

## **Appendix A - Evaluation**

- (i) Participation:**
  - a. Four (4) WFPS Firefighters
  - b. One (1) PPE Technician
- (ii) Measurements/Sizing:**
  - a. Each participant will be custom fitted for each set of turnout gear.
- (iii) Scoring:**
  - a. The evaluation shall be scored using a scale similar to:

### **Scores (example)**

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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- b. The evaluations will be converted to a numerical score, where each item on the scale represents a numerical value. For example, “Very Uncomfortable” is represented by the value of one (1) and “Very Comfortable” is represented by the value of six (6).
- c. The scores will be tallied for a total of one hundred and forty-four (144) points (6 points per test, 24 tests in total).
- d. The total score will be converted to represent a score out of 70 points.
- e. Participants will be provided the opportunity to leave a comment after each test, the comments will be in correlation with the score provided.
- f. The Proponents will be provided one (1) day for measuring of trial turnout gear.

## WFPS Turnout Gear Evaluation and Scoring 2020

Evaluated Gear: \_\_\_\_\_ Date: \_\_\_\_\_

Evaluator/Technician Name: \_\_\_\_\_

Signature: \_\_\_\_\_

### 1) Initial Inspection

- a. WFD technicians shall inspect all provided turnout gear ensembles for quality and workmanship including but not limited to seams, stitching, fabric edges, flaws and defects and score according to the 6 point scale. (circle one)

UNACCEPTABLE	POOR	FAIR	ACCEPTABLE	GOOD	EXCELLENT
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COMMENTS:

**2) Initial Fit (Pre-Washing)**

- a. Each evaluator will don the ensemble and assess for accuracy of personalize fit using the 6 point scale. (circle one)

UNACCEPTABLE      POOR      FAIR      ACCEPTABLE      GOOD      EXCELLENT

COMMENTS:

**3) Washing/Inspection**

- a. The ensemble shall be washed and dried 20 times according to supplied manufacturer's instructions and then re-inspected for quality and workmanship including but not limited to seams, stitching, fabric degradation and fading and scored according to the 6 point scale. (circle one)

UNACCEPTABLE	POOR	FAIR	ACCEPTABLE	GOOD	EXCELLENT
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COMMENTS:

- b. The drying time of ensembles will be assessed in between washings with respect to time of drying using normal department drying processes (The median drying time, indicated as FAIR, will be considered as 60 minutes with every 15 minutes span above or below resulting in the next scale score).

UNACCEPTABLE	POOR	FAIR	ACCEPTABLE	GOOD	EXCELLENT
> 85	70-85	50-70	35-50	20-35	<20

COMMENTS:

**4) Fit (Post-Washing)**

- a. Each evaluator will wear the ensemble and assess for accuracy of personalized fit using the 6 point scale. (circle one)

UNACCEPTABLE	POOR	FAIR	ACCEPTABLE	GOOD	EXCELLENT
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COMMENTS:

**5) Overall Comfort Test**

- a. Each evaluator will wear the ensemble and walk the perimeter of the test area after which they will rate the overall comfort of the gear with respect to walking using the 6 point scale (circle one).

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

**6) Ease of Movement Test**

- a. **Elbows** – Each evaluator will be led through a series of movements during which they are asked to consider the ease of movement around the elbows. The movement will be demonstrated first and then the evaluators will be asked to follow along for the 2 subsequent demonstrations. Following these exercises, the evaluators will be asked to rate the ease of movement of their garment on all the performed movements collectively. The movements are as follows:
  - i. In addition to your assigned turnout gear, don your gloves.
  - ii. Touch hands to the top of the same side shoulder, abduct arms to 90°, rotate arms so hands are at armpits (maintain shoulder abduction at 90°). Lower arms to neutral position, with arms by your side and repeat.
  - iii. Touch hands to the top of the same side shoulder, abduct arms to 90°, touch elbows in front of chest, then push them posteriorly as far as possible (maintain 90° shoulder abduction as much as possible). Lower arms to neutral position, and repeat.
  - iv. Bend elbows to 90°, abduct arms to 90°, adduct arms but maintain elbows at 90°, flex shoulders so elbows reach shoulder height (with elbows fixed at 90°), then laterally abduct arms posteriorly as far as possible while maintaining elbows at approximately 90° (do not squeeze shoulder blades together).
  - v. Rate the ease of movement of this garment with respect to the ELBOWS using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

**b. Knees** – Each evaluator will be led through a series of movements during which they are asked to consider the ease of movement around the knees. The movement will be demonstrated first and then the evaluators will be asked to follow along for the 2 subsequent demonstrations. Following these exercises, the evaluators will be asked to rate the ease of movement of their garment on all the performed movements collectively. The movements are as follows:

- i. From standing position, lower your upper body to a full crouch. Maintain an upright back posture (Hold for 5 seconds). Resume a standing position and repeat.
- ii. From standing position, lower your upper body to single point kneel (one knee), stand and alternate to the opposite leg, stand then assume a 2-point kneel lowering your buttocks to your heels. Maintain an upright back posture. Resume a standing position and repeat.
- iii. While in a standing position, with an upright back posture, raise one knee towards your chest, and rotate it outwards (laterally) in this position. Return to normal standing. Alternate with the opposite knee. Resume a standing position and repeat.
- iv. Rate the ease of movement of this garment with respect to the KNEES using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

c. **Shoulders** – Each evaluator will be led through a series of movements during which they are asked to consider the ease of movement around the shoulders. The movement will be demonstrated first and then the evaluators will be asked to follow along for the 2 subsequent demonstrations. Following these exercises, the evaluators will be asked to rate the ease of movement of their garment on all the performed movements collectively. The movements are as follows:

- i. In addition to your assigned turnout gear, don your gloves.
- ii. Reach across your chest, put one hand on the back of the opposite shoulder, return to normal position. Alternate with the other hand on the other shoulder, then place both hands on opposite shoulders simultaneously. Lower arms to neutral position, and repeat.
- iii. Touch hands to the top of the same side shoulder, abduct arms to 90°, touch elbows in front of chest, then push them posteriorly as far as possible (maintain 90° shoulder abduction as much as possible). Lower arms to neutral position, and repeat.
- iv. Bend elbows to 90°, abduct arms to 90°, adduct arms but maintain elbows at 90°, flex shoulders so elbows reach shoulder height (with elbows fixed at 90°), then extend arms posteriorly as far as possible while maintaining elbows at approximately 90°.
- v. With a straight arm, circle both arms in two full circles forwards, then backwards. Lower to neutral.
- vi. Rate the ease of movement of this garment with respect to the SHOULDERS using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

- d. **Back** – Each evaluator will be lead through a series of movements during which they are asked to consider the ease of movement around the back. The movement will be demonstrated first and then the evaluators will be asked to follow along for the 2 subsequent demonstrations. Following these exercises, the evaluators will be asked to rate the ease of movement of their garment on all the performed movements collectively. The movements are as follows:
- i. From a standing position, bend forward, without locking knees, and grasp middle shin with hands, return to upright standing position
  - ii. From standing, flex elbows to 90 degrees, abduct shoulders to just below shoulder height, and bring arms in front of you until your hands are 12” apart like you are grabbing a basketball. While in this position, bend forward to 75 degrees. Return to standing position.
  - iii. From standing, flex elbows to 90 degrees, abduct shoulders to just below shoulder height, and bring arms in front of you until your hands are 12” apart like you are grabbing a basketball. While in this position, hunch forward from mid-back, not waist. Return to standing position.
  - iv. From standing, with feet planted on the floor shoulder width apart, hips facing forward, turn your upper body left until your shoulders are at a 45-degree angle with respect to your feet, bend left until you can touch your knee with your hand, return to standing position. Repeat for right.
  - v. Rate the ease of movement of this garment with respect to the BACK using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

- e. **Seat** – Each evaluator will be lead through a series of movements during which they are asked to consider the ease of movement around the pant seat. The movement will be demonstrated first and then the evaluators will be asked to follow along for the 2 subsequent demonstrations. Following these exercises, the evaluators will be asked to rate the ease of movement of their garment on all the performed movements collectively. The movements are as follows:
- i. From standing position, assume a full crouch position, placing the palms of your hands on the floor. Resume a standing position and repeat.
  - ii. While in a standing position, raise one knee towards your chest, and rotate it outwards (laterally) in this position. Return to a neutral position. Alternate with the opposite knee. Maintain an upright back posture. Resume a standing position and repeat
  - iii. From a standing position, assume a forward lunge as low as is comfortable with your hands positioned on your forward knee for support. Resume a standing position. Alternate with the opposite leg forward. Resume a standing position and repeat.
  - iv. From a standing position, assume a sideways lunge to the left. Resume standing. Alternate lunging to the right side.
  - v. Rate the ease of movement of this garment with respect to the SEAT using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

**7) Ease of Donning Test**

- a. This test is organized to simulate the required speed when donning the turnout gear. When completing this test, the evaluators will be asked to consider all aspects of donning such as ease of donning quickly, ease of manipulating buckles, zippers or any securing devices, ease of donning and adjusting suspenders, tightening the waist, securing the collar, and so forth. Evaluators will be given the opportunity to don the garment slowly and ask any questions regarding procedures to don the turnout gear prior to commencing testing. Evaluators will don the entire ensemble including boots, gloves, flash hood and helmet. For the test, the evaluators will be asked to don the turnout gear quickly like in a routine alarm and then rate the difficulty of the activity using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

**8) Functional Comfort Test (Part 1-Without SCBA)**

- a. The following subtests will be performed without a SCBA but evaluators will be required to wear all other accompanying pieces such as boots, gloves, hood, and helmet. They are designed to simulated physical demands commonly experienced in the field. During these activities, the evaluators will be asked to consider the overall comfort of the garment. This can include anything from ease of movement to pressure points of buttons or buckles, position of shoulder/chest/thermal liner straps, ease of movement in the wristlets and so forth. The evaluators will be instructed to consider all aspects of the activity and all areas of the garment including the collar, shoulder strap placement, hardware, suspenders, etc. There are 3 subtests in this section. The evaluators will be given instructions for each, immediately prior to the test, and will complete an evaluation of overall comfort after each subtest. A comment section will also be provided for specific comments if the evaluators have them.
  
- i. **Roll Hose** – The evaluators will manually roll a 2.5”X 50’ hose and then unroll it. Evaluators will not wear their gloves during this procedure. At the end of this exercise the evaluators will be asked to rate the overall comfort of the turnout gear, considering all movements performed and all aspects of the turnout gear (restricted movement, pressure points, etc.). This is not a timed subtest, and the directions are as follows:
  - 1. Assume a one point kneel to initiate the rolling, then move into a mobile crouched posture as you move along the hose.
  - 2. Once completed, unroll the hose by throwing and kicking it out.
  - 3. Rate the overall comfort of your turnout gear with respect to hose rolling using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

- ii. **Rope Pull and Lower** – Evaluators will be asked to use the rope pull located at the training facility to raise and then lower in a controlled manner one length of 2.5”X 50’ hose approximately 4 floors. This will be done slow enough that the evaluators will remain conscious of the design of the turnout gear and their movements both within and because of the turnout gears. This is not a timed subtest. At the end of this exercise the evaluators will be asked to rate the overall comfort of the turnout gear, considering all movements performed and all aspects of the turnout gear (restricted movement, pressure points, etc.) using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

- iii. **Ladder** – For this subtest, evaluators will be asked to retrieve a standard ladder from the floor on one end of the testing facility, carry it the length of the facility to a designated area where they will then set up the ladder. A previously set up and secure ladder will then be used for climbing. The evaluators will be asked to climb  $\frac{1}{2}$  of the distance up the ladder, perform a leg lock with one leg and remain in that position for 5 seconds. Next the evaluator will climb to  $\frac{3}{4}$  distance from the top of the ladder where another leg lock will be performed with the alternate leg and again held for 5 seconds. Finally, the evaluator will climb down to the ground, drop the ladder that they set up, carry it across the testing facility and place it on the ground back in the designated area. This is not a timed subtest.

At the end of this exercise the evaluators will be asked to rate the overall comfort of the turnout gear, considering all movements performed and all aspects of the turnout gear (restricted movement, pressure points, etc.) using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

**9) Turnout Gear Compatibility Test (not timed tests)**

**a. Flash Hoods and Helmets** - During the evaluation, the evaluators will be asked to consider how easy it is to don the items, if there are any exposed gaps, snags or limited actions, pressure points from the collar anchoring system, any restricted neck movement and so forth. In general, how well do the items interface or work together with the turnout gear in both donning and general functioning. This is not a timed subtest, and the directions are as follows:

- i. While wearing both the pants and jacket, don your flash hood and helmet.
- ii. Run your hands around the collar to identify any areas of exposed skin
- iii. Evaluate the interface between the turnout gear and the hood and helmet (consider if there are any snags when securing the collar or any pressure points).
- iv. Standing upright, bend your neck forward, backwards, rotate to the left and right and bend laterally to the left and right. Roll your head counter clockwise and clockwise.
- v. Rate the compatibility of the hood and helmet with the turnout gear using the following 6-point scale:

VERY INCOMPATABLE	MODERATELY INCOMPATABLE	SLIGHTLY INCOMPATABLE	SLIGHTLY COMPATABLE	MODERATELY COMPATABLE	VERY COMPATABLE
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COMMENTS:

Remove the helmet, leaving the flash hood on for the next exercise.

b. **SCBA** – For this sub-test, evaluators will be provided with a standard SCBA. This sub-test is composed of two separate analyses, one assessing the SCBA interface with the turnout gear and the other assessing the compatibility of the SCBA with arm movements, each requiring the evaluator to fill out a separate 6-point scale. When assessing the SCBA interface, evaluators will be asked to consider the donning/doffing of the breathing apparatus, any required donning movement that is restricted by the garment, general comfort of the turnout gear (i.e. binding of the turnout gear caused by the SCBA interface, any pressure points), and so forth. While completing the arm movements in this test, evaluators will be asked to focus their attention on the turnout gear’s interface with the SCBA. This is not a timed subtest, and the directions for the first analysis are as follows:

**General Compatibility**

- i. With the turnout gear and flash hood already on, don the complete SCBA gear.
- ii. Remove the SCBA gear and then put it on once again.
- iii. Walk the prescribed course.
- iv. Walk at a moderately comfortable pace (you are not being timed).
- v. Note and record the compatibility of your garment with the SCBA using the following 6-point scale:

VERY INCOMPATABLE	MODERATELY INCOMPATABLE	SLIGHTLY INCOMPATABLE	SLIGHTLY COMPATABLE	MODERATELY COMPATABLE	VERY COMPATABLE
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COMMENTS:

Keep the SCBA on while completing the remainder of the compatibility assessment

**c. Shoulder Movement**

- i. Put one hand on the back of the opposite shoulder, alternate with the other hand, then attempt to place both hands on opposite shoulders simultaneously. Lower arms to neutral position, and repeat.
- ii. ii. Touch hands to same shoulder, abduct arms to 90°, touch elbows in front of chest, then push them posteriorly as far as possible (maintain 90° shoulder abduction as much as possible). Lower arms to neutral position, and repeat.
- iii. iii. Bend elbows to 90°, abduct arms to 90°, lower arms but maintain elbows at 90°, flex shoulder so elbows reach head level (with elbows fixed at 90°), then extend arms posteriorly as far as possible while maintaining elbows at approximately 90°.
- iv. iv. With a straight arm, circle both arms in two full circles forwards, then backwards.
- v. v. Note and record the ease of movement with your SCBA on using the following 6-point scale:

VERY RESTRICTED	MODERATELY RESTRICTED	SLIGHTLY RESTRICTED	SLIGHTLY FREE	MODERATELY FREE	VERY FREE
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COMMENTS:

d. **Gloves** – Using their own issued gloves, each evaluator will consider how easy the gloves are to don/doff, note any catching or bunching of the wristlets within the gloves, any restricted hand or finger movements and whether there are any gaps where skin is or can be exposed. While completing the arm movements in this test evaluators will be asked to maintain their focus on the gloves/wristlets only.

- i. While wearing your turnout gear, flash hood and SCBA, don your gloves and then your helmet.
- ii. Put one hand on the back of the opposite shoulder, alternate with the other hand, then place both hands on opposite shoulders simultaneously. Lower arms to neutral position, and repeat.
- iii. Touch hands to the top of the same shoulder, abduct shoulders to 90°, touch elbows in front of chest, then push them posteriorly as far as possible (maintain 90° shoulder abduction as much as possible). Lower arms to neutral position, and repeat.
- iv. Bend elbows to 90°, abduct arms to 90°, lower arms but maintain elbows at 90°, flex shoulders so elbows reach head level (with elbows fixed at 90°), then extend arms posteriorly as far as possible while maintaining elbows at approximately 90°.
- v. From a standing position, flex forward from the waist to 45 degrees, flex shoulders and elbows, and clasp hands close together at the edge of the table in front of you. Return to neutral position.
- vi. With a straight arm, circle both arms in two full circles forwards, then backwards.
- vii. Note and record the compatibility of your turnout gear with the gloves/wristlets on the provided evaluation recording sheet.

VERY INCOMPATABLE	MODERATELY INCOMPATABLE	SLIGHTLY INCOMPATABLE	SLIGHTLY COMPATABLE	MODERATELY COMPATABLE	VERY COMPATABLE
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COMMENTS:

**10) Functional Comfort Test (Part 2—With SCBA)**

- a. The following subtests will be performed with an SCBA and all other accompanying garment pieces including gloves, boots, flash hood and helmet. They are designed to simulated physical demands commonly experienced in the field. During these activities the evaluators will be asked to consider the overall comfort of the garment. This can include anything from ease of movement to pressure points of buttons or buckles, position of shoulder/chest/thermal liner straps, ease of movement in the wristlets and so forth. The evaluators will be instructed to consider all aspects of the activity and all areas of the garment including the collar, shoulder strap placement, hardware, suspenders, etc. There are 2 subtests in this section. The evaluators will be given instructions for each, immediately prior to the test, and will complete an evaluation of overall comfort after each subtest. A comment section will also be provided for specific comments if the evaluators have them.
  
- i. Building Climb, Crawl, Drag (with SCBA) - For this subtest, evaluators (while wearing their SCBAs) will start at the ground floor of the testing facility. They will be asked to climb two flights of stairs on one side of the building. Once on the third floor, they will enter the building and crawl on their hands and knees across the floor, through a simulated search course and back to the stairwell. At this point the evaluators will descend the stairs to the second floor and complete a dummy drag course. The evaluators will then climb down to the ground floor to complete the test. Evaluators will conduct this test in a realistic but completely controlled manner. This test is not timed. At the end of this exercise the evaluators will be asked to rate the overall comfort of the turnout gear, considering all movements performed and all aspects of the turnout gear (restricted movement, pressure points, etc.) using the following 6-point scale

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

**Note:** If the boot end of a pant leg rides up sufficiently to expose the firefighter's skin, the score will be set to "1".

- b. Keiser Sled (with SCBA)** - For this subtest, evaluators (while wearing their SCBAs) will complete one full length (five feet) of the Keiser sled. Generally, this takes approximately 20-25 blows with a specifically designed 9-lb sledge hammer. This is used as a standard test to simulate forcible entry chopping with an axe or sledge hammer. Evaluators will conduct this test in a quick but completely controlled manner. This test is not timed. At the end of this exercise the evaluators will be asked to rate the overall comfort of the turnout gear, considering all movements performed and all aspects of the turnout gear (restricted movement, pressure points, etc.) using the following 6-point scale:

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

## 11) Thermal Environment Test

This testing will evaluate the effects of cold or hot environments on the user including perceptions of heat and cold, feel of interior liner system and skin/liner moisture assessments.

### a. Hot Environment

- i. The evaluator will spend 10 minutes in a heated room/ sauna room doing light movements after which they will rate the effects of the hot environment including skin moisture levels and feel, “wetness” of interior liner and any wicking effects using the following 6 point scale.

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

**b. Cold Environment**

- i. The evaluator will spend 15 minutes in a -25 to -30 environment (lab or outdoors depending on season) where they will conduct light activities and then record their impressions of the impact of cold through the ensemble and its feel on the user using the following 6 point scale.

*Note: This test may be conducted independently or through the course of earlier testing depending on season and test environment.*

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS:

**12) Moisture and Drying Test (Overall or CPAT)**

- a. This test will be used to evaluate the build-up of interior moisture, wicking capabilities, standing gear drying and user comfort related to exercise induced sweating.

*Note: The evaluation will be based on the users experience during the earlier test components*

- i. The evaluator shall assess the effects of exercise induced moisture on themselves and the gear including interior moisture build-up, wicking capabilities, interior liner feel, standing/unassisted gear drying between evolutions and overall user comfort based on the following 6 point scale.

VERY UNCOMFORTABLE	MODERATELY UNCOMFORTABLE	SLIGHTLY UNCOMFORTABLE	SLIGHTLY COMFORTABLE	MODERATELY COMFORTABLE	VERY COMFORTABLE
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COMMENTS: