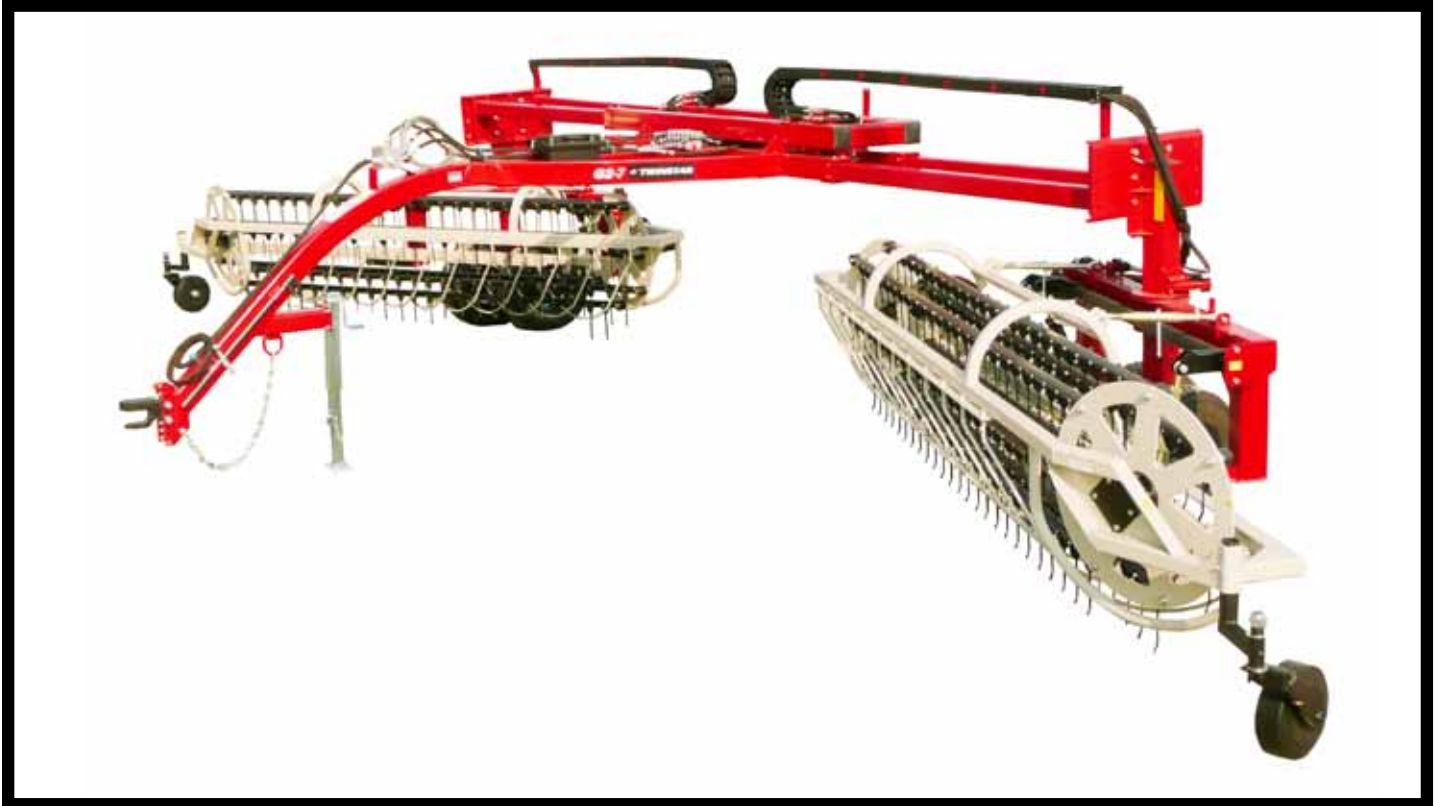




GENERATION 2 BASKET RAKE



◆ **MODEL 2027-G2** ◆

◆ **MODEL 2030-G2** ◆

OPERATOR'S MANUAL

September 2012

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SERIAL NUMBER LOCATION

Always give your dealer the serial number of your Twinstar Generation 2 Basket Rake when ordering parts or requesting service or other information.

The serial number plate is located where indicated. Please mark the number in the space provided for easy reference.

Model Number



Model Number _____

Serial Number _____

1 INTRODUCTION

Congratulations on your choice of a Twinstar Generation 2 Basket Rake to complement your farming operation. This equipment has been designed and manufactured to meet the needs of a discriminating buyer for the efficient raking of hay, grass or forage.

Safe, efficient and trouble free operation of your Generation 2 Basket Rake requires that you and anyone else who will be operating or maintaining the machine, read and understand the Safety, Operation, Maintenance and Trouble Shooting information contained within the Operator's Manual.



This manual covers the Generation 2 Basket Rake Models 2027-G2 and 2030-G2 manufactured by NORTHSTAR ATTACHMENTS LLC. Differences are explained where appropriate. Use the Table of Contents and Index as a guide to locate required information.

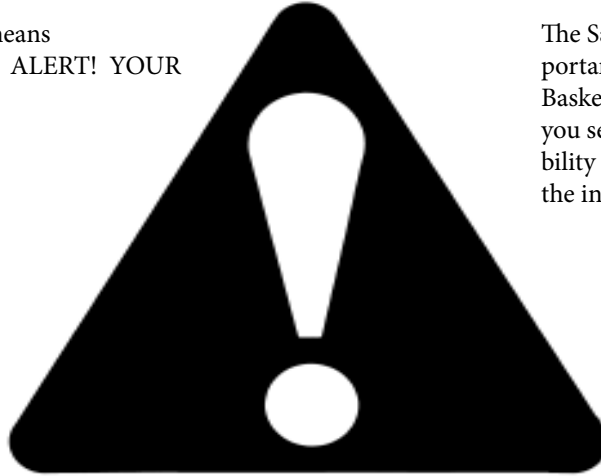
Keep this manual handy for frequent reference and to pass on to new operators or owners. Call your dealer if you need assistance, information or additional copies of the manuals.

OPERATOR ORIENTATION - The directions left, right, front and rear, as mentioned throughout this manual, are as seen from the driver's seat and facing in the direction of travel.

2 SAFETY

SAFETY ALERT SYMBOL

This Safety Alert symbol means
ATTENTION! BECOME ALERT! YOUR
SAFETY IS INVOLVED!



The Safety Alert symbol identifies important safety messages on the Twinstar Basket Rake and in the manual. When you see this symbol, be alert to the possibility of personal injury or death. Follow the instructions in the safety message.

Why is SAFETY important to you?

3 Big Reasons

- Accidents Disable and Kill
- Accidents Cost
- Accidents Can Be Avoided

Note the use of the signal words DANGER, WARNING and CAUTION with the safety messages. The appropriate signal word for each message has been selected using the following guide-lines:

SI NO LEE INGLES, PIDA AYUDA
A AIGUIEN QUE SI LO LEA PARA
QUE LE TRADUZCA LAS
MIDIDAS DE SEGURIDAD.

SIGNAL WORDS:

DANGER - Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations typically for machine components which, for functional purposes, cannot be guarded.

WARNING - Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury, and includes hazards that are exposed when guards are removed. It may also be used to alert against unsafe practices.

CAUTION - Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

If you have any questions not answered in this manual or require additional copies or the manual is damaged, please contact your dealer or NORTHSTAR ATTACHMENTS LLC, P.O. Box 1937, Yakima, WA 98907-1937 Phone: 509.452.1651 - Fax: 509.457.6601

2.1 GENERAL SAFETY

YOU are responsible for the SAFE operation and maintenance of your Twinstar Basket Rake. YOU must ensure that you and anyone else who is going to operate, maintain or work around the Basket Rake be familiar with the operating and maintenance procedures and related SAFETY information contained in this manual. This manual will take you step-by-step through your working day and alerts you to all good safety practices that should be adhered to while operating the Basket Rake.

Remember, YOU are the key to safety. Good safety practices not only protect you but also the people around you. Make these practices a working part of your safety program. Be certain that EVERYONE operating this equipment is familiar with the recommended operating and maintenance procedures and follows all the safety precautions. Most accidents can be prevented. Do not risk injury or death by ignoring good safety practices.

- Basket Rake owners must give operating instructions to operators or employees before allowing them to operate the machine, and at least annually thereafter per OSHA (Occupational Safety and Health Administration) regulation 1928.57.
- The most important safety feature on this equipment is a SAFE operator. It is the operator's responsibility to read and understand ALL Safety and Operating instructions in the manual and to follow these. Most accidents can be avoided.
- A person who has not read and understood all operating and safety instructions is not qualified to operate the machine. An untrained operator exposes himself and bystanders to possible serious injury or death.
- Do not modify the equipment in any way. Unauthorized modification may impair the function and/or safety and could affect the life of the equipment.
- Think SAFETY! Work SAFELY!

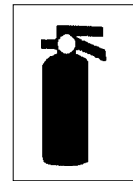
1. Read and understand the Operator's Manual and all safety signs before operating, maintaining, adjusting or unplugging the Basket Rake.



2. Have a first-aid kit available for use should the need arise and know how to use it.



3. Have a fire extinguisher available for use should the need arise and know how to use it.

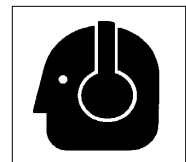


4. Wear appropriate protective gear. This list includes but is not limited to:

- A hard hat
- Protective shoes with slip resistant soles
- Protective goggles, glasses or face shield
- Heavy gloves
- Protective clothing



5. Install and secure all guards before starting.
6. Do not allow riders.
7. Wear suitable ear protection for prolonged exposure to excessive noise.
8. Place all controls in neutral, stop engine, set park brake, remove ignition key and wait for all moving parts to stop before servicing, repairing or unplugging.

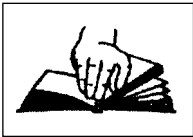


9. Clear the area of people, especially small children, before starting.
10. Review safety related items annually with all personnel who will operating or maintaining the Basket Rake.

2.2 EQUIPMENT SAFETY GUIDELINES

1. Safety of the operator and bystanders is one of the main concerns in designing and developing a machine. However, every year many accidents occur which could have been avoided by a few seconds of thought and a more careful approach to handling equipment. You, the operator, can avoid many accidents by observing the following precautions in this section. To avoid personal injury or death, study the following precautions and insist those working with you, or for you, follow them.
2. In order to provide a better view, certain photographs or illustrations in this manual may show an assembly with a safety shield removed. However, equipment should never be operated in this condition. Keep all shields in place. If shield removal becomes necessary for repairs, replace the shield prior to use.
3. Replace any safety sign or instruction sign that is not readable or is missing. Location of such safety signs is indicated in this manual.
4. Never use alcoholic beverages or drugs which can hinder alertness or coordination while operating this equipment. Consult your doctor about operating this machine while taking prescription medications.
5. Under no circumstances should young children be allowed to work with this equipment. Do not allow persons to operate or assemble this unit until they have read this manual and have developed a thorough understanding of the safety precautions and of how it works. Review the safety instructions with all users annually.
6. This equipment is dangerous to children and persons unfamiliar with its operation. The operator should be a responsible, properly trained and physically able person familiar with farm machinery and trained in this equipment's operations. If the elderly are assisting with farm work, their physical limitations need to be recognized and accommodated.
7. Use a tractor equipped with a Roll Over Protective Structure (ROPS) and a seat belt.
8. Never exceed the limits of a piece of machinery. If its ability to do a job, or to do so safely, is in question - DON'T TRY IT.
9. Do not modify the equipment in any way. Unauthorized modification result in serious injury or death and may impair the function and life of the equipment.
10. In addition to the design and configuration of this implement, including Safety Signs and Safety Equipment, hazard control and accident prevention are dependent upon the awareness, concern, prudence, and proper training of personnel involved in the operation, transport, maintenance, and storage of the machine. Refer also to Safety Messages and operation instruction in each of the appropriate sections of the Tractor and machine Manuals. Pay close attention to the Safety Signs affixed to the Tractor and the machine.

2.3 SAFETY TRAINING

1. Safety is a primary concern in the design and manufacture of our products. Unfortunately, our efforts to provide safe equipment can be wiped out by a single careless act of an operator or bystander.
2. In addition to the design and configuration of equipment, hazard control and accident prevention are dependent upon the awareness, concern, prudence and proper training of personnel involved in the operation, transport, maintenance and storage of this equipment.
3. It has been said, "The best safety feature is an informed, careful operator." We ask you to be that kind of an operator. It is the operator's responsibility to read and understand ALL Safety and Operating instructions in the manual and to follow these. Accidents can be avoided.
4. Working with unfamiliar equipment can lead to careless injuries. Read this manual, and the manual for your tractor, before assembly or operating, to acquaint yourself with the machines. If this machine is used by any person other than yourself, or is loaned or rented, it is the machine owner's responsibility to make certain that the operator, prior to operating:
 - a. Reads and understands the operator's manuals.
 - b. Is instructed in safe and proper use.
5. Know your controls and how to stop tractor, engine, and machine quickly in an emergency. Read this manual and the one provided with your tractor.
6. Train all new personnel and review instructions frequently with existing workers. Be certain only a properly trained and physically able person will operate the machinery. A person who has not read and understood all operating and safety instructions is not qualified to operate the machine. An untrained operator exposes himself and bystanders to possible serious injury or death. If the elderly are assisting with farm work, their physical limitations need to be recognized and accommodated.

2.4 SAFETY SIGNS

1. Keep safety signs clean and legible at all times.
2. Replace safety signs that are missing or have become illegible.
3. Replaced parts that displayed a safety sign should also display the current sign.
4. Safety signs are available from your authorized Distributor or Dealer Parts Department or the factory.

How to Install Safety Signs:

- Be sure that the installation area is clean and dry.
- Be sure temperature is above 50°F (10°C).
- Determine exact position before you remove the backing paper. (See Section 3).
- Remove the smallest portion of the split backing paper.
- Align the sign over the specified area and carefully press the small portion with the exposed sticky backing in place.
- Slowly peel back the remaining paper and carefully smooth the remaining portion of the sign in place.
- Small air pockets can be pierced with a pin and smoothed out using the piece of sign backing paper.

2.5 PREPARATION

1. Never operate the tractor and machine until you have read and completely understand this manual, the Tractor Operator's Manual, and each of the Safety Messages found on the safety signs on the tractor and machine.

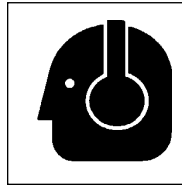
2. Personal protection equipment including hard hat, safety glasses, safety shoes, and gloves are recommended during assembly, installation, operation, adjust-



ment, maintaining, repairing, removal, or moving the implement. Do not allow long hair, loose fitting clothing or jewellery to be around equipment.

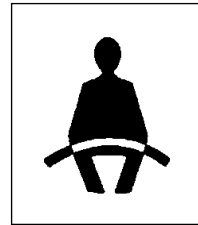
3. **PROLONGED EXPOSURE TO LOUD NOISE MAY CAUSE PERMANENT HEARING LOSS!**

Tractors with or without equipment attached can often be noisy enough to cause permanent, partial hearing loss. We recommend that you wear hearing protection on a full-time basis if the noise in the Operator's position exceeds 80db. Noise over 85db on a long-term basis can cause severe hearing loss. Noise over 90db adjacent to the Operator over a long-term basis may cause permanent, total hearing loss. NOTE: Hearing loss from loud noise (from tractors, chain saws, radios, and other such sources close to the ear) is cumulative over a lifetime without hope of natural recovery.



4. Operate the machine only with a tractor equipped with an approved Roll-Over-Protective Structure (ROPS). Always wear your seat belt. Serious injury or even death could result from falling off the tractor ---particularly during a turnover when the

operator could be pinned under the ROPS or the tractor.



5. Clear working area of stones, branches or hidden obstacles that might be hooked or snagged, causing injury or damage.
6. Operate only in daylight or good artificial light.
7. Be sure machine is properly mounted, adjusted and in good operating condition.
8. Ensure that all safety shielding and safety signs are properly installed and in good condition.
9. Before starting, give the machine a "once over" for any loose bolts, worn parts, cracks, leaks, frayed hoses and make necessary repairs. Always follow maintenance instructions.
10. Check hydraulic components. Tighten all leaking fittings. Replace any damaged parts.

2.6 OPERATING SAFETY

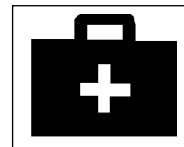
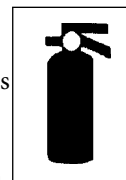
1. Please remember it is important that you read and heed the safety signs on the Twinstar Basket Rake. Clean or replace all safety signs if they cannot be clearly read and understood. They are there for your safety, as well as the safety of others. The safe use of this machine is strictly up to you, the operator.
2. All things with moving parts are potentially hazardous. There is no substitute for a cautious, safe-minded operator who recognizes potential hazards and follows reasonable safety practices. The manufacturer has designed this Unitized Basket Rake to be used with all its safety equipment properly attached, to minimize the chance of accidents. Study this manual to make sure you have all safety equipment attached.
3. If a safety shield or guard is removed for any reason, it must be replaced before the machine is again operated.
4. When the use of hand tools is required to perform any part of assembly, installation, adjustment, maintaining, repairing, removal, or moving, be sure the tools used are designed and recommended by the tool manufacturer for that specific task.
5. Personal protection equipment including hard hat, safety glasses, safety shoes, and gloves are recommended during assembly, installation, operation, adjustment, maintaining, repairing, removal, or moving. Do not allow long hair, loose fitting clothing, or jewellery to be around moving parts.
6. Always use two people to handle heavy, unwieldy components during assembly, installation, removal or moving.
7. Never place any part of your body where it would be in danger if movement should occur during assembly, installation, operation, maintaining, repairing, removal or moving.
8. Never place yourself between the tractor and machine while implement is in operation.
9. Place all controls in neutral, stop engine, set park brake, remove ignition key and wait for all moving parts to stop before servicing, repairing or unplugging.
10. Do not walk or work under a raised machine or attachment unless it is securely blocked or held in position. Do not depend on the tractor hydraulic system to hold the machine or attachment in place.
11. Install safety locks before transporting or working under components.
12. A heavy load can cause instability of the tractor. Use extreme care during travel. Slow down on turns and watch out for bumps. The tractor may need front counterweights to counterbalance the weight of the machine.
13. Never use alcoholic beverages or drugs which can hinder alertness or coordination while operating this equipment. Consult your doctor about operating this machine while taking prescription medications.
14. Do not allow riders on the machine or tractor at any time. There is no safe place for any riders.
15. Before you operate the machine, check over all pins, bolts, and connections to be sure all are securely in place. Replace any damaged or worn parts immediately.
16. Keep all hydraulic lines, fittings and couplers tight and free of leaks before using.
17. Do not allow anyone who is not familiar with the safety rules and operation instructions to use this machine.
18. Never allow children to operate or be around this machine.
19. Clear the work area of objects which might be picked up and snagged or entangled in the machine.
20. Keep hands, feet, hair, jewelery, and clothing away from all moving and/or rotating parts.

2.7 TRANSPORT SAFETY

1. Comply with state and local laws governing highway safety and movement of farm machinery on public roads.
2. The use of flashing amber lights is acceptable in most localities. However, some localities prohibit their use. Local laws should be checked for all highway lighting and marking requirements.
3. At all times, when driving the tractor and equipment on the road or highway under 20 mph (32 kph) use flashing amber warning lights and a slow moving vehicle (SMV) identification emblem. Do not exceed 20 mph (32 kph). Reduce speed on rough roads and surfaces.
4. Plan your route to avoid heavy traffic.
5. Always install transport locks, pins or brackets before transporting.
6. Always use a drawbar pin with retainer and a safety chain.
7. Do not drink and drive.
8. Be a safe and courteous driver. Always yield to oncoming traffic in all situations, including narrow bridges, intersections, etc. Watch for traffic when operating near or crossing roadways.
9. Turn into curves or go up or down hills only at a low speed and at a gradual steering angle. Make certain that at least 20% of the tractor's weight is on the front wheels to maintain safe steering. Slow down on rough or uneven surfaces.
10. Never allow riders on either tractor or machine.

2.8 MAINTENANCE SAFETY

1. Good maintenance is your responsibility. Poor maintenance is an invitation to trouble.
2. Follow good shop practices.
 - Keep service area clean and dry.
 - Be sure electrical outlets and tools are properly grounded.
 - Use adequate light for the job at hand.
3. Make sure there is plenty of ventilation. Never operate the engine of the towing vehicle in a closed building. The exhaust fumes may cause asphyxiation.
4. Before working on this machine, shut off the engine, set the brakes, and remove the ignition keys.
6. Never work under equipment unless it is blocked securely.
7. Use personal protection devices such as eye, hand and hearing protectors, when performing any service or maintenance work.
8. Where replacement parts are necessary for periodic maintenance and servicing, genuine factory replacement parts must be used to restore your equipment to original specifications. The manufacturer will not be responsible for injuries or damages caused by use of unapproved parts and/or accessories.
9. A fire extinguisher and first aid kit should be kept readily accessible while performing maintenance on this equipment.
10. Periodically tighten all bolts, nuts and screws and check that all cotter pins are properly installed to ensure unit is in a safe condition.
11. When completing a maintenance or service function, make sure all safety shields and devices are installed before placing unit in service.

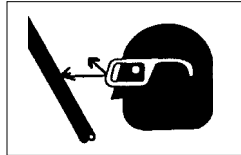


2.9 HYDRAULIC SAFETY

1. Always place all tractor hydraulic controls in neutral before disconnecting from tractor or working on hydraulic system.
2. Make sure that all components in the hydraulic system are kept in good condition and are clean.
3. Replace any worn, cut, abraded, flattened or crimped hoses.
4. Do not attempt any makeshift repairs to the hydraulic fittings or hoses by using tape, clamps or cements. The hydraulic system operates under extremely high-pressure. Such repairs will fail suddenly and create a hazardous and unsafe condition.
5. Wear proper hand and eye protection when searching for a high-pressure hydraulic leak. Use a piece of wood or cardboard as a backstop instead of hands to isolate and identify a leak.



6. If injured by a concentrated high-pressure stream of hydraulic fluid, seek medical attention immediately. Serious infection or toxic reaction can develop from hydraulic fluid piercing the skin surface.



2.10 STORAGE SAFETY

1. Store the unit in an area away from human activity.
2. Do not permit children to play on or around the stored machine.
3. Store the unit in a dry, level area. Support the frame with planks if required.

2.11 TIRE SAFETY

1. Failure to follow proper procedures when mounting a tire on a wheel or rim can produce an explosion which may result in serious injury or death.
2. Do not attempt to mount a tire unless you have the proper equipment and experience to do the job.
3. Have a qualified tire dealer or repair service perform required tire maintenance.
4. When replacing worn tires, make sure they meet the original tire specifications. Never undersize.

2.12 SIGN-OFF FORM

NORTHSTAR follows the general Safety Standards specified by the American Society of Agricultural Engineers (ASAE) and the Occupational Safety and Health Administration (OSHA). Anyone who will be operating and/or maintaining the Twinstar Basket Rake must read and clearly understand ALL Safety, Operating and Maintenance information presented in this manual.

Do not operate or allow anyone else to operate this equipment until such information has been reviewed. Annually review this information before the season start-up.

Make these periodic reviews of SAFETY and OPERATION a standard practice for all of your equipment. We feel that an untrained operator is unqualified to operate this machine.

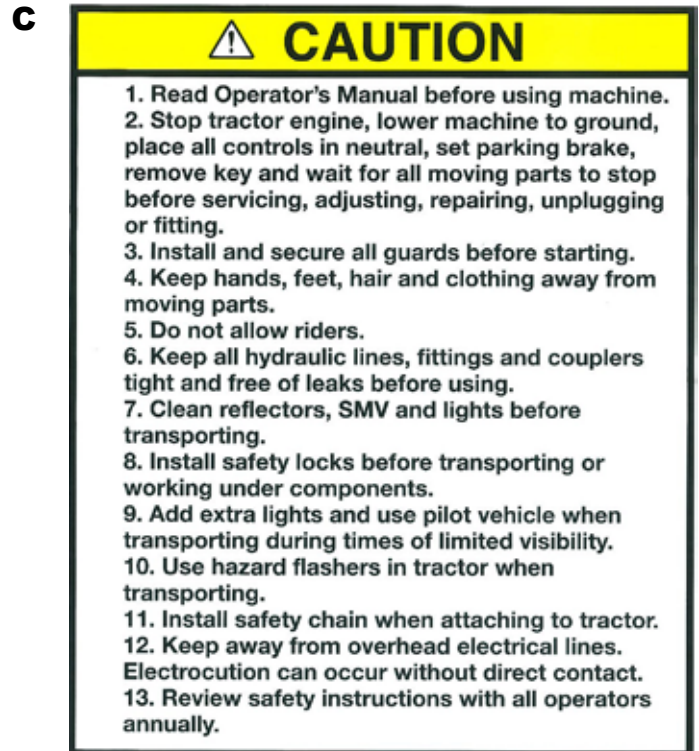
A sign-off sheet is provided for your record keeping to show that all personnel who will be working with the equipment have read and understand the information in the Operator's Manual and have been instructed in the operation of the equipment.

SIGN-OFF FORM

DATE	EMPLOYEES SIGNATURE	EMPLOYERS SIGNATURE

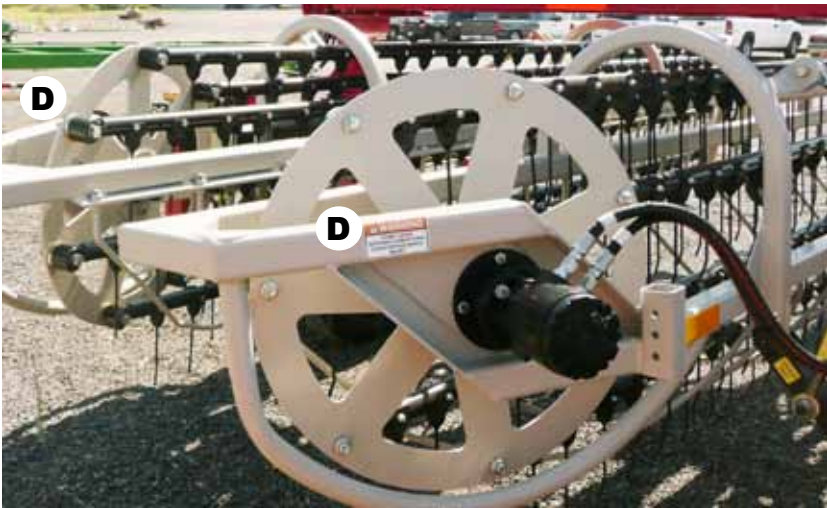
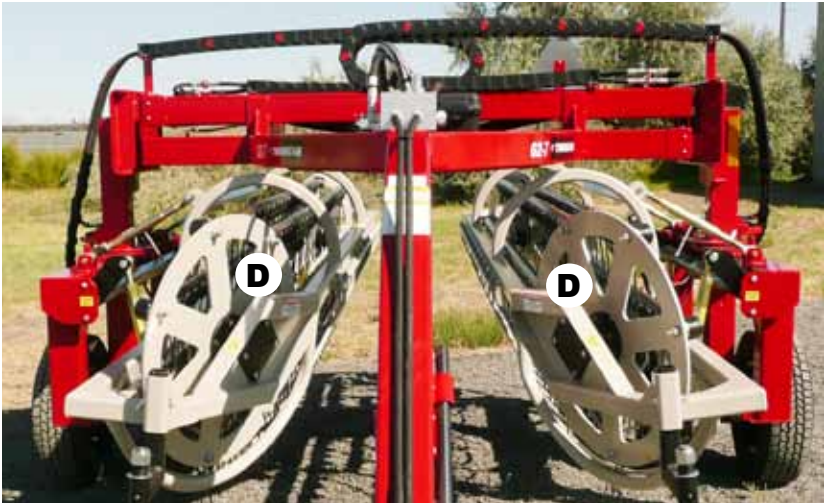
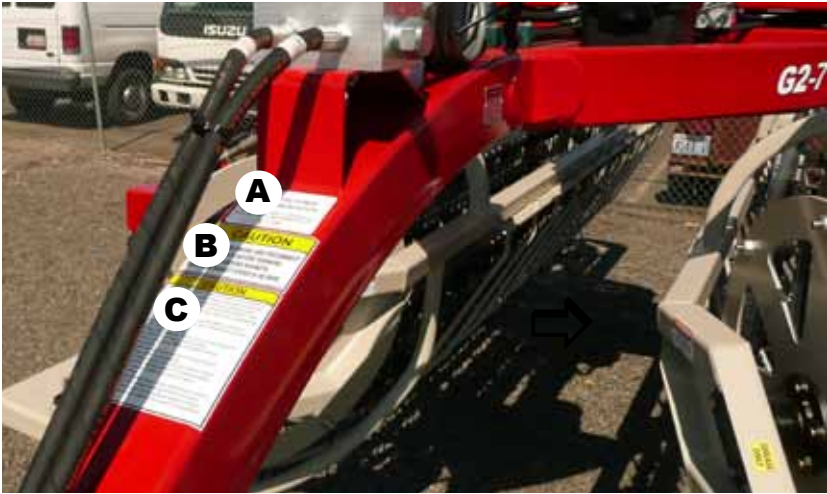
3 SAFETY SIGN LOCATIONS

The types of safety signs and locations on the equipment are shown in the illustration below. Good safety requires that you familiarize yourself with the various safety signs, the type of warning and the area, or particular function related to that area, that requires your SAFETY AWARENESS.



REMEMBER - If safety signs have been damaged, removed, become illegible or parts replaced without signs, new signs must be applied. New signs are available from your authorized dealer.

The types of safety signs and locations on the equipment are shown in the illustration below. Good safety requires that you familiarize yourself with the various safety signs, the type of warning and the area, or particular function related to that area, that requires your SAFETY AWARENESS.



REMEMBER - If safety signs have been damaged, removed, become illegible or parts replaced without signs, new signs must be applied. New signs are available from your authorized dealer.

4 OPERATION



OPERATING SAFETY

1. Read and understand the Operator's Manual and all safety signs before operating, servicing, adjusting, repairing or unplugging.
2. Do not allow riders.
3. Install and secure all guards and shields before starting or operating.
4. Keep hands, feet, hair and clothing away from moving parts.
5. Place all controls in neutral, stop tractor engine, set park brake, remove ignition key and wait for all moving parts to stop before servicing, adjusting, repairing or unplugging.
6. Place all tractor and machine controls in neutral before starting.
7. Never start or operate machine unless sitting on tractor seat.
8. Clear the area of bystanders, especially small children, before starting.
9. Clean reflectors, SMV and lights before transporting.
10. Use hazard flashers on tractor when transporting.
11. Do not put hands or feet under machine while tractor engine is running.
12. Review safety instructions with all operators annually.

4.1 TO THE NEW OPERATOR OR OWNER

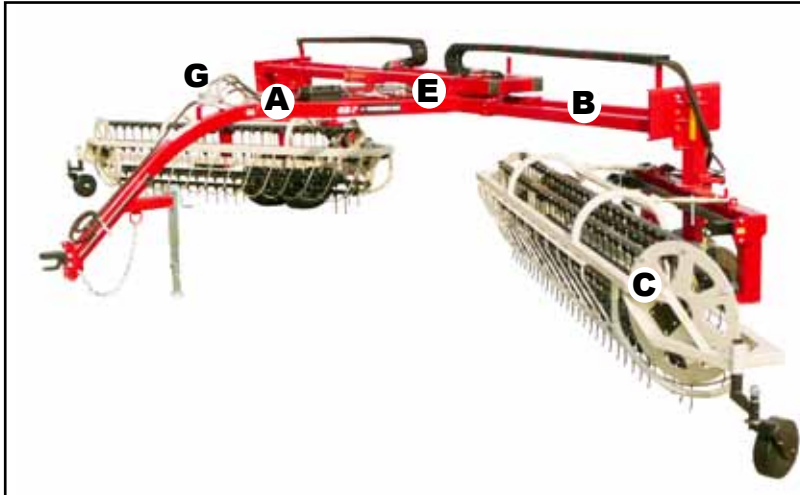
Twinstar Basket Rakes are designed as a rake for windrowing hay, grass or forage. Be familiar with the machine before starting.

It is the responsibility of the owner or operator to read this manual and to train all other operators before they start working with the machine. Follow all safety instructions exactly. Safety is everyone's business. By following recommended procedures, a safe working environment is provided for the operator, bystanders and the area around the worksite. Untrained operators are not qualified to operate the machine.

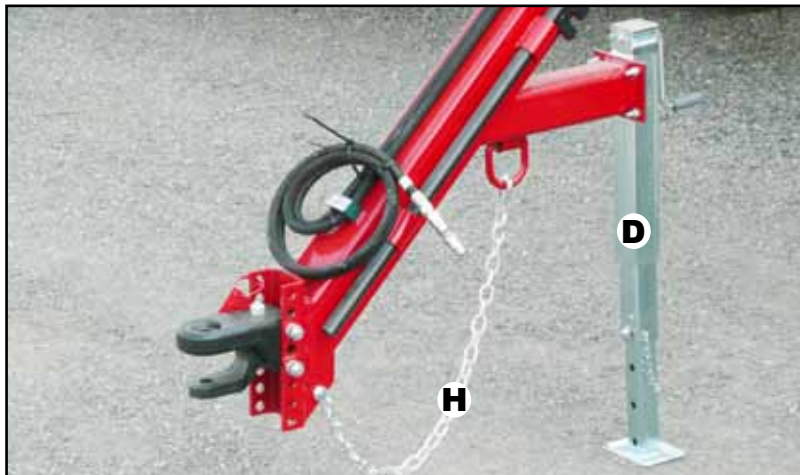
Many features incorporated into this machine are the result of suggestions made by customers like you. Read this manual carefully to learn how to operate the machine safely and how to set it to provide maximum field efficiency. By following the operating instructions in conjunction with a good maintenance program, your Unitized Basket Rake will provide many years of trouble-free service.

4.2 MACHINE COMPONENTS

Twinstar Basket Rakes consist of 2 hydraulically powered turning rake assemblies contained within a basket for picking up, sliding over and windrowing crop material. The frame can extend to spread the baskets out to match the crop material spacing. Each basket can be raised or lowered and angled appropriate for the application.



- A Main Frame
- B Extention Frames
- C Basket Rake Assembly
- D Tongue Jack
- E Control Valve
- F Drive Motors
- G Flow Control Valve



- H Safety Chains



Fig. 1 MACHINE COMPONENTS

4.3 BREAK-IN

Although there are no operational restrictions on the Basket Rake when it is used for the first time, it is recommended that the following mechanical items be checked:

- A. After operating for 1 hour:
 - 1. Check alignment of rake tines and baskets. Align as required.
 - 2. Check all hydraulic lines, hoses, fittings and couplers. Tighten all leaking fittings. Replace any damaged components.
 - 3. Torque all fasteners and hardware.
 - 4. Check the rake tines and baskets for entangled material. Remove any entangled material.
 - 5. Check tire pressure. Inflate as required.
- B. After operating for 10 hours:
 - 1. Repeat steps 1 through 5 listed above.
 - 2. Go to the normal servicing and maintenance schedule as defined in the Maintenance Section.

4.4 PRE-OPERATION CHECKLIST

Efficient and safe operation of the Twinstar Basket Rake requires that each operator reads and understands the operating procedures and all related safety precautions outlined in this section. A pre-operation checklist is provided for the operator. It is important for both personal safety and for maintaining the machine in good mechanical condition that this checklist be followed.

Before operating the Rake and each time thereafter, the following areas should be checked off:

- 1. Lubricate the machine per the schedule outline in the Maintenance Section.
- 2. Check alignment of rake tines and baskets. Align as required.
- 3. Check the rake tines and baskets. Remove any twine, wire or other material that has become entangled.
- 4. Make sure that all guards and shields are in place, secured and functioning as designed.
- 5. Check for hydraulic leaks. Tighten any leaking fittings.
- 6. Clean the lights and SMV emblem to ensure that they can be seen by other vehicles.

4.5 CONTROLS

Before starting to work, all operators should familiarize themselves with the location and function of the controls.

Control Box:

Each machine is designed with a control box that mounts in the tractor cab. Review the location and function of each switch before starting:

1. **Left Basket Angle In/Out:**
This 3 position spring-loaded-to-neutral-center toggle switch controls the angle of the left basket. Move the switch up (IN) and hold to angle the basket in. Move the switch down (OUT) and hold to angle the basket out. Release the switch and it will return to its neutral centered position. The left basket will remain at that position.
2. **Left Basket Extend/Retract:**
This 3 position spring-loaded-to-neutral-center toggle switch controls the position of the left basket. Move the switch up (EXTEND) and hold to extend the left basket. Move the switch down (RETRACT) to retract the basket. Release the switch and it will return to its neutral centered position. The left basket will remain at that position.
3. **Right Basket Angle In/Out:**
This 3 position spring-loaded-to-neutral-center toggle switch controls the angle of the right basket. Move the switch up (IN) and hold to angle the basket in. Move the switch down (OUT) and hold to angle the basket out. Release the switch and it will return to its neutral centered position. The right basket will remain at that position.
4. **Right Basket Extend/Retract:**
This 3 position spring-loaded-to-neutral-center toggle switch controls the position of the right basket. Move the switch up (EXTEND) and hold to extend the left basket. Move the switch down (RETRACT) to retract the basket. Release the switch and it will return to its neutral centered position. The right basket will remain at that position.



Fig. 2 CONTROL BOX

5. **Basket Raise/Lower:**
This 3 position spring-loaded-to-neutral-center toggle switch controls the height of the baskets. Move the switch up (RAISE) and hold to raise the baskets. Move the switch down (LOWER) and hold to lower the baskets. Release the switch and it will return to its neutral centered position. The frame/baskets will remain at that height.

4.6 INSTALLING CONTROLLER

A control box is provided with each Rake and includes the basket angle, position and height controls.

The control box is equipped with a predrilled mounting bracket to allow for easy installation. Position the box on the tractor or in the cab for easy access and viewing during operation.

A pair of wires on a short harness is used to provide 12 volt power to the box. Connect the black wire to ground and the red wire to a 12 volt potential.



Tractor

IMPORTANT

Do not connect across a 24 volt system. It will damage internal electrical components.

Secure the electrical harness to the hitch with tape or plastic ties. Provide sufficient slack for turning.



Fig. 3 CONTROLLER

Hitch

4.7 ATTACHING/UNHOOKING

The Rake should always be located on a level, dry area that is free of debris and other foreign objects. When attaching the machine to a tractor or a utility cart, follow this procedure:

1. Clear the area of bystanders, especially small children.
2. Make sure there is enough room and clearance to safely back up to the machine.
3. While backing up, align the hitch with the drawbar.
4. Stop tractor, set park brake, remove ignition key and wait for all moving parts to stop before dismounting.
5. Use a drawbar pin with provisions for a mechanical retainer. Install the retainer.
6. Connect the Hydraulics:
 - a. Use a clean rag or paper towel to clean the dirt from couplers on the hose ends and the tractor.
 - b. Connect the hoses to the tractor couplers. Be sure the couplers are securely seated.
 - c. Route and secure the hoses along the hitch with clips, tape or plastic ties to prevent binding and pinching. Be sure to provide slack for turning.

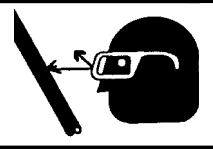



Fig. 4 DRAWBAR PIN



Fig. 5 HYDRAULIC SYSTEM

! WARNING



Use extreme care when working around a high-pressure hydraulic system. Make sure all connections are tight and all components are in good repair. Wear hand and eye protection when searching for suspected leaks.

7. Position the wiring harness between tractor and the Rake to prevent snagging. Be sure to provide slack for turning.
8. Raise the jack until it clears the ground. Remove jack from the hitch and mount in its transport position.
9. Attach the safety chain securely around the tractor drawbar cage to prevent unexpected separation.
10. Adjust the hitch clevis as required to position the PTO shaft as level as possible.
11. Reverse the above procedure when unhooking tractor. Be sure to place blocks under the jack if on soft ground.



Fig. 6 ELECTRICAL



Fig. 7 CLEVIS

4.8 FIELD OPERATION



OPERATING SAFETY

1. Read and understand the Operator's Manual and all safety signs before operating, servicing, adjusting, repairing or unplugging.
2. Do not allow riders.
3. Install and secure all guards and shields before starting or operating.
4. Keep hands, feet, hair and clothing away from moving parts.
5. Place all controls in neutral, stop tractor engine, set park brake, remove ignition key and wait for all moving parts to stop before servicing, adjusting, repairing or unplugging.
6. Place all tractor and machine controls in neutral before starting.
7. Never start or operate machine unless sitting on tractor seat.
8. Clear the area of bystanders, especially small children, before starting.
9. Clean reflectors, SMV and lights before transporting.
10. Use hazard flashers on tractor when transporting.
11. Do not put hands or feet under machine while tractor engine is running.
12. Review safety instructions with all operators annually.

Although the Twinstar Rake is easy to use, each operator should review this section to familiarize himself with the detailed safety and operating procedures. When using the machine, follow this procedure:

1. Clear the area of bystanders, especially small children.
2. Review and follow the Pre-Operation Checklist .
3. Attach the machine to the tractor. Be sure the frame is level. Adjust the hitch clevis as required.
4. Hydraulic System:
 - a. The Rake will operate on either a closed center or open centered system. Select the type of system at the control valve on the top of the frame.

Depress the knob on the valve and turn fully counterclockwise (180°) for open center and full clockwise (180°) for closed center. Once the type of system is selected, the valve can remain in its position unless the system changes.

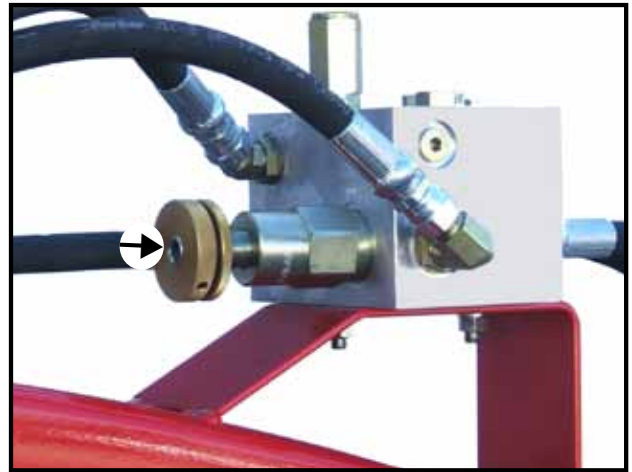


Fig. 8 CONTROL VALVE

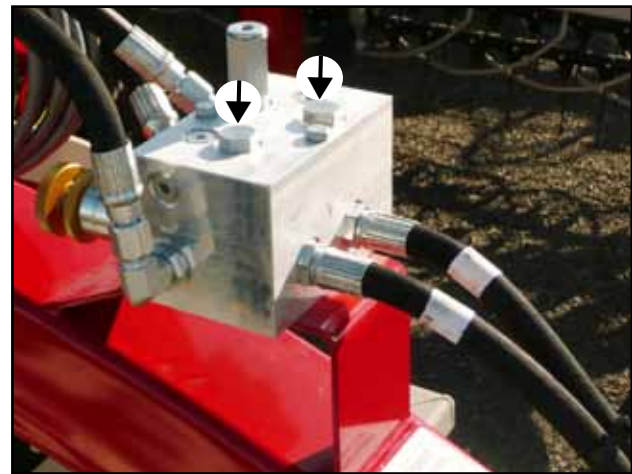
- b. Set the tractor flow at a maximum of 12 gpm; 8 gpm for basket motors and 4 gpm for cylinders.
- c. The basket circuit is designed with a flow control that can be used to control the amount of oil flowing to the basket motors. Turn the knob on the back of the valve clockwise to increase the flow and counter clockwise to decrease the flow. This flow control regulates 4-8 GPM's to the basket motors. DO NOT exceed a basket speed of 80 RPM.
- d. The rake is built at the factory with 2 hydraulic supply lines into the flow control valve but can be converted to a 4 line supply system. (Part # HR 4600)

Conversion to 4 Hose System:

- e. Remove plugs from the top ports on the flow control valve.
- f. Install #8 O-ring adaptors into the P2 and T2 ports.
- g. Make up and install hydraulic hoses to the fittings.
- h. Connect to another set of tractor remote couplers.
- i. Place the tractor valve in detent and check the system. It may be necessary to reverse the lines or tie the control lever open to obtain the proper function.
- j. Always perform a functional check on the system before starting. After connecting the hydraulic control valve into a remote outlet, you will need to operate the tractor's remote lever either forward or backward while operating the switches on the control box. The hydraulic control valve will only work while the remote lever is in one position and you may find it necessary to tie the lever open. You may reverse the direction that you need to move the lever by simply swapping the hoses that connect to remote outlet. If your tractor is open center and the remote flow is less than 20 GPM or your tractor is closed center, you may leave the lever tied open continuously.



Flow Control Adjustment



Conversion to 4 Hose System

Fig. 9 HYDRAULIC MANIFOLD

If you have connected the hydraulic control valve to a power beyond, simply use the switches on the control box to raise or lower the cylinders.

5. Review Your Work Plan:

- a. Engage the hydraulic circuit (s). Place the levers in detent or tie open.
- b. Extend the frame while approaching the working area.

IMPORTANT

Always move the machine when extending or retracting the frame to reduce the load on the structure.



Extending Basket Right



Extending Basket Left

Width Marker Instructions:

- Use the end of the main frame as a reference point while extending the baskets
- Extend the baskets to the preferred width and make note of the location of the marker closest to the reference point
- Use the markers and reference points to extend the baskets to the same width consistently.



Width Marker Decals

Fig. 11 EXTENDING FRAME

- c. Angle the baskets so they cover the material to be raked, turned or wind-rowed.



Fig. 12 ANGLE LEFT BASKET

- d. Lower the baskets until the tines are about 1/2 inch above the ground.



Fig. 13 ANGLE RIGHT BASKET

- e. Pull into the field to start working.



Fig. 14 BASKETS LOWERED AND RAKING

OPERATING HEIGHT

The best results are obtained when the basket is set so the tines are approximately 1/2 inch above the ground. To set the height:

1. Position the rake on a firm level area.
2. Lower the baskets as far as they will go.
3. With the wrenches provided turn the adjusting links to make the fine tine height adjustments. After adjustments are made on all four links lock the jam nut to maintain adjustments made. Do not extend adjusting links beyond the 20" maximum length.

BASKET TILT

The basket tilt can be adjusted to fit the application. To adjust:

1. Loosen the jam nut on the turnbuckles.
2. Adjust the turnbuckles to set the basket tilt.
3. Tighten the jam nuts.
4. Set both turnbuckles the same.
5. As a general guide:
 - Set the basket perpendicular for a loose, fluffy windrow.
 - Set the basket tilted forward for a tight, compact windrow.



Fig. 15 TINE HEIGHT ADJUSTMENT LINK



Fig. 16 BASKET TILT

8. Raking Positions:

The rake is designed with the flexibility of changing the configuration to handle:

- a. Light or heavy cuttings.
- b. Fluffy or tight windrow.
- c. Turn 2 windrows or
- d. Combine several windrows.

Each time the material is turned, it will reduce the drying time.

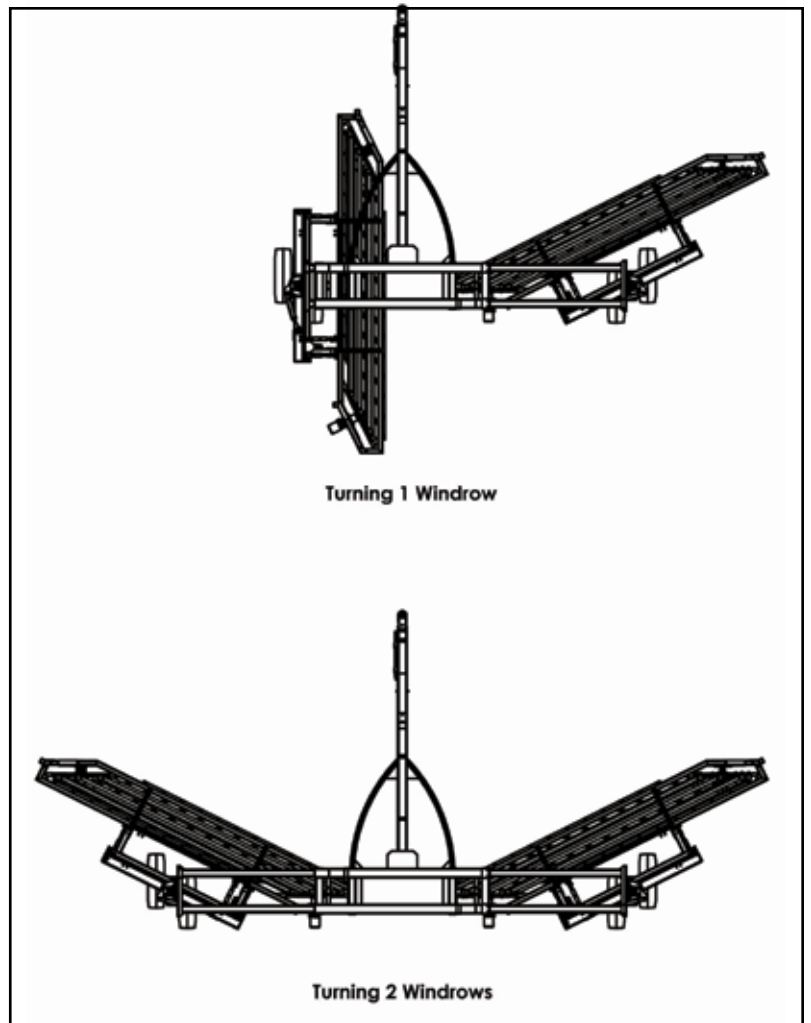


Fig. 17 RAKING CONFIGURATIONS

9. Field Speed:

The best travel speed is 4 to 10 mph depending on the crop and field conditions. Slow down if the crop material is dry and leaves are dropping off. Increase speed if the crop has not completely dried.



Fig. 18 WORKING

10. Stripper Bar Alignment:

The basket is formed by stripper bars on the bottom that must keep their shape and clearance to function properly. There should always be at least 1/2 inch clearance between the stripper bars and tines.

Use the stripper bar tool to set and adjust the position of the stripper bar.

Stripper Bar Adjustment:

- Inspect the Stripper Bar alignment by rotating the tine bars by hand and watching the teeth pass through the hay strippers - also listen for any teeth hitting the strippers
- Use the Stripper Bar Tool to re-align any stripper bars that have become misaligned by bending them back in place as shown in the illustration.
- This adjustment should be completed before every raking to prevent tooth and stripper bar damage - failure to do so can cause Tine Bar failure as well as basket frame fatigue.

Tooth Straightening Tool:

- Inspect teeth and straighten or replace teeth as needed before raking
- Slide the Tooth Tools on to the tooth as shown
- Position the Tools one on each side of the bend
- Use the leverage provided by the Tools to straighten the tooth



Tool Storage



Adjusting



Straightening

Fig. 19 STRIPPER BAR ALIGNMENT/TOOTH STRAIGHTENING

11. Optional Gauge Wheel:

An optional gauge wheel package is available to mount to the end of each basket to stabilize the basket if operating over rough terrain. Height settings are accomplished by removing and installing pins.



Fig. 20 OPTIONAL GAUGE WHEEL

12. Operating Hints:

- a. Use the hitch clevis to level the frame. The frame must be level for both ends of the baskets to be the same height above the ground.

Fig. 21 HITCH CLEVIS

- b. It is the responsibility of the operator to monitor the condition of the crop material and set the rake parameters to obtain the best results. Always check during the day to know how the material changes.



Fig. 22 FIELD

- b. Unless otherwise specified, the valve and control are designed to operate on a 12 volt, NEGATIVE GROUND system only. Connection to any other type of electrical system will likely result in severe and immediate damage to the control and/or solenoids. Power should be taken from a location at the fuse panel or key switch that is only "hot" when engine is running. This is to prevent the battery from being drained when tractor is not in use.



Valve



Control Box

Fig. 23 ELECTRICAL COMPONENTS

IMPORTANT

The power connection (red wire, provided in kit) MUST BE FUSED to protect the wiring in case of a short. Locate the fuse as close as possible to the source of power. The ground connection (black wire) should be connected directly to the frame of the tractor or to the engine block. Clean paint off the surface to ensure a good connection.

4.9 TRANSPORTING



TRANSPORT SAFETY

1. Make sure you are in compliance with all local regulations regarding transporting equipment on public roads and highways.
2. Make sure the SMV (Slow Moving Vehicle) emblem and all the lights and reflectors that are required by the local highway and transport authorities are in place, are clean and can be seen clearly by all overtaking and oncoming traffic.
3. Latch safety chain provided from rake to towing vehicle.
4. Do not exceed 20 mph (32 kph). Reduce speed on rough roads and surfaces.
5. Always use hazard flashers on the tractor when transporting unless prohibited by law.

When transporting the machine, review and follow these instructions:

1. Be sure all bystanders are clear of the machine.
2. Be sure the hydraulic circuit(s) are disengaged and all components have stopped running.
3. Be sure that the machine is securely attached to the tractor and a retainer pin and safety chain are installed.
4. Clean the SMV emblem, reflectors and lights and make sure they are working.
5. Be sure you are in compliance with all applicable lighting and marking regulations when transporting. Check with your local authorities.
6. Keep to the right and yield the right-of-way to allow faster traffic to pass. Drive on the road shoulder if permitted by law.
7. Do not allow riders.
8. Always use hazard flashers on the tractor when transporting unless prohibited by law.
9. Never transport the machine faster than 20 mph (32 km/h). The ratio of the tractor weight to the Rake weight plays an important role in defining acceptable travel speed. Table 1 summarizes the recommended travels speed to weight ratio.

Table 1 Travel Speed vs. Weight Ratio

Road Speed	Weight of fully equipped or loaded implement(s) relative to weight of Towing machine
Up to 32 km/h (20 mph)	1 to 1, or less
Up to 16 km/h (10 mph)	2 to 1, or less
Do not tow	More than 2 to 1



Fig. 24 TRANSPORT HITCH AND SAFETY CHAIN

4.10 STORAGE



STORAGE SAFETY

1. Store the unit in an area away from human activity.
2. Do not permit children to play on or around the stored machine.

After the season's use, the machine should be thoroughly inspected and prepared for storage. Repair or replace any worn or damaged components to prevent any unnecessary down time at the start of next season. To insure a long, trouble free life, this procedure should be followed when preparing the unit for storage:

1. Clear the area of bystanders, especially small children.
2. Thoroughly wash the machine using a pressure washer to remove all dirt, mud, debris and residue.
3. Inspect the tines and pivot for damage or entangled material. Repair or replace damaged parts. Remove all entangled material.
4. Inspect all hydraulic hoses, lines, couplers, and fittings. Tighten any loose fittings. Replace any hose that is badly cut, nicked, abraded or is separating from the crimped end of a fitting.
5. Lubricate all grease fittings. Make sure that all grease cavities have been filled with grease to remove any water residue from the washing. This also protects the bearing seals.
6. Touch up all paint nicks and scratches to prevent rusting.
7. Move to storage area.
8. Select an area that is dry, level and free of debris.
9. Unhook from tractor.
10. Place blocks under the stands and tire if required.
11. If the machine cannot be placed inside, cover with a waterproof tarpaulin and tie securely in place.
12. Store the machine in an area away from human activity.
13. Do not allow children to play on or around the stored machine.



Fig. 25 STORED

5 SERVICE AND MAINTENANCE



MAINTENANCE SAFETY

- Follow ALL the operating, maintenance and safety information in the manual.
- Support the machine with blocks or safety stands when changing tires or working beneath it.
- Follow good shop practices.
 - Keep service area clean and dry.
 - Be sure electrical outlets and tools are properly grounded.
 - Use adequate light for the job at hand.
- Use only tools, jacks and hoists of sufficient capacity for the job.
- Never work on basket, rotor or under the machine unless the tractor engine is off and the hydraulic hoses are disconnected.
- Make sure all guards are in place and properly secured when maintenance work is completed.
- Never wear ill-fitting, baggy or frayed clothing when working around or on any of the drive system components.
- Before applying pressure to a hydraulic system, make sure all lines, fittings and couplers are tight and in good condition.
- Relieve pressure from hydraulic circuit before servicing or disconnecting from tractor.
- Keep hands, feet, hair and clothing away from all moving and/or rotating parts.
- Clear the area of bystanders, especially children, when carrying out any maintenance and repairs or making any adjustments.

5.1 SERVICE

5.1.1 FLUIDS AND LUBRICANTS

1. Grease:
Use an SAE multipurpose high temperature grease with extreme pressure (EP) performance. Also acceptable is an SAE multipurpose lithium base grease.
2. Storing Lubricants:
Your machine can operate at top efficiency only if clean lubricants are used. Use clean containers to handle all lubricants. Store them in an area protected from dust, moisture and other contaminants.

5.1.2 GREASING

Use the Maintenance Checklist provided to keep a record of all scheduled maintenance.

1. Use a hand-held grease gun for all greasing.
2. Wipe grease fitting with a clean cloth before greasing, to avoid injecting dirt and grit.
3. Replace and repair broken fittings immediately.
4. If fittings will not take grease, remove and clean thoroughly. Also clean lubricant passageway. Replace fitting if necessary.

5.1.3 SLIDE TUBE MAINTENANCE

- Perform this maintenance at each cutting during the season or when slide functions are sticking or slow
- Fully extend both baskets
- Degease and clean each slide tube
- Visually inspect each slide tube for wear or damage
- Apply lubricant to slide tubes (HR-2009 Terand Gel Lubricant w/PTFE)
- Extend and retract baskets to distribute the lubricant and ensure proper operation.



Fig. 26 SLIDE TUBE MAINTENANCE

5.1.4 WHEEL TOWER NUT MAINTENANCE

- Remove plastic cap to access
- Tools needed: 3/4" Torque Wrench, 2-1/4" Dee Well Socket, 6" Extension
- Inspect the wheel tower nut torque during yearly maintenance or as needed (recommended torque is 150-180 ft. lbs.)

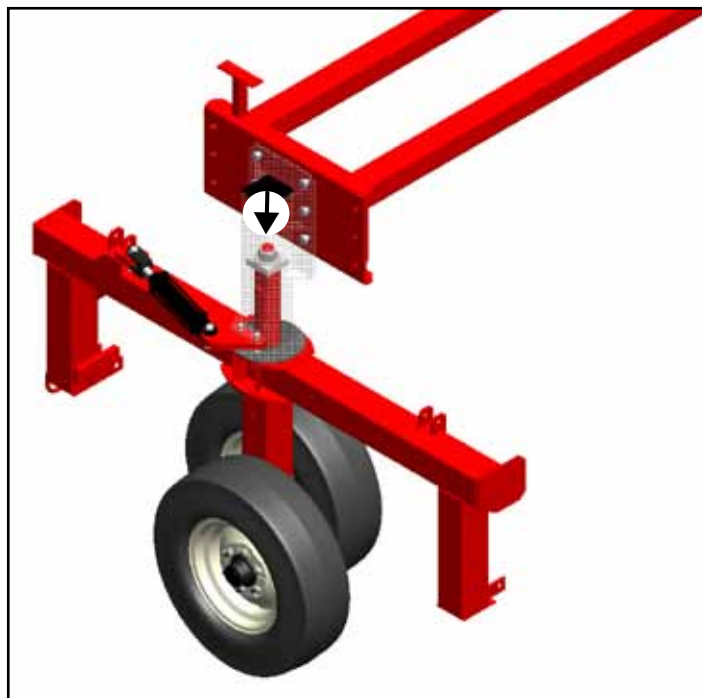


Fig. 27 WHEEL TOWER NUT MAINTENANCE

5.1.5 SERVICING INTERVALS

The period recommended is based on normal operating conditions. Severe or unusual conditions may require more frequent lubrication or oil changes.

8 Hours or Daily

1. Grease Parallel linkage pivots (3 locations each linkage) 4 linkages on machine.

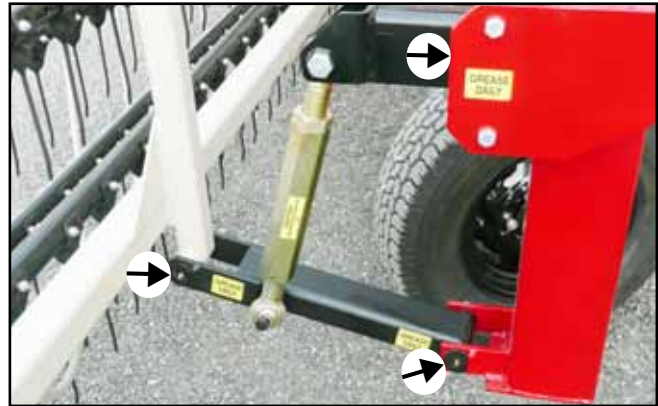


Fig. 28 PARALLEL LINKAGE

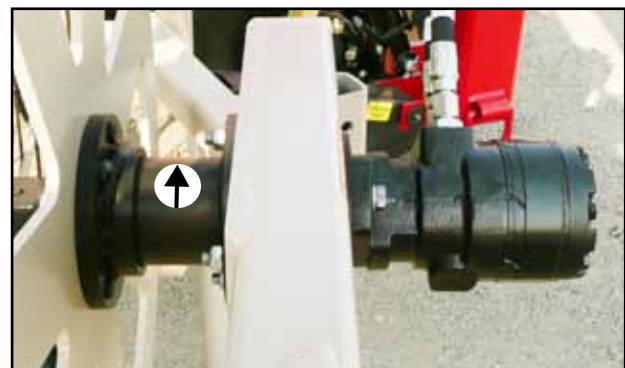
2. Grease basket pivot (2 location each set of wheels).



Fig. 29 BASKET PIVOT

3. Lubricate basket motor drive housing and idler knuckle every 40 hours of operation.

- Before putting the hay rake into service be sure that the drive hubs are fully greased (use the grease zirk installed in the housing to pump the cavity and the bearings rull of grease - pump grease until you feel some resistance and then add a few more pumps to insure both bearings have taken grease.
- Add one or two pumps of grease daily or as needed
- Use caution if a pneumatic grease gun is used as seal damage may occur
- Visually inspect the drivew hub bearings annually



Motor Drive Housing



Idler Knuckle

Fig. 30 BASKET MOTOR DRIVE HOUSING / IDLER KNUCKLE

Annually

1. Repack wheel bearings.
2. Repack basket idler hub.
3. Wash and clean machine.



Fig. 31 WHEELS AND BASKET ASSEMBLY



Fig. 32 BASKET IDLER HUB

5.1.6 SERVICE RECORD

See Lubrication and Maintenance sections for details of service. Copy this page to continue record.

ACTION CODE: G GREASE CL CLEAN R REPACK

MAINTENANCE	HOURS SERVICED BY												
8 Hours or Daily													
G Parallel Linkage													
G Castor Shaft													
Weekly													
G Basket Motor Drive Housing													
G Idler Knuckle													
Annually													
R Wheel Bearings													
CL Machine													
R Basket Idler Hub													

6 TROUBLE SHOOTING

Twinstar Basket Rake consists of 2 sets of hydraulically powered rake assemblies turning in a basket for turning or windrowing hay or crop material. It is a simple and reliable system that requires minimal maintenance.

In the following section, we have listed many of the problems, causes and solutions to the problems that you may encounter.

If you encounter a problem that is difficult to solve, even after having read through this trouble shooting section, please call your local dealer, distributor or NORTHSTAR ATTACHMENTS LLC. Before you call, please have this Operator's Manual and the serial number from your Basket Rake ready.

PROBLEM	CAUSE	SOLUTION
Crop material isn't picked up by tines.	Material goes between tines. Tines skip over ground. Wrong frame angle.	Increase rake turning speed. Driving too fast. Slow down. Change frame angle until material is picked up.
Windrow too tight.	Wrong basket angle.	Change basket angle to vertical.
Windrow too loose.	Wrong basket angle.	Tilt basket forward.
Frame won't move.	No power to valve. No oil flow to valve. Fuse blown at control box	Check and clean all terminals. Provide power to control box. Place tractor valve in detent or tie open. Replace as needed
Baskets do not revolve.	Hoses incorrectly hooked into tractor remote. Flow restriction in hydraulic system. Damaged bypass check valve. Damaged remote connections. Damaged adjustable flow cartridge. Damaged basket hydraulic motors.	Check and switch hoses as needed. Find restriction and eliminate. Replace parts as needed. Replace parts as needed. Replace parts as needed. Replace parts as needed.
Insufficient basket RPM Below 60 rpm for heavy-duty, Below 80 rpm for standard	Adjustable flow control knob is not turned completely in. Flow restriction in hydraulic motor circuit. Damaged remote connectors. Insufficient oil flow from tractor.	Turn knob clockwise until desired rpm is achieved. Find restriction and eliminate. Replace parts as needed. Raise tractor idle to increase oil flow.

PROBLEM	CAUSE	SOLUTION
<p>Insufficient basket RPM Below 80 rpm, continued . . .</p>	<p>Insufficient oil from tractor.</p> <p>Damaged adjustable flow cartridge.</p> <p>Damaged basket hydraulic motors.</p> <p>Damaged relief cartridge at flow control manifold.</p>	<p>Install rake to a tractor with sufficient flow capabilities.</p> <p>Install 4 hose option to enable the use of 2 tractor remotes for oil flow (Rake needs 12gpm total)</p> <p>Service tractor's hydraulic system.</p> <p>Replace parts as needed.</p> <p>Replace parts as needed.</p> <p>Replace parts as needed.</p>
<p>Baskets rpm are normal but rake functions are operating slowly.</p>	<p>Insufficient oil flow from tractor.</p> <p>Low voltage to rake control valve.</p> <p>Damaged coils and/or valve cartridges.</p> <p>Damaged fixed flow cartridge at flow control manifold.</p> <p>Damaged relief cartridge at rake control valve.</p>	<p>Raise tractor idle to increase oil flow.</p> <p>Install rake to a tractor with sufficient flow capabilities.</p> <p>Install 4 hose option to enable the use of 2 tractor remotes for oil flow (Rake needs 12gpm total)</p> <p>Service tractor's hydraulic system.</p> <p>Test voltage running to the coils at the valve and refer to the electrical installation information in the operator's manual.</p> <p>Replace parts as needed.</p> <p>Replace parts as needed.</p> <p>Replace parts as needed.</p>
<p>Baskets rpm are normal but rake functions won't operate.</p>	<p>Insufficient oil flow from tractor.</p>	<p>Raise tractor idle to increase oil flow.</p> <p>Install rake to a tractor with sufficient flow capabilities</p> <p>Install 4 hose option to enable the use of 2 tractor remotes for oil flow (Rake needs 12gpm total)</p> <p>Service tractor's hydraulic system.</p> <p>Damaged fixed flow cartridge Replace parts as needed. at flow control manifold.</p>

PROBLEM	CAUSE	SOLUTION
	<p>Low voltage to rake control valve.</p> <p>Short in electrical system.</p> <p>Blown fuse at control box.</p> <p>Damaged control box and/or wiring harness.</p> <p>Damaged coils and/or valve cartridges.</p>	<p>Test voltage running to the coils at the valve and refer to the electrical installation information in the operator's manual.</p> <p>Locate and repair or replace damaged components.</p> <p>Replace parts as needed.</p> <p>Replace parts as needed.</p> <p>Replace parts as needed.</p>
<p>Baskets raise and lower function is not operating properly.</p>	<p>Low voltage to coils at control valve ports C2 and/or C7.</p> <p>Damaged coils or cartridges at control valve ports C2 and/or C7.</p> <p>Damaged hydraulic cylinders.</p> <p>Damaged toggle switch at control box.</p>	<p>Test at coils and trace back to find possible short or damage to wiring or components.</p> <p>Replace parts as needed.</p> <p>Repair or replace parts as needed.</p> <p>Replace parts as needed.</p>
<p>Baskets angle in and out function is not operating properly.</p>	<p>Low voltage to coils at control valve ports C4/C9 for left basket or C5/C10 for right basket.</p> <p>Damaged coils or cartridges at control valve ports C4/C9 for left basket or C5/C10 for right basket.</p> <p>Wheel tower/pivot assembly nut (HR-0473) is over tightened.</p> <p>Damaged hydraulic cylinders.</p> <p>Damaged toggle switch at control box.</p>	<p>Test at coils and trace back to find possible short or damage to wiring or components.</p> <p>Replace parts as needed.</p> <p>Ensure nut is tightened between 150-160 (lb./ft.) (2-1/4" deep socket needed)</p> <p>Repair or replace parts as needed.</p> <p>Replace parts as needed.</p>
<p>Baskets extend and retract function is operating slowly.</p>	<p>Dust or debris in or on slide tubes</p> <p>Damaged coils or cartridges at control valve ports C1/C6 for left side or C3/C8 for right side.</p> <p>Damaged hydraulic cylinders.</p> <p>Damaged toggle switch at control box.</p>	<p>Clean and lube slide tubes (use recommended lube - TERAND GEL LUBRICANT W/ PTFE)</p> <p>Replace parts as needed.</p> <p>Repair or replace parts as needed.</p> <p>Replace parts as needed.</p>

PROBLEM	CAUSE	SOLUTION
Hydraulic system overheating.	<p>The rake control valve is set for an open center hydraulic system when the tractor is using a closed center system.</p> <p>Insufficient hydraulic oil tank capacity (primarily non-tractor custom hydraulic installations).</p> <p>Running hydraulic oil pressures significantly higher than the set psi of the relief cartridges in the Twinstar's hydraulic system.</p> <p>Damaged relief cartridge at flow control manifold or at the rake's control valve.</p>	<p>Refer to operator's manual for instructions on open center to closed center conversion.</p> <p>Replace with a tank having the proper capacity. Recommendation: A ratio of 2 gallons of oil for every 1 gpm of oil flow be used.</p> <p>Adjust the tractor's oil pressure to meet the needs of the Twinstar's hydraulic system.</p> <p>Replace parts as needed.</p>
Rake tines and/or tine bars rubbing or striking hay stripper bars.	<p>Hay stripper bars have become bent or mis-aligned.</p> <p>Damaged basket frames, tine bars or components.</p>	<p>Adjust hay stripper bars with adjustment tool provided until contact is eliminated.</p> <p>Repair or replace parts as needed.</p>
Ticking or popping sound coming from either end of baskets (around the star wheel).	<p>Damaged or seized tine bar bearings.</p> <p>Damaged star wheel.</p> <p>Dry bearings at Drive Hub or Idler Hub</p> <p>Damaged or seized drive hub or idler hub bearings.</p> <p>Loose tine bar, drive hub, idler hub, or star wheel mounting bolts.</p>	<p>Replace parts as needed.</p> <p>Replace parts as needed.</p> <p>Grease as needed.</p> <p>Replace parts as needed.</p> <p>Tighten bolts to torque specifications outlined in the operator's manual.</p>

7 SPECIFICATIONS

7.1 MECHANICAL

MODELS	2027-G2	2030-G2
MAXIMUM RAKING WIDTH	UP TO 27'	UP TO 30'
TRANSPORT WIDTH	10' - 9"	10' - 9"
OVERALL LENGTH	20' - 2"	20' - 2"
APPROX. WEIGHT	5100 LBS.	5600 LBS.
TIRE SIZE	(4) 7.50 X 15-6-PLY SMOOTH TREAD	(4) 7.50 X 15-6-PLY SMOOTH TREAD
RUBBER MOUNTED TINES	154 PER BASKET, OPT. 224 PER BASKET	175 PER BASKET, OPT. 259 PER BASKET
BASKET REEL SPEED	MAXIMUM 80 RPM	MAXIMUM 80 RPM
TINE BAR BEARINGS	PRECISION SEALED BALL BEARINGS	PRECISION SEALED BALL BEARINGS
HYDRAULIC REQUIREMENT	12 GALLONS PER MINUTE @ 2000 PSI	12 GALLONS PER MINUTE @ 2000 PSI
OPERATION SPEED	4 TO 10 MPH	4 TO 10 MPH
GAUGE WHEELS	OPTIONAL	OPTIONAL
BALL HITCH	OPTIONAL	OPTIONAL

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

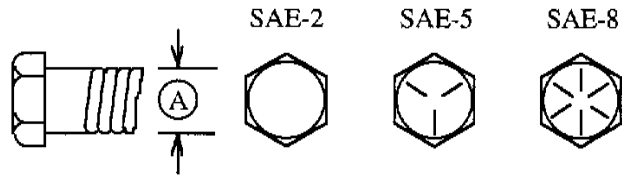
7.2 BOLT TORQUE

CHECKING BOLT TORQUE

The tables shown below give correct torque values for various bolts and capscrews. Tighten all bolts to the torques specified in chart unless otherwise noted. Check tightness of bolts periodically, using bolt torque chart as a guide. Replace hardware with the same strength bolt.

ENGLISH TORQUE SPECIFICATIONS

Bolt Diameter "A"	Bolt Torque *					
	SAE 2		SAE 5		SAE 8	
	N.m	(lb-ft)	N.m	(lb-ft)	N.m	(lb-ft)
1/4"	8	(6)	12	(9)	17	(12)
5/16"	13	(10)	25	(19)	36	(27)
3/8"	27	(20)	45	(33)	63	(45)
7/16"	41	(30)	72	(53)	100	(75)
1/2"	61	(45)	110	(80)	155	(115)
9/16"	95	(70)	155	(115)	220	(165)
5/8"	128	(95)	215	(160)	305	(220)
3/4"	225	(165)	390	(290)	540	(400)
7/8"	230	(170)	570	(420)	880	(650)
1"	345	(225)	850	(630)	1320	(970)



Torque figures indicated above are valid for non-greased or non-oiled threads and heads unless otherwise specified. Therefore, do not grease or oil bolts or capscrews unless otherwise specified in this manual. When using locking elements, increase torque values by 5%.

* Torque value for bolts and capscrews are identified by their head markings.



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