DRDC No. 03-CR-

MANIKIN TESTING ON A VARIETY OF LAND AND SEA SURVIVAL EQUIPMENT

by

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On behalf of

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EXECUTIVE SUMMARY

As part of the Thrust 3id12 and a tasking from the Air Forces, DRDC Toronto required testing to be conducted on a thermal manikin to evaluate the thermal performance of land and sea survival equipment. This report details the results of using the winter dress in both dry and wet conditions using current and proposed life rafts, sleeping bags, and auxiliary components using a simulated insulating survival bed constructed of spruce boughs. These results will provide the basis for testing using human subjects using the same sea survival equipment and the same test facilities (wave tank).

1.0 INTRODUCTION

1.1 BACKGROUND:

As part of the Thrust 3id12 and a tasking from the Air Forces, DRDC Toronto requires testing to be conducted on a thermal manikin to evaluate the thermal performance of land and sea survival equipment. Parallel to the manikin testing, human testing will be performed using the same sea survival equipment and the same test facilities (wave tank).

1.2 AIM:

To measure the thermal performance of various land and sea survival equipment in wind condition.

1.3 STATEMENT OF WORK:

The project will determine, utilizing a standardized, validated and reliable protocol (formally agreed upon between contractor and scientific authorities), the thermal performance in wind on various land and sea survival equipment. The details of the manikin test conditions are as follows:

1. Winter dressed (dry) in -30^{O}C sleeping bag with cold wind;
2. Winter dressed (dry) in proposed sleeping bag # 1 (-4^{O}C) with cold wind;
3. Winter dressed (dry) in proposed sleeping bag # 2 (-10^{O}C) with cold wind;
4. Winter dressed (dry) in current life raft with cold wind;
5. Winter dressed (dry) in proposed life raft with cold wind;
6. Winter dressed (dry) in -30^{O}C sleeping bag and life raft with cold wind;
7. Winter dressed (dry) in proposed sleeping bag # 1 (-4^{O}C) and life raft with cold wind;
8. Winter dressed (dry) in proposed sleeping bag # 2 (-10^{O}C) and life raft with cold wind;
9. Winter dressed (dry) in -30^{O}C sleeping bag and life raft over inflated life vest with cold wind;
10. Winter dressed (wet) in -30^{O}C sleeping bag with cold wind;
11. Winter dressed (wet) in proposed sleeping bag # 1 (-4^{O}C) with cold wind;
12. Winter dressed (wet) in proposed sleeping bag # 2 (-10^{O}C) with cold wind;
13. Winter dressed (wet) in current life raft with cold wind;
14. Winter dressed (wet) in proposed life raft with cold wind;
15. Winter dressed (wet) in -30^{O}C sleeping bag and life raft with cold wind;
16. Winter dressed (wet) in proposed sleeping bag # 1 (-4^{O}C) and life raft with cold wind;
17. Winter dressed (wet) in proposed sleeping bag # 2 (-10^{O}C) and life raft with cold wind;
18. Winter dressed (wet) in current life raft with cold wind in water;
19. Winter dressed (wet) in proposed life raft with cold wind in water;
20. Dressed with current constant wear immersion suit dry, in water with waves;
21. Dressed with current constant wear immersion suit wet (2 L of water added to the suit) in water with waves;
22. Dressed with modified constant wear immersion suit with foam liner dry, in water with waves;
23. Dressed with modified constant wear immersion suit with foam liner wet (2 L water), in water with waves;
24. Dressed with modified constant wear immersion suit with Thinsulate liner dry, in water with waves;
25. Dressed with modified constant wear immersion suit with Thinsulate liner wet (2 L water), in water with waves;
26. Spare test 1;
27. Spare test 2; and
28. Spare test 3.

1.3 STATEMENT OF WORK (Contd.):

DRDC Toronto will provide all the clothing and equipment required for the manikin tests. The contractor will make available the same test facilities used for the manikin testing for the human testing, i.e. wave pool and dressing area.

2.0 REFERENCES

2.1 CORD Document No. R95-018 (1995). Implementation of Test Protocol of Thermal Manikin Test System. The CORD Group Limited, Dartmouth: May 1995.

3.0 METHOD

3.1 METHODOLOGY:

The thermal performance of various land and sea survival equipment in wind was determined using a Thermal Instrumented Manikin Test System. During each test, environment, temperature, skin temperature and power consumption was recorded.

3.2 THERMAL MANIKIN TEST SYSTEM:

The Thermal Manikin Test System is a means for evaluating the thermal insulation of thermal protective clothing. In particular, this refers to survival suits for ocean emergencies and, in general, it refers to any human-use apparel. The system consists of a hollow aluminum manikin equipped with temperature sensors and electric heaters connected to a computer system.

In operation, the manikin is dressed in the human-use apparel to be tested and placed in an appropriate environment. The computing equipment then controls the heaters to maintain the skin of the manikin at a set temperature and measures the electrical power required to do so. This power is equivalent to the heat that escaped through the clothing due to the temperature difference across it. The power and temperature differences are then used, along with the known surface area of the manikin to calculate the thermal resistance offered by the apparel.

The system is designed for flexibility and ease of operation. To allow for different types of clothing, different sections of the manikin can be included or eliminated from the test as required.

The basic philosophy on which the design is based is that the thermal performance of a garment can be evaluated by unmanned tests on the whole garment under conditions identical or similar to actual operating conditions. This philosophy dictates that the system employs a life-sized watertight manikin capable of being heated to and maintained at a selected temperature.

Figure 1 gives a total view of the system. The visible components are the Thermally Instrumented Manikin (TIM), the control module, the computer, the environmental temperature sensors and the cables connecting these components. Basically, the manikin provides a shape of human proportions to fit inside the test garment. The combinations of the aluminum shell of the manikin and the output of heaters inside it provide for an approximately uniform temperature over the manikin surface. This temperature is sensed by sensors embedded in the manikin's shell and passed to the control module. The control module houses the programmed data acquisition system, the heater relays and other circuit components. The data acquisition system receives data from the temperature sensors on the manikin and controls the heater relays so that the manikin surface temperature remains constant. It also measures the

3.2 THERMAL MANIKIN TEST SYSTEM (Contd.):

environment temperature and the power applied to the manikin and is programmed with the surface area of the manikin. With this temperature, power and area data, it calculates the insulation value of the garment and passes this, along with other pertinent data to the computer. The computer acts as a control and display terminal and post-processor.

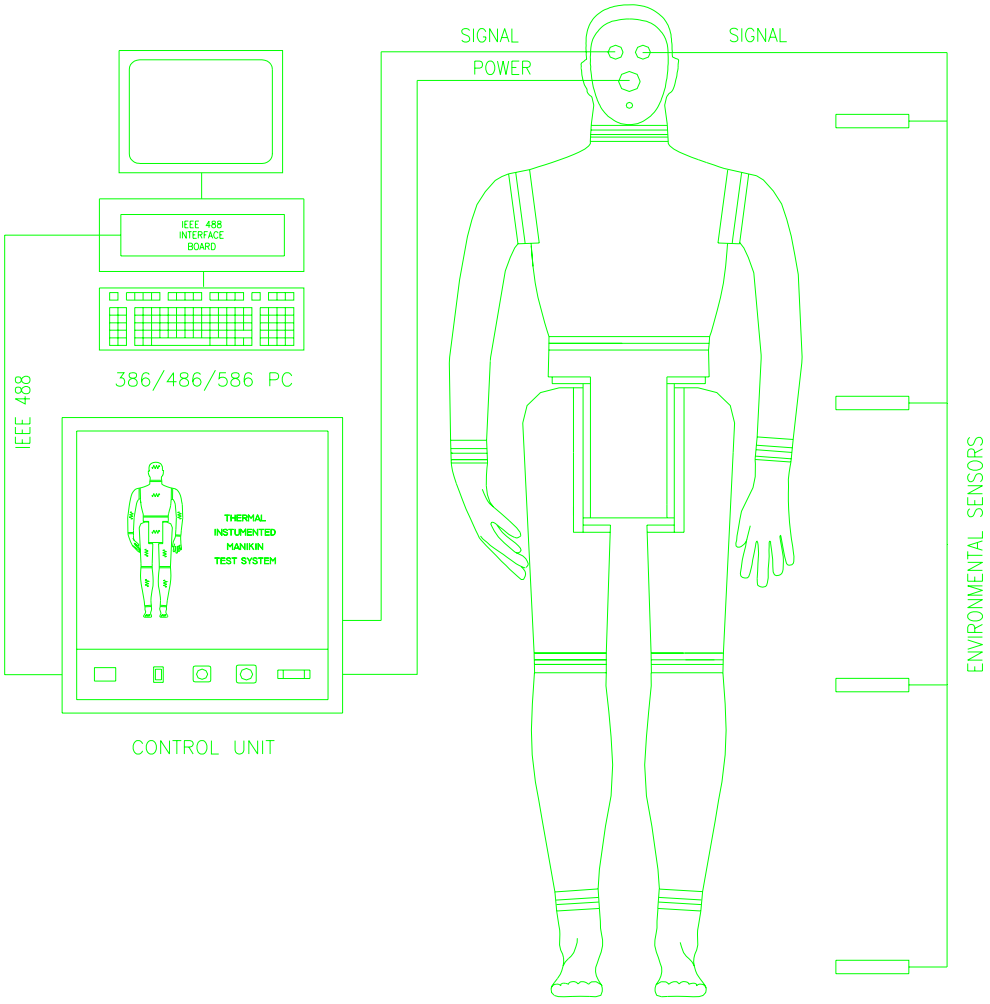

FIGURE 1

4.0 TEST EQUIPMENT

4.1 Control Module.
Model #: Micro-Mac 5000. Serial #: 98-9109404-001.
Last Calibration Date: March 31, 2003.
Calibration Due Date: March 31, 2004.

4.2 Instrumented Manikin.
Model #: TIM 1.
Last Calibration Date: March 31, 2003.
Calibration Due Date: March 31, 2004.

4.3 Desktop Computer.
Model #: MID-MSI 2600 ATX.
Calibration not required.

5.0 TEST CONDITIONS

5.1 For the testing performed prior to January 2004, testing was conducted in wind with an air speed of 20.5 km/h.

5.1.1 Ambient Air: 19.26 – 25.59

5.1.2 Relative Humidity: 50.0 – 79.0 $\pm$ 5 %

Despite the unintentional changes in the ambient air and relative humidity conditions, the conditions are not critical to the results rather it is the difference between the air temperature and body temperature, and that the latter was maintained constant across all conditions.

6.0 TEST ITEMS

6.1 Thermal Instrumented Manikin dressed in test garment and undergarment ensembles described in table 6.2.1 and 6.3.1.

6.2 Table 6.2.1 illustrates the garments and undergarments requested.

6.3 Table 6.3.1 illustrates the auxiliary components required for testing.

Run #	Garments and Undergarments
1 - 8,18 - 19	Dry - Winter flight jacket, coverall, pants, lined boots, leather mitts with wool liners. 2-piece winter underwear, wool socks, and balaclava
9 – 17	Wet – Simulated wet condition (nude)

Table 6.2.1

Run #	Auxiliary Components
1 - 17	6 inch thick spruce bough bed
7,8,19	Proposed balaclava and mitts
5,7,8,13,15,16,19	Proposed life raft
4,6,12,14,18	Current life raft
2,6,9,14,17	Current sleeping bag (-30^{O}C)
1,7,11,16	Proposed sleeping bag # 1 (-4^{O}C)
3,8,10,15	Proposed sleeping bag # 2 (-10^{O}C)
17	LP/SV lifejacket (inflated)

Table 6.3.1

7.0 TEST PROCEDURE

The land and sea survival equipment were tested using the procedures as directed in CORD Document No. R95-018 Implementation of Test Protocol of Thermal Manikin Test System May 1995. The manikin was lifted using an overhead hoist. The manikin was dressed in the above undergarment and garment ensemble and secured. Auxiliary components were added over the garments as described in Appendix “A” statement of work of contract number W7711-037858/001/TOR. The manikin was positioned into the prescribed test environment either lying onto the 6” bed of boughs or lowered into the water and positioned in the centre of the test tank in the natural flotation position. The environmental sensors were suspended around the manikin to provide the environmental temperature. Four 48” extraction fans were used to provide a uniform wind of 20.5 km/h over and around the manikin.

Entering all pertinent information into the system’s computer started a warm up period, while all sections of the manikin were warming up to the selected skin temperature. During that time, the conditions for the prescribed tests were implemented. Once all sections of the manikin reached the set point, the test automatically commenced. The test duration was four (4) hours to achieve steady state condition.

8.0 RESULTS

8.1 Table 8.1.1 illustrates final results of the thermal resistance testing rounded to four decimal points.

Run #	Description	Result CLO
1	Winter dress dry, in proposed sleeping bag # 1(-4^{O}C)	3.3845
2	Winter dress dry, in current sleeping bag (-30^{O}C)	4.3732
3	Winter dress dry, in proposed sleeping bag # 2(-10^{O}C)	3.9569
4	Winter dress dry, sitting in current life raft	2.7165
5	Winter dress dry, sitting in proposed life raft	2.6669
6	Winter dress dry, sitting in current life raft in current sleeping bag (-30^{O}C)	5.0508
7	Winter dress dry, sitting in proposed life raft in proposed sleeping bag # 1 (-4^{O}C), proposed mitts and balaclava	3.3885
8	Winter dress dry, sitting in proposed life raft in proposed sleeping bag # 2 (-10^{O}C), proposed mitts and balaclava	4.1373
9	Simulated winter wet dress (nude), in current sleeping bag (-30^{O}C)	3.4400
10	Simulated winter wet dress (nude), in proposed sleeping bag # 2 (-10^{O}C)	3.3714
11	Simulated winter wet dress (nude), in proposed sleeping bag # 1 (-4^{O}C)	1.7170
12	Simulated winter wet dress (nude), sitting in current life raft	0.6856
13	Simulated winter wet dress (nude), sitting in proposed life raft	0.8704
14	Simulated winter wet dress (nude), in current sleeping bag (-30^{O}C), sitting in current life raft	3.7007
15	Simulated winter wet dress (nude), in proposed sleeping bag # 2 (-10^{O}C), sitting in proposed life raft	3.4209
16	Simulated winter wet dress (nude), in proposed sleeping bag # 1 (-4^{O}C), sitting in proposed life raft	2.6589
17	Simulated winter wet dress (nude), in current sleeping bag (-30^{O}C) lying on inflated LP/SV life jacket	3.2049
18	Winter dress wet , sitting in current life raft in water, 8 L of water added to raft	0.2225
19	Winter dress wet , sitting in proposed life raft in water, 8 L of water added to raft	0.1507

Table 8.1.1

ANNEX “A”
RAW DATA

TEST NUMBER: 1867
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA6.TM1

DATE OF TEST: 06-12-2003
START TIME: 09:43:14
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, LEATHER MITTS WITH WOOL LINERS.
UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM,WOOL SOCKS,BALACLAVA.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: LYING ON 6 INCH THICK SPRUCE BOUGH BED WITH FEET TO THE WIND.
  HUMIDITY: 64
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: PROPOSED SLEEPING BAG # 1 (-4 DEG C),DRY CONDITION.

STOP TIME: 13:55:18 MINUTES SINCE START OF TEST: 252.05
ENVIRONMENT TEMPERATURE:
  INSTANTANEOUS: 22.61 AVERAGE OVER TEST TIME: 21.98

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.02	12.41	13.03	6.41	7.28	1.6949	1.5670
Chest	35.00	35.06	12.45	13.07	1.88	1.79	6.6591	7.3298
Back	35.00	35.04	12.43	13.04	2.35	3.33	5.6626	4.1975
Abdomen	35.00	35.03	12.42	13.04	1.46	1.56	3.0095	2.9671
Buttocks	35.00	35.01	12.40	13.02	2.11	2.90	3.2604	2.4982
Right Arm	35.00	35.02	12.41	13.03	3.08	3.25	2.9498	2.9419
Left Arm	35.00	35.02	12.41	13.04	3.42	3.11	2.3904	2.7607
Right Hand	35.00	35.07	12.46	13.09	2.15	2.05	1.8316	2.0244
Left Hand	35.00	35.09	12.48	13.10	1.52	1.55	2.5523	2.6354
Right Leg	35.00	35.04	12.43	13.05	5.77	6.51	4.9530	4.6033
Left Leg	35.00	35.05	12.44	13.05	5.37	5.58	4.9625	5.0134
Right Foot	35.00	35.03	12.42	13.05	2.57	2.19	2.1355	2.6295
Left Foot	35.00	35.02	12.41	13.05	2.53	2.08	2.1325	2.7342
Overall					40.63	43.16	3.4246	3.3845

   Total Power (W) For All Sections: 43.160
   Total Area (Square Meters): 1.736
   Overall Insulation Resistance (CLO): 3.3845

TEST NUMBER: 1868
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA7.TM1

DATE OF TEST: 06-12-2003
START TIME: 14:26:32
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, LEATHER MITTS WITH WOOL LINERS, UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM,WOOL SOCKS,BALACLAVA.
ENVIRONMENT: 20.5 KM WIND
  POSITION: LYING ON 6 INCH THICK SPRUCE BOUGH BED WITH FEET TO THE WIND.
  HUMIDITY: 63
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: (-30 DEG C) SLEEPING BAG,DRY CONDITION.

STOP TIME: 20:34:29 MINUTES SINCE START OF TEST: 367.95
ENVIRONMENT TEMPERATURE:
  INSTANTANEOUS: 24.03 AVERAGE OVER TEST TIME: 23.99

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.03	11.00	11.03	5.65	5.90	1.7036	1.6372
Chest	35.00	35.05	11.03	11.07	1.68	1.66	6.5928	6.7185
Back	35.00	35.02	10.99	11.04	2.36	2.69	5.0006	4.4035
Abdomen	35.00	35.04	11.01	11.04	1.19	1.14	3.2635	3.4333
Buttocks	35.00	35.01	10.98	11.02	3.00	2.19	2.0359	2.7969
Right Arm	35.00	35.06	11.03	11.05	0.94	1.70	8.5931	4.7731
Left Arm	35.00	35.04	11.01	11.05	2.33	1.88	3.1127	3.8787
Right Hand	35.00	35.06	11.04	11.08	1.08	0.96	3.2316	3.6633
Left Hand	35.00	35.08	11.06	11.09	0.77	1.23	4.4621	2.8120
Right Leg	35.00	35.04	11.01	11.05	1.66	2.96	15.2256	8.5771
Left Leg	35.00	35.05	11.02	11.06	3.01	3.35	7.8293	7.0761
Right Foot	35.00	35.09	11.06	11.06	0.50	1.34	9.6946	3.6586
Left Foot	35.00	35.05	11.02	11.06	0.88	1.32	5.4763	3.6466
Overall					25.06	28.29	4.9199	4.3732

   Total Power (W) For All Sections: 28.294
   Total Area (Square Meters): 1.736
   Overall Insulation Resistance (CLO): 4.3732

TEST NUMBER: 1869
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA8.TM1

DATE OF TEST: 06-13-2003
START TIME: 08:25:59
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, LEATHER MITTS WITH WOOL LINERS.
UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM,WOOL SOCKS,BALACLAVA.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: LYING ON 6 INCH THICK SPRUCE BOUGH BED WITH FEET TO THE WIND.
  HUMIDITY: 64.5
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: PROPOSED SLEEPING BAG # 2 (-10 DEG C), DRY CONDITION.

STOP TIME: 12:25:54 MINUTES SINCE START OF TEST: 239.90
ENVIRONMENT TEMPERATURE:
  INSTANTANEOUS: 24.61 AVERAGE OVER TEST TIME: 23.33

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.01	10.41	11.68	4.99	5.37	1.8242	1.9061
Chest	35.00	35.05	10.45	11.73	1.29	1.56	8.1620	7.5392
Back	35.00	35.04	10.43	11.70	2.65	3.37	4.2142	3.7255
Abdomen	35.00	35.05	10.44	11.72	0.77	1.10	4.7961	3.7770
Buttocks	35.00	35.01	10.40	11.68	2.65	2.66	2.1793	2.4410
Right Arm	35.00	35.03	10.42	11.69	1.49	1.85	5.1437	4.6407
Left Arm	35.00	35.04	10.43	11.71	1.20	1.82	5.7107	4.2314
Right Hand	35.00	35.07	10.46	11.74	1.09	1.12	3.0428	3.3243
Left Hand	35.00	35.08	10.47	11.75	1.22	1.37	2.6655	2.6661
Right Leg	35.00	35.04	10.43	11.70	5.90	5.55	4.0607	4.8427
Left Leg	35.00	35.04	10.43	11.70	3.61	4.61	6.1901	5.4293
Right Foot	35.00	35.05	10.44	11.72	1.50	1.42	3.0841	3.6543
Left Foot	35.00	35.06	10.45	11.72	0.96	1.32	4.7543	3.8575
Overall					29.32	33.12	3.9828	3.9569

   Total Power (W) For All Sections: 33.118
   Total Area (Square Meters): 1.736
   Overall Insulation Resistance (CLO): 3.9569

TEST NUMBER: 1870
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA9.TM1

DATE OF TEST: 06-13-2003
START TIME: 15:36:52
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, LEATHER MITTS WITH WOOL LINERS.
UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM, WOOL SOCKS, BALACLAVA.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND.
  HUMIDITY: 55
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN CURRENT LIFERAFT, DRY CONDITION.

STOP TIME: 21:48:43 MINUTES SINCE START OF TEST: 371.85
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 24.54 AVERAGE OVER TEST TIME: 25.07

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.01	10.47	9.94	5.36	5.56	1.7095	1.5654
Chest	35.00	35.05	10.51	10.00	2.36	2.04	4.4744	4.9305
Back	35.00	35.04	10.50	9.95	1.57	3.17	7.1926	3.3729
Abdomen	35.00	35.03	10.48	9.96	1.45	1.23	2.5546	2.8684
Buttocks	35.00	35.01	10.47	9.94	2.74	2.64	2.1228	2.0904
Right Arm	35.00	35.03	10.49	9.95	1.30	2.07	5.9274	3.5254
Left Arm	35.00	35.02	10.48	9.95	2.07	2.41	3.3271	2.7200
Right Hand	35.00	35.06	10.52	10.00	1.53	1.69	2.1823	1.8789
Left Hand	35.00	35.09	10.55	10.02	1.67	1.70	1.9612	1.8372
Right Leg	35.00	35.02	10.48	9.95	6.09	7.62	3.9516	3.0011
Left Leg	35.00	35.03	10.48	9.95	3.25	6.88	6.9098	3.0946
Right Foot	35.00	35.06	10.51	9.97	1.28	1.94	3.6324	2.2676
Left Foot	35.00	35.03	10.49	9.97	2.25	2.11	2.0220	2.0563
Overall					32.92	41.05	3.5667	2.7165

Total Power (W) For All Sections: 41.048
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 2.7165

TEST NUMBER: 1871
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA10.TM1

DATE OF TEST: 06-16-2003
START TIME: 10:45:51
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, LEATHER MITTS WITH WOOL LINERS.
UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM, WOOL SOCKS, BALACLAVA.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND.
  HUMIDITY: 79
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN PROPOSED LIFERAFT, DRY CONDITION.

STOP TIME: 14:45:49 MINUTES SINCE START OF TEST: 239.95
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 21.93 AVERAGE OVER TEST TIME: 19.86

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.01	13.08	15.15	7.60	9.75	1.5070	1.3602
Chest	35.00	35.07	13.14	15.21	2.04	3.04	6.4716	5.0233
Back	35.00	35.02	13.09	15.17	3.30	3.59	4.2547	4.5325
Abdomen	35.00	35.01	13.08	15.16	2.20	2.32	2.1064	2.3186
Buttocks	35.00	35.01	13.08	15.15	3.40	3.92	2.1341	2.1470
Right Arm	35.00	35.02	13.09	15.16	3.59	4.51	2.6709	2.4646
Left Arm	35.00	35.01	13.08	15.15	3.50	4.00	2.4588	2.4959
Right Hand	35.00	35.09	13.16	15.23	2.11	2.36	1.9712	2.0432
Left Hand	35.00	35.08	13.15	15.24	1.87	2.14	2.1890	2.2175
Right Leg	35.00	35.02	13.09	15.17	11.73	11.10	2.5653	3.1403
Left Leg	35.00	35.02	13.09	15.16	9.16	10.63	3.0605	3.0532
Right Foot	35.00	35.03	13.10	15.17	2.42	3.21	2.3947	2.0907
Left Foot	35.00	35.04	13.11	15.19	2.68	3.13	2.1265	2.1104
Overall					55.61	63.69	2.6371	2.6669

Total Power (W) For All Sections: 63.685
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 2.6669

TEST NUMBER: 1872
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA11.TM1

DATE OF TEST: 06-16-2003
START TIME: 15:05:04
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, LEATHER MITTS WITH WOOL LINERS.
UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM, WOOL SOCKS, BALACLAVA.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND.
  HUMIDITY: 64
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN (-30 DEG C) SLEEPING BAG, IN CURRENT LIFERAFT, DRY CONDITION.

STOP TIME: 23:04:57 MINUTES SINCE START OF TEST: 479.90
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 22.40 AVERAGE OVER TEST TIME: 22.70

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.01	12.61	12.32	6.74	5.46	1.6395	1.9754
Chest	35.00	35.06	12.66	12.37	1.60	1.28	7.9289	9.7265
Back	35.00	35.06	12.66	12.35	0.88	1.29	15.3619	10.2574
Abdomen	35.00	35.05	12.65	12.35	1.13	1.10	3.9618	3.9671
Buttocks	35.00	35.01	12.62	12.32	3.30	2.53	2.1247	2.7080
Right Arm	35.00	35.05	12.66	12.33	0.76	1.73	12.2187	5.2322
Left Arm	35.00	35.02	12.62	12.34	2.11	2.01	3.9280	4.0346
Right Hand	35.00	35.07	12.67	12.37	1.10	1.11	3.6614	3.5189
Left Hand	35.00	35.09	12.70	12.39	0.88	1.15	4.4747	3.3589
Right Leg	35.00	35.05	12.65	12.37	4.94	2.81	5.8834	10.1263
Left Leg	35.00	35.01	12.62	12.33	4.92	4.16	5.4915	6.3510
Right Foot	35.00	35.05	12.65	12.35	1.27	1.40	4.3934	3.8950
Left Foot	35.00	35.06	12.66	12.36	1.17	1.34	4.7263	4.0183
Overall					30.81	27.36	4.5929	5.0508

Total Power (W) For All Sections: 27.361
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 5.0508

TEST NUMBER: 1873
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA12.TM1

DATE OF TEST: 06-17-2003
START TIME: 10:03:14
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, PROPOSED MITTS.
UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM, WOOL SOCKS, PROPOSED BALACLAVA.
ENVIRONMENT: 20.5 KM WIND
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND.
  HUMIDITY: 55
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN (-4 DEG C) PROPOSED SLEEPING BAG # 1 IN PROPOSED LIFERAFT, DRY CONDITION.

STOP TIME: 15:31:59 MINUTES SINCE START OF TEST: 328.75
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 25.05 AVERAGE OVER TEST TIME: 23.24

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.00	9.96	11.76	6.98	8.38	1.2491	1.2293
Chest	35.00	35.06	10.01	11.82	1.35	1.69	7.4455	7.0412
Back	35.00	35.07	10.02	11.80	0.70	1.76	15.3457	7.2017
Abdomen	35.00	35.07	10.02	11.81	0.26	0.96	13.7555	4.3340
Buttocks	35.00	35.02	9.98	11.77	1.48	2.28	3.7561	2.8621
Right Arm	35.00	35.01	9.96	11.77	2.33	3.36	3.1319	2.5638
Left Arm	35.00	35.03	9.99	11.77	2.31	3.39	2.8468	2.2861
Right Hand	35.00	35.08	10.04	11.83	1.33	1.43	2.3954	2.6158
Left Hand	35.00	35.09	10.04	11.84	1.10	1.21	2.8424	3.0401
Right Leg	35.00	35.04	10.00	11.77	4.25	6.50	5.4006	4.1613
Left Leg	35.00	35.02	9.97	11.78	6.48	4.60	3.2964	5.4798
Right Foot	35.00	35.02	9.97	11.79	1.83	1.88	2.4119	2.7707
Left Foot	35.00	35.04	9.99	11.80	1.83	1.48	2.3792	3.4704
Overall					32.21	38.93	3.4697	3.3885

Total Power (W) For All Sections: 38.933
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 3.3885

TEST NUMBER: 1874
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA13.TM1

DATE OF TEST: 06-17-2003
START TIME: 16:03:37
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, PROPOSED MITTS.
UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM, WOOL SOCKS, PROPOSED BALACLAVA..
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND..
  HUMIDITY: 54
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN (-10 DEG C) PROPOSED SLEEPING BAG # 2 IN PROPOSED LIFE RAFT, DRY CONDITION.

STOP TIME: 22:03:34 MINUTES SINCE START OF TEST: 359.95
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 24.41 AVERAGE OVER TEST TIME: 24.66

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.00	10.59	10.35	5.93	5.01	1.5645	1.8075
Chest	35.00	35.07	10.66	10.41	1.26	1.09	8.4684	9.5803
Back	35.00	35.06	10.66	10.39	1.24	1.21	9.2151	9.1757
Abdomen	35.00	35.05	10.64	10.39	0.82	0.75	4.6002	4.9257
Buttocks	35.00	35.02	10.61	10.35	1.57	1.83	3.7622	3.1401
Right Arm	35.00	35.00	10.60	10.35	3.64	2.50	2.1350	3.0335
Left Arm	35.00	35.01	10.61	10.36	3.63	2.57	1.9205	2.6557
Right Hand	35.00	35.08	10.67	10.40	1.10	1.19	3.0798	2.7737
Left Hand	35.00	35.07	10.66	10.41	1.20	1.00	2.7676	3.2296
Right Leg	35.00	35.01	10.61	10.37	4.25	4.77	5.7324	4.9957
Left Leg	35.00	35.03	10.63	10.38	2.97	3.70	7.6684	6.0070
Right Foot	35.00	35.06	10.65	10.38	0.83	1.24	5.6549	3.6848
Left Foot	35.00	35.04	10.63	10.38	1.31	1.20	3.5253	3.7735
Overall					29.75	28.07	3.9962	4.1373

Total Power (W) For All Sections: 28.067
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 4.1373

TEST NUMBER: 1875
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA14.TM1

DATE OF TEST: 06-18-2003
START TIME: 10:56:59
DESCRIPTION OF SUIT TESTED: CURRENT SLEEPING BAG (-30 DEG C).
UNDERGARMENTS: NIL.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: LYING ON 6 INCH THICK SPRUCE BOUGH BED WITH FEET TO THE WIND.
  HUMIDITY: 50
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SIMULATED WET CONDITION.

STOP TIME: 15:56:56 MINUTES SINCE START OF TEST: 299.95
ENVIRONMENT TEMPERATURE:
  INSTANTANEOUS: 25.51 AVERAGE OVER TEST TIME: 24.01

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.01	9.50	11.00	5.98	7.05	1.3910	1.3654
Chest	35.00	35.04	9.53	11.06	2.78	1.97	3.4440	5.6382
Back	35.00	35.04	9.53	11.02	2.60	3.30	3.9391	3.5799
Abdomen	35.00	35.01	9.50	11.02	1.84	1.62	1.8277	2.4089
Buttocks	35.00	35.01	9.50	11.01	3.22	3.15	1.6391	1.9424
Right Arm	35.00	35.02	9.50	11.02	1.52	1.64	4.5708	4.9204
Left Arm	35.00	35.01	9.50	11.01	4.00	3.56	1.5635	2.0375
Right Hand	35.00	35.06	9.55	11.06	1.04	0.96	2.9021	3.6395
Left Hand	35.00	35.09	9.57	11.08	1.12	1.33	2.6696	2.5837
Right Leg	35.00	35.06	9.55	11.05	1.72	2.91	12.7874	8.7215
Left Leg	35.00	35.03	9.52	11.02	3.49	4.93	5.8400	4.7821
Right Foot	35.00	35.02	9.51	11.03	1.64	1.60	2.5677	3.0374
Left Foot	35.00	35.03	9.52	11.03	1.61	1.84	2.5719	2.6036
Overall					32.55	35.88	3.2737	3.4400

   Total Power (W) For All Sections: 35.879
   Total Area (Square Meters): 1.736
   Overall Insulation Resistance (CLO): 3.4400

TEST NUMBER: 1876
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA15.TM1

DATE OF TEST: 06-18-2003
START TIME: 17:16:04
DESCRIPTION OF SUIT TESTED: PROPOSED SLEEPING BAG # 2 (-10 DEG C).
UNDERGARMENTS: NIL.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: LYING ON 6 INCH THICK SPRUCE BOUGH BED WITH FEET TO THE WIND.
  HUMIDITY: 55
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SIMULATED WET CONDITION.

STOP TIME: 23:16:01 MINUTES SINCE START OF TEST: 359.95
ENVIRONMENT TEMPERATURE:
  INSTANTANEOUS: 24.72 AVERAGE OVER TEST TIME: 25.07

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.01	10.29	9.94	4.93	4.51	1.8297	1.9284
Chest	35.00	35.06	10.34	10.00	3.30	1.99	3.1463	5.0441
Back	35.00	35.04	10.32	9.96	2.54	3.09	4.3521	3.4524
Abdomen	35.00	35.04	10.32	9.97	1.69	1.25	2.1691	2.8317
Buttocks	35.00	35.03	10.31	9.96	1.95	1.67	2.9386	3.3089
Right Arm	35.00	35.03	10.31	9.95	1.62	2.03	4.6607	3.5907
Left Arm	35.00	35.02	10.30	9.96	2.66	1.97	2.5461	3.3215
Right Hand	35.00	35.06	10.34	10.00	1.32	1.44	2.4780	2.2045
Left Hand	35.00	35.10	10.38	10.01	1.07	1.34	3.0158	2.3265
Right Leg	35.00	35.02	10.30	9.94	6.84	6.67	3.4591	3.4258
Left Leg	35.00	35.02	10.30	9.95	4.20	4.08	5.2491	5.2255
Right Foot	35.00	35.02	10.31	9.96	2.09	1.56	2.1774	2.8275
Left Foot	35.00	35.03	10.32	9.97	1.59	1.47	2.8223	2.9388
Overall					35.80	33.08	3.2245	3.3714

   Total Power (W) For All Sections: 33.078
   Total Area (Square Meters): 1.736
   Overall Insulation Resistance (CLO): 3.3714

TEST NUMBER: 1877
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA16.TM1

DATE OF TEST: 06-19-2003
START TIME: 07:49:15
DESCRIPTION OF SUIT TESTED: PROPOSED SLEEPING BAG # 1 (-4 DEG C).
UNDERGARMENTS: NIL.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: LYING ON 6 INCH THICK SPRUCE BOUGH BED WITH FEET TO THE WIND.
  HUMIDITY: 50
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SIMULATED WET CONDITION.

STOP TIME: 10:49:13 MINUTES SINCE START OF TEST: 179.95
ENVIRONMENT TEMPERATURE:
  INSTANTANEOUS: 20.09 AVERAGE OVER TEST TIME: 19.26

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.00	14.91	15.73	25.99	27.76	0.5021	0.4963
Chest	35.00	35.07	14.97	15.81	5.89	5.59	2.5521	2.8438
Back	35.00	35.01	14.92	15.75	7.66	7.48	2.0900	2.2589
Abdomen	35.00	35.00	14.91	15.74	3.90	3.98	1.3558	1.4027
Buttocks	35.00	35.01	14.92	15.75	3.91	3.44	2.1204	2.5401
Right Arm	35.00	35.00	14.91	15.74	7.15	7.86	1.5290	1.4666
Left Arm	35.00	35.01	14.91	15.74	5.30	5.68	1.8536	1.8223
Right Hand	35.00	35.12	15.02	15.86	5.04	5.13	0.9447	0.9800
Left Hand	35.00	35.15	15.06	15.89	4.84	4.57	0.9673	1.0808
Right Leg	35.00	35.01	14.92	15.75	13.64	13.46	2.5136	2.6894
Left Leg	35.00	35.01	14.92	15.75	9.73	11.44	3.2827	2.9468
Right Foot	35.00	35.04	14.94	15.76	3.12	3.59	2.1177	1.9431
Left Foot	35.00	35.03	14.94	15.77	2.79	2.80	2.3257	2.4479
Overall					98.95	102.78	1.6897	1.7170

   Total Power (W) For All Sections: 102.776
   Total Area (Square Meters): 1.736
   Overall Insulation Resistance (CLO): 1.7170

TEST NUMBER: 1878
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA17.TM1

DATE OF TEST: 06-19-2003
START TIME: 11:19:10
DESCRIPTION OF SUIT TESTED: CURRENT LIFE RAFT.
UNDERGARMENTS: NIL.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND.
  HUMIDITY: 67
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN CURRENT LIFE RAFT, SIMULATED WET CONDITION.

STOP TIME: 13:19:08 MINUTES SINCE START OF TEST: 119.95
ENVIRONMENT TEMPERATURE:
  INSTANTANEOUS: 21.09 AVERAGE OVER TEST TIME: 20.65

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.00	13.91	14.35	27.66	28.45	0.4402	0.4417
Chest	35.00	35.08	13.99	14.44	13.61	13.48	1.0327	1.0760
Back	35.00	35.00	13.91	14.35	30.76	31.12	0.4851	0.4949
Abdomen	35.00	35.00	13.91	14.36	6.93	7.08	0.7112	0.7178
Buttocks	35.00	35.00	13.91	14.36	7.15	7.03	1.0807	1.1345
Right Arm	35.00	35.00	13.91	14.35	15.83	15.17	0.6442	0.6935
Left Arm	35.00	35.00	13.91	14.35	14.28	14.53	0.6411	0.6498
Right Hand	35.00	35.09	14.00	14.45	4.26	3.92	1.0414	1.1674
Left Hand	35.00	35.15	14.06	14.51	5.35	5.19	0.8176	0.8692
Right Leg	35.00	35.01	13.92	14.35	39.61	43.32	0.8077	0.7616
Left Leg	35.00	35.00	13.91	14.35	42.79	43.67	0.6961	0.7038
Right Foot	35.00	35.03	13.94	14.38	10.14	10.97	0.6072	0.5792
Left Foot	35.00	35.05	13.96	14.39	9.66	10.70	0.6286	0.5850
Overall					228.02	234.64	0.6838	0.6856

   Total Power (W) For All Sections: 234.644
   Total Area (Square Meters): 1.736
   Overall Insulation Resistance (CLO): 0.6856

TEST NUMBER: 1887
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA18.TM1

DATE OF TEST: 06-24-2003
START TIME: 09:57:15
DESCRIPTION OF SUIT TESTED: PROPOSED LIFERAFT.
UNDERGARMENTS: NIL.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND.
  HUMIDITY: 59
  ENV. FLOW SPEED:
  DIRECTION: From Back
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN PROPOSED LIFE RAFT, SIMULATED WET CONDITION.

STOP TIME: 11:57:13 MINUTES SINCE START OF TEST: 119.95
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 24.36 AVERAGE OVER TEST TIME: 24.09

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.00	10.64	10.91	18.66	19.78	0.4991	0.4831
Chest	35.00	35.10	10.74	11.01	7.69	8.75	1.4022	1.2637
Back	35.00	35.01	10.65	10.92	11.75	11.98	0.9721	0.9781
Abdomen	35.00	35.01	10.66	10.93	4.49	4.65	0.8412	0.8330
Buttocks	35.00	35.01	10.65	10.92	6.82	6.83	0.8671	0.8876
Right Arm	35.00	35.01	10.65	10.92	5.42	6.53	1.4393	1.2264
Left Arm	35.00	35.00	10.65	10.92	9.80	9.78	0.7146	0.7346
Right Hand	35.00	35.09	10.73	11.01	3.16	3.03	1.0766	1.1524
Left Hand	35.00	35.13	10.77	11.05	4.26	3.83	0.7870	0.8961
Right Leg	35.00	35.00	10.64	10.92	29.78	27.35	0.8213	0.9175
Left Leg	35.00	35.00	10.65	10.92	25.56	25.91	0.8916	0.9024
Right Foot	35.00	35.01	10.66	10.94	6.52	6.47	0.7228	0.7471
Left Foot	35.00	35.06	10.70	10.97	5.32	5.76	0.8742	0.8273
Overall					139.24	140.65	0.8571	0.8704

Total Power (W) For All Sections: 140.654
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 0.8704

TEST NUMBER: 1888
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA19.TM1

DATE OF TEST: 06-25-2003
START TIME: 11:13:34
DESCRIPTION OF SUIT TESTED: CURRENT SLEEPING BAG (-30 DEG C).
UNDERGARMENTS: NIL.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND.
  HUMIDITY: 55
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN CURRENT LIFE RAFT, SIMULATED WET CONDITION.

STOP TIME: 21:13:29 MINUTES SINCE START OF TEST: 599.90
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 22.30 AVERAGE OVER TEST TIME: 21.15

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.00	12.70	13.86	14.40	13.96	0.7723	0.8690
Chest	35.00	35.06	12.76	13.92	1.31	1.60	9.8073	8.7129
Back	35.00	35.06	12.76	13.90	1.02	1.18	13.4854	12.6586
Abdomen	35.00	35.05	12.75	13.89	0.78	0.88	5.7607	5.5888
Buttocks	35.00	35.01	12.71	13.87	2.20	2.44	3.2120	3.1626
Right Arm	35.00	35.05	12.75	13.88	1.10	1.92	8.4754	5.3094
Left Arm	35.00	35.03	12.73	13.87	2.65	3.20	3.1617	2.8539
Right Hand	35.00	35.07	12.77	13.93	1.09	1.16	3.7089	3.7887
Left Hand	35.00	35.10	12.80	13.94	1.00	1.22	3.9959	3.5623
Right Leg	35.00	35.02	12.72	13.87	5.73	7.18	5.1035	4.4391
Left Leg	35.00	35.04	12.74	13.88	4.22	4.92	6.4692	6.0388
Right Foot	35.00	35.05	12.75	13.89	0.91	1.27	6.2212	4.8511
Left Foot	35.00	35.05	12.75	13.91	1.04	1.06	5.3416	5.6916
Overall					37.43	41.99	3.8066	3.7007

Total Power (W) For All Sections: 41.988
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 3.7007

TEST NUMBER: 1889
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA20.TM1

DATE OF TEST: 06-26-2003
START TIME: 15:47:11
DESCRIPTION OF SUIT TESTED: PROPOSED SLEEPING BAG # 2 (-10 DEC C).
UNDERGARMENTS: NIL.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND.
  HUMIDITY: 59
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN PROPOSED LIFE RAFT, SIMULATED WET CONDITION.

STOP TIME: 22:47:07 MINUTES SINCE START OF TEST: 419.95
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 24.75 AVERAGE OVER TEST TIME: 25.59

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.01	10.27	9.42	5.32	4.65	1.6886	1.7732
Chest	35.00	35.06	10.31	9.47	1.56	1.53	6.6199	6.2109
Back	35.00	35.04	10.29	9.45	2.09	1.62	5.2809	6.2515
Abdomen	35.00	35.04	10.29	9.45	0.49	0.54	7.3794	6.1842
Buttocks	35.00	35.02	10.28	9.43	1.43	1.63	3.9985	3.2114
Right Arm	35.00	35.02	10.28	9.42	2.72	3.06	2.7679	2.2528
Left Arm	35.00	35.03	10.29	9.43	2.00	2.87	3.3923	2.1667
Right Hand	35.00	35.06	10.31	9.48	1.07	0.74	3.0626	4.0576
Left Hand	35.00	35.08	10.34	9.50	0.99	1.50	3.2503	1.9751
Right Leg	35.00	35.03	10.28	9.43	5.23	5.75	4.5217	3.7707
Left Leg	35.00	35.03	10.29	9.43	3.04	4.69	7.2430	4.3096
Right Foot	35.00	35.03	10.29	9.44	1.70	1.41	2.6755	2.9594
Left Foot	35.00	35.04	10.30	9.46	0.96	0.91	4.6548	4.5416
Overall					28.60	30.89	4.0269	3.4209

Total Power (W) For All Sections: 30.891
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 3.4209

TEST NUMBER: 1890
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA21.TM1

DATE OF TEST: 06-27-2003
START TIME: 10:46:37
DESCRIPTION OF SUIT TESTED: PROPOSED SLEEPING BAG # 1 (-4 DEG C).
UNDERGARMENTS: NIL.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING ON 6 INCH THICK SPRUCE BOUGH BED WITH BACK TO THE WIND.
  HUMIDITY: 50
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN PROPOSED LIFERAFT, SIMULATED WET CONDITION.

STOP TIME: 16:13:33 MINUTES SINCE START OF TEST: 326.95
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 24.10 AVERAGE OVER TEST TIME: 24.51

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.02	10.93	10.51	8.56	9.77	1.1181	0.9418
Chest	35.00	35.04	10.94	10.55	3.38	2.01	3.2568	5.2793
Back	35.00	35.04	10.94	10.53	1.44	1.74	8.1460	6.5016
Abdomen	35.00	35.03	10.93	10.53	1.73	0.95	2.2344	3.9412
Buttocks	35.00	35.02	10.92	10.50	1.48	2.35	4.0910	2.4847
Right Arm	35.00	35.01	10.92	10.52	5.71	3.45	1.4017	2.2360
Left Arm	35.00	35.01	10.91	10.52	4.12	3.26	1.7427	2.1213
Right Hand	35.00	35.08	10.99	10.57	1.94	1.81	1.7967	1.8461
Left Hand	35.00	35.06	10.96	10.58	1.55	1.40	2.1961	2.3583
Right Leg	35.00	35.05	10.95	10.51	2.75	9.79	9.1393	2.4697
Left Leg	35.00	35.03	10.93	10.53	3.61	4.60	6.4803	4.8985
Right Foot	35.00	35.01	10.92	10.52	2.79	1.95	1.7313	2.3888
Left Foot	35.00	35.03	10.93	10.54	1.63	1.25	2.9205	3.6566
Overall					40.69	44.32	3.0087	2.6589

Total Power (W) For All Sections: 44.319
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 2.6589

TEST NUMBER: 1891
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\m0311ta22.TM1

DATE OF TEST: 06-30-2003
START TIME: 09:58:07
DESCRIPTION OF SUIT TESTED: CURRENT SLEEPING BAG (-30 DEG C).
UNDERGARMENTS: NIL.
ENVIRONMENT: 20.5 KM WIND
  POSITION: LYING ON 6 INCH THICK SPRUCE BOUGH BED WITH FEET TO THE WIND.
  HUMIDITY: 64
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: INFLATED LIFE JACKET PLACED UNDER TORSO IN BOUGH BED, SIMULATED WET CONDITION.

STOP TIME: 16:43:39 MINUTES SINCE START OF TEST: 405.55
ENVIRONMENT TEMPERATURE:
INSTANTANEOUS: 22.58 AVERAGE OVER TEST TIME: 24.19

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	35.00	35.00	12.42	10.82	10.99	10.95	0.9895	0.8651
Chest	35.00	35.06	12.48	10.88	2.35	2.00	5.3383	5.4639
Back	35.00	35.04	12.46	10.84	2.00	2.75	6.6783	4.2328
Abdomen	35.00	35.04	12.46	10.85	1.04	0.96	4.2331	4.0178
Buttocks	35.00	35.01	12.43	10.83	2.56	2.45	2.6920	2.4513
Right Arm	35.00	35.01	12.43	10.84	1.50	1.42	6.0700	5.6015
Left Arm	35.00	35.03	12.45	10.83	2.04	2.84	4.0190	2.5087
Right Hand	35.00	35.07	12.49	10.88	0.66	0.89	5.9804	3.8600
Left Hand	35.00	35.07	12.49	10.89	1.47	0.90	2.6407	3.7575
Right Leg	35.00	35.03	12.45	10.84	5.05	6.02	5.6637	4.1408
Left Leg	35.00	35.02	12.44	10.85	5.53	3.86	4.8198	6.0212
Right Foot	35.00	35.02	12.44	10.85	2.68	1.57	2.0486	3.0466
Left Foot	35.00	35.05	12.47	10.86	1.34	1.26	4.0456	3.7435
Overall					39.22	37.87	3.5525	3.2049

Total Power (W) For All Sections: 37.869
Total Area (Square Meters): 1.736
Overall Insulation Resistance (CLO): 3.2049

TEST NUMBER: 1892
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\Program Files\tim1_1_34beta\M0311TA23.TM1

DATE OF TEST: 07-02-2003
START TIME: 12:15:51
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, LEATHER MITTS WITH WOOL LINERS.
UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM, WOOL SOCKS, BALACLAVA.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING IN LIFERAFT IN WATER.
  HUMIDITY: 60
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE IN CURRENT LIFERAFT, WET CONDITION, 8 LITRES OF WATER ADDED TO THE LIFERAFT.

STOP TIME: 16:15:49 MINUTES SINCE START OF TEST: 239.95
ENVIRONMENT TEMPERATURE:
  INSTANTANEOUS: 25.48 AVERAGE OVER TEST TIME: 24.69

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	31.50	31.53	6.05	6.83	2.60	4.22	2.0372	1.4157
Chest	31.50	31.56	6.07	6.87	4.33	4.27	1.4093	1.6152
Back	31.50	31.51	6.02	6.82	8.42	8.33	0.7679	0.8791
Abdomen	31.50	31.52	6.03	6.83	4.22	3.95	0.5063	0.6117
Buttocks	31.50	31.46	5.98	6.79	43.26	40.90	0.0768	0.0922
Right Arm	31.50	31.51	6.02	6.82	5.41	5.45	0.8163	0.9166
Left Arm	31.50	31.50	6.02	6.82	5.97	5.93	0.6638	0.7567
Right Hand	31.50	31.60	6.11	6.91	3.16	3.41	0.6117	0.6423
Left Hand	31.50	31.62	6.14	6.93	3.18	3.45	0.6010	0.6256
Right Leg	31.50	31.50	6.01	6.81	152.05	142.81	0.0909	0.1096
Left Leg	31.50	31.50	6.02	6.81	108.05	108.28	0.1193	0.1347
Right Foot	31.50	31.52	6.03	6.83	5.73	5.95	0.4654	0.5077
Left Foot	31.50	31.54	6.06	6.86	5.70	6.06	0.4619	0.4918
Overall					352.07	343.01	0.1914	0.2225

   Total Power (W) For All Sections: 343.013
   Total Area (Square Meters): 1.736
   Overall Insulation Resistance (CLO): 0.2225

Note: Total water removed from life raft was 32 litres.

TEST NUMBER: 1893
TEST TITLE: COLD WEATHER GARMENT EVALUATION.
FILE NAME: c:\tim1\M0311TA24.TM1

DATE OF TEST: 07-03-2003
START TIME: 12:07:29
DESCRIPTION OF SUIT TESTED: WINTER FLIGHT JACKET, COVERALL, PANTS, LINED BOOTS, PROPOSED MITTS.
UNDERGARMENTS: WINTER UNDERWEAR; TOP AND BOTTOM, PROPOSED BALACLAVA.
ENVIRONMENT: 20.5 KM WIND.
  POSITION: SITTING IN LIFERAFT IN WATER.
  HUMIDITY: 64
  ENV. FLOW SPEED:
  DIRECTION:
CABLE LENGTH: Short (50ft)
ADDITIONAL INFORMATION: SITTING ON INFLATABLE PILLOW IN PROPOSED LIFERAFT,WET CONDITION, 8 LITRES OF WATER ADDED TO THE LIFERAFT.

STOP TIME: 14:37:27 MINUTES SINCE START OF TEST: 149.95
ENVIRONMENT TEMPERATURE:
  INSTANTANEOUS: 24.75 AVERAGE OVER TEST TIME: 24.73

SECTION	SETPOINT (Deg C)	SKINTEMP (Deg C)	TEMP DIFF(Deg C) INSTANT	TEMP DIFF(Deg C) AVERAGE	POWER (WATTS) ST	POWER (WATTS) LT	INSULATION (CLO) ST	INSULATION (CLO) LT
Head	29.80	29.81	5.06	5.07	4.33	4.14	1.0219	1.0727
Chest	29.80	29.87	5.12	5.12	2.82	2.98	1.8252	1.7262
Back	29.80	29.80	5.04	5.06	21.50	21.31	0.2516	0.2545
Abdomen	29.80	29.80	5.05	5.07	5.01	4.49	0.3572	0.3992
Buttocks	29.80	29.79	5.04	5.05	37.10	36.94	0.0754	0.0759
Right Arm	29.80	29.79	5.04	5.04	8.79	7.22	0.4201	0.5116
Left Arm	29.80	29.81	5.06	5.06	6.11	6.78	0.5446	0.4912
Right Hand	29.80	29.83	5.08	5.09	14.19	13.38	0.1133	0.1204
Left Hand	29.80	29.89	5.14	5.13	12.31	12.29	0.1298	0.1298
Right Leg	29.80	29.65	4.89	4.72	165.33	163.70	0.0680	0.0663
Left Leg	29.80	29.80	5.05	5.05	86.42	87.12	0.1252	0.1242
Right Foot	29.80	29.83	5.08	5.09	1.00	1.45	2.2440	1.5560
Left Foot	29.80	29.83	5.08	5.09	2.01	2.31	1.0988	0.9597
Overall					366.93	364.10	0.1520	0.1507

   Total Power (W) For All Sections: 364.099
   Total Area (Square Meters): 1.736
   Overall Insulation Resistance (CLO): 0.1507

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14. ABSTRACT

(U) As part of the Thrust 3id12 and a tasking from the Air Forces, DRDC Toronto required testing to be conducted on a thermal manikin to evaluate the thermal performance of land and sea survival equipment. This report details the results of using the winter dress in both dry and wet conditions using current and proposed life rafts, sleeping bags, and auxiliary components using a simulated insulating survival bed constructed of spruce boughs. These results will provide the basis for testing using human subjects using the same sea survival equipment and the same test facilities (wave tank).

(U) Dans le cadre du vecteur 3id12 et d'une tâche assignée par les Forces aériennes, RDDC Toronto a exigé qu'on fasse des essais sur un mannequin thermique pour évaluer la performance thermique d'un équipement de survie terrestre et marin. Le présent rapport donne en détail les résultats du port d'une tenue d'hiver à l'état sec et au mouillé, dans un canot de sauvetage, courant et proposé, des sacs de couchage et des éléments auxiliaires, utilisant un lit de survie isolant simulé, fait de branches maîtresses d'épicéa. Ces résultats fourniront la base de tests menés sur des sujets humains utilisant le même équipement de survie marin et les mêmes installations d'essai (cuves à houle).

15. KEYWORDS, DESCRIPTORS or IDENTIFIERS

(U) thermal manikin, thermal resistance, emergency equipment, seat pack