

GUIDANCE ON THE USE OF UNDERWATER LIFTING BAGS

SCOPE

- 1.1 This guidance addresses the initial and periodical examination, testing, certification and maintenance of both closed and parachute type bags used to lift submerged objects.
- 1.2 This guidance also addresses the operational use of closed and parachute type lift bags and the safety precautions that should be taken during their use.
- 1.3 This guidance does not apply to water filled bags used as water weights for testing of other equipment.

2 OBJECTIVES

The objectives of this document are to provide clear guidance on:-

- (a) Fitness for purpose;
- (b) Examination and testing criteria;
- (c) Maintenance, which should be carried out to ensure the continuing integrity of each bag, as far as is possible, between its periodic tests;
- (d) Operational considerations;
- (e) Operational guidance;
- (d) Safety precautions to be taken into consideration during their use.

3 BACKGROUND

- 3.1 In some countries national regulations require the initial and periodic examination, testing and certification of all items of lifting equipment. In 1993 AODC published guidance AODC 063 - Underwater Air Lift Bags (ref. 1). Until AODC 063 was published, there was no guidance available specific to the air lift bags used in the under water industry.
- 3.2 AODC 063 was superceded in 1998 by Diving Division Guidance Number IMCA DO16.

3.3 The normal criteria for the testing of lifting equipment is to subject it to an overload test greater than its Safe Working Load (SWL) but in the case of underwater air lift bags this is not currently considered to be reasonably practicable. However this overload test should be taken in consideration in the design calculations.

4. NEW EQUIPMENT

4.1 Whilst this guidance does not address the design and manufacturing standards, generally the onus is on the manufacturer and/or the supplier of equipment to ensure that their product is fit for the purpose for which it is to be used and can be used safely.

4.2 The manufacturer/supplier should provide the purchaser with the following information and certification:

- (a) The factor of safety to which the underwater airlift bag is designed. Usually the minimum factor of safety is 5:1 of its safe working load (SWL). (The test criteria for webbing strops is 7:1)
- (b) The design has been type tested to the stated SWL (using the factor of safety in (a) above.
- (c) The bag supplied conforms to the type test.
- (d) Adequate information about the use for which the underwater air lift bag has been designed.
- (e) Details of maintenance requirements.
- (f) The capacity stated for the size should be plus 0%/minus 5% in fresh water.

4.3 The bag and its individual detachable lifting components e.g. strops, rings and shackles, should each be suitably marked or labelled with a unique serial number and its SWL. The lifting bag should be supplied with a certificate stating the unique serial number, the manufacturing standard, its SWL and listing component parts supplied with the bag.

4.4 Parachute type bags must be fitted with a suitable attachment point at or near the crown to allow a restraining line to be attached to the top of the bag.

4.5 Totally enclosed lift bags should be fitted with relief valves. These should be tested before use and set to maintain an internal pressure sufficient to fully inflate the bag to which they are fitted.

4.6 A historical record for each bag should be established and become part of the Preventative Maintenance System (PMS).

4.7 The above requirements apply to bags supplied as new on or before 1 June 1993. Equipment already in service on this date is addressed in paragraph 5 below.

5 EQUIPMENT SUPPLIED BEFORE 1 JUNE 1993

Whilst it is accepted that all the requirements for equipment supplied before June 1993 could not be met retrospectively, paragraphs 4.2 and 4.3 must be applied to such equipment at the time of the annual load test.

6 INITIAL & PERIODIC EXAMINATION, TESTING & CERTIFICATION

The categories of competent person appropriate to carry out examination, test and certification of equipment are defined in Appendix 1. Examination and test criteria are defined in Appendix II.

7 OPERATIONAL CONSIDERATIONS

7.1 Underwater air lift bags are not just a handy tool but a major piece of lifting equipment and must be treated as such. They differ from conventional lifting equipment in that the loading comes from the up thrust generated by the volume of water displaced when the bags are filled with air.

7.2 As they cannot be over inflated, lift bags will not normally lift loads, which are significantly greater than their designed safe working load. (The parachute type has an open bottom and when full the air spills out. The enclosed type has a relief valve that releases air when the internal pressure is approximately 2 psi (13.8k Pa) over ambient pressure). However, it is possible for the rigging to be subjected to additional snatch loads. These can be imposed in various ways, some examples are given below :

- (a) When the bag is used in water depths shallow enough for wave action to cause snatching and rapid changes in the dynamic loading,
- (b) When the bag has lifted up the load and the top of the bag is on the surface and therefore exposed to wave action,
- (c) When the lift bag is incorrectly rigged,
- (d) When the lift bag becomes snagged, breaks free and induces a shock load on the webbing strops or attachment points,
- (e) When the lift is assisted by a crane and there is movement on the vessel causing changes in the dynamic loading.

These additional loads should be provided for in the 5:1 safety factor, discussed in paragraph 4.2 (a)

- 7.3 Allowance should be made for the fact that sometimes more than one lift bag is attached to the same lift point and therefore there will be contact between the bags.
- 7.4 Incorrect rigging can also cause the SWL to be exceeded on attachment points due to the uneven distribution of the load. For example, where strops of different lengths are used, the load imposed on the shortest strop may be in excess on the design factor and could result in failure. It is essential that no lift bag be used that has modified or replacement components, which are not approved by the manufacturer.
- 7.5 A suitable restraining line must be fitted to parachute type bags and attached to a point on the top of the bag. This restraining line should be long enough to attach to an independent anchor point (see 8.7) to permit the bag to invert and release the gas should there be a failure of any part of the securing rigging of the bag. It should also be strong enough to resist the shock load caused by a rapidly ascending bag.

The restraining line should not be attached to other adjacent subsea equipment or structures which could themselves be damaged or cause a hazard in the event of failure.

8. OPERATIONAL GUIDANCE

A sketch illustrating a typical example of subsea rigging of parachute bags is shown at Appendix IV.

- 8.1. Before lift bags are used in underwater engineering tasks, a proper assessment of the task to be performed should be made. This assessment should include:
- (a) Calculations of the weight to be lifted or moved;
 - (b) Calculations of the size of the lift bag and type (enclosed or open) required;
 - (c) Calculations, where possible, to determine the centre of buoyancy and centre of gravity should be made so that steps can be taken to prevent the object being lifted spinning or turning over;
 - (d) The number of lift bags required;
 - (e) The positioning and attachment of the lift bag;
 - (f) Calculated safety factors for all of the above.

Note 1 *If the weight of the object to be lifted or moved is unknown, or the object is buried in the mud, the load can only be estimated. Precautions should be taken before the lift bags are attached to ensure that when they are inflated control of the load is not lost. The restraining line from the top of the bag, if secured to the load itself would perform its function should the lift bag attachment fail. It would not however prevent the load from going up in an uncontrolled fashion if the bag was accidentally over inflated. For this reason, the restraining line should normally be connected to an independent anchor point (see 8.7).*

Note 2 *Extreme care should be taken when using lift bags to overcome seabed suction or free mechanically locked or snagged equipment. A hold back strop and anchor should be available which is heavier than the up thrust created by the lift bag. This can be achieved by placing Dead Man Anchors (DMA) in the vicinity of the object and attaching slings from the object to the DMA.*

Note 3 *Only open bottom bags should be used where any form of ascent is planned or possible, such as vessel salvage or raising objects from the seabed. Fully enclosed bags should not be used for this purpose.*

8.2 Once the size/type and number of lift bags has been determined by the task specific assessment, then the bag(s) will need to be inspected before use for the following :

- (a) A check of the serial numbers on all of the components with the number of the certificate.
- (b) A check of the test date on the certificate.
- (c) Visual inspection of all components, even if the lift bags are new.
- (d) Visual inspection of the webbing strops and the stitching on the bags.
- (e) The “dump valve” at the top of the parachute bags should be checked to ensure that it is clean and can operate freely. The line attached to the “dump valve” should be checked to ensure that it is attached correctly and will operate the valve when pulled.

Note 4 *It is recommended that these lines are made of different materials and of different sizes so as to be readily distinguishable from other lines that may be present*

- (f) With parachute type bags, the restraining line should be checked to ensure that it is attached to the crown (top) of the bag so that the bag will invert should there be a failure of any part of the attached rigging.
- (g) With enclosed lift bags, the relief valve should be checked to ensure that it is free and clean.

- 8.4 If it is found, during the task specific assessment, that the lift points cannot be distributed evenly along the load, a spreader bar should be used with pad eyes at equal distances on top for the lift bag slings to be attached. There should also be pad eyes on the bottom of the spreader bar to enable slings to be attached to the load.

Note 5. If spreader bars are used then test certificates will be required and the safe working load marked on the bar.

- 8.5 If the load has been estimated then it may be necessary to provide residual lift capacity. In such cases it may be preferable to use a series of small lift bags, rather than a few large ones.
- 8.5 The use of Dead Man Anchors (DMAs) should be included in the task specific assessment prior to commencing operations that involve air lift bags. The in-water weight of any DMA should be sufficient so that the combined weight of the load and any DMA is greater than the total lift

9 MAINTENANCE

- 9.1 Before use, all bags should be examined by a competent person. If any defects or out of date certification are found the bag should not be used until repaired and/or re- tested.
- 9.2 Lift bags should be washed after use with fresh water and any grease or oil removed.
- 9.3 The dump valve on parachute type bags should be cleaned and dried and lightly powdered with French Chalk.
- 9.4 The relief valve on enclosed lift bags should be cleaned and lightly powdered with French Chalk.
- 9.5 Once cleaned the bag should be laid out so that it is fully extended. Fully enclosed bags should be fully inflated for inspection by a competent person.
- 9.6 The competent person should mark and record any defects in the historical log for that particular bag.
- 9.7 Any repairs should be carried out in accordance with the manufacture's instructions. When the repairs are completed it must be entered into the log for that bag.
- 9.8 When repaired or ready for storage the lift bags should be checked to confirm they are dry, rolled up (not folded) and stored in a clean dry place.
- 9.9 An example check list for use prior to using a lift bag and after maintenance is provided at Appendix III.

10 TRAINING

10.1 Personnel involved in the use of underwater lift bags should have a basic knowledge of the following :

- (1) Archimedes Principle
- (2) Hydrostatic Pressure
- (3) Absolute Pressure
- (4) Boyles Law

With an understanding of these 4 aspects personnel should be more aware of what can be accomplished by the use of lifting bags, the dangers that are present and the need for caution and strict controls.

10.2 Training should take place to make sure that personnel have a basic knowledge of the 4 subjects listed above.

10.3 Training should be given in accordance with the manufacturer's instructions, where appropriate, and should include but not be limited to:

- (a) storage, examination and testing of lift bags,
- (b) the deployment and rigging of lift bags;
- (c) the correct way to attach the restraining line used to invert the bag;
- (d) the correct way to use the dump valve and the precautions to be taken before using it; and
- (e) cleaning and maintenance of lift bags after use.

REFERENCES

1. IMCA DO16 'Underwater Air Lift Bags' November 1998.
2. IMCA DO18 'Code of Practice on the Initial and Periodic Examination, Testing and Certification of Diving Plant and Equipment Offshore, Inshore and Inland and from UK Flag Ships in accordance with UK Regulations.

APPENDIX 1

CATEGORIES OF COMPETENT PERSONS*

Category 1

a diving or lift support supervisor duly appointed by the diving contractor.

Category 2

a technician, certified Class 1 Chief Engineer, or other person, all specialising in such work who may be an employee of an independent company, or an employee of the owner of the equipment (unless specific legal restrictions apply), in which case his responsibilities should enable him to act independently and in a professional manner

Category 3

normally a classification society or insurance company surveyor, but who maybe an 'in-house' Chartered Engineer (unless legal restrictions apply), or a person of similar standing

Category 4

manufacturer or supplier of the equipment, or a company specialising in such work which has, or has access to, all the necessary testing facilities.

* as defined in IMCA DO18 'Code of Practice for the Initial and Periodic Examination, Testing and Certification of Diving Plant and Equipment'

APPENDIX II

EXAMINATION, TEST AND CERTIFICATION CRITERIA Both Parachute and Totally Enclosed Bags

When New or First Installed

Note: The “When in Service” requirements must also be complied with before the equipment can be put in service

Examination/Test	Category of Competent Person
Manufactured in accordance with a recognised code or standard or to Manufacturer’s Standard Specification and fit for the purpose it will be used for	3 or 4
Function test at SWL on installation	3 or 4

When in Service

Examination/Test	Validity Period	Category or Competent Person
Thorough Visual Examination of body and strops, check integrity of shackles and master links, check operation of dump, relief and inlet valves.	6 months	1, 2, 3 or 4
Load Test to maximum Safe Working Load	12 months	2, 3 or 4

Notes

- Both types of bags should be inflated for inspection, using a test plug for the parachute types. Care should be exercised during this exercise.
- Testing of lifting appliances and gear is normally carried out as part of the integral system. If individual components have to be replaced such as strops or shackles then this does not require re-testing provided the change is done on a “like for like” basis and the new component is supplied with the relevant examination and test certificate.

APPENDIX III

Sample Check List – For use prior to using a lifting bag and after maintenance.

LIFTING BAG CHECK LIST					
Customer:	Serial No:		Date:		
Certification No:	Work Load Limit (SWL):		Manufacturer:		
for ROV use					
for Diver use					
			Accepted	Not Accepted	Comments
Web Sling	Tag				
	Break in Seam				
	Break in Bearing Threads				
	General Condition.				
Lifting Bag	Master Line				
	Shackle				
	Ball Valve ROV use				
	Dump Valve Diver use				
	Fabric				
	Restraining Line				
	Attachment Point				
	Dump Valve Line Colour				
Leak Test	Air	9.02	Bar		
Preservation	Dry & Talcum				
			Completed	New Test	Comments
Repair Conducted	Web Sling			Water Test	
	Bag Fabric			Leak Test	
	Bag Valve			Leak Test	
Check Conducted By:..... Authorised Technician.					