



Rescue Hoist Ground Support Equipment Electric Version

Zephyr International LLC
Introduction and Training
Information

Overview of Training Program

- Introduction of system
- Benefits to the Users
- Theory of Operation
- When to use the GSE
- How to use the GSE
- General Maintenance

Introduction

- ZGS-11300-1
 - Mobile Electric Rescue Hoist Ground Support Equipment (RHGSE)

RHGSE Purpose

- The equipment is designed to assist in inspecting and maintaining the rescue hoist and the wire rope on the ground
 - It is not intended to perform repetitive tests of the hoist system without in-flight hoist operations in-between RHGSE operations
 - repetitive extension and retraction of the cable without using the hoist in flight is not recommended
 - the hoist cable may start to exhibit looseness near the ball end after excessive repetitive operations on the ground
 - Extending the cable in flight redistributes the strain in the outer layers of the hoist cable and tends to tighten the cable up in a cable with loose outer strands

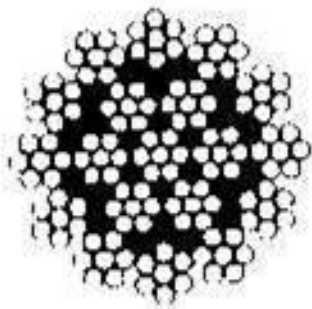
RHGSE Purpose

- Tension the RH wire rope on the hoist at all times during maintenance
- Protect the RH wire rope from damage due to improper ground handling or lack of space
- Clean, dry and lubricate the RH wire rope easily and quickly
- Provide RH wire rope objective inspection data and records
- Save the user time and money!!

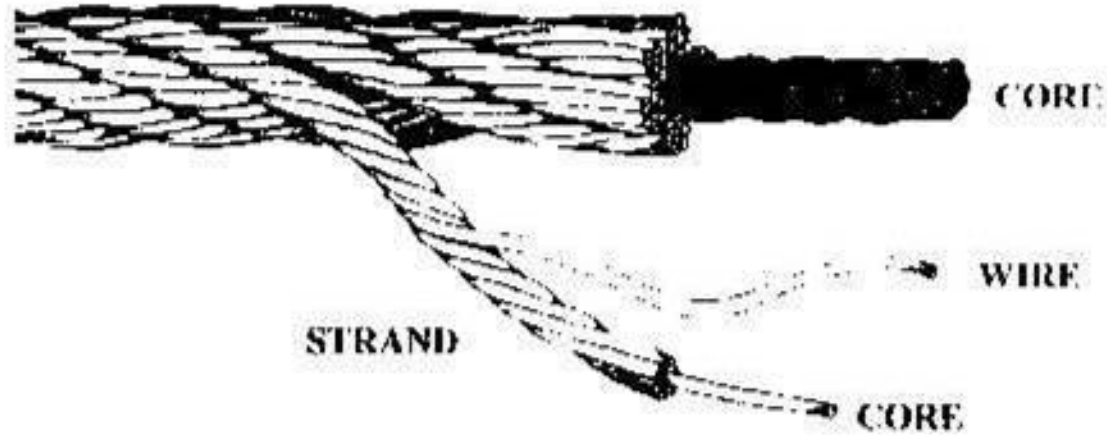
Cable Construction

- Let's digress here and talk about the cable and how it is made for a minute

Wire Rope Construction



**19 X 7
19 STRANDS
7 WIRES /STRAND**



Wire Rope Balance

- Inner and outer strands are wrapped around the inner wire rope core.
- Inner and outer strands oppose each others tendency to twist.
- Proper balance insures equal load sharing between the inner and outer strands.
- Unbalanced rope tends to loosen up.

What's the point?

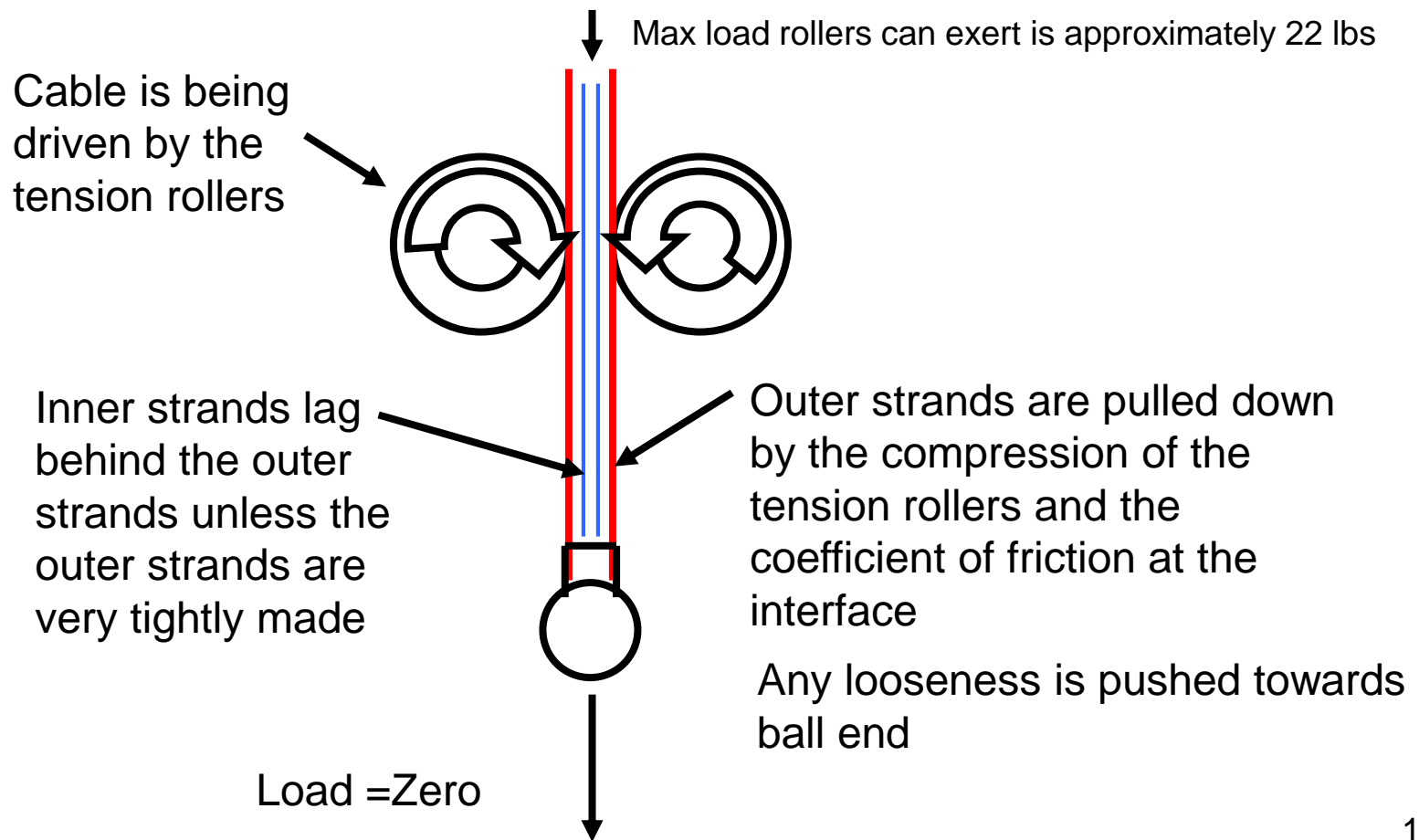
- Repeated running the hoist under no load on the ground
 - The hoist's tension rollers tend to milk all the inherent looseness in the cable's outer strands down to the ball end
 - Repetitive operation of the hoist with the RHGSE does not make the situation any better or worse

Why Cables get loose

- Manufacturing effects
 - Outer layer must be tight and remain tight over its installed life
 - Premature loosening is the result of the way the cable has been made
- Operational Effects
 - The rescue hoist tension rollers have an effect
 - The operational spectrum has an effect

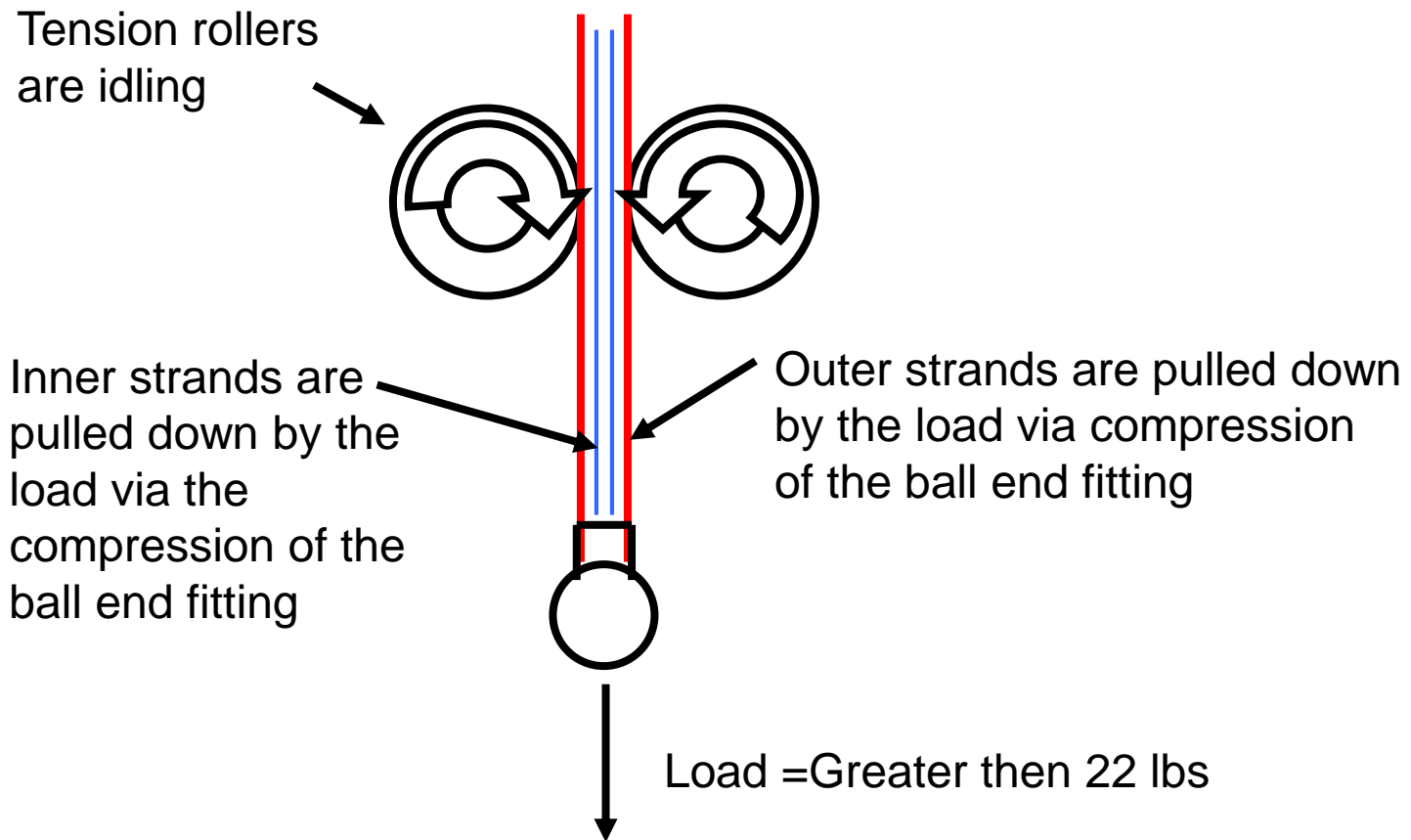
No Load Lowering

Effects of rescue hoist tension rollers



Loaded Cable Lowering

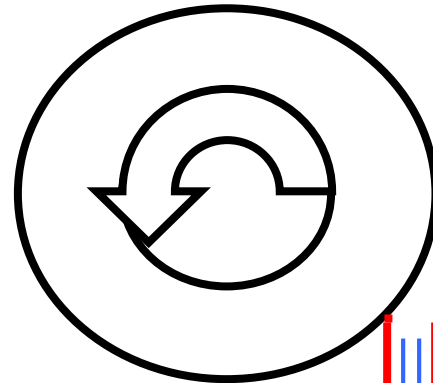
Effects of rescue hoist tension rollers



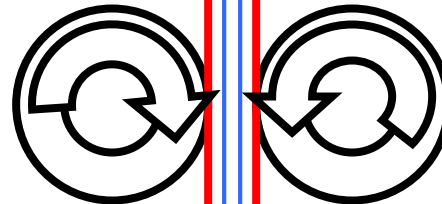
No load Raising

Effects of rescue hoist tension rollers

Tension rollers retard the outer strands while the cable is wrapped on the drum with approximately 20-30 lbs depending on how far out the cable is



Inner and outer strands are tensioned above the rollers by the capstan effect of wrapping the cable around the drum



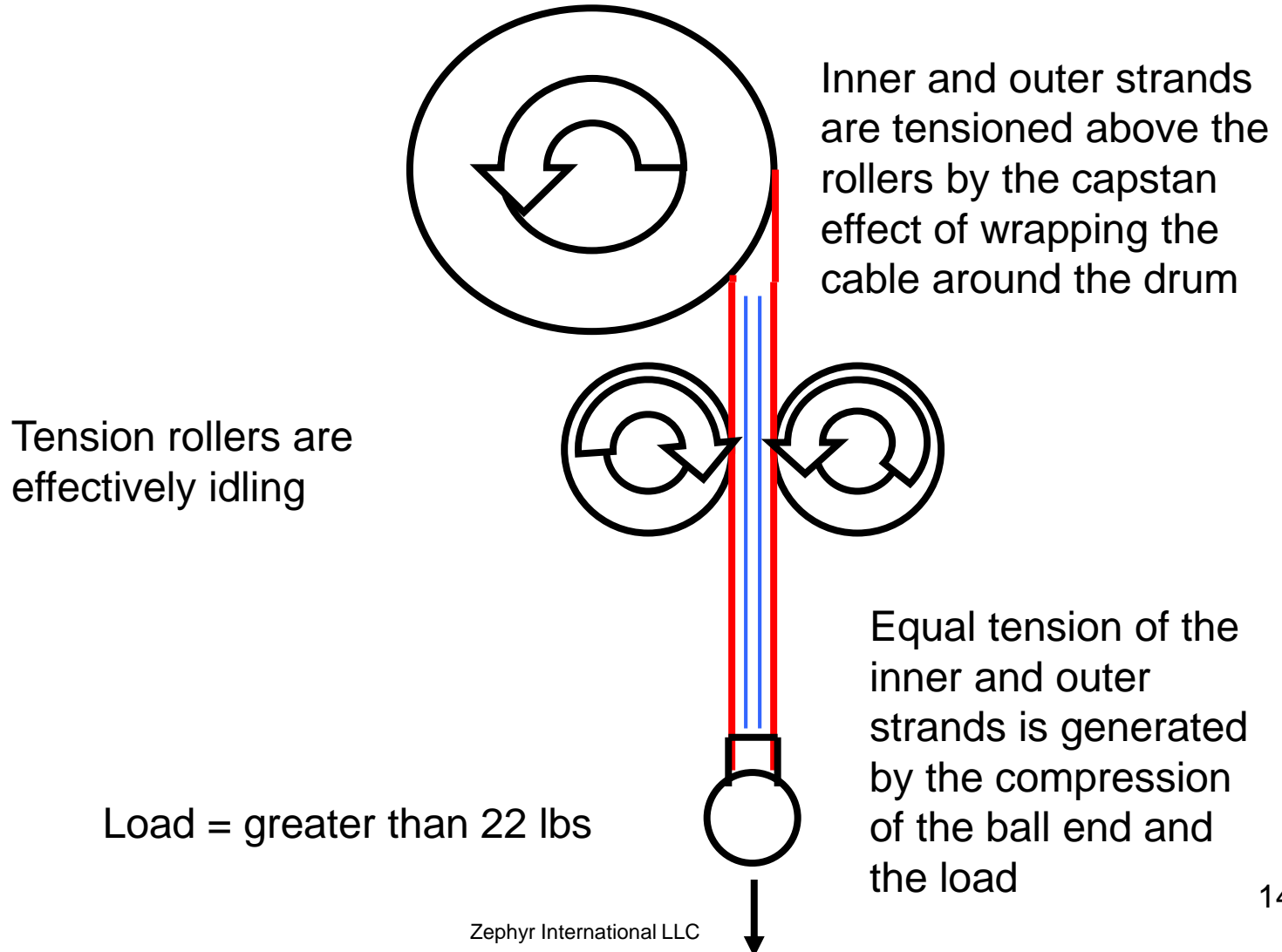
Any looseness of the outer strands are pulled toward the ball end by the tension rollers

Load = less then 22 lbs



Loaded Cable Raising

Effects of rescue hoist tension rollers



Back to the RHGSE

- When electricity is available you can use the electric mode.
- When it is not you can use the manual mode.

Back to the RHGSE

- The point is when extending, crank the handle so as not to let the cable become slack between and the top of the GSE and the hoist

RHGSE Design Attributes

- 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 positive manual 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 the rescue hook and bumper.
- Cleans and dries the wire rope during post flight inspections after salt water use.
- Lubricates the wire rope.
- Conditions and tensions a new wire rope before having to fly the helicopter.

RHGSE Usage Benefits

- Operate the rescue hoist under load without flying the aircraft
 - To check the hoist
 - To check the cable
 - To check the hoist / aircraft system
- Check the cable quickly and thoroughly
- Obtain increased knowledge of the condition of the cable
- Prevents cable loosening on drum and protects the cable at all time

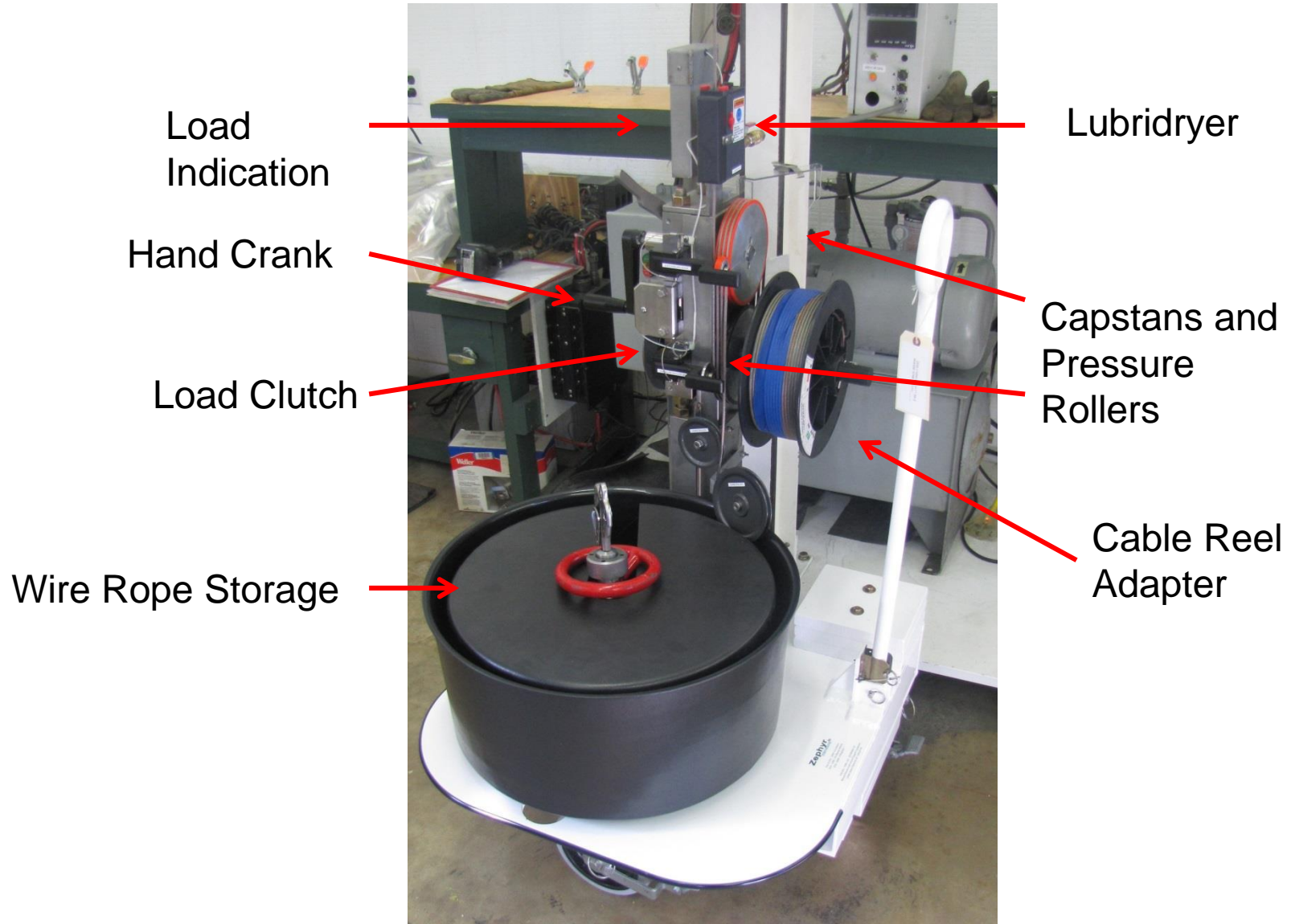
Theory of Operation

- The overall system is comprised of the following subsystems
 - Tensioning system
 - Load indicating System
 - Cleaning and lubricating system
 - Cable storage system

Technical Details

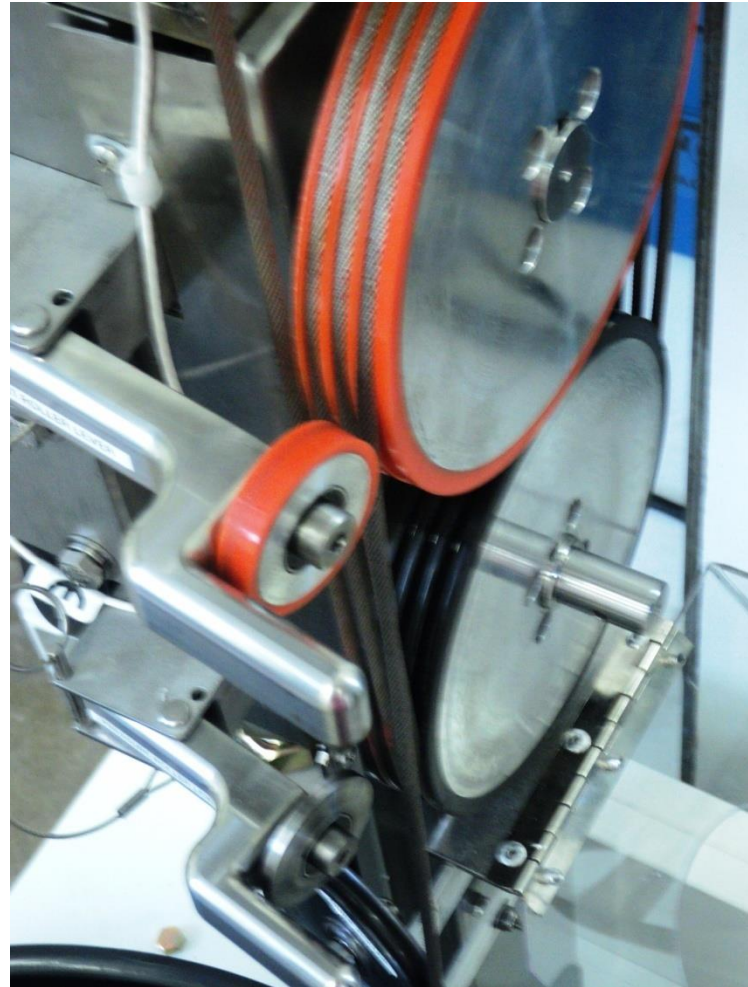
Subsystem components

- Hand crank
- Capstans and pressure rollers
- Load Clutch
- Load Indication system
 - Load cell
 - Display
- Wire rope storage
 - Rotatub
 - Spooler
- Lubrication and drying



Tensioning

- Prevents wire rope fouling on the rescue hoist when extending or retracting by applying tension to the wire rope via the dual capstans and hand crank or load clutch
- The tension is adjustable while retracting
- The tension is displayed to allow adjustment



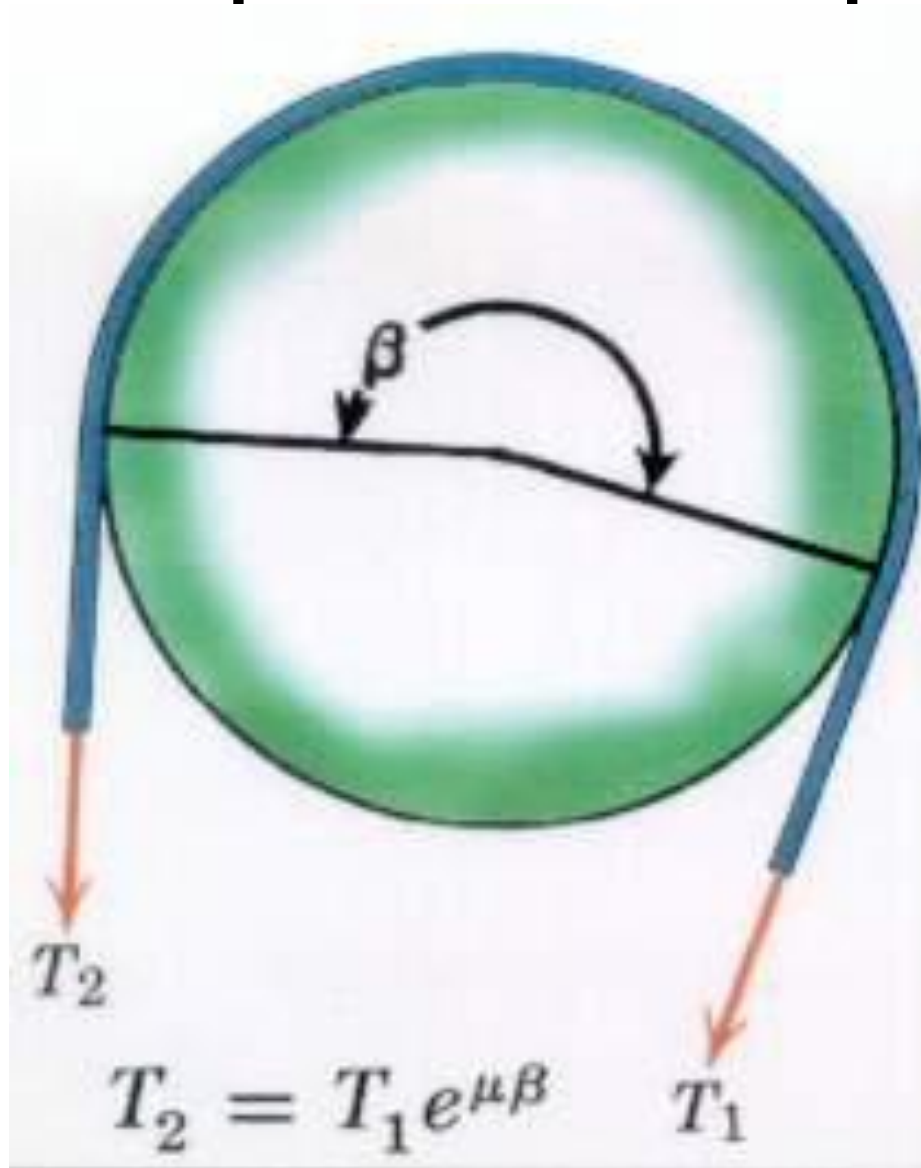


Hand crank is used to extend



Load clutch is used to retract

Capstan Principle

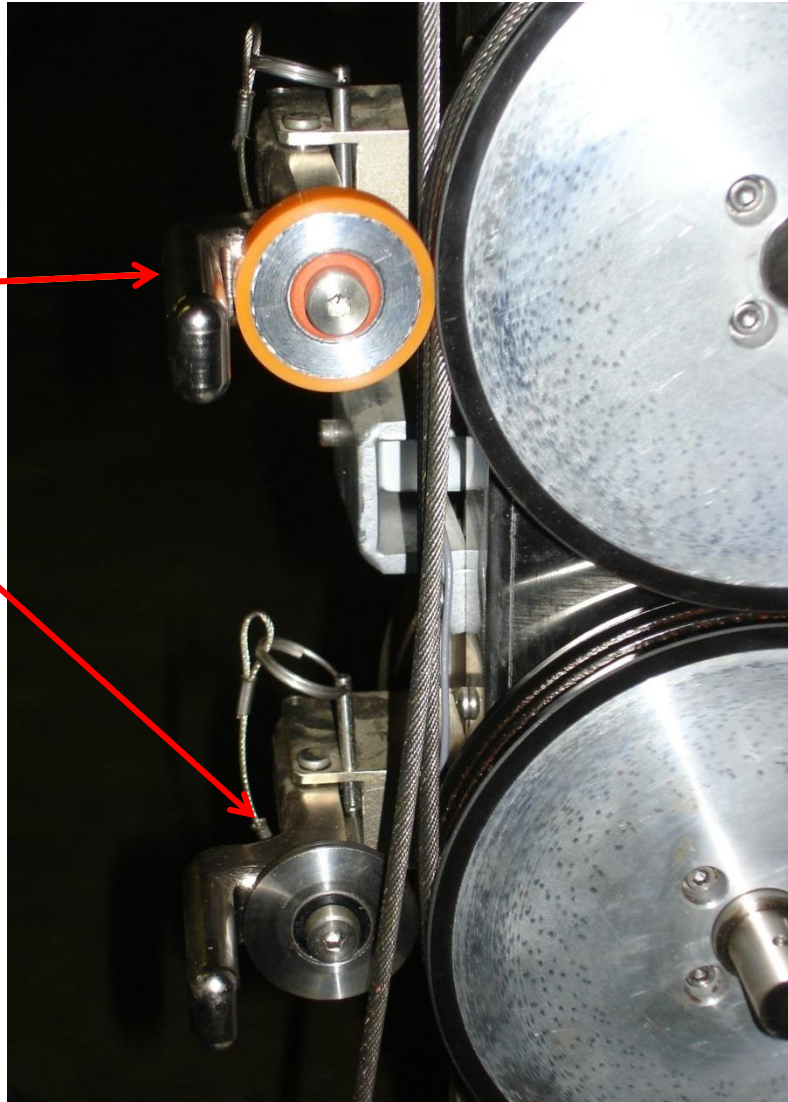


Tensioning

- 3 complete revolutions provides a high angle of wrap= β
- High coefficient of friction= μ
 - Affected by oil or water
 - Therefore with 1-2 lbs as T_1 , T_2 can be as high as 600 lbs
 - Slipping is function of load, i.e. the higher the load the more slip

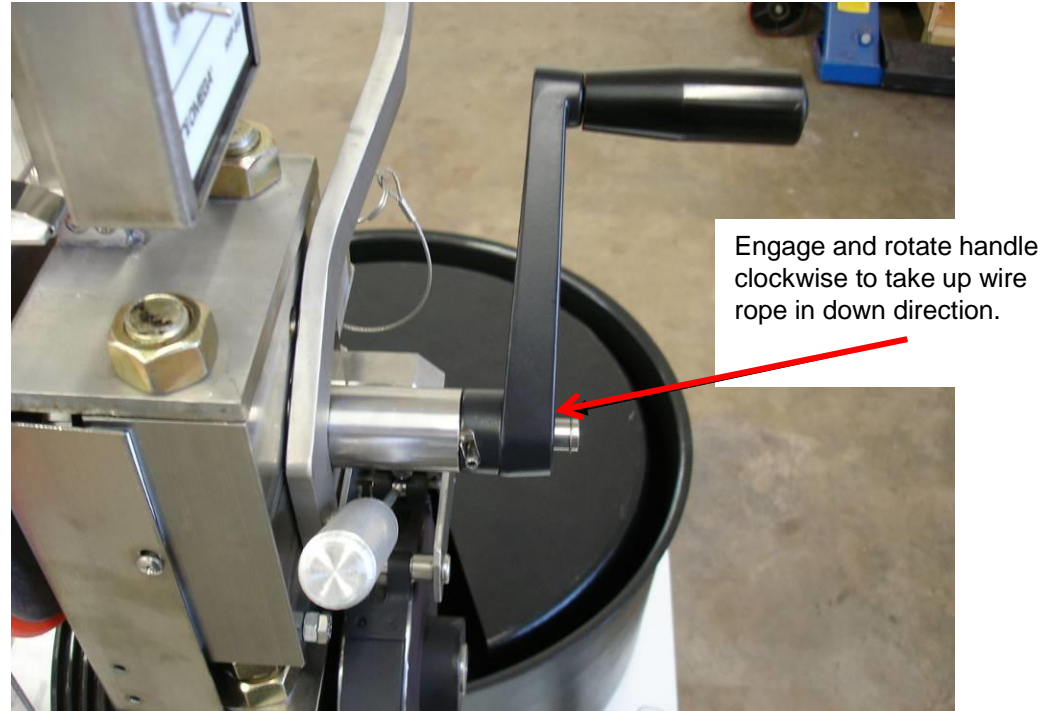
Exit and Pressure Rollers

The Exit and Pressure roller function is to keep the cable tight on the capstans at all times

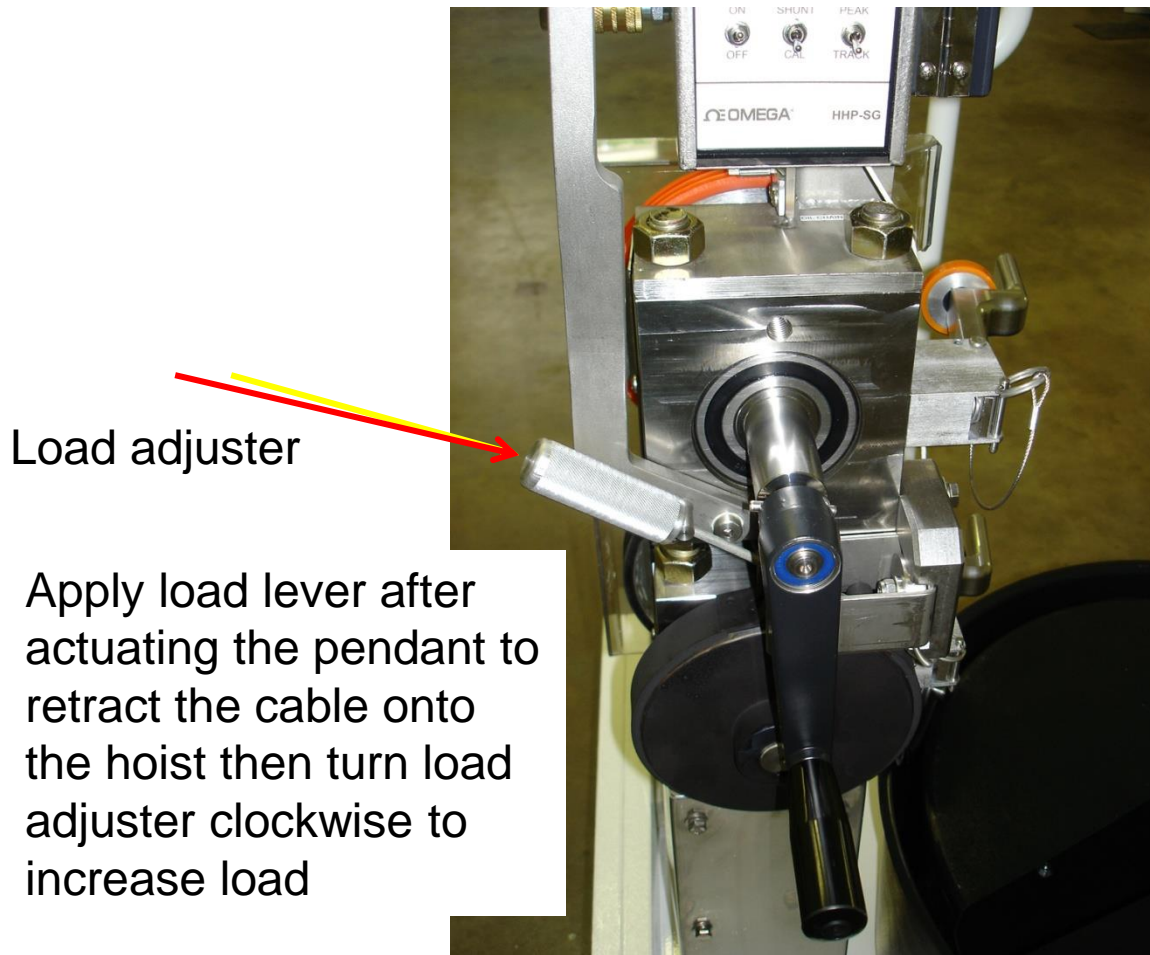


Extending the cable

Rotate handle clockwise to take up wire rope in down direction as the pendant is actuated to extend the hoist cable



Retracting cable under load



Load adjuster

Apply load lever after actuating the pendant to retract the cable onto the hoist then turn load adjuster clockwise to increase load

Load Indication System

Load adjuster

Load cell



Load indicator display



RHGSE Prevents Ground Handling Damage

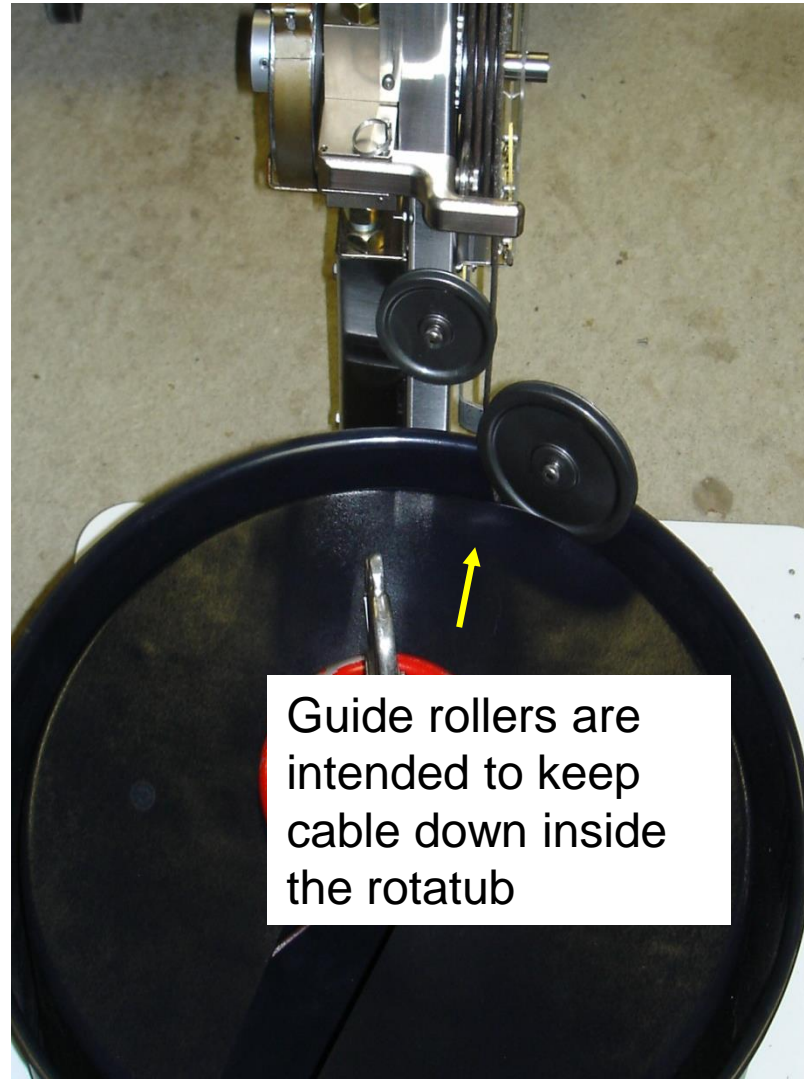
- Can be operated in confined spaces
- Prevents many risks of damage such as kinking and dirt and grit entrainment
- Prevents fouling of the wire rope on the hoist resulting from mishandling
- Prevents fouling of new wire rope by conditioning it

Wire Rope Storage & Protection

- Wire rope is stored neatly and evenly on a rotating drum that is timed exactly to match the rotation of the capstans

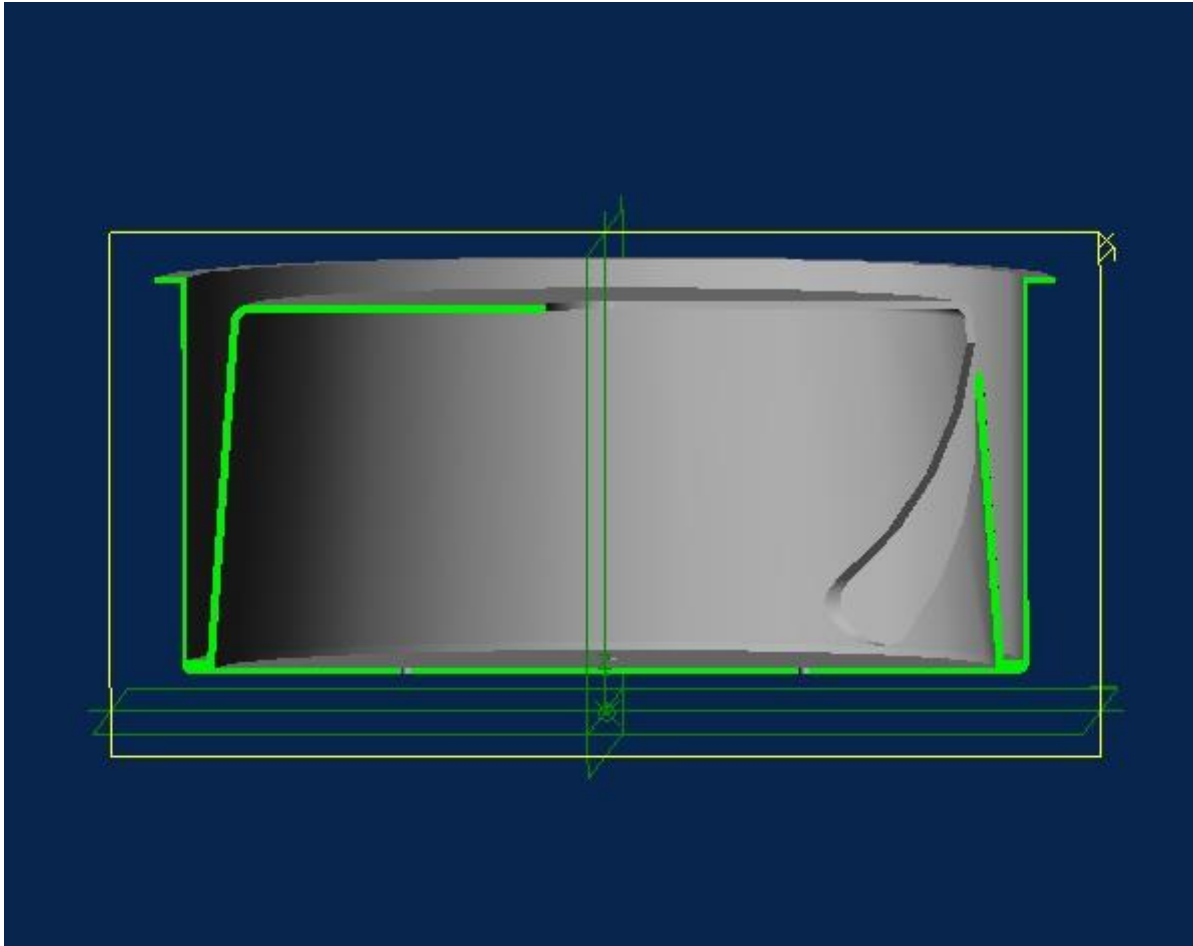


Cable Guide Rollers



Warning: Do not continue to operate the system if the cable rides to the top of the spooler, The Rotatub Clutch needs to be adjusted

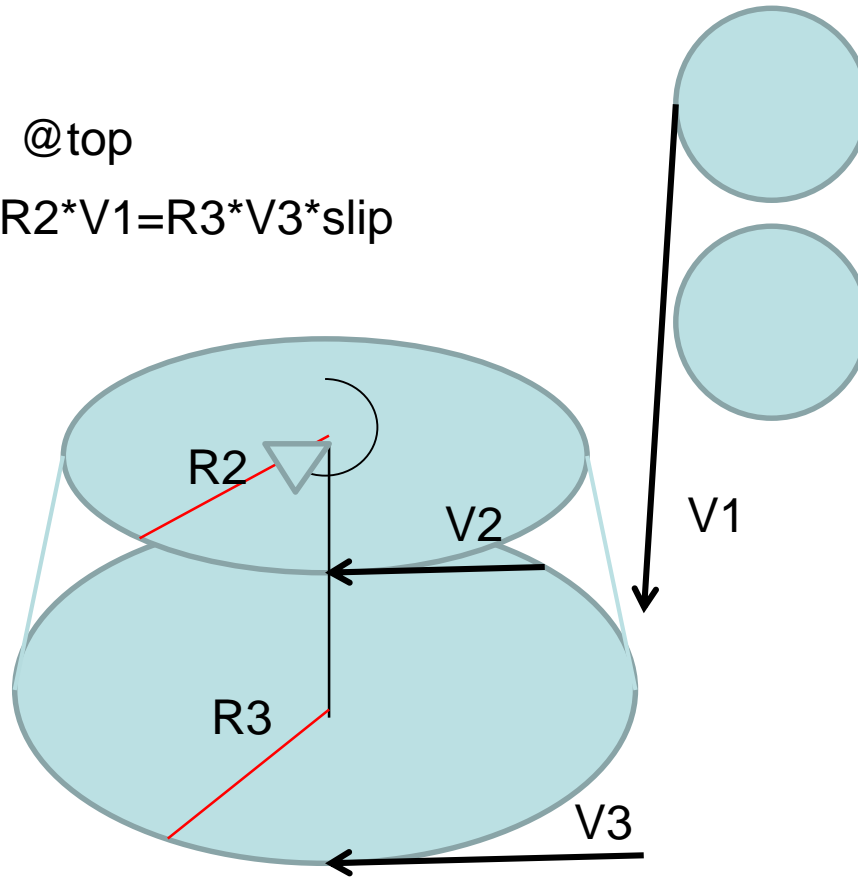
Rotatub and Spooler



Rotatub Clutch Slip

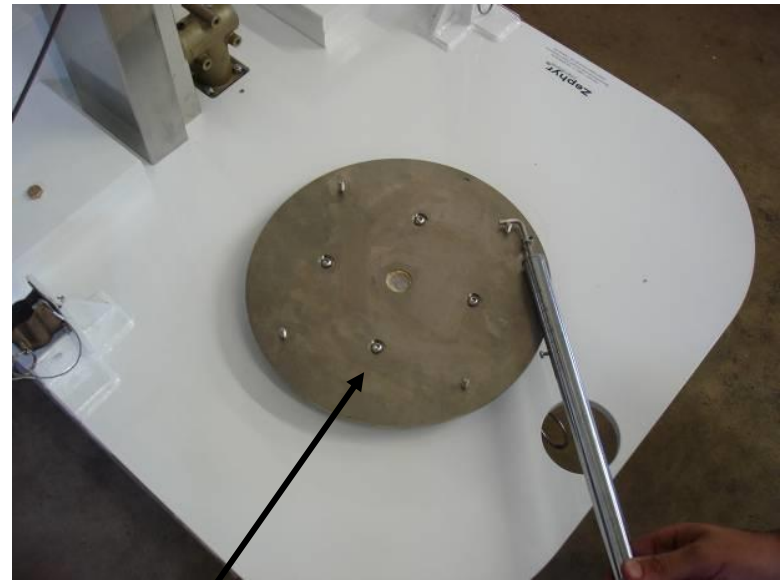
$V_2 = V_1$ @top

$R_2 \cdot V_2 = R_2 \cdot V_1 = R_3 \cdot V_3 \cdot \text{slip}$



Rotatub Position Compensation

- Rotatub and spooler are both independently adjustable
- Rotatub has a clutch to compensate for slip on the capstans
- Clutch is adjusted via (4) screws to obtain 5-6 lbs force with scale



Approx 6 lbs

Rotatub Slip Check



Cable diameter and condition

- The cable's diameter will affect the way the cable lays up in the Rotatub and Spooler
 - As the cable wears its diameter is reduced
 - The smaller the diameter of the cable the more it will slip on the capstans
 - The more it slips on the capstans the more it will ride to the top of the Spooler
 - The Spooler speed can be slowed to allow the cable to fall to the bottom of the Rotatub
 - **Never let the cable ride to the top of the spooler and escape the Rotatub**

When retracting close to full up

- Always watch the cable inside the rotatub to slow down and stop the hoist before the cable comes out of the spooler and hits the pressure roller
- **Caution: Failure to stop the hoist before the hook comes out of the Rotatub may cause damage to the RHGSE and the wire rope. Pay close attention to the number of turns in the Rotatub as the hook approaches the up limit position.**

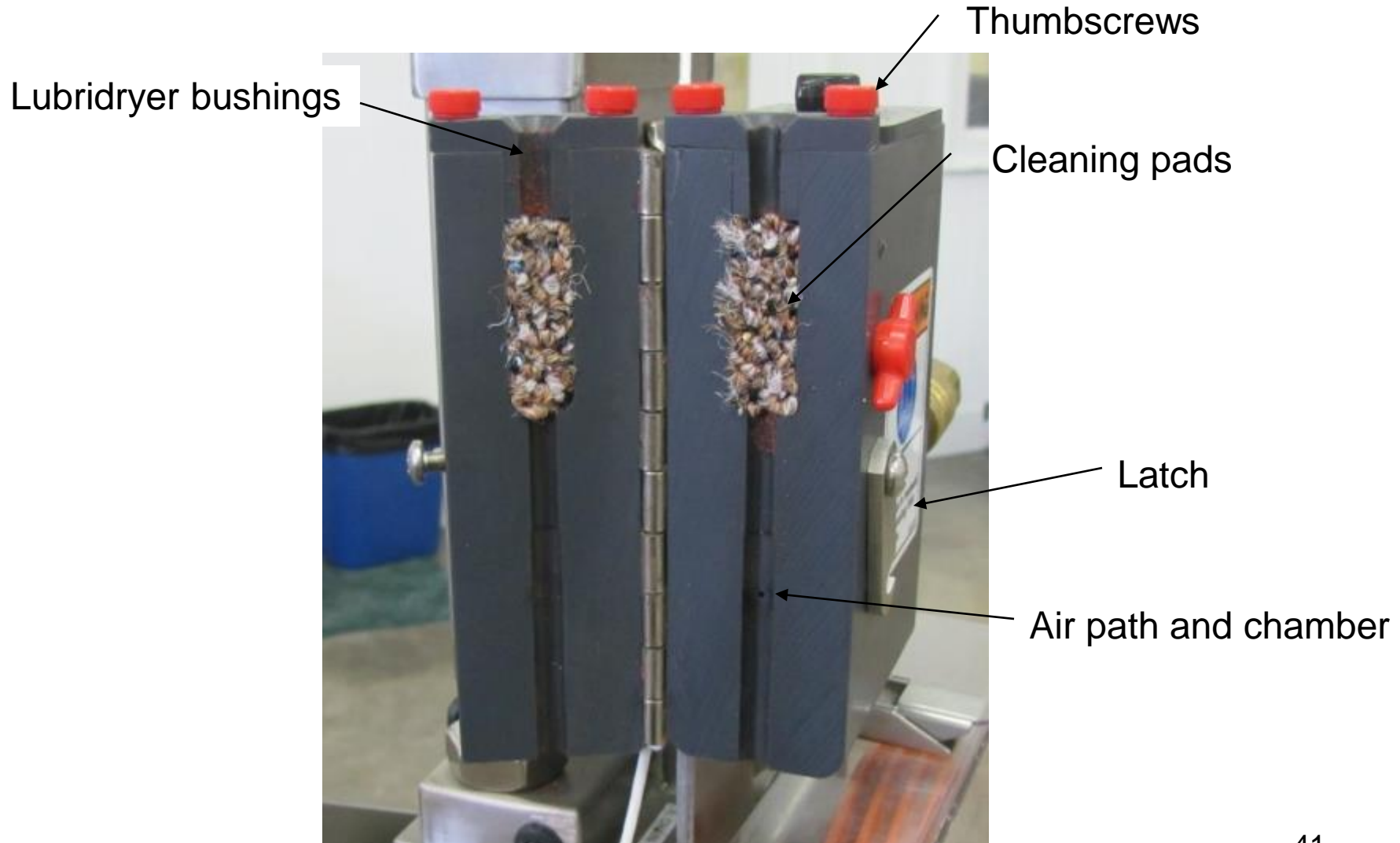
Cleaning, Drying, Lubricating the Cable

- Lubridryer uses pads to wipe debris, or salt off of the cable
 - Pads are easily replaced after every use or as required
 - Replace the pads after extending and before retracting to remove all saline residuals
- Rotatub can be filled with water to rinse off saline residuals
- Use of compressed air can blow water off of the cable as it is retracted

Cleaning and Desalinating



Lubridryer

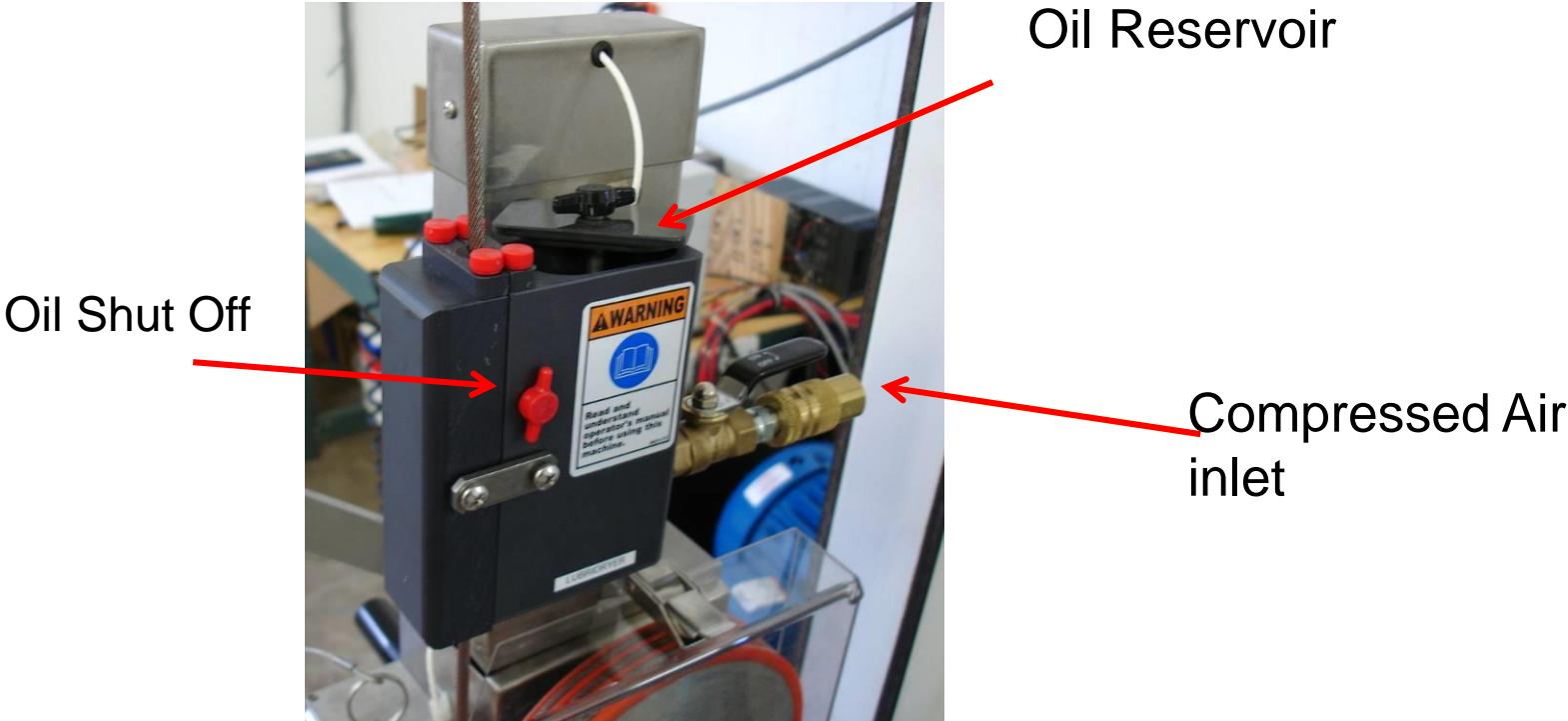


RHGSE Provides Wire Rope Cleaning

- Accomplished by a combination of water washing and pulling the wire rope through a set of cable pads
- The pads can be fed oil if required by the hoist OEM
- Wire Rope is dried by compressed air to remove the majority of the water entrained by the wire rope during desalinization



Wire Rope Cleaning and Drying



Capstan Cover

- Always close cover to prevent entanglement
- Cover Opens to the side



Cable Reel Adapter

- Allows unwinding and reeling on a new cable



When to use the GSE

- For Post Flight inspection when rescue hoist has been used
- To perform a 30 Day cable inspection if the hoist has been in use
- When changing a cable
- Whenever a cable is reeled out beyond the top layer to re-tension the cable
- To check hoist functions

Post Flight when hoist has been used

- To inspect the length of cable that was used
 - Verify no new damage
 - Provide a record
- To wash off saline residuals
- To restore tension on the lower layers
- To verify hoist functions

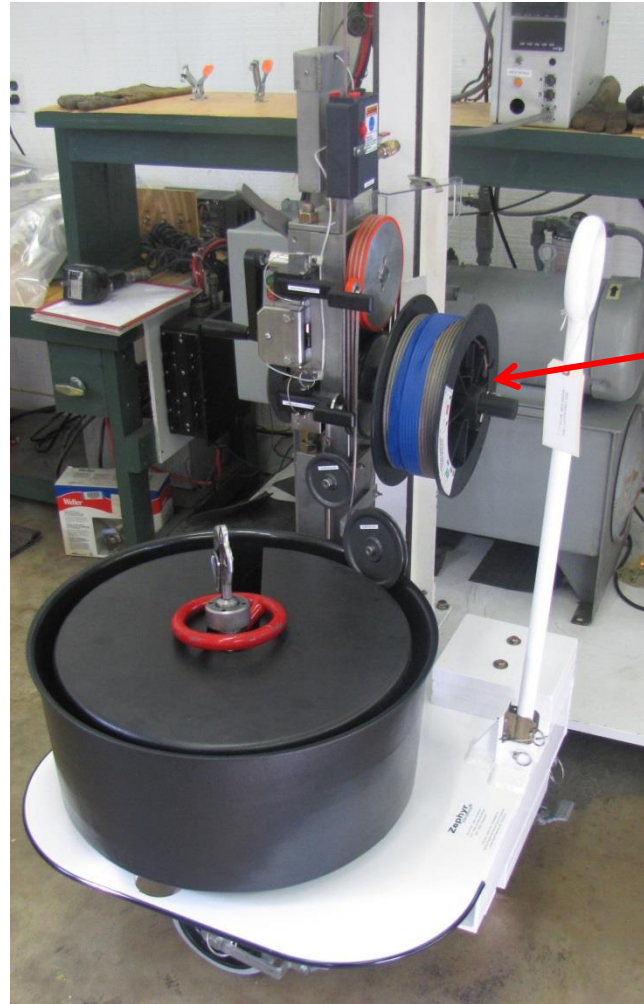
30 Day inspection

- To perform a full length cable inspection and document the results
- To verify hoist functions
- To restore tension in the cable on the lower layers
- Only required if the hoist has been in use over the last thirty days

When changing a cable

- Remove old cable
- Install new cable
- Condition new cable
- Tension new cable on the lower layers

Installing a new cable



Cable Reel Adapter

Conditioning a New Cable

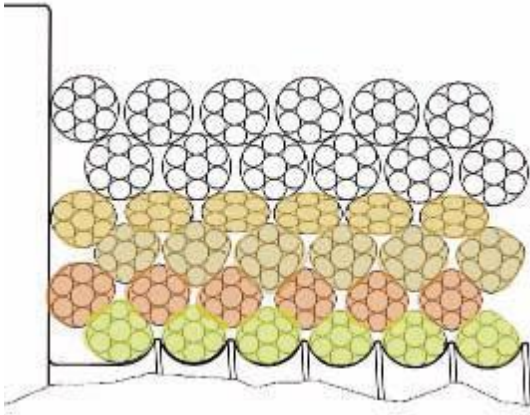
- Run the cable slowly off and on the hoist drum 3 times under increasing load and observe the cable wrapping and the limit switch actuation points
- This acclimates the cable to the smaller drum diameter compared to the reel it was stored on
- Set limit switches and adjust levelwind if required
- Increase the load while retracting during each evolution until 300 lbs. load is reached on the last retraction
- An in-flight hoist evolution cable afterwards provides optimum conditioning of the cable

Whenever a cable is reeled out beyond the top layer

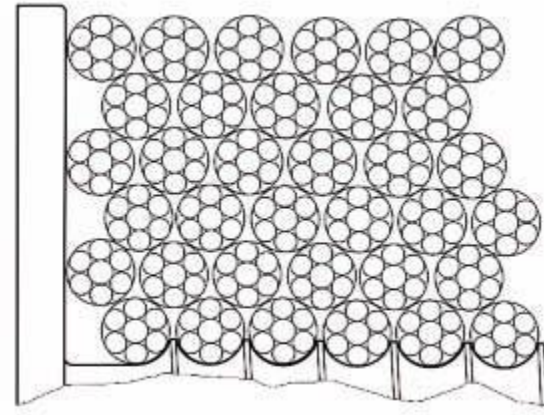
- In flight during a mission
- On the ground during an inspection
- To restore the tension in the cable on the lower layers

Pretensioning a cable

Restores tension to the lower layers of cable to prevent crushing and abrasion when a heavy load is lifted



The first 4 layers have lost their tension and begin to deform and get crushed by the hard wound top layers. Regular pretensioning of ALL layers will minimize the crushing effect.



Rope is installed with proper pretension onto the drum. All layers are hard wound and retain their round shape.

Also referred to as “Reseating” the cable

To check hoist functions

- Slow down / intermediate speed activation verification
- Full out limit switch verification
- Cable attachment verification
- Levelwind / drum adjustment verification

How to use GSE while extending

- Position the tool directly under hoist cable exit point
- Run out approximately 15-20 feet of cable
- Insert the hook and cable into the rotatub hook facing down to allow twist to be removed
- Wrap the cable around the capstans tightly
- Remove the pins from the tension rollers arms
- Turn the hook upside down and place the remaining cable into the Rotatub assembly so that there is no tension on the cable and the cable is between the guide rollers
- **Caution: Cable must be at the bottom of slot in Spooler**
- Use the pendant to activate the hoist to extend
- Crank the handle to stay ahead of the rescue hoist
- Extend the cable until the full out limit switch stops the hoist

Notes and Cautions for Extending

- Never operate the system without the clear cover closed
- Always insure both pressure rollers are engaged
- Always watch the first three turns of the capstans to insure the cable is wrapped properly and tightly
- When starting cable must be at the bottom of slot in Spooler
- Never let the cable ride to the top of the spooler and escape the Rotatub

How to use it while retracting

- Remove the crank handle
- Turn on the load indicator switch
- Activate the hoist using the pendant retract switch
- Apply the load lever and adjust the load as desired while running the hoist at a steady speed
- Run the cable back to near the starting position and stop before the hook starts to come out of the rotatub
- Turn off the load indicator
- Open the cover
- Install the pins in the tension roller arms
- Remove the hook from the rotatub and turn it hook side down
- Unwrap the cable from the capstans while removing twist in the cable
- Run the cable to full in and verify the slow down up limit switch functions, the full in switch functions and the homing load is proper
- Reposition the tool away from the helicopter

Notes and Cautions for Retracting

- Start retracting first then apply the load handle
- Do not adjust the load so high that the GSE lifts off the ground
- Do not adjust the GSE at a very slow speed
- Always pay attention to the end of the cable as it approaches full in and be prepared to stop before the hook exits the Rotatub
- When washing the cable apply 100 lbs. or less to prevent slipping on the capstans
- The cable will slip on the capstans at high loads, only apply high loads as required to condition cable or check hoist operation

Questions?

- Next perform setup and usage of the GSE in order to run the hoist on the aircraft
- Next vary the loads

General Maintenance

- Keep RHGSE clean and dry when not in use
- Change the pads every time the GSE is used to desalinate the cable
 - After extending the cable into the tub full of water and before retracting the cable
- Check the Rotatub Slip
- Check the Capstan Wear

Preventative Maintenance

- Wash salt water off of RHGSE after use
 - Do not spray water on indication system
- Oil the capstan drive chain once a month
- Adjust the Rotatub compensation clutch if it starts to slip too easily
 - Re-lubricate it once a year under heavy use

Periodic Maintenance

- Change wire rope cleaning pads
- Check Rotatub Slip Torque
- Lubricate the wheels
- Lubricate the chain
- Measure the Capstans

Change Wire Rope Pads



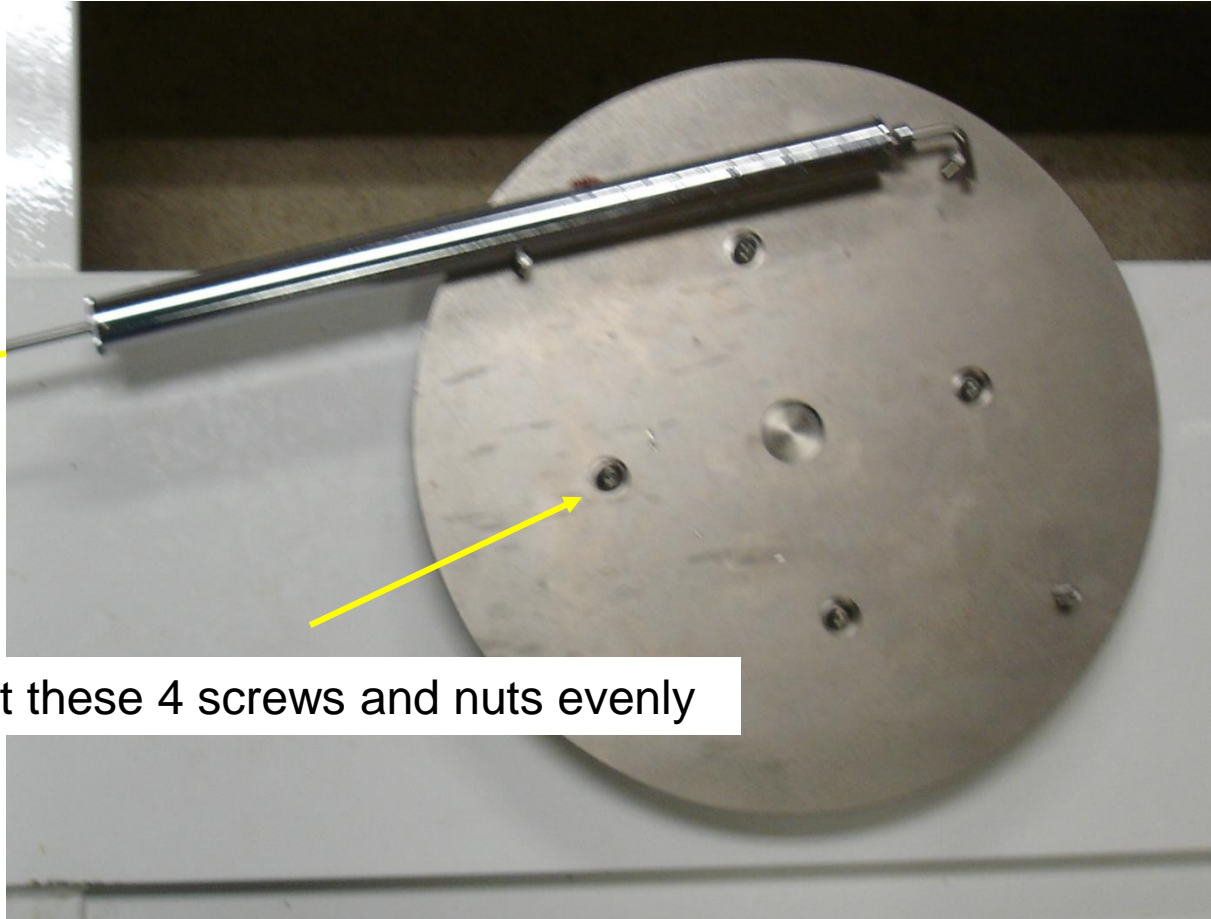
Used



New

Tighten Rotatub

5-6 lbs

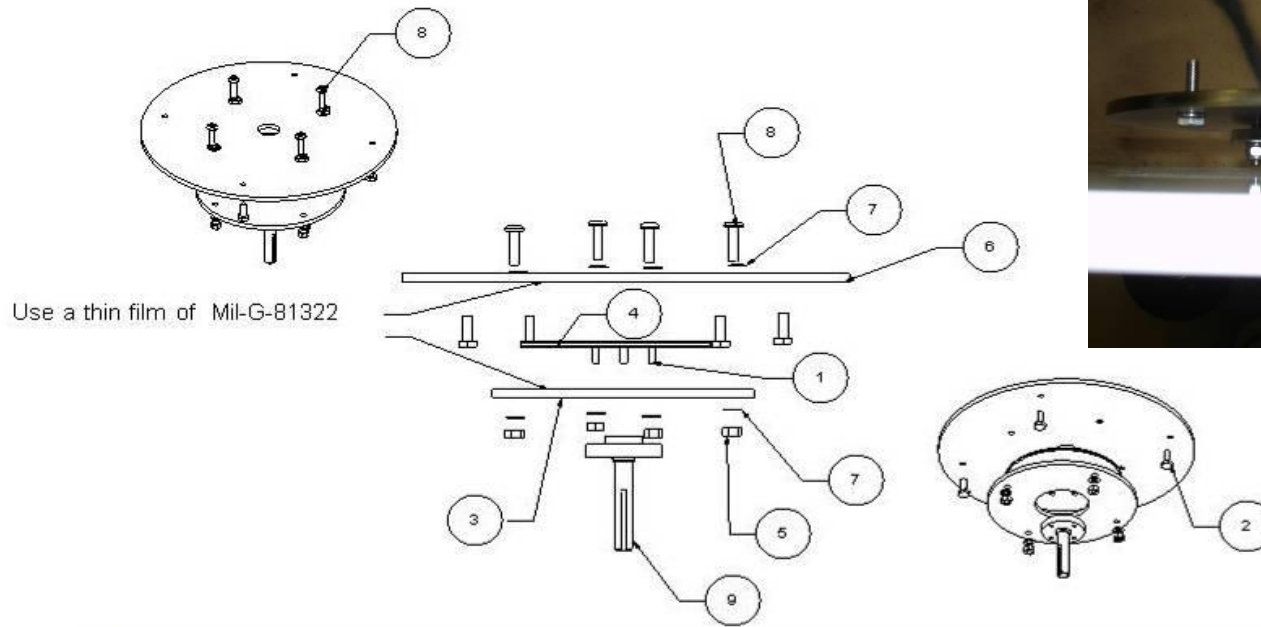


Adjust these 4 screws and nuts evenly

Lubricating Rotatub Clutch

- Grease used Mil-G-81322
- Clean off old grease
 - Apply a thin film to both sides of the center Bronze plate and the upper surface of the Lower plate and the lower surface of the Top plate
 - Reassemble and readjust the screws and Belleville washers

Infinitely Adjustable Platten



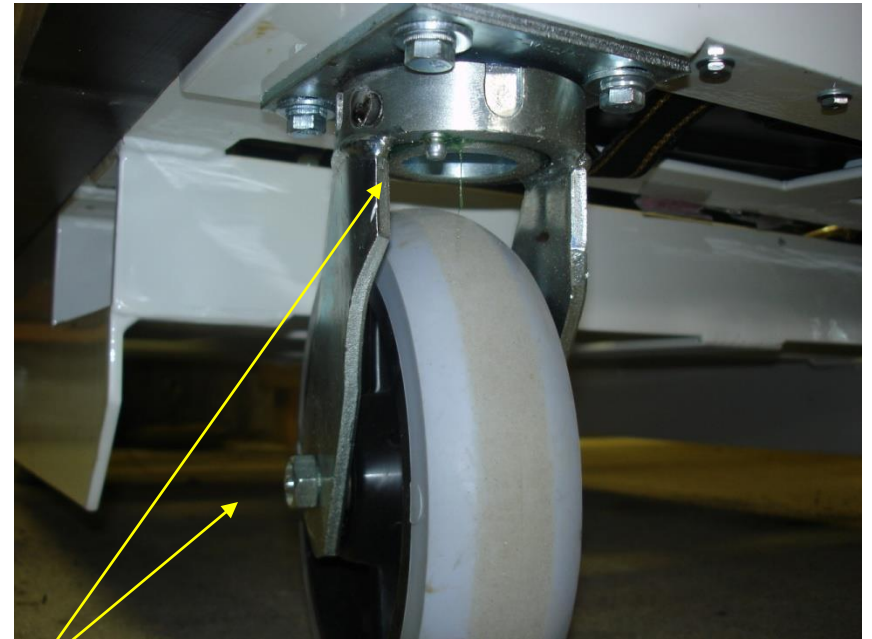
Item Number	Quantity	Part Number	Part Name	Revision	Comment
1	4		10-32 Flat Head .625 long		
2	4	1/4-20 x .75" long Cap S	.25 x .75 cap screw		
3	1	ZGS-10176-2	Infinitely adjustable Lower plate		
4	1	ZGS-10175-2	Infinitely Adjustable Platten Plate		
5	4	1/4 Lock Nut	.25 Lock nut		
6	1	ZGS-10180-2	Infinitely 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		

Checking the Capstans



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

Lubricate the wheels



Grease fittings

Lubricate the Capstan Chain



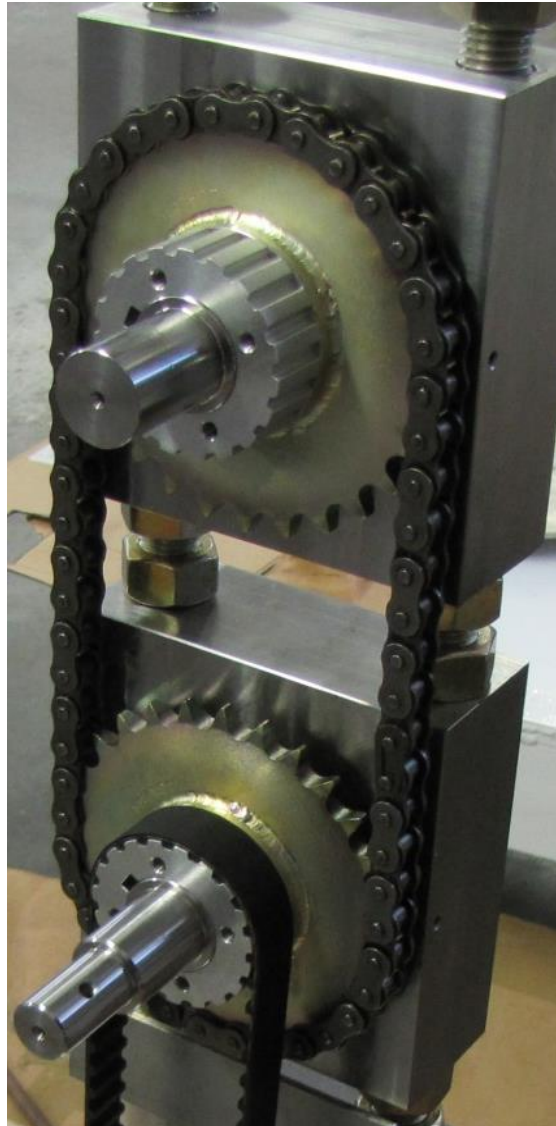
Depending on usage lubricate on monthly basis

Repairs

- Chain adjust
- Belt adjust
- Heads adjust

Capstan Chain

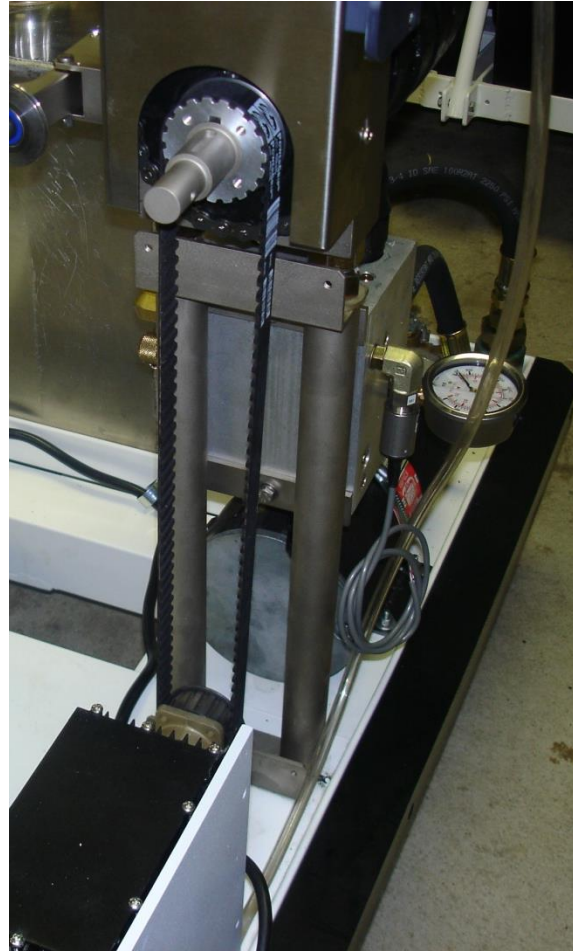
Tighten such that chain deflects about 1 mm with .5 kg force at the midpoint



Align sprockets with straight edge

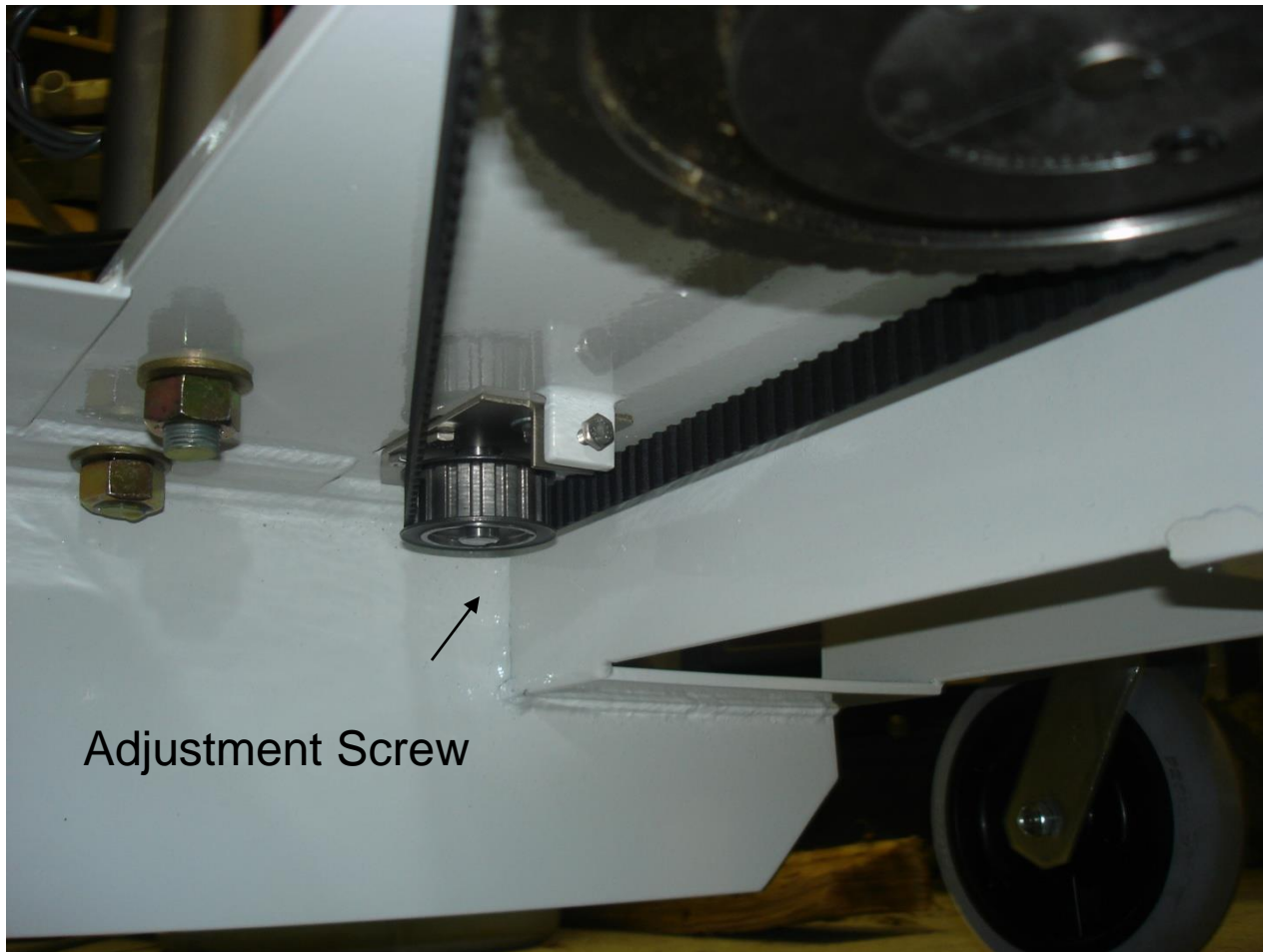
Vertical Drive Belt

Tighten such that the belt deflects about 2mm with .5 kg force at the midpoint



*Shown is a Hydraulic GSE, belts are the same in both.

Drum Drive Belt



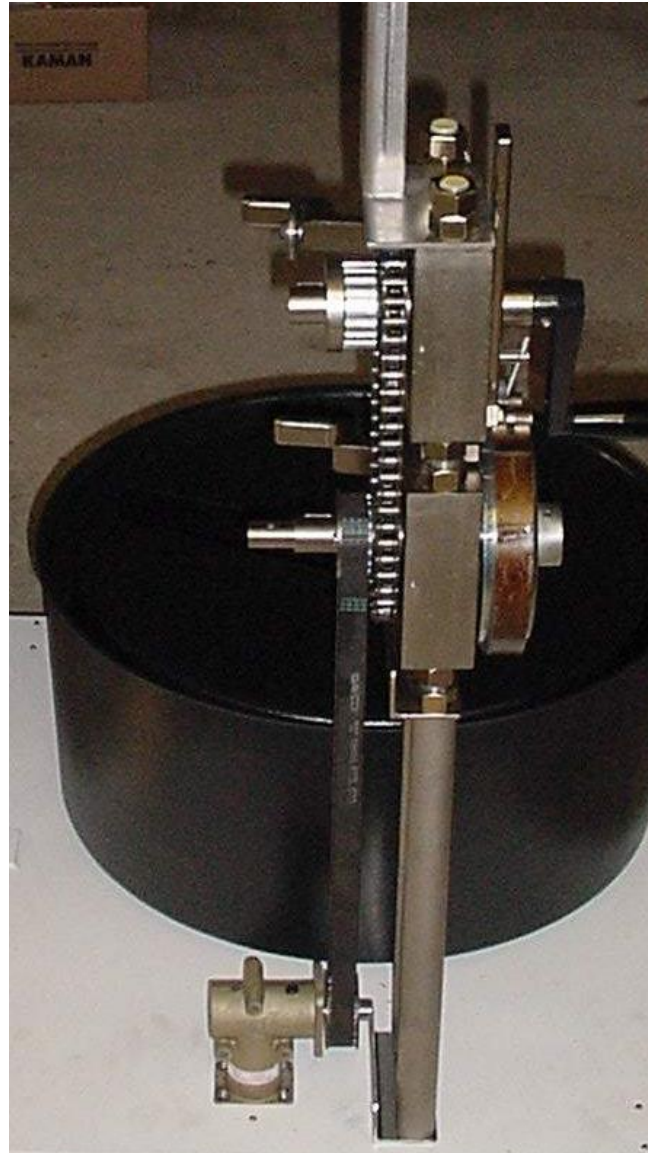
Adjustment Screw

Head Adjustment

Loosen nuts from
bottom to top

Tighten from bottom to
top

Insure heads are
aligned with each other
and with the base



Conclusion

- Read through the operators manual
- Contact Zephyr International LLC as required
 - Mike@zephyrintl.com
- Comments and suggestions are always welcome