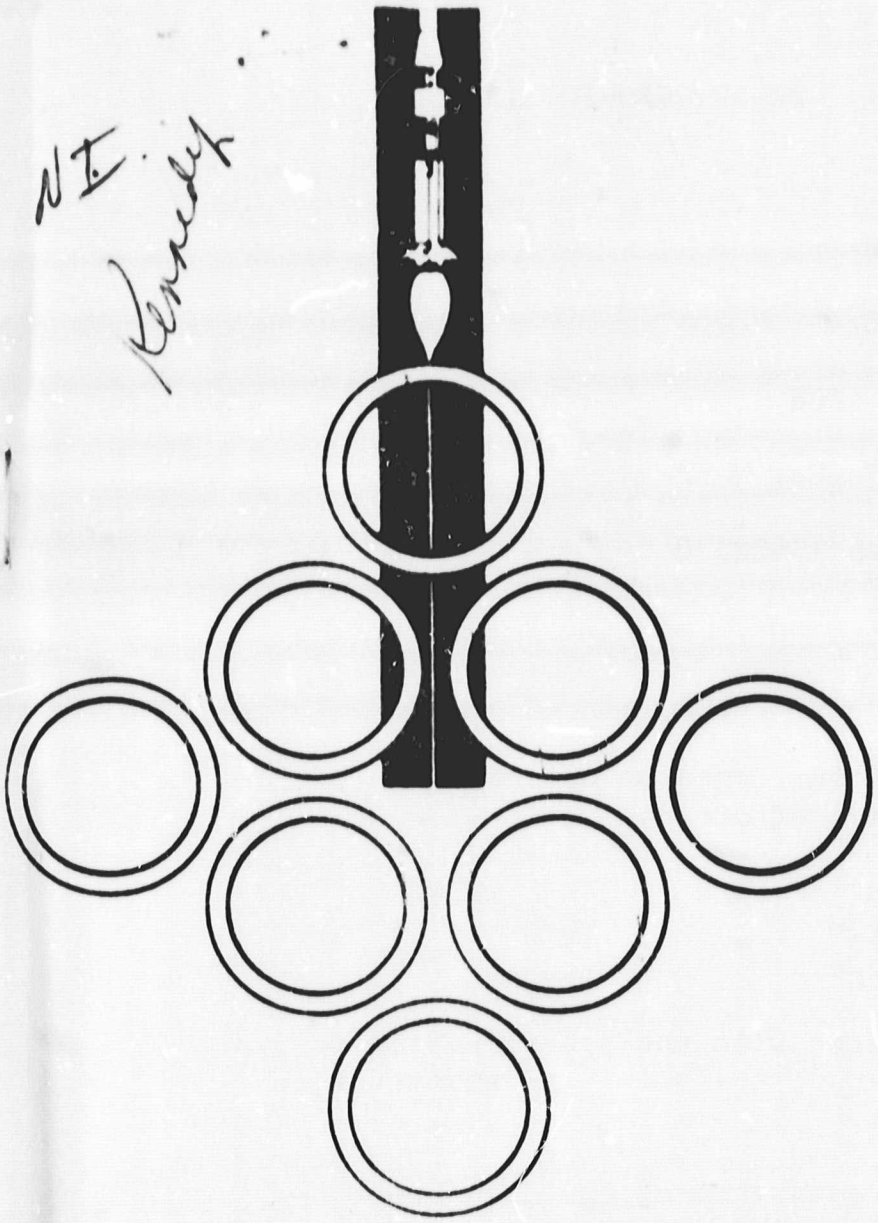

**ENGINEERING DEPARTMENT**

# TECHNICAL REPORT

TR-RE-CCSD-1135-3

August 10, 1968

## SATURN IB PROGRAM

## TEST REPORT
## FOR

GLOBE VALVE, 2 INCH, 6000 PSIG

Vacco Valve Company, Part Number M-6P-X469-2G

(With Modification Kit KM 7403)

NASA Drawing Number 10428530





SPACE DIVISION CHRYSLER CORPORATION

# TEST REPORT

# FOR

# GLOBE VALVE, 2 INCH

# Vacco Valve Company Part Number M-6P-X469-2G

# NASA Drawing Number 10428530

## ABSTRACT

This report presents the results of tests performed on one specimen of Globe Valve 10428530. The following tests were performed:

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Seat Erosion
5. Surge
6. Cycle

The specimen's performance was in accordance with the specification requirements of NASA Drawing Number 10428530, except following the seat erosion test and during the cycle test.

Following the seat erosion test, the threaded area of the stem began to bind due to metallic particles shearing off in the bonnet section. The threads were cleaned and lubricated, and testing was resumed.

Following the first 25 cycles of the cycle test, the specimen's seat leakage exceeded 1460 scim. Examination revealed that the seat had become eroded. A new seat was installed, and the test was resumed. During the twelfth cycle the seat again became eroded sufficiently to allow excessive leakage. A second replacement seat was installed, and testing was resumed with pressure being applied to the inlet port only. After 975 successful cycles, it was decided that the remaining 25 cycles should be performed with the outlet port pressurized. Cycle testing was permanently discontinued after 984 cycles due to an eroded seat.

All seat failures took place while the outlet port was pressurized. The sample performed satisfactorily with the inlet port pressurized.

| COMPONENT DATA | NASA DWG/SPEC/CODE NO. | FILE NO. |
|---|---|---|
| | 10428530 | GENERIC CODE D361102070020 |
| | FIND NO. A14629 | COMPLEX 34 |
| | REF DESIG. NO. | SYSTEM Pneumatic Supply |
| | PRIORITY IV | |
| NOMENCLATURE<br>Manual Globe Valve<br>2-Inch<br>6000 psig | MANUFACTURER<br>Vacco Valve Co. | SUBSYSTEM<br>Helium Storage Battery |
| | | NHA DWG. NO.<br>75M25415 |
| CRITICALITY NO. | MFG MODEL NO. | STOCK CODE NO. |
| CEI NO. | MFG PART NO.<br>M-6P-X469-2G with Mod. Kit KM7403 | REVISION: DATE 10-18-68 |
| MAINTENANCE MANUAL<br>TM-417-D | MFG DWG NO. | PREPARING ORGANIZATION<br>Chrysler Corporation |

SPECIFICATION REQUIREMENTS:

Operating Media: $GN_2$, GHe
Operating Pressure: 0 to 6000 psig
Proof Pressure: 11,000 psig
Burst Pressure: 24,000 psig
Maximum Torques
  Breakaway: 100 ft-lb with 6000 psig above seat
  Running: 50 ft-lb
  Seating: 100 ft-lb against 6000 psig
Body Material: 316 CRES
End Connections: 2 1/2 Grayloc XXS hubs
Flow Capacity: $C_V$ = 22.0 min.

FUNCTION:

The valve is used in the high pressure helium system to isolate the high pressure storage bottles from the compressor.

ASSESSMENT & RECOMMENDATIONS:

The valve successfully completed all tests in the primary flow direction. However, galling occurred on the poppet above the seat, after the seat erosion test. The valve was cleaned and lubricated and no further galling occurred. The soft seat ruptured during cycle testing in the reverse flow direction.

The valve is qualified for a mono directional flow valve. It should not be used where bedirectional flow is required.

TEST HISTORY:



| TEST REPORT NO. | TEST TYPE | REMARKS |
|---|---|---|
| TR-RE-CCSD-FO-1135-3 | Receiving Inspection<br>Proof Pressure<br>Functional<br>Seat Erosion<br><br>Surge Test<br>Cycle Test | Satisfactory<br>Satisfactory<br>Satisfactory<br>No seat leakage. Stem binding following test.<br>Satisfactory<br>Satisfactory in the primary flow direction. Soft seat ruptured in reverse flow direction. |

SERVICE HISTORY:

None - Modified part.

**APPROVAL**

**TEST REPORT**

**FOR**

**GLOBE VALVE**

**2 INCH, 6000 PSIG**

**Vacco Valve Company Part Number M-6P-X469-2G**

**(With Modification Kit KM 7403)**

**NASA Drawing Number 10428530**

**SUBMITTED BY:** G Collins

G. Collins
Test and Evaluation Section

**APPROVED BY:** R W Claunch

R. W. Claunch
Program Supervisor

**APPROVED BY:** V Vehko

V. J. Vehko, Director
Engineering Department

# TEST REPORT

# FOR

# GLOBE VALVE, 2 INCH, 6000 PSIG

Vacco Valve Company Part Number M-6P-X469-2G

(With Mod. Kit KM 7403)

NASA Drawing Number 10428530

AUGUST 10,1968

## 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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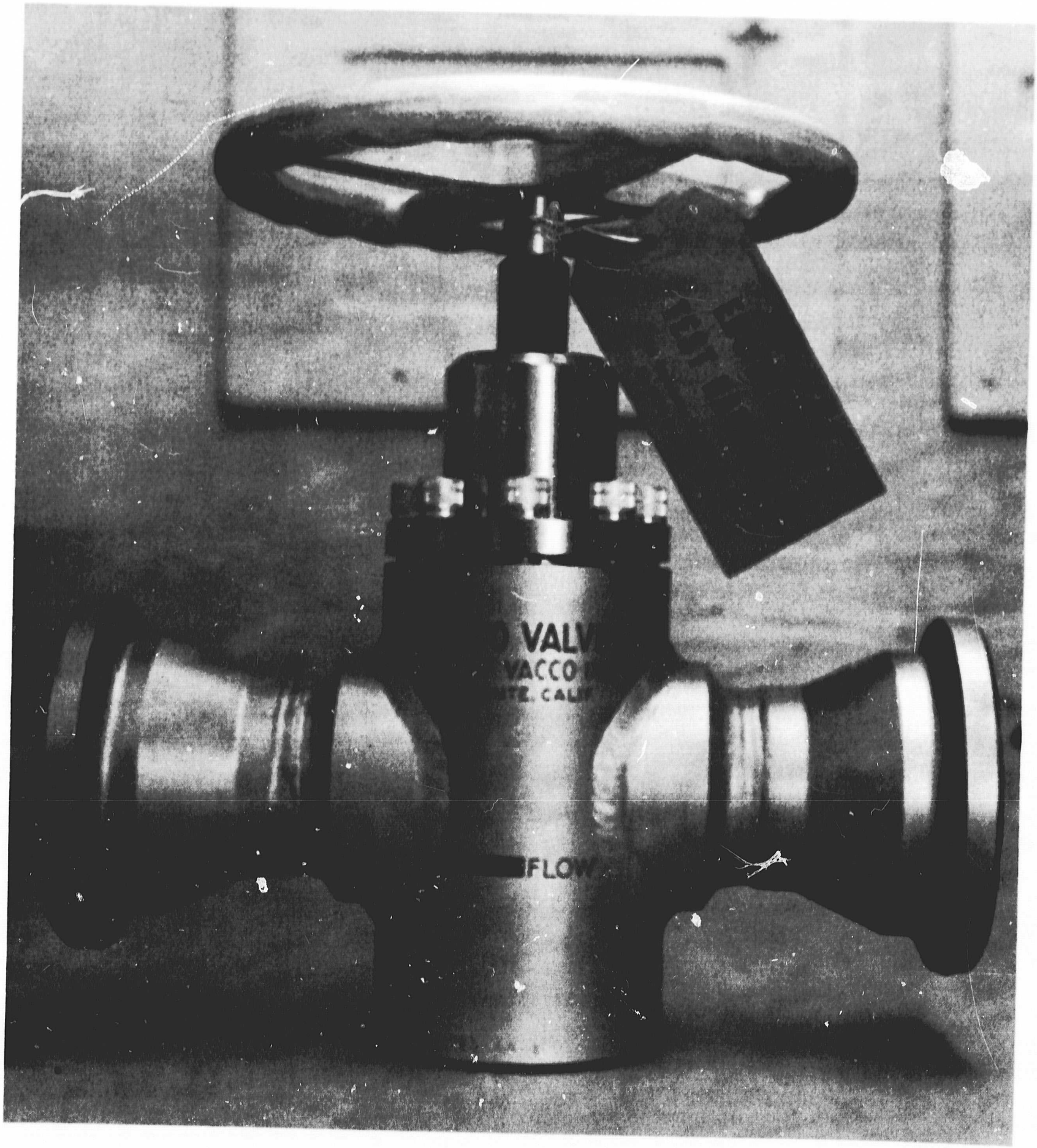



Globe Valve 10428530

**CHECK SHEET**

**FOR**

**GLOBE VALVE, 2 INCH, 6000 PSIG**

MANUFACTURER: Vacco Valve Company
MANUFACTURER'S PART NUMBER: M-6P-X469-2G (With Modification Kit KM 7403)
NASA PART NUMBER: 10428530
TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana
AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A. OPERATING MEDIUM: $GN_2$, He

B. OPERATING PRESSURE: Zero to 6000 psig

C. PROOF PRESSURE: 9000 psig

D. BURST PRESSURE: 24,000 psig

E. TORQUE REQUIREMENTS: Breakaway - 100 ft-lb max with 6000 psig above the seat

Running - 50 ft-lb max

Seating - 100 ft-lb max against 6000 psig

II. CONSTRUCTION

A. BODY MATERIAL: 316 CRES

B. END FITTING: 2-1/2 Inch XXS Grayloc Hubs

C. SEALS: Buna-N

D. SEAT: KEL-F

III. ENVIRONMENTAL CHARACTERISTICS

OPERATING TEMPERATURE RANGE: -20 to +120°F

IV. SPECIAL REQUIREMENTS

CLEANING SPECIFICATION: LOX Service per 10509305

V. LOCATION AND USE: Used in the high pressure helium system to isolate the high pressure storage bottles from the converter compressor facility.

TEST SUMMARY

GLOBE VALVE, 2 INCH, 6000 PSIG

NASA 10428530

| Environment | Units | Operational Boundry | Test Objective | Test Results | Remarks |
|---|---|---|---|---|---|
| Receiving Inspection | 1 | Drawings and Specifications | Check for conformance to documentation and for manufacturing defects | Satisfactory | Completed |
| Proof Pressure Test | 1 | 9000 psig for 5 minutes | Check for leakage and distortion | Satisfactory | No leakage or distortion |
| Functional Test | 1 | Inlet and outlet pressures to 6000 psig Closing torque 100 ft-lbs max. Breakaway torque 100 ft-lbs max. Running torque 50 ft-lbs max. | Check for leakage and distortion | Satisfactory | No leakage or distortion |
| Seat Erosion Test | 1 | Inlet and outlet pressures to 6000 psig flowing approximately 100 scfm for 4 hours | Verify that specimen's seat is not impaired by high pressure flow | Satisfactory | No deterioration to seat during test. Stem binding following test. |
| Surge Test | 1 | Inlet then outlet pressurized from zero to 6000 psig within 100 milliseconds | Verify that environment does not cause degradation or deformation | Satisfactory | No degradation or deformation |
| Cycle Test | 1 | 6000 psig to inlet or outlet port with the specimen vented to atmosphere for certain cycles and the downstream valve closed for the remaining cycles. | Determine if specimen operation is impaired by cycling | Inlet pressurized satisfactory Outlet pressurized unsatisfactory | Seat failures caused by pressurizing outlet port |

# SECTION I

# INTRODUCTION

## 1.1 SCOPE

1.1.1 This report describes the results of tests that were performed to determine if 2 Inch, Manually Operated Globe Valve 10428530 meets the operational and environmental requirements of John F. Kennedy Space Center Launch Complexes 34 and 37B.

1.1.2 One specimen was tested.

## 1.2 ITEM DESCRIPTION

The specimen has an operating pressure range from zero to 6000 psig. Globe Valve 10428530 is used in the high pressure helium system.

## 1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for Globe Valve 10428530:

a. 10428530, Component Specification

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

c. 10M01671 Level IV, Cleanliness Specification

d. Test Plan and Requirements CCSD-FO-1135-1

e. Test Procedure CCSD-FO-1135-2

## SECTION II

## RECEIVING INSPECTION

### 2.1 REQUIREMENTS

The globe valve shall be checked for conformance with the applicable NASA specification and applicable vendor data to the extend possible without disassembly of the test specimen. The specimen shall also be inspected for poor workmanship and manufacturing defects.

### 2.2 PROCEDURE

2.2.1 The specimen was visually and dimensionally inspected for conformance with NASA specification 10428530. The specimen was also checked for defective threads.

### 2.3 TEST RESULTS

The specimen complied with NASA specification 10428530. No evidence of poor workmanship or manufacturing defects was observed.

### 2.4 TEST DATA

Receiving inspection test equipment list and dimensional test data are presented in tables 2-1 and 2-2.

Table 2-1. Receiving Inspection Test Equipment List

| Item No. | Item | Manufacturer | Model/ Part No. | Serial No. | Calibration Date |
|---|---|---|---|---|---|
| 1 | 24 in. scale | L.S. Starrett Co. | No. 16R graduated | NASA 08-113 113-50-1061-C | N/A |

Table 2-2. Specimen Demensions

| Description | Actual Values |
|---|---|
| Weight of Specimen | 46.7 lbs |
| Length from Inlet to Outlet Port | 12-29/64 in. |
| Height (Valve opened) | 13-3/8 in. |
| Height (Valve closed) | 12.0 in. |
| Handle Diameter | 8-15/16 in. |
| Inlet and Outlet Flange Diameter | 5.0 in. |
| Inlet Port Opening | 1-25/32 in. |
| Outlet Port Opening | 1-25/32 in. |

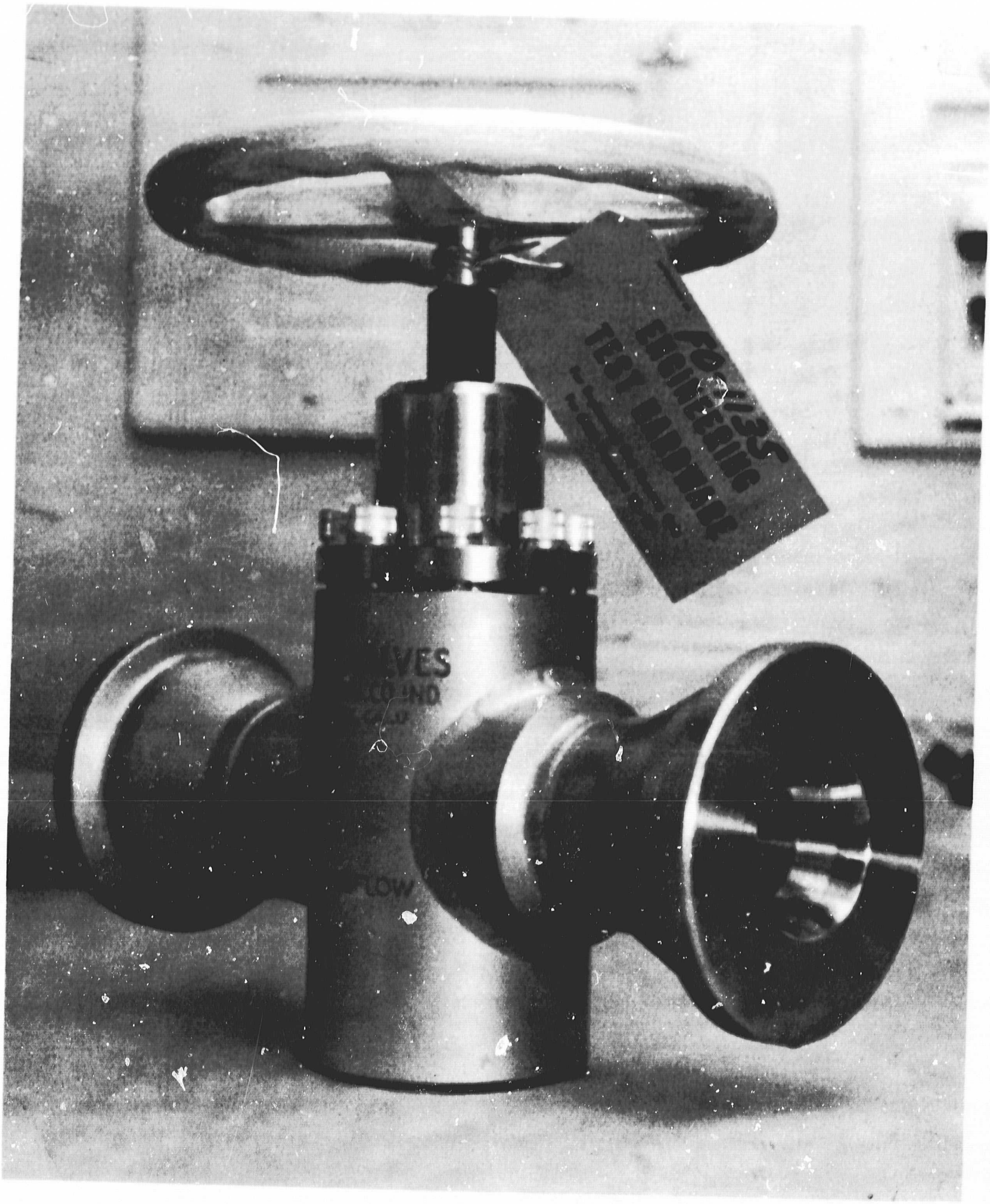



Figure 2-1. Receiving Inspection

## SECTION III

## PROOF PRESSURE TEST

### 3.1 TEST REQUIREMENTS

3.1.1 A proof pressure of 9000 psig shall be applied to the inlet port with the outlet port capped and the specimen in the open position for a period of 5 minutes.

3.1.2 Any leakage or distortion shall be monitored.

### 3.2 TEST PROCEDURE

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

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

3.2.3 The outlet port of specimen 1 was capped and the specimen was completely opened.

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

3.2.5 Pressure gauge 5 indicated 10,000 psig.

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

3.2.7 The 9000 psig pressure was maintained for 5 minutes.

3.2.8 Regulator 6 was adjusted for zero outlet pressure.

3.2.9 Hand valve 9 was opened to vent the specimen.

3.2.10 All test data was recorded.

## 3.3 TEST RESULTS

No leakage or distortion was observed.

## 3.4 TEST DATA

Proof pressure data is presented in tabel 3-2.

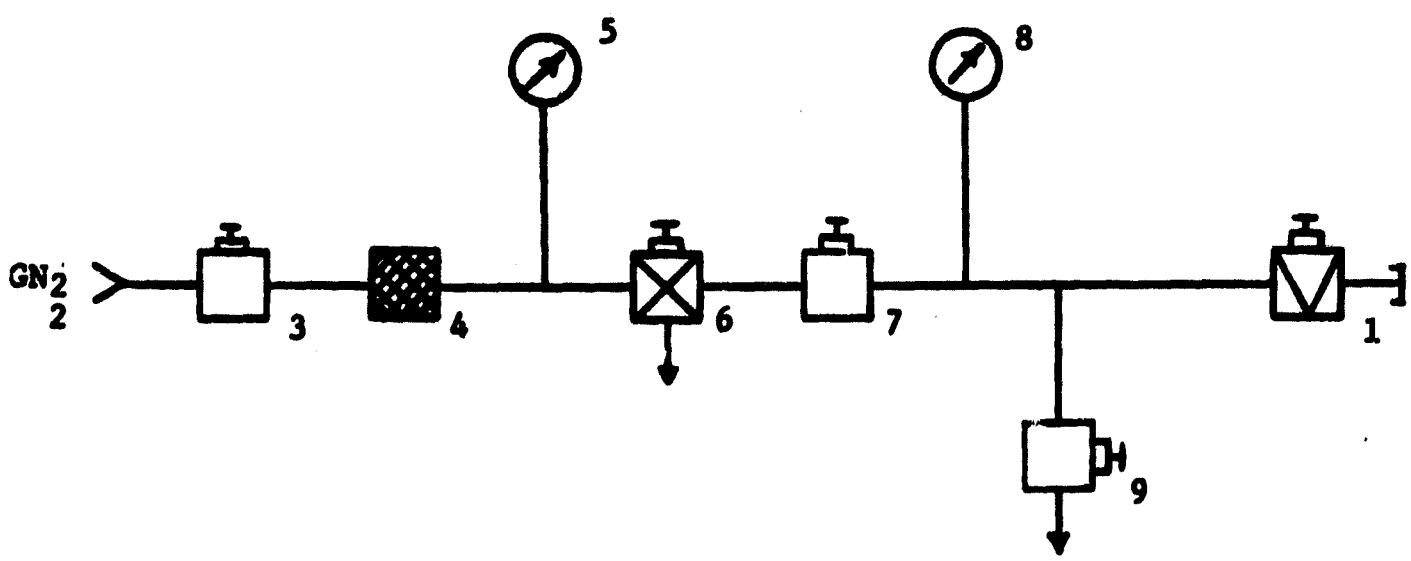



Figure 3-1. Proof Pressure Test Schematic

Table 3-1. Proof Pressure Test Equipment List

| Item No. | Item | Manufacturer | Model/ Part No. | Serial No. | Remarks |
|---|---|---|---|---|---|
| 1 | Test Specimen | Vacco Valve Company | M-6P-X469-2G (Modification Kit KM 7403) | 22144-1 | 2 inch Globe Valve |
| 2 | $GN_2$ Pressure Source | CCSD | N/A | N/A | 10,000 psig |
| 3 | Hand Valve | Combination Pump and Valve Co. | 380-3 | N/A | 1-1/2 inch |
| 4 | Filter | Microporous | 4813-F-2DM | N/A | 2-micron |
| 5 | Pressure Gage | Ashcroft | N/A | NASA 200G13-3 | 0 to 20,000 psig ±0.5% FS accuracy 12-7-67 |
| 6 | Pressure Regulator | Tescom Corp. | 25-102-1-20 | 3024 | 10,000 psig inlet 10,000 psig outlet |
| 7 | Hand Valve | Robbins Aviation | SSKG-250-4T | N/A | 1/4 inch |
| 8 | Pressure Gage | Heise | H49 & 80 | NASA-95-1653-B | 0 to 10,000 psig ±0.1% FS accuracy 1-5-68 |
| 9 | Hand Valve | Robbins Aviation | SSKG-250-4T | N/A | 1/4 inch |

Table 3-2. Proof Pressure Test Data

| | |
|---|---|
| Pressure | 9000 psig/5 minutes ($GN_2$) |
| Leakage | Zero |
| Distortion | Zero |

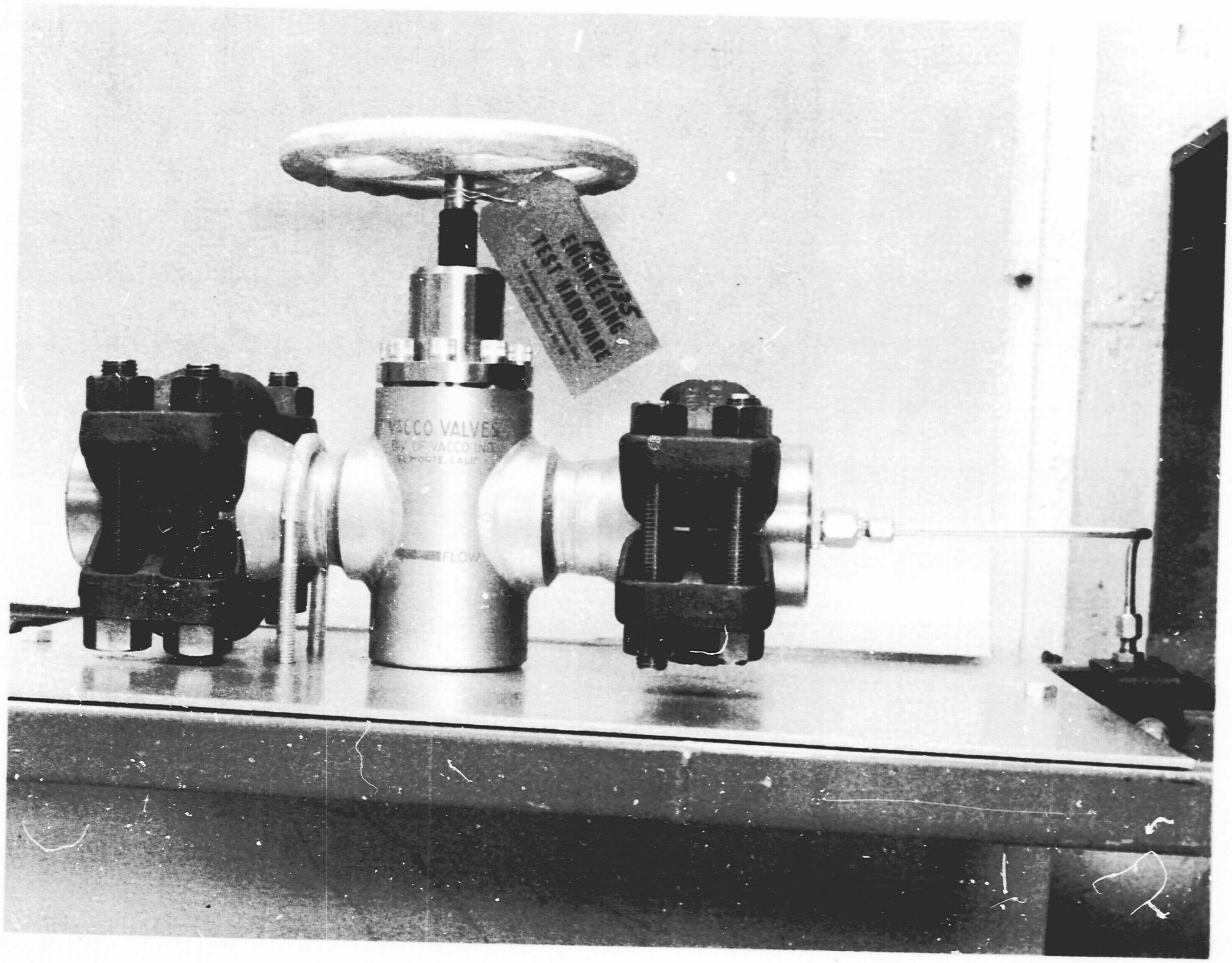



Figure 3-2. Proof Pressure Test Setup

## SECTION IV

## FUNCTIONAL TEST

### 4.1 TEST REQUIREMENTS

4.1.1 The test specimen shall be checked for leakage during a five minute period with the inlet port of the specimen pressurized to 6000 psig, specimen closed, and the outlet port vented. Any leakage shall be recorded.

4.1.2 The opening, closing, and normal running torque of the valve shall be determined with the inlet port pressurized to 6000 psig. Record all data.

4.1.3 The procedure described in 4.1.1 shall be performed once for the initial functional test and once for all subsequent functional tests. Procedures described in 4.1.2 shall be performed 5 times for each functional test.

4.1.4 The procedures described in 4.1.1 through 4.1.3 shall be repeated with pressure applied to the outlet port.

### 4.2 TEST PROCEDURE

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

4.2.2 The test setup was assembled as shown in figures 4-1 and 4-2 using the equipment listed in table 4-1.

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

4.2.4 All regulators were adjusted for zero outlet pressure and all hand valves were closed.

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

4.2.6 Regulator 6 was adjusted to establish 6000 psig on pressure gage 7.

4.2.7 Hand valve 10 was opened and leakage was monitored over a five minute period. When bubbles appeared in water tank 12, the amount of leakage was determined by the displacement of water in graduated cylinder 11.

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

4.2.9 Hand valve 8 and 10 were closed.

4.2.10 Regulator 6 was slowly adjusted to apply 6000 psig pressure to the specimen.

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

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

4.2.13 The specimen was then closed. The closing running torque and closing torque with flow were measured.

4.2.14 Hand valve 9 was opened and closed to vent the outlet pressure of the specimen. Hand valve 10 was opened.

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

4.2.16 The specimen was slowly closed and the torque that was required to stop the bubbles in water tank 12 was measured. This was the closing torque for the specimen.

4.2.17 The procedures described in 4.2.11 through 4.2.16 were repeated for a total of five runs.

4.2.18 The procedures of 4.2.7 were repeated.

4.2.19 Regulator 6 and hand valve 10 were closed.

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

4.2.21 Line 14 was attached to the outlet port of the specimen and line 15 was attached to the inlet port. The procedures of 4.2.3 through 4.2.20 were repeated.

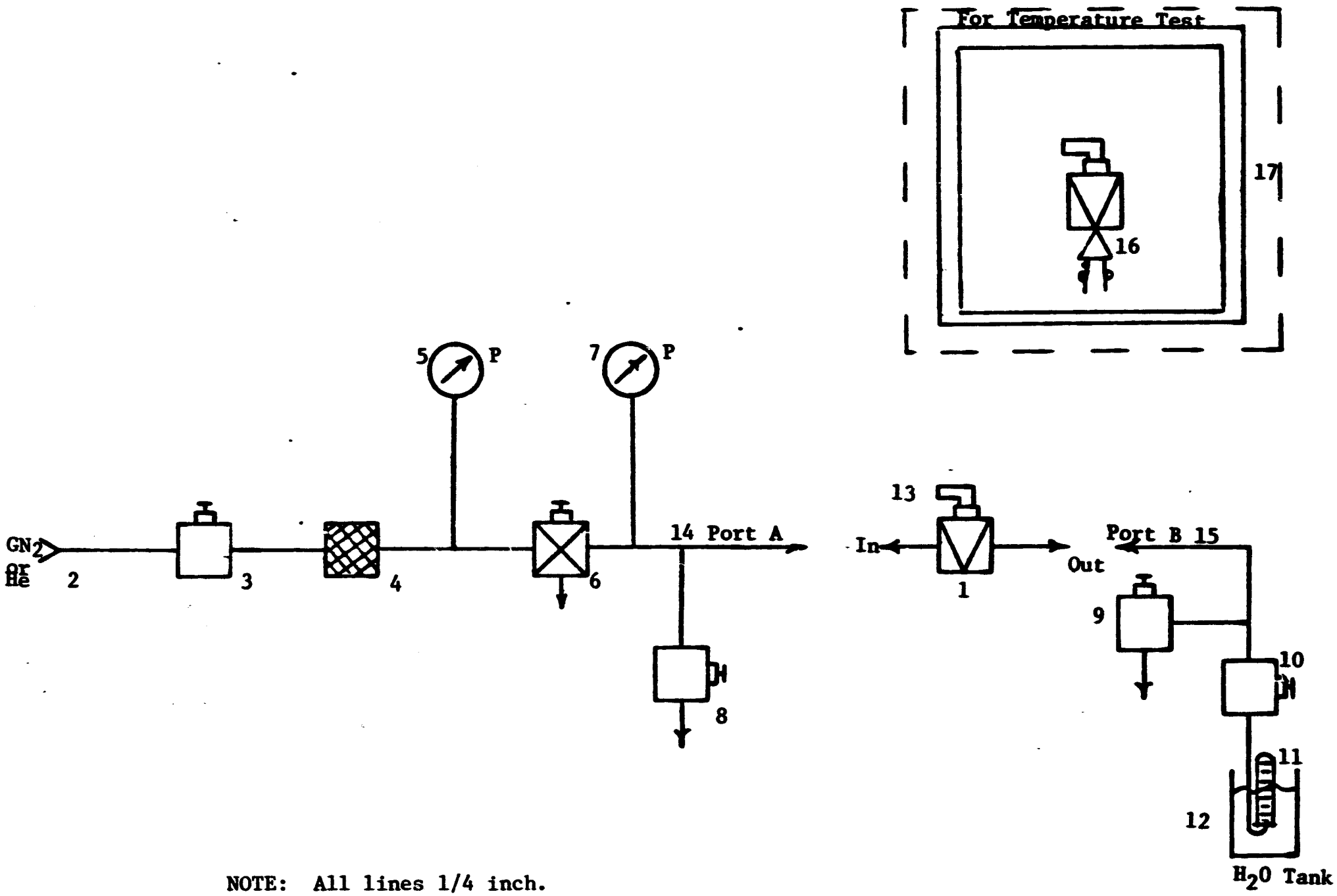
4.2.22 All data was recorded.

## 4.3 TEST RESULTS

The test specimen functioned satisfactorily during the initial functional test.

## 4.4 TEST DATA

Initial functional test data is presented in table 4-2.




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

Figure 4-1. Functional Test Schematic

Table 4-1. Functional Test Equipment List

| Item No. | Item | Manufacturer | Model/ Part No. | Serial No. | Remarks |
|---|---|---|---|---|---|
| 1 | Test Specimen | Vacco Valve Co. | M-6P-X496 2G (With Mod. Kit KM 1430) | 22144-1 | 2 inch Globe Valve 6000 psig |
| 2 | He Source | CCSD | N/A | N/A | 7000 psig |
| 3 | Hand Valve | Combination Pump and Valve Co. | N/A | N/A | 1-1/2 inch |
| 4 | Filter | Microporous | 4813-F2DM | N/A | 0 to 10,000 psig |
| 5 | Pressure Gage | Ashcroft | 1850 | NASA 20059-4P | ±0.5% FS accuracy Cal date 12-7-67 |
| 6 | Regulator | Tescom Corp. | 26-1002 | 1009 | 7000 psig inlet 0 to 7000 psig outlet |
| 7 | Pressure Gage | Ashcroft | 1850 | NASA 200594-Q | 0 to 10,000 psig ±0.25% FS accuracy Cal date 12-7-67 |
| 8 | Hand Valve | Grove | N/A | N/A | 1/4 inch |
| 9 | Hand Valve | Robbins | SSKG-250-4T | N/A | 1/4 inch |
| 10 | Hand Valve | Robbins | SSKG-250-4T | N/A | 1/4 inch |
| 11 | Graduated Cylinder | N/A | N/A | N/A | For leakage measurement |
| 12 | Water Tank | CCSD | N/A | N/A | Leakage detector |
| 13 | Torque Wrench | Sturtevant | S-200-1 | N/A | Replaces hand wheel of specimen (when required) Cal date 7-5-66 |
| 14 | Line | Superior Tube Co. | N/A | N/A | 1/4 inch |

Table 4-1. Functional Test Equipment List (Cont'd)

| Item No. | Item | Manufacturer | Model/ Part No. | Serial No. | Remarks |
|---|---|---|---|---|---|
| 15 | Line | Superior Tube Co. | N/A | N/A | 1/4 inch |
| 16 | Thermocouple | Minneapolis Honeywell | 30112 | N/A | -50 to +200 (±2.5)°F (temperature test only) |
| 17 | Thermal Chamber | Conrad | N/A | NASA 200494-1 | -25 to +200°F (temperature test only) |

Table 4-2. Initial Functional Test Data

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 200 | 6000 | 0 | 0 |
| 2 | 200 | 0 | 6000 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Specimen Outlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|---|
| | | | | | Opening | Closing | |
| 1 | 400 | 6000 | 0 | 300 | 18 | 10 | 450 |
| 2 | 450 | 6000 | 0 | 325 | 15 | 10 | 500 |
| 3 | 500 | 6000 | 0 | 375 | 15 | 10 | 300 |
| 4 | 300 | 6000 | 0 | 300 | 15 | 10 | 200 |
| 5 | 200 | 6000 | 0 | 300 | 15 | 10 | 200 |
| 6 | 200 | 0 | 6000 | 125 | 15 | 15 | 150 |
| 7 | 150 | 0 | 6000 | 125 | 15 | 15 | 125 |
| 8 | 125 | 0 | 6000 | 125 | 20 | 10 | 150 |
| 9 | 150 | 0 | 6000 | 120 | 15 | 15 | 300 |
| 10 | 300 | 0 | 6000 | 100 | 15 | 10 | 200 |

Note: No leakage

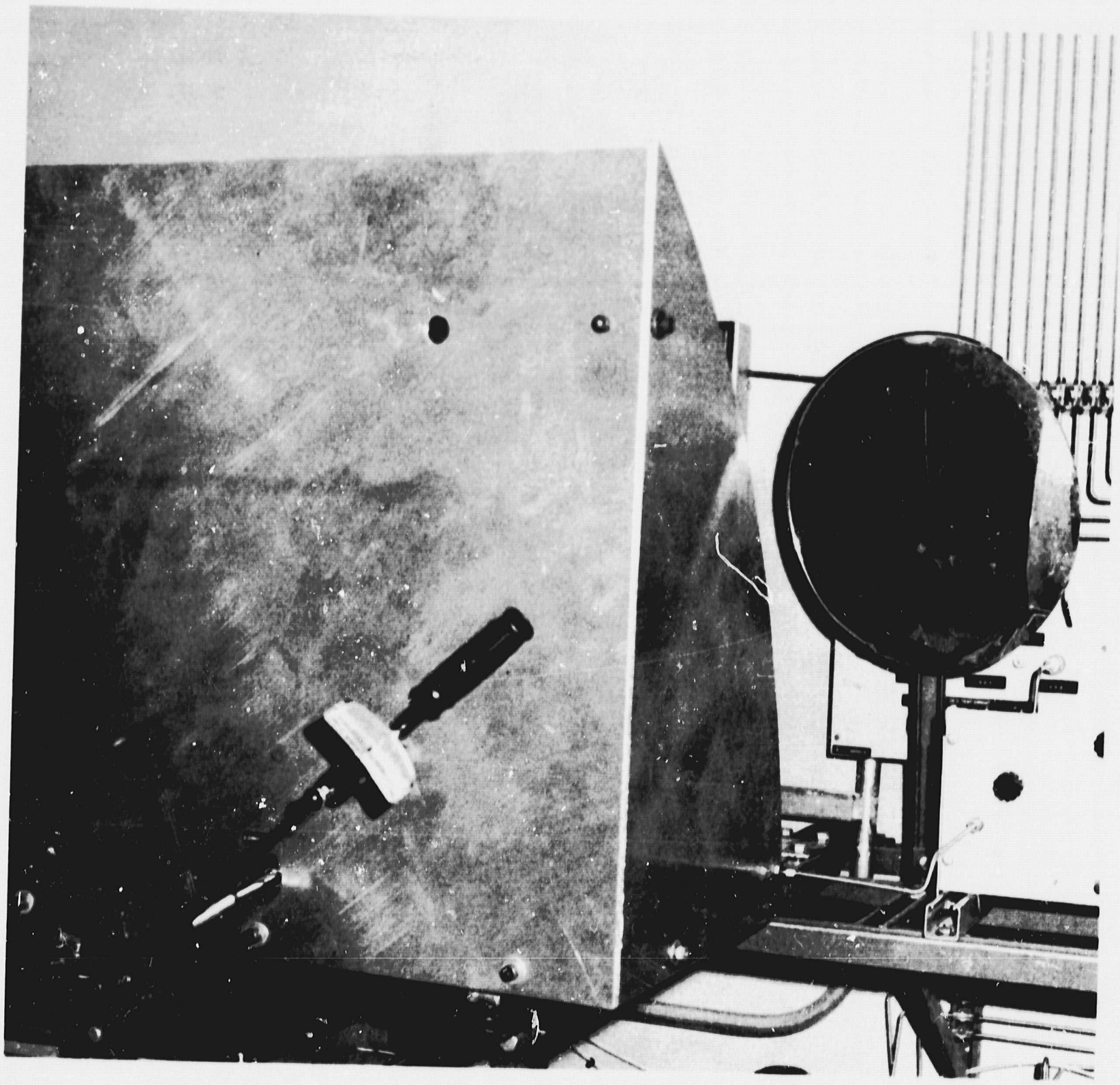


Figure 4-2. Function Test Setup

## SECTION V

## SEAT EROSION TEST

### 5.1 TEST REQUIREMENTS

5.1.1 A seat erosion test shall be performed on the test specimen.

5.1.2 The specimen inlet shall be pressurized to 6000 psig. The specimen shall be adjusted to flow approximately 100 scfm of $GN_2$ for four hours with the outlet pressure maintained below 50 psig.

5.1.3 A functional test shall be performed within one hour following the test.

5.1.4 The procedures described in 5.1.1 through 5.1.3 shall be repeated with pressure applied to the outlet port.

### 5.2 TEST PROCEDURE

5.2.1 The seat erosion test equipment was assembled as shown in figures 5-1 and 5-2. The equipment used is listed in table 5-1. Line 11 was attached to the specimen's inlet port and line 12 was attached to the outlet port.

5.2.2 Hand valve 2 and the test specimen were closed and regulator 5 was adjusted for zero outlet pressure.

5.2.3 Hand valve 2 was opened.

5.2.4 The supply pressure on gage 4 indicated 7000 psig.

5.2.5 Regulator 5 was adjusted to establish 6000 psig on pressure gage 6.

5.2.6 The test specimen was adjusted to provide 100 ($\pm$5) scfm flow while the outlet pressure was maintained below 50 psig.

5.2.7 The conditions described in 5.2.6 were maintained for four hours.

5.2.8 A functional test was performed within one hour following the seat erosion test.

5.2.9 Line 12 was then attached to the specimen's inlet port and line 11 was attached to the outlet port. The procedures of 5.2.2 through 5.2.8 were repeated.

5.2.10 All test data was recorded.

## 5.3 TEST RESULTS

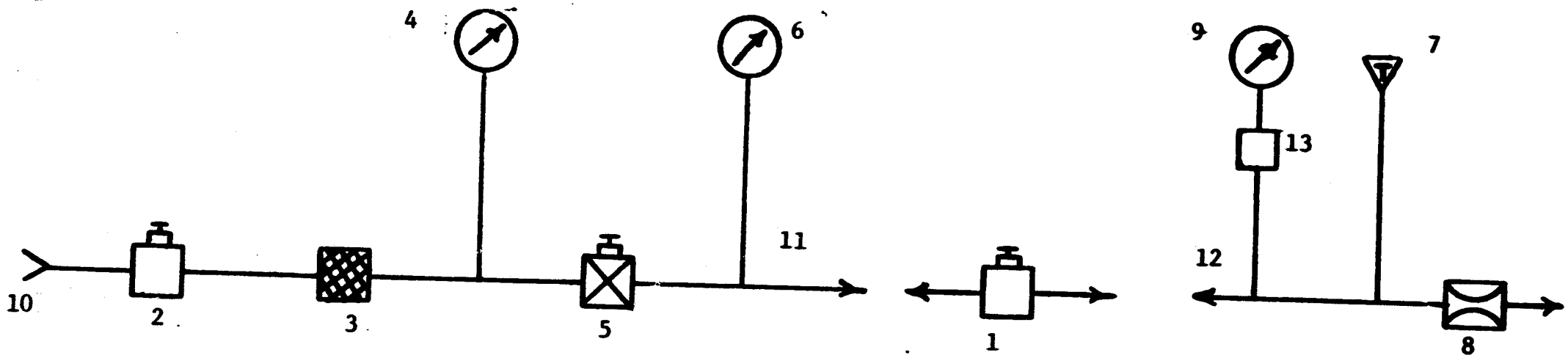
5.3.1 The test specimen successfully flowed approximately 100 scfm; first through the inlet port and then through the outlet port for four hours each. There was no apparent deterioration caused to the specimen.

5.3.2 During the functional test following the seat erosion test, the valve stem began binding. It was noted that small steel particles were present on the threaded area, apparently caused by metal to metal contact in the bonnet section. The particles were washed off with freon, the stem re-lubricated, and testing was resumed. Torque values were still according to specification.

## 5.4 TEST DATA

5.4.1 Test data recorded during the seat erosion test and the subsequent functional test are presented in tables 5-2 through 5-5.

5.4.2 A photograph of the steel particles which caused the specimen's stem to bind is shown in figure 5-3.




Note: All lines 1/2-inch.
Refer to table 5-1 for item Identification.

Figure 5-1. Seat Erosion Test Schematic

Table 5-1. Seat Erosion Test Equipment List

| Item No. | Item | Manufacturer | Model/ Part No. | Serial No. | Remarks |
|---|---|---|---|---|---|
| 1 | Test Specimen | Vacco Valve Co. | M-6P-X469-2G (With Mod. Kit 7403) | 22144-1 | 2 inch Globe Valve 6000 psig |
| 2 | Hand Valve | Controls Components | MV-1004-P-P | N/A | 1-1/2 inch |
| 3 | Filter | Permanent Filter Corp. | 9377-3154 | CPB-D10 | 2-micron |
| 4 | Pressure Gage | Ashcroft Corp. | N/A | NASA-95 1648-B | 0 to 10,000 psig ±0.5% FS accuracy Cal date 11-11-67 |
| 5 | Pressure Regulator | Tescom Corp. | 26-1021-20 | 3025 | 7000 psig inlet 0 to 6000 psig outlet |
| 6 | Pressure Gage | Heise | N/A | NASA 012452 | 0 to 10,000 psig ±0.1% FS accuracy Cal date 11-11-67 |
| 7 | Temperature Probe | Honeywell Corp. | 30112 | N/A | -50 to +200°F ±2.5°F |
| 8 | Flow Nozzle | Flowdyne Corp. | XN160450-SA | 2375 | Calibrated nozzle, $D_2$=.4545 to flow 100 scfm of $GN_2$ at inlet pressure of less than 50 psig |
| 9 | Pressure Gage | Heise | H34951 | NASA 014227 | 0 to 100 psig ±0.1% FS accuracy |
| 10 | $GN_2$ Source | CCSD | N/A | N/A | 7000 psig |
| 11 | Line | Superior Tube Co. | N/A | N/A | 1/2 inch |
| 12 | Line | Superior Tube Co. | N/A | N/A | 1/2 inch |
| 13 | Gage Saver | Fisher Controls | N/A | N/A | Set at 95 psig |

Table 5-2. Seat Erosion Test Data (Inlet Port Pressurized)

| Readings taken 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 | 21.0 | 5 | 465 |
| 2 | 6000 | 19.3 | 2 | 462 |
| 3 | 6000 | 18.0 | 0 | 460 |
| 4 | 6000 | 25.5 | 0 | 460 |
| 5 | 6000 | 20.0 | 5 | 465 |
| 6 | 6000 | 20.0 | 5 | 465 |
| 7 | 6000 | 21.4 | 2 | 462 |
| 8 | 6000 | 20.0 | 5 | 465 |
| 9 | 6000 | 19.0 | 5 | 465 |

Table 5-3. Functional Test Data Following Seat Erosion Test

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 450 | 6000 | 0 | 0 |
| 2 | 450 | 0 | 6000 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Specimen Outlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|---|
| | | | | | Opening | Closing | |
| 1 | 450 | 6000 | 0 | 150 | 20 | 15 | 225 |
| 2 | 225 | 6000 | 0 | 150 | 20 | 15 | 225 |
| 3 | 225 | 6000 | 0 | 150 | 20 | 15 | 300 |
| 4 | 300 | 6000 | 0 | 250 | 20 | 20 | 300 |
| 5 | 300 | 6000 | 0 | 250 | 20 | 20 | 300 |
| 6 | 300 | 0 | 6000 | 250 | 20 | 15 | 250 |
| 7 | 250 | 0 | 6000 | 300 | 20 | 18 | 250 |
| 8 | 250 | 0 | 6000 | 300 | 20 | 18 | 350 |
| 9 | 350 | 0 | 6000 | 300 | 20 | 18 | 400 |
| 10 | 400 | 0 | 6000 | 350 | 20 | 18 | 400 |

Table 5-4. Seat Erosion Test Data (Outlet Port Pressurized)

| Readings taken 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 | 22.5 | 5 | 465 |
| 2 | 6000 | 21.7 | 5 | 464 |
| 3 | 6000 | 19.0 | 5 | 465 |
| 4 | 6000 | 17.0 | 5 | 465 |
| 5 | 6000 | 22.2 | 0 | 460 |
| 6 | 6000 | 20.0 | 0 | 460 |
| 7 | 6000 | 19.0 | 0 | 460 |
| 9 | 6000 | 21.0 | 0 | 460 |

Table 5-5. Functional Test Data Following Seat Erosion Test

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 500 | 6000 | 0 | 0 |
| 2 | 400 | 0 | 6000 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Specimen Outlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) Opening | Running Torque (in-lbs) Closing | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|---|
| 1 | 400 | 6000 | 0 | 350 | 20 | 18 | 500 |
| 2 | 400 | 6000 | 0 | 400 | 20 | 18 | 400 |
| 3 | 425 | 6000 | 0 | 400 | 20 | 18 | 400 |
| 4 | 425 | 6000 | 0 | 425 | 20 | 18 | 800 |
| 5 | 425 | 6000 | 0 | 650 | 300 | 100 | 700 |
| | See note at bottom of page | | | | | | |
| 6 | 400 | 0 | 6000 | 150 | 40 | 25 | 400 |
| 7 | 400 | 0 | 6000 | 150 | 40 | 25 | 425 |
| 8 | 425 | 0 | 6000 | 150 | 40 | 25 | 425 |
| 9 | 425 | 0 | 6000 | 150 | 50 | 25 | 425 |
| 10 | 425 | 0 | 6000 | 150 | 50 | 25 | 425 |

Note: During the fourth and fifth cycle the valve stem began binding. Small particles were noted on the stem. These particles were cleaned off, the stem re-lubricated, and testing was resumed.

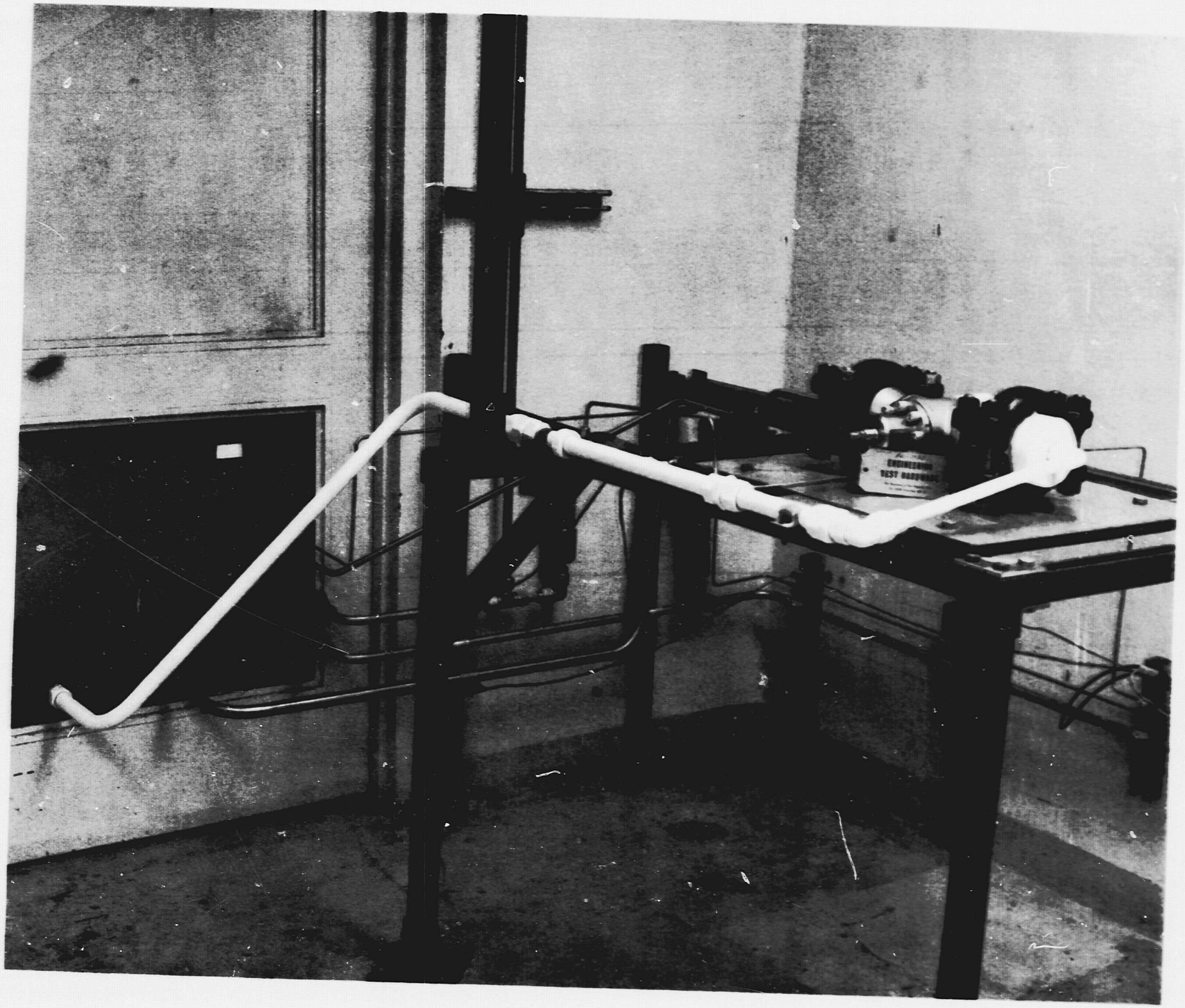


Figure 5-2. Seat Erosion Test Setup

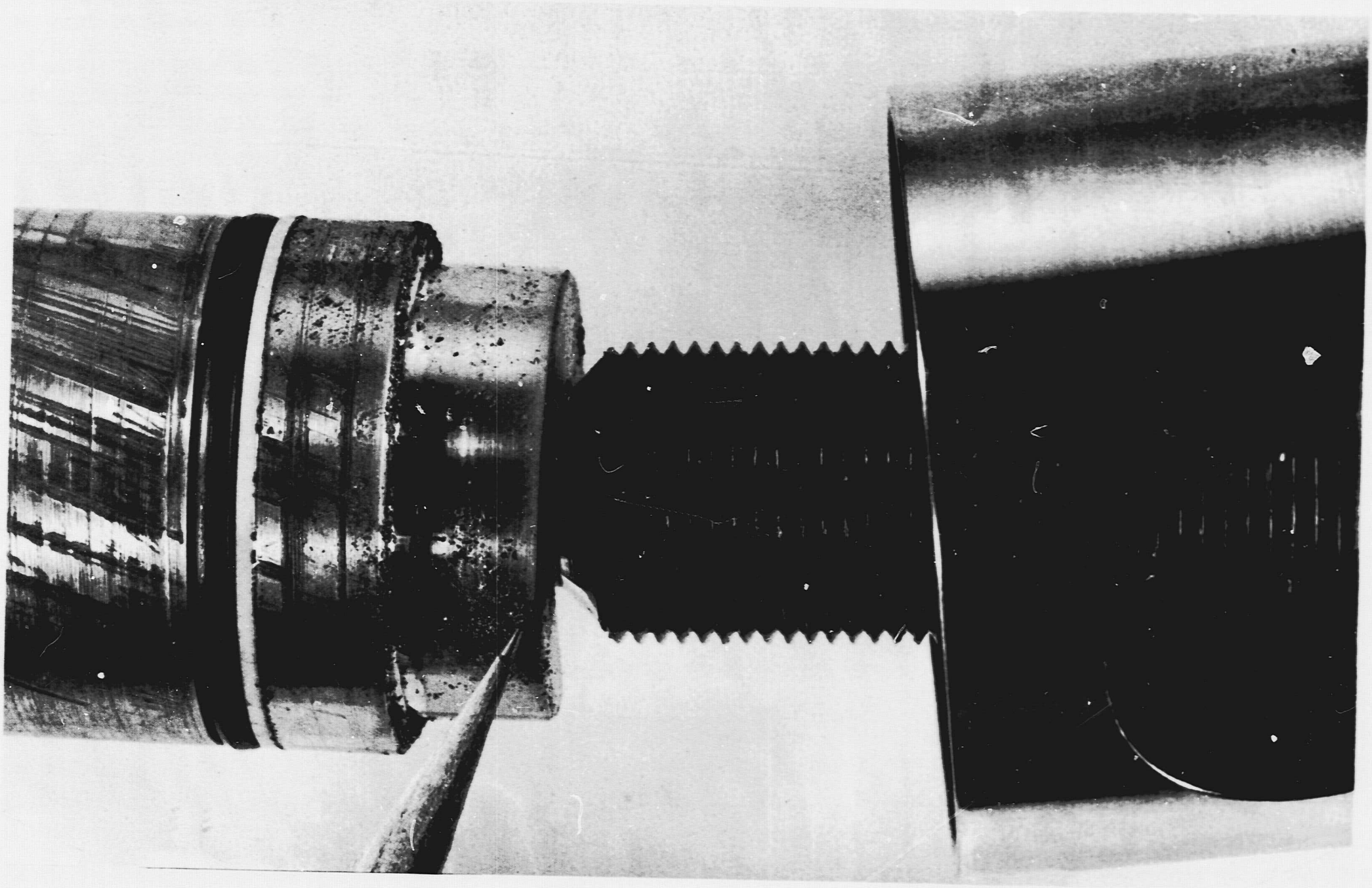


Figure 5-3. Metal Particles Produced from Metal to Metal Contact

## SECTION VI

## SURGE TEST

### 6.1 TEST REQUIREMENTS

6.1.1 The test specimen shall be subjected to 10 pressure surges with the specimen closed and 10 with the specimen 1/4 open, to determine if the environment causes degradation or deformation.

6.1.2 Each surge shall be an increase from zero to 6000 psig within 100 milliseconds. Pressure shall be applied to the specimen's inlet port. A functional test shall be performed within one hour following the test.

6.1.3 The procedures described in 6.1.1 and 6.1.2 shall be repeated with pressure applied to the outlet port.

### 6.2 TEST PROCEDURE

6.2.1 The test setup was assembled as shown in figures 6-1 and 6-3 using the equipment listed in table 6-1. Line 9 was attached to the inlet port of the test specimen and line 14 to the outlet port. All hand valves and the test specimen were closed.

6.2.2 Regulator 12 was adjusted for zero outlet pressure.

6.2.3 Hand valve 3 was then opened.

6.2.4 Pressure gage 5 indicated approximately 7000 psig.

6.2.5 Regulator 12 was adjusted until gage 13 indicated 6000 psig. Oscillograph 8 was turned on.

6.2.6 Switch 11 was closed to actuate solenoid valve 6.

6.2.7 The output of pressure transducer 7 was monitored and recorded on oscillograph 8.

6.2.8 Switch 11 was opened to deactuate solenoid valve 6.

6.2.9 The procedures described in 6.2.6 through 6.2.8 were repeated for a total of 10 cycles. Water tank 15 was monitored for evidence of specimen internal leakage throughout the test.

6.2.10 Line 14 was removed from tank 15. The stem was then turned until the specimen was approximately 1/4 opened and steps 6.2.6 through 6.2.8 were repeated for 10 additional cycles.

6.2.11 A functional test was performed within one hour following the test.

6.2.12 Line 9 was then attached to the specimen's outlet port and line 14 to the inlet port.

6.2.13 The procedures described in 6.2.6 through 6.2.11 were repeated.

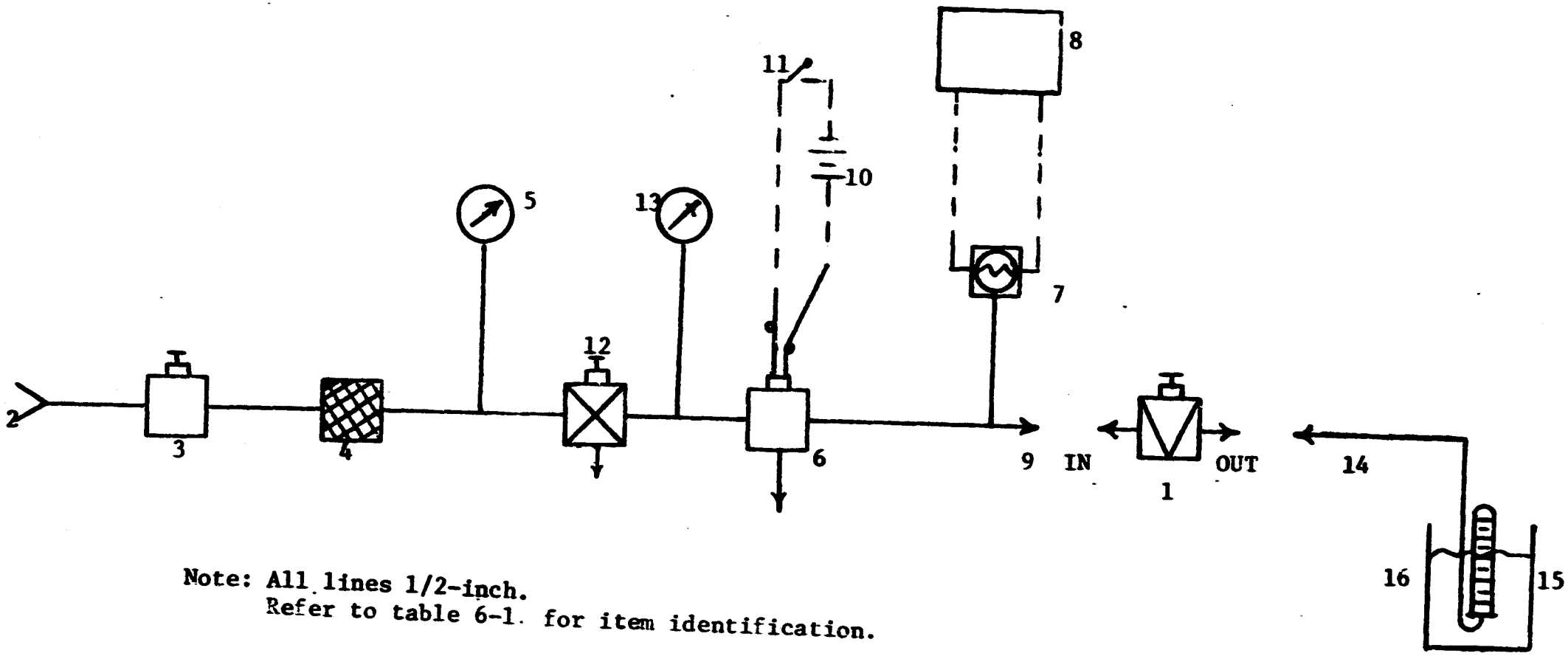
6.2.14 The specimen was checked for deformation and degradation. All test data was recorded.

## 6.3 TEST RESULTS

The test specimen withstood 20 surge cycles from 0 to 6000 psig at the inlet port and 20 subsequent cycles at the outlet port. Functional test results following each phase of cycling were satisfactory.

## 6.4 TEST DATA

6.4.1 Typical surge waveforms as recorded during the tests are presented in figures 6-2. Functional test data following the surge tests is presented in tables 6-3 and 6-4.




Note: All lines 1/2-inch.
Refer to table 6-1. for item identification.

Figure 6-1. Surge Test Schematic

Table 6-1. Surge Test Equipment List

| Item No. | Item | Manufacturer | Model/ Part No. | Serial No. | Remarks |
|---|---|---|---|---|---|
| 1 | Test specimen | Vacco Valve Co. | M-6P-X469-2G (With Mod. Kit KM 7403) | 22144-1 | 2 inch Globe Valve 6000 psig |
| 2 | $GN_2$ Source | CCSD | N/A | N/A | 10,000 psig |
| 3 | Hand Valve | Combination Pump and Valve Co. | N/A | N/A | 1-1/2 inch |
| 4 | Filter | Microporous | 4813-F-DM | N/A | 2 micron |
| 5 | Pressure Gage | Ashcroft | 1850 | NASA 200594-P | 10,000 psig ±0.5% FS accuracy Cal date 6-7-67 |
| 6 | Solenoid Valve | Marotta Valve Co. | MV-583 | 2915 | 3 way, 1/2 inch normally closed |
| 7 | Pressure Transducer | Statham | PA826-10M | NASA-95 1651-B | 0 to 10,000 psig ±0.25% FS accuracy Cal date 5-25-67 |
| 8 | Oscillograph Recorder | CEC | 124 | NASA 012586 | Used to record Pressure Impulse Cal date 8-2-67 |
| 9 | Line | Superior Tube Company | N/A | N/A | 1/2 inch |
| 10 | Power Supply | Lab Source | N/A | N/A | 28 vdc, 5 amp |
| 11 | Switch | Cutler Hammer | N/A | N/A | SPST |
| 12 | Regulator | Tescom Corporation | 26-1002 | 1009 | 6500 psig inlet 0 to 6000 psig outlet |
| 13 | Pressure Gage | Ashcroft | 1850 | NASA 200594-Q | 0 to 10,000 psig ±0.5% FS accuracy |
| 14 | Line | Superior Tube Co. | N/A | N/A | 1/2 inch |
| 15 | Water Tank | CCSD | N/A | N/A | Leakage detector |
| 16 | Graduated Cylinder | Pyrex Co. | NA | N/A | For leakage measurement |

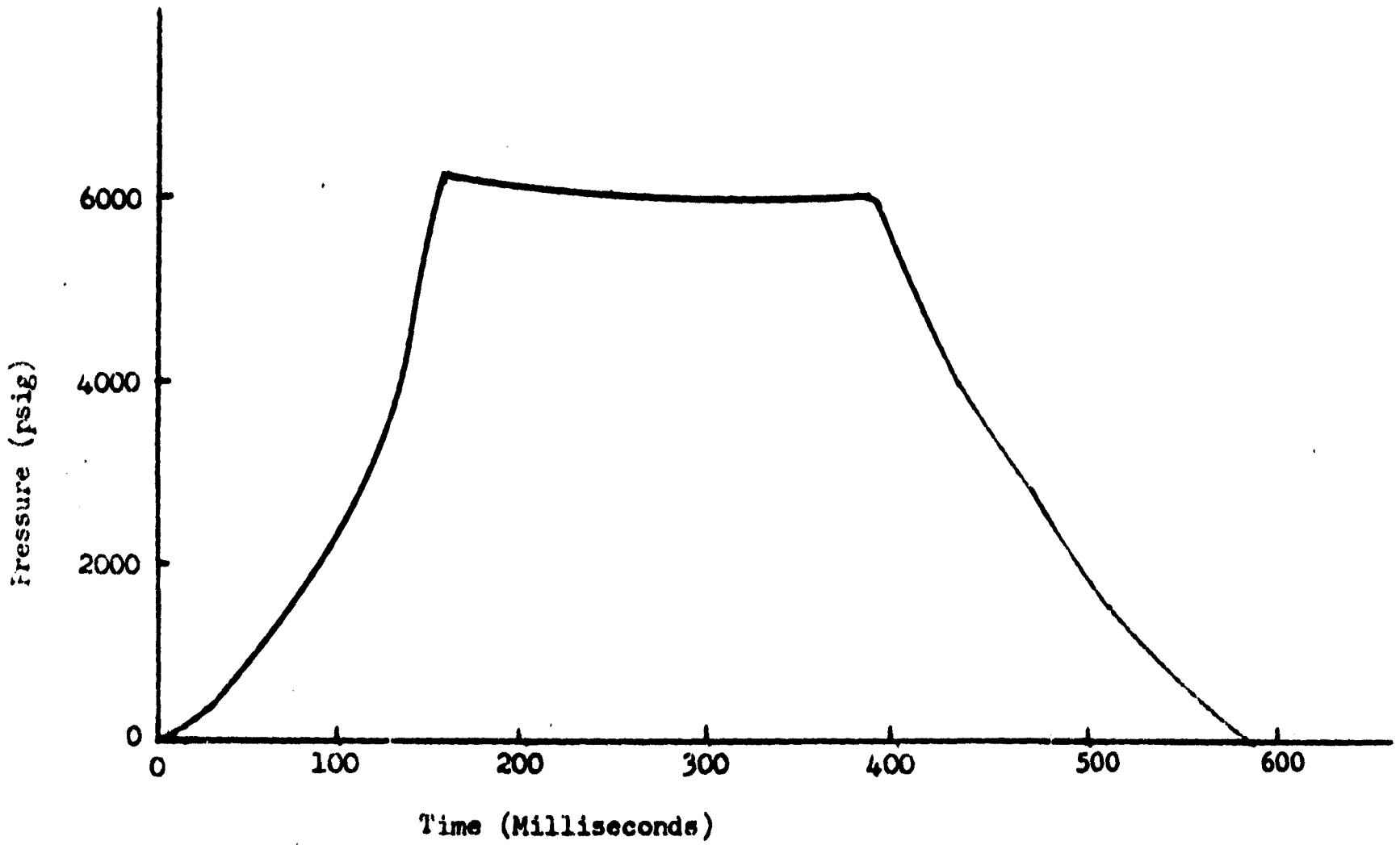



Figure 6-2. Typical Surge Wave Form

Table 6-2. Functional Test Data Prior to Surge Test (72 Hours Lapse Time)

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 445 | 0 | 6000 | 0 |
| 2 | 300 | 6000 | 0 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Specimen Outlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|---|
| | | | | | Opening | Closing | |
| 1 | 350 | 6000 | 0 | 150 | 40 | 20 | 300 |
| 2 | 475 | 6000 | 0 | 375 | 30 | 25 | 475 |
| 3 | 450 | 6000 | 0 | 400 | 40 | 25 | 450 |
| 4 | 400 | 6000 | 0 | 375 | 35 | 30 | 400 |
| 5 | 450 | 6000 | 0 | 400 | 35 | 25 | 450 |
| 6 | 445 | 0 | 6000 | 150 | 30 | 20 | 400 |
| 7 | 400 | 0 | 6000 | 200 | 40 | 25 | 400 |
| 8 | 400 | 0 | 6000 | 150 | 50 | 25 | 400 |
| 9 | 400 | 0 | 6000 | 125 | 45 | 25 | 300 |
| 10 | 300 | 0 | 6000 | 125 | 40 | 25 | 300 |

Table 6-3. Functional Test Data (Inlet Pressurized) Following Surge Test

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 450 | 6000 | 0 | 0 |
| 2 | 400 | 0 | 6000 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Specimen Outlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|---|
| | | | | | Opening | Closing | |
| 1 | 450 | 6000 | 0 | 400 | 35 | 25 | 450 |
| 2 | 450 | 6000 | 0 | 425 | 35 | 25 | 450 |
| 3 | 450 | 6000 | 0 | 425 | 35 | 25 | 400 |
| 4 | 400 | 6000 | 0 | 425 | 35 | 25 | 400 |
| 5 | 400 | 6000 | 0 | 300 | 35 | 25 | 400 |
| 6 | 400 | 0 | 6000 | 200 | 35 | 25 | 400 |
| 7 | 400 | 0 | 6000 | 175 | 35 | 25 | 400 |
| 8 | 400 | 0 | 6000 | 150 | 35 | 25 | 400 |
| 9 | 400 | 0 | 6000 | 150 | 35 | 25 | 400 |
| 10 | 400 | 0 | 6000 | 150 | 35 | 25 | 400 |

Table 6-4. Functional Test Data (Outlet Pressurized) Following Surge Test

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 400 | 6000 | 0 | 0 |
| 2 | 400 | 0 | 6000 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Specimen Outlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|---|
| | | | | | Opening | Closing | |
| 1 | 400 | 6000 | 0 | 400 | 35 | 20 | 400 |
| 2 | 400 | 6000 | 0 | 400 | 35 | 20 | 400 |
| 3 | 400 | 6000 | 0 | 150 | 35 | 20 | 400 |
| 4 | 400 | 6000 | 0 | 250 | 35 | 20 | 400 |
| 5 | 400 | 6000 | 0 | 150 | 35 | 20 | 400 |
| 6 | 400 | 0 | 6000 | 175 | 30 | 25 | 400 |
| 7 | 400 | 0 | 6000 | 175 | 30 | 25 | 400 |
| 8 | 400 | 0 | 6000 | 175 | 30 | 25 | 400 |
| 9 | 400 | 0 | 6000 | 175 | 30 | 25 | 400 |
| 10 | 400 | 0 | 6000 | 175 | 30 | 25 | 400 |

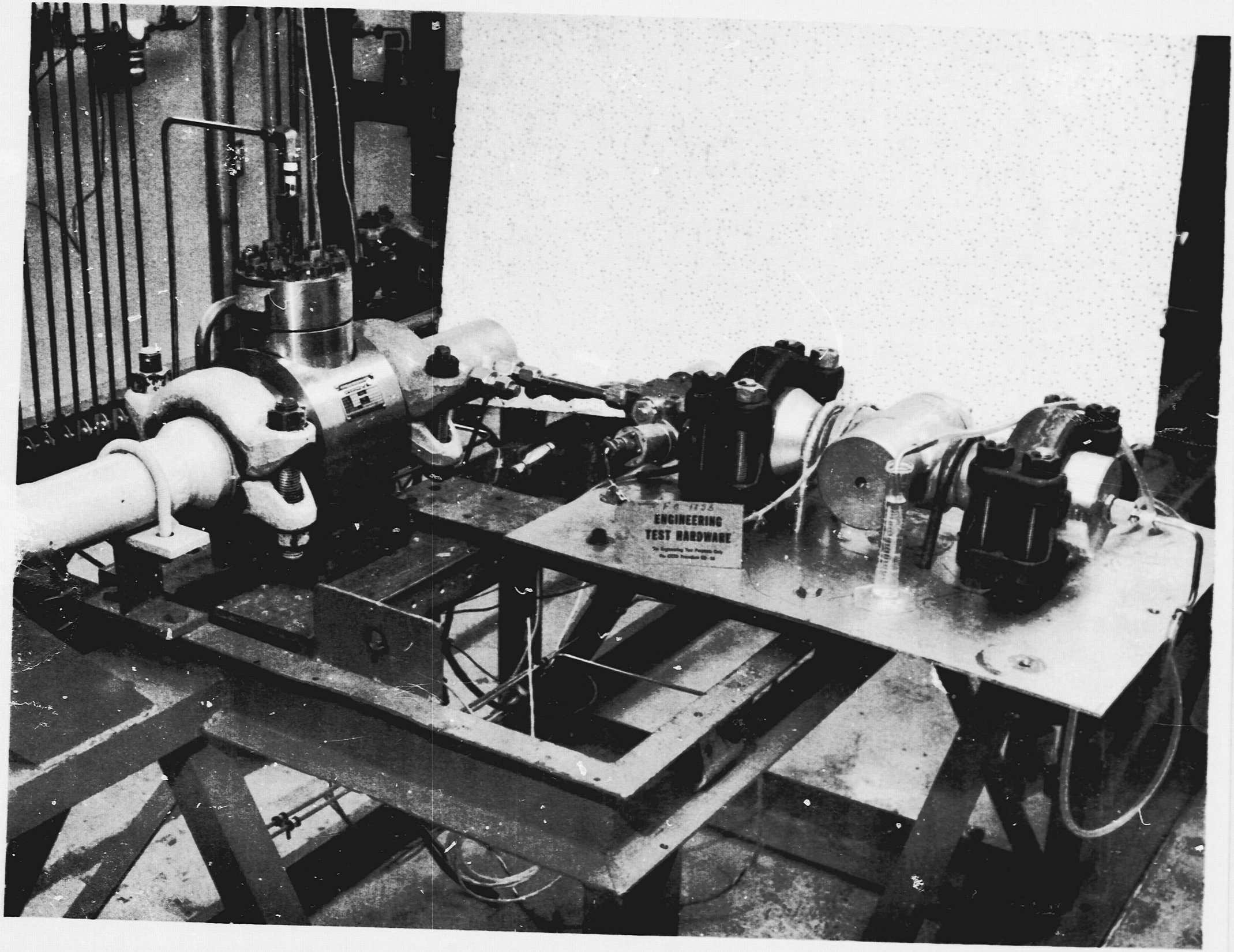



Figure 6-3. Surge Test Setup

# SECTION VII

# CYCLE TEST

## 7.1 TEST REQUIREMENTS

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

7.1.2 Two types of cycles shall be performed. One type with the inlet port pressurized to 6000 psig and another type with the outlet port pressurized to 6000 psig.

7.1.3 Certain cycles (to be called type I) shall be performed with the specimen vented to the atmosphere and with minimum flow restrictions upstream of the specimen. The other cycles (type II) shall be performed with the downstream line closed. However, the line shall be opened between cycles to vent downstream pressure.

7.1.4 Cycles shall be performed in groups as specified in table 7-1. A functional test shall be performed following each group of cycles. A total of 1000 cycles shall be performed on the specimen.

## 7.2 TEST PROCEDURE

7.2.1 A functional test was performed due to a delay of over 72 hours since the last functional tests.

7.2.2 The test setup was then assembled as shown in figures 7-1 and 7-2 using the equipment listed in table 7-2.

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

7.2.4 The inlet port or the outlet port of the specimen was connected to the upstream line according to the sequence shown in table 7-1.

7.2.5 Hand valve 10 was opened.

7.2.6 Hand valves 4 and 6 were then opened.

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

TYPE I CYCLES

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

7.2.9 Solenoid valve 9 was opened to pressurize the dome of regulator 11 which then established 6000 psig on pressure gage 13.

7.2.10 Motor 15 was rotated counter clockwise, by energizing cycle timer 17, to open the specimen.

7.2.11 Motor 15 was then reversed, by changing the polarity with cycle timer 17, to close the specimen.

TYPE II CYCLES

7.2.12 Solenoid valve 9 was opened to pressurize the dome of regulator 11 which then established 6000 psig on pressure gage 13.

7.2.13 Motor 15 was rotated counter clockwise, by energizing cycle timer 17, to open the specimen.

7.2.14 Motor 15 was then reversed, by changing the polarity with cycle timer 17, to close the specimen.

7.2.15 Solenoid valve 16c was opened to vent the downstream pressure.

7.2.16 Solenoid valve 16c was then closed.

7.3 TEST RESULTS

7.3.1 The test specimen was subjected to 25 type I cycles as described in 7.2.8 through 7.2.11. Following the 25 cycles, leakage past the

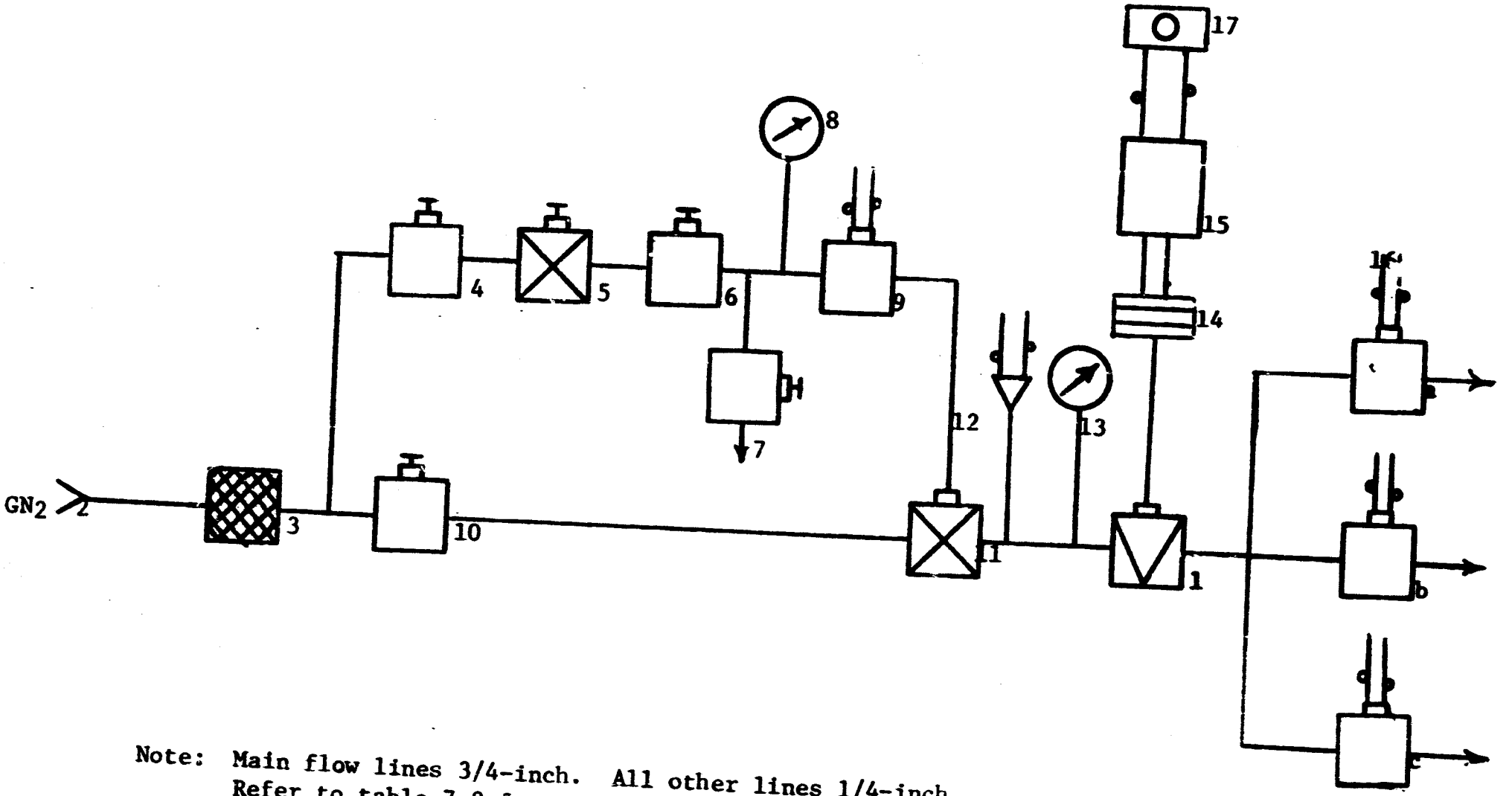
seat exceeded 1460 scim even with the maximum torque(1200 in-lbs) applied. The damaged seat was replaced and testing was continued. With the inlet port pressurized, ten (10) type I cycles were successfully completed. The outlet port was then pressurized and during the second cycle the seat was damaged. Leakage could not be stopped even with the maximum allowable torque applied.

7.3.2 Another seat was installed and a total of 975 cycles were successfully completed. At the request of CCSD-FO, only the inlet port was pressurized during these cycles. It was then requested that the outlet port be pressurized for the remaining 25 cycles. Cycle testing was permanently discontinued after 984 cycles due to an eroded seat.

7.3.3 A photograph of a typical eroded seat is shown in figure 7-3.

Table 7-1. Cycle Groups

| Groups | Pressurized Port | Cycles | Cycle Type |
|---|---|---|---|
| 1 | inlet | 1 - 5 | I |
| | outlet | 6 - 10 | |
| | inlet | 11 - 15 | |
| | outlet | 16 - 20 | |
| | inlet | 21 - 25 | |
| 2 | outlet | 26 - 35 | II |
| | inlet | 36 - 50 | |
| 3 | inlet | 51 - 75 | I |
| | outlet | 76 - 100 | |
| 4 | inlet | 101 - 200 | II |
| | outlet | 201 - 300 | |
| | inlet | 301 - 400 | |
| | outlet | 401 - 500 | |
| 5 | inlet | 501 - 600 | II |
| | outlet | 601 - 700 | |
| | inlet | 701 - 800 | |
| | outlet | 801 - 900 | |
| | inlet | 901 - 975 | |
| 6 | outlet | 976 - 985 | I |
| | inlet | 986 - 990 | |
| | outlet | 991 - 995 | |
| | inlet | 996 - 1000 | |




Note: Main flow lines 3/4-inch. All other lines 1/4-inch.
Refer to table 7-2 for item identification.

Figure 7-1. Cycle Test Schematic

Table 7-2. Cycle Test Equipment List

| Item No. | Item | Manufacturer | Model/ Part No. | Serial No. | Remarks |
|---|---|---|---|---|---|
| 1 | Test Specimen | Vacco Valve Company | M-6P-X469 2G (With Mod Kit KM 7403) | 22144-1 | 2 inch Globe Valve |
| 2 | $GN_2$ Source | CCSD | N/A | N/A | 10,000 psig |
| 3 | Filter | Permanent Filter | 937-73154 | 6P8-010 | 2 micron |
| 4 | Hand Valve | Aminco | 44-13126 | 58965 | 0 to 30,000 psig |
| 5 | Pressure Regulator | Tescom Corp. | 26-1021-20 | 3024 | 10,000 psig inlet 10,000 psig outlet |
| 6 | Hand Valve | Aminco | 44-13126 | 58965 | 30,000 psig |
| 7 | Vent Valve | Aminco | 44-13106 | 50011A | 30,000 psig |
| 8 | Pressure Gauge | Heise | H34955 | NASA 014231 | 0 to 10,000 psig ±0.1% FS accuracy Cal date 1-10-68 |
| 9 | Solenoid Valve | Marotta | MB-510-H | 190 | 6000 psig |
| 10 | Control Valve | Fisher | 470-D | 3572094 | 10,000 psig |
| 11 | Dome Regulator | Grove Valve | 211-B | 110751-1 | 10,000 psig |
| 12 | Thermocouple | Minneapolis Honeywell | N/A | N/A | -50 to 200 (±2.5)°F |
| 13 | Pressure Gauge | Heise | H-49480 | NASA 95-1653-B | 0 to 10,000 psig ±0.1% FS accuracy Cal date 1-10-68 |
| 14 | Clutch | Boston | Type V | R-025956 | 35 RPM |
| 15 | Motor | Westinghouse | Type CSP | CNO-5943 | 3 HP |
| 16 | Solenoid Valve (a) | Marotta | MB-583 | 2885 | 6000 psig |
| | Solenoid Valve (b) | Marotta | MB-583 | 2916 | 6000 psig |
| | Solenoid Valve (c) | Marotta | MB-583 | 372 | 6000 psig |
| 17 | Cycle Timer | Cramer Controls | 540 | 73336A | 115 VDC |

Table 7-3. Functional Test Data Prior to Cycle Test (72 Hours Lapse Time)

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 350 | 0 | 6000 | 0 |
| 2 | 400 | 6000 | 0 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Specimen Outlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|---|
| | | | | | Opening | Closing | |
| 1 | 400 | 6000 | 0 | 350 | 35 | 20 | 350 |
| 2 | 350 | 6000 | 0 | 350 | 35 | 20 | 450 |
| 3 | 450 | 6000 | 0 | 350 | 35 | 20 | 450 |
| 4 | 450 | 6000 | 0 | 300 | 35 | 20 | 450 |
| 5 | 450 | 6000 | 0 | 375 | 35 | 20 | 450 |
| 6 | 400 | 0 | 6000 | 175 | 35 | 20 | 350 |
| 7 | 350 | 0 | 6000 | 175 | 35 | 20 | 300 |
| 8 | 300 | 0 | 6000 | 175 | 35 | 20 | 300 |
| 9 | 300 | 0 | 6000 | 175 | 35 | 20 | 300 |
| 10 | 300 | 0 | 6000 | 175 | 35 | 20 | 300 |

Table 7-4. First 25 Cycles Of Cycle Group

| Group | Pressurized Port 6000 psig | Cycles 1 to 25 | Cycle Type | Remarks |
|---|---|---|---|---|
| 1 | Inlet<br>Outlet<br>Inlet<br>Outlet<br>Inlet | 1-5<br>6-10<br>11-15<br>16-20<br>21-25 | I | Functional test to be performed after 25 cycles |

Table 7-5. Functional Test Data After 25 Cycles

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 800 | 6000 | 0 | >1460 |
| 2 | 800 | 0 | 6000 | >1460 |

Note: The valve stem was torqued to the maximum 1200 in-lbs. Leakage was still in excess of 1460 scim. A new seat was installed.

Table 7-6. Functional Test Following Installation of a New Seat

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 250 | 6000 | 0 | 0 |
| 2 | 250 | 0 | 6000 | 0 |

| Run | Specimen Outlet Pressure (psig) | Specimen Inlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|
| | | | | Opening | Closing | |
| 1 | 6000 | 0 | 150 | 10 | 10 | 350 |
| 2 | 6000 | 0 | 175 | 10 | 10 | 200 |
| 3 | 6000 | 0 | 100 | 10 | 10 | 200 |
| 4 | 6000 | 0 | 100 | 10 | 10 | 200 |
| 5 | 6000 | 0 | 100 | 10 | 10 | 200 |
| 6 | 0 | 6000 | 175 | 10 | 10 | 250 |
| 7 | 0 | 6000 | 175 | 10 | 10 | 350 |
| 8 | 0 | 6000 | 300 | 10 | 10 | 350 |
| 9 | 0 | 6000 | 325 | 10 | 10 | 350 |
| 10 | 0 | 6000 | 325 | 10 | 10 | 350 |

Note: No leakage existed during the functional test

Table 7-7. Cycle Test Resumed With New Seat

| Group | Pressurized Port (6000 psig) | Cycles 1 to 25 | Cycle Type | Remarks |
|---|---|---|---|---|
| 1 | Inlet | 1-10 | I | No leakage |
| | Outlet | 11-12 | I | Leakage in excess of 1460 scim after completion of the twelth cycle |

Note: The valve stem was torqued to the maximum 1200 in-lbs. Leakage was still in excess of 1460 scim. Inspection revealed eroded seat.

Table 7-8. Functional Test Data After Installation of Second New Seat

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 260 | 6000 | 0 | 0 |

| Run | Applied Seating Torque (in-lbs) | Inlet Port Pressurized (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|
| | | | | Opening | Closing | |
| 1 | 260 | 6000 | 210 | 9.5 | 5 | 270 |
| 2 | 300 | 6000 | 200 | 12.0 | 5 | 300 |
| 3 | 305 | 6000 | 275 | 35.0 | 5 | 375 |
| 4 | 375 | 6000 | 300 | 35.0 | 5 | 525 |
| 5 | 575 | 6000 | 375 | 40.0 | 5 | 400 |

Note: No Leakage.

Table 7-9. Cycle Test Data After Second New Seat **Installation**

| Group | Pressurized Port (6000 psig) | Stem Torque (in-lbs) | Cycles | Cycle Type | Remarks |
|---|---|---|---|---|---|
| 1 | inlet | 450 | 1-10 | I | No leakage for first 10 individual cycles |
| 1 | inlet | 450 | 11-25 | I | No leakage |
| 2 | inlet | 450 | 26-50 | II | No leakage |
| 3 | inlet | 450 | 51-100 | I | No leakage |
| 4 | inlet | 550 | 101-500 | II | No leakage |
| 5 | inlet | 850 | 501-975 | II | No leakage |
| 6 | outlet | 850 | 976-978 | I | Leakage exceeded 800 scim |
| 6 | outlet | 900 | 979-981 | I | Leakage exceeded 1050 scim |
| 6 | outlet | 1200 | 982-984 | I | Leakage exceeded 1460 scim |
| | Note: Test permanently discontinued after 984 cycles due to eroded seat | | | | |

Table 7-10. Functional Test Data After 25 Cycles

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 450 | 6000 | 0 | 0 |

| Run | Applied Seating Torque (in-lbs) | Inlet Port Press-urized (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|
| | | | | Opening | Closing | |
| 1 | 450 | 6000 | 350 | 30 | 5 | 450 |
| 2 | 450 | 6000 | 375 | 25 | 5 | 450 |
| 3 | 450 | 6000 | 350 | 25 | 5 | 450 |
| 4 | 450 | 6000 | 400 | 25 | 5 | 450 |
| 5 | 450 | 6000 | 400 | 25 | 5 | 450 |

Table 7-11. Functional Test Data After 50 Cycles

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 450 | 6000 | 0 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|
| | | | | Opening | Closing | |
| 1 | 500 | 6000 | 475 | 35 | 5 | 535 |
| 2 | 525 | 6000 | 500 | 35 | 5 | 525 |
| 3 | 525 | 6000 | 500 | 35 | 5 | 525 |
| 4 | 525 | 6000 | 500 | 35 | 5 | 525 |
| 5 | 525 | 6000 | 500 | 35 | 5 | 525 |

Note: No Leakage.

Table 7-12. Functional Test Data After 100 Cycles

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 550 | 6000 | 0 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|
| | | | | Opening | Closing | |
| 1 | 550 | 6000 | 500 | 40 | 5 | 550 |
| 2 | 550 | 6000 | 550 | 40 | 5 | 550 |
| 3 | 550 | 6000 | 550 | 40 | 5 | 550 |
| 4 | 550 | 6000 | 550 | 40 | 5 | 550 |
| 5 | 550 | 6000 | 550 | 40 | 5 | 550 |

Note: No Leakage.

Table 7-13. Functional Test Data After 500 Cycles

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig | Leakage (scim) |
|---|---|---|---|---|
| 1 | 550 | 6000 | 0 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|
| | | | | Opening | Closing | |
| 1 | 550 | 6000 | 550 | 40 | 5 | 550 |
| 2 | 500 | 6000 | 550 | 40 | 5 | 550 |
| 3 | 550 | 6000 | 550 | 40 | 5 | 550 |
| 4 | 550 | 6000 | 550 | 40 | 5 | 550 |
| 5 | 550 | 6000 | 550 | 40 | 5 | 550 |

Note: No Leakage.

Table 7-14. Functional Test Data After 975 Cycles

| Run | Applied Seating Torque (in-lbs) | Inlet Pressure (psig) | Outlet Pressure (psig) | Leakage (scim) |
|---|---|---|---|---|
| 1 | 850 | 6000 | 0 | 0 |

| Run | Applied Seating Torque (in-lbs) | Specimen Inlet Pressure (psig) | Opening Torque (in-lbs) | Running Torque (in-lbs) | | Closing Torque (in-lbs) |
|---|---|---|---|---|---|---|
| | | | | Opening | Closing | |
| 1 | 750 | 6000 | 750 | 40 | 5 | 750 |
| 2 | 750 | 6000 | 800 | 40 | 5 | 800 |
| 3 | 800 | 6000 | 850 | 40 | 5 | 850 |
| 4 | 850 | 6000 | 850 | 40 | 5 | 850 |
| 5 | 850 | 6000 | 850 | 40 | 5 | 850 |

Note: No leakage. Test was discontinued after 984 cycles due to excessive seat leakage.

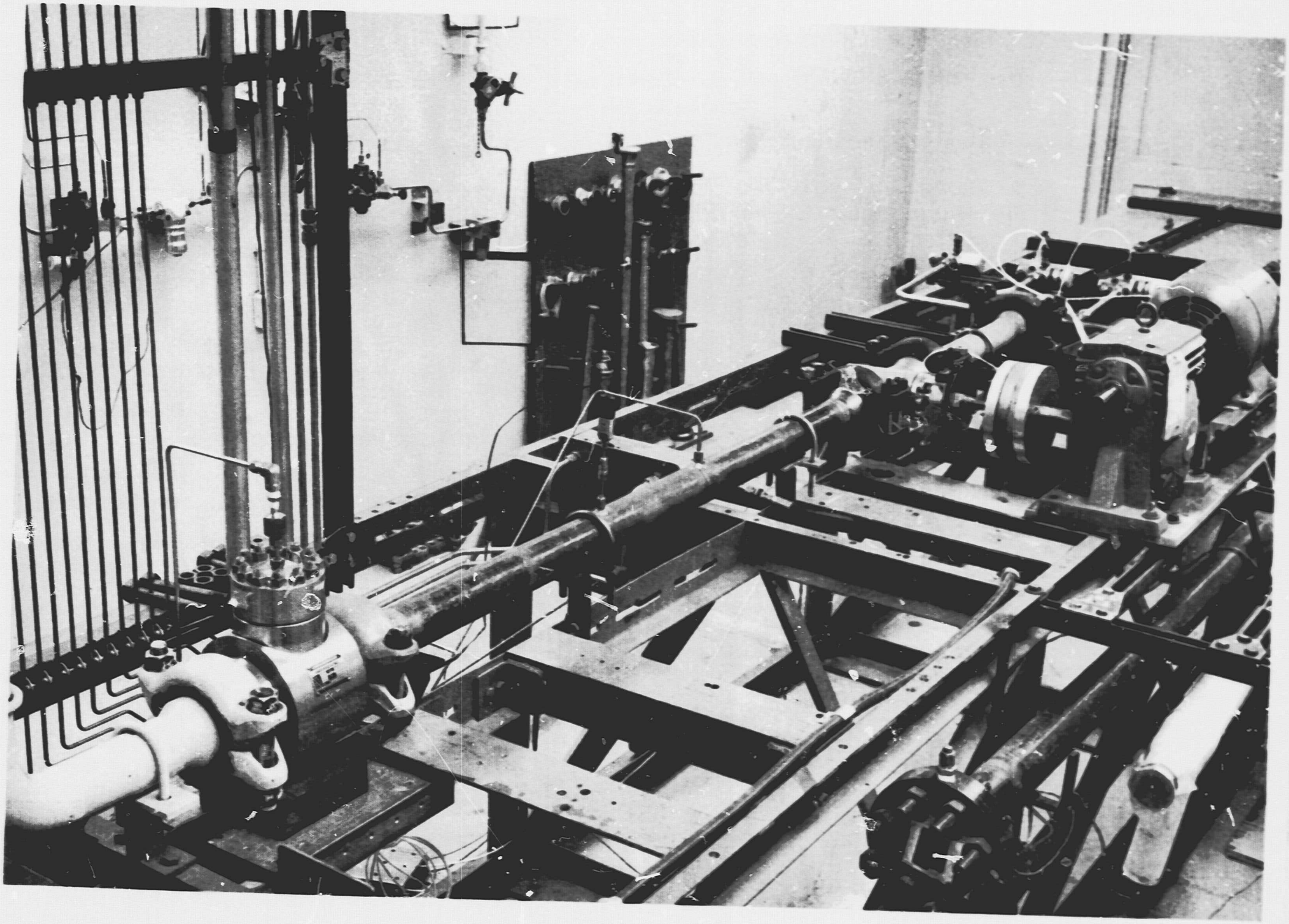


Figure 7-2. Cycle Test Setup

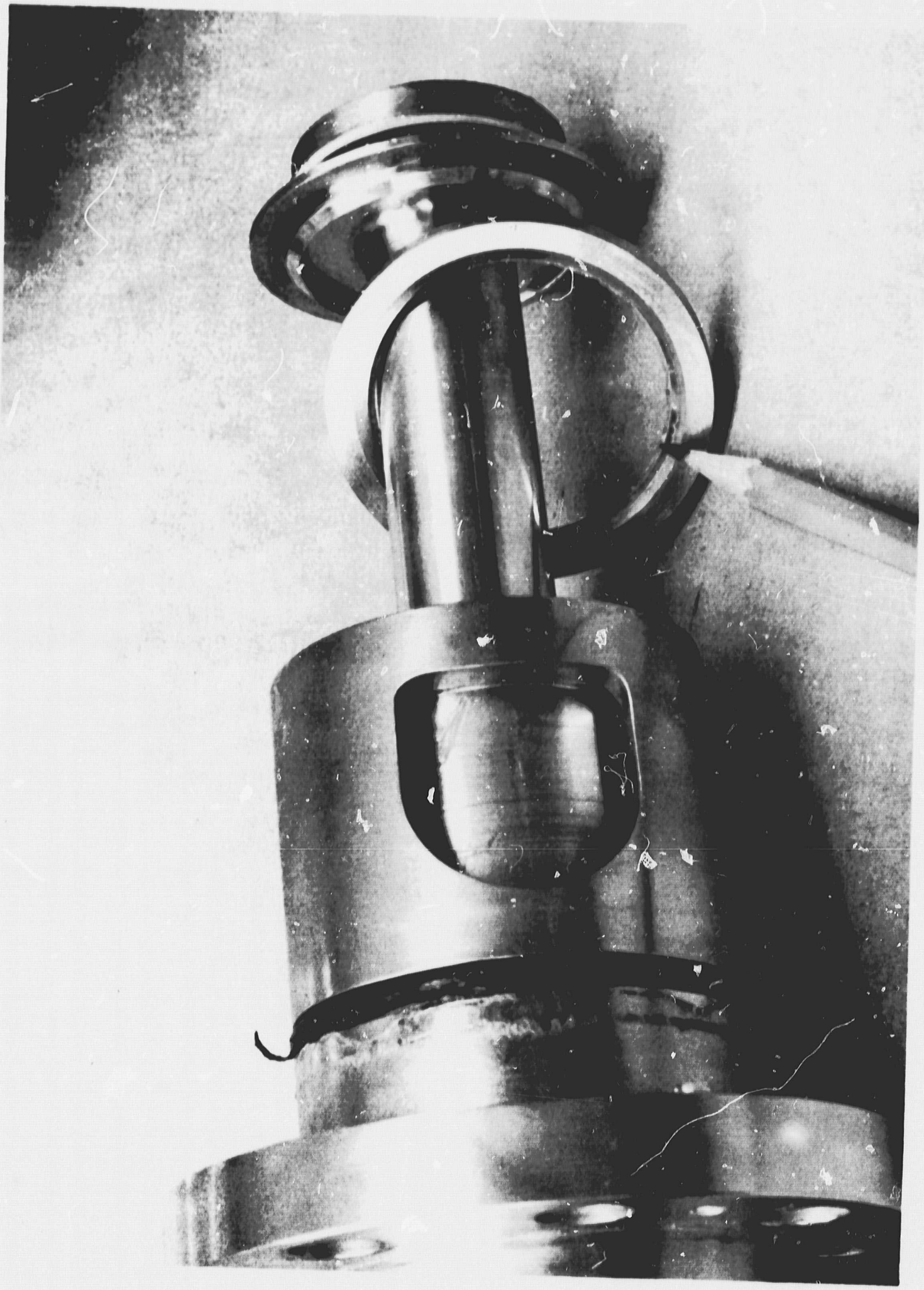


Figure 7-3. Typical Ercded Seat Failure.