FAIRCHILD HILLER
STRATOS-WESTERN
1800 ROSECRANS AVENUE
MANHATTAN BEACH, CALIF. 90266

REPORT ER 834-7

FINAL REPORT

FOR

RELIEF VALVE ASSY

Stratos PN 834000

NASA Spec. 20M32254

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Approved By: J. Feld, Chief Engineer

Approved By: T. Earl, Manufacturing Manager

20 May 1971

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SECTION I

INTRODUCTION

This report presents the results of a program to develop, manufacture, and qualify a relief valve assembly in accordance with MSFC Design Procurement Drawing 20 M 32254.

The valve is intended for use in the metabolic activity system of the biological experiments to be conducted in the Orbital Workshop (OWS) Vehicle.

The design was limited to the use of state-of-the-art techniques regarding valve design and fluid material compatibility.

The basic work performed and the three phases into which it was divided were as follows:

Phase I	Design, manufacture, and development test of one prototype relief valve.
Phase II	Manufacture of twelve relief valves per approved drawings of Phase I, two of which were used for pre-flight certification testing.
Phase III	The performance of pre-flight certification tests on two units.

SECTION II

SUMMARY

The relief valve assembly development program described in this document was performed under Contract NAS 8-26358. The program achieved all of the established requirements; and in addition demonstrated that the valve, based on design used in this program, is capable of meeting even more stringent performance requirements for internal leakage and pressure band (reseat to full flow).

The first phase culminated with the design approval of the valve, based on the results of analyses and development tests performed. The Phase I effort consisted of several tasks as described in Section III of this report. The second phase work consisted of fabrication of the individual parts, assembly of the valves, functional operation checkout, and acceptance testing. The consistency of the test results demonstrated the valve's ability to meet the specified requirements on a production quantity basis. No changes of design were required as a consequence of this phase of the program.

The third phase of the program consisted of conducting all of the tests outlined in ER 834-4 "Qualification Test Procedure", as pre-flight certification tests.

The valve successfully passed all of the specified requirements outlined in the reference engineering report as documented in the Qualification Test Report, ER 834-6. There were no changes in design required for accomplishment of this part of the program.

SECTION III

Phase I - Design and Development

This phase of the program was devoted to the detail design, analysis, prototype fabrication, and test evaluation of the relief valve assembly.

The tasks involved in this phase were as follows:

Task	Description	Document No.	Addendum
1	Design Selection	ER 834-2	I
2	Materials Selection	ER 834-2	I
3	Design Analysis	ER 834-2	I
4	Layout, Detail Design, and Checking	Drawings listed in Drawing 834001	I
5	Prototype Hardware Fabrication and Assembly	ER 834-3	
6	Development Verification Test Procedure	ER 834-1 "A"	I
7	Development Verification Tests	ER 834-5	I
8	Acceptance Test Procedure	834002	I
9	Qualification Test Procedure	ER 834-4	I
10	Phase I Approval	C-26358-005	

1.0 DESIGN SELECTION

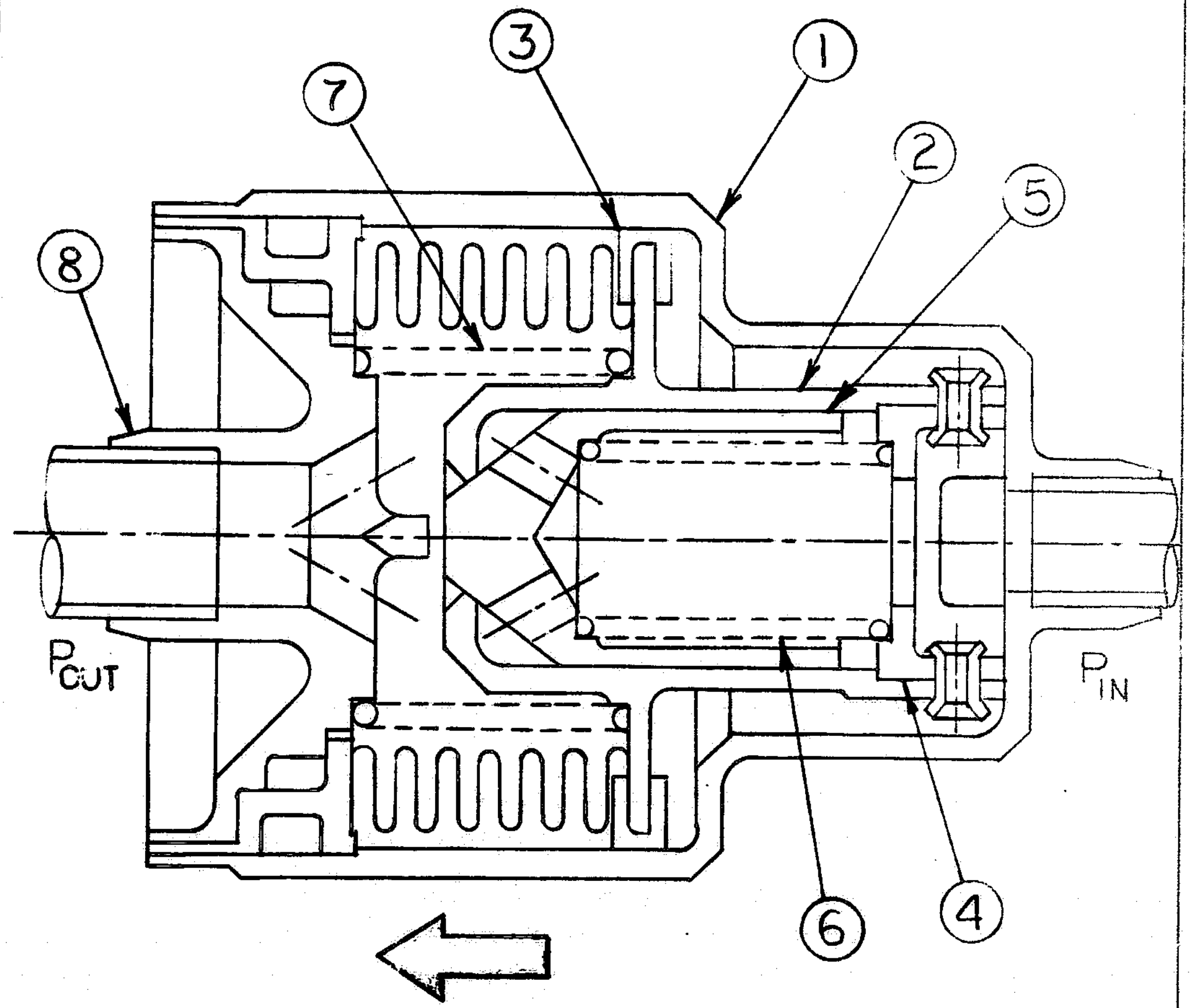
A survey was conducted during Phase I to take advantage of currently reported information pertaining to the design effort. The results of this review were integrated into the design analysis and had an important role in the selection of the inverted type valve.

The valve design configuration is an in-line inverted poppet-type relief valve. This valve design inverts the control element (refer to Figure 1) and seat of the conventional relief valve in such a way that the seat is spring-loaded closed against the control element (poppet). In this case, the seat loading spring (main spring) extablishes the reference force which reacts against the increase in inlet (upstream) pressure. The seat and poppet move together, compressing the seat loading spring. As inlet pressure rises, the poppet is forced harder against the seat, increasing the seating pressure until the poppet strikes the stop pin. Inlet pressure, acting in the annular area between the bellows mean diameter and the seat diameter moves the seat away from the now stationary poppet, causing the seat pressure to decrease rapidly until the valve opens.

As in conventional relief valves, the inverted type requires a positive seat load to prevent leakage. Below the minimum level required for sealing (established by the poppet-seat materials and seat geometric configuration), the valve starts to leak.

With the inverted relief valve, the actuation value of cracking pressure is much closer to the ideal cracking pressure than with the conventional valve. Figure 2 shows seating pressure versus inlet pressure for this inverted valve design and for an identical geometry conventional type. P_{sc} and P_{ic} are the actual dribble pressures for the standard and inverted design respectively.

Since the seating surface area is exceedingly small in comparison with the bellows area (240:1), the additional pressure force tending to open the valve after cracking is negligible and the valve does not open more than necessary to pass a required flow, and reseats very close to cracking pressure (0.10 to 0.40 psi lower). These characteristics render this valve design virtually chatter-free. Until the poppet reaches the stop pin, the seat-bellows assembly breathes like an accumulator, smoothing out minor pressure fluctuations.



DIRECTION OF FLOW

FIGURE 1

① HOUSING
② BELLOWS ASS'Y
③ GUIDE RING
④ SPRING RETAINER
⑤ POPPET
⑥ POPPET SPRING
⑦ MAIN SPRING
⑧ END PLATE & STOP PIN

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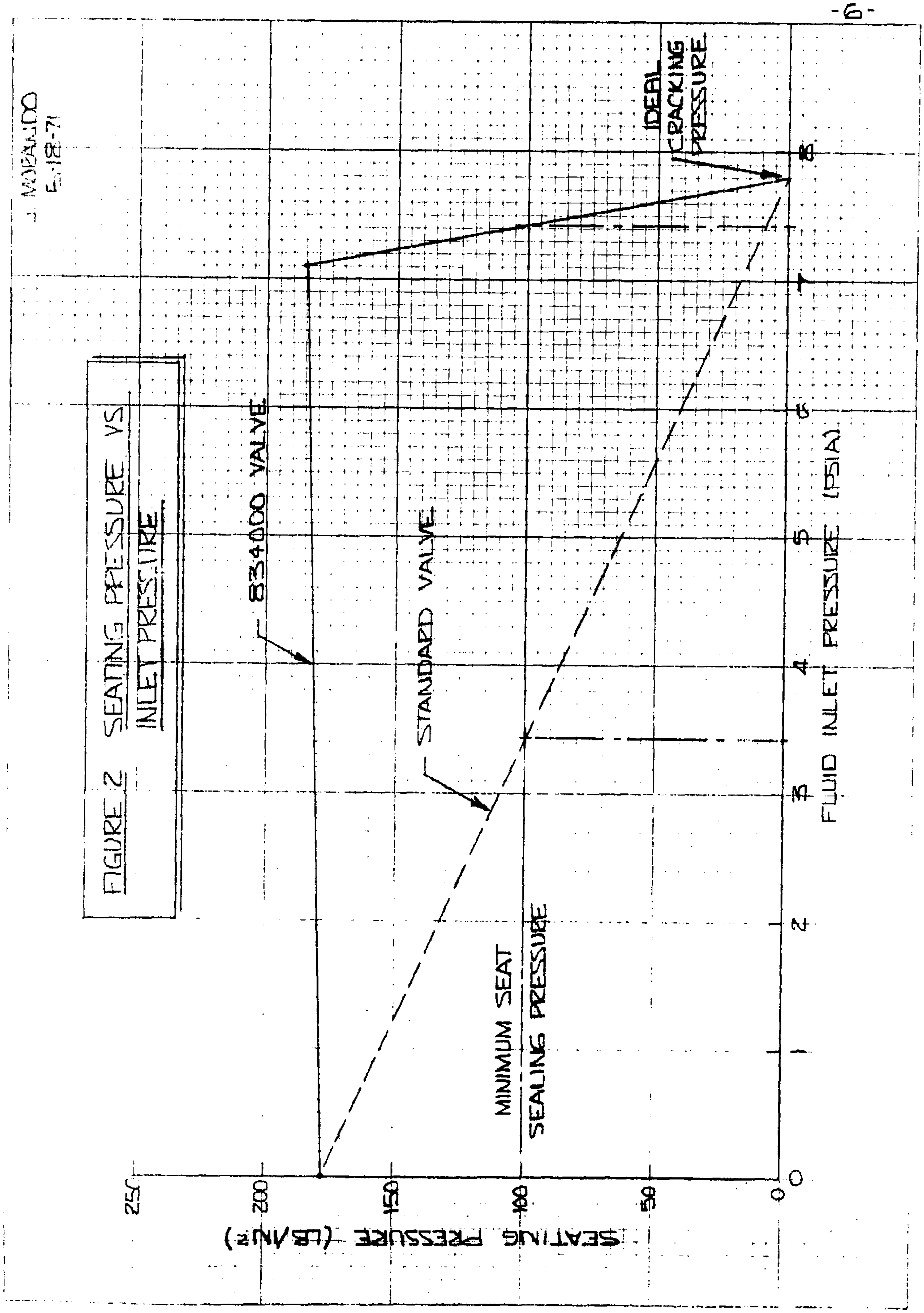

FIGURE 2 SEATING PRESSURE VS INLET PRESSURE

2.0 MATERIAL SELECTION

An investigation was conducted to select materials for the poppet-seat sealing interface to meet the low leakage requirements with the small seating load available (leakage is measured 0.50 psi below reseat pressure). (Refer to NASA Specification 20 M 32254.) Based on the required load per square inch for the different candidate materials, the actuator bellows were sized to generate the necessary cracking force (reference Addendum I, ER 834-2). The final selection was made based on bellows availability and fluid media compatibility, namely, 304L CRES for the seat material and KEL-F per AMS 3650 for the poppet material.

3.0 DESIGN ANALYSIS

A design analysis was initiated concurrently with the design review and material selection.(Refer to Addendum I, ER 834-2.) The purpose of the analysis was to provide the basis for engineering decisions, relating to the hardware detail design,of the prototype valve to be built at the end of Phase I of the program. The design analysis was concerned with establishing the valve internal configuration and determining all critical dimensions and finishes as well as all major stress levels.

Additional subjects covered because of the specific requirements of this design included: bellows life prediction and critical pressures, pressure drop, environmental effects, and structural considerations.

3.1 Environmental Effects

The environmental analysis was limited to consideration of acceleration and vibration forces.(Refer to Addendum I, ER 834-2.)

3.2 Bellows Operational Life

The valve design includes a bellows assembly as a dynamic seal and actuator combination between the inlet and outlet pressure side. The bellows, therefore, is compressed when the valve is moved to the open position and at null when the valve is in the closed position. The inside diameter of the bellows is normally exposed to 7.0 psia with a proof pressure of 18 psia.

The outside and inside diameter of the bellows were restricted by valve geometry. Within these constraints, the bellows design was selected. The analysis is presented in Addendum I, ER 834-2.

3.4 Structural Analysis

The structural analysis was confined exclusively to critical stress levels and pressures. The analysis was directed toward demonstrating that a large enough safety factor existed in all cases.(Refer to Addendum I, ER 834-2.)

4.0 HARDWARE DESIGN

The hardware design consisted of: A layout drawing of the valve design and all detail, subassembly and assembly drawings as necessary for prototype fabrication and assembly. The valve drawing list is shown in Figure 3. The assembly drawing, 834001, is included in Addendum I.

5.0 HARDWARE FABRICATION

Phase I, hardware fabrication, consisted of the prototype fabrication of all the necessary parts for one valve assembly conforming to the approved drawings.

6.0 DEVELOPMENT VERIFICATION TEST PROCEDURE

The development verification test procedure was prepared in accordance with the contract requirements specified in NASA Specification 20 M 32254. All of the details regarding this procedure can be found in Addendum I, ER 834-1, Revision "A".

7.0 DEVELOPMENT TESTS

The results of the development tests are presented in Table I. A more detailed discussion is included in Addendum I, ER 834-5. The prototype valve tested, successfully completed all of the development tests specified.

8.0 ACCEPTANCE TEST PROCEDURE

The acceptance test procedure was prepared and submitted as Document 834002; it describes the tests to be performed on the valve to establish its performance capability.

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PARTS LIST

ASSY. TITLE	ASSY. P/N	REV.
VALVE ASSY, RELIEF	834001	E

PREPARED BY	CHECKED BY	APPROVED BY
DATE	DATE	DATE

ITEM	ZONE	QTY.	DESCRIPTION	PART NO.	REV.	CODE IDENT	EFFECTIVITY FROM	EFFECTIVITY TO	MATERIAL	SPECIFICATION
1		1	VALVE ASSY	834001	E	01359			—	
2		1	VALVE BODY	834008	C	"			304 L CRES	QQ-S-763
3		1	BELLOWS ASSY	834010		"				
4		1	SEAT, BELLOWS PLT	834028	C	"			304 L CRES	QQ-S-763
5		1	BELLOWS, E.D.	834027		16519			NICKEL DEPOSITED	
6		1	END PLT. BELLOWS	834020		01359			304 L CRES	QQ-S-763
7		1	RING GUIDE	834007		"			TEFLON	AMS-3651
8		1	RETAINER SPRING	834013		"			304 L CRES	QQ-S-763
9		1	SPRING POPPET	834014	B	"			302 CRES	QQ-W-423 B
0		1	POPPET	834015		"			KEL-F	AMS-3650
1		1	RING DAMPER	834016		"			TEFLON	AMS-3651
2		1	SPRING MAIN	834017	A	"			302 CRES	QQ-W-423 B
3		1	FLANGE, OUTLET	834018		"			304 L CRES	QQ-S-763
4		1	TUBE, OUTLET	834019		"			321 CRES	MIL-T-8808
5		A/R	SHIM	834029		"			301/302/304 CRES	MIL-S-5059 COND A
6		A/R	SHIM	834030		"			301/302 CRES	MIL-S-5059 COND. A
7		1	STENCIL	834012		"				
8										
9										
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										
0										

NOTES

FIG. 3

PART NO. 834000

SHEET 1 OF 1

E-157SW7-70

Table 1

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254 S-W Part No. 834000 S/N__________ Date________

Ref. Paragraph	Test	Specification Requirements	Actual Performance	Remarks
6. 1	Examination of Product	Acceptable/ Non-acceptable	Acceptable (dimensional inspection included)	
6. 2	Internal Proof Pressure	Acceptable/ Non-acceptable	Acceptable	
6. 3	External Proof Pressure	Acceptable/ Non-acceptable	Acceptable	
6. 4 (a)	Internal Static Leakage	36 scch maximum	2. 70 scch	
6. 4 (b)	External Static Leakage	1.0×10^{-6} sccs	Non detectable leakage	
6. 5	Relief Operation	a) P outlet = 14. 7 psia crack: 21. 7 psia min. full flow: 23. 7 psia max. reseat: 21. 7 psia min.	a) crack: 23. 05 psia full flow: 23. 30 psia reseat: 22. 80 psia	

E-117A WB REV. 9/65

Table 1 (Continued)
RELIEF VALVE ASSEMBLY - DEVELOPMENT DATA

NASA Specification 20M32254 S/W Part No. 834000 S/N________ Date________

Ref. Paragraph	Test	Specification Requirements	Actual Performance	Remarks
6.8	Vibration	Sinusoidal Acceptable Nonacceptable Lift-off Acceptable Nonacceptable Random Acceptable Nonacceptable Ref. 6.5 crack: 7.0 min. psig full flow: 9.0 psig max. reseat: 7.0 min. psig	Acceptable Acceptable Acceptable Leakage: 3.4 scch 8.0 psig 8.5 psig 7.85 psig	
6.9	Life Cycle Repeat 6.5 every 250 cycles	1000 cycles Ref. 6.5 crack: 7.0 psig min. full flow: 9.0 psig max. reseat: 7.0 psig min internal leakage: 36 scch	 8.0 psig 8.55 psig 7.85 psig 2.7 scch	
6.10	Burst 6.10.1 Non des-destructive 6.10.2 Collapse 6.10.3 Destructive	Rupture - No rupture Collapse - No collapse Rupture Pressure 72 psig	No rupture No collapse	

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9.0 QUALIFICATION TEST PROCEDURE

The qualification test procedure was prepared and submitted in ER 834-4. A more detailed discussion can be found in Section IV of this report.

10.0 PHASE I APPROVAL

Approval of Phase I was received on October 27, 1970, in Document C-26358-005.(Refer to Addendum I.)

SECTION IV

Phase II

Phase II of the program consisted of fabrication and acceptance testing of twelve valve assemblies in compliance with the drawings and documentation approved in Phase I.

1.0 ACCEPTANCE TEST PLAN

The acceptance test plan is included in Addendum I as Drawing No. 834002.

2.0 ACCEPTANCE TESTS

The acceptance test results of all tested valves are included in Addendum II. Two valves presented anomalies during acceptance tests and were reported in Reliability Malfunction Report (RMR) 3382 and RMR 3383. The failure analysis for the subject valves, as well as the laboratory report, are part of Addendum II.

SECTION V

Phase III - Pre-flight Certification Tests

1.0 VALVE QUALIFICATION TESTS

1.1 Units Selection

Two units were selected at random from the twelve units manufactured and acceptance tested in Phase II and submitted to pre-flight certification tests.

1.2 Test Procedure

The test procedure and the applicable requirements are described in Engineering Report ER 834-4, Addendum I of this report.

1.3 Testing Agencies

All of the tests were conducted at Approved Engineering Test Laboratories (AETL), Los Angeles, California, with the exception of the performance tests after the CCOH environmental tests that were performed at Fairchild Stratos Division.

The results of outside tests are given in detail in AETL Test Report 5330-00-9545, dated April 30, 1971, included in Addendum I of Report ER 834-6.

1.4 Test Results

Both unit successfully completed all of the tests listed in Table 2, and, in all cases, exceeded the requirements listed in the qualification test procedure or the corresponding paragraph of NASA Specification 20 M 32254.

The results of all these tests were given in detail in Stratos Engineering Report ER 834-6.

TABLE 2

Valve "A" SN005	Valve "B" SN012	Report ER 834-4 Para. No.	NASA Spec. 20M32254 Para. No.
Corrosion contaminants oxygen/humidity test (CCOH)	Corrosion contaminants oxygen/humidity test (CCOH)	5.1.1	4.3.4.1
Performance	Performance	5.2.1 to 5.2.3	4.3.3.3 and 4.3.3.4
High Temperature	High Temperature	5.1.2	4.3.4.3
Performance	Performance	5.2.1 to 5.2.3	4.3.3.3 and 4.3.3.4
Low Temperature	Low Temperature	5.1.3	4.3.4.4
Performance	Performance	5.2.1 to 5.2.3	4.3.3.3 and 4.3.3.4
Vibration	Vibration	5.1.4 a), b), c), & d)	4.3.4.6 (a), (b), (c), & (d)
Performance	Performance	5.2.1 to 5.2.3	4.3.3.3 and 4.3.3.4
Life Cycle	Life Cycle	5.1.5	4.3.4.8
Performance each 250 cycles	Performance each 250 cycles	5.2.1 to 5.2.3	4.3.3.3 and 4.3.3.4
Performance after 1000cycles	Performance after 1000 cycles	5.2.1 to 5.2.5	4.3.3.1, 4.3.3.2, 4,3.3.3, 4.3.3.4
Collapse Pressure	Collapse Pressure	5.1.6	4.3.4.10
Burst Pressure		5.1.7	4.3.4.9.1
	Ultimate Pressure	5.1.8	4.3.4.9.2

SECTION VI

RESULTS AND CONCLUSIONS

This section summarizes the results which were reported in Sections II and III, and it draws conclusions which are based on these results.

1.0 RESULTS

The results of the program effort are presented here in terms of their effect on the functional capacity of the valve.

1.1 Internal Leakage

The ability to achieve a closure leakage of less than 1×10^{-3} SCCS, under inlet pressure conditions in very close proximity to cracking pressure was demonstrated. Production testing showed a marked consistency in the internal leakage test results, that corroborated the findings of development testing.

1.2 Valve Pressure Drop Versus Flow Rate

The tested valves demonstrated that pressure drop at full flow condition was well below the maximum specified, to the extent that a change in the specification doubling the maximum flow rate (from 300 scim to 600 scim) was achieved without the need of any design changes.

1.3 Performance

The specified value of 2.0 psi band from reseat to full flow was met with ample margin in all valves tested. In general, the reseat to full flow band was $0.50 < \Delta P < 0.80$ psi with the variation due almost exclusively to friction in the guide rings (see Figure 1 and Table 3).

1.4 Contamination

Despite the small forces available, valve seating forces are sufficiently high to assure good closure even under contaminated conditions (refer to ER 834-5). Flow cycle life demonstrated that a 10 micron filter is effective in protecting the sealing surfaces from impairment due to contaminants.

Table 3. Summary of Production Acceptance Tests

Unit S/N	Crack Pressure (psig)	Reseat Pressure (psig)	Δ_C - R	Full Flow Pressure (psig)	Δ_F - R	Internal Leakage (scch)
12	8.30	7.80	0.50	8.60	0.80	0.30
11	8.50	8.40	0.10	8.90	0.50	0.90
10	8.00	7.90	0.10	8.30	0.40	0.12
9	8.00	7.80	0.20	8.30	0.50	N.D.
8	8.00	7.90	0.10	8.40	0.50	0.90
7	8.60	8.20	0.40	8.90	0.70	7.20
6	7.80	7.60	0.20	8.10	0.50	N.D.
5	7.90	7.80	0.10	8.30	0.50	N.D.
4	8.30	8.20	0.10	8.50	0.30	0.60
3	7.80	7.60	0.20	7.90	0.30	2.40

2.0 CONCLUSIONS

The results presented above lead to the following conclusion:

The present design has proven sound and no design changes, improvements, or modifications are deemed necessary to meet the present specification requirements. The design has capablility to meet more stringent requirements as is, or with slight modifications.

ADDENDUM I

REPORT NO. ER 834-1
DEVELOPMENT VERIFICATION TEST
PROCEDURE FOR

RELIEF VALVE ASSEMBLY

Stratos-Western P/N 834000
NASA Spec. No. 20M32254

Prepared By: J. Amelsberg, Product Engineer

Approved By: J. Morando, Product Manager

Approved By: J. Feld, Chief Engineer

28 July 1970
Rev. A - 21 September 1970

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CHANGE RECORD

REV.	SECTION	PAGE	DESCRIPTION	DATE/ APPROVAL
A	Cover		Reflects "A" revision	
	3.1	1	George C. Marshall Space Flight Center Report 20M32254 - Valve Assembly, Relief WAS "2AM32254"	
	6.1	5	"---requirements outlined in paragraph 3.5---" WAS "--- requirements outlines in paragraph 3.5 ---"	
	6.5	6	"---- outlet pressure of 14.7 psia. The valve assembly shall fo from seat to full open to reseat at inlet pressures between 7.0 to 9.0 psi above outlet pressure. Full open is defined as the inlet pressure required to sustain a flow rate of 775 scim minimum of N_2 at 70°F inlet temperature with an outlet pressure of 14.7 psia. NOTE: Test conditions of 23.7 psia inlet, 14.7 psia outlet and 775 scim are equivalent to 9 psia inlet, 0 psia outlet and 300 scim." WAS "---outlet pressure of 14.7 psia. The cycles shall then be repeated with an outlet pressure of 4 psia max. The valve assembly shall go from seat to full open to reseat at inlet pressures between 7.0 to 9.0 psi above outlet pressure. Full open is defined as the inlet pressure required to sustain a flow rate of 300 scim minimum of N_2 at 70°F inlet temperature with an outlet pressure of 1×10^{-6} Torr. When tests are conducted at 14.7 psia outlet pressure the flow shall be 775 scim minimum of N_2 at 70°F. The test setup shall be as shown in figure 5."	
	6.6	6	"--- in accordance with 6.5. The test setup shall ---" WAS "--- in accordance with 6.5 except outlet pressure shall always be 14.7 psia. The test setup shall ---"	
	6.7	6	Same as change in paragraph 6.6 above.	

CHANGE RECORD

REV.	SECTION	PAGE	DESCRIPTION	DATE/ APPROVAL
A	6.8	7 and 8	Vibration Completely revised and rewritten	
	6.9	8	"--- in accordance with 6.5." WAS "--- in accordance with 6.5 except outlet pressure shall always be 14.7 psia."	
	Figure 5	14	Revised schematic - Added "Calibrated for the corresponding outlet pressure."	
		15	Ref. paragraph 6.5 revised: IS / WAS a) P outlet 14.7 / 4.0 psia crack 21.7 / 11.0 psia max. full flow 23.7 / 13.0 psia max. reseat 21.7 / 11.0 psia max. b) DELETED	
	Figure 6	17	Added new schematic "Figure 6. Component Vibration Axes."	

TABLE OF CONTENTS

1.0 INTRODUCTION

This document describes the development tests to be performed on the Relief Valve Assembly, Part No. 834000.

2.0 PURPOSE

The purpose of these tests is to provide data for application in the design of the prototype units to be used in the qualification testing in accordance with NASA Specification 20M32254 Valve Assembly, Relief.

3.0 APPLICABLE DOCUMENTS.

3.1 Listing

The following documents, of the issue noted, form a part of this drawing to the extent specified herein. This document should prevail in case of conflict.

George C. Marshall Space Flight Center

20 M32254	Valve Assembly, Relief
MSFC-SPEC-101	Flammability Requirements and Test Procedures for Materials in Gaseous Oxygen Environments
MSFC-SPEC-135	Welding, Fusion, Specification for
MSFC-SPEC-164	Cleanliness of Components for use in Liquid Oxygen, Fuel and Pneumatic Systems, Specification for
MSFC-DWG-10509306	Radiographic Inspection Procedures and Acceptance Standards for Fusion Welded Joints in Stainless and Heat Resistant Steel, Specification for
MSFC-DWG-10509308	Welding, Carbon, Low Alloy, and Stainless Steel, Manual or Automatic, Specification for

Military Specifications

MIL-B-5087B	Bonding, Electrical, and Lightning Protection, for Aerospace Systems
MIL-C-5541	Chemical Films and Chemical Films Materials for Aluminum and Aluminum Alloys
MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys

Military Standards

MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of
MIL-STD-810B	Environmental Test Methods for Aerospace and Ground Equipment
MIL-STD-831	Test Reports, Preparation of
MS-33586	Metal, Definition of Dissimilar

George C. Marshall Space Flight Center Standards

MSFC-STD-100	Castings, Aluminum and Magnesium Alloy, Radiographic Inspection of, Acceptance Standard for
MSFC-STD-105	Synthetic Rubber, Age Control of, Standard for

George C. Marshall Space Flight Center Publications

MSFC Engineering Standards Manual

Identification for Traceability (Quality and Reliability Assurance Laboratory).

Manned Spacecraft Center Publications

MSC-D-NA-0002	Procedures and Requirements for the Flammability and Offgassing Evaluation of Manned Spacecraft Nonmetallic Materials

4.0 TEST FACILITIES

The testing shall be performed at Stratos-Western Facilities, Manhattan Beach, California, unless otherwise noted.

5.0 GENERAL TEST REQUIREMENTS

5.1 Order of Tests and Examinations.

The order of tests and examinations shall be as specified herein.

5.2 Test and Examination Conditions.

Unless otherwise specified the tests and examinations shall be performed under conditions as follows:

a) Temperature - Standard temperature, 77°(± 18) F.

b) Relative humidity - 95 percent maximum

c) Atmospheric pressure - 14.7 (±0.7) pounds per square inch absolute (psia)

Tests shall be conducted under the conditions of Specification MIL-STD-810B, except as modified herein.

Equipment used to measure the unit parameters shall have an accuracy of one order of magnitude (factor of ten) greater than the required accurancy of the measurement to be made within state-of-the-art limitations.

5.3 Test Medium.

Unless otherwise specified in the individual tests, the test fluids used shall be as follows:

1. Nitrogen propellant pressurizing agent per MIL-P-27401

2. Helium propellant pressurizing agent per MIL-P-27407-1

3. Air

All fluids shall be passed through a 5 micron absolute level filter prior to entry into the test specimen.

5.4 Cleanliness - Test Equipment.

The level of cleanliness of the test equipment shall be such as to preclude damage to, or malfunction of the test specimen by contamination.

5.5 Instrument Calibration.

All inspection and measuring test equipment shall be calibrated against secondary standards which have been calibrated against primary standards by the National Bureau of Standards or an acceptable testing organization. Records shall be maintained including the data of last calibration. The due date shall be displayed on each item.

5.6 Test Data.

A note book type test log shall be kept throughout the testing. Each test shall be described in detail. All test data shall be recorded accurately and clearly.

The test data shall include, but is not limited to the following information.

1. Test agencies and personnel.

2. Test facilities location

3. Test schematic including control equipment

4. Equipment list

5. Test and measuring tolerances

6. Detail procedure

7. Accurate description and identification of test vehicle.

8. Strip charts shall be marked to show calibration and date.

6.0 DEVELOPMENT VERIFICATION TESTS

The unit shall be subjected to testing in the manner described. No deviation from these test sequence or procedures shall be made without prior project approval.

6.1 Examination.

The valve assembly shall be examined to check conformance to drawing number 834001,

All valve construction methods shall meet the requirements outlined in paragraph 3.5 of specification 20M32254.

6.2 Internal Proof Pressure.

The inlet and outlet ports of the valve assembly shall be slowly, pneumatically pressurized to 18 psig. This pressure shall be held for five minutes before reducing to zero. The valve assembly shall not present any sign of damage or permanent deformation. The test setup shall be as shown in figure 1.

6.3 External Proof Pressure.

The exterior of the valve assembly shall be slowly, pneumatically pressurized to 70 psig with the inlet and outlet ports at zero psig. This pressure shall be held for five minutes before reducing to zero. The valve assembly shall not present any sign of damage or permanent deformation. The test setup shall be as shown in figure 2.

6.4 Leakage.

Leakage testing shall be as follows:

a) Inlet - The inlet port shall be pressurized to 6.5 psig with air, or N_2. The valve assembly shall not exceed a leakage flow rate of 1×10^{-2} sccs from the outlet port.

This shall be done three times with one crack,- reseat cycle minimum between tests. The test setup shall be as shown in figure 3.

b) External - The exterior of the valve assembly shall be pressurized to 35 psig with air, H_e or N_2. The valve assembly shall not exceed a leakage flow rate of 1.0×10^{-6} sccs from the inlet and outlet ports combined. The test setup shall be as shown in figure 4.

6.5 Relief Operation.

The valve assembly shall be tested to check for operational conformance through three cycles minimum from crack to full open back to reseat. These cycles shall be done with an outlet pressure of 14.7 psia. The valve assembly shall go from seat to full open to reseat at inlet pressures between 7.0 to 9.0 psi above outlet pressure. Full open is defined as the inlet pressure required to sustain a flow rate of 775 scim minimum of N_2 at 70°F inlet temperature with an outlet pressure of 14.7 psia.

NOTE: Test conditions of 23.7 psia inlet, 14.7 psia outlet and 775 scim are equivalent to 9 psia inlet, 0 psia outlet and 300 scim.

6.6 High Temperature.

The valve assembly shall be tested in accordance with Method 501, Procedure I, of Standard MIL-STD-810B except the exposure period at plus 160°F shall be four hours. Steps 4 and 5 of the procedure shall be deleted. After this the valve assembly shall be examined for failure and tested in accordance with 6.5. The test setup shall be as shown in figure 5.

6.7 Low Temperature.

The valve assembly shall be tested in accordance with Method 502, Procedure I, of MIL-STD-810B except that steps 4 and 5 of the procedure shall be deleted. The storage temperature shall be -40°F and the storage period shall be four hours. After this the valve assembly shall be examined for failure and tested in accordance with 6.5. The test setup shall be as shown in figure 5.

6.8 **Vibration.**

The valve assembly shall be installed in a test setup which simulates the vehicle installation. Vibration testing shall be as follows:

a) Vehicle dynamics criteria. The test setup shall be subjected to a sinusoidal scan at 3.0 octaves per minute along each of the three major axes, as indicated in figure 6. The levels and frequency ranges shall be as follows:

(1) 3 to 7 Hz at 0.43 inches double amplitude displacement
(2) 7 to 14 Hz at 1.1 g peak
(3) 14 to 25 Hz at 0.11 inches double amplitude displacement
(4) 25 to 60 Hz at 3.6 g peak

b) Sine evaluation criteria. The setup shall be subjected to a sinusoidal scan at 1.0 octave per minute along each of the three major axes, as indicated in figure 6. The levels and frequency ranges shall be as follows:

(1) 20 to 100 Hz at 0.0020 inches double amplitude displacement.
(2) 100 to 2000 Hz at 1.0 g peak

c) Lift-off random criteria. The test setup shall be subjected to 1.0 minute of random vibration along each of the three major axes, as indicated in figure 6. The levels shall be as follows:

(1) 20 to 25 Hz at plus 10.0 db per octave
(2) 25 to 80 Hz at 0.20 g^2 per Hz
(3) 80 to 125 Hz at minus 6.0 db per octave
(4) 125 Hz at 0.080 g^2 per Hz
(5) 125 to 2000 Hz at minus 3.0 db per octave
(6) 2000 Hz at 0.0050 g^2 per Hz

Composite equals 6.8 grms

d) Boost random criteria. The test setup shall be subjected to 2.0 minutes of random vibration along each of the major axes, as indicated in figure 6. The levels shall be as follows:

(1) 20 Hz at 0.025 g^2 per Hz
(2) 20 to 25 Hz at plus 10.0 db per octave
(3) 25 to 80 Hz at 0.050 g^2 per Hz
(4) 80 to 125 Hz at minus 6.0 db per octave
(5) 125 Hz at 0.020 g^2 per Hz
(6) 125 to 2000 Hz at minus 3.0 db per octave
(7) 2000 Hz at 0.0012 g^2 per Hz

Composite equals 3.4 grms

At the conclusion of all vibration the valve assembly shall be examined for failure, and tested in accordance with 6.5 except outlet pressure shall always be 14.7 psia.

6.9 Life Cycle.

The valve assembly shall be subjected to 1000 cycles of operation. The cycles shall be from crack to full open back to reseat. After every 250 cycles the valve assembly shall be examined for failure and tested in accordance with 6.5.

6.10 Burst Pressure.

6.10.1 Nondestructive.

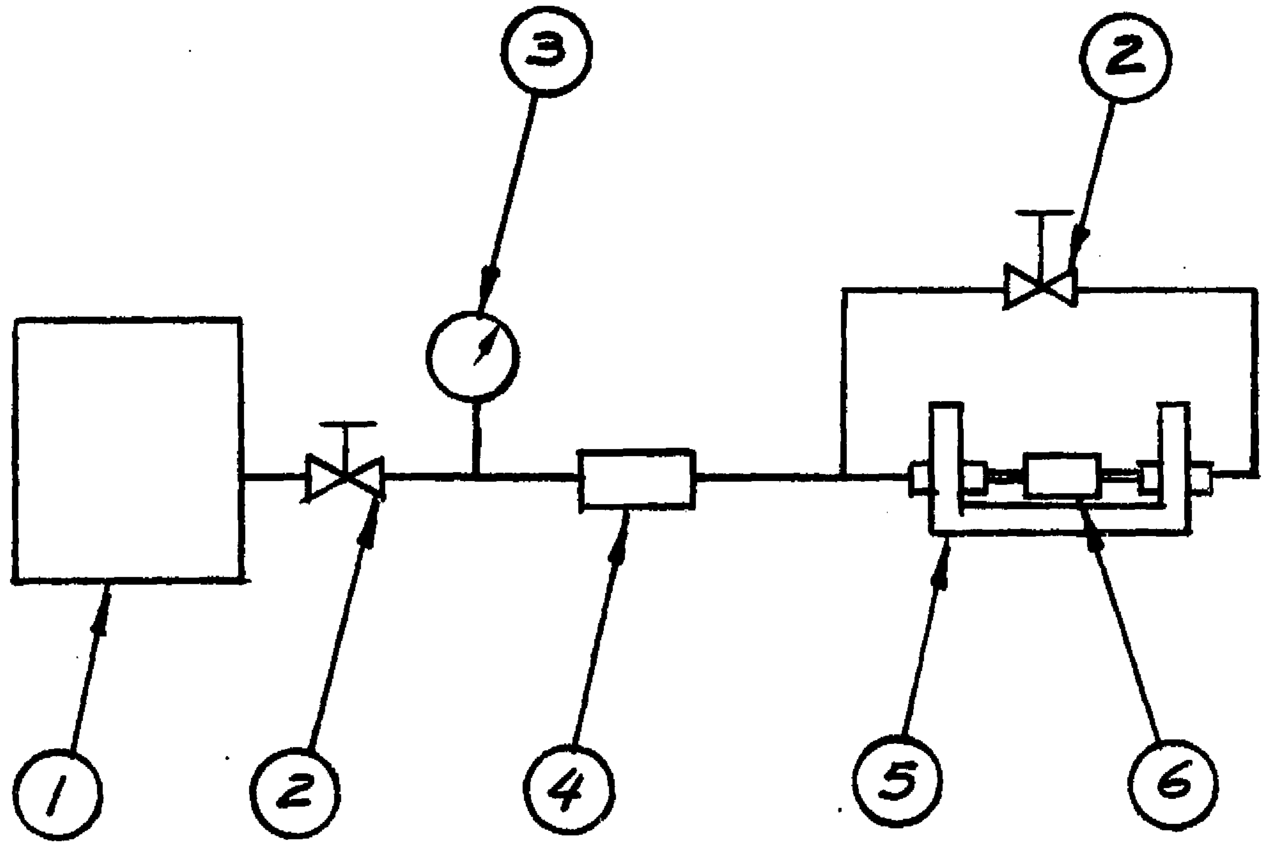
The inlet and outlet ports of the valve assembly shall be slowly pressurized to 36 psig. This pressure shall be held for three minutes before reducing to zero. The valve assembly shall not present any signs of rupture.

6.10.2 Collapse Pressure.

The exterior of the valve assembly shall be slowly pressurized to 140 psig with the inlet and outlet ports at zero psig. This pressure shall be held for three minutes before reducing to zero. The valve assembly shall not present any signs of collapse

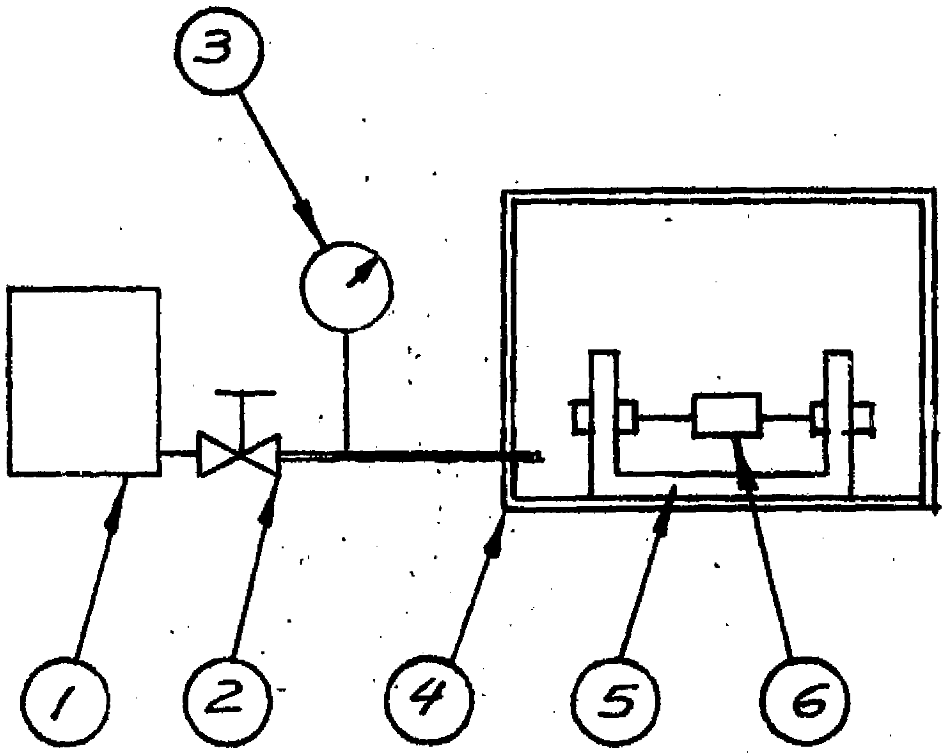
6.10.3 Destructive.

The inlet and outlet ports of the valve assembly shall be slowly pressurized to 36 psig. This pressure shall be held for three minutes. This pressure shall then be slowly increased until the valve assembly ruptures. The valve assembly shall rupture at 72 psig minimum.



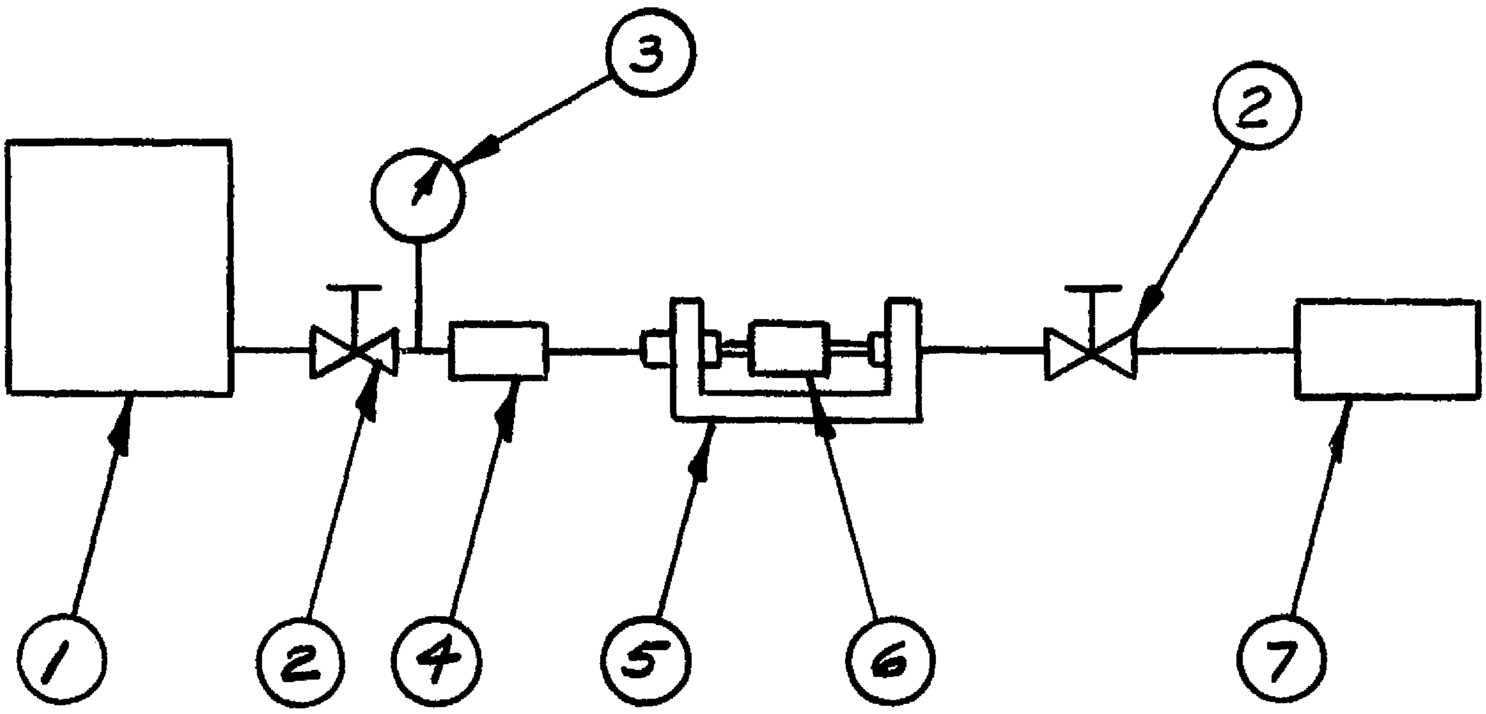
1. Helium Pressure Source
2. Hand Valves
3. Pressure Gage 0-25 psig
4. Filter 5 µ of better
5. Mounting Fixture
6. Test Specimen

Figure 1. Internal Proof Pressure Schematic



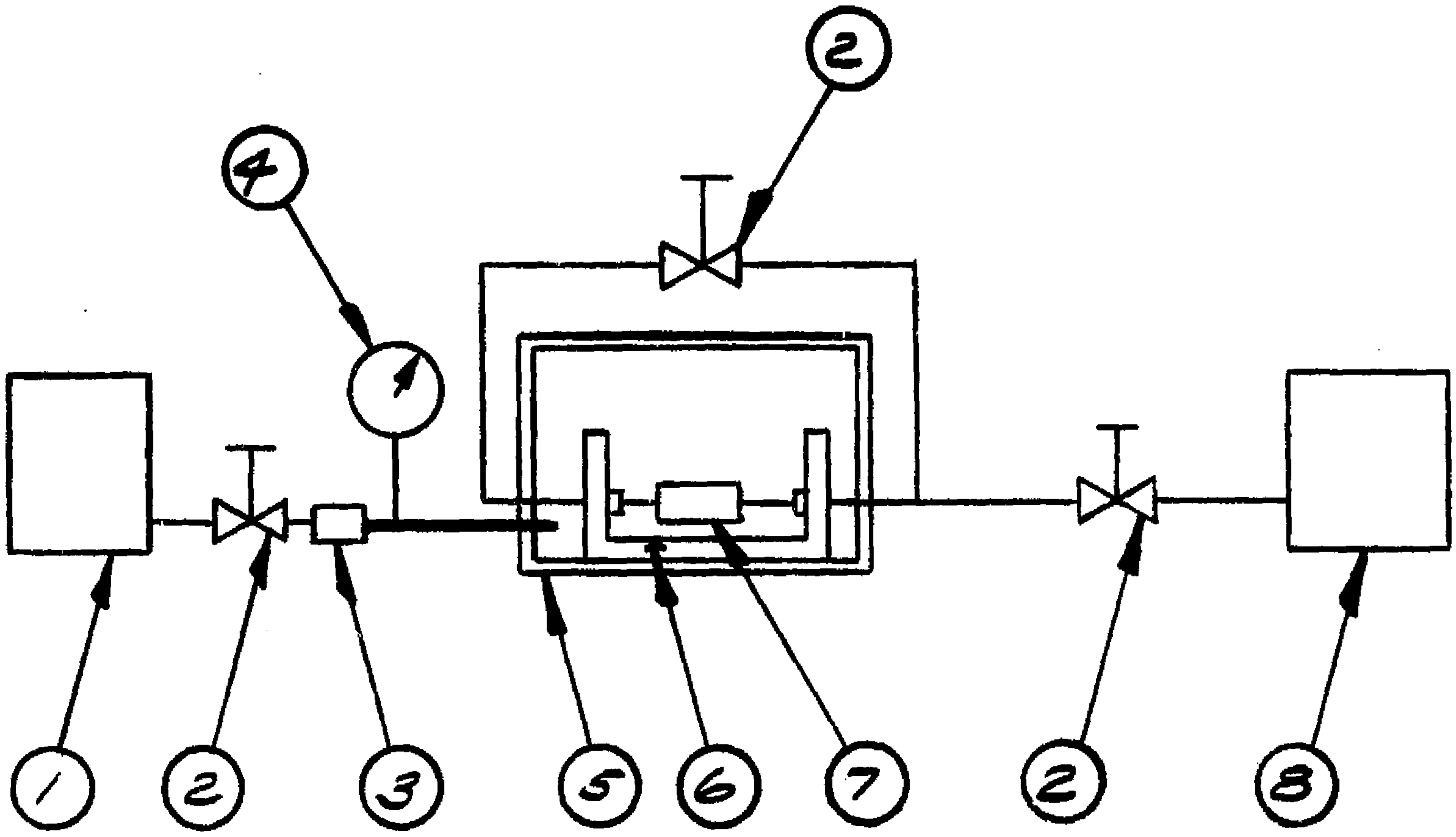
1. Helium Pressure Source
2. Hand Valve
3. Pressure Gage 0-200 psig
4. Pressure Chamber
5. Mounting Fixture
6. Test Specimen

Figure 2. External Proof Pressure Schematic



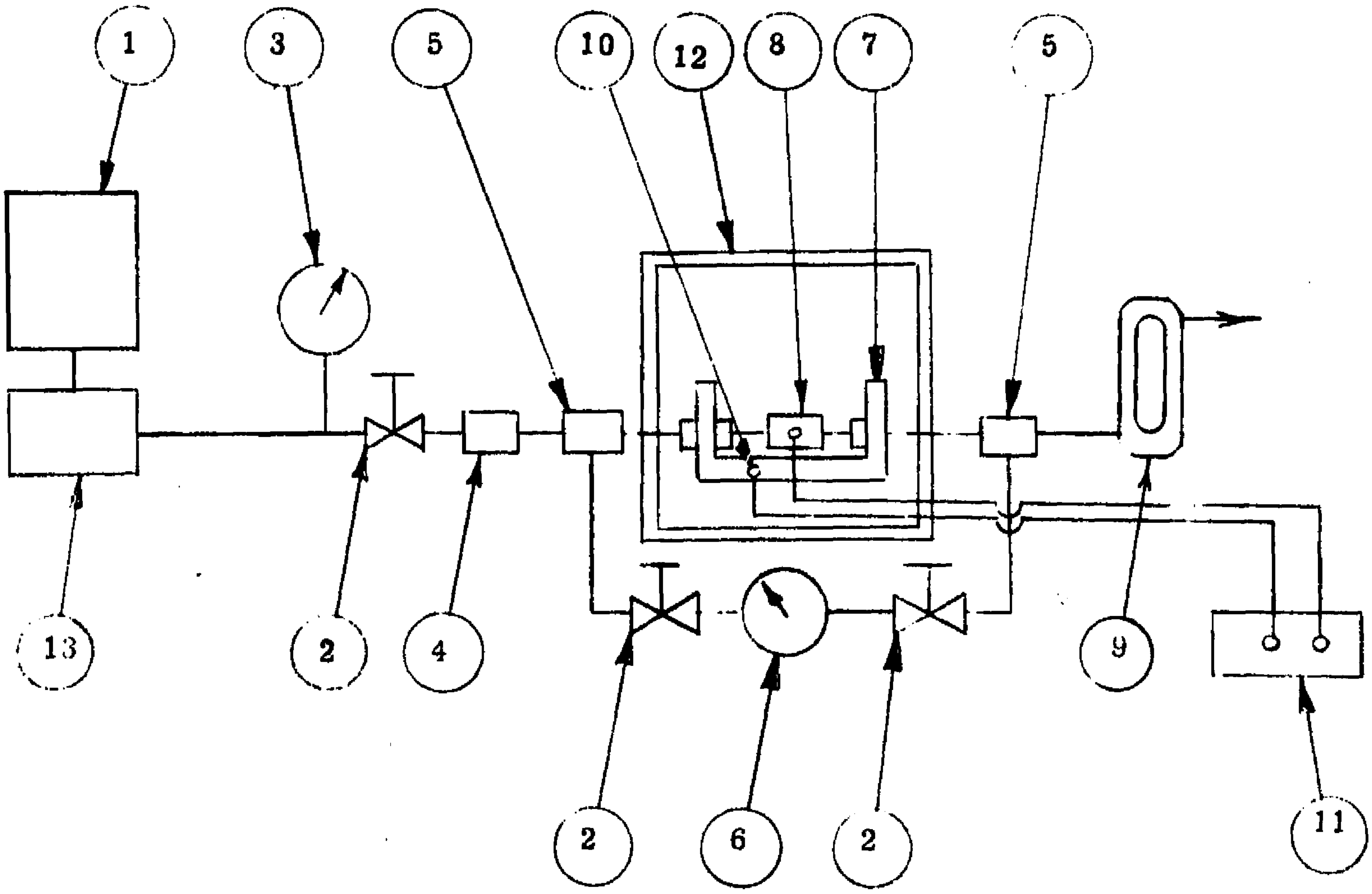
1. N_2 Pressure Source
2. Hand Valves.
3. Pressure Gage 0-25 psig
4. Filter 5μ or better
5. Mounting Fixture
6. Test Specimen
7. Isobaric Volume Change Leakage Detector

Figure 3. Internal Static Leakage Schematic



1. Helium Pressure Source
2. Hand Valves
3. Filter 5 μ of better
4. Pressure Gage 0-50 psig
5. Pressure Chamber
6. Mounting Fixture
7. Test Specimen
8. Mass Spectrometer CEC #24-120 or Equivalent

Figure 4. External Static Leakage Schematic



1 N_2 Pressure Source
2 Hand Valves
3 Pressure Gage 0-25 psia
4 Filter 5μ abs. or better
5 Piezometer or Equivalent
6 Differential Pressure Gage 0-10 psi
7 Mounting Fixture
8 Test Specimen
9 Flow Meter 0.02 to 1.00 scfm *
10 Thermocuples, 2-copper Constantan
11 Temperature Controller and Recorder
12 Temperature Chamber
13 3-Way Solenoid Valve

* The flow meter must be calibrated for the corresponding outlet pressure.

Figure 5. Relief Operation Schematic

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA				
NASA Specification 20M32254		S-W Part No. 834000	S/N	Date
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
6.1	Examination of Product	Acceptable/Nonacceptable		
6.2	Internal Proof Pressure	Acceptable/Nonacceptable		
6.3	External Proof Pressure	Acceptable/Nonacceptabe		
6.4 (a)	Internal Static Leakage	36 scch maximum		
6.4 (b)	External Static Leakage	1.0 x 10^{-6} sccs		
6.5	Relief Operation	a) P outlet = 14.7 psia crack: 21.7 psia min. full flow: 23.7 psia max. reseat: 21.7 psia min.	a) crack: psia full flow: psia reseat: psia	

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RELIEF VALVE ASSEMBLY - DEVELOPMENT DATA				
NASA Specification 20M32254		S/W P/N 834000	S/N	Date
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
6.8	Vibration	Sinusoidal Acceptable Non-acceptable Lift-off Acceptable Non-acceptable Random Acceptable Non-acceptable Ref. 6.5 Crack: 7.0 min. psig Full Flow: 9.0 max. psig Reseat: 7.0 min. psig		
6.9	Life Cycle Repeat 6.5 every 250 cycles	1000 Cycles Ref. 6.5 Crack: 7.0 psig min. Full Flow: 9.0 psig max. Reseat: 7.0 psig min. Internal Leakage 36 scch		
6.10	Burst 6.10.1 Non-destructive 6.10.2 Collapse 6.10.3 Destructive	Rupture - No Rupture Collapse - No Collapse Rupture Pressure 72 psig		

Conclusions:

Recommendations:

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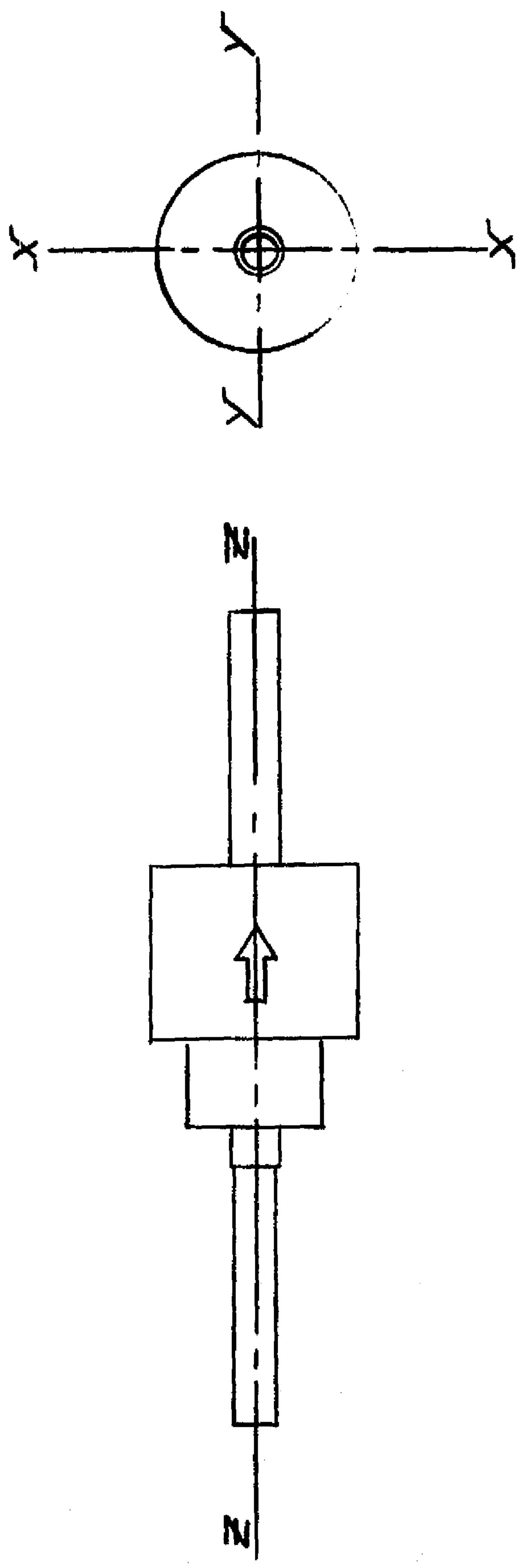

Figure 6. Component Vibration Axes.

REPORT NO. ER 834-2

DESIGN ANALYSIS VERIFICATION
FOR
RELIEF VALVE ASSEMBLY

STRATOS-WESTERN P/N 834000
NASA SPEC. NO. 20M32254

Prepared By: J. P. Amelsberg
J. Amelsberg, Product Engineer

Approved By: J. Morando
J. Morando, Product Manager

Approved By: J. Feld
J. Feld, Chief Engineer

31 July 1970

FAIRCHILD HILLER
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1.0 SCOPE

1.1 General

This design analysis verification establishes the assumptions and methods utilized in the dimensioning of Stratos-Western P/N 834000 relief valve assembly as set forth in NASA Spec. No. 20M32254.

1.2 Equipment Description

The relief valve assembly is intended to be used in the metabolic activity system of the Orbital Workshop (OWS).

2.0 GENERAL SPECIFICATION REQUIREMENTS

2.1 Working Pressures

2.1.1 Operational

a) Internal 9 psig
b) External 35 psig

2.1.2 Proof

a) Internal 18 psig
b) External 70 psig

2.1.3 Burst

a) Internal 36 psig
b) External 140 psig

2.2 Performance Requirements

2.2.1 Flow Rate

The flow shall be 300 scim of N_2 with an inlet pressure of 9.0 psia and an outlet pressure of 1×10^{-6} Torr at an inlet temperature of $70^{\circ}F$.

2.2.2 Operating Performance

The valve shall crack or reseat at a differential pressure of 7.0 psiΔ minimum and full flow at a differential pressure of 9.0 psiΔ maximum.

3.0 DESIGN ANALYSIS

3.1 Poppet Sizing

From paragraph 2.2.1.

Flow Rate : 300 scim GN_2

[1] $\dot{W} = \dfrac{\text{scim x Molecular Wt}}{4.01 \times 10^7}$

Then:

$$\dot{W} = \frac{300 \times 28}{4.01 \times 10^7} = 2.095 \times 10^{-4} \text{ lbs/sec.}$$

P_{in} = 9.0 psia

$P_{out} = 1 \times 10^{-6}$ Torr

$T_{in} = 70^\circ F = 529.7^\circ R \cong 530^\circ R$

The flow equation for sonic flow condition is given by:

[2] $$\dot{W} = \frac{A \, P_{in} C_D \sqrt{gk \left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}}{\sqrt{RT}} \quad \text{(lbs/sec)}$$

Where:

K = 1.4 specific heat ratio

$$R = \frac{1545}{\text{Molecular Wt.}} = \frac{1545}{28} = 55.2 \frac{\text{ft-lb}}{\text{lb}^\circ \text{R}}$$

C_D = 0.65 discharge coefficient

The orifice area required will then be:

[3] $$A = \frac{\dot{W} \sqrt{RT}}{P_{in} \, C_D \, S} \quad (\text{in}^2)$$

Where S is the sonic discharge constant for nitrogen ($P_2/P_1 < .528$)

[4] $S = \sqrt{gk \left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}} = 3.88 \text{ ft}^{1/2} \text{ sec}^{-1}$

Replacing in [3]

$$A = \frac{2.095 \times 10^{-4} \sqrt{55.2 \times 530}}{9.0 \times .65 \times 3.88} = 1.58 \times 10^{-3} \text{ in}^2$$

$A = .00158 \text{ in}^2$

$d \cong .045$ in

The valve has been provided with four (4) .075 diameter orifices for flow passage through the valve poppet (see figure 1). The poppet seat diameter has been selected as:

$D_{seat} = .175$ in

The required poppet stroke to obtain the minimum flow area is given by:

[5] $X_p = \frac{A}{\pi D_{seat}}$

Replacing values:

$$X_p = \frac{.00158 \text{ in}^2}{3.14 \times .175 \text{ in}} = .0028 \text{ in}$$

Selected X_p = .015 min.

3.2 Springs and Bellows Dimensioning

For the analysis that follows, refer to figure 1.

The following balance equations can be written:

A) The bellows will start to move at a pressure P_m given by:

[6] $P_m = \frac{F_{assy\ 1}}{A_B}$

Where:

$F_{assy\ 1}$ = Assembly load of main spring

A_B = Bellows effective area = .403 in^2

P_m = 6.05 psi adopted

Then:

$F_{assy\,1}$ = 6.05 x .40 = 2.435 lbs.

$F_{assy\,1} > \text{Max } G_{acc} \times M_D$

Where:

M_D = Dynamic mass = .033 lbs/g

Max G_{acc} = 8 g's

$F_{assy} > .033 \frac{lbs}{g} \times 8g = .264$ lbs.

The assembly load provided allows for almost 10 times the maximum vibration acceleration required.

B) At the moment the valve reaches cracking pressure, the balance e equation is:

[7] $F_{assy\,1} + (R_1 + R_B) X_1 + F_{assy\,2} = P_C (A_B - A_P)$

Where:

A_P = Poppet Area = .024 in.^{2}

R_1 = Spring 1 Rate

R_B = Bellows Rate = 2.00 lbs/in.

P_C = Cracking pressure = 7.8 psi > 7.0 psi min.

X_1 = Bellows stroke: .025 in (adopted)

C) At full flow condition, the balance equation is:

[8] $F_{assy\,1} + F_{assy\,2} + (R_1 + R_B)(X_1 + X_p) + R_2 X_p = P_F (A_B - A_p)$

Where:

$F_{assy\,2}$ = Assembly load of poppet spring = .30 lbs.

R_2 = Spring 2 rate, A_p = poppet area = .024 in.^{2}

X_p > .015 in. poppet stroke > .0028 in min required.

P_F = Full open pressure = 8.80 psi < 9.0 psi max.

Subtracting 8 - 7

[9] $(R_1 + R_2 + R_B)\, X_p = (P_F - P_c)(A_B - A_P)$

[10] $R_1 + R_2 \leq \dfrac{(P_F - P_C)(A_B - A_P)}{X_1} - R_B = 23$ lbs/in.

[11] $R_1 \leq \dfrac{P_c(A_B - A_P) - F_{assy\,1} - F_{assy\,2}}{X_1} - R_B = 8.4$ lbs/in.

$\therefore \quad R_2 \leq 14$ lbs/in.

The spring rates adopted are:

$R_1 = 8.0$ lbs/in ($X_1 = .026$ in.)

$R_2 = 4.0$ lbs/in ($X_p = .027$ in.)

Note: These rates will provide a valve stroke with ample margin to meet flow requirements.

4.0 STRESS ANALYSIS

4.1 Component Parts

4.1.1 Main Spring

The spring total force is given by:

[12] $F_T = F_{assy\,1} + R_1 (X_1 + X_p)$

$F_T = 2.400 + 8.0\,(.050) = 2.800$ lbs.

The spring stress equation is given by:

[13] $S_{max} = 2.55 \dfrac{F_T D_s K}{d^3}$

Where:

D_s = Mean spring diameter .520 in.

d = Wire diameter .044 in.

K = Wahl factor $= \dfrac{(4C-1)}{((4C-4)} + \dfrac{(.615)}{C}$ [14]

C = Spring index $= \dfrac{D}{d} = 11.8$

Consequently:

$$K = \left(\frac{47.2-1}{47.2-4}\right) + \left(\frac{.615}{11.8}\right)$$

$$K = 1.07 + .052 = 1.122$$

Replacing in [13]

$$S_{max} = \frac{2.55 \times 2.800 \times .520 \times 1.122}{8.55 \times 10^{-5}}$$

$$S_{max} < 50,000 \text{ psi}$$

The maximum allowable stress for 302 CRES wire is 120,000 psi.

$$S_{max} \ll S_{allowable}$$

4.1.2 Poppet Spring

The poppet spring selected has the following characteristics:

D_s = .250 in

d = .024 in

$F_{assy\ 2}$ = .30 lbs.

$F_t = F_{assy\ 2} + R_2 X_p$ = .380 lbs

$$C = \frac{.250}{.024} = 10.42$$

$$K = \left(\frac{41.7-1}{41.7-4}\right) + \left(\frac{.615}{19.42}\right) = 1.38$$

$$S_{max} = \frac{2.55 \times .380 \times .250 \times 1.138}{1.38 \times 10^{-5}}$$

$$S_{max} = 20,000 \text{ psi} \ll 120,000 \text{ psi}$$

4.1.3 Housing

At the larger diameter section:

$$[15] \quad S_{T\ yield} = \frac{P_p D_{max}}{2t}$$

P_p = Proof pressure S_t yield 304L : 28,000 psi

$$t \geq \frac{70 \times 1.00}{2 \times 28,000} = 1.25 \times 10^{-3} \text{ in}$$

$t \geq .00125$ in

The minimum housing wall thickness has been established as t = .034 in.

4.1.4 End Weld

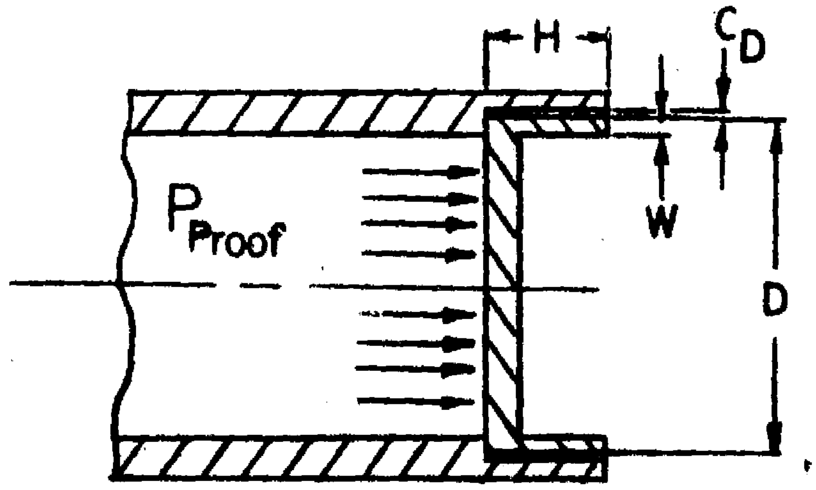
For the end weld design, the following equation is used:

$$[16] \quad P_{proof} = \left[\frac{4W}{D}\right] S_{T \cdot yield}$$

D = Weld joint diameter

W = Weld joint thickness

C_D = Diametral clearance



$$W = \frac{P_{proof} \times D}{4 \; S_t \text{ yield}}$$

P_{proof} (Internal) = 18 psig

$$W = \frac{18 \times 1.0}{4 \times 28,000} = 1.6 \times 10^{-4} \text{ in}$$

Adopted Weld Configuration

W = .015

H = .130

C_D = .003 max.

4.1.4 Bellows Stability

Refer to Figure 1

The nominal pressure rating of the bellows is determined by

$$[17]\ P_R = \frac{1.25 \times 10^6 \times t^2}{(2h - t)^2}$$

Where:

h = Convolution Height = $\frac{O.D. - ID}{2}$ = .132 in

t = Material Thickness = .0010 in.

P_R = 17.8 psi

Bellows Proof Pressure = 1.75 P_R = 31.2 psi > P_{proof} specified

P_{burst} = 2.5 P_R = 44.5 psi > P_{burst} specified

Note: A teflon ring (3) has been provided on the bellows end plate-seat assembly (2) enclosing a gas volume that will serve as damping element, but pressure is allowed within the volume thru controlled clearance.

4.1.5 Bellows Hoop Stress

The bellows hoop stress is calculated by converting the total area per inch of bellows running length into a tube of equivalent wall thickness and using the standard equation for cylinder hoop stress.

The equivalent wall thickness is given by

$$t_e = nt\ [0.57 + \frac{2h}{e}]$$

t = Thickness of one ply = .001 in

e = pitch (length of one convolution) = .058 in

n = No. of plies = 1

h = Height of a convolution = $\frac{D_o - D_i}{2}$ = .132 in

$t_e = .001\ [0.57 + \frac{.264}{.058}] = .0051$ in

$S_{\substack{max \\ burst}} = \frac{P_B\ D_m}{2\ t_e}$ $\qquad$ $S_{proof} = \frac{P_P\ D_m}{2\ t_e}$

$D_m = \frac{D_o + D_i}{2} = .735$

S_{burst} = 2580 psi $\qquad$ S_{proof} = 1290 psi

$$S_{burst} \ll S_{PN_i}$$

Based on the stress levels determined in 4.1.4 and 4.1.5, the bellows expected cycle life will be:

$L_C \gg 1 \times 10^8$ cycles

The specification requirement is 1×10^3 cycles

$L_C \gg$ Life Requirement

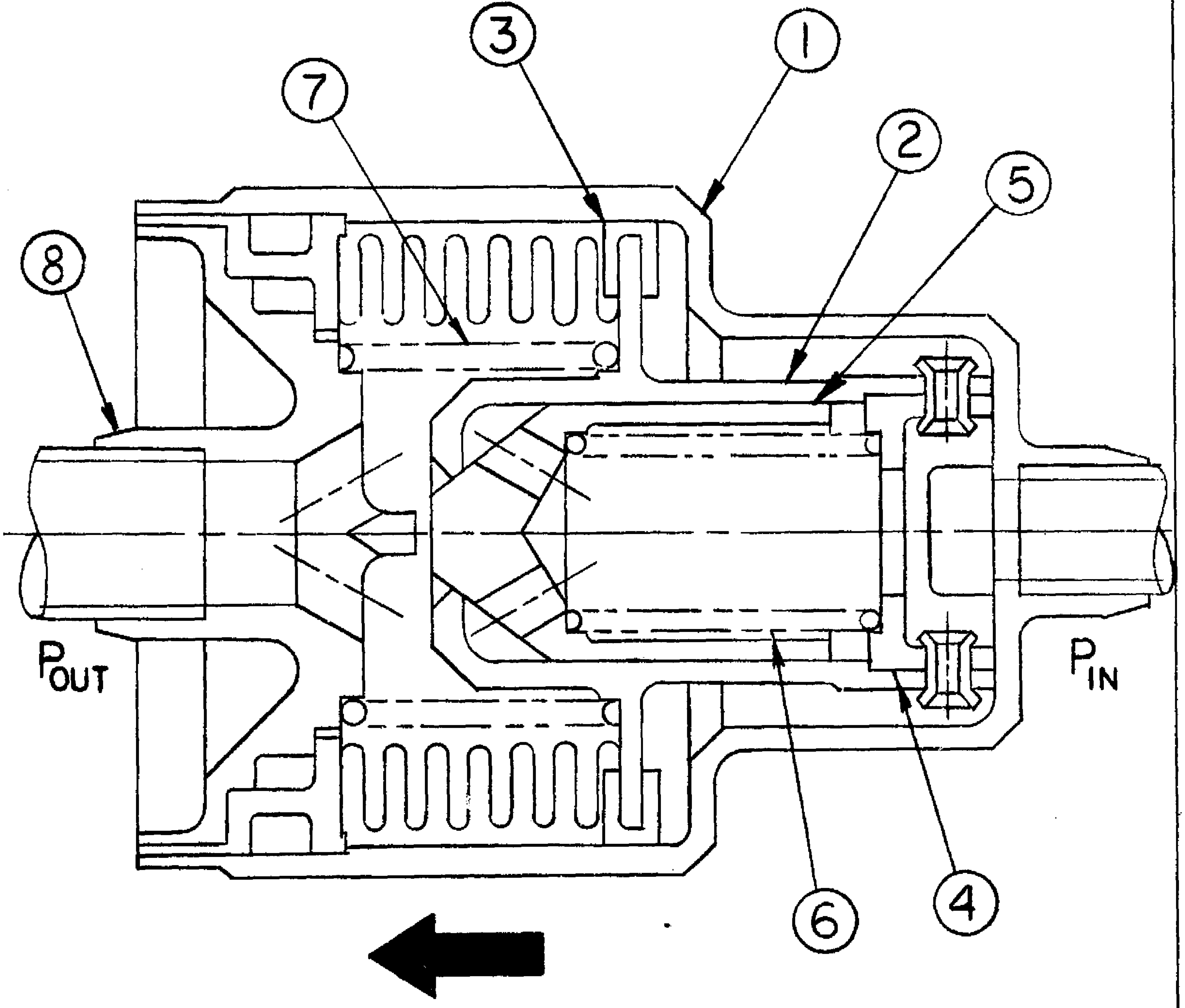


FIGURE 1

REPORT ER 834-3

ASSEMBLY PROCEDURE

RELIEF VALVE ASSEMBLY

Stratos-Western P/N 834000

Prepared By: J. Amelsberg, Senior Product Engineer

Approved By: J. Morando, Product Manager

Approved By: R.V. Smith, Staff Engineer, Reliability

30 September 1970

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1.0 INTRODUCTION

This document describes the procedure for assembling, adjusting, and pretesting the Relief Valve Assembly, Stratos-Western Part No. 834000.

2.0 APPLICABLE DOCUMENTS.

The following documents form a part of this document to the extent specified herein

Military

MIL-P-27401B	Propellant Pressurizing Agent, Nitrogen

NASA

Specification No. 20M32254	Specification for Relief Valve Assembly
MSFC 164(4)	Cleanliness of Components for Use in Oxygen, Fuel and Penumatic System

Stratos-Western

999-331	Contamination Control Procedure

3.0 ASSEMBLY PROCEDURES

The unit shall be assembled and pretested in accordance with these procedures prior to final assembly.

3.1 Precleaning

All detail parts shall be precleaned in accordance with Stratos-Western Specification No. 999-331, with the following exceptions:

a) Part No. 834015, Kel-F material poppet shall only be exposed to these tests and sequences

(1) Ultraviolet inspection
(2) Swab with pluronic No. L62LF
(3) Rinse with demineralized water

b) All remaining nonmetallic parts shall be cleaned per Specification No. 999-331, Section 'B', paragraph 4.3.

3.2 Preassembly Final Rinse

Qualitative tests are as follows:

a) Particulate contamination limits as taken from 500 milliliter minimum rinse sample:

Between 175 and 700 microns	Qty. 5 maximum
Between 700 and 2500 microns	Qty. 1 maximum
No particles greater than 2500 micron	

b) The nonvolatile residue shall not be greater than 0.001 grams per square foot of utilized fluid medium surface. This NVR shall be taken from the millipore rinse of the particulate count.

c) Immediately prior to assembling of unit, repeat ultraviolet inspection. No fluorescence of hydrocarbon smears shall be present.

3.3 <u>Final Cleaning (After ATP)</u>

a) The unit shall be taken to the clean room.

*b) Apply 10 psig of dry-filtered gaseous nitrogen to the inlet of the relief valve for 1 minute through a 2 micron absolute filter

c) After the first minute - stop - and insert a millipore and bomb downstream of the valve outlet. Purge unit again for one minute. Stop.

d) Remove and read the millipore pad. Particulate count must meet the particulate count limits of paragraph 3.2 (a)

e) Ultraviolet Examination: for hydrocarbon smears on exterior surface of the valve.

f) Visual Examination: inspect for exterior damage due to handling.

[illegible] Certified protective packaging shall be per Stratos-Western Specification No. 999-331, section 'B', paragraph 5.0.

4.0 PRELIMINARY ASSEMBLY

4.1 (Refer to drawing in figure 1.)

Install poppet (834015) in bellows assembly (834010), insert poppet spring (834014) and spring retainer (834013). Retain in place by using pin per MS51838-16 or equivalent. Measure force to start displacing the poppet from it's seat. Add shims (834030) until the force required is equal to F_o = 0.70 ± 0.02 pounds.

NOTE: Extreme care must be taken in order not to damage the bellows:

The force to displace the poppet 0.010 inch shall be F_s = 0.74 ± 0.02 pounds.

Finish assembling unit as shown in figure 1, using O-ring. seals ARP568-016 and -019 installed in the location shown, After assembly retain unit together with assembly fixture shown in figure 2. Submit unit to pretest. Test for cracking pressure, full flow pressure, reseat pressure and leakage, in setup per figures 3 and 4. Reshim under the main spring (834017) with shims (834029) as necessary until the valve performance meets the requirements listed.

a. Leakage at 6.5 psig inlet pressure 2 x 10^{-3} sccs

b. Cracking pressure 7.5 psig minimum*

c. Reseat pressure 7.5 psig minimum*

d. Full flow pressure is the inlet pressure required to flow 775 scim and shall not exceed 8.80 psig

All these values are to be met with an outlet pressure of 0 psig (14.7 psia).

4.2 Record final pretest performance, and number of shims required for poppet and main-springs.

* Cracking or reseating pressure is defined as the pressure required to sustain a flow of 50 sccm.

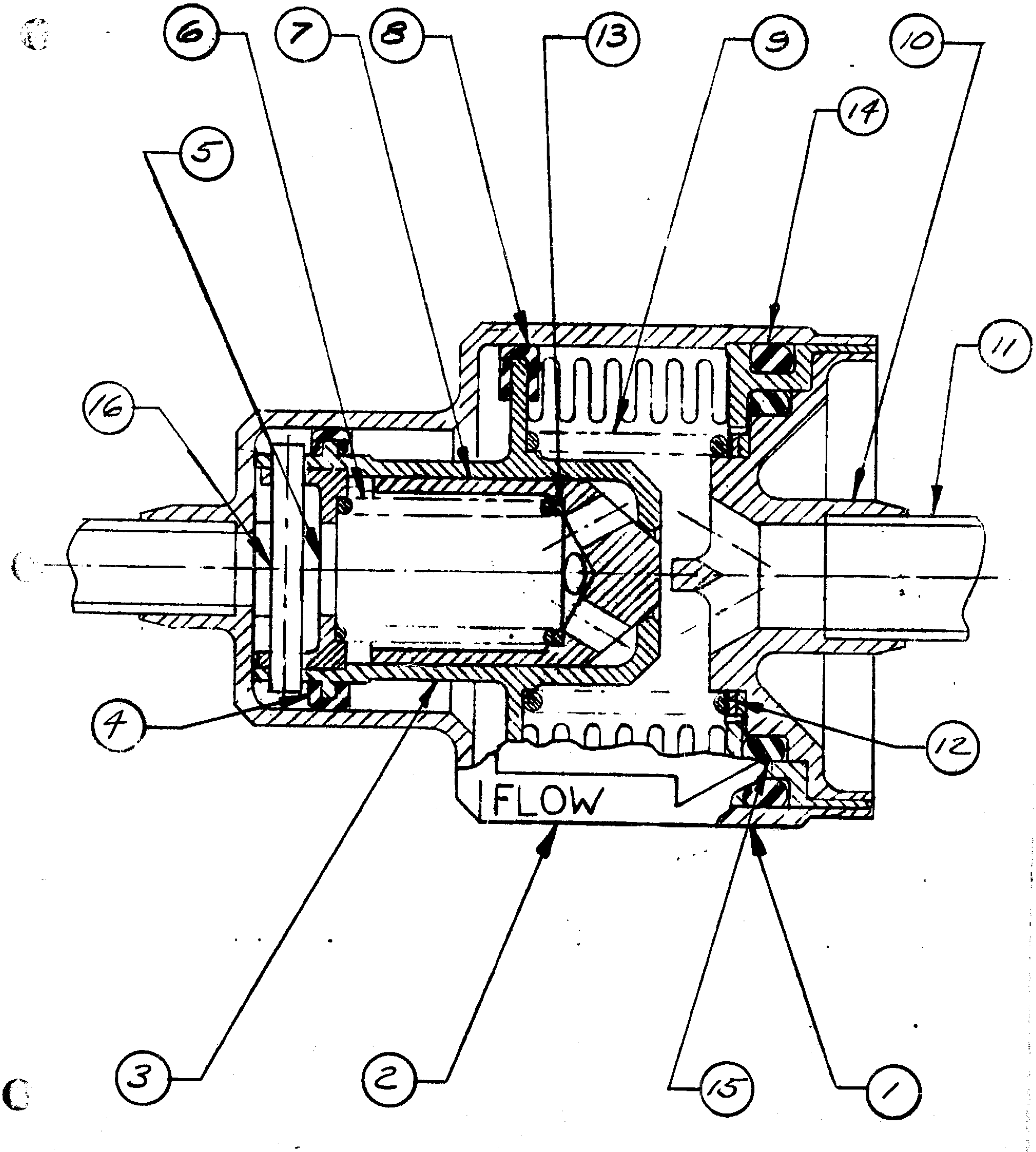


FIG I

QTY REQD	DESCRIPTION	PART NO.	ITEM
1	PIN	MS51833-16	16
1	SEAL, BUTYL	ARP568-016	15
1	SEAL, BUTYL	ARP568-019	14
A/R	SHIM	834030	13
A/R	SHIM	834029	12
1	TUBE, OUTLET	834019	11
1	FLANGE, OUTLET	834018	10
1	SPRING, MAIN	834017	9
1	RING, DAMPER	834016	8
1	POPPET	834015	7
1	SPRING, POPPET	834014	6
1	RETAINER, SPRING	834013	5
1	RING, GUIDE	834007	4
1	BELLOWS ASSY	834010	3
1	BODY, VALVE	834008	2
✓	VALVE ASSY	BASIC	1

FIG 1

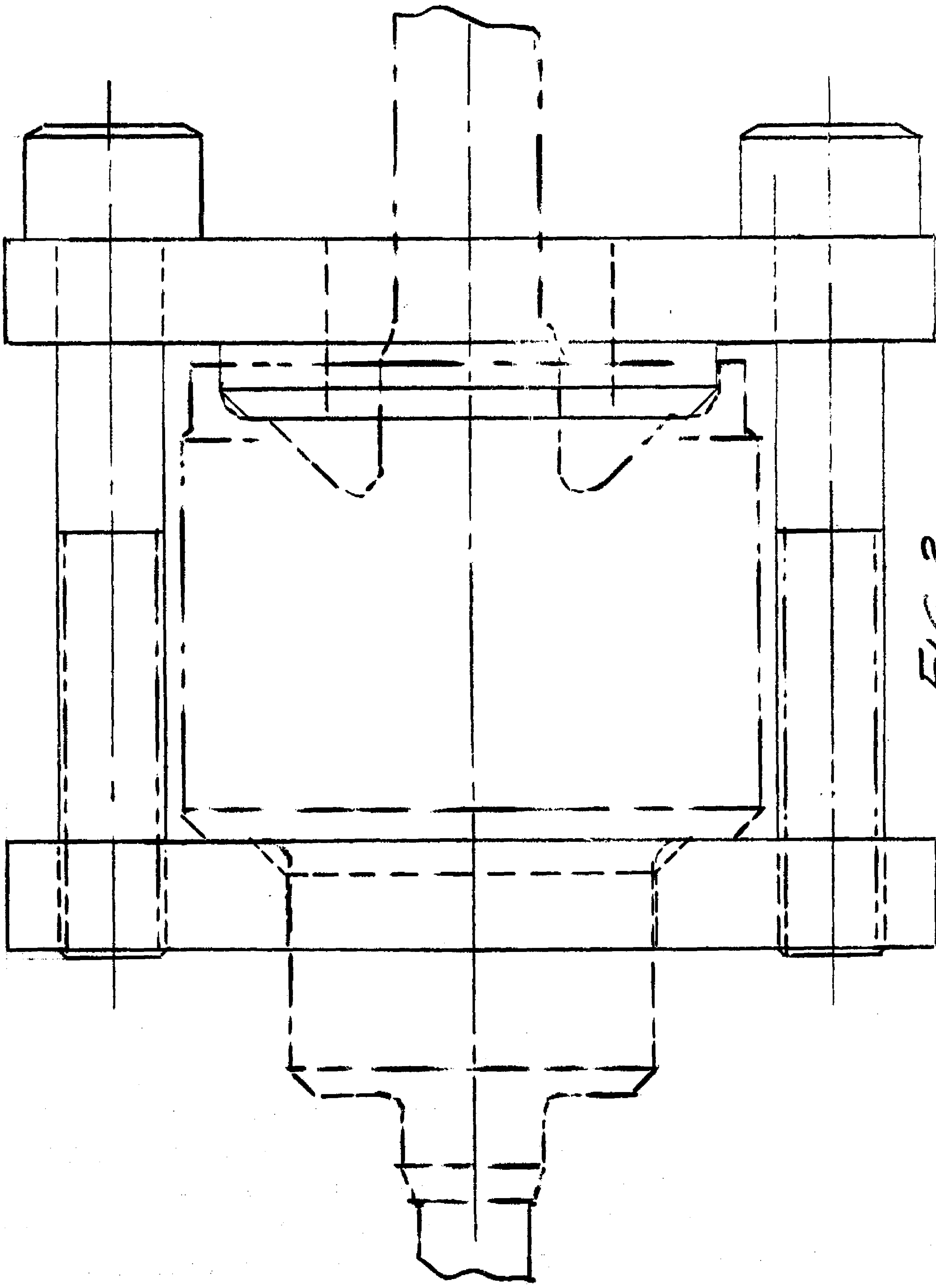
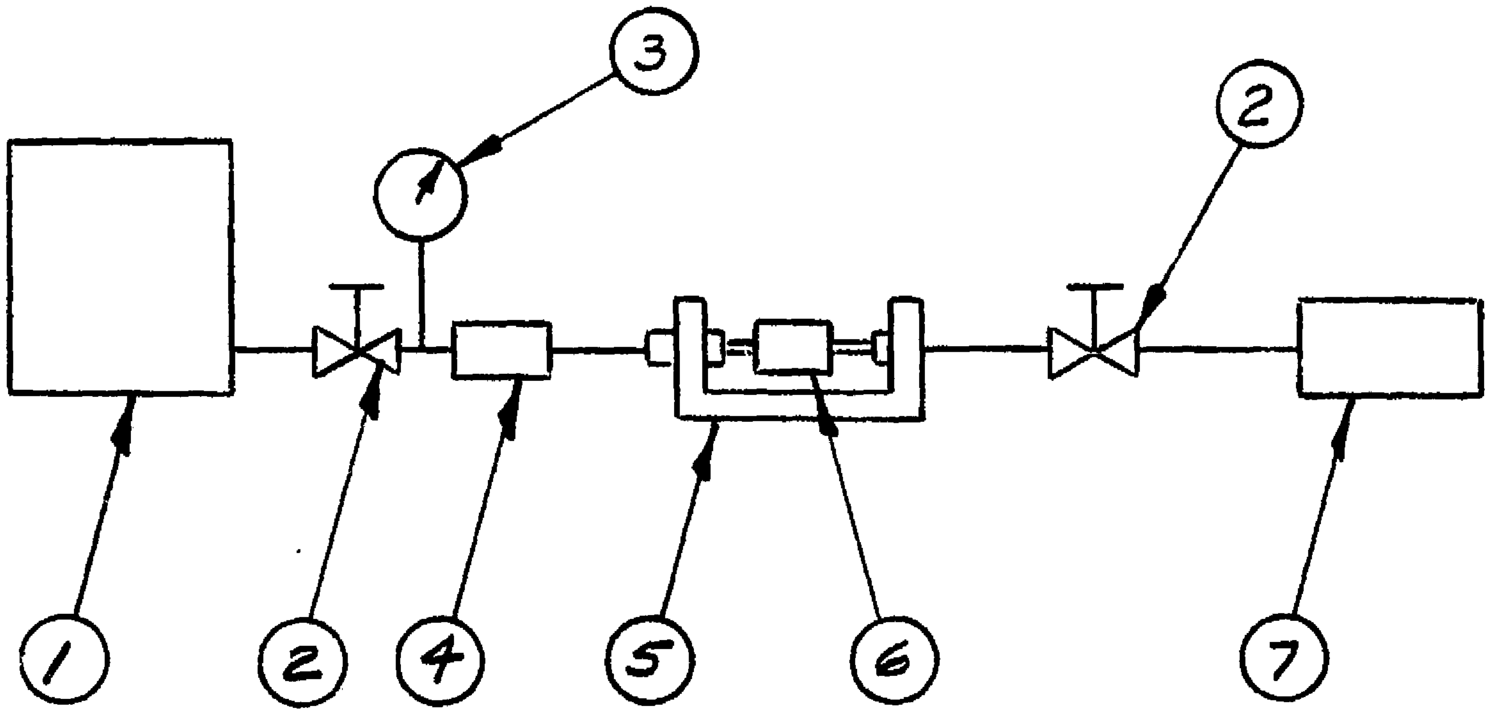
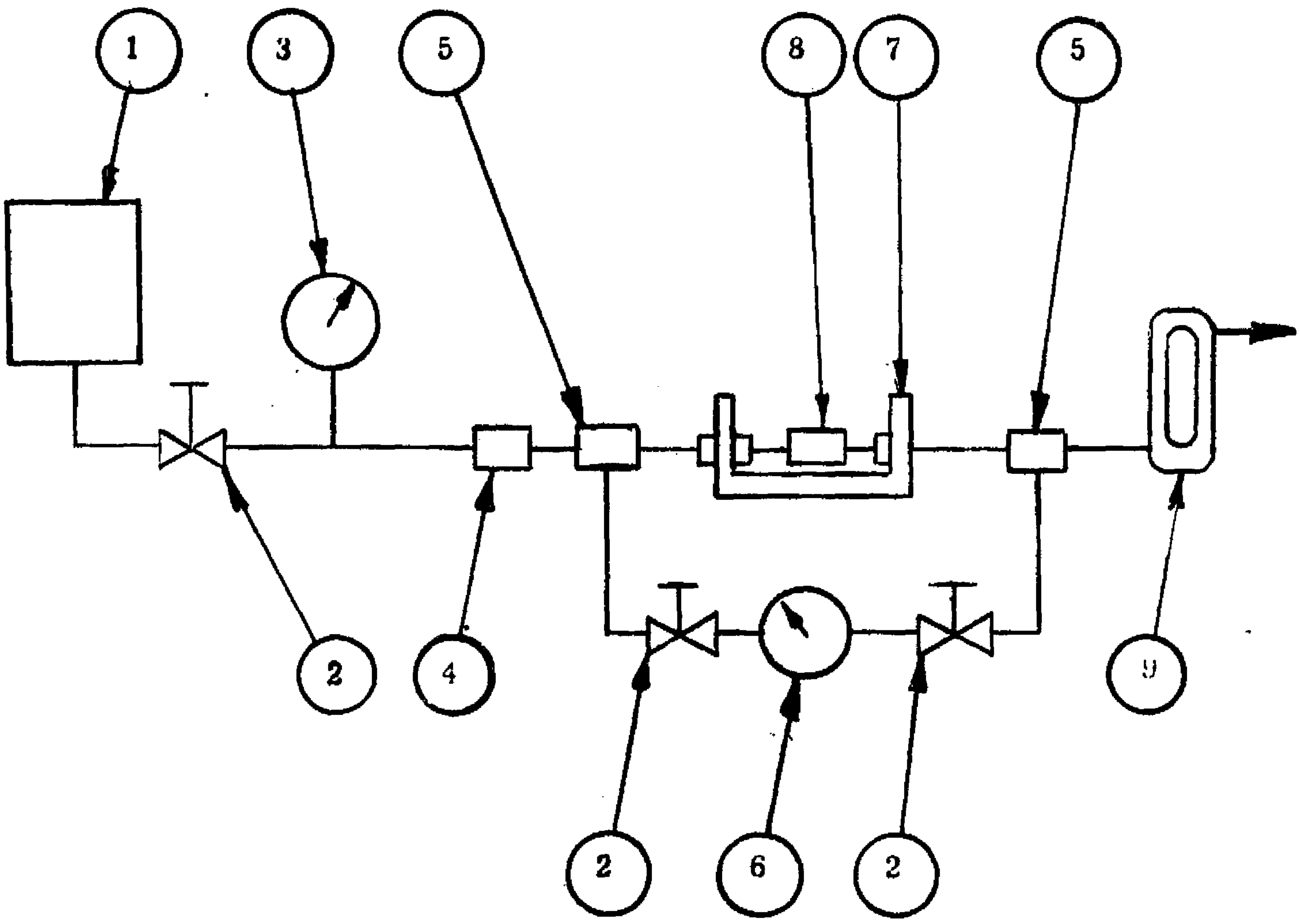


FIG 2



1. N_2 Pressure Source
2. Hand Valves.
3. Pressure Gage 0-25 psig
4. Filter 5 μ or better
5. Mounting Fixture
6. Test Specimen
7. Isobaric Volume Change Leakage Detector

Figure 3. Internal Static Leakage Schematic



1 N_2 Pressure Source
2 Hand Valves
3 Pressure Gage 0-25 psia
4 Filter 5 μ abs. or better
5 Piezometer or Equivalent
6 Differential Pressure Gage 0-10 psi
7 Mounting Fixture
8 Test Specimen
9 Flow Meter 0.02 to 1.00 scfm *

* The flow meter must be calibrated for the corresponding outlet pressure.

Figure 4 Relief Operation Schematic

QTP ER834 - 4

QUALIFICATION TEST PROCEDURE

RELIEF VALVE ASSEMBLY

Stratos-Western P/N 834000
NASA Spec. No. 20M32254

Prepared by: ______________________
J. Amelsberg, Product Engineer

Approved by: ______________________
R. Smith, Reliability Engineer

Approved by: ______________________
W. Wiegand, Test Supervisor

25 August 1970
Rev. A - 14 December 1970
Rev. B - 13 April 1971

FAIRCHILD HILLER
STRATOS-WESTERN
1800 ROSECRANS AVENUE
MANHATTAN BEACH, CALIF., 90266

CHANGE RECORD

REV.	SECTION	PAGE	DESCRIPTION	DATE/ APPROVAL
A			CN 11254	
		Title	Updated to A Revision - & Table of Contents	
	4.7	5	Was: Flowmeter with 0 to 1.00 scfm range IS: Flowmeter with 0.2 to 1.30 scfm range	
			Was: Pressure gages: 0-50 psig, 0-10 psid, 0-25 psig IS: Pressure gages: 0-60 psig, 0-30 psid, 0-30 psid	
	5.2.2	11	Was: Pressurized to 35 psig with air, He, or N_2. IS: Pressurized to 35 psig with gaseous helium	
			Was: as shown in figure 1 IS: as shown in figure 4	
	5.2.3	11	Was: Flowrate of 775 scim IS: Flowrate of 1550 scim	
			Was: sustained flowrate of 300 scim IS: Sustained flowrate of 600 scim.	
	5.2.5	11	NOTE: Was: Outlet and 775 scim IS: Outlet and 1550 scim.	
			Was: 0 psia outlet and 300 scim IS: 0 psia outlet and 600 scim.	
	Figure 1	13	Revised schematic	
	Figure 2	14	Revised Schematic	
	Figure 3	15	Revised Schematic	
	Figure 4	16	Revised Schematic	
	Figure 5	17	Revised Schematic	
	Figure 7	19	Revised Schematic	
	Test Logs	Sht. 1-18	Added to reflect actual tests	
B	5.2.3	11	WAS: Refer to figure 5. Repeat full open test once with an outlet pressure of 1×10^{-6} Torr. and minimum sustained flowrate of 600 scim Refer to figure 7. IS: Refer to figure 5. After performing the life cycle tests (para. 5.1.5) repeat a full open test once with a starting outlet pressure of 1×10^{-6} Torr. and a minimum sustained flowrate of 600 scim. Refer to figure 7. Changes Per CN 11587	

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1.0 SCOPE

1.1 General

This test plan establishes the conditions and procedures required for the qualification tests of the valve assembly, relief Stratos-Western part number 834000 as set forth in NASA specification 20M32254.

1.2 Equipment Description

The relief valve assembly is intended to be used in the metabolic activity system of the Orbital Workshop (OWS).

2.0 APPLICABLE DOCUMENTS

2.1 Listing

The following documents, of the issue noted, form a part of this drawing to the extent specified herein. This document should prevail in case of conflict.

George C. Marshall Space Flight Center

20M32254	Valve Assembly, Relief
MSFC-SPEC-101	Flammability Requirements and Test Procedures for Materials in Gaseous Oxygen Environments
MSFC-SPEC-135	Welding, Fusion, Specification for
MSFC-SPEC-164	Cleanliness of Components for use in Liquid Oxygen Fuel and Pneumatic Systems, Specifications for
MSFC-DWG-10509306	Radiographic Inspection Procedures and Acceptance Standards for Fusion Welded Joints in Stainless and Heat Resistant Steel, Specification for
MSFC-DWG-10509308	Welding, Carbon, Low Alloy, and Stainless Steel, Manual or Automatic, Specification for

Military Specifications

MIL-B-5087B	Bonding, Electrical, and Lightning Protection, for Aerospace Systems.
MIL-C-5541	Chemical Films and Chemical Films Materials for Aluminum and Aluminum Alloys
MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys

Military Standards

MIL-STD-130	Identification Marking of U. S. Military Property
MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of
MIL-STD-810B	Environmental Test Methods for Aerospace and Ground Equipment
MIL-STD-831	Test Reports, Preparation of
MS-33586	Metal, Definition of Dissimilar

George C. Marshall Space Flight Center Standards

MSFC-STD-100	Casting, Aluminum and Magnesium Alloy, Radiographic Inspection of, Acceptance Standard for
MSFC-STD-105	Synthetic Rubber, Age Control of, Standard for

George C. Marshall Space Flight Center Publications

MSFC Engineering Standards Manual

Identification for Traceability (Quality and Reliability Assurance Laboratory).

Manned Spacecraft Center Publications

MSC-D-NA-0002 Procedures and Requirements for the Flammability and Offgassing Evaluation of Manned Spacecraft Nonmetallic Materials

3.0 TEST FACILITIES

The testing shall be performed at Stratos-Western Facilities, Manhattan Beach, California, unless otherwise noted.

4.0 GENERAL TEST REQUIREMENTS

4.1 General

The valve shall successfully meet the requirements, values and tolerances contained in section 5 of this test plan.

4.2 Data Recording

The results of the tests shall be recorded in the appropriate data sheets. Documentary data sheets shall be signed and retained for record purposes.

4.3 Test and Failure Reporting

4.3.1 Reliability Malfunction Reports. All malfunctions or failures observed during testing shall be immediately recorded on a Stratos-Western RMR form and reported by telephone to Stratos-Western Reliability Engineering. Subsequent test action shall be controlled by the instructions recorded on the RMR by Reliability Engineering.

4.3.2 Test Summary. Within five (5) days after completion of the valve qualification test, a test summary shall be prepared which will contain the following:

a. Statement as to whether the unit passed or failed the test.

b. If failure occurred, a failure analysis and proposed corrective action, which shall be subject to customer approval.

c. If retest is required, the extent of retest shall be specified by the customer, which shall not exceed the original requirement, and the next anticipated test date.

d. Sample of data.

4.3.3 Test Reports. Within thirty (30) days after completion of the valve qualification testing, a test report shall be prepared which will contain the following:

a. Summary of results and conclusions.

b. Description of test performed.

c. Test conditions.

d. List of test equipment and calibration data.

e. Any test peculiarities or deviations.

f. Reduced data and graphs.

g. Original data sheets, including all test data from the time the valve was first presented for acceptance testing.

4.4 Test Conditions and Equipment

4.4.1 Order of Tests and Examinations. The order of tests and examinations shall be as specified herein.

4.4.2 Test and Examination Conditions. Unless otherwise specified the tests and examinations shall be performed under conditions as follows:

a. Temperature = Standard temperature, 77° ($\pm 18^{\circ}$)F.

b. Relative humidity - 95 percent maximum.

c. Atmospheric pressure - 14.7 ($\pm$0.7) pounds per square inch absolute (psia).

Equipment used to measure the unit parameters shall have an accuracy of one order of magnitude(factor of ten) greater than the required accuracy of the measurement to be made within state-of-the-art limitations.

4.4.3 Test Medium. Unless otherwise specified in the individual tests, the test fluids used shall be as follows:

a. Nitrogen propellant pressurizing agent for MIL-P-27401

b. Helium propellant pressurizing agent for MIL-P-27407-1

c. Air.

All fluids shall be passed through a 5 micron absolute level filter prior to entry into the test specimen.

4.5 Cleanliness - Test Equipment.

The level of cleanliness of the test equipment shall be such as to preclude damage to, or malfunction of the test specimen by contamination.

4.6 Instrument Calibration.

All inspection and measuring test equipment shall be calibrated against secondary standards which have been calibrated against primary standards by the National Bureau of Standards or an acceptance testing organization. Records shall be maintained including the date of last calibration. The due date shall be displayed on each item.

4.7 Test Equipment.

The following equipment or equivalents shall be used during testing:

a. Air tight environmental chamber for leakage and vacuum tests.

b. Mass spectrometer (CEC #24-120).

c. Flow meter with 0.2 to 1.30 scfm range (Fisher and Porter).

d. Temperature recorder -100°F to +200°F range (Honeywell Inc.).

e. Pressure gages: 0-200 psig
0-60 psig, 0-25 psia, 0-30 psid
0-30 psig
0-500 psig

f. Filter 5 micron absolute or better.

g. Hand valves (as required).

h. Mounting fixture.

i. Vacuum pump.

j. Dew point monitor.

k. Gas reservoir of 5000 inch^3 minimum.

l. Isobaric volume change leak detector.

m. 3-way solenoid valve.

4.8 Cleanliness Requisites.

During testing, the cleanliness level of the valve shall be protected at all times. The inlet and outlet of the valve shall be protected by external filters having a 5 micron absolute rating, cleaned in accordance with 4.8.1. If filters cannot be directly attached to the valve, the intermediate fittings used shall be clean to the same cleanliness level as the valve. If pressure measurements, are required between the component and the external filters, the pressure tap shall also be provided with filters in accordance with the foregoing. The filters shall be applied to the valve in an area equivalent to clean room per 4.8.1 and shall not be removed until testing has been completed. Removal shall also take place under the same conditions. During testing, any other precautions necessary to assure that the valve will remain clean, shall be incorporated into the test procedure. Lint free gloves are to be worn whenever the unit is handled.

4.8.1 Cleanliness. The valve shall be thoroughly cleaned using procedures and equipment which will provide a valve which is clean to the level specified herein. The gases and liquids used in the process shall have been passed, finally, through a 5 micron absolute filter. The cleaning equipment shall be so arranged that contamination cannot get into the immediate area of the parts being cleaned. Fittings or tools which will come in contact with the parts being tested shall be cleaned to the same level of cleanliness as the parts. The parts shall be cleaned until the final rise solution contains no more than the number of particles shown below per 100 milliliter solution filtered through a standard HA millipore filter.

Particle Size, Microns	Max. Number Particles
10 - 25	120
25 - 40	80
40 - 80	20
80 - up	0

4.9 Test Summary.

The prototype valves shall be subjected to the acceptance tests procedure described in ATP 834002. After these tests the valves shall be identified as valve samples "A" and "B", and tests performed to each valve in the sequence shown in 4.9.1.

4.9.1 Listing.

Valve "A"	Valve "B"	Paragraph
Corrosive contaminants, oxygen/humidity test (CCOH)		5.1.1
Performance	Performance	5.2.1 through 5.2.3
High Temperature	High Temperature	5.1.2
Performance	Performance	5.2.1 through 5.2.3
Low Temperature	Low Temperature	5.1.3
Performance	Performance	5.2.1 through 5.2.3
Vibration	Vibration	5.1.4
Performance	Performance	5.2.1 through 5.2.3
Life Cycle	Life Cycle	5.1.5
Performance (every 250 cycles)	Performance	5.2.1 through 5.2.3
Performance	Performance	5.2.4, 5.2.5.
Collapse Pressure	Collapse Pressure	5.1.6
Burst Pressure		5.1.7
	Ultimate Pressure	5.1.8

5.0 METHOD OF TESTING.

5.1 Environmental Tests.

5.1.1 Corrosive Contaminants, Oxygen/Humidity. The valve assembly shall be subjected to the environmental conditions of salt fog and oxygen/humidity in that order of sequence, with inlet and outlet ports capped.

The experiment hardware shall be exposed to a salt fog atmosphere for one hour in an unstowed configuration. The atmosphere shall be at ambient pressure, 90° to 97°F, and 85 +15, -10%, relative humidity. The salt solution shall be 1% sodium chloride by weight with a pH of 6.5 to 7.2. At the conclusion of this period, the experiment hardware shall be transferred within one hour to a chamber capable of performing the oxygen/humidity test. This portion of the test shall require that the experiment hardware, in an operation configuration shall be subjected to a 95± 5% oxygen atmosphere, a pressure of 5 psia (unless otherwise specified), and a temperature of 85 ± 5°F for a period of 12 hours.

At the conclusion of the twelve-hour period, moisture shall be introduced into the chamber within the first hour to obtain a relative humidity of 95 ± 5%. This condition shall then be maintained for a time period of 119 hours and within a temperature range of 40 to 90°F. Operation of the experiment hardware while in operational configuration shall be as specified in the equipment certification test specification. At no time during the performance of this test shall the experiment hardware be wiped or dried of any moisture or salt solution.

5.1.2 High Temperature. The valve assembly shall be tested in accordance with method 501, Procedure I, of MIL-STD-810B, except steps 4 and 5 shall be deleted. The exposure time to + 160° F shall be four hours. Test setup should be per figure 5.

5.1.3 Low Temperature. The valve assembly shall be tested in accordance with method 502, procedure I, of MIL-STD-810B, except steps 4 and 5 shall be deleted. The storage temperature shall be -40°F and the storage period shall be four hours. Test setup should be per figure 5.

5.1.4 Vibration

a) Vehicle dynamics criteria. The test setup shall be subjected to a sinusoidal scan at 3.0 octaves per minute along each of the three major axes as indicated in figure 6. The levels and frequency ranges shall be as follows:

(1) 3 to 7 Hz at 0.43 inches double amplitude displacement
(2) 7 to 14 Hz at 1.1 g peak
(3) 14 to 25 Hz at 0.11 inches double amplitude displacement
(4) 25 to 60 Hz at 3.6 g peak.

b) Sine evaluation criteria. The setup shall be subjected to a sinusoidal scan at 1.0 octave per minute along each of the three major axes as indicated in figure 6. The levels and frequency ranges shall be as follows:

(1) 20 to 100 Hz at 0.0020 inch double amplitude displacement
(2) 100 to 2000 Hz at 1.0 g peak

c) Lift-off random criteria. The test setup shall be subjected to 1.0 minute of random vibration along each of the three major axes as indicated in figure 6. The levels shall be as follows:

(1) 20 to 25 Hz at plus 10.0 db per octave
(2) 25 to 80 Hz at 0.20 g^2 per Hz
(3) 80 to 125 Hz at -6.0 db per octave
(4) 125 Hz at 0.080 g^2 per Hz
(5) 125 to 2000 Hz at minus 3.0 db per octave
(6) 2000 Hz at 0.0050 g^2 per Hz

Composite equals 6.8 grms

d) Boost random criteria. The test setup shall be subjected to 2.0 minutes of random vibration along each of the major axes, as indicated in figure 6. The levels shall be as follows:

(1) 20 Hz at 0.025 g^2 per Hz
(2) 20 to 25 Hz at +10.0 db per octave
(3) 25 to 80 Hz at 0.050 g^2 per Hz
(4) 80 to 125 Hz at -6.0 db per octave
(5) 125 Hz at 0.020 g^2 per Hz
(6) 125 to 2000 Hz at -3.0 db per octave
(7) 2000 Hz at 0.0012 g^2 per Hz
Composite equals 3.4 grms.

5.1.5 Life Cycle. The valve assembly shall be subject to 1000 cycles of operation. The cycles shall be from crack to full open to reseat. The test setup shall be per figure 5.

5.1.6 Collapse Pressure. The exterior of the valve assembly shall be slowly pressurized to 140 psig with the inlet and outlet ports of the valve vented to ambient. This pressure shall be held for three minutes before reducing to zero. The valve shall show no evidence of rupture, collapsing or destructive failure. The test setup shall be per figure 2.

5.1.7 Burst Pressure. The inlet and outlet ports of the valve assembly shall be slowly pressurized to 36 psig. This pressure shall be held for three minutes before reducing to zero. The valve shall show no signs of rupture, or destructive failure. The test setup shall be per figure 1.

5.1.8 Ultimate Pressure. The inlet and outlet ports of the valve assembly shall be slowly pressurized to 36 psig; this pressure shall be held for three minutes. Pressure shall then be slowly increased until the valve assembly rupture. The ultimate pressure at which failure occurs shall be recorded. The test setup shall be per figure 1.

5.2 Performance Tests.

NOTE: All test setups shown can be combined into a single test setup to maintain an uninterrupted testing sequence.

5.2.1 Internal Static Leakage. The inlet port shall be pressurized to 6.5 psig with air, or N_2. The valve assembly shall not exceed a leakage flow rate of 1×10^{-2} sccs from the outlet port.

This shall be done three times with one crack, reseat cycle minimum between tests. The test setup shall be as shown in figure 3.

5.2.2 External Static Leakage. The exterior of the valve assembly shall be pressurized to 35 psig with gaseous helium. The valve assembly shall not exceed a leakage flow rate of 1.0×10^{-6} sccs from the inlet and outlet ports combined. The test set-up shall be as shown in figure 4.

5.2.3 Relief Operation. The valve assembly shall be tested to check for operation conformance through three cycles minimum from crack to full open back to reseat. These cycles shall be done with an outlet pressure of 14.7 psia. The valve assembly shall go from crack to fully open to reseat at inlet pressures between 7.0 to 9.0 psi above outlet pressure. Full open is defined as the inlet pressure required to sustain a flow rate of 1550 scim minimum of N_2 at 70°F inlet temperature with an outlet pressure of 14.7 psia. Refer to figure 5. After performing the life cycle tests (para. 5.1.5) repeat a full open test once with a starting outlet pressure of 1×10^{-6} Torr. and a minimum sustained flowrate of 600 scim. Refer to figure 7.

NOTE: Test condictions of 23.7 psia inlet, 14.7 psia outlet and 1550 scim are equivalent to 9 psia inlet, 0 psia outlet and 600 scim.

5.2.4 Internal Proof Pressure. The inlet and outlet ports of the valve assembly shall be slowly, pneumatically pressurized to 18 psig. This pressure shall be held for five minutes minimum before reducing to zero. There shall be no evidence of damage, excessive permanent distortion, or deterioration. Refer to figure 1.

5.2.5 External Proof Pressure. The exterior of the valve assembly shall be slowly, pneumatically pressurized to 70 psig with the inlet and outlet ports at zero psig. This pressure shall be held for five minutes minimum before reducing to zero. There shall be no evidence of damage, excessive permanent distortion, or deterioration. Refer to figure 2.

5.3 Completion of Tests

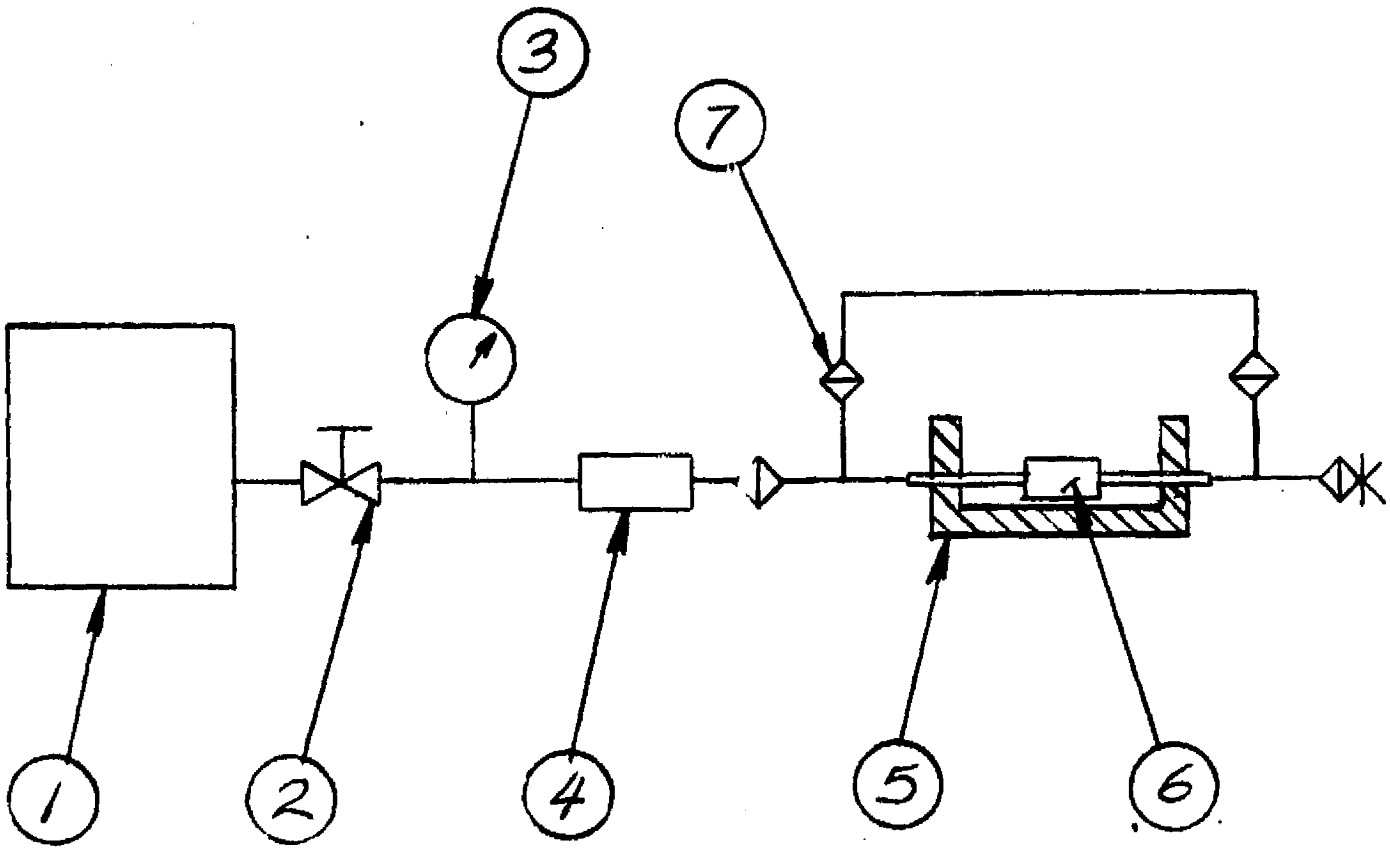
Upon completion of the test, record completion date and indicate satisfactory test of the valve in the log book.

5.4 Evidence of Satisfactory Valve

Upon completion of the test, sign the data sheets as evidence of satisfactory results.

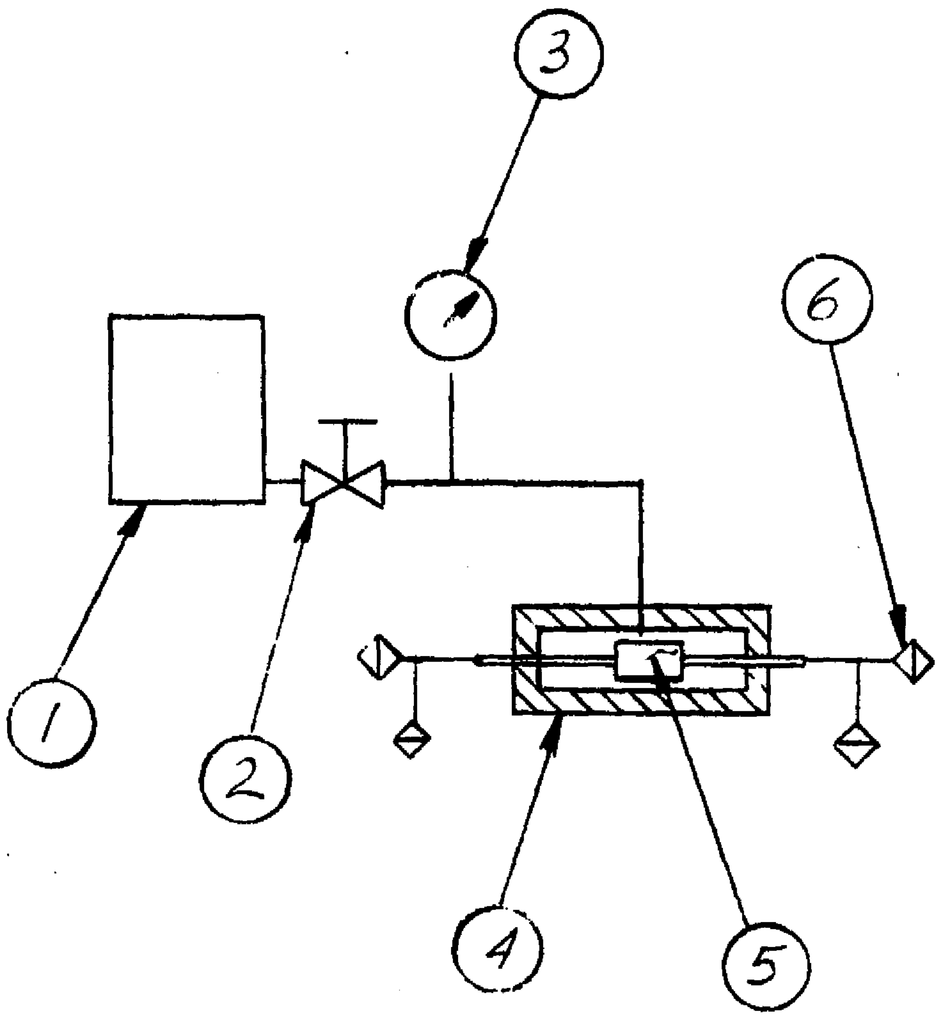
5.5 Unsatisfactory Valve

Failure of the valve to meet the test requirements shall constitute cause for remedial action. A failure report shall be made of each failure encountered during the test. A failure analysis and remedial action shall be submitted for approval.



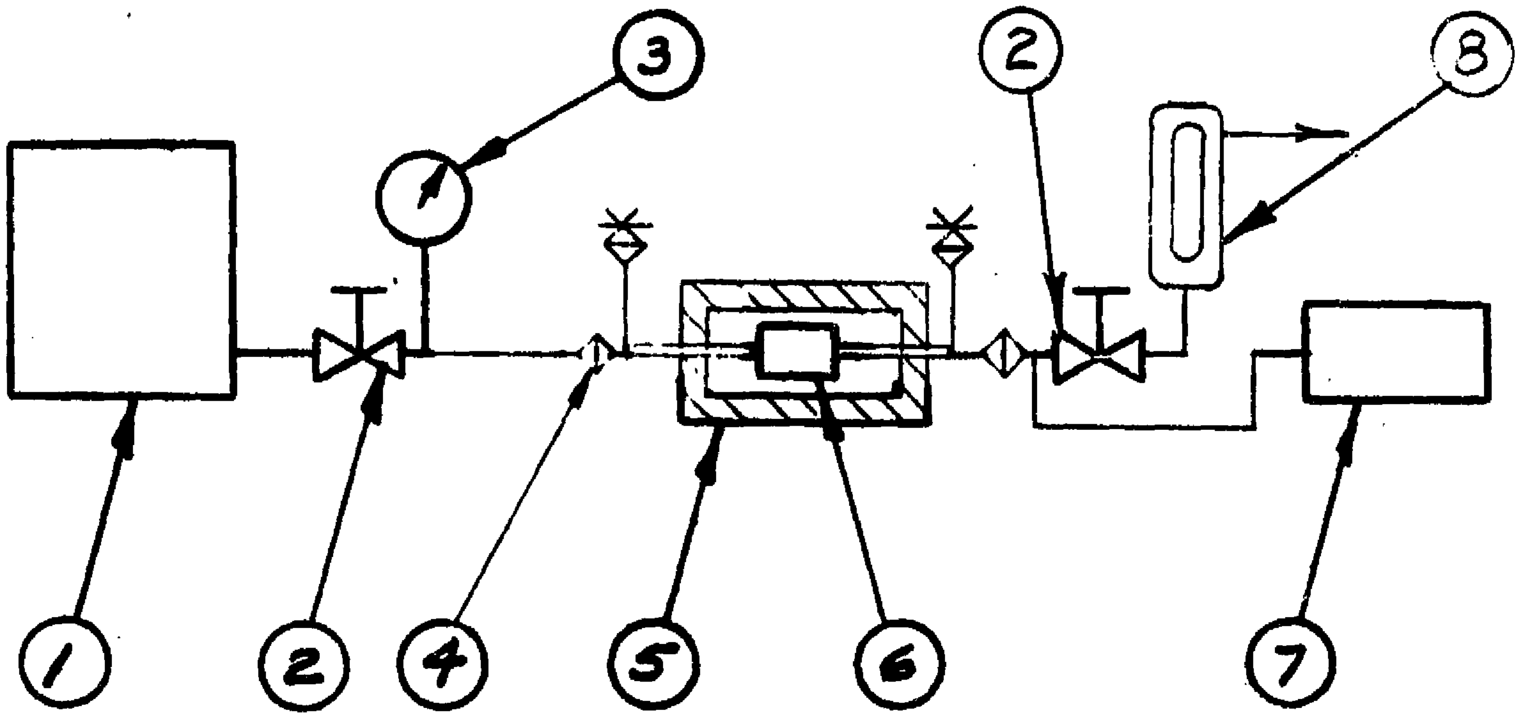
1. Helium Pressure Source
2. Hand Valve
3. Pressure Gauge, 0-60 psig or 0-500 psig
4. Filter 5m or better
5. Holding Fixture
6. Test Specimen
7. Filter 5m absolute or better

Figure 1. Burst and Ultimate Pressure Schematic



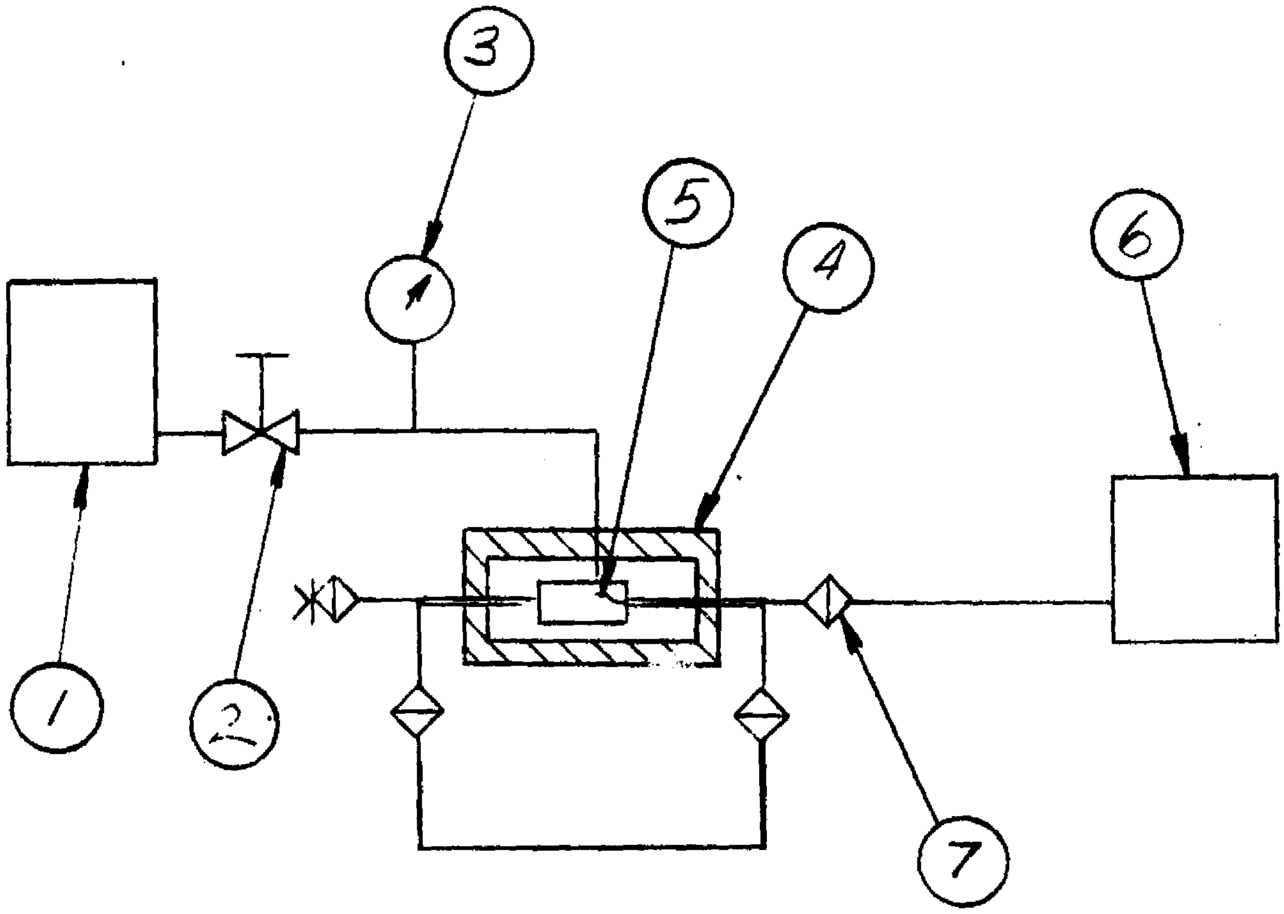
1. Helium Pressure Source
2. Hand Valve
3. Pressure Gauge, 0-200 psig
4. Pressure Chamber
5. Test Specimen
6. Filter 5 m absolute of better

Figure 2. Collapse Pressure Schematic



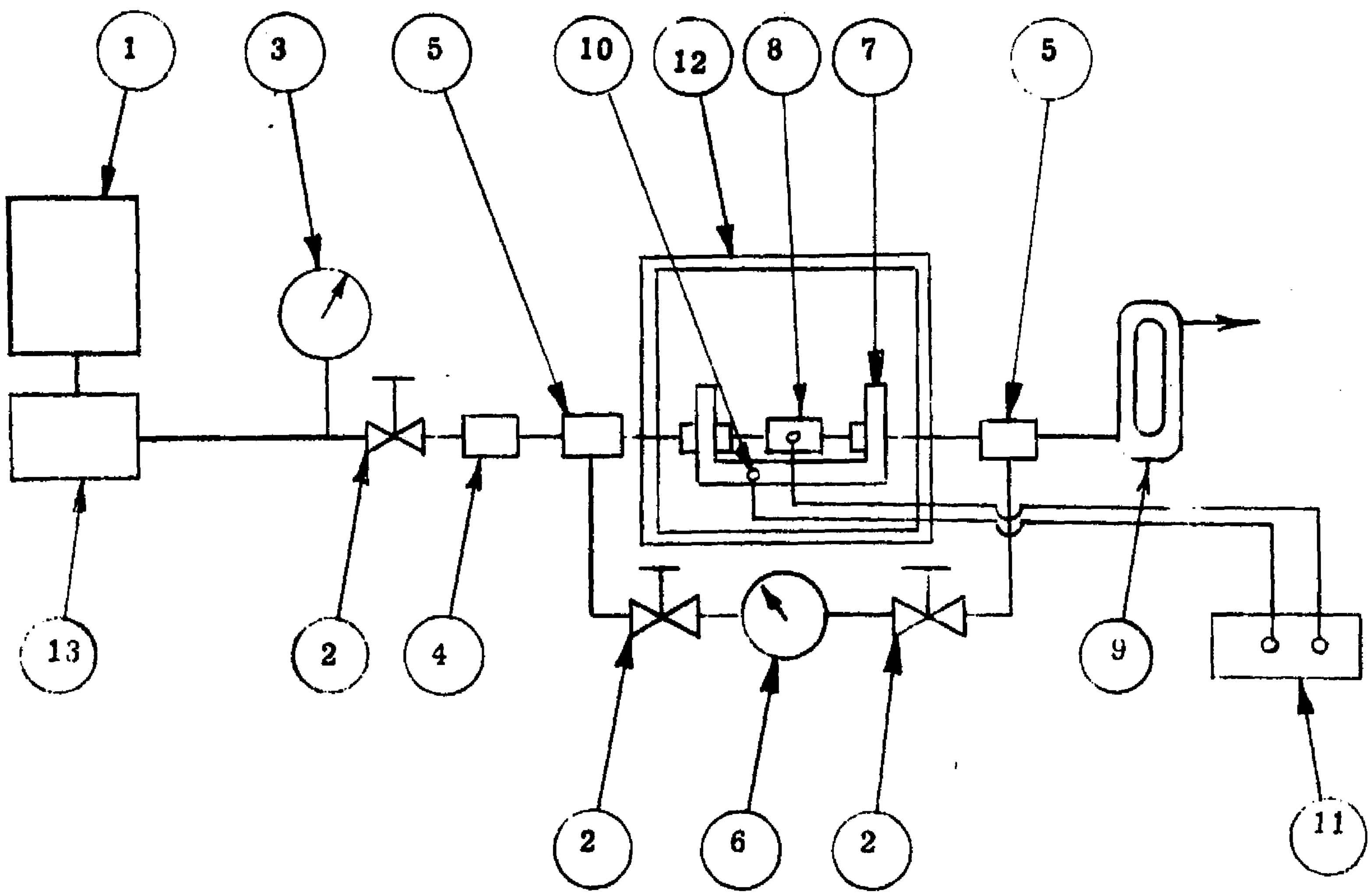
1. N_2 Pressure Source
2. Hand Valves.
3. Pressure Gage 0-30 psig
4. Filter 5μ or better
5. Pressure Chamber
6. Test Specimen
7. Isobaric Volume Change Leakage Detector
8. Flow Meter 0.2 - 1.30 scfm

Figure 3. Internal Static Leakage Schematic



1. Helium Pressure Source
2. Hand Valve.
3. Pressure Gauge, 0-60 psig
4. Pressure Chamber
5. Test Specimen'
6. Mass Spectrometer CEC #24-120 or equivalent.
7. Filter 5 m absolute or better

Figure 4. External Static Leakage Schematic



1 N_2 Pressure Source
2 Hand Valves
3 Pressure Gage 0-25 psia
4 Filter 5μ abs. or better
5 Piezometer or Equivalent
6 Differential Pressure Gage 0-30 psi
7 Mounting Fixture
8 Test Specimen
9 Flow Meter 0.2 to 1.30 scfm *
10 Thermocuples, 2-copper Constantan
11 Temperature Controller and Recorder
12 Temperature Chamber
13 3-Way Solenoid Valve

* The flow meter must be calibrated for the corresponding outlet pressure.

Figure 5. Relief Operation Schematic

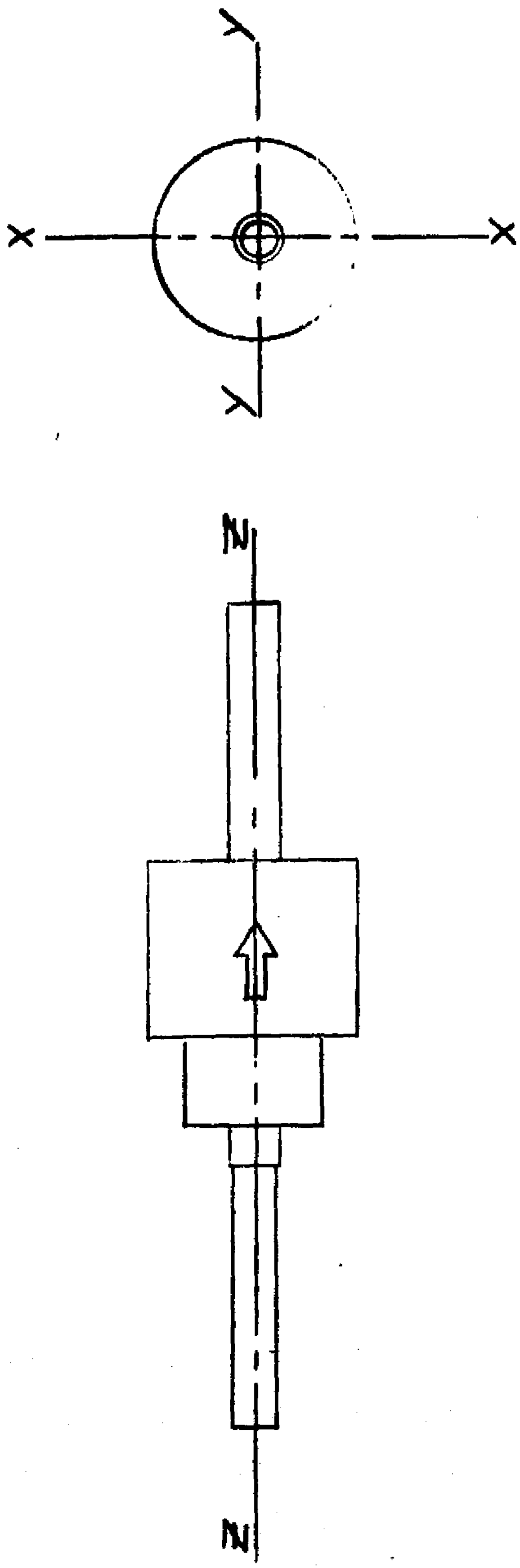
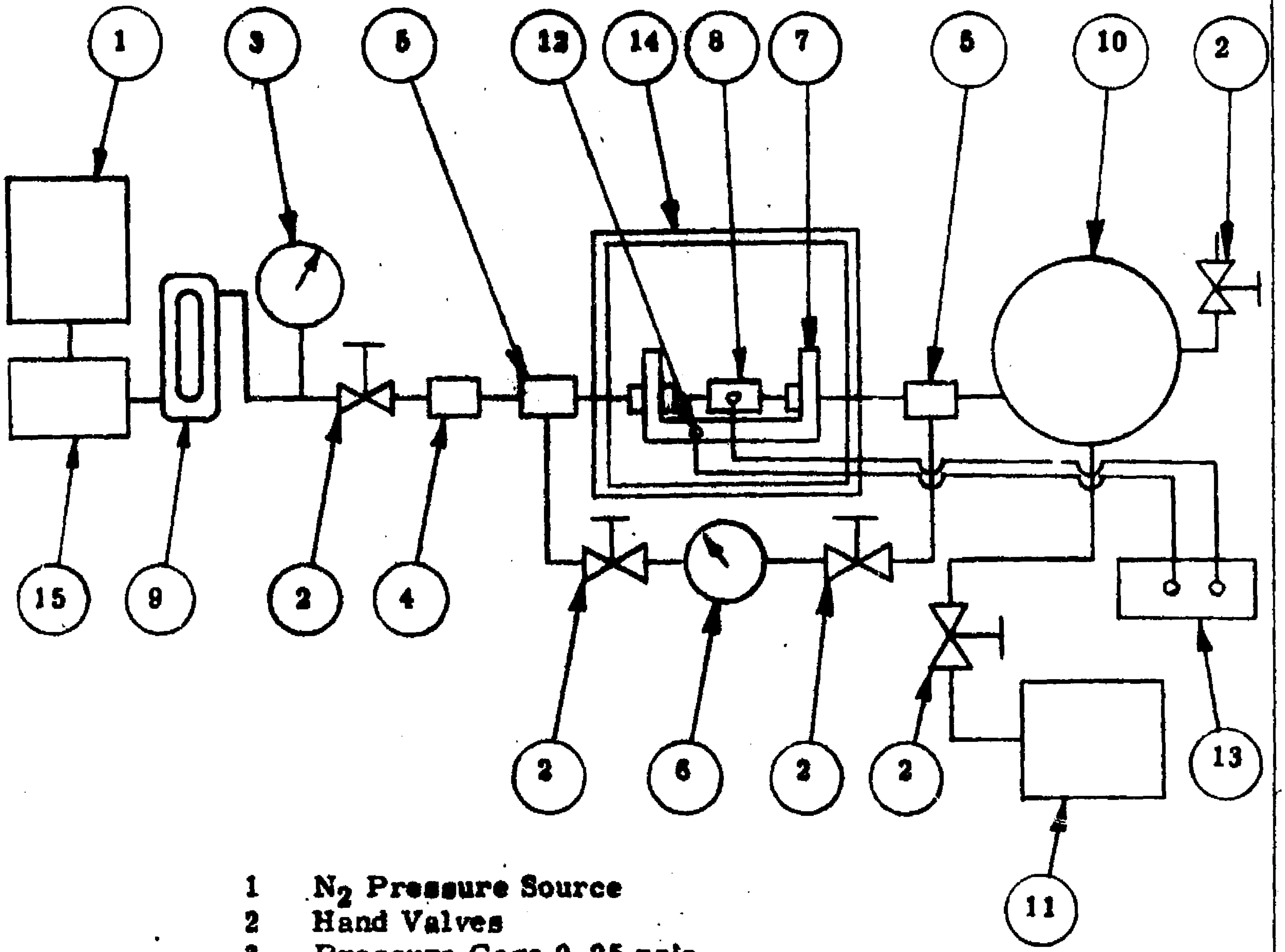


Figure 6. Component Vibration Axes.



1 N_2 Pressure Source
2 Hand Valves
3 Pressure Gage 0-25 psia
4 Filter 5 μ abs. or better
5 Piezometer or Equivalent
6 Differential Pressure Gage 0-10 psi
7 Mounting Fixture
8 Test Specimen
9 Flow Meter 0.22 to 1.30 scfm*
10 Ullage Gas Reservoir 5000 $inch^3$ minimum
11 Vacuum Pump
12 Thermocouples, 2-copper Constantan
13 Temperature Controller and Recorder
14 Temperature Chamber
15 3-Way Solenoid Valve

*Calibrated for the corresponding outlet pressure.

Figure 7. Relief Operation Schematic

FAIRCHILD HILLER
STRATOS - WESTERN

TEST LOG

PART NO. 834000	TEST DOC. ATP ER 834-4 REV. A
PART NAME Relief Valve Assembly	TEST FIXTURE
MODEL NO.	CUSTOMER INSP.
SERIAL NO.	GOV'T. INSP.
DATE	CO. INSP.

		INSPECTION STRATOS	INSPECTION CUST
5.1	Environmental Tests		
5.1.1	Corrosive Contaminants, Oxygen/Humidity		

Salt Fog - 1 hour
- Temperature ________ °F
- Relative Humidity ________ %
- PH ________

Oxygen - 12 hours
- Oxygen ________ %
- Pressure ________ psia
- Temperature ________ °F

Humidity - 119 hours
- Relative Humidity ________ %
- Temperature ________ °F

Performance Tests (paragraph 5.2)

Internal Static Leakage (paragraph 5.2.1)

A. Inlet Port: 6.5 psig — Actual ________ psig
Internal Leakage: 0.01 sccs — Actual ________ sccs
B. Inlet Port: 6.5 psig — Actual ________ psig
Internal Leakage: 0.01 sccs — Actual ________ sccs
C. Inlet Port : 6.5 psig — Actual ________ psig
Internal Leakage: 0.01 sccs max. — Actual ________ sccs

External Static Leakage (paragraph 5.2.2)

External Pressure: 35 psig — Actual ________ psig
External Leakage: 1×10^{-6} sccs max. — Actual ________ sccs

REMARKS:

TESTER

FAIRCHILD HILLER
STRATOS - WESTERN
TEST LOG

SHEET 2 OF 18

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

Relief Operation (paragraph 5.2.3)

A. Cracking Pressure: 7.0 psid min. Actual ________ psid

Full Flow: 9.0 psid max. Actual ________ psid

Reseat: 7.0 psid min. Actual ________ psid

B. Cracking Pressure: 7.0 psid min. Actual ________ psid

Full Flow: 9.0 psid max. Actual ________ psid

Reseat: 7.0 psid min. Actual ________ psid

C. Cracking Pressure: 7.0 psid min. Actual ________ psid

Full Flow: 9.0 psid max. Actual ________ psid

Reseat: 7.0 psid min. Actual ________ psid

Repeat full flow test once with outlet pressure of 1×10^{-6} Torr. and minimum sustained flowrate of 600 scim.

Full Flow: 9.0 max. Actual ________ psid

REMARKS: ________

TESTER ________

FAIRCHILD HILLER
STRATOS - WESTERN
TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

5.1.2 High Temperature Tests

Four hours at + 160°F — Actual ________ hours
Actual ________ °F

Performance Tests (paragraph 5.2)

Internal Static Leakage (paragraph 5.2.1)

A. Inlet Port: 6.5 psig — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

B. Inlet Port: 6.5 psig — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

C. Inlet Port: 6.5 psig — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

External Static Leakage (paragraph 5.2.2)

External Pressure: 35 psig — Actual ________ psig

External Leakage: 1×10^{-6} sccs max. — Actual ________ sccs

REMARKS: ________

TESTER ________

M-194-WB REV 3-63

FAIRCHILD HILLER
STRATOS - WESTERN
TEST LOG

SHEET 4 OF 18

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

Relief Operation (paragraph 5.2.3)

A. Cracking Pressure:	7.0 psid min.	Actual ________ psid	
Full Flow:	9.0 psid max.	Actual ________ psid	
Reseat:	7.0 psid min.	Actual ________ psid	
B. Cracking Pressure:	7.0 psid min.	Actual ________ psid	
Full Flow:	9.0 psid max.	Actual ________ psid	
Reseat:	7.0 psid min.	Actual ________ psid	
C. Cracking Pressure:	7.0 psid min.	Actual ________ psid	
Full Flow:	9.0 psid max.	Actual ________ psid	
Reseat:	7.0 psid min.	Actual ________ psid	

Repeat full flow test once with outlet pressure of 1×10^{-6} Torr. and minimum sustained flowrate of 600 scim.

Full Flow: 9.0 max. Actual ________ psid

REMARKS: ________

TESTER ________

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FAIRCHILD HILLER
STRATOS - WESTERN
TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

5.1.3 **Low Temperature Tests**

Four hours at -40°F — Actual ______ hours; Actual ______ °F

Performance Tests (paragraph 5.2)

Internal Static Leakage (paragraph 5.2.1)

A. Inlet Port: 6.5 psig — Actual ______ psig

Internal Leakage: 0.01 sccs max. — Actual ______ sccs

B. Inlet Port: 6.5 psig — Actual ______ psig

Internal Leakage: 0.01 sccs max. — Actual ______ sccs

C. Inlet Port: 6.5 psig — Actual ______ psig

Internal Leakage: 0.01 sccs max. — Actual ______ sccs

External Static Leakage (paragraph 5.2.2)

External Pressure: 35 psig — Actual ______ psig

External Leakage: 1×10^{-6} sccs max. — Actual ______ sccs

REMARKS: ______

TESTER ______

FAIRCHILD HILLER
STRATOS - WESTERN

TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

Relief Operation (paragraph 5.2.3)

A. Cracking Pressure:	7.0 psid min.	Actual ________ psid
Full Flow:	9.0 psid max.	Actual ________ psid
Reseat:	7.0 psid min.	Actual ________ psid
B. Cracking Pressure:	7.0 psid min.	Actual ________ psid
Full Flow:	9.0 psid max.	Actual ________ psid
Reseat:	7.0 psid min.	Actual ________ psid
C. Cracking Pressure:	7.0 psid min.	Actual ________ psid
Full Flow:	9.0 psid max.	Actual ________ psid
Reseat:	7.0 psid min.	Actual ________ psid

Repeat full flow test once with outlet pressure of 1×10^{-6} Torr. and minimum sustained flowrate of 600 scim.

Full Flow: 9.0 max. Actual ________ psid

REMARKS: ________

TESTER ________

FAIRCHILD HILLER
STRATOS - WESTERN

TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

5.1.4 Vibration Tests

Sine: 1 min. per axes. Actual ________ min.
Liftoff Random: 1 min. per axes. Actual ________ min.
Boost Random: 2 min. per axes. Actual ________ min.

Performance Tests (paragraph 5.2)

Internal Static Leakage (paragraph 5.2.1)

A. Inlet Port: 6.5 psig Actual ________ psig

Internal Leakage: 0.01 sccs max. Actual ________ sccs

B. Inlet Port: 6.5 psig Actual ________ psig

Internal Leakage: 0.01 sccs max. Actual ________ sccs

C. Inlet Port: 6.5 psig Actual ________ psig

Internal Leakage: 0.01 sccs max. Actual ________ sccs

External Static Leakage (paragraph 5.2.2)

External Pressure: 35 psig Actual ________ psig

External Leakage: 1×10^{-6} sccs max. Actual ________ sccs

REMARKS: ________

TESTER ________

FAIRCHILD HILLER
STRATOS - WESTERN
TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

Relief Operation (paragraph 5.2.3)

A. Cracking Pressure:	7.0 psid min.	Actual ______ psid	
Full Flow:	9.0 psid max.	Actual ______ psid	
Reseat:	7.0 psid min.	Actual ______ psid	
B. Cracking Pressure:	7.0 psid min.	Actual ______ psid	
Full Flow:	9.0 psid max.	Actual ______ psid	
Reseat:	7.0 psid min.	Actual ______ psid	
C. Cracking Pressure:	7.0 psid min.	Actual ______ psid	
Full Flow:	9.0 psid max.	Actual ______ psid	
Reseat:	7.0 psid min.	Actual ______ psid	

Repeat full flow test once with outlet pressure of 1×10^{-6} Torr. and minimum sustained flowrate of 600 scim.

Full Flow: 9.0 max. Actual ______ psid

REMARKS: ______

TESTER ______

FAIRCHILD HILLER
STRATOS - WESTERN

TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

5.1.5 Life Cycle Test

Cycle unit from crack to full open to reseat 250 cycles.

Actual ________ cycles

5.2 **Performance Tests** (paragraph 5.2)

5.2.1 **Internal Static Leakage** (paragraph 5.2.1)

A. Inlet Port: 6.5 psig — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

B. Inlet Port: 6.5 psig — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

C. Inlet Port: 6.5 psig — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

5.2.2 **External Static Leakage** (paragraph 5.2.2)

External Pressure: 35 psig — Actual ________ psig

External Leakage: 1×10^{-6} sccs max. — Actual ________ sccs

REMARKS: ________

TESTER ________

FAIRCHILD HILLER
STRATOS-WESTERN

TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

Relief Operation (paragraph 5.2.3)

A. Cracking Pressure:	7.0 psid min.	Actual ________ psid
Full Flow:	9.0 psid max.	Actual ________ psid
Reseat:	7.0 psid min.	Actual ________ psid
B. Cracking Pressure:	7.0 psid min.	Actual ________ psid
Full Flow:	9.0 psid max.	Actual ________ psid
Reseat:	7.0 psid min.	Actual ________ psid
C. Cracking Pressure:	7.0 psid min.	Actual ________ psid
Full Flow:	9.0 psid max.	Actual ________ psid
Reseat:	7.0 psid min.	Actual ________ psid

Repeat full flow test once with outlet pressure of 1×10^{-6} Torr. and minimum sustained flowrate of 600 scim.

Full Flow: 9.0 max. Actual ________ psid

REMARKS: ________________________________

TESTER ________________________________

FAIRCHILD HILLER
STRATOS - WESTERN

TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

5.1.5 Life Cycle Test (Continued)

Cycle unit from crack to full open to reseat 250 cycles.

Actual ______________ cycles.

Performance Tests (paragraph 5.2)

Internal Static Leakage (paragraph 5.2.1)

A. **Inlet Port: 6.5 psig** **Actual**__________**psig**

Internal Leakage: 0.01 sccs max. **Actual**__________**sccs**

B. **Inlet Port: 6.5 psig** **Actual**__________**psig**

Internal Leakage: 0.01 sccs max. **Actual**__________**sccs**

C. **Inlet Port: 6.5 psig** **Actual**__________**psig**

Internal Leakage: 0.01 sccs max. **Actual**__________**sccs**

5. **External Static Leakage** (paragraph 5.2.2)

External Pressure: 35 psig **Actual**__________**psig**

External Leakage: 1 x 10^{-6} sccs max. **Actual**__________**sccs**

REMARKS: ______________________________

TESTER ______________________________

FAIRCHILD HILLER
STRATOS-WESTERN
TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

Relief Operation (paragraph 5.2.3)

A. Cracking Pressure:	7.0 psid min.	Actual ______ psid	
Full Flow:	9.0 psid max.	Actual ______ psid	
Reseat:	7.0 psid min.	Actual ______ psid	
B. Cracking Pressure:	7.0 psid min.	Actual ______ psid	
Full Flow:	9.0 psid max.	Actual ______ psid	
Reseat:	7.0 psid min.	Actual ______ psid	
C. Cracking Pressure:	7.0 psid min.	Actual ______ psid	
Full Flow:	9.0 psid max.	Actual ______ psid	
Reseat:	7.0 psid min.	Actual ______ psid	

Repeat full flow test once with outlet pressure of 1×10^{-6} Torr. and minimum sustained flowrate of 600 scim.

Full Flow: 9.0 max. Actual ______ psid

REMARKS: ______

TESTER ______

FAIRCHILD HILLER
STRATOS - WESTERN

TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

5.1.5 Life Cycle Test (Continued)

Cycle unit from crack to full open to reseat 250 cycles.

Actual ________ cycles

Performance Tests (paragraph 5.2)

Internal Static Leakage (paragraph 5.2.1)

A. **Inlet Port: 6.5 psig** — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

B. **Inlet Port: 6.5 psig** — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

C. **Inlet Port: 6.5 psig** — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

External Static Leakage (paragraph 5.2.2)

External Pressure: 35 psig — Actual ________ psig

External Leakage: 1×10^{-6} sccs max. — Actual ________ sccs

REMARKS: ________

TESTER ________

FAIRCHILD HILLER
STRATOS - WESTERN

TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

Relief Operation (paragraph 5.2.3)

A. Cracking Pressure:	7.0 psid min.	Actual ______ psid	
Full Flow:	9.0 psid max.	Actual ______ psid	
Reseat:	7.0 psid min.	Actual ______ psid	
B. Cracking Pressure:	7.0 psid min.	Actual ______ psid	
Full Flow:	9.0 psid max.	Actual ______ psid	
Reseat:	7.0 psid min.	Actual ______ psid	
C. Cracking Pressure:	7.0 psid min.	Actual ______ psid	
Full Flow:	9.0 psid max.	Actual ______ psid	
Reseat:	7.0 psid min.	Actual ______ psid	

Repeat full flow test once with outlet pressure of 1×10^{-6} Torr. and minimum sustained flowrate of 600 scim.

Full Flow: 9.0 max. Actual ______ psid

REMARKS: ______

TESTER ______

FAIRCHILD HILLER
S T R A T O S - W E S T E R N

TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

5.1.5 Life Cycle Test (Continued)

Cycle unit from crack to full open to reseat 250 cycles
Actual ________ cycles

Performance Tests (paragraph 5.2)

Internal Static Leakage (paragraph 5.2.1)

A. Inlet Port: 6.5 psig — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

B. Inlet Port: 6.5 psig — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

C. Inlet Port: 6.5 psig — Actual ________ psig

Internal Leakage: 0.01 sccs max. — Actual ________ sccs

5.2.2 **External Static Leakage** (paragraph 5.2.2)

External Pressure: 35 psig — Actual ________ psig

External Leakage: 1×10^{-6} sccs max. — Actual ________ sccs

REMARKS: ____________________

TESTER ____________________

FAIRCHILD HILLER
STRATOS - WESTERN
TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

Relief Operation (paragraph 5.2.3)

A. Cracking Pressure: 7.0 psid min. Actual ________ psid

Full Flow: 9.0 psid max. Actual ________ psid

Reseat: 7.0 psid min. Actual ________ psid

B. Cracking Pressure: 7.0 psid min. Actual ________ psid

Full Flow: 9.0 psid max. Actual ________ psid

Reseat: 7.0 psid min. Actual ________ psid

C. Cracking Pressure: 7.0 psid min. Actual ________ psid

Full Flow: 9.0 psid max. Actual ________ psid

Reseat: 7.0 psid min. Actual ________ psid

Repeat full flow test once with outlet pressure of 1×10^{-6} Torr. and minimum sustained flowrate of 600 scim.

Full Flow: 9.0 max. Actual ________ psid

REMARKS: ________

TESTER ________

FAIRCHILD HILLER
STRATOS - WESTERN
TEST LOG

SHEET 17 OF 18

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

Internal Proof Pressure (paragraph 5.2.4)

Apply 18 psig to the inlet and outlet ports and hold for 5 minutes minimum before reducing to zero — Actual ________ psig

Evidence of damage, excessive permanent distortion, or deterioration — ☐ Yes ☐ No

External Proof Pressure (paragraph 5.2.5)

Apply 70 psig to the exterior or the valve assembly, and hold for 5 minutes minimum before reducing to zero — Actual ________ psig

Evidence of damage, Excessive Permanent Distortion or deterioration — ☐ Yes ☐ No

5.1.6 Collapse Pressure Test

Apply 140 psig external pressure and hold for 3 minutes minimum before reducing to zero. — Actual ________ psig

Evidence of rupture, collapsing or destructive failure. — ☐ Yes ☐ No

REMARKS: ____________________

TESTER ____________________

FAIRCHILD HILLER
STRATOS - WESTERN
TEST LOG

PART NO.	834000	TEST SPEC.	QTP ER 834-4 A
PART NAME	Relief Valve Assembly	TEST FIX	
MODEL NO.		CUSTOMER	
SERIAL NO.		GOV'T. INSP.	
DATE		CO. INSP.	

INSPECTION: STRATOS | CUST.

5. 1. 7 Burst Pressure Test (Valve A Only)

Apply 36 psig to the inlet and outlet ports and hold for 3 minutes minimum before reducing to zero.

Actual ________ psig

Evidence of rupture, or destructive failure. ☐ Yes ☐ No

5. 1. 8 Ultimate Pressure Test (Valve B Only)

Apply 36 psig to the inlet and outlet ports and hold for 3 minutes minimum.

Actual ________ psig

Ultimate Pressure: Actual _______ psig

REMARKS: ________

TESTER ________

REPORT ER 834-5

DEVELOPMENT VERIFICATION TEST REPORT FOR RELIEF VALVE ASSEMBLY

Stratos-Western P/N 834000
NASA Spec. No. 20M32254

Prepared By: J. Amelsberg, Product Engineer

Approved By: J. Morando, Product Manager

Date:

FAIRCHILD HILLER
STRATOS-WESTERN
1800 ROSECRANS AVENUE
MANHATTAN BEACH, CALIF., 90267

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the results of development verification tests performed on the Relief Valve Assembly, Part No. 834000, Serial No. D.U. (development unit). The purpose of the tests was to provide data to be used in the design of prototype units for use in qualification testing in accordance with NASA Specification No. 20M32254 Valve Assembly, Relief.

2.0 APPLICABLE DOCUMENTS

NASA

20M32254, Change A	Valve Assembly, Relief

Stratos-Western

ER 834-1, Change	Development Verification Test Procedure for Solenoid Valve, Part No. 683000

3.0 TEST PROCEDURE SUMMARY

The development verification tests were conducted in accordance with Procedure No. ER 834-1. The vibration tests were performed at Approved Engineering Test Laboratories, California, under the cognizance of Stratos-Western personnel. AETL's vibration test report containing the test procedure and results is included in Appendix I. All other tests were conducted at Stratos-Western facilities. The original data sheets are found in Appendix II.

Following assembly of the valve and prior to welding, the development test unit was pre-tested to verify, pressure drop, crack and reseat pressure. Pre-test included shimming of both the poppet and main springs to provide the required poppet stroke and seat pre-load. The unit was then welded and submitted for development verification testing.

After paragraph 6.10.2 of ER 834-1 (Collapse Pressure Test) the valve exhibited a leakage beyond the specification tolerance. It was then decided to eliminate testing per paragraph 6.10.3 (Destructive Pressure) in order to permit tear down of the valve for examination. It was found that contamination had located itself on the seat area restricting the valve closure. The material was found to be Butyl rubber from one of the fittings used to adapt the valve to the burst pressure test setup. Photographs are shown in figures 2 - 8

4.0 TEST METHODS AND RESULTS

The results of all tests are listed in table 1.

The vibration axes were selected as shown in figure 1 and the vibration results are included in Appendix I together with copies of the test log book kept during development.

5.0 CONCLUSIONS.

From the results of the development verification tests, it is concluded that the 834000 Relief Valve Assembly design is suitable for qualification test. No problems of any kind were discovered during the performance of the tests.

6.0 RECOMMENDATIONS

A slight increase in poppet seat loading could facilitate production by diminishing leakage possibilities due to variations in the seat or poppet as result of dimensional tolerances.

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254 | S-W Part No. 834000 | S/N ______ Date ______

Ref. Paragraph	Test	Specification Requirements	Actual Performance	Remarks
6.1	Examination of Product	Acceptable/ Nonacceptable	Acceptable (dimensional inspection included)	
6.2	Internal Proof Pressure	Acceptable/ Nonacceptable	Acceptable	
6.3	External Proof Pressure	Acceptable/ Nonacceptable	Acceptable	
6.4 (a)	Internal Static Leakage	36 scch maximum	2.70 scch	
6.4. (b)	External Static Leakage	1.0×10^{-6} sccs	Non detectable leakage	
6.5	Relief Operation	a) P outlet = 14.7 psia crack: 21.7 psia min. full flow: 23.7 psia max. reseat: 21.7 psia min.	a) crack: 23.05 psia full flow: 23.30 psia reseat: 22.80 psia	

FAIRCHILD HILLER
STRATOS-WESTERN
1800 ROSECRANS AVENUE, MANHATTAN BEACH, CALIF. 90266

RELIEF VALVE ASSEMBLY - DEVELOPMENT DATA

NASA Specification 20M32254		S/W Part No. 834000	S/N ________ Date ________	
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
6.8	Vibration	Sinusoidal Acceptable Nonacceptable Lift-off Acceptable Nonacceptable Random Acceptable Nonacceptable Ref. 6.5 crack: 7.0 min. psig full flow: 9.0 max. psig reseat: 7.0 min. psig	Acceptable Acceptable Acceptable Leakage: 3.4 scch 8.0 psig 8.5 psig 7.85 psig	
6.9	Life Cycle Repeat 6.5 every 250 cycles	1000 cycles Ref. 6.5 crack: 7.0 psig min. full flow: 9.0 psig max. reseat: 7.0 psig min. internal leakage: 36 scch	 8.0 psig 8.55 psig 7.85 psig 2.7 scch	
6.10	Burst 6.10.1 Nondestructive 6.10.2 Collapse 6.10.3 Destructive	Rupture - No rupture Collapse - No collapse Rupture Pressure 72 psig	No rupture No collapse Omitted	 *

Conclusions:

Recommendations:

*See paragraph 3.0

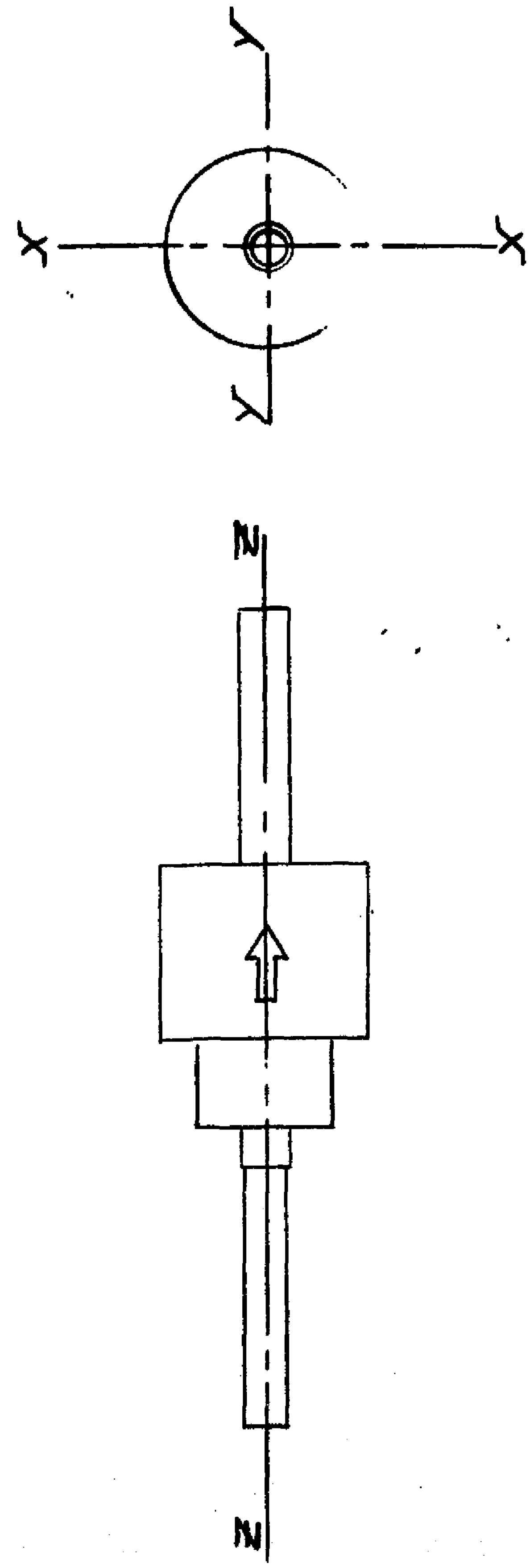

Figure 1. Component Vibration Axes.

APPENDIX I

DIMENSIONAL INSPECTION
RECORD SHEETS

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: SRATOS-R&D P. O. #: R. R. #:
PART NAME: BODY, VALVE ASSY PART NO. 834008 N/C MRR #:
TOOL ORDER NO. DATE INSPECTED: 8/17/70 PROJ. # C-152
Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.188 +.001 -.000 DIA.	.188		25	.625 ±.005 DIA	.6255	
2	.012 ±.002	.014		26	1.282 +.010 -.000	1.285	
3	SHARP CORNER	OK		27	.844 +.010 -.000	.852	
4	.156 +.004 -.001 DIA.	.1555		28	.050 ±.015 x 45°	.050 x 45°	
5	.187	.187		29	45°	45°	
6	.032 RAD	.03125		30	.130	.132	
7	.938 -.001	.937		31	1.000 +.000 -.005	.998	
8	.050 ±.015 x 45°	.050 x 45°		32	.032 R	.03125	
9	.500 ±.015	.500		33	32 ✓	16 ✓	
10	.312 ±.002	.312					
11	.002 R MAX	.001					
12	SHARP CORNER	OK					
13	.015 ±.002	.015					
14	.562 +.002 -.000 DIA.	.562					
15	32 ✓	16 ✓					
16	⊙B .002 DIA	.001					
17	.896 +.002 -.000 DIA	.896					
18	⊙A .002 DIA	.001					
19	32 ✓	16 ✓					
20	.925 +.002 -.000 DIA.	.925					
21	.250 ±.005 DIA	.250					
22	15°	15°					
23	.040 R	.040					
24	.040 ±.015 x 45°	.042 x 45°					

REMARKS:

DISPOSITION:

INSPECTED BY: [signature] (stamp)
TOOLING APPROVED
TOOLING REJECTED
CASTING APPROVED
CASTING REJECTED

APPROVED BY:

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS - R & D P. O. #: R. R. #:

PART NAME: TUBE, INLET PART NO. 834611 N/C MRR #:

TOOL ORDER NO. DATE INSPECTED: 8/18/70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	3.25	3.251					
2	.25 MIN (3)	.259 - ✓(6)					
3	.187 +.000 -.001 DIA	.1869					
	X DIM SHOWN						

REMARKS:

DISPOSITION:

INSPECTED BY: [signature]

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

APPROVED BY:

STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS R. + D. P. O. #: ______ R. R. #: ______

PART NAME: RING DAMPER PART NO. 834016 N/C MRR #: ______

TOOL ORDER NO. ______ DATE INSPECTED: 8/18/70 PROJ. #: C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC
1	.688 DIA.	.692					
2	$.895^{+.000}_{-.002}$ DIA.	.895					
3	63 ✓	32 ✓					
4	.010/.020 R. TYP	.012 R					
5	.010/.015	.012					
6	$.025^{\pm.002}$ TYP	.025 - .027					
7	$.038^{+.004}_{-.000}$	.038					

REMARKS:

DISPOSITION:

INSPECTED BY: [signature]

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

13

APPROVED BY:

STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS R+D. P. O. #: R. R. #:

PART NAME: RING, GUIDE PART NO. 834007 N/C MRR #:

TOOL ORDER NO. DATE INSPECTED: 8/18/70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.454 +.005 -.000 DIA	.455					
2	⊙ A .005 DIA	.001					
3	.561 +.000 -.002 DIA	.561					
4	.025 ±.005 RAD	.020R					
5	.020/.023	.022					
6	.003/.005R TYP	.003					
7	.034 +.004 -.000	.034					
8	.032 ±.002	.032 - .034					

REMARKS:

DISPOSITION:

INSPECTED BY: [signature]

TOOLING APPROVED ✓

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

APPROVED BY:

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS R & D P. O. # R. R. #
PART NAME: FLANGE, OUTLET PART NO. 834018 N/C MRR #
TOOL ORDER NO. DATE INSPECTED: 8/18/70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.329 ±.005	.330		25	.094 TYP	.094 TYP	
2	.297 ±.002	.297		26	15°	15°	
3	.040 ±.005	.041		27	.125 +.004 -.001 DIA 2 plcs	.125 2 plcs	
4	.125 ±.002	.126		28	.062	.062	
5	.120 +.000 -.005	.119		29	.100 +.000 -.005	.096	
6	63✓	16✓		30	.156	.156	
7	.891 +.000 -.001	.891		31	.300	.300	
8	SHARP CORNER	OK		32	45°	45°	
9	.025 × 45°	.023 × 45°		33	.688 DIA	.685	
10	.266 ±.001	.266		34	.312 ±.005 DIA	.312	
11	.010 ±.005 R	.005 R		35	.250 +.001 -.000 DIA	.250	
12	.032 R	.027		36	.012 ±.002	.0123	
13	.062 DIA	.0625		37	.209 +.005 -.001 DIA	.210	
14	.471 +.000 -.002 DIA.	.4708		38	.015 ±.002	.013	
15	.578 DIA.	.579		39	SHARP CORNER	OK	
16	⊙A .005 DIA	.001					
17	.626 +.000 -.002 DIA	.6255					
18	⊙B .002 DIA	.001					
19	32✓	16✓					
20	.736 +.000 -.001 DIA.	.736					
21	⊙A .001 DIA	.0005					
22	.047 R	.045					
23	.047 R	.0468					
24	30° TYP	30°					

REMARKS:

DISPOSITION:

INSPECTED BY: R.M. Jordan
TOOLING APPROVED
TOOLING REJECTED
CASTING APPROVED
CASTING REJECTED

15
APPROVED BY:

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS R & D. P. O. # R. R. #
PART NAME: SEAT, BELLOWS END PLATE PART NO. 834028 A MRR #
TOOL ORDER NO. DATE INSPECTED: 8/18/70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.564 ±.002	.564		25	85° 30'	85° 30' (MOLD)	
2	.032	.032		26 *	.158 ±.002	.158	
3	.038 +.000 -.002	.038		27	.050 R	.050 R	
4	.225	.225		28	.200 ±.005 DIA. x 90°	.2003 x 90°	
5	.002 R MAX	.001 R		29	⊙ A .0005 DIA	.0003	
6	.062	.062		30	16 ✓	16 ✓	
7	.062 R	.0625		31	16 ✓	16 ✓	
8	45°	45°		32	.792 ±.001	.791	
9	.453 +.000 -.002	.452		33	.002 R. MAX	.001 R	
10	45°	45°		34	.175 ±.001 DIA	.174	
11	.188	.188		35	.067 +.000 -.002 DIA. - 2 HOLES IN LINE .002	.067 IN LINE .0005	
12	.094	.094		36	.005/.010 R TYP	.007 R	
13	.450 ±.005 DIA.	.450		37	.375 +.002 -.000 DIA	.3755	
14	.471 +.000 -.002 DIA.	.471		38	32 ✓	32 ✓	
15	.850 +.000 -.002 DIA.	.850		39	.406 +.002 -.000 DIA.	.407	
16	.015 R	.012 R		40	.125 ±.002	.1265	
17	.02 R - 4 plcs	.020 R		41	.187 +.002 -.000	.187	
18	.030 ±.002	.0295		42	.015 ±.005 x 45°	.010	
19	.090	.092					
20	.437 ±.005 DIA.	.4375					
21	.132	.133					
22	.839 ±.001	.839					
23	.515 +.000 -.002 DIA.	.515					
24	.001/.004 R 8 ✓	.002 R 8 ✓					

REMARKS: * (26) DIM CHANGED TO MATCH DIA. OF BALL .218 DIA.

DISPOSITION:

INSPECTED BY: [signature] (stamp)
TOOLING APPROVED
TOOLING REJECTED
CASTING APPROVED
CASTING REJECTED

16
APPROVED BY:

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS R.&D. P. O. #: ______ R. R. #: ______

PART NAME: SEAT, BELLOWS END PLATE PART NO. 834028 A MRR #: ______

TOOL ORDER NO. ______ DATE INSPECTED: 8/18/70 PROJ. #: C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.564 ±.002	.564		25	85° 30'	85° 30' (MOLD)	
2	.032	.032		26 *	.158 ±.002	.158	
3	.038 +.000 -.002	.038		27	.050 R	.050 R	
4	.225	.225		28	.200 ±.005 DIA. x 90°	.2003 x 90°	
5	.002 R MAX	.001 R		29	⊙ A .0005 DIA	.0003	
6	.062	.062		30	16 ✓	16 ✓	
7	.062 R	.0625		31	16 ✓	16 ✓	
8	45°	45°		32	.792 ±.001	.791	
9	.453 +.000 -.002	.452		33	.002 R. MAX	.001 R	
10	45°	45°		34	.175 ±.001 DIA	.174	
11	.188	.188		35	.067 +.000 -.001 DIA. - 2 HOLES IN LINE .002	.067 IN LINE .0005	
12	.094	.094		36	.005/.010 R TYP	.007 R	
13	.450 ±.005 DIA.	.450		37	.375 +.002 -.000 DIA	.3755	
14	.471 +.000 -.002 DIA.	.471		38	32 ✓	32 ✓	
15	.850 +.000 -.002 DIA.	.850		39	.406 +.002 -.000 DIA	.407	
16	.015 R	.012 R		40	.125 ±.002	.1265	
17	.02 R - 4 plcs	.020 R		41	.187 +.002 -.000	.187	
18	.030 ±.002	.0295		42	.015 ±.005 x 45°	.010	
19	.090	.092					
20	.437 ±.005 DIA.	.4375					
21	.132	.133					
22	.839 ±.001	.839					
23	.515 +.000 -.002 DIA.	.515					
24	.001/.004 R 8 ✓	.002 R 8 ✓					

REMARKS: * (26) DIM CHANGED TO MATCH DIA. OF BALL .218 DIA.

DISPOSITION: ______

INSPECTED BY: [signature]

TOOLING APPROVED ______

TOOLING REJECTED ______

CASTING APPROVED ______

CASTING REJECTED ______

16

APPROVED BY: ______

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS R. & D. P. O. #: ________ R. R. #: ________

PART NAME: RETAINER, SPRING PART NO. 834013 N/C MRR #: ________

TOOL ORDER NO. ________ DATE INSPECTED: 8/19/70 PROJ. #: C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	$.177^{+.000}_{-.002}$	.177					
2	.004/.008 R	.004 R					
3	$.405^{+.000}_{-.002}$ DIA	.404					
4	.094	.094					
5	.188	.188					
6	.02 R - 4 plcs	.020 - 4 plcs.					
7	.090	.091					
8	$.187^{+.004}_{-.001}$ DIA.	.1875					
9	$.281^{+.004}_{-.000}$ DIA.	.282					
10	$.025 \pm .002$	.026					
11	$.115 \pm .005$	.116					
12	$.358 \pm .005$ DIA.	.360					
13	.020 R	.012					
14	$.067^{+.004}_{-.001}$ - 2 HOLES IN LINE .002	.067 - .001 IN LINE					
15	$.125 \pm .002$	(.119)	-.004/.51 ~~[illegible]~~				
16	.005 R MAX	.002					

REMARKS: USE AS IS [illegible]

DISPOSITION: ________

INSPECTED BY: [illegible signature]

TOOLING APPROVED ________

TOOLING REJECTED ________

CASTING APPROVED ________

CASTING REJECTED ________

17

APPROVED BY:

MFG ENG

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS R + D. P. O. #: R. R. #:

PART NAME: RETAINER, SPRING PART NO. 834013 N/C MRR #:

TOOL ORDER NO. DATE INSPECTED: 8/19/70 PROJ. #: C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.177 +.000 -.002	.177					
2	.004/.008 R	.004 R					
3	.405 +.000 -.002 DIA	.404					
4	.094	.094					
5	.188	.188					
6	.02 R - 4 plcs	.020 - 4 plcs					
7	.090	.091					
8	.187 +.004 -.001 DIA.	.1875					
9	.281 +.004 -.000 DIA.	.282					
10	.025 ±.002	.026					
11	.115 ±.005	.116					
12	.358 ±.005 DIA.	.360					
13	.020 R	.012					
14	.067 +.004 -.001 2 HOLES IN LINE .002	.067 - IN LINE .001					
15	.125 ±.002	.119	-.004/51 [illegible]				
16	.005 R MAX	.002					

REMARKS: USE AS IS [illegible]

DISPOSITION:

INSPECTED BY: [illegible signature]

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

APPROVED BY:

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS R & D. P. O. #: R. R. #:

PART NAME: POPPET, RELIEF VALVE PART NO. 834015 A MRR #:

TOOL ORDER NO. DATE INSPECTED: 8/19/70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.607 ±.001	.607					
2	32 √	√ 16					
3	.373 +.000 −.001 DIA	.3725					
4	⊙ A .001 DIA.	.0005					
5	√ 16	√ 16					
6	80°	80°					
7	.121 ±.002 DIA	.120					
8	.406 ±.005	.406					
9	.030	.030					
10	.076 +.004 −.001 DIA - 4 HOLES	.076 - 4 HOLES					
11	30° TYP	30°					
12	.005 R. MAX	.003 R					
13	.086 +.010 −.000	.087					
14	.218 DIA. × 120°	.217					
15	.281 +.004 −.000 DIA	.283					
16	.312 +.005 −.001 DIA	.3125					

REMARKS:

DISPOSITION:

INSPECTED BY: [signature] (stamp)

TOOLING APPROVED ✓

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

APPROVED BY:

Q.C. MFG. ENG.

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: STRATOS R & D   P. O. #   R. R. #

PART NAME: POPPET, RELIEF VALVE   PART NO. 834015 A   MRR #

TOOL ORDER NO.   DATE INSPECTED: 8/19/70   PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.607 ±.001	.607					
2	32	✓					
3	.373 +.000 -.001 DIA	.3725					
4	⊙A .001 DIA.	.0005					
5	✓	✓					
6	80°	80°					
7	.121 ±.002 DIA	.120					
8	.406 ±.005	.406					
9	.030	.030					
10	.076 +.004 -.001 DIA - 4 HOLES	.076 - 4 HOLES					
11	30° TYP	30°					
12	.005 R MAX	.003 R					
13	.086 +.010 -.000	.087					
14	.218 DIA. × 120°	.217					
15	.281 +.004 -.000 DIA	.283					
16	.312 +.005 -.001 DIA	.3125					

REMARKS:

DISPOSITION:

INSPECTED BY: [signature]

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

APPROVED BY:

Q.C.   MFG.   ENG.

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

Page 1 of 1

STRATOS R.&D.

VENDOR: Metal Bellows Corp. P. O. #: 33670 R. R. #:

PART NAME: Bellows PART NO. 834027 N/C MRR #:

TOOL ORDER NO. DATE INSPECTED: 8/24/70 PROJ. #: C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.865 ±.005 DIA.	.865					
2	.605	.605					
3	.405	.402					
4	.030 ±.015	.028					
5	.815 ±.015 DIA.	.809					
NOTE (4)	—	CERTS.	—				

REMARKS:

DISPOSITION:

INSPECTED BY: [signature] Jordan

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

19

APPROVED BY:

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

STRATOS R.&D.

VENDOR: METAL BELLOWS CORP. P. O. # 33670 R. R. #

PART NAME: BELLOWS PART NO. 834027 N/C MRR #

TOOL ORDER NO. DATE INSPECTED: 8/24/70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.865 ±.005 DIA.	.865					
2	.605	.605					
3	.405	.402					
4	.030 ±.015	.028					
5	.815 ±.015 DIA.	.809					
NOTE (4)	—	CERTS.	—				

REMARKS:

DISPOSITION:

INSPECTED BY: [signature] Jordan

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

19

APPROVED BY:

STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

Page 1 of 1

VENDOR: HEMPHILL SPRING Co. / STRATOS - R.& D P. O. # 3-3672 R. R. # 231071

PART NAME: SPRING, MAIN PART NO. 834017 N/C MRR #

TOOL ORDER NO. DATE INSPECTED: AUG 22 '70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

6 pcs.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.044	.044					
2	.476 ±.005	I.D. .478					
3	4	4					
4	6	6					
5	.264 MAX.	.250					
6	.389-2.60	lbs. ±.13 lbs. 2.50 lbs					
7	2°	1°					

REMARKS:

DISPOSITION:

INSPECTED BY: [signature]

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

APPROVED BY:

Q. C. ______ MFG. ______ ENG. ______

Form Q-175WB Rev 3/64

STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

VENDOR: HEMPHILL SPRING Co. STRATOS - R. & D P. O. # 3-3672 R. R. # 231071

PART NAME: SPRING, MAIN PART NO. 834017 N/C MRR #

TOOL ORDER NO. DATE INSPECTED: AUG 22 '70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

6 pcs.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.044	.044					
2	.476 ±.005	I.D. .478					
3	4	4					
4	6	6					
5	.264 MAX.	.250					
6	.389-2.60 lb. ±.13 lb.	2.50 lbs					
7	2°	1°					

REMARKS:

DISPOSITION:

INSPECTED BY:

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

APPROVED BY:

Q. C. MFG. ENG.

STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

Page 1 of 1

VENDOR: STRATOS R. & D. P. O. #_____ R. R. #_____

PA[illegible] NAME: END PLATE, BELLOWS PART NO. 834020 N/C MRR #_____

TOOL ORDER NO. _____ DATE INSPECTED: AS 25 '70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	$.312^{\pm .001}$	.3115					
2	$.094^{+.010}_{-.000}$	.094					
3	63✓	32✓					
4	.047	.049					
5	.004/.008 R	.004					
6	$.813^{+.000}_{-.002}$ DIA.	.811					
7	$.923^{+.000}_{-.001}$ DIA.	.923					
8	32✓	16✓					
9	$.010^{\pm .005}$ R	.010 R					
1C	.860 DIA.	(.821)	ALL .029				
11	$.187^{\pm .001}$	.187					
2	$.015^{\pm .001}$	.015					
3	SHARP CORNER	OK					
4	⊙B .005 DIA.	.001					
5	$.010^{\pm .005}$ R	.005 R					
6	$.015^{+.010}_{-.000}$ × 45°	.016 × 45°					
7	$.738^{+.002}_{-.000}$	.7385					
8	.600 DIA.	.600					
9	$.250^{+.005}_{-.000}$	.250					
c	$.893^{+.001}_{-.000}$ DIA.	.893					
	⊙A .001 DIA.	.0005					
	32✓	16✓					
3	.010 R. MAX	.003 R					
	.005 R MAX	.002 R					

[R]EMARKS: _____

[D]ISPOSITION: USE AS IS [signature]

INSPECTED BY [signature] (stamp)

TOOLING APPROVED _____

TOOLING REJECTED _____

CASTING APPROVED _____

CASTING REJECTED _____

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[A]PPROVED BY:

[Q].C. _____ MFG. _____ ENG. _____

STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

Page 1 of 1

VENDOR: STRATOS R.+D. P. O. #: R. R. #:

PA(NAME: END PLATE, BELLOWS PART NO. 834020 N/C MRR #:

TOOL ORDER NO. DATE INSPECTED: AUG 25 '70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.312 ±.001	.3115					
2	.094 +.010 −.000	.094					
3	63 ✓	32 ✓					
4	.047	.049					
5	.004/.008 R	.004					
6	.813 +.000 −.002 DIA.	.811					
7	.923 +.000 −.001 DIA.	.923					
8	32 ✓	16 ✓					
9	.010 ±.005 R	.010 R					
10	.860 DIA.	(.821)	.039				
11	.187 ±.001	.187					
12	.015 ±.001	.015					
13	SHARP CORNER	OK					
14	⊙B .005 DIA.	.001					
15	.010 ±.005 R	.005 R					
16	.015 +.010 −.000 × 45°	.016 × 45°					
17	.735 +.002 −.000	.7385					
18	.600 DIA.	.600					
19	.250 +.005 −.001	.250					
20	.593 +.001 −.000 DIA.	.593					
21	⊙A .001 DIA.	.0005					
22	32 ✓	16 ✓					
23	.010 R. MAX	.003 R					
24	.005 R MAX	.002 R					

REMARKS:

DISPOSITION: USE AS IS [signature]

INSPECTED BY [signature]

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

APPROVED BY:

Q.C. MFG. ENG.

FAIRCHILD STRATOS

STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

ENDOR: P. O. # R. R. #

PART NAME: BELLOWS ASSY PART NO. 834010 MRR #

TOOL ORDER NO. DATE INSPECTED: AUG 26 '70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	⊙A .005 DIA.	.003					
2	1.250/1.284	1.255					
3	⊙A .005 DIA	.005					

REMARKS:

DISPOSITION:

INSPECTED BY: [signature]

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

APPROVED BY:

FAIRCHILD STRATOS

STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

Page 1 of .

VENDOR: P. O. #: R. R. #:

PART NAME: BELLOWS ASSY PART NO. 834010 MRR #:

TOOL ORDER NO. DATE INSPECTED: AUG 20 '70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	⊙A .005 DIA.	.003					
2	1.250/1.284	1.255					
3	⊙A .005 DIA	.005					

REMARKS:

DISPOSITION:

INSPECTED BY: [signature]

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

23

APPROVED BY:

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

STRATOS R.&D.

FIRST ARTICLE INSPECTION

VENDOR: SHIMS INC. P. O. # 1-3715 R. R. # 231212

PART NAME: SHIM, SPRING PART NO. 834029 MRR #

TOOL ORDER NO. DATE INSPECTED: AUG 27 70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.475/.480 DIA.	.477					
2	.580 +.001 -.010 DIA.	.577					
3	.002	.002					
4	.003	.003					
5	.010	.009					

REMARKS:

DISPOSITION:

INSPECTED BY: M. Jordan (stamp)

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

23

APPROVED BY:

Q.C. MFG. ENG.

FAIRCHILD STRATOS
STRATOS DIVISION
MANHATTAN BEACH, CALIFORNIA

FIRST ARTICLE INSPECTION

STRATOS R & D.

VENDOR: SHIMS INC. P. O. # 1-3715 R. R. # 231212

PART NAME: SHIM, SPRING PART NO. 834029 MRR #

TOOL ORDER NO. DATE INSPECTED: AUG 27 '70 PROJ. # C-152

Note: All defects must be corrected and first article resubmitted before resuming manufacturing.

ITEM	B/P DIM	ACTUAL DIM.	DISC.	ITEM	B/P DIM	ACTUAL DIM.	DISC.
1	.475/.480 DIA.	.477					
2	.550 +.00/-.010 DIA.	.577					
3	.002	.002					
4	.003	.003					
5	.010	.009					

REMARKS:

DISPOSITION:

INSPECTED BY: [signature]

TOOLING APPROVED

TOOLING REJECTED

CASTING APPROVED

CASTING REJECTED

23

APPROVED BY:

Q.C. MFG. ENG.

DEVELOPMENT TEST
LOG SHEETS

DEVELOPMENT TEST
LOG SHEETS

PRE TEST 9-1-70

P_I Δ		LEAKAGE	
5.0		0	SCCM
5.5		0	"
6.0		0	"
6.5		0	"
7.0		0	"
7.5		.14	"
8.0		2.0	"
8.3	CRACK	50	"
8.6	FULL FLOW	775	SCIM
8.2	RESEAT	50	SCCM
7.0		.54	
6.5		.18	
6.0		.06	
5.5		.0	
5.0		.0	

PRE TEST 9-1-70 [initials]

P_I Δ		LEAKAGE
5.0		0 SCCM
5.5		0 "
6.0		0 "
6.5		0 "
7.0		0 "
7.5		.14 "
8.0		2.0 "
8.3	CRACK	50 "
8.6	FULL FLOW	775 SCIM
8.2	RESEAT	50 SCCM
7.0		.54
6.5		.18
6.0		.06
5.5		.0
5.0		.0

PRETEST AFTER WELD 9-1-70

PSI Δ		
5	.05 SCCM	
5.5	.055	
6	.06 SCCM	
6.5	.08 SCCM	
7	.14 SCCM	
7.5	.31 SCCM	
8.		
8.55	8.60	CRACK
8.8	8.8	FULL FLOW
8.45	8.5	RESEAT
8.		
7.5		
7	.30 SCCM	
6.5	.075 SCCM	.080
6.0	.065	

PRETEST AFTER WELD 9-1-70

PSIΔ		
5	.05 SCCM	
5.5	.055	
6	.06 SCCM	
6.5	.08 SCCM	
7	.14 SCCM	
7.5	.31 SCCM	
8.		
8.55 8.60	CRACK	
8.8 8.8	FULL FLOW	
8.45 8.5	RESEAT	
8.		
7.5		
7	.30 SCCM	
6.5	.075 SCCM	.080
6.0	.065	

Development Verification Tests. 9/3/70

P/N 834000 S/N. ER 834-1

Para	6.0	Development Verification tests.				
9 3 70	6.1	Examination.				
SWG 32	6.2	Internal proof Pressure.				Remarks:
		18 psig 5 minutes.				None
SWG 32	6.3	External Proof Pressure.				
		70 psig 5 mins.				None
	6.4	Leakage.				
SWG 32	(A)	inlet psig	Leakage.	crack	Reset.	
		6.5	.045	8.35	8.1	
		6.5	.030	8.3	8.1	
SWG 32		6.5	.10	8.3	8.15	
	(B)	External				
9 3 70		35 psig	NDL			None.
	6.5	Relief Operation.				
		SEE NEXT PAGE				

Development Verification Tests 9/3/70

P/N 834000 S/N. ER 834-1

PARA	6.0	Development Verification Tests.				
9 3 '70	6.1	Examination.				
SWG 32	6.2	Internal Proof Pressure.				Remarks:
		18 psig	5 minutes.			None
SWG 32	6.3	External Proof Pressure.				
		70 psig	5 mins.			None
	6.4	Leakage.				
SWG 32	(A)	Inlet Psig	Leakage.	Crack	Reseat	
		6.5	.045	8.35	8.1	
		6.5	.030	8.3	8.1	
SWG 32		6.5	.10	8.3	8.15	
	(B)	External				
9 3 '70		35 psig	NDL			None.
	6.5	Relief Operation.				
		SEE NEXT PAGE				

OUTLET VACUUM 9/16

	Cracking	Reseat	Full Flow
1)	8.25 psig	7.95 psig	8.65 psig
2)	8.25	7.90	8.65+
3)	8.25	7.90	8.65

PARA. 6.8) VIB. @ AETL 9/23/70 SEP 23 '70 SWB 32 I. Tokuda

PARA. 6.8 RELIEF OPERATION AFTER VIB.

	Cracking	Reseat	Full Flow
1)	8.0 psig	7.85 psig	8.47
2)	8.0	7.75	8.5
3)	8.0	7.70	8.55

PARA. 6.9) LIFE CYCLE 1100 cycles of Operation 9/24

RELIEF OPERATION AFTER EVERY 250 cycles.

Cycles	Cracking 1	Cracking 2	Cracking 3	Reseat 1	Reseat 2	Reseat 3	Full Flow 1	Full Flow 2	Full Flow 3
250	8.0	8.0	8.0	7.8	7.85	7.85	8.55	8.55	8.55
500	8.0	8.0	8.0	7.8	7.85	7.85	8.55	8.55	8.55
750	8.0	8.0	8.0	7.8	7.85	7.85	8.55	8.55	8.55
1100	8.0	8.0	8.0	7.8	7.85	7.85	8.55	8.55	8.55

PARA. 6.5 RELIEF OPERATION 9-15-70

OUTLET @ 14.7 PSIA

	CRACKING	RESEAT	PRESSURE @ 775 SCIM FLOW
(1)	8.15 PSIG	8.05	8.25 PSIG
(2)	8.20 "	8.0	8.25 "
(3)	8.15 "	8.05	8.25 "

RELIEF OPERATION AFTER 4.0 HRS. 9-16-70

@ +160°F

	CRACKING	RESEAT	PRESSURE @ 775 SCIM FLOW
1)	8.2 PSIG	7.90 PSIG	8.60 PSIG
2)	8.2 "	7.95 "	8.60 "
3)	8.2 "	7.90 "	8.60 "

PARA. 6.7 Relief Operation After 4.0 Hrs @ -40°F 9/16

	cracking	Reseat	pressure @ 775 Scim Flow
1)	8.16 psig	7.85	8.6 psig
2)	8.15 psig	7.90	8.64
3)	8.15 psig	7.90	8.6

PARA. 6.9)
LEAKAGE AFTER LIFE CYCLE - 9/24
6.5 psig INLET - LEAKAGE WAS 1.6 scc/min.
BACK FLUSHED UNIT to CLEAN - REPEAT LEAKAGE
6.5 psig INLET. LEAKAGE WAS - .045 scc

PARA. 6.10 BURST PRESSURE 9/24

6.10.1 NONDESTRUCTIVE

36 psig	INLET & OUTLET PORTS	NO DAMAGE (3 MINS) SWB 32 SEP 24 '70

6.10.2 COLLAPSE PRESSURE
140 psig EXTERIOR OF VALVE, INLET & OUTLET PORTS 0 psig
NO DAMAGE (3 MINS.) SWB 32 SEP 24 '70

(Added Operation:) RELIEF OPERATION

	Crack	Reseat	Full Flow → 775 Sccm
1)	8.25 psig	7.5 psig	9.0
2)	8.25 psig	7.5	9.0
3)	8.3 psig	7.5	9.0 SWB 32 SEP 24 '70
9/24 1)	7.95	7.85	8.45
2)	7.9	7.85	8.45
3)	7.9	7.85	8.45 SWB 32 SEP 24 '70

9/25/70

LEAKAGE AFTER BURST WAS 2.0 SCCM

645 psig INLET.

SWB 32 SEP 24 '70

VIBRATION RESULTS
AND PHOTOGRAPHS

APPROVED ENGINEERING TEST LABORATORIES
5320 W. 104th St., Los Angeles, Calif. 90045
AETL

Report No. 5330-00-9183

P.O. No. 5-4174

Date: 9-28-70

Government Contract No. NAS8-26358
5 Page Report

TESTED FOR

Fairchild-Hiller
1800 Rosecrans Avenue
Manhattan Beach, California

TEST ITEM

Relief Valve Assembly, Part Number 834000, "Development Unit"

TEST PERFORMED

Sinusoidal Vibration
Random Vibration

REFERENCES

George C. Marshall Space Flight Center Document Number 20M32254, Paragraph 4.3.4.6

TEST EQUIPMENT

AETL No.	Manufacturer	Instrument
D10L	M. B. Electronics	Vibration Exciter
D11L	M. B. Electronics	Amplifier
D38L	Plotamatic	X-Y Plotter
D41L	Endevco Corp.	Accelerometer
D49L	Moseley	Automatic Logarithmic Converter
D70L	M. B. Electronics	Accelerometer Integrator/Amplifier
D830S	M. B. Electronics	Random Control Console
E249L	Spectral Dynamics	Sweep Oscillator Servo

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TEST PROCEDURE AND TEST RESULTS

Sinusoidal Vibration

The specimen was subjected to a sinusoidal sweep for a period of 1.2 minutes along each of the three major orthogonal axes over the frequency range of 3 to 60 Hz at the following intensities:

Frequency(Hz)	Intensity
3 - 7	0.43 inch da
7 - 14	1.1 g peak
14 - 25	0.11 inch da
25 - 60	3.6 g peak

Visual examination at the conclusion of each axis of testing revealed no damage or other adverse effects.

The specimen was then subjected to a sinusoidal sweep for a period of 6.6 minutes in each of the three major orthogonal axes over the frequency range of 20 to 2000 Hz at the following intensities:

Frequency (Hz)	Intensity
20 - 100	0.0020 inch da
100 - 2000	1.0 g peak

Visual examination at the conclusion of testing in each axis revealed no damage or other adverse effects.

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APPROVED ENGINEERING TEST LABORATORIES
5320 W. 104th St., Los Angeles, Calif. 90045
AETL

Report No. 5330-00-9183

Date: 9-28-70

Random Vibration

The specimen was subjected to random vibration for a period of 1.0 minute in each of the three major orthogonal axes over the frequency range of 20 to 2000 Hz at the following intensities:

Frequency (Hz)	Intensity
20 - 25	10 db/octave rise
25 - 80	0.20 g^2/Hz
80 - 125	6 db/octave rolloff
125 - 2000	3 db/ octave rolloff

Total acceleration: 6.8 grms

Visual examination at the conclusion of testing in each axis revealed no damage or other adverse effects. The equalization plot is presented in this report.

The specimen was subjected to random vibration for a period of 2.0 minutes in each of the three major orthogonal axes over the frequency range of 20 to 2000 Hz at the following intensities:

Frequency (Hz)	Intensity
20 - 25	10 db/octave rise
25 - 80	0.05 g^2/Hz
80 - 125	6 db/octave rolloff
125 - 2000	3 db/octave rolloff

Total Acceleration: 3.4 grms

Visual examination at the conclusion of testing in each axis revealed no damage or other adverse effects. The equalization plot is presented in this report.

H. P. Schaaf 9/29/70
"COMPLETE TEST EVALUATION CONDUCTED"
DCASR/LA

OFFICIAL SEAL
KARL G. SCHMIDT
NOTARY PUBLIC - CALIFORNIA
LOS ANGELES COUNTY
My Commission Expires Sept. 22, 1973

SEP 2 8 1970

STATE OF CALIFORNIA
COUNTY OF LOS ANGELES } ss.

TRUMAN D. HARRIS, Project Mgr. being duly sworn, deposes and says: That the information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

Truman D. Harris

SUBSCRIBED and sworn to before me this 28 day of Sept. 1970

Karl G. Schmidt
Notary Public in and for the County of Los Angeles, State of California.

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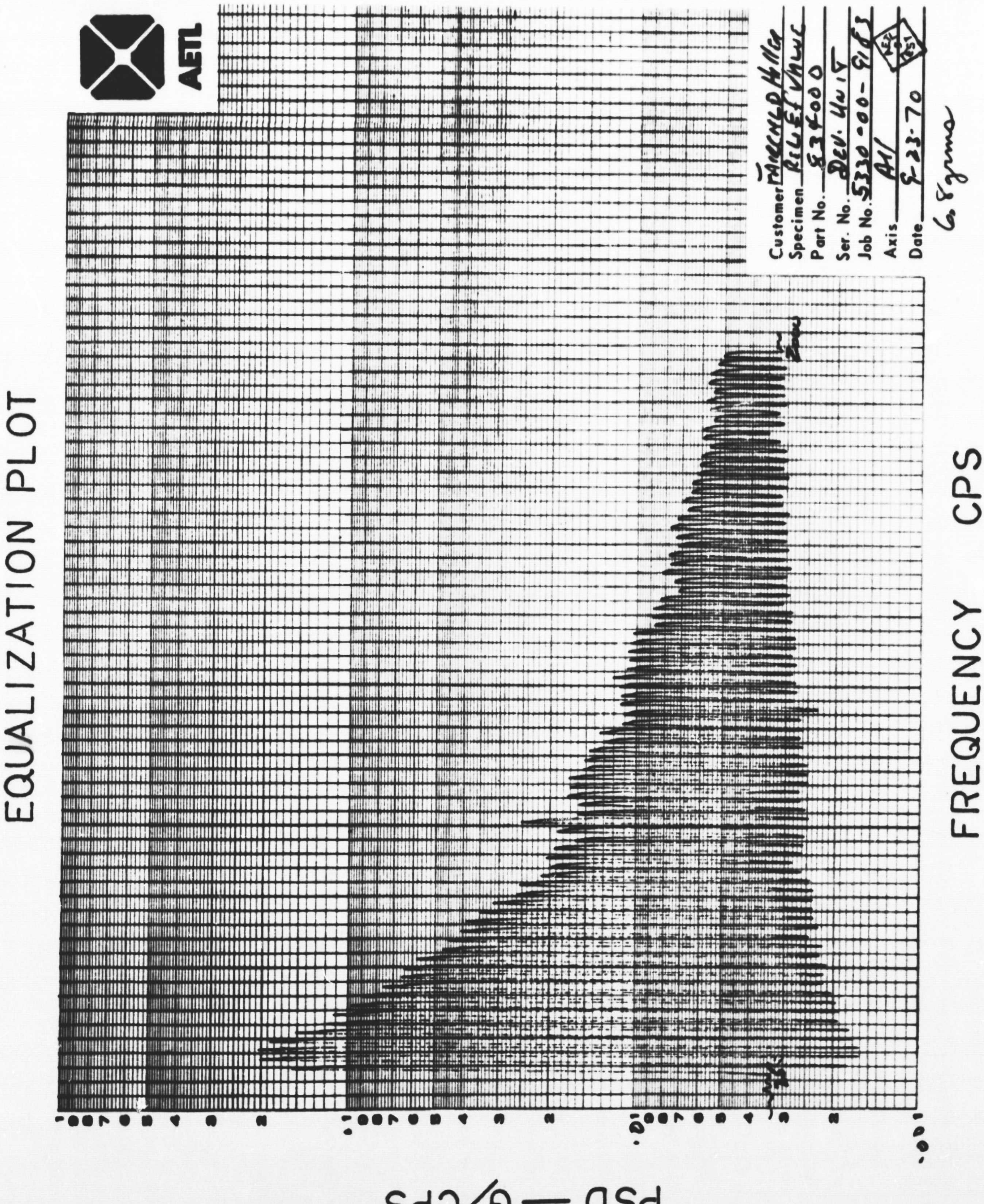
EQUALIZATION PLOT
AETL
Customer Fairchild Hiller
Specimen Relief Valve
Part No. 834000
Ser. No. Dev. Unit
Job No. 5330-00-9183
Axis A1
Date 5-23-70
FREQUENCY CPS
PSD — G²/CPS
.1
.01
.001

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Report No. 5330-00-9183

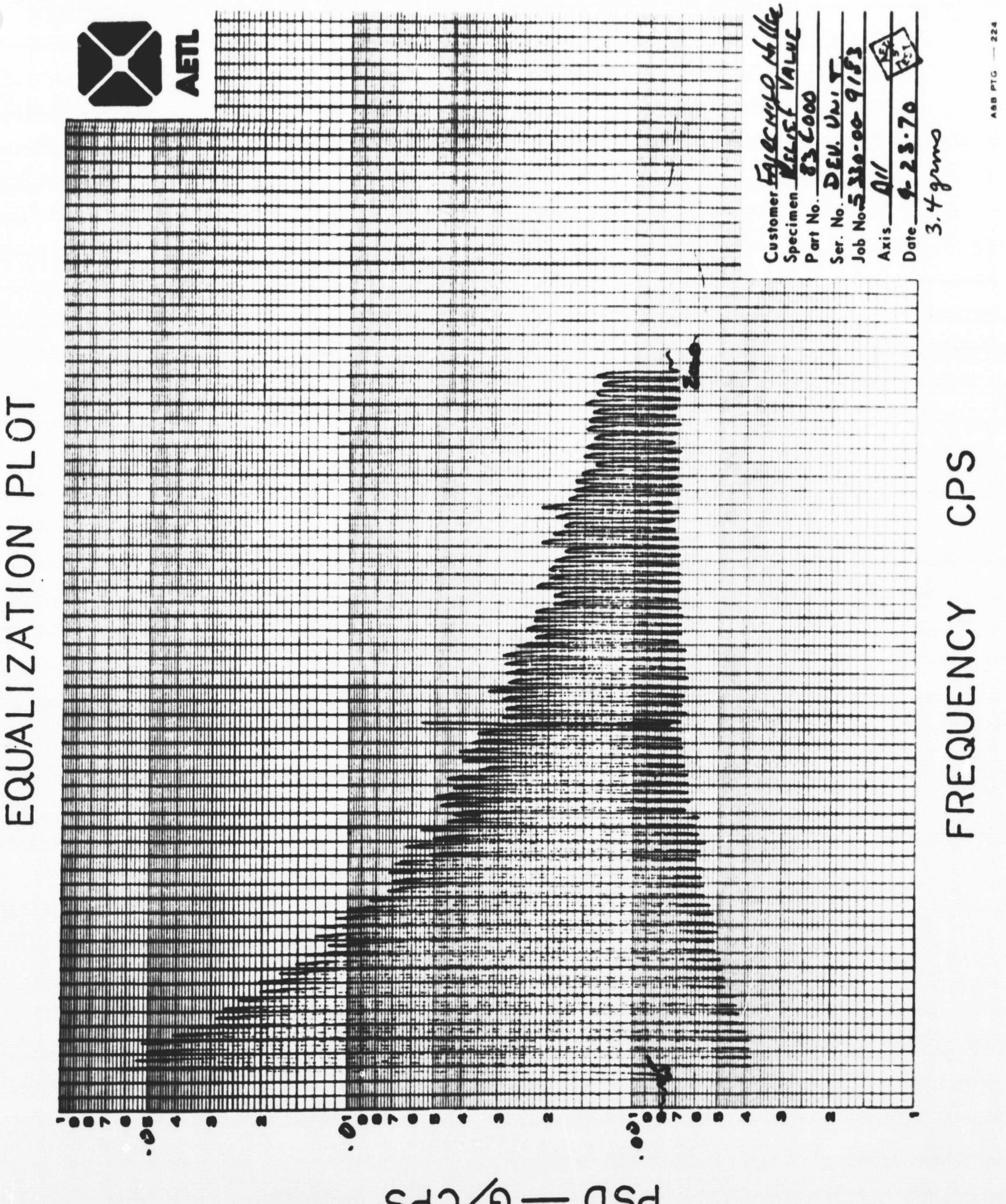

Figure 3. Relief Valve Poppet

Figure 5. Relief Valve Body Assembly (Inside View)

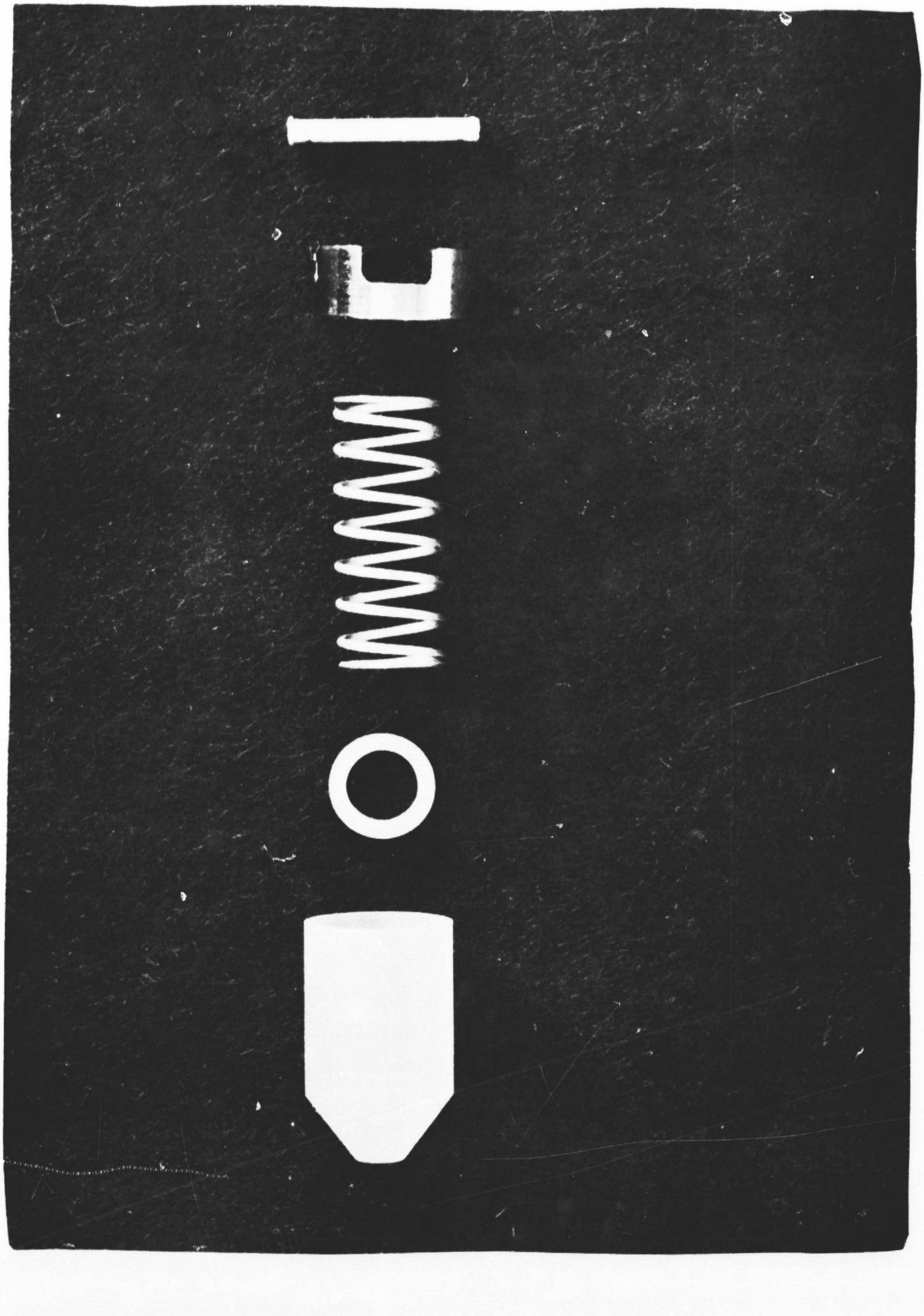

Figure 4. Relief Valve Poppet Assembly

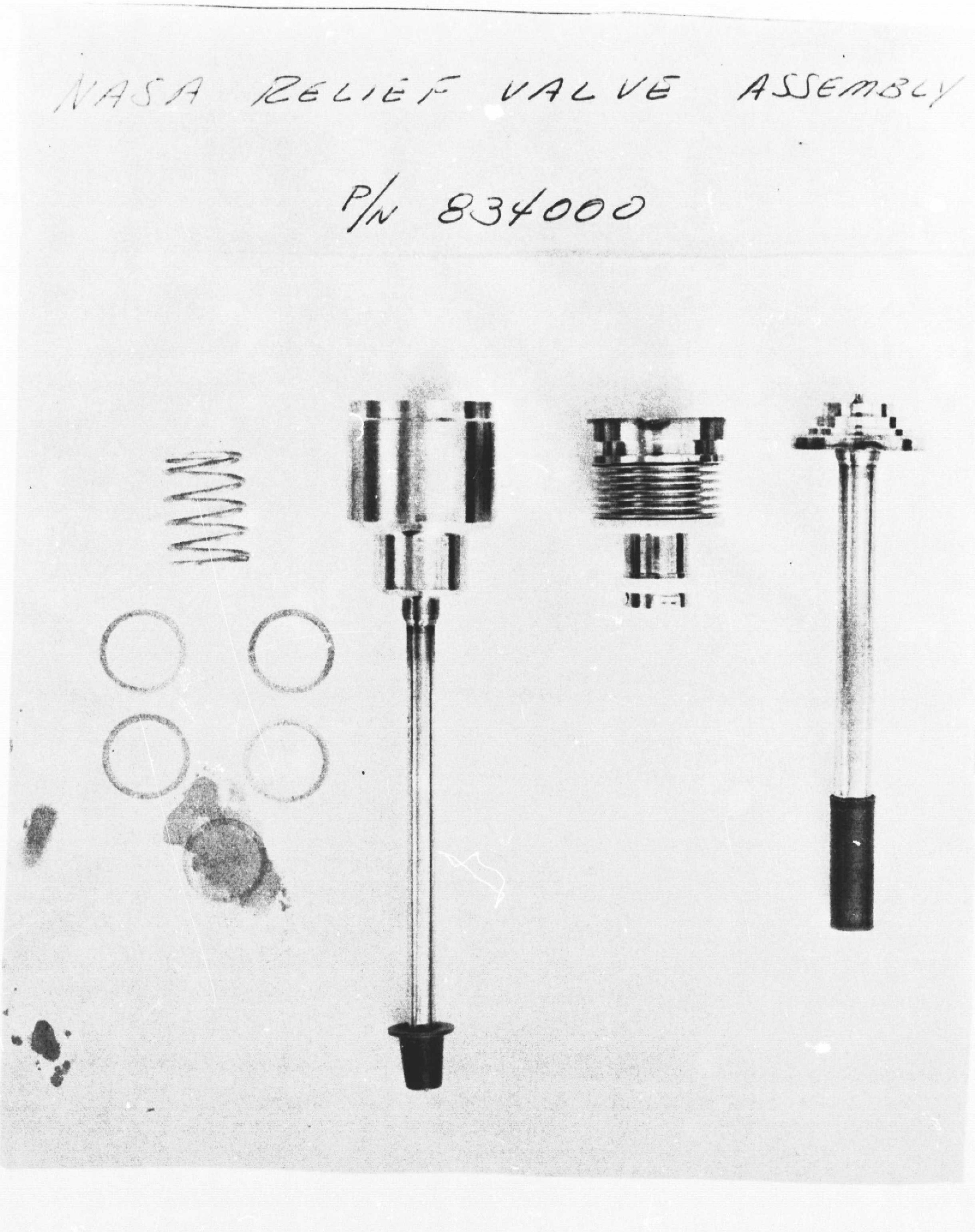

Figure 2.

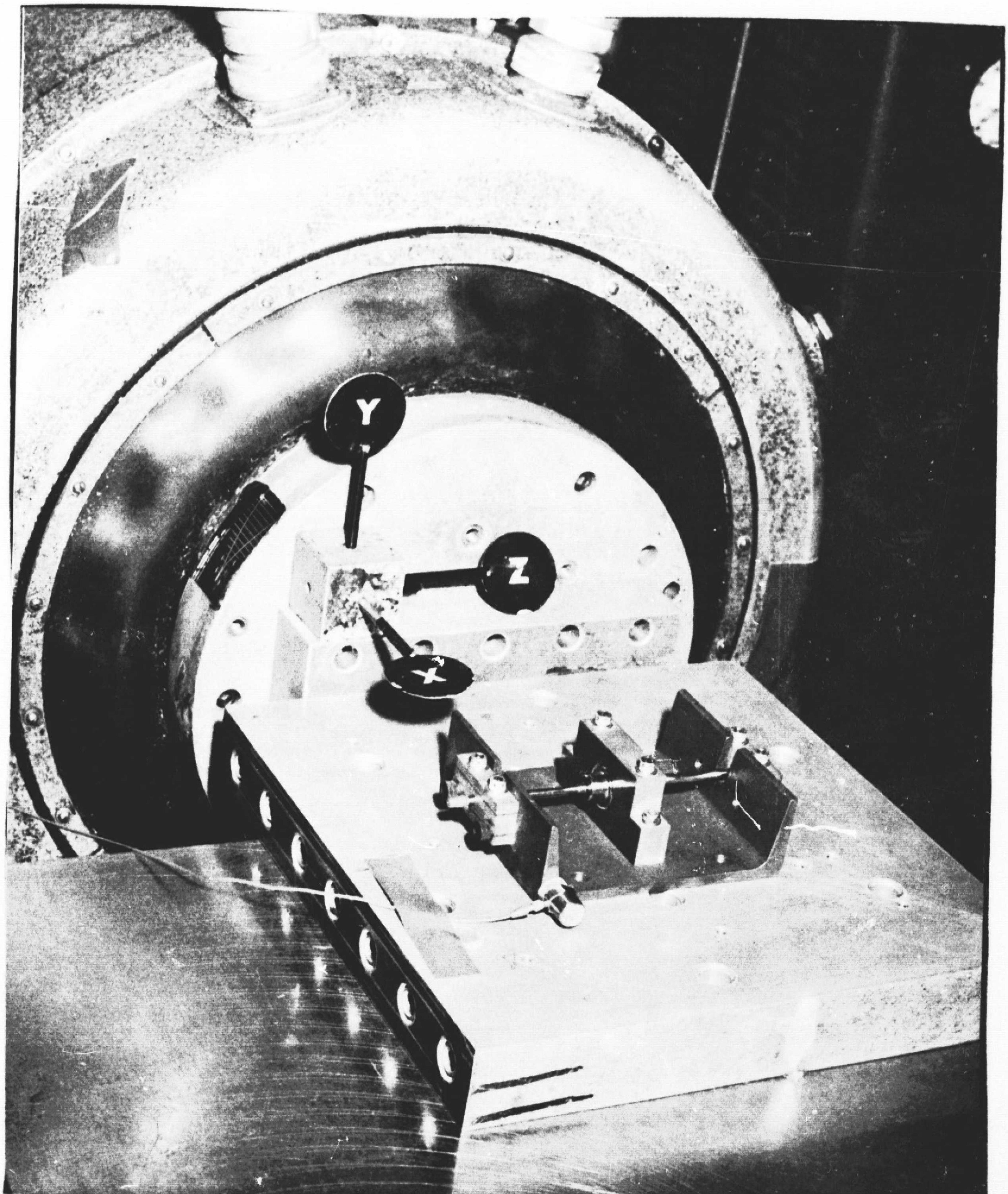

Figure 6. Vibration Test - XX Axis

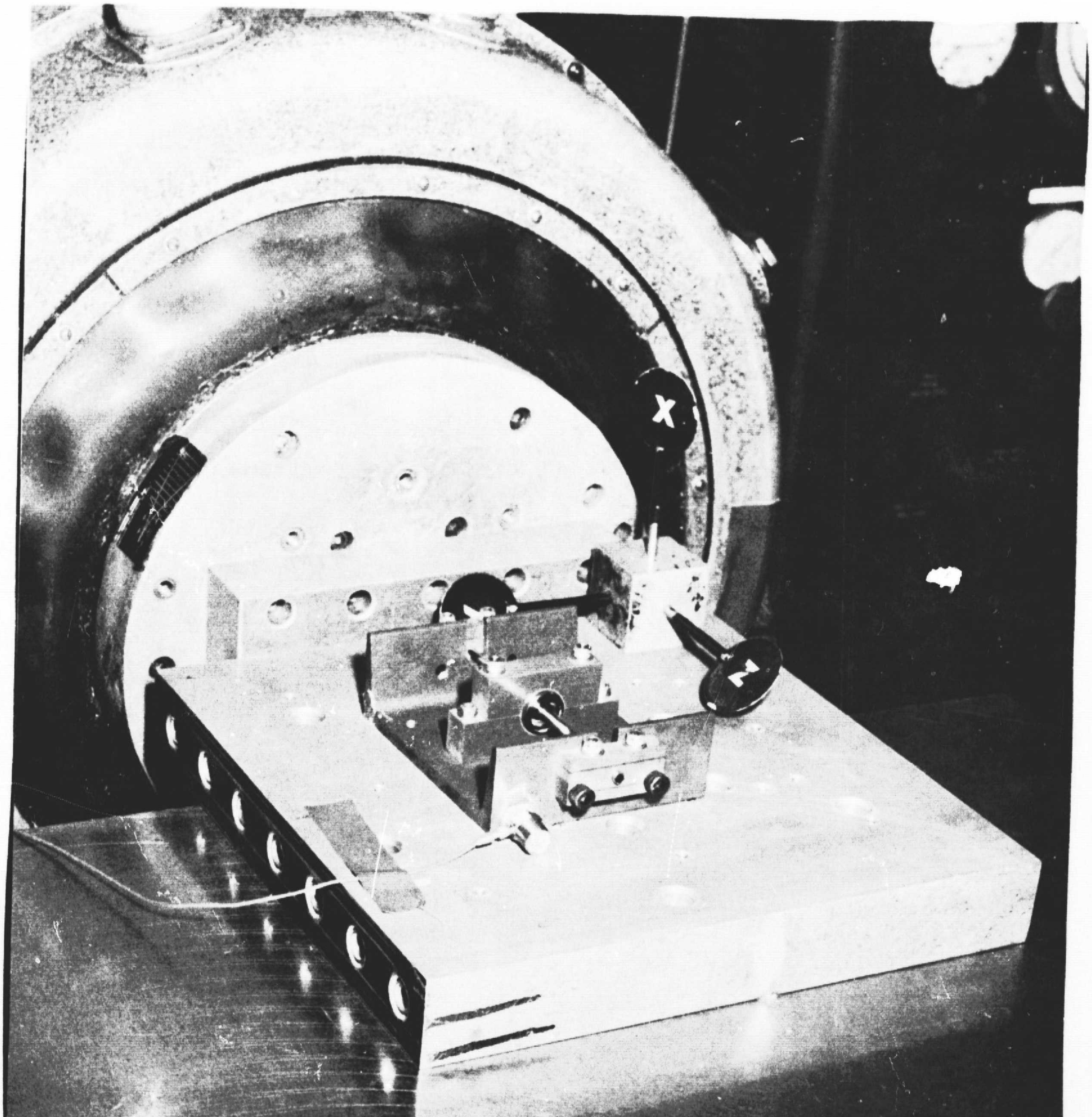

Figure 8. Vibration Test - ZZ Axis

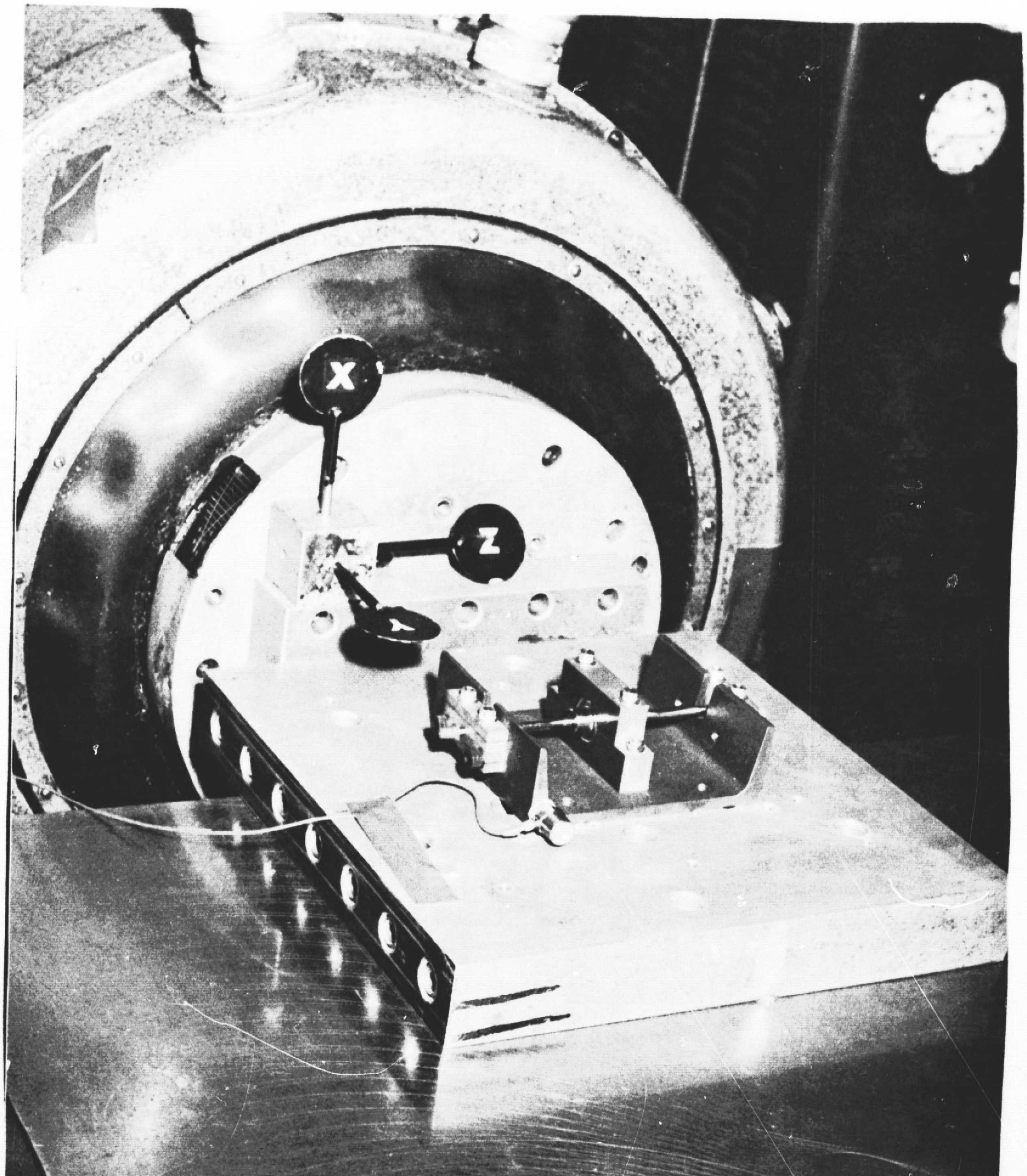

Figure 7. Vibration Test - YY Axis

NASA - MSFC
ASTRONAUTICS LABORATORY
ENGINEERING DIVISION

MEMORANDUM FOR: Fairchild Hiller Corporation 1800 Rosecrans Avenue Manhatten Beach, California 90266	ATTN: Richard Roberts CONTRACT NO.: NAS8-26358
SUBJECT: Review of Documents	DATE: October 27, 1970

The following documents have been reviewed and are approved:

1. Acceptance test procedure 834002 - CN10905 and CN11021.
2. Development test report ER834-5.
3. Qualification test procedure ER834-4.

This completes the requirements of phase I. Phase I is approved.

APPROVED BY: C. Edwards C. Edwards	CONCURRENCE: S&E-ASTN-EMA ______ S&E-ASTN-EMC ______ S&E-ASTN-EM ______	NUMBER: C-26358-005 SHEET 1 OF 1

NASA Technical Information Sheet MSFC

ASTN-72 (OT) September 1970

ADDENDUM II

FAIRCHILD HILLER
STRATOS - WESTERN

INTER-OFFICE COMMUNICATION

Subject: NASA Relief Valve Assembly - P/N 834000

eference: A. S/N 03825LO40005 - RMR 3382
B. S/N 03825LO40006 - RMR 3383

EM71- 2
January 4, 1971

To: R. Smith

From: R. Bertler

Both units in the above reference were disassembled for visual inspection. Contamination was found on both poppets and seats. Special relief valve inlet and outlet fittings were installed on the test stand prior to the acceptance test of both units. The fittings were only flush cleaned after weld. Component parts and fittings were delivered to Durkee Testing Laboratories for possible identification of constituents. The laboratory test report is attached.

Fairchild Hiller concludes the internal leakage reported for S/N 005 and the low reseat pressure reported for S/N 006 is the result of contamination from the component fittings on the test stand.

Corrective action has been implemented as follows:

1. New fittings were fabricated, wire brushed after weld and thoroughly flushed prior to use.

2. Production planning has been advised to revise sheet 5 of the Master Route Sheet to include cleaning per Stratos Spec. 999-331 after the spring retainer (834013) is welded to the bellows (834010).

R. Bertler
R. Bertler

RB:hb

cc: J. Feld
R. Harrison
E. LaPlante
J. Morando
R. Roberts

Attachment

December 21, 1970

DURKEE TESTING LABORATORIES

1520 West 178th St. • Gardena, California 90247

Phone (213) 321-9800

Lab No. ________

Our Rec. Log No. F1196

Your P.O. No.: ________

Report To:

Fairchild Hiller
1800 Rosecrans Avenue
Manhattan Beach, California

METALLURGICAL TEST REPORT

Introduction

This report deals with the metallographic investigation conducted on two (2) T-Fittings identified as "Outlet" and "Inlet", manufactured from 316 Stainless Steel, after the components were submitted to this laboratory for examination and evaluation of the inside diameter surfaces.

Test Results

The two valve components were first cross-sectioned in such a manner as to include a complete inside diameter view and a transverse view of the T-Fitting fusion welds.

Examination of the metallographic cross-sections of the T-Fittings showed evidence of contamination which resembled high temperature "scale" in the weld heat affected zones.

The high temperature products were present in both a tight bond and a "loose scaly" deposition.

The loose scale present is probably the result of material products that formed during the fusion welding operation and the brownish contamination is the result of high temperature volatization of one or more alloying constituents, still being intermetallic in nature, with the matrix material.

It is also believed that the contamination found on the poppet surfaces is a combination of the two aforementioned contaminants.

METALLOGRAPHER

Respectfully Submitted

DURKEE TESTING LABORATORIES

By ________

PRODUCTION ACCEPTANCE TEST

RESULTS

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N 03525-0400012	Date FEB 25 1971
Ref. Paragraph	Test	Specification Requirements	Actual Performance	Remarks
5.1.1	Examination of Product	Acceptable/~~Nonacceptable~~	FEB 25 1971	
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 psig MAR 3 '71	T 3 MAR 3 '71
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptable~~	35 psig MAR 3 '71	T 3 MAR 3 '71
5.1.4	Internal Static Leakage	36 scch maximum	1) 0 scch 2) .18 scch 3) .3 scch	T 3 MAR 3 '71
5.1.5	External Static Leakage	1.0 x 10^{-6} sccs	<3.6 X 10-7	T 3 MAR 3 '71
5.1.6	Relief Operation	Poutlet = 14.7 psia crack: 7.0 psid min. full flow: 9.0 psid max. reseat: 7.0 psid min.	(psid): 1 / 2 / 3 crack: 8.3 / 8.3 / 8.3 full flow: 8.7 / 8.6 / 8.6 reseat: 7.8 / 7.8 / 7.8	T 3 MAR 3 '71

Approvals: T 3

J. Tekeula MAR 3 '71 — R. Wheeler MAR 3 '71

S-W Q-C Date DCASR Date NASA Rep. Date

FAIRCHILD HILLER
STRATOS-WESTERN
1800 Rosecrans Avenue, Manhattan Beach, Calif. 90266

ATP 834002 "D"

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N 03825L040011	Date 12-1-71
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
5.1.1	Examination of Product	Acceptable/Nonacceptable		
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 psig - 5 min. SWB 15 DEC 8'70	Helicoid 0-30 psig
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptable~~	70 psig - 5 min. SWB 15 DEC 8'70	Helicoid 0-200 psig
5.1.4	Internal Static Leakage	36 scch maximum	1) .9 scch 2) 2.7 scch 3) .9 scch SWB 15 DEC 8'70	Helicoid 0-30 psig
5.1.5	External Static Leakage	1.0×10^{-6} sccs	< 5.8 X 10-7 SWB 15 DEC 8'70	MARSH 0-60 psig
5.1.6	Relief Operation	P outlet = 14.7 psia crack: 7.0 psid min. full flow: 9.0 psid max. reseat: 7.0 psid min.	(psid) 1 / 2 / 3 crack: 8.5 / 8.5 / 8.5 full flow: 8.9 / 8.9 / 8.9 reseat: 8.4 / 8.4 / 8.4 SWB 32 JAN 13'71	BARTON ΔP 0-30 psi

Approvals:

J. Tokuda (SWB 32) JAN 13'71 — S-W Q-C, Date

Robert W. Whe... 15 JAN 71 — DCASR, Date

N/A — NASA Rep., Date

FAIRCHILD HILLER
STRATOS-WESTERN
1800 ROSECRANS AVENUE, MANHATTAN BEACH, CALIF. 90266

C152
PO 9460

RELIEF-VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N 03825 040010	Date FEB 25 1971
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
5.1.1	Examination of Product	Acceptable/~~Nonacceptable~~	(SWB 24) FEB 25 1971	
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 PSIG - 5 MIN (T 8) FEB 26 71	
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptable~~	70 PSIG - 5 MIN (T 8) FEB 26 71	
5.1.4	Internal Static Leakage	36 scch maximum	1) 0 scch 2) — scch 3) .12 scch (T 8) FEB 26 71	
5.1.5	External Static Leakage	1.0×10^{-6} sccs	$< 3.7 \times 10^{-7}$ (T 8) FEB 26 71	
5.1.6	Relief Operation	Poutlet = 14.7 psia ~~crack: 7.0 psid min~~ full flow: 9.0 psid max reseat: 7.0 psid min	(psid) | 1 | 2 | 3 crack | 8.0 | 8.0 | 8.0 full flow | 8.3 | 8.3 | 8.3 reseat | 7.9 | 7.9 | 7.9 (T 8) FEB 26 71	

Approvals:

FAIRCHILD HILLER
STRATOS-WESTERN
1800 ROSECRANS AVENUE, MANHATTAN BEACH, CALIF. 90266

SIP 834002 Page No. 15

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N 03825 K040009	Date FEB 25 1971
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
5.1.1	Examination of Product	Acceptable/~~Nonacceptable~~	FEB 25 1971	
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 PSIG - 5 MIN FEB 26 '71	
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptabe~~	20 PSIG - 5 MIN FEB 26 '71	
5.1.4	Internal Static Leakage	36 scch maximum	1) -0- scch 2) -0- scch 3) -0- scch FEB 26 '71	
5.1.5	External Static Leakage	1.0×10^{-6} sccs	$< 1.3 \times 10^{-7}$	
5.1.6	Relief Operation	P outlet = 14.7 psia crack: 7.0 psid min. full flow: 9.0 psid max. reseat: 7.0 psid min.	(psid) 1 / 2 / 3 crack: 8.0 / 8.0 / 8.0 full flow: 8.3 / 8.3 / 8.3 reseat: 7.8 / 7.8 / 7.7 MAR 2 '71	

Approvals:

FAIRCHILD HILLER
STRATOS-WESTERN
1800 ROSECRANS AVENUE, MANHATTAN BEACH, CALIF. 90266

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N 03825L040008	Date 12-9-70
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
5.1.1	Examination of Product	Acceptable/Nonacceptable		
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 psig - 5 min SWB 15 DEC 9'70	Heliceid 0-30 psig
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptable~~	76 psig - 5 min. SWB 15 DEC 9'70	Heliceid 0-200 psig
5.1.4	Internal Static Leakage	36 scch maximum	1) 2.4 scch 2) 1.2 scch 3) 0.9 scch SWB 15 DEC 9'70	Heliceid 0-70 psig
5.1.5	External Static Leakage	1.0×10^{-6} sccs	<2.2x10-7 SWB 15 DEC 9'70	MARSH 0-60 psig
5.1.6	Relief Operation	P_{outlet} = 14.7 psia crack: 7.0 psid min. full flow: 9.0 psid max. reseat: 7.0 psid min.	(psid) 1 / 2 / 3 crack: 8.0 / 8.0 / 8.0 full flow: 8.4 / 8.4 / 8.4 reseat: 7.9 / 7.9 / 7.9 SWB 32 JAN 13'71	BARTEN ΔP-0-30psi

Approvals:

I. Tokuda — S-W Q-C — Date: SWB 32 JAN 13'71

Robert W Wheeler — DCASR — Date: 15 JAN 71

[signature] — NASA Rep. — Date

FAIRCHILD HILLER
STRATOS-WESTERN
1800 ROSECRANS AVENUE, MANHATTAN BEACH, CALIF. 90266

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N 03825L040007	Date 12-1-71
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
5.1.1	Examination of Product	Acceptable/Nonacceptable		
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 psig - 5 min. SWB 15 DEC 8 '70	Helicoid 0-30 psig
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptabe~~	70 psig - 5 min. SWB 15 DEC 8 '70	Helicoid 0-200 psig
5.1.4	Internal Static Leakage	36 scch maximum	1) 7.2 scch 2) 6.0 scch 3) 7.2 scch SWB 15 DEC 8 '70	Helicoid 0-30 psig.
5.1.5	External Static Leakage	1.0×10^{-6} sccs	< 5.3 X 10-7 SWB 15 DEC 8 '70	Marsh 0-60 psig
5.1.6	Relief Operation	Poutlet = 14.7 psia crack: 7.0 psid min. full flow: 9.0 psid max. reseat: 7.0 psid min.	(psid): 1 / 2 / 3 crack: 8.6 / 8.6 / 8.6 full flow: 8.9 / 8.9 / 8.9 reseat: 8.2 / 8.2 / 8.2 SWB 32 JAN 13 '71	BARTON ΔP. 0-30 psi

Approvals:

I. Tokuda SWB 32 JAN 13 '71 — S-W Q-C — Date

Robert W. Wheeler 13 Jan 71 — DCASR — Date

N/A — NASA Rep. — Date

FAIRCHILD HILLER
STRATOS-WESTERN
1800 ROSECRANS AVENUE, MANHATTAN BEACH, CALIF. 90266

E-117A WB REV. 8/65

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N 03825L040006	Date 3-19-71
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
5.1.1	Examination of Product	Acceptable/~~Nonacceptable~~	SWB 24	DIM. PER IDS
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 psig T 2	MAR 19 '71
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptable~~	70 psig T 2	MAR 19 '71
5.1.4	Internal Static Leakage	36 scch maximum	1) 0 scch 2) 0 scch 3) 0 scch	MAR 19 '71
5.1.5	External Static Leakage	1.0×10^{-6} sccs	7.2×10^{-7} T 8	MAR 19 '71
5.1.6	Relief Operation	P outlet = 14.7 psia crack: 7.0 psid min. full flow: 9.0 psid max. reseat: 7.0 psid min.	(psid) 1 / 2 / 3 crack: 7.9 / 7.8 / 7.8 full flow: 8.0 / 8.1 / 8.1 reseat: 7.6 / 7.5 / 7.6	MAR 19 '71

Approvals:

J. Tokuda	MAR 19 1971	R. Wheeler	MAR 19 1971		
S-W Q-C	Date	DCASR	Date	NASA Rep.	Date

FAIRCHILD HILLER
STRATOS-WESTERN
3000 ROSECRANS AVENUE, MANHATTAN BEACH, CALIF. 90266

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N C3825LC46605	Date 3-19-71
Ref. Paragraph	Test	Specification Requirements	Actual Performance	Remarks
5.1.1	Examination of Product	Acceptable/~~Nonacceptable~~		DIM. PER IDS
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 psig	
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptable~~	70 psig	
5.1.4	Internal Static Leakage	36 scch maximum	1) -0- scch 2) -0- scch 3) -0- scch	
5.1.5	External Static Leakage	1.0×10^{-6} sccs	$< 1.8 \times 10^{-7}$	
5.1.6	Relief Operation	Poutlet = 14.7 psia crack: 7.0 psid min. full flow: 9.0 psid max. reseat: 7.0 psid min.	see below	

(psid)	1	2	3
crack:	7.9	8.0	7.9
full flow:	8.2	8.3	8.3
reseat	7.8	7.8	7.8

Approvals:

I. Tokuda (T 3) MAR 19 '71		R. Wheeler			
S-W Q-C	Date	DCASR	Date	NASA Rep.	Date

FAIRCHILD HILLER
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ATP 834002 "D"

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STRATOS-WESTERN

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N 03825K040004	Date 12-7-70
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
5.1.1	Examination of Product	Acceptable/Nonacceptable		S NASA 640
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 psig - 5 min. SWB 15 DEC 7'70	Helicoid 0-30 psig NASA 640
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptabe~~	70 psig - 5 min. SWB 15 DEC 7'70	Helicoid 0-200 psig NASA 640
5.1.4	Internal Static Leakage	36 scch maximum	1) ~~.6~~ scch 2) .6 scch 3) .6 scch SWB 15 DEC 7'70	Helicoid 0-30 psig S NASA 640
5.1.5	External Static Leakage	1.0×10^{-6} sccs	< 3.4 X 10-7 SWB 15 DEC 7'70	MARSH 0-60 psig S NASA 640
5.1.6	Relief Operation	P outlet = 14.7 psia crack: 7.0 psid min. full flow: 9.0 psid max. reseat: 7.0 psid min.	(psid): 1 / 2 / 3 crack: 8.3 / 8.2 / 8.3 full flow: 8.5 / 8.5 / 8.5 reseat: 8.3 / 8.3 / 8.3 SWB 32 JAN 13'71	BARTO ΔP 0-30 psi S NASA 640

Approvals:

S-W Q-C	Date	DCASR	Date	NASA Rep.	Date
I. Tokuda (SWB 32)	JAN 13'71	Robert W. Wheeler	15 JAN 71	N/A	S NASA 640

RELIEF VALVE ASSEMBLY - ACCEPTANCE TEST DATA

NASA Specification 20M32254		S-W Part No. 834000	S/N 03825K040003	Date 12-8-70
Ref. Paragraph	**Test**	**Specification Requirements**	**Actual Performance**	**Remarks**
5.1.1	Examination of Product	Acceptable/Nonacceptable	SWB 22 1/15/71	
5.1.2	Internal Proof Pressure	Acceptable/~~Nonacceptable~~	18 psig - 5 min. SWB 15 DEC 8'70	Helicoid 0-30 psig
5.1.3	External Proof Pressure	Acceptable/~~Nonacceptable~~	70 psig - 5 min. SWB 15 DEC 8'70	Helicoid 0-200 psig
5.1.4	Internal Static Leakage	36 scch maximum	1) 1.5 scch 2) 2.4 scch 3) 2.4 scch SWB 15 DEC 8'70	Helicoid 0-30 psig
5.1.5	External Static Leakage	1.0 x 10^{-6} sccs	<5.6X10-7 SWB 15 DEC 8'70	Marsh 0-60 psig
5.1.6	Relief Operation	Poutlet = 14.7 psia crack: 7.0 psid min. full flow: 9.0 psid max. reseat: 7.0 psid min.	(psid) 1 / 2 / 3 crack: 7.8 / 7.8 / 7.8 full flow: 7.9 / 7.9 / 7.9 reseat: 7.6 / 7.6 / 7.6 SWB 32 JAN 13'71	Barton ΔP. 0-30psi

Approvals:

S-W Q-C	Date	DCASR	Date	NASA Rep.	Date
I. Takuda SWB 32	JAN 13'71	[signature]	15 JAN 71	N/A	

FAIRCHILD HILLER
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