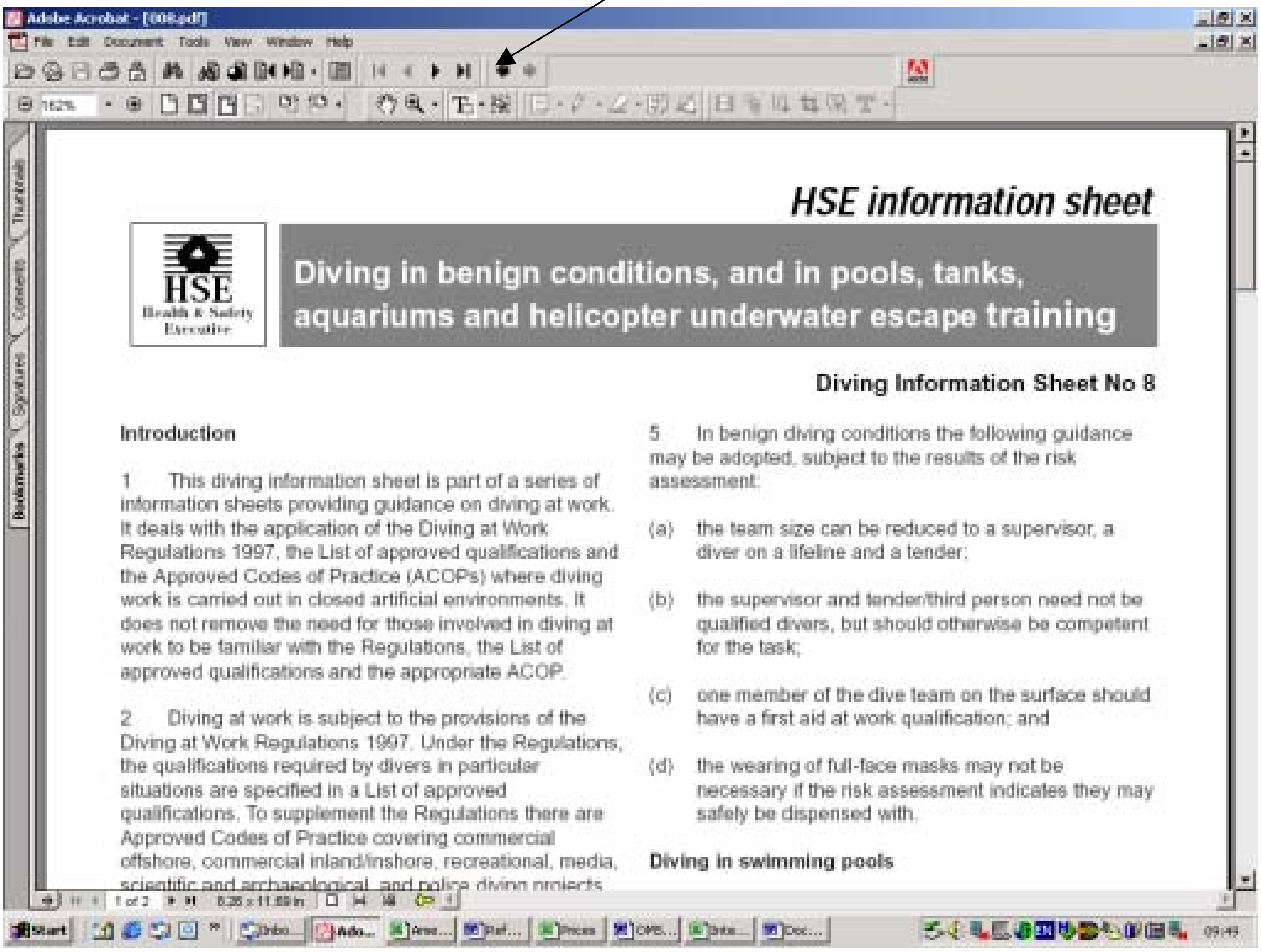
To navigate through the HSE Diving Information Sheets use the bookmarks to the left hand side of the screen

However, please note that due to the encryption placed upon sheets No 8 onward the only way to return to this index is by clicking on the return button



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Bell run and bell lock-out times, and bell run times in relation to habitats

Diving Information Sheet No 7

Introduction

1 This diving information sheet is part of a series of information sheets providing guidance on diving at work. It replaces the following diving safety memorandum: DSM 2/1992. The remaining DSMs have either been replaced by other diving information sheets, or will be cancelled when the Diving at Work Regulations come into force on 1 April 1998.

2 This information sheet sets down clear guidance on:

(a) bell run and bell lock-out times for two and three-man diving bells; and

(b) bell run times in relation to work carried out in habitats.

It is important to recognise that the various bell run and lock-out times set out in this sheet are, unless stated otherwise, to be regarded as maxima and will need to be reduced for very heavy work.

3 Bell run and bell lock-out times are interpreted as follows:

(a) **Bell run times**
The maximum bell run time is calculated from initial bell lock-off until the final lock-on to the diving system and the divers are ready to transfer. If, after the initial bell lock-off, the bell is returned to the system for any reason, no adjustment should be made to extend the bell run beyond 8 hours after the initial lock-off.

(b) **Bell lock-out times**
Lock-out time in the water is the elapsed time from when the diver is totally submerged after exiting the bell until the diver is back in the bell.

General

4 In order to ensure safe and efficient operations, it is important that diving personnel work with a time routine which allows them to develop a regular work and sleep pattern, and with a minimum rest period of 12 hours (ie not diving or carrying out pre or post-dive checks). Therefore, when bell diving operations are carried out around the clock, and on a continuous basis, they should be planned so that no diver takes part in a 6-hour lock-out operation or an 8-hour bell run more than once within a pre-planned 24-hour period.

5 **The practice of 'ratcheting', ie cycling the whole dive team in less than 24 hours, and then immediately recommencing the cycle to gain work time, should not be used.**

6 Reference is made in this information sheet to 'planned' bell run and lock-out times. This has deliberately been included, as diving operations should be organised in such a way that the time necessary to carry out certain tasks is assessed in advance by the project team. Diving supervisors should make a clear note in the diving operations record, before the operation starts, as to how long they feel the bell run and lock-outs will take. It will therefore serve as a guide to them, the divers, other members of the diving team, client representatives and others.

7 When divers are involved in tiring physical work, diving supervisors must appreciate that it may be appropriate for them to return to the bell for a short rest and to take refreshment before finishing their task. They should only do so with the consent of the diving supervisor, but such consent should in most, if not all, cases be given. This applies to all diving bell operations. The diving supervisor must ensure that the divers are offered a refreshment break of at least 15 minutes within 3 hours of the initial lock-out. If the diver agrees to forego such a break, then a timed entry should be made in the diving operations record and subsequently signed by the diver and diving supervisor.

Two-man bells

8 The total bell run time should be planned not to exceed 8 hours. The lock-out time in the water of divers from a two-man bell can be flexible within the total bell run time, up to a maximum of 4 hours. It may exceed this time, under exceptional circumstances, by a further maximum period of 30 minutes if it is necessary to complete a 'critical task', but then only with the agreement of the two divers and the diving supervisor. In this case their agreement should be recorded in the diving operations record.

Three-man bells

9 The total bell run time for a three-man bell (containing three divers) should be planned not to exceed 8 hours. If two divers lock-out simultaneously from the bell, then the lock-out shall be for a maximum of 6 hours (provided that the bell man remains in the bell.

except in an emergency, throughout the bell run). They should be organised in such a way that each diver has a dry dive, acting as standby diver/tender in the bell every third bell run.

10 On occasions, in advance of a bell run, a diving supervisor may judge that three divers will need to lock-out during the course of the dive. In this situation, as part of the pre-planning, the supervisor may organise lock-outs in the water on a flexible basis, within a maximum bell run time of 8 hours, so that each lock-out does not exceed 4 hours. Under exceptional circumstances, a 4-hour lock-out in the water may be extended by up to a maximum 30 minutes if it is necessary to complete a 'critical task', but then only with the agreement of the two divers and the diving supervisor. In this case their agreement should be recorded in the diving operations record.

Habitats

11 The work carried out in the dry in a habitat is generally concerned with the welding of pipes or structural members, and is very different from the work carried out by divers in the water.

12 The total bell run time should be planned not to exceed 8 hours. Once in the habitat, the divers need to assess the work that has to be carried out, set it up, carry it out, and then leave the habitat in a suitable condition for the next team. Recent assessment of several dozen habitat dives has indicated that such work can usually be completed within the planned 8-hour bell run. However it is appreciated that practical and technical problems can occur, eg the requirement, for technical reasons, for root and hot pass welds to be completed by a diver before passing on to the next team.

Further reading

1 *Commercial diving projects offshore. The Diving at Work Regulations 1997. Approved Code of Practice* L103 HSE Books 1998 ISBN 0 7176 1494 8

2 *Commercial diving projects inland/inshore. The Diving at Work Regulations 1997. Approved Code of Practice* L104 HSE Books 1998 ISBN 0 7176 1495 6

3 *Recreational diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L105 HSE Books 1998 ISBN 0 7176 1496 4

4 *Media diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L106 HSE Books 1998 ISBN 0 7176 1497 2

5 *Scientific and archaeological diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L107 HSE Books 1998 ISBN 0 7176 1498 0

6 *The Diving at Work Regulations 1997* SI 1997/2776 The Stationery Office 1997 ISBN 0 11 065170 7

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Printed and published by the Health and Safety Executive 2/98 DVIS7 C20

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Maintenance of diving bell hoist ropes

Diving Information Sheet No 6

Introduction

1 This diving information sheet is part of a series of information sheets providing guidance on diving at work. It replaces the following diving safety memorandum: DSM 5/1991. The remaining DSMs have either been replaced by other diving information sheets, or will be cancelled when the Diving at Work Regulations come into force on 1 April 1998.

2 The sheet gives recommendations on the composition and maintenance of diving bell hoist ropes. It gives guidance on examining and testing the ropes, and on how to determine whether a rope should be taken out of use.

3 The recommendations set out in this information sheet have been prepared on the basis of earlier guidance and discussions with industry representatives.

4 The recommendations apply to all main hoist ropes used for systems which transport divers through the water, including diving bells, wet bells, baskets etc. (In this guidance, the term 'bell' should be taken to include all these types of system.)

5 Based on the results of fatigue testing and other investigations at British Ropes Ltd and Reading University,[1] the recommendations give particular emphasis to the special problems associated with spin resistant multistrand ropes. **These ropes have a characteristic of developing large numbers of internal wire breaks, long before external signs of deterioration become apparent**. This characteristic becomes even more pronounced when the rope is frequently immersed or sprayed with sea water, as this leads to severe internal fretting wear.

Use of galvanised or bright (black) wire rope

6 Evidence, from studies of the effects of sea water on the degradation of wire rope, shows that the performance of galvanised rope is considerably superior to that of rope manufactured from bright, ungalvanised wire. Not only does the zinc provide sacrificial protection to the steel from general corrosion, it also counteracts corrosion fatigue and corrosion fretting. So it is recommended that only galvanised wire ropes be used for bell hoist ropes.

7 With regard to the potential risk of hydrogen embrittlement resulting from the cleaning process, not only are there numerous factors that render this almost impossible (including the hot dip in the zinc bath) but rope manufacture from an embrittled wire would be impossible. Therefore any suggestion that galvanised wire has been embrittled in this way is wholly without basis.

8 Galvanised or bright (black) wire ropes may be used as long as the guidance in this information sheet is followed.

Maintenance

9 All sheaves and guide rollers in contact with the moving rope should be given regular visual checks for surface wear, and lubricated to make sure that they run freely. This operation should be carried out at appropriate intervals (generally not exceeding more than one week during diving operations).

10 The rope should be maintained in a well lubricated condition using appropriate marine grade rope lubricants (as recommended by the rope manufacturer). The maintenance of internal lubricant is especially important for multistrand ropes, due to the way they are constructed.

11 A surface dressing should be applied at appropriate intervals from the winch drum to the bell, commensurate with the depth to which the bell is to be deployed during diving operations. Apply the surface dressing by whatever application method is convenient.

12 In order to make sure that the inner layers of the rope remain well lubricated, use an effective pressure lubricator[2] from the winch drum to the bell, commensurate with the depth to which the bell is to be deployed. This should be carried out at intervals not exceeding six months, and particularly at the end of an operating season, or if the diving system is not to be deployed for a period. The lubricant should be an appropriate heavy marine grade, as recommended by the manufacturer of the lubricator, and approved by the rope manufacturer.

13 In systems that use multilayer winding onto the winch drum, there is the possibility that local damage can be caused to the rope in the regions where the rope crosses from one layer to the next, or where the rope crosses over the turns in the layer beneath. In systems where this form of damage occurs, it is possible to extend the life of the rope. This is done by pulling in the back end of the rope on the drum by a length sufficient to move all the layer crossover regions on the rope, and the Lebus crossovers, where this type of winding is used. This cut-and-slip of the drum end of the rope does not eliminate the crossover damage but distributes it more uniformly over the rope length. Guidance on

whether this form of maintenance is necessary, and if so at what frequency, can only be given by an experienced rope examiner in relation to a specific installation. Where this kind of damage reaches a level which indicates that this form of maintenance should be carried out more frequently than every six months, then it is likely that either the wrong rope has been used or there is something fundamentally wrong with the reeving arrangement. In this case, take appropriate steps to reassess the installation.

14 When a new rope is installed, or when the end is pulled in (see paragraph 15), to avoid miscoiling and subsequent damage, it is important that the rope is tensioned as it is wound onto the drum. The weight of the loaded bell in water will indicate the correct magnitude of the load to apply for this operation. The chosen procedure should avoid damage to the rope and in particular should avoid rubbing contact with a hard object.

Inspection and testing

15 During diving operations, where practicable, all accessible rope and associated equipment should be checked visually once each day. Pay particular attention to the termination and the part of the rope entering the socket. On those systems where the termination is inaccessible, then the correct inspection arrangements should be agreed with the competent person.

16 A visual inspection of the rope, from the winch drum to the bell commensurate with the depth to which the bell is to be deployed, should be carried out at appropriate intervals during diving operations, as agreed with the competent person. At the same time, because multistrand rope tends to suffer internal damage, local reductions in diameter or lay distortions should be treated with the utmost suspicion as they are likely to indicate serious internal degradation. Any anomalies should be reported promptly to the diving supervisor who should record them and take appropriate action.

17 The rope and associated equipment must have been examined, tested and certified by a competent person[3] (ie someone who, in the case of the rope examination, has had suitable training and experience of rope examination) not more than six-months prior to any use. As an integral part of the diving system, at six-month intervals, the rope should be subjected to a static test at 1.25 times the safe working load, a functional test at the safe working load, and a visual examination. In addition, an overload test (1.5 times the safe working load) should be performed at installation or after any modification which affects its safe working. The safe working load (SWL) is defined as the weight of the rope and bell when the bell is operationally manned. This can be either in air at the surface, or at maximum depth, whichever is the greater.

18 At intervals not exceeding 12 months, the rope should be cut and reterminated in order to

(a) remove that part adjacent to the termination which is subject to the greatest corrosion due to depth and pressure, and also the part subject to the most severe dynamic loading as the bell is deployed; and

(b) permit an ultimate strength test to be carried out on a sample of the latter, ie that part subject to the most severe dynamic loading.

19 The rope should be cut back to just beyond the first sheave from the bell termination (with the bell fully submerged and allowing for swell). A length sufficient to provide two test samples should be removed from the sheave (in board) end of the cut section. In systems where there is a single vertical fall directly from the winch to the bell (where there is no multi-reeved cursor arrangement), it will be necessary to cut right back to the winch. Full details of the samples (identity and position) should be recorded. Should the first test prove unsatisfactory due to problems with testing procedures, a second test may be carried out. This alternative test should not be used as a way of avoiding discard where a valid test is performed which indicates low strength. (In certain circumstances the competent person may waive the recommendation to cut all the way back to the first sheave (see paragraph 30).

20 During retermination of the rope, a thorough internal examination of a short length of rope adjacent to the cut end should be conducted by a competent person. This is in order to assess:

(a) internal lubrication;

(b) internal wear;

(c) level of residual zinc;

(d) extent of corrosion.

21 After termination, the end fitting should be examined for good workmanship and general integrity. Pay particular attention to alignment, concentricity and lubrication at the socket entry. It is considered good practice to remove the serving at the socket entry, after completion of the termination, to facilitate inspection and effect any relubrication needed.

22 Where the competent person judges that it is highly likely the factor safety between rope strength and SWL will fall below 8:1 before the next examination, then he/she should request more frequent examination and testing.

23 When a rope is not in service, corrosion can take place, particularly within the rope where sea water may have been trapped by any external dressing. This means it is necessary to subject the rope to appropriate inspection and tests, as defined in the following paragraphs, before putting it back into service.

24 For installed equipment not in use, when the period of non-use exceeds one month, the wire rope and termination should be subjected to external visual inspection

to identify any corrosion or damage over the length from the winch drum to the bell. This should be commensurate with the depth to which the bell is to deployed.

25 If the period of non-use exceeds six months, the load test specified in paragraph 17 should be carried out.

26 If the period of non-use exceeds 12 months, the rope should be cut back and reterminated, and tested in accordance with paragraphs 18-22.

27 For demobilised equipment that is about to be mobilised, as an integral part of the lifting system, the rope should be subjected to an overload test at 1.5 times SWL. If the rope needs retermination during installation, then consideration should be given to removing samples for destruct testing (see paragraphs 18-19), in order to give 12-month validity to the rope certification. In all other respects, the requirements of paragraphs 24-26 apply.

28 It is recommended that once a year the six-monthly examination is supplemented by the use of an electromagnetic non-destructive test (NDT) device appropriate for the rope concerned. The inspector should use the NDT device to supplement the visual inspection, and in particular to help focus attention on areas of damage. Sections of the rope, from the winch drum to the bell, commensurate with the depth to which the bell is to be deployed, which should be given special attention are:

(a) the part immediately adjacent to the socket;

(b) the part which is in contact with the sheave nearest the bell as the bell enters the water;

(c) in systems which operate with heave compensation, and where there has been repeated operation at the same depth, the part or parts of rope which repeatedly move on and off sheaves or drum when the bell is at operating depth.

29 The NDT device used must be one which has been demonstrated to be suitable, and which the competent person considers acceptable, for the identification of internal damage in the type of rope being examined. The device should be used in accordance with the manufacturer's recommendations, with special regard to rope speed through the device, and diameter and construction of the rope. The device should be used in conjunction with a recorder which can provide a permanent record of the output of the device. This is so that, on successive examinations, a comparison can be made to help detect any degradation. Not only should the same or a similar instrument be used for successive examinations of a particular rope, but also careful records should be retained of any operating variables, instrument settings or calibration procedures, to ensure repeatability.

30 Where a NDT is performed as recommended here, then the recommendations (see paragraphs 18-19) for the annual removal of a length of rope from just beyond the first sheave from the bell termination (with the bell fully submerged and allowing for swell) may be set aside. Instead, a length sufficient to provide test samples for two ultimate tests (see paragraphs 18-19) should be cut from the bell end adjacent to the termination.

Discard criteria

31 Discard criteria, as specified in BS 6570, should be used. However, more specific recommendations are set out in paragraphs 32-35.

32 There should be an examination by a competent person who, when certifying the rope, should be satisfied from an interpretation of the examination that:

(a) the minimum breaking load has not been reduced by 10% or more of its strength when new, as certified by the manufacturer;

(b) the factor of safety between rope strength and SWL has not fallen below 8:1.

33 An ultimate strength test should be carried out and the rope discarded if:

(a) the minimum breaking load measured in the sample taken for testing purposes shows a reduction of 10% or more of the breaking load, when new, as certified by the manufacturer;

(b) the factor of safety between the measured rope strength and SWL has fallen below 8:1.

34 Alternatively, where either the examination or the test indicates a strength reduction as defined in paragraph 33, and the rope examiner is satisfied that the reduction is local to the more heavily loaded section of rope which carries the full weight of the bell in air then, provided the rope is cut back to remove all the doubtful parts, the rope may be retained in service. Where this procedure is followed, the security of the remainder should first be demonstrated by a further ultimate strength test of a sample taken from the end of the remaining rope.

35 If the discard criteria recommended in the preceeding paragraphs are met, then there need be no limitation on the life of the rope. The competent person may however feel that the frequency of testing should be reconsidered after a number of years' service.

Rope records

36 In the interests of good safe practice, and to help identify critical regions for inspection, it is recommended that full records should be kept for each diving bell hoist rope, from its first installation to discard. This rope record, which could generally be incorporated as part of the records of a planned maintenance programme, should record the information in paragraphs 37-40.

37 At installation, details of the installed rope should include:

(a) date and name of manufacturer;

(b) minimum breaking load and certificated test strength;

(c) diameter, construction, wire grade and surface treatment;

(d) date and length installed.

38 Confirmation (and a record of comments when appropriate) of daily and weekly inspections needs to be kept.

39 A record of lubrication (date, lubricant used and application method) needs to be kept.

40 A record of inspections, maintenance and testing, needs to include:

(a) results of six monthly and annual visual inspection;

(b) details of length removed;

(c) location of test sample and strength obtained;

(d) results of internal examination;

(e) details of the NDT, if applicable;

(f) details of pressure lubrication, if applicable;

(g) details of retermination;

(h) results of the functional tests.

41 Where possible, an identifying sleeve or tag should be used to indicate which record the rope relates to. The tag should also specify the maximum weight of the bell and rope.

42 None of the recommendations in this guidance are intended to conflict with or set aside any other recommendations, statutory or otherwise, which may relate to the inspection, maintenance and discard of diving bell hoist ropes or associated installations.

Notes

1 *Maintenance, inspection and discard of diving bell hoist ropes* OTH91 338 HSE Books 1993 ISBN 0 11 886387 8

2 An effective lubricator is one that will not only convey fresh lubricant to the core of the rope but will also displace entrained water. This generally requires high pressure application of a heavy grade of lubricant.

3 SI 1976/1019 Offshore Installations (Operating Safety, Health & Welfare) Regulations require that the 'competent person' is neither the owner nor an employee of the installation.

Further reading

1 *Commercial diving projects offshore. The Diving at Work Regulations 1997. Approved Code of Practice* L103 HSE Books 1998 ISBN 0 7176 1494 8

2 *Commercial diving projects inland/inshore. The Diving at Work Regulations 1997. Approved Code of Practice* L104 HSE Books 1998 ISBN 0 7176 1495 6

3 *Recreational diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L105 HSE Books 1998 ISBN 0 7176 1496 4

4 *Media diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L106 HSE Books 1998 ISBN 0 7176 1497 2

5 *Scientific and archaeological diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L107 HSE Books 1998 ISBN 0 7176 1498 0

6 *The Diving at Work Regulations 1997* SI 1997/2776 The Stationery Office 1997 ISBN 0 11 065170 7

7 *Degradation of galvanised multi-strand wire ropes* OTO97 036 HSE 1997 (available from Offshore Safety Division, Rose Court, 2 Southwark Bridge, London SE1 9HS)

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Exposure limits for air diving operations

Diving Information Sheet No 5

Introduction

1 This diving information sheet is part of a series of information sheets providing guidance on diving at work. It replaces the following diving safety memorandum: DSM 2/1990. The remaining DSMs have either been replaced by other diving information sheets, or will be cancelled when the Diving at Work Regulations come into force on 1 April 1998.

2 The sheet contains guidance on the maximum time that a diver, using air, should spend under water.

Exposure limits for air diving operations

3 HSE's policy is to recommend that diving, which uses air, should be organised in such a way that the planned bottom times* do not exceed the limits outlined in Table 1.

4 If a nitrox breathing mixture is being used, you can find out the maximum exposure by entering the equivalent air depth of the maximum dive depth in the table below.

Table 1 Maximum bottom time limitation for surface decompression, in-water decompression, and transfer under-pressure decompression diving

Depth		Bottom time limits (minutes)	
Metres	Feet	Transfer under-pressure	Surface decompression and in-water decompression
0-12	0-40	240	240
15	50	240	180
18	60	180	120
21	70	180	90
24	80	180	70
27	90	130	60
30	100	110	50
33	110	95	40
36	120	85	35
39	130	75	30
42	140	65	30
45	150	60	25
48	160	55	25
51	170	50	20

* *Bottom time:* the total elapsed time from when the diver is first exposed to a pressure greater than atmospheric, ie when leaving the surface, or on the start of pressurisation when a closed bell is employed in the observation mode, to the time (next whole minute) that the diver begins decompression (measured in minutes).

Further reading

1 *Commercial diving projects offshore. The Diving at Work Regulations 1997. Approved Code of Practice* L103 HSE Books 1998 ISBN 0 7176 1494 8

2 *Commercial diving projects inland/inshore. The Diving at Work Regulations 1997. Approved Code of Practice* L104 HSE Books 1998 ISBN 0 7176 1495 6

3 *Recreational diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L105 HSE Books 1998 ISBN 0 7176 1496 4

4 *Media diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L106 HSE Books 1998 ISBN 0 7176 1497 2

5 *Scientific and archaeological diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L107 HSE Books 1998 ISBN 0 7176 1498 0

6 *The Diving at Work Regulations 1997* SI 1997/2776 The Stationery Office 1997 ISBN 0 11 065170 7

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Compression chambers

Diving Information Sheet No 4

Introduction

1 This diving information sheet is part of a series of information sheets providing guidance on diving at work. It replaces the following diving safety memoranda: DSM 2/1984 and DSM 3/1984. The remaining DSMs have either been replaced by other diving information sheets, or will be cancelled when the Diving at Work Regulations come into force on 1 April 1998.

2 There are two sections, containing guidance on the following aspects of compression chambers:

(a) safety procedures for diving chamber operations;

(b) diving safety interlocks.

Safety procedures for diving chamber operations

3 The text reproduced in paragraph 4 was issued in a safety notice by the Norwegian Petroleum Directorate, and is supported by HSE.

4 In connection with diving accidents on the Norwegian Shelf, the Norwegian Petroleum Directorate gives the following recommendations:

(a) Clamping mechanisms, necessary for the chamber complex, evacuation device and bell to remain under pressure, should be equipped with an interlocking mechanism. This interlocking mechanism will make it impossible to open a clamping mechanism in the event that an undesirable drop in pressure will take place. We emphasise that it must be impossible to open the mating clamp between the bell and the chamber while the tunnel is under pressure.

(b) The person who operates the clamping mechanism must make sure that opening it will not cause an undesirable drop in pressure.

(c) The doors between the different compartments in the chamber complex should be kept closed whenever possible.

(d) All stations necessary for a safe diving operation should be equipped with a communications system which means the person on the station can understand their orders clearly. It should be possible to contact the diving supervisor from all these stations.

(e) The diving operation should be carried out in accordance with laid down procedures. During operations of special importance to the divers' safety, checklists should be used.

Diving safety interlocks

5 Diving systems should be fitted with safety interlocks where necessary, to prevent any unintentional pressurisation or de-pressurisation, or uncontrolled loss of pressure. Particular attention should be paid to chamber/bell mating systems, diver evacuation mating systems, and food and equipment locks.

6 Internal communicating doors in the transfer under-pressure chamber should be shut, and a seal should be obtained when the following take place: bell mating or unmating; and transfer of personnel or equipment. These doors should not be opened again until the internal door between the transfer chamber and the transfer trunk has been shut.

Further reading

1 *Commercial diving projects offshore. The Diving at Work Regulations 1997. Approved Code of Practice* L103 HSE Books 1998 ISBN 0 7176 1494 8

2 *Commercial diving projects inland/inshore. The Diving at Work Regulations 1997. Approved Code of Practice* L104 HSE Books 1998 ISBN 0 7176 1495 6

3 *Recreational diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L105 HSE Books 1998 ISBN 0 7176 1496 4

4 *Media diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L106 HSE Books 1998 ISBN 0 7176 1497 2

5 *Scientific and archaeological diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L107 HSE Books 1998 ISBN 0 7176 1498 0

6 *The Diving at Work Regulations 1997* SI 1997/2776 The Stationery Office 1997 ISBN 0 11 065170 7

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Printed and published by the Health and Safety Executive 2/98 DVIS4 C20

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Breathing gas management

Diving Information Sheet No 3

Introduction

1 This diving information sheet is part of a series of information sheets providing guidance on diving at work. It replaces the following diving safety memoranda: DSM 4/1976, DSM 16/1976, DSM 17/1976, DSM 10/1983, DSM 2/1989, DSM 2/1994 and DSM 5/1994. The remaining DSMs have either been replaced by other diving information sheets, or will be cancelled when the Diving at Work Regulations come into force on 1 April 1998.

2 There are six sections, containing guidance on the following aspects of breathing gas management:

(a) oxygen safety in diving systems;

(b) checking contents of breathing mixtures;

(c) on-line oxygen analysis of the breathing medium when diving shallower than 50 metres;

(d) divers' gas supply systems;

(e) the marking of air and nitrox quads;

(f) use of scuba in commercial diving.

Oxygen safety in diving systems

3 Fires have occurred when using high-pressure oxygen in diving operations. These have happened mainly when high-pressure oxygen has been opened up onto unpressurised lines. This has resulted in either explosions or localised fires. The majority of these incidents are caused by a combination of contaminated oxygen systems, or the use of materials in the oxygen system which are incompatible with oxygen and isenthropic heating caused by too rapid pressurisation of the lines.

4 It is also important to note that if polytetrafluoroethylene (PTFE) reaches a high enough temperature it creates phosgene gas, which is lethal.

5 The following points should be considered when designing and using oxygen supplies in diving systems:

(a) Reduce high-pressure oxygen to low-pressure (40 bars) at the main supply quad.

(b) Avoid long runs of flexible hose.

(c) All materials and fittings should be oxygen compatible.

(d) Avoid ball valves in high-pressure systems and low-pressure systems.

(e) Avoid sharp bends in oxygen piping.

(f) All oxygen piping connections and oxygen supply connections on storage cylinders should be blanked when not in use.

6 Further guidance on this subject is contained in the AODC Guidance Note Number 029 *Oxygen cleaning*, published by IMCA (International Marine Contractors Association - previously the Association of Offshore Diving Contractors).

Checking contents of breathing mixtures

7 Although gas supply companies are rigorous in controlling diving breathing mixtures, experience shows that it is possible for a mixture to be supplied which does not correspond to the cylinder markings.

8 All diving breathing mixtures should be checked on receipt, and re-checked immediately prior to connecting them to a diving gas supply or breathing apparatus charging system.

9 Further guidance on this subject is contained in the AODC Guidance Note Number 016 Rev 1 *Marking and colour coding of gas cylinders, quads and tanks for diving applications*, published by IMCA.

On-line oxygen analysis of the breathing medium when diving at depths less than 50 metres

10 When using commercially supplied air quads, nitrox mixes and pure oxygen, it is recommended that oxygen analysers, fitted with audio and visual Hi-Lo alarms, are provided for surface supplied diving operations.

11 To ensure the accuracy of the analysis, the sample point should be taken downstream of the dive control panel and immediately prior to the diver's umbilical.

Divers' gas supply systems

12 This section outlines potential design faults regarding divers' gas supply and the consequences of a primary failure.

Surface oriented diving

13 The gas supply system to a diver should be designed in such a way that, in the event of the diver's umbilical being cut or severed, it should not deprive any other diver or standby diver of their gas supply. Take note that it is impractical to isolate the affected gas supply just by manually shutting a valve.

Bell diving

14 The gas supply system in a diving bell should be designed in such a way that, if the main surface to bell umbilical pressure is lost, the emergency bell onboard gas is brought on-line to the diver or divers. This can be done either manually or automatically, with a safeguard against exhausting back into the main umbilical.

15 The gas supply system to the bell standby diver should give the option of using either unlimited surface gas supply or the independent limited onboard gas supply.

16 When designing new diving bells or modifying existing bells, you should consider the provision of an independent gas supply to each diver and the standby diver.

Divers' reserve supply

17 The breathing gas supply to divers' masks must be designed in such a way that if the diver's umbilical supply fails, the gas from the reserve or bailout cylinder does not exhaust into the sea.

18 Further guidance on this subject is contained in the AODC Guidance Note Number 028, *Divers' gas supply*, published by IMCA.

The marking of air and nitrox quads

19 There have been instances where air and nitrox quads have been wrongly identified. As a result the incorrect gas has been used for breathing purposes.

20 The Health and Safety Executive, in consultation with the IMCA Safety and Medical Committee and several major gas supply companies, has assessed several quad colour coding designs to eliminate identification problems.

21 The recommended design is based on BS EN 1089-3: 1997 *Transportable gas cylinders - cylinder identification. Part 3: Colour coding*. This is black and white banding on the quad frame. This will be extended to include oxygen/nitrogen mixtures (nitrox). This means all air and nitrox quads and cylinders should be marked as indicated:

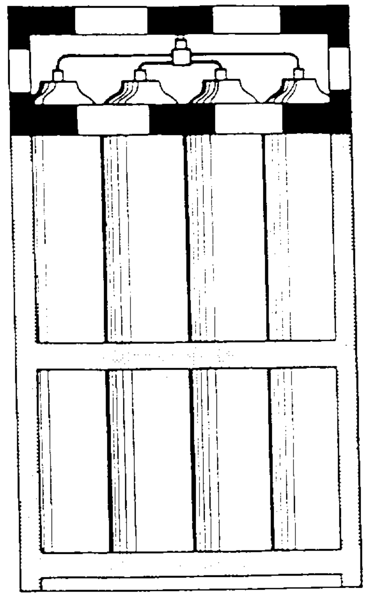
(a) Quad frames should be marked in short, alternating bands of black and white, with a maximum length of 20 cm (8 in). (See Figure 1)

(b) Cylinders within quads should be marked vertically on the body as follows.

AIR:	AIR DIVING QUALITY
NITROX:	% OXYGEN and % NITROGEN, DIVING QUALITY

22 The BS EN 1089-3: 1997 colour coding for nitrogen quads of solid black cylinder necks and solid black quad frame upper crossbars will remain unchanged.

Figure 1 The marking of air and nitrox quads



23 Quads will be changed to the new design as they are returned to base for refilling and/or refurbishment.

24 Further information on colour coding and marking of cylinders quads and banks is contained within AODC Guidance Note 016 Rev 1, published by IMCA.

Use of scuba in commercial diving

25 Scuba (self-contained underwater breathing apparatus) has limitations. It should not be used for:

(a) offshore diving operations in support of oil/gas projects;

(b) offshore, inshore and inland diving operations in support of construction, maintenance and salvage projects.

26 In other cases where scuba may be considered appropriate (eg work in an open tank or when clearing a fouled propeller), the risk assessment should take into account all hazards and environmental factors which may affect the safety of the diver, such as entrapment, tidal conditions, visibility and other operational constraints. The results of this risk assessment should be reflected in the dive plan.

Further reading

1 *Commercial diving projects offshore. The Diving at Work Regulations 1997. Approved Code of Practice* L103 HSE Books 1998 ISBN 0 7176 1494 8

2 *Commercial diving projects inland/inshore. The Diving at Work Regulations 1997. Approved Code of Practice* L104 HSE Books 1998 ISBN 0 7176 1495 6

3 *Recreational diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L105 HSE Books 1998 ISBN 0 7176 1496 4

4 *Media diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L106 HSE Books 1998 ISBN 0 7176 1497 2

5 *Scientific and archaeological diving projects. The Diving at Work Regulations 1997. Approved Code of Practice* L107 HSE Books 1998 ISBN 0 7176 1498 0

6 *The Diving at Work Regulations 1997* SI 1997/2776 The Stationery Office 1997 ISBN 0 11 065170 7

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HSE home page on the World Wide Web: http://www.open.gov.uk/hse/hsehome.htm

This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

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Diving system winches

Diving Information Sheet No 2

Introduction

1 This diving information sheet is part of a series of information sheets providing guidance on diving at work. It replaces the following diving safety memoranda: DSM 8/1977 and DSM 2/1987. The remaining DSMs have either been replaced by other diving information sheets, or will be cancelled when the Diving at Work Regulations come into force on 1 April 1998.

2 There are two sections, containing guidance on the following aspects of diving system winches:

(a) air-driven winches (air tuggers);

(b) diving bell hydraulic winch brake systems.

Air-driven winches (air tuggers)

3 Note the safety points in paragraphs 4-7 when using air-driven winches (air tuggers) in conjunction with personnel baskets, open bell handling systems, and as the second winch for horizontal pulling of a diving bell.

4 To comply with diving legislation, the diving contractor should provide, or arrange for the provision of all diving plant and equipment necessary for the safe conduct of the diving operation. The contractor must also make sure that the plant and equipment are of sound construction and suitable materials, in good working order at all times, and that they are adequate for the purpose. In particular, the contractor should make sure that all plant and equipment used at low temperatures are adequately protected against any malfunctions at low temperatures.

5 Any winch used in connection with a lifting appliance, which raises or lowers people, should be constructed so that a brake is automatically applied when the control lever, handle or switch is not held in the operating position. In addition, the winch should not be fitted with a pawl and ratchet gear on which the pawl has to be disengaged before raising or lowering operations.

6 The lifting wire for all winches should have a safety factor of 8 to 1 (ie a safety factor of 4 to 1 plus a 2 g factor to take dynamic loading into account).

7 Equipment which is not recommended by the manufacturer for use in the task of raising or lowering people should not be used.

Diving bell hydraulic winch brake systems

8 This section sets out the basic principles of hydraulic winch braking systems which should be adopted for diving purposes.

Winch design

9 All manriding hydraulic winches must incorporate two independent braking systems. The primary braking system may be achieved by an anti-runaway device, eg an overcentre valve.

10 The secondary braking system normally takes the form of a band brake or calliper brake although other methods exist. As most hydraulic winches are remotely operated, it is recommended that the secondary brake operates automatically whenever the operating lever is returned to neutral, or on loss of power. The brake is usually applied by a spring and released by hydraulic pressure.

11 In operation, the hydraulic circuit acts to stop the rotation on the winch and the secondary brake is then applied as pressure decays in the hydraulic system.

Testing

12 To avoid interference between the two brake systems, they must be tested separately. If a brake system fails during testing, then precautions must be taken. The hydraulic primary brake must be tested dynamically and the secondary brake tested statically.

13 All winch motors leak internally, but the creep that results should not cause the motor to go into freewheel if the secondary brake is disconnected. To make sure that the two brake systems are tested separately and safely, a safe method of carrying out these tests must be agreed with the competent person engaged for certification purposes.

Further reading

1 *Commercial diving projects offshore. The Diving at Work Regulations 1997. Approved Code of Practice* L103 HSE Books 1998 ISBN 0 7176 1494 8

2 *Commercial diving projects inland/inshore. The Diving at Work Regulations 1997. Approved Code of Practice* L104 HSE Books 1998 ISBN 0 7176 1495 6

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Printed and published by the Health and Safety Executive 2/98 DVIS2 C20

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General hazards

Diving Information Sheet No 1

Introduction

1 This diving information sheet is part of a series of information sheets providing guidance on diving at work. It replaces the following diving safety memoranda: DSM 6/1983, DSM 4/1988, DSM 4/1991 and DSM 3/1994. The remaining DSMs have either been replaced by other diving information sheets, or will be cancelled when the Diving at Work Regulations come into force on 1 April 1998.

2 There are four sections, containing guidance on the following hazards:

(a) diving from dynamically positioned vessels;

(b) explosion hazards from subsea housings containing rechargeable batteries;

(c) abrasive cutting discs;

(d) preventing explosions during oxy-arc cutting operations.

Diving from dynamically positioned vessels

3 Diving from dynamically positioned (DP) vessels is particularly hazardous because of the danger arising from divers, or their umbilicals, becoming fouled in propellers or thrusters.

4 Every diving contractor, so far as is reasonably practicable, should ensure that each diving operation is carried out from a suitable, safe place.

5 Care must be taken in the selection of vessels and personnel used for these operations. It is important to make sure that personnel have the necessary skills, and that the vessels are operated in a way which meets the statutory requirements.

6 The diving rules must incorporate proper procedures which emphasise the importance of close and efficient supervision, good diver tending, and comprehensive communication coverage, at all times.

7 A DP vessel may not always provide the necessary suitable, safe place for diving operations. Other means must be considered.

8 If a safe diving position cannot be maintained, then diving should not take place.

9 Further guidance on this subject can be found in the International Marine Contractors' Association (IMCA) Diving Division Guidance Note IMCA D 010.

Explosion hazards from subsea housings containing rechargeable batteries

10 Exploding battery-charging gases can be very dangerous.

11 It is strongly recommended that the following precautions are taken by contractors, who hold sealed pressure housings used to encapsulate rechargeable batteries which vent gases on recharging:

(a) The housings should be opened, and the equipment withdrawn, before batteries are recharged.

(b) The charging socket should be located internally so that access can only be made when the equipment is removed from the housing.

(c) All electronic equipment with integral battery supplies, which are encapsulated in pressure housings, should not be stored for long periods in a 'sealed condition'. It is important to note that stored batteries should be fully charged prior to storage and recycled according to the manufacturer's recommendations.

(d) All units should be treated with extreme caution and opened in a well-ventilated area where there is no danger of ignition.

Abrasive cutting discs

12 The adhesives used in the manufacture of these discs tend to be adversely affected by moisture. Obviously this situation is aggravated when a disc has been fully immersed in water.

13 The dangers of using a disc with a degraded adhesive are obvious, and it is strongly recommended that discs which have been taken underwater are discarded.

14 To prevent problems with new discs, it is recommended that they are stored horizontally in a warm dry atmosphere.

Preventing explosions during oxy-arc cutting operations

15 Over the years there have been a few serious explosive incidents, when the oxy-arc cutting technique has been used to cut into material and voids which have no known explosive properties.

16 A research project was carried out on the oxy-arc cutting technique at depth, using experimental data and computer modelling. It showed that there is enough hydrogen produced, during the time between making the rod 'hot' and striking the arc, to cause an explosion. During the research an interval of four seconds was shown to be long enough to produce sufficient hydrogen, at a working depth of 150 m, to cause a serious explosion, even in a half-used rod.

17 The probability of various items, such as depth, time interval, rod length, oxygen injection and striking the arc, combining to form an explosive situation is low. However, it is believed that the best way to avoid a dangerous situation during oxy-arc cutting operations, is by following the procedure given in paragraph 18.

Recommendation

18 The diver should:

(a) be in a position to start cutting;

(b) flush the torch with oxygen and maintain the flow;

(c) energise the cutting torch;

(d) strike an arc;

(e) proceed with the normal cutting procedure.

Note: If difficulty is experienced in striking the arc or maintaining the cut, the torch should be flushed again with oxygen, as a matter of routine.

Further reading

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