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TECHNICAL REPORT
69-40-PR

ACCEPTABILITY OF CARRYING DEVICES OF STANDARD AND EXPERIMENTAL DUFFEL BAGS

by

John M. McGinnis, Ph.D.

September 1968

UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760

Pioneering Research Laboratory
EPT-8

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Behavioral Sciences Division

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FOREWORD

Duffel bags developed many years ago were carried by one or two rope drawstrings which were threaded through grommets equally spaced around the top of the bag. After the drawstrings were pulled tight, the closed bag was slung over the shoulder by the extra rope.

Later the Army standardized a bag which was closed by placing four grommets over an elongated metal loop and holding them in place by a snap-hook. The hook was attached to one flat shoulder strap which was securely attached to the side of the bag at two places to form a grip for carrying by one hand.

The purpose of the present study was to determine the relative ease of carrying a newly designed duffel bag having two straps as compared with the standard one-strap bag and to secure an experimental basis for developing an improved item which will be easier to handle and more acceptable to Army personnel.

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ABSTRACT

The standard one-strap Army duffel bag, three experimental two-strap bags, and later two improved experimental two-strap bags were used by volunteer test subjects to carry loads over indoor and/or outdoor courses. The test subjects were observed and their handling of the bags recorded as they traversed the courses. The standard army bag with one shoulder strap was carried over the course by the average subject in four of five different positions as compared with the two-strap bags which were seldom carried in more than one position. Interviews were held on each day immediately after the final traversal of the course by each group to record individual preferences and comments concerning the bags. All three experimental (two-strap) bags were definitely preferred over the standard one strap design, and two experimental designs proved to be equally acceptable and definitely superior to the third experimental design. Later the two improved two-strap bags based on the best two of the three original experimental designs were compared and found to be equally acceptable. Although no direct experimental comparisons were made, comments indicated that the improved bags were considered to be superior to and more acceptable than the experimental bags which were tested first.

ACCEPTABILITY OF CARRYING DEVICES
STANDARD AND EXPERIMENTAL DUFFEL BAGS

Introduction

A requirement existe to improve the current carrying devicee on the Army duffel bag. The purpose of the proposed modification ie to facilitate eaee of carrying the bag on a eoldier'e back, leaving hi3 hands free and avoiding having to carry the bag on a single shoulder. The objectives of the study were to compare the acceptability of three experimental duffel bags with each other and with the standard bag, and to eecure information about the acceptability of the carrying devices of each bag ae a basis for improving ite deeign and developing a new bag which will be eaeier to carry.

Method

Duffel bags

A standard duffel bag and Type I, Type II, and Type III experimental bags were fabricated by the Clothing and Equipment Development Divieion of the Clothing and Organio Materiale Laboratory, U. S. Army Natick Laboratories (eee Appendix). They were made available, fully loaded (57-3/4-lbs.), to the Behavioral Sciencee Division of the Pioneering Research Laboratory at Natick. The duffel bags were ueed exactly as received over the indoor walking couree described below.

Test subjects

Twenty-four volunteer test eubjecte at Natiok's Olimatic Reeearch Laboratory, all enlieted men in good physical condition, participated in the experiment. They were used in different groupe and in a different order on the two walking courses.

Walking coursee and Proceduree

An "Indoor Walking Couree" approximately 2,000 feet in length wae eetabliehed to roughly eimulate an airport

terminal situation.* It wae mainly although not sntirely indoors. Test subjscte walked the course in a pre-determined random order at a steady pacs in approximately 8 minutes. An "Outdoor Walking Oourse" approximately the eame lsngth (2,000 fsst) as ths "Indoor Course" traversed walks and roads and did not include doore and steps which were includsd in ths indoor course.** It was completed in approximately 6½ minutes. Ths only steps involved in the outdoor course wers thoss up and down curbs. Howevsr, there were some gradual down hill elopse in the first half and a moderately etssp upgrade nsar the end of the courss. On both couress subjects were instructed to carry the bags in a etandard manner (i.e. the standard bag was carried by its strap ovsr one shouldsr and the experimental bags wsre carried with the strape over the shoulders)(see Appendix) during the first quarter of ths course, aftsr which they wsre free to carry ths bage in any way that thsy pleased. On the indoor courss, tset subjects were told to remain 5 to 10 pacee apart so that each test subject had to open all the doors. This distance wae reduced to 5 pacss on the outdoor couree. Instructions, rulss, pacesetting, and 12 minute rest periode between trials were essentially the same for both courses. For both courees a monitor recorded major changes in bag position and the point on the course whers thsy occurred. He also noted any othsr irregularitiss in performance such ae stopping, etaggering, stumbling, sxtreme posturss, and spontaneous remarke which wsrs rslevant to the bags.

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*Ths indoor courss started in the Climatic Building, went out the front door, down steps, across the street and up etsps into the Ressarch Building. Inside ths building it went up a flight of stairs to the sscond floor, through a door and down a corridor the length of ths sscond floor, through a door, down another flight of etairs, out the door and along the sidswalk to the weet end of ths Development Building. Then it went into ths Devslopment Building, along the corridor to ths east end and down the front steps to the eidewalk. From there it went south along the sidewalk past the front of the Research Building, acroes ths street, and up the eteps into the Olimatic Building.

**The outdoor walking course started in front of ths eaet door of the Research Building, went out to the sidswalk, along it to the circle, diagonally across ths circle, then eaet along the sidswalk on the south eids of "C" Street, to the firet intersection, eouth along ths sidewalk and strsst bstween the Climatic and Army Ressarch Institute for Environmental Medicine buildings almost to ths Officsre Olub, sast to ths road along the lake, north on it past the Army Rssearch Institute for Environmsntal Medicins building to ths interssotion with "C" Strest, wsst on the eidewalk up the hill to the Circle, and diagonally across the strset at the circle to the front of the Research Building.

Clothing and psrsonal equipment

Fatigues and leather combat boots were worn on the indoor course. On the outdoor course standard helmets and hslmet linsrs also were worn, along with webbing squipment. Ths lattsr included 3-1/4 pounds of simulated weight in each of two ammunition pouches, ths simulated weight and bulk of sun glasses, a new folding intrsnching tool in its carrier, and a cantsen (without cup) filled with water, for a total of 18-3/4 pounds. Also, sach test subject carried an M-1 carbine. Total weight carried on this courss was 80 pounds, clothing not included.

Experimsntal design

Three ssparate Latin square designs were ussd to compare the duffel bags. Each test subject travsrssd the indoor course once while carrying sach of four duffel bags, the standard, Typs I, Typs II and Type III. Twelve minute rest periods were allowed, following each traversal. Also, during the following week, each tsst subject travsrsed the outdoor courss oncs with the standard, Typs I and Type III bags. On Thursday of the third week, each of 16 test subjects traversed the indoor course twics while carrying the Typs IV and Type V bags, which were designed and constructed following experience with the standard, Typs I, Typs II, and Typs III bags on the two coursss. In each design a compensating order was used to minimize ordsr sffects.

Interviews

Interviews were held after the final traversal of the course by sach group. Test subjscts were not permitted to discuss the bags until after the interview, and they were interviewed in the order in which they traversed ths course. An interview outline was followed closely, so that the same questions wers asksd all test subjects regarding the bags carried. Overall prefsrsncss for ths bags were recorded first and questions wsre then asked ooncerning sach bag, in ordsr, beginning with the most prefsrred and ending with ths least preferred bag. Answers and spontaneous comments were rscorded as nearly verbatim as possible.

Favorable and unfavorable comments were tabulated separately for each of the bage and in reply to the queetion "Is there anything elee which you would like to eay about any of the bage?".*

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*Duffel Bag Test - Interview Outline

(After test, interview one man at a time. Do not give men an opportunity to confer.)

"YOU HAVE NOW CARRIED (4, 3 or 2) BAGS OVER THE COURSE."

"YOU CARRIED THEM IN THE ORDER:" (Indicate order in which bags were carried.)

"HERE ARE THE BAGS: "(Arranged in order: Standard, Type III, Type I, Type II).

1 2 3 4

"POINT TO THE ONE YOU LIKED BEST TO USE! NEXT BEST! NEXT! LEAST! (Record answers here)

#1.a. "WHY DID YOU LIKE THIS ONE" (POINT) BETTER THAN THE OTHERS?"

b. "WHAT ELSE DID YOU LIKE ABOUT THIS ONE?"

c. "WAS THERE ANYTHING YOU DID NOT LIKE ABOUT THIS ONE?"

#2.a. "WHAT DID YOU LIKE ABOUT THIS ONE?"

b. "WHAT DID YOU NOT LIKE ABOUT THIS ONE?"

#3 (Same as #2)

#4 (Same ae #2)

IS THERE ANYTHING ELSE WHIOH YOU WOULD LIKE TO SAY ABOUT ANY OF THE BAGS?"

Results

Prsfsrences

Prsfersnces for use of the bags were tabulatsd. On the indoor course the standard bag was least preferred, being ranked laet by all 24 test subjects. The Typs I bag was liksd best by 13 subjects, the Type III bag wae liked best by 10 subjects, and one eubjsct ranked the Type II bag first. The diffsrence in preference for the Type I and Type III bags wae not statietically significant on the Sign tset. Howsver, both ths Type I and Type III bags wsre significantly preferrsd over ths Typs II bag ($p < .05$) and the Type I, Type III and Type II bags were all significantly prsfsrred to the standard bag ($p < .01$) on the same test.

On the outdoor couree,* thirteen of the 24 tsst subjects prsfsrred to use the Type I bag, 10 preferred the Type III bag, none preferred ths standard bag, and one expressed no preference among the three.** Twenty-two of ths 24 test subjects rated the standard bag as the one they liked least, one expreseed no prsference between the bags, and ons rated the standard bag over the Type I bag becauss it was easier to shift the weight of the standard bag. In summary, both ths Type I and Type III bage were significantly preferrsd over the standard bag ($p < .05$ on the Sign test). The emall 13 to 10 preference for Type III over Type I was not statistically significant.

Carrying positions

Thsre wers no etatistically significant differsnces betwesn ths Type I, Type II, and Typs III bags (all two strap bage) for the total number of poeitions in which each bag was carried ovsr eithsr ths indoor or outdoor courses.

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*The standard, Typs I and Type III duffel bags were complstely rspacked after the indoor courss was completed and bsfors they wsre carrisd over ths outdoor couree. More clothing and other eoft matsrials wers uesd and all hard objects which might dig into the tsst eubjscts eithsr were removsd or hsavily wrapped in soft materials. The repacked bags were somewhat fuller and a littls lighter than bsfore (55 3/4-pounds for each of ths three bage).

**The Type II bag was not used ovsr the outdoor course for two reasone. It was significantly lower in accsptability over ths indoor couree than wers Typss I and III, and human factors analyeie and test subject commente emphasized ths discomfort caussd by the "D" rings at the lower snd of ths straps. Ths rings dug into the lower part of the back. This wae particularly true of ths csnter ring, whioh did not sssm to havs any uee. Sincs the deeirabls oharactsrietics of Type II also were oharactsristic of Type I, thsy wsrs not loet from the study.

Typically, each subject slung each two-strap bag over his shoulders by the straps and allowed it to remain in that position, except for minor shifting of the positions of the shoulder straps, until the course was completed. The only exceptions were that one subject carried the Type III bag in two positions on the indoor course and another carried both the Type I and Type III bags in two positions on the outdoor course. In contrast, the standard bag was carried in from one to 10 different positions by individual test subjects with a mean of 5.3 positions on the indoor course and 4.6 on the outdoor test course. The standard bag differed significantly from all three of the two-strap experimental bags in this respect, 23 to 0 ($p < .01$ on the Sign test). Only one subject carried the standard bag over the entire course in the original position with the strap slung over one shoulder.

Comments concerning experimental bags carried over the indoor course

Standard

Almost nothing was liked about the standard bag, except that "you can get most of your things in it" and "the hand grip on the side of the bag is sometimes handy". Most of the unfavorable comments related to awkwardness, discomfort, and the difficulty of handling and carrying in any position. The least disliked methods of carrying were balancing the bag on top of a shoulder, or across a shoulder and the back of the neck.

Type I

Favorable comments on the Type I bag, which ranked first in acceptability, were that the straps were farther apart, more comfortable, balanced better, and the bag was easier than the others to put on and to carry. Common unfavorable comments were that the straps cut into the shoulders, hurt a little under the arms, and pulled too heavily on the outside of the shoulders.

Type II

Favorable comments on the Type II bag were similar to those of the Type I bag, but were fewer in number. Unfavorable comments on the Type II bag dealt mainly with the "D" rings being heavy, noisy and digging into the lower part of the back. The center "D" ring was particularly annoying. As with the Type I bag, criticisms were made of lack of padding on the straps. Also the straps on the Type II bag were considered difficult to adjust.

Type III

The padding on the shoulder straps of the Type III bag was generally liked and almost half of the test subjects thought it was the easiest bag to carry. However, there were some complaints that the straps were too close at the shoulders and pressed on the sides and back of the neck. Other complaints were that the balance was awkward, and that the placement of the straps was not liked.

There were also some criticisms of lumpy and hard items in the bags which dug in when the bags were carried over the indoor course in some positions. These criticisms were made of all four bags, but applied particularly to the standard bag, which was carried in more different positions than the others.

Comments concerning bags carried over the outdoor course

These bags were carried along with webbing equipment and the M-1 carbine, a total weight of 80 lbs.

Standard

For the standard bag, comments in response to "What did you like about this bag?" were typically to the effect that they did not like anything about it. More specific comments were that it was awkward, hard to handle, very hard to carry off balance, "The worse thing in the world to carry"; "There is no way to put the bag so it is comfortable"; "There is no comfortable way of carrying it"; "One strap really cut in the shoulder"; and "There seemed to be no comfortable way to arrange strap for carrying".

Type I

Most of these were more favorable, such as "Went on easier, was comfortable, felt balanced on my back, rode easier on my shoulders, weight was distributed better, and straps had less pull around the shoulders." Unfavorable comments included "Straps rumple up and out into your shoulders"; "Straps are too far apart"; "Straps didn't fit onto your shoulder good"; "Pulls too heavily on the outside of the shoulders where the muscles are weaker"; "Was harder to put on and take off"; "It kept slipping to one side"; and "Likes straps attached to the side instead of the middle of the back".

Type III

These aleo were more favorable than comments about the standard bag: "Liked padding on the straps, kept more on the center when worn with the combat pack, carriee a lot easier, comfortable on my ehouldere"; "Think the weight ie better distributed and the strape are padded"; "I liked the padding and it was eaey to carry". For Type III, unfavorable comments were: "Hard to adjuet, more difficult than Type I to carry, do not like etraps close together (at top)"; "Puts preseure on back of my neck"; "Straps are too tight around the shoulder"; "It is the best of the three, and still feel eome pressure on the back and eidee of the neck".

Comments concerning the euitability of the walking courees

As a check on the suitability of the courees, the last six subjects who traversed the indoor course, and the 24 subjects who carried the bags over the outdoor course were aeked two questions. In anewer to the question "Was the course long enough for you to tell the difference between the bags?" 28 answered "yes", one answered "no", and one failed to answer. In reply to the question "Was the course longer than it needed to be?" only two thought the course was too long, one thought it was too long for the standard bag only, one thought it was not long enough, 24 thought that it wae not too long, and two did not answer. It appeare juetified to conclude that the couree were of reaeonable length and difficulty for the purpoee for which they wers used.

Evaluation of Improved Type IV and Type V bage

Conetruction of Type IV and Type V bags

All the comments made following traversal of the indoor and outdoor courses were read by the experimenter and by repreeentatives of the Clothing and Equipment Development Divieion (C&EDD) for suggestione for improving duffel bag design or conetruction. An improved Type IV duffel bag baeed on the Type III prototype and an improved Type V bag baeed on the Type I prototype were constructed by C&EDD and carried over the indoor couree. Both bags included padded ehoulder etraps and adjuetable aluminum bucklee ae used in the etandard lightweight webbing. The design and conetruction of both bage were improved in accordance with commente made by the teet subjects and as a reeult of the knowledge, experience and skill gained by C&EDD pereonnel while designing and conetructing load-carrying equipment.

Sixteen teet eubjecte who had already carried the etandard, Type I, Type II and Type III bage now carried Type IV and Type V bags over the indoor couree, following the eame procedurее except for modificatione required by the uee of only two bags.

Preferences

Eight teet eubjecte preferred the Type IV bag and 8 preferred Type V.

Comments

The most common reason for preferring either bag was the comfort with which it could be carried. The group was evenly divided regarding which bag was more comfortable. Most subjects coneidered both bage to be good onee, and differencce between them were described as small. The padding on the strape and the ease of adjueting the etrape were the best liked features.

Comparisons between Type IV and Type V bage and the other duffel bage

Because of non-availability of additional test subjecte and an immediate need to uee the reeulte of the study, no direct experimental comparisons were made between the Type IV and V bags and the standard and Type I, II and III bags. However, the 16 test eubjecte were aeked to expreee a preference between Type IV and V bags and thoee they had carried earlier. Of the 14 who expreseed a definite opinion, 11 preferred the Type IV and V bags, three did not think there was much difference between the two eets of bage, and none preferred the Standard or Type I, II or III bage. In general, the group judged the Type IV and V bage to be far euperior to the standard bag and definitely improved in comfort and convenience ae compared with the Type I, II and III bage.

Conclusione

When carried over the indoor couree, the Type I, II, and III duffel bage (all two-etrap bage) were significantly preferred by the test eubjecte over the etandard bag, and Type I and Type III were eignificantly preferred over Type II. There wae no eignificant difference in preferenoe between Typee I and III.

The Type I and Type II bags were carried over the entire indoor course in the same position without a major shift by all 24 test subjects, and only one test subject shifted the position of the Type III bag. In contrast, the standard bag was carried in over 5 different positions by the average test subject, and only one test subject carried this bag in the same position over the entire course.

The padding on the straps of the Type III bag was generally liked.

The test subjects' comments regarding the advantages and disadvantages of the strap arrangements on the Type I and Type III bags differed greatly and were sometimes contradictory.

When carried over the outdoor course with field equipment the Type III and Type I bags were significantly preferred over the standard bag, but did not differ significantly from each other in acceptability.

The standard bag was carried over the outdoor course in many more positions (mean is 4.63 per test subject) than the Type I bag (mean 1.04), or the Type III bag (mean 1.04).

The Type IV and Type V bags were preferred by equal numbers of test subjects.

The test subjects' comments regarding the advantages and disadvantages of the strap arrangements on the Type IV and Type V bags differed greatly and were sometimes contradictory.

Although no direct experimental comparisons were made, comments indicated that in general the Type IV and Type V bags were definitely more acceptable than the other bags used in the test. Best liked features were the padded straps and the easily adjustable buckles on the carrying straps.

Acknowledgments

A number of Personnel, both military and civilian, were involved in this study, and their participation is greatly appreciated. Efficient cooperation was received from the 24 Test Subjects and also from Mr. Fred Wardrop and Sergeant Gibson Nash of the Climatic Research Laboratory Coordination Office; Mr. John Slauta, Mr. Charles Sorrento, Mr. Eldon Metzger, and Mr. John Driscoll of the Clothing and Equipment Development Division; and Mr. Brian Crist, Mrs. Rosamond Kopelman, Captain Harold Kiess, Lt. Stephen Lacy, SP-4 Alfred Boileau and SP-4 Earl Summers of the Behavioral Sciences Division of the Pioneering Research Laboratory. Specialist Summers also prepared the duffel bag drawings. Specialist Boileau made an important contribution by observing the test subjects as they traversed the walking courses and by recording their behavior in relation to the bags carried.

APPENDIX

Descriptions, drawings and carrying positions of duffel bags.

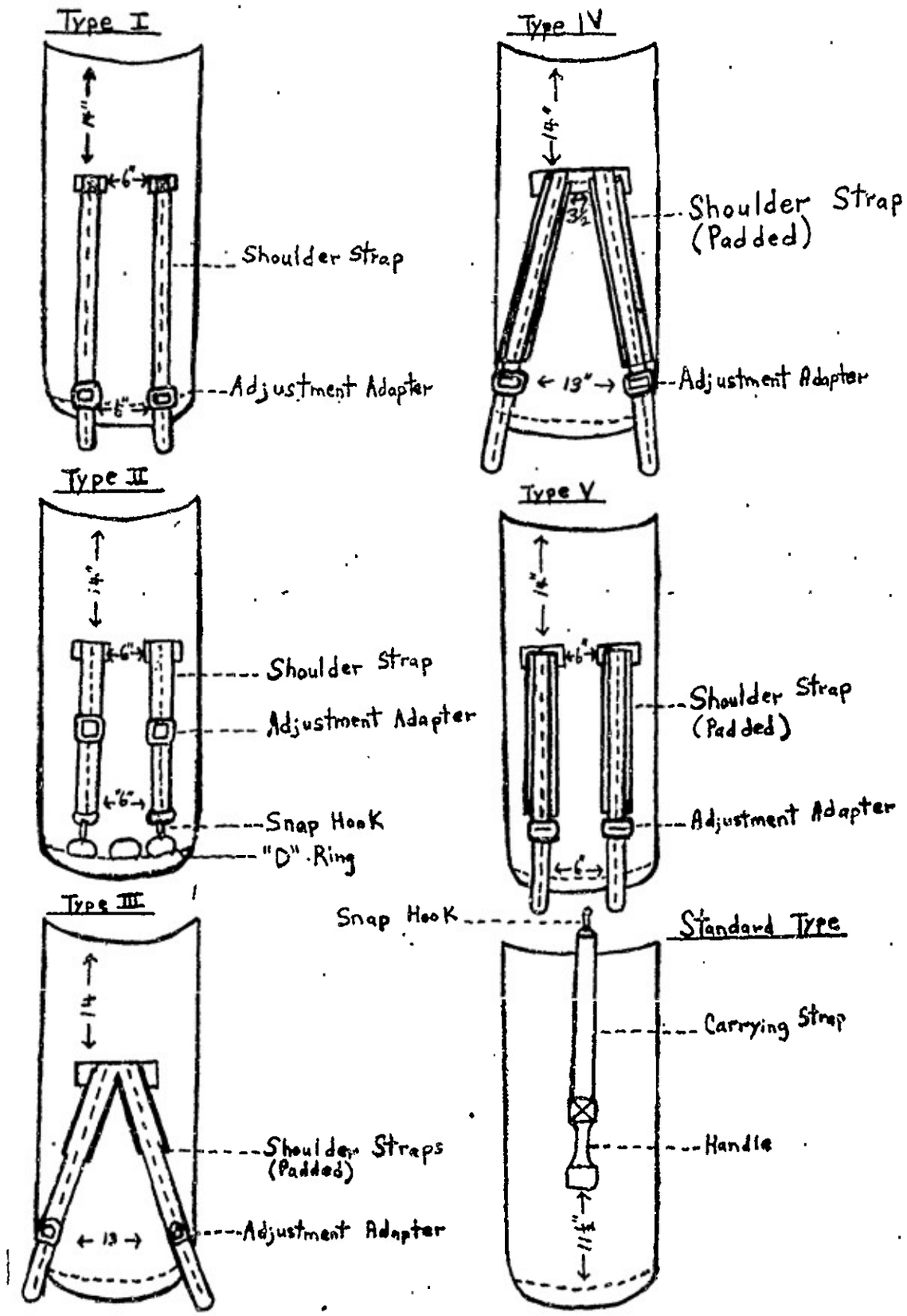
The experimental bags were made in accordance with rough prototypes constructed at Fort Lee and described in an "Evaluation Resume of Modified Duffel Bags", by SGT James H. Stripe, U.S. Army General Equipment Test Activity, Fort Lee, Virginia.* Each one was identical in size, shape and material to the current standard bag, but differ as follows:

Type I - Shoulder straps were provided. They were sewn at the top approximately 14 inches from the top of the bag, and the straps were approximately 6 inches apart. The straps were made of 1-3/4 inch wide cotton duck material and were 32 inches long. Two buckles, located on the bottom of the bag, were separated approximately 6 inches apart. The straps were threaded through the buckle and adjusted for fit.

Type II - Identical in design to the Type I bag, except that it was provided with three "D" rings at the bottom of the bag and each shoulder strap had an adjustment buckle and a snap hook. Each strap could be attached to either the "D" rings located on the side or to the "D" ring located in the center.

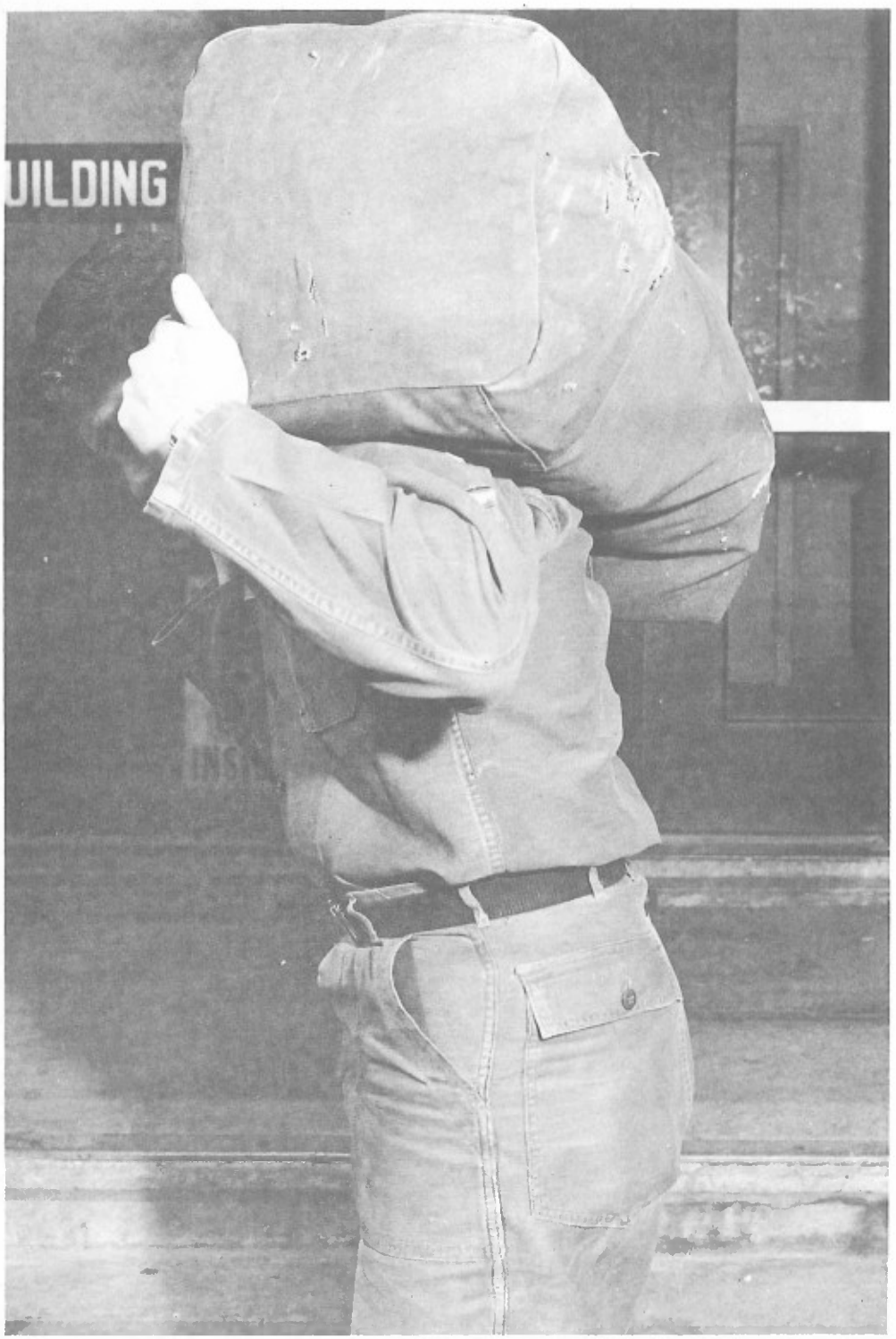
Type III - Identical in design to Type I bag, except the shoulder straps were located together at the top and separated about 15 inches at the bottom.

*undated report.

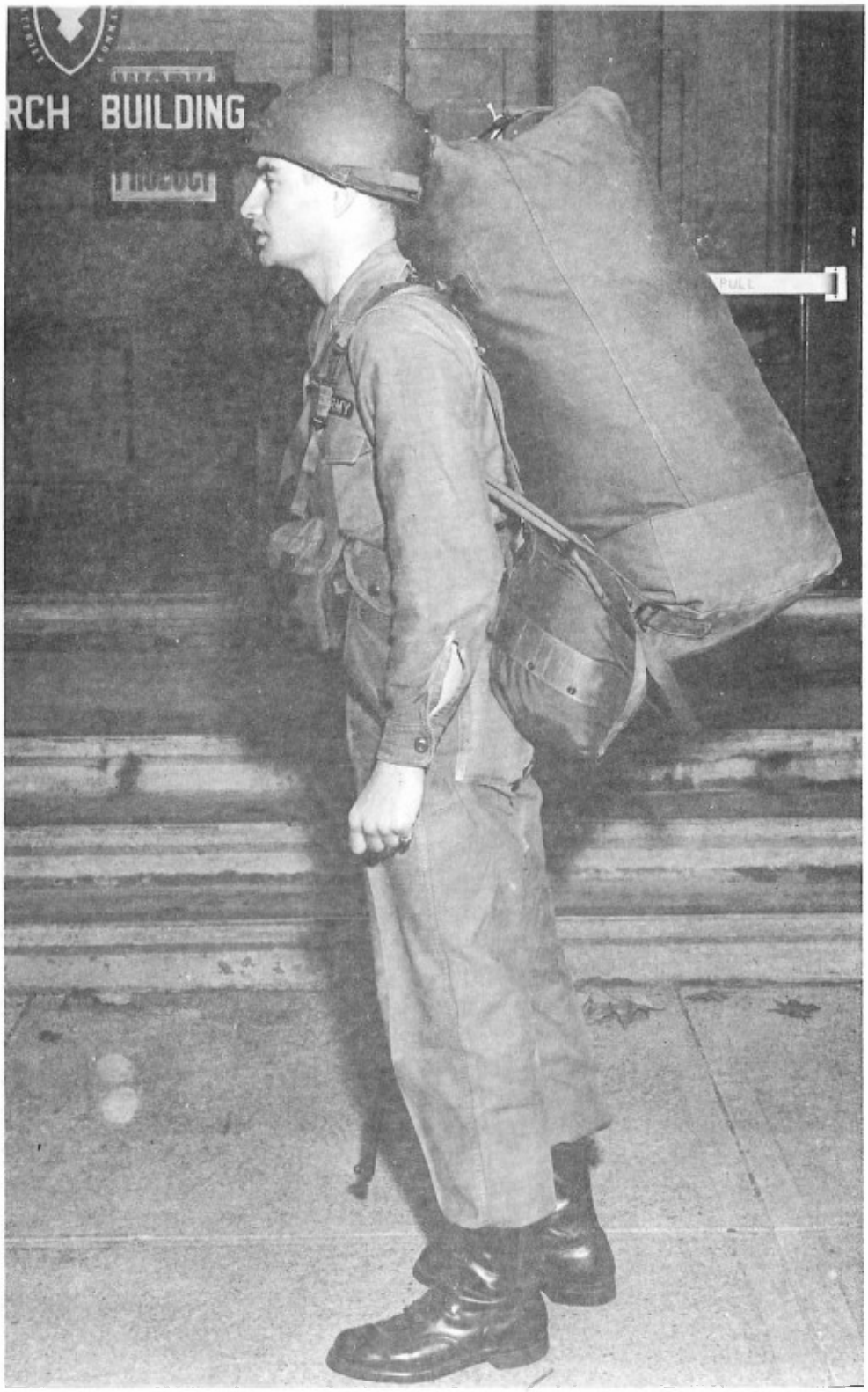


Duffel Bags - Standard and Types I, II, III, IV, and V.

Standard Duffel Bag, Slung Over Shoulder by Strap



Standard Duffel Bag, Balanced on Shoulder and Back of Neck



Type I Experimental Duffel Bag with Field Gear, Side View

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13. ABSTRACT

The standard one strap army duffel bag, three experimental two-strap bags, and later two improved experimental two-strap bags were used by volunteer test subjects to carry loads over indoor and/or outdoor courses. The test subjects were observed and their handling of the bags recorded as they traversed the courses. The standard army bag with one shoulder strap was carried over the course by the average subject in four of five different positions as compared with the two-strap bags which were seldom carried in more than one position. Interviews were held on each day immediately after the final traversal of the course by each group to record individual preferences and comments concerning the bags. All three experimental (two-strap) bags were definitely preferred over the standard one strap design, and two experimental designs proved to be equally acceptable and definitely superior to the third experimental design. Later the two improved two-strap bags based on the best two of the three original experimental designs were compared and found to be equally acceptable. Although no direct experimental comparisons were made, comments indicated that the improved bags were considered to be superior to and more acceptable than the experimental bags which were tested first.

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