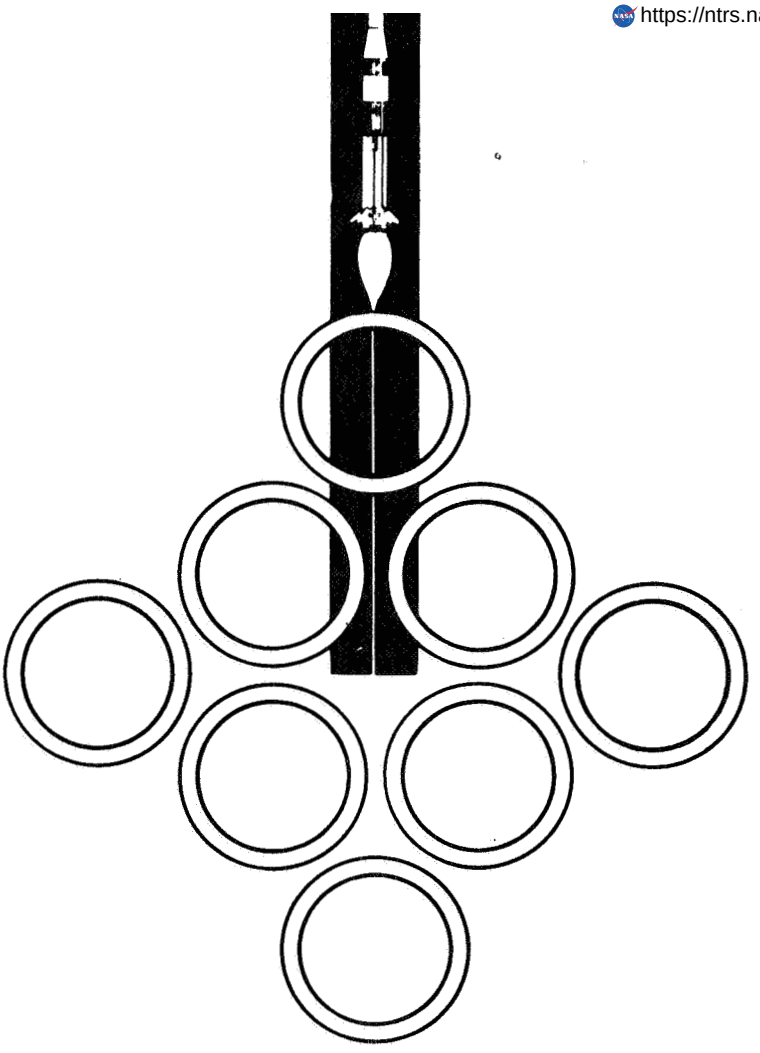

ENGINEERING DEPARTMENT

TECHNICAL REPORT

TR-RE-CCSD-FO-1110-3F

August 18, 1967

SATURN IB PROGRAM

TEST REPORT
FOR

8-INCH CHECK VALVE

Mission Valve and Pump Company Part Number 15 CPF-311

NASA Drawing Number 75M17763 HCV-9

SPACE DIVISION CHRYSLER CORPORATION

TEST REPORT

FOR

8-INCH CHECK VALVE

Mission Valve and Pump Company Part Number 15 CPF-311

NASA Drawing Number 75M17763 HCV-9

ABSTRACT

This report presents the results of the tests performed on one specimen of 8-Inch Check Valve 75M17763 HCV-9. The following tests were performed on the test specimen:

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. High Temperature
5. Surge
6. Flow
7. Cycle
8. Burst

The specimen successfully completed the above tests but failed to meet the functional leakage requirements of the John F. Kennedy Space Center as stated in TP-RE-CCSD-FO-1110-2F and NASA Drawing 75M17763 HCV-9.

Internal leakage rates were consistently above the maximum allowable leakage rate of 40 sccm during the test program.

Following installation of the Teflon-coated leaf pin and Teflon washers (see appendix A) the cracking pressure was within or below the specified range of 0.15 psig $\pm$20 percent.

TEST REPORT

FOR

8-INCH CHECK VALVE

Mission Valve and Pump **Company Part** Number 15 CPF-311

NASA Drawing Number 75M17763 HCV-9

August 18, 1967

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.

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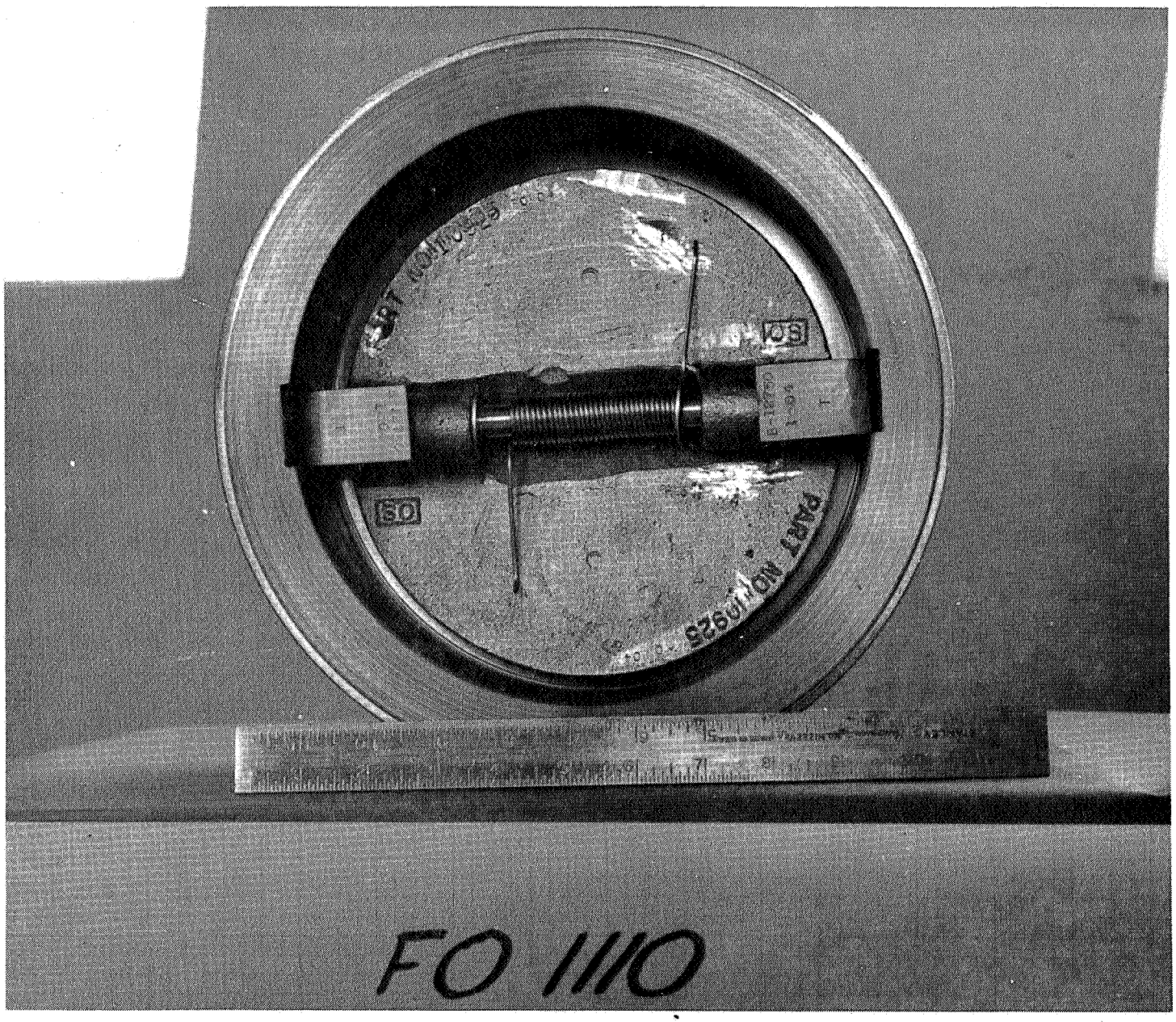


Check Valve 75M17763 HCV-9

CHECK SHEET

FOR

8-INCH CHECK VALVE

MANUFACTURER: Mission Valve and Pump Company
MANUFACTURERS PART NUMEBER: 15 CPF-311 Model C
NASA DRAWING NUMBER: 75M17763 **HCV-9**
TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana
AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A.	OPERATING MEDIUM:	GH2 at -400°F
B.	OPERATING PRESSURE:	75 psig
C.	PROOF PRESSURE;:	98 psig
D.	VALVE CAPACITY (C_V):	1900 (minimum)
E.	CRACKING PRESSURE:	0.15 psig ±20 percent

II. CONSTRUCTION MATERIAL

A.	BODY:	316 CRES
B.	END CONNECTIONS:	To mate with 8-inch 150-pound ASA raised face flange.

III. ENVIRONMENTAL REQUIREMENTS

	OPERATING TEMPERATURE:	-423 to +125°F

IV. LOCATION AND USE:

Used in the LH_2 system vaporizer units and the hydrogen vent located on the umbilical tower at John F. Kennedy Space Center Launch Complexes 34 and 37B.

TEST SUMMARY

8-INCH CHECK VALVE

Environment	Units	Operational Boundary	Test Objective	Test Results	Remarks
Receiving Inspection	1	Compliance with NASA and vendor drawings	Check for compliance with NASA and vendor drawings	Satisfactory	No evidence of poor workmanship or manufacturing defects
Proof Pressure	1	Pressurize to 98 psig for 5 minutes	Check for leakage and distortion	Satisfactory	No leakage or dkstortion
Functional Test	1	Pressurize specimen outlet to 5, 10, and 15 psig. The specimen cracking pressure shall be 0.15 psig ±20%	Check for internal and external leakage at 5, 10, and 15 psig using GH_2 at -400°F and GN_2. Determine specimen cracking pressure using GH_2 at -400°F and GN_2. Check leakage and cracking pressure in both horizontal and vertical position.		Internal leakage was above specified maximum of 40 sccm. In horizontal position, GN2 cracking pressure was below range and GH2 cracking pressure was above the specified range. In vertical position, cracking pressure was above specified range. There was no external leakage.
High Temperature Test	1	160°F for 72 hours	Determine if specimen operation, is impaired by high temperature environment		During and following high temperature exposure, internal leakage was above 40 sccm. During and following high temperature exposure, GN_2 and GH2 cracking pressures were above specified range.

TEST SUMMARY (CONTINUED)

8-INCH CHECK VALVE

Environment	units	Operational Boundary	Test Objective	Test Results	Remarks
Surge Test	1	0 to 65 psig within 100 milliseconds	Determine if specimen operation is impaired by surge		Following 25 and 50 surges to specimen inlet and outlet, internal leakage was above 40 sccm. GN_2 cracking pressure was above specified range following 25 and 50 inlet and outlet surges. GH_2 cracking pressure was above specified range following 25 inlet and 50 outlet surges, GH_2 cracking pressure was below specified range following 25 outlet and 50 inlet surges.
Installation of Teflon-coated Leaf Pin and Teflon Washers	1	Functional check	Check specimen operation after installation of Teflon leaf pin and washers		Internal leakage above 40 sccm. GN_2 cracking pressure was within specified range. GH_2 cracking pressure was below specified range.
Flow Test	1	Maintain specimen inlet pressure of 1 psig and vary specimen differential pressure from 0.1 to 1.0 psid	Determine flow over specimen differential pressure range of 0.1 to 1 psid while maintaining specimen inlet at 1 psig		Following flow test, internal leakage was above 40 sccm. Cracking pressure was below range.

TEST SUMMARY (CONTINUED)

8-INCH CHECK VALVE

Environment	Units	Operational Boundary	Test Objective	Test Results	Remarks
Flow Test (Continued)		Maintain specimen inlet pressure of 65 psig and vary specimen differential pressure from 0.1 to 0.4 psid	Determine flow over specimen differential pressure range of 0.1 to 0.4 psid while maintaining specimen inlet at 65 psig		
Cycle Test	1	1000 open-close cycles	Determine if specimen operation is impaired by cycling		Following 50, 100, 500, and 1000 cycles, internal leakage was above 40 sccm. Following 50, 100, 500, and 1000 cycles, GN_2 and GH_2 cracking pressures were below specified range.
Burst Test	1	260 psig. for five minutes	Check for leakage and distortion	Satisfactory	There was no leakage or distortion.

SECTION I

INTRODUCTION

1.1 SCOPE

This report presents the results of tests performed to determine if Check Valve 75M17763 HCV-9 meets the operational and environmental requirements for the John F. Kennedy Space Center Launch Complexes 34 and 37B. A summary of the test results is presented on pages viii through x.

1.2 ITEM DESCRIPTION

Check Valve 75M17763 HCV-9 is an 8-inch, unidirectional flow valve and is used in the LH_2 system vaporizer Units and on the S-IVB hydrogen vent line located on the umbilical tower.

1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for Check Valve 75M17763 HCV-9:

a. KSC-STD-164(D), Standard Environmental Test Methods for Ground Support Equipment Installations at Cape Kennedy

b. NASA Drawing 75M17763 HCV-9

c. Cleaning Standard MSFC-STD-164

d. Test Plan CCSD-FO-1110-1F

e. Test Procedure CCSD-FO-1110-2F

SECTION II

RECEIVING INSPECTION

2.1 REQUIREMENTS

The specimen shall be visually and dimensionally inspected for conformance with the applicable specifications prior to testing.

2.2 PROCEDURE

Perform a visual and dimensional inspection of the specimen to determine compliance with NASA drawing 75M17763 HCV-9 and the applicable vendor drawing to the extent possible without disassembly of the test specimen. At the same time the test specimen shall also be inspected for poor workmanship and manufacturing defects.

2.3 TEST RESULTS

The specimen successfully complied with the requirements of NASA drawing 75M17763 HCV-9. No evidence of poor workmanship or manufacturing defects was observed.

2.4 TEST DATA

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

Table 2-1. Specimen Specifics

Name	Check Valve
Serial No.	None
Size	8-inch
Model No.	15 CPF-311 Model C
Material	316 Stainless Steel
Diameter	11-inch
Thickness	5-inch
End Connections	ASA 150 lb, 8-in. Raised Face Flanges

SECTION III

PROOF PRESSURE TEST

3.1 TEST REQUIREMENTS

3.1.1 The test specimen shall be pressurized with GN_2 to a proof pressure of 98 psig. This pressure shall be maintained for 5 minutes.

3.1.2 The test specimen shall be checked for leakage and distortion.

3.2 TEST PROCEDURE

3.2.1 The proof pressure test setup as shown in figures 3-1 and 3-2 was assembled using the equipment listed in table 3-1.

3.2.2 All connections were determined to be tight, gages were installed and all valves were closed.

3.2.3 Valves 3 and 7 were closed, and the specimen was pressurized to 98 psig by adjusting regulator 6. The pressure was monitored on gage 8.

3.2.4 Hand valve 7 was closed and the specimen was checked for leakage over a 5-minute period by monitoring gage 8 for an indication of a drop in pressure at the specimen. The initial and final pressures were recorded.

3.2.5 Valve 3 was closed and the system and specimen were vented by opening valves 7 and 9. The specimen was checked for distortion.

3.3 TEST RESULTS

3.3.1 The test specimen was pressurized to 98 psig with GN_2 for five minutes.

3.3.2 There was no evidence of distortion or leakage.

3.4 TEST DATA

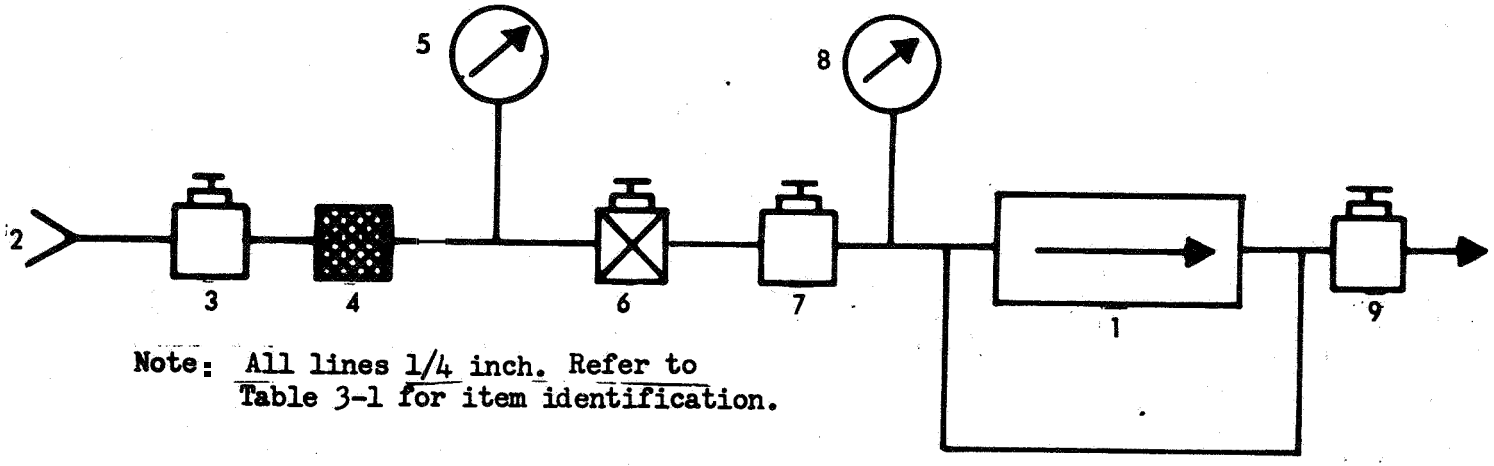
The test data presented in table 3-2 were recorded during the proof pressure test.

Table 3–1. Proof Pressure Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Mission Valve and Pump Company	15 CPF-311	None	8-inch check valve
2	GN_2 Pressure Source				3200-psig
3	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	1/4-inch
4	Filter	Bendix	6-13460 16-B-0	NA	2-micron
5	Pressure Gage	Duragage		200617-F	0-to 5000-psig ±1.0% FS Cal date 12-24-66
6	Regulator	Tescom Corp.	26-1003	1001	1-to 3000-psig inlet 0-to 500-psig outlet
7	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	1/4-inch
8	Pressure Gage	Heise			0-to 100-psig ±0.5% FS Cal date 5-23-67
9	Vent Valve	Robbins Aviation	SSKG-250-4T	NA	1/4-inch

Table 3-2. Proof Pressure Test Data

Initial Pressure	98 psig
Pressure After Five Minutes	98 psig
Leakage	None
Distortion	None



Note: All lines 1/4 inch. Refer to Table 3-1 for item identification.

Figure 3-1. Proof Pressure Test Schematic

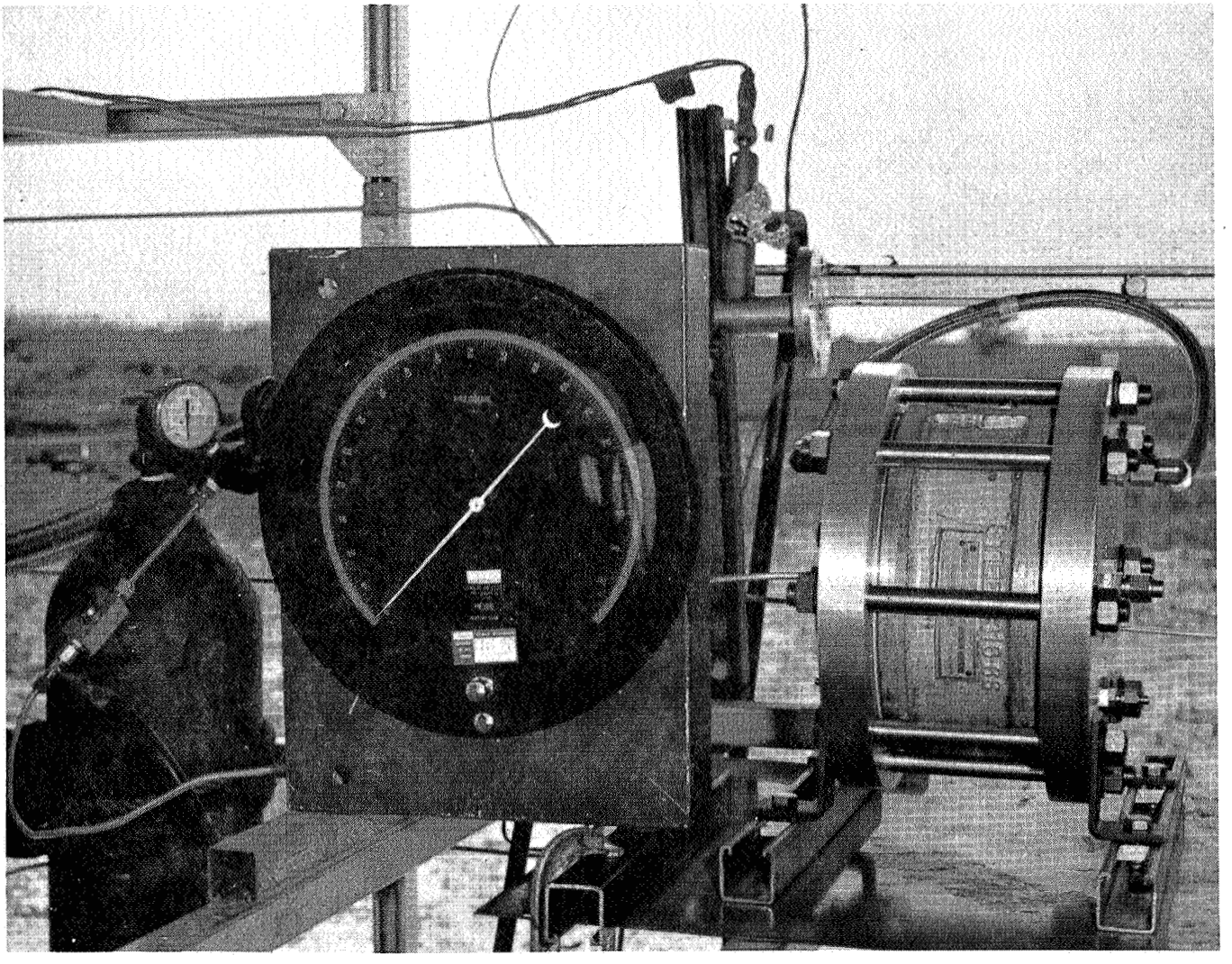


Figure 3-2. **Proof Pressure Test Setup**

SECTION IV

FUNCTIONAL TEST

4.1 TEST REQUIREMENTS

4.1.1 The specimen shall be installed in the horizontal position.

4.1.2 The inlet port of the test specimen shall be subjected to three pressurization cycles. A cycle shall consist of pressurizing the inlet port of the specimen from zero to 65 psig and then back to zero. GN_2 shall be used as the test medium.

4.1.3 The outlet port of the specimen shall be pressurized with GN2 to 5, 10, and 15 psig. The specimen shall be checked for external and internal leakage. No external leakage is allowed and the internal leakage shall not be greater than 40 sccm.

4.1.4 The inlet port of the test specimen shall be slowly pressurized to 1.0 psig and the cracking pressure shall be recorded. The cracking pressure shall be 0.15 **psig** $\pm$20 percent. GN_2 shall be used as the test medium.

4.1.5 The procedures described in 4.1.2 and 4.1.3 shall be performed as required to obtain consistent data.

4.1.6 The procedures described in 4.1.1 through 4.1.5 shall be repeated using GH_2 at -400°F as the test medium.

4.1.7 During the initial functional test only the procedures described in 4.1.2 through 4.1.5 shall be repeated while the specimen is mounted in the vertical position.

4.2 TEST **PROCEDURE**

4.2.1 TESTS WITH GN_2

4.2.1.1 The specimen was installed in the horizontal position with the post vertical as shown in figure 4-1 and with equipment as listed in table 4-1.

4.2.1.2 All connections were determined to be tight, all gages were installed, and all valves were closed.

4.2.1.3 Pneumatic valves 6 and 9 were opened and valve 19 was cracked. The specimen was pressurized with GN_2 to 65 psig by adjusting regulator 4. The pressure was monitored by means of transducer 17. Pneumatic valve 6 was closed and the system was vented to zero by opening pneumatic valve 16. This constituted one cycle. Three cycles were performed.

4.2.1.4 The specimen was installed using check valve installation B as shown in figure 4-1. All valves were determined to be closed.

4.2.1.5 Pneumatic valves 6 and 9 were opened and the specimen was pressurized with GN2 to 5, 10, and 15 psig by adjusting regulator 4. The pressure was monitored by means of transducer 17.

4.2.1.6 Valve 6 was closed and the specimen was checked for external leakage at 5, 10, and 15 psig monitoring transducer 17 for a drop in pressure. No external leakage was permitted. Internal leakage was checked at 5, 10, and 15 psig by monitoring flowmeter 20. The allowable internal leakage was 40 sccm. All data were recorded.

4.2.1.7 Pneumatic valve 8 was opened and the system was vented.

4.2.1.8 The specimen was installed as shown in figure 4-1 using check valve installation A and all valves were determined to be closed.

4.2.1.9 Pneumatic valves 6, 9, and 23 were opened and valve 19 was cracked. The specimen was pressurized with GN2 to 1 (+0, -0.2) psig by adjusting regulator 4. The pressure was monitored by means of transducer 17A. Pneumatic valves 6 and 23 were closed and the specimen was depressurized to zero by venting through valve 19.

4.2.1. 10 The cracking pressure of the specimen was determined from the data provided by oscillograph 21 during the test, described in 4.2.1.9. The specimen cracking pressure was 0.15 psig $\pm$20 percent.

4. 2.1.11 Tests described in 4.2.1.4 through 4.2.1.10 were repeated as often as necessary to obtain consistent data.

4.2.1.12 During the initial functional test *only*, the specimen was reinstalled in the vertical position and the tests described in 4.2.1.1 through 4.2.1.11 were repeated.

4.2.1.13 The specimen was installed in the horizontal position as shown in figure 4-1 using check valve installation C. A 1/4-inch flex hose was attached to the specimen. (The maximum length of the flex hose was 12 inches.) A lab tray was filled with water at a temperature of 70°F and leakage detector 22 (graduated tube) and the flex hose were placed in the tray as shown.

4.2.1.14 All valves were opened and the complete test system and specimen were purged with GN_2 to remove all oxidizing gases. All valves were closed and a minimum of 5-psig GN_2 was trapped in the system.

4.2.2 TESTS WITH GH_2

4.2.2.1 Pneumatic valve 14 was opened and control regulator 12 was cracked. The system was pressurized with GH_2 at 5 psig from GH_2 source 10. GH_2 was allowed to flow through the system until thermocouple 18 indicated a temperature of -400°F. Pneumatic valve 14 was closed and 5-psig GH_2 was trapped in the system.

4.2.2.2 Pneumatic valve 14 was opened and the specimen was pressurized with GH_2 at -400°F to 5, 10, and 15 psig by adjusting regulator 12. The pressure was monitored by means of transducer 17 and the temperature by means of thermocouple 18.

4.2.2.3 Valve 14 was closed and the specimen was checked for internal leakage at 5, 10, and 15 psig by monitoring leakage detector 22 for the presence of GH_2. The allowable leakage was 40 sccm. All data were recorded.

4.2.2.4 Pneumatic valves 8 and 9 were opened and the exit of the GH_2 was followed with GN_2 at 20 psig until all GH_2 had been purged from the specimen, vent, gage, and instrument lines.

4.2.2.5 The specimen was installed as shown in figure 4-1 using check valve installation A.

4.2.2.6 The purge procedure as described in 4.2.1.14 was repeated.

4.2.2.7 Control valve 19 was cracked and the system and specimen were vented for 10 seconds by opening valves 8 and 9.

4.2.2.8 The procedure described in 4.2.2.2 and 4.2.2.4 was repeated except the specimen was pressurized to 1 (+0, -0.2) psig.

4.2.2.9 The cracking pressure of the specimen was determined from the data provided by oscillograph 21 during the test described in 4.2.2.8.

4.2.2.10 The tests described in 4.2.1.13 through 4.2.2.9 were repeated as often as necessary to obtain consistent data.

4.3 TEST RESULTS

4.3.1 The specimen did not exhibit any external leakage.

4.3.2 While mounted in the horizontal position, the internal leakage was above the specified maximum of 40 sccm when measured at 5, 10, and 15 psig using GN_2 at ambient temperature and GH_2 at -400°F. The cracking pressure was below the specified range of 0.15 psig ±20 percent when measured using GN_2 at ambient temperature. Cracking pressure using GH_2 at -400°F was above the specified range.

4.3.3 When the specimen was mounted in the vertical position, the internal leakage was above the specified maximum of 40 sccm when measured at 5, 10, and 15 psig using GN_2 at ambient temperature. The cracking pressure was above the specified range of 0.15 psig ±20 percent when measured using GN_2 at ambient temperature.

4.4 TEST DATA

The data presented in tables 4-2 and 4-3 were recorded during the initial functional test.

Table 4–1. Functional Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Mission Valve and Pump Company	15 CPF-311	None	8-inch check valve
2	GN_2 Pressure, Source				0-to 300-psig
3	Pressure Gage	Victor	30-205-202		0-to 4000-psig
4	Regulator	Victor			0-to 3000-psig inlet 0-to 500-psig outlet
5	Pressure Gage	Victor			0-to 150-psig
6	Pneumatic Valve	Hoke	30201-1	NA	1/4-inch
7	Check Valve	Hoke	6214FSS	NA	1/2-inch
8	Pneumatic Valve	Hoke	30201-1	NA	1/4-inch
9	Pneumatic Valve	Hoke	30201-1	NA	1/4-inch
10	GH_2 Pressure Source		NA	NA	0-to 150-psig
11	Pressure Gage	U.S. Gage Company	10895		0-to 300-psig
12	Control Valve	Control Components	NA	NA	1/2-inch
13	Pressure Gage	Heise	H41044	95-1409B	0-to 100-psig ±0.1% FS Cal date 5-23-67
14	Pneumatic Valve	Hoke	DR-294AJ	NA	1/4-inch
15	Check Valve	Hoke	6214FSS	NA	1/2-inch
16	Relief Valve				165-psig
17	Pressure Transducer	C. E. C.	4-350-0001	95-1321-B	±0.5%
17A	Pressure Transducer	Statham		95-1657-B	0-to 5-psig ±0.5% Cal date 5-17-67

Table 4–1. Functional Test Equipment List (Continued)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
18	Thermocouple	Honeywell	NA	NA	±2°F accuracy
19	Control Valve	Control Components			1/2-inch
20	Flowmeter	Fisher–Porter	NA	200595	0–to 2000-sccm ±1.0% FS Cal date 2–16-67
21	Oscillograph	C. E. C.	NA	016558	Cal date 1–16-67
22	Leakage Detector	GCSD	NA	NA	200–cc graduated tube
23	Hand Valve.	Control Components	NA	NA	1/4-inch

Table 4-2. Initial Functional Test Data Obtained with Specimen in Horizontal Position

Test Medium	Cracking Pressure		Internal Leakage	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.10	5	135
	2	0.10	10	175
	3	0.10	15	262
GH_2 at -400°F	1	0.16	5	1312
	2	0.22	10	1968
	3	0.27	15	3116

Table 4-3. Initial Functional Test Data Obtained with Specimen in Vertical Position

Test Medium	Cracking Pressure		Internal Leakage	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.39	5	100
	2	0.39	10	160
	3	0.27	15	270

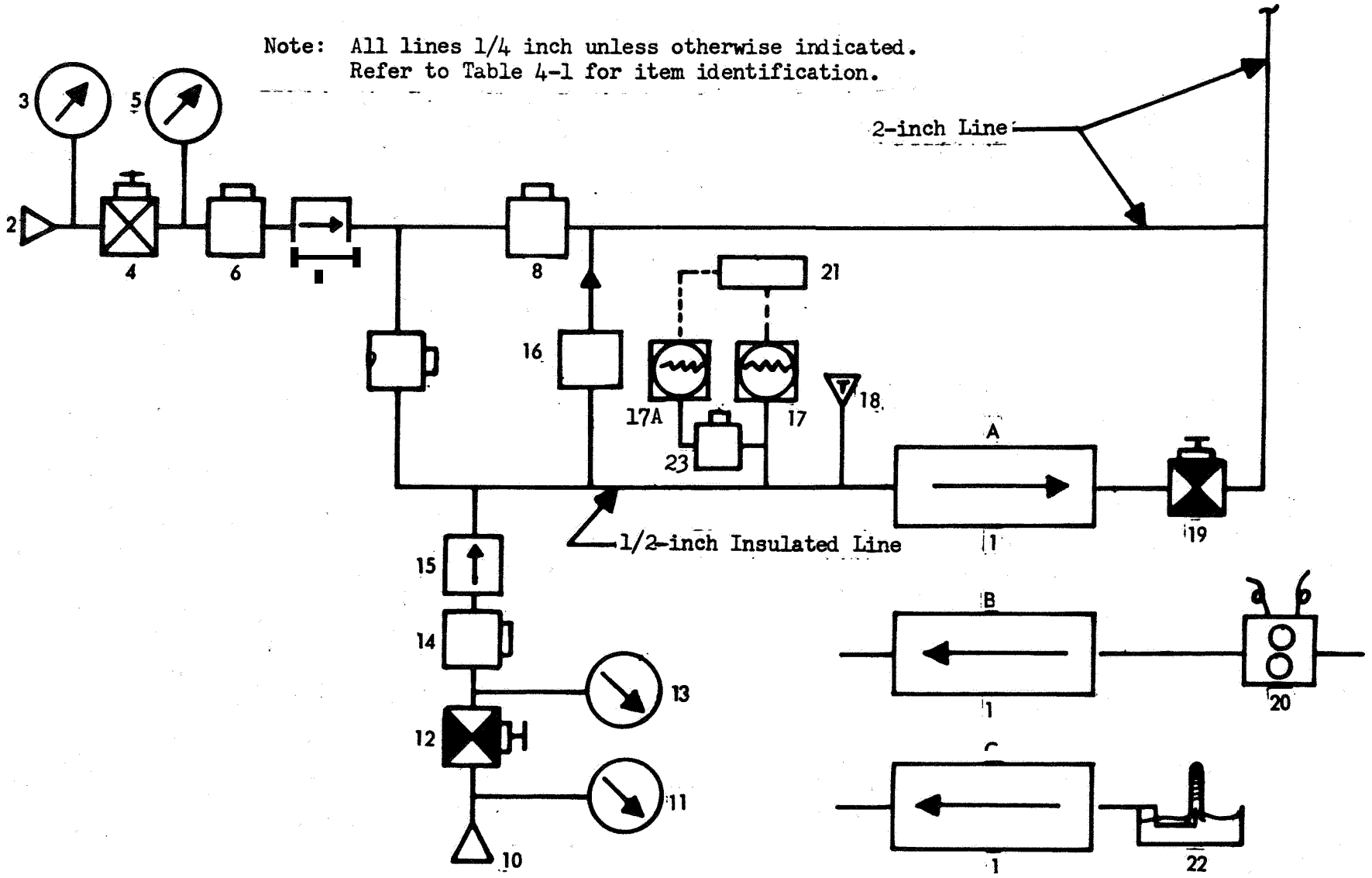


Figure 4-1. Functional Test Schematic

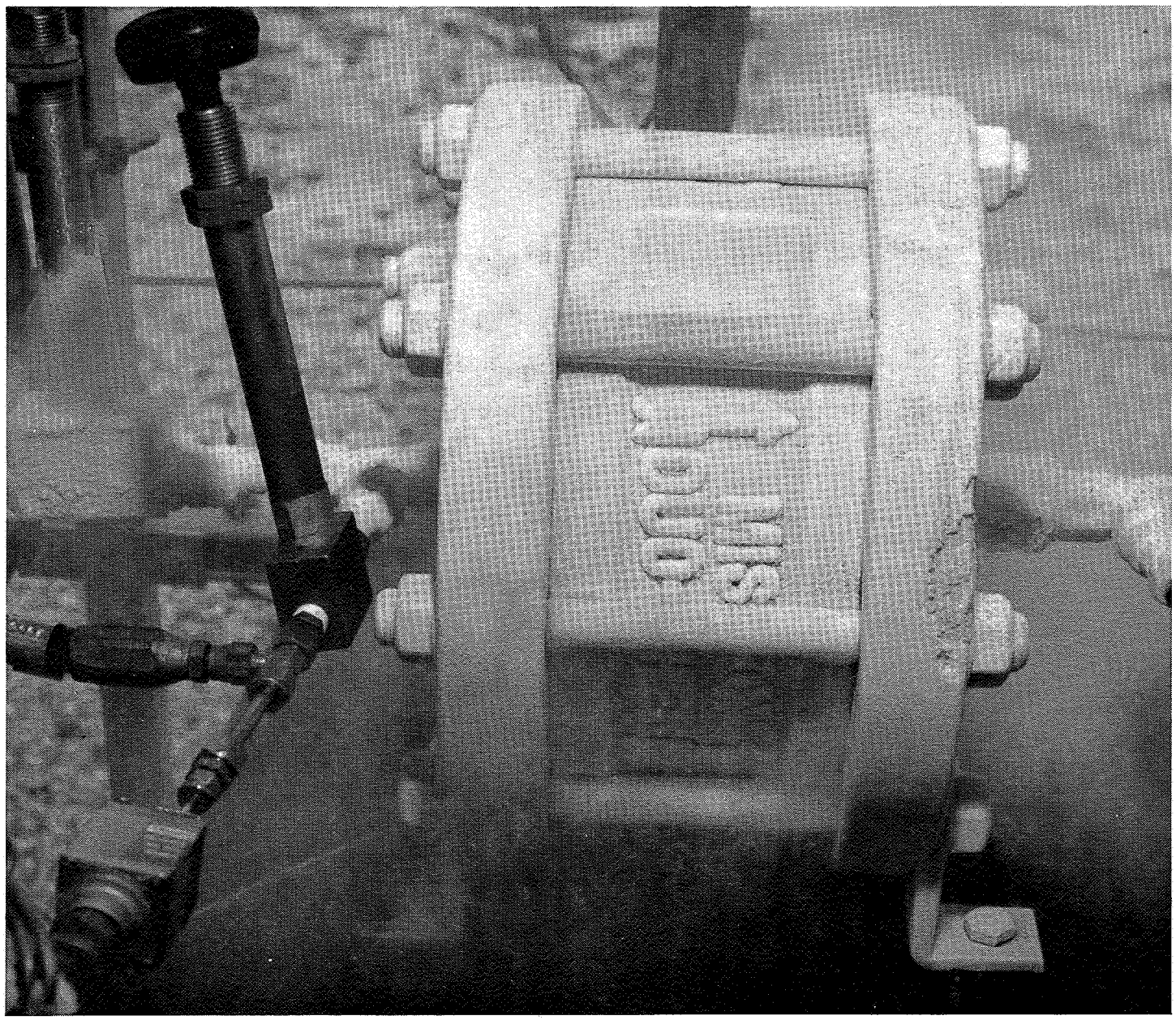


Figure 4-2. Functional Test Setup using GH2 at -400 F

SECTION V

HIGH TEMPERATURE TEST

5.1 **TEST REQUIREMENTS**

5.1.1 The test specimen shall be subjected to a high temperature test as specified in section 6, KSC-STD-164(D), Procedure I.

5.1.2 The temperature in the test chamber shall be maintained at 160 (+4, -0)°F and the relative humidity shall be controlled at 20 (±5) percent.

5.1.3 A functional test as described in section IV shall be performed during and after the high temperature.

5.2 **TEST PROCEDURE**

5.2.1 The specimen was installed in a high temperature chamber.

5.2.2 The chamber was maintained at a temperature of 160 (+4, -0)°F and a relative humidity of 20 (±5) percent for 72 hours.

5.2.3 A functional test as described in section IV was performed while the chamber was maintained at the conditions specified in 5.2.2.

5.2.4 The temperature of the test chamber was lowered to ambient conditions.

5.2.5 Within one hour after ambient conditions had been established, a functional test as described in section IV was performed.

5.3 **TEST RESULTS**

5.3.1 The specimen was subjected to a temperature of 160°F.

5.3.2 Functional test results obtained during high temperature exposure are described in the following paragraphs.

5.3.2.1 There was no external leakage.

5.3.2.2 Internal leakage was above the specified maximum of 40 sccm when measured at 5, 10, and 15 psig using GN_2 at ambient temperature and GH_2 at -400°F.

5.3.2.3 Cracking pressure measured by using GN_2 at ambient temperature and GH_2 at -400°F was above the specified range of 0.15 psig ±20 percent.

593.3 Functional test results obtained following high temperature exposure are described in the following paragraphs.

5.3.3.1 There was no external leakage.

5.3.3.2 Internal leakage was above the specified maximum of 40 sccm when measured at 5, 10, and 15 psig using GN_2 at ambient temperature and GH2 at -400°F.

5.3.3.3 Cracking pressure measured using GN_2 at ambient temperature and GH_2 at -400°F was above the specified range of 0.15 psig $\pm$20 percent.

5.4 TEST DATA

The data presented in tables 5-2 and 5-3 were recorded during and following high temperature exposure.

Table 5-1. Functional Test Results Obtained During High Temperature Exposure

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.39	5	66
	2	0.37	10	90
	3	0.37	15	114
GH_2 at -400°F	1	0.28	5	746
	2	0.22	10	984
	3	0.24	15	1148

Table 5-2. Functional Test Results Obtained After High Temperature Exposure

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.22	5	123
	2	0.29	10	172
	3	0.17	15	229
GH_2 at -400°F	1	0.20	5	738
	2	0.27	10	1148
	3	0.20	15	1640

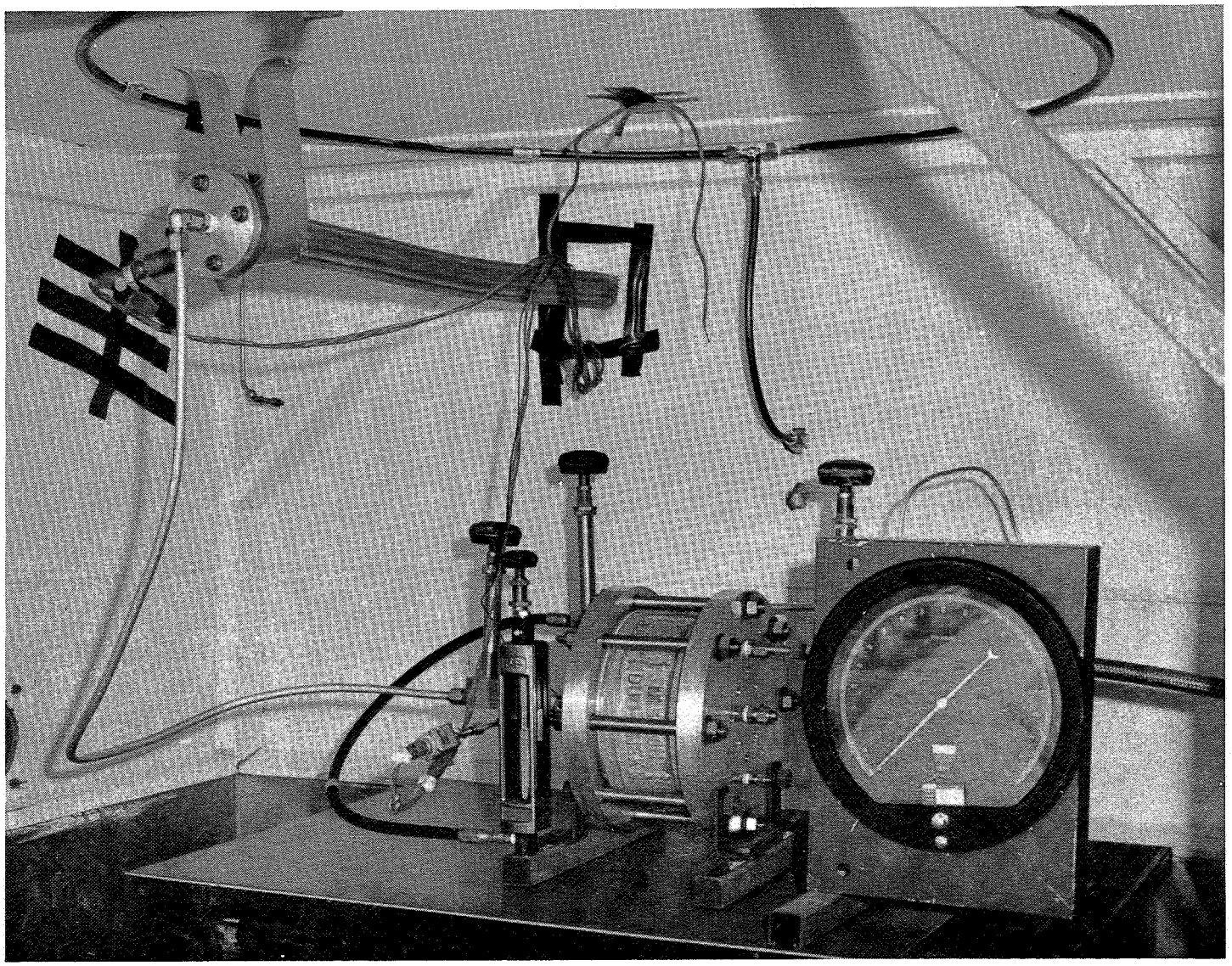


Figure 5-1. High Temperature Test Setup

SECTION VI

SURGE TEST

6.1 TEST REQUIREMENTS

6.1.1 The inlet port of the test specimen **shall** be pressurized from zero to 65 psig and back to zero. This shall constitute one cycle. A total of 50 cycles **shall** be performed. GN_2 **shall** be used as the test medium.

6.1.2 A functional test as specified in section IV **shall** be performed after 25 and 50 cycles.

6.1.3 The procedure described in 6.1.1 shall be repeated, except the position of the test specimen within the test setup shall be reversed.

6.1.4 A functional test as specified in section IV shall be performed after 25 and 50 cycles.

6.2 TEST PROCEDURE

6.2.1 CHECK VALVE INSTALLATION A

6.2.1.1 The specimen was installed using check valve installation A as shown in figures 6-1 and 6-2.

6.2.1.2 **It** was determined that all connections were tight, gages were installed and all valves were closed.

6.2.1.3 Valves 3, 7, and 8 were opened and valve 11 was cracked. Regulator 6 was adjusted for a downstream pressure of 65 psig as indicated by transducer 9. Valve 8 was closed.

6.2.1.4 Valve 8 was opened and the specimen was pressurized to 65 psig. Valve 8 was closed.

6.2.1.5 The pressurization rate was monitored by means of oscillograph 10. Control valve 7 was adjusted and the procedure described in 6.2.1.4 was repeated until a pressurization rate of zero to 65 psig in 100 milliseconds was achieved.

6.2.1.6 The procedures described in 6.2.1.3 through 6.2.1.5 describe one cycle. Fifty cycles were performed.

6.2.1.7 after 25 and 50 cycles, a functional test as specified in section IV, **was** performed.

6.2.2 CHECK VALVE INSTALLATION B

6.2.2.1 The specimen was installed using check valve installation B as shown in figure 6-1.

6.2.2.2 The procedures described in 6.2.1.2 through 6.2.1.7 were repeated.

6.3 TEST RESULTS

6.3.1 The test specimen inlet and outlet ports were each subjected to 50 pressure surges of 0- to 65-psig within 100 milliseconds. A typical surge waveform is shown in figure 6-3.

6.3.2 Functional test results obtained after 25 and 50 inlet pressure surges are described in the following paragraphs.

6.3.2.1 There was no external leakage following 25 and 50 surges.

6.3.2.2 Internal leakage was above the specified maximum of 40 sccm following 25 and 50 surges when measured at 5, 10, and 15 psig using GN_2 at ambient temperature and GH_2 at -400°F.

6.3.2.3 Following 25 surges, cracking pressure measured by using GN_2 at ambient temperature and GH2 at -400°F was above the specified range of 0.15 psig ±20 percent. Following 50 surges the GN2 cracking pressure was above the specified range and the GH2 cracking pressure was below the specified range.

6.3.3 Functional test results obtained after 25 and 50 outlet pressure surges are decribed in the following paragraphs.

6.3.3.1 There was no external leakage following 25 and 50 surges.

6.3.3.2 Internal leakage was above the specified maximum of 40 sccm following 25 and 50 surges when measured at 5, 10, and 15 psig using GN2 at ambient temperature and GH_2 at -400°F.

6.3.3.3 Following 25 and 50 surges, cracking pressure measured by using GN_2 at ambient temperature was above the specified range of 0.15 psig ±20 percent.

6.3.3.4 Following 25 surges, cracking pressure measured using GH_2 at -400°F was below the specified range of 0.15 psig ±20 percent. Following 50 surges, the GH_2 cracking pressure was above the specified range.

6.4 TEST DATA

6.4.1 The data presented in tables 6-2 and 6-3 were recorded after 25 and 50 inlet pressure surges.

6.4.2 The data presented in tables 6-4 and 6-5 were recorded after subjecting the specimen outlet to 25 and 50 pressure surges.

Table 6-1. Surge Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Mission Valve and Pump Company	15 CPF-311	None	8-inch check valve
2	Pressure Source				3000-psig
3	Hand Valve	Combination Pump Valve Company	130P5	NA	1-inch
4	Filter	Bendix Filter Div.	2-S-13460 16-B-0	NA	2-micron
5	Pressure Gage	Ashcroft	Dura-gage	NA	0-to 5000-psig ±1.0% FS Cal date 5-8-67
6	Regulator	Grove Valve and Regulator Company	WH-408-N4	NA	0-to 6000-psig inlet 0-to 6000-psig outlet
7	Control Valve	Combination Pump Valve Company	130P5	NA	1-inch
8	Solenoid Valve	Southwestern Valve Co.	MV121	NA	1-inch, 3-way
9	Pressure Transducer	C. E. C.	9-350-0001	95-1321B	0-to 500-psig ±0.5% FS Cal date 5-10-67
10	Recording Oscillograph	C. E. C.		016558	Cal date 1-16-67
11	Hand Valve	Robbins Aviation	SSKA-250-4T	NA	1/4-inch

Table 6-2. Functional Test Results Following 25 Inlet Pressure Surges

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.35	5	229
	2	0.45	10	360
	3	0.21	15	492
GH_2 at -400°F	1	0.19	5	902
	2	0.22	10	1558
	3	0.25	15	2132

Table 6-3. Functional Test Results Following 50 Inlet Pressure Surges

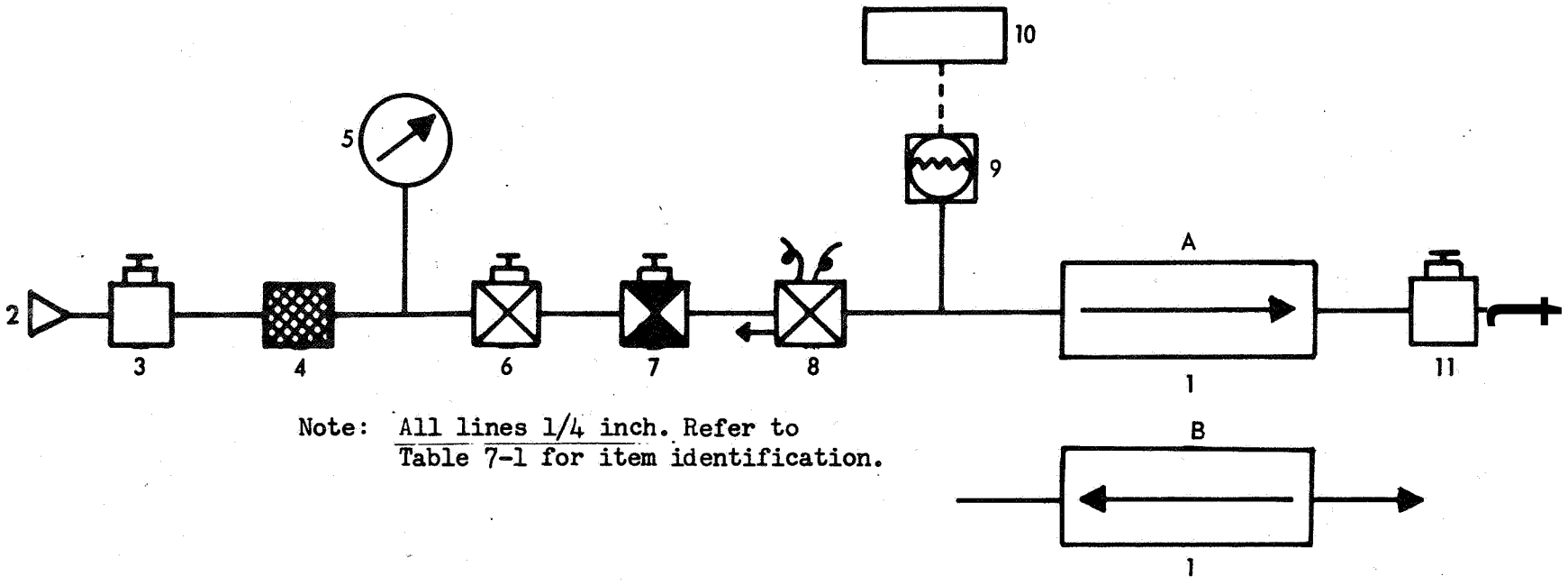
Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.19	5	115
	2	0.19	10	172
	3	0.19	15	2k6
GH_2 at -400°F	1	0.1	5	237
	2	0.1	10	336
	3	0.1	15	393

Table 6-4. Functional Test Results Following 25 Outlet Pressure Surges

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.18	5	98
	2	0.21	10	147
	3	0.21	15	221
GH_2 at -400°F	1	0.11	5	756
	2	0.11	10	1312
	3	0.12	15	2132

Table 6-5. Functional Test Results Following 50 Outlet Pressure Surges

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.22	5	90
	2	0.22	10	139
	3	0.25	15	205
GH_2 at -400°F	1	0.24	5	278
	2	0.23	10	410
	3	0.29	15	492



Note: All lines 1/4 inch. Refer to Table 7-1 for item identification.

Figure 6-1. Surge Test Schematic

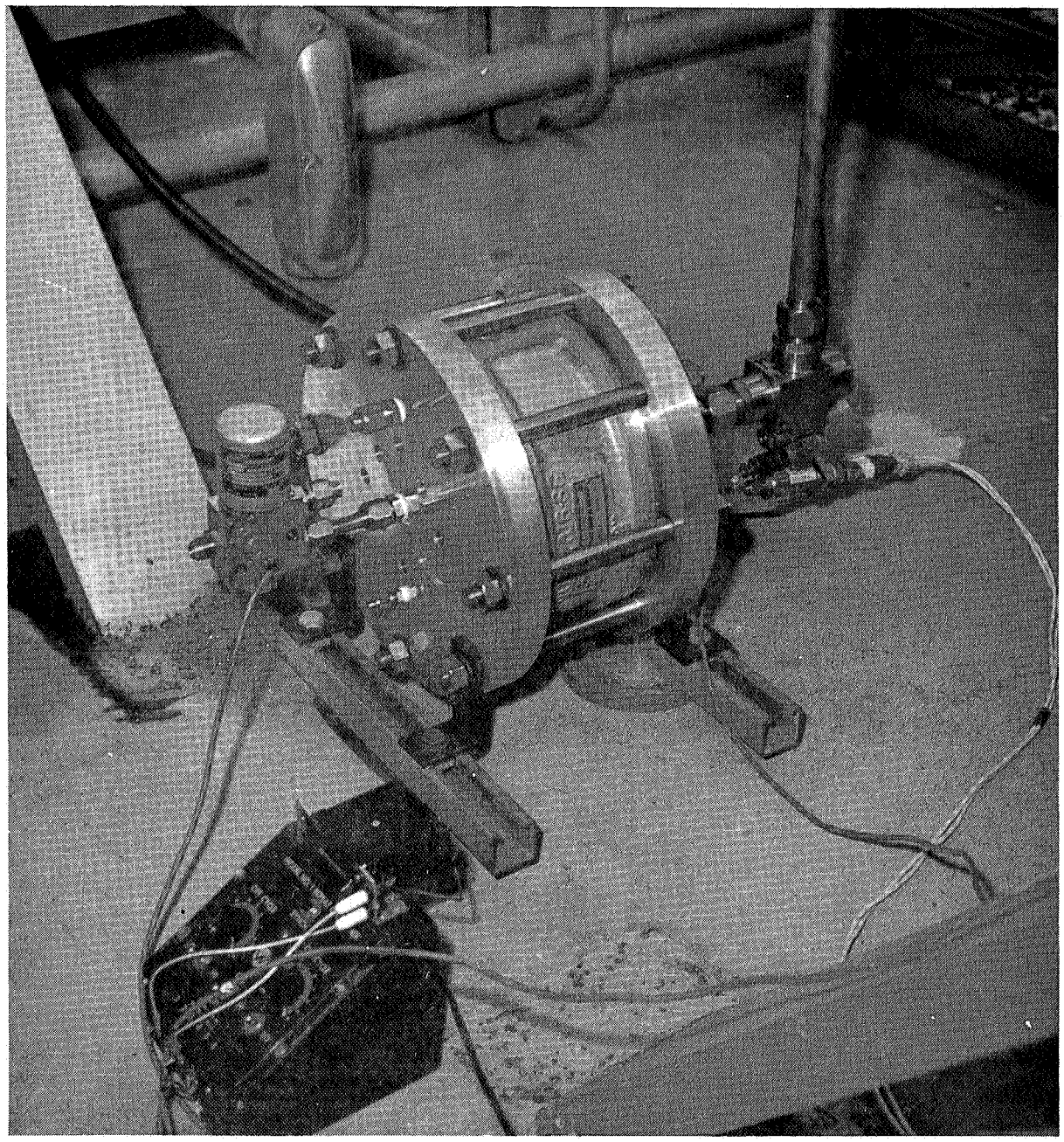


Figure 6-2. Surge Test setup

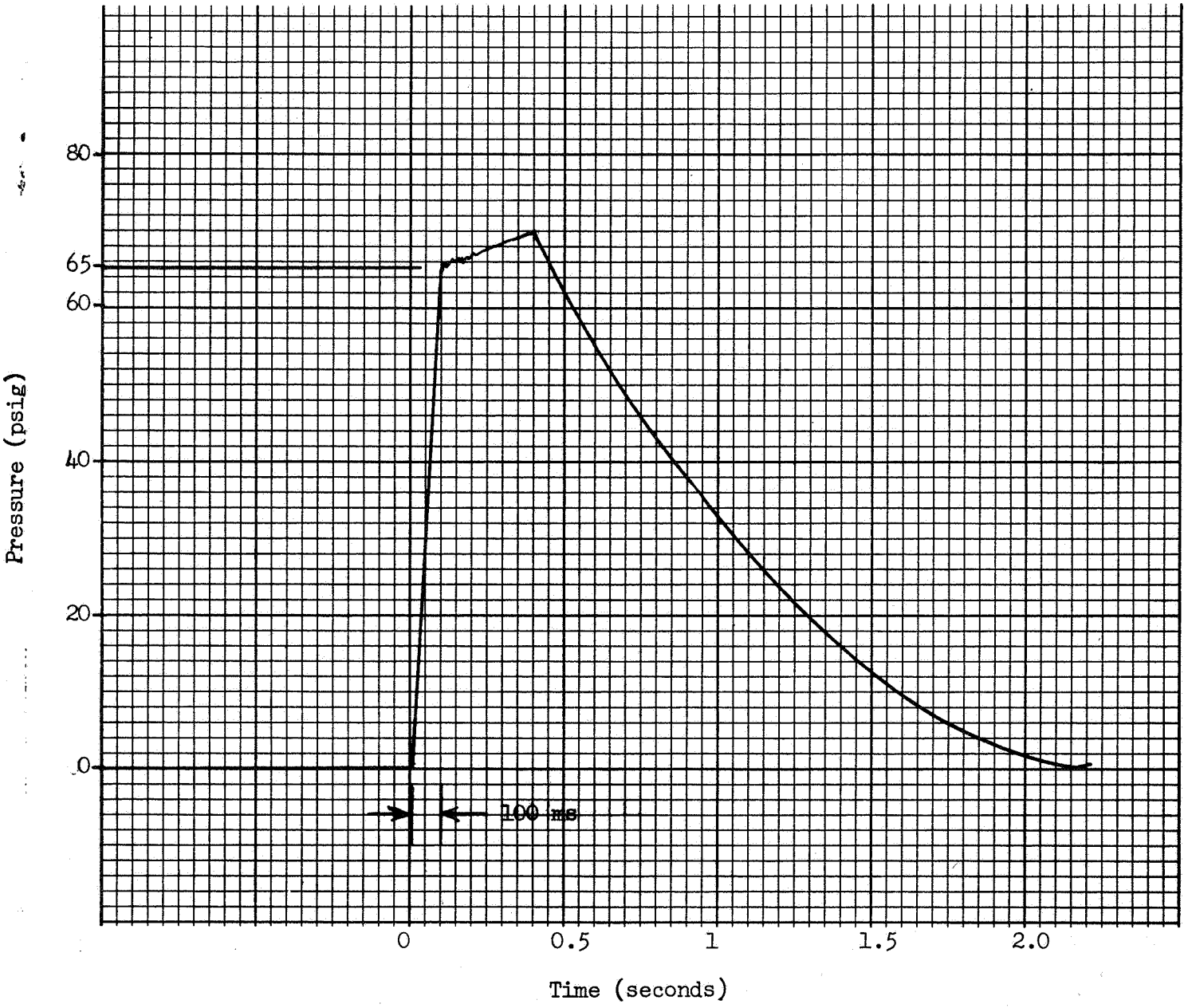


Figure 6-3. Typical Surge Waveform

SECTION VII

FLOW TEST

7.1 TEST REQUIREMENTS

7.1.1 A flow test shall be performed on the test specimen in the horizontal position using ambient GN_2 as the test medium.

7.1.2 The specimen inlet shall be pressurized at 1.0 psig and the flow determined for the differential pressure range of 0.1 to 1.0 psid across the specimen.

7.1.3 The specimen inlet shall be pressurized at 65.0 psig and the flow determined for the differential pressure range of 0.1 to 0.4 psid across the specimen.

7.1.4 Curves shall be plotted for flow versus ΔP for the 1.0 psig and 65.0 psig inlet pressure.

7.1.5 The specimen outlet shall be directly opened to the atmosphere and the movement of the leaves shall be observed. The specimen inlet pressure and the flowrate required to open the leaves 1/4, 1/2, and full open shall be determined.

7.1.6 A functional test as described in section IV shall be performed following the flow test.

7.2 TEST PROCEDURE

7.2.1 The specimen was installed as shown in figures 7-1 and 7-4 using the equipment listed in table 7-1.

7.2.2 Valves 3, 6, 7, and 17 were opened and regulator 8 was opened. GN_2 was flowed through the specimen at a specimen inlet pressure of 1 psig. Flowrate data were recorded with the specimen differential pressure stabilized at various pressures from 0.1 to 1 psi by monitoring gages 9 and 18A, thermocouple 11, transducers 10, 19, 21, and manometer 20.

7.2.3 GN_2 was flowed through the specimen at a specimen inlet pressure of 65 psig. Flowrate data were recorded with the specimen differential pressure stabilized at various pressures from 0.1 to 0.4 psi by monitoring gages 9 and 18B, thermocouple 11, transducers 10, 19, and 21, and manometer 20.

7.2.4 The specimen outlet was directly opened to the atmosphere. Flowrate data and specimen inlet pressure data were recorded while the specimen leaves were stabilized in the 1/4, 1/2, and full open positions.

7.2.5 The specimen was removed from the flow test setup. A functional test as described in section IV was performed.

7.3 TEST RESULTS

7.3.1 At 1 psig specimen inlet pressure, flowrates ranged from 6.5 to 2.3 lb/sec over a differential pressure range of 0.91 to 0.105 psid.

7.3.2 At 65 psig specimen inlet pressure, flowrates ranged from 11.0 to 3.8 lb/sec over a differential pressure range of 0.49 to 0.10 psid.

7.3.3 The flowrates required to open the specimen from 1/4 open to full open ranged from 1.7 lb/sec to 6 lb/sec.

7.3.4 Functional test results obtained following the flow test are described in the following paragraphs.

7.3.4.1 There was no external leakage.

7.3.4.2 Internal leakage was above the specified maximum of 40 sccm when measured at 5, 10, and 15 psig using GN_2 at ambient temperature and GH_2 at -400°F.

7.3.5.3 Cracking pressure measured using GN_2 at ambient temperature and GH_2 at -400°F was below the specified range of 0.15 psig $\pm$20 percent.

7.4 TEST DATA

7.4.1 Flow test data are presented in tables 7-2 and 7-3.

7.4.2 Curves of flow versus differential pressure for specimen inlet pressures of 1 and 65 psig are presented in figures 7-2 and 7-3.

7.4.3 The specimen inlet line pressures and flowrates required to open the specimen are presented in table 7-4.

7.4.4 Functional test results obtained following the flow test are presented in table 7-5

Table 7-1. Flow Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Mission Valve and Pump Company	15 CPF-311	None	8-inch check valve
2	GN_2 Supply	NA	NA	NA	3000-psig
3	Hand Valve	Combination Pump Valve Company	130P5	NA	1-inch
4	Pressure Gage	Ashcroft	Duragage	95-1643-B	0-to 5000-psig ±1.0% FS Cal date 5-8-67
5	Pressure Regulator	Tescom	26-1002-21	32B6	0-to 4000-psig inlet 0-to 4000-psig outlet
6	Hand Valve	Combination Pump Valve Co.	130P5		1-inch
7	Hand Valve	Combination Pump Valve Co.	130P5		1-inch
8	Pressure Regulator	Grove Valve and Regulator Co.	WH-408-N4	HA-5922	0-to 6000-psig inlet 0-to 6000-psig outlet
9	Pressure Gage	Heise	H41909	93-1091-C	0-to 1000-psig ±0.1% FS Cal date 6-27-67
10	Pressure Transducer	D. E. C.	4-350-0001	95-1321-B	3- to 500-psig Cal date 5-10-67
11	Thermometer	Honeywell	NA	NA	Thermocouple ±2°F
12	Flow Nozzle	Flowdyne Engineering Company	GN-321000	2402	6000-psi 0.996 orifice
13	Pressure Gage	Heise	H41908	93-1092-C	0-to 1000-psig ±0.1% FS Cal date 5-7

Table 7-1. Flow Test Equipment List (Continued)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
14	Ullage Tank				4000-psig
15	Burst Disc	Fike	36952	NA	100-psi at 70°F
16	Thermometer	Honeywell	NA	NA	Thermocouple ±2°F
17	Motor Operated Valve	Nord-Strom	21391	NA	6-inch, 200-psi
18A	Pressure Gage	Heise	H41044	95-1409B	0- to 100-psig ±0.10% FS Cal date 5-23-67
18B	Pressure Gage	Heise	H39703	95-1392B	0-to 30-psig ±0.10% FS Cal date 5-24-67
19	Pressure Transducer	C. E. C.	PG-15-A-S255	95-1660-B	0-to 500-psig Gal date 5-11-67
20	Manometer	King Engineering	ES-8 WM-50	012572	Incline manometer 0-to 8-inches Cal date 4-4-67
21	Differential Pressure Transducer	Statham		95-1657-B	0-to 5-psid Cal date 5-17-67
22	Oscillograph Recorder	C. E. C.		016558	Cal date 1-16-67
23	Temperature Indicator	Wiest Instrument Corp.		01946	±2°F Gal date 4-13-67

Table 7-2. Flow Test Data

Specimen Inlet Pressure (psig)	Specimen Pressure Differential (psid)	Flowrate (lb/sec)
1	0.91	6.5
1	0.60	5.3
1	0.49	4.7
1	0.38	4.2
1	0.35	4.0
1	0.105	2.3
65	0.49	11.0
65	0.32	9.3
65	0.29	8.9
65	0.24	8.2
65	0.20	7.6
65	0.17	7.0
65	0.15	6.0
65	0.125	5.3
65	0.10	3.8

Table 7-3. Tare Data

Specimen Inlet Pressure (psig)	Tare (psid)	Flowrate (lb/sec)
1.0	0.002	2.7
1.0	0.0014	2.4
1.0	0.0007	1.8
1.0	0.0003	1.4
65.0	0.0031	7.0
65.0	0.0024	5.8
65.0	0.0024	3.9
65.0	0.0000	2.9

Table 7-4. Specimen Opening Test Data

Position of Specimen Leaves	Specimen Inlet Pressure (psig)	Flowrate (lb/sec)
Full Open	1.0	6
1/2 Open	0.5	3.2
1/4 Open	0.1	1.7

Table 7-5. Functional Test Data Obtained Following Flow Test

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.050	5	98.4
	2	0.066	10	164
	3	0.049	15	262
GH_2 at -400°F	1	0.085	5	459
	2	0.082	10	721
	3	0.082	15	1016

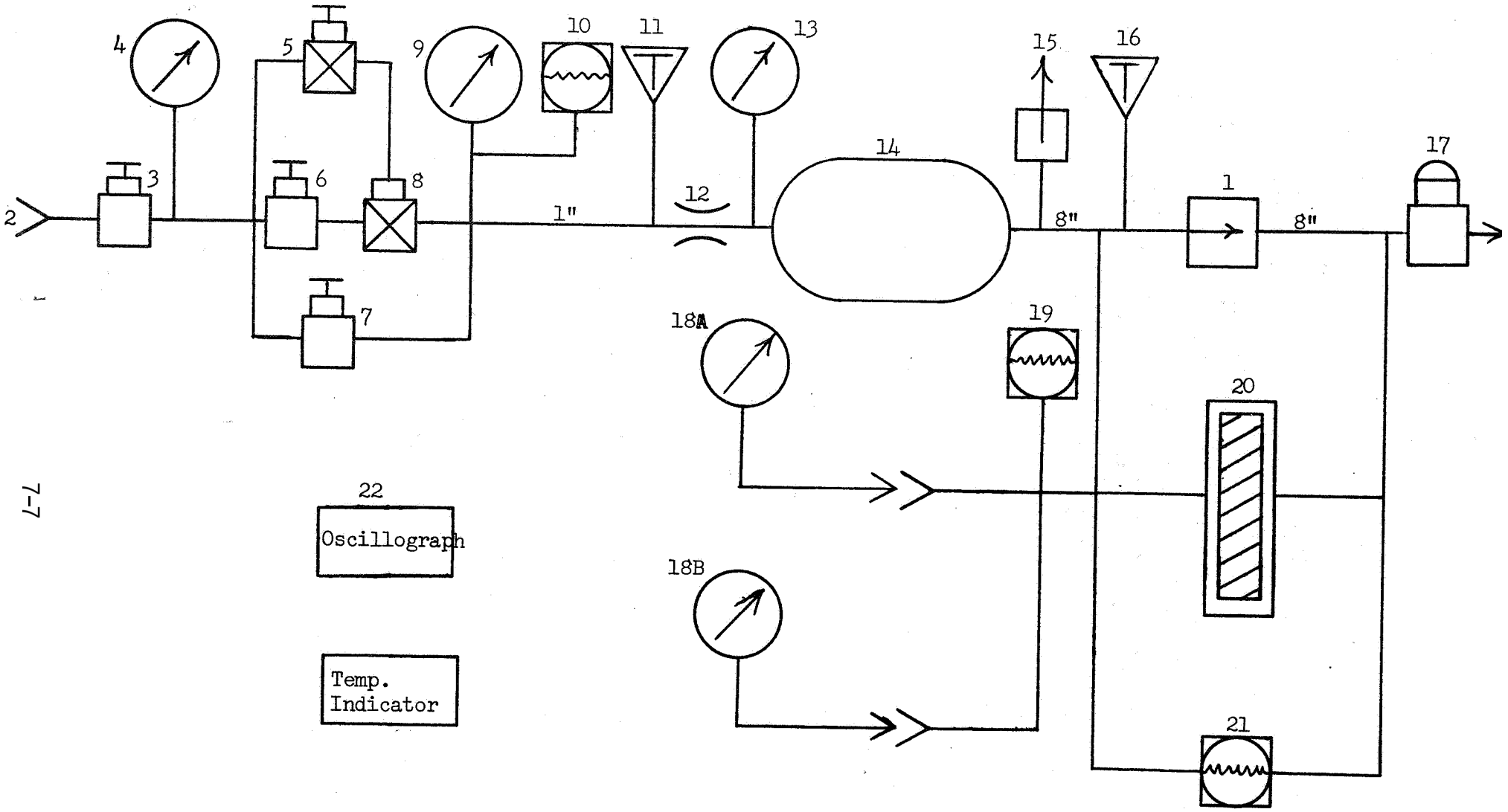


Figure 7-1. Flow Test Schematic

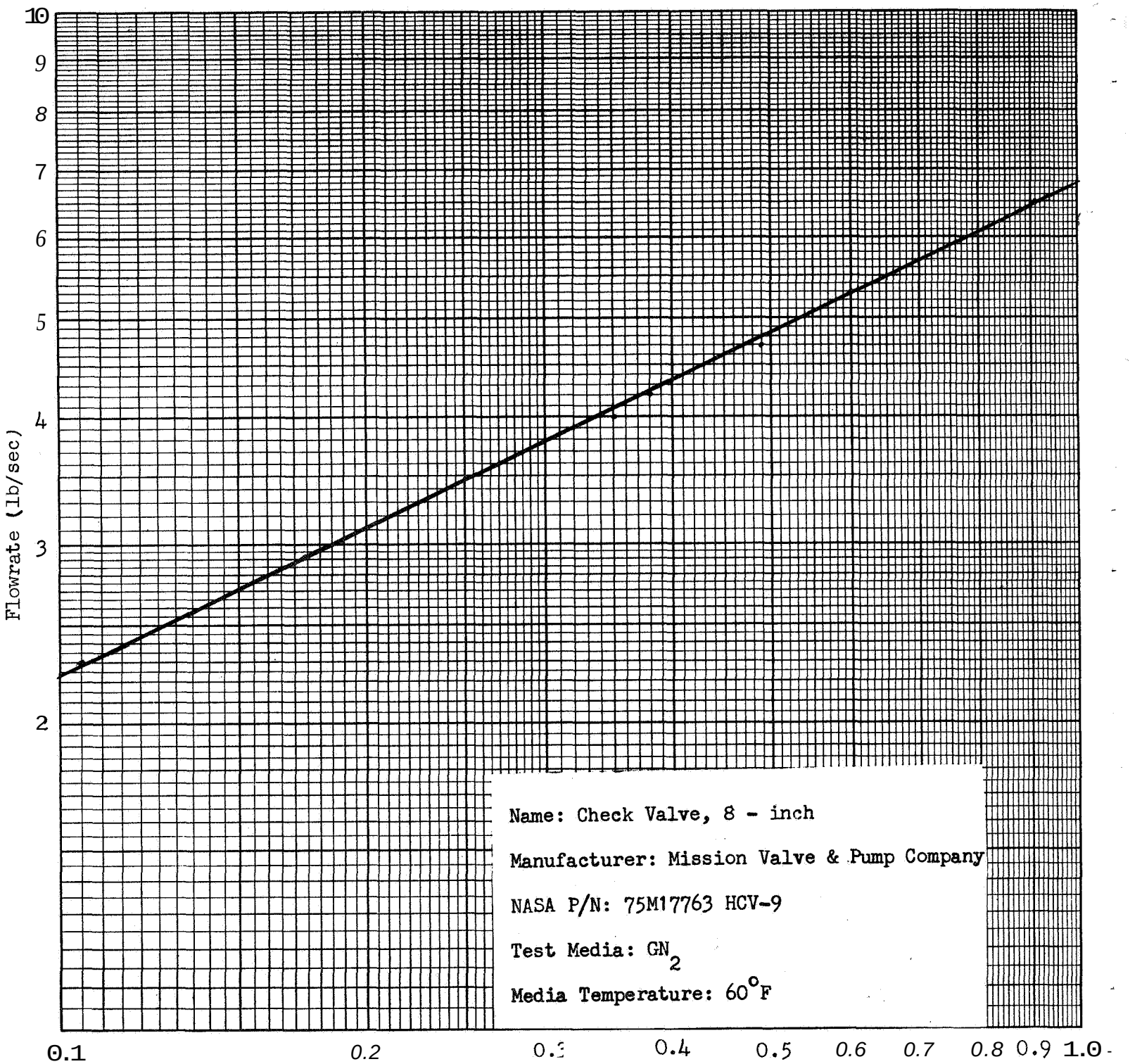


Figure 7-2. Flow vs. Differential Pressure for Specimen inlet Pressure of 1 Psig

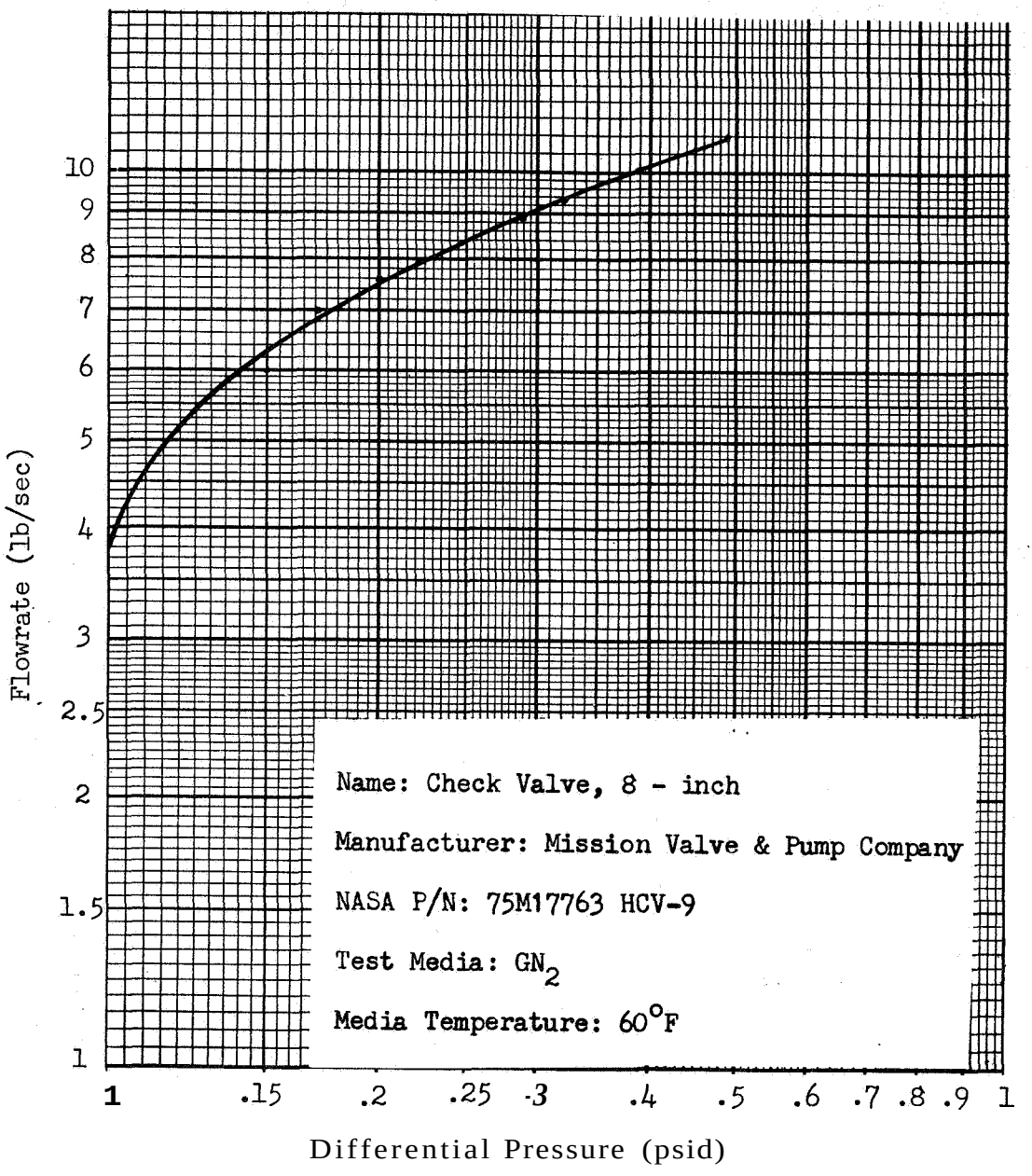


Figure 7–3. Flow vs. Differential Pressure for Specimen **Inlet** Pressure of 65 Psig

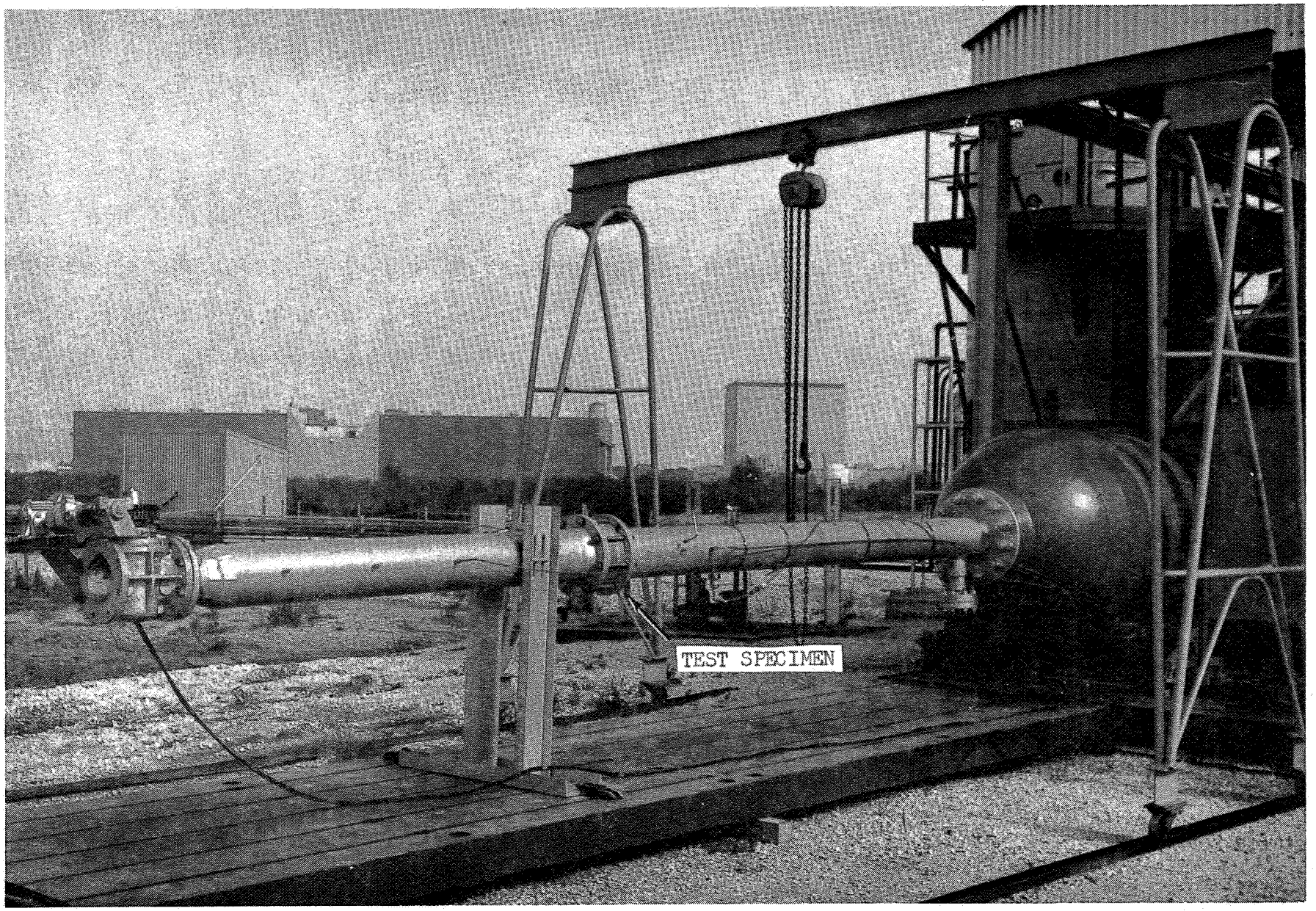


Figure 7-4. Flow Test Setup

SECTION VIII

CYCLE TEST

8.1 TEST REQUIREMENTS

8.1.1 The test specimen shall be cycled 1000 times. A cycle shall consist of mechanically moving the specimen leaves from the fully open to the closed position.

8.1.2 A functional test as specified in section IV shall be performed after 50, 100, 500, and 1000 cycles.

8.2 TEST PROCEDURE

8.2.1 The test specimen was installed in the setup shown in figures 8-1 and 8-2.

8.2.2 The specimen leaves were opened and closed 1000 times by operating the cycling fixture.

8.2.3 After 50, 100, 500, and 1000 cycles, a functional test was performed as specified in section IV.

8.3 TEST RESULTS

8.3.1 The test specimen leaves were mechanically opened and closed 1000 times.

8.3.2 Functional test results obtained following 50, 100, 500, and 1000 cycles are described in the following paragraphs.

8.3.2.1 There was no external leakage following 50, 100, 500, and 1000 cycles.

8.3.2.2 Following 50, 100, 500, and 1000 cycles, internal leakage was above the specified maximum of 40 sccm when measured at 5, 10, and 15 psig using GN_2 at ambient temperature and GH_2 at -400°F.

8.3.2.3 Following 50, 100, 500, and 1000 cycles, cracking pressure measured using GN2 at ambient temperature and GH_2 at -400°F was below the specified range of 0.15 psig ±20 percent.

8.4 TEST DATA

Functional test results obtained following 50, 100, 500, and 1000 cycles of the cycle test are presented in tables 8-2 through 8-5.

Table 8-1. Cycle Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Mission Valve and Pump Company	15 CPF-311	None	8-inch check valve
2	Cycle Test Fixture	CCSD	NA	NA	Mechanical cycling device

Table 8–2. Functional Test Results After 50 Cycles

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.045	5	115
	2	0.045	10	189
	3	0.040	15	492
GH_2 at -400°F	1	0.060	5	410
	2	0.040	10	656
	3	0.055	15	902

Table 8–3. Functional Test Results After 100 Cycles

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.055	5	123
	2	0.060	10	197
	3	0.060	15	410
GH_2 at -400°F	1	0.060	5	410
	2	0.060	10	574
	3	0.055	15	738

Table 8–4. Functional Test Results After 500 Cycles

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.055	5	123
	2	0.060	10	189
	3	0.060	15	278
GH2 at -400°F	1	0.080	5	492
	2	0.075	10	656
	3	0.070	15	902

Table 8–5. Functional Test Results After 1000 Cycles

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.041	5	107
	2	0.045	10	172
	3	0.040	15	246
GH_2 at -400°F	1	0.050	5	246
	2	0.040	10	328
	3	0.040	15	410

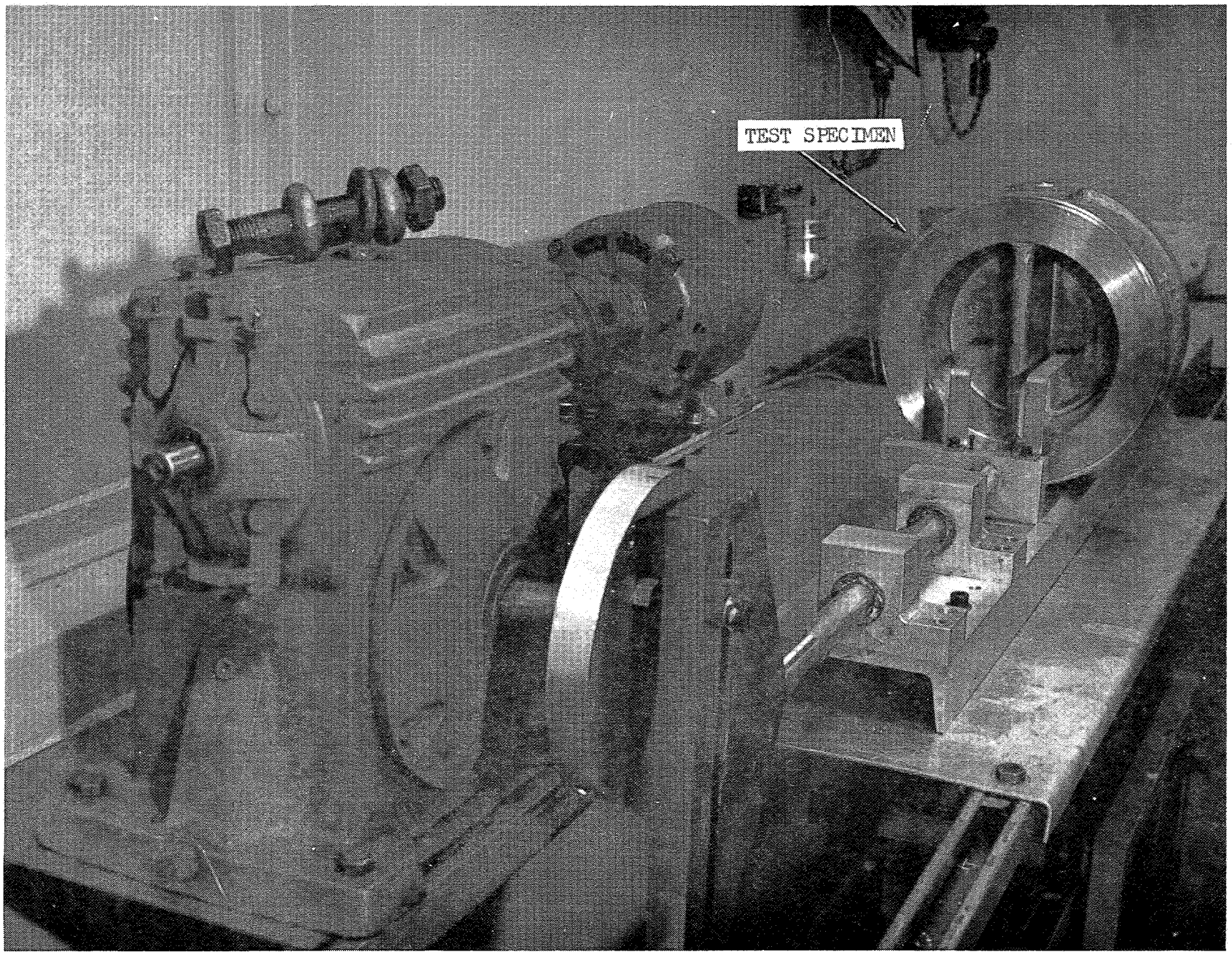


Figure 8-1 Cycle Test Setup, Leaves Closed

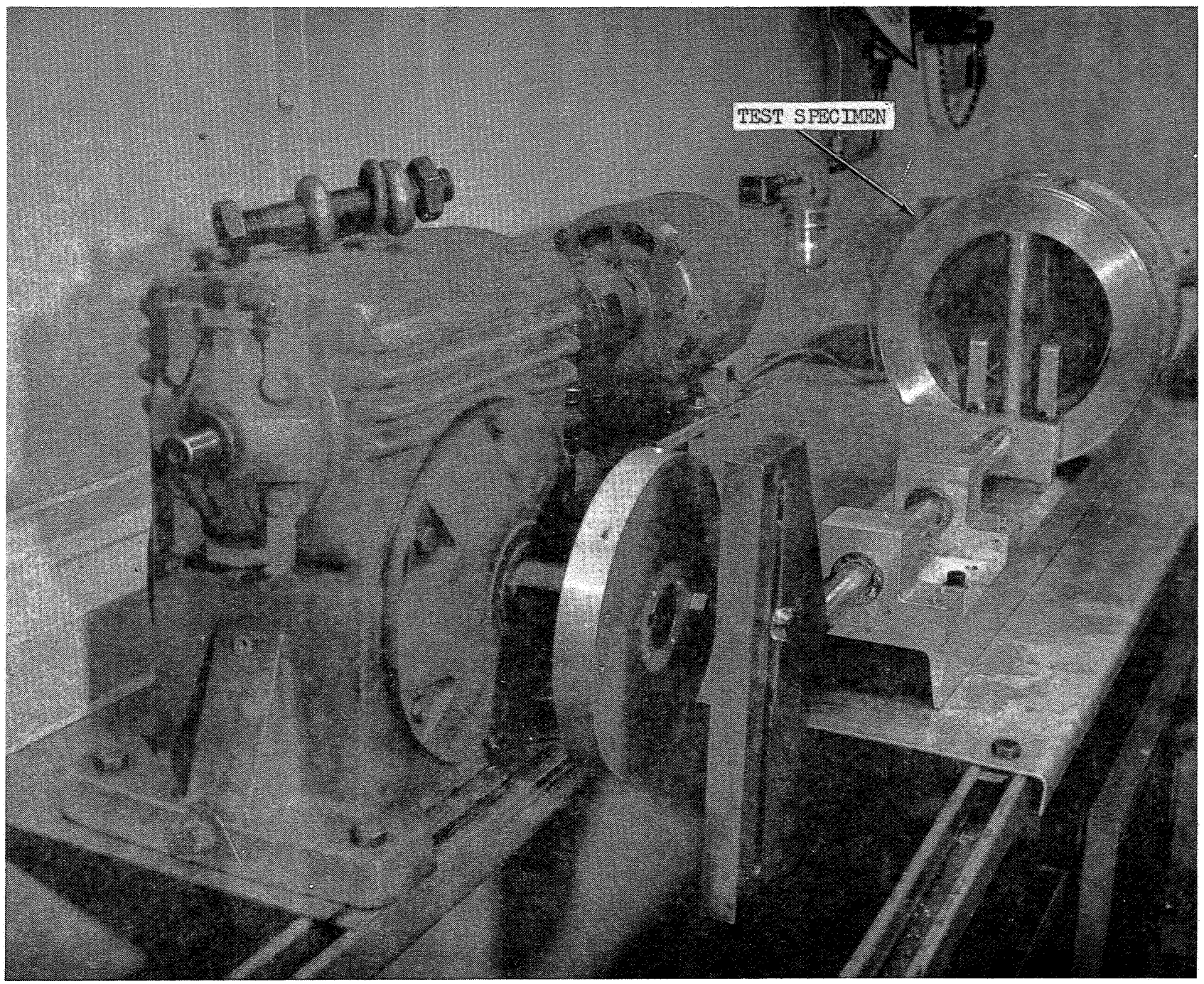


Figure 8-2. Cycle Test Setup, Leaves Open

SECTION IX

BURST TEST

9.1 TEST REQUIREMENTS

9.1.1 The inlet and outlet ports of the test specimen shall be simultaneously pressurized to 260 psig. This pressure shall be maintained for 5 minutes.

9.1.2 The specimen shall be checked for leakage and distortion.

9.1.3 Water shall be used as the test medium throughout the test.

9.2 TEST PROCEDURE

9.2.1 The test specimen was installed as shown in figures 9-1 and 9-2.

9.2.2 All connections were determined to be tight, gages were installed and all valves were closed.

9.2.3 Valves 4 and 6 were opened and the system was filled with water by activating pump 3. Valve 6 was closed.

9.2.4 The specimen was pressurized to 260 psig and valve 4 was closed. This pressure was maintained for 5 minutes. The pressure was monitored by means of gage 5 and any drop in pressure at the specimen during the 5-minute period was recorded.

9.2.5 Valve 6 was opened and the specimen was depressurized. The specimen was checked for distortion. All data were recorded.

9.3 TEST RESULTS

9.3.1 The inlet and outlet ports of the specimen were simultaneously pressurized to 260 psig for five minutes.

9.3.2 There was no leakage or distortion.

9.4 TEST DATA

Test data obtained during the burst test are presented in table 9-2.

Table 9-1. Burst Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Mission Valve and Pump Company	15 CPF-311	None	3-inch check valve
2	H_2O Reservoir	NA	NA	NA	5-gallon
3	Water Pump	Sprague Engineering	300-16-64	NA	0-to-30,000-psig
4	Hand Valve	Aminco	NA	NA	1/4-inch
5	Pressure Gage	Ashcroft	Duragage	NA	0-to 600-psig ±1.0% FS Cal date 5-2-67
6	Hand Valve	Aminco	NA	NA	1/4-inch

Table 9-2. Burst Test Data

Pressure	Leakage	Distortion
260 psig for five minutes	None	None

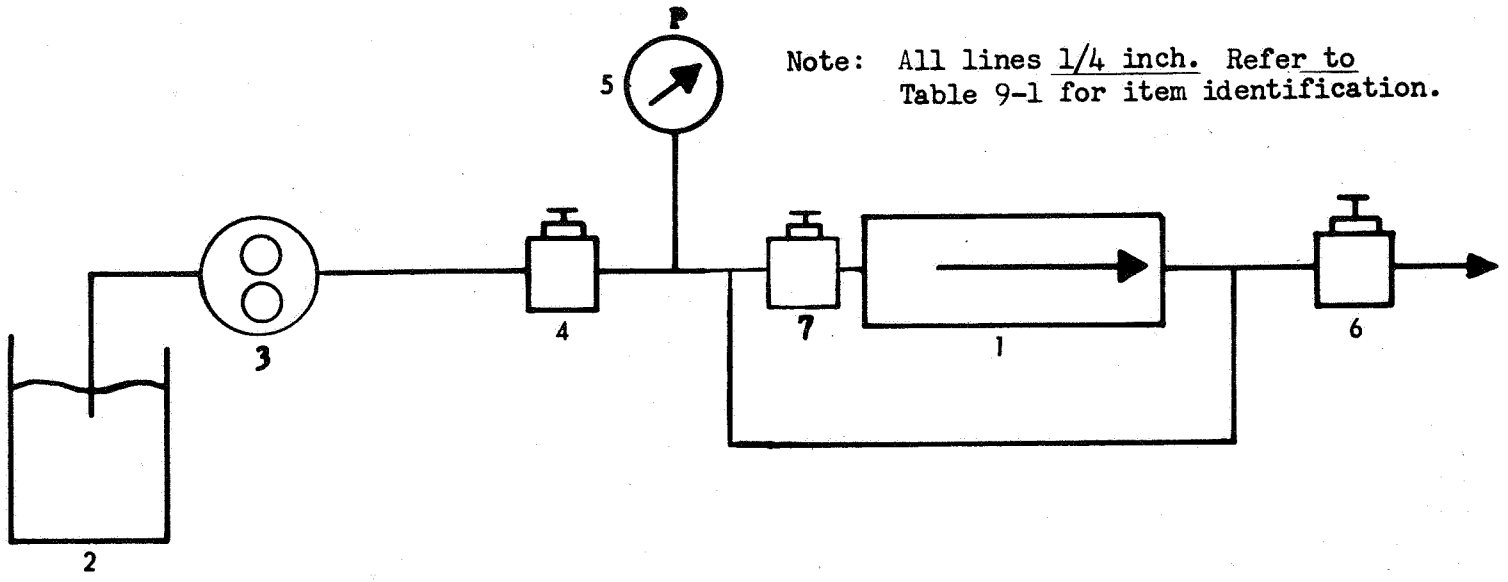


Figure 9-1. Burst Test Schematic

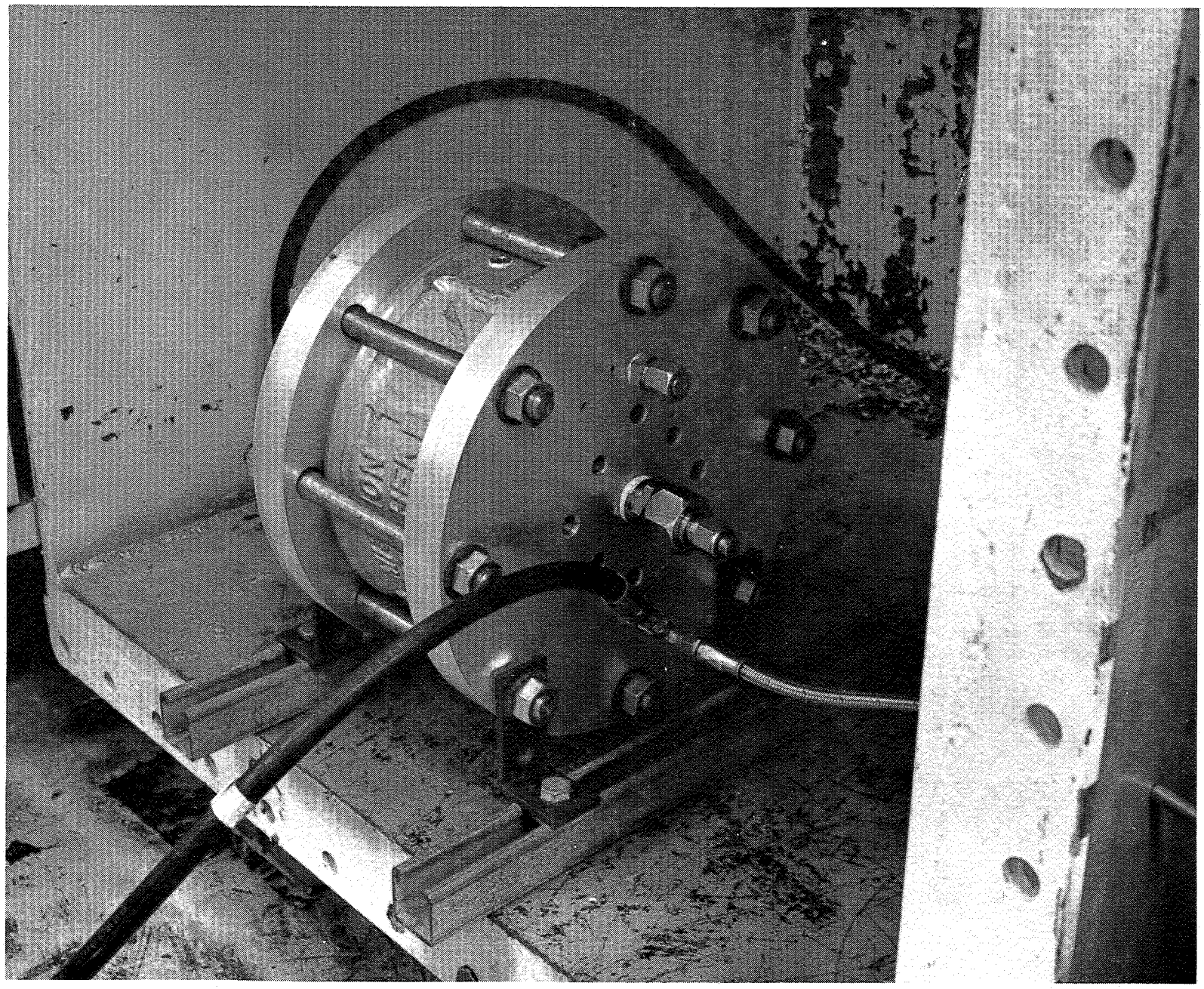


Figure 9-2. Test Setup

APPENDIX A

APPENDIX A

Installation of Teflon-Coated Leaf Pin and Teflon Washers

1. Discussion

1.1 Following the performance of the surge test and prior to the performance of the flow test, the stainless steel leaf pin and washers were replaced with a Teflon-coated pin and Teflon washers. The installation of the pin and washers is shown in figure A-1.

1.2 A functional test as described in section IV was performed following the installation of the pin and washers.

2. Test Results

2.1 Functional test results obtained after installation of the leaf pin and washers are described in the following paragraphs.

2.2 There was no external leakage.

2.3 Internal leakage was above the specified maximum of 40 sccm when measured at 5, 10, and 15 psig using GN_2 at ambient temperature and GH2 at -400°F.

2.4 Cracking pressure measured using GN_2 at ambient temperature was within the specified range of 0.15 psig ±20 percent. Cracking pressure measured using GH2 at -400°F was below the specified range.

3. Test Data

Functional test results obtained following installation of the pin and washers are presented in table A-1.

Table A-1. Functional Test Results Obtained After Installation of Teflon-Coated Leaf Pin and Teflon Washers

Test Medium	Cracking Pressure		Internal Pressure	
	Trial	Pressure (psig)	Pressure (psig)	Leakage (sccm)
GN_2 at ambient temperature	1	0.15	5	131
	2	0.15	10	205
	3	0.15	15	303
GH_2 at -400°F	1	0.075	5	574
	2	0.075	10	820
	3	0.080	15	1066

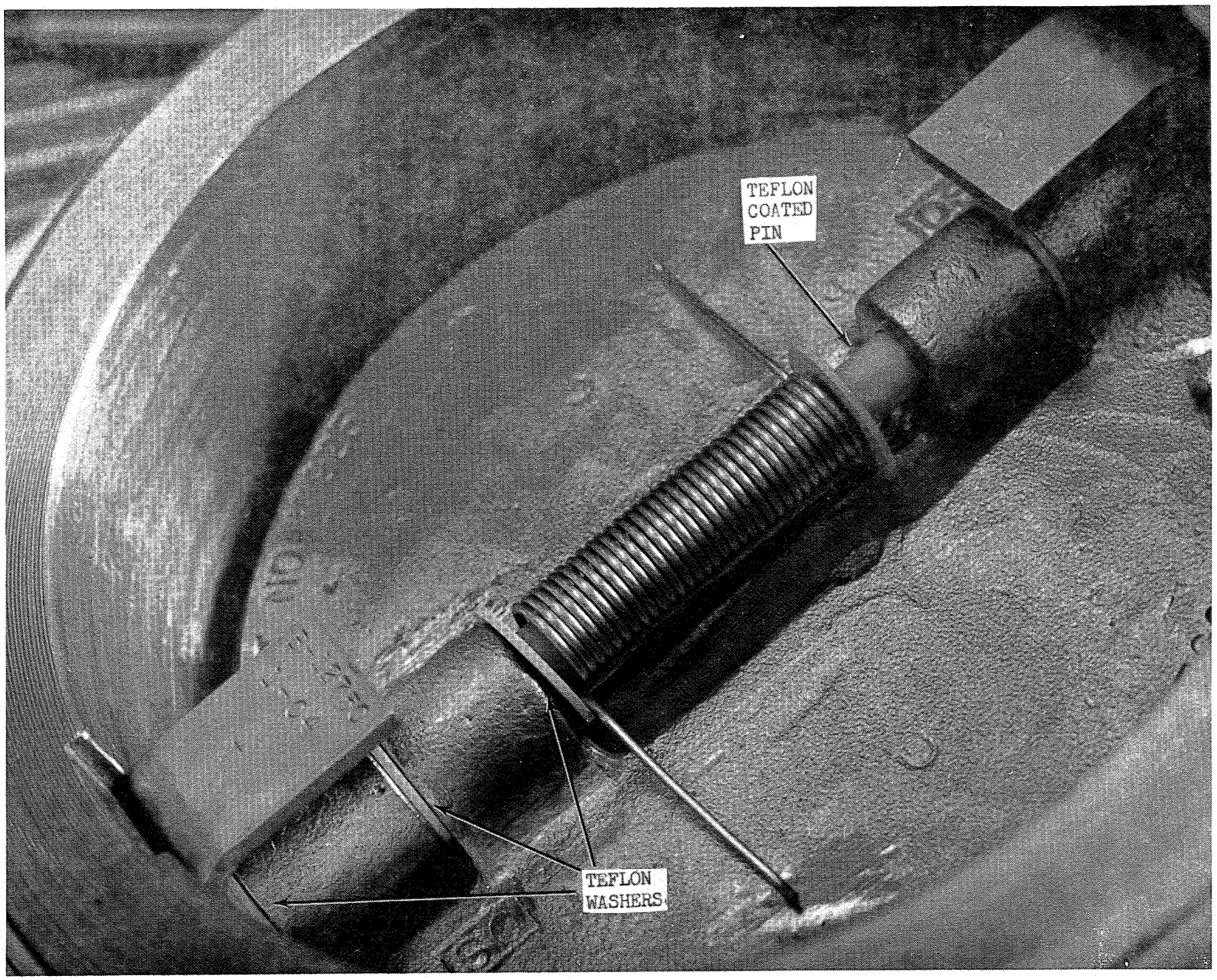


Figure A-1. Installation of Tefl -Coated Leaf Pin and Teflon Washers

APPROVAL

TEST REPORT

FOR

8-INCH CHECK VALVE

Mission Valve and Pump Company Part Number 15 CPF-311

NASA Drawing Number 75M13138 HCV-9

SUBMITTED BY:

P. D. M. Bogan
Test and Evaluation Section

APPROVALS:

R. W. Claunch
Program Supervisor

V. J. Vehko, Director
Engineering Department

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