



# **Compatibility test protocol for lifejackets and immersion suits on offshore installations**

Prepared by **Mensafe Limited**  
for the Health and Safety Executive

**OFFSHORE TECHNOLOGY REPORT  
2002/021**



# Compatibility test protocol for lifejackets and immersion suits on offshore installations

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First published 2002

ISBN 0 7176 2347 5

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# Compatibility Test Protocol for Lifejackets and Immersion suits on Offshore Installations

## CONTENTS

SECTION	PAGE
Foreword	v
Background	1
Introduction	1
Scope	2
1. Objectives	2
2. Basic principles	2
3. Test Subjects	3
3.1 Selection	3
3.2 Subject Sizes	3
3.3 Sex of Subjects	3
3.4 Fitness of Subjects	3
3.5 Test Clothing	3
4. Core Tests	4
4.1 Donning	4
4.2 Dexterity and Mobility	4
4.3 Jump Tests	5
4.4 Life raft Boarding	5
4.5 Self righting	5
5. Records	6
Appendices	
A    Compatibility with Mustering Arrangements	6
B    Compatibility with Evacuation Arrangements	6
C    Compatibility with Escape Arrangements	7
D    Compatibility with additional items fitted to the lifejackets and/or immersion suits	9
E    Compatibility with rescue and recovery arrangements	10
References for this protocol	11
Abbreviations used in this protocol	12



## **FOREWORD**

This publication has been approved by the Evacuation, Escape and Rescue Technical Advisory Group (EERTAG) and sets out the views of the Group on the compatibility testing of lifejackets when used in combination with immersion suits.

EERTAG is a technical liaison group, which is a forum for expertise in the area of evacuation, escape, rescue and recovery arrangements.

The principal aims of EERTAG are to:

- (i) Identify, compile and develop technical information on EER arrangements for offshore installations.
- (ii) Publish and disseminate that information within the offshore industry to enable improvements in EER capabilities.
- (iii) Provide information for suppliers, designers, operators and owners to take account of when developing their EER arrangements.
- (iv) Advise the industry and HSE on areas where further research and guidance may be needed.

Participating organisations include appropriate divisions of HSE; technical representatives of offshore operators including UKOOA, IADC and BROA; the TUC; ERRVA; MCA and any other similar organisations representing the offshore industry and regulatory agencies.

This protocol has been produced by a Working Group of EERTAG whose membership consisted of representatives from OSD, MCA, NUMAST, ERRVA, lifejacket manufacturers, immersion suit manufacturers and approved test houses. With specialist technical support and the secretariat for the working group being provided by Mensafe Ltd.

Through a consultation process it takes account of all stakeholders' views.

Whilst every effort has been made by the Working Group to ensure the accuracy of this document it is published and distributed on the understanding that neither the Working Group, nor its members collectively or individually assume any responsibility for any inadvertent misinformation or omissions, nor for the results in the use of this publication.



## **BACKGROUND**

To date there are three main standards groups which have specified requirements for lifejackets used in the offshore environment:

- The International Maritime Organisation (IMO) Safety of Life at Sea regulations (SOLAS) covering those lifejackets to be used by ships registered in the Flag States of the IMO, which includes Mobile Drilling Units and some FPSOs.
- The Civil Aviation Authority (CAA) for those lifejackets to be provided on helicopters for passengers and crew.
- The Comité Européen De Normalisation (CEN) for those situations where lifejackets are deemed necessary but there is no regulatory requirement to comply with the other two standards. It is noted that fixed offshore installations are one of those situations.

Immersion suit standards are also specified by the IMO and the CAA for crewmembers and there is a CEN standard in production for immersion suits.

Up to the present time, the offshore industry has accepted the performance standards used for type testing of lifejackets and immersion suits developed for the marine industry and helicopter crews.

A significant shortfall with these performance standards is that the compatibility and suitability of lifejackets and immersion suits when used in combination are not adequately addressed.

There have been several HSE and industry reports on tests of lifejacket and immersion suit combinations going back several years each indicating that several combinations are unsuitable for use offshore.

Also none of these standards considers all of the emergency situations faced by offshore installation personnel.

## **INTRODUCTION**

This Test Protocol is not attempting to replace these international standards with new standards for offshore installations. The intention is to enhance existing standards by devising a testing regime to take account of the compatibility problems posed by combinations of lifejackets and immersion suits likely to be used in differing emergency scenarios by offshore installation personnel.

The format for this Test Protocol is based on Core Tests, which covers those compatibility situations that are common to all installations e.g. Donning and in-water use.

Any installation specific compatibility requirements are included in the appendices. This protocol has been written as a stand-alone document but where compatibility testing has already been undertaken as part of an existing approval test or to a harmonized European Standard then those tests need not be repeated. To ensure effective use of resources any compatibility tests included in this protocol may be undertaken at the same time as formal approval tests.



### **Test conditions discussion**

Although the main Test Centres in the UK have wave machines the waveform between centres is not consistent. Therefore as there are no repeatable tests to ascertain the absolute performance of lifejackets or immersion suits then this document has used the worst case for self-righting, which is in calm fresh water. As well as achieving repeatability these tests also provided a comparison of products to aid specifiers in selecting the most appropriate and suitable equipment.

As the water temperatures experienced on the UKCS does not have a significant effect on the performance of lifejackets and immersion suits, a water temperature of 25<sup>0</sup>C was chosen for the comfort of the test subjects.

## **SCOPE**

The scope of this protocol is limited to those evacuation, escape and rescue arrangements in the Emergency Response Plan of an Offshore Installation that could be compromised if they are not compatible with lifejackets and/or immersion suits and associated items of equipment.

### **1. OBJECTIVES**

1. To assist Offshore Installation Duty Holders to satisfy themselves that any lifejackets and immersion suits intended to be used together are compatible and are suitable for use offshore.
2. To provide the regulator with an inspection tool when assessing compliance with the relevant legislation e.g. regulation 18 of PFEER.
3. To encourage manufacturers of lifejackets and immersion suits to consider compatibility in their designs and prototype testing.

### **2. BASIC PRINCIPLES**

1. The tests shall provide repeatable results
2. The tests shall be conducted with the equipment correctly fitted.
3. The tests shall be carried out in calm fresh water at a temperature of 25°C ± 2 °C.
4. The subjects shall receive any relevant basic instructions about donning and use in the water as offshore personnel would have received in their Basic Offshore Safety Induction & Emergency Training.
5. Test subjects shall receive suitable and sufficient instructions to enable them to undertake all the tests in a safe manner.
6. All tests should be subjected to a risk assessment

### 3. TEST SUBJECTS

#### 3.1 SELECTION

There shall be a minimum of 6 test subjects.

All test persons shall be familiar with the test equipment.

#### 3.2 SUBJECT SIZES

Table I - Subject sizes

HEIGHT m	WEIGHT kg
1.4 to 1.6	1 Person under 60 kg
	1 Person over 60 kg
Over 1.60 to 1.80	1 person under 70 kg
	1 person over 70 kg
Over 1.80	1 person under 80 kg
	1 person over 80 kg

#### 3.3 SEX OF SUBJECTS

Not more than 4 out of 6 of the test subjects (or an equivalent percentage if more than 6) shall be of any one sex.

#### 3.4 FITNESS OF SUBJECTS

The subjects should be capable of relaxing when in water out of their depth with the aid of a lifejacket.

#### 3.5 TEST CLOTHING

If the compatibility tests are being undertaken separately then the test clothing should comprise the following:

1. underwear
2. long-sleeved shirt;
3. trousers;
4. socks
5. long sleeved pullover;
6. appropriate footwear (if suit is used with footwear).

If the tests are being carried out in conjunction with other tests then the clothing throughout the tests shall be as defined in the relevant test standard e.g. EN ISO 15027-3 clause 3.8.1.2.

## **4.0 CORE TESTS**

### **4.1 DONNING**

Following a demonstration each person, out of sight of any other test persons, shall be able to unpack, don and fully secure the lifejacket plus the suit over the test clothing within 2 min at a temperature of  $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  and without assistance. If necessary, the test person may sit or lie on the floor but shall not make use of a chair or any vertical support.

#### **4.1.1 Comfort**

After donning and during the in water tests the assessment team shall ask the subjects about the comfort of the suit / lifejacket combinations. Paying particular attention to the following points:

- Face and neck seals
- Wrist seals
- Comfort in the arms and chest area when swimming or climbing into the raft
- Pressure on chest with inflatables
- Neck support (too much or too little)
- Any other areas the subject may feel discomfort

### **4.2 DEXTERITY & MOBILITY**

#### **4.2.1 Manual Dexterity**

Each test subject wearing test clothing, the suit system and a lifejacket shall be able to bend over (without squatting), pick up a length of 8 mm to 10 mm diameter rope, pass it round his waist and tie a double knot in front of them.

#### **4.2.2 Movement**

Each test subject shall be able to complete the following series of movements wearing test clothing, the suit system and a lifejacket. A pass shall be obtained if there is no visual damage to the seams of the suit and the tests are able to be completed by the test subjects, without any discomfort. If any subjects fail any of the following tests then they shall repeat them without the suit to ensure that they can perform them:

- a) kneel on both knees, lean forward and place both hands on the floor 450 mm in front of the knees;
- b) position hands at chest level, palms out, reach directly overhead, interlock thumbs, extend arms fully;
- c) kneel on the right knee, place left foot onto the floor with the left knee bent  $90\text{ }^{\circ}\text{C}$ . Touch toe of left foot with the thumb of the right hand;
- d) extend arms fully in front of body, lock thumbs together, twist upper body  $90^{\circ}$  to the left and right;
- e) stand with feet a shoulder width apart, arms at side. Raise the arms until they are parallel to the floor in front of the body. Squat down as far as possible;
- f) kneel as in movement c) with left arm hanging loosely at side, raise right arm fully overhead.

### **4.2.3 Walking**

Each test subject wearing the standard test clothing specified in 4.5 shall walk at a normal speed (2,5 to 3 km/h) a distance of 120m on a smooth wetted surface along a course with at least four turns of at least 90°. Each subject shall walk the course twice with test clothing and appropriate footwear alone, and the average time recorded. The routine shall be repeated with the subject wearing the suit system and test clothing. The average time for each subject wearing the suit shall not be more than 10 % greater than his average time without the suit. The subjects shall rest between each walk.

### **4.2.4 Climbing**

Each test subject shall climb a 5 m vertical ladder to a height where his feet are 3 m above the ground. The ladder shall be climbed twice with test clothing and appropriate footwear alone, and an average time to reach the 3 m height and return to the ground level recorded. The routine shall be repeated while wearing the suit, test clothing and a lifejacket, if required. The average time recorded for each subject wearing the suit system shall not be more than 10 % greater than his average time without the suit. The test subjects shall be allowed to rest between each climb.

### **4.3 JUMP TEST**

Each test subject wearing standard clothing, the suit system correctly fastened and a Lifejacket, uninflated if inflatable, shall jump feet first into the water from a height of 4.5 m  $\pm$  0.5 m Each test subject shall then leave the pool and the system be inspected for damage. If damage has occurred then the system shall be deemed to have failed.

### **4.4 LIFE RAFT BOARDING**

Each test subject shall enter the water wearing test clothing/suit plus lifejacket and shall swim for 25m  $\pm$  5 m and then attempt to board a representative offshore liferaft without any assistance.

This attempt shall be carried out in a test pool filled to a depth that prevents a test subject from pushing off from the bottom of the pool.

The test subject may have as many attempts at this action as required within a time limit of 5 min. At least 50% of the subjects shall board the raft unaided.

### **4.5 SELF RIGHTING TEST**

Each test subject wearing standard test clothing, the suit system and a lifejacket, shall swim three strokes forward (breast stroke) and then relax, arms by their sides and legs closed, face down in the test pool. When stable at least 4 out of the 6 subjects (or an equivalent percentage if more than 6) shall self-right from a face down position taking not more than 5 sec for the airways to be clear of the surface. Those subjects who do not self right must demonstrate that they can turn themselves from a face down to a face up position in not more than 5 sec. The mouth freeboard shall not be less than 120 mm or that required by the lifejacket standard, whichever is the greater.

## **5 RECORDS**

All the tests should be recorded using the appropriate SOLAS reporting format which is due for publications shortly, for the latest edition see Reference 11.

### **APPENDICES (to Appendix 4)**

#### **General**

Duty Holders must satisfy themselves that the lifejackets and immersion suits provided are compatible with all the arrangements in the Emergency Response Plans of specific installations.

The following appendices provide some topics, which might need to be considered.

#### **APPENDIX A COMPATIBILITY WITH MUSTERING ARRANGEMENTS**

This appendix sets out those arrangements where consideration needs to be given to the compatibility of lifejackets and immersion suits during mustering on an offshore installation.

##### **A1. Other PPE**

Where the Emergency Response Plan requires the provision of other personal protective equipment for use in an emergency then compatibility with these items needs to be considered. Such items might include PPE for use in conditions of fire, heat, gas escape, or smoke.

Donning of the immersion suits and lifejackets without removing any other PPE should be considered where the risk from these conditions can not be removed prior to donning.

##### **A2. Access and Egress**

Mobility around the installation should also be considered. A standard test for mobility is included in the Core Tests and should cover most situations. Duty Holders must satisfy themselves that there are no specific installation access or egress situations which are not compatible with the lifejackets and immersion suits provided.

#### **APPENDIX B COMPATIBILITY WITH EVACUATION ARRANGEMENTS**

Evacuation means the leaving of an installation and its vicinity, in an emergency, in a systematic manner and without directly entering the sea. Means of evacuation may include helicopters, TEMPSC and bridge links.

##### **B1. Evacuation By Helicopter**

If the Emergency Response Plan includes evacuation by helicopter then automatic lifejackets would not be compatible with this form of evacuation. The standard passenger helicopter used offshore may provide suitable lifejackets but Coastguard SAR helicopters probably will not.

The type of immersion suit would also have to be assessed to ensure it is compatible with the seats and restraint systems on a helicopter and the incorporation of any other equipment e.g. emergency breathing systems (see also Appendix D2). Integral mittens on some immersion suits may affect dexterity.

The ability to board a helicopter would also have to be assessed.

## **B2. Evacuation by TEMPSC**

Compatibility with the launch equipment should be considered whether davit launched or freefall. Access to the TEMPSC and boarding should also be considered.

Although TEMPSC are specified by the number of persons they can carry they may not be able to carry that many occupants wearing immersion suits and lifejackets, especially if the lifejackets are of the inherently buoyant type.

The shaped seats and harnesses provided in Freefall TEMPSC make an assessment of the compatibility with immersion suits and lifejackets more critical.

If heavy thermally insulated abandonment suits are employed for use in TEMPSC there is a significant risk of excessive fatigue and dehydration due to overheating. Which could compromise the survivor's capability for self help when being recovered from the TEMPSC. Compatibility with the operation of the equipment inside a TEMPSC including the radio, needs to be assessed.

## **APPENDIX C**

### **COMPATIBILITY WITH ESCAPE ARRANGEMENTS**

Escape means the process of leaving the installation, in an emergency, when the evacuation system has failed, it may involve entering the sea directly and is a 'last resort' method of getting persons off the installation.

Means of escape cover items which assist with the descent to the sea, such as davit launched life rafts, chute systems, ladders, individually controlled descent devices and items in which personnel can float on reaching the sea, such as throw over life rafts.

#### **C1. Escape by Davit Launched life raft**

Compatibility with the launch equipment should be considered as well as access to the life raft when boarding. It will probably be adequate to address launch equipment compatibility in a similar way to davit launch TEMPSC. The Dexterity tests in the Core Tests section will probably be sufficient for releasing the life raft.

#### **C2. Chute Systems**

There are several chute systems used on offshore installations but the most common is the Skyscape. This consists of a compartmentalised netting tube which is lowered over the side of the installation to a self contained reception raft. Duty Holders should be satisfied that on the installations where these are fitted and are part of the Emergency Response Plan the lifejackets and immersion suits are compatible with their efficient use. The immersion suit and lifejacket system employed should also be compatible with the method of recovering personnel from the reception raft.

It may not be necessary to test compatibility with the total length of these chute systems. Where the diameter of these chutes are similar then compatibility could be tested with a sample length of chute. If changes of direction are incorporated in the chute on the installation then the test chute should incorporate a change of direction.

### **C3. Ladders and other descent devices**

Compatibility with the standard vertical ladder without back hoops is covered in the Core Test 3.2.4.

However where there are specific requirements for individual installations then compatibility with these types of ladders should be assessed.

Where individually controlled descent devices and items in which personnel can float on reaching the sea are included as part of the Emergency Response Plan, such as throw over life rafts then these will also need to be considered

## **APPENDIX D COMPATIBILITY WITH ADDITIONAL ITEMS INCLUDING ANY FITTED TO THE LIFEJACKETS AND IMMERSION SUITS**

Lifejackets and immersion suits need to be assessed for compatibility with any additional items such as safety harnesses and lines, emergency lights, whistles, multichamber buoyancy systems, re-breather systems, buddy lines, spray hoods and protective covers. Although BS EN 394 specifies a number of additional items which may be fitted onto lifejackets some of these could equally be fitted onto immersion suits. The harnesses and lines used by Rope Access Personnel are considered separate items of equipment.

The overriding requirement regarding the function of any additional item is that it should be compatible with the relevant Emergency Response Plan.

### **D1. Spray hoods**

There is no specific requirement (in existing standards) to fit a spray hood to a lifejacket but they can be of great value in protecting the airways in rough water.

#### **D1.1 Deployment**

This should be tested in the water with the immersion suit being worn and the lifejacket inflated.

It should be capable of being fully deployed and removed by all the test subjects, without assistance, in 1 minute.

#### **D1.2 Post deployment**

Spray hoods after deployment should:

- Protect the airways from spume and water
- Not unduly restrict the wearer's vision
- Comply with BS EN 396 + A1 6.10 regarding the levels of CO<sub>2</sub> content inside hood.
- Be held clear of face to avoid claustrophobia
- Be robust enough to maintain design characteristics in adverse weather.

### **D2 Immersion Suit Re-breather Systems**

Several designs of immersion suits issued to offshore personnel for helicopter flights have re-breather systems either as an integral part of the suit or in some cases as a removable item.

Helicopter lifejackets are considered to be aircraft equipment and compatibility requirements between these lifejackets and the immersion suits issued for the helicopter flight are provided by the CAA (Reference 12).

Where the immersion suits issued for helicopter flights are intended to be used as part of the installation's Emergency Response Plan they must be assessed for compatibility with the lifejackets issued on the installation (see also Appendix B1).



## **APPENDIX E**

### **COMPATIBILITY WITH RESCUE AND RECOVERY ARRANGEMENTS**

The compatibility with lifejacket and immersion suits will need to be assessed against the arrangement provided under Regulation 17 of PFEER for rescue and recovery.

#### **E1 ERRV Scoop Systems**

Consideration will need to be given to the appropriateness of buddy lines including any associated snagging problems when being rescued by ERRV scoop systems such as the Dacon Scoop or Sea Lift.

#### **E2 Helicopter winching**

The compatibility of immersion suits and lifejackets with helicopter winching strops when being recovered from a TEMPSC or life raft or rescued from the sea will have to be considered e.g. will the lifejacket allow the strop to pass over it?

## References for this protocol

1. BSI Published Document. PD 6636:1998 Personal protective equipment - Lifejackets and buoyancy aids - Guidance for selection and use.
2. British Standard. BS EN 393:1994 Lifejackets and personal buoyancy aids - Buoyancy aids -50N
3. British Standard. BS EN 395:1994 Lifejackets and personal buoyancy aids - Lifejackets - 100N
4. British Standard. BS EN 396:1993 + A1 1998 Lifejackets and personal buoyancy aids - Lifejackets -150N
5. British Standard. BS EN 399:1994 Lifejackets and personal buoyancy aids - Lifejackets - 275N
6. EERTAG document EERTAG/D3/97 "An assessment of the evacuation of an offshore installation by TEMPSC".
7. European Standard. PrEN ISO 15027-1 1999 Immersion suits Part 1 Constant wear suits, requirements including safety
8. European Standard. PrEN ISO 15027-2 1999 Immersion suits Part 2 Abandonment suits, requirements including safety
9. European Standard. PrEN ISO 15027-3 1999 Immersion suits Part 3 Test methods
10. Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995
11. SOLAS Document Number DE 4318 Add.2 "Evaluation and Test Report".
12. New CAA Joint Technical Standing Order (JTSO) in preparation (to replace CAA Specifications 5 and 19).

### **Abbreviations used in this protocol**

BROA	British Rig Owners Association
BSI	British Standards Institution
CAA	Civil Aviation Authority
CEN	Comité Européen De Normalisation (European standards organisation)
EERTAG	Evacuation, Escape and Rescue Technical Advisory Group
ERRVA	Emergency Response and Rescue Vessel Association
FPSO	Floating Production, Storage and Off-loading installation
HSE	Health and Safety Executive
IADC	International Association of Drilling Contractors
IMO	International Maritime Organisation
ISO	International Standards Organisation
MCA	Maritime and Coastguard Agency
NUMAST	National Union of Maritime, Aviation and Shipping Transport Officers
OSD	Offshore Safety Division (of the HSE)
PFEER	Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995
PrEN	Provisional European Standard
ERRV	Emergency Response and Rescue Vessel
SOLAS	Safety Of Life At Sea convention of the IMO
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
TUC	Trade Union Congress
UKCS	United Kingdom Continental Shelf
UKOOA	United Kingdom Offshore Operators Association







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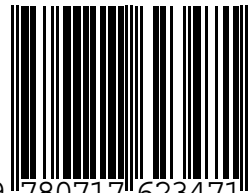
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OTO 2002/021

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ISBN 0-7176-2347-5



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