ENGINEERING DEPARTMENT
TECHNICAL REPORT
TR-RE-CCSD-PO-1139-3

TEST REPORT
FOR
DUAL BALL SHUTOFF VALVE
Flodyne Controls, Inc., Part Number 5C151
NASA Drawing Number 75K26264

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SPACE DIVISION
CHRYSLER CORPORATION
TEST REPORT

FOR

DUAL BALL SHUTOFF VALVE, ½-INCH, 1500 PSIG, CAM OPERATED

Flodyne Controls Inc. Part Number 5C151

NASA Drawing Number 75K26264

ABSTRACT

This report presents the results of test performed on three specimens of Cam Operated Dual Shutoff Valve 75K26264. The following tests were performed:

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Low Temperature
5. High Temperature
6. Vibration
7. Salt Fog
8. Life Cycle
9. Repeatability
10. Shaft Travel and Ball Rotation
11. Flow
12. Burst

The three Cam Operated Dual Ball Shutoff Valves met the requirements of NASA Drawing 75K26264 and TP-RE-CCSD-FO-1139-2 throughout the test program.
TEST REPORT

FOR

DUAL BALL SHUTOFF VALVE

FLODYNE CONTROLS INC., PART NUMBER 5C151

NASA DRAWING NUMBER 75K26264

April 10, 1968

CHRYSLER CORPORATION SPACE DIVISION, NEW ORLEANS, LOUISIANA
FOREWORD

This document was prepared by Chrysler Corporation Space Division, Michoud Assembly Facility, under Contract NAS 8-4016, Part VII, CWO 271620.
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FO-1139
DUAL BALL
SHUT-OFF VALVE

75K26264, ½-Inch, 1500-Psig, Cam Operated
CHECK SHEET
FOR
DUAL BALL SHUTOFF VALVE

Manufacturer: Flodyne Controls, Inc.
Manufacturer's Part Number: 5C151
NASA Drawing Number: 75K26264
Testing Agency: Chrysler Corporation Space Division, New Orleans, Louisiana
Authorizing Agency: NASA-KSC

I. FUNCTIONAL REQUIREMENTS:
   A. Operating Medium: MIL-H-5606
   B. Operating Pressure: 1500 psig
   C. Leakage at 1500 psig: External – None
      Internal – 5 cc per minute each side
   D. Actuation Force at 1500 psig: 550 pounds max

II. CONSTRUCTION:
   A. Body: Series 300 Stainless Steel
   B. Seals: Teflon

III. ENVIRONMENTAL REQUIREMENTS:
   Operating Temperature Range: -65 to +160°F

IV. LOCATION AND USE:
The valve is used as a braking device in the swing arm 1, 2, 3, and 4 systems.
**TEST SUMMARY**

**DUAL BALL SHUTOFF VALVE, \( \frac{1}{2} \)-INCH, 1500 PSIG, CAM OPERATED**

75K26264

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<td>3000 Psig</td>
<td>Check for leakage and distortion.</td>
<td>Satisfactory</td>
<td>No leakage or distortion.</td>
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<td>Functional Test</td>
<td>3</td>
<td>1500 Psig at 10 GPM</td>
<td>Determine closing force and leakage.</td>
<td>Satisfactory</td>
<td>Closing force in limits and no leakage.</td>
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<td>+25°F (+0, -4°F)</td>
<td>Determine if specimen operation is impaired by low temperature.</td>
<td>Satisfactory</td>
<td></td>
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<td>High Temperature Test</td>
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<td>125°F (+450°F)</td>
<td>Determine if specimen operation is impaired by high temperature.</td>
<td>Satisfactory</td>
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<td>Vibration: Sinusoidal</td>
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<td>10 to 18 cps @ 0.3 inches D.A.</td>
<td>Test for leakage and operation under sinusoidal vibration.</td>
<td>Satisfactory</td>
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<td></td>
<td>2</td>
<td>18 to 48 cps @ 5.0g peak</td>
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<td>48 to 90 cps @ 0.05 inches D.A.</td>
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<td>90 to 2000 cps @ 20.0g peak</td>
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<td>10 to 1000 cps @ 0.35g 2/cps</td>
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<td>2</td>
<td>1000 to 2000 cps @ -6 db/ octave</td>
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<td>240 (+ 2) hours exposure to atomized salt solution.</td>
<td>Determine if specimen operation is impaired by salt fog.</td>
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<td>5000 cycles</td>
<td>Determine if specimen operation is impaired by cycling.</td>
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<td>2500 cycles</td>
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<td>To measure the shaft travel required to flow and determine the variance between actuation cycles.</td>
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<td>Shaft Travel and Ball Rotation Test</td>
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<td>To correlate the degrees of ball rotation with shaft travel from 0 to .550 inches.</td>
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<td>Flow Test</td>
<td>1</td>
<td>NA</td>
<td>To correlate the flow rate at a ΔP of 1500 psig with actuator shaft position.</td>
<td>Satisfactory</td>
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<td>Burst Test</td>
<td>2</td>
<td>Valve open - 4500 psig for 5 min. Valve closed - 1500 psig for 5 min., then, 4500 psig for 5 min.</td>
<td>To determine if specimen will maintain burst pressure without leakage.</td>
<td>Satisfactory</td>
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SECTION I
INTRODUCTION

1.1 SCOPE

1.1.1 This procedure describes the tests to be performed to determine if Dual Ball Shutoff Valve 75K26264 meets the operational and environmental requirements for the John F. Kennedy Space Center Launch Complexes 34 and 37B. A summary of the test results is presented on pages xii and xiii.

1.1.2 Three valves shall be tested. Table 1-1 lists the tests to be performed and the test media.

1.2 ITEM DESCRIPTION

Dual Ball Shutoff Valve 75K26264 is manufactured by Flodyne Controls, Inc. as vendor part number 5C151. The valve has separate cavities with an operating pressure of 1500 psig. Operating media is MIL-H-5606 hydraulic fluid. The valve measures 7.5 by 4.0 by 7.8 inches.

1.3 APPLICABLE DOCUMENTS

1.3.1 The following documents contain the test requirements for Dual Ball Shutoff Valve 75K26264.

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

b. NASA Drawing 75K26264

c. Cleaning Standard MSFC-STD-164

d. Test Plan CCSD-FO-1139-1

e. Test Procedure TP-RE-CCSD-FO-1139-2
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<td>1 2 3</td>
</tr>
<tr>
<td>Receiving Inspection</td>
<td>II</td>
<td></td>
<td>X X X</td>
</tr>
<tr>
<td>Proof Pressure</td>
<td>III</td>
<td>Hydraulic Fluid</td>
<td>X X X</td>
</tr>
<tr>
<td>Functional</td>
<td>IV</td>
<td>Hydraulic Fluid</td>
<td>X X</td>
</tr>
<tr>
<td>Low Temperature</td>
<td>V</td>
<td>Hydraulic Fluid</td>
<td>X X</td>
</tr>
<tr>
<td>High Temperature</td>
<td>VI</td>
<td>Hydraulic Fluid</td>
<td>X X</td>
</tr>
<tr>
<td>Vibration</td>
<td>VII</td>
<td>Hydraulic Fluid</td>
<td>X X</td>
</tr>
<tr>
<td>Salt Fog</td>
<td>VIII</td>
<td></td>
<td>X X</td>
</tr>
<tr>
<td>Life Cycle</td>
<td>IX</td>
<td>Hydraulic Fluid</td>
<td>X X X</td>
</tr>
<tr>
<td>Repeatability</td>
<td>X</td>
<td>Hydraulic Fluid</td>
<td>X X X</td>
</tr>
<tr>
<td>Shaft Travel and Ball Rotation</td>
<td>XI</td>
<td></td>
<td>X X X</td>
</tr>
<tr>
<td>Flow</td>
<td>XII</td>
<td>Hydraulic Fluid</td>
<td>X</td>
</tr>
<tr>
<td>Burst</td>
<td>XIII</td>
<td>Hydraulic Fluid</td>
<td>X X</td>
</tr>
</tbody>
</table>
SECTION II

RECEIVING INSPECTION

2.1 TEST REQUIREMENTS

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

2.2 TEST PROCEDURE

A visual and dimensional inspection was performed on each specimen to determine compliance with NASA Specification 75K26264 Flodyne Controls, Inc. drawing number 5C151 to the extent possible without disassembling the specimen. At the same time the specimen was also inspected for poor workmanship and manufacturing defects.

2.3 TEST RESULTS

The three specimens complied with NASA drawing 75K26264 and Flodyne Controls, Inc. drawing number 5C151. No evidence of poor workmanship or manufacturing defects were observed.

2.4 TEST DATA

The data presented in table 2-1 were recorded during the receiving inspection.
<table>
<thead>
<tr>
<th>Name</th>
<th>Flodyne Controls Inc. Cam Operated Dual Ball Shutoff Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Normally Open</td>
</tr>
<tr>
<td>Flodyne P/N</td>
<td>5C151</td>
</tr>
<tr>
<td>Flodyne S/N</td>
<td>1 (Specimen 1)</td>
</tr>
<tr>
<td></td>
<td>4 (Specimen 2)</td>
</tr>
<tr>
<td></td>
<td>9 (Specimen 3)</td>
</tr>
<tr>
<td>Service Fluid</td>
<td>Hydraulic Fluid MIL-H-5606</td>
</tr>
<tr>
<td>Material</td>
<td>Series 300 Stainless Steel</td>
</tr>
<tr>
<td>Operating Pressure</td>
<td>1500 Psig</td>
</tr>
<tr>
<td>Customer Specification</td>
<td>75K26264</td>
</tr>
</tbody>
</table>
SECTION III
PROOF PRESSURE TEST

3.1 TEST REQUIREMENTS
Each specimen shall be pressurized with MIL-H-5606 hydraulic fluid to a proof pressure of 3000 psig. This pressure shall be maintained for 5 minutes and the specimen shall be checked for external leakage and distortion.

3.2 TEST PROCEDURE
3.2.1 The test specimen was installed as shown in figures 3-1, 3-2 and 3-3 utilizing the equipment listed in table 3-1.
3.2.2 It was determined that all connections were tight, gages were installed and operating properly, and all valves were closed.
3.2.3 Hand valves 3 and 5 were opened.
3.2.4 Using hand pump 2, MIL-H-5606 hydraulic fluid was pumped through the test setup until the system and specimen were free of air.
3.2.5 Hand valve 5 was closed and using hand pump 2, the specimen was pressurized until a 3000 psig was indicated by gage 4. This pressure was maintained for 5 minutes while the specimen was checked for external leakage and distortion. The pressure was then vented.
3.2.6 All data were recorded.

3.3 TEST RESULTS
The test specimens successfully completed the proof pressure test. No external leakage or distortion was noted.

3.4 TEST DATA
The data recorded during the proof pressure tests are presented in table 3-2.
Table 3-1. Proof Pressure Test Equipment List

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model/Part No.</th>
<th>Serial No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specimen</td>
<td>Flodyne Controls Inc.</td>
<td>5C151</td>
<td>1, 4, 9</td>
<td>Dual Ball Valve</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>½-Inch 1500 psig</td>
</tr>
<tr>
<td>2</td>
<td>Hand Pump</td>
<td>Wm. S. Pine, Inc.</td>
<td>160-3</td>
<td></td>
<td>0 to 5000 psig</td>
</tr>
<tr>
<td>3</td>
<td>Hand Valve</td>
<td>Robbin Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-Inch</td>
</tr>
<tr>
<td>4</td>
<td>Pressure Gage</td>
<td>Marsh Inst.</td>
<td>NA</td>
<td>95-1184B</td>
<td>0 to 10000 psig</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>± 0.1% FS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cal date 11-28-67</td>
</tr>
<tr>
<td>5</td>
<td>Hand Valve</td>
<td>Robbin Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-Inch</td>
</tr>
</tbody>
</table>

Table 3-2. Proof Pressure Test Data, All Specimens

<table>
<thead>
<tr>
<th>Test Media</th>
<th>MIL-H-5606</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>3000 psig</td>
</tr>
<tr>
<td>Duration</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Leakage</td>
<td>None</td>
</tr>
<tr>
<td>Distortion</td>
<td>None</td>
</tr>
</tbody>
</table>
Note: All lines \( \frac{1}{4} \)-Inch
Refer to table 3-1 for item identification.

Figure 3-1. Proof Pressure Test Schematic
Figure 3-2. Proof Pressure and Burst Test Setup
SECTION IV

FUNCTIONAL TEST

4.1 TEST REQUIREMENTS

4.1.1 A functional test shall be conducted on each specimen to determine the force required to close the specimen and to determine the leakage.

4.1.2 Using MIL-H-5606 hydraulic fluid as the pressure medium, establish 10 gpm flow at 1500 psig through the specimen. Close the specimen and measure the closing force. The closing force shall not exceed 550 lbs.

4.1.3 With the specimen closed, pressurize one side to 1500 psig. Measure leakage at the outlet.

4.2 TEST PROCEDURE

4.2.1 The specimen was installed as shown in figures 4-1 and 4-2 utilizing the equipment listed in table 4-1.

4.2.2 It was determined that all connections were tight, all gages were installed and operating properly, and all valves were closed.

4.2.3 Pump 2 was started and the outlet pressure, as indicated by gage 3, was adjusted to 1500 psig. Hand valves 6 and 7 were slowly opened until an operating medium flow of 10 gpm was indicated by flowmeters 4 and 5.

4.2.4 Hand valve 20 and solenoid valve 9 were opened, and regulator 10 was adjusted until the specimen closed. The closing pressure, indicated by pressure gage 18, was monitored and then converted to force.

4.2.5 Hand valves 6 and 7 were closed. Hand valves 13 and 14 were opened and the internal leakage was measured by graduated cylinders 15 and 16.

4.2.6 Hand valves 13 and 14 were closed. Solenoid valve 9 was actuated and cylinder 8 vented. Pump 2 was then shut down.

4.2.7 The specimen was installed in reverse to that shown in figure 4-1, thus the flow through the specimen was reversed. Steps 4.2.3 through 4.2.6 were repeated.

4.2.8 All test data were recorded.
4.3 TEST RESULTS

All three test specimens successfully met the functional test requirements.

4.4 TEST DATA

Data recorded during the functional test are presented in tables 4-2 through 4-4.
Table 4-1. Functional, Temperature, and Life Cycle Test Equipment List

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model Part No.</th>
<th>Serial No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specimen</td>
<td>Flodyne Controls, Inc.</td>
<td>5C151</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pump</td>
<td>Denison Eng. Corp.</td>
<td>PV08-035-51 L-02</td>
<td>3833</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pressure Gage</td>
<td>Marsh Inst. Co.</td>
<td>NA</td>
<td>95-1184B</td>
<td>0 to 3000 psig</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cal. date 11-28-67</td>
</tr>
<tr>
<td>4</td>
<td>Flowmeter</td>
<td>Cox</td>
<td>AN-12</td>
<td>019167</td>
<td>0 to 30 GPM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cal. date 1-25-68</td>
</tr>
<tr>
<td>5</td>
<td>Flowmeter</td>
<td>Waugh</td>
<td>FL-12-S11</td>
<td>106-1030- B</td>
<td>0 to 20 GPM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cal. date 11-4-67</td>
</tr>
<tr>
<td>6</td>
<td>Hand Valve</td>
<td>Vacco Valve Co.</td>
<td>NV-6P-403-2</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>7</td>
<td>Hand Valve</td>
<td>Vacco Valve Co.</td>
<td>NV-6P-403-2</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>8</td>
<td>Cylinder</td>
<td>Parker-Hannfin</td>
<td>CC-2AS14C</td>
<td>F-95985</td>
<td>2-inch bore</td>
</tr>
<tr>
<td>9</td>
<td>Solenoid Valve</td>
<td>Marotta Valve Co.</td>
<td>MV-714V</td>
<td>824</td>
<td>¼-inch</td>
</tr>
<tr>
<td>10</td>
<td>Regulator</td>
<td>Grove Valve &amp; Regulator Co.</td>
<td>15-LXH</td>
<td>L-41407</td>
<td>0 to 3000 psig</td>
</tr>
<tr>
<td>11</td>
<td>Hand Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>¼-inch</td>
</tr>
<tr>
<td>12</td>
<td>Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Hand Valve</td>
<td>Grove Valve Co.</td>
<td>M-149-18B</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>14</td>
<td>Hand Valve</td>
<td>Grove Valve Co.</td>
<td>M-149-18B</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>15</td>
<td>Graduated Cylinders</td>
<td>CCSD</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Graduated Cylinders</td>
<td>CCSD</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Pressure Gage</td>
<td>Acco Helicoid</td>
<td>NA</td>
<td>200506-AA</td>
<td>0 to 500 psig</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cal. date 9-26-67</td>
</tr>
<tr>
<td>18</td>
<td>Pressure Gage</td>
<td>Ashcroft Corp.</td>
<td>NA</td>
<td>95-1403</td>
<td>0 to 200 psig</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cal. date 10-14-67</td>
</tr>
<tr>
<td>19</td>
<td>Timer</td>
<td>Cramer Controls</td>
<td>540</td>
<td>3336A</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Hand Valve</td>
<td>Grove Valve Co.</td>
<td>10983KA2A</td>
<td>NA</td>
<td>¼-inch</td>
</tr>
</tbody>
</table>

4-3
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model Part No.</th>
<th>Serial No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Solenoid Valve</td>
<td>Marotta Valve Co.</td>
<td>MV-74</td>
<td>739</td>
<td>½-inch</td>
</tr>
<tr>
<td>22</td>
<td>Pressure Transducer</td>
<td>CEC</td>
<td>4-350-0001</td>
<td>95-1122-B</td>
<td>0 to 3000 psig</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cal. date 11-15-67</td>
</tr>
<tr>
<td>23</td>
<td>Pressure Transducer</td>
<td>CEC</td>
<td>4-350-0001</td>
<td>95-1119B</td>
<td>0 to 3000 psig</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cal. date 11-6-67</td>
</tr>
<tr>
<td>24</td>
<td>Temperature Chamber</td>
<td>CCSD</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Thermotron</td>
<td>Thermotron Inc.</td>
<td>NA</td>
<td>200895-13</td>
<td>-100 to +400°F</td>
</tr>
<tr>
<td>26</td>
<td>Thermocouple</td>
<td>Honeywell</td>
<td>728097-004</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>
**Table 4-2. Initial Functional Test Data**

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>271</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>272</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

**Table 4-3. Initial Functional Test Data**

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>278</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>262</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

**Table 4-4. Initial Functional Test Data**

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>292</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>301</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
SECTION V

LOW TEMPERATURE TEST

5.1 TEST REQUIREMENTS

5.1.1 A low temperature test shall be conducted on two test specimens to determine whether the environment caused degradation or deformation.

5.1.2 The rated low temperature shall be +25°F (+0, -4°F). The maximum temperature change rate shall be 1°F per minute.

5.1.3 A functional test shall be conducted during this test after which the chamber shall be returned to ambient conditions.

5.1.4 A functional test and a visual inspection shall be conducted within one hour after returning the chamber to ambient conditions.

5.2 TEST PROCEDURE

5.2.1 Specimens number 1 and 2 were placed in a temperature chamber as shown in figures 4-1, 4-2 and 5-1, utilizing the equipment listed in table 4-1.

5.2.2 The chamber was controlled to the specified test conditions of +25°F (+0, -4°F) and a relative humidity of between 60 and 90 percent was maintained.

5.2.3 A functional test was conducted when the specimen temperature stabilized.

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

5.2.5 Each of the two specimens were visually inspected and functionally tested within 1 hour following the establishment of ambient conditions.

5.2.6 All test data were recorded.

5.3 TEST RESULTS

The specimens, number 1 and 2, successfully met the requirements of the low temperature test.

5.4 TEST DATA

The data presented in tables 5-1, 5-2, 5-3, and 5-4 were recorded during the low temperature test.
Table 5-1. Functional Test Data Obtained During Low Temperature Test

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage Int</th>
<th>Leakage Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>275</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>275</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 5-2. Functional Test Data Obtained After Low Temperature Test

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage Int</th>
<th>Leakage Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>255</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>260</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 5-3. Functional Test Data Obtained During Low Temperature Test

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage Int</th>
<th>Leakage Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>275</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>265</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 5-4. Functional Test Data Obtained After Low Temperature Test

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage Int</th>
<th>Leakage Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>270</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>275</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
SECTION VI
HIGH TEMPERATURE TEST

6.1 TEST REQUIREMENTS

6.1.1 A high temperature test shall be conducted on two test specimens to
determine whether the environment caused degradation or deformation.

6.1.2 The rated high temperature shall be 125°F (+4, -0°F). The maximum
temperature change rate shall be 1° per minute.

6.1.3 A functional test shall be conducted during this test after which
the chamber shall be returned to ambient conditions.

6.1.4 A functional test and a visual inspection shall be conducted within
one hour after returning the chamber to ambient conditions.

6.2 TEST PROCEDURE

6.2.1 Specimens number 1 and 2 were placed in a temperature chamber as shown
in figures 4-1, 4-2 and 5-1, utilizing the equipment listed in table
4-1.

6.2.2 The chamber was controlled to the specified test conditions of +125°F
(+4, -0°F) and a relative humidity of between 60 and 90 percent was
maintained.

6.2.3 A functional test was conducted when the specimen temperature stabilized.

6.2.4 The chamber temperature was returned to ambient conditions upon comple-
tion of the functional test.

6.2.5 Each of the two specimens were visually inspected and functionally
tested within 1 hour following the establishment of ambient conditions.

6.2.6 All test data were recorded.

6.3 TEST RESULTS

The specimens, number 1 and 2, successfully met the requirements of the
high temperature test.

6.4 TEST DATA

The data presented in tables 6-1, 6-2, 6-3, and 6-4 were recorded during
the high temperature test.
Table 6-1. Functional Test Data Obtained During High Temperature Test

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>260</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>255</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 6-2. Functional Test Data Obtained After High Temperature Test

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>260</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>252</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 6-3. Functional Test Data Obtained During High Temperature Test

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>315</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>302</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 6-4. Functional Test Data Obtained After High Temperature Test

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>322</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>MIL-H-5606</td>
<td>1500</td>
<td>10</td>
<td>320</td>
<td>None</td>
</tr>
</tbody>
</table>
SECTION VII
VIBRATION TEST

7.1 TEST REQUIREMENTS

7.1.1 A vibration test shall be conducted on two test specimens in accordance with section 9 of KSC-STD-164(D), to the levels specified in GP-320, zone 3.2.1.

7.1.2 Each of the two specimens shall be subjected to sinusoidal and random vibration along three mutually perpendicular axes. The specimens shall be actuated in the final seconds of vibration in the Y axis.

7.1.3 A functional test shall be conducted on the specimens upon completion of the sinusoidal and random vibration along each axis.

7.2 TEST PROCEDURE

7.2.1 Specimens number 2 and 3 were installed on a vibration exciter as shown in figure 7-1 to permit vibration to be applied along the X axis (see figure 7-2).

7.2.3 Hand valve 4 was opened and using hand pump 5 the specimens were pressurized to 1500 psig as indicated by pressure gage 3. The specimens were subjected to sinusoidal and random excitation.

7.2.4 Sinusoidal Sweep

7.2.4.1 Specimens number 1 and 2 were subjected to sinusoidal vibration by scanning the frequency range logarithmically from 10 to 2000 cps and from 2000 to 10 cps for a test period of 20 minutes (10 minutes up and 10 minutes back). The vibration levels were as follows:

- 10 to 18 cps @ 0.3 Inches D.A.
- 18 to 48 cps @ 5.0g Peak
- 48 to 90 cps @ 0.05 Inches D.A.
- 90 to 2000 cps @ 20.0g Peak

7.2.4.2 A functional test was conducted on the specimens upon completion of the sinusoidal scan.

7.2.5 Random Excitation

7.2.5.1 Specimens number 1 and 2 were subjected to random vibration over the frequency range of 10 to 2000 cps for a period of five minutes. The vibration levels were as follows:

- 10 to 1000 cps @ 0.35g²/cps
- 1000 to 2000 cps @ -6 dB/octave
7.2.5.2 A functional test was conducted on the specimens upon completion of random vibration.

7.2.6 Each of the two specimens was subjected to vibration along each of the remaining two mutually perpendicular axes in accordance with subparagraphs 7.2.4 and 7.2.5. Each specimen was actuated during the final seconds of vibration in the Y axis.

7.3 TEST RESULTS

The specimens, number 2 and 3, successfully withstood vibration testing in the three mutually perpendicular axes.

7.4 TEST DATA

7.4.1 Typical control accelerometer plots, as recorded during the test, are presented in figures 7-5 and 7-6.

7.4.2 The functional test data, recorded during and after the vibration tests, are presented in tables 7-2 through 7-15.
Table 7-1. Vibration Test Equipment List

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model Part No.</th>
<th>Serial No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Test Specimen</td>
<td>Flodyne</td>
<td>5C151</td>
<td>4 and 9</td>
<td>Dual Ball Valve</td>
</tr>
<tr>
<td>2</td>
<td>Vibration Exciter System</td>
<td>MB Electronics</td>
<td>C-210</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pressure Gage</td>
<td>Marsh Instrument</td>
<td>NA</td>
<td>95-1184B</td>
<td>0 to 3000 psig Cal. date 11-28-67</td>
</tr>
<tr>
<td>4</td>
<td>Hand Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>¼-inch</td>
</tr>
<tr>
<td>5</td>
<td>Hand Pump</td>
<td>Wm. S. Pine Inc.</td>
<td>160-3</td>
<td>NA</td>
<td>0 to 5000 psig</td>
</tr>
<tr>
<td>6</td>
<td>Cylinder</td>
<td>Parker-Hannfin</td>
<td>CC-2AS14C</td>
<td>F-95986</td>
<td>2-inch bore</td>
</tr>
<tr>
<td>7</td>
<td>Gage</td>
<td>Ashcroft Corp.</td>
<td>NA</td>
<td>95-1403</td>
<td>0 to 200 psig Cal. date 10-14-67</td>
</tr>
<tr>
<td>8</td>
<td>Regulator</td>
<td>Oxweld Inc.</td>
<td>R-89</td>
<td>NA</td>
<td>0 to 3000 psig</td>
</tr>
<tr>
<td>9</td>
<td>GN₂ Supply</td>
<td>Air Products</td>
<td>NA</td>
<td>NA</td>
<td>0 to 2000 psig</td>
</tr>
</tbody>
</table>
### Table 7-2. Post Sinusoidal Sweep "X" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>285</td>
<td>None None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>260</td>
<td>None None</td>
</tr>
</tbody>
</table>

### Table 7-3. Post Random Vibration "X" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>285</td>
<td>None None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>290</td>
<td>None None</td>
</tr>
</tbody>
</table>

### Table 7-4. Post Sinusoidal Sweep "Z" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>288</td>
<td>None None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>290</td>
<td>None None</td>
</tr>
</tbody>
</table>

### Table 7-5. Post Random Vibration "Z" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>290</td>
<td>None None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>295</td>
<td>None None</td>
</tr>
</tbody>
</table>
### Table 7-6. Post Sinusoidal Sweep "Y" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>295</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>300</td>
<td>None</td>
</tr>
</tbody>
</table>

### Table 7-7. Post Random Vibration "Y" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>297</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>302</td>
<td>None</td>
</tr>
</tbody>
</table>

### Table 7-8. Data Obtained During Random Vibration "Y" Axis

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>0</td>
<td>297</td>
<td>None</td>
</tr>
</tbody>
</table>

7-5.
### Table 7-9. Post Sinusoidal Sweep "X" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>290</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>290</td>
<td>None</td>
</tr>
<tr>
<td></td>
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<td>None</td>
</tr>
</tbody>
</table>

### Table 7-10. Post Random Vibration "X" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>302</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>300</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

### Table 7-11. Post Sinusoidal Sweep "Z" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>302</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>300</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

### Table 7-12. Post Random Vibration "Z" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>297</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>302</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>
### Table 7-13. Post Sinusoidal Sweep "Y" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>300</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>302</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

### Table 7-14. Post Random Vibration "Y" Axis Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>302</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>308</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

### Table 7-15. Data Obtained During Random Vibration "Y" Axis

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>0</td>
<td>302</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Note: All lines \( \frac{1}{4} \)-inch.

Refer to table 7-1 for item identification.

Figure 7-1. Vibration Test Schematic (X and Y Axis)
Figure 7-2. Vibration Axes
Figure 7-3. Vibration Setup For X and Z Axes
Figure 7-6. Typical Random Vibration Plot - Control Accelerometer
SECTION VIII
SALT FOG TEST

8.1 TEST REQUIREMENTS

8.1.1 A salt fog test shall be conducted on two specimens to determine the resistance of the specimens to a salt atmosphere.

8.1.2 The salt fog test shall be performed in accordance with KSC-STD-164(D), section 17.

8.1.3 Each of the two specimens shall be exposed to the salt fog for 240 hours (+2 hours). The inlet and outlet ports of the specimens shall be capped during exposure to the salt atmosphere.

8.1.4 A functional test as specified in section IV shall be conducted upon completion of the salt fog test.

8.2 TEST PROCEDURE

8.2.1 Prior to the salt fog test, specimens number 2 and 3, each was visually inspected for corrosion, dirt, and oily films. All unnecessary oil films and dirt particles were removed, and spots of corrosion were noted.

8.2.2 With the inlet and outlet ports capped, each specimen was placed in the salt fog chamber as shown in figure 8-1 and listed in table 8-1. The chamber was adjusted to a temperature of 95°F so that the clean fog-collecting receptacle in the exposure zone could collect from 0.5 to 3 milliliters of solution per hour for 80 square centimeters of horizontal collecting area. This condition was maintained for 240 hours.

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

8.2.4 One hour after returning the specimens to room ambient conditions, a functional test was performed. All test data were recorded.

8.3 TEST DATA

Functional test data, recorded after the salt fog test, are presented in tables 8-2 and 8-3.
Table 8-1. Salt Fog Test Equipment List

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model Part No.</th>
<th>Serial No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Test Specimen</td>
<td>Flodyne, Inc.</td>
<td>5C151</td>
<td>4 and 9</td>
<td>Dual Ball Valve</td>
</tr>
<tr>
<td>2</td>
<td>Salt Fog Chamber</td>
<td>Industrial Filter</td>
<td>NA</td>
<td>53832</td>
<td>As Specified in KSC-STD-164(D)</td>
</tr>
</tbody>
</table>
### Table 8-2. Post Salt Fog Test Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>302</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>308</td>
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<td></td>
</tr>
</tbody>
</table>

### Table 8-3. Post Salt Fog Test Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>308</td>
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</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
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<td>10</td>
<td>316</td>
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</tr>
</tbody>
</table>
SECTION IX
LIFE CYCLE TEST

9.1 TEST REQUIREMENTS

9.1.1 A cycle test shall be conducted on the test specimens using MIL-H-5606 hydraulic fluid as the operating medium. Each specimen shall be cycled from full open to full closed position for 5000 cycles. Full open to full closed to full open shall constitute one cycle.

9.1.2 A functional test as specified in section IV shall be conducted after 50, 100, 500, 1000, 2000, 3000, 4000, 5000 cycles.

9.2 TEST PROCEDURE

9.2.1 Each specimen was installed in the life cycle setup as shown in figures 4-1, 9-1 and 9-2, utilizing the equipment listed in table 4-1.

9.2.2 It was determined that all connections were tight, all gages were installed and working properly, and all valves were closed.

9.2.3 Pump 2 was started and the pump discharge pressure was adjusted to 1500 psig as indicated by gage 3.

9.2.4 Hand valves 6 and 7 were adjusted until a hydraulic flow of 10 gpm was indicated on flowmeters 4 and 5.

9.2.5 Regulator 10, solenoid valves 9 and 21 and hand valves 11 and 20 were opened.

9.2.6 Hand valves 11 and 20 and regulator 10 were adjusted until a specimen closing rate of zero to 80 percent within 3.5 seconds and 80 percent to 100 percent within 0.5 seconds was attained.

9.2.7 Cycle timer 19 was adjusted until the proper sequencing of solenoid valves 9 and 21 was accomplished.

9.2.8 The rotation of the specimen from full open to full closed to full open constitutes one cycle.

9.2.9 5000 cycles were performed on specimen 1 with functional tests conducted after 50, 100, 500, 1000, 2000, 3000, 4000 and 5000 cycles. 2500 cycles were performed on specimen number 2 and 3 with functional tests conducted after 50, 100, 500, 1000, 1500, 2000 and 2500 cycles.

9.2.10 During the cycle tests, pressure at the specimen inlet was recorded by using transducers 22 and 23.

9-1
9.3 TEST RESULTS

The specimens successfully withstood the cycle test.

9.4 TEST DATA

9.4.1 Functional test data, recorded during the test, are presented in tables 9-1 through 9-23.

9.4.2 A typical surge waveform, recorded at specimen inlet, is presented in figure 9-3.
### Table 9-1. Pre-Cycle Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage Int</th>
<th>Leakage Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
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<td>265</td>
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</table>

### Table 9-2. Post-50 Cycle Functional Test Data

<table>
<thead>
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<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage Int</th>
<th>Leakage Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>270</td>
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<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>275</td>
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### Table 9-3. Post-100 Cycles Functional Test Data

<table>
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<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage Int</th>
<th>Leakage Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
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<td>None</td>
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<tr>
<td>Outlet</td>
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### Table 9-4. Post-500 Cycle Functional Test Data

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<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage Int</th>
<th>Leakage Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
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<td>10</td>
<td>270</td>
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<td>None</td>
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<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>275</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Table 9-5. Post-1000 Cycles Functional Test Data

| Flow Direction | Test Media | Pressure (Psig) | Flow (Gpm) | Closing Force (Pounds) | Leakage | | | |
|----------------|------------|-----------------|------------|------------------------|---------| | | |
| Inlet          | Mil-H-5606 | 1500            | 10         | 280                    | None    | None |
| Outlet         | Mil-H-5606 | 1500            | 10         | 275                    | None    | None |

Table 9-6. Post-2000 Cycles Functional Test Data

| Flow Direction | Test Media | Pressure (Psig) | Flow (Gpm) | Closing Force (Pounds) | Leakage | | | |
|----------------|------------|-----------------|------------|------------------------|---------| | | |
| Inlet          | Mil-H-5606 | 1500            | 10         | 290                    | None    | None |
| Outlet         | Mil-H-5606 | 1500            | 10         | 285                    | None    | None |

Table 9-7. Post-3000 Cycles Functional Test Data

| Flow Direction | Test Media | Pressure (Psig) | Flow (Gpm) | Closing Force (Pounds) | Leakage | | | |
|----------------|------------|-----------------|------------|------------------------|---------| | | |
| Inlet          | Mil-H-5606 | 1500            | 10         | 290                    | None    | None |
| Outlet         | Mil-H-5606 | 1500            | 10         | 285                    | None    | None |

Table 9-8. Post-4000 Cycles Functional Test Data

| Flow Direction | Test Media | Pressure (Psig) | Flow (Gpm) | Closing Force (Pounds) | Leakage | | | |
|----------------|------------|-----------------|------------|------------------------|---------| | | |
| Inlet          | Mil-H-5606 | 1500            | 10         | 325                    | None    | None |
| Outlet         | Mil-H-5606 | 1500            | 10         | 322                    | None    | None |
Table 9-9. Post-5000 Cycles Functional Test Data

<table>
<thead>
<tr>
<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
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<tbody>
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</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
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<td>10</td>
<td>325</td>
<td>None</td>
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</table>

Table 9-10. Post-50 Cycle Functional Test Data

<table>
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<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
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<tr>
<td>Outlet</td>
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Table 9-11. Post-100 Cycles Functional Test Data

<table>
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<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
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<td>252</td>
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<td></td>
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<td></td>
<td>None</td>
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<td>Outlet</td>
<td>Mil-H-5606</td>
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Table 9-12. Post-500 Cycles Functional Test Data

<table>
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<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
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<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
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<td>10</td>
<td>260</td>
<td>None</td>
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</table>
### Table 9-13. Post-1000 Cycles Functional Test Data

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<th>Pressure (Psig)</th>
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<th>Closing Force (Pounds)</th>
<th>Leakage</th>
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### Table 9-14. Post-1500 Cycles Functional Test Data

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<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>260</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
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</table>

### Table 9-15. Post-2000 Cycles Functional Test Data

<table>
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<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
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<td>275</td>
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<tr>
<td>Outlet</td>
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<td>275</td>
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</table>

### Table 9-16. Post-2500 Cycles Functional Test Data

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<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>275</td>
<td>None</td>
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<td>Mil-H-5606</td>
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</table>
### Table 9-17. Post-50 Cycle Functional Test Data

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<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int.</th>
<th>Ext.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>280</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>285</td>
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### Table 9-18. Post-100 Cycles Functional Test Data

<table>
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<th>Flow Direction</th>
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<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int.</th>
<th>Ext.</th>
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<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
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<td>10</td>
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<td>None</td>
<td>None</td>
<td>None</td>
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<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
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<td>10</td>
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### Table 9-19. Post-500 Cycles Functional Test Data

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<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int.</th>
<th>Ext.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
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<td>10</td>
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</table>

### Table 9-20. Post-1000 Cycles Functional Test Data

<table>
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<th>Flow Direction</th>
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<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int.</th>
<th>Ext.</th>
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<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
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<td>10</td>
<td>285</td>
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### Table 9-21. Post-1500 Cycles Functional Test Data

<table>
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<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
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<tbody>
<tr>
<td>Inlet</td>
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<td>None</td>
<td>None</td>
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<td>Outlet</td>
<td>Mil-H-5606</td>
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### Table 9-22. Post-2000 Cycles Functional Test Data

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<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>285</td>
<td>None</td>
<td>None</td>
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<td>10</td>
<td>285</td>
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<td>None</td>
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</tbody>
</table>

### Table 9-23. Post-2500 Cycles Functional Test Data

<table>
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<th>Flow Direction</th>
<th>Test Media</th>
<th>Pressure (Psig)</th>
<th>Flow (Gpm)</th>
<th>Closing Force (Pounds)</th>
<th>Leakage</th>
<th>Int</th>
<th>Ext</th>
</tr>
</thead>
<tbody>
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<td>Outlet</td>
<td>Mil-H-5606</td>
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<td>10</td>
<td>288</td>
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</table>

9-8
Figure 9-2. Life Cycle Test Setup
Figure 9-3. Typical Closing Cycle Pressure Recording At Specimen Inlet
SECTION X

REPEATABILITY TEST

10.1 TEST REQUIREMENTS

10.1.1 A repeatability test shall be conducted on each specimen to determine the minimum shaft travel required to close the specimen. This shall be accomplished by establishing a 10 gpm flow of MIL-H-5606 hydraulic fluid pressurized at 1500 psig, through the specimen. The specimen shall then be closed and the minimum shaft travel required to stop the flow measured.

10.2 TEST PROCEDURE

10.2.1 The specimen was installed as shown in figures 10-1 and 10-2 utilizing the equipment listed in table 10-1. A test reference view is shown in figure 10-3.

10.2.2 It was determined that all connections were tight, all gages were installed and operating properly, and all valves were closed.

10.2.3 Pump 2 was started and the outlet pressure as indicated by gage 3, was adjusted to 1500 psig. Hand valves 6 and 7 were slowly opened until a 10 gpm flow was indicated by flowmeters 4 and 5.

10.2.4 Hand valve 11 and solenoid valve 9 were opened and regulator 10 was adjusted until the specimen closed. Shaft travel, indicated by dial indicator 13 was recorded.

10.2.5 Hand valves 6 and 7 were closed. Hand valves 14 and 15 were opened to determine that specimen was closed and there is no internal leakage.

10.2.6 Hand valves 14 and 15 and regulator 10 was closed. Solenoid valve 9 was actuated, cylinder 8 vented and pump 2 was then shut down.

10.2.7 The specimen was installed in reverse to that shown in figure 10-1 thus, flow through the specimen was reversed. Steps 10.2.2 through 10.2.6.

10.3 TEST RESULTS

The minimum shaft travel to stop flow was determined.

10.4 TEST DATA

Data recorded during the test are presented in tables 10-2 through 10-7.
Table 10-1. Repeatability Test Equipment List

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model Part No.</th>
<th>Serial No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specimen</td>
<td>Flodyne Controls Inc</td>
<td>5C151</td>
<td>1, 4 and 9</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pump</td>
<td>Denison Eng. Corp.</td>
<td>PV08-035-51-L-02</td>
<td>3833</td>
<td>0 to 3000 psig</td>
</tr>
<tr>
<td>3</td>
<td>Pressure Gage</td>
<td>Marsh Instrument Co.</td>
<td>NA</td>
<td>95-11843</td>
<td>0 to 3000 psig Cal. date 11-28-67</td>
</tr>
<tr>
<td>4</td>
<td>Flowmeter</td>
<td>Cox</td>
<td>AN-12</td>
<td>019167</td>
<td>0 to 30 gpm Cal. date 1-25-68</td>
</tr>
<tr>
<td>5</td>
<td>Flowmeter</td>
<td>Waugh</td>
<td>FL-12-SR1</td>
<td>106-1030B</td>
<td>0 to 20 gpm Cal. date 11-4-67</td>
</tr>
<tr>
<td>6</td>
<td>Hand Valve</td>
<td>Vacco Valve Co.</td>
<td>NV-6P-403-2</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>7</td>
<td>Hand Valve</td>
<td>Vacco Valve Co.</td>
<td>NV-6P-403-2</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>8</td>
<td>Cylinder</td>
<td>Parker-Hannfin</td>
<td>CC-2AS14C</td>
<td>F 95985</td>
<td>2-inch bore</td>
</tr>
<tr>
<td>9</td>
<td>Solenoid</td>
<td>Marotta Valve Co.</td>
<td>MV-74V</td>
<td>824</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Regulator</td>
<td>Grove Valve Regulator Co.</td>
<td>15-LXH</td>
<td>L-41407</td>
<td>0 to 3000 psig range</td>
</tr>
<tr>
<td>11</td>
<td>Hand Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>12</td>
<td>Pressure Gage</td>
<td>Ashcroft Corp.</td>
<td>NA</td>
<td>95-1403</td>
<td>0 to 200 psig Cal. date 10-14-67</td>
</tr>
<tr>
<td>13</td>
<td>Dial Indicator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Hand Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>15</td>
<td>Hand Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-25-4T</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>16</td>
<td>Graduated Beaker</td>
<td>CCSD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Graduated Beaker</td>
<td>CCSD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Pressure Gage</td>
<td>Acco Helicoid</td>
<td>NA</td>
<td>200506-AA</td>
<td>0 to 500 psig Cal. date 9-26-67</td>
</tr>
<tr>
<td>19</td>
<td>Reservoir</td>
<td>CCSD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 10-2. Repeatability Test Data Specimen 1

<table>
<thead>
<tr>
<th>FLOW DIRECTION</th>
<th>TEST MEDIA</th>
<th>PRESSURE (psig)</th>
<th>FLOW (gpm)</th>
<th>SHAFT TRAVEL TO STOP FLOW (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>Ball # 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ball # 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 1 .379</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 1 .391</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 2 .373</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 2 .390</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 3 .375</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 3 .390</td>
</tr>
</tbody>
</table>

Table 10-3. Repeatability Test Data Specimen 1

<table>
<thead>
<tr>
<th>FLOW DIRECTION</th>
<th>TEST MEDIA</th>
<th>PRESSURE (psig)</th>
<th>FLOW (gpm)</th>
<th>SHAFT TRAVEL TO STOP FLOW (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>Ball # 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ball # 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 1 .372</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 1 .390</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 2 .373</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 2 .393</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 3 .375</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 3 .392</td>
</tr>
</tbody>
</table>

Table 10-4. Repeatability Test Data Specimen 2

<table>
<thead>
<tr>
<th>FLOW DIRECTION</th>
<th>TEST MEDIA</th>
<th>PRESSURE (psig)</th>
<th>FLOW (gpm)</th>
<th>SHAFT TRAVEL TO STOP FLOW (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>Ball # 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ball # 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 1 .370</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 1 .372</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 2 .369</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 2 .371</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 3 .369</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 3 .370</td>
</tr>
</tbody>
</table>

10-3
### Table 10-5. Repeatability Test Data Specimen 2

<table>
<thead>
<tr>
<th>FLOW DIRECTION</th>
<th>TEST MEDIA</th>
<th>PRESSURE (psig)</th>
<th>FLOW (gpm)</th>
<th>SHAFT TRAVEL TO STOP FLOW (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>Ball #1, Ball #2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 1: .366, Run 1: .370</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 2: .365, Run 2: .373</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 3: .367, Run 3: .372</td>
</tr>
</tbody>
</table>

### Table 10-6. Repeatability Test Data Specimen 3

<table>
<thead>
<tr>
<th>FLOW DIRECTION</th>
<th>TEST MEDIA</th>
<th>PRESSURE (psig)</th>
<th>FLOW (gpm)</th>
<th>SHAFT TRAVEL TO STOP FLOW (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>Ball #1, Ball #2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 1: .397, Run 1: .406</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 2: .394, Run 2: .405</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 3: .393, Run 3: .403</td>
</tr>
</tbody>
</table>

### Table 10-7. Repeatability Test Data Specimen 3

<table>
<thead>
<tr>
<th>FLOW DIRECTION</th>
<th>TEST MEDIA</th>
<th>PRESSURE (psig)</th>
<th>FLOW (gpm)</th>
<th>SHAFT TRAVEL TO STOP FLOW (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outlet</td>
<td>Mil-H-5606</td>
<td>1500</td>
<td>10</td>
<td>Ball #1, Ball #2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 1: .393, Run 1: .403</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 2: .393, Run 2: .402</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Run 3: .394, Run 3: .404</td>
</tr>
</tbody>
</table>
Figure 10-2  Setup For Measuring Shaft Travel During Repeatability Test
SECTION XI
SHAFT TRAVEL AND BALL ROTATION TEST

11.1 TEST REQUIREMENTS

11.1.1 A shaft travel and ball rotation test shall be conducted on each specimen to determine shaft travel versus ball rotation from the full open to the full closed position.

11.2 TEST PROCEDURE

11.2.1 Each specimen was installed as shown in figure 11-1, utilizing the equipment listed in table 11-1.

11.2.2 It was determined the specimen was in the full open position and the recording equipment was set at zero.

11.2.3 Using press 4, the specimen was actuated from zero to 0.550-inch shaft travel in increments of 0.050-inch maximum. The degree of ball rotation was recorded at each increment.

11.3 TEST RESULTS

Shaft travel versus ball rotation was recorded and plotted. There were no significant differences in data received from the three specimens. A disassembled view of a specimen is shown in figure 11-5.

11.4 TEST DATA

Data, obtained during the test, are presented graphically in figures 11-2 through 11-4.
Table 11-1. Shaft Travel and Ball Rotation Test Equipment List

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model Part No.</th>
<th>Serial No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specimen</td>
<td>Flodyne Controls Inc.</td>
<td>50151</td>
<td>1, 4 and 9</td>
<td>Dual Ball Valve</td>
</tr>
<tr>
<td>2</td>
<td>Combination</td>
<td>Brown &amp; Sharpe</td>
<td>NA</td>
<td>95-1406B</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Compass Square</td>
<td></td>
<td>NA</td>
<td>66-1174A</td>
<td>Cal. date 2-7-68</td>
</tr>
<tr>
<td>4</td>
<td>Dial Indicator</td>
<td>L. S. Starrett Co.</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Press</td>
<td>Drake Arbor Press</td>
<td>101-(\frac{1}{2})</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>
Figure 11-1. Shaft Travel And Ball Rotation Test Schematic
Figure 11-2. Shaft Travel versus Ball Rotation Specimen 1
Figure 11-3, Shaft Travel versus Ball Rotation Specimen 2
Figure 11—1. Shaft Travel versus Ball Rotation Specimen 3
SECTION XII

FLOW TEST

12.1 TEST REQUIREMENTS

12.1.1 A flow test shall be conducted on the test specimen to determine flow versus shaft travel at a differential (ΔP) of 1500 psig across the specimen. This shall be accomplished by using MIL-H-5606 hydraulic fluid as the pressure medium and closing the specimen until a ΔP of 1500 psig across the specimen can be established. The flow and shaft travel shall be measured at this position and in increments of 0.020-inch shaft travel until the specimen is fully closed while maintaining a ΔP of 1500 psig.

12.2 TEST PROCEDURE

12.2.1 Specimen number 1 was installed as shown in figure 12-1 utilizing the equipment listed in table 12-1.

12.2.2 It was determined that all connections were tight, all gages were operating properly, and all valves were closed.

12.2.3 The specimen and hand valves 4, 6, and 8 were opened.

12.2.4 Pump 2 was started and the pump outlet pressure, indicated by gage 3, was adjusted to 2000 psig.

12.2.5 Hand valve 13 was opened and regulator 16 and hand valve 8 were adjusted until a ΔP of 1500 psig, indicated by gages 3 and 5, could be established across the specimen. The flow and shaft travel were measured at this position and also at shaft travel increments of 0.020-inch until the specimen closed. A ΔP of 1500 psig was maintained.

12.2.6 Hand valve 8 and regulator 16 were closed, hand valve 14 was opened, cylinder 11 vented and pump 2 was then shut down.

12.3 TEST RESULTS

Flow data were recorded from 0.290-inch to 0.370-inch at 0.020 increments of shaft travel while maintaining a ΔP of 1500 psig across the specimen.

12.4 TEST DATA

Flow versus shaft position is presented graphically in figure 12-2.
Table 12-1. Flow Test Equipment List

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model Part No.</th>
<th>Serial No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specimen</td>
<td>Flodyne Controls Inc.</td>
<td>5C151</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pump</td>
<td>Denison Eng. Corp.</td>
<td>PV08-035-51-L-02</td>
<td>3833</td>
<td>0 to 3000 psig</td>
</tr>
<tr>
<td>3</td>
<td>Pressure Gage</td>
<td>Hese</td>
<td>NA</td>
<td>015537</td>
<td>0 to 5000 psig Cal. date 1-27-68</td>
</tr>
<tr>
<td>4</td>
<td>Hand Valve</td>
<td>Robbins</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>5</td>
<td>Pressure Gage</td>
<td>Ashcroft Duragage</td>
<td>95-1211-B</td>
<td></td>
<td>0 to 3000 psig Cal. date 11-10-67</td>
</tr>
<tr>
<td>6</td>
<td>Hand Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>7</td>
<td>Flowmeter</td>
<td>Waugh</td>
<td>FL-12-SR1</td>
<td>106-103013</td>
<td>½-inch, 20 gpm Cal. date 11-4-67</td>
</tr>
<tr>
<td>8</td>
<td>Hand Valve</td>
<td>Vacco Valve Co.</td>
<td>NV-6P-403-2</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>9</td>
<td>Reservoir</td>
<td>CCSD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Dial Indicator</td>
<td>Starrett Co.</td>
<td>NA</td>
<td>66-1174A</td>
<td>Cal. date 2-7-68</td>
</tr>
<tr>
<td>11</td>
<td>Cylinder</td>
<td>Parker-Hannfin</td>
<td>CC-2AS14C</td>
<td>F-95985</td>
<td>2-inch bore</td>
</tr>
<tr>
<td>12</td>
<td>Pressure Gage</td>
<td>Ashcroft Corp.</td>
<td>NA</td>
<td>95-1403</td>
<td>0 to 200 psig Cal. date 10-14-67</td>
</tr>
<tr>
<td>13</td>
<td>Hand Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>14</td>
<td>Vent Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>15</td>
<td>Pressure Gage</td>
<td>Acco Helicoid</td>
<td>NA</td>
<td>200506-AA</td>
<td>0 to 500 psig Cal. date 9-26-67</td>
</tr>
<tr>
<td>16</td>
<td>Regulator</td>
<td>Grove Valve &amp; Regulator Co.</td>
<td>15LXH</td>
<td>L-41407</td>
<td>0 to 3000 psig</td>
</tr>
</tbody>
</table>
SECTION XIII
BURST TEST

13.1 TEST REQUIREMENTS

13.1.1 A burst test shall be conducted on two specimens. Each specimen shall be in the open position and pressurized with MIL-H-5606 hydraulic fluid to 4500 psig for 5 minutes.

13.1.2 A leakage test shall be conducted on the two specimens. Each specimen shall be in the closed position with the inlet ports pressurized to 1500 psig and then with the pressure increased to 4500 psig.

13.2 TEST PROCEDURE

13.2.1 Specimen number 1 and 2, each was installed as shown in figures 13-1, 3-2 and 3-3, utilizing the equipment listed in table 13-1.

13.2.2 It was determined; all connections were tight, gages were installed operating properly, and that all valves were closed.

13.2.3 The specimen and hand valves 3 and 5 were opened.

13.2.4 Using hand pump 2, MIL-H-5606 hydraulic fluid was pumped until the test setup and specimen were free of air.

13.2.5 Hand valve 5 was closed and the specimen was pressurized until 4500 psig was indicated by gage 4. This pressure was maintained for 5 minutes while the specimen was examined for external leakage and distortion.

13.2.6 Hand valve 5 was opened and the specimen and test setup vented.

13.2.7 The line connecting the specimen outlet ports was removed and leak check lines were then installed.

13.2.8 The specimen and hand valve 5 were closed.

13.2.9 Using hand pump 2, the specimen was pressurized until 1500 psig was indicated by gage 4. This pressure was maintained for 5 minutes while the leakage into graduated cylinders 7 and 8 was monitored.

13.2.10 The specimen pressure was increased to 4500 psig. This pressure was maintained for 5 minutes while the leakage into graduated cylinders 7 and 8 was monitored.
13.3 TEST RESULTS

13.3.1 No visible leakage or distortion occurred during the burst tests.

13.3.2 Test results were considered satisfactory.

13.4 TEST DATA

Burst test data are presented in table 13-2.
Table 13-1. Burst Test Equipment List

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model Part No.</th>
<th>Serial No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specimen</td>
<td>Flodyne Controls Inc.</td>
<td>5C151</td>
<td>1 and 4</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hand Pump</td>
<td>W. S. Pine Inc.</td>
<td>160-3</td>
<td>NA</td>
<td>0 to 5000 psig</td>
</tr>
<tr>
<td>3</td>
<td>Hand Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>4</td>
<td>Pressure Gauge</td>
<td>Heise</td>
<td>NA</td>
<td>015537</td>
<td>0 to 5000 psig + 0.1% FS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cal. date 1-22-68</td>
</tr>
<tr>
<td>5</td>
<td>Hand Valve</td>
<td>Robbins Aviation</td>
<td>SSKG-250-4T</td>
<td>NA</td>
<td>½-inch</td>
</tr>
<tr>
<td>6</td>
<td>Burst Chamber</td>
<td>CCSD</td>
<td>NA</td>
<td>201344</td>
<td>3 ft by 3 ft by 3 ft.</td>
</tr>
<tr>
<td>7</td>
<td>Graduated Cylinder</td>
<td>CCSD</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Graduated Cylinder</td>
<td>CCSD</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>
Table 13-2. Burst Test Data

<table>
<thead>
<tr>
<th>Test Specimen</th>
<th>Burst Pressure Specimen Open (psig)</th>
<th>Burst Pressure Specimen Closed (psig)</th>
<th>Pressurization Time Each Position</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4500</td>
<td>1500 and 4500</td>
<td>5 minutes</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>4500</td>
<td>1500 and 4500</td>
<td>5 minutes</td>
<td>None</td>
</tr>
</tbody>
</table>
Figure 13-1. Burst Test Schematic
APPROVAL

TEST REPORT

FOR

DUAL BALL SHUTOFF VALVE, ½ INCH, 1500 PSIG, CAM OPERATED

Flodyne Controls Inc., Part Number 5C151

NASA Drawing Number 75K26264

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