

The medical examination and assessment of divers (MA1)

This document replaces the previous version of MA1 which was last updated in April 2008. It updates administrative aspects and includes some re-ordering of sections, clarification of text and introduction of a full reference list. The document does not represent a fundamental review of the medical considerations, which remain consistent with the previous version.

Approved Medical Examiners of Divers should consult the Health and Safety Executive AMED web pages for information and updates on issues affecting their work: www.hse.gov.uk/diving/ameds.htm.

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Introduction

1 This document details the Health and Safety Executive (HSE) standards for the medical assessment of divers at work. They are for use by HSE Approved Medical Examiners of Divers (AMEDs) in performing medical examinations and assessments for the purposes of the Diving at Work Regulations 1997¹.

2 The standards reflect the need to protect the health, safety and welfare of divers at work. They take account of the mental and physical requirements for meeting reasonably foreseeable underwater emergencies and the physiological effects of working in a hyperbaric environment.

Legal aspects

3 Diving is a high hazard activity and there are specific regulations on diving at work to control the risks - the Diving at Work Regulations 1997 (DWR). The DWR cover all dives when one or more divers are at work in the diving industry whether employed or self-employed. They apply to everyone from the client to the diver undertaking the work for the client. All persons involved have a responsibility to take measures to ensure the health and safety of those taking part in the diving project as well as their own. Further information is available on the HSE diving website².

4 Five Approved Codes of Practice, tailored to the needs of different sectors of the diving industry, accompany the DWR:

- commercial diving projects offshore³;
- commercial diving projects inland/inshore⁴;
- recreational diving projects⁵;
- media diving projects⁶;
- scientific and archaeological diving projects⁷.

5 Under the DWR, all divers at work must have a valid certificate of medical fitness to dive, issued by an AMED. The certificate is valid for up to 12 months. It needs renewing before it expires if the diver wishes to continue diving at work.

6 It is a legal requirement that an individual must not dive in a diving project if they know of anything, including any illness or medical condition, which makes them unfit to dive.

7 In order to undertake medical examinations and assessments under the DWR, a doctor must have a valid 'Certificate of Approval' issued by HSE. This authorises the AMED to conduct medical examinations under the regulations for a stated period. The HSE AMED web pages contain further information on the approval process⁸.

Role of the AMED

8 AMEDs must have knowledge of different types of diving, diving work environments and diving medicine and keep up to date with any relevant developments. They must undertake specialised training in basic underwater medicine and refresh this training at least once every five years. The AMED must also demonstrate access to suitable facilities and equipment for conducting medical examinations. The HSE AMED web pages contain further details.

9 Divers must be medically fit to undertake their work. They must not have a medical condition that will jeopardise their health and safety or that of colleagues. The AMED has a duty to decide whether an individual is fit to dive, fit to dive with restrictions or unfit to dive. They must then issue the diver with a certificate of medical fitness to dive (see paragraphs 22-25). If a diver is unhappy with the decision of the AMED, they can formally appeal against it (see paragraphs 28-29).

10 The medical standards in this document provide a framework against which the AMED must consider fitness to dive. However, it does not cover every scenario AMEDs are likely to face. Occasionally, they may need to seek further advice and specialist assistance (see paragraphs 26-27).

Medical assessment process

11 When diving on recreational, media, or scientific and archaeological projects using approved recreational diving qualifications, the diver may have had a medical examination as required by their recreational diving organisation. The AMED can use discretion to decide if some investigations already undertaken need repeating, taking account of the diver's medical history, current health status and time elapsed since the last recreational medical examination. If information from a previous medical examination is unavailable, incomplete or not current, the AMED is entitled to repeat the investigations.

Initial medical examination

12 Anyone considering a career in diving should initially complete a medical questionnaire to determine whether anything in their medical history would preclude them from following this profession. The diver fact sheet in Appendix 1 contains a suitable questionnaire and background information. On completion, it needs confirmation from the individual's GP. The GP is not required to conduct a physical examination to confirm the medical history. Any costs incurred are the responsibility of the prospective diver. The HSE diving website contains general advice for GPs on medical standards for diving.

13 The AMED should request and then consider the information provided in the medical questionnaire. The presence of a disqualifying medical condition at this stage may avoid the expense of proceeding to a full initial medical examination.

14 The comprehensive initial medical examination, following the standards in this document, is particularly important. It may identify medical issues and provides an opportunity to counsel prospective divers about their significance in relation to future career prospects. Appendix 2 summarises the routine investigations to perform. Once accepted on a commercial diver training and/or assessment course, but before beginning training, all trainees must undergo a full initial medical examination with an AMED. The AMED must make candidate divers aware of any medical problems that may affect their long-term health or future employment prospects. They must record the initial test results on an MA2 form (see paragraphs 22-25) for comparison with subsequent annual medical assessments. Using the annual results log in Appendix 3 will facilitate such comparisons over time.

Annual medical examination

15 At intervals not exceeding 12 months, all divers covered by the DWR must see an AMED who will assess their fitness to dive at work for the following 12 months. The AMED will base their judgement of fitness on a careful assessment of any medical condition in relation to the safety of the diver and the requirements of the work activities they will perform. The medical standards in this document provide a framework for the AMED to use. Appendix 2 summarises the routine investigations to perform.

16 Medical records (MA2 forms) from the initial and any subsequent annual examinations must be available for comparison at each successive examination. The minimum requirement is for divers to produce a copy of their last medical examination (MA2) at the time of their annual medical assessment unless they return to the AMED who conducted the previous medical examination. AMEDs should keep the pink copy of MA2 for at least seven years (see paragraph 24). An AMED may decline to perform a medical examination on a diver who presents without a copy of their MA2 form or details of their last medical examination. Information for divers is available in the fact sheet in Appendix 1.

Return to work medical assessment

17 Any condition or injury occurring during a diver's career may influence their fitness for work. Under certain specific circumstances, following illness or injury, a diver must undergo re-examination by an AMED to assess their fitness to return to work. For example, any cardiac, pulmonary, neurological or otological disorder, including neurological decompression illness, or any condition requiring the diver to be off work for more than 14 days.

18 A return to work medical assessment requires a specific examination of the possible effects of the particular illness or injury on diving safety and the ability to undertake diving work. It does not replace the requirement for an annual medical assessment. The fact sheet in Appendix 1 provides divers with information on return to work medical assessments.

Recommended periods away from diving following decompression illness

19 The recommended minimum times away from diving after successful treatment with no sequelae are as follows:

SIMPLE DECOMPRESSION ILLNESS, LIMB PAIN, SKIN 'BEND', LYMPHATIC SWELLING, FATIGUE etc	
Uncomplicated recovery	24 hours
Recurrence/relapse requiring further recompression	7 days
NEUROLOGICAL DECOMPRESSION ILLNESS	
Altered sensation in limbs only	7 days
Audiovestibular, motor disturbance	28 days
OTHER	
Pulmonary decompression illness	28 days

20 The period away from diving for those diving at work in the recreational sector should be longer. This is because of the nature of their diving patterns and profiles, and the lack of supervision. The Divers Alert Network (DAN) website provides recommendations on diving layoff times for recreational divers⁹.

21 In anything other than a case of simple decompression illness, the AMED must conduct the review in consultation with the treating hyperbaric doctor and/or a diving medical specialist. This will assist in making a decision about fitness, the timing of return to diving work and further investigations as appropriate.

Certificate of medical fitness to dive

22 On completion of the initial or annual examination, the AMED must issue the diver with a certificate of medical fitness to dive. The certificate must state:

- the period (which must not exceed 12 months) during which the person issuing the certificate considers the person named in the certificate will remain fit to dive; and
- any other limitations as to the nature or category of diving to which it relates.

23 Where the AMED conducts an annual medical assessment less than one month before the current medical certificate expires, the date of the new certificate may begin from the expiry date of the current version.

24 The medical form (MA2) is in triplicate. The AMED should complete each section of the clinical assessment in as much detail as possible. They should give the white copy to the diver, retain the pink copy for seven years and send the blue copy to HSE within seven days of completing the medical examination. If necessary, the AMED can keep separate clinical records where there is additional medical information beyond that recorded on MA2.

25 Options exist for restricting certification of diving activities based on duration of certification, type and remoteness of diving, and frequency and depth of diving. Such restrictions require careful consideration. It is important to ensure they are appropriate to the underlying medical condition and the type of diving undertaken, and do not unnecessarily restrict employment opportunities. Some limits, such as maximum depth, are not usually sensible but to exclude a category of diving can be appropriate. Where an AMED identifies any restrictions, they should record them on the certificate of medical fitness to dive at the time of issue.

Second opinion and additional advice

26 AMEDs have a duty to reach a conclusion about fitness to dive. Where doubt exists about fitness, they should consult with other AMEDs and/or appropriate medical specialists. HSE can provide information on suitable medical specialists (to contact HSE, see the AMED web pages).

27 AMEDs should follow current guidance on medical confidentiality¹⁰ and the requirements of the Data Protection Act 1998¹¹.

Appeals

28 Where an individual is found to be unfit to dive or fit to dive with restrictions, the AMED should inform the diver, in general terms, of the reason for their conclusion. They should advise the individual of their right to a formal appeal and record this action.

29 Once informed of the decision, the individual must apply in writing to the HSE Principal Medical Inspector, within 28 days. HSE will consult a medical specialist in the relevant field, if necessary. The diver fact sheet (Appendix 1) explains the appeals procedure.

Medical considerations

General aspects

Gender

30 Generally, the same fitness criteria apply to both male and female divers. However, the possible harmful effects that exposure to increased pressure may have on a foetus, mean a commercial diver who is pregnant or suspects she might be pregnant, should not dive.

Age

31 There is no lower or upper age limit for medical fitness to dive. The AMED should seek evidence of necessity and motivation in older divers. A diver must retain the physical capacity to undertake work underwater even if offset by greater experience. This will normally require greater than average fitness as age increases.

Medication

32 Medical fitness to dive using medication depends upon the:

- type of diving;
- underlying pathology (physical and/or psychological);
- effects of medication on fitness to dive and the consequences of its abrupt cessation during diving activities.

33 The assessment must include the underlying condition for which the individual is taking medication. This may be the most important factor. The extent of organ function and symptom control with medication use is likely to be relevant. The assessment should also include the length of time the individual has been on medication (eg adaption to side effects) and the consequences of treatment cessation in the event of its loss. It should consider the potential for unexpected side effects resulting from interaction with increased pressure.

Smoking

34 Divers should be discouraged from smoking, although it is not a bar to diving. However, the onset of smoking related diseases, such as chronic obstructive pulmonary disease, ischaemic heart disease and peripheral vascular disease, may disqualify, depending on severity.

Disability

35 Given the enormous range of disabilities and functional loss that may present from prospective or existing divers, it is not possible to give definitive

advice. Each disability will present with a unique set of characteristics that will need a detailed and individual clinical risk assessment. Complex cases may require input from a diving medical specialist.

36 The AMED must consider the safety of the diver and others involved in the diving project. There may be additional risks to divers going to the aid of another diver who is in difficulty. Other relevant issues include:

- the size of the diving project;
- use of safety divers;
- the nature of the diving environment;
- the effects of medication;
- functional loss and adaptations;
- whether the condition is progressive or associated with remissions and relapses.

37 Functional loss in an experienced diver, who has demonstrated a continuing ability to dive safely, may be acceptable due to behavioural and functional adaptation. Such a functional loss may be unacceptable in an individual wishing to start a career in diving.

38 The decision on fitness to dive at work should take into account the requirements of the Disability Discrimination Act 1995¹². Restrictions to diving such as depth, frequency, type and location, must be justified on grounds of safety and functionality.

Infection and impaired immunity

39 A diver with a communicable disease may start diving once the underlying condition is resolved. In cases of doubt about fitness after such an illness (eg the presence of complications), the AMED should withhold the certificate of medical fitness to dive until they consult the doctor involved in the clinical care of the individual.

40 A positive HIV test need not preclude diving. Development of any new medical condition in an HIV positive individual will require re-assessment of fitness. If signs and symptoms of AIDS emerge, the diver is likely to be unfit to dive due to the physical problems of the condition and the need for regular medication. The AMED should consider such cases on an individual basis.

41 A diver with impaired immunity for other reasons, such as splenectomy, needs careful consideration. It may require a restriction on the type of diving undertaken. The risk of infection, even with prophylactic antibiotic usage and access to medical care, needs assessing in relation to foreign travel, diving in microbiologically contaminated water and working in saturation conditions.

Obesity

42 Obesity is important in diving because of its inverse relationship with fitness, the fit of wetsuit and weights, and co-existing disease such as

diabetes, hypertension and sleep apnoea. In addition, there are theoretical reasons why obesity may increase the risk of decompression illness. AMEDs may wish to refer to the NICE clinical guideline on obesity for further information on prevention, assessment and management¹³.

43 Each medical examination should include measurement and recording of the diver's height and weight (in underwear and bare feet) and calculation of Body Mass Index (BMI in kg/m²).

44 At a BMI >27, dietary and fitness advice is recommended, in the hope of pre-empting restriction on reaching a BMI of 30.

45 Where the BMI reaches 30, the AMED should estimate fat content using a suitable method such as skin calipers or skin impedance. A body fat content in excess of 30% may be a reason for rejection until weight is satisfactorily reduced, particularly if associated with a lack of overall physical fitness.

46 Use of a restricted duration of certification (such as six months) may be appropriate to warn the diver of the significance of the current BMI and trend, and if it would promote a reduction in weight through dietary and lifestyle changes. Discretion is appropriate if an elevated BMI is associated with increased lean body mass.

Mental health assessment

47 The primary consideration in all cases must include the risk to the individual's safety and that of those around them, taking into account the risk of recurrence of psychiatric or psychological disorders. The AMED should pay particular attention to the various stresses associated with the type of work, remote location and risks involved.

48 Individuals should be free from psychiatric illness and cognitive impairment. They should not be suffering from psychological or personality problems or disorders that would interfere with their in-water safety or that of others. Particular attention should be paid to anxiety disorders due to the clear link between anxiety/panic and diving accidents.

49 The following disorders, which, while quiescent, still exclude an individual from diving:

- schizophrenia;
- bipolar affective disorder;
- recurrent depression;
- disorders asymptomatic due to treatment.

50 The following disorders, which if resolved, and where there have been no further episodes for two years or more, may allow passing an individual as

fit to dive. Obtaining a specialist report may be appropriate to confirm the diagnosis and prognosis.

- Adjustment reactions.
- Single episodes of depression. More severe episodes may need to be regarded in the same way as recurrent depression.
- Deliberate self-harm.
- Anxiety disorders. Some anxiety responses may be specific to the diving environment, therefore resolution on land may not equate with resolution in water.
- Isolated psychotic episodes.

51 The use of psychotropic medication should exclude an individual from diving. Use of such medication for management of chronic pain needs individual assessment and input from a diving medical specialist (see paragraphs 32-33).

52 A diver may be fit to dive where the following disorders do not interfere with in-water safety:

- Phobias. Most simple, specific phobias would not preclude an individual from diving. However, agoraphobia and/or claustrophobia are contraindications to diving.
- Severe pre-menstrual syndrome (PMS) - also known as pre-menstrual dysphoric disorder (PMDD). A diver with PMS may be passed as fit providing they are told not to dive while suffering from the effects of this disorder.

Alcohol, drug or substance misuse

53 Alcohol dependence and drug or substance misuse is incompatible with diving. With any history of current misuse, there must be doubt about fitness for diving. As a minimum, there should be a lengthy period of stability (such as 12 months) off the misused substance, without medication or relapse. Obtaining a specialist report may be appropriate to confirm the diagnosis and prognosis.

Respiratory system

54 Clinical examination of the respiratory system should be normal. For assessing the diver, HSE recommends the use of the 'British Thoracic Society guidelines on respiratory aspects of fitness for diving'¹⁴.

55 Legislation limiting radiation exposure is contained in the Ionising Radiation (Medical Exposure) Regulations 2000 (as amended in 2006)^{15, 16}. Therefore, routine chest radiography at the initial medical examination is not required. Chest X-ray should only be performed if justified on individual clinical grounds. The AMED should consider the individual's history, findings from the physical examination and whether the potential information derived

from radiography will assist in making a decision on fitness for diving activities.

56 A PA chest X-ray is still required for submarine escape trainees at initial examination.

57 The conditions listed below may be contraindications to diving or require additional investigation. In cases of doubt about fitness, the AMED should seek an opinion from a diving medical specialist.

- Acute respiratory disease such as pulmonary infection.
- Chronic lung disease that results in a reduction of exercise capacity (eg chronic obstructive pulmonary disease, sarcoidosis, cystic fibrosis, tuberculosis, pulmonary fibrosis).
- Previous spontaneous pneumothorax unless treated by bilateral surgical pleurectomy and associated with normal lung function and thoracic imaging performed after surgery.
- Previous traumatic pneumothorax unless healed and associated with normal lung function, including flow-volume loop and thoracic imaging.
- Previous chest surgery or pneumomediastinum.
- Presence of large bullae or cysts due to increased risk of barotrauma.
- Chronic obstructive pulmonary disease carries a theoretical increased risk of barotrauma and reduced exercise tolerance. Subjects will probably be advised against diving on the basis of reduced pulmonary function (FEV1 <80% predicted).
- Sarcoidosis has been associated with pulmonary barotrauma. Diving is contraindicated in subjects who have active sarcoidosis. Those with resolved sarcoidosis demonstrated by normal chest radiography and pulmonary function testing may be fit for diving.
- Those with active tuberculosis should not dive. After curative treatment, they may dive if lung function and chest radiography are normal.
- Diving is contraindicated in those with cystic fibrosis and pulmonary involvement.
- Fibrotic lung disease reduces lung compliance and impairs gas transfer, and is therefore a contraindication to diving.

Asthma

58 For assessing the diver, AMEDs should follow the 'British Thoracic Society/Scottish Intercollegiate Guidelines Network: British guideline on the management of asthma'¹⁷.

59 Individuals with asthma should be found unfit to dive if they have wheeze precipitated by exercise, cold or emotion.

60 Individuals with asthma may be permitted to dive if they are on either Step 1 or 2 of the British Thoracic Society guidelines and they:

- are free of asthma symptoms;
- have normal spirometry (FEV1 >80% predicted and FEV1/FVC >70% predicted); and
- have a negative exercise test (<15% fall in FEV1 after exercise).

61 A diver with asthma should monitor their condition with regular, twice daily peak flow measurements and should refrain from diving if they have:

- active asthma (ie symptoms requiring relief medication in the 48 hours preceding a dive);
- reduced peak expiratory flow rate (more than 10% fall from best values);
- increased peak flow variability (more than 20% diurnal variation).

Cardiovascular system

62 The function of the cardiovascular system should enable the diver to sustain strenuous muscle activity at depth. There should not be an increased risk of loss of consciousness or incapacitation compared with the healthy, general population.

63 Any organic heart disease is a cause for rejection unless considered by a cardiologist to be haemodynamically unimportant. That includes all types of cardiomyopathy, ischaemic heart disease, haemodynamically important valvular disease, cyanotic heart disease and other shunts.

ECG

64 The initial examination should include a resting ECG with interpretation, and any abnormality discussed with a cardiologist.

65 At annual medical examinations, a resting ECG is required only for divers aged 40 years and then subsequently every five years, unless there is a clinical indication for more frequent testing such as the presence of risk factors. Any significant change in the ECG needs further evaluation.

Ischaemic heart disease

66 Symptomatic ischaemic heart disease is incompatible with diving. The requirement for medication to control symptoms is a contraindication but preventive medication such as aspirin or lipid lowering agents is acceptable.

67 At the initial examination, an individual found incidentally to have ischaemic heart disease should be declared unfit.

68 An individual who is symptom free following conventional coronary bypass surgery remains unfit to dive. An individual who has had percutaneous coronary intervention (angioplasty) or minimally invasive surgical revascularisation might be considered fit if:

- the procedure has resulted in revascularisation;
- they remain symptom free;
- they have a normal cardiac stress exercise test to the relevant cardiological levels and can meet the physical requirements.

69 Individuals that have undergone revascularisation as above require careful assessment by a cardiologist with an interest in diving medicine who will decide on the need for further follow up.

Dysrhythmia

70 Any dysrhythmia that might cause incapacity in water will disqualify.

71 Disorders of cardiac rhythm, except for sinus arrhythmia and infrequent ventricular extrasystoles, require specialist evaluation and are likely to be a cause for rejection, particularly at the initial medical examination.

Pacemaker

72 In most cases, the indication for pacing is likely to be a contraindication to diving. It requires careful assessment of the type of diving and type of pacemaker, with input from a cardiologist who has an interest in diving medicine.

Patent foramen ovale

73 Examination for the presence of an intracardiac shunt is not a requirement of either the initial or annual examinations.

74 However, examination for a patent foramen ovale should be undertaken in a diver who has suffered neurological, cutaneous or cardiorespiratory decompression illness. This is particularly important where there is a history of migraine with aura or where the dive profile was not obviously contributory, since it may be pertinent to an assessment of the overall risk to the diver of continuing to dive. A positive finding is not necessarily a reason for a declaration of unfitness. However, the opinion of a cardiologist with an interest in diving medicine is recommended.

Valvular heart disease

75 Auscultation of the heart should be normal. Murmurs are acceptable only if deemed physiological. Where doubt exists, the AMED should refer the diver for specialist opinion or further investigation such as echocardiography.

76 Atrial or ventricular septal defects, aortic or mitral stenosis, and coarctation, are contraindications to diving. Other valvular conditions, including bicuspid aortic valve and mitral valve prolapse, require cardiac evaluation. Cardiac function, in terms of exercise capacity, should be normal.

Blood pressure

77 At initial examination, the resting blood pressure for a young diving candidate should not exceed 140 mmHg systolic or 80 mmHg diastolic, using the fifth phase as an indicator and with the patient supine. The effect of age is a consideration for older candidates along with the possible impact of a rise in blood pressure during a diver's potential career.

78 At subsequent annual examinations, mild hypertension (systolic BP = 140-159 mmHg; diastolic BP = 90-99 mmHg - see the NICE clinical guideline on hypertension¹⁸) would not be a contraindication providing that:

- either no medication was required, or the medication taken had no implications for diving safety;
- there was no evidence of end organ damage.

79 Where doubt exists, the AMED must consult a cardiologist with an interest in diving medicine.

Peripheral circulation

80 The peripheral circulation should be capable of providing adequate peripheral perfusion even in cold conditions. Clinical evidence of impaired circulation requires further evaluation. Peripheral vascular disease may predispose to cold injury. Contraindications include:

- varicose veins associated with circulatory impairment (eg varicose eczema);
- conditions known to be associated with impaired organ perfusion.

Central nervous system

81 The central nervous system should be clinically and functionally normal. Assessment of the central nervous system is one of the most important elements of the initial and annual medical examinations.

82 A careful history is essential. The AMED should specifically seek a history of visual, hearing, balance, coordination, sensation, bladder, bowel or sexual dysfunction. A history of predisposition to episodes of impaired consciousness or awareness, convulsions, disturbances of speech, vision or motor control are incompatible with diving. The AMED must look for and exclude conditions that may mimic decompression illness or jeopardise safety.

83 Assessment of central nervous system function includes both physical and psychological aspects. The diver must be psychologically capable of undertaking diving activity. The diver's manner, attitude, verbal and intellectual responses, form part of the examination. Where any doubt exists, the AMED may need to obtain a specialist clinical psychological assessment.

84 The neurological examination should be detailed and include assessment of cranial nerve function, the motor and sensory systems, balance, coordination, gait proprioception, vibration sense and two-point discrimination. Deep tendon reflexes, plantar responses and abdominal reflexes should be elicited. The AMED should record the baseline clinical findings in detail in MA2 (see paragraph 24) to allow detection of any subsequent variation from normal.

85 The following are contraindications to diving:

- Any form of epilepsy, other than febrile convulsions occurring before the age of five years. However, if a diver remains fit free for 10 years without medication or treatment, they may be fit to dive but will require expert assessment and possibly further investigations.
- Recurrent, unprovoked loss of consciousness of unknown aetiology or recurrent episodes of fainting.
- Neurological diseases such as stroke, multiple sclerosis or Parkinson's disease.
- Severe motion sickness.
- Severe migraine, particularly with complicated aura and excess daytime somnolence.

86 A history of previous intracranial surgery is not an absolute contraindication to diving providing there is no history of subsequent epilepsy, increased risk of seizure or persisting neurological deficit. However, expert neurological assessment is recommended.

87 A history of significant head injury carries a risk of post-traumatic epilepsy. The individual needs careful assessment with input from a diving medical specialist to determine their risk when compared with the normal, healthy population. The epilepsy risk assumes significance when there has been a depressed skull fracture, intracranial haematoma, unconsciousness or post-traumatic amnesia greater than 30 minutes, or when focal neurological signs have accompanied the injury. Post-traumatic amnesia is the time from injury until the point from which there is continuous recall.

88 Minor episodes of head injury (less than 30 minutes unconsciousness or post-traumatic amnesia) provide grounds for temporary unfitness for a period of four weeks, subject to a review by an AMED. However, minor head injuries may lead to persisting post-concussional symptoms and divers should not return to work until these have resolved.

Musculoskeletal system

89 The diver must have the appropriate degree of mobility, strength and dexterity for the diving activities and work undertaken. The disabled diver requires a careful and individual clinical risk assessment (see paragraphs 35-38).

90 Divers with a history of low back pain require careful assessment because of the risk of sudden incapacitation and sciatic pain mimicking decompression illness.

91 Legislation limiting radiation exposure is contained in the Ionising Radiation (Medical Exposure) Regulations 2000 (as amended in 2006)^{15, 16}. For saturation divers (diving at depths of 50 metres or more, in the water for over four hours), routine long bone X-rays are no longer required before undertaking saturation diving. Long bone radiography and/or MRI is indicated in cases of suspected dysbaric osteonecrosis.

ENT

92 Hearing should permit understanding of normal conversation. Initial examination requires an audiometric assessment covering the range 500 Hz to 6 KHz. An audiogram should be repeated after an episode of aural barotrauma or where required as part of a hearing conservation programme. Saturation divers may need advice and regular follow up.

93 The ear canal must be free from obstruction such as wax. Narrowing of the ear canal, such as exostoses, should not preclude diving unless severe enough to limit or prevent ear equalisation.

94 The tympanic membrane must be intact. There should be evidence of movement of the tympanic membrane on ear clearing. In doubtful cases, the diver may require referral for a tympanogram to demonstrate normal middle ear pressures.

95 The following are contraindications to diving:

- After middle ear barotrauma until any middle ear fluid is reabsorbed. Tympanic membrane erythema and retraction should have resolved.
- All active infections of the ear canal and middle ear until resolved. Cases of chronic ear canal or middle ear disease, such as cholesteatoma, may require diving medical specialist advice.
- Previous mastoidectomy unless it was a simple mastoidectomy that is well healed with no complications and has an intact posterior wall. Tympanic membrane and middle ear function must be normal.
- Previous stapedectomy.
- Ménière's disease and other vertiginous conditions.

96 Individuals with long-standing scarred tympanic membranes, well healed perforations or surgically healed perforations, can attempt to dive if they have normally mobile tympanic membranes, normal eustachian tube function and no retraction or thinning of the tympanic membrane due to previous disease.

97 There should be no nasal or sinus symptoms of disease and the nasal airway should be free from signs of obstruction. An individual can dive after successful treatment or natural resolution of acute nasal and sinus infections. Chronic nasal and sinus infections may be reversible and an individual can dive after successful treatment. Use of oral or topical medication, such as decongestants, antihistamines or steroids, requires careful consideration and usually advice from a diving medical specialist.

98 A diver with any condition that produces obstruction of the nasal passages, such as nasal polyps or deviated septum, can dive after confirmation of successful treatment.

99 Laryngoceles are a reason to disqualify until corrected. Any condition causing an incompetent larynx is a contraindication, as is the presence of a tracheostomy.

Vision

100 Visual acuity, with or without correction, and colour vision must be adequate for the type of diving activity such as the requirement to read a watch, computer, depth gauge, tables and instrumentation. Visual acuity of 6/9 in both eyes is likely to be adequate. Colour vision is important for specific inspection tasks. Appropriate colour vision screening and confirmatory tests, if needed, should be used.

101 Divers requiring optical correction can use a prescription faceplate if using a facemask. Soft, gas permeable contact lenses are suitable while hard, impermeable lenses are unsuitable unless fenestrated. There is a risk of infection with all contact lenses and it may be difficult to maintain sterility in a saturation environment. Use of disposable lenses may reduce this risk.

102 The risk associated with diving after ophthalmic surgery requires careful evaluation and individual assessment in conjunction with the surgeon and/or a diving medical specialist. Certain procedures may involve the instillation of gas into the globe and individuals should not dive until all gas is reabsorbed. Experience to date has not demonstrated difficulties for divers following radial keratotomy.

Dental health

103 Divers require a high standard of dental health. It is necessary to retain a mouthpiece and the presence of dental cavities may be associated with barotrauma. Unattached dentures should be removed during any diving activity.

104 Divers should see a dentist at a frequency based on current Department of Health guidelines and their own dental status. In cases of doubt about dental health, a certificate of dental fitness should be obtained.

Endocrine system

105 Diving results in numerous neurological reflexes and hormonal responses. It is unlikely that those suffering from endocrine conditions leading to impaired thermoregulation, cardiac or muscular insufficiency, would be found fit. A proven or suspected abnormality requires detailed assessment.

Diabetes

106 The detection of glycosuria requires investigation. The AMED must refer any diver with diabetes mellitus, whether insulin, tablet or diet controlled, to a diving medical specialist for detailed individual assessment.

107 If the initial assessment detects any form of diabetes before diver training, the individual is unlikely to have a career as a professional diver because of the certainty of later disqualification due to complications. Generally, diabetics should not become professional divers. Under certain circumstances, they may train under medical supervision and become divers for limited diving operations. At this stage, the diver must have good control and no diabetic complications.

108 Once diabetes is diagnosed in a working diver, an automatic disqualification is no longer acceptable because of disability discrimination legislation (see paragraphs 35-38). Factors to consider include the nature of the work, the diving environment, the degree of control achieved by treatment and the safety of the diver. Each case should have a detailed and individual assessment, which is likely to involve a diving medical specialist.

109 The presence or development of diabetic complications such as atherosclerosis, cardiomyopathy, proliferative retinopathy, peripheral vascular disease, diabetic foot syndrome, nephropathy and neuropathy, will disqualify. Evidence of poor control with hypoglycaemic episodes is likely to lead to disqualification.

Thyroid disease

110 Patients with thyroid disease who are in a stable state (such as treated thyrotoxicosis or hypothyroidism) may be fit to dive providing they have no cardiovascular complications of the disorder. Gross thyroid disease is a contraindication to diving. However, on replacement therapy, stable hypothyroidism can be compatible with professional diving even when one or two doses of thyroxine are missed.

Other disorders

111 Use of cortisol replacement for whatever reason is a contraindication to diving because of the risk of collapse associated with illness, injury or stress.

112 Divers with any other endocrine disorder must be referred to an endocrinologist and the results discussed with a diving medical specialist for detailed individual assessment.

Genitourinary system

113 Initial and annual medical examinations should include dipstick urinalysis for blood, protein and glucose. Abnormal results require investigation.

114 A history of renal disease or urinary tract investigation requires more detailed assessment. The presence of genitourinary or renal tract disease associated with abnormal renal function is usually a cause for rejection. Cases of renal calculi and colic should be assessed on an individual basis after specialist investigation. The presence of a sexually transmitted disease will disqualify until adequately treated.

Gastrointestinal system

115 Gastrointestinal function should be normal with no increased tendency to vomiting, dyspepsia, reflux, bleeding, perforation, diarrhoea or pain. Hepatic and pancreatic function should be clinically normal.

116 Inflammatory bowel disease, gall bladder pathology and pancreatitis are contraindications to diving. The presence of an abdominal wall hernia should be a contraindication until repaired. Dyspepsia requires investigation.

117 A previous history of peptic ulceration requires careful assessment. Before considering fitness, objective evidence of ulcer healing and symptom resolution is necessary. The requirement for regular, continued H2 blocker therapy for the control of peptic ulceration is not acceptable for diving. The risk of recurrence after the successful completion of a course of triple therapy is sufficiently low to permit a return to diving.

118 For saturation diving, successful surgical treatment of peptic ulceration could permit a return to diving after careful consideration.

119 The presence of a stoma is likely to be compatible with limited types of diving activity of short duration. Obtaining advice from the surgeon is recommended.

Skin

120 The skin barrier should be functionally intact and without increased susceptibility to infection.

121 Any condition that may affect thermal control is a contraindication. Prolonged periods in water and exposure to high humidity, especially in saturation environments, increase the risk of disabling skin infection and can exacerbate many pre-existing dermatoses. Severe exfoliative disorders are contraindications. Acute or chronic infections are a cause for temporary unfitness until controlled.

Haematology

122 The initial examination should include a full blood count. There is no requirement for a sickle cell test. Any abnormalities found require further investigation. No blood tests are required at subsequent annual examinations unless clinically indicated.

123 Sickle cell anaemia (HbSS), other sickle cell disorders (including HbSC, HbSD, HbSO and HbS beta thalassaemia) and thalassaemia major are contraindications to diving. A small number of individuals can have one of the other sickle cell disorders and be unaware of it. However, they will be anaemic and detected by performing a full blood count. For comparison, the AMED should use information from the local haematology laboratory on normal haemoglobin levels for the relevant population.

124 Carriers of sickle cell or thalassaemia trait are not believed to be at significantly increased risk during diving and may therefore be fit to dive.

Exercise testing

125 Following a review of the validity of exercise testing in 2004, HSE recommended the use of an appropriate step test at initial and annual medical examination. It is preferred to the bicycle ergometer and other methods for simplicity, cost, convenience and because it is adequate for the purpose. There is no ideal, single exercise test to measure aerobic and physical demands and the capacity needed for all possible combinations of work (eg diving activities, equipment configuration, gas mixtures and emergencies).

126 An annual step test creates a baseline for future comparisons, allowing feedback to the diver on their fitness. It therefore also serves as a health promotion tool, reminding the diver to keep fit.

127 Whichever step test the AMED uses, they must follow the appropriate protocol for testing and calculation of VO₂ max, in a standardised manner. The candidate must be adequately fit and the AMED should assess maximum oxygen uptake. The majority of divers will be able to achieve an exercise level equivalent to 13 METS or 45 ml/kg/min (lean body mass) oxygen consumption. The AMED should consider the results of the test together with other aspects such as resting pulse, blood pressure, BMI (see paragraphs 42-46) and lung function. Measurement of peak expiratory flow rate, before, 5 and 10 minutes after the step test, provides a useful screen for exercise induced wheeze (see paragraphs 58-61).

128 The review of exercise testing also considered safety of the procedure and examined several possibilities for diver cardiac risk assessment. HSE bases its approach to risk assessment on the principle 'so far as is reasonably practicable' (SFAIRP). This legal concept does not mean taking every conceivable measure to reduce risk. There can be more than one method for controlling a risk. A disproportionate cost of controlling a risk can be taken into account.

129 HSE recommends considering all divers to be at risk of a cardiac event during a step test. This approach avoids the difficulties of using assessment tools which may not be sensitive or specific enough to identify individuals with risk factors. They can have their own problems with false positive (resulting in unnecessary investigations and attendant risks) and false negative results.

130 The AMED has a responsibility to conduct a clinical assessment of the risk and the suitability of undertaking a step test. This will need to take account of the diver's medical history, clinical examination and investigation results, fitness and the presence of cardiac risk factors. In addition, other relevant factors include the AMED's clinical knowledge and training in basic life support, geographical location, lone working and access to emergency assistance. It is not possible to specify all elements of the risk assessment because of the widely differing nature of AMED locations, working environments, medical speciality and training.

131 AMEDs should consider the approach contained in the Resuscitation Council (UK) document: 'Cardiopulmonary resuscitation guidance for clinical practice and training in Primary Care'¹⁹. Those undertaking exercise testing of divers should have up to date training in basic life support and resuscitation skills following the standards of the Resuscitation Council (UK). They should provide resuscitation equipment (eg an automated external defibrillator (AED)), depending on the findings of the risk assessment, and ensure adequate access for an ambulance crew and vehicles in an emergency. There should be a clear procedure to follow in the event of a collapse.

132 Before proceeding to exercise testing, the AMED should conduct appropriate and relevant history taking and a physical examination of the diver. This includes examination of the cardiovascular system, assessment of any cardiac risk factors, blood pressure and resting ECG (if clinically relevant). Appendix 4 contains a cardiac screening tool that the AMED can use before exercise testing.

Appendix 1 - Diver fact sheet and medical questionnaire

Introduction

This fact sheet is for divers at work and those considering a career as a commercial diver. It provides information on medical fitness for diving at work. Diving is physically and mentally demanding. Good health is essential.

Under the Diving at Work Regulations 1997, you must pass a thorough initial medical examination by an Approved Medical Examiner of Divers (AMED). AMEDs are approved by the Health and Safety Executive (HSE) and trained in diving medicine. The AMED will issue you with a certificate of medical fitness to dive that is valid for up to 12 months. To renew the certificate, you must undergo an annual medical examination by an AMED before the expiry date.

It is a legal requirement that you must not dive in a diving project if you know of anything, including any illness or medical condition, which makes you unfit to dive.

Pre-employment

At the earliest possible stage, you need to complete a medical questionnaire (Annex 1) to see if there is anything in your medical history that might exclude you from a career in diving. On completion of the questionnaire, you should ask your GP to confirm the medical history from your medical records. They are entitled to charge you a fee for this service. Once signed by you and your GP, you should pass the questionnaire to an AMED for review. The presence of a disqualifying medical condition identified at this stage may avoid the expense of an initial medical examination by the AMED. If you go on to have an initial medical examination, you should do so before committing yourself to the cost of undertaking diver training.

Return to work medical assessment

Any condition or injury occurring during your career as a diver may influence your fitness to work. Under certain specific circumstances following illness or injury, you must undergo re-examination by an AMED to assess your fitness to return to work. For example, where you have suffered any heart, lung, brain, nervous system, ear, nose or throat disorder, including decompression illness, or any illness or injury requiring you to be off work for more than 14 days. A return to work medical assessment requires a specific examination of the possible effects of your illness or injury on diving safety and your ability to work as a diver. It does not replace the requirement for an annual medical examination.

Certificate of medical fitness to dive

Following your medical assessment, the AMED will issue you with a white copy of the certificate of medical fitness to dive (MA2). You must give this to the AMED at your next annual medical examination. The AMED is obliged to review it for comparative purposes. If you do not produce the last MA2 on the date of your annual medical assessment, the AMED is entitled to refuse to examine you. HSE Diving Inspectors may ask to see your current MA2 to ensure you are medically cleared to dive.

Appeals

If an AMED decides you are unfit to dive or fit to dive with restrictions, they should explain the reasons for their decision. The AMED may consult with a diving medical specialist or other medical specialist before deciding on your fitness to dive.

Once informed of the AMED's decision, you can appeal against it, within 28 days, by writing to: Principal Medical Inspector, Corporate Medical Unit, Health and Safety Executive, Redgrave Court, Merton Road, Bootle, Merseyside, L20 7HS. If necessary, HSE will consult a medical specialist in the relevant field.

HSE is responsible for funding the cost of the appeal but is not responsible for any travel and accommodation costs you incur as a result. Experience has shown that appeals can take a considerable period of time to complete. HSE does not accept all appeals. If an AMED finds you are unfit to dive due to a condition that is clearly a disqualification for commercial diving (eg a history of epilepsy), it is unlikely HSE will progress an appeal.

Annex 1 - Medical questionnaire for completion by candidate divers and confirmation of medical history by their GP

QUESTION	YES	NO
(Females only) Are you pregnant?		
Are you taking any prescribed or other medication?		
Have you ever had or do you now have:		
Mental illness?		
Claustrophobia?		
Lung disease (eg chronic obstructive pulmonary disease)?		
Collapsed lung (pneumothorax)?		
Injury or surgery to the chest?		
Asthma?		
Disease of the heart and circulation, including high blood pressure (hypertension), angina, heart attack (myocardial infarction), chest pains, palpitations and irregular heart rate (arrhythmia)?		
Epilepsy?		
Blackouts or recurrent fainting?		
Disease of the brain or nervous system (eg strokes or multiple sclerosis)?		
Severe motion sickness?		
Migraine?		
Injury or surgery to the head or spine?		
Ear, nose, throat or sinus problems?		
Diabetes?		
Persistent stomach or intestinal problems?		
Skin disease?		
Blood disorders?		

If the candidate diver or GP has any comments on the medical history, please use another sheet.

Candidate diver - I certify that the above answers are correct:

Full name..... DoB.....

Address.....

Signature..... Date.....

GP - I confirm the medical history:

Practice stamp

Signature..... Date.....

Appendix 2 - Summary of the routine investigations to perform at initial and annual medical examinations

INVESTIGATION	INITIAL EXAMINATION	ANNUAL EXAMINATION
Spirometry	✓	✓
Chest X-ray ¹	X	X
Resting ECG	✓	Aged 40 years, then 5 yearly
Audiometry ²	✓	X
Urinalysis	✓	✓
Full blood count ³	✓	X
Sickle cell testing ³	X	X
Step test	✓	✓

The AMED may require some investigations more frequently, based on clinical need, risk assessment and health surveillance purposes.

¹ See paragraphs 55-56

² See paragraph 92

³ See paragraph 122

Appendix 3 - MA2 annual results log

Date of examination								
FEV1								
FVC								
FEV1/FVC%								
Weight								
BMI								
Hb*								
Smoker?								
BP								
Cardiac screen								
ECG*								
Step test								
Audiometry*								
Urinalysis								

*As required

Appendix 4 - Cardiac screening tool

QUESTION	YES	NO
If undertaken, is the resting ECG normal?		
If the ECG is abnormal, was it previously investigated?		
Is there a history of, or evidence of:		
Coronary artery disease?		
- Angina?		
- CABG?		
- Coronary angioplasty?		
Cardiac arrhythmia?		
- Implanted pacemaker?		
- Implanted cardiac defibrillator?		
Peripheral vascular disease?		
- Intermittent claudication?		
- Aortic aneurysm?		
Cardiomyopathy?		
- Heart failure?		
Hypertension?		
- BP > 160/100?		
- End organ damage?		

References and further information

- 1 The Diving at Work Regulations 1997 SI 1997/2776
www.legislation.gov.uk/ukxi/1997/2776/contents/made
- 2 HSE diving website: www.hse.gov.uk/diving/index.htm (for information on the regulatory framework for diving at work, diver training and medical fitness)
- 3 Commercial diving projects offshore. Diving at Work Regulations 1997. Approved Code of Practice L103 HSE Books 1998 ISBN 978 0 7176 1494 3
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- 7 Scientific and archaeological diving projects. Diving at Work Regulations 1997. Approved Code of Practice L107 HSE Books 1998 ISBN 978 0 7176 1498 1
www.hse.gov.uk/pubns/priced/l107.pdf
- 8 HSE AMED web pages: www.hse.gov.uk/diving/ameds.htm (for information on the approval process, contact details for enquiries and training)
- 9 Divers Alert Network website: www.diversalertnetwork.org
- 10 Guidance on Ethics for Occupational Physicians (Sixth edition). Faculty of Occupational Medicine of the Royal College of Physicians 2006 ISBN 1 86016 280 0
- 11 Data Protection Act 1998 www.legislation.gov.uk/ukpga/1998/29/contents
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- 14 British Thoracic Society guidelines on respiratory aspects of fitness for diving. Thorax 2003;58:3-13 www.brit-thoracic.org.uk/guidelines/diving-guideline.aspx

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- 16 The Ionising Radiation (Medical Exposure) (Amendment) Regulations 2006 SI 2006/2523 www.legislation.gov.uk/uksi/2006/2523/contents/made
- 17 British Thoracic Society/Scottish Intercollegiate Guidelines Network: British guideline on the management of asthma 2011 www.brit-thoracic.org.uk/guidelines/asthma-guidelines.aspx
- 18 Hypertension: quick reference guide. Clinical guideline 127. National Institute for Health and Clinical Excellence 2011 ISBN 978 1 84936 672 4 www.nice.org.uk/nicemedia/live/13561/56015/56015.pdf
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