A Protocol for the Evaluation of Coverall Fit

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Evaluating fit is an inexact science and can be very subjective based on the wearers' or judges' preference and perceptions (Yu, 2004). The use of expert judges is the most common method of evaluating fit (Yu, 2004; Watkins, 1995). This paper proposes a protocol to triangulate the assessment of expert judges in evaluating the fit of protective coveralls. Protection from the environment is the main function of protective coveralls The functionality and fit of current protective coveralls is generally poor, and researchers have shown that wearability and fit of coveralls affect compliance with established safety standards (Ashdown & Watkins, 1992; Huck, Maganga, & Kim, 1997). Thus, there is continued need to improve the overall design of these one-piece protective garments, especially in the area of fit and mobility.

A comprehensive investigation of user-needs through industry site visits was performed in an effort to gain an in depth understanding of the user of disposable coveralls. These site visits included worker observation and interviews. After synthesizing user-need data, the design process was utilized to improve coverall design details with an emphasis on user-needs, movement, and fit. Three prototypes were developed and compared to the standard coverall design. Body scanning technology, user responses, and expert evaluation were used to determine the best coverall design with the best fit and mobility.

Seven extreme body postures were identified to use during fit evaluation. A fit and mobility evaluation was conducted with 26 participants (11 women, 15 men) over the course of five cycles, who met the ANSI and ISEA size specifications for size M, L, XL, 2XL, and 3XL. A protocol was developed for scanning participants in four coverall variations in seven dynamic postures plus the control (standing) posture. The seven movement postures were selected based on ANSI and ISEA wear-test standards for coveralls. After the scan of each movement, the researchers asked the participants to answer questions related to fit and asked the participants to mark any location on the suit that impacted fit or mobility on an image of a person in a coverall. Figure 1 is an example of participant wear-test feedback sheet that was collected for a specific coverall and movement. At the end of each scanning session, the participants were asked open ended questions regarding comfort and fit, and were asked to rank the four coveralls that they had worn.

Two experts in fit analysis evaluated the scanned images at 13 fit points using wrinkle analysis. Each area of the coverall was analyzed on a seven-point scale ranging from 1 (unacceptably loose or long) to 7 (unacceptably tight or short). A score of 4 represented an acceptable fit.

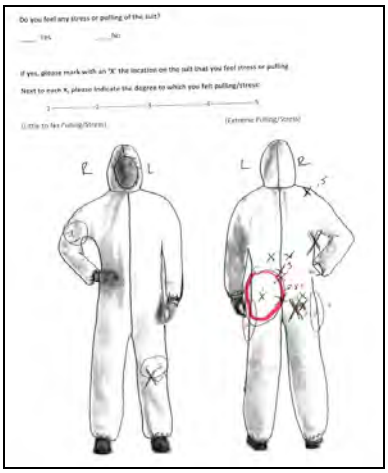

Figure 1 Participant Wear-Test Form

The scanned data and evaluation was corroborated with data from participant fit evaluations and interviews (Figure 2). This allowed the researchers to triangulate the qualitative data and reduce the reliance solely on the assessment by the fit experts.

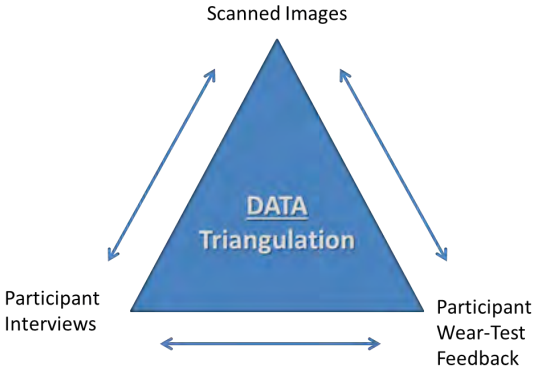

Figure 2 Three types of data were used in order to assess the fit of coverall designs.

Detailed fit analysis identified critical areas of the coverall that required continued design development. This procedure and process of evaluation has supported the development of two patent pending coverall designs and a new sizing system.

Ashdown, S.P. & Watkins, S.M. (1992). Movement analysis as the basis for the development and evaluation of a protective coverall design for asbestos abatement. In J.P. McBriarty & N.W. (Eds.), *Performance of protective clothing: ASTM STP 1133* (pp660-674). Philadelphia, PA: ASTM.

Huck, J., Maganga, O., and Kim, Y. (1997). Protective overalls: Evaluation of garment design and fit. *International Journal of Clothing Science and Technology*, 9(1), 45–61.

Watkins, S. (1995). *Clothing. The portable environment.* (2nd. ed.). Iowa State University Press.

Yu, W. (2004). Objective evaluation of clothing fit. In J. Fan, W. Yu, & L. Hunter (Eds.), *Clothing Appearance and Fit: Science and Technology* (pp. 72-88). Cambridge, England: Woodland Publishing Limited.