Instructions for Manikin Tests on Cold Weather Clothing at KSU

The manikin test measures the insulation (clo) value of a cold weather clothing ensemble. Then the insulation value is used in a whole-body heat loss model to predict the temperature for comfort under certain conditions at different activity levels.

Every time you send a set of products for testing, email the **KSU Submission Form for Cold Weather Clothing** file to merediths@ksu.edu. Send the file in Word format – not PDF. Only one form is needed for a set of garments; we will prepare one report and invoice. *If you require a separate report and invoice for each test, then prepare separate submission forms.*

Section 1. Company Information. Enter your company information and contact information on the form.

Section 2. Purchase Order, Invoice, and Payment. If you provide a purchase order number, we will put the PO number on the invoice. Companies may pay by check, wire transfer, or credit card. Instructions are given on the invoice. If you want the invoice sent to someone other than the company contact, indicate this on the form. Invoices are normally sent after the report has been issued.

Section 3. Test protocol and price. We will assume that you will send one garment sample of a given type. We will put it on the manikin with the base ensemble and run three replications of the test in a row under steady-state conditions. If you prefer to provide three specimens of each sample type, then we will run one replication on each specimen and average the results.

Select a test type on the form.

Option A is for adult clothing. The ASTM F 2732 method provides a temperature rating range based on the insulation value of the cold weather clothing tested with a base ensemble and low and high activity levels. The temperature rating will decrease as the activity of the wearer increases. This is an ISO 17025 accredited test at our laboratory.

Option B is for children's clothing. There are no manikin standards for children's clothing. Therefore, we follow the same basic procedures as ASTM F 1291 and ASTM F 2732, modified for a child-size manikin (size 8). This method cannot cite ASTM F 2732 temperature ratings. We use a unique model to determine the temperature ratings of children's clothing based on the physiology of a child at different ages and activity levels.

Base ensemble. You must select one of the base ensemble options under the test method. The adult base ensemble provided by KSU is compliant with ASTM F2732. ASTM base ensemble #1 is used with jackets, jacket/pant sets, and coveralls. It consists of briefs, socks, athletic shoes, jeans, knit mock turtleneck long-sleeve shirt, fleece cap, and insulated fleece gloves. ASTM base ensemble #2 is used with cold weather pants that are to be tested alone. It consists of all the garments in base ensemble #1, plus a standard jacket. The child base ensemble provided by KSU is similar to the ASTM F 2732 base ensemble. A company can also provide their own base ensemble garments for testing. We

can test these to see if they comply with the ASTM F2732 standard requirements (one additional test, $600). If they do not comply, then you cannot cite ASTM F2732 temperature ratings. If requested, we will keep your base ensemble garments at IER for future testing.

Local insulation values. If you want to compare some garments made with different materials, designs, or construction, we can calculate the average insulation value for the body zones of the manikin covered by the garment. For example, in the case of a jacket, we would use the average zone data for the arms and torso. This technique will maximize differences between two jackets. We can also provide the insulation values for each individual zone.

Thermal imaging. A FLIR E5-XT infrared camera will be used. Thermal imaging is only available as an add-on service to manikin testing. Images are considered supplemental information. Due to issues with emissivity and reflectivity of different surfaces, associated temperature scales will not be provided. Color scales of different photos/samples may not match.

Section 4. Garment samples – sizing, labeling, and sending samples. Select the clothing size that will fit the manikin properly. Mixing sizes will lead to variability in the results. The manikins' measurements are given in tables at the end of this document. The adult manikin, Stan, usually wears a men's medium or women's large size jacket.

Label each garment with a number code using a permanent felt-tip marker or a hang tag. List the garment codes and descriptions on the form. This information will be copied and put in the report. If a garment is to be tested several ways, list it like the example below.

15. Extreme Squall Jacket (Style #455822).
15A. Outer shell and fleece liner tested together.
15B. Outer shell of jacket tested only (without liner)
15C. Fleece liner tested only (without shell)

Note: In this example, there are 3 manikin tests done on jacket #15 ($600 x 3 = $1,800).

Garments with a hood will have to be cut to get the hood around the hook in the manikin's head. Then we will pin or tape the hood back together for the test. If you choose to test with the hood hanging down or detached the insulation value will be lower and the temperature rating will be higher.

Send the garments to:
Meredith Schlabach
Institute for Environmental Research
Kansas State University
0056 Seaton Hall
Manhattan, KS 66506
Phone: 785-532-2284
email: merediths@ksu.edu

If you are sending products from a country other than the United States, please make sure that you pay all customs duties and brokerage fees associated with the shipment.

Timing. We test garments in the order they are received at KSU. We can measure the insulation value of 1-3 ensembles in a 24-hour period. During holidays and campus vacation breaks turn times will be longer.

Test report. A test report will be prepared and emailed as a PDF file with the company's name and technical report number as the file name.

Section 5. Return of garments. Provide your company's preferred shipping company and account number for return shipping (e.g., Federal Express, UPS, DHL) on the form. If the return shipping account is invalid, then you will be invoiced to reimburse KSU for return shipping expenses. Let us know if you require overnight shipping. We can also donate the garments to charity.

Section 6. Export Controls Compliance. Indicate if you are contracting, working, or acting for or on behalf of a national government. Include information about the agency or the branch of a national government that you are associated with.

Adult Manikin: Stan's Body Measurements

Measurement Location	Amount	
	cm	in
Chest circumference at arm pit level	90.8	35.75
Natural waist circumference	75.6	29.75
Hip circumference (widest point)	92.7	36.5
Arm length from shoulder tip to wrist	61	24
Front length from neck base to natural waist	43.2	17
Back shoulder width from shoulder tip to shoulder tip	44.4	17.5
Inseam length to top of shoe (from crotch to ankle)	78.7	31
Foot length (taken on bottom of foot) **Men's shoe and boot size 12**	26.7	10.5
Height	177.2	69.75

Child Manikin: Sonny's Body Measurements (Boy's size 8)

Measurement Location	Amount	
	cm	in
Chest circumference at arm pit level	66.0	26
Natural waist circumference	62.2	24.5
Hip circumference (widest point)	71.1	28
Inseam length to top of shoe (from crotch to ankle)	59.7	23.5
Foot length (taken on bottom of foot) **Kid's shoe size 3.5 and boot size 4**	19.8	7.8
Height	129.5	51