

Guidance for appointed doctors on the Work in Compressed Air Regulations 1996

Medical surveillance of workers undertaking work in compressed air

Introduction

1 This document provides guidance for appointed doctors on conducting medical surveillance of employees working in compressed air, for the purposes of the Work in Compressed Air Regulations 1996.¹

2 It replaces the previous version published in July 2012, following a review by the Health and Safety Executive (HSE). Appointed doctors should be familiar with further guidance on working in compressed air produced by HSE² and the British Tunnelling Society.³ They should also be familiar with HSE's appointed doctor website.⁴

Background

3 The Work in Compressed Air Regulations 1996 (WCA) provide a framework for the management of health and safety risks by those in charge of tunnelling and other construction work in compressed air. To help minimise risks to health, regulation 10(1) requires employers to make sure all employees working in compressed air are under adequate medical surveillance by an appointed doctor.

4 Regulation 16(3) requires a person engaged in compressed-air work to report any medical or physical condition they believe is likely to make them unfit or unsuitable for such work to the compressed-air contractor and, in the case of an employee, to the employer.

5 The key health effects associated with work in compressed air are:

- barotrauma – a change in the surrounding pressure causes damage to air-containing cavities in the body which are directly connected with the surrounding atmosphere, principally the ears, sinuses and lungs;
- decompression illness – predominantly a condition involving pain around the joints, or more rarely a serious, potentially life-threatening condition which may affect the central nervous system, heart or lungs; and
- dysbaric osteonecrosis – a long-term, chronic condition which damages the long bones, hips or shoulder joints.

Using this guidance

6 Compressed-air workers should be medically and physically fit to do their work. The medical examination should enable appointed doctors to identify those medical conditions that might exclude an individual from working in compressed air (either permanently or temporarily) or require further specialist assessment.

7 HSE's document, *The medical examination and assessment of commercial divers (MA1)*,⁵ provides further information on specific medical conditions and their relevance to fitness to dive, and should be read in conjunction with this guidance. Both commercial divers and compressed-air workers are exposed to hyperbaric environments, although there are differences in the nature of their work and working conditions.

8 If there is doubt about a person's fitness to do compressed-air work, appointed doctors should seek specialist advice where appropriate and adopt a risk-based approach in each case. The risk assessment should consider:

- any specialist advice received;
- relevant history and examination findings;
- test results; and
- the nature of the work and working conditions.

9 Doing a risk assessment supported by the guidelines in this document allows appointed doctors to use discretion in making a justifiable and informed judgement on fitness to work in compressed air.

Role of the appointed doctor

10 As an appointed doctor, you must be competent in occupational medicine and have specialist knowledge of hyperbaric medicine. For the former, the minimum requirement is a Diploma in Occupational Medicine. Given the complexities of the tunnelling environment and compressed-air work, specific experience of the construction industry would be beneficial.

11 Knowledge of hyperbaric medicine can be gained from courses in diving medicine. In this context, you should have the same level of training as an HSE Approved Medical Examiner of Divers (AMED), which includes a requirement for refresher training at least once every five years.⁶

12 Your role as an appointed doctor is to:

- examine all those proposed for work in compressed air and certify medical fitness before each worker is initially exposed to increased pressure;
- assess and certify continuing fitness of all workers at a suitable frequency;
- maintain accurate and comprehensive clinical records;
- provide workers with information on the health effects associated with work in compressed air; and
- submit statistical returns on request.

13 Employers normally seek to have the contract medical adviser appointed under WCA to undertake medical surveillance. This may help with continuity between conducting surveillance and providing treatment. If the appointed doctor also acts as the contract medical adviser, and may therefore personally supervise hyperbaric treatments, they must be medically fit to enter the hyperbaric chamber if required.

Medical surveillance

14 The objective of medical examinations is to ensure, as far as possible, that an employee is fit to work in compressed air. They can also be an opportunity to make sure workers are aware of the health effects associated with work in compressed air and highlight the risks that underlying medical disorders may present.

15 All those working in compressed air should also be fit for construction site and tunnel work. In particular, they should be able to evacuate quickly to an area of safety in case of an emergency, such as fire or face instability.

16 Adequate medical surveillance includes a pre-exposure medical examination followed by a full medical examination at least once every 12-month period an individual works in compressed air.

17 Medical surveillance is not adequate unless further assessments are also made:

- at a frequency related to the working pressure (see paragraphs 21–25);
- following any significant illness or incapacity causing an inability to work; and
- following any episode of ill health related to work in compressed air.

Pre-exposure and annual medical examinations

18 The content of medical examinations is detailed in paragraphs 26–66. Their complexity means it is impractical for one doctor to examine large numbers of workers at short notice. You should have access to all the information required to fully assess an individual's fitness to work in compressed air. Do not base decisions on inadequate or incomplete information, no matter how urgent the apparent need. Medical examinations should be arranged well before work begins. Employers should not assume that any individual, including those with professional involvement in the contract, will be found fit for this type of work.

19 Where the findings of an earlier medical examination by another appointed doctor are available, the current appointed doctor can use discretion to decide whether to accept those findings as proof of fitness. In making a decision, they should consider the time since the medical examination and whether the findings are complete. If necessary, they should conduct another examination. Appointed doctors should cooperate to make results of previous medical surveillance available to minimise unnecessary examinations. Where possible, records should be held on-site to facilitate this.

20 Appointed doctors should be aware that on any contract some staff may be recruited several months in advance, building up a reserve of fit workers. Health changes in the intervening months may be significant.

Assessment of continuing fitness for work

21 A thorough annual medical examination and reporting of minor illnesses that may affect fitness for work will help minimise the risk of hyperbaric illnesses as a result of underlying medical conditions. However, you should monitor continuing fitness of individuals for work in compressed air during the course of a contract.

22 Monitoring should comprise a review of the individual's health based on sickness absence records, compressed-air work history and any reported discomfort or ill health arising from exposure to compressed air. The review should take place at the compressed-air site, where detailed records of exposure are available and where information can be obtained from lock attendants, those in charge and individual workers. The review may include examination of the ears, nose and throat or other systems, at the discretion of the appointed doctor.

23 Appropriate intervals for assessing continuing fitness for work in compressed air are:

- once every three months for work taking place at pressures up to but not including 1.0 bar;
- monthly when pressures are 1.0 bar or over;
- more frequently, at the discretion of the appointed doctor, when work involves arduous physical activity or mixed gas applications.

24 Any employee whose continuing fitness for work in compressed air is in doubt should be examined. Return to work following decompression illness requires careful consideration. The relationship between a patent foramen ovale and other right-to-left shunts, and neurological, vestibular, cutaneous and cardiorespiratory decompression illness, is now well established. Therefore, any worker who has suffered these should be assessed by a cardiologist with a special interest in hyperbaric/diving medicine.

25 This is particularly important where the profile of compressed-air exposure was not obviously contributory, since it may influence an assessment of the overall risk to the individual of continuing to work in a hyperbaric environment. Consultation with the cardiologist and, if necessary, the treating physician, will assist in making decisions about fitness to work and the timing of return to compressed-air work.

Medical examinations

26 The first examination for an individual about to work in compressed air on any contract and the annual full examination should include:

- a health questionnaire;
- a full clinical examination;
- pure tone audiometry;
- spirometry; and
- an exercise test.

Questionnaire and interview

27 You should check all points of the questionnaire used as some workers may not fully understand the importance of certain injuries and accidents. Assess the amount of previous exposure to pressure and any previous health effects due to working in a hyperbaric environment.

28 A number of individuals who genuinely fear work in compressed air may appear for examination. You should identify where this is the case and assess whether they are psychologically suited to work in compressed air. If you are satisfied an individual is not psychologically suited to this work, you should certify them as unfit.

Gender

29 Generally, the same fitness criteria apply to both male and female workers. However, due to the possible harmful effects that exposure to increased pressure may have on a foetus, a worker who is pregnant or suspects she might be pregnant should not work in compressed air.

30 As appropriate, you should talk to female workers about the potential risk to a foetus from the effects of working in a hyperbaric environment and explain the need to declare a pregnancy early.

Age

31 There are no age limits for workers. They must meet the medical requirements for carrying out work in compressed air, irrespective of age. They must also retain the physical and functional capacity to do their work, even if this is offset by greater experience.

Obesity

32 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 safety, for example, reduced capacity to access and carry out work in confined spaces. You should measure and record the worker's height, weight and waist circumference, and calculate body mass index (BMI in kg/m²).⁷

33 High BMI 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. Where this is relevant, you can use discretion in determining fitness to work in compressed air. Waist circumference is a simpler measure and better predictor of body fat and future health risk.

34 BMI and waist circumference measurements should be considered along with examination findings and the result of exercise testing in determining fitness for work in compressed air. Workers with a BMI of ≥ 35 kg/m² and/or a waist circumference of >102 cm (males) or >88 cm (females), are unlikely to be fit for work in compressed air. You should provide dietary and fitness advice to such individuals and consider referring them to their GP.

Ear, nose and throat

35 All workers should have a pure tone audiogram.⁸ Noise-induced hearing loss is common in compressed-air workers and, if severe, may lead to communication difficulties. In such cases, an individual risk assessment of their ability to communicate should be performed.

36 Hearing loss typical of auditory barotrauma is less frequently seen but can be recognised in the 6-8 kHz range, usually as unilateral losses of 25 dB upwards.

37 Individuals exposed to compressed air must be able to clear their ears and should be free from relevant ear disease.

38 The external auditory meatuses should be clean and free of excessive wax and infection. A small amount of wax may be left in situ. The middle ear should be free of effusion and infection. Scarred tympanic membranes are acceptable providing they are intact and Eustachian tube function is normal. A dry perforation of the ear drum should not disbar an individual from working in compressed air. Previous difficulty with flying, sport or professional diving, or tunnel work, suggests caution is necessary in the compression test.

39 The nasal airways should be clear and free of infection and the sinuses free of disease. Any acute illness should be treated and chronic illness carefully assessed. Nasal obstruction caused by a deviated nasal septum or nasal polyps is amenable to medical or surgical treatment. After successful treatment, the individual can work in compressed air.

Respiratory system

40 The respiratory system should be clinically and functionally normal.

41 The individual should perform spirometry at rest and you should record PEF, FEV₁ and FVC. You should also consult a respiratory physician with a special interest in hyperbaric/diving medicine for any individual 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 individual:

- 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.

42 The respiratory response to the exercise test should also be recorded (see paragraphs 62–64). Measure 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 hyperbaric/diving medicine.

43 Routine chest radiography is not required. A chest X-ray should only be performed if justified on individual clinical grounds, taking into account medical history and examination findings.

44 Where there is doubt about respiratory fitness to work in compressed air, seek the opinion of a respiratory physician with a special interest in hyperbaric/diving medicine.

Cardiovascular system

45 The cardiovascular system should be clinically and functionally 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 hyperbaric/diving medicine. The peripheral circulation should be normal.

46 Resting blood pressure should be measured. 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 has no implications for safety; and
- there is no evidence of end organ damage.

47 An ECG should be recorded if clinically indicated. Where a clinical need is established, the ECG should be conducted before exercise testing.

Nervous system

48 You should conduct a full clinical neurological assessment and assess the individual's mental state.

49 The cranial nerves should be intact. All motor functions should be normal but stable abnormalities which do not interfere with safety may be acceptable. There should be no abnormality of coordination or balance.

50 A history of spinal or cerebral decompression illness may disbar the individual from working in compressed air. Look for and exclude conditions that may mimic decompression illness or jeopardise safety. You should give careful consideration to the safety of any worker using psychotropic medication.

Musculoskeletal system

51 Old injuries and arthritic changes should be carefully assessed for their effects on safety and liability to cause pain which could be confused with decompression illness.

52 You should examine the back and obtain any history of back injury. Back surgery requires careful assessment. Severe, persistent pain or evidence of a prolapsed intervertebral disc should disbar the individual from compressed-air work, the latter at least temporarily.

53 Routine, long-bone X-rays are not required for surveillance of compressed-air workers. Long-bone radiography and/or MRI is indicated in cases of suspected dysbaric osteonecrosis.

Vision

54 Corrected distance vision should be 6/12 or better using both eyes. Near vision should be sufficient to perform the tasks required. Colour vision requires checking if it is relevant to the work.

Dental health

55 The mouth, tonsillar fauces and gums should be healthy. There should be no obvious dental cavities where air can get trapped. Full dentures are permitted.

Endocrine system

56 The detection of glycosuria requires investigation. You should refer any compressed-air worker with diabetes mellitus, whether insulin, tablet or diet controlled, to a medical specialist with a special interest in diabetes and hyperbaric/diving medicine, for detailed individual assessment.

57 When assessing fitness in an individual with diabetes, consider the nature of the work and working conditions, the degree of control achieved by treatment, and the safety of the individual and others. Regular (at least annual) specialist review by their endocrinologist is required and the individual should be well motivated and educated in relation to their diabetes care.

58 Active thyroid disease is a contraindication.

Gastrointestinal system and urinalysis

59 The abdomen should be normal to palpation. There should be no herniae.

60 Medical examinations should include dipstick urinalysis. Abnormal results require investigation.

Haematology

61 There is no requirement for a full blood count or sickle cell test unless clinically indicated.

Exercise testing

62 At initial and annual medical examinations, you should perform an exercise test to assess cardiorespiratory fitness. Before proceeding to the exercise test, you should conduct an assessment of the risk and suitability of undertaking the test. Those conducting exercise testing should have up-to-date training in basic life-support and resuscitation skills following the standards of the Resuscitation Council (UK).⁹ Further information on exercise testing and risk assessment is available in HSE's *The medical examination and assessment of commercial divers (MA1)*.⁵

63 You should conduct a Chester Step Test (CST) to estimate maximal oxygen uptake (VO_2 max). This is a measure of aerobic capacity and cardiorespiratory fitness. To interpret the result of the exercise test, you should conduct a risk assessment. This should include the overall findings of the medical examination in relation to the work undertaken and fitness required to evacuate quickly in case of an emergency and/or to rescue a colleague. Therefore, it is important that you have a clear understanding of the range of roles and duties that individual compressed-air workers may undertake and their working environment.

64 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 42).

Application of findings

65 You must decide whether the individual you have examined is fit to work in compressed air, fit to work with restrictions (eg on the pressure or duration of exposure) or unfit to work (either permanently or temporarily). You should consider any specialist advice obtained, relevant history and examination findings, test results and general physical fitness in relation to the work to be undertaken. The result of the assessment must be recorded in the statutory health record and in the individual's health and exposure record.

66 Casual visitors to compressed-air workings should be discouraged. Medical standards should not be lowered for 'VIPs' who wish to visit workings, including those with professional involvement in the contract.

Records

Health record

67 The results of medical surveillance are recorded in a health record maintained by the employer for each worker. It contains personal details of the worker and space to record the date, type and result of each medical assessment. The health record should contain information on the items listed in the first four bullet points in paragraph 74.

68 The health record is the employer's statutory record (regulation 10(3) of WCA) of the results of medical surveillance and they must keep it for at least 40 years from the date of the last entry made in it.

69 Work restrictions that may be specified in the health record include:

- maximum pressure to which a worker should be exposed;
- maximum duration of exposure per shift;
- number of entries to be made per day; or
- date of the next assessment.

70 Employers should ensure that any restriction is brought to the attention of the compressed-air contractor so they can notify lock attendants. Any list of those fit to enter compressed air should be clearly marked to indicate that a restriction applies to the worker concerned, and a note of the nature of the restriction retained.

71 Individual employees should be given a personal health and exposure record (see paragraphs 73–76) that summarises the results of medical surveillance, hyperbaric exposure and training. The health section in the individual health and exposure record duplicates the employer's health record.

Clinical records

72 You should maintain accurate and comprehensive clinical records.

Compressed-air worker's health and exposure record¹⁰

73 Employees have a personal responsibility to safeguard their health and exposure record and to present it to their employer so it can be updated and checks made before entering compressed air. All lists of personnel fit to enter the workings should be kept up to date.

74 The health and exposure record should contain the following information:

- personal details of the employee – name, national insurance number, date of birth, address (permanent);
- details of the employer – name, address, contracts at which the employee is exposed to compressed air;
- details of the appointed doctor – name, address, phone number, name and address of contract medical adviser (if different);
- details of medical surveillance – date, type and result of each assessment, including any restriction imposed on the exposure of the employee;
- details of exposure – date, shift, maximum working pressure, working period for each exposure; and
- details of training – date of the instruction and training required by regulation 15 of WCA.

75 The compressed-air contractor should retain the health and exposure record until work in compressed air is completed or the individual leaves employment. During that time, it should be readily available to the worker named on it or their employer.

76 At the end of the contract or when workers leave employment, their compressed-air worker's health and exposure record must be returned to them, updated to include:

- name and details of the appointed doctor;
- details of all medical surveillance; and
- details of exposures, decompressions and any decompression illness.

References

- 1 *The Work in Compressed Air Regulations 1996* SI 1996/1656
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- 3 *A guide to the Work in Compressed Air Regulations 1996*
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- 5 *The medical examination and assessment of commercial divers (MA1)*
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