

# UNCLASSIFIED

|                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                        |
|                                                                                                                                                                        |
|                                                                                                                                                                        |
|                                                                                                                                                                        |
| AD NUMBER                                                                                                                                                              |
| AD408628                                                                                                                                                               |
| NEW LIMITATION CHANGE                                                                                                                                                  |
| TO<br>Approved for public release, distribution unlimited                                                                                                              |
| FROM<br>Distribution authorized to U.S. Gov't. agencies only; Specific Authority; 26 FEB 1963. Other requests shall be referred to Naval Ordnance Lab., White Oak, MD. |
| AUTHORITY                                                                                                                                                              |
| USNOL ltr, 29 Aug 1974                                                                                                                                                 |

THIS PAGE IS UNCLASSIFIED

CATALOGED BY 112C

AS AD No. 408628

408 628

NOLTR 63-43

TRANSISTOR WATER ENTR / SHOCK  
RESISTANCE SURVEY FOR RUGGEDIZED  
SONOBUOY

Without restrictions  
to distribution.  
☒ Approval by Bureau required for all  
subsequent release.

NOL

26 FEBRUARY 1963

UNITED STATES NAVAL ORDNANCE LABORATORY, WHITE OAK, MARYLAND

NOLTR 63-43

NO

This report contains commercially restricted in-  
formation and is not to be distributed to Non-  
Government addressees without express author-  
ization from the Naval Ordnance Laboratory.

U.S. NAVAL ORDNANCE LABORATORY

WHITE OAK  
SILVER SPRING, MARYLAND



To all holders of (NOLTR 63-43) **AD 408628L**  
insert change; write on cover 'Change 1 inserted'  
Approved by Commander, U.S. NOL

Change 1  
29 January 1965  
3 pages

V. W. Kintz  
By direction

This publication is changed as follows:

Replace pages 1 and 11 of NOLTR 63-43 with attached.

**408628L**

Insert this change sheet between the cover and the title page of your copy.

**TRANSISTOR WATER ENTRY SHOCK RESISTANCE SURVEY  
FOR RUGGEDIZED SONOBUOY**

**Prepared by  
Ralph E. Tabler  
Environment Simulation Division**

**ABSTRACT:** Transistor types 2N169A, 2N220, 2N200, and 2N741 were tested for their resistance to water-entry shock. A total of 147 transistors was mounted in one of three ways: (1) polyethylene holder and potted in polyethylene, (2) polyethylene holder and potted in Dow-Corning 601, and (3) potted in Dow-Corning 601 alone. The polyethylene holder and the 601 potting proved to be the most shock resistant mounting method. All of the transistors proved to be sufficiently rugged to survive the water-entry shock expected in service use of the NOL free fall miniature SONOBUOY.

**PUBLISHED APRIL 1965**

**U. S. NAVAL ORDNANCE LABORATORY  
WHITE OAK, MARYLAND**

**Change 1**

26 February 1963

**Transistor Water Entry Shock Resistance Survey for  
Ruggedized SONOBUOY**

The tests reported herein were conducted under the Bureau of Naval Weapons Task RUDC-2B00/212 1/F001 13 002, "SONOBUOY Ruggedization", to provide data on water-entry shock resistance of commercial transistors. The tests were performed at the Naval Ordnance Laboratory (White Oak) using the 5- and 15-inch Air Guns. This is the first time that transistors have been tested, using different mounting techniques, for water entry shock resistance. The data reported have been used in the SONOBUOY development and may prove useful in future ordnance ruggedization programs. The conclusions presented are those of the Environmental Evaluation Department.

The assistance of Messrs. D. J. Femiano of the Air and Surface Electrical Engineering Department and R. A. Ferraro of the Air and Surface Mechanical Engineering Department in planning the test program and the many shots made in the 5-inch Hi "G" Air Gun by Mr. C. A. Siess of the Public Works Department is gratefully acknowledged.

R. E. ODENING  
Captain, USN  
Commander

*V. M. KORTY*  
V. M. KORTY  
By ~~direction~~

TRANSISTOR WATER ENTRY SHOCK RESISTANCE SURVEY  
FOR RUGGEDIZED SONOBUOY

Prepared by  
Ralph E. Tabler  
Environment Simulation Division

ABSTRACT: Transistor types 2N169A, 2N220, 2N200, and 2N741 were tested for their resistance to water-entry shock. A total of 147 transistors was mounted in one of three ways: (1) polyethylene holder and potted in polyethylene, (2) polyethylene holder and potted in Dow-Corning 601, and (3) potted in Dow-Corning 601 alone. The polyethylene holder and the 601 potting proved to be the most shock resistant mounting method. All of the transistors proved to be sufficiently rugged to survive the water-entry shock expected in service use of the NOL free fall miniature SONOBUOY.

This report contains information on commercially available products or devices and is not to be distributed to non-Government addressees without written authorization from the Naval Ordnance Laboratory.

U. S. NAVAL ORDNANCE LABORATORY  
WHITE OAK, MARYLAND

NOLTR 63-43

26 February 1963

Transistor Water Entry Shock Resistance Survey for  
Ruggedized SONOBUOY

The tests reported herein were conducted under the Bureau of Naval Weapons Task RUWC-2B00/212 1/F001 13 002, "SONOBUOY Ruggedization", to provide data on water-entry shock resistance of commercial transistors. The tests were performed at the Naval Ordnance Laboratory (White Oak) using the 5- and 15-inch Air Guns. This is the first time that transistors have been tested, using different mounting techniques, for water entry shock resistance. The data reported have been used in the SONOBUOY development and may prove useful in future ordnance ruggedization programs. The conclusions presented are those of the Environmental Evaluation Department.

The assistance of Messrs. D. J. Femiano of the Air and Surface Electrical Engineering Department and R. A. Ferraro of the Air and Surface Mechanical Engineering Department in planning the test program and the many shots made in the 5-inch H1 "G" Air Gun by Mr. C. A. Siess of the Public Works Department is gratefully acknowledged.

R. E. ODENING  
Captain, USN  
Commander

*V. M. KORTY*  
V. M. KORTY  
By direction

# CONTENTS

|                                  | Page |
|----------------------------------|------|
| INTRODUCTION . . . . .           | 1    |
| Water Entry. . . . .             | 1    |
| TEST PROCEDURE . . . . .         | 3    |
| EVALUATION OF FAILURES . . . . . | 9    |
| TEST RESULTS . . . . .           | 10   |
| CONCLUSIONS. . . . .             | 10   |

# ILLUSTRATIONS

| Figure | Title                                                                  | Page |
|--------|------------------------------------------------------------------------|------|
| 1      | Idealized Acceleration-Time Curves of NOL<br>Captive Air-Guns. . . . . | 2    |
| 2      | Orientation and Wiring. . . . .                                        | 5    |
| 3      | Potting Methods . . . . .                                              | 6    |
| 4      | Transistors (Case Removed). . . . .                                    | 7    |
| 5      | List of Failures vs. Potting and Shock Level. . .                      | 11   |
| 6      | Failures vs. Potting and Shock Level. . . . .                          | 12   |

# TABLES

| Table | Title                                                                                                  | Page |
|-------|--------------------------------------------------------------------------------------------------------|------|
| 1     | Polyethylene Holder With Polyethylene Potting,<br>Direction of Acceleration vs. Sample Size . . . .    | 8    |
| 2     | Polyethylene Holder With Dow Corning 601 Potting,<br>Direction of Acceleration vs. Sample Size . . . . | 8    |
| 3     | Dow Corning 601 Potting Only (No Hclder),<br>Direction of Acceleration vs. Sample Size . . . .         | 9    |

# REFERENCE

(a) NOLR 1056, "Shock Testing Facilities"



## INTRODUCTION

1. The Naval Ordnance Laboratory is engaged actively in developing a ruggedized free-fall miniature SONOBUOY. Because the SONOBUOY is basically a hydrophone, amplifier, and transmitter, rugged electrical components are absolutely necessary for a reliable free-fall buoy. The Laboratory has accumulated considerable data and experience in ruggedization and miniaturization techniques from previous tasks such as VT Fuzes. From these tasks information on the ruggedness and mounting methods of resistors, capacitors, coils and miniature vacuum tubes is available. However, little information of this type is available on transistors. Because all the circuitry as presently conceived in the SONOBUOY(NOL) is transistorized, it was felt that mounting and ruggedness data were needed for transistors. A test program was planned not only to be useful to the SONOBUOY development program, but also for future ordnance ruggedization programs.

WATER ENTRY

2. Because the free-fall buoy enters the water at velocities as high as 350 knots, it can experience high deceleration forces at the air-sea interface. The water-entry shock occurs in two phases. The first or impact phase is the initial momentum exchange between the water and the entering body. This shock is of a short duration and a high acceleration. For the NOL buoy it is on the order of 0.15 to 0.25 millisecond in duration and 4,000 to 5,000 g in peak. In terms of velocity changes, this is from 10 to 20 feet per second. The second, or drag phase, is due to the viscous forces after the underwater flow pattern has developed. This acceleration is of the order of 400 to 800 g peak and 15 to 25 milliseconds duration.

3. To simulate water-entry shock, NOL has developed captive air guns using special two-phase pistons. The air gun is basically a long closed tube (58 feet for the 15-inch gun) with a piston containing the test specimen at one end. A mechanical latch releases the piston on command and the piston with the test specimen is accelerated down the tube. Because the tube is closed off, the pressure builds up at the other end and decelerates the piston. After several oscillations in the tube, friction finally brings the piston to rest. At this time the muzzle end of the door is opened and the piston and specimen are removed from the gun. In order to simulate the two-phase water-entry shock, the piston is equipped with a movable carriage and an anvil. The carriage holding the test specimen is set a fraction of an inch from

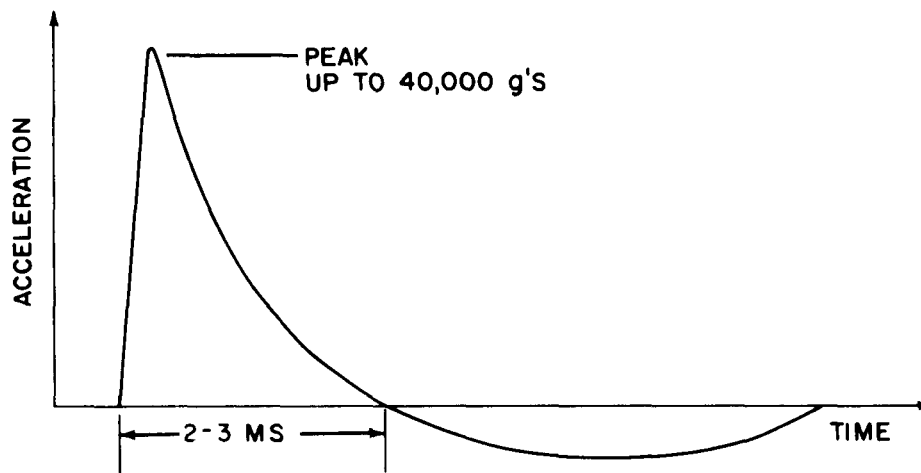
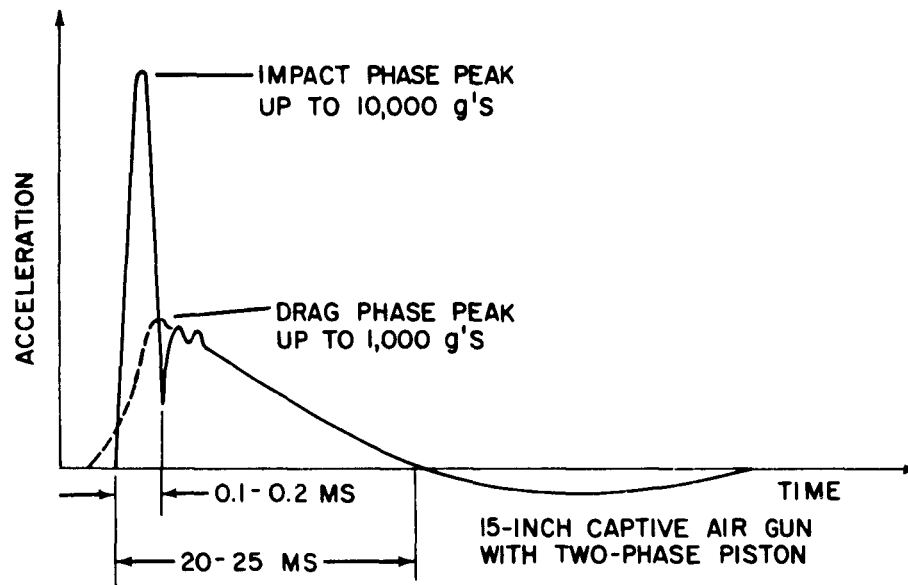


FIG. 1 5" HI-G AIR-GUN  
IDEALIZED ACCELERATION-TIME  
CURVES OF NOL CAPTIVE AIR-GUNS

the anvil by adjustable guides and held in place by springs. Upon release of the piston, the carriage immediately strikes the anvil and is held there by spring loaded fingers. This results in a steel-on-steel impact of high acceleration for a short duration similar to the first phase of water entry. The drag is simulated by the acceleration of the piston as it continues down the tube. The top curve of figure 1 is an idealized acceleration-time curve produced in the NOL 15-inch Air Gun using a two-phase piston. The bottom curve is an idealized acceleration-time curve produced using a single phase piston in the NOL 5-inch Hi-G Air Gun. By use of the NOL 5-inch Hi-G Air Gun impact phase pulses greater than 10,000 g can be simulated. More details on the air guns and water-entry simulation are given in reference (a).

#### TEST PROCEDURE

4. To test the transistors for ruggedness, seven levels of shock were chosen. The first three levels were obtained in the 15-inch Air Gun. In order to go to higher shock levels, it was necessary to use the 5-inch Hi-G Air Gun. This gun uses only single phase pistons; thus the last four levels are single phase shocks. Because the potted transistor is small and rigid, it is more responsive to high frequency shocks. The short duration impact shock excites these systems and their response is altered by the second or drag phase shock in the NOL 15-inch Air Gun using a two-phase piston in a manner thought to simulate water entry shock. The short rise time (less than .1 millisecond) high magnitude NOL 5-inch Hi-G Air Gun single phase pulse also excites these rigid systems and the sustained acceleration alters their response in much the same manner as true water-entry shock. Hence, the shift in simulation technique from two-phase to single-phase at shock level 4 is considered logical as well as practical. The following are the shock levels used:

- Level 1 - 20 feet per second velocity change impact phase with a 450 g peak drag phase
- Level 2 - 25 feet per second velocity change impact phase with a 500 g peak drag phase
- Level 3 - 30 feet per second velocity change impact phase with an 800 g peak drag phase
- Level 4 - 10,000 g peak
- Level 5 - 15,000 g peak

Level 6 - 20,000 g peak

Level 7 - 25,000 g peak

In the first three shock levels, the impact phase is given in terms of velocity change because the instrumentation to determine this in the air gun is much simpler than that required for acceleration. In the remainder of this report when reference is made to a shock level, it will be defined as above.

5. Normally in circuit design, one tries to obtain commercial components that meet the necessary electrical and environmental requirements. If there are shock limitations in the component, it is often possible to mount or support them in such a manner to meet the requirements at hand. After studying the electrical and mechanical characteristics of various potting compounds to determine if they meet the SONOBUOY environmental requirements, three methods for mounting the transistors for the NOL SONOBUOY were considered. It was decided to incorporate all three of these different mounting methods in the transistor shock test to obtain more data to aid in a final selection.

6. In the three potting methods, only two compounds were used: Dow Corning 601, which is a room temperature vulcanizing mixture, and low density polyethylene which is inserted around the components at 50 psi and 320°F. By making component holders from solid high density polyethylene stock and potting either the 601 or the low density polyethylene around them, two methods of mounting the transistors were effected. The third was to pot the transistors in the 601 without the holder. This can be done conveniently because of the room temperature characteristics of the Dow Corning 601.

7. The transistors were potted in available fuze containers. They were mounted in the polyethylene holders and wired to the base of the fuze can. Figure 2 shows the orientation and wiring of the transistors without the holder and the can removed. The reason for the different orientations was to determine if the transistors had a directional shock sensitivity. After they were mounted and wired in the can, they were potted in one of the three aforementioned ways. Figure 3 shows the potted units with the outer can removed.

8. When referring to the direction the transistor was shocked, the numbers associated with the arrows in figure 4 will be used. These illustrations of the internal structure give the direction of the shock (applied acceleration) with

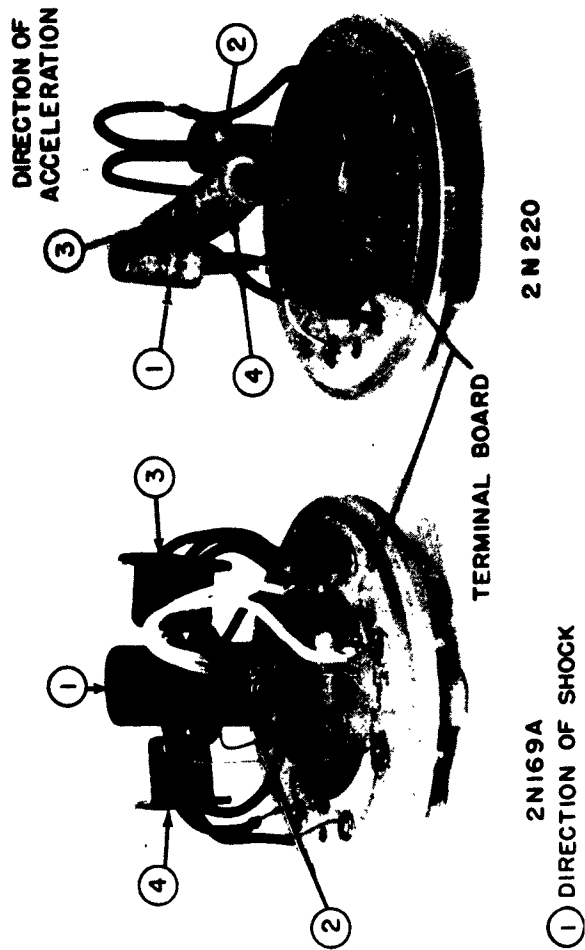


FIG. 2 ORIENTATION AND WIRING

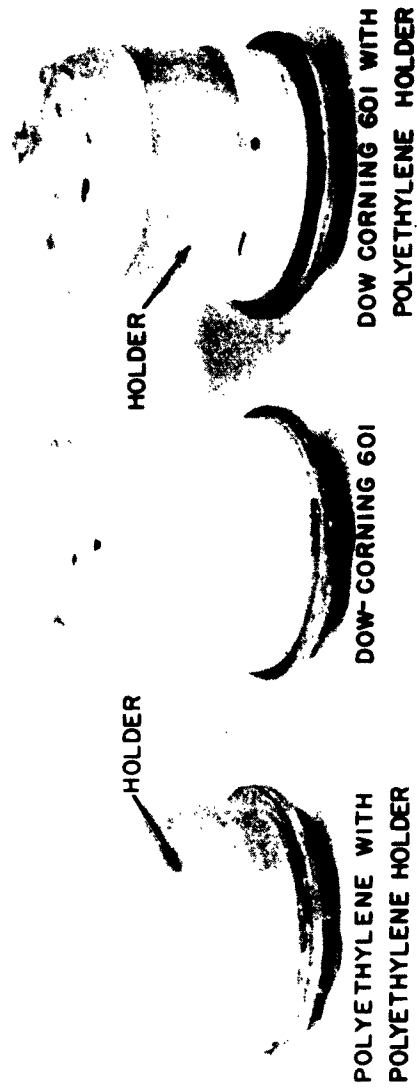


FIG. 3 POTTING METHODS

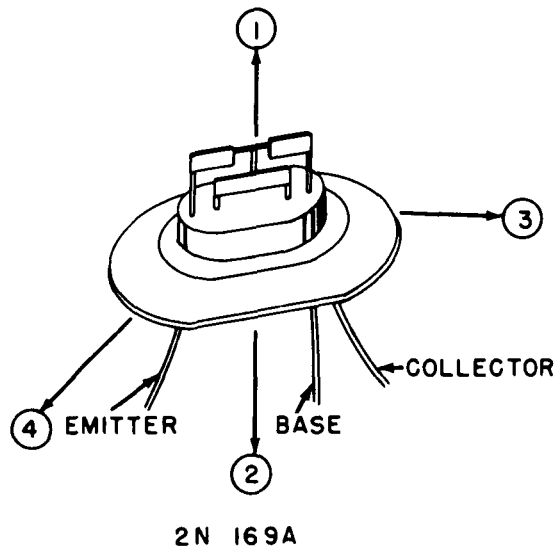
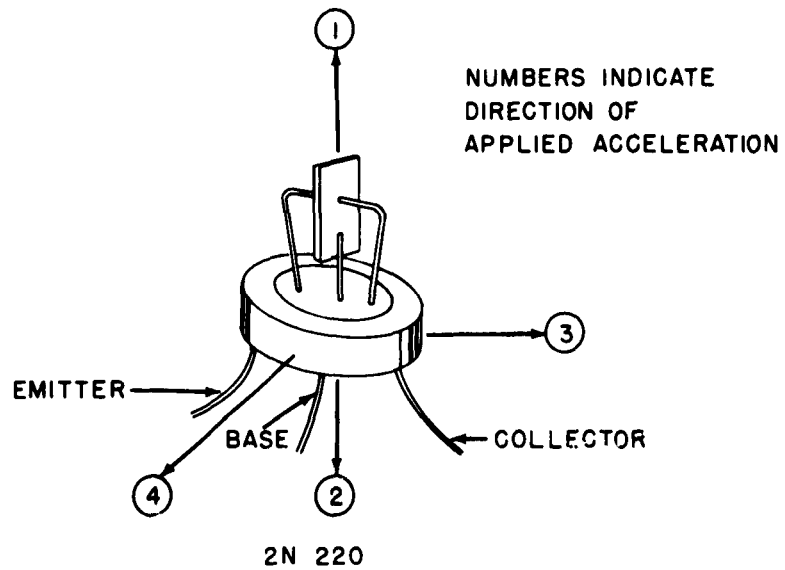


FIG. 4 TRANSISTORS (CASE REMOVED)

respect to the transistor's construction. They also give some ideas of how mechanical failure could occur with different directions in the two transistors shown.

9. Two factors were considered in the selection of the transistors to be tested: (1) their possible use in the SONOBUOY circuits, and (2) their availability from stock at NOL. Using these criteria, the following transistors were selected: 2N741, 2N700, 2N220 and 2N169A. Because the latter two were more plentiful, they were the most used in the program. These types do not cover all the transistor functions required in the SONOBUOY circuit. Other transistors were tested but their numbers were too small to obtain sufficient data for concrete conclusions.

10. The following tables give the way in which the transistors were divided as to direction, potting method, and type:

TABLE 1. POLYETHYLENE HOLDER WITH POLYETHYLENE POTTING  
DIRECTION OF ACCELERATION VS SAMPLE SIZE

| <u>Direction</u> | <u>2N169A</u> | <u>2N220</u> | <u>2N700</u> | <u>2N741</u> |
|------------------|---------------|--------------|--------------|--------------|
| 1                | 5             | 5            | 3            | 2            |
| 2                | 5             | 5            | 3            | 2            |
| 3                | 5             | 5            | 3            | 2            |
| 4                | <u>2</u>      | <u>2</u>     | <u>0</u>     | <u>0</u>     |
| Total Sample     | 17            | 17           | 9            | 6            |

TABLE 2. POLYETHYLENE HOLDER WITH DOW CORNING 601 POTTING  
DIRECTION OF ACCELERATION VS SAMPLE SIZE

| <u>Direction</u> | <u>2N169A</u> | <u>2N220</u> | <u>2N700</u> | <u>2N741</u> |
|------------------|---------------|--------------|--------------|--------------|
| 1                | 5             | 5            | 3            | 2            |
| 2                | 5             | 5            | 3            | 2            |
| 3                | 5             | 5            | 3            | 2            |
| 4                | <u>2</u>      | <u>2</u>     | <u>0</u>     | <u>0</u>     |
| Total Sample     | 17            | 17           | 9            | 6            |



TABLE 3. DOW CORNING 601 POTTING ONLY (NO HOLDER)  
DIRECTION OF ACCELERATION VS SAMPLE SIZE

| <u>Direction</u> | <u>2N169A</u> | <u>2N220</u> |
|------------------|---------------|--------------|
| 1                | 2             | 2            |
| 2                | 2             | 2            |
| 3                | 2             | 2            |
| 4                | <u>2</u>      | <u>2</u>     |
| Total Sample     | 8             | 8            |

This is a total sample of 114 transistors: 42, 2N169A; 42, 2N220; 18, 2N700; and 12, 2N741.

#### EVALUATION OF FAILURES

11. Because the SONOBUOY is not turned on until after water entry, the transistors are nonoperating during the shock. Thus, to determine the effect of the test, each transistor was checked prior to the shock series and after each shock. The transistors were not monitored during the shock tests. The checks were made using a Tektronix Model 575 curve tracer for the collector current and collector voltage family of curves. Significant deviation from the original curves was classified as failure. If there was insignificant change, the transistor was then subjected to the next shock level until the series of seven shocks was completed. Repeated shocks on the transistor could progressively weaken their shock resistance, but the number of transistors required to test unshocked samples each time was unreasonable for the information desired.

12. When a failure was detected by the curve tracer, the transistor was X-rayed in an effort to determine if it was an open circuit or short circuit type of failure. Further examination included removal of the case and a visual inspection. In general, this type of failure was not investigated too thoroughly because it was felt that the fact that it failed at a certain shock level was far more important than how it failed. This approach was taken because this was an "off-the-shelf" transistor ruggedness test program and not a design program.

### TEST RESULTS

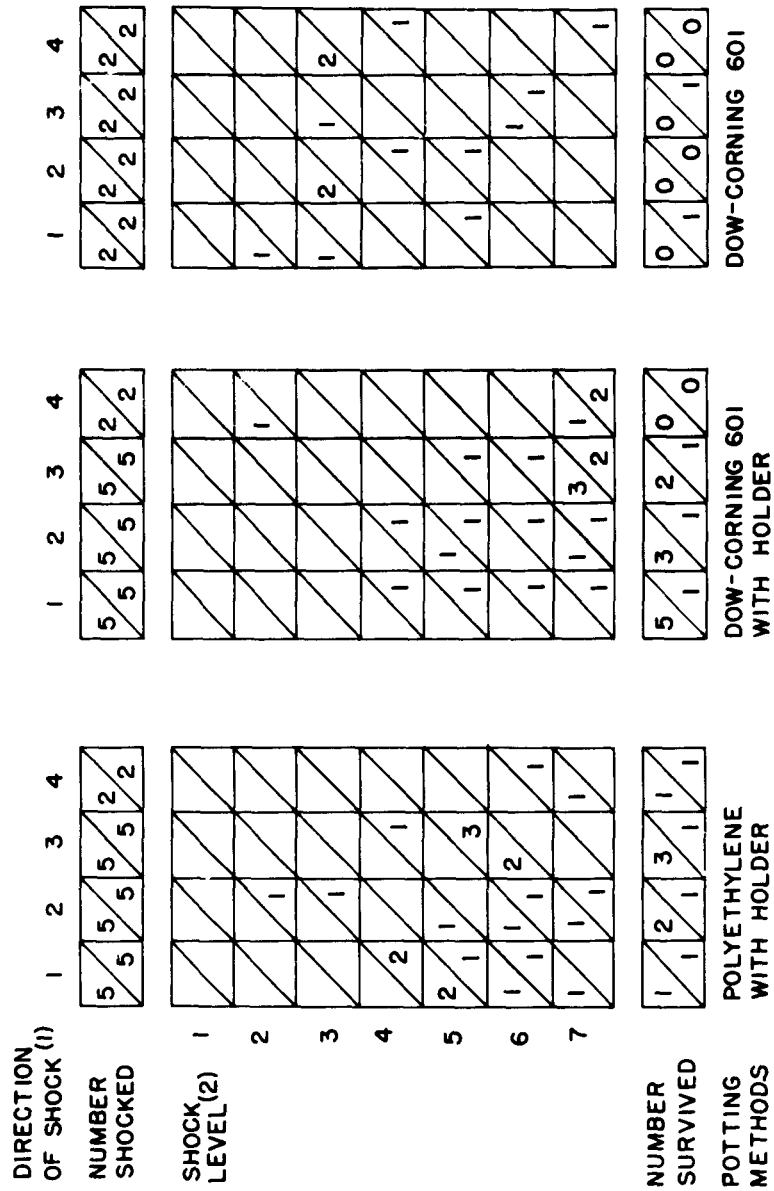
13. After completing the seven shock levels, there was only one 2N700 and one 2N741 that failed. Both failures were at the level seven shock. Because only two failed, no significant conclusion could be drawn about directional sensitivity or potting methods for these two transistor types. The important thing, however, is the fact that they withstood such high shock. Both types are high frequency transistors, small and light compared to the other two types tested. It is felt that this small size is the major factor accounting for their high shock resistance.

14. Since there were several failures in the 2N169A and the 2N220 samples, a few conclusions may be drawn from the results. Figure 5 is a table of the failures and the levels at which they occurred. Seventy-nine percent of the 2N220's and sixty percent of the 2N169A's had failed after the seventh shock level. All the failures were mechanical. Either the semiconductor junction cracked and separated, or there was a short due to a permanent displacement of the elements. Approximately 60% of the failures were open circuits and the remaining 40% were shorts.

### CONCLUSIONS

15. Figure 6 is a combined plot of the 2N220 and 2N169A failures versus potting and shock levels. It can be seen that a higher percentage of the failures occurs in the 601 alone at lower levels. The best potting method seems to be the polyethylene holder potted in Dow Corning 601. This type of potting creates a low frequency mounting system because the holder acts as a large rigid mass and the 601 acts as a very soft spring. This type of mount sees little of the high rise time shock of short duration.

16. There were no failures at the first shock level. This shock is slightly in excess of what is expected for the (NOL) SONOBUOY. Thus, all the transistors and mounting methods tested would be satisfactory for application in the buoy. But if improved shock resistance characteristics are necessary, this program has demonstrated that the smaller transistors are more shock resistant and that the polyethylene holder potted in Dow Corning 601 is the best mounting method of those tested.

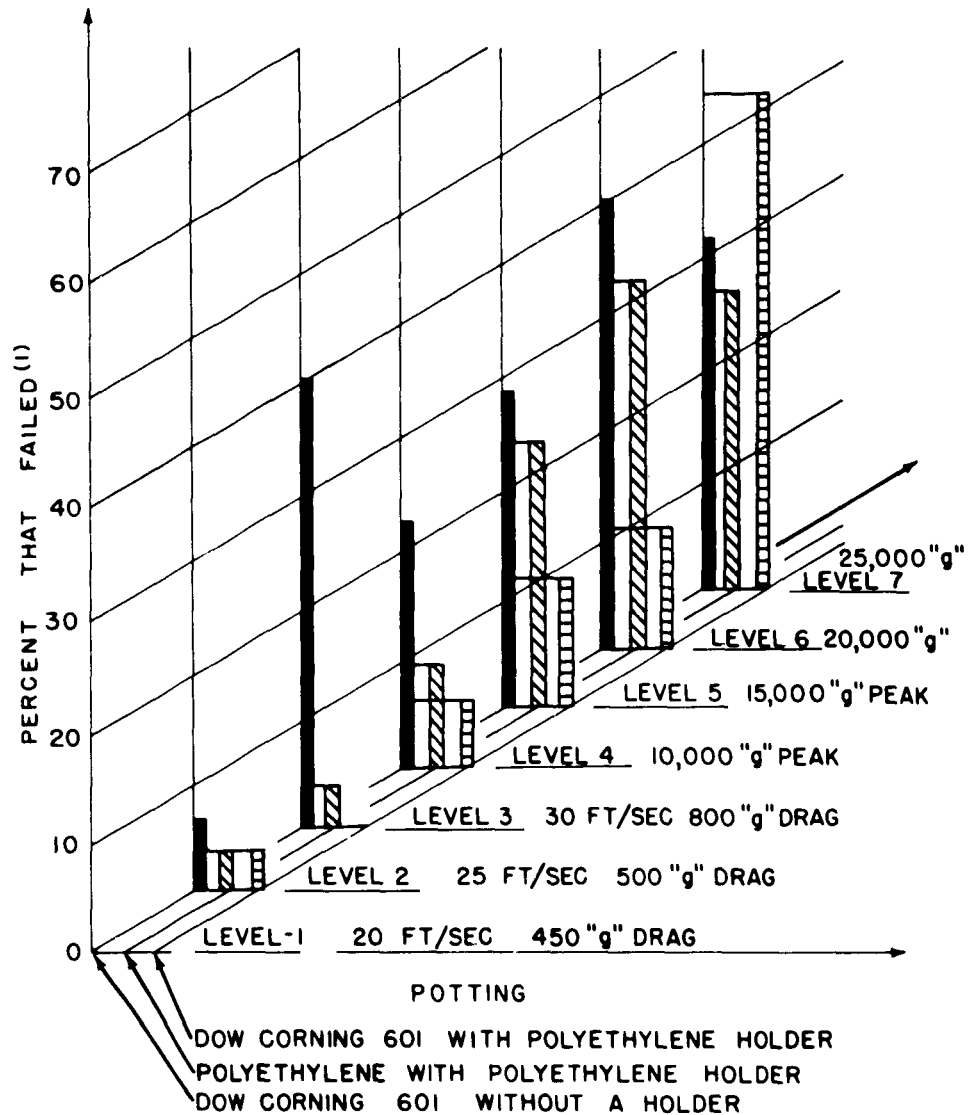


KEY: 2N169A 2N220 THE NUMBER OF FAILURES AT THAT SHOCK LEVEL DIRECTION

NOTE: (1) THE DIRECTION OF THE SHOCK IS AS DEFINED BY FIG. 4

(2) THE SHOCK LEVELS ARE DEFINED ON PAGE 3-4

FIG. 5 LIST OF FAILURES VS POTTING AND SHOCK LEVEL



NOTE (i) THE NUMBER SHOCKED AT EACH LEVEL DIFFERS BY THE NUMBER THAT FAILED AT THE PREVIOUS LEVEL. THIS IS THE COMBINED FAILURES OF THE 2N169A AND THE 2N220.

FIG.6 FAILURES VS POTTING AND SHOCK LEVEL

DISTRIBUTION

|                                                                                                                                                                                                             | Copies |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Chief, Bureau of Naval Weapons<br>Navy Department<br>Washington 25, D.C.<br>Attn: Library, DIS 3 (4 copies)<br>Code CU<br>Code RR<br>Code RREN<br>Code RRRE<br>Code RU<br>Code RUDC<br>Code RUVO<br>Code SP | 12     |
| Armed Services Technical Information Agency<br>Arlington Hall<br>Arlington, Virginia                                                                                                                        | 10     |
| Resident Inspector of Naval Material, Utica<br>c/o General Electric Corporation<br>French Road<br>Utica, New York                                                                                           |        |
| Commanding Officer<br>U. S. Naval Air Development Center<br>Johnsville, Pennsylvania                                                                                                                        |        |
| Commanding Officer<br>U. S. Naval Air Facility<br>APO 406<br>New York, New York                                                                                                                             |        |
| Commanding Officer<br>U. S. Naval Air Facility<br>Monterey, California                                                                                                                                      |        |
| Commanding Officer<br>U. S. Naval Engineering Experiment Station<br>Annapolis, Maryland                                                                                                                     |        |
| Commanding Officer<br>U. S. Naval Research Laboratory<br>Washington 25, D.C.                                                                                                                                |        |
| Commanding Officer and Director<br>David W. Taylor Model Basin<br>Carderock, Maryland                                                                                                                       |        |

DISTRIBUTION

Copies

Commander  
U. S. Naval Weapons Laboratory  
Dahlgren, Virginia

Commanding Officer  
U. S. Naval Weapons Station  
Yorktown, Virginia

Commanding Officer  
U. S. Fleet Anti-Submarine Warfare School  
San Diego 47, California

Commanding General  
Marine Corps Air Station  
Cherry Point, North Carolina

Commanding General  
Marine Corps Air Station  
El Toro  
Santa Ana, California

Commanding Officer  
U. S. Naval Parachute Facility  
El Centro, California

Commanding Officer  
U. S. Naval Underwater Ordnance Station  
Newport, Rhode Island

Commanding Officer  
U. S. Naval Weapons Evaluation Facility  
Kirtland Air Force Base  
Albuquerque, New Mexico

Bureau of Naval Weapons Representative  
c/o Westinghouse Electric Corporation  
P.O. Box 746  
Baltimore 3, Maryland

Bureau of Naval Weapons Representative  
Applied Physics Laboratory  
Johns Hopkins University  
8621 Georgia Avenue  
Silver Spring, Maryland

DISTRIBUTION

Copies

Bureau of Naval Weapons Representative  
Raytheon Manufacturing Company  
Waltham, Massachusetts

Commanding Officer  
U. S. Naval Ordnance Test Station  
China Lake, California

Commanding Officer  
U. S. Naval Ordnance Test Unit  
Naval Base  
Key West, Florida

Officer in Charge  
U. S. Naval Air Mine Defense Development Unit  
Panama City, Florida

Commander  
U. S. Naval Missile Center  
Point Mugu, California

Officer in Charge  
U. S. Naval Air Technical Services Facility  
700 Robbins Avenue  
Philadelphia 11, Pennsylvania

Commander  
U. S. Naval Air Test Center  
Patuxent River, Maryland

Commanding Officer  
U. S. Naval Aviation Engineering Service Unit  
U. S. Naval Air Material Center  
Philadelphia 12, Pennsylvania

Commanding Officer  
Office of Naval Research  
Branch Office  
207 West 24th Street  
New York 11, New York

Commanding Officer  
Office of Naval Research  
Branch Office  
495 Summer Street  
Boston 10, Massachusetts

DISTRIBUTION

Copies

Commanding Officer  
Office of Naval Research  
Branch Office  
The John Crerar Library Building  
Tenth Floor, 86 East Randolph Street  
Chicago 1, Illinois

Commanding Officer  
Office of Naval Research  
Branch Office  
1030 East Green Street  
Pasadena 1, California

Commanding Officer  
Office of Naval Research  
Branch Office  
1000 Geary Street  
San Francisco 9, California

Office of Chief of Naval Operations  
Operations Evaluation Group (OPO 3 E G)  
Washington 25, D.C.

Defense Atomic Support Agency  
Washington 25, D.C.

2

Office of Naval Research  
Washington 25, D.C.  
Code 323

2



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Naval Ordnance Laboratory, White Oak, Md.<br/>(MOL technical report 63-43)<br/>TRANSISTOR WATER ENTRY SHOCK RESISTANCE SURVEY FOR RUGGEDIZED SONOBUOY (U), by Ralph E. Tabler. 26 Feb. 1963. 12p. illus., diagr., tables. Task RUDC-2B00/212 1/FOO1 13 002.</p> <p>UNCLASSIFIED</p> <p>Transistor types 2N169A, 2N220, 2N200, and 2N741 were tested for resistance to water-entry shock. 147 transistors were mounted in one of three ways: (1) polyethylene holder and potted in polyethylene, (2) polyethylene holder and potted in Dow-Corning 601, and (3) potted in Dow-Corning 601 alone. The polyethylene holder and the 601 potting proved the best mounting methods. All transistors proved sufficiently rugged to survive the water-entry shock expected in service use of the MOL free fall miniature SONOBUOY.</p> | <ol style="list-style-type: none"> <li>1. Sonobuoys</li> <li>2. Transistors - Water entry</li> <li>3. Transistors - Shock tests</li> </ol> <p>I. Title<br/>II. Tabler, Ralph E.<br/>III. Project</p> <p>Abstract card is unclassified.</p> |
| <p>Naval Ordnance Laboratory, White Oak, Md.<br/>(MOL technical report 63-43)<br/>TRANSISTOR WATER ENTRY SHOCK RESISTANCE SURVEY FOR RUGGEDIZED SONOBUOY (U), by Ralph E. Tabler. 26 Feb. 1963. 12p. illus., diagr., tables. Task RUDC-2B00/212 1/FOO1 13 002.</p> <p>UNCLASSIFIED</p> <p>Transistor types 2N169A, 2N220, 2N200, and 2N741 were tested for resistance to water-entry shock. 147 transistors were mounted in one of three ways: (1) polyethylene holder and potted in polyethylene, (2) polyethylene holder and potted in Dow-Corning 601, and (3) potted in Dow-Corning 601 alone. The polyethylene holder and the 601 potting proved the best mounting methods. All transistors proved sufficiently rugged to survive the water-entry shock expected in service use of the MOL free fall miniature SONOBUOY.</p> | <ol style="list-style-type: none"> <li>1. Sonobuoys</li> <li>2. Transistors - Water entry</li> <li>3. Transistors - Shock tests</li> </ol> <p>I. Title<br/>II. Tabler, Ralph E.<br/>III. Project</p> <p>Abstract card is unclassified.</p> |
| <p>Naval Ordnance Laboratory, White Oak, Md.<br/>(MOL technical report 63-43)<br/>TRANSISTOR WATER ENTRY SHOCK RESISTANCE SURVEY FOR RUGGEDIZED SONOBUOY (U), by Ralph E. Tabler. 26 Feb. 1963. 12p. illus., diagr., tables. Task RUDC-2B00/212 1/FOO1 13 002.</p> <p>UNCLASSIFIED</p> <p>Transistor types 2N169A, 2N220, 2N200, and 2N741 were tested for resistance to water-entry shock. 147 transistors were mounted in one of three ways: (1) polyethylene holder and potted in polyethylene, (2) polyethylene holder and potted in Dow-Corning 601, and (3) potted in Dow-Corning 601 alone. The polyethylene holder and the 601 potting proved the best mounting methods. All transistors proved sufficiently rugged to survive the water-entry shock expected in service use of the MOL free fall miniature SONOBUOY.</p> | <ol style="list-style-type: none"> <li>1. Sonobuoys</li> <li>2. Transistors - Water entry</li> <li>3. Transistors - Shock tests</li> </ol> <p>I. Title<br/>II. Tabler, Ralph E.<br/>III. Project</p> <p>Abstract card is unclassified.</p> |
| <p>Naval Ordnance Laboratory, White Oak, Md.<br/>(MOL technical report 63-43)<br/>TRANSISTOR WATER ENTRY SHOCK RESISTANCE SURVEY FOR RUGGEDIZED SONOBUOY (U), by Ralph E. Tabler. 26 Feb. 1963. 12p. illus., diagr., tables. Task RUDC-2B00/212 1/FOO1 13 002.</p> <p>UNCLASSIFIED</p> <p>Transistor types 2N169A, 2N220, 2N200, and 2N741 were tested for resistance to water-entry shock. 147 transistors were mounted in one of three ways: (1) polyethylene holder and potted in polyethylene, (2) polyethylene holder and potted in Dow-Corning 601, and (3) potted in Dow-Corning 601 alone. The polyethylene holder and the 601 potting proved the best mounting methods. All transistors proved sufficiently rugged to survive the water-entry shock expected in service use of the MOL free fall miniature SONOBUOY.</p> | <ol style="list-style-type: none"> <li>1. Sonobuoys</li> <li>2. Transistors - Water entry</li> <li>3. Transistors - Shock tests</li> </ol> <p>I. Title<br/>II. Tabler, Ralph E.<br/>III. Project</p> <p>Abstract card is unclassified.</p> |