

Holmatro HLB Lifting Bag Systems

What the Rescuer Needs to Know
Before Operating The System

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Session Objective

- The Objective of this session is to increase the user's knowledge of the proper operation, use and care of the Holmatro HLB Lifting Bag System
- This Training session does not take the place of or supercede any training protocol required by your department's SOPs for performing rescue using these systems.

Personal Responsibility Code

The member companies of FEMSA that provide emergency response equipment and services want responders to know and understand the following:

1. Firefighting and Emergency Response are inherently dangerous activities requiring proper training in their hazards and the use of extreme caution at all times.
2. It is your responsibility to read and understand any user's instructions provided with any piece of equipment you may be called upon to use.
3. It is your responsibility to know that you have been properly trained in Firefighting and/or Emergency Response and in the use, precautions, and care of any equipment you may be called upon to use.

Personal Responsibility Code

4. It is your responsibility to be in proper physical condition and to maintain the personal skill level required to operate any equipment you may be called upon to use.
5. It is your responsibility to know that your equipment is in operable condition and has been maintained in accordance with the manufacturer's instructions.
6. Failure to follow these guidelines may result in death, burns or other severe injury.

Fire and Emergency Manufacturers and Services Association, Inc.

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www.FEMSA.org

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Program Outline

- How Do Lifting Bags Work?
- Lifting Bag Characteristics & Specifications
 - Construction
 - Chemical Resistance
 - Temperature Range
 - Warranty
- Product Range
 - Lifting Bags
 - Accessories

Program Outline

- Operation of Lifting Bags
 - Connection
 - Disconnection
- Proper Lifting Techniques
- Post-use Inspection
- Care and Storage
- Training

How Do Lifting Bags Work?

- Lifting bags are capable of lifting enormous loads
- In our case up to 150,532 lbs!
- Lifting force is created by applying a specified pressure across a known area.
- The scientific name for this simple principle is:
 - *Pascal's Principle*

Pascal's Principle:

$$P \times A = F$$

Pressure times Area
Equals Force

Operating Pressure

- Our system operates at a maximum of 116 psi/8 bar
- This represents the “P” in the equation



Surface Area



- This HLB-20 lifting bag measures 20.125" x 20.125"
- Surface area then equals 405 in sq.
- This represents the "A" in the equation.

Let's Plug In The Numbers...

$$P \times A = F$$

$$116 \text{ pounds/in}^2 \times 405 \text{ in}^2 = 46,980 \text{ lbs}$$

$$46,980 \text{ lbs} \div 2,200 \text{ lbs/ton}^* = 21.35 \text{ tons of lift}$$

*Metric ton

$$46,980 \text{ lbs} \div 2,000 \text{ lbs/ton}^* = 23.49 \text{ tons of lift}$$

*USA (short) ton

OK...Now I'm Confused

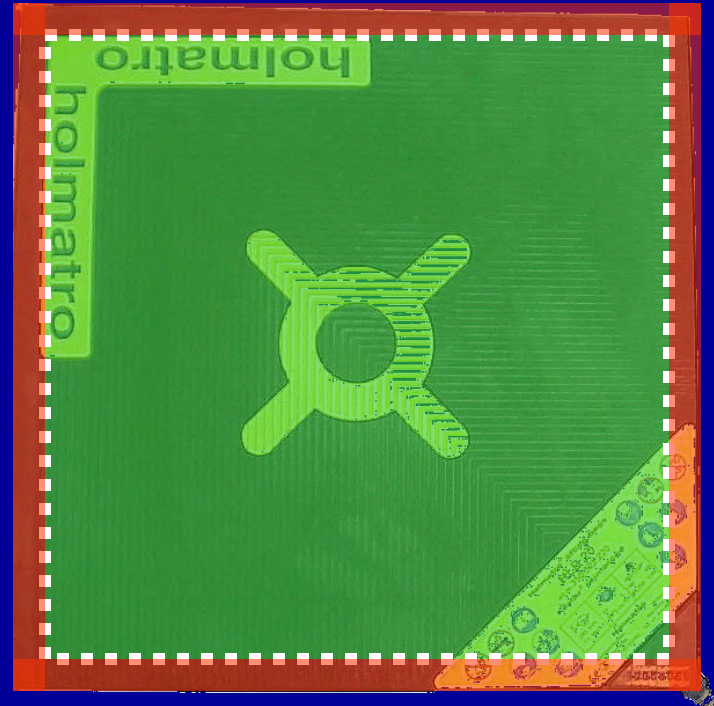
- This *is* an HLB-20, right?
- Why didn't the answer come out to exactly 20 tons?
- Okay, just a couple more items to thoroughly confuse you, then I'll clear everything up!

We must consider...

- The construction of any brand of lifting bag is basically an envelope design
- Because this “envelope” is formed by the four sealed edges of the bag...
- The inflation area does not include the ENTIRE surface area of the bag.
- The actual surface area is the total *minus* whatever the small area of the edges equals

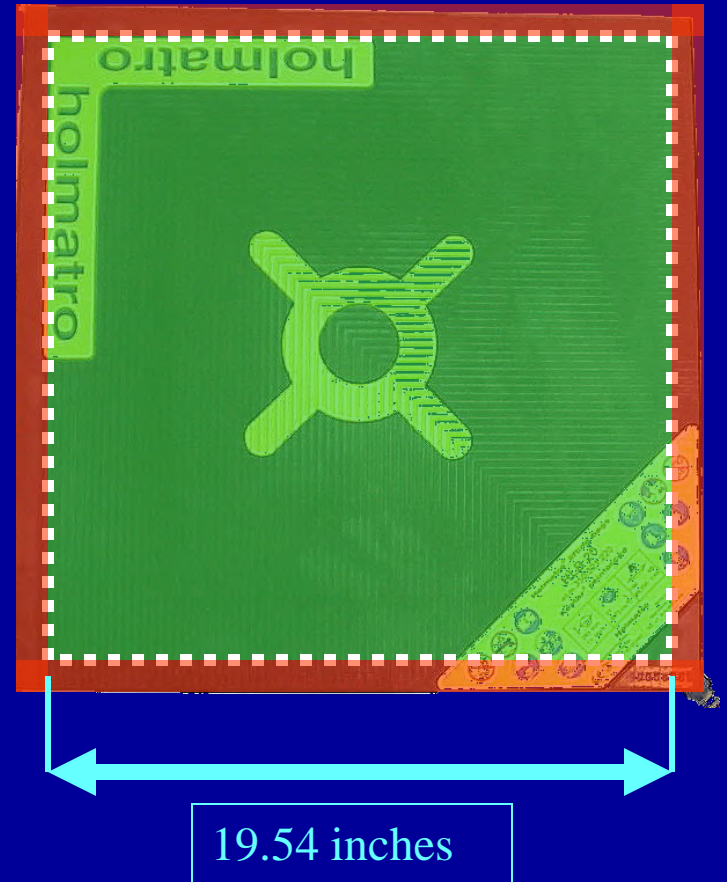
Like this...

- Once we take into account the **loss of area** for the edges
- We can see the **actual useable area** of the bag



Let's re-do the math...

- Actual surface area is 19.54 in x 19.54 in or:
 - 381.81 in²
- 381.81 in² x 116 psi = 44289.96 lbs.
- Round up to make it simple and divide by 2,200 lbs gives
 - 20.13 metric tons



Inflation Characteristics

- Next we must consider what happens when we introduce compressed air into the lifting bag...
- As the air volume increases the bag becomes more convex or rounded...



Inflation Characteristics

- This gives us lift height and at the same time...
- Reduces the surface area in ***contact*** with the object being lifted



Contact Area vs. Surface Area

- So far we have looked at the available **surface area** of the bag and used that to calculate the maximum lift of the bag.
- In actual use what really matters is the **contact area** of the bag.
- Whatever the actual contact area is between the object being lifted and the surface of the bag determines how much can be lifted, and how high!

Contact Area

Is the total area (in²) of the bag that comes in contact with the object to be lifted.

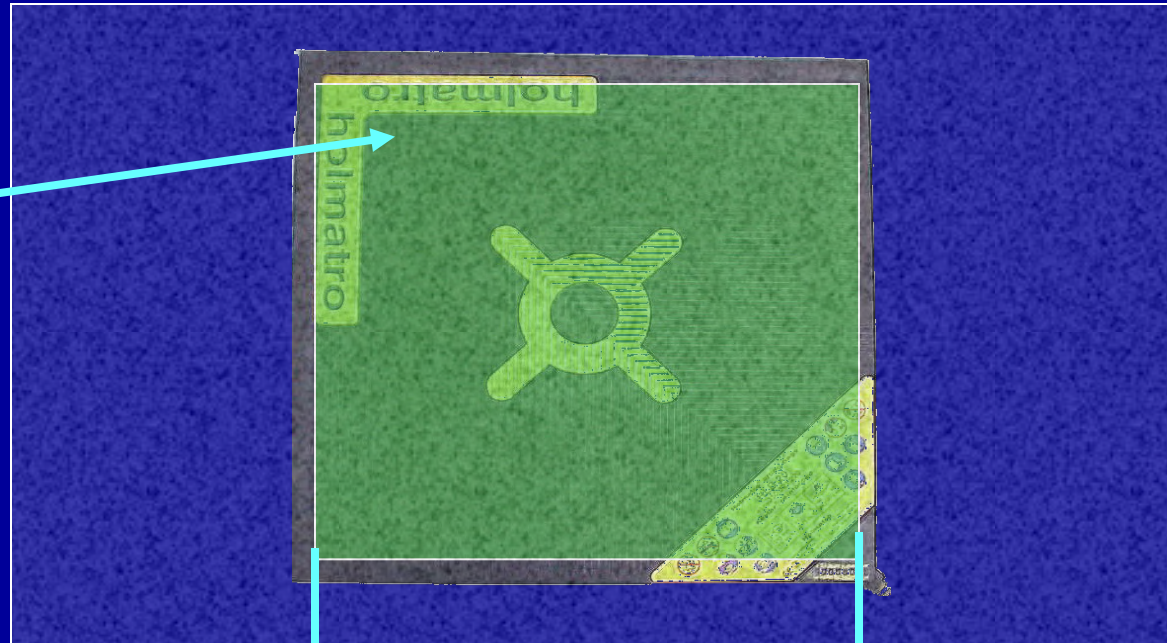
View from the Top

Contact
Area:

381.81in²

x 116psi

=44,290 lbs



0.0"

Object being lifted

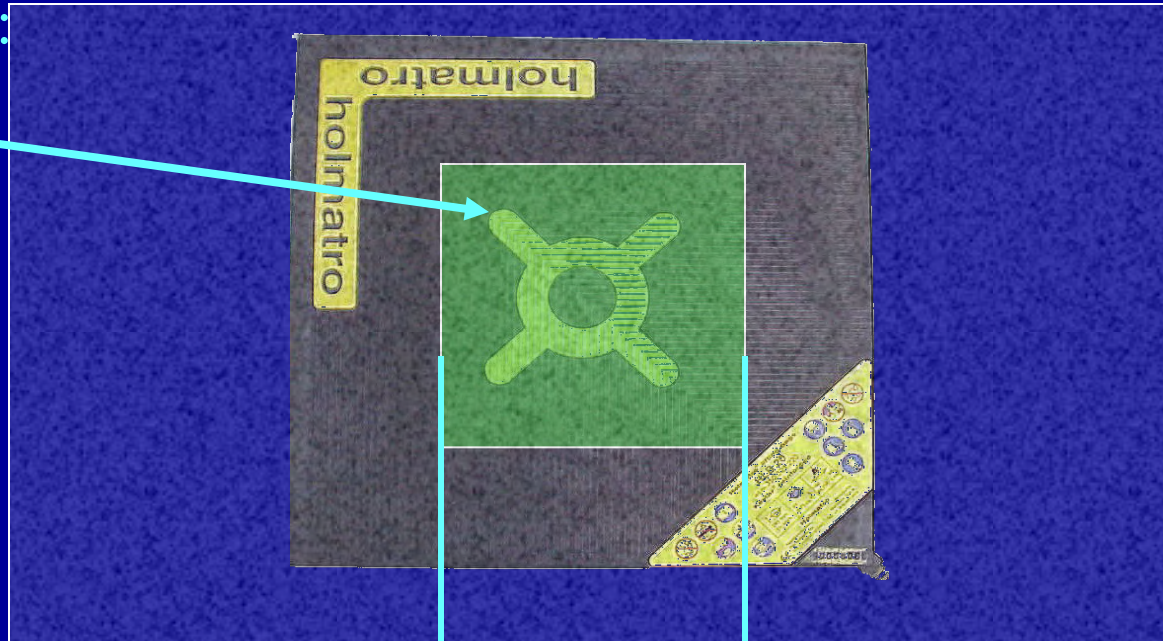
View from the Top

Contact Area:

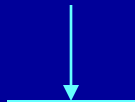
133.8in²

x 116psi

=15,925 lbs



4.75"



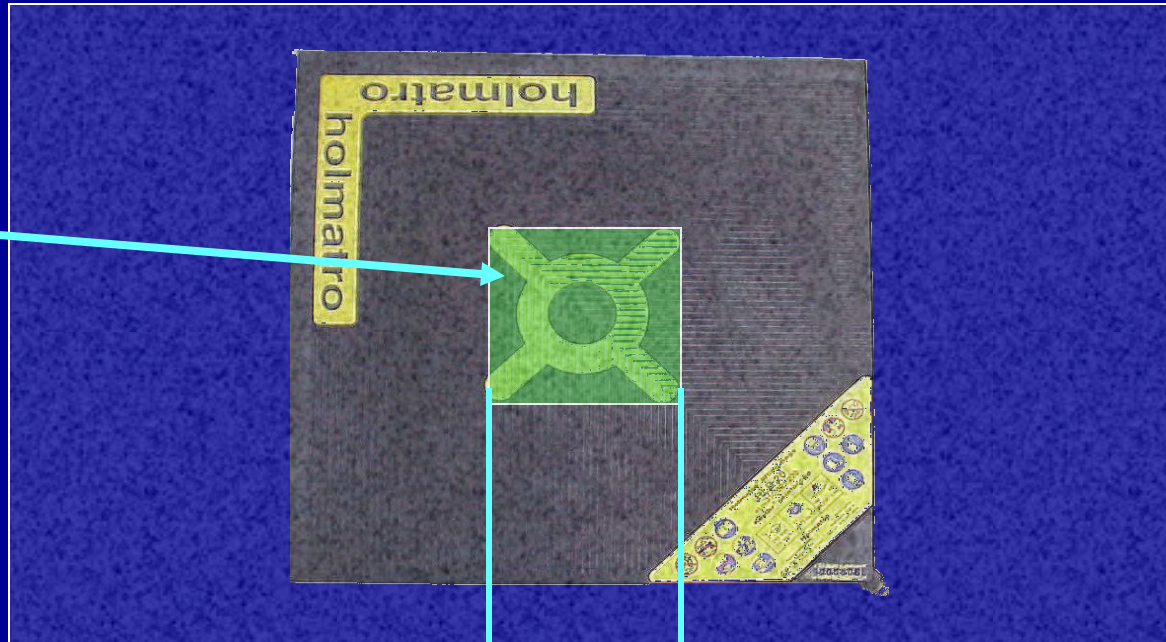
View from the Top

Contact
Area:

84.9in²

x 116psi

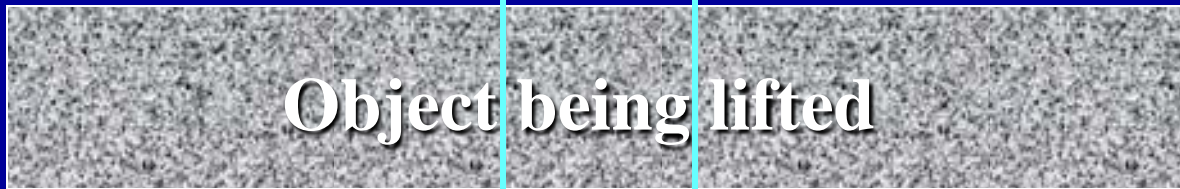
=9856 lbs



6.25"



Object being lifted



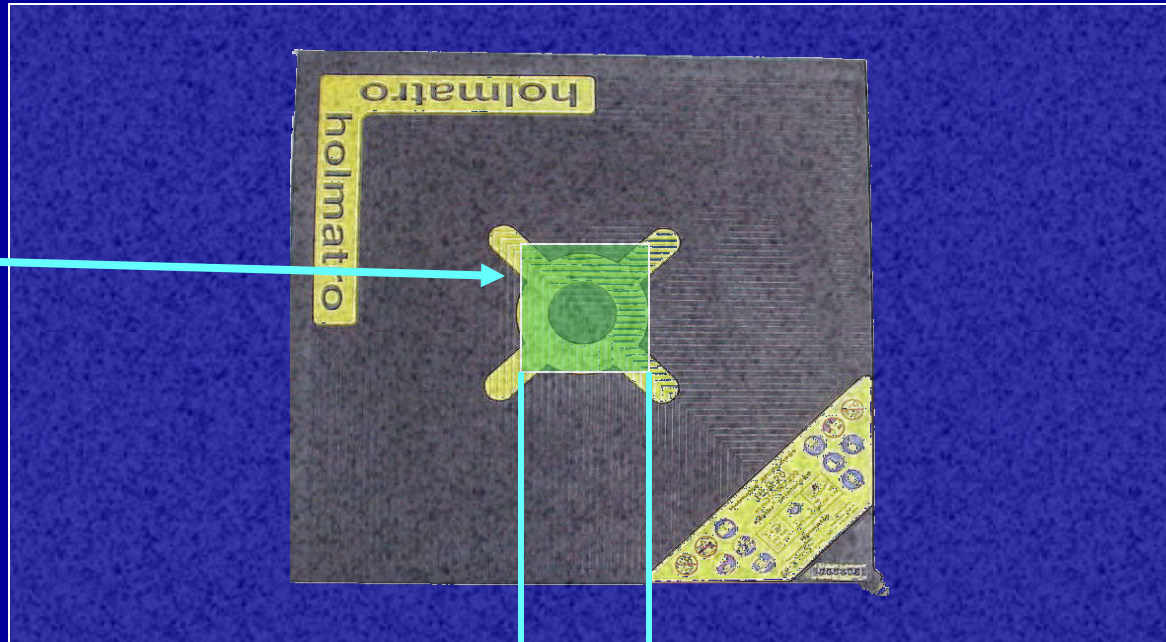
View from the Top

Contact
Area:

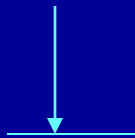
26.27in²

x 116psi

=3,047.3 lbs



8.75"

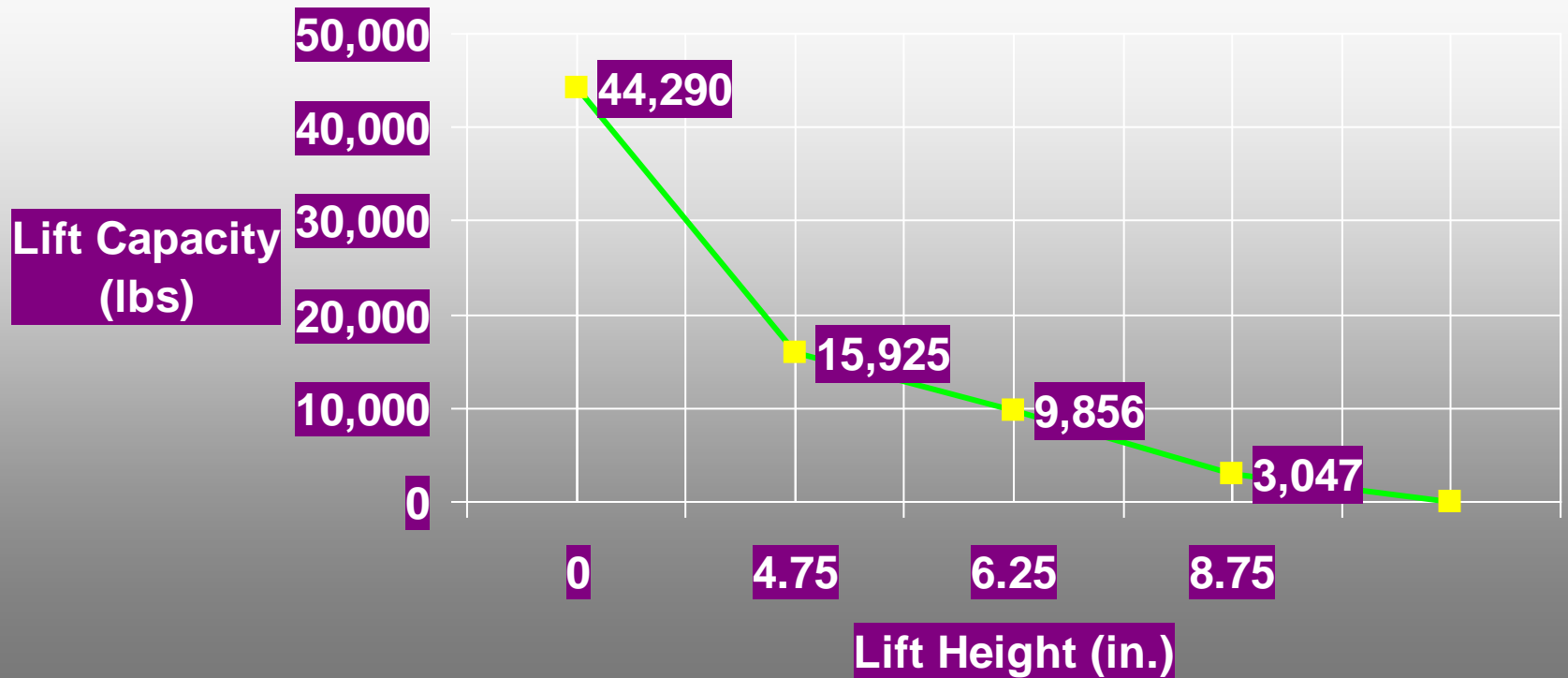


Object being lifted



Let's Graph Our Example...

Lift Capacity Vs. Lift Height - HLB20



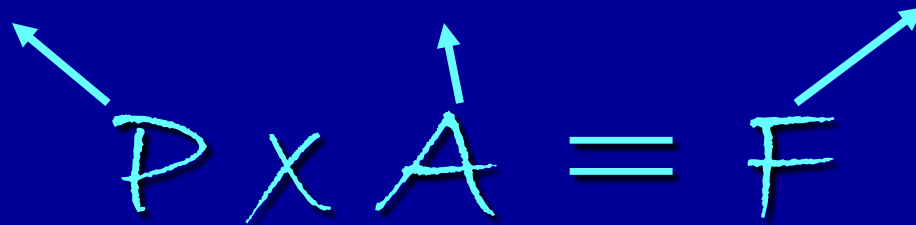
To Sum It All Up

- The higher the bag lifts an object the smaller the contact area becomes...
- Therefore the higher we lift, the less weight we can lift
- To maximize our lifting we must maximize contact area!

To Sum It All Up

- Force on an object is created by the amount of contact area x the working pressure of the system.
- Pascal's Principle can be reworded for our purposes as:

System Pressure x Contact Area = Amount of Force Possible

$$P \times A = F$$
The equation $P \times A = F$ is written in a light blue, handwritten style. Three arrows originate from the underlined text above: one points to the letter 'P', one points to the letter 'A', and one points to the letter 'F'.

Lifting Rules of Thumb

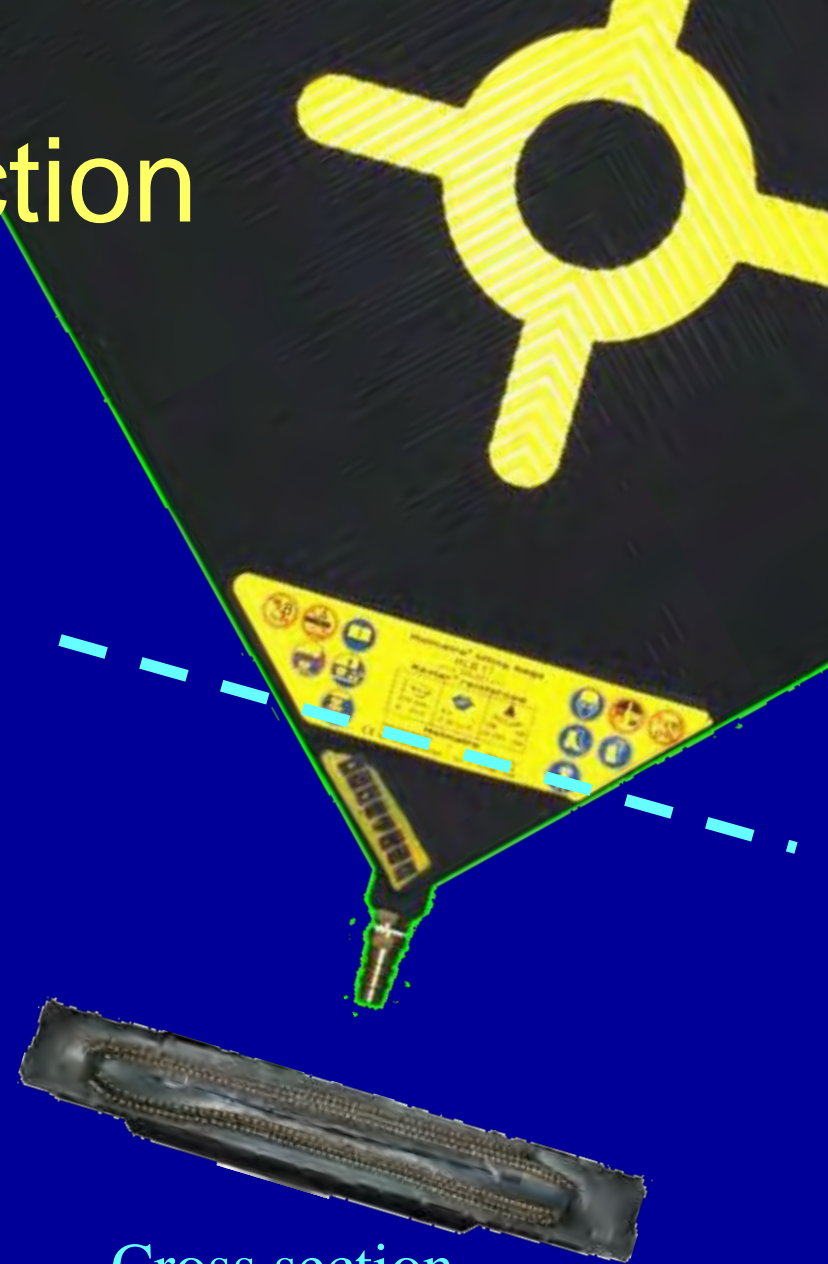
- Most frequently we are needing lift height not lift capacity...most passenger cars weigh between 2-4 tons.
- To lift one ton (2,000 lbs) only requires a little more than 4" x 4" (16 in²) of contact area.
- Two tons requires only about 6" x 6" (36 in²) of contact area.
- How much area is required to lift 4 tons?
 - 68.9 in², or 8.3" x 8.3"

Lifting Bag Characteristics

Construction

Construction

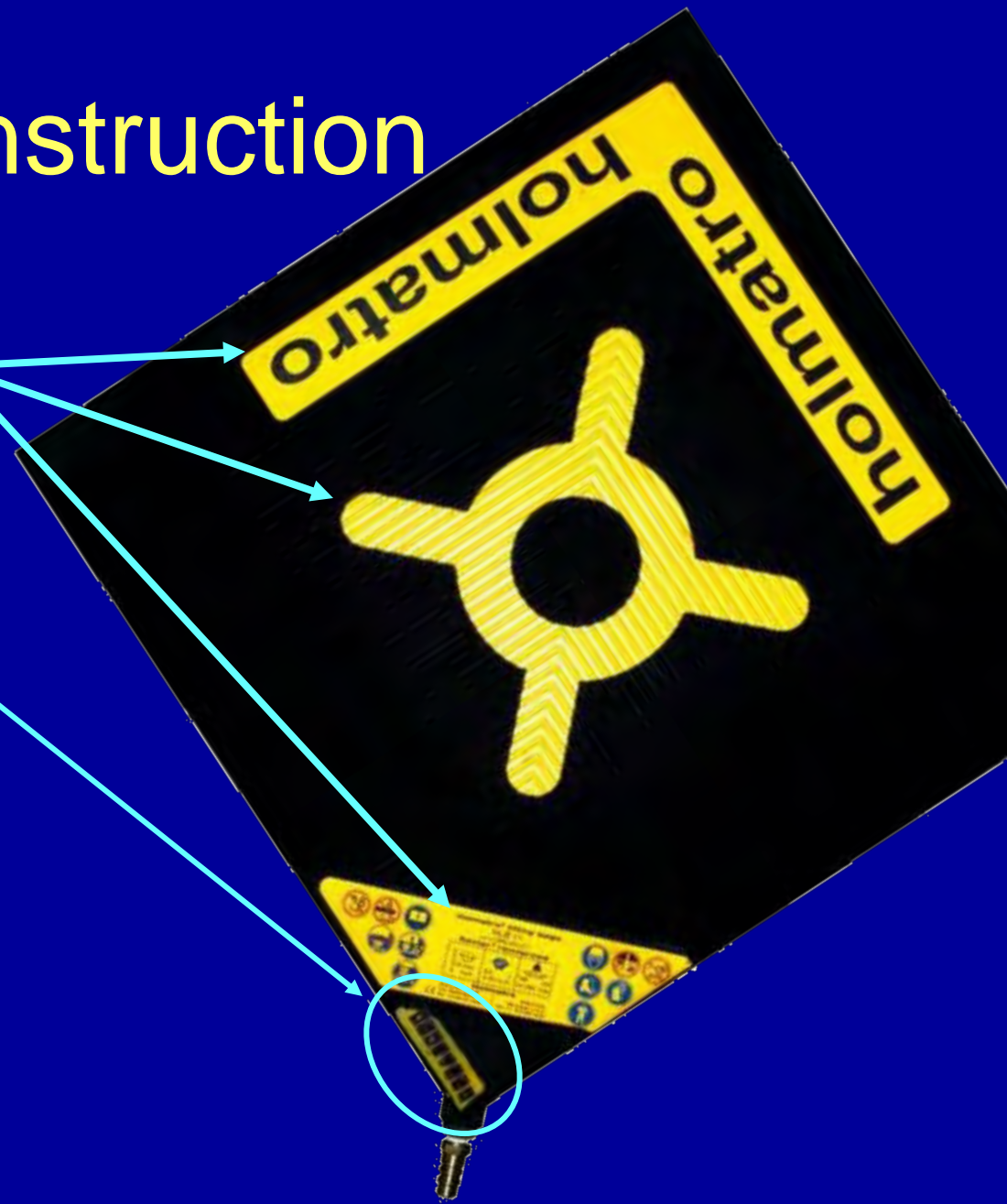
- Holmatro HLB series bags are made of a specialized blend of rubber, reinforced by three Kevlar® plies throughout the circumference.
- To avoid stretching during use, the Kevlar® is pre-stressed before being incorporated in the construction of the bag.



Cross section

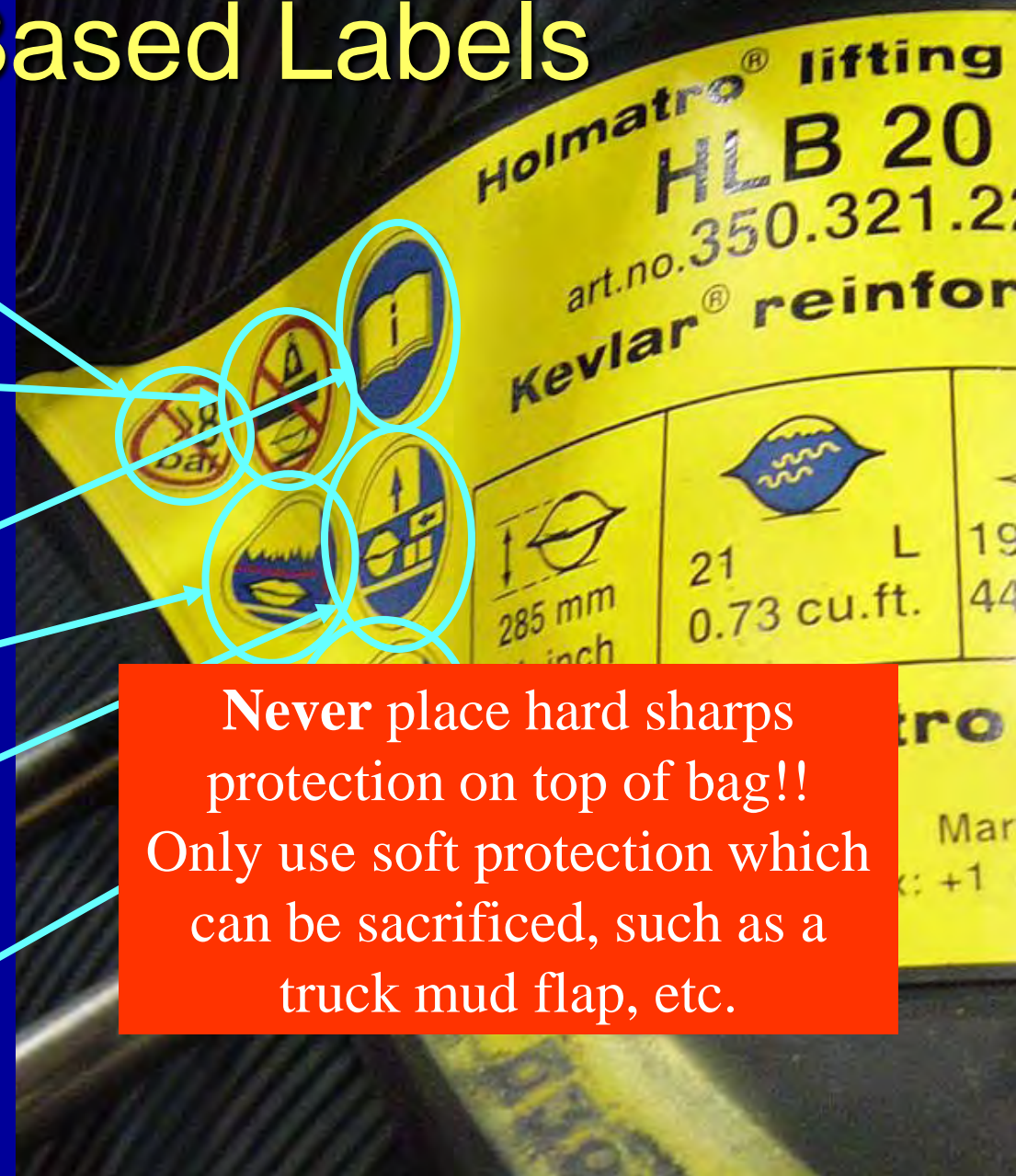
Construction

- All labels are vulcanized into the bag
- Serial number and production code is stamped into each bag



Icon Based Labels

- Don't exceed 116 psi/8 bar working pressure
- Don't add weight to a lifted load
- Read operation manual before use
- Provide protection against sharp protrusions
- Crib as you lift
- Do not stack more than 2 lifting bags. Place the larger bag on bottom



Never place hard sharps protection on top of bag!!
Only use soft protection which can be sacrificed, such as a truck mud flap, etc.

Icon Based Labels



- Wear proper eye protection
- Never place cribbing between the bag and the load
- Wear safety shoes
- Wear proper protective gloves
- Wear proper protective clothing

Construction

- Holmatro has a unique grip pattern for better performance
- This grip pattern is molded into the bag, not a separate layer added later
- “L” shaped grooves lock two bags together when stacked



Chemical Resistance

- Holmatro lifting bags are rated for resistance to a broad range of chemical substances.
- A chemical resistance chart is part of the Owner's Manual that comes with each system.

Temperature Range

- Even though lifting bags are formulated of rubber compounds, they still offer a very broad operating range
- For continuous use the temperature range is:



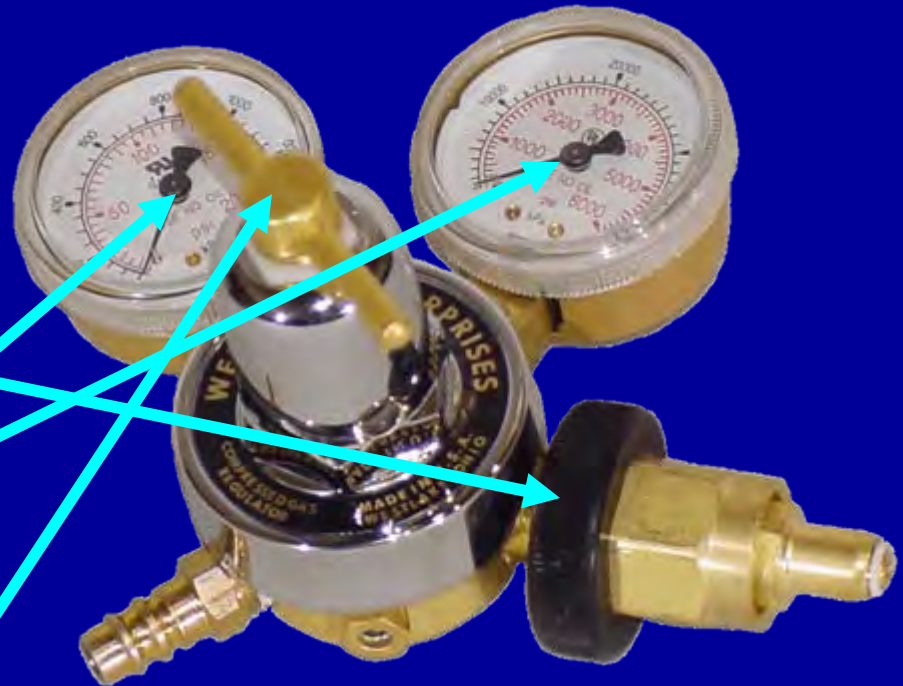
to



Pressure Regulators

Features

- Available in two models:
 - PRV120 for 2216 psi air bottles
 - HPRV120 for 4500 psi air bottles
- Hand tight nuts for connection to air bottle
- Two gauges:
 - Input pressure gauge
 - Output pressure gauge
- Manual regulator pressure adjustment key



Shown: HPRV120

Pressure Regulators

Connection to air bottle

- Ensure o-ring seal is present before attaching to cylinder.
- Ensure that regulator adjustment key is loosened (turn counter-clockwise) 1-2 turns
- Attach regulator to air bottle and tighten nut by hand.
- High pressure (input) gauge is closest to cylinder
- Flow pressure (output) gauge shows pressure to lifting bag

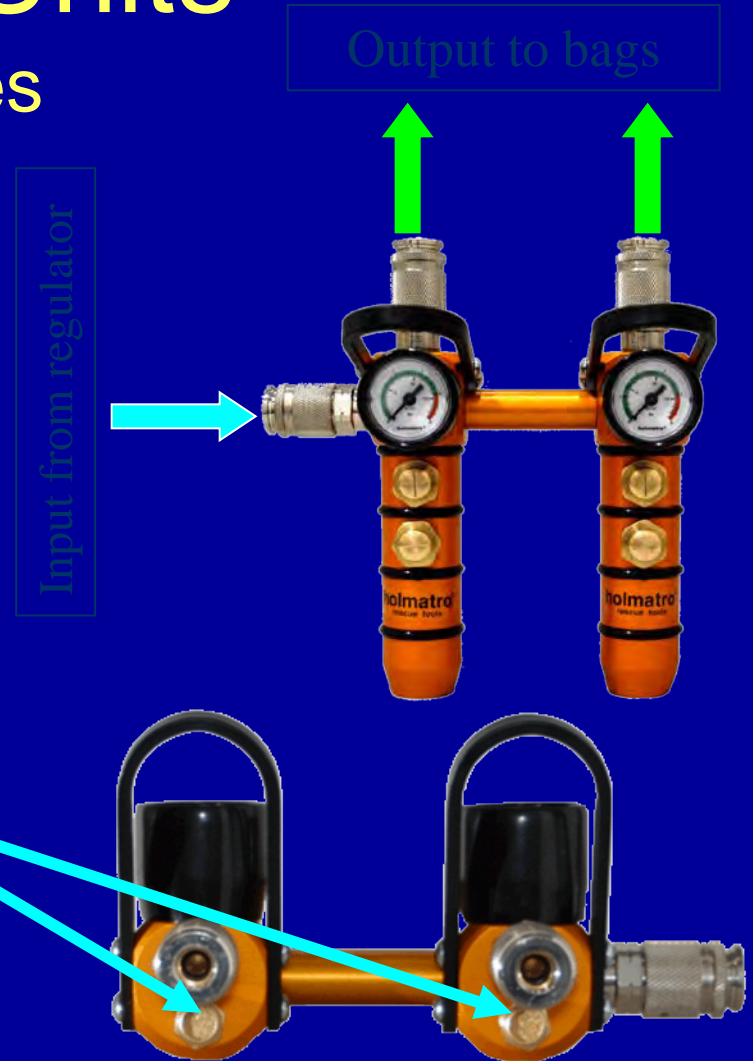


Shown: PRV120

Control Units

Features

- Available in three models:
 - as single SCV10U
 - double DCV10U (shown) and
 - heavy duty HDC10U
- All models have quick connect auto locking couplers on **input** and **output** ports
- All models have built in factory set safety relief valves
- All controls have a dead man function



Control Units

Operation

- On SCV10/DCV10 models
 - Top “+” button allows air from cylinder to enter lifting Bags
 - Bottom “-” button allows air from lifting bags to be expelled through control unit to outside



Model DCV10

Air Hoses



- Air hoses are constructed of polyurethane with a special reinforcing fiber weave
- Special weave design allows push in fittings, making them field replaceable
- Couplers are automatic self-locking type
- To connect: push male nipple into female coupler
- To disconnect, rotate silver collar 1/4 turn, and pull back on collar.

Shut Off Hoses

- Shut off hoses w/safety relief valve attach to lifting bag allowing over pressure protection to remain when disconnecting from control unit



Operation of Lifting Bags

- Connection of the system should be accomplished quickly.
- Practice proper connection sequence to become familiar with all components

Connection Sequence

When used with compressed air bottle

1. Connect the air hose between the bag and the control unit
 - Connect shut off hoses now if needed during lift operation
2. Connect the pressure regulator to the air bottle.
3. Connect the air hose from the pressure regulator to the control unit.
4. Open the compressed air bottle. The high pressure gauge, which is the gauge closest to the bottle, indicates the pressure in the bottle.
5. The other gauge shows the pressure that will flow to the lifting bag. Set the regulator so that the lifting bag pressure is 116 psi maximum.
6. Place the lifting bag under the object to be lifted. The system is now ready for use.

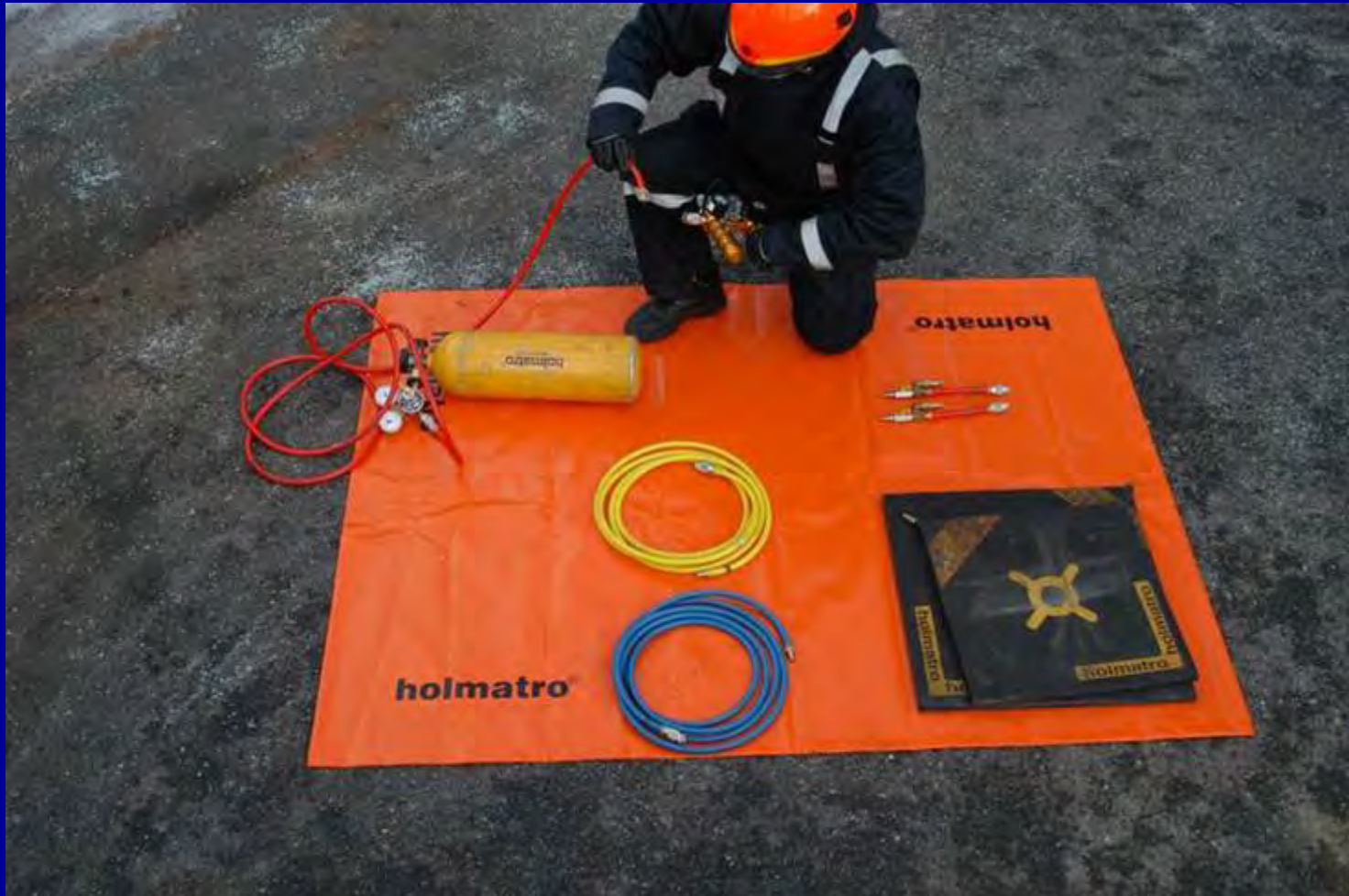
1. Connect the air hose between the bag and the control unit



2. Connect the pressure regulator to the air bottle.



3. Connect the air hose from the pressure regulator to the control unit.



4. Open the compressed air bottle. The high pressure gauge, which is the gauge closest to the bottle, indicates the pressure in the bottle.



5. The other gauge shows the pressure that will flow to the lifting bag. Set the regulator so that the lifting bag pressure is 116 psi maximum.



6. Place the lifting bag under the object to be lifted. The system is now ready for use.



Lifting Operations

- As with any rescue operation, safety of the rescuer and patients is the priority
- Always exercise caution when performing lifting operations
- Always have plenty of cribbing material available to support the load AS IT IS BEING LIFTED.
- NEVER leave a load supported only by a lifting bag.

Lifting Operations

- SAFETY Considerations
- Placement of lifting bags
- Adjusting height of lifting bags
- Stacking lifting bags
- Inflation sequence
- Lowering the load

Safety

- Avoid placing yourself under an unstable load
- Never stack more than two (2) lifting bags
- Never place anything between 2 lifting bags
- Chock vehicle wheels before beginning any lifting operation
- Follow all warnings on the lifting bag label and in the users manual

Safety

Operator Position

- Maintain a safe distance during lift
- If space permits, position yourself to the side of possible ejection path of lifting bags

Safety

Improper Operator Position

- This operator should be to the side of the possible ejection path of the lifting bags



Safety

Improper Placement

- These bags have not been centered under the rocker channel
- This will lead to bags shifting position during inflation...



Safety

Shifting Bags

- These bags have shifted position...notice the angle
- They represent a potential ejection hazard



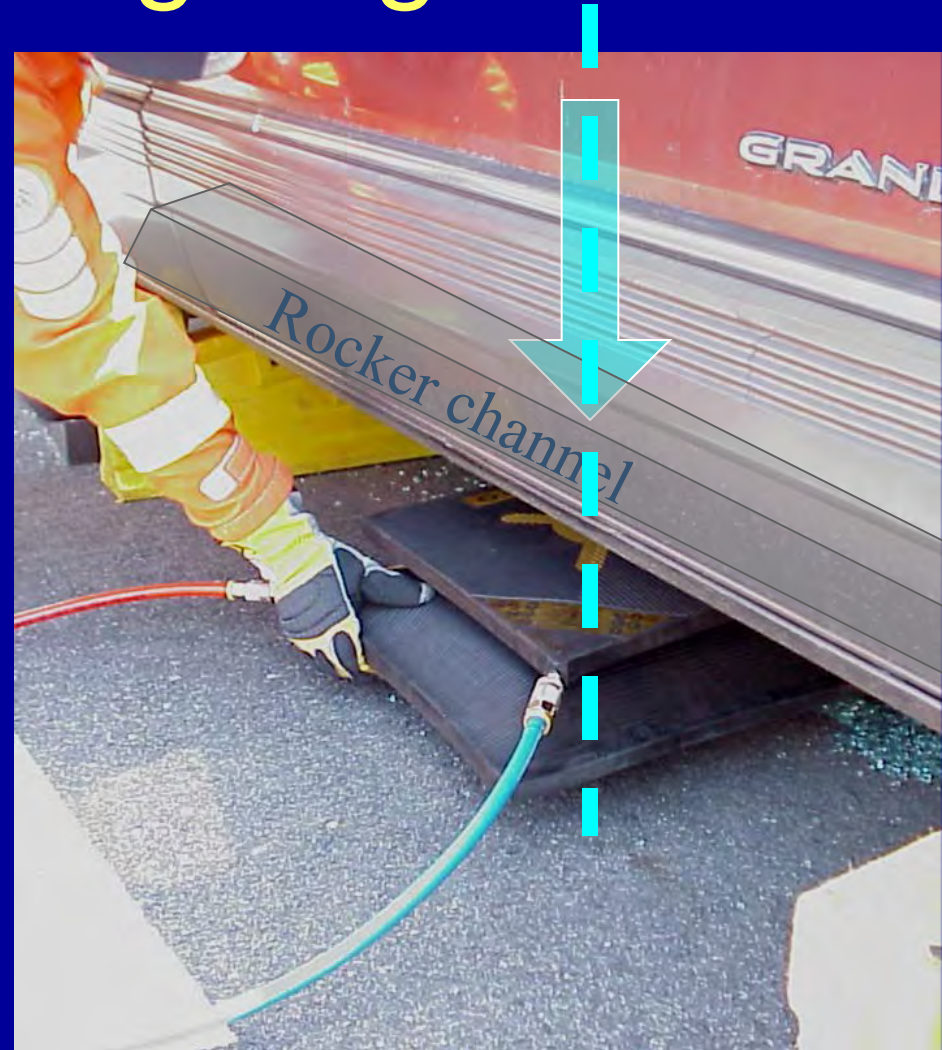
Safety

Proper Operator Position



Placing Lifting Bags

- Locate lifting bag so that the centering mark is directly underneath the object to be lifted.
- Remember to look for maximum contact area between bag and load when placing bag
- Protect the top of the bag against sharp objects by placing SOFT protection that can be sacrificed between bag and the load. (i.e. truck mud flap)
- NEVER place hard objects between load and top of bag surface
- **IMPORTANT!** Be conscious of heat sources under vehicle, i.e. catalytic converter



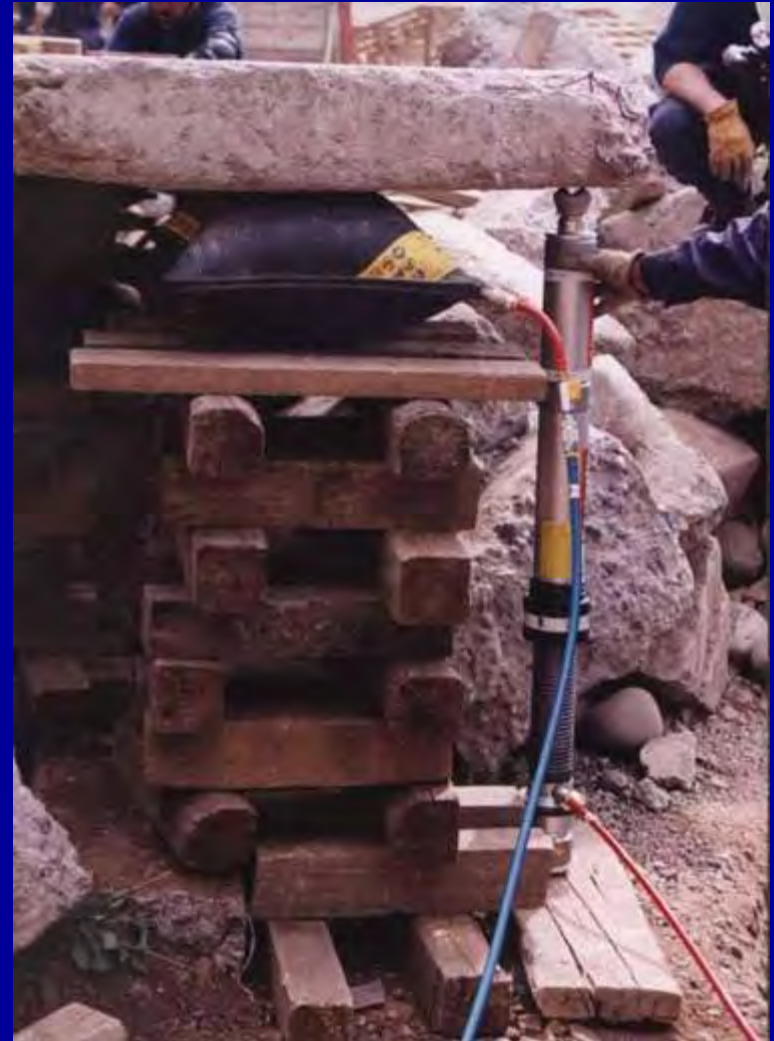
Placing Lifting Bags

- When there is not enough insertion space for bag placement you may need to use another device to create space
- Holmatro's power wedge can create a 2 inch space from only $\frac{1}{4}$ inch gap...



Adjusting Height

- Sometimes the object being lifted is high above the lifting surface (i.e. large vehicle, SUV, etc..)
- In this case you can build a box crib beneath the object
- Always place lifting bags on TOP of cribbing



Single Bag Lift

- Because the maximum height of any Holmatro lifting bag is 1" they are easily placed under loads with minimum clearance.
- Once lift is achieved, crib the load and continue
- If more lift height is needed, you can now introduce a second bag on top of the first



Stacking Bags

Two Bag Lift

- When space permits and maximum lift height is desired, place both bags beneath load.



Stacking Bags

Two Bag Lift

- Inflate the bottom bag FIRST



Stacking Bags

Two Bag Lift

- Complete the lift by inflating the top bag
- Place cribbing to secure lifted object



Inflation Sequence

With lifting bag system correctly connected and bags properly placed you can now begin the lift

1. Using the controller, begin slowly inflating the bottom bag
2. Place cribbing as the load begins to rise
3. Once an adequate height is reached secure the load with cribbing.
4. Leave the bag inflated. If using shutoff hose, close quarter turn valve.
5. Air supply hose may now be disconnected from lifting bag



Deflation Sequence

- Always deflate bags using the control unit
- Carefully remove cribbing. It may be necessary to slightly inflate lifting bags.
- If using two lifting bags, deflate in the opposite order of lift sequence:
 - Deflate top bag first
 - Deflate bottom bag last

Disconnecting the System

- Once load is securely lowered:
- Turn off valve on air bottle
- NOTE: There is still air pressure in the rest of the lifting bag system
- Release pressure from system. On SCV/DCV10 units, a quick way to achieve this is to depress both “+” and “-” buttons at the same time.
- Now you can disconnect all components

Inspection After Use

- Before storing lifting bag system components it is necessary to **visually inspect** all parts for any damage
- *Immediately remove any damaged components from service and notify your Holmatro dealer.*

Maintenance and Storage Procedures

- Regulator/Pressure Reducer: Should be stored where it will not sustain damage. Before storage return your regulator to neutral (zero) setting
- Control Unit: Store in a container to prevent any damage
- Hoses: wind in a coil, belted or tied with couplers joined. Do not place heavy objects on top of stored hoses.

Maintenance and Storage Procedures

- Lifting Bags:
 - The air inlet nipple is the most vulnerable part of the bag. Always replace the plastic cap and store in such a way as to avoid damage to the nipple.
 - If damaged, nipple can be field replaced
 - Store bags out of direct contact with sunlight as the UV rays can cause degradation of the rubber compound

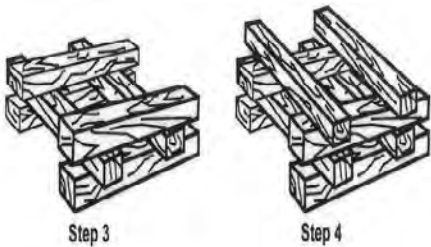
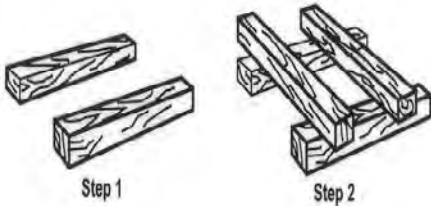
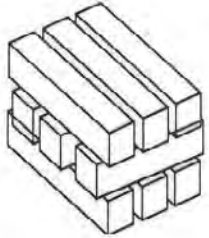
Maintenance and Storage Procedures

- Lifting Bags (cont'd):
 - Cleaning. After use in oil, sand, dirt bags can be cleaned using only a mild soap and water solution. Clean with a brush or broom, rinse and let dry.
 - **NEVER** use solvents to clean bags
 - **NEVER** use preservatives such as Armorall® or tire spray as they may cause damage and will create slippery and unstable surfaces.

Box Cribbing

SCFD 4 BOX CRIBBING
LESSON PLAN

The points of contact have to be in line and the box needs to be square as you build it.
The height of the box cannot exceed 1 ½ times the length of the cribbing.
If the load is heavier than a standard passenger vehicle use 3 per layer for 9 points of contact.



Do not reach under load.
Use 2 x 4 cribbing to position pieces in pinch area.



Cribbing will be stored on the apparatus in this order.



Wedges will be taped together for storage.
The tape for this is in the MVA bag under the Officer's seat.



Remove from service any cribbing that is split, broken, or damaged.



Training

Remember: Training is an
on-going process, not a one
time event