2 November 1965

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to

REON TECHNICAL MEMORANDUM

ACCEPTANCE TEST REPORT
HOT BLEED VENT VALVE ASSEMBLY
FOR
NRX/EST

P/N 1010083-99, S/N 017

MASTER

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Reviewed for
Classification (Unclassified)

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ABSTRACT

Presented are the results of a test conducted on the hot bleed vent valve assembly (HBVVA) to be utilized in the NRX/EST engine system. The HBVVA successfully completed the test, demonstrating functional adequacy during flow of (1150°R, 550 psig), hydrogen media. The HBVV was accepted for use in the engine system.

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I. INTRODUCTION

The NRX/EST engine system utilizes a Hot Bleed Vent Valve Assembly (HBVVA) (Figure 1) which is located in the turbine inlet line vent stack upstream of the turbine block valve assembly (Figure 2). The HBVVA functions as an on-off valve and during reactor only test is open to bypass the hot reactor bleed gas to atmosphere. Presented are the results of tests conducted to establish acceptability prior to use in the NRX/EST Engine System.

II. DESCRIPTION OF THE TEST ITEM

The HBVVA is comprised of a turbine power control valve (Figure 3) with a piston-gear type actuator (Figure 4) and two (2) three (3) way solenoid pilot valves. (Figure 5). The HBVVA fails closed in the event of actuation pressure failure. The serial and part and serial numbers of the major components in the assembly are:

HBVV	P/N 1010083-99	S/N 017
Actuator	P/N 1010084-29	S/N 017
Marotta 3-Way P/N 803944-1		S/N's 689 and 691
Solenoid Valves		

The HBVVA design operating parameters were:

Nominal Operating Pressure	550 psig
Nominal Operating Temperature	1150°R
Nominal Actuation Time	1 second - open 1 second - close
Nominal Actuation Pressure	500 psig

III. TEST RESULTS

A. Twelve (12) tests were conducted in July, 1965. Tests (1) through (8) were ambient pressure tests comprising proof, leak, actuation timing and failure mode tests. Tests nine (9) through (11) were high temperature gaseous hydrogen flow tests comprising actuation timing failure mode, and functional cycle tests. The test setup for the gaseous hydrogen tests is shown in Figure 6.

Test twelve (12) was a post test internal leakage test. The test plan was as shown in Appendix A and the test request was as shown in Appendix B. Results of the 3-way solenoid valve acceptance tests were as shown in Figures 7 and 8.

B. The tests demonstrated operational and functional capability with hot (1150°R, nominal) hydrogen media at 550 psig nominal pressure. Valve assembly actuation time was 0.34 seconds average to open and 0.786 seconds average to close during the cycle test to three (3) complete cycles, (close to open to close = one (1) cycle). Valve assembly "fail close" characteristics were demonstrated. Prior to the hot gas flow test, an ambient proof, leak and timing test was conducted. Pre-test internal (across the disk seal, valve closed) leakage rate was 6 standard cubic feet per minute (scfm) at a differential pressure of 25 psi GH_2 and post-test internal leakage was 32 scfm at a differential pressure of 25 psi GH_2 . Pre-test leakage rate was calculated from gaseous helium test data and post-test leakage rate was calculated from gaseous nitrogen test data.

Comparison of test data with NRX/EST requirements is as follows:

<u>PARAMETER</u>	<u>ACCEPTANCE TEST DATA</u>	<u>NRX/EST REQUIREMENTS</u>
Inlet Pressure, psig	512	524
Inlet Temperature, °R	1125	1143
Actuation Time Open, seconds	0.3	1
Actuation Time Closed, seconds	0.8	1
Fail Characteristic (actuation pressure failure)	Closed	Closed

The Hot Bleed Vent Valve Assembly (HBVVA) was accepted for use in NRX/EST Engine System.

C. A test data summary is shown in the following table:

Test No.	Test Desc.	Specimen Position	Accept. Test Temp.	Actual Test Temp.	Accept. Pressure Media	Actual Pressure (psig)	Accept. Criteria	Test Results
1	Proof	Valve-open	Amb.	-	1200 $\pm$ 20GN ₂	1200	No failure or permanent set.	Satisfactory
2	Proof	Valve-closed	Amb.	-	750 $\pm$ 10 GN ₂	750	No failure or permanent set.	Satisfactory
3	Proof	Actu.-open closed	Amb.	-	750 $\pm$ 10 GN ₂	750	No failure or permanent set.	Satisfactory
4	External Leakage	Valve-open	Amb.	-	600 $\pm$ 10 GN ₂	600	16.9 x 10 ⁻⁵ scfm	No discernable leakage.
5	Internal Leakage	Valve-closed	Amb.	-	25 $\pm$ 10 GN ₂	25	8 scfm	3.7 scfm
6	Leak	Actu.-open closed	Amb.	-	500 $\pm$ 10GHe	500	Record	No visual external leakage.
7	Timing	Actu./-open Valve closed	Amb.	-	600 $\pm$ 10GHeV. 500 $\pm$ 10GHeA.	600 500	Record	.20 sec. open ave. .33 sec. closed ave.
8	Fail Closed	Valve/Actu.	Amb.	-	0 Valve 500 $\pm$ 10 GHe act.	0 500	Record	Failed Closed
9	Timing	Valve/Assy open-closed	1100 $\pm$ 50°R	1126°R	550 $\pm$ 50 GN ₂ 500 $\pm$ 50 GHe	511.5 534.4	Record	.34 sec. open, ave. .78 sec. close, ave.
10	Fail Closed	Valve Assy Open	1100 $\pm$ 50°R	1124°R	550 $\pm$ 50 GN ₂ 500 $\pm$ 50 GHe	511.5 534.4	Close	Satisfactory
11	Cycle	Valve Assy Open/Closed 3 Cycles	1100 $\pm$ 50°R	1124°R	550 $\pm$ 50 GN ₂ 500 $\pm$ 50 GHe	513.9 535.6	No evidence of binding	Satisfactory

PRE FLOW TEST LEAKAGE DATA

Differential Press., psi	Media	Leakage, scfm
25	GHe	4.35
50	GHe	6.20
75	GHe	7.70
100	GHe	9.60

POST TEST LEAKAGE DATA

Differential Press., psi	Media	Leakage, scfm
10	GN ₂	3.27
25	GN ₂	8.42
50	GN ₂	9.59
75	GN ₂	10.5
96	GN ₂	11.1

The 3/8" solenoid operated three (3) way valve acceptance test data summary is shown in figure (7). The valves satisfactory completed the eight (8) tests.

Appendix (A)

1.2.2-65-H-007

4 March 1965

HERVA TEST PLAN
HOT BYPASS VENT VALVE (HBVV)

P/N 114110-9

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RECM

ABSTRACT

Presented is the test plan for the development of a valve for use as the Hot Bypass Vent Valve in the NRX/EST NERVA engine.

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- B. Development Tests
- C. Security Requirements
- D. Report Requirements

ENCLOSURE

- (1) HDVV Test Plan Chart

REFERENCE

- (1) NERVA Valve Test Specification 1.2.2-65-S-001 dated
20 January 1965

I. INTRODUCTION

The Hot Bypass Vent Valve (HBVV) is a 4" diameter normally closed valve located in the turbine bypass vent line on the NRX/EST engine system. The function of the valve is to allow operation of the NRX/EST system as a reactor only test by bypassing nozzle bleed port flow around the TPA turbine to atmosphere. The valve to be used for this purpose is a NERVA turbine power control valve with a pneumatic "on-off" actuator, (P/N 1114110-9). The unit is the same as the turbine block valve (TBV) except for the actuator spring location.

This document delineates the test plan for developing a valve to conform to specification control drawing AGC-SCD-1114655, and to document the performance characteristics of the valve.

II. DISCUSSION

A. Test Objective

The objective of the test series is to demonstrate the capability of the valve to adequately function in the environment of the NRX/EST. Functional adequacy is defined as satisfying the performance criteria of AGC-SCD-1114655.

B. Development Tests

A schedule of the specific tests to be conducted to develop P/N 1114110-9-4" butterfly valve, for use as the HBVV, and the operating conditions for each test are shown in Enclosure (1). Detailed test procedures, data requirements and basic test schematics are presented in the NERVA Valve Test Specification, Reference (1). The applicable paragraph of the Specification is stated in Enclosure (1) for each test to be conducted.

4 March 1965

1.2.2-65-R-007

Page 2

C. Security Requirements

The valve and the data are unclassified.

D. Report Requirements

A test result report will be issued at the completion of the tests.

HBVV ACCEPTANCE TEST PLAN AND ACCEPTANCE CRITERIA
(INITIALLY CLOSED)

VALVE - 4" BUTTERFLY VALVE P/N 114110-9 OR EQUIVALENT

SCHEDULED COMPLETION DATE

TEST NO.	TEST DESCRIPTION	TEST PURPOSE	TEST SPECIMEN	TEST SPECIMEN POSITION	TEST TEMPS.	CONDITIONING MEDIUM	PRESSURE MEDIA			APPLICABLE SECT. TEST SPEC. - 1.2.2-65-S-001	TEST LOCATION	SCHEDULE 1965					ACCEPTANCE CRITERIA
							ERT	FLUID	PRESSURE PSI			J	F	M	A	M	
1.	INTERNAL PROOF PRESSURE TEST	PROVE STRUCTURAL INTEGRITY	VALVE	OPEN	AMBIENT		VALVE	GN ₂	1200±20	I A	CONTROLS LAB					Δ	NO FAILURE OR PERMANENT SET
2.	INTERNAL PROOF PRESSURE TEST	PROVE STRUCTURAL INTEGRITY	VALVE	CLOSED	AMBIENT		VALVE	GN ₂	750±10 ΔP	I C	CONTROLS LAB					Δ	NO FAILURE OR PERMANENT SET
3.	INTERNAL PROOF PRESSURE TEST	PROVE STRUCTURAL INTEGRITY	ACTUATOR	OPEN/ CLOSED	AMBIENT		ACTU.	GN ₂	750±10	I E	CONTROLS LAB					Δ	NO FAILURE OR PERMANENT SET
4.	EXTERNAL JOINT LEAK TEST	DETERMINE LEAKAGE RATES	VALVE	OPEN	AMBIENT		VALVE	GHe	600±10	II A	CONTROLS LAB					Δ	.12 x 10 ⁻⁵ SCFM
5.	INTERNAL SEAL LEAK TEST	DETERMINE LEAKAGE RATES	VALVE	CLOSED	AMBIENT		VALVE	GHe	25±2 ΔP	II C	CONTROLS LAB					Δ	8 SCFM
6.	ACTUATOR LEAK TEST	DETERMINE LEAKAGE RATES	ACTUATOR	OPEN/ CLOSED	AMBIENT		ACTU.	GHe	500±10	II E	CONTROLS LAB					Δ	TO BE RECORDED
7.	ACTUATION SYSTEM TIMING TEST	DETERMINE ACTUATION TIMING	VALVE & ACTUATOR	OPEN/ CLOSED	AMBIENT		VALVE ACTU.	GHe GHe	600 ± 10 500 ± 10	III A	CONTROLS LAB					Δ	TO BE RECORDED
8.	SYSTEM "FAIL CLOSED" TEST	PROVE "FAIL CLOSED" CHARACTERISTICS	VALVE & ACTUATOR	OPEN TO CLOSE	AMBIENT		VALVE ACTU.	GHe GHe	600 ± 10 500 ± 10	III A	CONTROLS LAB					Δ	VALVE MUST CLOSE
9.	ACTUATION SYSTEM TIMING TEST	DETERMINE "HOT" ACTUATION TIMING	VALVE & ACTUATOR	CLOSED TO OPEN/ OPEN TO CLOSED	1100 ± 50°R	GH ₂	VALVE ACTU.	GH ₂ GHe	550 ± 50 500 ± 10	PROCEDURE TO BE SPECIFIED IN A TEST REQUEST	TEST AREA H-4A					Δ	1 SEC OPEN (MAX) 1 SEC CLOSE (MAX)
10.	SYSTEM "FAIL CLOSED" TEST	DEMONSTRATE "HOT" FAIL CLOSED CHARACTERISTICS	VALVE & ACTUATOR	CLOSE	1100 ± 50°R	GH ₂	VALVE ACTU.	GH ₂ GHe	550 ± 50 ±	PROCEDURE TO BE SPECIFIED IN A TEST REQUEST	TEST AREA H-4A					Δ	VALVE MUST REMAIN CLOSED
11.	ENDURANCE CYCLE TEST	PROVE OPERATIONAL INTEGRITY	VALVE & ACTUATOR	OPEN & CLOSED (3 CYCLES)	1100 ± 50°R	GH ₂	VALVE ACTU.	GH ₂ GHe	550 ± 50 500 ± 10	PROCEDURE TO BE SPECIFIED IN A TEST REQUEST	TEST AREA H-4A					Δ	VALVE MUST OPEN AND CLOSE WITHOUT EVIDENCE OF BINDING

1-7-2-65-R-034

AEROJET-GENERAL CORPORATION
TEST REQUEST

CONTROL NO. _____

TEST SERIES NO. _____

WORK AUTHORIZATION NO. 0910-62-470

TO: J. W. Reglow AT: LBP Test Zone "H" DATE: 15 June 1965

REQUESTED BY: J. P. Mathews *J.P. Mathews* AUTHORIZED BY: *L.D. Johnson*

TEST REQUESTED: ACCEPTANCE TEST OF VALVES FOR USE ON THE NRX/EST.

1. OBJECT OF TEST: Demonstrate satisfactory operation of the NRX/EST Turbine Power Control Valve, Turbine Block Valve and Hot Bleed Vent Valve.

2. INFORMATION DESIRED: Per Attachment.

3. MATERIAL FURNISHED: Per Attachment.

4. SUGGESTED TEST SETUP: Per Attachment.

(ATTACH SKETCH IF NECESSARY)

5. SUGGESTED TEST PROCEDURE: Per Attachment.

6. BUDGET: _____ MAN HOURS: S/H TEST _____ HRS. MATERIALS: \$ _____
 H/H TEST _____ HRS.

7. REMARKS: _____

FOR TEST DIVISION USE ONLY

ASSIGNMENTS		DISTRIBUTION	
TEST ENGINEER			
TEST FACILITIES			
ASSIGNED BY	DATE		

w/O 0910-62-470
15 June 1965
JFM:db

TEST REQUEST

FOR

ACCEPTANCE TEST OF THE NRX/EST

- (1) TURBINE POWER CONTROL VALVE
- (2) HOT BLEED VENT VALVE
- (3) TURBINE BLOCK VALVE

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- 1.2 Test Objectives
- 1.3 Test Schedule
- 1.4 Report Requirements
- 1.5 Security Requirements
- 1.6 Engineering Liaison
- 1.7 Photographic Requirements
- 1.8 Material Furnished/Special Test Equipment

(2) Operating Requirements

- 2.1 Test Setup Requirements
 - 2.1.1 Mechanical
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- 2.4 Post-Test Hardware Disposition

(3) Data Acquisition

- 3.1 Instrumentation Requirements
- 3.2 Data Accuracy
- 3.3 Data Package
- 3.4 Parameter Identification and Port Location

(4) Special Precautions

Enclosure:

- (1) Sketch 1.2.2-65-S-043 "Test Setup"
- (2) Sketch 1.2.2-65-S-044 "Facility Instrumentation Tap Locations"
- (3) Sketch 1.2.2-65-S-045 "Test Run Profile"

Referenced Drawings:

- (a) Drawing 101C083-99 "Hot Bleed Vent Valve"
- (b) Drawing 101C083-109 "Turbine Block Valve"
- (c) Drawing 803944-1 (Marotta) "Three (3) Way Solenoid Valve"
- (d) Drawing 284840-114 "Turbine Power Control Valve and Actuator Assembly"
- (e) Drawing 2775020-2 "TPCV Control System" (Amplifier-Magnetic)

- (a) Report 1.2.2-65-R-026 "NERVA Test Plan for acceptance
of the NRX/EST Turbine Power Control Valve and Actuator
Assembly"
- (b) Report 1.2.2-65-R-007 "Hot Bleed Vent Valve Acceptance Test
Plan and Acceptance Criteria"
- (c) Report 1.2.2-65-R-025 "Turbine Block Valve Test Plan and
Acceptance Criteria"
- (d) Report 1.2.2-65-R-032 "Operational Checkout Requirements of the
Turbine Power Control Valve and Actuator Assembly Prior to
NRX/EST Acceptance Testing"

(1) General Requirements

1.1 Test Components

1.1.1 The Test Components are as Follows:

<u>NAME</u>	<u>P/N</u>	<u>S/N</u>	<u>QUANTITY</u>
Turbine Power Control Valve and Actuator Assembly	284840-119	018	1
Hot Bleed Vent Valve	1010083-99	017	1
Turbine Block Valve	1010083-109	016	1
Three (3) Way Solenoid Valve	803944-1	677, 689, 691, 692	4
Magnetic Amplifier	2775020-2	008	1

1.1.2 All of the components specified above will be acceptance tested for use in the NRX/EST during one (1) heated hydrogen flow test on the E-4A Facility.

1.1.3 Following is a brief description of the components and their function on the NRX/EST Assembly.

1.1.3.1 Turbine Power Control Valve and Actuator (TPCVA):

The TPCVA consists of a standard Turbine Power Control Valve which is driven by a Bendix Pneumatic (CH₂) Actuator. The component will receive position commands through the magnetic amplifier from the Master Engine Programmer during the NRX/EST Test Program. For the E-4A Acceptance Test, Test Division Controls Personnel will provide the controls system in lieu of a Master Engine Programmer.

1.1.3.2 Hot Bleed Vent Valve:

The Hot Bleed Vent Valve (HBVV) is a two (2) position four (4) inch butterfly valve (identical to the TPCV body) which is driven by a rack and pinion type actuator, pressurized with 500 ± 10 psig of GHe. The valve can be positioned either open or closed and is spring loaded to the closed position; therefore, fail-safe closed. The valve assembly function on the NRX/EST is to provide venting of the turbine drive gas in the event of a "reactor only" (NRX) test. For the planned Engine System Test (EST), the HBVV will be closed.

1.1.3.3 Turbine Block Valve

The Turbine Block Valve (TBV) is identical to the HBVV except that the actuator spring loaded open; therefore, "fail-safe" open.

1.1.3.4 Three (3) Way Solenoid Valve

The solenoid valves function as pilot valves for the TBV and HBVV. Two pilot valves are required to operate a single actuator. There is no specific acceptance criteria which must be demonstrated other than satisfactory operation in opening and closing the TBV and HBVV.

1.2 Test Objectives

The test objective is to demonstrate satisfactory operation of the TPCVA, HBV, and HBVV for use on the NREX/EST. Satisfactory demonstration of operation will include opening and closing of the TBV and HBVV at flow conditions and subjecting the TPCVA to certain functions at flow conditions. Specific requirements are stated in Section (2), "Operating Requirements".

1.3 Test Schedule

One (1) test will be required to acceptance test the components and will be accomplished on or about 20 June 1965.

1.4 Report Requirements

1.4.1 The Test Engineer Remarks Sheet shall be completed and delivered to the Project Engineering, Department 7452, Attention: J. P. Mathews, within four (4) working days.

1.4.2 Quality Control Requirements

Complete quality control documentation will be required for the acceptance test.

1.4.3 A record shall be maintained of operating time (electrical power and actuation pressure being "on") on the TPCV. Functional operation of the TPCV should be kept to a minimum. A record shall be kept of the number of functional cycles (on-off) that the TBV and HBVV received prior to the acceptance test. Actuation of both valves should be held to a minimum.

1.5 Security Requirements

All test hardware and test data are UNCLASSIFIED.

1.6 Engineering Liaison

Verbal notice shall be given to the cognizant project representative at least one (1) hour prior to the test. Contact J. P. Mathews, Extension 5-8472, or Home Phone: 783-7922 (Roseville).

All test hardware problems shall be coordinated through the cognizant project representative.

1.7 Photography

A still 8 1/2 x 11 black and white photograph shall be taken of each test article prior to installation in the test stand. The picture shall include an overall view of each test article, using white background. Identify each article by name, part number and serial number on the background paper.

Photographs shall be taken of the overall test setup on E-4A prior to the acceptance tests. Ten (10) copies of each photograph shall be delivered to the project department within ten (10) working days. Operate one (1) 32 FPS color movie camera during the test. Coverage shall include all test hardware.

1.8 Material Furnished/Special Test Equipment

1.8.1 Material Furnished by Requesting Department 7452:

1.	P/N 1010083-99	Hot Bleed Vent Valve	S/N 017
2.	P/N 1010083-109	Turbine Block Valve	S/N 016
3.	P/N 284840-119	Turbine Power Control Valve and Actuator Assembly	S/N 018
4.	P/N 2775020-2	Amplifier-Magnetic	S/N 008
5.	P/N 803944-1	Three (3) Way Solenoid Valve	S/N's 677, 689, 691, 692
6.	P/N MVH 59629-450	Marman Couplings	5 Each
7.	P/N 283410	Conoseals	(As Required)

1.0.2 Special Equipment to be Provided by the Test Division

1. Frequency Generator for step function commands to TPCVA.
2. Control System to operate the TPCVA.
3. Connector, position indicator, P/N PT06P-10-65 to mate with TBV and HBVV Connectors. Two (2) each required.
4. P/N MS 3106E10SL-4S (C) "Cannon" connector to mate with pilot valves for solenoid energizing circuit, four (4) each required.
5. Filters - 10 micron absolute two (2) each required.

2.0 Operating Requirements

2.1 Test Setup Requirements

2.1.1 Mechanical and electrical test setup requirements are presented in Enclosure (1).

2.1.2 Parameter identification and line port locations are specified in Enclosure (2).

2.2 Test Sequence

NOTE: "FLOW START" AND "FLOW STOP" ARE RESPECTIVELY DEFINED AS BEING THE TIMES AT WHICH THE H-4A FACILITY FLOW CONTROL VALVE IS SIGNALED TO "OPEN" AND "CLOSE".

2.2.1 Pre-Test Conditions

1. TBV and HBVV pressure set to 500 ± 10 psig GHe .
2. TPCV actuation pressure set to 215 ± 10 psig GE_2 .
3. TBV and HBVV position full open. (Power off TBV, power-on TBV).
4. TPCV position light "on" and set 525 psig on pressure demand pot.
5. Records on 30 seconds prior to "flow start".

2.2.2 Test Conditions

1. Open the facility flow control valve to introduce GE_2 through the TBV and HBVV at a pressure rise rate of 200 ± 100 psi/sec until 500 ± 50 psig is achieved at P_{gyl}. Valve inlet temperature shall be 1200^{+50}_{-0} °R at valve inlet. (T_{ex1}) Valve inlet pressure should be maintained with 200 psi of set point during valve cycling operation. NOTE: STEPS 2 THROUGH 4 WILL DEMONSTRATE THE FAILSAFE CAPABILITY OF THE HBVV.

2. Reference Enclosure (1), Page (2). Close the HBVV by breaking Switch "B".

3. "Break" Switch "A" and "make" Switch "B". The HBVV should remain in the closed position. Observe decay on PgE.

4. Open the HBVV by "making" Switch "A". Observe pressure increase to 500 psig on PgE.

5. Cycle the HBVV two (2) times.

NOTE: STEPS 5 THROUGH 6 WILL DEMONSTRATE THE FAILSAFE CAPABILITY OF THE TBV. REFERENCE ENCLOSURE (1) PAGE (2).

6. With the TBV in the open position, "break" Switch "A" and "make" Switch "B". Observe pressure decay on PgD and the TBV remains in the open position.

7. "Break" Switch "B" and "make" Switch "A" on the TBV, and observe pressure increase to 500 psig on PgD.

8. Cycle the TBV three (3) times. NOTE: STEP 7 COMPLETES THE ACCEPTANCE TEST OF THE TBV AND THE HBVV.

9. Close the HBVV.

10. Set the TPCV manual control potentiometer to match the TPCV position and switch from pressure control to manual control.

11. Using the manual control pot, position the TPCV to full open, then to full closed, then to 60 degrees.

12. Subject the TPCV to a step input command signal at an amplitude of ± 5 degrees (10° step) for 5 cycles at a frequency of 0.3 CPS.

13. Position the TPCV to 36 degrees and increase a 0.1 CPS sine wave command signal amplitude from zero (0) to a value which causes initial butterfly motion as indicated by the position potentiometer. Butterfly motion should occur at a command signal input of ± 20 millivolts.

14. Position the TPCV to 50 degrees.

15. Simultaneously initiate heater shutdown and TPCV "SCRAM". When the TPCV indicates closed, immediately "break" the SCRAM circuit and the TPCV should return to the 50 degree position.

16. Position the TPCV, HBVV and TBV to full closed prior to removal from the Test Facility.

2.3 Kill Parameters

The test will be terminated if P_{gyl} exceeds 850 psig.

2.4 Post-Test Hardware Disposition

The acceptance test hardware shall be removed from the test stand re-packaged and delivered to the Controls Laboratory, Building 2002, for further disposition.

3.0 Data Acquisition

3.1 Instrumentation Requirements

The instrumentation requirements are listed on the following page. Location of facility instrumentation parts and parameter identification is given in Enclosure (1) and (2).

<u>Parameter</u>	<u>Operating Range</u>	<u>Sample Rate</u>	<u>Oscillograph Recorder</u>	<u>Sanborn Recorder</u>	<u>Brown Recorder</u>	<u>Milliscale Printout</u>
<u>Pressures</u>						
PgY1a	0-1000 psig	20	X		X	X
PgY1b	0-1000 psig	10				X
PgY3a	0-1000 psig	20				X
PgY3b	0-1000 psig	10				X
PgY4a	0-1000 psig	20				X
PgZ1a	0-1000 psig	20	X		X	X
PgZ1b	0-1000 psig	10				X
△PgZa	0-1000 psig	20	X		X	X
△PgZb	0-1000 psig	20				X
PgA	0-500 psig	10			X	X
PgD	0-1000 psig	10			X	X
PgE	0-1000 psig	10			X	X
PgF	0-1000 psig	20	X		X	X
<u>Temperatures</u>						
TgY 1a	70-1500°F	10			X	X
TgY 1b	70-1500°F	10				X
TgY 3a	70-1500°F	10				X
<u>Command and Position Functions</u>						
CTPCV	0-10VDC	20	X	X		X
LTPCV	0-10VDC	20	X	X		X
LTHV	0-10VDC	20	X	X		X
LHBVV	0-10VDC	20	X	X		X
<u>Switch Traces</u>						
(HBVV - Open - Close)			X	X		X
(TBV - Open - Close)			X	X		X
TPCV SCRAM (Open-Close)			X (offset when switch makes)			
TPCV Position Light Circuit			X (offset when lit)			

3.2 Data Accuracy

The following errors, allowing $\pm$ two standard deviations (± 2) from the mean and based on the implied assumptions of normal distribution of errors, are the maximum that can be permitted on the final recorded data.

<u>Parameter</u>	<u>Error (95.4% confidence)</u>
Pressure Level (% full scale)	$\pm 0.6\%$
Temperature (70°F to 1500°F Range)	$\pm 1.5\%$ (of point)
Position Readout (% full range)	$\pm 0.4\%$

3.3 Data Package

3.3.1 Millisecic Printout

Two (2) copies of the millisecic printout shall be delivered to the Project Department (J. P. Mathews, Department 7452, Building 2019A2) within one (1) working day following the test.

The printout sample rate is four (4) samples per second (One (1) sample every 0.25 seconds).

3.3.2 Cal-Comp Plots

Plot A to contain: P_{gY1} , T_{gY1} , LEBVV vs. time.

Plot B to contain: P_{gZ1} , T_{gZ1} , LTPCV, CTPCV P_{gZ} vs. time.

Data should be plotted every 0.25 seconds of test time. The time interval (X axis) should be one (1) inch per second. Two (2) blue-line copies of the plots are required.

(4) Special Precautions

Extreme care shall be taken to insure that no damage is incurred by the test hardware. The hardware is "one-of-a-kind" item for which there are no spares. Therefore, the following procedures shall be taken:

1. Save shipping containers, closures and packing material for return shipment.
2. Keep the valves covered with plastic bags whenever possible.
3. Keep valve functional checks to a minimum.
4. Maintain a GN_2 trickle purge (less than 10 psig) on the TPCVA actuation inlet port whenever the valve is without electrical power.

5. Do not apply Bendix Actuator supply gas pressure until the actuator electrical power is "on". (Trickle purge excepted)
6. Do not apply more than 5 volts (10 milliamperes) to the Bendix Actuator pots when measuring pot resistance.
7. Do not apply voltage to the Bendix Actuator pots unless the magnetic amplifier is plugged in.
8. Do not exceed 900 psig on the Bendix Actuator supply gas pressure.
9. Maintain supply gas pressure to the Bendix Actuator any time the valve temperature is above 200°F.
10. NOTE: THE 0° AND 90° POSITION LIMITS ARE WIRED WITHIN THE MAGNETIC AMPLIFIER, THEREFORE, NO EXTERNAL LIMIT DEVICES ARE REQUIRED. BOTH THE FEED-BACK AND POSITION POTENTIOMETERS ARE DELIVERED TO THE MAGNETIC AMPLIFIER. THE SCRAM CIRCUIT CONNECTS TO PINS 9 AND 7 ON THE AMPLIFIER. THE CIRCUIT IS NORMALLY OPEN. SEE ENCLOSURE (1) PAGE (3) FOR WIRING CONNECTIONS.

ENCLOSURE (1)
 PAGE 1 OF 3
 1.0.0-65-5-043

SCHEMATIC
ELECTRICAL AND PLUMBING
FOR
TRV AND HRYV PILOT VALVES

ENCLOSURE (11)
PAGE 2 OF 3
1.2.2.65-5-043

TURBINE BLOCK VALVE PILOT VALVES

HOT BLEED VENT VALVE PILOT VALVES

SCHEMATIC - BENDIX NT-CZ

INSTRUMENTATION TAP LOCATIONS - H4A

SEC AA

PgY1a

PgY1b

TgY1a

TgY1b

SEC CC

(A) PgY4a

SEC BB

(A) PgY3a

(B) PgY3b

(C) TgY3a

(D) TgY3b

HOT BLEED VENT VALVE
TURBINE BLOCK VALVE

(A) PgZ1a

(B) PgZ1b

(A) PgZ2a

ENCLOSURE (2)
PAGE 1052
12-65-5-044

PARAMETER IDENTIFICATION AND LOCATION

PRESSURES

P_{GY_1} a, b	Static pressure 11 inches upstream of the Turbine Block Valve.
P_{GY_3} a, b	Static pressure 10 inches downstream of the Hot Bled Vent Valve.
$P_{GY_{4a}}$	Static pressure 4 inches downstream of flow nozzle.
P_{GZ_1} a, b	Static pressure 4 inches upstream of the TPCV.
P_{GZ_2} a	Static pressure 4 inches downstream of the TPCV.
ΔP_{GZ_2} a, b	Static differential pressure between P_{GZ_1} and P_{GZ_2}
P_{GA}	Static pressure TPCV actuator drive gas inlet.
P_{GP}	Static pressure - TBV port 3-to-cylinder line
P_{GE}	Static pressure - HBVV port 4-to-cylinder line
P_{GP}	Static pressure-pilot valve inlet pressure-actuation, TBV and HBVV.

TEMPERATURES

T_{GY_1} a, b	Temperature 11 inches upstream of the TBV.
T_{GY_3} a, b	Temperature 11 inches downstream of the HBVV.

Hot Bleed Vent Valve P/N 1010083-99
S/N 017 Post Test NRI Acceptance Test

End (1)

NRX/EST SCHEMATIC

1.2.2-65-3-081

NERVA PROGRAM

6-9-55

HOT BLEED VENT VALVE

PN 1010083-99 3/4 N 017

NERVA PROGRAM

Figure 3
1.2.2-65-5-079

ACTUATOR

7/N 101C084

NRX/EST TBV & HBVV
SCHEMATIC

3/4" SOLENOID OPERATED

THREE (3) WAY VALVE
FOR HBVV5/8" MAROTTA THREE (3) WAY SOLENOID VALVE,
P/N 80594-1
S/N 689

Test No.	Test Description	Test Purpose	Test Specimen	Test Specimen Position	Test Temp. °R	Cond. Medium	Pressure Media			Applicable Spec. Test Spec. 1.2.2-65-B-COI	Test Location	Acceptance Criteria
							Part	Fluid	psig			
1	Internal Proof Pressure Test	Prove Structural Integrity	Valve	Energized	Amb.		Valve	CH ₂	1000±10	I. C	Controls Lab.	No sign of distortion or permanent set
2	Internal Proof Pressure Test	Prove Structural Integrity	Valve	De-energized	Amb.		Valve	CH ₂	1000±10	I. C	Controls Lab.	No sign of distortion or permanent set
3	Internal Seal Leak Test	Determine Leakage Rates	Valve	Energized	Amb.		Valve	He	500±10	II. C	Controls Lab.	1 x 10 ⁻³ sec/sec
4	Internal Seal Leak Test	Determine Leakage Rates	Valve	De-energized	Amb.		Valve	He	500±10	II. C	Controls Lab.	1 x 10 ⁻³ sec/sec
5	Coil Resistance	To Determine Coil Resistance	Valve	De-energized	Amb.		Valve				Controls Lab.	18.7Ω 7/19 OTMS
6	Endurance Test	Prove Operational Integrity	Valve	Energized & De-energized	Amb.		Valve			III. A	Controls Lab.	Internal Leakage Per Steps 3 & 4 After 30 Cycles
7	Dissection Strength	To Determine Pin to Case Resistance	Valve	Energized & De-energized	Amb.		Valve				Controls Lab.	1.7 x 10 ⁶ lbs. energized six (6) hours.
8	Actuation Timing	To Determine Actuation Time	Valve	Energized & De-energized	Amb.		Valve				Controls Lab.	Valve operates No. 5 sec. Valve open & closed in less than one (1) sec.

NOTE: 3/8" NPTMA THREE (3) WAY SOLENOID VALVE,
 P/N 08112
 SN 691

3/8" SOLENOID OPERATED
 THREE (3) WAY VALVE
 FOR HBW

Test No.	Test Description	Test Purpose	Test Specimen	Test Specimen Position	Test Temp. °F	Cond. Medium	Pressure Part	Fluid	psig	Applicable Sec. Test Spec. 3.2.2-69-3-60	Test Location	Acceptance Criteria
1	Internal Proof Pressure Test	Prove Structural Integrity	Valve	Energized	Amb.	/	Valve	CH ₂	1000±10	I. C	Controls Lab.	No sign of distortion or permanent set.
2	Internal Proof Pressure Test	Prove Structural Integrity	Valve	De-energized	Amb.	/	Valve	CH ₂	1000±50	I.	Controls Lab.	No sign of distortion or permanent set.
3	Seal Leakage Test	Determine Leakage Rates	Valve	Energized	Amb.	/	Valve	He	500±10	II. C	Controls Lab.	1 x 10 ⁻⁵ sec/sec
4	Seal Leakage Test	Determine Leakage Rates	Valve	De-energized	Amb.	/	Valve	He	500±10	II. C	Controls Lab.	1 x 10 ⁻⁵ sec/sec
5	Resistance Test	To Determine Coil Resistance	Valve	De-energized	Amb.	/	Valve	/	/	/	Controls Lab.	18.5Ω 7A M29 / 19 OHMS
6	Endurance Test	Prove Operational Integrity	Valve	Energized & De-energized	Amb.	/	Valve	/	/	III. A	Controls Lab.	No leakage stops 3 & 4 after 30 Cycles
7	Proof Pressure Strength	To Determine Pin to Case Resistance	Valve	Energized & De-energized	Amb.	/	Valve	/	/	/	Controls Lab.	1x10 ⁸ following valve energized for six (6) hours.
8	Actuation Timing	To Determine Actuation Time	Valve	Energized & De-energized	Amb.	/	Valve	/	/	/	Controls Lab.	Valve operates in approx 0.5 sec Valve open & close in less than one (1) sec.