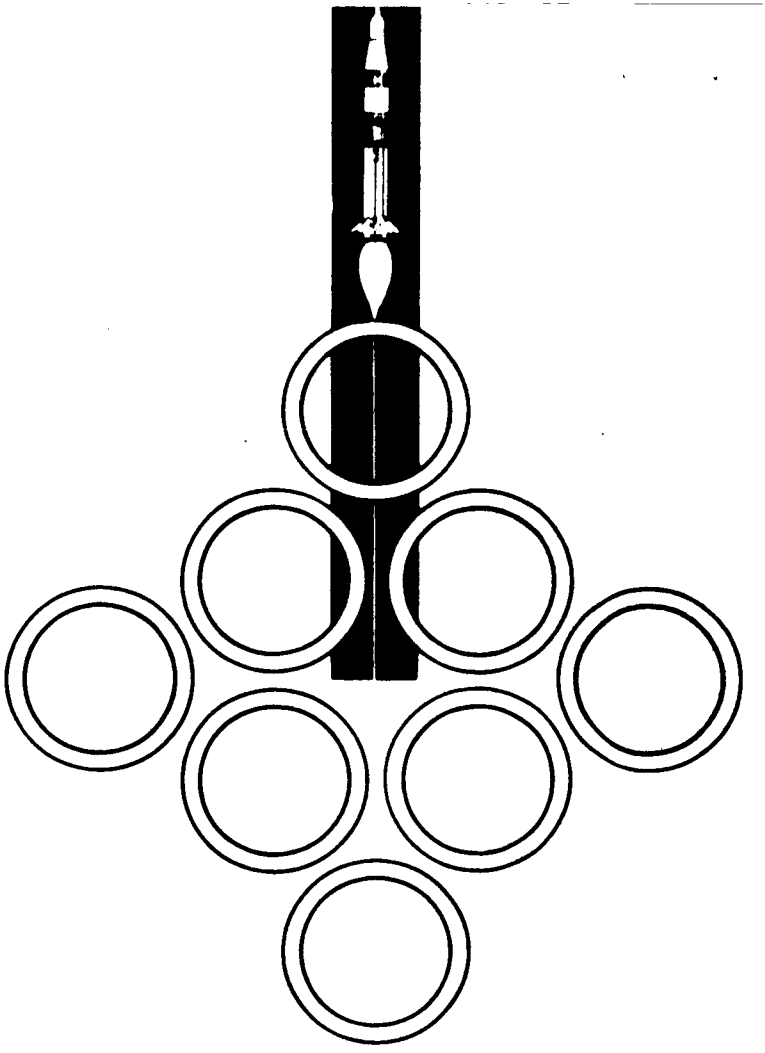

ENGINEERING DEPARTMENT

TECHNICAL REPORT

TR-RE-CCSD-FO-1132-3

April 3, 1967

SATURN IB PROGRAM

TEST REPORT
FOR

3/8-INCH RELIEF VALVE

Sage Engineering Company Part Number 1-2044

NASA Part Number 75M02172-8

SPACE DIVISION CHRYSLER CORPORATION

TEST REPORT

FOR

3/8-INCH RELIEF VALVE

Sage Engineering Company Part Number 1-2044

NASA Part Number 75M02172-8

ABSTRACT

This report presents the results of tests performed on three specimens of Relief Valve 75M02172-8. The following tests were performed:

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Flow

Specimen 2 failed the functional test; specimens 1 and 3 failed the flow test. Because of these failures, surge, low temperature, high temperature, vibration and life cycle tests were not performed. Specimen 2 evidenced poppet seat damage and failed to seal leak-tight. The other two specimens evidenced inability to open fully and would close at 165 per cent of cracking pressure.

TEST REPORT

FOR

3/8-INCH RELIEF VALVE

Sage Engineering Company Part Number 1-2044

NASA Part Number 75M02172-8

April 3, 1967

CHRYSLER CORPORATION SPACE DIVISION - NEW ORLEANS, LOUISIANA

FOREWORD

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

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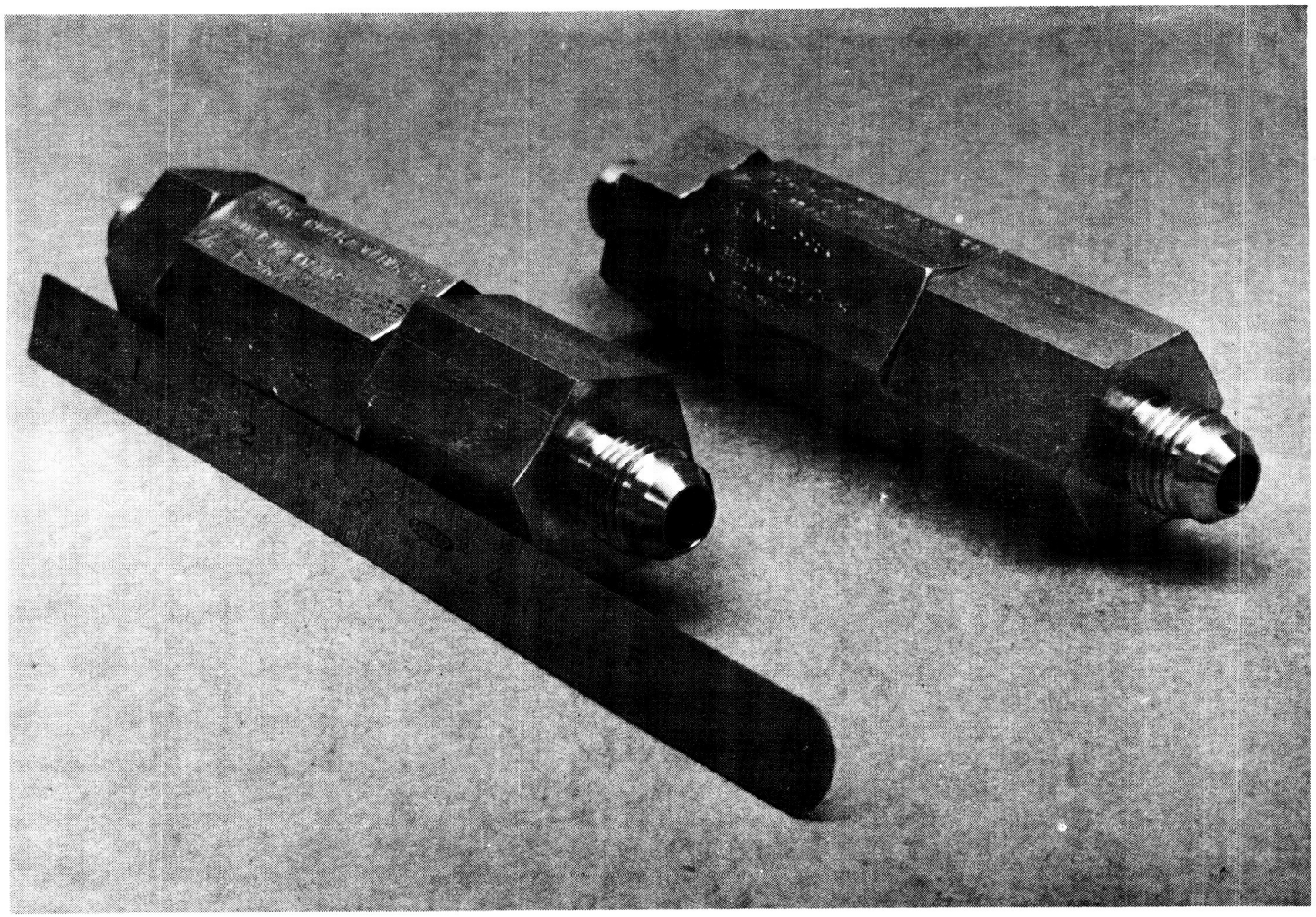


Relief Valve, 75M02172-8,3/8-Inch

CHECK SHEET

FOR

3/8-INCH RELIEF VALVE

MANUFACTURER: Sage Engineering Company
MANUFACTURER'S PART NUMBER: 1-2044
NASA PART NUMBER: 75M02172-8
TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana
AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A.	OPERATING MEDIA:	Dry air, nitrogen or helium
B.	SETTING RANGE:	1250 to 1950 psig
C.	CRACKING PRESSURE:	1500 ($\pm$75) psig
D.	RESEATING PRESSURE:	1320 psig minimum
E.	PROOF PRESSURE:	3750 psig
F.	BURST PRESSURE:	5000 psig minimum

II. CONSTRUCTION

A.	BODY MATERIAL:	316 stainless steel
B.	SEAL MATERIAL:	Teflon
C.	DIAMETER:	1-inch nominal
D.	END FITTING:	MC 172-6 (inlet and outlet)
E.	ORIFICE SIZE:	0.187

III. ENVIRONMENTAL CHARACTERISTICS

A.	TEMPERATURE RANGE:	-40 to +250°F

IV. SPECIAL REQUIREMENTS

A.	CLEANING SPECIFICATION:	A10M01671, Level IV

V. LOCATION AND USE: Utilized in Pneumatic Distribution System on Launch Complexes LC-34 and LC-37B in the 1250 psig GN_2 swing arm 2 umbilical release system on valve panel 5. The valve functions as an over-pressure protection device.

TEST SUMMARY

3/8-INCH RELIEF VALVE

75M02172-8

Environment	Units	Operational Boundary	Test Objective	Test Results	Remarks
Receiving Inspection	3	Specifications and drawings	Conformance with drawings and specifications	Satisfactory	
Proof Pressure Test	3	3750 psig for 5 minutes	Check for leakage	Satisfactory	
Functional Test	3	0 to cracking pressure to 0 for 5 cycles	Determine cracking and reseating pressures	Specimens 1 and 3 satisfactory; Specimen 2 unsatisfactory	Specimen 2 leaked after the poppet reseated.
Flow Test	2	0 to 110% of cracking pressure	Determine flow rate	Unsatisfactory	Valves would not open fully.

SECTION I

INTRODUCTION

1.1 SCOPE

This report presents the results of tests that were performed to determine if Relief Valve 75M02172-8 meets the operational and environmental requirements for John F. Kennedy Space Center Launch Complexes 34 and 37B. A summary of the test results is presented on page vii.

1.2 ITEM DESCRIPTION

1.2.1 Three specimens of Relief Valve 75M02172-8, designated specimens 1, (S/N 3386), 2 (S/N 3387), and 3 (S/N 3388), were tested.

1.2.2 The valve is a 3/8-inch, mono-directional flow valve and is used to prevent over-pressurization of the 1250 psig GN_2 swing arm 2 umbilical release system on valve panel 5.

1.2.3 The valve is manufactured by Sage Engineering Company and is 4.54-inches in length. It has a hexagonal body with a maximum width of 1-inch (flat to flat) and a MC 172-6 fitting on each end. The valve has an orifice size of 0.187-inch. During normal operation, the valve is opened by GN_2 flow and is closed by a spring.

1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for Relief Valve 75M02172-8.

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

b. NASA Drawing 75M02172-8, component specification

c. Test Plan CCSD-FO-1132-1F

d. Technical Procedure TP-RE-CCSD-FO-1132-2F

SECTION II

RECEIVING INSPECTION

2.1 REQUIREMENTS

The relief valve specimen shall be checked for conformance with NASA specification 75M02172-8 and applicable vendor drawings to the extent possible without disassembly of the specimen. The specimen shall also be inspected for poor workmanship and manufacturing defects.

2.2 PROCEDURE

Visual and dimensional inspections of the test specimens were performed to determine compliance with Sage Engineering Company drawing 1-2044 to the extent possible without disassembly of the test specimens. At the same time the test specimens were inspected for poor workmanship and manufacturing defects.

2.3 TEST RESULTS

The specimens complied with Sage Engineering Company drawing 1-2044. No evidence of poor workmanship or manufacturing defects was observed.

2.4 TEST DATA

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

Table 2-1. Receiving Inspection Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Micrometer	Starrett	224 set A	NASA 08-113 106-115-B	Range: 2 to 5-inch Cal date 12-16-66
2	Micrometer	Starrett	NA	NASA 08-113 106-1116-B	Depth gage Cal date 12-15-66
3	Micrometer	Craftsman	4090	NASA 08-113 106-1137-P	Range: 0 to 1-inch Cal date 1-9-67
4	Scale	Fairbanks Morse	SP-5231	NASA 08-113 014113	Weight Cal date 2-21-66

Table 2-2. Receiving Inspection Test Data

Measurement	Specification (Vendor Drawing 1-2044)	Specimen 1 Serial No. 3386	Specimen 2 Serial No. 3387	Specimen 3 Serial No. 3388
Width (inch)	1.00	1.00	1.00	1.00
Length (inch)	4.54 (±.03)	4.54	4.53	4.54
Inlet Fitting Length (inch)	0.56	0.56	0.56	0.56
Outlet Fitting Length (inch)	0.56	0.56	0.56	0.56
Weight (lb)	1	0.7	0.7	0.7

igure 2-1. Receiving Inspection Test

SECTION III

PROOF PRESSURE TEST

3.1 TEST REQUIREMENTS

3.1.1 A proof pressure of 3750 psig shall be applied simultaneously to the inlet and outlet ports of the test specimen for 5 minutes. GN_2 shall be the test medium.

3.1.2 Any leakage or distortion shall be monitored.

3.1.3 The inlet and outlet ports shall be vented simultaneously.

3.2 TEST PROCEDURE

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

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

3.2.3 Hand valve 2 was opened, and pressure gage 4 read 4,000 psig.

3.2.4 Regulator 5 was adjusted to establish 3750 psig on pressure gage 6. This simultaneously pressurized the specimen inlet and outlet ports.

3.2.5 The 3750 psig pressure was maintained for 5 minutes. The test specimen was monitored for leakage by the water displacement method.

3.2.6 Hand valve 2 was closed and the inlet and outlet ports of the specimen were simultaneously vented by opening valve 8.

3.2.7 All data were recorded.

3.3 TEST RESULTS

Specimen 3 did not leak and there was no evidence of damage. Specimens 1 and 2 leaked at the Teflon seal between the outlet end cap and the body of the valve. Specimen 1 leaked 10 scim at 3750 psig, and specimen 2 leaked excessively at 1000 psig. It was found that the caps on the outlet ends were below the required torque of 50 ft-lbs.

Both specimens were retorqued and retested. Specimen 1 was leak-tight but specimen 2 leaked by the outlet end cap at the rate of 33 scim under 3750 psig pressure. A new Teflon seal was installed in specimen 2 making it leak-tight during the proof pressure test.

3.4 TEST DATA

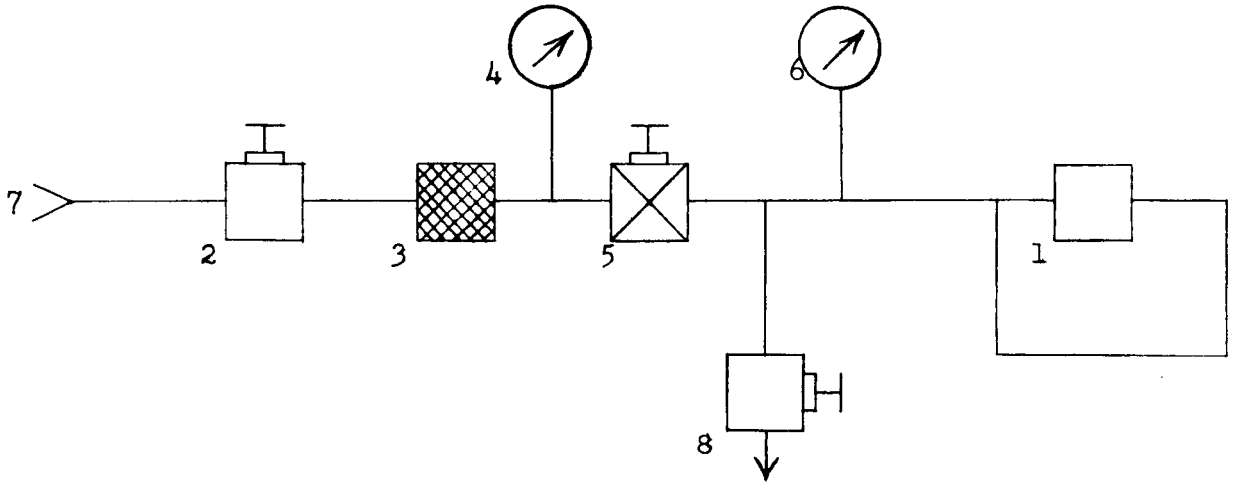
The data presented in table 3-2 were recorded during the test.

Table 3-1. Proof Pressure Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Sage Engineering	1-2044	3386, 3387, and 3388	3/8-inch relief valve
2	Hand Valve	Hoke	100G	NA	1/4-inch
3	Filter	Fluid Dynamics	FX 1561	HQ66	2-micron
4	Pressure Gage	Ashcroft	Maxisafe	NASA 08-113 95-1648-B	0 to 20,000-psig ±0.5% FS accuracy Cal date 12-15-66
5	Pressure Regulator	Tescom Corp.	26-1021-24	8360	10,000-psig inlet 0 to 10,000-psig outlet
6	Pressure Gage	Heise	NA	NASA 08-113 012452	0 to 10,000-psig ±0.1% FS accuracy Cal date 12-6-66
7	GN_2 Pressure Source	Laboratory Source	NA	NA	4000-psig
8	Hand Valve	Tescom Corp.	30-1100-104C	NA	1/4-inch

Table 3-2. Proof Pressure Test Results

	Specimen	Initial	After Retorquing End Cap	After Replacing Seal
Pressure	1	3750 psig	3750 psig	NA
Leakage		10 scim	Zero	NA
Distortion		None	None	NA
Pressure	2	1000 psig	3750 psig	3750 psig
Leakage		Excessively	33 scim	Zero
Distortion		Seal was damaged	Seal was damaged	None
Pressure	3	3750 psig	NA	NA
Leakage		Zero	NA	NA
Distortion		None	NA	NA



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

Figure 3-1. Proof Pressure Test Schematic

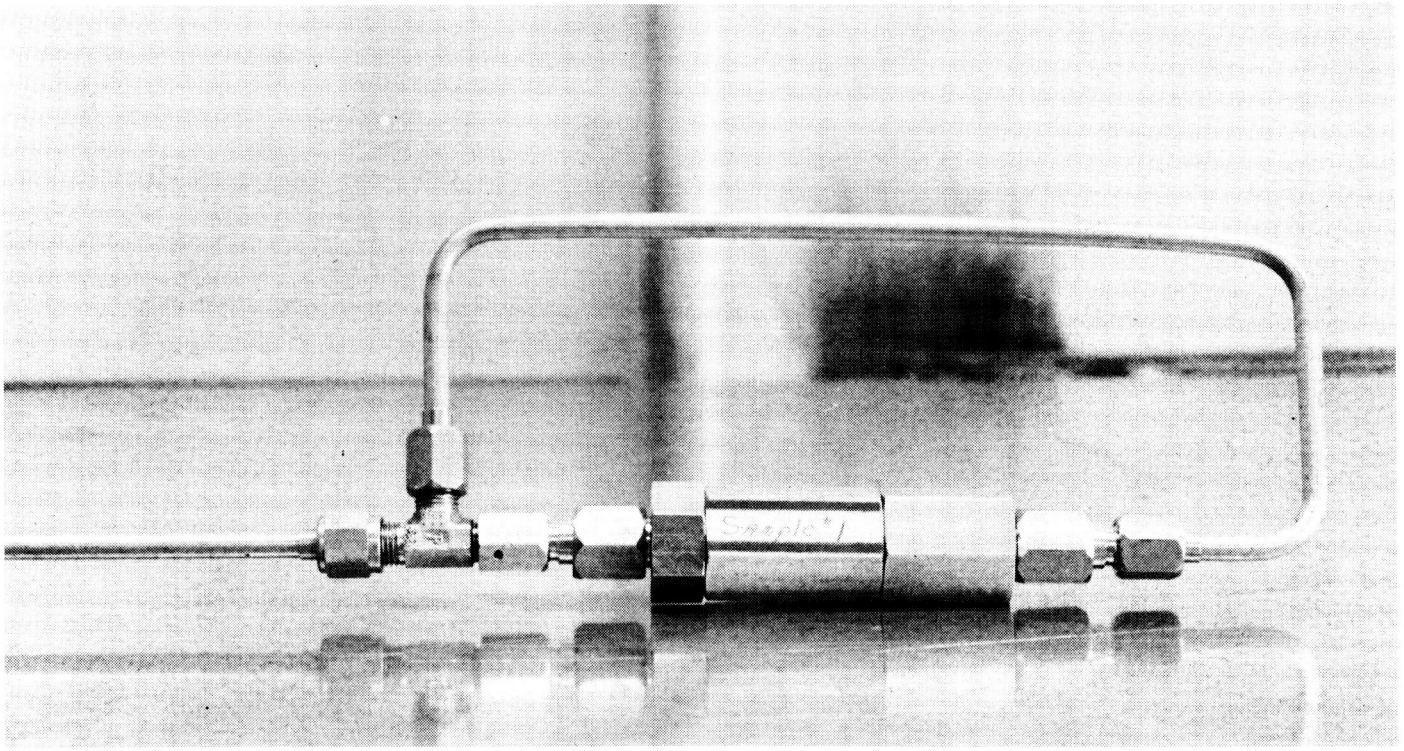


Figure 3-2. Proof Pressure Test Setup

SECTION IV

FUNCTIONAL TEST

4.1 TEST REQUIREMENTS

4.1.1 A functional test shall be performed on the specimen using GN_2 as the test medium.

4.1.2 The inlet port shall be slowly pressurized from 1250 psig to cracking pressure and back to 1250 psig. The cracking and reseating pressures shall be recorded. Five such cycles shall be performed initially. Subsequent functional tests shall consist of three such cycles.

4.1.3 The cracking pressure shall be 1500 ($\pm$75) psig, and the reseating pressures shall be 1320 psig minimum.

4.2 TEST PROCEDURE

4.2.1 The functional test setup was assembled as shown in figure 4-1 utilizing the equipment listed in table 4-1.

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

4.2.3 Hand valve 2 was opened and pressure gage 4 indicated 3000 psig.

4.2.4 Regulator 5 was adjusted to 1250 psig as read on pressure gage 6.

4.2.5 Regulator 5 was slowly adjusted to increase specimen inlet pressure until bubbles appeared in water tank 7. The pressure indicated on gage 6 at which bubbles appeared was recorded as the cracking pressure.

4.2.6 The pressure was decreased slowly, and the pressure at which the bubbles ceased in water tank 7 was recorded as the reseating pressure.

4.2.7 Procedures in 4.2.5 and 4.2.6 were performed five times during the initial functional test and three times during subsequent functional tests.

4.2.8 All test data were recorded.

4.3 TEST RESULTS

During the initial functional test, specimen 1 failed to open or close within the allowed pressures; specimen 2 was within tolerance for the first three cycles, but failed during the fourth and fifth cycles; specimen 3 opened below the allowed cracking pressure (see table 4-2). The specimens were then adjusted to operate within tolerances. At pressures ranging to 110 per cent of cracking pressure the valves would slam

between the open and closed positions. The valves would also stick in the closed position and cause pressure to build up above 1600 psig before venting. It is believed that the poppet seat on specimen 2 was damaged since the valve continued to leak after the poppet had reseated. Because of this damage specimen 3 was substituted for specimen 2.

4.4 TEST DATA

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

Table 4-1. Functional Test Equipment List

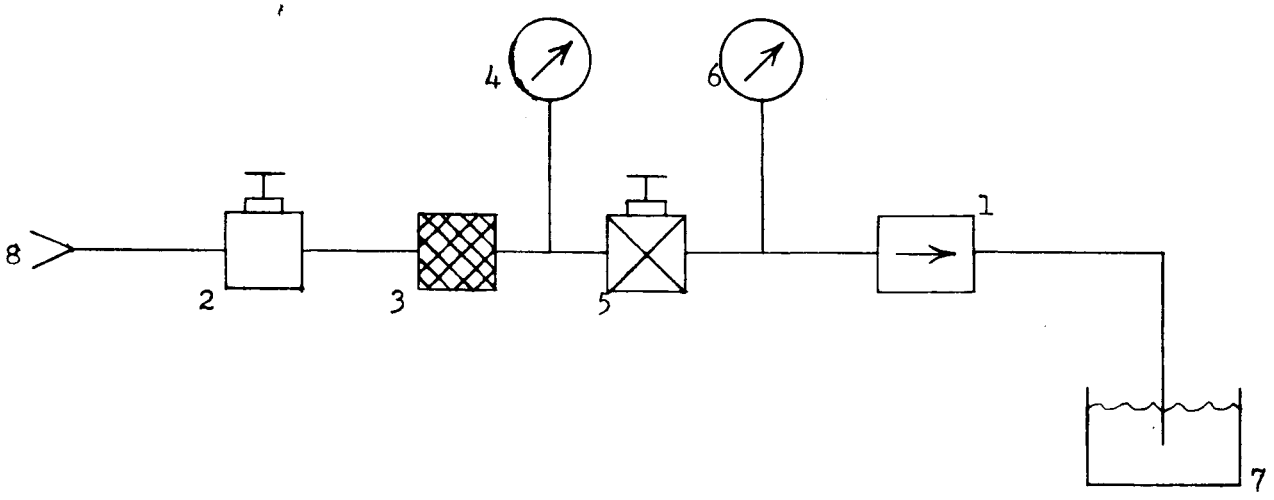
Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Sage Engineering	1-2044	3386, 3387, and 3388	3/8-inch relief valve
2	Hand Valve	Combination Valve Pump Company	CAT 380-4	PL-64	1/2-inch
3	Filter	Bendix Corp.	2-8-13460 -16-B-0	58	2-micron
4	Pressure Gage	Ashcroft	NA	NASA 08-113 200616-L	0 to 5000-psig ±0.5% FS accuracy Cal date 1-25-67
5	Pressure Regulator	Tescom Corp.	26-1003	1008	6000-psig inlet 0 to 4000-psig outlet
6	Pressure Gage	Heise	NA	NASA 08-113 200616-D	0 to 5000-psig ±0.1% FS accuracy Cal date 1-25-67
7	Water Beaker	Pyrex	NA	NA	
8	GN_2 Pressure Source	Laboratory Source	NA	NA	3000-psig

Table 4-2. Initial Functional Test Results

Specimen	Run	Cracking Pressure (psig) Required: 1500 (±75)	Reseating Pressure (psig) Required: 1320 min
1	1	1400	1230
	2	1370	1295
	3	1355	1310
	4	1365	1305
	5	1365	1316
2	1	1550	1468
	2	1480	1460
	3	1490	1480
	4	1495	1100
	5	1350	1000
3	1	1410	1325
	2	1380	1335
	3	1380	1330
	4	1383	1335
	5	1380	1335

Table 4-3. Functional Test Results After Readjusting

Specimen	Run	Cracking Pressure (psig) Required: 1500 (±75)	Reseating Pressure (psig) Required: 1320 min
1	1	1505	1475
	2	1504	1460
	3	1505	1470
	4	1505	1470
	5	1510	1465
3	1	1485	1455
	2	1490	1430
	3	1500	1450
	4	1505	1445
	5	1505	1445



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

Figure 4-1. Functional Test Schematic

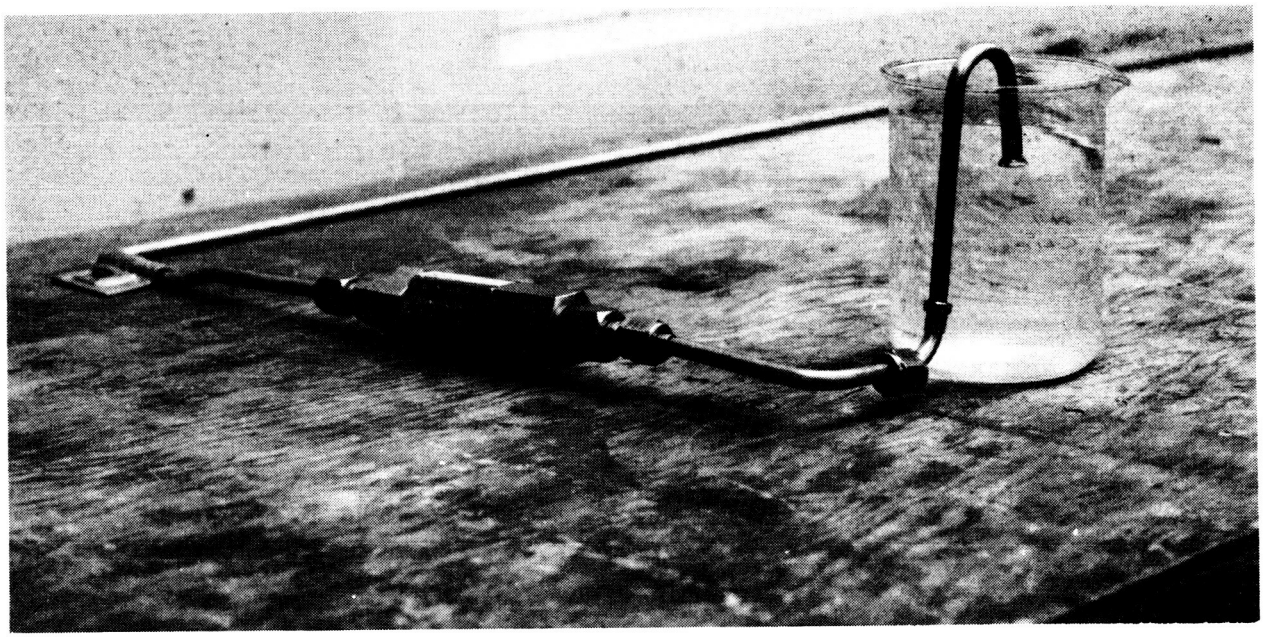


Figure 4-2. Functional Test Setup

SECTION V

FLOW TEST

5.1 TEST REQUIREMENTS

5.1.1 Tests shall be performed to determine the maximum flow rate of the specimen when exposed to an inlet pressure of 110 per cent of cracking pressure. GN_2 shall be the test medium.

5.1.2 A curve of flow versus inlet pressure shall be developed.

5.1.3 A functional test (refer to section IV) shall be performed if 72 hours or more have elapsed since the previous test.

5.2 TEST PROCEDURE

5.2.1 A functional test was performed as 72 hours had elapsed since the previous test.

5.2.2 Specimens 1 and 3, each, were installed in a test setup as shown in figure 5-1 utilizing equipment listed in table 5-1.

5.2.3 Pressure regulator 6 was adjusted to zero outlet pressure, and hand valve 3 was opened.

5.2.4 Using pressure regulator 6, the test system was pressurized until 110 per cent of cracking pressure (as measured during functional tests) was indicated on pressure gage 8 or until a flow measurement could be taken.

5.2.5 The flow was calculated.

5.2.6 After **each delay** of a day or more in testing, both specimens had to be readjusted to open and close within the allowable pressures.

Note: Ullage tank 12 was added to the test setup after approximately 10 runs had been made on both specimens. The tank was installed to prevent the valves from chattering during low flows.

5.3 TEST RESULTS

5.3.1 Both test specimens operated erratically during the flow test. Typically, the specimens would crack near the normal cracking pressure (1500 psig) but would not open fully. As the pressure was increased further, the specimens closed fully at approximately 2500 psig and remained closed as the inlet pressure was reduced. Two times,during approximately 15 cycles performed on each sample, the valve opened fully allowing flow measurement to be made. Testing was terminated at this point.

5.4 TEST DATA

Test data recorded during the test are presented in table 5-5. Functional test data taken before the flow test are presented in tables 5-2, 5-3, and 5-4.

The flow rate was calculated as follows:

$$Q_S = \frac{Q_M \left(\frac{P}{14.7} \right) 530}{460 + T}$$

where: Q_S = Standard flow rate (scfm)

Q_M = Measured flow rate (cfm)

P = Absolute pressure at flowmeter (psia)

T = Temperature (°F)

Table 5-1. Flow Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Sage Engineering	1-2044	3386, and 3388	3/8-inch relief valve
2	GN_2 Pressure Source	Laboratory Source	NA	NA	3000-psig
3	Hand Valve	Combination Valve Pump Company	CAT 380-4	PL-64	$1\frac{1}{2}$-inch
4	Filter	Bendix Corp.	2-8-13460 -16-B-0	58	2-micron
5	Pressure Gage	Ashcroft	NA	NASA 08-113 200616-L	0 to 5000-psig ±0.5% FS accuracy Cal date 1-25-67
6	Pressure Regulator	Tescom Corp.	26-1003	321	3000-psig inlet 0 to 3000-psig outlet
7	Pressure Gage	Heise	H-35844	NASA 08-113 200616-D	0 to 3500-psig ±0.1% FS accuracy Cal date 1-25-67
8	Pressure Gage	Heise	H-35837	NASA 08-113 200616-B	0 to 5000-psig ±0.1% FS accuracy Cal date 1-25-67
9	Thermocouple	West	IN-5	NASA 08-113 019460	-100 to +400°F ±2.5°F accuracy Cal date 10-14-66
10	Flowmeter	Potter Aero Co.	NA	NASA 08-106 1012-B	Turbine type 0 to 100-scfm Cal date 11-8-66
11	Frequency Readout	Beckman Inst., Inc.	5311	NASA 08-113 018771	5 digit Cal date 2-1-67
12	Ullage Tank	American Bosch	ACB300085	G10226	231-cu. in. 5000-psig max

Table 5-2. Functional Before Flow Test After Resetting

Specimen	Run	Cracking Pressure (psig)	Reseating Pressure (psig)
1	1	1460	1425
	2	1460	1435
	3	1465	1435
3	1	1480	1405
	2	1475	1408
	3	1480	1405

Table 5-3. Functional During Flow Test After Resetting

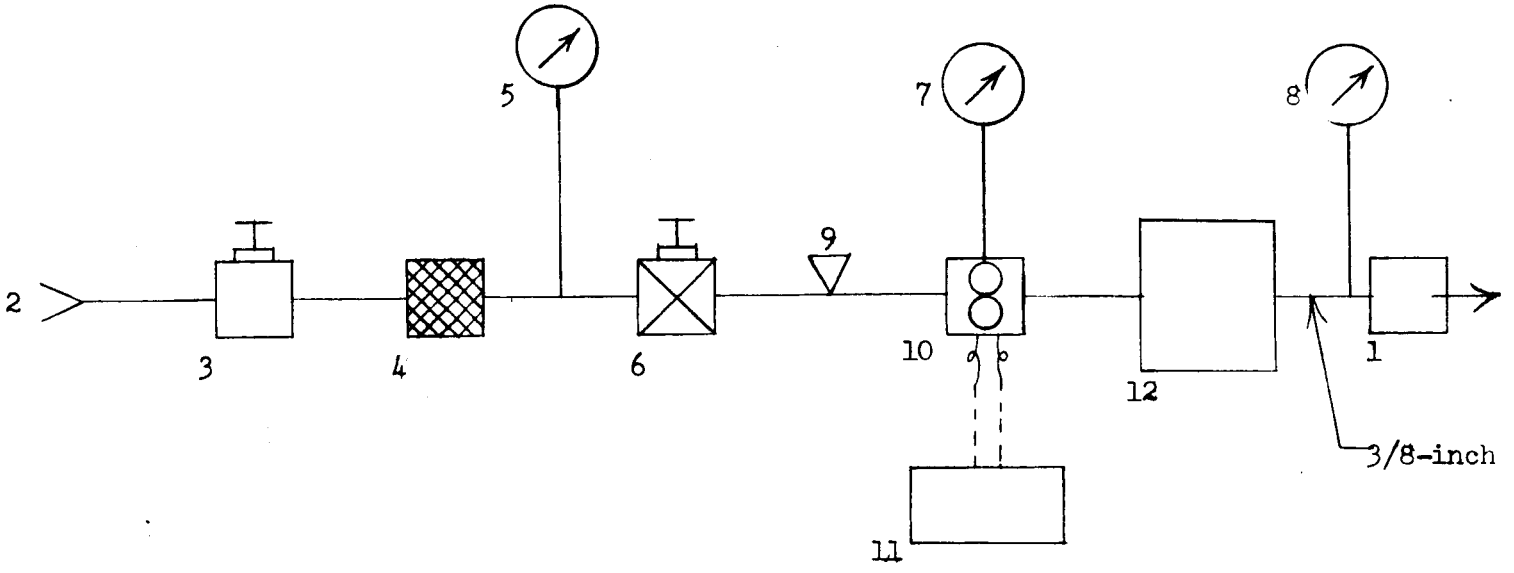
Specimen	Run	Cracking Pressure (psig)	Reseating Pressure (psig)
1	1	1465	1415
	2	1460	1405
	3	1450	1400
3	1	1515	1425
	2	1515	1430
	3	1515	1440

Table 5-4. Functional During Flow Test After Resetting

Specimen	Run	Cracking Pressure (psig)	Reseating Pressure (psig)
1	1	1530	1485
	2	1550	1475
	3	1540	1465
3	1	1550	1510
	2	1565	1485
	3	1550	1475

Table 5-5. Flow Test Data

Specimen	Specimen Pressure (psig)	Flowmeter Pressure (psig)	Temperature (°F)	Measured Flow (cfm)	Standard Flow (scfm)
1	1830	1880	65	6.0	781
1	1700	1850	70	5.5	698



Note: Flow lines 3/4-inch unless otherwise indicated.
Gage lines 1/4-inch.
Refer to table 5-1 for item identification.

Figure 5-1. Flow Test Schematic

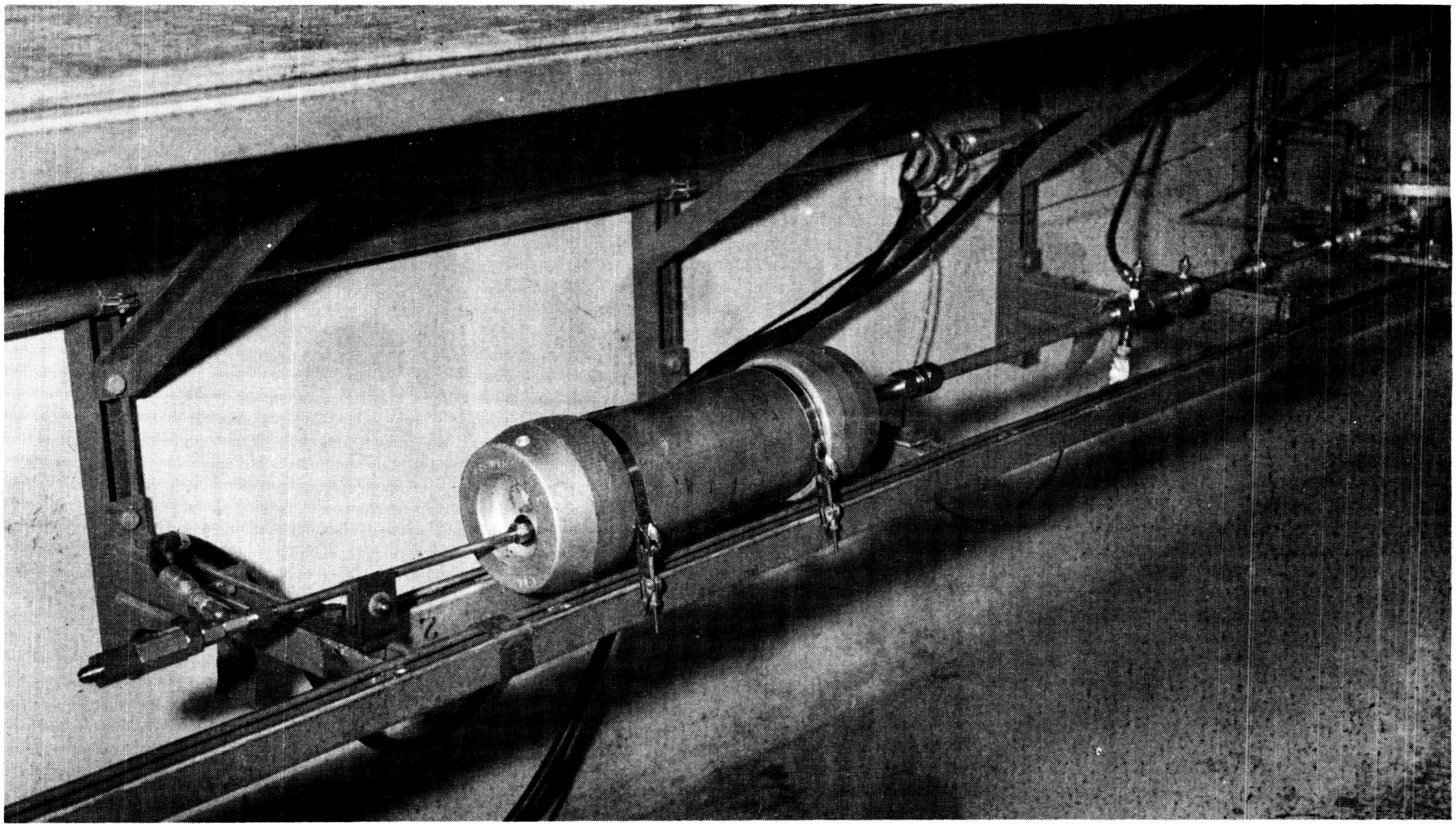


Figure 5-2. Flow Test Setup

APPROVAL

TEST REPORT

FOR

3/8-INCH RELIEF VALVE

Sage Engineering Company Part Number 1-2044

NASA Part Number 75M02172-8

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