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TEST AND EVALUATION OF RIX PORTABLE HIGH-PRESSURE AIR COMPRESSO--ETC(U)
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NAVY EXPERIMENTAL DIVING UNIT

Report 6-77

TEST AND EVALUATION OF RIX PORTABLE HIGH-PRESSURE AIR COMPRESSOR

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Panama City, Florida 32407

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Amperage

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

The Rix portable, oil-free, axial piston, high-pressure air compressor, model 153B-3 was tested and evaluated by the Navy Experimental Diving Unit.

The unit failed before completion of one test cycle and is not recommended for Navy approval.

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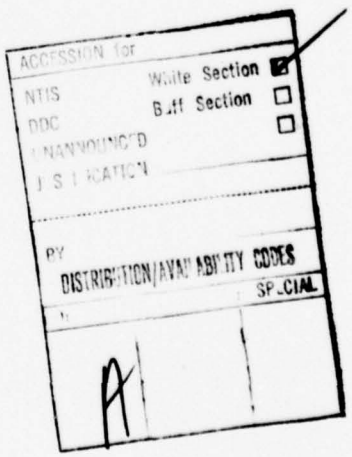

LIST OF ILLUSTRATIONS

ABSTRACT

The Rix portable axial-piston, oil-free, high-pressure air compressor, model 153B-3 was tested and evaluated by the Navy Experimental Diving Unit to determine its suitability for Navy use.

The test was terminated before one complete test cycle because the second stage suction valve spring fragmented after 33 hours of use.

The compressor is unsatisfactory in its present configuration and is not recommended for Navy approval.

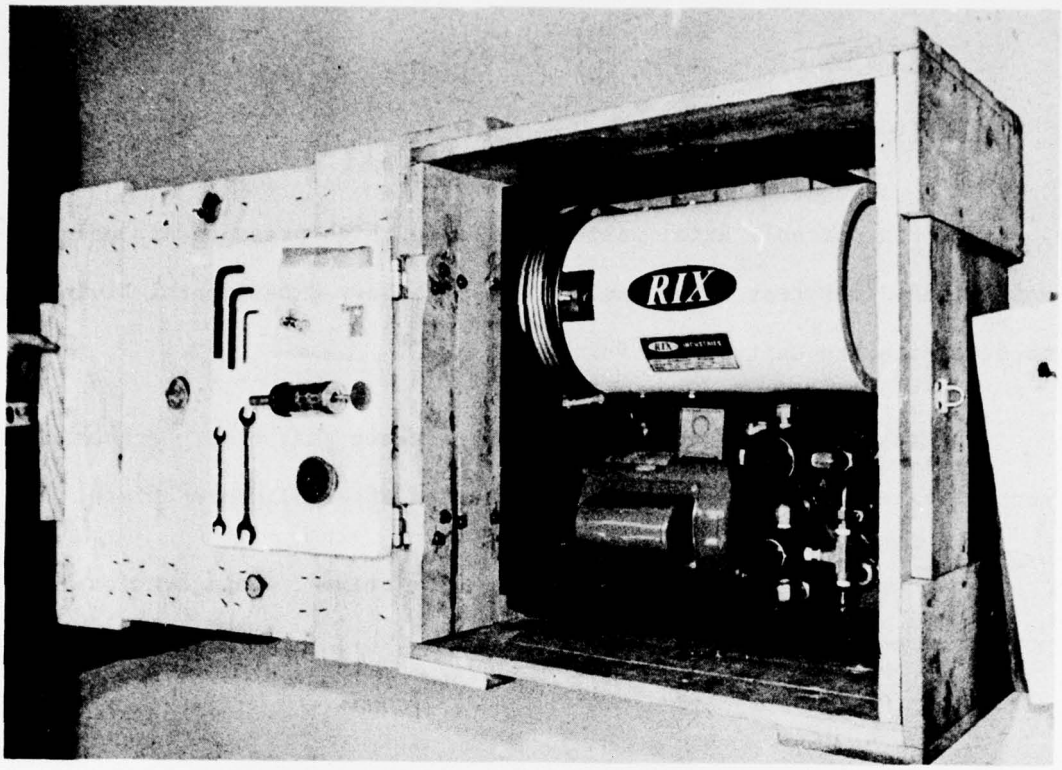

FIGURE 1. RIX PORTABLE AIR COMPRESSOR, MODEL 153B-3, AS RECEIVED FROM MANUFACTURER

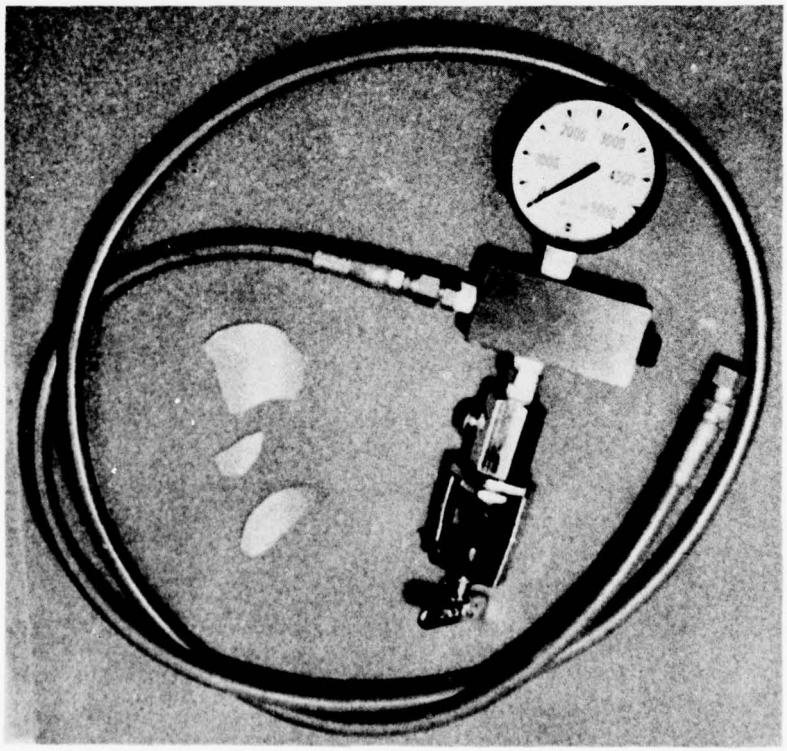

FIGURE 2. CHARGING HOSE FOR RIX PORTABLE AIR COMPRESSOR AS RECEIVED FROM MANUFACTURER

INTRODUCTION

By direction of the Naval Sea Systems Command (Code 00C), letter serial 1538, the Rix oil-free, axial-piston, high-pressure air compressor, model 153B-3 (see Figures 1 and 2) was tested by the Navy Experimental Diving Unit. This air compressor is manufactured by Rix Industries of Emeryville, California.

The Rix model 153B-3 air compressor is a hand-carried unit that provides high-pressure air for purposes such as on-site filling of scuba tanks, rescue air tanks, and remote air sampling. The axial-piston design incorporates a swash plate that converts shaft rotary motion to reciprocating motion to drive the piston. Because no oils or lubricants are in the cylinder or piston area, air p[illegible] depends solely on the operating environment. Two moisture separator[illegible] a back pressure regulator provide moisture separation from the compressed air. All components are mounted on a single stand equipped with carrying handles. Compressor specifications are given in Appendix C.

TEST PROCEDURE

Upon receipt of the Rix portable air compressor (Figures 1 and 2), an air sample was taken and submitted to Naval Coastal Systems Laboratory (NCSL) for analysis. The compressor was then operated for 6 hours, discharging to the atmosphere, and a second air sample was taken and submitted for analysis.

As specified by the manufacturer, the air compressor was operated in its normal upright position away from gasoline engines or other sources of contamination.

The test procedures were performed in accordance with the test plan presented in Appendix A.

TEST EQUIPMENT

The following test equipment was required for test and evaluation of the Rix oil-free, axial-piston air compressor (see Figures 3, 4, and 5).

a. Thermistor YSI, and meter Model 44TD, serial No. 1946.

b. Laminar flow element, Meriam Model, 50MW20-2.

c. Volt-ohm-microammeter, Simpson Model 269-AF.

d. AC ampmeter adapter, clamp on, Simpson Model 150.

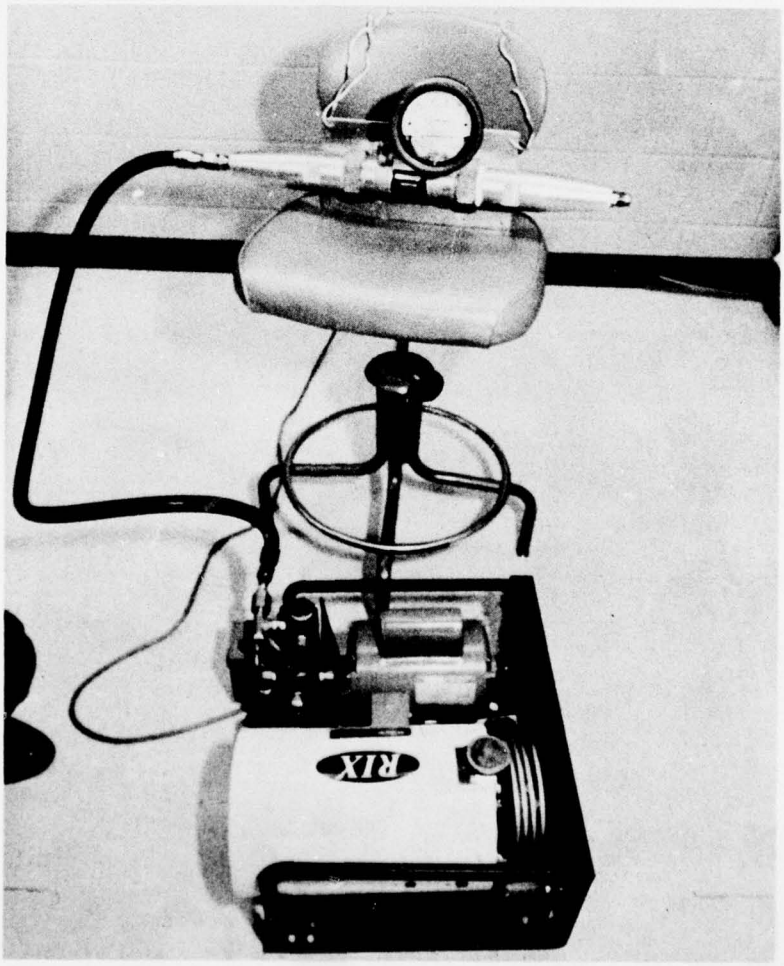

FIGURE 3. TEST SETUP FOR MEASURING FLOW RATE

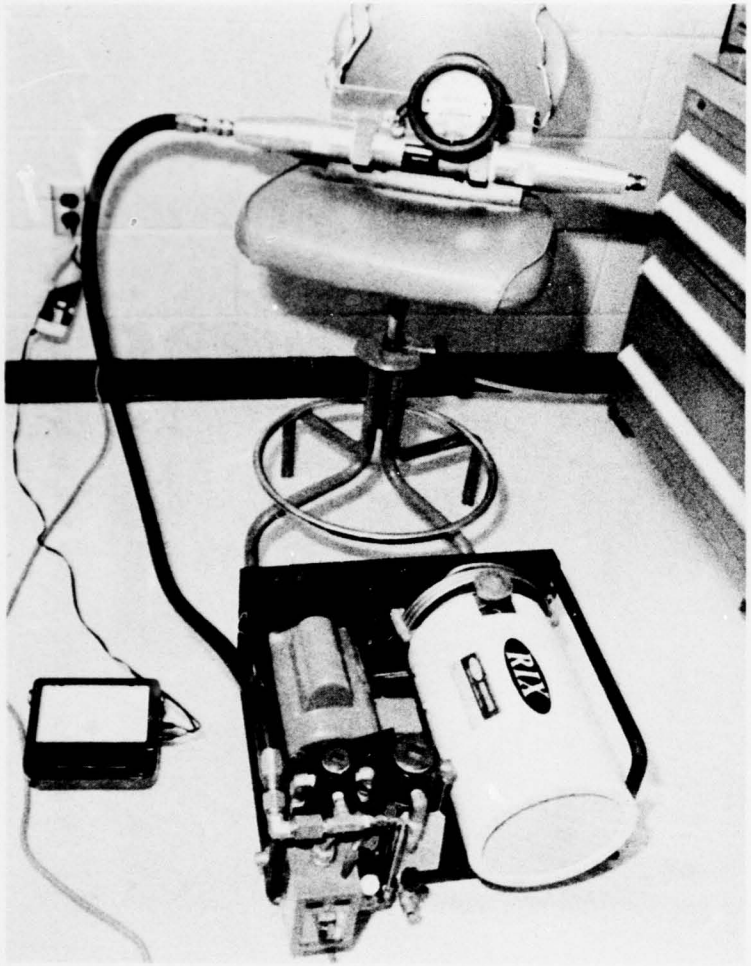

FIGURE 4. TEST SETUP FOR MEASURING AMPERAGE

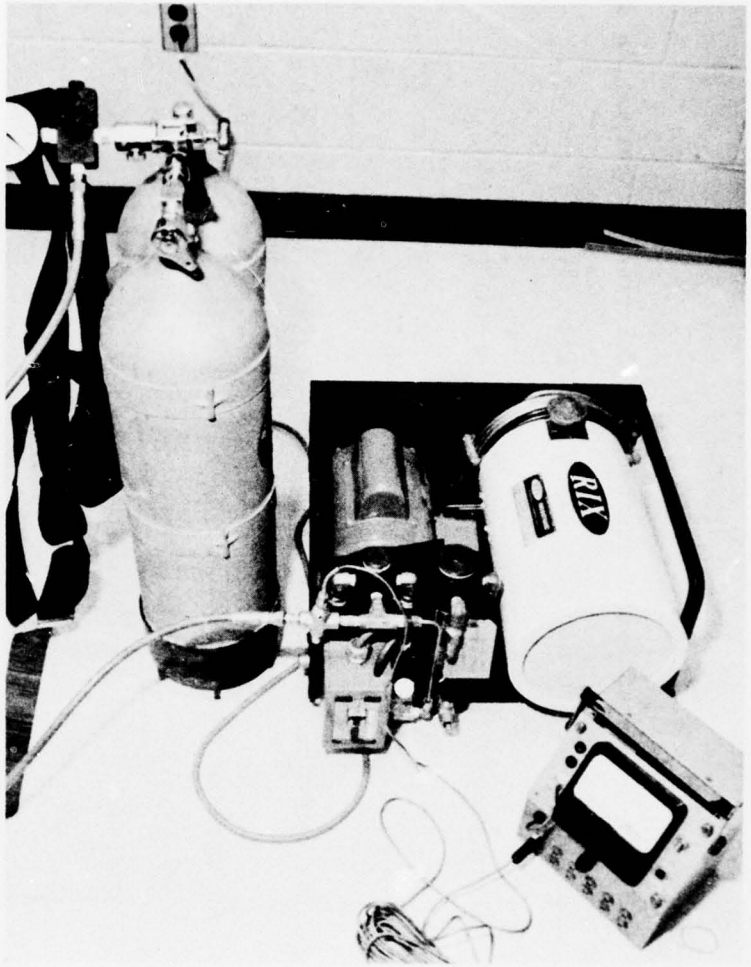

FIGURE 5. TEST SETUP FOR MEASURING DISCHARGE TEMPERATURE

RESULTS AND DISCUSSION

The Rix portable air compressor was powered from a conventional 115-volt, 60-Hz power outlet capable of 20-amp service.

When the air compressor was received, an air sample was obtained and submitted to NCSL for analysis. Results of the analysis, although within acceptable limits, showed contamination from halogenated hydrocarbons, probably from a cleaning solvent used at the factory. Results of this analysis are given in Appendix C.

After 6 hours of operation with the compressor discharging to atmosphere, a second air sample was obtained and submitted for analysis. This sample, with no traces of cleaning solvent, was well within acceptable limits for breathing air. Results of the analysis of the second air sample are also given in Appendix C.

Beginning with the second day of test, the compressor was set up as shown in Figures 3, 4, and 5. Flow was measured at 2.2 acfm (absolute cubic feet per minute) under no load. After 7 hours and 52 minutes of operation, the compressor was drawing more than 20 amps of current, causing the building circuit breaker to trip repeatedly as higher pressures were attained. The electrical plug and cord were not rated for more than 20 amps; therefore, they were replaced with a 10-gauge wire cord and a plug compatible with the building circuitry. The test was continued with a 30-amp circuit breaker.

After operation for 10 hours and 1 minute, the charging hose was found to be leaking back under the jacket, causing the jacket to embolize. The hose was replaced and the test was continued.

On the sixth day of testing, rain made it necessary to move the compressor and test equipment indoors. The rain revealed that the electric motor and switch are not splash proof. In addition, the air inlet filter design permits rain or salt spray to be introduced into the first stage inlet. The unit, therefore, is not satisfactory for use where it will be exposed to precipitation or salt spray.

The first stage relief valve began to lift intermittently after 27 hours and 33 minutes of operation. Although the charging rate did not change, the amperage fluctuated each time the relief valve lifted. On the seventh day of test, the relief valve continued to lift, and, after 34 hours and 13 minutes of operation, lifting was almost continuous and the charging rate was reduced to 1.9 acfm. At this time, the compressor was stopped and the manufacturer was notified of the problem. At the direction of the manufacturer, the second stage head was removed and the suction valve was inspected. The second stage suction valve spring had broken into five sections, one of which was lodged between the second stage piston head and cylinder (see Figures 6 through 9).

The test was terminated and the compressor was reassembled hand-tight with the second stage suction valve still removed. The entire unit was then returned to the manufacturer.

Analysis of test results showed that the air compressor average charge rate was 2.383 acfm, the average amperage load was 20.8 amps, and the average temperature differential between inlet and outlet was 26.165 degrees F. The first, second, and third stage relief valves operated within the manufacturer's specifications.

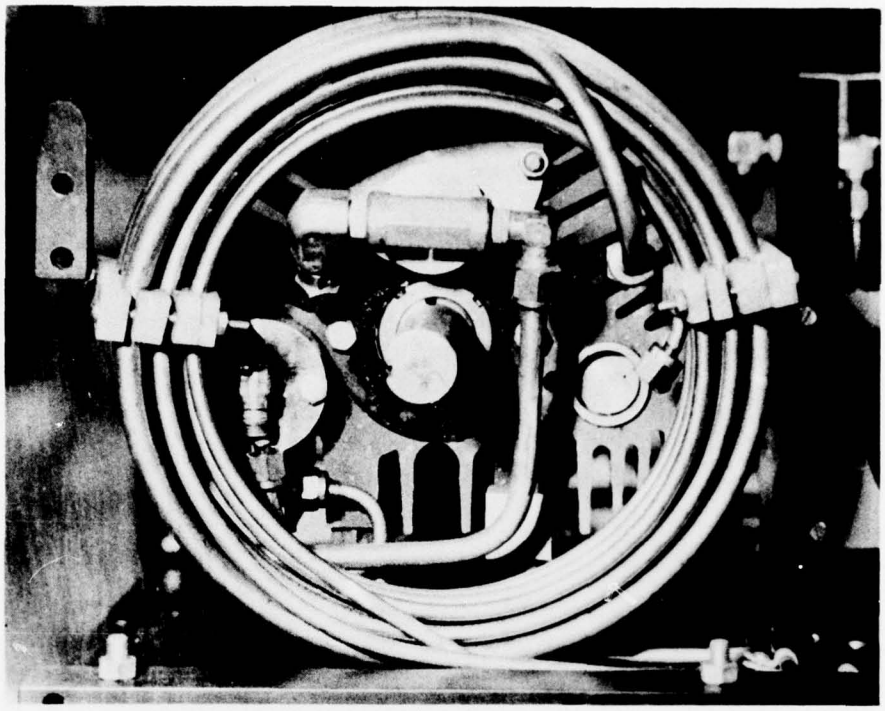

FIGURE 6. SECOND STAGE HEAD REMOVED

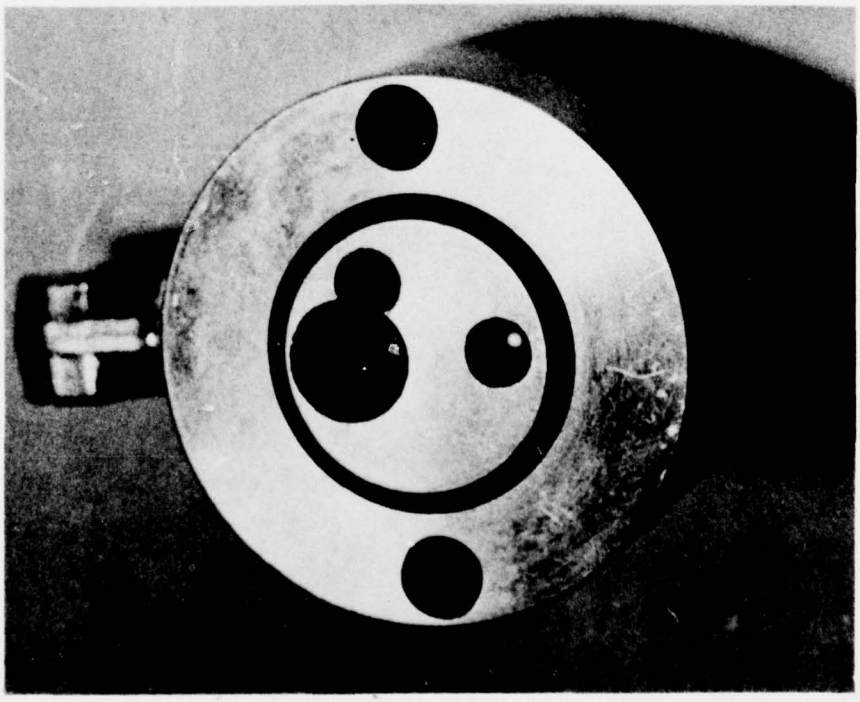

FIGURE 7. SECOND STAGE HEAD

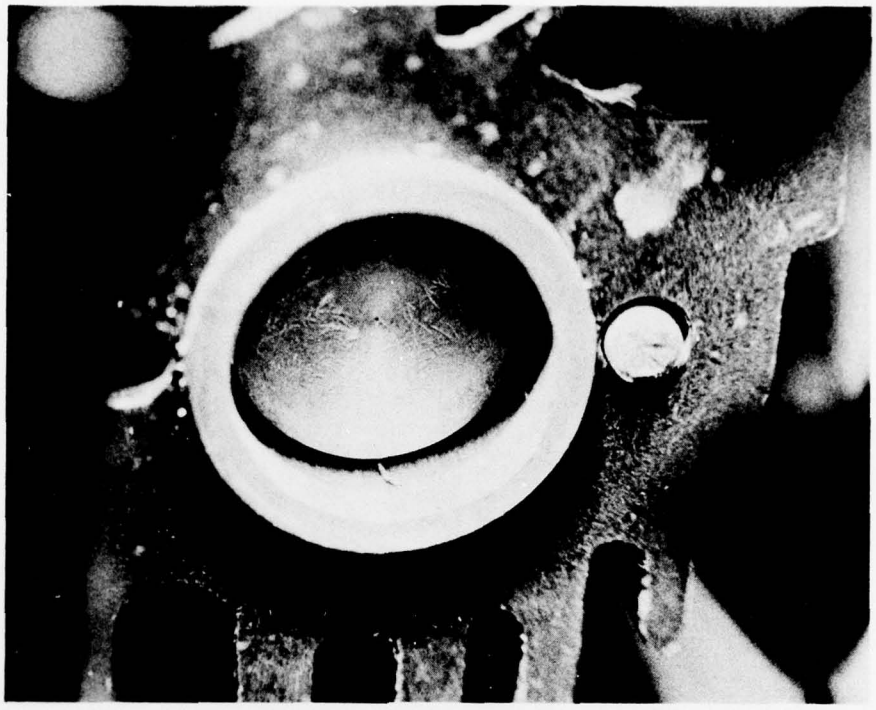

FIGURE 8. SECOND STAGE CYLINDER AND PISTON

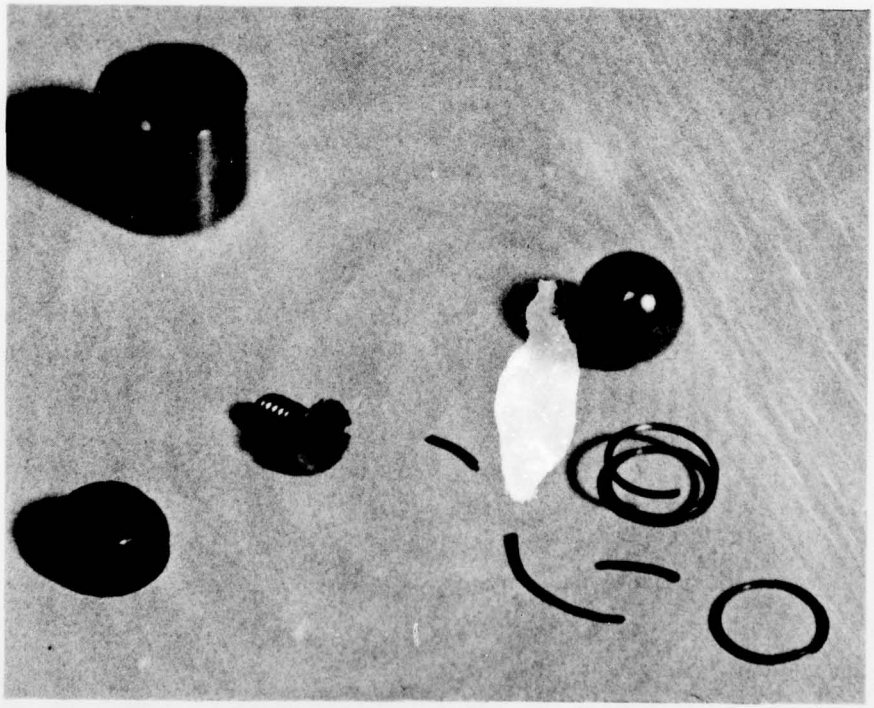

FIGURE 9. SECOND STAGE SUCTION VALVE

CONCLUSIONS AND RECOMMENDATIONS

Results of the test of the Rix portable high-pressure air compressor revealed the following deficiencies.

a. The present 14-gauge wiring is not rated for more than 20-amp service.

b. The electric motor and switch are not splash-proof.

c. The intake filter does not provide adequate protection against moisture being drawn into the first stage.

d. The charging hose proved deficient after only 10 hours of use.

e. A faulty spring caused failure of the second stage suction valve after 27 hours of operation.

Although the Rix model 153B-3 compressor supplies extremely pure air, in its present design, it could not fulfill the requirements of U.S. Navy divers. The Rix portable high pressure air compressor, model 153B-3, is, therefore, not recommended for U.S. Navy approval.

APPENDIX A

TEST PLAN

1. Operate the compressor for 6 hours under no-load condition.

2. Take air sample and submit it to Naval Coastal Systems Laboratory (NCSL) for analysis. Repeat sampling and analysis every 50 hours during testing.

3. Measure flow under a no-load condition with a Laminar flow-element. Repeat flow measurement each week of testing.

4. Operate the compressor daily for 6 hours, changing alternately to two sets of twin 71.2-cubic-foot scuba tanks to a pressure of 2250 psi. Repeat operation until 200 hours of operation are logged.

5. Log amp reading at start of daily test and every 500 psi thereafter as each set of tanks is charged.

6. Log air temperature of atmosphere and discharge of compressor every 500 psi as each set of tanks is charged.

7. Take water condensate sample and submit it to clean van for analysis.

8. Upon completion of 200 hours of operation, change third-stage seal (specified in manufacturer's Maintenance Handbook).

9. Operate the compressor for 6 hours daily, changing alternately to two sets of twin 50-cubic-foot scuba tanks to a pressure of 3000 psi.

10. Repeat steps 3, 5, 6, 7, and 9 until 400 hours of operation are logged.

11. Check pressure cutoff switch for proper operation (3000 psi). Repeat check every 50 hours of operation.

12. Check pressure relief valve for proper operation (3250 psi). Repeat check every 50 hours of operation.

APPENDIX B

SPECIFICATIONS

The Rix Oil-Free Axial-Piston Air Compressor has the following characteristics.

Standard equipment	Moisture separator system
	Filling hose
	Relief valves (all stages)
	Pressure gauge
	Pressure maintaining valve
	Filling attachment (scuba yoke or as specified)
	Compressor intake filter
Compressor life	Indefinite with routine maintenance
Discharge pressure	3100 psi, maximum
Capacity	2.0 SCFM
Speed	1700 rpm
Power required	1.7 hp
Stages	3
Stroke	0.94 in.
Cooling system	Air, direct-drive fan
Drive	V-belt

Motor	2 hp, 3450 rp, capacitor start, open frame
Mount	Single skid with carrying handles
Size	18-1/2 in. Lx 16-1/8 in. W x 11 1/8 in. H
Weight	95 lbs
Lubrication	Oil free
Ambient operating temperature range	0° to 120°F
Ambient operating pressure range	Sea level to 15,000 ft (reduced capacity at altitude)
Nominal discharge pressures at 3000 psi	First stage: 60 to 80 psi Second stage: 450 to 600 psi Third stage: 3000 psi
Relief valve settings	First stage: 130 psi Second stage: 800 psi Third stage: 3200 psi
Rotation	Counterclockwise (facing pulley end of shaft)

APPENDIX C

AIR SAMPLE ANALYSIS RESULTS

MEMORANDUM

25 February 1977

From: A. Purer, Code 712
To: BM2 S. M. Larson, NEDU

Subj: Air analysis, portable Rix compressor

1. In accordance with your request of 24 February 1977, the air sample delivered to the Gas Analysis Laboratory was analyzed and found to contain:

O_2	21%
N_2	78%
Ar	.9%
CO_2	483 ppm
CO	<.5 ppm
Total hydrocarbons*	15.2 ppm
Total halogens	2.5 ppm
Methane	2 ppm
Ethane	<10 ppm
Acetylene	81 ppb
Acetone	11 ppb
Benzene	<10 ppb
C_4+	3.3 ppm
Freon	35 ppb
Unknown hydrocarbon**	2-4 ppm

*Expressed as methane equivalents.
**This appears to be some type of cleaning solvent.

2. The above sample is contaminated with a halogenated hydrocarbon. Also, the total hydrocarbon concentration is high, although within the limit of 20 ppm.

A. PURER

Copy to:
E. L. Sharp, Code 712

MEMORANDUM

3 March 1977

From: A. Purer, Code 712
To: QM2 J. M. Zowacki, NEDU

Subj: Air analysis, portable Rix compressor

1. In accordance with your request 28 February 1977, the air sample delivered to the Gas Analysis Laboratory was analyzed and found to contain:

O_2	21%
N_2	78%
Ar	.9%
CO_2	324 ppm
CO	<1 ppm
Total hydrocarbons*	1.3 ppm
Total halogens	<1 ppm
Methane	1 ppm
Ethane	<10 ppb
Acetylene	<10 ppb
Acetone	<10 ppb
Benzene	<10 ppb
C_4+	<1 ppm

*Expressed as methane equivalents.

2. The above sample showed no appreciable contamination; all components were within the acceptable range.

A. PURER

Copy to:
NEDU (LCDR B. Banks, LCDR J. Malec,
HTC R. Fine, BM2 S. M. Larson)
712, E. L. Sharp

APPENDIX D

MAN-HOURS REQUIRED

The man-hours required for the test of the Rix Oil-Free, Axial Piston Air Compressor are listed below.

	Men	Hours	Man-Hours
Test plan	1	6	6
Test procedure	2	20	40
Air analysis	2	2	4
Photography	1	1	1
Log analysis	1	3	3
Manuscript preparation	1	12	12
		Total	66 Man-Hours