Standard Test Method for Reflective Safety Clothing

Developed in 2011 by IHVCA Committee; editorially revised and reaffirmed 2012.

1. Purpose and Scope

This test method is intended for the determination of the performance level according to the performance class of the high visibility safety clothing. They are to be tested by measuring the required reflective area and background material area from specified viewing angles as specified in International High Visibility Clothing Association IHVCA Reflective Safety Clothing Standard.

2. Principle

The front, back, side, shoulder, and rear area of the garment are defined and the areas are measured. The area is measured on a smooth flat plane, using a square measuring grid method as defined in section 5.1.

3. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedures and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufactures MUST be consulted for specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

3.1 Good laboratory practices should be followed. Wear safety glasses in all laboratory areas.

3.2 Manufacturer's safety recommendation should be followed when operating laboratory testing equipment.

4. Apparatus and Materials

4.1 Transparency square grid paper of finest grid spacing at 1 cm and heavier grid spacing at 10 cm.

4.2 A flat and smooth surface, size no less than 70 cm X 1.5 cm

4.3 Rules marked in millimeters, eighths or tenths of a centimeter, or in inches, sixteenths of an inch.

4.4 Marker

4.5 Label

4.6 Iron

5. Test Specimens

5.1 Sampling and Preparation:

Testing clothing from which specimens are to be taken from must be the smallest size offered in the tested style or item number.

5.1.1 Panels of each test specimen must be able to spread flat on a surface as in Section 4.2.

5.1.2 Prior to marking, condition test specimens as directed in ASTM D 1776, Standard Practice for Conditioning and Testing Textiles, condition each specimen 24 hours at 20 ± 2°C (68 ± 2°F) and 65 ± 5 % relative humidity by laying each test specimen separately on a screen or conditioning rack.

5.1.3 Lay the sample on a flat surface as in Section 5.2. Do not allow any section of the sample to hang over the edge of the work table.

5.2 Marking of Reflective Area

Mark each test specimen based on the part of clothing as defined as follows:

5.2.1 Front panels: Lay the subject sample flat on a flat horizontal surface with the front side facing up. Mark each of the reflective material area within Area A as in Figure 1 uppers and/or Figure 3 trousers/pants.

5.2.2 Back panels: Lay the subject sample flat on a flat horizontal surface with the back side facing up. Mark each reflective material area within Area B depicted in the Upper Figures 2 and/or trousers/pants in Figure 4.

5.2.3 Shoulder/Hat panels: Lay the subject sample flat on a flat horizontal surface with the front side facing up. Draw a line 15 cm from the top edge of the shoulder line parallel to the shoulder line. From the high point of the shoulder start drawing a 15 cm line for Area C as shown in Figure 1 and Figure 2. Flip the subject sample and lay the subject sample flat on a flat horizontal surface with the back side facing up. Draw a line 15 cm from the top edge of the shoulder line parallel to the shoulder line. From the high point of the shoulder, draw a 15 cm line for Area C as shown in Figure 1 and Figure 2. Mark the edge of the reflective area in area C.

5.2.4 Sleeve panels: Lay the subject sample flat on a flat horizontal surface with the front side facing up. Starting at the end of the shoulder area, draw a line along the middle of the sleeve, down to the cuff. Flip the sample and repeat the above process. Define the territory of area C. Mark the edge of all reflective material within shoulder area C.

5.2.5 Rear panel: The rear panel is located at the lower part of back side of the torso, 15 cm below the waist line. Lay the subject sample on a flat horizontal surface with the back side facing up. A line in the waist level will be drawn 15 cm parallel to the above line toward the hem direction. Mark each reflective material area between the above lines as area E.

5.3 Preparing Specimens

5.3.1 Collect reflective material from each panel area flat within the marked lines of each panel as marked in Section 5.2 on a horizontal plane. Attach a label of the marked panel group on each of the marked reflective materials in the panel area, as the reflective material specimens.

5.3.2 All the remaining outer shell fabric is considered as background material specimens.

6. Measurement of Reflective Material Area and Background Material Area

6.1 After conditioning, lay each test specimen of the same panel group as described in Section 6.3, without tension on the flat smooth, horizontal surface as described in Section 5.2.

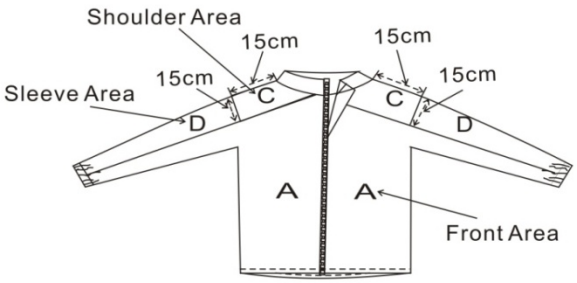
6.2 Remove the wrinkles in most fabrics. Flatten sufficiently by iron or by another instrument that will not cause measurement bias at time of measurement.

6.3 Place square grid paper as described in Section 5.1 over the top of each of the specimens, including reflective material and background material, and count the number of squares, each represent 1 cm^2. Combine partial squares to nearest count.

6.4 The total reflective area in each of the front, back, shoulder, sleeve and rear panel areas shall be added together separately and recorded in the measurement area, filled in Table C-1.

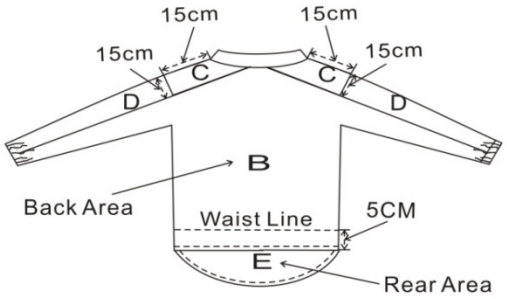
6.5 Each measurement area shall be converted to total visual equivalent area according to IHVCA Reflective Safety Clothing Standard, Section 5.4.5, and Table 4 and tabulated as Table C-1.

6.6 Precision for this test method has not been established. Until a precision statement is generated for this test method, use standard statistical techniques in making any comparisons of test results for either within-laboratory or between laboratory averages.



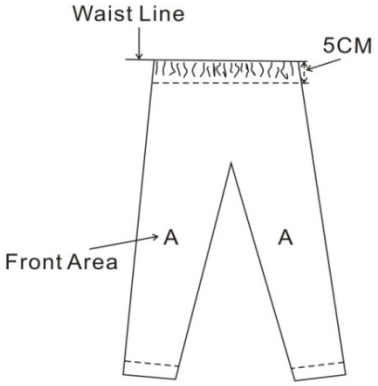
Front

Figure 1. Upper



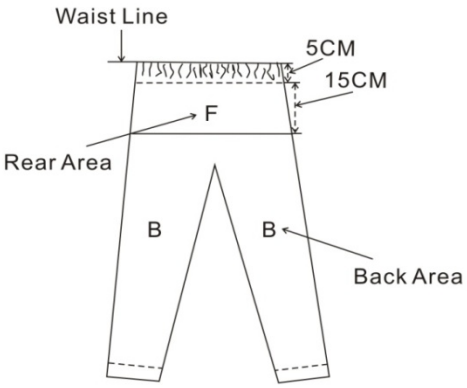
Back

Figure 2. Upper



Front

Figure 3. Pants/Trousers



Back

Figure 4. Pants/Trousers

7. Calculation and Interpretation

7.1 For combined performance reflective systems, the total background material area shall be the total area of the combined performance reflective material areas in addition to the remaining background material area.

7.2 Given the performance level of the testing sample, the required minimum visual area A_I for each class computed in Appendix C, Table C-1 shall comply with IHVCA Reflective Safety Clothing Standard, Section 5.4.4, and Table 3. The visual area A_I is computed based on either separated performance reflective material or combined performance material as in Table C-1.

7.3 For each of the performance levels, the visual area A_I must be equal or exceed the required minimum A_I as tabulated in Table D-1.

7.4 For garments containing both of Separated Performance and Combined Performance materials the required visual area A_I of the Separated Performance material shall covert to equivalent Combined Performance visual area by the ratio of visual area listed in IHVCA Reflective Safety Clothing Standard Table 3

Table C-1 Converting Factor of Measured Area (A_M) to Planar Area (A_P)

Reflective Area	Measured Area (A_M)	Observation Direction				
		Font	**Back**	**Side**	**Top**	**Rear**
Front	A1	A1 X 64%	0	A1 X 8%	A1 X 5%	0
Back	A2	0	A2 X 64%	A2 X 8%	A2 X 5%	A2X 5%
Shoulder	A3	A3 X 32%	A3 X 32%	A3 X 20%	A3 X 64%	0
Sleeve	A4	A4X 32%	A4 X 32%	A4 X 32%	A4 X 26%	0
Rear	A5	0	A5 X 64%	A5 X 16%	A5 X 5%	A5 X 64%
	Total. A= Σ (A1..A5)	**$A_P=\Sigma(..)$**	**$A_P=\Sigma(..)$**	**$A_P=\Sigma(..)$**	**$A_P=\Sigma(..)$**	**$A_P=\Sigma(..)$**

Note: See Figure 1-4, for the Terminologies of Reflective Area and Observation Direction

Table D-1 . Performance Class According to Performance Level and the Converted Planar A_P

❖ Separated Performance ❖ Combined Performance	evel:_____ Required Minimum A_I:_____ (As defined in IHVCA Section 5.3.4, Table 1) Class:_____					
	Font	Back	Side	Top	Rear	Pass/ Failed
Class 1	$A_P > A_I$	$A_P > A_I$	-	-	-	
Class 2	$A_P > A_I$	$A_P > A_I$	-	$A_P > A_I$	-	
Class 3	$A_P > A_I$	$A_P > A_I$	$A_P > A_I$	$A_P > A_I$	-	
Class 4	$A_P > A_I$	$A_P > A_I$	$A_P > A_I$	$A_P > A_I$	$A_P > A_I$	

Notes: 1. The converted Planar Area A_P must be equal to or larger than the required minimum A_I.

8. Report

Retroreflective materials and background materials shall be certified by 3rd party ISO/IEC 17025:2005 accredited laboratory

8.1 Report for each sample tested:
(a) Performance Class of the sample shall be reported. When the sample meets more than one performance class, the highest class shall be reported. The required A_I for the subject class shall be claimed.

(b) The adjusted A_I viewing in various directions including front, back, sides, top and rear shall be computed and listed in the report.
(c) Performance Levels of the sample shall be reported. Each of the adjusted A_p as described in 8.1(b) shall be recorded and compared with the required A_I as described in 8.1(a).
(d) The adjusted A_P viewing in various directions including front, back, sides, top and rear shall be computed and listed in Table C-1.
(e) Record "Pass" for converted Planar Area A_p that exceeds the minimum requirement A_I for specific level.
(f) Record "fail" for those the adjusted A_p less than the required A_I. (same comment above)

8.2 Certification for each sample tested:
For the sample meets the requirements, a certification of the high-visibility risk-related clothing based on IHVCA Reflective Safety Clothing Standard. A certification shall include the following information: model number, brand name (if any), manufacturer, performance class, performance level, background material area, Certification Company's name, address, signature, name, seal and date of certification.

IHVCA 2011 High Visibility Clothing Compliance Certificate

It is hereby certified that the subject sample meets all of the requirements as stated in IHVCA 2012 Standard for Reflective Safety Clothing as a compliant Reflective Safety Clothing of Performance Class and Level certified herein. All relevant materials have been 3rd party certified with documents referenced under this certificate number. The subject item has been measured for the appropriate amount of visible reflective material and background material for the smallest size offered for this product.

Model Number _____ Brand Name _____

Manufacturer _____

Visibility Performance Class _____

Visibility Performance Level _____

Area of Background Material _____

Certified by:

Company Name_____

Address_____

City, State, Zip_____

Country_____

Signed:_____Sealed:_____

Name:_____Date:_____

The undersigned hereby warrants that he/she is authorized to legally bind the organization identified above.