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RESEARCH REPORT

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REPORT NO. One.

TITLE: COMPARISON OF DIFFERENT TYPES OF PARACHUTE HARNESS WITH PARTICULAR REFERENCE TO EASE OF RELEASE.

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SUMMARY:

The U.S. Navy type and the British "quick release" type of parachute harness have been tested with respect to the ease and speed of release under the following conditions:

1. On land under good conditions.

2. On land in simulated bad weather:
   a) In high wind.
   b) With wet hands and harness.
   c) At 0°F.
   d) With heavy flying mittens.

3. In the water and suspended above the water:
   a) In the water.
   b) Suspended 8 ft. above water.
   c) In the water; life jacket inflated.

4. Using one hand:
   a) Dry.
   b) With wet hands and harness.

Two examples of accidental jamming are discussed and the subject of accidental release is considered.

CONCLUSIONS:

1. In the majority of cases studied the British "quick release" type of parachute harness was released with greater speed and ease than the U.S. Navy type.

2. However, only under exceptional circumstances is a difference in speed of release in favor of the British type "quick release" harness considered of importance. These conditions are (1) with heavy flying mittens, (2) using one hand and (3) in or above water.

3. Under the condition of preliminary partial release, the speed of release was greater from the U.S. Navy type than from the British "quick release" type of harness.

4. The danger of accidental jamming and probably of accidental release is much greater with the British than with the Navy type harness.

METHODS:

A comparison of the ease and speed of release of the U.S. Navy and British Army "quick release" types[1] of parachute harness was made under the conditions listed below. In each case subjects were observed and timed as they completely disengaged themselves from the harness.

1. On land under good conditions:
   Subjects wore heavy winter flying gear.

2. On land in simulated bad weather:
   The terrain for these tests was smooth (Chevalier Field).

   a) In a high wind:
      The wind was created by the propellor of an SNV turning over at 1800 r.p.m.

      1) Without preliminary partial release.
         At the start of the experiments the subjects lay face down with the parachute canopy attached and open. Timing was begun as the canopy filled with air and was continued until the subject had spilled the air from the parachute and completely disengaged himself from the harness. The subjects were dragged varying distances up to about 100 feet and were sometimes lifted several feet off the ground.

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[1] The British "quick release" type of parachute harness used in these tests was obtained from the U.S. Air Force Materiel Proving Grounds, Eglin Field, Fla. This harness and parachute were made by the Irwin Air Chute Limited, Fort Erie, Ont. Its number was 20X-12, and Type R.C./Seat, Royal Canadian Air Force. It is shown in Figures 1 to 4 in this report.

2) With preliminary partial release. All three snaps were undone on the Navy harness, and the British "quick release" was rotated into position for opening but not yet released. In these experiments the subjects did not attempt to control the parachute canopy but simply disengaged themselves from the harness as rapidly as possible. They invariably were free of the Navy harness before being dragged any appreciable distance but were usually dragged about 60 feet before getting free of the British harness.

While subjects were being dragged, considerable quantities of moist red sandy soil were scooped up and jammed into the harness release mechanisms.

b) With wet hands and harness:
In these experiments heavy winter flying gear was worn, but parachute canopies were not attached.

c) At $0^{\circ}F$.:
Subjects wore heavy winter flying gear without gloves, and experiments were run in the chill chamber.

d) With heavy mittens:
Subjects wore heavy winter flying gear and heavy gauntlet type mittens with independent thumb and index finger. Experiments were run at room temperature.

3. In the water and suspended above the water. Experiments were performed in the swimming pool.

a) In the water the open canopy was thrown over or near the subjects.

b) Suspended 8 ft. above water the subjects swung freely from the parachute risers.

c) In the water; life jacket inflated.

4. Using only one hand:

a) Comparison of Navy and British harness. Subjects wore heavy winter flying gear and disengaged themselves from the harness with the left hand only. Because of the arrangement of the snaps on the Navy harness, it was somewhat easier to undo them with the left hand. Experiments were performed both under dry conditions and with the harness and hands wet.

b) Comparison of right and left hands with the Navy harness.
Experimental conditions were as in 4 (a) but tests were performed dry only.

RESULTS:

The results are given in Tables I, II, III and IV. The British type harness was quicker to release (1) on land under good conditions, (2) under cold conditions, (3) with heavy mittens, (4) in and (5) above the water, (6) in the water with life jacket inflated and (7) when one hand was used. The U.S. Navy type parachute harness was quicker to release under the conditions of preliminary partial release.

In Table II (a) (1) the times give little indication of the time taken to get out of the harness since most of the recorded time was taken up in spilling the air from the canopy and getting the parachute under control.

In Table II (a) (2) the recorded times are not strictly comparable since the Navy harness was completely unbuckled at the start while the British "quick release" still had to be depressed. The Navy harness blew free of the subject almost instantly when the arms were raised, but an appreciable period of time was required to press the British "quick release" because the subject was being dragged face-down along the ground and could not readily get at the release mechanism. In addition, the "quick release" was sometimes difficult to depress because of being partially clogged with dirt.

Possibly as a result of previous partial clogging with dirt, the British "quick release" mechanism completely jammed while experiments were being performed in the water.* The apparatus had to be taken apart, cleaned and repaired before further experiments could be carried on.

Experiments in the chill chamber at 0°F. were performed after the "quick release" had been cleaned and repaired. In the first series of tests the mechanism became more and more difficult to depress, and finally became impossible to release, so that the subject was unable to get out of the harness without help. The "quick release" mechanism on being inspected again, was found to be lubricated with oil, removal of which eliminated any further difficulty in opening the "quick release" at 0°F. (see Table II (c)).

DISCUSSION:

The seat type British parachute harness used in these experiments was borrowed from Eglin Field and is shown in Figures 1 to 4. Both the leg straps and the shoulder straps differ from models which are in current wide-spread use. Since the "quick release" mechanism is standard in its essential features, however, the tests described above provide a reasonable basis for evaluating this aspect of the British harness.

The experiments here reported were simplified in order to determine the relative merits of the two types of parachute harness under conditions involving a minimum number of variables and a minimum number of extraneous factors. The results demonstrate that the British harness can be released with greater speed and ease than the Navy type. However, since for routine land and water landings the British and United States procedures differ, the characteristics of the harness must be evaluated with reference to the details of these procedures.

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* See Appendix A for description of this jamming.

British airmen landing on land are instructed to release the harness as soon as they strike the ground, without first spilling the air from the parachute canopy. "When the parachutist has dropped to within about 100 ft. from the ground, he should rotate the press button of the quick release box from the locked position into the operating position by giving it a quarter turn in a clockwise direction, thus bringing the red warning mark on the periphery to the top. On the instant the feet touch the ground the press button should be given a sharp blow inwards to the body, whereupon the harness will be instantly released and the parachute with the weight of the body removed, will have its descent checked and will drift away with the wind."* The United States airmen are instructed to spill the air from the canopy and bring it under control first, and then disengage themselves from the harness. The British "quick release" should thus show to best advantage in a high wind where difficulty might be encountered in bringing the canopy under control. The difference in speed of release under these conditions is shown by comparing the Navy times in Table II (a) (1) (average 37 seconds) with the British times in Table II (a) (2) (average 12 seconds). The United States procedure includes the moderately difficult technique of controlling the parachute canopy, a technique which is eliminated by the British "quick release". This advantage of the British equipment might be of great importance if the subject was injured.

For a water landing the British airmen are instructed to push the "quick release" when their feet touch the water. "The preparations for alighting in water with this type of harness are exactly the same as for alighting on the ground, but when a few feet above the surface of the water the parachutist should straighten his body and place the feet together. Then, as the feet touch the water the harness should be released by giving the press button a vigorous blow with one hand whilst the other hand is employed in pinching the nostrils together with the thumb and forefinger, the elbows being kept pressed close to the sides."** United States airmen are instructed to undo all three snaps before touching the water, keeping the shoulder straps in position by crossing their arms. The harness is then completely released by extending the arms over the head the instant the feet touch the water. The difference in speed of final release under these conditions is of no significance since both maneuvers are virtually instantaneous.

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* British Air Ministry, Air Publication 1182, Vol. I, Part I, Sect. 1, Chap. 3, Para. 36.

** British Air Ministry, Air Publication 1182, Vol. I, Part I, Sect. 1, Chap. 3, Para. 41.

The fact that the British "quick release" mechanism jammed twice during a limited number of tests suggests that this danger may be significant. The combination of dirt and water, which may have precipitated the first jamming, is quite within the range of possibility under operational conditions. The second instance of jamming, probably resulting from the combination of improper oiling and exposure to cold, indicates that careful maintenance is essential.*

Jamming of the United States Navy harness did not occur and it is unlikely that it could ever jam completely. Because of the simplicity and exposed construction of the snaps, foreign material interfering with release can be seen, and any such material be removed easily. Furthermore, the harness is fastened by three separate snaps, the release of any two of which allows the subject to get out. However, in these tests, it was impossible to reproduce the tight fit of the U.S. Navy type produced by the sudden opening of the canopy in actual use.

Not only is the incidence of jamming more frequent but also the danger resulting from jamming is more serious in the case of the British harness. If the "quick release" mechanism jams, it is extremely difficult to get out of the harness and no alternative release procedures are available.

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* "Quick release boxes should be completely dismantled periodically for thorough internal examination and cleaning. Once every quarter is a suitable time for home stations..... At stations abroad where dust and sand are likely to enter and impede proper working and increase wear, releases are to be used unlubricated and should be inspected internally at shorter periods. In all other circumstances the mechanism should be sparingly lubricated with anti-freezing oil (Stores Ref. 34A/43 and 46)."

British Air Ministry, Air Publication 1182, Vol. I, Part I, Sec. 6, Para. 37.

The importance of increased speed of release depends both upon the amount of time saved and upon the need for saving time. It is estimated from the findings presented in this report that the British "quick release" would save less than 30 seconds for the average landing on land and no time at all for the average water landing. The need for saving time in a landing on land is great when the British procedure is followed, since in a wind the subject will be dragged until released. If the American procedure is followed and the parachute canopy is first brought under control, there is ordinarily no need for extreme speed of release. The need for saving time in a water landing is great when the British harness is used, since complete release must be accomplished after the feet touch the water. There is generally no such need for speed when the United States Navy harness is used, since the time-consuming features of the release are supposed to be accomplished in advance during descent. Obviously special situations can be visualized where the need of speed of release would be much greater than in the average situations represented here.

The British "quick release" mechanism, being more complicated in construction than the U.S. Navy snaps, requires more intelligent maintenance and use. With repeated inspections and checks such as the British insist upon, the dangers of mechanical failure are minimal. Failure due to lack of familiarity with the operation of the "quick release" are likewise minimal if personnel are properly instructed and repeatedly drilled. Accidental release has occurred, but evaluation of this danger is impossible without evidence as to frequency.

The advantages of a quicker and easier British release mechanism must be balanced against the advantages of a more reliable United States Navy releasing device.

## General Comments Concerning the British "Quick Release" Type of Parachute Harness.

The present knob on the British "quick release" type of parachute harness is very hard to grasp on account of its circular construction. It is suggested that this knob should be made hexagonal.

The harness is very poor fitting and difficult to adjust. The leg straps pull directly upward instead of to the side. There is a potential source of danger in the riser hook clamps if the pilot should fall on them. The rip cord pocket button fastener is of poor construction. It could easily pull loose during a jump and, under these conditions, the pilot would not be able to reach his rip cord.

## APPENDIX A.

## FOULING OF BRITISH "QUICK RELEASE" TYPE OF PARACHUTE HARNESS.

1. During the experiments conducted in water, the British "quick release" type of parachute harness jammed and could not be released. Upon inspection, the following conditions were noted.

a. Back plate of the release pin arrangement was burred.

b. Release pins were routed and had many small snags around their bases.

c. A small amount of dirt, composed of sand and clay material, was present. This material had combined with a small amount of oil, which caused a gum-like mass to form.

2. It is considered that the fouling of the release was caused by the burring of the pins and the pin socket plate. Due to the engineering of the release, it is considered possible that a collection of oil and dirt could cause the release to foul. However, in this case, the dirt was only a contributing cause of the failure.

## TABLE I

## TIME REQUIRED FOR COMPLETE RELEASE OF PARACHUTE HARNESS

### On Land Under Good Conditions

| | NAVY HARNESS | | BRITISH HARNESS | |
|---|---|---|---|---|
| | Subjects | Time in Seconds | Subjects | Time in Seconds |
| Standing; heavy winter flying gear | Ar | 10 | Ar | 4 |
| | He | 8 | He | 4 |
| | Wi | 5 | Wi | 3 |
| | Do | 6 | Do | 3 |
| | Wa | 7 | Wa | 3 |
| | Average | 7 | Average | 3 |

## TABLE II

## TIME REQUIRED FOR COMPLETE RELEASE OF PARACHUTE HARNESS

### On Land in Simulated Bad Weather

| | NAVY HARNESS | | BRITISH HARNESS | |
|---|---|---|---|---|
| | Subjects | Time in Seconds | Subjects | Time in Seconds |
| a) In high wind; parachute canopy attached and open | | | | |
| 1) Without preliminary partial release | Do | 43 | Ro | 48 |
| | Cr | 43 | Du | 42 |
| | Wi | 31 | Do | 27 |
| | Sh | 30 | St | 76 |
| | Ri | 39 | Fu | 25 |
| | Average | 37 | Average | 44 |
| 2) With preliminary partial release | St | 4 | Wi | 24 |
| | Ro | 1 | He | 1 |
| | Sh | 1 | Ro | 10 |
| | Ar | 1 | Ri | 10 |
| | Fu | 1 | Fu | 15 |
| | Average | 2 | Average | 12 |
| b) With wet hands and harness | Wa | 8 | Wa | 4 |
| | Do | 6 | Do | 3 |
| | Wi | 5 | Wi | 3 |
| | He | 5 | He | 6 |
| | Ar | 8 | Ar | 5 |
| | Average | 6 | Average | 4 |

TABLE II

Continued

| | NAVY HARNESS | | BRITISH HARNESS | |
|---|---|---|---|---|
| | Subjects | Time in Seconds | Subjects | Time in Seconds |
| c) At 0°F.; with heavy winter flying gear but no gloves | | | | |
| 1) With oil in "quick release" mechanism | Wi | 5 | Wi | 4 |
| | Da | 10 | Da | 4 |
| | St | 11 | St | 5 |
| | Ni | 14 | Ni | 15 |
| | Dr | 13 | Dr | (60+)[1] |
| | Average | 11 | Average | 7 |
| 2) With no lubrication in "quick release" mechanism | | | Ro | 5 |
| | | | Du | 5 |
| | | | Le | 5 |
| | | | St | 7 |
| | | | Fu | 4 |
| | | | Average | 5 |
| d) With heavy mittens and heavy winter flying gear | Ni | 17 | Ni | 4 |
| | Fu | 24 | Fu | 6 |
| | Du | 16 | Du | 4 |
| | Wi | 29 | Wi | 11 |
| | Ri | 12 | Ri | 5 |
| | Average | 20 | Average | 6 |

[1] Mechanism jammed on account of the type of oil used. Results not used in average.

## TABLE III

## TIME REQUIRED FOR COMPLETE RELEASE OF PARACHUTE HARNESS

### In Water and Suspended Above Water

| | NAVY HARNESS | | BRITISH HARNESS | |
|---|---|---|---|---|
| | Sub-jects | Time in Seconds | Sub-jects | Time in Seconds |
| a) In the water; canopy open | Do | 11 | Do | 5 |
| | Wi | 7 | Wi | 5 |
| | Fu | 11 | Gr | 5 |
| | Pa | 12 | Bu | 9 |
| | Le | 12 | Al | 5 |
| | Average | 11 | Average | 6 |
| b) Suspended 8 ft. above water | Do | 8 | Do | 2 |
| | Fu | 6 | Fu | 2 |
| | St | 6 | Wi | 2 |
| | Wi | 4 | Wa | 3 |
| | Ar | 7 | He | (12)[1] |
| | Average | 6 | Average | 2 |
| c) In the water; life jacket inflated | Do | 8 | Do | 13 |
| | Al | 26 | Al | 12 |
| | Wi | 6 | Wi | 6 |
| | Bu | 12 | Bu | 7 |
| | Ar | 12 | Ar | 9 |
| | Average | 13 | Average | 9 |

[1] Subject swinging. Release delayed since subject was concerned with the possibility of hitting the side of pool. Result not used for average.

## TABLE IV

## TIME REQUIRED FOR COMPLETE RELEASE OF PARACHUTE HARNESS

### With One Hand Not Used

| | NAVY HARNESS | | BRITISH HARNESS | |
|---|---|---|---|---|
| | Sub-jects | Time in Seconds | Sub-jects | Time in Seconds |
| a) Comparison of Navy and British harness (using left hand) | | | | |
| 1) Dry | Ar | 18 | Ar | 3 |
| | He | 30 | He | 5 |
| | Wi | 14 | Wi | 4 |
| | Do | 49 | Do | 3 |
| | Wa | 15 | Wa | 3 |
| | Average | 25 | Average | 4 |
| 2) Harness and hands wet | Wa | 15 | Wa | 4 |
| | Do | 14 | Do | 5 |
| | Wi | 7 | Wi | 4 |
| | Ar | 23 | Ar | 4 |
| | He | 10 | He | 5 |
| | Average | 14 | Average | 4 |
| | NAVY HARNESS RIGHT HAND | | NAVY HARNESS LEFT HAND | |
| b) Comparison of right and left hands with Navy harness | | | | |
| | Ni | 86 | Ni | 36 |
| | Fu | 31 | Fu | 13 |
| | Du | 33 | Du | 12 |
| | Wi | 9 | Wi | 18 |
| | Ri | 10 | Ri | 9 |
| | Average | 34 | Average | 18 |