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TECHNICAL REPORT
75-91-CEMEL

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**HISTORY OF THE DEVELOPMENT OF
THE LINCLOE LOADCARRYING EQUIPMENT**

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by

Eldon C. Metzger

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July 1975

UNITED STATES ARMY
NATICK DEVELOPMENT CENTER
NATICK, MASSACHUSETTS 01760



Clothing, Equipment & Materials Engineering Laboratory
CEMEL-148

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20. ABSTRACT (cont.)

in 1965 calling for the development of Lightweight Individual Clothing and Equipment (LINCLOE). After years of requirement changes, prototype failures and with continuous close cooperation between the user and the developer the present system was adopted as Standard A, 17 January 1973, and the task was terminated.

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PREFACE

This report, in narrative form, describes work carried out in the development of improved loadcarrying equipment as part of the Army's program for the development of lightweight individual clothing and equipment (LINCLOE). Although referred to as the LINCLOE Loadcarrying Equipment (LINCLOE LCE) all during its development stages, the designation was changed after its adoption to All-Purpose Lightweight Individual Carrying Equipment (ALICE).

This investigation was performed under Project No. 1J664713DL40 - Clothing and Equipment.

The author wishes to thank Major I. E. Stefaniw, Test Officer, US Army Infantry Board for his contributions to the final pack design and curved shoulder straps which improved significantly the comfort when wearing the packs; Mr. Michael M. Arslanian, NDC, for his assistance in the development of the hardware and pack frame; and the members of the Personal Equipment Branch, Mr. T. Strain, Mr. W. Lomba and especially Mr. C. Sorrento for their outstanding support and in the fabrication of prototype items.

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Based principally on the conclusions and recommendations of "A Study to Reduce the Load of the Infantry Combat Soldier", 1962,¹ and "A Study to Conserve the Energy of the Combat Infantryman", 1964,² a Quantitative Materiel Requirement (QMR),³ was established in 1965 calling for the development of Lightweight Individual Clothing and Equipment (LINCLOE).

Although the development of the LINCLOE loadcarrying equipment was not officially started until after approval of the task by the Army Materiel Command Technical Committee (AMCTC) on 27 April 1966, development of lightweight loadcarrying equipment (LCE) really began in 1961 with the development of a lightweight rucksack made of nylon fabrics and an aluminum frame which weighed 3 pounds (1.4 kg) as compared to the 7.5 pound (3.4 kg) cotton and steel item which it replaced (Fig. 1).

The development of this lightweight rucksack led to an informal inquiry by officers of the infantry community as to the possibility of reducing the weight of the M-1956 cotton equipment (belt, suspenders, canteen cover, first aid/compass case, intrenching tool carrier, ammunition cases, and combat pack)(Fig. 2). As a result of this interest, a set of this equipment was made in 1962, substituting available nylon materials for the cotton. This set of nylon equipment weighed slightly more than 3 pounds (1.4 kg) as opposed to 5 pounds (2.3 kg) for the cotton items. These two items, the lightweight rucksack and the set of nylon M-1956 equipment, formed the basis for that portion of the LINCLOE QMR dealing with LCE. Annex A to the QMR set a goal of 3.3 pounds (1.5 kg) for the individual LCE and 3 pounds (1.4 kg) for the rucksack.

It was decided that the design of the new equipment would follow basically that of the standard equipment with material changes from cotton to nylon and replacement of the brass and steel hardware with aluminum or plastic items. The design of the pack frame would be changed by eliminating both the horizontal and vertical curves of the standard frame, thereby, providing a stable base for items carried on it when used as a packboard type item. Also, the design was changed to eliminate the side extensions at the lower part of the frame which often became snagged in use and interfered somewhat with arm movement.

Even though they were not considered at the time of the establishment of the QMR and the subsequent Technical Characteristics (TC's)⁴ covering the LCE which were adopted in January 1966, weapons changes and consequently, ammunition carrying requirements which were to have a significant bearing on the evaluation of the equipment design began to occur prior to establishment of the TC's.



Figure 1. Lightweight Rucksack



Figure 2. M-1956 Cotton Loadcarrying Equipment

Before our involvement in Vietnam, the Army was using two rifles, the M-1 and the M-14. A cotton ammunition case was provided that accommodated either 7 clips of the M-1 ammunition in a bandoleer folded accordion fashion or 3 magazines of the M-14 rifle ammunition. Early in the Vietnam conflict the M-16 rifle began to come into use. A 20-round ammunition magazine was used with this rifle. Initially, the same ammunition case as used for the M-1 and M-14 rifle ammunition was used for the 20-round magazine for the M-16 rifle, but as the magazines were much shorter than the M-14 magazines, they were difficult to extract from the case. A shorter case was then provided for the M-16 rifle magazines; the first procurements were of cotton items and later ones, of nylon, because of durability problems being encountered with cotton LCE in Vietnam.

In August of 1965 the US Army Weapons Command (WECOM) in a letter⁵ to the US Army Combat Developments Command (CDC) requested an ammunition case for a 30-round magazine for the M-16 rifle.

Also, in this same time frame the US Army in Vietnam (USARV) was asking for a vest to carry the ammunition for the M-79 Grenade Launcher. In December 1965, US Army Natick Laboratories (NLABS) in a letter⁶ to CDC requested establishment of a valid requirement for an M-79 Ammunition Vest. In reply by 1st Indorsement,⁷ to the NLABS letter, CDC established a valid requirement for the M-79 Ammunition Vest and "a vest for ammunition magazines for personnel armed with the M-14 or M-16 automatic rifle" and recommended that these items be developed as components of the LINCLOE leadcarrying system and that detachable pockets for the M-14 and M-16 ammunition be considered for use with this vest. In March of 1966, HQ, Department of the Army, Office of the Chief of Research and Development approved⁸ an AMC request for "initiation of tasks to develop ammunition vests for personnel armed with M-79, M-14 and XM-16E1 weapons" and directed that the tasks be established under the LINCLOE LCE project and stated that the TC's for the vest would be incorporated as annexes to the LINCLOE QMR.

The design effort went slowly, due to the concentration on the design and development of items to meet the requirements of the Vietnam conflict, although projects were initiated investigating the feasibility of replacing much of the steel and brass hardware with aluminum or plastic items. A vest for carrying the ammunition of the M-79 grenade launcher was designed, tested and adopted (Fig. 3), but no effort was expended on the design of a vest for ammunition magazines for personnel armed with the M-14 or M-16 rifles at this time, due to the pressures of the Vietnam requirements, and such an item was not presented at the Engineering Concept Review,⁹ held at NLABS, 15 March 1967. The concept approved at the meeting was for a belt to be supported by suspenders, to which could be attached component items such as ammo cases, canteen cover, intrenching tool carrier, first aid/compass case, machete sheath, bayonet knife scabbard, etc. (Fig. 4). A pack somewhat larger than the M-1961 cotton pack would be provided which could be attached for carrying either on the belt at the small of the back, on the shoulders or attached to a frame. The frame with shoulder straps and removable cargo shelf would be designed to be worn over the suspenders and belt. At this meeting, a requirement for an additional pack much larger than that to be provided with the LCE was discussed, but decision as to its inclusion was to be submitted to DA for approval.



Figure 3. M-79 Grenade Ammunition Vest

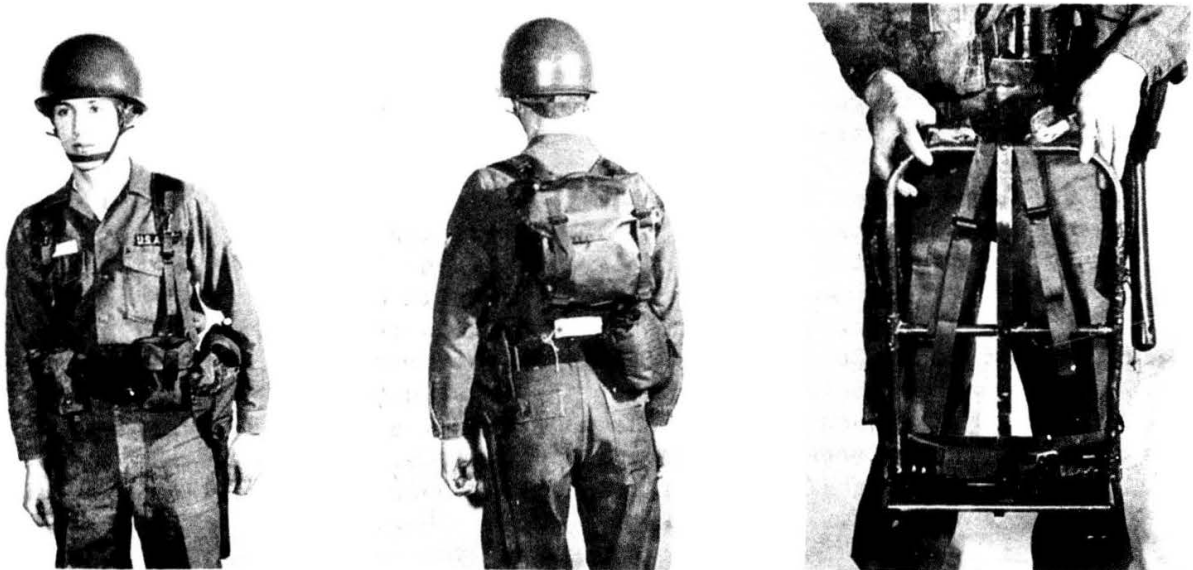


Figure 4. First Prototypes LINCLOE Loadcarrying Equipment

In the year that followed the Engineering Concept Review, the following items were developed:

a. A belt of the same basic design as the standard, but made of nylon webbing, aluminum eyelets and having a plastic quick-release buckle.

b. A vest (Fig. 5), to replace the suspenders, made of nylon mesh fabric and webbings with adjustable straps which attached to the upper row of eyelets in the belt. The vest had nylon webbing loops both front and back to which the various ammo cases and other items could be attached by keepers with slide. Front closure was accomplished by a combination of Velcro and plastic snap fasteners. A quick adjusting take-up strap was in the back to provide fit.

c. A small nylon pack (Fig. 6), a little larger than the M-16 item. It had a form-fitting top; a waterproof throat; a single pocket across the front on the outside and an envelope pocket against the back on the inside; and a web equipment carrying strap on each side. This pack was designed to be worn on the shoulders or attached to a pack frame either in a high or low position. To attach the pack to the frame two metal hooks were riveted to the top of the pack which slipped into loops attached to the frame and two metal loops were riveted to the bottom of the pack which were engaged by the claws of clamps riveted to the frame. These held the pack securely to the frame. To keep the hooks and loops properly spaced they were mounted on acrylonitrile-butadiene-styrene (ABS) plastic strips sewn vertically to the back of the pack. There was a large "D" ring at the top of the pack and a small one at the bottom on each side to which the shoulder straps attached when the pack was to be worn on the shoulders without the frame.

d. A large pack (Fig. 7) intended to be used by troops operating in Alpine and Arctic environments as well as by Special Forces troops. This pack was developed even though final approval had not yet been received. The top of this pack was closed by means of a draw cord secured with a plastic catch. The top opening was covered with a flap which contained a pocket. Three outside pockets were located at the lower rear of the bag. The two side pockets were tunneled with an equipment hanger above each. The center pocket lid was secured by a buckle, snap fastener, strap arrangement, which provided adjustment as well as rapid access to the contents of the pocket. There were two equipment hangers located on each side with a web loop beneath each, through which securing straps could be placed. There were also two loops for securing straps on the bottom of the bag. This pack was equipped with the same means of attaching it to the pack frame as was the small pack. The two packs, small and large, could be used interchangeably on the frame.

e. An aluminum pack frame (Fig. 8). The vertical sides and horizontal top bar were formed of a single piece of tubing; the center horizontal and vertical bars were of flat stock. A shaped horizontal piece of flat aluminum at the bottom of the frame held the lower back strap in position and maintained the spacing of the side members. The padded upper shoulder straps attached to metal "D" rings at the top of the frame with aluminum snap hooks. These upper shoulder straps were equipped with spring loaded aluminum buckles through which the lower shoulder straps were threaded, and which provided rapid and secure adjustment as well as a quick release capability. These lower shoulder straps had snap hooks which engaged in holes on each side of the bottom horizontal frame member. The shoulder straps



Figure 5. Vest, Combat



Figure 6. Pack, Combat, Small



Figure 7. Pack, Combat Large



Figure 8. Pack Frame

were made removable, so that they could be used with the pack. There were four clamps, two on the inside of both the center and lower horizontal bars which were used to secure the pack to the frame. The lower back strap was of 3-inch (76 mm) wide nylon webbing which threaded through slots at each side of the lower horizontal bar and was adjusted and held in place with an adaptor, quick fit.

f. Ancillary equipment included the canteen cover, ammo case, and first/aid compass case which were nylon copies of the standard items and the intrenching tool carrier which was made of nylon duck with an ABS plastic protector on the inside to prevent damage from the sharp edges of the tool and with the top flap secured with two plastic snap fasteners. These items were presented at the Design Characteristics Review and Prototype System Review (DCR/PSR),¹⁰ held concurrently at NLABS, 26 March 1968. It was recommended that the Engineering/Service Test (ET/ST) be carried out on the LCE design reviewed and with the understanding that any design changes required prior to testing would be accomplished without holding another Review. Annex A, Item 4 of the QMR was amended by letter,¹¹ from OCRD, DA to USAMC and USACDC dated 3 June 1968, making official the requirement for a large pack (rucksack).

In July of 1969, test items manufactured by the US Army Support Center, Richmond, VA under the supervision of NLABS were sent to the US Army Infantry Board (USAIB), Ft. Benning, GA; US Army Tropic Test Center (USATTC), Ft. Clayton, C.Z.; US Army Arctic Test Center (USAATC), Ft. Greely, AK; and the General Equipment Test Activity (GETA), Ft. Lee, VA. Some of the test items differed significantly from those presented at the DCR/PSR. The major changes were as follows:

a. The belt was changed by eliminating the center row of eyelets and replacing the single-end hooks at each end with double-end hooks which engaged in the two outside rows of eyelets for size adjustment.

b. Two plastic prong fasteners were used to secure the front of the vest replacing the combination velcro/snap fastener closure.

c. Plastic keepers with slide replaced the steel ones on the first aid/compass case and the water canteen cover.

d. A plastic intrenching tool carrier, injection molded of ethylene vinyl acetate replaced the nylon fabric item with the protective plastic insert.

Testing started in July at USAIB; September at USATTC; October at USAATC; and November at GETA.

On the 19th of July 1969, the Infantry Team (composed of the Commanding General, Fort Benning, GA; Commanding General of the Infantry School; Commanding Officer of the Combat Developments Command Infantry Agency; and the Commanding Officer of the Infantry Board) met at Fort Benning, GA,¹² to discuss improvement of infantry items of individual clothing and equipment. The LINCLOE LCE Project Officer from NLABS was invited to attend this meeting and present the status of loadcarrying items. The Commanding General of Fort Benning was unaware of the effort underway to improve the LCE as well as other items of individual clothing and equipment. As a result of the Project Officer's attendance at this meeting, a Non-commissioned Officers' (NCO) Board was established to suggest improvements to items, and arrangements were made for the Infantry Team and NCO Board to visit NLABS for briefings on developments and an exchange of ideas. This visit took place on 5-6 August 1969. The NCO Board

had reviewed the LINCLOE LCE under test and the nylon M-36 equipment being provided our forces in Vietnam and arrived at characteristics which they considered desirable. These characteristics, many of which were already incorporated in either standard equipment, that under test, or in superseded models, were as follows:

a. Belt:

- (1) Have a quick release capability.
- (2) Provide simple means of belt adjustment.
- (3) Eliminate center row of eyelets.

b. Suspenders (Provide the following):

- (1) Wider shoulder straps.
- (2) One size to fit all people.
- (3) Thumb type adjustment (pinch-type buckle) for straps with the ends folded to retain the straps in the buckles.
- (4) Keepers on all straps.
- (5) Three straps only on suspenders (single strap in back).
- (6) Piece of nylon web across forward ends of padding to hook flashlight, compass, etc.
- (7) Padding that will not roll from prolonged use or wet weather.
- (8) All snaps and hooks made of plastic.

c. Canteen Cover:

- (1) Remove insulation.
- (2) Enlarge size.
- (3) Retain pocket for water purification tablets.
- (4) Use plastic keepers with side for attachment to belt.

d. Intrenching Tool Carrier:

- (1) Make larger to accept latest modification of tool.

e. First Aid/Compass Case:

- (1) Make large enough to accept compass and selected first aid items.

f. Case, Small Arms Ammunition:

- (1) Have a means of retaining magazines in the pouch and in their proper position when one is removed.
- (2) Change the method of carrying the grenades on each side of the ammo case to a pocket with a retaining strap.
- (3) Increase the size of the drainage eyelet in the bottom of the case.
- (4) Use the plastic-pronged latch as the closing device.

g. Combat Pack:

- (1) Have two sizes of packs with the smaller one being two-thirds the size of the large pack under test.

- (2) Have three large and three small pockets on the outside of each pack with extra straps and eyelets on the outside for tie-down of equipment.
- (3) Include a divider within the pack on the back position to hold a radio in the pack.
- (4) Provide waterproof inserts.
- (5) Provide quick release devices on the shoulder straps.
- (6) Have adjustment straps on inside of pack to reduce size when desired.

h. Pack Frame:

- (1) Provide 6" (152 mm) to 8" (203 mm) length adjustment at bottom of frame.
- (2) Provide a crossbar (shelf) that can be adjusted the full length of the frame.
- (3) Add a second backstrap at approximate mid-point of frame.
- (4) Provide rot-resistant shoulder straps.
- (5) Make shoulder straps removable for use as carrying straps.

i. M-60 Machine Gunners Vest:

- (1) Provide a mesh vest capable of carrying two M-7 assault packets or one T-7 pouch.

j. M-79 Grenade Vest:

- (1) Make entire vest of nylon netting, except grenade pockets.

It was pointed out to the Infantry Team and NCO Board members at this time that we could not add 3 small pockets in addition to the 3 pockets already on the outside of the small pack because of lack of space; that it would be a time consuming effort to develop an adjustable pack frame and that the chances of coming up with a satisfactorily functioning lightweight item were quite small; and that it was necessary to sew the grenade pockets to a fabric base rather than mesh on the M-79 Grenade Vest to control distortion of the vest. It was agreed that NLABS would provide six sets of equipment which would include as many of the agreed-to-changes as possible for evaluation by the Infantry Team to determine (1) the extent NLABS fulfilled the recommendations and improvements agreed to with the NCO Board; (2) to what extent the selected modified items met the existing requirements of the QMR; and (3) to provide the position to be taken by the Infantry Team on the clothing and equipment provided by NLABS.

Right after testing of the LINCLOE LCE was initiated many failures began to occur. These were as outlined below:

a. The "D" rings at the top of the pack frame to which the shoulder straps attached separated, since they were not welded closed as required.

b. The ABS plastic strips sewn to the back of the small packs and used to maintain the spacing of the hooks and loops broke.

c. The plastic keeper with slide used on the canteen cover broke.

d. The plastic snap fasteners used as closures on the canteen cover and intrenching tool carrier broke.

e. The retaining plates of the plastic-pronged latches used as closures on the combat vest came off, resulting in loss of the latches.

f. The spot welds holding the top plate on the pinch-type buckles used on the adjustment straps of the combat vest failed.

g. The aluminum rivets used to attach the hooks to the small combat pack failed.

h. The paint on the pack frame chipped and scratched.

Because of these failures the test at the Tropic Test Center was cancelled on 30 December 1969. The test of the small packs at the Infantry Board was stopped, and twenty-five of these packs were modified by replacing the ABS plastic strips used to properly space the hooks and loops with a high density polyethylene material. Although this seemed to arrest the breakage problem of the strips, the hooks at their top popped-off because of rivet failures, and in March 1970, the test of the packs had to be stopped again.

In January 1970, the Infantry Board completed the evaluation of the six sets of modified equipment for the Infantry Team, and on 17 March 1970, a conference was held at Ft. Benning to review the results of this evaluation. Each item evaluated was discussed, and agreement was reached as to the changes that should be made to make each item acceptable. It was also agreed that the test of the LINCLOE LCE should be stopped and new items be designed to reflect the characteristics developed as a result of the evaluation of the six sets of modified LCE by the Infantry Team.

On 25 March 1970, USACDC in a letter ¹³ to USAMC referencing the 17 March meeting recommended termination of the test of the LINCLOE LCE and stated that a change to the QMR was being staffed and additional information would be provided when available. In a 1st Indorsement to this letter to NLABS dated 7 April 1960, USAMC concurred in the recommendation to terminate the test.

In a letter ¹⁴ to USAMC dated 15 April 1960, USACDC described the next generation of LCE for service testing based on the agreements of the 17 March meeting. The following items were recommended when modified as indicated:

a. Belt, Individual Equipment: (Fig. 9A)

Design as furnished for evaluation with two (one upper and one lower) rows of eyelets and aluminum quick release buckle, as furnished for Product Improvement Test of M-1956 LCE (completed 1967).

b. Cover, Water Canteen: (Fig. 9D)

Design as furnished for evaluation, but utilizing improved closure snaps.

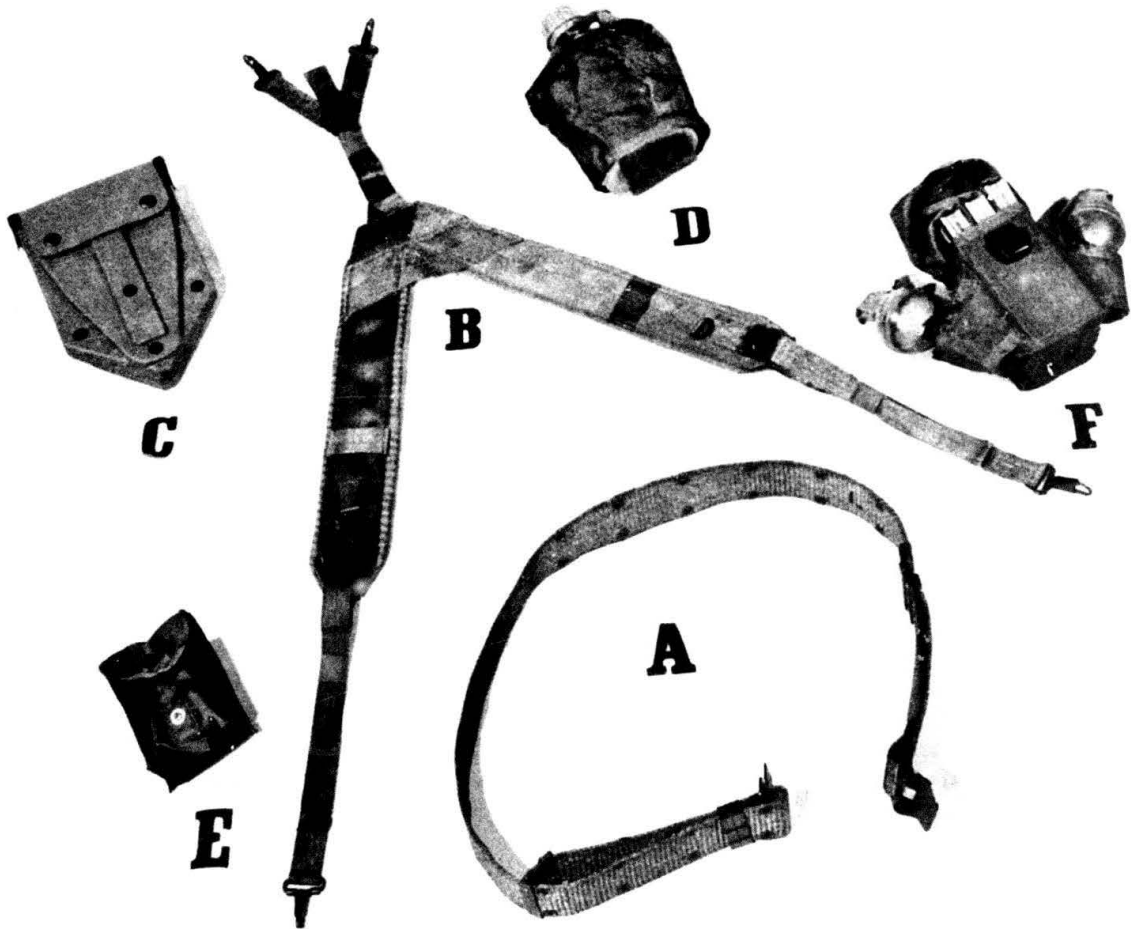


Figure 9. Fighting Load Items

c. Case, Small Arms Ammunition: (Fig. 9F)

Design as furnished for evaluation with modification of nylon suspension clip band to improve stability and with a plastic front closure device (male-female) as furnished for Service Test of LCE.

d. Carrier, Intrenching Tool: (Fig. 9C)

Design as furnished for Service Test of LCE except utilizing improved closure snaps.

e. Suspenders, Loadcarrying: (Fig. 9B)

Design as furnished for evaluation modified to provide a small "Y" strap in the back to obtain a four-point suspension system for better balance.

f. Case, Field First Aid, Individual: (Fig. 9E)

Information on this item to be provided upon receipt of data from the Office of the Surgeon General.

g. Frame, Aluminum, Rucksack: (Fig. 10)

Design as furnished for evaluation, except use hard anodizing process on aluminum framing. Recommended development of an adjustable rucksack frame be considered under the QMDO for Advanced Design Individual Clothing and Equipment System (ADICES).

h. Pack, Nylon, Combat (Large): (Fig. 11)

Design as furnished for evaluating, except use improved closure snaps and waterproof inserts. Also, recommend the three small pockets be enlarged to accommodate one M-16 magazine.

i. Pack, Nylon, Combat (Small): (Fig. 12)

Design as furnished for evaluation, except use improved closure snaps and include waterproof inserts and a large internal compartment as provided in the large pack.

j. M-60 Ammunition Vest: (Fig. 13)

Design as furnished for evaluation, but modify to incorporate a size and adjustment system to provide a more suitable fit for all individuals.

The letter also recommended that a coordination meeting be held at the earliest possible date to discuss necessary changes to the LINCLOE QMR and related technical characteristics. In the first indorsement to this letter to NLABS, USAMC directed that NLABS prepare revisions to the 1965 TC's and to Annex A of the QMR; provide estimated costs and a schedule for providing modifications; provide recommendations for DA approval and convene a meeting as requested in basic letter.

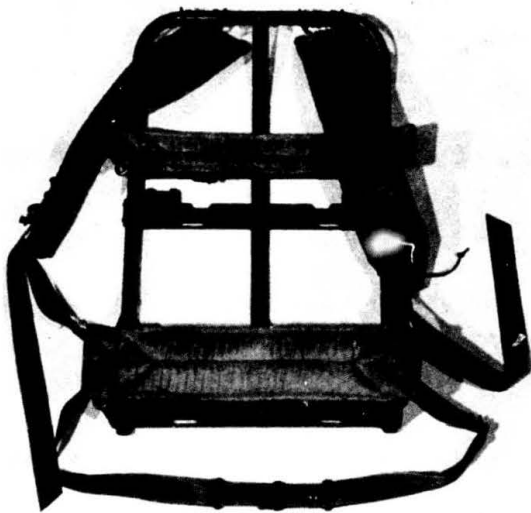


Figure 10. Frame, Aluminum, Rucksack



Figure 11. Pack, Nylon, Combat, Large



Figure 12. Pack, Nylon, Combat, Small



Figure 13. M-60 MG Ammunition Vest

This meeting ¹⁵ was held at HQ USAMC on 7 May 1970, and it was agreed that USACDC would develop essential and desirable characteristics on the individual items for approval by DA.

During April and early June, a prototype system of LCE was fabricated as described in USACDC letter of 15 April 1970. This set of equipment was presented to the NCO Board and Infantry Team for review at Ft. Benning, GA, 18-19 June 1970.

On 29 July 1970, Major Williamson, USACDC and Mr. Metzger, Project Officer, met at NLABS and drafted a revision of the LINCLOE QMR as it pertained to LCE including the characteristics for each individual item. This was based primarily on the agreements reached at the 17 March 1970 meeting. However, there was one major exception. A third pack was added to the system by the Project Officer. This was the small combat pack developed for use in the LINCLOE system. It was felt that even though it had been considered too small by the NCO Board, it should be retained and its disposition determined as the result of service test. The bag of the Tropical Rucksack had been modified to meet the NCO Board requirement for a small pack by adapting it to be worn either on the back without a frame, or attached to the pack frame.

A meeting ¹⁶⁻¹⁷ was held at DCSLOG, 30 July 1970, to review the actions required and tentative time schedules involved in developing the second generation of the LINCLOE LCE. The draft revision to the QMR was presented, and it was agreed that it would be staffed world wide through CDC liaison elements and that the introductory portion or the cover letter of transmission to DA should provide rationale and justification to support the significant weight increase. This increase was in contradiction of past studies on the conservation of the soldier's energy by lightening the weight of his clothing and individual equipment.

In a letter, ¹⁸ dated 25 September 1970, USACDC forwarded to DA the proposed changes to the QMR for approval. DA approved these changes subject to incorporation of their comments which were included as an inclosure to a letter, ¹⁹ dated 2 October 1970 to USACDC and USAMC. The Prototype Systems Characteristics Review ²⁰ was held at NLABS, 5 October 1970. The DA-approved QMR and corresponding TC's were reviewed and agreed to with minor changes. The prototype system based on the changed QMR and TC's was demonstrated.

Fifteen sets of the LCE representing the latest thinking and fabricated in-house by NLABS were shipped to USAREUR 17 November 1970, for evaluation in response to a directive from USACDC (letter of 9 April 1970).

In December 1970, a work order was placed with the US Army Support Center, Richmond, VA for fabrication of 300 sets of the latest design LCE for service test. When completed, the test items were sent to NLABS, assembled and sent to the following test sites in August 1971: USAIB, Ft. Benning, GA; USAATC, Ft. Greely, AK; USMC, Quantico, VA; and 10th Special Forces, Ft. Devens, MA. During the pre-test inspection of the test items by the Infantry Board at Ft. Benning, it was discovered that the plastic tabs at the inside top of each pack between the metal hook back-up plate and the pack fabric were broken. These plastic tabs were intended to prevent cutting of the pack fabric by the metal plate under use stress. In addition, the quick release pull tab on the waist straps would catch and not release. The faulty packs and waist straps were returned from the USAIB,

and USAATC to NLABS for modification. The modified items were returned to the test sites in November of 1971 and all test items which had been held up pending completion of the modification to the packs and waist strap were returned to the USAATC, Ft. Clayton, C.Z. The service test was initiated at this time.

By March of 1972, so many deficiencies and shortcomings had developed in the equipment that the US Army Test and Evaluation Command requested that the test at the USAIB be suspended until test items could be repaired or replaced, but that the Panama and Alaska tests continue to determine that no new failures were the result of specific environmental problems. A meeting ²¹ was held at Ft. Benning, 6 April 1972 with representatives of USAMC, USAIB, USATECOM and NLABS attending, at which the Test Officer gave a detailed report of the failures. As the result of the discussion which followed, it was agreed that NLABS would take the following actions in order that the test could be resumed by 9 June 1972:

a. Provide fifty pairs of combat suspenders in which the one-inch pinch-type adjusting buckles would be replaced with the standard non-slip buckles. The teeth in the pinch-type buckles bent inward under load pressure and strap slippage occurred. It was also considered that the quick adjustment feature provided by these buckles was not necessary on the suspenders.

b. Provide fifty shoulder straps with a pull tab quick-release. Quick release had been effected by pulling a string attached to the cam of the quick adjusting buckle, which permitted the lower shoulder strap to slip through the buckle, thereby releasing the pack. However, the strap would often catch in the buckle, and quick release could not be accomplished. Also, a stiffer webbing was used in the lower shoulder strap to eliminate "roping", and the upper aluminum and the lower wire snap hooks were replaced with steel snap hooks.

c. Provide fifty each upper and lower back straps for the frame with improved tightening devices. This was done by replacing the quick fit adapter buckle, which permitted the straps to work loose in use, with a turn-buckle arrangement.

d. Provide one-hundred ammunition cases modified to correct deficiencies and to eliminate the magazine retaining tabs. The retaining tabs slowed the removal of the magazines from the cases. Also, serious fraying developed in the nylon fabric and webbing, which caused the binding tape to separate from the grenade pockets and the slide keeper retaining loops on the back of the case to pull out from the side seams. The patterns were changed to require the pockets to be cut in the warp direction of the fabric and the binding to be attached with an overedge stitch. The webbing for the slide keeper retaining loops was changed to a lighter weight and turned under at the ends.

e. Provide one-hundred wide "D" rings as well as webbing to permit USAIB to modify fifty each size - small, and medium packs. It had been found that these packs were uncomfortable to wear without the frame. The shoulder straps caused discomfort to the neck area. The packs were equipped with a one-inch (25 mm) "D" ring at the top to which the shoulder straps were attached. This was replaced with a three-inch (76 mm) "D" ring which permitted a wider spacing of the shoulder straps. This, it was thought, would alleviate the discomfort.

f. Provide fifty pack frames modified to correct problems at the shoulder attachment point and diagonal brace at the bottom of the frame. The aluminum loops which were attached to the top of the frame by aluminum rivets became worn through use. The aluminum attaching rivets would shear when the loops were subjected to shock treatment. Steel loops and rivets were substituted for the aluminum ones. In addition, the tubular diagonal brace at the lower part of the frame was replaced with a flat sheet brace attached with steel rivets and a tubular reinforcement piece was inserted in the lower portion of each of the side tubes of the frame for additional strength in this critical area. In this configuration, the frame with a 40 pound (18kg) load, when dropped so that it hit on one of its lower corners, could withstand repeated drops from a 40 inch (102 cm) height onto a steel plate.

It was also agreed at this meeting that after nine weeks of testing, the USAIB would evaluate the results of the test to determine if a prediction could be made for the 120-day service life of the item.

Modifications of the items were completed in-house at NLABS, and the items were flown by military aircraft to Ft. Benning on 1 June 1972, but the test was not reinitiated by the USAIB until 3 July 1972 and was completed 18 August 1972. The Final Report ²² was received from the USATECOM, 24 November 1972. As a result of the test, the Infantry Board recommended that no further developmental effort be expended on this equipment as a system; the fighting loadcarriers of the test LCE be improved to provide component replacement for the existing M-56 LCE (nylon); the technical and functional requirements for the existence load carriers be re-evaluated to determine if any significant advantage could be gained by further development of the test system or improvement of the standard items; the requirement for the machine gun ammunition vest be deleted; and modified components be submitted to the USAIB for test prior to type classification. On the 31st of October 1972, representatives from NLABS visited the USAIB at Ft. Benning, ²³ to discuss the problems which arose during the testing of each item and to arrive at a unified position with regard to the status of each. The following agreements were reached:

a. Belt: (Fig. 14-1)

It was agreed to adopt the test belt, but with the standard buckle. The test item had been equipped with a two-piece aluminum buckle which provided a quick release capability. This buckle had been used at one time by the Army, but its use had been discontinued because of problems with accidental opening. The NCO Board during the 5-6 August 1969 meeting asked for this buckle and said that accidental opening was a minor problem outweighed by what they considered the advantages of the buckle; i.e., its flat configuration and quick opening feature. However, the buckle was not acceptable to the test personnel. NLABS was to initiate work to come up with a satisfactory quick release buckle, but this effort would not interfere with type classification of the belt.

b. Suspenders: (Fig. 14-2)

It was agreed to type classify a set of suspenders similar in design to those tested, but modified so that adjustability was increased by four inches.

c. Canteen Cover: (Fig. 14-5)

It was agreed to reject the test item; to retain the standard nylon cover, modified by stiffening the closing flaps so that they would not collapse and interfere with insertion of the canteen; and to enlarge the standard cover somewhat for easier extraction and insertion of the cup. As requested by the NCO Board, the test cover was made without the pile liner, whose purpose was to provide evaporative cooling, and with openings in the bottom to provide better drainage and to make extraction of the cup easier. However, the test indicated that the pile liner added shape to the cover and kept it from collapsing completely when empty, making insertion of the cup much easier. It was also considered that the openings in the bottom constituted a camouflage hazard as the metal of the cup bottom was exposed.

d. Ammunition Case: (Fig. 14-6)

It was agreed to adopt the case as tested.

e. Intrenching Tool Carrier: (Fig. 14-3)

It was agreed to adopt the test item.

f. First Aid/Compass Case: (Fig. 14-4)

It was agreed to reject the test item and retain the standard nylon item in the system. The adopted characteristics required this item to be of sufficient size to carry two field bandages and a package of sodium chloride-sodium bicarbonate mixture. The standard item accommodated one field bandage and a package of the mixture. Therefore, the test item was made larger to accommodate the additional bandage. However, before testing had been completed, two bandages had been packaged together in a container the same size as that which carried one bandage previously; therefore, the standard item now met the requirement satisfactorily.

g. Small Pack:

It was agreed to reject the test item. Even though the test pack was larger than the standard combat pack which had been adopted in 1956, it was considered that its capacity was too limited and that there was no requirement for a small pack.

h. Medium Pack:

The Test Officer felt that the packs had been designed principally for use on the pack frame and that not enough attention had been paid to comfort when the pack was worn in what he considered its primary mode of use; i.e., without the frame. It was agreed that NLABS would improve the comfort when the pack is worn without the frame; add cords and rings inside the pack to be used for size reduction when desired; enlarge the radio pocket inside the pack; and provide modified packs to USAIB within two weeks for evaluation.

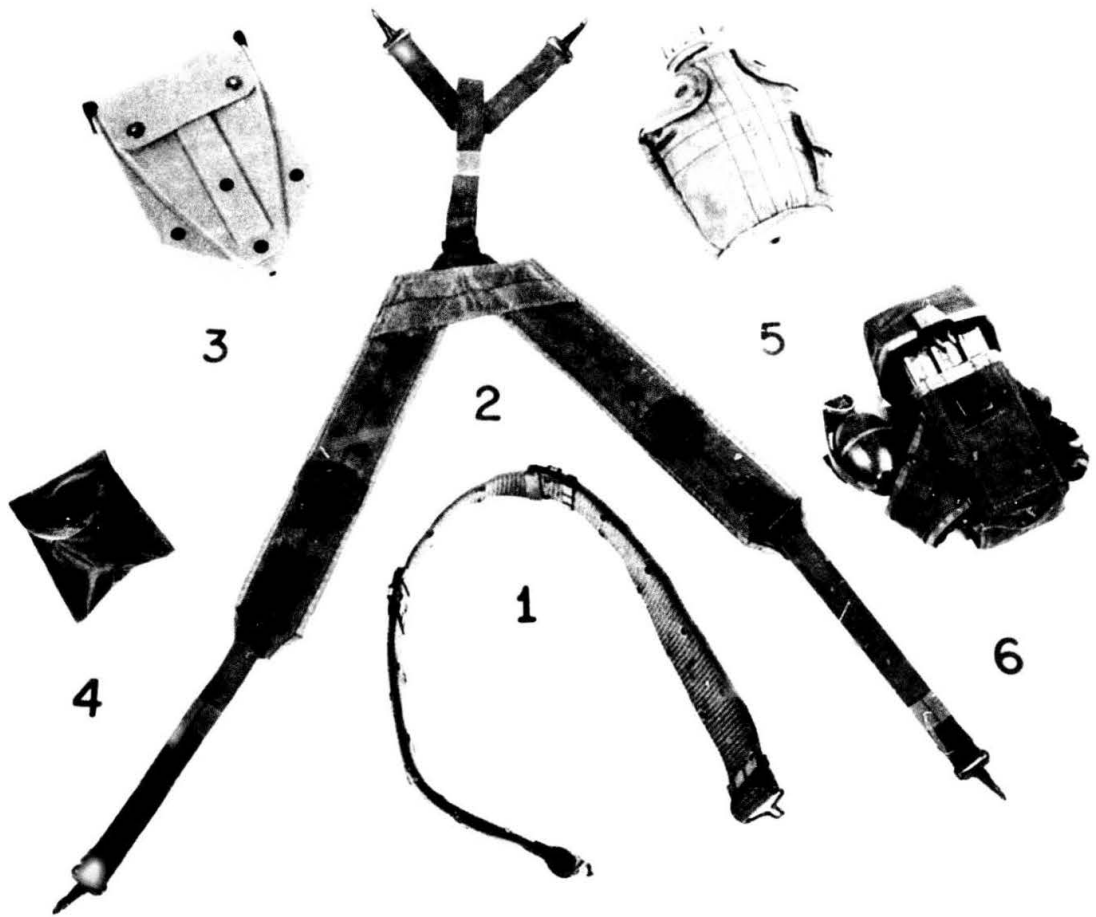


Figure 14. Final Design of Fighting Load Items



Figure 15. Medium Combat Pack

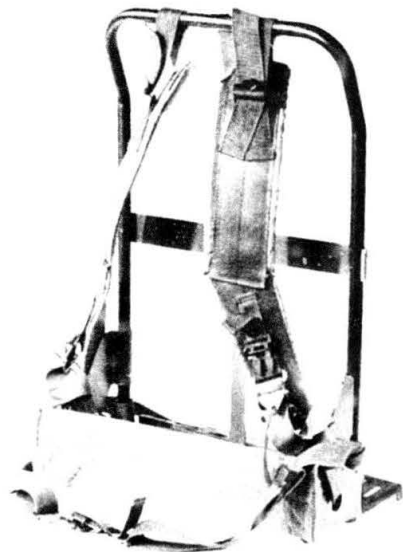


Figure 16. Frame, Aluminum, Rucksack

i. Large Pack:

It was agreed that the regular infantry did not need such a large pack, but that it should be adopted for special operational requirements such as in the Arctic and for Special Forces type operations where increased pack capacity is required.

j. Pack Frame:

It was considered that the pack frame was over-designed and consequently heavier than need be; that the pack attaching system of hooks and latches was susceptible to failure and that it was noisy. The noise was caused by the rattle of the metal snap hooks at both ends of the shoulder straps hooking loosely into free-moving rings on the frame which also had a tendency to rattle. The Infantry Team requested that NLABS attempt to reduce the weight of the frame, eliminate as much as possible the noise producing hardware and provide a more durable pack attaching system. It was agreed that NLABS would provide modified frames within two weeks for evaluation.

Five medium packs were provided the USAIB for evaluation in which the attaching hooks and loops with attendant plastic stiffeners were eliminated. Instead, these packs were provided with a padded pocket or sleeve at the outside top into which the top of the pack frame was slipped for attachment and with straps and buckles at the bottom to secure it to the frame (Fig. 15). These modifications eliminated durability problems and improved the comfort considerably when the pack was worn without the frame.

In addition, five pack frames (Fig. 16) were provided on which the pack attaching clamps, the upper back strap frame member, and the rings at the top of the frame for attaching the shoulder straps had been removed. Curved shoulder straps were attached to the frames by means of straps and buckles (Fig. 16). These modifications resulted in over a pound reduction in weight and eliminated the noise problem. Retest of the modified medium packs and frames was conducted by the USAIB during the period of 27 November - 18 December 1972. Based on the results,²⁴ USATECOM concluded²⁵ that the deficiencies and shortcomings previously reported with regard to the medium pack and frame had been corrected; that the modified pack and frame constituted a significant improvement over the model tested during EST; and that the capability of the medium pack to be worn without the frame had been significantly improved. It was recommended that the modified medium pack and frame be considered suitable for type classification.

The formal Development Acceptance (DEVA) Review²⁶ on the LINCLOE Loadcarrying System was held at NLABS, 17 January 1973. By vote of the voting members, it was agreed that the following selected items of the LINCLOE LCE which had undergone EST and the modified components which were submitted for retest be type classified standard:

Belt, Individual Equipment; Sizes Medium-Large

Field Pack, Canvas, Sizes Medium-Large

Suspenders, Field Pack

Carrier, Intrenching Tool

Frame, Field Pack

Shelf, Cargo Support

Strap, Webbing

Cover, Field Pack, Camouflage Pattern

Case, Small Arms Ammunition

The adoption of this equipment as Standard A authorized by this review successfully completed this project, and the task was terminated at this time.

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