# 5.6.4.2 Procedure

Using ordinary clothing, subjects who are completely unfamiliar with the PFD shall attempt to don the PFD to a snug fit. If the attire customary to the designated purpose of the PFD can have an adverse effect on the test results, the tests shall be repeated with at least one subject wearing such attire. Each subject may have two attempts as follows.

# 5.6.4.2DV DT Modification by replacing the first paragraph of clause 5.6.4.2 as follows:

For PFDs according to ISO 12402-3 to ISO 12402-4 and UL 12402-5:2012, wearing either a bathing costume or ordinary clothing, subjects who are completely unfamiliar with the PFD shall attempt to don the PFD to a snug fit. If the attire customary to the designated purpose of the PFD or ordinary clothing can have an adverse effect on the test results, the tests shall be repeated with at least one subject wearing such attire. For lifejackets according to ISO 12402-1 and ISO 12402-2 the test shall be run wearing ordinary clothing. Each subject may have two attempts as follows.

a) For all PFDs, the first attempt shall be with no assistance, guidance or prior demonstration. The PFD, with closures undone and adjusted to fit a mid-sized subject, shall be placed on the deck, face up, in front of the test subject. The instruction provided shall be identical for each subject and shall be equivalent to the following: "PLEASE DON THIS DEVICE QUICKLY AND SECURELY SO YOU CAN ABANDON SHIP." The attempt shall be timed. Donning is considered complete when the subject has donned and securely adjusted all methods of securing the PFD to the extent needed to meet the in-water performance requirements for the performance level of PFD, including inflation, if needed.

# 5.6.4.2ADV D1 Modification by adding the new fourth sentence to clause 5.6.4.2a as follows:

# The instruction shall include the requirement to inflate an inflatable PFD.

b) For PFDs according to ISO 12402-2 to ISO 12402-6, the second attempt, if necessary, shall be after the test subject has read the instructions printed on the PFD.

# 5.6.4.2BDV DT Modification by replacing 5.6.4.2b as follows:

# b) When a subject does not follow the donning instructions on the second attempt, the subject shall be replaced, provided that no other subject dons the device in the same improper manner.

NOTE For the purposes of testing, a facsimile of the instructions may be provided separately.

c) For lifejackets according to ISO 12402-1, if necessary, the second attempt shall be after the subjects have viewed a demonstration of proper donning of the lifejacket.

For lifejackets according to ISO 12402-1, each subject shall make one additional donning attempt using the procedures specified in a) while using heavy-weather clothing consisting of an arctic parka with hood and warm cotton gloves.

5.6.4.2DV.1 DT Modification by replacing the last paragraph of clause 5.6.4.2 as follows:

If specified in the relevant parts of ISO 12402, each subject shall make one additional donning attempt using the procedures specified in a) while using heavy weather clothing.

# 5.6.4.2DV.2 *DT* Modification by adding the following paragraphs to clause 5.6.4.2 as follows:

In addition, inflatable PFD's shall be donned with the PFD fully inflated. The second attempt, if necessary, should allow the test subjects to be instructed that partial deflation is acceptable to successfully don the PFD in the inflated condition. Donning is considered complete when the subject has donned and securely adjusted the PFD to the extent needed to meet the in-water performance requirements of the performance level of PFD, including full re-inflation of the inflatable chamber via the oral inflation tube.

For devices requiring additional action by the user, such as oral inflation or other activities in the way of secondary donning, this test is to be repeated in the water.

# 5.6.4.3 Results

All PFDs shall be capable of being completely donned by at least 75 % of persons using ordinary clothing and who are completely unfamiliar with the PFD within a period of 1 min without assistance, guidance or prior demonstration. If less than 75 % of the first group of test subjects are able to don the lifejacket within the 1 min period on the first attempt, a second and third set of test subjects may be used to cumulatively demonstrate meeting the 75 % criterion. If used, the second and third sets of subjects shall meet the same criteria as the first set of subjects.

# 5.6.4.3DV.1 DE Modification by replacing the second sentence of the first paragraph of clause 5.6.4.3 as follows:

If less than 75 % of the first group of test subjects are able to don the PFD within the 1 min period on the first attempt, a second and third set of test subjects may be used to cumulatively demonstrate meeting the criterion specified.

For PFDs according to ISO 12402-2 to ISO 12402-6, after the subjects have read the instructions printed on the PFD, the PFD shall be capable of being completely donned by all persons without assistance within a period of 1 min.

For lifejackets according to ISO 12402-1, after the subjects have viewed a demonstration of proper donning of the lifejacket, the PFD shall be capable of being completely donned by all persons without assistance within a period of 1 min.

For lifejackets according to ISO 12402-1, using heavy weather clothing, all persons shall be able to correctly don it within a period of 1 min without assistance.

# 5.6.4.4 Secondary donning

All devices requiring additional action by the user, such as oral inflation or other activities in the way of secondary donning, shall be tested on each subject to demonstrate that they can be accomplished within

the prescribed time. The subjects shall prove that the necessary action for secondary donning and inflation can be performed in water and on land within the prescribed time.

# 5.6.5 Water entry test

#### 5.6.5.1 Principle

PFDs shall be evaluated for their ability to stay on a user when falling or jumping into the water, and to remain in a usable position. The evaluation is intended to cover most unfavourable attitudes of water entry.

The PFD shall withstand any damage when the user jumps from height. The PFD shall be tested according to the designated design. The test shall prove all service conditions, i.e. for a PFD being inflated both automatically and manually, or if of multi-chamber design also with one of the compartments uninflated. The tests shall be repeated as many times as necessary to verify all service conditions.

The subject shall be familiar with jumping from such height.

Without readjusting the PFD, the test subject shall jump vertically into the water, feet first. The test subject shall be allowed to hold on to the PFD or brace arms during water entry according to 5.6.5.2.2 and 5.6.5.2.3 to avoid possible injury.

# 5.6.5.1DV DT Modification by deleting the fourth paragraph of clause 5.6.5.1:

The test subject shall come to rest with the mouth clear of the water by at least the required freeboard.

# 5.6.5.1DV.1 D1 Modification by replacing the fifth paragraph of clause 5.6.5.1 with the following:

The ability of an automatic inflation system to bring the subject to the surface of the water shall is evaluated for both activation function and time to surface.

Any elastic parts used to improve the fit of the garment shall be cut prior to the test.

# 5.6.5.2 Procedure

5.6.5.2.1 An inflatable PFD shall be donned and inflated by the primary means of inflation. Non-inflatable PFDs shall be donned. The test subject, initially with arms held vertically over the head, shall fall or step into the water, feet first, from a height of  $(1\ 000\ ^0_{+500})$  mm. Upon going into the water, the test subject shall relax to simulate a state of utter exhaustion. Water entry in other orientations such as a dive or a feet-first step with arms at sides shall be performed if they are more likely to produce adverse results.

5.6.5.2.1DV.1 D1 Modification by replacing clause 5.6.5.2.1 as follows:

All PFD's shall be donned in accordance with the manufacturer's instruction for use prior to water entry. For an inflatable PFD, the subject shall enter the water in the device configuration and order of jumps defined in <u>Table 9DV</u>. For all PFD's, the test subject, initially with arms held vertically over the head, shall fall or step into the water, feet first, from a height of (1000  $\pm$ 100) mm. Water entry in other orientations such as a dive or a feet-first step with arms at sides shall be performed if they are more likely to produce adverse results.

Order of Jumps	Jump Height (mm) <sup>1</sup>	Conditions of Device Before Jump
1	1000	Fully inflated after donning <sup>2</sup>
2	1000	Deflated with automatic inflation system armed
3	1000	Deflated with manual inflation armed but with automatic inflation system disarmed
4	3000	Fully Inflated <sup>2,3</sup>
5	4500	Fully Inflated <sup>4</sup>
Note 1 – All jump heights have a tolerance of ± 100 mm		
Note 2 – Secondary donning shall be completed prior to jump		
Note 3 – For ISO 12402-2 thru 12402-4 and UL 12402-5:2012 devices only		
Note 4 – For ISO 12402-1 devices only		

Table 9DV Water entry configurations for inflatable PFDs

For manual  $CO_2$ -inflated PFDs the test shall be repeated after evacuating the inflation chamber and reinflating it manually once in the water with the appropriate size  $CO_2$ -filled cylinder. For automatic  $CO_2$ inflatable PFDs the test shall be repeated on the uninflated device, with the system armed, after evacuating the inflation chamber.

# 5.6.5.2.1DV.3 D1 Modification by adding a third paragraph for clause 5.6.5.2.1 as follows:

In addition to the water entry configurations in <u>Table 9DV</u>, for a device that incorporates automatic and manual-auto inflation systems, jump sequence 2 shall be repeated by at least three subjects, however the subjects shall enter the water in a dive position. Upon going into the water, the subjects shall relax to simulate a state of utter exhaustion.

5.6.5.2.2 When testing PFDs according to ISO 12402-2 to ISO 12402-5, the feet-first water entry tests shall be repeated with the subject entering the water from a height of  $(3\ 000\ ^0_{+500})$  mm.

# 5.6.5.2.2DV D1 Modification by replacing entire clause 5.6.5.2.2 as follows:

When testing lifejackets according to ISO 12402-2, ISO 12402-3, or ISO 12402-4 and inflatable buoyancy aids according to UL 12402-5:2012, the feet-first water entry tests shall be repeated with the subject entering the water from a height of (3 000  $^{0}_{+500}$ ) mm. Subjects shall be instructed to hold onto the device during this water entry.

5.6.5.2.3 For PFDs according to ISO 12402-1, the test subject shall additionally perform this test by jumping vertically into the water, feet first, from a height of  $(4 \ 500^{0}_{+500})$  mm.

# 5.6.5.2.3DV *DT* Modification by adding the following sentence to the end of clause 5.6.5.2.3:

Subjects shall be instructed to hold onto the device during this water entry.

5.6.5.2.4DV DT Modification by adding a new clause to 5.6.5:

When testing child PFDs according to 5.6.5.2.1 pv.1, subjects unwilling or unable to enter the water from an elevated height shall be given the option to jump from the side of the pool with arms held vertically over the head.

When testing child PFDs, the water entry tests according to 5.6.5.2.2DV and 5.6.5.2.3 shall not be conducted.

When testing infant PFDs, the water entry tests according to <u>5.6.5.2</u> shall not be conducted.

# 5.6.5.3 Results

Record the individual and average of all subjects' trunk angles from vertical. Record the individual and average of all subjects' face plane (head) angles from horizontal.

The panel shall examine the PFD and note any damage.

The panel shall observe that the PFD is not dislodged, does not harm the wearer, has not been damaged to endanger its in-water performance, and brings the wearer to the surface in the attitude specified in the applicable part of ISO 12402. When not required to bring the subject to a face-up position, the panel shall observe that the PFD permits the subject to maintain a vertical or backwards inclined attitude without having to carry out any movement other than postural adjustment or small head movements.

5.6.5.3DV D1 Modification by replacing entire clause 5.6.5.3 as follows:

5.6.5.3.1DV After each water entry record the freeboard:

a) For buoyancy aids, record if the individual freeboards are positive according to UL 12402-5.

b) For lifejackets, record the individual freeboards according to ISO 12402-1 to ISO 12402-4.

In addition, after each water entry, the panel shall:

a) Observe that the PFD is not dislodged;

b) Observe that the PFD does not harm the wearer;

c) Observe whether the PFD brings the wearer to the surface in the attitude specified in the applicable part of ISO 12402 and UL 12402-5:2012 and provides adequate faceup stability,

d) Observe whether an inflatable PFD completely opens and is located on the subject as intended by the manufacturer.

5.6.5.3.2DV When not required to bring the subject to a face-up position, the panel shall observe whether the PFD permits the subject to maintain a vertical or backwards inclined attitude without having to carry out any movement other than postural adjustment or small head movements.

5.6.5.3.3DV For inflatables, after each sequence of water entry testing, the device shall be examined for incorrect distribution through the inflation chambers such as an unopened cover, twisted shoulder, or the like. In addition, for automatic and manual-auto devices, the times to bring the subjects to the surface of the water shall be recorded.

5.6.5.3.4DV After each water entry described above, each PFD shall be examined and any damage noted. The PFD may be removed from the subject for examination.

#### 5.6.6 Self-righting and stability test

#### 5.6.6.1 Principle

5.6.6.1.1 The tests according to 5.6.6.3 shall demonstrate that a PFD (see ISO 12402-2:2006, 5.6, to ISO 12402-4:2006, 5.6) being evaluated provides,

a) for lifejackets and buoyancy aids, an adequate face-up stability, and associated resistance to being turned face down by waves or other forces, and

# 5.6.6.1.1DV.1 D1 Modification of replacing the first sentence and item "a" of clause 5.6.6.1.1 as follows:

The tests according to <u>5.6.6.3</u>a) are to evaluate whether a lifejacket (see ISO 12402-1:2006, 5.6 to ISO 12402-4:2006, 5.6) being evaluated provides,

# a) an adequate face-up stability, and associated resistance to being turned face down, and

b) for buoyancy aids, the intended potential for bringing the user face up in the unlikely event that the user either enters the water face down and unconscious, or becomes unconscious in the water.

# 5.6.6.1.1DV.2 *DT* Modification by replacing the item "b" paragraph of clause 5.6.6.1.1 as follows:

# b) the intended potential for bringing the user face up in the unlikely event that the user either enters the water face down and unconscious, or becomes unconscious in the water.

These test procedures recognize that different body types present differing resistance to the face-up turning capacity of a PFD, and therefore are intended to evaluate a wide range of the population with as few test subjects as possible.

An inflatable PFD shall be tested inflated by its primary means of inflation. Chambers provided with only oral inflation capability shall be tested inflated to 4 kPa.

Because a tense subject is not representative nor simulates a state of utter exhaustion, the starting time for all righting tests shall not begin until the subject is noted to be in a relaxed position. A relaxed position should be achieved by having the subject relax his or her body with arms placed perpendicular to the body (as in mid-position of a breaststroke) and head going into the water at the same time. If turning starts before the subject has relaxed, the test is invalid and the test is to be repeated. If the PFD is so buoyant that the subject cannot get his/her face down into the water before being righted, the turn is to be counted.

NOTE The amount of air in test subjects' lungs has a profound influence on the test results, and subjects should be instructed accordingly. For a 'normal breath' or 'half breath' the lungs should be near the top of 'tidal volume' only. A person in repose, breathing normally, will be at the top of tidal volume when their lungs are at their highest, or largest, during such a breathing cycle. When the procedure requires the subject to 'exhale' or exhale in the water, the subject relaxes completely while allowing air to gradually flow out of the lungs, not forcing it out, until they reach 'functional residual capacity' (FRC) and no less. A person in repose, breathing normally, will be at FRC when their lungs are at their lowest, or smallest, during such a breathing cycle.

5.6.6.1.2 The test according to 5.6.6.3 b) is to demonstrate that a buoyancy aid according to ISO 12402-5, that is not designed to self right the wearer provides adequate face-up stability, and associated resistance to being turned face down by waves or other forces.

# 5.6.6.2 Apparatus

For testing PFDs according to ISO 12402-1 to ISO 12402-5, the reference vest used shall be constructed in accordance with Annex  $\underline{B}$ ,  $\underline{C}$  or  $\underline{D}$  according to the size of the PFD being tested.

# 5.6.6.2DV D2 Modification by replacing clause 5.6.6.2:

For testing PFDs according to ISO 12402-1 the reference vest used shall be constructed in accordance with Annex <u>B</u>, <u>C</u>, or <u>D</u> according to the size of PFD being tested.

# 5.6.6.3 Procedures

During testing the panel shall observe whether any closure fails to remain secure.

Unless otherwise specified, for each of the following procedures, as the subject places the face in the water the lungs shall be near the top of tidal volume by instructing the subject to take a normal breath or half breath.

For lifejackets according to ISO 12402-1, the tests shall be repeated with each test subject in the reference vest.

The PFD shall be tested on each test subject by carrying out the following tests as called for by its intended performance level, in the relevant part of ISO 12402 applicable to its intended classification.

a) Leg release righting test

Facing away from the test assistant, the subject shall attain a face-down horizontal position in the water, but with mouth held out of the water. The feet shall be supported, shoulder-width apart with the heels at the surface of the water, by a test assistant. The subject shall be instructed in the following sequence:

- straighten the legs;
- put the arms along the sides;
- allow the arms, shoulders, and body to completely relax;
- lower the face into the water while breathing out normally; and
- relax the neck.

During the relaxation phase, the test assistant shall maintain the subject in a stable position. Immediately after the subject has relaxed with the face in the water, the test assistant shall release the subject's feet. The subject shall remain limp while the turning time is measured. The turning

time is determined from the release of the feet until the subject's mouth is clear of the water, to the nearest 0,1 s. The test shall be conducted six times, discarding the highest and lowest turning times and averaging the remaining four times.

NOTE Child subjects not able to relax the arms are instructed to straighten the arms along the sides.

#### 5.6.6.3DV D2 Modification by replacing the 3<sup>rd</sup> paragraph of clause 5.6.6.3 as follows:

When performing these tests when using the RTD method, the tests described in 5.6.3.3 a), b), c), e), and f) shall be repeated with the same subject wearing the appropriate RTD.

5.6.6.3ADV Modification by replacing item "a" of clause 5.6.6.3 as follows:

a) Leg release righting test

Facing away from the test assistant, the subject shall attain a face-down horizontal position in the water, but with mouth held out of the water. The feet shall be supported, shoulder-width apart with the heels at the surface of the water, by a test assistant. After assuming a starting position with the legs straight and arms along the sides, the subject shall be instructed in the following sequence to allow the body to gradually and completely relax:

- allow the arms, and shoulders to relax;
- allow the legs to relax, and then the spine; and
- relax the neck, allowing the face to fall into the water while breathing out normally.

During the relaxation phase, the test assistant shall maintain the subject in a stable position. Immediately after the subject has relaxed with the face in the water, if possible, simulating a state of utter exhaustion, the test assistant shall release the subject's feet. The subject shall remain limp while the turning time is measured. The turning time is determined from the release of the feet until the subject's mouth is clear of the water, to the nearest 0,1 s. The test shall be conducted six times, discarding the highest and lowest turning times and averaging the remaining four times.

NOTE Child subjects not able to relax the arms may be instructed to straighten the arms along the sides.

b) Vertical stability test

During the test, the panel shall observe whether any closure fails to remain secure.

For determination of the floating position of buoyancy aid, each subject shall don the device and enter the water. The subject shall then assume an upright, slightly behind vertical position in the water, keeping the head, torso, and legs in the same plane, while holding the arms at the sides. A straight rod with an inclinometer attached may be used to establish the starting position is  $5^{\circ} \pm 2^{\circ}$  degrees behind vertical. The subject shall maintain this position until the device induces motion (forward or backward of vertical). Then, the subject shall allow the arms, legs, torso, and head to assume their naturally relaxed positions so that the head falls in the direction of induced motion. If motion is not induced, the subject shall allow the head to fall backwards and then allow the arms, legs, and torso to assume their naturally relaxed positions. After the subject has attained an attitude of relaxed static balance, the freeboard of the subject shall be measured while the subject is at the lowest level attained during the normal breathing cycle.

# c) Flotation attitude test

To assess floating attitude for lifejackets, the angle of the trunk and head shall be measured. Measure the angle of the face in relation to the horizontal, using an imaginary line from the chin to the forehead. Measure the angle of the body trunk in relation to vertical, using an imaginary line from the shoulder to the hip. The angle of the trunk shall be measured underwater to reduce any effect due to the refraction properties of water.

# 5.6.6.3CDV DE Modification by replacing last sentence of item "c" of clause 5.6.6.3 as follows:

The angle of the trunk shall be measured in such a way to reduce any effect due to the refraction properties of water.

# 5.6.6.3DDV D2 Modification by adding items "d", "e", and "f" to clause 5.6.6.3:

#### Flotation test for buoyancy aid

d) For a buoyancy aid, each subject shall don the device and enter the water. The subject shall then attain a face-down position in the water. On the command "Go" the subject shall attempt to turn to a stable face up position in which respiration is not impeded. The time from the command "Go" until a stable face up position is achieved shall be recorded.

Alternate self-righting test for child devices (when applicable)

e) For a child device, the following method may be used as an alternative to the <u>5.6.6.3ADV</u> leg release test. The device is to be fastened in the intended manner on the subject. The subject is to gently push-off from the side of the pool, take a single breaststroke, and then face down in the water, relax and exhale slowly. The turning time is to be recorded. The test then is to be repeated two additional times. As an alternative, the device is to be fastened in the intended manner on the subject, who then is to be placed in a face down (mouth above the water) position in the water and released. The turning time is to be recorded. The subject then is to repeat the test two additional times.

Self-righting test for infant devices

f) For an infant device, the device is to be fastened in the intended manner on the subject, who then is to be placed in a face down (mouth above the water) position in the water and released. To prevent the test subject from inhaling water during the test it is permissible to gently blow air into the infant's face immediately prior to the release. The turning time is to be recorded. The test is to be repeated two additional times.

# 5.6.6.4 Results

5.6.6.4.1 Report whether any closure securing the PFD to the body does not remain secure during the tests.

5.6.6.4.2 For lifejackets according to ISO 12402-1 to ISO 12402-4, report the average time to bring each test subject's mouth clear of the water without him/her having to carry out any voluntary movement.

#### 5.6.6.4.2DV D2 Modification of clause 5.6.6.4.2:

For lifejackets according to ISO 12402-1 to ISO 12402-4, report the average time to bring each test subject's mouth clear of the water without him/her having to carry out any voluntary movement with both the candidate device and RTD, as applicable.

5.6.6.4.3 For buoyancy aids according to ISO 12402-5, report whether

a) any subject's respiration is impeded in an attitude of relaxed static balance at any time,

b) there is any tendency to turn a subject face down from the position of relaxed static balance in the water,

c) there is any negative freeboard.

If any one of these conditions is reported, the device is considered to have failed.

#### 5.6.6.4.3DV D2 Modification by replacing entire clause 5.6.6.4.3 as follows:

For buoyancy aids according to UL 12402-5, report:

a) Whether any subject's respiration is impeded in an attitude of relaxed static balance at any time,

b) Whether there is any tendency to turn a subject face down from the position of relaxed static balance in the water,

c) Whether there is any negative freeboard for level 50 devices, and

d) The individual and average freeboard for level 70 devices.

#### 5.6.6.4.4 Floating attitude

For both, lifejackets and buoyancy aids, report the measured trunk and face angles.

#### 5.6.6.4.4DV DT Modification by replacing the text of clause 5.6.6.4.4 as follows:

For lifejackets, report the measured trunk and head angles.

5.6.6.4.4DV.1 D2 Modification by replacing the text of clause 5.6.6.4.4 as follows:

For lifejackets, report the measured trunk and head angles with both the candidate device and RTD, as applicable.

# 5.6.7 Ergonomics

# 5.6.7.1 Principle

While being observed by the test panel, the test subjects shall assess comfort and interference with motion when using the PFD to determine whether the PFD is fit for the intended and emergency use.

# 5.6.7.2 Procedure

# 5.6.7.2.1 General

The test panel shall observe ease of movement and elicit comments from the subjects relating to comfort or interference with desirable behaviour or movements during all the human subject tests. The panel shall pay particular attention to

a) head and limb movement, and their potential to interfere with emergency use or the subject desiring to remove the PFD due to discomfort, and

b) any interference with vision, hearing or breathing.

Assessments shall be made both out of and in the water, and with the PFD both inflated and uninflated, if applicable.

The panel shall assess donning/secondary-donning actions, swimming and encumbrance.

# 5.6.7.2.2 Inflation

An inflatable PFD shall permit the user to top up the inflation by mouth while in or out of the water using either hand independently.

# 5.6.7.2.2DV D2 Modification by replacing entire clause 5.6.7.2.2 as follows:

During the human subject performance tests and use tests of an inflatable PFD each test subject shall demonstrate whether the PFD allows him or her to manually inflate and to top up the inflation by mouth while in or out of the water using either hand independently.

# 5.6.7.2.3 Oral inflation

With each test subject in the water, the PFD shall permit secondary donning and oral inflation sufficient to provide the test subject with positive freeboard within 45 s for any PFD up to 150 N buoyancy. For PFDs over 150 N buoyancy, an additional 15 s is allowed for each additional 50 N buoyancy.

# 5.6.7.2.3DV D1 Modification by replacing entire clause 5.6.7.2.3 as follows:

# 5.6.7.2.3.1DV D1 Principle

The purpose of this test is to evaluate the ease of inflation via oral inflation using either hand.