

The medical examination and assessment of commercial divers (MA1)



MA1 (rev4)
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This document replaces the previous version of MA1 published in December 2011, following a review by the Health and Safety Executive (HSE). In undertaking the review, HSE collaborated with the UK Sports Diving Medical Committee and received contributions from invited experts on the following sections of MA1: obesity, mental health, respiratory fitness, cardiovascular fitness, neurological fitness, ENT, diabetes and exercise testing. The document also contains revisions to sections on the gastrointestinal system and haematology, and updates administrative aspects.

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Introduction

1 This document contains Health and Safety Executive (HSE) standards and guidelines for the medical examination and assessment of working divers. They are primarily for use by HSE Approved Medical Examiners of Divers (AMEDs) in performing fitness to dive medicals for the purposes of the Diving at Work Regulations 1997.¹ They are intended to influence professional practise and, as a consequence, enhance the quality and reduce any unnecessary variability of fitness to dive assessments undertaken by HSE AMEDs. In addition, they provide a benchmark against which HSE can audit the performance of AMEDs and consider appeals from divers to review the decisions of AMEDs.

2 The standards and guidelines 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, high risk activity and there are specific regulations on diving at work to control the risks. The Diving at Work Regulations 1997 (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 work for the client. All persons involved have a responsibility to take measures to safeguard the health and safety of those taking part in the diving project as well as their own. Further information is available on HSE's diving website.²

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

- Commercial diving projects offshore;³
- Commercial diving projects inland/inshore;⁴
- Recreational diving projects;⁵
- Media diving projects;⁶ and
- Scientific and archaeological diving projects.⁷

5 Under 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 (Regulation 13(1) of DWR) 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 fitness assessments under 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. HSE's AMED web pages contain further information on the approval process.⁸

Using MA1

8 Professional divers should be medically and physically fit to undertake their work. The medical examination has two aims. It should enable AMEDs to identify those medical conditions that might exclude an individual from commercial diving (either permanently or temporarily) or require further specialist assessment. It should also assess the functional capacity of the diver to undertake their work safely. Applying the standards and guidelines set out in this document will help achieve these aims and promote a consistent approach to fitness assessments. They are based on scientific evidence and expert opinion and are subject to periodic review.

9 MA1 specifies medical conditions that are an absolute contraindication to diving or require further specialist assessment and those where a diver may be considered fit to dive or fit to dive with restrictions. It does not cover all conditions that divers may present with or that may be identified at their medical. In such cases, AMEDs should obtain additional advice as required.

10 If there is doubt about an individual's fitness to dive, AMEDs should seek specialist advice where appropriate and adopt a risk-based approach in each case. The risk assessment should consider any specialist advice obtained, relevant history and examination findings, test results, and the type of diving and working conditions. Performing a risk assessment supported by the standards and guidelines in this document allows AMEDs to use discretion in making a justifiable, informed judgement on fitness to dive.

Role of the AMED

11 AMEDs must have knowledge of different types of diving, diving work environments, diving physiology/pathophysiology and fitness to dive. They must keep up to date with relevant developments and have a good understanding of the different types of commercial diving and their hazards and risks, in order to inform decisions on fitness to dive. Therefore, practical experience of diving would be advantageous. To gain HSE approval, AMEDs must undertake specialised training in diving medicine. They need to refresh this training at least once every five years to maintain their AMED status. Information on suitable training courses is available in HSE's AMED web pages.

12 AMEDs must have access to suitable facilities and equipment for conducting medical examinations. They must retain overall responsibility for the medical examination, even where they delegate certain aspects (eg spirometry) to other suitably trained and competent staff (eg nurses or occupational health technicians). The AMED must undertake the physical examination of the diver and is ultimately responsible for assessing their fitness to dive.

13 The role of the AMED is to:

- conduct medical examinations and fitness to dive assessments with reference to the standards and guidelines in this document;
- identify medical conditions that may present a risk to the diver and others involved in a diving project, and determine whether the diver has the functional capacity to safely undertake their work;
- consult where there is doubt about fitness to dive (paragraphs 25–27) and perform a risk assessment to determine a diver's fitness, taking account of the diving activity to be undertaken;
- determine whether the diver is fit to dive, fit to dive with restrictions or unfit to dive;

- issue a certificate of medical fitness to dive which clearly states the AMEDs decision on fitness (paragraphs 28–31);
- inform the diver of their right to appeal where the AMED decides they are unfit to dive or fit to dive with restrictions (paragraph 32);
- remind the diver of their legal obligation not to dive in a diving project if they know of anything that would make them unfit to dive (paragraph 6); and
- provide divers with information on the potential health effects of diving.

Medical assessment process

14 When diving 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 is unavailable, incomplete or not current, the AMED should repeat the investigations.

Initial medical examination

15 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. AMEDs should direct individuals to the updated diver fact sheet on HSE's AMED web pages,⁸ which contains a suitable questionnaire and background information. On completion, the questionnaire responses need 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. GPs can be directed to HSE's diving website for further information. If the individual is not UK based (eg they may have come to the UK for commercial diver training), they should still provide a completed medical questionnaire signed by their usual attending physician. In the very exceptional circumstance where the individual does not have an attending physician or GP equivalent, the AMED should ask them to complete and sign the medical questionnaire as a self-declaration, having gone through it with them.

16 The AMED should request the medical questionnaire and consider the information provided. The presence of a disqualifying medical condition at this stage may avoid the expense of proceeding to a full initial medical examination. The AMED cannot consider an individual's fitness to dive at initial assessment without health information confirmed by their GP. This also applies to divers seen by an AMED for the first time where they had a previous medical examination with another AMED but cannot provide evidence of the outcome of that medical.

17 Candidates should be advised of the need for a good level of physical fitness to become a diver and the requirement to successfully complete an exercise test as part of the medical examination. They can then consider whether they are likely to meet the appropriate level of physical fitness.

18 Before beginning a commercial diver training and/or assessment course, all trainees must undergo an initial medical examination with an AMED. This initial, comprehensive medical is particularly important. Appendix 1 summarises the routine investigations to perform. 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 28–31) for comparison with subsequent annual medical assessments. Use of the

Diver's Medical Record form, in addition to MA2, is convenient for recording and comparing examination findings and test results over time.⁸

Annual medical examination

19 At intervals not exceeding 12 months, all divers covered by DWR must see an AMED who will assess their fitness to dive at work for the following 12 months. Appendix 1 summarises the routine investigations to perform. In addition, the diver should be asked if they have had any relevant health issues since their previous medical. The AMED should base their judgement of fitness on careful assessment of any medical condition in relation to the safety of the diver and the work activities they will perform.

20 The MA2 form (see paragraphs 28–31) from the most recent examination needs to be available for comparison at each successive examination. The minimum requirement is for divers to produce a copy of their last MA2 form at the time of their annual medical assessment unless they return to the AMED who conducted the previous medical examination. Without a previous MA2, the AMED should treat the medical as an initial examination.

Return to work medical assessment

21 Any condition or injury occurring during a diver's career may influence their fitness for diving work. Under certain 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 pulmonary, cardiac, neurological or otological disorder, including decompression illness, or any condition requiring the diver to be off work for more than 14 days. Divers have a legal obligation not to dive if they know of anything that would make them unfit to dive.

22 A return to work medical assessment requires 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 examination.

23 Return to work following decompression illness (DCI) requires careful consideration. The relationship between a patent foramen ovale and other right-to-left shunts, and neurological, vestibular, cutaneous and cardiorespiratory DCI, is now well established. Therefore, any diver who has suffered these should be assessed by a cardiologist with a special interest in diving medicine. This is particularly important 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. Consultation with the cardiologist and if necessary the treating hyperbaric physician, will assist in making decisions about fitness to dive and the timing of return to diving work.

24 Any diver with a history of immersion pulmonary oedema requires assessment by a cardiologist with a special interest in diving medicine before returning to diving, and in most cases return to diving will not be permitted.

Second opinion and additional advice

25 AMEDs should reach a conclusion about fitness to dive. Where doubt exists, they should consult with other AMEDs and/or appropriate medical specialists. For chronic conditions (eg diabetes or asthma) where there is a likelihood of change

over time, to assess fitness to dive the AMED should obtain relevant information from the medical specialist responsible for the individual's clinical care. Where an individual with a chronic medical condition which could affect fitness to dive is seen for the first time, they should be referred to a diving medical specialist for evaluation. If the individual's condition then changes, the AMED should consider whether re-referral to the diving medical specialist would be appropriate.

26 HSE has a list of diving medical specialists for advice and referrals. In this document, reference to a medical specialist (eg respiratory physician or cardiologist) with a special interest in diving medicine, means a diving medical specialist on HSE's list.

27 AMEDs should follow current guidance on medical confidentiality⁹ and the requirements of the Data Protection Act 1998.¹⁰

Certificate of medical fitness to dive

28 On completion of the initial or annual examination, the AMED must issue the diver with a certificate of medical fitness to dive. This certificate is part of the MA2 form which is used to record details of the medical examination and assessment. The certificate must indicate whether or not the diver is fit to dive, and if fit 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.

29 For practical purposes, 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. The period from the expiry date of the current certificate to the expiry date of the new certificate must not exceed 12 months. The certificate must not be extended beyond this period for any reason.

30 When filling in MA2 forms, the AMED should complete each section of the clinical assessment in as much detail as possible. They should give a copy to the diver, retain a copy for seven years and send a 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 the MA2 form.

31 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 type of diving undertaken. They must not unnecessarily restrict employment opportunities. Some limits, such as maximum depth, are not usually meaningful, but to exclude a category of diving may be appropriate. Where an AMED identifies any restrictions, they must record them on the certificate of medical fitness to dive at the time of issue.

Appeals

32 Where an individual is found to be unfit to dive or fit to dive with restrictions, the AMED should inform them of the reason for their decision. They should also advise them of their right to appeal to HSE within 28 days for a review of the decision and

record this action. HSE's diving website contains full details of the medical appeals procedure.¹¹

General medical considerations

Gender

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

Age

34 There is no lower or upper age limit for medical fitness to dive. However, a diver must retain the physical and functional capacity to undertake work underwater even if offset by greater experience. This will normally require greater than average fitness as age increases.

Medication

35 Medical fitness to dive when using medication depends on:

- the type of diving;
- underlying pathology (physical and/or psychological);
- the effects of medication, taking into account the physiological effects of diving; and
- the consequences of its abrupt cessation during diving activities.

36 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, are also relevant. The assessment should 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

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

Disability

38 Given the enormous range of disabilities and functional loss that may be present in 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 risk assessment. Complex cases may require input from a diving medical specialist.

39 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;
- the use of safety divers;
- the nature of the diving environment;
- effects of medication;
- functional loss and adaptations; and
- whether the condition is progressive or associated with remissions and relapses.

40 The decision on fitness to dive at work should take into account the requirements of the Equality Act 2010.¹² Restrictions to diving must be justifiable.

Infection and impaired immunity

41 A diver with a communicable disease, including sexually transmitted disease, may start diving once the underlying condition is resolved. See paragraph 42 for information on HIV. In cases of doubt about fitness after such an illness (eg the presence of complications), the AMED must withhold the certificate of medical fitness to dive until they consult the doctor involved in the clinical care of the individual.

42 A positive HIV test need not preclude diving.¹³ 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. However, the AMED should consider such cases on an individual basis and obtain specialist advice as appropriate.

43 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 use and access to medical care, needs assessing in relation to foreign travel, diving in microbiologically contaminated water and working in saturation conditions.

Malignancy

44 A malignant condition and any treatment side effects should be assessed on an individual basis and will require information from the doctor responsible for the individual's clinical care. Any individual found fit to dive is likely to need regular review.

Obesity

45 Obesity has a negative impact on physical fitness and is associated with long-term disease (eg cardiovascular disease, hypertension and type 2 diabetes). It also has practical implications for diver safety (eg fit of equipment and the capacity to access and undertake work in confined spaces).

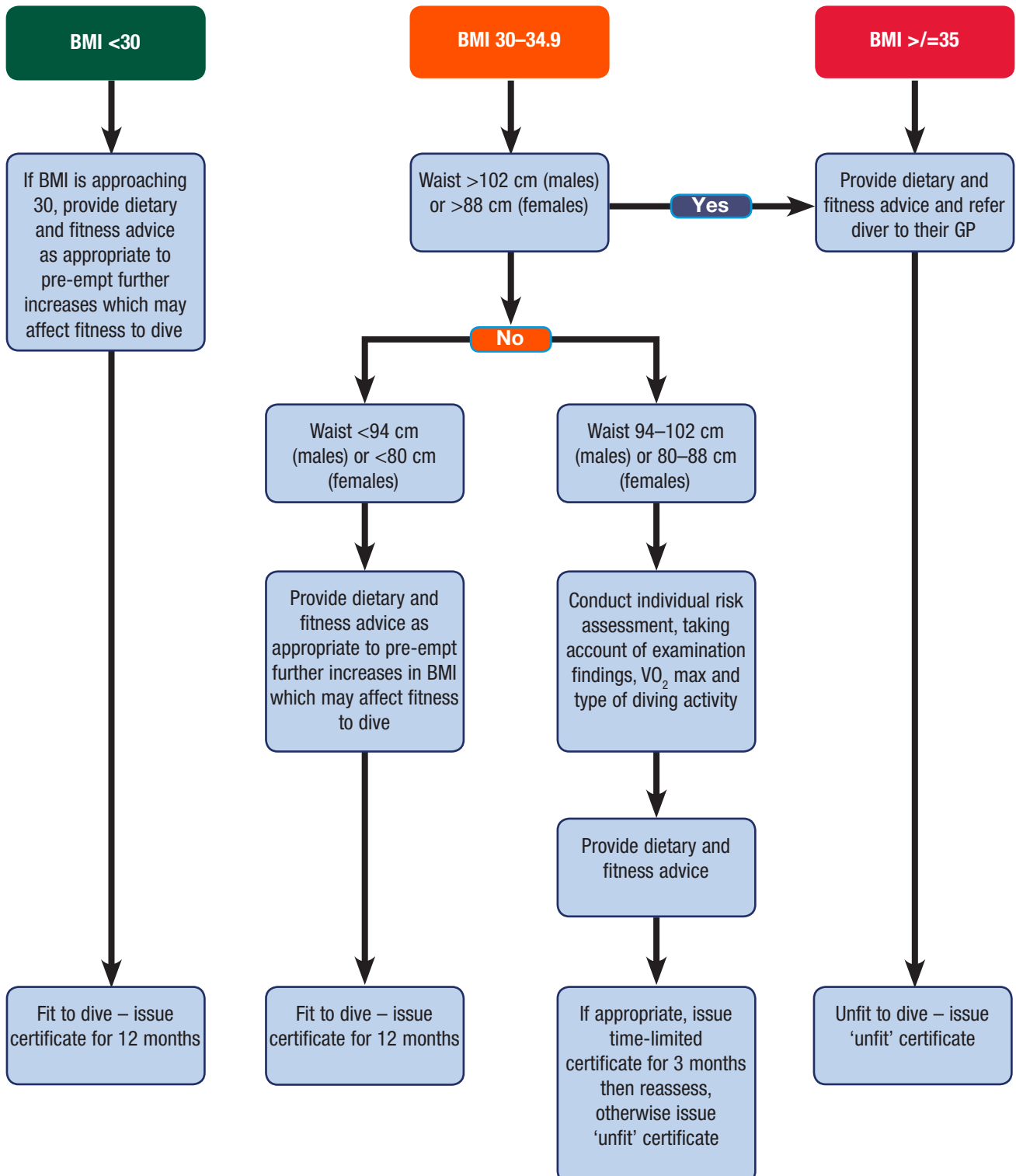
46 At each medical examination, the AMED must measure and record the diver's height, weight and waist circumference, and calculate Body Mass Index (BMI in kg/m²).^{14, 15} There is no requirement to estimate body fat using callipers or bioimpedance.

47 BMI is a population measure, traditionally used to identify individuals most likely to be overweight or obese. High values generally indicate excessive body fat

and increased health risk. However, BMI is a less accurate measure of adiposity in adults who are highly muscular. Waist circumference is a simpler measure and better predictor of body fat and future health risk.

48 To help interpret results, AMEDs should refer to the guide in Figure 1.

Figure 1 Flow chart to aid interpretation of BMI and waist circumference measurements



Mental health

49 AMEDs must consider the risk to the diver's safety and the safety of those around them, taking into account the risk of recurrence of psychiatric or psychological disorders. They should pay particular attention to the various stresses associated with the type of work, remote location and risks involved.

50 Individuals should be free from psychiatric symptoms and cognitive impairment. They should not be suffering from psychological or personality issues 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.

51 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 psychological assessment.

52 Some disorders, if symptomatic, would exclude an individual from all types of diving. They are:

- schizophrenia;
- bipolar affective disorder; and
- recurrent depression.

53 When the above disorders are asymptomatic due to treatment, the AMED must obtain an opinion from a psychiatrist with a special interest in diving medicine.

54 The following disorders, if resolved, and where there have been no further episodes for at least six months while off psychotropic medication (or at least 12 months off psychotropic medication for divers working in saturation or undertaking other diving deeper than 50 metres), may be compatible with diving. Obtaining a specialist report might 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

55 The use of psychotropic medication (eg SSRIs for anxiety and/or depression) is a contraindication for saturation diving or other diving deeper than 50 metres. For other types of diving where there is a continuing need for psychotropic medication, the AMED must obtain an opinion from a psychiatrist with a special interest in diving medicine.

56 Use of such medication for management of chronic pain needs individual assessment and input from a diving medical specialist.

57 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

58 Alcohol dependence and drug or substance misuse is incompatible with 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

59 The respiratory system should be clinically and functionally normal. A comprehensive respiratory history is essential and AMEDs should consider using a standardised questionnaire.

60 At each medical examination, the candidate must perform spirometry at rest and the AMED must record PEF, FEV₁ and FVC. The AMED must consult a respiratory physician with a special interest in diving medicine for any candidate with FEV₁ and/or FVC lower than 80% of the predicted value for gender, age and height (corrected for ethnicity), FEV₁/FVC ratio less than 70% or with any other significant abnormality of pulmonary function. However, if any one of the spirometry measurements is borderline, referral may not be necessary if the diver has had a previously documented minor abnormality of pulmonary function that has not deteriorated, has no symptoms, completes a normal exercise test and has no other cardiorespiratory abnormality.

61 The respiratory response to the exercise test must also be recorded (see paragraphs 128–136). Document PEF or FEV₁ at 5, 10 and 15 minutes post-exercise and consider using the Borg scale or similar to assess breathlessness in a structured manner. If PEF or FEV₁ fall by at least 15% at 5, 10 and/or 15 minutes post-exercise, or if there are any other features suggestive of exercise-induced bronchoconstriction from the medical or occupational history, consult a respiratory physician with a special interest in diving medicine.

62 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 to dive. If additional assistance in interpretation is needed or imaging other than a plain chest X-ray is required, a respiratory physician with a special interest in diving medicine must be consulted.

63 If there is any doubt about respiratory fitness, the AMED must seek an opinion from a respiratory physician with a special interest in diving medicine. Table 1 sets out specific circumstances in which an opinion must be sought and when a respiratory condition would be a contraindication to diving without the need for further assessment.

Table 1 Respiratory conditions that are an absolute contraindication to diving or require further assessment

Condition	Candidate unfit to dive without need for further assessment	Candidate needs further assessment by respiratory physician with special interest in diving medicine	Additional guidance for specialists in secondary care
Acute respiratory disease such as pulmonary infection	All cases, until resolved with no sequelae		
Asthma	Requiring BTS Step 3 treatment and/or admitted to hospital with exacerbation in last 3 months; unstable asthma	Controlled on Step 1 or 2 of BTS guidelines – refer when diver is seen for the first time (initial medical) and consider re-referral if the condition subsequently changes (see paragraph 65)	Individuals with asthma should be found unfit to dive if they have wheeze precipitated by exercise, cold or emotion
Chronic obstructive pulmonary disease		All cases	
Cystic fibrosis	Pulmonary involvement	All other cases	
Tuberculosis	Active tuberculosis	After curative treatment, if lung function and chest radiography are normal	
Pulmonary fibrosis	Disease which reduces lung compliance and impairs gas transfer	All other cases	
Previous chest surgery; pneumomediastinum; pulmonary barotrauma; traumatic pneumothorax including cardiothoracic surgery		All cases	Candidate might be fit to dive if injury has healed and is associated with acceptable lung function and thoracic imaging
Presence of large bullae or cysts	All cases		Due to increased risk of barotrauma
Sarcoidosis	Active sarcoidosis	Resolved sarcoidosis demonstrated by normal chest radiography and pulmonary function testing	
Previous spontaneous pneumothorax		All cases	Candidate may be fit to dive if treated by bilateral surgical pleurectomy and associated with normal lung function and thoracic imaging performed after surgery
Chronic lung disease not mentioned elsewhere		All cases	

Asthma

64 For assessing the asthmatic diver, AMEDs should follow *British guideline on the management of asthma A national clinical guideline* by the British Thoracic Society/ Scottish Intercollegiate Guidelines Network.¹⁶ Table 1 includes information on asthma.

65 Individuals with asthma may be permitted to dive (where they have been assessed by a respiratory physician in accordance with Table 1), 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 ($FEV_1 > 80\%$ predicted and $FEV_1/FVC > 70\%$); and
- have a negative exercise test ($< 15\%$ fall in PEF or FEV_1).

66 A diver with asthma should monitor their condition with regular, twice daily, PEF measurements and bring records of these measurements to subsequent medicals. They should be advised to refrain from diving if they have:

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

Cardiovascular system

67 The cardiovascular system should be clinically and functionally normal and 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.

68 Any organic heart disease is a cause for rejection unless considered haemodynamically unimportant by a cardiologist with a special interest in diving medicine.

Blood pressure

69 AMEDs must obtain resting blood pressure at each examination. When measuring blood pressure, standardise the environment and provide a relaxed, temperate setting, with the person quiet and seated, and their arm outstretched and supported (see NICE clinical guideline on hypertension).¹⁷

70 Mild hypertension (systolic BP = 140–159 mmHg; diastolic BP = 90–99 mmHg) would not be a contraindication providing that:

- either no medication is required or the medication taken has no implications for diving safety; and
- there is no evidence of end organ damage.

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

ECG

72 An ECG is not required at initial or annual medical examination unless clinically indicated. Where an AMED obtains an ECG, they should discuss any abnormality with a cardiologist.

Ischaemic heart disease

73 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.

74 At the initial examination, an individual found incidentally to have ischaemic heart disease needs further assessment by a cardiologist with a special interest in diving medicine.

75 An individual who is symptom free following conventional coronary bypass surgery, percutaneous coronary intervention (angioplasty) or minimally invasive surgical revascularisation, requires careful assessment by a cardiologist with a special interest in diving medicine (also see Table 1 for traumatic pneumothorax including cardiothoracic surgery).

Dysrhythmia

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

77 Disorders of cardiac rhythm, except for infrequent ventricular extrasystoles, require evaluation by a cardiologist with a special interest in diving medicine and are likely to be a cause for rejection. Sinus arrhythmia is normal in young people.

Pacemaker

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

Patent foramen ovale (PFO)

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

80 However, the relationship between a PFO and other right-to-left shunts, and neurological, vestibular, cutaneous and cardiorespiratory DCI, is now well established. Furthermore, migraine with aura is associated with an increased prevalence of a large PFO and other right-to-left shunts and therefore an increased risk of DCI. Any diver who has suffered these should be assessed by a cardiologist with a special interest in diving medicine (see paragraph 23). This is particularly important 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.

Valvular heart disease

81 Auscultation of the heart should be normal. Murmurs are acceptable only if deemed physiological or haemodynamically unimportant. Evidence of valvular heart disease requires assessment by a cardiologist with a special interest in diving medicine.

82 Congenital heart disease, even if repaired surgically or by interventional techniques, requires assessment by a cardiologist with a special interest in diving medicine.

Peripheral circulation

83 The peripheral circulation should be capable of providing adequate peripheral perfusion even in cold conditions. Evidence of impaired circulation, either on history or examination, requires further evaluation. Peripheral vascular disease may predispose to cold injury. Contraindications include:

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

Nervous system

84 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.

85 Assessment of central nervous system function includes both physical and psychological aspects (see paragraph 51).

86 A careful history is essential. The AMED should specifically seek a history of visual, hearing, speech, swallowing, motor, sensory, balance, coordination, bladder, bowel and sexual dysfunction. A history of predisposition to episodes of impaired consciousness or awareness, convulsions and 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.

87 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 and plantar responses should be elicited. The AMED should record the baseline clinical findings in detail on the MA2 form to allow detection of any subsequent variation.

88 The following are contraindications to diving:

- Any form of seizure activity, other than febrile convulsions occurring before the age of five years. However, if a diver remains seizure free for 10 years without medication or treatment, they may be fit to dive but will require assessment by a diving medical specialist
- Recurrent, unprovoked loss of consciousness of unknown aetiology or recurrent episodes of fainting
- Severe motion sickness
- Severe migraine (frequency and symptoms), particularly with excess daytime somnolence

89 Neurological diseases such as stroke, multiple sclerosis or Parkinson's disease should be considered on an individual basis and will require an opinion from a neurologist with a special interest in diving medicine.

90 Following a stroke or transient ischaemic attack (TIA), a diver requires at least 12 months without further problems to be considered fit to dive. An opinion from a neurologist with a special interest in diving medicine would be necessary. The possibility of other cardiovascular pathology must be investigated and excluded by a cardiologist with a special interest in diving medicine.

91 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. The reason for intracranial surgery is often the more important factor when assessing epilepsy risk. A neurological assessment by a diving medical specialist must be sought.

92 A history of moderate to severe 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 taken from the time of injury until the point from which there is continuous recall.

93 Mild episodes of head injury (less than 30 minutes unconsciousness or post-traumatic amnesia) provide grounds for temporary unfitness for a period of 4–6 weeks, subject to a review by an AMED. However, mild head injuries may lead to persisting post-concussional symptoms and divers should not return to diving work until these have resolved.

Musculoskeletal system

94 The diver must have the appropriate degree of mobility, strength and dexterity for the diving activities and work undertaken. Musculoskeletal problems require a careful and individual risk assessment.

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

96 Routine long bone X-rays are not required for surveillance of divers. Long bone radiography and/or MRI is indicated in cases of suspected dysbaric osteonecrosis.

Ear, nose and throat

97 Hearing that allows understanding of normal conversational voice is adequate for all types of diving at work. If there is any doubt, a risk assessment should be conducted, taking account of relevant factors, including the diver's ability to communicate and respond to warning signals and the type of diving. Initial examination requires an audiometric assessment covering the range 500 Hz–6 KHz. An audiogram should be repeated after an episode of aural barotrauma or where required as part of a hearing health surveillance programme.¹⁸ Saturation divers may need regular follow up.

98 The ear canal must be free from obstruction such as wax. Narrowing of the ear canal, caused by exostoses for example, should not prevent diving unless severe enough to limit or impede ear equalisation.

99 The tympanic membrane must be intact. Movement of the tympanic membrane should be seen on performing a Valsalva manoeuvre. If there is any doubt that eustachian tube function is hindered, refer the diver for a tympanogram.

100 The following are contraindications to diving:

- Previous stapedectomy
- Active Ménière's disease or other vertiginous conditions
- Any active infection of the ear canal or middle ear until resolved
- Cases of chronic ear canal or middle ear disease, such as cholesteatoma. These will require advice from a diving medical specialist
- Any mastoid surgery that has removed the posterior ear canal wall
- After middle ear barotrauma until all symptoms and signs have fully resolved. Advice from a diving medical specialist may be required

101 Scarred tympanic membranes or healed perforations do not prohibit diving as long as individuals have intact tympanic membranes and normal eustachian tube function.

102 The nose should be clear with no obstruction. Any nasal or sinus symptoms should be treated appropriately. Acute infection of the nose/sinuses is a contraindication to diving and should be treated appropriately. Once resolution has occurred and the nose is clear, the individual can dive. Chronic nasal and sinus conditions may be treatable. Providing this is successful, the individual can dive. A requirement for oral or topical medications, such as decongestants, antihistamines or steroids, requires careful consideration and advice from a diving medical specialist.

103 Nasal obstruction caused by a deviated nasal septum or nasal polyps is amenable to medical or surgical treatment. After successful treatment, the individual can dive.

104 Any condition causing an incompetent larynx is a contraindication to diving as is the presence of a tracheostomy. A laryngocele is also a contraindication until corrected surgically.

Vision

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

106 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.

107 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

108 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.

109 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

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

Diabetes

111 The detection of glycosuria requires investigation. The AMED must refer any diver with diabetes mellitus, whether insulin, tablet or diet controlled, to a medical specialist with a special interest in diabetes and diving medicine, for detailed individual assessment (see paragraph 25).

112 When assessing fitness to dive in an individual with diabetes, consider the nature of the work and diving environment, the degree of control achieved by treatment and safety of the diver and others on the diving project. Regular (at least annual) specialist review is required and the individual should be well motivated and educated in relation to their diabetes care. It is unlikely that an individual with diabetes would be fit for saturation diving.

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

Thyroid disease

114 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

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

116 Divers with any other endocrine disorder or those receiving systemic steroid therapy must be referred to an endocrinologist and the results discussed with a diving medical specialist for detailed individual assessment.

Genitourinary system

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

118 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.

119 If the history suggests prostatic disease, this should be carefully evaluated. The occurrence of acute retention would be a particular problem for saturation divers.

Gastrointestinal system

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

121 Active inflammatory bowel disease, gall bladder pathology and pancreatitis are contraindications to diving. Quiescent disease would require the opinion of a diving medical specialist. The presence of an abdominal wall hernia is a contraindication until repaired. Dyspepsia requires investigation. Gastrointestinal surgery which results in the potential for gas trapping, requires an opinion from the surgeon and, if necessary, a diving medical specialist.

122 A previous history of peptic ulceration requires careful assessment. Active peptic ulcer disease is not acceptable for diving. If an individual has peptic ulceration that is kept under review and is quiescent with medication, they may be fit to dive.

123 The presence of a stoma is likely to be compatible with limited types of diving activity. The AMED may need to obtain advice from the individual's surgeon.

Skin

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

125 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

126 There is no requirement for a full blood count at initial or annual medicals and no need for a sickle cell test, unless clinically indicated.

127 Sickle cell anaemia (HbSS), other sickle cell disorders (including HbSC, HbSD, HbSO and HbS beta thalassaemia) and thalassaemia major are contraindications to diving. 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

128 Professional diving can be very demanding, both physically and mentally, and divers need a good level of physical fitness. This is particularly important for underwater emergencies where a diver may need to rescue a colleague. At initial and annual medical examinations, AMEDs must conduct an exercise test to assess cardiorespiratory fitness. They can then provide feedback to the diver on their physical fitness and it serves as a health promotion tool to remind the diver to keep fit.

Safety

129 Before proceeding to an exercise test, the AMED should conduct an assessment of the risk and suitability of undertaking the test. This should take account of the diver's medical history, examination findings, investigation results, general fitness and the presence of any cardiac risk factors. Appendix 2 contains a cardiac screening tool that the AMED can use.

130 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). Resuscitation equipment (eg an automated external defibrillator (AED)) should be provided, depending on the findings of the risk assessment. There should be a clear procedure to follow in the event of a collapse. AMEDs should consider the approach in the Resuscitation Council (UK) document *Quality standards for cardiopulmonary resuscitation and training*.¹⁹

Testing

131 At each initial and annual medical, AMEDs should perform a Chester Step Test (CST) to estimate the maximal oxygen uptake (VO_2 max).²⁰ This is a measure of aerobic capacity and cardiorespiratory fitness. Other methods for evaluating VO_2 max are available, each with its limitations. The CST has several advantages. It requires minimal equipment, is inexpensive, is relatively easy to perform and standardise, and requires little skill from the participant.

132 The measurement error associated with the CST is around 12–15% but accuracy of the results can be improved by careful standardisation of pre-test conditions and test procedures. Therefore, it is important AMEDs adopt a standardised approach when following the appropriate protocol for performing the test and estimating VO_2 max. When properly conducted, the CST is reliable on a test-retest basis, reasonably valid for estimating aerobic capacity and suited to monitoring changes.

133 Working divers should be able to achieve a minimum VO_2 max of 45 ml/kg/min (see Figure 2). This is equivalent to an energy expenditure of 13 METS (metabolic equivalent of task). As a comparison, the recommended aerobic capacity standard for UK firefighters, who undertake work that can be physically demanding and requires periods of sustained effort in arduous conditions, is 42 ml/kg/min.²⁰

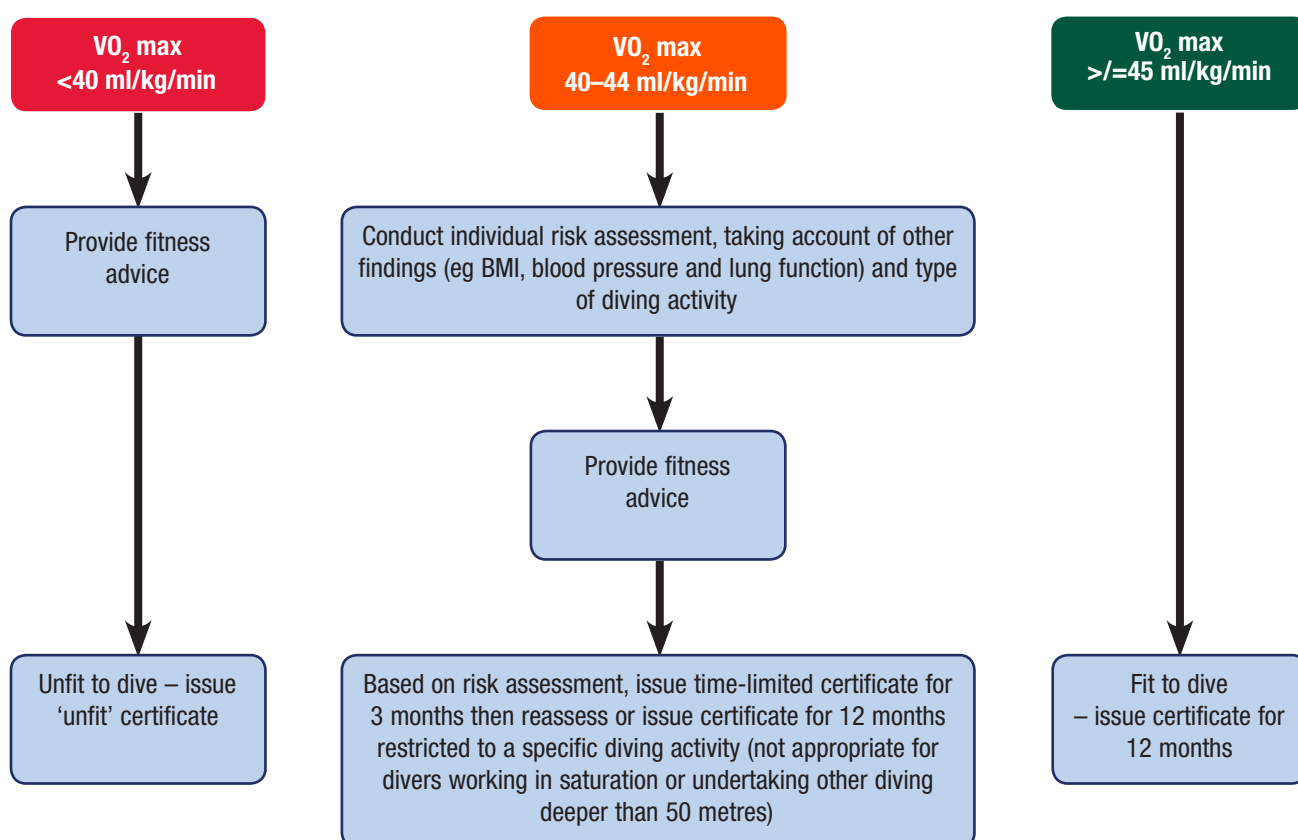
134 If there is doubt about the accuracy of results from the CST for a particular diver, the AMED should consider whether an alternative test for estimating VO_2 max would be appropriate. Suitable tests could include a Treadmill Test or Multi-Stage Shuttle Run Test.²⁰ A maximal exercise test requiring the subject to exercise to the point of exhaustion should only be undertaken after a careful and detailed assessment of the risk and suitability of performing the test (see paragraphs 129–130). In addition, the individual may require close monitoring while undertaking the test.

135 Although the CST is essentially a functional test, measuring PEF or FEV₁ before, and 5, 10 and 15 minutes after the test, provides a screen for exercise-induced wheeze (see paragraph 61).

Interpretation

136 To help interpret results, AMEDs should refer to the guide in Figure 2. If the result is borderline, even after repeat testing, the AMED should take account of all relevant findings and the type of diving activity to be undertaken when deciding on fitness to dive. In reaching a decision, they should document any discussions they may have had with other AMEDs and specialists before issuing a certificate of medical fitness to dive.

Figure 2 Flow chart to aid interpretation of VO_2 max values



Appendix 1 Summary of routine investigations to perform at initial and annual medical examinations

Investigation	Initial examination	Annual examination
Exercise test	Yes	Yes
BMI	Yes	Yes
Waist circumference	Yes	Yes
Spirometry	Yes	Yes
Post-exercise PEF/ FEV ₁	Yes	Yes
Resting blood pressure	Yes	Yes
Urinalysis	Yes	Yes
Audiometry	Yes	If clinically indicated
Chest X-ray	If clinically indicated	If clinically indicated
Resting ECG	If clinically indicated	If clinically indicated
Full blood count	If clinically indicated	If clinically indicated
Sickle cell test	If clinically indicated	N/A

Appendix 2 Cardiac screening tool

Question	Yes	No
If undertaken, is the resting ECG normal?		
If the ECG is abnormal, has it been 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?		

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