C.R. LAURENCE CO., INC.

MANUAL ROTATOR 2800 DC-VOLTAGE

CAT. NO. MR1611LDC

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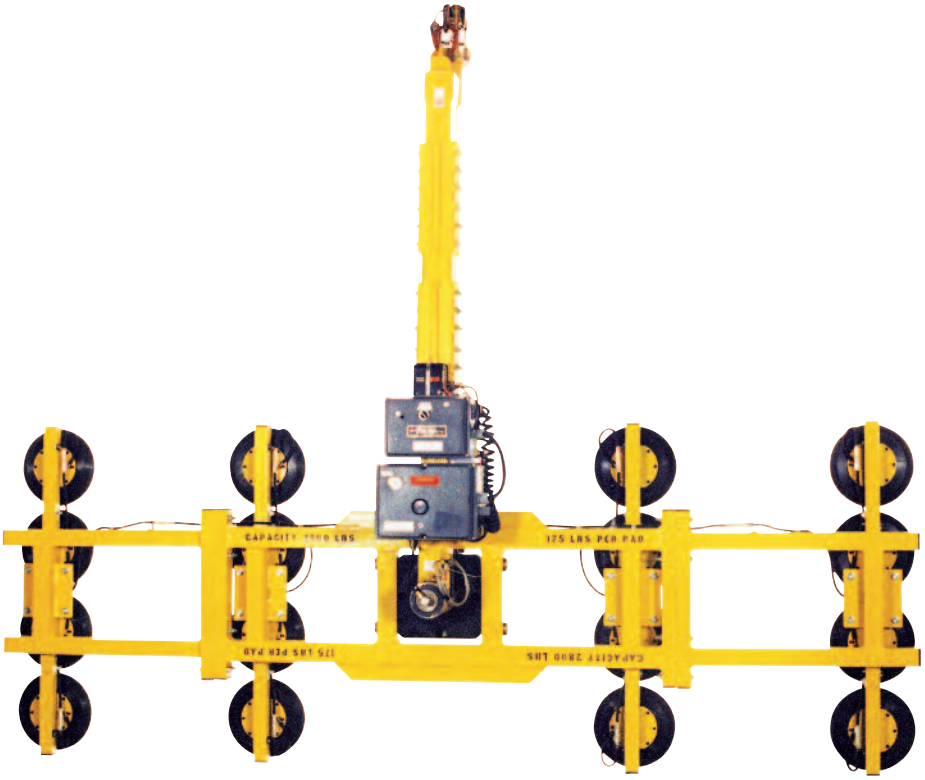
Wood's Powr-Grip CO., INC.



Please read and understand all instructions. Failure to follow all instructions listed herein may result in electric shock, fire and/or serious personal injury.

SPECIFICATIONS

Model Number:	MR1611LDC	
Power Source:	12 volts DC, 22 amps	
Battery Capacity:	26 amp-hours	
Vacuum Pads:	Sixteen 11" (28 cm) nominal diameter, lipped (Model G3370), 55 durometer natural-polybutadiene rubber, spring-mounted (¼" / 7 mm travel), with #60 filter screen	
Pad Spread (to outer edges):[1]	**Maximum Width**	= 49" (1245 mm)
	Minimum Width	= 12" (305 mm)
	Maximum Length	= 169" (4293 mm)
	Minimum Length	= 40-3/4" (1035 mm)
Load Characteristics:	Flat contact surface; Maximum thickness at full load capacity = 1" (25.4 mm).[2]	
Maximum Load Capacities:[1]	**Per-Pad Capacity**	= 175 lbs (80 kg)
	for 16-Pad Configuration	= 2800 lbs (1270 kg)
	for 4-Pad Configuration	= 700 lbs (320 kg)

- rated at 16" Hg (-54 kPa) on clean, smooth, nonporous flat surfaces -

⚠ ***WARNING: Using the lifter on rough or porous materials may reduce load capacity.***

Lifter Weight:	685 lbs (311 kg)
Rotation Capability:	Manual, 360°, with automatic locking at each ¼ revolution (when desired)
Vacuum Pump:	Diaphragm type, 3 SCFM (85 liters/minute) nominal airflow
Vacuum Reserve Tank:	Vacuum reservoir extends battery life by reducing pump cycles required to maintain vacuum.
Vacuum Gauge:	Dial gauge indicates current vacuum level in positive inches of Hg and negative kPa.
Vacuum Lift Light:	Green light is energized whenever vacuum level is sufficient for lifting maximum load weight (higher than 16" Hg / -54 kPa).
Options:	See appendix for instructions about optional features.
Operating Elevation:	Maximum = 7000 feet (2133 meters)
Operating Temperatures:	15° to 105° F (-9° to 40° C)

[1] For a complete listing of Pad Spread and Load Capacity for each pad frame configuration, see ASSEMBLY: TO CHANGE THE PAD FRAME CONFIGURATION.

[2] Allowable thickness increases as load weight decreases; contact Wood's Powr-Grip for help in determining the maximum thickness permitted when handling any specific load.

WARNINGS

Powr-Grip is pleased to offer the most reliable vacuum lifters available. Despite the high degree of security provided by this product, certain precautions must be observed to protect the operator and others.

Always wear personal protective equipment that is appropriate for the material being handled. Follow trade association guidelines.

Always operate the lifter under conditions approved for its design (see OPERATION: BEFORE USING THE LIFTER).

Never operate a lifter that is damaged, malfunctioning, or missing parts.

Never operate a lifter if the sealing edge of any vacuum pad is cut or otherwise damaged.

Never remove or obscure warning labels.

Never operate a lifter if the load capacity or any warning appears to be missing or obscured.

Always make certain the faces of all vacuum pads and the contact surface of the load are clean prior to applying the vacuum pads.

Never exceed the load capacity or attempt to lift loads the lifter was not designed for.

Never attempt to lift cracked or broken glass with this lifter.

Always position the vacuum pads correctly on the load prior to lifting (see OPERATION: TO APPLY THE PADS TO A LOAD).

Never lift a load when any vacuum indicator shows inadequate vacuum.

Never touch the vacuum release controls during a lift. This may result in loss of attaching vacuum and release of the load.

Never allow people to ride on the lifter or the load being lifted.

Never lift a load higher than necessary or leave suspended loads unattended.

Never lift a load over people.

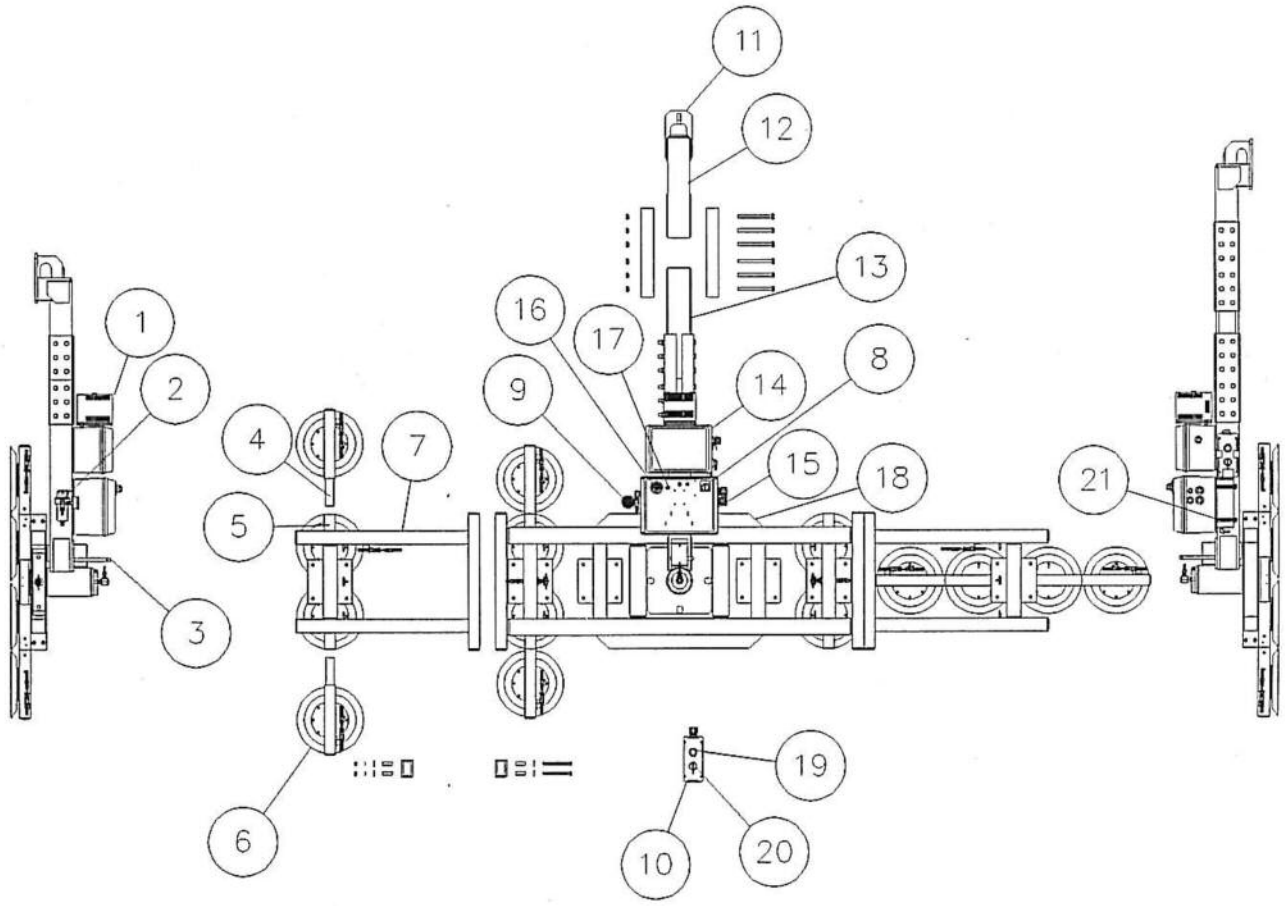
Always keep other personnel far enough away from the lifter to avoid injury in the event of an unexpected load release.

Always place the power control in the inactive position and, when possible, disconnect the power source before opening any enclosure on the lifter. (Only applicable to powered lifters)

Always remember that modifications to the lifter may compromise its safety. Wood's Powr-Grip cannot be responsible for the safety of a lifter that has been modified by the customer. For consultation, contact Wood's Powr-Grip.

OPERATING FEATURES

Note: Components featured in the following instructions for assembling, operating or maintaining the vacuum lifter are underlined on their first appearance in each section.



Standard MR1611LDC shown.

1 BATTERY CHARGER
2 AIR FILTER
3 ROTATION RELEASE LEVER
4 REMOVABLE PAD ARM
5 ROTATING PAD ARM
6 VACUUM PAD
7 REMOVABLE SECTION of PAD FRAME
8 POWER SWITCH
9 VACUUM GAUGE
10 REMOVABLE CONTROL PENDANT
11 LIFT BAIL
12 LIFT BAR
13 LIFT BAR EXTENSION
14 BATTERY ENCLOSURE
15 ENCLOSURE with VACUUM PUMP and VACUUM SWITCH
16 BATTERY GAUGE
17 BATTERY TEST BUTTON
18 CENTER SECTION of PAD FRAME
19 VACUUM LIFT LIGHT
20 APPLY/RELEASE SWITCH
21 VACUUM RESERVE TANK

ASSEMBLY

TO SET UP THE LIFTER

1) Remove the top of the shipping crate and all devices for restraining or protecting the vacuum lifter during shipping.
2) Suspend the lifter from a crane as follows: Select hoisting equipment (crane and hoist, when applicable) rated to carry the maximum load weight plus the lifter weight (see SPECIFICATIONS: Maximum Load Capacities and Lifter Weight).

   Note: Any application of the lifter must conform to all statutory or regulatory standards that relate to the hoisting equipment when used in its geographical location (eg, relevant OSHA standards in the USA).[3]

   Release the lifter's rotation latch (see OPERATION: TO ROTATE THE LOAD EDGEWISE) and raise the lift bar to a vertical orientation, until the rotation latch re-engages.

   Note: When you are planning to use the removable sections of the pad frame, install the lift bar extension before proceeding further (see TO CHANGE THE PAD FRAME CONFIGURATION to follow).

⚠ ***WARNING: Hoisting equipment hook must be fitted with restraining latch to prevent lift bail from slipping off under any circumstances.***

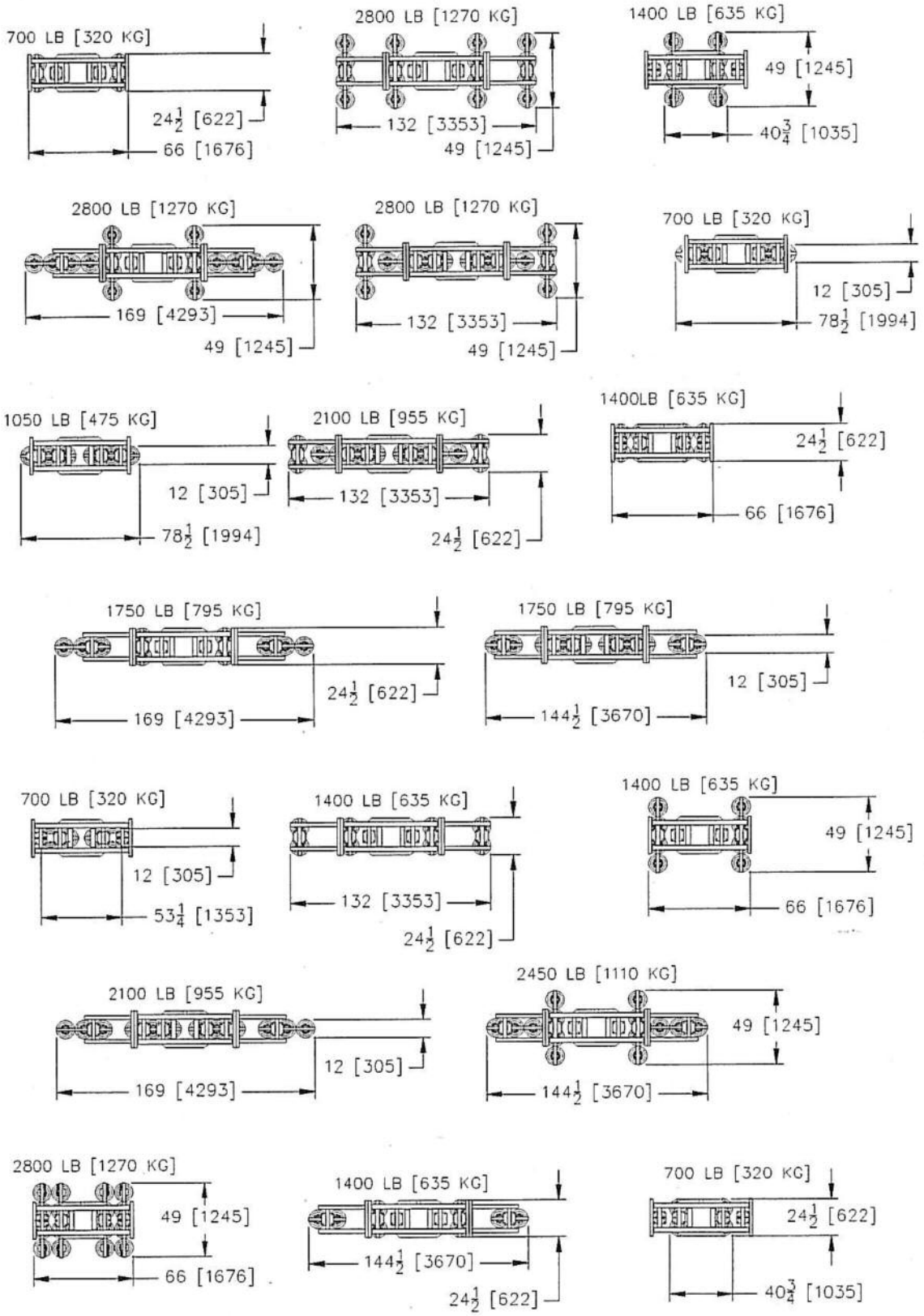
   Attach the hoisting equipment hook to the lift bail, and use the hoisting equipment to raise the lifter out of the shipping crate. Be careful to avoid damaging any vacuum pads. Remove the pad covers and save them for use whenever the lifter is stored.
3) Assemble the pad frame in the configuration that will provide optimal support of the load while lifting (see TO CHANGE THE PAD FRAME CONFIGURATIONS to follow). Now the lifter is operational.
4) Perform Operational and Load Tests for the lifter as directed in MAINTENANCE: TESTING SCHEDULE.

TO CHANGE THE PAD FRAME CONFIGURATION

This lifter offers a variety of pad frame configurations to accommodate different load dimensions and weights (see illustrations on following page). Configurations are created by installing or removing the pad frame's outer, removable sections and removable pad arms, and/or by rotating the pad frame's rotating pad arms. Some configurations also require the lift bar extension (see To Install the Lift Bar Extension to follow).

Always arrange the vacuum pads in a symmetrical configuration, in both horizontal and vertical dimensions. After changing the pad frame configuration, make sure all vacuum hoses are secure and routed to avoid being pinched, snagged, abraded or otherwise damaged while the lifter is in operation. Also be sure to verify that all pads are connected and functioning correctly.

[3] If hoisting equipment is rated to lift loads weighing more than 2204 lbs (1000 kg), CE Standard prEN 292-3:1995, section 6.8.2 requires the hoisting equipment to be fitted with a load capacity limiter and a capacity overload indicator.



Pad Spread and Load Capacity

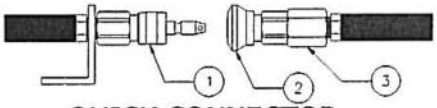
To Install (and Remove) the Lift Bar Extension

The lift bar extension must be used whenever the pad frame's removable sections are attached. Otherwise, the extended pad frame would strike the lift bail during rotation. The lift bar extension can be removed whenever the removable sections are not attached to the pad frame.

1) Support the lifter so that hoisting equipment is not required to hold it upright. Make sure the lifter is supported securely before removing the hoisting equipment hook from the lift bail.
2) Remove the twelve 1/2-13 bolts from the lift bar joint and remove the joint couplers.
3) Install the lift bar extension between the upper and lower sections of the lift bar.
4) Install joint couplers at the joints on either end of the lift bar extension.
5) Install and securely tighten twelve 1/2-13 bolts for each of the two lift bar joints.
6) To remove the lift bar extension, reverse this procedure.

To Install (and Remove) the Removable Sections of the Pad Frame

1) Align one removable section with the center section of the pad frame.
2) Align the bolt holes on each side of the joint where the removable section attaches to the center section. Insert eight 3/8-16 bolts through the bolt holes and tighten the bolts securely. Make sure the bolt spacers located inside the pad frame's tubes remain in place.
3) Remove the male end of the quick connector from the spring clip on the pad frame's removable section. Thread the vacuum hose through the opening for this purpose at the pad frame joint. Push the male and female ends of the quick connector together until they lock.
4) Repeat steps #1-3 to install the other removable section of the pad frame.

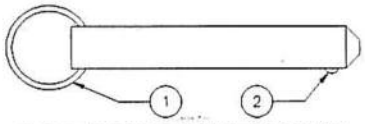


QUICK CONNECTOR
1) MALE END
2) RELEASE RING
3) FEMALE END

5) To remove the pad frame's removable sections, reverse this procedure. Move the release ring on the female end of the quick connector away from the male end to separate the ends.

To Install (and Remove) Removable Pad Arms

1) Insert the end of a removable pad arm in one socket on the pad frame, so that the holes align for the cotterless hitch pin.
2) Secure the removable pad arm in the pad frame by pushing a 3/8" cotterless hitch pin through the holes until the retaining ball emerges on the far side of the pad frame socket.



COTTERLESS HITCH PIN
1 PULL RING
2 RETAINING BALL

3) Remove the end of the quick connector from the spring clip on the rotating pad arm. Push the male and female ends of the quick connector together until they lock.
4) Repeat steps #1-3 to install each pad arm required for the pad frame configuration desired.
5) To remove the removable pad arms, reverse this procedure. Move the release ring on the female end of the quick connector away from the male end to separate the ends. Store removed pad arms in a clean, dry location to protect them from environmental exposure.

To Rotate Rotating Pad Arms

1) Remove the four 1/2-13 bolts that secure each rotating pad arm on the pad frame.
2) Rotate the arm 90° and reinstall the bolts.
3) Repeat steps #1-2 to rotate each pad arm as required for the pad frame configuration desired.

BEFORE USING THE LIFTER

All of the following preparations must be completed prior to lifting any load.

Taking Safety Precautions

The operator must read and understand this *INSTRUCTIONS* manual, including all ***WARNINGS***, before using the lifter. If necessary, contact Wood's Powr-Grip or an authorized dealer for assistance.

⚠ ***WARNING: Always wear appropriate personal protective equipment.***

The operator must wear any personal protective equipment and take any other precautions required to handle the load safely. Consult appropriate trade association guidelines to determine what precautions are necessary for each type of load material.

Evaluating the Intended Use

The operator must determine whether the lifter is capable of performing each intended task, in view of specific design limitations: Consult the SPECIFICATIONS to review the Maximum Load Capacity, Pad Spread and other lifter capabilities, as well as the Operating Elevation, Operating Temperatures, and Load Characteristics required to operate the lifter. Any other use is not recommended. While the minimum load dimensions are determined by the Pad Spread, the maximum load dimensions are determined by the allowable overhang, or the amount of material that can extend sideways beyond the vacuum pads without breaking or otherwise being damaged.[4]

⚠ ***WARNING: Moisture reduces slip resistance of vacuum pads.***

Using the lifter in wet environments may require the operator to take special precautions: Moisture on contact surfaces of the load or vacuum pads diminishes slip resistance, thereby reducing the lifter's effective load capacity. Although the lifter's exterior surfaces can tolerate some exposure to water vapor, they are not designed to be water-tight. Submerging the lifter or using it in rain may damage lifter components; these and similar conditions must be avoided.

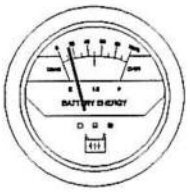
CAUTION: Examine each air filter regularly, and empty when necessary.

The lifter is equipped with one or more air filters to help protect the vacuum system from contaminants. Dual filters are required when using the lifter on wet load surfaces. In order for a filter to function, the operator must empty the filter bowl before enough liquid accumulates to contact any portion of the filter element (see MAINTENANCE: AIR FILTER MAINTENANCE).

Note: Vacuum pads can stain or deform load surfaces with light colors or soft coatings. Test such surfaces for detrimental effects before using the lifter on them.

[4] The allowable overhang depends on the kind of load material being lifted, the thickness of the material, and the angle at which it is handled (if any). Since materials such as glass, stone or sheet metal each have different physical properties, the allowable overhang must be evaluated separately for each type of load. If necessary, contact Wood's Powr-Grip or an authorized dealer for help in determining the recommended overhang in a specific situation.

Performing Inspections and Tests



Perform all inspections and tests required by the INSPECTION and TESTING SCHEDULES (see MAINTENANCE). In addition, if the lifter has been in storage, always conduct a VACUUM TEST before placing it in service (see MAINTENANCE).

⚠ ***WARNING: Always check battery energy before using the lifter.***
(See MAINTENANCE: BATTERY TEST)

Confirming the Pad Frame Configuration

⚠ ***WARNING: Load Capacity of lifter varies, depending on pad frame configuration.***

Make sure the pad frame has been assembled in the configuration that will provide optimal support of the load while lifting (see ASSEMBLY: TO CHANGE THE PAD FRAME CONFIGURATION). The pad frame configuration selected must be appropriate both for the weight and for the dimensions of the load to be lifted.

Note: If hoisting equipment is rated to lift loads weighing more than 2204 lbs (1000 kg), CE Standard prEN 292-3:1995, section 6.8.2 requires the hoisting equipment to be fitted with a load capacity limiter and a capacity overload indicator.

TO APPLY THE PADS TO A LOAD

Inspecting the Contact Surfaces

Make certain that the contact surfaces of the load and all vacuum pads are free of any contaminants that could prevent the pads from sealing against the load (see MAINTENANCE: VACUUM PAD MAINTENANCE).

⚠ ***WARNING: Using the lifter on rough or porous materials may reduce load capacity.*** (see Vacuum Level on Rough or Porous Surfaces to follow.)

Powering up the Lifter

Place the power switch in the "ON" position (blue indicator light remains illuminated while power is engaged). The power switch must remain in the "ON" position while operating the lifter.[5]

⚠ ***WARNING: Never turn power off while operating lifter.***

Placing the power switch in the "OFF" position during lifter operation could result in the release of the load and possible injury to the operator.

[5] If the vacuum pump or any other powered component fails to function while the power switch is in the "ON" position, examine each circuit breaker (adjacent to power switch) to determine whether it has interrupted the electrical circuit to the component. Although the operator can reset the circuit breaker, the power interruption may indicate an electrical problem that requires attention. Correct any deficiency before resuming normal operation of the lifter (see wiring diagram provided).

Positioning the Lifter on the Load

The lifter must be attached only to vertically oriented loads. Center the lifter's pad frame to within 2" (51 mm) of the load center, since off-center loading can cause the load to rotate unexpectedly, and it may also damage the lifter.[6] Make sure that all vacuum pads will fit entirely on the load's contact surface (see SPECIFICATIONS: Pad Spread) and that they will be loaded evenly while lifting. Then apply the lifter to the load so that all pads are touching the contact surface.

Sealing the Pads Against the Load

Turn the apply/release switch on the removable control pendant to the "APPLY" position (clockwise). This engages the vacuum pump, causing vacuum to be drawn immediately at the vacuum pads. Press the lifter onto the load until all the pads seal against it. The apply/release switch must remain in the "APPLY" position throughout the entire lift.

⚠ ***WARNING: Keep apply/release switch in "APPLY" position throughout lift.***

Note: If a vacuum pad has been lying against a hard object (as during shipping), it may be slightly distorted. Although initially it may be difficult to apply the pad to a load, this condition should correct itself with continued use.

Reading the Vacuum Gauge

The vacuum gauge indicates the current vacuum level in the lifter's vacuum system. The *green* range indicates vacuum levels sufficient for lifting the maximum load weight, whereas the *red* range indicates vacuum levels that are ***not*** sufficient for lifting the maximum load weight. The gauge needle should show a sudden surge in vacuum as the vacuum pads seal against the load. If it takes more than 5 seconds for the vacuum level to reach 5" Hg (-17 kPa), press individually on any pads that have not yet sealed.

Load Capacity and the Lift Light

The lifter's Maximum Load Capacities (see SPECIFICATIONS) are rated at a vacuum level of 16" Hg (-54 kPa). After the lifter has attained this level, the vacuum pump turns off automatically, to conserve battery energy. At the same time, the green vacuum lift light turns on, to indicate that the lifter is ready to lift the maximum load weight.

⚠ ***WARNING: Never attempt to lift maximum load weight unless green lift light is illuminated.***

If vacuum decreases, the lift light turns off and the pump turns on again automatically to maintain a minimum level of 16" Hg (-54 kPa). Do not attempt to lift the maximum load weight unless the lift light is illuminated; such an attempt could result in a load release and possible injury to the operator.

[6] The lifter is designed to handle the maximum load weight (see SPECIFICATIONS: Maximum Load Capacities) when the load's center of gravity is positioned within 2" (51 mm) of the pad frame's center point. Occasional loading deviations are permissible, provided that the operator can maintain control of the load at all times and that the load weight is low enough to avoid damaging the lifter.

Vacuum Level on Smooth, Nonporous Surfaces

When the lifter is attached to clean, smooth, nonporous load surfaces, it should be able to attain a vacuum level of 16" Hg (-54 kPa) or more, except when used at high elevations (see SPECIFICATIONS: Operating Elevation). If not, make sure the vacuum switch is adjusted correctly (see MAINTENANCE: VACUUM SWITCH ADJUSTMENT). If the vacuum switch cannot be adjusted to maintain 16" Hg (-54 kPa), perform the VACUUM TEST (see MAINTENANCE) to determine whether there is a deficiency in the vacuum generating system.

Vacuum Level on Rough or Porous Surfaces

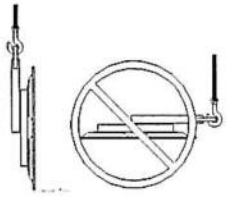
When the lifter is attached to rough or porous load surfaces, it may not be able to attain 16" Hg (-54 kPa), due to leakage in the seal between the vacuum pads and the load surface. In such cases, the operator must exercise special care to determine whether the lifter can safely lift a load.

⚠ ***WARNING: Although pads may seal against load at lower vacuum levels, load capacity decreases proportionally with decreasing vacuum.***

Although the vacuum level may remain below 16" Hg (-54 kPa), the lifter should be able to lift a load ***provided that the load is light enough and the pads seal sufficiently***. However, be advised that the lifter's load capacity is proportional to the vacuum level attained: For example, at a vacuum level of 10" Hg (-34 kPa), the lifter's load capacity is reduced to 62.5% of maximum. Whenever the vacuum level is lower than 16" Hg (-54 kPa), make sure that vacuum is sufficient to lift the load's weight ***before attempting a lift***. Furthermore, ***never attempt to lift a load when the vacuum level is lower than 10" Hg (-34 kPa)***, no matter how light the load may be.

TO LIFT AND MOVE THE LOAD

⚠ ***WARNING: Never attempt to lift load when lifter is in horizontal orientation.***



Controlling the Lifter and Load

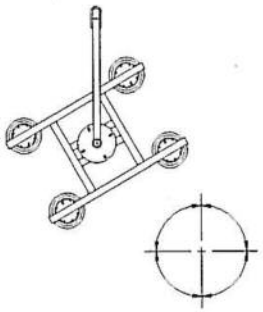
When vacuum indicators show that the lifter is ready, use the hoisting equipment to raise the lifter and load as needed to clear any obstacles in their path. Use any appropriate means to keep the lifter and load in the desired orientation while they are suspended from the crane. Once sufficient clearance is established, the load can be rotated as desired (see TO ROTATE THE LOAD EDGEWISE to follow).

About Pumping Cycles

Lifting loads with a rough, porous or contaminated contact surface can result in leakage that causes the vacuum pump to run frequently or continuously. Since excessive pumping quickly reduces battery energy, the operator should minimize pumping when possible. In the case of contamination, thoroughly clean the faces of the vacuum pads and the contact surface of the load before attempting another lift (see MAINTENANCE: VACUUM PAD MAINTENANCE). If the pump runs at intervals of ten minutes or less while the lifter is attached to clean, smooth, nonporous materials, the leakage is likely to be in the vacuum system. In this event, perform the VACUUM TEST (see MAINTENANCE) and check for damage to the pads' sealing edges.

To Rotate the Load Edgewise

⚠ ***WARNING: Make sure load is positioned correctly on lifter; unbalanced loads may rotate unexpectedly.***



Remember that the load is longer in its diagonal dimensions than in its side dimensions; raise the load high enough to clear any obstacles when rotating. Keep the load under control at all times, using hand cups or other appropriate means. Disengaging the pad frame's rotation latch allows the load to rotate. Pull on the 3/16" diameter cable that hangs from the rotation release lever to disengage the rotation latch, and rotate the load to the desired position.

To stop the load's motion automatically at each quarter turn, simply let go of the cable to the rotation release lever immediately after initiating the rotation, so that the rotation latch engages at the next stop. Whenever rotation is not required, keep the rotation latch engaged, to prevent accidental damage to the load and possible injury to the operator.

To Release the Pads from the Load

⚠ ***WARNING: Load must be fully supported before releasing vacuum pads.***

When the load is at rest and fully supported, turn the apply/release switch to the "RELEASE" position (counter-clockwise) to force air into the vacuum pads, quickly breaking the vacuum seal. Continue to hold the apply/release switch in this position until the pads disengage completely from the load.

When the apply/release switch is no longer held in the "RELEASE" position, it automatically returns to the neutral position. Do not turn the apply/release switch to the "APPLY" position until the pads are contacting the next load to be lifted. This conserves battery energy and reduces the time required to apply the pads to the load, by preventing the vacuum reserve tank from losing its vacuum.

AFTER USING THE LIFTER

Leave the apply/release switch in the neutral position and place the power switch in the "OFF" position (blue indicator light shuts off when power is disengaged).

Supporting the Lifter

Since placing weight on the vacuum pads can damage their faces or sealing edges, support the lifter so that the pads hang free when it is not in use. Built-in parking feet can be used to support an unloaded lifter when not suspended from a crane: Make sure the pad frame is oriented vertically with the parking feet at the bottom. Gently lower the lifter until the parking feet support its entire weight. Make sure the lifter leans securely against an appropriate support; then detach the hoisting equipment hook from the lift bail.

Storing the Lifter

Use the covers supplied to keep the vacuum pads clean. Charge the battery completely when placing it in storage and at six-month intervals thereafter (see MAINTENANCE: BATTERY RECHARGE). After charging the battery, disconnect the battery from the vacuum generating system, in order to prevent power drainage.[7] Preferred temperatures for storing the battery are 32° to 70° Fahrenheit (0° to 21° Celsius). Higher temperatures require the battery to be charged more frequently. Storage at temperatures above 100° Fahrenheit (38° Celsius) should be avoided.

[7] To access the battery leads, place the power switch in the "OFF" position and remove the battery enclosure cover.

MAINTENANCE

⚠ ***WARNING: Always make sure battery is disconnected before servicing lifter.***

INSPECTION SCHEDULE

Perform inspections routinely, according to the following frequency schedule (based on recommendations in ASME Standard B30.20-1999, sections 2.3.1 through 2.3.3):

Every-Lift Inspection

- Examine the vacuum pads and load surface for contamination or debris (see VACUUM PAD MAINTENANCE to follow).
- Examine the vacuum pads, controls and indicators for visual damage (see VACUUM PAD MAINTENANCE to follow).
- Test the battery for adequate charge (see BATTERY TEST to follow).

If a battery's charge appears to be inadequate, charge and retest the battery (see BATTERY RECHARGE to follow). If any other deficiency is detected during the inspection, correct it before using the lifter and perform the Frequent Inspection to follow.

Frequent Inspection

(*following every 20-40 hours' use; or whenever lifter is out of service for 1 month or more*)

- Examine the lifter's structure for visual damage.
- Examine the vacuum system for visual damage.
- Examine the air filter for conditions requiring service (see AIR FILTER MAINTENANCE to follow).
- Perform the VACUUM TEST to follow.
- Check for unusual vibrations or noises while operating the lifter.

If any deficiency is detected during the inspection, correct it before using the lifter and perform the Periodic Inspection to follow.

Periodic Inspection

(*following every 250-500 hours' use; or whenever lifter is out of service for 1 year or more*)

- Examine the entire lifter for external evidence of looseness, excessive wear, deformation, cracks, excessive corrosion, dents to structural or functional components, cuts, or any deficiency which might constitute a hazard.
- Keep a written record of all Periodic Inspections.

If any deficiency is detected during the inspection, return the lifter to Wood's Powr-Grip or an authorized dealer for repair (see LIMITED WARRANTY).

Infrequent Use

If a lifter is used less than 1 day in a 2-week period, perform the Periodic Inspection *each time before using the lifter.*

TESTING SCHEDULE

Perform these tests (based on recommendations in ASME Standard B30.20-1999, sections 2.3.1 through 2.3.3) when placing the lifter in service *initially* and *each time following a repair or modification*. Correct any deficiency and retest before using the lifter.

Operational Tests

- Perform the VACUUM TEST to follow.
- Test all features and functions of the lifter (see OPERATING FEATURES, OPERATION and MAINTENANCE).

Load Test

Prove that the lifter can lift 125% of its rated Load Capacity (see SPECIFICATIONS), using an actual load or an equivalent simulation. Employ the following method to test with an actual load:

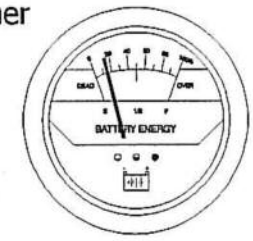
1) Attach the vacuum pads to a test load with appropriate weight and surface characteristics (see SPECIFICATIONS and OPERATION).
2) Raise the load a minimum distance, to assure that the load is supported by the lifter.
3) Hold the load for 2 minutes.
4) Lower the load for release.

Note: See MAINTENANCE topics to follow for additional directions about inspecting and testing specific lifter components.

MAINTENANCE SCHEDULE

Unless specified elsewhere in this *INSTRUCTIONS* manual, the lifter does not require maintenance on a routine basis. Instead, maintenance must be performed whenever a deficiency is indicated by routine inspections or tests. Any maintenance warranted must be performed before resuming normal operation of the lifter.

BATTERY TEST



The lifter is equipped with a battery gauge to help the operator evaluate whether the battery has adequate energy for lifting. Factors such as the condition of the battery, the time required to execute a lift, and the porosity of the load combine to determine how much battery energy is needed. ***It is the operator's responsibility to evaluate these conditions and to make sure the battery has sufficient energy to complete a lift safely.*** Check the battery energy before every lift and also at the end of each day's use, to decide whether a charge is needed (see BATTERY RECHARGE to follow).[8] Never use the lifter when battery energy registers lower than 20%, regardless of the estimated energy requirement.

⚠ ***WARNING: Never use lifter if battery energy is lower than 20% of capacity.***

When the power switch is in the "ON" position and the apply/release switch is in the neutral (center) position, the operator must press the battery test button to make the energy level register on the battery gauge. This enables the operator to check the battery energy while the lifter is powered up but *not* attached to a load.

When the power switch is in the "ON" position and the apply/release switch is in the "APPLY" (right) position, the battery gauge automatically monitors the energy level of the battery. This enables the operator to check the battery energy while the lifter is powered up and attached to a load. However, the battery gauge shuts off temporarily to protect the circuitry while the vacuum pump is running. When the pumping cycle is completed, the battery gauge requires a few moments to stabilize before it displays an accurate energy reading again.

Note: If the lifter has not been used since the battery was charged, the battery gauge may falsely indicate an energy level that is higher than actual, due to a "surface charge" on the battery. After the pump runs for approximately one minute, the surface charge dissipates, allowing the operator to take an accurate energy reading.

BATTERY RECHARGE

Only use a battery charger supplied by or approved by Wood's Powr-Grip; other chargers may reduce battery life. Charge the battery as soon as possible after any extended use of the lifter, or whenever the battery gauge indicates diminished energy (see BATTERY TEST preceding). Temperatures higher than 70° Fahrenheit (21° Celsius) require the battery to be charged more frequently. ***CAUTION: Charge battery only while lifter's power switch is in the "OFF" position.*** Operating the lifter when the charger is connected to an AC power source could result in permanent damage to the charger.

The type of battery charger provided with the lifter differs according to the input voltage to be used. Identify the input voltage marked on the charger and plug it in to an appropriate power source.[9] The way that each charger indicates the charging status is different, as follows:

[8] The battery charger must be disconnected from its AC power source in order to test the battery energy; otherwise, the energy reading on the battery gauge would not be accurate.

[9] Any external power supply must conform to all applicable local codes.

- For chargers with *120-volt* nominal AC input, a red light and a green light indicate the charging status:[10] Initially, the *red* light turns on to indicate that the battery is being charged at a high rate. When the battery attains approximately 80% of its maximum charge, the *green* light begins to flash, to indicate that charging is continuing at a lower rate. When the battery is fully charged, the charger switches to a maintenance mode and the green light stops flashing but remains illuminated.
- For chargers with *100-volt* or *240-volt* nominal AC input, a series of lights indicates the level of charging that has been attained, along with the charging rate.[11] When the battery is fully charged, the charger switches to a maintenance mode and the "READY" light turns on.

When the lifter and its charger are used as directed, the battery should take no more than 8 hours to charge completely.[12] Be sure to unplug the charger and check the battery energy again before operating the lifter (see BATTERY TEST preceding). If the charger is working but the battery does not charge adequately, the battery may need to be replaced. Following long-term use, a battery gradually loses capacity; replace it whenever the operating time between recharging is no longer satisfactory.

VACUUM PAD MAINTENANCE

Inspection

Inspect each vacuum pad for the following deficiencies routinely, as directed in the preceding INSPECTION and TESTING SCHEDULES. Correct any deficiency before using the lifter.

- contaminants on the pad face or sealing edges: Soil build-up on sealing edges can prevent pads from sealing adequately. Follow the directions to clean pads as necessary (see following discussion).
- Filter screen missing from pad face: This screen helps prevent debris from plugging the vacuum hose and the air filter. Replace any missing screen immediately (see REPLACEMENT PARTS LIST).
- Nicks, cuts or abrasions in sealing edges: Pad damage can reduce the lifter's load capacity. Replace any damaged pad immediately (see REPLACEMENT PARTS LIST).

⚠ ***WARNING: Replace vacuum pad if sealing edge has any nicks, cuts or abrasions.***

[10] If neither of the status lights turns on when this charger is plugged in, there may be a problem with the AC power source. If the lights alternate between red and green, there may be a problem with the connections to the battery or the battery may be defective. If the green light turns on immediately, the battery may already be fully charged, the charger's output fuse may be blown or the battery may be defective. The fuse is located in a holder on the charger's output cord. A blown fuse may indicate that the connections to the battery are reversed.

[11] If the status lights do not turn on when this charger is plugged in, the charger's fuse may be blown or the connections to the battery may be reversed. The fuse is located behind a small panel where the power cord connects to the charger. If the charger's "READY" light flashes or its fuse blows when the charger is plugged in, remove the charger from its mounting plate and make sure the selector switch on the charger's base is set to the correct input voltage.

[12] Both kinds of charger are designed to automatically sense the energy level of the battery and reduce the charging rate when the battery is fully charged. Accordingly, the charger does not need to be unplugged until the lifter is going to be used again.

Cleaning

Regularly clean the face of each vacuum pad to remove oil, dust and any other contaminants. Acceptable cleaning agents include soapy water, glass cleaner and alcohol. Do *not* use other solvents, petroleum-based products (including kerosene, gasoline and diesel fuel) or any harsh chemicals for cleaning, because they can damage the pad and create a hazard to the operator or others.

⚠ ***WARNING: Never use solvents, gasoline or other harsh chemicals to clean vacuum pad.***

To prevent liquid from contaminating the vacuum system during cleaning, cover the suction hole in the recess for the filter screen or make sure the pad faces downward. Use a clean sponge or lint-free cloth to apply an appropriate cleanser and wipe the pad face clean. A toothbrush (or similar brush with bristles *that do not harm rubber*) may be used to remove contaminants clinging to sealing edges.[13] Rinse all residue from the pad face, and allow the pad to dry completely before using the lifter.

VACUUM TEST

Test the vacuum system for leakage routinely, as directed in the preceding INSPECTION and TESTING SCHEDULES.

1) Clean the face of each vacuum pad as previously directed (see VACUUM PAD MAINTENANCE: Cleaning).
2) Apply the lifter to a smooth, nonporous, clean surface. The surface should be flat or possess no more curvature than the lifter is designed for (if any).[14] When the pumping cycle is completed, the vacuum level should register above 16" Hg (-54 kPa) on the vacuum gauge (if not, see VACUUM SWITCH ADJUSTMENT to follow).
3) After the vacuum pump stops running, leave the pads attached to the surface and place the power switch in the "OFF" position, to interrupt the energy flow from the battery.
4) Monitor the vacuum gauge: *The vacuum level should not decrease by more than 4" Hg (-14 kPa) in 10 minutes.*

⚠ ***WARNING: If lifter fails vacuum test, discontinue use immediately.***

Correct any deficiency in the vacuum system before using the lifter. Contact Wood's Powr-Grip or an authorized dealer for assistance.

Note: One or more wiring diagrams are provided in the final section of this *INSTRUCTIONS* manual for reference when servicing the lifter or trouble-shooting a deficiency.

[13] If these cleaning methods are not successful, contact Wood's Powr-Grip or an authorized dealer for assistance.

[14] Any test material used must be fully and independently supported, and capable of bearing the lifter's weight. Do not use the lifter to lift the test material during the vacuum test.

AIR FILTER MAINTENANCE

(for 4.4 oz [130 ml] bowl size filters)

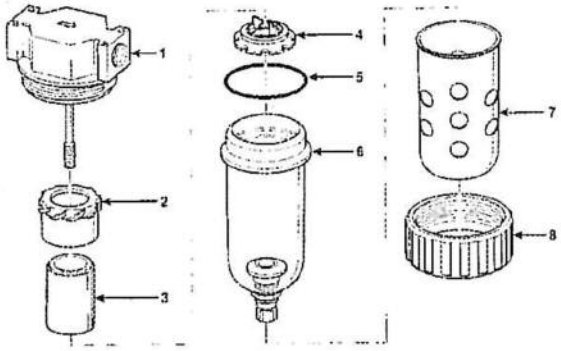
Filter Function and Conditions Requiring Service

An air filter prevents solid particles and liquid from contaminating components in the vacuum system.

CAUTION: Examine air filter regularly and empty when necessary.

Liquid must not contact any portion of the filter element; remove trapped liquid regularly. Replace the element if it has an overall dirty appearance, or if there is a noticeable increase in the time required to attain full vacuum. (Refer to REPLACEMENT PARTS LIST for filter element kit.)

Filter Service Procedures



1) Unscrew the threaded collar (8) from the body (1). Support the body while twisting the collar, to protect the vacuum line fittings from being damaged. Then remove the bowl guard (7) and the bowl (6).
2) Determine whether the filter element (3) needs to be replaced (see Conditions Requiring Service preceding). *If so*, proceed to step 3.

   If not, remove any liquid or contaminants from the bowl; clean the old bowl seal (5) with mild soap and water; and skip to step 7.
3) Unscrew the baffle (4), and remove the element and deflector (2).
4) Discard the element and the bowl seal (5).
5) Clean all internal parts and the bowl, using mild soap and water only. Do *not* use any other cleaners.
6) Install the deflector and a new filter element; then screw the baffle back on (tighten gently, finger tight) to hold the element in place.
7) Lubricate the new or cleaned bowl seal, using a mineral base oil or grease (such as the lubricant furnished in the filter element kit). Do *not* use synthetic oils, such as esters, or silicones.
8) Place the bowl seal around the rim of the bowl. Then install the bowl on the body, taking care to avoid contaminating the filter element with lubricant.
9) Install the bowl guard and the collar, tightening it only hand-tight (28-32 in-lbs [316-362 N-cm] torque).
10) Test the vacuum system to be certain the air filter does not leak (see VACUUM TEST preceding, if applicable).

⚠ ***WARNING:*** When the air filter is being used on a *vacuum* system, rather than with pressure, using the twist drain to remove liquid from the bowl is ***not*** recommended. ***Never*** disturb the twist drain, as contaminants could lodge in the drain seal and cause a vacuum leak.

VACUUM PUMP MAINTENANCE

(for Thomas pump no. 2907CDC22/12)

⚠ ***WARNING: Before proceeding with any maintenance, disconnect power source.***

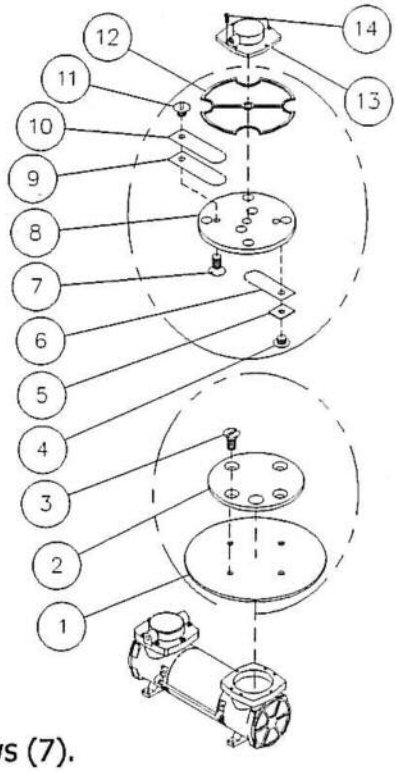
If the vacuum pump takes too long to attain full vacuum, it may require maintenance (see Vacuum Apply and Release Times in SPECIFICATIONS, if applicable). Replace the diaphragms, valve flappers or head gaskets as necessary to obtain acceptable pump performance. Perform the following procedures on both heads of the pump.

Replacing a Diaphragm (1)

1) Remove the six head screws (14) and remove the head (13).
2) Remove the four diaphragm hold-down screws (3) and the diaphragm hold-down plate (2).
3) Replace the diaphragm (1) and reverse the above procedure for reassembly.

Replacing an Intake Valve Flapper (6)

1) Remove the six head screws (14) and remove the head (13).
2) Remove the intake valve flapper screw (4) and the intake valve keeper (5).
3) Replace the intake valve flapper (6) and reverse the above procedure for reassembly.



Replacing a Set of Exhaust Valve Flappers (9 & 10) and a Head Gasket (12)

1) Remove the six head screws (14) and remove the head (13).
2) Turn the head upside-down and remove the five valve plate screws (7).
3) Lift out the valve plate (8) to access the exhaust valve flappers (9 & 10) and head gasket (12).[15]
4) Remove the exhaust valve flapper screw (11) and replace the exhaust valve flappers.
5) Replace the head gasket and reverse the above procedure for reassembly.

1 DIAPHRAGM
2 DIAPHRAGM HOLD-DOWN PLATE
3 DIAPHRAGM HOLD-DOWN SCREWS
4 INTAKE VALVE FLAPPER SCREW
5 INTAKE VALVE KEEPER
6 INTAKE VALVE FLAPPER (METAL)
7 VALVE PLATE SCREWS
8 VALVE PLATE
9 EXHAUST VALVE FLAPPER (PLASTIC)
10 EXHAUST VALVE FLAPPER (METAL)
11 EXHAUST VALVE FLAPPER SCREW
12 HEAD GASKET
13 HEAD
14 HEAD SCREWS

[15] ***CAUTION:*** Depending on the product, the vacuum system may require the valve plate (8) to be rotated to an orientation different from the one shown. When removing the valve plate, always take note of its orientation in the pump head (13), and install the valve plate the same way during reassembly. In all cases, the valve plate must be oriented so that its intake hole is matched with the head port that connects to the check valve.

VACUUM SWITCH ADJUSTMENT

Vacuum Switch Function

A vacuum sensor/electrical switch assembly controls the vacuum pump and the vacuum lift light for a DC lifter. When the power switch is in the "ON" position, turning the apply/release switch to the "APPLY" position activates the vacuum pump, which evacuates the vacuum pads. After the lifter attains a vacuum level sufficient for lifting the maximum load weight (hereafter, "maximum capacity level"), the vacuum switch automatically turns off the pump and turns on the lift light. [16] In order to maintain sufficient vacuum, the vacuum switch automatically turns on the pump and turns off the lift light again before vacuum decreases to a level that is lower than the maximum capacity level.

Conditions Requiring Readjustment

At the factory, the vacuum switch is set to maintain the vacuum level specified for Maximum Load Capacity (see SPECIFICATIONS). However, shipping vibrations or shocks, normal wear, or other conditions may adversely affect this adjustment. Periodically verify the switch adjustment by comparing how the vacuum pump and the vacuum lift light function in relation to the vacuum level registered on the vacuum gauge, as follows:

- If the pump *turns off* and the lift light *turns on before* vacuum attains the maximum capacity level, it is likely that the air filter's element is dirty. ***Any filter element that obstructs airflow must be replaced*** (refer to AIR FILTER MAINTENANCE preceding). Otherwise, the pump would turn off at vacuum levels that are not sufficient to lift the maximum load weight.
- If the pump *turns off* but the lift light *does not turn on after* vacuum attains the maximum capacity level, the light bulb may be burned out. The bulb should be replaced when necessary. Otherwise, the operator might wait unnecessarily for the lift light to turn on, after the lifter has already attained sufficient vacuum to lift the maximum load weight.
- If the pump *does not turn off* and the lift light *does not turn on after* vacuum increases to a level much *higher* than the maximum capacity level, the vacuum switch may be adjusted to maintain a lower vacuum level. Otherwise, the pump would continue to run unnecessarily after the lifter has attained sufficient vacuum to lift the maximum load weight.
- If the pump *does not turn on* and the lift light *does not turn off before* vacuum decreases to a level *lower* than the maximum capacity level, the vacuum switch ***must be adjusted to maintain a higher vacuum level.***[17] Otherwise, the lifter would not maintain sufficient vacuum to lift the maximum load weight.

[16] When using the lifter at high elevations, reduced atmospheric pressure may prevent the vacuum generating system from attaining the vacuum level set at the factory. This causes the pump to run continuously. If the maximum load capacity is not required, the operator can adjust the vacuum switch to maintain a lower vacuum level, allowing the pump to cycle normally. However, be advised that ***load capacity decreases proportionally with decreasing vacuum***, based on the level specified for maximum load capacity. For example, if a lifter attains maximum capacity at 16" Hg (-54 kPa), load capacity decreases by 6.25% for each inch of Hg subtracted from (or for each 3.4 kPa added to) the vacuum level. ***Always maintain a minimum vacuum level of 10" Hg (-34 kPa)***, regardless of the vacuum level specified for maximum capacity.

[17] In order to observe lifter functions while vacuum is decreasing, it may be necessary to create a controlled leak in the vacuum system (e.g., by breaking the seal between one or more vacuum pads and the test surface).

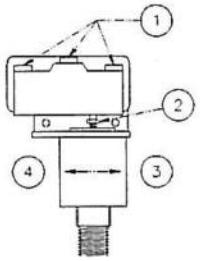
Adjustment Procedure

⚠ ***WARNING: Load capacity decreases whenever vacuum switch is adjusted to maintain lower vacuum level.***

1) Using a 1/4" open-end wrench (as provided), turn the adjustment screw about 1/6th turn at a time (approximately one flat of the screw head).

   To maintain a *lower* vacuum level, turn the screw *clockwise* (when viewing vacuum switch from end with electrical connectors).

   To maintain a *higher* vacuum level, turn the screw *counter-clockwise* (when viewing vacuum switch from end with electrical connectors).



1 ELECTRICAL CONNECTORS
2 ADJUSTMENT SCREW
3 TO MAINTAIN HIGHER VACUUM
4 TO MAINTAIN LOWER VACUUM

2) Recheck the vacuum switch setting following each 1/6th turn of the adjustment screw. In order to test the adjustment accurately, release the vacuum pads completely before reapplying them to a test surface.

   When the vacuum switch is adjusted correctly, the vacuum pump turns off only *after* vacuum increases to a level higher than the maximum capacity level; and the pump turns on again *before* vacuum decreases to a level lower than the maximum capacity level.

REPLACEMENT PARTS LIST

Stock No.	Description	Qty.
66191	Pump Gasket	2
66189	Pump Valve Flapper - Plastic (for exhaust port)	2
66186	Pump Valve Flapper - Metal (for intake and exhaust ports)	4
66183	Pump Diaphragm	2
66135	Vacuum Pump - Diaphragm Type - 3-SCFM (85 liters/minute) - 12 V DC	1
65443	Vacuum Hose - 3/8" (9.5 mm) ID (approx. 6" / 15 cm in length)	1
65438	Vacuum Hose - 1/8" (3.2 mm) ID (approx. 6" / 15 cm in length)	1
65430	Vacuum Hose - 7/32" (5.6 mm) ID (approx. 179" / 45 cm in length)	1
65244	Solenoid Valve - 12 V DC - 5 W	1
65240	Solenoid Valve - 12 V DC - 11 W	2
65211AM	Check Valve - 1/8 NPT	1
65010	Pad Spring - Coil Type	16
64709AM	Battery Charger - 120 V AC	1
64708AM	Battery Charger - 100 / 240 V AC	1
64667	Battery - 12 V DC - 26 Amp-Hours	1
64590	Battery Gauge	1
64495	Fuse (for 120 V battery charger)	1
64463	Circuit Breaker - 25 A	1
64288	Bulb - 14 V - Flanged (for power indicator light)	1
64283	Bulb - 13 V - Bayonet (for vacuum lift light)	1
64262	Green Lens (for vacuum lift light)	1
64236	Vacuum Switch - 1/4 NPT	1
64200	Push-Button Switch (for battery test button)	1
64191	Contact Block (for power switch)	1
58168	Guard for Rotating Union	1
53132	Hose Fitting - Tee - 5/32" (4.0 mm) ID	6
53126	Pad Fitting - Tee - 3/64" (1.2 mm) ID	8
53120	Pad Fitting - Elbow - 3/64" (1.2 mm) ID	8
49646T	Vacuum Pad - Model G3370 / 11" (28 cm) Diameter - Lipped	16
49150	End Plug - 2-1/2" x 2-1/2" x 1/4" (63.5 mm x 63.5 mm x 6.4 mm) Tubing Size	4
49122	End Plug - 2" x 2" x 1/4" (50.8 mm x 50.8 mm x 6.4 mm) Tubing Size	24
29353	Nylon Pad Cover	16
20270	1/4" (6.4 mm) Open-End Wrench (for adjusting vacuum switch)	1
16132	Filter Element Kit (for 4.4 oz / 130 ml bowl size air filter)	1
16052	Quick Connect - 1/8 FNPT - Female End	12
16050	Quick Connect - 1/8 FNPT - Male End	12
15910	Vacuum Gauge - 1/8 NPT - CBM Type	1
15650	360° Rotating Union - 1/4 NPT	1
15630	Pad Filter Screen - Large	16
13516	Cotterless Hitch Pin - 3/8" x 4" (10 mm x 64 mm)	8
10900	Shoulder Bolt - Socket Head - 5/16" X 1/2" X 1/4-20 Thread (for mounting pads)	96

SERVICE ONLY WITH IDENTICAL REPLACEMENT PARTS SUPPLIED BY OR APPROVED BY WOOD'S POWR-GRIP CO., INC.

ASME/ANSI STANDARDS

excerpted from
ASME Standard B30.20-1999: BELOW-THE-HOOK LIFTING DEVICES
Chapter 20-2: Group II - Vacuum Lifting Devices

Section 20-2.3 - Inspection, Testing, and Maintenance

20-2.3.1 Inspection Classification

(a) *Initial Inspection.*

(1) New and reinstalled lifting devices shall be inspected by a designated person prior to initial use to verify compliance with applicable provisions of this volume.

(2) Altered, repaired, or modified lifting devices shall be inspected by a designated person. The inspection may be limited to the provisions affected by the alteration, repair, or modification, as determined by a qualified person.

(b) *Inspection Intervals.* Inspection procedure for vacuum lifting devices in regular service is divided into three general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the vacuum lifting device and the degree of their exposure to wear, deterioration, or malfunction. The three general classifications are designated as *every lift*, *frequent* and *periodic*, with respective intervals between inspections as defined below:

(1) *Every Lift Inspection.* The following items are to be inspected by the operator before and/or during every lift with records not required.

(a) surface of the load for debris

(b) seal of the vacuum pad for debris

(c) condition and operation of the controls

(d) condition and operation of the indicators, meters, and pumps where applicable

(2) *Frequent Inspection.* Visual examinations by the operator or other designated persons with records not required.

(a) normal service - monthly

(b) heavy service - weekly to monthly

(c) severe service - daily to weekly

(d) special or infrequent service - as recommended by a qualified person before and after each occurrence

(3) *Periodic Inspection.* Visual inspection by a qualified person who makes records of apparent external conditions to provide the basis for a continuing evaluation. An external coded mark on the vacuum lifting device is an acceptable identification in lieu of records.

(a) normal service - equipment in place - yearly

(b) heavy service - as in (a) above, unless external conditions indicate that disassembly should be done to permit detailed inspection - semiannually

(c) severe service - as in (b) above - quarterly

(d) special or infrequent service - as recommended by a qualified person before the first occurrence and as directed by the qualified person for any subsequent occurrences

20-2.3.2 Frequent Inspection. Items such as the following shall be inspected at intervals as defined in para. 20-2.3.1(b)(1). In addition, visual observations should be conducted during regular service for any damage or evidence of malfunction which appears between regular inspections. Any deficiencies such as those listed below shall be carefully examined, and determination made as to whether they constitute a hazard. Examine:

(a) all load carrying portions of the machine for deformation, cracks, and excessive wear;

(b) the vacuum generator for output;

(c) all vacuum pad seal rings for cuts, tears, excessive wear, and presence of foreign particles;

(d) all vacuum lines and vacuum line connections for leakage, cuts, kinks, and collapsed areas of hoses;

(e) the vacuum reservoir for leaks and visual damage;

(f) the entire vacuum system, including indicator lights, gages, horns, bells, pointers or other warning devices, and vacuum level indicators, by attaching a nonporous, clean surface to the vacuum pad or pads and then stopping the vacuum source. The vacuum level in the system shall not decrease by more than the manufacturer's specified rate.

20-2.3.3 Periodic Inspection. Complete inspections of the vacuum lifting device shall be performed at intervals as defined in para. 20-2.3.1(b)(2). Any deficiencies, such as listed below, shall be examined and determination made as to whether they constitute a hazard. These inspections shall include the requirements of para. 20-2.3.2, and, in addition, items such as the following:

(a) external evidence of

(1) looseness

(2) wear

(3) deformation

(4) cracking

(5) corrosion

(b) external evidence of damage to

(1) supporting structure

(2) motors

(3) controls

(4) other auxiliary components

(c) warning label required by para. 20-2.2.1(c)

20-2.3.4 Testing

20-2.3.4.1 Operational Tests

(a) New and reinstalled lifting devices shall be tested by a designated person prior to initial use to verify compliance with applicable provisions of this volume, including, but not limited to, the following:

(1) moving parts

(2) latches

(3) stops

(4) limit switches

(5) control devices

(6) vacuum pad seals

(7) vacuum lines

(b) Altered, repaired, or modified lifting devices shall be tested by a designated person. This test may be limited to the provisions affected by the alteration, repair, or modification, as determined by a qualified person with guidance from the manufacturer.

(c) The seals and connections shall be tested for leaks by attaching a smooth, nonporous, clean material to the vacuum pad or pads and then stopping the vacuum source. Vacuum level in the system shall not decrease by more than manufacturer's specified rate.

(d) All indicator lights, gages, horns, bells, pointers, or other warning devices and vacuum level indicators shall be tested by the same method as in Section 20-2.3.4.2 below.

(e) Dated reports of all operational tests shall be filed.

20-2.3.4.2 Load Test

(a) Prior to initial use, all new, altered, repaired, or modified vacuum lifting devices shall be load tested and inspected by, or under the direction of, a qualified person. A written report shall be prepared by the qualified person and placed on file, confirming the load rating of the vacuum lifting device. The load rating should not be more than 80% of the maximum load sustained during the test. Test loads shall not be more than 125% of the rated load of the system, unless otherwise recommended by the manufacturer or a qualified person.

(b) Altered, repaired, or modified vacuum lifting devices shall be tested by a designated person. This test may be limited to the provisions affected by the alteration, repair, or modification, as determined by a qualified person with guidance from the manufacturer.

(c) The rated load test shall consist of one of the following procedures.

(1) *Actual Load Test*

(a) Attach pads to the designated test load.

(b) Raise the test load a minimum distance to assure that the load is supported by the vacuum lifting device.

(c) Hold load for 2 minutes.

(d) Lower the load for release.

(2) *Simulated Load Test.* Using a test fixture, apply forces to all load-bearing components, either individually or in assemblies, equivalent to the force encountered by the components if they were supporting a load that was 125% of the rated load.

(d) After the test, the vacuum lifting device shall be visually inspected. Any deficiencies shall be corrected before the lifting device is placed in service. If the correction affects the structure, then the lifter shall be retested.

20-2.3.5 Maintenance

(a) *Preventive Maintenance.* A preventive maintenance program should be established and be based on recommendations made by the vacuum lifting device manufacturer or a qualified person. **[Manufacturer's note: Unless otherwise specified in the *INSTRUCTIONS* manual, lifters do not require maintenance on a routine basis. Instead, maintenance must be performed whenever a deficiency is indicated by routine inspections or tests.]**

(1) All vacuum pads, sealing rings, mufflers and filters should be cleaned per the manufacturer's recommendations.

(2) The vacuum generator should be maintained according to the manufacturer's recommendations.

(3) Replacement parts shall be at least equal to the original manufacturer's specifications.

(b) *Maintenance Procedure*

(1) Before adjustments and repairs are started on a vacuum lifting device, the following precautions should be taken.

(a) Locate the vacuum lifting device where it will cause the least interference with other operations in the area.

(b) Place all controls in the "off" condition.

(c) Pull the vacuum lifting device's main power disconnect switch and lock it in the de-energized position. This switch may or may not be located on the vacuum lifting device.

(d) Provisions should be made for qualified persons to work on energized equipment when adjustments and tests are required.

(2) After adjustments and repairs have been made, the vacuum lifting device shall not be restored to service until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed from the vacuum lifting device.

(c) *Adjustments and Repairs.* Any hazardous conditions disclosed by the inspection requirements of para. 20-2.3.1 shall be corrected before normal operation of the vacuum lifting device is resumed.

(1) Adjustments and repairs shall be done only by qualified personnel.

(2) Adjustments shall be maintained to assure correct functioning of components.

(3) Repairs or replacements shall be made as needed.

(4) Replacement parts shall be at least equal to the original manufacturer's specifications.

(5) If repairs of load sustaining members are made by welding, identification of materials shall be made and appropriate welding procedure shall be followed.

(d) *Lubrication.* All moving parts of the vacuum lifting device for which lubrication is specified should be regularly lubricated. Care should be taken to follow manufacturer's recommendations as to points and frequency of lubrication, maintenance of lubrication levels, and types of lubricant to be used. **[Manufacturer's note: Unless otherwise specified in the *INSTRUCTIONS* manual, moving parts do not require regular lubrication. No attempt to lubricate parts should be made except as directed in the *INSTRUCTIONS* MAINTENANCE section.]**

Section 20-2.4 - Operation

20-2.4.1 Operators. Below -the-hook lifting devices shall be operated only by a designated person(s).

20-2.4.2 Qualifications. Qualifications for operators of below-the-hook lifting devices are as follows.

(a) The operator shall be instructed in the use of the device by a designated person. Instructions should include, but not be limited to, the following:

(1) application of the lifter to the load and adjustments of the lifts, if any, that adapt it to various sizes or kinds of loads;

(2) instructions in any special operations or precautions;

(3) condition of the load itself required for operation of the lifter such as balance, or degree of order of stacked loads, or surface cleanliness, bending, load thickness, etc.;

(4) storage of lifter to protect it from damage;

(5) that the rated load of the lifting device not be exceeded nor the capacity of the hoisting equipment be exceeded by the combined weight of the load, the lifting device, and rigging;

(6) charging of the battery (if required);

(7) the purpose of indicators, meters, or alarms on the vacuum lifter;

(8) the proper attachment of adaptors to vacuum lifters for special load handling.

(b) The operator shall demonstrate the ability to operate the lifter as instructed before assuming responsibility for using the lifter.

20-2.4.3 Conduct of Lifting Device Operators

(a) The operator shall give attention to the operation of the lifts during a lifting sequence.

(b) When physically or otherwise unfit, an operator shall not engage in the operation of the equipment.

(c) The operator shall be responsible for those operations under his/her direct control. Whenever there is any doubt as to safety, the operator shall consult with a designated person before handling the load.

(d) The operator shall respond only to instruction from designated persons. However, the operator shall obey a stop order at all times, no matter who gives it.

(e) The operation of the lifter shall be observed before using and during a shift. A defect observed shall be carefully examined by an appointed person. If the defect constitutes a hazard, the lifter shall be removed from service.

(f) The operator shall be familiar with standard hand signals when applicable.

(g) The operator shall land any attached load and store the lifter before leaving the lifting device.

(h) All controls shall be tested by the operator before using during a shift. If any controls do not operate properly, they should be adjusted or repaired before operations are begun.

(i) The operator shall not ride or allow others to ride loads.

20-2.4.4 Lifting Device Operating Practices

(a) Lifting devices shall be operated only by the following qualified personnel:

(1) designated person;

(2) trainees under the direct supervision of a designated person;

(3) maintenance and test personnel, when it is necessary in the performance of their duties;

(4) inspectors (lifting devices).

(b) The lifting device shall not be loaded in excess of it rated load or handle any load for which it is not designed.

(c) The lifter shall be applied to the load in accordance with the instruction manual.

(d) Before lifting, the operator shall make sure that lifter ropes or chains are not kinked, and that multiple part lines are not twisted about each other.

(e) Care should be taken to make certain the load is correctly distributed for the lifter being used.

(f) The temperature of the load should not exceed the maximum allowable limits of the lifter.

(g) The lifter shall be brought over the load in such a manner as to minimize swinging.

(h) Care shall be taken that there is not sudden acceleration or deceleration of the load.

(i) Do not allow load or lifter to come into contact with any obstruction.

(j) The operator shall avoid carrying the load over people.

(k) The lifter shall not be used for side pulls or sliding the load unless specifically authorized by a qualified person.

(l) If power goes off while making a lift, the operator shall immediately warn all persons in the vicinity of the lifter and land the load if at all possible to do so.

(m) The vacuum lines shall be free from kinks and twists, and shall not be wrapped around or looped over portions of the lifter that will move during the lift.

(n) The pad contact surface shall be clean and free of loose particles.

(o) Before starting to lift, verify that the vacuum level indicator has reached the required level.

(p) Before starting to lift, raise the load a few inches to establish that the vacuum lifting device has been correctly applied and that a stable vacuum level exists.

(q) The operator shall not leave suspended loads unattended.

20-2.4.5 Miscellaneous Operating Practices

(a) An operator shall not use a lifting device which is tagged "Out of Service" or otherwise designated as nonfunctioning.

(b) "Out of Service" tags on lifting devices shall not be removed without the approval of the person placing them or an authorized person.

(c) The lifter, when not in use, should be stored at an assigned location.

(d) Caution should be taken that operating markings or tags shall not be removed or defaced. Those removed or defaced shall be replaced.