Underwater Air Lift Bags

The International Marine Contractors Association

www.imca-int.com

IMCA D 016 Rev. 3
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- Safety, Environment & Legislation
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There are also four regional sections which facilitate work on issues affecting members in their local geographic area – Americas Deepwater, Asia-Pacific, Europe & Africa and Middle East & India.

IMCA D 016 Rev. 3

This update of earlier IMCA and AODC guidance documents was prepared by IMCA, under the direction of its Diving Division Management Committee.

This document specifically supersedes IMCA D 016 Rev. 2, dated May 2003, which is now withdrawn.

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IMCA D 016 Rev. 3 – June 2007

Appendices

1 Scope

This guidance addresses the initial and periodic examination, testing, certification and maintenance of underwater type bags (cylindrical totally enclosed, closed and open parachute bags) used to lift submerged objects.

This guidance also addresses the operational use of open parachute type lift bags and the safety precautions that should be taken during their use.

This guidance does not apply to water-filled bags used as water weights for testing of other equipment.

This document updates IMCA D 016 Rev. 2 with changes which encompass:

- general small editorial updates; and
- revision of section 8 and Appendix 5 to provide examples of different types of lifts.

2 Objectives

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

i) fitness for purpose;

ii) examination and testing criteria;

iii) maintenance, which should be carried out to ensure the continuing integrity of each bag, as far as is possible, between its periodic tests;

iv) operational considerations;

v) operational guidance;

vi) safety precautions to be taken into consideration during their use.

3 Definitions

DMA	dead man anchor or independent anchor point which, after assessment, is a suitable point from which to restrain the load
Dump line	this is attached to the dump valve inside the lift bag and is used for fine control and deflation of the bag buoyancy by the diver
Inverter line	this is attached to the top of an open parachute bag. Its purpose is to invert the bag if it becomes detached from the load being lifted
Restraining or hold-back rigging	this is provided to restrain or hold-back the positive buoyancy of the lift bag. It should be attached in such a way as to prevent an uncontrolled ascent of the load being lifted. It should be fitted between the load being lifted and a fixed point.

4 Background

In some countries, national regulations require the initial and periodic examination, testing and certification of all items of lifting equipment. In 1993 AODC (the forerunner of IMCA) published guidance note AODC 063 – *Underwater Air Lift Bags*. Until AODC 063 was published, there was no guidance available specific to the air lift bags used in the underwater industry. This guidance document has subsequently been updated three times, with this version superseding the previous text IMCA D 016 Rev. 2.

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.

The testing of the rigging used with underwater air lift bags is defined in IMCA D 018 – *Code of Practice on the Initial and Periodic Examination, Testing and Certification of Diving Plant and Equipment* (Ref. 1), with additional information included specific to underwater air lift bags and set out in Appendix 2.

5 New Equipment

Whilst this guidance does not address design and manufacturing standards, generally the onus is on the manufacturer and/or 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.

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

i) The factor of safety to which the underwater air lift bag is designed. Usually the minimum factor of safety is 5:1 on its safe working load (SWL) (the test criteria for webbing strops is 7:1);

ii) The design has been type tested to the stated SWL (using the factor of safety in (i) above);

iii) The bag supplied conforms to the type test;

iv) Adequate information about the use for which the underwater air lift bag has been designed;

v) Details of maintenance requirements;

vi) The capacity of the bag;

vii) The capacity stated for the size should be plus 5%/minus 0% in fresh water.

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 lift bag should be supplied with a certificate stating the unique serial number, the manufacturing standard, its SWL and listing the component parts supplied with the bag.

Open parachute type bags must be fitted with a suitable attachment point at or near the crown to allow an inverter line to be attached to the top of the bag. Some bags up to 50 kg SWL are not manufactured with an inverter line; in such cases they should be used in conjunction with hold-back rigging.

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.

A historical record for each bag should be established and become part of the planned maintenance system (PMS).

6 Initial and Periodic Examination, Testing and 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 2.

7 Operational Considerations

Underwater air lift bags are not just a handy tool, but also 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.

7.1 Rigging

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 13.8 kPa (2 psi) 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:

i) When the bag is used in water depths shallow enough for wave action to cause snatching and rapid changes in the dynamic loading;

ii) When the bag has lifted up the load and the top of the bag is on the surface and therefore exposed to wave action;

iii) When the lift bag is incorrectly rigged;

iv) When the lift bag becomes snagged, breaks free and induces a snatch load on the webbing strops or attachment points;

v) Where 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 5 (i).

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.

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 length are used, the load imposed on the shortest strop may be in excess of 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.

7.2 Inverter Lines

A suitable inverter line must be fitted to parachute type bags and attached to a point on the top of the bag. It should be strong enough to resist the snatch load caused by a rapidly ascending bag, bearing in mind that a longer inverter line will allow the bag to achieve a greater upwards velocity and, hence, will create a larger snatch load. For this reason the slack in the inverter line should be minimised. The inverter line should be long enough to attach to the load being lifted, to permit the bag to invert and release the air should there be a failure of any part of the securing rigging of the bag. It should be attached to a suitable point as identified during the planning of the lift. Depending on the type of lift, this could be attached to the load itself or a suitable DMA/structural member. Some bags up to 50 kg SWL are not manufactured with an inverter line; in such cases they should be used in conjunction with hold-back rigging. Engineering consideration should be given to the material selected for use as the inverter line as it may be subjected to snatch loading.

7.3 Hold-Back Rigging

The need for suitable hold-back rigging will be dependent on the type of lift being carried out (see 8.2). If required then suitable hold-back rigging should be fitted between the load being lifted and a DMA or other subsea structure that is not part of the load being lifted (see 8.8). This rigging should be arranged in such a way to resist a snatch load caused by a rapidly ascending load and to stop an uncontrolled ascent. Hold-back rigging should not be attached to other adjacent subsea equipment or structures which could themselves be damaged or cause a hazard in the event of a failure. Engineering consideration should be given to the material selected for use as hold-back rigging as it may be subjected to snatch loading. Consideration should be given to the length of the hold-back rigging to avoid unnecessary slack.

8 Operational Guidance

Several sketches illustrating typical examples of subsea rigging of parachute bags are shown in Appendix 5.

8.1 Before lift bags are used in underwater engineering tasks, a proper assessment of the task to be performed should be made. This would normally take the form of a risk assessment and the development of an appropriate lift plan. This should include the following:

i) Calculations of the weight to be lifted or moved;

ii) Calculations of the size of the lift bag and type (enclosed or open) required (bags should be of the minimum size necessary to achieve the required lift);

iii) Calculations, where possible, to determine the centre of buoyancy and centre of gravity so that steps can be taken to prevent the object being lifted spinning or turning over;

iv) The number of lift bags required;

v) The positioning and attachment of the lift bag(s);

vi) Calculated safety factors for all of the above;

vii) Determining the category of lift to be carried out as this will determine the need for a hold-back line and also the identification of a suitable securing point for the inverter line (see 8.2 for definitions of lift categories).

Note 1 *If the weight of the object to be lifted or moved is unknown or the object is buried in 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 inverter 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, hold-back rigging should normally be connected to an independent anchor point (see 8.8).*

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 upthrust created by the lift bag. This can be achieved by placing dead man anchors (DMAs) in the vicinity of the object and attaching suitable rigging from the object being lifted or moved to the DMA.*

Note 3 *Generally only open bottom parachute 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. However some totally enclosed parachute and cylindrical lift bags can be used for salvage down to depths of 30 metres. The capability of the bag should be checked with the manufacturer before undertaking such activities.*

Note 4 *Historically, there have been cases where significant variations between the stated and actual capacities of lift bags have been found, in some cases up to 20%.*

8.2 Air bag lifts are segregated into two general categories – static and dynamic:

- **Static lift** – this is where an air lift bag is secured by hold-back rigging and used as a single lift point, commonly known as a 'skyhook'. The air lift bag has very positive buoyancy, but it is directly restrained to anchor points, therefore, the lift bag is fixed and the load is free to move vertically with the use of a suitably approved lifting device;
- **Dynamic lift** – the air lift bag is used to lift the load directly, and used typically for the movement of loads between locations. The air lift bag and the load tends to be neutrally buoyant with a system of restraints in place. In such instances the lift bag and load are moved together.

See Appendix 5 for examples of lifting categories.

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

i) A check of the serial numbers on all of the components with the number on the certificate;

ii) A check of the test date on the certificate;

iii) Visual inspection of all components, even if the lift bags are new;

iv) Visual inspection of the webbing strops and the stitching on the bags;

v) The 'dump valve' at the top of 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 *It is recommended that these lines are made of different materials and/or of different diameters, so as to be readily distinguishable by the divers from other lines that may be present.*

vi) With parachute type bags, the inverter 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;

vii) With enclosed lift bags, the relief valve should be checked to ensure that it is free and clean.

8.4 When closed lift bags are used care should be taken to ensure that they are never attached in the vertical position or can rotate into the vertical position. It is important that closed lift bags are used in the correct orientation and details of this will normally be found in the manufacturer's instructions.

8.5 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 padeyes at equal distances on top for the lift bag slings to be attached. There should also be padeyes on the bottom of the spreader bar to enable slings to be attached to the load.

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

8.6 If the load has been estimated, 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 fewer large ones.

8.7 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 that the total lift force applied by the lift bag(s), thus preventing the possibility of an uncontrolled ascent of the load to the surface.

8.8 In normal circumstances hold-back rigging should be attached to an independent anchor point. A risk assessment needs to be conducted if it is proposed that this attachment is omitted.

8.9 The bag should not be left unattended during inflation.

8.10 Consideration should be given to the inflation sequence to ensure that, during subsea inflation prior to 'lift', the number of bags which are partially filled at any one time is minimised. It is recommended that each bag be partially filled on site sufficiently to lift the bag so that each bag can be checked prior to full inflation.

8.11 The dump valve should be fitted with a dump line to enable it to be operated by the diver from a safe location. In some cases it may be necessary to extend the line to allow the diver to be in a safe position. This aspect should be taken into consideration when planning the work. Both the dump line and any extension should be easily identifiable and distinguishable from any other nearby line.

8.12 Weather conditions should be taken into consideration prior to the deployment of lift bags. Current and visibility as well as the water depth should also be considered.

8.13 When deploying two divers at one time on a project, the visibility in the area the divers are to work should to be taken into consideration. Poor visibility could be an additional hazard for the divers and should to be taken into account when doing the risk assessments.

8.14 The procedures should reflect the number of divers working on the same job. Strict controls should be in place to ensure that lift bags are not inflated or deflated until both divers have been informed and each knows where the other and their umbilicals are in relation to the work area. The supervisor must not give the order to inflate or deflate the bags until the divers are ready.

8.15 Divers should always position themselves whilst working with lift bags so that their umbilicals are never routed over or directly under lift bags and loads. In the event of a rigging failure the divers risk being pulled upwards or trapping their umbilicals. Divers should be aware of their umbilical position in relation to the work.

9 Maintenance

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.

Lift bags should be washed after use with fresh water and any grease or oil removed.

The dump valve on parachute type bags should be cleaned and dried and lightly powdered with French chalk.

The relief valves on enclosed lift bags should be cleaned and lightly powdered with French chalk.

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.

The competent person should mark and record any defects in the historical log for that particular bag.

Any repairs should be carried out in accordance with the manufacturer's instructions. When repairs are completed, they must be entered in to the log for that bag.

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.

An example checklist for use prior to using a lift bag and after maintenance is provided at Appendix 3.

10 Training

Personnel (e.g. supervisors, engineers and divers) who use underwater lift bags should have a basic knowledge of the following:

i) Archimedes' Principle

ii) Hydrostatic Pressure

iii) Absolute Pressure

iv) Boyle's Law

With an understanding of these four 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.

Training should be given to personnel involved in lift bag operations in accordance with the manufacturer's instructions or as set out in this guidance note. Training of surface personnel should include but not be limited to:

i) storage, examination and testing of lift bags;

ii) the deployment and rigging of lift bags; and,

iii) cleaning and maintenance of lift bags after use.

Training of divers should include but not be limited to:

i) the correct way to attach the inverter line used to invert the bag; and,

ii) the correct way to use the dump valve and the precautions to be taken before using it.

11 References

Ref. 1 *Code of Practice on the Initial and Periodic Examination, Testing and Certification of Diving Plant and Equipment* (IMCA D 018, February 1999)

Categories of Competent Person

Category 1	a diving or life 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 may be an 'in-house' Chartered Engineer or equivalent (unless legal restrictions apply), or a person of similar standing.
Category 4	the manufacturer or supplier of the equipment, or a company specialising in such work which has, or has access to, all the necessary testing facilities.

Examination, Test and Certification Criteria

Both parachute and totally enclosed bags

When new, when first installed or when moved

Note: *All of the 'when in service' requirements must also be complied with before the equipment can be put in to 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	3 or 4

When in service

Examination/Test	Validity Period	Category of 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. A risk assessment should be undertaken prior to this operation.
- 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 retesting provided the change is done on a 'like-for-like' basis and the new component is supplied with the relevant examination and test certificate.
- The SWL function test should take the form of a water load test suspended from an appropriate device. The 'skirt' on certain lift bags may be long to overcome air spillage underwater, and this additional material may permit an overloading of the bag by approximately 10%.

Sample Air Lift Bag Pre-Use Checklist

Identification number: ....

Safe working load: ....

Bag type: Parachute / enclosed *(delete as applicable)*

Load test expiry date: ....

Leak test expiry date: ....

Item to be checked		Acceptable Yes	No	Not fitted	Comments
1	**Check the general condition of the lift bag material**				
1.1	General condition/appearance of bag material/fabric and eyelets				
1.2	Check inside of the bag for damage or debris, check condition of the dump line				
1.3	Safe working load (SWL) is clearly shown on lift bag				
1.4	Identification number is clearly shown on the lift bag				
1.5	Details on certificate(s) agree with the identification number on the lift bag				
2	**Check the general condition of the rigging**				
2.1	General condition/appearance of rigging items				
2.2	Condition of all the web slings				
2.3	Condition of the stitching retaining the web slings				
2.4	Web slings are not crossed over or twisted				
2.5	Condition of the masterlink(s)				
2.6	Condition of the shackles				
2.7	All shackle pins are secured in place (e.g. screw pin shackles ty-wrapped)				
2.8	Web slings, shackles and master links are of an appropriate SWL for the bag				
2.9	Details on certificate(s) agree with identification numbers on rigging items				
3	**Check the functional items on the lift bag**				
3.1	Check the integrity of the inverter line attachment point(s) to the lift bag				
3.2	Check that the length of inverter line is adequate				
3.3	Confirm that the inverter line is clearly different from the dump line				
3.4	Condition/appearance of the dump valve				
3.5	Test the dump valve function – pull the dump line to test the valve action				
3.6	Confirm the dump valve is free from blockage/mud plugs				
3.7	Confirm the dump valve O-ring seal is in place				
3.8	Check that the length of the dump line is adequate				
3.9	Confirm that the dump line is clearly different from the inverter line				
3.10	Condition/appearance of the quarter turn valve(s)				
3.11	Function the quarter turn valve handle(s), confirm valve(s) opens and closes				
3.12	Confirm quarter turn valve(s) are free from blockage/mud plugs				
3.13	Condition/appearance of relief valve(s)				
3.14	Confirm relief valve(s) are free from blockage/mud plugs				

Checks completed by: ....

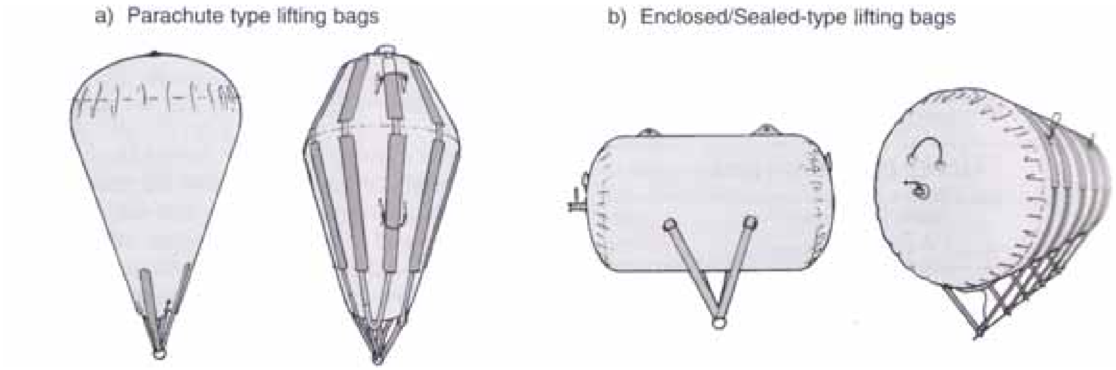
Date: ....

Sample Underwater Lifting Bag Repair Checklist

Two types of lifting bags are manufactured:

i) Parachute type with an open bottom skirt

ii) Totally enclosed lifting bags



This checklist provides guidance on the repair and maintenance of these two different types of lifting apparatus.

Parachute Type Lifting Bags

Five areas require inspection and maintenance:

1 Main body of lift bag:
   - i) Degrease bag if required
   - ii) Clean in fresh water and degrease bag
   - iii) Check for damage, abrasion etc. on bag body material
   - iv) Roll dry bag and store (do not fold)

   To fully leak test it is possible to insert an inflatable plug to block off the bag. This plug has an overpressure valve permitting air to flow into the main bag and inflate it. Leak testing using soapy water is then possible on seams and any suspect abraded areas.

2 Shackles:
   - i) Check that the shackles are the correct rating in size and capacity for the lifting weight of the lift bag
   - ii) Serial numbers must match certificates
   - iii) Check for signs of damage and fatigue. Replace if suspect

3 Strops and straps:
   - i) Check that strops and stitching are sound. Inspect for signs of abrasion and stitching tear
   - ii) Serial numbers must match certificates
   - iii) Check the 'crown' of the lift bag where the straps either attach to the bag or attach to a ring at the top of the bag for signs of damage or wear

4 Valve:
   - i) Check valve is functioning
     - ♦ pull dump cord
     - ♦ check valve seat for debris
     - ♦ ensure valve re-seats
     - ♦ if not functioning correctly, remove from bag and service in accordance with manufacturer's instructions
   - ii) Clean and dry valve - dust with French chalk

5 Restraining/hold-back rigging:
   - i) Is it properly fitted?
   - ii) Is it easily identifiable from other lines? (colour-coded, different thickness?)
   - iii) Is the hold-back rigging long enough to be attached to anchor point?

Update logbook with any changes and inspection details, including name of competent person/repairer.

Totally Enclosed Lifting Bags

Repair and inspection procedure as above but with the following differences:

1 Spreader bar (if used) – check this is load certified;

2 Leak testing – main bag can be inflated and soapy water applied to look for areas of leakage;

3 Inlet valve to be function tested;

4 Outlet/relief valve to be function tested;

5 Drying inside of the bag is desirable prior to storage but is difficult. Bulk water can be removed by inflating the bag with the outlet valve in the lowest position. Flushing with air will assist drying.

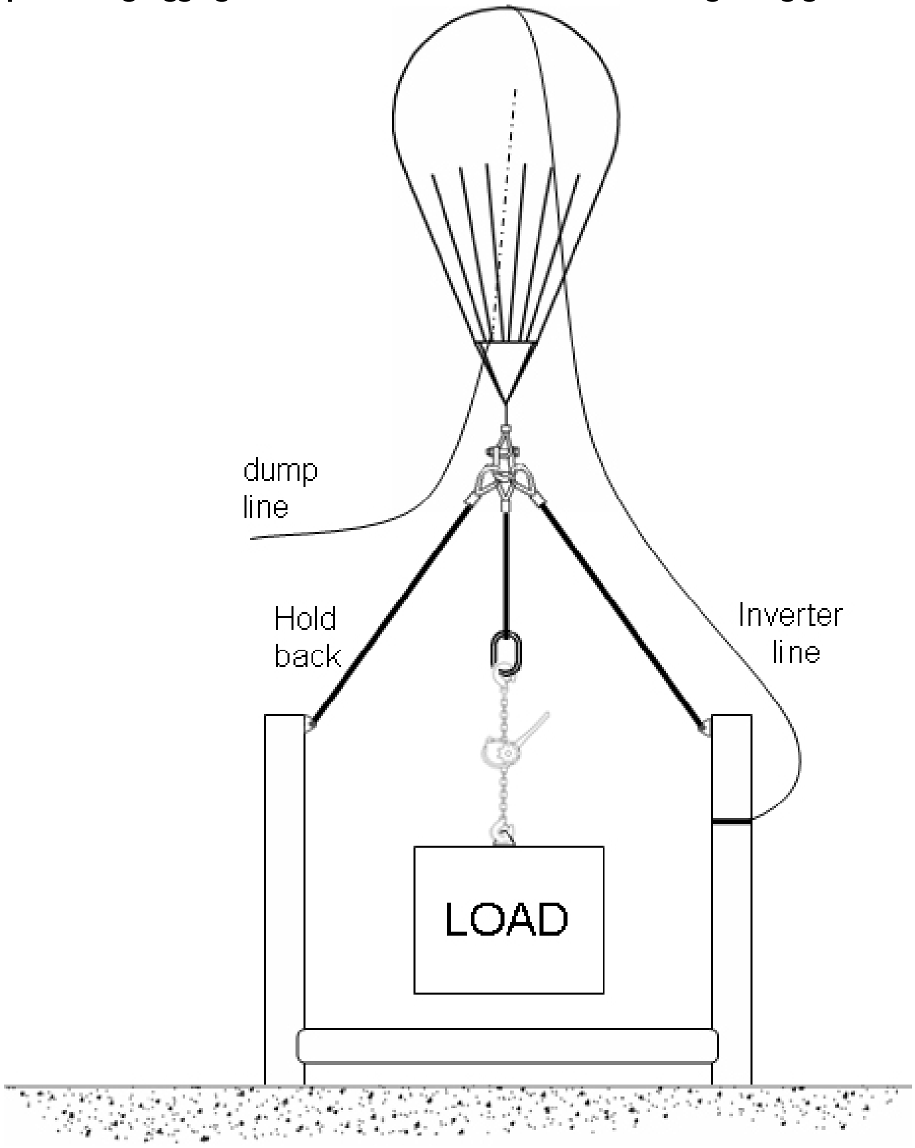
Examples of Different Lifting Categories

NB *The following sketches are indicative only, to illustrate different types of lift and rigging arrangements, and are not to scale.*

Lower Load into Manifold/Tree Base – Static

- Both the inverter line and hold-back line should be secured to a subsea structural member or a suitable DMA.
- Ensure hold-back line is shorter than inverter line.
- The bag provides a fixed lifting point from which the load can be either raised or lowered by mechanical means.

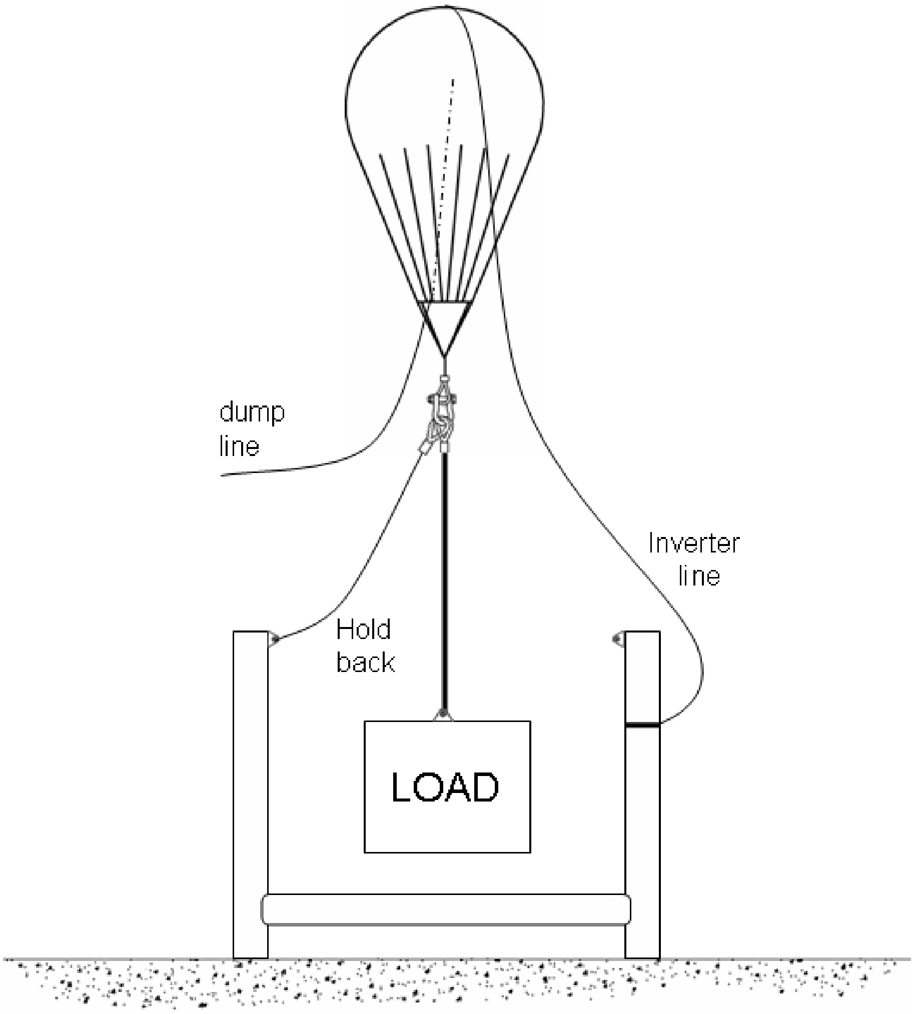
In this example lift bag rigging failure would result in the load and bag being grounded.



Lower Load into Manifold/Tree Base – Dynamic

- In this example both the inverter line and hold-back are secured to a subsea structural member or a suitable DMA.
- The hold-back line should be shorter than the inverter line.
- This dynamic lift involves moving the load vertically and horizontally.
- The difference between this type of lift and a static lift is that a dynamic lift is used for a neutral load.

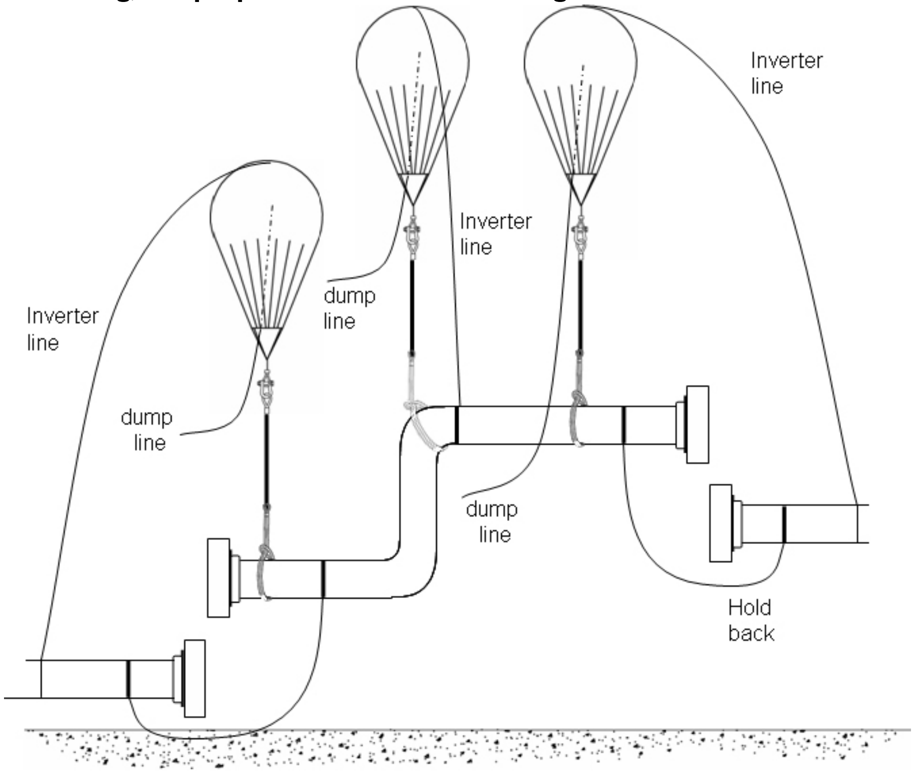
In this example any rigging failure would result in the load and bag being grounded.



Manoeuvre Spool Flange to Align with Manifold Flange – Dynamic

- In such a case it is necessary to have at least two hold-backs, one at either end of the spool secured to either structural members or a suitable DMA.
- The hold-back line should be shorter than the inverter line.
- The SWL capacity of the hold-back should exceed the total buoyancy and take into account acceleration/ snatch loading. Hold-backs should typically be wire rope slings or lifting strops.
- Lifting devices such as lever hoists are not suitable as retaining lines – they are positional/alignment devices with complex failure modes.
- At least one of the inverter lines from one of the air bags needs to be be secured to subsea structural members or a suitable DMA.
- The total up-thrust from one of the bags should not be capable of lifting the load.

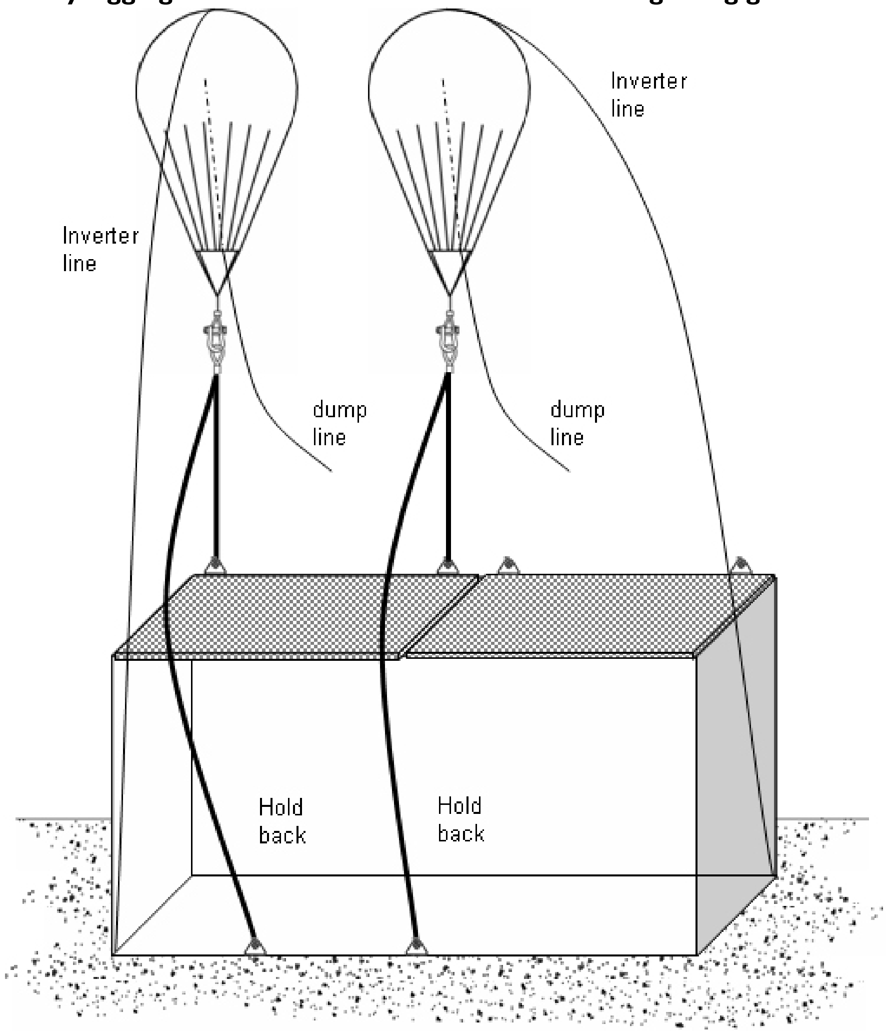
In this example any rigging failure would tension the inverter line and would cause the bag(s) to deflate resulting in the load being lowered. The inverter rope is not being used as rigging equipment as it is not expected to experience the entire load, but simply to fulfil its function of inversion of air lift bag, the purpose for which it was designed.



Roof Panel Opening/Closing – Dynamic

- In the event that roof panels are detachable then hold-backs are required to be fitted to the structural members or suitable DMA and this would constitute a dynamic lift.
- If they are hinged then hold-backs are still required as the hinges may have been submerged for considerable periods of time and should not to be relied upon.
- The hold-back line should be shorter than the inverter line.
- Consideration should be given to the lengths of both the inverter and hold-back lines to allow for change in height when the roof panel is open.

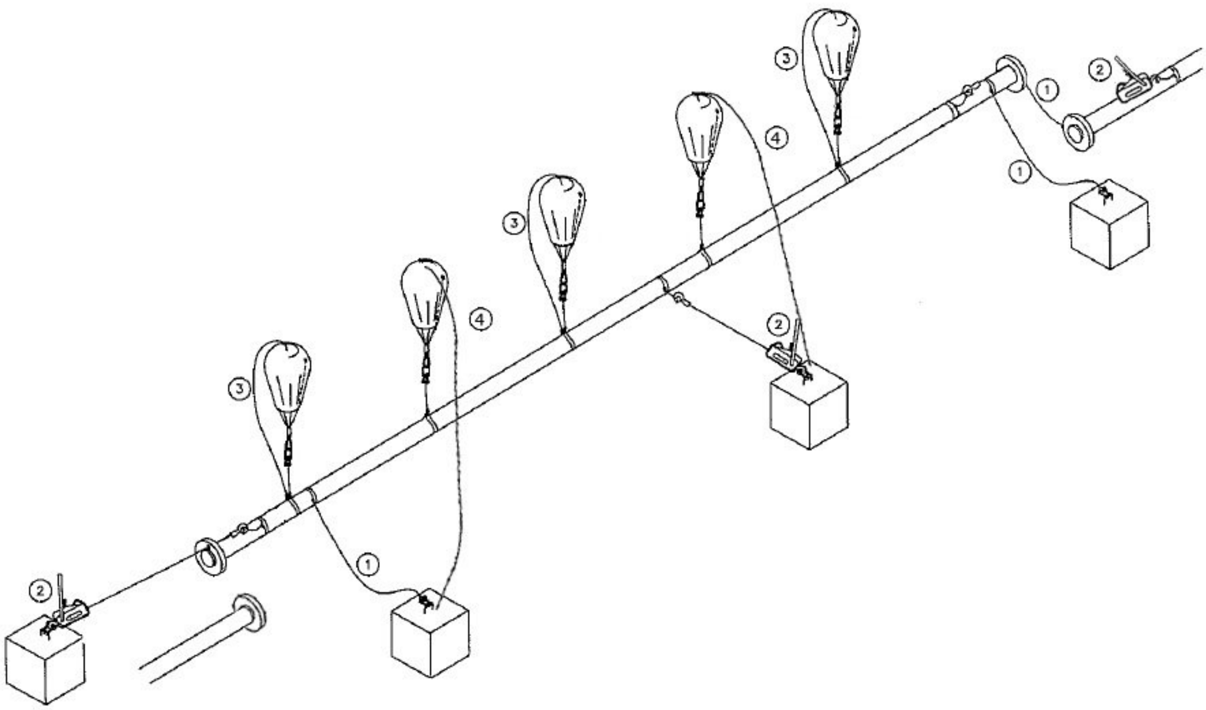
In this example any rigging failure would result in the load and bag being grounded.



Multiple Airbag Lift – Dynamic

- In complex lifts using multiple bags it is not necessary to secure each and every inverter line to existing structural members as they have the potential to become trip hazards.
- A significant proportion of inverters should be affixed to strong points to decant sufficient buoyancy to ground the load.
- Hold-backs are required at either end.
- The hold-back line should be shorter than the inverter line.
- Positional/alignment devices, such as lever hoists, are not suitable substitutes for hold-backs.

In this example any rigging failure would result in the load and bag being grounded.



KEY

1 Hold-back rigging. For the purpose of this example the new spool piece should be secured to both the DMAs and the existing pipeline/structure

2 Positional/alignment devices

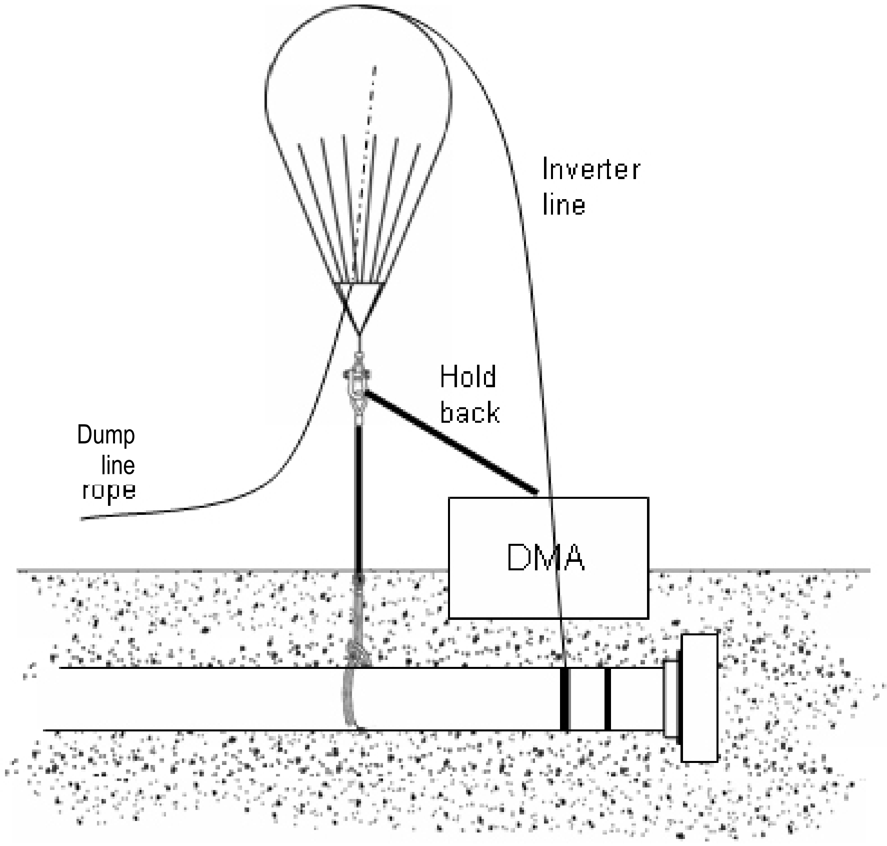
3 Inverter lines attached to the load

4 Inverter lines attached to the DMA (this would ground the load in the event of hold-back failure).

Breakover Lift – Dynamic

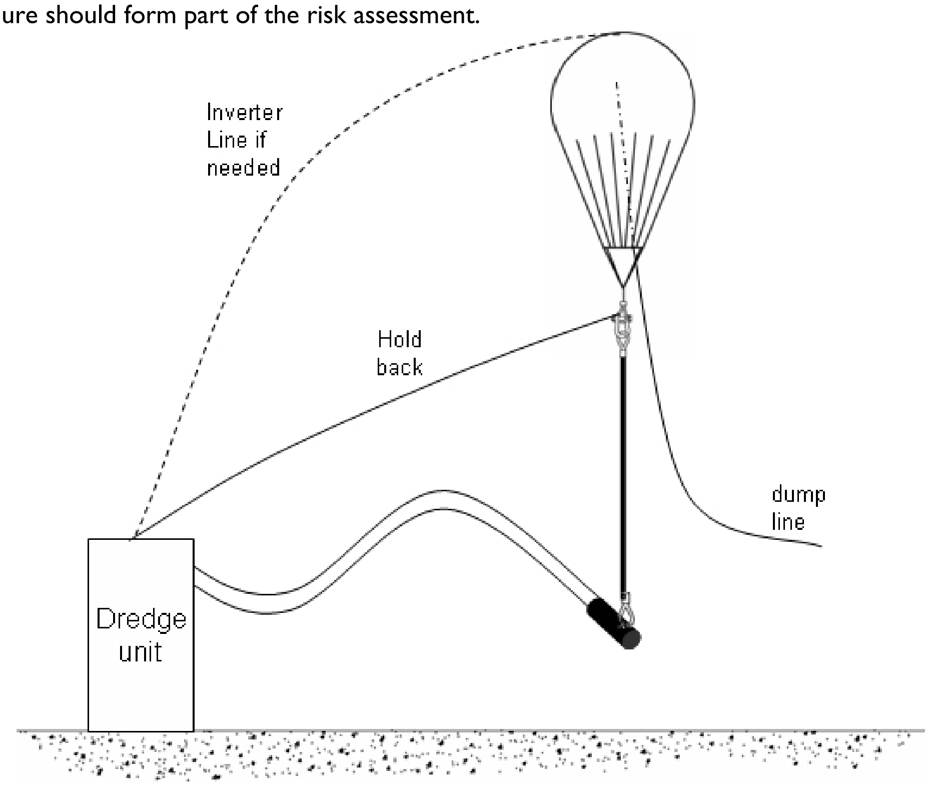
- The inversion line must be secured to subsea structural members or a DMA.
- There is the need for a hold-back as some times considerable buoyancy is required to release the load from the mud (suction) and on release the buoyancy continues to act.
- The inverter line needs to be of a length to ensure that the hold-back rigging supports the load before the inversion line is tensioned.

In this example any rigging failure would result in the load and bag being grounded.



Support Dredge Unit Nozzle Manual Lifting Aid – Dynamic

In this example, even though a small bag is used because of the positive buoyancy this is still a dynamic lift. If an inverter line is fitted then this should be connected to the dredge unit or a DMA. If there is no inverter line then a hold-back line should be connected between the air lift bag and the dredge unit or DMA. Consideration of rigging failure should form part of the risk assessment.



Moving Equipment to/from a Work Basket Manual Lifting Aid – Dynamic

- This example shows a small lift bag with capacity of less than 50 kg which might not fitted with an inverting line.
- In the absence of inverting lines there **must** be a hold-back in place to restrain the lift bag going to surface in the event of a load rigging failure.

In this example consideration of rigging failure should form part of the risk assessment.