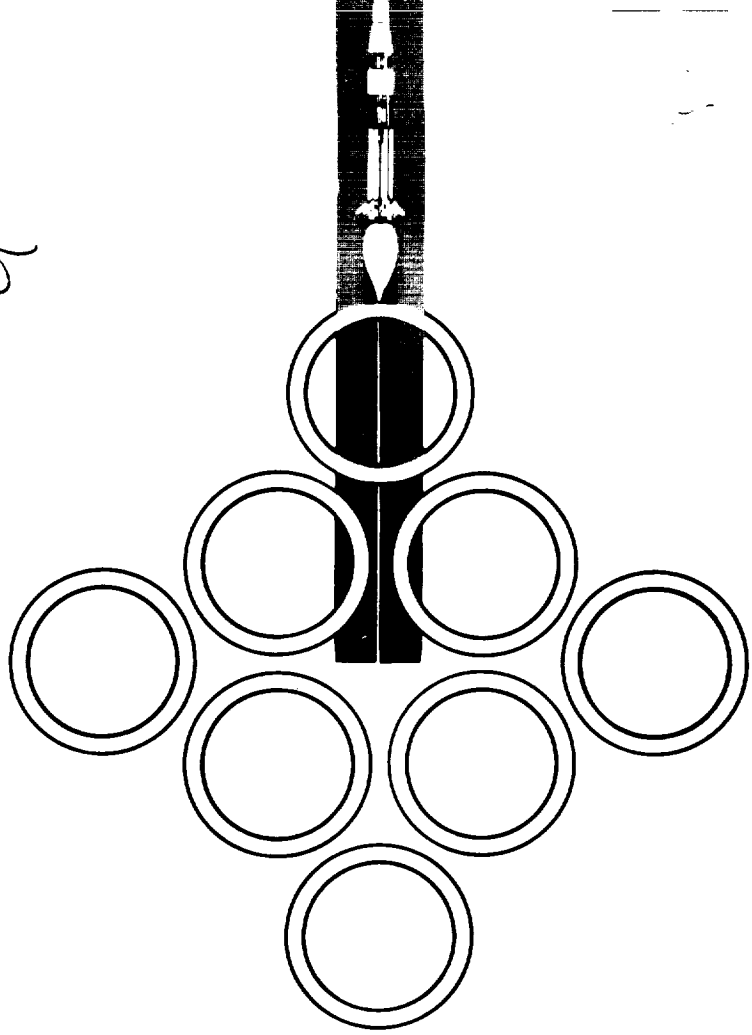

ENGINEERING DEPARTMENT

TECHNICAL REPORT

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December 20, 1966

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TEST REPORT
FOR

FLEXIBLE HOSE, $\frac{1}{4}$-INCH, 3000-PSIG

Aeroquip Corporation Part Number 675003-4-0420

NASA Drawing Number 75M11337-4-0420

SPACE DIVISION CHRYSLER CORPORATION

TEST REPORT
FOR
FLEXIBLE HOSE, $\frac{1}{4}$-INCH, 3000 PSIG

Aeroquip Corporation Part Number 675003-4-0420

NASA Drawing Number 75M11337-4-0420

ABSTRACT

This report presents the results of tests performed on three specimens of Flexible Hose 75M11337-4-0420. The following tests were performed:

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Low Temperature
5. High Temperature
6. Surge
7. Prolonged Pressure
8. Vibration
9. Salt Fog
10. Life Cycle
11. Flexure
12. Burst

Performance of the flexible hoses was in accordance with specification requirements of NASA drawing 75M11337-4-0420 throughout the test program, except that leakage occurred at the fittings of all three specimens during most tests. This leakage did not increase significantly as testing progressed. Testing was continued on the premise that proof pressure testing with helium, and an inspection prior to installation, would preclude a leaking hose being installed in the system.

TEST REPORT

FOR

FLEXIBLE HOSE, $\frac{1}{4}$-INCH, 3000-PSIG

Aeroquip Corporation Part Number 675003-4-0420

NASA Drawing Number 75M11337-4-0420

December 20, 1966

CHRYSLER CORPORATION SPACE DIVISION - NEW ORLEANS, LOUISIANA

FOREWORD

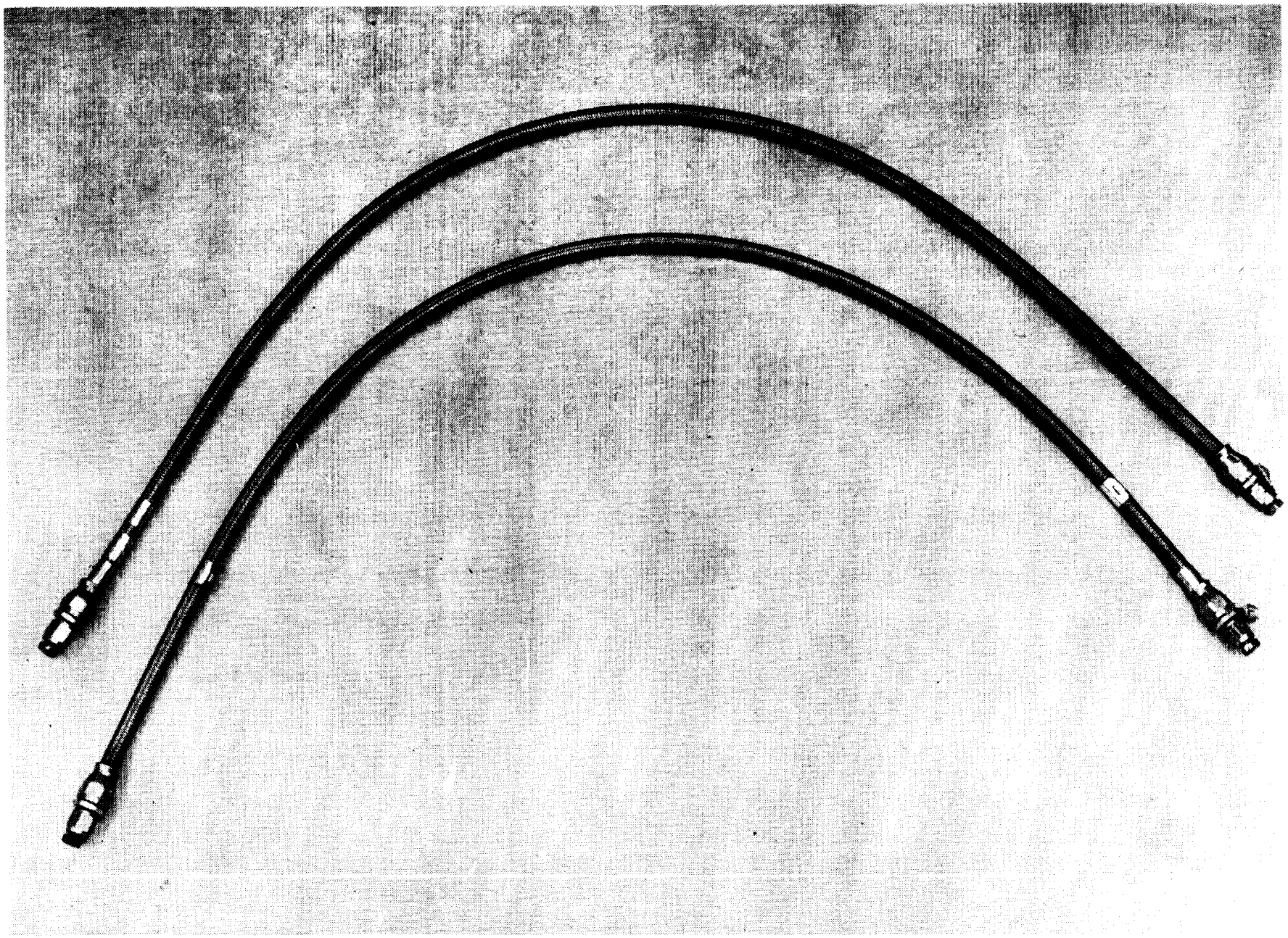
The tests reported herein were conducted for the John F. Kennedy Space Center by Chrysler Corporation Space Division (CCSD), New Orleans, Louisiana. This document was prepared by CCSD under contract NAS 8-4016, Part VII, CWO 271620.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

LIST OF TABLES (CONTINUED)



Flexible Hose, $\frac{1}{4}$-Inch, 75M11337-4-0420

CHECK SHEET

FOR

FLEXIBLE HOSE, $\frac{1}{4}$-INCH

MANUFACTURER: Aeroquip Corporation
MANUFACTURER'S PART NUMBER: 675003-4-0402
NASA PART NUMBER: 75M11337-4-0420
TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana
AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A.	OPERATING MEDIUM:	Gaseous air, nitrogen, or helium
B.	OPERATING PRESSURE:	3000 psig
C.	LEAKAGE:	Bubble-tight below 3000 psig
D.	PROOF PRESSURE:	4500 psig
E.	BURST PRESSURE:	12,000 psig minimum

II. CONSTRUCTION

A.	BODY MATERIAL:	Stainless steel, wire braid
B.	LINING MATERIAL:	Teflon
C.	LENGTH:	42 inches
D.	DIAMETER:	$\frac{1}{4}$-inch nominal
E.	FITTINGS:	AN818-4

III. ENVIRONMENTAL REQUIREMENTS

A.	TEMPERATURE RANGE:	-60°F to +400°F

IV. SPECIAL REQUIREMENTS

A.	CLEANING SPECIFICATION:	A1OM01671, Level IV
B.	IDENTIFICATION TAGS:	C75M04185-2-8

V. LOCATION AND USE: Swing arm 2 at John F. Kennedy Space Center Launch Complexes 34 and 37B.

TEST SUMMARY

FLEXIBLE HOSE

75M11337-4-0420

Environment	Units	Operational Boundary	Test Objective	Test Results	Remarks
Receiving Inspection	1,2,3	Specifications and drawings	Conformance to drawings and specifications	Satisfactory	
Proof Pressure Test	1,2,3	4500 psig	Verify capability to withstand high pressure	Specimen 1 unsatisfactory. Specimens 2 and 3 satisfactory.	Specimen 1 leaked at collars while pressurized with helium.
Functional Test	1,2,3	3000 psig	To determine if specimens meet functional requirements	Unsatisfactory	All specimens leaked at collars. Leakage continued throughout test.
Low Temperature Test	1,2	5°F	Verify capability to withstand low temperature	Satisfactory	
High Temperature Test	1,2	160°F	Verify capability to withstand high temperature	Satisfactory	
Surge Test	1,2	0 to 3000 psig in 100 milliseconds 1000 cycles	Verify capability to withstand pressure surges	Satisfactory	
Prolonged Pressure Test	1,2,3	3000 psig for 48 hours	Verify capability to withstand prolonged pressure	Satisfactory	
Vibration Test	2,3	Resonant-2g peak 5 to 3000 cps Sine-20g peak 10 to 2000 cps Random-0.05 g^2/cps	Verify capability to withstand vibration	Satisfactory	
Salt Fog Test	1,2	240-hour exposure	Verify capability to withstand salt fog	Satisfactory	
Cycle Test	1,2,3	80,000 cycles 0 to 3000 to 0 psig	Verify capability to withstand repeated	Satisfactory	

TEST SUMMARY (CONTINUED)

FLEXIBLE HOSE

75M11337-4-0420

Environment	Units	Operational Boundary	Test Objective	Test Results	Results
Flexure Test	1,2,3	Bend radius 3.0 inches 1000 times	Verify capability to withstand repeated flexing	Satisfactory	
Burst Test	1,2,3	12,000 psig	Determine specimen burst pressures	Satisfactory	Specimen 1 burst at 19,000 psig. Specimen 2 burst at 19,500 psig. Specimen 3 burst at 18,000 psig.

SECTION I

INTRODUCTION

1.1 SCOPE

This report presents the results of tests that were performed to determine if flexible hose 75M11337-4-0420 meets the operational and environmental requirements for the John F. Kennedy Space Center Launch Complexes 34 and 37B. A summary of the results is presented on pages viii and ix.

Three specimens of the flexible hose assembly were tested, and were numbered 1 through 3 for identification purposes.

1.2 ITEM DESCRIPTION

Flexible hose 75M11337-4-0420 is manufactured by Aeroquip Corporation as vendor part number 675003-4-0420. The hose is 42 ($\pm\frac{1}{2}$) inches long and has a nominal diameter of $\frac{1}{4}$-inch; it is constructed of stainless steel wire braid and is teflon lined. The hose has an operating pressure of 3000 psig and is rated for use with air, nitrogen, or helium.

1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for flexible hose 75M11337-4-0420:

a. A75M11337, component specification

b. KSC-STD-164(D), dated September 17, 1964, Standard Environmental Test Methods for Ground Support Equipment Installations at Cape Kennedy

c. A1OM01671, cleanliness requirement

d. Test Plan CCSD-FO-1005-1R

e. Technical Procedure TP-RE-CCSD-FO-5R

SECTION II

RECEIVING INSPECTION

2.1 TEST REQUIREMENTS

The specimens shall be checked for conformance to NASA drawing 75M11337-4-0420 and applicable specifications to the extent possible without disassembly. The specimens shall also be inspected for evidence of poor workmanship and manufacturing defects.

2.2 TEST PROCEDURE

The flexible hose assemblies were checked for conformance with NASA drawing 75M11337. At the same time, the test specimens were also inspected for defective threads and welds, and the wire braid was inspected for damage.

2.3 TEST RESULTS

The test specimens complied with NASA drawing 75M11337. No evidence of damage, poor workmanship or manufacturing defects was observed.

2.4 TEST DATA

The data presented in table 2-1 were recorded during the inspection.

Table 2-1. Dimensions of Test Specimens

Measurement	Allowable Dimension	Dimension of Sample Number					
		1		2		3	
Length	42 ($\pm\frac{1}{2}$) inches	42-1/32		42-1/16		42	
End Fitting Diameter	----	R	L	R	L	R	L
		0.54	0.54	0.54	0.53	0.53	0.53
End Fitting Length	----	0.63	0.64	0.64	0.64	0.63	0.64

R - Right fitting dimension
L - Left fitting dimension

SECTION III

PROOF PRESSURE TEST

3.1 TEST REQUIREMENTS

3.1.1 Test specimens 1, 2 and 3 shall be subjected to the proof pressure of 4500 psig.

3.1.2 Proof pressure shall be maintained for 5 minutes.

3.1.3 Leakage shall be monitored during this test.

3.2 TEST PROCEDURE

3.2.1 The proof pressure test setup was assembled as shown in figure 3-1.

3.2.2 While submerged in water, test specimens 1, 2 and 3 were pressurized with GN_2 to 4500 psig. Specimen 1 was initially pressurized with gaseous helium, since 4500 psig GN_2 was not available at the time. Later, specimens 1, 2 and 3 were pressurized to 4500 psig with GN_2 when the GN_2 pressure was available.

3.2.3 Each assembly was subjected to the proof pressure for a period of 5 minutes.

3.2.4 Leakage was monitored by checking for bubbles. No leakage was allowed.

3.2.5 The pressure was removed and each assembly was examined for signs of structural deformities resulting from this test. All data was recorded.

3.3 TEST RESULTS

3.3.1 No structural deformities resulted from this test.

3.3.2 Specimen 1 leaked when initially pressurized with helium, and a pressure drop of 175 psig in 5 minutes was recorded. No leaks were detected for any specimen when pressurized with GN_2.

3.4 TEST DATA

The data presented in table 3-1 were recorded during the test.

Table 3-1. Proof Pressure Test Leakage Data

Media	Location	Allowable	Sample Leakage (ml/min)		
			1	2	3
He	Right collar	None	1.3	-	-
	Left collar	None	2.4	-	-
	Hose body	None	0.0	-	-
GN_2	Right collar	None	0	0	0
	Left collar	None	0	0	0
	Hose body	None	0	0	0

Table 3-2. Proof Pressure Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	$\frac{1}{4}$-inch flexible hose
2	GN_2 or GHe Pressure Source	CCSD	NA	NA	5000 psig
3	Gage, Penumatic Pressure	Ashcroft	NA	NASA No. 200616-K	0 to 5000 psig $\pm\frac{1}{2}$% FS accuracy Cal. Date: 4-25-66
4	Regulator, Hand Loaded	Tescom Corp.	26-1003	1008	6000 psi inlet 0 to 4000 psi outlet
5	Filter, Pneumatic	Bendix	1730150	NA	2-micron
6	Valve, 3-Way Solenoid	Marotta	MV-74	NA	3000-psig operating press.
7	Valve, Variable Orifice	Whitey	22RF4	NA	micro valve
8	Tank, Water	CCSD	NA	NA	aluminum
9	Switch	Cutler-Hammer	ST42D	NA	SPST
10	Power Supply	Perkin Electronics	MRST28-300A	NASA No. 009941 SN 63-293	28V DC, 3 Amp

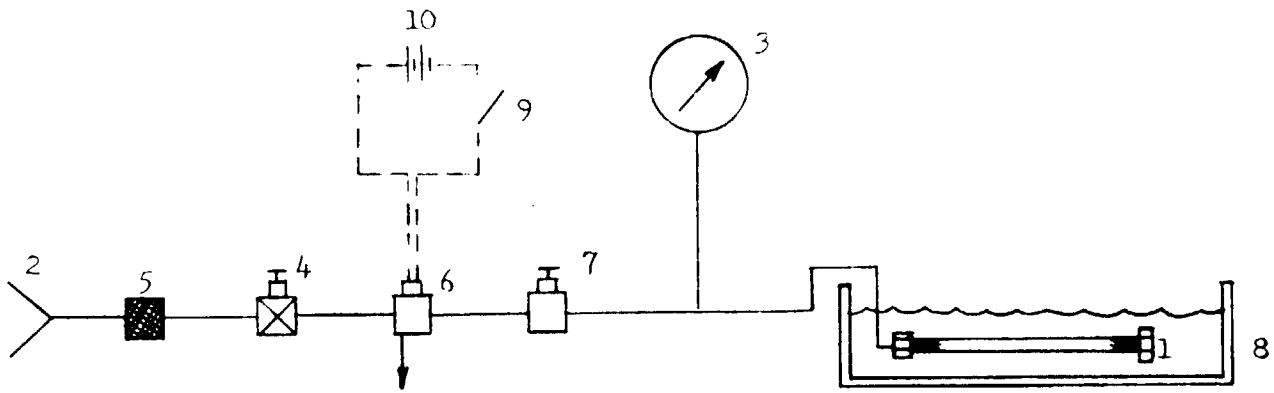


Figure 3-1. Proof Pressure and Functional Test Schematic

SECTION IV

FUNCTIONAL TEST

4.1 TEST REQUIREMENTS

4.1.1 Test specimens 1, 2 and 3 shall be subjected to 15 pressure cycles from zero to 3000 psig and back to zero while the specimen is submerged in water.

4.1.2 Leakage shall be monitored during the test.

4.2 TEST PROCEDURE

4.2.1 The functional test setup was assembled as shown in figure 3-1.

4.2.2 Each of the test specimens 1, 2 and 3 was pressurized with gaseous helium to 3000 psig and was then depressurized to zero while the specimen was submerged in water. This pressurization and depressurization cycle was repeated 15 times.

4.2.3 Leakage was monitored. No leakage was allowed.

4.2.4 Each specimen was examined for deterioration of the Teflon lining and for any breaks in the steel wire strands.

4.3 TEST RESULTS

Sample 1: Very small leaks were noted under both collars.

Samples 2 and 3: Following the 15th pressurization cycle, very small leaks were noted under both collars.

4.4 TEST DATA

Functional test data is presented in table 4-1.

Table 4-1. Initial Functional Test Leakage Data

Test	Location	Sample Leakage (ml/min)		
		1	2	3
Initial Functional	Right collar	0.3	0.1	0.1
	Left collar	1.4	0.3	0.3
	Hose body	0	0	0

Table 4-2. Functional Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	$\frac{1}{4}$-inch flexible hose
2	He Pressure Source	CCSD	NA	NA	3500 psig
3	Gage, Pneumatic Pressure	Ashcroft	NA	NASA No. 200616K	0 to 5000 psig $\pm\frac{1}{2}$% FS accuracy Cal. date: 4-25-66
4	Regulator, Hand Loaded	Tescom Corp.	26-1003	1004	6000 psi inlet 0 to 4000 psi outlet
5	Filter, Pneumatic	Microporous	48BF-2DM	NA	2-micron
6	Valve, 3-Way Solenoid	Marotta	MV-74	NA	3000 psig operating press.
7	Valve, Variable Orifice	Whitey	22F4	NA	micro valve
8	Tank, Water	CCSD	NA	NA	aluminum
9	Switch	Cutler-Hammer	ST42D	NA	SPST
10	Power Supply	Perkins Electronics	MRST28-300A	NASA No. 009941 SN 63-293	28V DC, 3 amp

SECTION V

LOW TEMPERATURE TEST

5.1 TEST REQUIREMENTS

5.1.1 A low temperature test will be performed on test specimens 1 and 2, while pressurized with GN_2 to 3000 psig, to determine whether the environment causes degradation or deformation.

5.1.2 The rated low temperature is 5 (+0, -4)°F. Maximum temperature change rate shall be 1°F per minute.

5.1.3 A functional test shall be performed during this test. The specimen will not be submerged in water. Leakage will be monitored by noting pressure drop.

5.2 TEST PROCEDURE

5.2.1 Test specimens 1 and 2 were placed in a low temperature chamber as shown in figures 5-1, 5-2 and 5-3.

5.2.2 A functional test was not required since 72 hours had not elapsed since the previous functional test.

5.2.3 The chamber was controlled to the specified test conditions, maintaining a relative humidity between 60 and 90 per cent.

5.2.4 A functional test was performed when temperature stabilization was obtained. Temperature stabilization is defined as a maximum temperature change rate of 4°F per hour as determined from the instrumentation monitoring the test item.

5.2.5 The chamber temperature was returned to ambient conditions upon completion of the functional test.

5.2.6 The test item was visually inspected and functionally tested within 1 hour following the return to ambient conditions. All data was recorded.

5.3 TEST RESULTS

Sample 1: No pressure drop was noted during low temperature functional tests. Leaks were noted under each collar and 6 inches from the end of the test specimen during the functional test at ambient conditions.

Sample 2: No leaks were noted at low temperature or ambient conditions.

5.4 TEST DATA

Functional data is shown in table 5-1.

Table 5-1. Functional Data For Low Temperature Test

Test	Location	Sample Leakage (ml/min)	
		1	2
Low Temperature	Right collar	0	0
	Left collar	0	0
	Hose body	0	0
Ambient	Right collar	0.5	0
	Left collar	1.5	0
	Hose body	0.8	0

Table 5-2. Low Temperature Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	$\frac{1}{4}$-inch flexible hose
2	Gage, Pneumatic Pressure	Ashcroft	NA	NASA No. 200616K	0 to 500 psi $\pm\frac{1}{2}$% FS accuracy Cal. date 4-25-66
3	Gage, Thermocouple	Minneapolis-Honeywell	NA	NA	0 to 150°F $\pm$2.5°F accuracy
4	Regulator, Hand Loaded	Tescom Corp.	26-1003	1005	6000 psig inlet 0 to 4000 psig outlet
5	Filter, Pneumatic	Microporous	48BF-2DM	NA	2-micron
6	Valve, 3-Way Solenoid	Marotta	MV-74	NA	$\frac{1}{4}$-inch
7	Valve, Variable Orifice	Whitey	22F4	NA	$\frac{1}{4}$-inch
8	Chamber, Temperature	Conrad	NA	NASA No. 200394	-100 to +300°F
9	Switch	Cutler-Hammer	ST42D	NA	SPST
10	Fixture	CCSD	NA	NA	aluminum
11	Helium Pressure Source	CCSD	NA	NA	3500-psig
12	Power Supply	Perkins Electronics	MRST28-300A	NASA No. 009941 SN 63-293	28V DC, 3 amp

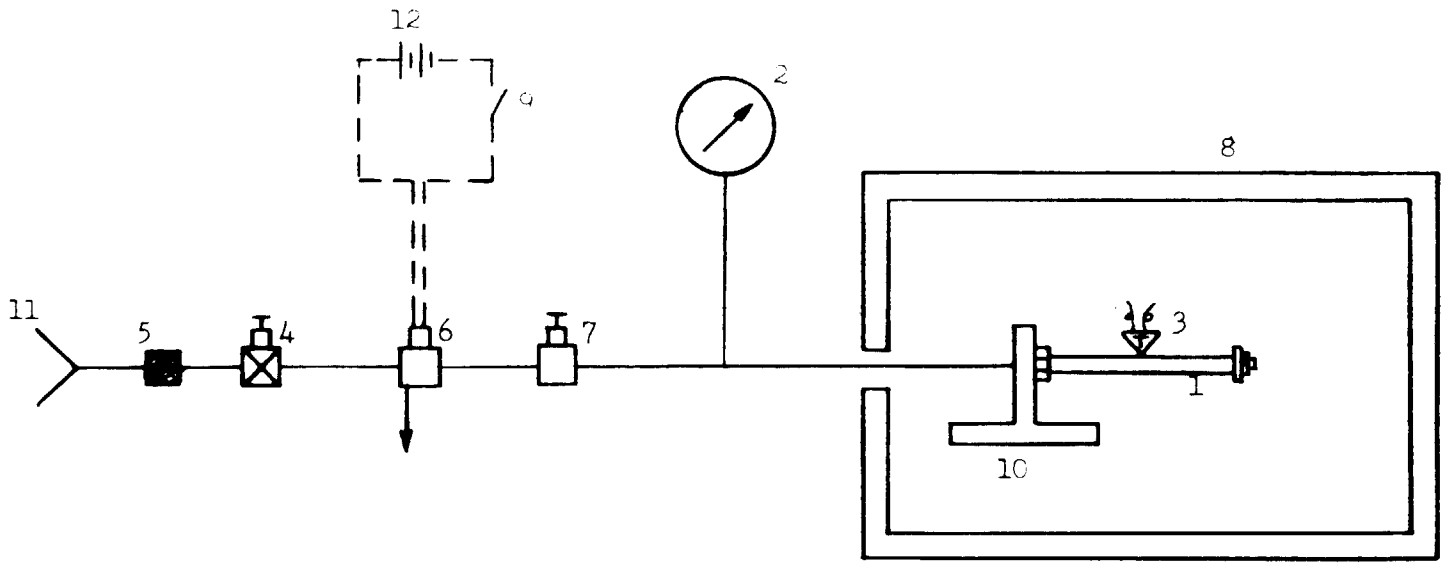


Figure 5-1. Low and High Temperature Test Schematic

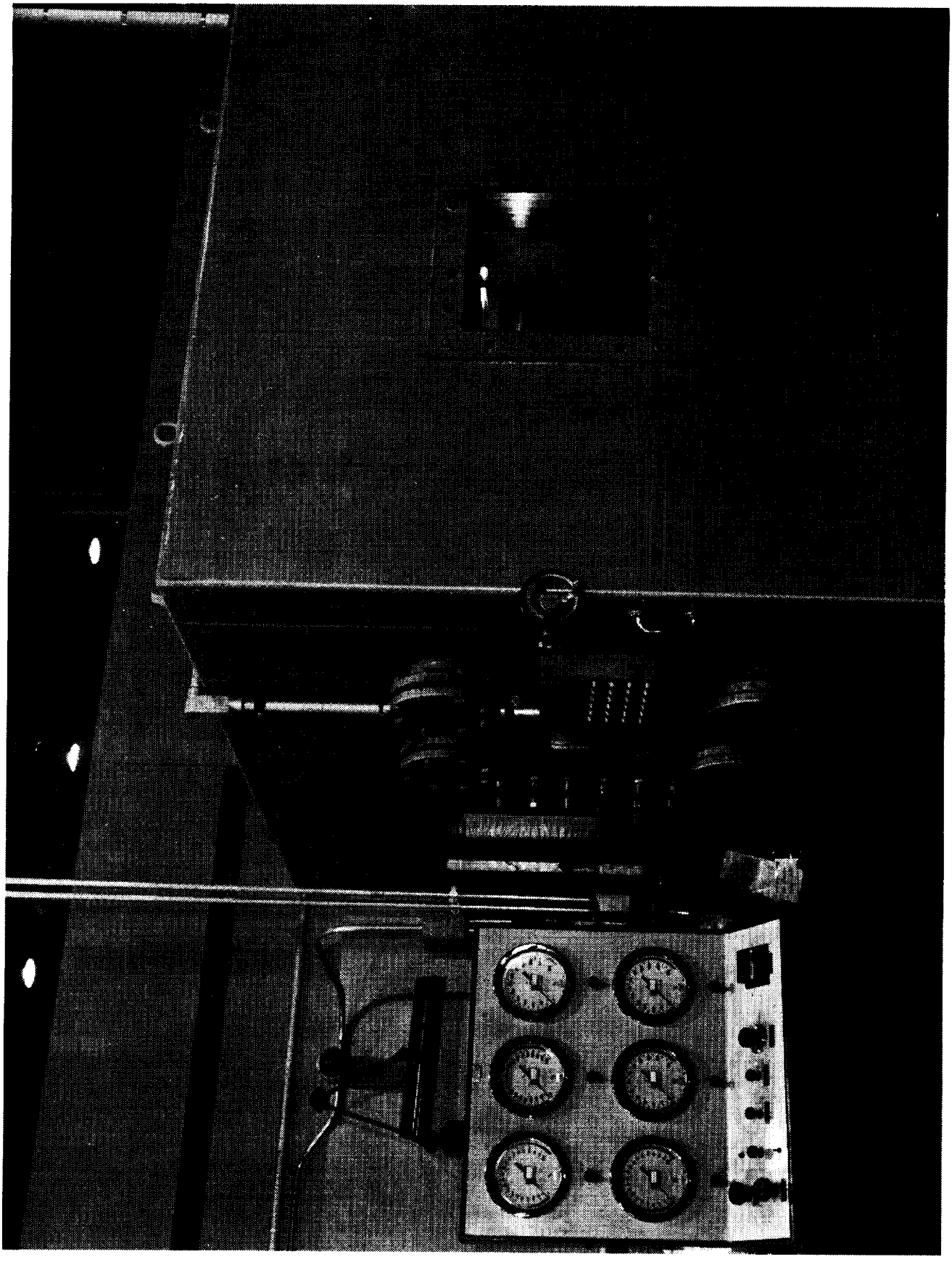


Figure 5-2. High and Low Temperature Test Setup

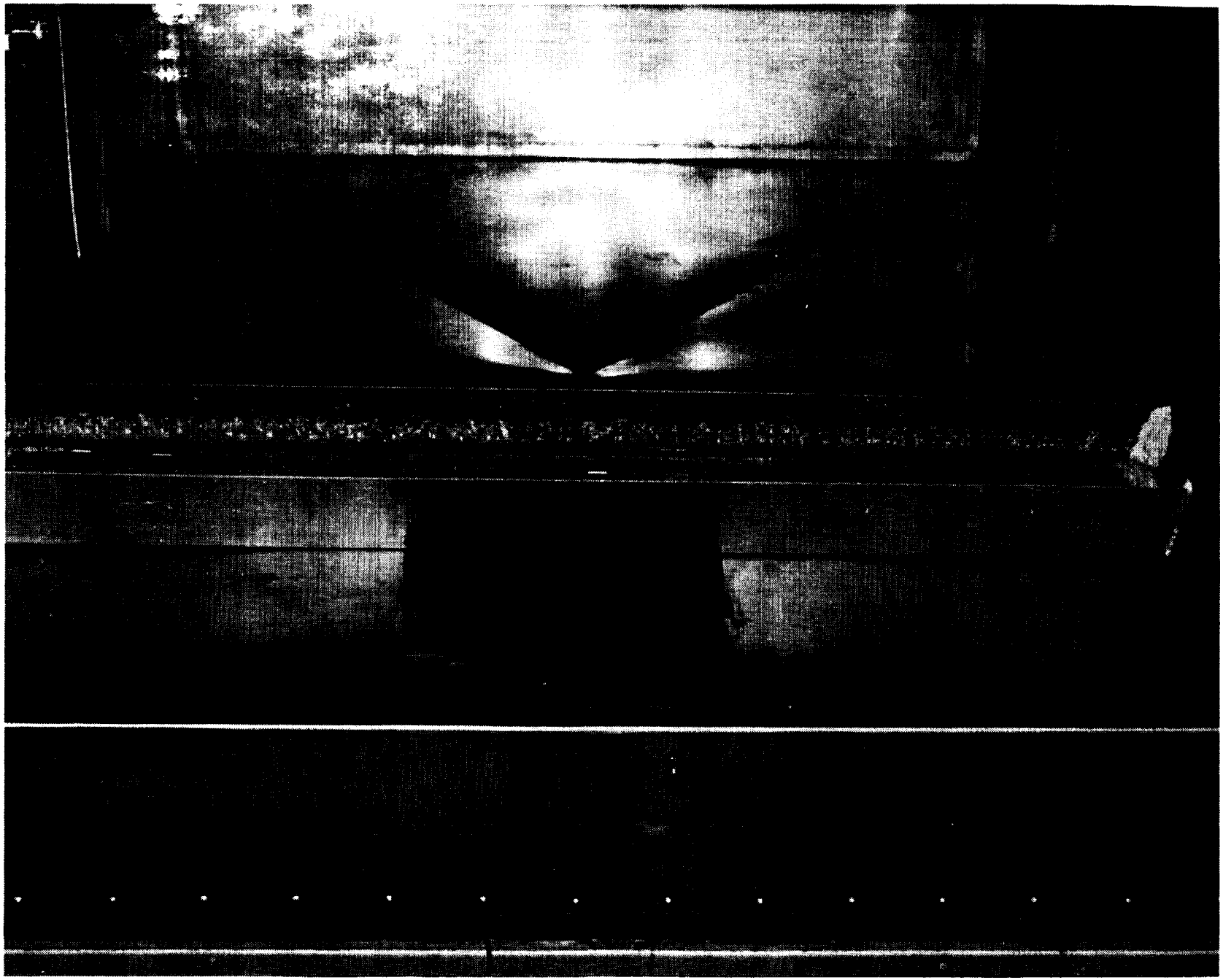


Figure 5-3. High and Low Temperature Test Setup

SECTION VI

HIGH TEMPERATURE TEST

6.1 TEST REQUIREMENTS

6.1.1 A high temperature test will be performed on test assemblies 1 and 2 to determine whether the environment causes degradation or deformation.

6.1.2 The rated high temperature is 160 (+4, -0)°F.

6.1.3 A functional test shall be performed during this test.

6.2 TEST PROCEDURE

6.2.1 Test assemblies 1 and 2 were placed in a high temperature chamber as shown in figures 5-1, 5-2 and 5-3.

6.2.2 A functional test was performed since more than 72 hours had elapsed since the previous functional test.

6.2.3 The chamber was controlled to the specified test conditions, maintaining a relative humidity of 20 ($\pm$5) per cent and operating pressure.

6.2.4 This temperature was maintained for a period of 72 (+2, -0) hours.

6.2.5 A functional test was conducted while the chamber temperature was maintained.

6.2.6 The chamber temperature was returned to ambient conditions upon completion of the functional test.

6.2.7 The test specimen was visually inspected and functionally tested within 1 hour following the establishment of ambient conditions.

6.2.8 The test data was recorded.

6.3 TEST RESULTS

Sample 1: Leaks were noted under both collars before, during, and after high temperature tests. Leakage rates were higher in the right collar (plugged fitting end) during the high temperature test.

Sample 2: Leaks were noted before, during, and after high temperature, with leakage rates substantially higher in the left collar during high temperature.

6.4 TEST DATA

Functional test data are presented in table 6-1.

Table 6-1. Functional Data For High Temperature Test

Test	Location	Sample Leakage (ml/min)	
		1	2
Ambient	Right collar	0.5	1.0
	Left collar	5.5	5.0
	Hose body	0	1.5
High Temperature	Right collar	0.5	1.0
	Left collar	10.0	*8.0 and 8.0
	Hose body	0	1.5
Ambient	Right collar	1.0	1.0
	Left collar	5.0	5.0
	Hose body	0	1.0

* Two leaks were noted on left collar during high temperature.

Table 6-2. High Temperature Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	$\frac{1}{4}$-inch flexible hose
2	Gage, Pneumatic	Ashcroft	NA	NASA No. 200616H	0 to 5000 psig $\pm\frac{1}{2}$% FS accuracy Cal. date: 12-25-66
3	Gage, Thermocouple	Minneapolis-Honeywell	NA	NA	0 to 150°F $\pm$2.5°F accuracy
4	Regulator, Hand Loaded	Tescom Corp.	26-1003	1004	6000-psig inlet 4000-psig outlet
5	Filter, Pneumatic	Bendix	1730150	NA	2-micron
6	Valve, 3-Way Solenoid	Marotta	MV-74	NA	3000-psig operating press.
7	Valve, Variable Orifice	Whitey	22F4	NA	micro valve
8	Chamber, Temperature	Conrad	NA	NASA No. 200394	-100°F to 300°F
9	Switch	Cutler-Hammer	ST42D	NA	SP/ST
10	Fixture	CCSD	NA	NA	aluminum
11	Helium Pressure Source	CCSD	NA	NA	3500-psig
12	Power Supply	Lambda	LA50-03BM	NASA No. 010269	28V DC Cal. date: 11-15-66

SECTION VII

SURGE TEST

7.1 TEST REQUIREMENTS

7.1.1 A surge test will be performed on test assemblies 1 and 2 to determine whether the environment causes degradation or deformation.

7.1.2 The surge cycle shall consist of pressurizing the test specimen from 0 to 3000 psig in 100 milliseconds. A total of 1000 cycles shall be conducted.

7.2 TEST PROCEDURE

7.2.1 A functional test was not required since 72 hours had not elapsed since the previous functional test.

7.2.2 Test assemblies 1 and 2 were placed in a surge test setup as shown in figures 7-1 and 7-2.

7.2.3 Using GN_2, the test assembly was surged from 0 to 3000 psig in 100 milliseconds.

7.2.4 A total of 1000 cycles were conducted.

7.2.5 The surge time history was recorded on an oscillograph recorder.

7.2.6 A functional test was conducted within 1 hour following completion of testing. All data were recorded.

7.3 TEST RESULTS

7.3.1 Upon completion of the surge test and a functional test, both samples were pressurized to 3000 psig for 5 minutes. Leakage was noted at both collars on samples 1 and 2.

7.3.2 The test results were considered satisfactory.

7.4 TEST DATA

7.4.1 A typical surge pulse time history is shown in figure 7-3.

7.4.2 Functional test data are presented in table 7-1.

Table 7-1. Functional Data For Surge Test

Test	Location	Sample Leakage (ml/min)	
		1	2
Functional After Surge	Right collar	2.0	1.7
	Left collar	3.0	3.5
	Hose body	0	0

Table 7-2. Surge Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	¼-inch flexible hose
2	GN_2 Pressure Supply	CCSD	NA	NA	3500-psig
3	Valve, 3-Way Solenoid	Marotta	MV-74	NA	3000-psig operating press.
4	Timer, Cycle	G. C. Wilson Company	Model 1	NA	Cam-operated
5	Counter	Durant	NA	NA	4-digit
6	Test Fixture	CCSD	NA	NA	Aluminum
7	Transducer, Pressure	CEC	NA	2520	0 to 5000 psig ±½% FS accuracy Cal. date: 4-16-66
8	Recorder, Oscillograph	CEC	5-124	NASA No. 012592	Cal. date: 8-28-66
9	Valve, Variable Orifice	Whitey	22F4	NA	micro valve
10	Filter	Bendix	1730150	NA	2-micron
11	Regulator	Tescom Corp.	26-1003	1005	6000 psig inlet 4000 psig outlet
12	Power Supply	Perkins Electronics	MRST28-300A	NASA No. 009941 SN 63-293	28V DC, 3 amp
13	Switch	Cutler-Hammer	ST42D	NA	SPST

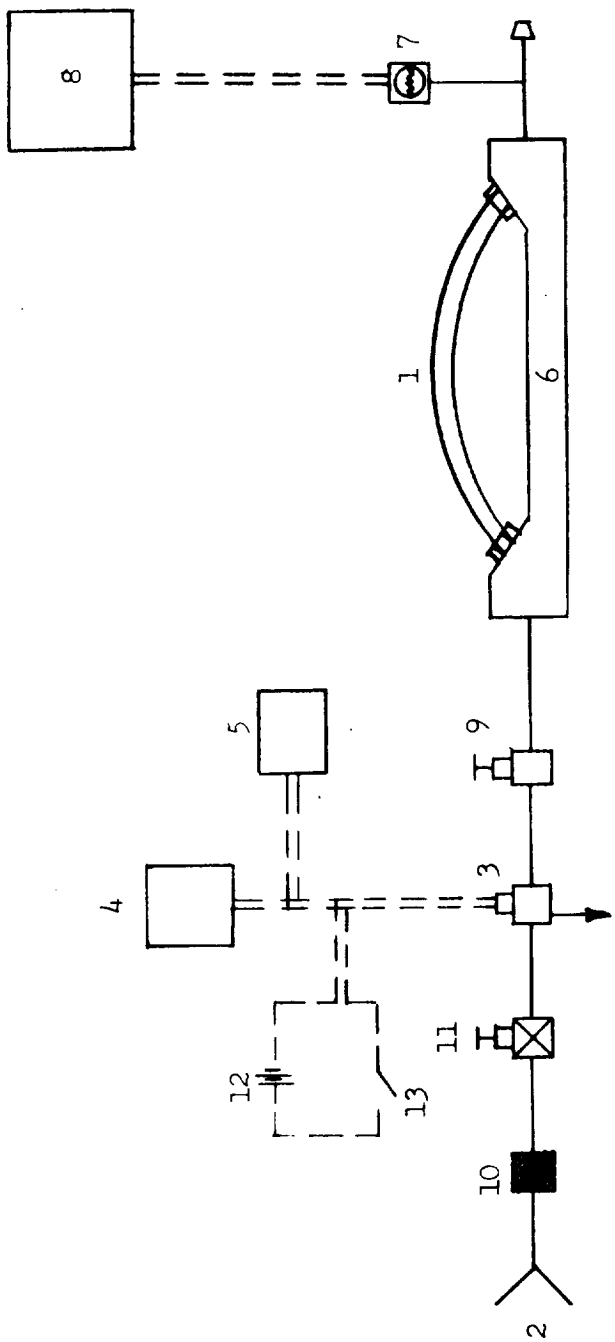


Figure 7-1. Surge Test Schematic

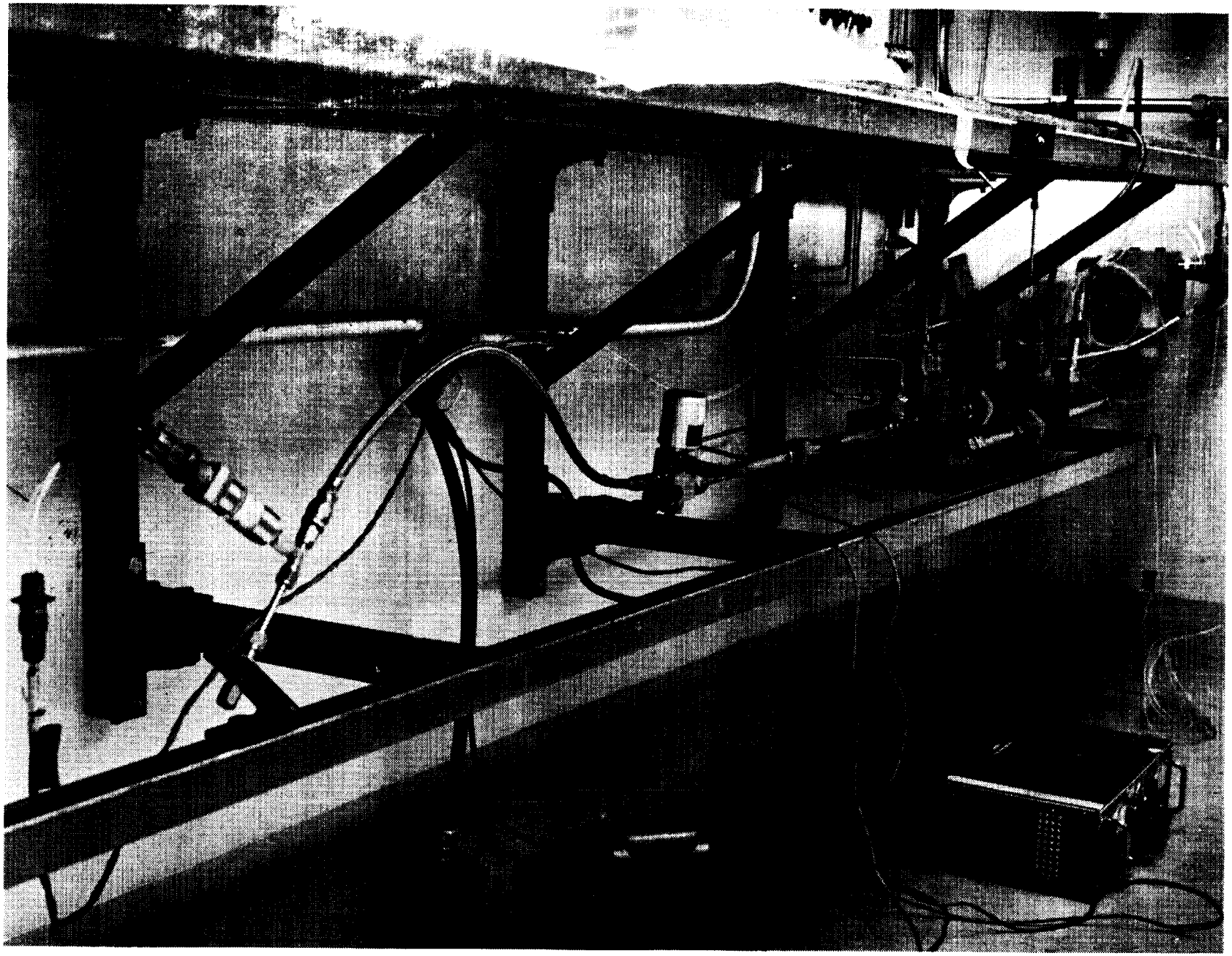


Figure 7-2. Surge Test Setup

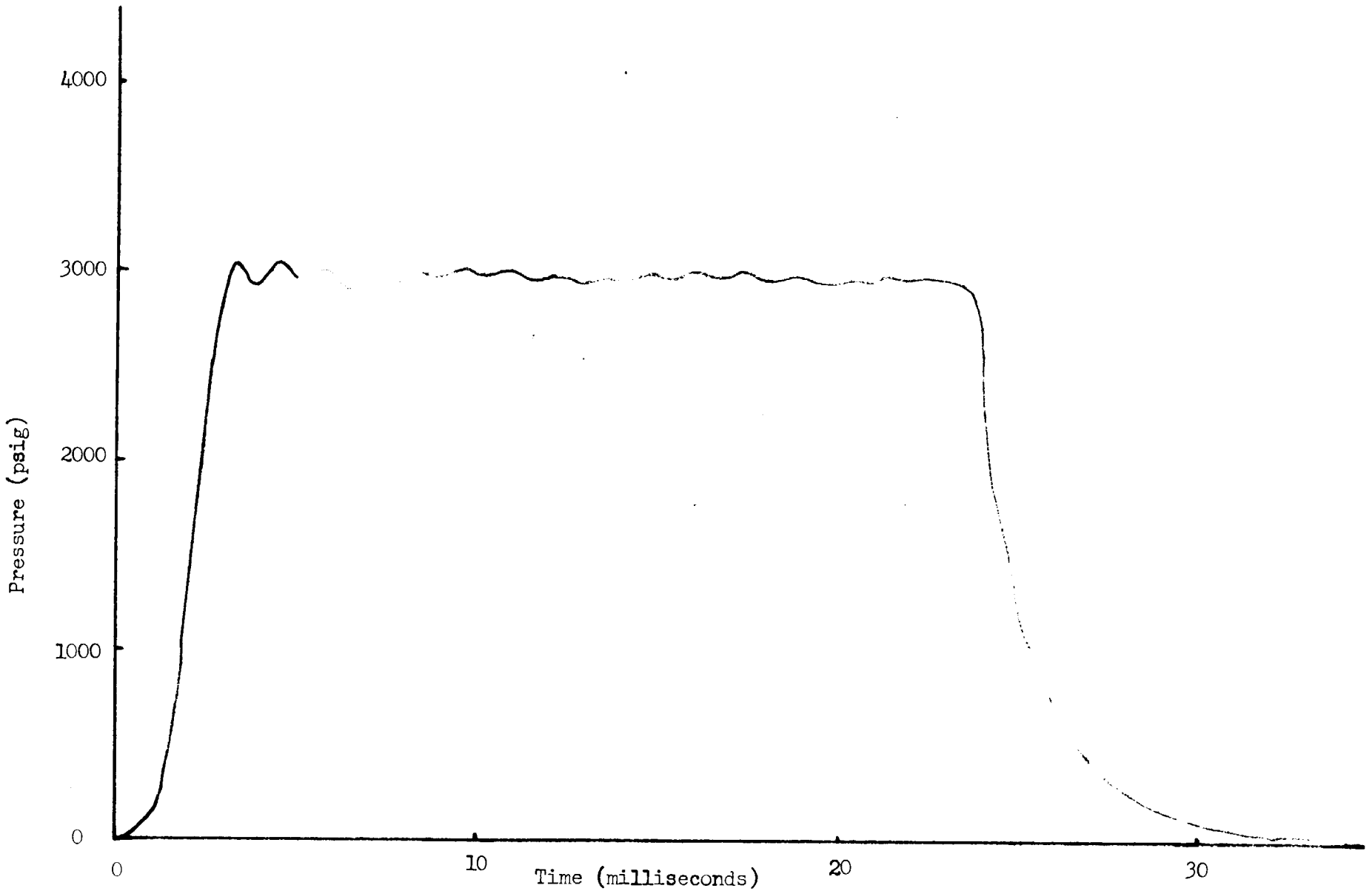


Figure 7-3. Typical Surge Test Pressure Vs. Time History

SECTION VIII

PROLONGED PRESSURE TEST

8.1 TEST REQUIREMENTS

8.1.1 A prolonged pressure test will be performed on test assemblies 1, 2 and 3, while pressurized with GN_2 to 3000 psig, to determine whether degradation or deformation occurs.

8.1.2 The prolonged pressure shall continue for a period of 48 hours.

8.1.3 Leakage shall be monitored.

8.2 TEST PROCEDURE

8.2.1 The specimen was installed in a test setup as shown in figures 3-1 and 8-1.

8.2.2 A functional test was not required since 72 hours had not elapsed since the previous functional test.

8.2.3 Test assemblies 1, 2 and 3 were pressurized to 3000 psig for a period of 48 hours.

8.2.4 Leakage was monitored throughout the test.

8.2.5 A functional test was performed within 1 hour following completion of the test.

8.2.6 The specimen was inspected for deterioration of the Teflon lining and for any breaks in the steel wire strands. All data was recorded.

8.3 TEST RESULTS

8.3.1 Leakage was noted at the collars of the three specimens, and 6 inches from collar of sample 2, during the prolonged pressure test. Following functional testing of the specimens, each sample was pressurized to 3000 psig and pressure was maintained for 5 minutes.

8.3.2 Test results were satisfactory.

8.4 TEST DATA

Functional test data are presented in table 8-1.

Table 8-1. Functional Data For Prolonged Pressure Test

Test	Location	Sample Leakage (ml/min)		
		1	2	3
Ambient	Right collar	2.3	1.8	2.0
	Left collar	3.7	3.4	4.0
	Hose body	0	0.8	0

Table 8-2. Prolonged Pressure Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	¼-inch flexible hose
2	GN_2/He Pressure Source	CCSD	NA	NA	3500-psig
3	Gage, Penumatic Pressure	Ashcroft	NA	NASA No. 200616K	0 to 5000 psig ±½% FS accuracy
4	Regulator, Hand Loaded	Tescom Corp.	26-1003	S/N 1008	Cal date: 4-25-66
5	Filter, Pneumatic	Bendix	1730150	NA	2-micron
6	Valve, 3-Way Solenoid	Marotta	MV74	NA	3000 psig operating press.
7	Valve, Variable Orifice	Whitey	22F4	NA	micro valve
8	Tank, Water	CCSD	NA	NA	aluminim
9	Switch	Cutler-Hammer	ST42D	NA	SPST
10	Power Supply	Perkins Electronic	MRST28-300A	NASA No. 009941 S/N 63-293	28V DC, 3 amp

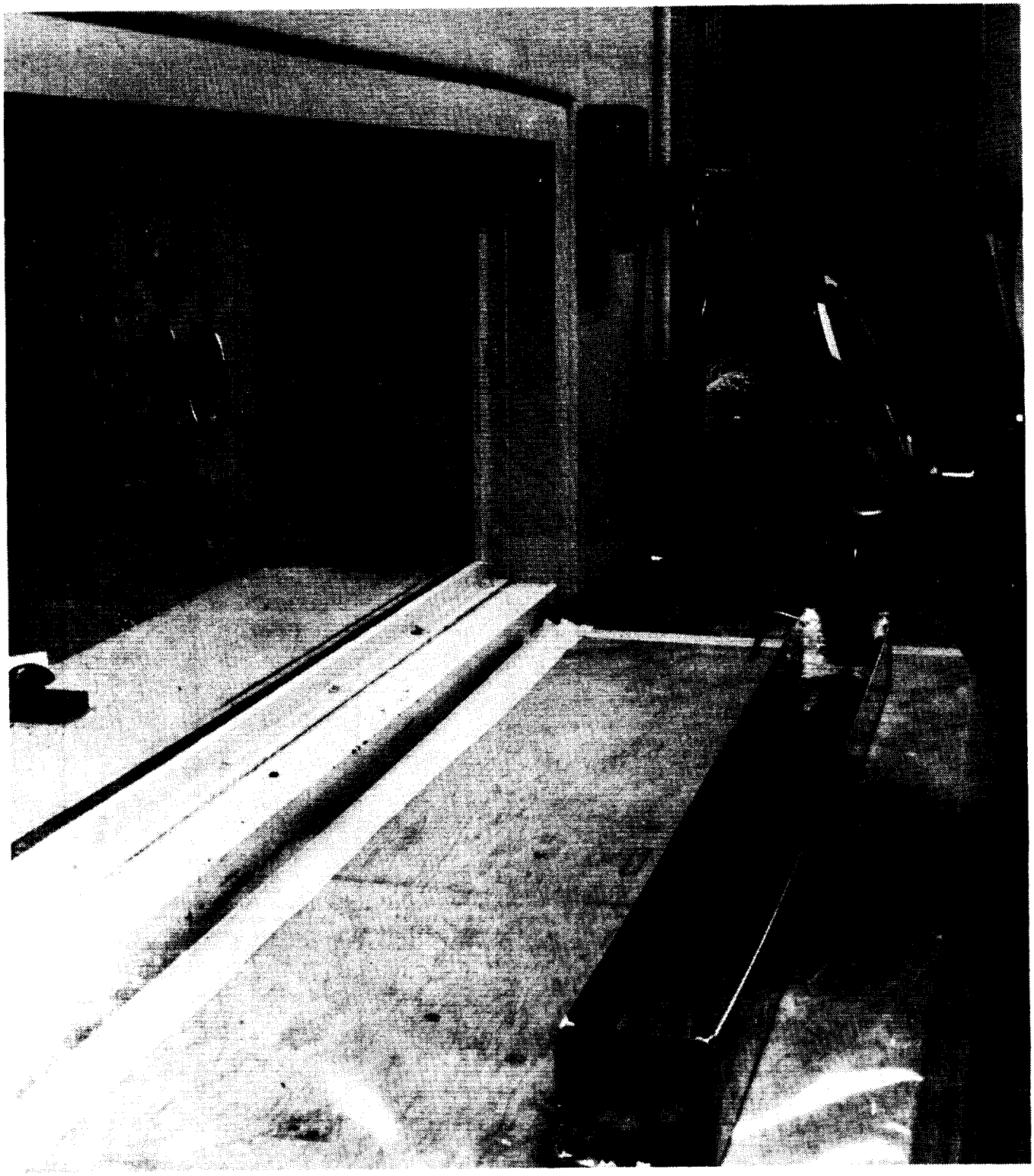


Figure 8-1. Prolonged Pressure Test Setup

SECTION IX

VIBRATION TEST

9.1 TEST REQUIREMENTS

9.1.1 A vibration test will be performed on test specimens 2 and 3, while pressurized with GN_2 to 3000 psig, to determine whether the environment causes degradation or deformation. The test shall be performed in accordance with KSC-STD-164(D), Section 9, figures 9-1 and 9-2, level C.

9.1.1.1 Resonant Frequency Search. The fixture and test specimen assembly shall be exposed to sinusoidal vibration at the input levels shown in table 9-1. A frequency range of 5 to 3000 cps shall be traversed logarithmically in directions of both increasing and decreasing frequency over a time period not to exceed 15 minutes per axis. Actual time shall be noted. All fixture and test specimen resonant frequencies and the structural member in resonance shall be noted. In addition, critical frequencies of the test specimen shall be noted. Critical frequencies are defined as those frequencies at which functional degradation occurs.

Table 9-1. Resonant Frequency Search Levels

Frequency (cps)	Displacement (DA/in.)	Acceleration (g)
5 to 65	0.01	--
65 to 3000	--	2

9.1.1.2 Sinusoidal Sweep. In one 20-minute sweep, the frequency range shall be scanned logarithmically from 10 to 2000 cps and back to 10 cps. Critical frequencies of the test specimen shall be noted. The test item shall be functionally tested after this test has been completed. The sinusoidal sweep input levels shall be as shown in table 9-2.

Table 9-2. Sinusoidal Sweep Vibration Levels

Frequency	Displacement (DA/in.)	Acceleration (g)
10 to 65	0.1	--
65 to 2000	--	20

9.1.1.3 Random Excitation. The test specimen shall be exposed to random vibration at the specified levels over a frequency range from 10 to 2000 cps for a period of 5 minutes. The test specimen shall be pressurized to 3000 psig during random exposure. The test specimen shall be functionally tested after this test has been completed. The specified random input levels shall be as shown in table 9-3.

Table 9-3. Random Excitation Vibration Levels

Frequency (cps)	Slope (db/octave)	PSD (g^2/cps)
10 to 100	+6	--
100 to 1000	--	0.05
1000 to 2000	-6	--

9.1.2 Acceleration shall be measured at the test assembly from accelerometers mounted on the assembly.

9.1.3 The vibration test shall be conducted in three mutually perpendicular axes. The previously described testing is for one axis and shall be completed before proceeding to the next axis.

9.2 TEST PROCEDURE

9.2.1 Resonant Frequency Search

9.2.1.1 The test assembly was mounted on the vibration fixture as shown in figures 9-1 and 9-2.

9.2.1.2 The assembly was pneumatically pressurized with air to 3000 psig.

9.2.1.3 The frequency range of 5 to 3000 cps and back to 5 cps was logarithmically scanned over a time period of 15 minutes in two axes. Input levels are shown in table 9-1.

9.2.1.4 Actual survey time was recorded.

9.2.1.5 All fixture and test item resonant frequencies, and the structural member in resonance were recorded.

9.2.1.6 All critical frequencies were recorded.

9.2.2 Sinusoidal Sweep Test

9.2.2.1 A functional test was performed since 72 hours or more had elapsed since the previous functional test.

9.2.2.2 The frequency range of 10 to 2000 cps and back to 10 cps was logarithmically scanned over a time period of 20 minutes in two axes. Input levels are shown in table 9-2.

9.2.2.3 All critical frequencies were recorded.

9.2.2.4 A functional test was performed after each axis had been completed.

9.2.3 Random Excitation Test

9.2.3.1 The test specimen was subjected to random excitation for 5 minutes in each of two axes while pressurized to 3000 psig with GN_2. The specified random input levels are shown in table 9-3.

9.2.3.2 The test data was recorded.

9.2.3.3 A functional test was performed after each axis had been completed.

9.3 TEST RESULTS

9.3.1 Leakage rated remained approximately the same, during vibration testing, as they did in previous tests.

Test results were considered satisfactory.

9.4 TEST DATA

Test data recorded during the test are presented in table 9-5. Vibration plots are shown in figures 9-3 through 9-5.

Table 9-4. Vibration Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	$\frac{1}{4}$-inch flexible hose
2	Gage, Pneumatic Pressure	Ashcroft	NA	NASA No. 200490-C	0 to 5000 psig $\pm\frac{1}{2}$% FS accuracy Cal. date: 5-21-66
3	Regulator, Hand Loaded	Tescom Corp.	26-1003	NA	6000 psig inlet 4000 psig outlet
4	Filter, Pneumatic	Bendix	1730150	NA	2-micron
5	Valve, 3-Way Solenoid	Marotta	MV-74	NA	3000 psig operating press.
6	Valve, Variable Orifice	Whitey	22F4	NA	micro valve
7	Switch	Cutler-Hammer	ST42D	NA	SP/ST
8	Fixture	CCSD	NA	NA	aluminum
9	Vibration Exciter	MB	C-10	NA	1200-lb. force
10	Monitoring Accelerometers	Endevco	2220	MA39	Crystal
11	Control Accelerometer	Endevco	2217	HC72	Crystal
12	GN_2 Pressure Source	CCSD	NA	NA	3500 psig
13	Power Supply	Lambda	LA50-03BM	NASA No. 010269	28V DC
14	Gage, Pneumatic Pressure	Ashcroft	NA	NASA No. 200490-F	0 to 5000 psig $\pm\frac{1}{2}$% FS accuracy Cal. date: 5-21-66

Table 9-5. Vibration Test Data

	Time (minutes)	Critical Frequency (cps)	Sample Leakage (ml/min)	
			1	2
Y-Axis				
Resonant	12	70 and 1500	---	---
Sine	20	70 and 1500	---	---
Functional	--	---	5.1	5.3
Random	5	---	---	---
Functional	--	---	5.5	5.6
X-Axis				
Resonant	10	250, 1200 and 1600	---	---
Sine	20	250, 1200 and 1600	---	---
Functional	--	---	5.5	5.5
Random	5	---	---	---
Functional	--	---	5.6	5.4

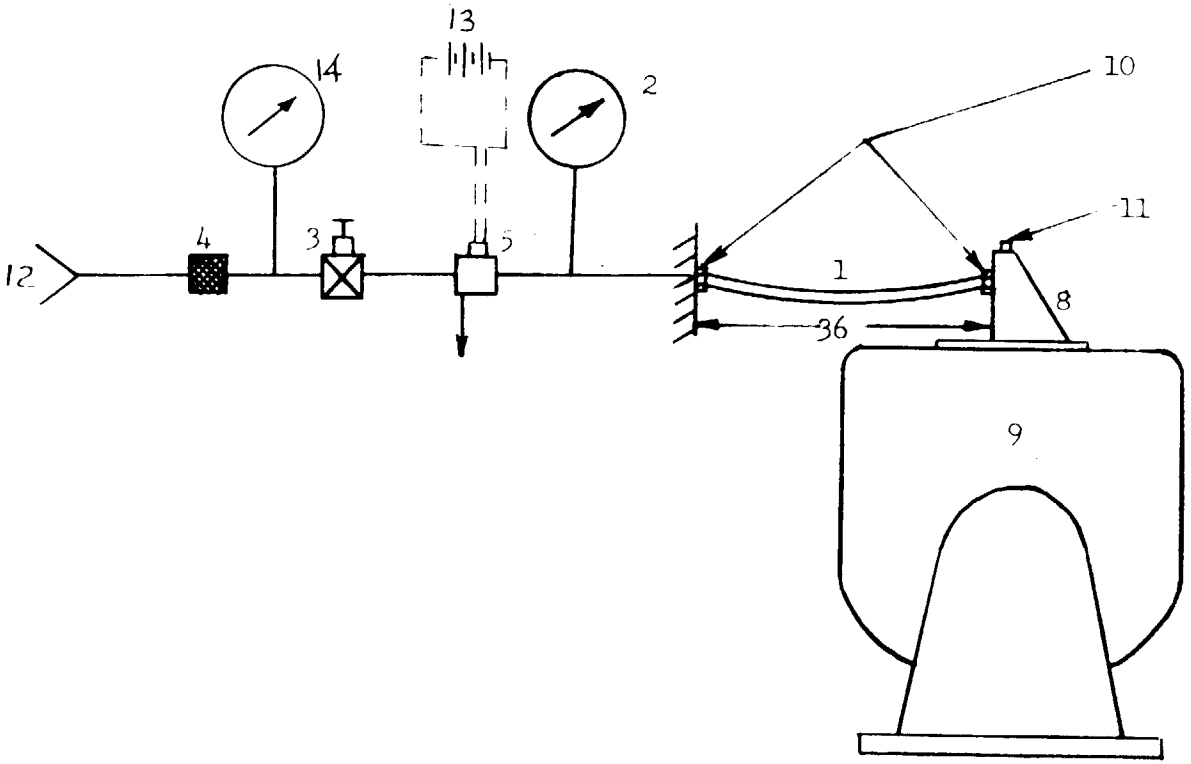


Figure 9-1. Vibration Test Schematic

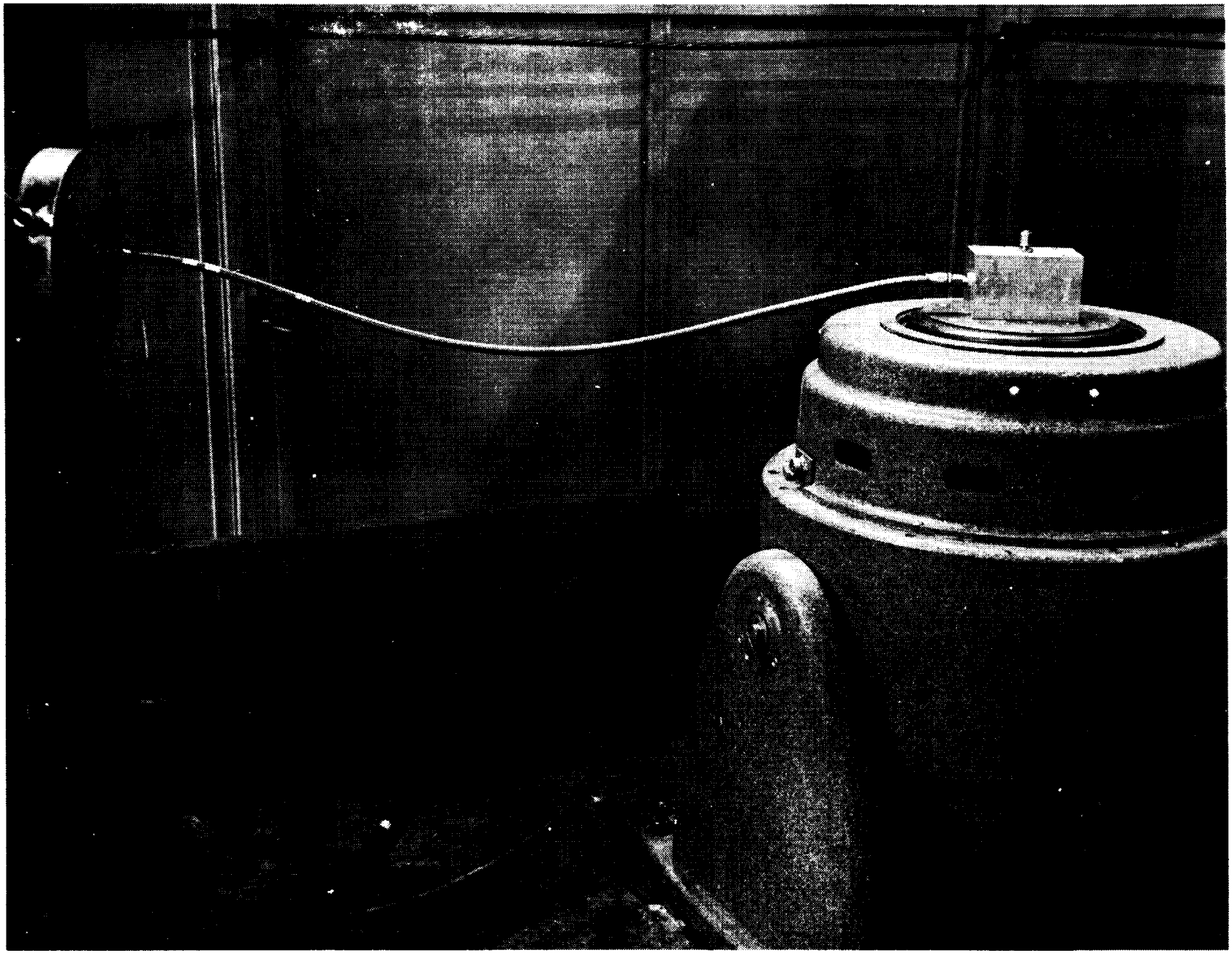


Figure 9-2. Typical Vibration Test Setup

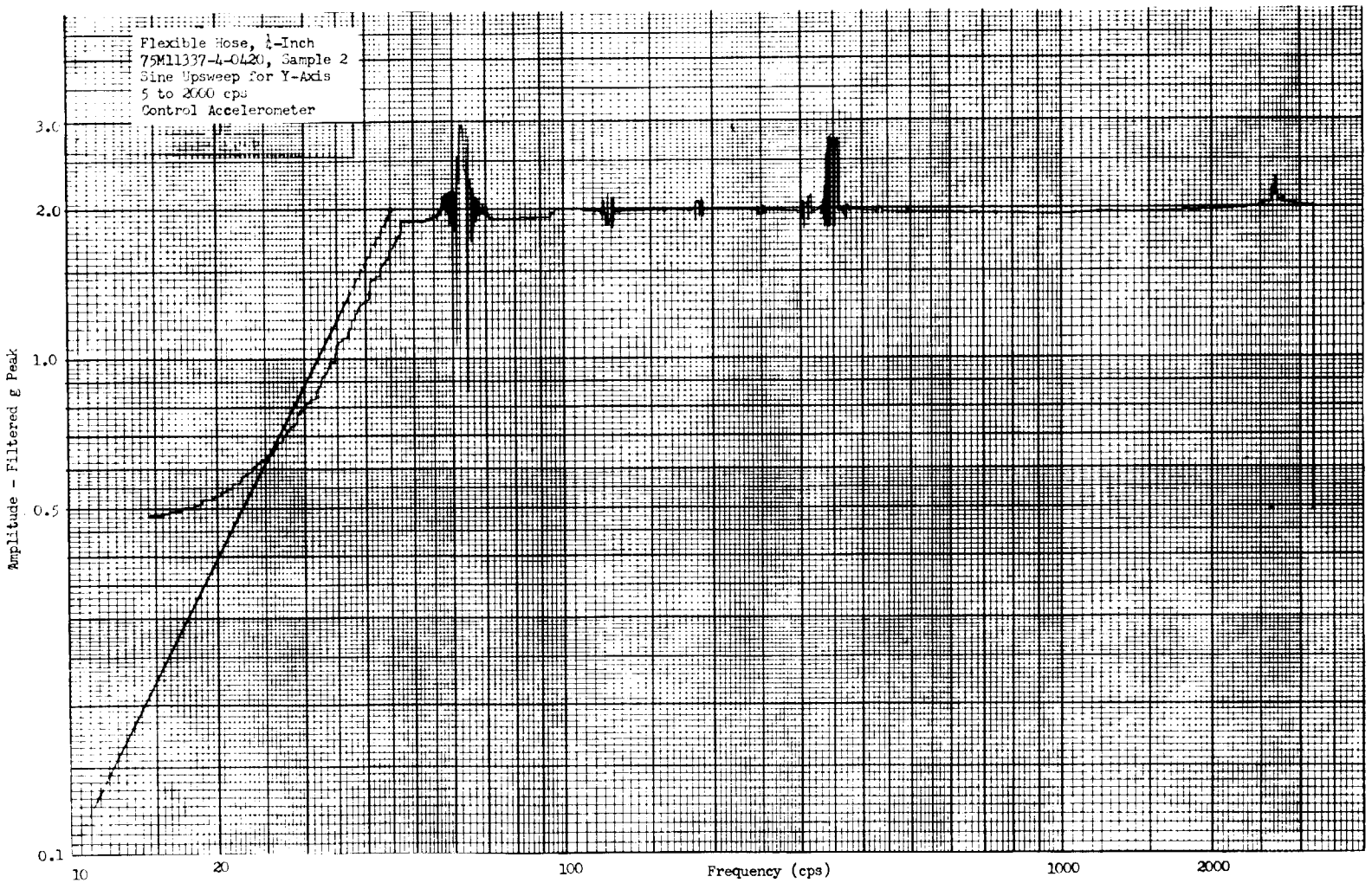


Figure 9-3. Typical Resonant Vibration Plot

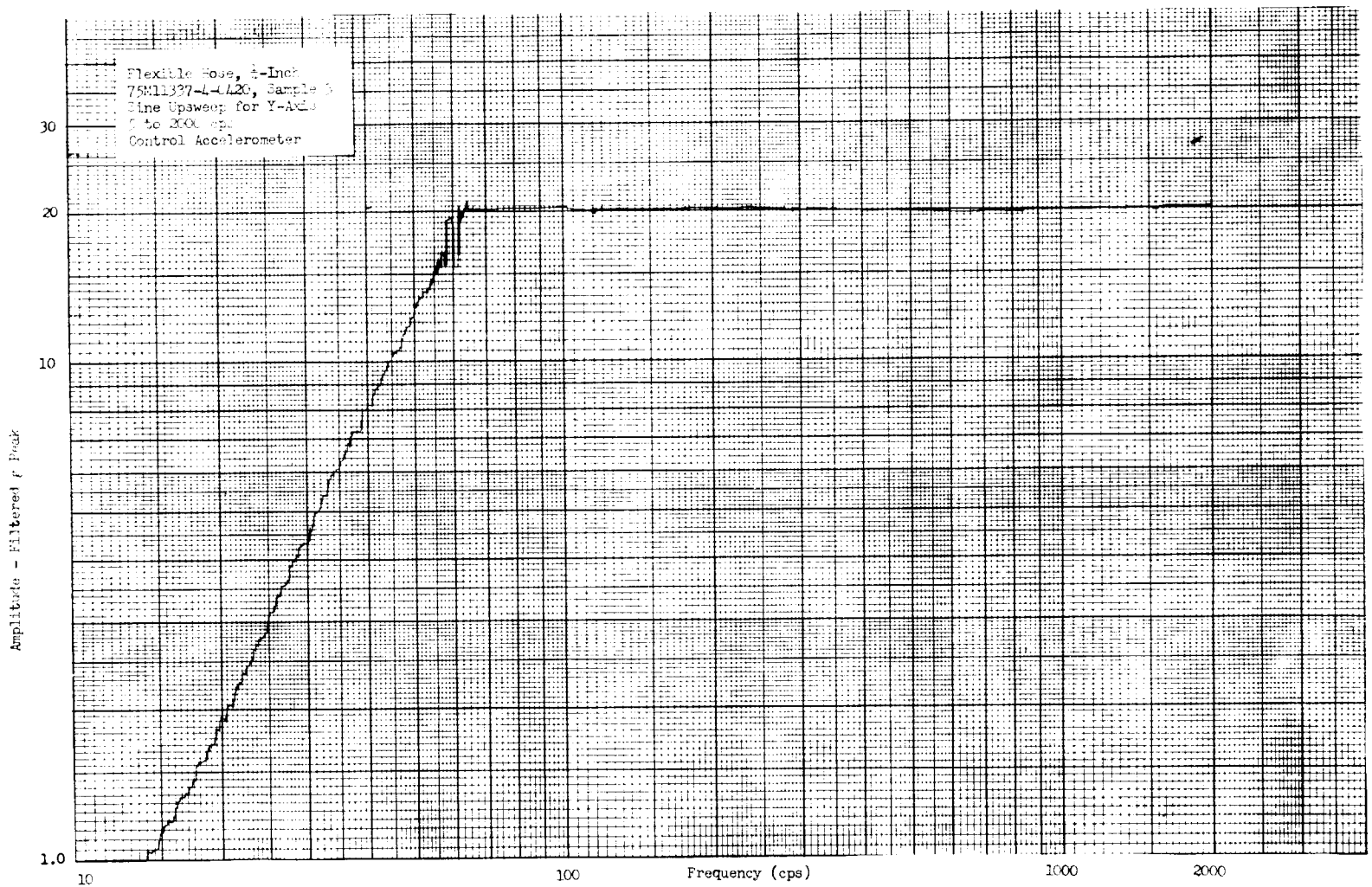


Figure 9-4. Typical Sine Sweep Vibration Plot

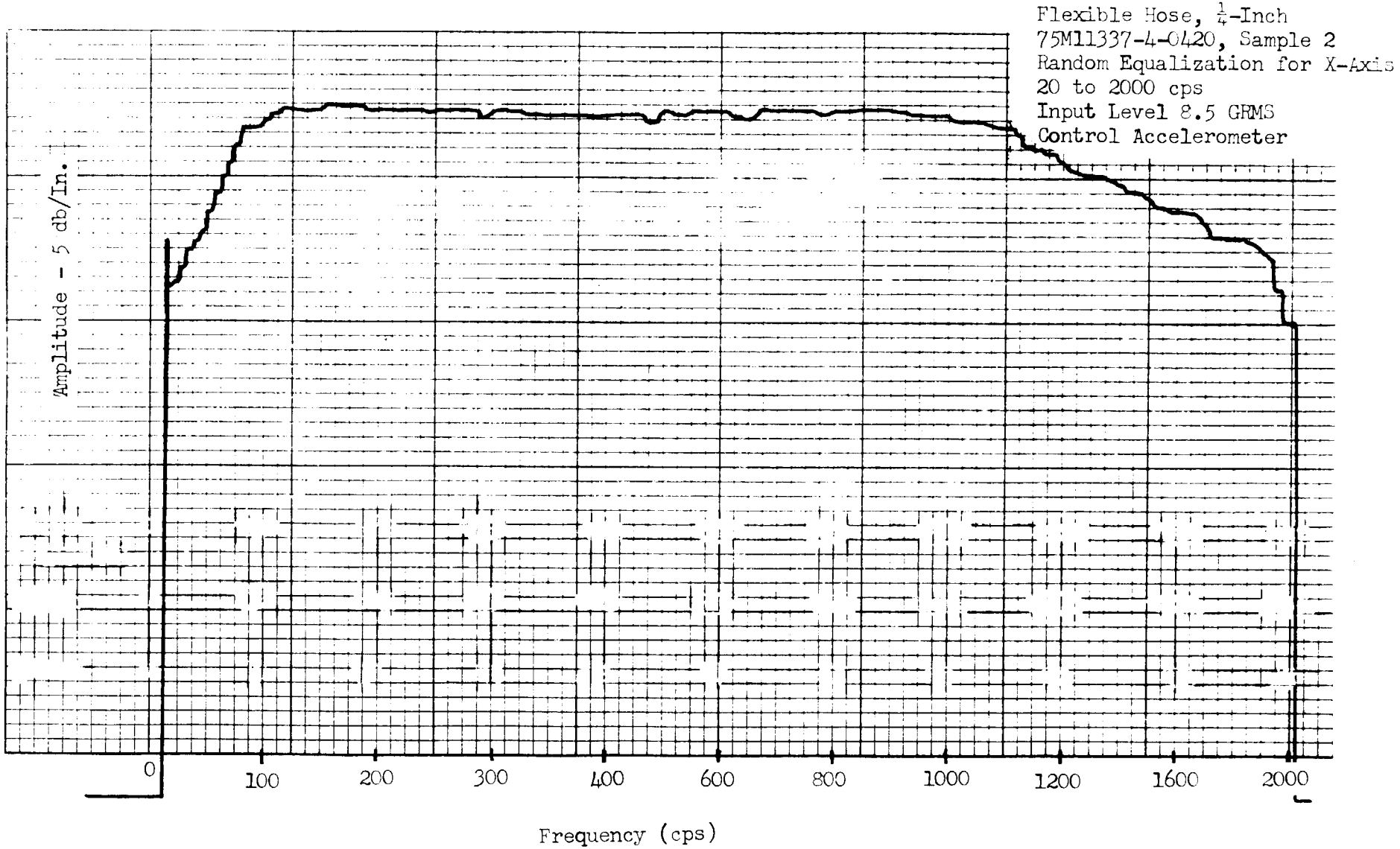


Figure 9-5. Typical Random Vibration Plot

SECTION X

SALT FOG TEST

10.1 TEST REQUIREMENTS

10.1.1 Test specimens 1 and 2 shall be subjected to a salt fog test. The test specimens shall be placed in a test chamber with all the additional equipment described in KSC-STD-164(D). The flexible hoses shall be subjected to an atomized salt solution for a period of 240 (±2) hours.

10.1.2 The solution shall contain 5 parts by weight of salt in 95 parts by weight of water with no more than 200 parts per million of total solids. The specific gravity of the salt solution shall be from 1.023 to 1.037 with a reference temperature of 95 (+2, -1)°F. The salt solution shall also have a pH value of 6.5 to 7.2. Diluted, chemically pure, hydrochloric acid or chemically pure sodium hydroxide may be used to adjust the pH value.

10.1.3 Measurements of the characteristics of the salt solution shall be made according to KSC-STD-164(D).

10.1.4 Following the prolonged exposure of 240 hours, the test specimens shall be subjected to a functional test within 1 hour after returning to room ambient conditions.

10.2 TEST PROCEDURE

10.2.1 The test specimens were visually inspected for corrosion, dirt, and oily films.

10.2.2 The test specimens were placed in the test chamber (see figure 10-1).

10.2.3 The chamber was adjusted so that the temperature was 95 (+4, -2)°F and the clean fog collecting receptacle in the exposure zone would collect from 0.5 to 3.0 milliliters of solution per hour for each 80 cm^2 of horizontal collecting area.

10.2.4 These conditions were maintained for 240 (±2) hours.

10.2.5 At the end of the 240-hour period, the test specimens were removed from the chamber and were allowed to return to room ambient conditions.

10.2.6 Salt deposits were removed as necessary for making mechanical connections.

10.2.7 Within 1 hour after returning to room ambient conditions, a functional test was performed as specified in section IV.

10.2.8 The test specimens were inspected and the salt deposits were removed.

10.2.9 All test data were recorded.

10.3 TEST RESULTS

10.3.1 Leakage remained approximately the same as during the previous test. Results were satisfactory.

10.4 TEST DATA

10.4.1 Functional test data are presented in table 10-1.

Table 10-1. Functional Data For Salt Fog Test

Test	Location	Sample Leakage (ml/min)	
		1	2
Functional 1 hr. after salt fog	Right collar	1.9	1.5
	Left collar	3.1	3.5
	Hose body	0	0

Table 10-2. Salt Fog Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	$\frac{1}{4}$-inch flexible hose
2	Test Chamber, Salt Fog	Industrial Filter and Pump Company	411.1C	S 3632	

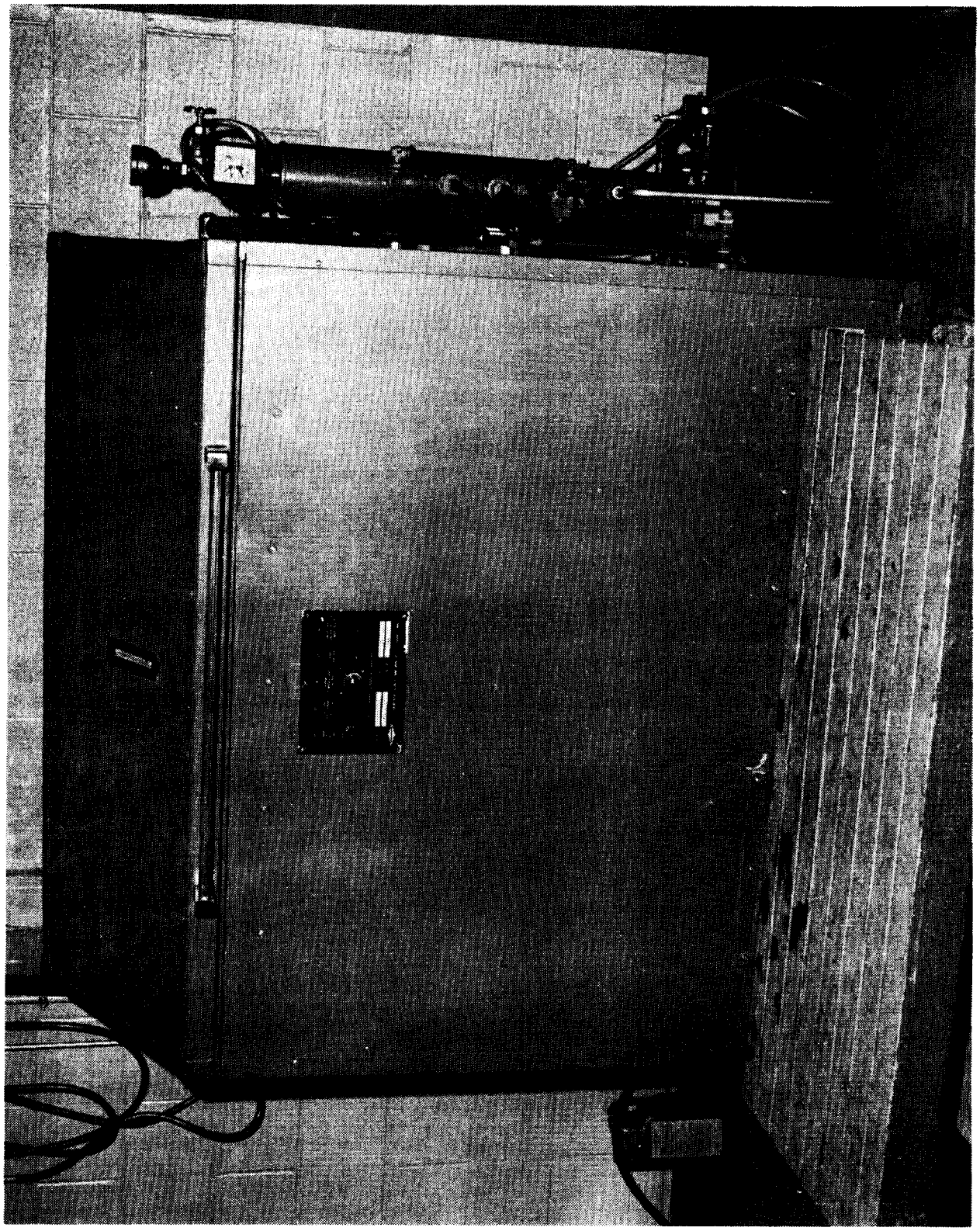


Figure 10-1. Salt Fog Test Chamber

SECTION XI

LIFE CYCLE TEST

11.1 TEST REQUIREMENTS

11.1.1 A life cycle test will be performed on test specimens 1, 2 and 3 to determine whether the environment causes degradation or deformation.

11.1.2 The specimen shall be subjected to 80,000 pressurization cycles. Each cycle shall consist of pneumatically pressurizing the specimen to 3000 psig and depressurizing it back to zero.

11.1.3 A functional test shall be performed to check for leakage after 500, 1000, 5000 and 10,000 cycles, and every 10,000 cycles thereafter.

11.2 TEST PROCEDURE

11.2.1 Test assemblies 1, 2 and 3 were placed in a life cycle test setup as shown in figures 11-1 and 11-2.

11.2.2 The test specimens were subjected to 80,000 pressurization cycles.

11.2.3 A functional test was performed to check for leakage after 500, 1000, 5,000 and 10,000 cycles, and every 10,000 cycles thereafter.

11.3 TEST RESULTS

11.3.1 Test results were satisfactory.

11.4 TEST DATA

Data recorded during the test are presented in table 11-1.

Table 11-1. Functional Data Obtained During Life Cycle Test

No. Cycles	Location	Sample Leakage (ml/min)		
		1	2	3
500	Right collar	1.8	1.7	2.8
	Left collar	3.6	3.4	2.9
	Hose body	0	0.5	0.5
1000	Right collar	2.0	1.6	2.7
	Left collar	3.7	3.9	3.0
	Hose body	0	0.8	0.4
5000	Right collar	1.4	1.7	2.4
	Left collar	4.3	4.1	3.6
	Hose body	0	0.9	0.6
10,000	Right collar	1.8	1.0	2.5
	Left collar	5.2	5.1	3.8
	Hose body	0	0.6	0.6
20,000	Right collar	0.5	0.5	1.4
	Left collar	2.1	1.6	1.2
	Hose body	0	0.5	0.5
30,000	Right collar	0.6	1.6	2.3
	Left collar	2.0	3.9	5.8
	Hose body	0	0.8	0.6
40,000	Right collar	1.1	1.3	2.0
	Left collar	2.3	3.8	2.3
	Hose body	0	0.5	0.2
50,000	Right collar	1.0	1.4	1.7
	Left collar	2.4	4.1	2.1
	Hose body	0	0.4	0.2
60,000	Right collar	1.5	1.8	2.6
	Left collar	3.7	3.6	2.9
	Hose body	0	0.6	0.4
70,000	Right collar	1.5	1.7	1.0
	Left collar	4.1	4.1	2.8
	Hose body	0	0.9	0.5
80,000	**Right collar**	**1.3**	**1.0**	**1.1**
	Left collar	**4.0**	**4.1**	**2.8**
	Hose body	**0**	**0.5**	**0.4**

Table 11-2. Life Cycle Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	$\frac{1}{4}$-inch flexible hose
2	Filter, Pneumatic	Bendix	1730150	NA	2-micron
3	Regulator, Hand Loaded	Tescom Corp.	26-1003	1004	6000 psig inlet 4000 psig outlet
4	Valve, 3-Way Solenoid	Marotta	MV-74	NA	3000 psig operating press.
5	Timer	G. C. Wilson and Company	Model 1	NA	Cam operated
6	Counter	Durant	NA	NA	4-digit
7	Valve, Variable Orifice	Whitey	22F4	NA	micro valve
8	Gage, Pneumatic Pressure	Heise	H 35831	NASA No. 200594-I	0 to 5000 psig ±0.1% FS accuracy Cal. date: 5-24-66
9	Fixture	CCSD	NA	NA	aluminum
10	Switch	Cutler-Hammer	ST42D	NA	SP/ST
11	GN_2 Pressure Source	CCSD	NA	NA	3500-psig
12	Power Supply	Perkins Electronics	MRST 28-300A	NASA No. 009941 S/N 63-293	28V DC, 3 amp
13	Gage, Pneumatic Pressure	Ashcroft	NA	NASA No. 200594-O	0 to 5000 psig ±.5% accuracy Cal. date: 5-24-66
14	Gage, Pneumatic Pressure	Ashcroft	NA	NASA No. 200594-N	0 to 5000 psig ±0.5% FS accuracy Cal date: 5-24-66

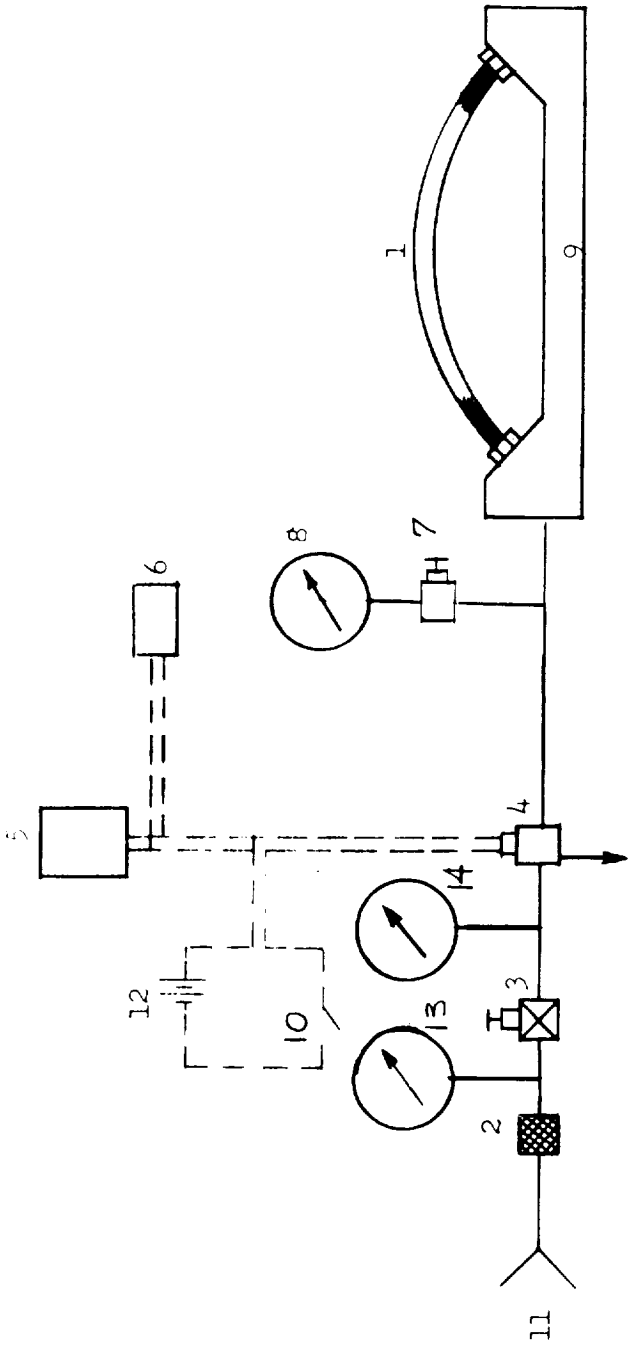


Figure 11-1. Life Cycle Test Schematic

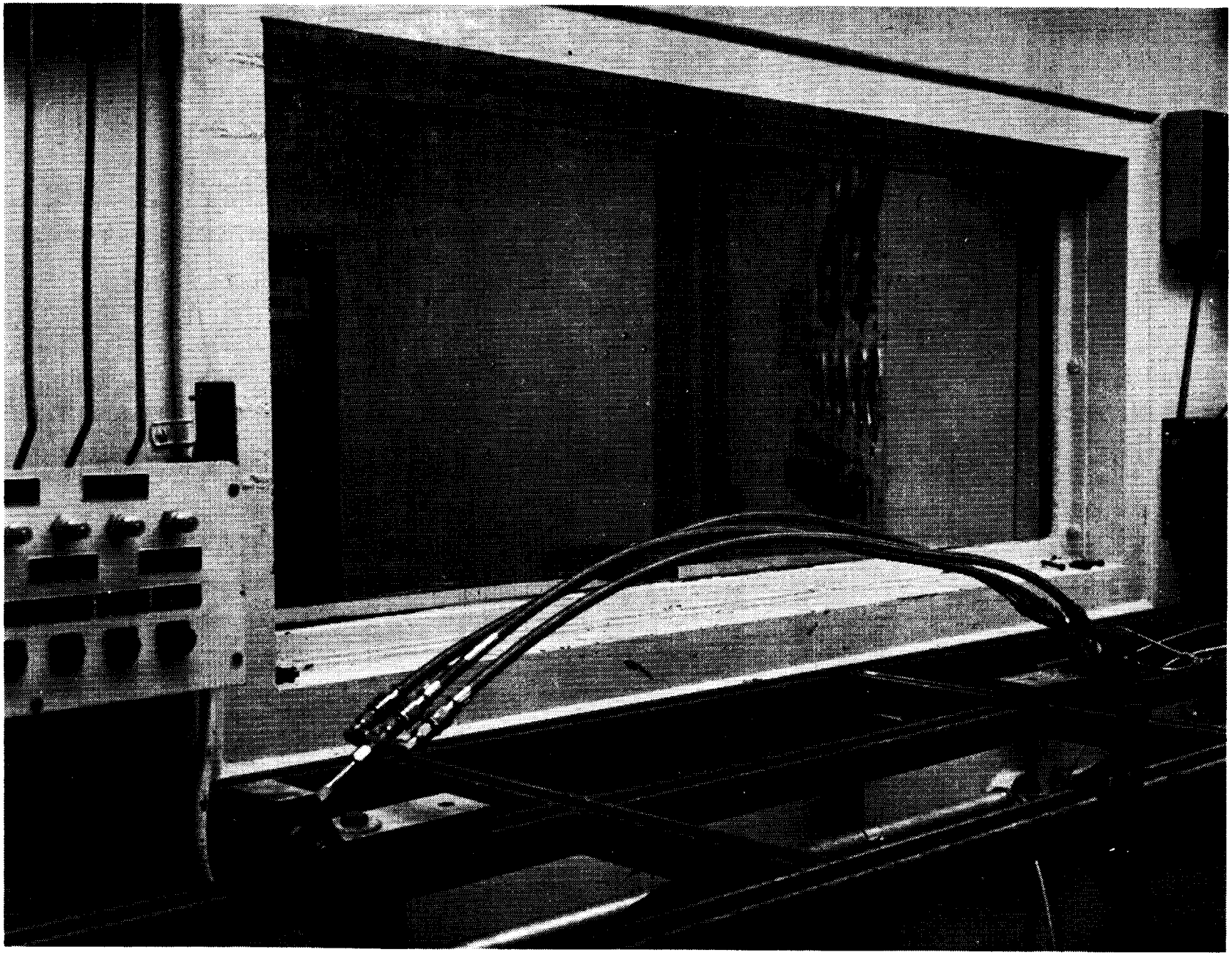


Figure 11-2. Life Cycle Test Setup

SECTION XII

FLEXURE TEST

12.1 TEST REQUIREMENTS

12.1.1 A flexure test will be performed on test assemblies 1 and 2, while pressurized with GN_2 to 3000 psig, to determine whether the environment causes degradation or deformation.

12.1.2 The test specimen shall be bent near the fitting end to as close to the minimum bend radius (3.00 inches) as possible while the specimen is under operating pressure. Bending of the specimen should be repeated 1,000 times.

12.1.3 Leakage shall be monitored by noting gage pressure drop throughout the test.

12.2 TEST PROCEDURE

12.2.1 A functional test was not required since 72 hours had not elapsed since the previous functional test.

12.2.2 Test assemblies 1 and 2 were placed in a flexure test setup as shown in figures 12-1 and 12-2.

12.2.3 The test specimen was bent near the fitting end to as close to the bend radius (3.00 inches) as possible while at operating pressure. The specimen was bent 1,000 times.

12.2.4 The specimen was inspected for broken wire strands and deterioration of the Teflon lining after 25, 50, and 100 cycles, and each 100 cycles thereafter.

12.2.5 Leakage was monitored throughout the test.

12.2.6 A functional test was performed within 1 hour following completion of testing. All data were recorded.

12.3 TEST RESULTS

12.3.1 Leakage remained the same as prior to the flexure test, therefore pressure drop could not be monitored. The drop was so great over this time interval that the supply pressure had to be regulated.

12.4 TEST DATA

Functional test data are presented in table 12-1.

Table 12-1. Functional Data For Flexure Test

Test	Location	Sample Leakage (ml/min)	
		1	2
Ambient functional	Right collar	1.8	1.7
	Left collar	3.2	3.6
	Hose body	0	0

Table 12-2. Flexure Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	$\frac{1}{4}$-inch flexible hose
2	Gage, Pneumatic Pressure	Heise	H35833	NASA No. 200617-D	0 to 3500 psig +.1% FS accuracy Cal date: 12-28-66
3	Regulator, Hand Loaded	Tescom Corp.	26-1003	322	0 to 4000 psig
4	Filter, Pneumatic	Bendix	1730150	NA	2-micron
5	Valve, 3-Way Solenoid	Marotta	MV-74	NA	3000 psig operating press.
6	Valve, Variable Orifice	Whitey	22F4	NA	micro valve
7	Switch	Cutler-Hammer	ST42D	NA	SP/ST
8	Motor, Electrical	Wagner	J599K4199	NA	1725 rpm
9	Gear Box	Reductor-Boston, Mass.	Type U	NA	Ratio: 50 to 1
10	Drive Wheel	CCSD	NA	NA	aluminum
11	Drive Rod	CCSD	NA	NA	aluminum
12	Guide Plate	CCSD	NA	NA	aluminum
13	GN_2 Pressure Source	CCSD	NA	NA	3500-psig
14	Power Supply	Perkins Electronics	MRST28-300A	NASA No. 009941 S/N 63-293	28V DC, 3 amp

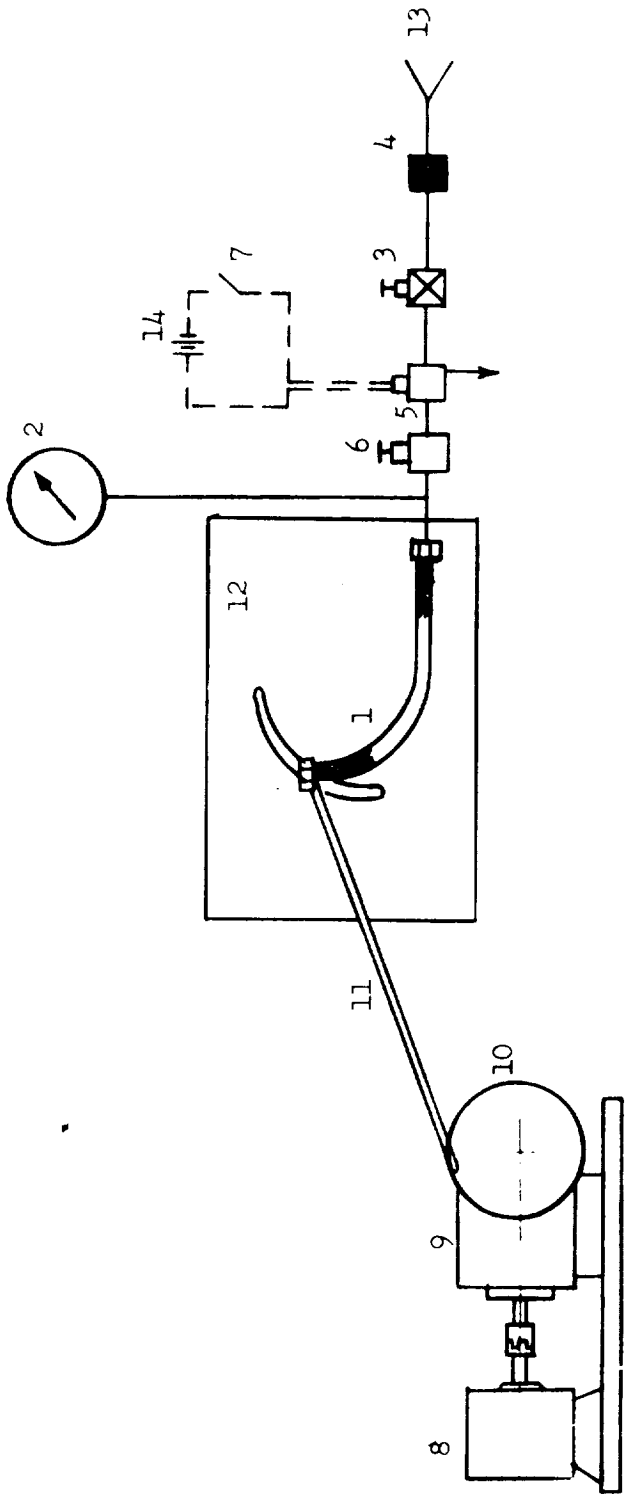


Figure 12-1. Flexure Test Schematic

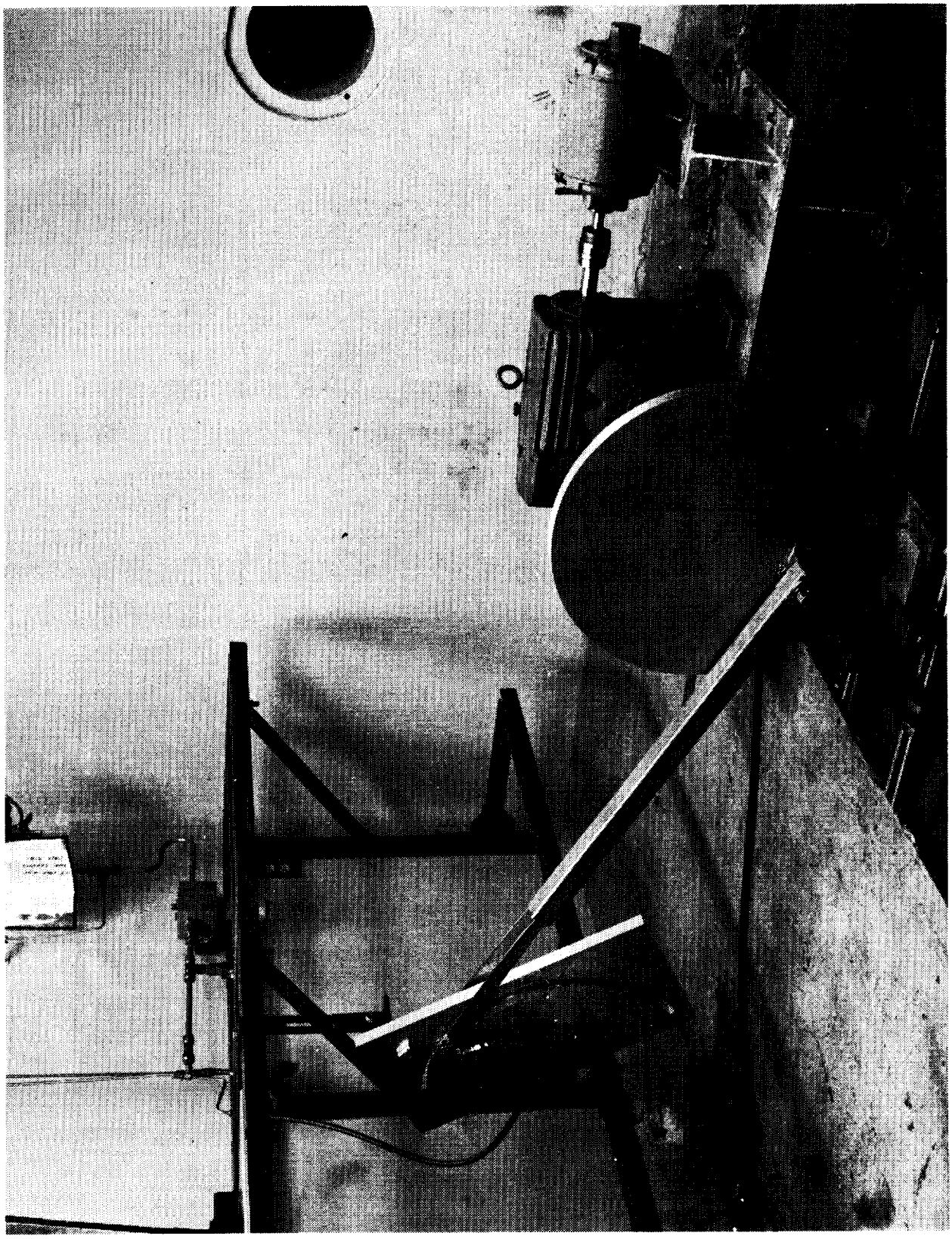


Figure 12-2. Flexure Test Setup

SECTION XIII

BURST TEST

13.1 TEST REQUIREMENTS

13.1.1 A burst pressure test will be performed on test assemblies 1, 2 and 3 to determine whether the assemblies will satisfy minimum burst pressure requirements.

13.1.2 The minimum burst pressure shall be maintained for 5 minutes.

13.1.3 Visual inspection shall be given for specimen structural damage and leakage.

13.1.4 Pressurization of the specimen shall be continued until rupture occurs.

13.1.5 The rupture pressure shall be recorded.

13.2 TEST PROCEDURE

13.2.1 Test specimens 1, 2 and 3 were placed in a burst test setup as shown in figure 13-1.

13.2.2 The specimens were pressurized hydrostatically to 12,000 psig for a period of 5 minutes.

13.2.3 Leakage was monitored throughout the test.

13.2.4 The specimens were inspected for structural damage.

13.2.5 The specimens were pressurized until rupture occurred.

13.2.6 The rupture pressure was recorded.

13.3 TEST RESULTS

13.3.1 All three test specimens exceeded the minimum allowable burst pressure of 12,000 psig. **No leakage was observed.**

13.4 TEST DATA

13.4.1 Specimen 1 burst at 19,000 psig.
Specimen 2 burst at 19,500 psig.
Specimen 3 burst at 18,000 psig.

Table 13-1. Burst Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Aeroquip Corp.	675003-4-0420	NA	$\frac{1}{4}$-inch flexible hose
2	Hydrostatic Pressure Source	CCSD	NA	NA	Variable: 0 to 20,000 psig
3	Gage, Hydrostatic Pressure	Astra	NA	NASA No. 011893-A	0 to 100,000 psig $\pm$1% FS accuracy Cal. date: 11-2-66
4	Chamber, Burst	CCSD	NA	NA	steel
5	Valve, Hand	Robbins Aviation Company	SSKG 250-4T	NA	$\frac{1}{4}$-inch

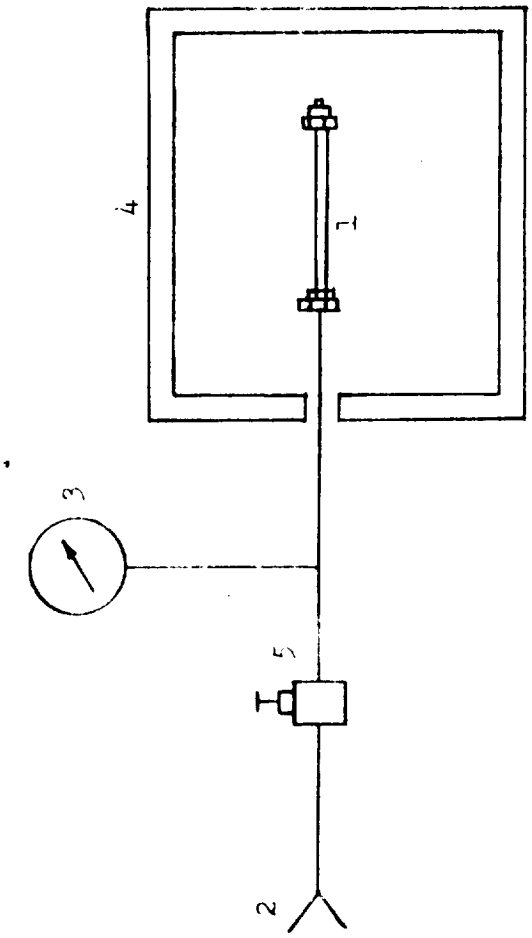


Figure 13-1. Burst Test Schematic

APPROVAL

TEST REPORT

FOR

FLEXIBLE HOSE, $\frac{1}{4}$-INCH, 3000-PSIG

Aeroquip Corporation Part Number 675003-4-0420

NASA Drawing Number 75M11337-4-0420

SUBMITTED BY:

Robert Kolowith

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