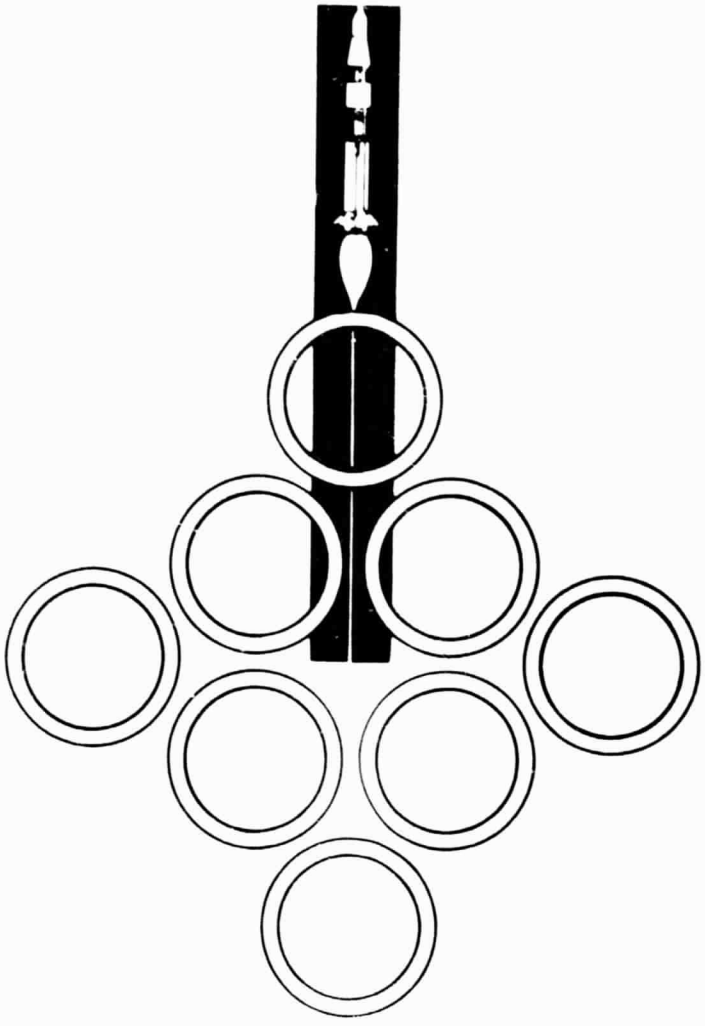

ENGINEERING DEPARTMENT

TECHNICAL REPORT

TR-RE-CCSD-FO-1136-3

May 15, 1968

SATURN IB PROGRAM

TEST REPORT
FOR

MANUAL GLOBE VALVE, 3/4-INCH, 6000 PSIG

Accessory Products Company, Part Number 5072X1004-(13, 23)

NASA Drawing Number 75M09220 PGLV-5

SPACE DIVISION CHRYSLER CORPORATION

TEST HISTORY: Sheet 2 of 2

TEST REPORT NO.	TEST TYPE	REMARKS
TR-RE-CCSD-FO-1136-3	Receiving Inspection	Satisfactory
	Proof Pressure	Satisfactory
	Functional	Spec. 1 excessive leakage, spec. 2, 3, satisfactory
	Surge	Satisfactory
	Seat Erosion	Spec. 1 excessive leakage, spec. 2, 3 satisfactory
	Low Temperature	Satisfactory
	High Temperature	Spec. 3 excessive leakage, spec. 2 satisfactory
	Cycle	Satisfactory
TR-RE-CCSD-FO-1136-3A, Addendum 1	Cycle	Satisfactory

SERVICE HISTORY:

None

(Continued)

stalled and the specimen performed satisfactory until stem thread galling occurred during cycle 345. The threads were cleaned and testing resumed. The plug end of the stem sheared loose during cycle 987 and testing was discontinued on this specimen.

Specimen 3 (-23 configuration) leaked excessively past the seat during the functional test following the high temperature test. A new hard seat was installed and during cycle 42 of the cycle test, the modified seat retainer apparently contracted and caused poppet galling. An original type seat retainer was installed and the specimen performed satisfactorily until cycle 424 when the stem threads galled. Testing was discontinued.

An additional test was performed to determine the effect of high flow rates of high pressure helium through the modified valve (Vespel SP-1 seat & 17-4 PH stem). Test report TR-RE-CCSD-FO-1136-3A, Addendum 1 presents the procedure used and the results obtained in this test. One hundred open-close cycles were performed with a maximum leakage rate of one bubble every two minutes being recorded.

The APCO valve with the Vespel SP-1 seat seal and the 17-4 PH stem is considered qualified for use. Krytox 240 AC lubricant should be used on stem threads to prevent galling.

Stuffing box bonnet kit No. 507299 x 1004 will convert existing Accessory Products Co. valves, both series 5072 and 5075, to the current production level.

The following cross reference is extracted from sheets 1 and 2 of Accessory Products Co. drawing No. 5072 x 1004.

APCO Part No.	Replaces APCO Part No.	NASA Spec. Ident. No.	NASA Drawing No.
5072 x 1004-11	5072 x 1004-1	PGLV-2	75M05871
5072X1004-12	5072X1004-2	PGLV-9	"
"	"	PGLV-17	"
5072X1004-13	5072X1004-3	PGLV-10	"
5072X1004-13	5072X1004-3	PGLV-3	75M09618
5072X1004-12	5072X1004-2	PGLV-3	75M09220
5072X1004-13	5072X1004-3	PGLV-5	"
5072X1004-11	5072X1004-1	PGLV-4	"
5072X1004-11	5072X1004-1	PGLV-2	75M13208
5072X1004-23	-	-	75M09220

We trust the above is satisfactory. Please do not hesitate to contact the undersigned in the event of further question.

Very truly yours,

FLUID SCIENTIFIC, INC.

W. J. Spencer
Authorized Representative
Accessory Products Company

WJS:cs

FLUID SCIENTIFIC
INCORPORATED

P. O. Box 1043
Merritt Island, Florida 32952
Phone: (305) 632-8906

October 8, 1968

Chrysler Corporation
8880 Astronaut Blvd.
Cape Canaveral, Florida

Attention: Mr. James F. Crawford, Dept. 6924

Subject: Chrysler Corp. Engineering Department
Technical Report TR-RE-CCSD-FO-
1136-3, Dated May 15, 1968

Re: Accessory Products Company Manual
Globe Valve Drawing No. 5072 x 1004

Gentlemen:

This is to clarify the type of materials to be furnished for the soft seat and for the stem in the Accessory Products Co. valves, Drawing No. 5072 x 1004. Please note the current level for sheet #2 of this drawing is Rev. "D", dated 27 Aug. 1968. This revision is subsequent to the date of the subject test report and should be considered when reviewing the report.

Test specimen No. 1 per the test report was a 5072 x 1004-13 valve, with a Kel-F seat. Specimens No. 2 and 3 were 5072 x 1004-23, containing Vespel SP-1 soft seats and 17-4 PH stem assemblies. Specimen No. 1 was the only -13 valve produced with a Kel-F seat, and was later modified to contain the Vespel seat.

The Drawing Rev. "D" incorporates the Vespel SP-1 soft seats and 17-4 PH stems for all current valve production. Lubrication per Note # 6 is also revised, indicating the use of Krytox 240 AC (Dupont) on threads, O-Rings, and sliding parts. This lubricant has received NASA approval, and has been successful in eliminating galling problems.

TR-RE-CCSD-FO-1136-3

TEST REPORT

FOR

MANUAL GLOBE VALVE, 3/4 INCH, 6000 PSIG

Accessory Products Company, Part Number 5072X1004-(13, 23)

NASA Drawing Number 75M09220 PGLV-5

May 15, 1968

CHRYSLER CORPORATION SPACE DIVISION - NEW ORLEANS, LOUISIANA

TEST REPORT
FOR
MANUAL GLOBE VALVE, 3/4 INCH, 6000 PSIG
ACCESSORY PRODUCTS COMPANY, PART NUMBER 5072X1004-(13, 23)
NASA DRAWING NUMBER 75M09220 PGLV-5

ABSTRACT

This report presents the results of tests performed on three specimens of Manual Globe Valve 75M09220 PGLV-5. The following tests were performed:

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Surge
5. Seat Erosion
6. Low Temperature
7. High Temperature
8. Cycle

The valves were tested to qualify a modified bonnet assembly which includes the plug and soft seat. Specimen 1 was Accessory Products Company (APCO) P/N 5072X1004-13. This valve had a modified sealing surface on the plug using a Kel-F 81 soft seat and a "V" ring Teflon packing around the stem. Specimens 2 and 3 were APCO P/N 5072X1004-23 which incorporated a new seat design using a Vespel SP-1 soft seat and Teflon "V" ring packings for stem seals.

The test was started using Specimen No. 1 only. Specimen 1 successfully completed receiving inspection and the proof pressure test but leaked excessively during the initial functional test. Inspection of the hard female seat revealed scratches which were considered a quality control problem. A new hard seat was installed and proof pressure, functional, and surge tests were performed with satisfactory results. Excessive leakage occurred following the seat erosion test. The soft seat was replaced and the test was repeated with similar results. After each of the seat erosion tests, chunks had been blown off the Kel-F seat seal. Testing was discontinued on the P/N 5072X1004-13 configuration.

A new bonnet assembly converting to the Vespel SP-1 seat was installed in specimen 1 and a seat erosion test was performed. No leakage occurred; however, the stem threads galled so that the valve could not be closed after four cycles. No further testing was performed on Specimen No. 1.

Specimens 2 and 3 were submitted by the vendor. These were -23 configuration with a 17-4 PH stem assembly in lieu of the 316 CRES stem assembly.

Specimen 2 leaked slightly during the functional test following the seat erosion test; however, testing was continued. After 50 cycles, the modified seat retainer apparently contracted and caused poppet galling. An original type seat retainer was installed and the specimen performed satisfactorily until stem thread galling occurred during cycle 345. Threaded areas were cleaned, relubricated and testing was continued until cycle 987. At this point, the plug end of the stem sheared loose and testing was discontinued.

Specimen 3 leaked excessively past the seat during the functional test following the high temperature test. A new seat was installed and during cycle 42 of the cycle test, the modified seat retainer apparently contracted, similar to that of Specimen 2, and caused poppet galling. An original type seat retainer was installed and the specimen performed satisfactorily until cycle 424 when the stem threads galled. Testing was discontinued.

A publication change required a sequence change for the surge test (Section V), for Specimens 2 and 3 to be performed after the cycle test (Section IX). Due to threaded stem areas of both specimens being badly galled during cycle testing surge testing was not performed.

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 NAS8-4016, Part VII, CWO 271620.

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LIST OF TABLES (Continued)

Manual Globe Valve 75MO9220 PGLV-5

CHECK SHEET

FOR

MANUAL GLOBE VALVE, 3/4-INCH, 6000 PSIG

SPECIMEN NO. 1

MANUFACTURER: Accessory Products Company, Whittier, California

MANUFACTURER'S PART NUMBER: 5072X1004-13

NASA PART NUMBER: 75M09220 PGLV-5

SERIAL NUMBER: 796

TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, La.

AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A. OPERATING MEDIUM: Gaseous Hydrogen, Gaseous Helium

B. OPERATING PRESSURE: 0 to 6000 psig

C. TORQUE REQUIREMENTS

BREAKAWAY: 10 ft-lb max with 6000 psig above the seat
RUNNING: 5 ft-lb max
SEATING: 10 ft-lb max against 6000 psig

II. CONSTRUCTION

A. BODY MATERIAL: 316 stainless steel

B. PACKING: Teflon and glass (15%)

C. SEAT SEAL: KEL-F

D. CONTROL KNOB: 380 aluminum

E. INLET AND OUTLET CONNECTION: AND10050-12

III. ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE: 5°F to 150°F

IV. LOCATION AND USE: The manual globe valve is used in the high pressure gaseous hydrogen system to vent the storage batteries.

CHECK SHEET

FOR

MANUAL GLOBE VALVE, 3/4-INCH, 6000 PSIG

SPECIMEN NOS. 2 AND 3

MANUFACTURER: Accessory Products Company

MANUFACTURER'S PART NUMBER: 5072x1004-23

NASA PART NUMBER: 75M09220 PGLV-5

TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, La.

AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A. OPERATING MEDIUM: Gaseous Hydrogen, Gaseous Helium

B. OPERATING PRESSURE: 0 to 6000 psig

C. TORQUE REQUIREMENTS

BREAKAWAY: 10 ft-lb max with 6000 psig above seat
RUNNING: 5 ft-lb max
SEATING: 10 ft-lb max against 6000 psig

II. CONSTRUCTION

A. BODY MATERIAL: 316 stainless steel

B. PACKING: 15% Glass filled teflon

C. SEAT SEAL: Vespel SP-1

D. CONTROL KNOB: Aluminum

E. INLET & OUTLET CONNECTION: AND10050-12

III. ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE: 5°F to 150°F

IV. LOCATION & USE: The manual valve is used in the gaseous high pressure hydrogen system to vent the storage batteries.

TEST SUMMARY
MANUAL GLOBE VALVE, 3/4-INCH, 6000 PSIG
75M09220 PGLV-5

Environment	Units	Operational Boundary	Test Objective	Test Results	Remarks
Receiving Inspection	1,2,3	Specifications and Drawings	Conformance to drawings and specifications	Satisfactory	Completed
Proof Pressure	1,2,3	9,000 psig, 5 minutes	Determine structural integrity	Satisfactory	Test Completed
Functional Test	1,2,3	6000 psig Torque requirements: Unseating: 10 ft-lb; Running: 5 ft-lb; Seating: 10 ft-lbs	Check for leakage and torque values	Specimens 1 Unsatisfactory (acceptable after rework) Specimen 2: Slight leakage acceptable Specimen 3: Satisfactory	Specimen 1 leaked excessively at the outlet port with the inlet port pressurized at 6000 psig. Testing completed on 1, 2, 3
Surge Test	1	0 to 6000 psig at inlet within 100 milliseconds	Determine if specimen operation is impaired by surge pressure	Satisfactory	Test Completed
Seat Erosion Test	1,2,3	100 scfm flow with inlet pressure of 6000 psig & outlet pressure below 50 psig	Determine if flow causes degradation or deformation	Specimen 1: Unsatisfactory Specimen 2: Slight leakage acceptable Specimen 3: Satisfactory	Specimen 1 failed twice following two separate tests Test completed 2, 3

TEST SUMMARY (Contd.)

Environment	Units	Operational Boundry	Test Objective	Test Results	Remarks
Low Temperature Test	2, 3	5(+0, -4)°F	Determine if Specimen operation is impaired by low temperature	Specimen 2: Unsatisfactory Satisfactory after new seat installation Specimen 3: Satisfactory	Test Completed
High Temperature Test	2, 3	150(+4, -0°F	Determine if specimen operation is impaired by high temperature	Specimen 2: Satisfactory Specimen 3: Unsatisfactory, Satisfactory after new seat installation	Test Completed
Cycle Test	2, 3	Opening and closing specimen with the inlet port pressurized at 6000 psig	Determine if cycling causes degradation or deformation due to accumulative wear	Specimen 2, 3: Unsatisfactory	Specimen 2, 3 stem binding. Specimen 2 plug end sheared

Note: A surge test was tc be performed on specimens 2 and 3 following the cycle test; however, both specimens failed during the cycle test and further testing was discontinued.

SECTION I

INTRODUCTION

1.1 SCOPE

1.1.1 This report presents the results of the tests that were performed to determine if Manual Globe Valve 75M09220 PGLV-5 meets the operational and environmental requirements of the John F. Kennedy Space Center. A summary of the test results is presented on pages xi and xii.

1.1.2 Three specimens were tested. The tests were performed by using the test media listed in table 1-1.

1.2 ITEM DESCRIPTION

Manual Globe Valve 75M09220 PGLV-5 was designed to be manually operated at pressures between zero and 6000 psig and at temperatures ranging from +5°F to +150°F.

1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for Manual Globe Valve 75M09220 PGLV-5.

a. 75M09220 PGLV-5, Component Specification

b. KSC-STD-164(D), Environmental Test Methods

c. Test Plan CCSD-FO-1136-1F, Test Requirements

d. Technical procedure TP-RE-CCSD-FO-1136-2F

1.4 TEST SEQUENCE

1.4.1 The test specimens were tested in sequence shown in table 1-1 and in accordance with KSC-STD-164(D), unless otherwise specified.

1.4.2 A functional test was performed before (if 72 hours or more had elapsed since the previous functional test), during (when specified), and within one hour following each test.

1.4.3 Test media was as specified in table 1-1.

Table 1-1. Test Sequence and Media

Test	Section	Medium
Receiving Inspection	II	
Proof Pressure	III	GN_2
Functional	IV	He
Surge (Specimen 1)	V	GN_2
Seat Erosion	VI	GN_2
Low Temperature	VII	He
High Temperature	VIII	He
Cycle	IX	GN_2
Surge (Specimens 2 and 3)*	X	GN_2

*Surge testing on specimens 2 and 3 was not performed since both failed during cycle testing.

SECTION II

RECEIVING INSPECTION

2.1 REQUIREMENTS

Each test specimen shall be visually and dimensionally checked for conformance with NASA drawing 75M09220 PGLV-5, applicable specifications and vendor data to the extent possible without disassembly of the specimen.

2.2 PROCEDURE

Each specimen was inspected for conformance with NASA drawing 75M090220 PGLV-5 and applicable vendor drawings without disassembly of the specimen as shown in figure 2-1. The specimens were also inspected for defective threads, poor workmanship, and manufacturing defects.

2.3 TEST RESULTS

Each specimen complied with NASA drawing 75M09220 PGLV-5. No evidence of poor workmanship or manufacturing defects was observed.

2.4 TEST DATA

The data presented in tables 2-1 and 2-2 was recorded during the inspection.

Table 2-1. Receiving Inspection Test Equipment List

Item No.	Item	Manufacturer	Model Part No.	Serial No.	Calibration Date
1	Scale	Brown and Sharp	300	NASA 101-1013	7-23-64

Table 2-2. Receiving Inspection Test Data

Item	Actual Data		
	Specimen 1	Specimen 2	Specimen 3
Housing Length	3-3/4 in.	3-25/32 in.	3-25/32 in.
Housing Width	1-11/16 in.	1-13/16 in.	1-13/16 in.
Housing Height	2-0 in.	2-1/8 in.	2-1/8 in.
Total Height (Valve Closed)	5-1/16 in.	5-5/32 in.	5-5/32 in.
Total Height (Valve Opened)	5-17/32 in.	5-11/16 in.	5-43/64 in.
Valve Handle Diameter	2-3/8 in.	2-3/8 in.	2-1/8 in.
Weight	4-1/2 lb	4-1/2 lb	4-1/2 lb
Number of turns to open	7-1/4	7-1/8	7-1/8

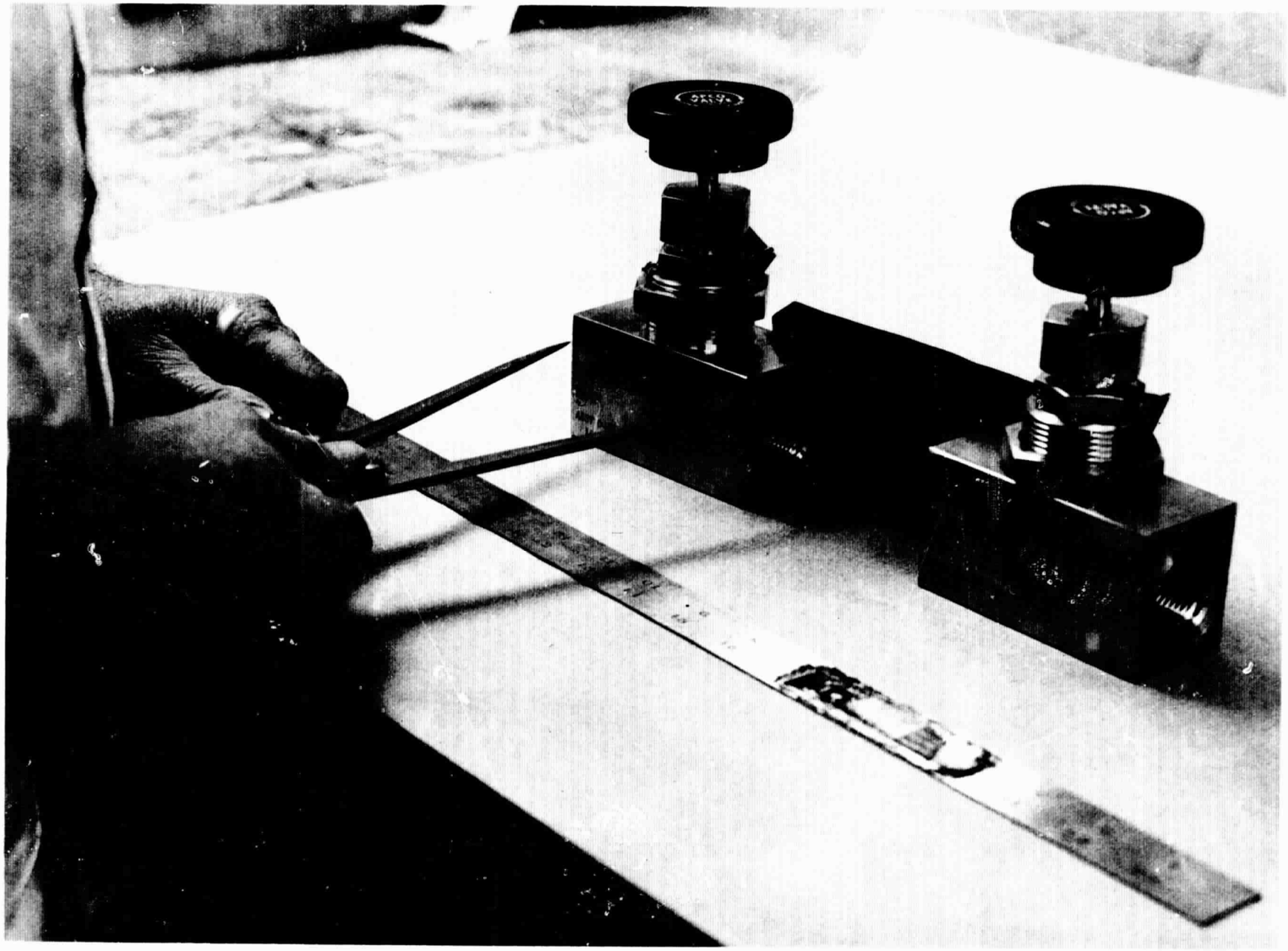


Figure 2-1. Receiving Inspection

SECTION III

PROOF PRESSURE TEST

3.1 TEST REQUIREMENTS

3.1.1 The test specimens shall be subjected to proof pressure of 9000 psig. The pressure shall be applied to the inlet port for 5 minutes with the outlet port capped and the specimen in the open position.

3.1.2 Leakage and distortion shall be monitored.

3.2 TEST PROCEDURE

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

3.2.2 The outlet port was capped and the specimen was completely opened.

3.2.3 All hand valves were closed and regulator 6 was adjusted for a zero outlet pressure.

3.2.4 Hand valves 3 and 7 were opened and pressure was applied using source 2.

3.2.5 Pressure gage 5 indicated 10,000 psig.

3.2.6 Regulator 6 was adjusted until pressure gage 8 indicated 9000 psig.

3.2.7 The 9000 psig pressure was maintained for 5 minutes while the specimen was checked for leakage.

3.2.8 Regulator 6 was adjusted for a zero outlet pressure as indicated on pressure gage 8.

3.2.9 Hand valve 9 was opened and the pressure vented. The specimen was then checked for distortion. All data was recorded.

3.3 TEST RESULTS

Test specimens 1, 2 and 3 had no leakage or distortion when the inlet ports were pressurized to 9000 psig for 5 minutes.

3.4 TEST DATA

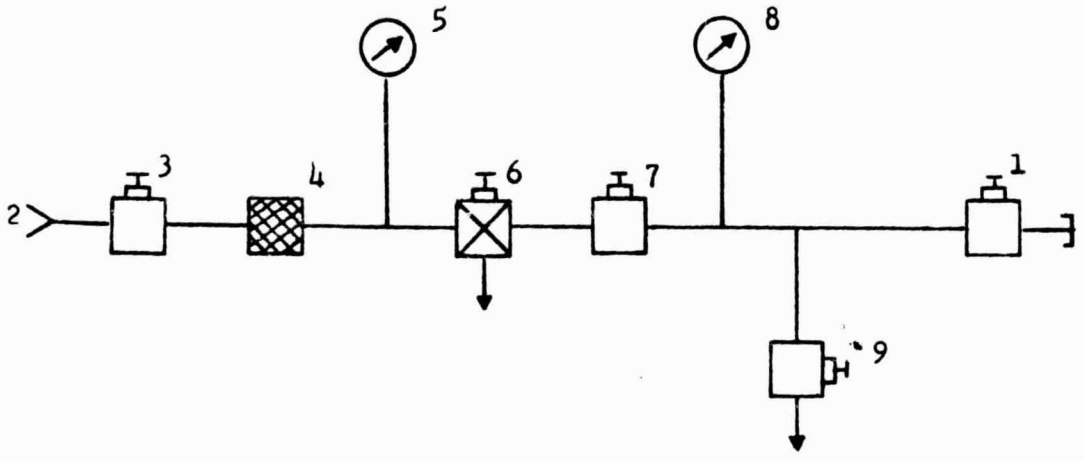
3.4.1 The test data presented in table 3-2 was recorded during the proof pressure test.

Table 3-1. Proof Pressure Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Accessory Products Company	5072X 1004(-13, -23)	75M09220 PGLV-5	Manual Globe Valve, 3/4-Inch
2	GN_2 Pressure Source	CCSD	NA	NA	10,000 psig
3	Hand Valve	Combination Pump and Valve Co.	380-3	NA	1-1/2 Inch
4	Filter	Microporous	4813-F 2DM	NA	2 Micron
5	Pressure Gage	Ashcroft	NA	NASA 200613-3	0 to 20,000psig ±2.0% FS Cal Date 6/7/67
6	Pressure Regulator	Tescom Corp	26-1021-20	3024	10,000 psig inlet 10,000 psig outlet
7	Hand Valve	Robbins Aviation	SSKG-250 -4T	NA	1/4 Inch
8	Pressure Gage	Heise	H49480	NASA 95-1653-B	0 to 10,000psig Cal Date 7/5/67
9	Hand Valve	Robbins Aviation	SSKG-250 -4T	NA	1/4 Inch

Table 3-2. Proof Pressure Test Data

Specimen No.	Pressure	Leakage	Distortion
1	9000 psig/5 minutes	Zero	Zero
2	9000 psig/5 minutes	Zero	Zero
3	9000 psig/5 minutes	Zero	Zero



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

Figure 3-1. Proof Pressure Test Schematic

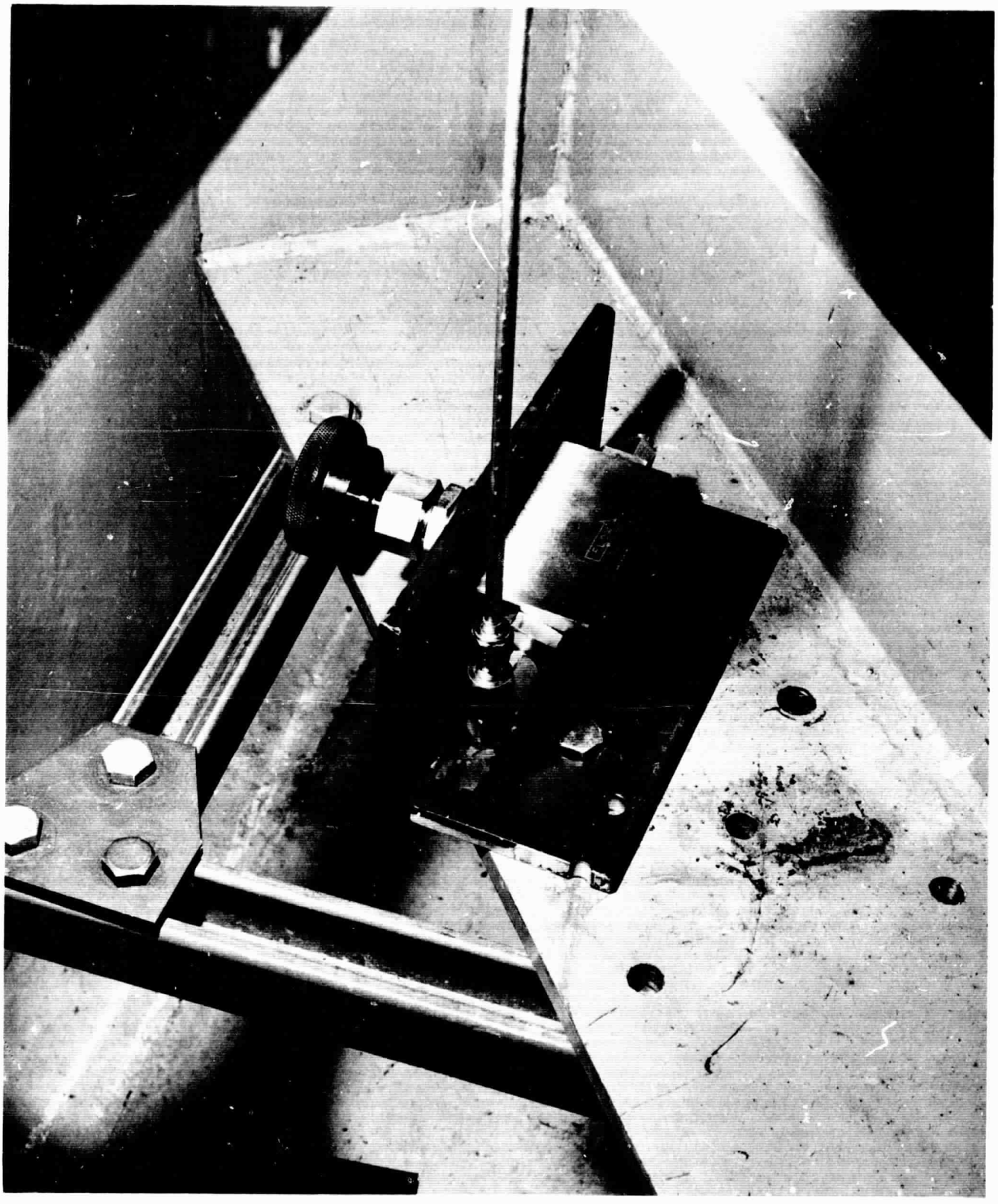


Figure 3-2. Proof Pressure Test Setup

SECTION IV

FUNCTIONAL TEST

4.1 TEST REQUIREMENT

4.1.1 Test specimen 1 shall be inspected for leakage with the outlet port pressurized to 6000 psig, specimen closed, and the inlet port vented.

4.1.2 Test specimens 1, 2 and 3 shall be inspected for leakage with the inlet port pressurized to 6000 psig, specimen closed, and the outlet port vented.

4.1.3 The opening, seating and running torque of each specimen shall be determined with the inlet port pressurized to 6000 psig.

4.1.4 The requirements described in 4.1.1 and 4.1.2 shall be performed once at the beginning of the initial functional test and once at the beginning of all subsequent functional tests. The requirements described in 4.1.3 shall be performed five times during the initial functional test and five times for all subsequent functional tests. Requirement 4.1.2 shall be performed one additional time at the end of each functional test.

4.1.5 All test data shall be recorded.

4.2 TEST PROCEDURE

4.2.1 Line 14 was connected to the outlet port of specimen 1 only and line 15 was connected to the inlet port.

4.2.2 The test setup was assembled as shown in figure 4-1 and 4-2 using the equipment listed in table 4-1 except for thermocouple 16 and thermal chamber 17.

4.2.3 The hand wheel of the test specimen was replaced with torque wrench 13 and the test specimen was closed using the maximum seating torque.

4.2.4 Regulator 6 was adjusted for zero outlet pressure and all hand valves were closed.

4.2.5 Hand valve 3 was opened. Supply pressure on gage 5 indicated 7000 psig.

4.2.6 Pressure regulator 6 was adjusted to establish 6000 psig as indicated on pressure gage 7.

4.2.7 Hand valve 10 was opened. If bubbles appeared in water tank 12, the amount of leakage was determined by the displacement of water in graduated cylinder 11.

4.2.8 Pressure regulator 6 was adjusted for zero outlet pressure. Hand valve 8 was opened to vent the specimen.

4.2.9 Hand valves 8 and 10 were closed.

4.2.10 Line 14 was connected to the inlet port of the specimen and line 15 was connected to the outlet port.

4.2.11 The procedures described in 4.2.6 through 4.2.9 were repeated.

4.2.12 Pressure regulator 6 was adjusted until gage 7 indicated 6000 psig.

4.2.13 The breakaway torque of the specimen was measured by slowly applying the maximum torque required to unseat the specimen.

4.2.14 After the breakaway torque was measured, the specimen was completely opened. The running torque required was measured from breakaway until the specimen was fully opened.

4.2.15 The specimen was closed and the closing running torque was measured.

4.2.16 Hand valve 9 was opened and closed to vent the outlet pressure on the specimen.

4.2.17 Hand valve 10 was opened.

4.2.18 The specimen was slowly opened until bubbles appeared in water tank 12.

4.2.19 The specimen was slowly closed and the torque required to stop the bubbles in water tank 12 was measured. This was the closing torque for the specimen at operating pressure.

4.2.20 Pressure regulator 6 and hand valve 10 were closed.

4.2.21 Hand valves 8 and 9 were opened and closed to vent the specimen.

4.2.22 The procedures described in 4.2.12 through 4.2.21 were repeated five times.

4.2.23 Procedure 4.2.12 was repeated. Hand valve 10 was opened. The specimen was closed using the maximum allowable seating torque. When bubbles appeared in water tank 12, the amount of leakage was determined by displacement of water in graduated cylinder 11 .

4.2.24 Hand valve 10 was closed and pressure regulator 6 was adjusted for zero outlet pressure.

4.2.25 Hand valves 8 and 9 were opened and closed to vent the system.

4.2.26 Procedures 4.2.1 through 4.2.25 were repeated for all subsequent functional tests on specimen 1 and also repeated if 72 hours or more had elapsed since the previous functional test.

4.2.27 Procedures 4.2.10 through 4.2.25 were repeated for all subsequent functional tests on specimens 2 and 3 and also repeated if 72 hours or more had elapsed since the previous functional test.

Table 4-1. Functional Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Accessory Products Company	5072X 1004(-13, -23)	75M09220 PGLV-5	Manual Globe Valve, 3/4-inch
2	He Source	GCSD	NA	NA	7000 psig
3	Hand Valve	Combination Pump and Valve Co.	NA	NA	1-1/2-inch
4	Filter	Microporous	4813-F 2DM	NA	2 micron
5	Pressure Gage	Ashcroft	1850	200594-P	0 to 10,000 psig ±2.0 FS Cal. Date 6/7/67
6	Pressure Regulator	Tescom Corp.	26-1002	1009	6000 psig inlet 0 to 6000 psig outlet
7	Pressure Gage	Ashcroft	1850	200594-Q	0 to 10,000 psig ±0.25% FS Cal. Date 6/7/67
8	Hand Valve	Grove	NA	NA	1/4-inch
9	Hand Valve	Robbins	SSKG-250-4T	NA	1/4-inch
10	Hand Valve	Robbins	SSKG-250-4T	NA	1/4-inch
11	Graduated Cylinder	NA	NA	NA	For leakage measurement
12	Water Tank	NASA	NA	NA	Leakage detector
13	Torque Wrench	Sturtevant	S-300-1	NA	Replaces hand wheel of specimen (when required) Cal Date 7/5/66
14	Line	Superior Tube Co.	NA	NA	1/4-inch
15	Line	Superior Tube Co.	NA	NA	1/4-inch
16	Thermocouple	Minneapolis Honeywell	30112	NA	-50 to +200 (±2.5)°F (temperature test only)
17	Thermal Chamber	Conrad	NA	200494-1	-25 to +200°F (temperature test only)

4.3 TEST RESULTS

During the initial functional test, specimen 1 leaked excessively through the outlet port while in the closed position and with the inlet port pressurized to 6000 psig. Leakage in excess of 20 scim still existed with the stem torque to 140 inch-pounds. Disassembly of the specimen revealed a semi-circular scratch on the hard seat. It was also observed that the seat retainer was barrel shaped to the extent of making the holes oblong. A new seat retainer, seat, and soft goods were furnished by the vendor and after installation a successful functional test was performed. Specimens 2 and 3 functioned satisfactorily during the initial functional test.

4.4 TEST DATA

4.4.1 Functional test data are presented in tables 4-2, 4-3, 4-4 and 4-5.

4.4.2 Figure 4-3 shows typical damage.

Table 4-2. Specimen 1 Initial Functional Test Data

Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	140	0	6000	20
2	140	6000	0	20

Note: Vendor furnished a new seat and soft goods to rectify the leakage. Testing was then continued.

Table 4-3. Specimen 1 Functional Test Data (After Installation of New Seat and Soft Goods)

Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	50	0	6000	0
2	50	6000	0	0

Run	Applied Seating Torque (in-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in-lb)	Running Torque (in-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	55	18	35	0
2	40	6000	30	18	30	0
3	30	6000	20	17	30	0
4	30	6000	20	18	30	0
5	30	6000	20	20	30	0

Table 4-4. Specimen 2 Initial Functional Test Data

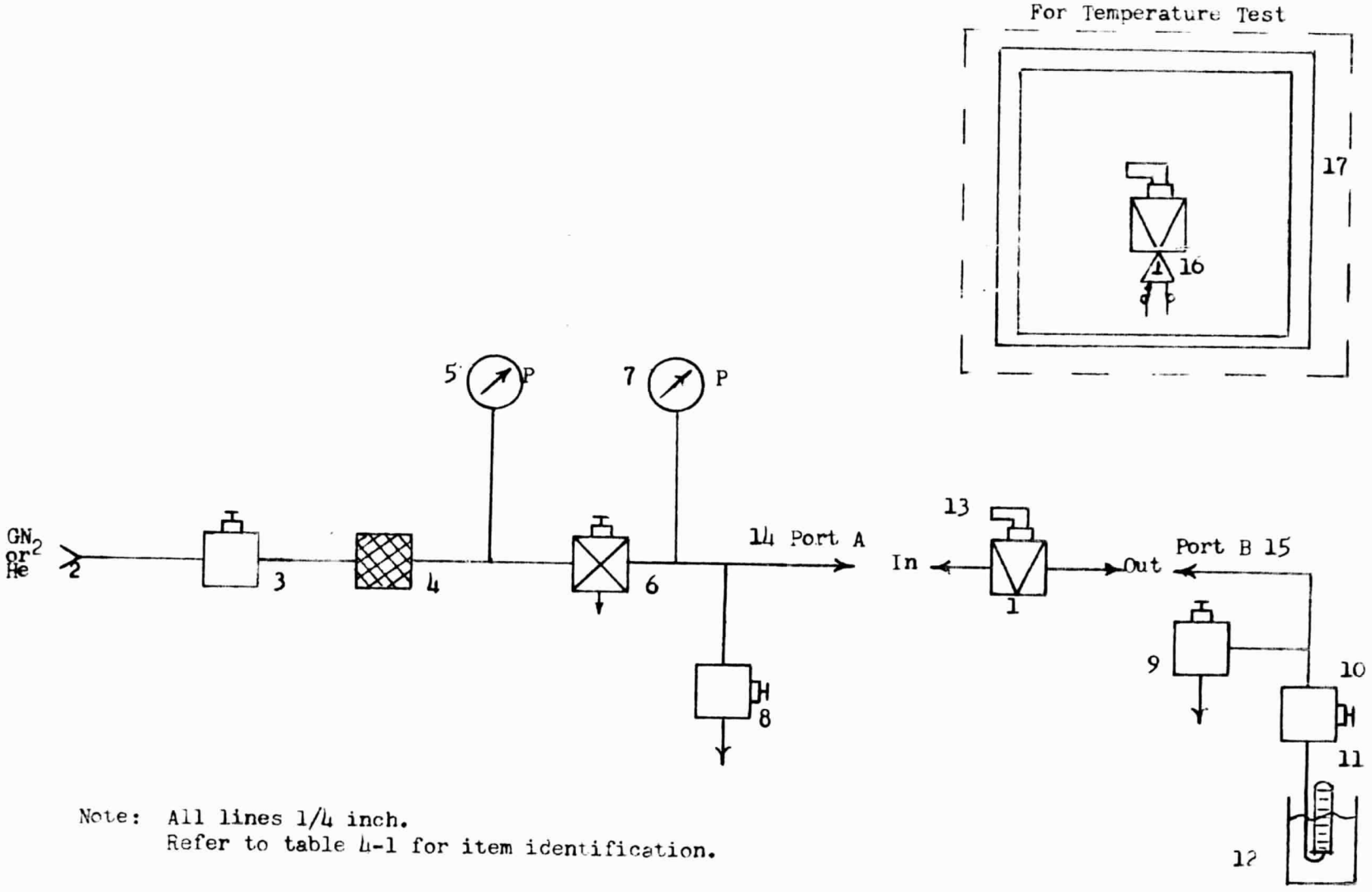
Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	80	6000	0	0

Run	Applied Seating Torque (in-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in-lb)	Running Torque (in-lb)		Leakage (scim)
				Opening	Closing	
1	80	6000	65	20	35	0
2	110	6000	90	20	35	0
3	100	6000	80	20	35	0
4	90	6000	80	20	35	0
5	80	6000	60	20	35	0

Table 4-5. Specimen 3 Initial Functional Test Data

Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in-lb)	Running Torque (in-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	30	20	35	0
2	40	6000	30	20	35	0
3	40	6000	30	20	35	0
4	40	6000	30	20	35	0
5	40	6000	30	20	35	0



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

Figure 4-1. Functional Test Schematic

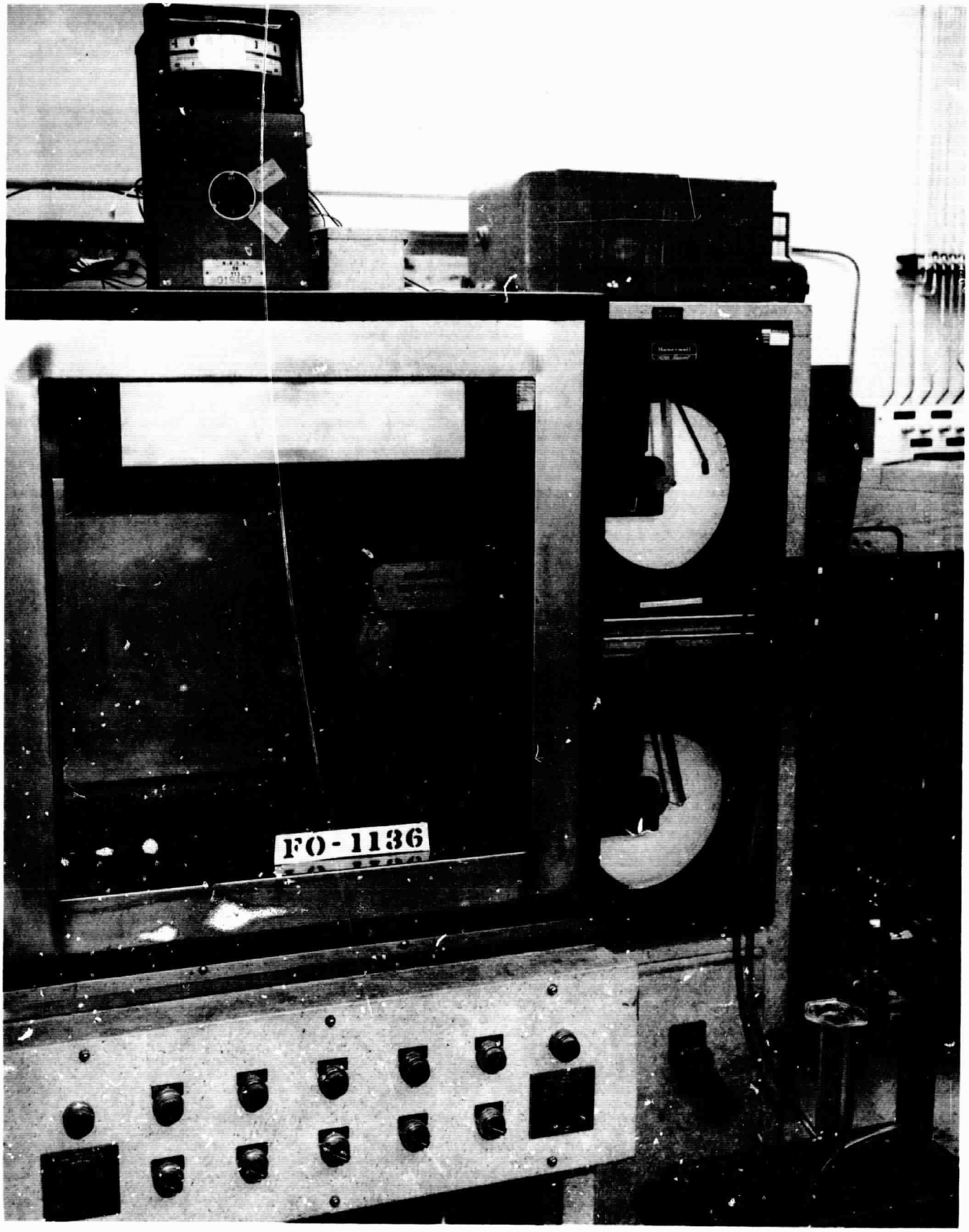


Figure 4-2. Functional Test Setup

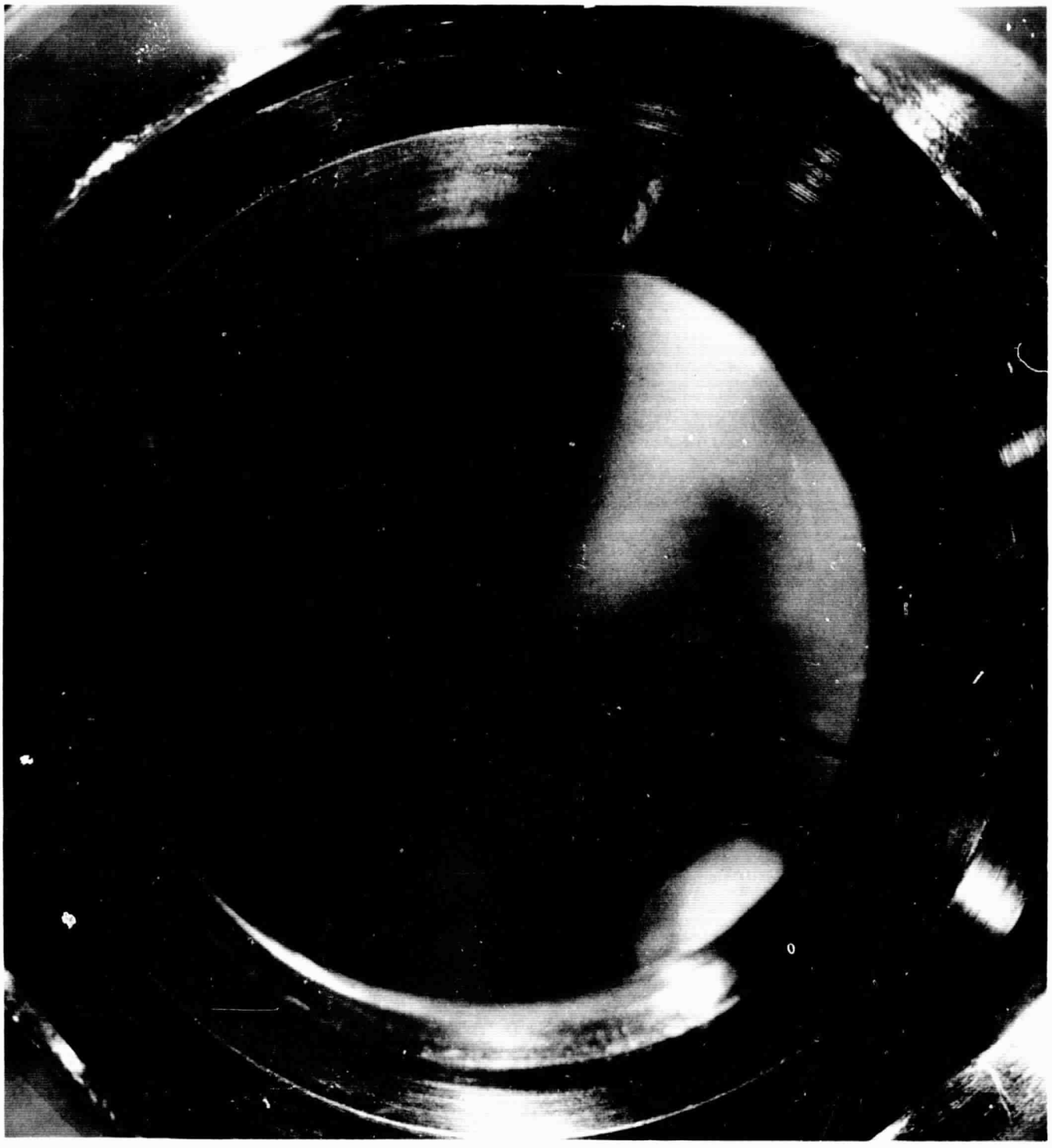


Figure 4-3. Hard Seat Damage

SECTION V

SURGE TEST

5.1 TEST REQUIREMENTS

5.1.1 A surge test shall be performed on test specimen 1 following the initial functional test and on specimen 2 and 3 following the cycle test according to publication changes published 1/12/68.

5.1.2 The specimens shall be pressurized from zero to 6000 psig within 100 milliseconds in the direction of flow.

5.1.3 Ten cycles shall be performed with the valve in the closed position and ten cycles with the valve partially open. The specimens shall be monitored for internal leakage during the test.

5.2 TEST PROCEDURE

5.2.1 The surge test setup was assembled as shown in figures 5-3, 5-4 and 5-5 using the equipment listed in table 5-1.

5.2.2 All hand valves were closed and regulator 6 was adjusted for zero outlet pressure.

5.2.3 The specimen was closed and hand valve 12 was opened.

5.2.4 Hand valve 3 was opened.

5.2.5 Pressure gage 5 indicated approximately 6500 psig.

5.2.6 Regulator 6 was adjusted until 6000 psig was indicated on pressure gage 7.

5.2.7 Switch 9 was closed causing the pressure port of solenoid valve 8 to open.

5.2.8 The pressure impulse was recorded on oscillograph 10.

5.2.9 Switch 9 was opened causing the pressure port of solenoid valve 8 to close and the vent port to open.

5.2.10 The procedures described in 5.2.7 through 5.2.9 were performed ten times with the valve closed. The valve was slightly opened for 10 additional cycles.

5.2.11 During each surge when the specimen was closed, leakage was monitored by using water tank 15 and graduated cylinder 14.

5.2.12 A functional test was performed on the specimen within one hour following the surge test.

5.3 TEST RESULTS

Test specimen 1 withstood 20 surge cycles within 100 milliseconds with the inlet pressurized from 0 to 6000 psig. Ten cycles were performed with the outlet closed and ten with the outlet partially opened. A publication change was written requesting that surge testing on specimens 2 and 3 be performed following cycle testing, however, both specimens failed during cycle testing and further testing was discontinued.

5.4 TEST DATA

5.4.1 Typical surge wave forms as recorded during the testing of specimen 1 are presented in figure 5-1 and 5-2.

5.4.2 Functional test data following the surge test are presented in table 5-2.

Table 5-1. Surge Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Accessory Products Company	5072X 1004-13	75M09220 PGLV-5	Manual globe valve, 3/4-inch
2	GN_2 Pressure Source	CCSD	NA	NA	10,000 psi
3	Hand Valve	Combination Pump & Valve Co.	NA	NA	1-1/2 inch
4	Filter	Microporous	4813-F 2DM	NA	2 micron
5	Pressure Gage	Ashcroft	1850	200594-P	0 to 10,000 psig ±2.0% FS Cal date 6/7/67
6	Pressure Regulator	Tescom Corp.	26-1002	1009	6500 psig inlet 0 to 6000 psig outlet
7	Pressure Gage	Ashcroft	1850	200594-Q	0 to 10,000 psig ±2.0% FS Cal date 6/7/67
8	Solenoid Valve	Marotta Valve Co.	MV583H	912	1/4-inch, 3-way
9	Switch	Cutler-Hammer	NA	NA	SPST
10	Oscillograph	CEC	124	012586	Used to record pressure impulse Cal date 8/2/67
11	Pressure Transducer	Statham	PA826 10M	954651-B	0 to 10,000 psig ±0.5% FS Cal Date 5/25/67
12	Hand Valve	Robbins	SSKG-250-4T	NA	1/4-inch
13	Power Supply	Plant Source	NA	NA	28 vdc
14	Graduated Cylinder	Pyrex Co.	NA	NA	For leakage measurement
15	Water Tank	CCSD	NA	NA	Leakage detector

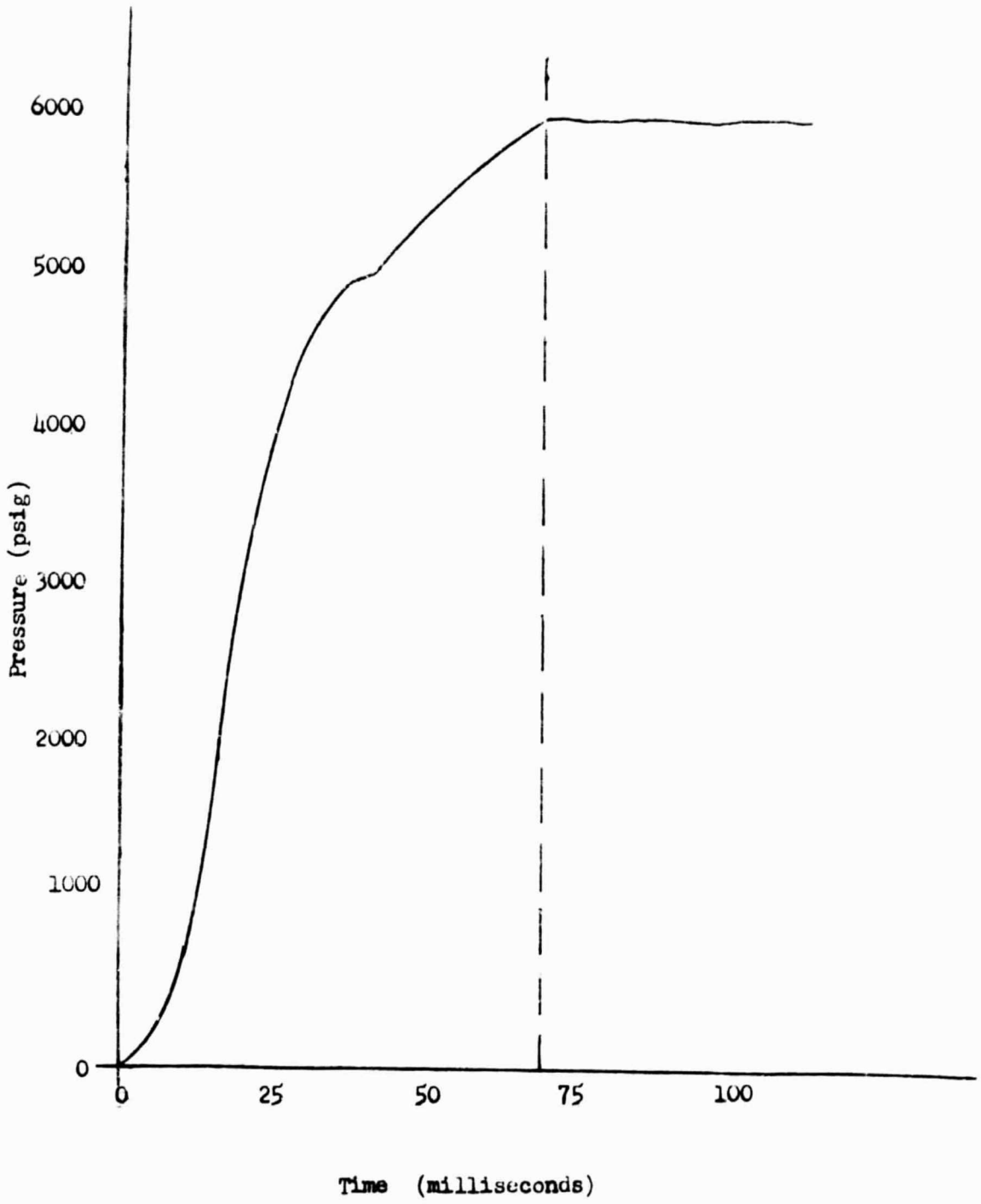


Figure 5-1. Typical Surge Wave Form (Outlet Closed)

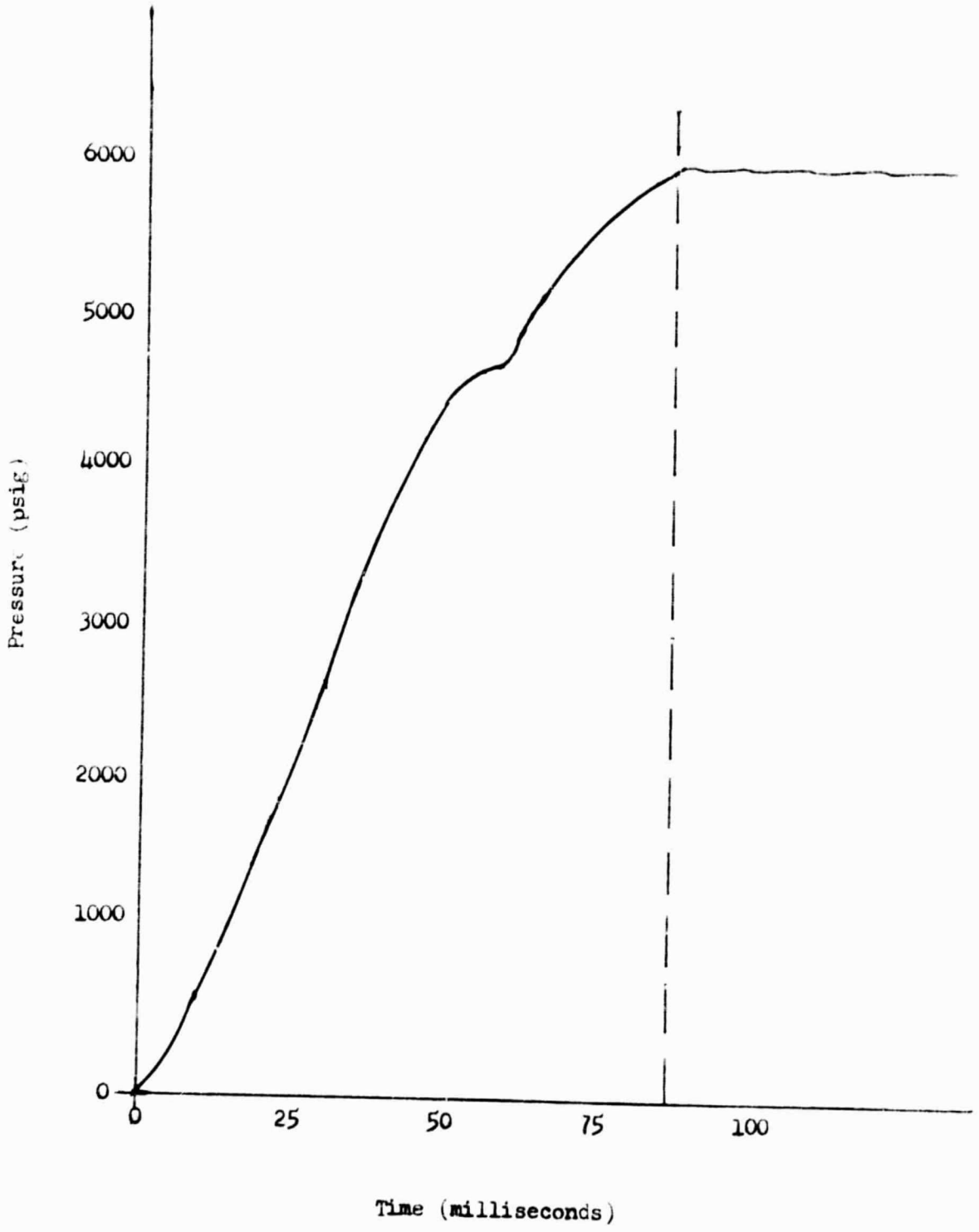
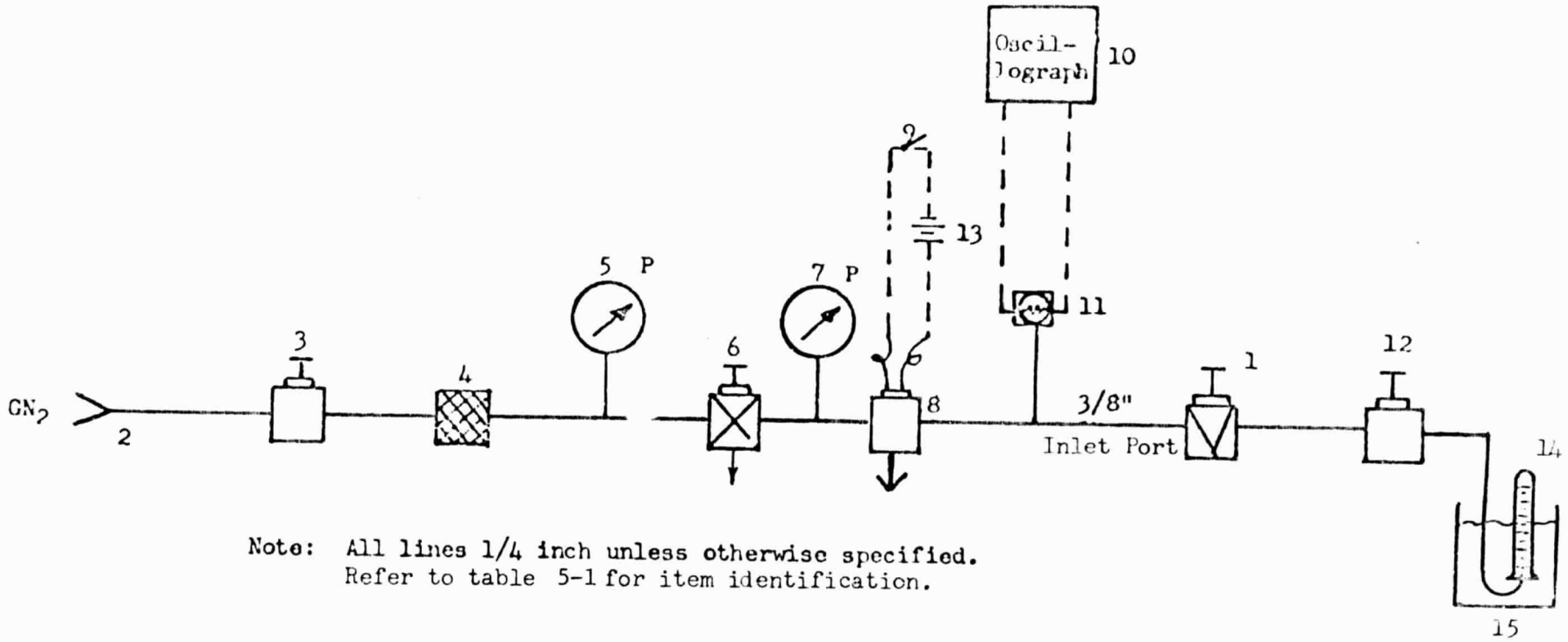


Figure 5-2. Typical Surge Wave Form (Outlet partially opened)

Table 5-2. Specimen 1 Functional Test Data Sheet (Following Surge Testing)

Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	50	0	6000	0
2	50	6000	0	0

Run	Applied Seating Torque (in-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in-lb)	Running Torque (in-lb)		Leakage (scim)
				Opening	Closing	
1	50	6000	35	18	40	0
2	30	6000	20	20	42	0
3	35	6000	22	20	35	0
4	30	6000	22	20	35	0
5	35	6000	25	20	35	0



Note: All lines 1/4 inch unless otherwise specified.
Refer to table 5-1 for item identification.

Figure 5-3. Surge Test Schematic

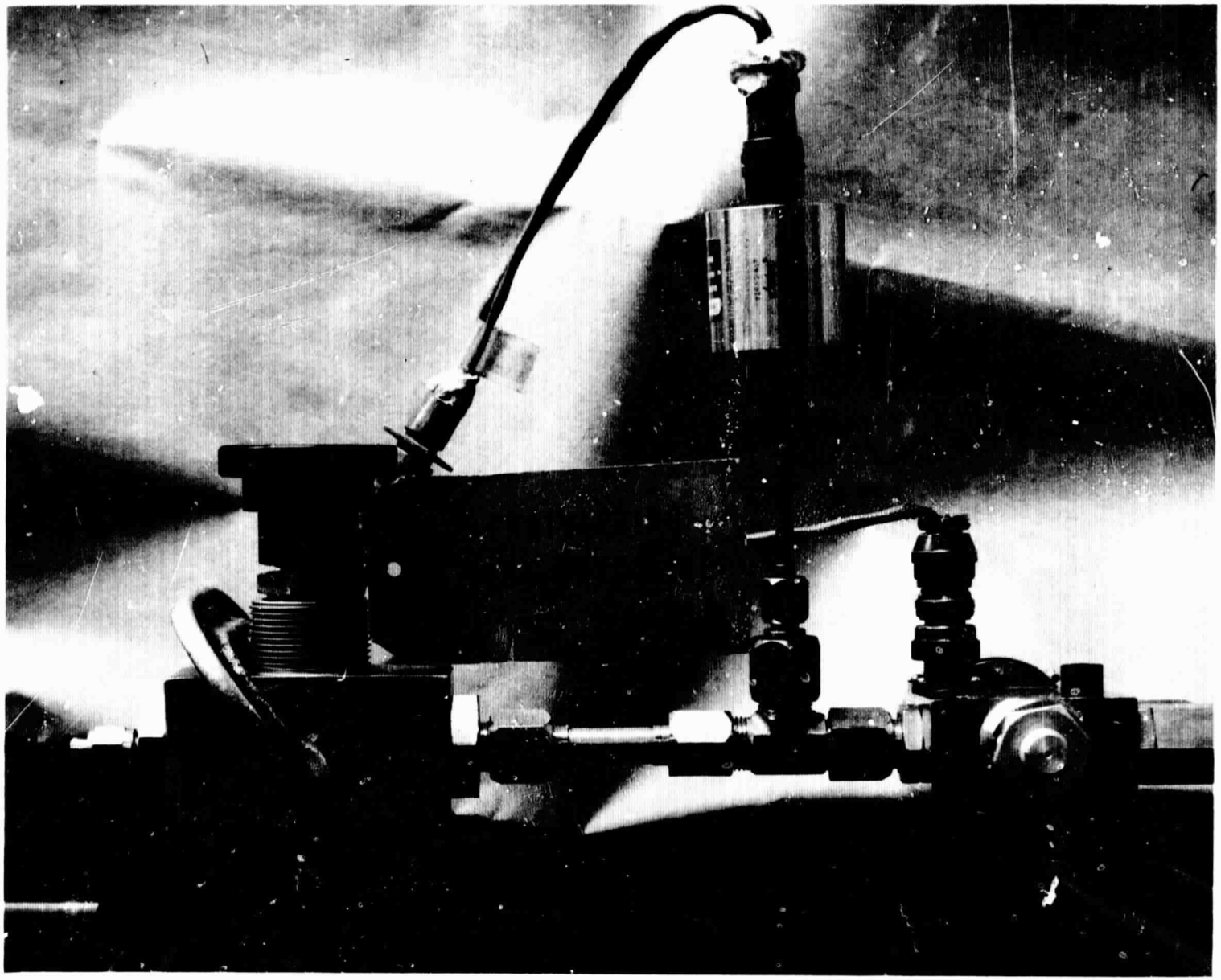


Figure 5-4. Surge Test Setup

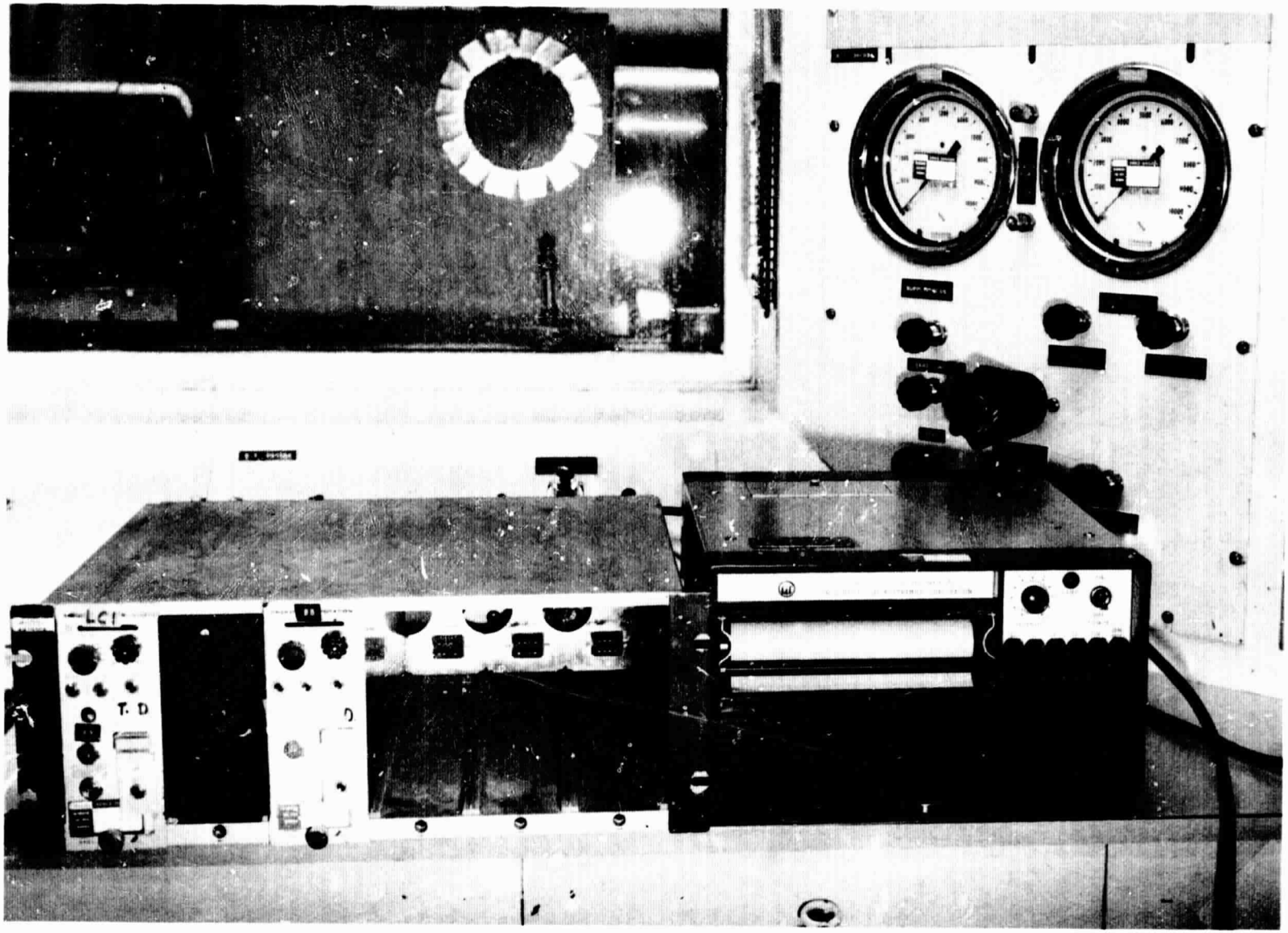


Figure 5-5. Surge Test Setup

SECTION VI

SEAT EROSION TEST

6.1 TEST REQUIREMENTS

6.1.1 A seat erosion test shall be performed on the test specimen to determine if high velocity GN_2 flow causes degradation or deformation.

6.1.2 The specimen shall be set to flow approximately 100 scfm of GN_2 with an inlet pressure of 6000 psig and an outlet pressure below 50 psig. The flowrate shall be maintained for four hours.

6.1.3 A functional test shall be performed within one hour following the seat erosion test.

6.1.4 All test data shall be recorded.

6.2 TEST PROCEDURE

6.2.1 The test setup was assembled as shown in figures 6-1 and 6-2 using the equipment listed in table 6-1.

6.2.2 All hand valves were closed and pressure regulator 5 was adjusted for zero outlet pressure.

6.2.3 Hand valves 4, 7, 10 and 8 were opened.

6.2.4 Pressure regulator 5 was slowly opened until a reading of 6000 psig was indicated on pressure gage 6.

6.2.5 A pressure of 6000 psig was indicated on pressure gage 11.

6.2.6 The test specimen was slowly opened until a pressure of 21.7 psig was indicated on gage 14 and $0^{o}F$ was registered on temperature recorder 13. This established a GN_2 flow of 100 scfm.

6.2.7 The flow was continued for four hours. Pressure gage 14 was monitored for an increase in pressure which might indicate erosion of the valve seat.

6.2.8 Regulator 5 and hand valve 8 were closed and the test specimen was removed from the system.

6.2.9 A functional test was performed on the specimen within one hour following the seat erosion test.

6.2.10 All test data was recorded.

6.3 TEST RESULTS

6.3.1 Specimens 1, 2 and 3 successfully flowed approximately 100 scfm of GN_2 with an inlet pressure of 6000 psig and an outlet pressure below 50 psig.

6.3.2 Specimen 1 leaked excessively during the functional test that followed the seat erosion test. The damaged soft seat was replaced. During the immediate functional test, the new soft seat became eroded similar to the previous one. A re-designed stem assembly, including all new soft goods, was installed and testing was resumed. A second seat erosion test was performed successfully; however, during the subsequent functional test the threaded area of the stem became galled making it impossible for it to be rotated. Testing of specimen 1 was permanently discontinued.

6.3.3 Specimen 2 failed to seat during the first three cycles of the functional test, following the seat erosion test with 6000 psig inlet pressure and the valve stem torqued to the maximum allowable 120 in-lbs. However, during the next two cycles, the specimen seated with zero leakage at 70 and 50 inch-lbs of torque, respectively. Testing was continued.

6.3.4 Specimen 3 was monitored as having zero leakage during the functional test following the seat erosion test.

6.4 TEST DATA

6.4.1 Test data taken during the seat erosion tests are shown in tables 6-2 through 6-12.

6.4.2 Figures 6-3 and 6-4 show specimen 1 soft seat failures.

Table 6-1. Seat Erosion Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Specimen	Accessory Prods. Company	5072X-1004-(13, 23)	75M09220 PGLV-5	Manual Globe Valve, 3/4-inch
2	GN_2 Source	CCSD	NA	NA	10,000 psig
3	Filter	Permanent Filter Corporation	9377-3154	CPB-010	2 micron
4	Hand Valve	Control Components	MV-1004-P-P	NA	12,000 psig
5	Regulator	Tescom Corporation	26-1021-20	3025	10,000 psig inlet 10,000 psig outlet
6	Pressure Gage	Ashcroft	95-1648-B	NA	20,000 psig Cal date 11/11/67
7	Hand Valve	Control Components	MV1004 P-P	NA	12,000 psig
8	Hand Valve	Cardair Lebanan	3510-0077	NA	10,000 psig
9	Dome Loader	Grove	201-B	RA-7049	10,000 psig inlet 6,000 psig outlet
10	Hand Valve	Tescom Corporation	30-1100-104	NA	10,000 psig
11	Pressure Gage	Heise		NASA 012452	0-10,000 psig Cal date 11/11/67
12	Thermocouple	Honeywell Corporation	30112	NA	-50 to 200 $\pm 2.5^{\circ}F$
13	Temperature Readout	West Corporation	IN-5	64090 417	-100 to $400^{\circ}F$ cal date 8/9/67
14	Pressure Gage	Heise	H34951	NASA 014227	0 to 100 psig $\pm 0.5\%$ FS
15	Flow Nozzle	Flowdyne Corporation	XN160450 SA	2375	O_2 .4545 to flow 100 scfm

Table 6-2. Specimen 1 Initial Seat Erosion Test Data

Readings taken for four hours at 1/2 hour intervals	Pressure upstream of specimen (psig)	Pressure between specimen and nozzle (psig)	Temperature between specimen & .4545 inch diameter nozzle	
			°F	Rankine
1	6000	21.7	0	460
2	6090	21.5	3	463
3	6050	21.9	4	464
4	6040	21.0	2	462
5	6000	23.0	2	462
6	6040	22.3	2	462
7	6000	21.0	0	460
8	6040	21.7	3	463
9	6000	20.8	0	460

Table 6-3. Specimen 1 Functional Test Data (Following Initial Seat Erosion Test)

Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	50	0	6000	0
2	150	6000	0	1400

Note: Due to a damaged soft seat, testing was momentarily discontinued.

Table 6-4. Specimen 1 Functional Test Data (After Installation of New Soft Seat)

Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	70	0	6000	0
2	150	6000	0	1400

Note: Testing was again momentarily discontinued due to eroded soft seat.

Table 6-5. Specimen 1 Functional Test Data
(After Installation of New Stem Assembly)

Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	30	6000	0	0

Run	Applied Seating Torque (in-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in-lb)	Running Torque (in-lb)		Leakage (scim)
				Opening	Closing	
1	30	6000	20	25	40	0
2	45	6000	25	25	43	0
3	60	6000	50	40	75	0
4	75	6000	65	60	70	0
5	70	6000	60	40	60	0

Table 6-6. Specimen 1 Seat Erosion Test Data (Following Installation of New Stem Assembly)

Reading taken for four hours at 1/2 hour intervals	Pressure Upstream of specimen (psig)	Pressure between specimen and nozzle (psig)	Temperature between specimen & 0.4545-inch diameter nozzle	
			^{0}F	Rankine
1	6000	22.2	7	467
2	6000	22.3	5	465
3	6000	22.3	-5	455
4	6000	22.1	0	460
5	6000	22.1	2	462
6	6000	21.2	-7	453
7	6000	21.8	0	460
8	6000	21.8	-2	458
9	6000	22.2	-6	454

Table 6-7. Specimen 1 Functional Test Data (Following Second Seat Erosion Test)

Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	70	6000	0	0

Run	Applied Seating Torque (in-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in-lb)	Running Torque (in-lb)		Leakage (scim)
				Opening	Closing	
1	70	6000	50	40	140	0
2	150	6000	150	60	140	0
3	160	6000	140	120	140	0
4	See Note:					
5						

Note: During the third cycle, the stem established a permanent bind, shearing off at the deeply indented set screw area. Disassembly of the specimen revealed excessive galling in the male and female threaded sections. Testing was permanently discontinued.

Table 6-8. Specimen 2 Functional Test Data
(Following a 72 Hour Delay)

Run	Applied Seating Torque (in-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	120	6000	0	0.27

Run	Applied Seating Torque (in-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in-lb)	Running Torque (in-lb)		Leakage (scim)
				Opening	Closing	
1	120	6000	70	20	30	0.26
2	120	6000	90	20	35	0.27
3	120	6000	90	20	30	0.28
4	120	6000	90	20	30	0.26
5	120	6000	90	20	35	0.27

Note: Due to the insignificant amount of leakage, CCSD recommended test continuation.

Table 6-9. Specimen 2 Seat Erosion Test Data

Readings taken for four hour at 1/2 hour intervals	Pressure upstream of specimen (psig)	Pressure between specimen and nozzle (psig)	Temperature between specimen & 0.4545-inch diameter nozzle	
			^{o}F	^{o}R
1	6000	23.2	-7	453
2	6000	23.6	-3	457
3	6000	24.0	-5	455
4	6000	24.5	-2	458
5	6000	24.4	-5	455
6	6000	22.5	-5	455
7	6000	22.4	-5	455
8	6000	22.3	-5	455
9	6000	22.5	-5	455

Table 6-10. Specimen 2 Functional Test Data
(Following Seat Erosion Testing)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	50	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	120	6000	40	20	30	1.5
2	120	6000	90	20	35	1.5
3	120	6000	70	20	35	1.0
4	70	6000	60	20	35	0
5	50	6000	50	20	40	0

Note: The specimen stopped leaking after the third cycle and testing was continued.

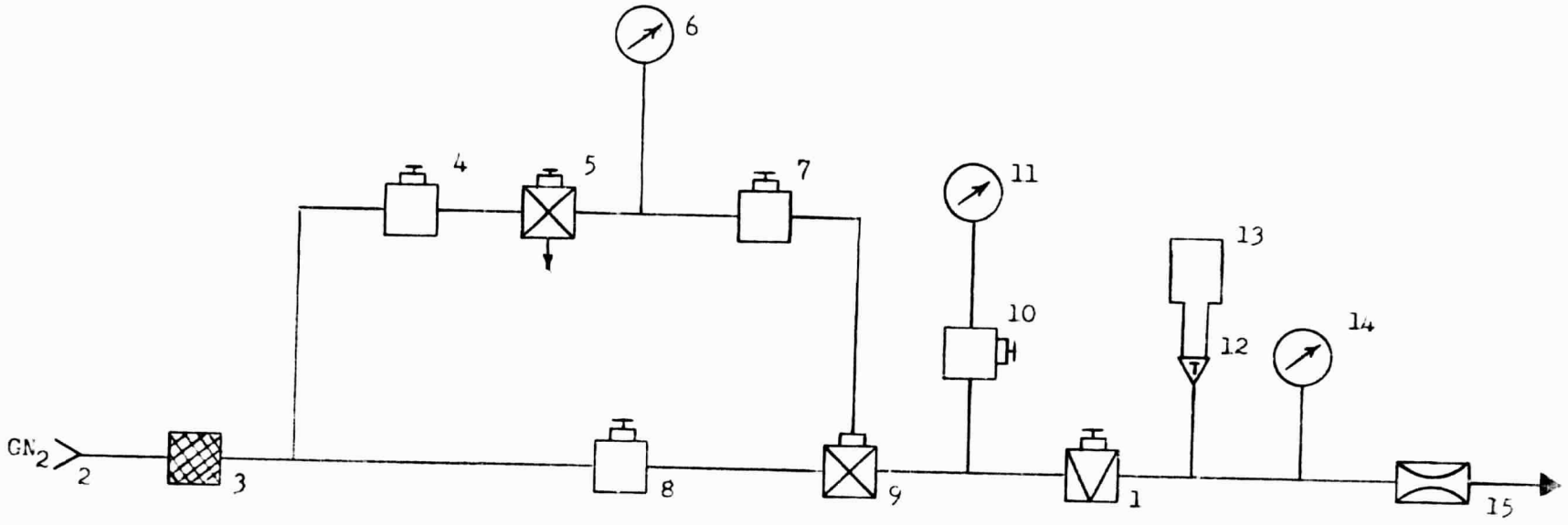
Table 6-11. Specimen 3 Seat Erosion Test Data

Readings taken for four hour at 1/2 hour intervals	Pressure upstream of specimen (psig)	Pressure between specimen and nozzle (psig)	Temperature between specimen & 0.4545-inch diameter nozzle	
			^{o}F	^{o}R
1	6000	23.2	3	463
2	6000	21.9	-5	455
3	6000	21.9	-3	457
4	6000	21.9	-5	455
5	6000	21.4	-5	455
6	6000	21.0	-5	455
7	6000	21.0	-2	458
8	6000	21.0	0	460
9	6000	20.6	-5	455

Table 6-12. Specimen 3 Functional Test Data
(Following Seat Erosion Test)

Run	Applied Seating Torque (in -lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	30	20	40	0
2	40	6000	30	25	40	0
3	40	6000	25	25	40	0
4	40	6000	25	25	35	0
5	40	6000	20	20	30	0



Note: All lines 3/4-inch.
Refer to table 6-1 for item identification.

Figure 6-1. Seat Erosion Test Schematic

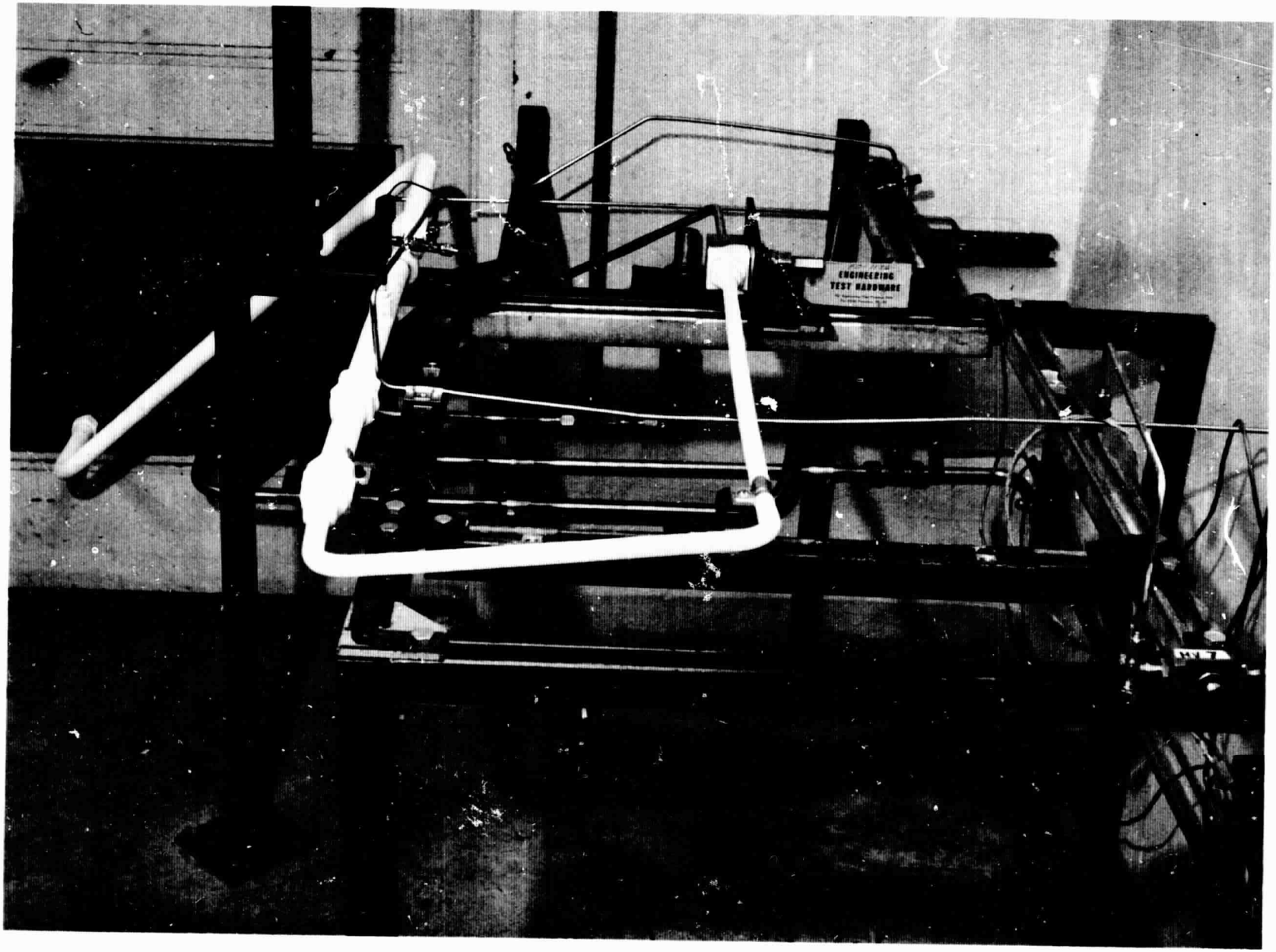


Figure 6-2. Seat Erosion Test Setup

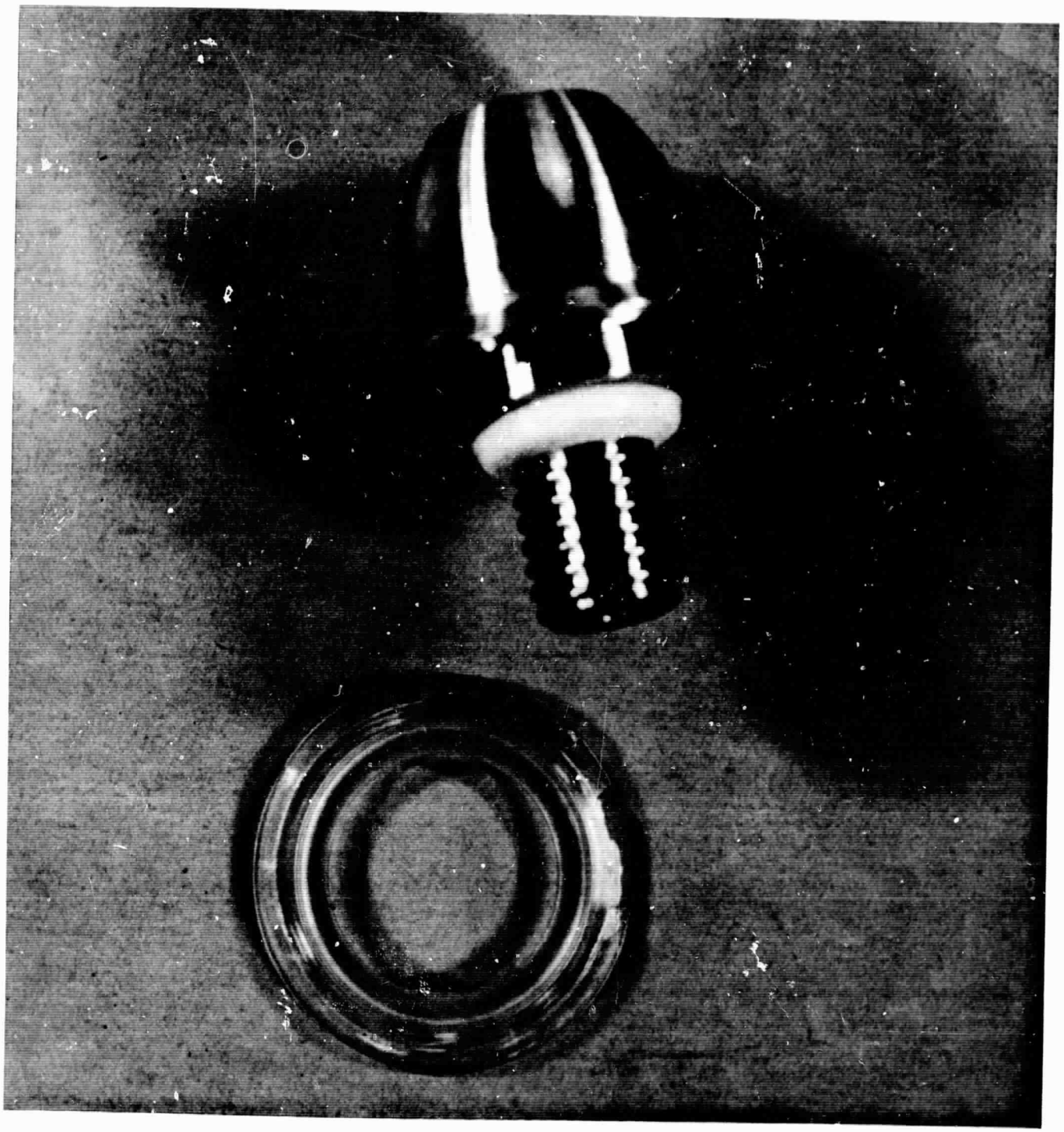


Figure 6-3. Specimen 1 - Kel-F Seat

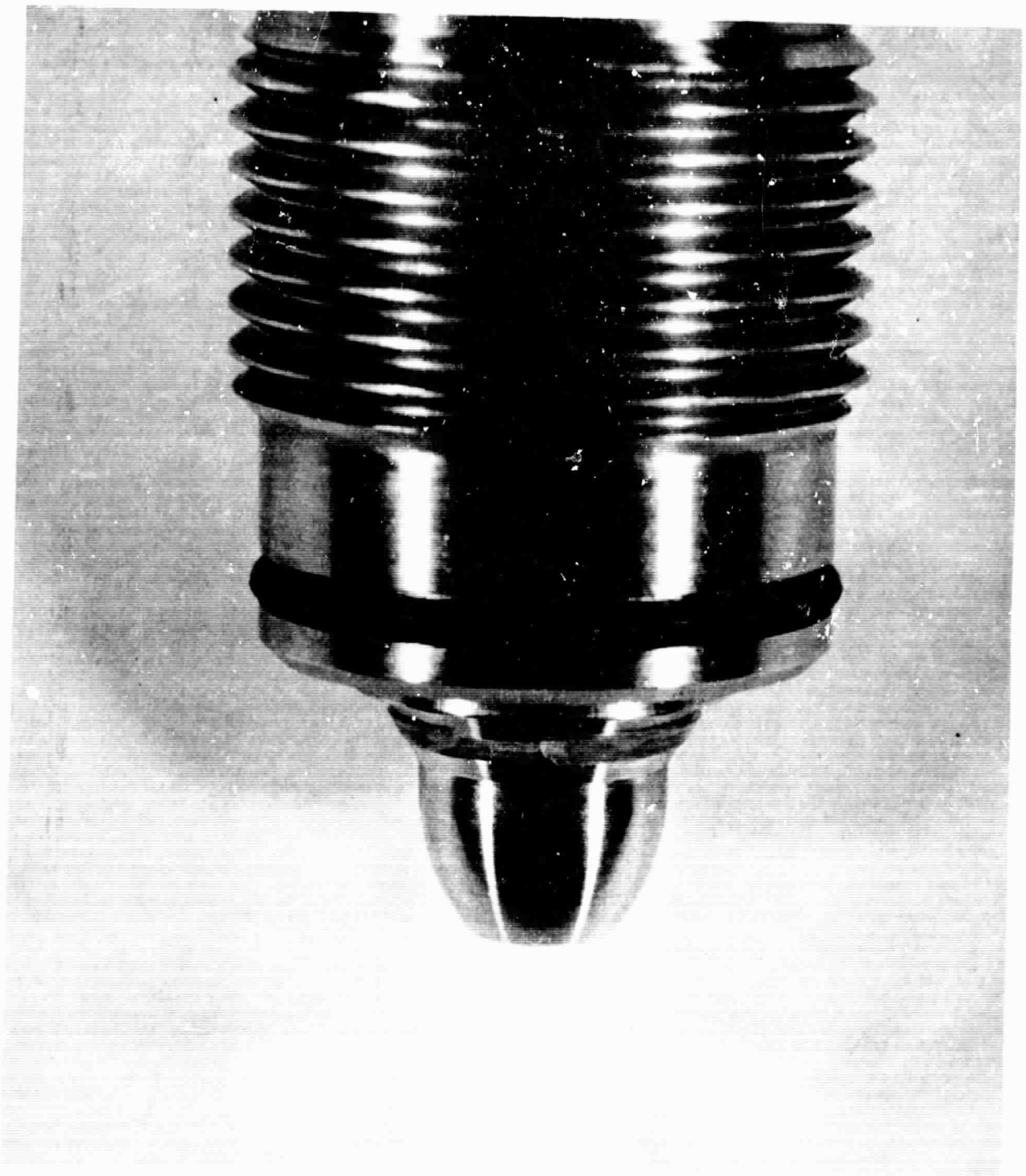


Figure 6-4. Specimen 1 Kel-F Seat Failure

SECTION VII

LOW TEMPERATURE TEST

7.1 TEST REQUIREMENTS

7.1.1 A test shall be performed on the test specimen to determine if low temperature causes degradation or deformation.

7.1.2 A functional test shall be performed during and after this test.

7.2 TEST PROCEDURE

7.2.1 The test specimen was installed in the low temperature chamber 17 as shown in figure 4-1 using the equipment listed in table 4-1.

7.2.2 A functional test was performed on specimen 3 because more than 72 hours had elapsed since the previous functional test.

7.2.3 Chamber 17 was controlled to the specified 5°F, and a relative humidity between 60 to 90 percent was maintained. A maximum temperature change rate of 1°F per minute was not exceeded.

7.2.4 A functional test was performed on the specimen after temperature stabilization. Temperature stabilization is defined as a maximum temperature change rate of 4°F per hour as determined from the instrumentation monitoring the test specimen.

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

7.2.6 The test specimen was visually inspected and functionally tested within 1 hour following the return to ambient conditions.

7.2.7 All test data was recorded.

7.3 TEST RESULTS

7.3.1 Specimen 2 leaked in excess of 4 scim when stabilized at a temperature of 5°F with the inlet port pressurized to 6000 psig and the valve stem torqued to 170 in-lbs. A new hard seat was installed and testing was continued.

7.3.2 Specimen 3 showed no apparent adverse effects from thermal changes.

7.4 TEST DATA

The test data recorded during the tests are presented in tables 7-1 through 7-5.

Table 7-1. Specimen 2 Functional Test Data at 5°F

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	170	6000	0	4

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (in.-lb)
				Opening	Closing	
1	170	6000	140	20	35	4.0
2	170	6000	140	20	30	4.5
3	See Note:					
4						
5						

Note: CCSD-FO requested the installation of a new hard seat and to continue testing.

Table 7-2. Specimen 2 Functional Test Data (After Installation of New Hard Seat)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	20	25	40	0
2	40	6000	20	30	40	0
3	50	6000	30	40	55	0
4	40	6000	50	40	45	0
5	40	6000	20	25	40	0

Table 7-3. Specimen 3 Functional Test Data (Following a 72 Hour Delay)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	30	20	30	0
2	40	6000	35	20	30	0
3	35	6000	20	17.5	30	0
4	35	6000	20	20	30	0
5	35	6000	20	21	30	0

Table 7-4. Specimen 3 Functional Test Data at 5°F

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closed	
1	40	6000	65	25	35	0
2	40	6000	40	35	35	0
3	35	6000	30	20	25	0
4	35	6000	35	20	30	0
5	35	6000	30	20	30	0

Table 7-5. Specimen 3 Functional Test Data at Ambient Conditions

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	35	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	35	6000	20	18	35	0
2	35	6000	25	18	35	0
3	35	6000	25	18	30	0
4	35	6000	20	18	30	0
5	35	6000	20	18	35	0

SECTION VIII

HIGH TEMPERATURE TEST

8.1 TEST REQUIREMENTS

8.1.1 A test shall be performed on the test specimen to determine if high temperature causes degradation or deformation.

8.1.2 The rated high temperature is 150 (+40, -0)°F.

8.1.3 A functional test shall be performed during and after this test.

8.2 TEST PROCEDURE

8.2.1 The test specimen was installed in the high temperature chamber 17 as shown in figure 4-1 using the equipment listed in table 4-1.

8.2.2 Chamber 17 was controlled to the specified 150°F, and a relative humidity of 20 (±5) percent. The maximum temperature change rate of 1°F per minute was not exceeded.

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

8.2.4 A functional test was performed on the specimen while the chamber temperature was maintained.

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

8.2.6 The specimen was visually inspected and functionally tested within 1 hour following the return to ambient conditions.

8.2.7 All test data were recorded.

8.3 TEST RESULTS

Specimens 2 and 3 showed no apparent adverse effects from thermal changes; however, specimen 3 leaked 8.5 scim when returned to ambient temperature and when torqued to the maximum 120 inch-lb with the inlet port pressurized to 6000 psig. Additional torque would not reduce the leakage. A new hard seat was installed at the request of CCSD-FO and testing was continued.

8.4 TEST DATA

The test data recorded during the tests are presented in tables 8-1 through 8-4.

Table 8-1. Specimen 2 Functional Test Data at 150°F

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	30	15	25	0
2	40	6000	30	15	30	0
3	35	6000	35	15	30	0
4	30	6000	20	15	25	0
5	30	6000	20	15	25	0

Table 8-2. Specimen 2 Functional Test Data at Ambient Temperature

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	25	15	30	0
2	30	6000	20	15	35	0
3	35	6000	20	15	30	0
4	30	6000	15	15	30	0
5	30	6000	20	15	30	0

Table 8-3. Specimen 3 Functional Test Data at 150°F

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	50	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	50	6000	30	20	35	0
2	40	6000	25	20	35	0
3	40	6000	20	20	35	0
4	40	6000	25	20	35	0
5	40	6000	25	20	35	0

Table 8-4. Specimen 3 Functional Test Data at Ambient Temperature

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	100	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	100	6000	70	15	35	0
2	100	6000	70	15	35	0
3	110	6000	80	20	35	0.1
4	110	6000	90	25	40	0.4
5	120	6000	85	50	40	8.5

NOTE: CCSD-FO recommended that a new hard seat be installed to eliminate leakage and then resume testing.

SECTION IX

CYCLE TEST

9.1 TEST REQUIREMENTS

9.1.1 A test shall be performed on the specimen to determine if cycling causes degradation or deformation.

9.1.2 Each cycle shall consist of pressurizing the inlet port to 6000 psig and opening and closing the specimen.

9.1.3 Certain cycles (to be called type I) shall be performed with the specimen vented to the atmosphere and with a minimum restriction upstream of the specimen. The other cycles (type II) shall be performed with a downstream valve closed. However, this downstream valve will be opened between cycles to vent the specimen.

9.1.4 Cycles shall be performed in groups as specified in table 9-1. A functional test shall be performed following each group of cycles. A total of 1000 cycles shall be performed.

9.2 TEST PROCEDURE

9.2.1 The test setup was assembled as shown in figures 9-1 and 9-2 using the equipment listed in table 9-2.

9.2.2 All valves were closed and the pressure regulators were adjusted for zero outlet pressure.

9.2.3 The upstream pressure line was attached to the inlet side of the specimen and the downstream line to the outlet of the specimen.

9.2.4 Hand valve 10 was opened.

9.2.5 Hand valves 4 and 6 were opened.

9.2.6 Pressure regulator 5 was adjusted to establish 6000 psig on pressure gage 8.

TYPE I CYCLES

9.2.7 Solenoid valves 16a, 16b and 16c were energized to the open position.

9.2.8 Solenoid valve 9 was energized allowing dome pressure on regulator 11 which in turn established 6000 psig on pressure gage 13.

9.2.9 The motor 15 was rotated counter clockwise by energizing cycle timer 17 causing the specimen to open.

9.2.10 The motor 15 was then reversed by changing polarity on cycle timer 17, thereby closing the specimen.

TYPE II CYCLES

9.2.11 Solenoid valve 9 was energized allowing dome pressure on regulator 11, which in turn established 6000 psig on pressure gage 13.

9.2.12 The motor was rotated counter clockwise by energizing cycle timer 17, causing the specimen to open.

9.2.13 The motor 15 was then reversed by changing the polarity on cycle timer 17, thereby closing the specimen.

9.2.14 Solenoid valve 16c was energized to vent the downstream side on the specimen.

9.2.15 Solenoid valve 16c was then de-energized to the closed position.

Table 9-1. Cycle Sequence

Group	Cycle in Group	Cycle Type
1	1 - 25	I
2	26 - 50	II
3	51 - 100	I
4	101 - 500	II
5	501 - 975	II
6	976 - 1000	I

9.3 TEST RESULTS

9.3.1 Specimen 2 successfully performed 50 complete cycles;however, during cycle 51 the valve would not seat. Inspection revealed scratches around the stem base and around the inner base of the seat retainer. The original type seat retainer, which allows greater stem clearance, was installed and testing was continued. During cycle 345 the stem began binding. Inspection disclosed that the male and female threads had galled. CCSD-FO requested that the stem be cleaned, the threads re-lubricated and testing continued. The specimen completed 987 cycles then failed to seat. Inspection revealed that the threads had sheared off the plug end of the stem. Apparently the plug unscrewed and the force from the stem torque contributed to the shearing. Testing of specimen 2 was permanently discontinued.

9.3.2 During cycle 42, specimen 3 failed to seat. Inspection revealed scratches around the stem base and around the inner base of the seat retainer, similar to that of specimen 2. An original type seat retainer was installed and testing was continued. During cycle 424 the stem threads began binding. The threads were damaged similar to those of specimen 2. At the request of CCSD-FO testing was permanently discontinued.

9.4 TEST DATA

9.4.1 Functional test data for cycle tests of specimens 2 and 3 are shown in tables 9-3 through 9-16.

9.4.2 Figure 9-5 shows typical seat retainer damage to the specimens 2 and 3 during cycle 51 and 42, respectively.

9.4.3 Figure 9-3 shows thread galling typical of specimens 2 and 3 during cycles 345 and 424.

9.4.4 Figure 9-4 shows sheared plug threads of specimen 2.

Table 9-2. Cycle Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Accessory Prods. Company	5072X1004 -23	NASA 75M09220 PGLV-5	3/4-inch Manual Globe Valve
	GN_2 Source	CCSD	NA	NA	0-10,000 psig
3	Filter	Permanent Filter	93773154	6PB010	2 Micron
4	Hand Valve	Aminco	44-13126	58965	0-30,000 psig
5	Pressure Regulator	Tescom Corp.	26-1021-20	3024	10,000 In 10,000 Out
6	Hand Valve	Aminco	44-13126	58965	0-30,000 psig
7	Vent Valve	Aminco	44-13106	50011A	0-30,000 psig
8	Pressure Gage	Heise	014231	H34955	0-10,000 psig Cal date 1/10/ 68
9	Solenoid Valve	Marotta	MB-510-H	190	0-6000 psig
10	Control Valve	Fisher	470-D	3572094	0-10,000 psig
11	Dome Regulator	Grove Valve	211-B	110751-1	0-10,000 psig
12	Thermo Couple	Minneapolis Honeywell	NA	NA	-50 to 200 (±2.5)°F
13	Pressure Gage	Heise	95-1653-B	H49480	0-10,000 psig Cal date 1-10-68
14	Clutch	Boston	Type-U	R-025956	35 RPM
15	Motor	Westinghouse	Type CSP	CNO-5943	3 HP
16	Solenoid Valve	Marotta	MB-583	2885	0-6000 psig
	Solenoid Valve	Marotta	MB-583	2916	0-6000 psig
	Solenoid Valve	Marotta	MB-583	372	0-6000 psig
17	Cycle Timer	Cramer Controls	540	Y3336A	115 VDC

Table 9-3. Specimen 2 Functional Test Data (Following a 72 Hour Delay)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	35	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	25	15	30	0
2	40	6000	25	15	30	0
3	40	6000	30	15	30	0
4	40	6000	30	15	35	0
5	40	6000	30	15	35	0

Table 9-4. Specimen 2 Functional Test Data (Following 25 Cycles)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	35	15	30	0
2	40	6000	35	15	30	0
3	40	6000	35	15	30	0
4	40	6000	35	15	30	0
5	40	6000	35	15	30	0

Table 9-5. Specimen 2 Functional Test Data (Following 50 Cycles)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	35	20	45	0
2	40	6000	35	30	45	0
3	45	6000	40	30	45	0
4	45	6000	40	30	45	0
5	45	6000	45	40	50	0

NOTE: The seat retainer of the specimen was replaced before performing cycle 51 since there was insufficient internal clearance for the stem.

Table 9-6. Specimen 2 Functional Test Data (Following New Seat Retainer Installation)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	25	15	30	0
2	40	6000	20	15	30	0
3	40	6000	20	15	30	0
4	40	6000	22	15	30	0
5	40	6000	20	15	30	0

Table 9-7. Specimen 2 Functional Test Data
(Following 75 Cycles)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	35	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	35	6000	20	15	25	0
2	35	6000	25	15	30	0
3	35	6000	25	15	30	0
4	35	6000	25	15	30	0
5	35	6000	25	15	30	0

Table 9-8. Specimen 2 Functional Test Data
(Following 100 Cycles)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	30	20	30	0
2	35	6000	30	15	30	0
3	35	6000	25	20	30	0
4	40	6000	30	20	30	0
5	35	6000	30	20	30	0

Table 9-9. Specimen 2 Functional Test Data after Damaged Threads Were Refurbished (Following Cycle 345)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	40	15	30	1.0
2	40	6000	20	15	30	1.0
3	40	6000	20	15	30	1.1
4	40	6000	20	15	30	1.1
5	40	6000	25	15	30	1.0

Note: CCSD-FO requested that galled threads be cleaned and re-lubricated and continue testing following cycle 345.

Table 9-10. Specimen 2 Functional Test Data
(Following 500 cycles)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0.37

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	30	15	30	1.2
2	45	6000	30	15	30	0
3	40	6000	30	15	30	0
4	45	6000	30	15	30	0
5	45	6000	30	15	30	0.1

Table 9-11. Specimen 2 Functional Test Data
(Following 975 Cycles)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	15	15	30	0
2	35	6000	20	15	30	0
3	35	6000	20	15	30	0
4	35	6000	20	15	30	0
5	35	6000	20	15	30	0

Note: Following Cycle 987, the plug end threads of the poppet stem sheared and testing was permanently discontinued.

Table 9-12. Specimen 3 Functional Test Data Following Hard Seat Installation Before Cycle Testing

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	35	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	35	6000	25	20	35	0
2	35	6000	25	20	35	0
3	35	6000	25	20	35	0
4	35	6000	40	20	35	0
5	35	6000	25	20	35	0

Table 9-13. Specimen 3 Functional Test Data
(Following 25 Cycles)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	35	10	25	0
2	40	6000	35	10	35	0
3	40	6000	30	15	30	0
4	35	6000	30	20	35	0
5	35	6000	30	20	35	0

Table 9-14. Specimen 3 Functional Test Data After New Seat Retainer Installation Following Cycle 42

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	35	10	25	0
2	40	6000	35	10	35	0
3	40	6000	30	15	30	0
4	35	6000	30	20	35	0
5	35	6000	30	20	35	0

Note: CCSD-FO requested installation of an original type Seat Retainer and continuation of testing.

Table 9-15. Specimen 3 Functional Test Data
(Following 50 Cycles)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

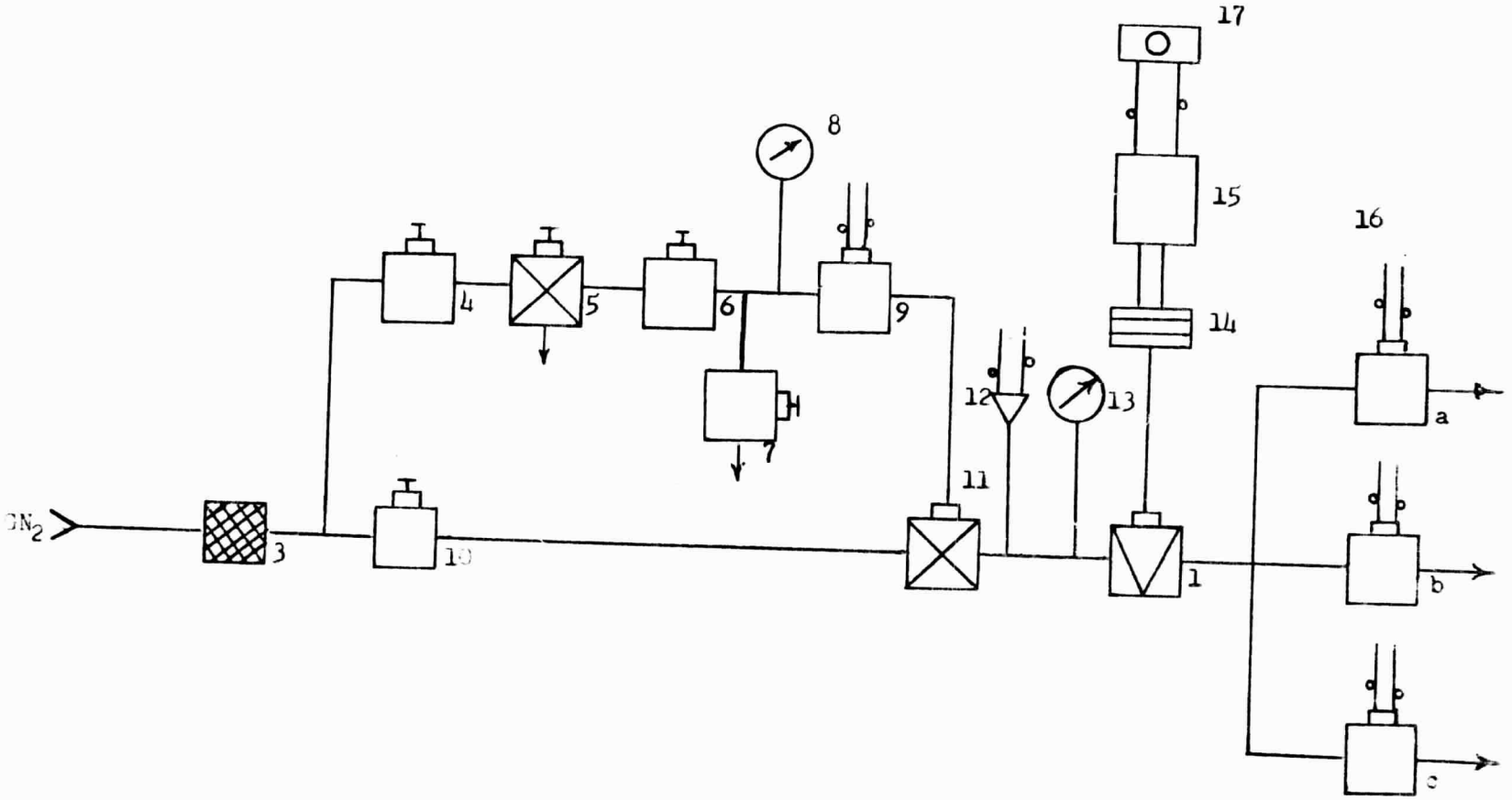
Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	35	30	40	0
2	40	6000	40	30	35	0
3	40	6000	30	30	40	0
4	40	6000	30	20	40	0
5	40	6000	25	25	40	0

Table 9-16. Specimen 3 Functional Test Data
(Following 100 Cycles)

Run	Applied Seating Torque (in.-lb)	Inlet Pressure (psig)	Outlet Pressure (psig)	Leakage (scim)
1	40	6000	0	0

Run	Applied Seating Torque (in.-lb)	Specimen Inlet Pressure (psig)	Opening Torque (in.-lb)	Running Torque (in.-lb)		Leakage (scim)
				Opening	Closing	
1	40	6000	25	10	30	0
2	35	6000	25	10	25	0
3	35	6000	20	10	25	0
4	35	6000	20	10	25	0
5	35	6000	20	10	25	0

Note: CCSD-FO requested test discontinuation after Cycle 424 when the stem threads of the specimen became badly galled.



Note: Main flow line 3/4 inch. All other lines 1/4 inch.
Refer to table 9-2 for item identification.

Figure 9-1. Cycle Test Schematic

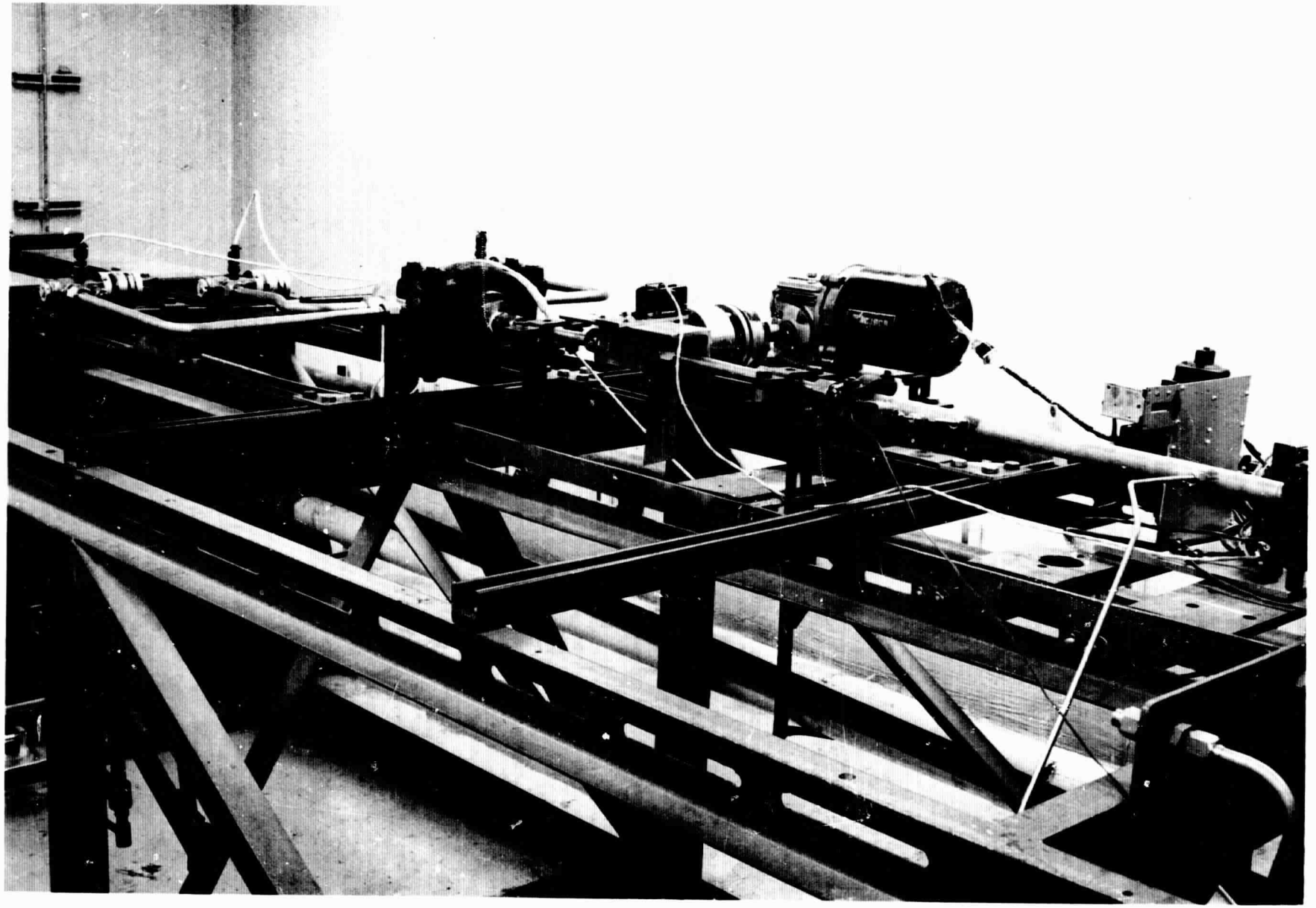


Figure 9-2. Cycle Test Setup

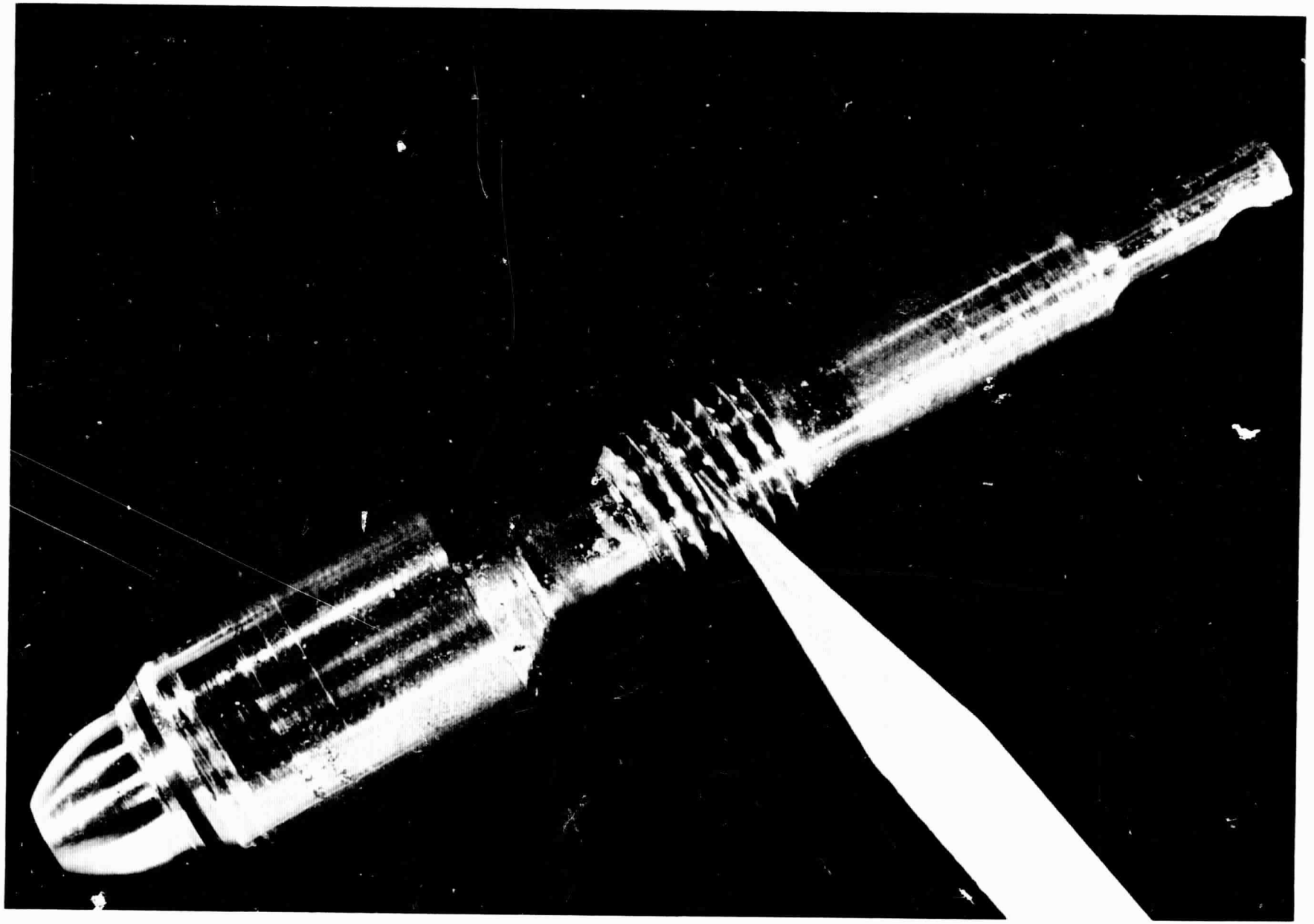


Figure 9-3. Thread Galling Drawings

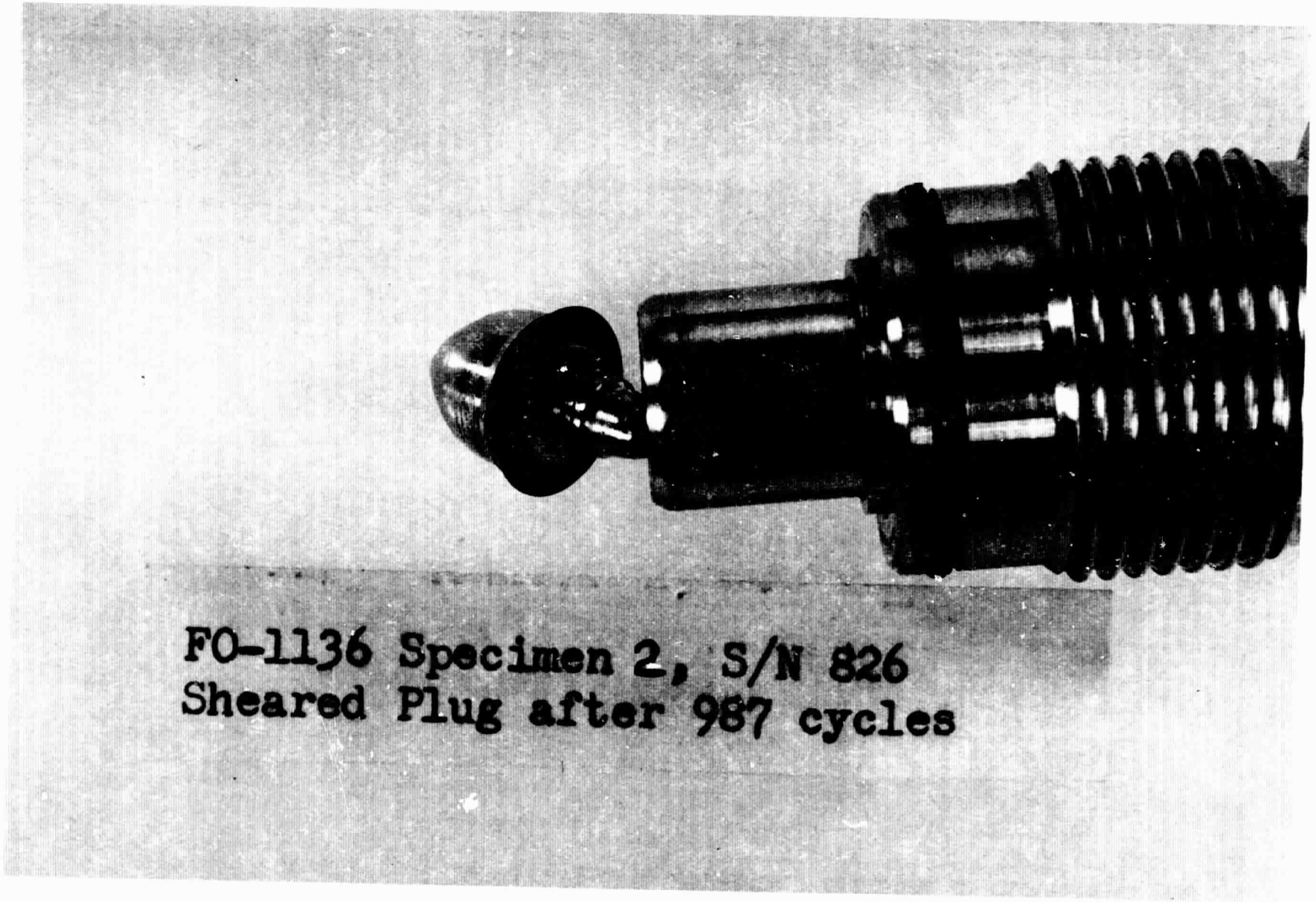


Figure 9-4. Specimen 2 - Sheared Plug After 987 Cycles

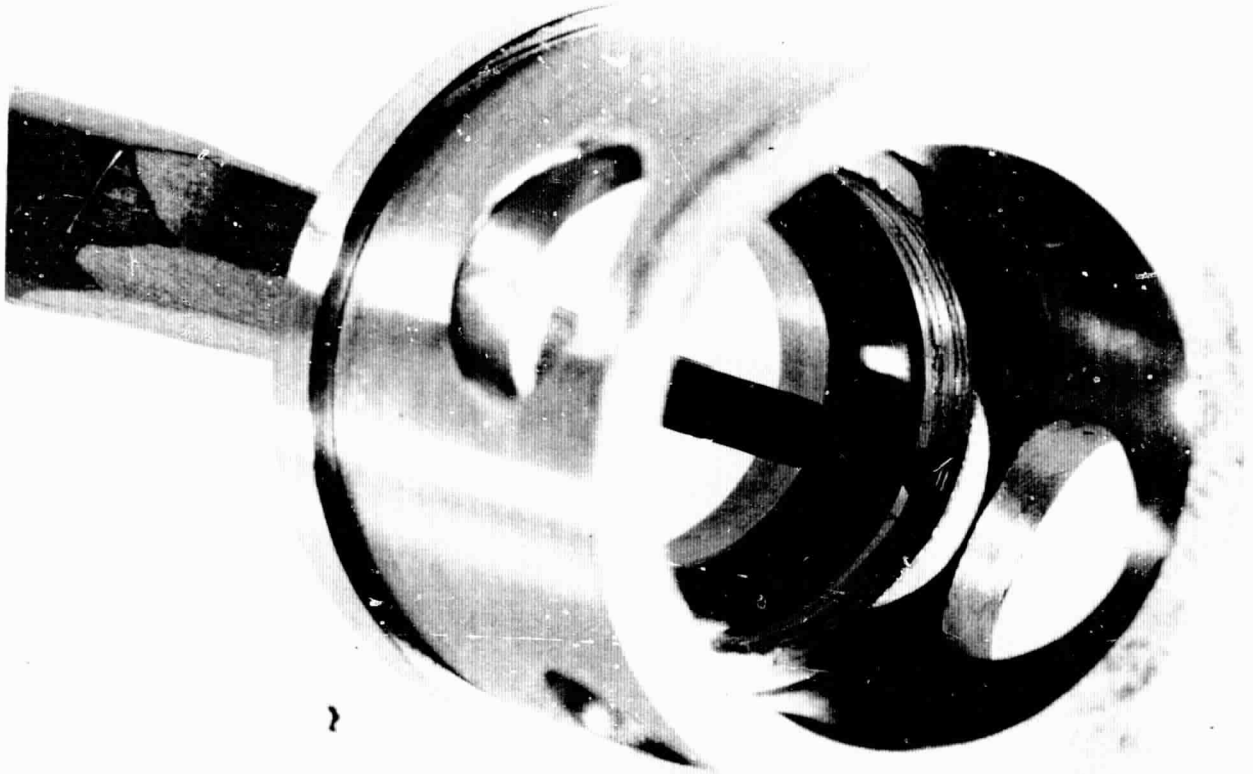


Figure 9-5. Specimens 2 and 3 - Typical Seat Retainer Damage

APPROVAL

TEST REPORT

FOR

MANUAL GLOBE VALVE, 3/4-INCH, 6000 PSIG

Accessory Products Company, Part Number 5072X1004 - (13,23)

NASA Drawing Number 75M09220 PGLV-5

SUBMITTED BY

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