● PSF: Subject File

Carter, John Franklin
"Report on Lightweight Exposure Suits" 5/1/44

REPORT ON LIGHTWEIGHT EXPOSURE SUITS

May 1, 1944

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SUMMARY

REPORT ON URGENT NEED FOR LIGHTWEIGHT EXPOSURE SUITS

The heavy-weighted boot-type of so-called "life-saving suits" now required by Coast Guard regulations on ocean-going Merchant Vessels ARE DANGEROUS.

The Chief of Naval Operations has instructed Armed Guard crews neither to use nor to accept them. Their removal has been recommended. The Coast Guard has taken no action to date.

Official experiments and tests have shown the value and urgent need for lightweight protective exposure clothing for survivors of ship sinkings or plane crashes at sea--particularly in cold water.

Recommendations.- Action should be taken by Naval and Air Services to:

1. Review all available data on exposure suits.
2. Conduct final tests to form basis of immediate procurement and distribution to Air, Naval, and Merchant crews.

May 1, 1944

LIGHTWEIGHT EXPOSURE SUITS

Seagoing personnel of the merchant and naval service and air crews on overwater routes are NOT being furnished with any suitable type of exposure suit.

Early in the War the British Ministry of War Transport, acting on the recommendation of a Medical Committee, authorized the Government purchase and issue to every British merchant seaman and officer a lightweight exposure suit. Approximately 300,000 of these lightweight (3 pounds-6 ounces) suits have been furnished to British sailors.

Constructed of fine weave rubberized fabric in the form of pants with stocking feet and jacket with parka-hood these suits have served to provide lightweight "oilskins" for survivors in lifeboats and on rafts. Their issue and availability has done much to improve the British merchant seamans' morale.

In actual use by survivors they have shown inestimable value as protection against exposure.

In contrast to the British issue of this effective and useful equipment American merchant ships are required by regulation of the U.S. Coast Guard to have on board a so-called "life-saving suit" for each crew member. These suits are heavy and bulky--14 to 17 pounds--

have WEIGHTS in each boot and their use rapidly accelerates exhaustion of survivors having them on in the water.

Reports of their dangerous character have been repeatedly received by ONI and forwarded both to COMINCH and to Coast Guard. However, no action to bring about the substitution of a suitable exposure suit has been taken to date.

Naval personnel assigned to merchant vessels or members of armed guard units have been definitely instructed by official Memoranda that such suits are dangerous and further that they are not to utilize or receive issue of any types of lifesaving suits. Justification in detail for this stand is set forth in (Attachments A and B).

The dangerous qualities of these weighted lifesaving suits were further pointed out by the Liaison Committee on Emergency Rescue Equipment. In Recommendation No. 3 (Attachment C) issued pursuant to Memorandum Directive No. 58 (Attachment D) of the Joint U.S. Chiefs of Staff the Committee said:

"It is recommended that immediate steps be taken to remove from Merchant vessels and military transports, all existing types of the so-called "lifesaving suits." These suits have proved to be dangerous.

"It is further recommended that immediate steps be taken to furnish personnel on the above types of vessels with a 'protective exposure suit.' A satisfactory suit has been developed (Attachments E, F and G). The covering specifications should be generally followed particularly as regards the qualities and characteristics of the neoprene coating. The suit as packed in the buoyant bag container should not exceed six pounds in weight.

"The Committee advises that the primary need of survivors is for an overall garment which will protect them from exposure and which is of such a character that it may be comfortably worn in boats and on rafts and of such weight as to be readily accessible and available in time of emergency. June 5, 1943."

Neither the Commandant nor the Chairman of the Merchant Marine Council of the U.S. Coast Guard have heeded this recommendation. No action looking forward to the removal of these suits has been taken in spite of the desire on the part of enlightened personnel of the Training Division of the War Shipping Administration to take action. The Coast Guard has in fact reaffirmed their previous stand (Attachments H and J).

The dangerous character of these alleged lifesaving suits has been reported officially in ONI digests. For example:

"The loss of life.....may be attributed to.....

"4) That there was considerable trouble with the Morner rubber life saving suits, many of which could not be securely fastened and therefore filled with water.... December 29, 1942."

"The 'Vaco' rubber lifesuits provided the men were useless and were removed by survivors." December 18, 1942.

"Three of the merchant crew were wearing rubber suits at the time they were spilled from the capsized boat. They were able to reach the raft only with great difficulty as, due to the submersion and the heavy seas, the rubber suits partially filled with water. These men were very much dissatisfied with the rubber suits. The Navy gun crew had been offered the use of rubber suits by the ship, but had refused. March 29, 1943."

"On the same vessel one man jumped overboard without any life jacket under his 'life saving suit' and stated that if he had not been a robust strong swimmer

and had not had assistance to cut the suit off his body he would have drowned. March 29, 1943."

The uselessness of a heavy weighted suit worn over a life jacket is evident since:

1. Any buoyancy supplied by trapped air is very transitory.
2. The suit filled with water closely counter-balances the 16 pounds of buoyancy afforded by the Kapok life jacket, which the survivor is supposed to be sure to remember to wear.

As a consequence THE OSCILLATING MOTION OF THE SEA "DUNKS" THE SURVIVOR WITH EACH WAVE UNTIL HE IS THOROUGHLY DROWNED.

The operation is much the same as the vertical motion of a whistling buoy! Exhaustion is further speeded by the helmet type suspension and the raglan cut of the weighted suit placing all the strain on the neck muscles to hold the head up. A more efficient device for "life taking" would be hard to devise.

As a test the Director of the Marine Section of the American Red Cross was placed in a suit in the Potomac River on a moderately choppy day. Although an excellent swimmer (ex All-American football star), he was in a drowning condition in about twenty minutes.

The accelerated results in the open sea can best be left to the imagination. HOWEVER, OFFICIAL COAST GUARD TESTS WERE CONDUCTED EITHER IN A SWIMMING POOL OR IN CALM WATER.

Further confusion and additional loss of life is added by the fact that present regulations require the merchant seamen to be drilled in the use of the suits. A division of loyalty is thereby created in the minds of all between attending to the lifeboat and life raft launching and donning the "life saving suit" and jumping overboard. The seamen themselves have repeatedly called for additional boat drills and instruction of green crews. The continuance of the use of these dangerous suits impairs drift efficiency and assists panic conditions to grow.

A lightweight (5 lbs.) exposure suit packed in a watertight bag, easily carried and stowed is recommended. This suit or its equivalent of even lighter weight materials has been thoroughly tested (Attachment K).

As a proposed "aviation exposure suit" it has been adopted by the Royal Canadian Air Force, and it is now becoming standard equipment.

The need for a lightweight coverall exposure garment generally of the type shown in the attached photographs is unquestionable. Production of such suits

in quantity and their immediate issue to all seagoing personnel (with the possible exception of combat ships), as well as to airborne passengers and air crews (Attachment L, N, and O) on overwater routes, is definitely indicated.

Continuance of manufacture of heavy dangerous "life-saving suits" (of which upward of 200,000 have now been made) (Attachment M) utilizes labor and strategic materials, i.e., rubber and neoprene, to a great disadvantage.

The production and use of these suits should be discontinued at once and a tough lightweight EXPOSURE SUIT should be produced and distributed immediately.

ATTACHMENT A

N A V Y D E P A R T M E N T
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON

Op-23L-th
SO-627 146
Serial 212623

July 1, 1942.

RESTRICTED
RESTRICTED

From: The Vice Chief of Naval Operations.
To : The Commandant, U. S. Coast Guard.

Subject: Life Saving Suits for Naval Personnel on Merchant Vessels.

References: (a) Ltr. from Commandant, U. S. Coast Guard, CG-MC-5047 to Min of June 23, 1942.
(b) VCNO restricted ltr. Op 23L-JH SO-25788, Serial 139523 of May 13, 1942.

1. In reply to paragraph 1, reference (a), attention is invited to paragraph 1, reference (b), in which it was formally stated that the Navy does not require life saving suits for its personnel. This decision was the result of careful investigation of several types of life saving suits. The suits were not approved for numerous reasons such as:

(a) Cumbersomness, making it extremely difficult to effectively carry out the primary duty of Armed Guard and Merchant Gun Crew; that is to defend the ship by opening and maintaining fire against the enemy as long as the guns are afloat and serviceable.
(b) The suits do not permit a man to exert himself strenuously for more than a very short period of time, and are not suitable for wear during action due to the combined weight of the suit, life preserver and the ballast.
(c) Loss of time in providing and putting on the suits when moments count most, such as in opening fire on the enemy.
(d) Possibility of puncture during action which would result in flooding the suit, thereby nulifying possible benefits.
(e) The reports of losses due to enemy action have so far failed to indicate that the suits are being used for the purpose for which they were provided by Coast Guard regulations. This is probably due to the lack of time during surprise attacks and the tremendous resultant damage caused by torpedo, gas vapor or cargo explosions.

(Over)

(f) In case of burning oil on the surface of the water it would appear difficult, if not impossible, for the wearer of an inflammable rubber suit to submerge or swim under water sufficiently to escape under these conditions.

2. Beyond stating that the Navy Department does not require life saving suits for its personnel, the Department prefers to leave the decision relative to changes in the Inspection and Navigation regulations to the judgment of the Coast Guard.

/s/F. J. HORNE

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All Port Directors
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Op-39

ATTACHMENT B

NAVY DEPARTMENT
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON

Op-23L-2-ack

Serial No. 341123

RESTRICTED

RESTRICTED 1 December 1943

From: Chief of Naval Operations.
To : Armed Guard Officers.

CHIEF OF NAVAL OPERATIONS ARMED GUARD BULLETIN 25-43.

SUBJ: Rubber Life Saving Suits.

1. The attention of Armed Guard officers is invited to the fact that the Navy does not require rubber life saving suits for Armed Guard personnel. This policy is a result of careful investigation of several types of life saving suits, and such life saving suits were not approved for numerous reasons, such as:

(a) Cumbersomness, making it extremely difficult to effectively carry out the primary duty of Armed Guard and Merchant Gun Crew; that is to defend the ship by opening and maintaining fire against the enemy as long as the guns are afloat and serviceable.

(b) The suits do not permit a man to exert himself strenuously for more than a very short period of time, and are not suitable for wear during action due to the combined weight of the suit, life preserver and the ballast.

(c) Loss of time in providing and putting on the suits when moments count most, such as in opening fire on the enemy.

(d) Possibility of puncture during action which would result in flooding the suit, thereby nullifying possible benefits.

(e) Possibility of the suits cracking or splitting due to improper stowage and deterioration over long periods of time. Men have been lost when they have jumped overboard in a cracked or punctured suit, without a life jacket inside the suit. The suit filled with water, pulling the man under. Suits also have filled with water due to leakage in the closures and around the neck band.

(f) In case of burning oil on the surface of the water it would appear difficult, if not impossible, for the wearer of an inflammable rubber suit to submerge or swim under water sufficiently to escape under these conditions.

(OVER)

Op-23L-2-ack
Serial No. 341123

RESTRICTED 1 December 1943

2. The Navy Department desires that Armed Guard officers decline to accept issue of the rubber life saving suits to themselves or their men.

/s/ V. D. CHAPLINE
By direction.

AUTHENTICATED:

Edw C. Cleave.

EDW. C. CLEAVE, Commander, USNR.

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Number 3.

EMERGENCY RESCUE EQUIPMENT

COORDINATOR OF RESEARCH & DEVELOPMENT, U. S. NAVY
AND
LIAISON COMMITTEE ON EMERGENCY RESCUE EQUIPMENT
(Established by the Joint U. S .Chiefs of Staff)

RECOMMENDATION

Subject: SUBSTITUTION OF PROTECTIVE EXPOSURE SUITS for "Lifesaving suits" on Merchant Vessels and Military Transports.

It is recommended that immediate steps be taken to remove from merchant vessels and military transports, all existing types of the so-called "life saving suits". These suits have proved to be dangerous.

It is further recommended that immediate steps be taken to furnish personnel on the above types of vessels with a "protective exposure suit". A satisfactory suit has been developed for the United States Coast Guard by the B. F. Goodrich Company and the covering specifications should be generally followed particularly as regards the qualities and characteristics of the neoprene coating. The suit as packed in the buoyant bag container should not exceed six pounds in weight.

The Committee advises that the primary need of survivors is for an overall garment which will protect them from exposure and which is of such a character that it may be comfortably worn in boats and on rafts and of such weight as to be readily accessible and available in time of emergency.

June 5, 1943

285-1

JOINT CHIEFS OF STAFF

April 15, 1943 MEMORANDUM FOR INFORMATION NO. 58 Copy No. 18

PLAN FOR ORGANIZATION OF COMMITTEE ON EMERGENCY RESCUE EQUIPMENT

Note by the Secretaries

On December 20, the Director of Strategic Services sent a proposal to the Secretary of the Joint Chiefs of Staff for a "Coordinating Committee on Emergency Rescue Equipment." This proposal was submitted to the Deputy Chiefs of Staff and received their approval. The Secretary of the Joint Chiefs of Staff on January 13, notified the Director of Strategic Services of this approval and requested the Office of Strategic Services to arrange for the establishment of a Coordinating Committee on Emergency Rescue Equipment, the proposed plan to be submitted to the Joint Chiefs of Staff for consideration prior to activating the Committee. Accordingly, on February 15, the Director of Strategic Services submitted a proposed plan.

The Deputy Chiefs of Staff considered this plan and agreed that:

(a) The Navy Department assume responsibility for:

(1) Coordinating the work of Service and other governmental agencies concerned with methods, techniques and procedures for emergency rescue or with research, development and production of emergency rescue equipment.

(2) Assembling, evaluating and disseminating to such agencies information relating to these matters and recommending appropriate action in connection therewith.

(3) Maintaining liaison with agencies of other United Nations (such as the British Ministry of Air-Sea Rescue) concerned with these matters.

(b) A liaison committee be appointed to assist the Navy Department in the performance of the above functions, consisting of:

(1) A representative of the Army Air Forces.

(2) A representative of the Maritime Commission.

(3) A representative of the Office of Scientific Research and Development.

(4) A representative of the Office of Strategic Services.

(c) The Office of Strategic Services be informed of these decisions.

J. R. DEANE) Joint
F. B. ROYAL) Secretariat.

NAVY DEPARTMENT

OFFICE OF THE CHIEF OF NAVAL OPERATIONS

Op-10A-MD
Serial 36510

WASHINGTON

April 20, 1943

From: The Vice Chief of Naval Operations.
To: The Coordinator of Research and Development.

Subject: Committee on Emergency Rescue Equipment.

Enclosure: (A) J.C.S. Memorandum for Information No. 58; Copy No. 18.

1. The Joint Deputy Chiefs of Staff have approved a plan for coordinating the matters relative to the research and development of emergency rescue equipment. It was agreed that the Navy would assume the responsibility in this field.

2. It is requested that the Coordinator of Research and Development undertake the leadership in getting cooperation and action from the several government departments and agencies and such other appropriate action as may be necessary to implement the approved plan as set forth in Enclosure (A).

Carl F. Espe
By Direction

Copy to:
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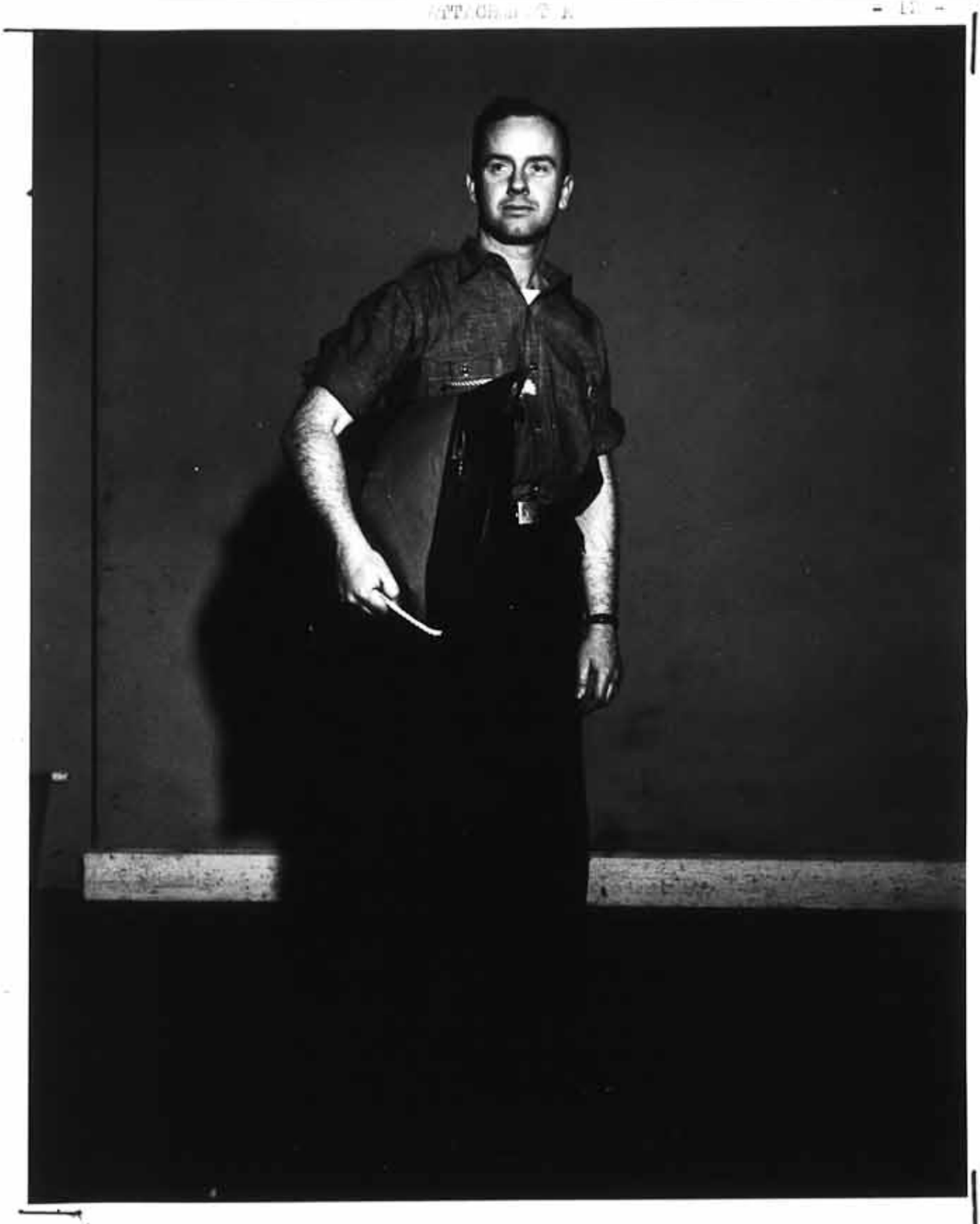
Secretariat, J.C.S.



BUOYANT BAG

FOR PROTECTIVE EXPOSURE SUIT

SUIT AS ROLLED AND PACKED IN BAG PROVIDES BUOYANCY TO SUPPORT ONE OR TWO PERSONS IN THE WATER. MOUTH INFLATION TUBE ON BAG SHOULD BE USED TO INSURE BUOYANCY DURING LONG PERIODS. WHEN STOWED IN LIFEBOATS OR RAFTS BLACK SIDE OF BAND ON BAG SHOULD BE EXPOSED TO DECREASE VISIBILITY FROM THE AIR. IN EMERGENCY, USE RED - ORANGE SIDE OF BAND IN ORDER THAT SUIT MAY BE READILY SEEN IF THROWN OVERBOARD OR FLOATS OFF SINKING VESSEL. AT NIGHT USE LIGHT.

Revised
5-6-43

THE B. F. GOODRICH COMPANY

SUGGESTED SPECIFICATIONS
FOR
PROTECTIVE EXPOSURE SUITS

MODEL NO. 1A

A. APPLICABLE SPECIFICATIONS

A-1. The following specifications, of the issue in effect on date of Invitation for Bids, form a part of this specification.

Federal Specifications
CCC-T-191, Textiles: Test Methods
DDD-S-751, Stitches: Seams: and Stitching
ZZ-R-601, Rubber Goods: General Specifications.
(Methods of Physical Tests and Chemical Analysis)

Army-Navy Aeronautical Standard
AN-230 Grommets - Plain and Spur (with washers)
AN-JJ-N-151 Webbing Cotton

U. S. Army Specifications
6-39-C - Cloth, Balloon, Finished

Corps of Engineers, U. S. Army Specifications
T-1298 - Cement, Neoprene, Self Curing
T-1296-A - Fabric, Neoprene, Balloon

B. TYPE, COLOR AND SIZE

B-1. Type - Protective Exposure Suits shall be synthetic rubber surfaced double texture fabric, of the one-piece or coverall type. The upper part of the suit shall be sack shaped equipped with a helmet and Kapok filled collar; the lower part shall consist of legs and boots. Each suit shall be made with raglan sleeves fitted with 5-fingered gloves, and set in suit to provide quick entrance for the arms of the wearer. Entrance is through the top of the suit only and must be large enough to easily go on a fully clothed man wearing a life vest. The top of the suit must be constructed to close easily and quickly, and afford maximum waterproof protection.

B-2. Color - Protective Exposure Suits shall be black throughout with the exception of the cap which shall be red-orange.

B-3. Size - Shall be made one size only and the boots shall be large enough to fit over a size 12 leather workshoe.

C. GENERAL REQUIREMENTS

C-1. Weight of Suit - No suit shall weigh more than 6 pounds.

C-2. Dimensions - The measurements of the finished suits shall be as follows:

THE B. F. GOODRICH COMPANY
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MODEL NO. 1A

C. GENERAL REQUIREMENTS (CONT'D)

C-2. Dimensions (Cont'd)

Breast	63"
Waist	63"
Trunk (Neck, under crotch to neck)	34"
Length (Top of suit to bottom of heel)	78"
Entrance (Opening to neck)	64"
Length under arm (Armpit to tip of glove)	29"
Around Elbow	19"
Around Seat	63"
Around Knee	23"
Crotch to Heel	35-1/2"
Boot (Size)	Must fit Size 12 Leather Workshoe
Boot (Heel to top)	8"

C-3. Construction of Seams - Machine sew all seams using lock stitch, type 301 Federal Specification DDD-S-751. There shall be not less than 8 nor more than 10 stitches per inch. Use seam type LSak-2 of Federal Specifications DDD-S-751. The edges of the sewn material shall be to the inside of the suit. An area 1/2 inch in width on either side of the center of the seam shall be cemented and the seam covered, on both the inside and the outside of the suit, with a bias cut Neoprene coated tape 3/4" in width conforming to Air Corps Specification No. 16100, Style No. 602-N.

C-4. Neck Closure - Shall consist of Type "HH" Balloon Cloth, Neoprene coated on the outside, and attached to the top of the suit, and extending completely around the perimeter of the neck opening. It shall be formed by stitching or cementing one edge of the fabric to the top of the suit, and then hemmed over to form a drawstring channel. One draw string 76" long shall be threaded through the drawstring channel with the ends of the drawstring put through a non-rusting metal grommet which shall be placed through the middle of the fabric, forming a drawstring loop. A rust-proof metal fastener (Stanley Pull-Tite Line Tightener or equivalent) shall be attached to the drawstring ends to provide a fastening device which when sliding along the drawstring pulls the fabric closure into ruffles around the neck, bearing on the surface of a crescent shaped sponge rubber pad, thus providing a watertight seal.

The fastener must slide easily and the neck close properly under all conditions encountered in service. The wearer must be able to adjust the neck closure when floating in the water.

C-5. Arm and Leg Adjustment Straps - Inasmuch as only one size suit is furnished, to provide some degree of fitting range each glove shall be fitted at the wrists with a take-up strap and each leg at the ankle shall also be fitted with a take-up strap.

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SUGGESTED SPECIFICATIONS
FOR
PROTECTIVE EXPOSURE SUITS
MODEL NO. 1A

C. GENERAL REQUIREMENTS (CONT'D)

C-6. Buoyancy Chamber - A buoyancy chamber shall be provided attached to and extending around the suit under the arms. The chamber shall be inflated by breath through a rubber hose. The inflation hose shall be bent and slid through a loop or keeper to seal off the air in the chamber. The distribution of buoyancy shall be such that the wearer is floated normally on his back.

C-7. Manufacture - Protective Exposure Suits shall be sewn together from vulcanized material with all seams cemented and taped.

D. DETAILED REQUIREMENTS

D-1. Fabric

Type of Fabric	Weight Sq. Yd. Ounces	Count Warp	Count Filling	Tensile Strength Warp	Tensile Strength Filling
Balloon Cloth (Type SS)	1.70	120	120	32	30 (Strip)
Balloon Cloth (Type HH)	2.05	120	120	40	40
Balloon Cloth	3.5	80	80	55	50
Osnaburg (Clean)	14.0	23	23	150	160 (Grab)

D-2. Neoprene Coating on Body Fabrics - The Neoprene coating shall be suitably compounded and properly vulcanized so as to age well under service conditions. The coating of Neoprene shall be applied to the fabric in a manner as described in Engineers Corps Specification T-1296-A.

D-3. Neoprene Coating on Strap Fabrics - The Neoprene coating shall be suitably compounded and properly vulcanized so as to age well under service conditions and shall have the following physical properties . . .

Tensile Strength (Min.)	1300
Ultimate elongation (Min.)	500%
Shore Hardness	50-60

D-4. Cement, Neoprene Self-Curing - The cement used in cementing tape over the seams of the suit shall conform to Corps of Engineers, U. S. Army, specification No. T-1298.

D-5. Neoprene Seaming Tapes - The Neoprene seaming tapes used shall be made from type HH Balloon Cloth cut on a 45° bias and conforming to Engineers Corps Specification T-1296-A Style No. E 9010.

THE B. F. GOODRICH COMPANY
SUGGESTED SPECIFICATIONS
FOR
PROTECTIVE EXPOSURE SUITS
MODEL NO. 1A

D. DETAILED REQUIREMENTS (CONT'D)

D-6. Two Ply Cloth Neoprene Coated Body Fabric - Construction of the two-ply suit fabric shall conform to Engineers Corps Specification No. T-1296A Style No. N100C Balloon envelope fabric, with the following exceptions:

1. Aluminum coating specified be substitute with an equal weight on Neoprene coating.
2. Permeability requirement be altered to 15 max.
3. Total weight tolerance be ± 10%

D-7. Arm and Leg Adjustment Strap and Loop Material - Shall be made from Osnaburg as specified in D-1, friction coated on both sides and calender coated on both sides with the Neoprene compound as described in D-3, giving a total overall thickness of .050" gauge.

D-8. Gloves - Shall be light weight cotton fleece lined canvas gloves with a knit wrist band coated with rubber or Neoprene latex. The coating shall be not less than .010" gauge nor more than .020" gauge in thickness. Each glove shall be provided with a knurled palm patch.

D-9. Inflation Means for Flotation Chamber - Shall consist of a molded Neoprene fitting with a tubular appendage parallel to its base to which the inflation tube is attached. The tube is closed off by bending and inserting through a keeper loop attached to the suit 6 inches down from the base of the neck opening.

D-10. Rubber Hose for Inflation - Shall be rubber or Neoprene and of a high grade. The inside diameter shall be 1/4" with a wall thickness of not less than .050" gauge. The length shall be such that the wearer of the suit can conveniently place the tube in his mouth for inflation.

D-11. Neck Closure - Shall be of Type HH Balloon Cloth coated on one side with Neoprene as specified in D-2, to give an overall weight of not less than 3.5 ounces per square yard.

D-11a. Neck Closure Grommet - Size #2 Brass, Spur grommet and washer.

D-11b. Neck Closure Grommet Stay - Shall be made of the above specified body fabric.

D-11c. Drawstring - Shall be #5 cotton line or equivalent.

D-11d. Metal Fastener - Shall be Stanley Pull-Tite Line Tightener or equivalent.

D-11e. Front Neck Closure Pad - Shall consist of a built up or molded rubber, or synthetic sponge crescent shaped pad, sealed to prevent water absorption. The pad shall be approximately 1¼ inch thick at the center and taper out to a thin edge at the ends.

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FOR
PROTECTIVE EXPOSURE SUITS
MODEL NO. 1A

D. DETAILED REQUIREMENTS (CONT'D)

D-11. Neck Closure -

D-11e. (cont'd)
The inside radius of the pad shall be not more than 2 inches, and the width shall be such as to provide good contact with the wearer's neck. This pad shall be cemented to the front center of the neck band.

D-11f. Rear Neck Pad - Shall consist of a rubber or synthetic sponge pad 1/2 inch thick and 6 inches long cemented into the back of the neck band with the edges tapered off. The draw cord passes over this pad and prevents the cord from cutting into the wearer's neck.

D-12. Helmet and Face Shield - Shall be made of 3.5 ounce Balloon Cloth as specified in D-1, coated with black Neoprene on the inside and red-orange Neoprene on the outside. The coating shall be evenly distributed between the two sides giving a total weight of 6.5 to 7.0 ounces per sq. yd. The helmet shall be bound around the edge coming in contact with the wearer's face with a 1/2 inch black bias fold cotton tape. The helmet shall be sewn to the back of the suit at the base of the neck band, and shall be large enough to fit over a stocking cap and provide normal movement of the wearer's head.

The face shield shall consist of a piece of the above specified helmet material, sewn at its top corners into the helmet so that it may be placed in the back of the helmet when not used or may be worn as a protective face shield. Eye holes shall be provided at the proper location, and all edges shall be bound with 1/2 inch black bias cotton tape.

D-13. Kapok Filled Collar - Shall be made from the above specified body fabric or of an approved waterproof light duck bound around its edges with 1/2" black bias cotton tape and provided with a hook similar to Keeler Brass Co. #S460 attached to a strap sewn on the right hand corner of the collar.

A size #1 brass grommet and washer shall be placedon the left hand corner so as to provide an eye for the hook. It shall be filled with 3 ounces of Kapok or other buoyant material so as to provide a rigid padding at the base of the neck for keeping the wearer's head up when floating on his back, and be so designed as to keep an unconscious man's face out of the water if in a prone position. The collar shall be sewn on to the suit at the base of the neck band and four size #00 brass grommets and washers shall be installed on 2 inch centers going through the helmet and collar close to their point of attachment on the suit. The grommets provide drainage of the water trapped between the helmet and neck band.

THE B. F. GOODRICH COMPANY
SUGGESTED SPECIFICATIONS
FOR
PROTECTIVE EXPOSURE SUITS
MODEL NO. 1A

D. DETAILED REQUIREMENTS (CONT'D)

D-14. Hoisting Strap - Shall be 1" wide cotton webbing with a minimum tensile strength of 575 pounds conforming to Type II of Army-Navy Aeronautical Specification AN-JJ-W-151. It shall be sewn or cemented to the suit in such a manner so as to permit the wearer to be hoisted out of the water without putting undue strain on the suit. A loop shall be formed by the ends of the straps which terminate amid the shoulders in the back of the suit as shown in Figure I and II.

D-15. Air Expulsion Valves - Shall be of the rubber flutter Valve type encased in a plastic protective housing as shown on the Chemical Warfare Service, Edgewood Arsenal Drawing E5-2-427, Type M-10 Outlet Valve.

E. CONSTRUCTION OF SUIT

E-1. Body - The body of the suit shall consist of not more than 2 panels of Neoprene coated body fabric as described in D-6. All the seams shall be made as described in C-3.

E-2. Sleeves - Each sleeve shall be made from one panel of Neoprene coated body fabric as described in D-6, with the seam on underside extending from the arm pit to the wrist. Seams shall be as described in C-3. Neoprene covered canvas gloves shall be attached to the sleeves at the wrist by sewing and taping with a 1¼" wide tape.

E-3. Flotation Chamber - The flotation chamber shall be made of body fabric as described in D-6. A molded Neoprene fitting as described in D-11 is cemented to the front center of the air chamber with a patch of the body material reenforcing the valve. The exposed seams on the inside and outside of the suit where the flotation chamber is sewn on shall be taped so as to make the flotation chamber air tight.

E-4. Boots - Shall be over-the-shoe style, approximately 8" high and shall not weigh over 1-1/2 lbs. per pair. Loops shall be provided at the heel and at the ankle for a 5/8" wide strap. The boots shall be sewn to the legs of the suit and taped with a 1¼" tape on the inside and outside.

E-5. Neck Band - The neck band shall be made as described in D-11 and attached by cementing or sewing, less than a 1/2" lap seam. A 3/4" bias tape shall be put over the inside seam.

E-6. Wrist Adjustment Straps - Shall be 5/8" in width and be equal in length to the circumference of the glove at the point of attachment. The straps shall be held in place by 2 loops attached to the sleeve 9" from the finger tips so the buckle will be directly above the junction of the thumb and index finger.

E-7. Boot Adjustment Straps - Shall be 5/8" in width and 21-1/2" long.

THE B. F. GOODRICH COMPANY
SUGGESTED SPECIFICATIONS
FOR
PROTECTIVE EXPOSURE SUITS
MODEL NO. 1A

F. BUOYANT BAG. TYPE, SIZE, CONSTRUCTION

F-1. Type - Shall consist of an envelope type of Neoprene coated fabric bag of such dimensions as to contain the Protective Exposure Suit when properly folded. The open end of the bag shall be so constructed so as to seal the contents and keep them dry when the bag is immersed in water. One surface of the bag shall have an inflatable section that is equipped with a molded Neoprene Fitting with a tubular appendage parallel to its base to which the inflation tube is attached. The tube is closed off by bending and inserting through a keeper loop attached to the junction of the tube and fitting. Handles of 1/4" sash cord shall be provided and attached to the bag by inserting through grommets of suitable size. A reversible color band is attached to one edge of the bag and when wrapped around the bag and snapped in place forms a red-orange marker or when reversed forms a black section that blends with the rest of the bag.

F-2. Size - The measurements of the finished buoyant bag shall be as follows:

Overall Length	26"
Overall Width	20 1/2"
Inside Length	25 1/2"
Outside Width	17"
Inflatable Section	16" x 17"
Width of Color Band	5-3/4"
Length of Color Band	37"

F-3. Construction - The buoyant bag shall be made from two pieces of body fabric cemented together around their three edges for a distance of 1-1/3". A 1 inch crotch tape is laid 1/2" in from the edge to reinforce the seam. The inflatable section is formed by cementing a piece of body fabric of the size indicated above to the surface of the bag using 1/2" seam and 1 inch crotch tape reinforcement. The molded valve is installed 2 inches in from the edge of the inflatable section and in the center of the bag. To one side of the mouth opening of the bag is cemented a 3/4" wide strip of stiffening material such as 3 ply belting. Three dot snaps are attached to the bag in such a position as to maintain a water-tight closure when the mouth of the bag is rolled up around the stiffening strip. The reversible color band is made from the above specified helmet material bound on its edges with 1/2" black bias fold cotton tape. It is cemented to the border of the bag between the handles and reinforced with a 1 inch crotch tape. Two dot snaps are provided to hold the end of the band in place.

G. MARKING - SUIT, BAG

G-1. Suit - Each completed suit shall be legibly and permanently marked on the outside surface with the following:

THE B. F. GOODRICH COMPANY
SUGGESTED SPECIFICATIONS
FOR
PROTECTIVE EXPOSURE SUITS
MODEL NO. 1A

G. MARKING - SUIT, BAG (CONT'D)

G-1. (cont'd)

- Name of Manufacturer-
PROTECTIVE EXPOSURE SUIT
Waterproof and Windproof, Affords
Necessary Protection Against Wind
and Sea for Personnel in Life Boats
or Life Rafts.
KEEP IT HANDY AT ALL TIMES

G-2. Bag - Each completed buoyant bag shall be legibly and permanently marked on the outside surface with the following:

- Name of Manufacturer-
BUOYANT BAG
For Protective Exposure Suit
Suit as rolled and packed in bags provides buoyancy to support one or two persons in the water. Mouth inflation tube on bag should be used to insure buoyancy during long periods. When stowed in life boats or rafts black side of band on bag should be exposed to decrease visibility from the air. In emergency, use red-orange side of band in order that suit may be readily seen if thrown overboard or floats off sinking vessel. At night use light.

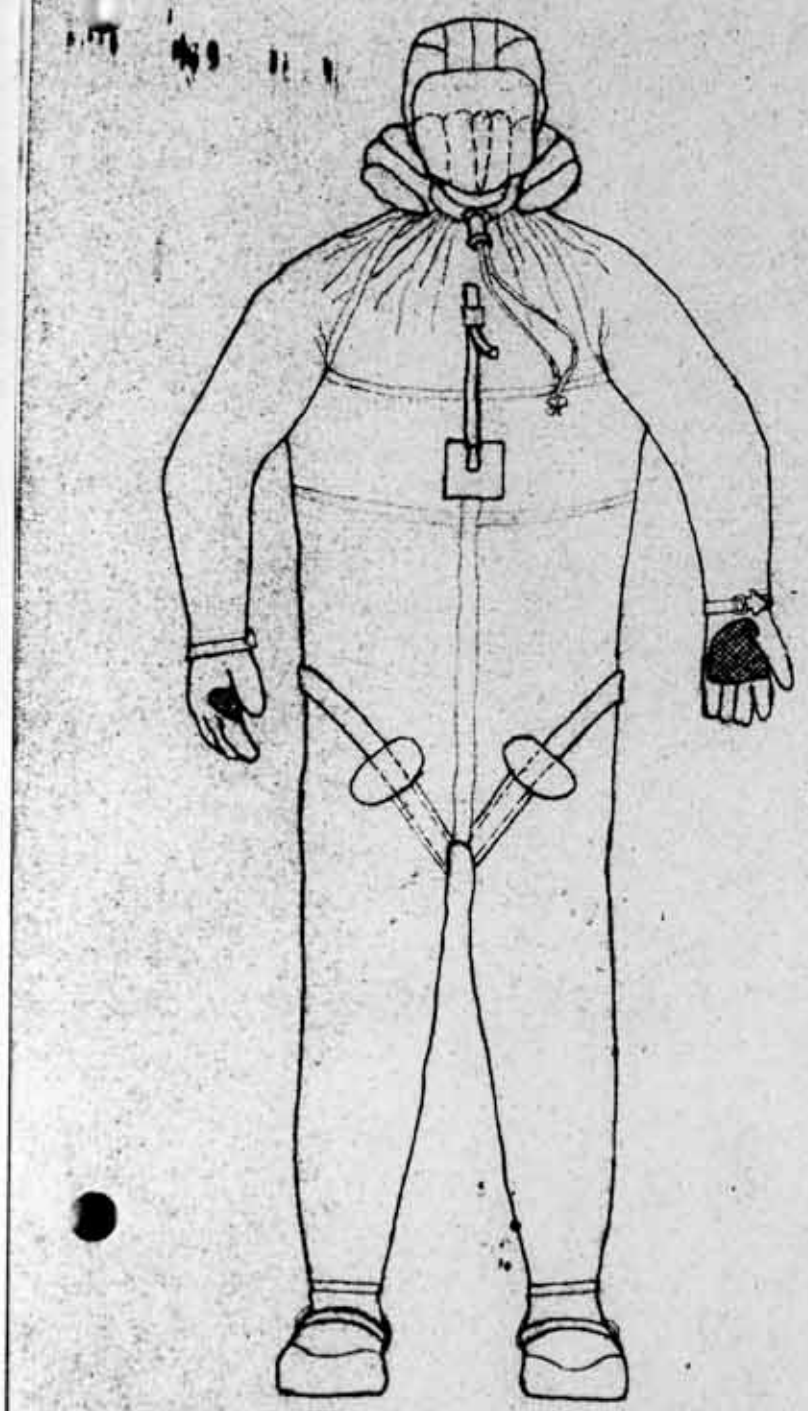
H. METHODS OF SAMPLING, INSPECTION AND TEST

H-1. Sampling - Each completed suit shall be subject to inspection to insure conformity with the requirements of this specification. A representative number of each size on order shall be checked thoroughly and carefully for adherance with dimensions and with constructional details. In addition, samples of all materials entering into the fabrication of the suit shall be taken and inspected under the applicable specifications.

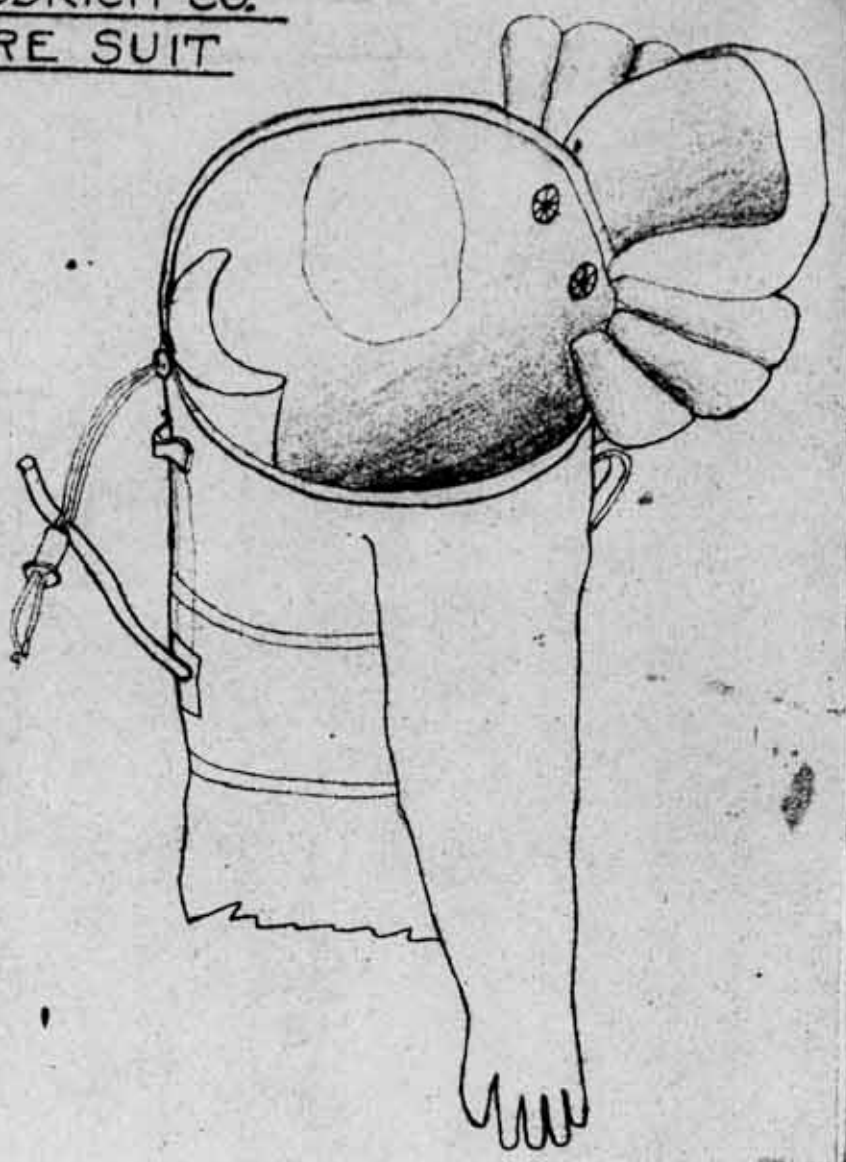
H-2. Inspection - All materials shall be subject to inspection during the course of manufacture and upon completion in accordance with the requirements of the U. S. Coast Guard.

THE B.F. GOODRICH CO.

PROTECTIVE EXPOSURE SUIT



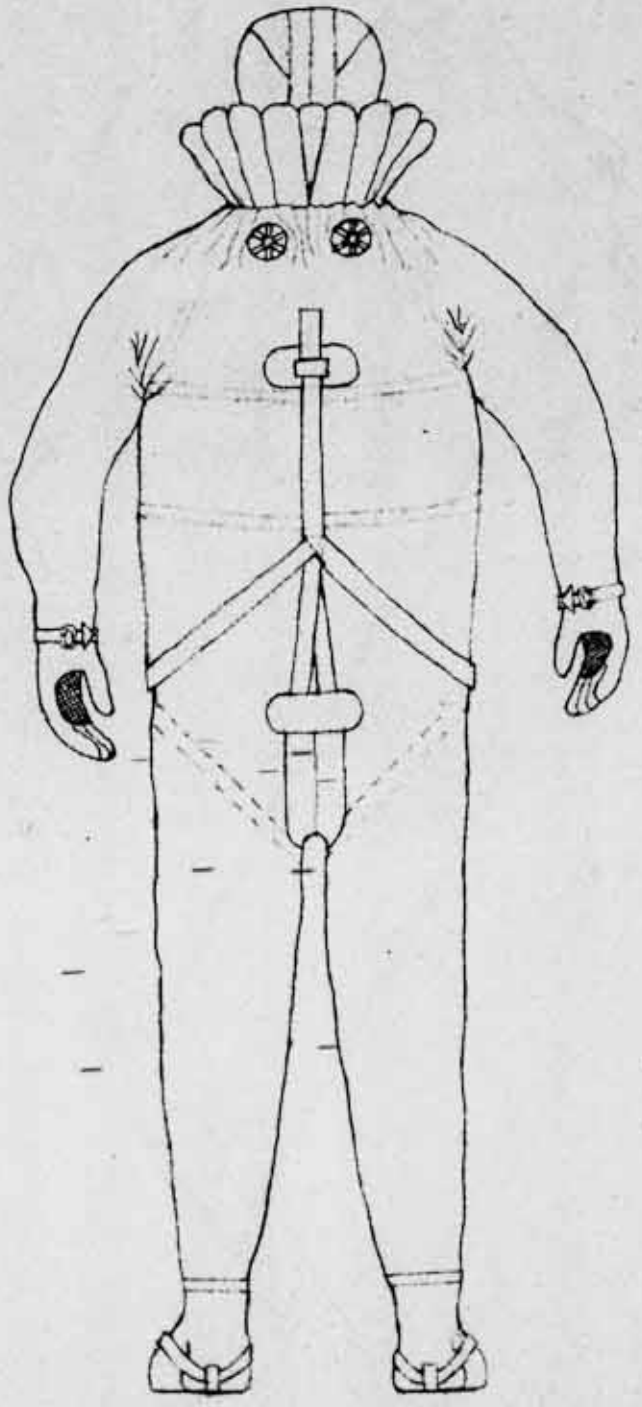
FRONT VIEW.



VIEW SHOWING NECK OPEN

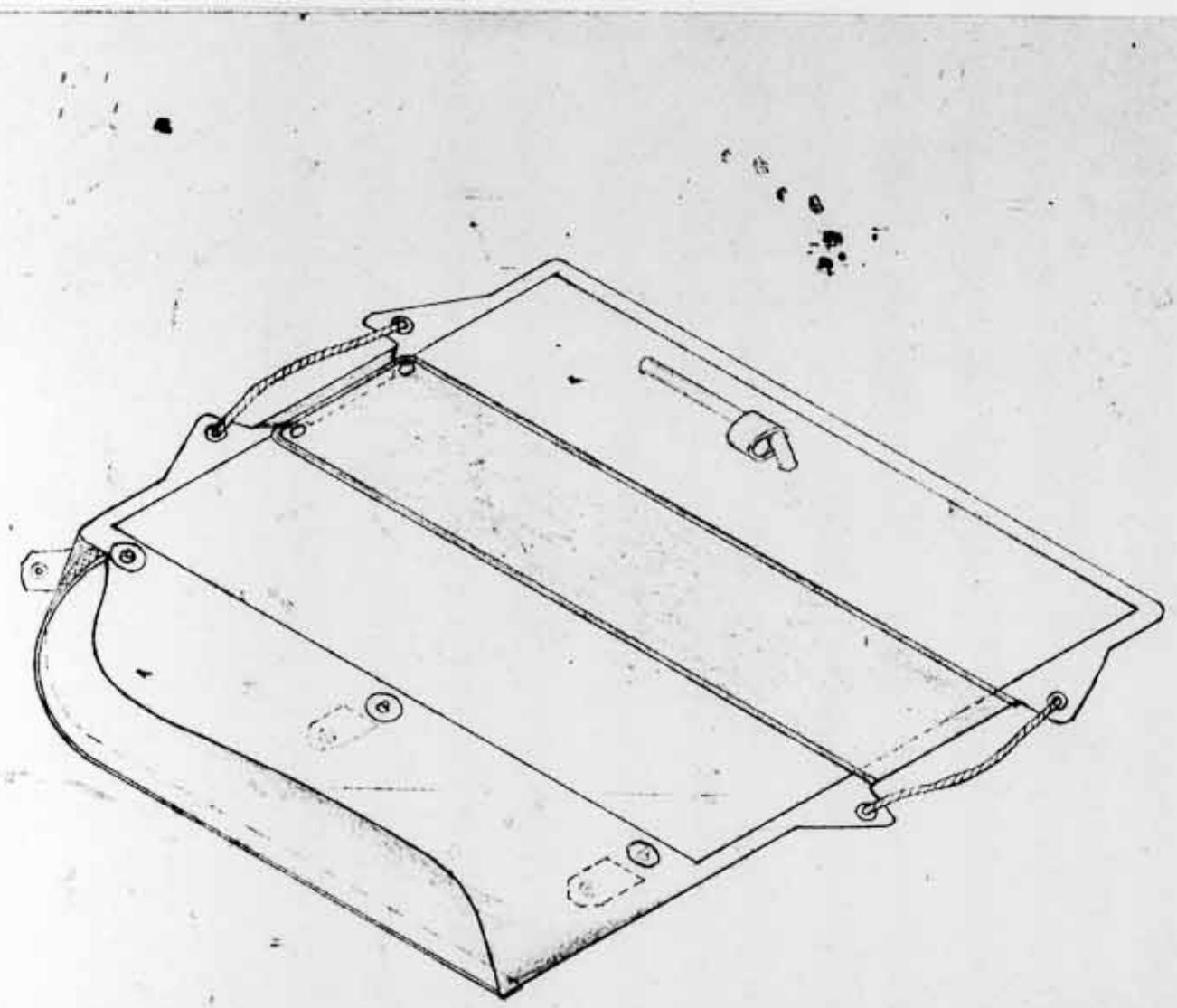
FIGURE 1

THE B.F. GOODRICH CO.
PROTECTIVE EXPOSURE SUIT



REAR VIEW

FIGURE II



THE B. F. GOODRICH CO.

BUOYANT BAG

FIGURE III

Dwn By PMcFFR

COPY

ATTACHMENT H

WAR SHIPPING ADMINISTRATION
Training Organization
Washington 25,D. C.

22 July, 1943

To: S-ACAD
CO-CSPC AIR MAIL
CO-CSSM AIR MAIL

Subject: Lifesaving suits

Enclosed herewith is an excerpt from the Federal Register published Friday, July 16, 1943, advising that the Commandant of the U.S. Coast Guard has withdrawn approval of certain lifesaving suits.

In view of the fact that such suits are now not approved, it is believed that the provision:"that the suits now on board merchant vessels may be continued in service provided such suits are in good and serviceable condition" will have little effect on seamen as a whole, and the suits will undoubtedly not be used by Merchant Marine personnel. Therefore, instruction in the use of heavy rubber lifesaving suits should be discontinued immediately.

H.V. NERNEY /s/

H.V. NERNEY
Acting

CC: DS-NY
DS-NO
DS-SF
AS-CC-ED
CO-TV EMERY RICE
CI-B
CI-H
Chief Inspection Officer
Lt. Comdr. Earle F. Hiscock, USCGR

Excerpt from FEDERAL REGISTER, Friday, July 16, 1943

"APPROVAL WITHDRAWN

Approval is withdrawn from the following items of equipment:

LIFESAVING SUITS

Goodall Rubber Company, Inc., Philadelphia, Pa. Goodall Style CF "Overboard" suit. (1942) (Original approval, 17 July, 1942, 7 F.R. 5495)

B. F. Goodrich Company, Akron, Ohio, B. F. Goodrich Company lifesaving suit, Model 1 (1942) (Original approval, 14 August, 1942, 7 F.R. 6394)

B. F. Goodrich Company, Akron, Ohio, B. F. Goodrich Company lifesaving suit, Model 2 (1942) (Original approval, 26 September, 1942, 7 F.R. 7616)

R. L. Morey Company, Inc., New York, N. Y. Boston fire-resistant overboard cover-all lifesaving suit, Model CM (1942) (Original approval 14 August, 1942, 7 F.R. 6394)

Seamless Rubber Company, New Haven, Conn. Model M-M-1 lifesaving suit (1942) (Original approval 14 August, 1942, 7 F.R. 6394)

Universal Life-Suit Company, Los Angeles, Calif. Universal lifesaving suit (1942) (Original approval 17 July, 1942, 7 F.R.5495)

Universal Life-Suit Company, Los Angeles, Calif. Universal lifesaving suit, Model LSS-2 (1942) (Original approval 8 October, 1942, 7 F.R. 7980)

Vaco, Inc., New York, N.Y. Vaco lifesaving suit (gloveless type) (Original approval 17 July, 1942, 7 F.R. 5495)

The Watertight Slide Fastener Corporation, New York, N.Y. Morner lifesaving suit (1942) (Original approval 17 July, 1942, 7 F.R. 5495)

Notwithstanding the withdrawal of approvals, any of the foregoing suits now on board merchant vessels may be continued in service, provided such suits are in good and serviceable condition.

R. R. Waesche,
Commandant.

July 14, 1943.

(F.R. Doc. 43-11347; Filed, July 15, 1943; 9:39 a.m.)"

PRESENT REQUIREMENTS FOR LIFESAVING SUITS ON MERCHANT SHIPS

NEOPRENE SUITS NOW REQUIRED ON VESSELS OVER 1000 TONS

From recent reports and other communications to headquarters, it appears that there is considerable confusion existing among ship owners and operators, marine inspection field personnel, and officers of ocean-going cargo and tank vessels relative to the present requirements regarding lifesaving suits aboard such vessels of 1,000 gross tons or over. This state of uncertainty seems to have been brought about by two factors:

(1) The recommendation put forth by the office of the Emergency Rescue Equipment Section about 6 months ago to the effect that certain rubber lifesaving suits were dangerous and should be removed in favor of a proposed lightweight "exposure suit" for wear only in boats or on rafts; and

(2) The withdrawal of approval on all existing rubber suits by the Coast Guard, published in the Federal Register on July 16, 1943.

The facts of the matter are simply these: Ever since April 18, 1942, ocean and coastwise cargo and tank vessels of over 1,000 gross tons have been required to be equipped with one approved lifesaving suit for each person employed thereon by the operator of the vessel. Such suits, of a type approved by the Commandant, are still required under the provisions of section 153.12 of subchapter 0.

Approval was withdrawn on all of the then existing rubber suits in July 1943 for two reasons, namely:

(1) The scarcity of rubber, of which all the original suits were composed, making it obligatory to withdraw approval for their manufacture.

(2) The final development and availability of a single standard synthetic rubber (Neoprene) suit, comprising various improvements gained as a result of 18 months' use of the former suits, and on the whole a vastly superior lifesaving appliance, embodying the utmost in protective qualities.

Lately, reports have indicated the existence aboard ship of an increasing number of defective old-type suits. It has been found that several suits have torn or ripped when subjected to hard usage, and for this reason it is believed that these suits may have been stowed adjacent to radiators or steam pipes, or that they may have come in contact with oil or grease, either of which conditions would tend to cause deterioration of the material. The suits referred to were some of the earliest manufactured. It is therefore important that all lifesaving suits on ocean-going vessels be carefully examined before the start of a voyage to insure their being in good condition and properly stowed. Any suits then considered to be defective or in any way unserviceable should be replaced by new standard Neoprene suits.

To summarize: The regulation requiring lifesaving suits aboard merchant ships of over 1,000 gross tons is still in effect as formerly, the only difference being that all replacements must be with the present standard Neoprene suit (September 1943 specification). Suits of other types previously approved and on which the approval has been withdrawn may be continued in use so long as they are still in good and serviceable condition.

OFFICE OF COORDINATOR OF RESEARCH AND DEVELOPMENT, U.S.N.
EMERGENCY RESCUE EQUIPMENT SECTION ANL
ROYAL CANADIAN AIR FORCE FLYING CLOTHING COMMITTEE

JOINT UNITED STATES - CANADIAN AIR/SEA RESCUE EQUIPMENT TRIALS

Washington - Ottawa

TACTICAL TEST REPORT

Exposure Suit - Aviation

November 21, 1943

1. Preliminary Review:

Air/Sea Emergency Rescue Equipment Trials (#6 U.S. Series).

2. Subject:

Studies of Air Force Personnel exposed in the North Atlantic Ocean in November.

3. Purpose:

A. To clinically evaluate the physiological hazards of exposure to cold, particularly loss of body heat, in the North Atlantic Ocean under simulated operational conditions.

B. To critically evaluate the effectiveness of a water-tight, wind proof exposure suit in protecting personnel from loss of body heat and exposure to cold.

Two principle types of aviation exposure suits were tested. The first was constructed of neoprene-nylon, or nylon-silk, or neoprene balloon clothing. This suit had a water-tight zipper closure extending from the base of the trunk to the base of the neck. This suit was closely tailored to fit over winter shearling flying clothing. It weighed slightly over two pounds. The second type of suit tested was made out of nylon covered with butyl or similar material. This type had a drawstring neck closure and was very loosely tailored. The purpose of this type of suit was to provide a quickly donned ditching suit.

JOINT UNITED STATES (E.R.E.S.) - CANADIAN (R.C.A.F.) AVIATION EXPOSURE SUIT DEVELOPMENTAL GROUP.

Subject: Report on Exposure to Cold of Personnel Awaiting Rescue at Sea.
Place: Washington - Montreal - Halifax - Toronto.
Purpose: Study of Exposure and Protection.
Date: November 30, 1943.

CONCLUSIONS

A. The major problems of a castaway are exposure, dehydration and rescue.

B. Exposure is a highly lethal hazard to military and civilian personnel operating in northern latitudes. A human body cools when immersed in water of a temperature less than 92°F. The warmest open ocean water in any latitude at any time of the year is 84°F. Individuals exposed to water of this temperature undergo significant cooling, and need the protection of a waterproof suit in the water. Individuals, even in such warm climates, while sitting on life rafts lose body heat rapidly due to evaporative cooling, unless provided with a waterproof suit. The rate of loss of body heat increases rapidly as the temperature of the air and water falls. For example personnel in Aleutian areas (water 30°F) survive less than thirty minutes.

C. Severity of exposure to cold as a lethal factor is dependent on such variables as wind velocity, temperature of both air and water, degree of wetness of clothing, humidity, physical activity of the individual, duration of exposure and variation in individual susceptibility.

D. Long exposure to sea water, though not severe enough to kill, does, by a general chilling of the body, act locally causing gangrene.

E. It is exceedingly difficult and sometimes impossible for personnel to climb into a life raft after heavy flying clothing has become water soaked. Moreover, even if such a sodden individual manages to get into the life raft he will shortly be incapacitated through evaporative cooling, and will be unable to operate his emergency equipment.

F. An exposure suit of the type tested when worn over a flying suit, or similar clothing will protect an individual for many hours in cold water or in life rafts.

Lieut. Comdr. Earle F. Hiscock, U.S.C.G.R.
Technical Aide for Emergency Rescue Equipment E. F. Hiscock

Lt. Colonel George W. Holt, M-C, E.R.E.S.
Chairman of Tests George W. Holt

Mr. John P. Bader, OQMG, E.R.E.S. John P Bader

Dr. L. H. Newburgh, N.R.C., (U.S.)

Wing Commander M.M. Foss, R.C.A.F., AMAS/DOE

Flight Lieutenant H. J. Bright, D.M.S./Air#1C.I.U. H J Bright

Dr. J.A. Kitching, N.R.C., (Canada)

Dr. Edouard Page, N.R.C., (Canada) Edouard Page

DIGEST OF TRIAL LOG

Seven individuals dressed in aviation exposure suits and various types of heavy winter clothing or flying clothing, went overboard between 1500 and 1600 on November 17, swam about 30 yards to a raft and remained on the raft during the night until about 0600 on November 18. During this period the air temperature was 36°F and the water temperature was 42°F. None of these men were removed from the raft before the completion of this part of the test at 0600 November 18. No individuals dressed in aviation exposure suits abandoned the test before the completion of the test, although in some cases watertight closures were not perfect and the exterior of the clothing was wet.

One individual, not in an aviation exposure suit, but otherwise warmly dressed in a Canadian type E flying suit, went overboard, swam 35 yards, but needed help to board the raft. He donned the exposure suit after some difficulty, began to complain of great discomfort and cold extremities in 20 minutes, was shivering severely in 40 minutes and was ordered removed to the sick bay by the observing medical officer at the end of 50 minutes. Another individual, warmly dressed, but without an exposure suit, swam 25 yards to the dinghy, was immersed for a period of 2 minutes, required help to enter the dinghy, donned an exposure suit and was also removed to the sick bay after 50 minutes.

Two individuals boarded the raft from a rowboat at about 1600 hours on November 17, warmly dressed in winter flying clothing, but without an exposure suit. Both were removed to the sick bay at about 0100 on November 18 shivering and complaining.

The above establishes in a practical test under simulated service conditions what had previously been established in laboratory tests:

(1) That the exposure suit if reasonably watertight protects the warmly dressed individual against the cooling effect of water and evaporative cooling from wet clothing so that it is possible for him to withstand immersion and exposure to cold air temperatures under extremely severe conditions.

(2) That the protection afforded individuals who wet their clothing and put on the exposure suit over the clothing, is of value, but under the temperatures and conditions of this particular test the protection lasted only for a limited period.

(3) That individuals warmly dressed in dry winter flying clothing, but not protected by exposure suits, having gotten into the raft dry (from a boat) were, though subject to spray, able to remain with reasonable comfort for a considerable period. They were finally forced to give up at 0100 November 18. Other individuals in aviation exposure suits who had been immersed were brought aboard at 0600 on the 18th in a perfectly comfortable condition. Their statements and conditions at this time indicated that they could have remained for hours and even days, in the raft, protected by an exposure suit over their winter flying clothing.

INTRODUCTION

This war differs from previous ones in that there is a marked increase in the incidence of disasters at sea. This is largely due to the expansion of the use of aircraft not only for travel over water, but also as a combat weapon. There is an equally serious hazard due to the frequent destruction of surface craft.

As an example of the end result of these disasters, reference may be made to the fact that immersion in Aleutian waters results in death in less than twenty minutes.

For years this matter has been studied in various parts of the world. The realization of the urgency of the problem resulted in a series of conferences between certain interested personnel of the United States and Canadian Services. At these conferences the following decisions were made:

(a) To secure test samples of prototype protective garments.

(b) To test these in the North Atlantic Ocean.

References:

1. Naval Medical Research Institute Reports One and Two, Project X 189--Protective Clothing for Subjects Immersed in Cold Water.

2. "Recommendations - Airborne Rubber Rafts and Sea Survival Equipment" dated August 25, 1943.

3. Tactical Operational Study, AAFS/T, Orlando, Florida, dated 16 July 1943.

4. An Appraisal of Some Devices for Obtaining Drinking Water from the Sea Under Actual Conditions on Inflatable Life Rafts, Pensacola, Florida, dated August 11, 1943.

5. Seven-man Life Raft Study, Cape Hear, North Carolina, June 21, 1943.

6. Map Scientific and Technical Memoranda No. 8/43, Safety of Aircraft in Ditching.

HISTORICAL BACKGROUND

A. On the basis of the past experience of members of the Emergency Rescue Equipment Section, U.S. with the effects of exposure to cold, wind and water soaking, and on the basis of air/sea rescue equipment trials held between January 1943 and July 1943 in subtropical waters off Florida, the Emergency Rescue Equipment Section, in August 1943, recommended the immediate design, production, procurement, and issue of a lightweight exposure suit as a part of life raft accessory equipment. (Reference #3 Introduction)

B. It has been frequently observed that flying clothing is inadequate protection for castaways from the exposure to cold, wind and water such as occurs even in Florida waters from November to April during sun-up hours, and in Florida waters from June to August on the warmest nights. A recent British report covering many phases of air craft safety, particularly those relating to ditching and survival, stresses the need for overcoming the effects of EXPOSURE. It is significant that this report, after reviewing their relative positions and the factors effecting the successful return alive of members of air craft crews making forced landings in water, concludes "everything possible is being done to improve these features, but, from the designers point of view, the exposure risk is the most difficult of them all to meet. The target at which we have aimed continued to be:--'GET THE CREW INTO THE DINGHY DRY.'"

C. Death may result in ten minutes from immersion in the Aleutian waters.

D. In order to determine the proper design and construction of an exposure suit, and thus assure satisfaction of operational requirements, several conferences were held at the Office of the Emergency Rescue Equipment Section, Washington, D.C. These conferences were attended by representatives of many American and Canadian groups. Later meetings were held in Montreal, Halifax and Toronto.

E. On the basis of specifications formulated at these conferences a variety of prototype aviation exposure suits has been produced.

F. It was concluded at these conferences that the aviation exposure suits should be tested in the North Atlantic Ocean under simulated operational conditions and plans were formulated accordingly.

NOTE: On November 7, 1918 Mr. Walter Fry submitted to the U.S. Navy the FRY SAFETY SUIT which was duly tested and tried on Long Island Sound during that winter. Mr. Fry swam in water of 39°F for several hours, and it was concluded that this garment served well as a protective exposure suit for personnel lost at sea..... It would appear significant that the suit designed by Mr. Fry more closely approximates the light weight exposure suit recommended on the date of June 5, 1943 for personnel on merchant and transport vessels than does the "lifesaving suit" now carried under United States Coast Guard regulations.

LOG OF TRIALS

On November 17th and 18th the following exposure experiments were conducted. All individuals were normal in every respect at the time of the physical examination, just prior to beginning the experience.

1. At 1440 hours on November 17th Flying Officer Simes went overboard and swam a distance of thirty-five yards. He was dressed in a Canadian type E flying suit, and did not have on an aviation exposure suit. He attempted, for a period of one minute and forty seconds to board the United States E-1 raft which had no ladder on it, but was unable to do so. He complained of the cold, and was pulled into the raft. He attempted to don the nylon neoprene exposure suit, but due to the fact that he did not open the zipper more than half way down, and did not notice this, he had to remove the flying jacket before he could get the exposure suit over the upper half of his torso. After being in the raft for a period of twenty minutes he complained of great discomfort due to cold extremities. Forty minutes after boarding the dinghy his condition was such as to cause the observing Medical Officer to order him removed to the sick bay. On examination in the sick bay his rectal temperature had dropped 3°F. He showed marked erythema of both hands and feet, and shivering continued for a period of twenty minutes after being placed in bed with hot water bottles placed on the extremities. There was a decrease in superficial sensitivity to pin prick and to deep pressure of both feet.

2. At 1545 hours on November 17th Sgt. Bourdage went overboard dressed in a shearling flying suit, winter underwear, and an OD uniform. He did not have on an exposure suit. He swam a distance of 25 yards to a RCAF type H dinghy, and was immersed for a period of two minutes. He boarded the dinghy with some difficulty. He then donned the exposure suit while sitting in the dinghy. When he donned the exposure suit he noticed that he had lost one of his shearling boots while swimming from the mother craft to the life raft. He put on the exposure suit without waiting for the lost boot to be returned. He stayed in the life raft for a period of fifty minutes after which time it was necessary to remove him to the sick bay. He was fairly comfortable for the first twenty minutes in the life raft, after putting on the exposure suit, and played cards with the other men. After playing cards for twenty minutes he began to shiver. This continued until he was in bed in the sick bay. Upon examination in the sick bay he showed marked erythema of the foot which was clothed in a boot, and less erythema on the foot from which the boot had been lost. Examination showed the following temperature decreases: oral none, rectal 1.8°F, axillary .8°F.

It is interesting to note that in this case the foot from which the boot was lost exhibited no abnormal sensory changes. The foot which was clothed in a wet shearling boot inside the exposure suit exhibited complete anesthesia to deep and superifical sense stimuli. He was unable to determine by deep pressure sense, for a period of five minutes after returning to the sick bay, whether or not he was walking on the shearling boot covered foot, and the foot was anesthetic to superficial sense. Within a period of two hours Sgt. Bourdage was subjectively normal in all respects.

3. At 1600 hours on November 17th Sgt. D. Scharnahorn boarded a rubber life raft from a row boat. He was wearing winter flying clothing, winter underwear, shearling boots, and wool gloves. He remained in the life raft until 0100 hours on November 18th. He was removed, upon the recommendation of the Medical Officer, from the raft after complaining of cold and wetness. At approximately midnight Sgt. Scharnahorn, while asleep, inadvertantly dropped his right foot over the side of the raft. His foot was immersed for approximately thirty minutes before he awakened. He stated that the immersed foot was completely numb up to a distance of four inches above the ankle, and that upon awakening he had noticed the needle sensation. Upon knocking his two feet together he noticed that he had no sensation in his right foot. On boarding the mother craft he stated that when he stepped on the right foot he had no sensation of pressure. Upon examination in the sick bay his right foot was markedly erythematous. This was most pronounced on the digits. No swelling was present. His temperature decreases were as follows: oral 0°F, rectal .8°F, axillary 0°F. At 0600 hours both feet appeared the same, and subjectively this individual was normal.

4. At 1610 hours on November 17th Sgt. Stewart boarded a rubber dinghy from a row boat. He was dressed in winter flying clothing, winter underwear, shearling boots, wool gloves, and OD uniform. He remained in the raft until 0100 hours on November 18th, at which time he requested removal to the mothership. He was shivering, complained of cold hands and cold feet, and had been fairly well wet through from the spray. Upon examination in the sick bay his extremities appeared normal with the exception of mild erythema of his feet. His temperature decreases recorded at this time were: oral 2°F, rectal 2.6°F, axillary 1.8°F. He did not have on an exposure suit.

5. Sgt. Yard went overboard at 1500 hours on November 17th in an aviation exposure suit, winter shearling flying clothing, winter underwear, and shearling boots. He swam a distance of thirty yards from the escort vessel to the rubber raft. It was noted that he boarded the raft with great ease due to the buoyancy of the exposure suit. He remained in the raft until 0600 hours the following day, November 18th. This individual sustained a drop in body temperature during the period he was in the water and the raft as follows: oral 2.8°F, rectal 1.6°F, axillary 1.4°F.

6. At 1500 on November 17th Sgt. H. D. McLeod jumped off the stern of the escort vessel, falling a distance of 16 feet before striking the water. The watertight neck closure aviation exposure suit did not rupture. Air was expelled freely through the valve. Sgt. McLeod swam a distance of 40 yards to a rubber raft. He stated that he could swim with ease and that he could board the rubber raft with ease due to the buoyancy of the combined clothing. Sgt. McLeod was dressed in an aviation exposure suit, latest type American electrically heated suit, winter underwear, and electrically heated type boots. He remained in the raft until 0600 hours on the morning of the 18th of November, at which time he showed a temperature drop of 2.4°F. He did not complain of coldness in his hands and feet, and was completely dry.

7. At 1530 hours on November 17th Sgt. W. A. Lamb went overboard dressed in an aviation exposure suit, type E Canadian flying suit, winter underwear, wool gloves, and shearling boots. He swam a distance of thirty yards from the escort vessel to the raft which he boarded with ease.

Lamb remained in the raft until 0600 hours on the morning of November 18th at which time he reported to the infirmary in the escort vessel. He showed a decrease in body temperature of 3.6°F oral decrease, rectal 1.2°F, and axillary 2.2°F.

8. At 1530 hours on November 17th Sgt. C. W. Anderson went overboard dressed in an aviation exposure suit type E Canadian flying suit, winter underwear, and wool gloves. He swam a distance of thirty-five yards to the dinghy and boarded it with ease. He remained in the raft until 0600 hours the following morning, November 18th, at which time his body temperature showed the following decreases: oral 3.8°F, rectal 2°F, axillary 1.4°F.

9. At 1530 hours on November 17th Sgt. E. Johnston went overboard dressed in an aviation exposure suit, and shearling flying clothing. He swam a distance of thirty yards to the life raft and remained in the life raft until 0600 hours on November 18th. Body temperatures showed the following decreases: oral 3.2°F, rectal 3°F, and axillary 3.4°F. This type of exposure suit was one ply nylon, and seepage through the material caused considerable dampness to the exterior of the flying suit. He did not complain of chilling of the extremities.

10. Sgt. Reichardt went overboard at 1600 hours on November 17th dressed in an aviation exposure suit, winter underwear, OD uniform, shearling flying clothing, shearling boots, and winter underwear. He remained in the raft until 0600 hours, November 18th, at which time he was removed to the sick bay. Upon examination he showed no color or vascular aberrations of the extremities. It was noted that water had seeped through his one ply nylon aviation exposure suit, and that the outside of his flying suit was damp. The inside of his flying suit was dry. The following temperature decreases were recorded: oral 1.8°F, rectal 2.4°F, axillary 1.8°F.

11. At 1620 hours on November 17th Sgt. Bangay went overboard dressed in an aviation exposure suit, OD uniform, shearling flying suit, winter underwear, and wool gloves. He remained in the raft until 0600 hours on the morning of November 18th. Upon examination it was noted that the exterior of his winter flying suit was damp, and that it had been from seepage through his one ply aviation exposure suit, over the shoulders and back. His temperature decreases were: oral 3.2°F, rectal 2°F, axillary 2.4°F.

12. A member of the RCAF air crew was dressed in a United States winter shearling flying suit with regulation parachute harness and Canadian K type parachute dinghy attached, after which he jumped from a height of about five feet into the water to simulate a fighter plane ditching. After four minutes he had to be rescued. He was unable to either open the dinghy or remove the harness and had given up fully exhausted.

13. A member of the RCAF air crew was dressed in United States shearling flying clothing, an EXPOSURE SUIT equipped with parachute harness and individual parachute type dinghy. He jumped overboard in the same manner under simulated "ditching" conditions, opened the K type dinghy, and boarded it in ten minutes.

It was the opinion of all men who stayed in the rafts during the night that the aviation exposure suit afforded them a great deal of protection. They uniformly stated that they would be willing to remain in the raft for a much longer period--several days, if requested. They slept

well in the raft, and were warm and comfortable. It should be noted that during the period of these tests the wind, for the most part, was blowing about 18 to 25 miles from the North and West, with snow flurries. The water and air temperatures approximated 42°F and 36°F, respectively. During the night of the 17th and 18th, from about 2200 through 0300, there was a moderate snowfall with a stiff breeze. However, examination of subjects during this period revealed that they were all asleep.

In the interpretation of rectal temperatures the diurnal cycle should not be overlooked. It is not unusual for the rectal temperatures of normal persons to be 2°F. lower in the early morning than in the evening. Another less generally recognized factor is the effect of rest on the rectal temperature. The mere change from the upright to the sitting position will cause the rectal temperature to fall about 1 degree F. in an hour's time. The effect is even greater when an individual lies down after walking about or being mildly active. A maximal fall of 2 degrees F. is commonplace and takes about two hours to reach a final level.

In regard to shivering, it should be realized, that shivering is a means of greatly increasing the rate at which the organism is producing heat. The violent muscular contractions will increase the heat production three or four fold over that of the resting state. Accordingly, when the organism shivers, one has clear evidence that an attempt is being made to compensate for repated loss of heat. This increased heat production may be sufficient to prevent cooling of the body or if the environmental conditions are severe, a progressive fall of internal temperature will take place in spite of the most violent shivering.

RELATED TEST DATA

1. Flotation level in vertical position is at nipple line when the exposure suit is worn over winter flying clothing.

2. Flotation is easily maintained in vertical position if desired.

3. Survivor can "float" in horizontal position in the same manner as if dressed in ordinary swimming attire.

4. Flotation provided by the air trapped in winter flying clothing, kept dry by an exposure suit, permitted all individuals to board life rafts with ease.

5. Flotation of the combined winter flying suit and exposure suit permitted individuals to float for a minimum period of three hours. In no case did flotation fail and it appeared that the individual could have floated for many additional hours.

6. It is much easier to swim especially in high seas if the dry winter flying suit is covered with an exposure suit.

7. The U. S. Single Ply Nylon-Neoprene suit, and the Canadian Vinylite Coated suit, are not sufficiently waterproof, to prevent seepage during long continued exposure in a life raft.

8. Wetting of the shearling clad foot in 42°F water for a period of one hour causes a temporary, but complete loss of superficial and deep sense. The extremity was bright red, but not swollen, and the individual first complained of needle sensation and loss of ability to tell when he walked on the exposed foot. After an exposure of 14 hours at an air temperature of 34°F, and water temperature of 40°F. individuals exposed in a raft while clothed in winter flying clothing and an exposure suit did not complain of any discomfort. Further individuals immersed in water for an hour or more while clothed in exposure suits did not complain of any discomfort.

9. It is essential to have a reasonably, but not absolutely, water tight neck closure in an exposure suit if immersed individuals are to be protected for any considerable length of time from loss of body heat, especially from the feet and hands.

10. The combination of an exposure suit over American shearling, electrically heated, or Canadian type E flying suits, provides protection from disabling loss of body heat for more than twenty four hours with a water temperature of 40°F, and an air temperature of 29°, for individuals in rubber life rafts.

11. Wet individuals without an exposure suit found great difficulty in boarding rubber rafts due to cold exposure and increased weight of water soaked Canadian winter flying clothing. F/O Simes went overboard dressed in a Canadian Type E flying suit, swam for one minute, and then attempted unsuccessfully to board a rubber raft. It was necessary to pull this man into the U. S. M-1 raft (without

ladder). After sitting in a life raft for 40 minutes violent shivering set in. Simes was then removed to the sick bay at the request of the Medical Officer.

12. The lined waterproof exposure suit provided in the standard Lindholme Dinghy equipment was difficult for a man dressed in winter flying clothing to get into. It would apparantly be necessary to discard a portion of the winter flying clothing to properly get into the equipment and fasten it.

13. Three individuals in dinghys with wet winter flying clothing covered with an exposure suit did not suffer serious discomfort for a period of one hour. They complained of cold hands in about thirty minutes, of cold feet in forty minutes, and in fifty minutes they were shivering severely. No feeling of hand perspiration discomfort was reported by test personnel.

14. Individuals with wet winter flying clothing on can survive longer with the added protection of an exposure suit than without.

15. Rubber covered winter flying boots increase the time required to don the neoprene lined suit boots if the latter are closely tailored.

16. The lowest donning time is obtained with a loose fitting exposure suit under all circumstances. However, a large suit is unsuitable for wearing while flying.

17. It is difficult to don closely fitted exposure suits over wet winter flying clothing.

18. It is difficult to swim in heavy flying clothing without an exposure suit.

19. The trials involving as they did a number of men swimming to, and boarding, rubber rafts brought out forcibly the need for attention to accessories which will aid exhausted flyers to get aboard. A stirrup type ladder together with a knotted line across the raft as in the Canadian H type dinghy would be of great assistance.

20. A small hand type smoke signal which has been developed for consideration as to its suitability for use in rubber rafts was still visible at a distance of 8 miles, altitude 2500 ft., with a visibility of 7 miles, ceiling overcast 5000 ft.

This section of the report refers to observations on a loosely tailored drawstring neck closure type of quick donning exposure suit. It was considered by the committee that certain services have a serious and an immediate need for such equipment.

(a) Fabric and Coating:

In the two weeks which preceded the tests at Halifax, it was possible to produce the following prototypes of exposure suits:

Suit No. 1: Made of nylon with natural rubber coating on one side only, by Dominion Rubber Company.
Suit No. 2: Made of rubber-coated cotton for the upper part and of butyl-coated nylon from the waist down.
Suit No. 3: Made of butyl-coated nylon.
Suit No. 4: Made of butyl-coated nylon.
Suit No. 5: Made of vinylite-coated (VYNW) nylon.

All five Canadian suits were similar in general design. Their essential feature consisted in overall dimensions such as to accomodate all the required clothing. Drawstring neck closures were used in all cases. Boots and mitts were attached to the suit and some form of leg tightener was used. A hood with a bib extending fanwise under the chin was also provided. The legs of the suits had the same circumference as the sole in order to facilitate donning. The following features, however, require further description:

Ankle and Leg Tighteners: Suits 1, 2 and 3 had elastic bands channeled above and around the ankle. No. 4 was fitted with knee high zippers originating at the front ankle position, the tapes being sewed upwards and in diverging directions, so that pulling up of the slider gathered in some of the extra fulness of the leg. Suit No. 5 had a drawstring arrangement which tightens the fold around the instep, behind the heel, and around the knee. The foot and ankle part of the drawstring was exposed.

Mitts: Mitts of material similar to that of the suits were used. The mitts were all of the chopper type with the exception of those used on Suit No. 5. No wrist tighteners were used.

Drawstrings: The drawstrings were so arranged as to make nearly a turn and a half around the neck closure. In suits Nos. 1, 2, 3, and 4, the two ends of the string emerged from the channel separately, through eyelets placed on either side of the front median line of the suit and approximately 2½ feet apart. In No. 5 suit, two strings anchored at the shoulder points crossed at the back of the channel and came out together in front. The rubber (No. 1) and butyl (No. 3) suits had a nylon cord with a silky finish and the plastic suit had a waxed sashcord. Uncoated fabric was used for the channels of the rubber suits only. Drawstring stoppers were of the notch type, the string being locked by forcing it casually into a wedge-shaped notch cutting across the orifice of the plug through which the string is drawn.

Methods:

A. Swimming pool tests - Preliminary tests were conducted at the local Y.M.C.A. pool to detect the presence of possible leaks and to evaluate the functional characteristics of the suits under ideal conditions. Subjects wore the test suits over full flying clothing, including Mae Wests. They were first instructed to swim for five minutes with their heads above water in order to test for leakage other than at the neck closure. Then they dived in head first to see in what position they came back to the surface, and they finally lay still on their backs for one minute as a test of adequate neck closure. The subjects were weighed in their flying clothing before and after the test to measure the amount of water which had soaked in, and any water found in the exposure suit was also added in.

B. Donning tests - For an investigation of the ease with which the suits could be donned, the subjects were first shown how to put the suit on and off, after which donning tests were carried out without further direction or assistance being given. Donning was first carried out on the deck of the mothership and over dry clothing, secondly, over dry clothing but in aircraft dinghies, and thirdly, over wet clothing in the dinghies. The subjects were instructed not to hurry but to proceed as methodically as possible.

C. Tests of floating, swimming, and boarding dinghies in sea - Subjects wearing the exposure suits with and without Mae Wests stayed in the water for variable lengths of time. They were then instructed to climb in and out of dinghies and to perform various tasks. Ease of movement and subjective reaction to environment were recorded. Tests were carried out in the Bedford Basin and in the open sea.

D. Ditching drill - Operational personnel from the R.C.A.F. station at Dartmouth were shown the suits and were asked to try them on and to comment on them. Ditching drills were then carried out in a Ventura and in a Canso. Time to complete the drill and other pertinent data were recorded.

Results:

A. Swimming pool tests:

(1) Leakage: After 5 minutes of swimming without immersion of the head, the subjects reported as follows:

Suit No. 1: No leakage detected.
Suit No. 2: Slight leakage in right hand and right foot.
Suit No. 3: Slight leakage in right hand.
Suit No. 4: Bad leakage in hands and feet.
Suit No. 5: Appreciable leakage in both feet.

It is realized that these leakages were probably due to hasty seaming and that they can be avoided in production.

After the subjects had dived in head first and had lain still on their backs in the water for one minute, they all reported slight leaks at the neck. The total weights of water taken in during all these tests were as follows:

Suit No. 1: $\frac{1}{2}$ lb.
Suit No. 2: $2\frac{1}{2}$ to $3\frac{1}{2}$ lbs.

Suit No. 3: 2½ to 3½ lbs.
Suit No. 4: 1½ lbs.
Suit No. 5: 2½ to 3½

(2) Flotation: All subjects came up to the surface in the prone position after diving in head first. No difficulty was experienced by anyone in turning over to the supine position. It was clearly demonstrated that the quantity of air trapped in the legs was not nearly enough to hold a man inverted with his head below the surface. Difficulty was at first experienced by all subjects in forcing their feet below the surface, but this did not in any way hinder them from swimming with their heads well clear of the water.

(3) Valves: In connection with the use of valves to release the air from the inside of the suit, work done at Naval Medical Research Institute included a practical test to determine the efficacy of such valves. A large man wore an exposure suit over heavy clothing. This exposure suit contained one valve at the back of the neck. So attired he dove head-first into a pool of water. Reaching a depth so that he was completely submerged, his feet were definitely below the water surface to begin with. He made no effort to right himself but nevertheless was in a comfortable position on his back ten seconds after entering the water. While he was submerged, a stream of large air bubbles rose through the water indicating that the hydrostatic pressure of the water was driving the air trapped in the exposure suit out through the valve. The experiment was repeated with only one change, the valve was filled so that the air could not escape through it. In this case it took about thirty seconds for the man to lie released on the surface of the water because the trapped air tended to keep his feet up and he had to struggle, in order to get and keep his head above the water. The trapped air would escape slightly around the neck closure. The individual, an experienced swimmer, felt that it was a great advantage to have an opening valve for the escape of air. The valve in question is the type employed in the A-10 oxygen mask.

B. Donning tests:

(1) Over dry clothing, on the deck of the ship: The subjects tried the exposure suits on once before the tests were begun. Because of this lack of practice, emphasis in this and subsequent tests was laid on correct donning rather than on speed. Donning was done over full R.C.A.F. flying clothing, including flying suit type E, flying gloves type E, flying boots, type A, and no Mae West.

Donning on deck, over dry clothing, was accomplished by all five subjects without any assistance in about two minutes, the best time being forty seconds.

(2) Over dry clothing, in aircraft dinghies: The same subjects were next required to repeat the donning (again over full flying clothing) in aircraft dinghies on the water. Four of the men were placed together in a Type K dinghy (circular), and the fifth man was provided with a dinghy. Three subjects completed donning within 1½ minutes, a fourth subject took 2 to 3 minutes, and the last man took about 4 minutes. There was no mutual assistance, although in actual operations the men would be able to help each other.

(3) Over wet clothing, in aircraft dinghies: Three of the same subjects jumped into the water, and were helped into dinghies. Donning the exposure suits over wet flying clothing in the dinghies proved far more difficult. The subject wearing suit No. 4 (which had a mica coating on the inside for added slipperiness) donned his suit in 3 minutes. He then helped the subject wearing suit No. 2, and this was donned in 5 minutes. The third subject donned suit No. 5 in 6 minutes unassisted, after being told that the bottom of his type E jacket had curled at the back and was interfering with pulling up of the exposure suit.

Results of all these tests appear to be very satisfactory in view of the lack of practice of the subjects and of the fact that no method of folding the suits for easy donning had yet been devised.

C. Tests of floating, swimming, and boarding dinghies in the sea:

(1) In Bedford Basin, Halifax: During the tests in Bedford Basin, the sea was calm, water temperature was 44°F, and air temperature 38°F.

A test was first carried out with the drawstring neck suit worn over flying clothing, but without boots or Mae West. This suit is provided with an air escape valve at the back. The subject was still floating satisfactorily at the end of thirty minutes, when the experiment was concluded, in spite of leaks in both feet and in the right hand. By that time, the extremities were cold but not unbearably so, and the subject felt he could have stayed in indefinitely had it not been for the leaks. Neck closure was found to be satisfactory. At first the subject could get his feet down only by violent kicking and he had to keep struggling to hold himself in a vertical position. The difficulty in maintaining this position gradually decreased as water leaked into the feet.

Two subjects wearing the suits Nos. 1 and 3 over full flying clothing stayed in the water continually for an hour and a half after which they boarded a type H dinghy for a short rest period. They then went in and out of the water and performed various operations such as righting an upset type H dinghy, inflating a type K dinghy, climbing in and out of them, catching apples and eating them while in the water, smoking cigarettes during a rest period in a dinghy, etc. Details of these operations were recorded with a movie camera. The two subjects were brought back to the ship after 2-3/4 hours and reported they were feeling fine. The following observations were made on the above two subjects wearing suits No. 1 and No. 3:

(a) Although one subject did not wear a Mae West, he apparently floated and maneuvered just as well as the other subject.
(b) Both subjects floated very high in the water, either lying on their back or in a vertical position.
(c) They apparently had no trouble in pushing their feet down when so requested and in keeping this position although it required definite activity to do so.
(d) When floating on their back in a completely relaxed condition, the nose was low in the water with the face above the surface. This would not be satisfactory for an unconscious man floating in rough water. It also favors leakage at the neck.

(e) When floating on the back the neck closure can be held above water only by a sustained effort which soon becomes tiresome.

(f) When in a vertical position, the neck closure is well above water and little leakage is experienced at the neck.

(g) After 10 minutes in the water, both men were very warm and one was sweating. One of the men reported leaks in the feet and in one glove, and he felt cold after 1½ hours immersion. The other subject also reported getting cold at about the same time, due to neck leakage and to a tear in one glove. Neither were very cold, although they shivered occasionally and both stated they were feeling fine as soon as they boarded the dinghy some 15 minutes later.

(h) Boarding either type H or type K dinghy was quite easy and relatively little water was shipped in the process. The man floated so high in the water that the ladder was not used.

(2) <u>In open sea, about 7 miles from shore; slight swell and slight cross chop</u>, water temperature 40°F, air temperature 35°F.

Tests were carried out by two of the authors (E.P. & J.A.K.) as well as one other subject. The object was to verify the observations of previous subjects, and to test the exposure suits in rough water. As the sea was too calm for a thorough test, a large high speed crash boat was used to make waves. Observations made were in agreement with those of previous subjects and the following points were brought out more clearly:

1. Although it requires a good deal of effort to push the feet down, the strain is not excessive; once this is done the vertical position can be maintained without undue effort.
2. As long as one remains in the vertical position, the neck closure is well above water, and little leakage occurs even in rough water. The hood and bib is of distinct value in this respect.
3. The only time when water leaks in appreciably through the neck is when the wearer is lying flat on his back. This is not likely to occur if the suit is only used to swim a short distance in the dinghy.
4. Once aboard the dinghy, the wearer can loosen up the drawstrings and reach the pockets of his flying suit either by reaching in through the neck opening of the exposure suit or by withdrawing one or both arms from the sleeves of the exposure suit.
5. In spite of the rather large amount of water which was shipped, sensations of cold were restricted to the extremities (one hour exposure). Upon undressing, it was found that damp areas on the underwear were mostly confined to the seat region and to the legs below the knees.
6. Manual dexterity of subjects wearing the watertight mitts over flying gloves was good enough to allow them to undo knots in wet ropes, adjust and work the dinghy pump, etc.
7. Slipperiness of the drawstring within the channel was found to be an important factor, both for closing and opening the neck. A nylon cord slipping over uncoated nylon gave excellent results, waxed sashcord over plastic coated nylon was poor,

neither was a nylon cord over butyl coated nylon very satisfactory.

D. Ditching Drill

Exposure suits Nos. 1 to 5 were shown to and tried by the crews of a Ventura and a Canso aircraft. The crew of the Ventura then climbed into their aircraft each carrying an exposure suit. After closing the hatch, the alarm was given and the ditching drill started. Three minutes later, all the men were out of the aircraft with the required peices of equipment and the exposure suits properly donned.

The test was repeated with the crew of the Canso. They took a little longer to go through the ditching drill but all came out with the exposure suit on. One man snagged his suit in the leg below the knee but did not know how it happened. Mae Wests were worn on these tests. The men were otherwise fully clothed. (Type E flying suits, Type E flying gloves, flying boots and helmets.)

These men were favorably impressed with the exposure suits, and thought that the benefit derived from an exposure suit was well worth the extra trouble and time involved in donning the suit before ditching. They did not consider it practical to wear an exposure suit, of the loosely fitting type as shown them, continuously in multiplace aircraft on operational flying owing to the extreme snagging hazards and the possible restrictions in movement. No flight test of this was made. Nor were they interested in a suit which cannot be donned in the aircraft prior to ditching. They did not think the connections to the earphones were much of a problem.

Conclusions:

Bearing in mind the requirements set forth in the introductions to this section of the report, and realizing that seam leaks can be avoided in exposure suits produced under specifications and rigidly inspected, we have reached the following conclusions:

1. It is perfectly clear that the aviation exposure suit to be donned prior to ditching is one of the most important of all items of emergency equipment in northern latitudes. This conclusion is fully justified for the following reasons:

(a) It is difficult to climb aboard a dinghy after being in the water without an exposure suit. The numbing effect of cold water and the great weight of water held in the clothing combine to make this operation severely fatiguing at best, and probably impossible in many operational instances. The exposure suit protects the body from the cold water, keeps the clothing dry and light, and in addition by its great buoyancy helps a man to lift himself into the dinghy.

(b) Even if a man without an exposure suit gets into a dinghy, he will not after his cold immersion remain for long in a condition to make use of the various other items of emergency equipment with which he is provided.

2. Any of these 5 prototype aviation exposure suits may be recommended for adoption with little modification. This conclusion is justified by the following observational findings:

(a) The suits afforded a sufficient protection from exposure.
(b) The suits can be put on sufficiently quickly for a large majority of members of crews of multiplace aircraft involved in ditching to be able to don them before such ditching.
(c) The suits allowed sufficient ease of movement and manual dexterity for members of aircrews to perform all their duties connected with ditching.
(d) The suits were satisfactory from the point of view of flotation, swimming, and boarding the dinghy. The distribution of buoyancy was in no case such as to force a man into a dangerous position.

3. Apart from the above general conclusions, deductions may be drawn as to certain particular features of design:

(a) In any light-weight exposure suit worn over shearling winter flying boots there will be a tendency for the legs to rise to the surface because of the great buoyancy of these boots. This feature is not a significant disadvantage for the purposes under consideration in this section of the report.
(b) Because ease of donning, simplicity of operation and reliability of neck closure are of primary importance, a drawstring neck closure is, for the immediate purpose of Canadian procurement, preferable to a slide fastener. It is recognized that the further development of watertight slide fasteners may revoke this conclusion at some future time.
(c) For purposes of ditching (having a very short period of immersion in mind) complete watertightness is not essential, and slight leakage at the neck does not detract seriously from the effectiveness of the exposure suit.

4. An exposure suit of the type under consideration is not suitable for pilots of fighter aircraft. For these, entirely differently styled exposure suits would be required, suitable for wear at readiness and flight. Form-fit would take precedence over donning, and ventilation or vapor permeability would be needed.

Recommendations:

1. It is recommended that for immediate procurement, a suit be considered which is similar in design to the prototypes already tested, and incorporating the following features:

(a) Reinforcing tape around the edge of the soles.
(b) Elastic tape around the ankles and wrists.
(c) Drawstring channel to be of nylon coated on the outside only. Automatic locking device for drawstring with simple release mechanism.
(d) Reinforcing patch around palm of hand.
(e) Colored markings inside and outside the suit to identify the back and front of the suit, and the median front line of the suit and of each leg, and the left and right foot.

(f) Stiffer pull tab on the hood to facilitate finding it and pulling hood over the head.
(h) Slightly larger overall length of the suit.
(i) Maximum weight of 3 lbs.

2. It is recommended that because of the urgency of the problem, any water-tight fabric be accepted which meets reasonable specifications as to water-tightness, flexibility in the cold, resistance to abrasion, tear strength, and strength and watertightness of seams.

3. It is recommended that further developmental work be carried out on this type of suit. One of the first improvements suggested is the incorporation of an inflatable chamber in the head and neck region to keep the neck closure above water when the subject is floating on his back. Provision for draining the suit through the feet may also be desirable in the event of considerable leakage arising from snagging during ditching operations.

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North Pacific Flyers Don't Expect to Live If Downed at Sea

By NORMAN BELL
Associated Press War Correspondent

AN ALEUTIAN BASE, April 24 (Delayed).—United States Army and Navy airmen carrying the war across the frigid North Pacific to Japan's own soil don't count on survival if forced down at sea.

And between their Aleutian bases and the Japanese Kurile Island targets there is nothing but sea—cold, stormy and vast.

The young pilots and navigators, who guide the big 11th Air Force Liberators and Fleet Air ("Flair") Wing Four's Venturas and Catalinas on the bombing and reconnaisance missions, have to be good. They fly "on guts and sense of duty"—in the words of Commodore Leslie E. Gehres, "Flair" Wing Four's commander. They complete their missions because they have been thoroughly trained and know their business.

Long Over Water Missions.

The Liberators—of Maj. Gen. Davenport Johnson's 11th Air Force—have been flying the longest all-over water missions of the global war since they struck at the Kurile Island of Matsuwa for the first time in mid-March.

Matsuwa is approximately 1,000 miles from the Outer Aleutians. In between there is not even a rock that a bird could alight on.

"Flair" Wing Four's amphibious Catalinas started the North Pacific night missions and then the job on the Navy side was taken over by the fast medium Ventura bombers. They have been striking on Empire Express schedule at Paramushiro and Shumishu, northernmost of the Kuriles. The round-trip distance flown is about 1,600 miles—by far the longest raiding flights ever made by medium bombers of that type.

And besides being the longest, the missions are among the coldest and loneliest of the war. Temperatures are always below freezing. The bombers, taking off into the night, are quickly lost from each other. It is every plane for itself.

"Get Back or Else."

I have flown on both Army and Navy missions and the crew in each case knew it was "get back or else." In the killing cold water below no one could live long—a half hour perhaps at the most.

Safety devices with which all planes are equipped wouldn't help much, probably only prolong the end a short time.

The crew of a Navy patrol Catalina, which was forced down and foundered comparatively close to Attu, was sighted on rubber rafts from another plane at noon March 31. The weather closed in. By the time a rescue destroyer found the raft three days later all were dead.

"Flair" Wing 4 headquarters reported that Lt. N. P. Wyman of Edgewood, R. I., commander of the plane, and his officers and men waved off another Catalina rather than have it attempt a rescue landing in the face of a 45-knot wind and 15-foot waves.

Kiska Was "Duck Soup."

The Liberators and Venturas, both land planes, would give the crews even less chance to take to rafts than the amphibious.

"My boys would rather be bombing Attu and Kiska again—that was duck soup compared to this," said Capt. Thomas Wood of Wheeler, Tex., commander of a squadron of the B-24 Liberators.

"But," he added, "these combat crews are peculiar. Maybe they don't like the job, but just try to leave one crew member out of a mission!"

Navy crews are the same. I heard Lt. (j. g.) Lloyd Black of Philadelphia protest vigorously to his squadron commander because he had heard that, due to a change of plans, his plane was to be left out of a mission last January. Lt. Black went. His plane was the second off.

VICTORY LIFE SAVING SUIT

BY MORNER

Important Instructions

1

In putting on your life saving suit time is of vital importance. Keep your suit in a handy place folded back as shown in this illustration with the tops of the boots turned inside out.

2

Step into the suit with your shoes on, grasping edges of boots firmly with both hands. If possible, balance yourself by leaning against a bulkhead.

3

You can work in your suit by day and sleep in it at night by folding it around you and tieing sleeves together at the waistline.

4

The next step is pulling the hood on over your head, making sure it is well down over your ears.

5

Now slip both arms into the sleeves putting your fingers all the way into the fingers of the gloves. Grasp the ends of the drawstring firmly.

6

Pull the drawstring with both hands until the closing is comfortably tight around the neck. If necessary, pull the straps tight on the gloves and boots to assure better fit.

7

Before jumping into the water crouch down and press arms over chest, forcing excess air out. You are now fully protected by the VICTORY Life Saving Suit.

IMPORTANT INSTRUCTIONS

FOR THE USE
AND CARE
OF THE

MORNER LIFE SAVING SUIT

INTERNATIONAL ACCEPTANCE

United States
ACCEPTED MARCH, 1941

Denmark
ACCEPTED FEBRUARY, 1940

Sweden
ACCEPTED JANUARY, 1940

Norway
ACCEPTED NOVEMBER, 1939

A Personal Message From
H. G. MORNER
Inventor of the
MORNER
LIFE SAVING SUIT

I would like to assure the user of the Morner Life Saving Suit that I have given years of study and thought to the perfection of its present design and that I have personally used the suit under emergency conditions and have made numerous successful demonstration tests before the Government officials of four countries.

I can say without qualification that the Morner Life Saving Suit offers the maximum protection against exposure or drowning. The remarkable life saving performance of the suit is a matter of record.

Approved by the U. S. Government and in use today by more than 25,000 seaman, the Morner Life Saving Suit is fully deserving of your complete confidence.

It is important that you read carefully the following instructions on how to put on the suit and how to take care of it. By all means practice getting in and out of it and be sure to practice the proper and very simple method of operating the slide fastener.

The Morner Suit might mean the difference between life and death, so take its care and operation seriously and keep it close to you day and night in dangerous waters.

Sincerely yours,

Hans G. Morner

H. G. MORNER

When passing through dangerous waters time is vitally important, so the suit should be kept in a convenient place folded back with the tops of the boots turned inside out as shown in Illustration 1.

In stepping into suit with shoes on, grasp sides of boots firmly with both hands and, if convenient, balance yourself by leaning against a bulkhead. See Illustration 2.

Suit can be utilized as a semi-worksuit by folding it back to the waistline and holding in position by tieing arms together. At night in dangerous waters the wearer can sleep in this same arrangement of the suit. See Illustration 3.

To save time, in placing arms in suit use the same motion as getting into an overcoat for the first arm, but the second arm should be inserted into the suit with the elbow first as shown in Illustration 4.

After you are fully in the suit, adjust hood over head by placing thumbs of both hands into hood and stretching into place. The next step is to close the collar, first locating the hook with your left hand and then bringing the elastic strap over with your right hand. This should be practiced a number of times until you have the feeling of the operation. See Illustration 5.

The next and final step after fastening the collar is the closing of the front of the suit with the patented slide fastener. With your right hand grip firmly the wooden knob and with your left hand press on the metal fastener. Now tilt your head back and pull firmly parallel to your

(continued on next page)

(continued from preceding page)

body with your right hand as close to the body as possible, which avoids a right angle pull. See Illustrations 6 and 7. Each suit has a bottle of castor oil which should be used on the rubber outside grooves, and it is important that a coating of oil be on these grooves at all times.

Made in one size the Morner Life Saving Suit might seem large to a man under medium height and weight, but this can be corrected by fastening the straps at the ankles and the wrists. This keeps the boots and gloves in place assuring normal movement and use of both. See Illustration 8.

One of Numerous Letters Received from Seamen Who Owe Their Lives to the Morner Life Saving Suit.

New York, N. Y.
June 28, 1942

Morner Life-Saving Suit Co.
15 Whitehall St.
New York, N. Y.

Gentlemen:

I am writing this letter to let you know that we used your "Life-Saving Suit" when our ship was torpedoed off the coast of Puerto Rico on June 5, 1942 and I don't mind admitting that it not only was responsible for our being here to write this note, but it also was a great help in protecting us from the cold at night and also from the rain in both day and night.

We heard that you were sending some kind of a medal to the ones that used your suits when their ship was torpedoed, and so we are now writing to see if it is true. We were on the Standard Oil of N. J. tanker C. O. Stillman when she was hit. Incidentally, I was on the J. H. Senior, a ship of the same company, which was about the first ship in the company to get those "Suits", and we used to have contests to see who could put those suits on. I had the record—18 seconds—all zipped up too.

So, we will wait to hear further from you. You may sent it collect if you wish to the addresses below.

GORDON G. McRAE, A.B.
13 Bailey Street
Everett, Mass.

MYLES F. McGARVEY
19 Buffum Street
Lynn, Mass.

IMPORTANT GENERAL INSTRUCTIONS

The Morner Life Saving Suit is made in one size to fit everybody. Short men should pull the straps on the boots and gloves. When fully dressed inspect your comrades' suits and ask them to check you before jumping off. Just before jumping, close arms over chest, bend knees, and press out some of the excess air. Hold your nose with one hand to prevent salt water from entering. Then jump feet first.

As you come up to the surface, get into a vertical position by kicking with your feet and stretching your arms forward. This is the position in which you can rest and ventilate the suit, if necessary. Keep your arms in front of you floating in the water. Then decide where to swim. Swim with a back stroke using only your arms as paddles.

If you become too warm, gain an upright position by kicking your feet a few times and then opening the collar of the suit to allow fresh air to enter.

The suit can also be put on without taking the vest out of it as the vest is provided with snaps to attach it to the suit. Donning of the suit in this case is the same as shown in the pictures where the vest is separate.

Getting into suit, putting on hood, and closing front should not take more than 30 seconds; so practice this operation repeatedly until you can be completely in the suit in this length of time.

Take care of the suit that will be entrusted to you. When stored, hang the suit on a hanger with the vest buttoned into it as this will prolong the life of the suit.

Further instructions will be found printed inside the suit and on the vest. Remember that 100% satisfaction and results can only be obtained by practice over and over in the use of the suit. Also note that the suit will keep you afloat even if filled with water, provided the vest is worn or attached to the suit.

Should the moment come when your life depends on this suit, be calm and confident in the knowledge that the Morner Life Saving Suit will support you in the water under all conditions.

S. O. S. CLUB

Members of the S. O. S. Club are seamen whose lives have been saved at sea by the Morner Life Saving Suit. In addition to a life membership in the Club, each member receives a silver plaque with his name engraved on it.

If the Morner Life Saving Suit is responsible for saving your life, all you have to do to become a member of this Club and to receive a plaque is to write us how the Morner Suit saved your life.

WATERTIGHT
SLIDE FASTENER CORP.
15 Whitehall Street
New York, N. Y.

NAVY DEPARTMENT

Exhibit N

OFFICE OF COORDINATOR OF RESEARCH AND DEVELOPMENT
EMERGENCY RESCUE EQUIPMENT SECTION

(64-1-2)

20 August, 1943

RECOMMENDATIONS - AIRBORNE RUBBER RAFTS AND SEA SURVIVAL EQUIPMENT

In order to effect more proper coordination between all services concerned with the use, design, procurement and efficiency of airborne rubber rafts and sea survival equipment, a meeting was held 3, 4 and 5 August, 1943. Nearly all personnel who participated in previous sea trials of rubber rafts and equipment were present, as follows:

Lt. Comdr. E. F. Hiscock, U.S.C.G.R. Technical Aide	Office of Coordinator of Research and Development, U.S. Navy
J. P. Bader, U.S.Q.M.C.	"
Capt. C. M. Murphy, A.T.C.	"
Lt. N. S. Bartow, U.S.N.R.	"
Col. D. B. Dill, U.S.Q.M.C.	Tempo "A" Bldg., Washington, D.C.
Col. G. E. Ledfors, A.A.F.	Air Surgeon's Office
Maj. S. K. Calhoun, A.A.F.	4E1025 Pentagon
Maj. C. H. Waltz, A.C.	Winston-Salem, N.C.
Maj. M. M. Boynton, M.C.	" " "
Maj. H. R. Seiwell, A.C.	5E275 Pentagon
Maj. G. W. Holt, M.C.	Orlando, Florida
Emerson Day	Medical Dept., T.W.A.
Harry C. Goakes	Chief Flight Engineer, T.W.A.
Group Captain R.H.S. Spaight	R.A.F. Delegation
Wing Commander P. A. Lee	" "
Lt. P. H. Futcher, U.S.N.R. (M.C.)	N.M.R.I., Bethesda, Md.
Lt. W. V. Consolazio, U.S.N.R. (M.C.)	" "
Capt. A. E. Hudson, A.D.T.I.C.	2D829 Pentagon
Capt. G. H. Morris, A.D.T.I.C.	4E1035 Pentagon
Capt. A. W. Kessler, A.T.C.	Washington, D. C.
1st Lt. Rex A. Moody, A.C.	Winston-Salem, N.C.
2nd Lt. Richard B. Tibby, A.C.	5E275 Pentagon
Dr. D. Denny-Brown	Neurological Unit, Boston City Hospital Boston, Mass.
Dr. L. H. Newburgh	N.M.R.I., Bethesda, Md.
M. Raynesford, A.T.C.	Washington, D.C.

These previous tests were:

Date	Location	Auspices of
15-20 April, 1943	Gulf of Mexico (Off Eglin Field, Florida)	U.S. Army Air Force and Quartermaster Corps
20-24 June, 1943	Gulf of Mexico (Off Tarpon Springs, Fla.)	U.S. Army Air Force A.F.S.A.T., Orlando, Florida
16-21 June, 1943	Atlantic Coast (Off Cape Fear, N.C.)	Air Transport Command U.S. Army
6-12 July, 1943	Gulf of Mexico (Off Pensacola, Florida)	Coordinator of Research and Development, U.S. Navy

All pertinent phases of the efficient functioning of all sizes of rubber rafts and accessory equipment as presently furnished for use in aircraft of both Army and Navy, were considered. Full discussion was had on many and various points bearing on raft construction, seaworthiness, design and and accessory equipment. The whole problem of sea survival in general in various ocean areas, including climatological data, were presented to the group, as well as testimony of survivors and examination of ditching reports. A brief outline of the points of discussion and findings and conclusions follows.

(1) EXPOSURE SUITS. No U.S. air service or facility provides pilots or airborne personnel with any type of exposure suit at the present time. The British have for the past nine months been furnishing all flying personnel accompanying convoys in the North Atlantic routes with a type of exposure suit worn when aloft, known as the PASK suit. Data on this suit was presented to the group by Dr. Newburgh, Naval Medical Research Institute, Bethesda, Maryland, who at the same time furnished and presented background experimental data pointing definitely to the urgent need for providing a suitable lightweight exposure suit for all airborne personnel. The group was amazed by Dr. Newburgh's statement that prevention of slow body cooling is only obtained when water is 92-93 degrees Fahrenheit. Statements of personnel and observers participating in sea trials of rafts clearly indicated that suffering from chill and cold without an exposure suit is a primary factor in energy loss and morale breakdown due to discomfort. Furthermore, it was pointed out that while the tests were carried on in reasonably warm water, personnel adrift in 60 and 70 degree water would most definitely need an exposure suit to survive at all.

IT WAS RECOMMENDED unanimously:

(a) That a general and immediate need for a light weight exposure suit for all airborne personnel as a part of the sea survival equipment exists.

(b) That this need is such as to necessitate serious consideration being given to immediate production of such suits for use in existing rafts.

(c) That an exposure suit of the most improved design and construction and light weight character (maximum weight approximately 26 oz.) be provided for all new rafts.

(d) That the exposure suit provided for use on existing rafts should be of such character as to be packed in buoyant containers or otherwise readily accessible for jettison when rafts are thrown out of plane.

(e) That on new rafts provision be made to pack the exposure suits as part of the raft equipment. This matter will be touched on later on rafts' redesign.

(2) PROTECTION AGAINST SUN. Parallel to the need for an exposure suit has been found the necessity for protecting survivors adrift in rubber rafts from the direct rays of the sun. Unless this is done, the dehydration of the

body is very much accelerated, and personnel suffer from eye infections and irritation from bright light. Further, sunburn may be severe enough to cause serious suffering and pave the way for general breakdown of morale. Experiences of the British in designing sea survival equipment for airborne personnel have been largely under conditions of sun and sea as they exist adjacent to the British Isles. On the other hand, combat and transport personnel of the U.S. air services are flying in areas where the ocean expanses are greater, difficulties of search and rescue considerable and where tropical conditions are necessarily an important consideration.

IT WAS RECOMMENDED unanimously:

(a) That the most urgent need existed for an awning as a means of sun protection on existing rafts.

(b) That a well designed simplified type of awning be part of general design of new rafts.

It was the thought of the group that existing rafts could be modified by the issuance of a kit to provide in five and seven man rafts an additional support for an oar and cross arm to hold the awning in the stern, and that this, together with the utilization of the mast grommet and socket in the bow, would, with the sail or tarpaulin, be all that could be done to fill the immediate need.

It was further pointed out that the dual purpose of the awning in serving as a water catching device made it most necessary that it be designed with that end in view and equipped with simple fabric tubes or drains to provide a means of filling water containers. This deficiency in existing raft equipment was considered by the group and after general discussion of the need of such a simple device by survivors,

IT WAS RECOMMENDED unanimously:

(a) That immediate steps be taken to provide a light weight rubber bag or other durable lightweight water container to enable survivors to store rainwater in quantity.

(b) That while results of tests on various types of sunburn creams indicated that one or two gave excellent protection, no need for any great quantity of such creams would exist in view of the awning protection to be provided. It was, however, recommended unanimously that small amounts of sunburn cream be issued to airborne personnel and, further, that an additional tube of boric acid ointment be provided in the first aid kit for use on irritation of the eyes caused by glare and sunlight.

The desirability of providing all airborne personnel with full length light weight closely knit woolen socks as a further protection against sunburn of the feet and ankles was concurred in. It was agreed that instructions to commanders of airborne troops should be issued to this effect.

(3) INSULATION OF RAFT BOTTOM. The rapid cooling of the bottoms on the present rafts due to the lack of insulation from the sea was discussed. The

results of the various tests, particularly those at Pensacola, were placed before the Committee, as was further information on refrigeration of the body adjacent to water as given by Dr. Newburgh. Climatological charts of water temperatures were further mentioned by Lt. Tibby, who pointed out that 50 and 60 degree Fahrenheit water was prevalent in many areas now commonly flown over.

IT WAS RECOMMENDED unanimously:

(a) That insulation by inclusion of inflated bottom or other practical means be made a part of the general design of all new rubber rafts.

(b) That if it is possible to do so, modification of existing rafts by the issuance of a light weight lattice work material which could be supported from the upper surface of the main inflation tubes to hold survivors off the bottom be provided. Concurred that such an arrangement or its equivalent was most necessary to enable survivors in existing types of rafts to obtain sufficient rest to prevent early exhaustion.

(4) SUN HELMET, SUN GLASSES OR EQUIVALENT. The problem of protecting the head and face, as well as the eyes, against the glare of the sun was discussed and it was the concurrence of all those participating in raft tests, as well as observers, that with the awning protection provided in consequence of the recommendations under (2) above, the Foreign Legion type of sun helmet need not be included for use on new and existing rafts.

IT WAS RECOMMENDED unanimously:

(a) That Army fatigue hat or equivalent, together with a reasonably substantial pair of sun glasses with one or two spares, be provided for new rafts.

(b) That the design work on the sun helmet with visor protector be continued with a view to providing one item eventually to take the place of sun glasses and hats.

(c) That present airborne personnel be instructed as to the importance of hats and utilization of sun glasses in rafts.

(5) INSTRUCTIONS FOR SURVIVAL. General discussion of the need for a simple instruction sheet or pamphlet to be included in duplicate on each raft. It was generally conceded that such a pamphlet containing practical advice would improve morale and enable personnel confused by shock and fatigue to recall some of the necessities of raft existence.

Insofar as equipment was concerned, the more adequate and prominent labeling of same was recommended, as was the additional inclusion of printed instructions on and in the raft structure itself.

IT WAS RECOMMENDED UNANIMOUSLY:

(a) That Flight Control Command group at Winston-Salem draw up a tentative draft of an instruction sheet for circulation and comment. (Note - There is attached the tentative draft submitted by Maj. Waltz as a portion of a manual now in preparation. A covering letter which returned same with comment from the Emergency Rescue Equipment Section is also attached. As will be noted, it was felt that additional paragraphs on drinking water and seasickness, should be included.) Comment is requested on the suitability of the article as a raft pamphlet.

(6) SEASICKNESS. It was generally concurred that the problem of seasickness was not one that could be dismissed lightly by the group and that further details of the possibilities of combating this malady should be searched for. As a consequence, Dr. Newburgh suggested that steps be taken to contact Dr. D. Denny-Brown of Harvard Medical School, Boston, Chairman of the National Research Council Committee on Seasickness. Dr. Brown agreed to come to Washington to tell the group the present status of the seasickness research on August 5, 1943.

He presented a brief resume of the research which has been conducted and the results obtained. Concrete recommendation which Dr. Brown made was to the effect that there was a possible remedy available which could be utilized by men on rafts, which was

(i) .6 of a milligram of hyoscine every 4 hours.

(ii) 1/4 grain of morphine tartrate or sulphate given intravenously every 4 to 6 hours.

There is attached for the benefit of those of the group who did not hear Dr. Brown's statements, a partial transcript of his remarks.

(7) RAFT DESIGN. General discussion of the adequacy of the design and construction of present rafts indicated general concurrence that the one man raft should be greatly improved. After more detailed discussion of the adequacy of the present one man raft

IT WAS RECOMMENDED unanimously:

(a) That the one man raft be increased in size with consequent improvement in stability with, if necessary, a sacrifice of strength and abrasive resistance of the material. (Note - It was the feeling that such increase in size could be made without increasing the weight or packing volume.) Redesign to include the insulation of bottom (3 above) to provide protection against cold water, as well as combination awning and rain water catchment device.

(b) That the one man rubber life raft (as well as all other rubber rafts) be packed and include in their equipment all accessories necessary for sea survival. It was the consensus of opinion that any variation in the amount of drinking water carried or water making equipment (desalination equipment) over land areas, should consist in adding

water or accessories to the parachute back pack and/or the plane store. The minimum equipment on the one man raft of the new and improved design was agreed to as follows:

1 can water, 11 oz., plus one package (wt. 14 oz.) of chemicals to provide by desalination 7 pints of drinking water.

1 fluorescein cake for dye-marking water.

1 rubber sponge.

1 bailing cup.

(c) That the five and seven man raft be redesigned to generally include the following improvements:

(1) Greater cubic capacity with inner plane areas increased to improve comfort.

(2) The whole form and characteristics of the raft to be optimum for sailing with the rig provided.

(3) Consideration to be given to providing a strong light weight sleeping "hammock" suspended from the gunwales in order to provide a more horizontal sleeping position.

(4) Bulwarks of a type easily erected to be provided around outer perimeter, at least one foot high amidships.

(5) A compass with suitable protective mounting in a non-breakable plastic container to be provided.

(6) Respective charts, waterproof in nature, covering, in most cases, all areas and routes.

(7) Bailing sponge, as well as a bellows type pump, for topping off or pumping bilge.

(8) Fishing kit.

(9) Signal pistol (Very or parachute flares) or roman candles.

(10) CO2 bottle to be easily removable, with instructions for removal.

(11) Suitable weather tight container for loose equipment. In general, equipment stowage to be provided for all items on the inside of the bulwark when erected.

(12) A ladder of rope or other suitable light weight material secured thwartships at the midline, as well as bottom grips to facilitate turning over capsized raft. Hand holds in a few places inside to enable exhausted or otherwise stricken personnel to more easily get aboard.

(13) A fatigue hat for each person the raft is to carry together with a pair of substantial sun glasses.

(14) Raft to be designed with insulated bottom and with awning and water catchment device.

(15) Exposure suit for each person.

(16) Drinking water for each person equivalent to 7 pints and 11 ounces. (One 11 ounce can and one desalination kit to make 7 pints.)

In consideration of all raft design the fact that all equipment, accessories and arrangement must be simple, foolproof and suitable to stand stowage in temperatures 180 degrees Fahrenheit down to minus 40 degrees Fahrenheit without deterioration or damage.

CONFERENCE MEETING
5 August, 1943

Presenting the problem of seasickness.

DOCTOR FUTCHER:
In tests at Pensacola and Wilmington seasickness has been such a problem that survival during the first 48 hours may be impossible. A man's getting back into the raft if in difficulty or using any equipment may not be possible due to sickness.

MAJOR WALTZ:
On one test a raft had to put one man ashore from seasickness because he was "pulseless", had lost 6½ lbs., and was out of his head. After 36 hours he was still sick; however, he was the only one of eight who was seasick.

DOCTOR FUTCHER:
On two tests 50% of the men vomited the first day on a really rough sea, on the other three days no one was sick on a very calm sea. On the other test at Pensacola, one subject was an experienced naval flying officer who averaged thirty hours a month in the air, was not sick while flying, but had to be put ashore on the test because he was so sick. One subject on the raft was ill before he went out in a one man raft; he became so seasick that he was unable to cover his legs and was severely sunburnt. According to the reports submitted by aviation machinist's mates, sea sickness in operation flying might be only temporary. One question that has arisen is should remedies that are available now be put into kits, in the hope that at a future date we would be able to substitute a proven remedy that would solve the problem?

DOCTOR BROWN:
We have been working on the problem of motion sickness since last July and the Canadians started a year earlier. It was found by the British that you could make a subject sick in a fourteen foot swing and in that way you could select those who would be liable to air sickness and sea sickness. A great deal of testing has been done on the swing because of difficulty in getting sea trials. A large group of remedies have been examined at various times.

The remedies boiled down to three possibilities: Either hyoscine alone or a mixture containing hyoscine. Results in the swing, air or sea have not yet determined whether hyoscine alone or in a mixture is best for combating motion sickness. A mixture has been developed by Lilly containing sodium amytol and hyoscine barbitrates.

The Canadians have a good deal of evidence that hyoscine taken two hours and a half before motion helps prevent sickness in the swing. This is to be carried out in sea trials. Results not available.

Other mixtures have been proposed. Atrophine is thought to be as good as hyoscine, however, more information is needed. Atrophine alone is not as good as it is in a mixture to prevent motion sickness.

Chlobutal as an active principle in medicine is not as good. The remedies preferred are either hyoscine or hyoscine amytol. Canadians have developed phenabarbital with atrophine and on experimental tests it has been very successful with animals, but the results have not been as good with humans. It would be wise to try sodium amytol in Barron's V-9.

One of the pharmacologists favored pure hyoscine because it is simple, good, and no evidence showed that mixing any other drugs added anything at all.

Tests have been carried out at Commando Camps with hyoscine without any impariment of ability. Psychological tests with hyoscine have shown no deleterious effects. Hyoscine does not harm vision or marksmanship in a dose of .65 milligrams. Hyoscine does repress sweat. It is possible to give repeated doses of hyoscine over a period without ill effect.

In answer to the question of seasickness in tests, do you think this is true sickness as a result of having been thrown into the sea? Would it be shock which may run down the blood pressure?

DOCTOR FUTCHER:
It might be due to the loss of a lot of fluid, dehydration was very great.

DR. BROWN:
Hyoscine is a good preventive although it is not known how it works. The question is whether a mixture of sodium amytol is good. Help is needed on it.

DOCTOR FUTCHER:
A passenger is not able to take the drug until he hits the water.

DOCTOR BROWN:
It would not be as useful as if given before hand. Captain Wolfe in experiments found that nausea stops immediately if the stomach is contracted. His idea is that if you have a relaxed stomach you have nausea.

COMMANDER HISCOCK:
Have they tried a binder to contract the stomach?

DOCTOR BROWN:
No information.

DOCTOR FUTCHER:
What is your advice on a group of flyers that come down in rough water, inflate the raft and sit in it. Have we anything that might tide them over the period when they are likely to be seasick? Have we anything that gives promise of relief?

DOCTOR BROWN:
I know of nothing at the moment than to recommend hyoscine alone. A 6

milligram dose repeated every hour if necessary.

COMMANDER HISCOCK:
Let us set up an experiment to take a typical group of flyers. An experiment would show whether the remedy is useful.

DOCTOR FUTCHER:
How many subjects would you be satisfied with in rough weather, one series of rafts not to get any remedy.

DOCTOR BROWN:
12 subjects. Two or three people will be sick in each group.

MR. BADER:
Camp Edwards has a method of grading chronic seasickness. Would they be good subjects for a test?

DR. BROWN:
25 to 30% are liable to motion sickness. They have a machine that produces motion sickness.

COMMANDER HISCOCK:
Has any work been done to differeniate between sea sickness and air sickness? Mr. Goakes is not liable to air sickness, but in a raft he became seasick.

DR. BROWN:
Subjects are liable to become sick from one type of motion and not from another. The phenomenon seems to be the same; however, there is a different pyschological effect.

DR. FUTCHER:
If difficulties were encountered in procuring these tests, would observations already made on hyoscine be conclusive?

DR. BROWN:
Short of a test under ideal conditions, tests already conducted by the Canadians, British and Randolph Field are satisfactory, and reasonably adequate now. The question is, what is gained when amytol is added?

COMMANDER HISCOCK:
Would it be worthwhile to put amytol in the equipment and get personnel to test it immediately?

DR. BROWN:
Yes. If, when the men get seasick, does it help to get out of the raft and swim around?

DR. FUTCHER:
Not a natural desire.

COMMANDER HISCOCK:
Too difficult to get in and out of the raft.

MR. BADER:
A large percentage of the men are unable to swim.

DR. FUTCHER:
What are the ill effects if a subject becomes panicky and takes his first three doses of hyoscine at once and others at intervals throughout the day?

DR. BROWN:
He would get dopey, in view of the fact that tests show it requires 2.7 milligrams before you get dopey.

LT. TIBBY:
If the men did not taken any until they became sick, would it help them?

DR. BROWN:
No evidence. One difficulty is in waiting until they get sick.

COMMANDER HISCOCK:
Would it be possible to take a dose before they become sick?

DR. BROWN:
Hyoscine would have to be put in the first aid kit of the plane as well as in the kit of the raft.

MR. BADER:
Is there any reason to belive that, if after repeated doses during the first twenty-four hours and the supply was exhausted, the subject would become acclimated.

DR. BROWN:
A subject should be acclimated.

COMMANDER HISCOCK:
Would it help him to use the equipment provided and the water making apparatus?

DR. BROWN:
One or two doses will not interfere with efficiency.

DR. FUTCHER:
Hyoscine cuts done sweating. Does it have other particular effects.

DR. BROWN:
Visual.

DR. FUTCHER:
After a dose and a repeated doseage an hour later, would it be difficult to spot a plane?

COMMANDER HISCOCK:
After twenty-four hours everyone gets sick.

DR. BROWN:
Is there any sedative in the first aid kit?

COMMANDER HISCOCK:
There is none in the Army kit.

MR. BADER:
A sedative should be put into the kit.

MAJOR CASTLE:
What is the effect of morphine on sea sickness?

DR. BROWN:
No one has tried it on seasickness. All observations have been made with men going into action. No information.

DR. FUTCHER:
A sedative should be provided because some men become excited or delirous and jump overboard. What do you suggest as the ideal sedative for a life raft?

DR. BROWN:
Use hyoscine as a sedative in this case. I don't know of any work on delirium or dehydration.

MR. BADER:
Any work with benzedrine?

DR. BROWN:
Using benzedrine in combination with hyoscine or ciccosine. The only effective combination in benzedrine and hyoscine. I don't know whether that is more beneficial than hyoscine alone. Canadians have combined hyoscine and benzedrine in Niaycine.

COMMANDER HISCOCK:
Wouldn't a combination of benzedrine and hyoscine combat seasickness and give the men a lift during their first twenty-four hours so they could use their equipment?

DR. BROWN:
Benzedrine won't help them get any sleep.

MR. BADER:
Don't you think it would be more effective to stay awake for the first twenty-fours hours and crank the radio at the scene of the crash.

DR. BROWN:
I would keep it up for twenty-four hours.

(Then followed a discussion of previous tests where seasickness interfered with the operation of equipment being tests.)

OCEAN SURVIVAL

Keep Your Shirt On --

Figuratively and Literally

There Are Three Important Aids To
Survival That You Won't Find In
Your Kit -- Determination To Get
Ashore, Calmness, and Common Sense

Ocean Survival

AFTER DITCHING

Once you have ditched and you and your crew are safely in your life raft, do the following things immediately and do them in the following order:

1. Fasten your life-raft kit to the floor of the raft with the tie strings provided. If it isn't tied down you will stand a good chance of losing it.
2. Inflate the cross bulkheads with your hand pump.
3. If the gas cartridge failed to fully inflate the raft, "top-off" the main buoyancy chambers with your hand pump.
4. Lash all loose gear -- knives, bailing buckets, etc. -- to the hand line that runs around the raft.
5. Rig the tarpaulin or a sail, yellow side up, as a canopy to protect you from the sun. THIS IS PARTICULARLY IMPORTANT IN THE TROPICS -- exposure to the hot tropical sun will not only cause a painful burn but it will increase your thirst.
6. Take stock of your provisions, water, and equipment.
7. Stow your signalling equipment -- signalling mirror, sea marker dye, flares, and signalling pistol -- where you can get at it quickly. Even on a clear day you will have only a few minutes for signalling a rescue plane from the time you first see it on the horizon until it is out of sight.
8. Locate your position. Lay out a course to some definite objective and try to stick to it. Rafts can be sailed.
9. If the water is calm enough to launch the antenna kite or balloon, get your emergency radio into operation.

10. If there are two or more rafts, connect them with a line.

Stay near your plane as long as it remains afloat. Rescuers will be searching for you along the line of your known route. The silhouette of your plane will help them find you.

Don't get excited and don't rush. Seconds and minutes are of little importance on a life raft except in an emergency. Time is one thing you won't be lacking. Do things deliberately and slowly -- you'll not only save valuable energy, which in turn will help to conserve your body fluids, but you will save yourself unnecessary dunkings. Life rafts tip over easily. Don't shout. Don't talk unnecessarily. Save your energy.

SAVE YOUR CLOTHES. You may find it pretty hot during your first day on your life raft. If you do, don't follow the natural urge to strip off all your clothes and toss them overboard. Your clothes are important parts of your equipment -- they will protect you from the sun during the day and the cold during the night, and, by wetting them periodically during a particularly hot day, you can cut down perspiration. Remember, every time you perspire you lose valuable body moisture that can be replaced only by drinking more liquids.

Stay under the shade of your canopy and keep your arms, head and legs covered. This will help to keep your thirst to a minimum and your mental and physical efficiency at a maximum. Sunburn and dehydration can kill a man.

If you have a hat -- any kind of a hat -- wear it. If you have sun glasses, wear them. Keep your socks on and make sure that they always cover the open space between the bottom of your pant legs and the tops of your shoes. If your life-raft kit contains sunburn lotion or cream use it.

WATER AND FOOD. Thirst will be your biggest problem. A man in good physical condition can live for twenty or thirty days without food. Without water, he can live only about a week and a half at the most.

Do without both food and water for your first twenty-four hours, and, if you can, stretch your fasting period into the third or fourth day. After that, ration both your food and the canned water in the kit. Don't eat much -- food increases your thirst -- and when you drink, make the most of your water by keeping it in your mouth as long as you can. Swish it around your tongue, gargle it, and moisten your lips before swallowing. Always save enough of your day's ration for a sip just before you try to settle down for the night.

When it rains, arrange your tarpaulin and your sail to collect it in large puddles. After the first few minutes, dump the first water that has collected -- it will probably be brackish from the coating of salt on the cloth -- and start collecting more. Before filling whatever containers you have, drink all you can comfortably hold. Recent tests have shown that your body can store water, and your stomach makes a far better storage container than a bailing bucket or tin cans. Drink all you can take, then store the rest, preferably in the regulation water cans which you have already emptied. Contrary to general belief, little of the water taken in large quantities when you are dehydrated is lost through perspiration or excessive urination. A quart of water in your body is worth two or three quarts stored where it can be lost if the raft tips over or it is spoiled by sea spray and salt.

DON'T DRINK SEA WATER. No matter what your urge may be, don't drink sea water if you want to live to reach shore. The salt in the water literally saps body moisture. Instead of quenching your thirst, it will make you thirstier.

PERIODIC DUNKINGS will help to reduce your thirst. Go over the side slowly to keep the salt water out of your mouth. Don't dive. There's just one dunking precaution -- in the tropics you can get a sunburn even though your body is underwater.

DON'T DRINK URINE! It is poisonous and will only decrease your resistance and increase your thirst.

DON'T DRINK LIQUOR! It will nauseate you. Save it for the celebration upon reaching land.

DON'T EAT IF YOU HAVE NO WATER. Digestion uses up your body fluids.

DON'T SMOKE IF YOU HAVE NO WATER. Smoking, like eating, increases your thirst.

CHEW GUM, it will help to keep your mouth moist. If you have no gum, suck on a piece of cloth or a button clipped from your shirt.

DRINKING FISH. Fish juice is one of the best substitutes for water. Two methods may be used to get the juice from fish. One is to place the raw flesh in your mouth and suck the juice out. Another, and the most practical method, is to place the meat in a piece of cloth and twist it tightly until the juice, a slightly pinkish liquid, is extracted. Any piece of cloth from your shirt, sail, silk from a parachute or any other part of your apparel, can be used to squeeze out the juice. The juice is sweet, lacking the strong taste of fish. Men have survived for many days on fish and fish juice alone.

The blood of fish and turtles can also be utilized as a thirst quencher.

FOOD. Aside from the regular rations in your kit, fish and birds will be your main food source. The life-raft kit contains a complete and practical assortment of fishing equipment consisting of lines and hooks, dehydrated pork-rind for bait, a hook-sharpening stone, a jig, a small hand net, a feathered

lure, a harpoon which can be fastened on the end of an oar, a knife, extra hooks and sinkers, and fishing instructions.

When you start fishing, use the small lines and hooks baited with the pork-rind first. When you catch a small fish, part of it can be used to bait the larger hooks and lines for larger fish. If you can't get live bait and the pork-rind fails to do the trick, bait your hook with a piece of colored cloth, a piece of bright tin can, or even a button from your shirt. Try anything and everything. Be satisfied with small fish. Big fish will break your lines, swim off with your hooks and bait, and may capsize the raft.

Keep your bait moving continually to give it the appearance of being alive.

Never tie your fishing line to any part of your body or to any part of the raft. Instead, let one of the other members of the crew hold the spool end of the line while you do the actual fishing.

When you catch a fish, lift him into the boat carefully, catching him in your hand net and transferring him to your rubber bailing bucket where he can be grasped without touching him with your hands. A good crack on the back of the head with the handle end of one of the oars will stop his wiggling.

Be particularly careful not to puncture the raft with hooks, knife, harpoon, or the sharp point of a fish's fin.

Take good care of your fishing kit. Before your trip is over it may be the only thing that stands between you and hunger. Dry the hooks and the lines before stowing them away.

Raw fish is neither salty nor unpleasant to the taste. Clean your fish just as soon as you catch it. Wash the meat free of blood. Save the entrails, except the liver, for bait. If the liver is pink it may be eaten. If it is dark, throw it away.

If you have more raw fish than you can eat, cut it into narrow strips and place it along the top of the buoyancy chamber in the sun to dry. Dried fish will keep for several days.

Don't eat shark unless you have an ample supply of water. The same holds for skates, rays, seaweed, and crabs. Jellyfish, sea snakes, parrot fish, and puffer fish are poisonous to humans, but they can be used as bait. Just because a fish glows green at night, don't throw it away and give up a good meal. Phosphorescent fish are safe to eat.

Turtles also are good eating and can be killed by a sharp blow on the head. Practically everything about a turtle can be eaten except the shell, the stomach, and the kidneys. Eat the liver immediately after killing. Blood from the breast should be drained and drunk immediately, allowing no time for the blood to coagulate. The fat may be saved to eat with the fish. A word of caution, however -- when cutting off the turtle's head, the jaws may snap shut and the claws may scratch.

At night, you can attract fish by shining a light on the water or hanging your signalling mirror on the edge of the raft so that it reflects the moonlight. If there are any small fish in the neighborhood, they will see the light and rise to the surface where they can be speared or scooped up in your hand net. This method is particularly good for attracting flying fish. Skimming across the water, they will be attracted by the light, bang against the side of the raft, and fall into the water where they will lie momentarily blinded on the surface.

Birds make good food, but they are scarce and difficult to catch.

SEAMANSHIP. Rafts can either be paddled or sailed, or you can depend on

the natural currents. Even if you have no sail, your raft because of its flat bottom, shallow draft, and relatively high freeboards will sail itself.

Your sea anchor, however, is just as important as your sail. In a storm, it will keep you headed into the wind, and when the wind is in the wrong direction it will check your drift. If you have no sea anchor, or lose it, a piece of drift wood, a life preserver, or your bailing bucket securely tied to the end of a line will serve.

When fastening lines, securing equipment, or rigging a sail or canopy, make sure that the knots are tight and tied so that they can be untied easily. The best all-around knot for this purpose is the square knot.

When using a sail, never secure both corners of the foot, or lower edge. Instead hold the line attached to one corner in your hand. Then, if a storm comes up or there is a sudden gust of wind there will be no danger of ripping the sail, breaking the mast or capsizing the raft.

If there is more than one man on the raft, a routine of watches should be established so that at least one member of the crew will be on the alert at all times. As a precaution against losing the raft if it should overturn at night, the man on watch should be attached to the raft by means of a line at least ten feet long.

RAFT HEALTH. A raft ailment that can become serious unless the proper precautions are taken is a condition known as "Immersion Foot". Continued exposure to cool or cold sea water plus the necessarily cramped positions that must be assumed in a raft tend to cut down circulation in the legs and feet. This in turn produces swelling, sores, and a feeling of numbness which if allowed to continue may cause serious infection. To guard against it, keep

your feet as dry as possible. If your socks and shoes get wet, remove the socks, wring them out and put them back on again. Move your feet around and wiggle your toes to encourage circulation. If your feet do become swollen and sore, don't rub them; you may bruise the flesh and hasten infection. If open sores exist, sprinkle them with sulfanilimide powder.

Continued exposure to salt water also may cause saltwater burns or boils. Cover large boils with sulfanilimide ointment and then bandage. Don't prick or squeeze the boils to get the matter out.

Boric acid ointment from the first aid kit can be used to treat cracked or parched lips, cracked skin, or inflammation of the eyelids. Painful and bloodshot eyes should be covered with a light cloth or bandage.

You can't expect a bowel movement when you are taking little or no food; don't worry about it if you have none. Don't attempt to give yourself a salt-water enema, and don't take a strong laxative even if one is available. Also, because of the rationing of water, there may be some difficulty in passing urine. This is to be expected and is no cause for alarm.

SIGNALLING. Your life-raft kit contains a good assortment of signalling devices -- flares, Very pistol and cartridges, mirror, whistle, radio, colored tarpaulin, and sea marker slick -- take care of them as well as you take care of your rations and water.

If you see an airplane or a surface ship during the day, when the sun is shining, your best signalling device will be your signalling mirror. Most emergency kits now are fitted with a special signalling mirror, which is a double-faced mirror (i.e. mirrored on both sides) provided with a crossline sighting or aiming hole. If you have one, it can be used in either of the two ways illustrated.

Ocean Survival

If the angle of the sun and the airplane or surface ship is not too great degrees maximum) you can hold the mirror about three inches away from your face and sight at the plane through the crosslines. The light from the sun shining through the crosslines will form a cross of light on your face and this cross will be reflected in the rear surface of the mirror. Then, still sighting on the airplane through the crosslines, adjust the angle of the mirror until the reflection of the light spot on the rear of the mirror coincides with the crosslines on the mirror. The mirror then will be accurately aimed at the target.

If the angle between the target and the sun is great (more than 90 degrees) the second method shown must be used. Hold the mirror in your right hand as shown, sight at the airplane through the crosslines, and then adjust the angle of the mirror until the reflection of the light spot on your hand coincides with the actual crosslines on the mirror. This method will work even under conditions where the airplane or ship is almost on one horizon and the sun is almost 180 degrees away on the opposite horizon. On a bright day, the flash from the mirror can be seen for 15 miles.

The cans of sea slick in your kit also are for daytime use. When a plane is sighted, pour a quantity of the sea marker on the water. It will spread and form a large yellowish-green slick or spot on the surface. One man should pour the slick overboard, while another crew member uses the signalling mirror. Get the slick out as soon as possible; it takes time to spread.

If a plane comes close by, don't shout. Use the whistle provided in your kit. Your shouts can't possibly be heard by the men in the airplane. The shrill note of the whistle stands a better chance of penetrating the droning sound of the motors. In any event, concentrate on your signalling mirror. It will be your best daytime bet.

During the day, keep your tarpaulin cover yellow side up. If you are using either the tarpaulin or the sail as a canopy, rig it yellow side up. Rafts with colored canopies are visible a considerably further distance than rafts without canopies.

When the weather permits, operate your emergency radio for a period of fifteen minutes at least every hour. Try to operate the set to include the three-minute silent periods starting at a quarter after and a quarter of the hour, Greenwich time. Follow the instructions printed on the radio's case. In strong winds use the kite antenna. If there is little or no wind, use the hydrogen balloon. WARNING: Don't smoke when operating the hydrogen generator for the balloon, and don't spill the contents of the generator, it will burn.

At night if you think a friendly ship is near, plug in the signal lamp and operate the transmitter manually, using the Continental code printed on a card near the crank socket.

At night your flares and Very pistol will be your best signalling devices. Keep your flares dry. If they get wet they will be useless.

Keep your Very pistol dry. It will rust easily and after prolonged exposure may not function. Save your Very cartridges until you actually hear a rescue plane. Don't fire them on a chance that they'll be seen, and when you do discharge them fire almost vertically to get the maximum height.

LETTER FROM COORDINATOR OF RESEARCH AND DEVELOPMENT, U.S. NAVY, EMERGENCY RESCUE EQUIPMENT SECTION TO MAJOR G. H. WALTZ RETURNING TENTATIVE DRAFT OF INSTRUCTION SHEET.

17 August 1943

From: Coordinator of Research and Development, U.S. Navy
To: Major G. H. Waltz
Flight Control Command
Winston-Salem, N.C.

Subject: "Ocean Survival", suggestions of changes in the manuscript.

1. Thank you for forwarding a draft of the finished manuscript for "Ocean Survival" to Mr. Lloyd George, Chief, Technical Literature, Emergency Rescue Equipment Section. It has been reviewed by the staff of that section, and it is felt that it is a compact, clear statement of essential problems confronting raft survivors, together with much good advice for solving these problems.

2. There have been several suggestions made for improvement of the manuscript. These are:

(a) There is a need for something more on the subject of morale than is provided by the four lines on page 1. Some encouragement should be provided. It would help if the survivors could be reminded that someone is trying to find them; that there is such a thing as an Air-Sea Rescue system. Other publications in this field are careful to cover morale:

"Ocean Survival", put out by the AAF at Eglin Field, Florida, states, "Don't give in to the sea! Life is worth a gamble, just when you think you cannot go on a minute longer, help may be on the way".

"Safety Measures for Merchant Marine", states that, "Men in boats should remember that their chances of survival depend primarily on their mental attitude and cooperation with the Officer in Charge. If you can't be cheerful, be quiet".

The British publication, "A Guide to the Preservation of Life at Sea After Shipwreck", says that, "Experience has shown time and time again that the comfort and, indeed, the chances of survival of those adrift depend upon the frame of mind of the boats company".

Transcontinental & Western Airlines, Inc.'s, "Life Raft Instructions", says, "Make up your mind right now that you are going to get home. Go about it cooly and calmly. Remember, making shore in a life raft is no longer front page news, it happens every day. You can get home...And you will get home...If you are determined to get home."

(b) On the subject of water it has been suggested that men be advised to stock up before abandoning a plane, if there is time. A statement on page 4, directly following the first paragraph, may help; something along this line perhaps: "If there is extra water on your plane and you have time, drink all you can. Remember, the body makes a good storage tank".

(c) It has been suggested that almost all of the material on page 5 under the heading, "Drinking Fish", be eliminated in the light of recent findings. It has been brought to our attention that trying to extract water from the flesh of fish is an unsatisfactory enterprise in view of the amount of pressure needed to accomplish the purpose. Tests have shown that any effort to use a cloth to wring juice from fish will result in breaking the cloth before any juice is squeezed out.

(d) It is felt that something should be added on the subject of sea sickness. While experiments in the use of hyoscine have not resulted in including this drug in medical kits, the kits often do contain morphine. There is something to be said for suggesting that a quarter of grain of morphine be given when a man has continued retching until he is in danger of death. Something along this line might be inserted just before "Raft Health" on page 8.

(e) In relation to what is said about the signal mirror on page 10, you will want to know that directions printed on the back of the Emergency Signal Mirror, ESM/1, have been changed. It now reads as follows: "(1) Holding this side of mirror a few inches from your eye, face it halfway between the sun and rescuer. (2) If sun shining through cross does not fall on your person, intercept it with hand or other surface. Tilt mirror so as to see in

this round reflector the image of the bright cross thus formed. (3) While sighting rescuer through center of cross, tilt mirror to direct bright image back through cross. Signal is now aimed directly at rescuer. Practice sweeping horizon with aimed beam even if no rescue is in sight, as mirror has range up to 10 miles". It is suggested that the script conform to these directions. On p. 10, the distance given for mirror visibility should be changed to read, "..... up to 10 miles".

(f) In the paragraph on the sea marker on page 10, in place of "quantity", it would be better to be concrete and say, "the complete contents of a can". The same point is true about spreading time. Instead of, "it takes time to spread", say, "it takes approximately two minutes to spread to a well marked area".

(g) In the last two paragraphs on page 11, it would be better to explain <u>how</u> to keep the flares and Very pistol dry.

Exhibit O

Quoted from Bureau of Naval Personnel Information Bulletin, pp. 32-35, February, 1944.

Exhibit Q

Survival in the South Seas

The Story of a Naval Aviator's 20 Days on a Raft, With Notes by BuM&S on What He Did to Keep Himself Alive

By Lt. (jg) GEORGE H. SMITH

On 14 July my flight took off from Guadalcanal at 1330 for a routine combat patrol over Rendova and Munda. We were flying Grumman Wildcats. En route to Munda we encountered a series of thunderheads that were so well developed that we could neither go over nor under them. We were, however, able to circle the storm to the south, and arrived on station one hour late.

Though our mission was combat patrol, we found it necessary to start home almost immediately, for we had barely enough gas to get us home by skirting the storm to the south as we had done coming in. We decided that it would be best to fly "on the water," following the coast of New Georgia as far as possible, then go "on instruments." Flying through the clouds on instruments, we hoped to break out by the time we got to the Russell Islands.

My compass, unfortunately, was not working, so my only hope was to fly wing on someone whose instruments were all intact. Shortly after entering the clouds at the eastern end of New Georgia, our formation dispersed and every man was on his own. It would have been foolish for me to continue on instruments with a compass I couldn't depend on, so I returned to Rendova. I decided to try to go around the storm to the south and possibly get close to the Russell Islands before running out of fuel and facing a landing in the water. I followed that plan, but the storm had moved farther south, and when I came down in the water at 1900, I was between 50 to 70 miles south of the Russell Islands.

Landing a Wildcat on the ocean is like dropping a pebble on the water. The water impedes its progress, but it continues to go down. After the belly of my plane hit the water, the plane went forward 15 or 20 feet, then nosed down for Davy Jones's locker.

Fortunately, I was prepared. I had the hood locked open, and I had an extra canteen and an extra emergency kit on my parachute harness. My shoulder straps and safety belt were drawn as tight as I could get them. When the plane stopped its forward motion, I disengaged the safety harness, kept my parachute buckled on me, gave a hard push with my legs and went about five feet up to the surface.

My rubber raft was of the small, one-man, seat-pack type that is an integral part of the seat-type parachute. Once in the water, it took about five minutes to unpack and inflate the raft. It was dark when I landed on the water but, despite that fact, I finally succeeded in removing and inflating the raft. I dumped my heavy, water-soaked parachute pack into the raft and painstakingly worked myself aboard, being careful all the while not to capsize the raft and run the risk of losing it in the dark. Completely exhausted, I lay athwartships for almost five minutes, vomiting up the sea water I had swallowed during the struggle in the water. When I was sufficiently rested, I worked myself farther into the raft and assumed the sitting position from which, but for a very few exceptions, I was not to stir for 20 days.

This naval aviator's experience in the South Pacific attracted considerable attention when it was used as the basis for a sequence in the comic strip, "Don Winslow of the Navy." His informal report is reprinted here in main, with several panels from the comic strip used by permission of Bell Syndicate, Inc., and with interpolated comments (in italics) prepared by the Bureau of Medicine and Surgery as a guide to other personnel who may find themselves similarly at sea.

The night air blowing through my water-soaked clothes gave me a chill, but I shivered for nearly two hours before I finally weakened and decided to unpack my parachute for a blanket.

(This is an example of why the Navy is so interested in exposure suits. The Naval Medical Research Institute is working on a suit which will meet these needs. Lt. Smith's experience also shows that a tarpaulin to serve for protection and for collection of rain water should be a part of all raft equipment. Extra pieces of his parachute might have been used as a sea anchor.)

Once unpacked, the chute was so big and clumsy that there was not room in the raft for all of it. I therefore cut off half the shroud lines and stowed them in the raft against possible future need, and cut off the top half of the canopy to use as a blanket. The rest I tied in a bundle, secured to the raft with an eight-inch length of shroud line, and, along with the pack and harness, threw them overboard.

By this time, the moon was well above the horizon. It was a friendly, full moon, which I was destined to observe through one complete phase before it should finally disappear and leave me lost and lonely amidst endless black nights. I decided to try to get a little sleep. Unable to lie down in the little raft, I devised a method of sleeping in the sitting position. I tucked my parachute silk under my feet, pulled it back over my knees and over my head, then tucked it in behind me. The silk would then support my head, throwing the weight against my feet. Even with that device, I was unable to get more than two or three hours of sleep each night. The waves and swells were consistently 10 to 20 feet high. As soon as I would doze off, a wave would break over the boat and wake me up. Then I would bail out the water, doze again, another wave, and so on into the night.

The days were hot, the nights were cold, and the wind and waves were merciless. To combat the heat of the day, I kept my flight suit, helmet, shoes, sun glasses and even my gloves on. I made a mask out of parachute silk for my face. As a result I suffered very little from sunburn. My light brown hair bleached to a pale yellow despite my helmet's protection.

(This was the very best thing he

could have done. Use of this improvised mask was an excellent idea. Sunburn cream would have been most useful. The Navy has an effective sunburn cream which will be standard equipment soon.)

The wind and waves presented a much more difficult problem than the sun. I kept my sea anchor out so the raft would ride "bow-into-the-waves." At night, my parachute silk reduced the shock of being hit by breaking waves, but it did not keep me dry. The constant pounding of the waves was nerve-wracking. I soon started cussing at them. The cussing gave way to screaming, and then I got hold of myself. I stopped and prayed for strength to withstand the merciless pounding.

I carried morphine syrettes in my emergency kit for relief from severe pain. When my nerves seemed near the breaking point, I used the morphine to give me relaxation. When I was under the influence of the dope, the pounding of the waves ceased to irritate me. I resorted to it on three different occasions, all at night.

(This was wise use of morphine syrettes and this shows the reason why they should be in every emergency kit.)

The three weeks that I spent adrift in the Coral Sea were not without their exciting moments. I had always wanted to see a whale, and during the first week that wish was fulfilled six times. The first appeared on 16 July. I heard a noise like large rollers breaking on a beach. Looking in the direction of the noise, I saw two whales of the sperm whale or blackfish type. One was coming right toward my raft. He would roll on the surface of the water, blow, then submerge for almost 100 feet before coming to the surface to roll and blow again. I tried to paddle out of his way, but could make no headway in the heavy sea. I thought of shooting him with my pistol but soon realized that I could not kill him with such a small weapon and that the shot would just enrage him. I put my pistol and paddles away, checked to see that all my equipment was secured to the raft, inflated my "Mae West" and waited for the crisis.

(It is of utmost importance to secure all gear to the raft as soon as possible.)

The whale came to the surface, put his nose against the starboard side of the raft, pushed it about 10 feet through the water and then slid under the boat. He was about 40 feet long and, as he slid under me, every inch of the 40 feet seemed like a mile. The water was clear as a crystal ball, and I watched that huge mammal submerge to the port side of the raft. He continued on his way, rolling and blowing as he went.

At dusk on 18 July I heard a very violent splashing off my port beam. On closer observation I saw what appeared to be a fight between a marlin and a mackerel. The marlin was seven or eight feet long, had an 18-inch "spike" and apparently was trying to catch the 30-inch mackerel. The fight was one of the most violent actions I have ever witnessed. The two fish came directly toward my raft and the last time they jumped out of the water and splashed back in they were just three feet from me. I had visions of the marlin's "spike" piercing my raft and leaving me on the ocean without a seat. God must have been with me, for the fish disappeared and I didn't see them again.

On 20 July I saw the first of many Japanese planes that I was to see before being rescued. I drifted on course of about 300 degrees deep into enemy waters. A few enemy planes passed directly over me as low as 500 feet but failed to see me. I saw an average of one plane a day from then on, some friendly, some enemy, and others too far away to be recognized. I signaled some with tracer ammunition from my .45, with a mirror which I flashed in the sun, and with sea-marker dye. But not a one was to see my signals until 1 August.

(Proper use of the present signaling mirror could hardly have failed to attract attention. It is deadly accurate when it is used properly. Lt. Smith probably had no signaling mirror.)

On 24 July I saw the first shark.

Ordinarily the sea anchor held the bow of the raft into the waves, but around 1330 on this day I noticed that I was riding sideways up the waves. A fish line which I had secured near the center of the starboard side of the raft was taut and drawn out at a 90-degree angle to the side of the raft. Suddenly the fish line snapped, the raft swung back to its usual position, and a shark's fin broke the surface of the water. He swam under the raft and with his dorsal fin cut a fish line that I had secured to the port side. Thinking a dead shark would float, I tried to shoot him. The bullet struck home. The shark jumped from the water, then floundered and sank. The same thing happened when I tried to shoot a mackerel, so I decided not to waste ammunition on fish.

On 28 and 29 July half a dozen sharks were with me day and night. Only one, however, made an attempt to attack, and it was a small one about four feet long. Most of those that I saw were at least six or seven feet in length. My lone would-be attacker rolled over on its side and turned almost belly-up to get into position to bite. I could see its curved mouth, ugly teeth and beady, pig-like eyes.

But again God was with me. My enemy failed to carry through his attack.

(This indicates the desirability of a really efficient shark repellant, upon which much work is now being done by the Navy's research men.)

At dusk on 29 July a huge wave threw the raft end-over-end. Luckily I had all of my equipment securely lashed to the raft and the raft itself was secured to my body by a 12-foot length of shroud line. I had seen sharks less than half an hour before, and now I thought of the possibility that they were lurking unseen in the black water.

At one point in my training I had been told that sharks were cowards and that they would hesitate to attack a man that moved about violently; so I kicked and splashed with all my might while I righted the raft.

(This procedure was exactly right.)

I succeeded in getting aboard with little difficulty and was happy to find not a single article of equipment lost.

When I landed on the sea, I had two days emergency rations with me. These included six small cans of pemmican, three chocolate bars, a small jar of malted milk tablets, some multiple vitamin tablets, some vitamin B1 tablets and about three pints of water. I didn't eat a thing the first day.

(Shipwrecked personnel almost invariably do not desire to eat or drink for the first 24 hours.)

The second day I decided to ration my food to make it last at least 12 days.

(It is very wise to ration food as Lt. Smith did.)

I allowed myself, therefore, four

mouthfuls of water each day, half a chocolate bar, which I alternated every other day with one can of pemmican, two malted milk tablets, one multiple vitamin tablet and one vitamin B1 tablet.

On the fourth morning I found an eight-inch fish in my sea anchor. I didn't know how it had gotten there, but that didn't worry me. I took it out and ate it raw.

All attempts to wring moisture out of the flesh failed.

(*The "fish juice fable" is still unfortunately found in many pamphlets for the shipwrecked. It has been proved impossible to wring by hand any appreciable moisture from fish.*)

I tried to cut the meat into small squares and wring it out in parachute silk. The silk became oily, but it wasn't enough even to moisten my tongue. Then I tried wringing it out in gauze with the same lack of results. I took some of the flesh and put it between the rounded sides of two canteens, squeezing and rolling to get a wringer action, but this, too, was ineffective.

On several occasions I speared fish with my sheath knife, for that was the only way I could catch them. They refused to take the baited hooks I hung on lines on the side of the raft. Tiny minnows appeared under the raft during the first few days and stayed there until I was rescued. I made a seine out of mosquito netting, caught some of the minnows and swallowed them alive. I had always ridiculed the college boys who gained notoriety by swallowing live gold fish, but I guess now they must have been hungry—because it can be done if a fellow is hungry enough.

(*Sharp bones and scales make it inadvisable to swallow live fish.*)

I kept my .45 in fairly good condition by "field stripping" and cleaning it every day. At first I lubricated it with sea water. After the first week I greased it with fatty tissue from birds.

I shot many birds during the 20 days, most of them "brown boobies," goose-like birds with a five-foot wing span. I ate the liver and drank the blood. The rest of the meat was not as palatable as the liver, but I cut it into very small pieces, chewed them and swallowed them whole. I had to force it down, but I knew in my mind that my body was getting nourishment.

(*The drinking of the blood of birds or fish is advised because it adds fluids to the body as well as nutrition.*)

When I shot the birds late in the afternoon, after they had been fishing all day, they had fish in their throats. These fish were predigested to some extent. The stomach juices had started to work on them and the meat was tender. I could pull it away from the bones, chew it and swallow it. It tasted as though it had been partially cooked. It was perhaps the best thing I had to eat outside of my regular rations.

Before I ran out of fresh water, I decided to experiment with drinking sea water. I tried to rig a distilling apparatus out of two canteens, but it was unsuccessful. I tried iodine in the water but that, of course, did not work. I didn't expect it to, but I had nothing to lose by trying. I even tried putting sulfanilamide in the water. Not being a chemist, I thought by some miracle that it might precipitate the salt. It did not.

My malted milk tablets were in a small jar with a metal cap of the "screw-on" type. I rigged a valve on the cap that would open under pressure. Securing the bottle to my fish line, I lowered it into the water. The valve opened at about a 40-foot depth and admitted water. I had two reasons for doing this. First of all I thought that the water at that depth, being under terrific pressure, might not have as much salt in the solution as the water at the surface and I might be able to drink it. Secondly, I thought that it might be colder than the water at the surface and that the bottle might sweat in the sun, like a pitcher of ice water, allowing me to lick the sweat off the bottle. Both assumptions were false and the experiment was entirely unsuccessful.

One day I saw a "booby bird" land on the water, dip its long neck under the surface and take a drink. It made me angry. I couldn't understand why the bird, which was only flesh and blood like myself, could drink sea water which I could not. I shot the bird, retrieved him quickly and cut him open to trace the course of the water through his digestive system.

There wasn't a thing unusual about it. The water just went in his mouth, down his throat and into his stomach.

Around the intestines of the "booby birds" I found a handful of fat, which I used for greasing my gun. One day the thought occurred to me that I might grease my mouth with the fat and get sea water into my stomach without tasting the salt. I did that. I greased my mouth, swallowed some to grease my throat, esophagus and stomach, and drank sea water until the grease was washed away. For five days I drank a pint of water each day without ill effects. One night, when my raft capsized, I swallowed enough salt water to become nauseated. When I got back on the raft, I felt like vomiting. I got out some of the bird's fat and swallowed it, and my stomach was settled immediately.

(*The Bureau of Medicine and Surgery strongly advises that this procedure NOT be followed. A complete article on the subject will be presented in a forthcoming issue of the* INFORMATION BULLETIN.)

On the night of 26 July it rained continuously all night. I laboriously filled my canteens. I caught the rain water in my sea anchor but couldn't put it into the canteen because of the rough sea.

(*Another example showing the need for a tarpaulin, preferably with a tube so located that water might be poured from it into a canteen.*)

I finally solved the problem by putting the water in my mouth, then filling the canteen like a mother robin feeding its young. When the canteen was full, it was still raining and I caught another cup of water. I didn't want to waste it, so I drank the rain water, thus ending the sea-water experiment.

(*It is very desirable for survivors to drink all the rain water they can because, in cases of dehydration, water is absorbed and stored in the tissues instead of being given off by the kidneys as when the body has been receiving its normal water supply.*)

On 1 August at 0900, after I had seen nothing but Japanese planes for several days, a New Zealand land-based Lockheed Hudson passed very close to me. The tail gunner saw my sea-marker dye spread on the water.

The plane turned, made a wide circle and flew down close to the raft. For the first time in my life, and I hope the last, I cried for joy. The New Zealanders circled for about one hour. I was afraid they would check my position and leave without dropping supplies, and, frankly, I was getting pretty hungry and thirsty by this time. I put on my rubber paddles, leaned back in the raft, and signaled

in semaphore the letters E-A-T. They made another wide circle, and then dropped an inflated life jacket with supplies attached. The bundle hit the water about 30 feet from my raft. I paddled to it and found Army-type emergency rations, a canteen of water, a map marking my position, ammunition for my .45, a waterproof flashlight, first-aid equipment, a Very pistol and star shells, and other useful items. I was hungry but I ate sparingly, not knowing how soon I would be rescued.

(*It is always wise to conserve rations.*)

The New Zealanders flew by once more, wobbled their wings, and headed for home.

I watched for a rescue plane the rest of that morning and all that afternoon, but none appeared. I watched, waited, hoped and prayed all day of 2 August, but there was no rescue in sight.

About 2300 on 2 August my raft capsized again. Being rather weak by this time, it took me about 15 minutes to turn my raft over and get aboard. During the struggle I lost my parachute-silk blanket and a pencil I had been using to keep a log. I was in misery the rest of the night. It was then that I realized how much warmth the parachute had provided.

(*This shows the necessity of securing all gear to the raft as soon as possible.*)

3 August was a dreary day. Mist and thunderstorms were all around me. I didn't expect rescue. I was convinced that I had drifted so far out of position that the rescue planes couldn't find me. I was, therefore, a surprised and happy man when, at 1100, I spotted three Navy Catalina flying boats approaching me. Two passed within half a mile but failed to see me. The third passed directly overhead and saw the sea-marker dye I had spread on the water.

He dropped a smoke bomb to mark my position and called the other planes back, and all three circled the raft. The waves and swells were 10 feet high. It would have been a rough sea for any craft, let alone a flying boat.

Two of the planes lowered their retractable wing floats and made an attempt to land. Both pilots decided, upon closer observation of the waves, not to risk setting down on such a choppy sea. About that time I drifted into a rain squall and the rescue planes lost sight of me completely.

The third pilot was a little more adventuresome than the others. Although he could not see me, he decided that, if one of them did not land on the water in that vicinity, they would probably never find me again. He dropped his depth charges and about 800 gallons of gasoline to lighten the plane and made a power-stall landing on the water.

His starboard wing float hit a swell as he was landing and started to spin the plane to that side. Quick as a cat, the pilot hit the throttle on the starboard engine, and kicked the rudder and stick to port. The lumbering Catalina straightened out and dropped into the sea. A wave broke over her and smashed the port gun blister, filling the after compartment with water. The plane remained afloat, however, and the crew bailed out the water as it taxied into the rain squall where I had disappeared. After taxiing about two miles, they found me, gorging myself on the last of the rations that had been dropped to me on 1 August.

Despite the Catalina's precarious position on a heavy sea in enemy waters, I for one was in the lap of luxury:

I stretched out on a dry bunk, pulled a warm blanket over me, drank some fresh water and smoked a cigarette while one of the crewmen fixed me two tumblers of grapefruit juice, a couple cups of coffee, two big steaks and a large dish of peas.

The sea was so rough that the pilot decided not to risk a take-off at that time. He asked me if the water ever got any smoother out there, but I couldn't offer him much encouragement. Although the waves were running at least 10 feet high, it was my smoothest sea since 14 July.

We stayed on the water all that afternoon and all that night. The plane weathercocked into the wind and the swells constantly hit the wing floats from the side. The Catalina creaked and groaned like an old haunted house. The waves engulfed the bow of the plane and broke against the hull. It was a tribute to our aircraft engineers that such a light structure as the hull of an airplane managed to withstand the merciless pounding of a heavy, angry sea.

I was indescribably grateful for companionship, and the courageous crewmen kept up a continual conversation with me despite seasickness.

At dawn of 4 August the navigator reported that we were 100 miles due south of the enemy air base at Kahili on Bougainville. The waves were still 10 feet high, but the pilot decided to attempt a take-off nonetheless. He reasoned that, if we stayed on the water, the plane would break up in the heavy sea. And the possibility of Jap strafing was always a threat. He felt that he had a 50-50 chance of getting the plane airborne. If the take-off failed, we would all be in the water that much sooner.

The take-off was successful! The cumbersome plane bounced off the top of one swell and spanked onto another, knocking some rivets out of the hull. It bounced into the air about 10 knots slower than it should have been to be airborne, but again the pilot's skill saved our lives. No one but an expert pilot could have held that plane in the air without spinning. Ours was an expert, and we remained airborne.

Before taking off, the crew had lightened the ship by throwing every bit of loose gear overboard, saving just a very few rounds of ammunition for an emergency.

After we had been airborne about ten minutes, three more Catalinas appeared and escorted us home. They had come out to search for their lost plane. I was taken to a field hospital on Florida Island.

Though my rations were meager, I had been able to keep my body in fairly good condition. I lost 20 pounds during the 20 days and suffered somewhat from pressure sores that developed on my elbows, back and buttocks. On the raft, my feet were wrinkled and white from constant immersion in salt water. After I was rescued my hands, feet and ankles began swelling.

(*Cramped quarters are bad but unavoidable on a one-man raft. This swelling of the feet and ankles was due to immersion and the dependent position of the legs.*)

When the rescue plane hit the beach, I was unable to walk. There was absolutely no feeling from the waist down.

After three days in the field hospital, I was strong enough to go on. I shaved off my beard and started my long trip home.