the blade is minimal.
Sharpening

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 take 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.

11. When grinding is complete, file the outside edge with a hand file to remove any burr buildup. When filing, hold the cup as shown in FIG. and with the rear of the hand file angled 15 deg., file off any burrs on the outside edge. A minimal burr may roll into the inside bevel and need not be removed.
Reel Cutting Unit
Manufacturers
Specifications
John Deere recommends Relief Grinding the reels before spin grinding for these reasons:

* Reduced blade contact area, results in less friction, requiring less horse power to drive the reel.
* Ensures longer wear life.
* Less time is required to backlap.
* Reduces pulling and tearing of the grass as the unit gets dull by use.
* Provides an area for backlapping compound to be trapped to more effectively backlap reels.
* Relief grinding removes metal from the trailing edge of the blade forming an angle (Relief Angle) to reduce the contact area of the cutting edges.
* Because of the relief grind it is possible, with backlapping, to true a reel (make it round) if a blade is .001" to .002" too high.

BACKLAPPING

This procedure is used to sharpen the cutting edges when grinding is not necessary. See Reel/Bed Knife Grinding, in this section, to determine if grinding is necessary.

Backlapping, when compared to grinding, removes a very small amount of metal, requires less time and will effect a smooth, clean cut.

The backlapping procedure is accomplished by spinning the reel backwards while applying special abrasive compounds to the reel. Usually course compounds are used initially followed by a finer abrasive for final honing. Recommended grits for fairways and roughs are 60, 80, and 120. Reel sharpening compounds should not be toxic, oily or greasy.

The cutting unit should be inspected, backlapped, adjusted and checked daily for a uniform cut along the complete length of the bed knife. It is important that the adjustment allows the reel to turn freely without dragging against the bed knife. Metal-to-metal contact will generate heat, causing the reel to expand and intensifying the dragging that produces more heat. This viscous cycle will quickly “shut-down” the mower.

SMOOTH ROLLER

The roller is used as a ground sensing device to detect changes in the contour of the turf as the mower moves forward.

A smooth roller is always used on the rear of a cutting unit to establish the cutting height range.
<table>
<thead>
<tr>
<th>TRACTOR</th>
<th># OF BLADES</th>
<th>RELIEF GRIND(^1)</th>
<th>BACK GRIND(^1)</th>
<th>TOP FACE</th>
<th>BEDKNIFE RELIEF</th>
<th>FRONT FACE(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turf King II 76</td>
<td>5</td>
<td>6 - 9'</td>
<td>20 - 40'</td>
<td>6 - 8'</td>
<td>FWD</td>
<td>93' 5/32'</td>
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<td>3 - 5'</td>
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</table>

1 Angle is in reference to center line of reel blade.

2 Angle is in reference to bottom ground surface of bedknife.

Fractional dimension is width of ground face.
Toro Reel and Bed Kife Regrinding Guidelines

REEL TAPER ILLUSTRATION

REEL DIA TAPER = D₁ - D₂
# Toro Reel and Bed Knife Regrinding Guidelines

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>GR 500</th>
<th>GR 1000</th>
<th>RM 5100</th>
<th>RM 5300</th>
<th>RM 108</th>
<th>RM 216</th>
<th>RM 6500</th>
<th>TURF PRO HTM 175</th>
<th>SPARTAN RM 11</th>
<th>SPARTAN RM 5 &amp; 7</th>
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<th>RM 4500</th>
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<td>Front Angle Range</td>
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</tbody>
</table>

* The angle on all Greensmowers should be about 45° if measured from the reel blade front surface.
** If height-of-cut is 1/2" (13mm) or lower on these reels, the Bedknife Front Angle should be increased up to 30°.