



Hydraulic Rescue Hoist Ground Support Equipment

ZGS-10000-5-2

Operation and Maintenance Manual

United States Patent # 7,429,031 B1



ZGS-10000-5-2 Mobile Hydraulic RHGSE

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Before operation of the Ground Support Equipment, thoroughly review the entire manual in order to prevent damage to the wire rope, hoist, helicopter or operator.

1) Introduction

The purpose of this manual is to describe the operation and maintenance of the Zephyr International LLC Hydraulic Rescue Hoist Ground Support Equipment (RHGSE). **Cautions are noted in Red where required.**

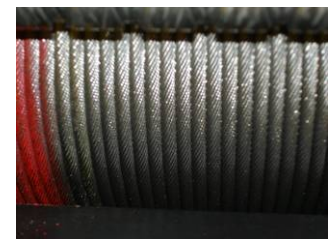
2) Purpose of the Equipment

The equipment is designed to assist in the inspection and maintenance any helicopter rescue hoist and its wire rope on the ground.

The equipment is:

- Man portable to and from the helicopter in order to perform pre and post flight checks of the wire rope and rescue hoist system.
- Allows one person to perform all inspections and maintenance operations in a minimum amount of time
- Maintains constant tension on the wire rope as it extends and applies a heavy load over the length as it retracts, while protecting the wire rope in a rotating tub during hoist maintenance.
- Accommodates any rescue hook and bumper configuration.
- Clean and dries the wire rope during post flight inspections after salt water use
- Lubricates the wire rope if required by the manufacturer
- Specifically designed to tension the wire rope and hook assembly without having to fly the helicopter after a cable inspection

Operation of the RHGSE requires strict situational awareness of the wrapping of the cable on the machine, and strict limitation of the speeds and loads applied. It is a tool to check the hoist operational performance and the cable's condition and perform the tasks of cleaning, drying and lubricating the cable. It is not designed to perform acceptance tests as per the OEMs manual.



The RHGSE maintains clean & tight wire rope storage on the rescue hoist drum

3) System Description:

The Rescue Hoist Ground Support equipment consists of several subsystems that provide a complete system solution to rescue hoist and wire rope maintenance. The subsystems include the following:

Mobile Frame

The mobile frame is easily transportable. It can be moved easily by one person to position under the rescue hoist next to the aircraft. It has a tow handle that can be used to tow it to the aircraft and it can be lifted via a fork lift. Do not exceed 5 mph / 8 kph when towing the RHGSE. A work platform has been added to allow the maintainer to work on the hoist to set limit switches, change the cable etc. An eye bolt and tether allows the hook and the cable end to be tensioned.

When not in use the tow handle should be stored in the upright position to eliminate the possibility of tripping over it.

When using the work platform insure the brakes are applied, and use care when standing on it.

Batteries and Charger

There are two 12 volt batteries included to provide power for the system. Each battery is a sealed Absorbed Glass Mat lead acid battery. *Absorbed Glass Mat (AGM)* batteries are the latest step in the evolution of lead-acid batteries. Instead of using a gel, an AGM uses a fiberglass like separator to hold the electrolyte in place. The physical bond between the separator fibers, the lead plates, and the container make AGMs spill-proof and the most vibration and impact resistant lead-acid batteries available today. The batteries are air transportable and sealed to eliminate leakage. Two of the batteries are used in series to provide 24 VDC to the hydraulic drive motor / pump assembly. The 12 volts required for the displays is provided by the inboard battery.

The onboard battery charger is a totally sealed computer regulated unit that monitors and charges each battery separately. The charger maintains the batteries in top condition by regulating the charging current. Powered with three-step automatic circuitry and on-board computer control, the TPRO220 shares a total of 20-amps. This unit is fully encapsulated, making it extremely vibration resistant and completely waterproof. It is designed to be connected indefinitely keeping batteries topped off and ready to go for short-term or long-term storage. The unit also features reverse polarity protection, ignition protection, and dual-color LED mode indicator lights. **The system is protected by fuses in the event of a short circuit.**

Back Up DC Power Adapter

The system includes a receptacle that can be used to provide 28 volts power to the take up for continuous operation or as a backup to the batteries if they are not recharged. There is a battery switch on the frame. Position 1 is for operation with the batteries, Position 2 is for operation with the backup supply. The displays use 12 volt from the inboard battery therefore, the batteries should be kept charged at all times even if the backup system is being used. **Do not leave the battery switch in the Both position.**

Hydrostatic Hydraulic Drive

The hydrostatic hydraulic drive consists of a 24 volt drive motor coupled to a hydraulic pump. The system uses Mil-H-83282 hydraulic oil.

The type of fluid is marked on the hydraulic tank and mixing of different type fluids could lead to leakage or failure of the hydraulic components.

The maximum pressure in the circuit is limited by a pressure relief valve. The system includes a hydraulic manifold that encloses the pressure relief valve and three other hydraulic valves. The manifold is coupled to a hydraulic motor which in turn drives the capstans. When the hydraulic fluid returns to the tanks it passes through a filter. The filter includes an indicator to warn when the filter

needs to be replaced. When the system is used to extend the wire rope from the rescue hoist, the hydraulic motor pulls the wire rope off the hoist as if the hoist was lowering a load. When the system is used to retract the wire rope onto the rescue hoist, the hydraulic system creates a load on the wire rope. The load in the up direction is easily adjustable. To adjust the load in the down direction one must remove the lockout cap and use a tool to adjust the load.

Never actuate the rocker switch in the extend direction unless the rescue hoist wire rope has been attached to the capstans and all prerequisites for running in the extend direction have been completed. The rotating drum will spin very fast if this occurs and anything placed on the spooler will be ejected from the rotatub.

Capstans and Pressure Roller Arms

The load is transmitted to the wire rope using two capstan drive rollers. Each roller is precisely sized to accommodate the wire rope and feed the wire rope into the rotating tub. The capstans are made from a material that maintains high friction between the wire rope and the rollers, even if the wire rope is lubricated.

The capstans will wear over time depending on the loads applied and the speed of operation. The wear limits are published in this manual.

The capstans are covered by a hinged transparent guard. The transparent guard actuates a limit switch. When the guard is open the machine will not operate. The wire rope is held tight against the capstans by two pressure roller arms at the entry and exit tangent points where the wire rope contacts the capstans. **Use care when removing the pins to not impact the upper tensioner's base with your knuckles.**

Lubridryer Assembly

The wire rope is cleaned, dried and can be lubricated using the Lubridryer. The Lubridryer includes replaceable pads that clean the wire and also can be used to provide lubrication to the wire rope. If the rotating tub has been filled with fresh water to wash saline residue off the cable, compressed air from the on-board air compressor is used by the Lubridryer to dry the wire rope as it is reeled back on the rescue hoist. The Lubridryer is equipped with an oil shut off to stop the flow of oil when not in use.

Wire Rope Load Indicator Length and Speed Indicators

The load applied to the wire rope is indicated via a digital indicator that utilizes the signal from a load cell. The length and Speed of the cable in the rotating drum is indicated via two digital readouts that utilizes the output signal of a magnetic encoder. The cable length indicator counts up to indicate the length of cable unreeled from the rescue hoist and down as the cable length exits the rotating drum. The readouts are for reference only. It is recommended to limit the speed of operation to approximately 100 feet per minute for routine maintenance actions.

If the battery charger is left unplugged or the system is used continuously for more than two hours the battery may dip below 8 volts, if this happens the displays will start blinking then go out completely.

If the readouts fail due to low voltage or a blown fuse the operator must use caution and visually watch the wire rope as it approaches the starting position.

Rotatub and Spooler

The wire rope is collected in a rotating tub and spooler system. The incremental length of the wire rope as it reels off and on the capstans is fixed, while the incremental length of the wire rope as it lays up in the rotatub and spooler is variable. Therefore the rotatub position is compensated during reeling in to accommodate the accumulated error in length. The rotatub can be filled with fresh water to rinse saline residuals off the wire rope. A plug is provided to drain the water.

The proper adjustment of the Rotatub clutch is critical to the proper operation and wrapping of the cable in the tub.

The rotatub and rescue hoist should be observed alternately when the RHGSE is in use.

Do not continue to operate the machine if the cable rides to the top of the spooler, if the cable comes out of the tub it will immediately be kinked and ruined.

Controls

The hydraulic drive system is controlled via a three position rocker switch located next to the Lubridryer. The indicators are powered via a toggle switch (Power) on the face of the control section next to the hydraulic tanks. The compressor is controlled via a toggle switch on the face of the control section.

All of the electronic components are protected by fuses. When activating the rocker switch insure the capstan covers are closed and no risk of entanglement exists for any persons in the vicinity of the RHGSE. The capstan cover actuates a limit switch and the system will not operate with the capstan cover open.

Work Platform

The system is equipped with a work platform that allows one to stand on the frame to allow working on the hoist, or for visual inspection of the hoist operation. **Insure the wheel locks are locked when using the work platform**

Hook Attachment Proof Check Point

The system is equipped with an eye bolt and a tether that can be used to perform a hook load test. Once a load is applied the frame will lift off the ground slightly and 640 lbs. is applied to the end of the cable and the hook attachment.

4) Setting up the RHGSE

The equipment is shipped in a sturdy wooden crate specifically designed to transport and store the RHGSE.



Remove the screws from the crate where they are marked "remove".

Remove the front panel and turn it upside down to use as a ramp to roll the RHGSE out of the crate.



Remove the restraint piece at the base of the RHGSE

Roll the RHGSE out of the crate and down the ramp created by the front panel.

Hydraulic oil has been shipped with the unit, remove the panel and the wood restraint piece and remove the hydraulic oil from the crate.

Spare Lubridryer pads, Tub plugs and fuses are inside the Rotatub under the spooler. Remove them and place them to the side.

Roll the RHGSE out of the crate and down the ramp carefully to insure the transparent capstan cover does not contact the crate or anything else.

The battery selector switch can be damaged if attention is not paid to the proximity equipment in the vicinity.

Then attach the Lubridryer with the supplied (2) screws as shown.

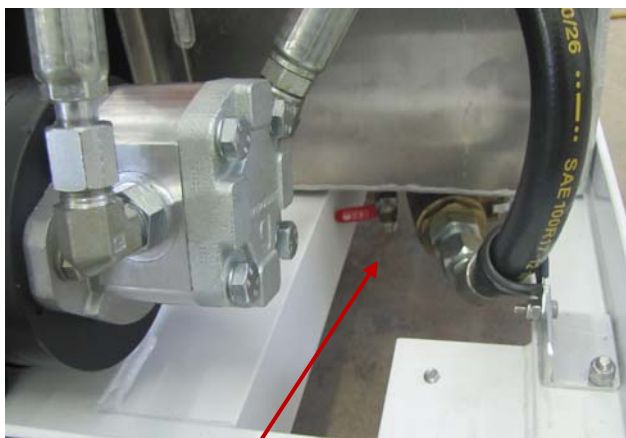


Lubridryer

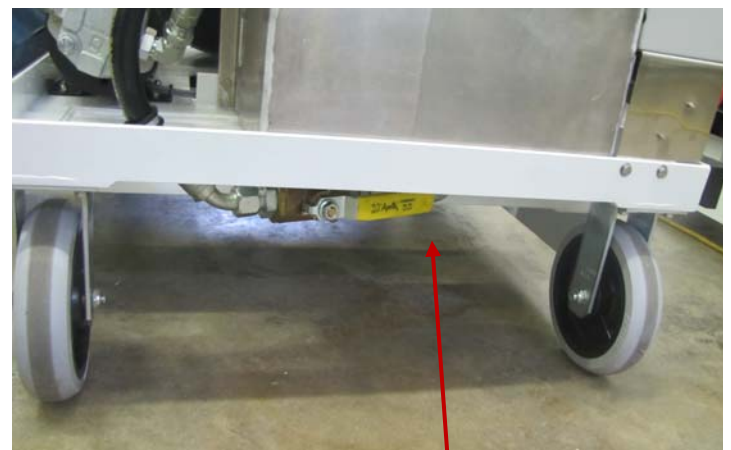


Fill the RHGSE with hydraulic oil supplied or use the specified oil. The unit has been tested with hydraulic oil specifically for the customers operation. Mixing of oil types is not recommended. Fill the tank with a minimum of 10 gallons of hydraulic oil. The hydraulic oil tank maximum capacity is 12 gallons.

Verify the drain valve is shut and the exit valve is open.



Drain Valve Shut
(Red handle)



Exit valve open
(Yellow handle)

Open the outboard battery box and attach the two positive terminals to the threaded post, and the main positive terminal to the main post. Check to verify all the battery connections are tight. Open the inboard battery box and attach the two positive terminals to the positive terminal post.

Check the power to the indicator and control box.



Power Switch



Plug the battery charger in and verify that the battery bank charging lights illuminate. **It is critical** that the batteries be charged and maintained in the charged state as soon as possible upon uncrating the equipment.



5) Theory of Operation

The wire rope is reeled off of the helicopter hoist and is wrapped three times around the capstans then the rescue hook is positioned in a rotating tub. A spooler holds the rescue hook and establishes the starting position of the wire rope to achieve an even storage of the wire rope in the rotating tub. The wire rope is held firmly in the special grooving of the capstans by two tension roller assemblies. The tension roller assemblies are held open by hitch pins when installing and removing the wire rope from the capstans. The RHGSE is operated by using the rocker switch to select retract or extend. When the helicopter hoist is reeling out, the hydraulic pump and motor will provide a steady load and will rotate the rotatub at the speed allowed by the rescue hoist. When reeling in; the wire rope pulls against the capstans to develop torque on the hydraulic motor and develop a heavy load in the wire rope depending on the setting of the reel in load valve. A set of pads installed in the Lubridryer cleans the cable, and can provide lubrication via an oil reservoir if required. When the wire rope is to be cleaned using fresh water, the tub is filled with water, and compressed air is fed to an orifice located below the Lubridryer to dry the cable as it is retracted. After the cleaning is finished the tub is easily drained via a removable plug.

The RHGSE weighs approximately 900 lbs. dry, i.e. No water in Rotatub and is easily transportable.

6) Operation of the equipment

The operation of the RHGSE is simple, but proper rescue hoist maintenance requires strict attention to detail and situational awareness of the operation of the rescue hoist and the RHGSE at all times.

RHGSE operation requires:

- Attaching the wire rope to the system through the MagSens, Lubridryer around the capstans and into the Rotatub.
- Adjusting the spooler position and compensating for length error
- Operating the rescue hoist controls
- Activating the extend or retract mode rocker switch
- Activating the power switch
- Filling with water and then draining the rotating tub
- Replacing the lubricating and cleaning pads
- Activating the onboard air compressor

Cautions:

Before operation of the Ground Support Equipment, thoroughly review the entire manual in order to prevent damage to the wire rope, hoist, helicopter or operator.

When not in use the tow handle should be stored in the upright position to eliminate the possibility of tripping over it.

The system is protected by fuses in the event of a short circuit.

The type of fluid is marked on the hydraulic tank and mixing of different type fluids could lead to leakage or failure of the hydraulic components.

Never actuate the rocker switch in the extend direction unless the rescue hoist wire rope has been attached to the capstans and all prerequisites for running in the down direction have

been completed. The rotating drum will spin very fast if this occurs and anything placed on the spooler will be ejected from the rotatub.

The cable wrapping in the rotatub should be observed at all times when the RHGSE is in use.

All of the electronic components are protected by fuses. When activating the rocker switch insure the capstan covers are closed and no risk of entanglement exists for any persons in the vicinity of the RHGSE.

Never operate the RHGSE with loose clothing, jewelry, ties, long hair or anything that may become entangled with a wire rope.

Never actuate the rocker switch when the transparent capstan cover is open. The transparent guard does include a shut off switch.

Never actuate the rocker switch to the extend position with a slack wire rope.

Always observe the wire rope at all times and be prepared to stop at any time.

Always pay attention to the wire rope for indications it is approaching the full out position. In the event the full out limit switch of the rescue hoist does not stop the hoist, stop the hoist by removing the down command from the pendant.

Failure of the rescue hoist full out limit switches could cause the wire rope to come off of the rescue hoist drum. Be prepared to stop the system if that happens.

It is essential that the rocker switch be set to the correct position when reeling in, in order to prevent damage to the wire rope, or the operator. Do not actuate the rescue hoist pendant in the up direction without actuating the rocker switch to the retract direction. Running the hoist up when the rocker switch is switched to the extend direction will lift the RHGSE off the ground as a dead load and could cause damage to the wire rope, aircraft or operator.

When using the fresh water rinse the maximum retracting load should be reduced to 100 lbs.

Do not allow excessive water to enter the air cleaner at the inlet to the air compressor.

If the readouts fail due to low voltage or a blown fuse the operator must use caution and visually watch the wire rope as it approaches the starting position.

When tightening the wire rope to remove the slack do not jerk the cable with the hoist control.

Do not activate the rocker switch to the extend position if there is any slack in the wire rope. Remove any slack with the rescue hoist first, then activate the extend switch to the extend position.

Failure to stop the hoist at or near the starting point (zero indicated cable length) will cause damage to the GSE and possible damage to the hoist wire rope. An alarm will sound if you run the hoist beyond the starting position indicating you should stop immediately.

Always disconnect the fitting from the main positive battery terminal before repairs of or servicing any of the moving components of the RHGSE.

Use caution when standing on the work platform.

Insure the wheel locks are locked when using the work platform

Do not continue to operate the machine if the cable rides to the top of the spooler, if the cable comes out of the tub it will immediately be kinked and ruined.

6.1) Installing the wire rope in the Lubridryer

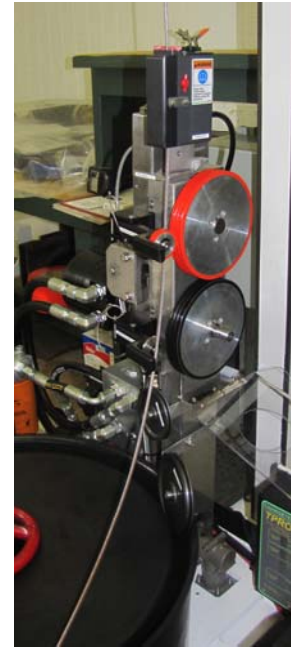
With approximately 16-25 feet (painted length) of wire rope paid out of the helicopter hoist, open the Lubridryer by flipping the latch up and opening the covers. Position the wire rope in the Lubridryer and close the covers and latches.



Step 1



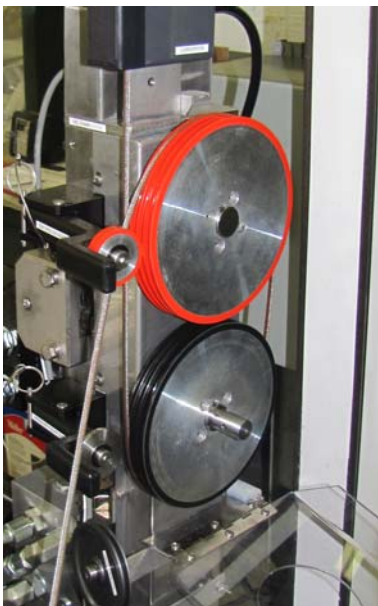
Step 2



Step 3

6.2) Wrapping wire rope around capstans

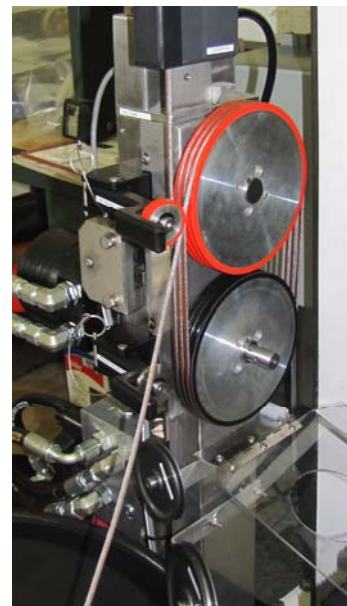
Wrap the wire rope around the capstans three times starting with the lower capstan innermost groove as shown:



Step 4



Step 5



Step 6



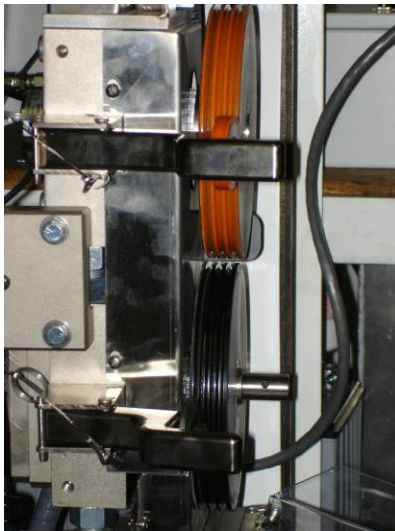
Step 7



Step 8

6.3) Applying the pressure rollers

Remove the pins to apply the pressure rollers to the wire rope after it is wrapped on the capstans. **Use care when removing the lower tensioner pin to not hit the upper base with your knuckles.**



Open Position



Operating Position

Insert the pins into the pin storage hole in the pressure roller arm base. Give a strong tug on the wire rope to insure it is imbedded in the grooves of the capstans.

Never actuate the rocker switch when the transparent capstan cover is open.

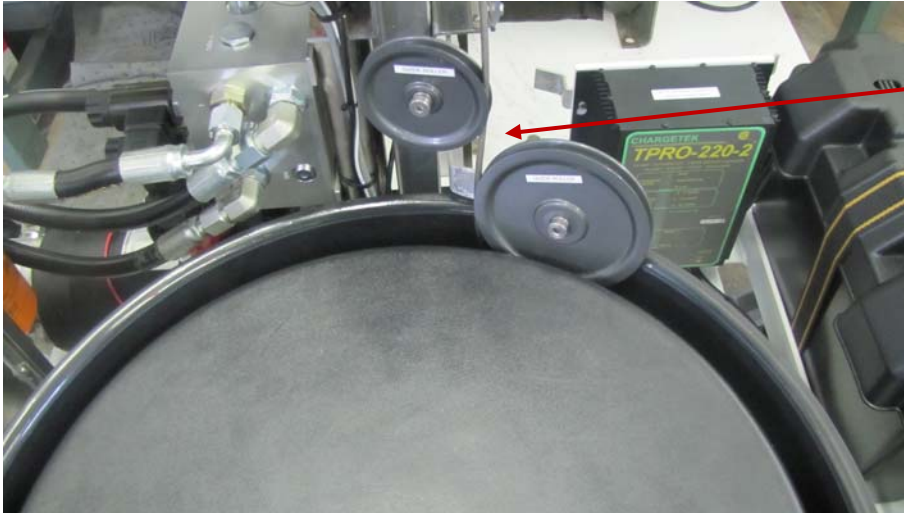
Close the transparent cover.

6.4) Setting the Rotatub and Spooler orientation

It is important to set the spooler orientation correctly in order to wrap the entire length of cable in the rotating tub.

The rotatub and spooler can be adjusted as required to correct the relative position of the wire rope wrapped in the rotatub versus the capstans. This provides the ability to adjust the relative wrapping of the rotatub to the capstans if required for any reason at any time.

If not enough wire rope is paid out from the rescue hoist to place the wire rope in the spooler correctly once the wire rope is wrapped on the capstans and the tensioners are applied, activate the rocker switch to extend and run the hoist in the down direction for a couple of feet and adjust the spooler as required.



Note the wire rope position. Lift and rotate the spooler to place the wire rope in the cable guide rollers and loosely wrapped into the spooler slot, while rotating the rotatub clockwise

Setting the initial position of the rotatub to the wire rope in the spooler is accomplished by rotating the rotatub manually in a clock wise direction. Once the cable is completely reeled out, one can adjust the position of the drum by rotating the drum in the counter clockwise position as required to keep the cable properly positioned in the cable guide and not too tight on the spooler.

The spooler may be a tight fit in the rotatub. Once the spooler is in the starting position push it down to firmly seat it in the rotatub. Check to insure the wire rope is loosely sitting in the bottom of the grooved cutout in the spooler

6.5) Applying a reel out load to the wire rope

To run the hoist down, the wire rope must be properly wrapped around the capstans and the rotatub and spooler set in the proper relative position, the slack removed from the wire rope and the capstan transparent cover closed.

Never actuate the rocker switch to the extend position with a slack wire rope.

The hydraulic system will start and the load indicator will show the load being applied to the wire rope. Note: The load in the extend direction is set at approximately 100 lbs at the factory. The load that is indicated is for reference only and is within 10% of the actual load in the cable.



6.6) Running rescue hoist in the down direction (Extending)

Turn on the power switch, and then activate the rocker switch in the extend direction. Actuate the rescue hoist pendant to start the hoist running in the down direction. Start slowly and observe the wire rope to insure it is completely seated in the capstan grooves. Run the hoist in the down direction at a speed that allows you to observe the hoist operation. Extend the wire rope completely; always paying careful attention to the helicopter hoist and to the condition of the wire rope. If the wire rope snags in the Lubridryer pads for any reason such as a kink or a broken wire or broken strand; the wire rope will loosen between the top of the Lubridryer. In this event, the wire rope needs to be replaced; run the wire rope out into the drum and follow the manufacturer's instructions for replacing the hoist wire rope. Absent any deficiencies noted during inspection, run the hoist in the down direction until the helicopter hoist is stopped by the rescue hoist full out limit switches.

Always observe the cable as it wraps on the spooler, if the extending load is adjusted too high then excessive slipping may occur. If this happens, either reduce the load or reach down and cause the Rotatub to slip thus allowing the cable to fall to the bottom of the spooler.

Do not adjust the extending load, use 100 lbs as the nominal load while extending.

Failure of the rescue hoist full out limit switches could cause the wire rope to come off of the rescue hoist drum. Be prepared to stop the system if that happens.

Do not continue to operate the machine if the cable rides to the top of the spooler, if the cable comes out of the tub it will immediately be kinked and ruined.

6.7) Running the rescue hoist in the up direction (Retracting)

Do not actuate the rescue hoist pendant in the up direction without actuating the rocker switch to the retract direction. Running the hoist up when the rocker switch is switched to the extend direction will lift the RHGSE off the ground as a dead load and could cause damage to the wire rope, aircraft or operator.

Do not continue to operate the machine if the cable rides to the top of the spooler, if the cable comes out of the tub it will immediately be kinked and ruined.

Actuate the rocker switch to the retract direction. With the hoist control pendant run the helicopter hoist in the up direction. The wheel brakes on the RHGSE should be unlocked to allow the equipment to center itself under the hoist. Observe the wrapping of the wire rope on the rescue hoist drum. Approximately 20 feet before the wire rope is completely retracted onto the hoist drum, slow down and observe the rotatub. Stop the hoist operation when the spooler is in approximately the same position as starting and there are no more wraps in the rotatub and the counter reading approaches zero. The load can be adjusted to any value between 5 to 600 lbs.

Note: The indicated load in the retract direction is accurate within +/- 5%.

6.8) Replacement of the Lubridryer pads

The Lubridryer pads are replaced by removing the four thumbscrews, removing the bushings and removing the old Lubridryer pads and then installing new pads.



Used pads



One set of screws, bushing and pad



New pads installed

6.9) Using oil lubrication

The Lubridryer includes a reservoir that can be filled with oil. Use oil only as per the hoist manufacturer's recommendations. The reservoir is also used to store spare Lubridryer pads.

When oil is added to the reservoir it seeps through two small holes to lubricate the rear pad. The front pad should be soaked in oil before installing it. Therefore always keep a spare set of pads in the reservoir of oil to use as the next set.

Wipe excess oil off of the frame and use a clean cloth to keep the oil off of the capstans when the RHGSE is not in use. Turn the red wing screw three turns counterclockwise to open the oil passage and close it when not in use.



6.10) Adjusting the retracting load

The reel in load is adjusted by turning the adjustment knob on the lower pressure relief valve. To increase the load, turn the knob clockwise when looking up at the knob or counterclockwise from a standing position.



Retracting load adjustment knob

Never try to adjust the retracting load while retracting the wire rope at a very slow speed. This will lead to cogging of the hydraulic motor and an inaccurate adjustment. Obtain a moderate steady speed then make the adjustment while maintaining that speed.

Normally a load of 200 lbs is sufficient to insure a tight set of wraps on the hoist drum. The only time a load as high as 600 lbs is required is when conditioning a cable after it has been installed.

6.11) Adjusting the extending load

The extending load is adjusted by turning the knob on the upper pressure relief valve. To increase the load, turn the knob clockwise.



Extending load adjustment knob

Note: The maximum load in the down direction is approximately 250 lbs, However to prevent excessive slippage it is recommended to limit the load in the down direction to 100 lbs unless required to troubleshoot the hoist

Always observe the cable as it wraps on the spooler, if the extending load is adjusted too high then excessive slipping may occur. If this happens, either reduce the load or reach down and cause the Rotatub to slip thus allowing the cable to fall to the bottom of the spooler.

Do not continue to operate the machine if the cable rides to the top of the spooler, if the cable comes out of the tub it will immediately be kinked and ruined.

6.12) Using fresh water wash

When using the fresh water rinse the maximum retracting load should be reduced to 100 lbs.

In order to flush away saline residuals after salt water exposure, fill the rotating tub $\frac{3}{4}$ of the way with fresh water and extend the wire rope all the way down. Using a hose rinse off the helicopter hoist and the wire rope between the helicopter hoist and the rotatub. Turn on the air compressor switch and carefully observe the wire rope at all times on the capstans. Retract the entire wire rope out of the rotatub, and remove the plug at the bottom.



Drain plug

When using the GSE to rinse saline residuals off the cable it is recommended to run the cable out into the Rotatub full of water then change the Lubridryer pads. Then run the cable back onto the hoist using compressed air to dry the cable. After the cycle is complete the Lubridryer pads full of saline residuals should be removed and discarded.

6.13) Using the Dryer

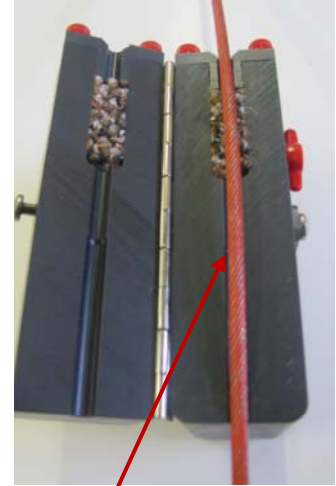
After extending the wire rope into the rotatub and after it has been filled with water, actuate the rocker switch in the retract direction and run the rescue hoist in the up direction. Compressed air will force the majority of the water off the cable prior to leaving the Lubridryer.



Compressor Switch



Compressor



Air exit point

Do not allow excessive water to enter the air cleaner at the inlet to the air compressor.

6.14) Setting Swivel Locks

The system is supplied with locks to prevent the front wheels from swiveling. The swivels should be allowed to rotate for moving the RHGSE around the hanger and aircraft and then locked once the RHGSE has been positioned under the rescue hoist cable. To lock the swivels once the wheels have been positioned, rotate the ring to a horizontal orientation and engage the detent on the wheel with the pin. To unlock the swivels pull the ring out of engagement and rotate the ring to a vertical orientation.



Locked position

Swivel locking mechanism



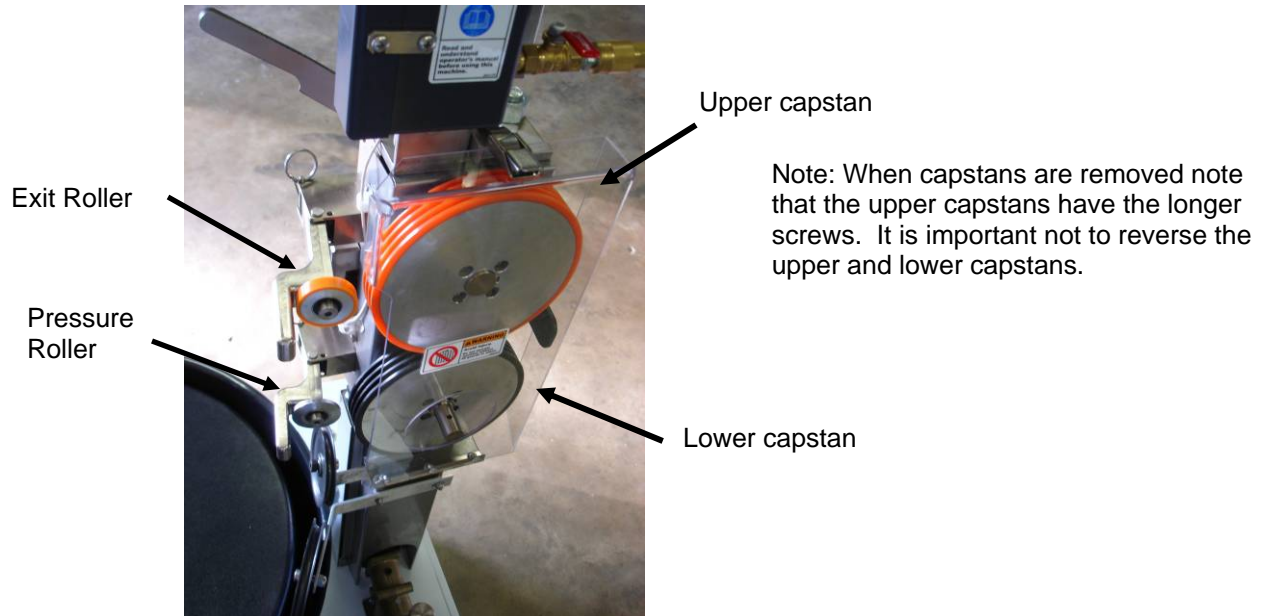
Unlocked position

Note: When using the MagSens system the swivel locks should be in the unlocked position to allow the RHGSE to center itself under the hoist and thus prevent any fleet angle during the checking of the cable

6.15) Changing the capstans to accommodate a different wire rope size.

(Optional if purchased different capstans to accommodate for a different size wire rope)

Remove the capstans and mark them according to their location, i.e. top or bottom. Install the different capstans using the screws that were removed. Check the wrapping of the wire rope to insure the wire rope stays tight on the capstans.



6.16) Removing the wire rope from the hoist

The RHGSE can coil the wire rope for removal and disposal. Run the wire rope completely out into the Rotatub. Bypass the full out limit switch on the hoist as directed in the OEM manual, and run the hoist in the down direction until the wire rope can be removed from the hoist. Disconnect the wire rope from the hoist and run the remaining rope into the Rotatub.

Remove the hook assembly from the wire rope. Then reach down through the slot in the spooler and collect the wire rope spool in your hand and pull the spooler away from the tension rollers and lift the spooler and wire rope coil out of the Rotatub. Flip the spooler upside down and the wire rope will slide off in a neat coil. Discard or store the wire rope as appropriate.

6.17) Installing a new wire rope with the cable reel extension

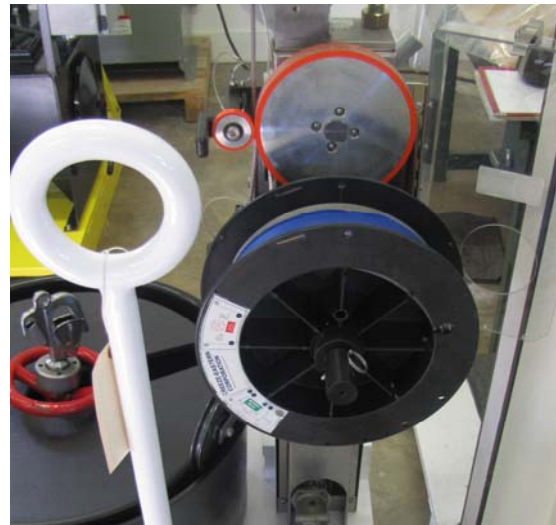
The RHGSE has the ability to attach the wire rope shipping reel in order to facilitate installation of a new wire rope.

Attach the ZGS-10454-1 Cable Reel Extension with its pin as shown.

Slide the shipping reel on the extension and attach the wire rope following the OEM's instructions. The adapter can be used with both major OEM's cable shipping reels.



Goodrich Cable Reel



Breeze Cable Reel

Once the wire rope is completely on the rescue hoist, remove the cable reel and cable reel extension and run the wire rope on and off the hoist onto the RHGSE three or four times while increasing the load incrementally on each cycle in order to condition the wire rope.

Conditioning a New Wire Rope

RH cable conditioning is the process of acclimating the newly installed cable to the smaller diameter of the rescue hoist drum.

It is only required for new cables and is not effective at salvaging cables that do not meet the Mil-Spec and have loose outer strands. The loose strands may disappear temporarily but will soon return as soon as the cable is extended with no load on it.

Cable conditioning should be done with a low load and at slow speed, while gradually increasing the load up to the rated load.

Always extend with a low load of approximately 20-100 lbs. and at a max speed of 100 feet per minute in either direction

Perform 3 cycles

Extend at 100 lbs. then retract the cable at 100 lbs., then 200 lbs., then 300 lbs.

Then during the next flight extend the cable to full extension and retract under approximately 200 lbs. load. This procedure is considered the best practice by the hoist OEMs.

6.18) Using the auxiliary DC power input

Position 1 is for operation with the batteries, Position 2 is for operation with the backup supply. The displays use 12 volt from the inboard battery therefore, the batteries should be kept charged at all times even if the backup system is being used. **Do not leave the battery switch in the Both position.**

6.19) Using the work Platform

When using the work platform, use care when getting on an off to not kick the oil tank sight gage.

Insure the wheel locks are locked when using the work platform

6.20) Using the 600 lbs. check point to check the hook attachment

After every evolution use the hook attachment point and tether to check the hook attachment and apply a 640 lbs. load to the end of the cable.

7.0) Maintenance of the RHGSE

7.1) Storage of the RHGSE

After using the RHSGE it should be stored indoors in a dry location. Use compressed air to blow off any water remaining on the RHGSE or towel dry. The battery charger should be plugged in at all time when in storage.

7.2) General Preventive Maintenance

- Keep the RHGSE MagSens Head relatively dry.
- Rinse off the RHGSE after a wire rope cleaning.
- Do not impact the Rotatub, especially in cold operating conditions.
- Do not leave water in the tub in conditions likely to freeze.
- Clean any excess oil from exposed portions of the upright assembly as required.
- Wash the RHGSE capstans with water when required to clean and then set out to dry or blow off excess water with compressed air.
- Keep all loose components in their respective storage locations.
 - Tub plug in the rotatub
 - Tension release hitch pin in the pressure roller base storage holes
 - Spare Lubridryer pads in the Lubridryer reservoir

7.3) Periodic Maintenance

Table of Periodic Maintenance Tasks

Task	Paragraph	Period
Charging the batteries	7.3.A	Daily
Replacing the batteries	7.3.B	On condition/ approx. 3 -4 years
Change the hydraulic fluid filter	7.3.C	On condition
Lubricate the wheels and Swivels	7.3.D	Yearly
Lubricate the adjustable platen	7.3.E	On condition
Adjust the adjustable platen	7.3.E	On Condition
Check the capstans	7.3 E.1	On condition / approx. 2-3 years
Clean the Lubridryer	7.3.F	As required
Replace the Lubridryer pads	7.3.G	As required during water wash
Replace the MagSens or Lubridryer bushings	7.3 H	As required
Capstan drive chain oiling	7.3.I	Monthly
Inspect the belts and chain for tension	7.3.J, K,L, M	Yearly

Always disconnect the fused positive battery terminal before making repairs or servicing any of the moving components of the RHGSE.

A) Charging the batteries

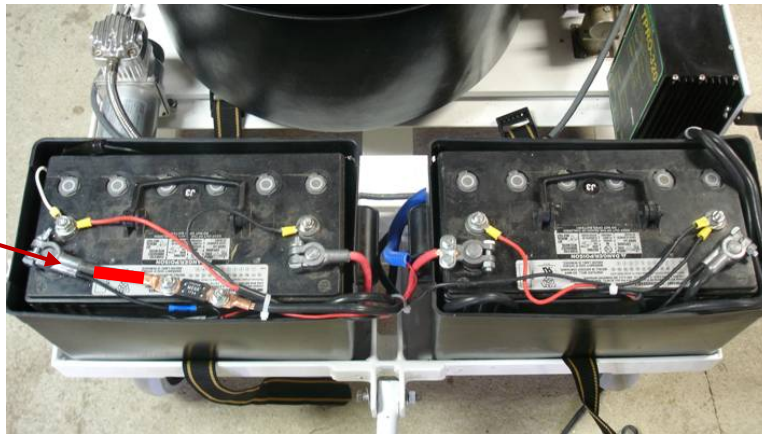
Whenever the RHGSE is not in use the battery charger should be plugged in. When the battery charger is not being used store the electrical cord as shown.



Battery charger cord storage

B) Replacing the batteries

The two main batteries weigh 79 lbs each. Loosen the battery cover straps and remove the tops of the battery boxes. Disconnect all terminals and replace the batteries. Note the polarity markers on the wires for proper connection of the new batteries. Dispose of the old batteries properly.



+ terminal

C) Maintaining the hydraulic system

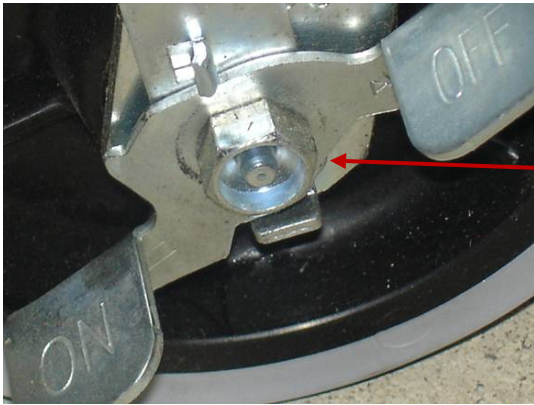
The hydraulic system should be maintained leak free. If leakage develops tighten the appropriate fitting. The hydraulic filter includes a pop up indicator and a spin on cartridge. The filter cartridge should be replaced on condition when the indicator indicates a blocked filter. The hydraulic oil should be sampled every year depending on the environmental conditions. The hydraulic oil should be filtered and recycled as required by the sampling results.



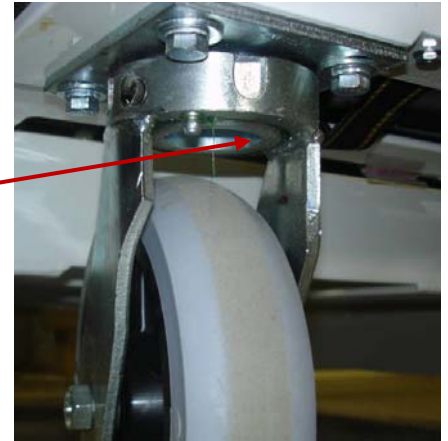
Spin on filter element

D) Lubricating the wheels and swivels

The wheels and swivels should be lubricated on a yearly basis with a good quality general purpose grease.



Grease fittings

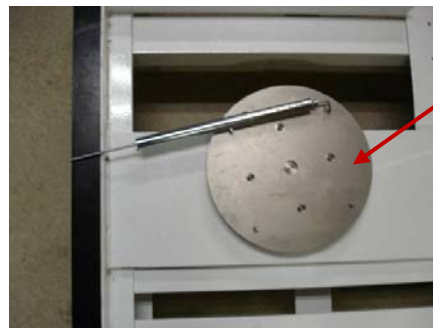


E) Checking and lubricating the adjustable platen

With the cable attached to the capstans (to prevent rotation) rotate the Rotatub fully counter clockwise while looking down upon it. It should rotate with moderate to light force (1-2 lbs.) at the outer diameter of the Rotatub. To adjust the rotation force, remove the tub by removing the (4) lock nuts and washers in the tub, and adjust the four adjustment screws until 5-6 lbs. force is required to slip the adjustable platen while measuring the force with a spring scale as shown below. To re-lubricate the platen use MIL-G-81322 Grease on the upper and lower surfaces of the bronze disc.



View of adjustable platen

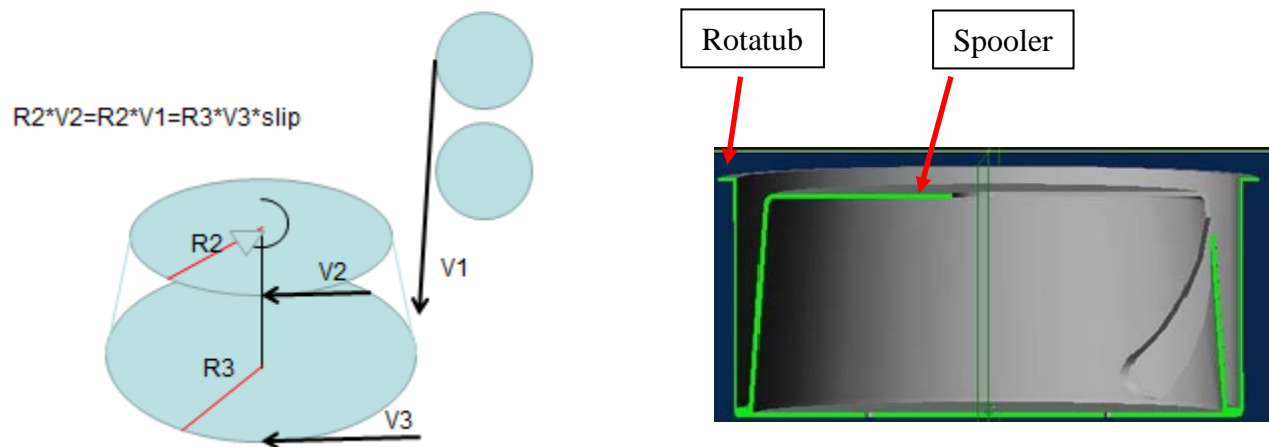


(4) Adjustment screws

Views of adjustable platen with tub removed and slip value being measured

A quick check procedure is to use a 0-10 lbs. spring scale and hold the tub while the extend switch is activated by the hole in the tub to prevent it from rotating. The force to hold the Tub stationary should be approximately 2-3 lbs.

Rotatub Clutch Slip



The above pictures show that as the cable is wrapping at the bottom of the spooler it is going at maximum speed which is the same speed as it is coming off the capstans. As the cable starts to climb up on the spooler it starts to slow down due to the reduced diameter. But the Rotatub must actually go faster in order to collect the cable and not allow it to back up in the Rotatub. Therefore the clutch is slipping the most when the cable is at the bottom of the spooler. If the clutch does not slip properly the cable is forced up the spooler and there is less room on the spooler to collect all the cable.

Do not continue to operate the machine if the cable rides to the top of the spooler, if the cable comes out of the tub it will immediately be kinked and ruined.

Effect of overall cable diameter

When a cable is new its diameter is at its maximum and is approximately .194 inches. As it accumulates time in service it wears and stretches and its diameter becomes smaller over time. As the diameter is reduced the slippage on the capstans increases. As the slippage increases the tension in the cable as it wraps on the Spooler increases. When this happens the cable may start to ride to the top of the spooler. If this is noted during extending, the operator can slow down the Rotatub with a hand or foot contact to allow the cable to fall to the bottom of the Rotatub in order to complete the evolution. Afterwards the Rotatub clutch should be adjusted as per paragraph 7.15 above.

Effect of cable manufacturing process

When a cable is manufactured it is critical that the producer properly setup and engineer the manufacturing process. During the manufacturing process the producer must strive to properly balance the inner and the outer strands to create a spin resistant cable that will wrap on a modern rescue hoist drum. In order to do this the wires and the strands are preformed so that they do not abrade on each other under load and they do not tend to unwrap under load. If the preforming and balancing is incorrect the cable will loosen up prematurely. If it is required to keep the cable installed then hoisting in a hover with a heavy load will tighten the cable back up temporarily but the area where the looseness began will soon reappear. If a cable that is bordering on being loose is used with a RHGSE with a Rotatub clutch that is set too high, the result can be the loosening of the cable between the top of the RHGSE and the rescue hoist.

Effect of cable lubrication

When a cable is new the internal spaces between the wires are full of the lubricant used to produce them. One rescue hoist manufacturer removes the external lubrication and the other does not. Therefore it is the operator' responsibility to determine if adding additional lubricant is required. If additional external lubricant is applied then the coefficient of friction is reduced and slippage on the capstans increases.

Effect of worn capstans

The capstans will wear as a result of slipping and heavy loading. The first groove on the lower capstan will wear out first because it has the heaviest load applied to it. The lower capstan is of a harder material than the upper capstan. When the wear of the capstans becomes significant the cable will slip excessively on the capstans. The results may be seen as the cable starting to ride to the top of the spooler or twisting of the cable between the top of the RHGSE and the rescue hoist.

Zephyr International maintains excess inventory of spare capstans and has a trade in policy, whereby when a user advises they need a new set of capstans, for a fixed price a new set can be sent out immediately and the users then return the old pair to Zephyr for refurbishment.

In general, in order to reduce cable slippage, reduce the cable load and or the speed of operation.

E-1) Checking the Capstans

It is essential to replace the capstans when the pitch diameter of the first groove, of the lower roller becomes too small. To check the pitch diameter a 6-7 inch micrometer is required and a set of pins of the correct diameter is required.

There are several capstans available for the different size cables in use. It is important to use the correct style capstans for the type of cable being serviced. The following table lists the relevant dimensions for each capstan style



Cable Diameter	Lower Capstan Part number	Measurement Pin diameter	Minimum dimension over pin
3/16 inch	ZGS-10113-20-1	.185	6.745 in
4.5 mm	ZGS-12474-1	.175	6.725 in
5/32 inch	ZGS-10113-30	.156	6.715 in
3.5 mm	ZGS-10340-1	.132	6.695 in
1/8 inch	ZGS-10113-40	.120	6.685 in

Note: ZGS-12474-1 can be used for 3/16 and 4.5 mm cables.

F) Lubridryer cleaning

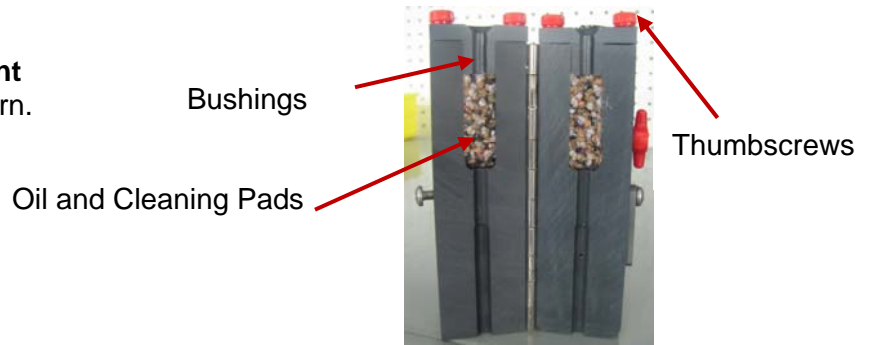
Occasionally clean the Lubridryer reservoir out because dirt and dust will accumulate over time

G) Oil and Cleaning pads replacement

Open the Lubridryer and unscrew the (4) thumbscrews. Remove the two Lubridryer bushings. Remove the used Lubridryer pads. Discard of the used pads properly. Insert new pads, install the bushings and thumbscrews.

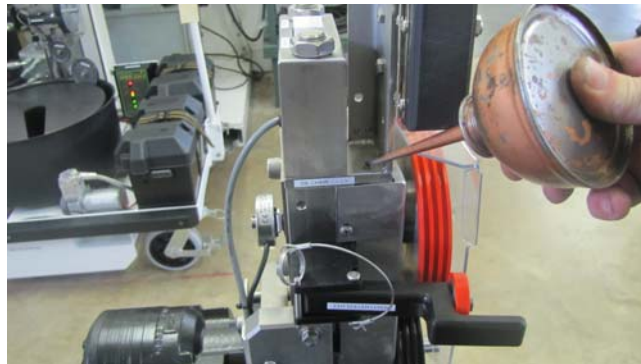
H) Lubridryer Bushings Replacement

Replace the bushings when excessively worn.



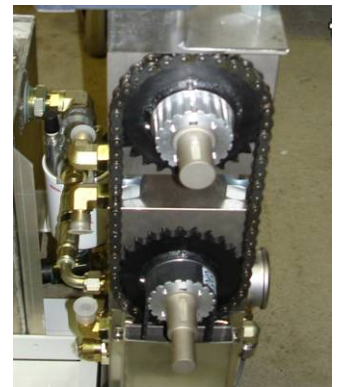
I) Capstan drive chain oiling

Once a month drip a few drops of oil on the upper capstan chain through the small hole in the upright bracket base



J) Chain and belt adjustments

Before making any adjustments remove the covers. The capstan shafts are coupled by a roller chain. The heads are adjustable on two threaded rods. To make any adjustments of the chain or vertical drive belt requires loosening and adjusting all of the nuts from the top of the upright assembly down. When making adjustments always loosen from the top down and then tighten from the bottom up while checking to insure belt or chain for proper tension and the upright components are square to each other and the base when completely tight. While the chain cover is off check the tightness of the setscrews in the chain sprockets and capstan drive pulleys



K) Capstan drive chain adjustment

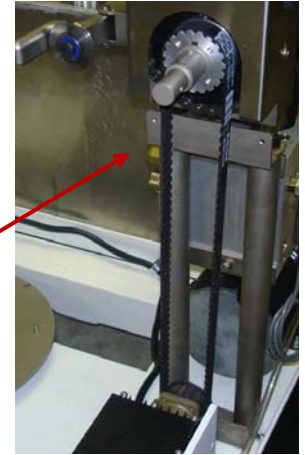
The upper capstan chain should be adjusted depending on usage, and once a year it should be checked. Check for excessive chain looseness by removing the capstans, removing the upper capstan cover to expose the chain. Check the chain by pressing on the chain. The chain should be tight with a small deflection of 1/32 of an inch with moderate hand force.

L) Vertical drive belt adjustment

The vertical drive belt should be adjusted depending on usage, and once a year it should be checked.

Remove the vertical belt cover. Adjust the lower capstan head upwards to obtain approximately 1/8 inch deflection with a light hand force. Readjust the chain, and then replace the rocker switch support.

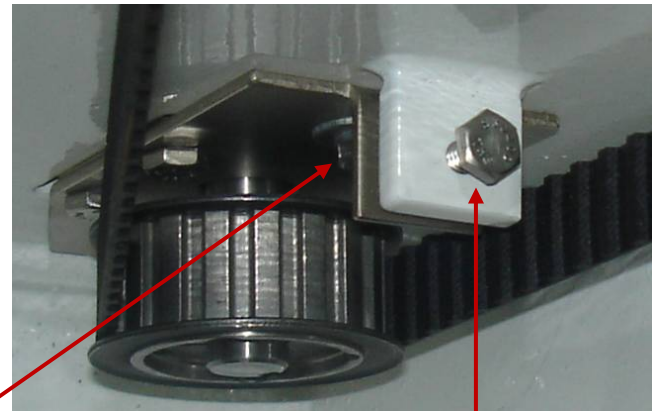
Vertical Drive Belt



M) Drum drive belt adjustment

The drum drive belt should be adjusted depending on usage, and once a year it should be checked.

Loosen the (2) screws that hold the Anglegear assembly to the base. Turn the drum belt adjusting screw so as to tighten the drum drive belt such that a small deflection of approximately 1/16 an inch is obtained with moderate hand force. Tighten the two cap screws securely.



Attachment Screws

Adjusting Screw

N) Calibrating the Load Indication System

The Ground Support System is not intended for precision load application but only as a tool to be used to apply approximate loading to insure the cable is tensioned and conditioned during ground maintenance. However in the event one desires to understand the accuracy of the load display then the following section applies. **The display of the load is accurate to within +/- 5% only in the retracting direction. Each machine is tested in the factory to insure it is within these limits.**

The displayed load in the extend direction is slightly higher than the actual load due to the slight inefficiency of the capstans and the fact that the motor must overhaul the load.

The load indication system consists of a load cell and a load display. The load cell reacts the torque of the hydraulic motor as it pulls or resists the pull of the wire rope.

Therefore the exact calibration curve for each machine is measured in the factory and a calibration curve calculated. The calibration curve is supplied with each machine.

Do not attempt to tighten or loosen the bolt that attaches the load cell to the reaction arm. Doing so will change the load cell display and render it inaccurate.

There are two methods to set the load cell display, one is with a fixed hoist test facility, and the other is to use the known weight of the GSE to set the display at the point where the GSE starts to lift off the ground

Method using the Fixed Hoist Test Facility

In order to calibrate the load display system the mobile GSE must be checked on a fixed hoist test facility. In the event the FHTF is available the following procedure applies.

Perform a load calibration run, Set up the Omega DP25BS as follows

- 1) Set Dip switches for a 0-100 MV input signal
12345678
XOCCOXXO
- 2) Set dip switches for a 10 V excitation voltage
12345678
COCOCCOO
- 3) Program the meter as follows
 - a. Select input type **INPt**
 - i. **100M**
 - b. Select decimal point display
 - i. **FF.FF**
 - c. Scale with unknown loads as follows:
 - d. Determine the load cell sensitivity from the load cell calibration sheet. Load Cell sensitivity is $mV\ out = LSC = \underline{\hspace{2cm}}$
 - i. **IN1= internal meter value (press tare twice then press Menu to store the value**
IN2= $LSC \times 5 \times 100 = \underline{\hspace{2cm}}$
 - ii. **Rd1=0000**
 - iii. **Rd2=LSC**
 - e. Select Reading Configuration to set the input resolution
 - i. Set R.2=1 for a 20mV input signal
- 4) Set up the system and measure the actual loads indicated by the test frame and the output of the load cell in mV and record them on the test data sheet.
- 5) Plot the results and calculate the slope of the curve in lbs /mV and the y intercepts point.
- 6) Calculate the GSE max load **$Y = M \times LSC + B$** to determine the mechanical correction factor
- 7) Change the decimal point display to **FFFF**
- 8) Reprogram the meter with the new **$Rd2 = Y = \underline{\hspace{2cm}}$**
- 9) Make another run and measure the actual test frame indicated loads and the GSE indicated loads
 - a. Plot the new loads and determine if the indicated loads are with 5% of each other at the high end of each range.
 - i.e. extending maximum load range is 300 lbs
 - i.e. retracting maximum load range is 600 lbs
- 10) Enter the results into the calibration test data record and include the data into the ATP record for the particular unit.

If no fixed hoist test facility is available, one can check the load readout by retracting at medium to fast speed. The RHGSE will start to lift off the ground at around 600 lbs.

Scaling with known loads Method

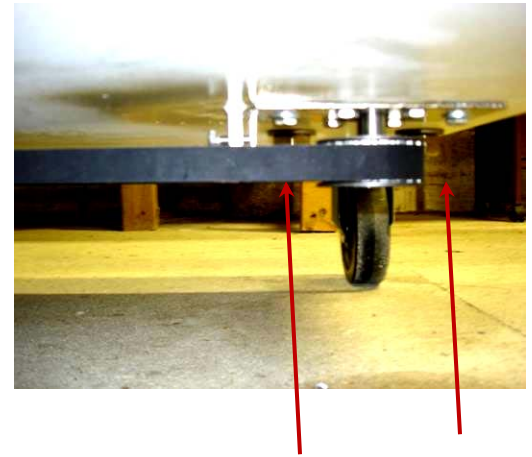
With the rocker switch set to the retract mode position, i.e. pump running but no movement

1. Press the **MENU** button until the meter shows RD.S.O.
2. Press the **>TARE** button. The meter shows IN1 (Input 1).
IN1 (Input 1) is the unscaled display reading at minimum input.
3. Press the **>TARE** button again. The meter shows last stored value for Input 1.
4. Press the **>TARE** button once more. The meter shows the actual signal being received.
5. Press the **MENU** button to store this value as IN1 (Input 1). The meter shows RD1 (Read 1). RD1 (Read 1) is the desired display reading at Input 1.
6. Press the **>TARE** button. The meter shows the last stored value for Read 1.
7. Press the **^NT/GRS** button to change the value of your digits to 0000
8. Press the **>TARE** button to scroll horizontally to the next digit.
9. Press the **MENU** button to store value as RD1. The meter shows IN 2(Input 2).
10. Start retracting the load with the hoist, and adjust the load on the GSE until the GSE just starts to lift off the ground. Try to keep the load as steady as possible. (This requires an assistant to run the hoist while the next steps are performed.
11. Press the **>TARE** button again. The meter shows the last stored value for Input 2.
13. Press the **>TARE** button once more. The meter shows the actual signal being received.
14. Press the **MENU** button to store Input 2 value. The meter shows RD 2(Read 2).
RD2(Read 2) is the desired display reading at input 2.
15. Press the **>TARE** button. The meter shows the last stored value for Read 2.
16. Press the **^NT/GRS** button to change the value of your digits to 0600
17. Press the **>TARE** button to scroll horizontally to the next digit until the meter reading matches the load cell meter reading of 600
18. Press the **MENU** button to store value as RD 2(Read 2). The meter momentarily shows STRD, followed by RD.CF. Meter scaling is now complete.

7.4) Standard Replacement Procedures

A) Drum drive belt replacement

Jack up the RHGSE and place on car jacks to allow access to the drum drive belt. Loosen the two screws that hold the Anglegear assembly to the base. Turn the drum belt adjusting screw so as to loosen up the drum drive belt to remove and replace it.



Loosen these screws to adjust or replace the drum drive belt

B) Vertical drive belt replacement

Lower the lower capstan head enough that the vertical drive belt can be removed and replaced.

C) Drive Chain Replacement

Remove the upright bracket and loosen all the $\frac{3}{4}$ nuts above and below the two head assemblies to remove the chain tension. Locate the master link and using a flat blade screwdriver pop off the retainer and remove the link and the chain. Attach a new chain and replace the master link. Insure the heads are aligned to each other and square to the frame as they are tightened from the bottom up.

D) Hydraulic Filter replacement

The Hydraulic filter can be unscrewed and replaced by hand pressure. Be sure to shut off the hydraulic shut off valve first and open it again after the filter has been replaced.

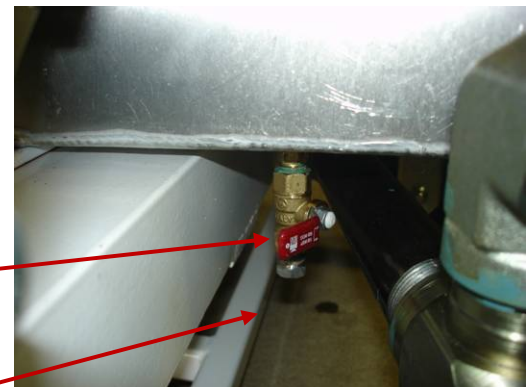
E) Hydraulic Fluid Replacement

To drain the hydraulic fluid remove the drain plug located on the left bottom portion of the hydraulic tank. Open the drain valve and drain the fluid into an approved container. Use hydraulic pipe thread sealant when reattaching the plug, not Teflon tape. Close the drain valve

Replace the hydraulic fluid with new or recycled hydraulic oil of the same type that was removed.

Drain Valve- rotate handle down to open

Drain Plug



F) Other Hydraulic System Maintenance

If any hydraulic system components require replacement, close the main inlet valve to prevent the hydraulic oil from draining down from the tank. It is critical that the valve be opened again before starting the motor and pump assembly.



Valve Open



Valve Closed

G) Capstan Replacement

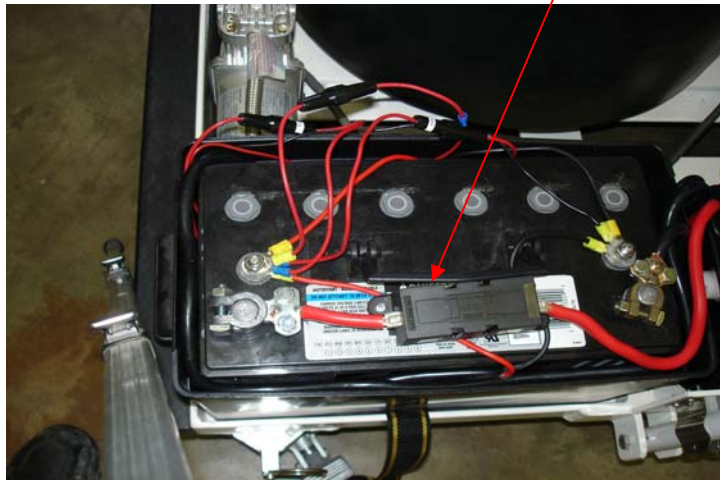
Check the capstans for wear, they can be easily replace when required. Also, if different size wire rope is to be serviced then the capstans will have to be changed to accommodate the different wire rope diameters.

Replacing Capstans					
	<p>Open the cover and remove the (4) 10-32 x 1-1/2 screws from the upper capstan. Remove old capstan <i>(Note: that the upper capstan uses longer screws than the lower capstan.)</i></p>		<p>Verify the .7 Key has remained in its location</p>		<p>Install new upper Capstan (Orange) and attach using the (4) 10-32 x 1-1/2 screws</p>
	<p>Remove (4) 10-32 x 1-1/4 screws from the Lower Capstan (Black) And remove old Capstan</p>		<p>Verify the .8 Key has remained in its location</p>		<p>Install new lower capstan (Black) and attach using the (4) 10-32 x 1-1/4 screws</p>

H) Replacing the fuses.

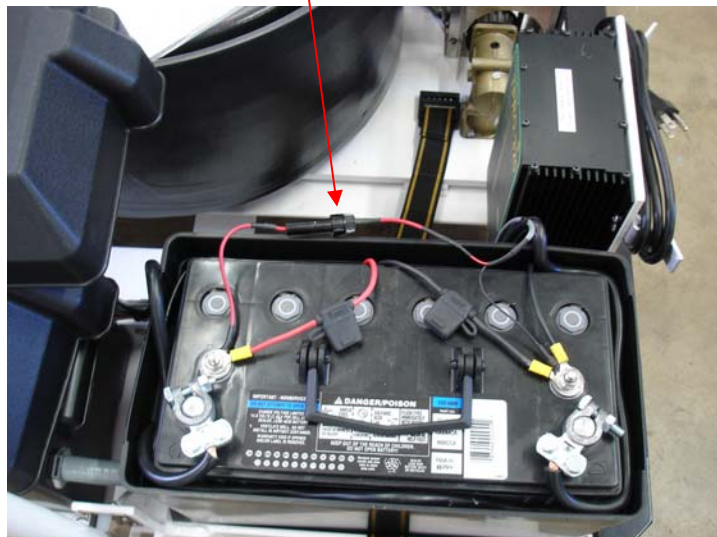
There are several fuses included in the system. The main fuse is under the outboard battery cover. The main fuse is rated for 200 amps. If the battery wire connections become loose or if the extending load is adjusted above 150 lbs the main fuse may blow. It is there to protect the motor from excessive current. In the event the main fuse blows check all the battery wire connections to insure they are tight and check the extending load setting to insure it is less than 150 lbs. A spare main fuse is included in the spare parts package included in the system

Main Fuse Location

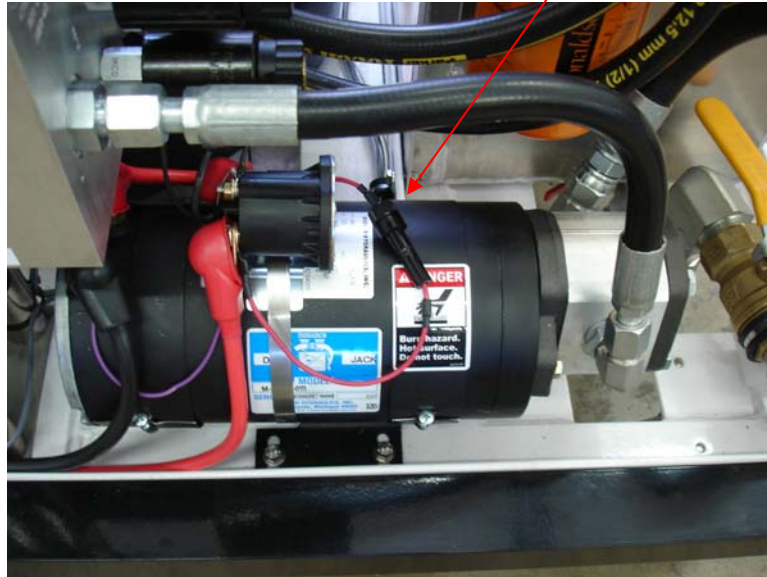


There are two control fuses rated for 5 amps each. One is located under the inboard battery cover and the other is attached to the motor/ pump positive terminal.

Control Section Fuse location

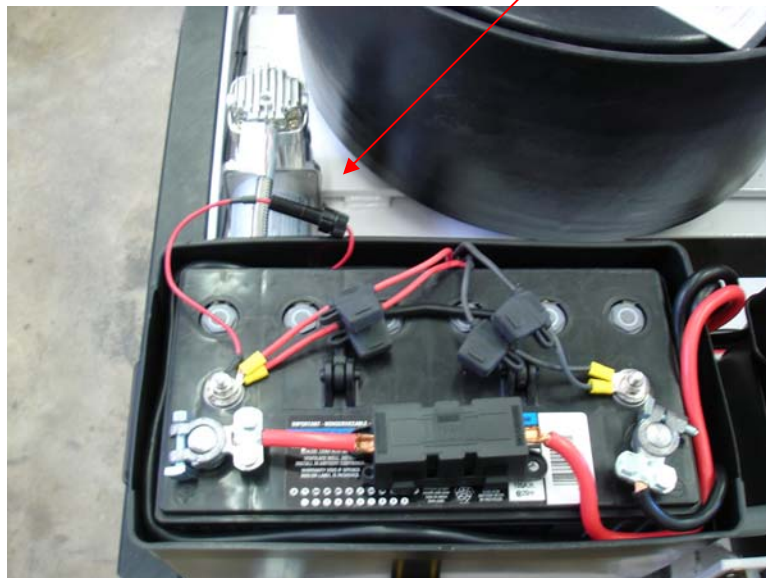


Motor starting and direction control circuit fuse location



There is a 15 amp fuse that protects the air compressor.

Air compressor fuse location



There are (2) one amp fuses inside the control section for each display

Control Section fuses location



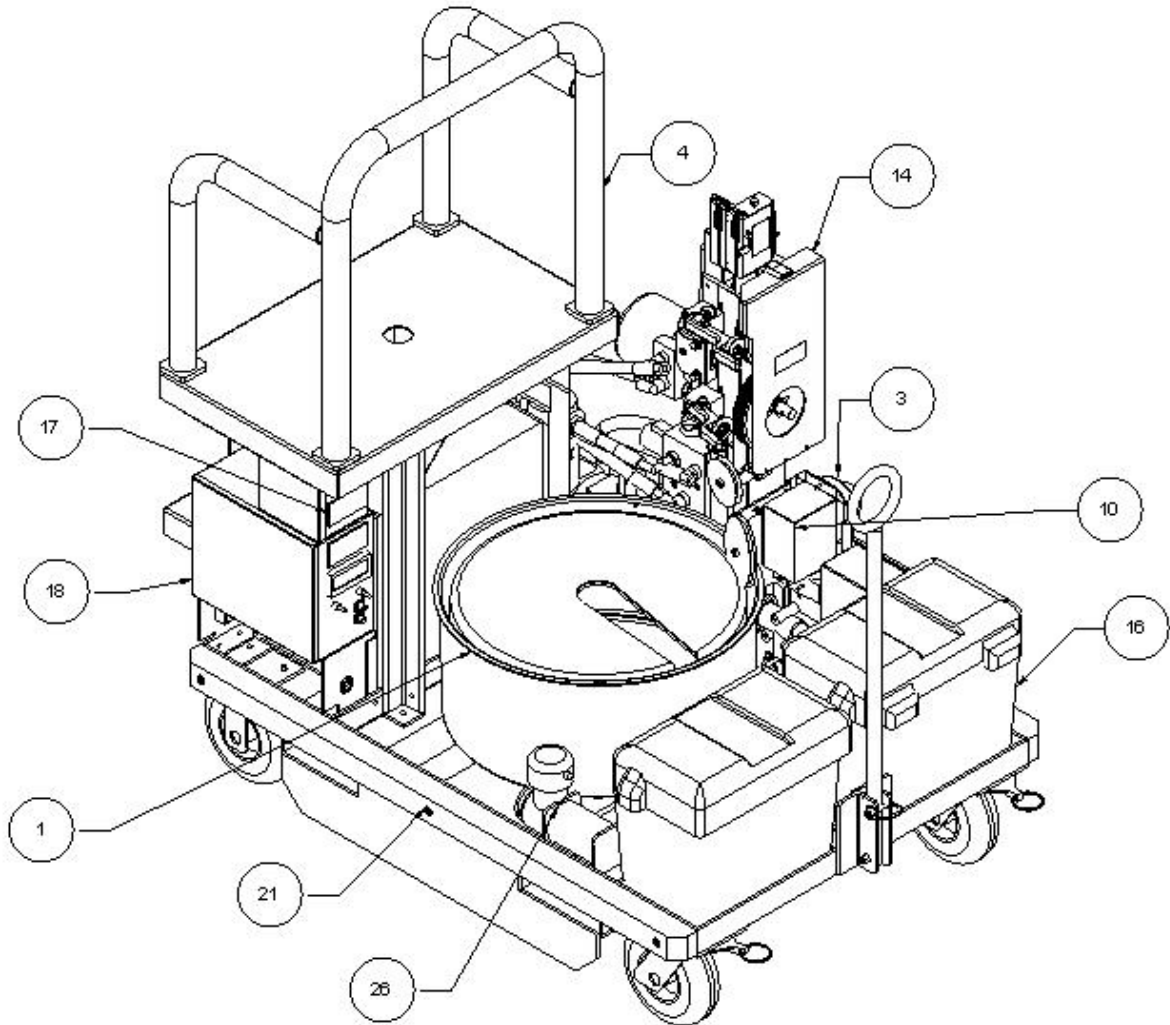
8.0) Standard Replacement Parts List

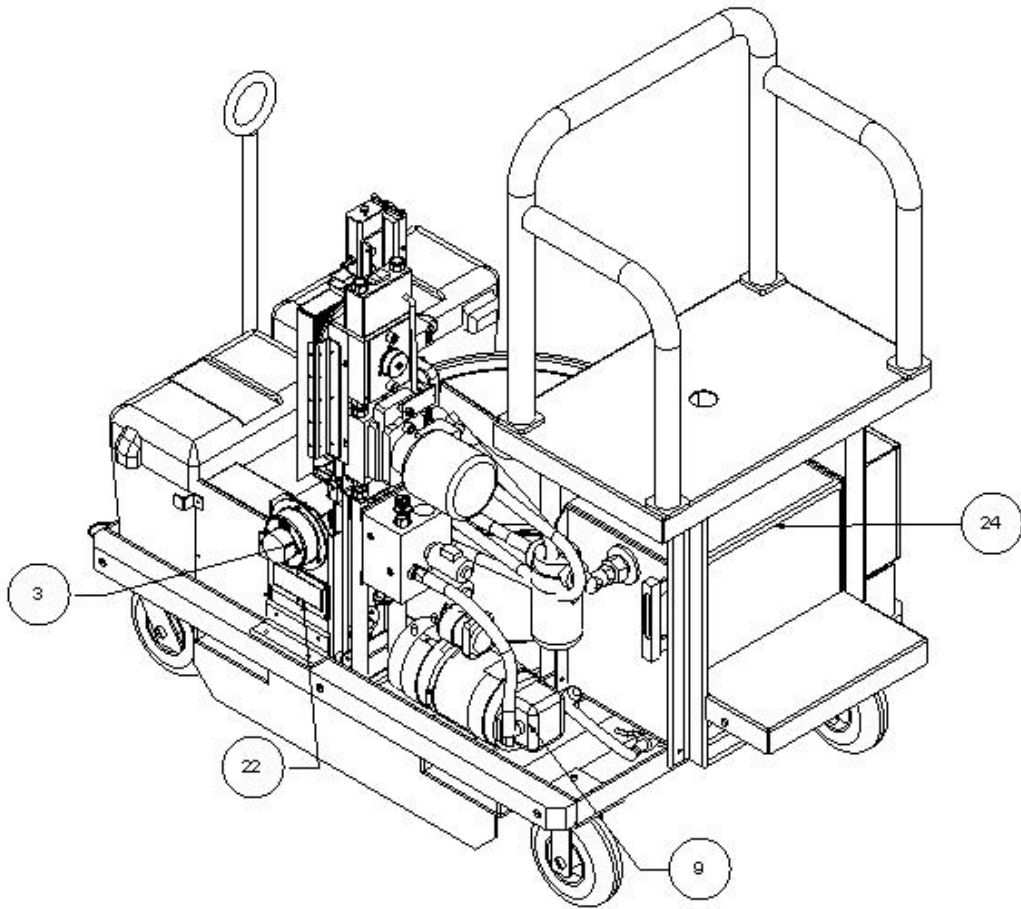
Parts List	
Part Name	Part Number
Batteries	
Battery (Main) MK8A31DT	ZGS-10056-1
Belts	
Drum Drive Belt	ZGS-10025-1
Vertical Drive Belt	ZGS-10040-1
Capstans and Cover	
Capstan Upper (orange) for 3/16" wire rope <i>(was ZGS-10113-20 is replaced by ZGS-12474-2)</i>	ZGS-12474-2
Capstan Lower (black) for 3/16" wire rope <i>(was ZGS-10113-20-1 is replaced by ZGS-12474-1)</i>	ZGS-12474-1
Capstan 1/8" diameter wire rope	ZGS-10113-40
Capstan 5/32" diameter wire rope	ZGS-10113-30
Capstan 3.5 mm diameter wire rope	ZGS-10340-1
Capstan Cover Assembly	ZGS-10328-4
Drum & Spooler	
Rotatub	ZGS-10022-1
Spooler	ZGS-10357-1
EC Hook Cable Spooler [For use only with the EC145 and EC135 Hook]	ZGS-11134-1
Plug for Rotatub	ZGS-10149-1
Encoders	
Encoder Assembly	ZGS-10301-1
Filters	
Oil Filter Cartridge - Donaldson P176565 Hydraulic Filter	ZGS-10069-2
Handles	
Tow Handle	ZGS-10111-1
Load Indicators	
Load Cell Assembly	ZGS-10316-1
Lubridryer	
Lubridryer Bushings	ZGS-10126-1
Lubridryer Pads (100 in the package)	ZGS-10104-10
Motor/Pumps	
Motor/Pump Assembly	ZGS-10017-1
Tensioning Wheels/Rollers	
Tension Release Pins	ZGS-10047-1
Pressure Roller Assembly	ZGS-10127-1
Exit Roller Assembly	ZGS-10294-1
Tension Wheel Small	ZGS-10258-1
Tension Wheel Large	ZGS-10259-1

Fuses (commercially available)	
Compressor Fuse - 15 amps (1per)	NA
Control Fuse - 5 amps (1per)	NA
Length Readout - 1 amp (1per)	NA
Load Readout - 1 amp slow blow (1per)	NA
Main Fuse 200 amps (1per)	ZGS-10287-1
MagSens Circuit - 1 amp (1per)	NA

8.1) Illustrated Parts Breakdown

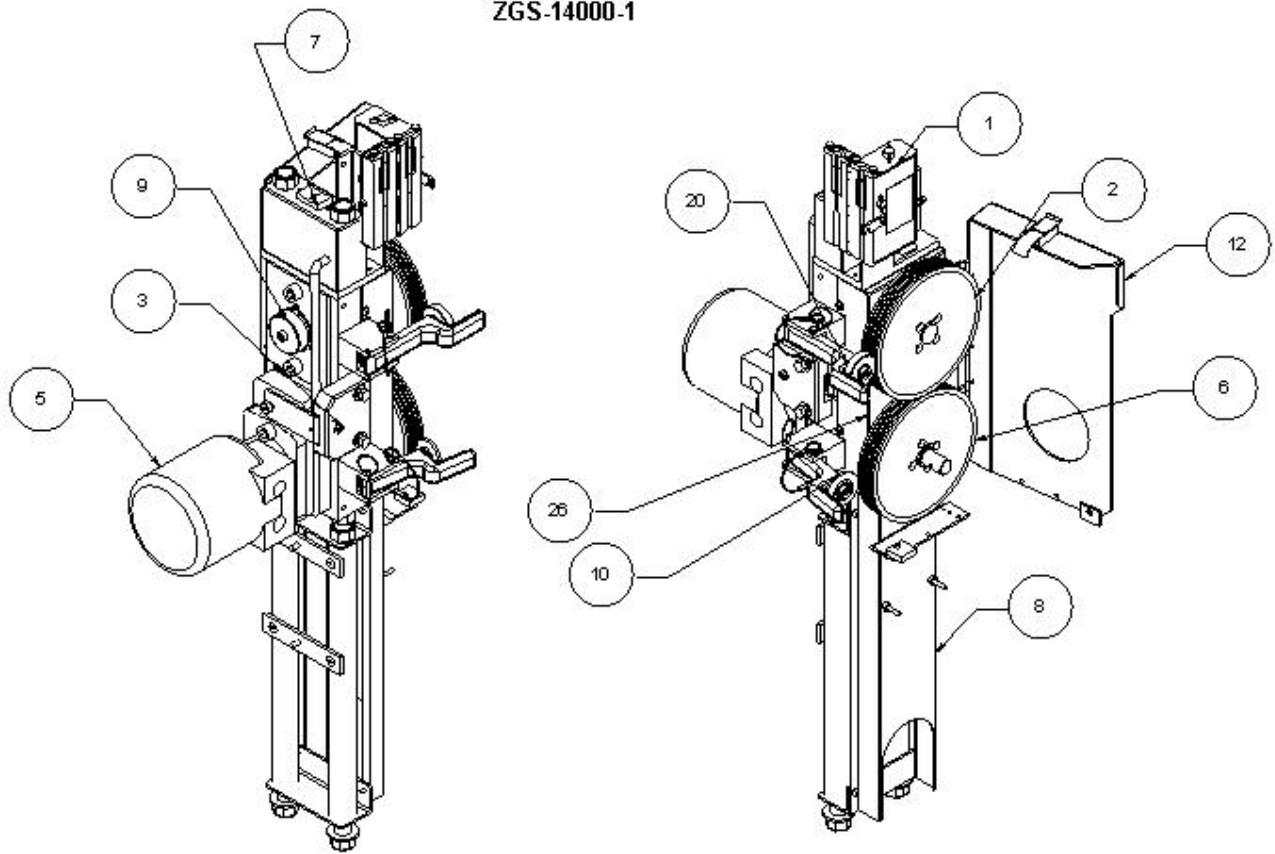
ZGS-10000-5-2





Item Number	Quantity	Part Number	Part Name	Revision	Comment
1	1	ZGS-10022-1	Tab , GSE		
2	1	ZGS-10357-1	Spooler Basic		
3	1	Marinco # 2101	Battery Selector Switch		
4	1	ZGS-10457-1	Work Platform		
5	1	ZGS-10479-2	2 inch Pulley Assembly upper		
6	1	ZGS-10375-1	Capstan Cover Switch Assembly		
7	1	ZGS-10068-1	Manifold Assy		
8	2	ZGS-10056-1	8A31 MK Battery		
9	1	ZGS-10017-1	Motor Pump Assembly		
10	1	ZGS-12671-1	28 Volt Battery Switch Cover		
11	1	CLP-16S	LS Actuator Clevis Pin		
12	1	ZGS-10040-1	Drive Belt, Vertical		
13	1	ZGS-10025-1	Drive Belt, Drum		
14	1	ZGS-14000-1	Upright assembly improved		
15	1	ZGS-10149-1	Tab Plug		
16	2	ZGS-10078-1	Battery Box		
17	1	ZGS-10192-1	Cable Length Digital Display		
18	1	ZGS-10300-1	Control Station No MagSens		
19	1	ZGS-10362-1	Tension Wheel Assembly Small		
20	1	ZGS-10363-1	Tension wheel		
21	1	ZGS-10359-1	Phantom Assy 1		
22	1	4650B	28 volt Receptacle		
23	1	ZGS-10057-1	TPRO Charger		
24	1	ZGS-10095-2	Hydraulic Tank Assembly v1		
25	1	ZGS-10479-1	2 inch Pulley Assembly		
26	1	ZGS-10052-1	32538 Vair Compressor		

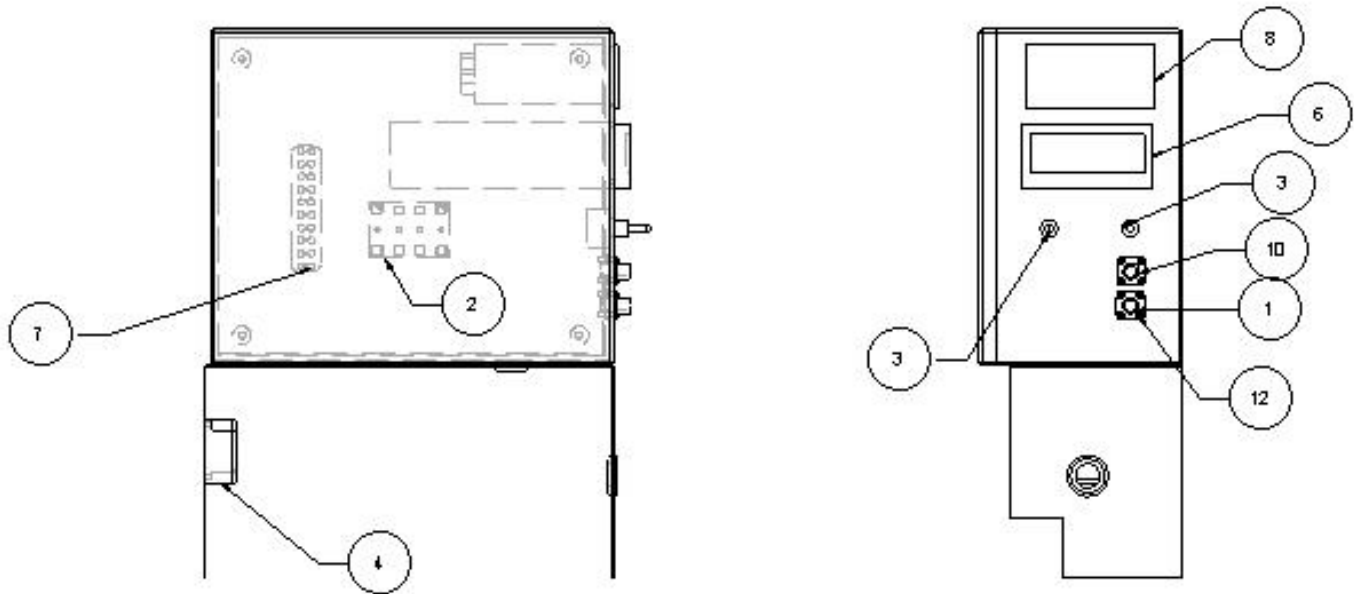
ZGS-14000-1



Item Number	Quantity	Part Number	Part Name	Revision	Comment
1	1	ZGS-10048-1	LubriDryer Assembly		
2	1	ZGS-10113-20	Capstan ML6		
3	1	ZGS-10316-1	Load Cell Assembly		
4	1	ZGS-10107-1	Roller Chain		Under Chain Cover
5	1	ZGS-10067-1	0080 Hyd Motor		
6	1	ZGS-10113-20-1	Capstan ML6-80		
7	1	ZGS-10063-1	SW3823 Rocker Switch		
8	1	ZGS-10045-1	Belt Guard Assembly		
9	1	ZGS-10301-1	Encoder Assembly		
10	1	ZGS-10127-1	Tension Roller Assy		
11	1	MMC #1674A62	Magnetic Catch		
12	1	ZGS-10328-4	Capstan Cover Assy Magnetic Latched		
13	1	ZGS-10123-1	Capstan Pulley Key		
14	1	32828238	Grommet .25 ID		
15	2	8-32 x .375 Pan Head	8 32 x .38		
16	1		8-32 nut		
17	1	ZGS-11220-1	Tensioner PivotArm, Lower Shipboard		
18	1	8-32 x .375 Pan Head	8 32 x .75		
19	1	ZGS-10374-1	Wiring Harness Assembly		
20	1	ZGS-10129-1	Tensioner assy upper		
21	1	ZGS-10330-1	Lanyard Assy		
22	1	ZGS-10114-2	Base, Tensioner Lite		
23	1	ZGS-10046-1	Latch Catch		
24	1	FPSC3-15R	Tension Release Pin Long		
25	1	CLP-48S	Clevis Pin Tensioner		
26	1	ZGS-11064-1	Chain Guard Cover Assy		

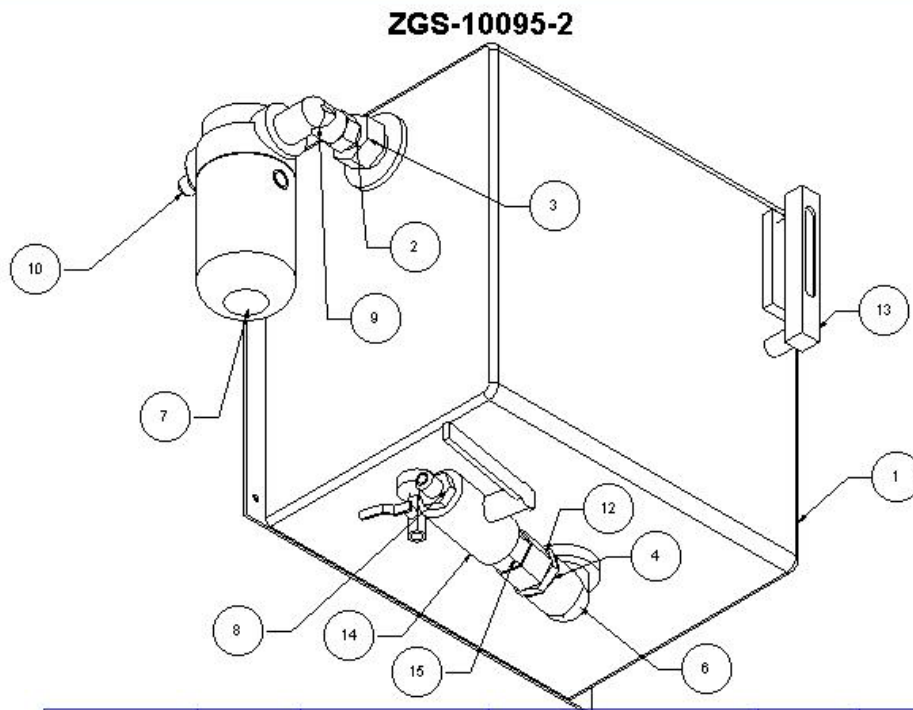
Control Station ZGS-10300-1

Control Station ZGS-10300-1



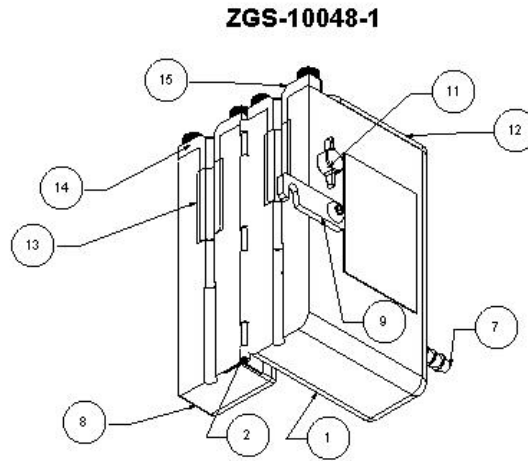
Item Number	Quantity	Part Number	Part Name	Revision	Comment
1	1	MS3112E8-4P	Box Receptacle, Load		
2	1	ZGS-10168-1	Fuse Block		
3	2	ZGS-10157-1	Power Switch		
4	1	ZGS-10191-1	Piezo Siren		
5	1	ZGS-10158-1	Box Support		
6	1	ZGS-12109-3	Load Cell Display Meter 12 VDC		
7	1	ZGS-10163-1	Terminal Board		
8	1	ZGS-10192-1	Cable Length Digital Display		
9	1	ZGS-10292-1	Control Box No MagSens		
10	1	MS3112E8-4S	Box Receptacle, length		

Hydraulic Tank Assembly ZGS-10095-1



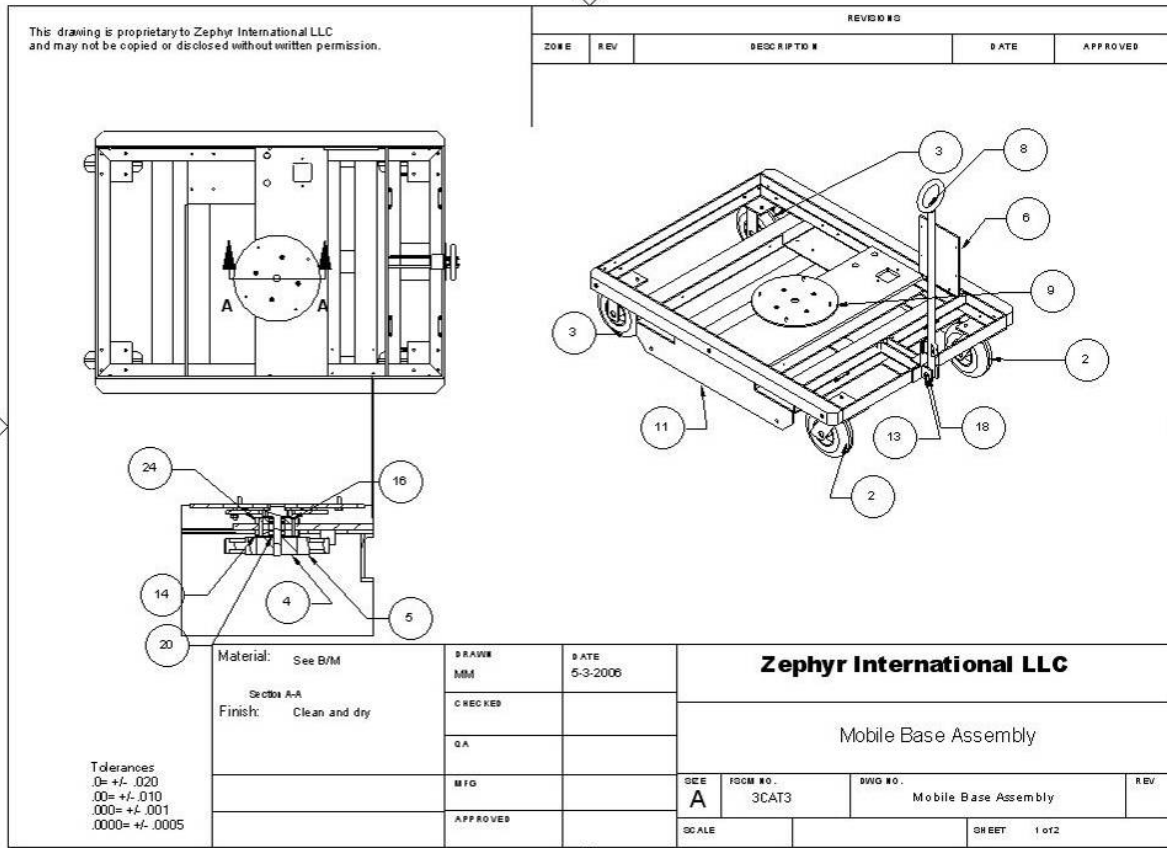
Item Number	Quantity	Part Number	Part Name	Revision	Comment
1	1	ZGS-10070-1	Hydro Slave Tank		
2	1	12-3/4 F50F	12- .75 F50F Adapter		
3	1	1 1/4 x 3/4 PTR	1.25 x .75 PTR		
4	1	1.25 x 1 PTR	1.25 x 1 PTR		
5	1	ZGS-10252-1	.25 Ball Valve		
6	1	1 1/4CD	1.25 NPT Street Elbow		
7	1	ZGS-10069-1	Filter		Donaldson P176565 element
8	1	12-16 F50X	12-16 F50X Straight thread Conne		
9	1	12 A0EG5	SAE 12 Elbow		
10	1	8-12 F50X	8-12 F50X Straight thread Connec		
11	1	ZGS-10253-1	.25 close nipple		
12	1	1-16 FHG5	1-16 FHG5		
13	1	G617-05-A-1-4	Sight Gage		
14	1	77-905-01	Ball Valve SAE Ports		
15	1	16 F50HAD	16 F50HAD		

Lubridryer Assembly



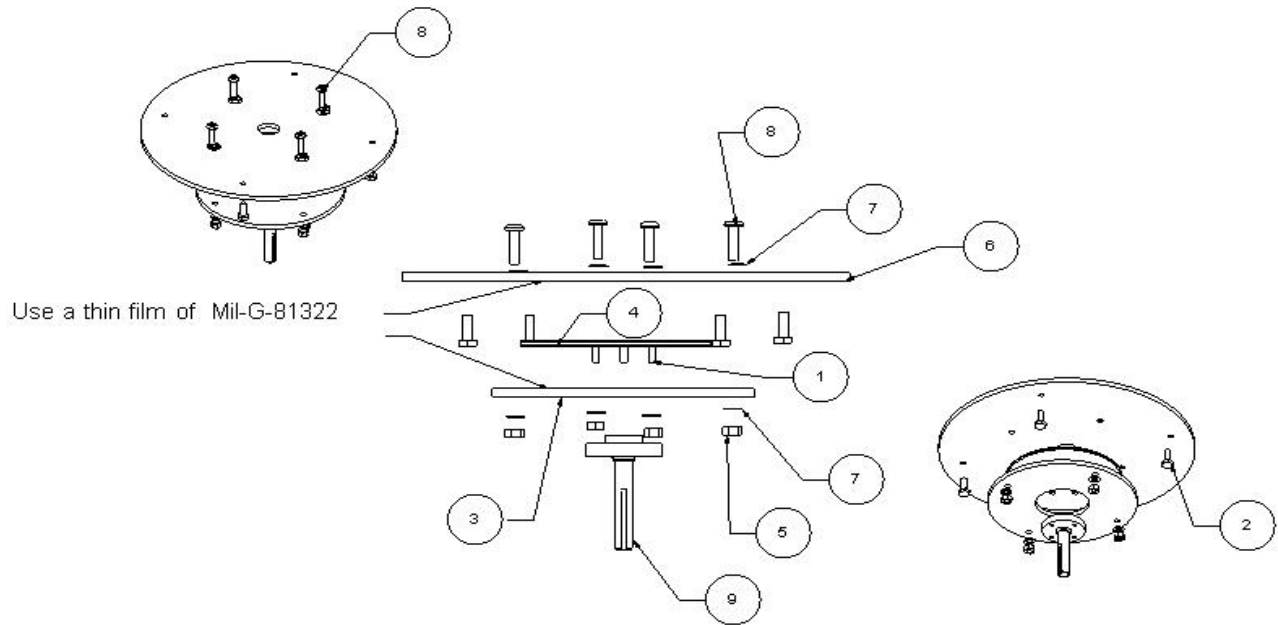
Item Number	Quantity	Part Number	Part Name	Revision	Comment
1	1	ZGS-10055-1	Oiler Tank Air Housing		
2	1	ZGS-10050-1	Capstan Hinge		
3	1	ZGS-10137-1	Lubridryer Screw Assembly		
4	1	MS01:J6411-FF	Label, Safety Instructions		
5	6	8-32 x .375 Pan Head	8 32 x .38		
6	1	1/4 Look Nut	.25 Look nut		
7	1		.25 NPT Air Fitting		
8	1	ZGS-10049-1	Oiler Dryer Front		
9	1	ZGS-10051-1	Oiler Latch		
10	2		10 32 x .5		
11	1	ZGS-10361-1	#10 Thumbscrew		
12	1	ZGS-10124-1	Lubridryer Cover		
13	2	ZGS-10104-1	Lubridryer Pad		
14	4	ZGS-10147-1	#6 Thumbscrew 1-2 in long		
15	2	ZGS-10126-1	Lubridryer Bushing		

Phantom Assembly 1



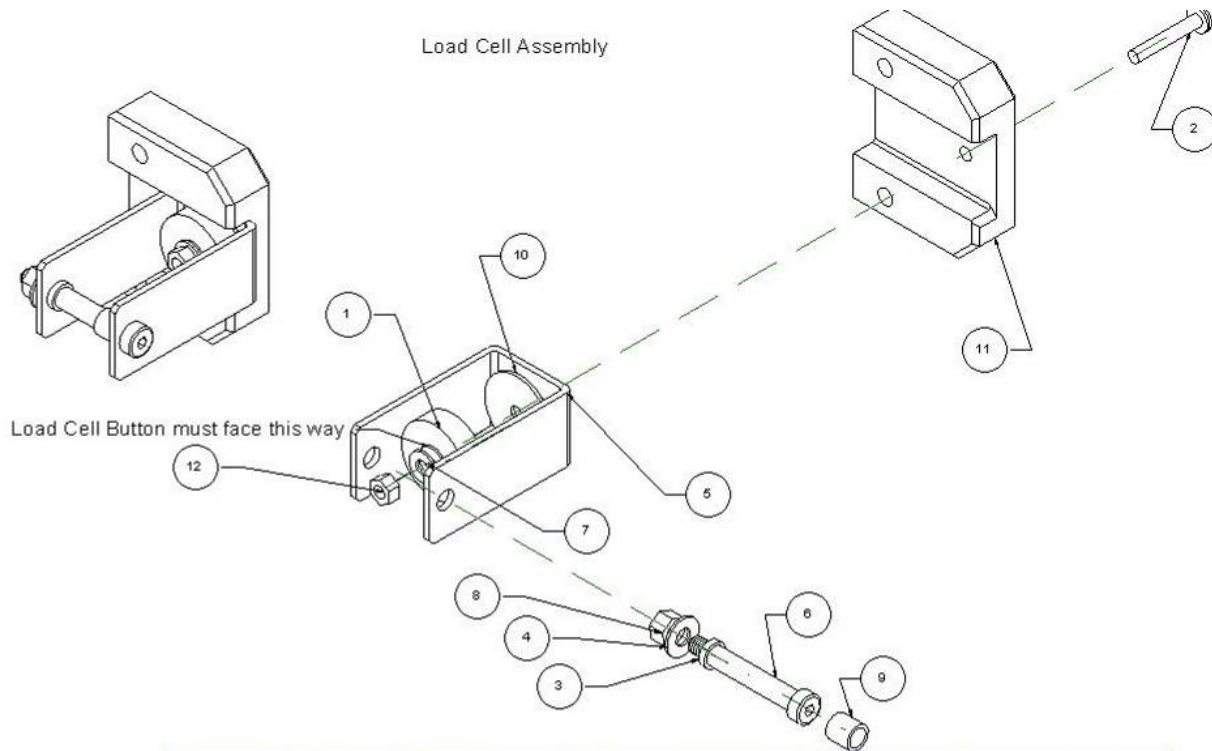
Item Number	Quantity	Part Number	Part Name	Revision
1	1	ZGS-10121-1	Axel Sleeve	
2	2	ZGS-10144-2	Swiveling Tornado Caster	
3	2	ZGS-10143-2	Rigid Tornado Caster	
4	1	ZGS-10024-1	Taper Lock 6 inch Pulley .5 inch br	
5	1	ZGS-10023-1	Pulley , 6 inch	
6	1	ZGS-10097-1	Charger Support	
7	2	ZL-1031-1	Leg, Mounting Standoff	
8	1	ZGS-10111-1	Tow Handle	
9	1	ZGS-10248-1	Infinity adjustable platen assy	
10	1	ZGS-10195-1	Side Guard	
11	1	ZGS-10001-2	Frame Assembly Basic	
12	1	ZGS-10265-1	Side Guard, Steel	

Infinately Adjustable Platten



Item Number	Quantity	Part Number	Part Name	Revision	Comment
1	4		10-32 Flat Head .625 long		
2	4	1/4-20 x .75" long Cap S	.25 x .75 cap screw		
3	1	ZGS-10176-2	Infinately adjustable Lower plate		
4	1	ZGS-10175-2	Infinately Adjustable Platten Plate		
5	4	1/4 Lock Nut	.25 Lock nut		
6	1	ZGS-10180-2	Infinately Adjustable Platten Top Plat		
7	8	ZGS-10183-1	Belleville Washer		
8	4	ANSI B18.6.3	1-4 x 28 x 1 machine screw		
9	1	ZGS-10020-1	Axel		

Load Cell Assembly



Item Number	Quantity	Part Number	Part Name	Revision	Comment
1	1	ZGS-11099-2	Thru Hole Load Cell		Assy with connector is ZGS-10316-1
2	1	ANSI B18.6.3	1-4 x 28 x 1.5 machine screw		
3	1		3-8 shaft spacer .12 long		
4	1		.312 Flat Washer		
5	1	ZGS-11113-1	Load reaction clevis		
6	1	ZGS-10190-1	.375 stripper bolt 2 long		
7	1		.25 Flat Washer		
8	1	5/16 -18 Locknut	.312 locknut		
9	1		3-8 shaft spacer .5 long		
10	1	1/4- 1 1/4	Fender Washer		
11	1	ZGS-11112-1	Load Brake Support		
12	1	1/4 Lock Nut	.25 Lock nut		

Hook Check Tether- ZGS-10519-1

9.0) Technical Support

Please contact Zephyr International LLC with any questions
 1-843-365-2675 zephyrintl@rcn.com