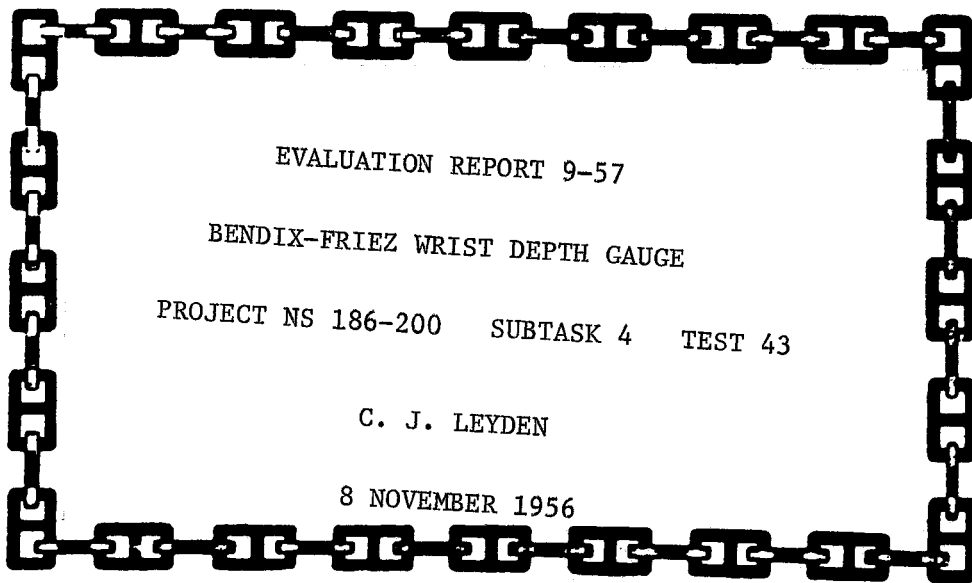


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EVALUATION REPORT 9-57

BENDIX-FRIEZ WRIST DEPTH GAUGE

PROJECT NS 186-200 SUBTASK 4 TEST 43

C. J. LEYDEN

8 NOVEMBER 1956

AD #780415

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ABSTRACT

This report covers the evaluation of the Bendix-Friez Wrist Depth Gauge to determine the ability of the gauge to meet the accuracy and visibility specifications as outlined by the Bureau of Ships to depths of 200 feet.

The gauge was tested objectively by chamber depth runs to 200 feet with instrumentation for recording true depth. The gauge was tested subjectively by the use of a subject in a completely darkened tank filled with 8 feet of water.

The results are discussed constructively and lead to specific conclusions about the apparatus and its suitability for acceptance by the Bureau of Ships.

SUMMARY

PROBLEM

Is the Bendix-Friez Wrist Depth Gauge accurate enough to meet the specifications as outlined by the Bureau of Ships?

What is the degree of visibility of the luminous dial?

FINDINGS

- (1) The accuracy of the gauge's depth readings does not successfully meet the specifications of the Bureau of Ships.
- (2) The dial of the gauge is readable in a completely darkened tank at a distance of 10 to 14 inches.

ADMINISTRATIVE INFORMATION

On 1 October 1956, Mr. Draper of BuShips, Code 538, delivered by hand a Bendix-Friez Wrist Depth Gauge, serial #1, for testing to determine conformance to purchase specifications. Work at the Experimental Diving Unit was performed under the continuing project NS 186-200, Subtask 4, Test 43 entitled "Miscellaneous Swimmer's Auxiliary Equipment"

Magnetic signature testing and shock testing called for in the specifications was carried on under the direction of the Bureau of Ships and is not covered in this report.

C. J. LEYDEN, BMI(DV), USN was designated project engineer. Work commenced 8 October and was completed 18 October 1956.

The following breakdown indicates the manpower requirements expended for this project:

<u>DESCRIPTION</u>	<u>MANHOURS</u>
Instrumentation	5
Five depth runs	15
Drafting	2
Reporting	8
	<hr/>
TOTAL	30

This manuscript was submitted for review on 8 November 1956 and was accepted on 9 November 1956. This report is issued in the Evaluation Report series, distributed only by the Bureau of Ships.

1. OBJECT

1.1 Objective

1.1.1 The objective of this project is twofold, namely:

- (1) Check the accuracy of the gauge's depth reading by conducting test dives in accordance with criteria set forth in the specifications.
- (2) Ascertain the degree of visibility of the luminous dial by using the depth gauge in a totally or partially darkened tank.

1.2 Scope

1.2.1 This report covers specification testing and reporting. This evaluation includes objective depth runs to 200 feet, in accordance with the criteria set forth in the specification, and subjective luminosity tests in a darkened tank.

1.3 Background

1.3.1 The subject depth gauge was manufactured by the Bendix-Friez Corporation in accordance with BuShips' "Tentative Specification, Gauge, Depth, Wrist" undated. The instrument was previously tested by the manufacturer.

2. DESCRIPTION

2.1 General

2.1.1 The Bendix-Friez depth gauge is circular in shape, having a diameter of 2 inches and a thickness of 1 inch. The weight of the gauge, including the wrist strap and rubber protector, is approximately 5.28 ounces. The casing is made of brass. The face of the gauge has the numbers 1 through 20 inscribed on the underside of the glass face under which is a luminous ring.

2.1.2 The gauge conforms to the following manufacturer's blueprints:

XAV-70822	WRIST PRESSURE GAGE ASSEMBLY
X-S-71242	DIAL ASSEMBLY

3. PROCEDURE

3.1 Depth Runs

3.1.1 For these tests, the Bendix-Friez Wrist Depth Gauge was placed in a beaker of water and placed in the recompression chamber opposite a port so as to be visible from the outside. A 0 to 220 degree farenheit thermometer was suspended in the beaker so as to be visible from the outside.

3.1.2 After arranging the apparatus in the chamber, the chamber door was closed. The chamber was then taken down to a depth of 200 feet, stopping every ten feet with the wrist gauge controlling the stops. Upon reaching 200 feet, the chamber was brought to the surface reversing the

foregoing procedure. Again the wrist gauge controlled the stops.

3.2 Depth Run Instrumentation

3.2.1 A large mercury manometer having one side connected to the chamber was used to record the true depth for all stops up to and including the 100 foot stop. From 100 to 200 feet, the chamber depth gauge (with readings corrected in accordance with the calibration curve) was used to record the true depth of all stops.

3.2.2 At each ten foot stop the following information was recorded:

- (1) Depth reading of the wrist gauge
- (2) True depth as calculated from either the mercury manometer or chamber depth gauge readings.
- (3) Ambient temperature

3.3 Luminosity Run

3.3.1 For this test a subject was placed in a completely darkened tank filled with 8 feet of water. The subject wore the wrist gauge on his left wrist.

3.4 Conversion Data

3.4.1 Since the Bendix-Friez wrist depth gauge is calibrated in depth of sea water with a specific gravity of 1.025, it was necessary to convert all readings. Conversion data is as follows:

- (1) Using the formula (pressure (in Hg) x 1.107 = feet of sea water)(s.g. 1.025) the mercury manometer readings in inches were converted to feet of sea water (specific gravity 1.025)).
- (2) Using the formula (depth in feet x 1.003 = feet of sea water) (s.g. 1.025) the chamber depth readings were converted to feet of sea water (specific gravity 1.025)).

4. RESULTS

4.1 Depth Runs

4.1.1 The tabulated results of the five depth runs are presented in Table 1-a on the following page. The table shows the tabulated error for each run and the average error of the five runs in feet of sea water (specific gravity 1.025). The table also shows the average ambient temperature of each run.

4.2 Luminosity Run

4.2.1 In a completely darkened tank the wrist gauge is readable at a distance of approximately 10 to 14 inches.

5. DISCUSSION

5.1 Depth Runs

5.1.1 Paragraph 3.4 of the specification criteria states, "The pressure mechanism and indicating dial shall be such that at any instant and at any dial position the depth of sea water will be indicated with an accuracy of plus or minus 1 foot in the 0 to 50 foot range; and with an accuracy of plus or minus 3 foot in the 50 to 200 foot range." Table 1-a shows that the gauge remained within the specification limits until the 30 foot stop on ascent was reached. The 30, 20, and 10 foot stops show that the gauge exceeds the specification limit of plus or minus 1 foot in the 0 to 50 foot range.

5.2 Luminosity Run

5.2.1 The results of the luminosity run indicate that the luminosity of the gauge is sufficient for the dial to be readable in complete darkness.

6. CONCLUSIONS

6.1 Accuracy

6.1.1 The accuracy of the Bendix-Friez Wrist Depth Gauge does not meet the specifications as outlined by the Bureau of Ships (5.1.1).

6.2 Visibility

6.2.1 The visibility of the Bendix-Friez Wrist Depth Gauge is adequate for the gauge to be read in complete darkness (5.2.1).

TABULATED DATA OF ACCURACY TESTS

DEPTH READING OF WRIST GAUGE	RUN I	RUN II	RUN III	RUN IV	RUN V	AVERAGE ERROR	AVERAGE AMBIENT TEMPERA.
0	0	+1	+1	+1	+1	+1.0	80°F
10	-.70	-1.36	-1.14	-.26	-1.09	-.91	"
20	-.11	-.74	-.85	+.04	-.74	-.48	"
30	+.28	-.11	-.45	+.33	-.17	-.004	"
40	+.90	+.63	-.10	+.96	+.41	+.56	"
50	+1.03	+.65	+.26	+2.14	+.92	+1.0	"
60	+1.16	+.94	.63	+1.55	+1.11	+1.08	"
70	+1.18	+.79	+.57	+1.73	+1.12	+1.08	"
80	+.64	+.87	+.70	+1.59	+1.09	+.98	"
90	+.61	+.56	+.22	+1.33	+.88	+.92	"
100	+.52	+.52	+.18	+1.24	+.63	+.82	"
110	+.23	-.67	+.33	+.33	-.17	+.01	"
120	+.48	-1.65	-.64	-.64	-.64	-.62	"
130	+.29	-1.62	-.31	-.61	-.61	-.57	"
140	+.42	-1.58	-.58	-.58	-.58	-.58	"
150	+.35	-1.56	-.55	-.55	-.55	-.57	"
160	-.59	-1.53	-.51	-.52	-1.02	-.83	"
170	+.51	-1.50	-.49	-1.50	-1.50	-.90	"
180	-.06	-1.47	-1.47	-1.47	-1.47	-1.19	"
190	-.43	-1.44	-2.44	-2.44	-1.94	-1.73	"
200	-.90	-2.41	-2.40	-2.41	-2.41	-2.11	"
190	-1.44	-1.44	-2.44	-2.44	-2.44	-2.04	"
180	-1.47	-1.47	-2.47	-2.47	-2.47	-2.07	"
170	-1.50	-1.50	-2.50	-2.50	-2.50	-2.10	"
160	-1.53	-1.53	-1.53	-2.53	-2.53	-1.93	"
150	-1.54	-1.56	-1.56	-1.56	-1.56	-1.56	"
140	-1.59	-1.59	-1.59	-1.59	-1.59	-1.59	"
130	-1.62	-1.62	-1.62	-1.67	-.61	-1.43	"
120	-1.65	-1.65	-.64	-1.65	-.64	-1.25	"
110	-.67	-.67	-.67	-.67	+.33	-.47	"
100	-1.37	+1.25	-1.81	-.92	-.92	-1.05	"
90	-1.16	-1.21	-1.55	-1.66	-1.00	-1.12	"
80	-.05	-.79	-1.28	-.63	-.90	-.73	"
70	-1.09	-.87	-1.36	+.52	-.37	-.63	"
60	-.78	-.55	-1.32	-.06	-.11	-.56	"
50	-.73	-.74	-1.40	-.02	-.41	-.66	"
40	-.64	-1.25	-1.48	-.59	+.35	-.72	"
30	-1.27	-1.00	-1.44	-.66	-1.11	-1.10	"
20	-1.24	-1.24	-1.57	-1.07	-1.29	-1.28	"
10	-1.59	-1.25	-2.36	-1.70	-.74	-1.53	"
0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	"

NOTE: An average error of sign negative indicates wrist depth gauge reading greater than true depth. Apply average error algebraically to wrist depth gauge reading to obtain true depth.

TABLE 1-a

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Evaluation Report 9-57	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Bendix-Friez Wrist Depth Gauge		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. J. Leyden		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Experimental Diving Unit Washington Navy Yard Washington, D.C. 20374		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NS186-200, Sub. 4, Test 43
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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Diving Equipment Evaluation		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report covers the evaluation of the Bendix-Friez Wrist Depth Gauge to determine the ability of the gauge to meet the accuracy and visibility specifications as outlined by the Bureau of Ships to depths of 200 feet. The gauge was tested objectively by chamber depth runs to 200 feet with instrumentation for recording true depth. The gauge was tested subjectively by the use of a subject in a completely darkened tank filled with 8 feet of water.		