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**Product Information**

This Service and Operating Manual applies to the following Bushman machinery:

<b>Product Type:</b>	<b>Load Inverter</b>
<b>Model Number:</b>	
<b>Rated Load Capacity:</b>	
<b>Serial #:</b>	
<b>Registered User:</b>	
<b>Date Shipped:</b>	

For warranty information, service, and replacement parts information, please call your local dealer or Bushman Equipment at (800) 558-7850. Please have the above information available when calling.

This manual should be kept with the machine at all times. In the event the machine is re-sold, or transferred to another facility, please contact the factory so that we can update our service and warranty records.



## **Introduction**

Congratulations on your purchase of a Bushman Load Inverter. When correctly installed, operated, and maintained the load inverter is a most reliable and efficient means of turning large and heavy loads. Load inverters have been successfully used to turn products ranging from sheet steel stacks to thermoformed panels for the construction industry.

The Bushman barrel-type load inverter is designed and built to provide many years of efficient service. Like any piece of industrial equipment, there are some important safety rules to follow when installing and operating this equipment.

This manual provides instructions for correctly installing, using and maintaining this equipment. Due to the customized nature of the equipment, some information may not apply to your Inverter. If you are not the first owner of this equipment, you should consult the factory before operating to ensure that its specifications are appropriate for your application. Additionally, some service and safety information relating to specialized components such as conveyor drives, gear motors, electrical components, etc. may be contained in the instruction documents provided by their manufacturers. Refer to these documents before servicing or working with these components.

### Safety Instructions

#### Safety Instructions for Load Inverters:

1. Do not operate this equipment unless you have been trained and authorized to do so.
2. Before using inverter, inspect it for proper operation and condition.
3. Before using inverter, inspect all safety devices (such as bogey wheel guards) to be certain they are in place and functioning properly.
4. Do not exceed the inverter's capacity as stated on the serial number plate.
5. Center loads on the load/unload platforms. Make sure that the load to be inverted is appropriately sized and shaped. All pallets or skids used should be flat and in good condition, with no broken boards. The top of the load should be parallel to the base.
6. Keep the entire load within the perimeter of the platform while the inverter is in motion.
7. Ensure that people and objects are clear of the areas beneath the platform and immediately surrounding the perimeter of the inverter while it is in motion.
8. **DANGER!** Do not work under inverter without the maintenance device(s) in position or the machine safely blocked and secure. See the maintenance section of this manual to learn about safe use of the maintenance device and how to block machine safely.

### Responsibilities of Operator

#### Inspection and Maintenance

The machine shall be inspected and maintained in proper working order in accordance with the manufacturer's operating/maintenance instructions and safe operating practices.

#### Removal from Service

Any machine not in safe operating condition shall be removed from service until it is repaired to the original manufacturer's specifications.

#### Repairs

All repairs shall be made by authorized personnel in conformance to the manufacturer's instructions.

#### Operators

Only trained and authorized personnel shall be permitted to operate the machine.

1. Before using the machine, the operator shall have:
  - A. Read and/or have explained and understood the manufacturer's operating instructions and safety rules, or have been trained by a qualified person.
  - B. Inspected the machine for proper operation and condition. Any suspect item shall be carefully examined and a determination made by a qualified person as to whether it constitutes a safety hazard. All unsafe items shall be corrected before further use of the machine.
2. During operation the machine shall be used only in accordance with its intended use and within the manufacturer's limitations and safety rules.
  - A. Do not overload the machine.
  - B. Ensure that all safety devices are operational and in place.

#### Modifications and Alterations

Modifications or alterations of machinery shall only be made with the written permission of the original manufacturer. These changes shall be in conformance with all applicable standards and shall render the equipment as safe as it was before modification. These changes shall also satisfy all safety recommendations of the original equipment manufacturer for the particular application of the machine.

### Description of Equipment

The barrel-type load inverter consists of a series of rings, formed from rolled steel channel. These rings are connected by longitudinal members to form a cylindrical shaped “barrel” cradle. The cradle rests on four bogey wheels, one at each corner of the machine. The bogey wheels are attached to a base plate or frame that rests on the floor.

Attached to one or more of the rolled steel rings will be a heavy-duty riveted roller chain. This chain is driven via a gearbox by an electric motor. At each end of rotation, electrical limit switches or other sensors halt rotation of the barrel.

Located on one platform within the barrel cradle, is a hydraulic scissors clamp. This scissors clamp uses double-acting hydraulic cylinders to raise and lower the platform. The scissors clamp uses a hydraulic pressure switch to sense when a load has been successfully clamped.

See section on “**Hydraulic Scissors Clamp**” in this manual for information on servicing and operating the scissors clamp.

### Operation of Equipment

Load inverters are used to invert or “turn over” large and heavy loads of materials. The scissors clamp and pressure switch allows a wide range of sizes and weights of loads to be inverted using this equipment, however some loads may require special handling or preparation before inverting.

Normal operation consists of placing the load to be inverted into the machine. This is done either by using a forklift or other material handling trucks. If equipped with powered roller conveyors, loads may be conveyed into the machine. Care should be taken that no load or portion of the load extends outside of the machine. Severe personal injury or damage to the equipment may result if the machine is operated with part of a load extending outside of the machine.

When the load is positioned inside the machine, the “clamp” portion of the cycle is started. Hydraulic fluid is pumped from the reservoir into the double-acting hydraulic cylinders in the scissors clamp. The clamp platform descends until it contacts the top of the load. This increases the hydraulic system pressure until the appropriate clamp pressure is attained. Once clamp pressure is attained, the inversion cycle begins.

During the inversion cycle, the gear motor drives the inversion cradle in a circle, until the electrical limit switches are tripped. At this point, the load is fully inverted. The scissors clamp will then automatically retract. Loads may then be removed from the machine, either using a forklift, or (if supplied) using the powered conveyor.

### Installation

Bushman inverters are shipped completely assembled and ready to install. If the unit is to be pit-mounted, an appropriate size pit should be prepared before moving the unit into position. (Contact factory for instructions regarding pit size, etc.)

Careful consideration should be given to placement of the inverter within the plant. It should be placed on a level, dry floor, of suitable strength to bear the weight of the equipment and its load. There should be sufficient space to allow the unit to be loaded and unloaded using overhead hoists and or forklift-type material handling trucks. Consideration should also be given to the placement of the power supply cable and control box cord. Severe personal injury and or death can result if electrical cables are cut accidentally. Sufficient overhead clearance should be provided so that the largest potential load can rotate freely.

Inverters are supplied with lag-down holes in the base plate. It is recommended that all inverters be bolted to the floor using appropriately sized bolts. Failure to bolt unit down can result in severe injury to persons using the equipment, and possible damage to equipment or materials.

The machine may be transported through the plant by one of three methods:

1. Lift eyes are provided at each corner of the inverter. An appropriately rated chain may be attached to each lift eye, and the unit may be moved via overhead cranes or hoists. Refer to manufacturer's plate on base of inverter for weight information.
2. Chains attached to the lift-eyes may be lifted by a forklift-type truck. Check that the weight of the equipment does not exceed forklift capacity.
3. The unit is shipped from the factory with wooden blocks at each corner underneath the base plate. Forklift forks may be inserted between these blocks. Take care to only lift the unit from the side, and to make sure that the forks extend sufficiently to lift the unit safely. Blocks may be removed once the machine is in place by lifting each corner of the inverter in turn with a forklift or hoist, unbolting and removing the block, and then lowering each corner.

### Voltage Requirements

The inverter is designed to operate on a variety of power supply voltages. The Bushman inverter uses a multi-voltage motor; however, it is shipped with overload protection heaters appropriate to the operator requirements as specified to the factory at the time of order. If the unit is connected to a power supply with a voltage different from what it was originally specified to the factory, replacement overloads should be installed before operation. Failure to install correct overloads will result in inverter failure, and can result in damage to the equipment and possible serious or fatal personal injury.

### Remote Motor Starter

If the starter is mounted externally, it will be necessary to supply 3-phase power of the appropriate voltage to the starter, and then wire the starter to the motor in the base frame. In most cases, the motor leads will terminate in an outlet box in the base frame and the leads from the starter can be wired to this outlet box. A control circuit transformer is provided with the magnetic starter and additional wires will be required from the transformer to an outlet box in the base frame. These will pick up the limit switch and the push button that can be attached to this outlet box.

### Photo-eyes

If the inverter is equipped with external photo-eyes, they should be positioned at the ends of the machine to detect the presence of a load. They will be wired to the junction box attached to the PLC. Each lead from the photo-eye assembly will be labeled. Attach each numbered wire to the matching terminal in the junction box.

The photo-eyes may need to be adjusted depending on the “reflectivity” of the load. Highly reflective loads may trigger a false reading, and may not stop the conveyor drive properly. Refer to the technical documentation that is supplied with the photo-eyes for more information.

### Internal Motor Starter

If the starter is mounted internally, it is necessary to knock out a hole in the enclosure box inside the base frame of the unit. If your inverter was ordered with J.I.C. standard enclosures, you will have to drill a hole through the enclosure and fit a gasket around the wire). A power cord should then be inserted through this hole. Attach each wire to one terminal on the motor starter, labeled L1, L2, and L3.

### Reverse Phase Relay

Bushman inverters are equipped with a reverse phase relay that prevents accidental incorrect rotation of the unit if it is wired out of phase. Should the unit fail to operate when power is supplied, and the push buttons are depressed, it will be necessary to reverse any two of these line wires. Do not attempt to adjust or work on the reverse phase relay. Most inverters are shipped with a Reverse Phase Relay that has a red L.E.D. indicator light. This indicator light will illuminate when power has been correctly installed, and the unit is wired in phase.

### Operation

After the starter and operating switches have been connected as above, and are in accordance with the attached wiring diagrams, the inverter is ready to operate. Bushman recommends that before production use, a full range of load sizes and configurations be tested in the machine to ensure that clamp pressures and other settings are correct. During testing, it is recommended that personnel stand clear from the machine, and that an operator observes the machine. Use the “E-Stop” button to halt operation of the machine, if any unexpected condition occurs during testing.



### Using the Inverter

#### WARNING!

Do not place loads on the inverter that overhang either platform or exceed the rated load capacity of the machine. Doing so places extreme stress on the motor, gearbox, and chain, and can cause breakage of these components and severe personal injury or death.

Once the load to be inverted is in place, you may begin the inversion cycle. The operator should ensure that the area around and underneath the machine is free from obstructions, and that persons in the area stand clear. The operator should then depress the appropriate pushbutton to begin inversion.

#### Operating Condition

The inverter should rotate smoothly, and without any scraping or banging noises. If any of these conditions are noted, the operator should immediately discontinue use of the equipment until it has been checked by qualified maintenance personnel. Jerking motion or scraping and banging noises are indications that the unit is not operating correctly and requires maintenance. Never place any part of the body inside the Inverter while it is operating, or without blocking and securing the inversion cradle.

#### Chain Breakage

Should the chain break during operation, do not attempt to service the machine until the load has been removed and the platform returned to the "balanced" 45-degree position, and the maintenance pin inserted. Chain breakage is usually an indication that the platforms are not rotating freely because of damage to the frame or because of loading more than the stated capacity. Do not replace chains until the cause of the breakage has been determined and corrected. If the breakage is found to be a result of overloading, contact the factory regarding possible upgrading of your existing inverter.

In situations where you wish to invert a load that is not unitized (e.g. a pallet load of multiple cartons, etc.) make sure that the load is secured and banded before upending. Do not place any straps or chains across the rolling surfaces of the upending platform.

### Safe Operating Procedure

Ensure that all operators and maintenance personnel working with the equipment have read and/or had explained, and understand these safety instructions before operating or performing work on the equipment. Failure to heed these instructions can possibly lead to severe personal injury.

1. Keep clear of the machinery at all times, and particularly when it is operating.
2. Do not climb or ride on the machine.
3. Ensure that all safety guards and limit switches are in place and are in working order.
4. Do not enter area under the machine unless the machine has been electrically locked and tagged out, and the moving cradle has been placed and blocked in the "balanced" position.
5. Never remove the chain(s) or any other component of the drive system without first ensuring that the moving cradle is in the "balanced" position and blocking it in this position. The cradle is held in the vertical and horizontal position by the chain(s) and the drive system and is unbalanced. When the chain(s) or drive system is loosened, the cradle will move rapidly to the "balanced" position, and could cause serious injury to any person close to it.
6. Should it be necessary, for operational reasons, to be on one of the cradle platform surfaces, always use the correct ladders, safety harnesses, and other safety equipment necessary to protect persons from falling from unprotected heights.
7. Do not bump the cradle with the product being rotated or with cranes, crane hooks, or lift trucks. Shock loads may cause failure of the chain(s) or other drive system components and could cause unexpected movement of the cradle and injury to persons.
8. Never try to lubricate moving machinery. Ensure lockout and tag-out procedures are used before all lubrication and maintenance.
9. Keep rotator chain(s) correctly adjusted to prevent excess wear and stress on the drive system. See sections on chain adjustment for instructions on adjusting chain(s).
10. Use extreme caution at all times when loading and unloading the machine to ensure that the load is always in a secure mode.
11. Do not overload the machine. See the rated capacity on the serial plate.
12. Do not rotate loads that project over front edge of the cradle platform. Ensure all loads are centrally placed and even from side to side.

### Maintaining the Inverter

A qualified person who understands all safety and operating instructions should perform all maintenance.

#### Hydraulic Scissors Clamp

Refer to the appropriate manual sections for information relating to the hydraulic scissors platform.

#### Daily Operator Checks

Inspect the machine to ensure that all guards and limit switches are in place.

Check to see that the cradle is square and that both platforms are square and parallel to the floor. If this is not the case, the cradle may have come off its supporting bogey wheels, or a bogey wheel bearing may have failed. If this is the case, **DO NOT** operate machine, and request maintenance assistance.

Before loading the machine, operate the unit unloaded through one complete cycle. Observe rotation and smoothness of operation. Report any unusual observations and/or noises, and **DO NOT** operate machine until it has been checked and repaired.

Check control power cord for wear.

During normal operation of the machine, report any unusual observations and/or noises that may suddenly occur. **DO NOT** use the machine until a qualified person has checked it.

#### Quarterly Maintenance

Qualified maintenance personnel should perform the following at least quarterly:

1. Check chains and drive components (sprockets, bushings, etc.) for wear and correct adjustment. See instructions for adjusting chains.
2. Check oil level in gear reducer. If necessary, bring oil to correct operating level. See section in manual covering gearbox.
3. Flush all bearings with grease. "Zerk" type fittings are found at all bearing locations, and are fitted with a red plastic removable cap. See attached diagram for grease point locations. Use high quality 120# multi-purpose grease.
4. Check bogey wheels for wear.
5. Adjust spring-load motor brake if necessary. See details in section on brakes.
6. Check electrical cords and components for wear.

### Lubrication

Flush all bearings with grease four times a year. Bushman recommends using a good grade of 120# multi-purpose grease. Zerk fittings will be found at all bearing locations. Bearings are found in all members which rotate during operation around a fixed shaft or in the rollers which support the rotating cradle assembly. At the same time, the oil level in the gearbox should be checked. Please consult the lubrication and maintenance information for the gear motor that is included at the end of this manual.

### Chain Tensioning and Replacement

Inverters are driven by a powered sprocket turning a chain that is fixed to either a circular plate or a rolled steel channel that is part of the inverting cradle. It is necessary to maintain adequate tension in this chain and not to allow it to become slack. Slackness in the chain will result in excess wear and shock loads on the drive system.

The chain is correctly adjusted when it is held snugly against its circular backing plate or rolled steel channel. If the chain can be pulled away from the backing plate, then it is too loose and requires adjustment.

### Adjustment Procedure

Remove all loads from the inverter. Use the manual control buttons located inside the electrical panel to rotate the machine to the “start” position, with the scissors clamp at the bottom of the inverter. When the platforms are in this position, use chains or other devices to “lock” the rotating inverter cradle in position. This will prevent accidental movement of the platform. Disconnect power to the inverter using the correct lockout procedures

Check anchor bolt adjustment range at the end of the chain. All bolts should have approximately the same amount of thread showing through the anchor nut. If this is not the case, loosen one end and tighten the other until the thread showing is approximately equal.

Tighten both anchor bolts equally until the chain is just snug against the backing plate. There should be no droop in the chain, and it should not come away from the backing plate when pulled at 90 degrees to the plate. The chain should still have some flex in it if not it is over-tensioned.

For units with two chains, it is necessary to ensure that each chain has a similar tension. Use a torque wrench to match the tension on each chain.

Remove the maintenance locking pin (if supplied) and then restore power and observe operation of the unit. On two-chain units, the cradle should rotate evenly on the bogey wheels without a tendency to move in one or the other direction. Should this happen, then one chain is tighter than the other is. If this happens, repeat until unit tracks evenly.

### Chain Replacement

Should it ever be necessary to replace chain, due to either wear or breakage, and then follow the procedures above, ensuring that the chain anchor bolts are correctly adjusted when the new chain is installed.

**Limit Switches**

Bushman inverters are equipped with four limit switches; two switches are located at each end of the 180° of travel. The inside limit switch of each pair is the normal stopping limit switch that stops the platform in a level position. If the platform should begin to stop slightly short of 180° or slightly beyond 180°, the limit switch should be re-adjusted by changing the position of the operating arc of the limit switch. If this does not correct the situation, there is also a certain amount of adjustability in the cam that trips the limit switch. The outside limit switch at each end of 90 degree travel is a safety or over travel limit switch. These switches will only operate if the first stop switch becomes inoperative or is damaged. If the inverter stops at the overtravel limit switch, the inside limit switch should be replaced. Contact the factory for replacement limit switch information. Do not operate the inverter until both inside limit switches are operating correctly.



**Statement of Warranty**

Bushman Equipment will replace, F.O.B. the factory, any goods which are defective in materials and workmanship within 12 months of date of shipment, provided the buyer returns the defective materials, freight and delivery prepaid, to the manufacturer, which shall be the buyer's sole remedy for defective materials.

Manufacturer shall not be liable to purchaser or any other person or entity for consequential or incidental damages. The end user is responsible for the integrity of any structure, crane or fixture to which Bushman products have been attached. This warranty does not apply to equipment and/or components, which have been altered in any way or subjected to abusive or abnormal use, inadequate maintenance or lubrication, or use beyond seller recommended capacities and specifications.

Manufacturer shall not be liable under any circumstances, for labor costs expended on such goods or consequential damages. Manufacturer shall not be liable to purchaser or any other person or entity for loss or damage directly or indirectly arising from the use of goods or from any other cause.

No employee, agent, officer or seller is authorized to make further oral or written representations or warranty of fitness or to waive any of the foregoing terms of sale, and none shall be binding on the manufacturer.

If there are any problems or questions regarding this equipment or its application, contact your local sales representative or Bushman Equipment directly at 262-790-4207.

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