

used to meet this paragraph, the inflation mechanism must meet the requirements for commercial hybrid PFDs in §160.077-15(c) of this chapter, and the tests required under §160.077-21(c)(3) of this chapter. Auxiliary buoyancy, if fitted and/or inflated, must not interfere with righting.

(c) *Thermal protection.* The suit must be designed to protect against loss of body heat as follows:

(1) The thermal conductivity of the suit material when submerged 1 m (39 in.) in water must be less than or equal to that of a control sample of 4.75 mm ($\frac{3}{16}$ in.) thick, closed-cell neoprene foam. The control sample of foam must have a thermal conductivity of not more than 0.055 watt/meter-° K (0.38 Btu-in./hr.-sq.ft.-°F).

(2) The suit must provide the wearer with sufficient thermal insulation, following one jump into the water from a height of 4.5 m, to ensure that the wearer's body core temperature does not fall more than 2 °C (3.6 °F) after a period of 6 hours immersion in calm circulating water at a temperature of between 0 °C (32 °F) and 2 °C (35.6 °F).

(d) *Donning time.* Each suit must be designed so that a person can don the suit correctly within two minutes after reading the donning and use instructions described in §160.171-15(a).

(e) *Vision.* Each suit must be designed to allow unrestricted vision throughout an arc of 60° to either side of the wearer's straight-ahead line of sight when the wearer's head is turned to any angle between 30° to the right and 30° to the left. Each suit must be designed to allow a standing wearer to move head and eyes up and down far enough to see both feet and a spot directly overhead.

(f) *Water penetration.* An immersion suit must be designed to prevent undue ingress of water into the suit following a period of flotation in calm water of one hour.

(g) *Splash protection.* Each suit must have a means to prevent water spray from directly entering the wearer's mouth.

(h) *Storage temperature.* Each suit must be designed so that it will not be damaged by storage in its storage case at any temperature between -30 °C (-22 °F) and +65 °C (149 °F).

(i) *Flame exposure.* Each suit must be designed to prevent sustained burning or continued melting after it is totally enveloped in a fire for a period of 2 seconds.

(j) *Oil resistance.* Each immersion suit must be designed to be useable after a 24 hour exposure to diesel oil.

§ 160.171-13 Storage case.

(a) Each suit must have a storage case made of vinyl coated cloth or material that provides an equivalent measure of protection to the suit.

(b) Each storage case must be designed so that it is still useable after two seconds contact with a gasoline fire.

§ 160.171-15 Instructions.

(a) Each suit must have instructions for its donning and use in an emergency. The instructions must be in English and must not exceed 50 words. Illustrations must be used in addition to the words. These instructions must be on the exterior of the storage case or printed on a waterproof card attached to the storage case or to the suit.

(b) If the suit has an inflatable auxiliary means of buoyancy, separate instructions covering the use of the inflation valve must be provided on the suit near the valve or on a waterproof card attached near the valve.

(c) Instructions for donning and use of the suit in an emergency must also be available in a format suitable for mounting on a bulkhead of a vessel. This placard must be in English, must include illustrations, and must include a warning as to the risk of entrapment in a submerged compartment due to the buoyancy of the suit.

(d) Instructions for donning and use of the suit in an emergency, instructions for care and repair of the suit, and any additional necessary information concerning stowage and use of the suit on a vessel must be available in 8½×11 loose-leaf format suitable for inclusion in the vessel's training manual.

§ 160.171-17 Approval testing for adult size immersion suit.

Caution: During each of the in-water tests prescribed in this section, a person ready to render assistance when

needed should be near each subject in the water.

(a) *General.* An adult size immersion suit must be tested as prescribed in this section. If the suit is also made in a child size, a child size suit must be tested as prescribed in §160.171-19. If the suit is also made in an oversize adult size, an oversize adult suit must be tested as prescribed in §160.171-17(g) to determine the measured buoyancy for the suit. No additional testing will be required if the oversize adult suit is of the same design as the adult suit except for extra material to provide for larger persons.

(b) *Test samples.* Each test prescribed in this section may be performed by using as many immersion suits as needed to make efficient use of the test subjects and test equipment, except that each subject in the impact test described in §160.171-17(c)(11) must not use more than one suit during the test, and the suits used in the impact test must also be used in the thermal protection test described in §160.171-17(d).

(c) *Mobility and flotation tests.* The mobility and flotation capabilities of each immersion suit must be tested under the following conditions and procedures:

(1) *Test subjects.* Seven males and three females must be used in the tests described in this paragraph. The subjects must represent each of the three physical types (ectomorphic, endomorphic, and mesomorphic). Each subject must be in good health. The heaviest subject, of either sex, must weigh at least 135 kg (298 lb.). The heaviest male subject must weigh at least 115 kg (254 lb.) and the lightest male subject must weigh not more than 55 kg (121 lb). The heaviest female subject must weigh at least 115 kg (254 lb.) and the lightest female subject must weigh not more than 55 kg (121 lb). Each subject must be unfamiliar with the specific suit under test. Each subject must wear a standard range of clothing consisting of:

- (i) Underwear (short sleeved, short legged);
- (ii) Shirt (long sleeved);
- (iii) Trousers (not woolen);
- (iv) Woolen or equivalent synthetic socks;
- (v) Rubber soled work shoes.

(2) *Donning time.* Each subject is removed from the view of the other subjects and allowed one minute to examine a suit and the manufacturer's instructions for donning and use of the suit in an emergency. At the end of this period, the subject attempts to don the suit as rapidly as possible without the aid of a chair or any support to lean on. If the subject does not don the suit completely, including gloves and any other accessories, within two minutes, the subject removes the suit and is given a demonstration of correct donning, and again attempts to don the suit. At least nine of the ten subjects must be able to don the suit completely, including time to remove shoes if necessary, in two minutes in at least one of the two attempts.

(3) *Field of vision.* The immersion suit's field of vision must be tested as follows:

(i) While wearing a suit, each subject sits upright and faces straight ahead. An observer is positioned to one side of the subject at an angle of 60° away from the subject's straight-ahead line of sight. The observer must be able to see the subject's closest eye at this position. The observer then walks past the front of the subject to a position on the subject's other side that is at an angle of 60° away from the subject's straight-ahead line of sight. The suit must not obstruct the observer's view of the subject's eyes at any point between the two positions.

(ii) While wearing the suit, each subject stands upright and faces straight ahead. An observer is positioned to one side of the subject at an angle of 90° away from the subject's straight-ahead line of sight. The subject then turns his or her head through an arc of 30° toward the position of the observer. This procedure is repeated with the observer positioned on the other side of the subject at an angle of 90° away from the subject's straight ahead line of sight. The suit must not obstruct the observer's view of the subject's eyes when the subject's head is turned 30° toward the observer.

(iii) While wearing the suit, each subject stands upright and faces straight ahead. Through a combination of head and eye movement, the subject looks first at a spot directly overhead, then

looks at a spot on or between the feet. An observer must verify that the subject can make the necessary head and eye movements while wearing the suit.

(4) *Hand dexterity.* A physician must always be present during this test. While wearing a suit, including a removable glove if any, and after being immersed in water at 5 °C (41 °F) for a period of one hour, each subject must be able to pick up a 9.5 mm ($\frac{3}{8}$ in.) diameter wooden pencil from a flat hard surfaced table using only one hand. Still using only one hand, the subject must be able to position the pencil and write with it. At least eight of the ten test subjects must be able to complete this test. This test may be performed in conjunction with the thermal protection test described in §160.171-17(d), in which case five of the six test subjects specified in §160.171-17(d)(1) must be able to complete the test.

(5) *Walking.* A 30 m (100 ft.) long walking course must be laid out on a smooth linoleum floor. The finish on the floor must allow water to lie on it in a sheet rather than in beads. The course may have gradual turns, but must not have any abrupt change in direction. Each subject is timed walking the course two times at a normal pace with the floor dry. Each subject then dons a suit and is timed again walking the course two times with the floor wet. The subject is given adequate rest between trials to avoid fatigue. The subject must not slip on the wet floor when wearing the suit. The average time for each subject to walk the course while wearing the suit must be not more than 1.25 times the subject's average time to walk the course without the suit.

(6) *Climbing.* A vertical ladder extending at least 5 meters (17 feet) above a level floor must be used for this test. Each subject is timed climbing the ladder twice to a rung at least 3 meters (10 feet) above the floor. The subject then dons a suit and is again timed climbing to the same rung twice. The subject is given adequate rest between trials to avoid fatigue. The average time for each subject to climb the ladder while wearing the suit must not be more than 1.25 times the subject's average time to climb the ladder without the suit.

(7) *Swimming and water emergence test.* A pool with an inflatable liferaft at one side must be used for this test. The liferaft must be of a type approved under Subpart 160.051 of this Chapter and must not have a boarding ramp. Each subject, wearing a life preserver but not the immersion suit, enters the water and swims 25 m. The subject must then be able to emerge from the pool onto the liferaft using only the hands placed on top of the liferaft as an aid and without pushing off of the bottom of the pool. Any subject unable to emerge onto the liferaft within 30 seconds is disqualified for this test. At least five subjects must qualify and be used for this test. If less than five subjects of the original ten qualify, substitute subjects must be used. Each qualified subject, after sufficient rest to avoid fatigue, repeats this test wearing an immersion suit instead of the life preserver. At least two-thirds of the qualified subjects must be able to swim this distance, and emerge onto the liferaft within 30 seconds, wearing the immersion suit.

(8) *Stability and retroreflective material.* While wearing the suit in water without any auxiliary means of buoyancy, each subject assumes a face-up position and then allows his or her body to become limp. The distance from the water surface to the lowest part of the subject's mouth or nose is measured. This procedure is repeated using the auxiliary means of buoyancy, if one is provided. For each test subject, the stable position and the distance of the mouth and nose above the water must be prescribed in §160.171-11(a)(2) and §160.171-11(a)(3). During this test, each subject must be viewed by observers to determine whether the retroreflective material of the suit meets §160.171-9(n).

(9) *Righting.* Each subject while wearing a suit in water, without the use of any auxiliary means of buoyancy, takes a deep breath, assumes a face-down position, allows his or her body to become limp, and slowly expels air. The suit must cause the subject to turn to a position where the face is clear of the water within 5 seconds; or if the suit does not turn the subject within 5 seconds, the subject must be able to turn face up under his or her own power within 5 seconds. If the suit is

provided with any means of auxiliary buoyancy, the procedure is repeated under each of the following applicable conditions:

(i) With any means of auxiliary buoyancy attached but not inflated;

(ii) With any means of auxiliary buoyancy which must be inflated by the wearer inflated according to the instructions; or

(iii) With any means of auxiliary buoyancy which inflates automatically inflated by its automatic mechanism.

(10) *Water and air penetration.* Each subject is weighed while wearing a pre-wetted suit without any auxiliary means of buoyancy. The subject jumps into water from a height that will cause the subject to be completely immersed. The subject swims or treads water for approximately one minute, emerges from the water, and is weighed within 10 seconds after emerging. The procedure is repeated with the subject entering the water headfirst. If air accumulates in the legs as the subject enters the water head-first, it must be expelled automatically. At the end of this test, the weight of the subject in the suit must not exceed the weight of the subject in the suit at the beginning of the test by more than 500 grams. Each test subject then re-enters the water and floats for a period of one hour. The subject then emerges from the water and is weighed within 10 seconds. The weight of the subject in the suit at the end of this test must not exceed the weight of the subject in the suit at the beginning of the period of flotation by more than 200 grams.

(11) *Impact.* While wearing a suit without any auxiliary means of buoyancy, each subject jumps into water feet first six times from a height of 4.5 m (15 ft.) above the water surface. Each subject must be able to assume a face up stable position without assistance after each jump. The suit must not tear, separate at any seam, or exhibit any characteristic that could render it unsafe or unsuitable for use in water.

(d) *Thermal protection.* The thermal protection capability of a suit must be tested under the following conditions and procedures;

(1) *Test subjects.* Male subjects must be used for this test. Each subject must be familiarized with the test procedure

before starting the test. Each subject must have somatotype parameters within the following ranges according to the Heath-Carter anthropometric method: endomorphy 3.5 ± 1.0 ; mesomorphy 4.0 ± 1.5 ; ectomorphy 3.5 ± 1.0 .

NOTE: The following publication, among others, contains guidance for use of the Heath-Carter anthropometric method: "Body Type and Performance," Hebbelinck and Ross; FITNESS, HEALTH AND WORK CAPACITY, INTERNATIONAL STANDARDS FOR ASSESSMENT; Larson, L. A. (Ed.); International Committee for the Standardization of Physical Fitness Tests; Macmillan; New York; 1974 (pp. 266-283).

Each subject must have had a normal night's sleep before the test, a well-balanced meal 1 to 5 hours before the test, and no alcoholic beverages for 24 hours before the test. In addition to the suit, each subject must wear:

(i) Underwear (short sleeved, short legged);

(ii) Shirt (long sleeved);

(ii) Trousers (not woolen);

(iv) Woolen or equivalent synthetic socks;

(v) Work shoes, if the suit is designed for shoes to be worn inside.

(2) *Test equipment.* The test must be conducted in calm water with a temperature between 0 °C (32 °F) and 2 °C (35.6 °F). The air temperature 300 mm (1 ft.) above the water surface must be between minus 10 °C (14 °F) and 20 °C (68 °F). Each subject must be instrumented with an electrocardiograph, a thermistor or thermocouple in the rectum placed 150 mm (6 in) beyond the anus, thermistor or thermocouple in the lumbar region, a thermistor or thermocouple on the tip of the index finger, and a thermistor or thermocouple on the tip of the great toe. Each thermistor or thermocouple must have an accuracy of 0.1 °C (0.18 °F). The suits used in this test must be the same ones previously subjected to the impact test described in §160.171-17(c)(11).

(3) *Test procedure.* A physician must always be present during this test. Before donning the suit, each subject rests quietly in a room with a temperature between 10 °C (50 °F) and 25 °C (77 °F) for 15 minutes. The rectal temperature is then recorded as the initial rectal temperature. The subject dons a suit as rapidly as possible without

damaging the instrumentation and immediately enters the water. The subject assumes a face-up, stable floating position. No auxiliary means of buoyancy may be used during this test. The subject remains in the water engaging in activity that maintains the heart rate between 50 and 140 per minute for the first hour, and between 50 and 120 per minute during the remainder of the test, except that no attempt is made to control heart rate if the subject is shivering. Each thermistor or thermocouple reading is recorded at least every 10 minutes.

(4) *Completion of testing.* Testing of a subject ends six hours after he first enters the water, unless terminated sooner.

(5) *Termination of test.* Testing of a subject must be terminated before completion if any of the following occurs:

(i) The physician determines that the subject should not continue.

(ii) The subject requests termination due to discomfort or illness.

(iii) The subject's rectal temperature drops more than 2 °C (3.6 °F) below the initial rectal temperature, unless the physician determines that the subject may continue.

(iv) The subject's lumbar, finger, or toe temperature drops below 10 °C (50 °F), unless the physician determines that the subject may continue.

(6) *Test results.* The test results must be prepared as follows:

(i) The total rectal temperature drop during the test period and the average lumbar, finger and toe temperature at the end of the test must be determined for each subject in the test, except subjects who did not complete testing for a reason stated in paragraph (d)(5)(i) or (d)(5)(ii) of this section. These temperatures and temperature drops must then be averaged. The average drop in rectal temperature must not be more than 2 °C (3.6 °F), and the average lumbar, toe and finger temperature must not be less than 5 °C (41 °F). Data from at least four subjects must be used in making these temperature calculations.

(ii) Rates of toe, finger, lumbar, and rectal temperature drop for each subject who did not complete testing for a reason stated in paragraph (d)(5)(iii) or

(d)(5)(iv) of this section must be determined using the highest temperature measured and the temperature measured immediately before testing was terminated. These rates must be used to extrapolate to 6 hours the estimated rectal, finger, lumbar, and toe temperature at the end of that time. These estimated temperatures must be the temperatures used in computing the average temperatures described in paragraph (d)(6)(i) of this section.

(e) *Insulation.* Suit material must be tested under the following conditions and procedures, except that if the suit material meets the requirements for the control sample in paragraph (e)(1)(iii) of this section, the test procedure in paragraph (e)(2) of this section is not required.

(1) *Test equipment.* The following equipment is required for this test:

(i) A sealed copper or aluminum can that has at least two parallel flat surfaces and that contains at least two liters (two quarts) or water and no air. One possible configuration of the can shown in figure 160.171-17(e)(1)(i).

(ii) A thermistor or thermocouple that has an accuracy of ± 0.1 °C (± 0.18 °F) and that is arranged to measure the temperature of the water in the can.

(iii) A control sample of two flat pieces of 4.75 mm (3/16 in.) thick, closed cell neoprene foam of sufficient size to enclose the can between them. The control sample must have a thermal conductivity of not more than 0.055 watt/meter-°K (0.38 Btu-in./hr.-sq.ft.-°F). The thermal conductivity of the control sample must be determined in accordance with the procedures in ASTM C 177 or ASTM C 518 (incorporated by reference, see § 160.171-3).

(iv) Two flat pieces of suit material of sufficient size to enclose the can between them. The surface covering, surface treatment, and number of layers of the material tested must be the same as those of material used in the suit. If the material used in the suit varies in thickness or number of layers, the material tested must be representative of the portion of the suit having the least thickness or number of layers.

(v) A clamping arrangement to form a watertight seal around the edges of

the material when the can is enclosed inside. A sealing compound may be used. Figure 160.171-17(e)(1)(v) shows one possible arrangement of the clamping arrangement.

(vi) A container of water deep enough to hold the entire assembly of the can, material, and clamp at least 1 meter (39 in.) below the surface of the water.

(vii) A means to control the temperature of the water in the container between 0 °C (32 °F) and 1 °C (33.8 °F).

(viii) A thermistor or thermocouple that has an accuracy of ± 0.1 °C (0.18 °F) and that is arranged to measure the temperature of the water in the container at the depth at which the can, material, and clamp are held.

(2) *Test procedure.* The can is held under water (which can be at room temperature) and clamped between the two pieces of the neoprene control sample so that the assembly formed conforms as closely as possible to the shape of the can, and so that water fills all void spaces between the can and the sample. When the water temperature in the can is at or above 45 °C (113 °F), the assembly is then placed in the container and submerged to a depth of 1 m (39 in.) at the highest point of the assembly. The water temperature in the container must be between 0 °C (32 °F) and 1 °C (33.8 °F) and must be maintained within this range for the remainder of the test. No part of the assembly may touch the bottom or sides of the container. Every two minutes the assembly is shaken and then inverted from its previous position. The time for the water inside the can to drop from 45 °C (113 °F) to 33 °C (91 °F) is recorded. This procedure is performed three times using the control sample and then repeated three times using the suit material instead of the control sample. The shortest time for the drop in water temperature when the suit material is used must be greater than or equal to the shortest time when the neoprene control sample is used.

(f) *Storage temperature.* Two samples of the immersion suits, in their storage cases, must be alternately subjected to surrounding temperatures of -30 °C to +65 °C. These alternating cycles need not follow immediately after each other and the following procedure, re-

peated for a total of ten cycles, is acceptable:

(1) 8 hours conditioning at 65 °C to be completed in one day;

(2) The specimens removed from the warm chamber that same day and left exposed under ordinary room conditions until the next day;

(3) 8 hours conditioning at -30 °C to be completed the next day; and

(4) The specimens removed from the cold chamber that same day and left exposed under ordinary room conditions until the next day. At the conclusion of the final cycle of cold storage, two test subjects who successfully completed the donning test in paragraph (c)(2) of this section enter the cold chamber, unpack and don the immersion suits. Alternatively, the suits may be unpacked in the chamber, then removed and immediately donned. Neither of the suits must show damage such as shrinking, cracking, swelling, dissolution or change of mechanical qualities.

(g) *Measured buoyancy.* The buoyancy of a suit must be measured under the following conditions and procedures:

(1) *Test equipment.* The following equipment is required for this test:

(i) A mesh basket that is large enough to hold a folded suit, and that is weighted sufficiently to overcome the buoyancy of the suit when placed in the basket.

(ii) A tank of water that is large enough to contain the basket submerged with its top edge 50 mm (2 in.) below the surface of the water.

(iii) A scale or load cell that has an accuracy of 0.15 Newtons (1/2 oz.) and that is arranged to support and weigh the basket in the tank.

(2) *Test procedure.* The basket is submerged so that its top edge is 50 mm (2 in.) below the surface of the water. The basket is then weighed. Thereafter, a suit is submerged in water and then filled with water, folded, and placed in the submerged basket. The basket is tilted 45° from the vertical for five minutes in each of four different directions to allow all entrapped air to escape. The basket is then suspended with its top edge 50 mm (2 in.) below the surface of the water for 24 hours. At the beginning and end of this period, the basket and suit are weighed underwater. The

measured buoyancy of the suit is the difference between this weight and the weight of the basket as determined at the beginning of the test. The measured buoyancy after 24 hours must not be more than 5% lower than the initial measured buoyancy. The measured buoyancy after 24 hours is used to determine adjusted buoyancy as described in paragraph (h) of this section.

(h) *Adjusted buoyancy.* The adjusted buoyancy of a suit is its measured buoyancy reduced by the percentage buoyancy loss factor of the buoyant suit material. The percentage buoyancy loss factor is part of the buoyancy rating code determined in accordance with UL 1191, except that the minimum number of samples required to determine each property is 10 instead of 75.

(i) *Suit flame exposure.* The suit's resistance to flame must be tested under the following conditions and procedures:

(1) *Test equipment.* The following equipment is required for this test:

(i) A metal pan that is at least 300 mm (12 in.) wide, 450 mm (18 in.) long, and 60 mm (2½ in.) deep. The pan must have at least 12 mm (½ in.) of water on the bottom with approximately 40 mm (1½ in.) of gasoline floating on top of the water.

(ii) An arrangement to hold the suit over the gasoline.

(2) *Test procedure.* A suit is held from its top by the holding arrangement. The gasoline is ignited and allowed to burn for approximately 30 seconds in a draft-free location. The suit is then held with the lowest part of each foot 240 mm (9.5 in.) above the surface of the burning gasoline. After two seconds, measured from the moment the flame first contacts the suit, the suit is removed from the fire. The suit must not sustain burning or continue melting after removal from the flames. If the suit sustains any visible damage other than scorching, it must then be subjected to the stability test described in paragraph (c)(8) of this section, except that only one subject need be used; the impact test described in paragraph (c)(11) of this section, except that only one subject need be used; the thermal protection test described in paragraph (d) of this section, except that only one subject need be used; and the buoyancy

test described in paragraph (g) of this section, except that the buoyancy test need be conducted for only 2 hours.

(j) *Storage case flame exposure.* The storage case must be tested using the same equipment required for the suit flame exposure test. The immersion suit must be inside the storage case for this test. The storage case is held from its top by the holding arrangement. The gasoline is ignited and allowed to burn for approximately 30 seconds in a draft-free location. The storage case is then held with its lowest part 240 mm (9.5 in.) above the surface of the burning gasoline. After two seconds, measured from the moment the flames first contact the case, the case is removed from the fire. If the case is burning, it is allowed to continue to burn for six seconds before the flames are extinguished. The storage case material must not burn through at any point in this test and the immersion suit must not sustain any visible damage.

(k) *Corrosion resistance.* Each metal part of a suit that is not 410 stainless steel, or for which published evidence of salt-spray corrosion resistance equal to or greater than 410 stainless steel is not available, must be tested as described in ASTM B 117 (incorporated by reference, see §160.171-3). A sample of each metal under test and a sample of 410 stainless steel must be tested for 720 hours. At the conclusion of the test, each sample of test metal must show corrosion resistance equal to or better than the sample of 410 stainless steel.

(l) *Body strength.* The body strength of a suit must be tested under the following conditions and procedures:

(1) *Test equipment.* The test apparatus shown in figure 160.171-17(1)(1) must be used for this test. This apparatus consists of—

(i) Two rigid cylinders each 125 mm (5 in.) in diameter, with an eye or ring at each end;

(ii) A weight of 135 kg (300 lb.); and

(iii) Ropes or cables of sufficient length to allow the suit to be suspended as shown in Figure 160.171-17(1)(1).

(2) *Test procedure.* The suit is cut at the waist and wrists, or holes are cut into it as necessary to accommodate

the test apparatus. The suit is immersed in water for at least two minutes. The suit is then removed from the water and immediately arranged on the test apparatus, using each closure as it would be used by a person wearing the suit. The 135 kg (300 lb.) load is applied for 5 minutes. No part of the suit may tear or break during this test. The suit must not be damaged in any way that would allow water to enter or that would affect the performance of the suit.

(m) *Seam strength.* The strength of each different type of seam used in a suit must be tested under the following conditions and procedures:

(1) *Test equipment.* The following equipment must be used for this test.

(i) A chamber in which air temperature can be kept at 23 °C (73.4 °F) ± 2 °C (1.8 °F) and in which relative humidity can be kept at 50% ± 5 %.

(ii) A device to apply tension to the seam by the means of a pair of top jaws and a pair of bottom jaws. Each set of jaws must grip the material on both sides so that it does not slip when the load is applied.

(2) *Test samples.* Each test sample must consist of two pieces of suit material, each of which is a 100 mm (4 in.) square. The two pieces are joined by a seam as shown in figure 160.171-17(m)(3). For each type of seam, 5 samples are required. Each sample may be cut from the suit or may be prepared specifically for this test. One type of seam is distinguished from another by the type and size of stitch or other joining method used and by the type and thickness of the materials joined at the seam.

(3) *Test procedure.* Each sample is conditioned for at least 40 hours at 23 °C (73.4 °F) ± 2 (1.8 °F) C and 50% ± 5 % relative humidity. Immediately after conditioning, each sample is mounted individually in the tension device as shown in figure 160.171-17(m)(3). The jaws are separated at a rate of 5 mm/second (12 in./minute). The force at rupture is recorded. The average force at rupture must be at least 225 Newtons (50 lb.).

(n) *Tear resistance.* The tear resistance of suit material must be determined by the method described in ASTM D 1004. If more than one material is used, each material must be

tested. If varying thickness of a material are used in the suit, samples representing the thinnest portion of the material must be tested. If multiple layers of a material are used in the suit, samples representing the layer on the exterior of the suit must be tested. Any material which is a composite formed of two or more materials bonded together is considered to be a single material. The average tearing strength of each material must be at least 45 Newtons (10 lb.).

(o) *Abrasion resistance.* The abrasion resistance of each type of suit material on the exterior of the suit must be determined by the method described in Federal Test Method Standard 191, Method 5304.1. If varying thicknesses of exterior suit material are used, samples representing the thinnest portion of the material must be tested. If exterior material has multiple layers, samples of the layer on the outside surface of the suit must be tested. Any exterior material which is a composite formed of two or more layers bonded together is considered to be a single material and the abradant must be applied to the surface that is on the exterior of the suit. The residual breaking strength of each material must be at least 225 Newtons (50 lb.).

(p) *Test for oil resistance.* After all its apertures have been sealed, an immersion suit is immersed under a 100 mm head of diesel oil, grade No. 2-D as defined in ASTM D 975 (incorporated by reference, see §160.171-3) for 24 hours. The surface oil is then wiped off and the immersion suit subjected to the leak test prescribed in §160.171-17(c)(10). The ingress of water must not be greater than 200 grams.

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§ 160.171-19 Approval testing for child size immersion suit.

A child size suit must pass the following tests:

(a) The stability test prescribed in §160.171-17(c)(8), except that only six children need be used as test subjects and they can be of either sex. The subjects must be within the ranges of weight and height prescribed in §160.171-9(m). The heaviest subject must weigh at least 10 kg (22 lb.) more