

Norwegian guidelines for medical examination of occupational divers

Saksområdet som denne trykksaken handler om forvaltes av Sosial- og helsedirektoratet.
Spørsmål om innholdet rettes til direktoratet på telefon 24 16 30 00



Statens helsetilsyn

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Foreword

This manual with the new guidelines for medical examinations of occupational divers and the accompanying English translation, is the end product of a comprehensive process, with contributions from a broad range of individuals and institutions in addition to contributions received in connection with the hearing process.

The Norwegian Board of Health appointed a working party to review the guidelines issued 03. March 1980 (I-2090). The initial draft proposals were completed 19. March 1997. The working party consisted of:

- Consultant Leif Aanderud, M.D., Haukeland Hospital/University of Bergen
- Professor Alf Brubakk, M.D., NTNU/Sintef Unimed, Stolt Comex Seaways
- Commander (senior grade) Svein Eidsvik, Diving medical officer, Royal Norwegian Navy
- Medical practitioner Rajinder Midha, Norwegian Directorate of Labour Inspection
- Consultant Jan Risberg, M.D., NUI/ Haukeland Hospital/University of Bergen_The Chairman was Dr. Jan Risberg.

The following have made important contributions to specific chapters:

- Consultant Svein Færestrand (Cardiology)
- Professor Otto Inge Molvær (ENT)
- Military Dentist Jon-Edgar Stalheim (Odontology)
- Professor Johan H. Seland (Ophthalmology)
- Consultant Einar Thorsen (Pulmonary Medicine)
- Professor Rune Ulvik (Clinical Biochemistry)
- Consultant Ingar Wilhelmsen (Psychiatry)
- Associate Professor Alex Wisnes (Exercise testing)
- Professor Sylvi Aanderud (Endocrinology)

The English translation is primarily the result of Hans Petter Roverud's and Anne Brakstad's efforts, while Dr. Stephen Doherty, Health & Safety Executive (HSE), has contributed in harmonisation of the guidelines in relation to the British equivalents, in addition to some translation.

However, the Norwegian Board of Health is solely responsible for the contents of these new guidelines. If there should be any ambiguity in the bilingual interpretation of these guidelines, the Norwegian version should be used.

An updated electronic version will be available at the Norwegian Board of Health's homepage:
<http://www.helsetilsynet.no>

The Norwegian Board of Health wishes to thank all contributors for their efforts and wishes to express confidence in a continued strong effort in quality control of the health services for our occupational divers.

Norwegian guidelines for medical examination of occupational divers

Introduction

- 1.1 The purpose of these guidelines is to assist doctors who perform medical examination of occupational divers according to Norwegian national legislation. The guidelines give recommendations concerning the extent and the frequency of examinations, and define the medical requirements to be met by occupational divers.
- 1.2 The regulations for diving inshore are based on the "Regulations of Diving" (Order no. 511; later referred to as "511") issued by the Norwegian Directorate of Labour Inspection (DLI). The corresponding regulations for offshore diving have been issued by the Norwegian Petroleum Directorate (NPD) in "Regulations Relating to Manned Underwater Operations in the Petroleum Activities" (later referred to as the "Offshore Diving Regulations"). Relevant references are cited in the last chapter of these guidelines. In order to perform occupational diving (commercial diving), the diver must have completed qualifying training and hold a diving certificate, issued by either DLI or NPD. Both supervising authorities also require that an occupational diver should hold a valid medical certificate before being considered fit to perform occupational diving. These guidelines apply primarily to doctors who will examine divers in accordance with medical standards outlined in the Offshore Diving Regulations and in "511".
- 1.3 The Norwegian Board of Health in conjunction with DLI and NPD recommend that medical examinations of occupational divers that are covered by "511" and the Offshore Diving Regulations are based on these guidelines.
- 1.4 Some areas of inshore diving are not regulated by "511" i.e. §1, police diving and military diving. The Norwegian Board of Health recommends the use of these guidelines when examining divers from these exempted groups. The advised frequency of examinations depends on the age group, diving method, e.g. saturation- or air-diving and the amount of diving activities. The extent of the medical examination and the health requirements should follow the recommendations given in these guidelines.
- 1.5 Medical examination of recreational divers is not covered by these guidelines. This category of diving is fully covered in "Guidelines for Medical Examination of Recreational Divers" (Norwegian text only).

Requirements for doctors who perform medical examinations, and are responsible for the certification of occupational divers

- 2.1 Doctors who will issue medical certificates for occupational divers (i.e. a medical declaration in accordance with requirements issued by DAT and NPD), must be approved by the Norwegian Board of Health. Doctors must be re-certified every two years.
- 2.2 In order to be granted approval to examine and issue medical certificates for occupational divers, the doctor must demonstrate sufficient theoretical knowledge, practical skills and have access to facilities/equipment appropriate for testing divers, in addition to be able to demonstrate knowledge of the relevant regulations.

- 2.3 Qualifying courses: Pending further notice, doctors who have attended the Royal Norwegian Navy's course for diving doctors or other equivalent course of at least 5 days duration (36 hours of lessons), and have passed the course exam, will be approved as qualified doctors. Each doctor must have access to test equipment needed to perform spirometry, ECG, test of physical capacity, audiometry, and X-ray diagnosis.
- 2.4 The approved doctor must remain fully updated on the development of procedures and regulations and be able to prove this to The Norwegian Board of Health. The board can revoke or decline to renew the approval if the annual number of medical examinations issued in accordance with the requirements is low (i.e. less than 6), and/or the doctor is not fully updated with current diving practice. Participation in diving medicine-related courses lasting for at least one day (7 hours) every second year is recommended as a minimum; the doctor may alternatively choose to document similar professional development through participation in relevant seminars, conferences etc.

General requirements for the health of the occupational diver

- 3.1 Any candidate applying for enrolment at a professional diving training school should be medically fit for diving and hold a valid diving medical certificate. "Medically fit" for occupational diving means that the candidate must be free from any condition that may represent a safety risk to himself/herself or others. The candidate should not be exposed to unnecessary health risks (acute injuries as well as long-term health effects) during training or later at regular work, even though the damage may not be deemed a direct safety risk to himself/herself or others. If the approved doctor finds that a continued diving career may expose the candidate to detrimental health effects further follow-up is recommended.
- 3.2 Divers holding a diving certificate class I or II from NPD should be declared fit for occupational offshore diving provided no illness, injury or other medical condition makes the candidate a risk for his own safety or that of others. The doctor should examine the candidate as thoroughly as needed to establish/exclude any other medical condition that may be affected by diving. If the doctor finds such medical conditions, the diver should be informed of the possible consequences of continued diving. Declaration of unfitness to dive should be issued only if the health conditions may constitute a safety risk to the diver or other team members.
- 3.3 Divers holding a diving certificate from DLI, class I, III, S or R, should be declared fit for inshore occupational diving unless there is any illness, injury or disability that may constitute a safety risk for the diver him-/herself or others, or may lead to impaired health for the diver. The doctor is expected to investigate medical conditions likely to cause immediate or long term health effects, even if such conditions are considered irrelevant for the divers in-water safety. Medical conditions likely to inflict immediate injury or illness or long term health effects affecting quality of life are disqualifying for inshore occupational diving according to DLI regulations ("511").

Frequency and extent of examination

- 4.1 The initial medical examination will normally concur with enrolment in commercial diving class. This examination (the "primary examination") will be a full medical examination, identifying all medical conditions that may be affected by diving or may have any effect on the diver's safety. These guidelines specify examination procedures and specific health requirements at the initial examination.

- 4.2 During their diving career occupational divers should be medically assessed on an annual basis. Such examinations should be made by approved doctors and be of an extent that ensures that the diver is fit to dive and will not constitute any risk for his/her own safety or that of others. The guidelines specify examination methods and health requirements made at such annual examinations.
- 4.3 Occupational divers about to start further training in order to qualify for higher certificates, should go through a medical examination as extensive as the initial examination. When assessing the medical fitness the doctor has to consider whether increased diving activity or other diving procedures (according to the new level of training) could affect the diver's health or constitute any danger to others. Candidates should not be accepted for further qualifying training when it seems likely that the training and further diving activity will expose the diver to risk of health issues which would affect the quality of life, future alternative careers or conditions necessitating treatment.

Return to work after serious injury or illness (including decompression illness)

- 5.1 Any condition or injury occurring during a diver's career may influence fitness for work. Under certain specific circumstances (any cardiac, pulmonary or neurological disorder including neurological decompression illness or any condition requiring the diver to be off work for more than 14 days) a diver must present to an approved doctor for re-examination for assessment of fitness to return to work. The doctor must decide whether a specific examination of the diver is necessary, or whether the medical condition is innocuous and requires no further assessment. This is a specific examination related to the possible effects of the particular illness or injury, and does not replace the requirement for an annual medical assessment.

Certificate of medical fitness to dive

- 6.1 On completion of the annual medical assessment the approved doctor must reach a conclusion about the diver's fitness to dive. Where doubt about fitness exists, consultation with other approved doctors and specialists should take place.
- 6.2 Inshore divers will get the formal/written declaration of fitness to dive inshore from the certifying doctor and the Norwegian Directorate of Labour Inspection (DLI). The certifying doctor should decide whether the candidate is medically fit to dive and make a declaration on form 213F which is sent to DLI, who will issue the formal decision to the diver after administrative control of the declaration.
- 6.3 Offshore divers (performing diving according to the Offshore Diving Regulations) will undergo an examination similar to that of inshore divers. The certifying doctor should decide whether the candidate is medically fit to dive, and issues a declaration on a form issued by the Norwegian Petroleum Directorate. A copy of this declaration should be sent to the Directorate.
- 6.4 A Norwegian Declaration of health issued on the appropriate form from NPD in accordance with the Regulations is recognised as being equivalent to the corresponding British Declaration of fitness to dive in Great Britain (in- and offshore) in accordance with an agreement between HSE, NPD and the Norwegian Board of Health, dated 24th September 1996.

Medical certificates with restrictions

- 7.1 Divers examined in accordance with these guidelines will usually be declared either fit or unfit for professional diving. Certain medical conditions may cause restrictions to the diver's fitness to accomplish specific diving tasks or use specific diving procedures. Examples of such restrictions are refusal to allow saturation diving and advice for extra decompression time.
- 7.2 The approved doctor should consider very carefully the suitability and the reason for this type of restrictions (item 7.1 above). If he or she finds after careful consideration that such restrictions are warranted, they should be entered in the diver's logbook as well as on the medical certificate.
- 7.3 Usually there is no reason to give the diver specific depth restrictions. If such a restriction is set, the certifying doctor must obtain a second opinion from an experienced diving doctor¹.

Declaration of unfitness for diving - appeal procedure

- 8.1 *General.* A declaration of medical fitness or unfitness is an administrative decision in agreement with §2 of the Public Administration Act (Norwegian "Forvaltningsloven") The right to appeal is described in this act. The time limit for appeal is in general three weeks from the time the diver was announced the decision.
- 8.2 *Inshore diving* A diver appealing a decision of unfitness for in-shore occupational diving should forward the complaint to DLI.
- 8.3 *Offshore diving.* The approved doctor should inform the diver concerning his right to appeal a decision of (un-)fitness for diving. The diver should present his formal complaint to the approved doctor. The approved doctor may adhere to or alter the initial decision. If the initial decision is maintained, the approved doctor is required to forward the complaint for final decision by the Norwegian Board of Health. The Norwegian Board of Health may issue further directions concerning appeal procedures.

¹ In Norway the Section for Hyperbaric Medicine (including clinical diving medicine), at Haukeland hospital in Bergen, can contribute with advice in such matters. In addition, the diving Medical officer of the Royal Norwegian Navy (at Haakonsværn Naval Base near Bergen) has long experience in such matters.

General medical considerations

Diving history

1. This is to be ascertained in detail and carefully recorded. The doctor should make himself familiar with the diver's previous diving career, and at each annual examination pay particular attention to the diving performed since the previous examination. The diver should produce his/her personal diving log at the examination.

Age

2. Based on medical criteria there are no lower or upper age limits for divers. However, it is unusual for anyone below the age of leaving school to undergo diver training and none under the age of 18 is accepted for work offshore. The Norwegian "Arbeidsmiljøloven" (Act relating to workers' environment) defines age limits for various types of work. In an older person evidence should be sought for motivation and fitness. A diver must retain the necessary physical capacity to undertake work under water. This may require greater than average fitness as age increases.

Gender

3. In general the same fitness criteria apply to male and female divers. The major difference between female and male divers relates to possible harmful effects that exposure to increased pressure may have on a foetus. Consequently a diver who is pregnant or who suspects that she may be pregnant should not dive and should be temporarily declared unfit to dive when pregnancy is confirmed.

Previous medical history

4. Prior to the primary examination prospective divers should have arranged for their general practitioner to provide a report detailing their medical history. Candidates to diving schools should produce a copy of their medical history and records if he/she has previously been treated for serious illness, injuries or accidents. The diver should, in his/her own declaration, confirm that he/she accepts the certifying doctor obtaining relevant medical information if the diver is not able to produce such himself/herself. At subsequent annual assessments further reports will be required only if there is a relevant clinical problem that requires further evaluation.

Smoking

5. Smoking can cause serious illness and damage to health, including cardiovascular disease, decreased pulmonary capacity and reduced work capacity. Such damage to health may be of an extent inconsistent with further diving. Divers should therefore be discouraged from smoking.

Alcohol, drug and substance abuse

6. Current abuse of alcohol, drugs or other substances creating dependency is incompatible with diving. The approved doctor should issue a Declaration of unfitness to dive (on a permanent or temporary basis) if such conditions have been revealed. Fitness for diving must be carefully considered in the case of a previous history of abuse. A prolonged period of abstinence from alcohol/drug abuse must be documented before a Medical Certificate can be issued. The doctor should consider issuing a certificate with a shorter period of validity than usual.

Psychiatric illness

7. Individuals should be free from significant psychological and psychiatric illness, either past or present. A significant illness would be one leading to functional occupational impairment, requiring hospitalisation or protracted medication. Any previous history of psychiatric illness should be assessed carefully and a second opinion sought if necessary.
8. The approved doctor must show careful judgement if he/she finds any sign of previous psychiatric illness with risk of recurrence. Recurrence may be provoked by various factors associated with the work, remote location and other risks involved.
9. Personality disorders would be cause for exclusion. However, an individual with an acquired psychosis (anxiety or depression) might be assessed by a specialist and found fit to dive after a suitable period of normality without any therapy.
10. Schizophrenia and bipolar affective disorder are causes for disqualification.
11. Phobias may be successfully treated. Guidance on the risk of recurrence should be obtained from the individual's psychiatrist before the approved doctor reaches a conclusion.

Medication

12. Medical fitness to dive whilst under medication is dependant on the underlying pathology; the effects of medication on the diver's physical and cognitive capacity; the consequences of an abrupt cessation of the medication, in addition to the type of diving. Assessment must include that of the underlying condition for which medication is being taken; - this may be the most important consideration. The assessment must also consider the length of time which an individual can safely be without medication without functional impairment. The possibility of unexpected side effects as a result of interaction with pressure should also be considered.

Malignancy

13. A malignant condition should be assessed on an individual basis and will require information from the doctor responsible for the patient's care. Any such person considered fit to dive is likely to require regular review.

Communicable diseases

14. The approved doctor should pay special attention to communicable diseases. Serious communicable diseases should as a rule be disqualifying until treatment has been completed. If there is any doubt as to the person's fitness after such illness, the certificate of medical fitness should be withheld until the doctor involved in the initial care of the patient has been consulted. The assessment should address the clinical presentation of the illness (functional condition) and to what extent other personnel could be infected. Previous serious communicable disease should not present reason for disqualification to dive.
15. A positive HIV test need not mean the end of diving. However, any change in the medical condition of the HIV positive person should be considered carefully before certificate of fitness is given. Diving restrictions may be appropriate. However, the development of the symptoms and signs of AIDS will almost certainly lead to medical unfitness, because of the physical problems of the condition.

The medical examination

Morphology

1. The primary consideration is a diver's mobility and agility. Individuals with a Body Mass Index (BMI)⁰ greater than 30 should have further assessment of body fat content by measurement of skin-fold thickness at four sites (Durnin & Womersley 1974). A body fat content in excess of 30% may be considered a reason for rejection until weight has been satisfactorily reduced.

Respiratory system

1. The nasal airway should be free from signs of obstruction. There should be no evidence of chronic sinus disease. Clinical examination of the respiratory system should be normal. The chest should be anatomically normal. There should be no evidence of obstructive or restrictive lung diseases. The gas exchange capability and the structural integrity of the lungs should be normal as assessed by ordinary clinical examination and if necessary supplemented with X-ray diagnosis. Persons with medical conditions influencing the gas exchange would normally be disqualified for occupational diving.
2. Contraindications to diving are:
 - acute respiratory illness
 - chronic lung disease which results in a reduction of exercise capacity
 - previous spontaneous pneumothorax
 - the presence of bullous lung disease
 - chronic obstructive airways disease
 - chest injury, particularly penetrating injury resulting in pleural adhesions or pulmonary scarring
3. Full size chest X-ray, both frontal (PA) and lateral projection should be taken before the primary medical examination. The frontal radiograph should include both the inspiratory and expiratory modes. Chest X-ray should be taken at subsequent examinations at the doctor's discretion if the diver has experienced illness or injury that may affect pulmonary function or structure.
4. Spirometry should be performed at the primary examination and each subsequent annual assessment. An adequate FEV₁ is important in relation to exercise capacity and as a measure of airflow obstruction. Reduction in FVC represents a risk factor for pulmonary barotrauma. Both FEV₁ and FVC should be greater than 80% of the predicted normal value for a person of the same race, gender, height and age. FEV₁/FVC should be greater than 75% at the first examination and greater than 70% at subsequent assessments. Divers not achieving these standards should be referred for specialist assessment unless the approved doctor is specially experienced in assessment of the results.
5. The examination should be performed according to relevant guidelines made by the European Respiratory Society³. The majority of modern spirometers, including those made for mobile use,

² Calculated as W/h^2 where W: Weight in kg, h: height in m.

³ Current revision published in Eur Resp J 1993, 6, Suppl. 16.

comply to the set quality standards. Still, the doctor must have a satisfactory system for calibration of the spirometer. The normal values of the ERS guidelines are recommended.

Asthma

1. Asthma is normally a contraindication to diving. Asthma causing impaired work capacity is a definite contraindication to diving. A requirement for regular bronchodilator medication is a contraindication to diving also. However, individuals with mild asthma (where lung function remains normal for most of the time and there are no attacks provoked by cold, exercise or airway irritants, like smoke or air pollutants) may be assessed as medically fit to dive. The diver should have a normal lung function and capacity to perform a standardised exercise test without reduction of capacity or signs of bronchoconstriction. A diver with mild asthma may be considered fit to dive even if his condition requires regular prophylactic medication (e.g. corticosteroid inhalants, but not bronchodilators) in order to control the symptoms.
 2. A previous history of childhood asthma is not a contraindication provided that there has been a reasonable interval (several years) since the last symptoms.
 3. Individuals with asthma require careful assessment. This should include a standardised exercise test including dynamic spirometry before and after testing and chest x-ray. A bronchial provocation test (e.g. with cold, histamine, metacholine or hypertonic saline, etc.) and assessment by a specialist may be required. The criteria should be applied more strictly at the primary medical examination than to a fully trained diver who develops later onset of asthma.
 4. Persons assessed with a possible diagnosis of asthma are likely to be found either fully fit or unfit. It is unlikely that a certificate of fitness with a restriction on diving activity (as a depth restriction) would be appropriate.
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Cardiovascular system

1. The function of the cardiovascular system should be such that the diver is able to sustain strenuous muscle activity at depth (ref. "Exercise testing"). There must be no increased risk of loss of consciousness or incapacitation. Divers in good physical shape with an enlarged heart due to training are not considered pathological.
2. Any organic heart disease is a cause for rejection unless considered by a cardiologist to be haemodynamically unimportant. This includes all types of cardiomyopathies, ischaemic heart disease, haemodynamically important valvular disease, cyanotic heart disease and other shunts.

Ischaemic heart disease

3. Symptomatic ischaemic heart disease is incompatible with diving. The requirement for medication to control a cardiac condition is a contraindication.
4. At the primary examination prior to commencing diver training, individuals found to have present or previous ischaemic heart disease should be declared unfit. If such ischaemic disease is suspected or found at the annual assessment, full specialist evaluation, with exercise testing, would be required. Individuals who are free of symptoms following coronary bypass surgery remain unfit to dive, even if the surgery is considered technically successful. Thoracotomy is considered to increase the risk of pulmonary decompression barotrauma. Individuals who have had PTCA (percutaneous transluminal coronary angioplasty) might be considered fit provided the procedure has been demonstrated to produce revascularisation, they remain symptom free, have a normal cardiac stress exercise test and can meet the physical requirements. Such tests (and following approval) should be performed no earlier than 3 months post-surgery. The diver must also satisfy the ordinary physical requirements. If considered fit, individuals will require careful follow-up on a regular basis.

Dysrhythmias

5. Any dysrhythmia which might cause incapacity will disqualify. Disorders of cardiac rhythm, except for sinus arrhythmia and ventricular extrasystoles, require specialist evaluation and are likely to be a cause for rejection, particularly if found at the primary examination. For further explanation see text below (ECG).

Pacemaker

6. In most cases where a pacemaker is medically indicated, this very condition is likely to be a contradiction to diving. If the approved doctor considers the underlying condition not to be disqualifying, a careful assessment of type of diving and type of pacemaker used will be necessary. A second opinion given by a cardiological specialist will be required in such cases. Pacemakers with piezo-electric sensors have proved to be sensitive to changes in surrounding pressure and are therefore not compatible with diving. Some pacemakers may also be deformed by changes in

pressure. As a rule, it is therefore medically inadvisable to dive with a pacemaker or any implantable defibrillator.

Patent foramen ovale

7. Examination for the presence of an intracardiac shunt is not a requirement, neither at the primary examination nor at annual assessments in otherwise asymptomatic divers. However, an examination for possible patent foramen ovale can be justified in a diver who has suffered neurological decompression illness, particularly where the provoking dive was performed according to accepted diving tables. If, during such an examination PFO is found in a diver, he/she should be informed that the condition might predispose for increased risk of neurological decompression illness, after otherwise uncomplicated and correctly performed dives. A declaration for unfitness for diving should not be issued in such cases.

Valvular heart disease

8. Auscultation of the heart should be normal. Murmurs are acceptable only if deemed to be physiological. When in doubt, referral for specialist opinion or further investigation such as echocardiography should be considered.
9. Atrial or ventricular septal defects, symptomatic aortic or mitral stenosis are contraindications to diving. Coarctation is also a contraindication. Other valvular conditions, including bicuspid aortic valve or mitral valve prolapse would require specialist cardiac evaluation. Cardiac function in terms of exercise capacity should be normal.

Blood pressure

10. At the primary examination the resting blood pressure should not exceed 160/90, (performed after the patient has been resting supine for 5 minutes). The possible impact of a rise in blood pressure during a diver's prospective career should be considered. At subsequent annual assessments, mild hypertension would not be a contraindication provided that either no medication is required or that the medication taken has no implications on diving safety and there is no evidence of any organ damage (nephropathy, retinopathy etc.).

ECG

11. At the primary examination a 12-lead standard resting ECG should be performed. Any abnormality should be discussed with a cardiologist. At subsequent annual medical assessments an ECG is only required for divers aged under 40 if there is a clinical indication, such as objective signs of cardiac disease or the presence of high-risk factors for ischaemic heart disease. After the age of 40 an ECG should be performed on a 5-yearly basis. Pathological changes in the ECG will require further specialist evaluation.
12. At the primary examination an ECG should be performed immediately after the exercise test, in order to detect possible frequency- or exercise dependant arrhythmia. The approved doctor should pay special attention to arrhythmias at the end of the exercise test. This may be adequately assessed using one lead only. It is adequate that this examination is performed with one lead. With divers

with risk factors for ischaemic heart disease a standard 12 channel ECG should be performed during and after exercise test, and also at the annual medical examinations.

Exercise testing

1. Diving is a strenuous activity. A commercial diver must be physically capable of taking care of himself and any co-divers in case of unforeseen incidents involving, for instance, prolonged strenuous swimming, need for great arm strength etc.
2. An assessment of the candidate's exercise capacity must be carried out at the primary examination according to standard methods. The diver must be adequately fit to take care of his own and other's safety in an emergency situation. One of the following methods (minimum requirement in square brackets) should be followed:
 - Direct measurement of Max VO₂ on ergometer bicycle or treadmill [>45 ml/min/kg (<30 years), >40 ml/min/kg (>30 years)] (Åstrand and Rodal 1986)
 - Indirect measurement of Max VO₂ with an ergometer bicycle or treadmill [requirements as above] (Åstrand and Rodal 1986)
 - Rockport mile test (Kline et al 1987)
 - Harvard Physical Fitness test [>80] (DeVries and Klafs 1965)
 - RAFT [<190] (HSE 1987)⁴
 - 5000 m running : [$<22'45''$]
 - 20 km cycling [$<48'$]
 - 10 km walking [$<72'$]
 - Cycling on an ergometer bicycle, 20 km, 100W [$<48'$]
 - 400 m swimming [$<10'$]
 - 1000 m swimming [$<30'$]
3. Tests in pt. 2 above are listed in recommended order. Swimming is, to a greater extent than the other activities, dependent on technique and should, if possible, be avoided as the only means of fitness assessment.
4. At subsequent annual examinations the doctor should make sure that the diver is adequately fit. The test is preferably performed with a standardised exercise test (see above), but such an examination is not necessary if the doctor, based on his/her knowledge of the diver, considers the diver to be adequately fit.
5. The recommended examination method is a direct measurement of oxygen uptake during an exercise test on treadmill or ergometer bicycle. The result of the test should be considered together with other aspects such as blood pressure, obesity and lung function. Measurements of peak expiratory flow rate (PEF) before, 5 and 10 minutes after the exercise test (other than swimming) provide a useful screening for exercise induced wheeze.

⁴ Royal Army Fitness Test (RAFT): The candidate steps up and down on a 43 cm high footstool for 5 min, 30 times a minute. The pulse is measured 30 seconds, 1, 2 and 3 minutes after the exercise has ended. The sum of these 30-second pulse counts should be less than 190.

Peripheral circulation and microcirculation

1. The peripheral circulation should be capable of providing adequate peripheral perfusion even in cold conditions. Clinical evidence of impaired circulation will require further evaluation. Peripheral vascular disease may predispose to cold injury. Contraindications are:
 - varicose veins associated with circulatory impairment (for example, varicose eczema)

Central nervous system

1. Assessment of the central nervous system is one of the most important aspects of the medical history as well as the clinical examination.
2. The central nervous system should be clinically and functionally normal. The neurological examination should be detailed and include the cranial nerves, motor and sensory system as well as balance, co-ordination and gait.
3. Assessment of central nervous function includes physical as well as 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 doubt exists, specialist clinical psychological assessment might be required.
4. Predisposition to impairment of consciousness, convulsions, disturbances of speech, vision or motor control or disturbances of orientation and balance are incompatible with diving. Conditions that may mimic decompression illness or jeopardise safety must be sought out and excluded. The baseline and variation from normal must be carefully recorded at the preliminary medical examination. In particular, a history of visual, hearing, balance, co-ordination, sensory, bladder, bowel or sexual dysfunction should be sought out.

Contraindications to diving are:

- claustrophobia, severe motion sickness (incl. seasickness), migraine, particularly with visual, motor or sensory disturbance, and excessive daytime somnolence
 - previous intracranial surgery
 - any unprovoked loss of consciousness, recurring episodes of fainting or epilepsy, other than febrile convulsions occurring up to the age of five years.
5. There are inherent dangers in diving if there has been significant brain damage or there is a risk of post-traumatic epilepsy. After head injury, a history of depressed skull fracture or intracranial haematoma, unconsciousness or posttraumatic amnesia greater than 30 minutes or focal neurological signs are reasons for rejection. Neuropsychological assessment may be required. Minor head injuries (less than 30 minutes of unconsciousness or PTA) are a reason to declare temporary unfitness for a period of 4 weeks subject to review by an approved doctor.

Musculo-skeletal system

1. The diver must have unimpeded mobility and dexterity and must be of sufficient physical strength and agility to meet the demands of the proposed work. In particular, all joints should have a normal range of functional mobility.

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

Ears

1. The diver must be able to equalise pressure in both ears. Visual confirmation of eustachian function should be obtained. Obstruction of the ear canal should be assessed by a specialist with knowledge of diving. In the case of infection in the ear canal or middle ear the diver should be temporarily disqualified to dive. There should be no increased susceptibility to infection. The tympanic membrane should be intact and vestibular function normal, as demonstrated by a Romberg's test or a better method. Menière's disease is a contraindication to diving.
2. Hearing should be of a level which permits normal understanding of speech and speech communication. Pure tone audiometry covering the range of 250, 500, 1000, 2000, 3000, 4000 and 6000 Hz in each ear in a room shielded from noise is required at the primary examination. The candidate should normally not be accepted for training (basic or advanced training) if the hearing loss of better ear >35 dB for the frequency range <3000 Hz or >50 dB $=3000$ Hz (better ear). The approved doctor can make an exception after having obtained a second opinion from an ENT specialist. An exception is appropriate when it is evident that it is a stable condition where diving is not expected to have any influence on the development of the illness and where further loss of hearing is not expected. An audiogram should be carried out at the annual examination, but it may be considered adequate if the diver perceives speech at a distance of 1 metre.

Vision

1. Visual acuity, with or without correction, and colour vision must be adequate for the type of diving activity; for example, requirement to read instrumentation such as on a watch, depth gauge or tables. Colour vision is important for specific inspection tasks.
2. The visual acuity should be examined using the Snellen chart at 5 m distance or longer, or by any better method. The chart must be adequately lit; each eye should be examined separately with and without best correction. Colour vision should be examined at the start of the diving career with an accepted method⁵. The field of vision should be examined using Donder's test or a better method.
3. At the start of the diving career and when attending advanced training (for higher certification status) the corrected vision on the best eye should be 5/10 or better. At later annual assessments there are no formal requirements as to visual acuity except the general requirement that vision should be adequate for the underwater tasks carried out. There is no requirement regarding normal colour vision for a candidate starting at a commercial diving school, but colour blindness should be recorded in the diver's log. When starting at a commercial diving school or at later qualifying training, the field of vision should be normal. An exception may be made in individual cases if there are minor scotomas without any practical consequence for vision and where there is no underlying disease with a risk of recurrence or deterioration.
4. Divers requiring optical correction can use a prescription faceplate if using an oro-nasal mask. Soft gas permeable contact lenses have been used satisfactorily. Hard impermeable lenses are unsuitable.

⁵ Usually Ischiara, Bostrøm-Kugelberg or Hertel-Stelling

unless fenestrated. There is a risk of infection with all contact lenses and it may be difficult to maintain sterility in a saturation environment. The use of disposable lenses may reduce this risk.

5. The risks associated with diving after ophthalmic surgery require careful evaluation and individual assessment in conjunction with the surgeon. Certain procedures involve the instillation of gas into the globe, and radial keratotomy may adversely affect the ability of the cornea to tolerate trauma or pressure change. Excimer laser photorefractive keratectomy (PRK) is generally well tolerated, and does not represent a contraindication for diving.

Dental status

1. Divers are required to have a high standard of dental health, and a well preserved set of teeth. The bite must be such that a mouthpiece can be used without difficulty. At the clinical and radiological examinations particular emphasis must be put on dental conditions which may cause special problems under pressure. Dental barotrauma is usually caused by already existing cavities, problems or illness in teeth and supporting tissue. Examples of this may be loose/fractured fillings or teeth, caries (primary or secondary), as well as periapical changes around root canals or teeth with pulpa changes. Unattached dentures should be removed before diving.
2. Divers should undergo dental check-ups at a regular basis and the dentist should be aware that the individual is a diver. Where doubt exists a dentist with special experience with diving related dental problems/conditions should be consulted (e.g. through the Section for Hyperbaric Medicine at Haukeland Hospital in Bergen).

Endocrine system

1. Diving causes numerous neurological reflexes and hormonal responses. It is unlikely that individuals suffering from endocrine conditions leading to impaired thermo-regulation, cardiac or muscular insufficiency would be found fit. A suspected abnormality must be assessed by a specialist.
2. Glycosuria should be investigated. Type I diabetes mellitus is treated with insulin and would be a contraindication to diving due to the risk of hypoglycaemia. Type II diabetes treated with oral hypoglycaemic medication may cause hypoglycaemia. A diver with type II diabetes treated with diet alone may be able to dive if the blood glucose level is satisfactory controlled. Prior to diving blood glucose should be >5 mmol/l and prolonged fasting must be avoided before diving. Candidates with diabetes requiring medication should not dive. Second opinion should be obtained from a specialist before any conclusion is made. Generally, the approved doctor should be restrictive when assessing diabetes in candidates applying for enrolment at a diving school. At later assessments the approved doctor should consider the extent and type of diving, as well as assess whether diving may be continued with restrictions imposed.
3. Patients with thyroid diseases should not dive when in a thyrotoxic phase. Patients with a pituitary or adrenal gland disorder should not dive without satisfactory substitution therapy and only after a sufficient period of observation.

Genito-urinary system

1. A history of renal disease or urinary tract investigation will constitute reasons for more detailed assessment. Venereal disease will disqualify from diving until adequately treated. The presence of genito-urinary disease or renal tract disease associated with abnormal renal function is usually a cause for rejection. Cases of renal stones or colic should be judged on an individual basis after specialist investigation.
2. Urine analysis using dipstick or any better method should be undertaken routinely at first examination and then annually. As a minimum the urine should be analysed for blood, protein and glucose.

Gastro-intestinal system

1. Gastro-intestinal function should be normal with no increased tendency of vomiting, dyspepsia, reflux, bleeding, perforation, diarrhoea or pain. Hepatic and pancreatic function should be clinically normal. 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 will require investigation.
2. A previous history of peptic ulceration requires careful assessment. Objective evidence of ulcer healing (gastroscopy) and resolution of symptoms are necessary before fitness to dive can be considered. The requirement for regular continued H2-blocker therapy for the control of peptic ulceration is not acceptable. The risk of recurrence after the completion of a course of triple therapy is sufficiently low to permit a diver to return to diving if treatment is considered successful.
3. The presence of a stoma is likely to be compatible with limited types of diving activity of short duration only.

Skin

1. The integument should be functionally intact and without increased susceptibility to infection.
2. Any condition that may affect the skin's thermal control is a contra-indication. Prolonged periods in water and exposure to high humidity, especially in saturation environments, increase the risk of disabling skin infection and exacerbate a number of pre-existing dermatoses. Generalised chronic skin diseases such as extensive atopic eczema; generalised severe psoriasis, chronic urticaria, recurrence of cutaneous infections and other extensive dermatoses increasing the risk of infection represent contraindications to diving. Acute infections may be causes for temporary unfitness until cured.

Radiology

1. See also RESPIRATORY SYSTEM
2. Long-bone x-rays are required for divers starting training for these certificates:
 - Class II (bell diver)
 - Class III (hard hat diver)

3. Later skeletal X-ray examinations should be based on clinical assessment. It should be noted that the risk of aseptic bone necrosis is expected to increase when diving deeper (>30 m) and after having suffered from decompression illness.
4. Aseptic bone necrosis is a well documented though rarely occurring consequence of diving. The injuries are usually located in the shaft of the long bones. Juxta-articular lesions causing pain, stiffness or other symptoms should normally give cause for declaration of unfitness to dive. If asymptomatic shaft lesions are found, the diver should be informed of the extent of the damage. Shaft lesions normally will not have any influence on the diver's safety and should only affect the health certificate in exceptional cases.

Laboratory tests/haematology

1. Any disorder leading to significantly impaired ability to transport oxygen is likely to be a contraindication to diving. Abnormal results should be referred for specialist opinion.
2. If the diver's ethnic origin so dictates, the approved doctor should perform haemoglobin electrophoresis and examination with regard to sickle cell disease. Manifest sickle cell disease and thalassaemias are contraindications to diving. Heterozygote carriers of the sickle cell trait or heterozygote individuals with thalassaemia trait are at no extra risk when diving.
3. Haemoglobin concentration and sedimentation rate should be checked during the primary medical examination and at later annual examinations. Anaemia or elevated sedimentation rate should be further investigated. Such individuals should not be given a declaration of fitness to dive at the primary examination until the cause of abnormal values is found. A full blood count should be taken at subsequent annual examinations as well.

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