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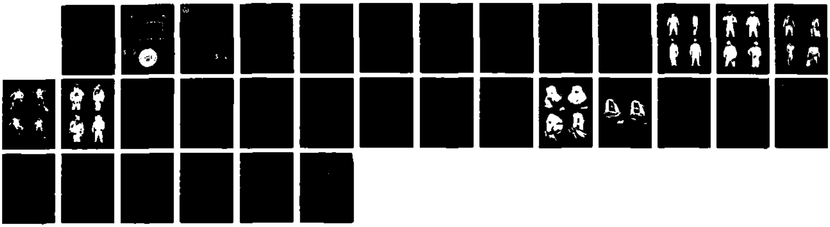

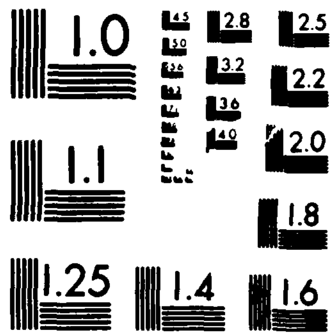

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NAVY EXPERIMENTAL DIVING UNIT

REPORT NO. 1-87

EVALUATION OF THE SECUMAR 34 FM LIFE PRESERVER

CLARK G. PRESSWOOD

MARCH 1987

NAVY EXPERIMENTAL DIVING UNIT

(6)

DEPARTMENT OF THE NAVY
NAVY EXPERIMENTAL DIVING UNIT
PANAMA CITY, FLORIDA 32407-5001

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CLARK G. PRESSWOOD

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Secumar 34 FM life preserver	NEDU Test Plan 86-26
Secumar TSK 2/42 life preserver	life preserver
Draeger LAR V UBA	buoyancy compensation device (BCD) (contd)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

As directed by NAVSEA Task 86-41, the Navy Experimental Diving Unit evaluated the Secumar 34 FM life preserver for suitability for use with the Draeger LAR V UBA. As a result of manned and unmanned testing, the Secumar 34 FM life preserver is recommended for Approved for Navy Use (ANU) status when used with the Draeger LAR V UBA.

(contd)

19. Continued

inflation bladder;
inflation valve; piercing pin
pierce pin
840-AMS inflator
840-AMLS inflator

20. Continued

An evaluation of a new design pierce pin for the Halkey-Roberts inflation valve was conducted in conjunction with the Secumar 34 FM evaluation. This evaluation was conducted in accordance with NAVSEA Task 86-57. Two of the new design pins were evaluated and found to function acceptably in over 80 combined inflations. The new gray color Halkey-Roberts AMS and AMLS inflation valves which utilize the new design pin are recommended as a replacement to the Halkey-Roberts valves which utilize the hollow rolled design pin currently in use.

Table of Contents

Glossary

ANU	Approved for Navy Use
BCD	Buoyancy compensation device
CO_2	Carbon dioxide gas
°F	Temperature in degrees Fahrenheit
FSW	Feet of seawater
NAVSEA	Naval Sea Systems Command
NEDU	Navy Experimental Diving Unit
UBA	Underwater breathing apparatus

Abstract

As directed by NAVSEA Task 86-41, the Navy Experimental Diving Unit evaluated the Secumar 34 FM life preserver for suitability for use with the Draeger LAR V UBA. As a result of manned and unmanned testing, the Secumar 34 FM life preserver is recommended for Approved for Navy Use (ANU) status when used with the Draeger LAR V UBA.

An evaluation of a new design pierce pin for the Halkey-Roberts CO_2 inflation valve was conducted in conjunction with the Secumar 34 FM evaluation. This evaluation was conducted in accordance with NAVSEA Task 86-57. Two of the new design pins were evaluated and found to function acceptably in over 80 combined inflations. The new gray color Halkey-Roberts 840-AMS and 840-AMLS inflation valves which utilize the new design pin are recommended as a replacement to the Halkey-Roberts valves which utilize the hollow rolled design pin currently in use.

KEY WORDS:

Approved for Navy Use (ANU)
carbon dioxide (CO_2) cylinder
Secumar 34 FM life preserver
Secumar TSK 2/42 life preserver
Draeger LAR V UBA
NAVSEA Task 86-41
NAVSEA Task 86-57
NEDU Test Plan 86-26
life preserver
buoyancy compensation device (BCD)
inflation bladder
inflation valve
pierce pin
840-AMS inflator
840-AMLS inflator

I. INTRODUCTION

As directed by NAVSEA Task 86-41, an evaluation of the Secumar 34 FM life preserver was conducted to determine its suitability for use with the Draeger LAR V Underwater Breathing Apparatus (UBA). A comparative evaluation with the presently used U.S. Navy approved Secumar TSK 2/42 life preserver was also conducted. These life preservers are manufactured in the Federal Republic of Germany by Bernhardt Apparate Brau GmbH u. Co., SECUMAR Rettungsgerate. Secumar Products are distributed in the United States by National Draeger, Inc., 101 Technology Drive, P.O. Box 120, Pittsburgh, Pennsylvania 15230.

The Secumar 34 FM utilizes the Halkey-Roberts 840-AMLS inflation valve for CO_2 cylinder actuation. The Halkey-Roberts inflation valves which utilize the hollow rolled pierce pin design have been the subject of NAVSEA Diving Advisories and a Diving Equipment Manufacturers Association (DEMA) notice due to reliability concerns over the possible breakage of these pins. An evaluation of a new design pierce pin provided by the manufacturer was conducted in accordance with NAVSEA Task 86-57. The manufacturer of this inflation valve is Halkey-Roberts, Subsidiary of Kidde, 11600 Ninth Street North, St. Petersburg, Florida 33702-1090.

II. BACKGROUND

Reference (a) reported test results of an evaluation of several Secumar model life preservers, including the Secumar TSK 21, TSK 2/42, TSK 47, 34 FM, and a Scubapro and Parkways model. As a result of this evaluation, the Secumar TSK 2/42 was recommended as the preferred life preserver for use with the Draeger LAR V UBA. This life preserver utilizes two compressed air inflation cylinders which provides a buoyancy compensation capability. The TSK 2/42 is now Approved for Navy Use (ANU) with the LAR V in accordance with NAVSEAINST 9597.1A.

The Secumar 34 FM model was not recommended for approval because it is a CO_2 actuated life preserver which, due to its configuration, should be considered a flotation device which is not feasible for subsurface buoyancy control during dives. Some users of the Draeger LAR V UBA may carry substantial quantities of ancillary equipment, thus requiring the use of a buoyancy compensation device (BCD) over a flotation device only. A discussion of the advantages and disadvantages of compressed air cylinder inflation and buoyancy compensation over CO_2 inflation is provided in the discussion section of this report (Section VI).

III. SECUMAR 34 FM FUNCTIONAL DESCRIPTION

The Secumar 34 FM life preserver is specifically designed for use with chest-worn diving apparatuses. It is worn around the neck and fixed to the body by an adjustable waist strap and two adjustable thigh straps. A single 34 gram CO_2 cylinder with a Halkey-Roberts 840-AMLS single pull inflation valve comprises the inflation assembly. The inflation cord handle is colored red with white lettering "jerk to inflate." When properly assembled, the inflation cord handle hangs outside the velcro protective cover for easy access. An oral inflation valve is provided, along with a whistle. The inflatable buoyancy chamber is folded up and inserted inside a protective cover which is then velcroed shut, providing a low profile, streamlined style. The 34 FM is worn under the UBA, weight belt, and other ancillary equipment. Illustrations of a donned 34 FM are provided in Figure 1. Illustrations of donning procedures are provided in Figures 2 and 3. These figures are derived from the manufacturers instruction manual.

Pulling the inflation cord activates the inflation process, causing the buoyancy chambers to separate the velcro protective cover, inflating to a size and buoyancy level which is dependent upon depth, and increases with decreasing depth. Actual buoyancy levels are provided in Section V. Illustrations of an inflated 34 FM are provided in Figures 4 and 5.

IV. SECUMAR 34 FM SPECIFICATIONS

Number of Buoyancy Chambers:	One
CO_2 Cylinder:	34 grams ± 1.5 grams; approximately 17 liters of expanded CO_2 gas; ½ inch threaded connection
Type of Inflator:	Manual CO_2 actuator, Halkey-Roberts inflation valve 840-AMLS (½ inch thread)
Weight:	1.1 kg (2.42 lbs.) with a single 34 gram CO_2 cylinder installed
Color:	Olive green
Accessories:	Signal whistle, double-tone, with cord
Inflated Measurement:	550 mm x 300 mm x 100 mm
Oral Inflator:	Locking ring type

V. TEST PROCEDURE AND RESULTS

Appendix A provides the test plan. The evaluation included static lift tests, surface floating attitude tests, swim characteristics, leak test, and cold water functioning tests. Test procedures and results are provided in this section. Testing was conducted on two Secumar 34 FM life preservers provided to NEDU by National Draeger, Inc.

A. Static Lift Test. Pounds of upward force (buoyancy) was measured on two inflated 34 FM life preservers at depths of 60, 55, 50, 45, 40, 35, 30, 25, 20, 15, 10, 5 and 1 FSW in an open ocean environment. A single Secumar TSK 2/42 life preserver was subjected to the same test at maximum inflation so that a comparative evaluation could be performed. Test results are provided in Table 1.

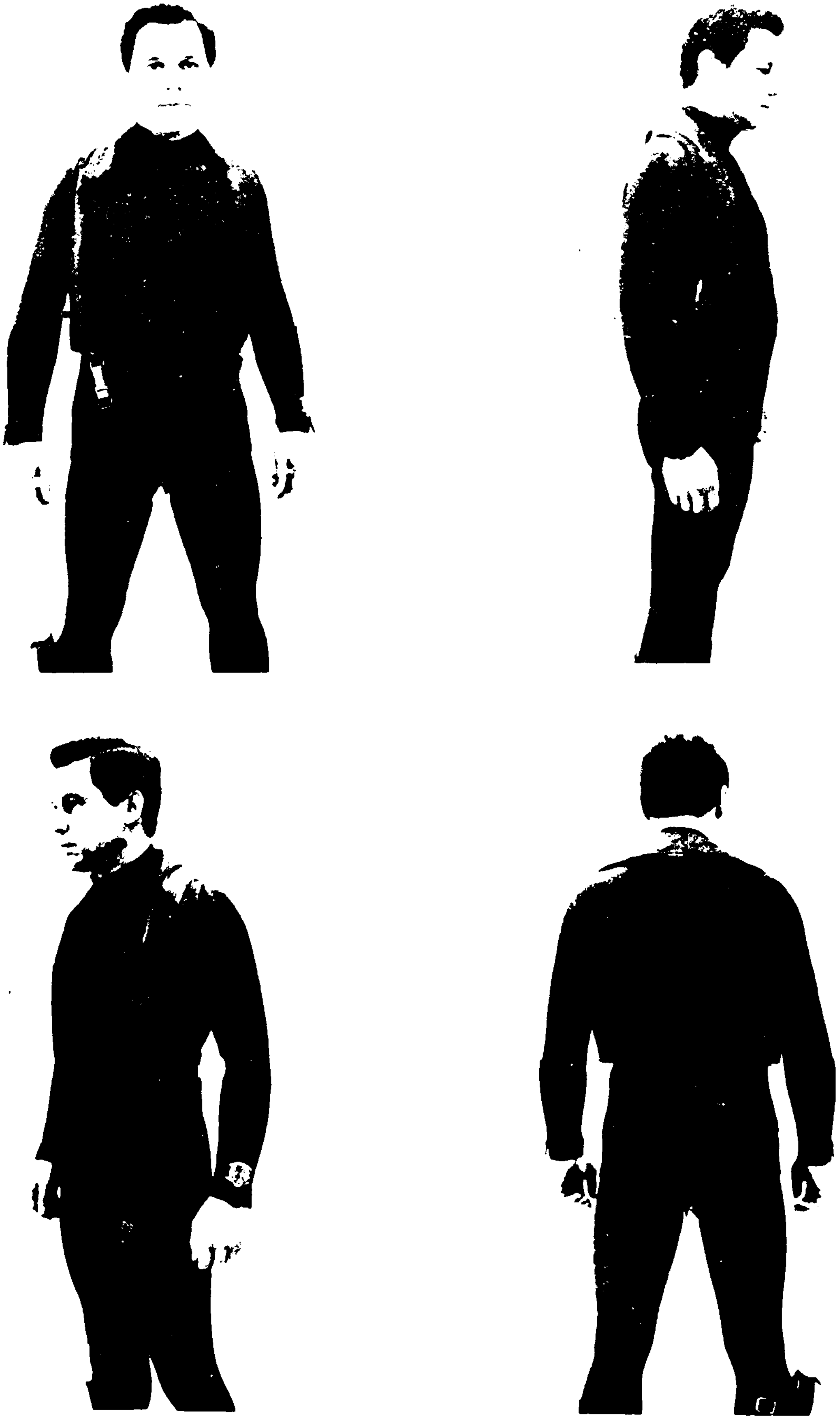

Figure 1. Donned Secumar 34 FM Life Preserver

Figure 2. Secumar 34 FM Donning Procedures

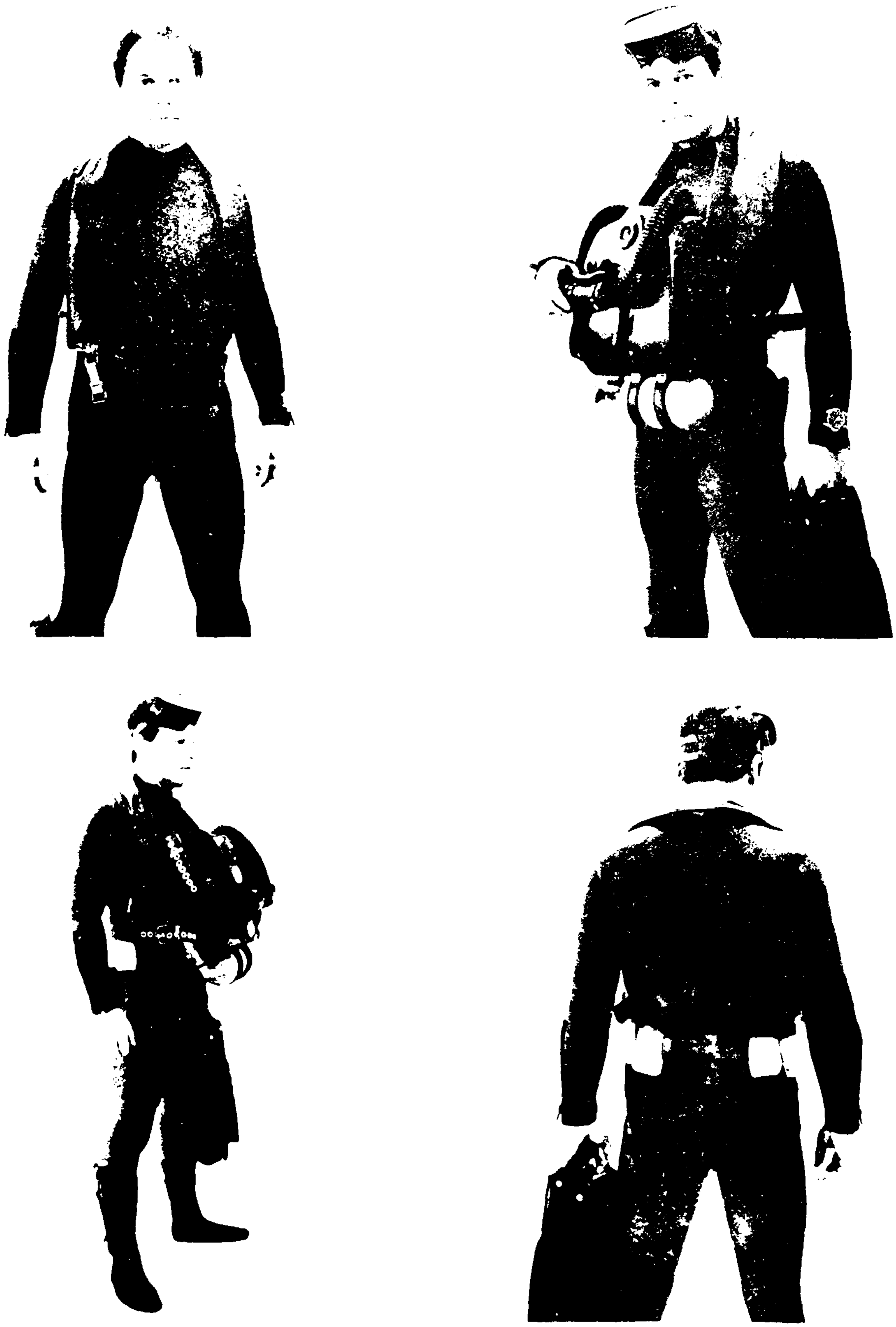

Figure 3. Secumar 34 FM with Draeger LAR V UBA and Weight Belt

Figure 4. In-water Inflated Characteristics of the Secumar 34 FM

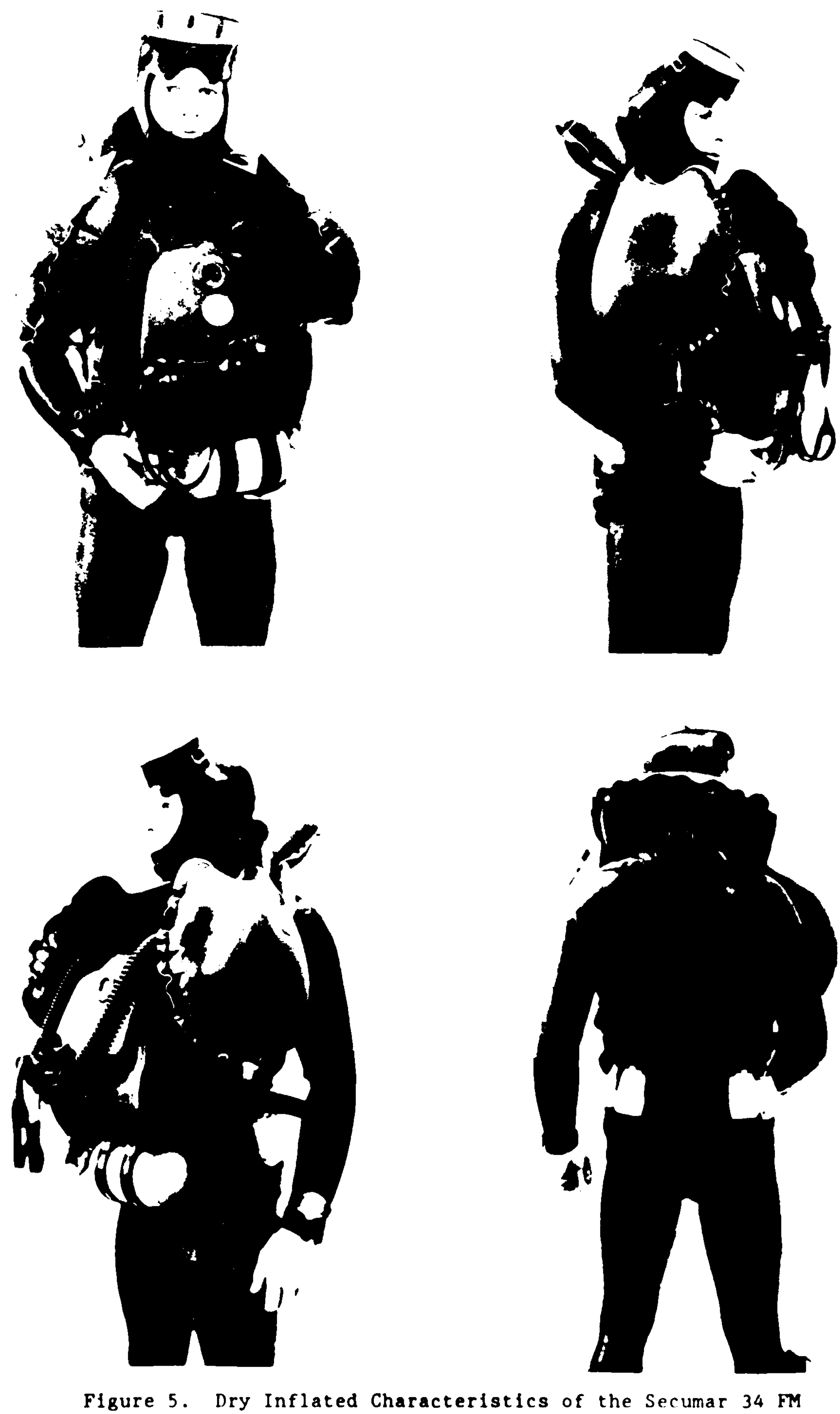

Figure 5. Dry Inflated Characteristics of the Secumar 34 FM

Test results show that at an operating depth of 25 FSW, the Secumar 34 FM provides 20.5 pounds of buoyancy. A maximum buoyancy of 36 pounds was provided at 1 FSW and 14 to 14.5 pounds of buoyancy was provided at the maximum LAR V operating depth of 50 FSW.

Table 1. Open Ocean Static Lift Test Results

Test Depth (FSW)	Secumar 34 FM #1 Pounds of Buoyancy	Secumar 34 FM #2 Pounds of Buoyancy	Secumar TSK 2/42 Pounds of Buoyancy
1	36	35	32
5	35	35	32
10	29	27.5	32
15	25.5	26	32
20	24	23	32
25	20.5	20.5	32
30	19.5	18	32
35	18	17	32
40	17	15	32
45	14.5	15	32
50	14.5	14	32
55	14	14	32
60	13	13	33

The Secumar TSK 2/42 provides a constant 32 pounds of buoyancy regardless of depth, to the maximum test depth of 60 FSW when fully inflated. This is due to the use of air inflation cylinders which can provide maximum buoyancy at all tested depths. If the inflation bladder receives a maximum fill at depth, the expansion of air which occurs as depth decreases is automatically vented through the overpressure relief valve.

The Secumar 34 FM does not utilize an overpressure relief valve, as one 34 gram CO_2 cylinder provides maximum inflation bladder fill only on the surface, and thus there is no danger of bladder overinflation. Life preserver overinflation could only occur if excessive gas were added to the inflation bladder prior to actuating the CO_2 cylinder. It is therefore apparent that the 34 FM cannot be used for buoyancy compensation, even if the oral inflation valve is used to add buoyancy prior to the dive. Minor amounts of trapped air within the bladder prior to inflation would not pose a hazard.

B. Surface Floating Attitude Test

1. 34 Gram CO2 Cylinder. Manned inflations were conducted from a depth of 15 feet of fresh water in the NEDU test pool to evaluate surface floating attitudes attained when simulating an unconscious diver. Thirty-four gram CO_2 cylinders provided by the manufacturer were used for this test. Various equipment configurations and diver attitudes were used to provide a wide range of tests in various scenarios, and to subject the two 34 FM life preservers to numerous inflations to evaluate inflation bladder integrity and CO_2 inflator mechanism reliability. Table 2 provides test results, and is a combined result of 40 inflations on two 34 FM life preservers.

Test results indicate that, when simulating an unconscious diver, inflation of the 34 FM from a depth of 15 feet of freshwater always brought the diver to a head up position except for Bravo diver with weight belt released and completely flooded LAR V. This is the only scenario that resulted in a face down position. Bravo diver wore a ¼ inch wet suit, whereas Alpha diver wore a 3/16 inch wet suit, and Alpha diver surfaced face up on the same test. LAR V breathing bags were approximately half full on all inflations, except for flooded LAR V test scenarios during which both the canister and breathing bag were completely flooded.

The manufacturer's instruction manual specifies that if the diving apparatus breathing bag is not filled, the diver's position in the water will be vertical after inflation while still resulting in approximately 6 cm between the divers mouth and surface of the water. A half filled bag (the usual case) will result in a safe backward inclined position (face up). Testing shows that a head up (vertical, mouth at or just above water level) position vice face up (backward inclined position) resulted in a few cases when the LAR V was completely flooded, specifically when a wet suit top only was worn, both with weight belt donned and released.

The few cases which resulted in a head up, mouth at or just above water level, and the two cases of face down position are considered inconsequential in relation to the numerous, reliable face up positions achieved over the forty test runs. This is especially true considering that the use of buddy lines are required between closed circuit oxygen divers (except during very unusual scenarios), and thus buddy assistance is ensured for the stricken diver. It is probable that the Secumar TSK 2/42 life preserver would result in similar diver surface flotation attitudes, considering the similarity of inflation bladder designs. Although most Navy approved life preservers are "horse collar" type, there is no alternative to the lapel wrap-around inflation bladder design for use with chest worn UBAs.

2. Halkey-Roberts Inflation Valve. The Secumar 34 FM life preservers tested at NEDU utilize the Halkey-Roberts 840-AMLS inflation valve for CO_2 actuation. This valve previously utilized a hollow rolled 420 stainless steel pierce pin vice a solid constructed pin following a design change in mid 1984. In August 1986 the Diving Equipment Manufacturers Association (DEMA) identified a possible problem with this pierce pin. The problem identified was a potential breaking of the pierce pin (breakage might not be apparent), which might fail to activate the CO_2 cylinder, thereby failing to inflate the life preserver.

Table 2. Surface Floating Attitude Test Results, 34 Gram CO_2 Cylinder

Diver Status			Diver Surface Flotation Attitude					
			Alpha Diver			Bravo Diver		
U/W Attitude	Garment	Equipment Status	Face Up	Face Down	Other	Face Up	Face Down	Other
Horizontal	No Wet Suit	LAR V Donned	✓			✓		
Vertical	No Wet Suit	LAR V Donned	✓			✓		
Horizontal	No Wet Suit	LAR V Flooded	✓			✓		
Vertical	No Wet Suit	LAR V Flooded	✓			✓		
Horizontal	Wet Suit Top and Weight Belt	LAR V Donned	✓			✓		
Vertical	Wet Suit Top and Weight Belt	LAR V Donned	✓			✓		
Horizontal	Wet Suit Top,and Weight Belt	LAR V Flooded			Mouth Low to Water, Head Up			Mouth Low to Water, Head Up
Vertical	Wet Suit Top and Weight Belt	LAR V Flooded			Mouth Low to Water, Head Up	✓		
Horizontal	Wet Suit Top, Weight Belt Released	LAR V Donned	✓			✓		
Vertical	Wet Suit Top, Weight Belt Released	LAR V Donned	✓			✓		
Horizontal	Wet Suit Top, Weight Belt Released	LAR V Flooded			Mouth Low to Water, Head Up			Mouth Low to Water, Head Up
Vertical	Wet Suit Top, Weight Belt Released	LAR V Flooded	✓					Mouth Low to Water, Head Up
Horizontal	Full Suit and Belt	LAR V Donned	✓			✓		
Vertical	Full Suit and Belt	LAR V Donned	✓			✓		
Horizontal	Full Suit and Belt	LAR V Flooded	✓			✓		
Vertical	Full Suit and Belt	LAR V Flooded	✓			✓		
Horizontal	Full Suit and Belt Released	LAR V Donned	✓			✓		
Vertical	Full Suit and Belt Released	LAR V Donned	✓			✓		
Horizontal	Full Suit and Belt Released	LAR V Flooded	✓				✓	
Vertical	Full Suit and Belt Released	LAR V Flooded	✓				✓	

Following the identification of this problem by DEMA, NAVSEA (00C) transmitted Diving Advisories 86-18 and 86-19 which required examination of all life preservers/buoyancy compensation devices purchased after 1 January 1983 which have a CO_2 inflation mechanism, or have had CO_2 inflation mechanisms repaired or replaced. CO_2 inflation mechanisms which contain markings identifying it as a "Roberts valve" were required to be discontinued from use until a retrofit of the Roberts valve became available. The U.S. Navy MK 4, Fenzy, and Seatec buoyancy compensators were unaffected by these diving advisories.

Two Halkey-Roberts 840-AMS inflators with a new solid design pierce pin were provided to NAVSEA (00C3) by the manufacturer. NAVSEA Task 86-57 directed NEDU to evaluate this new inflator. It was first proposed to conduct the inflator test using the Secumar 34 FM life preserver so that the life preserver and inflator tests could be combined. However, the 34 FM utilizes the 840 AMLS valve which is the same as the 840 AMS inflator provided for testing except that the AMLS series utilizes ½ inch threads to accommodate European manufactured CO_2 cylinders. The AMS series utilizes 3/8 inch threads typical of CO_2 cylinders available in the United States. Both inflators are stamped 840 AM on the inflator body due to the same basic mold being used in manufacture. The 840-AMS and 840-AMLS inflators are manufactured with stainless steel internal parts whereas the 840-AM and 840-AML are manufactured of cadmium plated steel which are <u>not</u> to be used for diving due to the corrosion of the cadmium plated steel parts. The AM and AML are designed for aviation use only, where the inflator is kept dry in storage until emergency use is required.

It was decided to remove the hollow rolled pierce pin from the 840-AMLS inflators provided with the Secumar 34 FM life preserver and replace them with the new solid design pin taken from the 840-AMS inflators provided for testing by Halkey-Roberts. The 40 manned test inflations listed in Table 2 were conducted with the new pierce pin. All inflations proved to be reliable with no delays or pin fractures occurring.

Halkey-Roberts no longer manufactures the rolled pierce pin for use in its 840-AMS and 840-AMLS series inflators. A gray body indicates the new pin change.

3. <u>38 Gram CO2 Cylinder</u>. In order to provide additional reliability tests on both the 34 FM and the new pierce pin, another 40 inflations were conducted in the test pool with the two 34 FM life preservers in the same test conditions, except that the 840-AMLS inflator was replaced with the 840-AMS provided by Halkey-Roberts, and 38 gram CO_2 cylinders were used.

It was found that the 34 FM life preserver was not designed for use with a 38 gram net weight CO_2 cylinder. CO_2 actuation resulted in slight overinflation of the flotation bladder which resulted in discomfort to the wearer as a result of pushing the divers head too far forward. The entire 40 test runs were still conducted in order to provide a better evaluation of inflation bladder integrity after numerous test runs which provided excessive life preserver internal pressure.

Table 3 provides the results of the forty 840-AMS inflator test runs with the 34 FM life preserver. No inflation delays or pin fractures occurred. Test results for the 38 gram CO_2 cylinders are comparative to the 34 gram CO_2 cylinder test results.

4. Predive Assembly Procedures. The 40 test inflations reported by Table 1 were preceded by a number of additional inflations to develop life preserver assembly procedures. The Secumar 34 FM is folded up inside a protective cover sealed with velcro tape. Folding procedures provided by the manufacturers instruction manual are unclear. Proper folding procedures are important to prevent the right or left inflation bladder 'lapels' from rotating during the inflation process. This rotation can cause a twist between the neck inflation bladder section and the right or left lapel sections. This can have the result of pushing the divers head too far forward when inflation is achieved.

Secumar 34 FM life preserver assembly procedures are provided as follows:

a. Lay the completely deflated inflation bladder and cover flat with oral inflation tube up.

b. Ensure oral inflation tube locking device is secured in the upward position (tight against the mouthpiece).

c. Install a new 34 gram ½ inch thread CO_2 cylinder into the inflation valve hand tight, ensuring the actuator handle is in the up position, and the inflation bladder/CO_2 inflation system separator flap is properly positioned over the CO_2 cylinder retaining loop.

d. Inflation bladder is to be folded longitudinally in accordion fashion. Fold approximately 3½ inches of the outer edge of the left lapel of the inflation bladder underneath the main body of the inflation bladder. Oral inflation tube remains facing up.

e. Fold approximately 3½ inches of the inner edge of the left lapel underneath the main body of the inflation bladder.

f. Fold the remaining area in half longitudinally, laying the inner half on top of the outer half of the inflation bladder, covering up the inflation tube. Start closing the velcro tape at the bottom of the protective cover.

g. Fold approximately 3½ inches of the outer edge of the right lapel longitudinally on top of the main body, ensuring that the actuator inflation cord is free.

h. Accordion fold the remaining portions of the right lapel on top of itself using two 3½ inch folds as follows: fold approximately 3½ inches of the inner edge of the right lapel underneath the main body; fold remaining area in half longitudinally, folding the inner half on top of the outer half.

Table 3. Surface Floating Attitude Test Results, 38 Gram CO_2 Cylinder

Diver Status			Diver Surface Flotation Attitude					
			Alpha Diver			Bravo Diver		
U/W Attitude	Garment	Equipment Status	Face Up	Face Down	Other	Face Up	Face Down	Other
Horizontal	No Wet Suit	LAR V Donned	✓			✓		
Vertical	No Wet Suit	LAR V Donned	✓			✓		
Horizontal	No Wet Suit	LAR V Flooded	✓			✓		
Vertical	No Wet Suit	LAR V Flooded	✓			✓		
Horizontal	Wet Suit Top and Weight Belt	LAR V Donned	✓			✓		
Vertical	Wet Suit Top and Weight Belt	LAR V Donned	✓			✓		
Horizontal	Wet Suit Top and Weight Belt	LAR V Flooded	✓			✓		
Vertical	Wet Suit Top and Weight Belt	LAR V Flooded	✓			✓		
Horizontal	Wet Suit Top, Weight Belt Released	LAR V Donned	✓			✓		
Vertical	Wet Suit Top, Weight Belt Released	LAR V Donned	✓			✓		
Horizontal	Wet Suit Top, Weight Belt Released	LAR V Flooded		✓			✓	
Vertical	Wet Suit Top, Weight Belt Released	LAR V Flooded	✓			✓		
Horizontal	Full Suit and Belt	LAR V Donned	✓			✓		
Vertical	Full Suit and Belt	LAR V Donned	✓			✓		
Horizontal	Full Suit and Belt	LAR V Flooded	✓			✓		
Vertical	Full Suit and Belt	LAR V Flooded	✓			✓		
Horizontal	Full Suit and Belt Released	LAR V Donned	✓			✓		
Vertical	Full Suit and Belt Released	LAR V Donned	✓					Delay to Face Up (5 sec.)
Horizontal	Full Suit and Belt Released	LAR V Flooded		✓			✓	
Vertical	Full Suit and Belt Released	LAR V Flooded		✓			✓	

i. Start closing velcro tape at bottom of protective cover. Ensure actuator handle extends outside protective cover.

j. On left side of top (neck) portion of the inflation bladder, fold approximately 3½ inches of outer edge underneath.

k. On right side of top (neck) portion of inflation bladder, fold 3½ inches of outer edge on top.

l. Fold entire neck portion down so that nylon retaining strap is facing up and is flat.

m. Making the next fold on strap side of nylon retaining strap gromet, fold neck portion of inflation bladder upwards.

n. In two equal size accordion folds, lay remaining material on top of main body, folding down and back up. This completes the accordion fold process. Figures 6 and 7 provide illustrations. Figure 6 does not illustrate the current Halkey-Roberts inflation valve.

o. Join velcro tape at top center of protective liner of neck section. Join remaining tape, tucking in folded portions of inflation bladder as required.

C. Swim Characteristics. Familiarization swims were conducted with the Secumar 34 FM life preserver to evaluate fit, comfort, and human engineering. The 34 FM was found to be easy to don and comfortable to wear. The inflator handle is easily accessible. The two adjustable thigh straps can slip down on the thighs if the diver assumes a crouched position, but immediately readjust when the body is straightened.

The UBA can be removed without affecting the life preserver because the 34 FM is worn underneath other equipment, whereas the Secumar TSK 2/42 fastens over the front of the UBA. The 34 FM has a low profile design with its folded configuration.

D. Leak Test. Following the surface floating attitude test which involved over 80 combined inflations on two life preservers, the Secumar 34 FM life preservers were submitted to leak tests to evaluate inflation bladder integrity. Both life preservers were completely inflated orally with CO_2 cylinder installed. Leak check solution was applied over the entire life preserver. No leaks were found. The life preservers were left inflated for 16 hours, with no noticeable deflation occurring.

E. Cold Water Functioning Test. Two Secumar 34 FM life preservers were stored in a temperature controllable freezer set at 29°F. The top half of the life preservers were dry. The bottom half, including the inflation valves, were submerged in a bath of seawater to which propylene glycol was added to prevent water freeze up at 29°F. Two hours elapsed after life preserver immersion to allow temperature equalization between the life preservers and the air and glycol water solution. The freezer door was then opened and the inflators were actuated. Both life preservers inflated without delay or freeze up.

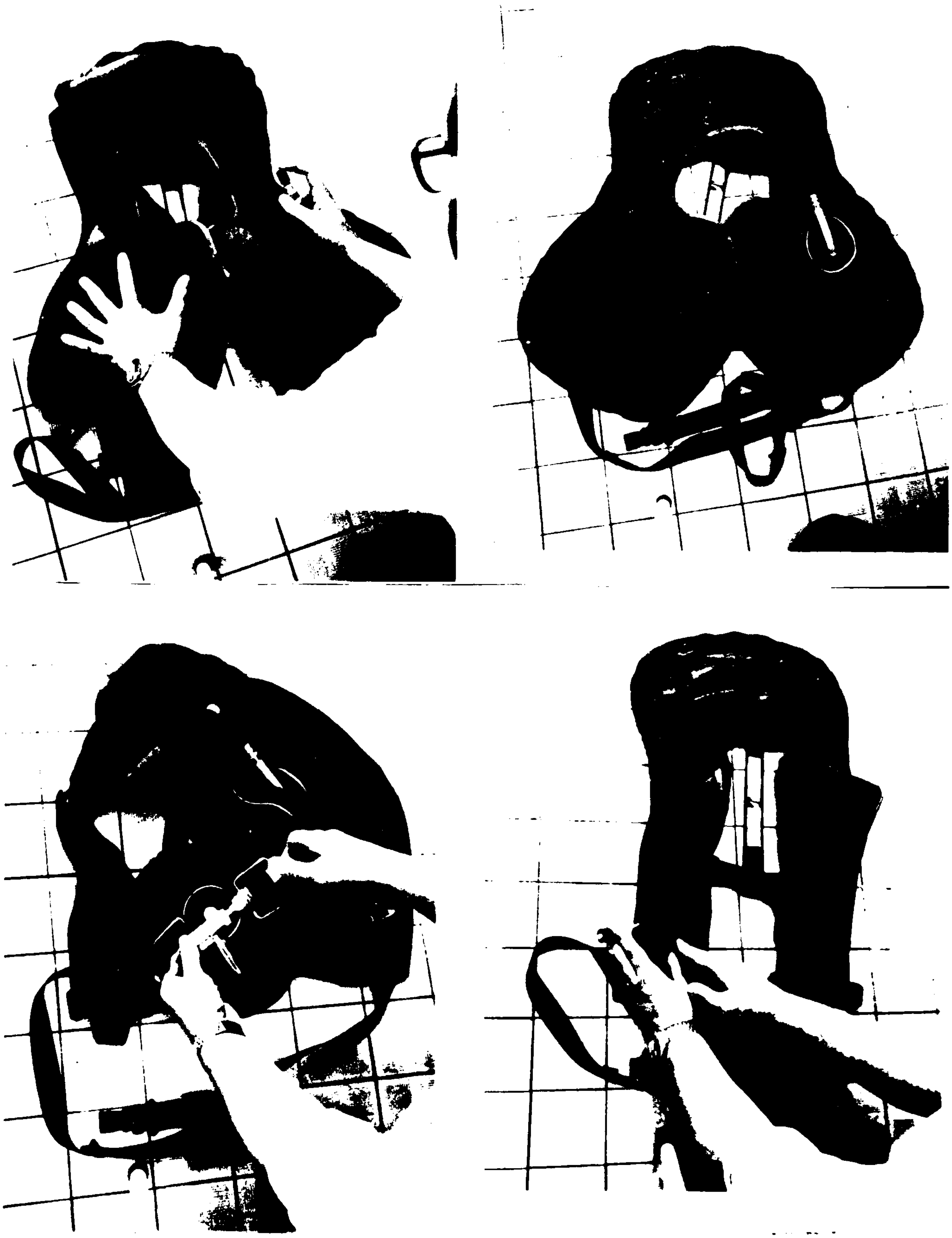

Figure 6. Secumar 34 FM Assembly Procedures

Figure 7. Joining Velcro Tape

This test was then repeated under the same test conditions except that 24 hours elapsed from immersion of the two 34 FM life preservers to actuation. Both life preservers inflated without delay or freeze up.

VI. DISCUSSION

Due to the corrosion problems experienced with the compressed air inflation cylinders on the Secumar TSK 2/42 life preserver, the Secumar 34 FM was evaluated as a possible replacement for the TSK 2/42, or as an additional approved life preserver with the Draeger LAR V UBA. Possible advantages of the 34 FM over the TSK 2/42 are listed as follows:

- Reduced magnetic signature
- Covers less area on divers body, therefore somewhat less encumbering
- Reduced weight (2.42 lbs. for 34 FM; approximately 8 lbs. for TSK 2/42)
- Predive charging of air inflation cylinders not required
- Inspection, maintenance, and periodic replacement of air cylinders and air cylinder valves not required
- UBA can be easily removed during swim

Advantages of the TSK 2/42 over the 34 FM includes the following:

- Buoyancy compensation capability
- Capable of providing maximum buoyancy at all depths (if required)
- No weighing or purchase of CO_2 cylinders or inflator maintenance required
- No inflation bladder predive folding required

An evaluation of the air inflation cylinder corrosion and cylinder valve thread distortion problems experienced with the Secumar TSK 2/42 life preserver is provided by reference 2. CO_2 inflation mechanisms have also experienced problems during Navy use. Aluminum inflator mechanisms on the UDT and UDT modified life jackets can experience salt build-up if not properly maintained. The Seatec Sunfish Tuff Tiger buoyancy compensator recently experienced problems with the plastic threaded insert stripping out, and resulted in a nickel plated brass insert retrofit to correct this problem. The MK 4 life preserver inflation mechanisms experienced maintainability and serviceability problems, and resulted in development of a plastic inflator mechanism incorporating a metal threaded insert.

The Halkey-Roberts inflators utilize a plastic body, stainless steel internal parts, and metal threaded insert, however the hollow rolled pierce pin has been the subject of NAVSEA Diving Advisories due to the possibility of pin breakage. The weakness of the pin may possibly be the result of improper heat treating. The hollow rolled design was engineered to provide increased gas flow upon CO_2 actuation, however the new design pin provides adequate gas flow. Except for the pierce pin problem, the Halkey-Roberts inflators have not proven to be subject to maintenance or reliability problems. The new design pin will correct this discrepancy.

The Secumar 34 FM should provide reduced maintenance over the Secumar TSK 2/42 and provides a lighter, smaller configuration. The in depth training in oxygen diving procedures which combat swimmers receive provides practice in buoyancy control techniques which tends to reduce the requirement for a buoyancy control capability in a life preserver. Actual operational experience may result in varied diver preferences on the requirement for a buoyancy compensation device over a life preserver only, however it is probable that the currently used Secumar TSK 2/42 is seldom used for buoyancy compensation..

VII. CONCLUSIONS

The Secumar 34 FM life preserver provides acceptable buoyancy characteristics and reliability, should result in reduced maintenance, and is smaller and lighter than the Secumar TSK 2/42. Accordingly, it is recommended that this life preserver be Approved for Navy Use (ANU).

The Halkey-Roberts 840-AMS and 840-AMLS series inflators which contain the new design pin are now colored gray to differentiate these inflators from the old pin design. It is recommended that all ANU life preservers/buoyancy compensators which use the Halkey-Roberts inflation valve be retrofitted with the new gray model. The Halkey-Roberts AM and AML inflator mechanisms are not recommended for diving use due to the use of cadmium plating over steel, vice stainless steel internal parts.

VIII. REFERENCES

1. NEDU Report 4-82, 'Draeger LAR V Underwater Breathing Apparatus and Life Jacket/Buoyancy Compensator U.S. Army Field Evaluation,' R.W. Dowgul, September 1982.

2. NEDU Technical Memorandum No. TM86-12, 'Test and Evaluation of a Modified Version of a High Pressure Insert S24-400 01 and Two Alternative Compressed Air Cylinders for the Secumar TSK 2/42 Life Preserver,' Clark G. Presswood, LT, USN, and David W. Laconte, HTC, USN, November 1986.

APPENDIX A

DEPARTMENT OF THE NAVY
NAVY EXPERIMENTAL DIVING UNIT
PANAMA CITY, FLORIDA 32407-5001

IN REPLY REFER TO:

NAVY EXPERIMENTAL DIVING UNIT

STANDARD TEST PLAN

TEST AND EVALUATION OF THE SECUMAR 34 FM LIFE PRESERVER AND A MODIFIED VERSION OF A HIGH PRESSURE INSERT FOR THE SECUMAR TSK 2/42 LIFE PRESERVER AIR CYLINDER VALVE

TEST PLAN NUMBER 86-26

SEPTEMBER 1986

Submitted:	Reviewed:	Approved:
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RECORD OF CHANGES

Except as provided for herein, changes will be made only on the authority of the Commanding Officer, NEDU. A dark vertical line in the left-hand margin indicates the coverage of change.

CHANGE NO.	AUTHORITY	INSERTION	SECTION	INITIAL

TABLE OF CONTENTS

References.

(a) NAVSEA Task 86-41
(b) NAVSEA SS500-AR-OM1-0109N865, Operations and Maintenance Instructions of SECUMAR TSK 2/42 Life Preserver
(c) NEDU Report 4-82
(d) COMNAVSPECWARGRU TWO 031810Z Jul 86
(e) COMNAVSPECWARGRU ONE 011815Z Jul 86

1. Introduction. The SECUMAR TSK 2/42 life preserver is the only life preserver presently approved for use with the Draeger LAR V closed circuit oxygen underwater breathing apparatus (UBA). This life preserver utilizes two compressed air inflation cylinders for emergency ascent and buoyancy compensation. These cylinders are manufactured from carbon steel which have experienced corrosion problems. This is particularly the case when water is allowed to enter the cylinder, possibly due to either bleeding down all the pressure in the bottle and leaving the valve open underwater, charging the bottles with water remaining in the valve, or to condensation of water in the cylinder due to rapid cylinder pressure drops which may occur when the cylinder is used for buoyant ascent. In order to counter this problem, reference (b) was changed to include a mandatory interior visual inspection whenever cylinder pressure drops to 100 psi or below. However, repeated visual inspection can be a problem in that the cylinders have metric tapered threads (DIN fittings) which connect to tapered thread valves. After several PMS inspections the cylinder/valve threads can become distorted and may not seal properly. If cylinder pressure does not drop to 100 psi or below, visual inspections are still required semiannually.

National Draeger, Inc. has provided NEDU with a modified version of a high pressure insert S24-400 01 for the SECUMAR TSK 2/42 air cylinder valve. This modified part has a check valve that allows high pressure air to exit the air cylinder, but prevents reverse flow into the cylinder, preventing seawater and other contaminants from entering and causing corrosion of the bare steel cylinder interior. This modified part will be evaluated as a possible replacement for the presently used part.

The SECUMAR 34 FM life preserver will also be evaluated for suitability with the Draeger LAR V UBA. This life preserver utilizes a single 34 gram CO_2 cylinder and actuator for inflation in lieu of the dual compressed air cylinder system used on the SECUMAR TSK 2/42. The SECUMAR 34 has previously been evaluated along with the SECUMAR TSK 21, TSK 2/42, and TSK 47. Reference (c) provides the results of this evaluation, and recommends against the use of the SECUMAR 34 because it does not provide a buoyancy compensation capability. However, SPECWAR commands have recently indicated that the SECUMAR TSK 2/42 is not generally used as a buoyancy compensation device (references (d) and (e) refer). Therefore, the SECUMAR 34 will be further evaluated as an additional life preserver approved for use with the Draeger LAR V UBA.

2. Personnel Requirements. A four man dive team will be required for each test phase which requires that a diving evolution be conducted. Additionally, closed circuit oxygen dives will require that a corpsman be present. Those test phases which do not require that a diving evolution be conducted will utilize two personnel.

3. Test Parameters

a. PHASE I. Static Lift Test. Pounds of upward force (buoyancy) exerted by the SECUMAR 34 life preserver will be evaluated at various depths.

b. PHASE II. Surface Floating Attitude Test. Life preservers will be inflated at a depth of 15 FSW with various diver attitudes and diver equipment to evaluate surface floating attitudes attained when simulating an unconscious diver.

c. PHASE III. Swim Characteristics. 1000 yard compass swims will be conducted by the SPECWAR Division to evaluate fit and comfort.

d. PHASE IV. Evaluation of a Modified High Pressure Insert for the SECUMAR TSK 2/42 Air Cylinder Valve. The one-way insert will be evaluated for its effectiveness in keeping water out of the cylinder while submerged with the valve open.

4. Instrumentation. An underwater load measurement device and underwater slate or paper will be required to log buoyancy data.

5. Test Procedure

a. PHASE I. Static Lift Test. At an ocean depth of 60 FSW a load measurement device will be rigged on the bottom so that life preserver depth is 55 FSW. The life preserver will then be inflated and the pounds of upward force (buoyancy) recorded after full inflation. Two tests will be conducted at each of the following depth increments: 15, 25, 35, 45, and 55 FSW.

b. PHASE II. Surface Floating Attitudes. Diver-subjects will breath-hold swim to the bottom of the NEDU test pool and inflate life preservers, simulating an unconscious diver when rising to the surface. Surface floating attitudes which result will be recorded. Divers will not breathe compressed air so as to avoid the risk of arterial gas embolism. Two test runs will be conducted in each of the following diver attitude/equipment configurations.

(1) Diver horizontal stomach down:

(a) No wet suit, LAR V donned.

(b) No wet suit, LAR V flooded.

(c) Wet suit top and weight belt, LAR V donned.

(d) Wet suit top and weight belt, LAR V flooded.

(e) Wet suit top, weight belt released, LAR V donned.

(f) Wet suit top, weight belt released, LAR V flooded.

(g) Full wet suit and weight belt, LAR V donned.

(h) Full wet suit and weight belt, LAR V flooded.

(i) Full wet suit, weight belt released, LAR V donned.

(j) Full wet suit, weight belt released, LAR V flooded.

(2) Diver vertical, head down. Same diver attitudes/equipment configurations as (1) above.

c. PHASE III. Swim Characteristics. Two 1000 yard compass swims will be conducted by one swim pair (SPECWAR Division personnel) to evaluate fit, comfort, and human engineering in an operational scenario.

d. PHASE IV. Evaluation of a Modified High Pressure Insert for the SECUMAR TSK 2/42 Air Cylinder Valve. The one-way insert will be installed in a life preserver which will be taken to the bottom of the NEDU test pool and flooded with water. The cylinder will have been previously drained of pressure and the cylinder valve will be open. The cylinder will then be evaluated for internal water leakage.

6. Program.

a. PHASE I. One day.

b. PHASE II. One day.

c. PHASE III. One day.

d. PHASE IV. One day.

7. Safety Rules and Emergency Procedures. During open water dives which utilize the Draeger LAR V as a breathing source, buddy lines and buoys will be used, and a diving corpsman will be in ready standby at all times. Approved diving procedures for the LAR V will be followed except that a prototype life preserver will be used.

8. Termination Criteria. Testing of the SECUMAR 34 FM life preserver will be terminated if a major equipment failure occurs which is due to faulty design or manufacture.

9. Report Production. An NEDU report and letter of recommendation will be drafted by the SPECWAR Projects Officer upon the conclusion of testing.

END

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