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CWL TECHNICAL MEMORANDUM 33-1

INTERIM REPORT

CWL PROJECT ORDER
CLASS I - [illegible]

by

Norman Reich

February 1950

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Directorate of Development
U.S. Army Chemical Warfare Laboratories
Army Chemical Center, Maryland

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CWL Technical Memorandum 33-19
Status Report
CWL Teaversal Program
Phase B - "Pick-Up"

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ABSTRACT

(C) Object.

The object of this phase of the Traversal Program is to estimate the quantity of V-agent that can be picked up on the clothing of troops traversing contaminated areas.

(C) Results.

"Creep and crawl" trials simulating a straight-line traversal of open terrain under fire were conducted at Army Chemical Center, Maryland, on test sites where the moderately dense vegetation (80 to 90% coverage) was maintained at a height of 3 to 6 in. The quantity of simulant picked up on the U.S. Army fatigue uniforms of test subjects crawling across the area within an hour after the dispersion of simulant averaged approximately 1% of the contamination density per unit length of the traversal path (ie, P' = 0.01 CL; where P' is the pick-up of simulant, g; C is the contamination density, g/sq m; and L is the distance traversed, m). This relationship appeared to be independent of the particle size of the dispersed simulant, although evidence exists to show that particle size does have some effect on the transferability of simulant and agent.

A comparison of the transferability of agent to that of simulant indicated that the relative transferability of agent decreased with increasing contamination. This relationship may be expressed as R = exp-(0.06 C), where R is the ratio of agent to simulant picked up on the cloth-covered roller. The constant of this equation is an approximation based on limited data and requires substantiation by further testing.

From the foregoing it was assumed that, if V-agent were used instead of simulant in the "creep and crawl" trials, the average quantity of agent that would have been picked up could be represented by the equation P = 0.01 CL exp -(0.06 C).

The quantity of agent picked up on the cloth-covered roller traversing contaminated areas one day after the dispersion of V-agent averaged approximately 4% of that picked up when the traversal was effected within one hour after the dispersion. This reflects the apparently rapid decline in agent available for pick-up, a fact which was corroborated in CWL Technical Memorandum 33-19, dated 9 February 1959, covering Phase A (Persistence) of the CWL Traversal Program. (Note: The results presented are specific for a particular field activity and for essentially one type of terrain condition. Additional testing is required to provide information relative to other field activities performed on V-ex and other types of terrain.)

Table of Contents

INTERIM REPORT
CWL TRAVERSAL PROGRAM
PHASE B - "PICK-UP"

I. (C) OBJECT.

The object of this phase of the Traversal Program is to estimate the quantity of V-agent that can be picked up on the clothing of troops traversing contaminated areas.

II. (U) AUTHORITY.

This study was authorized in the Chemical Warfare Laboratories Traversal Program, dated 25 March 1957.

III. (C) INTRODUCTORY REMARKS.

To study and assess the traversal and occupational hazards of dispersed V-agent, the CWL Traversal Program was implemented by direction of the Deputy Commander for Scientific Activities, U.S. Army Chemical Warfare Laboratories. This program is divided into three related phases: Phase A - Persistence and Decontamination - determining the persistence of V-agent and factors governing this persistence; Phase B - "Pick-Up" - determining the quantity of agent transferred to personnel traversing or occupying contaminated areas; and Phase C - Casualty Production - estimating the effectiveness of "pick-up" in producing casualties. These phases are detailed in a CWL document, subject: The Casualty Producing Capability of V-agent when Dispersed as Terrain Contaminant (C), dated 25 March 1957.

This report is concerned primarily with the results of the areal traversal trials conducted under Phase B of the Traversal Program. These trials were designed to provide information relative to the transferability of V-agent to the uniforms of troops crawling across contaminated terrain (ie, simulating the traversal of open areas under fire at night). No tests employing the direct measurement of V-agent pick-up on the clothing of test subjects were considered because of the hazard to participating personnel. Therefore, the objectives of this phase of the program had to be satisfied by estimating the pick-up of V-agent from the results of Field Test No. 1324 and Test Plan No. 29 which were prepared and executed by Test Division. Field Test No. 1324 provided for the conduct of a series of "creep and crawl" trials to determine the quantity of simulant picked up on the uniforms of test subjects crawling across terrain on which simulant was disseminated in specified ranges of contamination densities and particle sizes. Test Plan No. 29 provided for a series of trials to establish (1) the relative transferability of simulant from the ground to both man and a cloth-covered roller, and (2) the relative transferability of agent and simulant from the ground to the roller. The resulting man-to-roller and agent-to-simulant data provided the basis for estimating the quantities of agent that would have been picked up by test subjects had V-agent instead of simulant been used in the "creep and crawl" trials.

The pick-up due to other activities in the field is yet to be studied. However, as a result of a series of field trials conducted at Army Chemical Center in March 1954, a considerable quantity of such data is available. This information is reported in CRLR 500, subject: Liquid Agent Picked Up by Troops Traversing Areas Contaminated with CW Agents, dated 7 December 1955. It is planned to study the extent to which this large body of information is applicable to the present problem.

All data relative to "pick-up" accumulated since the inception of this phase of the program in July 1957 are incorporated in this report. These results and the inferences drawn therefrom are regarded as interim in character, and as such are issued for temporary or limited use only. They may be superseded when additional data are received and evaluated.

IV. (C) EXPERIMENTAL.

4. "Crawl and Crawl" Trials.

a. Procedure.

The "crawl and crawl" trials, as prescribed in the test directive for Field Test No. 1324, were conducted on "J" Field, Army Chemical Center, on a site selected for the uniformity of vegetation which covered about 90% of the terrain surface. This area was divided into test strips [illegible] wide by 50 ft long. To insure similar terrain conditions for each trial, the grass on these strips was maintained at 3 to 6 in. In each trial, five of six test strips were contaminated with simulant (dibutyl phthalate dyed with Fisher Red) disseminated uniformly by means of a mechanical device. The spinning-disk aerosolizer (figure 1, appendix C) was employed for the distribution of small particles, whereas the multijet disperser (figure 2, appendix C) was employed for large particles. The uniformity of the contamination and the particle size distribution were determined from sampling cans and 4x6 paper placed strategically along each test strip. As soon as practicable (2½ to 3 min) after the dissemination of simulant, each test strip was traversed by two test subjects*, each crawling as if he were advancing under fire along an assigned path one a side. For this reversal, the dress consisted of U.S. Army fatigue uniforms over cotton drawers and long-sleeved undershirts; the test subjects also wore cotton gloves and helmet liners, and carried simulated (wooden) rifles. As soon as the 50-meter traversal was effected, all clothing was removed, and traces of simulant on the rifles, helmet liners and skin were swabbed with solvent. The skin and all swabs were furnished for analysis at the close of the trial. Items of clothing were photographed and sectioned prior to being analyzed for the quantities of simulant picked up on the various parts of the uniform.

*In the last four trials, a cloth-covered roller (figure 4, appendix C), was substituted for the second test subject traversing 3 of the 5 test strips. (cf, par 3 b 1).

2. Results.

During the period of July 1957 through May 1958, a total of eleven "creep and crawl" trials were conducted. In these trials simulant was disseminated in densities ranging from 0.3 to 13.6 g/sq m with particle size distributions having mass median diameters of about 90 to 3,100 microns. The data derived from these trials, representing a total of 103 individual traversals, are presented in tables 1 through 11, appendix A. Photographs of the representative distributions of simulant on clothing are included as figures 5 through 7, appendix C.

The quantity of simulant picked up on the uniforms of test subjects was found to be directly proportional to the density of the disseminated agent. The average pick-up was equal to 1% of the contamination density per unit length of the traversal path, or as alternately phrased, equal to 0.01 times the contamination density times the distance traversed (viz, for the 50-meter traversal during these "creep and crawl" trials, the average pick-up was numerically equal to one-half the contamination density). This relationship, which appeared to hold equally well over the entire range of densities employed, appeared to be independent of the particle size of the dispersed agent.

In general the simulant on the uniforms was located, in descending order of contamination, on the gloves, lower abdomen, elbows, knees, forearms, upper abdomen, thighs, shins, chest, and upper arms. This distribution of simulant is presented graphically in figures 1 and 2, appendix B, and is summarized in the table below. Variations in pick-up and distribution of the simulant on uniforms were attributed to differences in the manner in which individuals crawled; they could not be ascribed to the physical characteristics (ie, height and weight) of the subjects nor to the traversal time.

DISTRIBUTION OF SIMULANT ON CONTAMINATED UNIFORMS

Location	Average Percentage of Total Pick-Up
Jacket	
Chest, left	3.0
Chest, right	1.9
Upper Abdomen, left	6.5
Upper Abdomen, right	3.8
Upper Arm, left	1.3
Upper Arm, right	0.8
Elbow, left	7.6
Elbow, right	5.1
Forearm, left	6.0
Forearm, right	4.4
Trousers	
Lower Abdomen, left	8.1
Lower Abdomen, right	6.4
Thigh, left	5.7
Thigh, right	4.5
Knee, left	6.1
Knee, right	4.7
Lower Leg, left	3.4
Lower Leg, right	2.6
Gloves	
Left	8.0
Right	9.9

In three of the eleven trials, the pick-up deviated significantly from characteristic results. In trials 5 and 7 roughly half the anticipated quantity of simulant was picked up. This reduced pick-up was attributed to the frozen terrain during trial 5, and to the dead and very dry vegetation covering the area during trial 7. In trial 11 the use of a different dye in preparing the simulant was assumed responsible for the pick-up which was apparently twice the anticipated quantity.

B. "Man-Vs-Roller" Trials.

1. Procedure.

In accordance with Test Plan No. 29, as amended, the test site on Graces Quarters was divided into 20 adjacent test strips, 2 meters by 25 meters, which were numbered consecutively. To eliminate grass height as a variable in these trials, the grass was mowed to 3 in. on days of test. On the ten

odd-numbered strips simulant (dibutyl phthalate dyed red) was disseminated uniformly in a specified range of densities in both large and small particle sizes. Large droplet sizes (about 3,000 microns) were generated by the multijet disperser (figure 2, appendix C); small particle sizes (about 500 microns), by the same device equipped with air-operated spray nozzles (figure 3, appendix C). As soon as practicable after the dissemination of simulant (ie, about 15 min, the time to collect the contents of sampling pans used to check the uniformity of dispersion), each test strip was traversed as in the "creep and crawl" trials described in par A, 1, above, however, with the cloth-covered roller substituting for the second test subject. The quantities of simulant picked up on both clothing and cloth of the roller were determined. (Note: One test subject was employed throughout these trials. His selection for these trials was based on a cursory review of "creep and crawl" data which indicated that his manner of crawling resulted in pick-up most representative of the average of all test subjects.)

2. Results.

The results of these ten trials conducted in June 1958 to establish the relative transferability of simulant from terrain to the uniform of a crawling test subject and to the cloth-covered roller are presented in tables 12 and 13, appendix A. These tables also include supplementary data derived from "creep and crawl" trials (see footnote b b).

The average quantity of simulant picked up on the uniform of the test subject was somewhat in excess of 1% of the contamination density per unit length of the traversal path. This pick-up was not significantly different from the results derived from "creep and crawl" trials conducted on "M" Field (cf par A, 2, above).

A good correlation was obtained between the comparative quantities of simulant picked up by man and the cloth-covered roller; ie, ratio of simulant picked up by the roller to that picked up by man appeared to be essentially constant and independent of particle size. The same relationship was found in the supplementary trials conducted in conjunction with "creep and crawl" tests on "M" Field.

Figure 3, appendix B, indicates that smaller particles are somewhat more transferable from the terrain to cloth than are the larger particles. This relationship between particle size and pick-up was not detectable from "creep and crawl" data because of the overshadowing effects of minor differences in crawling techniques of individual test subjects, and differences in terrain characteristics during the 10-mo test period.

C. "Agent-Vs-Simulant" Trials.

1. Procedure.

As prescribed in Test Plan No. 29, the trials described in par B, 1, above, were rerun on the even-numbered test strips with VX substituted for

simulant and with the traversal of the strips by test subjects eliminated. As soon as practicable after the dispersion of toxic agent, the roller, covered with two layers of cotton sateen cloth, was rolled along the left side of the strip. In a like manner, the right side of the strip was traversed by the roller on the following day. In both cases, as soon as the traversal was effected, each layer of cloth was removed from the roller and analyzed for agent picked-up. The procedure of analysis used was the DB3 method.

2. Results.

The results of 10 trials conducted in July and August 1958 to determine the quantity of V-agent picked up from contaminated terrain by the cloth-covered roller are included as table 14, appendix A.

When the quantity of agent picked up on the roller traversing the test strip within an hour after contamination was compared with the quantity of simulant picked up under similar conditions in trials described in par B, above, it was found that the relative transferability of agent decreased with increasing contamination. This relationship is graphically depicted in figure 4, appendix B, where the ratio of agent to simulant pick-up is plotted against contamination density on semi-logarithmic paper to produce a straight line whose equation is $R = \exp -(0.06\ C)$; where R is the ratio of agent to simulant pick-up; and C, the contamination density in g/sq m. This line was based on limited data, and the equation, therefore, requires substantiation by further testing.

As was the case with simulant, agent disseminated in smaller particles was picked up somewhat more efficiently by the roller on the first traversal than was agent disseminated in the larger droplets. Whereas the pick-up of simulant was found to be directly proportional to the contamination density (within test limits), the pick-up of agent leveled off or became less efficient with increasing ground contamination.

The penetration of agent from the top layer of cloth to the under layer was not significant during the first traversal, amounting to an average of about 2%. However, on the second traversals of trials 6 through 10 performed on wet terrain, the increased percentage of agent on the undercloth indicated the aid to penetration provided by moisture.

The quantity of agent picked up on the roller traversing the contaminated area one day after the dispersion of V-agent was found to average approximately 4% of that picked up on a roller traversing the area within an hour after contamination is effected. This indicates the rapid decline in agent available for transfer to troops traversing the area.

V. (C) DISCUSSION.

The over-all objective of the Traversal Program is the estimation of the casualty producing capabilities of V-agent dispersed as a ground contaminant. The performance of the trials covered in this report provided agent pick-up data which, when coupled with information relative to the percutaneous toxicity of the agent and its penetration through treated and untreated fabrics, permit an estimation of

APPENDIX A

TABULATED DATA

TABLE 1

CREEP AND CRAWL TRIAL NO. 1

Date: 15 July 1957

Test Subject	A	B	C	D	E	F	G	H	I	J
Height (in.)	71	69	75	67	70	71	67	69	65	69
Weight (lb.)	165	155	175	165	190	210	135	175	150	185
Uniform No.	38	36	40	38	44	48	32	40	36	42
Contamination Density (g./sq.m.)	0.330	0.330	0.315	0.315	0.315	0.325	0.305	0.305	0.295	0.295
Particle Size (μ, MMD)	560	560	505	505	455	455	415	415	290	280
Traversal Time (min. - sec.)	3-52	3-52	3-52	3-52	2-45	2-45	2-45	2-45	4-16	4-1
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms									
Jacket										
Chest, left	3	7	2	10	2	2	7	0	2	6
Chest, right	4	3	2	7	0	0	5	0	0	6
Upper Abdomen, left	7	13	5	9	4	6	8	17	3	6
Upper Abdomen, right	10	4	5	7	2	3	8	14	0	5
Upper Arm, left	0	0	0	0	0	0	0	0	0	0
Upper Arm, right	0	0	0	0	0	0	0	0	0	0
Elbow, left	6	6	7	7	6	5	18	11	15	8
Elbow, right	3	5	5	4	4	1	7	3	2	4
Forearm, left	7	7	13	9	2	4	11	8	5	13
Forearm, right	2	6	9	5	2	1	7	4	7	9
Trousers										
Lower Abdomen, left	11	8	16	6	12	9	9	17	8	6
Lower Abdomen, right	12	1	9	11	12	7	15	14	5	10
Thigh, left	9	6	16	6	9	10	13	15	11	7
Thigh, right	9	3	10	5	7	7	8	13	6	7
Knee, left	6	7	5	4	2	7	9	8	8	9
Knee, right	6	3	5	6	6	6	7	8	8	6
Lower Leg, left	0	4	1	0	0	5	0	5	3	0
Lower Leg, right	0	2	0	6	0	0	1	5	1	0
Gloves										
Left	16	19	9	15	11	14	26	13	13	12
Right	16	15	6	11	8	13	26	19	11	16
Miscellaneous										
Rifle	3.2	3.4	0.5	2.3	2.4	0.4	1.8	2.9	1.1	0.9
Underwear										
Cuff, left	0.7					0.4	3.8	2.9	0.5	
Cuff, right	0.6			0.8	1.8	1.1	3.4		4.8	1.0
TOTALS*	127	116	124	130	90	100	185	186	108	109
Pick-Up Factor**	0.770	0.703	0.719	0.754	0.554	0.615	1.214	1.220	0.732	0.875

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.

**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

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TABLE 1

CREEP AND CRAWL TRIAL NO. 1

Date: 15 July 1957

Test Subject	A	B	C	D	E	F	G	H	I	J
Height (in.)	71	69	75	67	70	71	67	69	65	69
Weight (lbs.)	165	135	195	165	190	210	135	175	150	195
Uniform No.	38	36	44	38	42	48	31	40	35	45
Contamination Density (gm./sq.m.)	0.330	0.330	0.325	0.325	0.325	0.325	0.305	0.305	0.295	0.295
Particle Size (μ, MMD)	560	560	505	505	455	455	415	415	290	280
Traversal Time (min. - sec.)	3-52	3-52	3-52	3-52	2-45	2-45	2-45	2-45	4-16	4-1
Location of Pick-Up	Simulant Picked up (gm.) on Various Sections of Uniforms									
Jacket										
Chest, left	3	7	2	10	2	2	7	0	2	6
Chest, right	4	3	9	7	0	0	5	0	0	6
Upper Abdomen, left	7	12	5	9	4	6	8	17	3	6
Upper Abdomen, right	10	4	5	7	2	3	8	14	0	5
Upper Arm, left	0	0	0	0	0	0	0	0	0	0
Upper Arm, right	0	0	0	0	0	0	0	0	0	0
Elbow, left	0	0	2	0	0	5	18	11	15	8
Elbow, right	6	6	7	4	6	1	7	3	2	4
Forearm, left	2	5	5	4	1	4	11	8	5	13
Forearm, right	7	7	12	8	2	1	7	4	2	9
	2	6	9	5	2					
Trousers										
Lower Abdomen, left	11	2	16	6	12	9	9	17	8	6
Lower Abdomen, right	12	1	9	11	12	7	15	14	5	10
Thigh, left	9	6	16	6	9	10	13	16	15	2
Thigh, right	9	3	10	5	7	7	9	18	4	7
Knee, left	6	7	5	4	3	7	2	8	8	8
Knee, right	6	3	5	6	6	6	7	8	8	6
Lower Leg, left	0	4	1	0	0	5	0	5	3	2
Lower Leg, right	0	2	0	6	0	0	1	5	1	0
Gloves										
Left	16	12	2	15	11	14	26	13	13	12
Right	16	15	6	11	8	13	26	12	11	16
Miscellaneous										
Rifle	3.2	3.4	0.5	2.3	2.4	0.4	1.8	2.9	1.1	0.9
Underwear						0.4	3.8	2.9	0.5	
Cuff, left	0.7					1.4	3.4		4.8	1.0
Cuff, right	0.6			0.8	1.8					
TOTAL*	127	116	124	130	90	100	185	186	108	109
Pick-Up Factor**	0.775	0.703	0.719	0.754	0.554	0.615	1.214	1.220	0.732	0.875

Remarks:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

2

TABLE 2

CRAWL AND CRAWL TRIAL NO. 2

16 July 1957

Test Subject	C	A	J	D	G	L	F	H	B	I
Height (in.)	75	71	69	67	67	70	71	69	69	65
Weight (lb.)	195	165	185	165	135	180	210	175	155	150
Uniform No.	10	44	11	56	2	59	47	48	15	51
Contamination Density (g./sq.m.)	1.64	1.64	2.24	2.24	1.95	1.95	1.71	1.71	5.55	5.55
Particle Size (μ, MMD)	505	505	505	505	415	415	350	350	420	420
Traversal Time (min. - sec.)	2-51	2-24	3-56	3-46	3-12	3-23	3-54	3-52	2-15	4-48
Location of Pickup	Simulant Picked up (mg.) on Various Sections of Uniform									
Jacket										
Chest, left	6	17	101	99	50	64	56	25	105	59
Chest, right	7	18	62	39	31	36	62	52	30	35
Upper Abdomen, left	20	35	69	67	61	75	84	174	177	67
Upper Abdomen, right	20	16	32	33	40	49	96	70	60	92
Upper Arm, left	8	2	26	27	11	3	12	9	77	69
Upper Arm, right	2	3	12	17	13	4	11	10	24	27
Elbow, left	26	14	62	76	50	37	71	51	187	241
Elbow, right	27	21	46	47	19	33	31	59	77	107
Forearm, left	66	45	142	172	115	100	96	107	419	315
Forearm, right	58	30	127	63	30	85	55	54	99	131
Trousers										
Lower Abdomen, left	62	49	93	98	72	119	104	84	236	118
Lower Abdomen, right	42	68	52	55	90	99	112	92	98	263
Thigh, left	80	34	70	56	91	48	119	50	129	259
Thigh, right	52	37	45	32	36	45	77	48	83	119
Knee, left	77	30	41	32	69	37	35	33	74	145
Knee, right	36	27	36	33	28	31	17	32	55	119
Lower Leg, left	34	71	41	24	79	31	40	61	149	137
Lower Leg, right	30	29	45	22	28	28	24	40	62	81
Gloves										
Left	55	68	52	77	85	110	233	75	294	209
Right	57	59	58	67	138	102	93	102	118	202
Miscellaneous										
Rifle	5	9	6	11	19	7	12	19	17	32
Underwear										
Cuff, left	2.6	0.3	0.4	0.0	0.1	0.3	8.3	0.2		0.4
Cuff, right	0.6	1.8	0.5	3.0		11.3	8.4	8.2		14.3
Skin		0.1	0.8	1.9	0.6	1.4	1.9	0.1	0.7	1.0
TOTAL*	767	673	1197	1072	1037	1210	1122	1150	2553	2848
Pick-Up Factor**	0.936	0.822	1.069	0.957	1.064	1.241	1.663	1.316	0.919	1.025

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pickup factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 2

CRAWL AND CRAWL TRIAL NO. 2

16 July 1957

Test Subject	C	A	J	D	G	L	F	H	B	I
Height (in.)	75	71	69	67	67	70	71	69	69	65
Weight (lb.)	195	165	185	165	135	180	210	175	155	150
Uniform No.	10	44	11	56	2	50	47	48	15	51
Contamination Density (g./sq.m.)	1.64	1.64	2.24	2.24	1.95	1.95	1.71	1.71	5.55	5.55
Particle Size (μ, MMD)	505	505	505	505	415	415	350	350	420	420
Traversal Time (min. - sec.)	3-51	2-24	3-56	3-46	3-12	3-22	3-54	3-52	2-15	4-48
Location of Pick-Up	**Simulant Picked up (mg.) on Various Sections of Uniform**									
Jacket										
Chest, left	6	17	104	99	50	64	56	25	105	59
Chest, right	7	15	62	39	31	36	62	52	30	25
Upper Abdomen, left	20	35	69	67	61	75	84	104	177	67
Upper Abdomen, right	20	46	32	33	40	42	96	70	60	92
Upper Arm, left	8	2	26	27	11	3	12	9	77	69
Upper Arm, right	2	3	19	17	13	4	13	10	24	27
Elbow, left	26	34	62	76	50	77	72	51	187	241
Elbow, right	27	21	48	47	19	73	31	58	77	107
Forearm, left	66	45	142	122	105	100	86	107	419	315
Forearm, right	58	30	107	63	30	85	55	54	99	131
Trousers										
Lower Abdomen, left	62	49	83	70	72	11	104	84	236	118
Lower Abdomen, right	42	68	58	52	90	93	112	82	98	263
Thigh, left	80	34	70	56	81	49	119	80	129	259
Thigh, right	52	37	45	32	36	45	77	48	83	119
Knee, left	77	30	41	32	62	37	35	33	74	145
Knee, right	38	27	36	33	28	31	17	32	55	117
Lower Leg, left	34	21	41	24	79	31	40	61	149	137
Lower Leg, right	30	29	45	32	28	28	24	40	62	81
Gloves										
Left	55	68	52	77	85	110	223	75	294	269
Right	57	59	58	67	138	102	93	102	118	202
Miscellaneous										
Rifle	5	9	6	11	10	7	12	12	17	32
Underwear										
Cuff, left	2.6	0.3	0.4	0.0	0.1	0.3	8.3	0.2		0.4
Cuff, right	0.6	1.8	0.5	3.0		11.3	8.4	8.2		14.3
Skin	.	0.1	0.2	1.9	0.6	1.4	1.9	0.1	0.7	1.0
TOTALS	767	673	1197	1072	1037	1210	1122	1150	2553	2848
Pick-Up Factor**	0.936	0.822	1.069	0.957	1.064	1.241	1.663	1.346	0.919	1.025

2

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

1

TABLE 3

CREEP AND CRAWL TRIAL NO. 3

18 July 1957

Test Subject	H	I	C	E	F	B	D	G	A	J
Height (in.)	69	65	75	70	71	69	67	67	71	69
Weight (lb.)	175	150	195	180	210	155	165	135	165	185
Uniform No.	39	65	43	68	66	45	70	6	41	17
Contamination Density (g./sq.m.)	9.33	9.33	11.5	11.5	11.4	11.4	9.76	9.76	12.2	12.2
Particle Size (μ, MMD)	365	365	325	325	365	325	325	325	390	390
Traversal Time (min. - sec.)	6-12	7-19	5-19	5-28	3-9	3-11	3-23	2-43	3-40	5-0
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms									
Jacket										
Chest, left	212	36	85	326	261	236	830	168	335	296
Chest, right	75	24	116	173	109	119	419	203	334	396
Upper Abdomen, left	484	52	234	248	614	243	484	215	518	545
Upper Abdomen, right	220	34	160	214	387	130	236	284	517	288
Upper Arm, left	275	50	62	61	230	164	109	82	185	314
Upper Arm, right	25	9	43	55	37	81	62	60	65	229
Elbow, left	484	232	289	291	358	126	289	163	369	415
Elbow, right	160	65	118	130	190	220	207	111	141	329
Forearm, left	297	209	495	329	623	235	383	239	493	700
Forearm, right	151	207	159	243	253	91	353	136	189	758
Trousers										
Lower Abdomen, left	143	116	759	417	726	219	376	185	746	382
Lower Abdomen, right	179	151	705	636	567	298	388	425	605	156
Thigh, left	306	157	91	260	642	81	154	136	393	61
Thigh, right	134	86	255	234	233	130	118	169	278	282
Knee, left	146	72	242	242	148	35	306	101	383	199
Knee, right	89	89	136	156	164	86	209	131	229	196
Lower Leg, left	219	74	217	154	295	62	189	103	461	119
Lower Leg, right	111	98	161	171	140	149	134	192	240	146
Gloves										
Left	315	306	151	110	360	306	759	600	867	526
Right	126	267	217	160	730	550	366	856	954	1044
Miscellaneous										
Rifle	25		37	94	34		40	76	59	92
Underwear										
Cuff, left	0.8		11.4	26.0	0.8		5.0	9.6		1.9
Cuff, right	51.6	73	1.1	129.0	0.4			52.6	2.0	43.6
Skin	0.1	1.4	1.1	2.4	4.2	0.5	7.7	2.7	5.1	0.8
TOTALS	4781	3333	5199	5050	7331	3844	6214	4561	8218	7450
Pick-Up Factor**	1.015	0.499	0.904	0.879	1.291	0.673	1.274	0.935	1.359	1.222

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 3

CREEP AND CRAWL TRIAL NO. 3

18 July 1957

Test Subject	H	I	C	E	F	B	D	G	A	J
Height (in.)	69	65	75	70	71	69	67	67	71	69
Weight (lb.)	175	150	195	180	210	155	165	135	165	135
Uniform No.	69	65	43	68	66	44	70	6	44	17
Contamination Density (g./sq.m.)	9.33	9.33	11.5	11.5	11.5	11.4	9.76	9.76	12.2	12.2
Particle Size (μ, MMD)	365	365	325	325	365	325	325	325	390	390
Traversal Time (min. - sec.)	6-12	7-19	5-19	5-20	3-9	3-11	3-23	2-48	3-40	5-0
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms									
Jacket										
Chest, left	213	36	85	326	261	236	230	188	335	296
Chest, right	75	24	115	173	179	119	119	203	314	396
Upper Abdomen, left	498	52	234	248	611	243	484	215	618	545
Upper Abdomen, right	220	34	160	214	387	150	236	284	517	288
Upper Arm, left	275	50	62	61	230	164	109	82	195	314
Upper Arm, right	25	9	43	55	37	81	62	60	65	229
Elbow, left	484	232	249	291	352	126	249	163	368	415
Elbow, right	160	65	148	130	190	220	207	111	141	399
Forearm, left	297	209	195	329	523	235	383	239	493	700
Forearm, right	151	203	157	243	253	91	253	136	189	758
Trousers										
Lower Abdomen, left	443	146	248	417	726	214	326	185	746	182
Lower Abdomen, right	179	154	105	236	567	298	188	125	605	156
Thigh, left	309	157	212	260	642	84	194	136	393	61
Thigh, right	114	86	255	214	233	140	118	169	278	282
Knee, left	146	73	242	242	118	35	306	101	383	199
Knee, right	69	51	140	156	164	86	209	131	289	196
Lower Leg, left	219	114	217	154	295	62	189	101	461	119
Lower Leg, right	111	94	161	121	140	149	134	192	260	146
Gloves										
Left	315	306	240	410	360	306	752	600	867	526
Right	496	247	217	449	730	550	366	856	954	1014
Miscellaneous										
Rifle	25		37	24	34		40	76	59	92
Underwear										
Cuff, left	0.8		11.4	76.0	0.8		5.0	9.6		1.9
Cuff, right	51.6	73	1.1	129.0	6.4			52.6	2.0	49.6
Skin	0.1	1.4	1.1	7.4	4.2	0.5	7.7	2.7	5.1	0.8
TOTALS	4761	2333	5199	5959	7331	3844	6214	4501	8218	7459
Pick-Up Factor**	1.035	0.499	0.904	0.879	1.291	0.672	1.274	0.936	1.359	1.222

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up by the uniform per meter of traversal.

1

CONFIDENTIAL

TABLE 4

[illegible] AND [illegible] FIELD NO. [illegible]

[illegible] October 1957

Test Subject	[illegible]	J	C	[illegible]	D	F	[illegible]	K	L	[illegible]
Height (in.)	69	69	75	[illegible]	67	71	70	[illegible]	60	71
Weight (lb.)	175	185	[illegible]	155	165	[illegible]	[illegible]	200	160	165
[illegible]	84	[illegible]	21	24	27	81	95	83	25	28
Contamination Density ([illegible]/sq.cm)	[illegible]	2.67	[illegible]	0.94	[illegible]	1.28	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] (μ, [illegible])	595	595	605	605	590	590	660	660	700	700
[illegible]	[illegible]	2-10	[illegible]	2-25	2-20	[illegible]	2-20	[illegible]	2-20	[illegible]
Location of Pick-up	[illegible]									
[illegible]										
[illegible], left	55	114	[illegible]	[illegible]	43	21	[illegible]	[illegible]	19	21
[illegible]	25	65	12	24	22	22	71	[illegible]	11	[illegible]
[illegible]	[illegible]	[illegible]	11	[illegible]	[illegible]	[illegible]	71	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	75	13	[illegible]	13	27	4	[illegible]	35	[illegible]
[illegible], left	[illegible]	0	0	0	[illegible]	0	0	0	5	0
[illegible]	0	0	[illegible]	0	0	0	0	0	0	0
[illegible]	[illegible]	[illegible]	15	25	46	[illegible]	17	74	42	13
[illegible], right	22	[illegible]	[illegible]	7	[illegible]	25	[illegible]	[illegible]	33	[illegible]
[illegible]	[illegible]	[illegible]	30	[illegible]	[illegible]	[illegible]	136	[illegible]	[illegible]	51
[illegible]	30	51	[illegible]	12	15	[illegible]	[illegible]	36	37	[illegible]
[illegible]										
[illegible], left	104	[illegible]	[illegible]	[illegible]	45	80	155	[illegible]	72	[illegible]
[illegible], right	113	125	23	25	17	[illegible]	[illegible]	[illegible]	62	[illegible]
[illegible]	94	[illegible]	[illegible]	71	[illegible]	15	94	[illegible]	79	[illegible]
[illegible]	84	[illegible]	29	14	12	37	[illegible]	[illegible]	[illegible]	57
[illegible]	[illegible]	69	31	[illegible]	[illegible]	11	[illegible]	111	77	75
[illegible]	[illegible]	[illegible]	[illegible]	13	15	34	66	[illegible]	[illegible]	55
[illegible]	59	[illegible]	[illegible]	[illegible]	[illegible]	15	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	24	59	12	13	15	[illegible]	32	[illegible]	32	11
[illegible]	77	101	[illegible]	[illegible]	[illegible]	34	57	71	[illegible]	[illegible]
[illegible]	77	82	33	14	16	15	45	[illegible]	75	[illegible]
[illegible]	9	4	1	1	2	3	4	2	2	2
[illegible] wear										
[illegible], left	1.8	5.3	[illegible]	2.7	1.5	0.4	4.1	1.6	2.4	1.8
[illegible], right	[illegible]	2.0	[illegible]	0.4	0.6	1.9	1.1	2.1	2.0	3.1
Total*	1477	1712	394	368	493	432	1342	1402	1045	944
Pick-Up Factor**	1.106	1.282	0.338	0.283	0.770	0.675	0.579	0.917	1.035	0.632

Remarks:

*Total quantity of simulant picked up on jacket, trousers, and gloves.

**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 4

CREEP AND CRAWL TRIAL NO. 4

29 October 1957

Test Subject	A	B	C	D	E	F	G	H	I	J
Height (in.)	69	69	75	69	67	71	70	69	60	71
Weight (lb.)	175	155	195	155	165	190	200	160	105	185
Uniform No.	84	89	91	94	97	81	85	83	95	98
Contamination Density (g./sq.m.)	2.67	2.67	0.91	0.91	1.23	1.38	3.06	3.06	3.03	3.03
Particle Size (μ, MMD)	595	595	605	605	590	590	660	660	700	700
Traversal Time (min. - sec.)	2-0	2-10	1-25	3-35	2-20	2-15	2-20	2-10	2-30	2-0
Location of Pick-up	Simulant Picked up (mg.) on Various Portions of Uniform									
Jacket										
Chest, left	55	114	16	21	13	21	19	35	18	21
Chest, right	28	65	17	21	22	22	71	11	11	7
Upper abdomen, left	181	119	11	21	11	19	71	15	10	37
Upper abdomen, right	70	75	13	19	13	25	47	30	36	22
Upper Arm, left	0	0	0	0	6	0	0	0	5	0
Upper Arm, right	0	0	0	0	0	0	0	0	0	0
Elbow, left	109	166	15	25	16	19	47	76	12	19
Elbow, right	22	125	19	7	11	25	69	64	33	37
Forearm, left	49	179	20	14	37	30	196	114	26	61
Forearm, right	30	51	13	12	15	19	62	36	37	37
Trousers										
Lower abdomen, left	104	106	19	28	16	20	155	104	72	63
Lower abdomen, right	113	128	23	25	19	27	136	63	62	66
Thigh, left	94	65	26	21	29	15	94	56	79	31
Thigh, right	31	57	29	11	12	27	67	47	41	52
Knee, left	142	69	21	25	52	11	117	111	77	73
Knee, right	96	91	19	13	15	34	66	96	63	55
Lower leg, left	52	47	16	15	18	15	58	43	37	43
Lower leg, right	24	58	12	13	15	19	30	45	32	41
Shoe	77	101	13	25	23	24	57	71	103	39
Sock	77	82	33	14	16	45	46	85	75	79
Glove Inserts										
Right	2	4	1	1	2	3	4	2	2	2
Underwear										
Chest, left	1.8	5.3	2.0	0.7	1.5	0.4	4.1	1.6	2.4	1.8
Chest, right	2.0	2.0	2.0	0.4	0.6	1.9	1.1	2.1	2.0	3.1
Total*	1477	1712	394	368	493	432	1342	1402	1045	844
Pick-up Factor**	1.106	1.282	0.438	0.283	0.770	0.675	0.978	0.917	1.035	0.632

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

2

TABLE 5

CREEP AND CRAWL TRIAL NO. 5

10 February 1953

Test Subject	B	M	G	C	M	K	F	E
Height (in.)	69	72	67	75	67	69	72	70
Weight (lb.)	155	200	135	195	135	200	190	180
Uniform No.	8	77	7	57	78	63	87	86
Contamination Density (g./sq.m.)	5.66	5.66	6.29	6.29	6.59	6.59	7.09	7.09
Particle Size (μ, MMD)	1550	1500	1400	1400	1100	1100	1300	1300
Traversal Time (min. - sec.)	3-12	4-22	3-18	3-30	5-10	5-40	4-13	4-18
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniform							
Jacket								
Chest, left	8	5	39	4	5	91	9	15
Chest, right	9	3	31	3	8	43	6	18
Upper Abdomen, left	41	21	105	26	11	206	36	31
Upper Abdomen, right	23	14	135	8	25	101	12	45
Upper Arm, left	8	4	6	5	1	32	10	35
Upper Arm, right	15	5	55	13	4	9	6	4
Elbow, left	26	32	105	19	49	302	100	92
Elbow, right	26	27	49	45	70	79	51	97
Forearm, left	45	24	55	77	95	129	61	70
Forearm, right	55	29	106	98	179	54	49	109
Trousers								
Lower Abdomen, left	100	119	110	191	98	380	226	185
Lower Abdomen, right	83	100	210	216	103	79	50	83
Thigh, left	40	89	59	86	100	309	138	116
Thigh, right	42	117	58	112	38	117	51	130
Knee, left	18	51	67	61	101	284	79	87
Knee, right	27	86	90	67	119	103	66	69
Lower Leg, left	11	25	45	86	22	54	55	88
Lower Leg, right	11	27	45	95	22	31	23	29
Gloves								
Left	64	13	123	137	61	162	64	60
Right	67	89	106	128	92	135	89	37
Miscellaneous								
Rifle	6	3	7	5	4	10	3	6
Underwear								
Cuff, left					1	2	1	1
Cuff, right					10	1	8	1
Elbow					126	85	7	
Skin			0.4		0.2	0.3		0.4
TOTALS	719	882	1582	1523	1202	2700	1175	1350
Pick-Up Factor**	0.254	0.311	0.503	0.484	0.364	0.818	0.331	0.381

REMARKS:

NOTE: Trial performed on frozen terrain at ground temperature 0°F.

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 5

CREEP AND CRAWL TRIAL NO. 5

10 February 1958

Test Subject	B	M	G	C	N	K	O	E
Height (in.)	69	72	67	75	67	69	72	70
Weight (lb.)	155	200	135	195	135	200	190	180
Uniform No.	8	77	7	57	78	63	87	86
Contamination Density (g./sq.m.)	5.66	5.66	6.29	6.29	6.59	6.59	7.09	7.09
Particle Size (μ, MMD)	1550	1500	1400	1400	1100	1100	1300	1300
Traversal Time (min. - sec.)	3-12	4-22	3-18	3-30	5-10	5-40	4-18	4-18
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms							
Jacket								
Chest, left	8	5	39	4	5	91	9	15
Chest, right	9	3	31	3	8	43	6	18
Upper Abdomen, left	11	21	105	24	11	206	36	31
Upper Abdomen, right	23	14	175	26	25	101	12	45
Upper Arm, left	8	4	6	5	1	32	10	35
Upper Arm, right	15	5	55	13	4	9	6	4
Elbow, left	26	22	105	42	49	302	100	92
Elbow, right	26	27	49	45	70	79	51	97
Forearm, left	45	24	55	77	95	129	61	70
Forearm, right	55	29	106	98	179	54	49	109
Trousers								
Lower Abdomen, Left	100	119	110	191	98	380	226	185
Lower Abdomen, right	83	100	210	210	103	79	50	83
Thigh, left	60	89	52	86	100	309	134	116
Thigh, right	42	117	58	112	38	117	51	130
Knee, left	18	51	67	61	101	284	79	87
Knee, right	27	88	90	67	119	103	66	69
Lower Leg, left	11	25	45	86	22	54	55	88
Lower Leg, right	11	27	45	95	22	31	23	29
Gloves								
Left	64	13	123	137	61	162	64	60
Right	67	89	106	128	92	135	89	37
Miscellaneous								
Rifle	6	3	7	5	4	10	3	6
Underwear								
Cuff, left					1	2	1	1
Cuff, right					10	1	8	1
Elbow					126	85	7	
Skin			0.4		0.2	0.3		0.4
TOTAL*	719	882	1582	1523	1202	2700	1175	1350
Pick-Up Factor**	0.254	0.311	0.503	0.484	0.364	0.818	0.331	0.381

REMARKS:

NOTE: Trial performed on frozen terrain at ground temperature 0°F.

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

2

TABLE 5

CREEP AND CRAWL TRIAL NO. 5

10 February 1958

Test Subject	B	H	G	C	N	K	O	E
Height (in.)	69	72	67	75	67	69	72	70
Weight (lb.)	155	200	135	195	135	200	190	180
Uniform No.	8	77	7	57	78	63	87	86
Contamination Density (g./sq.m.)	5.66	5.66	6.29	6.29	6.59	6.59	7.09	7.09
Particle Size (μ, MMD)	1550	1500	1100	1100	1100	1100	1300	1300
Traversal Time (min. - sec.)	3-12	4-22	3-18	3-30	5-10	5-40	4-18	4-18
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms							
Jacket								
Chest, left	8	5	39	4	5	31	9	15
Chest, right	9	3	31	3	8	43	6	18
Upper Abdomen, left	11	21	105	24	11	206	36	31
Upper Abdomen, right	23	14	175	26	25	101	12	45
Upper Arm, left	8	4	6	5	1	32	10	35
Upper Arm, right	15	5	55	13	4	9	6	4
Elbow, left	26	32	105	32	49	302	100	92
Elbow, right	26	27	49	45	70	79	51	97
Forearm, left	45	24	55	77	95	129	61	70
Forearm, right	55	29	106	98	179	54	49	109
Trousers								
Lower Abdomen, left	100	119	110	141	98	380	226	185
Lower Abdomen, right	83	100	210	216	103	79	50	83
Thigh, left	40	89	52	86	100	309	138	116
Thigh, right	43	117	58	112	38	117	51	130
Knee, left	18	51	67	61	101	284	72	87
Knee, right	27	86	70	67	118	103	66	69
Lower Leg, left	11	25	45	86	22	54	55	88
Lower Leg, right	11	27	45	95	22	31	23	29
Gloves								
Left	54	13	123	137	61	162	64	60
Right	67	89	106	128	92	135	89	37
Miscellaneous								
Rifle	6	3	7	5	4	10	3	6
Underwear								
Cuff, left					1	2	1	1
Cuff, right					10	1	8	1
Elbow					126	85	7	
Skin			0.4		0.2	0.3		0.4
TOTALS	719	882	1582	1523	1202	2700	1175	1350
Pick-Up Factors**	0.254	0.311	0.503	0.484	0.364	0.818	0.331	0.381

REMARKS:

NOTE: Trial performed on frozen terrain at ground temperature 0°F.

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 6

CREEP AND CRAWL TRIAL NO. 6

11 February 1958

Test Subject	D	C	G	I	O	K	E	B	J	F
Height (in.)	67	75	67	65	72	69	70	69	62	68
Weight (lb.)	165	195	135	150	190	200	180	155	185	198
Uniform No.	64	89	1	79	80	71	61	9	74	58
Contamination Density (g./sq.m.)	6.00	6.00	5.53	5.53	3.94	3.94	4.86	4.86	5.12	5.12
Particle Size (μ, MMD)	1300	1300	1300	1300	1100	1100	1300	1300	1300	1300
Traversal Time (min. - sec.)	3-0	4-23	6-0	7-43	4-35	5-55	4-10	2-28	6-25	8-25
Location of Pick-up	Simulant Picked-up (mg.) on Various Sections of Uniforms									
Jacket										
Chest, left	101	4	51	25	10	50	64	31	188	14
Chest, right	37	2	23	11	8	15	20	33	49	7
Upper Abdomen, left	159	32	104	210	167	198	323	248	296	338
Upper Abdomen, right	53	29	70	40	24	70	149	169	127	72
Upper Arm, left	39	0	29	55	2	18	65	28	44	77
Upper Arm, right	18	4	170	3	4	0	27	55	32	3
Elbow, left	173	125	62	192	79	44	91	76	58	119
Elbow, right	106	109	72	53	62	15	24	40	78	95
Forearm, left	107	26	108	323	85	275	154	116	203	211
Forearm, right	62	76	176	94	46	55	74	62	179	139
Trousers										
Lower Abdomen, left	233	122	226	60	331	271	89	188	200	475
Lower Abdomen, right	107	137	371	39	125	182	112	43	211	43
Thigh, left	54	88	85	137	204	159	142	150	128	438
Thigh, right	35	119	127	59	103	11	147	52	30	119
Knee, left	89	104	127	253	181	88	135	134	61	357
Knee, right	83	72	251	72	94	82	125	91	109	100
Lower Leg, left	55	33	57	116	98	148	101	92	48	224
Lower Leg, right	29	67	116	29	27	55	128	22	55	131
Gloves										
Left	137	104	202	217	10	256	99	140	170	108
Right	154	67	302	168	107	192	82	212	252	194
Miscellaneous										
Rifle	7	6	9	9	38	40	49	7	25	169
Underwear										
Cuff, left	13				12	2			1	
Cuff, r.	1				3	1	4.0		26	
Skin	4.1		0.2	3.5	1.3	6.9	0.1	2.5	1.4	
TOTAL*	1841	1330	2729	2224	1697	2174	2143	1962	2567	3143
Pick-up Factor**	0.613	0.443	0.988	0.805	0.882	1.104	0.882	0.817	1.000	1.229

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 6

CREEP AND CRAWL TRIAL NO. 6

11 February 1958

Test Subject	D	C	G	I	O	K	E	B	J	F
Height (in.)	67	75	67	65	72	69	70	69	69	68
Weight (lb.)	165	195	135	150	190	200	180	155	185	198
Uniform No.	64	89	1	79	80	71	61	9	74	58
Contamination Density (g./sq.m.)	6.00	6.00	5.53	5.53	3.94	3.94	4.86	4.86	5.12	5.12
Particle Size (μ, MMD)	1300	1300	1300	1300	1100	1100	1300	1300	1300	1300
Traversal Time (min. - sec.)	3-0	4-23	6-0	7-43	4-35	5-55	4-10	2-28	6-25	6-25
Location of Pick-Up	Simulant Picked-up (mg.) on Various Sections of Uniform									
Jacket										
Chest, left	101	4	51	25	10	50	64	31	188	14
Chest, right	37	2	23	11	8	15	20	33	49	7
Upper Abdomen, left	159	32	104	210	167	198	323	248	296	332
Upper Abdomen, right	53	29	70	40	24	70	149	169	127	72
Upper Arm, left	39	0	29	55	2	18	65	28	44	77
Upper Arm, right	18	4	170	3	4	0	27	55	32	3
Elbow, left	173	125	62	192	79	44	91	76	58	148
Elbow, right	106	109	72	53	62	15	24	40	78	35
Forearm, left	107	26	108	323	85	275	154	116	203	211
Forearm, right	62	76	176	94	46	55	74	62	179	139
Trousers										
Lower Abdomen, left	233	122	226	60	331	271	89	188	200	475
Lower Abdomen, right	107	137	371	38	125	182	112	43	211	43
Thigh, left	54	88	85	197	204	159	142	150	128	434
Thigh, right	35	119	127	59	193	11	147	52	30	139
Knee, left	89	104	127	253	181	88	135	134	51	357
Knee, right	83	72	251	72	94	82	125	91	109	100
Lower Leg, left	55	33	57	116	28	148	101	92	43	224
Lower Leg, right	29	67	116	29	27	55	118	22	55	131
Gloves										
Left	137	104	202	217	10	256	99	180	170	108
Right	164	67	302	168	107	192	82	212	251	194
Miscellaneous										
Rifle	7	6	9	9	38	40	49	7	25	169
Underwear										
Cuff, left	13				12	2			1	
Cuff, right	1				3	1	4.0		26	
Skin	2.1		0.2	2.5	1.3	6.9	0.1	2.5	1.4	
TOTAL*	1841	1330	2729	2224	1697	2174	2143	1982	2567	3143
Pick-Up Factor**	0.613	0.443	0.988	0.805	0.862	1.104	0.882	0.817	1.000	1.229

NOTES:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

2

CONFIDENTIAL

TABLE 7

CREEP AND CRAWL TRIAL NO. 7

17 March 1958

Test Subject	H	F	G	B	P	I	E	F	Q
Height (in.)	69	68	75	69	68	65	70	67	70
Weight (lbs)	175	195	195	155	195	150	180	165	160
Uniform No.	31	62	19	75	67	72	88	60	73
Contamination Density (g./sq.m.)	6.18	1.58	5.89	5.89	6.18	5.53	5.53	4.45	4.45
Particle Size (μ, MMD)	1180	1180	1275	1275	900	1350	1350	1200	1200
Traversal Time (min. - sec.)	4-0	4-0	4-0	4-0	4-0	5-0	5-20	3-0	4-48
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniform								
Jacket									
Chest, left	42	13	3	7	7	11	52	78	70
Chest, right	71	0	1	0	5	4	64	25	7
Upper Abdomen, left	277	388	125	151	94	34	33	220	141
Upper Abdomen, right	116	34	42	73	12	16	60	143	70
Upper Arm, left	11	33	30	2	0	7	4	10	6
Upper Arm, right	8	5	3	10	1	0	2	11	80
Elbow, left	218	278	208	191	29	106	194	95	90
Elbow, right	106	151	154	176	82	87	120	105	38
Forearm, left	115	69	90	8	14	0	111	38	14
Forearm, right	32	106	94	52	36	0	60	49	
Trousers									
Lower Abdomen, left	195	268	230	72	32	0	137	34	119
Lower Abdomen, right	107	32	120	35	16	0	143	59	90
Thigh, left	104	113	4	25	31	0	54	52	50
Thigh, right	79	33	74	54	13	0	67	58	65
Knee, left	354	270	259	54	18	39	86	67	62
Knee, right	119	118	77	128	16	45	28	53	100
Lower Leg, left	86	43	143	40	5	5	40	14	25
Lower Leg, right	65	16	27	17	1	11	16	17	20
Gloves									
Left	137	119	95	136	29	148	72	64	72
Right	169	200	107	128	27	148	79	115	108
Miscellaneous									
Rifle		20	8	15	5	9	11	9	13
Underwear									
Cuff, left	414	618	1.3	14	1.5	148	37	44	70
Cuff, right	14	922	930	247	27	23	32	219	134
Skin	0.7	10.0		0.6	1.0	0.4	0.9	1.2	
TOTAL*	2311	2285	1871	1378	478	660	1402	1301	1234
Pick-Up Factor**	0.749	0.740	0.636	0.469	0.605	0.839	0.508	0.584	0.554

REMARKS:

NOTE: Terrain covering consisted of dead, dry, matted grass.

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

CONFIDENTIAL

17 March 1958

Test Subject	H	F	C	B	F	I	E	F	G
Height (in.)	69	68	75	69	68	65	70	67	70
Weight (lb.)	175	195	195	155	195	150	180	165	160
Uniform No.	31	62	12	75	67	72	88	60	73
Contamination Density (g./sq.m.)	6.18	1.58	5.89	5.89	6.18	5.53	5.53	4.45	4.45
Particle Size (μ, MMD)	1180	1180	1275	1275	900	1350	1350	1200	1200
Traversal Time (min. - sec.)	4-0	4-0	4-0	4-0	4-0	5-0	5-20	3-0	4-18
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms								
Jacket									
Chest, left	42	13	3	7	7	11	52	78	70
Chest, right	71	9	1	8	5	4	64	25	7
Upper Abdomen, left	277	383	125	151	94	34	33	220	141
Upper Abdomen, right	116	34	42	73	18	16	40	143	70
Upper Arm, left	11	33	30	2	0	7	4	10	6
Upper Arm, right	8	5	3	10	1	0	2	11	89
Elbow, left	219	238	208	191	29	106	144	95	98
Elbow, right	106	151	154	178	42	87	120	105	38
Forearm, left	115	62	90	8	14	0	111	38	14
Forearm, right	32	106	94	52	36	0	60	49	
Trousers									
Lower Abdomen, left	125	283	230	71	32	0	137	34	119
Lower Abdomen, right	127	32	120	35	16	0	143	59	90
Thigh, left	104	143	4	25	31	0	54	52	50
Thigh, right	79	33	74	54	13	0	67	58	65
Knee, left	354	270	259	54	18	38	86	67	62
Knee, right	119	118	79	128	16	45	28	53	100
Lower Leg, left	86	43	143	40	0	5	40	14	25
Lower Leg, right	65	36	37	17	1	11	16	17	20
Gloves									
Left	197	112	75	136	29	148	72	64	72
Right	169	200	107	128	27	148	79	115	108
Miscellaneous									
Rifle		30	2	15	5	9	11	9	13
Underwear									
Cuff, left	414	618	2.35	126	4	148	77	64	70
Cuff, right	42	988	930	217	97	148	79	219	135
Skin	0.7	10.0		0.6	1.0	0.4	0.9	1.2	
TOTALS*	2311	2285	1871	1378	478	660	1402	1301	1234
Pick-Up Factor**	0.749	0.740	0.636	0.469	0.605	0.739	0.508	0.584	0.554

REMARKS:

NOTE: Terrain covering consisted of dead, dry, matted grass.

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

CONFIDENTIAL

2

TABLE 8

CREEP AND CRAWL TRIAL NO. 8

14 April 1958

Test Subject	P	C	E	B	D	A	R	I	Q
Height (in.)	68	75	70	69	67	71	67	65	70
Weight (lb.)	195	195	180	155	165	165	130	150	160
Uniform No.	40	39	59	4	34	36	33	37	22
Contamination Density (g./sq.cm.)	2.38	2.38	2.13	2.59	2.59	2.43	2.03	2.03	2.08
Particle Size (μ, MMD)	940	940	1100	940	940	960	830	830	880
Traversal Time (min. - sec.)	4-40	4-10	2-15	2-30	2-20	3-42	2-30	5-45	5-45
Location of Pick-up	Simulant Picked up (mg.) on Various Sections of Uniforms								
Jacket									
Chest, left	20	15	23	16	49	16	35	13	14
Chest, right	6	0	20	1	8	6	9	4	12
Upper Abdomen, left	87	53	132	46	110	130	76	30	160
Upper Abdomen, right	295	38	66	19	28	92	51	9	60
Upper Arm, left	53	16	25	6	23	16	10	56	8
Upper Arm, right	11	12	13	19	12	14	8	6	11
Elbow, left	130	92	140	62	93	158	89	79	105
Elbow, right	76	78	110	117	53	111	85	70	45
Forearm, left	67	40	43	21	55	61	83	61	70
Forearm, right	79	49	106	42	32	71	67	83	43
Trousers									
Lower abdomen, left	286	113	101	100	194	148	77	20	246
Lower Abdomen, right	50	139	59	90	81	116	93	13	11
Thigh, left	195	66	71	27	47	125	100	17	93
Thigh, right	88	44	50	67	21	98	62	22	46
Knee, left	131	97	153	64	64	231	106	63	118
Knee, right	62	59	54	104	39	129	65	71	43
Lower Leg, left	110	103	137	35	55	88	70	24	106
Lower Leg, right	222	40	46	31	41	43	35	16	74
Gloves									
Left	79	50	34	63	107	89	62	70	54
Right	158	57	117	145	94	230	94	69	145
Miscellaneous									
Rifle	17	15	11	13	24	25	14		28
Underwear									
Cuff, left		38				0.2	0.7		
Cuff, right	0.0	3.2		2.2	1.0	8.9	17.0	2.2	10.8
Elbows	0.3	2.0	0.4			0.7	1.6	3.1	5.2
Neck								1.2	
Thighs	0.5		0.2		0.6				
Skin	0.4	3.5	0.2	1.4	0.1	0.3	0.1	0.2	0.2
TOTALS*	2198	1219	1170	1074	1236	1971	1277	796	1464
Pick-Up Factors**	1.806	1.024	1.380	0.829	0.939	1.622	1.258	0.784	1.408

*Total quantity of simulant picked up on jacket, trousers, and gloves.

**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 8

CREEP AND CRAWL TRIAL NO. 3

14 April 1958

Test Subject	F	C	E	B	D	A	H	I	Q
Height (in.)	68	75	70	69	67	71	67	65	70
Weight (lbs.)	195	195	180	155	165	165	130	150	160
Uniform No.	40	39	59	4	34	36	33	37	22
Contamination Density (g./sq.m.)	2.38	2.39	2.13	2.59	2.59	2.43	2.03	2.03	2.08
Particle Size (μ, MMD)	940	940	1100	940	940	960	830	830	880
Traversal Time (min. - sec.)	4-40	4-10	2-15	2-30	2-20	3-42	2-30	5-45	5-45
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms								
Jacket									
Chest, left	20	10	23	16	49	16	35	13	11
Chest, right	6	0	20	1	8	6	9	4	12
Upper Abdomen, left	87	53	122	46	110	130	76	30	160
Upper Abdomen, right	295	38	66	14	28	92	51	9	60
Upper Arm, left	53	14	25	6	23	16	10	56	8
Upper Arm, right	11	12	13	19	12	14	8	6	11
Elbow, left	130	92	110	62	93	158	89	79	105
Elbow, right	76	78	110	117	53	111	85	70	45
Forearm, left	67	40	43	71	55	61	83	61	70
Forearm, right	79	47	106	42	30	71	67	82	43
Trousers									
Lower Abdomen, left	286	113	101	100	194	146	177	20	216
Lower Abdomen, right	80	139	59	50	81	146	93	13	11
Thigh, left	195	66	71	77	47	125	100	17	93
Thigh, right	88	44	50	67	21	88	62	22	46
Knee, left	131	97	123	64	64	231	106	63	118
Knee, right	62	59	51	124	39	198	65	71	43
Lower Leg, left	115	103	127	31	55	86	70	24	106
Lower Leg, right	222	46	47	31	61	43	35	16	74
Gloves									
Left	74	50	34	42	127	59	62	70	54
Right	175	67	117	244	94	230	94	69	145
Miscellaneous									
Rifle	17	15	11	13	21	25	14		20
Underwear									
Cuff, left		38				0.2	0.7		
Cuff, right	2.0	3.2		7.2	1.0	4.2	17.0	2.2	10.8
Elbows	0.3		0.1			0.7	1.0	3.1	5.2
Neck								1.2	
Thighs	0.5		0.2		0.6				
Skin	0.4	2.6	0.2	1.0	0.1	0.3	0.1	0.2	0.2
TOTALS*	2178	1912	1470	1074	1216	1971	1277	736	2164
Pick-up Factor**	1.846	1.024	1.350	0.939	0.939	1.622	1.958	0.784	1.496

Remarks:

*Total quantity of simulant picked up on jacket, trousers, and gloves.

**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

2

CONFIDENTIAL

TABLE 9

GRASS AND GRAVEL TRIAL NO. 9

17 April 1958

Test Subject	B	C	D	F	A	I	J	Q	K
Height (in.)	69	75	67	68	72	65	67	70	67
Weight (lb.)	155	195	165	195	165	150	165	160	130
Uniform No.	3	18	20	26	23	42	119	32	76
Contamination Density (c/m/sq.m.)	13.6	13.6	12.1	10.5	10.5	9.85	10.7	10.7	8.0
Particle Size (, dpm)	2510	2510	2510	2510	2510	2510	2510	2510	2510
Traversal Time (min. - secs.)	1-35	3-35	3-0	3-55	3-55	4-22	5-0	5-0	1-50
Location of Pick-Up	Simulant Picked up (mgs.) on Various Sections of Uniforms								
Jacket									
Chest, left	28	27	76	42	14	30	413	95	77
Chest, right	28	38	193	29	28	5	96	46	30
Upper Abdomen, left	234	153	378	414	109	23	228	230	650
Upper Abdomen, right	13	108	267	201	33	9	115	172	169
Upper Arm, left	35	31	56	46	57	30	129	34	21
Upper Arm, right	24	17	23	45	26	25	66	12	25
Elbow, left	420	453	937	564	521	580	182	402	276
Elbow, right	332	307	331	373	131	123	479	200	116
Forearm, left	13	283	525	266	290	94	166	281	180
Forearm, right	12	321	198	137	103	127	261	122	137
Trousers									
Lower Abdomen, left	319	320	661	353	344	216	405	487	128
Lower Abdomen, right	94	324	150	102	292	104	340	281	281
Thigh, left	65	130	166	244	247	361	429	111	273
Thigh, right	102	117	68	106	330	216	132	113	67
Knee, left	50	446	240	197	275	320	162	159	315
Knee, right	154	138	79	151	232	251	190	198	134
Lower Leg, left	71	115	140	225	275	269	174	82	252
Lower Leg, right	70	128	73	86	235	117	185	124	56
Gloves									
Left	396	192	373	205	236	229	414	320	79
Right	421	332	328	596	700	289	297	578	171
Miscellaneous									
Rifle	25	3	24	34	26		16	14	9.4
Underwear									
Cuff, left		8							
Cuff, right		8.8	1.1		0.5	68.0	4.1		4.1
Elbows		9.2	3.0	9.4	12.5	4.6	29.4	12	0.4
Abdomen	2.4	1.6	3.6	2.3	2.6	8.3	2.6	129	4.7
Neck	1.7		2.8	0.3	0.1		6.3	0.8	2.1
Thighs							0.6		
Skin							0.4	2.8	
TOTAL*	2881	3950	5062	4884	4388	3428	4933	4127	3361
Pick-Up Factor**	0.424	0.581	0.837	0.930	0.836	0.696	0.922	0.771	0.840

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.

**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 9

CREEP AND CRAWL TRIAL NO. 9

17 April 1958

Test Subject	B	C	D	F	A	E	D	G	K
Height (in.)	69	75	67	68	71	65	67	70	67
Weight (lb.)	155	195	165	195	165	150	165	160	130
Uniform No.	3	18	20	26	23	42	119	32	76
Contamination Density (gm./sq.ft.)	13.6	13.6	12.1	10.5	10.5	9.85	10.7	10.7	8.0
Particle Size (μ, MMD)	2510	2510	2510	2510	2510	2510	2510	2510	2510
Traversal Time (min. - sec.)	1-35	3-35	3-0	3-55	3-55	4-22	5-0	5-0	1-50
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms								
Jacket									
Chest, left	28	27	76	42	14	30	413	95	77
Chest, right	28	38	193	29	28	5	96	46	39
Upper Abdomen, left	234	153	378	414	109	23	228	240	650
Upper Abdomen, right	13	108	267	201	31	9	115	172	169
Upper Arm, left	35	31	56	46	57	30	129	34	21
Upper Arm, right	24	17	23	45	26	25	66	12	25
Elbow, left	420	453	937	564	521	580	182	402	276
Elbow, right	332	307	331	373	131	123	479	200	116
Forearm, left	13	253	525	266	270	94	166	281	180
Forearm, right	12	321	198	137	103	127	261	122	137
Trousers									
Lower Abdomen, left	319	320	461	353	314	216	405	487	128
Lower Abdomen, right	94	324	150	102	292	104	340	281	281
Thigh, left	65	130	166	244	247	341	429	111	273
Thigh, right	102	117	69	146	310	266	192	113	67
Knee, left	50	446	240	197	275	320	162	159	315
Knee, right	154	138	72	151	232	251	190	198	124
Lower Leg, left	71	135	140	295	275	269	174	82	252
Lower Leg, right	70	128	73	86	235	117	185	144	56
Gloves									
Left	396	192	373	205	236	289	414	320	79
Right	421	339	323	596	700	289	297	578	171
Miscellaneous									
Rifle	25	3	24	34	26		16	14	9.4
Underwear									
Cuff, left		8	1.1		0.5	68.8	4.1		4.1
Cuff, right		8.8	3.9	9.4	12.5	4.6	29.4	12	0.4
Elbows	2.4	9.8	3.6	2.4	2.6	8.3	2.6	149	4.3
Abdomen	1.7	1.6	2.8	0.3	0.1		6.3	0.8	2.1
Back							0.6		
Thighs							0.4	2.8	
Skin		8.9	1.6	7.1	1.4	1.9	1.7	0.3	1.8
TOTALS	2831	3650	5062	4884	4388	3428	4933	4127	3361
Pick-Up Factor**	0.424	0.581	0.837	0.930	0.836	0.696	0.922	0.773	0.840

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

2

TABLE 10

CREEP AND CRAWL TRIAL NO. 10

15 May 1958

Test Subject	H	J	D	F	C	G	B	E	
Height (in.)	69	69	67	68	75	67	67	69	70
Weight (lb.)	175	195	165	195	195	155	165	155	180
Uniform No.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Contamination Density (g./sq.m.)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Particle Size (μ, MMD)	3120	3120	3120	3120	3120	3120	3120	3120	3120
Traversal Time (min. - sec.)	3-30	7-0	7-0	5-30	5-30	3-15	7-0	4-45	3-0
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms								
Jacket									
Chest, left	38	112	118	19	0	38	118	4	4
Chest, right	26	35	35	17	0	13	35	0	0
Upper Abdomen, left	73	98	101	87	32	35	101	39	104
Upper Abdomen, right	62	26	38	[illegible]	15	14	38	6	13
Upper Arm, left	10	47	26	12	8	0	26	3	5
Upper Arm, right	3	24	35	8	6	12	35	16	6
Elbow, left	88	212	66	115	96	29	66	64	129
Elbow, right	11	57	96	52	92	49	96	72	62
Forearm, left	54	148	41	66	26	33	41	4	68
Forearm, right	22	44	57	39	63	47	57	6	42
Trousers									
Lower Abdomen, left	38	93	62	94	133	18	62	41	48
Lower Abdomen, right	32	48	45	91	92	51	75	38	45
Thigh, left	28	52	36	86	69	13	36	30	59
Thigh, right	38	45	45	86	49	24	45	58	65
Knee, left	63	66	29	73	52	11	29	24	46
Knee, right	122	15	37	63	34	15	37	70	37
Lower Leg, left	59	30	44	25	11	12	44	7	68
Lower Leg, right	0	26	34	17	12	38	34	11	40
Gloves									
Left	71	127	26	29	48	71	26	89	68
Right	115	139	165	127	86	53	165	123	69
Miscellaneous									
Rifle	6	5	4	4		5	4	7	6
Underwear									
Cuff, left			1.7			3.3	1.7		
Cuff, right	5.4		19.3	16.9			19.3		3.7
Elbow									0.3
Skin				0.2	0.3			0.2	0.1
TOTAL*	853	1104	[illegible]	[illegible]	922	572	[illegible]	705	[illegible]
Pick-Up Factor**	1.176	1.377	1.476	1.837	1.475	1.413	1.047	0.893	1.245

REMARKS:

NOTE: Trial was performed on damp terrain.

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 10

CREEP AND CRAWL TRIAL NO. 10

15 May 1958

Test Subject	H	J	D	F	C	G	D	B	[illegible]
Height (in.)	69	69	67	68	75	67	67	69	70
Weight (lb.)	175	185	165	195	195	195	165	155	[illegible]
Uniform No.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Contamination Density (g./sq.m.)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Particle Size (μ, MMD)	3120	3120	3120	3120	3120	3120	3120	3120	3120
Traversal Time (min. - sec.)	3-30	7-0	7-0	5-30	5-30	3-15	7-0	1-45	3-0
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms								
Jacket									
Chest, left	38	112	118	19	0	38	118	4	4
Chest, right	26	35	35	17	0	13	35	0	0
Upper Abdomen, left	73	98	101	87	42	35	101	39	104
Upper Abdomen, right	62	26	38	45	18	14	38	6	43
Upper Arm, left	10	47	26	12	8	0	26	3	5
Upper Arm, right	3	24	35	8	6	12	35	16	6
Elbow, left	88	219	66	115	96	29	66	64	129
Elbow, right	11	57	96	52	92	49	96	72	67
Forearm, left	54	108	41	68	26	33	41	4	68
Forearm, right	22	44	57	33	69	47	57	6	42
Trousers									
Lower Abdomen, left	38	93	62	94	133	18	62	41	48
Lower Abdomen, right	32	48	75	91	92	51	75	38	46
Thigh, left	28	52	36	86	69	13	36	30	59
Thigh, right	38	45	45	86	40	24	45	58	65
Knee, left	62	66	29	73	52	11	29	24	46
Knee, right	122	15	37	63	36	11	37	70	37
Lower Leg, left	59	30	44	25	11	12	44	7	68
Lower Leg, right	0	26	34	17	12	38	34	11	40
Gloves									
Left	71	127	26	29	48	71	96	89	68
Right	115	139	165	127	86	53	165	123	69
Miscellaneous									
Rifle	6	5	4	4		5	4	7	6
Underwear						3.3	1.7		
Cuff, left			1.7				19.3		3.7
Cuff, right	5.4		19.3	16.9					0.3
Elbow				0.2	0.3			0.2	0.1
Skin									
TOTALS	853	1,104	[illegible]	[illegible]	922	572	[illegible]	705	[illegible]
Pick-Up Factor**	1.176	1.177	1.476	1.837	1.475	1.413	1.047	0.893	[illegible]

REMARKS:

NOTE: Trial was performed on damp terrain.

*Total quantity of simulant picked up on jacket, trousers, and gloves.

**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

CONFIDENTIAL

2

[illegible]

TABLE II

[illegible] TEST NO. II

28 May 1958

Test Subject	D	P	E	R	Y	[illegible]	F	T	I
Height (in.)	67	67	67	69	69	70	68	65	71
Weight (lb.)	135	165	155	175	185	160	155	150	165
Uniform No.	29	111	29	106	101	110	107	103	102
Contamination Density (g./sq.m.)	0.90	0.39	0.86	2.23	0.61	0.91	0.78	0.78	0.81
Particle Size (μ, MD)	550	550	550	550	550	550	550	550	550
Traversal Time (min. - sec.)	3-0	4-0	3-45	3-0	6-0	5-45	5-45	5-45	2-15
Location of Pick-Up	Simulant Picked up (mg.) on Various Sections of Uniforms								
Jacket									
Chest, left	38	39	28	120	59	39	21	11	0
Chest, right	33	10	9	57	23	33	43	6	0
Upper Abdomen, left	34	138	55	156	78	74	51	33	20
Upper Abdomen, right	28	24	32	101	28	53	93	16	36
Upper Arm, left	6	20	11	15	13	14	56	6	3
Upper arm, right	51	5	16	6	9	14	20	3	3
Elbow, left	29	3	57	61	111	82	15	89	55
Elbow, right	13	59	46	214	10	51	36	38	24
Forearm, left	45	74	11	67	3	32	39	50	144
Forearm, right	11	36	39	72	47	45	93	20	28
Trousers									
Lower Abdomen, left	58	191	33	226	21	25	191	25	29
Lower Abdomen, right	28	36	24	139	15	28	51	23	49
Thigh, left	21	35	21	157	33	33	153	29	25
Thigh, right	15	35	49	139	28	43	56	40	55
Knee, left	11	11	22	159	17	29	72	72	42
Knee, right	21	24	22	129	23	11	34	27	50
Lower Leg, left	0	15	11	131	19	15	21	4	9
Lower Leg, right	0	24	8	52	0	0	0	0	0
Gloves									
Left	138	147	55	211	103	70	72	201	61
Right	95	213	100	149	111	175	72	201	55
Miscellaneous									
Rifle	5	10		30	11	19	19	12	13
Underwear									
Cuff, left		2.7	0.5		2.2	3.6			2.7
Cuff, right			3.2		2.2	3.4			
Elbows	7.4						0.4		
Abdomen		0.4	0.2	35.5			1.6		
Neck		0.2	0.2	0.6					
Skin								2.7	
TOTAL*	774	1164	33	2819	898	976	1146	698	631
Pick-Up Factor**	1.72	2.37	1.38	2.22	2.22	2.16	2.94	1.79	1.56

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, [illegible].

**Pick-up factor equals percent [illegible]

TABLE II

CHEMICAL AGENT CRANK TRIAL NO. 11

28 May 1958

Test Subject	C	D	E	H	J	K	P	T	A
Height (in.)	67	67	62	64	69	70	68	65	71
Weight (lbs.)	135	165	135	175	185	160	195	150	165
Uniform No.	29	111	98	106	101	110	107	103	102
Contamination Density (g./sq.m.)	0.70	0.39	0.36	0.83	0.61	0.81	0.78	0.78	0.91
Particle Size (μ, AD)	550	550	550	550	550	550	550	550	550
Traversal Time (min. - sec.)	1-0	1-0	2-15	2-0	1-0	1-0	2-15	2-15	2-15

Location of Pick-up	Simulant Picked up (mg.) on various portions of uniform								
Jacket									
Chest, left	38	32	28	120	59	39	21	11	2
Chest, right	23	10	7	57	23	33	43	6	2
Upper Abdomen, left	30	134	55	156	48	74	54	33	20
Upper Abdomen, right	25	24	32	101	28	59	93	16	26
Upper Arm, left	1	30	11	12	12	11	55	6	5
Upper Arm, right	51	1	46	4	2	46	39	3	5
Elbow, left	22	1	57	61	111	32	15	2	65
Elbow, right	1	4	4	2	10	51	36	34	22
Forearm, left	1	4	11	1	1	32	39	50	14
Forearm, right	1	36	32	32	49	45	22	20	21
Trousers									
Lower Abdomen, left	50	121	32	221	71	28	141	2	29
Lower Abdomen, right	74	2	28	134	19	28	51	23	69
Thigh, left	21	1	61	157	33	18	153	29	35
Thigh, right	15	3	39	130	23	19	50	40	59
Knee, left	1	3	7	152	15	17	79	27	31
Knee, right	0	3	7	174	23	24	31	1	2
Lower Leg, left	0	1	1	122	19	2	0	0	0
Lower Leg, right	0	21	1	32	0	0			
Gloves									
Left	32	1	2	220	100	72	73	201	61
Right	55	212	190	120	111	195	82	204	65
Miscellaneous									
Rifle	5	32		37	11	15	17	12	13
Underwear		2.7	2.5		2.2	3.6			2.7
Cuff, left	7.4		2.5		2.0	7.4	2.4		
Cuff, right				35.5			1.0		
Calves		2.1	2.1	2.6					
Abdomen		2.0	2.0						
Neck								2.7	
Skin									
TOTALS*	778	1113	732	2813	898	578	1113	678	631
Pick-up Factor**	1.72	2.27	1.62	1.77	2.22	2.16	2.24	1.72	1.60

NOTES:

*Total quantity of simulant picked up by all areas of uniform and underwear.

**Pick-up factor equals grams picked up per gram per square meter of contamination.

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Table 12

Pick-up [illegible] Trials

17 June 1952

Test Number	A	A	A	A	A	A	A	A	A	A
Weight (lbs)	71	71	71	71	71	71	71	71	71	71
Weight (lbs)	165	169	165	165	165	165	165	165	166	165
Position	138	112	114	115	129	91	92	93	95	96
Contamination Density (gm/sq. in.)	1.05	0.99	0.80	0.73	0.734	1.02	3.11	5.62	7.70	10.62
Particle Size (1, 2, etc)	Large	Large	Large	Large	Large	Small	Small	Small	Small	Small
Traversal Rate (min. per yd.)	1-7	1-7	1-7	2-2	2-58	1-4	1-2	1-50	1-3	1-2

Location of Pick-up

Percentage (and weight) in various locations of uniform

Jacket

Chest, left	69	11	29	10	14	0	5	16	36	21
Chest, right	74	11	32	9	13	0	8	22	25	30
Upper abdomen, left	46	33	77	14	13	3	24	63	98	164
Upper abdomen, right	135	63	55	7	9	14	31	45	93	130
Lower arm, left	41	20	14	5	15	7	29	9	9	32
Lower arm, right	74	27	19	5	6	7	1	12	7 -	8
Back, left	265	146	240	59	59	46	127	156	206	290
Back, right	213	153	195	61	33	46	57	65	134	148
Forearm, left	133	233	151	31	37	23	61	93	129	160
Forearm, right	117	113	135	33	23	24	27	33	110	181

Trousers

Lower abdomen, left	111	109	93	36	16	33	74	137	187	179
Lower abdomen, right	221	149	174	17	24	24	61	135	56	254
Leg, left	112	126	131	22	5	9	37	42	113	167
Thigh, left	187	93	53	14	6	6	11	16	126	202
Knee, left	134	144	243	23	31	14	92	135	131	158
Knee, right	183	117	15	22	22	34	50	145	65	75
Lower leg, left	95	133	117	14	9	0	13	59	213	100
Lower leg, right	125	87	36	29	3	0	25	257	150	135

Shoes

Left	63	14	13	16	17	8	105	145	254	335
Right	317	351	197	23	16	7	162	335	562	650

Miscellaneous

Helmet	21	5	24	7	1	14	15	30	64	86
Total Face										
Neck, left	1.0	2.0					1.0	1	2	1
Neck, right	1.0			2.0	4.0		1.0	3	4	4
Glasses	3.0	1.0	10.0							
Finger							1.0		3.0	
Soil	1.0	1.0								
TOTAL*	2956	2308	2335	669	393	470	991	1,965	9688	3413
Pick-up Factors**	1.279	1.329	1.295	1.033	2.115	1.268	1.274	1.486	1.395	1.311

REMARKS:

*Total quantity of simulant picked up on jacket, trousers, and gloves.
**Pick-up factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

TABLE 12

Pickup of Dust in Air-Vs.-Roller Trials

19 June 1956

Test Subject	A	A	A	A	A	A	A	A	A	A
Height (in.)	71	71	71	71	71	71	71	71	71	71
Weight (lbs.)	165	165	165	165	165	165	165	165	165	165
Surface Area	108	112	114	113	109	91	92	93	95	96
Aerosol Concentration (mg./sq.in.)	17.5	6.95	9.42	2.96	0.734	1.44	3.11	5.29	7.70	10.42
Particle Size (μ, mmd)	Large	Large	Large	Large	Large	Small	Small	Small	Small	Small
Universal Line (Min. # sets)	1-7	1-7	1-10	1-2	0-25	1-4	1-9	1-50	1-3	1-2
Location of Pickup	Simulant Picked Up (mg.) on Right Surface of Uniform									
Jacket										
Chest, Left	62	11	29	10	14	0	5	16	30	21
Chest, Right	74	11	39	0	33	0	2	22	25	30
Upper Abdomen, Left	96	33	77	11	33	3	24	63	98	144
Upper Abdomen, Right	135	63	88	7	9	14	33	65	93	130
Upper Arm, Left	41	20	115	6	18	7	27	6	9	32
Upper Arm, Right	76	27	17	9	6	7	1	10	7	8
Elbow, Left	265	166	270	99	59	16	177	136	206	290
Elbow, Right	293	157	205	61	33	16	37	45	134	148
Forearm, Left	193	132	135	36	37	23	61	93	129	160
Forearm, Right	147	113	125	53	23	25	24	33	110	181
Trousers										
Lower Abdomen, Left	111	109	99	75	16	38	74	137	187	173
Lower Abdomen, Right	221	149	111	5	5	27	65	135	56	254
Knee, Left	142	106	125	22	5	0	30	42	113	167
Knee, Right	227	92	53	14	6	6	11	14	136	202
Shin, Left	234	146	223	63	31	14	92	176	131	158
Shin, Right	183	117	150	45	22	36	50	136	85	75
Lower Leg, Left	98	133	117	14	0	0	13	57	113	100
Lower Leg, Right	105	87	36	29	0	-	25	157	150	135
Gloves										
Left	239	134	159	46	37	66	109	145	254	335
Right	518	251	227	93	46	94	162	295	562	650
Miscellaneous										
Cuff	21	21	24	7	4	14	15	39	64	86
Underwear										
Top, Left	4.0	2.0					1.0	1	2	1
Top, Right	4.0			3.0	4.0		1.0	3	4	4
Shorts	3.0	1.0	17.0							
Thigh							1.0		3.0	
Neck	1.0	1.0								
Total*	2356	2308	2435	765	368	420	991	1965	2688	3413
Pickup Factor**	1.279	1.329	1.405	1.093	2.115	1.264	1.274	1.186	1.395	1.311

REMARKS

*Total quantity of simulant picked up on jacket, trousers, and gloves.

**Pickup factor equals percent of the ground contamination picked up on the uniform per meter of traversal.

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APPENDIX A

Table 13

Comparative Pick Up on Roller and Man

Date	Test subject	Contamination density	Approx particle size	Pick-Up		
				Roller	Man	Roller/Man
		g/sq m	μ	g	g	
19 Jun 58	A	10.5	Large	3.61	3.36	1.08
19 Jun 58	A	6.95	Large	2.66	2.31	1.15
19 Jun 58	A	9.42	Large	3.85	2.84	1.36
19 Jun 58	A	2.90	Large	0.94	0.77	1.22
19 Jun 58	A	0.72	Large	0.49	0.39	1.25
19 Jun 58	A	1.44	Small	0.94	0.46	2.04
19 Jun 58	A	3.11	Small	1.20	0.99	1.21
19 Jun 58	A	5.29	Small	1.91	1.57	1.22
19 Jun 58	A	7.79	Small	3.93	2.69	1.46
19 Jun 58	A	10.4	Small	4.00	3.41	1.17
14 Apr 58	E	2.13	1100	1.90	1.47	1.29
14 Apr 58	A	2.43	1000	2.07	1.97	1.05
14 Apr 58	[illegible]	2.08	900	1.48	1.46	1.01
17 Apr 58	D	12.1	2500	6.48	5.06	1.28
17 Apr 58	I	9.85	2500	5.00	3.43	1.46
17 Apr 58	R	8.00	2500	3.82	3.36	1.14
15 May 58	H	1.45	3100	1.09	0.85	1.28
15 May 58	G	0.81	3100	0.80	0.57	1.40
15 May 58	E	1.62	3100	1.45	1.01	1.44
28 May 58	G	0.90	600	1.24	0.77	1.61
28 May 58	H	2.53	600	3.08	2.82	1.09
28 May 58	A	0.81	600	1.32	0.63	2.09

Remarks:

1. Trials conducted on 19 Jun 58 were run in accordance with Test Plan No. 29. The other data presented were obtained in conjunction with "creep and crawl" trials.

2. Physical characteristics of test subjects appear in preceding tables.

APPENDIX A

Table 14

Comparative Transferability of Agent and Simulant

Trial no.	Contamination density	Particle size	Roller Pick-Up				
			First Traversal			Second Traversal	
			Top cloth	Under cloth	Ratio agent/sim*	Top cloth	Under cloth
	g/sq m		mg	mg		mg	mg
1	8.5	Small	2,440	23	0.68	27	1
2	13.9	Small	2,390	43	0.41	80	2
3	6.9	Small	2,530	40	0.89	17	2
4	3.6	Small	1,270	52	0.85	16	1
5	2.2	Small	250	25	0.29	10	1
6	10.0	Large	2,000	7	0.53	76	54
7	12.9	Large	1,290	23	0.25	60	59
8	8.2	Large	1,250	2	0.40	47	23
9	3.4	Large	1,100	15	0.85	18	11
10	1.0	Large	520	16	1.34	7	5

Remarks:

*In establishing the ratio of agent to simulant pick-up, corresponding values of simulant pick-up were obtained from curves in figure 3, appendix B, which were fitted to data obtained on 10 June 1953 as presented in table 13, this appendix.

APPENDIX B

GRAPHS AND CHARTS

FIGURE 1

DISTRIBUTION OF SIMULANT ON UNIFORMS OF TEST SUBJECTS

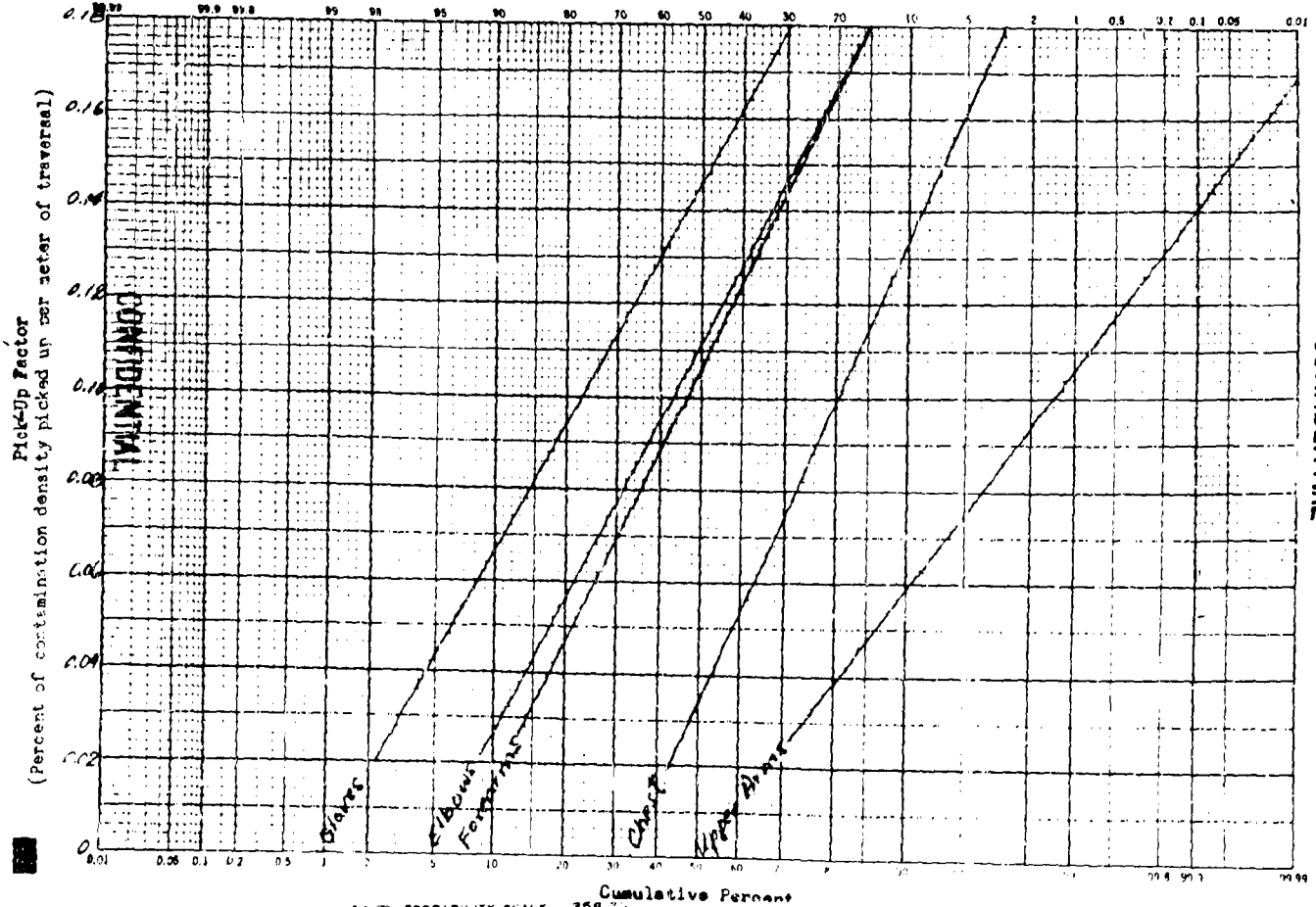
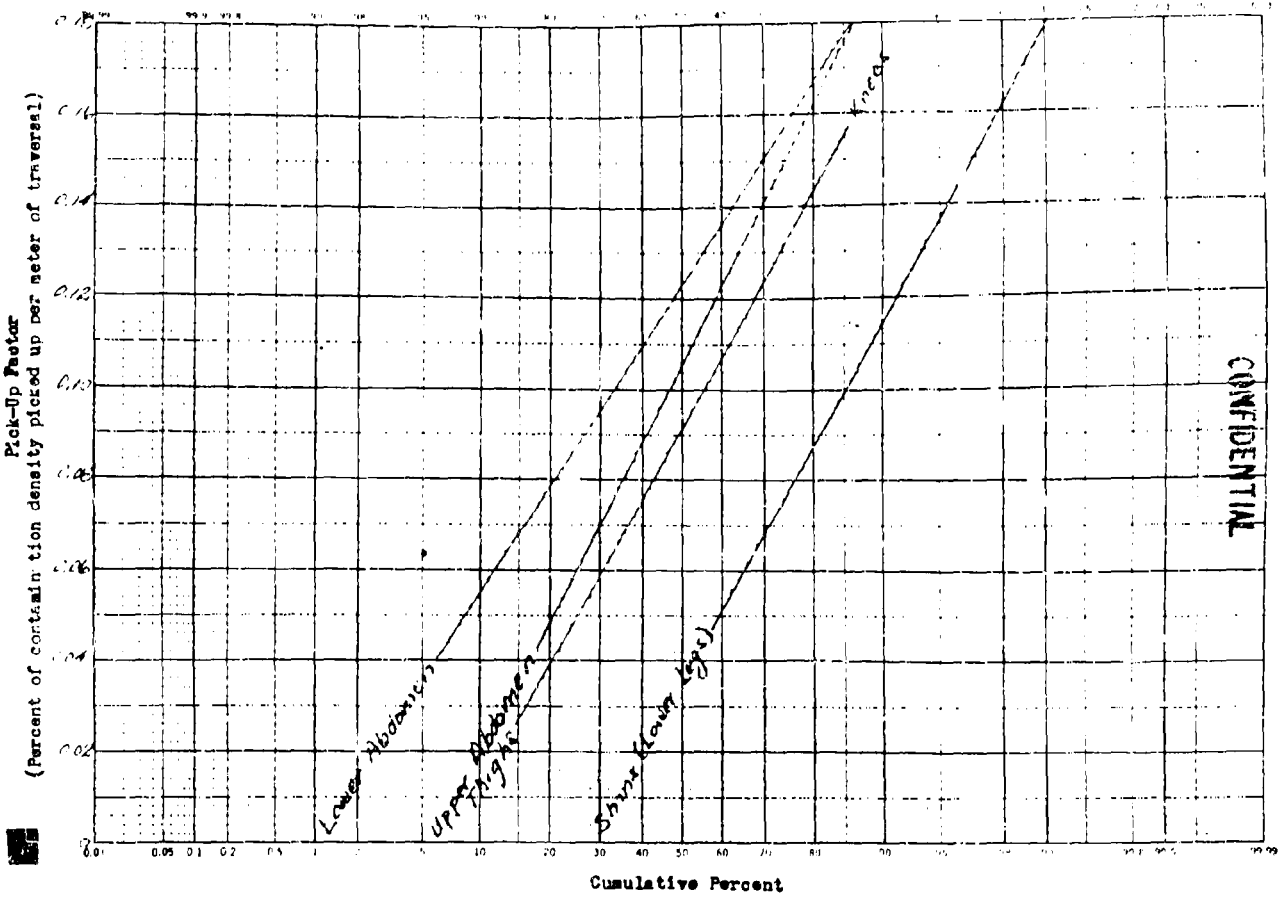


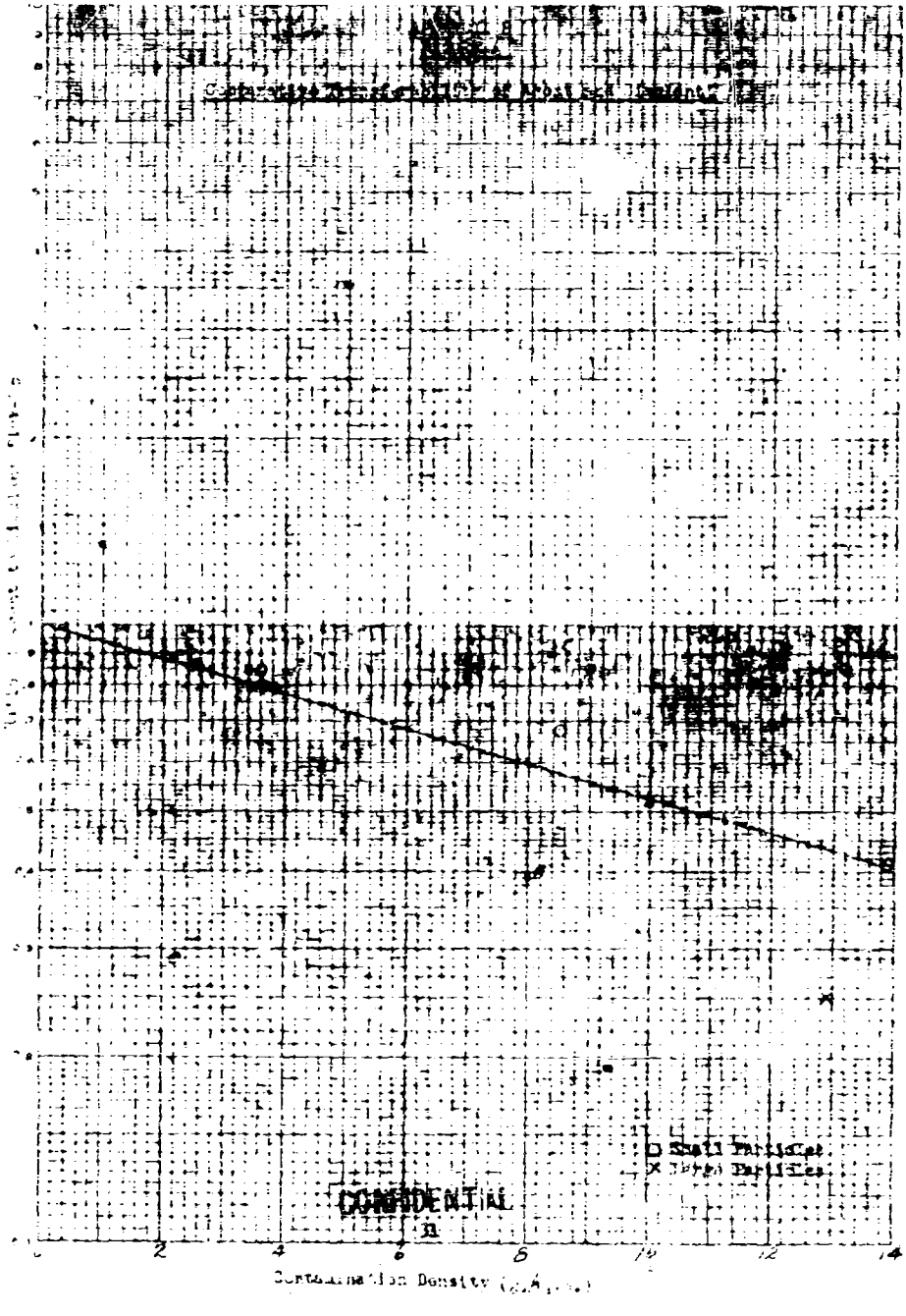
FIGURE 2

FIGURE 2

DISTRIBUTION OF SIMULANT ON UNIFORMS OF TEST SUBJECT



Contaminant Density (g/cm³)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APPENDIX C

PHOTOGRAPHS

FIGURE 1

SPINNING TIP APPARATUS

View shows sled-mounted spinning tip apparatus employed in dispersing simulant in fine droplets.

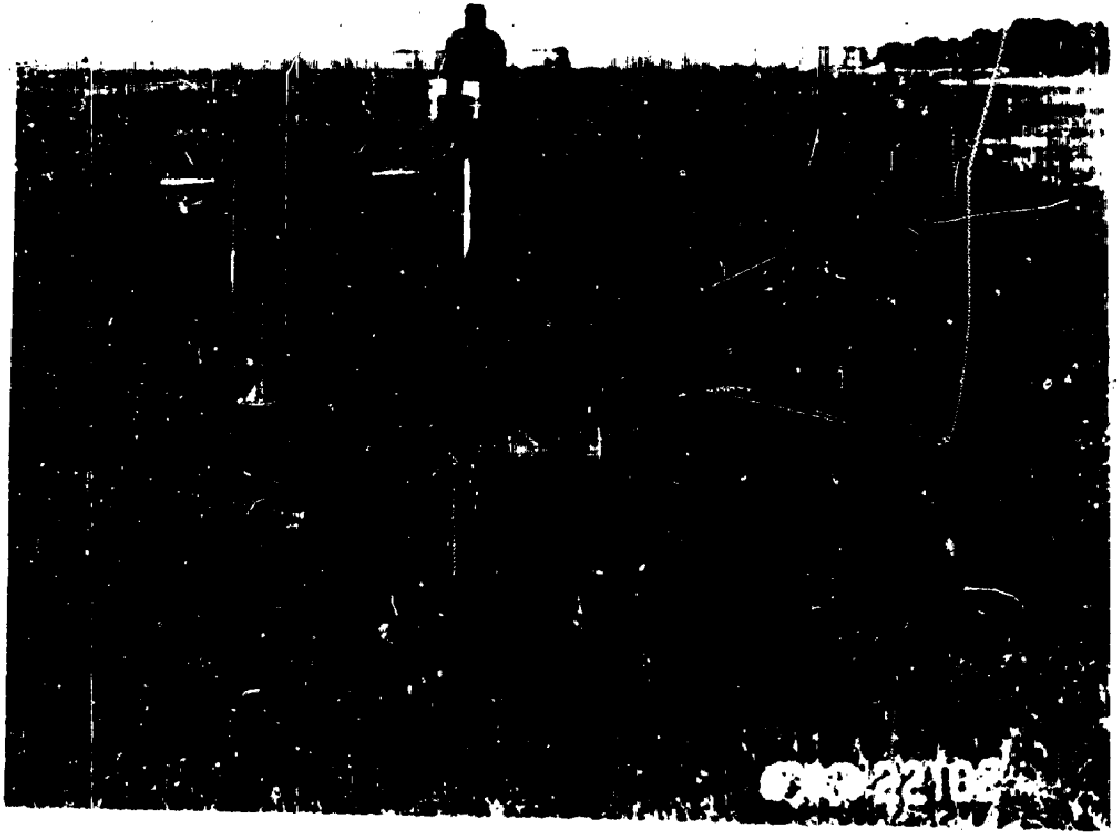

FIGURE 2

MULTIJET DISPERSER

View shows sled-mounted multijet disperser employed in the dissemination of large droplets. The sled for the spinning tip apparatus is seen in the background.

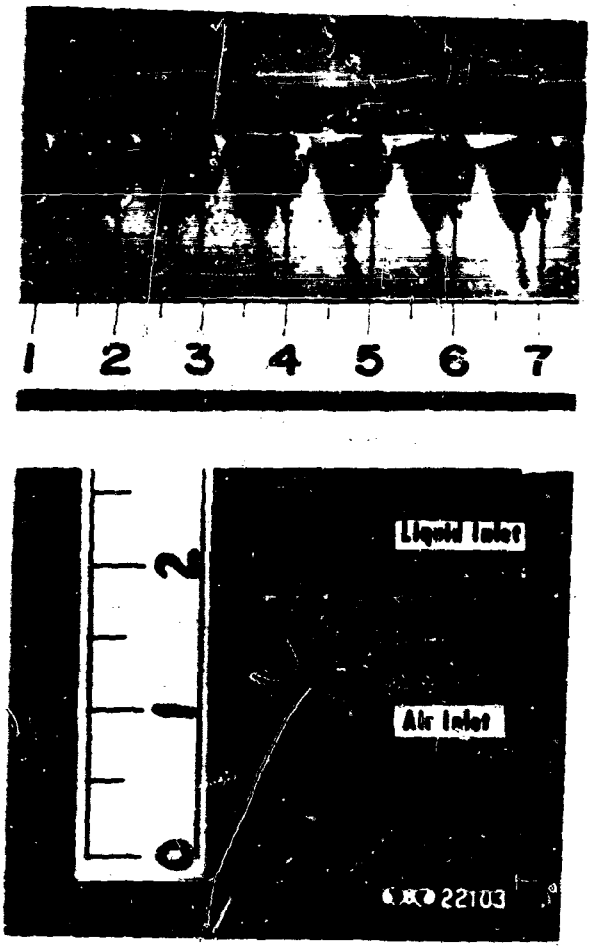

FIGURE 3

NOZZLES FOR MULTIJET DISPERSER

Top view shows a section of the disperser manifold with needles for disseminating 3 mm droplets. Bottom view shows nozzles for disseminating shattered droplets averaging less than 0.5 mm in diameter.

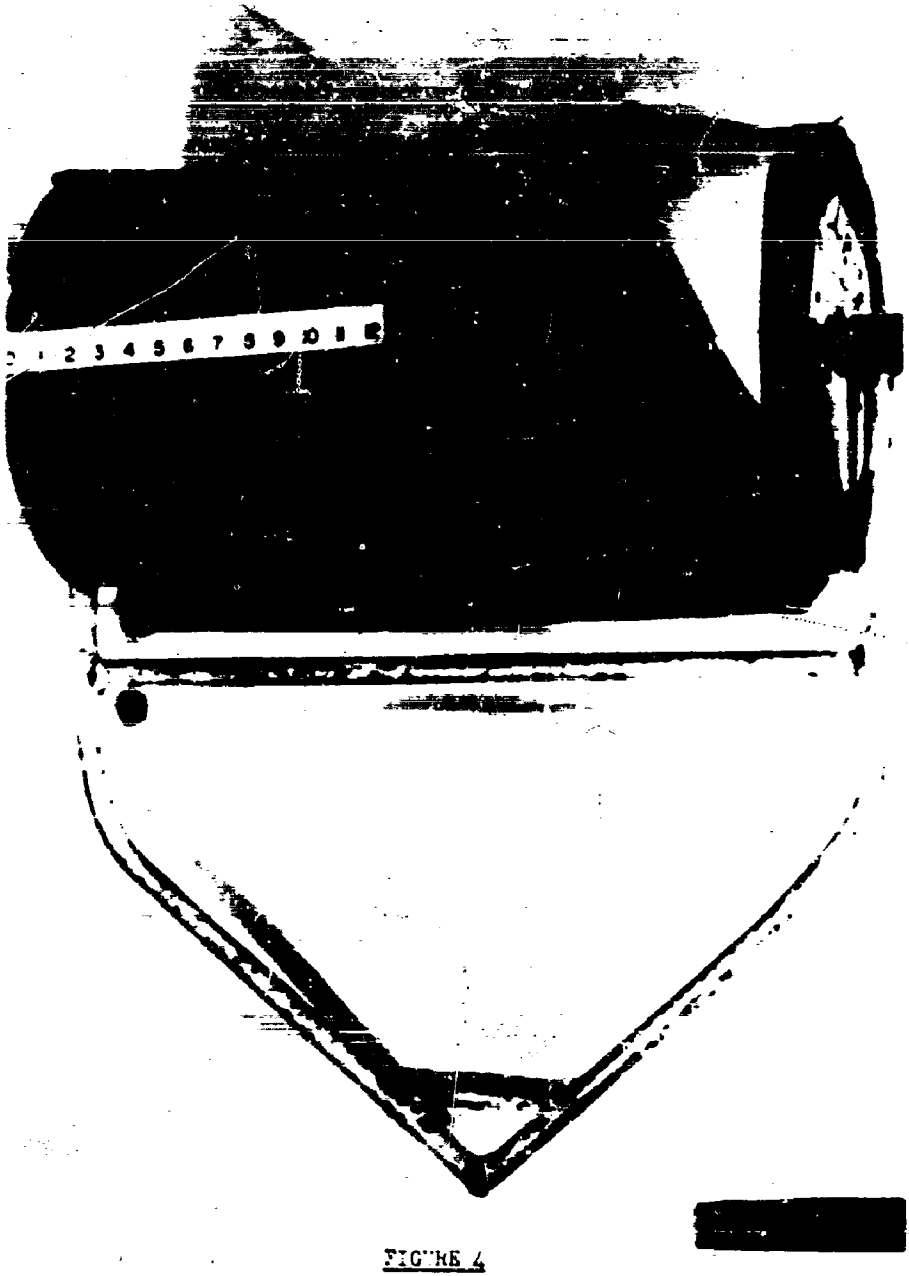

FIGURE 4

CLOTH-COVERED ROLLER

In this view the cotton sateen cover is lifted to show the 1/2-in. thick foam rubber pad covering the steel drum of the roller.

FIGURE 5

CONTAINMENT INTERIOR (LIGHT)

FIGURE 6

CONTAMINATED UNIFORM (MEDIUM)

View shows contaminated clothing mounted on a plane surface after seams were cut.

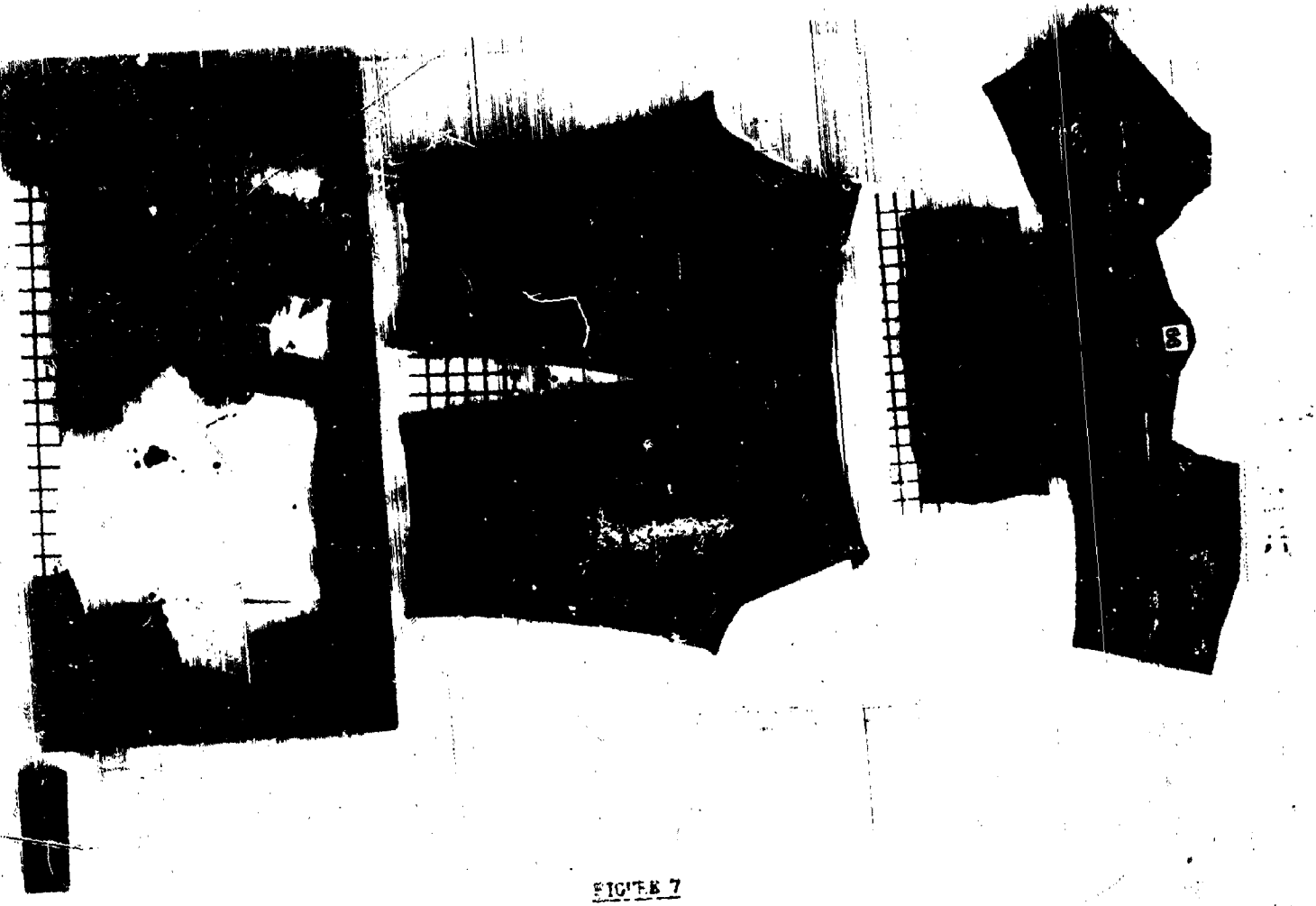

FIGURE 7

CONTAMINATED [illegible] (HEAVY)

View shows contaminate, clothing [illegible] on a clean surface after seams were cut.

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EDGEWOOD CHEMICAL BIOLOGICAL CENTER
5183 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MD 21010-5424

REPLY TO
ATTENTION OF

RDCB-DSR-S

JUL 1 1 2016

MEMORANDUM THRU Director, Edgewood Chemical Biological Center, (RDCB-D/ Dr. Joseph Corriveau), 5183 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010-5424

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RONALD L. STAFFORD
Security Manager

1. Manthie, J.H., Heitkamp, D.H. Dorsey, R.W., Stark, W.C., Bona, D.M., Moore, R.D., and Cameron, K.P., *Mustard Contact Hazard, Correlation of Effects on Skin with Contamination Levels Recovered from Dental Dam and Painted Steel Surfaces*, CRDEC-TR-88142, August 1988 (Dist. B. - U. S. Government Agencies) **DTIC: CBRNIAC-CB-009397**

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4. Reich, N., *Interim Report CWL Traversal Program Phase B – Pick-Up (Effects of Ground Moisture), CWL Technical Memorandum 33-26*, U.S. Army Chemical Warfare Laboratories, Army Chemical center, MD, June 1960 (Dist. C. - U. S. Government Agencies and their Contractors) **DTIC: AD0318492**

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