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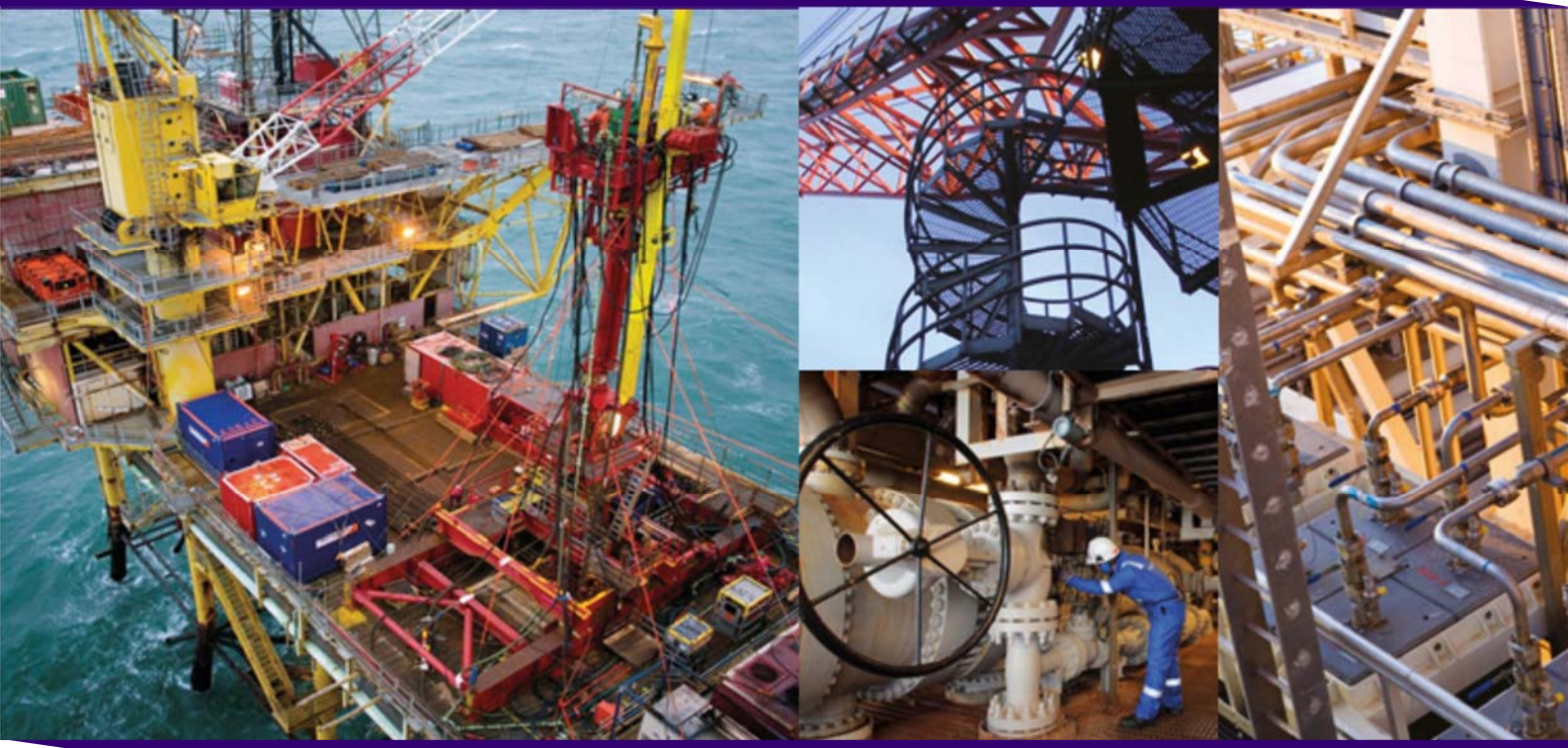

Medical Aspects of Fitness for Offshore Work: Guidance for Examining Physicians

Section 4: Fitness to undertake in-water EBS training exercises

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Foreword

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Contents

List of Abbreviations

Abbreviations	Definitions
BTS	British Thoracic Society
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAPP	Canadian Association of Petroleum Producers
COPD	Chronic Obstructive Pulmonary Disease
EBS	Emergency Breathing System
ENT	Ears, Nose and Throat
FEV1	Forced Expiratory Volume in 1 second
FVC	Forced Vital Capacity
HUET	Helicopter Underwater Escape Trainer
HSE	Health and Safety Executive
NICE	National Institute of Clinical Effectiveness
PSTASS	Passenger Short Term Air Supply System
SCUBA	Self Contained Underwater Breathing Apparatus
SIGN	Scottish Intercollegiate Guideline Network

1 Introduction

The implementation of in-water training exercises with compressed-air emergency breathing apparatus (EBS) for survival course trainees also requires the implementation of a medical assessment of trainees' medical fitness to participate in such training.

Breathing compressed air underwater involves the hazard of barotrauma, but for healthy survival course trainees the risk of this occurring in the circumstances of training is assessed to be very low. A description of the nature of the training exercises and the physics of gas expansion at the shallow depths involved in the training is at paragraph 12.2 of these guidelines.

2 Medical Assessment

2.1 Objective of medical assessment

The objective of the fitness for in-water EBS training is to:

a) ensure trainees have understood the nature of the hazard of barotrauma, that some medical conditions may increase the risk, and the importance of providing an accurate medical history in order to individually assess risk

b) classify trainees as either 'fit' or 'unfit' for in-water EBS training as simply as possible

c) ensure all trainees have received explanation of risk mitigation measures in general, and that trainees with medical conditions have received personalised risk mitigation advice relevant to their condition.

d) provide documentary confirmation of fitness status, for employers and training providers

2.2 Method of assessment

The examinee should complete sections 1 and 2 of the questionnaire (paragraph 8), and any positive answers clarified. At this stage it will be appropriate to discuss the hazard and risk of barotrauma, and ensure the examinee has had sufficient opportunity to provide an accurate medical history. For examinees without any relevant medical history, it will then be possible to explain the risk mitigation measures inherent in the training itself, and then certify fitness to participate in training without need of further tests or physical examination.

For examinees with a history of relevant medical condition(s), physical examination of the respiratory and/or ENT systems, and/or performance of lung function tests where relevant, will be appropriate, unless a clear history of absolute contraindication to training is obtained (in which case the examining doctor may directly certify unfitness for training). The outcome of assessment, given the results of history, relevant examination and test results, will be determined by the guidance on specific conditions at paragraph 3 below.

Where examining doctors suspect a clinical diagnosis relevant to EBS in-water training despite lack of history, they should undertake clinical examination and/or lung function testing and/or other relevant tests as considered appropriate. In some cases this will be sufficient for examining doctors to sufficiently exclude the presence of the suspected diagnosis to be comfortable in certifying fitness to train; in others, the suspicion of a new clinical diagnosis will either be confirmed, or not confidently excluded. In these circumstances the examining doctor will wish to refer appropriately (according to local arrangements, insurance status of examinee etc.) to either confirm or clarify diagnosis, and to seek clinical information (as per paragraph 3) to enable them to subsequently conclude the assessment. Examinees may be issued confirmation of 'temporarily unfit – pending reports' status if necessary while this takes place.

Trainees with asthma or COPD but nevertheless found fit to train should be provided with the additional risk mitigation advice at paragraph 9.

The assessment process is summarised in the flowchart at paragraph 7.

3 Guidance on specific medical conditions

Asthma

Approximately 8% of examinees may be expected to give a history of current asthma, and a further 3% of resolved past asthma. A history of resolved childhood asthma may be disregarded for in-water EBS training. For examinees with current asthma, any history of symptoms in circumstances similar to those of survival pool training, such as during swimming or indeed during previous 'dry' EBS training should be sought.

The chest should be examined to confirm absence of wheeze where a history of good control is given. Lung function testing (FEV1) should be performed.

Examinees with asthma will be unfit for training if any one or more of the following are found:

a) recent (within past three months) severe exacerbation (e.g. hospital admission)

b) FEV1 less than 60% of predicted

c) Examinee is at 'high-dose therapies' or 'continuous or frequent use of oral steroids' steps of BTS/SIGN guideline 153, 2016 (Ref 1) (figure 2 on page 78, and table 9 on pages 70/71 are particularly relevant).

d) Wheeze is precipitated by exercise, cold or emotion of the nature/degree to be encountered in training, despite treatment.

Chronic Obstructive Pulmonary Disease (COPD)

COPD is likely to be uncommonly stated as a known diagnosis by examinees (approximately 1%) but may be more commonly suspected by examining doctors. NICE clinical guideline cg101 (23 June 2010) (Ref 2) provides a useful reference point for examining doctors wishing advice on assessment of a suspected new diagnosis. Of particular note is that the diagnosis should not be made on a single diagnostic test or criteria, but on a combination of history, examination and spirometry.

Examining doctors considering a strategy of performing 'routine' spirometry on all examinees in an effort to 'find undiagnosed cases' would in effect be screening for COPD, and should ensure that they are aware of the expected prevalence of COPD in the particular population they intend to test, the sensitivity and specificity of the cut-off values of spirometric variables they choose to consider indicative of COPD, and the positive predictive value and other screening test characteristics of the screening strategy they are considering.

Examinees with an established or 'confirmed after clinical suspicion' diagnosis of COPD should be considered fit for training if their FEV1 is 50% or greater of predicted, i.e. if they are no worse than 'stage 2, moderate' on the NICE 101 (2010) guideline. Examinees should be considered unfit if FEV1 is less than 50% of predicted, i.e. if they are at 'stage 3, severe' or worse on the NICE 101 guideline.

Spontaneous pneumothorax

A history of spontaneous pneumothorax is likely in less than 1% of examinees, but should be considered an **absolute contraindication** to in-water EBS training, unless treated by bilateral pleurectomy, in which case examining doctors should seek advice in the first instance from the treating clinician. Bilateral pleurectomy is a significant surgical procedure and is unlikely to be justified solely as a means to achieve eligibility for in-water EBS training.

Traumatic pneumothorax (including post-thoracotomy)

Examinees should be considered fit for training unless there are indications that there were lasting complications of surgery or injury, recovery has been abnormal or incomplete, and/or there is residual lung function impairment.

Sarcoidosis

Sarcoidosis is likely to be uncommon (less than 1%) in examinees. Unless the clinical manifestations include effects on other organ systems sufficient to lead to a finding of unfitness for offshore work, most cases are likely to be coincidental findings on chest x-rays for other purposes. Such cases should be considered fit for training if there is no requirement for clinical treatment. Examinees will be unfit for training if their sarcoidosis requires treatment (most likely with steroids).

Cystic fibrosis

Pulmonary cystic fibrosis is likely to be encountered in approximately 0.1% of examinees or fewer, and should be considered an **absolute contraindication** to EBS in-water training.

Pulmonary fibrosis

Pulmonary fibrosis is likely to be only rarely encountered among examinees, and may well render an examinee unfit for offshore work due to effects on exercise tolerance. Those with a diagnosis of pulmonary fibrosis and sufficient exercise tolerance to be generally fit for offshore work should be considered fit for training if FVC is 50% or greater of predicted, and unfit if FVC is less than 50% of predicted.

(Known) Lung bullae or cysts

Should be considered an **absolute contraindication** to in-water EBS training.

Pulmonary Tuberculosis

This is an unlikely diagnosis in the UK population of examinees, but those with a history of pulmonary TB will be fit for training once clinically recovered, with evidence of normal lung function and chest x-ray.

ENT conditions

The pressure changes at the depths of in-water EBS training are unlikely to cause any major clinical ENT effects. Trainees encountering difficulty in clearing their ears at the shallowest depth exercises should be identified before proceeding to 'deeper' exercises, and those with acute upper respiratory infections/conditions should be identified by training centre fitness-to-train enquiries 'on the day'.

Persons with a tracheostomy or incompetent larynx will be unable to participate in survival training pool exercises generally and should not be encountered in EBS training.

Persons with an acute perforated tympanic membrane will be unfit to train until it has healed/resolved. Those with a chronic perforated tympanic membrane will be unfit to train if they have been advised by their treating clinician to avoid water immersion and/or diving.

Those with a history of nasal obstruction, mastoid surgery, chronic ear disease, or chronic nasal/sinus conditions, Meniere's disease or other vertiginous condition, should be considered unfit to train if they have been advised by their treating clinician to avoid water immersion and/or diving.

Other miscellaneous conditions

This guidance cannot cover every possible medical circumstance that examining doctors may encounter. Rare, 'small print' conditions (such as non-immersion pulmonary oedema, related to vigorous physical activity, or some immersion-related disturbed physiological states) may exceptionally be encountered by examining doctors. Such cases will generally have been given advice to avoid diving, swimming, and/or immersion in water, and this advice would rule out participation in in-water EBS training. Similarly, some examinees may have no clinical contraindication to in-water training, but may find the very low risk of barotrauma psychologically intolerable – in such cases they should be certified unfit to train (on the basis of being 'psychologically unsuited').

Ref 1: SIGN 153. British guideline on management of asthma. September 2016

Ref 2: NICE clinical guideline cg101. Chronic obstructive pulmonary disease in over 16s: diagnosis and management. 23rd June 2010.

4 Certification

The certificate templates at paragraphs 10 (Fit to train) and 11 (Unfit to train) should be used, and the appropriate certificate issued following conclusion of the assessment.

5 Procedures for those ‘unfit to train’

It is understood that examinees found unfit for in-water EBS training (of which it is expected there will be very few) will likely be permitted to complete survival training by 'dry' EBS training exercises only. This implies that the occupational consequences of being found unfit to train should not be severe. It is not therefore thought necessary to establish an 'appeal' procedure for those unfit to train. However, examinees who contend unacceptably severe occupational consequences of being found unfit to train may contact Oil & Gas UK to request an 'exceptional circumstances' review of their case: this would involve seeking the opinion of a doctor specifically experienced in diving medicine (of which there are few in UK practice) and should not be expected to result in a change of fitness certification where a diagnosis and assessment findings in accordance with paragraph 3 of this guidance has been established. It is only likely to be relevant to unusual or 'small print' clinical presentations, and examining doctors should not in any circumstances routinely advise examinees found unfit to train to 'appeal' to Oil & Gas UK.

6 Statistics

Examining doctors should be prepared to submit statistics on number of assessments performed, outcomes, and reasons for any unfit to train outcomes. The data required will be:

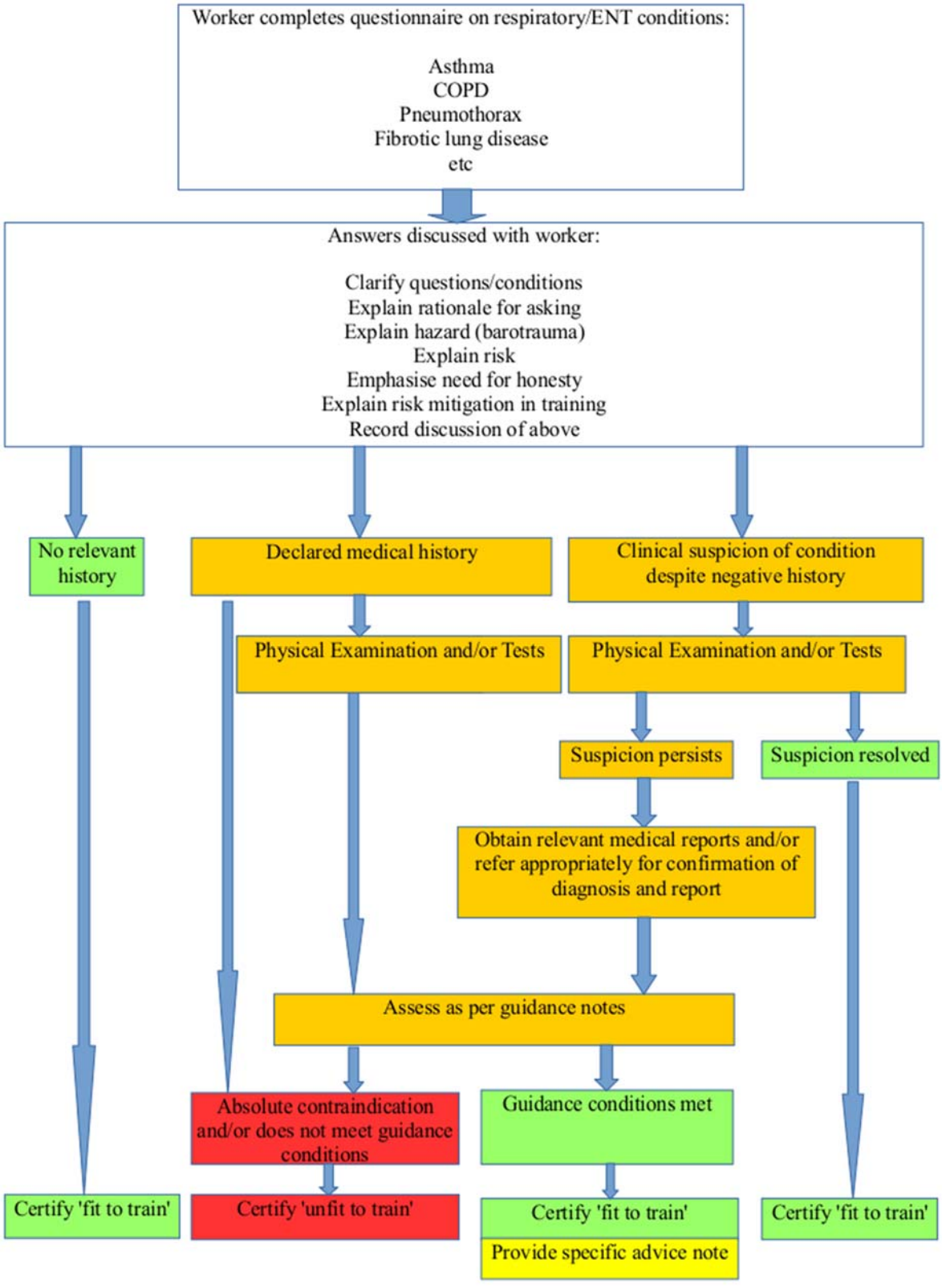
a) Total number of assessments
b) Number found 'fit to train' (by age group and gender)
c) Number found 'unfit to train' (by age group and gender)
d) Number found 'temporarily unfit while pending further assessment') (by age group and gender)
e) Reason(s) (i.e. nature of clinical condition) for finding of unfit to train (by age group and gender)

A suitable template for recording and returning the information is below (complete a separate table for each gender):

	Total	<20	20-29	30-39	40-49	50-59	60+
A. Fit							
B. Unfit							
C. Temporarily unfit							
C (i) of which later fit							
C (ii) of which later unfit							

Examining doctors should be prepared to submit statistics on outcomes of fitness for in-water EBS training assessments along with statistical returns of outcome of Oil and Gas UK medical assessments at annual renewal of registration.

7 Process Flowchart



8 Questionnaire

Assessment of Fitness for in-water training using Category A PSTASS Emergency Breathing Equipment

Instructions: Examinee - Complete sections 1 and 2. Give form to examining doctor.
OGUK Doctor – Complete sections 3 to 6.

Section 1 – About You	
Forename(s)	Surname
Date of Birth:	
Address:	
Your GP:	
Your Employer:	
Your Job Title:	

Section 2 – Your medical history:		
Have you had in the past, or do you currently have, any of the following:	Yes	No
Spontaneous pneumothorax (collapsed lung)		
Traumatic pneumothorax		
Asthma		
Reactive Airways Disease		
COPD (chronic obstructive pulmonary disease)		
Emphysema		
Sarcoidosis		
Tuberculosis		
Pulmonary Fibrosis		
Cystic Fibrosis		
Lung Bullae or Cysts		
Chest or 'open-heart' surgery		
Any other chest or lung disease		
Lung problems related to vigorous physical activity and/or immersion in water (including but not limited to non-immersion pulmonary oedema)?		
Are you currently using (or have you had to use in the past) inhalers/puffers for asthma, COPD or chest infections?		
Are you currently using any medications for a persisting ear nose or throat condition (do not include common cold or hayfever)		
Have you been advised to avoid swimming/immersion of your ears in water?		
Have you been advised to avoid diving because of any problem related to your ears, nose, sinuses or throat?		
Brief details of 'yes' answer(s):		

Section 3 – Examining Doctor notes on positive answers at section 2 (if relevant)

Section 4 – Clinical Examination (if indicated)			Indicated / Not indicated
i) Chest	Normal	Abnormal (give details)	
ii) Ears, Nose and Throat	Normal	Abnormal (give details)	
iii) Other (if relevant)	Normal	Abnormal (give details)	

Section 5 – Results of Spirometry (if indicated)					Indicated / Not indicated
Measured FEV1	litres	Predicted FEV1	litres	Measured FEV1 as % of Predicted FEV1	%
Measured FVC	litres	Predicted FVC	litres	Measured FVC as % of Predicted FVC	%

Section 6 – Review of Information and Conclusion	
Circle one:	
A.	Fit for in-water PSTASS EBS training
B.	Temporarily unfit for PSTASS EBS training
C.	Indefinitely unfit for in-water PSTASS training
Notes:	
I confirm that the hazard and risk of barotrauma in in-water EBS training exercises, the need for an accurate medical history from the examinee, and relevant risk mitigation measures, have been discussed with the examinee.	

Doctor signature:	Oil&Gas UK PIN No.:	GMC Reg No:	Date:

9 Advice Notes

General advice for all examinees/trainees (may be given verbally by examining doctors):

You are presently fit for in-water EBS training. However, if your medical condition changes between now and the training, you should advise the training centre. You will be asked about this at the training centre on the day of training itself. If you have a temporary medical condition (for example, a 'cold', flu, chest infection or 'ear trouble') on the day of training, you should tell the training provider about it.

The training exercises gradually increase in depth (although all depths are shallow) and complexity (although all are in fact straightforward) – if you develop any problems (such as breathing difficulty, ear pain, or anything else) at any stage in the exercises, you should advise the training staff immediately.

Asthma

You are presently fit for in-water EBS training. However, if your asthma worsens between now and the training, you should advise the training centre.

You should check your PEFR (peak expiratory flow rate) on the day of training. This should be 80% or more of your normal reading. If not, you should tell the training centre staff. You should already have a peak flow meter and know your normal peak flow reading, as part of your asthma treatment plan – if not, ask your GP, asthma nurse or asthma clinic about this now.

If your chest is tight or wheezy for any reason on the day of training, you should tell the training centre staff

You should take your asthma medication as usual on the days before, during and after training. In addition, you should take a usual dose of your 'reliever' inhaler as shortly as practical before commencing the pool exercises.

If you develop any asthma symptoms at any stage of the pool exercises, you should tell the training staff immediately.

COPD

You are presently fit for in-water EBS training. However, if your COPD worsens between now and the training, you should advise the training centre.

You should take any COPD medication you have been prescribed as usual on the days before, during and after training. In addition, you should take a usual dose of any 'reliever' inhaler you have been given as shortly as practical before commencing the pool exercises.

If you develop any chest symptoms at any stage of the pool exercises, you should tell the training staff immediately.

10 Fit to Train Certificate Template

Certificate of Fitness

to undertake 'in-water' training with PSTASS Category A Emergency Breathing Equipment

Name:

Date of Birth:

Employer:

Job Title:

This is to certify that the above named underwent assessment of his/her medical fitness to undertake in-water training with PSTASS emergency breathing equipment, in accordance with the Oil & Gas UK guideline for assessment of fitness to undertake training. The above named is

FIT

to undertake in-water PSTASS EBS training.

Date of Assessment:

Signed:

Name:

Date:

11 Unfit to Train Certificate Template

Unfit to Train Certificate

Name:

Date of Birth:

Employer:

Job Title:

The above named has NOT been found fit to undertake in-water EBS training, and is UNFIT to train

Date of Assessment:

Signed:

Name:

Date:

Issued following assessment of medical fitness to undertake in-water training with PSTASS Category A emergency breathing equipment, in accordance with the Oil & Gas UK guideline for assessment of fitness to undertake training.

12 Webinar

12.1 Recording

On 13th September 2017 Oil & Gas UK held a webinar to introduce this guidance to examining doctors. Approximately 200 of the total 1000 examining doctors on the list viewed the webinar. Participants were provided with the Explanatory Notes at paragraph 12.2, the Flowchart at paragraph 7, and a summarised version of the guidance at paragraph 3. A recording of the webinar in .mp4 format is provided with this guidance, but additional copies are available to examining doctors on request from: doctors@oilandgasuk.co.uk

12.2 Explanatory Notes

Background:

Following a helicopter crash off Sumburgh in August of 2013 in which four passengers died (two from drowning, one from cardiac arrest, and one from an incapacitating head injury) the CAA directed the UK oil and gas industry to introduce a more easily deployed emergency breathing system, and the 'PSTASS' (Passenger Short-Term Air Supply System) compressed-air breathing apparatus was introduced to service for passengers on offshore helicopter flights in the UK sector of the North Sea in 2015. Following trials in November 2015 and December 2016, the HSE has concluded the risks of introducing PSTASS equipment into survival training courses can be sufficiently mitigated, and in-water training exercises using PSTASS are expected to commence at survival training centres no later than January 2018.

Risks of helicopter incidents:

CAP1145, the CAA report following the August 2013 crash, lists 24 helicopter incidents between 1992 and 2012, 7 (28%) of which involved fatalities. Many incidents were 'other' in nature (for example, lightning strike, landing gear problems) but three were ditchings (a controlled landing on water) and five were uncontrolled impacts with the sea (a crash). The overall rate of helicopter incidents was 1 in 588,235 flying hours (1 in 1.25 million flights) for a controlled ditching into the sea, and 1 in 357,142 flight hours (1 in 714,285 flights) for uncontrolled impact with the sea.

The PSTASS system:

The PSTASS system consists of a small compressed air cylinder integrated into the passenger lifejacket, providing sufficient air for up to one minute, connected to a conventional demand valve and mouthpiece. The system is easily and rapidly deployable and being 'always on', has no need for operation of on/off switches for successful use.

The general hazard of breathing compressed air underwater:

The general hazards of breathing compressed gasses and/or air in water are well understood from both the commercial and recreational diving experience. The principle hazard to be considered for the helicopter scenario is that of overpressure damage ('barotrauma') occurring in gas-filled spaces in the body. The principle effects which could immediately cause harm both in training and in a helicopter emergency are pneumothorax and/or arterial gas embolism, which arise as a consequence of the relationship between gas volume and pressure changes with depth.

Risk of barotrauma in commercial and recreational diving:

The 2003 British Thoracic Society guidelines on medical fitness to dive provide some figures on incident rates in Royal Navy submarine escape training, military diving, commercial diver training, and recreational diving. From these figures, the overall risk of barotrauma can be calculated to range from 1 in 76,968 (pneumomediastinum in military divers) through 1 in 200,527 (pneumothorax in military divers) to 1 in 491,000 (gas embolism in recreational divers). It is considered that for a trainee in normal health, the risk of barotrauma from in-water PSTASS training exercises (where the pressure and volume changes are substantially less – see below) should not exceed these figures.

The nature of in-water PSTASS exercises:

Survival training pool exercises will involve a series of six exercises with the PSTASS unit, beginning with facial immersion in the water, then minimal submersion of the head underwater, followed by a shallow underwater swim/pull along a bar on the side wall of the pool. Each exercise lasts at most 30 seconds, during which five or six breaths are taken from the EBS. The specific exercises are:

a) deploy EBS above water, place face in water while floating on surface, breathe from EBS

b) place face in water on surface, deploy EBS underwater and breathe from EBS

c) place face in water on surface, deploy EBS underwater (with non-dominant hand) and breathe from EBS

d) deploy EBS above water, then descend to maximum 70 cm depth, breathe from EBS

e) descend to maximum 70 cm depth, then deploy EBS underwater and breathe from EBS

f) deploy EBS, swim/pull 'hand-over-hand' along a bar at maximum depth 70cm while breathing from EBS

The purpose of exercises a), b) and c) [figures 1&2] is to gain the trainee's confidence that the system will provide air without inhalation of water; the purpose of exercises d) and e) is to gain the trainee's confidence that the system can be deployed and used with the head and mouth submerged (figure 3), and the purpose of exercise f) (figure 4) is to gain the trainee's confidence that the system can be successfully used while moving through the water (as it would be in the cabin of an inverted ditched or crashed helicopter). Trials of the EBS system with volunteer subjects have shown universal positive feedback from trainees in meeting these objectives.


Fig 1


Fig 2


Fig 3

Fig 1: breathing at surface, and Fig 2: deploy EBS at surface: note much of thorax is out of the water, and demand valve is at ~15 to 20cm depth

Fig 3: breathe from EBS at ~50cms: head and thorax completely immersed


Fig 4

Fig 4: hand-over-hand pull along bar: bar at 70cm; buoyancy of body means thorax and head are shallower – back of head is 'breaking surface', and depth of thorax/demand valve is shallower than 70cm.

In diving terms, the survival training exercises are closest in nature to the early stages (pool training exercises) of recreational scuba diving training, but will not reach the same depth. In addition, survival training using PSTASS differs from scuba diving in that offshore workers will not progress to open-water diving in the cold or dark (survival training pools are warm [29 degrees C] and well-lit); there is no requirement in survival training to undertake marked physical exertion (there is no need to swim against a tidal current, wear weights or large tanks, or pull a heavy 'umbilical'), and there is no need for the worker to rescue a 'buddy' or self-rescue (at least one safety diver in the pool at all times). The exercises do not require more than minimal in-water physical effort and while it is known that immersion in water may cause an increase in cardiopulmonary system workload, for the vast majority of participants this should not result in significantly increased respiratory effort.

Risk of barotrauma in PSTASS in-water exercises:

The risk of barotrauma in the PSTASS exercises described is considered to be 'very low', and very much lower than in submarine escape training, military diving, commercial diver training, and recreational

diving, for which there is some quantitative data. The potential pressure/volume relationships are much less extreme than in recreational or commercial diving, and the circumstances of the exercises are much less prone to panic-inducing incidents. Risk mitigating measures during survival training PSTASS exercises will include a) strict control of depth, b) progressive exercises to gain confidence and reduce scope for anxiety, and c) individual instructor/trainee direct supervision during exercises to ensure no breath-holding on ascent. BSAC (the British Sub-Aqua Club) reports training many thousands of recreational divers without a single known occurrence of barotrauma in pool training exercises in the past seventeen years, and experience from Canada has also been event-free to date (see below).

PSTASS training experience in Canada

In-water HUEBA (Helicopter Underwater Emergency Breathing Apparatus, the same type of system as the UK PSTASS equipment) exercises were introduced into survival training in Canada in 2009. CAPP (the Canadian Oil & Gas UK equivalent) reports that at least 10,000 Canadian offshore workers have undertaken shallow-water exercises similar to those which will be undertaken in the UK, and in addition have also undertaken SWET (Shallow Water Escape Trainer) chair training (which is NOT expected to be undertaken in the UK), without any reported adverse medical events. The Canadians have since gone further, introducing PSTASS equipment to HUET training exercises in June 2016, again so far without reported problems.

Medical assessment considerations for PTSASS/EBS:

The assessment of recreational divers in the UK provides a useful reference point. In the UK, an offshore worker who wished to take up recreational sports diving (which could ultimately include open-water diving to the depth limit of air diving at 50metres) may do so by completing a self-declaration form in which they confirm that they do not have any of a number of relevant medical conditions. Note that no specific medical examination or test is required. Those unable to make a declaration of absence of such medical conditions are required to contact a medical referee for further discussion and assessment, which may or may not involve specific medical examination or test(s). The UKDMC (UK Sports Diving Medical Committee) provides the rationale that it considers this a safe and appropriate system of medical assessment for a leisure activity.

The Health and Safety Executive (HSE) considers use of compressed air breathing equipment in survival training in principle to be 'diving at work'. This would legally require trainees to undergo a full commercial diver medical examination by an HSE Approved Medical Examiner of Divers. However, having observed the December 2016 pool trials of the specific five exercises described above, the HSE has subsequently exempted trainees from this requirement provided that they a) possess an in-date Oil & Gas UK medical and that b) they also follow a similar system of self-declaration of absence of relevant medical conditions. This is consistent with practice in Canada, where CAPP medical assessment for in-water PSTASS training (including PSTASS in HUET) is for the inclusion of a number of questions within the CAPP medical (Oil & Gas UK medical equivalent) to elicit a history of clinical pathology relevant to increased risk of barotrauma, with further assessment (involving specialist input in some cases) of those with a history of such pathology.

The Oil & Gas UK scheme for medical assessment of trainees prior to in-water PSTASS exercises will be as follows:

1. Potential trainee completes a specific questionnaire, focused on (mostly respiratory) conditions that would improve the chance of identifying increased risk of barotrauma.

2. The potential trainee questionnaire answers are discussed with him/her, to clarify that the questions and their significance are understood, and where non-negative answers are given.

3. Where the Oil & Gas UK doctor is satisfied that there is no history or clinical suspicion of a relevant medical condition, the trainee is certified 'fit to train'.

4. Where a history of relevant medical condition is apparent, the Oil & Gas UK doctor will perform relevant clinical examination and/or test(s) (for example, lung function tests), and use condition-specific guidance to classify examinees as either ‘fit to train’ or ‘unfit to train’. Where a medical condition is clinically suspected by the Oil & Gas UK doctor despite a negative history, the Oil & Gas UK doctor will perform relevant clinical examination and/or test(s) (for example, lung function tests), and refer appropriately for confirmation of diagnosis and reports to allow completion of assessment against the condition-specific guidance.

The format of the assessment allows for documented discussion with the potential trainee of the nature of the hazard of breathing compressed air underwater, the risk of doing so applicable to the PSTASS exercises, the risk mitigation measures in training, provision of specific instruction to those 'fit to train' with medical conditions (e.g. asthma), and the trainee's understanding and acceptance of that advice.

There are some conditions (e.g. history of spontaneous pneumothorax, cystic fibrosis of lungs) which would be regarded as absolute contraindications to in-water EBS training, while others (COPD for example) will be 'relative contraindications', the outcome of assessment depending on the extent and severity of the condition.

It is understood that oil and gas industry personnel found medically 'not fit to train' will likely be excused in-water training, and will complete their survival training by 'dry-training for EBS'.

Supplementary explanation - some Gas Law Physics

Remember: a) Boyle's Law: Pressure x volume = constant 'k' (assuming constant temperature)

b) Pressure changes by 1 atmosphere (='bar') for every 10 metre change in depth

c) normal atmospheric pressure at the earth's surface is 1 atmosphere, not 'zero'

Physics of pressure and volume changes in a notional recreational (sports) diving problem scenario:

Divers typically suffer barotrauma in ‘problem situations’ resulting in acute anxiety and rapid ascent to the surface while breath-holding. Consider a recreational scuba diver who dives to 30 metres below the surface: since pressure increases by 1 atmosphere for every 10 metres depth, at this depth the

surrounding pressure is 4 atmospheres. Boyle's Law of gases (Pressure x Volume = constant 'k', assuming constant temperature) means that if the diver takes a breath (tidal volume) of 700mls, 'k' will be = 700 (V) x 4 (P) = 2800. In a rapid ascent while breath-holding and with the glottis closed, as the diver ascends to 20 metres, 'k' remains at 2800, pressure reduces to 3 atmospheres, and the volume of that tidal volume breath would increase (if able to freely expand) to 2800 / 3 = 933mls. At 10 metres pressure has reduced further to 2 atmospheres, and with 'k' still at 2800, volume would increase to 2800 / 2 = 1400mls. As the diver reaches the surface, where pressure is 1 atmosphere, volume would reach 2800mls. These changes can be summarised in Table 1 below:

Table 1 – Boyle's Law at various depths

Depth	Original inspired volume	Absolute Pressure (atmospheres)	'k'	New volume at depth
Surface	700 mls	1	2800	2800 mls
10 m	700 mls	2	2800	1400 mls
20 m	700 mls	3	2800	933 mls
30 m	700 mls	4	2800	n/a

While the actual physiological situation is clearly more complex (the discussion above ignores the volumes of air within residual volume and expiratory reserve volume, for example), figure 5 illustrating typical lung volumes during the respiratory cycle clearly shows the nature of the hazard – in the situation described above, the diver's original tidal breath volume alone (ignoring residual and expiratory reserve volumes) of 700mls inhaled at 30m depth could increase to 2800mls at the surface. The 'extra' 2100mls increase on the original 700mls is alone a volume which is greater than the maximum further physiological expansion of his thorax, the inspiratory reserve volume (of approx. 2000mls). Provided the diver breathes normally during ascent, the 'extra' 2100mls volume is eliminated through respiration, but in breath-holding with a closed glottis and no route for the excess volume to pass to the surrounding environment via the mouth, gas expansion causes a corresponding 'overpressure' which may cause the 'extra' gas volume to rupture through the lung parenchyma to the pleural cavity (a pneumothorax), mediastinum, and/or enter the vascular system and be transported round the circulation as an arterial gas embolism (AGE), with potentially fatal effect.

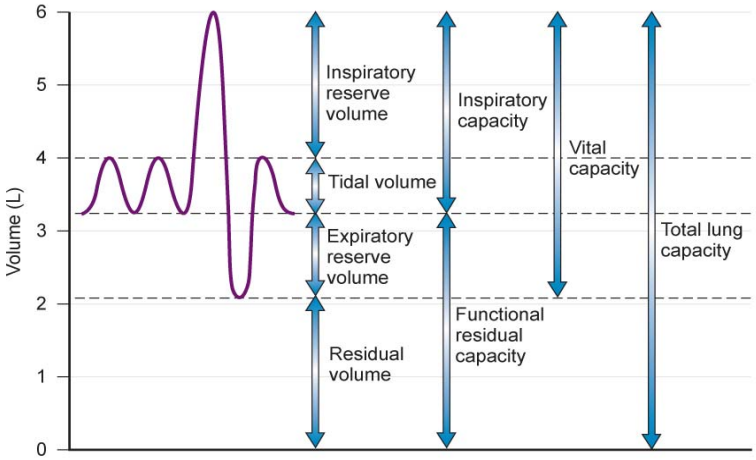


Figure 5 – typical lung volumes in respiratory cycle

Physics of pressure and volume changes in PSTASS exercises:

The same pressure/volume calculations as were considered earlier for open-water scuba diving may be performed for the PSTASS exercises. PSTASS training will take place at a maximum depth of 70 cm, at which the ambient pressure is 1.07 atmospheres (10m = 2 atm, 5m = 1.50 atm, 1m [100cm] = 1.10 atm, and 70 cm = 1.07 atm). Note that for most of the exercises the depth will be substantially shallower, as discussed later.

A tidal volume breath of 700mls taken at a depth of 70cm (=pressure 1.07 atmospheres) gives 'k' = 700 x 1.07 = 749, and in the worst-case scenario of a breath-hold and surface with closed glottis, this volume of air would tend to expand to 749 / 1 = 749mls at the surface. For a typical individual the 'extra' 49mls created by expansion due to ascent with closed glottis is a volume which appears to suggest low risk of barotrauma.

Table 2

Depth	Original inspired volume	Pressure (atmospheres)	'k'	New volume at depth
Surface	700 mls	1	749	749 mls
70 cm	700 mls	1.07	749	n/a

If the additional volumes of the physiological residual volume (from fig 5, around 2000mls) and expiratory reserve volume (from fig 5, around 1300mls) are also included in the calculation, the results at Table 3 are obtained:

Table 3

Depth	Original volume (VT plus RV plus ERV)	Pressure (atmospheres)	'k'	New volume at depth
Surface	4000 mls	1	4280	4280 mls 
70 cm	700+2000+1300 = 4000 mls	1.07	4280	n/a 

Again, the 'extra' 280mls potentially created by expansion due to reduced pressure is a volume which appears to suggest low risk of barotrauma

In practice, the actual depth of the regulator, and hence inspired air pressure and potential for volume expansion, will be less. Expected values for depth and inspired air pressure for exercises a) to e) are:

a) depth 15-20 cm, pressure 1.015 to 1.02 atmospheres

b) depth 15-20 cm, pressure 1.015 to 1.02 atmospheres

c) depth 30-40 cm, pressure 1.03 to 1.04 atm

d) depth 30-40 cm, pressure 1.03 to 1.04 atm

e) depth 15-40 cm, pressure 1.015 to 1.04 atm.

For additional context, the deliberate respiratory tract 'overpressure' applied therapeutically by CPAP devices in treatment of sleep apnoea is typically 4-16 cm of water, but can be 25-30 cm of water.

12.3 Webinar Q & As

A number of webinar participants posed questions. These, and the answers to them, are reproduced below:

1. The training providers are going to have to sort out those with medical issues long before they arrive for the course as most of us can't deliver a number of medicals at no notice when these trainees arrive.

A: it is intended that the fitness assessment will take place ***prior to*** attendance for training.

2. Also these are like SCUBA no-mask swims which many diver trainees find difficult first time.

A: The practical trials showed that trainees had no difficulty with the EBS apparatus. The exercises are structured in a progressive, confidence-building manner, and the majority of trainees are expected to manage without significant difficulty.

3. How do we approach the assessment of a person with bronchiectasis?

A: Persons with bronchiectasis should be assessed under the guidance notes for COPD. Note that the guidance applicable to 'known bullae or cysts' may be relevant.

4. Will we be able to get a copy of the questionnaire?

A: Yes – see paragraph 8

5. How does a "not fit for training" verdict impact on person's eligibility for OGUK certification?

A: It doesn't – they are two separate questions '(is the person fit for offshore work?' and 'is the person fit to undertake the specific in-water training exercises?')

6. Some personnel will have a worsening of their childhood asthma or current asthma with sea water - does the use of hypertonic saline challenge testing have any role to be used in the certification of asthmatics or childhood asthma personnel?

A: No – the training pool water is chlorinated fresh water (the same as a swimming pool), not sea water, so this issue is not relevant to the assessment of fitness for training.

7. Do we create our own certificate or will OGUK create a generic certificate?

A: Certificate templates are at paragraphs 10 and 11.

8. Are OGUK members aware that this will have a cost implication?

A: The assessment should not be onerous in either time or resources for the majority of examinees, so it is not anticipated that examining doctors will charge burdensome fees.

9. Should the training site be equipped with a hyperbaric recompression chamber to treat arterial gas embolism associated with barotrauma, if it happened?

A: All training providers already employ safety divers working under diving at work regulations, and they will have a 'dive plan' which will include arrangements for response to dive-related medical events. This would be expected to include arrangements for contact with the nearest dive medical support service and hyperbaric chamber, and these same arrangements would provide for response to any barotrauma event occurring in a trainee.

10. Although probably exceedingly rare in practice, a client with Marfan's syndrome but no history of spontaneous pneumothorax - fit to train?

A: The guidance applicable to 'other miscellaneous conditions' is relevant here.

11. Obtaining medical reports from GPs can be a problem. Would a covering letter from OGUK explaining the importance be helpful to send to the GP? Who pays for the report?

A: It is not envisaged that there will be frequent need for GP (or other) reports. If needed however, examining doctors will of course explain the context of their request for a GP report in their correspondence seeking it. It seems unlikely that additional separate correspondence to be read by GPs would elicit a more amenable response to requests for reports. The report should be paid for by

the person paying for the assessment, but examining doctors should ensure they have agreement to meet the cost before incurring it.

12. If delegates attending training providers are coming from overseas they won't have been assessed before. If they have an assessment on the day and there is a problem would it not be the case that you could deem them fit for land based training so they can undertake their course?

A: There are over 1000 examining doctors in over 60 countries around the world, and it does not seem unreasonable to expect that persons should obtain certification of fitness to train before arriving in the UK for training. For those who are unable to do so, assessment may indeed result in a finding of unfitness or temporary unfitness while clarifying medical details. See paragraph 5 for expected outcomes in this event.

13. if the person fails this questionnaire – will he/she still be able to undergo training, but without compressed air?

A: See paragraph 5 – it is expected that this will likely be the case.

14. For COPD - FEV1 of >50% is lower than that indicated in the OGUK medical guidelines. Why has this been set so low?

A: See response to question 5: there are two separate questions '(is the person fit for offshore work?' and 'is the person fit to undertake the specific in-water training exercises?') and two different questions can reasonably be expected to have two different answers.

15. Do you see the EBS/PSTASS system developing i.e. at depth as part of HUET?

A: Not a medical question as such, but answered by Trish Sentence of Oil & Gas UK – the question of introducing EBS training into HUET exercises is not presently under discussion.

16. The trainee can use bronchodilator before training but the situation is different in emergency, so, is it practical to allow patients on medication to do the training?

A: Yes, it is perfectly feasible for persons with asthma to take a dose of inhaler prior to pool exercises (as shown by the fact that this is and has been frequent practice among persons with asthma undertaking HUET exercises). The training and medical assessment have been structured and planned with the objective of reducing the probability of an emergency in training to a very low level, even for those with medical conditions requiring medication.

17. Will the separate EBS medical assessment certificate be included in the annual return form?

A: See paragraph 6: examining doctors will be required to return statistics of numbers of assessments done, numbers passed and failed, and reasons for failure.

18. A worker with past history of decompression sickness, will it be a contraindication for the training?

A: No – the hazard of in-water training is barotrauma, not decompression sickness. The depth and duration of the in-water training exercises is not sufficient to pose any hazard of decompression sickness.

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