

European Technical Standard Order

Subject: HELICOPTER CREW AND PASSENGER INTEGRATED IMMERSION SUITS

1 - Applicability

This ETSO gives the requirements which integrated immersion suits for use on helicopters, that are manufactured on or after the date of this ETSO, must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2- Specific

None.

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in Appendix 1 to this ETSO.

3.1.2 - Environmental Standard

None.

3.2 - Specific

None.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2.

4.2 - Specific

As given in Appendix 1.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

EN documents may be purchased from the European Committee for Standardisation (CEN), Rue de Stassart 36, B-1050 Brussels, Belgium or any CEN member.

APPENDIX 1. EASA STANDARD FOR HELICOPTER CREW AND PASSENGER INTEGRATED IMMERSION SUITS.

1. Purpose

- 1.1 This specification prescribes the minimum standard of design and performance for helicopter crew and passenger integrated immersion suits.
- 1.2 An integrated immersion suit is defined as an immersion suit which incorporates the functionality of a lifejacket. The wearing of a separate lifejacket is not required.

2. Scope

- 2.1 This standard covers integrated immersion suits for use on helicopters.
- 2.2 The integrated suit shall comprise at least the following:-
 - a) A dry coverall
 - b) Hand and head coverings
- 2.3 Where applicable any additional or optional items designed to be used with the suit e.g. thermal liner, shall be considered as part of the integrated immersion suit as far as this specification is concerned.

3. Donning

- 3.1 It is assumed for the purpose of this specification that the suit is donned prior to boarding the aircraft.
- 3.2 The integrated suit and any attached equipment shall be capable of being donned without assistance and shall be capable of being sealed and adjusted by the wearer without assistance prior to boarding the aircraft.
- 3.3 Air retained inside the suit after donning which could adversely affect egress, the manoeuvrability or flotation attitude, shall be capable of being exhausted, either automatically or by the wearer.
- 3.4 It must be possible to complete all actions required to don the head covering required by paragraph 2.2(b) and seal the suit within 10 seconds. These actions shall be possible both when seated with harness fastened and when in the water with the suit inflated.
- 3.5 The wearer shall be able to complete all actions required to don the hand covering required by paragraph 2.2(b) when tested in accordance with paragraph 3.11.6.5 of EN ISO 15027-3:2002 except that this shall be demonstrated by each subject after immersion in water at a temperature no higher than 10°C (50°F) for a period of 3 minutes.

4. Freedom of movement

- 4.1 The integrated suit shall be designed to a standard which will allow the wearer to carry out all normal and emergency functions and movements necessary for the operation of a helicopter and its equipment.
- 4.2 The design of the integrated suit shall allow tailoring to fit the individual wearer or, where suits are not individually tailored, the size range must be satisfactory for all

wearers whose significant body dimensions range from the 5th percentile female to the 95th percentile male, and adequate for most of the 5% at each extreme.

- 4.3 The inflated suit shall not significantly hinder the boarding of a liferaft with the sprayhood deployed. This shall be demonstrated by testing to paragraph 3.4 of Appendix 2.
- 4.4 The wearing of the integrated suit, inflated or uninflated, shall not prevent the wearer from assisting others while in the water nor from assisting them to board a liferaft from the water.
- 4.5 The integrated suit, when correctly donned and adjusted, shall not prevent the wearer from having an acceptable field of vision. This shall be demonstrated by testing to paragraph 3.7 of Appendix 2.

5. Comfort

- 5.1 The design of the integrated suit shall minimise any discomfort to the wearer so as to avoid jeopardising safety. Particular attention should be given to the level of thermal comfort afforded the wearer on long into-sun flights in summer.

6. Compatibility

- 6.1 The integrated suit shall be designed, and the materials used in its construction chosen, to have no features which would be likely to have any detrimental effect on the operation of any helicopter or its equipment. In particular any part of the suit which might pose a snagging hazard during flight, emergency egress or recovery, shall be suitably covered, protected or restrained. All materials used shall be compatible with materials used in the construction of approved liferafts.
- 6.2 Any attached equipment shall not compromise the basic survival function of the suit by causing puncturing, fretting or distortion of the material, or changes in its mechanical properties.

7. Materials

- 7.1 All materials used shall be to an acceptable specification which shows the material to be suitable for its intended application. The materials used shall meet the requirements of paragraph 4.14 of EN ISO 15027-1:2002, with the exception of paragraph 4.14.3 of EN ISO 15027-3:2002 Resistance to Illumination Test.
- 7.2 The integrated suit and its equipment shall be so designed and constructed as to remain serviceable for the period between scheduled inspections. The choice of materials used shall be such that, when stowed in accordance with the relevant instructions, neither the suit nor its attached equipment shall be liable to become unserviceable through material deterioration or chafing, or from any other cause. Due consideration shall be taken of the possible temperature variations during stowage which may range between -30°C and +65°C (-22°F and +149°F). This shall be demonstrated by testing to paragraph 3.9 of EN ISO 15027-3:2002. The normal operating temperatures for the immersion suit shall be -5°C to +40°C (23°F to 104°F).
- 7.3 The outer fabric used in the construction of the suit shall be of low flammability. It shall not have a burn rate greater than 100mm/min (4in/min) when tested in

accordance with the horizontal test of CS-25 Book 1 Appendix F Part 1 (b)(5) or other approved equivalent method.

8. Evacuation

8.1 A person wearing the uninflated suit shall be able to exit the helicopter through any Emergency Exit or Push-out Window down to the minimum acceptable size of 430mm x 355mm (17in x 14in). This action shall be possible in air or under water. This shall be demonstrated by testing to paragraph 3.3 of Appendix 2.

9. Buoyancy and floating position

9.1 The trapped buoyancy due to the suit and recommended clothing, with the suit fully vented, shall be no more than 150N (33.7lbf) when measured in accordance with paragraph 3.11.7.2 of EN ISO 15027-3:2002.

9.2 The buoyancy of the inflated suit shall be sufficient to ensure that a person wearing clothing and the integrated suit shall have a floating position such that the angle between the body and the horizontal is not greater than 60°. This shall be demonstrated by testing to paragraph 3.6 of Appendix 2.

9.3 The mouth must be at least 120mm (4.7in) above the waterline (mouth freeboard) and the nose freeboard shall not be less than the mouth freeboard, even when the wearer is incapacitated. This shall be demonstrated by testing to paragraph 3.5 of Appendix 2.

9.4 The inflated suit shall allow the wearer to turn from a face down position into a stable face up floating position within 5 seconds. This shall be demonstrated by testing to paragraph 3.2 of Appendix 2.

10. Breathing protection

10.1 A sprayhood shall be fitted.

10.1.1 The wearer shall be able to deploy the sprayhood within 20 seconds when wearing the inflated suit in or out of the water.

10.1.2 The sprayhood will not be considered suitable if it can in any way retain water when deployed.

10.1.3 The angles of vision shall not be unduly restricted, and the ability to swim and manoeuvre shall not be impaired with the sprayhood deployed.

10.1.4 The suit's light source shall not be masked by the presence of the sprayhood.

10.1.5 The materials used in the sprayhood's construction shall be compatible with those of the suit and shall in no way be able to cause damage to the buoyancy chambers or fabric of the suit or liferaft.

10.1.6 The sprayhood, whether stowed or deployed, should not cause inconvenience during winching or other rescue and recovery operations.

10.1.7 Means shall be provided to ensure that the level of carbon dioxide in the deployed sprayhood is within safe limits. This shall be demonstrated by testing to paragraph 6.10 of EN 396:1993 or equivalent.

11. Thermal protection

11.1 The suit shall provide the user with thermal protection in the water that at least satisfies the test requirements of paragraph 3.8 of EN ISO 15027-3:2002 as a class B suit system.

12. Water ingress

12.1 The integrated suit shall be so constructed that not more than 200g (7oz) of water shall leak into the suit when measured in accordance with paragraph 3.7 of EN ISO 15027-3:2002.

13. Conspicuity and location aids

13.1 Passenger Integrated Immersion Suits

To facilitate search and rescue operations, those parts of the suit which will be visible when in the water shall be of a highly conspicuous colour and comply with paragraph 4.5 of EN ISO 15027-1:2002.

13.2 Crew Integrated Immersion Suits

Where possible integrated suits for crew use shall meet the requirements of 13.1. However, the choice of suit colour may vary to minimise the risk of the suit reflecting on surfaces within the flight deck.

13.3 A passive light system of retro-reflective material shall be provided. This shall conform to the technical specification detailed in IMO SOLAS 83, Chapter III, Resolution A.658(16), Annex 2 or equivalent. A minimum area of 300cm² (46in²) shall be provided, distributed in accordance with paragraph 4.12 of EN ISO 15027-1:2002.

13.4 The integrated suit shall be fitted with a flashing survivor locator light that meets the requirements of ETSO-C85a. The light shall flash at a rate between 50 and 70 flashes per minute. The location of the light shall be such that maximum practical conspicuity is achieved when in the water with the suit inflated. The light shall activate automatically and have a manually operated on/off switch.

13.5 A whistle shall be provided which complies with the requirements of paragraph 4.3 of EN394:1994 or equivalent.

14. Recoverability

14.1 The integrated suit must be fitted with a lifting becket which complies with the requirements of paragraph 4.15 of EN396:1993 or equivalent.

14.2 The inflated or uninflated suit shall not adversely affect recovery of the wearer by the use of a rescue strop with a circumference of 180cm (70in).

15. Group help

15.1 The integrated suit shall be equipped with a buddy line which complies with the requirements of paragraph 4.6 of EN394:1994 or equivalent.

16. Inflation system. The integrated suit must comply with this section unless it can, without additional inflation, meet the requirements of paragraphs 9.2 and 9.3 and maintain them for the duration of the test period of paragraph 17.2.

16.1 General

- 16.1.1 The integrated suit shall have two separate means of inflation. The primary means shall be a manually-initiated stored gas system together with a standby oral inflation system capable of repeated use. The required buoyancy shall be obtainable by either method.
- 16.1.2 A means of releasing the pressure in the suit is required and shall be of a type capable of repeated use. Protection shall be provided against inadvertent deflation.
- 16.1.3 After inflation by either method, it shall be possible to deflate the suit and then to reinflate it by using the standby system. The standby inflation system shall be readily accessible, simple and obvious in operation and it shall be impossible for any valve which may be used to be inadvertently left open. It shall be possible to "top up" the suit orally whilst in use and without loss of inflation pressure.

16.2 Stored Gas System

- 16.2.1 Location of the actuating means of this type of system shall be such that it can be operated by either hand, in or out of the water. The method of releasing the stored gas into the suit shall be obvious; however, suitable marking shall be provided to advise the user.
- 16.2.2 The amount of stored gas provided shall be capable of inflating the suit to achieve the correct buoyancy as specified in paragraph 9.3 within 5 seconds of actuation at +20°C (68°F).
- 16.2.3 Adequate protection shall be provided to guard against any inadvertent initiation of an inflation when the wearer is passing through an emergency exit or when the suit is dropped from a height of 1.5m (5 feet).
- 16.2.4 The force required to manually initiate inflation must be a minimum of 20N (4.5lbf) and a maximum of 120N (27lbf) when tested in accordance with paragraph 6.8.4 of EN396:1993 or equivalent.

16.3 Oral Inflation System

- 16.3.1 The oral inflation tube shall comply with the requirements of paragraph 4.5 of EN396:1993 or equivalent.
- 16.3.2 It shall be positioned such that it can readily be used in and out of the water. After use, the device shall return to a position such that it will not produce facial injuries during a jump into the water as specified in paragraph 3.1 of Appendix 2.

17. Testing

17.1 Strength Pressure Test

The integrated suit shall have proof and ultimate factors of not less than 3 and 5 respectively on the pressure at which it is designed to be inflated by the primary means, at a stabilised ambient temperature of +45°C (113°F), and in no case shall

the proof and ultimate pressures be less than 15kPa (2lbf/in²) and 25kPa (3.3lbf/in²) respectively.

17.2 Buoyancy

The integrated suit shall retain buoyancy after use of the primary inflation system to such an extent that after a period of 12 hours the requirements of paragraphs 3.5 and 3.6 of Appendix 2 are still met.

17.3 Performance Tests

The performance of all integrated suits shall be tested in accordance with Appendix 2.

18. Inspection Testing and Repair

18.1 The procedure for inspecting, testing and repairing integrated suits shall be established by the manufacturer and shall be capable of ensuring that all suits satisfy the requirements of this specification throughout their service lives. As part of the procedure, suits shall be inspected at intervals to ensure they are always ready for immediate and effective use in the water. Special attention shall be paid to seals and fasteners. Suits shall be required to be immediately removed from service for repair or replacement if damage or deterioration is discovered that may lead to the suit failing to satisfy a routine leak test when one is next carried out.

18.2 The procedures for servicing, inspection, repair and testing shall be described in the manufacturer's manual.

18.3 The frequency of servicing and inspections shall be agreed with the manufacturer holding design approval for the suit.

19. Marking

19.1 Each detachable part of the integrated suit assembly shall, where reasonably practicable, be marked with:-

- (a) The manufacturer's approved inspection stamp.
- (b) The part number.
- (c) Date of manufacture or batch record.
- (d) Serial number

19.2 In the case of passenger integrated suits, the suit shall be marked with:-

- (a) Suit model designation
- (b) The manufacturer's name and address
- (c) Date of manufacture and Serial Number
- (d) Date at which next scheduled service and overhaul are due
- (e) Modification standard

19.3 In the case of crew integrated suits, the suit shall be marked with:-

- (a) The name of the crew member to whom it has been allocated
- (b) Rank of crew member marked externally, e.g. epaulettes.
- (c) Suit model designation
- (d) The manufacturer's name and address
- (e) Date of manufacture and Serial Number
- (f) Date at which next scheduled service and overhaul are due
- (g) Modification standard

- 19.4 The charged inflation cylinder shall be marked in accordance with paragraph 8.2 of EN396:1993 or equivalent, and include its date of manufacture.
- 19.5 When marking is not practicable alternative means must be agreed.

APPENDIX 2. INTEGRATED IMMERSION SUIT SYSTEM PERFORMANCE TESTING

1. Purpose

1.1 These tests are to demonstrate satisfactory performance of the integrated immersion suit system.

2. Test conditions

2.1 The following tests shall be conducted in calm water. The water temperature shall be $25\pm 2^{\circ}\text{C}$ ($77\pm 4^{\circ}\text{F}$).

2.2 Pass/fail criteria

All samples shall pass all objective tests to meet the requirements of ETSO-2C502 Integrated Immersion Suits. However, due to the high variability between subjects and the difficulty in assessing some subjective measures, it is permitted that an integrated immersion suit does not completely meet the requirements of the following subjective tests in a single example and in no more than in one test subject. In these circumstances, two other subjects within the same weight category and with the same sex should be subjected to the same test. If this additional test is still not clearly passed then the integrated immersion suit shall be deemed to have failed, whilst if it is clearly passed then it may be deemed to have passed the test overall.

3. Performance tests

3.1 Jump Test.

Each test subject shall perform a jump test in accordance with paragraph 3.11.6.1 of EN ISO 15027-3:2002.

3.2 Turning Test

Each test subject shall perform a turning test in accordance with paragraph 3.11.6.3 of EN ISO 15027-3:2002.

3.3 Escape Test Underwater

Each test subject shall be required to swim through an opening not greater than 430mm x 355mm (17in x 14in) (minimum acceptable size of helicopter escape window) positioned with the top of the opening at least 300mm (12in) below the surface of the water with the suit uninflated. At least one of the subjects for this test shall be required to have a shoulder width measurement of at least 500mm (19.7in).

3.4 Swim Test

Each test subject wearing the integrated suit and clothing shall swim on their back for 20 minutes. The hands and arms shall be kept in the water even if not being used for propulsion. Each test subject shall then board a liferaft fitted with boarding facilities, without undue effort and without assistance, with the suit sealed, inflated and the sprayhood deployed. The pool used shall be of sufficient size and depth to prevent the subject gaining assistance by "pushing off" from the side or bottom while performing this test.

3.5 Freeboard

Immediately following the swim test, the clearance of each test subject's face above the water shall be measured, with the subject behaving normally and when simulating unconsciousness. The clearance of the mouth (mouth freeboard) shall be a minimum of 120mm (4.7in) above the waterline in both cases. It shall be established that the nose freeboard is not less than the mouth freeboard.

3.6 Floating position

The angle of the test subject's body shall be measured by an appropriate method. The angle between the body and the horizontal shall be recorded and shall not be greater than 60°.

3.7 Field of vision

The wearer's field of vision shall not be unduly restricted when tested in accordance with paragraph 3.11.6.6 of EN ISO 15027-3:2002