

TORNADO 15 AND TORNADO 15 PTO



OPERATOR'S MANUAL SAFETY

MANUFACTURED BY:
MORBARK, INC.

76347-270
07/05

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.



WARNING

The engine exhaust from this product contains chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.

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INTRODUCTION

Congratulations on your purchase of a new Morbark brush chipper. The brush chipper, designed and introduced by the world's leading manufacturer of portable chippers, is produced with the finest components and workmanship available. If you show proper care and maintenance, your brush chipper will prove to be a safe and reliable unit.

This manual was prepared to make it easy for you to operate and maintain your new brush chipper. In addition to guidelines for safe operation and maintenance that you will find included with this book, a separate Parts Book will be included with your machine showing parts listings and detailed assembly illustrations.

The serial number of your brush chipper is located on the side of the tongue. If for any reason you should find it necessary to correspond with us or one of our dealers, please include this number.

We believe it is the responsibility of the customer to ensure that all personnel, especially operators and maintenance people, view any applicable video tapes and become familiar with this operator's manual prior to working with or around the brush chipper. Safety is everyone's responsibility, but the owner/operator must assume the duty of making sure that these training tools are actually used to help prevent injury.

The information, specifications and illustrations in this manual are based on the information in effect at the time of approval for printing. We reserve the right to discontinue model lines at any time or to change specifications of design without notice and without incurring obligations.

Please contact us with any suggestions or comments (positive or negative) concerning the design or operation of your chipper. Your input is greatly appreciated and ensures product development that will meet or exceed the needs of the tree care professionals such as yourself.

Again, thank you and please call us for your future chipper requirements.

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LOCKOUT PROCEDURES

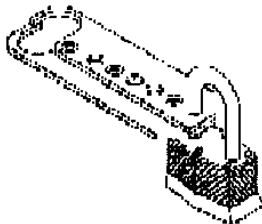
1. Lockout procedures shall be used at all times when maintenance is being done or the machine is being shut down. This will prevent accidents and prevent the machine from accidentally being started by other crewmembers or passersby.
2. The engine, electrical panel or other power source of any equipment to be maintained, adjusted or repaired shall be locked out by each employee doing the work in order to prevent unintended motion, startup or release of stored energy which could cause personal injury.
3. Safety locks are for the personal protection of the employees and are only to be used for locking out equipment. Each and every person shall have their own lock and key and be trained on proper lockout procedures in accordance with OSHA requirements.
4. Equipment with main disconnect switches shall be turned off and locked in the off position only after the electrical power is shut off at the point of operational control. Failure to follow this procedure may cause arcing and possibly an explosion.
5. After locking out the power source, the employee shall try to start the equipment, machine or operate the controls to ensure no unintended motion will occur or test the equipment and machine by use of appropriate test equipment to determine that the energy isolation has been effective.
6. When two (2) or more employees work on the same equipment, each person is responsible for attaching his/her own lock. There shall be a separate lock for every person working on the machine. Safety locks and adapters are to be affixed to levers, switches, valves etc, in the non operative (off) position.
7. Upon completion of the work, each employee must remove his/her lock, rendering the machine operable when the last lock is removed.
8. The employee responsible for removing the last lock, before doing so, shall assure that all guards have been replaced, the equipment, machine or process is cleared for operation and appropriate personnel notified that power is being restored.



DANGER

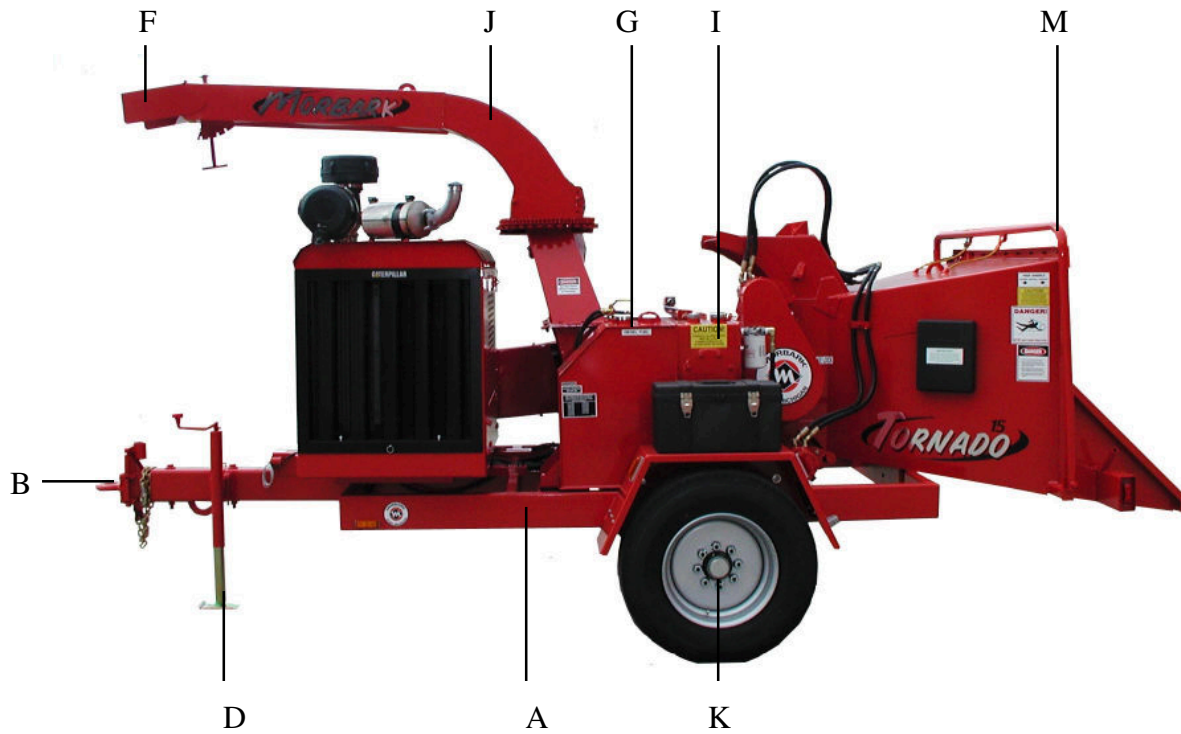


Each and every person performing any type of maintenance and whenever the machine is not in operation shall follow lockout procedures. Failure to lock out while performing maintenance could result in serious personal injury or death!



Morbark equipment is designed to be quickly and easily locked out whenever maintenance or repairs are performed. Train your crew to lock out every time.

LOCATION OF CHIPPER COMPONENTS



A. Frame	F. Discharge Flipper	K. Axle
B. Hitch	G. Fuel Tank	L. Hood / Hinged
C. Infeed	H. Belt Shield	M. Feed Control Arm
D. Jack Stand	I. Hydraulic Oil Tank	N. Serial Number Plate
E.. Instrument Panel	J. Discharge Chute	



SPECIFICATIONS

TORNADO 15 TRAILERIZED MACHINE

General

Length 194 in (493 cm)
Width 83 in (211 cm)
Height 100 in (254 cm)
Weight 7000 lb (3175 kg)
Electrical System 12 Volt

Chipper

Drum Diameter 20 in (51 cm)
Drum Width 23 in (58 cm)
Knife Length 10.5 in (27 cm)
Knife Configuration 2
Capacity 13 in (33 cm) roundwood

Power Options

Cat, Perkins, John Deere and Cummins 80 - 130 hp (60 - 97 kw)

Infeed Sytem

Infeed opening 37 x 56 in (94 x 142 cm)
Feed Wheel Opening 15 x 20 in (38 x 51 cm)

Tank Capacities

Diesel Fuel 31 gal (117 Litre)
Hydraulic Fluid 14 gal (53 Litre)

LOCATION OF CHIPPER COMPONENTS

TORNADO 15 PTO MACHINE



A. Adjustable Deflector
B. Deflector Handle
C. Control Bar
D. Manual Holder
E. Feed Wheel Belt Shield

F. Infeed Tray
G. Feed Wheel Motor
H. Chipper Belt Shield
I. PTO Shaft
J. Serial Number Plate

SPECIFICATIONS

TORNADO 15 PTO MACHINE

General

Length 84 in (213 cm)
Width 52 in (132 cm)
Height 98 in (249 cm)
Weight 4400 lb (1996 kg)
Electrical System 12 Volt

Chipper

Drum Diameter 20 in (51 cm)
Drum Width 23 in (58 cm)
Knife Length 10.5 in (27 cm)
Knife Configuration 2
Capacity 13 in (33 cm) roundwood
Tractor Size 100 - 130 hp (75 - 97 kw)

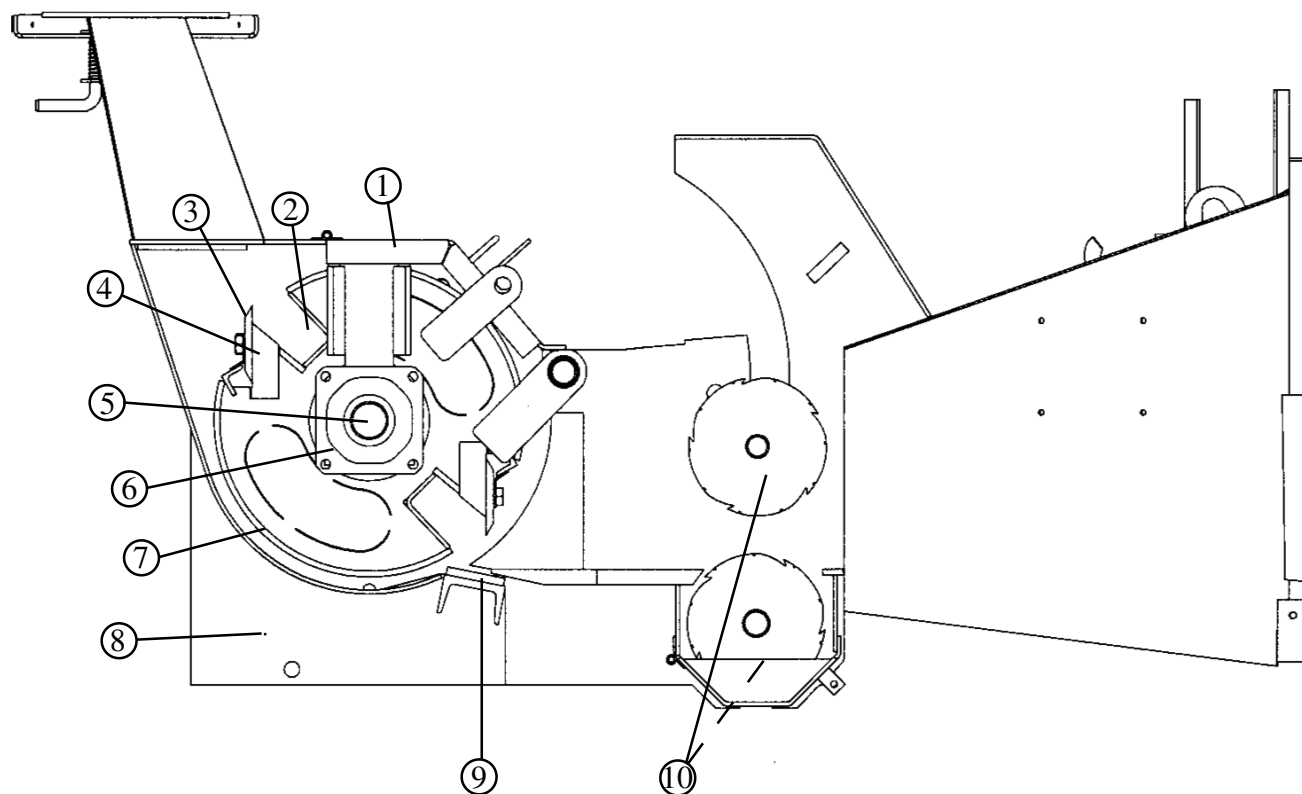
Infeed Sytem

Infeed opening 33 X 44 in (84 x 112 cm)
Feed Wheel Opening 16 X 20 in (41 x 51 cm)

Tank Capacities

Hydraulic Fluid 13 gal (49 Litre)

DESCRIPTION OF CHIPPER COMPONENTS



DESCRIPTION OF CHIPPER COMPONENTS

1. **CHIPPER HOOD** - Allows the operator access to the chipper drum.
2. **CHIPPER POCKETS** - Each drum is designed with chipper pockets to allow for accumulation until discharged.
3. **CHIPPER KNIFE** - These are attached to the knife holder with four (4) bolts per knife.
4. **KNIFE HOLDER** - These are the fixtures mounted in the drum to which the knives are bolted.
5. **CHIPPER SHAFT** - This shaft is connected to the drum by means of two (2) bushings, then rests on a pair of pillow block bearings for support.
6. **CHIPPER BEARINGS** - These support the chipper drum.
7. **CHIPPER DRUM** - This is the component in which the knives are mounted. The chipper drum is dynamically balanced and should not be welded on or modified.
8. **CHIPPER BASE** - The chipper base holds the chipper drum assembly and its bearings. The base is a welded construction.
9. **KNIFE ANVIL** - The chipper knife cuts against the knife anvil. The knife anvil is adjustable.
10. **FEED WHEEL** - Feeds the material at a steady rate to the chipper drum.

SAFETY

OBSERVE SAFETY SIGNS AND MESSAGES

THINK SAFETY: Safety is a combination of operator common sense and alertness at all times when the machine is being operated or serviced.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all messages that follow this symbol to avoid serious injury or death.



DANGER indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death. The sign will have the color combination of red and white.



WARNING indicates a potentially hazardous situation, which if not avoided, could result in serious injury or death. The sign will have the color combination of orange and black.



CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. The sign will appear on the machine with the color combination of yellow and black.

OBSERVE "CAUTION" MESSAGES

Messages labeled "CAUTION" (without the alert symbol) will appear in your operator's manual to provide specific instructions for performing adjustments, services etc. If these instructions are not followed, it could result in damage to the machine.

DO NOT MODIFY MACHINE

Any modification to the machine must be approved by Morbark. Unauthorized modifications to the machine may impair the function and/or safety and affect machine life or cause serious injury or death.

BEFORE OPERATING

Read and understand the operator's manual, instructions and safety signs on the machine and all controls affecting machine functions.

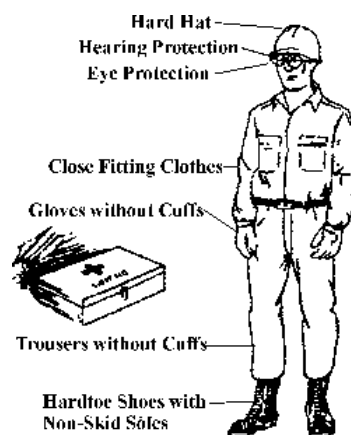
SAFETY

WEAR PROTECTIVE CLOTHING

Wear close-fitting clothing and safety equipment appropriate to the job.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Prolonged exposure to loud noise can cause impaired or loss of hearing.



HANDLE FUEL SAFELY AVOID FIRES

Handle fuel with care. It is highly flammable. Do not refuel the machine while smoking or when near open flames or sparks.

Always stop engine before refueling machine. Fill the tank outdoors.

Prevent fires by keeping machine clean of accumulated trash, grease and debris. Always clean up spilled fuel.

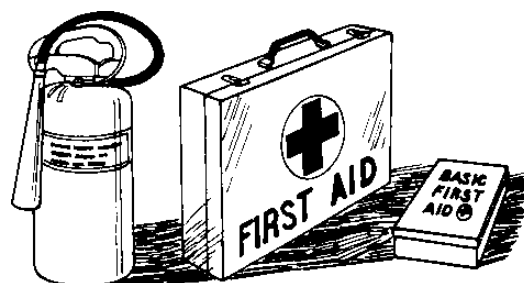


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital and fire department near your telephone.



PROTECT CHILDREN

Keep children and other personnel away when operating machine.

Do not let children or untrained personnel operate machine.

SAFETY SIGNS

SAFETY STICKERS

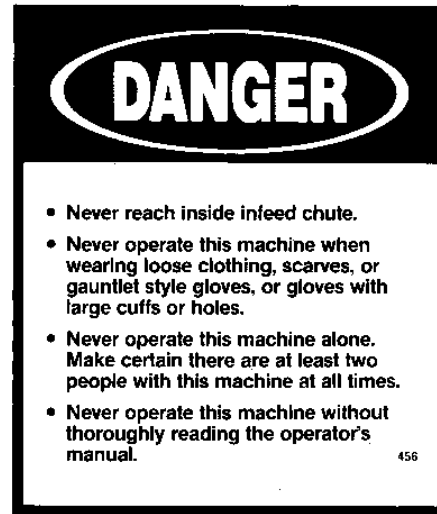
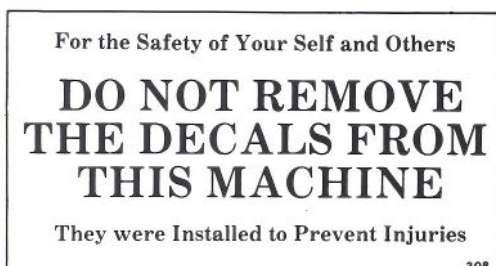
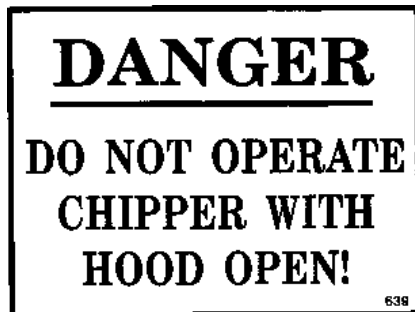
READ SAFETY SIGNS CAREFULLY

Carefully read and follow all safety signs.

Danger signs identify the most serious hazards.

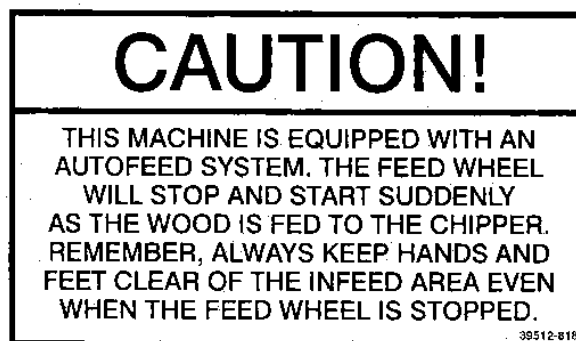
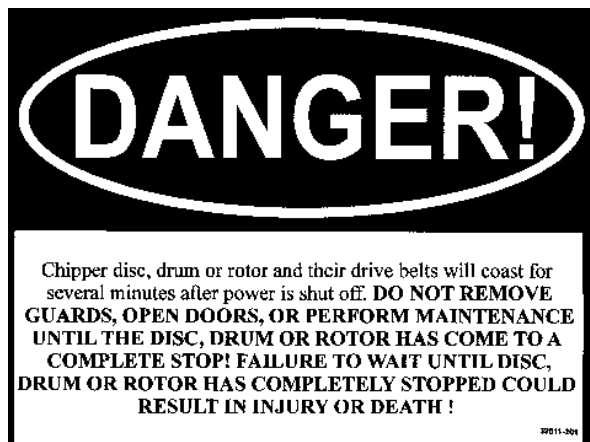
Keep safety signs in good condition.
Replace any missing or damaged safety signs. Signs are attached to machine near specific hazard areas.

If decals are required, they can be purchased through your local dealer.



SAFETY SIGNS

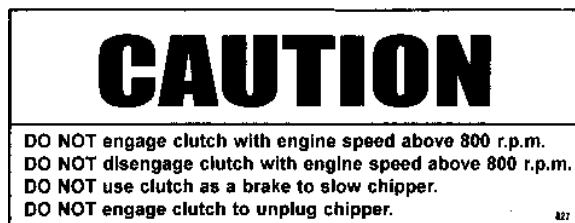
SAFETY STICKERS CON'T



SAFETY PRECAUTION READ BEFORE OPERATING THIS MACHINE

It is the owner's responsibility to instruct all equipment operators and support personnel in the operation of this equipment. All owners have been supplied with an operators manual containing instructions and safety precautions on the operation of this equipment. It is extremely important that anyone working on or around this equipment be completely familiar with the operators manual to ensure their safety in working with this equipment. If the operators manual for this equipment is not available, the manufacturer will be pleased to supply a new manual.

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CRIME PREVENTION

GOOD ADVICE

Keep your machine damage-free.

Follow the advice on these pages to reduce vandalism, discourage theft and help recover your machine if it is stolen.

TAKE A BITE OUT OF
CRIME
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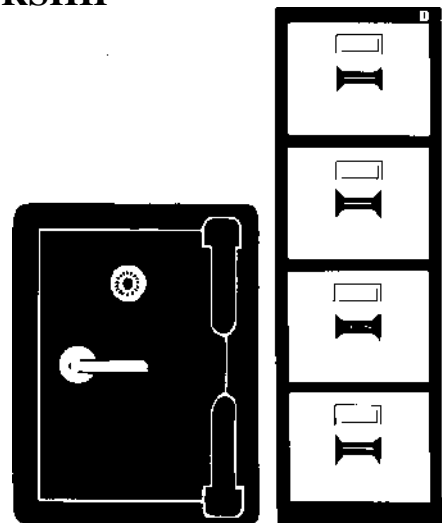
RECORD IDENTIFICATION NUMBERS

1. Record Serial Number (S/N) of machine and identification numbers of engine, clutch, hydraulic components etc. EXACTLY as they appear on the plates. These numbers can be found in your morbark check sheet supplied with your machine and on the various components.
2. Check that the complete and correct numbers appear on all documentation (insurance, financial, warranty etc.) Keep all documents in a safe location.
3. If available, participate in an "owner applied numbering program" and mark your own machines.



MAINTAIN DOCUMENTED PROOF OF OWNERSHIP

1. Keep in a safe location all documents (invoices, warranty etc.) that accompanied your machine at the time of purchase.
2. Take color photographs of each machine from all sides and several different angles.
3. Maintain an up-to-date inventory of all equipment and machines. Check regularly to insure no machines have been stolen.
4. Update all documents and photographs when a major change is performed to your machine - changing power unit, clutch, loader etc.



CRIME PREVENTION

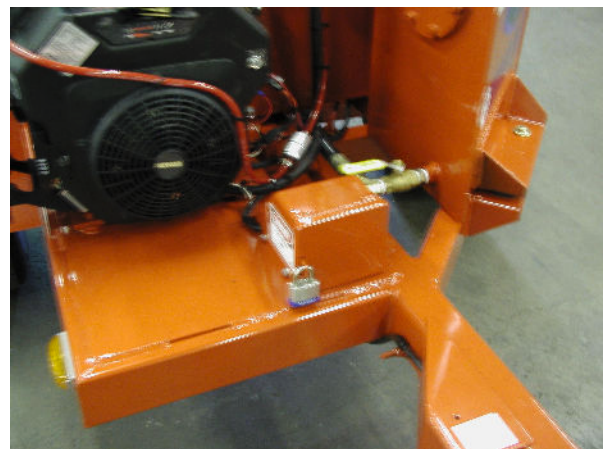
PARK INDOORS OUT OF SIGHT WHEN POSSIBLE

1. Remove ignition key and the main power switch box key when applicable. Place hard-to-move equipment in front of exits.
2. If machine is being stored, remove the battery or any essential component in the electrical system.
3. Secure all openings.



PARKING OUTDOORS

1. Park out of sight as much as possible.
2. Remove ignition key and lock the main power switch box when applicable.
3. Make law enforcement aware of your presence in an area and provide them with a contact person to assist them in dealing with suspicious activity.
4. Solicit assistance from neighbors or merchants who permanently reside near the parking area.



REDUCE VANDALISM

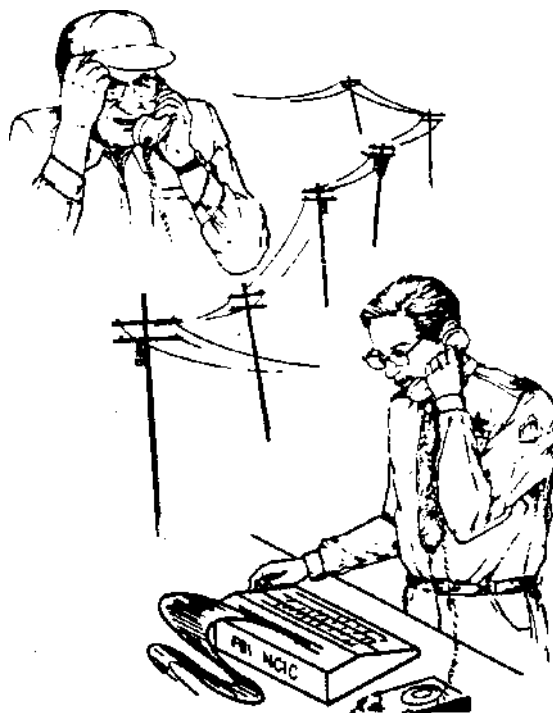
1. Install vandal protection devices, especially if parking machine in high risk areas.
2. Solicit assistance for watching machine from individuals living in the area.
3. Take written notes and report to law enforcement all suspicious vehicles or persons.



CRIME PREVENTION

REPORT THEFT

1. If a theft occurs, notify the law enforcement agency having jurisdiction and the insurance carrier immediately.
2. Give a full description and a complete set of serial and identification numbers (found on the tongue near the front) to the investigating officer and insurance carrier.
3. If available, provide the investigating officer with photographs of the actual machine, manufacturers literature and knowledge of any identifiable marks that would assist in identifying the machine.
4. Ask for verification that the stolen machine has been entered into the National Crime Information Center (NCIC) operated by the FBI in Washington D.C.
5. Regularly check the identification plates on all machines and report any missing or destroyed plate.



FIRE PROTECTION

1. Perform daily maintenance.
2. It is the operator's responsibility to remove debris and accumulated oil, grease and other flammable material around the power unit and around bearings daily. Pressure wash your machine weekly. During dry conditions or heavy leaf fall periods, clean the unit twice daily or as frequently as needed.
3. Inspect battery cables, connections, wiring and electrical components weekly. Use the battery disconnect switch whenever the machine is left unattended.
4. Have an approved, charged fire extinguisher on the machine or on the site AT ALL TIMES. Check the extinguisher regularly to be sure it remains charged. Other fire suppression equipment should be installed on the unit. Water tanks are very good fire suppression units as is a halon gas extinguisher.
5. Have the operator watch and check the equipment for 15-20 minutes after shut down to ensure adequate "cool down time."

CAUTION: Many fires occur after shut down.

6. Park the machine a minimum of 50 ft. from other equipment in an area cleared of excess debris to minimize fire spread.
7. Maintain a proper level of coolant in the radiator to avoid overheating.
8. Never transport flammable liquids on the machine in separate containers (gas cans, jugs etc.)
9. When refueling, shut off power unit and DO NOT SMOKE.
10. Keep all sparks and flames away from batteries.

SAFETY OPERATION

IMPORTANT SAFETY INFORMATION!

For Owners and Operators of Morbark Brush Chippers.

For a safe and productive operation, follow the procedures discussed in this section. **Safety guidelines are written in bold print.** All personnel must observe these guidelines when working with the equipment.

This Safety Manual has been prepared for all owners and operators of Morbark hand-fed brush and tree chippers.

SAFETY IS NO ACCIDENT.

Like all good things worth having, proper safety training and operating procedures require effort, commitment and concentration every minute of every day.

Accidents don't just happen. They are caused by people who make mistakes.

We strongly encourage you to review this information immediately with all employees working with and around your hand-fed brush chipper.

It is also imperative to review this information with any new employees **BEFORE** they work with the chipper.

We urge you to review these safety procedures with your employees on a regular basis throughout the year. Safety training is not a one-shot affair. It requires your continuous commitment.

Over the life of the chipper, it is not unusual to have as many as 20 or 30 different operators. Even though we are aware of very few accidents, we are concerned that some operators may not receive all the proper training.

As a manufacturer, we design the safest machine possible and make every effort to protect the operator from harm.



SAFETY OPERATION

Before anyone starts up a brush chipper, they should know this: **ANY MACHINE THAT CAN PULL IN A WHOLE TREE AND CHIP IT IN LESS THAN A MINUTE IS DANGEROUS IF THE OPERATOR DOES NOT FOLLOW PROPER SAFETY PROCEDURES.**

Following are the step-by-step procedures required to safely operate your brush chipper.

Every operator must wear the proper clothing and protective gear on the job.

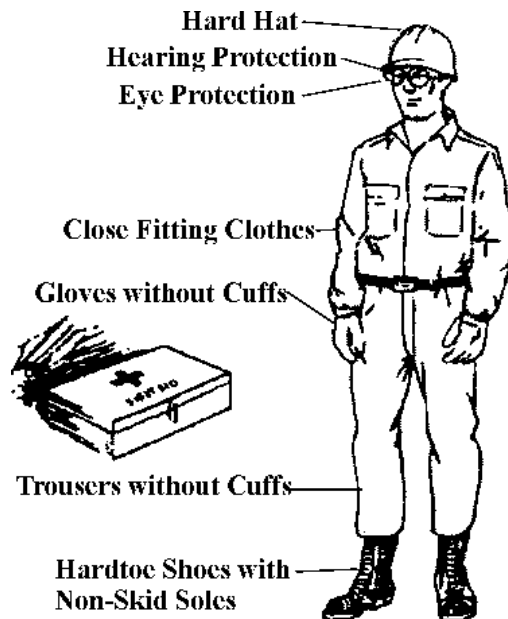
Clothing must be close fitting and must be kept tucked in. The recommended working attire consists of hard hat, safety goggles, ear and eye protection, gloves without cuffs, trousers without cuffs and hard toe shoes with nonskid soles.

Gloves are recommended to protect the operator's hands, but gauntlet style gloves must never be worn due to the possibility of snagging.

Work boots with good traction must be worn to reduce the possibility of slipping.

Before operating the chipper, all operators must read and understand all safety information in the operator's manual and all safety decals on the machine. These decals must never be removed. If they are worn or frayed, new decals must be ordered from your local brush chipper dealer.

Prior to starting the chipper each day, a pre-startup walk-around inspection must be done. Check for missing hood latches and pins or cracked and worn hinges. Check to make sure all bolts, nuts and belts are tight. Broken or damaged components must be repaired before the machine is put in operation. Also inspect the infeed chute to make certain there are no tools or wood debris obstructing the infeed.



SAFETY OPERATION

If the chipper is attached to a truck or van, make certain the hitch is secure and the safety chains are properly attached.

If the chipper is not attached to a vehicle, the tongue must be blocked and wheel chocks must be placed under both wheels to keep the chipper from moving.

The safety control bar simply controls the flow of hydraulic oil to the motor that drives the chipper's feed wheel. We believe our design of the safety control bar is the best possible safety feature. Accessible along the entire top of the infeed and down both sides, this control bar instantly stops and reverses the hydraulic feed wheel, giving the operator complete control.

The control bar has three positions. It is pulled to turn the feed wheel forward and pushed to reverse the feed wheel. In between forward and reverse is the neutral position. It is vital that operators know and understand its function. During the course of a working day, the chipper operator will use this control bar hundreds of times to control the feed of wood and brush. It becomes second nature for an experienced operator to use the bar and it is very important to train any new operators in its use.

Before starting the engine, the safety control bar must be placed in the neutral position.

While chipping wood, the single most important safety rule is **NEVER, UNDER ANY CIRCUMSTANCES, PLACE YOUR HANDS OR FEET INSIDE THE INFEED CHUTE WHILE THE MACHINE IS RUNNING!**

It should be remembered that the only reason for the infeed chute or shroud is to protect the operator from becoming entangled in the feed wheel. It has absolutely no bearing on the utility or operation of the machine.



SAFETY OPERATION

Again, the single most important chipper safety rule is **NEVER BREAK THE PLANE OF THE INFEED CHUTE WITH YOUR HANDS AND NEVER, FOR ANY REASON, ATTEMPT TO KICK BRUSH IN WITH YOUR FEET!**

To safely feed short material into your chipper, place the feed system in the neutral position, lay the short material on top of longer material and engage the feed system.

You must never attempt to feed handfuls of twigs, leaves and other material that has been raked up. There is no way to get it into the chipper without violating safety rules. This material must be placed in the chip van or chip pile directly. Not only is it dangerous to feed the material, but it can contain rocks, metal and other material that can damage the chipper.

Brush and limbs must always be fed butt end first.



SAFETY OPERATION

At least two people must be on the job site at all times. No one must ever operate the chipper alone.

It is the operator's responsibility to ensure that other workers or bystanders are kept away from the path of discharged chips.

Be prepared in case of an accident. Always have a first aid kit and fire extinguisher handy on the job site.

Never attempt to unclog the chipper or perform any other type of maintenance when the chipper is running.

Before performing any maintenance on the chipper, always turn off the engine and remove the ignition key.

Also, keep in mind that the chipper drum will coast for several minutes after the machine is shut off. **ALWAYS MAKE CERTAIN THE DRUM HAS COME TO A COMPLETE STOP BEFORE ATTEMPTING ANY MAINTENANCE.**

Never open the chipper hood until you are certain the drum has come to a complete stop. **NEVER, UNDER ANY CIRCUMSTANCES, RUN THE CHIPPER WHEN THE HOOD IS OPEN.**

Always use the drum lock pin to hold the drum in place before performing any knife maintenance.



SAFETY OPERATION

When refueling the chipper, always be certain there is no open flame or source of a spark in the vicinity of the machine.

Always remove the ignition key and lock the engine control panel when the machine is left unattended for any reason.

No one must ever operate the chipper when under the influence of drugs, alcohol or prescription medications which could in any way affect the operator's performance and concentration.

When the chipper is attached to a vehicle, never attempt to feed material until the vehicle has come to a complete stop, the parking brake is applied and the driver has exited the vehicle.

When the chipper is attached to an aerial lift truck, always be aware of any power lines in the vicinity. If the bucket should come in contact with power lines for any reason, the current could travel through the truck to the chipper. Never operate or touch the chipper until all aerial operations in the vicinity of power lines are completed.

Whenever possible, the chipper must be set up on level ground.

Never stand in front of the chipper discharge chute. Never direct the flow of chips towards anyone. Flying wood chips are very dangerous.

Never just turn the engine off and leave the key in the ignition. If the key is accidentally left in the "on" position, the engine can start while the chipper drum is being turned by hand.

Whenever the chipper belt drive guard is removed for service, replace it after you have finished. Guards are built for your protection. **USE THEM.**

Never attempt to do any type of maintenance on the machine while the engine is running.



SAFETY OPERATION

As an owner or operator of a brush chipper, you know what a useful tool it is. With anti-burning and anti-burying regulations spreading across the country, it is absolutely necessary that we have brush chippers to dispose of and recycle brush and wood waste.

It is equally necessary that we operate these machines in the safest manner possible.

We have done all we can do to manufacture the safest chipper possible that will still do the job it is intended for. But no matter how we build it, **IT CAN BE DANGEROUS IF IT ISN'T USED PROPERLY.**



It is the responsibility of the owner to ensure that operators are properly trained and that they practice safe operating procedures on the job.

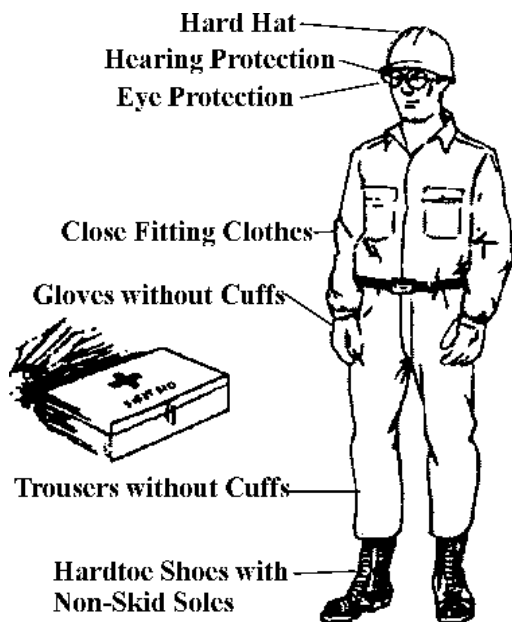
These chippers are designed to give years of service. Over the course of the life of the chipper, it may have several owners and dozens of different operators. It is vital that each new operator be trained in safety and that even experienced operators are given safety reviews from time to time.

Safety is just too important to be taken lightly. With proper information and commitment to safety every day, your Morbark hand-fed chipper will give you years of reliable, safe service.

SAFETY HINTS

1. Under no circumstances must any modifications be made without factory authorization. This machine was designed to do a specific job and alterations could result in injury to the operator or machine.
2. Never leave one person to work at the job site alone. If an accident occurs, someone could suffer or even die before help arrived.
3. Keep bystanders away from the machine during operation. Only the operator should be at the machine.
4. Be constantly aware of people and obstacles in your job area while operating the machine.
5. Never change or work on the chipper knives unless you wear gloves. The knives are very sharp and can seriously cut you.
6. Make sure the tail lights and turn signals operate properly before transporting machine.
7. Never haul the machine without safety chains securely attached.
8. Never smoke, weld or use any type of flame around the fuel tank.
9. Remember, do not attempt any maintenance without first removing the ignition key and locking out the engine panel.

SAFETY OPERATION



NEW ENGINE BREAK-IN

Proper break-in will lead to trouble free operation and increased engine life. The factory test given to a new engine is not sufficient to establish the polished bearing surfaces which are so necessary for good performance and long life. There is no quick way to force the establishment of good bearing surfaces. These can only be obtained by running a new engine carefully and under reduced loads for a short period of time.

Consult the Engine Operator's Manual located at the rear of this handbook for operation and safety guidelines.

CLOTHING

Avoid wearing loose clothing, particularly cuffs and scarves, that can catch on branches and pull you into the chipper. Wear appropriate safety equipment at all times.

PRIOR TO STARTING YOUR MACHINE

If not attached to towing vehicle, block the tongue of the machine. Never use the adjustable jack as the sole support when operating the machine.

Block the wheels.

Check for foreign objects in the chipper housing, infeed area.

Check all safety devices and controls. Make sure they are in good working condition and operating properly before chipper is put in operation.

Make sure all shields and covers are in place and secure.

Make sure no one is in the path of flying wood chips.

It is your responsibility as an operator to make sure that all bystanders are at a safe distance from the equipment.



SAFETY OPERATION

BRUSH PREPARATION

Inspecting and organizing the brush prior to chipping will allow the job to be performed more efficiently and provide added safety in performing the job by minimizing the danger of foreign material, vines etc from entering the chipper. Pre-trimming and proper de-limbing will allow the brush to be drawn easily through the chipper.

Inspect all brush for all non-wood materials such as metal, glass or stone. Feeding such materials into the chipper will not only damage the cutting blades, but they can even shatter the blades. These blade fragments CAN cause serious personal injury, death and/or property damage.

Remove vines from the material being chipped. Do not leave vines in the area around the chipper and DO NOT ATTEMPT to place vines into the chipper. Material entangled in vines CAN result in personnel becoming entangled, resulting in SERIOUS injury or DEATH. Vines may hide foreign materials that CAN cause equipment damage. Vines wrapping around the disc CAN result in bearing failure.

1. Arrange trees, tree limbs or brush with the cut ends facing the chipper infeed chute.
2. **Do Not** cut trees, tree limbs or brush into short pieces, i.e. short logs or sticks.
3. **Do** cut trees, tree limbs or brush into lengths that can be safely handled. This will reduce the number of pieces that have to be fed into the chipper and the time required to perform the job. Cut wood at an angle to help ease the feed rollers open and to facilitate feeding. Chipper performance is best when the feed wheels are securely gripping the material as it is feeding into the cutting disc.

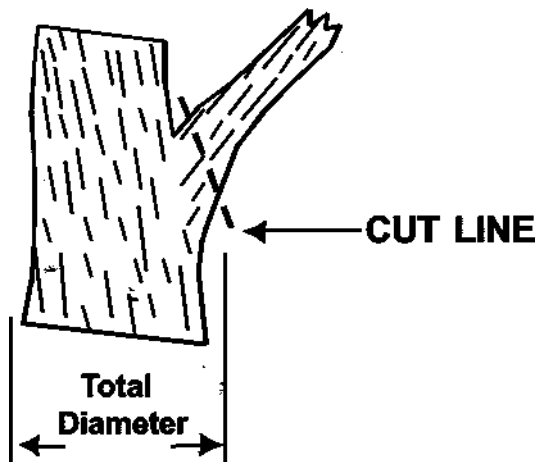
Be sure to cut all trees, tree limbs and brush into lengths that can be safely handled. DO NOT attempt to lift material that is too heavy to be lifted safely. Serious back injury CAN result from attempting to lift material that is too heavy or from improper lifting techniques. ALWAYS keep your back straight when lifting and lift with your legs.

SAFETY OPERATION

BRUSH PREPARATION CON'T

Know the limitations of your chipper. Never attempt to feed material too large for your chipper. Always pre-cut large crotches to ensure adequate clearance through the transition area.

When preparing large material for feeding, properly trimming the crotches will greatly reduce the amount of downtime from clearing jammed materials.



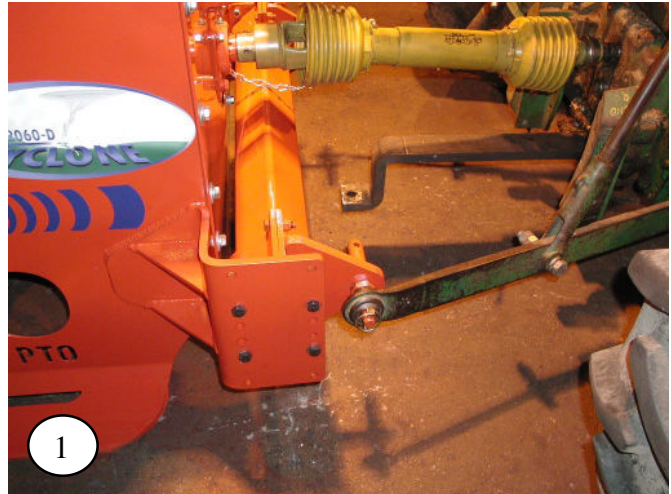
SAFETY OPERATION

PTO HOOKUP



CAUTION: MAKE SURE THE AREA BEHIND YOUR TRACTOR IS CLEAR BEFORE BACKING UP TO CHIPPER.

1. Align tractor 3-way hitch arms to the mounting brackets on the chipper. Pin and secure chipper to tractor hitch arms.



2. Slide the PTO driveshaft onto the splined shaft of your tractor.



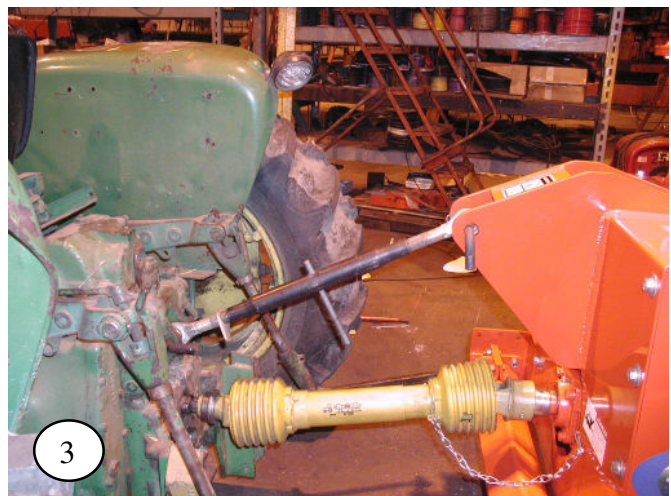
DANGER/ENTANGLEMENT HAZARD: NEVER ATTACH OR REMOVE THE DRIVESHAFT WITH THE PTO DRIVE ENGAGED. WAIT UNTIL PTO DRIVE COMES TO A COMPLETE STOP BEFORE ENTERING DRIVE AREA.



3. Hook up the adjustable upper link arm (not supplied) and adjust so the chipper infeed is horizontal to the ground.



CAUTION: ONLY OPERATE CHIPPER ON A LEVEL SURFACE IN AN AREA THAT IS FREE OF OBSTACLES.



SAFETY OPERATION

MACHINE START-UP

NOTE: Most engines include a safety shutdown system. This system will shut down if coolant temperature is too high or oil pressure is too low. If service is required, please contact your nearest authorized dealer.

1. Check all engine fluids.

NOTE: On machines equipped with a permissive start button, hold the button in, start the engine and hold the permissive start button until oil pressure reaches operating pressure (approx. 5 seconds.)



WARNING: Make sure the chipper hood is secured and latched before start-up

2. Start the engine according to your engine operator's handbook, located in the rear of this manual.
3. Let the engine idle according to your engine operator's handbook until the engine stabilizes.

CAUTION: Do not allow the engine to idle with the clutch disengaged for no longer than 2-3 minutes or failure to the pilot bearing will occur.



4. Engage clutch at 600-800 RPM by slipping (bumping) the clutch for a 2-3 second count. Disengage the clutch handle and allow the engine to regain RPM, then fully engage the clutch handle.

NOTE: Listen for noise that might indicate broken or loose machine parts. If unusual noise is detected, the machine should be shut down immediately and evaluated by a competent person.



CHIPPING WOOD

5. Always position the throttle at full RPM while chipping.
6. Feed material into infeed spout. Never allow your hands to enter the infeed spout. Feed short material by placing it on top of longer material that is feeding into the chipper.

NOTE: For proper break-in, it is recommended that you begin by feeding 2" - 3" diameter material into the chipper and gradually work up to larger diameter material during the first 4 - 8 hours of operation.

7. Observe gauges throughout operation.

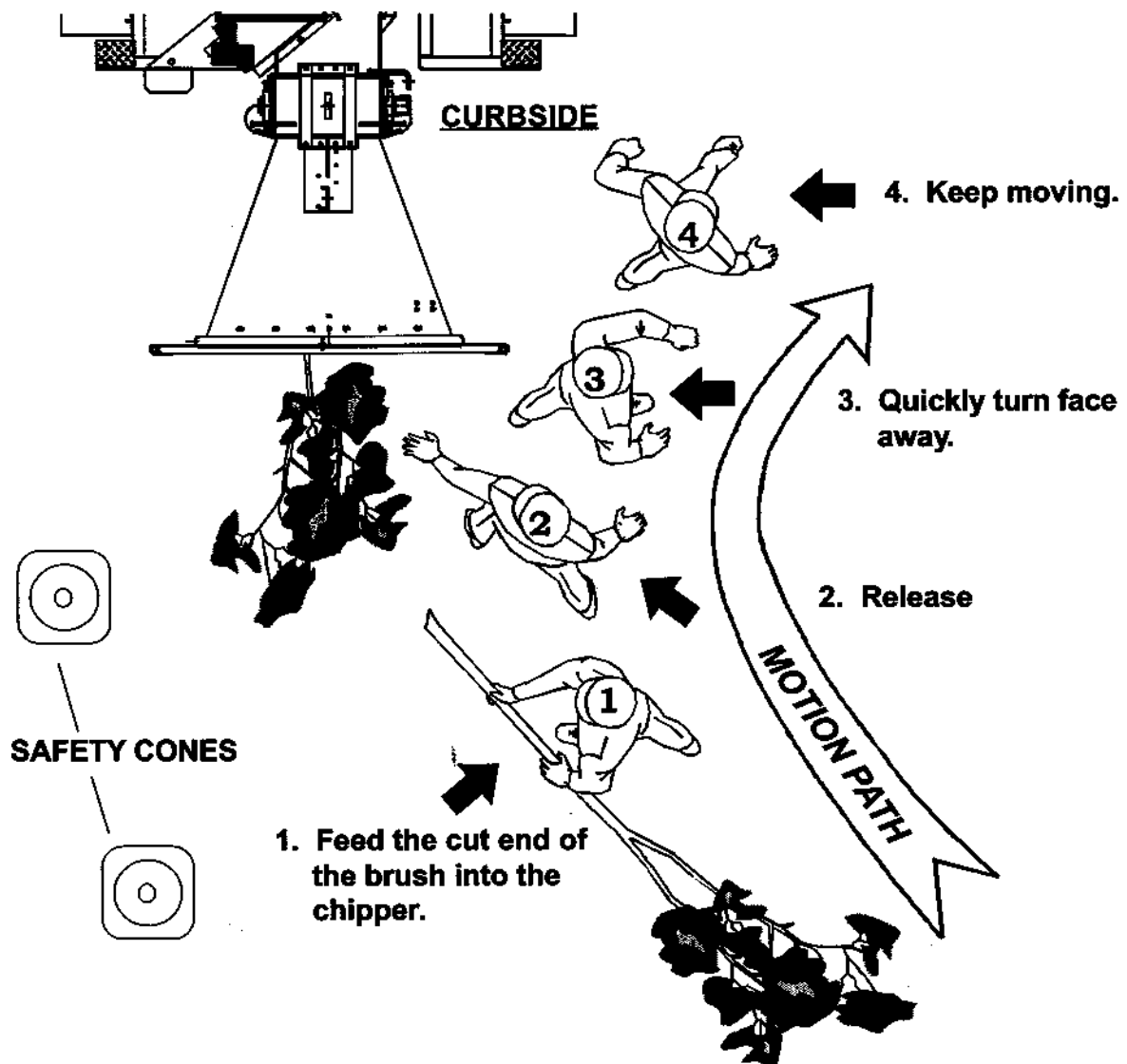


SAFETY OPERATION

FEEDING BRUSH TO THE CHIPPER

Keep the working area clear of limbs and debris. Tripping or entanglement hazards CAN cause the operator to be dragged into the chipper, causing serious injury or death. Always stand to the side of machine when feeding chipper.

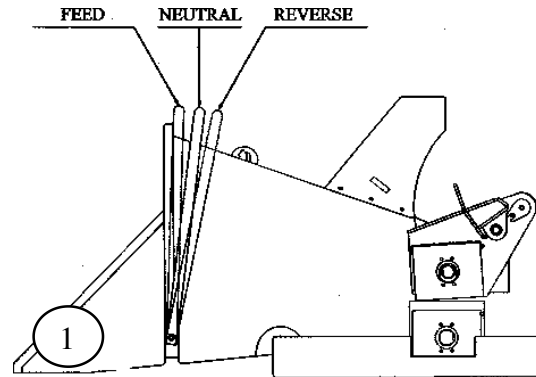
Do not throw clean up sweepings into the cutter mechanism. Foreign material such as stones, wire or metal CAN cause blade failure, resulting in serious personal injury.



SAFETY OPERATION

MACHINE SHUT DOWN

1. Disengage the hydraulic feed system by moving the feed control bar to the NEUTRAL or center position.



2. Push the throttle control in to reduce engine speed to idle.



3. When the engine and cutter drum reach idle speed, disengage clutch.



4. Turn off the ignition switch, remove the key and lock engine control panel.



ENGINE CONTROLS

1. **PERMISSIVE START BUTTON** - Used in conjunction with the key switch to start engine.
2. **KEY SWITCH** - Used in conjunction with the permissive start button to start engine.
3. **TEMPERATURE GAUGE** - Measures engine coolant temperature. (See power unit operation and maintenance manual for more information.)
4. **AMMETER** - Indicates the status of the engine charging system.
5. **ENGINE OIL PRESSURE** - Measures engine oil pressure. (See power unit operation and maintenance manual for more information.)
6. **TACHOMETER/SPEED SWITCH** - The tachometer measures the revolutions per minute of the power unit.
Refer to LOR for speed switch setting procedures.
7. **HOOR METER** - An hour meter registers the amount of time the electrical power is being sent to the power unit.

CAUTION: Never add cold water to a hot engine, cracking of engine components may occur. Allow the engine to cool, then add coolant.

CAUTION: Never let engine RPM drop below 2100 RPM when operating.



(Typical Control Panel)

Actual control panel layout and controls are determined by engine type and model. Please check the Engine Operator Manual supplied with your machine for individual function.

FEED CONTROLS

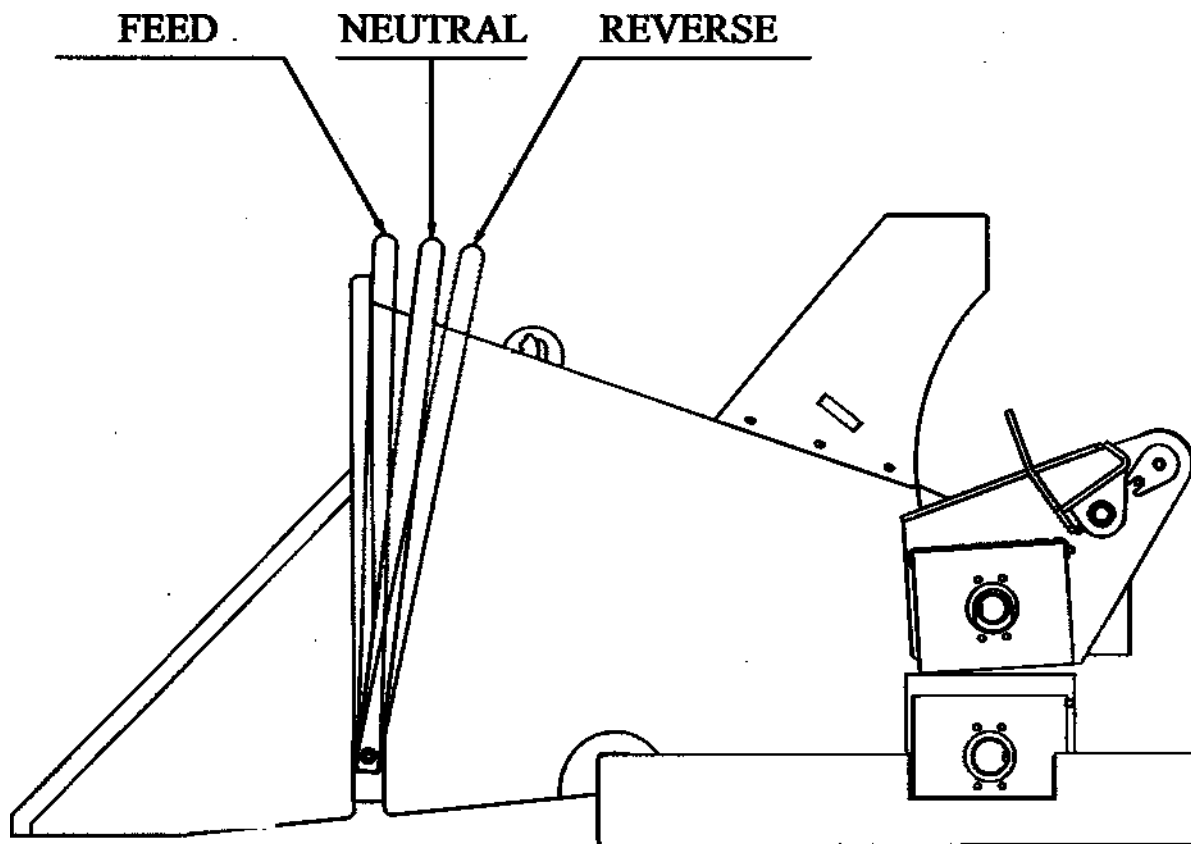
The feed rollers are controlled by pushing or pulling the feed control bar, which is located on the top and both sides of the feed chute.

The 3 (Three) control positions are:

FEED - Pulls material into the chipper cutting zone.

NEUTRAL - Stops movement of the feed rollers.

REVERSE - Activates the rollers to push material out of the chipper drum cutting zone.



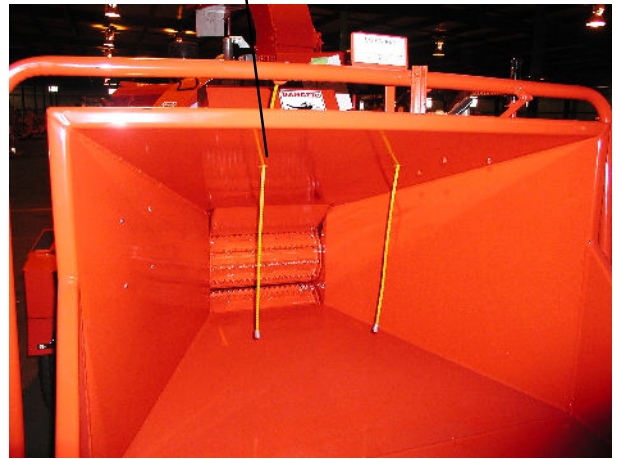
SAFETY CONTROLS

EMERGENCY SHUT DOWN BUTTON - (OPTIONAL) - Push button in until power unit stops. (Be sure to pull back out when motor has completely shut down.)

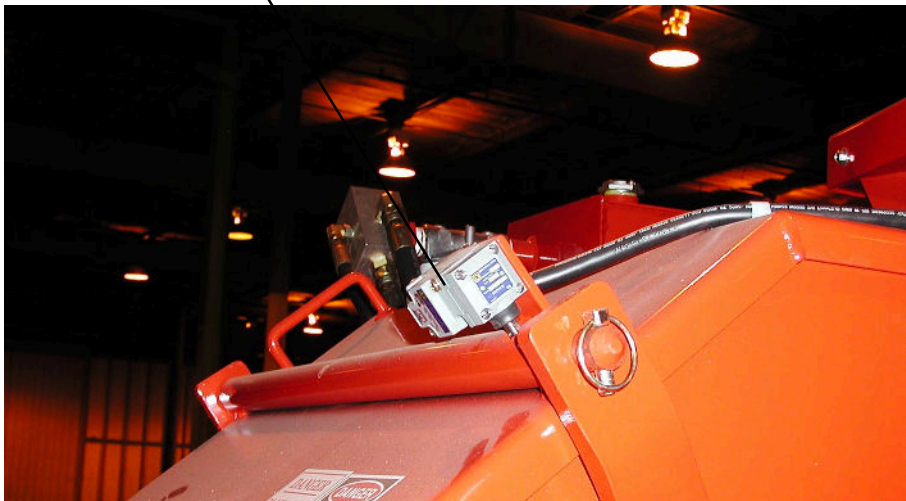
 **CAUTION:** This button should only be used for emergency shut down.



SAFETY CABLES - Pull these to reverse the feed system in case of emergency.



HOOD SAFETY SWITCH - This machine is equipped with a hood safety switch. This will not allow the machine to start with hood open.



Morbark Parts the solution to your problems. Buying your parts elsewhere just does not pay.



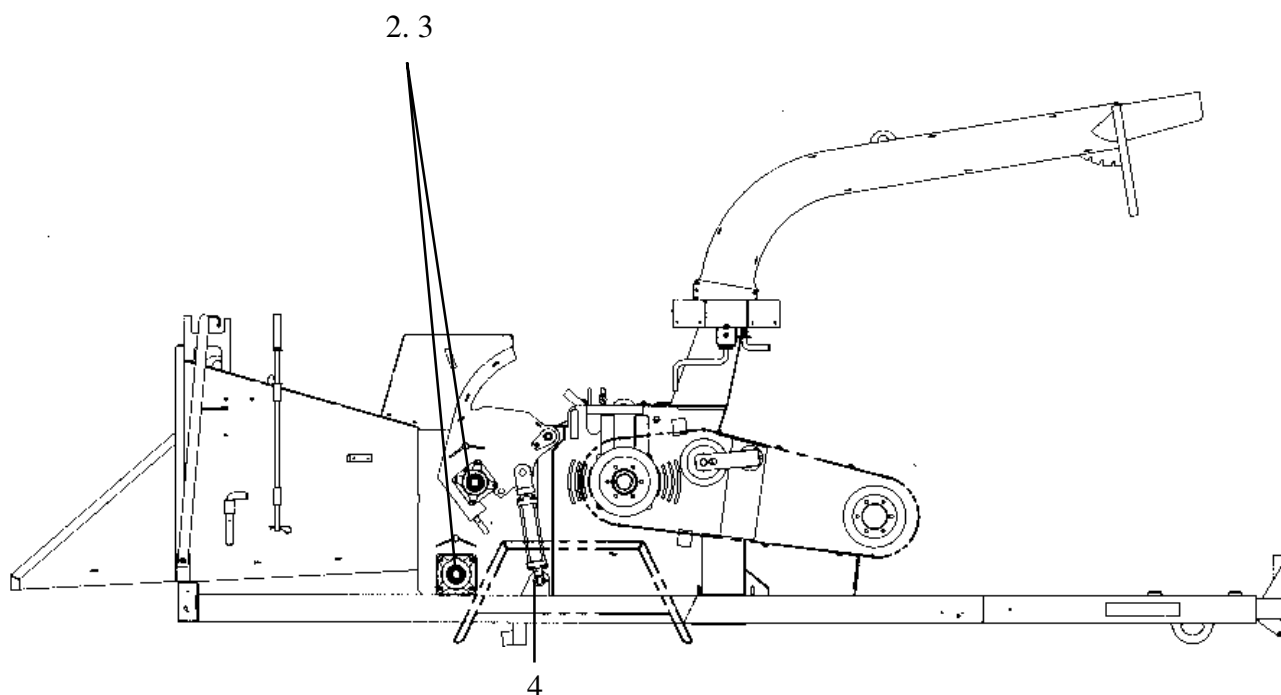
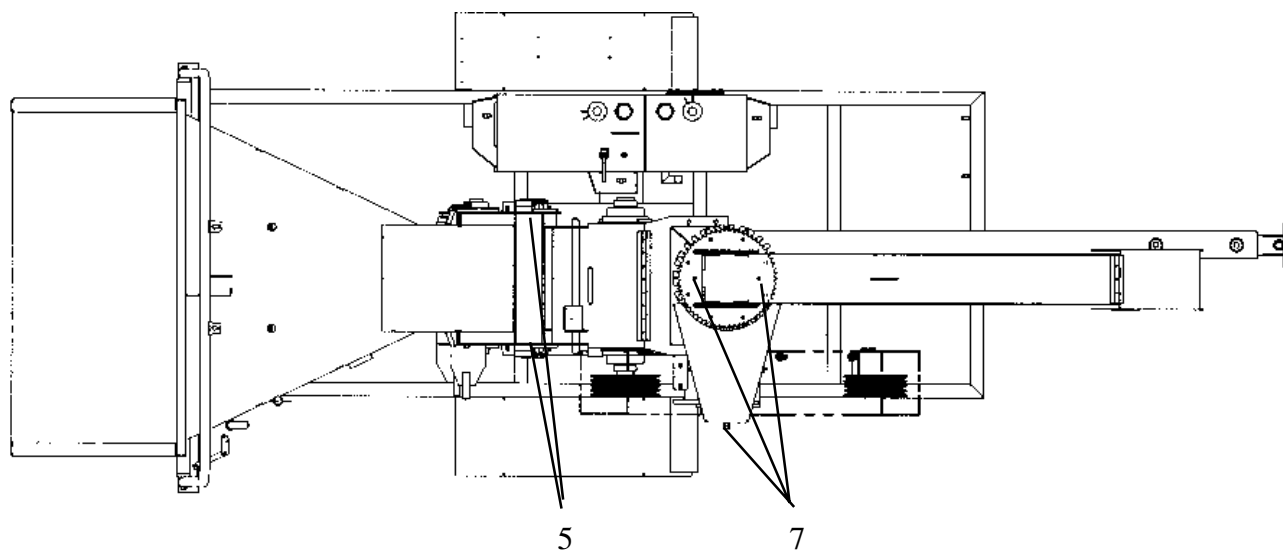
GENUINE MORBARK PARTS
800/255-8839 800/832-5618 FAX
WWW.MORBARK.COM

ROUTINE MAINTENANCE SCHEDULE

Please note that the following maintenance intervals apply for normal operating conditions only. Intervals are hours of operations based on 8 hours per day, 5 days per week. If your operating conditions are difficult, adjust the specified intervals accord		Start up	8 hours	40 hours	400 hours	Twice Yearly
<u>CHIPPER</u>	<u>PROCEDURES</u>					
Complete machine	visual inspection (condition, leaks)	X	X			
	clean		X			
Engine oil	check and change according to engine manual	X	X			
	increase to full level if required					
Engine coolant	check and change according to engine manual	X	X			
	increase to full level if required					
Engine air pre-cleaner	tap filter and blow out with compressed air		X			
Engine air filter	clean when indicator is red ¹⁾					
Radiator screen	tap screen and blow out with compressed air		X			
Clutch	adjust ²⁾					
	grease according to clutch manual					
Drum bearings	clean and repack ³⁾					X
	check clearance when repacking					
Drum knives	inspect		X			
	sharpen or replace when chip quality deteriorates					
Drum knife bolts	inspect when checking drum knives ⁴⁾			X		
	replace when worn or damaged					
Drum knife holders	inspect when checking drum knives			X		
	replace when worn or damaged					
Drum knife holder bolts	inspect when checking drum knives ⁴⁾			X		
	replace when changing holders					
Drum knife clearance	adjust when changing drum knives			X		
Drum anvil	inspect when checking drum knives			X		
	replace when worn or damaged					
Drum drive belts	inspect ⁴⁾		X	X		
	tighten to proper tension ⁵⁾					
	replace when worn					
Feedwheel teeth	cut off and replace when worn					
Tires	check air pressure before moving					
Chain drives	check tension, alignment and lubrication	X	X			
<u>HYDRAULICS</u>						
Oil filters	replace				X	
Hydraulic oil	check					
	increase to 3/4 full ⁶⁾					
1) Engine compression may change indicator. Therefore, try to reset the indicator by pressing the rubberized button before cleaning pre-cleaner or changing air filters						
2) Adjustment of new clutch must be done several times within a short period of time to insure proper operation. See OEM manual for adjustment procedures.						
3) Use only EP-2 rated grease						
4) During 1st week check all belt and bolts every 8 hrs, after 1st week check weekly						
5) According to specifications listed in your Morbark Operators Safety Manual						
6) Change every 2000 hours						

ROUTINE LUBRICATION SCHEDULE

LUBRICATION SCHEDULE



ROUTINE LUBRICATION SCHEDULE

LUBRICATION SCHEDULE

Please note that the following maintenance intervals apply for normal operating conditions only. Intervals are hours of operations based on 8 hours per day, 5 days per week. If your operating conditions are difficult, adjust the specified intervals accordingly.	40 hours	1000 hours
1) Wheel Axle ¹⁾		
2) Top feed wheel bearings (2 places)	X	
3) Bottom feed wheel bearings (2 places)	X	
4) Yoke cylinder pins (4 places)	X	
5) Yoke pivot pin (2 places)	X	
6) Clutch (4 places) ¹⁾		
7) Discharge chute swivel and crank handle (3 places)	X	
X = 1 SHOT OF GREASE		
Use only EP-2 rated grease		
1) See Manual supplied with your machine		



ROUTINE MAINTENANCE

Safety and daily maintenance are the two most important things to remember when operating machinery. A small amount of daily maintenance will make the weekly or monthly maintenance much easier and less expensive. While maintaining your brush chipper, please follow the safety guidelines which are written in **bold print**.

ALWAYS REMOVE THE IGNITION KEY, LOCK OUT THE ENGINE PANEL, DISENGAGE THE CLUTCH AND INSTALL THE DRUM LOCK PIN BEFORE ATTEMPTING ANY MAINTENANCE.

DO NOT, UNDER ANY CIRCUMSTANCES, OPEN THE CHIPPER HOUSING WITHOUT FIRST MAKING SURE THE CHIPPER DRUM HAS COME TO A COMPLETE STOP AND THE POWER UNIT IS OFF.

Because of the high temperature of the coolant, use caution when removing radiator cap.

Always shut off the machine before refueling.

Do not smoke, weld or use any type of flame near the machine when refueling.

Always wear appropriate clothing and safety equipment while maintaining your machine.

Always wear leather gloves when changing or servicing chipper knives.

Always replace all safety guards after servicing your machine.

Always make sure all filler plugs and caps are in place after servicing.

When starting power unit indoors, make sure the area is properly ventilated.

Do not attempt to unplug the chipper infeed spout while the chipper is running.



ROUTINE MAINTENANCE

MILL BEARING GREASING INSTRUCTIONS



WARNING: To ensure that the drive does not start unexpectedly, turn off and lockout or tag power source before proceeding.

INSPECTION

Inspect drum shaft. Ensure that the shaft is smooth, straight and clean.

Inspect bearing. Do not allow bearing to be exposed to any dirt or moisture. Do not remove slushing compound, since it acts as both a protectant and lubricant and is also compatible with standard greases.

NOTE: Housing caps and bases are not interchangeable. They must be matched with mating half. Install non-expansion bearing first (located on the drive side of the drum.)

1. Apply a light coating of oil or other rust inhibitor to the adapter area of the shaft.
2. Measure the internal clearance of the bearing before mounting. Place the bearing in an upright position. Seat the inner ring and roller elements by pressing down firmly on the inner ring bore while rotating the inner ring a few times. Position the roller assemblies so that a roller is at the top most position on both sides. Press these top rollers inward ensuring contact with center guide flange (above 6 1/2" only.) Using a feeler gauge, measure the clearance for both sides by inserting as far as possible and sliding over top of roller. Write down the measured clearance for use in step 3D.

NOTE: Do not rotate bearing when moving feeler between roller and outer ring.

3. Install the bearing parts in the following sequence:

NOTE: Bearing can only be correctly installed one way.

A. Seal Ring - Install a seal ring on shaft.

B. Adapter - Slide adapter onto the shaft, threaded end outboard to the approximate

location of the bearing. Apply light coating of oil to sleeve O.D.

C. Bearing - Make sure the internal clearance has been written down. Install bearing on adapter sleeve, large end of tapered bore first. Locate bearing in proper position on shaft.

D. Lockwasher and Locknut - Install the lockwasher (8" and smaller sizes only) on the adapter with inner prong located in the slot and toward the bearing. Install lock nut, chamfered face toward bearing. Install non expansion ring on drive side of bearing. (**CAUTION:** Do not use a non expansion ring in idler bearing.)

4" shaft and smaller - Tighten locknut using spanner wrench and hammer until clearance noted in step 2 is reduced by amount shown in Table 1. During this step, shaft should be supported so all weight is off the bearing.

4-13/16" to 10-1/2" shaft - Tighten locknut by hand followed by light tapping on a bar inserted in notches on O.D. of locknut until snug against bearing. Tighten all micro mount screws evenly in sequence and in small increments (10° to 15° turns) until clearance is reduced. Loosen all screws until they are snug at large end of nut. Screws have been staked at factory to prevent removal. However, restake if necessary. Tighten locknut until it is tight against bearing. (Use drift pin and hammer. Do not overtighten.)

Find a lockwasher tab that aligns with a locknut slot and bend tab into slot. If slot is past tab, then tighten - not loosen - locknut to allow prong to fit in adapter slot. Lock plates for the 9" must be hand fitted on the job.

Table 1—Internal Clearance Reduction

Shaft Diameter	Reduction in Internal Clearance
1-15/16, 2-3/16	.0012/.0015
2-7/16, 2-1/2, 2-11/16, 2-3/4	.0015/.0020
2-15/16, 3, 3-3/16, 3-7/16, 3-1/2	.0018/.0025
3-15/16, 4, 4-3/16	.0020/.0028
4-7/16, 4-1/2, 4-15/16, 5	.0025/.0035
5-3/16, 5-7/16, 5-1/2	.0030/.0040
5-15/16, 6, 6-7/16, 6-1/2	.0030/.0045
6-15/16, 7	.0035/.0050
7-1/2, 7-15/16, 8	.0040/.0055
8-7/16, 8-1/2, 8-15/16, 9	.0045/.0060
9-7/16 — 10-1/2	.0045/.0065

SAFETY OPERATION

INSPECTING CHIPPER KNIVES

1. Throttle engine down and disengage the clutch.



DANGER/THROWN DEBRIS, CUT, PINCH HAZARD: Make sure the drum has come to a complete stop before attempting any maintenance.



CAUTION: Do not use your hand to check for drum movement.



DANGER/THROWN DEBRIS HAZARD: Do not use the clutch for inspecting knives for any reason.

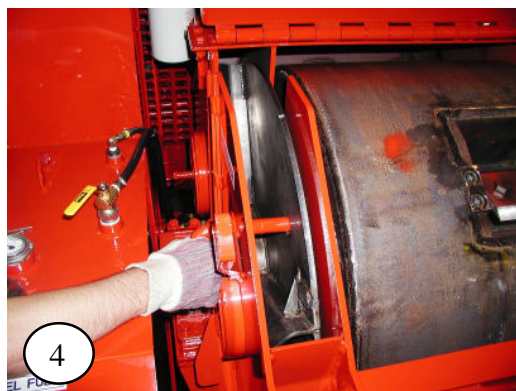


DANGER/THROWN DEBRIS, CUT, PINCH HAZARD: Shut power unit off before any maintenance is performed.

2. Remove chipper hood lock pin and open the hood.
3. Turn drum by hand until first knife is accessible.
4. Install drum lock pin.
5. Inspect knife. If knife needs to be replaced, refer to "Changing Chipper Knives" section.
6. If knife is in good condition, check all knife bolts for tightness. Refer to the torque chart.
7. Remove the drum lock pin and rotate the drum by hand until the next knife is accessible.
8. Replace the drum lock pin.
9. Repeat steps 5 and 8 until all knives are checked.
10. After inspecting all knives and bolts, remove the drum lock pin.
11. Close chipper hood, install hood pin and lynch pin.

MAKE ONE LAST VISUAL INSPECTION

1. Check tightness of all bolts.
2. Clear infeed of all debris.
3. You are now ready to begin chipping.



ROUTINE MAINTENANCE

CHANGING CHIPPER KNIVES

1. Throttle engine down and disengage the clutch.



DANGER/THROWN DEBRIS, CUT, PINCH HAZARD: Make sure the drum has come to a complete stop before attempting any maintenance.



CAUTION: Do not use your hand to check for drum movement.



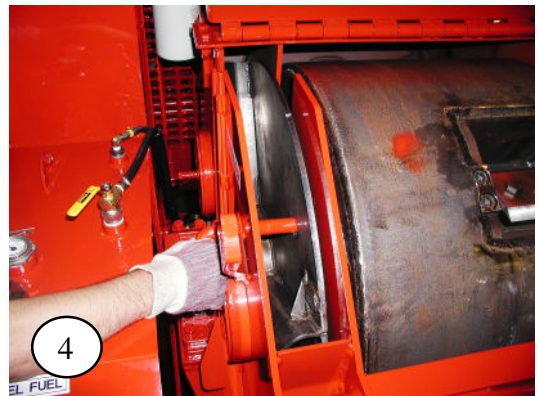
DANGER/THROWN DEBRIS HAZARD: Do not use the clutch for changing knives for any reason.



DANGER/THROWN DEBRIS, CUT, PINCH HAZARD: Shut power unit off before any maintenance is performed.

2. Remove chipper hood lock pin and open the hood.
3. Rotate drum so knife is accessible.
4. Install drum lock pin.
5. Remove the four (4) knife bolts.
6. Remove all dirt and chip particles from the knife and knife pocket with a wire brush.
7. Inspect the knife holder for wear.
8. Reverse, grind or replace the knife.
9. Place the knife onto the knife holder and insert bolts. Slide the knife back (away from anvil) against the knife bolts. Torque to specifications listed in the torque chart.
10. Remove drum lock pin.
11. Repeat this process for each knife.
12. After changing knives, close chipper hood and replace hood lock pin.

CAUTION: Adjust anvil each time you replace or sharpen knives. Refer to adjusting anvil clearance.



ROUTINE MAINTENANCE

INSPECTING AND ADJUSTING THE KNIFE ANVIL CLEARANCE

To inspect and adjust the knife anvil clearance, follow these steps:

1. Throttle engine down and disengage the clutch.



DANGER/THROWN DEBRIS, CUT, PINCH HAZARD: Make sure the drum has come to a complete stop before attempting any maintenance.



CAUTION: Do not use your hand to check for drum movement.



DANGER/THROWN DEBRIS HAZARD: Do not use the clutch for adjusting anvil clearance for any reason.

2. Be certain feed wheel control bar is in the neutral position.
3. Raise the feedwheel yoke and pin.



DANGER/CRUSH HAZARD: Failure to use yoke locks may result in serious injury or death.

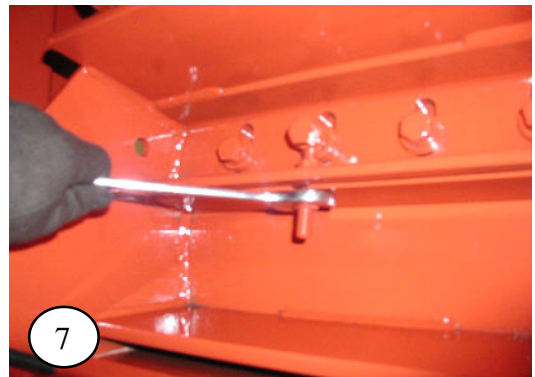
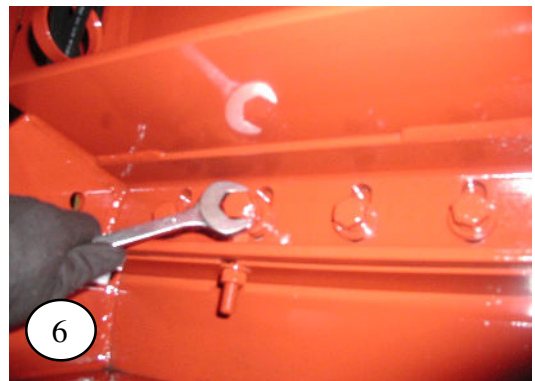
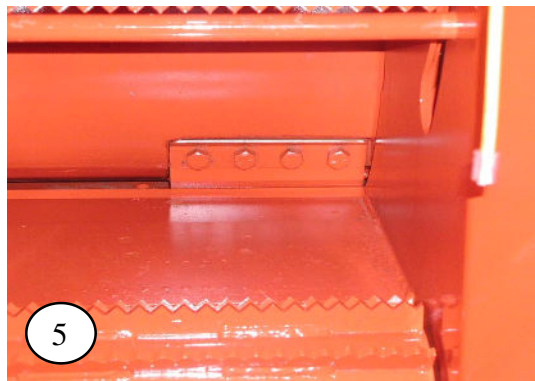


DANGER/THROWN DEBRIS, CUT, PINCH HAZARD: Shut power unit off before any maintenance is performed.



CAUTION: Two (2) people are required at all times when adjusting anvil.

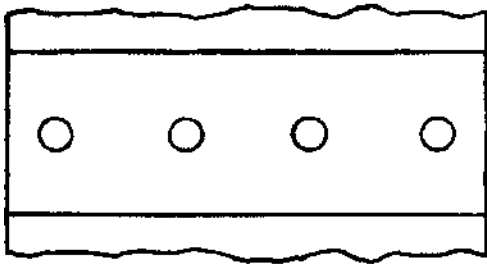
4. The anvil clearance can be checked by reaching into the infeed spout.
5. Use a feeler gauge to check the clearance between the knife anvil and the cutting edge of each knife. Set anvil to the knife that is located closest to the anvil.
6. Loosen the six (6) anvil bolts.
7. Slide the anvil to the desired position using the two (2) eye bolts located behind the anvil bolts.
8. Retighten the anvil bolts. Refer to torque chart.
9. Turn the drum backwards to check for proper clearance on the other knives, ensuring that all the knives are no closer than .045" and no further than .080"



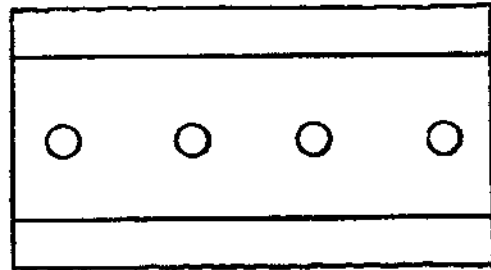
ROUTINE MAINTENANCE

WHAT YOU SHOULD KNOW ABOUT CHIPPER KNIFE MAINTENANCE

Properly maintained chipper knives will give you longer service. When knives are badly abused you can usually only expect minimal sharpenings before the knife is worn out. With proper maintenance and frequent knife changes, you can get more knife sharpenings per edge. When sharpening knives, proper grinding techniques must be used.

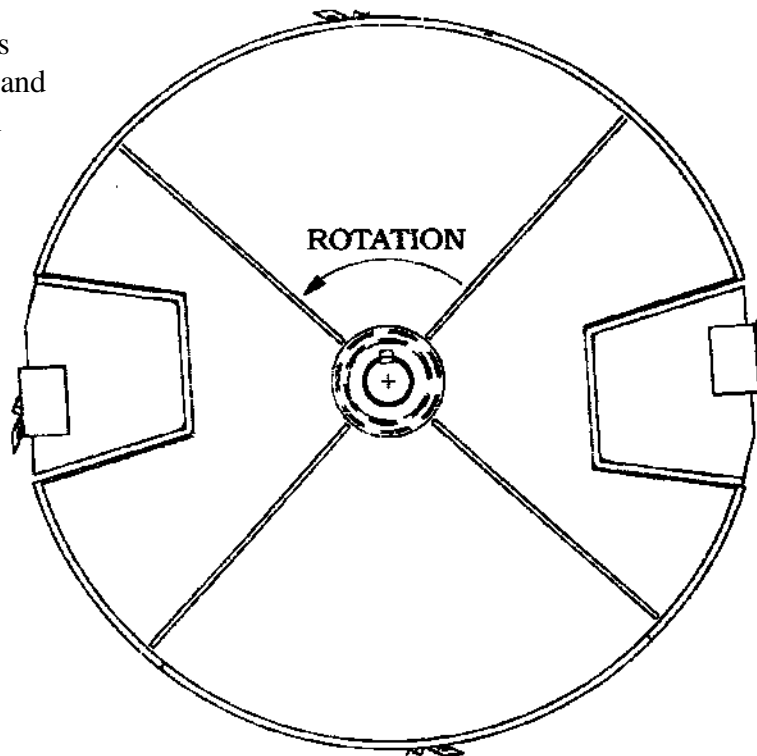


**Badly abused
chipper knife.**

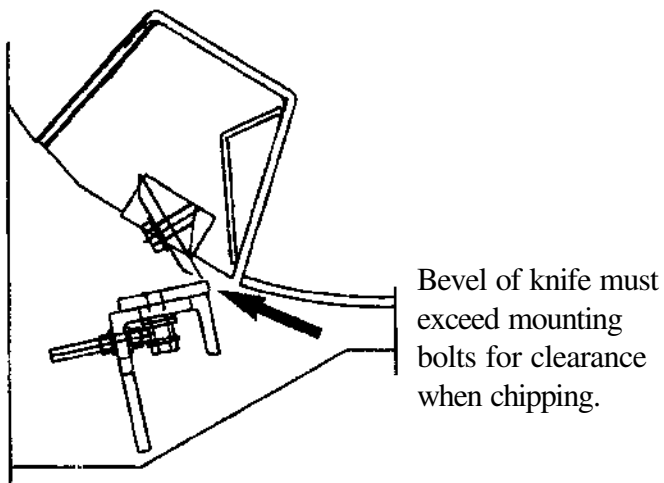


**Due for a
knife change.**

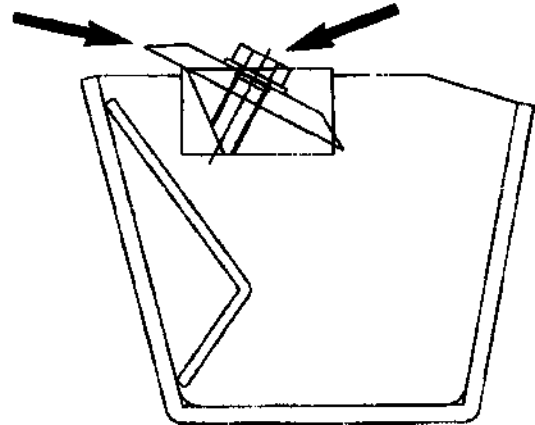
When changing knives and holders, pockets and holders must be clean and free of all foreign material. Use a wire brush to thoroughly clean pocket.



ROUTINE MAINTENANCE



Use proper hardware for mounting knife to holder. Torque mounting bolts properly to eliminate wood packing and possible knife breakage.



Proper anvil clearance, sharp anvils and knives should be maintained for quality chips. A good, efficient cut can eliminate plugging problems and undue stress on the chipper.

Repair costs and down time can be greatly reduced by using sharp knives and a good square anvil. A chipper strains trying to feed wood through dull knives. Dull knives are caused by:

- Use of wrong cutting angles and bevels.
- Improper care of knives.
- Long overdue knife changes.
- Poor grinding procedures.
- Dirty material being chipped.
- Foreign items in material (nails, wire, steel etc.)

10 STEPS TO LASTING PERFORMANCE

1. Use knives of correct steel composition and hardness.
2. Maintain proper cutting angle and sharpening techniques.
3. Practice frequent knife changes.
4. Maintain proper anvil clearance.
5. Maintain square anvil.
6. Use matched sets.
7. Do not use knives that are too narrow.
8. Keep anvil and knife bolts tight.
9. Be sure knife pockets and holders are clean when changing knives.
10. Protect cutting edges of knives when not in chipper.

ROUTINE MAINTENANCE

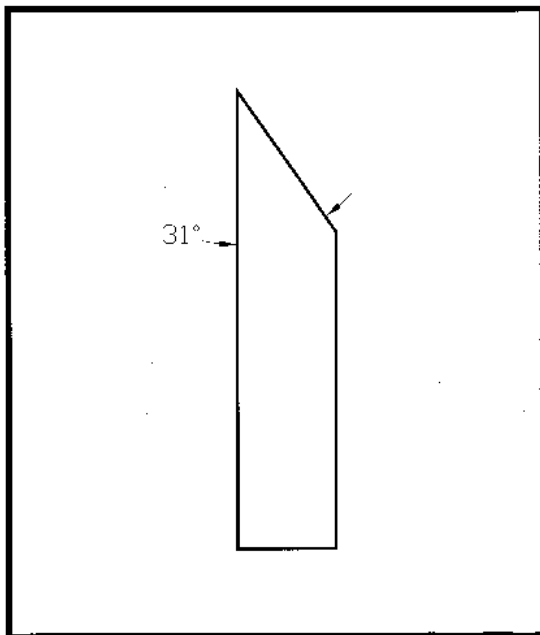
KNIFE GRINDING

Sharp knives cause less wear on the machine and increase fuel economy. The brush chipper is equipped with double-edged chipper knives. When one cutting surface of the knife becomes dull, simply rotate the knives.

The time between knife sharpening will depend on many factors including:

- a. Species of wood.
- b. Weather conditions. Rain causes the trees to pick up soil while being dragged to the chipping site. Soil is extremely hard on knives.
- c. Amount of chipper production.
- d. The quality of the knife. Knives should be sharpened professionally with a coolant type surface grinder. (Morbark Inc. knives are recommended.)

Knives should be ground at 31°.



ROUTINE MAINTENANCE

TIGHTENING TORQUE GUIDE

GRADE 5

Coarse Thread

Size	Clamp Load	Plain	Plated
1/4-20 (.250)	2,025	8 ft. lbs.	76 in. lbs.
5/16-18 (.3125)	3,338	17 ft. lbs.	13 ft. lbs.
3/8-16 (.375)	4,950	31 ft. lbs.	23 ft. lbs.
7/16-14 (.4375)	6,788	50 ft. lbs.	37 ft. lbs.
1/2-13 (.500)	9,075	76 ft. lbs.	57 ft. lbs.
9/16-12 (.5625)	11,625	109 ft. lbs.	82 ft. lbs.
5/8-11 (.625)	14,400	150 ft. lbs.	112 ft. lbs.
3/4-10 (.750)	21,300	266 ft. lbs.	200 ft. lbs.
7/8-9 (.875)	29,475	430 ft. lbs.	322 ft. lbs.
1-8 (1.000)	38,625	644 ft. lbs.	483 ft. lbs.
1 1/8-7 (1.125)	42,375	794 ft. lbs.	596 ft. lbs.
1 1/4-7 (1.250)	53,775	1120 ft. lbs.	840 ft. lbs.
1 3/8-6 (1.375)	64,125	1470 ft. lbs.	1102 ft. lbs.
1 1/2-6 (1.500)	78,000	1950 ft. lbs.	1462 ft. lbs.

Fine Thread

1/4-28 (.250)	2,325	10 ft. lbs.	87 in. lbs.
5/16-24 (.3125)	3,675	19 ft. lbs.	14 ft. lbs.
3/8-24 (.375)	5,588	35 ft. lbs.	26 ft. lbs.
7/16-20 (.4375)	7,575	55 ft. lbs.	41 ft. lbs.
1/2-20 (.500)	10,200	85 ft. lbs.	64 ft. lbs.
9/16-18 (.5625)	12,975	122 ft. lbs.	91 ft. lbs.
5/8-18 (.625)	16,350	170 ft. lbs.	128 ft. lbs.
3/4-16 (.750)	23,775	297 ft. lbs.	223 ft. lbs.
7/8-14 (.875)	32,475	474 ft. lbs.	355 ft. lbs.
1-12 (1.000)	42,300	705 ft. lbs.	529 ft. lbs.
1-14 (1.000)	32,275	721 ft. lbs.	541 ft. lbs.
1 1/8-12 (1.125)	47,475	890 ft. lbs.	668 ft. lbs.
1 1/4-12 (1.250)	59,550	1241 ft. lbs.	930 ft. lbs.
1 3/8-12 (1.375)	72,975	1672 ft. lbs.	1254 ft. lbs.
1 1/2-12 (1.500)	87,750	2194 ft. lbs.	1645 ft. lbs.

GRADE 8

Coarse Thread

Size	Clamp Load	Plain	Plated
1/4-20 (.250)	2,850	12 ft. lbs.	9 ft. lbs.
5/16-18 (.3125)	4,725	25 ft. lbs.	18 ft. lbs.
3/8-16 (.375)	6,975	44 ft. lbs.	33 ft. lbs.
7/16-14 (.4375)	9,600	70 ft. lbs.	52 ft. lbs.
1/2-13 (.500)	12,750	106 ft. lbs.	80 ft. lbs.
9/16-12 (.5625)	16,350	153 ft. lbs.	115 ft. lbs.
5/8-11 (.625)	20,325	212 ft. lbs.	159 ft. lbs.
3/4-10 (.750)	30,075	376 ft. lbs.	282 ft. lbs.
7/8-9 (.875)	41,550	606 ft. lbs.	454 ft. lbs.
1-8 (1.000)	54,525	909 ft. lbs.	682 ft. lbs.
1 1/8-7 (1.125)	68,700	1288 ft. lbs.	966 ft. lbs.
1 1/4-7 (1.250)	87,225	1817 ft. lbs.	1363 ft. lbs.
1 3/8-6 (1.375)	103,950	2382 ft. lbs.	1787 ft. lbs.
1 1/2-6 (1.500)	126,450	3161 ft. lbs.	2371 ft. lbs.

Fine Thread

1/4-28 (.250)	3,263	14 ft. lbs.	10 ft. lbs.
5/16-24 (.3125)	5,113	27 ft. lbs.	20 ft. lbs.
3/8-24 (.375)	7,875	49 ft. lbs.	37 ft. lbs.
7/16-20 (.4375)	10,650	78 ft. lbs.	58 ft. lbs.
1/2-20 (.500)	14,400	120 ft. lbs.	90 ft. lbs.
9/16-18 (.5625)	18,300	172 ft. lbs.	129 ft. lbs.
5/8-18 (.625)	23,025	240 ft. lbs.	180 ft. lbs.
3/4-16 (.750)	33,600	420 ft. lbs.	315 ft. lbs.
7/8-14 (.875)	45,825	668 ft. lbs.	501 ft. lbs.
1-12 (1.000)	59,700	995 ft. lbs.	746 ft. lbs.
1-14 (1.000)	61,125	1019 ft. lbs.	764 ft. lbs.
1 1/8-12 (1.125)	77,025	1444 ft. lbs.	1083 ft. lbs.
1 1/4-12 (1.250)	96,600	2012 ft. lbs.	1509 ft. lbs.
1 3/8-12 (1.375)	118,350	2712 ft. lbs.	2034 ft. lbs.
1 1/2-12 (1.500)	142,275	3557 ft. lbs.	2668 ft. lbs.

1. Parts using rivet nuts torque to 25 Ft. Lbs. Maximum.
2. Always use the torque values above when specific torque values are not available.
3. Do not use above values in place of those specified in other sections of this manual; special attention should be observed when using SAE Grade 6, 7 and 8 Capscrews.
4. The above is based on use of clean, dry threads.
5. Reduce torque by 10% when engine oil is used as a lubricant.
6. Reduce torque by 20% if new plated capscrews are used.
7. Capscrews threaded into aluminum may require reductions in torque of 30% or more of Grade 5 capscrews torque and must attain two capscrew diameters of thread engagement.



CAUTION: If replacement capscrews are of a higher grade than originally supplied, adhere to torque specifications for that placement.

**Based on IFI 5th Edition Technical Data N-12/N-16, using Equation (1) and a torque coefficient, K=0.20 for nonplated steel fasteners and K=0.15 for plated fasteners.

These Figures represent an estimate of torque (torque being the measurement of friction, not tension) required to induce given preload (clampload) in a bolt for noncritical applications only. For critical or special applications where greater control is desired this should be experimentally determined. This applies to washer faced or double chamfered hex nuts (or bolts, if bolt is torqued) having a width across flats of approximately 1.5 times the nominal diameter and having threads free of interference. Because of the many interrelated variables that directly or indirectly affect friction, such as surface texture, type of coating or finish, lubrication, speed of tightening, human error, etc., it is possible to experience as much as $\pm 25\%$ deviation in preload (clampload) with the use of a torque wrench.

ROUTINE MAINTENANCE

B-LOC HUBS

INSTALLATION AND REMOVAL INSTRUCTIONS FOR B-LOC™ LOCKING ASSEMBLY SERIES B112

Thank you for purchasing a B-LOC™ Keyless Frictional Locking Device. B-LOC™ keyless connectors provide a high capacity, zero-backlash shaft/hub or coupling connection by means of a mechanical interference fit. Please follow these INSTALLATION AND REMOVAL INSTRUCTIONS carefully to ensure proper performance of this B-LOC™ unit.

ⓘ WARNING ⓘ

When installing or removing B-LOC™ products, always adhere to the following safety standards:

1. Be sure that all power switches are locked out before installing or removing B-LOC™ products.
2. Eye protection is required when installing or removing B-LOC™ products - please wear safety glasses and protective clothing.

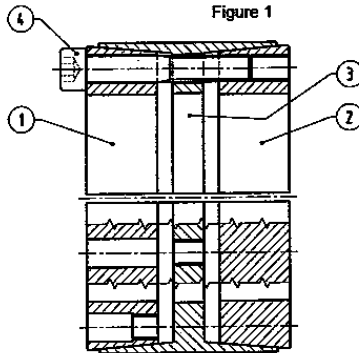
INSTALLATION

(Refer to Figures 1 and 2)

B-LOC™ Locking Assemblies are supplied lightly oiled and ready for installation. When reinstalling a used unit, make sure that all slits are aligned and that front and rear clamp collars are not reversed (when assembled correctly there are no holes or threads behind taps in clamp collar Item 1, and no threads behind taps in center collar Item 3). The frictional torque capacity of these devices is based on a coefficient of friction of 0.12 for lightly oiled screw, taper, shaft and bore contact areas.

Therefore, it is important not to use Molybdenum Disulfide (e.g., Molykote, Never-Seeze or similar lubricants) in any Locking Assembly installation.

Make sure that locking screw, taper, shaft and bore contact areas are clean and lightly oiled and that all collar slits are aligned.



2. Loosen all locking screws by a minimum of four (4) turns and transfer at least two (2) screws to push-off threads in clamp collar Item 1 to disengage this part from center collar Item 3. Similarly, transfer at least two (2) screws to push-off threads in center collar Item 3 to disengage this part from clamp collar Item 2 (see Figure 2).
3. Completed assembly can now be placed on shaft and inserted into hub bore by pushing against face of collar Item 1 while ensuring that collar Item 2 is not engaged at tapers during this phase.
4. After placement of Locking Assembly, relocate locking screws used for separation of collars.
5. Hand tighten connection and confirm that clamp collar Item 1 is parallel with face of part to be attached to shaft and/or with the front facing edge of center collar Item 3.
6. Use torque wrench and set it approximately 5% higher than specified tightening torque M_A . Tighten locking screws in either a clockwise or counterclockwise sequence (it is not necessary to tighten in a diametrically opposite pattern), using only 1/4 (i.e., 90°) turns for several passes until 1/4 turns can no longer be achieved.
7. Continue to apply overtorque for 1 to 2 more passes. This is required to compensate for a system-related relaxation of locking screws since tightening of a given screw will always relax adjacent screws. Without overtightening, an infinite number of passes would be needed to reach specified tightening torque.
8. Reset torque wrench to specified torque (M_A) and check all locking screws. No screw should turn at this point, otherwise repeat Step 7 for 1 or 2 more passes. It is not necessary to re-check tightening torque after equipment has been in operation.

B-LOC Corporation 26 Gilbert Street Monroe, NY 10950

NOTE: In installations subjected to extreme corrosion, the slits in clamp collars Item 1 and Item 2, as well as in center collars, should be sealed with a suitable caulking compound or equivalent. Likewise, push-off threads should also be protected from corrosion.

INSTALLATION OF B-LOC™ LOCKING ASSEMBLIES OVER SHAFT KEYWAYS

The Locking Assembly should be positioned so that slits in Locking Assembly collars that contact the shaft are located approximately opposite the keyway. In addition, a locking screw should be centered directly over the keyway.

When tightening locking screws, it is important to follow the installation procedure outlined above, which specifies equal 1/4 turns of each locking screw. Failure to follow these instructions could result in excessive tightening of the screw over the keyway, possibly causing permanent deformation of the Locking Assembly collars. Even after 1/4 turns can no longer be achieved, it is important to continue to use equal turning angles for every screw until the specified tightening torque is reached.

REMOVAL

(Refer to Figure 2)

Prior to initiating the following removal procedure, check to ensure that no torque or thrust loads are acting on the Locking Assembly, shaft or any mounted components.

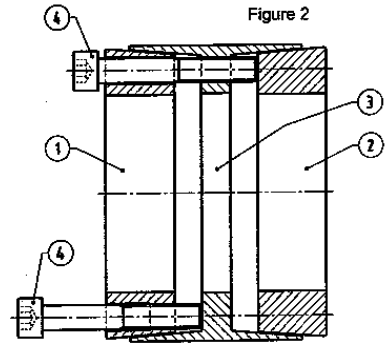
IMPORTANT! Make sure ends of locking screws used for removal are ground flat and are slightly chamfered to prevent damage to screw and collar threads during push-off.

1. Check to ensure that axial movement of clamp collars - necessary for release of connection - is not restricted. Likewise, ensure that push-off threads are in good condition.

2. Remove all locking screws. Transfer required number of screws into all push-off threads of clamp collar Item 1 (see Figure 2).

3. Release collar Item 1 by progressively tightening all push-off screws. Typically, the push-off screws appear to be completely tight after just one pass of tightening without any noticeable separation of clamp collars. Although it seems that the screws cannot be tightened further, several more rounds of torquing in either a clockwise or counterclockwise sequence will increase the push-off force in the system and ultimately release part of the front collar. Afterwards, only the screws which are still tight should be tightened further until complete dismounting is achieved. Remove clamp collar Item 1.

4. Transfer locking screws used for dismounting of clamp collar Item 1 into all push-off threads in center collar Item 3 (see Figure 2). Release clamp collar Item 2 by repeating procedures outlined in Step 3.



LOCKING SCREW SIZES AND SPECIFIED TIGHTENING TORQUE M_A B112 LOCKING ASSEMBLY

Metric Series	Inch Series	Tightening Torque M_A (ft-lbs)	Screw Size	Hex Key Size (mm)
25 x 55 to 35 x 60	1 to 1-7/16	12	M 6	5
40 x 75 to 65 x 95	1-1/2 to 2-3/16	30	M 8	6
70 x 110 to 90 x 130	2-5/8 to 3-5/8	60	M 10	8
100 x 145 to 120 x 165	3-3/4 to 4-3/4	105	M 12	10
130 x 180 to 160 x 210	4-15/16 to 6	166	M 14	12
170 x 225 to 260 x 325	6-7/16 to 8	257	M 16	14
280 x 355 to 340 x 425		500	M 20	17
360 x 455 to 600 x 695		675	M 22	17

For technical assistance, please call 1-800-865-7756

ROUTINE MAINTENANCE

ADJUSTING THE BELT TENSION

To check for proper tension of belts, follow the directions in V-Belt tension gauge.

1. Throttle engine down and disengage the clutch.



DANGER/THROWN DEBRIS, CUT, PINCH HAZARD: Make sure the drum has come to a complete stop before attempting any maintenance.



CAUTION: Do not use your hand to check for drum movement.



DANGER/THROWN DEBRIS HAZARD: Do not use the clutch for adjusting belts for any reason.



DANGER/THROWN DEBRIS, CUT, PINCH HAZARD: Shut power unit off before any maintenance is performed.

To adjust the chipper belt tension, follow these steps:

2. Remove the belt shield.
3. Loosen the engine bolts.
4. Adjust chipper belt to obtain proper belt tension by using engine adjusting bolts.
5. Tighten bolts with proper torque.

CAUTION: Adjust both sides evenly to ensure proper sheave alignment.

6. Whenever the belt shield is removed for service, replace it after you have finished. Shields are built for your protection. **Use them.**



ROUTINE MAINTENANCE

HOW TO USE A V-BELT TENSION GAUGE



WARNING: Before doing maintenance or tensioning on belt drives, turn equipment off and lock out the power source.

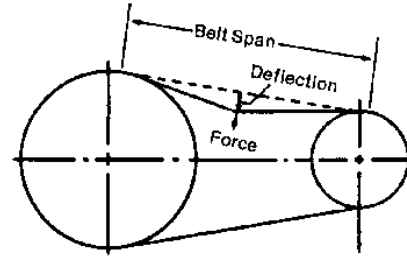
1. Place a matched set of belts over the sheave grooves. Take up the slack until the belts appear fairly tight.
2. With the drive stopped, measure the belt span length of your drive (see table 1.) Set the rubber O-ring on the body of the tension gauge (S/N 29841-093) at the dimension equal to 1/64" for every inch of span length. For example, the deflection for a 32" span is 1/64" x 32-1/2".
3. Set the O-ring on the plunger at 0 against the body of the tension gauge.
4. With the tension gauge perpendicular to the span, apply a force to a belt in the center of the span. Deflect the belt until bottom of the large O-ring is even with the top of the next belt or the bottom of a straightedge laid across the top of other belt(s) on the drive. Release pressure and read pounds of force used at O-ring on plunger.

Note: When new belts are installed on a drive, the tension will drop rapidly during the first few hours. Thus, for new belts, tighten to the initial installation deflection force shown in the table.

5. Check tension frequently during the first 24 hours of operation. Subsequent retensioning should fall between the minimum and maximum forces shown in the tables.
6. Compare the force required in step 4 with the ranges in table 2. Tighten or loosen belts to bring them into the recommended range.

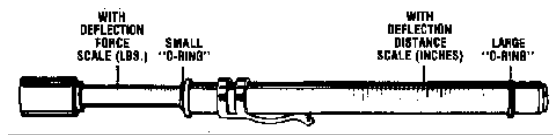
Note: The proper tension for V-belt drive is the lowest tension at which the belts won't slip under peak load conditions.

1.



5V	7.10- 8.50	19.2	16.7	13.0
	9.00-11.80	23.3	20.3	15.6
	12.50-16.00	27.3	23.8	18.5
8V	12.50-16.00	50.9	44.3	34.4
	17.00-20.00	57.1	49.8	38.8
	21.20-24.80	61.3	53.3	41.4

2.



B	4.6- 5.4	6.0	5.1	4.0
	5.6- 7.4	6.3	5.5	4.2
	8.6- 9.4	6.6	5.7	4.4
C	7.0- 8.5	13.2	11.5	8.8
	9.0-12.0	13.9	12.1	9.3
	13.0-16.0	14.6	12.6	9.7
D	12.0-15.5	26.5	22.9	17.6
	16.0-18.0	27.8	24.3	18.7
	22.0-27.0	29.1	25.6	19.6

Note: All belts can be found in the **Parts Book** supplied with your machine.

Note: A new belt for tension purposes is a belt with zero running time.

Note: After a belt has been in operation for two minutes it is considered used.

Note: The best set of matched belts will not perform well if either the drive or driven sheaves are worn out. These sheaves should be inspected any time the belts are replaced. If the sheaves show signs of excessive wear they should be replaced so that maximum belt life can be obtained.

CAUTION: Failure to follow these guidelines could result in premature belt failure, belt rollover and P.T.O. bearing failure.

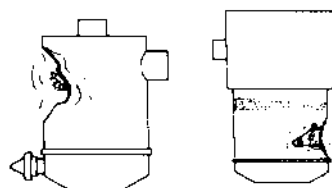
ROUTINE MAINTENANCE

AIR FILTER MAINTENANCE

NOTE: It's the customer's responsibility to follow all steps of air filter maintenance.

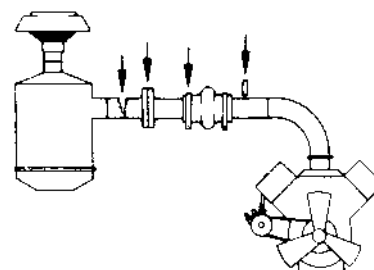
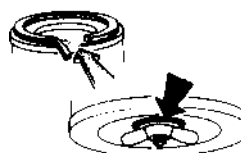
Low pre-cleaner efficiency will cause short element life. Low pre-cleaning efficiency can be caused by:

1. Leaking dust cup to air cleaner body joint; cup must seal 360° around the air cleaner.
2. A damaged or missing dust evacuator valve.
3. Plugging or build-up in the vanes of the pre-cleaner.
4. Damage to the pre-cleaning section of the air cleaner.



TO PREVENT AIRBORNE CONTAMINANTS FROM ENTERING THE ENGINE:

1. Check to make sure the element has not been damaged in handling. Examine for dents and holes.
2. Check to make sure all gaskets are sealing. Examine for dust trails, which indicate leaks. Check to be certain the wingnut is tight.
3. Examine the clean air transfer tubing for cracks, loose clamps or loose flange joints.
4. Check either fittings (if used) to be certain no contaminants are entering the engine through these connections.
5. Check the service indicator for damage, lockup function is working and correct calibration per engine manufacturers recommendation.



ROUTINE MAINTENANCE

BASIC ELEMENT SERVICE PRECAUTIONS

1.

7-Step Filter Element Replacement

1 Remove the old element gently

'Baby' that dirty filter, until you get it clear of the housing. Accidentally bumping it while still inside means dropped dirt and dust that will contaminate the clean side of your filter housing, before the new filter element has a chance to do its job.



2 Always clean the inside of the housing carefully

Dirt left in the air cleaner housing spells death for your engine. Use a clean, damp cloth to wipe every surface clean. Check it visually to make sure it's clean before putting in a new filter.



3 Always clean the gasket sealing surfaces of the housing

An improper gasket seal is one of the most common causes of engine contamination. Make sure that all hardened dirt ridges are completely removed, both on the bottom and top of the air cleaner.



4 Check for uneven dirt patterns

Your old filter has valuable clues to dust leakage or gasket sealing problems. A pattern on the element clean side is a sign that the old filter element was not firmly sealed or that a dust leak exists. Identify the cause of that leak and rectify it before installing a new filter.



5 Press your fresh gasket to see that it springs back

Make sure your new filter is made with a highly compressible gasket that springs back (promptly) when finger pressure is released. A high quality gasket is one of the most important parts of the filter.



6 Make sure the gasket seats evenly

If you don't feel the gasket seating evenly for a perfect seal, you don't have protection. Re-check to see if the sealing surface in the housing is clean, and ensure that the filter is the correct model. It may be too short for the housing.



7 Ensure air-tight fit on all connections and ducts

Check that all clamps and flange joints are tight, as well as the air cleaner mounting bolts. Seal any leaks immediately — leaks mean dirt is directly entering your engine.



ROUTINE MAINTENANCE

TRANSPORTING THE BRUSH CHIPPER

1. The standard towing hitch on the brush chipper is a 2" ball. Be sure the towing vehicle hitch is properly equipped for the hitch on your brush chipper. The towing vehicle should be capable of handling a minimum of 600# tongue weight.
2. Check to make sure that the hitch has been properly attached and safety pins installed.
4. Check tire pressure to ensure proper inflation, which is found on the side of the tire.
5. Hook up electrical connections and be sure tail lights and turn signals function properly.
6. Cradle safety chains under towing hitch and securely attach them to the towing vehicle. Raise tongue jack and swivel to horizontal position.
7. Clean infeed of all debris.
8. Remove wheel blocks and check around machine for any tools or loose items that might be lost during transport.
9. Before moving your brush chipper, be sure to check wheel rims for fatigue or loose bolts.



Always use this equipment in accordance with your local OSHA guidelines.

UNDERSTANDING HYDRAULICS

HYDRAULIC SAFETY

BE CAREFUL OF:

1. Leaks
 - a. Puddles of fluid are slippery and hazardous.
 - b. Most hydraulic oils will vaporize and ignite, disastrous fires are possible.
 - c. Leaking fluid may be hot and can produce severe burns.
 - d. Fluid can squirt out under high pressure with dangerous force. Pin hole jets can pierce skin and damage eyes.



WARNING: Escaping fluid under pressure can penetrate the skin, causing serious personal injury. Relieve pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Use a piece of cardboard or paper to search for leaks. Never use your hand! If any fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury or gangrene may result.

2. Hot Components
 - a. Pumps and motors.
 - b. Relief valves.
 - c. Anyplace fluid has been flowing.



CAUTION: Always wear safety goggles or safety glasses during maintenance.

3. Stored energy - Even with the power unit off, there may be energy stored in the system due to:
 - a. Stalled feedwheels.
 - b. Suspended loads, booms and stabilizers.
 - c. Charged accumulators.
 - d. Electrical voltage.

CAUTION: Never boost pressure settings on hydraulics. This will void the manufacturer's warranty.

A hydraulic pump makes oil flow but there must be resistance for the flow to generate pressure.

If a motor or a cylinder does not work or works slowly, the fluid must be slipping through it or bypassing the work completely. Trace the lines to the motor or the cylinder, then place a pressure check on the working line. When the pump is working at the proper gallons per minute (GPM) and the pressure checks out OK, you will find that in most cases your motor or your cylinder is defective. If the pressure is too low, the pump or the relief valve is causing the difficulties. Clean relief valve thoroughly. Reassemble relief valve and check the pressure again.

Example: If the pump is pumping six gallons in 30 seconds and the pump is a 12 GPM, then you know that it is performing at capacity. If it will only pump two or three GPM in 30 seconds, you know that the pump is only performing at 50% of its capacity. If the pump is performing properly, the relief valve is defective. If the pump isn't performing right, it will need repairing or replacement. When the pump is pumping at the proper GPM and the pressure is correct, you will find that in most cases, your hydraulic motor or cylinder is defective.

FILTERS

The filters mounted on the hydraulic tank are 10 micron absolute and should not be replaced with any filter not meeting or exceeding this rating.

HYDRAULIC OIL

Change hydraulic oil every 2000 operating hours or one year under normal conditions and every 1000 hours or 6 months, whichever comes first, when under extremely dirty conditions. If hydraulic component failure is a regular maintenance problem, monthly testing of the system will help determine your change periods.

CAUTION: Do not use any hydraulic oil that does not contain anti-wear additives.

UNDERSTANDING HYDRAULICS

TESTING HYDRAULIC FLUID

Test the fluid regularly. A number of formal test kits are available to evaluate the condition of hydraulic fluid or a fluid sample can be sent to a lab for evaluation. However, there are simple signs of fluid degradation such as a color shift, bad aroma or feel of grit in a sample.

Don't neglect maintenance. Set up and adhere to a rigid preventative maintenance schedule. One of the most important elements in such a program is changing or adding to the fluid on schedule.

WHEN TO CHANGE FLUID

Blotter spot test. This is a very simple test in which a drop of fluid is placed on a piece of blotter paper. If the blotter remains colorless or develops only a light yellow ring, oxidation is under control. Even when color develops but is uniform throughout, the oil is serviceable. If the sample shows distinct rings, the fluid should be changed. When a distinct dark spot remains in the middle but lighter-colored oil migrates outward in the blotter paper, the oil has or is about to dump sludge or other products into the system. This indicates that the time for fluid replacement has passed.

Listen for a sound change. If the operating system changes in sound level usually louder or other than normal sounds, it is time to evaluate the fluid's condition.

Test for acid content. A shift in the acid content may indicate a break down in the fluid. Acid test kits are available from fluid suppliers and the tests are easy to carry out.

CAUTION!

**HYDRAULIC OIL SIGHT GAUGE
MUST BE $\frac{3}{4}$ FULL.
CHANGE HYDRAULIC OIL
FILTERS EVERY 400 HOURS.**

39511-149

HYDRAULIC OIL

THIS RESERVIOR WAS FILLED
INITIALLY WITH
**PETRO CANADA HYDREX XV
HYDRAULIC FLUID**

WHEN REFILLING THE SYSTEM
WE RECOMMEND

**PETRO CANADA HYDREX XV
OR EQUIVALENT
OPERATING RANGE:**

-40° TO 77° C (-40° TO 170° F)
CHANGE OIL EVERY 2,000 HOURS

IF TEMPERATURE EXCEEDS 170°F, CHANGE INTERVAL TO EVERY
1,000 HOURS. FOR EVERY 16°F TEMPERATURE INCREASE, REDUCE
INTERVAL BY 60%. EXTENDED DRAIN ACCEPTABLE, ONLY WITH
ONGOING OIL TREND ANALYSIS PROGRAM AND TEMPERATURES
AVERAGING LESS THAN 140°F

FLUID PROPERTIES:

245 VISCOSITY INDEX
ANTI-WEAR
EXCELLENT OXIDATION STABILITY
RUST, CORROSION, FOAM RESISTANCE
GOOD DEMULSIBILITY
HIGH DIELECTRIC STRENGTH

39511-149

SERVICING HYDRAULICS

THE SEVEN STEPS OF TROUBLE SHOOTING:

1. Talk to the operator.
2. Know the system - schematics.
3. Inspect the machine.
4. List probable causes.
5. Test probable causes.
6. Repair the system.
7. Check for root causes.

GATHER INFORMATION (Steps 1, 2 and 3)

Information is very important. Before you can determine why a machine isn't working, you need to know:

-How it works.

-Correct pressure settings, gauge readings.

-What repairs and maintenance or modifications the machine has had.

-The symptoms of the failure, in detail.

-How the failure occurred.

Often, an operator can tell you something that will help, like whether the failure was sudden or gradual or whether there were any unusual noises when their machine stopped working.

ISOLATING AND REPAIRING THE TROUBLE (Steps 4, 5, and 6)

Based upon the information you have gathered, use your knowledge of hydraulics and information we have supplied to analyze the problem.

There will probably be more than one possible cause of the malfunction.

Confirm or eliminate the easiest possible causes first. Save checks that involve downtime or major disassembly for last.

Always proceed **SYSTEMATICALLY**, rather than randomly!

This means that every step you take should have a good reason behind it. The efficient trouble-shooter knows what he is looking for when:

-Asking questions.

-Reading schematics.

-Observing, testing or taking the machine apart.

PREVENTING FUTURE PROBLEMS (Step 7)

After repairing the machine, consider: Why did the fault occur? Could proper maintenance have prevented the condition which led to the failure?

Take whatever steps are necessary to reduce the chances of a similar problem occurring again.

SERVICING HYDRAULICS

PROBABLE CAUSES

NOISY PUMP

Air in the system: Check fittings, cracked hoses and other parts on the pump intake. Check hydraulic tank. The tank must be kept 3/4 full.

CAUTION: Never fill hydraulic tank completely full at any time. System drainage will cause the tank to overflow and spill out.

Cavitation (vacuum in pump): Check for clogged or restricted intake line or plugged air vent in tank.

Loose or worn pump parts: Look for worn gaskets and replace if necessary. Check for clean and proper fluid.

Stuck pump vanes, valves, pistons etc: Disassemble and clean thoroughly. Avoid the use of files, emery cloth, steel hammers etc, on a machined surface. Products of fluid deterioration such as gums, sludges, varnishes and lacquers may cause sticking. Use solvent to clean parts and dry thoroughly before reassembling. If parts are stuck by corrosion or rust, they will probably have to be replaced.

Pump out of alignment with drive: Check alignment. Misalignment may be caused by temperature variation.

OVERHEATING

Viscosity too high: Check recommendations. Unusual temperature conditions may cause fluid of proper viscosity for working temperature to thicken too much on the way to the pump. In this case, use of a fluid with higher viscosity index may cure trouble.

High discharge pressure: Such parts may cause undue friction. Look for signs of excessive friction. Be sure all parts are in alignment.

Low oil: Maintain proper oil level, at least 3/4 full. If the tank is low, less fluid will be available to carry away the heat, raising the oil temperature.

PUMP NOT PUMPING

Pump shaft turning in the wrong direction: Shut down immediately. Some types of pumps can turn in one direction only.

Intake clogged: Make sure tank is cleaned periodically. Fluid must be kept 3/4 full.

Air leak in intake: If any air is going through pump, it will cause noise. Pour fluid over points suspected of leakage; if noise stops, you have found the leak.

Oil too heavy: If fluid is too heavy, some types of pumps cannot pick up prime. Fluid that is too heavy can do great damage to hydraulic systems. Drain and refill with oil of the proper viscosity.

LOW PRESSURE IN SYSTEM

Relief valve setting too low: With an improper setting, fluid may flow from the pump through the relief valve and back to the tank without reaching the point of use. To check relief setting, block pressure line beyond relief valve and check line pressure with a pressure gauge.

Relief valve stuck open: Clean dirty relief valves (see maintenance.) A stuck valve may be an indication that the system contains dirty or deteriorated hydraulic oil.

Broken, worn or stuck pump parts: Install pressure gauge and block system just beyond relief valve. If no noticeable pressure is developed and relief is okay, look for mechanical trouble in pump. Replace worn and broken parts.

Valves sticking or binding: Check suspected parts for mechanical problems such as misalignment, bent, worn etc then look for signs of dirt, sludge, varnishes and lacquers caused by deterioration.

Sluggishness when machine is first started: Sluggishness is often caused by fluid that is too thick at starting temperatures. If you can put up with this for a few minutes, fluid may thin out enough to give satisfactory operation, but if it does not thin out or if surrounding temperature remains relatively low, you may have to switch to a fluid with a lower pour point and lighter viscosity. Under severe conditions, immersion heaters are sometimes used.

TROUBLE SHOOTING THE CHIPPER

PROBLEM

PROBABLE CAUSES AND SOLUTIONS

Chipper will not feed properly.

1. Dull knives. Sharpen or replace knives.
2. Loose belts. Check for the proper belt tension.
3. Knives ground at incorrect angle. Grind knives at 31°, refer to knife grinding section.
4. Obstruction in infeed spout. If material lodges in the chipper, raise yoke and install yoke lock pin. **TURN OFF ENGINE, REMOVE THE IGNITION KEY, DISENGAGE THE CLUTCH AND WAIT FOR THE DRUM TO COME TO A COMPLETE STOP.** Carefully pull the material from the infeed. Resume operation.

Chipper bearing running too hot (210° F Maximum).

1. Lubricate or replace bearings.
2. Drum RPM too high. Do not exceed 2250 RPM'S.

Discharge spout plugged.

1. Obstruction in discharge spout. Swivel the discharge so that it can be lowered to its lowest position, (with 2 people), take out the back 2 bolts of the discharge where it bolts to the Swivel Assy, carefully tilt down as far as it will go and carefully remove obstruction.
2. Chipper drum RPM too low. Always run chipper at full throttle when chipping.

Chipper drum wobbles.

1. Bushings are loose. Torque to 80 ft. lbs.
2. Bearings cap loose. Torque to 80 ft. lbs.
3. Chipper bearings worn. Replace.
4. Knife pocket is plugged with material. Unplug pockets.

Chipper drum will not turn.

1. Check for obstruction in chipper housing.
2. Check for seized chipper bearings. Lubricate or replace.

PRESSURE SETTINGS

Model	Stabilizer Relief	Main Relief	Down Pressure Relief Valve	Pressure Reducing Valve	Added Down Pressure	Feedwheel RPM	
						Top	Bottom
TORNADO 15	2200 PSI	2000 PSI-Yoke	Set @ 800 RPM	750 PSI	600 PSI	17	36
		2000 PSI-Feed					

STEPS TO FOLLOW IF YOU FEEL YOU HAVE A WARRANTABLE FAILURE

1. Order the repair parts from Morbark. Contact us at (800) 255-8839.
 - a. Inform the Morbark parts person that it is a possible warranty, and he will send a claim form with instructions necessary for filing a claim.
 - b. All parts leaving Morbark will be invoiced to the customer. When the failed parts and completed warranty claim form are returned to Morbark and the cause of failure is determined to be a defect in materials or workmanship, a credit will be issued.
 - c. If labor expenses are to be considered for reimbursement, a completed and approved "Prior Authorization" form must be on file at Morbark and attached to the warranty claim upon completion.
2. Filling out the claim form:
 - a. Fill in the date.
 - b. Customers phone number.
 - c. Fill in failure date.
 - d. Dealer name does not apply on direct sales, region # and sales/service rep's name if it is being filled out by one of our field reps.
 - e. Model and S/N and hours on unit at time of failure.
 - f. Customer name, address.
 - g. Customer delivery date.
 - h. Customer complaint in detail. Attach more sheets if necessary.
 - i. Parts used, quantity, part number, description and price invoiced. Attach Morbark, Inc.'s invoice. For any outside purchases, you'll need to attach invoices from the supplier. Morbark retains the right to refuse any claim where Morbark replacement parts were not used.
 - j. Authorized by: The contact person at the customer's site if more information is required.
3. After replacing the defective components:
 - a. Box up the failed parts.
 - b. Ship the warranty consideration parts to: MORBARK, INC., 8507 S. Winn Road, Winn, MI 48896, ATTENTION: Warranty Returns
 - c. Use the pink copy of the claim, along with a copy of the Morbark invoice as a packing slip.
 - d. The customer keeps the golden rod copy for his records and any future inquiries concerning the claim.
 - e. All returned parts must be shipped freight prepaid.
4. The white, yellow and green copies need to be mailed in an envelope to Morbark Warranty, PO Box 1000, Winn, MI 48896. Both the parts and claim need to be received for warranty consideration.

If there are any questions or comments, please call the Warranty Department.

8507 Winn Road
Winn, Michigan 48896

MORBARK, INC.
WARRANTY

Telephone
989-866-2381

Morbark, Inc. (Morbark) warrants to the original purchaser that this product will be free from defects in materials and workmanship under normal use and operating conditions subject to the conditions and exclusions stated below. No representative, agent or dealer of Morbark or any other person is authorized to modify, expand or extend this warranty in any manner or make any representation on Morbarks behalf in connection with the sale of any equipment covered by this Warranty.

WARRANTY PERIOD: The Warranty period is as follows:

1. One (1) year from the date of original delivery with extended one-year warranty on Morbark components only on all 2001 and subsequent year models of hand fed brush chippers.
2. Six (6) months from the date of original delivery for all other new equipment.
3. A lesser period if stated on the Equipment Order.

EXCLUSIONS: This Warranty shall not apply to:

1. Equipment which has been subjected to misuse, neglect, modification, alteration, accident or lack of normal maintenance or service.
2. Replacement of routine maintenance items and wear parts such as knives, anvils, hammers, screens, belts, bearings etc.
3. Fire damage.
4. Components manufactured by others that are warranted by the manufacturers thereof, including engines, engine components, batteries, tires etc.

PURCHASERS EXCLUSIVE REMEDY: The exclusive remedy of the purchaser in the event the equipment does not conform to this Warranty shall be repair or replacement of the equipment (at the option of Morbark) without charge to the purchaser, when the equipment is returned to Morbarks factory at 8507 South Winn Road, Winn, Michigan or at such other locations as may be designated in writing by Morbark. Morbark is not responsible for the cost of transport or related charges in connection with return of any equipment to Morbark under this Warranty. Morbark shall have sole discretion to determine whether and to what extent the equipment is defective in materials or workmanship. The acceptance by Morbark of any equipment returned is not an admission that the equipment is defective and if Morbark determines the equipment is not covered by this Warranty, the equipment shall be returned to the purchaser at purchaser's expense.

WARRANTY VALIDATION: Morbark shall be under no warranty obligation unless a Warranty Validation Report is completed and returned to Morbark, Inc., 8507 South Winn Road, Winn, Michigan, properly dated and signed by the purchaser within thirty (30) days of delivery of the equipment.

DISCLAIMER OF WARRANTIES: THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED. MORBARK MAKES NO OTHER WARRANTIES AS TO THE EQUIPMENT AND IN PARTICULAR, MAKES NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE EXPRESSLY DISCLAIMED.

LIMITATION OF DAMAGES: MORBARK SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, DIRECTLY OR BY SUBROGATION, INCLUDING BUT NOT LIMITED TO ANY CLAIMS FOR FIRE DAMAGE, LOST PROFITS,