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THERMAL INSULATION OF AIR FORCE CLOTH

A CATALOG AND PART 5 OF A SERIES

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FOREWORD

This report was initiated under Project No. 7164, "Physiology of Flight," Task No. 71830, "Human Thermal Stress in Extended Environment," and administered under the direction of the Biomedical Laboratory, Aerospace Medical Division, Wright Air Development Division. This research effort was conducted in the Biothermal Section of the Biophysics Branch.

ABSTRACT

Results of the fifth of a series of thermal insulation studies performed with electrically heated hand, foot, head, and entire body models are presented. The experimental data include results obtained with light, medium, and heavy clothing types, as well as with thermal protective items of a specialized nature. A revised catalog listing individually the insulation in clo units of numerous recently developed clothing items is included. These are arranged in order of increasing value in each clothing category (i.e., light, medium, and heavy). Since catalog values were obtained either by separate measurement, or by a difference method, these two techniques for body clothing insulation measurement are described. Advantages and limitations of each respective method are discussed. Relationship between the measured and calculated thermal insultation of clothing assemblies is shown graphically and correction factors for use with each category of catalogued clothing are graphed. The effect of laundering on thermal insulation of many recent Air Force clothing assemblies is illustrated and discussed.

PUBLICATION REVIEW

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INTRODUCTION

Human exposure to thermal extremes and survival from emergency exposure to cold air or water is a constant problem in present Air Force operations. Within high performance aircraft or during re-entry periods within ballistic or hypersonic glide vehicles or spacecraft, high ambient temperatures far in excess of the comfort zone may frequently result. Furthermore, high altitude escape, cold water immersion, or prolonged survival under arctic conditions are specific problem areas requiring continuous development and evaluation of many types of specialized protective clothing.

An extensive amount of information concerning Air Force clothing has accumulated since the original catalog was published in 1956. The present report includes thermal insulation data obtained since that date and also contains a completely revised, up-to-date catalog in which all items are arranged in a convenient, logical form. The primary purpose of such a catalog is to permit simple yet accurate calculations of the insulative value of various clothing combinations. Properly used these calculations will provide realistic and valid predictions of human tolerance in various environmental conditions.

Comparative techniques used for thermal insulation measurements of body clothing are described in some detail since these data form the most substantial portion of the catalog. Experimental evidence demonstrating the relationship between the measured versus calculated (from catalog data) thermal insulation values is shown. The general usefulness of these catalogued values, as indicated graphically, appears well substantiated.

Proper maintenance of protective clothing is essential for functional effectiveness. The more recently developed synthetic fabric material (Dacron, Orlon, etc,) may be readily laundered by conventional washing methods, so insulation changes resulting from laundering had to be measured. The results of these studies are described in Section 4 and are plotted in figure 3.

METHODS

Methods routinely used since 1946 by this Laboratory for evaluating the thermal insulation of complete clothing assemblies, handgear, footgear, headgear, and other types of protective clothing were used in these studies. Details of the techniques devised for testing each type of clothing have been described in previous reports (refs. 1, 2, 3, 4). These emphasize the advantage of using physical models rather than human subjects for thermal insulation measurements and for screening purposes in clothing evaluation. We emphasize that the use of these physical models has definite limitations. Thermal insulation measurements with these models are based on radiative - conductive - convective heat transfer. Evaporative heat loss or vapor permeability of fabrics thus cannot be assessed with these physical models. However, for most Air Force thermal exposures where crewmembers are exposed to significant heat loads, thermal comfort or reasonable tolerance time is best achieved by using ventilated clothing. High vapor permeability of even the most effective clothing available to date fails to provide the evaporative heat loss required in thermal exposures of even a moderate stress level. Consequently measurements of clothing vapor permeability while valuable in overall clothing evaluations are not critical in assessing present Air Force flight or emergency protective clothing.

Physical methods for measuring thermal insulation on small samples of synthetic fibers, cotton, wool, and blends of these have been used previously (ref. 5) to select potential wool pile substitutes. Measurements of thermal insulation of various types of furs have also been reported (ref. 6). However, since both of these studies were performed only on a flat test surface, the factors of fit, entrapped air layers, compression resulting from overlying clothing, and the shape factor characteristic for an entire copper manikin, are lacking. These guarded hot plate methods while providing valuable selection or screening data thus fail to provide thermal insulation values as truly valid as those reported and cataloged in this report.

RESULTS

The results of these thermal insulation studies are presented in four sections. Section 1 lists test data completed on Air Force clothing items and on assemblies since the prior report (October 1956). Section 2 consists of an extended, revised clothing catalog arranged by type and in order on increasing clo* or insulation value. Section 3 compares several techniques used for measurement of the thermal insulation of body clothing. Limitations and advantages of each are discussed, and the relationship between the respective methods graphically shown. Section 4 discusses the effects of conventional laundering on thermal insulation of protective clothing and these results are shown graphically.

The individual catalog values were again based on either separate measurement or were derived by a difference method in the case of multilayered or heavy insulation. These values, in view of results presented in Section 3, may be used to calculate validly either (a) by the total or mean effective clothing insulation as previously defined (ref. 4); or (b) by the sub-total or area clothing insulation used to cover certain surface areas only, i.e., head, or body (trunk, arms, and legs), hands, and feet. The correction factors presented thus permit a more accurate prediction of the actual or effective clothing insulation to be expected when various single items are combined in various types of clothing assemblies.

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*Clo - Unit of insulation defined as the insulation necessary to maintain in comfort a sitting-resting subject in a normally ventilated room where air movement is 20 feet per minute, temperature is 70°F, and humidity is less than 50 percent.

SECTION 1

THERMAL INSULATION OF AIR FORCE CLOTHING

(Part 5 of a series)

TABLE 1

INSULATION TESTS OF LIGHT (BODY) CLOTHING (0.0 - 1.5 clo)

TEST NO.	MODEL	q_b*	$T_s - T_a$	I_g
(1)	Thermistor Suit, Combed Cotton, (28-reg.)			
1	1	66.0	100.8 - 78.5	0.34
2	1	72.9	107.0 - 84.0	0.27
3	1	78.5	108.5 - 84.0	0.26
			Average:	0.30
				±0.04
				±13%
(2)	Two-piece Allen-A Insulaire Thermal Underwear (Size 7) (after 10 washings)			
1	1	98.1	110.1 - 79.5	0.24
2	1	88.1	110.8 - 83.0	0.26
3	1	80.8	104.4 - 78.0	0.40
			Average:	0.30
				±0.07
				±23%
(3)	"DUOFOLD" Two-layer Insulated Underwear, T-shirt, 42, Trousers, 36-L Duofold Inc., Mohawk, N.Y. (after 10 washings)			
1	1	77.6	106.6 - 82.0	0.29
2	1	74.1	102.3 - 75.0	0.45
3	1	68.2	100.3 - 80.0	0.23
			Average:	0.32
				±0.08
				±25%
(4)	Ground Crew Climatic Clothing a. Cotton T-shirt and briefs b. Gray cotton field trousers			
1	1	72.2	100.7 - 74.0	0.44
2	1	80.8	104.5 - 76.5	0.37
3	1	89.3	110.3 - 79.5	0.37
			Average:	0.39
				±0.03
				±7.7%

TEST NO.	MODEL	V_b"	$T_s - T_a$	I_g
(5)	Two-piece Allen-A Insulaire Thermal Underwear (Size 7)			
1	1	58.7	102.8 - 81.0	0.45
2	1	67.1	106.0 - 83.0	0.36
3	1	72.7	106.4 - 80.5	0.40
			Average:	0.40
				±0.03
				±7.5%
(6)	"VALHALLA" Two-piece Brynje Underwear, large, Norwegian - American Knitting Mills, Bennington, Vt.			
1	1	57.5	114.6 - 84.0	0.30
2	1	71.7	116.3 - 76.0	0.40
3	1	54.3	109.3 - 77.0	0.50
			Average:	0.40
				±0.07
				±18%
(7)	"DUOFOLD" Two-layer Insulated Underwear, T-shirt, 42, Trousers, 36-L Duofold Inc., Mohawk, N.Y.			
1	1	63.3	100.6 - 77.0	0.45
2	1	74.5	106.1 - 79.0	0.42
3	1	90.0	110.4 - 79.0	0.38
			Average:	0.42
				±0.02
				±4.8%
(8)	"NORAK" Two-piece Brynje Underwear, med., Norwegian - American Knitting Mills, Bennington, Vt.			
1	1	57.8	117.2 - 81.0	0.59
2	1	49.1	108.5 - 78.5	0.55
3	1	55.2	113.5 - 82.5	0.39
4	1	56.2	111.4 - 83.0	0.22
5	1	61.9	120.5 - 85.0	0.43
			Average:	0.44
				±0.11
				±25%
(9)	"IDEAL" Two-piece Brynje Underwear, large, Brynje Health Underwear, Norway			
1	1	50.7	111.8 - 81.5	0.51
2	1	54.8	114.9 - 83.0	0.46
3	1	63.9	119.8 - 84.0	0.39
			Average:	0.45
				±0.04
				±8.9%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(10)	Standard AF two-piece 50-50 Cotton-Wool Underwear (medium) (after 10 washings)			
1	1	56.2	97.9 - 77.0	0.45
2	1	69.1	102.3 - 80.0	0.51
3	1	74.9	109.2 - 80.5	0.48
			Average:	0.48
				±0.02
				±4.2%
(11)	Standard AF Two-piece 50-50 Cotton-Wool Underwear (medium)			
1	1	50.2	105.6 - 85.0	0.57
2	1	61.1	104.9 - 82.0	0.45
3	1	54.6	102.4 - 81.0	0.51
			Average:	0.51
				±0.04
				±7.8%
(12)	Two-piece Cotton-Wool Underwear, Style 303			
1	1	73.3	101.9 - 73.5	0.50
2	1	90.1	115.8 - 79.0	0.56
			Average:	0.53
				±0.03
				±5.7%
(13)	Experimental Two-piece Underwear, Style V-1S and V-1D 50% Vicara, 40% Cotton, 10% Nylon			
1	1	85.2	115.0 - 80.0	0.57
2	1	75.4	113.4 - 83.0	0.55
3	1	66.5	108.0 - 82.0	0.51
			Average:	0.54
				±0.02
				±3.7%
(14)	Two-piece Allen-A Insulaire Thermal Underwear (medium), as used by Navy (after 10 washings)			
1	1	71.8	105.6 - 76.5	0.55
2	1	70.2	111.9 - 83.0	0.57
3	1	62.1	109.5 - 85.5	0.50
			Average:	0.54
				±0.03
				±5.6%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(15)	Two-piece Allen-A Insulaire Thermal Underwear (medium) as used by Navy			
1	1	69.4	105.2 - 77.0	0.56
2	1	74.3	109.8 - 77.0	0.66
3	1	80.1	112.7 - 80.0	0.56
			Average:	0.59
				±0.04
				±6.8%
(16)	Two-piece Underwear, Heavy Zone, Cotton-Wool, Style 303			
1	1	76.0	120.7 - 87.5	0.65
2	1	61.2	112.9 - 87.5	0.58
3	1	53.3	111.9 - 89.5	0.60
			Average:	0.61
				±0.03
				±4.9%
(17)	Experimental Two-piece Underwear, Style V-2S and V-2D 85% Vicara, 15% Nylon, DuPont (after 10 washings)			
1	1	64.5	108.9 - 81.5	0.61
2	1	70.6	108.4 - 77.5	0.65
3	1	74.6	109.6 - 78.0	0.61
			Average:	0.62
				±0.02
				±3.2%
(18)	Two-piece Underwear, Style 301 (bulk orlon between two cotton layers) (after 10 washings)			
1	1	60.1	101.9 - 76.0	0.63
2	1	65.2	110.9 - 83.0	0.62
3	1	66.3	112.1 - 83.5	0.63
			Average:	0.63
				±0.00
				±0.0%
(19)	Experimental Two-piece Underwear, Style 302 (Vicara and Nylon between two layers of cotton)			
1	1	61.3	113.2 - 86.0	0.67
2	1	74.5	115.8 - 82.5	0.58
3	1	65.1	111.1 - 82.5	0.66
			Average:	0.64
				±0.03
				±4.7%

TEST NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(20)	"SET SNUG" Two-piece Curon Insulated Underwear, med., Set Snug Knitwear Co., Incl. (after 10 washings)			
1	1	59.8	102.3 - 75.0	0.72
2	1	58.3	107.3 - 83.0	0.60
3	1	67.5	112.6 - 82.5	0.69
			Average:	0.67
				±0.05
				±7.5%
(21)	Two-piece Underwear, Style 301 (bulk orlon between two cotton layers)			
1	1	76.3	116.6 - 81.0	0.79
2	1	71.0	114.2 - 81.0	0.75
3	1	59.1	108.1 - 82.5	0.64
			Average:	0.71
				±0.05
				±7.1%
(22)	Experimental Two-piece Underwear, Style V-2S and V-2D (85% Vicara, 15% Nylon, DuPont)			
1	1	76.6	114.8 - 84.6	0.54
2	1	70.1	112.4 - 81.5	0.66
3	1	65.9	109.9 - 82.5	1.05
			Average:	0.75
				±0.20
				±27%
(23)	Two-piece Heavy Underwear, Heavy Zone, Style 303, Cotton and Wool			
1	1	68.3	108.0 - 75.5	0.77
2	1	72.1	110.7 - 76.0	0.79
3	1	78.9	112.5 - 76.0	0.73
			Average:	0.76
				±0.02
				±2.6%
(24)	Experimental Inflatable Exposure Suit (not inflated)			
1	1	44.3	93.8 - 71.5	0.86
2	1	51.6	99.2 - 75.0	0.75
3	1	62.9	105.2 - 76.0	0.73
			Average:	0.78
				±0.05
				±6.4%

TEST NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(25)	Experimental Inflatable Exposure Suit (inflated)			
1	1	44.5	99.6 - 79.0	0.73
2	1	52.8	106.9 - 82.5	0.73
3	1	62.5	109.4 - 78.0	0.85
4	1	61.8	109.3 - 79.0	0.81
			Average:	0.78
				±0.05
				±6.4%
(26)	Ground Crew Climatic Clothing Assembly a. Cotton T-shirt and briefs b. Gray Cotton shirt and trousers			
1	1	71.9	106.6 - 70.0	0.87
2	1	78.1	111.6 - 73.0	0.83
3	1	85.5	117.4 - 75.5	0.81
			Average:	0.84
				±0.02
				±2.4%
(27)	One-piece Flight Alert Suit a. Two-piece "Norak" Brynje underwear b. One-piece flight alert suit			
1	1	46.5	103.7 - 80.5	0.84
2	1	55.1	107.9 - 79.5	0.89
3	1	53.7	107.4 - 80.0	0.88
			Average:	0.87
				±0.02
				±2.3%
(28)	Light (Non-ventilated) Assembly a. One-piece cotton thermocouple underwear b. Light flying suit (K-2B) c. Flight helmet (P-1) d. Heavy wool knit socks e. Saran spacer shoes			
1	2	58.7	104.2 - 74.0	0.94
2	2	52.2	102.5 - 77.1	0.86
3	2	48.8	99.7 - 74.0	0.98
			Average:	0.93*
				±0.04
				±4.3%

* Mean effective clo (1 clo_m)

TEST NO.	MODEL	q_b*	$T_s - T_a$	I_g
(29)	"SET SNUG" Two-piece Curon Insulated Underwear, med. Set Snug Knitwear Co., Inc.			
1	1	53.3	104.8 - 75.0	1.03
2	1	60.7	108.9 - 76.0	0.97
3	1	69.7	115.5 - 77.0	1.01
			Average:	1.00
				±0.02
				±2.0%
(30)	British Orally Inflatable Anti-Exposure Suit, not inflated (P. Frankenstein)			
1	1	37.1	101.5 - 80.0	1.09
2	1	53.1	108.3 - 80.0	0.95
			Average:	1.02
				±0.07
				±6.9%
(31)	Light (Non-ventilated) Assembly a. One-piece cotton thermocouple underwear b. Anti-exposure suit (MD-1), boots attached c. Flight helmet (P-1) d. Heavy wool knit socks			
1	2	44.1	102.1 - 76.0	1.18
2	2	50.0	103.8 - 77.5	0.98
3	2	46.0	99.4 - 75.5	0.96
			Average:	1.04*
				±0.09
				±8.7%
(32)	Cotton T-shirt and Shorts a. Cotton T-shirt and shorts b. Blue serge 100% wool shirt (A-1) and trousers (E-1)			
1	1	38.5	105.3 - 84.0	1.01
2	1	45.1	110.7 - 85.0	1.06
3	1	51.2	114.9 - 86.0	1.04
			Average:	1.04
				±0.02
				±1.9%

* Mean effective clo ($I\ clo_m$)

TEST NO.	MODEL	V_b"	$T_s - T_a$	I_g

(33) "VALHALLA" Two-piece Underwear, large

a. Two-piece Valhalla underwear. large
b. Gray serge 100% wool shirt (A-1) and trousers (E-1)

1	1	57.5	114.6 - 84.0	0.95
2	1	71.7	116.3 - 76.0	1.95
3	1	54.3	109.3 - 77.0	1.15
			Average:	1.05
				±0.07
				±6.7%

(34) British Orally Inflatable Anti-Exposure Suit, inflated, 3-4 cm H_2O (P. Frankenstein)

1	1	45.7	103.6 - 77.0	1.10
2	1	51.9	107.4 - 78.5	1.02
			Average:	1.06
				±0.04
				±3.8%

(35) IDEAL Two-piece Underwear, large (BRYNJE Health Underwear, Norway)

a. Two-piece Ideal (Brynje) underwear, large
b. Gray serge 100% wool shirt (A-1) and trousers (E-1)

1	1	50.7	111.8 - 81.5	1.16
2	1	54.8	114.9 - 83.0	1.11
3	1	63.9	119.8 - 84.0	1.04
			Average:	1.10
				±0.04
				±3.6%

(36) Modified Flight Clothing (L.W. Foster Sportwear Co.) Assembly 1 (after 10 washings)

a. Two-piece 50-50 cotton-wool underwear
b. Light flying suit, SFS-1

1	1	41.5	103.6 - 79.0	1.13
2	1	45.9	99.9 - 71.5	1.21
			Average:	1.17
				±0.04
				±3.4%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(37)	Gray Serge 100% Wool Shirt (A-1) and Trousers (E-1)			
	a. Two-piece 50-50 cotton-wool underwear b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
1	1	45.3	110.9 - 83.0	1.20
2	1	53.7	116.3 - 82.5	1.24
3	1	47.8	114.7 - 85.0	1.22
			Average:	1.22
				±0.01
				±0.8%
(38)	Ground Crew Climatic Clothing Assembly			
	a. Cotton T-shirt and briefs b. Gray cotton shirt and trousers c. "Jacket 1"			
1	1	57.4	110.6 - 75.0	1.22
2	1	62.9	115.5 - 76.5	1.22
3	1	64.8	117.5 - 77.0	1.23
			Average:	1.22
				±0.00
				±0.00
(39)	Modified-Flight Clothing (L.W. Foster Sportwear Co.) Assembly 1			
	a. Two-piece 50-50 cotton-wool underwear b. Light flying suit, SFS-1			
1	1	50.0	115.1 - 85.5	1.13
2	1	44.8	116.6 - 88.5	1.23
3	1	41.3	107.9 - 81.0	1.31
			Average:	1.22
				±0.06
				±4.9%
(40)	Experimental Sealed Insulation Full Pressure Suit, CSU-5/P			
1	1	51.5	121.6 - 88.0	1.31
2	1	63.8	121.9 - 82.0	1.23
			Average:	1.27
				±0.04
				±3.1%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(41)	Get-Me-Down Suit, CSU-4/P			
1	1	46.1	101.7 - 72.0	1.29
2	1	50.5	105.1 - 72.0	1.33
3	1	51.4	110.3 - 77.0	1.30
			Average:	1.31
				±0.02
				±1.5%
(42)	Ground Crew Climatic Clothing Assembly			
	a. Two-piece cotton-wool underwear, Style 303			
	b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
1	1	47.3	111.3 - 80.0	1.35
2	1	54.7	116.0 - 80.0	1.33
3	1	60.7	119.3 - 79.0	1.35
			Average:	1.34
				±0.01
				±0.8%
(43)	"Weatherall" Two-piece Liner (30-70 acetate-virgin wool, Outdoor Products Co. Bloomfield, N.J.)			
1	1	42.9	107.0 - 78.0	1.39
2	1	50.9	113.1 - 80.0	1.31
			Average:	1.35
				±0.04
				±2.9%

TABLE 2

INSULATION TESTS OF MEDIUM (BODY) CLOTHING (1.50 - 3.00 clo)

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(1)	Experimental Polyurethane Suit, Convair Co.			
1	1	41.9	114.4 - 83.5	1.63
2	1	48.3	116.9 - 82.0	1.58
3	1	49.6	117.8 - 81.5	1.61
			Average:	1.61
				±0.02
				±1.2%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g

(2) Spacer Insulated Coverall, P/N S-885

a. Two-piece 50-50 cotton-wool underwear
b. Spacer insulated coverall, P/N S-885

1	1	48.0	108.6 - 74.0	1.53
2	1	50.0	118.4 - 79.0	1.73
3	1	47.0	114.7 - 77.5	1.74
			Average:	1.67
				±0.09
				±5.4%

(3) "Zero Wear" Two-piece Polyurethane ("Curon") Lined Underwear Tan Colored, Curtiss-Wright, Quehanna, Pa. (medium)

a. Two-piece 50-50 cotton-wool standard AF underwear
b. "Zero Wear" polyurethane lined underwear, tan

1	1	53.1	118.3 - 78.0	1.64
2	1	52.9	124.3 - 84.0	1.65
3	1	43.7	113.3 - 78.5	1.75
			Average:	1.68
				±0.05
				±2.9%

(4) Modified Flight Clothing (L.W. Foster Sportswear Co.), Assembly 2

a. Two-piece 50-50 cotton-wool underwear
b. Light flying suit, SFS-1
c. Light jacket, LW2

1	1	33.0	108.0 - 84.5	1.50
2	1	35.2	105.6 - 78.0	1.72
3	1	36.1	115.7 - 85.0	1.92
			Average:	1.71
				±0.14
				±8.2%

(5) Modified Flight Clothing (L.W. Foster Sportswear Co.), Assembly 2 (after 10 washings)

a. Two-piece 50-50 cotton-wool underwear
b. Light flying suit, SFS-1
c. Light jacket, LW2

1	1	41.7	105.3 - 74.0	1.62
2	1	45.9	112.2 - 75.0	1.80
			Average:	1.71
				±0.09
				±5.3%

TEST NO.	MODEL	V_b"	$T_s - T_a$	I_g
(6)	"Zero Wear" Two-piece Polyurethane ("Curon") Lined Underwear Red Colored, Curtiss-Wright, Quehanna, Pa., (Men's, long size)			
	a. Two-piece 50-50 cotton-wool standard AF underwear b. "Zero Wear" polyurethane lined underwear, red			
1	1	35.1	103.7 - 77.0	1.65
2	1	38.5	106.6 - 76.0	1.76
3	1	39.2	110.3 - 79.0	1.76
			Average:	1.72
				±0.05
				±2.9%
(7)	Navy Clothing for Intermediate Cold Weather			
	a. Two-piece 50-50 cotton-wool underwear b. Navy jacket and trousers for intermediate cold weather, medium			
1	1	32.5	103.8 - 79.0	1.66
2	1	38.7	112.1 - 81.0	1.78
			Average:	1.72
				±0.06
				±3.5%
(8)	Ground Crew Climatic Clothing Assembly			
	a. Two-piece cotton-wool underwear, Style 303 b. Gray serge 100% wool shirt (A-1) and trousers (E-1) c. "Jacket 1" d. Collared jacket, two layers of wool backed nylon, wool-to-wool ("Jacket 2")			
1	1	46.7	113.7 - 77.0	1.73
2	1	40.9	116.1 - 76.5	1.80
3	1	51.5	118.9 - 79.0	1.69
			Average:	1.74
				±0.04
				±2.3%
(9)	Modified Flight Clothing (L.W. Foster Sportswear Co.), Assembly 3 (after 10 washings)			
	a. Two-piece 50-50 cotton-wool underwear b. Light flying suit, SFS-1 c. Light jacket, LW-2A			
1	1	39.6	106.5 - 75.0	1.76
2	1	46.7	115.5 - 77.5	1.81
			Average:	1.79
				±0.03
				±1.7%

TEST NO.	MODEL	C_b"	$T_s - T_a$	I_g
(10)	"Skagway" Sportsman Garment (Eugene Urow)			
	a. Two-piece 50-50 cotton-wool underwear b. Two-piece "Skagway" sportsman garment, Eugene Urow, Style No. 3497, dacron butt insulation, medium			
1	1	34.0	107.0 - 78.0	1.94
2	1	39.4	108.6 - 76.5	1.82
3	1	41.9	108.6 - 75.0	1.78
			Average:	1.85
				±0.06
				±3.2%
(11)	Experimental Coverall CWU-1/P (formerly XB-78), outer shell 5.3 oz. nylon, interlining 8 oz. rayon wool			
	a. Two-piece 50-50 cotton-wool underwear b. Experimental coverall, CWU-1/P			
1	1	49.9	114.6 - 74.5	1.78
2	1	46.3	113.7 - 74.0	1.95
3	1	44.8	113.4 - 76.0	1.88
			Average:	1.87
				±0.06
				±3.2%
(12)	Experimental Flying Coverall, CWU-1/P, with nylon-taffeta (136 x 69) liner attached			
	a. Two-piece 50-50 cotton-wool underwear b. Experimental flying coverall, CWU-1/P, and liner			
1	1	39.4	111.4 - 78.5	1.88
2	1	43.5	116.9 - 81.0	1.85
3	1	37.1	112.7 - 79.5	1.90
			Average:	1.88
				±0.02
				±1.1%
(13)	"Skagway" Sportsman Garment (Eugene Urow) (after 10 washings)			
	a. Two-piece 50-50 cotton-wool underwear b. "Skagway" sportsman garment, Eugene Urow, Style No. 3497, Dacron butt insulation, medium			
1	1	34.5	107.0 - 78.0	1.90
2	1	44.8	115.1 - 78.0	1.86
			Average:	1.88
				±0.04
				±2.1%

TEST NO.	MODEL	q_b*	$T_s - T_a$	I_g
(14)	Navy Assembly for Intermediate Cold Weather			
	a. Waffle knit two-piece underwear, standard A-1 (medium)			
	b. Jacket (A-2) and trousers (X-54), (medium)			
1	1	32.3	103.4 - 72.0	1.83
2	1	34.6	108.3 - 78.5	1.96
3	1	38.7	108.9 - 77.0	1.87
			Average:	1.89
				±0.05
				±2.6%
(15)	"Dutchess" Flite Wear (after 10 washings)			
	a. Two-piece 50-50 cotton-wool underwear			
	b. "Dutchess" Flite Wear, Style T-500, two-piece, dacron butt insulation, medium			
1	1	31.6	101.9 - 76.5	1.78
2	1	35.3	105.4 - 74.5	2.01
			Average:	1.90
				±0.12
				±6.3%
(16)	Experimental Polyether Urethane Foam Liner, U.S. Rubber Co. (after 10 washings)			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Two-piece experimental liner, medium			
1	1	42.8	112.3 - 76.0	1.92
2	1	46.7	115.0 - 75.0	1.95
3	1	52.3	122.5 - 79.0	1.87
			Average:	1.91
				±0.03
				±1.6%
(17)	Experimental Flying Coverall, CWU-1/P, with Nylon-Millium Liner attached			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Experimental flying coverall, CWU-1/P, and liner			
1	1	33.8	110.7 - 77.0	2.38
2	1	36.7	116.4 - 87.0	1.77
3	1	42.4	118.5 - 86.5	1.67
			Average:	1.93
				±0.29
				±15%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(18)	Experimental Two-piece Dynel Insulation Liner, U.S. Rubber (after 10 washings)			
1	1	45.4	115.2 - 76.0	1.97
2	1	41.9	115.5 - 79.0	1.99
3	1	40.7	110.2 - 77.0	1.83
			Average:	1.93
				±0.07
				±3.6%
(19)	Ground Crew Climatic Clothing Assembly			
	a. Two-piece cotton-wool underwear, Style 303			
	b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
	c. "Jacket 1"			
	d. Collared jacket, two layers of wool-backed nylon, wool-to-wool ("Jacket 2")			
1	1	40.9	112.8 - 75.0	1.93
2	1	44.6	115.5 - 78.5	1.86
3	1	47.1	119.3 - 78.0	2.01
			Average:	1.93
				±0.05
				±2.6%
(20)	"Satillite" Two-piece Insulated Underwear (Outwear Co.)			
	a. Two-piece 50-50 cotton-wool underwear			
	b. "Satillite" two-piece underwear, Outwear Co., Style T-100, Dacron butt insulation, medium			
1	1	32.8	109.4 - 81.5	1.93
2	1	36.7	111.3 - 80.0	1.93
3	1	31.0	107.5 - 80.5	1.99
			Average:	1.95
				±0.03
				±1.5%
(21)	Dormer Werner Two-piece Insulated Underwear			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Dormer Werner Inc., two-piece 100% Dacron insulated underwear, Arctic Feather and Down Co., Style No. 46, medium			
1	1	37.3	107.8 - 77.0	1.85
2	1	40.3	112.5 - 78.0	1.95
3	1	42.9	117.1 - 79.0	2.04
			Average:	1.95
				±0.06
				±3.1%

TEST NO.	MODEL	Q_b''	$T_s - T_a$	I_g
(22)	Experimental Jacket, XMA-1			
	a. Two-piece 50-50 cotton-wool underwear b. Blue serge 100% wool shirt (A-1) and trousers (E-1) c. Experimental jacket, XMA-1 d. Standard cotton field trousers			
1	1	40.4	116.3 - 81.0	2.00
2	1	37.3	112.2 - 80.0	1.97
3	1	49.5	122.4 - 80.5	1.92
			Average:	1.96
				±0.03
				±1.5%
(23)	Experimental Flying Coverall (CWU-1/P) with Liner, rayon-sateen (180 x 60) a. Two-piece 50-50 cotton-wool underwear b. Experimental CWU-1/P flying coverall with liner			
1	1	34.4	109.9 - 79.5	2.03
2	1	37.7	110.2 - 78.0	1.94
3	1	45.1	119.9 - 81.0	1.97
			Average:	1.98
				±0.03
				±1.5%
(24)	"Satillite" Two-piece Insulated Underwear (Outwear Co.) (after 10 washings) a. Two-piece 50-50 cotton-wool underwear b. "Satillite" two-piece underwear, Outwear Co., Style T-100, Dacron butt insulation, medium			
1	1	35.1	106.6 - 75.5	2.04
2	1	42.5	111.6 - 75.5	1.92
			Average:	1.98
				±0.06
				±3.0%
(25)	Spacer Insulated Coverall, P/N S-885 a. Two-piece 50-50 cotton-wool underwear b. Spacer insulated coverall, P/N S-885 c. Water barrier coverall			
1	1	42.7	117.8 - 80.0	2.03
2	1	49.9	121.8 - 78.0	2.01
3	1	52.0	118.9 - 74.0	1.97
			Average:	2.00
				±0.02
				±1.0%

ITEM NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(26) Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 3				
	a. Two-piece 50-50 cotton-wool underwear b. Light flying suit, SFS-1 c. Light jacket, LW-2A			
1	1	44.2	114.2 - 80.0	1.69
2	1	37.4	125.5 - 91.0	2.15
3	1	35.9	124.1 - 91.0	2.15
			Average:	2.00
				±0.20
				±10%
(27) Modified (Sealed Insulation) Get-Me-Down Suit, CSU-5/P				
1	1	34.1	110.6 - 81.5	1.94
2	1	37.7	110.5 - 78.0	2.01
3	1	39.3	111.3 - 75.5	2.11
			Average:	2.02
				±0.06
				±3.0%
(28) Modified Flight Clothing (L.W. Foster Sportswear, Co.) Assembly 4 (after 10 washings)				
	a. Two-piece 50-50 cotton-wool underwear b. Medium, woven urethane M-3 jacket and trousers			
1	1	35.9	102.5 - 71.5	1.97
2	1	40.7	111.4 - 75.0	2.06
			Average:	2.02
				±0.05
				±2.5%
(29) Experimental Coverall (CWU-1/P) with Rayon-Sateen-Millium Liner				
	a. Two-piece 50-50 cotton-wool underwear b. Experimental coverall, CWU-1/P with liner			
1	1	46.9	120.2 - 78.5	2.05
2	1	35.5	106.2 - 75.0	2.02
3	1	38.4	108.7 - 74.0	2.07
			Average:	2.05
				±0.02
				±1.0%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(30)	"Polar Wear" Two-piece Liner, 100% Dacron (Dormer-Werner Inc., Bloomfield, N.J.) (after 10 washings)			
	a. Two-piece 50-50 cotton-wool underwear b. "Polar Wear" Liner			
1	1	42.5	112.6 - 75.5	2.07
2	1	43.2	113.8 - 76.0	2.00
3	1	48.5	117.7 - 74.0	2.08
			Average:	2.05
				±0.03
				±1.5%
(31)	Experimental Flying Coverall (CWU-1/P) with Neoprene Coated Nylon Rip Stop Liner, Type 1			
	a. Two-piece 50-50 cotton-wool underwear b. CWU-1/P flying coverall with liner			
1	1	34.7	109.8 - 81.5	1.82
2	1	38.7	114.4 - 79.0	2.13
3	1	42.3	116.6 - 76.5	2.23
			Average:	2.06
				±0.16
				±7.8%
(32)	Experimental Polyether Urethane Foam Liner, U.S. Rubber Co.			
	a. Two-piece 50-50 cotton-wool underwear b. Experimental two-piece polyether urethane foam liner			
1	1	45.0	119.0 - 78.5	2.08
2	1	42.4	114.7 - 78.0	1.97
3	1	45.1	119.0 - 77.5	2.14
			Average:	2.06
				±0.06
				±2.9%
(33)	Experimental Two-piece Dynel Insulation Liner, U.S. Rubber Co.			
	a. Two-piece 50-50 cotton-wool underwear b. Experimental Dynel Insulation liner, medium			
1	1	38.0	115.5 - 82.0	2.02
2	1	39.0	117.3 - 81.0	2.12
3	1	45.3	121.0 - 79.0	2.17
			Average:	2.10
				±0.06
				±2.9%

ITEM NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(34)	Ground Crew Climatic Clothing Assembly			
	a. Two-piece cotton-wool underwear, Style 303			
	b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
	c. "Jacket 1"			
	d. "Jacket 2"			
	e. Collarless jacket, two layers of wool backed nylon, wool-to-wool ("Jacket 3")			
1	1	43.6	110.2 - 77.5	1.97
2	1	46.1	120.7 - 78.0	2.16
3	1	45.8	121.7 - 78.5	2.17
			Average:	2.10
				±0.09
				±4.4%
(35)	Modified Ground Crew Climatic Clothing			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
	c. "Jacket 1", light weight			
	d. Modified "Jacket 2", intermediate			
1	1	36.1	107.2 - 75.0	2.06
2	1	39.3	113.1 - 77.0	2.14
			Average:	2.10
				±0.04
				±1.9%
(36)	U.S. Rubber Co. Two-piece Insulated Underwear, USR-W-200 urethane plastic foam insulation, medium			
1	1	37.5	107.5 - 74.5	2.02
2	1	40.6	111.2 - 73.0	2.21
			Average:	2.12
				±0.10
				±4.7%
(37)	"Wunderwear" Two-piece Liner, (tubular quilting, Nylon shells, quilted with 100% Dacron (fiberfold) (after 10 washings)			
	a. Two-piece 50-50 cotton-wool underwear			
	b. "Wunderwear" two-piece liner			
1	1	35.7	115.4 - 81.5	2.23
2	1	34.7	111.0 - 79.0	2.15
3	1	29.8	107.2 - 81.0	2.02
			Average:	2.13
				±0.08
				±3.8%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g

(38) Navy Assembly for Very Cold Weather

a. Waffle knit standard two-piece underwear, A-1, medium
b. Jacket (A-1) and trousers (X-54), medium-regular, without buttoned-in liner in jacket

1	1	36.8	111.6 - 76.0	2.29
2	1	35.9	108.3 - 75.0	2.17
3	1	45.9	118.0 - 78.5	1.96
			Average:	2.14
				±0.12
				±5.6%

(39) Experimental Polyurethane Jacket, MA-1 (3.3 oz. Nylon lined), DuPont

a. Two-piece 50-50 cotton-wool underwear
b. Gray serge 100% wool shirt (A-1) and trousers (E-1)
c. Standard cotton field trousers
d. Experimental jacket (MA-1)

1	1	38.1	119.6 - 85.0	2.11
2	1	33.7	112.2 - 80.5	2.21
			Average:	2.16
				±0.05
				±2.3%

(40) Dormer Werner Two-piece Insulated Underwear (after 10 washings)

a. Two-piece 50-50 cotton-wool underwear
b. Dormer Werner Inc., two-piece 100% Dacron insulated underwear, Arctic Feather and Down Co., Style No. 46, medium

1	1	34.9	102.8 - 70.5	2.16
2	1	39.7	111.3 - 74.5	2.16
			Average:	2.16
				±0.00
				±0.0%

(41) "Wunderwear" Two-piece liner (tubular quilting, nylon shells quilted with 100% Dacron fiberfold)

a. Two-piece 50-50 cotton-wool underwear
b. "Wunderwear" two-piece liner

1	1	40.7	116.4 - 78.5	2.21
2	1	41.2	118.3 - 80.0	2.17
3	1	42.8	123.7 - 83.5	2.20
			Average:	2.19
				±0.02
				±0.9%

TEST NO.	MODEL	Q_b *	$T_s - T_a$	I_g
(42)	"Dutchess" Flite Wear			
	a. Two-piece 50-50 cotton-wool underwear			
	b. "Dutchess" Flite Wear, Style T-500, two-piece, Dacron butt insulation, medium			
1	1	30.6	109.5 - 80.5	2.23
2	1	33.5	111.5 - 80.0	2.20
3	1	35.6	115.2 - 82.0	2.18
			Average:	2.20
				±0.02
				±0.9%
(43)	"Comfortall" Two-piece Liner (Tempron Clothing-Budd Insulated Products, Inc., Larchmont, N.Y.)			
	a. Two-piece 50-50 cotton-wool underwear			
	b. "Comfortall" two-piece liner			
1	1	45.4	121.3 - 80.0	2.11
2	1	38.0	118.5 - 82.0	2.27
3	1	40.8	116.4 - 77.5	2.25
			Average:	2.21
				±0.07
				±3.2%
(44)	"Eskimo Brand" Two-piece Liner (Brooks Insulating Clothing Co., New York,N.Y.)			
	a. Two-piece 50-50 cotton-wool underwear			
	b. "Eskimo Brand" two-piece liner			
1	1	32.6	107.6 - 77.0	2.20
2	1	39.9	116.1 - 78.5	2.21
3	1	42.9	123.1 - 80.0	2.40
			Average:	2.27
				±0.09
				±3.9%
(45)	"Winterseal" Two-piece Liner (Refrigerator Clothing Co., New York, N.Y.)			
	a. Two-piece 50-50 cotton-wool underwear			
	b. "Winterseal" two-piece liner, medium			
1	1	44.7	123.2 - 82.0	2.15
2	1	40.1	120.3 - 81.5	2.29
3	1	36.1	119.7 - 84.0	2.36
			Average:	2.27
				±0.08
				±3.5%

TEST NO.	MODEL	Q_b*	$T_s - T_a$		I_g
(46)	"Polar Wear" Two-piece Liner (100% Dacron, Dormer-Werner, Inc., Bloomfield, N.J.)				
	a. Two-piece 50-50 cotton-wool underwear b. "Polar Wear" two-piece liner, medium				
1	1	37.8	112.4 - 75.0		2.36
2	1	39.9	118.6 - 80.0		2.29
3	1	42.9	124.3 - 82.5		2.31
				Average:	2.32
					±0.03
					±1.3%
(47)	"Wunderwear" Two-piece Dacron-filled Liner, (tan, 3 x 3 construction)				
	a. Two-piece 50-50 cotton-wool underwear b. "Wunderwear" two-piece liner				
1	1	41.2	127.9 - 80.0		2.41
2	1	44.1	129.9 - 79.5		2.35
3	1	46.6	130.8 - 80.0		2.19
				Average:	2.32
					±0.08
					±3.4%
(48)	Get-Me-Down Suit (CSU-4/P) and Trilock Spacer Coverall				
1	1	38.2	115.8 - 79.0		2.28
2	1	41.8	118.4 - 77.0		2.36
				Average:	2.32
					±0.04
					±1.7%
(49)	U.S. Rubber Two-piece Insulated Underwear, USR-W-200				
	a. Two-piece 50-50 cotton-wool underwear b. USR-W-200 Jacket and trousers, urethane plastic insulation, nylon outer shell, medium, U.S. Rubber Co.				
1	1	30.3	108.3 - 79.5		2.24
2	1	32.7	114.0 - 81.5		2.37
3	1	36.0	112.9 - 77.0		2.38
				Average:	2.33
					±0.06
					±2.6%

TEST NO.	MODEL	$\mathcal{L}_b$"	$T_s - T_a$	I_g

(50) "Weatherall" Two-piece Liner (30-70 Acetate-Virgin Wool, Outdoor Products Co., Bloomfield, N.J.)

a. Two-piece 50-50 cotton-wool underwear
b. "Weatherall" two-piece liner, medium

1	1	33.6	119.3 - 83.5	2.59
2	1	41.7	120.2 - 81.0	2.20
3	1	42.1	122.3 - 82.0	2.27
			Average:	2.35
				±0.16
				±6.8%

(51) Experimental Intermediate Assembly (Vibrafoan, U.S. Rubber Co.)

a. Two-piece 50-50 cotton-wool underwear
b. Gray serge 100% wool shirt (A-1) and trousers (E-1)
c. Experimental Vibrafoan field jacket
d. Standard cotton field trousers

1	1	37.7	117.7 - 81.0	2.31
2	1	34.6	116.0 - 81.5	2.38
3	1	39.5	121.1 - 81.5	2.39
			Average:	2.36
				±0.03
				±1.3%

(52) Modified B-78 Coverall (1/8" Durolite, U.S. Rubber Co.)

a. Two-piece 80-20 cotton-wool underwear
b. Blue serge 100% wool shirt (A-1) and trousers (E-1)
c. Modified B-78 coverall

1	1	43.4	115.4 - 72.5	2.36
2	1	36.2	110.5 - 73.0	2.50
3	1	42.1	118.5 - 78.0	2.27
			Average:	2.37
				±0.08
				±3.7%

(53) Experimental Polyurethane Jacket (MA-1, Nylon-Wool Lined, DuPont)

a. Two-piece 50-50 cotton-wool underwear
b. Gray serge 100% wool shirt (A-1) and trousers (E-1)
c. Standard cotton field trousers
d. Experimental MA-1 jacket

1	1	38.2	118.6 - 82.0	2.21
2	1	31.3	113.8 - 80.0	2.64
3	1	32.7	115.1 - 83.0	2.33
			Average:	2.41
				±0.17
				±7.1%

TEST NO.	MODEL	q_b''	$T_s - T_a$	I_g
(54)	Experimental Intermediate Assembly, U.S. Rubber Co.			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Experimental field jacket, Insul Air, U.S. Rubber Co.			
	d. Standard cotton field trousers			
1	1	40.1	123.6 - 83.0	2.43
2	1	39.3	120.4 - 79.5	2.52
3	1	40.2	120.6 - 81.5	2.30
			Average:	2.42
				±0.08
				±3.3%
(55)	Navy Assembly for Very Cold Weather			
	a. Standard waffle knit two-piece underwear, A-1, medium			
	b. Jacket (A-1) with buttoned-in liner and trousers (X-54), medium			
1	1	31.7	110.1 - 79.0	2.33
2	1	35.2	115.7 - 80.5	2.37
3	1	35.2	121.0 - 83.5	2.59
			Average:	2.43
				±0.11
				±4.5%
(56)	Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 5 (after 10 washings)			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Blue serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Medium woven urethane M-3 jacket and trousers			
1	1	31.9	107.1 - 73.5	2.55
2	1	42.1	107.7 - 66.5	2.32
			Average:	2.44
				±0.12
				±4.9%
(57)	"Wunderwear" Dacron-filled Liner, O.D. (after 10 washings)			
1	1	26.1	114.0 - 83.0	2.49
2	1	22.7	109.5 - 83.0	2.43
3	1	44.3	137.6 - 83.0	2.46
			Average:	2.46
				±0.02
				±0.8%

TEST NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(58)	Ventilating Garment Assembly (as used in cold chamber tests, using heated ventilating air)			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Ventilating garment (MA-2)			
	c. Heavy parka (N-2A) and trousers (D-1A)			
	d. Cotton flight cap			
	e. Green mitten insert			
	f. Heavy two-piece mitten set, arctic wear			
	g. Medium weight wool socks			
	h. Heavy weight wool socks			
	i. Flying boots (A-6A), large			
1	1	43.7	127.8 - 82.0	2.54*
2	1	46.9	132.0 - 83.0	2.53
3	1	51.8	136.2 - 83.0	2.47
			Average:	2.51
				±0.03
				±1.2%
(59)	Standard Intermediate Assembly			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Standard field jacket with buttoned-in wool pile liner			
	d. Standard cotton field trousers			
1	1	37.7	118.7 - 81.0	2.39
2	1	38.5	122.7 - 82.5	2.53
3	1	31.9	112.4 - 79.0	2.62
			Average:	2.52
				±0.08
				±3.2%
(60)	Experimental Jacket, MA-1, Polyurethane, Lined with 3.3 oz. Nylon, Dupont			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Blue serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Heavy flight trousers (D-1A)			
	d. Experimental MA-1 jacket			
1	1	30.2	119.7 - 87.0	2.64
2	1	34.9	121.6 - 84.0	2.63
3	1	39.9	124.7 - 84.0	2.45
			Average:	2.57
				±0.08
				±3.1%

*mean effective clo (I_{clo_m})

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(61)	Navy Dark Green Flying Suit (Curtis-Wright)			
	a. Two-piece 50-50 cotton-wool underwear b. Blue serge 100% wool shirt (A-1) and trousers (E-1) c. Dark green Navy flying suit			
1	1	38.0	121.0 - 80.5	2.59
2	1	29.8	115.0 - 83.0	2.62
3	1	40.9	119.4 - 79.0	2.50
			Average:	2.57
				±0.05
				±1.9%
(62)	Experimental Jacket, MA-1, Polyurethane, Nylon-Wool Lined			
	a. Two-piece 50-50 cotton-wool underwear b. Blue serge 100% wool shirt (A-1) and trousers (E-1) c. Heavy flight trousers (D-1A) d. Experimental MA-1 jacket			
1	1	33.8	121.1 - 89.0	2.69
2	1	42.2	127.6 - 89.0	2.49
3	1	37.7	129.7 - 87.0	2.80
			Average:	2.66
				±0.11
				±4.1%
(63)	"Wunderwear" Two-piece Insulated Underwear (after 10 washings)			
	a. Two-piece 50-50 cotton-wool underwear b. "Wunderwear" jacket and trousers, tan color, 3 X 3 construction, dacron insulation, medium			
1	1	30.7	111.3 - 78.0	2.65
2	1	33.4	116.6 - 80.0	2.69
3	1	34.5	121.1 - 82.5	2.76
			Average:	2.70
				±0.04
				±1.5%
(64)	Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 4			
	a. Two-piece 50-50 cotton-wool underwear b. Medium woven urethane M-3 jacket and trousers			
1	1	33.9	118.1 - 79.0	2.86
2	1	32.7	119.9 - 84.0	2.69
3	1	35.0	124.7 - 85.0	2.81
			Average:	2.79
				±0.06
				±2.2%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g

(65) Two-piece Navy Flying Suit, MIL-S-18342A (AER)

a. Two-piece 50-50 cotton-wool underwear
b. Blue serge 100% wool shirt (A-1) and trousers (E-1)
c. Navy flying jacket (40-L) and trousers (34-L)

1	1	26.1	114.5 - 83.0	3.03
2	1	39.2	117.2 - 78.5	2.80
3	1	29.5	114.0 - 82.0	2.65
			Average:	2.83
				±0.14
				±4.9%

(66) Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 5

a. Two-piece 50-50 cotton-wool underwear
b. Blue serge 100% wool shirt (A-1) and trousers (E-1)
c. Medium woven urethane M-3 jacket and trousers

1	1	21.6	105.6 - 80.0	2.96
2	1	19.7	107.0 - 84.0	2.91
3	1	23.6	112.0 - 84.0	2.97
			Average:	2.95
				±0.02
				±0.7%

(67) RCAF Heavy (Zone VII) Two-piece Flying Suit

a. Two-piece 50-50 cotton-wool underwear
b. Gray serge 100% wool shirt (A-1) and trousers (E-1)
c. RCAF two-piece flying suit, jacket and trousers zipped together

1	1	29.4	116.3 - 81.0	3.01
2	1	29.1	115.8 - 81.5	2.94
3	1	29.7	118.1 - 83.0	2.95
			Average:	2.97
				±0.03
				±1.0%

TABLE 3

INSULATION TESTS OF HEAVY (BODY) CLOTHING (more than 3.0 clo)

TEST NO.	MODEL	Q_b *	$T_s - T_a$	I_g
(1)	Dynel Insulated Coverall, MD-3A			
	a. Two-piece 50-50 cotton-wool underwear b. Blue serge 100% wool shirt (A-1) and trousers (E-1) c. Dynel insulated coverall (tight fit in shoulders), MD-3A			
1	1	35.5	115.6 - 75.5	2.79
2	1	30.2	116.1 - 76.5	3.35
3	1	29.1	111.5 - 78.0	2.86
			Average:	3.00
				±0.23
				±7.6%
(2)	Standard Impermeable Assembly			
	a. Two-piece 50-50 cotton-wool underwear b. Anti-G suit (G-4B), med.-reg. c. Ventilating garment, (MA-1) d. Gray Navy liner, size 46 e. Anti-exposure suit (MR-4) f. Flight helmet (P-1) g. Wool knit gloves h. Heavy wool socks i. Bristolite boots			
1	1	38.5	125.5 - 79.5	3.04*
2	1	40.8	128.7 - 78.7	3.04
3	1	41.5	130.8 - 81.0	3.06
			Average:	3.04
				±0.01
				±0.3%
(3)	Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 7			
	a. Two-piece 50-50 cotton-wool underwear b. Medium jacket and trousers, M-3 c. White parka, P-4			
1	1	22.9	113.3 - 86.0	3.08
2	1	23.6	117.8 - 90.0	2.94
3	1	25.9	122.3 - 89.0	3.27
			Average:	3.10
				±0.12
				±3.9%

*mean effective clo ($I\ clo_m$)

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(4) Two-piece Norwegian Survival Kit insulation				
	a. Two-piece 50-50 cotton-wool underwear			
	b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Heavy flight jacket (N-2) and trousers (D-1)			
	d. Two-piece Norwegian survival kit insulation			
1	1	35.1	114.6 - 72.0	3.05
2	1	33.9	116.9 - 75.0	3.12
3	1	37.0	124.9 - 78.0	3.22
			Average:	3.13
				±0.07
				±2.2%
(5) Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 6				
	a. Two-piece 50-50 cotton-wool underwear			
	b. Blue serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Heavy jacket and trousers, H-3A			
1	1	18.9	100.8 - 77.0	3.18
2	1	23.1	113.1 - 84.0	3.19
3	1	25.5	121.3 - 90.0	3.09
			Average:	3.15
				±0.04
				±1.3%
(6) Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 6 (After 10 washings)				
	a. Two-piece 50-50 cotton-wool underwear			
	b. Blue serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Heavy jacket and trousers, H-3A			
1	1	33.5	122.2 - 81.5	3.06
2	1	30.2	118.5 - 80.0	3.24
			Average:	3.15
				±0.09
				±2.9%
(7) Experimental Down-Filled Coverall (SAC)				
	a. Two-piece 50-50 cotton-wool underwear			
	b. Blue serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Experimental down-filled coverall			
1	1	34.2	126.3 - 83.0	3.29
2	1	31.1	120.4 - 82.0	3.12
3	1	28.7	118.8 - 83.0	3.15
			Average:	3.22
				±0.11
				±3.4%

Test NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(8) Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 7 (after 10 washings)				
	a. Two-piece 50-50 cotton-wool underwear b. Medium jacket and trousers, M-3 c. White parka, P-4			
1	1	34.5	118.3 - 74.5	3.22
2	1	37.3	124.0 - 76.0	3.28
			Average:	3.25
				±0.03
				±0.9%
(9) Navy Clothing for Extreme Cold Weather				
	a. Two-piece 50-50 cotton-wool underwear b. Navy jacket and trousers for intermediate cold weather c. Navy jacket and trousers for extreme cold weather			
1	1	26.9	115.8 - 81.0	3.30
2	1	31.6	120.2 - 79.5	3.28
			Average:	3.29
				±0.01
				±0.3%
(10) Encapsulated Seat Survival Clothing (Hagen)				
	a. T-shirt and shorts b. Flight alert suit, size 40R c. Down-filled suit with hood d. Wool knit gloves e. Down filled mitten f. Wool socks			
1	1	27.2	111.7 - 75.5	3.41
2	1	32.5	118.4 - 77.0	3.24
3	1	37.0	123.4 - 75.5	3.30
			Average:	3.32*
				±0.06
				±1.82

*mean effective clo value ($I\ clo_m$)

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(11)	Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 8			
	a. Two-piece 50-50 cotton-wool underwear b. Heavy jacket and trousers, H-3A c. White parka, P-4			
1	1	23.1	109.5 - 79.5	3.32
2	1	31.2	121.5 - 80.5	3.36
			Average:	3.34
				±0.02
				±0.6%
(12)	Ground Crew Climatic Clothing Assembly			
	a. Two-piece 50-50 cotton-wool underwear, style 303 b. Gray serge 100% wool shirt (A-1) and trousers (E-1) c. "Jacket 1" d. Parka ("Jacket 4") and trousers (wool backed nylon inner shell, wool frieze insulation, neoprene coated rip stop outer shell)			
1	1	24.7	110.4 - 78.0	3.35
2	1	27.7	107.0 - 71.0	3.31
3	1	30.5	111.5 - 70.0	3.50
			Average:	3.35
				±0.06
				±1.8%
(13)	"Wunderwear" Two-piece Insulated Underwear			
	a. Two-piece 50-50 cotton-wool underwear b. "Wunderwear" jacket and trousers, O.D. color, 4 x 4 construction, Dacron insulation			
1	1	32.6	118.8 - 77.0	3.26
2	1	41.5	128.9 - 76.0	3.24
3	1	36.9	127.1 - 76.5	3.54
			Average:	3.35
				±0.13
				±3.9%

TEST NO.	MODEL	Q_b*	$T_s - T_a$	I_g

(14) Standard AF Permeable Assembly

a. Two-piece 50-50 cotton-wool underwear
b. Anti-G suit (G-4B)
c. Ventilating garment (MA-1)
d. Heavy flight jacket with hood (N-3) and trousers (D-1A)
e. Flight helmet (P-1)
f. Wool knit gloves
g. Heavy wool knit socks
h. Brostolite boots

1	1	40.7	123.0 - 71.0	3.30*
2	1	45.9	132.4 - 76.0	3.14
3	1	36.1	127.9 - 75.0	3.87
4	1	45.4	131.8 - 73.5	3.30
			Average:	3.40
				±0.23
				±6.8%

(15) Rayon Acetate Batting Coverall, MD-3A

a. Two-piece 50-50 cotton-wool underwear
b. Blue serge 100% wool shirt (A-1) and trousers (A-1)
c. Rayon Acetate Batting coverall, MD-3A, Medium

1	1	36.4	127.4 - 83.0	3.07
2	1	30.3	122.7 - 80.5	3.66
3	1	26.5	115.6 - 79.0	3.51
			Average:	3.41
				±0.25
				±7.3%

(16) Experimental Heavy Flying Suit (N-2; D-1; 5/16" thick)

a. Two-piece 50-50 cotton-wool underwear
b. Gray serge 100% wool shirt (A-1) and trousers (E-1)
c. Experimental heavy flight jacket (N-2) and trousers (D-1)

1	1	30.9	117.1 - 76.0	3.41
2	1	33.5	120.4 - 76.0	3.40
3	1	28.9	117.5 - 78.0	3.52
			Average:	3.44
				±0.05
				±1.5%

*Mean effective clo (1 clo_m)

TEST NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(17)	Experimental Encapsulated Seat Survival Clothing, Style I, Model II			
	a. Two-piece "NORAK" Brynje Underwear, T-shirt, long trousers, med.			
	b. Flight alert suit			
	c. Down-filled one-piece suit with hood			
	d. Down-filled mitten, right hand with trigger finger			
	e. Three pairs heavy wool socks, felt muffle sock and down-filled boots			
1	1	21.9	111.9 - 80.0	3.57
2	1	25.9	115.5 - 79.0	3.56
3	1	29.8	120.9 - 80.0	3.44
			Average:	3.52
				±0.06
				±1.7%
(18)	Modified Flight Clothing (L.W. Foster Sportswear Co.) Assembly 8			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Heavy jacket and trousers, H-3A			
	c. White parka, P-4			
1	1	32.9	126.8 - 82.0	3.51
2	1	32.9	120.9 - 75.0	3.61
			Average:	3.56
				±0.05
				±1.4%
(19)	Ground Crew Climatic Clothing Assembly			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
	c. "Jacket 1"			
	d. "Jacket 2"			
	e. "Jacket 3"			
	f. "Jacket 4" and heavy trousers			
			Calculated value:	3.60
(20)	Modified Ground Crew Climatic Clothing			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Gray serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Heavy jacket, parka type, (#4), and trousers			
1	1	23.3	113.3 - 80.5	3.65
2	1	29.1	121.4 - 80.0	3.70
			Average:	3.68
				±0.03
				±0.8%

TEST NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(21)	British Orally Inflatable Anti-Exposure Suit (P. Frankenstein) inflated to 6-33 cm H_2O			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Blue serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Heavy flight jacket (N-3, large-short) and trousers (D-1)			
	d. British orally inflatable anti-exposure suit			
1	1	30.1	121.7 - 75.0	4.09
2	1	34.1	123.5 - 75.0	3.70
3	1	29.2	116.7 - 78.0	3.40
			Average:	3.73
				±0.24
				±6.4%
(22)	British Orally Inflatable Anti-Exposure Suit (P. Frankenstein) inflated to 2-4 cm H_2O			
	a. Two-piece 50-50 cotton-wool underwear			
	b. Blue serge 100% wool shirt (A-1) and trousers (E-1)			
	c. Heavy flight jacket (N-3, large-short) and trousers (D-1)			
	d. British orally inflatable anti-exposure suit			
1	1	28.0	120.7 - 80.5	3.74
2	1	25.3	117.2 - 81.0	3.72
			Average:	3.73
				±0.01
				±0.3%
(23)	Experimental Encapsulated Seat Survival Clothing, Style II, Model I			
	a. Two-piece "NORAK" Brynje underwear, T-shirt, long trousers, med.			
	b. Flight alert suit			
	c. Down-filled jacket with hood, and trousers			
	d. Down-filled one finger mitten			
	e. Two pairs heavy wool socks and down-filled boots			
1	1	32.8	127.2 - 79.0	3.74
2	1	23.8	118.9 - 84.0	3.73
3	1	26.1	116.5 - 76.0	3.99
			Average:	3.82*
				±0.11
				±2.9%

* Mean effective clo (1 clo_m)

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(24)	Experimental Down-Filled Coat, Aqua Colored			
	a. Cotton T-shirt and shorts b. One-piece flying suit (K-2B) c. Experimental down-filled coat			
1	1	21.3	114.1 - 82.0	3.96
2	1	17.8	109.0 - 85.0	3.66
3	1	19.5	115.9 - 85.5	3.98
			Average:	3.84
				±0.15
				±3.9%
(25)	Experimental Down-filled Coat			
	a. T-shirt and shorts b. K-2B coverall c. Experimental down-filled coat			
1	1	19.5	115.0 - 29.5	3.98
2	1	19.1	112.1 - 83.0	4.01
3	1	17.8	109.0 - 85.0	3.43
4	1	21.3	114.1 - 82.0	3.96
			Average:	3.85
				±0.21
				±5.5%
(26)	Commercial Type Parka (N-3) and Trousers (Wm F. Niemi Co., Seattle, Wash).			
	a. Two-piece 50-50 cotton-wool underwear b. Experimental (commercial type) parka (N-3) and trousers			
1	1	27.3	119.3 - 81.0	3.63
2	1	26.3	118.2 - 77.0	4.14
3	1	25.3	118.9 - 78.5	4.23
			Average:	4.00
				±0.25
				±6.3%
(27)	British Orally Inflatable Anti-Exposure Suit (P. Frankenstein) uninflated			
	a. Two-piece 50-50 cotton-wool underwear b. Blue serge 100% wool shirt (A-1) and trousers (E-1) c. Heavy flight jacket (N-3), large-short, and trousers (D-1) d. British orally inflatable anti-exposure suit			
1	1	29.4	123.3 - 81.0	3.75
2	1	30.7	126.8 - 78.5	4.16
3	1	34.3	133.4 - 79.0	4.20
			Average:	4.04
				±0.19
				±4.7%

TEST NO.	MODEL	Q_b*	$T_s - T_a$		I_g
(28)	Experimental Encapsulated Seat Clothing (Hagan)				
	a. Two-piece "NORAK" Brynje underwear, T-shirt, long trousers, medium				
	b. Flight alert suit				
	c. Down-filled one-piece suit with hood				
	d. Down-filled mitten, right hand with trigger finger				
	e. Three pairs heavy wool socks, felt muffle sock and down-filled boots				
1	1	20.0	109.2 - 75.5		4.41
2	1	25.3	114.0 - 77.0		3.72
3	1	27.3	118.2 - 75.0		4.09
				Average:	4.07*
					±0.24
					±5.9%

TABLE 4

INSULATION TESTS OF SLEEPING BAGS

TEST NO.	MODEL	Q_b*	$T_s - T_a$		I_g
(1)	Sleeping Bag-Life Raft Combination				
	a. Nude sitting copper manikin				
	b. Sleeping bag-life raft combination (Irving Air Chute Co.)				
1	2	34.8	99.7 - 81.0		0.86
2	2	48.1	101.8 - 78.0		0.73
3	2	55.9	110.0 - 85.0		0.58
				Average:	0.72
					±0.10
					±14%
(2)	Sleeping Bag-Life Raft Combination				
	a. Nude sitting copper manikin wrapped in 28 ft parachute canopy				
	b. Sleeping bag-life raft combination (Irving Air Chute Co.)				
1	2	27.1	109.1 - 87.0		1.72
2	2	29.6	110.3 - 81.5		2.21
3	2	32.0	109.6 - 81.0		1.96
				Average:	1.96
					±0.16
					±8.2%

* Mean effective clo ($I\ clo_m$)

TEST NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(3)	Experimental Polyurethane Derivative Filled Sleeping Bag			
	a. Man in supine position b. Standard AF 50-50 cotton-wool underwear c. Experimental sleeping bag			
1	1	26.6	116.1 - 80.0	3.39
2	1	28.9	120.8 - 80.5	3.51
3	1	24.0	112.9 - 81.0	3.31
			Average:	3.40
				±0.07
				±2.1%
(4)	Survival Sleeping Bag, MC-1			
	a. Nude standing copper manikin b. MC-1 sleeping bag, 100% downfilled, fluffed 10 times, having been pressure-packed (200 psi)			
1	1	25.2	111.6 - 73.5	3.97
2	1	27.1	115.8 - 76.5	3.78
3	1	35.7	128.4 - 78.0	3.66
			Average:	3.80
				±0.11
				±2.9%
(5)	Experimental Sleeping Bag, 350 in^3			
	a. Man in supine position b. Two-piece 50-50 cotton-wool underwear c. Experimental sleeping bag			
1	1	35.7	134.4 - 79.0	4.00
2	1	31.8	120.1 - 80.0	4.07
3	1	29.4	125.6 - 76.0	4.41
			Average:	4.16
				±0.17
				±4.1%
(6)	Survival Sleeping Bag, MC-1			
	a. Nude standing copper manikin b. MC-1 sleeping bag, 100% downfilled, fluffed 10 times			
1	1	32.2	122.4 - 70.0	4.33
2	1	34.1	127.1 - 71.5	4.34
3	1	28.9	119.8 - 71.5	4.46
			Average:	4.38
				±0.05
				±1.1%

TABLE 5

INSULATION TESTS OF HEADGEAR

TEST NO.	MODEL	Q_b"	$T_s - T_a$		I_g
(1)	Down Filled Detachable Hood, Universal Size (Gray Manufacturing Co.)				
1	2	22.2	101.8 - 84.8		1.85
2	2	21.5	100.7 - 86.0		1.56
3	2	18.9	96.5 - 84.0		1.49
				Average:	1.63
					±0.14
					±8.6%
(2)	Experimental Flying Helmet MA-3, ventilated				
1	2	73.8	133.0 - 77.0		1.79
2	2	68.3	125.0 - 76.5		1.64
3	2	50.4	114.5 - 74.0		1.93
				Average:	1.79
					±0.10
					±5.6%
(3)	Experimental Flying Helmet MA-3, non-ventilated				
1	2	73.8	137.0 - 77.5		1.96
2	2	68.3	127.0 - 69.0		2.07
3	2	50.4	119.5 - 70.0		2.49
				Average:	2.17
					±0.21
					±9.7%
(4)	Flight Helmet MA-3, ventilated				
1	2	68.3	132.0 - 75.0		2.03
2	2	50.4	126.0 - 77.0		2.45
3	2	59.7	129.0 - 76.0		2.19
				Average:	2.22
					±0.15
					±6.8%
(5)	Flight Helmet MA-3, non-ventilated				
1	2	68.3	134.0 - 73.0		2.21
2	2	50.4	131.0 - 75.5		2.85
3	2	59.7	131.0 - 73.0		2.45
				Average:	2.50
					±0.23
					±9.2%

TEST NO.	MODEL	Q_b''	$T_s - T_a$		I_g
(6)	Flight Helmet MA-2				
1	2	35.7	119.0 - 76.5		3.13
2	2	40.6	121.5 - 78.0		2.76
3	2	49.1	120.5 - 75.5		2.28
				Average:	2.72
					±0.23
					±8.5%

TABLE 6

INSULATION TESTS OF HANDGEAR

TEST NO.	MODEL	Q_b''	$T_s - T_a$		I_g
(1)	Inner Rubber Glove (MC-2 Glove Assembly)				
1	1	159.7	105.5 - 96.3		0.18
2	1	177.3	110.0 - 99.3		0.19
3	1	193.1	109.7 - 97.1		0.20
				Average:	0.19
					±0.01
					±5.3%
(2)	U.S. Navy Five Finger Glove, A 461-1				
1	1	122.9	99.5 - 90.2		0.24
2	1	140.4	100.0 - 89.4		0.23
3	1	159.7	104.2 - 93.5		0.21
				Average:	0.23
					±0.01
					±4.3%
(3)	Brown Leather Glove, Style HG 123, Size 10				
1	1	163.2	101.3 - 88.8		0.27
2	1	140.4	98.5 - 87.3		0.25
3	1	175.5	107.5 - 96.1		0.26
				Average:	0.26
					±0.01
					±3.8%

TEST NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(4)	Grey Wool Glove (#8, New Pattern, Fotiaire Glove, Inc.)			
1	1	106.1	104.0 - 93.6	0.30
2	1	122.9	108.5 - 96.1	0.31
3	1	142.8	113.0 - 98.3	0.32
			Average:	0.31
				±0.01
				±3.2%
(5)	Glove Set, MA-1			
	a. Knitted wool insert b. Leather shell			
1	1	136.8	113.0 - 97.7	0.34
2	1	167.1	115.0 - 98.5	0.32
3	1	175.5	119.3 -100.1	0.33
			Average:	0.33
				±0.01
				±3.0%
(6)	One-Finger Leather Mitten (#10 New Pattern, Fotiaire Glove Inc.) Chamois Lined, Size large			
1	1	140.8	116.5 - 99.7	0.37
2	1	122.9	112.0 - 95.8	0.40
3	1	108.7	108.5 - 94.2	0.40
			Average:	0.39
				±0.01
				±2.6%
(7)	One-Finger Mitten, Aluminized Fabric (Asbestos) (#9 New Pattern- 3M Brand, Fotiaire Glove Inc.)			
1	1	144.8	122.0 - 103.7	0.39
2	1	124.5	118.5 - 102.0	0.41
3	1	106.1	112.5 - 98.0	0.42
			Average:	0.41
				±0.01
				±2.4%
(8)	One-Finger Leather Mitten, Insulation: 2 Byrd Cloth, 1 Rubber Layer (#5 New Pattern, Fotiaire Glove Inc.)			
1	1	106.1	109.0 - 93.6	0.45
2	1	124.4	113.0 - 95.7	0.43
3	1	140.4	118.0 - 97.9	0.44
			Average:	0.44
				±0.01
				±2.3%

TEST NO.	MODEL	ϕ_b"	$T_s - T_a$	I_g
(9)	One-Finger Leather Mitten, Insulation: 2 Glass Cloth, 1 Rubber Layer, uninflated (#6 Old Pattern, Fotiaire Glove Inc.)			
1	1	140.4	117.0 - 98.1	0.42
2	1	122.9	112.0 - 94.2	0.45
3	1	106.1	109.5 - 94.0	0.45
			Average:	0.44
				±0.01
				±2.3%
(10)	One-Finger Leather Mitten, Insulation: 2 Glass Cloth, 1 Rubber Layer, fully inflated (#6 Old Pattern, Fotiaire Glove Inc.)			
1	1	106.1	111.5 - 96.1	0.45
2	1	124.5	115.5 - 97.0	0.46
3	1	149.9	116.5 - 95.1	0.46
			Average:	0.46
				±0.00
				±0.0%
(11)	One-Finger Leather Mitten, Insulation 2 Byrd Cloth, 1 Rubber Layer (#1 New Pattern, Fotiaire Glove Inc.)			
1	1	105.3	109.5 - 93.2	0.48
2	1	122.8	115.0 - 95.7	0.48
3	1	140.4	120.7 - 98.2	0.49
			Average:	0.48
				±0.00
				±0.0%
(12)	One-Finger Leather Mitten, Insulation: 2 Aluminized Rayon, 1 Rubber Layer (#3 New Pattern, Fotiaire Glove Inc.)			
1	1	105.3	106.0 - 88.2	0.52
2	1	122.9	113.0 - 90.2	0.57
3	1	168.2	118.0 - 93.2	0.46
			Average:	0.52
				±0.04
				±7.8%
(13)	One-Finger Leather Mitten, Insulation: 2 Glass Cloth, 1 Rubber Layer (#6 Old Pattern, Fotiaire Glove Inc.), partially inflated			
1	1	159.2	124.5 - 96.7	0.54
2	1	140.8	120.0 - 94.5	0.56
3	1	124.4	116.0 - 93.7	0.55
			Average:	0.55
				±0.01
				±1.8%

TEST NO.	MODEL	Q_b*	$T_s - T_a$	I_g
(14)	Wool Lined Leather Glove for Industrial Purpose			
1	3	71.7	91.0 - 77.6	0.58
2	3	84.6	95.0 - 80.0	0.55
3	3	96.0	100.0 - 82.5	0.56
			Average:	0.56
				±0.01
				±1.8%
(15)	One-Finger Leather Mitten, Insulation: 2 Aluminized Rayon, 1 Rubber Layer (#7 New Pattern, Fotiaire Glove Inc.) Uninflated			
1	1	106.1	108.5 - 89.3	0.56
2	1	122.4	115.0 - 91.6	0.59
3	1	140.8	121.0 - 95.2	0.57
			Average:	0.57
				±0.01
				±1.8%
(16)	One-Finger Leather Mitten, Insulation: 1 Byrd Cloth, 1 Asbestos, 1 Rubber Layer (#4 New Pattern, Fotiaire Glove Inc)			
1	1	140.8	115.0 - 89.3	0.56
2	1	122.8	112.0 - 89.2	0.57
3	1	105.3	109.0 - 88.4	0.60
			Average:	0.58
				±0.02
				±0.4%
(17)	Experimental Down-filled 2-Finger Mitten for Encapsulated Seat Survival Clothing, Style II, Model I			
1	1	112.3	108.8 - 86.0	0.63
2	1	76.5	108.3 - 90.4	0.57
3	1	79.0	105.5 - 90.8	0.57
			Average:	0.59
				±0.03
				±5.1%
(18)	Navy Anti-Contact Mittens			
1	1	140.0	120.5 - 94.0	0.58
2	1	110.6	113.0 - 90.9	0.62
3	1	122.9	117.0 - 93.1	0.60
			Average:	0.60
				±0.01
				±1.7%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(19)	One-Finger Leather Mitten, Insulation: 2 Aluminized Rayon, 1 Rubber Layer, fully inflated (Fotiaire Glove Inc. #7 New Pattern)			
1	1	140.8	121.0 - 94.1	0.59
2	1	122.9	115.0 - 91.4	0.59
3	1	106.1	112.0 - 90.3	0.63
			Average:	0.60
				±0.02
				±3.3%
(20)	One-Finger Leather Mitten, Insulation 1 Byrd Cloth, 1 Aluminized Rayon, 1 Rubber layer (#2 New Pattern, Fotiaire Glove Inc.)			
1	1	140.4	119.0 - 92.3	0.58
2	1	122.4	118.0 - 92.8	0.62
3	1	105.3	108.5 - 87.7	0.61
			Average:	0.60
				±0.02
				±3.3%
(21)	One-Finger Leather Mitten, Insulation: 2 Aluminized Rayon, 1 rubber layer, partially inflated (#7 New Pattern, Fotiaire Glove Inc.)			
1	1	106.1	114.0 - 91.9	0.64
2	1	122.8	118.5 - 92.6	0.65
3	1	144.9	122.5 - 93.8	0.61
			Average:	0.63
				±0.02
				±3.2%
(22)	One-Finger Leather Mitten, Insulation: 2 Sunbak Cloth, 1 Rubber layer (#8a New Pattern, Fotiaire Glove Inc.)			
1	1	103.5	113.8 - 89.8	0.72
2	1	122.9	119.5 - 92.4	0.68
3	1	140.4	126.0 - 95.0	0.68
			Average:	0.69
				±0.02
				±2.9%

TEST NO.	MODEL	Q_b*	$T_s - T_a$		I_g
(23)	Experimental Mitten for Encapsulated Seat Survival Clothing				
	a. Leather Glove, B-3A b. Down-filled experimental mitten for encapsulated seat survival clothing				
1	1	121.1	120.0 - 89.8		0.77
2	1	142.2	124.0 - 92.0		0.69
3	1	121.1	130.3 - 90.9		0.86
				Average:	0.79
					±0.06
					±7.6%
(24)	Anti-Exposure Suit Mitten with Wool Insert for Air-Inflatable Anti-Exposure Suit				
1	2	99.0	115.7 - 85.2		0.95
2	2	89.2	113.5 - 89.7		0.82
3	2	82.8	113.0 - 92.3		0.77
				Average:	0.85
					±0.07
					±8.2%
(25)	Standard AF Mitten Assembly, N-4				
	a. Wool knit five-finger glove b. Leather shell, Spec. 3142, Type A-11A, medium c. N-4 (1) Inner blue mitten, blanket material (2) Outer leather (palm) and fur (back) mitten				
1	1	109.0	122.0 - 87.1		0.95
2	1	105.8	121.0 - 87.6		0.98
3	1	122.8	124.0 - 90.1		0.85
4	1	133.2	134.0 - 92.4		0.97
5	1	108.6	121.0 - 86.8		0.97
				Average:	0.94
					±0.07
					±7.4%
(26)	Standard Mitten for MD-1				
	a. Wool knit insert b. Nylon-neoprene outer mitten				
1	1	122.8	129.7 - 80.0		0.75
2	1	101.9	128.8 - 79.0		0.98
3	1	87.7	125.5 - 80.0		1.09
4	1	70.2	117.0 - 84.0		0.95
5	1	79.0	124.0 - 85.0		1.02
				Average:	0.96
					±0.09
					±9.4%

TEST NO.	MODEL	Q_b*	$T_s - T_a$		I_g
(27)	Experimental Down-Filled Aqua-Colored Mitten				
1	1	106.1	128.0 - 92.5		1.03
2	1	122.4	135.5 - 94.5		1.03
3	1	108.1	126.0 - 92.2		0.97
				Average:	1.01
					±0.03
					±3.0%
(28)	Experimental Down-filled Mitten for Encapsulated Seat Survival Clothing, Style I, Model II				
1	2	87.6	115.7 - 85.3		1.07
2	2	79.5	112.5 - 85.2		1.06
3	2	66.5	105.5 - 83.2		1.04
				Average:	1.06
					±0.01
					±0.9%
(29)	Experimental Curved One-Finger Bristolite Sealed Insulation Glove, Type 2, medium				
1	1	92.9	126.0 - 91.0		1.16
2	1	105.0	131.0 - 93.6		1.09
3	1	87.7	122.0 - 86.8		1.24
4	1	114.0	127.0 - 88.5		1.04
5	1	105.2	131.3 - 92.6		1.13
				Average:	1.13
					±0.05
					±4.4%
(30)	Anti-Exposure Suit Mitten, Attached to Air-Inflatable Anti-Exposure Suit MD-2, Spacer insulated				
1	1	107.1	127.3 - 88.4		1.12
2	1	91.2	119.3 - 86.7		1.10
3	1	73.7	113.5 - 85.9		1.16
				Average:	1.13
					±0.02
					±1.8%

TEST NO.	MODEL	Q_b''	$T_s - T_g$		I_g
(31)	Leather Flying Gloves, Wool Insulation, Rubberized Fabric Gauntlets, J.M. Rubins & Sons				
1	1	84.2	120.3 - 88.2		1.18
2	1	96.5	126.8 - 91.2		1.14
3	1	107.1	129.8 - 91.5		1.10
				Average:	1.14
					±0.03
					±2.6%

TABLE 7

INSULATION TESTS OF FOOTGEAR

TEST NO.	MODEL	Q_b''	$T_s - T_a$		I_g
(1)	Experimental (Sealed Insulation) Leather Boot, Size 901/2				
	a. Medium wool sock b. Experimental leather boot				
1	2	78.2	99.2 - 78.0		0.34
2	2	63.6	99.8 - 77.0		0.35
3	2	74.8	96.7 - 76.0		0.35
4	2	88.4	97.2 - 72.0		0.38
5	2	102.1	103.2 - 75.0		0.35
				Average:	0.35
					±0.01
					±2.9%
(2)	Experimental Alert Flight Boot, Full Leather Sole with Patch of Rubber Cemented to Outside Sole, Size 9D				
1	2	125.9	98.0 - 83.4		0.36
2	2	149.6	107.7 - 90.3		0.36
3	2	127.1	103.5 - 90.3		0.32
				Average:	0.35
					±0.02
					±5.7%
(3)	Experimental Alert Flight Boot, Leather Midsole and full Composition Rubber and Cord outer Sole, Size 10-1/2C				
1	2	126.1	104.0 - 89.2		0.36
2	2	149.5	111.0 - 93.7		0.36
3	2	126.1	102.5 - 87.5		0.37
				Average:	0.36
					±0.01
					±2.8%

TEST NO.	MODEL	Q_b *	$T_s - T_a$	I_g
(4)	Experimental Alert Flying Suit, Leather Midsole and Synthetic Sponge Rubber Outsole of approximately 2 times the thickness of Leather Midsole, Size 10-1/2C			
1	2	127.1	108.0 - 93.2	0.36
2	2	149.2	114.0 - 96.3	0.37
3	2	126.1	111.5 - 95.8	0.38
			Average:	0.37
				±0.01
				±2.7%
(5)	Experimental Flying Boot, Zipper in Center, Lacing on both Sides of Zipper, Insulated, Size 11E (Dahner Tank Boots)			
1	2	102.2	100.2 - 70.5	0.40
2	2	113.2	103.0 - 70.0	0.40
3	2	125.9	111.7 - 75.0	0.40
			Average:	0.40
				±0.00
				±0.0%
(6)	MC-2 Boot, Zipper, Laced Leather Boot, Size 10			
1	2	112.2	107.3 - 91.7	0.43
2	2	138.3	114.3 - 96.3	0.40
3	2	123.4	108.3 - 90.7	0.44
			Average:	0.42
				±0.02
				±4.8%
(7)	Boot, Combat, Leather, Flying, USAF MIL-B-11077A, Size 9D			
	a.Medium weight wool sock			
	b.Boot, leather, combat, flying			
1	2	75.8	92.0 - 80.5	0.46
2	2	100.0	101.8 - 87.5	0.44
3	2	89.5	101.7 - 88.8	0.45
4	2	102.0	105.7 - 91.0	0.45
			Average:	0.45
				±0.01
				±2.2%
(8)	Felt Alert Boot (Chippewa Co.), Size 11D			
	a. Cushion sole sock			
	b. Felt alert boot, 11D, commercial version for SAC Proc., Chippewa Co.			
1	2	100.9	99.0 - 77.8	0.65
2	2	113.2	102.0 - 80.1	0.60
3	2	124.2	104.5 - 80.6	0.59
4	2	150.0	113.0 - 82.9	0.62
			Average:	0.61
				±0.02
				±3.3%

TEST NO.	MODEL	Q_b"	$T_s - T_a$	I_g
(9)	Experimental Down-filled Boot for Encapsulated Seat Survival Clothing Style II, Model I (No underlying socks)			
1	4	55.1	107.5 - 81.5	1.46
2	4	48.5	104.2 - 78.9	1.61
3	4	61.7	111.2 - 83.0	1.41
4	4	71.7	118.8 - 86.0	1.41
			Average:	1.47
				±0.08
				±5.4%
(10)	White Rubber Boot (Hood) as Worn in Cold Water Immersion Tests a. Light weight wool socks b. White Rubber Boot (Hood), size 8R			
1	2	73.5	124.2 - 85.3	1.64
2	2	67.3	118.0 - 82.8	1.62
3	2	56.1	113.2 - 82.6	1.69
			Average:	1.65
				±0.03
				±1.8%
(11)	Experimental Down-filled Boot for Encapsulated Seat Survival Clothing, Style I, Model II			
1	4	48.5	111.3 - 83.5	1.77
2	4	57.3	117.8 - 84.6	1.79
3	4	67.3	124.7 - 85.6	1.79
			Average:	1.78
				±0.01
				±0.6%
(12)	Experimental Down-filled Boot for Encapsulated Seat Survival Clothing (no underlying socks)			
1	2	113.4	143.6 - 84.5	1.61
2	2	74.7	126.7 - 80.8	1.89
3	2	87.2	138.3 - 83.7	1.93
4	2	62.3	125.3 - 83.7	2.06
5	2	58.5	119.0 - 82.8	1.91
			Average:	1.88
				±0.11
				±5.9%

SECTION 2

REVISED AND EXTENDED CATALOG OF CLOTHING ITEMS

a. LIGHT (BODY) CLOTHING (0.0 - 1.5 clo)

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	REFERENCE PAGE
			LBS	IN	CLO			
(1) ONE-PIECE UNDERWEAR								
80-20 cotton-wool underwear	Vassar	36	0.45	0.02	0.3	0.067	I	8
Thermistor Suit, combed cotton		28-reg.			0.3		V	5
50-50 cotton-wool thermocouple underwear	Revere	large			0.5		II	4
							III	7
Lambskin underwear, short sleeves					1.0		III	10
(2) TWO-PIECE UNDERWEAR								
Cotton underwear	Munsing	46;34	0.59	0.02	0.2	0.100	IV	7
Thermal underwear	Allan-A Insulaire	7	1.40	0.085	0.3	0.283	V	5
Two-layer insulated underwear, T-shirt, trousers	DUOFOLD	42;36-L	0.83	0.075	0.4	0.188	V	5
Brynje underwear	VALHALLA	large	0.75	0.07	0.4	0.175	V	6
Brynje underwear	NORAK	medium	0.99	0.105	0.4	0.263	V	6
80-20 cotton-wool T-shirt and briefs			0.39	0.03	0.5	0.060	III	12
Standard AF 50-50 cotton-wool underwear		med.	1.87	0.09	0.5	0.180	V	7
Cotton-wool underwear	Style 303	"	1.19	0.08	0.5	0.160	V	7
50-40-10 vicara-cotton-nylon underwear	V-1S;V-1D	"	1.87	0.06	0.5	0.120	V	7
Navy thermal underwear	Allan-A Insulaire	"	1.73	0.09	0.5	0.180	V	7
Brynje underwear	IDEAL	large	0.63	0.085	0.5	0.170	V	6
50-50 orlon-cotton underwear	Hanes	"			0.6		III	7
50-50 vicara-cotton underwear	Onita	"			0.6		III	8
50-40-10 vicara-cotton-nylon underwear	Gibbs	"			0.6		III	8
Heavy zone cotton-wool underwear	Style 303	"			0.6		V	8
35-15 vicara-nylon underwear	V-2S;V-2D	"	1.72	0.06	0.6	0.100	V	8
Underwear with bulk orlon between two cotton layers	Style 301	"	1.34	0.09	0.6	0.150	V	8

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	REFERENCE PAGE
			LBS.	IN..	CLO			
Underwear with vicaranylon between two cotton layers	Style 302	*	1.74	0.085	0.6	0.142	V	8
50-50 cotton-wool pajama type underwear, O.D	QM	*	1.52	0.07	0.7	0.100	III	8
50-50 cotton-wool underwear	XB-67	large			0.9		I	8
Cotton, pajama type, waffle weave, underwear		medium			0.9		II	4
Cotton, double layer, pajama type underwear, yellow		medium			0.9		II	4
Standard Navy, waffle underwear	A-1	medium			0.9		V	18
Curon insulated underwear	Set Snug	medium	1.77	0.115	1.0	0.115	V	11
(3) ANTI-G SUITS								
Standard anti-G suit	G-4A	large-reg.			0.6		III	9
Experimental anti-G suit	G-4A Dupont	large-reg.			0.6		III	9
Standard anti-G suit	G-4B	med-reg.	4.13		1.1		IV	9
(4) EXPOSURE SUITS								
Standard anti-exposure suit	MD-1	med.-reg.	6.41		0.4		IV	24
Vapor permeable Navy anti-exposure suit	Mk-III				0.4		III	16
Exp. inflatable exposure suit	MD-2		9.70	0.16	0.8	0.200	V	9
Experimental flotation and survival suit after wetting and drying	Celanese Corp.	med.-reg.			0.9		IV	14
Continuous wear exposure suit	R-2				0.9		III III III	12 18 19
British orally inflatable exposure suit not inflated inflated (3-4 cm H_2O)	P. Frankenstein				1.0 1.1		V V	11 11
Experimental flotation and survival suit before wetting	Celanese Corp.	med.-reg.			1.2		IV	16

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I Ratio	REFERENCE PART	REFERENCE PAGE
			LBS.	IN.	CLO			
Arctic emergency survival parka, 1/2 in. wool pile interlining	N-3				1.2		II	11
Standard two-layer, wool backed nylon coverall	MD-3A	med.-reg	3.58	0.18	1.4	0.129	IV	17
(5) LINERS								
Experimental one-piece exposure suit liner	D.Clark	medium			0.6		III	11
Experimental two-piece exposure suit liner	D. Clark	med.-reg.			0.6		IV	10
"Zero Wear" two-piece polyurethane(Curon) liner tan	Curtiss-Wright		1.39	0.14	1.2	0.117	V	15
red		"	1.43	0.13	1.2	0.108	V	16
Two-piece polyther urethane foam liner	U.S.Rubber	"		0.25	1.2	0.208	V	23
Two-piece Dynel liner	U.S.Ruber	"		0.26	1.2	0.218	V	23
"Skagway" jacket and trousers	Urow 3497	medium	1.69	0.155	1.3	0.119	V	17
"Weatherall" two-piece 30-70 acetate-Virgin wool liner	Outdoor Products	med.-reg.	2.31	0.23	1.4	0.164	V	14
"Polar Wear" two-piece 100% Dacron liner	Dormer-Werner,Inc.	"	1.90	0.255	1.4	0.182	V	26
"Wunderwear" two-piece 100% Dacron liner, tubular quilted	Shelly Co.	"	1.75	0.27	1.4	0.193	V	22
"Satillite" jacket and trousers	Outwear T-100	medium	1.92	0.245	1.4	0.175	V	19
Two-piece insulated underwear	Dormer-Werner 46	medium	1.85	0.18	1.4	0.129	V	19
Blue liner, quilted, for use with Mk-IV anti-exposure suit	Navy	46-reg.	5.08	0.53	1.5	0.353	III	13
"Comfortall" two-piece liner	Budd Ins. Prod., Inc.	med.-reg.	3.05	0.26	1.5	0.173	V	25
"Weatherall" jacket and trousers	Outdoor Products	med-reg.	2.31	0.29	1.5	0.193	IV	19
(6) ONE-PIECE COVERALLS								
Standard coverall	A-4	medium			0.3		I	9
Water barrier coverall			1.80	0.01	0.3	0.033	V	20
Flight alert suit		medium	2.83	0.03	0.5	0.075	V	10

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	PAGE
			LBS.	IN.	CLO			
Experimental coverall	Sunbak	medium			0.7		I	9
Gabardine coverall	A-4	medium			0.9		I	8
Trilock Spacer Coverall					1.0		V	26
Spacer Insulated Coverall	P/N S-885		4.10	0.16	1.1	0.146	V	15
Experimental Navy outer coverall	WN-1	large			1.2		II	12
Experimental two-layer wool-backed nylon coverall	AMD-3A	medium	3.92	0.18	1.4	0.129	IV	17
(7) ONE-PIECE FLYING SUITS								
Blue worsted wool gabardine (men's) flying suit	L-1A	med.-reg.			0.5		IV	8
Nylon, Dobby weave flying suit	K-2A	med.-reg.			0.6		III	8
Byrd Cloth flying suit	K-2B	med.-reg.		0.01	0.6	0.017	III	8
Cotton-nylon, Dobby weave, very light flying suit	K-2C	med.-reg.			0.6		III	9
Light flying suit (L.W. Foster)	LFS-1		2.13	0.01	0.6	0.017	V	12
Quilted flying suit	AB-73	med.-reg.			0.8		II	5
Alpaca wool flying suit					0.9		II	8
Summer flying suit	AN-S-31A	med.-large			1.0		I	8
Modified B-78, 1/8" durolite	B-78 U.S.Rubber	med.-reg.	4.92	0.16	1.0	0.160	V	27
Cotton flying suit	K-2	large-reg.			1.1		IV	10
Experimental flying suit	CWU-1/P	med.-reg.			1.2		V	17
Experimental flying suit with 136 x 69 nylon-taffeta liner	CWU-1/P	med.-reg.			1.2		V	17
Experimental flying suit with nylon-millium liner		med.-reg.			1.2		V	18
Navy electrically heated flying suit	Colvinex	med.-reg.			1.3		III	9
Experimental flying suit with 130 x 60 rayon-sateen liner	CWU-1/P	med.-reg.			1.3		V	20
Experimental flying suit with rayon-sateen-millium liner	CWU-1/P	med.-reg.			1.3		V	21
Experimental flying suit with neoprene coated nylon rip stop, type I liner	CWU-1/P	med.-reg.			1.4		V	23

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	REFERENCE PAGE
			LBS.	IN.	CLO			
(8) TWO-PIECE FLYING SUITS								
Gray cotton shirt and trousers		med.-reg.	1.72	0.035	0.6	0.058	V	10
Gray serge 100% wool shirt and trousers	A-1; E-1	med.-reg.	3.56	0.03	0.6	0.050	V	13
OD shirt and trousers	QM	med.-reg.			0.7		I	8
Blue serge 100% wool shirt and trousers	A-1; E-1	med.-reg.	3.75	0.04	0.7	0.057	III	10
Jacket with hood and trousers, both with one-layer interliner, cotton	N-2;D-1	med.-reg.	9.11	0.345	0.7	0.493	II	7
Fiberglas lined jacket and trousers	QM	med.-reg.			0.7		II	6
Jacket with hood and trousers, both with two-layer cotton waffle weave interliner	N-2;D-1	med.-reg.			0.7		II	7
Blue serge 40-60 orlon-wool shirt and trousers	A-1;E-1	med.-reg.			0.8		III	10
Blue serge 40-60 dacron-wool shirt and trousers	A-1;E-1	med.-reg.			0.8		III	10
Fiberglas lined sport jacket and gabardine trousers	Stanley, E-1	med.-reg.			0.8		II	9
Navy flight jacket and trousers	A-2;A-54	med.-reg.	7.54	0.205	1.0	0.205	V	18
OD heavy wool knit shirt and gabardine trousers	A-1;E-1	med.-reg.			1.1		II	5
Submarine jacket and trousers	Navy	med.-large			1.1		II	5
Jacket and trousers for intermediate cold weather	Navy	medium	5.21	0.21	1.1	0.191	V	16
Fiberglas lined parka and trousers	QM	med.-reg.			1.2		II	8
Field jacket and cotton trousers		small		0.115	1.2	0.096	IV	15
Navy jacket and trousers	A-1;X-54	med.-reg.	6.21	0.20	1.2	0.167	V	24
Navy dark green flying suit		med.-reg.	3.82	0.18	1.2	0.150	V	30
Experimental polyurethane jacket and heavy trousers	MA-1;D-1A	med.-reg.	7.59		1.3		V	30

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	REFERENCE PAGE
			LBS.	IN.	CLO			
Nylon-dacron frieze shirt and trousers	N-2A;D-1A	large-reg.		0.40	1.4	0.286	III	14
Flying jacket and trousers	B-15C;	med.-reg.		0.23	1.4	0.164	III	14
Navy jacket and trousers	AL-1;WL-1	large			1.4		II	6
Navy winter flying suit	MIL-S-18 342A	med.-reg.	4.51	0.19	1.4	0.136	V	31
Alpaca wool flying suit	B-48-A	med.-reg.			1.5		I	9
(9) SPECIAL ITEMS								
Two-piece Norwegian survival kit insulation					0.2		V	33
Flight jacket	A-2	medium			0.3		I	9
High altitude pressure suit	T-1	medium			0.3		IV	8
Ventilating garment	MA-1	medium			0.4		IV	11
Ventilating garment	MA-2	medium	2.93		0.4		IV	11
Mock chenille spacer suit no sleeves	1233-E	medium			0.4		IV	11
"Jacket 1" of ground crew climatic clothing assembly			1.31	0.08	0.4	0.200	V	13
"Jacket 2" of ground crew climatic clothing assembly			1.71	0.12	0.4	0.300	V	16
"Jacket 3" of ground crew climatic clothing assembly			1.38	0.07	0.4	0.175	V	22
Neoprene coated nylon barrier suit		medium			0.5		II	7
Light jacket (L.W.Foster)	LW-2		1.59	0.17	0.5	0.340	V	15
Modified "Jacket 2" of ground crew climatic clothing assembly			1.63	0.13	0.5	0.260	V	22
Experimental jacket	XMA-1	medium	2.27	0.11	0.6	0.183	V	20
Experimental polyurethane jacket, 3.3 oz. nylon lined	MA-1 DuPont	medium	2.17	0.16	0.7	0.229	V	29
Light jacket (L.W.Foster)	LW-2A		1.69	0.11	0.8	0.138	V	21
Experimental Vibrafoam field jacket	U.S. Rubber	medium	2.66	0.18	0.9	0.200	V	27
Experimental InsulAir jacket	U.S. Rubber	medium	3.91	0.19	0.9	0.211	V	28
Experimental polyurethane nylon-wool lined jacket	MA-1 DuPont		2.46	0.21	0.9	0.233	V	27

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	REFERENCE PAGE
			LBS.	IN.	CLO			
Winter overcoat	Commercial	medium			1.0		IV	15
Standard field jacket with buttoned-in wool pile liner		medium	4.54	0.30	1.0	0.300	V	29
Experimental jacket with buttoned-in polyurethane liner	MA-1	medium			1.2		V	30
Parachute canopy					1.2		V	40
Experimental sealed insulation full pressure suit	CSU-5/P				1.3		V	13
Get-me-down pressure suit	CSU-4/P				1.3		V	14
(10) SLEEPING BAGS								
Sleeping bag-life raft combination	Model 1				0.4		IV	26
Sleeping bag-life raft combination	Irving				0.7		V	40
Sleeping bag-life raft combination	Model 2				1.5		IV	26
(11) HEADGEAR								
Summer flying helmet, cotton twill	AN-H-15	medium			0.1		IV	29
Flying helmet, leather	A-11	medium			0.2		IV	29
Outer hood for MD-1		medium			0.3		IV	29
Flying helmet, leather shearling, intermediate zone type	A-11	large			0.4		IV	29
Wool knit toque	Navy	medium			0.4		IV	29
Flight helmet, leather sheepskin	A-13	extra large			0.4		IV	30
Outer hood, Terry cloth, rocket fuel handler		medium			0.4		IV	30
Inner hood for MD-1		medium			0.5		IV	30
Khaki sun helmet, rigid fiber covered with cotton twill		medium			0.6		IV	30
Outer and inner hood for MD-1		medium			0.7		IV	30
Flying helmet, leather shearling, winter wear	AN-H-16	medium			0.7		IV	31
Flight helmet	P-1	large			0.7		IV	31

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE ARF	PAGE
			LBS.	IN.	CLO			
Helmet, aircrew, winter wear	B-9	medium			0.8		IV	31
Inner vinyl hood for rocket fuel handler		medium			0.8		IV	31
Flight helmet	P-4	large			0.8		IV	31
Firefighters protective hood	A-1	medium			1.4		IV	32
(12) GLOVES								
Leather gloves	B-3A	medium			0.2		IV	32
Very light flying gloves, mosquito resistant	K-1	medium			0.2		IV	33
Glove insert, 75-25 wool-nylon		medium			0.2		IV	33
Rayon insert, brown		medium						
Inner rubber glove	MC-2	medium			0.2		V	43
Navy four finger glove	A461-1	medium			0.2		V	43
Glove set: wool insert, sheepskin glove	MA-1	medium			0.3		IV	33
Wool glove insert, olive drab		medium			0.3		IV	34
Flying gloves for anti-exposure suit	F-1	medium			0.3		IV	34
Brown leather glove	MG-123	medium			0.3		V	43
Gray wool glove	Fotiaire #8, new pattern	medium			0.3		V	44
Glove assembly	MA-1	medium			0.3		V	44
Wool lined leather glove (industrial purpose)			1.16		0.6		V	46
Leather flying gloves, wool insulation, rubberized fabric gauntlets	Robins				1.1		V	50
(13) MITTENS								
Insert, horsehide	N-2	medium			0.3		IV	34
Insert, wool knit, brown		medium			0.3		IV	34
Insert, aircrew, blue	N-3A	medium			0.4		IV	35
Inflatable mitten, not inflated		medium			0.4		IV	35
Mitten set: brown wool insert, leather mitten	MA-1	medium			0.4		IV	35
One-finger mitten, leather, chamois lined	Fotiaire #10, new pattern	medium			0.4		V	44

DESCRIPTION	TYPE	SIZE	WEIGHT LBS.	THICKNESS IN.	INSULATION CLO	T/I REFERENCE REPORT	PAGE
One-finger mitten, aluminized fabric (asbestos)	Fotiaire #9, new pattern 3M	medium			0.4	V	44
One-finger mitten, leather, Byrd cloth insulated	Fotiaire #5, new pattern	medium			0.4	V	44
One-finger mitten, leather, insulation; 2-glass cloth, 1-rubber layer, not inflated	Fotiaire #6, old pattern				0.4	V	45
One-finger mitten, leather, insulation: 2-Byrd cloth, 1 rubber layer	Fotiaire #1, new pattern	medium			0.5	V	45
One-finger mitten, leather, 2 aluminized rayon, 1 rubber layer	Fotiaire #3, new pattern	medium			0.5	V	45
Mitten set: brown wool insert, nylon mitten	N-4A	medium			0.6	IV	36
Experimental mitten set: brown wool insert, leather mitten (MA-1), experimental exposure suit mitten		medium			0.6	IV	36
One-finger mitten, leather, insulation: 2 aluminized rayon, 1 rubber layer inflated and not inflated	Fotiaire #7, new pattern	medium			0.6	V	46
Anti-contact mitten	Navy	medium			0.6	V	46
One-finger mitten, leather, insulation: 2 glass cloth, 1 rubber layer, partially inflated	Fotiaire #6, old pattern	medium			0.6	V	45
One-finger mitten, leather, insulation: 1 Byrd cloth, 1 aluminized rayon, 1 rubber layer	Fotiaire #2 new pattern	medium			0.6	V	47
One-finger mitten, leather	Fotiaire #9a, new pattern	medium			0.6	V	47
Down filled mitten for encapsulated clothing	Style II, Model I		0.32		0.6	V	46

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	PAGE
			LBS.	IN.	CLO			
Experimental, down-filled mitten for encapsulated seat survival clothing					0.6		V	48
Mitten set, artic wear		medium			0.7		IV	37
One finger mitten, leather, insulation: 2 sunbak cloth, 1 rubber layer	Fotiaire #8a, new pattern	medium			0.7		V	47
Experimental heavy mitten	N-4B	medium			0.9		IV	37
Standard AF assembly: wool knit glove, leather shell A-11A, inner blue mitten, outer leather mitten	N-4	medium			0.9		V	48
Anti-exposure suit mitten with wool insert for air-inflatable anti-exposure suit					0.9		V	48
Arctic mitten with OD wool glove insert		medium			1.0		IV	38
Standard mitten for MD-1 (wool insert, nylon-neoprene inter mitten)		medium medium			1.0 1.0		IV V	38 48
Experimental down-filled mitten		medium			1.0		V	49
Experimental curved one-finger, bristolite sealed mitten	Type 2	medium			1.1		V	49
Down-filled mitten for encapsulated clothing	Style 1 Model II		0.27		1.1		V	49
Anti-exposure suit mitten, spacer insulated, attached to air-inflatable anti-exposure suit MD-2					1.1		V	49
(14) SOCKS								
Black light weight ribbed cotton socks		medium			0.3		IV	38
Experimental lambskin socks		medium			0.3		III	25
Light weight wool knit socks		medium			0.3		IV	29
Medium weight wool knit socks		medium			0.3		IV	29

DESCRIPTION	TYPE	SIZE	WEIGHT LBS.	THICKNESS IN.	INSULATION CLO	T/I RATIO	REFERENCE PART	REFERENCE PAGE
Heavyweight wool knit socks		medium			0.4		IV	44
25-75 cotton-wool socks		medium			0.5		IV	39
100% wool socks with pull strap (wool felt duffel)		medium			0.9		IV	42
(15) SHOES								
High rubber overshoe	MC-1	medium			0.3		IV	41
Black dress shoe, Oxford		medium			0.3		IV	40
Black GI service shoe, ankle height, for MD-1 use		medium			0.3		IV	39
Intermediate flying shoe	A-17	medium			0.3		III	26
Black leather service shoe		medium			0.4		IV	40
Intermediate flying shoe	Hood A-17	medium			0.5		III	27
High rubber overshoe	N-2	medium			0.7		IV	41
(16) BOOTS								
Experimental, sealed insulation, leather boot		medium			0.2		V	50
Combat boot, leather, flying	MIL 13-11077A	medium			0.2		V	51
Flight alert boot		medium			0.3		V	50
Felt alert boot	Chippewa				0.3		V	51
Experimental alert flight boot, full leather sole with patch of rubber cemented to outside sole		medium			0.4		V	50
Experimental alert flight boot, leather mid sole and full composition rubber and cord inter sole		medium			0.4		V	50
Experimental alert flight boot, leather mid sole and synthetic sponge rubber outer sole		medium			0.4		V	51
Experimental flying boot	Dahner	medium			0.4		V	51
Zipper laced flying boot	MC-2	medium			0.4		V	51
Flying boot with Saran spacer	A-17	medium			0.5		III	27
Men's mukluk	N-1B	medium			0.5		IV	42
Men's mukluk, survival		medium			0.5		IV	43

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	PAGE
			LBS.	IN.	CLO			
Flying boot without Saran spacer	A-17	medium			0.6		III	27,28
Sealed insulation boot	Hood 3	medium			0.7		III	28
Standard heavy flying boot	A-17	medium			0.8		IV	41
Experimental flying boot, Insulite, wool felt mid sole	A -17	medium			1.0		IV	42
Bristolite boot		medium			1.0		IV	45
Standard wool pile insulated flying boot, cork-rubber mid sole	A-17	medium			1.1		IV	43
White rubber boots	Hood				1.4		V	52
Down filled boot for encapsulated clothing	Style II Model		1.42		1.5		V	52

B. MEDIUM (BODY) CLOTHING (1.5-3.0 clo)

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	PAGE
			LBS.	IN.	CLO			
(1) UNDERWEAR								
One-piece cellular vinyl sponge coldbar suit	WCRDC	medium			1.5		IV	10
Two-piece coldbar suit	T-53	med-reg			1.8		IV	12
(2) ANTI-EXPOSURE SUITS								
Experimental anti-exposure suit	Clark	medium			1.7		IV	15
Anti-exposure suit with spacer	AML	medium			1.9		IV	18
without spacer	AML	medium			2.0		IV	20
Outer impermeable suit	AML-DL	medium			2.0		III	15
Sealed insulation suit, front zipper		medium			2.3		III	12
(3) LINERS								
One-piece polyurethane liner	Convair	medium		0.27	1.6	0.169	V	14
"Eskimo Brand", two-piece liner	Brooks	med-reg	3.42	0.36	1.6	0.225	V	25

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	REFERENCE PAGE
			LBS.	IN.	CLO			
"Winterseal" two-piece liner	Refrigiwear	med-reg	2.31	0.275	1.6	0.172	V	25
"Dutchess" Flite wear	Dutchess T-500	medium	1.87	0.185	1.6	0.116	V	25
"Refrigiwear" jacket and trousers	Burnett	med-reg		0.285	1.7	0.168	IV	20
Urethane plastic insulated jacket and trousers	USR-W-200	medium	1.99	0.295	1.7	0.174	V	26
"Wunderwear" two-piece 100% dacron liner, 3X3 construction	Shelly	med-reg	2.51	0.375	1.8	0.208	V	26
Dacron insulated jacket and trousers	USR-W-200				2.1		V	
"Wunderwear" two-piece 100% dacron liner, 4X4 construction	Shelly	med-reg	2.90	0.48	2.4	0.200	V	35
(4) ONE-PIECE COVERALLS								
Experimental down-filled coverall	SAC	medium	5.53	0.53	1.8	0.294	V	33
Experimental rayon acetate coverall	MD-3A	med-reg.	5.58	0.48	2.5	0.194	V	36
(5) ONE-PIECE FLYING SUITS								
Electrically heated flying suit	C-1	medium			1.6		II	10
Lightweight fiberglas flying suit	B-78	medium			2.0		III	14
Lightweight, quilted, milkweed filled flying suit	B-78	medium			2.1		III	15
Down-filled suit with hood, trousers	Hagan		7.10		2.7		V	34
(6) TWO-PIECE FLYING SUITS								
Alpaca wool flying jacket and trousers	B-15,A-11	med-reg		0.295	1.5	0.193	I	9
Flying jacket and trousers	B-15B;A-11B	med-reg			1.6		II	6
Flying jacket and trousers, thermal cloth interlined	B-15B;A-11B	med-reg			1.6		I	9
Alpaca wool flying suit	B-48-A2	med-reg			1.6		I	9

DESCRIPTION	TYPE	SIZE	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	REFERENCE PAGE
			LBS.	IN.	CLO			
Heavy flying jacket with hood and trousers, wool pile interlined	N-2;D-1	large-regular	7.11	0.345	1.6	0.216	II	9,10
Dynel batt jacket and trousers	U.S.Rubber	med-reg		0.24	1.6	0.150	IV	20
Heavy flight jacket and trousers	N-3;D-1	med-reg	10.75		1.6		V	
Jacket and trousers for extreme cold weather	Navy		8.63	0.34	1.6	0.213	V	34
Alpaca flying suit	B-48-A3	med-reg			1.7		I	9
Unifoam (polyurethane) jacket and trousers	WCRDC	med-reg		0.285	1.7	0.168	IV	21
Leather shearling jacket and trousers		med-reg			1.7		I	9
RCAF flying suit, jacket and trousers zipped together	RCAF ZONE VII	med-reg	6.63	0.305	1.7	0.177	V	31
Flying jacket with hood and trousers	N-3;F-1	med-reg	9.45	0.315	1.8	0.175	II	10,11,13
Outer parka and trousers	QM	large-med			1.9		II	12,13
Heavy flying shirt and trousers	N-2;A-1	large-med			1.9		III	16
Quilted parka and trousers	B-9;A-8	med-reg			1.9		I	10
Field jacket and trousers		large-reg			1.9		IV	21
Alpaca wool parka and trousers	B-11;A-10	med-reg			2.0		II	8
Flying suit for use with MK-IV	Navy	med-reg		0.29	2.0	0.145	IV	22
Navy flying jacket and trousers with buttoned-in liner	A-1;X-54	med-reg	8.48	0.415	2.0	0.208	V	28
Woven urethane jacket and trousers (L.W. Foster)	M-3		3.95	0.19	2.0	0.095	V	30
Heavy jacket and trousers(L.W. Foster)	H-3A		5.00	0.345	2.0	0.173	V	33
Navy flying jacket with hood and trousers	N-2A;D-1	extra large		0.345	2.2	0.157	III	17,18

DESCRIPTION	TYPE	SIZE	WEIGHT LBS.	THICKNESS IN.	INSULATION CLO	T/I RATIO	REFERENCE PART	REFERENCE PAGE
Heavy aircrew jacket and trousers	N-3B;F-1B	large-reg	9.45	0.315	2.4	0.131	IV	24
Experimental flying jacket and trousers 5/16" thick	N-2;D-1	med-reg	9.11	0.345	2.5	0.138	V	36
Heavy,white parka and trousers(L.W. Foster)	P-4		6.63	0.37	2.5	0.148	V	35
Modified parka (#4) and trousers of ground crew climatic clothing			6.11	0.30	2.5	0.120	V	35
Experimental polyurethane field jacket and Type F-1 trousers	US Rubber Dayton Rubber			0.38	2.7	0.141	IV	24
(7) SPECIAL ITEMS								
Fiberglas filled jacket	A-11 Drybak	large-reg			1.7		II	7
"Jacket 4" of ground crew climatic clothing, and trousers			9.41	0.325	1.9	0.171	V	37
Modified (sealed insulation) Get-Me-Down pressure suit	CSU-5/P				2.0		V	21
Experimental down-filled coat	Hagan	medium	2.64	1.05	2.2	0.477	V	39
Experimental down-filled coat	Hagan		2.64	1.05	2.8	0.375	V	39

DESCRIPTION	TYPE	MANIKIN CLOTHING	WEIGHT OZ.	THICKNESS IN.	INSULATION CLO	T/I RATIO	REFERENCE PART	REFERENCE PAGE
(8) SLEEPING BAGS								
Sleeping bag - life raft combination, General Tire and Rubber Co.	Ramat	none			2.4		IV	27
Casualty bag	QM	heavy assembly			2.5		II	13
Sleeping bag on A-3 mattress, fluffing 10 X	QM;M-1	Heavy assembly	52		2.6		III	22
Sleeping bag	QM;M-1	heavy assembly	52		2.7		III	22

DESCRIPTION	TYPE	MANIKIN CLOTHING	WEIGHT OZ.	THICKNESS IN.	INSULATION CLO	T/I RATIO	REFERENCE PART	REFERENCE PAGE
Experimental polyurethane derivative filled sleeping bag		underwear			2.7		V	41
Sleeping bag on A-3 mattress	QM;M-1	underwear	28		2.8		III	20
Sleeping bag, Thurstone liner, on A-3 mattress	QM;M-1	underwear	36		2.9		III	20
Sleeping bag - life raft combination, General Tire and Rubber Co.	Ramat	heavy assembly			3.0		IV	28
Sleeping bag on A-3 mattress	QM-M-1	underwear	52		3.0		III	21
Sleeping bag on A-3 mattress	AM;M-1	underwear	36		3.0		III	20
(9) HEADGEAR			LBS.					
Down-filled detachable hood					1.6		V	42
Experimental flying helmet	MA-3				2.2		V	42
Flying helmet	MA-3				2.5		V	42
Flying helmet	MA-2				2.7		V	42
(10) BOOTS								
Down filled boot for encapsulated clothing	Style I Model II		1.1		1.8		V	52
Experimental down filled boot for encapsulated clothing					1.9		V	52
C. HEAVY (BODY) CLOTHING								
		SIZE	LBS.					
(1) TWO-PIECE FLYING SUITS								
Experimental one-piece down-filled suit (encapsulated clothing)	Style I Model II		2.60	0.72	3.0	0.186	V	37
Flying jacket (N-3) and trousers	Niemi	med-reg	7.84	0.66	3.3	0.200	V	39
Experimental two-piece down-filled suit (encapsulated clothing)	Style II Model I		3.85	0.77	3.5	0.175	V	38

DESCRIPTION	TYPE	MANIKIN CLOTHING	WEIGHT	THICKNESS	INSULATION	T/I RATIO	REFERENCE PART	REFERENCE PAGE
			OZ.		CLO			
(2) SLEEPING BAGS								
Sleeping bag on A-3 mattress	QM;M-1	underwear	44		3.3		III	20
Sleeping bag on A-3 mattress	Ven Veen	underwear	50		3.4		IV	28
Sleeping bag on A-3 mattress, fluffing 10 X	QM;M-1	underwear	52		3.4		III	21
Sleeping bag on A-3 mattress	QM;M-1	underwear	48		3.4		III	21
Sleeping bag	Van Veen	underwear	50		3.5		IV	28
Experimental sleeping bag	350in^3	underwear			3.5		V	41
Sleeping bag, Thurstone liner, on A-3 mattress	QM;M-1	underwear	52		3.8		III	21
100% down-filled sleeping bag (having been pressure packed)	MC-1				3.8		V	41
100% down-filled sleeping bag	MC-1				4.4		V	41
Sleeping bag	QM;A-3	heavy assembly	medium		7.0		II	14

SECTION 3

COMPARATIVE TECHNIQUES FOR MEASURING THERMAL INSULATION OF BODY CLOTHING

In part 4 of this series of thermal insulation of Air Force body clothing* (ref. 4) the individual values reported in the catalog were based either on separate measurements of the items, or were derived by a difference method for multilayered assemblies. Although this difference method yielded values which were reasonably reliable and representative of the clothing insulation as worn, the method is not devoid of error nor free of technical criticism. To determine the reliability of the values obtained by such a method we decided to compare the catalog value (or sum of values in case of multilayered assemblies) with the mean value actually obtained by total assembly measurements on the copper manikin. Results of this comparison for light, medium, and heavy insulative clothing assemblies are presented in figure 1. As indicated by the mean curve and degree of scatter of individual points, the values in general show reasonably good correlation between total assembly values obtained by the difference method and those determined with the total measurements. The results are based on 58 comparisons. Eleven tests were conducted with light insulative clothing; thirty tests with medium weight clothing and seventeen tests were conducted with heavy clothing. Greatest divergence from a linear relationship between measured vs calculated (catalog) values is indicated in the light clothing zone, with slight divergence also occurring in the heavy clothing range. Best correlation is obtained in the medium or intermediate weight clothing range. The relationship is illustrated in figure 2 where a similar correlation is shown in terms of the correction factors. In this graph the body insulation (I_g) in clo is first obtained by simple addition of the selected clothing values. This is then multiplied by the corresponding correction factor to yield a corrected or actual thermal insulation which would result if this particular assembly were tested on the copper manikin.

By using the above procedure, the catalog values will yield more accurate and quantitatively reliable predictions of human tolerance time for environmental exposures. For operational field use where insulative testing of protective clothing on physical models is not possible the recommended procedure for using these catalog values should prove practical and valuable.

* Body clothing includes insulation covering the arms, legs and trunk areas.

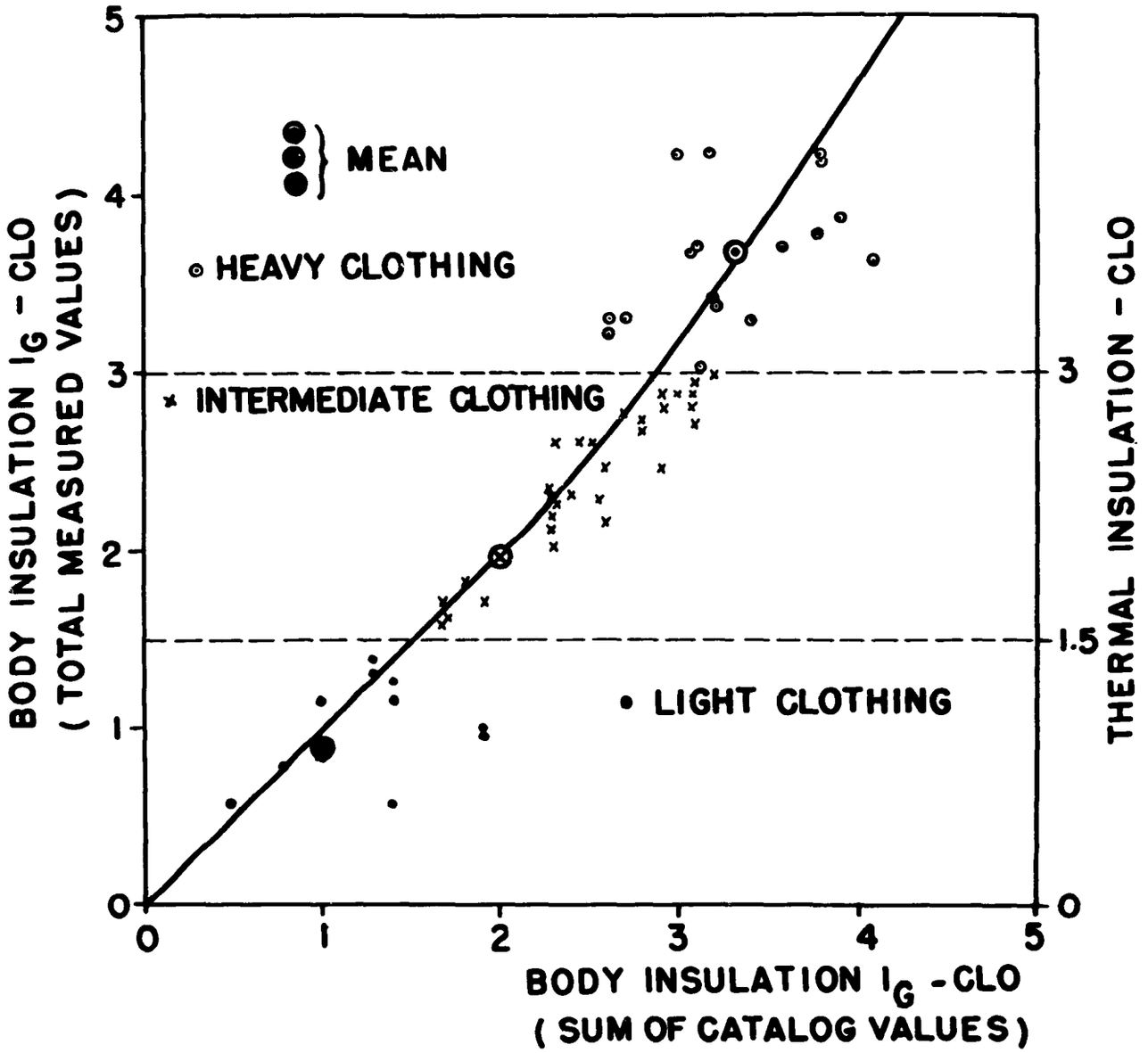

Figure 1. Measured versus Calculated Body Insulation Values

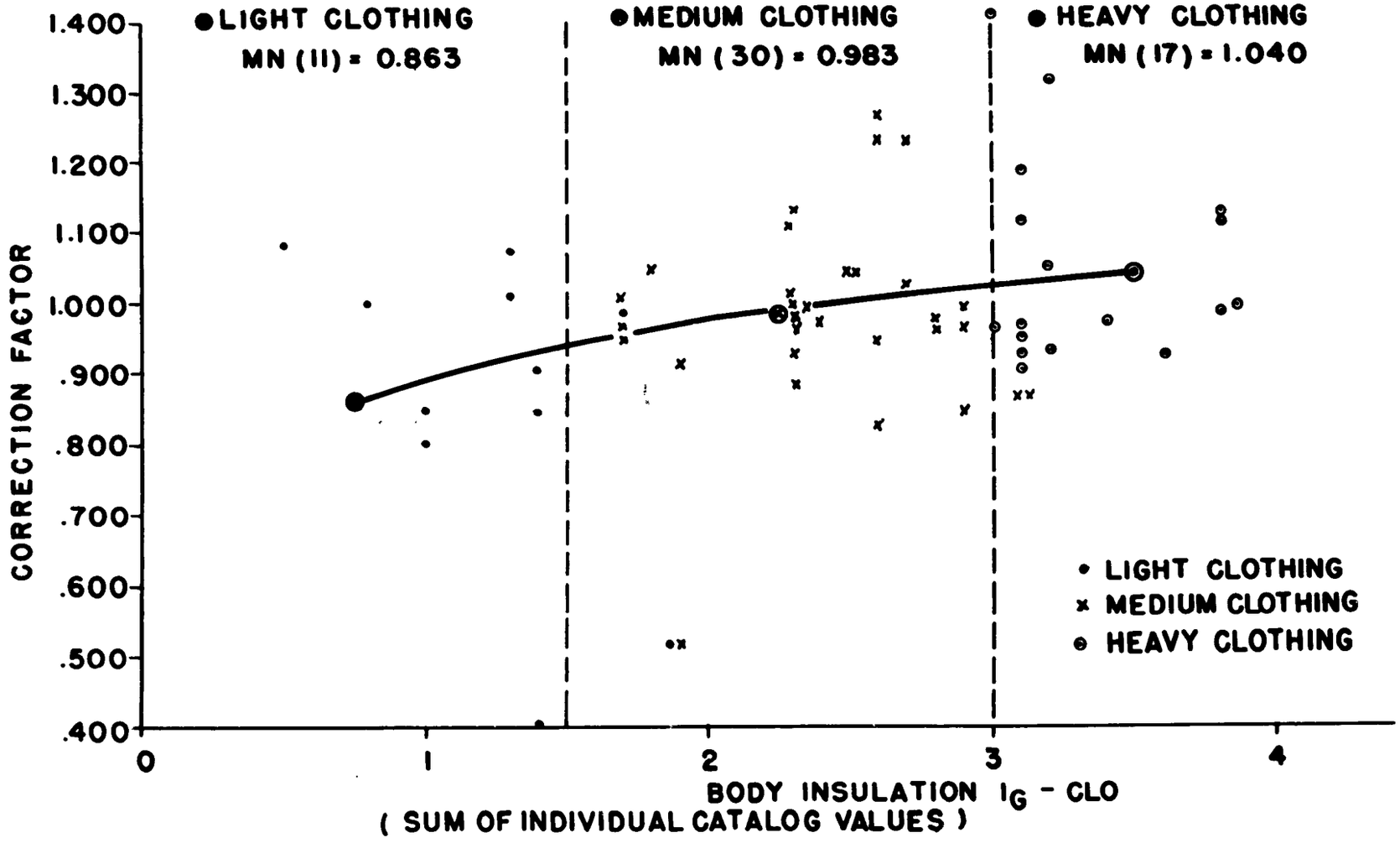

Figure 2. Correction Factors for Calculating Thermal Insulation of Body Clothing

SECTION 4

LAUNDERING EFFECTS ON CLOTHING INSULATION

Tests with a number of clothing items, particularly underwear, were carried out to study the effects of laundering on thermal insulation. The clo value of a new clothing item was determined in a test series on the copper manikin. Then, this item was laundered and dried ten times. In a second test series on the physical model, using approximately the same test conditions, the thermal insulation of the laundered clothing was determined and the result compared with that of the initial or unlaundered test series.

Except for a very few cases, where the laundering process may have loosened the insulating material, thus producing more insulating air space, laundering generally decreased the thermal insulation of clothing. Shrinkage of the material is possibly the main reason for this decrease. Shrinkage causes the clothing to fit tighter which, in turn, decreases the entrapped air layers between clothing and body surface, thus lowering the total insulation. In clothing with an insulating interlining, tight fit compresses the insulation material and thus eliminates a part of the small air spaces between the fibers of that material which again results in decreased insulation.

The fact that laundering also decreased thickness of most clothing items leads to the conclusion that washing also changes the physical characteristics of the material. We could not study these physical changes in detail, but we assume, depending on the type of material, the following changes may occur:

(a) breakage of fibers in nonelastic materials;

(b) shrinkage of individual fibers;

(c) other changes in the fiber structure.

Figure 3 illustrates the insulation losses due to laundering various types of underwear. These are expressed in percent of the initial insulation value. Included below the blocks are brand names of the underwear and, above the blocks, the type of insulating material used. Three characteristic types of underwear can be distinguished:

(a) items using synthetic material;

(b) items using an insulating air layer between two layers of material;

(c) single layer items.

Of the above three groups, single layer underwear is least affected by laundering (7.5%). Highest insulation loss was observed in the insulated, double-layer underwear (24.5%). When washing this type of underwear the air

layer is replaced by water. Apparently the two layers of material are not completely separated after drying, therefore, the insulating air layer is lost or only partially restored. Much individual variation in insulation loss was observed in the remaining group of clothing fabricated with synthetic insulation materials (4-33%). Dynel, dacron, bulk orlon and polyether urethane foam showed the least insulation losses. Furthermore, the type of insulation material, the way the clothing is constructed, and thickness of the insulation play roles in influencing the effects of laundering. For example, of the four dacron-insulated items in figure 3, two lost only 4%, the remaining two lost 14 and 16% respectively, of their initial thermal insulation.

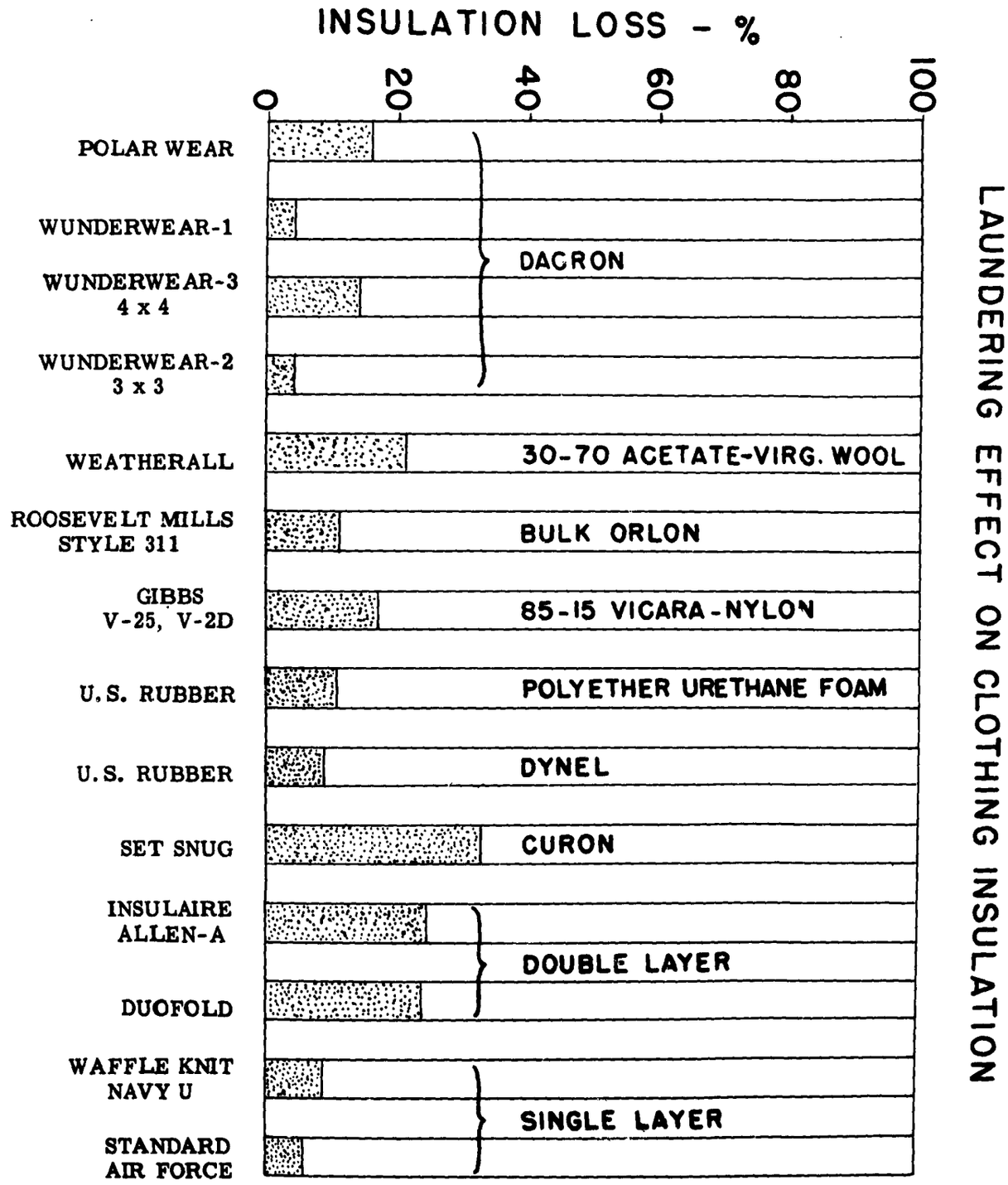

Figure 3. Laundering Effect on Clothing Insulation

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Results of the fifth of a series of thermal insulation studies performed with electrically heated hand, foot, head, and entire body models are presented. The experimental data include results obtained with light, medium, and heavy clothing types, as well as with thermal protective items of specialized nature. A revised catalog listing individually the insulation in clo units of numerous

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