Subsalve USA

Engineered From The Bottom Up!

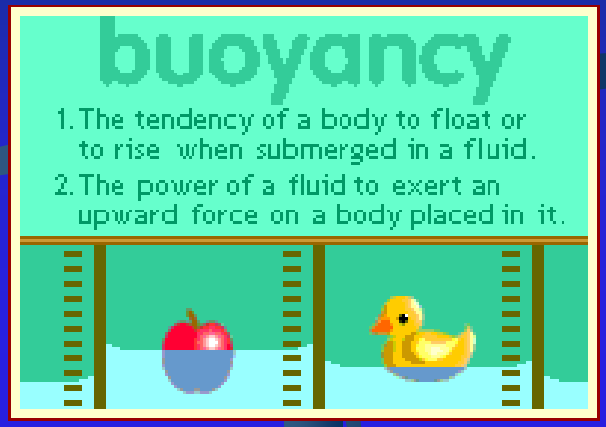
The Principles of Buoyancy and Underwater Lift Bags

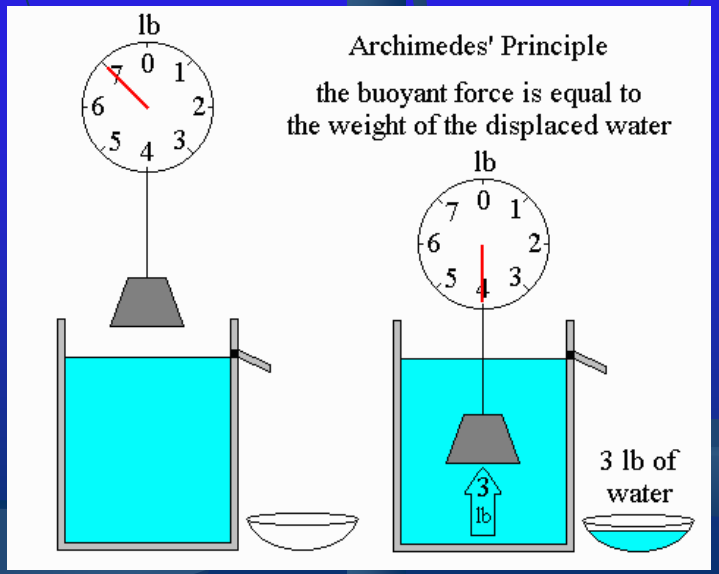
Archimedes Principle

A body wholly or partially submerged in a fluid is buoyed up by the weight of the fluid displaced

Sea water = 64 lbs. / cu.ft.

Fresh water = 63 lbs. / cu.ft.





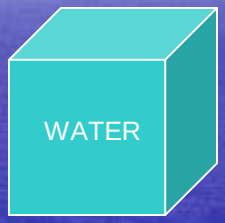
Mediums

GASES

5 **grams/cu.ft**.

1 **gram/cu.ft**.

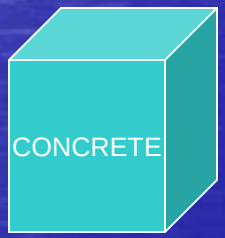
LIQUIDS



64 **lbs/cuft**.

40 **lbs**./cuft.

SOLIDS



150 lbs/cu.ft.

650 lbs**./**cu.ft.

Underwater Weight/Buoyant Force

Dry Weight

- Displacement

= Underwater Weight

- Air
- Helium
- Oil
- Water
- Concrete
- Steel

OPERATIONS & USE OF LIFT BAGS

PRE-DIVE AND POST DIVE PROCEDURE

1. *BEFORE AND AFTER EACH DIVE LIFT BAGS AND COMPONENTS MUST BE CAREFULLY INSPECTED FOR ANY DAMAGE. ANY DAMAGE OR WEAR MUST BE RECORDED AS WELL AS ANY ACTION TAKEN. ALL USE MUST BE RECORDED. (SEE REPAIR INSTRUCTIONS IF REPAIRS ARE REQUIRED)*

2. *ALWAYS THOROUGHLY WASH ALL COMPONENTS AS WELL AS LIFT BAG BODIES WITH FRESH WATER AND ALLOW TO DRY BEFORE STORING. LUBRICATED RELIEF VALVES WITH O RING GREASE AND SPRAY WITH SILICON SPRAY. TIGHTEN SET SCREWS IN CAP AS NECESSARY. LUBRICATE BALL VALVE AND QUICK DISCONNNECT WITH MARINE LUBRICANT SPRAY OR WD 40.*

3. *PLACE A TAG ON THE LIFT BAG CLEARLY IDENTIFYING THE DATE, CONDITION, AND RECORDERS NAME WHEN THE BAG WAS STORED. STORE IN A DRY LOCATION NOT TO EXCEED 100 DEGREES F. STORE IN HANGING POSITION IF POSSIBLE, ROLL OR FOLD WITH FEWEST FOLDS POSSIBLE.*

4. *Once the job or task is determined, several steps must be taken to properly rig the lift bag(s). It is extremely important to carefully plan each phase of the job, as well as having all of the necessary equipment; i.e.: rigging, air, hose, boat, manpower, etc., not to mention good weather and sea conditions. Proper planning is the first and most important phase of any project, in addition to carefully and safely executing the plan. Determine dry weight and displacement of object being raised. Consider the total buoyancy required with a safety factor. Consider bottom conditions, silting, suction, etc.*

OPERATIONS & USE OF LIFT BAGS

PLAN AND EXECUTE THE SALVAGE PLAN. PLAN AND EXECUTE THE DIVE PLAN

1. ***Positioning of the lift bag(s): Always place bags where lift is best balanced and the best leverage is attained, over the object being lifted. TRY TO DETERMINE THE CENTER OF MASS OF THE OBJECT BEING LIFTED (ENGINE(S) SIZE, CABIN LOCAION, ADDITIONAL DECK EQUIPMENT, CARGO, ETC.) ALWAYS PLACE THE LIFT BAGS EXTERNALLY AND KEEP THE CENTER OF BOUYANCY ABOVE THE CENTER OF MASS.***

2. ***Always attach lifting lines, straps, or cables completely around the object being lifted. When possible, secure additional lines directly to the object. Make sure that lifting straps/lines are at least rated equal to the lift capacity of the lift bag. When possible, attach to structural lifting points (shafts, struts, rudder posts, through scuppers) Do not position straps/lines or lift bags where extreme chafing can cause damage to them.***

3. ***Always attach control lines and tow lines prior to lift.***

4. ***Attach lift bags to rigging with shackles rated at least equal to the lift capacity of the lift bag. ALWAYS ATTACH TO ALL RECOMMENDED LIFT POINTS FOR EACH DESIGN LIFT BAG (I.E.: OPEN BOTTOM, ENCLOSED, OR PONTOON.)***

Continued…

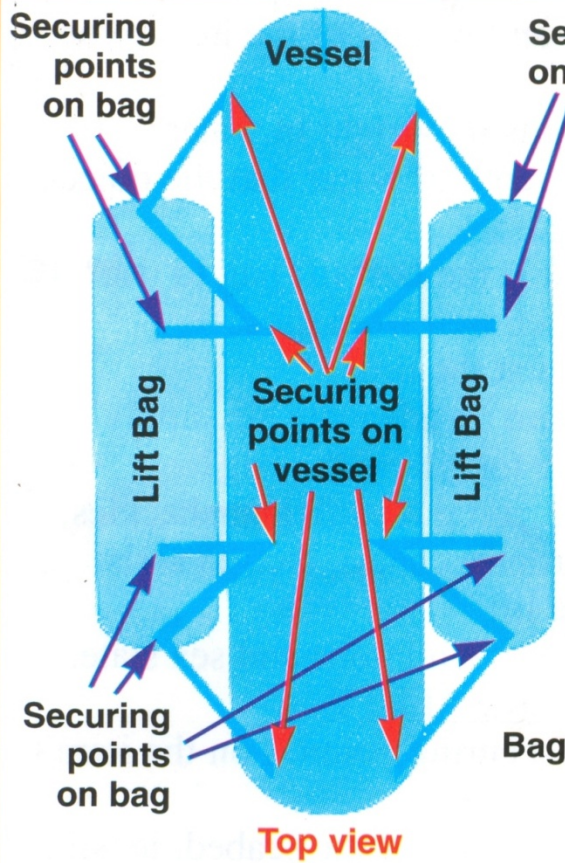
5. *When using multiple lift bags, distribute the lift over the entire length or width of the object being lifted. Always balance lift bags evenly, using bags of equal lift capacity on each side of the object. ALWAYS USE MULTIPLE BAGS TO DISTRIBUTE THE LOAD AND DISTRIBUTE THE RISK. When possible, manifold all air lines to fill lift bags simultaneously, for even lift.*

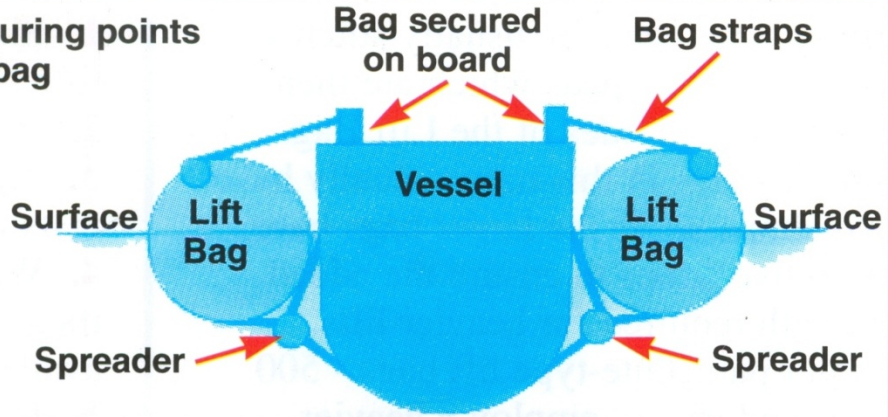
6. *When inflating lift bags, insert air line or regulator into the bottom of the lift bag, or attach an air line directly on to the inflation valve. Always partially inflate each lift bag to insure proper rigging, location and clearance. ALWAYS INFLATE FRON THE CENTER OF MASS OUTWARD. As the bag and object begin to rise, stand clear and out of the lifting path. Do not stay directly under or over the object during lift, or when lift is completed. Make sure the surface is clear over the object prior to lift.*

7. *To dump air from a lift bag for any reason, either pull the lanyard or open the ball valve to allow enough air to escape to bring the bag down to the desired level. Then release the lanyard or shut the valve.*

8. *Once the object has been successfully lifted to the surface, secure additional lines if being towed. If being lifted into a boat or out of the water, secure additional lines to the object and LIFT THE OBJECT - NOT THE BAG DIRECTLY.*

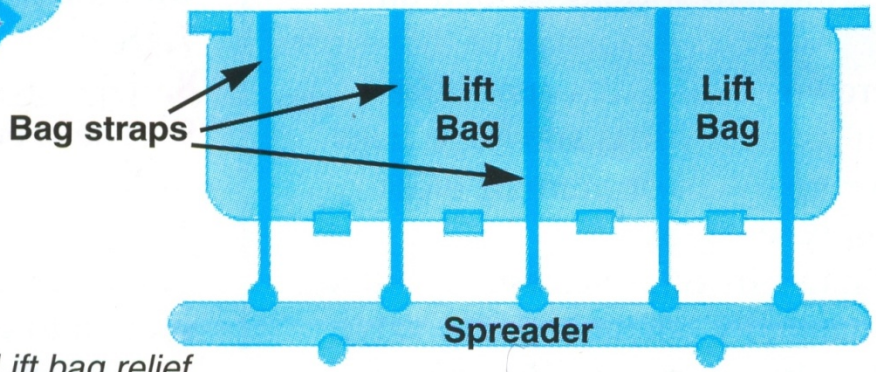
RIGGING RECOMMENDATIONS





Lift bags should be shackled to the spreader, joining the bag straps to the bar. The bar should be secured to the hull or connected to the other spreader bar.

Enclosed Lift Bag



- *Filling valves.*
- *Lift bag relief valves.*
- *Securing lugs on spreader bar.*
- *Securing points for lift. Attach to the vessel.*

Lift bags should be well secured to the vessel using as many securing points as possible to prevent lifting or pulling away from vessel or moving along vessel.

PRECAUTIONS

1. *The use of SUBSALVE USA lift bags is at the user's own risk; thus ALWAYS exercise extreme caution using lift bags.*

2. *Plan the lifting job thoroughly, i.e., necessary air, lines, hardware, weather forecasts, towing and lifting procedures, etc. Always carry an adequate air supply (compressor or scuba cylinders), and an additional air supply for divers to fill the lift bags.*

3. *CONSIDER WATER DEPTH (REFER TO AIR INFLATION CHART FOR TOTAL AIR REQUIRED)*

4. *When rigging air and lift lines be careful not to entangle divers or diving apparatus.*

5. *Use rigging of first quality, using rated hardware and slings - rated for lifts intended.*

PRECAUTIONS

SUMMARY OF LIFT BAG USE:

1. Be aware of the DANGERS when using lift bags.
2. Have experienced Lift Bag personnel on site.
3. Carry out full calculations on the item to be lifted or supported.
4. Ensure that you have the appropriate combination of bags. And that you know which bags to use.
5. Ensure that you have plenty of support equipment: ie., shackles, ropes, strops, chain, marine ply, canvass, compressed air, hoses, etc..
6. Check the strength of the lifting points on the item you are lifting or supporting.
7. Use Parachute Bags for lifting. Use Enclosed Bags for surface flotation, especially when towing.
8. Be aware of the sea conditions, including sea state, currents, tides and monitor the weather forecast.
9. Take your time, and remove any thing that can damage the bags, ie., barnacles, jagged metal, etc..
10. And finally.....

BE PREPARED FOR THE UNEXPECTED!

Professional 50,000 lb lift bag rocketing 150 ft. into the air after rigging failure on (Speigel Grove).

Lift Bag Air Inflation Chart

Depth (feet)

Lift Capacity (lbs.)

	Surface	33′	66′	99′	132′	165′	198′	231′	264′	297′	330′
Ambient Press	14.7	29.4	44.1	58.8	73.5	88.2	102.9	117.6	132.3	147.0	161.7
50 lbs.	0.8	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8
100 lbs.	1.6	3.2	4.8	6.4	8.0	9.6	11.2	12.8	14.4	16.0	17.6
200 lbs.	3.2	6.4	9.6	12.8	16.0	19.2	22.4	25.6	28.8	32.0	35.2
500 lbs.	6.4	15.8	23.7	31.6	39.5	47.4	55.3	63.2	71.7	79.0	86.9
1000 lbs.	15.8	31.6	47.4	63.2	79.0	94.8	110.6	126.4	142.2	158.0	173.8
2000 lbs.	31.6	63.2	94.8	126.4	158.0	189.6	221.2	252.8	284.4	316.0	347.6
3000 lbs.	47.5	95.0	142.5	190.0	237.5	285.0	332.5	380.0	427.5	475.0	522.5
6000 lbs.	95.1	190.2	285.3	380.4	475.5	570.6	665.7	760.8	885.9	951.0	1046.1
12000 lbs.	190.2	380.4	570.6	760.8	951.0	1141.2	1331.4	1521.6	1711.8	1902.0	2092.2
20000 lbs.	317	634	951	1268	1585	1902	2219	2536	2853	3170	3487

When all else fails… add more bags!