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Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SVHSER 6226

FINAL REPORT
for the
VELOCITY CONTROL PROPULSION SUBSYSTEM
of the
RADIO ASTRONOMY EXPLORER SATELLITE
for
GODDARD SPACE FLIGHT CENTER
under
CONTRACT NO. NAS 5-11463

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Senior Experimental Engineer

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RAE-B Engineering Manager

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RAE-B Program Manager

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NOTICE

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1.0 INTRODUCTION

The Velocity Control Propulsion Subsystem (VCPS) was designed, manufactured and tested by Hamilton Standard under contract to Goddard Space Flight Center for use on the Radio Astronomical Explorer (RAE-B). The purpose of the VCPS is to provide the propulsion required for trajectory and lunar orbit corrections of the spacecraft. A GFE clamp assembly physically attaches the VCPS to the spacecraft and the unit is ejected after completing the required corrections. The VCPS is physically and functionally separated from the spacecraft except for the electrical and telemetry interfaces.

A GFE transtage provides the superstructure on which the VCPS is assembled. The subsystem consists of two 5 lb_f rocket engine assemblies (REAs), 4 propellant tanks, 2 latching valves, 2 fill and drain valves, a system filter, pressure transducer, gas and propellant manifolds and electrical heaters and thermostats. Figures 1 and 2 provide schematics of the fluid and electrical systems respectively. A series of photographs of the VCPS are presented in Appendix A to provide a visual reference of the unit.

The RAE-B VCPS program covered the design, manufacture and qualification of one subsystem. This subsystem was to be manufactured, subjected to qualification tests; and refurbished, if necessary, prior to flight. The VCPS design and test program precluded the need for refurbishing the subsystem and the unit was delivered to GSFC at the conclusion of the program described herein.

2.0 SUMMARY

The VCPS was acceptance tested per Hamilton Standard Plan of Test SVHS 5618 and met all test requirements. The unit was released for qualification testing on 24 March 1972.

Qualification testing was performed in accordance with Hamilton Standard Plan of Test SVHS 5619. Testing was grouped into structural, environmental and firing performance tests. Appropriate base point and monitoring tests were included before and after each significant test sequence. All testing was conducted at Hamilton Standard with the exception of Mass Properties, Acceleration and Thermal Verification; these tests were performed at GSFC, D. T. Brown and General Electric; respectively.

The qualification testing was completed on 18 August 1972. Two hardware discrepancies were encountered and successfully resolved during qualification program. The first involved an REA heater and was detected during the first electrical test when the REA/tank heater circuit gave an incorrect resistance reading. An analysis of the REA heater malfunction was performed, reference GSFC malfunction report #D02908, and as a result, all flight and flight spare heaters were replaced with new equipment manufactured in accordance with more stringent procedures to prevent a recurrence of the malfunction.

The second anomaly occurred during the thermal verification test conducted at General Electric, Valley Forge, Pennsylvania in its solar simulation chamber. The VCPS thermal control subsystem was unable to maintain the propellant tanks and line temperatures to specification requirements. Hamilton Standard subsequently modified the tank thermal analysis by incorporating the test results and changed the tank coating pattern as required to maintain a 45°F min. fuel temperature. The propellant line insulation was redesigned and the heater power changed to provide the required line temperatures. A thermal vacuum test of the VCPS verified the acceptabiity of these modifications.

Subsequent to the delivery of the VCPS, a need for modification of the gas manifold was established; a copy of the report on that hardware change is included in Appendix E.

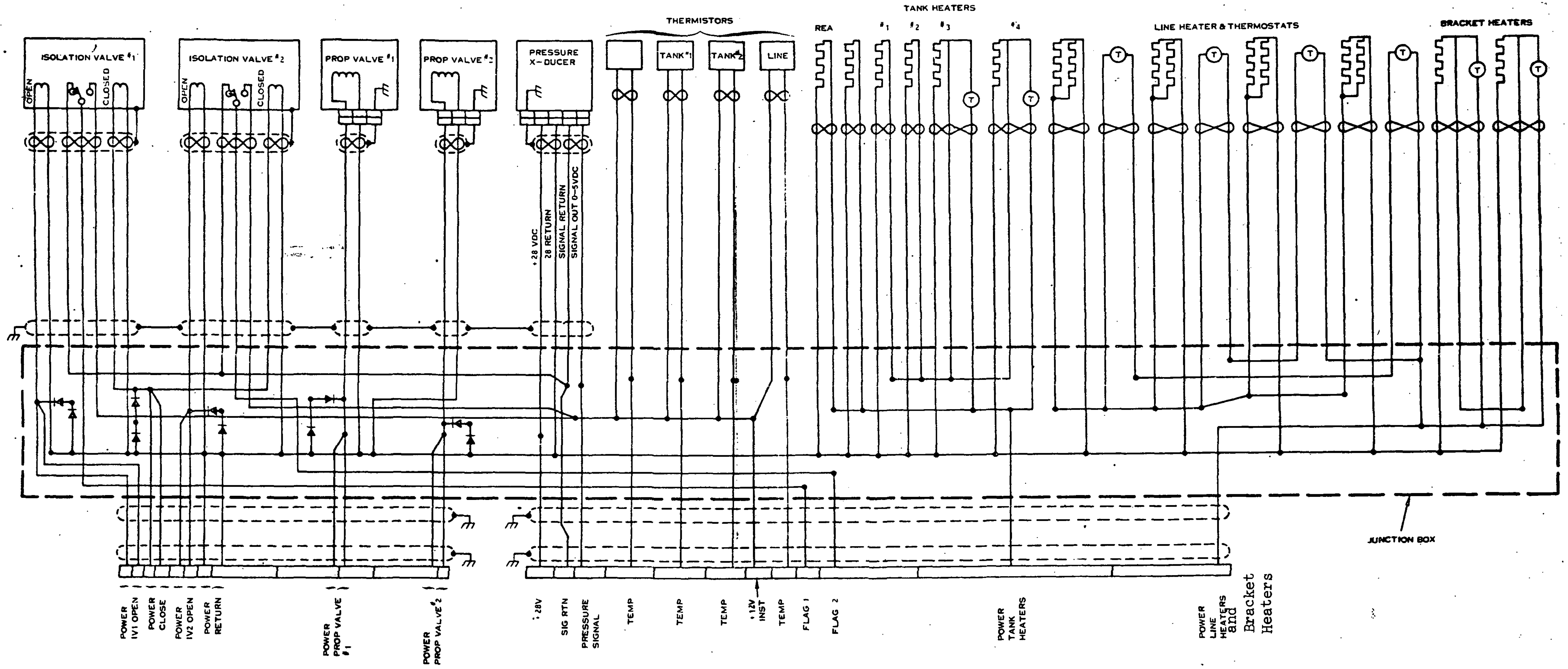
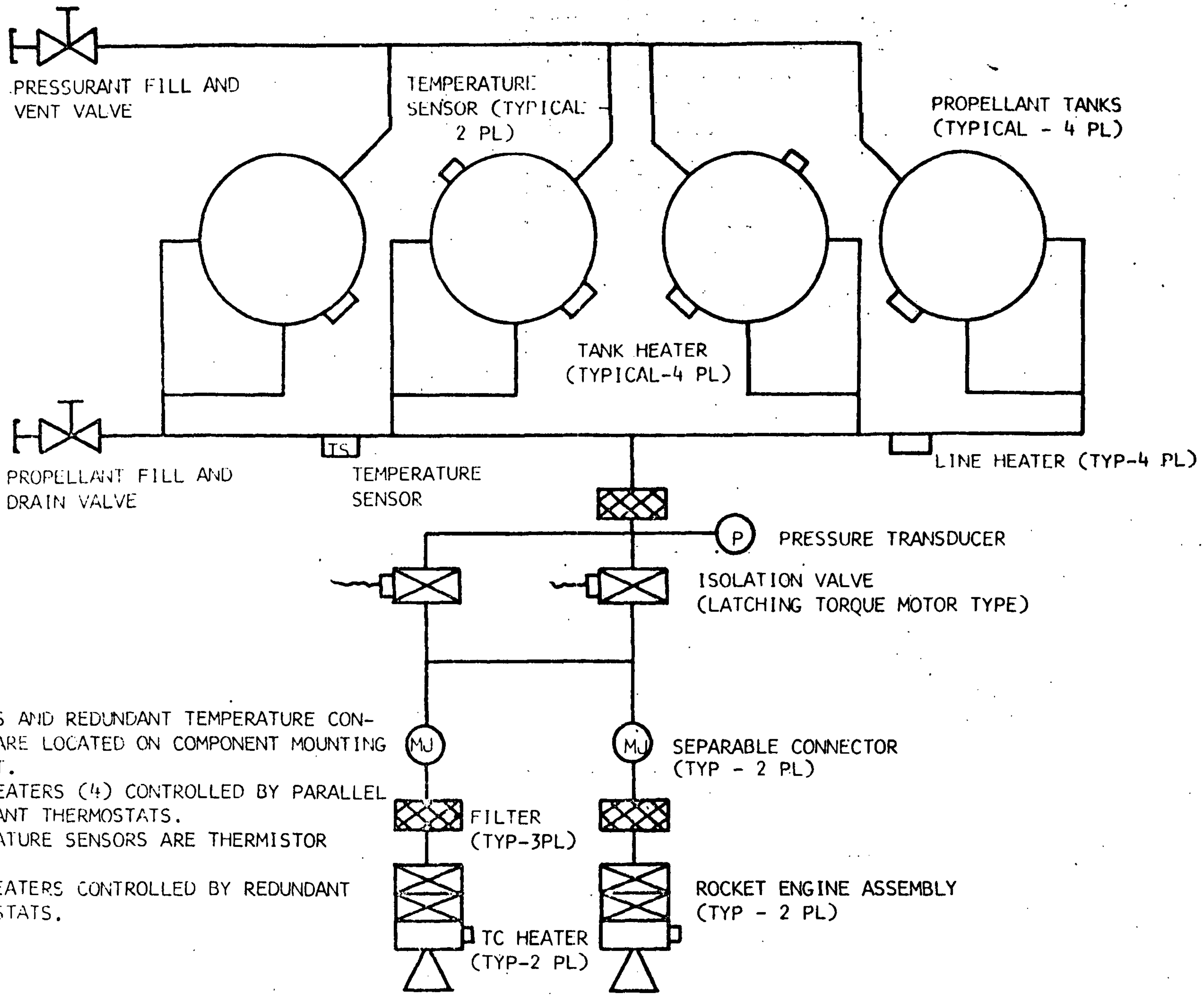


FIGURE 2. SUBSYSTEM ELECTRIC SCHEMATIC

PROPULSION SYSTEM SCHEMATIC



NOTES:
1. HEATERS AND REDUNDANT TEMPERATURE CONTROLS ARE LOCATED ON COMPONENT MOUNTING BRACKET.
2. TANK HEATERS (4) CONTROLLED BY PARALLEL REDUNDANT THERMOSTATS.
3. TEMPERATURE SENSORS ARE THERMISTOR TYPE.
4. LINE HEATERS CONTROLLED BY REDUNDANT THERMOSTATS.

FIGURE 1

3.0 ACCEPTANCE TEST

The VCPS acceptance test was designed to verify the proper assembly of the wiring harness, the operation of the electrical components and the leakage integrity of the manifold and the flow control valves. Testing was performed in accordance with Hamilton Standard Specification SVHS 5618.

After the VCPS was fully assembled and passivated, the acceptance test was started with a visual examination of the unit. The unit met all drawing requirements; some cosmetic defects were noted and repaired. The acceptance test was successfully completed on 3/18/72. Table 1 is a summarization of the Acceptance testing and shows the test sequence and provides a brief description of the test requirements and results.

TABLE I

RAE-B VCPS ACCEPTANCE TEST SUMMARY

Test No.	Test Name	References SVHS5619 Para.	References AT Sheet Page	Specification Requirement	Test Results
1	Examination of Product	4.5.1	5	Visual Examination. Inspection of installation dimensions.	Unit passed visual examination. All dimensions within drawing requirements.
2	Electrical Check	4.5.2	6 - 27	Verify VCPS electrical interface.	All circuits demonstrated proper continuity and pin usage.
				Pressure Transducer PSIA — Req'd Output (±.05 VDC)	Pressure — Output
				100 — 1.61 ± .05 VDC	100 psia — 1.59 VDC
				200 — 3.12 ± .05 VDC	200 psia — 3.13 VDC
				260 — 4.62 ± .05 VDC	300 psia — 4.67 VDC
				REA & Latch Valves Determine baseline values for resistance, opening response and closing response.	Actual — REA #1 — REA #2 — Latch #1 — Latch #2 Resistance — 41.6 ohms — 47.5 ohms Opening — 13 ms — 15 ms — 25 ms — 25 ms Closing — 38 ms — 28 ms — 26 ms — 24 ms
				Thermistor Calibrate within 10% at ambient temperature.	Actual: Amb. temp. 70.8°F Tank #1 70.1°F Line 70°F Tank #2 70.1°F Bracket 70.1°F
				Heaters Circuit resistance within 5% of:	Actual:
				REA & Tank 20.5 ohms	21.0 ohms
				REA 72.0 ohms	74.4 ohms
				Bracket 36.0 ohms	34.8 ohms
				Line 144.0 ohms	144.2 ohms
3	Proof Pressure	4.5.4	29 - 31	Proof 450 psia min. Collapse 5 mm Hg max.	The VCPS fluid manifold and tanks suffered no permanent deformation after being subjected to 452 psia proof and 1.8 mm Hg collapse pressure.
4	Internal Leakage	4.5.5	32 - 34	8 scc/hr GN_2 for sum of latching valves or thrust control valves.	Latching Valves 1.25 scc/hr Thrust Control Valves 0.4 scc/hr
5	External Leakage	4.5.6	35 - 43	Total VCPS external leakage shall not exceed 1 x 10^{-4} scc/sec He.	Actual: 4.7 x 10^{-6} scc/sec He
6	Dry Weight	4.5.3	28	VCPS dry weight less GFE shall not exceed 20.5 lbs	Actual: 19.257 lbs
7	Post Test Inspection	4.5.7	44	Review tests for compliance to specification requirements. Visual Examination	Unit met all acceptance test requirements. Unit passed visual examination.

FOLDOUT FRAME 1

FOLDOUT FRAME 2

4.0 QUALIFICATION TEST

Qualification testing was conducted in accordance with Hamilton Standard specification SVHS5619 and appropriate operation sheets. An additional thermal vacuum test was run after the completion of the original sequence due to the out of specification conditions which occurred in the thermal verification test sequence 19. A sequential tabulation of the qualification test program is given in Table II. Each of the test sequences is summarized in Table III and a more detailed description of each test is provided in the following paragraphs.

TABLE II

RAE-B VCPS QUALIFICATION TEST SEQUENCE

	Test	Completion Date
1.	System Firing Base Point	3/25/72
2.	Decontamination and Contamination Check	3/25/72
3.	Internal Leakage	3/26/72
	External Leakage	3/27/72
4.	Electrical Check	3/28/72
5.	Mass Properties	4/6/72
6.	Contamination Check	4/6/72
7.	Acceleration	4/11/72
8.	Contamination Check	4/12/72
9.	Internal Leakage	4/13/72
	External Leakage	4/13/72
10.	Electrical Check	4/14/72
11.	Vibration	4/19/72
12.	Contamination Check	4/19/72
13.	Proof Pressure	4/20/72
14.	Internal Leakage	4/20/72
15.	Alignment	4/20/72
16.	Electrical	4/21/72
17.	External Leakage	4/22/72
18.	Visual Examination	4/22/72
19.	Thermal Verification	5/9/72
20.	Contamination Check	5/11/72
21.	Thermal Vacuum	5/19/72
22.	Contamination Check	6/1/72
23.	Internal Leakage	6/1/72
	External Leakage	6/2/72
24.	Electrical Check	6/3/72
25.	Spin Firing	6/7/72
26.	System Firing Base Point	6/9/72
27.	Wet Weight	6/9/72
28.	Mission Profile	6/10/72
29.	Extreme Temperature and Vacuum Firing	6/19/72
30.	Decontamination and Contamination Check	6/20/72
31.	Insulation Verification	7/28/72
32.	Contamination Check	7/28/72
33.	Alignment	8/14/72
34.	Internal Leakage	8/15/72
	External Leakage	8/16/72
35.	Electrical Check	8/18/72
36.	Post Test Inspection	8/23/72

TABLE III

RAE-B VCPS QUALIFICATION TEST SUMMARY

Test Sequence	Test Name	References Spec. Para.	AT Sheet Pages	Specification Requirement		Test Results	
1	System Firing Basepoint	4.3.1	1 - 6	Provide baseline performance impulse vs. time for VCPS.		See Sequence 26.	
2	Decontamination and Contamination Check	4.3.2	7 - 11	Cleanliness Verification			
				Particle Size	No. Allowable	Actual No.	
				0 - 5 microns	Unlimited	-	
				5 - 10	1200	25	
				10 - 25	200	4	
				25 - 50	50	2	
				50 - 100	5	1	
				100	0	0	
				50 metallic	0	0	
3	Leakage	4.3.3	12 - 25	Allowable internal leakage			
				Sum of Latch Valves	8 scc/hr GN_2	Sum of Latch Valves	0.4 scc/Hr GN_2
				Sum of Thrust Control Valves	8 scc/hr GN_2	Sum of REAs	0.2 scc/hr GN_2
				External Leakage	1 x 10^{-4} scc/sec He	Total VCPS External Leakage	2.6 x 10^{-6} scc/sec He
4	Electrical	4.3.4	26 - 50	Pressure Transducer			
				PSIA	Output Req'd	Pressure	Output
				100	1.61 ± .05 VDC	101 psia	1.62 VDC
				200	3.12 ± .05 VDC	200 psia	3.12 VDC
				260	4.01 ± .05 VDC	258 psia	3.97 VDC
				Thermistor		Actual	
				Calibrate to within 10% of amb. temp.		Tank #1 73.5°F	Line 74°F
				Ambient 73.5°F		Tank #2 71°F	Bracket 74°F
				Heaters Circuit resistance shall be:		Actual Resistance	
				REA and Tank	20.5 ± 1 ohm	20.8 ohms	
				REA	72 ± 3.6 ohms	73.8 ohms	
				Bracket	36 ± 1.8 ohms	35.0 ohms	
				Line	144 ± 7.2 ohms	143.0 ohms	
				Valves Current and voltage traces of the latching and thrust control valves actuation shall exhibit standard characteristics.		Visual examination of valve traces showed no discrepancies.	

TABLE III (continued)

Test Sequence	Test Name	References		Specification Requirement	Test Results
		Spec. Para.	AT Sheet Pages		
5	Mass Properties	4.3.5	50 - 53	Center of Mass: ± 0.015 of 2 axis Static Balance: 20 oz-in max Dynamic Balance: 250 oz-in^2 max	Testing performed at GSFC. Reference NASA GSFC Mass Properties Report Appendix E of this report.
6	Contamination	4.3.2	54	Same as Sequence 2	Actual No. Particles 10 8 7 1 0 0
7	Acceleration	4.3.6	55 - 57	Simultaneous application of 3 g's in the +X and 14.7 g's in the +Z 3 g's in the +Y and 14.7 g's in the +Z	Test performed at D. T. Brown Resultant load 15 g's applied at 137.5 in at 62 RPM for 1 minute.
8	Contamination	4.3.2	58 - 60	Same as Sequence 2.	Actual No. Particles 2.5 1 1 0 0 0
9	Leakage	4.3.3	61 - 73	Same as Sequence 3.	Sum of Latching Valves: 1.4 scc/hr GN_2 Sum of REAs : 0.6 scc/hr GN_2 Total VCPS External : .15 x 10^{-4} scc/sec He
10	Electrical	4.3.4	74 - 91	Same as Sequence 4.	Pressure Transducer Pressure — Output 105 psia — 1.67 VDC 202 psia — 3.16 VDC 260 psia — 3.99 VDC Thermistor: Room Ambient 76°F Tank #1 75°F — Line 75.5°F Tank #2 74°F — Bracket 75°F

TABLE III (continued)

		References			
Test Sequence	Test Name	Spec. Para.	AT Sheet Pages	Specification Requirement	Test Results
					Heater Circuit Resistance REA and Tank: 20.8 ohms REA 73.8 ohms Bracket 34.75 ohms Line 143.0 ohms Visual examination of valve traces showed no discrepancies.
11	Vibration	4.3.7	92 - 98	Vibration - See Appendix C for levels required and visual examination for structural damage.	See Appendix C for control accelerometer plots. No structural damage noted.
12	Contamination	4.3.2	99 - 100	Same as Sequence 2.	Actual No. Particles 2 1 0 0 0 0
13	Proof	4.3.8	102	450 ± 10 psia.	450 psia, visually examination showed no structural damage.
14	Internal Leakage	4.3.3	103 - 104	Same as Sequence 3	Sum of latching valves: 1 scc/hr GN_2 max. Sum of REAs: Nil
15	Engine Alignment	4.3.10	117 - 118	Each REA must be within ±30 minutes of the spacecraft center of gravity location.	Actual misalignment: REA #1 9.0 minutes max. REA #2 7.5 minutes max.
16	Electrical	4.3.4	119 - 136	Same as Sequence 4.	Pressure Transducer Pressure — Output 101 psia — 1.62 VDC 205 psia — 3.20 VDC 258.4 psia — 3.98 VDC Thermistors: Ambient temperature 75°F Tank 1 75°F Bracket 74.5°F Tank 2 74.5°F Line 75°F

TABLE III (continued)

Test Sequence	Test Name	References Spec. Para.	 AT Sheet Pages	Specification Requirement	Test Results
					Heater Resistances REA and Tank 20.9 ohms REA 73.8 ohms Bracket 34.9 ohms Line 142.8 ohms Visual examination of valve traces showed no discrepancies.
17	External Leakage			Total VCPS external leakage shall be 1×10^{-4} scc/sec He max.	Actual $.13 \times 10^{-4}$ scc/sec He
18	Visual Examination			Visually examine the VCPS for physical damage.	No discrepancies were noted.
19	Thermal Verification	4.3.11	137 - 145	No recorded VCPS temperature shall exceed the range of 45°F to 140°F. The VCPS tank electrical heaters shall not be required to actuate in the 2 hour cold case.	Propellant line temperatures were below 45°F in the 60° cruise condition. Propellant line and tank temperatures were below 45°F in both 60° and 0° case. The tank heater actuated in the 0° cold case. Corrective action for this malfunction is detailed in the engineering report of Appendix D.
20	Contamination Check	4.3.2		Same as Sequence 2.	Actual No. Particles 16 12 2 1 0 0
21	Thermal Vacuum	4.3.12	146 - 155	Temperature cycle the VCPS between 45°F and 140°F; 6 times; a) Thrust Control Valves - power drain shall not exceed 10 watts b) Latch Valve shall actuate as indicated by position switch c) A thermostates shall actuate between 55 ± 5°F and deactuate between 65 ± 5°F.	a) Thrust Control Valve's average power: REA #1: @ 45°F 1.38 watts; @ 140°F 1.17 watts REA #2: @ 45°F 1.38 watts; @ 140°F 1.17 watts b) No discrepancies.

TABLE III (continued)

Test Sequence	Test Name	References Spec. Para.	 AT Sheet Pages	Specification Requirement	Test Results
					c) NOTE: (*) The recorded line and tank thermostat temperatures during the first three cycles were in error due to the time lag in the VCPS temperature duration.

CYCLE

	1 On	 Off	2 On	 Off	3 On	 Off	4 On	 Off	5 On	 Off	6 On	 Off
Line	(*)	(*)	(*)	(*)	52.5	(*)	53	67.5	51.5	69.0	51.5	68
Bracket	56	(*)	55.5	65.5	56.0	64.5	55.0	62.0	57.0	65.0	55.0	61.5
Tank	52.0	(*)	52.5	(*)	52.5	(*)	52.7	66.5	52.5	67	52.0	67

°F

22	Contamination Check	4.3.2	156 - 158	Same as Sequence 2.	Actual No. Particles 2.0 1.0 0 0 0 0
23	Leakage	4.3.3	159 - 171	Same as Sequence	Latching Valve - Nil Thrust Control - Nil Total VCPS External Leakage - .336 x 10^{-4}
24	Electrical Check	4.3.4	172 - 189	Same as Sequence 4.	Pressure Transducer Pressure / Output 100.3 psia 1.60 VDC 201.4 psia 3.14 VDC 261.7 psia 4.02 VDC Thermistor - Room Ambient Temp. 74.0°F Tank #1 73.5°F Bracket 73.5°F Tank #2 73°F Line 73.0°F Heater Circuit Resistance REA and Tank 20.8 ohms REA 73.8 ohms Bracket 34.7 ohms Line 142.1 ohms

TABLE III (continued)

Test Sequence	Test Name	References Spec. Para.	 AT Sheet Pages	Specification Requirement	Test Results
					Visual examination of valve traces showed no discrepancies.
25	Spin Firing	4.3.16	214-219	VCPS shall not exhibit any abnormal firing characteristics such as P_c discontinuities or roughness when compared to previous non-spinning firings.	Engine P_c and tank pressure traces were visually examined and found to be smooth and continuous.
26	System Firing Basepoint	4.3.1	190 - 195	Impulse delivered shall be within 5% of the Sequence 1 basepoint data.	Impulse delivered by VCPS in 2 minutes. Initial Tank Pressure: 100 psia / 260 psia Sequence #1: 667 lb-sec / 1413 lb-sec Sequence #26: 653 lb-sec / 1369 lb-sec Tolerance: - 2.1 % / - 3.1%
27	Wet Weight	4.3.13	198 - 199	VCPS wet weight shall not exceed 66 lbs. The propellant consumed during the mission profile test shall be determined.	VCPS weight 65.8 lbs. Propellant consumption 42.4 lbs
28	Mission Profile	4.3.14	200 - 205	The VCPS mission average I_{sp} shall be 220 sec. or greater.	Mission Average I_{sp} 225.6 sec.
29	Extreme Temperature and Vacuum Firing	4.3.15	206 - 213	Demonstrate thermal vacuum operation of the REAs at 140,000 ft. altitude min. and 45°F and 120°F.	Reference Figure 3 for impulse delivered by VCPS.
30	Decontamination and Contamination Check	4.3.2	220 - 223	Same as Sequence 2.	Actual No. Particles 10 2 1 0 0 0
31	Propellant Line Insulation Verification Test		Appendix #1 1 - 10	The VCPS propellant lines temperature shall not be less than 45°F.	Actual minimum line bemperature was 51°F. See Appendix B for full thermal report.
32	Contamination Check		Appendix #1 11 - 13	Same as Sequence 2.	Actual No. Particles 8 3 1 1 0 0

TABLE III (continued)

Test Sequence	Test Name	References		Specification Requirement	Test Results
		Spec. Para.	AT Sheet Pages		
33	Alignment	4.3.10	Appendix #1 45 - 47	Same as Sequence 15.	Actual Misalignment REA #1 12 minutes REA #2 12 minutes
34	Leakage	4.3.3	Appendix #1 14 - 26	Same as Sequence	Internal Leakage Latching Valves 0.4 scc/hr GN_2 Thrust Control Valve 0.7 scc/hr GN_2 External Leakage Total VCPS .5 x 10^{-6} scc/hr GN_2
35	Electrical Check	4.3.4	Appendix #1 27 - 44	Same as Sequence 4.	Pressure Transducer Output 101.7 psia 1.61 VDC 203.0 psia 3.17 VDC 255.7 psia 3.94 VDC Thermistor: Ambient Temperature 72°F Tank #1 71.5°F Line 71.4°F Tank #2 71.5°F Bracket 71°F
				Heater Circuit Resistance REA and Tank 20.7 ohms REA 71.6 ohms Bracket 34.6 ohms Line 36.0 ohms	Heater Circuit Resistance REA and Tank 20.7 ohms REA 71.6 ohms Bracket 34.6 ohms Line 35.7 ohms
					Visual examination of valve traces showed no discrepancies.
36	Post Test Inspection		Appendix #1 47	Review data for compliance to specification requirements. Visual inspection of VCPS.	All data conformed to specification requirements or was reviewed and found acceptable via MRA.

4.1 System Firing Base Point, Sequence 1 and 28

The purpose of this test was to provide a firing base point for comparison of VCPS performance before and after the structural and environmental qualification tests.

Both sequences were performed at identical conditions in the H-5 vacuum test cell. The VCPS was loaded with 12 lbs of hydrazine and pressurized to 260 psia. The unit was fired for 2 minutes with an initial pressure of 260 psia and then refired for 2 minutes after venting the VCPS pressure to 100 psia. No test anomalies were encountered during either test sequence.

The following table shows the impulse delivered by the VCPS and each REA for each firing.

IMPULSE DELIVERED (lbs-sec)

	Sequence 1		Sequence 26	
	@ 100 psia	@ 260 psia	@ 100 psia	@ 260 psia
VCPS Total	667	1413	653	1369
REA #1	333	707	330	689
REA #2	334	706	323	680

Impulse delivered by the system was repeated within 3.2% of the initial base point after being subjected to test sequences 2 thru 25. This repeatibility is considered excellent and demonstrates that the VCPS performance capabilities were unaffected by the structural and environmental testing.

4.2 Decontamination and Contamination Check, Sequence 2, 8, 12, 20, 22, 30 and 32

The VCPS was decontaminated after each test sequence in which the unit was loaded with hydrazine or referee fluid. Contamination checks were made after each decontamination check and after major structural and environmental tests and prior to delivery.

The purpose of the decontamination procedure was to assure the complete removal of hydrazine propellant from the system. This was done by gravity draining the residual hydrazine and flushing the VCPS with high purity water. The water is then drained and removed by an IPA flush and vacuum drying of the system.

A contamination check was made during the IPA flushing sequence by withdrawing an effluent sample and performing a particulate count on the sample. Each contamination check made during the qualification test was found to be well within the allowable CE-5 cleanliness level.

4.2 continued

CE-5 Cleanliness Level

Particle Size	Allowable Count
0 - 5 Micron	Unlimited
5 = 10	1200
10 - 25	200
25 - 50	50
50 - 100	5
100	0
50 Metallic	0

4.3 Leakage, Sequence 3, 9, 14, 17, 23

Internal leakage test was performed after various environmental tests to verify the leakage rate between the propellant source and the thrust chamber. Four internal leakage measurements were made during each sequence:

1. the sum of the latching valve leakage at 300 psia
2. the sum of the latching valves leakage at 15 psia
3. the REA #1 thrust control valve at 300 psia
4. the REA #2 thrust control valve at 300 psia

The internal leakage rates were measured by pressurizing the VCPS, as required, with the appropriate valves closed and collecting the gaseous nitrogen leakage via the water displacement method. The external leakage was measured by the mass spectrometer method with the unit pressurized to 300 psia GH_e.

The following table shows the allowable leakage rates compared to the maximum values exhibited during any of the test sequences.

Leakage Check	Allowable	Maximum Recorded	Sequence
Internal			
Sum of Latching Valves	8 scc/hr GN_2	1.4 scc	9
Sum of REAs	8 scc/hr GN_2	.6 scc	9
External Leakage	$1x10^{-4}$ scc/ sec GH_e	$3.4x10^{-5}$	23

4.4 Electrical Check, Sequence 4, 10, 16, 24, 35

The purpose of the electrical check was to verify the nominal operation of each electrical component by a functional check at appropriate intervals throughout the qualification test. Included in the test are functional checks of the REA valves, latching valves, pressure transducer, electrical heaters, thermostats and thermistors.

4.4 continued

All the electrical components checked out properly throughout the qualification test except the REA heater. During the first electrical check, sequence 4, an REA heater was found to be defective. The defective unit was removed and replaced with a spare heater. The malfunction analysis of the REA heaters is covered in RDR #02908 in Appendix B. As a result of the investigation, heater manufacturing procedures were revised and all REA heaters were replaced with new units made to the revised procedures.

Test Sequence 35 shows a line heater circuit resistance of 36 ohms compared to 144 in previous tests, this change reflects the line heater wiring change from series to parallel heating elements, required as a result of the propellant line temperature problem.

4.5 Mass Properties — Sequence 5

This test was performed at the NASA facility at GSFC. The NASA provided test report is included in Appendix D. During the mass properties testing it was found that the balance of the VCPS could be varied by the propellant filling rate. The proper fill rate will subsequently be determined by GSFC after delivery of the unit.

4.6 Acceleration — Sequence 7

Acceleration testing was conducted at D. T. Brown test facility. The VCPS contained high purity water and was pressurized to 250 psia. The mounting fixture was designed to provide 3 g's in the X or Y axis while applying 14.7 g's simultaneously in the Z axis. Two one minute runs were made accelerating the unit in the +X, +Z and +Y +Z axes. The acceleration parameters were: arm length - 137.5 inches, 62 RPM with a resultant load of 15 g's. All test parameters were within specification.

4.7 Vibration — Sequence 11

The purpose of the vibration test was to demonstrate that the VCPS and GFE transtage could structurally withstand and successfully operate after being subjected to the required vibration levels. Since the transtage hub was to be tested at the same time as the VCPS, GSFC provided Hamilton Standard with a mass simulating spacecraft and the personnel to assemble the system. The VCPS/spacecraft assembly was tested as a unit during the sinusoidal vibration below 200 Hz and for the entire random input. The spacecraft was removed for sinusoidal inputs above 200 Hz. The VCPS was fully loaded with high purity water and pressurized to 245 psia. Figure 3 shows the test set up and Table 4 provides a listing of the recording accelerometers used. The test engineering report including the control input level plots are provided in Appendix C.

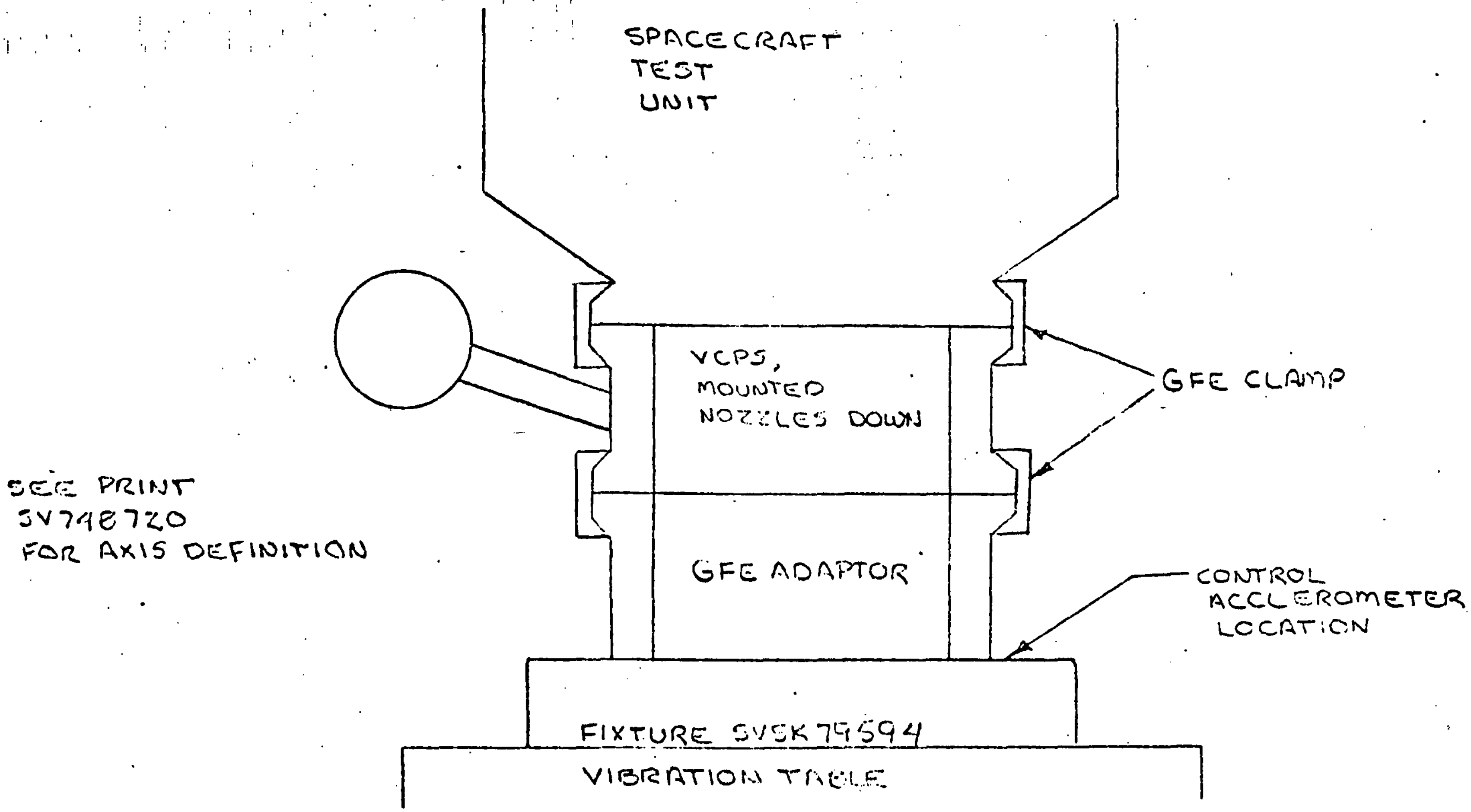


FIGURE 3 VIBRATION TEST SETUP

TABLE 4

Install accelerometers on the test item and record outputs during testing as shown in the following Table:

	VIBRATION INPUT AXIS		
ACCELEROMETER LOCATIONS	X	Y	Z
Fixture (Control)	X, Y, Z	X, Y, Z	X, Y, Z
Spacecraft C.G.	X, Y	X, Y	X, Y
REA Mount	X	Y	Z
Tank Mount	X	Y	Z
Latch Valve Mount			Z
Junction Box Mount			Z
Pressure Transducer			Z
Hub (Inside, near arm bracket mount)	X	Y	Z

4.8 Proof Pressure — Sequence 13

The purpose of the proof pressure test was to verify the integrity of the VCPS tanks and manifold after the structural qualification test sequences. The VCPS was pressurized to 450 psia for 2 minutes. No visual damage was incurred by the VCPS and the unit passed all subsequent leakage tests.

4.9 Engine Alignment — Sequence 15 & 33

The REAs were initially aligned during the VCPS assembly. The alignment tests were performed after the structural qualification test and after the firing test prior to shipment. Auto collimators and optical targets were used to initially align and subsequently check the alignment of the REAs to within ± 30' from the theoretical VCPS C.G. The test values in all cases fell between 7.5 and 13 minutes from the C.G.

4.10 Visual Examination — Sequence 18

At the completion of the structural qualification tests the VCPS was thoroughly examined by Hamilton Inspection personnel for any damage which may have been incurred. No damage was noted.

4.11 Thermal Verification — Sequence 19

The purpose of the thermal verification test was to demonstrate the capability of the VCPS thermal design to maintain the propellant system within the temperature range of 45°F to 140°F, under solar simulated flight conditions. Testing was performed at General Electric's test facility in Valley Forge, Pennsylvania.

The VCPS was instrumented throughout with non-flight thermocouples, loaded with 6 lbs of referee fluid and pressurized to 100 psia. Figure 4 shows the spacecraft/VCPS sun angle relationship. The spacecraft/VCPS was mounted on a spin fixutre which was capable of rotating the system to achieve sun angles of 120° (warm cruise) and 60° (cold cruise), while spinning at 55 rpm. The zero degree sun angle was achieved by turning of the solar simulator. Although the problems associated with the use of thermocouples readout through a slip ring greatly reduced the amount of useful data achieved, it was evident that the VCPS was unable to maintain propellant lines and tanks pressure above freezing during the 60° and 0° sun angle modes. The following table briefly summarizes and compares the test results to the expected temperatures.

4.11 continued

Thermocouple Location	Sun Angle 120° Predicted	Actual	60° Predicted	Actual	0° Predicted	Actual
Propellant Tank Outlet	82°F	84°F	112°F	72°F	67°F	10°F
Bracket Area	ALL READINGS WERE WITHIN SPECIFICATION					
Propellant Line	N/A	101°F	55°F	42°F	48°F	10°F

This problem and the subsequent corrective action, as agreed to by Hamilton Standard and GSFC is documented in GSFC Malfunction Report D02909 ref. Appendix B. A detailed description of the subsequent thermal analysis and verification test is provided in the engineering report included as Appendix

4.12 Thermal Vacuum Sequence 21

The purpose of this thermal vacuum test was to demonstrate the operation of the VCPS components, except engine firing, at the specified temperature extremes of 45°F and 140°F. This testing was performed in Hamilton Standard's 10 ft. x 10 ft. thermal vacuum chamber. The VCPS was loaded with referee fluid and pressurized to 250 psia for the testing.

The unit was subjected to six (6) temperature cycles between the temperature limits with a 2 hour hold period at each extreme. The operation of each component was checked during each temperature hold and the electrical heaters and thermostats operation was tested on each cycle. All components demonstrated satisfactory operation.

Two test conditioning problems were encountered during the thermal vacuum testing. First, some difficulty in maintaining the required 1 x 10^{-5} torr pressure was encountered. The chamber pressure slipped up to 1.5 x 10^{-5} torr for two short periods during the 48 hour test. The second problem involved the rate of temperature cycling. The rate of temperature change during the first three cycles was too fast causing a temperature distribution within the VCPS because of what appeared to be improper thermostat activation. During the last three temperature cycles the cycling rate was sufficiently slow to allow the proper recording of the thermostat temperatures.

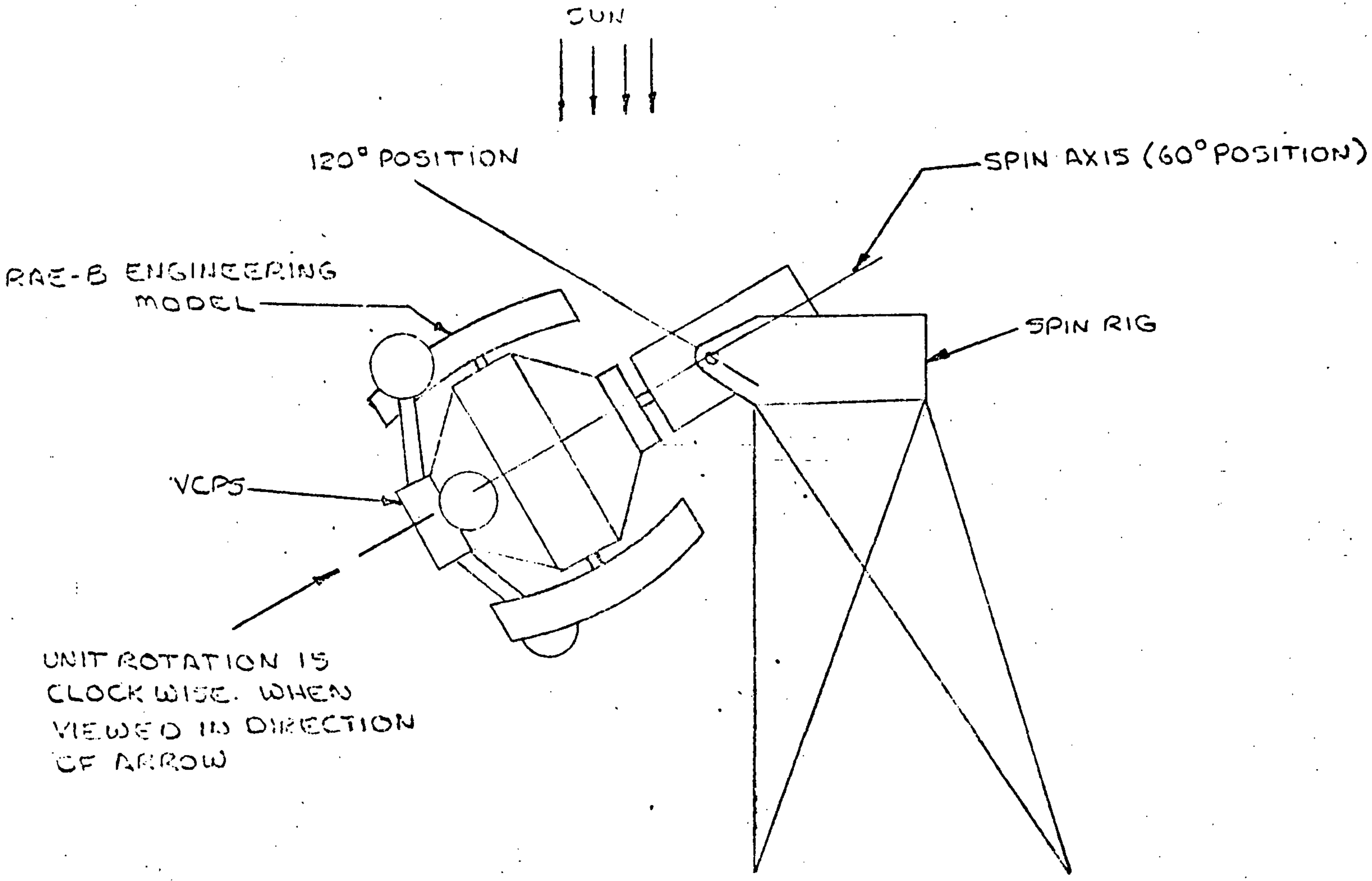


FIGURE 4 THERMAL VERIFICATION

4.13 Spin Firing — Sequence 25

The spin firing test was conducted to demonstrate that the engine thrust and tank blowdown characteristics are not affected by the vehicle spin rate.

Testing was performed in the H-4 firing cell at ambient temperature and pressure. The VCPS was loaded with 45 lbs of hydrazine and pressurized to 245 psia. REA chamber pressure and the VCPS pressure transducer were recorded via a slip ring during each firing. Two firings of 2 minutes each were conducted at 55 ± 5 rpm and 12 ± 2 rpm for a total of 8 minutes firing time. Visual examination and comparison of the REA P_c and tank pressure traces show the traces to be smooth, continuous and typical of non-spin firing traces.

4.14 Wet Weight — Sequence 27

The purpose of the wet weight test was to determine the mass of propellant consumed during the mission profile test. In order to achieve the accuracy required to provide significant data, a balance scale was built into the firing cell for this test.

Dry Weight	45.65 lbs
Propellant Loaded	+45.20
Gas	+ .42
Total Wet Weight	91.27
Less Weight of VCPS after Mission Profile	48.87
Propellant Consumed	42.4 lbs.

4.15 Mission Profile — Sequence 28

The purpose of the mission profile test was to subject the VCPS to a typical mission firing sequence and verify the average specific impulse for that mission. The system was initially loaded with 45.2 lbs of N_2H_4 pressurized to 245.5 psia. Testing was conducted in the H-5 firing cell with the initial chamber pressure at 100,000 ft. minimum. Four (4) firings were performed with firing time based on the engine performance required to provide impulse of 7253, 770, 1377 and 151 lbs/second respectively. No test anomalies were encountered. The test result for the mission profile are summarized in the following table.

4.15 continued

	Initial Conditions				
	Tank Press.	REA Temp.	Firing Time	Delivered Impulse	Mission I_{sp}
1	245.5 psia	68°F	870 sec	7356 lb-sec	
2	123 psia	87°F	114 sec	726 lb-sec	
3	112 psia	93°F	222 sec	1312 lb-sec	
4	100 psia	94°F	24 sec	125 lb-sec	
TOTAL			1230 sec	9519 lb-sec	225.6 secs

4.16 Extreme Temperature and Vacuum Firing

Sequence 29

The purpose of this testing was to provide firing data for temperature performance prediction and to demonstrate the operation of the REA in thermal vacuum environment. Testing was conducted in the H-5 firing cell with the chamber initially evacuated to 140,000 feet min. prior to each firing. The VCPS was installed loaded with 45 lbs. of propellant and pressurized to 245 psia.

Temperature conditioning was accomplished by preconditioning the VCPS and propellant prior to loading the system and evacuating the cell. The VCPS was then loaded with conditioned fuel and the VCPS temperature was maintained by conditioning the transtage mounting block while slowly evacuating the test cell. For the 40° firing, the firing cell had to be backfilled with dry GN_2 to prevent condensed moisture from freezing on the unit as the cell was evacuated.

The following table outlines the test conditions and results of the thermal vacuum firing test.

						Impulse Delivered (lb-sec)		
Run	VCPS Bracket Temp.	Propellant/ Tank Temp.	REA Temp.	Initial Tank Pressure	Run Time (mins.)	REA #1	REA #2	Total
1	145°F	136°F	125°F	242 psia	2	624	630	1254
2	70°F	80°F	60°F	180 psia	2	502	507	1009
3	42°F	45°F	50°F	143 psia	2	428	431	859
4	143°F	125°F	136°F	163 psia	2	471	476	947
5	60°F	75°F	60°F	132 psia	2	402	405	807
6	40°F	45°F	40°F	112 psia	2	365	364	729

4.17 Propellant Line Insulation Verification Test Sequence 31

The testing was performed in addition to the original qualification test program as a result of the malfunction of the VCPS during the thermal verification test, sequence 19. The purpose of the testing was to verify the selection of the proper insulation thermal characteristics, demonstrate the acceptability of the insulation assembly procedure, and to provide the data necessary for the thermal model to generate the space/flight temperatures.

The test was conducted at Hamilton Standard in the 10 ft. x 10 ft. thermal vacuum chamber. Test conditions were set to simulate worst case conditions by having zero sun input and controlling the line interfaces, hub and tanks, to minimum expected temperatures. Three thermal modes were tested. First, the VCPS was allowed to reach steady state with 12 VDC input to the line heaters. Secondly, heater input was then increased to 13.8 VDC until steady state was achieved. Finally, the heaters were deactivated and the VCPS temperatures were monitored during a 2 hour cool down.

The test results showed that the propellant line temperatures were maintained above freezing even in this worst case test and that the minimum expected line temperature under flight conditions is 51°F. A detailed description of this testing and the results of the subsequent thermal analysis is provided in the engineering report in Appendix E of this report.

4.18 Post Test Inspection Sequence 36

This test sequence included a final visual examination of the VCPS by HS Inspection and DCASO personnel and a complete review of the test data for compliance to the specified requirements.

The visual examination revealed no major discrepancies although some minor cosmetic flaws were noted. These were repaired by simple cleaning or in the case of the gold surfaces, the flaws were covered by vapor deposited gold kapton tape. The test data was reviewed and found to be compliant with the specified requirements.

5.0 TANK THERMAL ANALYSIS AND PROPELLANT LINE THERMAL ANALYSIS

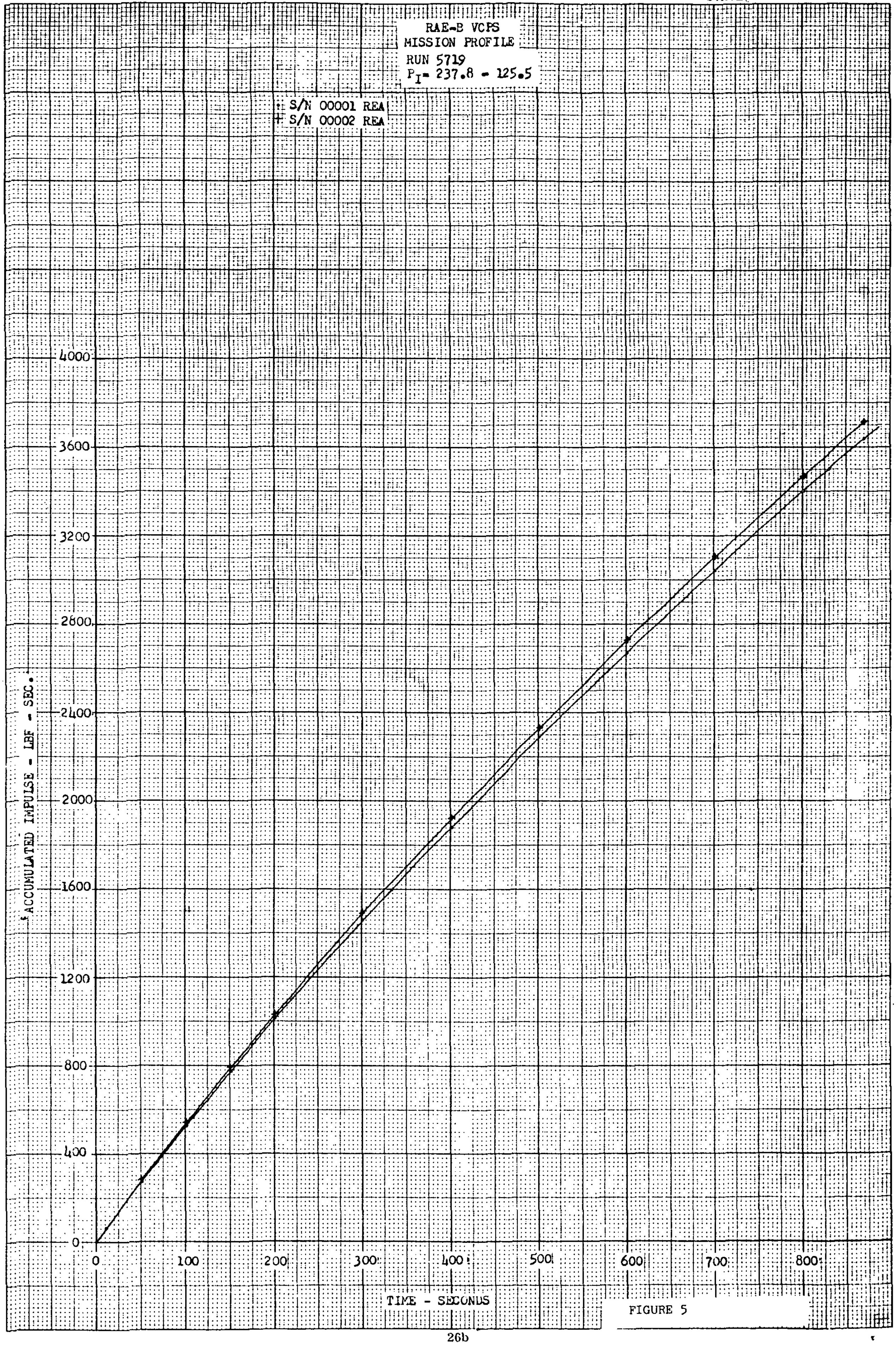

RAE-B VCPS
MISSION PROFILE
RUN 5719
P_I= 237.8 - 125.5
S/N 00001 REA
+ S/N 00002 REA
ACCUMULATED IMPULSE - LBF - SEC.
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
0
100
200
300
400
500
600
700
800
TIME - SECONDS

FIGURE 5

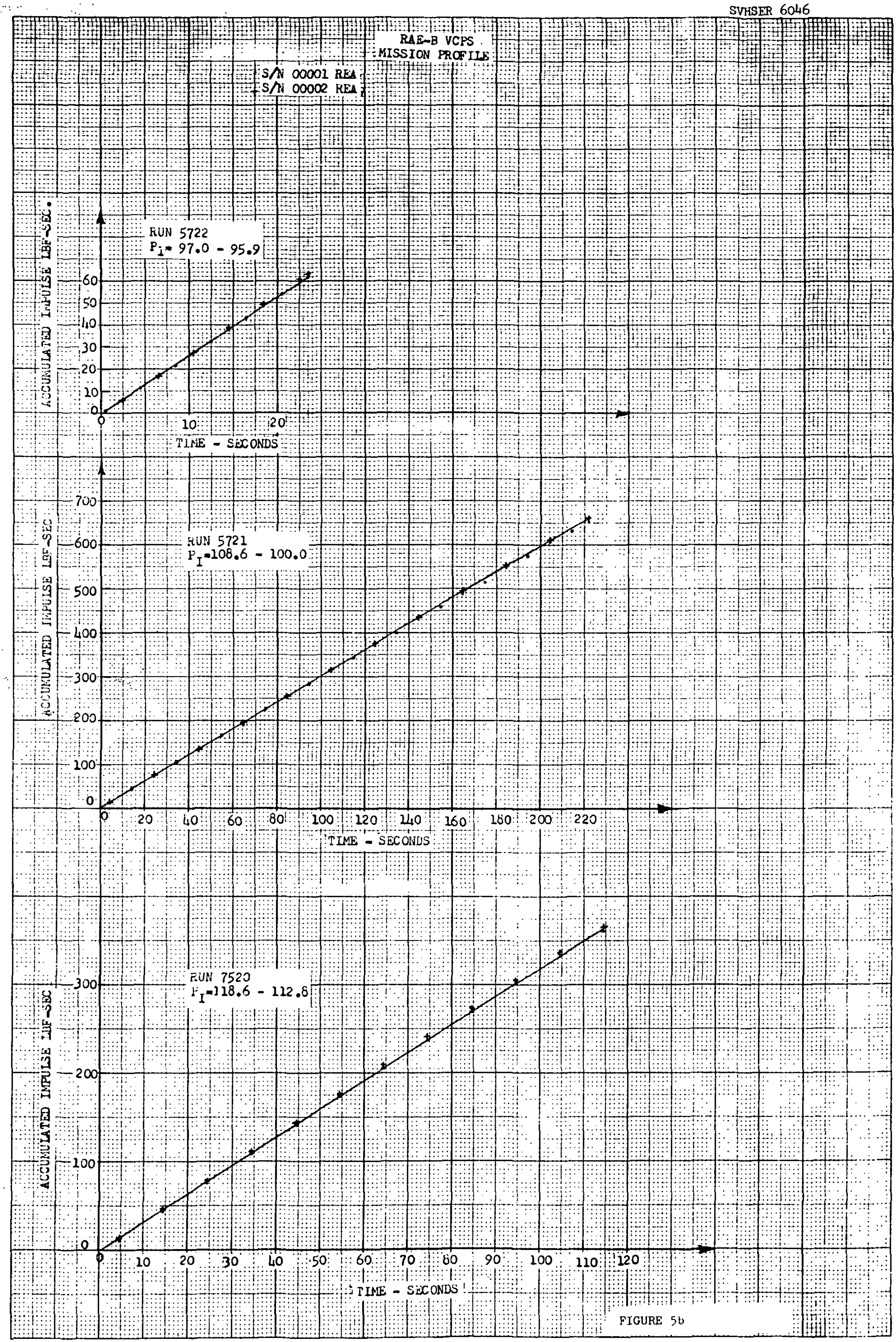

RAE-B VCPS
MISSION PROFILE
S/N 00001 REA
S/N 00002 REA
RUN 5722
P_I= 97.0 - 95.9
ACCUMULATED IMPULSE LBF-SEC.
0
10
20
30
40
50
60
0
10
20
TIME - SECONDS
RUN 5721
P_I=108.6 - 100.0
ACCUMULATED IMPULSE LBF-SEC
0
100
200
300
400
500
600
700
0
20
40
60
80
100
120
140
160
180
200
220
TIME - SECONDS
RUN 7520
P_I=118.6 - 112.8
ACCUMULATED IMPULSE LBF-SEC
0
100
200
300
0
10
20
30
40
50
60
70
80
90
100
110
120
TIME - SECONDS

FIGURE 5b

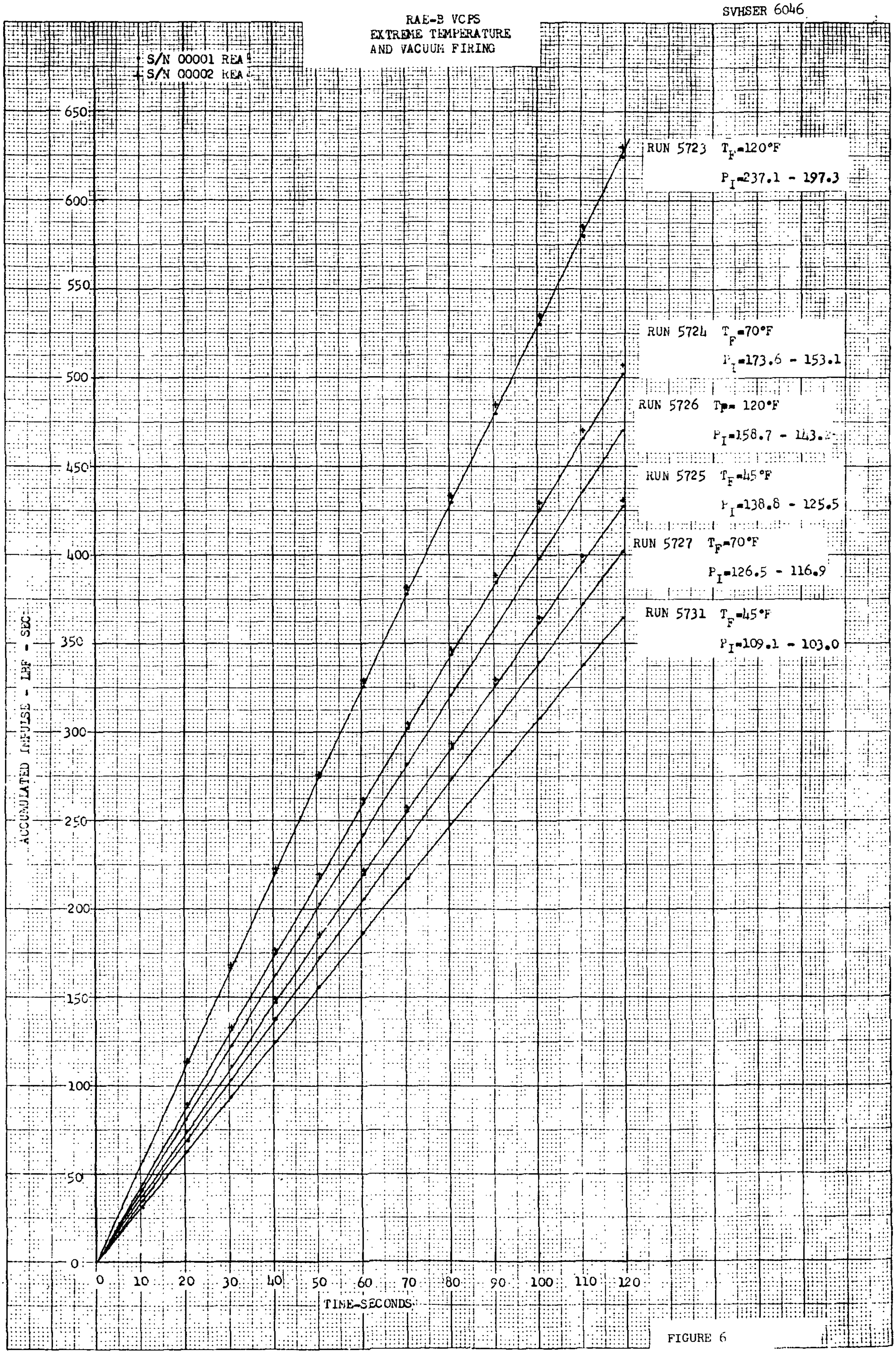

RAE-B VCPS
EXTREME TEMPERATURE
AND VACUUM FIRING
S/N 00001 REA
S/N 00002 REA
RUN 5723 T_F=120°F
P_I=237.1 - 197.3
RUN 5724 T_F=70°F
P_I=173.6 - 153.1
RUN 5726 T_F= 120°F
P_I=158.7 - 143.2
RUN 5725 T_F=45°F
P_I=138.8 - 125.5
RUN 5727 T_F=70°F
P_I=126.5 - 116.9
RUN 5731 T_F=45°F
P_I=109.1 - 103.0
ACCUMULATED IMPULSE - LBF - SEC
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
110
120
TIME-SECONDS

FIGURE 6

RAE-B VCPS

TANK THERMAL ANALYSIS REPORT

34<

1.0 INTRODUCTION

The intent of this report is to document the thermal analysis effort relative to the VCPS tanks conducted since the thermal verification test of May 1972. The pretest analysis and test results are included along with subsequent analyses which served to correlate the thermal model and provide definition of the tank coating changes required for operation within specification limits.

2.0 SUMMARY

The solar thermal verification test showed a large discrepancy between the pre-test tank temperature predictions and the actual test results. A large predicted thermal gradient across the tank failed to materialize and the cooldown rate during the 2 hour transient dark period exceeded the predicted rate by a large amount resulting in temperatures far below the specification minimum. Subsequent analyses have produced a thermal model which duplicates the test results. The original discrepancy has been found to be a combination of oversimplified thermal modeling together with factors unique to the test setup and solar lamps. The mission thermal analysis has been redone using the improved thermal model with the result that 56% of the Black Paint stripe on each tank must be taped over with vapor deposited gold to insure satisfactory operation in space.

3.0 DISCUSSION

3.1 Requirements

The VCPS specification S-723-P-19 requires that tank propellant temperatures remain between 45^{o}F and 140^{o}F with the additional requirement that the tank heaters not turn on; implying that the minimum tank temperature allowable is 50^{o}F at the tank outlet. These criteria must be met over environmental variations characterized by two extremes, hereafter referred to as "HOT CASE" and "COLD CASE" defined as follows:

HOT CASE

Steady state cruise at 120^{o} spin axis inclination (to the solar vector) followed by a 2 hour transient period at 180^{o} inclination with minimum fuel load in the tanks of 6 lbs N_2H_4, total.

COLD CASE

Steady state cruise at 60^{o} spin axis inclination followed by a 2 hour transient period at 0^{o} inclination with minimum fuel load of 6 lbs N_2H_4, total.

3.2 Thermal Design Philosophy

The principal thermal design objective was to establish a passive thermal control coating system which would minimize the difference in propellant temperature between the hot case and cold case cruise conditions so that the subsequent full sun and dark transients would not yield out of spec temperature excursions. This required that the effective solar absorbtance of the tank be higher for the cold case than for the hot case to compensate for the difference in solar projected area (incident solar flux) between the 120° and 60° spin axis angles. Another requirement was to provide a low overall emittance to minimize the 0° spin axis cooldown rate while maintaining the proper α/ϵ ratio for cruise operation. The coating arrangement selected was vapor deposited gold (Vacuum Metallizing Corp.) with a stripe of black paint applied to the upper (+Z) half of the tank to reduce the overall α/ϵ to the desired value (2.2) and simultaneously, by its placement, effect a higher absorptance in the 60° spin axis attitude. Figure 1 shows the tank stripe orientation relative to the solar vector at the 60° and 120° spin angle. Vapor deposited aluminum would have been a more desireable coating, since it has a lower α and the same ϵ as gold, but the tank vendor was worried about a possible corrosion problem involving aluminum and the tank material. Figure 2 shows the solar projected area of the black paint stripe in its original configuration as a function of spin angle inclination. The effective solar absorbtance of the tank with this stripe configuration is .412 at the 60° spin angle and .30 at the 120° spin angle.

3.3 Thermal Design Analysis

The original thermal design analysis was accomplished using the VCPS system thermal model which contains three tank nodes with associated vehicle and VCPS connectors. This model, the tank portion of which is shown in Figure 3, was input to HSD's general heat transfer computer program and run on the IBM 370-165 computer. A significant portion of the information required to set up this model was supplied by NASA/GSFC early in the design. These data, Table I, included the solar projected area of the tanks, arms and transtage, the view factors from the tanks to space and nearby vehicle surfaces, the temperatures of nearby spacecraft surfaces, and the emittance and solar absorbtance of all system external surfaces. Since the tank model has three nodes, it was necessary to aportion the NASA/GSFC supplied solar inputs amont the three equal surface area nodes. This was accomplished approximately through the use of the GSFC shadow photographs and hand calculations. The resulting solar projected area of the three nodes for the hot and cold cases is shown below:

3.3 (continued)

Solar Projected Area (4 tanks) ~ FT^2

	HOT CASE		COLD CASE	
Spin Angle	120°	180°	60°	0°
Solar Ap				
Nodes 1	.5076	.633	.547	0
2	.4804	.916	.394	0
3	.384	.633	.122	0

It should be noted that the solar input is much more evenly distributed in the 120° spin axis case than in the 60° spin axis case where the input to the outboard tank node is considerably higher than that to the other nodes. The increase shadowing corresponding to the 60° spin angle intercepts the inboard areas of the tanks.

3.3.1 Pre-Test Predictions

Hot case and cold case temperature predictions were made after the VCPS had received the vapor deposited gold coating and the black tank stripe had been applied. The analysis was performed for space operation (as opposed to test chamber conditions which were not known at the time) with the intent of adjusting the model after the test to interpret the data at test conditions. Since the test was planned not to include the hot transient condition (180° spin angle) the predictions presented below omit this case. The predictions are based on a solar constant of 442 BTU/FT^2-HR, 0°R radiation sink and the spec minimum fuel load of 6 lbs N_2H_4 (1.5 lbs per tank).

PREDICTED TEMPERATURES °F

	NODE		
Case	Tank 1	Tank 2	Tank 3
Cold Case Cruise (60° spin angle)	112	88	32
Cold Case Transient (0° spin angle, 2 hrs)	67	-4	-13
Hot Case Cruise (120° spin angle)	82	85	79

The most significant aspect of these predictions was the large temperature gradient between the outlet (fuel) end of the tank (NODE "Tank 1") and the opposite end ("Tank 3") for cold case cruise. The clarity afforded by hindsight would suggest that transport mechanisms within the tank tending to relax this favorable temperature gradient should have been added to the model at that point since the absence of the gradient at the design α/ε would have resulted in excessively low fuel temperatures during the transient (0° spin angle) condition. This was not apparent at the time.

3.4 Test Conditions and Operation

The test was conducted in the General Electric Co. solar simulator at Valley Forge Space Center, King of Prussia, Pa. The VCPS was mounted to a GSFC supplied engineering model of the spacecraft, which was in turn coupled at the +Z end of the spin fixture. The combination was rotated at 55 RPM during the test and was processed from the initial 120° spin axis inclination (hot case), after equilibrium was achieved, to the 60° attitude (cold case cruise). At the latter spin angle, the spacecraft Z axis was at 30° to the horizontal (the solar source is reflected from ceiling mounted mirrors). The tanks contained 5.3 lbs of isopropyl alcohol which was added to the 1 lb of water already in the system (but probably not in the tanks). The intent was that the tanks contain 6.3 lbs of alcohol-water mixture to match the thermal mass of 6 lbs of N_2H_4. After equilibrium was achieved at the 60° spin angle, the solar source was turned off for 2 hours to simulate the transient condition at 0° spin angle.

A considerable amount of difficulty was encountered with thermocouple data errors generated by the slip ring temperature gradients. Fortunately the flight thermistors were utilized in the test providing very accurate tank temperatures at the outlet end and the means for correcting thermocouple data taken elsewhere on the tanks. The tank meridian thermocouple (NODE "Tank 2") failed early in the test.

The test conditions are summarized below:

Solar Power Intensity	118 w/ft^2
Cold Wall Temperature	-270°F
Tank Pressure	100 psia
Tank Load	5.3 lbm isopropyl alcohol
Vacuum	9.5×10^{-7} torr
Spacecraft RPM	55

3.5 Test Results

Table II shows the tank temperatures from the various test conditions compared to the pre-test predictions. The data shows two significant discrepancies when compared to the predictions:

The predicted temperature gradient was absent (the test data temperatures are rougly equal to the average value of the three predicted temperatures).

The cooldown rate during the 2 hour dark transient was far greater than predicted.

3.5 (continued)

Both discrepancies suggest the presence of some type of transport phenomena "shorting" the three tank nodes together, evening out the gradient and increasing the heat loss during the transient by distributing the stored heat of the liquid in NODE "Tank 1" over the entire tank surface.

3.6 Data Analysis

The post test analysis had the following major objectives:

1) Review the thermal model for errors and oversimplifications which may have contributed to inaccurate predictions.

2) Investigate the test conditions for phenomena peculiar to the test which will not occur in space.

3) Produce a thermal model which duplicates test results.

4) Replace "test conditions" with "space conditions" in the model and determine coating changes required for satisfactory thermal performance in space.

Prior to going into the details of converting the model to the G.E. test conditions, some runs were made using the space model with the following changes:

Run "A" - All 3 tank nodes were thermally shorted together and the cold case rerun. The results (Table III) agree far better with respect to cooldown rate and cold case temperature distribution than do the original predictions. A re-evaluation of the model calculations failed to reveal any errors other than failure to predict the thermal coupling of the 3 tank nodes. At this point, the various possible internal transport mechanisms where listed, evaluated, and added to the model if found significant:

1. Internal Radiation Among Tank Nodes and Fuel Puddle - A radiation network linking the 3 tank nodes (the fuel puddle is lumped into "Tank 1") and the tank attachment (NODE "ARM") was set up using 0.8 for the internal emittance. The effect of tank radiation alone is significant (Run B, Table III) and the conclusion must be drawn that it should have been in the model from the beginning. The coupling afforded by radiation alone, however, is insufficient to explain the test results.

3.6 (continued)

2. Natural Convection in the Pressurant Gas - The presence of a large radial acceleration in the tanks (2.3 g's at 55 RPM) and a high pressurant density (100 psi N_2) produces significant convective coefficients between the warm end (NODE Tank 1) and colder tank areas. Convective coefficients were estimated treating the internal geometry as parallel plates with appropriate separation. Both horizontal and vertical plates were calculated reasoning that the tank geometry would produce convective coefficients somewhere between those two extremes. Figure 4 is a plot of the convective coefficients vs. tank delta T. These were added to the model along with the radiation (Run "C" Table III). These results show further improvement in the direction of matching the test data, but not to the degree of Run "A" (complete thermal short of the 3 tank nodes).

3. Mass Transfer (Diffusion) - Diffusion rates for alcohol through nitrogen were calculated to assess the relative importance of evaporation from the fuel puddle and subsequent condensation on colder areas of the tank. Calculated mass transfer rates were found to be negligible.

4. Fuel Sloshing - During the test, the orientation of the tanks was such that a ±1.0 g oscillatory side loading was applied to the fuel puddle along with the constant 2.3 g radial acceleration normal to the puddle surface. An estimate of slosh natural frequency gave a value of 2 hz. Since the system was spinning at 1 hz, and the unamplified response of the puddle to the ±1.0g would include an angle of 30° about the normal axis of the puddle, the proximity of the slosh exitation to the natural frequency suggests that the fuel was probably sloshing all over the inside of the tank during the test. This has been modeled as run "A" Table III.

   The conclusion drawn from these preliminary runs, "A" through "C", is that sloshing probably isothermalized the tank during the test although as run "C" suggests, the data would have been nearly the same without sloshing due to radiation and convection. Sloshing will be precluded in space, but the radiation and convection effects were left in the model for later predictions of space temperatures with new tank coating distributions in the cold case. If the natural convection values utilized in the model are excessive, this will tend to make the resulting design conservative. The natural convection was not added to subsequent hot case runs because leaving it out is conservative.

At this stage in the analysis, the G.E. test conditions were added to the model. These changes consisted of the following:

3.6 (continued)

1. Changing the radiation sink temperature to -270°F, the measured cold wall temperature plus 30°C to provide a realistic effective value of -215°F.

2. Changing solar flux from 129 w/ft^2 to 118 w/ft^2 with 3% added to account for chamber reflections.

3. Adjusting absorbtance of the vapor deposited gold tank coating to account for the deviation of the G.E. solar lamp spectrum from the solar spectrum. The data below was generated by GSFC from tank coating samples provided by HSD and the G.E. lamp spectrum:

Tank Sample #	GE	Solar
S/N 002	.172	.219
S/N 011	.200	.258

4. Altering the paddle and spacecraft skin cooldown rate to correspond to cutting off the solar source during the 2 hour transient dark period from the GSFC provided cooldown rates which reflected a precession to a 0° spin angle.

COLD CASE COOLDOWN RATES

	60° CRUISE TEMP °F	TEMP. AT END OF 2 HR TRANSIENT
Space	Paddle = 32°F, Skin = 50°F	Paddle = 23°F, Skin = -60°F
Solar Sim Test	Paddle = 32°F, Skin = 50°F	Paddle = -200°F, Skin = -200°F

With these changes, the model was run for both the hot and cold test conditions. The results showed computed cruise temperatures, especially in the hot case, to be significantly below the test results when using the higher of the two sets of absorbtance values in item 3 above. In order to force correlation of the model with the test results, the solar projected area of the tanks was increased by 5% in the cold case and 15% in the hot case. The original and final solar projected areas for the 3 tank nodes are given below:

Node	Tank 1		Tank 2		Tank 3	
	60°	120°	60°	120°	60°	120°
Orig Ap	.547	.5076	.394	.4804	.122	.384
Final Ap	.573	.582	.413	.551	.128	.440

3.6 (continued)

This adjustment can be justified physically in terms of including in the model the additional solar input of reflected sunlight from the spacecraft and paddles. The reflected solar flux was not included in the tank model input originally. A comparison of the adjusted model output with test temperatures is given by Run D, Table III.

3.7 Coating Modification Analysis

Having matched the test data with the adjusted model, the inputs were changed to space conditions:

1) Solar constant = 430 BTU/ft^2 hr (125) w/ft^2
2) Sink temp. = -460°F
3) Tank gold absorbtance from .200 to .258
4) Slosh connectors removed
5) Natural convection connectors removed for hot case runs (left in for cold case)
6) Fuel load thermal mass was changed to 6 lbs of N_2H_4

A nodal diagram of this model configuration is given by Figure 5. A cold case run was made to determine what would happen if the mission were flown with the tanks "as is". The results, Run E, Table III, show that although the propellant (Tank 1) does not fall to as low a temperature in space as in the test, it does fall far below the spec minimum of 45°F and, in fact, would freeze. An obvious solution to this problem would be to eliminate enough of the black paint stripe to raise the cruise temperature and reduce the cooldown rate in the dark transient with the overall constraint of not exceeding specification maximum temperatures during the hot case transient (180° spin angle) condition.

Since physical removal of the black paint stripe is not possible nondestructively, a mystic vapor deposited gold Kapton tape was selected to cover the stripe where necessary. A sample of this tape was sent to GSFC and the emittance and solar absorbtance were measured.

$$\epsilon_n = .02 \qquad \alpha \text{ solar} = .215$$

Both the radiative properties and physical appearance of this material are quite close to those of the gold tank coating.

Using the properties above for the gold tape, a series of hot case and cold case runs were made varying the percentage of black stripe area taped over (uniformly). The results are plotted on Figure 6.

3.7 (continued)

Based on these results, it was decided to tape 56% of the black stripe area. The taping pattern, chosen for simplicity and to avoid wrinkles is shown by Figure 6 . The predicted operating temperature extremes for this configuration are given below:

	Temperatures °F		
	Tank 1 (Fuel)	Tank 2	Tank 3
Cold Case Cruise (60° Spin Angle)	99	98	92
Cold Case Transient (0° Spin Angle, 2 hrs)	53	44	43
Hot Case Cruise (120° Spin Angle)	135	138	131
Hot Case Transient (180° Spin Ange, 2 hrs)	145	154	145

As indicated in the transient hot case above, the predicted propellant temperature can be 145°F which is +5°F higher than the VCPS specification S-723-P-19 max. propellant temperature of 140°F. The HS position has been to establish an upper limit of 140°F on hydrazine systems which will be operational in space for two or more years primarily to minimize hydrazine gas evolution. The hydrazine decomposition process occurs at all temperatures but can be accelerated by increasing temperature or by using materials which tend to promote the reaction. In the VCPS the gold nickel braze is more catalytic than any of the other materials used in the system. A test program was conducted by the Rocket Propulsion Laboratory of the Air Force to study the effect of hydrazine gas evolution in the presence of gold, nickel braze material. The results of this study are reported in AFRPL-TR-69-77 entitled "The Catalytic Decomposition of Hydrazine on Gold, Nickel, and a Gold/Nickel Brazing Alloy". From this report it has been concluded that a 140°F maximum hydrazine temperature for three months in the VCPS will produce decomposition at levels acceptable to the VCPS. In addition, short term exposure of temperature as high as 250°F for several one day periods can also be accommodated. Also, the VCPS was passivated with hydrazine at 120°F for 24 hours with no indication of pressure rise. Therefore, the transient (less than 2 hours) hot case temperature of 145°F is not considered a problem based on the above information.

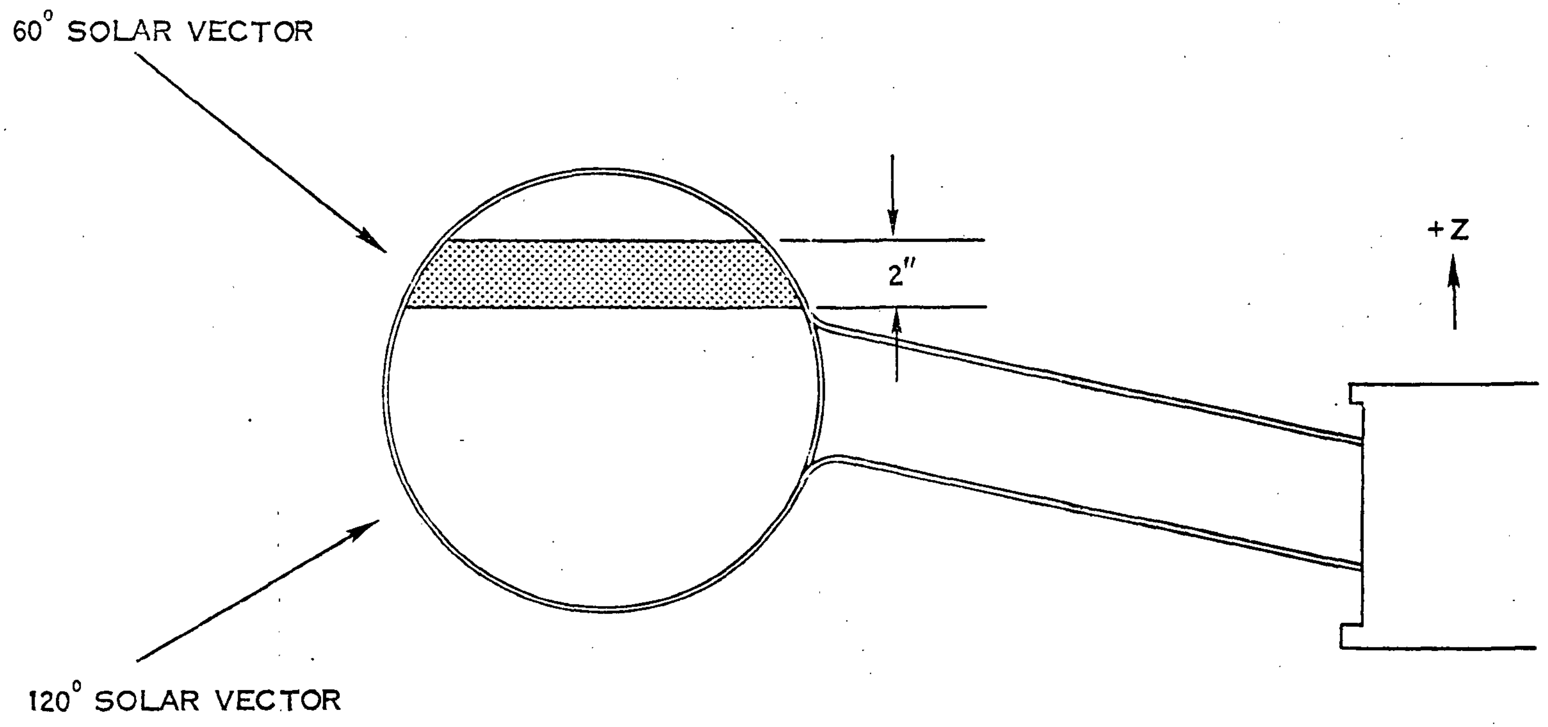


FIGURE 1. TANK STRIPE PLACEMENT

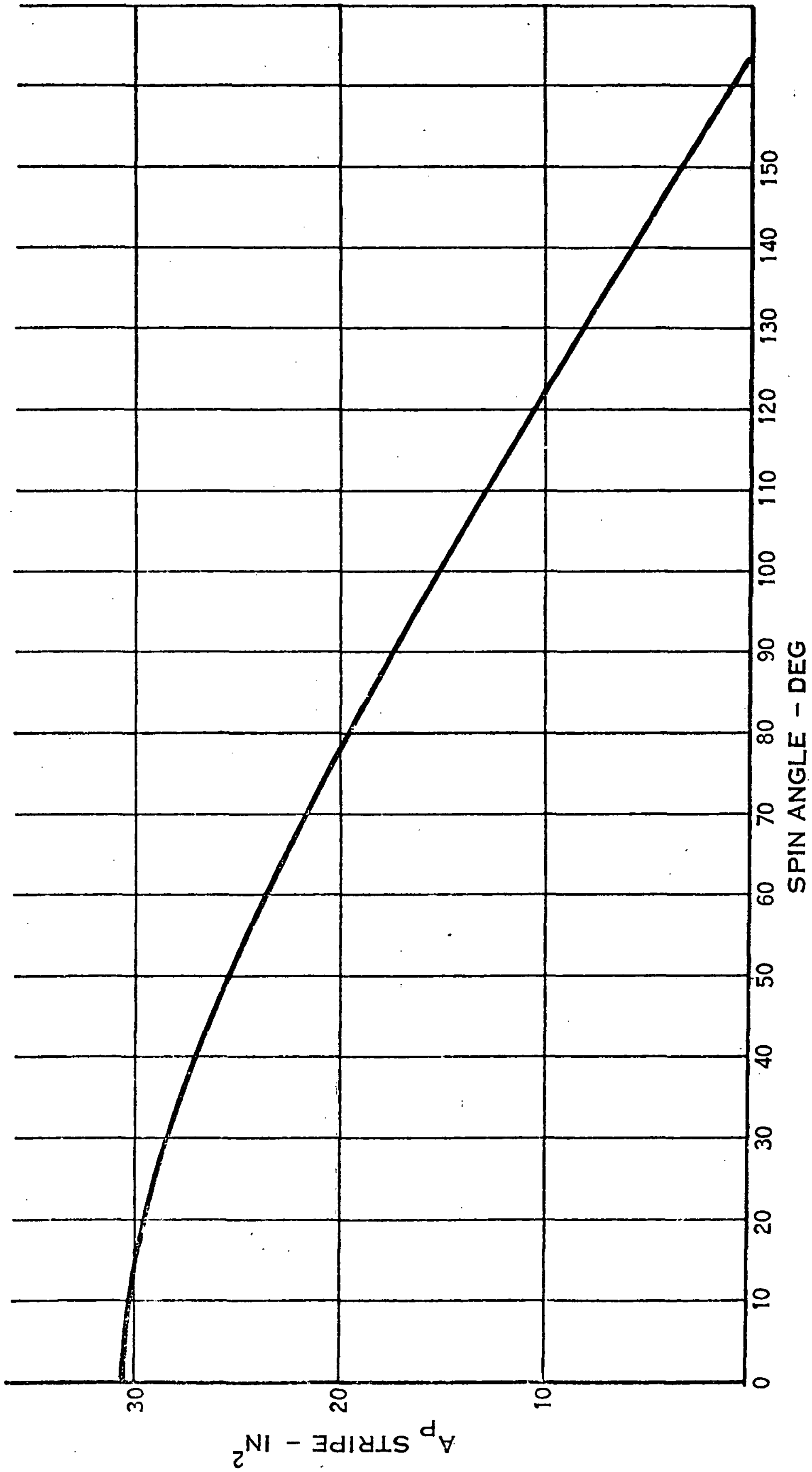


FIGURE 2. STRIPE PROJECTED AREA VS SPIN ANGLE (ONE TANK)

TABLE I

GSFC SUPPLIED DATA

Material Properties	ϵ_n	α_{solar}
Vapor Deposited Aluminum	.04	.12
Black Paint	.87	.96
Vapor Deposited Gold (Tank)	.02	.22
Paddles	$\epsilon_H = .82$	.71

View Factors from tanks

To:	F_{IJ}	Radiating Area
Paddles	.21	37.3 ft^2
Cylindrical Skin	.055	8.0 ft^2
Conical Skin	.035	5.34 ft^2
Space	.70	-

Item	Cold Cruise 60°	Cold Transient 10°	Hot Cruise 120°	Hot Transient 170°
Solar Projected Area (1 Tank)	.265 ft^2	0	.343 ft^2	-
Temperatures				
Cyl. Skin	10°C	-50°C @ 2hrs	5°C	-50°C @ 2 hrs
Lower Conic	-15°C	-30°C @ 2 hrs	3°C	38°C @ 2 hrs
Paddle	0°C	-5°C @ 2 hrs	-2°C	-5°C @ 2 hrs

TABLE II

COMPARISON OF TEST RESULTS TO PRE-TEST PREDICTIONS

	Hot Case Cruise 120° Spin Angle		Cold Case Cruise 60° Spin Angle		Cold Case Transient 2 hrs sun off	
NODE	Prediction	Test	Prediction	Test	Prediction	Test
Tank 1 (Fuel)	82	84	112	72	67	10
Tank 2	85	-	88	-	-4	-
Tank 3	79	78	32	65	-13	20

TABLE III

THERMAL MODEL RESULTS

Run	Case	Temperatures, °F		
		Tank 1	Tank 2	Tank 3
Solar Simulation Test Data	Hot Cruise	84	-	78
	Cold Cruise	72		65
	Cold Trans	10		20
"A" Slosh (Nodes Shorted)	Cold Cruise	66	66	66
	Cold Trans	22	21	21
"B" Tank Internal Radiation	Cold Cruise	77	72	56
	Cold Trans	38	10	9
"C" Radiation + Gas Convection	Cold Cruise	71	68	62
	Cold Trans	29	17	17
"D" Radiation, Convection, Slosh, G.E. Test Conditions and Solar Flux Adjustment	Cold Cruise	73	73	72
	Cold Trans	8	8	7
	Hot Cruise	84		81
"E" Run "D" Tanks "As Is" in Space	Cold Cruise	81	80	73
	Cold Trans	28	18	17

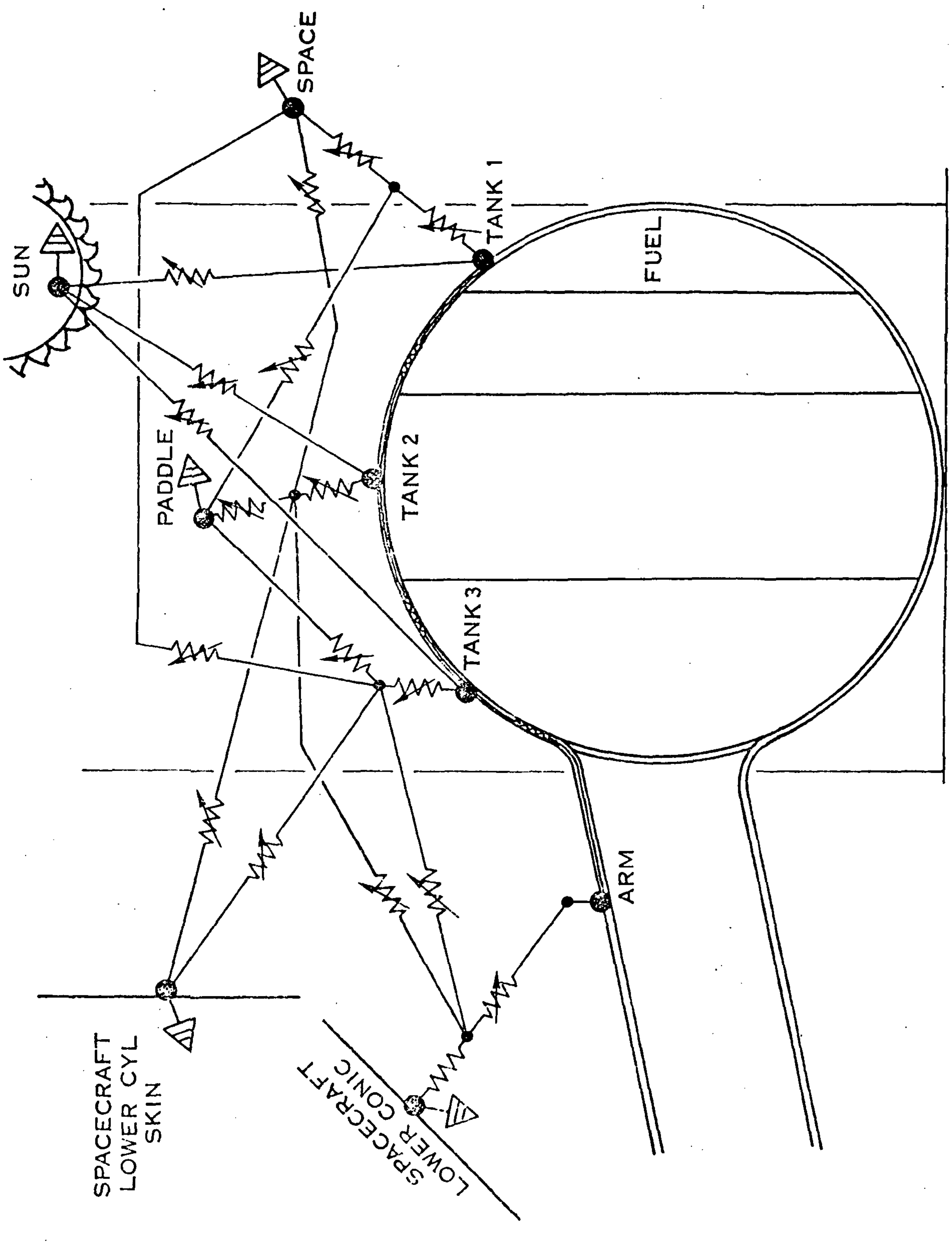


FIGURE 3. RAE–B VCPS TANK THERMAL MODEL PRE–TEST VERSION

RAE–B

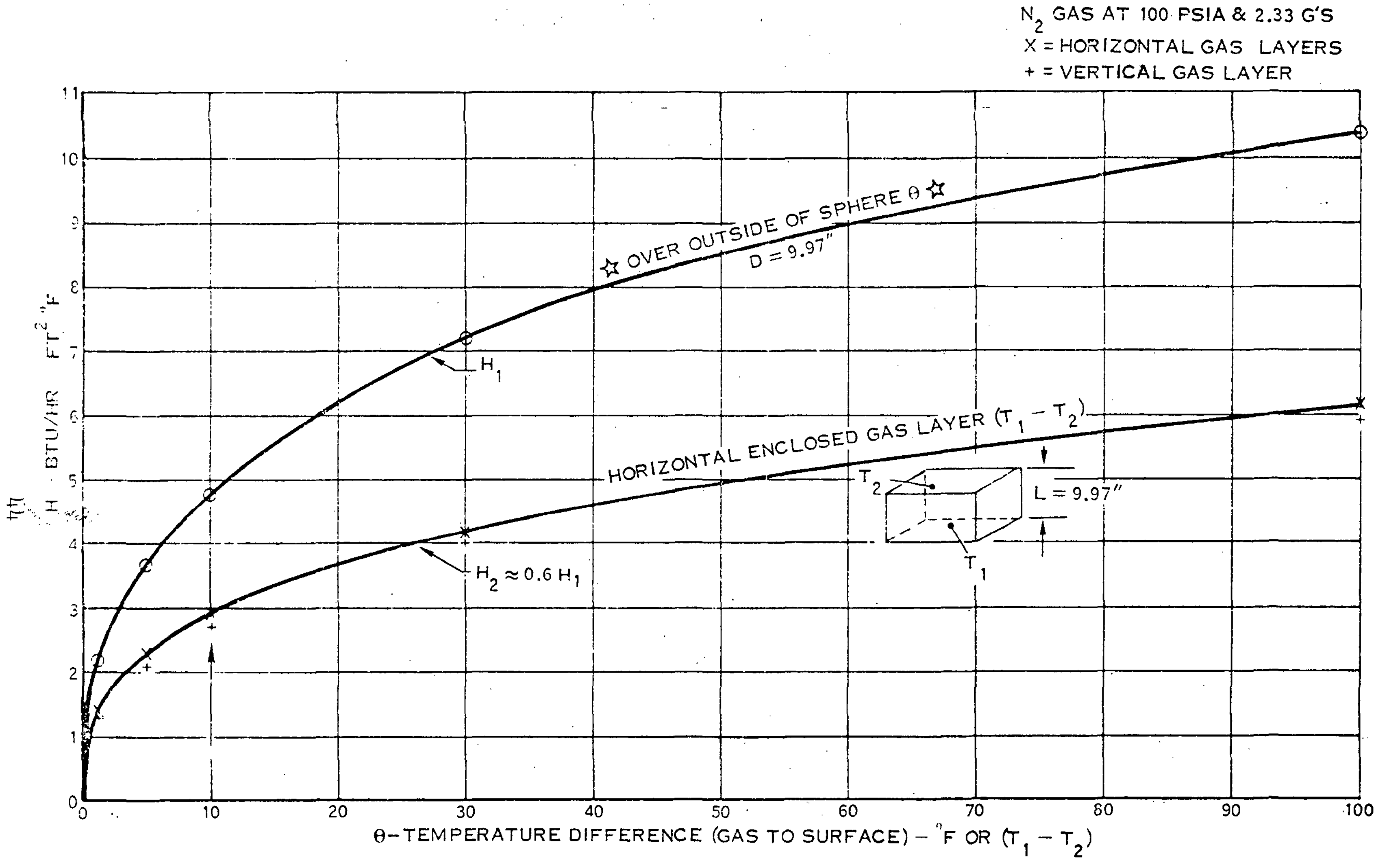


FIGURE 4. ESTIMATED FREE CONVECTION HEAT TRANSFER COEFFICIENT INSIDE TANKS

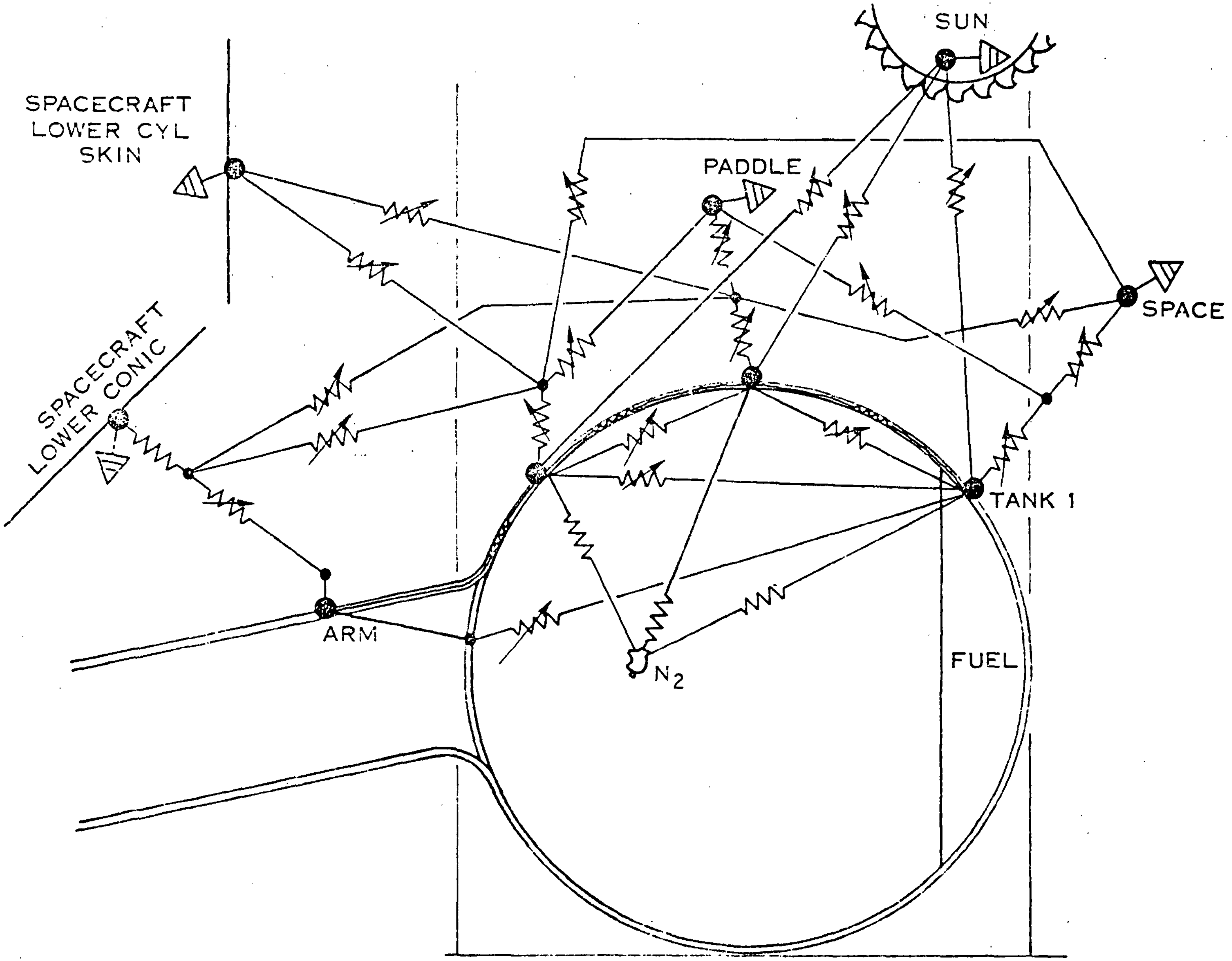


FIGURE 5. RAE–B VCPS TANK THERMAL MODEL FINAL VERSION

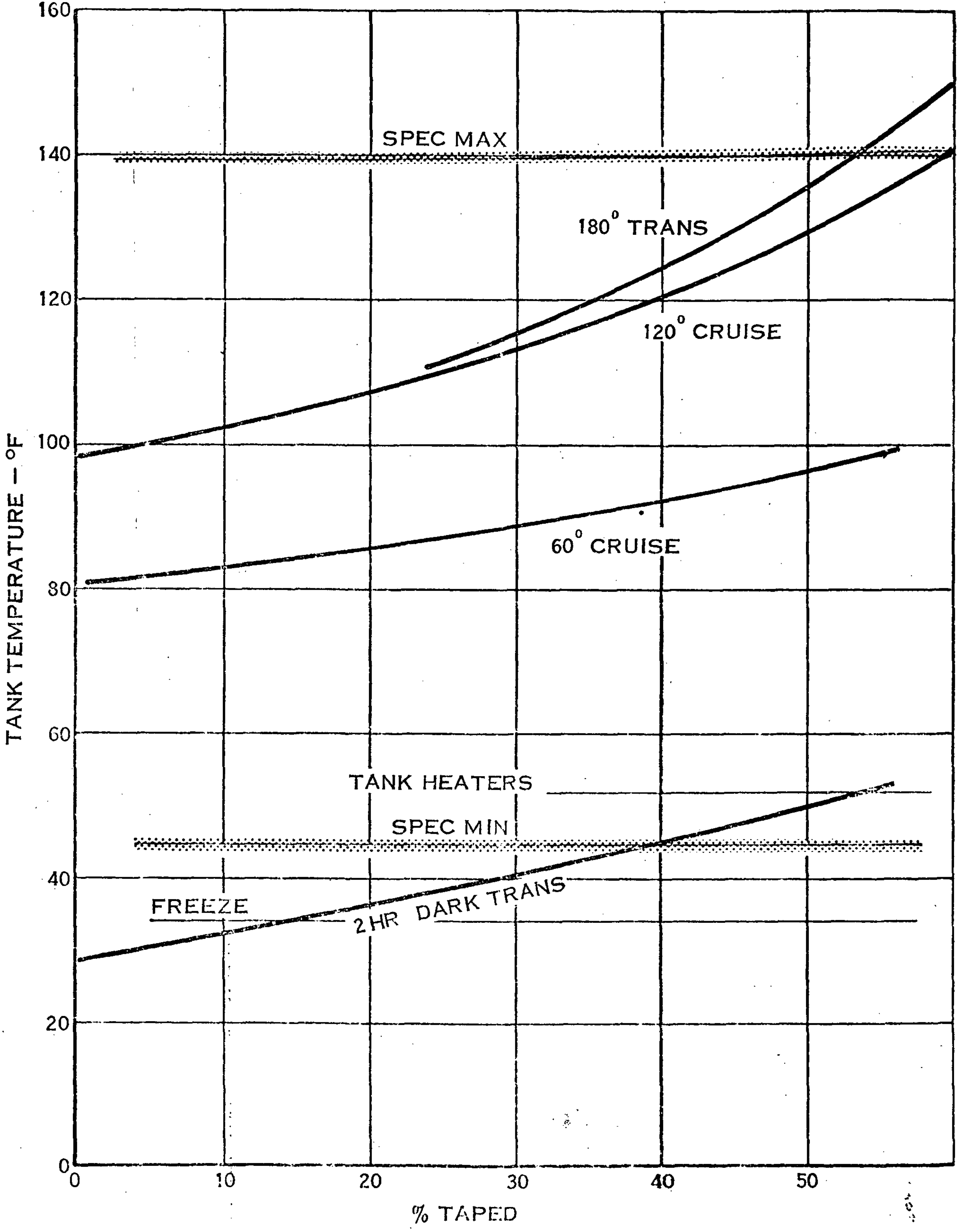


FIGURE 6. TANK COATING MODIFICATIONS

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RAE-B VCPS

PROPELLANT LINE THERMAL REPORT

1.0 INTRODUCTION AND SUMMARY

This report presents the development and qualification of the RAE-B Velocity Control Propulsion System propellant line thermal configuration. Subsequent to a propellant line low temperature problem experienced during a solar simulation test at G.E., thermal analyses and propellant line development tests were performed. The resulting configuration indicated that significant improvement in line insulation could be attained but increased heater power would also be required. The new line insulation/increased heater power configuration was then incorporated in the VCPS and a thermal vacuum test was performed. Analysis of these test results indicate propellant line temperatures will be within specification under flight conditions.

2.0 DISCUSSION

The solar simulation test conducted on the VCPS at G.E. showed that the thermal design of the propellant lines was inadequate to maintain the propellant line temperatures above freezing.

2.1 Development Program

A development program was initiated where the test data was analyzed and tests of line insulations were performed at the detail level. This program provided the results shown in Table I and the following conclusions:

a) Line insulation thermal effectiveness could be improved by utilizing loose wrap multilayer insulation with an overlapping seam covered by gold Kapton tape.

b) The propellant line would require additional heater power even with the best insulation.

2.2 Verification Test

The VCPS propellant line thermal design was modified and the VCPS reassembled by rewiring the line heater to provide 1 watt/line at 12 VDC and reinsulating with loose wrap insulation utilizing gold Kapton tape (configuration #3 on Table I). In addition the existing thermocouples were removed and replaced with GFE thermistors in the locations shown in Table II and Figure 1. The propellant tanks and +Z surface of the hub were covered with aluminized Mylar insulation to control the propellant line end condition in a zero sun angle condition.

A thermal vacuum test was conducted in the Hamilton Standard 10' x 10' vacuum chamber to provide temperature distribution data on the propellant line at zero sun angle, or worst case condition. This data was then reduced, via the VCPS thermal model, to provide the propellant line thermal characteristics for the appropriate VCPS flight conditions.

2.3 Test Results

The VCPS was operated in three modes during the thermal vacuum test to provide adequate data for analysis and to check the thermal model at more than one point. The three test conditions were steady state with 12 VDC heater input, steady state with 13.8 VDC heater input and 0 VDC heater input for 2 hours. Table III shows the raw data for each test phase. The chamber conditions were monitored throughout the test. Chamber pressure was maintained below 10^{-5} torr and the effective chamber sink temperature is shown in Table III.

The transient (power off) cooldown was performed to obtain an effective thermal mass per unit length characteristic for the lines. The effective cold wall temperature, measured with a suspended blackbody within the chamber, was approximately -190°F while data was being taken. Tank temperatures at the outlets were 50°F or below (they were cooling very slowly throughout the test).

The data analysis involved inputting the test conditions to the propellant line thermal model and "tuning" the insulation properties until the model reproduced the test data, resulting in insulation performance characteristics measured at the system level. Insulation conductance, emittance, and line thermal mass measured in this manner provide the basis for a new set of predictions for space operation. These predictions were made with the thermal model by replacing the test effective cold wall temperature with the space sink (-460°F) and adding solar input.

At both power settings, the minimum temperature occurred at position A-4, the tube clamp near the end of the arm. There appears to be a local heat leak at this point caused by the insulation penetration of the clamp itself, along with instrumentation lead heat leaks from the many wires leaving the blanket at that location. (These leads will be clipped before flight, substantially reducing this heat loss). Minimum line temperature was 41.8°F at 12 volts and 48.5°F at 13.8 volts. The one hour transient cooldown produced an 18° temperature drop (48°F to 30°F) at location A-4 and similar ΔT's elsewhere. It should be noted that the line temperatures on the other instrumented arm were at least 10°F higher throughout. The more heavily instrumented line is the coldest of the four because it incorporates the fill and drain valve, the four thermostats and does not have the double insulation wrap in as many places as do the three other lines.

2.4 Thermal Model

The propellant line program divides a pair of lines (a tank on each end and the transtage Tee in the middle) into 70 nodes, 35 line nodes and 35 insulation nodes. The program has stored in a data file such data as the heater locations, clamp locations, and locations of Tee's (fill and drain tee and transtage tee) which are treated as heat leaks. A separate data file holds a solar input

2.4 (continued)

table for each spin axis angle. The solar input was calculated earlier in the RAE-B program thermal studies. The propellant lines were sketched onto the GSFC shadow photographs to determine the location of dark areas on the lines. Solar projected area outside of shadowed locations was then determined by drawing board projection of the solar vector onto the propellant line axis. This was done in 15° increments throughout the vehicle spin (360°) and the results numerically averaged over one spin to yield a table of solar intensity versus position for each propellant line.

The program is operated on a TYMSHARE Corp. Terminal. This allows rapid manipulation of the model to achieve a desired result.

2.5 Data Correlation and Extrapolation

The program was input for the 12 volt and 13.8 volt steady state conditions. It was found necessary to simulate the heat leak at location A-4 by decreasing the clamp thermal resistance from 500 BTU/°F-hr to 150 BTU/°F-hr. The primary criteria for acceptable correlation was matching the minimum temperature. Table IV shows the temperature distribution (key temperatures) for the test conditions and corresponding analysis results. The insulation properties necessary to produce these calculated distributions are shown also. It should be noted that the 13.8 volt case yields a higher insulation conductance (poorer performance) than does the 12 volt case. A tendency toward this behavior is expected since the conductance of superinsulation increases with insulation temperature. The higher conductance (C = .029) was used in the extrapolation of these results to space operation.

A number of transient cooldown runs were made to match the cooldown rate experienced in test. This yielded a thermal mass per inch value of .003 BTU/°F-in for later use in the space transient analysis.

The values of insulation conductance measured in this series of tests are somewhat higher than those measured in the tube element tests shown in Table I. This discrepancy was anticipated owing to the fact that it was much more difficult to apply insulation at the system level than it was to insulate the free peice of propellant line in the tube element test.

The higher insulation conductance was left in the model for conservatism and the solar input and space temperature (-460°F) were added. For cold case cruise (60° spin axis angle), an average power consumption of .64 watts/line (64% duty cycle) will occur with the temperature distribution shown in Table IV. From this temperature distribution, the cold case transient condition was input (1 hour

2.5 (continued)

with no solar flux ~ 0^o spin axis angle). A line power value of one watt was utilized along with the effective thermal line mass determined in the test. The temperature distribution after the one hour dark period is shown in Table IV. The temperatures are above the specified minimum 45°F.

TABLE I

LINE INSULATION SUMMARY

					Power Required		
	Configuration	O. D. (in.)	Conductivity (BTU/ft^2-hr-^oF)	ϵ outside	Transient (watts/line)	SS Dark	Margin
	Design Pt.	.75	.02	.05	1/3	.68	None
#1	Original VCPS (Test Sample)	.75	.19	.12	Excessive		-
#2	2nd Generation (Overlap Seam, Gold Kapton Tape)	1.0	.025 (SS) .035 (T)	.053 (SS) .06 (T)	.7	1.0	Slight
#3	3rd Generation (2nd + overwrap 5 layer)	1.35	.011 (SS) .013 (T)	.048 (SS) .06 (T)	.5	.8	Slight <.1

Notation: SS = Steady State

T = Transient

TABLE II

RAE-B VCPS THERMISTOR LOCATION

KEY		
	A - Propellant Lines	E - Components and Bracket
	B - Tank	F - Spacecraft
	C - Arm and Hub	
	D - Interior Lines	"R" Prefit Existing Thermistor

No.	Location	Code	Old Code (Thermocouple)
1	Line A @ Line/Tank Vert Port	A-1	N/A
2	Line A @ Line/Tank Horz Port	A-2	N/A
3	Line A	A-3	11 A 1
4	Line A	A-4	11 A 2
5	Line A @ Thermostat	A-5	N/A
	Line A @ Tee	RA-1	Flt Hardware
6	Line A	A-6	11 A 4
7	Line A @ Thermostat	A-7	N/A
8	Line A @ Tee	A-8	11 B 1
9	Line B @ Tee	A-9	11 B 2
10	Line B	A-10	11 B 3
11	Tank on Paint Stripe	B-1	9A
12	Tank Equator	B-2	9C
13	Tank in Mount Area	B-3	9B
	Tank Thermistor #1	RB-1	Flt Hardware
	Tank Thermistor #2	RB-2	Flt Hardware
14	Arm	C-1	11C
15	Hub Exterior	C-2	N/A
16	Hub Shelf #1	C-3	11 D 1
17	Hub Shelf #2	C-4	11 D 2
18	Line A Internal	D-1	10-1
19	Line B Internal	D-2	10-2
20	REA #1 on Chamber	E-1	N/A
21	REA #2 on Chamber	E-2	N/A
22	TCV #1	E-3	4
23	Latch Valve	E-4	5
24	Transducer	E-5	7
25	Bracket Near Edge	E-6	8-1
26	Bracket Middle	E-7	N/A
	Bracket Thermistor	RE-1	Flt Hardware
27	Filter	E-8	N/A

Ref: Attached drawing for thermistor locations.

TABLE III

ACTUAL VCPS TEMPERATURES (°F)

Time	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10	B-3	C-2	C-4	D-1	D-2	E-5	E-7	E-8	Effective Sink
16 hrs @ 12 VDC																			
22:15	52.2	47.1	46.5	42.1	52.3	56.7	54.9	57.2	66.2	52.5	38.0	39.0	46.7	52.9	48.5	69.0	59.0	56.4	-192°F
22:30	51.2	47.2	46.4	42.2	52.3	56.6	55.0	57.2	66.2	52.5	37.9	38.6	46.4	53.0	48.5	68.7	60.4	55.8	-192°F
22:45	51.7	47.2	46.3	42.0	52.2	56.6	54.9	57.0	66.1	52.2	37.8	38.4	46.2	53.0	48.5	68.9	62.2	56.5	-192°F
23:00	51.6	46.5	46.5	42.1	52.5	56.7	55.1	57.4	66.2	52.5	37.6	38.2	46.0	52.9	48.5	68.8	57.3	55.9	-192°F
23:15	51.0	46.9	46.3	42.0	52.0	56.1	54.7	56.8	65.6	51.9	37.4	38.2	46.2	52.8	48.4	68.8	62.3	56.1	-190°F
23:30	51.4	46.6	46.2	41.9	52.1	56.6	54.7	56.9	65.8	51.8	37.3	38.3	46.2	52.8	48.4	69.0	60.2	56.6	-190°F
23:45	51.1	47.0	46.3	42.0	52.3	56.5	55.0	57.1	66.0	51.9	37.1	38.4	46.2	52.7	48.4	68.7	58.6	55.8	-190°F
24:00	50.7	46.4	46.1	41.8	52.2	56.3	54.7	56.9	65.8	51.7	37.0	37.8	45.8	52.7	48.3	68.8	62.3	56.2	-190°F
5 hrs @ 13.8 VDC																			
5:15	49.8	43.2	53.3	49.0	62.7	67.3	64.3	67.0	77.9	61.6	34.3	34.9	42.6	56.9	51.0	68.5	61.6	56.0	-190°F
5:30	49.5	43.0	53.4	49.0	62.8	67.1	64.4	67.1	77.9	61.7	34.2	36.7	43.9	56.7	50.8	68.1	58.2	55.4	-183°F
5:45	49.5	42.9	53.1	48.8	62.5	67.0	64.1	66.8	77.7	61.5	34.2	37.3	44.9	56.5	50.8	68.3	61.2	55.4	-183°F
6:00	49.2	42.7	53.1	48.9	62.5	66.8	64.3	66.9	77.8	61.8	34.0	37.2	45.0	56.5	50.8	68.0	61.0	55.4	-183°F
6:15	49.2	42.6	53.2	48.7	62.5	67.4	64.2	66.9	77.7	61.7	33.9	36.9	45.1	56.5	50.8	68.0	59.0	56.0	-183°F
6:30	49.0	42.4	53.2	48.7	62.4	66.8	64.2	66.8	77.9	61.7	33.7	36.9	44.5	56.5	50.8	67.9	61.1	55.5	-183°F
6:45	49.1	42.4	53.1	48.6	62.5	67.1	64.1	66.9	78.0	61.6	33.6	37.5	45.0	56.5	50.8	68.1	58.8	55.9	-185°F
7:00	48.8	42.3	53.0	48.5	62.3	66.8	64.1	66.7	77.9	61.7	33.5	37.8	45.4	56.5	50.8	67.9	62.2	55.7	-185°F
Heaters Off																			
7:10	46.2	41.6	52.0	47.8	60.8	62.8	63.5	65.3	76.1	61.0	33.5	37.7	45.4	56.5	49.9	68.0	60.3	56.1	-185°F
7:20	43.3	41.2	48.5	44.6	56.2	58.0	60.1	60.2	70.8	56.9	33.4	37.9	45.5	56.2	49.9	68.2	56.3	54.4	-185°F
7:30	41.9	40.1	45.1	41.4	52.3	54.4	56.2	56.7	66.5	53.3	33.3	38.2	45.7	55.9	49.8	67.3	53.6	54.5	-185°F
7:40	40.8	38.3	41.5	38.0	48.3	50.5	52.6	52.7	62.1	49.2	33.1	38.6	45.9	55.3	49.5	66.8	51.2	53.3	-185°F
7:50	39.9	37.1	38.3	34.9	44.7	47.1	49.2	49.2	58.0	45.4	33.1	38.5	45.9	54.4	48.9	66.2	49.4	51.9	-182°F
8:00	39.0	35.8	35.2	32.1	41.2	43.9	45.9	45.9	54.4	41.9	33.0	38.0	45.6	53.4	48.2	65.6	47.7	50.4	-183°F
8:10	38.5	34.7	32.1	30.1	39.0	41.7	44.3	43.7	51.9	39.6	33.0	37.7	45.3	52.6	47.6	64.1	46.7	48.4	-183°F

TABLE IV

PROPELLANT LINE TEMPERATURE CORRELATION (°F)

										Insulation			
Case	Thermistor Location	A-3	A-4 (@ Clamp)	A-5	A-6	A-7	A-8 (@ Transtage Tee)	A-1 (@ Tank)	A-2 (@ Tank)	C (BTU/ft^2-hr °F)	D (in.)	∈	Sink Temp. (°F)
12.0 Volts	Test Data	46.1	41.8	52.2	56.3	54.7	56.9	50.7	46.4	-	1.35	-	-190
	Thermal Model	43.0	40.5	49.7	55.1	58.3	57.5	48	48	.020	1.35	.05	-190
13.8 Volts	Test Data	53	48.5	62.3	66.8	64.1	66.7	48.8	42.3	-	1.35	-	-190
	Thermal Model	49.8	47.6	62.0	69	72.5	71.0	42	42	.029	1.35	.05	-190
Space Operation	Cold Cruise 60° spin angle 1 watt nominal	60.3	55.6	55.9	51.6	52.5	52.2	70	70	.029	1.35	.05	-460
	Cold Transient 1 hr @ 0° spin angle, 1 watt	57.8	53.4	58.1	58.6	60.9	59.8	50	50	.029	1.35	.05	-460

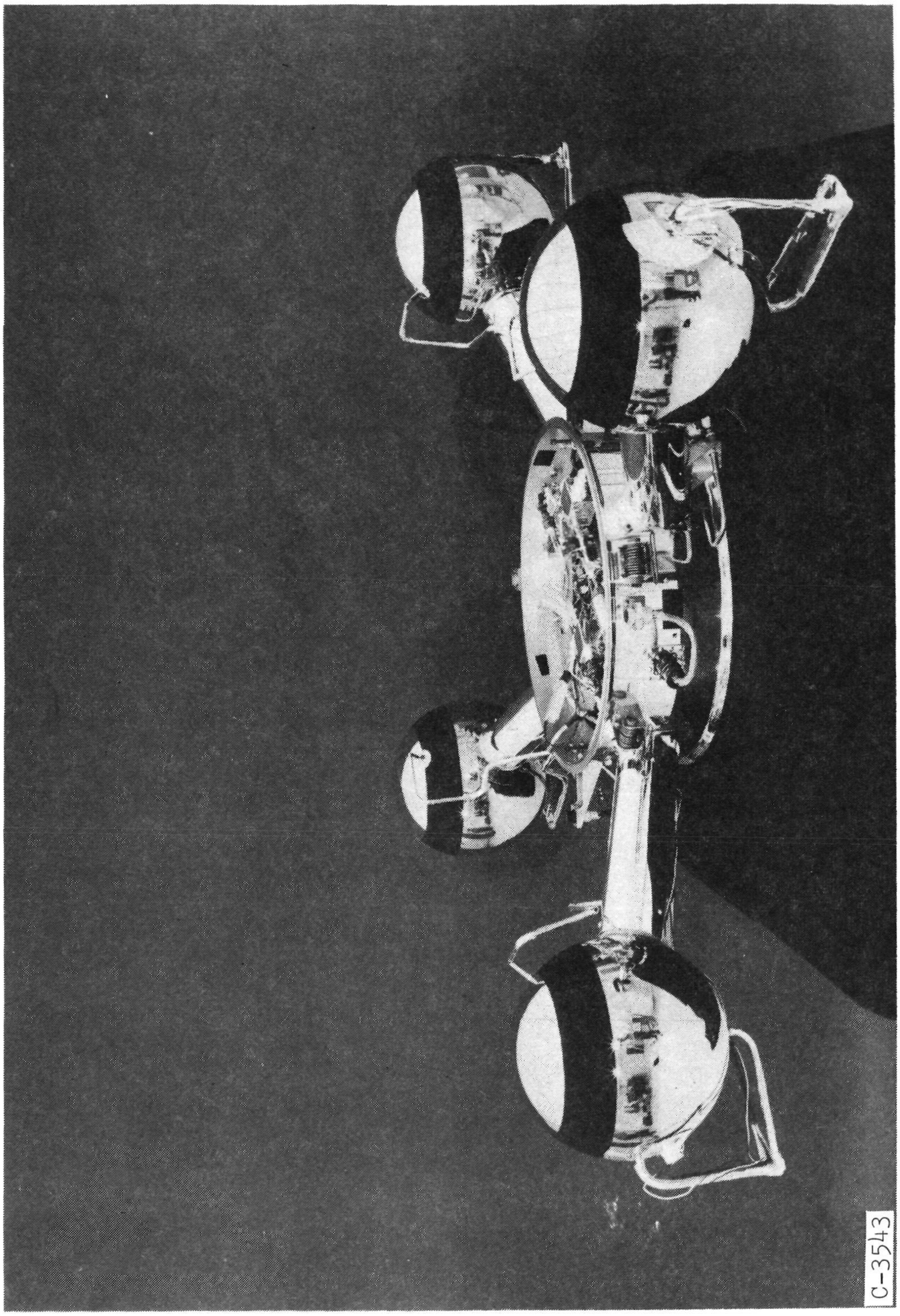
6.0 HSD POST DELIVERY ACTIVITIES

DATE	TASK
3/19-3/22/73 GSFC	1. Performed fluid load using H_2O to determine effect on system unbalance caused by fluid distribution in tanks. Results were acceptable within specified requirements.
5/14-5/22/73 KSFC	1. Performed proof pressure test. 2. Performed calibration of VCPS pressure transducer. 3. Performed internal leakage test on VCPS latch valves and thrust chamber valves. 4. Loaded VCPS with N_2H_4 on balance table to verify proper fluid distribution and pressurized with GN_2 for flight.

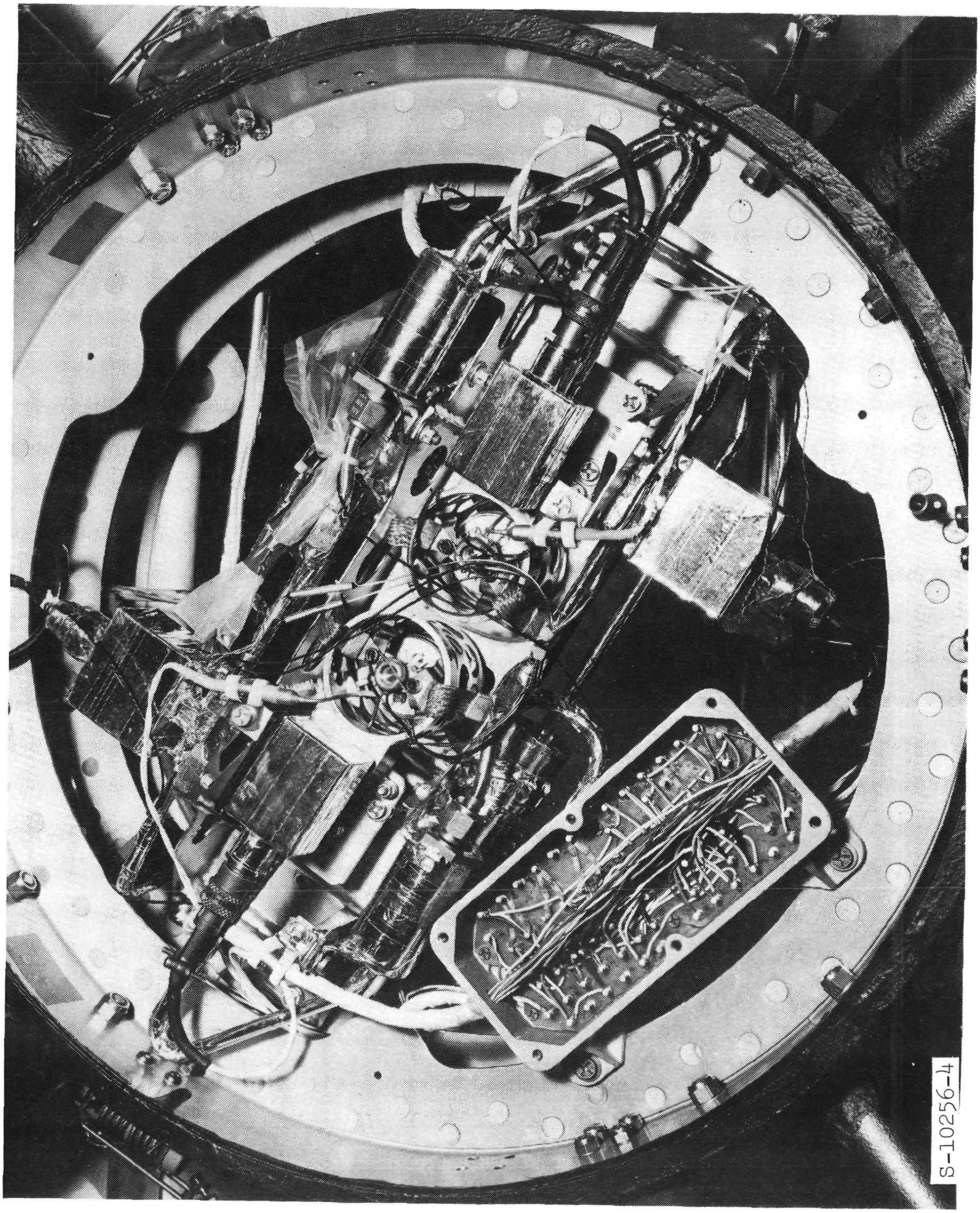
- The above tasks all gave acceptable results within specified requirements.

APPENDIX A

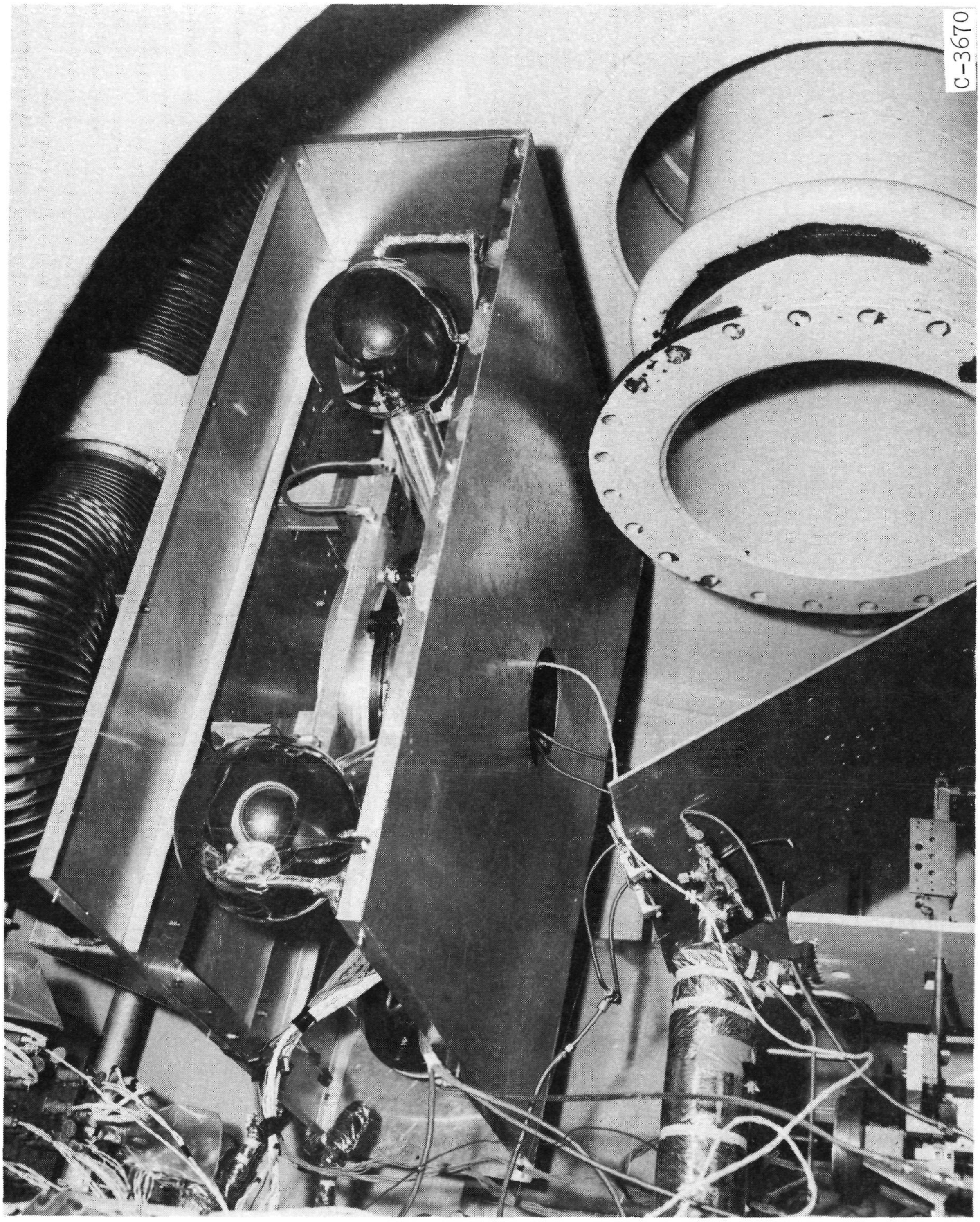
PHOTOGRAPHS



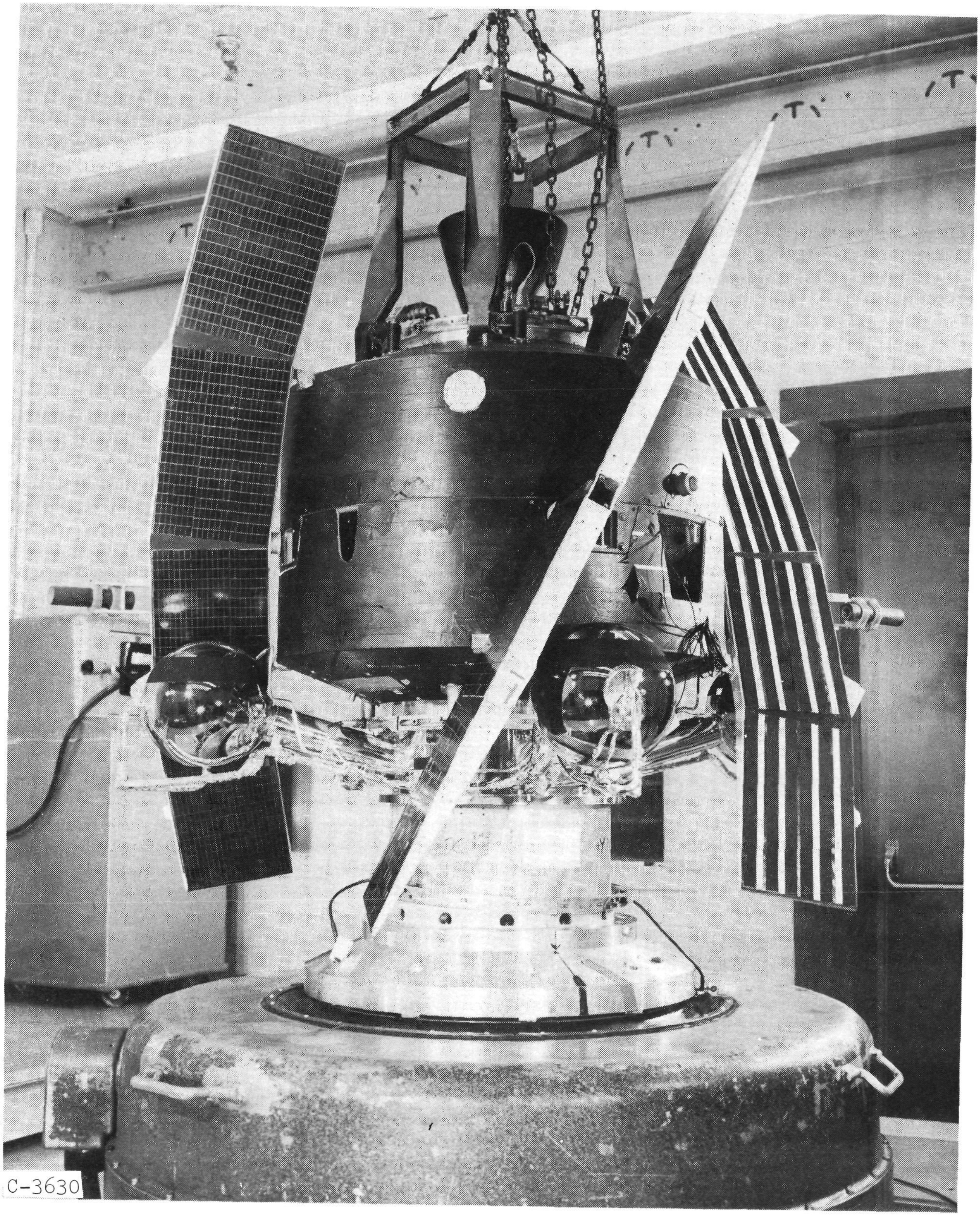
COMPLETED VCPS



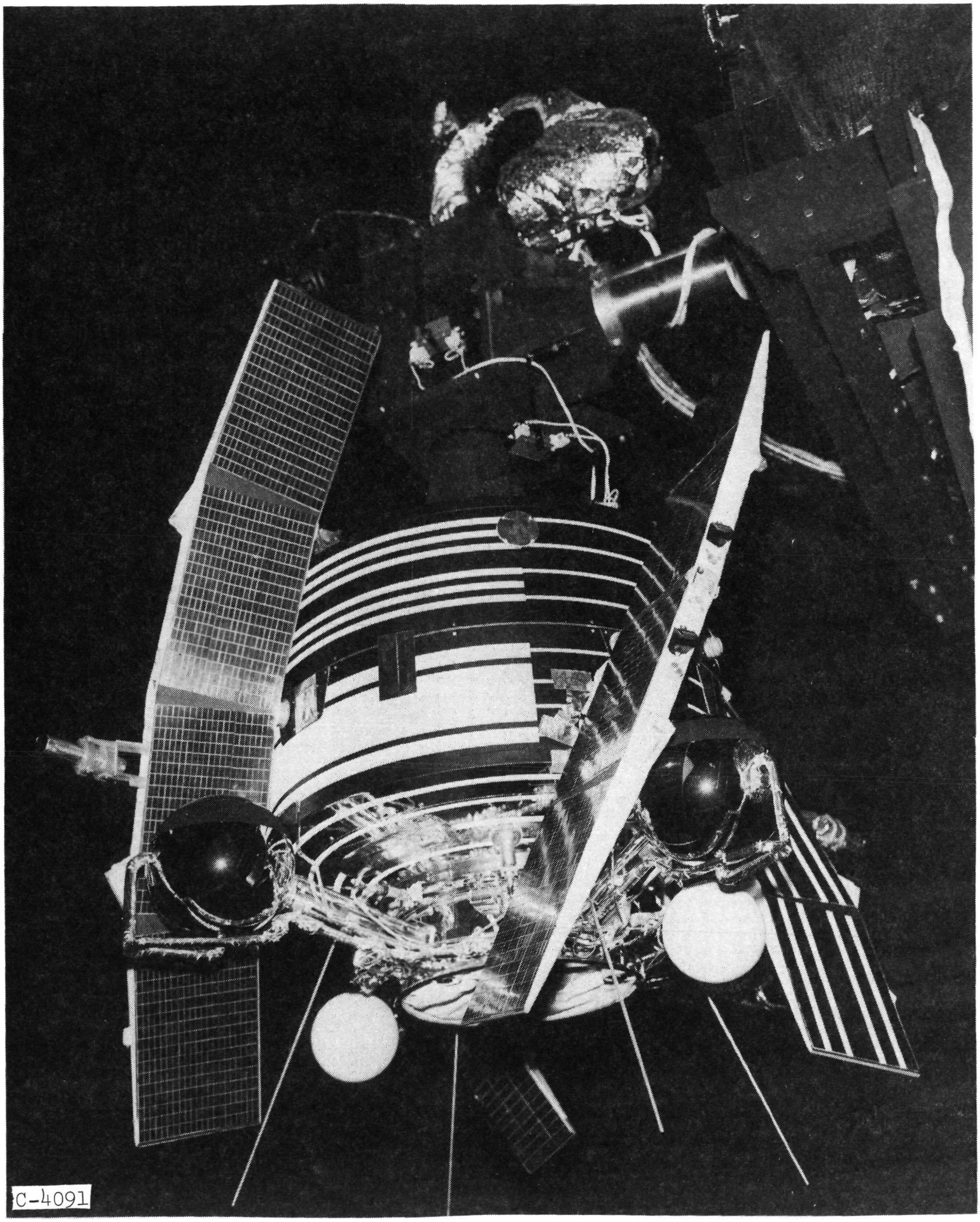
INTERIOR OF VCPS HUB



VCPS IN THERMALLY CONDITIONED FIRING FIXTURE
(Sides removed for clarity)



VCPS AND SPACECRAFT AT VIBRATION TEST



VCPS AND SPACECRAFT AT SOLAR SIMULATION TEST

APPENDIX B

GSFC MALFUNCTION REPORTS

69<

GSFC MALFUNCTION REPORT

NO **D** 02908

Project: RAE-B

(2) Spacecraft:

(3) Operation: 0

(4) Un HRS X

System or Experiment: CPS

(6) Date & Time of Malfunction: Yr 72 Mo 3 Day 28 Time 1200

(7) Date of Report: Mo 3 Day 30

8)Cr

NAME	IDENTIFICATION NUMBER	SERIAL NUMBER	MANUFACTURER
(9) Component REA		→	Hamilton Standard
(10) Assembly TCA			Hamilton Standard
(11) Sub-Assembly HEATER TCA	SV748711-1	2	Thermal Systems
(12) Part HEATER TCA	Manufacturers Part Number 76-3464-1		Thermal Systems

(13) Malfunction Occurred During: 1 ☒ Qualification Test 2 ☐ Acceptance Test 3 ☐ Integration Test 5 ☐ Launch Operations 7 ☐ Bench Test 8 ☐ Post Launch

Reliability J. Boye 3/30/72

(14) Environment When Failed: 1 ☐ Acceleration 2 ☐ Shock 3 ☐ Thermal-Vacuum 4 ☒ Temperature 5 ☐ Humidity 6 ☐ Vibration 7 ☐ Ambient 8 ☐ Acoustic A ☐ RFI/EMC 0 ☐ Vacuum

(15) Hardware Level When Failed: 1 ☐ Part 2 ☐ Sub-Assembly 3 ☐ Assembly 4 ☐ Component 5 ☒ System (VCPS) 6 ☐ Spacecraft

6) REFERENCE

acecraft Log Book #____ Page ____ Test Procedure SVHS 5619 Para 4.3.4.2.2.El

7) Description of the Malfunction: After engine firing heater resistance was 56 ohms vs required value of 74 ± 5%. Resistance from heater element to case was 5000 ohms vs required value of "open circuit". Investigation has been initiated.

Target closure date is 4/17/72

Responsible Engineer is Mr. E. K. Moore

8) Originator: Mr. E. K. Moore Phone: (203) 623-1621-565 Organization: Hamilton Standard

Do Not Write Below This Line

INSTRUCTIONS

(1) Originator – Fill in blocks (1) through (18), with all known information, as defined in instructions on the back of this form.

(2) Distribute copies in accordance with project directions.

70<

FC 4-2 (6. 70)

Copy 1

GSFC MALFUNCTION REPORT

NO D 029

(1) Project: RAE-B

(2) Spacecraft:

(3) Operation: 0

(4) Unit HRS 1 ☒ C 2

(5) System or Experiment: CPS

(6) Date & Time of Malfunction: Yr 72 Mo 3 Day 28 Time 1200

(7) Date of Report: Mo 3 Day 30

8)Cri YES 1 ☐

NAME	IDENTIFICATION NUMBER	SERIAL NUMBER	MANUFACTURER
(9) Component REA		→	Hamilton Standard
(10) Assembly TCA			Hamilton Standard
(11) Sub-Assembly HEATER TCA	SV748711-1	2	Thermal Systems
(12) Part HEATER TCA	Manufacturers Part Number 76-3464-1		Thermal Systems

(13) Malfunction Occurred During: 1 ☒ Qualification Test 3 ☐ Integration Test 7 ☐ Bench Test 2 ☐ Acceptance Test 5 ☐ Launch Operations 8 ☐ Post Launch Reliability.

(14) Environment When Failed: 1 ☐ Acceleration 3 ☐ Thermal-Vacuum 5 ☐ Humidity 7 ☐ Ambient A ☐ RFI/EMC 2 ☐ Shock 4 ☒ Temperature 6 ☐ Vibration 8 ☐ Acoustic 0 ☐ Vacuum

(15) Hardware Level When Failed: 1 ☐ Part 3 ☐ Assembly 5 ☒ System (VCPS) 2 ☐ Sub-Assembly 4 ☐ Component 6 ☐ Spacecraft

(16) REFERENCE

Spacecraft Log Book # ______ Page ______ Test Procedure SVHS 5619 Para 4.3.4.2.2.E1

(17) Description of the Malfunction: After engine firing heater resistance was 56 ohms vs required value of 74 ± 5%. Resistance from heater element to case was 5000 ohms vs required value of "open circuit". Investigation has been initiated.

Target closure date is 4/17/72

Responsible Engineer is Mr. E. K. Moore

(18) Originator: Mr. E. K. Moore Phone: (203) 623-1621-565 Organization: Hamilton Standard

Do Not Write in This Space

(19) Cause of the Malfunction: Failure analysis included X-ray, insulation resistance, heater resistance, spectral analysis, conductometric carbon analysis and ignition test. Analysis indicated that organic contamination of the heater wire or MgO insulation, or both, resulted in the presence of elementary carbon in the MgO. This caused a partial electrical short between the heater wires and between the wires and the case.

Do Not Write in This Space

(20) Corrective Action Taken: All heaters will be replaced by new heaters manufactured with the inclusion of the following steps.

A. Heater element supplier to degrease resistance wire in acetone.

B. Heater element supplier to cut resistance wire to desired length and heat electrically in air: (1) wire unsupported except at ends later removed, (2) heat to maintain approximately 1,700° surface temperature for 2 minutes minimum, (3) prevention of any

If Corrective Action is Required on Other Units, List Units by Serial No. Continued on next page.

Do Not Write in This Space

(21) Failure Analysis Performed? YES 1 XX NO 2 ☐ Organization That Performed Failure Analysis Thermal Systems, with Hamilton Standar Collaboratio

Failure Analysis Report Number "Minutes of Meeting held at Thermal Systems Date 4/11/72

(22) Action Taken on Failed Unit: 1 ☐ Rework/Repair 2 ☐ Modified 3 ☒ Discarded 4 ☒ Replaced 5 ☐ None Date ______

Organization That Performed Rework/Repair N/A

(23) Is Retest Required? 1 ☐ Yes 2 XX No If Yes, State Retest Requirements ______

(24) Retest Results N/A Satisfactory 1 ☐ Unsatisfactory 2 ☐ Remarks: N/A

(25) Unit May Be Used For N/A Flight 1 ☐ Test Only 2 ☐

N/A

Yr	Mo	Day	Date MR Closed	GSFC Project Approval	GSFC MRRT Approval	Date	Contractor Approval	Date
							Bauer	4/26/

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GSFC MALFUNCTION REPORT

NO D [redacted]

Project | (2) Spacecraft | (3) Operation | (4) Units HRS CYS

System or Experiment | (6) Date & Time of Malfunction: Yr Mo Day Time | (7) Date of Report: Mo Day | 8) Critical YES NO 1 2

NAME	IDENTIFICATION NUMBER	SERIAL NUMBER	MANUFACTURER
(9) Component		→	
(10) Assembly			
(11) Sub-Assembly			
(12) Part	Manufacturers Part Number		

(13) Malfunction Occurred During: 1 ☐ Qualification Test 2 ☐ Acceptance Test 3 ☐ Integration Test 5 ☐ Launch Operations 7 ☐ Bench Test 8 ☐ Post Launch

(14) Environment When Failed: 1 ☐ Acceleration 2 ☐ Shock 3 ☐ Thermal-Vacuum 4 ☐ Temperature 5 ☐ Humidity 6 ☐ Vibration 7 ☐ Ambient 8 ☐ Acoustic A ☐ RFI/EMC 0 ☐ Vacuum

(15) Hardware Level When Failed: 1 ☐ Part 2 ☐ Sub-Assembly 3 ☐ Assembly 4 ☐ Component 5 ☐ System 6 ☐ Spacecraft

6) REFERENCE

acecraft Log Book # ______ Page ______ Test Procedure ______ Para ______

7) Description of the Malfunction:

3) Originator: | Phone: | Organization:

Do Not Write in This Space

9) Cause of the Malfunction:

Do Not Write in This Space

) Corrective Action Taken: contact of wire and any other heater element component with organic material.

C. Thermal Systems shall bake each unterminated heater assembly in air at 1,700°F for a minimum of one hour.

97R 4/21/72

Corrective Action is Required on Other Units, List Units by Serial No. S/N 001, 002, 004

Do Not Write in This Space

(21) Failure Analysis Performed? YES 1 ☐ NO 2 ☐ Organization That Performed Failure Analysis ______ Failure Analysis Report Number ______ Date ______

(22) Action Taken on Failed Unit: 1 ☐ Rework/Repair 2 ☐ Modified 3 ☐ Discarded 4 ☐ Replaced 5 ☐ None Date ______ Organization That Performed Rework/Repair ______

(23) Is Retest Required? 1 ☐ Yes 2 ☐ No If Yes, State Retest Requirements ______

(24) Retest Results: Satisfactory 1 ☐ Unsatisfactory 2 ☐ Remarks:

(25) Unit May Be Used For: Flight 1 ☐ Test Only 2 ☐

Yr | Mo | Day | Date MR Closed | GSFC Project Approval | GSFC MRRT Approval | Date | Contractor Approval | Date 4/20/72 ✓

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GSFC MALFUNCTION REPORT

NO D. 02

(1) Project RAE-B

(2) Spacecraft

(3) Operation

(4)

System or Experiment

(6) Date & Time of Malfunction Yr 72 Mo 05 Day 09 Time

(7) Date of Report Mo 05 Day 18

	NAME	IDENTIFICATION NUMBER	SERIAL NUMBER	MANUFACTURER
(9) ~~Component~~	VCPS	SV748720-1	1000	Hamilton Standard
(10) Assembly				
(11) Sub-Assembly				
(12) Part		Manufacturers Part Number		

(13) Malfunction Occurred During: 1 ☒ Qualification Test 2 ☐ Acceptance Test 3 ☐ Integration Test 5 ☐ Launch Operations 7 ☐ Bench Test 8 ☐ Post Launch

Reliability: 5/18

(14) Environment When Failed: 1 ☐ Acceleration 2 ☐ Shock 3 ☒ Thermal-Vacuum 4 ☐ Temperature 5 ☐ Humidity 6 ☐ Vibration 7 ☐ Ambient 8 ☐ Acoustic A ☐ RFI/ 0 ☐ Vacu

(15) Hardware Level When Failed: 1 ☐ Part 2 ☐ Sub-Assembly 3 ☐ Assembly 4 ☐ Component 5 ☒ System (VCPS) 6 ☐ Spacecraft

(16) REFERENCE

Spacecraft Log Book # ____ Page ____ Test Procedure SVHS 5619 Para 4.3.11

(17) Description of the Malfunction: VCPS was undergoing thermal verification testing at G. E., Valley F
per step 11 of Ref. Qual~~ity~~ Test Procedure. At the end of 2 hours, tank temp. was +11°F
and line temp. was -13°F. The required temp. is 40°F min. Unit was returned to HS (Win
Locks, Ct.) for continuation of Qual~~ity~~ Test (authorized by TWX GSFC to HS dated 5/12/72)
Target closure date is 7/15/72.

Closure responsibility E. K. Moore

Originator: M. Bonar Phone: (203) 623-1621 x494 Organization: Hamilton Standard

Do Not Write Below This Line

INSTRUCTIONS

(1) Originator – Fill in blocks (1) through (18), with all known information, as defined in instructions on the back of this form.

(2) Distribute copies in accordance with project directions.

GSFC MALFUNCTION REPORT

NO D 02909

oject: RAE-B

(2) Spacecraft

(3) Operation

(4) Units: HRS 1 ☐ CYS 2 ☐

stem or Experiment

(6) Date & Time of Malfunction: Yr 72 Mo 05 Day 09 Time

(7) Date of Report: Mo 05 Day 13

(8) Critical: YES 1 ☐ NO 2 ☐

NAME	IDENTIFICATION NUMBER	SERIAL NUMBER	MANUFACTURER
Component [illegible]	SV748720-1	→ 1009	Hamilton Standard
) Assembly			
) Sub-Assembly			
) Part	Manufacturers Part Number		

) Malfunction Occurred During: 1 ☒ Qualification Test 3 ☐ Integration Test 7 ☐ Bench Test 2 ☐ Acceptance Test 5 ☐ Launch Operations 8 ☐ Post Launch

Reliability: F.K. 5/18/72

) Environment When Failed: 1 ☐ Acceleration 2 ☐ Shock 3 ☒ Thermal-Vacuum 4 ☐ Temperature 5 ☐ Humidity 6 ☐ Vibration 7 ☐ Ambient 8 ☐ Acoustic A ☐ RFI/EMC 0 ☐ Vacuum

) Hardware Level When Failed: 1 ☐ Part 2 ☐ Sub-Assembly 3 ☐ Assembly 4 ☐ Component 5 ☒ System (VCPS) 6 ☐ Spacecraft

REFERENCE

raft Log Book # ______ Page ______ Test Procedure SVHS 5619 Para 4.3.11

Description of the Malfunction: [illegible] was undergoing thermal verification testing at G. E., Valley Forge
r [illegible] ~~Qual~~ Test Procedure. At the end of 2 hours, tank temp. was +11°F
d line temp. was -[illegible]°F. The required temp. is 40°F min. Unit was returned to HS (Windsor
Locks, Ct.) for continuation of ~~Qual~~ Test (authorized by TWX GSFC to HS dated 5/12/72).
[illegible] closure date is 7/15/72.
[illegible] Responsibility R. K. Moore

riginator: [illegible] Phone: [illegible] 623-1621 [illegible] Organization: Hamilton Standard

Not Write in This Space

ause of the Malfunction: A failure analysis of the VCPS thermal design was conducted at Hamilton
dard by comparing the reduced data from the thermal verification test to the original
mal model. The thermal model input parameters were varied until the model prediction
ely approximated the test results. This analysis yielded the following conclusions:
he tank temperature distribution and rapid loss of temperature was duplicated by shorting
internal tank thermal nodes together b) the tank nodes were shorted during the thermal

Not Write in This Space

~~XXXXXXXXXXXXXX~~ verification test via natural connection of the pressurant gas, internal
ation and propellant sloshing c) the convection and radiation phenomenon will exist under
nt condition and should be included in the thermal model d) the thermal properties of the
ellant line insulation would have to have been significantly poorer than expected by the
mal model to yield the test results. Tests subsequently performed on line insulation re-
from the VCPS confirmed that the insulation thermal properties were as poor as the VCPS

ctive Action is Required on Other Units, List Units by Serial No.

Not Write in This Space

Failure Analysis Performed? YES 1 ☒ NO 2 ☐ Organization That Performed Failure Analysis HSD
Failure Analysis Report Number ACS-2093-2.3-099 Date 31 Aug. 1972

Action Taken on Failed Unit: 1 ☒ Rework/Repair 2 ☒ Modified 3 ☐ Discarded 4 ☐ Replaced 5 ☐ None Date Aug. 1972
Organization That Performed Rework/Repair HSD

Is Retest Required? 1 ☒ Yes 2 ☐ No If Yes, State Retest Requirements Done - See above report

Retest Results: Satisfactory 1 ☒ Unsatisfactory 2 ☐ Remarks:

Unit May Be Used For: Flight 1 ☒ Test Only 2 ☐

Mo	Day	Date MR Closed	GSFC Project Approval	GSFC MRRT Approval	Date	Contractor Approval	Date
						Al Bauer	10/5/72

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GSFC MALFUNCTION REPORT

NUD 02

(1) Project RAE-B

(2) Spacecraft

(3) Operation

(4) U HRS 1 ☐

(5) System or Experiment

(6) Date & Time of Malfunction Yr. 72 Mo 05 Day 09 Time

(7) Date of Report Mo 05 Day 1

	NAME	IDENTIFICATION NUMBER	SERIAL NUMBER	MANUFACTURER
(9) Component	VCPS	SV718730-1	→ 1000	Hamilton Standard
(10) Assembly				
(11) Sub-Assembly				
(12) Part		Manufacturers Part Number		

(13) Malfunction Occurred During: 1 ☒ Qualification Test 3 ☐ Integration Test 7 ☐ Bench Test 2 ☐ Acceptance Test 5 ☐ Launch Operations 8 ☐ Post Launch

Reliability: F.R. 5/18

(14) Environment When Failed: 1 ☐ Acceleration 3 ☒ Thermal-Vacuum 5 ☐ Humidity 7 ☐ Ambient A ☐ RFI/E 2 ☐ Shock 4 ☐ Temperature 6 ☐ Vibration 8 ☐ Acoustic 0 ☐ Vacuu

(15) Hardware Level When Failed: 1 ☐ Part 3 ☐ Assembly 5 ☒ System (VCPS) 2 ☐ Sub-Assembly 4 ☐ Component 6 ☐ Spacecraft

(16) REFERENCE

Spacecraft Log Book # ____ Page ____ Test Procedure SVHS 5619 Para 4.3.11

(17) Description of the Malfunction: VCPS was undergoing thermal verification testing at G. E., Valley Fo
per step 11 of Ref. Qual Test Procedure. At the end of 2 hours, tank temp. was [illegible]
and line temp. was [illegible]. The required temp. is 40°F min. Unit was returned to HS (Wind
Locks, Ct.) for continuation of Qual Test (authorized by TWX GSFC to HS dated 5/12/72)
Target closure date is 7/15/72.
Closure responsibility R. K. Moore

(18) Originator: M. Bomar, [illegible] Phone: (203) 623-1621 x[illegible] Organization: Hamilton Standard

Do Not Write in This Space

(19) Cause of the Malfunction: (continued)

test results indicated. Hamilton then conducted a series of development tests on various li
insulation configurations. It was found that line insulation could be manufactured and
assembled with substantially improved thermal characteristics but that it would require addi
tional line heater power even when the best line insulation configuration was used.

Do Not Write in This Space

(20) Corrective Action Taken: Agreement was then reached with NASA to proceed with the following action:
a) determine by analysis any changes to the tank thermal design required to maintain proper
flight temperatures b) remove and replace the line insulation with the best available config
ration c) replace the thermocouple instrumentation with G.F.E. thermistors d) rewire the pro
pellant line heaters to provide 1 watt heat input to each line e) conduct a thermal vacuum t
on the VCPS propellant line, simulating worst case specification with zero sun input. The t

If Corrective Action is Required on Other Units, List Units by Serial No. (#20 continued on attached sheet)

Do Not Write in This Space

(21) Failure Analysis Performed? YES 1 ☒ NO 2 ☐ Organization That Performed Failure Analysis HSD
Failure Analysis Report Number ACS-2093-2.3-099 Date 31 Aug. 197

(22) Action Taken on Failed Unit: 1 ☒ Rework/Repair 2 ☒ Modified 3 ☐ Discarded 4 ☐ Replaced 5 ☐ None Date Aug. 1972
Organization That Performed Rework/Repair HSD

(23) Is Retest Required? 1 ☒ Yes 2 ☐ No If Yes, State Retest Requirements Done - See above report

(24) Retest Results: Satisfactory 1 ☒ Unsatisfactory 2 ☐ Remarks:

(25) Unit May Be Used For: Flight 1 ☒ Test Only 2 ☐

Yr	Mo	Day	Date MR Closed	GSFC Project Approval	GSFC MRRT Approval	Date	Contractor Approval	Date
							W Bauer	10/5/7

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Page 2 cont'd Copy

GSFC MALFUNCTION REPORT

NO D 02909

oject RAE-B	(2) Spacecraft	(3) Operation	(4) Units HRS 1 ☐ CYS 2 ☐	
stem or Experiment	(6) Date & Time of Malfunction: Yr 72 Mo 05 Day 09 Time	(7) Date of Report: Mo 05 Day 13	(8) Critical YES 1 ☐ NO 2 ☐	

NAME	IDENTIFICATION NUMBER	SERIAL NUMBER	MANUFACTURER
~~Component~~ CPS	SV 748720-1	1000	Hamilton Standard
) Assembly			
) Sub-Assembly			
) Part	Manufacturers Part Number		

) Malfunction Occurred During: 1 ☒ Qualification Test 2 ☐ Acceptance Test 3 ☐ Integration Test 5 ☐ Launch Operations 7 ☐ Bench Test 8 ☐ Post Launch Reliability: H.R. 5/18/72

) Environment When Failed: 1 ☐ Acceleration 2 ☐ Shock 3 ☒ Thermal-Vacuum 4 ☐ Temperature 5 ☐ Humidity 6 ☐ Vibration 7 ☐ Ambient 8 ☐ Acoustic A ☐ RFI/EMC 0 ☐ Vacuum

) Hardware Level When Failed: 1 ☐ Part 2 ☐ Sub-Assembly 3 ☐ Assembly 4 ☐ Component 5 ☒ System (VCPS) 6 ☐ Spacecraft

REFERENCE

raft Log Book # ____ Page ____ Test Procedure SVHS 5619 Para 4.3.11

Description of the Malfunction: VCPS was undergoing thermal verification testing at G. E., Valley Forge
r step 11 of Vac. Qual Test Procedure. At the end of 2 hours, tank temp. was +11 F
d line temp. was -??F. The required temp. is 40°F min. Unit was returned to HS (Windsor
cks, Ct.) for continuation of the ~~[illegible]~~ Test (authorized by TWX GSFC to HS dated 5/22/72).
rget closure date is 7/15/72.
Closure responsibility by [illegible]. K. Moore

riginator: M. Bemar, [illegible] | Phone: (203) 623-1621 x494 | Organization: Hamilton Standard

o Not Write in This Space

~~XXXXXXXXXXXXXX~~ (#20 continued) analysis indicated that the proper temperature range would
maintained if the proper emittance to absorbence ratio is selected. The proper α/ϵ ratio
achieved by covering 56% of the tank black paint strip area with vapor deposited gold
on tape. With the propellant tanks modified in this way, the min 60° cruise temperature is
ulated to be 96°F with a 50°F min temp. during the 2 hr. dark transient. VCPS propellant
es were reinsulated and the line heaters rewired in accordance with E.C. E40500-64. The

o Not Write in This Space

~~XXXXXXXXX~~ thermal vacuum test was performed and test data analyzed. The minimum
temperatures under any flight is calculated to be 51°F. This Malfunction Report is
sed on the basis of the above action and the acceptance of Hamilton Standard Thermal Report
-2093-2.3-099.

ective Action is Required on Other Units, List Units by Serial No.

o Not Write in This Space

1) Failure Analysis Performed?	YES 1 ☒ NO 2 ☐ Organization That Performed Failure Analysis HSD Failure Analysis Report Number ACS-2093-2.3-099 Date 31 Aug. 1972
2) Action Taken on Failed Unit	1 ☒ Rework/Repair 2 ☒ Modified 3 ☐ Discarded 4 ☐ Replaced 5 ☐ None Date Organization That Performed Rework/Repair HSD
3) Is Retest Required?	1 ☒ Yes 2 ☐ No If Yes, State Retest Requirements Done - See above report
4) Retest Results	Satisfactory 1 ☒ Unsatisfactory 2 ☐ Remarks:
5) Unit May Be Used For	Flight 1 ☒ Test Only 2 ☐

Mo	Day	Date MR Closed	GSFC Project Approval	GSFC MRRT Approval	Date	Contractor Approval	Date
							10/5/72

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APPENDIX C

VIBRATION REPORT

HBF 1436 6/67

SLS TEST ENGINEERING
TEST REPORT

FILE CODE TER 2762

DATE

PROGRAM RAE-B **TEST ITEM** SV748720 **S/N** 1

NAME OF TEST QUAL. VIBRATION **DATE OF TEST** 4/15 - 4/18/72

TEST SPECIFICATION SVHS 5619 **TEST PLAN**

CONCLUSIONS

RECOMMENDATIONS (OPTIONAL)

OBSERVATIONS (OPTIONAL) INCLUDED HERE ARE ACCELEROMETER RESPONSE CURVES, LOG SHEETS AND PHOTOS OF ABOVE VIBRATION TEST.

TOTAL TEST TIME

ENDURANCE CYCLES

ORIGINAL COPY

CC: CHIEF OF RELIAB./CHIEF OF DESIGN
TEST ENGINEERING FILE

TEST ENGINEER WESMITH **APPROVED/DATE** R. Mero 6/20/72

SIGNATURE WESmith

DATE 6/20/72

Memo File Code RAEB-VCPS-1212

Memorandum to:

Page 1 of 3

Program RAE-B

Test Item(s) VCPS

Date of Test 4-15/4-18-72

Serial No.(s) 00001

Name of Test QUALIFICATION

Specification AT-VCPS

Subject:

THE ABOVE ITEM WAS VIBRATED AT HSD ON RIG 26 IN A LOADED AND PRESSURIZED CONDITION. THE VCPS WAS MOUNTED ON FIXTURE SVSK 79594. PORTIONS OF THE TESTING WERE PERFORMED WITH THE VCPS ONLY AND OTHERS WERE PERFORMED WITH THE SPACECRAFT MOUNTED TO THE VCPS.

CONCLUSION:) THE VCPS CAN WITHSTAND THE SPECIFIED VIBRATION WITH NO SIGNS OF STRUCTURAL DEGRADATION WHILE LOADED WITH 45±0.5LBS HIGH PURITY WATER, AND PRESSURIZED TO 260± PSIA GN_2.

CON'T

Test Engineer S. MEHMED JR

Signature Sami Mehmed Jr

Date of Report 5-12-72

Approved Paul J. Malsch

Date May 12, 1972

DEVIATIONS:

1) RESPONSE DATA FROM LOCATION [HZ], PRESSURE TRANSDUCER MOUNT, TEST 14 LOOKS VERY QUESTIONABLE AS SHOWN BY TRACE 49. THE ACCELEROMETER AT LOCATION [HZ] WAS NOT DAMAGED OR UNFASTENED, HOWEVER THE SIGNAL SHOWN ON TRACE 49 REPRESENTS NOISE ONLY.

2) TEST 16, TRACE 60 REPRESENTING LOCATION [HZ] MUST BE QUESTIONED SINCE TRACE 49 DOES NOT LOOK REALISTIC. TRACE 60 HOWEVER DOES APPEAR TO REPRESENT A REALISTIC LEVEL

3) TEST Nº 16 WAS ACCEPTED BY NASA REPRESENTIVE, MR M. CALABRESE, AFTER THE FOLLOWING OVERTEST OCCURRED. (I.O.C. ACCEPTING THE TEST IS INCLUDED IN THE REPORT). SUBJECTED TEST ITEM TO ±6.2 GPK FROM 23-27HZ AND ±2.9GPK AT 82HZ. THE CAUSE WAS DUE TO A MALFUNCTION IN THE ELECTRONIC SWEEP/HOLD CONTROL LOGIC.

4) TEST 10, TRACE 23, LOCATION [BY] DATA WAS NOT SECURED BECAUSE THE ACCELEROMETER LOOSENED FROM ITS ATTACHMENT POINT.

CON'T

DEVIATIONS CON'T

5) A REDUCED CONTROL CURVE FOR TEST Nº 7, Y AXIS, IS NOT INCLUDED. THE INFORMATION WAS NOT RECORDED FOR THIS TEST BECAUSE THE DATA PATCH CORD WAS NOT PROPERLY CONNECTED TO THE RECORDER INPUT

6) TEST NUMBER 17 AND TEST NUMBER 10 TRACES 24 AND 13 RESPECTIVELY INDICATED TOLERANCE DEVIATIONS AT 60 HZ AND 120 HZ. THESE DEVIATIONS WERE CAUSED BY 60 HZ NOISE WHICH WAS NOT DETECTED DURING THE TEST.

RESULTS:

1) THE SPACECRAFT C.G. DID NOT EXCEED ±4.5 GPK DURING TESTING BETWEEN 16 AND 23 HZ AS LIMITED BY THE SPECIFICATION.

2) THE SPACECRAFT C.G DID EXCEED ±4.5GPK AS SHOWN ON TRACE 24 TEST 7 ONLY.

3) NO VISIBLE STRUCTURAL DAMAGE WAS DETECTED.

Table of Contents

Section I

Test Background

A) Instrumentation and Calibration List

B) Block Diagram of Test System

C) Illustration of Item & Transducer Location

D) Random Analysis Outline

LABORATORY OPERATIONS ENGINEERING
TEST EQUIPMENT
RIG 26 MB C210

ITEM	MANUFACTURER	ACCURACY	MODEL	S/N
Signal Conditioner	Unholtz-Dickie	±2%	610RM-3	133
Signal Conditioner	Unholtz-Dickie	±2%	610R	202
Logarithmic Converter	Moseley	±5%	N165-T2	451
Logarithmic Converter	Moseley	±5%	7561A	825-00944
Exciter Control	MB Electronics	±4%	N575/576	142
*Differential AC/DC Voltmeter	John Fluke	±0.05%	803BR	582
Wide Range Oscillator	Hewlett Packard	±2%	200CDR	229-45434
Oscilloscope	Hewlett Packard	±5%	130C	3200-1326
*Counter	Anadex	±1 Count	CF200R	2933
Dynamic Analyzer	Spectral Dynamics	Linearity ±3% D.C. Out ±0.25db Filter Sig.±0.25db	SD101A	233
*Spectral Density Voltmeter	Ballantine	±2%	321	866
X-Y Plotter	Moseley	±5%	135	1542
X-Y Plotter	Hewlett Packard	±5%	7030A	823-01313
Dynamic Analyzer	Spectral Dynamics	±0.25db Log D.C.	SD101B	39
Sine Wave Center	Ling Electronics		SCO-100	39

Standard Calibration Period - Entire system 2 months and also item * are 4 months.

TEST EQUIPMENT (cont'd)
RIG 26 MB C210

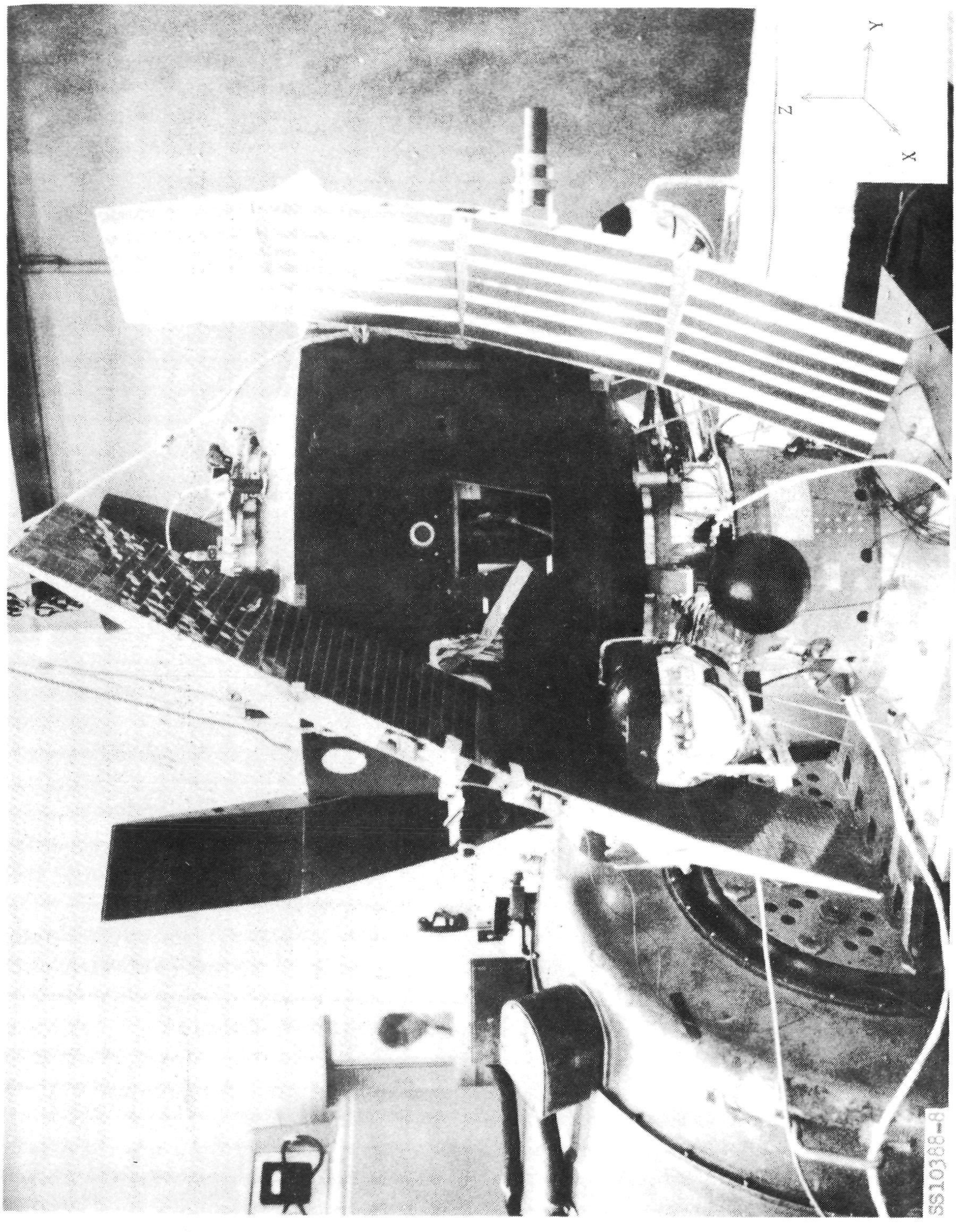
ITEM	MANUFACTURER	MODEL	S/N
Galvanometer Amplifier	Honeywell	T66A-500	6-3373
Attenuator	Hewlett Packard	350A	E11060
Constant Level Output Adapter	Spectral Dynamics	SD11	39
Tape Junction Unit	HSD	B	1
Oscilloscope	Tektronix	RM561-A	009168
Time Base Horiz. Plug-In	Tektronix	2B67	016133
Four Trace Vert. Amp. Plug In	Tektronix	3A74	003197
Spectrum Equalizer	Ling Electronics	SE80D	113
Spectrum Equalizer	Ling Electronics	SE80C	114
Channel Mode Selector	Ling Electronics	CM40B	271
Low Frequency Equalizer	Ling Electronics	5LF-8A	174
Manual Selector Switch	Ling Electronics	SSM-100A	114
Channel Mode Selector	Ling Electronics	CM40B	263
Control Panel	Ling Electronics	CP-10B	170
Driver Amplifier	Ling Electronics	A-10	165
Dual Noise Generator	Ling Electronics	GRN200B	167

TEST EQUIPMENT (cont'd)
RIG 26 MB C210

ITEM	MANUFACTURER	MODEL	S/N
Meter Range Selector	Ling Electronics	MR40B	282
Meter Range Selector	Ling Electronics	MR40B	278
Power Distribution	Ling Electronics	PB10	162
Displacement Limiter	MB Electronics	N20	429
Multiple Level Control	MB Electronics	N661	340
Multiple Channel Amplifier	MB Electronics	N270	401
Equalizer By-Pass	MB Electronics	N322	586
Control Panel	MB Electronics	N619	344
Amplitude Protector Control	MB Electronics	N56	481
Null Meter Panel	MB Electronics	N152	315
Power Supply	MB Electronics	N138	168
Amplifier	MB Electronics	5140	302
Exciter	MB Electronics	C210	251
Low Pass Filter	MB Electronics	N171	360
Power Supply	Ling Electronics	APS102	32
Power Supply	Ling Electronics	APS10A	165
Power Supply	Ling Electronics	APS1130	113
Power Supply	Ling Electronics	APS103	27
Spectrum Analyzer	Ling Electronics	SA100	162CAB-A
Spectrum Analyzer	Ling Electronics	SA100	162CAB-B

TEST EQUIPMENT
RIG 26 MB C210 (cont'd)

ITEM	MANUFACTURER	MODEL	S/N
Master Schedule Selector	MB Electronics	N230	397
Signal Selector	MB Electronics	N151-T1	587
Signal Selector	MB Electronics	N151-T1	616
Tape Recorder	Ampex	FR1200	122-0301
Visicorder	Honeywell	1508	15-2098
Galvanometer Amplifier	Honeywell	T66A-500	6-3383
Signal Selector	MB Electronics	N151-T1	586
Waveform Synthesizer	Exact	20	375
Power Supply	MB Electronics	N141	135
Transducer Excitation	ENDEVCO	SR1000EP	MB01
Multiple Channel Scanner	MB Electronics	N280-T2	403
Power Selector	MB Electronics	N320	215
Power Amplifier	MB Electronics	N290	467
Peak Notch Equalizer	MB Electronics	N20	722
Master Control Panel	MB Electronics	N240	579
Variable Gain Amplifier	MB Electronics	N310	434
X-Y Recorder Input Selector	MB Electronics	N74	317



TYPICAL TEST SETUP

C2

Hamilton Standard
DIVISION OF UNITED AIRCRAFT CORP
UA

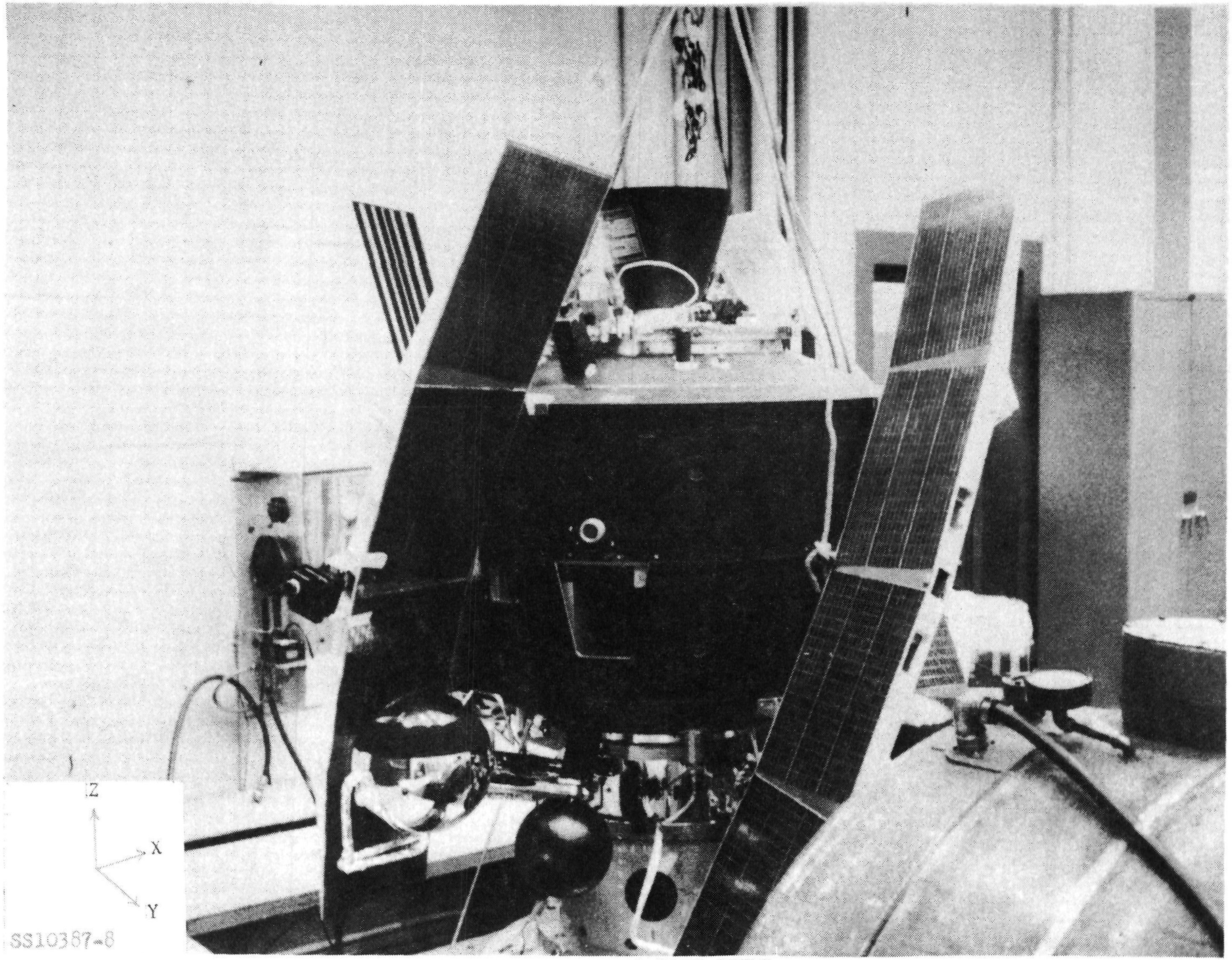
Laboratory Operations Engineering

TEST EQUIPMENT

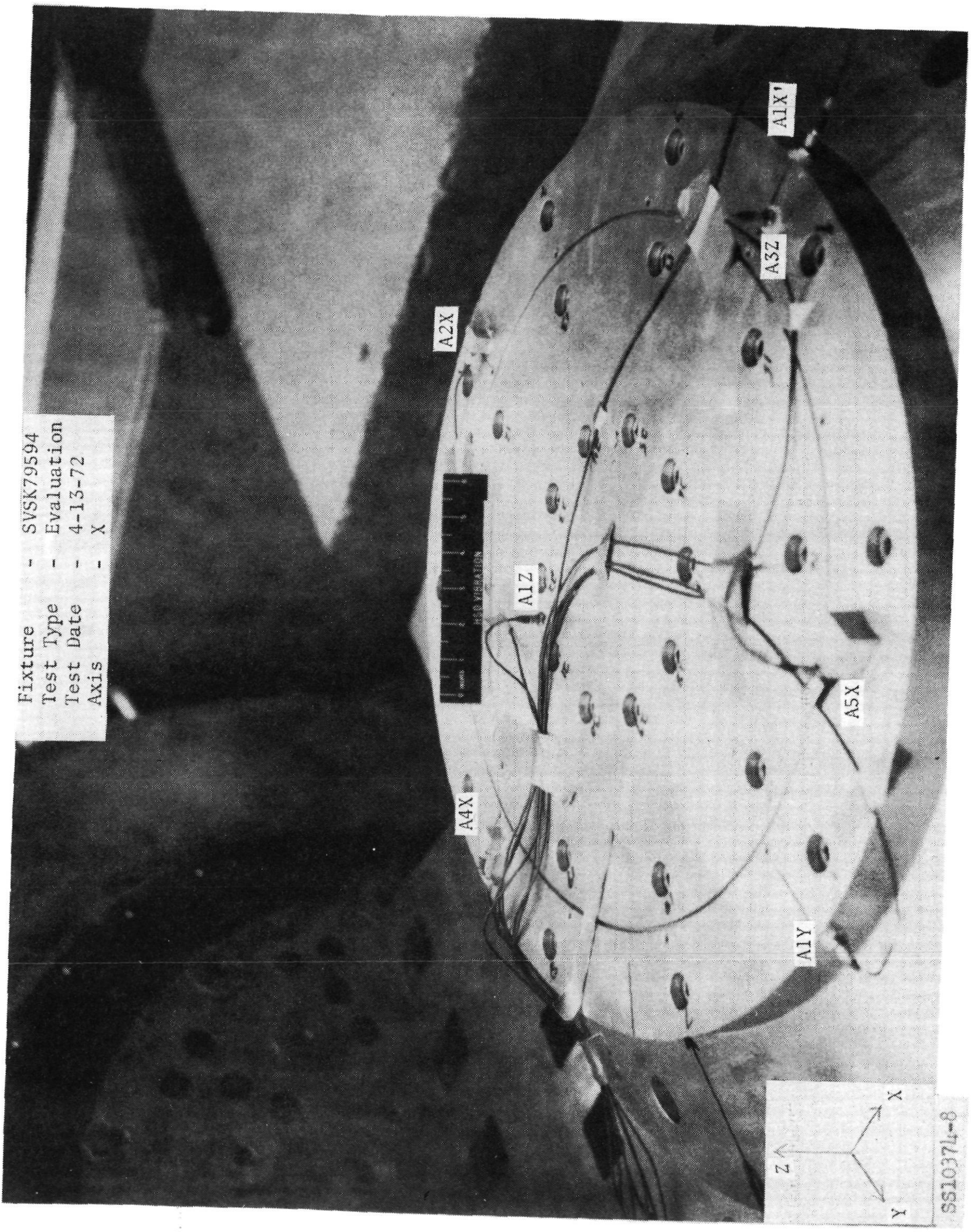
Item	Manufacturer	Accuracy	Model	S/N	Calibrated	
Accelerometer	**Endevco**	**±2%**	2226	NB62	3-20-72	A
Accelerometer	**Endevco**	**±2%**	2226	TD40	3-9-72	A
Accelerometer	**Endevco**	**±2%**	2226	TE83	3-20-72	A
Accelerometer	**Endevco**	**±2%**	2226	TD44	3-20-72	A
Accelerometer	**Endevco**	**±2%**	2226	TG75	3-20-72	A
Accelerometer	**Endevco**	**±2%**	2226	WR11	3-9-72	A
Accelerometer	**Endevco**	**±2%**	2226	TD45	3-9-72	A
Accelerometer	**Endevco**	**±2%**	2226	TD48	3-9-72	A
Accelerometer	**Endevco**	**±2%**	2226	TG74	3-9-72	A
Accelerometer	**Endevco**	**±2%**	2222	XM21	4-10-72	A
Accelerometer	Endevco	±2%	2222	YK20	4-10-72	A
Accelerometer	Endevco	±2%	2222	XN32	4-10-72	A
Accelerometer	Endevco	±2%	2222	XJ29	4-10-72	A
Accelerometer	Endevco	±2%	2222	RN81	3-23-72	A
Accelerometer	Endevco	±2%	2222	WF75	4-10-72	A
Accelerometer	Endevco	±2%	2215	VG57	3-9-72	A
Accelerometer	Endevco	±2%	2215	VH49	3-9-72	
Accelerometer	Endevco	±2%	2215	WH97	3-9-72	
Accelerometer	Endevco	±2%	2215	VH46	3-9-72	

Standard calibration period is 2 months.

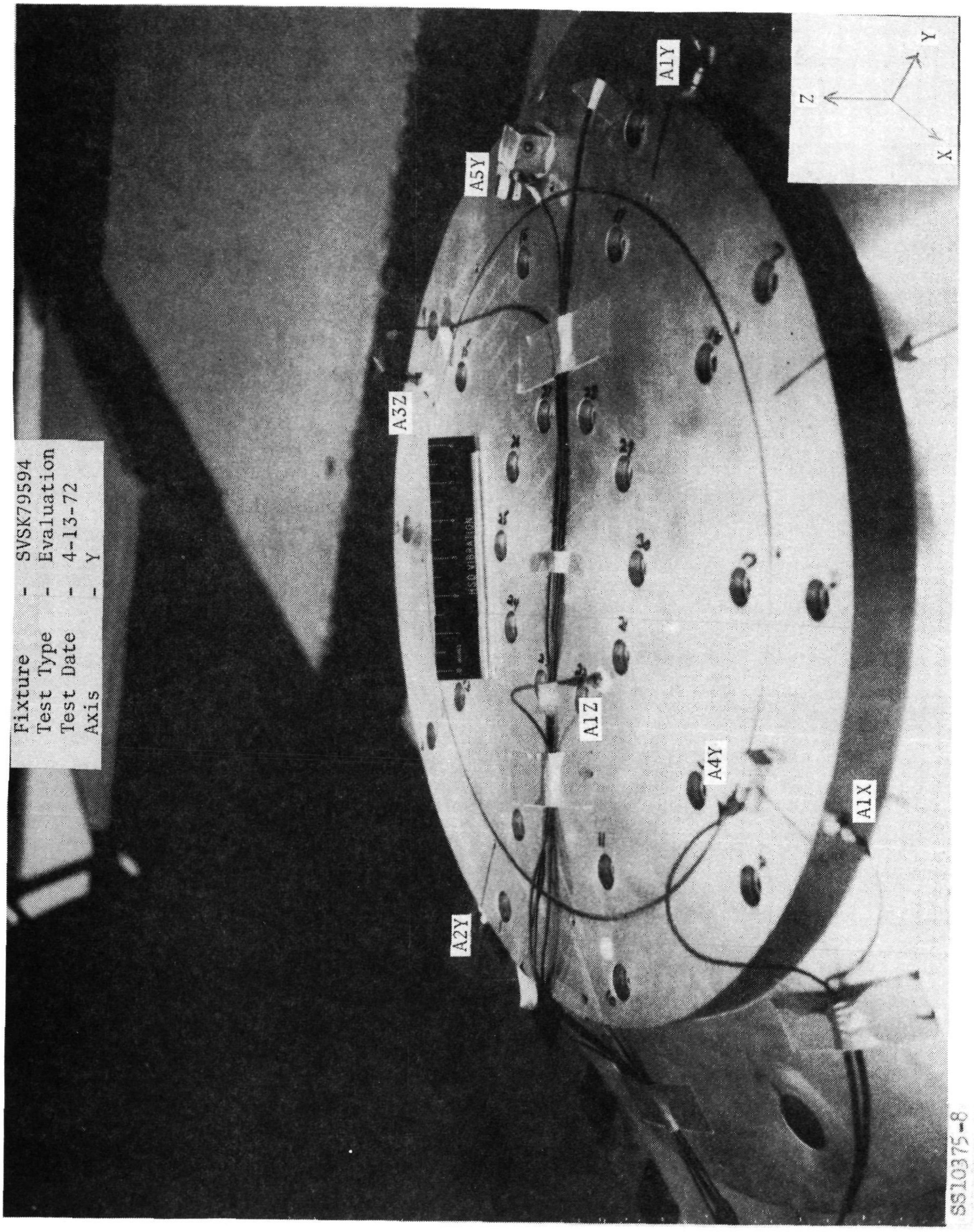
A = Used for this test.

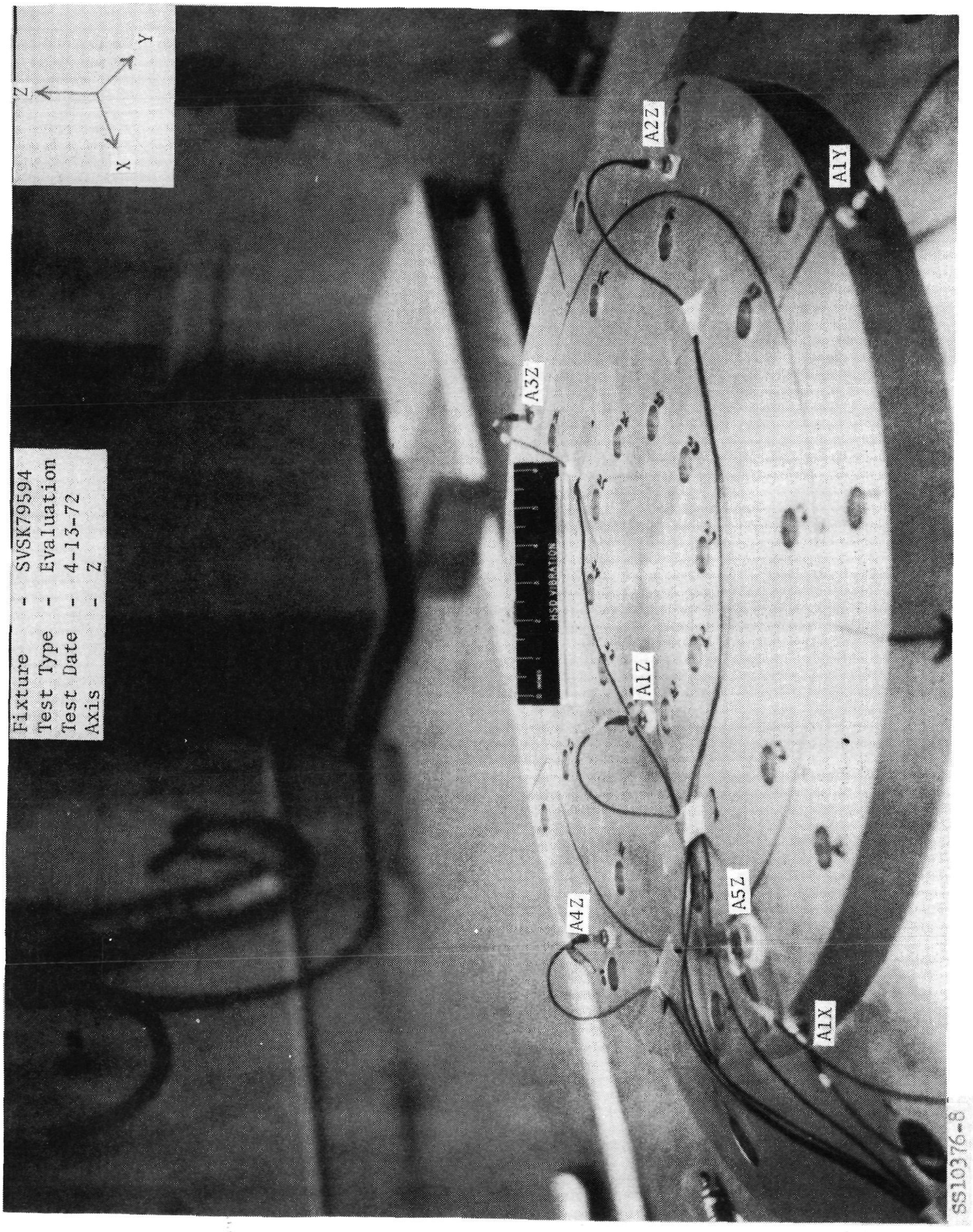


TYPICAL TEST SETUP

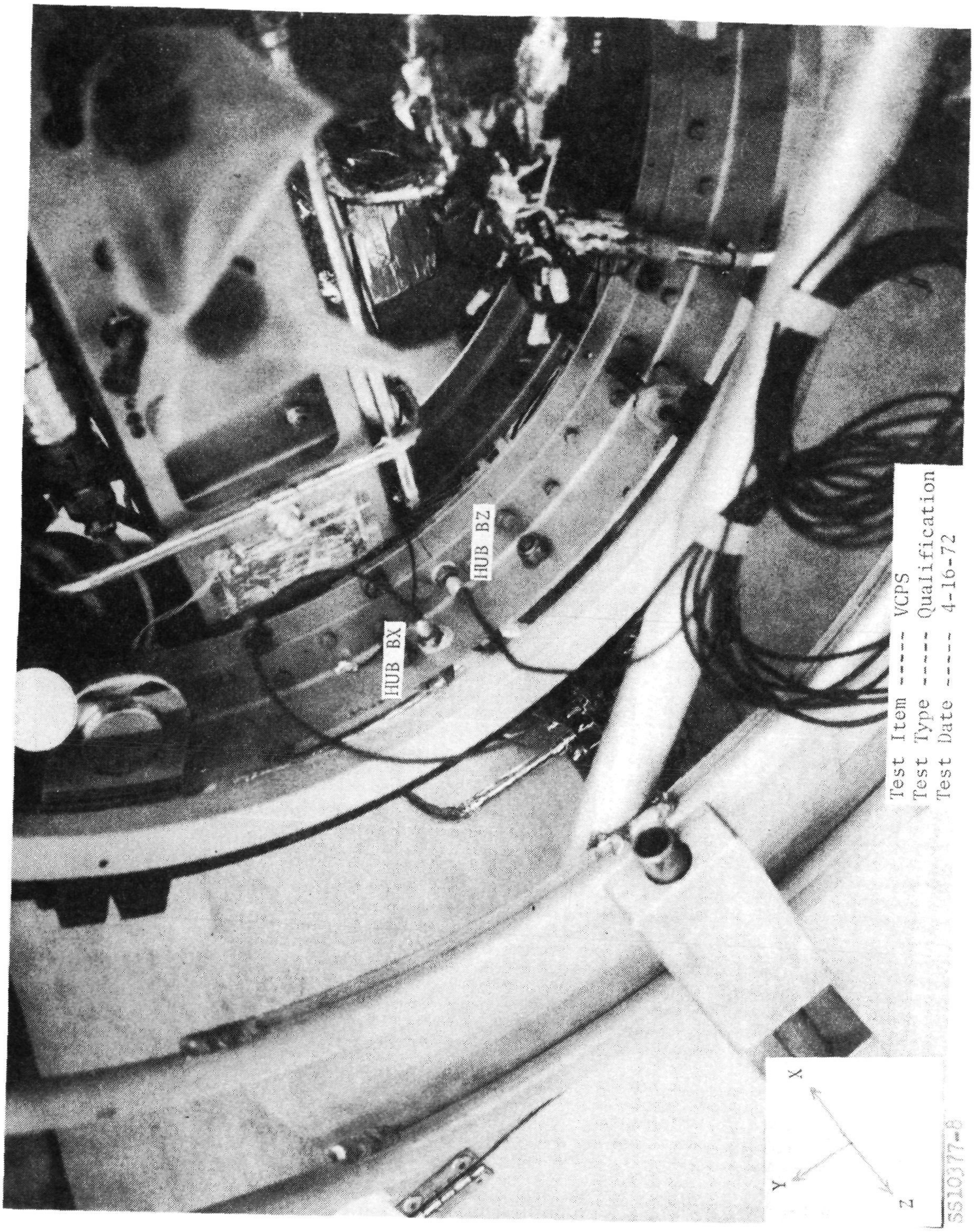


Fixture - SVSK79594
Test Type - Evaluation
Test Date - 4-13-72
Axis - X


Fixture - SVSK79594
Test Type - Evaluation
Test Date - 4-13-72
Axis - Y
A1Y
A5Y
A3Z
A1Z
A4Y
A1X
A2Y
Z
Y
X
SS10375-8



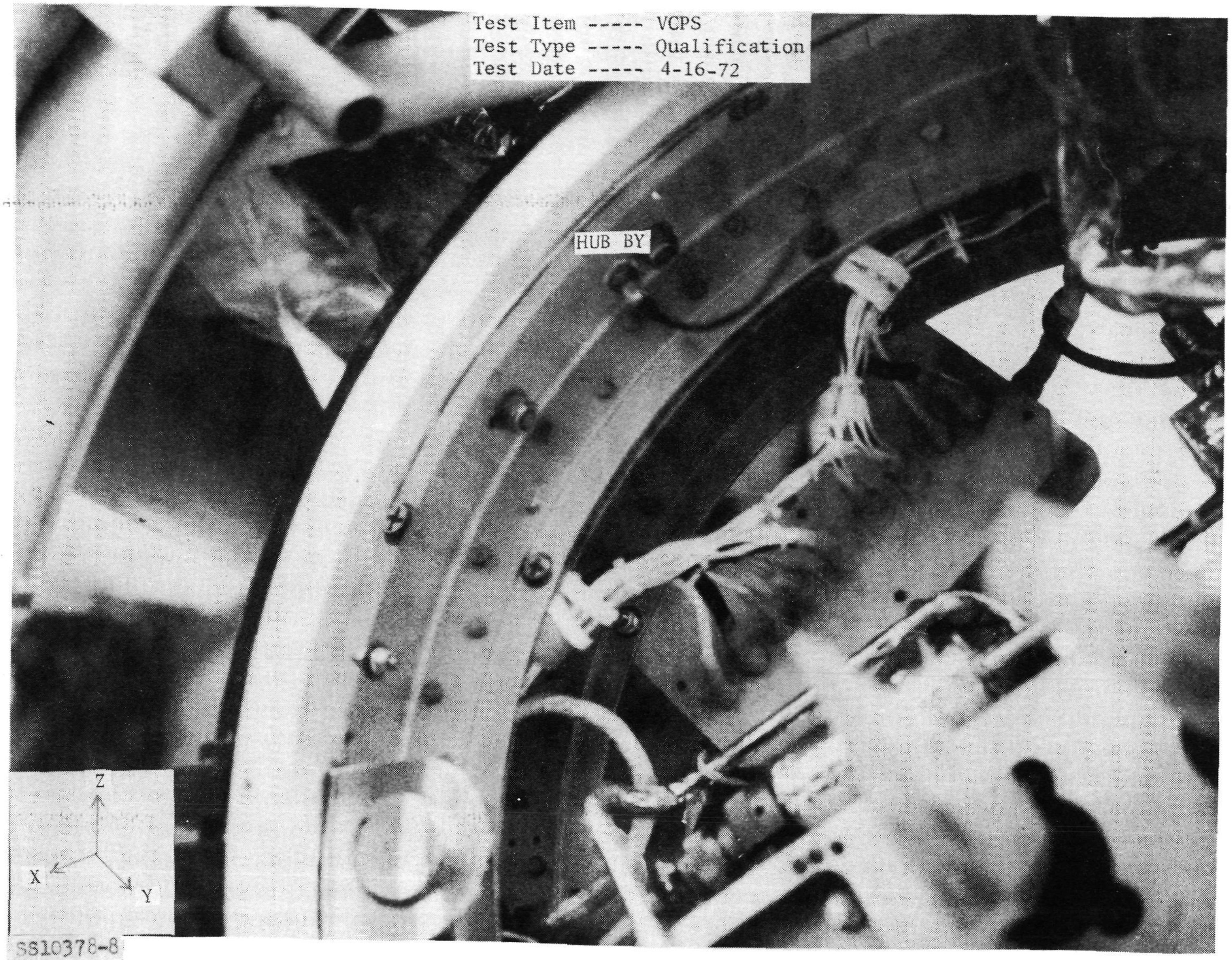
Fixture - SVSK79594
Test Type - Evaluation
Test Date - 4-13-72
Axis - Z



Test Item ----- VCPS
Test Type ----- Qualification
Test Date ----- 4-16-72

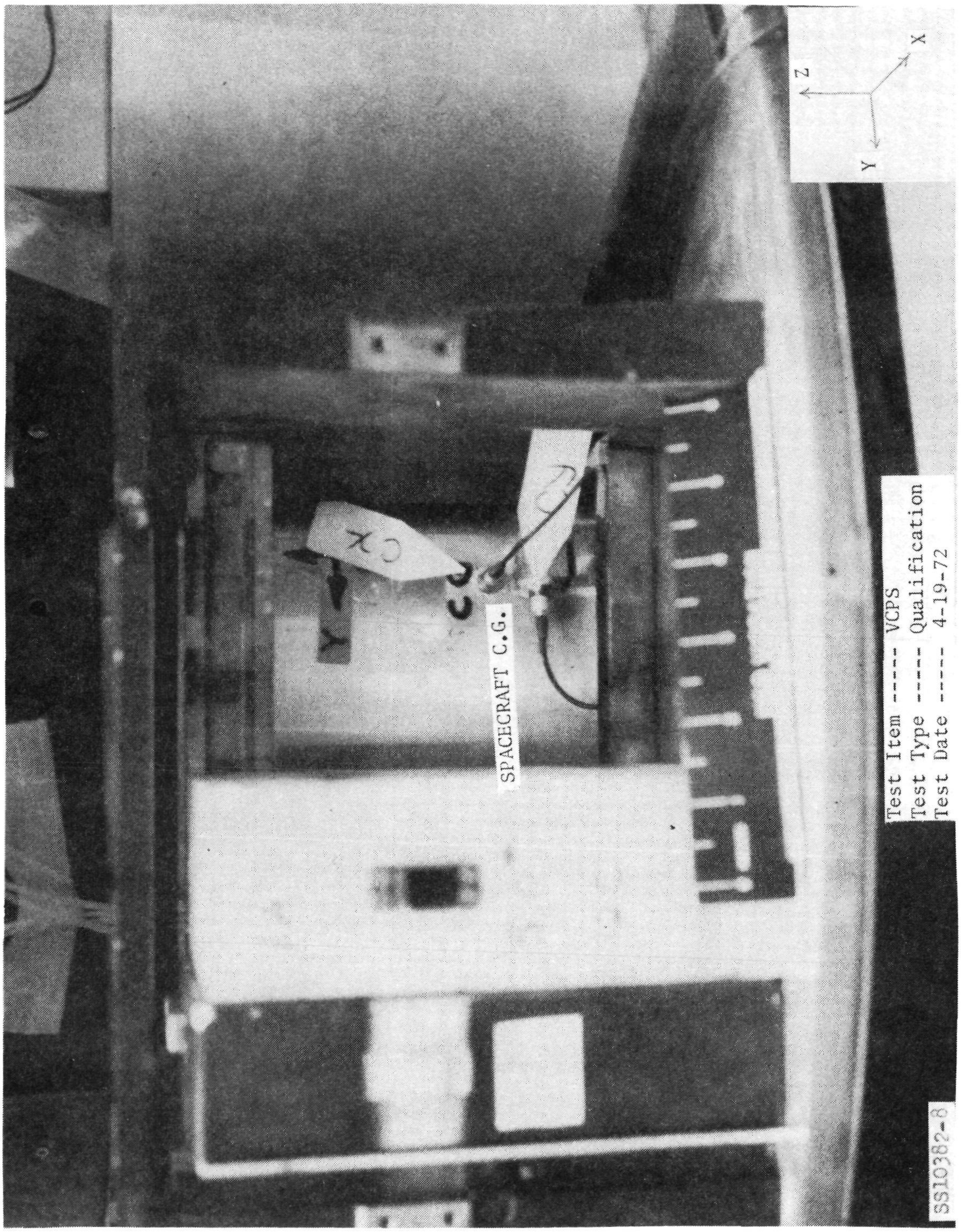
95<

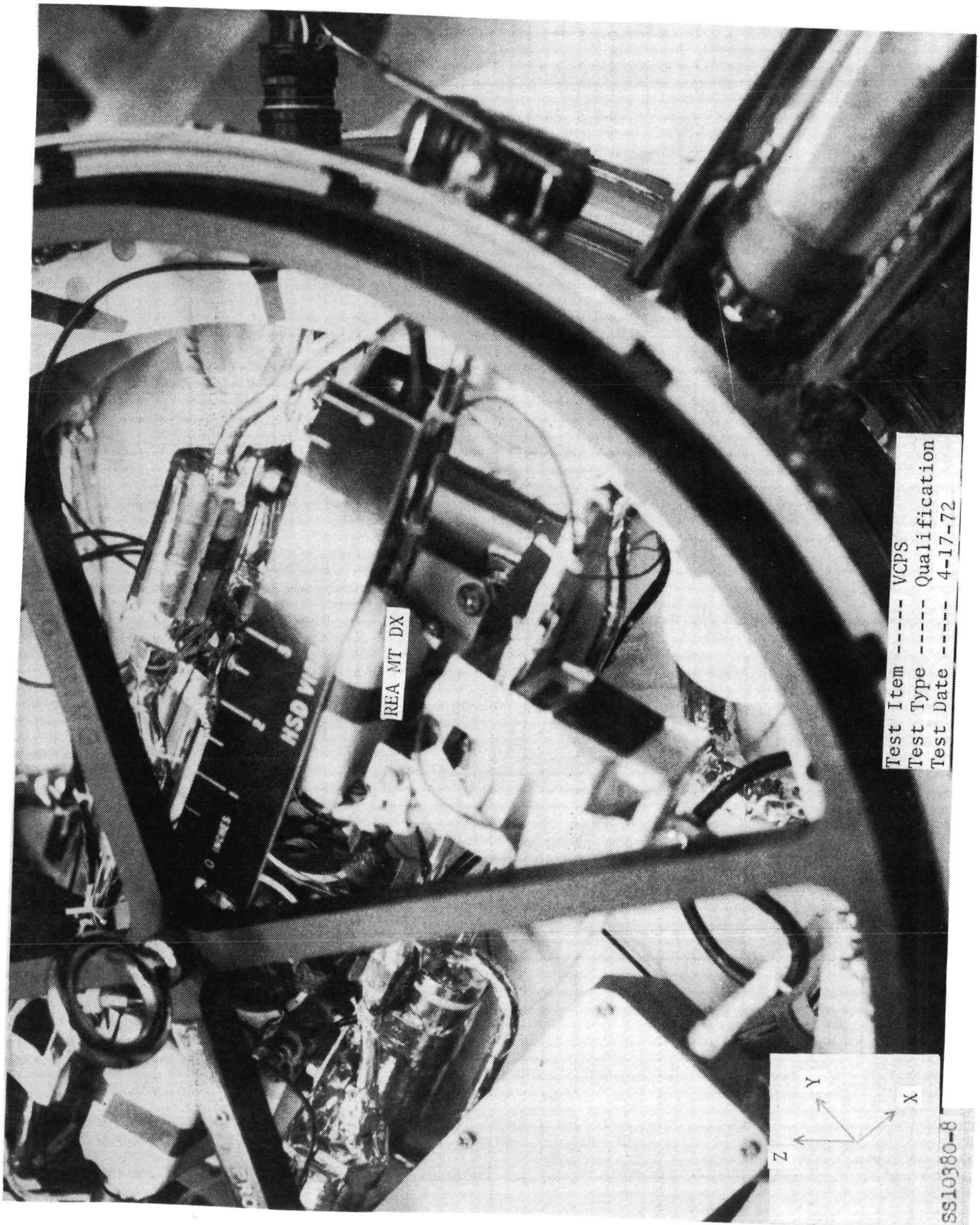
C14



Test Item ----- VCPS
Test Type ----- Qualification
Test Date ----- 4-16-72

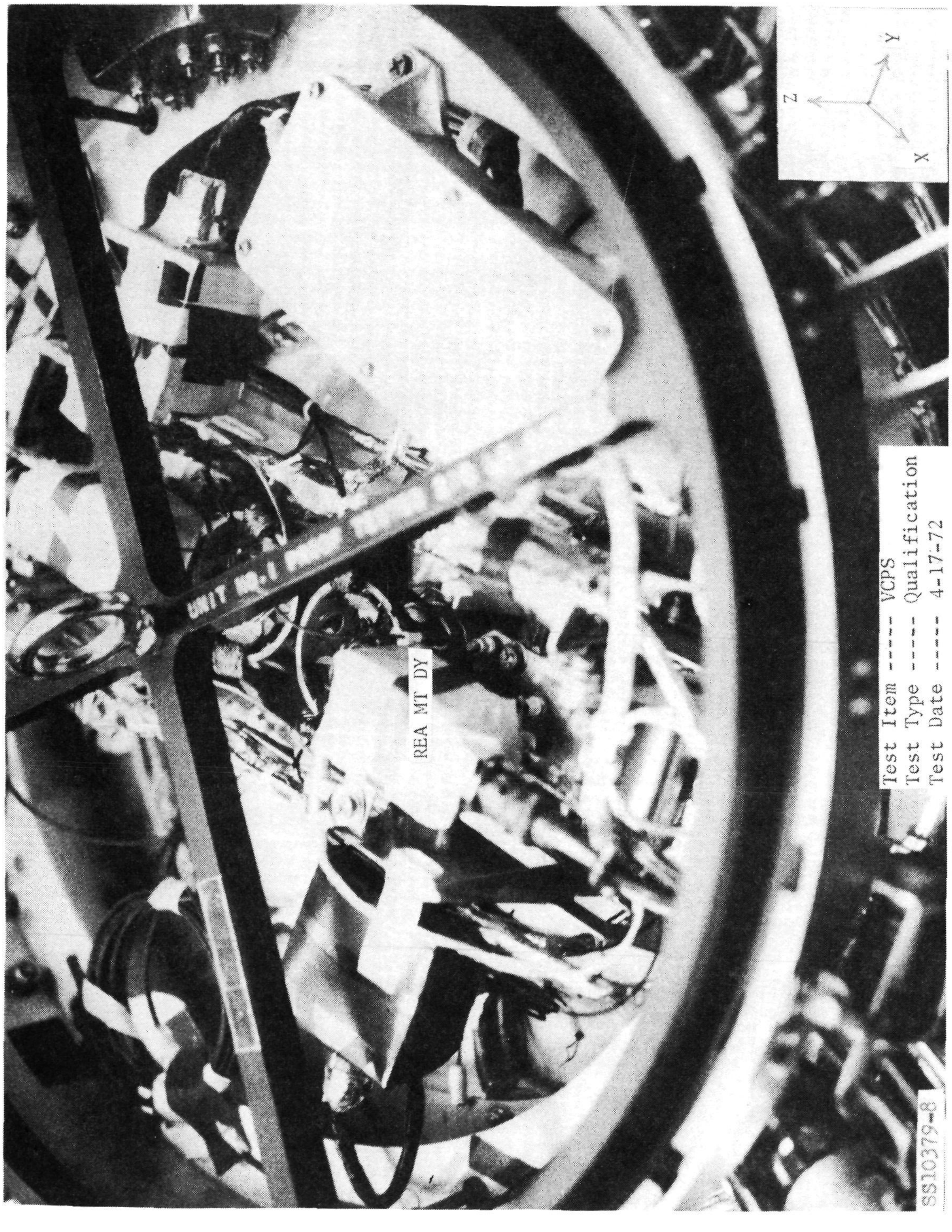
SS10378-8

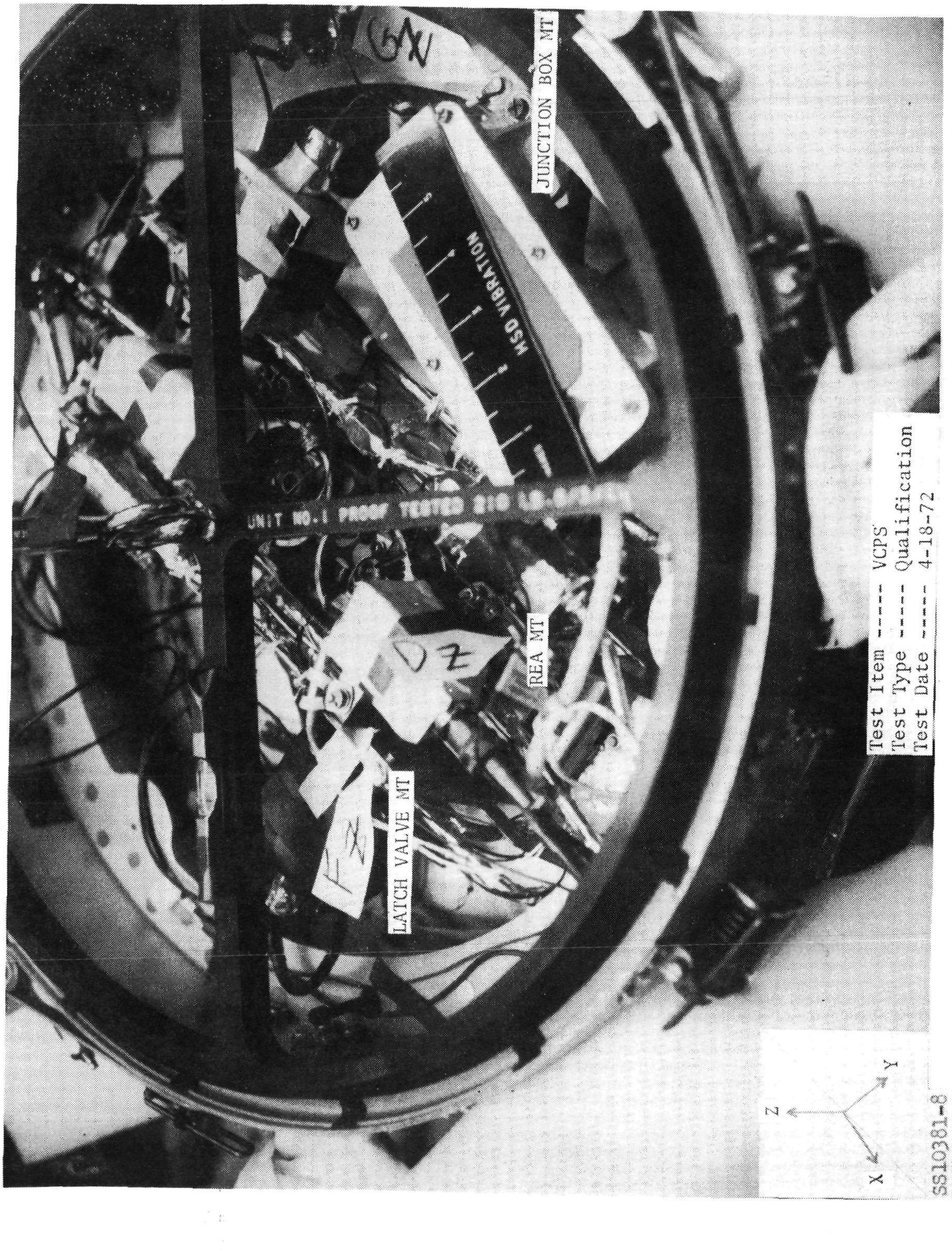

Z
X
Y
C X
Y
SPACECRAFT C.G.
Test Item ----- VCPS
Test Type ----- Qualification
Test Date ----- 4-19-72
SS10382-8



Test Item ----- VCPS
Test Type ----- Qualification
Test Date ----- 4-17-72

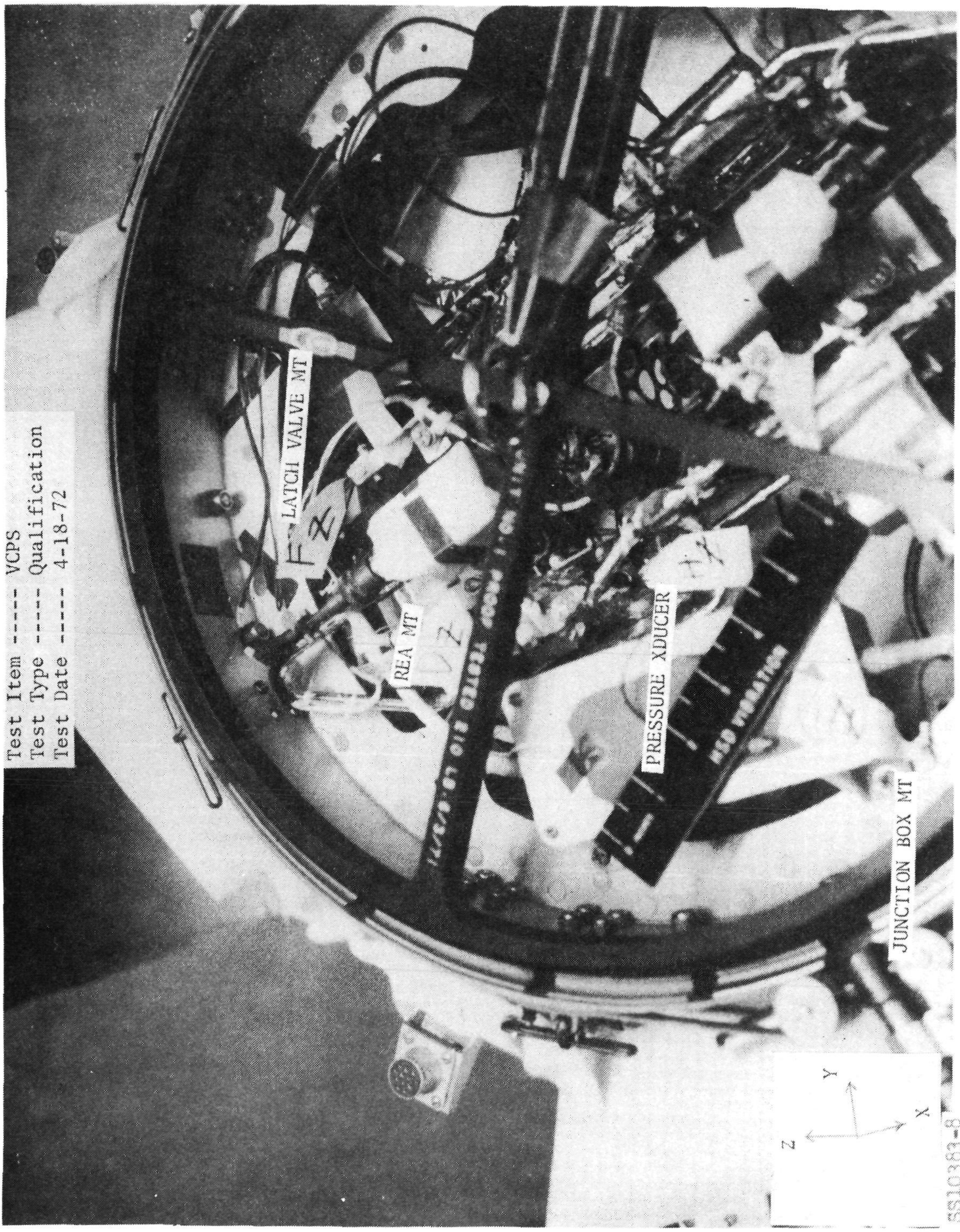
SS10380-8


Z
Y
X
UNIT NO. 1
REA MT DY
Test Item ----- VCPS
Test Type ----- Qualification
Test Date ----- 4-17-72
SS10379-8

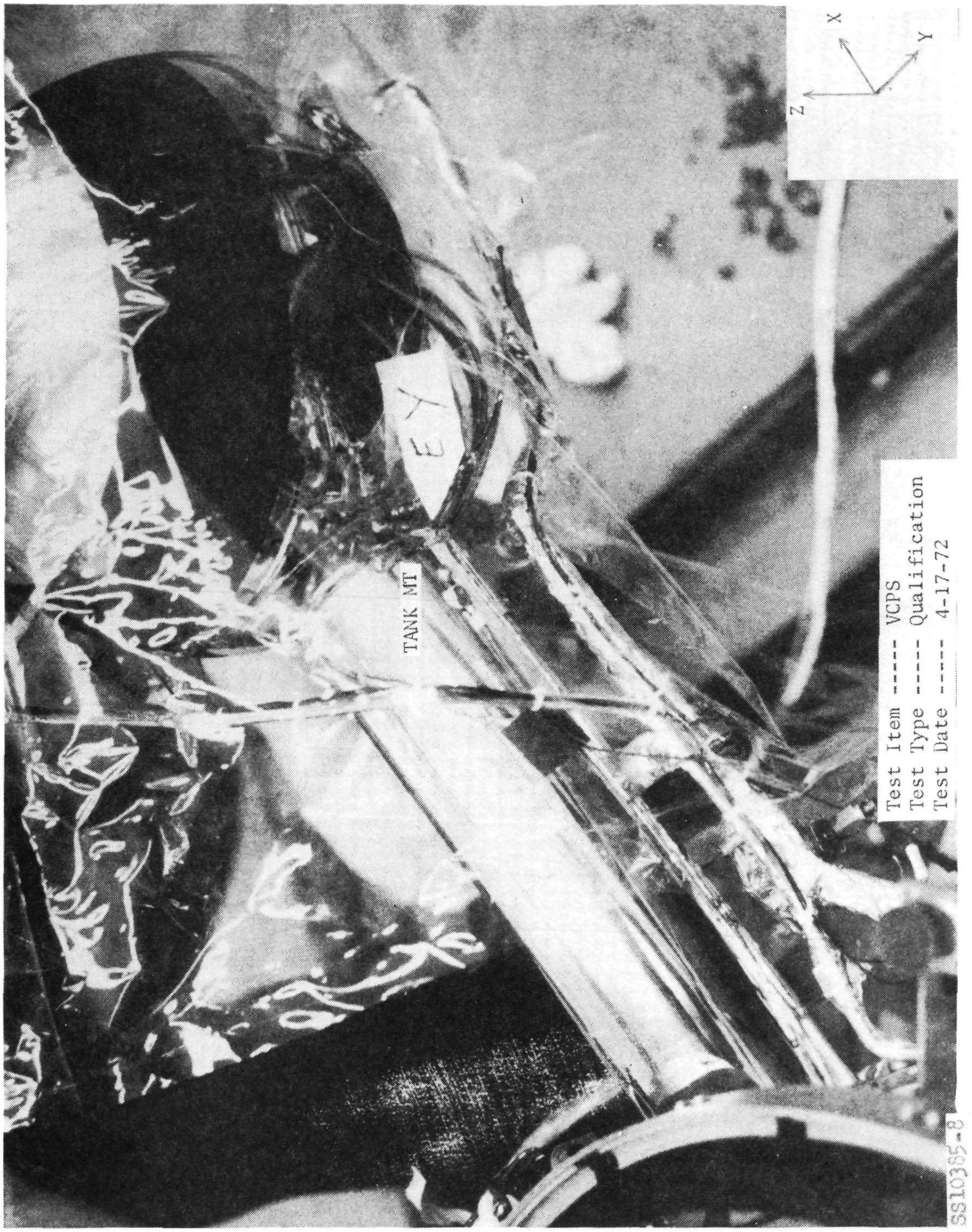


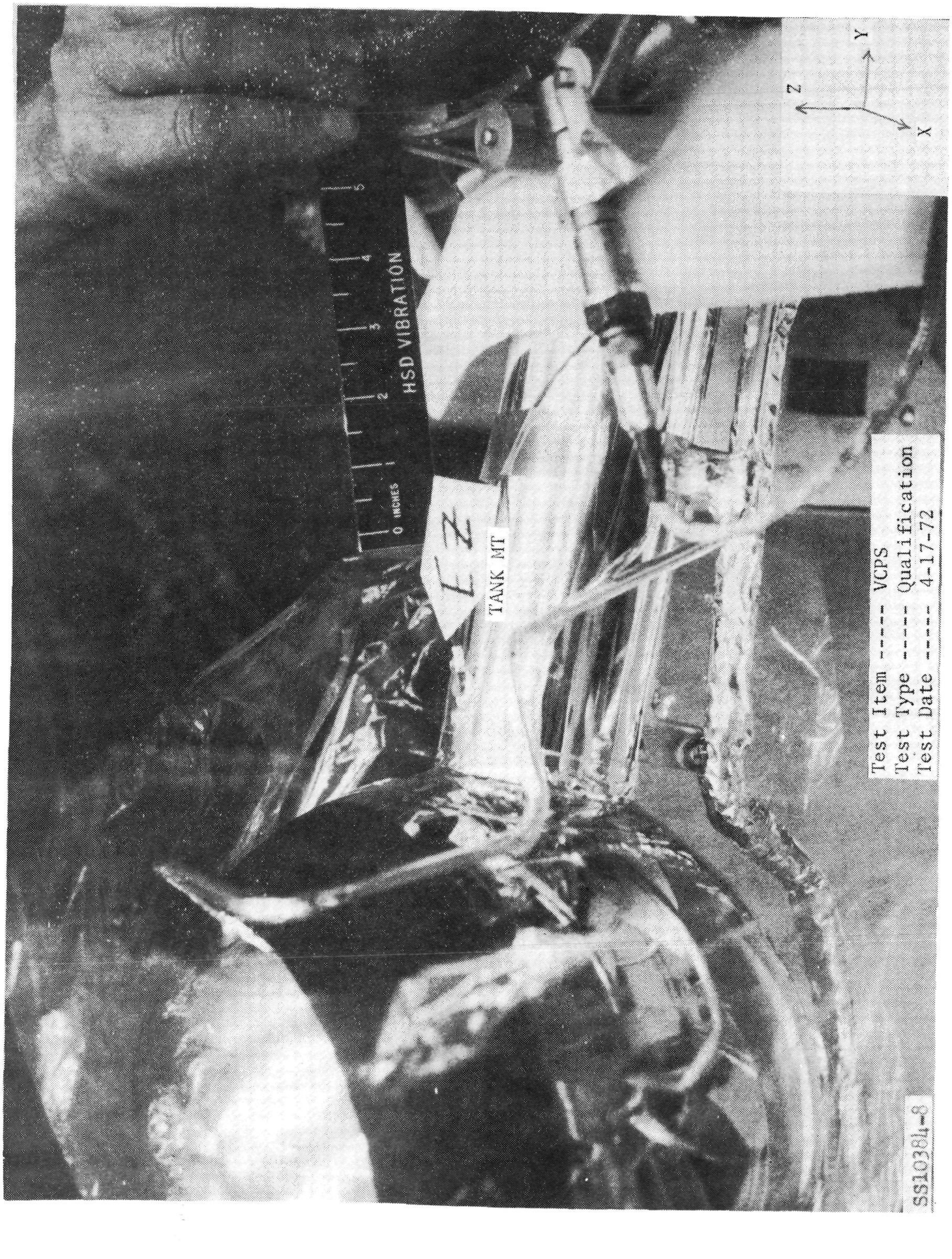
Test Item ----- VCPS
Test Type ----- Qualification
Test Date ----- 4-18-72

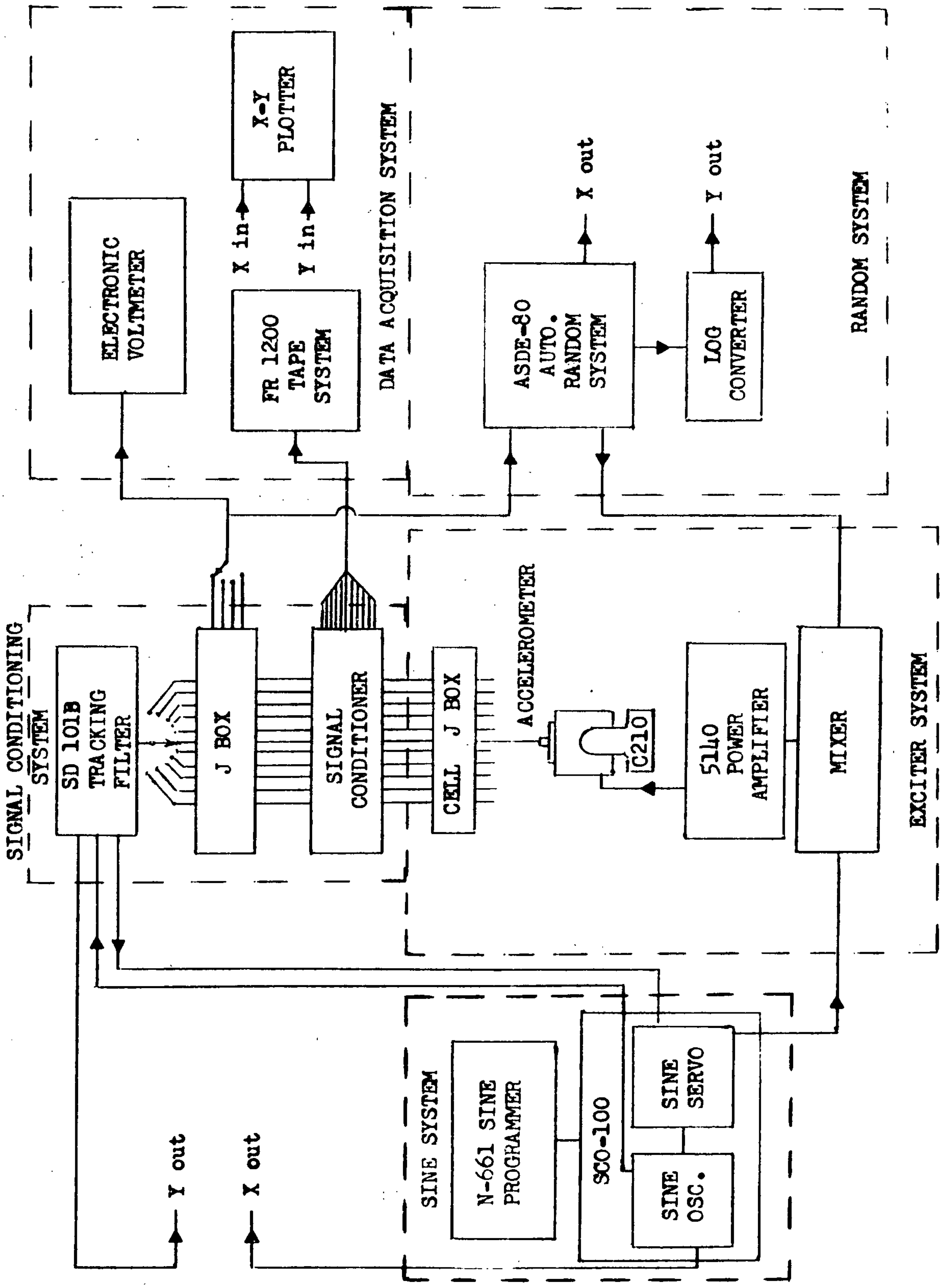
SS10381-8


Test Item ------ VCPS
Test Type ------ Qualification
Test Date ----- 4-18-72
LATCH VALVE MT
REA MT
PRESSURE XDUCER
HSD VIBRATION
JUNCTION BOX MT
Z
Y
X
SS10383-8


Z
Y
X
X
E
TANK MT
TEST ITEM --- VCPS
TEST TYPE --- QUALIFICATION
TEST DATE --- 4/17/72
SS10386-8


Z
X
Y
TANK MT
Test Item ------ VCPS
Test Type ------ Qualification
Test Date ------ 4-17-72
SS10385-8


Z
Y
X
HSD VIBRATION
0 INCHES
1
2
3
4
5
Z
TANK MT
Test Item ------ VCPS
Test Type ------ Qualification
Test Date ------ 4-17-72
SS10384-8



SSD VIBRATION GENERATING SYSTEM RIG 26 / MB C-210

RANDOM VIBRATION ANALYSIS

METHOD B

The power spectrum density analyzer is a SD301B REAL TIME ANALYZER and a SD302A ENSEMBLE AVERAGER whose calibration for each test is based on a calibrated signal supplied from equipment listed in the instrumentation section.

1. ANALYZER PARAMETERS

Analysis Range Upper Limits (Hz)	Bandwidth (Hz) (3db Filter)	*Resolution (Hz)	Effective (Noise) Bandwidth (Hz)
20,000	60	40	64
10,000	30	20	32
5,000	15	10	16
2,000	6	4	6.4
500	1.5	1	1.6
100	0.30	0.2	0.32
50	0.15	0.1	0.16
10	0.03	0.02	0.032

*Spacing of filter location.

2. DEGREES OF FREEDOM

For real time analysis the bandwidth resolution is the reciprocal of the analysis period (BT = 1).

$N = 2 \times B \times T \times (\text{No. of Ensembles})$

$N = 2 \times \text{No. of Ensembles}$

No. of Ensembles available:

1, 2, 4, 8, 16, 32, 64 (normally used unless specified),

128, 256, 512, 1024.

Section II

X - Axis
- A) Sine Data
- B) Random Data

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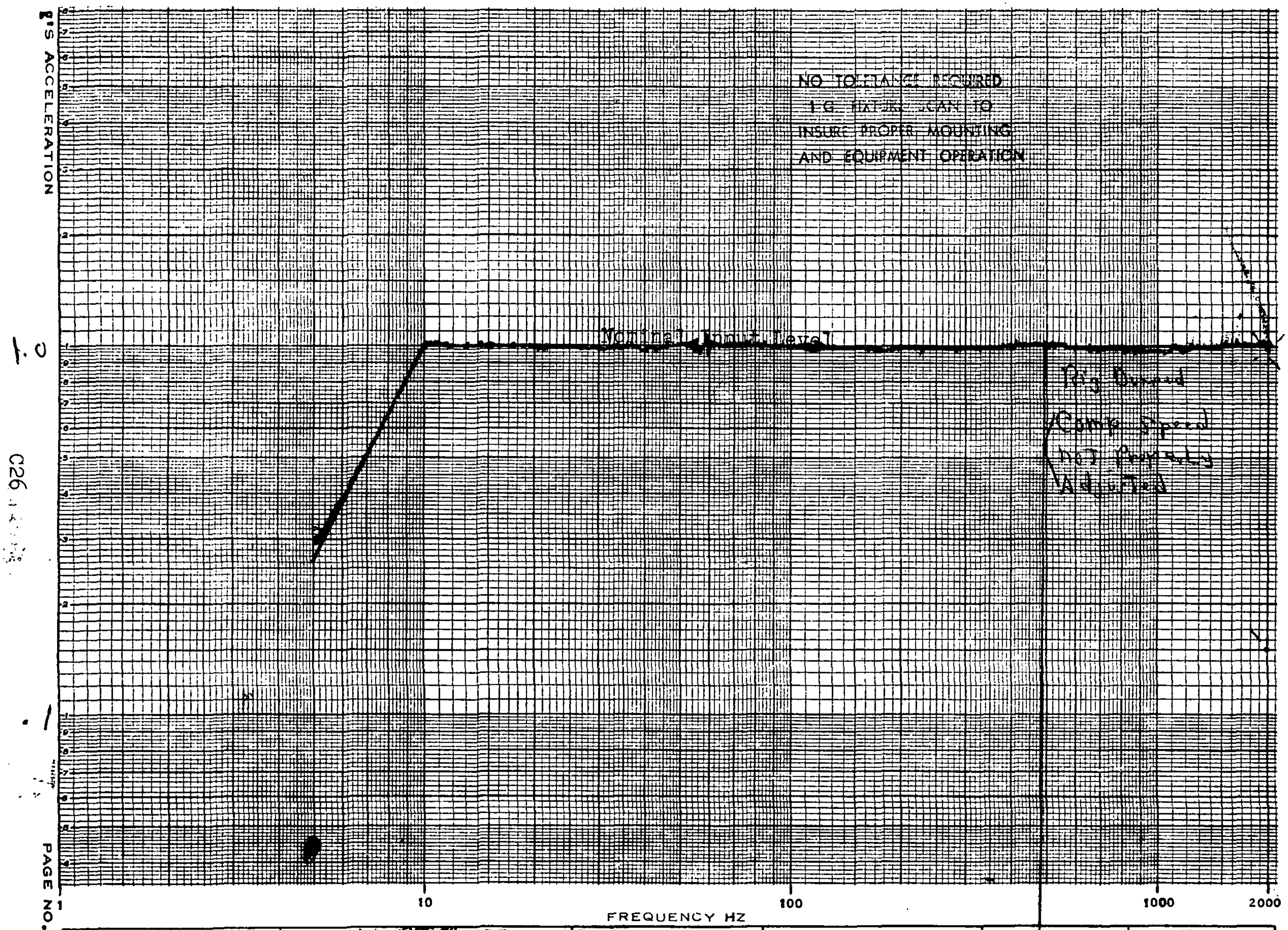
SINE VIBRATION TEST

RIG: #26
OPERATOR: P. Jodoin
WITNESS:
WITNESS:
TEST NO.: 7
TEST ENGINEER: S. Mehmed
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-14-72
TIME: 1120

INPUT LEVEL: 1.0 g
EXCIT. AXIS: x
ACCEL S/N: TD40
SENSING AXIS: x
ACCEL SENSITIVITY: — MV RMS / GP; 2.805 COL / GP
FILTER: 10-100-200 HZ B.W.
FILTER CROSSOVER: @ 70-700 HZ
SWEEP RATE: 4.0 OCT/MIN
TAPEREEL NO.: 012294
☑ LIVE
☐ FROM TAPE
COMPR. SPEED: Var. DB/SEC.
CHG.@ – HZ TO – DB/SEC.
CHG.@ – HZ TO DB/SEC.
NON OPERATING
☑ CONTROL
☐ RESPONSE
TEMP.: 74° °F
LOCATION: A1x′
SPECIAL CONDITIONS: Bare Fixture Scan

MASTER PG 1774

REPORT NO.:



NO TOLERANCE REQUIRED
1G FIXTURE SCAN TO
INSURE PROPER MOUNTING
AND EQUIPMENT OPERATION

Rig Dumped
Comp Speed
not Properly
Adjusted

FREQ. RANGE & DIRECTION: 5-2KHZ
ITEM: ~~SVSK79594~~ VCPS-FIXT
CODE: —
SERIAL NO.: SVSK79594
SPEC.: AT-VCPS
PARA.: 4.3.7
AMEND.: —
ACTION SHEET NO.: —
ATA NO.: —
TYPE OF TEST: Accept Test BARE FIXT
NAME OF TEST: Sine Sca

C26

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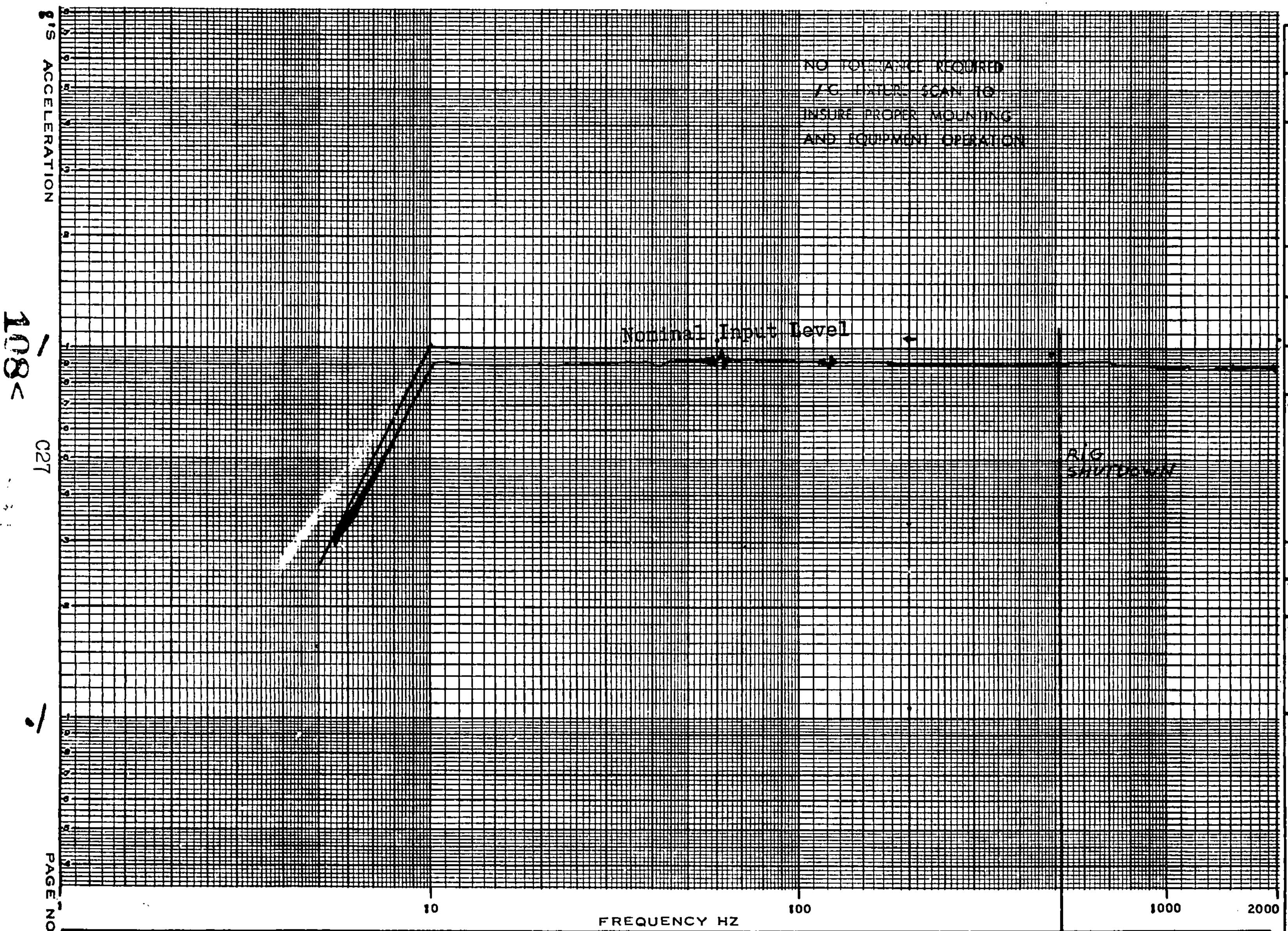
Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	MICKET	16	7 ch 2

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	RAE-B	4-14-72	1120



INPUT LEVEL ± 1 g

EXCIT. AXIS X

ACCEL S/N TD46

SENSING AXIS X

ACCEL SENSITIVITY — MV RMS / GP

2.805 COL / GP

FILTER 10/100/200 HZ B.W.

FILTER CROSSOVER @ 70 - 700 HZ

TAPE REEL NO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☒ CONTROL

☐ RESPONSE

TEMP. 74 °F

LOCATION A1X' A/X'

Hook-up #3

SPECIAL CONDITIONS

MASTER PG 1774

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	TYPE OF TEST
5-2000HZ	SVSK79594	—	—	FIXTURE SURVEY

SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
AT-VCPS	4.3.7	—	BARE FIXTURE	SINUSOIDAL SCAN

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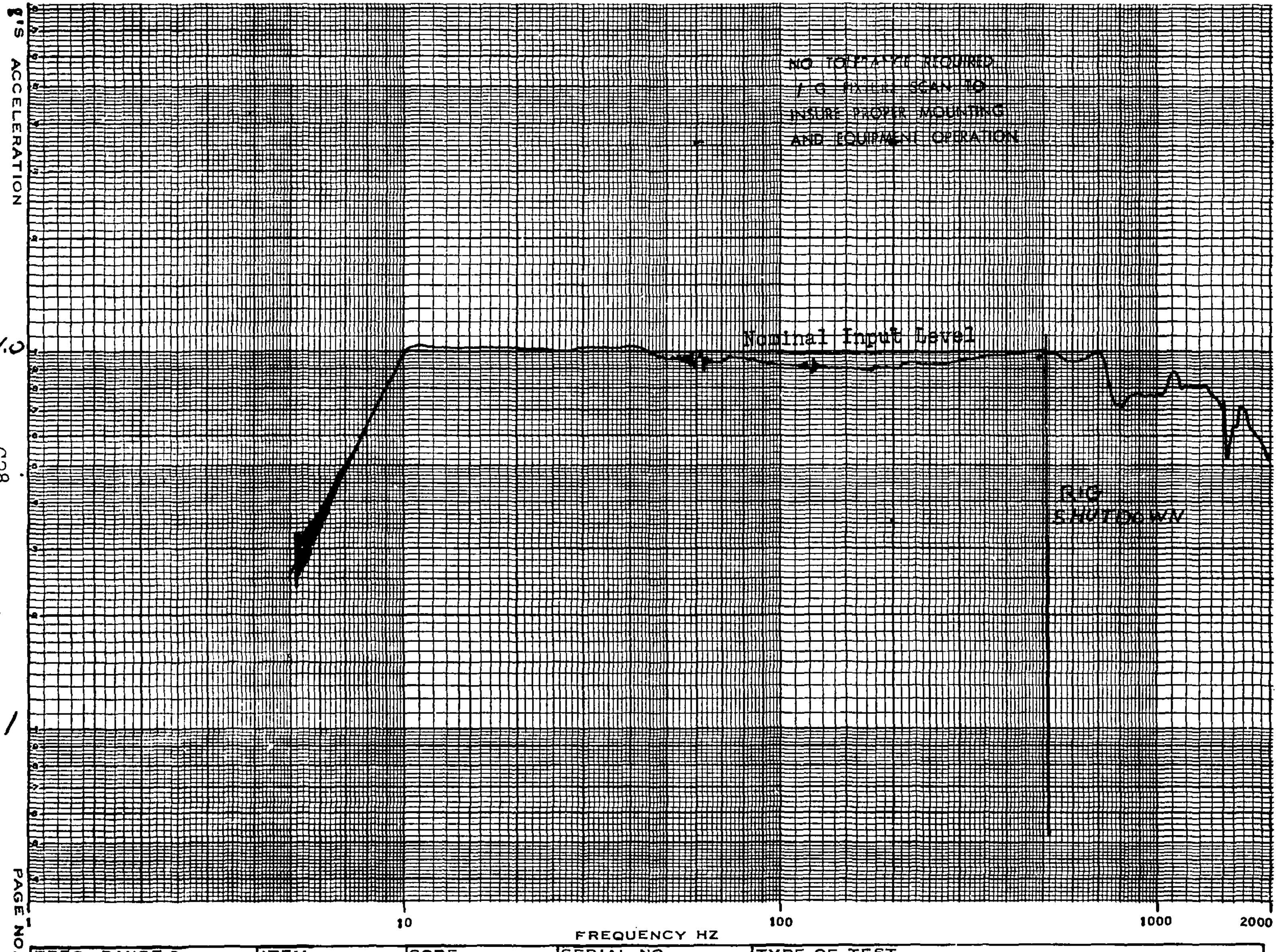
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION UA®

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	MICKET	18	7 ch 4

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	RAE-B	4-14-72	1120



INPUT LEVEL ± 1 g

EXCIT. AXIS X

ACCEL S/N T044

SENSING AXIS X

ACCEL SENSITIVITY — MV RMS / GP

2.773 COL / GP

FILTER 10/100/200 HZ B.W.

FILTER CROSSOVER @ 70 - 700 HZ

TAPEREEL NO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 74 °F

☐ CONTROL

☒ RESPONSE

LOCATION A2X A2X

Hook-up #3

SPECIAL CONDITIONS

MASTER PG1774

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	TYPE OF TEST
5-2000Hz	SVSK79594	—	—	FIXTURE SURVEY

SPECIFICATION PARA. AMEND. PHASE NAME OF TEST

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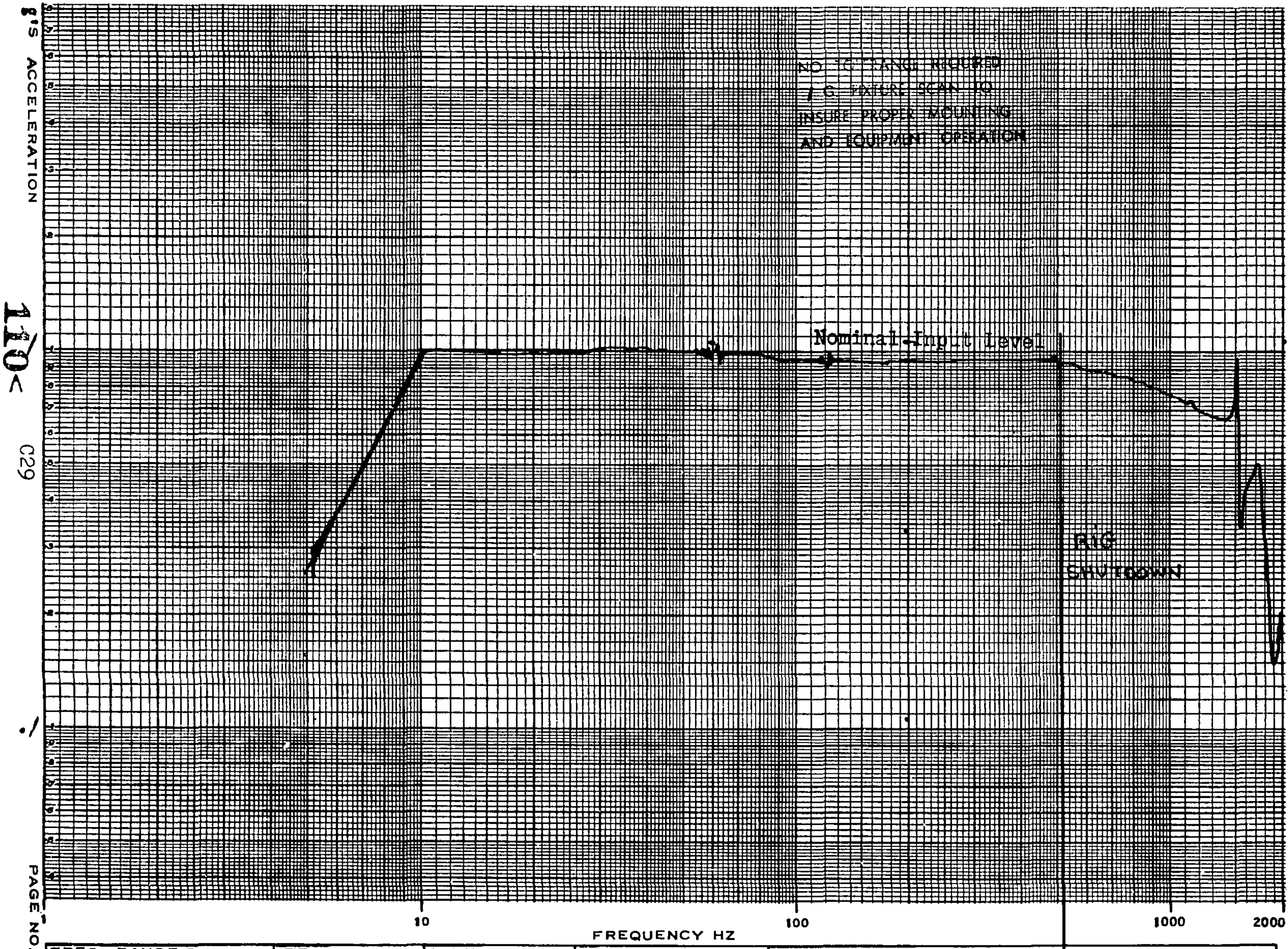
Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 20	TEST NO. 7 ch6
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-14-72	TIME 1120



NO TC CHANGE REQUIRED
1 G FIXTURE SCAN TO
INSURE PROPER MOUNTING
AND EQUIPMENT OPERATION

INPUT LEVEL ± 1 g
EXCIT. AXIS X
ACCEL S/N WR11
SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP
2,956 COL / GP
FILTER 10/100/200 HZ B.W.
FILTER CROSSOVER @ 70-700 HZ
TAPE REEL NO. 012294
SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 74 °F
☐ CONTROL
☒ RESPONSE
LOCATION A4X A4X
HOOK-UP #3
SPECIAL CONDITIONS
MASTER PG 1774

REPORT NO.

PAGE NO.

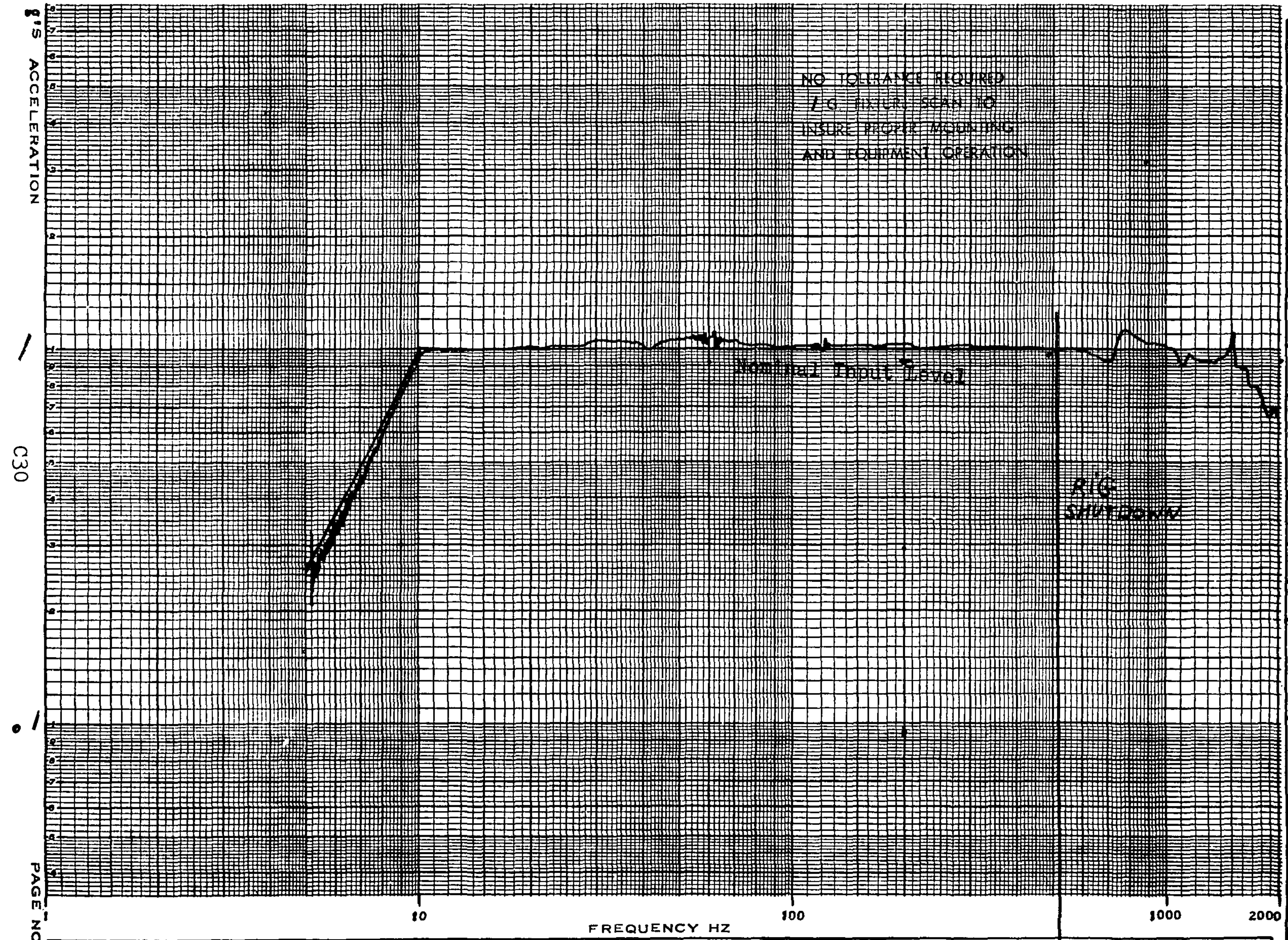
FREQ. RANGE & DIRECTION 5-2000HZ	ITEM SVSK 79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION AT-VCPS	PARA. 4.3.7	AMEND. —	PHASE BARE FIXTURE	NAME OF TEST SINUSOIDAL SCAN

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 21	TEST NO. 7 ch 7
TEST ENGINEER MEHMED.	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-14-72	TIME 1120



NO TOLERANCE REQUIRED
1 G FIXTURE SCAN TO
INSURE PROPER MOUNTING
AND EQUIPMENT OPERATION

INPUT LEVEL ± 1 g

EXCIT. AXIS X

ACCEL S/N VG53

SENSING AXIS X

ACCEL SENSITIVITY 10.886 MV RMS / GP

~~2.794~~ COL / GP

FILTER 10/100/200 HZ B.W.

FILTER CROSSOVER @ 70-700 HZ

TAPE REEL NO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO - DB/SEC

NON-OPERATING

TEMP. 74 °F

☐ CONTROL

☒ RESPONSE

LOCATION ASX ASX

Hook-up #3

SPECIAL CONDITIONS

MASTER HG 1774

REPORT NO.

FREQ. RANGE & DIRECTION 5-2000 Hz	ITEM SVSK79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION	PARA.	AMEND.	PHASE RARE	NAME OF TEST

C30

111<

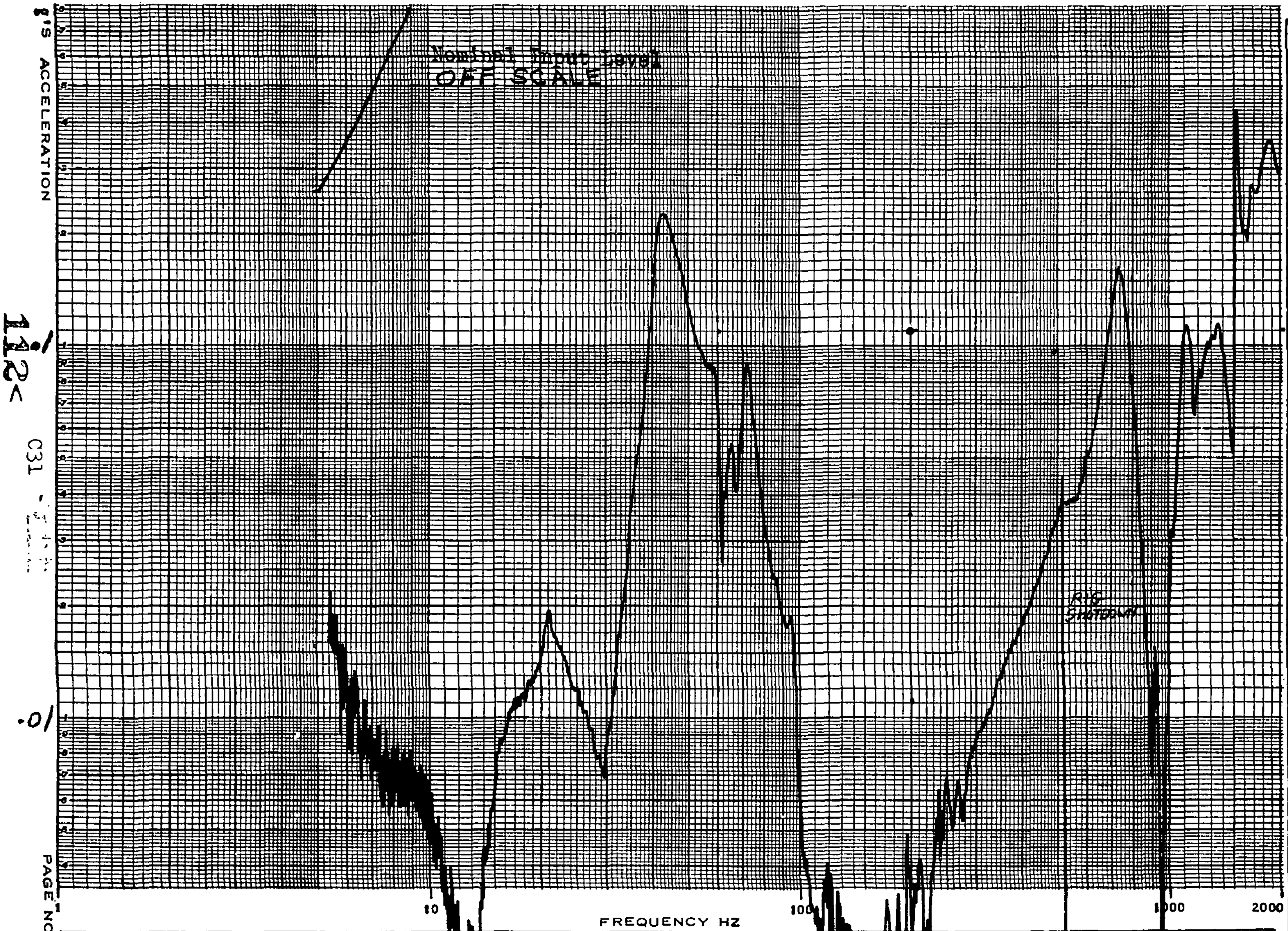
HSF 1633 A 2/69

Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	MICKET	17	7 ch 3

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	RAE-B	4-14-72	1120



INPUT LEVEL ± 1 g

EXCIT. AXIS X

ACCEL S/N TE83

SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS/GP

2.722 COL/GP

FILTER 10/100/200 HZ B.W.

FILTER CROSSOVER @ 70-700 HZ

TAPEREEL NO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP 74 °F

☐ CONTROL

☒ RESPONSE

LOCATION A/Y A/Y

Hook-up #3

SPECIAL CONDITIONS MASTER PG 1774

REPORT NO.

FREQ. RANGE & DIRECTION	ITEM	CH.	SERIAL NO.	TYPE OF TEST
5-2000Hz	SVSK79594	—	—	FIXTURE SURVEY

SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
AT-YCPS	4.3.7	—	BARE FIXTURE	SINUSOIDAL SCAN

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

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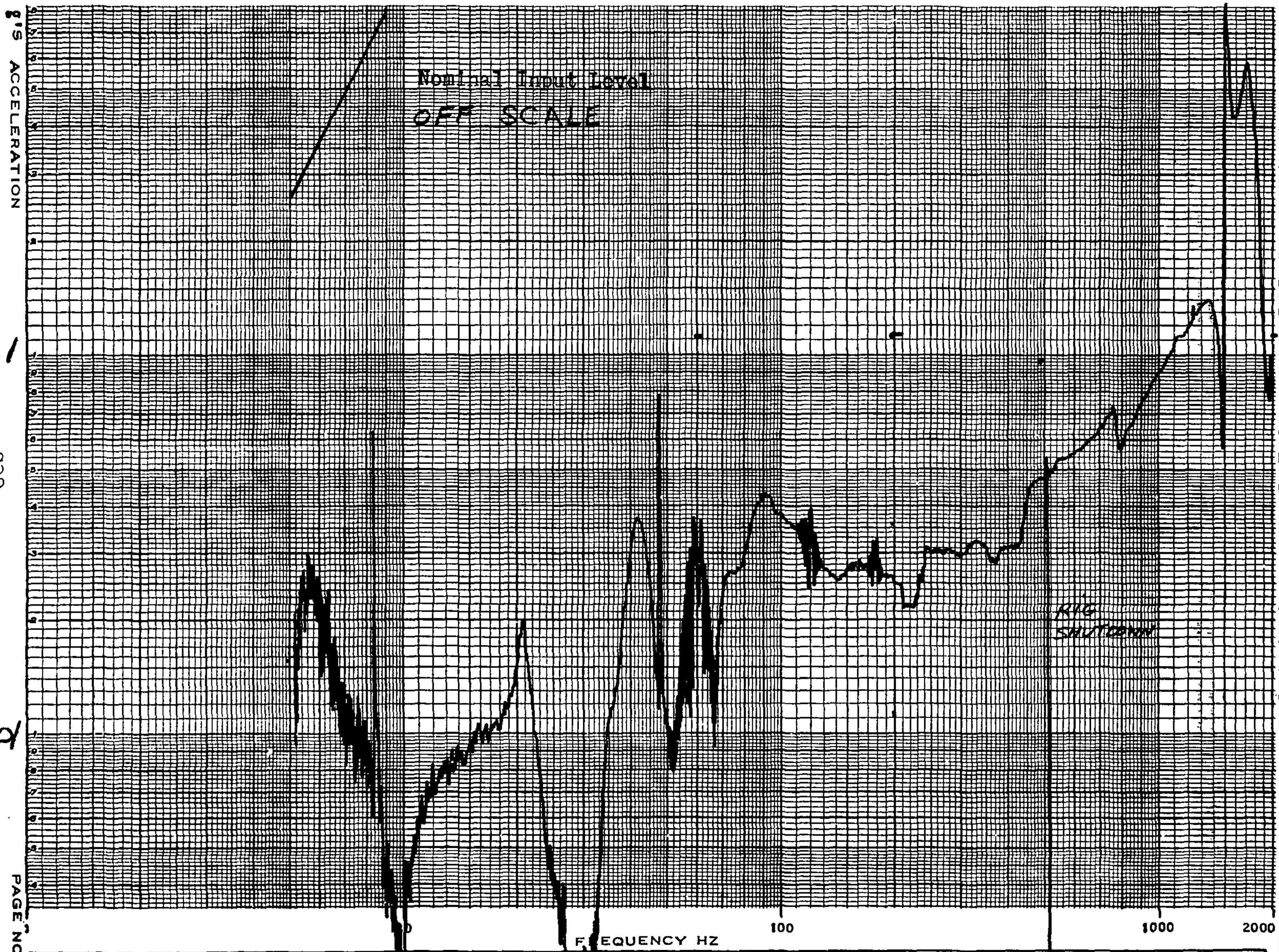
SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: MICKET
TRACE NO.: 15
TEST NO.: 7 ch1
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE:
TIME:



INPUT LEVEL: ± 1 g
EXCIT. AXIS: X
ACCEL S/N: NB62
SENSING AXIS: Z
ACCEL SENSITIVITY: — MV RMS / GP
2.698 COL / GP
FILTER: 10/100/200 HZ B.W.
FILTER CROSSOVER: @ 70 - 700 HZ
TAPE REEL NO.: 012294
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ —HZ TO— DB/SEC
CHG@ —HZ TO— DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION: A1Z A/Z
HOOK-UP # 3
SPECIAL CONDITIONS: MASTER PG 1774
REPORT NO.:

FREQ. RANGE & DIRECTION: 5-2000HZ
ITEM: SVSK 79594
CODE: —
SERIAL NO.: —
TYPE OF TEST: FIXTURE SURVEY
SPECIFICATION:
PARA.:
AMEND.:
PHASE: BARE
NAME OF TEST:

C32

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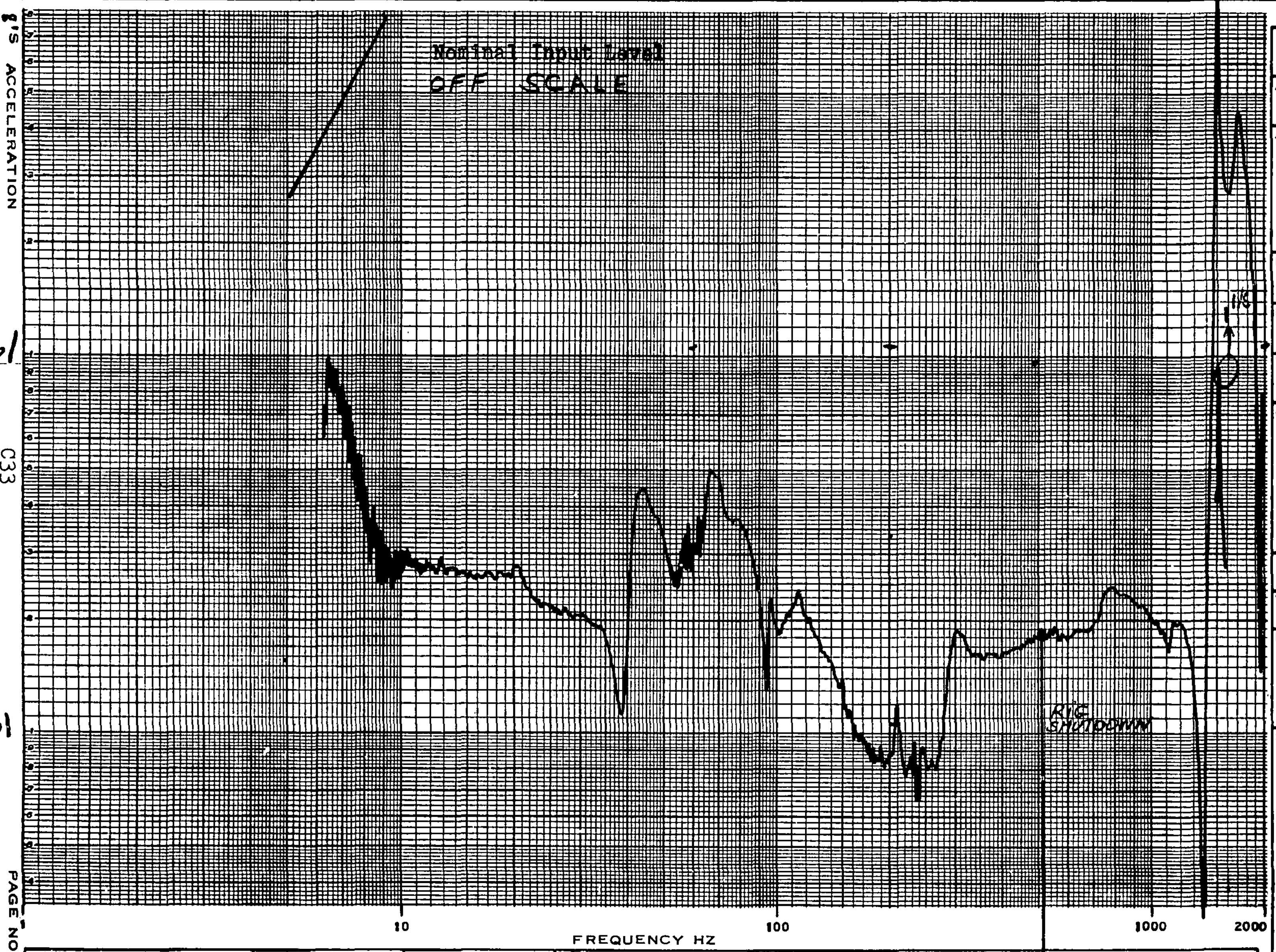
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 19	TEST NO. 7 5
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-14-72	TIME 1120



114<

C33

INPUT LEVEL ± 1 g

EXCIT. AXIS X

ACCEL S/N TG75

SENSING AXIS Z

ACCEL SENSITIVITY — MV RMS / GP

2.791 COL / GP

FILTER 10/100/200 HZ B.W.

FILTER CROSSOVER @ 70 - 700 HZ

TAPE REEL NO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 74 °F

LOCATION A3Z A3Z

Hook-up #3

SPECIAL CONDITIONS MASTER PG-1774

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-2000HZ	ITEM SVSK 79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION AT-VCPS	PARA. 4.3.7	AMEND. —	PHASE BARE FIXTURE	NAME OF TEST SINUSOIDAL SCAN

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

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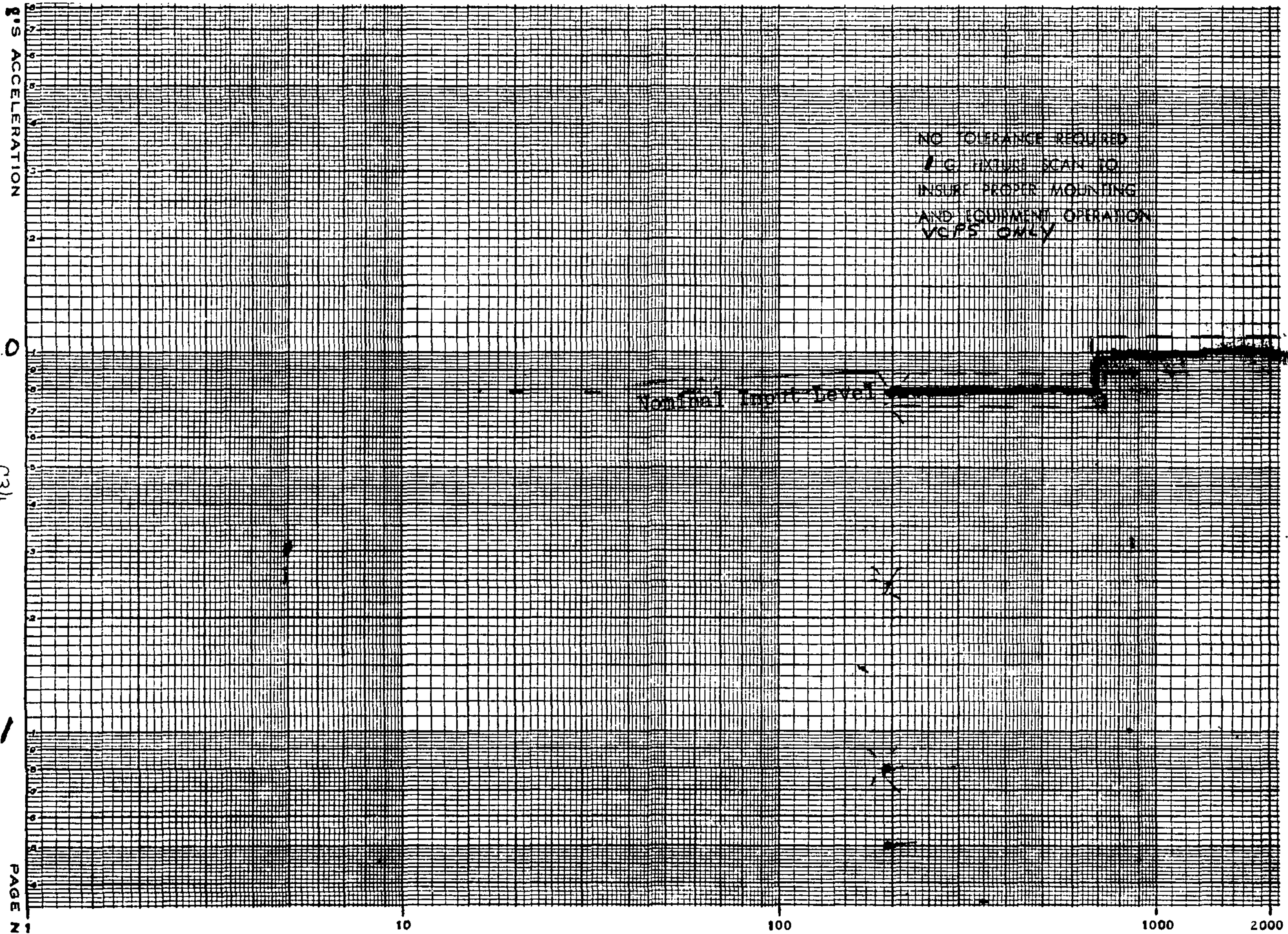
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	WITNESS A. McCarthy 4-15-72	WITNESS		TEST NO. 2
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B		DATE 4-15-72	TIME 1410



NO TOLERANCE REQUIRED
1 G FIXTURE SCAN TO
INSURE PROPER MOUNTING
AND EQUIPMENT OPERATION
VCPS ONLY

INPUT LEVEL: 1 g
EXCIT. AXIS: X
ACCEL S/N: 7040
SENSING AXIS: X
ACCEL SENSITIVITY: — MV RMS / GP; 2.805 COL / GP
FILTER: [redacted] - 100-200 HZ B.W.
FILTER CROSSOVER: @ [redacted] - 700 HZ
SWEEP RATE: 4 OCT/MIN
TAPE REEL NO.: 012295 ☒ LIVE ☐ FROM TAPE
COMPR. SPEED: VAR DB/SEC.
CHG.@ - HZ TO DB/SEC.
CHG.@ - HZ TO DB/SEC.
NON OPERATING ☒ CONTROL ☐ RESPONSE
TEMP. 74 °F
LOCATION: AIX'
SPECIAL CONDITIONS. HOOK-UP #1 (VCPS) ITEM LOADED AND PRESSURIZED.
REPORT NO.
PAGE NO.

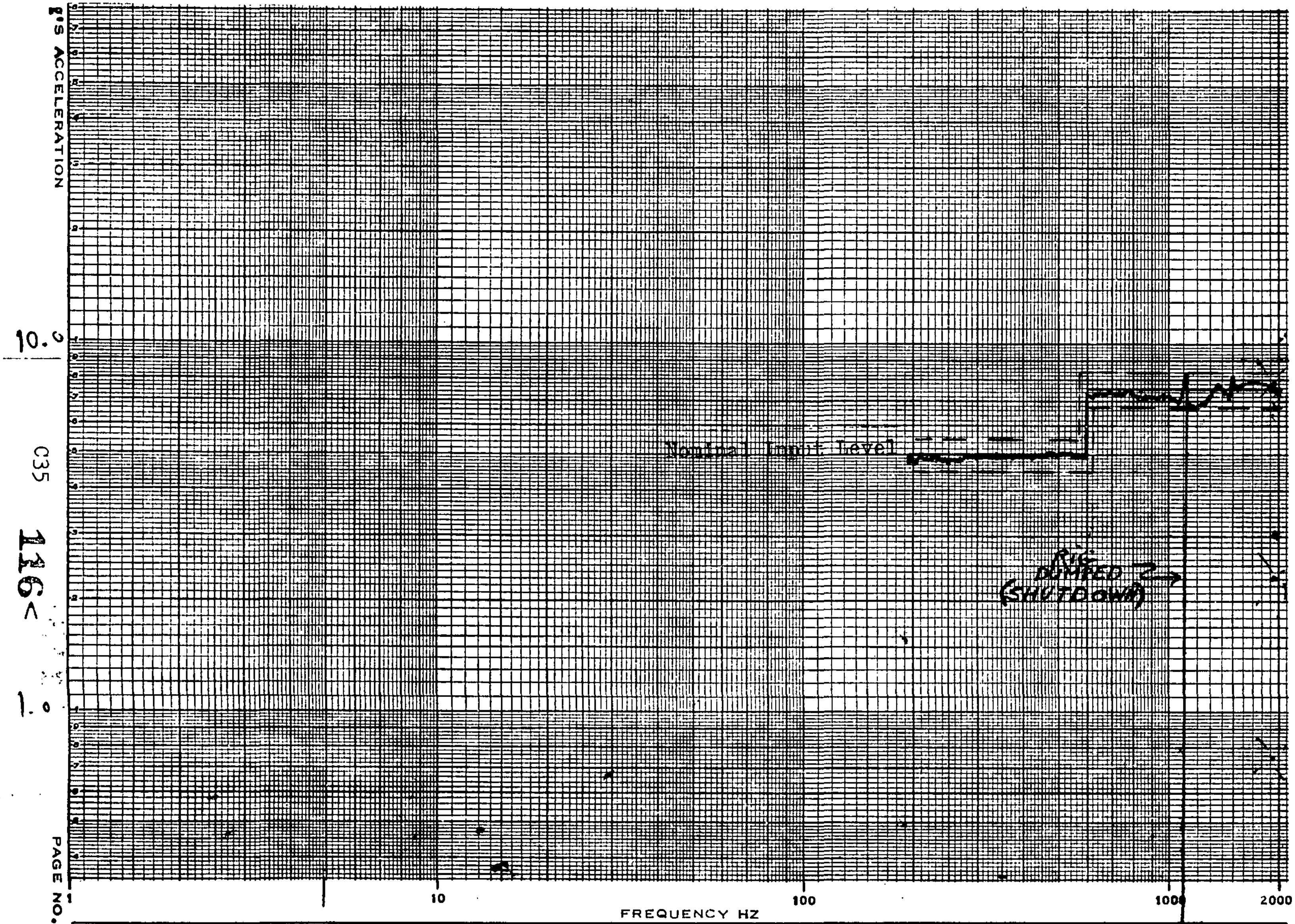
FREQ. RANGE & DIRECTION 200-2000 HZ	ITEM VCPS	CODE SV 748720-1	SERIAL NO. S/N 00001	SPEC. AT-VCPS	PARA. 4.3.7	AMEND. —
ACTION SHEET NO. —	ATA NO. —	TYPE OF TEST FIXTURE/VCPS SURVEY		NAME OF TEST SCAN LOW LEVEL SINUSOIDAL +		

Standard A® DIVISION OF UNITED AIRCRAFT CORPORATION HSF-1633.1 2/69

SINE VIBRATION TEST

* will be noted on unit history

RIG 26	OPERATOR JODOIN	WITNESS * A. McCarthy 4/15/72	WITNESS —	TEST NO. 3
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-15-72	TIME 1420



INPUT LEVEL 7.5 g
EXCIT. AXIS X
ACCEL S/N TD40
SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP
2.805 COL / GP
FILTER [redacted]-100-200 HZ B.W.
FILTER CROSSOVER @ [redacted]-700 HZ
SWEEP RATE 4.0 OCT/MIN
TAPE REEL NO. 012295 ☑ LIVE ☐ FROM TAPE
COMPR. SPEED Var DB/SEC.
CHG.@ _ HZ TO _ DB/SEC.
CHG.@ — HZ TO DB/SEC.
NON OPERATING ☒ CONTROL ☐ RESPONSE
TEMP. 73 °F
LOCATION A1X′
HOOK-UP #1
SPECIAL CONDITIONS THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY
VCPS LOADED
PRESSURIZED
REPORT NO.

FREQ. RANGE & DIRECTION 200-2000Hz	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	SPEC. AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 2
ACTION SHEET NO. —	ATA NO. —	TYPE OF TEST QUAL - VCPS ONLY		NAME OF TEST SINUSOIDAL VIBRATION		

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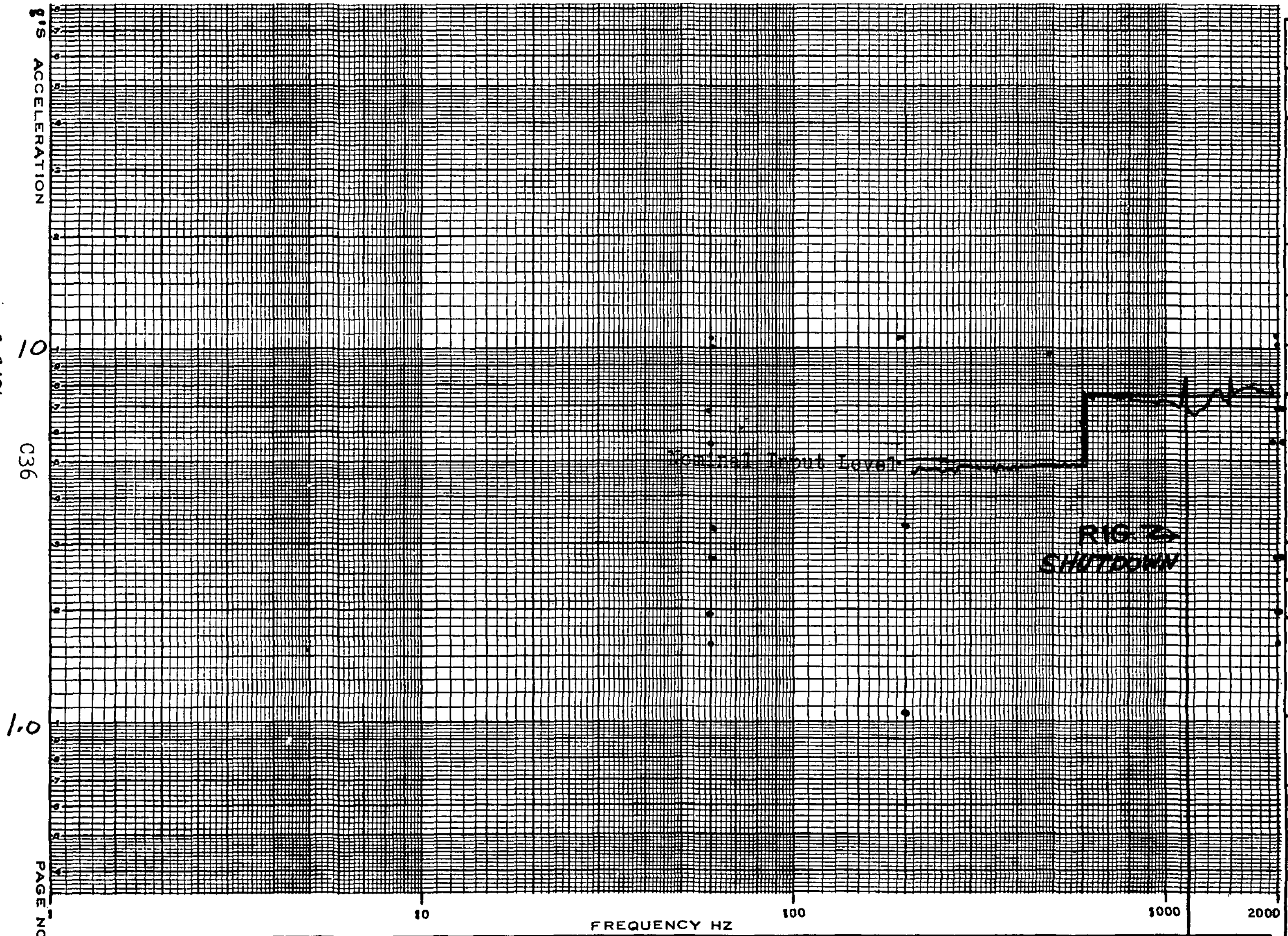
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 1
TEST NO.: 3
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-15-72
TIME: 1420



INPUT LEVEL: ± 7.5 g
EXCIT. AXIS: X
ACCEL S/N: TD40
SENSING AXIS: X
ACCEL SENSITIVITY: — MV RMS / GP; 2.805 COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER: @ 700 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☒ CONTROL
☐ RESPONSE
TEMP. 73 °F
LOCATION: A/X'
HOOK-UP #1
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.:

PAGE NO.:

FREQ. RANGE & DIRECTION: 200-2000Hz
ITEM: VCPS
CODE SV: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL -
SPECIFICATION:
PARA.:
AMEND.:
PHASE:
NAME OF TEST:

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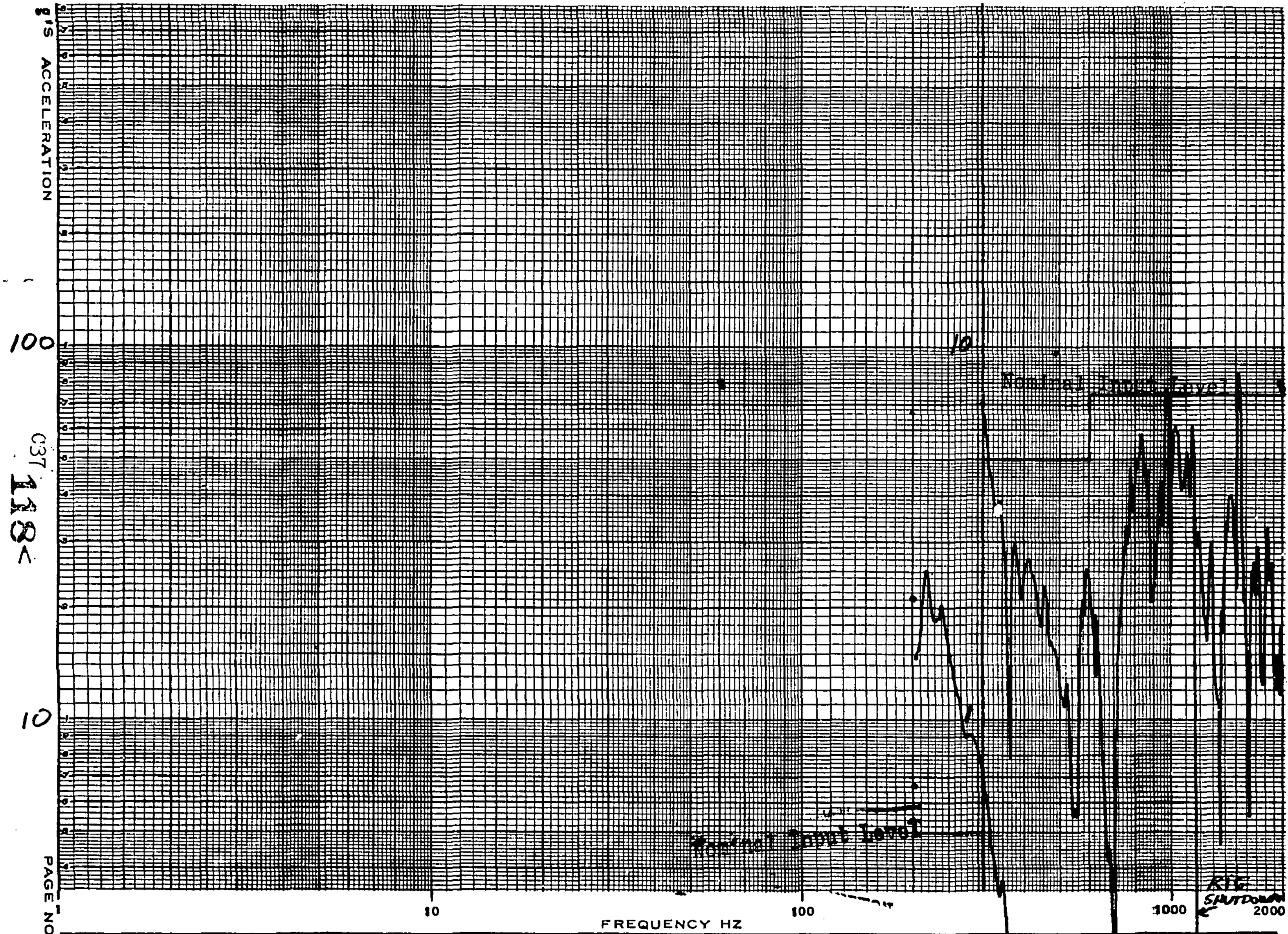
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 8	TEST NO. 3
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-15-72	TIME 1420



INPUT LEVEL ± 7.5 g	EXCIT. AXIS X
ACCEL S/N TD44	SENSING AXIS X

ACCEL SENSITIVITY 3.035 MV RMS / GP

— COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPEREEL NO. 012295	SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 73 °F

☐ CONTROL

☒ RESPONSE

LOCATION BX

HUB HOOK-UP #1

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 200-2000 Hz	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 2	PHASE VCPS ONLY	NAME OF TEST SINUSOIDAL VIBRATION

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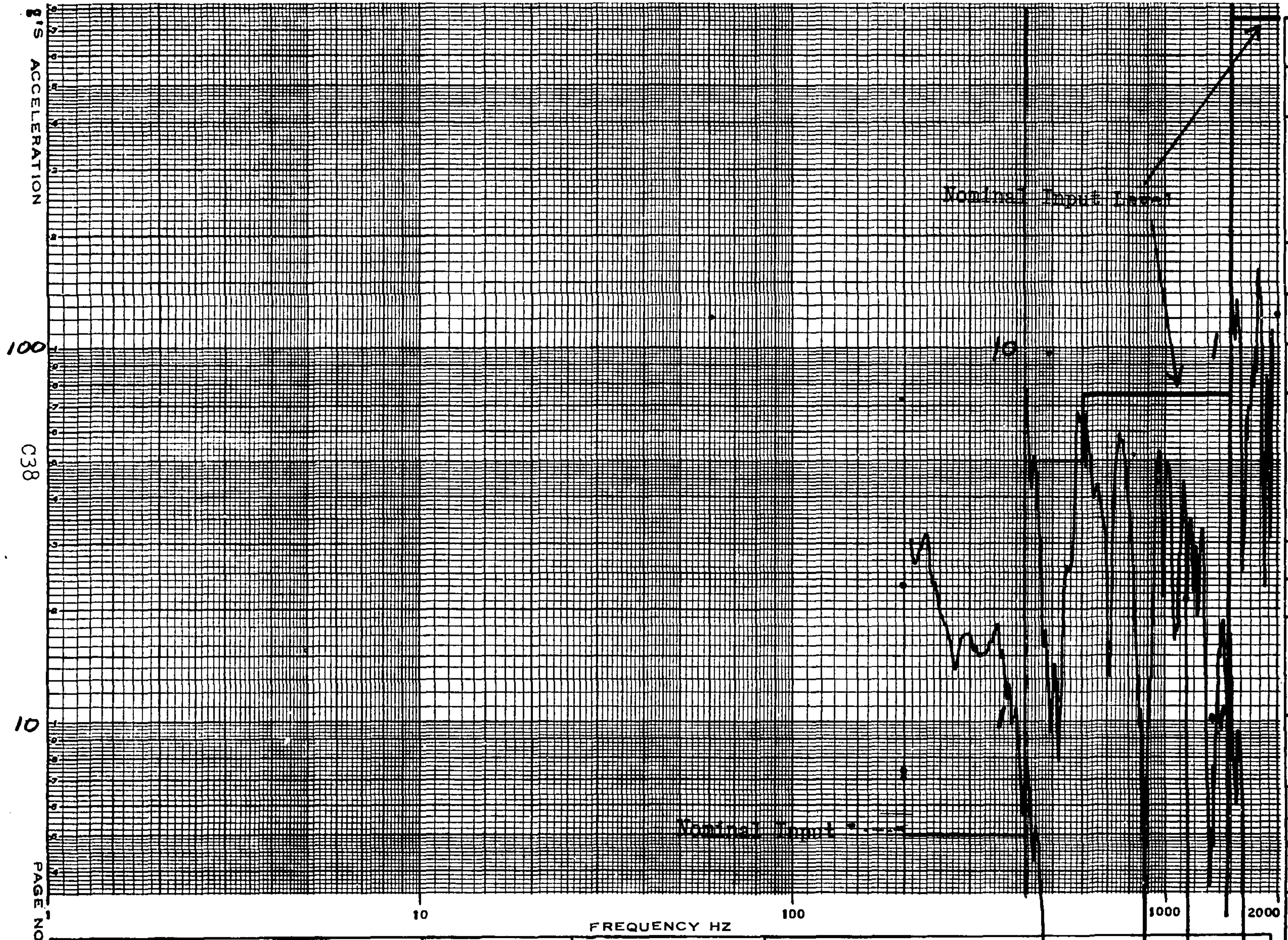
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 3	TEST NO. 3
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-15-72	TIME 1420



Nominal Input Level

Nominal Input

INPUT LEVEL ± 7.5 g	EXCIT. AXIS X
ACCEL S/N XM21	SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP 1.370 COL / GP	
FILTER 100/200 HZ B.W.	
FILTER CROSSOVER @ 700 HZ	
TAPE REEL NO. 012295	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC	
CHG@ — HZ TO — DB/SEC	
CHG@ — HZ TO — DB/SEC	
NON-OPERATING	☐ CONTROL ☒ RESPONSE
TEMP. 73 °F	
LOCATION DX REA MOUNT HOOK-UP #1	
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED	

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 200-2000 HZ	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION	PARA.	AMEND.	PHASE VCPS	NAME OF TEST

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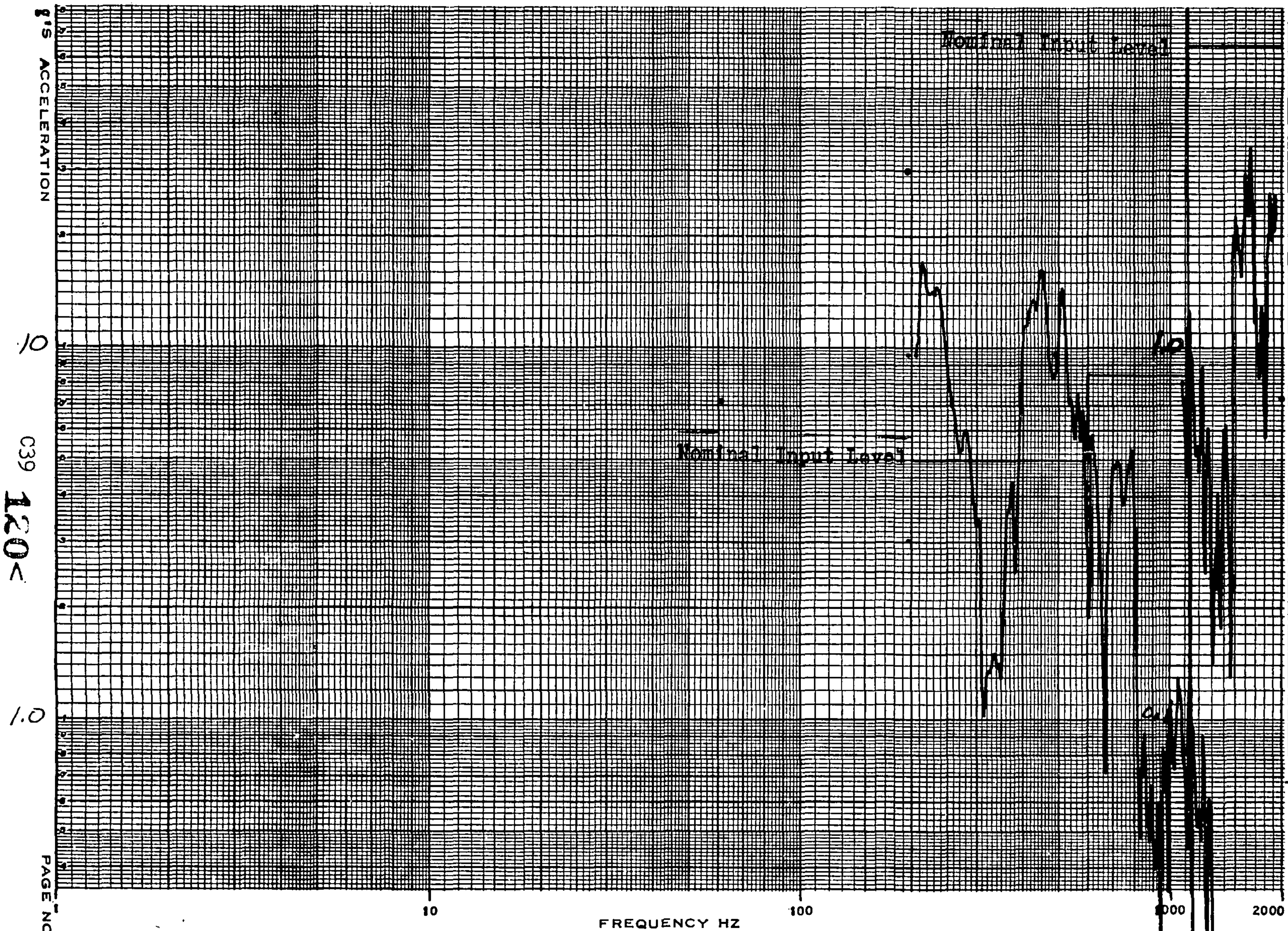
SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	JODOIN	4	3

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	RAE-B	4-15-72	1420



INPUT LEVEL ± 7.5 g	EXCIT. AXIS X
ACCEL S/N WF75	SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP 1.051 COL / GP	
FILTER 100/200 HZ B.W.	
FILTER CROSSOVER @ 700 HZ	
TAPE REEL NO. 012295	SWEEP RATE 4 OCT/MIN
COMPR. SPEED YAR DB/SEC CHG@ — HZ TO — DB/SEC CHG@ — HZ TO — DB/SEC	
NON-OPERATING	☐ CONTROL
TEMP. 73 °F	☒ RESPONSE
LOCATION EX TANK MOUNT HOOK-UP #1	
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED	
THIS PORTION OF THE TEST PERFORMED WITH VCPS ONLY	REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	TYPE OF TEST
200-2000Hz	VCPS	SY 748720-1	00001	QUAL

SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
AT-VCPS	4.3.7.5	NOTE 2	VCPS ONLY	SINUSOIDAL VIBRATION

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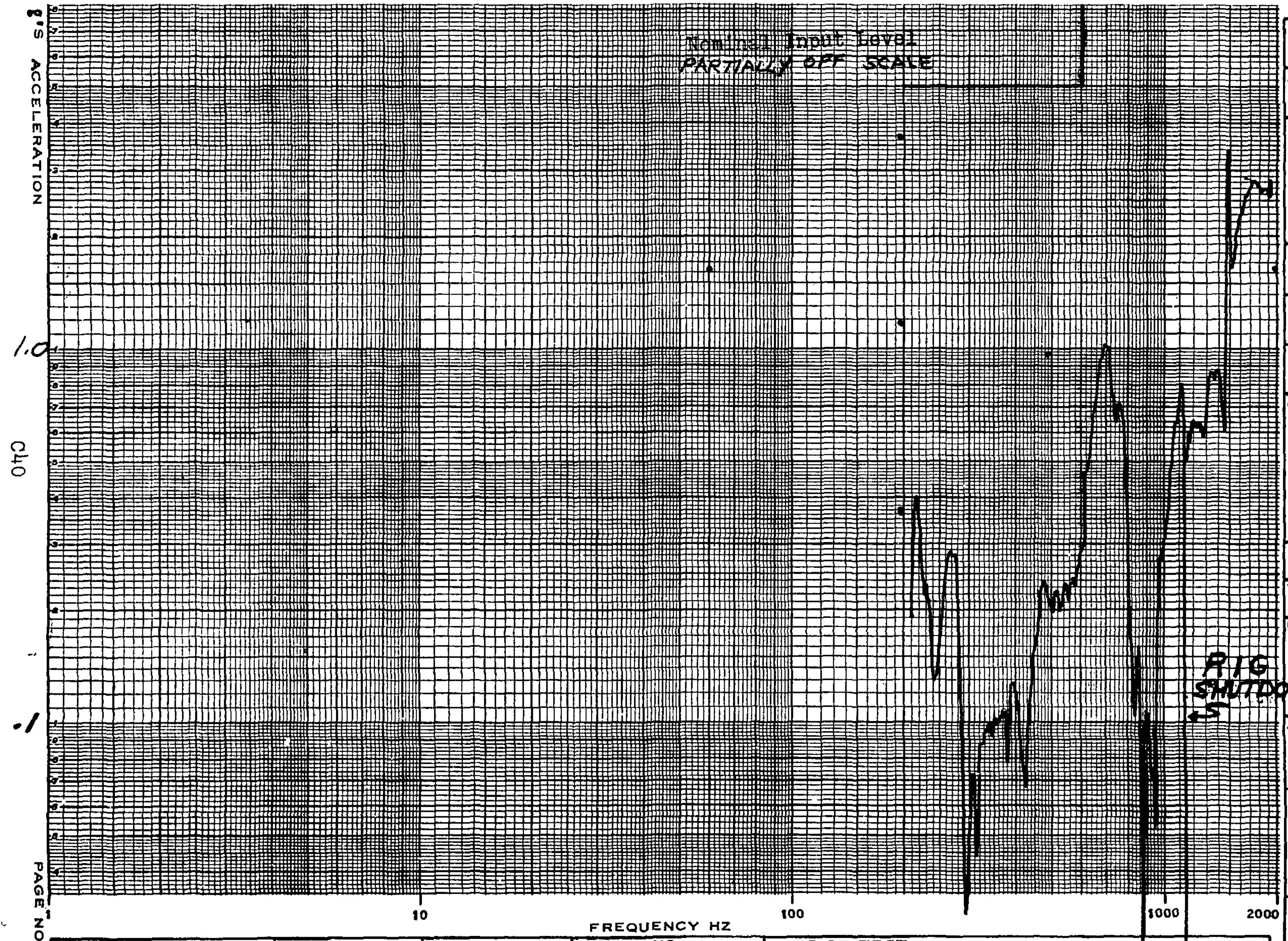
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 2	TEST NO. 3
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-15-72	TIME 1420



INPUT LEVEL ± 7.5 g	EXCIT. AXIS X
ACCEL S/N TE83	SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS / GP; 2.722 COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPEREEL NO. 012295	SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 73 °F

LOCATION A1Y HOOK-UP #1

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH VCPS ONLY

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 200-2000HZ	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST

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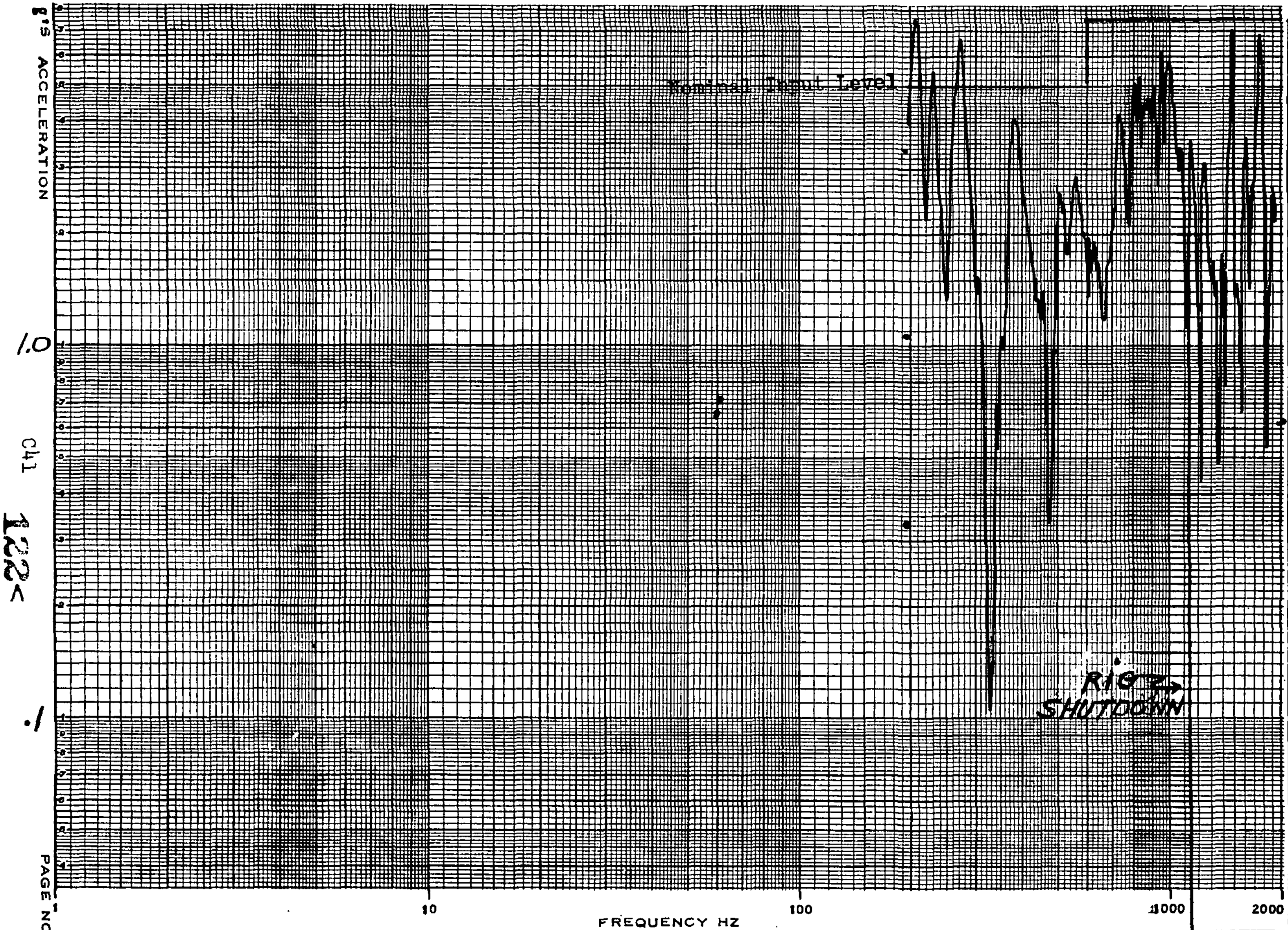
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN		PLOTTED BY JODOIN	TRACE NO. 9	TEST NO. 3
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B		DATE 4-15-72	TIME 1420



INPUT LEVEL ± 7.5 g

EXCIT. AXIS X

ACCEL S/N WR11

SENSING AXIS Y

ACCEL SENSITIVITY 3.016 MV RMS / GP

— COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPEREEL NO. 012295

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 73 °F

LOCATION BY HUB HOOK-UP #1

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 200-2000Hz	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 2	PHASE VCPS ONLY	NAME OF TEST SINUSOIDAL VIBRATION

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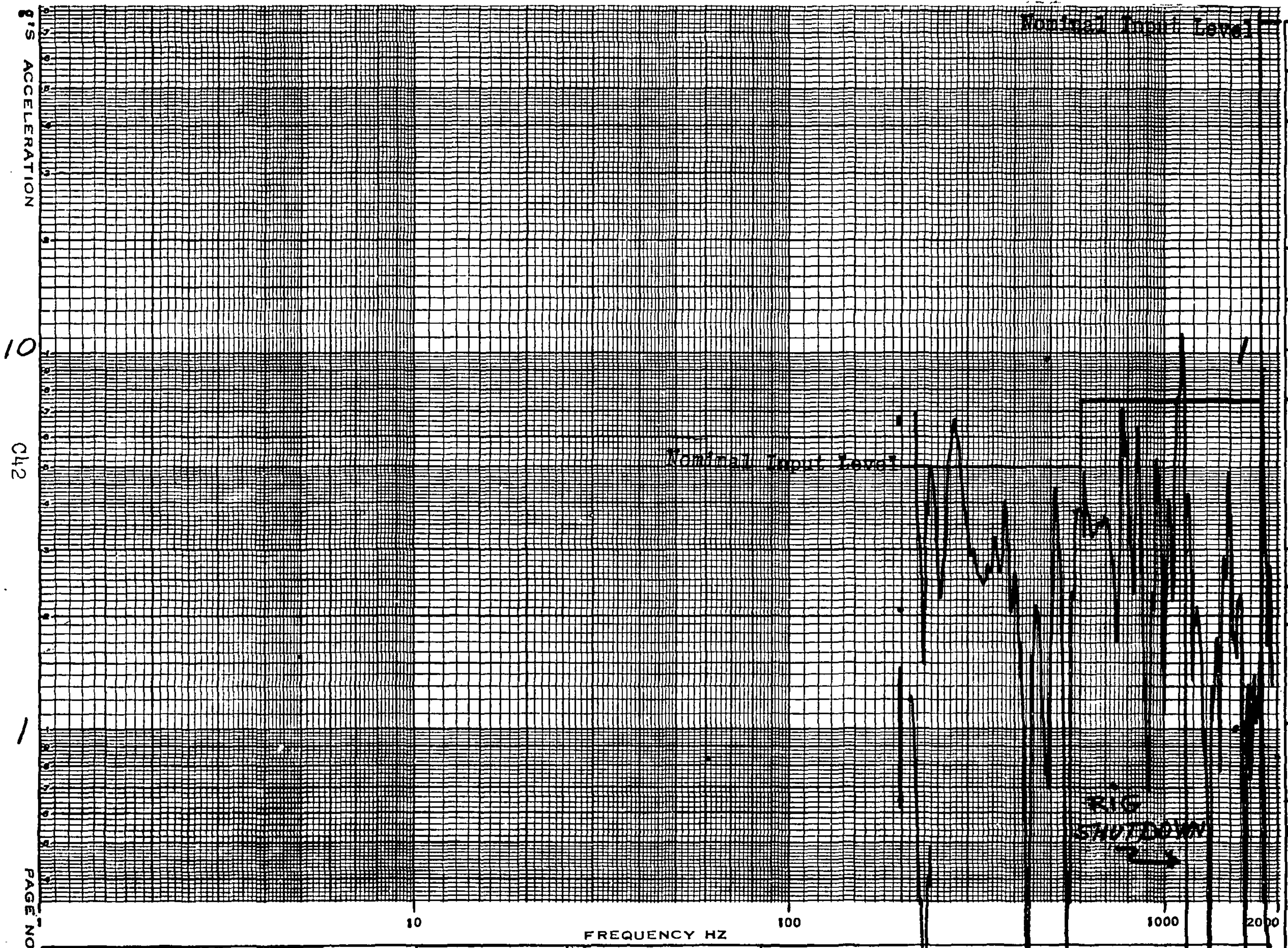
SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 6
TEST NO.: 3
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: PAE-B
DATE: 4-15-72
TIME: 1420



INPUT LEVEL: ± 7.5 g
EXCIT. AXIS: X
ACCEL S/N: YK20
SENSING AXIS: Y
ACCEL SENSITIVITY: 1.523 MV RMS / GP
— COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER: @ 700 HZ
TAPEREEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 73 °F
☐ CONTROL
☒ RESPONSE
LOCATION: DY
REA MOUNT HOOK-UP #1
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
THIS PORTION OF THE TEST PERFORMED WITH VCPS ONLY
REPORT NO.:
PAGE NO.:

FREQ. RANGE & DIRECTION: 200-2000 HZ
ITEM: VCPS
CODE SY: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION:
PARA.:
AMEND.:
PHASE:
NAME OF TEST:

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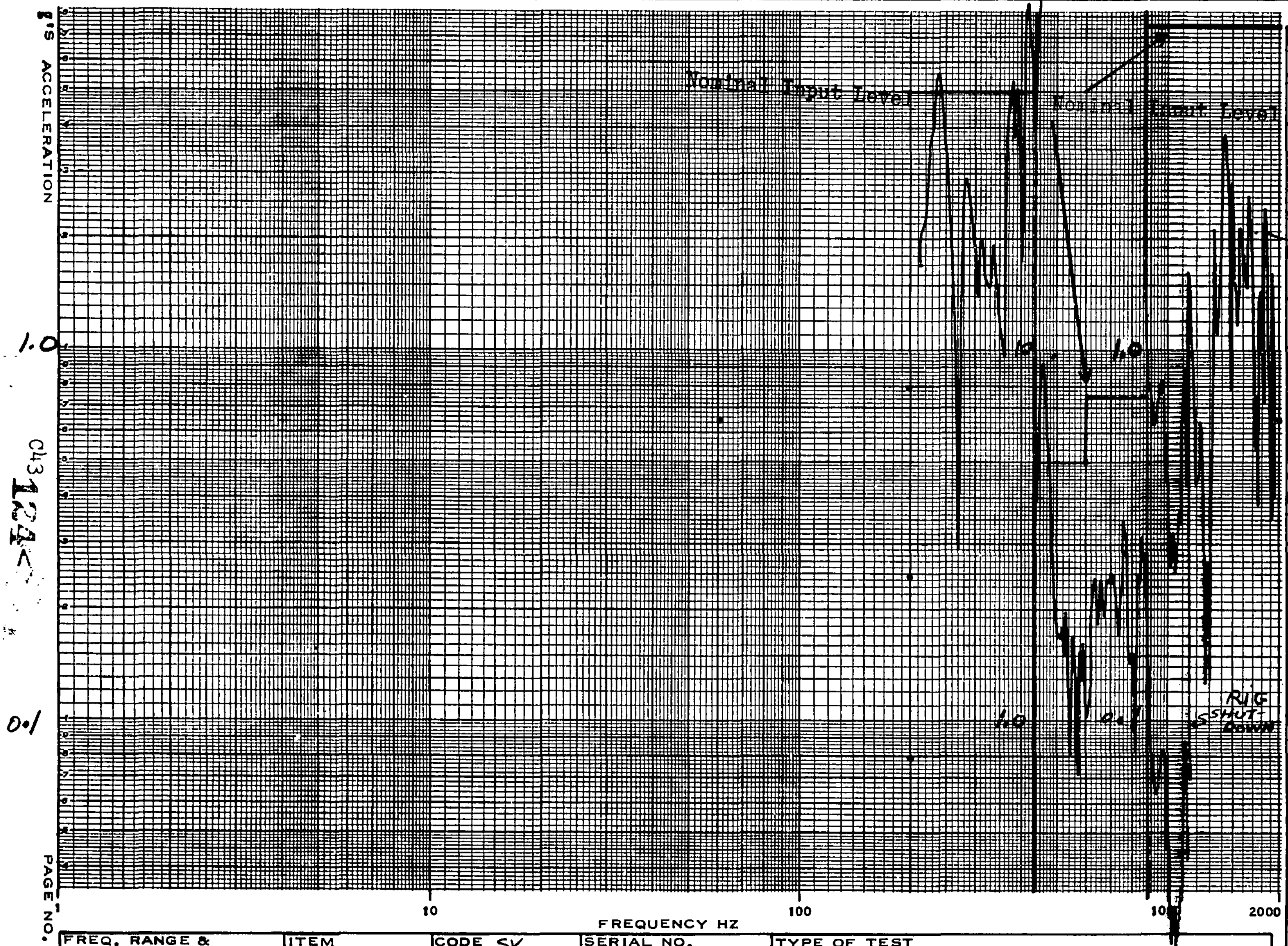
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 7	TEST NO. 3
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-15-72	TIME 1420



INPUT LEVEL ± 7.5 g

EXCIT. AXIS X

ACCEL S/N XN32

SENSING AXIS Y

ACCEL SENSITIVITY 1.261 MV RMS / GP

— COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPEREEL NO. 012295

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 73 °F

LOCATION EY

TANK MOUNT HOOK-UP #1

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH VCPS ONLY

REPORT NO.

FREQ. RANGE & DIRECTION 200–2000 Hz	ITEM VCPS	CODE SY 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 2	PHASE VCPS ONLY	NAME OF TEST SINUSOIDAL VIBRATION

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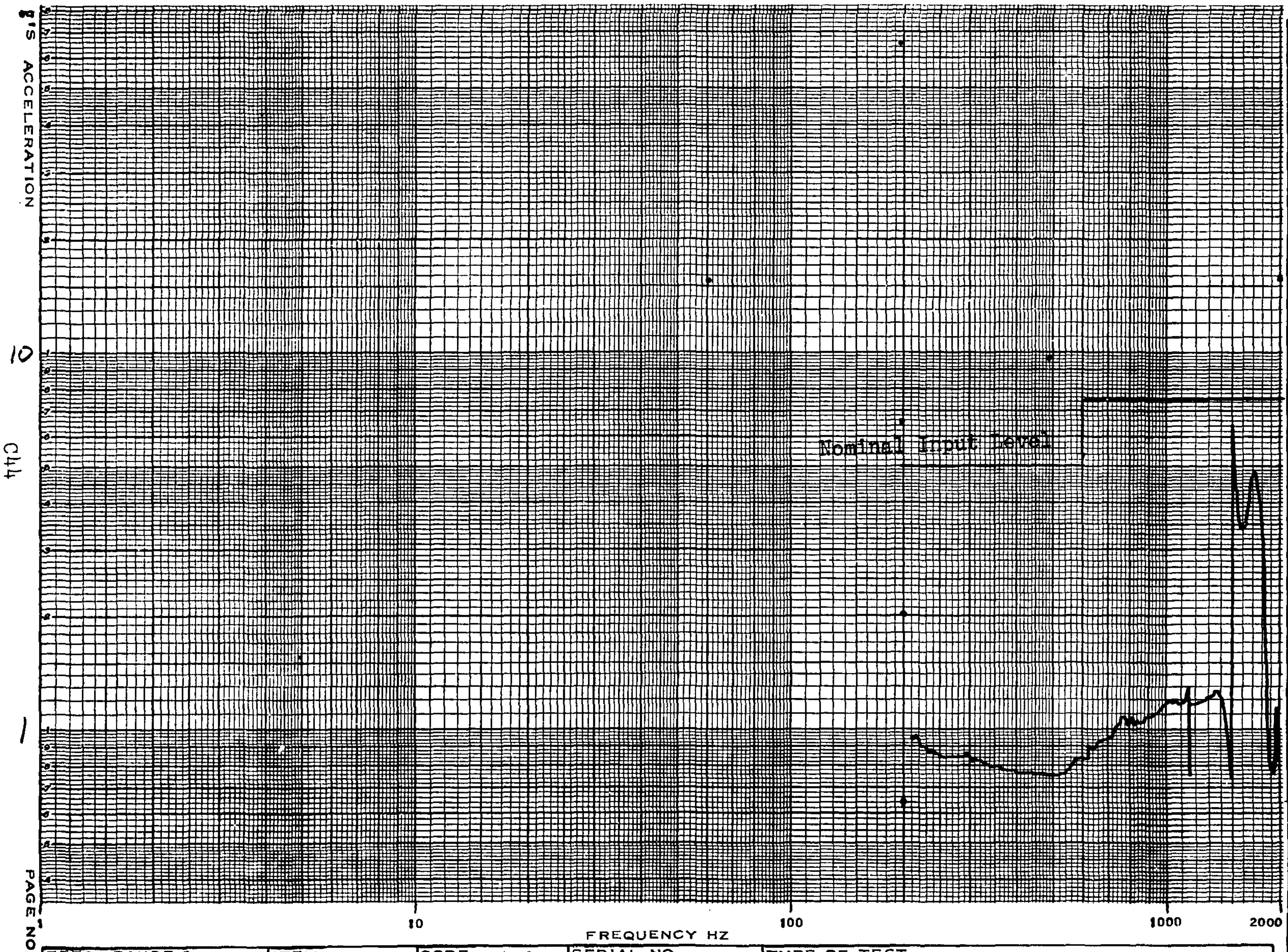
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 5
TEST NO.: 3
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-15-72
TIME: 1420



INPUT LEVEL: ± 7.5 g
EXCIT. AXIS: X
ACCEL S/N: NB62
SENSING AXIS: Z
ACCEL SENSITIVITY: 3.052 MV RMS / GP
— COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER: @ 700 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 73 °F
☐ CONTROL
☒ RESPONSE
LOCATION: A1Z
HOOK-UP # 1
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED

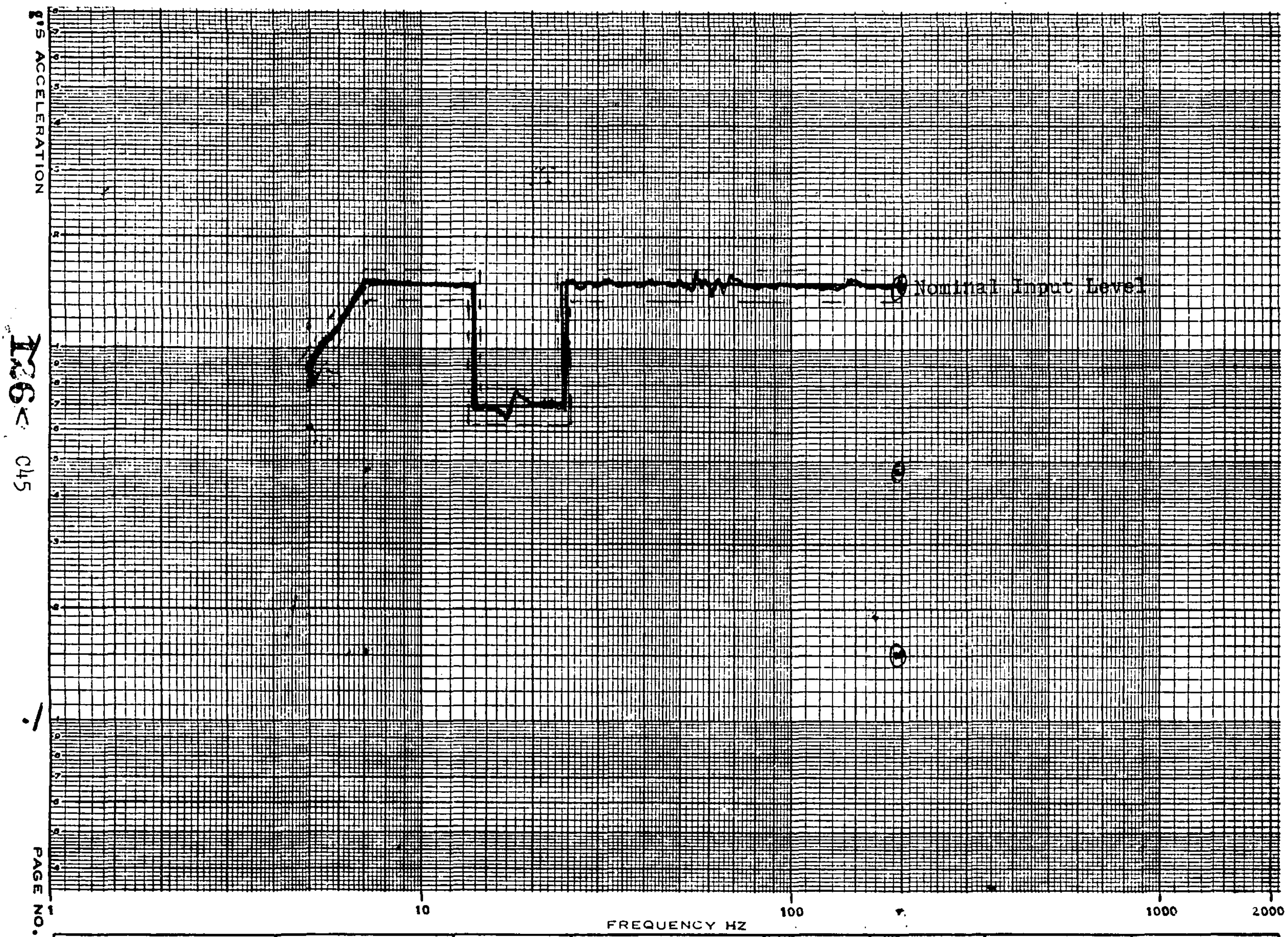
THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

FREQ. RANGE & DIRECTION: 200-2000HZ
ITEM: VCPS
CODE CV: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION
PARA.
AMEND.
PHASE
NAME OF TEST

Standard DIVISION OF UNITED AIRCRAFT CORPORATION HSF-1633.1 2/69

RIG 26	OPERATOR MICKET/JODOIN	WITNESS —	WITNESS M. Quinn	TEST NO. 11
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-18-72	TIME 0715



INPUT LEVEL 1.5 g	EXCIT. AXIS X
ACCEL S/N TD40	SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP 2.805 COL / GP	
FILTER 10-100-[redacted] HZ B.W.	
FILTER CROSSOVER @ 70-[redacted] HZ	
SWEEP RATE 4 OCT/MIN	
TAPEREEL NO. 012295	☒ LIVE ☐ FROM TAPE
COMPR. SPEED YAR DB/SEC.	
CHG.@ – HZ TO – DB/SEC.	
CHG.@ – HZ TO – DB/SEC.	
NON OPERATING	☒ CONTROL
TEMP. 74 °F	☐ RESPONSE
LOCATION A1X' HOOK-UP #1	
SPECIAL CONDITIONS VCPS LOADED + PRESSORIZED H₀ #1 SPEC MODIFIED BETWEEN 5-14Hz BY MIKE CALABRESE, PROJECT WAS COGNIZANT	REPORT NO.

FREQ. RANGE & DIRECTION 5-200Hz	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	SPEC. AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 1&3
ACTION SHEET NO. —	ATA NO. —	TYPE OF TEST QUAL		NAME OF TEST SINUSOIDAL VIB		

PAGE NO.

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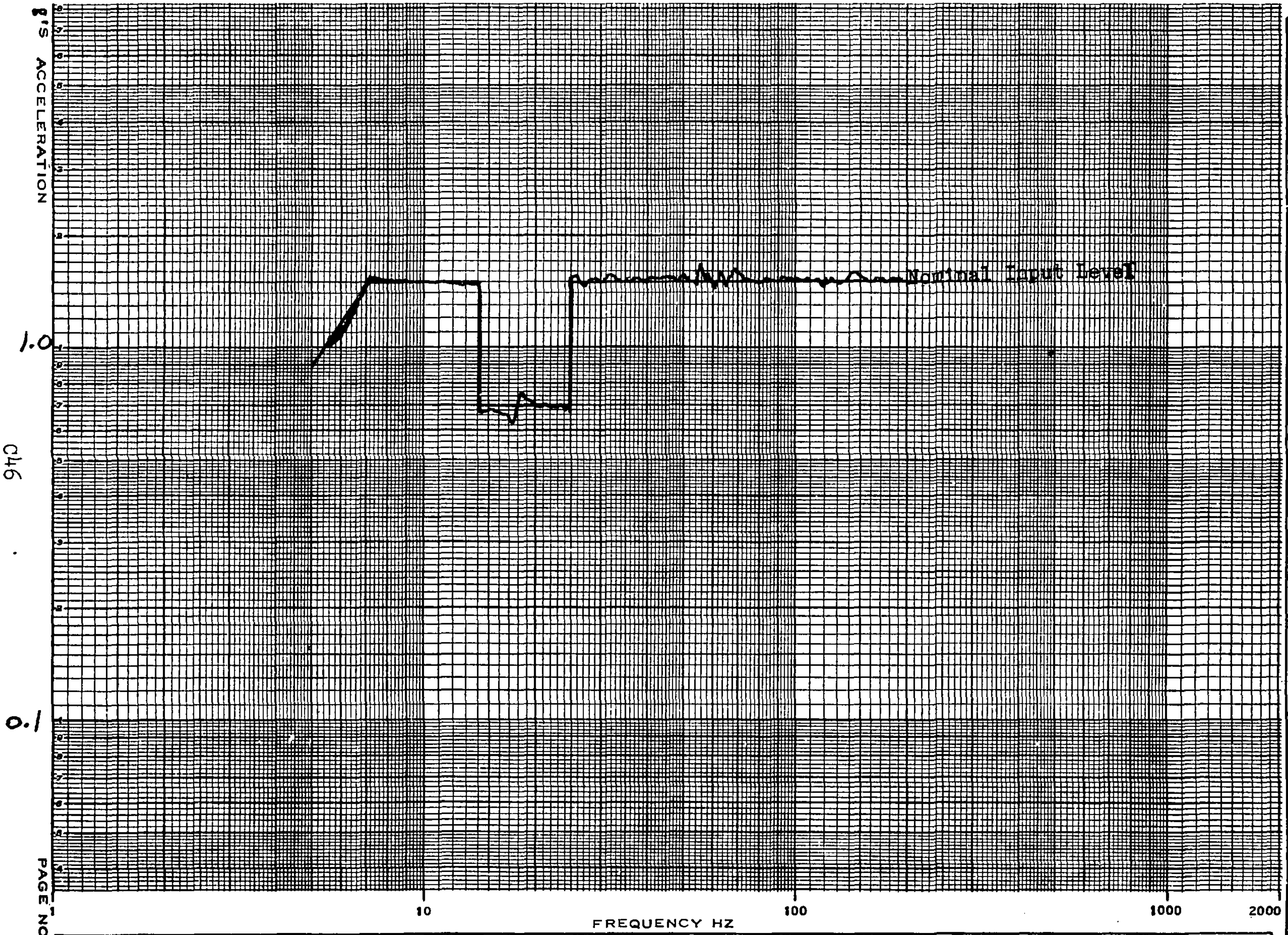
SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 30
TEST NO.: 11
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-18-72
TIME: 0715



INPUT LEVEL: ± 1.5 g
EXCIT. AXIS: X
ACCEL S/N: 7D40
SENSING AXIS: X
ACCEL SENSITIVITY: — MV RMS / GP
2.805 COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 74 °F
☒ CONTROL
☐ RESPONSE
LOCATION: AIX'

HOOK-UP #1

SPECIAL CONDITIONS: SPECIFICATION MODIFIED BETWEEN 5-14 HZ.

COMPLETE PACKAGE. VCPS LOADED AND PRESSURIZED.

REPORT NO.:

PAGE NO.:

FREQ. RANGE & DIRECTION: 5-200HZ
ITEM: RAE-B VCPS
CODE: SV 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION:
PARA.:
AMEND.:
PHASE: VCPS
NAME OF TEST:

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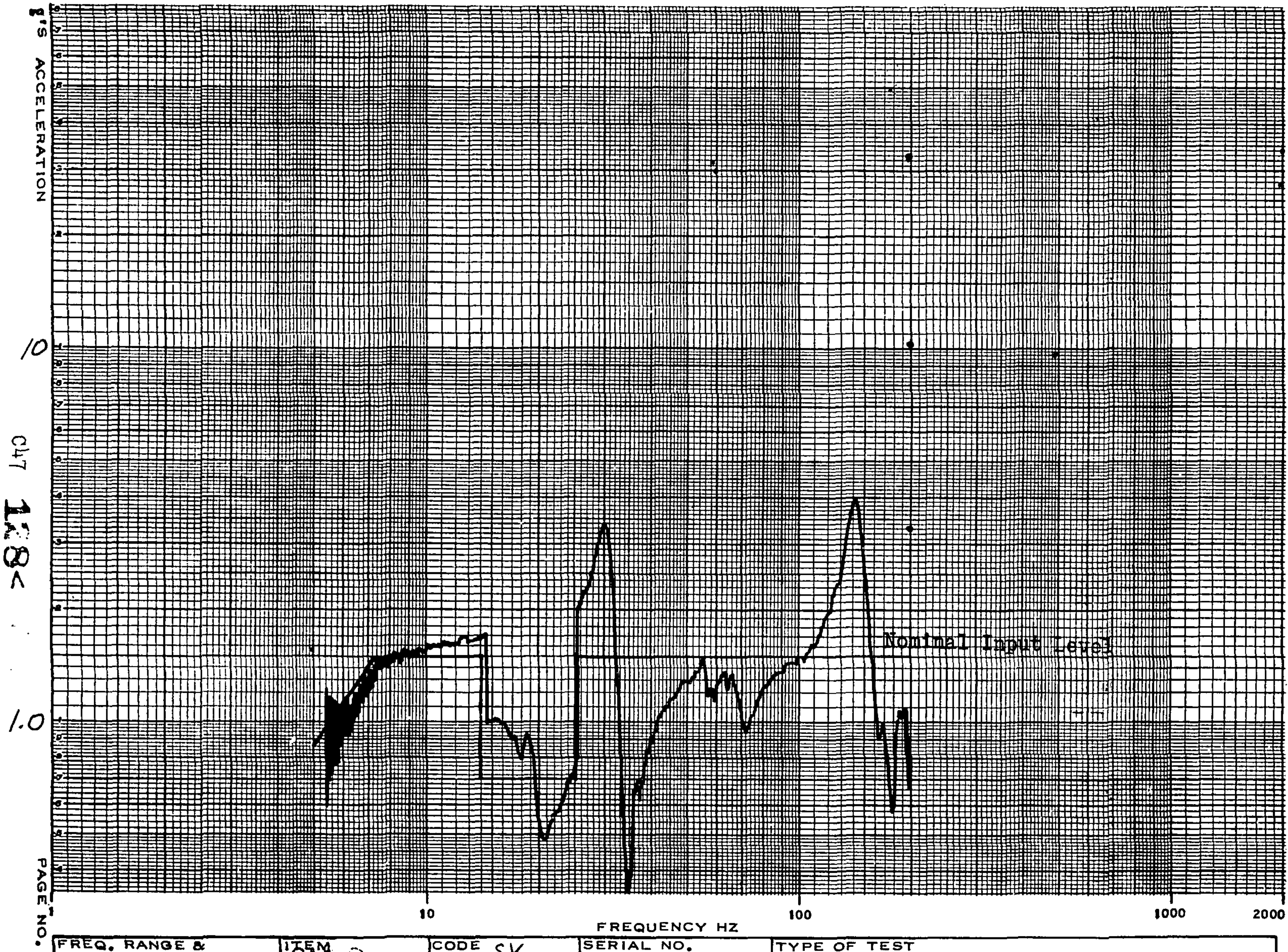
HSF 1633 A 2/69 **Standard**

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 39
TEST NO.: 11
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-18-72
TIME: 0715



INPUT LEVEL: ± 1.5 g
EXCIT. AXIS: X
ACCEL S/N: TD44
SENSING AXIS: X
ACCEL SENSITIVITY: 3.035 MV RMS / GP
— COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPEREEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 74 °F
☐ CONTROL
☒ RESPONSE
LOCATION: BX
HUB HOOK-UP#1
SPECIAL CONDITIONS: SPECIFICATION MODIFIED BETWEEN 5-14HZ
COMPLETE PACKAGE VCPS LOADED AND PRESSURIZED
REPORT NO.

FREQ. RANGE & DIRECTION: 5-200HZ
ITEM: RAE-B VCPS
CODE: SV 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION: AT-VCPS
PARA.: 4.3.7.5
AMEND.: NOTE 1&3
PHASE: VCPS AND SPACECRAFT
NAME OF TEST: SINUSOIDAL VIBRATION

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SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 34	TEST NO. 11
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-18-72	TIME 0715

INPUT LEVEL ± 1.5 g	EXCIT. AXIS X
ACCEL S/N 7045	SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP 2.650 COL / GP	
FILTER 10/100 HZ B.W.	
FILTER CROSSOVER @ 70 HZ	
TAPEREELNO. 012295	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC CHG@ — HZ TO — DB/SEC CHG@ — HZ TO — DB/SEC	
NON-OPERATING TEMP. 74 °F	☐ CONTROL ☒ RESPONSE
LOCATION CX SPACECRAFT C.G. HOOK-UP #1	
SPECIAL CONDITIONS SPECIFICATION MODIFIED BETWEEN 5-14Hz COMPLETE PACKAGE. VCPS LOADED AND PRESSURIZED	

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-200HZ	ITEM RAE-B VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION	PARA.	AMEND.	PHASE VCPS	NAME OF TEST

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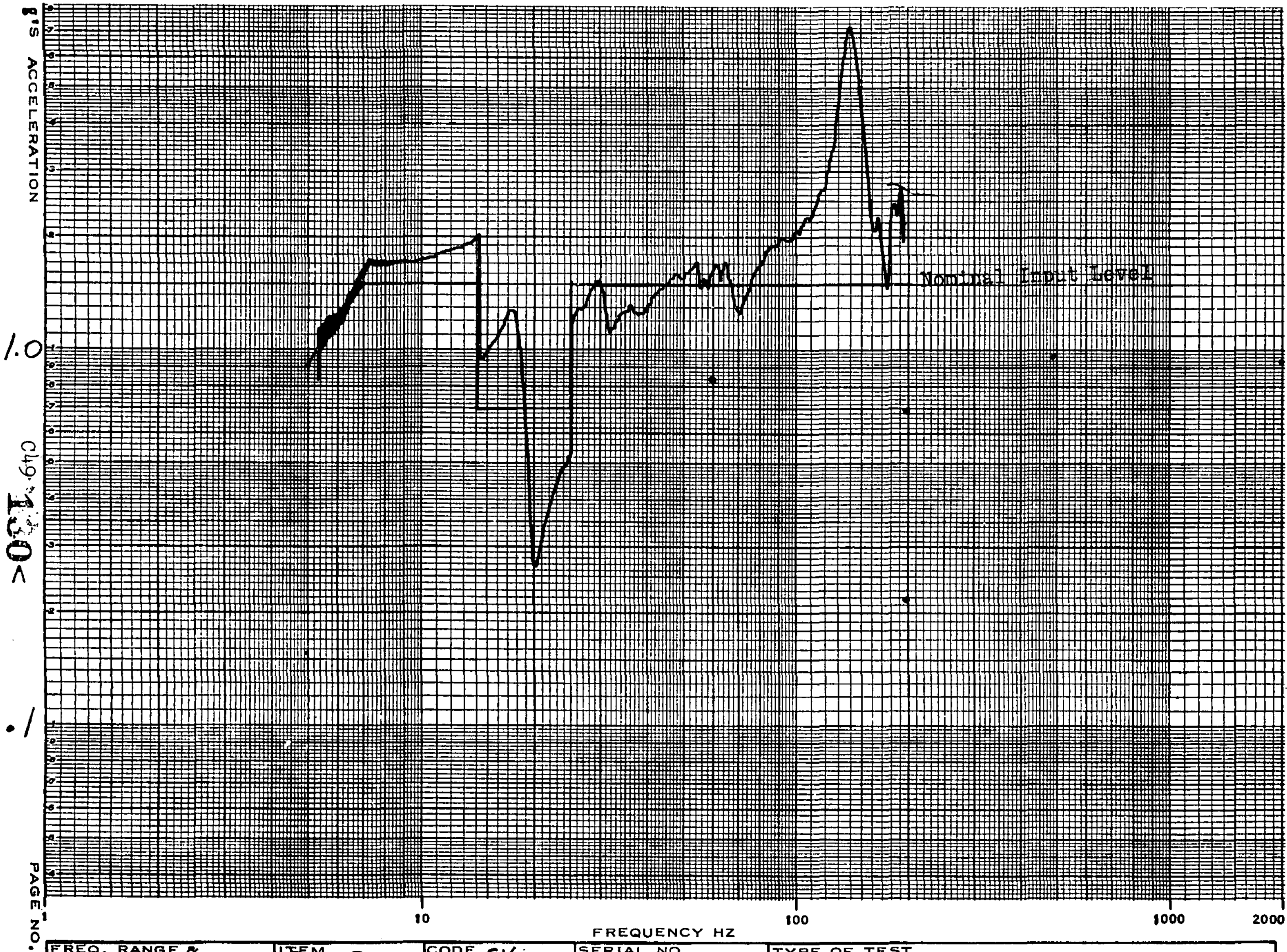
SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 32
TEST NO.: 11
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-18-72
TIME: 0715



INPUT LEVEL: ± 1.5 g
EXCIT. AXIS: X
ACCEL S/N: XM21
SENSING AXIS: X
ACCEL SENSITIVITY: — MV RMS / GP; 1.370 COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPEREEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION: DX
REA MOUNT
HOOK-UP#1
SPECIAL CONDITIONS: SPECIFICATION MODIFIED BETWEEN 5-14HZ
COMPLETE PACKAGE. VCPS LOADED AND PRESSURIZED.
REPORT NO.

FREQ. RANGE & DIRECTION: 5-200HZ
ITEM: RAE-B VCPS
CODE SV: 748720-1
SERIAL NO.: 0000/
TYPE OF TEST: QUAL
SPECIFICATION: AT-VCPS
PARA.: 4.3.7.5
AMEND.: NOTE 1 & 3
PHASE: VCPS AND SPACECRAFT
NAME OF TEST: SINUSOIDAL VIBRATION

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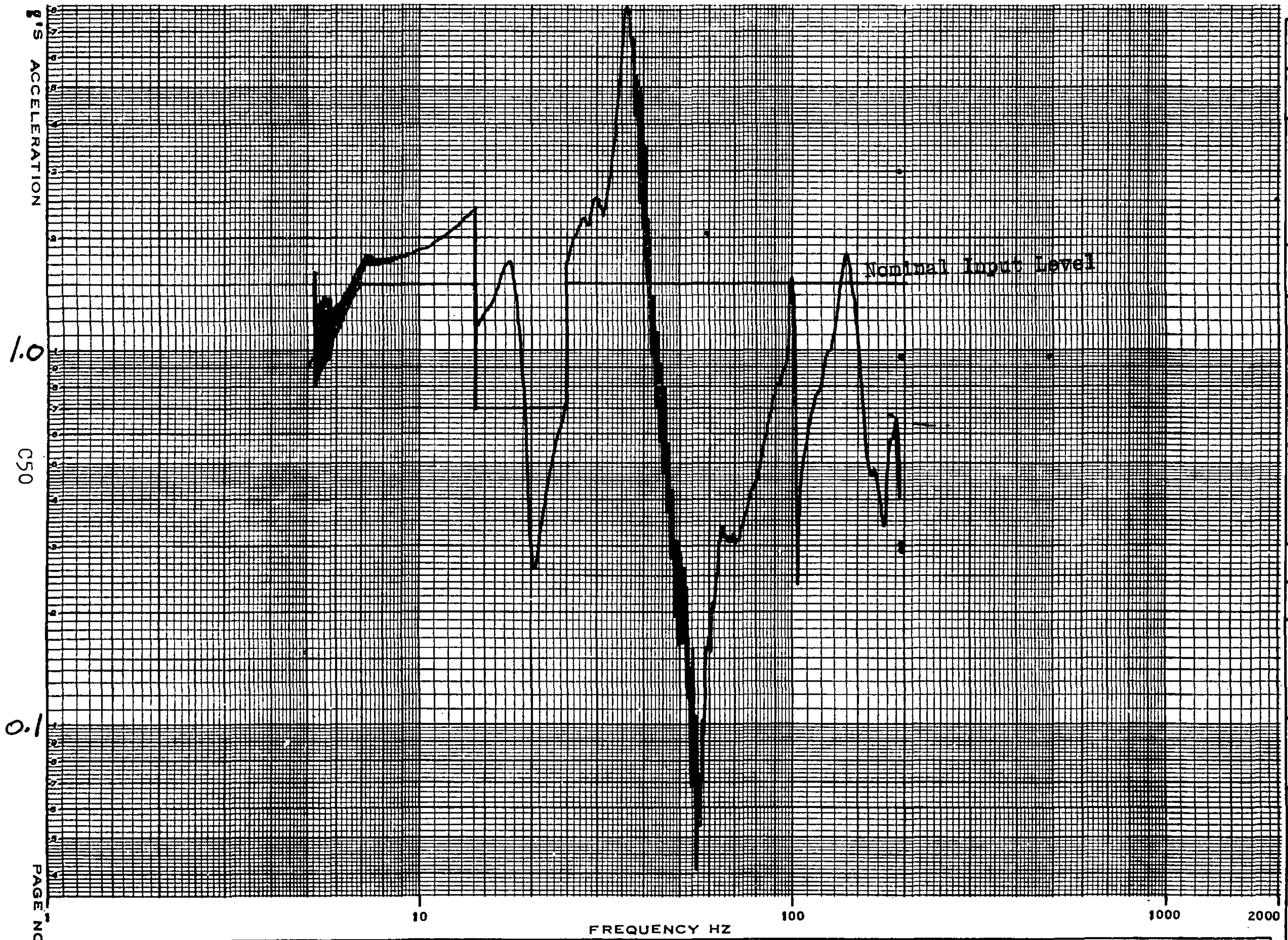
SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	JODOIN	33	11

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	PAE-B	4-18-72	0715



C50

INPUT LEVEL ± 1.5 g

EXCIT. AXIS X

ACCEL S/N WF75

SENSING AXIS X

ACCEL SENSITIVITY — MV RMS / GP

1.051 COL / GP

FILTER 10/100 HZ B.W.

FILTER CROSSOVER @ 70 HZ

TAPE REEL NO. 012295

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 74 °F

LOCATION EX

TANK MOUNT HOOK-UP #1

SPECIAL CONDITIONS

SPECIFICATION MODIFIED BETWEEN 5-14 Hz

COMPLETE PACKAGE. VCPS LOADED AND PRESSURIZED.

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	TYPE OF TEST
5-200 Hz	PAE-B	SV 748720-1	00001	QUAL

SPECIFICATION PARA. AMEND. PHASE VCPC NAME OF TEST

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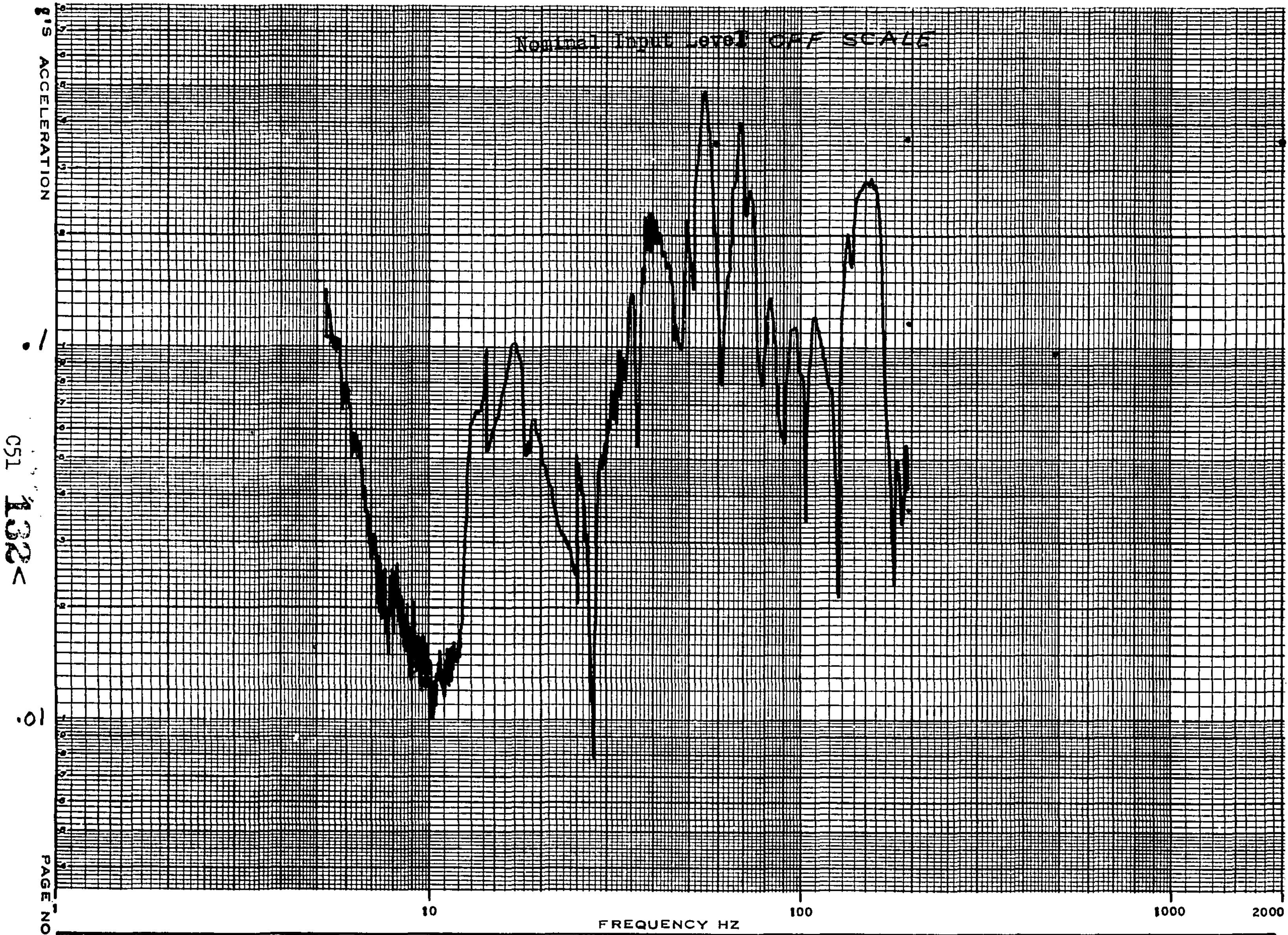
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 31	TEST NO. 11
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-18-72	TIME 0715



INPUT LEVEL ± 1.5 g
EXCIT. AXIS X
ACCEL S/N TE83
SENSING AXIS Y
ACCEL SENSITIVITY — MV RMS / GP; 2.722 COL / GP
FILTER 10/100 HZ B.W.
FILTER CROSSOVER @ 70 HZ
TAPEREEL NO. 012295
SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION A1Y

HOOK-UP #1

SPECIAL CONDITIONS
SPECIFICATION MODIFIED BETWEEN 5-14HZ

COMPLETE PACKAGE VCPS LOADED AND PRESSURIZED

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-200HZ	ITEM RAE-B VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 1 & 3	PHASE VCPS AND SPACECRAFT	NAME OF TEST SINUSOIDAL VIBRATION

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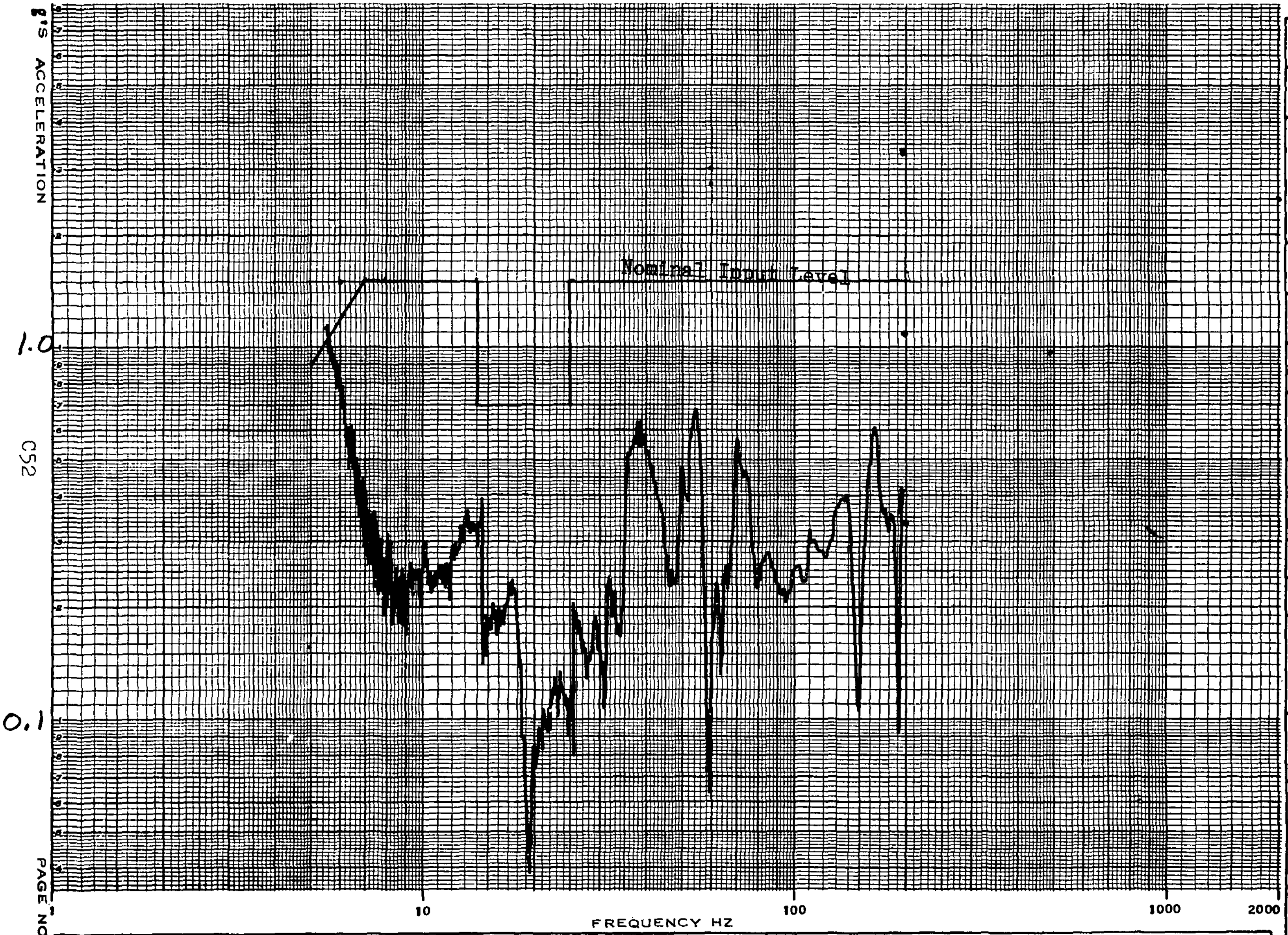
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 40	TEST NO. 11
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-18-72	TIME 0715



INPUT LEVEL ± 1.5 g	EXCIT. AXIS X
ACCEL S/N WR11	SENSING AXIS Y
ACCEL SENSITIVITY 3.016 MV RMS / GP	
— COL / GP	
FILTER 10/100 HZ B.W.	
FILTER CROSSOVER @ 70 HZ	
TAPE REEL NO. 012295	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC	
CHG@ — HZ TO — DB/SEC	
CHG@ — HZ TO — DB/SEC	
NON-OPERATING	☐ CONTROL
TEMP. 74 °F	☒ RESPONSE
LOCATION BY HUB HOOK-UP #1	
SPECIAL CONDITIONS SPECIFICATION MODIFIED BETWEEN 5-14HZ COMPLETE PKG. VCPS LOADED AND PRESSURIZED	

REPORT NO.

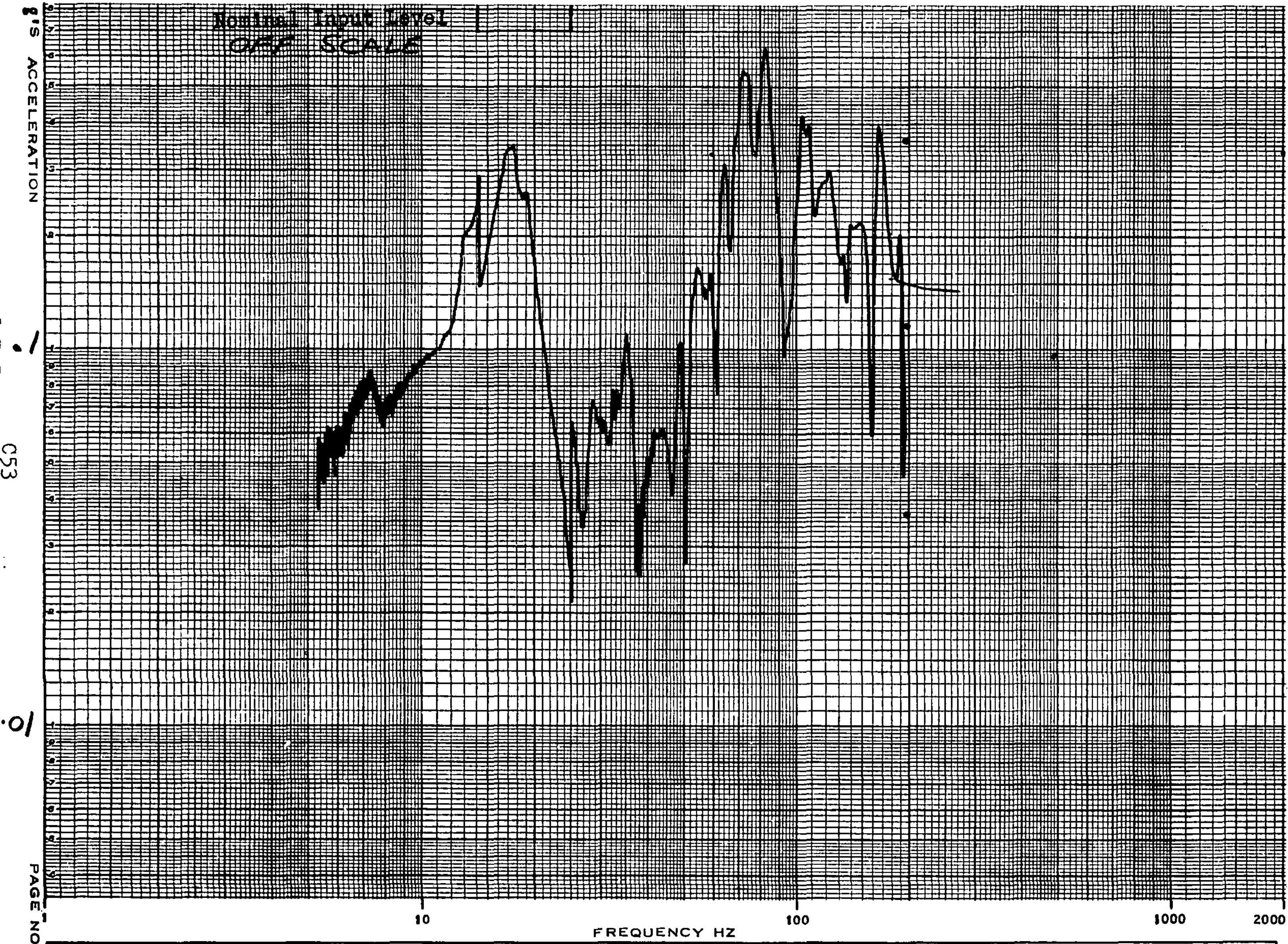
FREQ. RANGE & DIRECTION 5-200Hz	ITEM RAE-B VCPS	CODE SY 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION	PARA.	AMEND.	PHASE VCPS	NAME OF TEST

PAGE NO.

HSF 1633 A 2/69 **Standard** DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 35
TEST NO.: 11
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-18-72
TIME: 0715



INPUT LEVEL: ± 1.5 g
EXCIT. AXIS: X
ACCEL S/N: TD48
SENSING AXIS: Y
ACCEL SENSITIVITY: — MV RMS / GP
2.788 COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 74 °F
☐ CONTROL
☒ RESPONSE
LOCATION: CY
SPACECRAFT C.G.
HOOK-UP #1
SPECIAL CONDITIONS: SPECIFICATION MODIFIED BETWEEN 5-14HZ
COMPLETE PKG
VCPS LOADED AND
PRESSURIZED
REPORT NO.

FREQ. RANGE & DIRECTION: 5-200HZ
ITEM: RAE-B VCPS
CODE SV: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION: AT-VCPS
PARA.: 4.3.7.5
AMEND.: NOTE 1&3
PHASE: VCPS AND SPACECRAFT
NAME OF TEST: SINUSOIDAL VIBRATION

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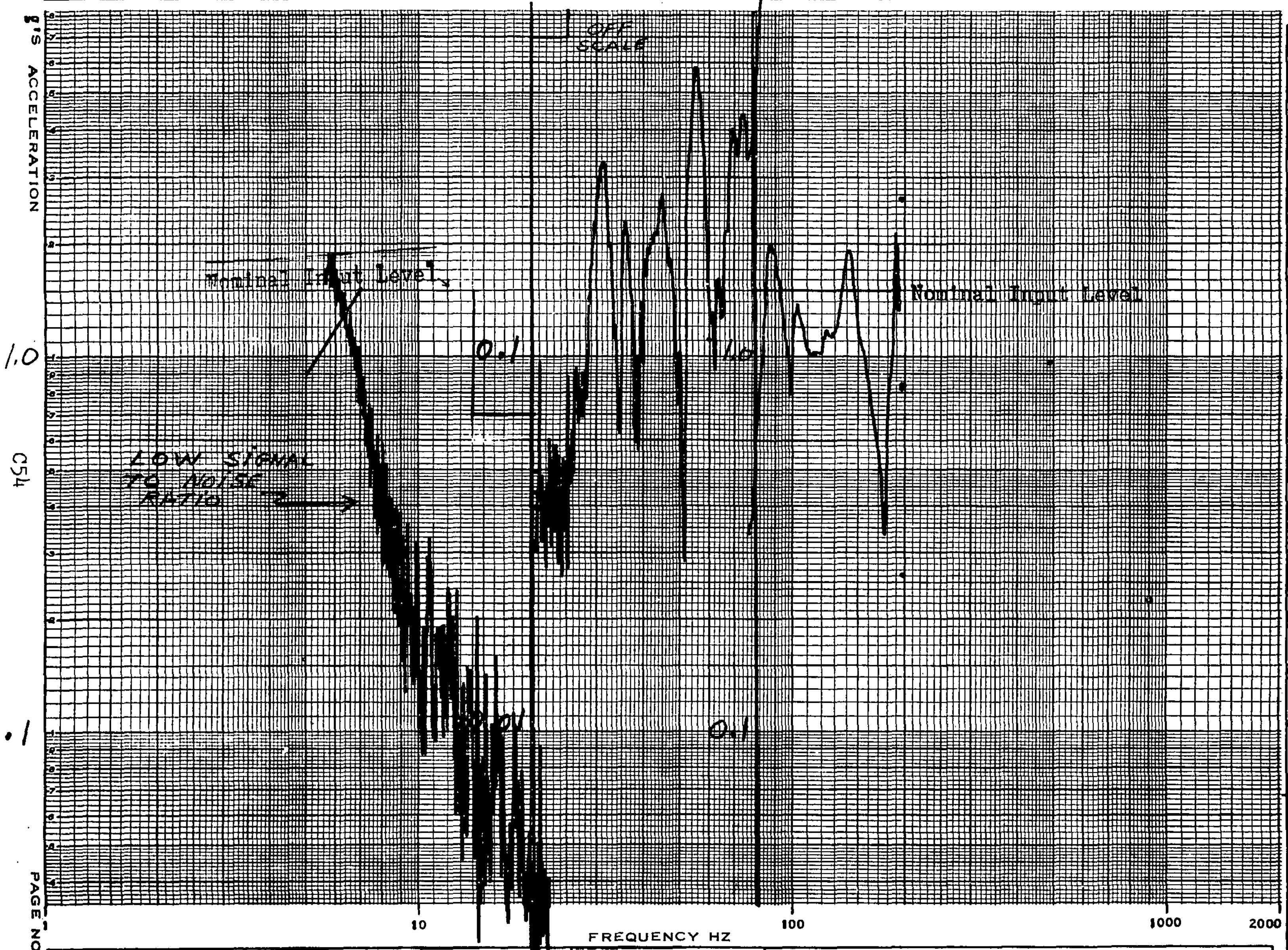
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 37	TEST NO. 11
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-18-72	TIME 0715



INPUT LEVEL ± 1.5 g	EXCIT. AXIS X
ACCEL S/N YK20	SENSING AXIS Y
ACCEL SENSITIVITY 1.523 MV RMS / GP — COL / GP	
FILTER 10/100 HZ B.W.	
FILTER CROSSOVER @ 70 HZ	
TAPEREELNO. 01229S	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC	
CHG@ — HZ TO — DB/SEC	
CHG@ — HZ TO — DB/SEC	
NON-OPERATING TEMP. 74 °F	☐ CONTROL ☒ RESPONSE
LOCATION DY REA MOUNT HOOK-UP #1	
SPECIAL CONDITIONS SPECIFICATION MODIFIED BETWEEN 5-14Hz.	
COMPLETE PKG VCPS LOADED AND PRESSURIZED	REPORT NO.

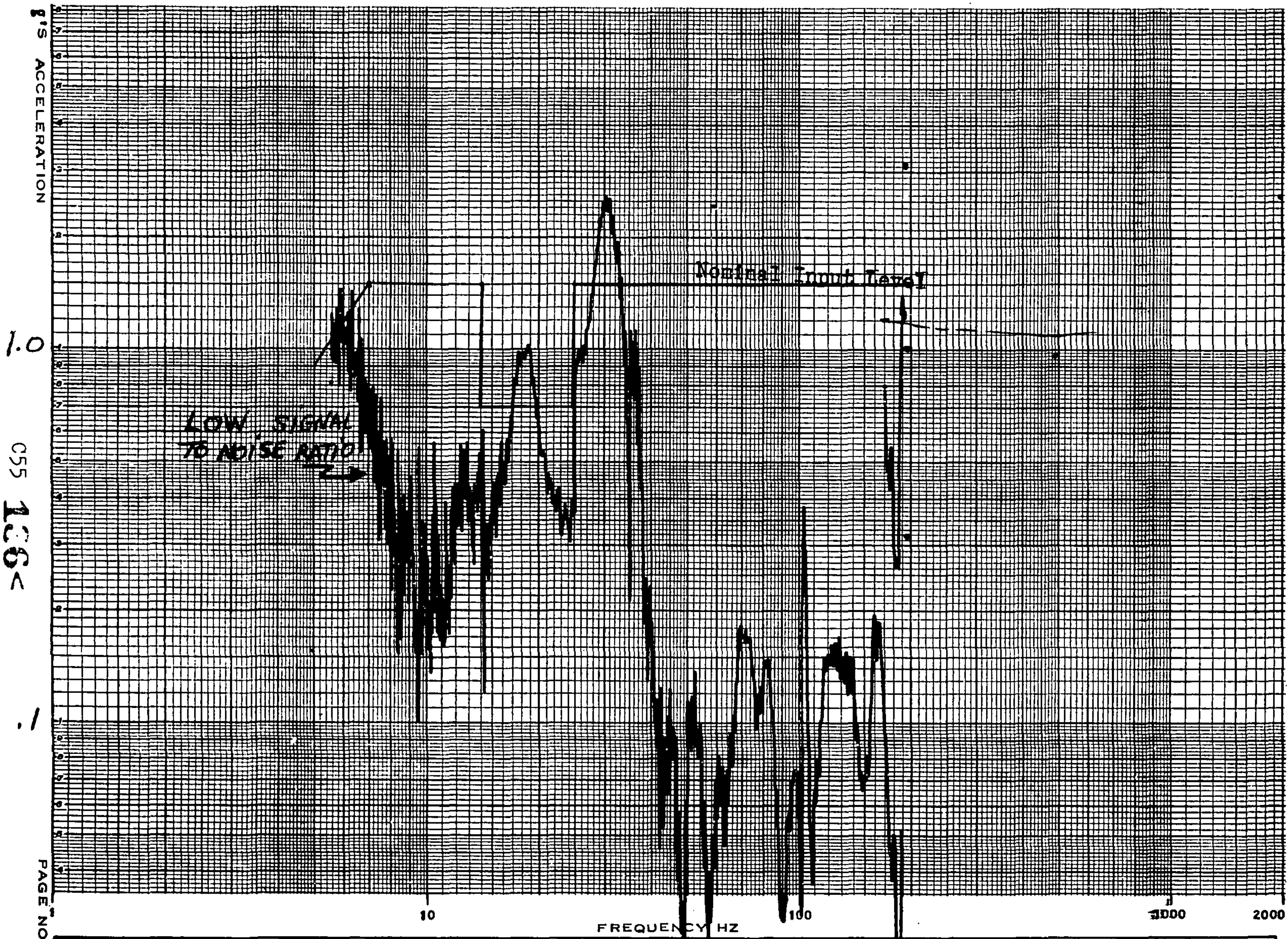
FREQ. RANGE & DIRECTION 5-200Hz	ITEM RAE-B VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION	PARA.	AMEND.	PHASE VCPS	NAME OF TEST

HSF 1633 A 2/69 **Standard** A®

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	JODOIN	33	11

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	[illegible]	4-18-72	0715



INPUT LEVEL ± 1.5 g

EXCIT. AXIS X

ACCEL S/N XN32

SENSING AXIS Y

ACCEL SENSITIVITY 1.261 MV RMS / GP

— COL / GP

FILTER 10/100 HZ B.W.

FILTER CROSSOVER @ 70 HZ

TAPE REEL NO. 012295

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 74 °F

☐ CONTROL

☒ RESPONSE

LOCATION EY TANK MOUNT HOOK-UP #1

SPECIAL CONDITIONS SPECIFICATION MODIFIED BETWEEN 5-14HZ

COMPLETE PKG.

VCPS LOADED AND PRESSURIZED

REPORT NO.

FREQ. RANGE & DIRECTION	ITEM	CODE SV	SERIAL NO.	TYPE OF TEST
5-200HZ	RNE-C VCPS	748720-1	00001	QUAL

SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
AT-VCPS	4.3.7.5	NOTE 1 & 3	VCPS AND SPACECRAFT	SINUSOIDAL VIBRATION

PAGE NO.

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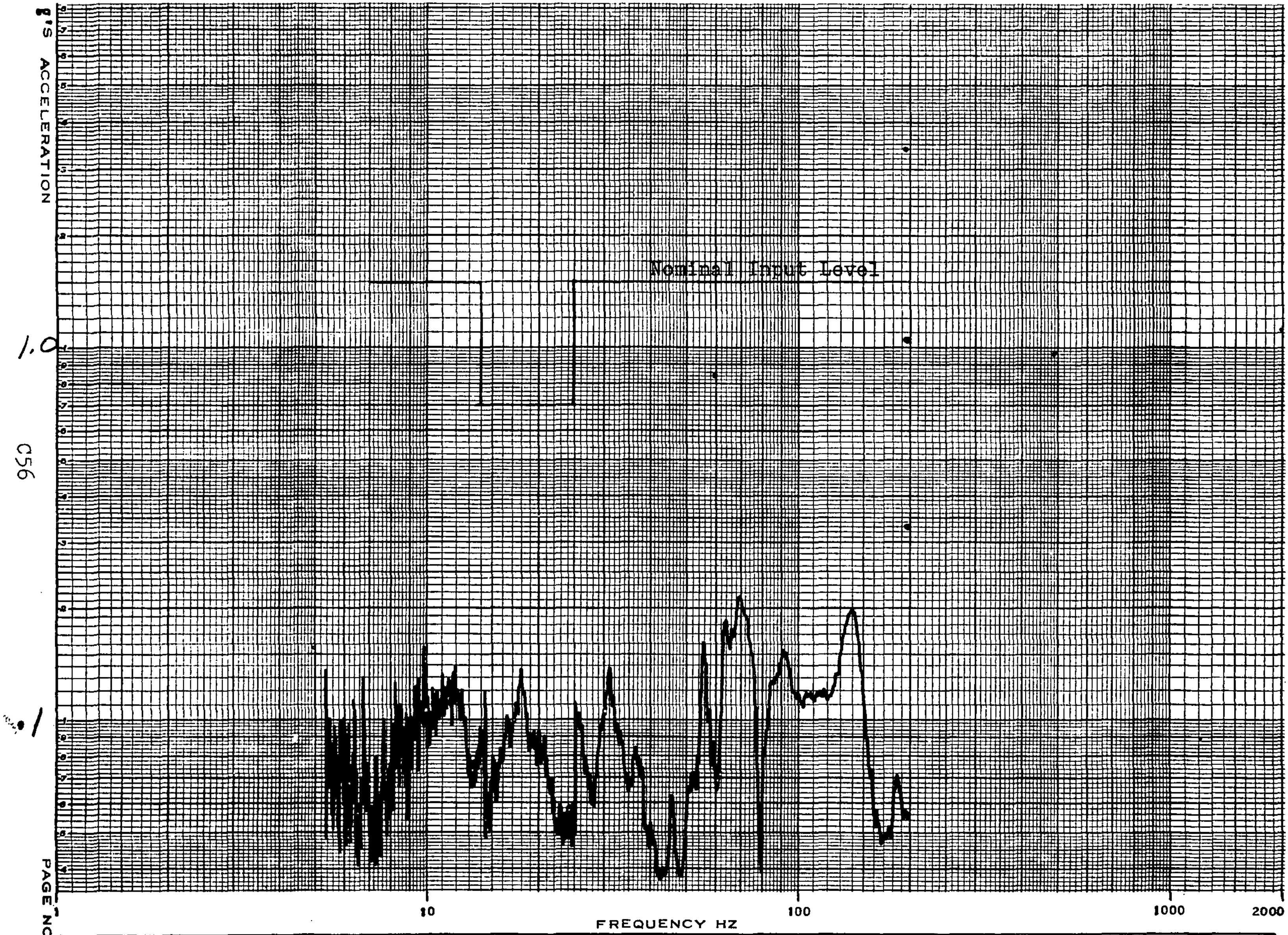
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 36
TEST NO.: 11
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-18-72
TIME: 0715



INPUT LEVEL: ± 1.5 g
EXCIT. AXIS: X
ACCEL S/N: NB62
SENSING AXIS: Z
ACCEL SENSITIVITY: 3.052 MV RMS / GP; — COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION: A1Z
SPECIAL CONDITIONS: SPECIFICATION MODIFIED BETWEEN 5-14HZ

COMPLETE PKG
VCPS LOADED AND PRESSURIZED

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION: 5-200HZ
ITEM: RAE-B VCPS
CODE: SV 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION
PARA.
AMEND. —
PHASE: VCPS
NAME OF TEST

C56

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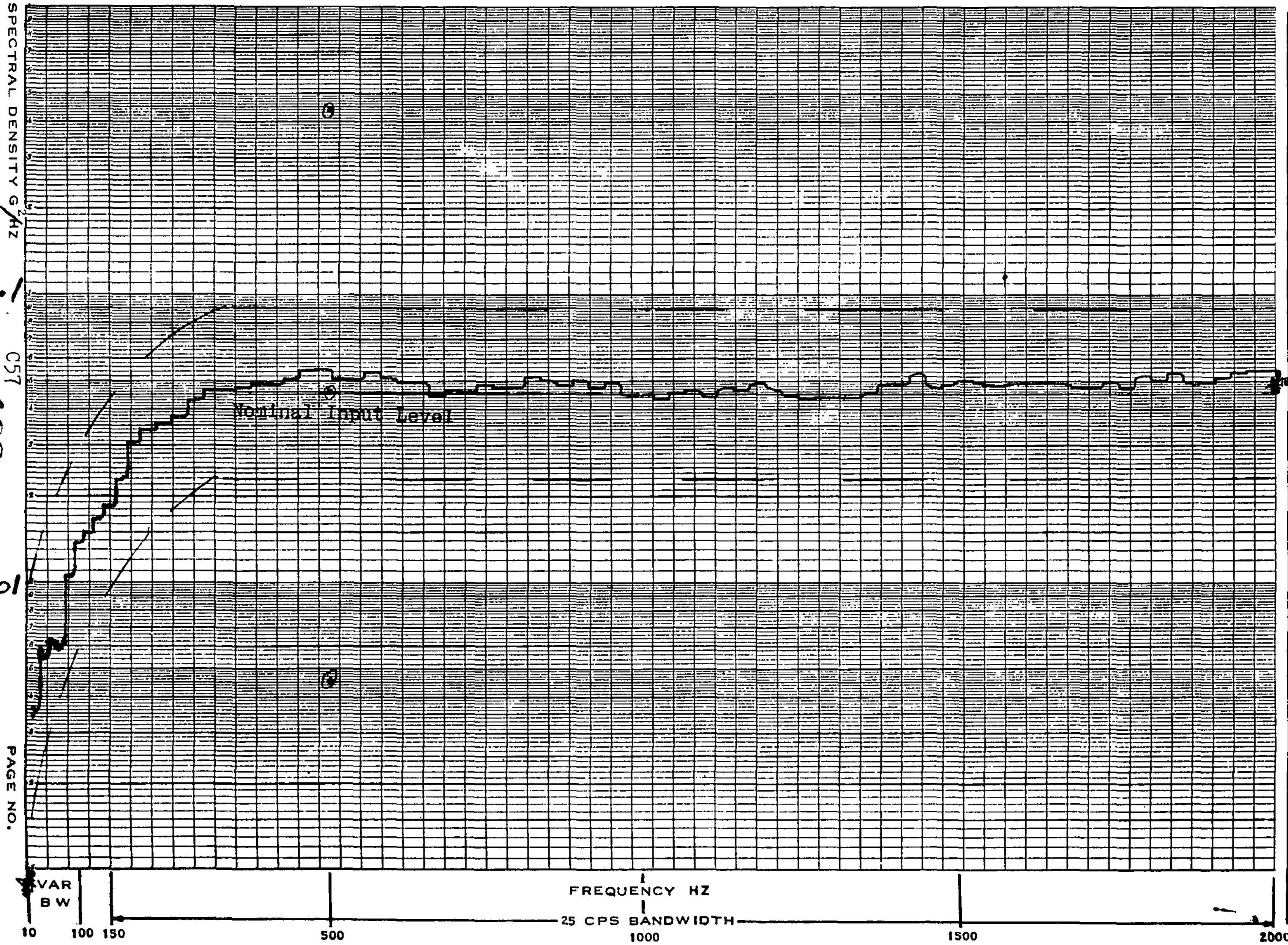
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD A

PLOTTED BY MICKET	CHECKED BY GEIB	TEST ENGINEER MEHMED		RIG NO. 26	WITNESS M.	WITNESS —
PROJECT RAE-B	ITEM VCPS	CODE SV748720-1		SERIAL NO. 00001	TYPE OF TEST QUAL	
SPEC. AT-VCPS	PARA. 4.3.7.5	PHASE COMPLETE PKG RANDOM VIB	ATA NO. —	ACTION SHEET NO. —	DATE 4-18-72	TEST NO. 10



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EXCITATION ALONG X AXIS

GRMS INPUT 9.2

NON-OPERATING

TEMP. 74 °F

PERIOD OF TEST ☑ START ☐ END

DURATION OF TEST 2.0 MIN.

ACCEL. SERIAL NO. TD40

ACCEL. SENSITIVITY — MV RMS/GP

2.805 COL/GP

ACCEL. SENSING X AXIS

ACCEL. LOCATION A1X'

HOOK-UP #1

TAPEREEL NO. 012295

SPECIAL CONDITIONS VCPS LOADED & PRESSURIZED HU #1

NOTE # 1+4 AT sheets

REPORT NO.

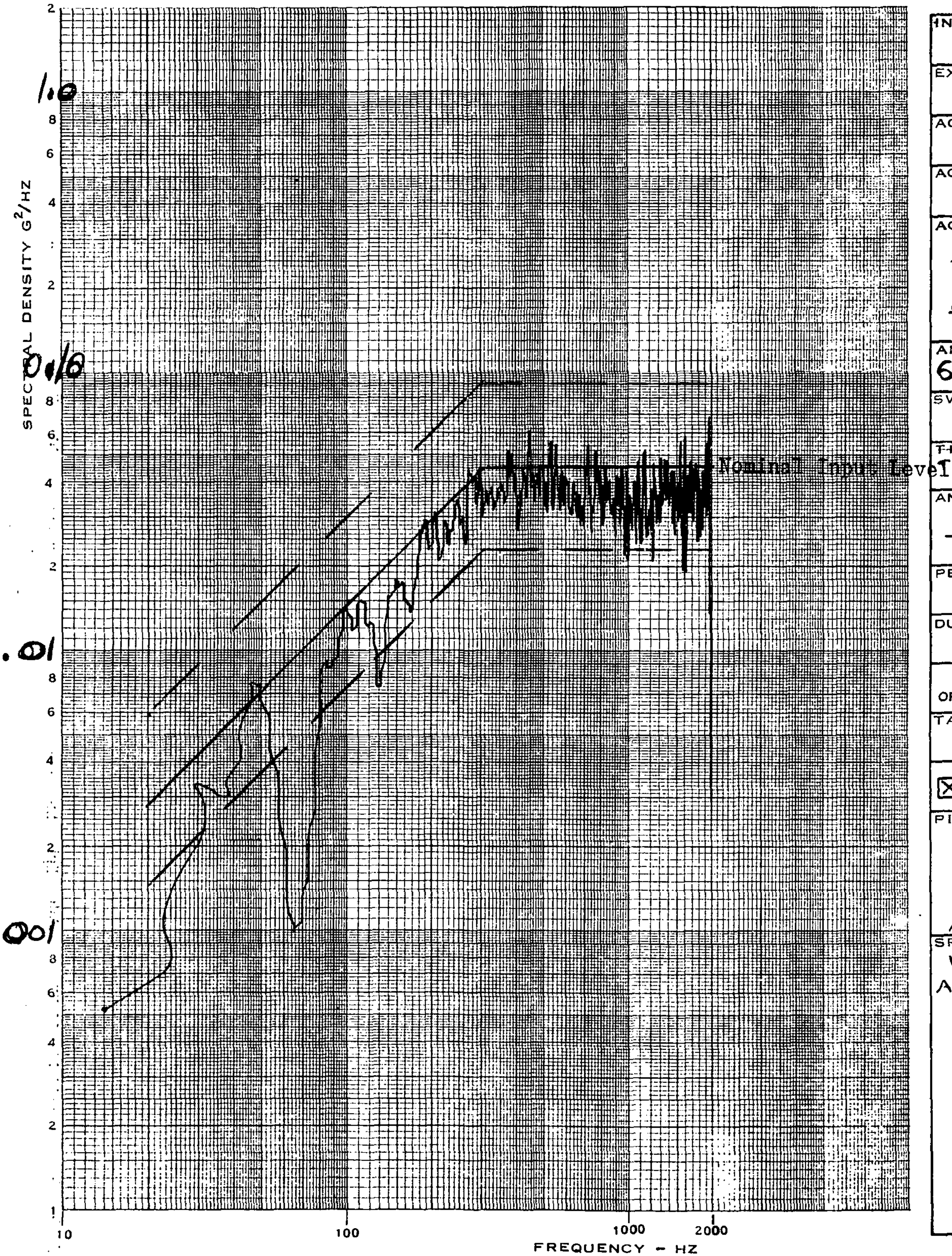
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26
OPERATOR B. M.
PLOTTED BY S. M.
TRACE NO. 13
TEST NO. 10
TEST ENGINEER S. M.
CHECKED BY T. G.
DATE 4-18-72
TIME 0650



INPUT LEVEL 9.2 GRMS
EXCITATION AXIS X
ACCEL SERIAL NUMBER TD40
ACCEL SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP
2.805 COL / GP
ANAL FILTER - HZ B.W. 6
SWEEP SPEED - OCT/MIN
TIME CONSTANT - SEC
ANNAL. CALIBRATION 11.23 g^2/HZ F.S.
PERIOD OF TEST ☐ START ☒ END
DURATION 2.0 MIN
NON OPERATING
TEMP. 74 °F
TAPE REEL NO. 012295
☒ CONTROL ☐ RESPONSE
PICKUP LOCATION AIX
Hook-up #1
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.

PROJECT RAE-B
ITEM VCPS
CODE SV 748720-1
SERIAL NUMBER 00001
TYPE OF TEST QUAL
SPEC. AT-VCPS
PARA. 4.3.7.5
AMEND. NOTE 1&4
PHASE VCPS AND SPACECRAFT
RANDOM —
PAGE NO.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

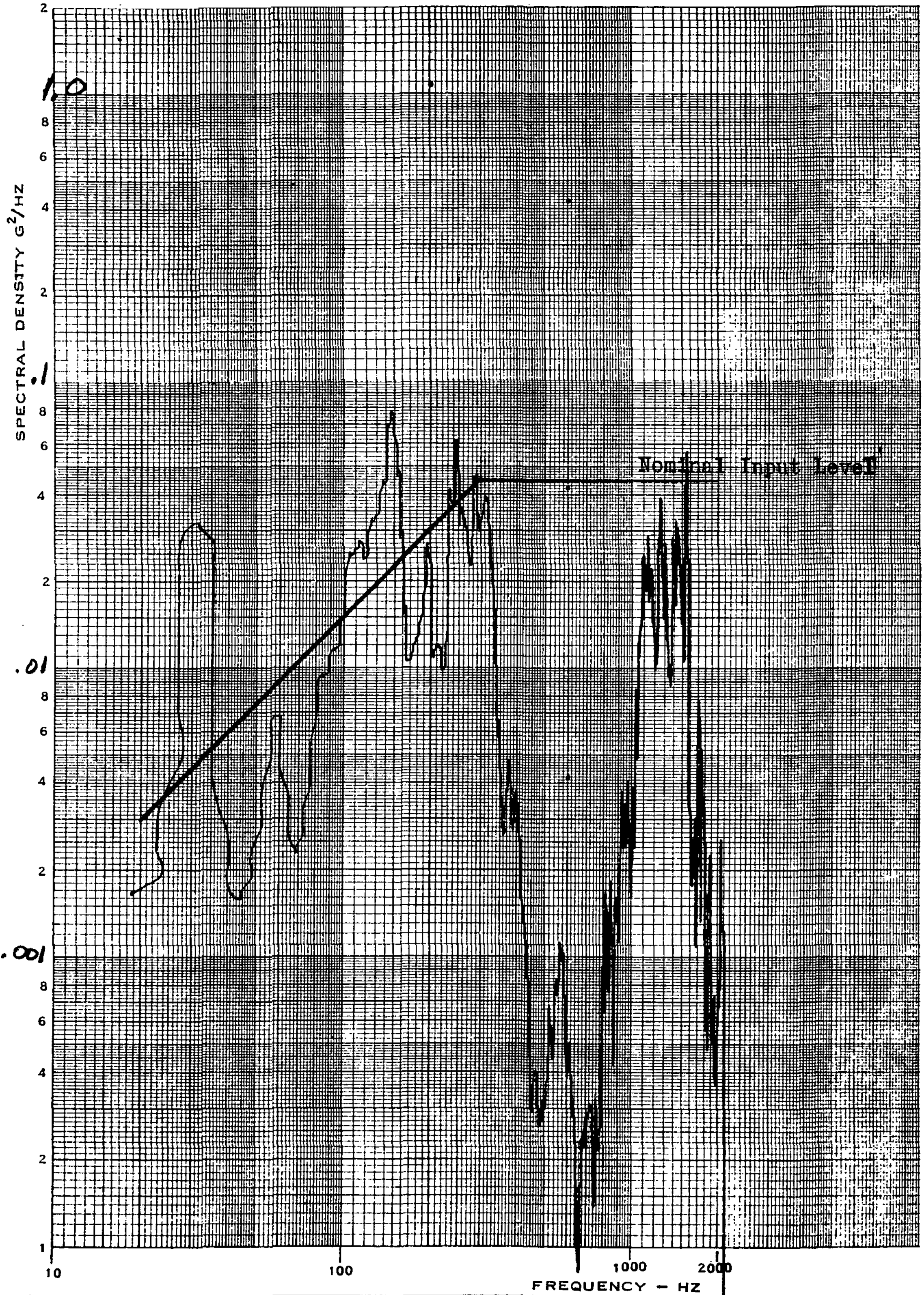
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	MICKET	MEHMED	22	10

TEST ENGINEER	CHECKED BY	DATE	TIME
MEHMED.	GEIB	4-18-72	0650



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS X

ACCEL SERIAL NUMBER TD44

ACCEL SENSING AXIS X

ACCEL SENSITIVITY 3.035 MV RMS / GP

— COL / GP

ANAL FILTER - HZ B.W. 6 [redacted] | [redacted] | [redacted]

SWEEP SPEED - OCT/MIN [redacted] | [redacted] | [redacted]

TIME CONSTANT - SEC [redacted] | [redacted] | [redacted]

ANNAL. CALIBRATION 108.26 g^2/HZ F.S.

PERIOD OF TEST ☐ START ☒ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION Bx
HUB
HOOK-UP #1

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT	ITEM	CODE	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	SY 748720-1	00001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7.5	NOTE 1 & 4	VCPS AND SPACECRAFT	—	

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

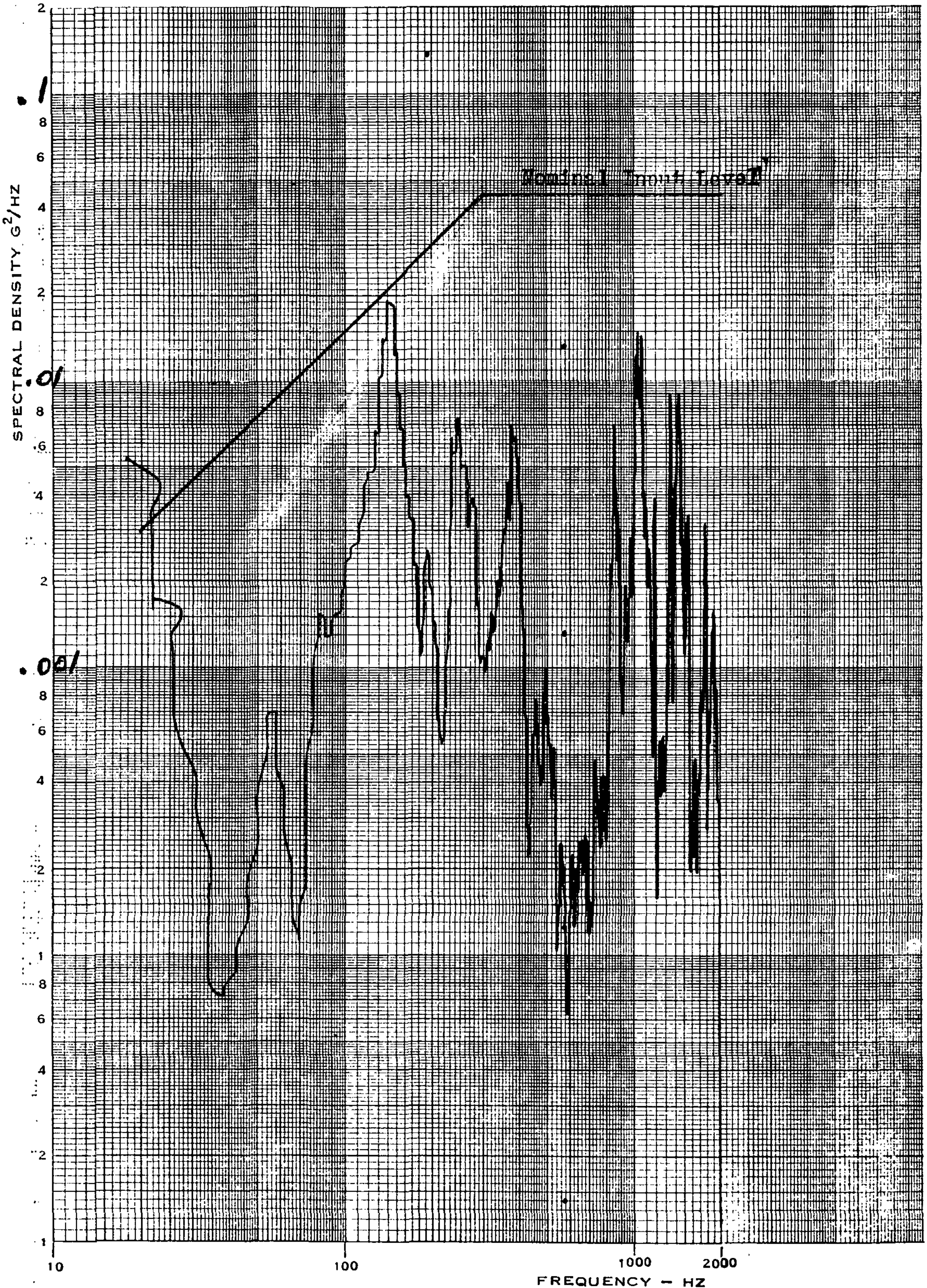
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	B. M	S. M.	17	10

TEST ENGINEER	CHECKED BY	DATE	TIME
S. M.	T. G.	4-18-72	0650



INPUT LEVEL 9.2 GRM

EXCITATION AXIS X

ACCEL SERIAL NUMBER TD45

ACCEL SENSING AXIS X

ACCEL SENSITIVITY — MV RMS / GP
2.650 COL / GP

ANAL FILTER – HZ B.W. 6 ■ | ■ | ■

SWEEP SPEED – OCT/MI ■ | ■ | ■

TIME CONSTANT – SEC ■ | ■ | ■

ANNAL. CALIBRATION 1.398 g²/HZ F.S.

PERIOD OF TEST ☐ START ☒ END

DURATION 2.0 MI

NON OPERATING

TEMP. 74

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONS

PICKUP LOCATION CX
SPACECRAFT C.G.
HOOK-UP #1

SPECIAL CONDITIONS
VCPS LOADED AND PRESSURIZED

PROJECT	ITEM	CODE	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	SV 748720-1	0001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7.5	NOTE 1&4	VCPS AND SPACECRAFT	—	

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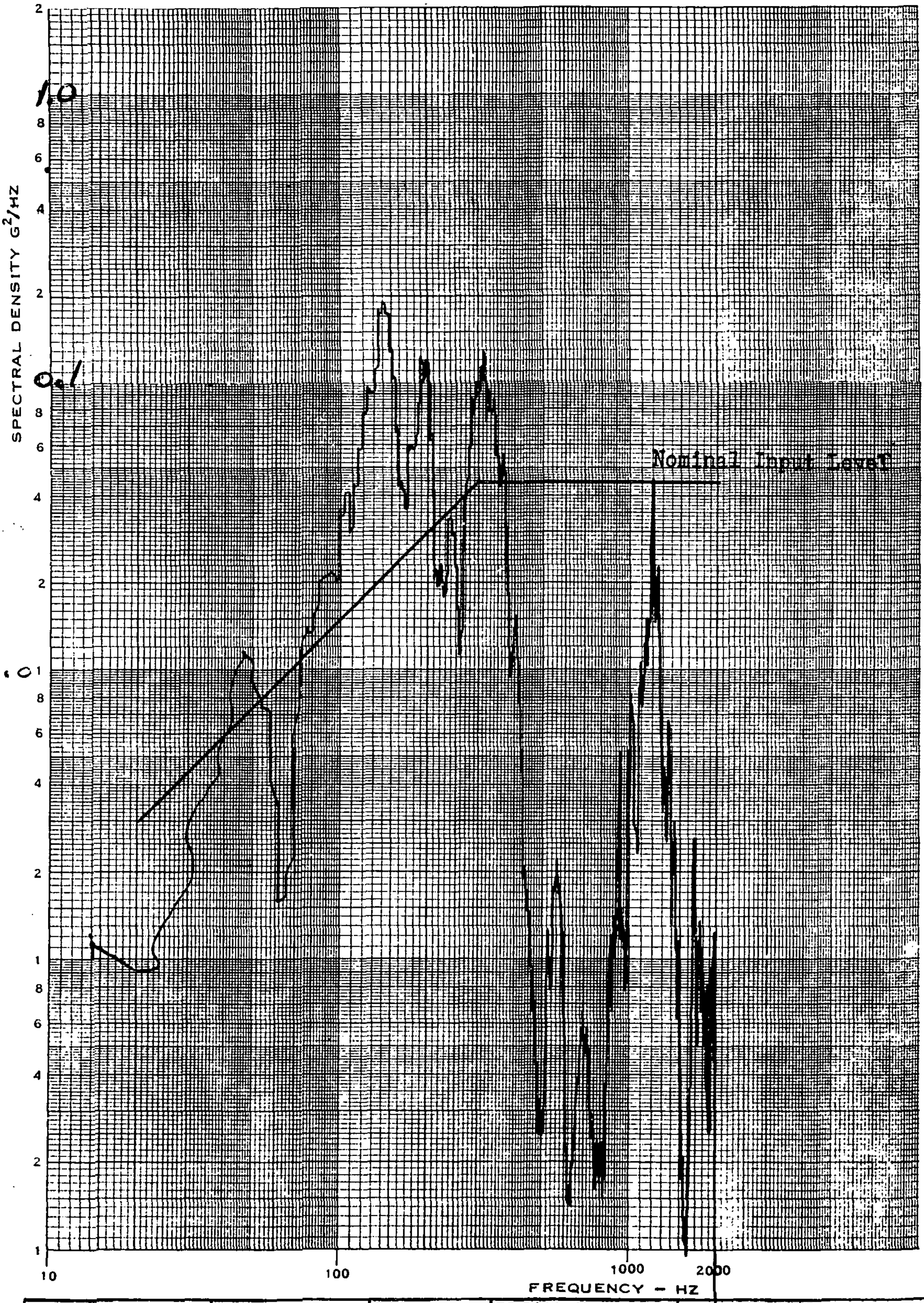
RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	B. M	S. M	15	10

TEST ENGINEER	CHECKED BY	DATE	TIME
S. M.	T. G.	4-18-72	0650



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS X

ACCEL SERIAL NUMBER XM21

ACCEL SENSING AXIS X

ACCEL SENSITIVITY — MV RMS / GP

1.370 COL / GP

ANAL FILTER - HZ B.W. 6[redacted] | [redacted] | [redacted]

SWEEP SPEED - OCT/MIN [redacted] | [redacted] | [redacted]

TIME CONSTANT - SEC [redacted] | [redacted] | [redacted]

ANNAL. CALIBRATION 47.08 g^2/HZ F.S.

PERIOD OF TEST ☐ START ☒ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION
DX
REA MOUNT
HOOK-UP #1

SPECIAL CONDITIONS
VCPS LOADED
AND PRESSURIZED

PROJECT	ITEM	CODE	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	SY 748720-1	00001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7.5	NOTE 1 & 4	VCPS AND SPACECRAFT	—	

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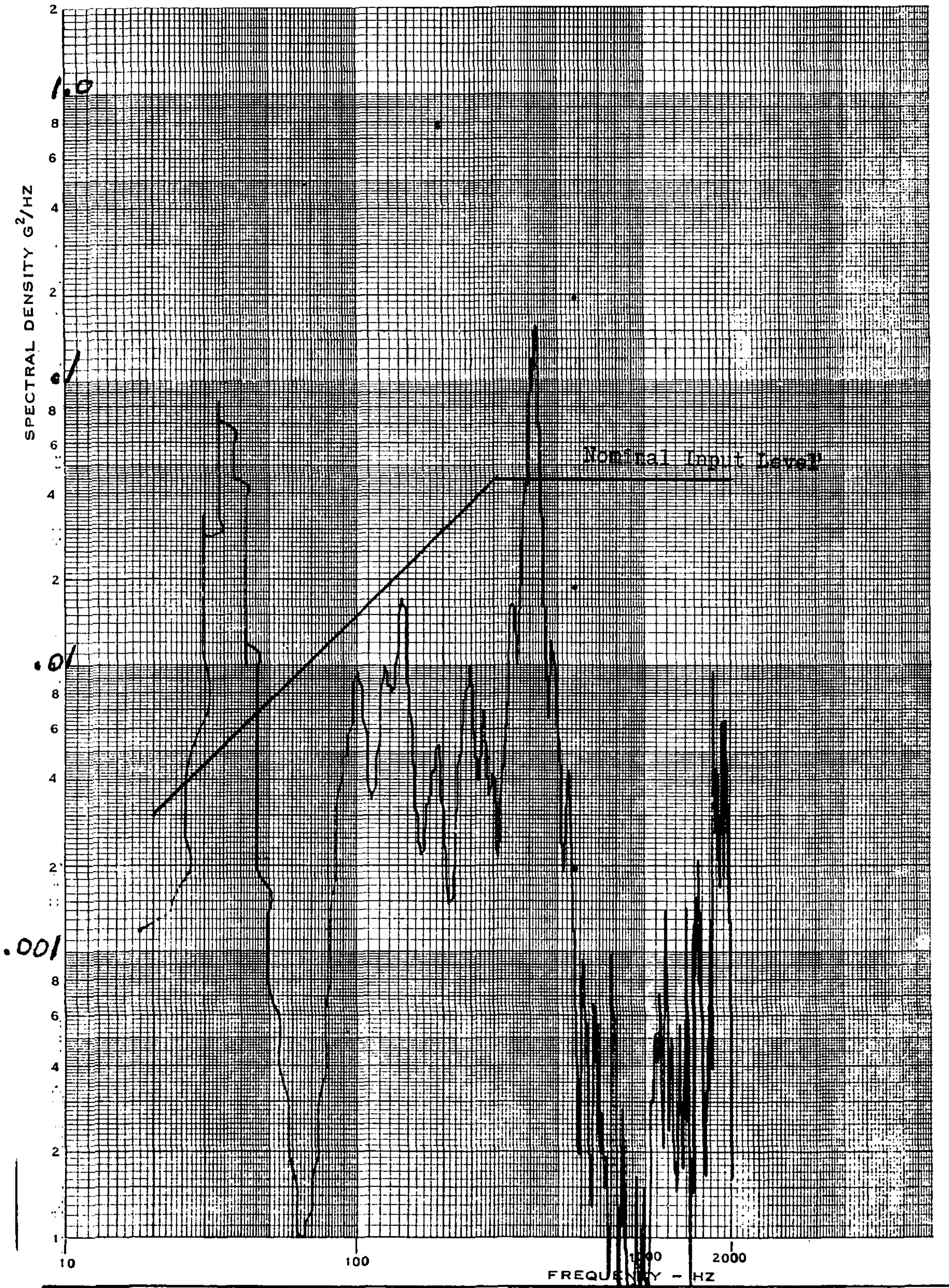
RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635B

REPORT NO.

RIG 26	OPERATOR B. M.	PLOTTED BY S M	TRACE NO. 16	TEST NO. 10
TEST ENGINEER S. M	CHECKED BY T. G.		DATE 4-18-72	TIME 0650



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS X

ACCEL SERIAL NUMBER WF75

ACCEL SENSING AXIS X

ACCEL SENSITIVITY — MV RMS / GP; 1.051 COL / GP

ANAL FILTER - HZ B.W. 6 | |

SWEEP SPEED - OCT/MIN | |

TIME CONSTANT - SEC | |

ANNAL. CALIBRATION 80.01 g^2/HZ F.S.

PERIOD OF TEST ☐ START ☒ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION
EX
TANK MOUNT
Hook-up #1

SPECIAL CONDITIONS
VCPS LOADED AND PRESSURIZED.

PROJECT RAE-B	ITEM VCPS	CODE SV 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL	
SPEC. AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 1 & 4	PHASE VCPS AND SPACECRAFT	RANDOM —	PAGE NO.

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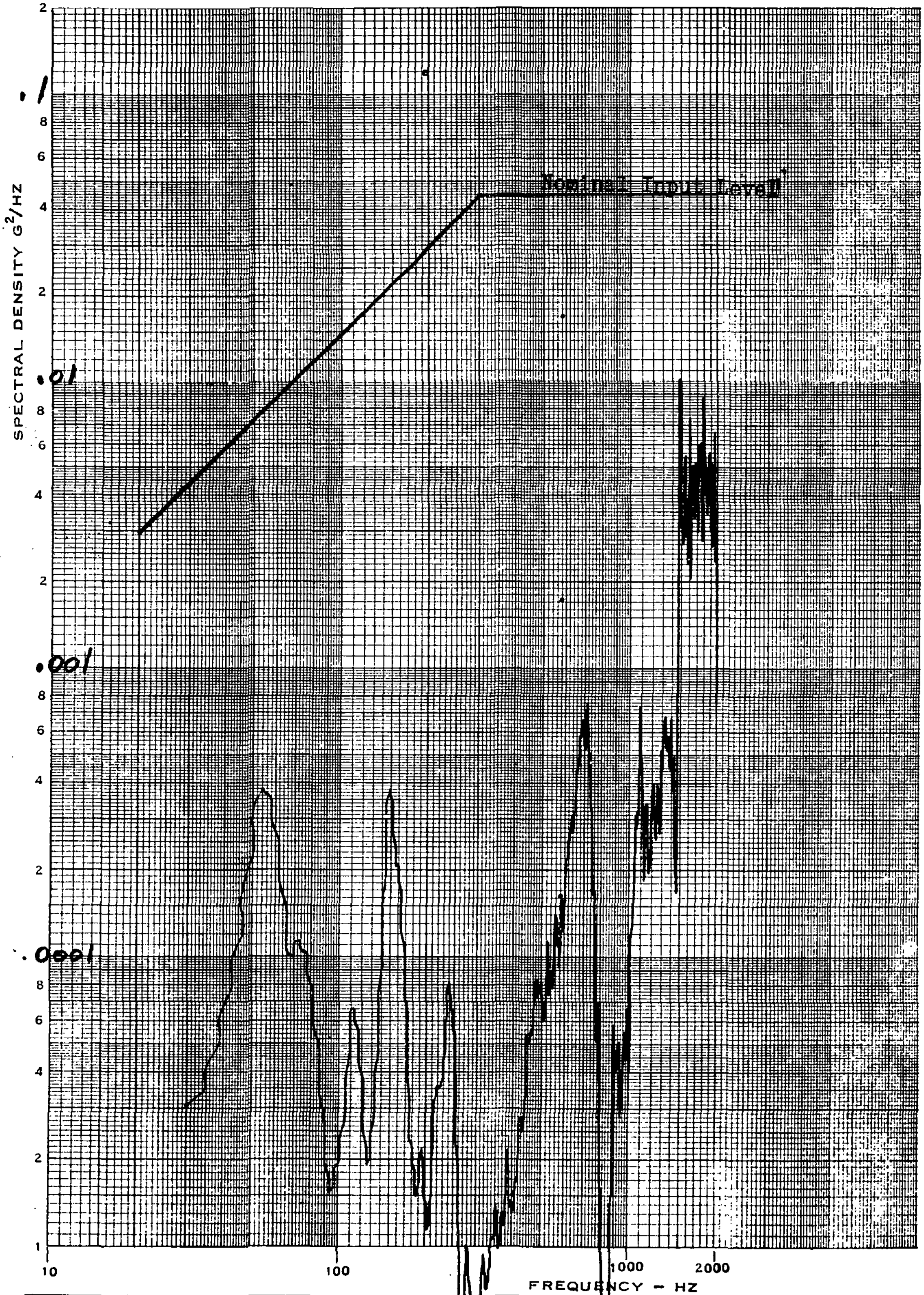
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	B.M	S.M	14	10

TEST ENGINEER	CHECKED BY	DATE	TIME
B.M	T. G	4-18-72	0650



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS X

ACCEL SERIAL NUMBER TE83

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS / GP

2.722 COL / GP

ANAL FILTER – HZ B.W. 6 [redacted] | [redacted] | [redacted]

SWEEP SPEED – OCT/MIN [redacted] | [redacted] | [redacted]

TIME CONSTANT – SEC [redacted] | [redacted] | [redacted]

ANNAL. CALIBRATION 11.92 g²/HZ F.S.

PERIOD OF TEST ☐ START ☒ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION A1Y

Hook-up #1

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT	ITEM	CODE	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	SV 748720-1	00001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7.5	NOTE 154	VCPS AND SPACECRAFT	—	

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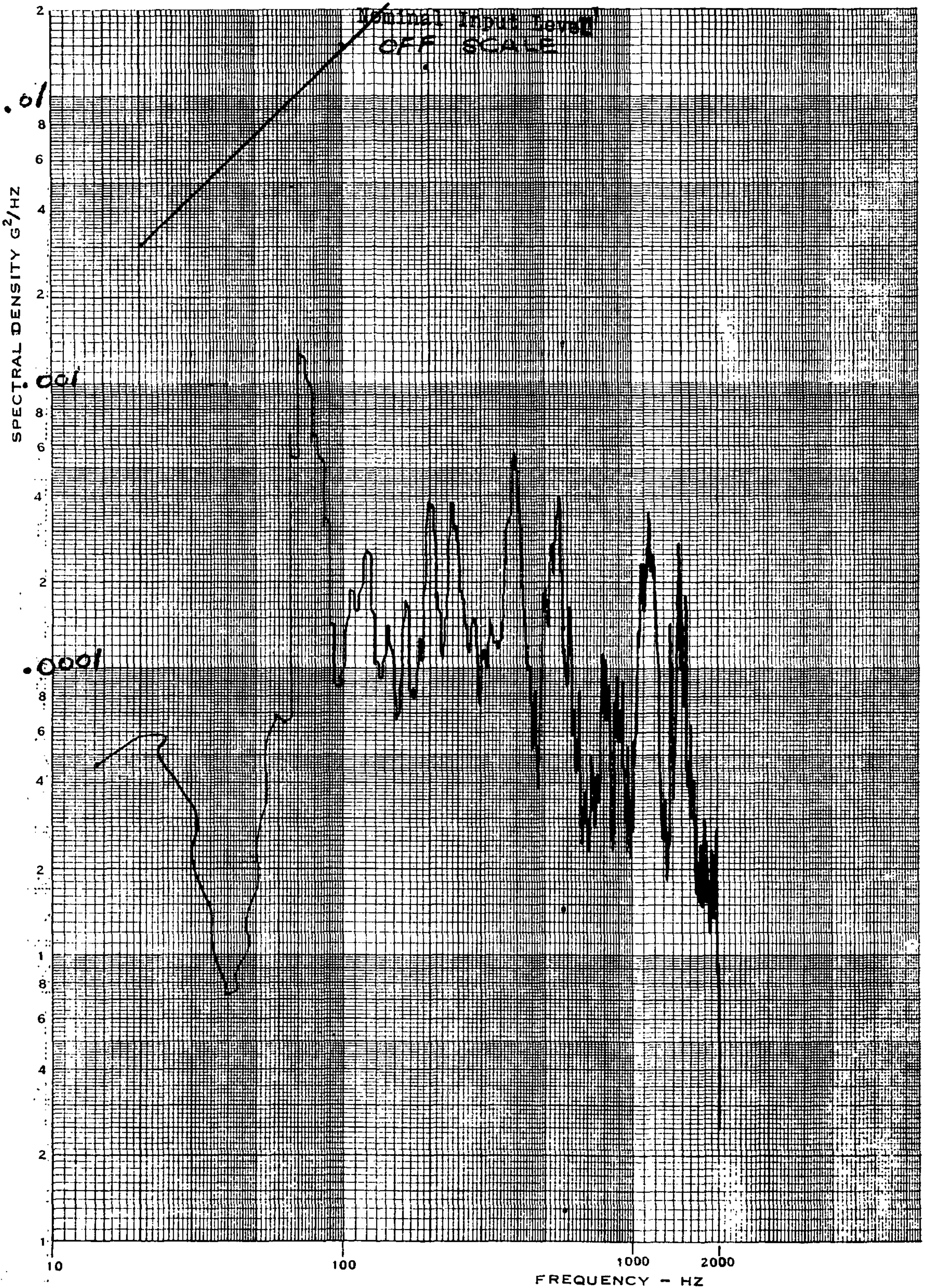
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26	OPERATOR B. M	PLOTTED BY S. M.	TRACE NO. 18	TEST NO. 10
TEST ENGINEER S. M	CHECKED BY T. G.		DATE 4-18-72	TIME 0650



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS X

ACCEL SERIAL NUMBER TD48

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS / GP

2.788 COL / GR

ANAL FILTER - HZ B.W. 6 [redacted] | [redacted] | [redacted]

SWEEP SPEED - OCT/MIN [redacted] | [redacted] | [redacted]

TIME CONSTANT - SEC [redacted] | [redacted] | [redacted]

ANNAL. CALIBRATION 1.263 g²/HZ F.S.

PERIOD OF TEST ☐ START ☒ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION CY

SPACECRAFT C.G.

HOOK-UP #1

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.

PROJECT RAE-B	ITEM VCPS	CODE SV 748724	SERIAL NUMBER 00001	TYPE OF TEST QUAL	
SPEC. AT-VCPS	PARA. 4.3.7.5	AMEND. 1 & 4 NOTE	PHASE VCPS AND SPACECRAFT	RANDOM —	PAGE NO.

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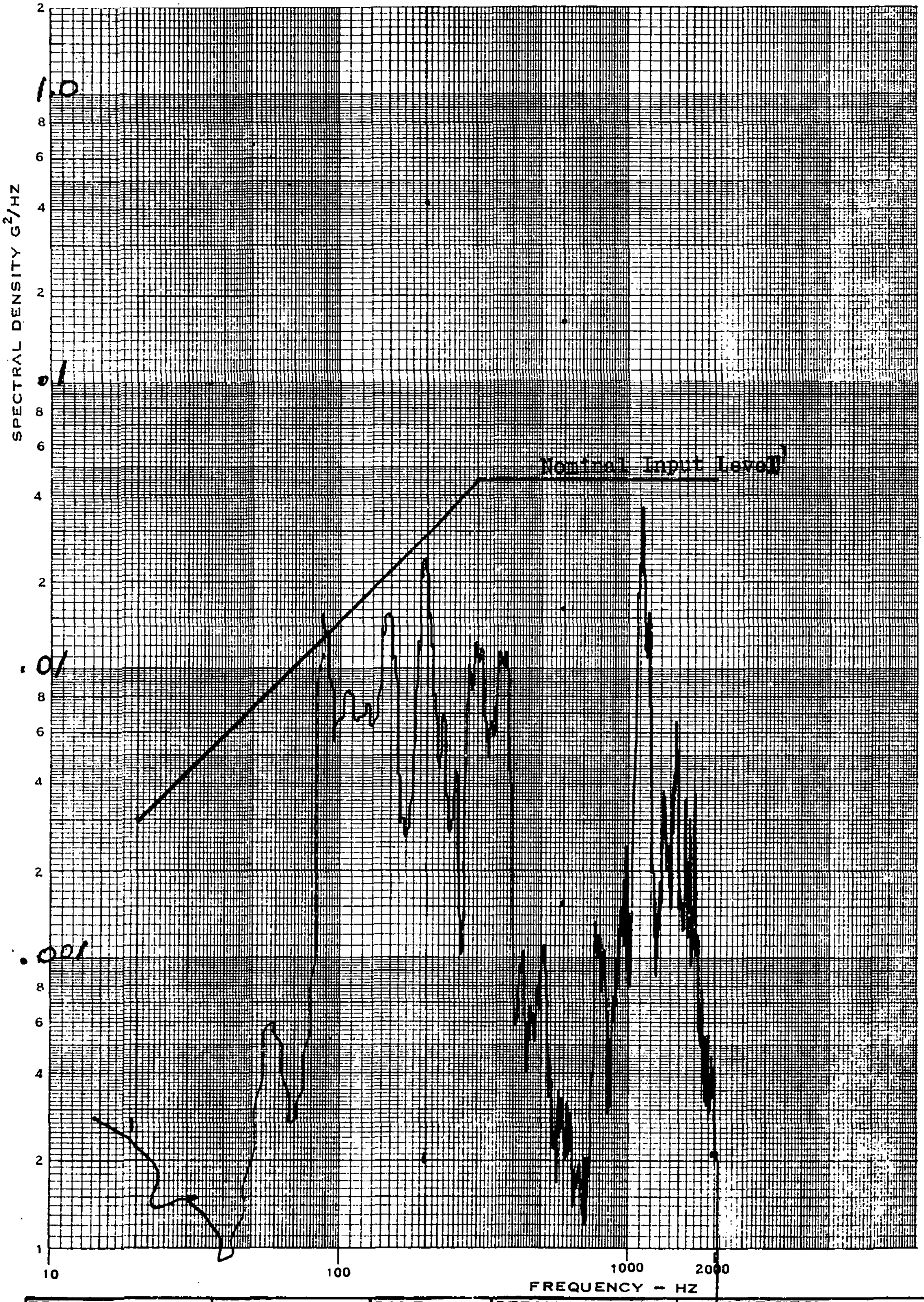
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635B

REPORT NO.

RIG 26	**OPERATOR** B M	**PLOTTED BY** S M	**TRACE NO.** 20	**TEST NO.** 10
TEST ENGINEER S. M		**CHECKED BY** T G	**DATE** 4-18-72	**TIME** 0650



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS X

ACCEL SERIAL NUMBER YK20

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY 1.523 MV RMS / GP

— COL / GP

ANAL FILTER - HZ B.W. 6 [redacted] | [redacted] | [redacted]

SWEEP SPEED - OCT/MIN [redacted] | [redacted] | [redacted]

TIME CONSTANT - SEC [redacted] | [redacted] | [redacted]

ANNAL. CALIBRATION 429.9 g^2/HZ F.S.

PERIOD OF TEST ☐ START ☒ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION
DY
REA MOUNT
HOOK-UP #1

SPECIAL CONDITIONS
VCPS LOADED
AND PRESSURIZED

PROJECT RAE-B	**ITEM** VCPS	**CODE** SV 748720-1	**SERIAL NUMBER** 00001	**TYPE OF TEST** QUAL

SPEC. AT-VCPS	**PARA.** 4.3.7.5	**AMEND.** 1&4 NOTE	**PHASE** VCPS AND SPACECRAFT	**RANDOM** —	**PAGE NO.**

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Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

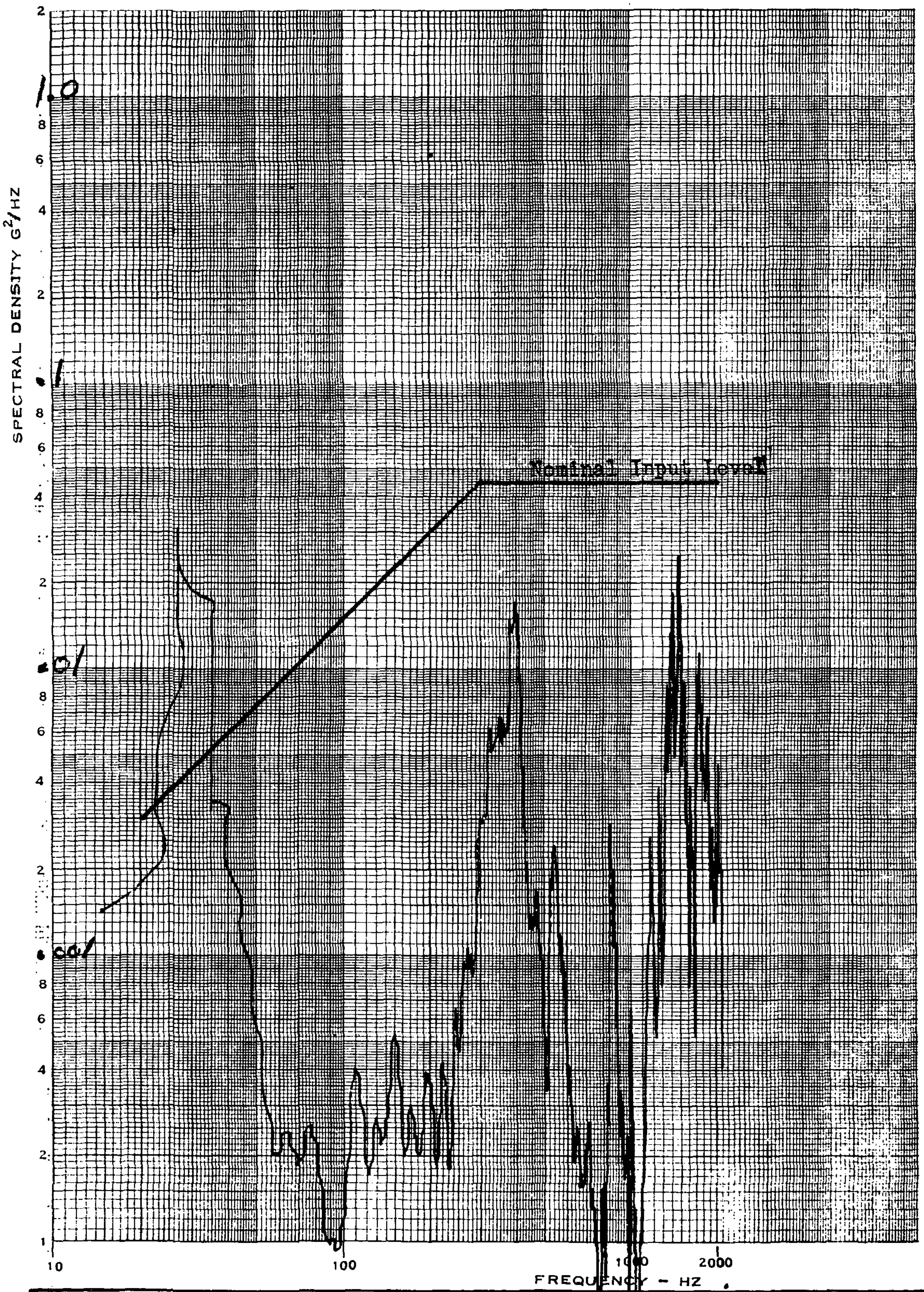
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	B. M	S. M	21	10

TEST ENGINEER	CHECKED BY	DATE	TIME
S. M	T. G	4-18-72	0650



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS X

ACCEL SERIAL NUMBER XN32

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY 1.261 MV RMS / GP

— COL / GP

ANAL FILTER – HZ B.W. 6

SWEEP SPEED – OCT/MIN

TIME CONSTANT – SEC

ANNAL. CALIBRATION 627.1 g²/HZ F.S.

PERIOD OF TEST ☐ START ☒ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION
EY
TANK MOUNT
HOOK-UP #1

SPECIAL CONDITIONS
VCPS LOADED
AND PRESSURIZED

PROJECT	ITEM	CODE	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	SY 748720-1	0001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7.5	NOTE 1 & 4	VCPS AND SPACECRAFT	—	

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Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

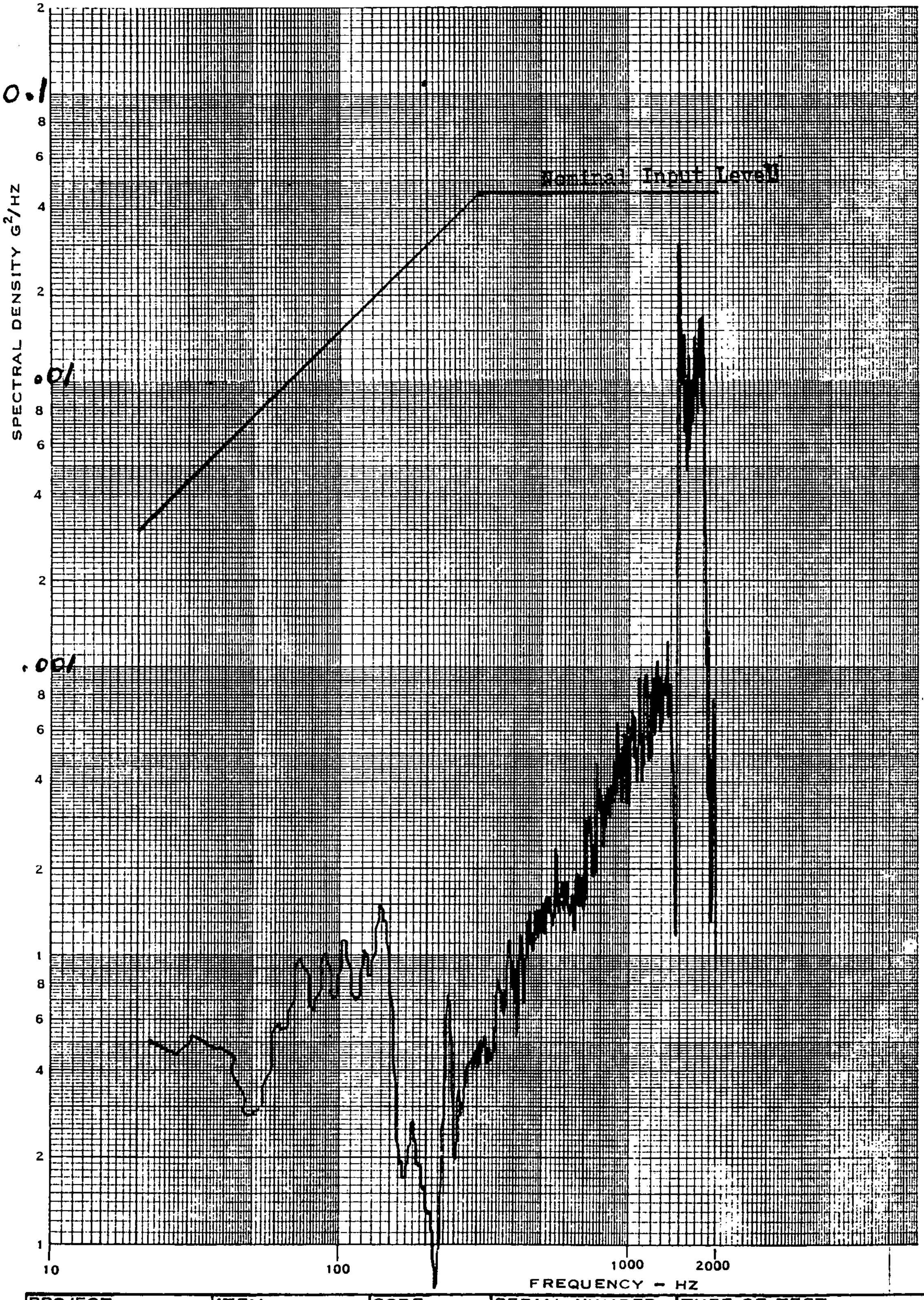
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	B M	S. M	19	10

TEST ENGINEER	CHECKED BY	DATE	TIME
S. M	T. G.	4-18-72	0650



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS X

ACCEL SERIAL NUMBER NB62

ACCEL SENSING AXIS Z

ACCEL SENSITIVITY 3.052 MV RMS / GP

— COL / GP

ANAL FILTER – HZ B.W. 6

SWEEP SPEED – OCT/MIN

TIME CONSTANT – SEC

ANNAL. CALIBRATION 107.06 g²/HZ F.S.

PERIOD OF TEST ☐ START ☒ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION A1Z

HOOK-UP #1

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.

PROJECT	ITEM	CODE SY	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	748720-1	00001	QUAL

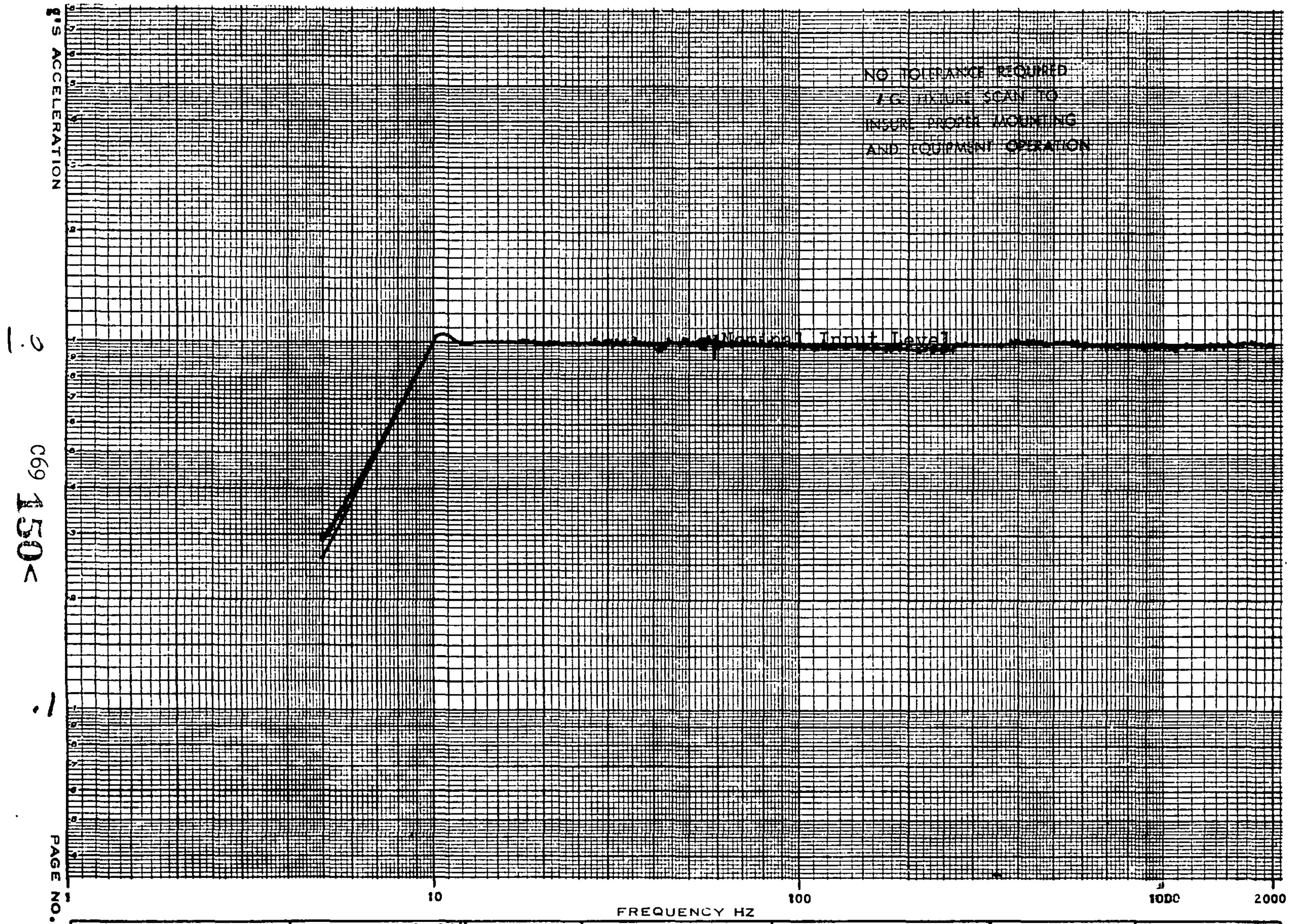
SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7.5	1 & NOTE 4	VCPS AND SPACECRAFT	—	

Section III

Y - Axis
- A) Sine Data
- B) Random Data

Standard DIVISION OF UNITED AIRCRAFT CORPORATION HSF-1633.1 2/69

RIG #26
OPERATOR P. Jodoin
WITNESS —
WITNESS —
TEST NO. 5
TEST ENGINEER S. Mehnert
CHECKED BY GEIB
PROJECT RAE-B
DATE 4-17-72
TIME 1540



NO TOLERANCE REQUIRED
1G FIXTURE SCAN TO
INSURE PROPER MOUNTING
AND EQUIPMENT OPERATION

INPUT LEVEL 1.0 g
EXCIT. AXIS Y
ACCEL S/N TE83
SENSING AXIS Y
ACCEL SENSITIVITY — MV RMS / GP
2.722 COL. / GP
FILTER 10-100-200 HZ B.W.
FILTER CROSSOVER @ 70.700 HZ
SWEEP RATE 4.0 OCT/MIN
TAPEREEL NO. 012294
☑ LIVE
☐ FROM TAPE
COMPR. SPEED Var DB/SEC.
CHG.@ ~ HZ TO ~ DB/SEC.
CHG.@ ~ HZ TO ~ DB/SEC.
NON OPERATING
☑ CONTROL
☐ RESPONSE
TEMP. 74 °F
LOCATION Aly Hook-up #2
SPECIAL CONDITIONS Bare Fixture
MASTER PG1774
REPORT NO. —

FREQ. RANGE & DIRECTION 5-2K Hz
ITEM SVSK79594 VCPS-FIXT
CODE —
SERIAL NO. SVSK79594
SPEC. AT-VCPS
PARA. 4.3.7
AMEND. —
ACTION SHEET NO. —
ATA NO. —
TYPE OF TEST Accept Test
NAME OF TEST Sine Scan

PAGE NO.

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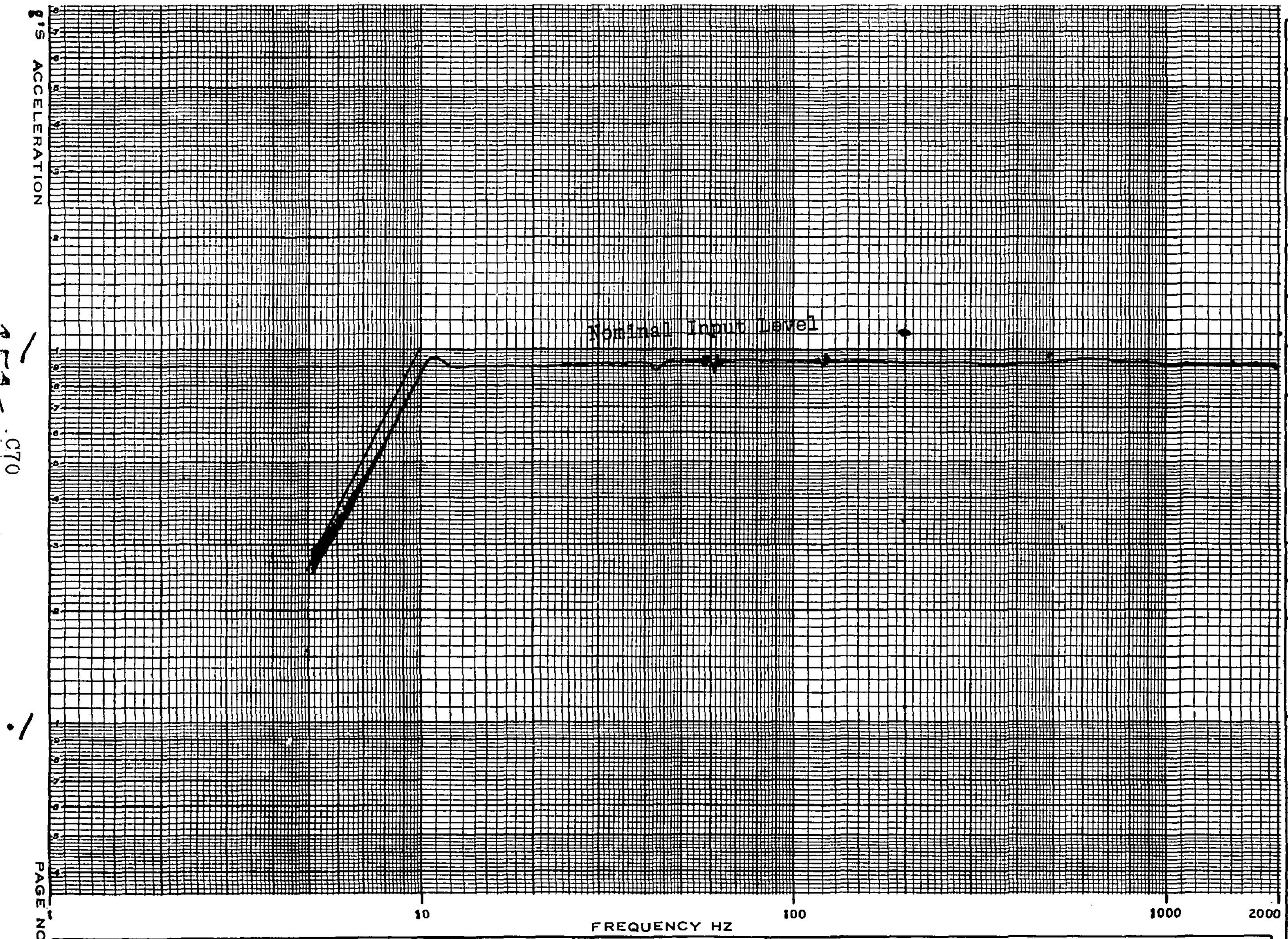
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION UA®

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 10	TEST NO. 5 ch3
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-13-72	TIME 1540



INPUT LEVEL ± 1 g	EXCIT. AXIS Y
ACCEL S/N TE83	SENSING AXIS Y
ACCEL SENSITIVITY	
—	MV RMS / GP
2.722	COL / GP
FILTER 10-100-200 HZ B.W.	
FILTER CROSSOVER @ 70-700 HZ	
TAPEREEL NO. 012294	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC	
CHG@ — HZ TO __ DB/SEC	
CHG@ — HZ TO — DB/SEC	
NON-OPERATING	☒ CONTROL
TEMP. 74 °F	☒ ~~RESPONSE~~
LOCATION A1Y A1Y Hook-up #2	
SPECIAL CONDITIONS AWAY FROM SHAKER HEAD. REFERENCE LOG SHEET 1774. MASTER # 1774	REPORT NO.

FREQ. RANGE & DIRECTION 5-2000HZ	ITEM SVSK79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION	PARA.	AMEND.	PHASE RAE	NAME OF TEST

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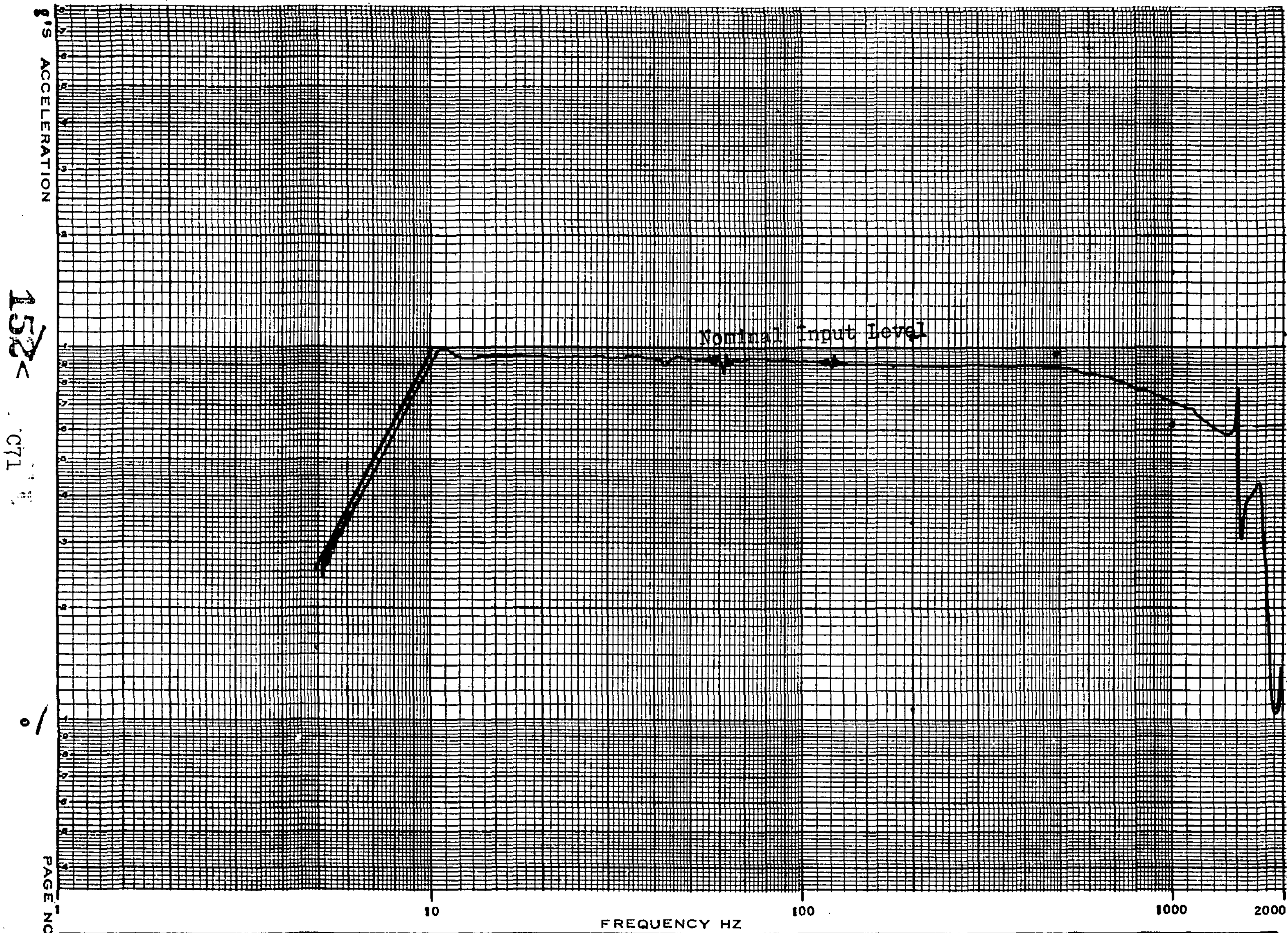
Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: MICKET
TRACE NO.: 11
TEST NO.: 5 ch 4
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B RAE B
DATE: 4-13-72
TIME: 1540



INPUT LEVEL: ± 1 g
EXCIT. AXIS: Y
ACCEL S/N: TD44
SENSING AXIS: Y
ACCEL SENSITIVITY: — MV RMS / GP
2.773 COL / GP
FILTER: 10-100-200 HZ B.W.
FILTER CROSSOVER: @ 70-700 HZ
TAPE REEL NO.: 012294
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION: 4, Y
A2Y
Hook-up #2
SPECIAL CONDITIONS: CLOSEST TO DRIVER
MASTER PG 1774
REPORT NO.:
PAGE NO.:

FREQ. RANGE & DIRECTION: 5-2000 Hz
ITEM: SVSK 79594
CODE: —
SERIAL NO.: —
TYPE OF TEST: FIXTURE SURVEY
SPECIFICATION: AT-VCPS
PARA.: 4.3.7
AMEND.: —
PHASE: BARE FIXTURE
NAME OF TEST: SINUSOIDAL SCAN

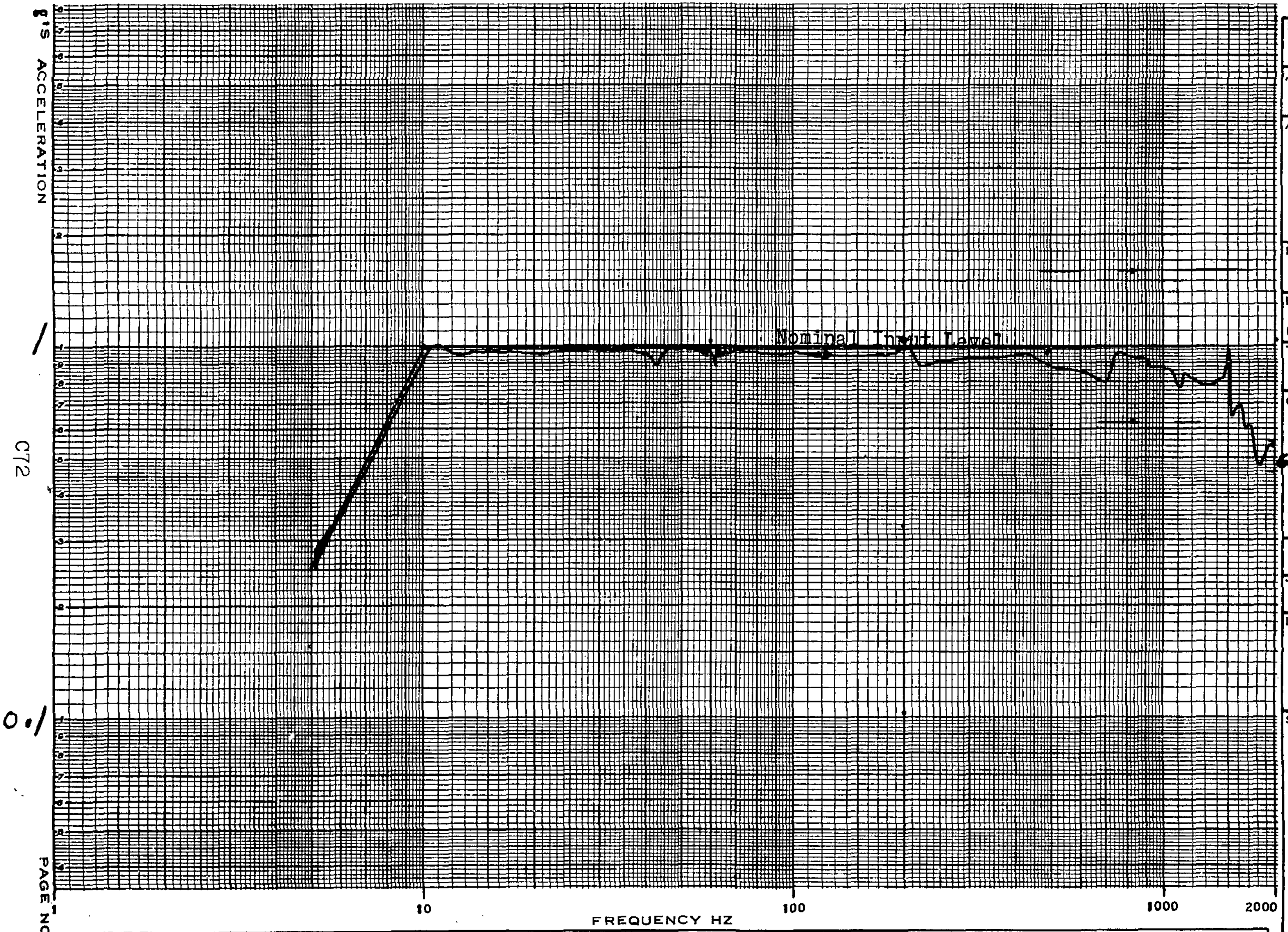
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

HSF 1633 A 2/69

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	MICKET	13	5 ch#1

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	RAE-B RAE-B	4-13-72	1540



INPUT LEVEL ± 1 g

EXCIT. AXIS Y

ACCEL S/N WR11

SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS / GP; 2.456 COL / GP

FILTER 10-100-200 HZ B.W.

FILTER CROSSOVER @70 - 700 HZ

TAPEREEL NO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED YAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 74 °F

☐ CONTROL

☒ RESPONSE

LOCATION A4Y A4Y
HOOK-UP #2

SPECIAL CONDITIONS

MASTER PG 1774

REPORT NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	TYPE OF TEST
5-2000 HZ	SYSK 79594	—	—	FIXTURE SURVEY

SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
			BARE	

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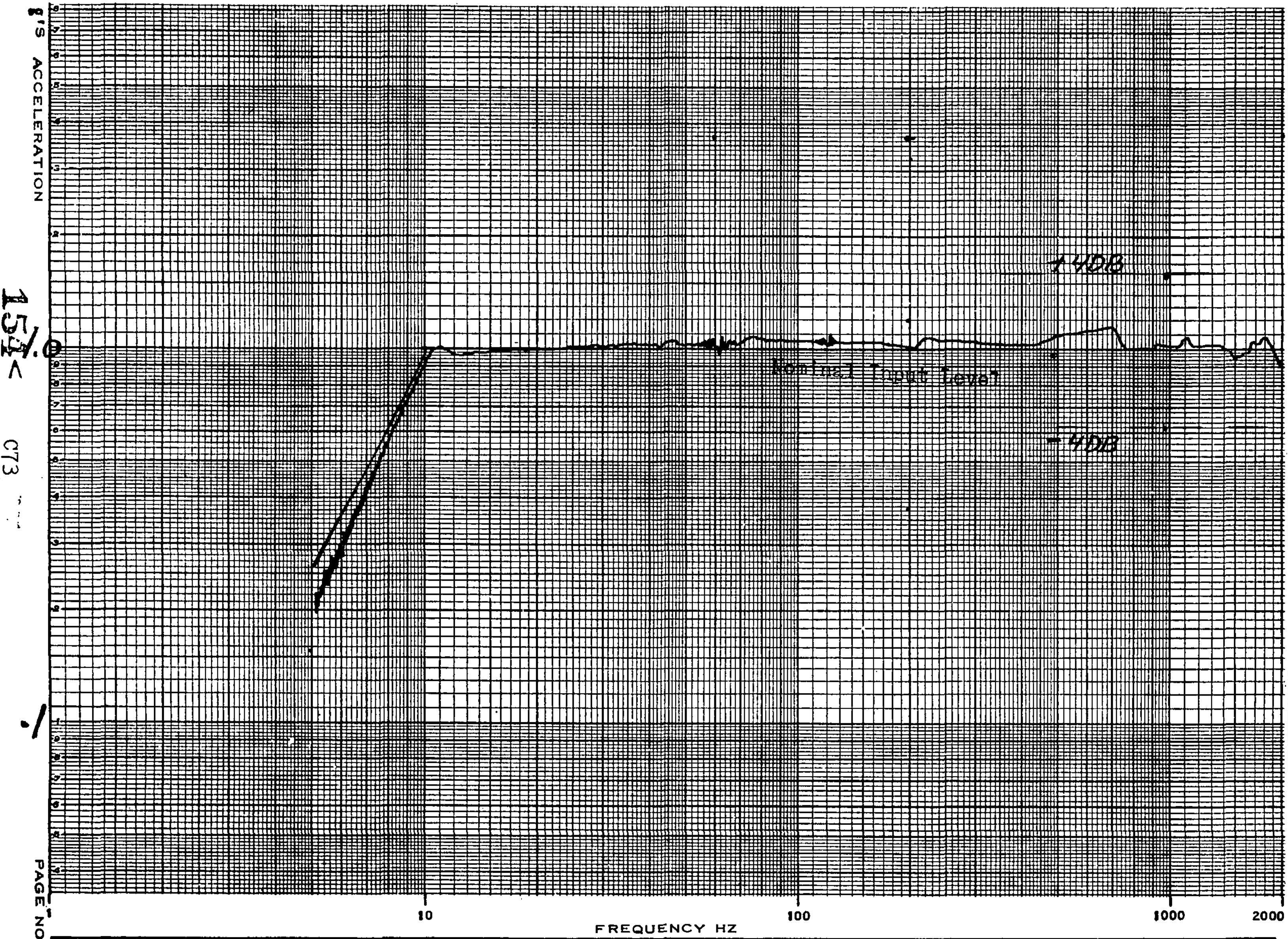
Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	MICKET	14	5 ch #7

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	RAE-B RAE-B	4-19-72	1540



INPUT LEVEL ± 1 g

EXCIT. AXIS Y

ACCEL S/N VG57

SENSING AXIS Y

ACCEL SENSITIVITY 10.886 MV RMS / GP

— COL / GP

FILTER 10-100-200 HZ B.W.

FILTER CROSSOVER @ 70-700 HZ

TAPEREEL NO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED YAR DB/SEC

CHG@ HZ TO DB/SEC

CHG@ HZ TO DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP 75 °F

LOCATION ASY ASY

HOOK-UP #2

SPECIAL CONDITIONS

MASTER PG 1774

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	TYPE OF TEST
5-2000 Hz	SVSK 79594	—	—	FIXTURE SURVEY

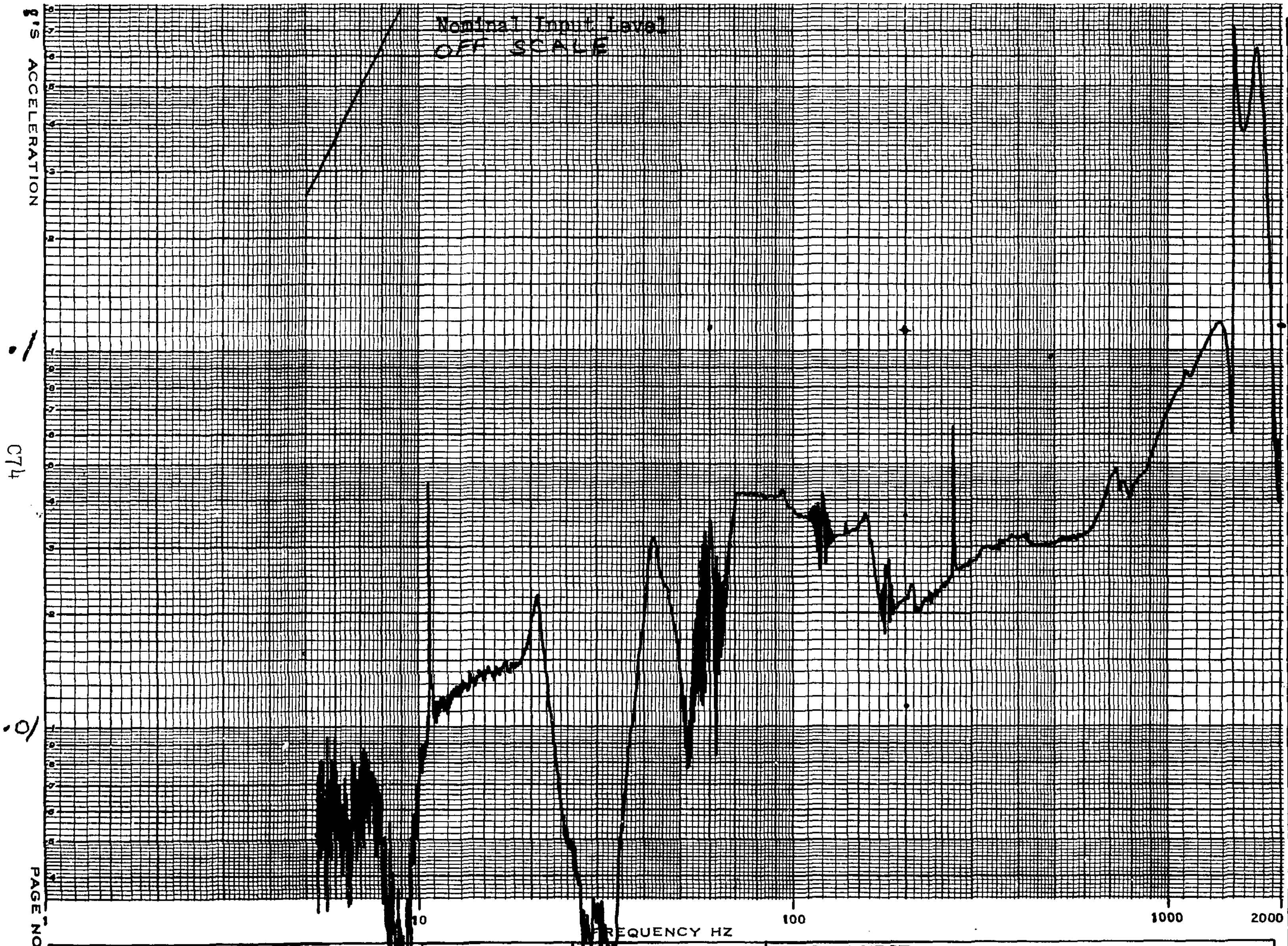
SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
AT-VCPS	4.3.7	—	BARE FIXTURE	SINUSOIDAL SCAN

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 8	TEST NO. 5 ch#1
TEST ENGINEER MEHMED	CHECKED BY. GEIB	PROJECT RAE-B RAE B	DATE 4-13-72	TIME 1540



INPUT LEVEL ± 1 g	EXCIT. AXIS Y
ACCEL S/N NB62	SENSING AXIS Z
ACCEL SENSITIVITY — MV RMS / GP 2.698 COL / GP	
FILTER 10-100-200 HZ B.W.	
FILTER CROSSOVER @ 70-700 HZ	
TAPE REEL NO. 012294	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC	
CHG@ — HZ TO — DB/SEC	
CHG@ — HZ TO — DB/SEC	
NON-OPERATING TEMP. 75 °F	☐ CONTROL ☒ RESPONSE
LOCATION A1Z A1Z HOOK-UP #2	
SPECIAL CONDITIONS MASTER PG 1774	

REPORT NO.

FREQ. RANGE & DIRECTION 5-2000HZ	ITEM SVSK 79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION	PARA.	AMEND.	PHASE RAE	NAME OF TEST

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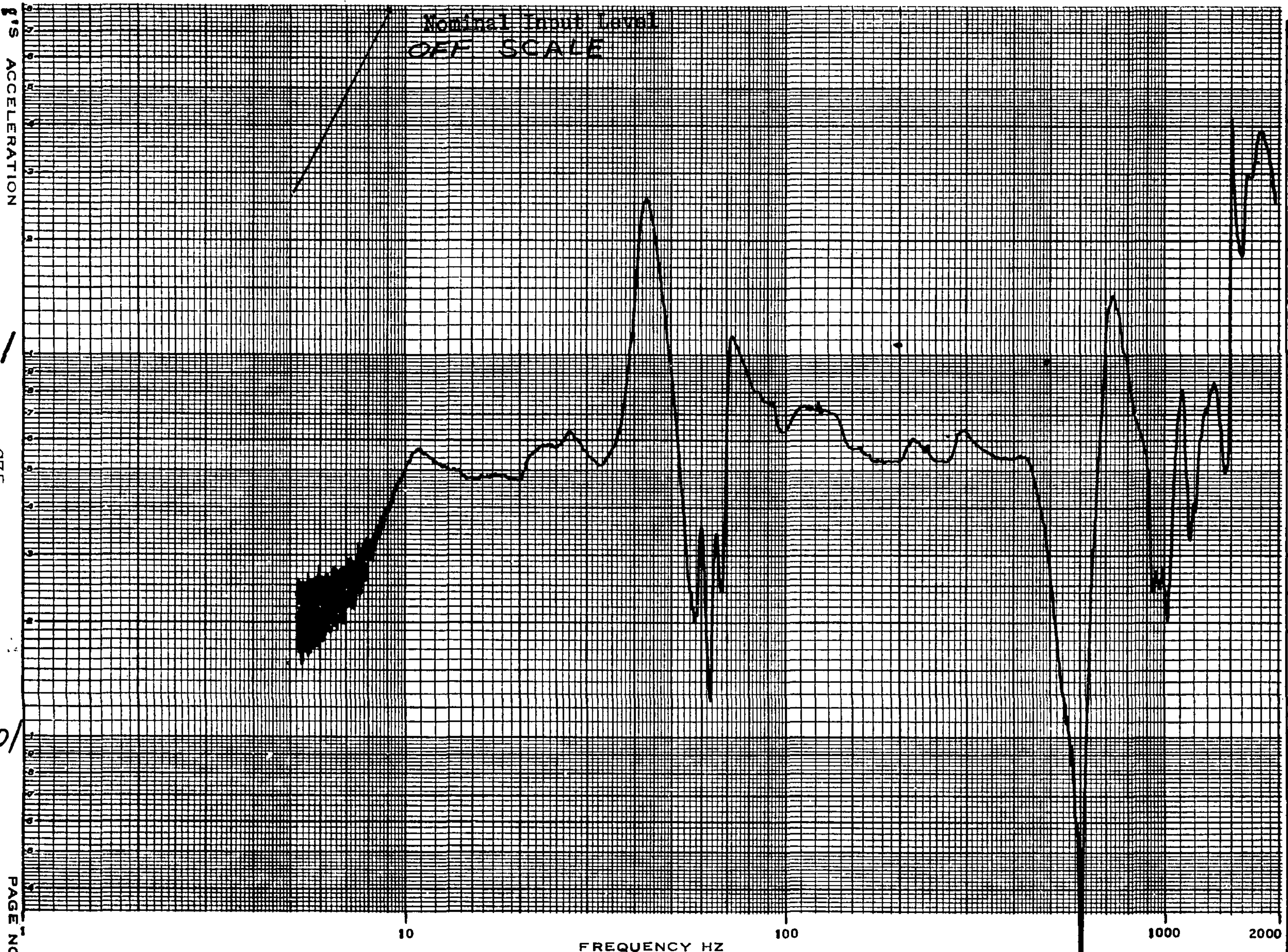
Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 9	TEST NO. 5 ch 2
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-13-72	TIME 1540



INPUT LEVEL ± 1 g

EXCIT. AXIS Y

ACCEL S/N TD40

SENSING AXIS X

ACCEL SENSITIVITY — MV RMS / GP

2.805 COL / GP

FILTER 10-100-200 HZ B.W.

FILTER CROSSOVER @ 70-700 HZ

TAPEREELNO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 75 °F

☐ CONTROL

☒ RESPONSE

LOCATION A1X

A1X

Hook-up #2

SPECIAL CONDITIONS

MASTER PG 1774

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-2000 HZ	ITEM SVSK79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION AT-VCPS	PARA. 4.3.7	AMEND. —	PHASE BARE FIXTURE	NAME OF TEST SINUSOIDAL SCAN

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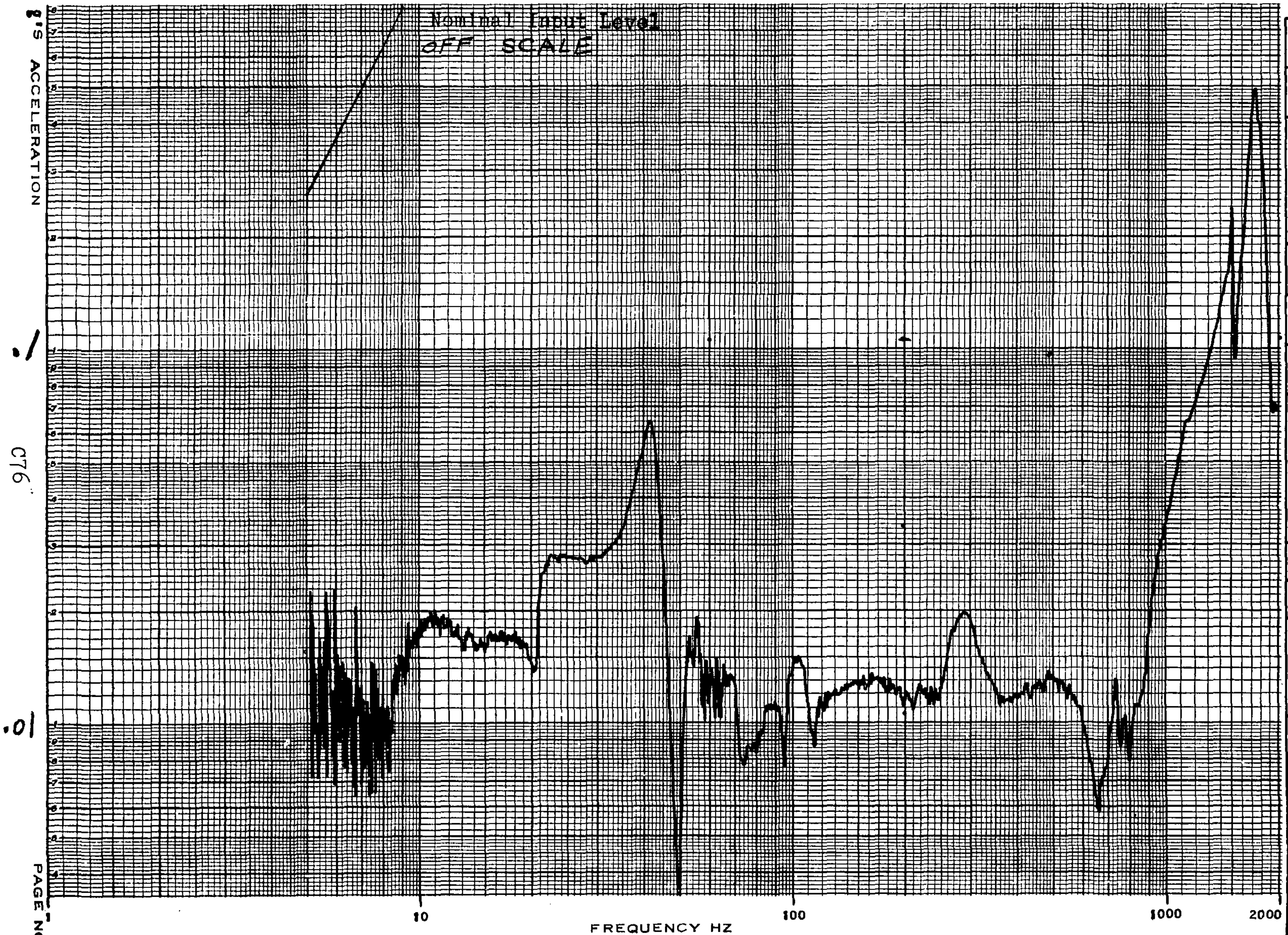
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION UA®

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 12	TEST NO. 5 ch#5
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B RAE-B	DATE 4-13-72	TIME 1540



INPUT LEVEL ± 1 g	EXCIT. AXIS Y
ACCEL S/N TG75	SENSING AXIS Z

ACCEL SENSITIVITY
— MV RMS / GP
2.791 COL / GP

FILTER
10-100-200 HZ B.W.

FILTER CROSSOVER
@ 70-700 HZ

TAPE REEL NO. 012294	SWEEP RATE 4 OCT/MIN

COMPR. SPEED
VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC

NON-OPERATING
TEMP. 74 °F
☐ CONTROL
☒ RESPONSE

LOCATION
A3Z A3Z
Hook-up #2

SPECIAL CONDITIONS
MASTER 86 1774

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-2000HZ	ITEM SVSK79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION	PARA.	AMEND.	PHASE BAKE	NAME OF TEST

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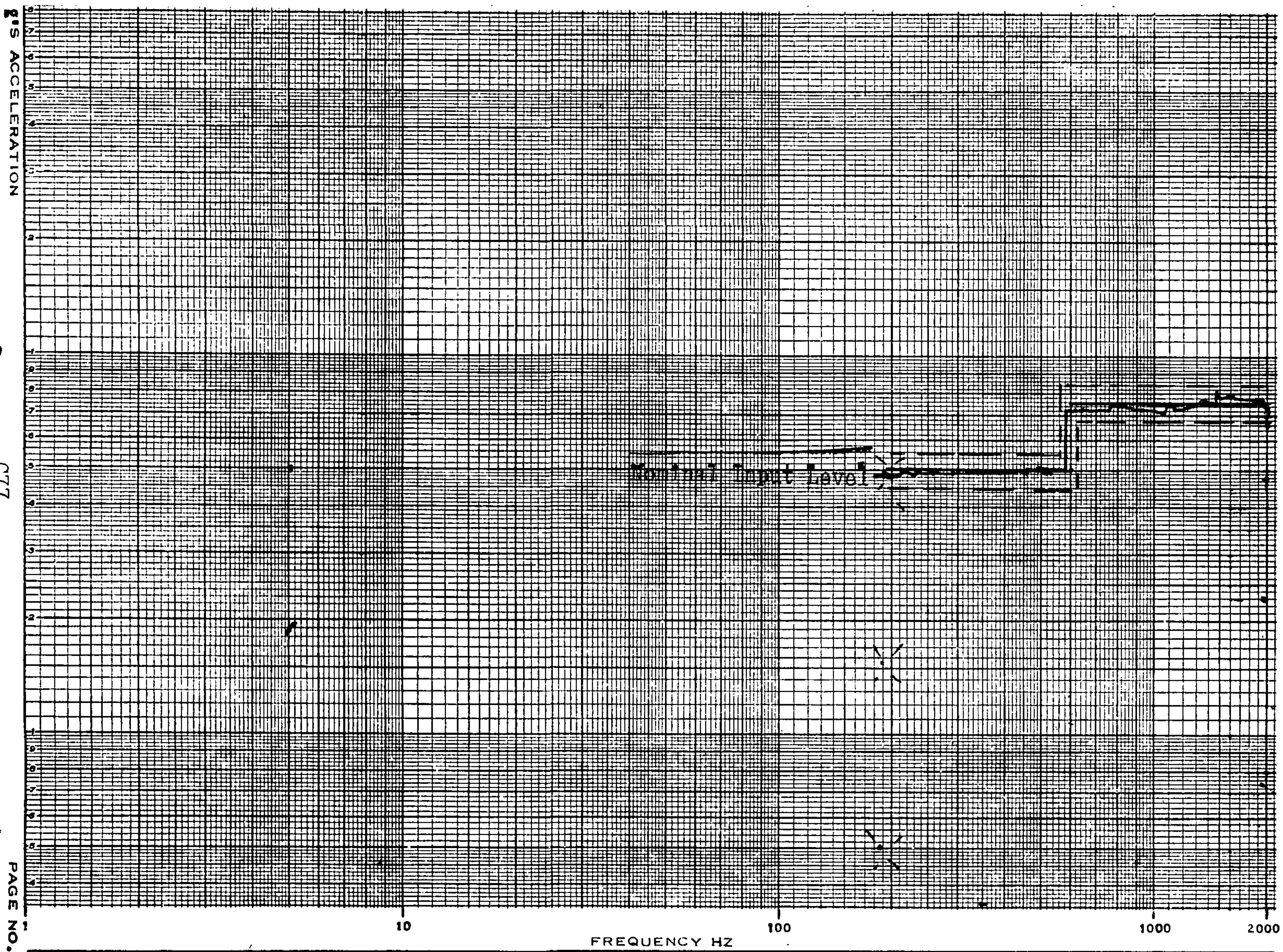
Standard DIVISION OF UNITED AIRCRAFT CORPORATION A® HSF-1633.1 2/69

RIG 26	OPERATOR P. Jodoin	WITNESS A. McCarthy 4/15/72	WITNESS —	TEST NO. 5
TEST ENGINEER S. Mehmed Jr.	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-15-72	TIME 1545



INPUT LEVEL 7.5 g
EXCIT. AXIS Y
ACCEL S/N TE83
SENSING AXIS Y
ACCEL SENSITIVITY — MV RMS / GP
2.722 COL / GP
FILTER -100-200 HZ B.W.
FILTER CROSSOVER @ -700 HZ
SWEEP RATE 4.0 OCT/MIN
TAPE REEL NO. 012295
☑ LIVE
☐ FROM TAPE
COMPR. SPEED Var DB/SEC.
CHG.@ — HZ TO — DB/SEC.
CHG.@ — HZ TO — DB/SEC.
NON OPERATING
☑ CONTROL
☐ RESPONSE
TEMP. 74 °F
LOCATION Aly
SPECIAL CONDITIONS THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY
VCPS LOADED
PRESSURIZED
REPORT NO.

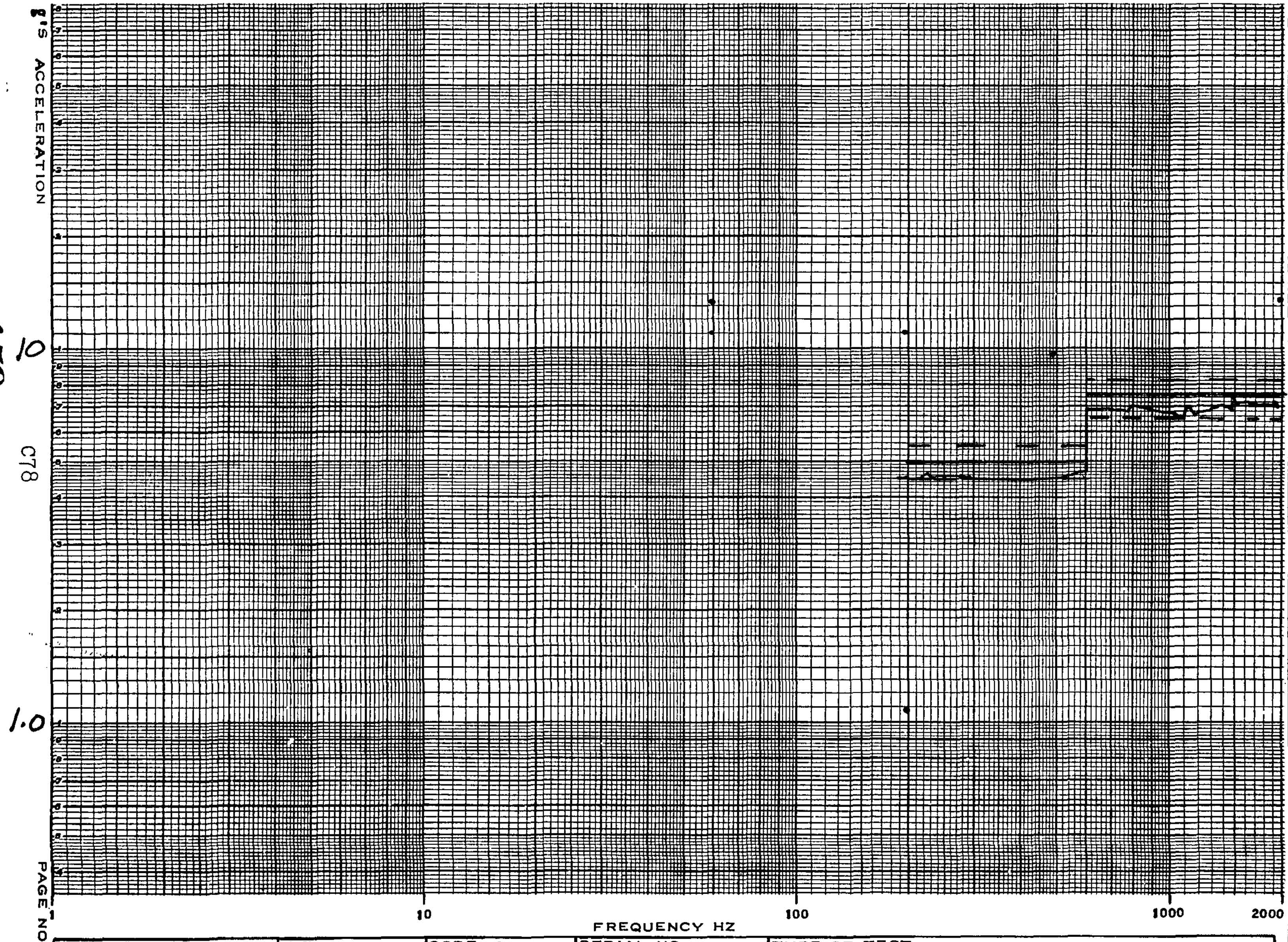
FREQ. RANGE & DIRECTION 200 - 2000Hz	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	SPEC. AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 2
ACTION SHEET NO. —	ATA NO. —	TYPE OF TEST Qual - VCPS only		NAME OF TEST SINUSOIDAL VIBRATION		

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

HSF 1633 A 2/69

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 11
TEST NO.: 5
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-15-72
TIME: 1545



INPUT LEVEL: ± 7.5 g
EXCIT. AXIS: Y
ACCEL S/N: TE83
SENSING AXIS: Y
ACCEL SENSITIVITY: — MV RMS / GP; 2.805 COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER: @ 700 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☒ CONTROL
☐ RESPONSE
TEMP. 74 °F
LOCATION: A1Y

HOOK-UP #2

SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

TRACE REPLOTTED TO CERTIFY LEVEL.

FREQ. RANGE & DIRECTION: 200-2000HZ
ITEM: VCPS
CODE SV: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION
PARA.
AMEND.
PHASE
NAME OF TEST

HSF 1633 A 2/69

Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26

OPERATOR JODOIN

PLOTTED BY JODOIN

TRACE NO. 18

TEST NO. 5

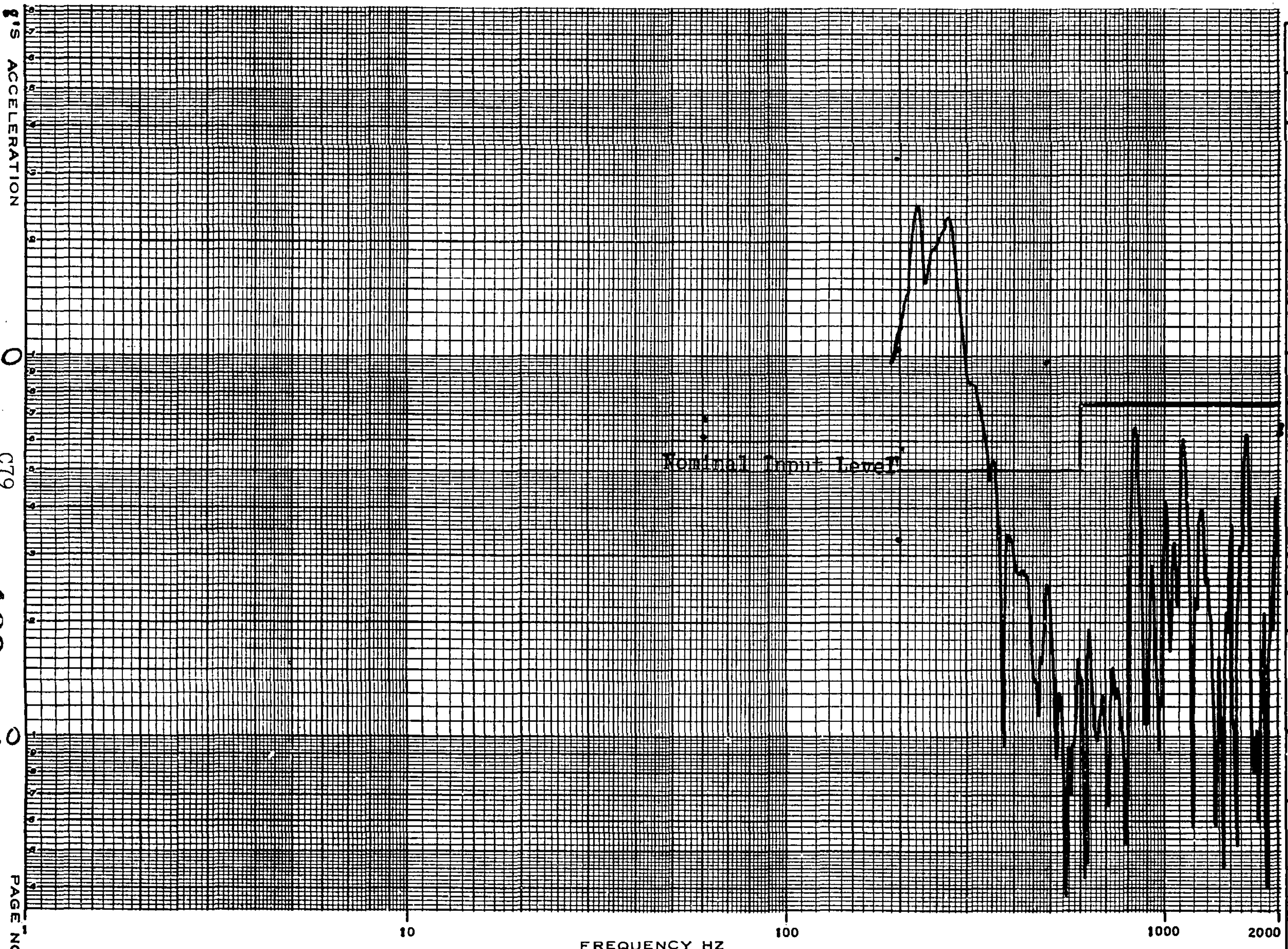
TEST ENGINEER MEHMED

CHECKED BY GEIB

PROJECT RAE-B

DATE 4-15-72

TIME 1545



INPUT LEVEL ± 7.5 g

EXCIT. AXIS Y

ACCEL S/N WR11

SENSING AXIS Y

ACCEL SENSITIVITY 3.016 MV RMS / GP

— COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPE REEL NO. 0/2295

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 75 °F

LOCATION BY HUB HOOK-UP #2

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

FREQ. RANGE & DIRECTION 200-2000HZ

ITEM VCPS

CODE SV 748720-1

SERIAL NO. 00001

TYPE OF TEST QUAL

SPECIFICATION AT-VCPS

PARA. 4.3.7.5

AMEND. NOTE 2

PHASE VCPS ONLY

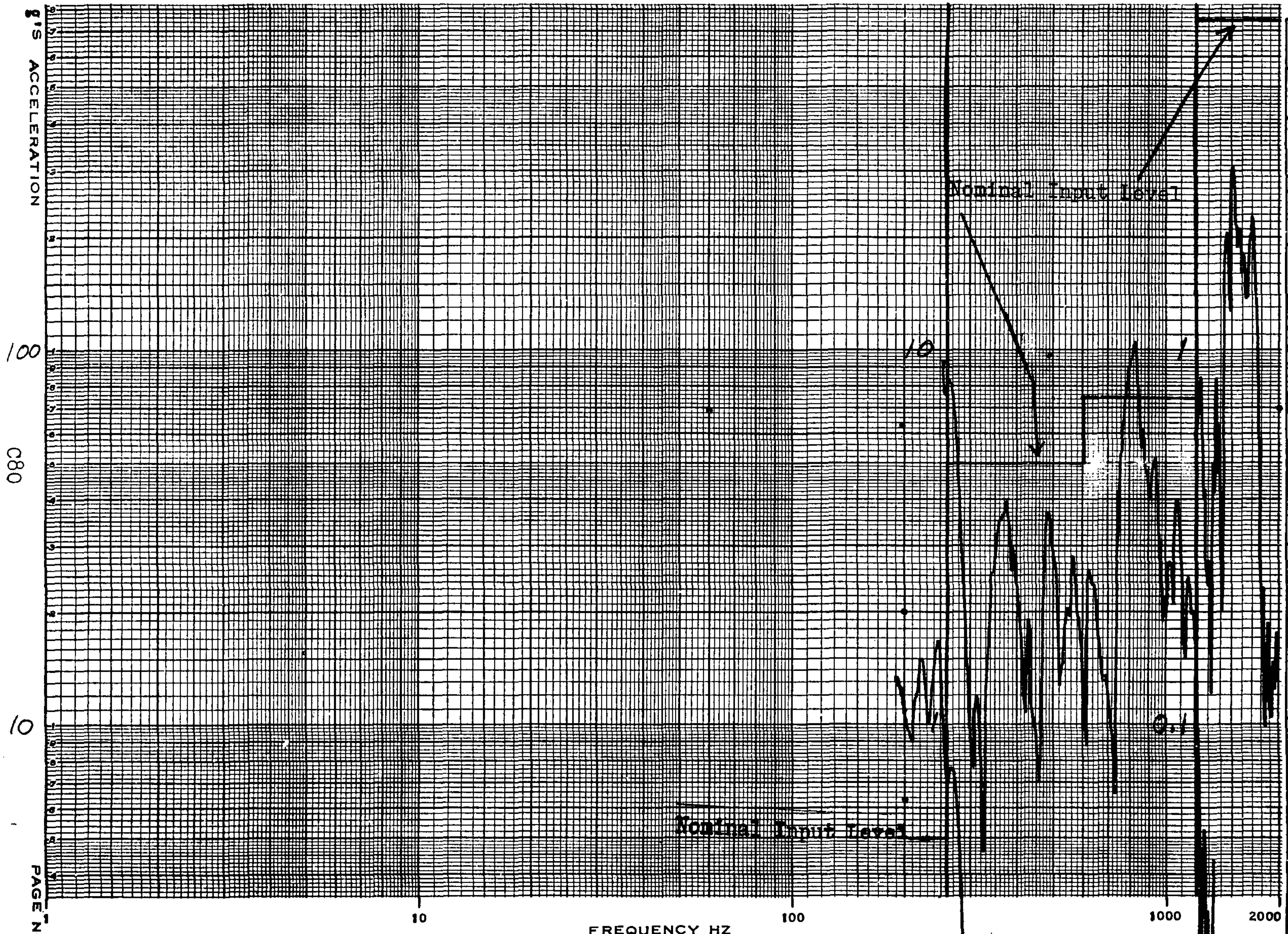
NAME OF TEST SINUSOIDAL VIBRATION

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION UA®

HSF 1633 A 2/69

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 12
TEST NO.: 5
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-15-72
TIME: 1545



INPUT LEVEL: ± 7.5 g
EXCIT. AXIS: Y
ACCEL S/N: YK20
SENSING AXIS: Y
ACCEL SENSITIVITY: — MV RMS / GP
1.596 COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER @ 700 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 75 °F
LOCATION: DY
REA MOUNT
HOOK-UP #2
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY
REPORT NO.

PAGE NO.

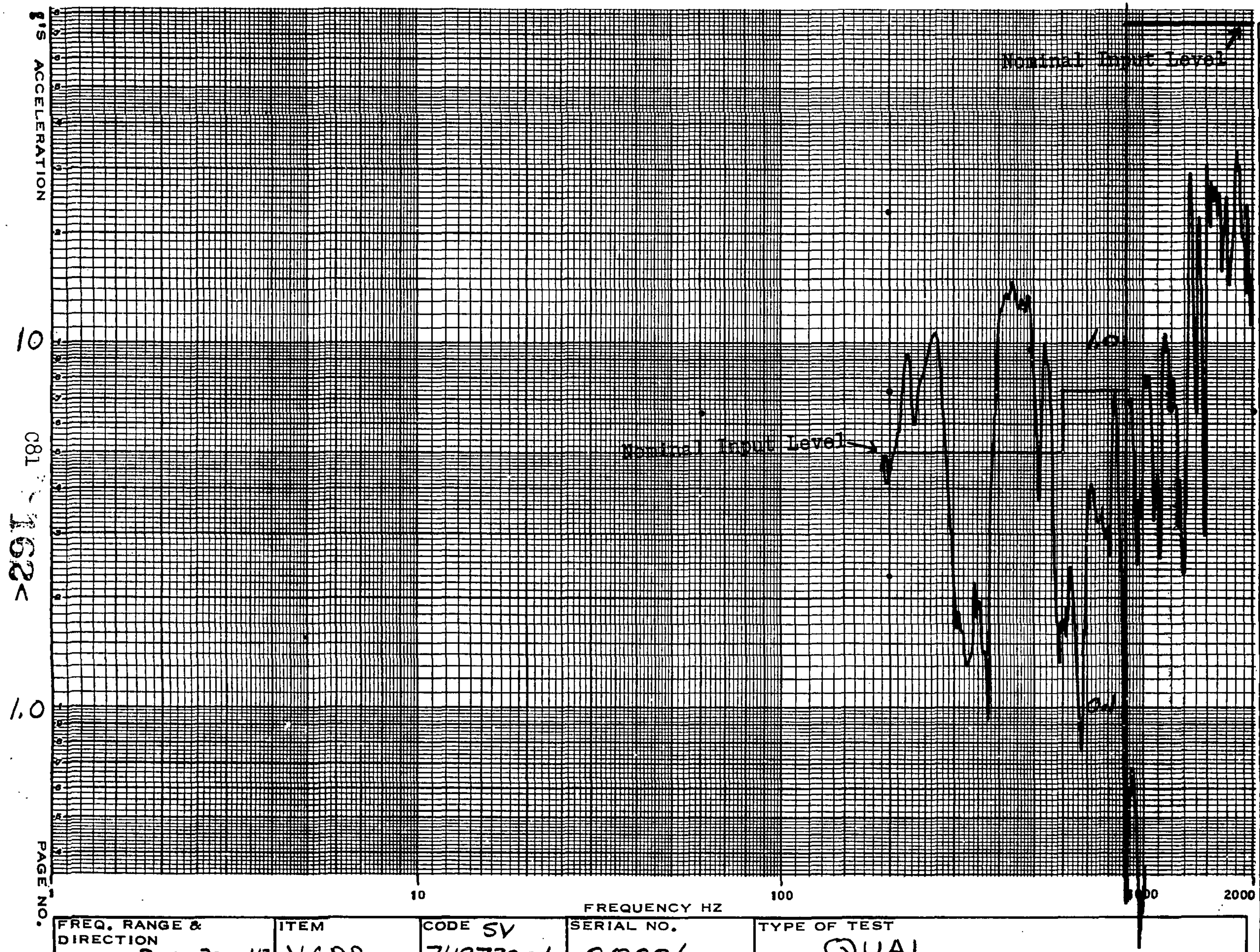
FREQ. RANGE & DIRECTION: 200-2000Hz
ITEM: VCPS
CODE: SV 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION
PARA.
AMEND.
PHASE
NAME OF TEST

HSF 1633 A 2/69

Standard A® DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 13	TEST NO. 5
TEST ENGINEER MEHIMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-15-72	TIME 1545



INPUT LEVEL ± 7.5 g	EXCIT. AXIS Y
ACCEL S/N XN32	SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS / GP; 1.297 COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPE REEL NO. 01229S	SWEEP RATE 4 OCT/MIN

COMPR. SPEED YAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING TEMP. 75 °F	☐ CONTROL ☒ RESPONSE

LOCATION EY

TANK MOUNT
Hook-up #2

SPECIAL CONDITIONS
VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

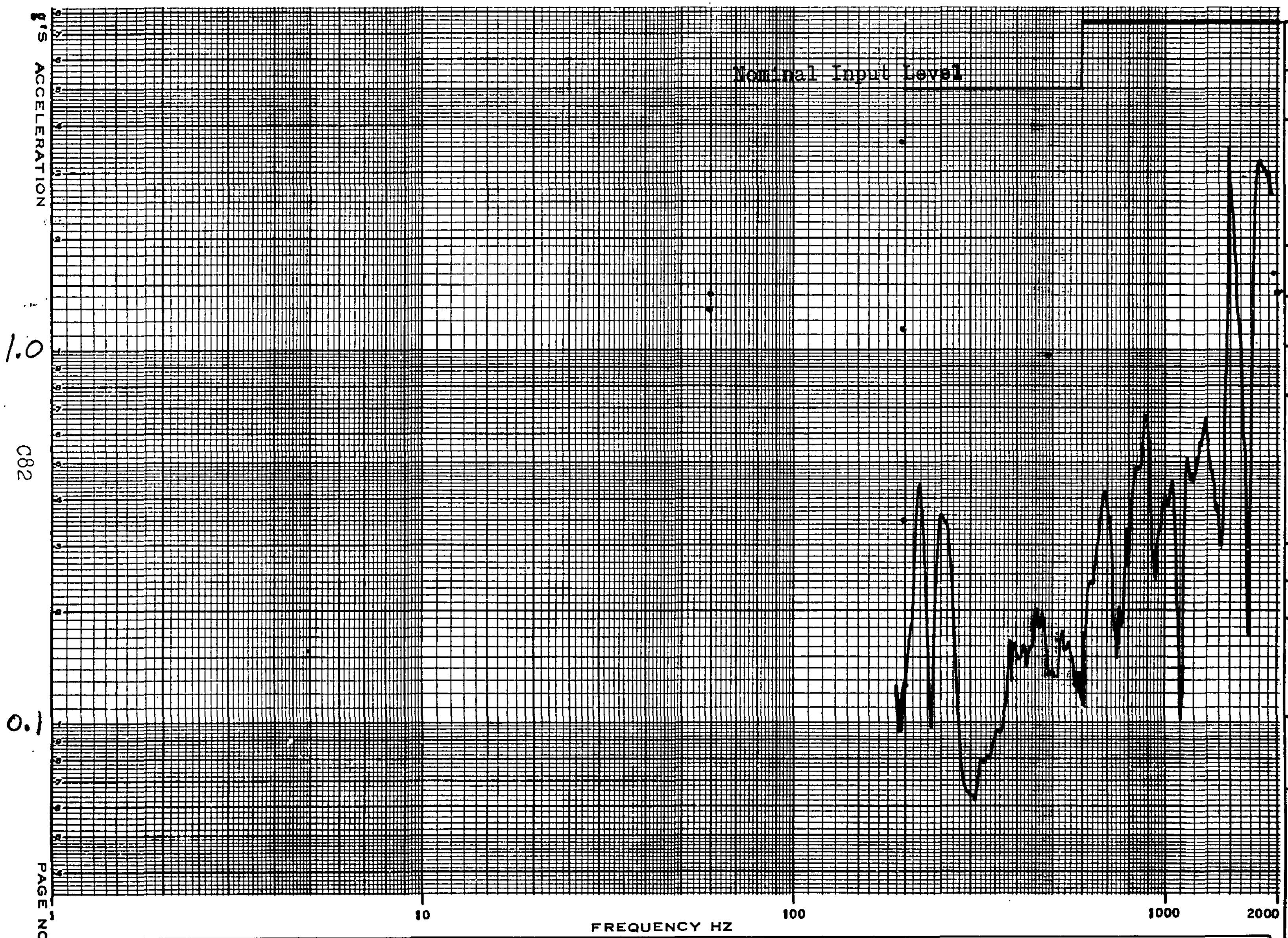
FREQ. RANGE & DIRECTION 200-2000 HZ	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 2	PHASE VCPS ONLY	NAME OF TEST SINUSOIDAL VIBRATION

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

HSF 1633 A 2/69

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 10
TEST NO.: 5
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-15-72
TIME: 1545



INPUT LEVEL: ± 7.5 g
EXCIT. AXIS: Y
ACCEL S/N: TD40
SENSING AXIS: X
ACCEL SENSITIVITY: — MV RMS / GP; 2.805 COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER: @ 700 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 75 °F
☐ CONTROL
☒ RESPONSE
LOCATION: AIX'
Hook-UP # 2
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

PAGE NO.

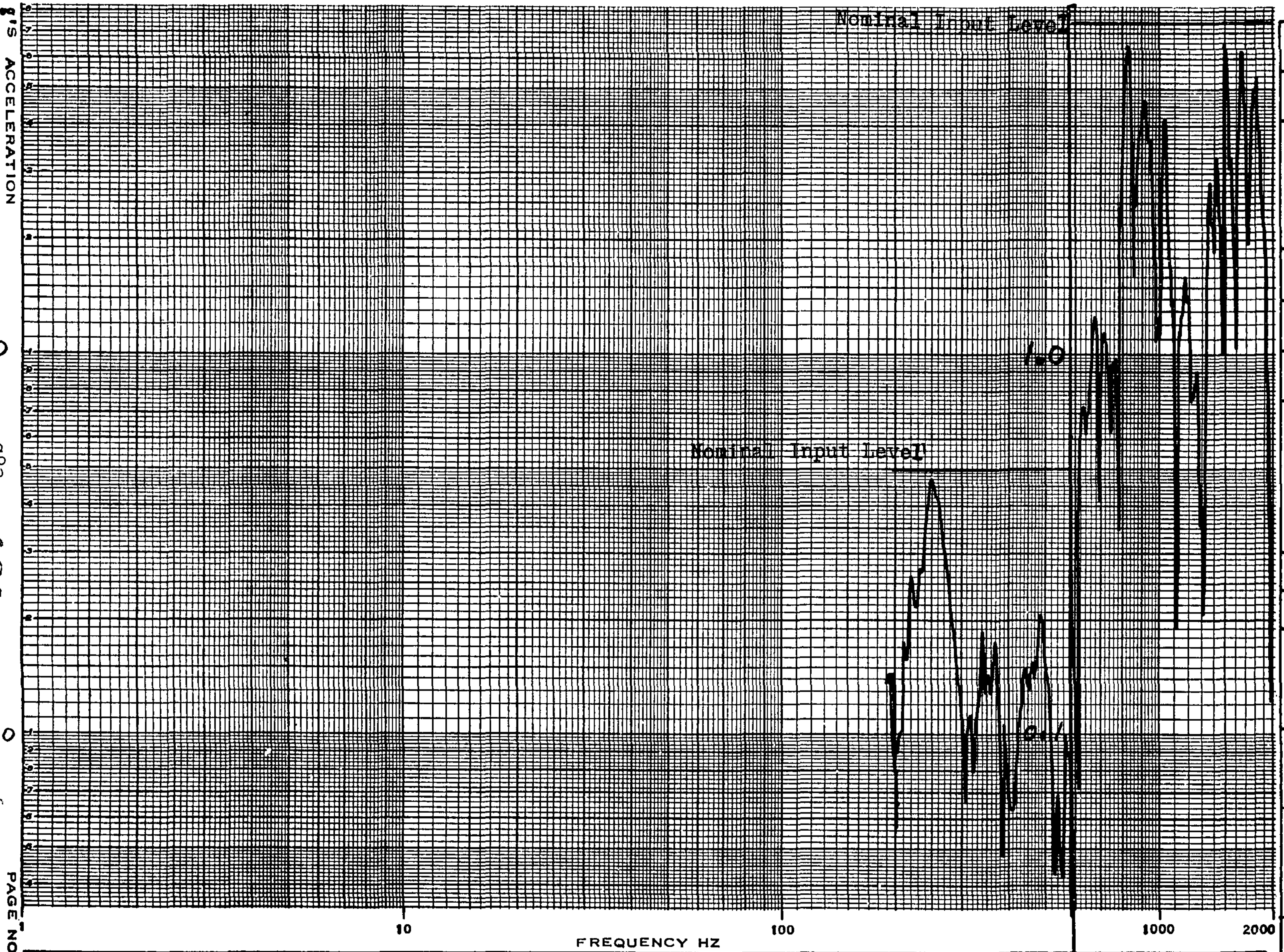
FREQ. RANGE & DIRECTION: 200-2000Hz
ITEM: VCPS
CODE SV: 748720-1
SERIAL NO.: 0.0001
TYPE OF TEST: QUAL
SPECIFICATION
PARA.
AMEND.
PHASE
NAME OF TEST

HSF 1633 A 2/69 **Standard** DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	JODOIN	17	5

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	RAE-B	4-15-72	1545



INPUT LEVEL ± 7.5 g	EXCIT. AXIS Y
ACCEL S/N TD44	SENSING AXIS X

ACCEL SENSITIVITY 3.035 MV RMS / GP

— COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPE REEL NO. 01229 5	SWEEP RATE 4 OCT/MIN

COMPR. SPEED YAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING	☐ CONTROL
TEMP. 75 °F	☒ RESPONSE

LOCATION BX HUB HOOK-UP #2

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION	ITEM	CODE SY	SERIAL NO.	TYPE OF TEST
200-2000 HZ	VCPS	748720-1	00001	QUAL

SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
AT-VCPS	4.3.7.5	NOTE 2	VCPS ONLY	SINUSOIDAL VIBRATION

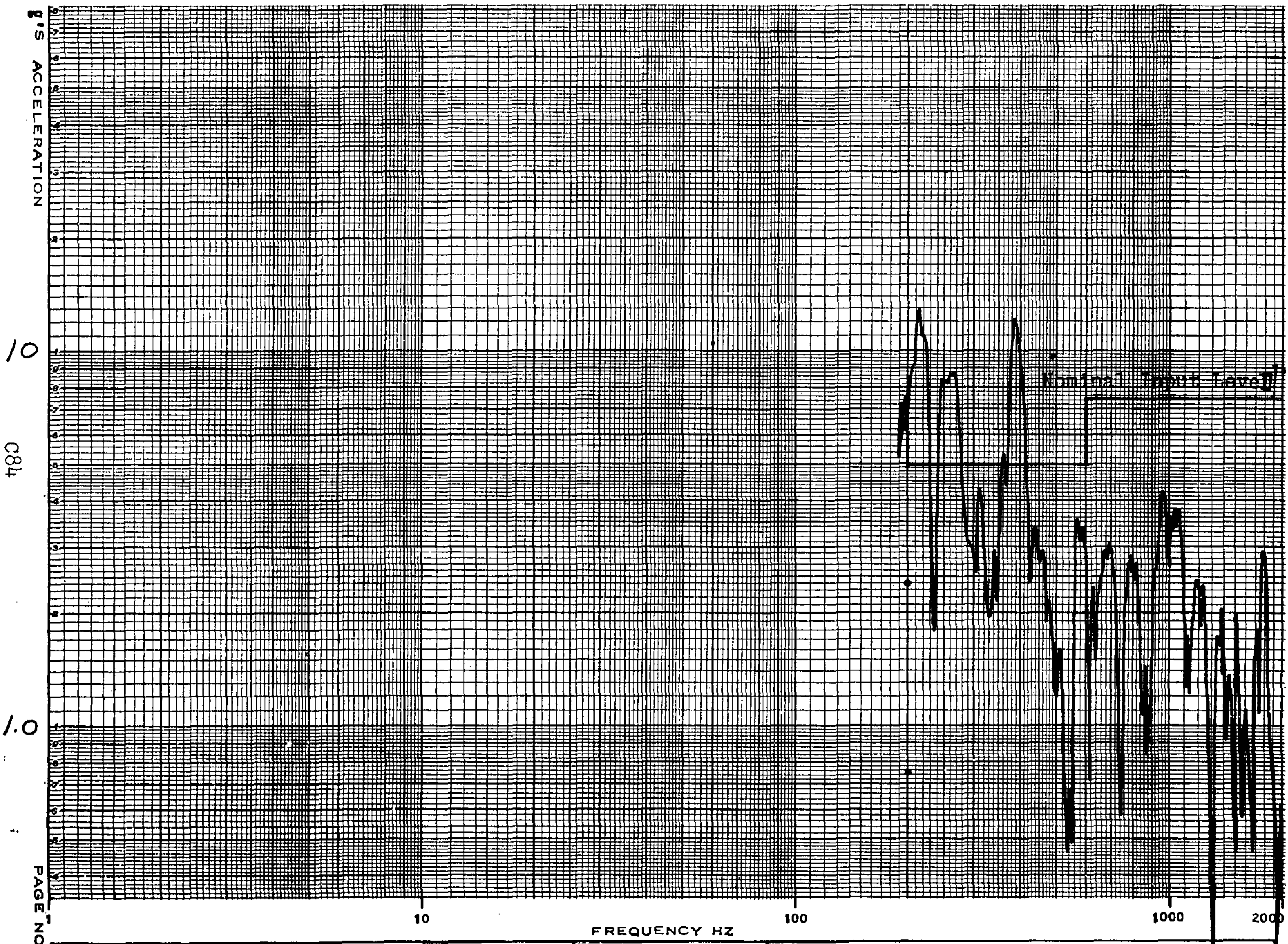
HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	JODOIN	15	5

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	[illegible]	4-15-72	1545



PAGE NO.

INPUT LEVEL ± 7.5 g

EXCIT. AXIS Y

ACCEL S/N XM21

SENSING AXIS X

ACCEL SENSITIVITY 1.325 MV RMS / GP

— COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPEREEL NO. 01229S

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 75 °F

LOCATION
DX
REA MOUNT
HOOK-UP # 2

SPECIAL CONDITIONS
VCPS LOADED AND PRESSURIZED

THIS PORTION
OF THE TEST
PERFORMED WITH
THE VCPS ONLY

REPORT NO.

FREQ. RANGE & DIRECTION	ITEM	CODE SV	SERIAL NO.	TYPE OF TEST
200-2000HZ	VCPS	748720-1	00001	QUAL
SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST

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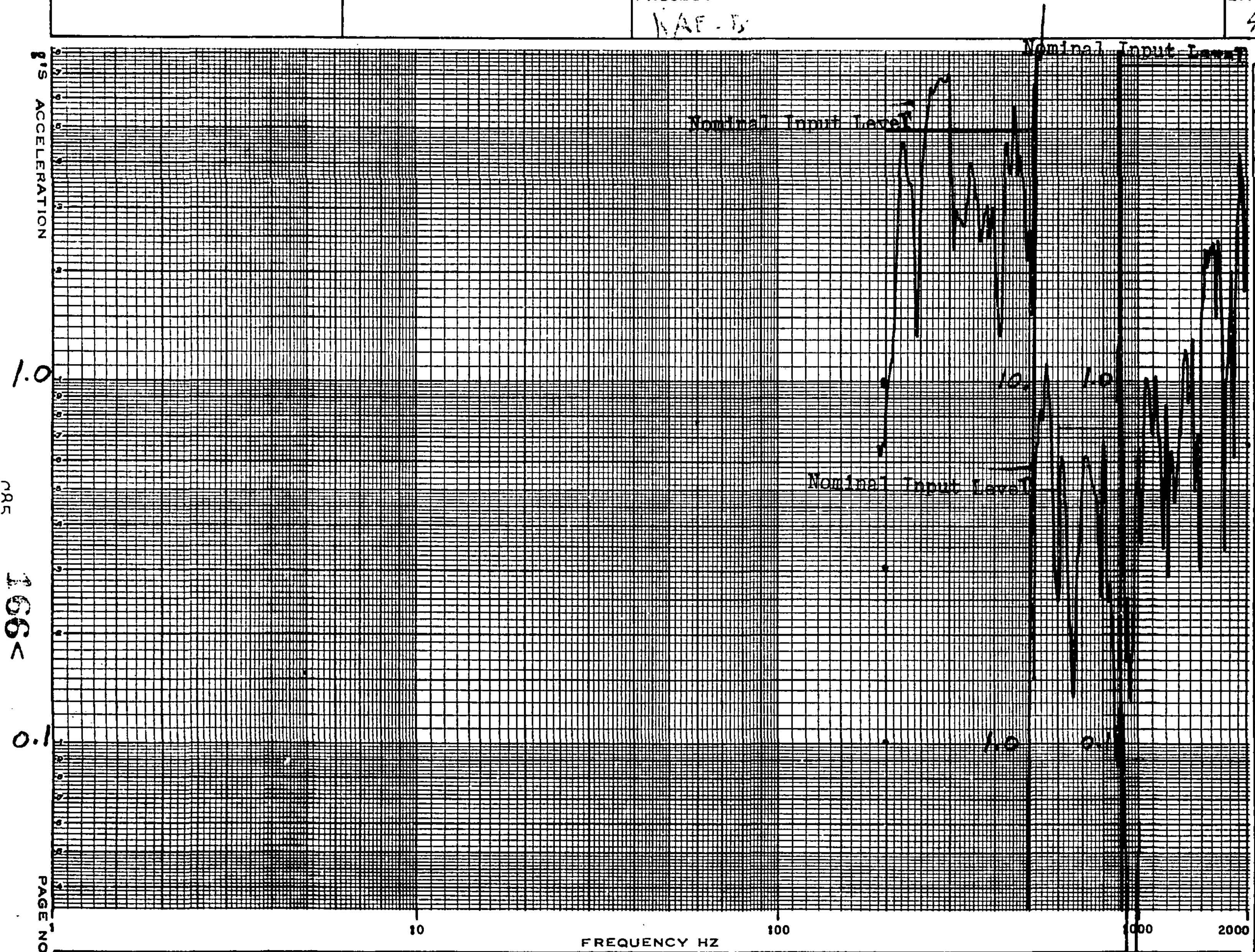
SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO. 16	TEST NO. 9
TEST ENGINEER	CHECKED BY	PROJECT NAF-B	DATE 4-15-72	TIME 1545



INPUT LEVEL ± 7.5 g

EXCIT. AXIS Y

ACCEL S/N

SENSING AXIS

ACCEL SENSITIVITY ____ MV RMS / GP ____ COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPE REEL NO. 012295

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ HZ TO DB/SEC

CHG@ HZ TO DB/SEC

NON-OPERATING

☐ CONTROL

☐ RESPONSE

TEMP. 75 °F

LOCATION EX TANK MOUNT HOOK-UP#2

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION	ITEM VCPS	CODE	SERIAL NO.	TYPE OF TEST
SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST

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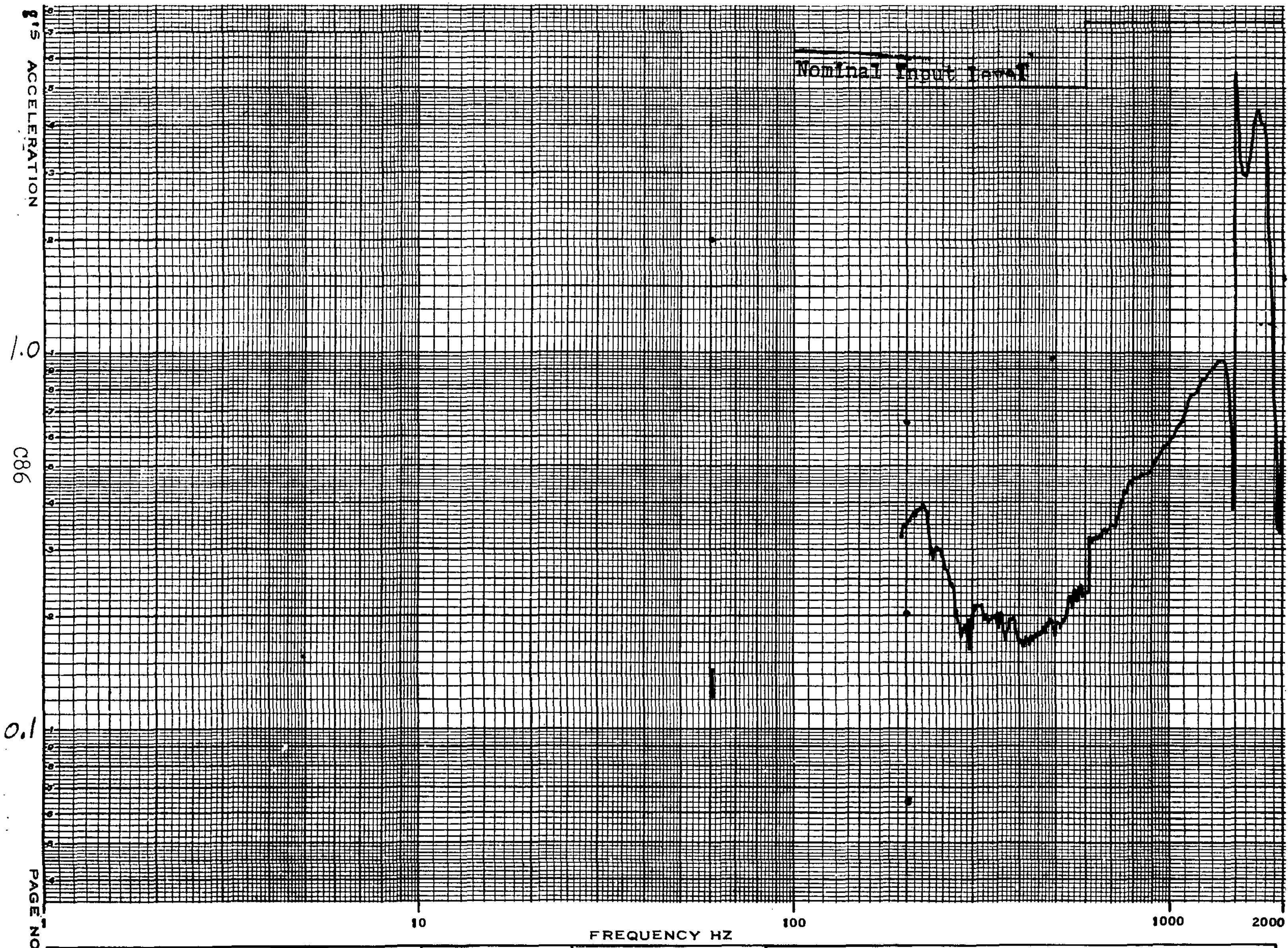
SINE VIBRATION TEST

RIG: 2 6
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 14
TEST NO.: 5
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: NAE-D
DATE: 4-15-72
TIME: 1545



INPUT LEVEL: ± 7.5 g
EXCIT. AXIS: Y
ACCEL S/N: NB62
SENSING AXIS: Z
ACCEL SENSITIVITY: 3.052 MV RMS / GP
— COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER: @ 700 HZ
TAPEREEL NO.: 01229 5
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: YAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 75 °F
LOCATION: A1Z
HOOK-UP # 2
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED

THIS PORTION OF THE TEST PERFORMED WITH THE VCPS ONLY

REPORT NO.

PAGE NO.

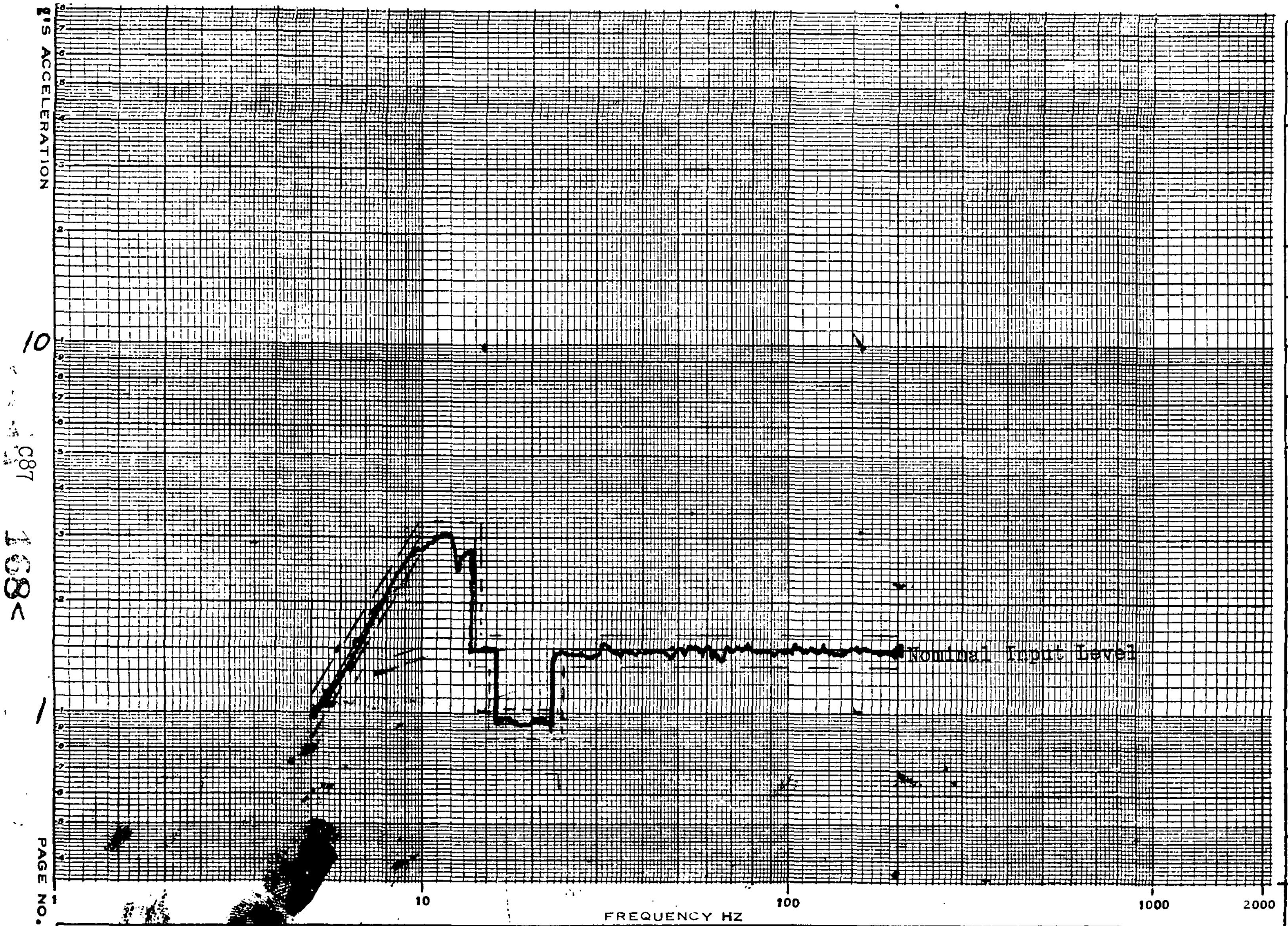
FREQ. RANGE & DIRECTION: 200 - 2000 HZ
ITEM: VCPS
CODE SV: 748720-1
SERIAL NO.: 0.0.0.1
TYPE OF TEST: QUAL
SPECIFICATION
PARA.
AMEND.
PHASE
NAME OF TEST

C86

Hamilton Standard
DIVISION OF UNITED AIRCRAFT CORPORATION
HSF-1633.1 2/69

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	WITNESS	WITNESS —		TEST NO. 7
TEST ENGINEER S. Mehmed Jr.	CHECKED BY GEIB	PROJECT RAE-B		DATE 4-17-72	TIME 1145



PAGE NO.

INPUT LEVEL 3 g	EXCIT. AXIS Y
ACCEL S/N TE88	SENSING AXIS Y
ACCEL SENSITIVITY — MV RMS / GP 2.722 COL / GP	
FILTER 10-100-[redacted] HZ B.W.	
FILTER CROSSOVER @ 70-[redacted] HZ	
SWEEP RATE 4 OCT/MIN	
TAPEREEL NO. 012295	☒ LIVE ☐ FROM TAPE
COMPR. SPEED VAR DB/SEC.	
CHG.@ - HZ TO - DB/SEC.	
CHG.@ - HZ TO - DB/SEC.	
NON OPERATING	☒ CONTROL
TEMP. 75 °F	☐ RESPONSE
LOCATION A1Y	
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED. SPACECRAFT C.G. MONITORED	REPORT NO.

[illegible] AT 17½ CPS
THE [illegible]
[illegible]
[illegible]

FREQ. RANGE & DIRECTION 5-200HZ	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	SPEC. AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 1&3
ACTION SHEET NO. —	ATA NO. —	TYPE OF TEST [illegible]		NAME OF TEST SINUSOIDAL VIBRATION		

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

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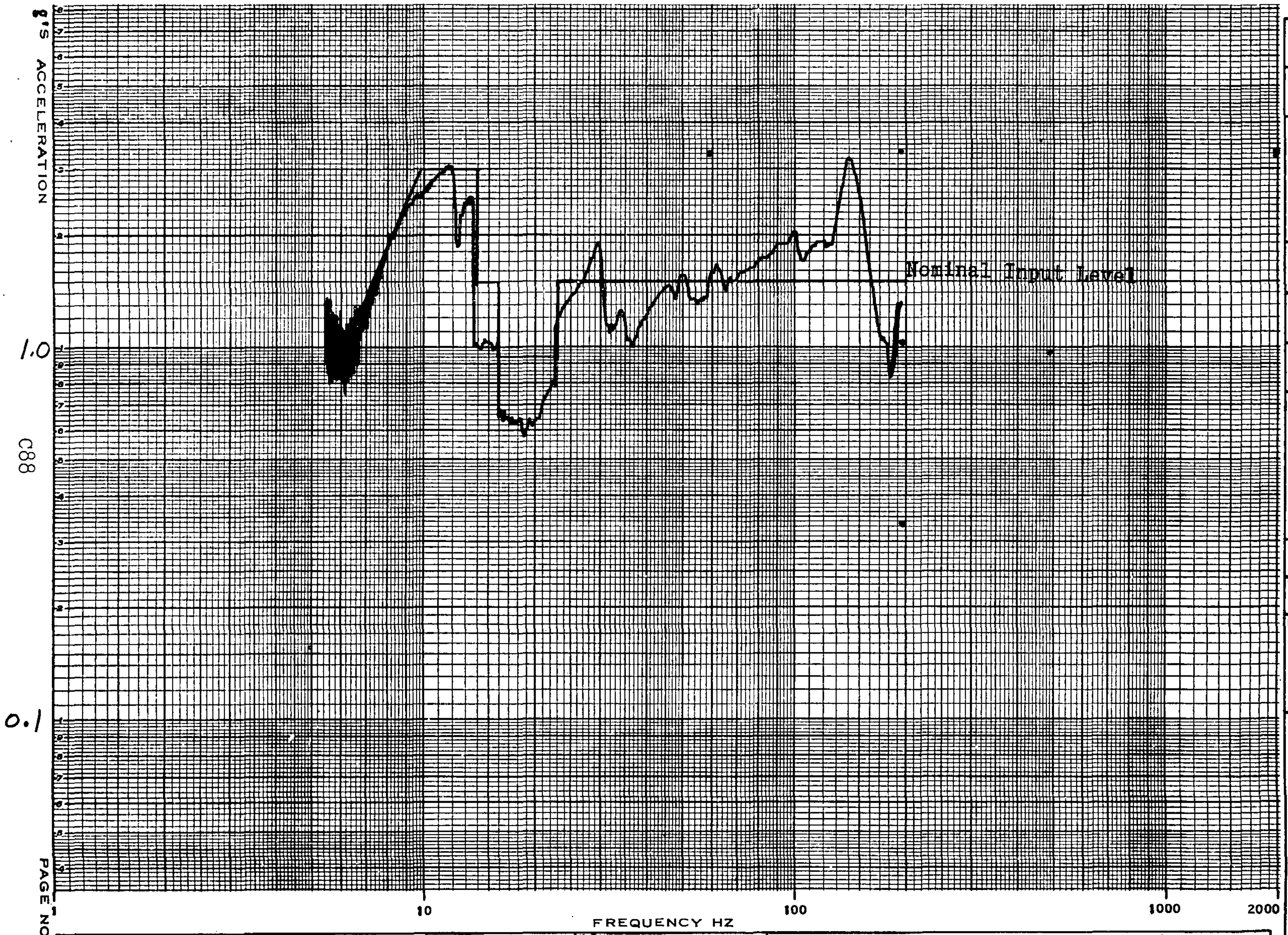
SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 29
TEST NO.: 7
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RA
DATE: 4-17-72
TIME: 1145



INPUT LEVEL: ± 3 g
EXCIT. AXIS: Y
ACCEL S/N: WR11
SENSING AXIS: Y
ACCEL SENSITIVITY: 3.016 MV RMS / GP
— COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPEREELNO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 75 °F
☐ CONTROL
☒ RESPONSE
LOCATION: BY
HUB
HOOK-UP #2
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
REPORT NO.
PAGE NO.

FREQ. RANGE & DIRECTION: 5-200HZ
ITEM: RAE-D VCPS
CODE SV: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION
PARA.
AMEND.
PHASE
NAME OF TEST

C88

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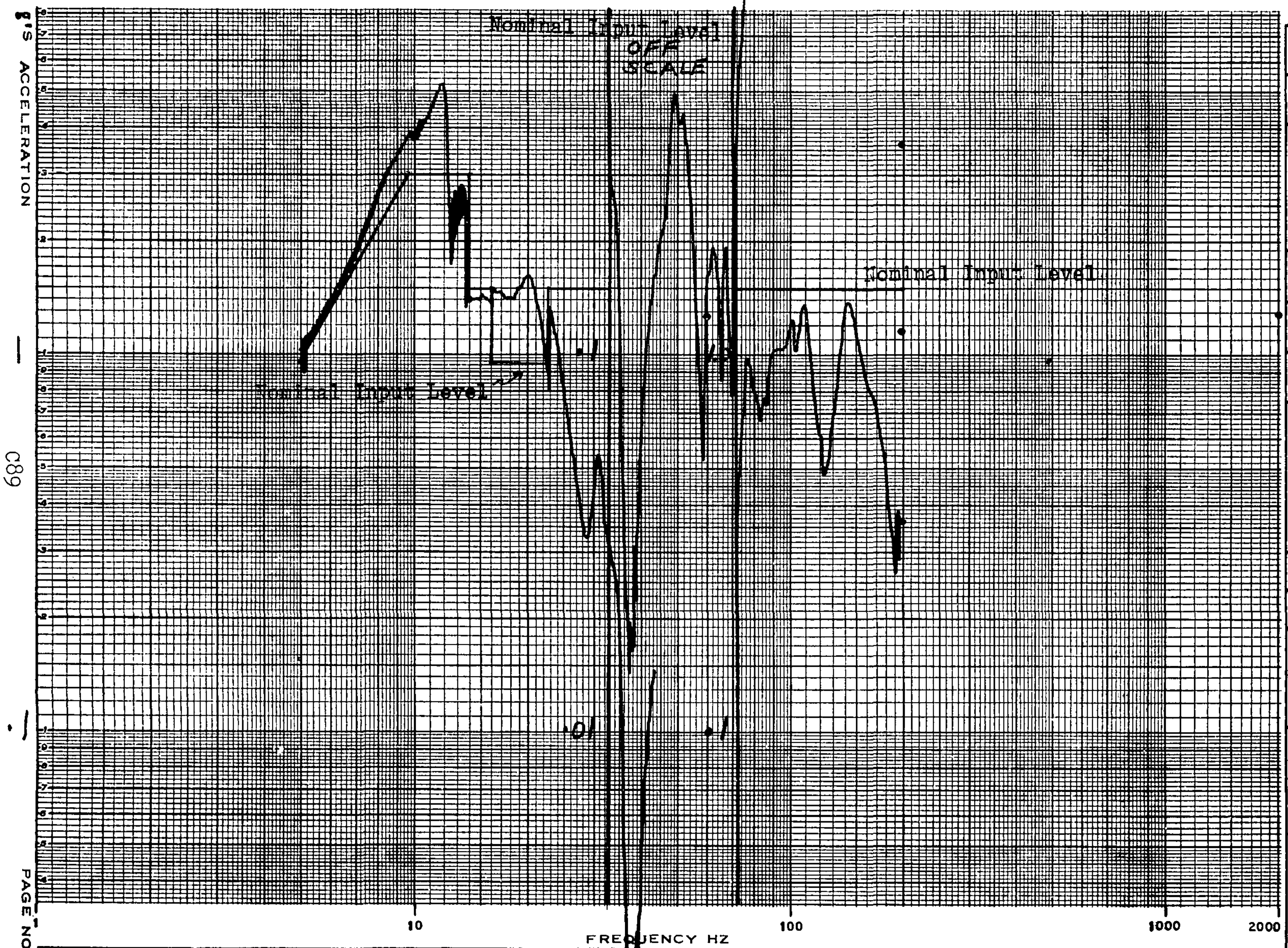
SINE VIBRATION TEST

RIG 26
OPERATOR JODOIN
PLOTTED BY JODOIN
TRACE NO. 24
TEST NO. 7
TEST ENGINEER MEHMED
CHECKED BY GEIB
PROJECT RAE-B
DATE 4-17-72
TIME 1145



INPUT LEVEL ± 3 g
EXCIT. AXIS Y
ACCEL S/N TD48
SENSING AXIS Y
ACCEL SENSITIVITY — MV RMS / GP
2.65 COL / GP
FILTER 10/100 HZ B.W.
FILTER CROSSOVER @ 70 HZ
TAPE REEL NO. 012295
SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 75 °F
☐ CONTROL
☒ RESPONSE
LOCATION CY
SPACECRAFT C.G.
HOOK-UP #2
SPECIAL CONDITIONS
VCPS LOADED AND PRESSURIZED.

REPORT NO.

FREQ. RANGE & DIRECTION 5-200HZ
ITEM RAE-B VCPS
CODE SV 748720-1
SERIAL NO. 00001
TYPE OF TEST QUAL
SPECIFICATION AT-VCPS
PARA. 4.3.7.5
AMEND. NOTE 1 & 3
PHASE VCPS AND SPACECRAFT
NAME OF TEST SINUSOIDAL VIBRATION

HSF 1633 A 2/69

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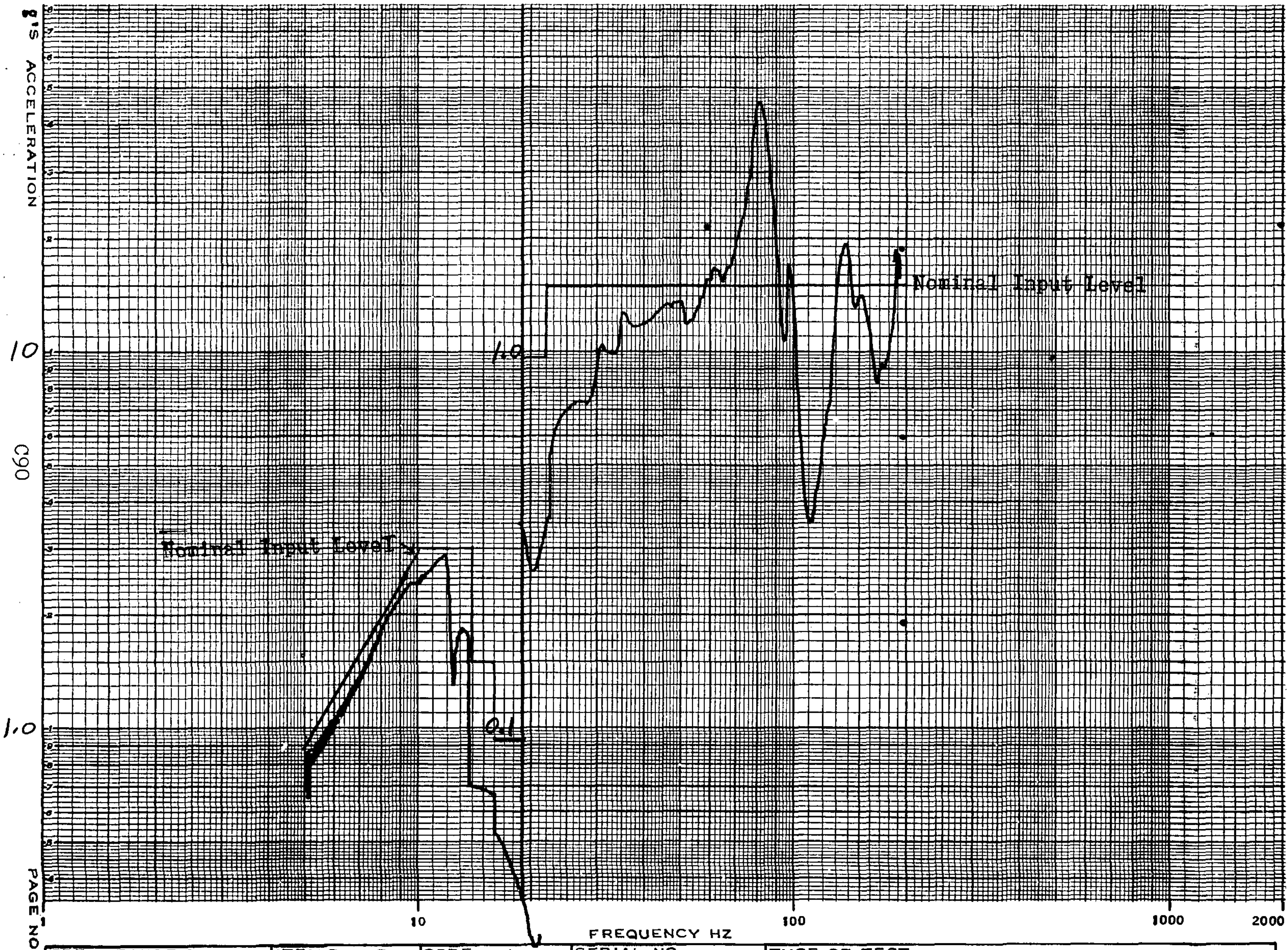
SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 1
TEST NO.: 7
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-17-72
TIME: 1145



INPUT LEVEL: ± 3 g
EXCIT. AXIS: Y
ACCEL S/N: YK20
SENSING AXIS: Y
ACCEL SENSITIVITY: — MV RMS / GP
1.596 COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER @ 70 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 75 °F
LOCATION: DY
REA MOUNT
HOOK-UP #2
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
REPORT NO.:

FREQ. RANGE & DIRECTION: 5-200HZ
ITEM: RAE-B VCPS
CODE: SV 748720-1
SERIAL NO.: 0.0001
TYPE OF TEST: QUAL
SPECIFICATION:
PARA.:
AMEND: NOTE
PHASE: VCPS
NAME OF TEST:
PAGE NO.

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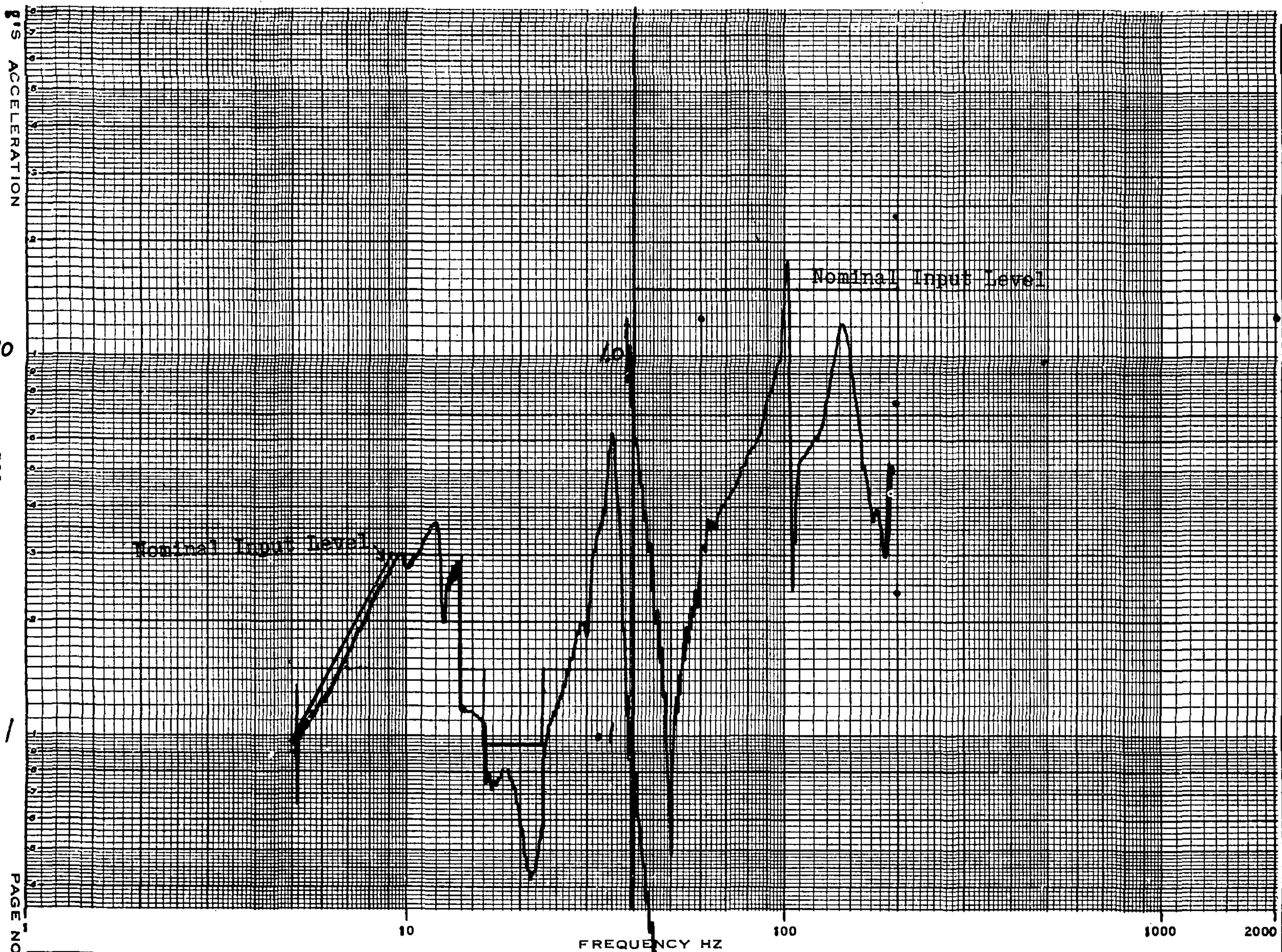
SINE VIBRATION TEST

RIG 26
OPERATOR JODOIN
PLOTTED BY JODOIN
TRACE NO. 22
TEST NO. 7
TEST ENGINEER MEHMED
CHECKED BY GEIB
PROJECT [illegible]
DATE 4-17-72
TIME 1145



INPUT LEVEL ± 3 g
EXCIT. AXIS Y
ACCEL S/N XN32
SENSING AXIS Y
ACCEL SENSITIVITY — MV RMS / GP
1.297 COL / GP
FILTER 10/100 HZ B.W.
FILTER CROSSOVER @ 70 HZ
TAPEREEL NO. 012295
SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 75 °F
☐ CONTROL
☒ RESPONSE
LOCATION EY
TANK MOUNT HOOK-UP #2
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.
REPORT NO.

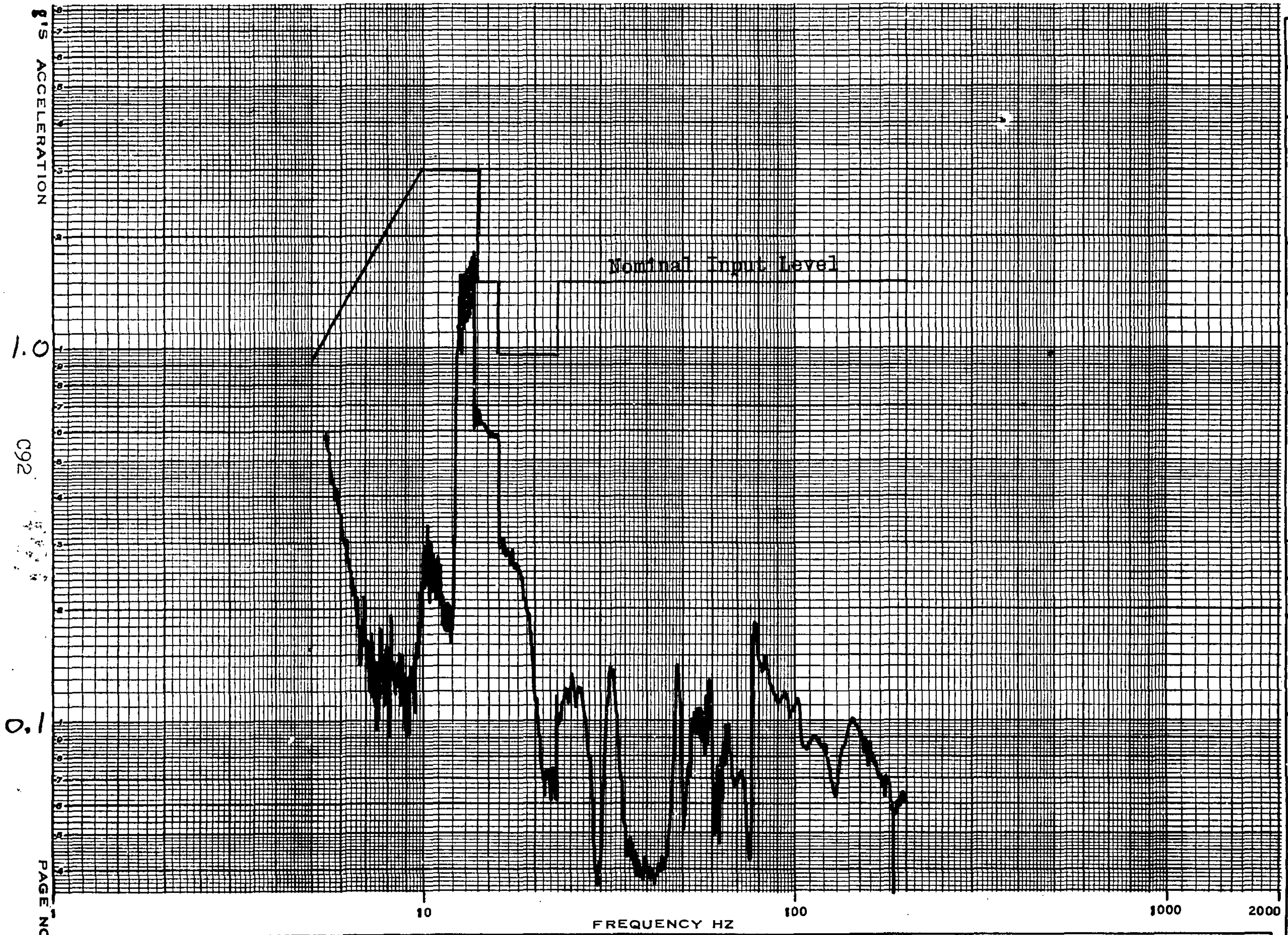
FREQ. RANGE & DIRECTION 5-200Hz
ITEM TAE-B VCPS
CODE SV 748720-1
SERIAL NO. 00001
TYPE OF TEST QUAL
SPECIFICATION AT-VCPS
PARA. 4.3.7.5
AMEND. NOTE 1 & 3
PHASE VCPS AND SPACECRAFT
NAME OF TEST SINUSOIDAL VIBRATION

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 25
TEST NO.: 7
TEST ENGINEER: ME
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-17-72
TIME: 1145



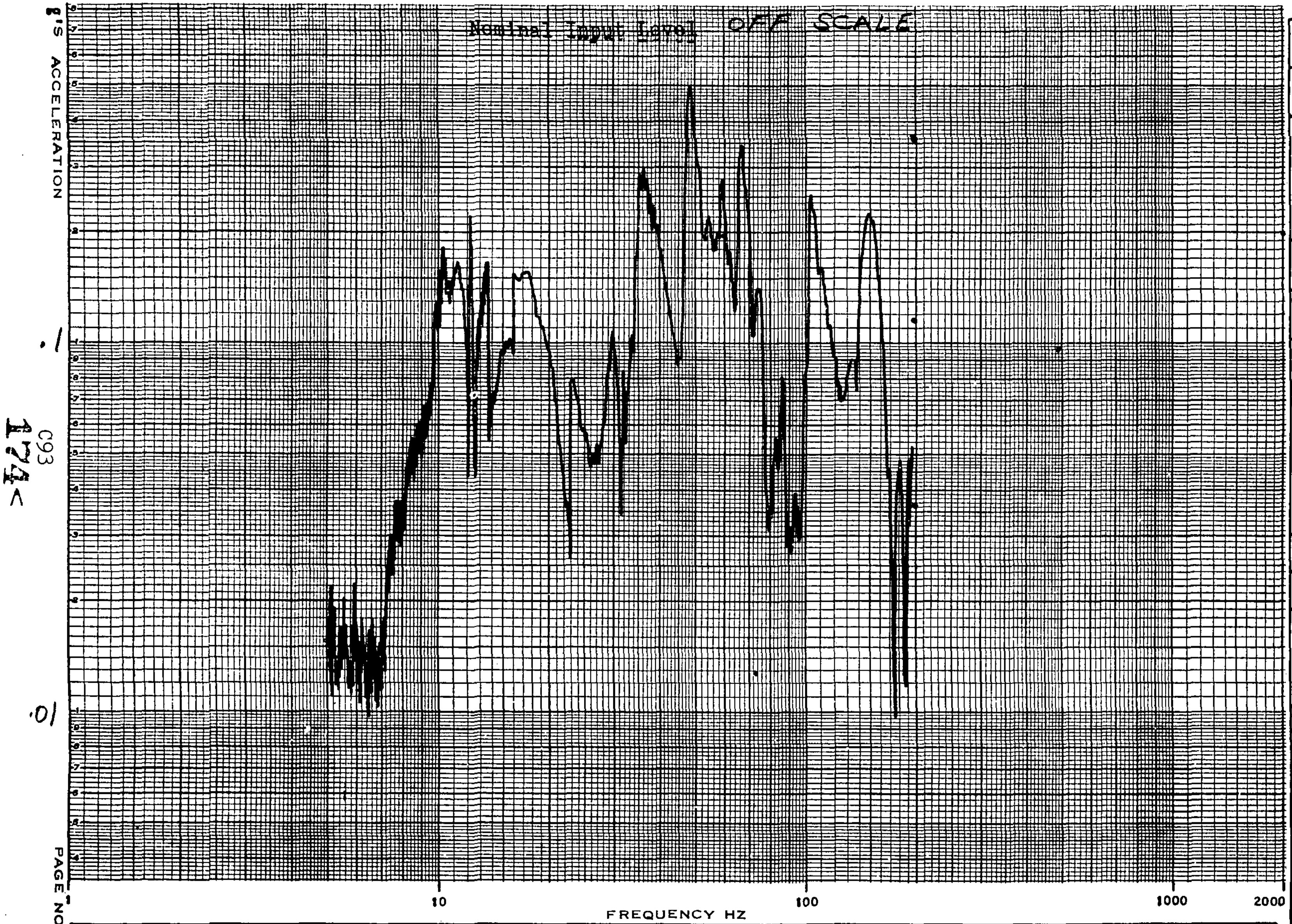
INPUT LEVEL: ± 3 g
EXCIT. AXIS: Y
ACCEL S/N: NB62
SENSING AXIS: Z
ACCEL SENSITIVITY: 3.052 MV RMS / GP
— COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPE REEL NO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 75 °F
☐ CONTROL
☒ RESPONSE
LOCATION: A1Z
HOOK-UP #2
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED.
REPORT NO.:
PAGE NO.:

FREQ. RANGE & DIRECTION: 5-200HZ
ITEM: RAE-B VCPS
CODE: SV 748720-1
SERIAL NO.: 0000/
TYPE OF TEST: QUAL
SPECIFICATION
PARA.
AMEND.
PHASE VCPS
NAME OF TEST

HSF 1633 A 2/69 **Standard** DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26
OPERATOR JODOIN
PLOTTED BY JODOIN
TRACE NO. 19
TEST NO. 7
TEST ENGINEER MEHMED
CHECKED BY GEIB
PROJECT RAE-B
DATE 4-17-72
TIME 1145



INPUT LEVEL ± 3 g
EXCIT. AXIS Y
ACCEL S/N TD40
SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP; 2.805 COL / GP
FILTER 10/100 HZ B.W.
FILTER CROSSOVER @ 70 HZ
TAPEREELNO. 012295
SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 75 °F
☐ CONTROL
☒ RESPONSE
LOCATION AIX'
HOOK-UP # 2
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.
REPORT NO.
PAGE NO.

FREQ. RANGE & DIRECTION 5-200Hz
ITEM RAE-B VCPS
CODE SY 748720-1
SERIAL NO. 00001
TYPE OF TEST QUAL
SPECIFICATION AT-VCPS
PARA. 4.3.7.5
AMEND. NOTE 1 & 3
PHASE VCPS AND SPACECRAFT
NAME OF TEST SINUSOIDAL VIBRATION

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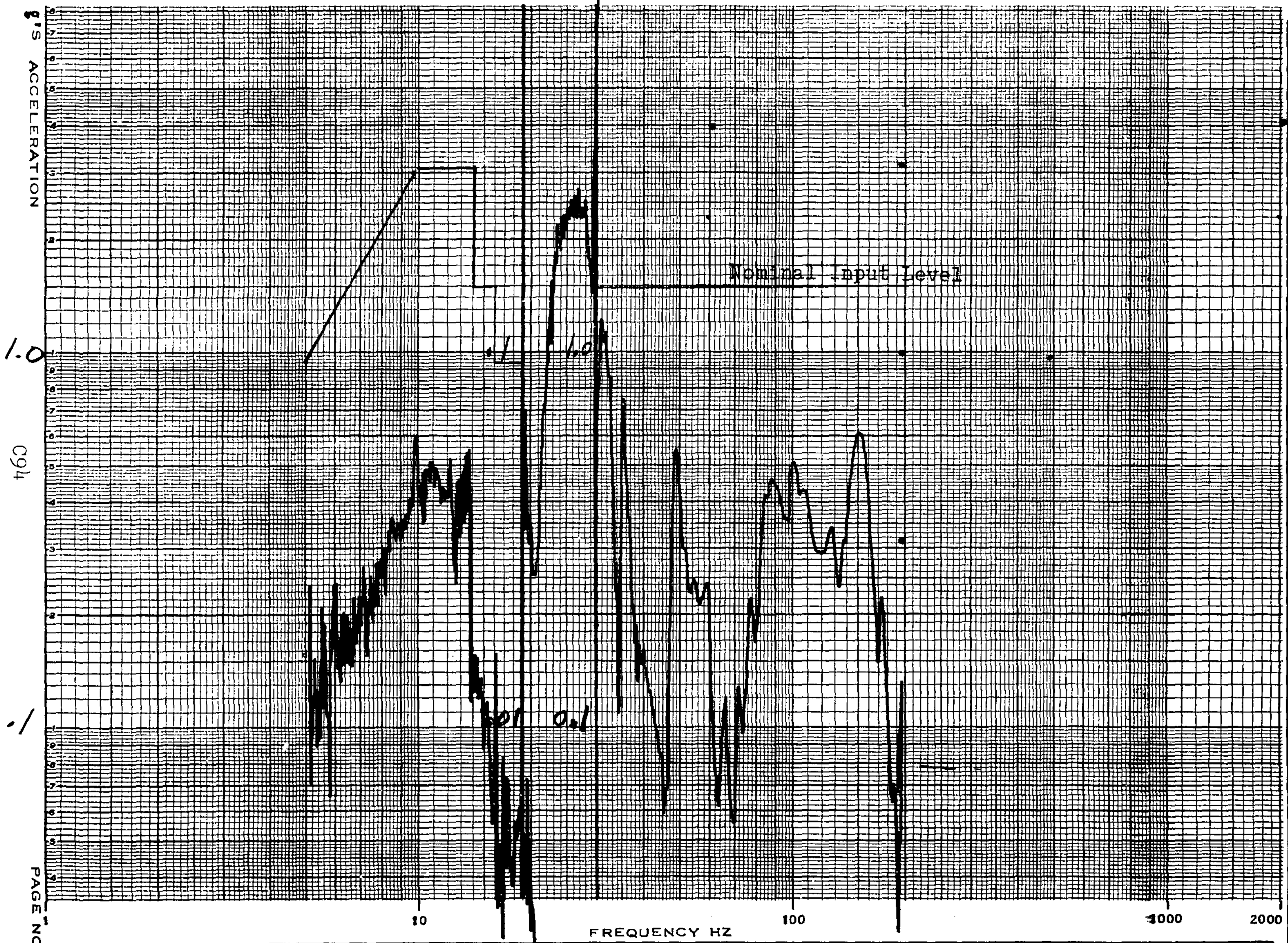
SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 28	TEST NO. 7
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE [illegible]-10-72	TIME 1145



INPUT LEVEL ± 3 g	EXCIT. AXIS Y
ACCEL S/N TD44	SENSING AXIS X
ACCEL SENSITIVITY 3.035 MV RMS / GP — COL / GP	
FILTER 10/100 HZ B.W.	
FILTER CROSSOVER @ 70 HZ	
TAPE REEL NO. 012295	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC	
CHG@ — HZ TO — DB/SEC	
CHG@ — HZ TO — DB/SEC	
NON-OPERATING TEMP. 75°F	☐ CONTROL ☒ RESPONSE
LOCATION Bx HUB HOOK-UP #2	
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.	

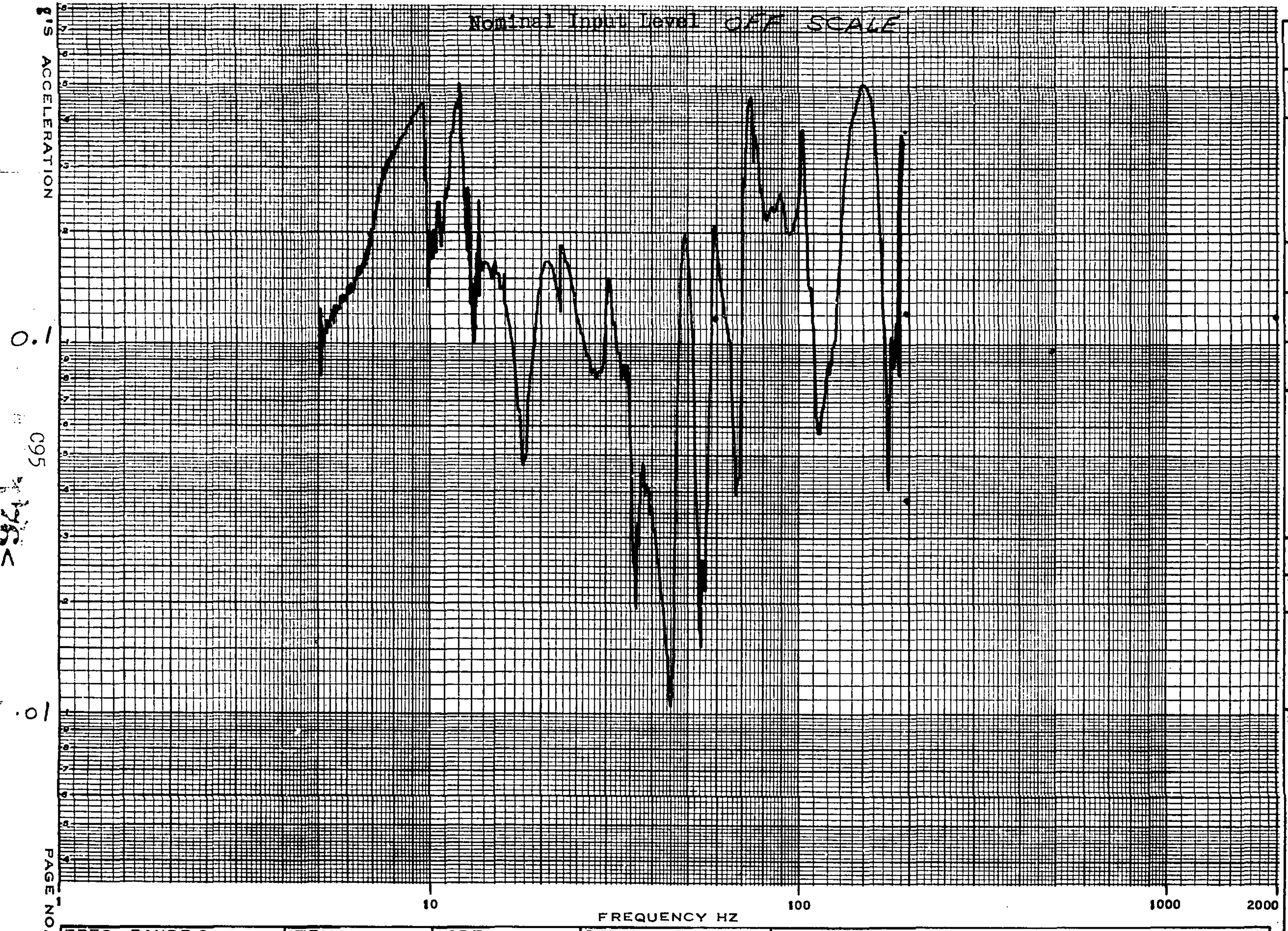
REPORT NO.

FREQ. RANGE & DIRECTION 5-200Hz	ITEM RAE-B VCPS	CODE SV 748720-1	SERIAL NO. 0001	TYPE OF TEST QUAL
SPECIFICATION	PARA.	AMEND.	PHASE VCPS	NAME OF TEST

HSF 1633 A 2/69 **Standard** A®

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODoIN
PLOTTED BY: JODOIN
TRACE NO.: 23
TEST NO.: 7
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: Y[illegible]-B
DATE: 4-17-72
TIME: 1145



INPUT LEVEL: ± 3 g
EXCIT. AXIS: Y
ACCEL S/N: TD45
SENSING AXIS: X
ACCEL SENSITIVITY: — MV RMS/GP; 2.650 COL/GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPEREELNO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 75 °F
☐ CONTROL
☒ RESPONSE
LOCATION: CX
SPACECRAFT C.G.
HOOK-UP #2
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
REPORT NO.

FREQ. RANGE & DIRECTION: 5-200Hz
ITEM: Yol-B VCPS
CODE SV: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION: AT-VCPS
PARA.: 4.3.7.5
AMEND. NOTE 1 & 3
PHASE VCPS AND SPACECRAFT
NAME OF TEST: SINUSOIDAL VIBRATION

C95

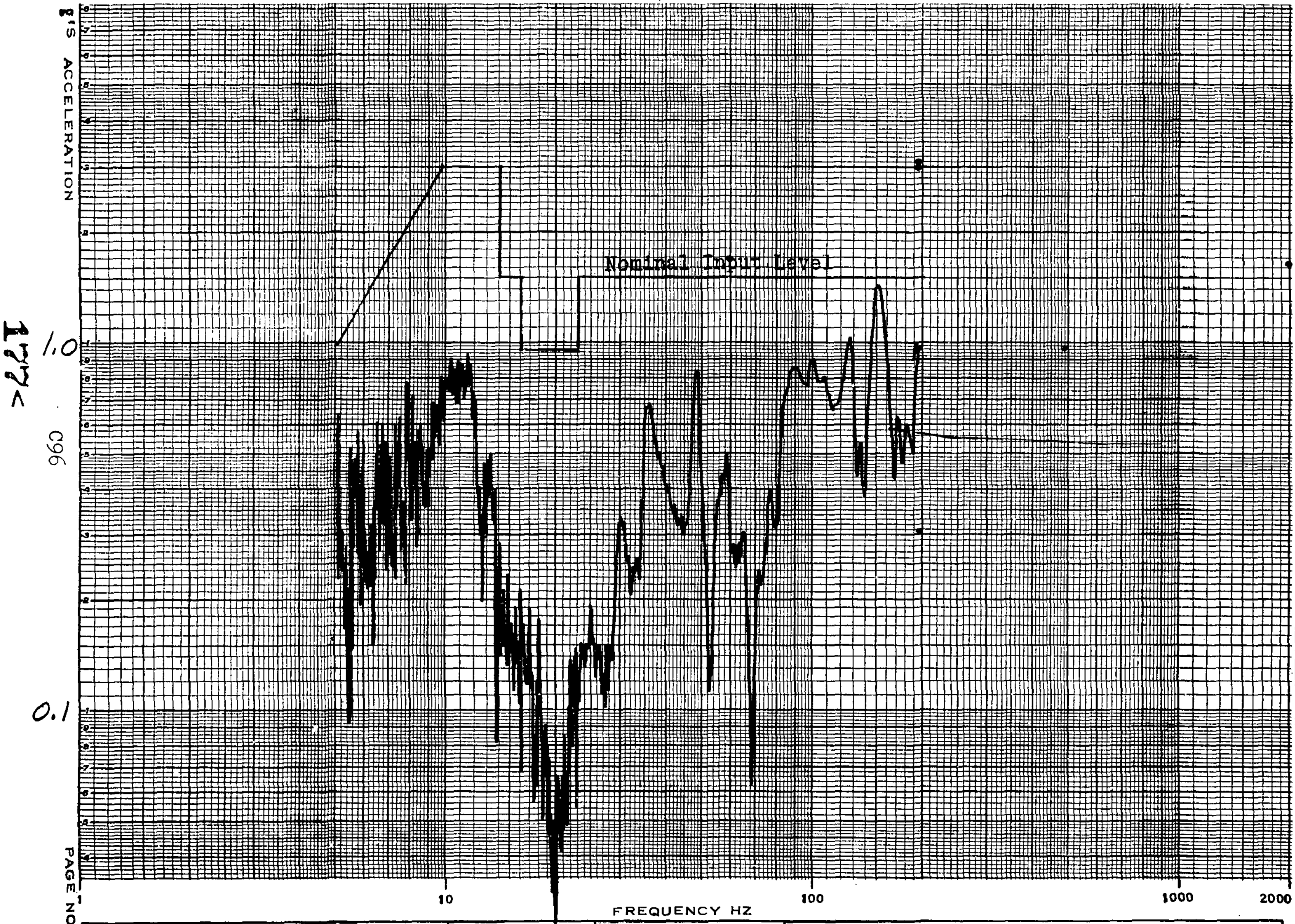
HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION UA®

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	JODOIN	[illegible]	1

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	RAE-B	4-17-72	1145



INPUT LEVEL ± 3 g

EXCIT. AXIS Y

ACCEL S/N XM21

SENSING AXIS X

ACCEL SENSITIVITY 1.325 MV RMS / GP

— COL / GP

FILTER 10/100 HZ B.W.

FILTER CROSSOVER @ 70 HZ

TAPE REEL NO. 012295

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 75 °F

LOCATION DX

REA MOUNT

HOOK-UP#2

SPECIAL CONDITIONS

VCPS LOADED AND PRESSURIZED.

REPORT NO.

FREQ. RANGE & DIRECTION	ITEM	CODE SV	SERIAL NO.	TYPE OF TEST
5 - 200HZ	RAE-B VCPS	748720-1	00001	QUAL

SPECIFICATION PARA. AMEND. PHASE NAME OF TEST

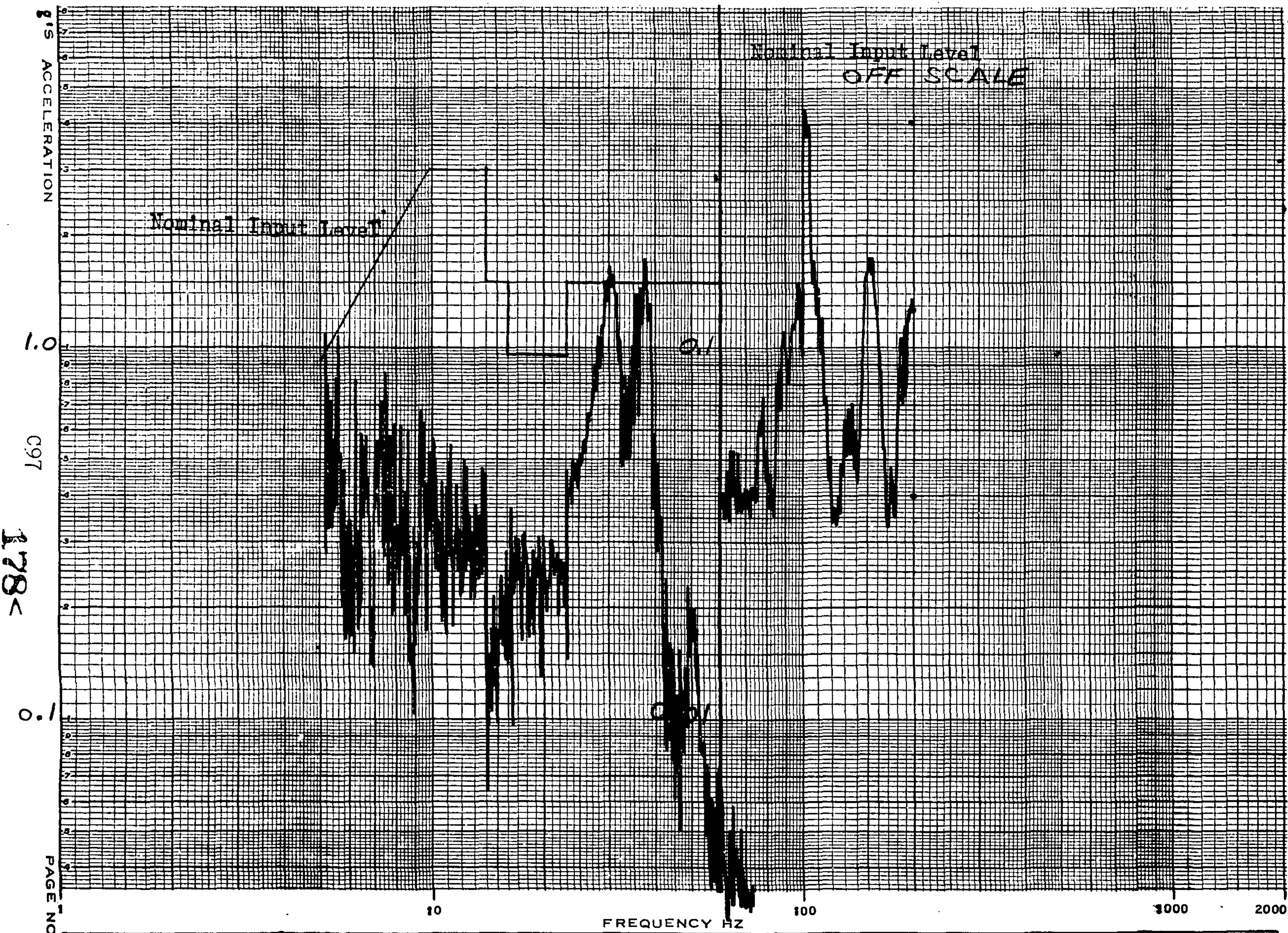
C96

177<

HSF 1633 A 2/69 **Standard** A®

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 27
TEST NO.: 7
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: [illegible]
DATE: 4 17-72
TIME: 1145



INPUT LEVEL: ± 3 g
EXCIT. AXIS: Y
ACCEL S/N: WF75
SENSING AXIS: X
ACCEL SENSITIVITY: 1.001 MV RMS / GP
— COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPEREELNO.: 012295
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 75 °F
☐ CONTROL
☒ RESPONSE
LOCATION: EX
TANK MOUNT
HOOK-UP # 2
SPECIAL CONDITIONS: VCPS LOADED
AND PRESSURIZED.
REPORT NO.

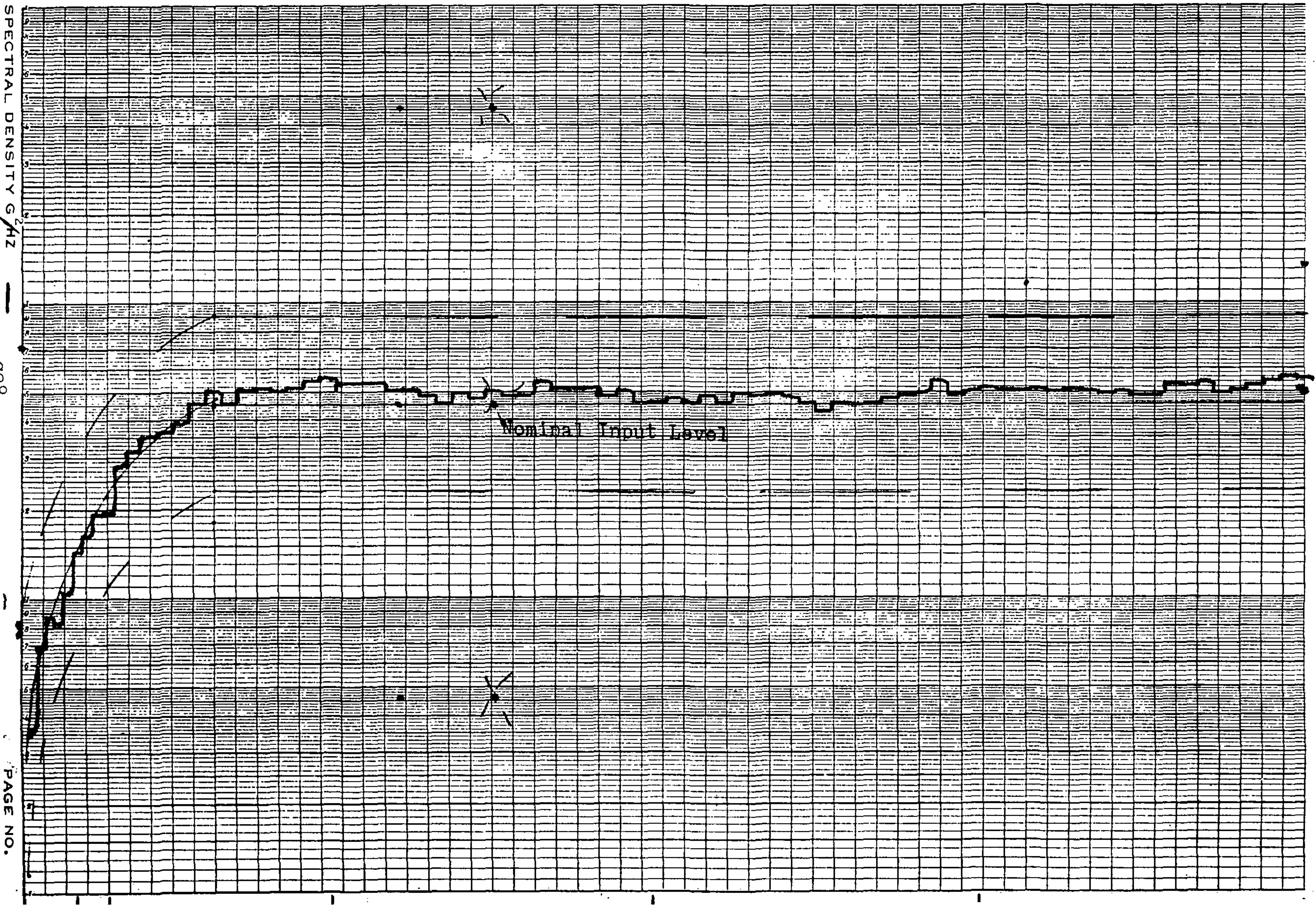
FREQ. RANGE & DIRECTION: 5-200Hz
ITEM: RAE-B VCPS
CODE SY: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION: AT-VCPS
PARA.: 4.3.7.5
AMEND. NOTE: 1 & 3
PHASE: VCPS AND SPACECRAFT
NAME OF TEST: SINUSOIDAL VIBRATION

HSF-1634A

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD A

PLOTTED BY P. Jodoin	CHECKED BY MEHMED		TEST ENGINEER T. Geib	RIG NO. 26	WITNESS 4-17-72	WITNESS
PROJECT RAE-B	ITEM VCPS with Space Craft		CODE SV748720-1	SERIAL NO. 00001	TYPE OF TEST Qual	
SPEC. AT-VCPS	PARA. 4.3.7	PHASE Rand - COMPLETE PKG	ATA NO. —	ACTION SHEET NO. —	DATE 4-17-72	TEST NO. 9



EXCITATION ALONG Y AXIS

GRMS INPUT 9.2

NON-OPERATING

TEMP. 74 °F

PERIOD OF TEST ☑ START ☐ END

DURATION OF TEST 2.0 MIN.

ACCEL. SERIAL NO. TE83

ACCEL. SENSITIVITY — MV RMS/GP

2.722 COL/GP

ACCEL. SENSING Y AXIS

ACCEL. LOCATION A1Y

TAPEREELNO. 012295

SPECIAL CONDITIONS VCPS Loaded & Pressurized SPACECRAFT INSTALLED. NOTE 1 & 4

REPORT NO.

C98

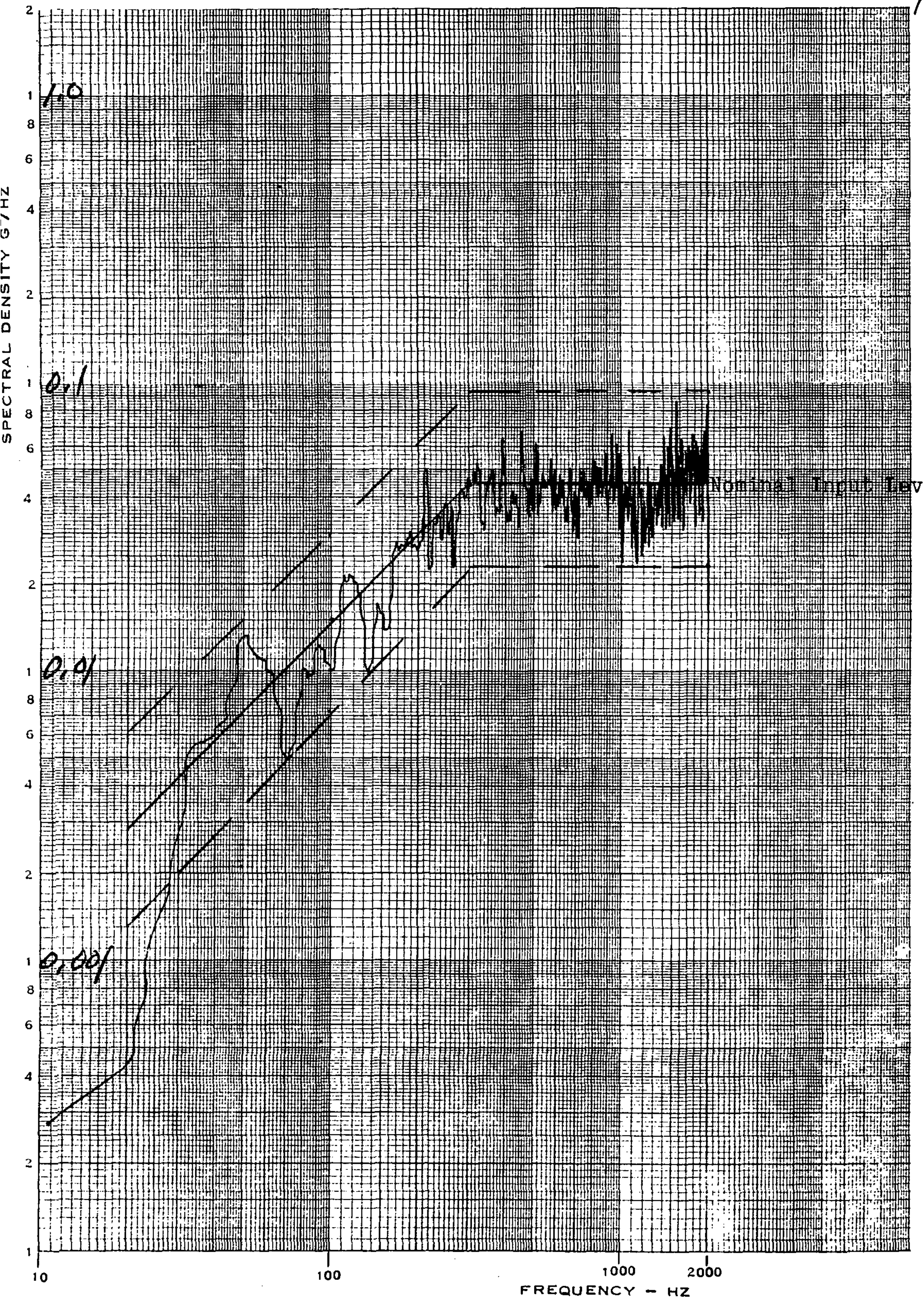
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26	OPERATOR P.J.	PLOTTED BY T.G.	TRACE NO. 2A	TEST NO. 9
TEST ENGINEER T.G.	CHECKED BY MEHMED		DATE 4/17/72	TIME 1700



INPUT LEVEL 9,2 GRMS

EXCITATION AXIS Y

ACCEL SERIAL NUMBER TE83

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS / GP; 2,722 COL / GP

ANAL FILTER – HZ B.W. 6 — | — | —

SWEEP SPEED – OCT/MIN — | — | —

TIME CONSTANT – SEC — | — | —

ANNAL. CALIBRATION 12,2 g^2/HZ F.S.

PERIOD OF TEST ☐ START ☑ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☑ CONTROL ☐ RESPONSE

PICKUP LOCATION A1Y

HOOK-UP #2

SPECIAL CONDITIONS

PLOTTED 1 MINUTE INTO RUN.

VCPS LOADED AND PRESSURIZED

PROJECT RAE-B	ITEM VC-PS	CODE SV 748720-1	SERIAL NUMBER 0000/	TYPE OF TEST QUAL	
SPEC. AT-VCPS SVHS 5619	PARA. 4.3.7	AMEND. NOTE 1 & 4	PHASE COMPLETE PKG	RANDOM —	PAGE NO.

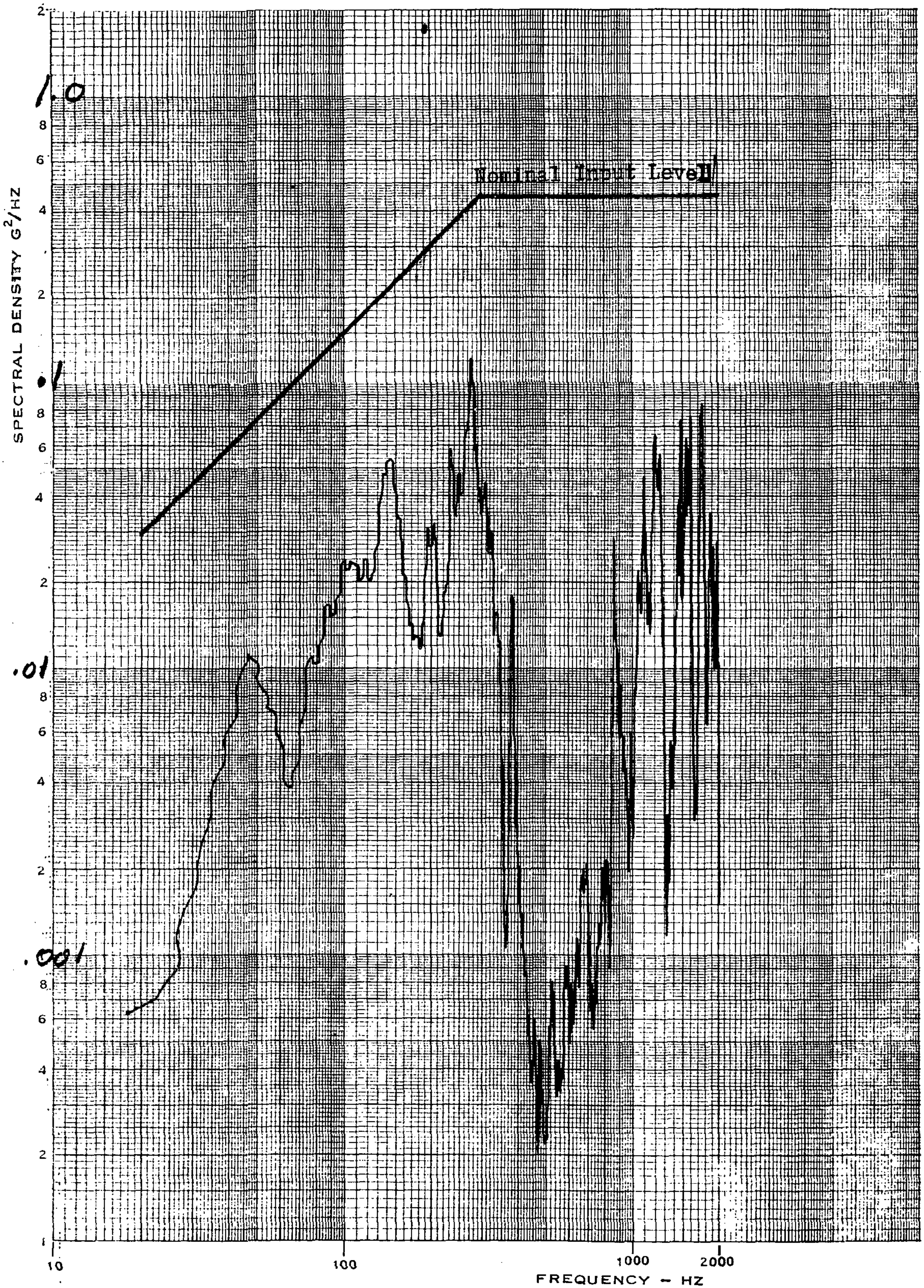
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26	OPERATOR P. J	PLOTTED BY T. G	TRACE NO. 12	TEST NO. 9
TEST ENGINEER S. M	CHECKED BY S M		DATE 4-17-72	TIME 1700



INPUT LEVEL 9.2 GRM

EXCITATION AXIS Y

ACCEL SERIAL NUMBER WR11

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY 3.016 MV RMS / GP

— COL / GP

ANAL FILTER - HZ B.W 6 | — | —

SWEEP SPEED - OCT/MI — | — | —

TIME CONSTANT - SEC — | — | —

ANNAL. CALIBRATION 17.54 g²/HZ F.S.

PERIOD OF TEST ☒ START ☐ END

DURATION 2.0 MI

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONS

PICKUP LOCATION
BY
HUB
Hook-UP #2

SPECIAL CONDITIONS
VCPS LOADED
AND PRESSURIZE

PROJECT RAE-B	ITEM RAE-B	CODE SV 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL	
SPEC. AT-VCPS	PARA. 4.3.7	AMEND. NOTE 154	PHASE COMPLETE PKG	RANDOM —	PAGE NO.

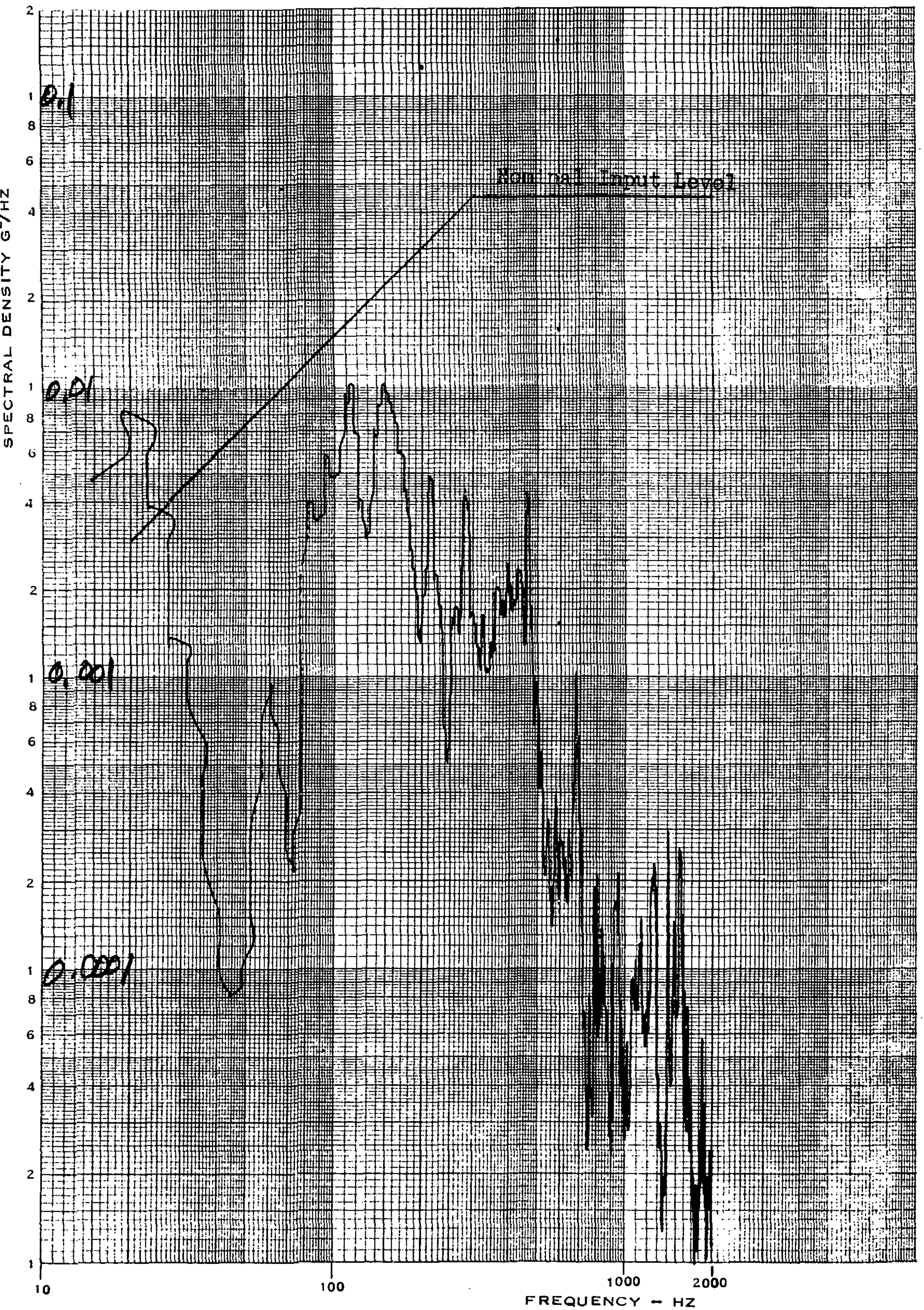
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26	OPERATOR P.J.	PLOTTED BY T.G.	TRACE NO. 6	TEST NO. 9
TEST ENGINEER T.G.	CHECKED BY MEHMED		DATE 4/17/72	TIME 1700



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS Y

ACCEL SERIAL NUMBER TD48

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY 2.788 MV RMS / GP, COL / GP

ANAL FILTER – HZ B.W. 6 | — | —

SWEEP SPEED – OCT/MIN — | — | —

TIME CONSTANT – SEC — | — | —

ANNAL. CALIBRATION 1.27 g^2/HZ F.S.

PERIOD OF TEST ☑ START ☐ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION CY

HOOK-UP #2

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT RAE-B	ITEM VCPS	CODE SV 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL

SPEC. AT-VCPS SVHS 5619	PARA. 4.3.7	AMEND. NOTE 1 & 4	PHASE COMPLETE PKG	RANDOM —	PAGE NO.

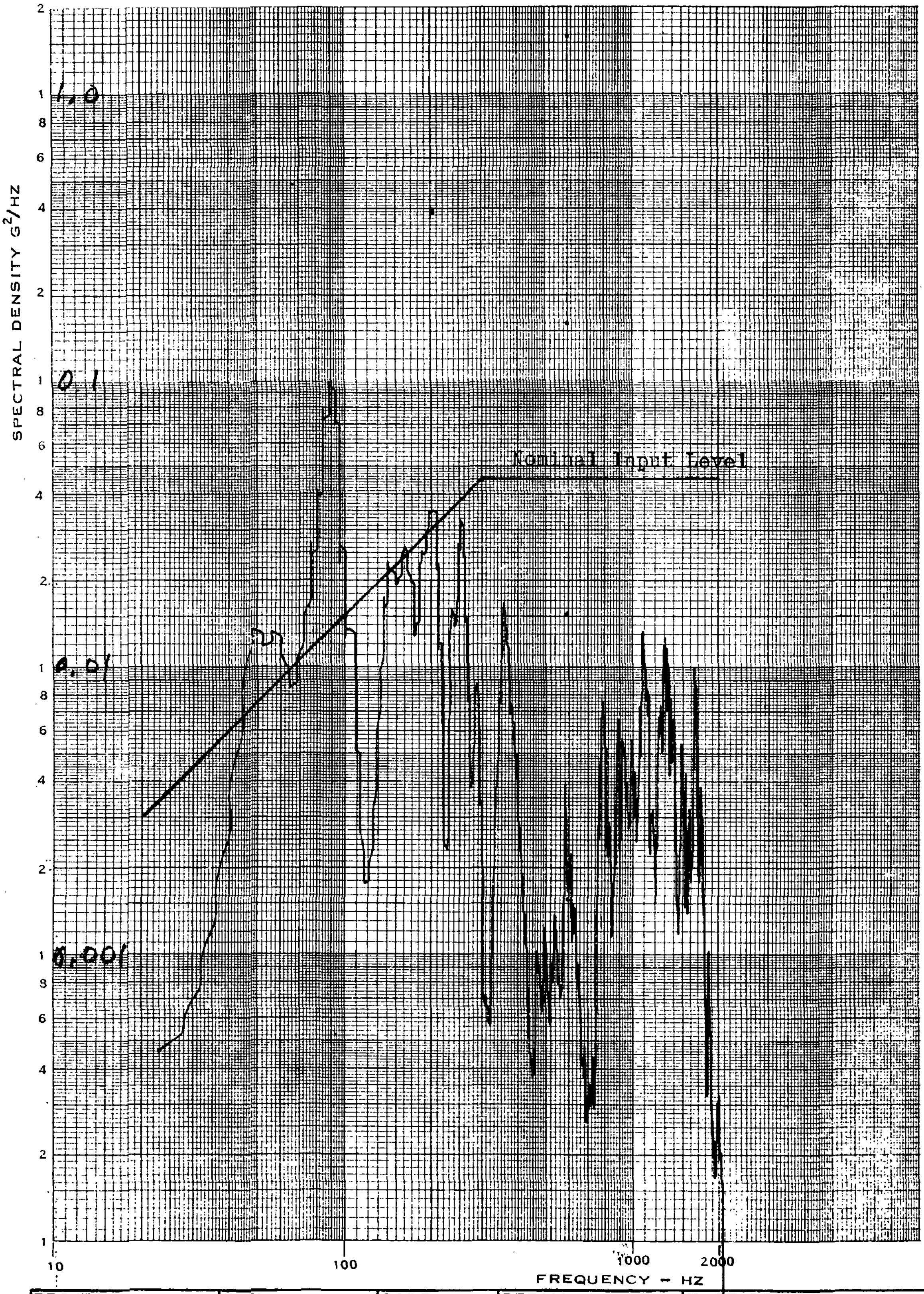
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26	OPERATOR P.J.	PLOTTED BY T.G.	TRACE NO. 3	TEST NO. 9
TEST ENGINEER T.G.	CHECKED BY MEHMED		DATE 4/17/72	TIME 1700



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS Y

ACCEL SERIAL NUMBER YK20

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS / GP ; 1.596 COL / GP

ANAL FILTER - HZ B.W. 6 — | — | —

SWEEP SPEED - OCT/MIN — | — | —

TIME CONSTANT - SEC — | — | —

ANNAL. CALIBRATION 3.87 g^2/HZ F.S.

PERIOD OF TEST ☑ START ☐ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION Dy

HOOK-UP #2

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT RAE-B	ITEM VCPS	CODE SV 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL
SPEC. AT-VCPS SUHS 5619	PARA. 4.3.7	AMEND. NOTE 1&1	PHASE COMPLETE PKG	RANDOM —	PAGE NO.

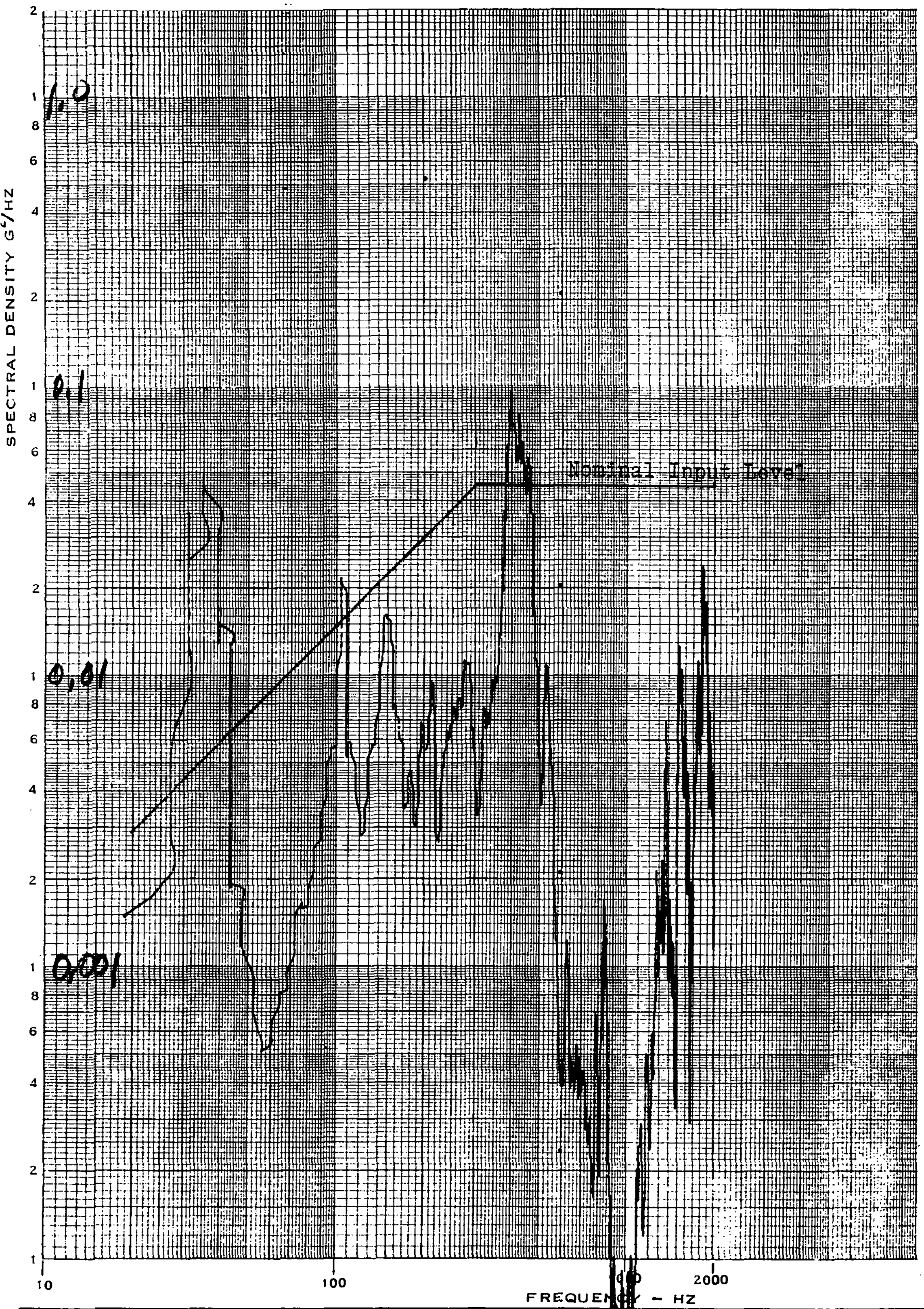
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26	OPERATOR P.J.	PLOTTED BY T.G.	TRACE NO. 4	TEST NO. 9
TEST ENGINEER T.G.	CHECKED BY MEHMED		DATE 4/17/72	TIME 1700



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS Y

ACCEL SERIAL NUMBER XN32

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS / GP

1.297 COL / GP

ANAL FILTER – HZ B.W. 6 | |

SWEEP SPEED – OCT/MIN | |

TIME CONSTANT – SEC | |

ANNAL. CALIBRATION 52.5 g²/HZ F.S.

PERIOD OF TEST ☑ START ☐ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION Ey

HOOK-UP #2

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT RAE-B	ITEM VCPS	CODE SV 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL
SPEC. AT-VCPS SVHS 5619	PARA. 4.3.7	AMEND. NOTE 1 & 4	PHASE COMPLETE — PKG	RANDOM —

PAGE NO.

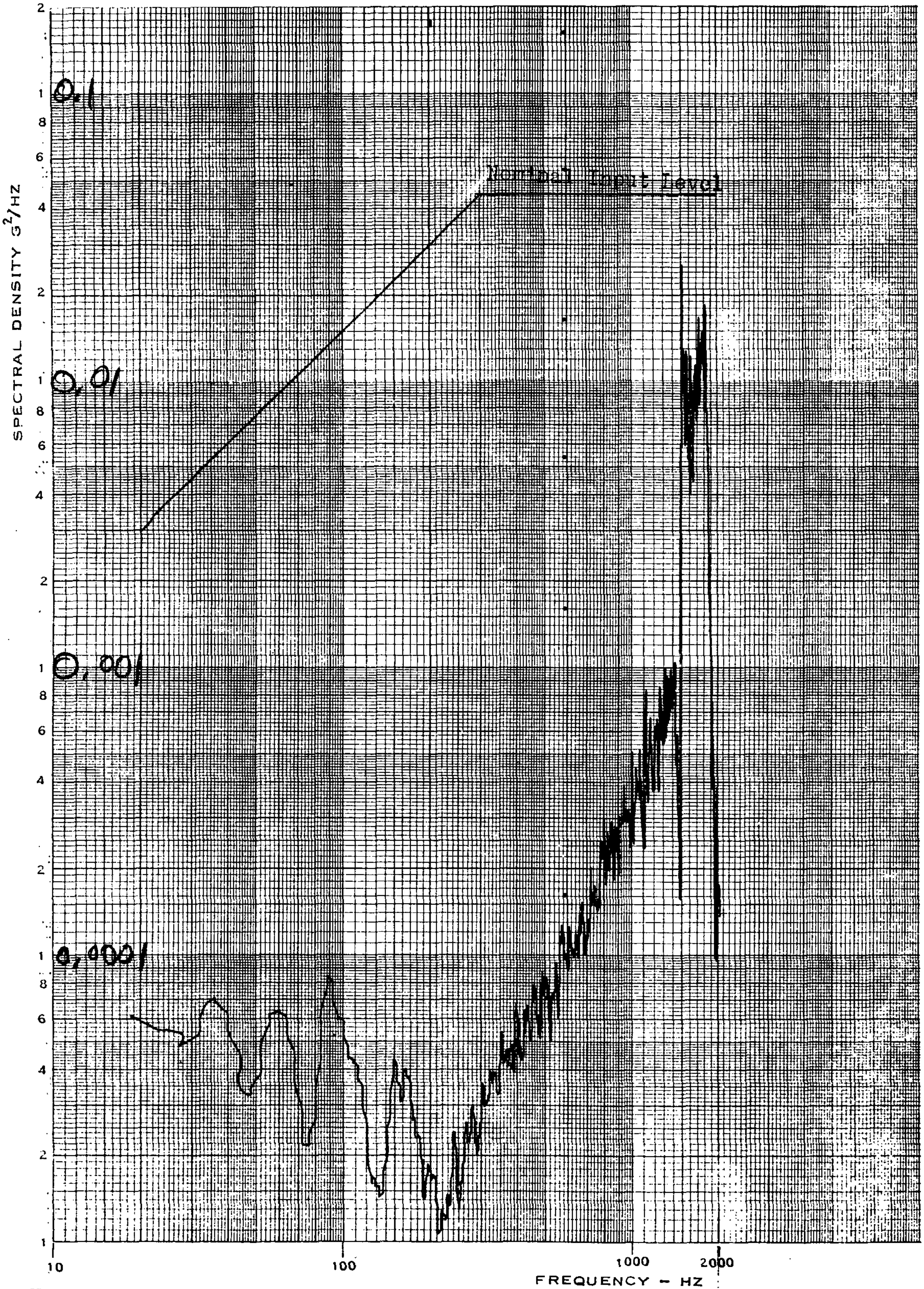
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26	OPERATOR P. J	PLOTTED BY T. G	TRACE NO. 7	TEST NO. 9
TEST ENGINEER T. G.	CHECKED BY MEHMED		DATE 4/17/72	TIME 1700



INPUT LEVEL: 9,2 GRM

EXCITATION AXIS: Y

ACCEL SERIAL NUMBER: NB62

ACCEL SENSING AXIS: Z

ACCEL SENSITIVITY: 3,052 MV RMS / GP

COL: — GP

ANAL FILTER - HZ B.W.: b

SWEEP SPEED - OCT/MI

TIME CONSTANT - SEC

ANNAL. CALIBRATION: 17,2 g^2/HZ F.S.

PERIOD OF TEST: ☑ START ☒ END

DURATION: 2.0 MI

NON OPERATING

TEMP.: 74 °F

TAPE REEL NO.: 0/2295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION: A1Z

HOOK-UP #2

SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED

PROJECT RAE-B	ITEM VCPS	CODE SV 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL	
SPEC. AT-VCPS SVHS 5619	PARA. 4.3.7	AMEND. NOTE 1 & 4	PHASE COMPLETE PKG	RANDOM —	PAGE NO.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

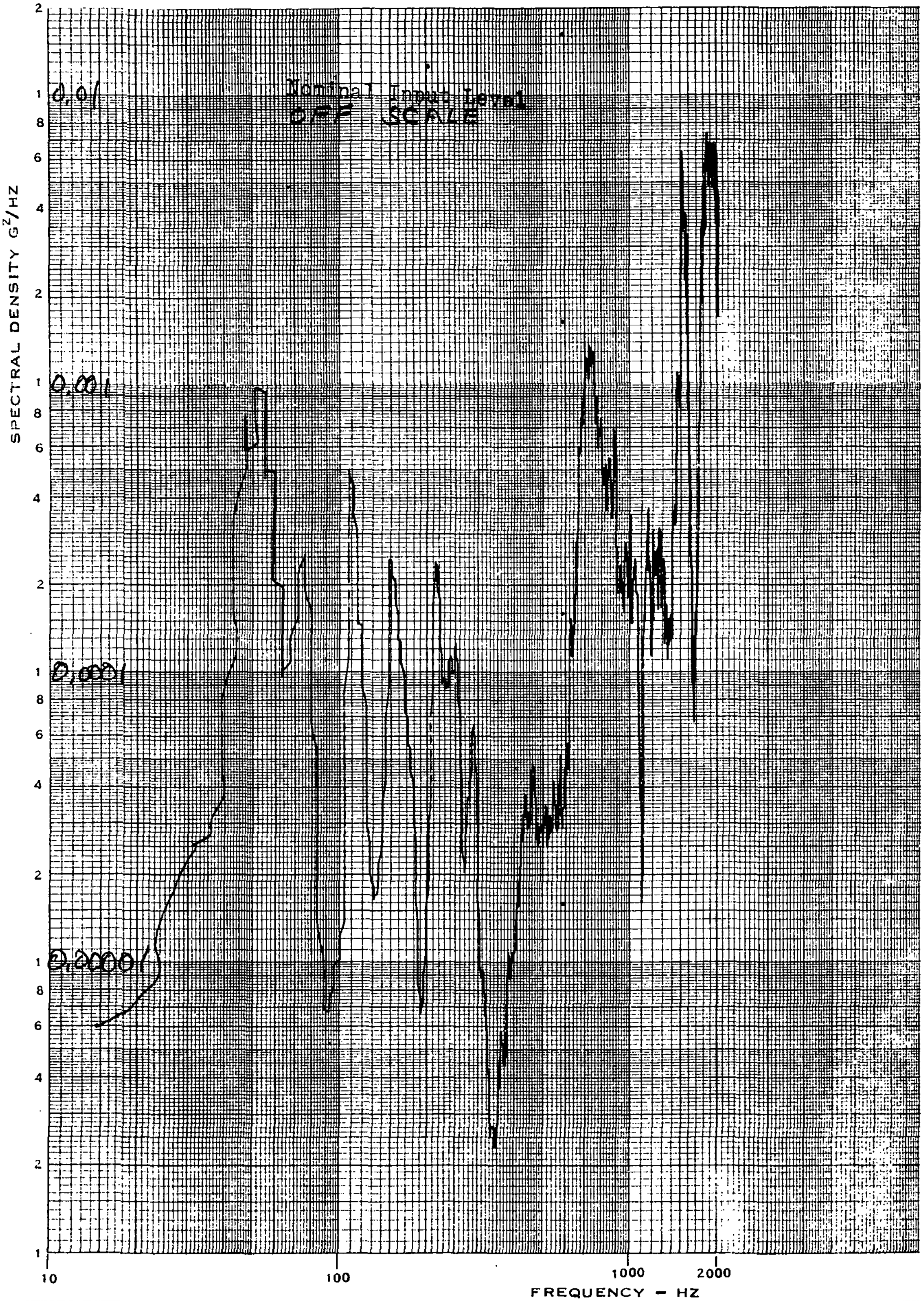
RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	P. J	T. G	1	9

TEST ENGINEER	CHECKED BY	DATE	TIME
T. G	MEHMED	4/17/72	1700



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS Y

ACCEL SERIAL NUMBER TD40

ACCEL SENSING AXIS X

ACCEL SENSITIVITY — MV RMS / GP

2.805 COL / GP

ANAL FILTER - HZ B.W. 6 [redacted] | [redacted] | [redacted]

SWEEP SPEED - OCT/MIN [redacted] | [redacted] | [redacted]

TIME CONSTANT - SEC [redacted] | [redacted] | [redacted]

ANNAL. CALIBRATION 1.25 g²/HZ F.S.

PERIOD OF TEST ☒ START ☐ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION A1X'

HOOK-UP #2

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT	ITEM	CODE SV	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	748T20-1	0001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS SVHS 5619	4.3.7	NOTE 1&4	COMPLETE PKG	—	

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

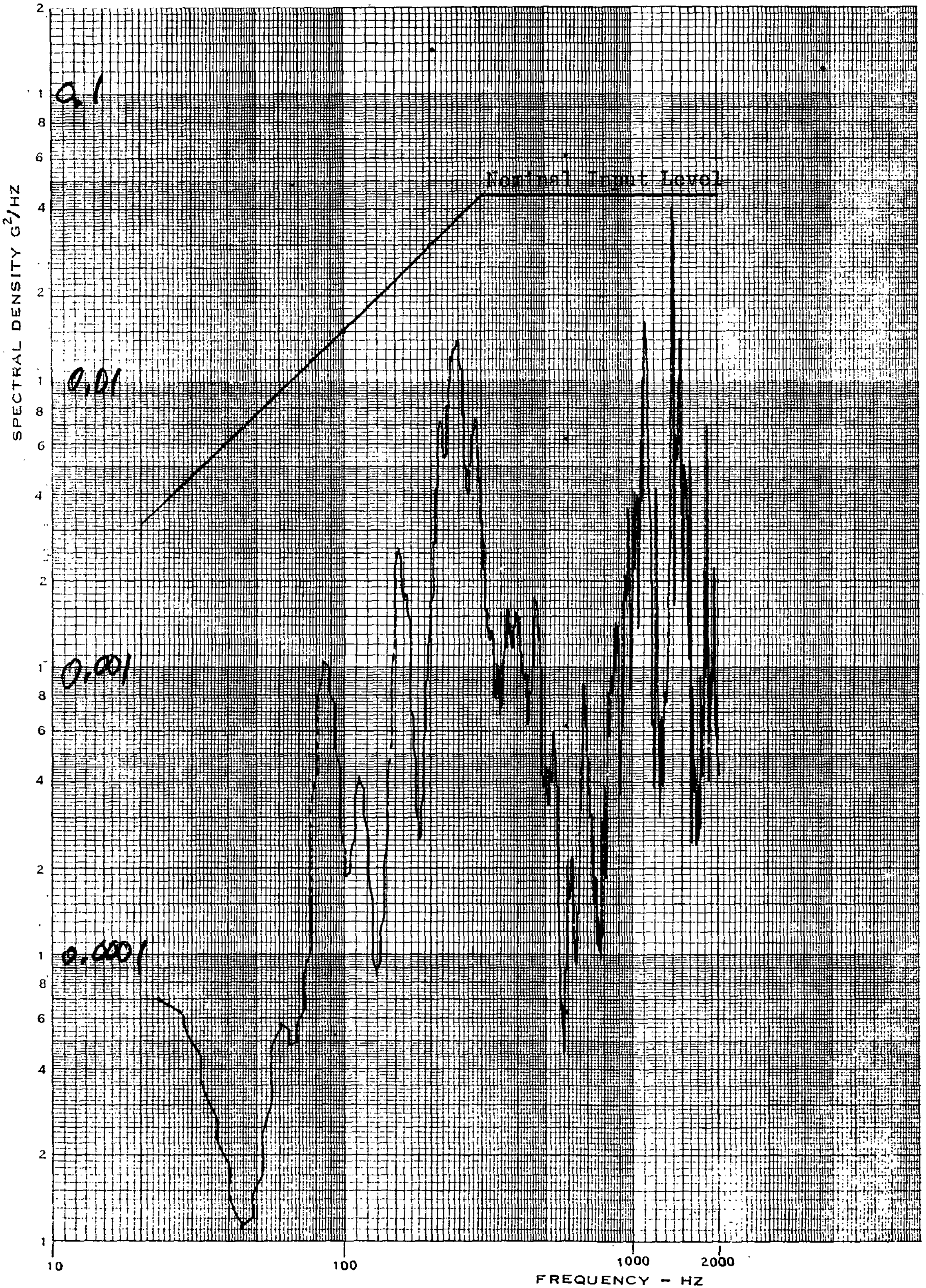
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	P.J.	T.G.	5	9

TEST ENGINEER	CHECKED BY	DATE	TIME
T.G.	MEHMED	4/17/72	1700



INPUT LEVEL 9.2 GRM

EXCITATION AXIS Y

ACCEL SERIAL NUMBER TD45

ACCEL SENSING AXIS

ACCEL SENSITIVITY — MV RMS / GP

2,650 COL / GP

ANAL FILTER - HZ B.W. [✓ 10] | 20 | 50

SWEEP SPEED - OCT/MI 0.7 | 0.2 | 0.3

TIME CONSTANT - SEC 2.5 | 1.25 | 0.5

ANNAL. CALIBRATION 1.41 g²/HZ F.S.

PERIOD OF TEST ☑ START ☐ END

DURATION 20 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION Cx

HOOK-UP #2

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT	ITEM	CODE SV	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	748720-1	00001	QUAL

SPEC. AT-VCPS	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
SVHS 5619	4.3.7	NOTE 1 & 4	COMPLETE PKG	—	

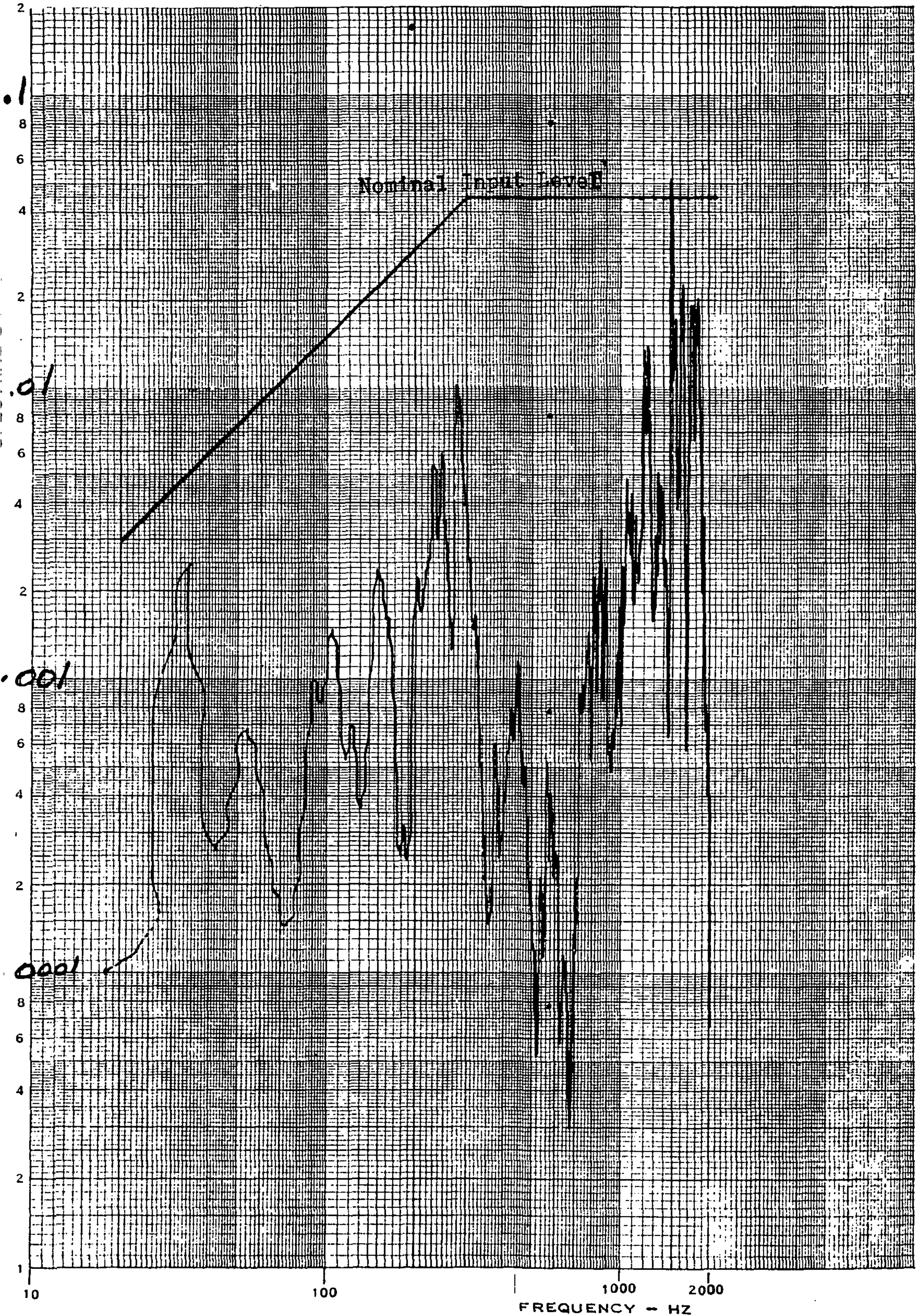
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26	OPERATOR P. J	PLOTTED BY T. G	TRACE NO. 11	TEST NO. 9
TEST ENGINEER S. M	CHECKED BY S. M		DATE 4-17-72	TIME 1700



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS Y

ACCEL SERIAL NUMBER TD44

ACCEL SENSING AXIS X

ACCEL SENSITIVITY 3.035 MV RMS / GP

— COL / GP

ANAL FILTER – HZ B.W. 6 – | – | –

SWEEP SPEED – OCT/MIN – | – | –

TIME CONSTANT – SEC – | – | –

ANNAL. CALIBRATION 17.32 g^2/HZ F.S.

PERIOD OF TEST ☒ START ☐ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION Bx HUB Hook-UP #2

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT RAE-B	ITEM VCPS	CODE SV 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL	
SPEC. AT-VCPS	PARA. 4.3.7	AMEND. NOTE 1 & 4	PHASE COMPLETE PKG	RANDOM —	PAGE NO.

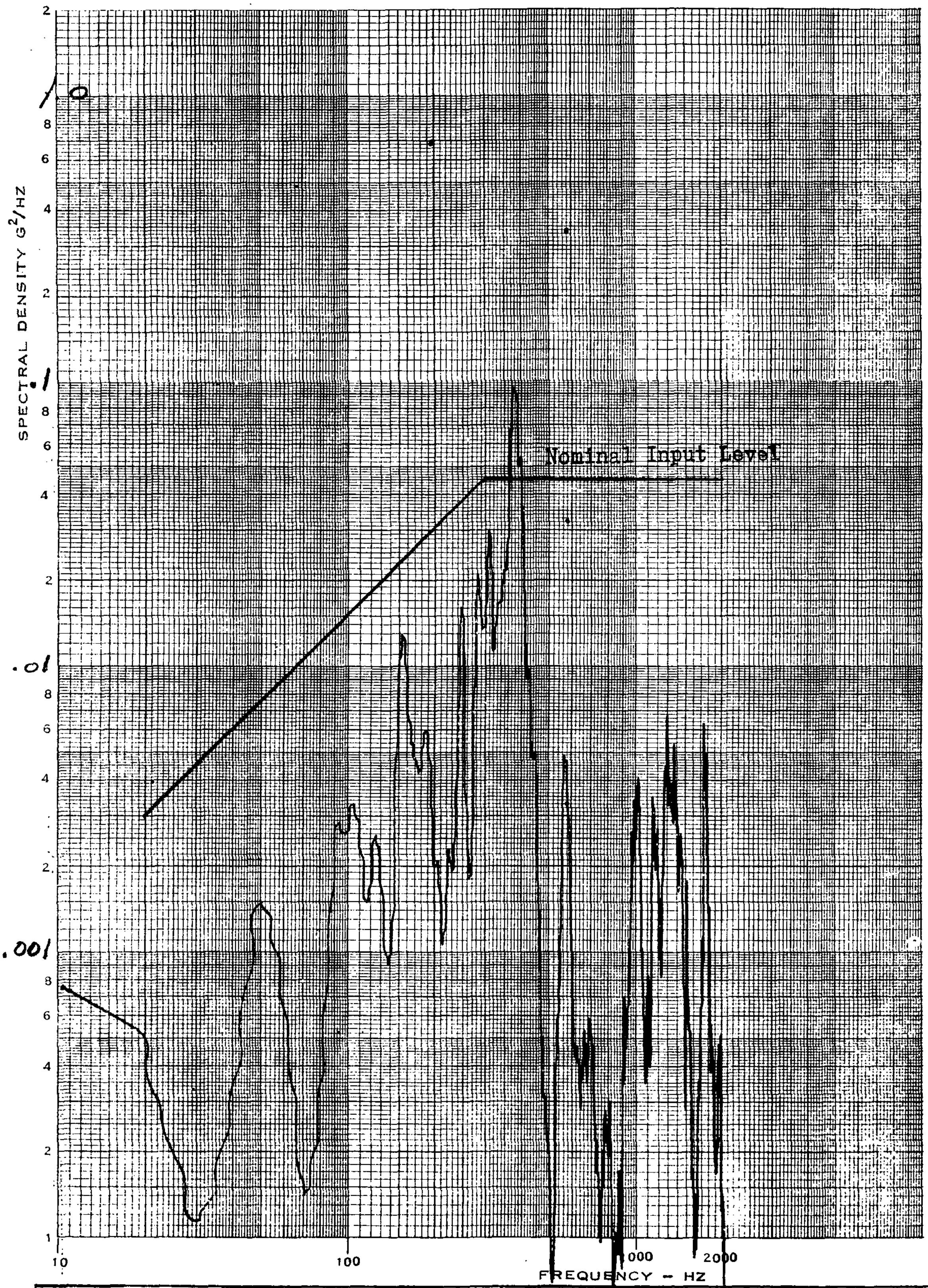
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26
OPERATOR P. J
PLOTTED BY T. G.
TRACE NO. 9
TEST NO. 9
TEST ENGINEER S. M
CHECKED BY S. M
DATE 4-17-72
TIME 1700



INPUT LEVEL 9.2 GRN
EXCITATION AXIS Y
ACCEL SERIAL NUMBER YK20
ACCEL SENSING AXIS X
ACCEL SENSITIVITY 1.523 MV RMS / GP
— COL / GP
ANAL FILTER - HZ B.W 6 | — | —
SWEEP SPEED - OCT/M — | — | —
TIME CONSTANT - SEC — | — | —
ANNAL. CALIBRATION 68.78 g²/HZ F.S.
PERIOD OF TEST ☒ START ☐ END
DURATION 2.0 MI
NON OPERATING
TEMP. 74
TAPE REEL NO. 012295
☐ CONTROL ☒ RESPONS
PICKUP LOCATION DX REA MOUNT Hook-UP #2
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

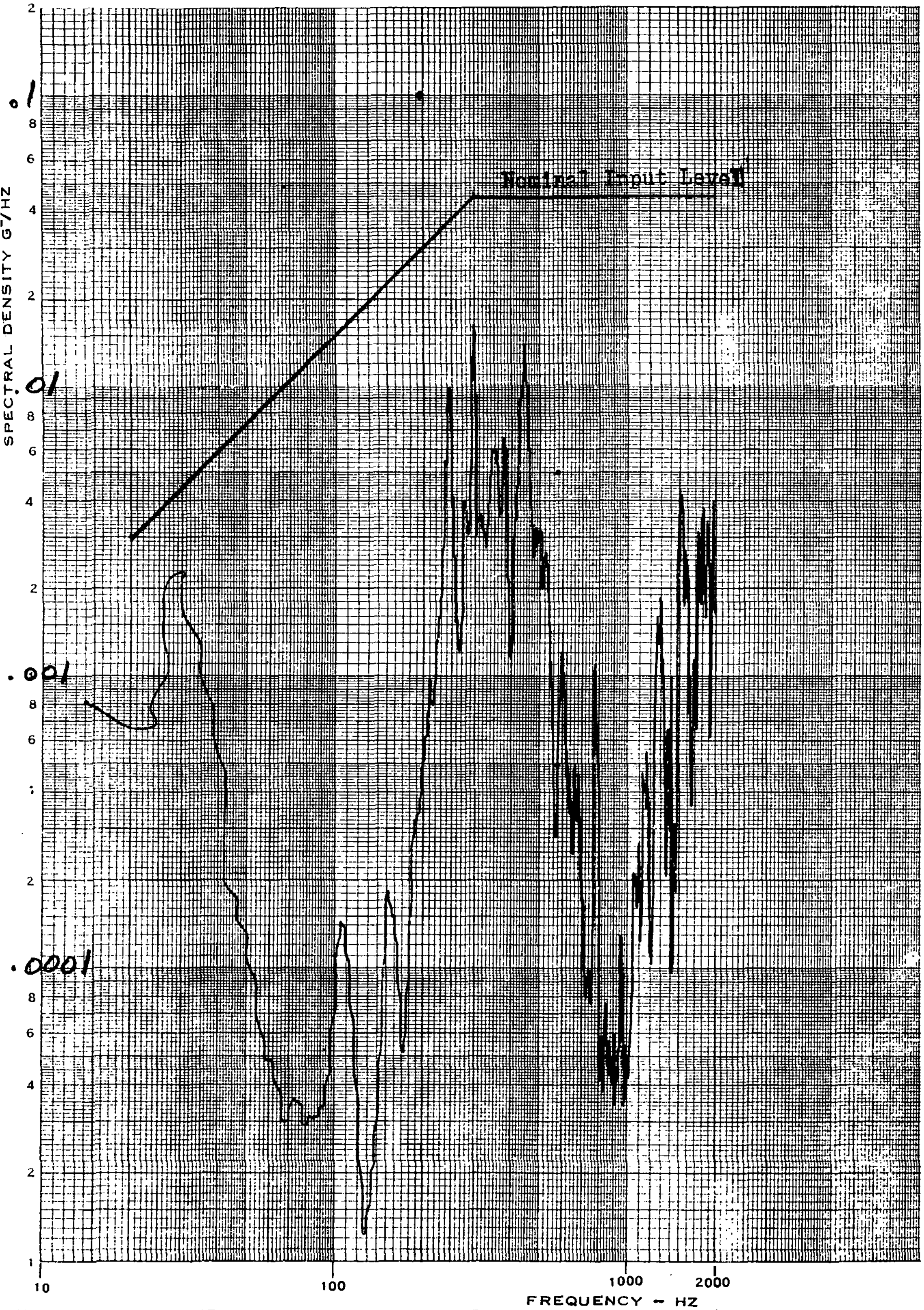
PROJECT RAE B
ITEM VCPS
CODE SV 748720-1
SERIAL NUMBER 00001
TYPE OF TEST QUAL
SPEC. AT-VCPS
PARA. 4.3.7
AMEND. NOTE 1 & 4
PHASE COMPLETE PKG
RANDOM —
PAGE NO.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.				
RIG 26	OPERATOR P. J	PLOTTED BY T. G	TRACE NO. 10	TEST NO. 9
TEST ENGINEER S. M	CHECKED BY S. M		DATE 4-17-72	TIME 1700



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS Y

ACCEL SERIAL NUMBER XN32

ACCEL SENSING AXIS X

ACCEL SENSITIVITY 1.261 MV RMS / GP — COL / GP

ANAL FILTER – HZ B.W. 6 — | — | —

SWEEP SPEED – OCT/MIN. — | — | —

TIME CONSTANT – SEC — | — | —

ANNAL. CALIBRATION 100.3 g^2/HZ F.S.

PERIOD OF TEST ☒ START ☐ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012295

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION
EX
TANK MOUNT
HOOK-UP #2

SPECIAL CONDITIONS
VCPS LOADED
AND PRESSURIZED

PROJECT RAE-B	ITEM VCPS	CODE SY 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL
SPEC. AT-VCPS	PARA. 4.3.7	AMEND. NOTE 1 & 4	PHASE COMPLETE PKG	RANDOM
PAGE NO.				

Section IV

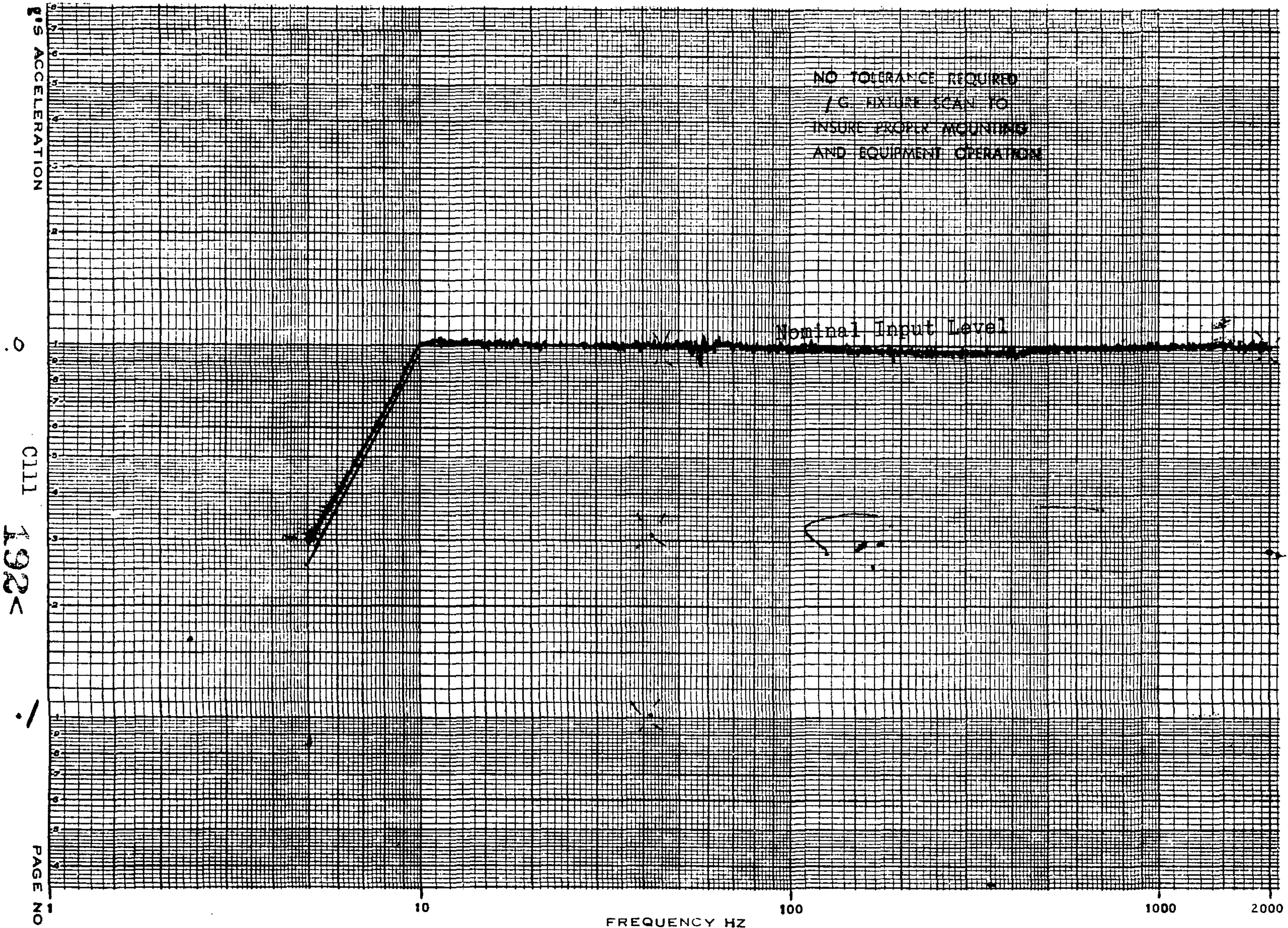
Z - Axis

A) Sine Data

B) Random Data

Standard Ⓐ® HSF-1633.1 2/69

RIG: #26
OPERATOR: P. Jodoin
WITNESS: —
WITNESS: —
TEST NO.: 3
TEST ENGINEER: S. Mehmed
CHECKED BY: GE/B
PROJECT: RAE-B
DATE: 4-13-72
TIME: 1000



INPUT LEVEL: 1.0 g
EXCIT. AXIS: Z
ACCEL S/N: NB62
SENSING AXIS: Z.
ACCEL SENSITIVITY: — MV RMS / GP; 2.698 COL / GP
FILTER: 10-100-200 HZ B.W.
FILTER CROSSOVER: @ 70-700 HZ
SWEEP RATE: 4.0 OCT/MIN
TAPEREEL NO.: 012294 ☑ LIVE ☐ FROM TAPE
COMPR. SPEED: Var. DB/SEC.
CHG.@ ~ HZ TO ~ DB/SEC.
CHG.@ — HZ TO — DB/SEC.
NON OPERATING ☑ CONTROL ☐ RESPONSE
TEMP. 75 °F
LOCATION: A1Z Hook-up #1
SPECIAL CONDITIONS: Bare Fixture SVSK79594

MASTER PG 1774

REPORT NO.

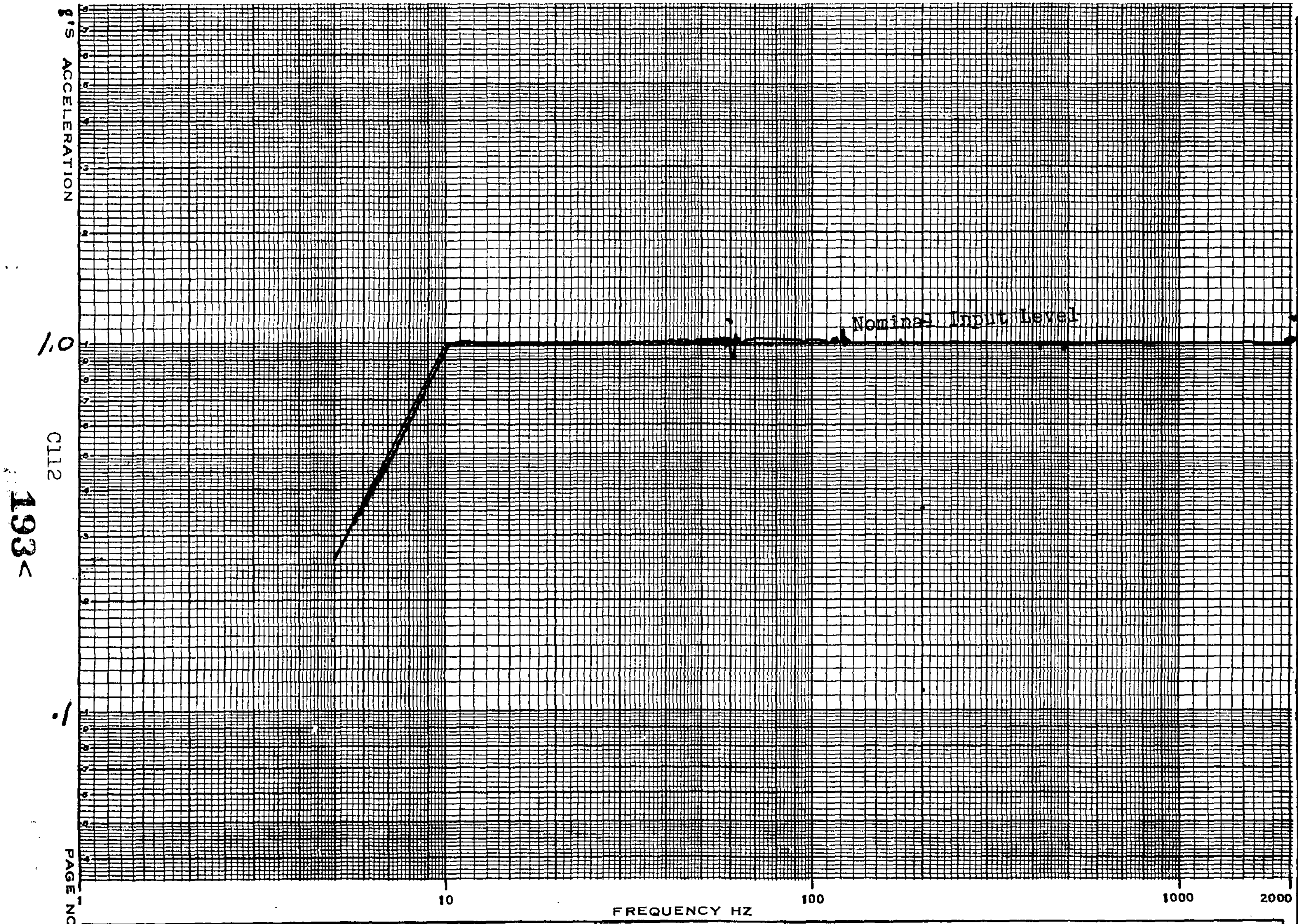
FREQ. RANGE & DIRECTION: S-2KHZ
ITEM SVSK79594: VCPS-FIXT
CODE: —
SERIAL NO.: SVSK79594
SPEC.: AT-VCPS
PARA.: 4.3.7.
AMEND.: —
ACTION SHEET NO.: —
ATA NO.: —
TYPE OF TEST: BARE FIXTURE Accept Test
NAME OF TEST: Sine Scan

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26
OPERATOR JODOIN
PLOTTED BY MICKET
TRACE NO. 1
TEST NO. 3 ch#1
TEST ENGINEER MEHMED
CHECKED BY GEIB
PROJECT RAE-B RAE-B
DATE 4-13-72
TIME 1000



C112

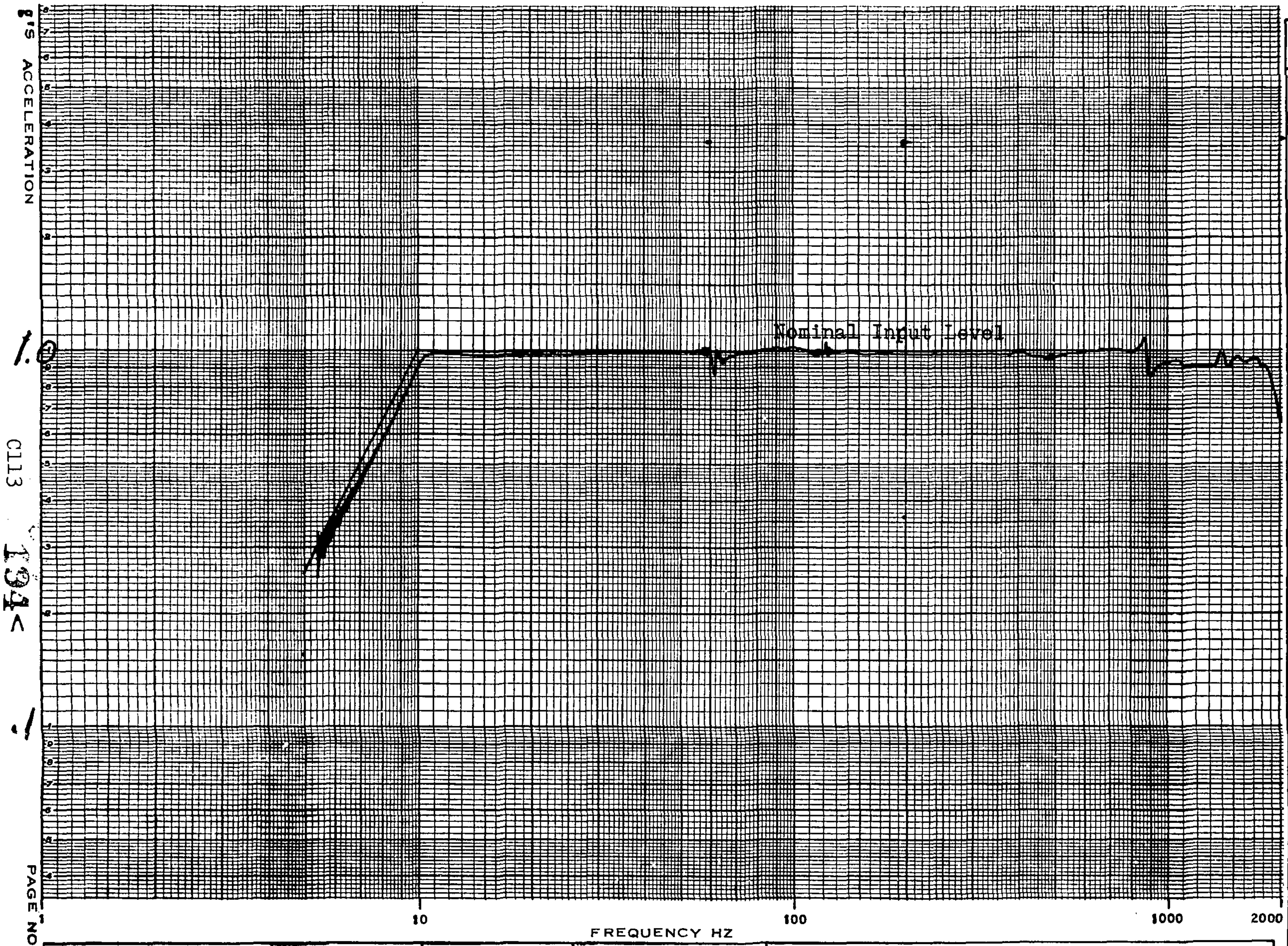
193<

INPUT LEVEL ± 1 g
EXCIT. AXIS Z
ACCEL S/N NB62
SENSING AXIS Z
ACCEL SENSITIVITY — MV RMS / GP
2.698 COL / GP
FILTER 10-100-200 HZ B.W.
FILTER CROSSOVER @ 70-700 HZ
TAPE REEL NO. 012294
SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 75 °F
☒ CONTROL
☐ RESPONSE
LOCATION A1z A1Z
Hook-up #1
SPECIAL CONDITIONS BARE FIXTURE
MASTER PG 1774
REPORT NO.
PAGE NO.

FREQ. RANGE & DIRECTION 5-2000Hz
ITEM SVSK 79594
CODE —
SERIAL NO. —
TYPE OF TEST FIXTURE SURVEY

HSF 1633 A 2/69 **Standard** H®

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 4	TEST NO. 3 CHU
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-13-72	TIME 1000



INPUT LEVEL ± 1 g
EXCIT. AXIS Z
ACCEL S/N T044
SENSING AXIS Z
ACCEL SENSITIVITY — MV RMS / GP
2.773 COL / GP
FILTER 10-100-200 HZ B.W.
FILTER CROSSOVER @ 70-700 HZ
TAPEREELNO. 012294
SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 75 °F
LOCATION F2E A2Z
HOOK-UP #1
SPECIAL CONDITIONS BARE FIXTURE

MASTER PG 1774)

REPORT NO.

FREQ. RANGE & DIRECTION 5-2000HZ	ITEM SVSK79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION AT-YCPS	PARA. 4.3.7	AMEND. —	PHASE BARE FIXTURE	NAME OF TEST SINUSOIDAL SCAN

PAGE NO.

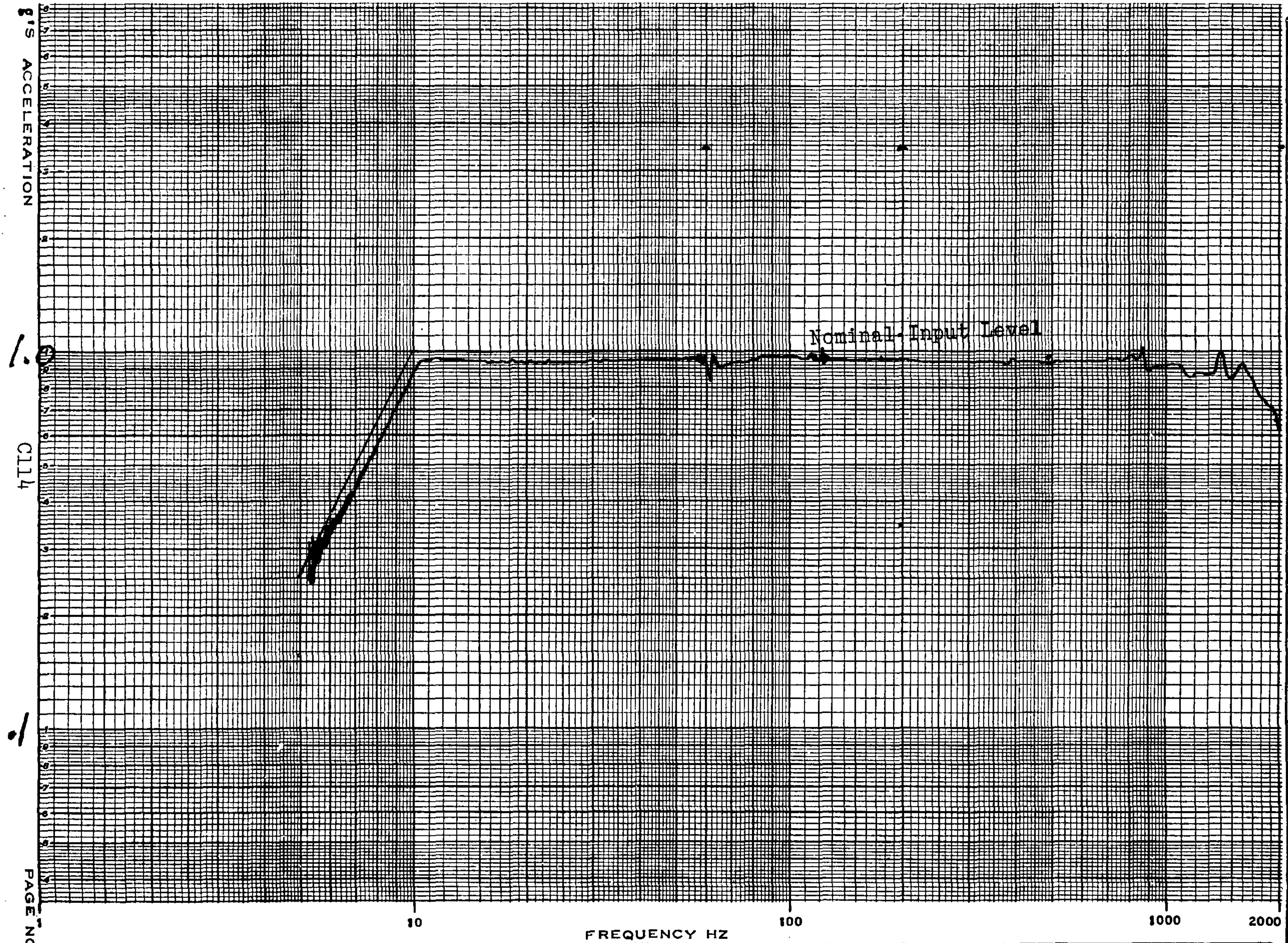
C113

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION UA®

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 5	TEST NO. 3 c/s
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-13-72	TIME 1000



INPUT LEVEL ± 1 g

EXCIT. AXIS Z

ACCEL S/N TG75

SENSING AXIS Z

ACCEL SENSITIVITY — MV RMS / GP

2.791 COL / GP

FILTER 10-100-200 HZ B.W.

FILTER CROSSOVER @ 70-700 HZ

TAPE REEL NO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO DB/SEC

CHG@ — HZ TO DB/SEC

NON-OPERATING

TEMP. 75 °F

☐ CONTROL

☒ RESPONSE

LOCATION A_{3Z} A3Z

HOOK-UP #1

SPECIAL CONDITIONS BARE FIXTURE

MASTER PG 1774

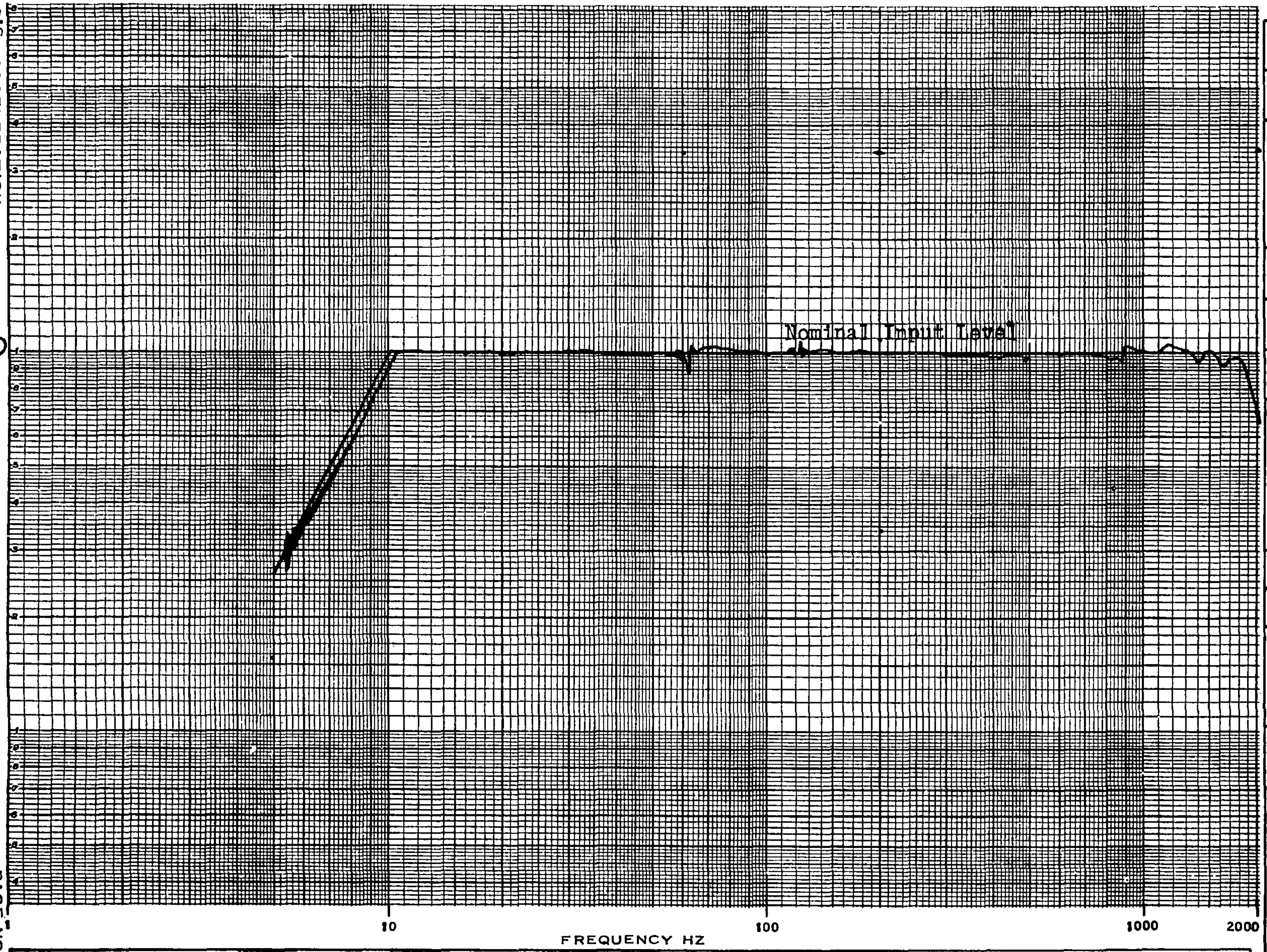
REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-2000 HZ	ITEM SVSK79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY

HSF 1633 A 2/69 Standard

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 6	TEST NO. 3 ch1
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-13-72	TIME 1000



INPUT LEVEL ± 1 g	EXCIT. AXIS Z
ACCEL S/N WR11	SENSING AXIS Z
ACCEL SENSITIVITY — MV RMS / GP 2.956 COL / GP	
FILTER 10-100-200 HZ B.W.	
FILTER CROSSOVER @ 70 - 700 HZ	
TAPE REEL NO. 012294	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC CHG@ — HZ TO — DB/SEC CHG@ — HZ TO — DB/SEC	
NON-OPERATING TEMP. 75 °F	☐ CONTROL ☒ RESPONSE
LOCATION A4z A4Z HOOK-UP #1	
SPECIAL CONDITIONS BARE FIXTURE MASTER PG 1774	REPORT NO.

FREQ. RANGE & DIRECTION 5-2000HZ	ITEM SVSK79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION AT-VCPS	PARA. 4.3.7	AMEND. —	PHASE BARE FIXTURE	NAME OF TEST SINUSOIDAL SCAN

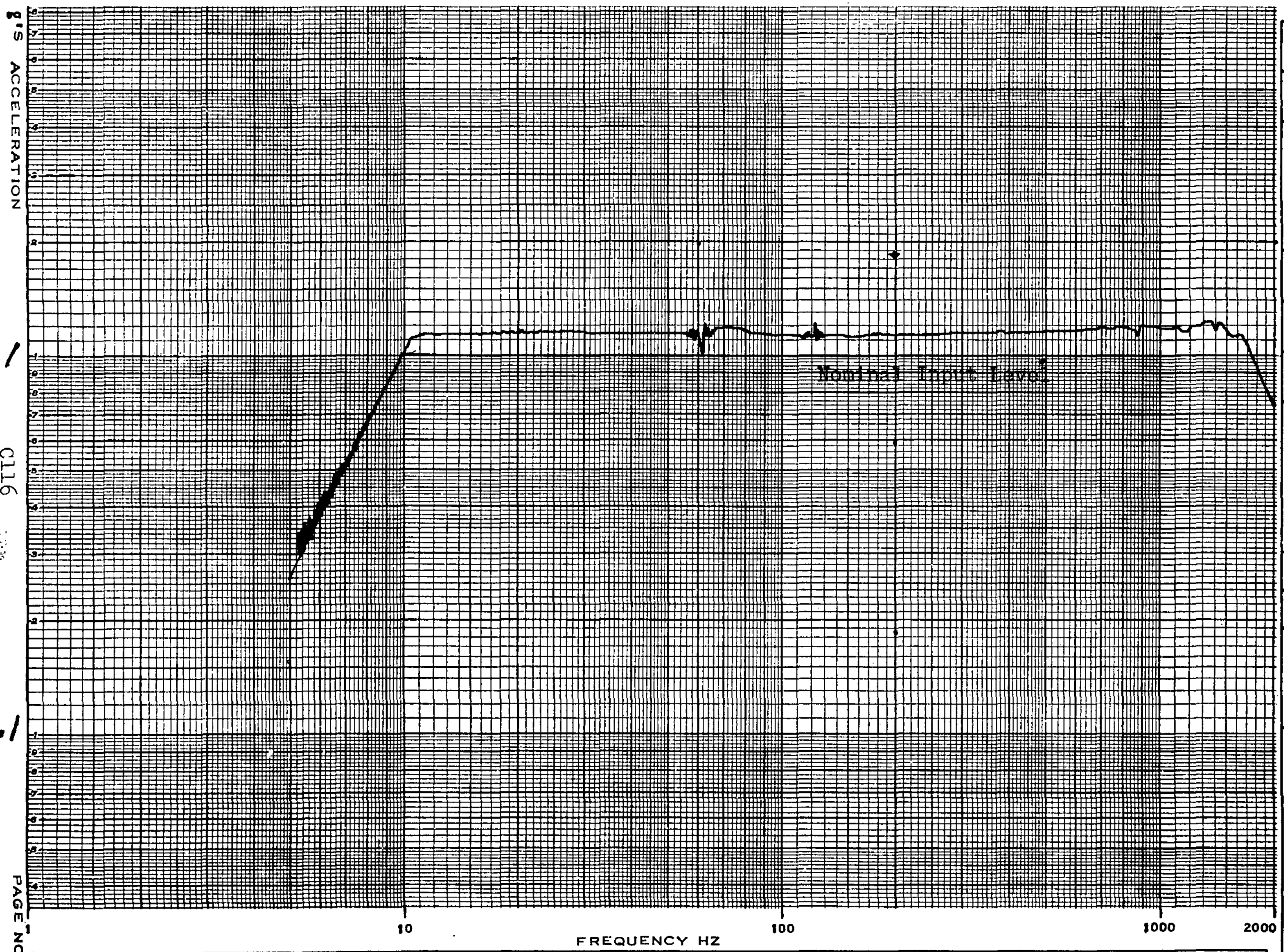
PAGE NO.

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 7	TEST NO. 3 ch7
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B RAE-B	DATE 4-13-72	TIME 1000



INPUT LEVEL ± 1 g

EXCIT. AXIS Z

ACCEL S/N VG57

SENSING AXIS Z

ACCEL SENSITIVITY 10.886 MV RMS / GP

— COL / GP

FILTER 10-100-200 HZ B.W.

FILTER CROSSOVER @ 70-700 HZ

TAPE REEL NO. 012294

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 75 °F

LOCATION A5Z A5Z

Hook-up #1

SPECIAL CONDITIONS

BARE FIXTURE

MASTER PG 1774

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-2000Hz	ITEM SVSK79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION	PARA	AMEND.	PHASE	NAME OF TEST

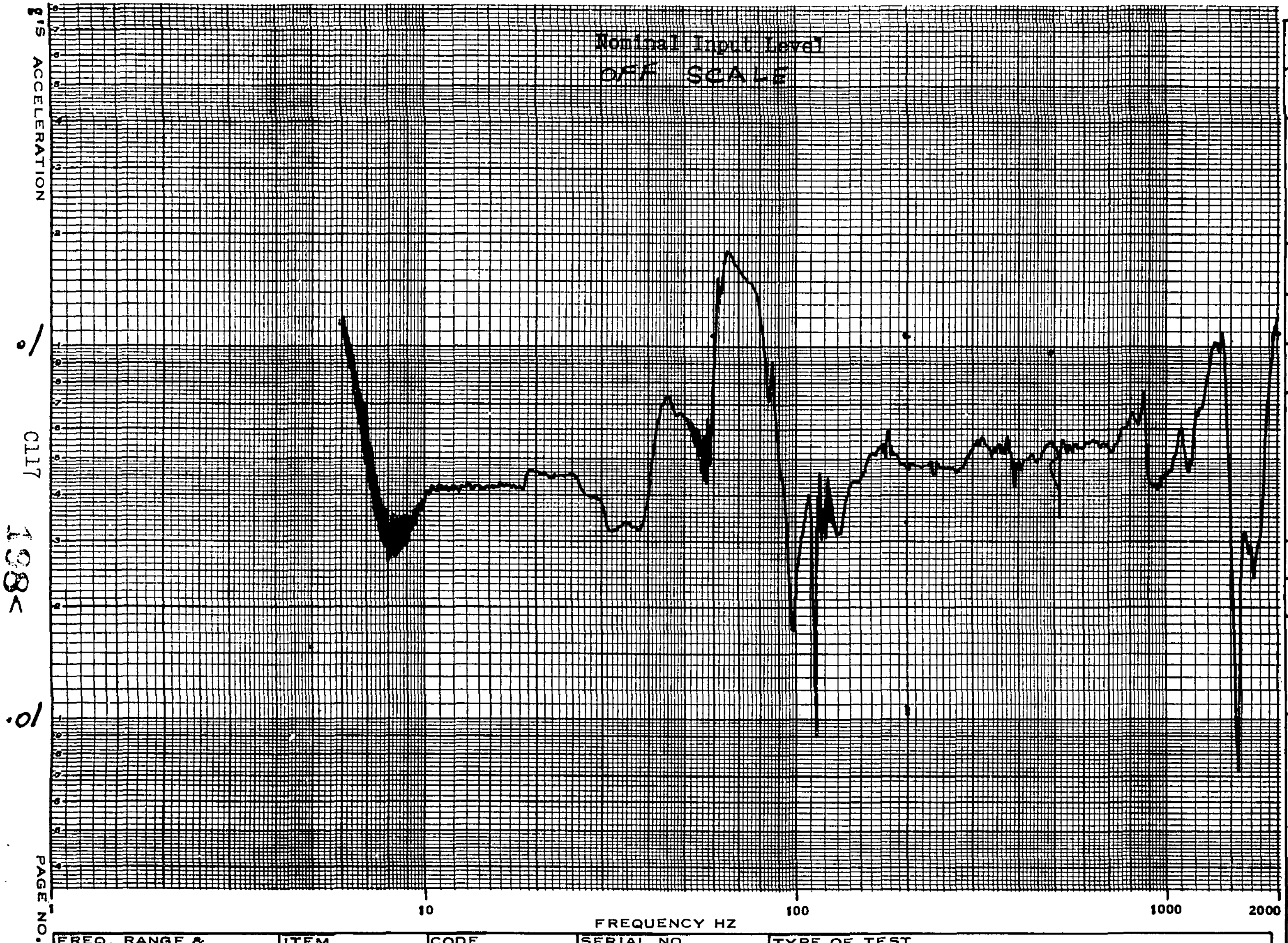
197<

C116

HSF 1633 A 2/69 **Standard** A®

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY MICKET	TRACE NO. 7	TEST NO. 3 of 2
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-13-72	TIME 1000



INPUT LEVEL ± 1 g	EXCIT. AXIS Z
ACCEL S/N TD40	SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP 2.805 COL / GP	
FILTER 10-100-200 HZ B.W.	
FILTER CROSSOVER @ 70-700 HZ	
TAPEREELNO. 012294	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC CHG@ — HZ TO — DB/SEC CHG@ — HZ TO — DB/SEC	
NON-OPERATING TEMP. 75 °F	☐ CONTROL ☒ RESPONSE
LOCATION A1X HOOK-UP #1	
SPECIAL CONDITIONS A1X BARE FIXTURE MASTER AE1774	REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-2000HZ	ITEM SVSK79594	CODE —	SERIAL NO. —	TYPE OF TEST FIXTURE SURVEY
SPECIFICATION AT-VCPS	PARA. 4.3.7	AMEND. —	PHASE BARE FIXTURE	NAME OF TEST SINUSOIDAL SCAN

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26

OPERATOR: JODOIN

PLOTTED BY: MICKET

TRACE NO.: 3

TEST NO.: 3 ch 3

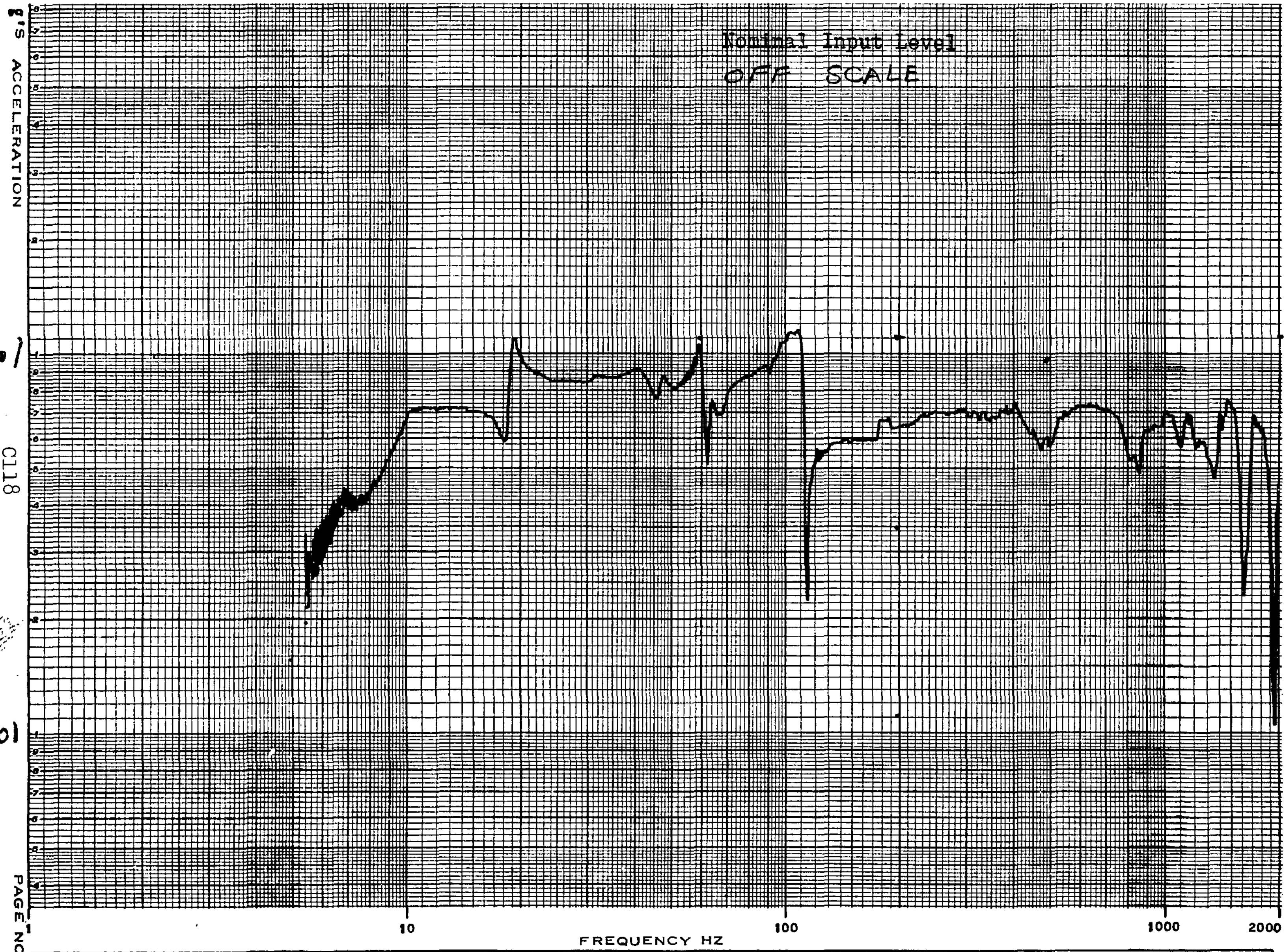
TEST ENGINEER: MEHMED

CHECKED BY: GEIB

PROJECT: RAE-B

DATE: 4-13-72

TIME: 1000



INPUT LEVEL: ± 1 g

EXCIT. AXIS: Z

ACCEL S/N: TE83

SENSING AXIS: Y

ACCEL SENSITIVITY: — MV RMS / GP; 2.722 COL / GP

FILTER: 10-100-200 HZ B.W.

FILTER CROSSOVER: @ 70-700 HZ

TAPEREEL NO.: 012294

SWEEP RATE: 4 OCT/MIN

COMPR. SPEED: VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 75 °F

☐ CONTROL

☒ RESPONSE

LOCATION: A1Y

Hook-up #1

SPECIAL CONDITIONS: BARE FIXTURE

MASTER HG 1774

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION: 5-2000HZ

ITEM: SVSK79594

CODE: —

SERIAL NO.: —

TYPE OF TEST: FIXTURE SURVEY

C118

Standard H® HSF-1633.1 2/69

RIG: #26

OPERATOR: P. Jodoin

WITNESS: —

WITNESS: —

TEST NO.: 13

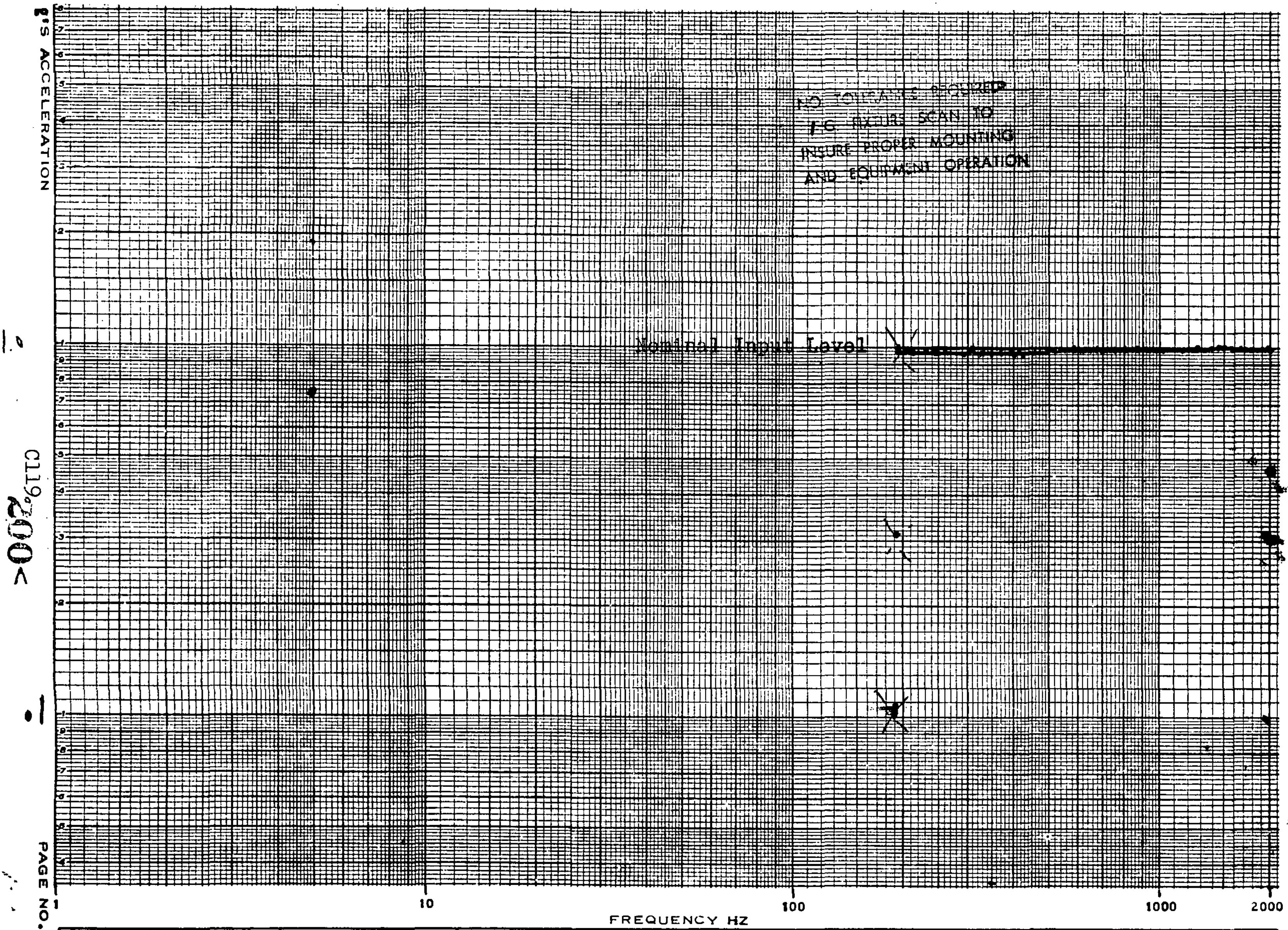
TEST ENGINEER: T. Geib

CHECKED BY: MEHMED

PROJECT: RAE-B

DATE: 4-18-72

TIME: 1650



INPUT LEVEL: 1.0 g

EXCIT. AXIS: Z

ACCEL S/N: NB62

SENSING AXIS: Z

ACCEL SENSITIVITY: — MV RMS / GP; 2.698 COL / GP

FILTER: 100-200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

SWEEP RATE: 4 OCT/MIN

TAPEREEL NO.: 0P2296 ☑ LIVE ☐ FROM TAPE

COMPR. SPEED: Var DB/SEC.

CHG.@ — HZ TO DB/SEC.

CHG.@ — HZ TO DB/SEC.

NON OPERATING ☑ CONTROL

TEMP. 74 °F ☐ RESPONSE

LOCATION: V A17

SPECIAL CONDITIONS: Vcps Only Loaded & Pressurized

REPORT NO.:

PAGE NO.:

FREQ. RANGE & DIRECTION: 200-2000

ITEM: VCPS

CODE SV: 748720-1

SERIAL NO.: 00001

SPEC.: AT-VCPS

PARA.: 4.3.7

AMEND.: —

ACTION SHEET NO.: —

ATA NO.: —

TYPE OF TEST: Qual —

NAME OF TEST: Sine Scan ITEM/FIXTURE

C119 200<

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION UA® HSF-1633.1 2/69

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	WITNESS	WITNESS M. Quraishi		TEST NO. 14
TEST ENGINEER GEIB	CHECKED BY MEHMED	PROJECT RAE-B		DATE 4-18-72	TIME 1765

INPUT LEVEL 10 g

EXCIT. AXIS Z

ACCEL S/N NBG2

SENSING AXIS Z

ACCEL SENSITIVITY — MV RMS / GP

2.698 COL / GP

FILTER [redacted] -100 - 200 HZ B.W.

FILTER CROSSOVER @ [redacted] -700 HZ

SWEEP RATE 4 OCT/MIN

TAPEREEL NO. 01229 6 ☒ LIVE ☐ FROM TAPE

COMPR. SPEED VAR DB/SEC.

CHG.@ ~HZ TO ~ DB/SEC.

CHG.@ ~HZ TO ~ DB/SEC.

NON OPERATING ☒ CONTROL ☑ RESPONSE

TEMP. 74 °F

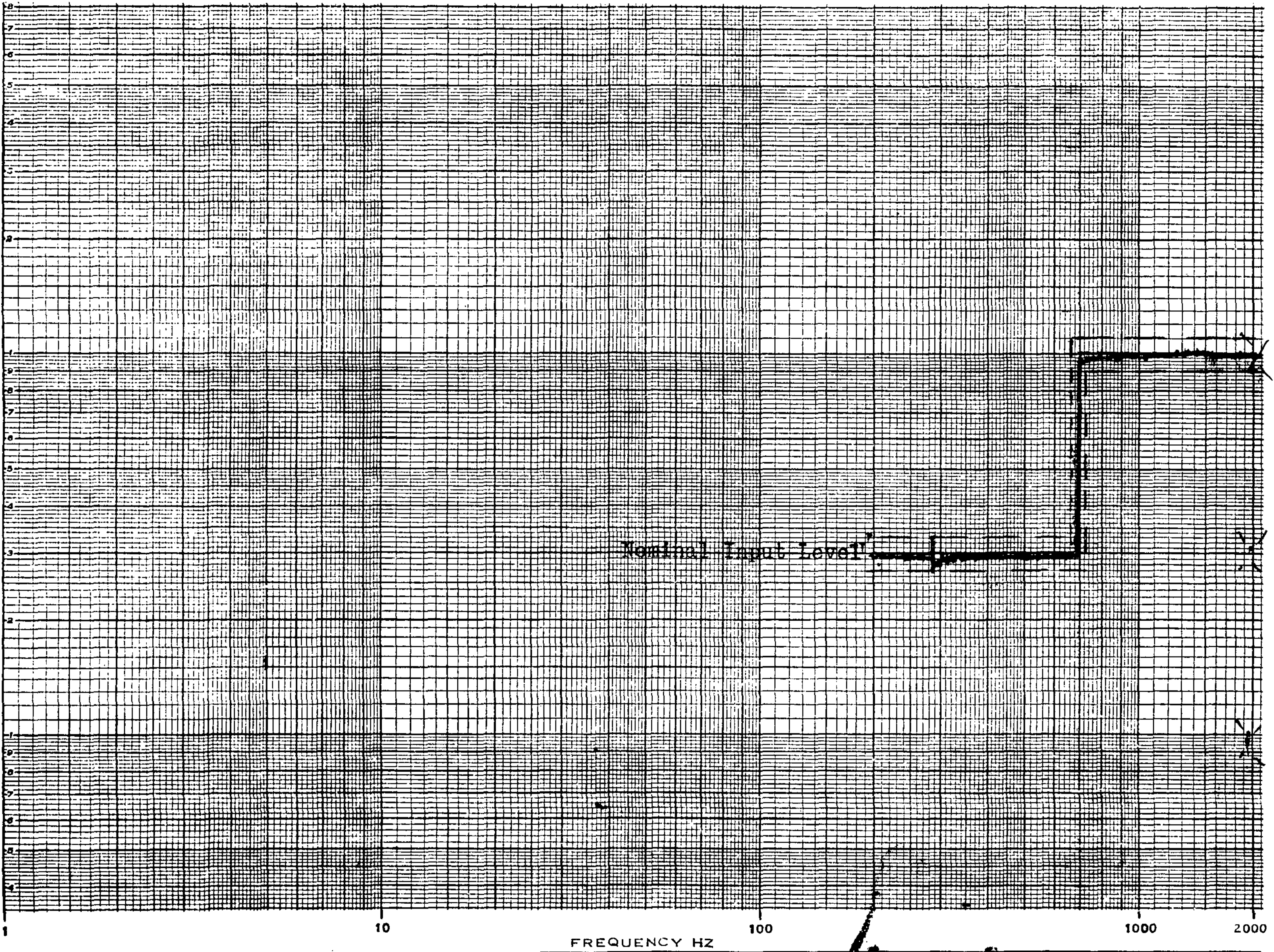
LOCATION A1Z

SPECIAL CONDITIONS VCPS ONLY

VCPS LOADED AND PRESSURIZED

SEE NOTE 2 OF AT-VCPS

REPORT NO.



PAGE NO.

FREQ. RANGE & DIRECTION 200-2KHZ	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	SPEC. AT-VCPS	PARA. 43.7.5	AMEND. NOTE 2
ACTION SHEET NO. —	ATA NO. —	TYPE OF TEST QUAL		NAME OF TEST SINUSOIDAL VIBRATION		

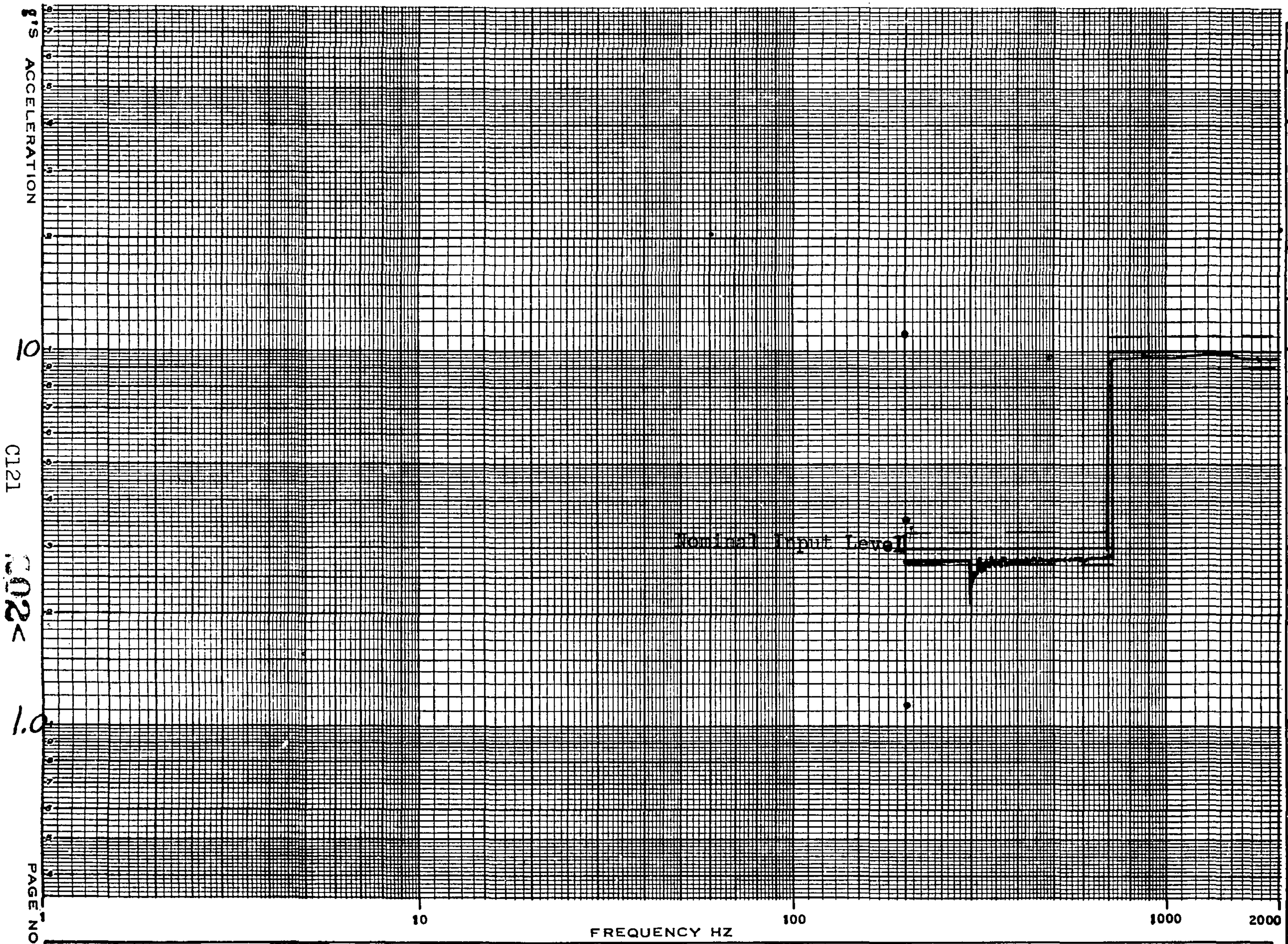
C120

201<

HSF 1633 A 2/69 **Standard** A®

SINE VIBRATION TEST

RIG 26	OPERATOR P. J	PLOTTED BY P. J	TRACE NO. 41	TEST NO. 14
TEST ENGINEER S. M	CHECKED BY T. G	PROJECT RAE-B	DATE 4-18-72	TIME 1705



INPUT LEVEL ± 10 g	EXCIT. AXIS Z
ACCEL S/N NB62	SENSING AXIS Z
ACCEL SENSITIVITY — MV RMS / GP 2.698 COL / GP	
FILTER 100/200 HZ B.W.	
FILTER CROSSOVER @ 700 HZ	
TAPE REEL NO. 012196	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC CHG@ — HZ TO — DB/SEC CHG@ — HZ TO — DB/SEC	
NON-OPERATING	☒ CONTROL
TEMP. 74 °F	☐ RESPONSE
LOCATION A1Z HOOK-UP # 3	
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.	
REPORT NO.	

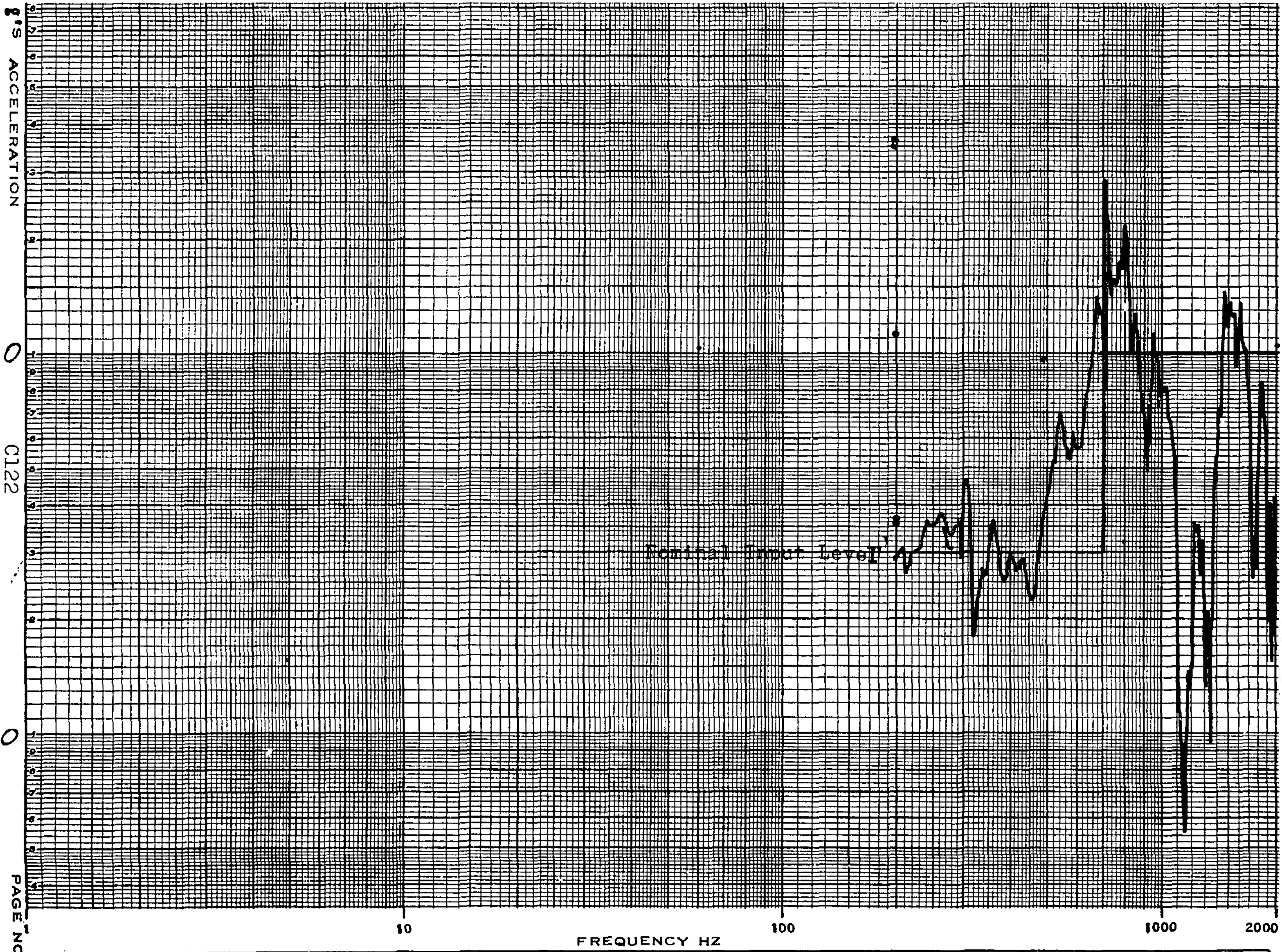
FREQ. RANGE & DIRECTION 200-2000HZ	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 2	PHASE VCPS ONLY	NAME OF TEST SINUSOIDAL VIBRATION

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26
OPERATOR: P. J
PLOTTED BY: P. J
TRACE NO.: 42
TEST NO.: 14
TEST ENGINEER: S. M
CHECKED BY: T. G
PROJECT: RAE-B
DATE: 4-18-72
TIME: 1705



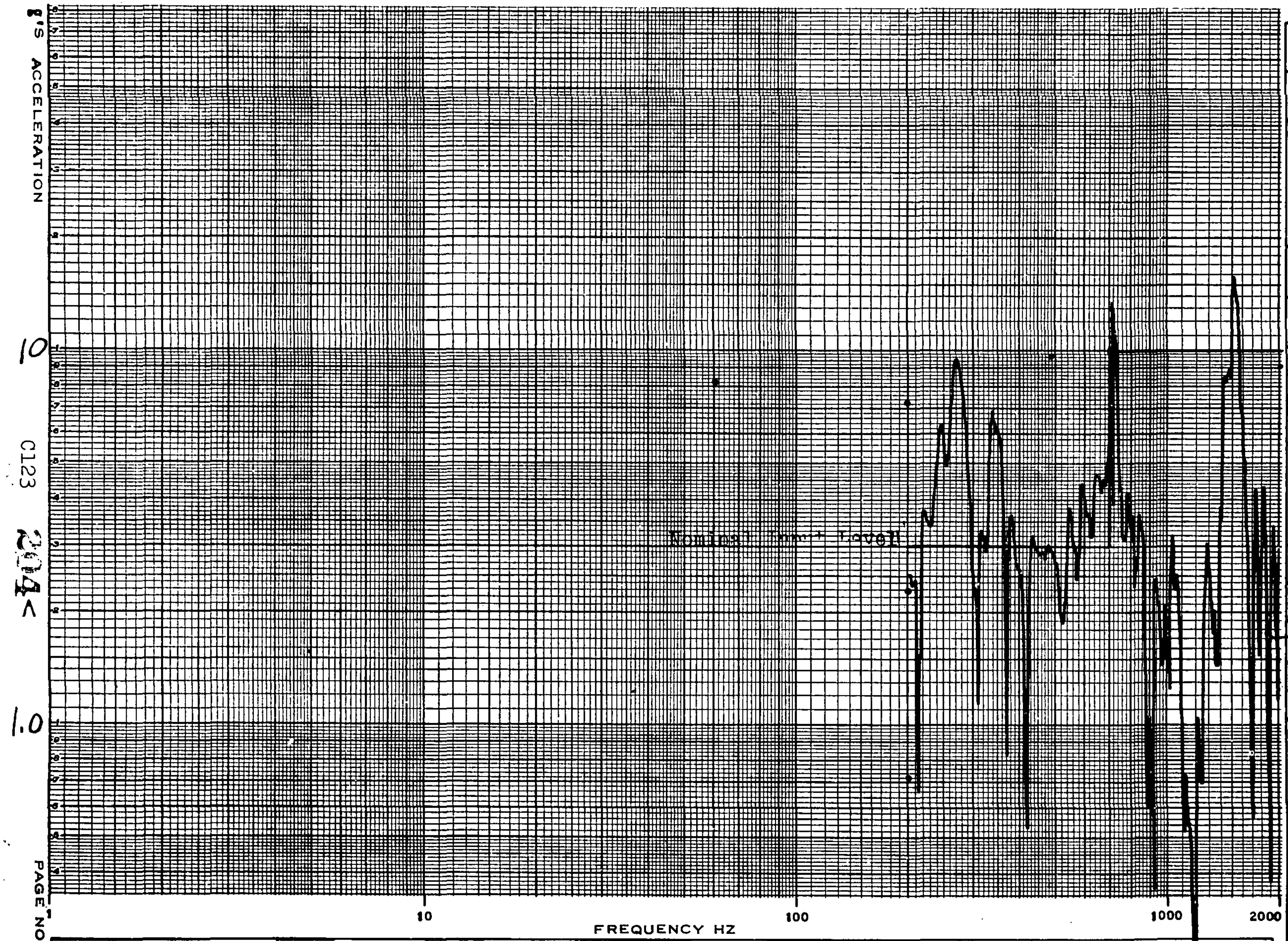
INPUT LEVEL: ± 10 g
EXCIT. AXIS: Z
ACCEL S/N: TG75
SENSING AXIS: Z
ACCEL SENSITIVITY: — MV RMS / GP
2.791 COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER: @ 700 HZ
TAPEREELNO.: 012296
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 74 °F
☐ CONTROL
☒ RESPONSE
LOCATION: BZ HUB HOOK-UP #3
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
REPORT NO.:
PAGE NO.:

FREQ. RANGE & DIRECTION: 200-2000 HZ
ITEM: VCPS
CODE SV: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL

HSF 1633 A 2/69 **Standard** A®

SINE VIBRATION TEST

RIG 2G	OPERATOR P. J	PLOTTED BY P. J	TRACE NO. 43	TEST NO. 14
TEST ENGINEER S. M	CHECKED BY T. G	PROJECT RAE-B	DATE 4-18-72	TIME 1105



INPUT LEVEL ± 10 g	EXCIT. AXIS Z
ACCEL S/N XM21	SENSING AXIS Z

ACCEL SENSITIVITY — MV RMS / GP

1.370 COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPE REEL NO. 012296	SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 74 °F

LOCATION Dz
REA MOUNT
HOOK-UP # 3

SPECIAL CONDITIONS
VCPS LOADED
AND PRESSURIZED

REPORT NO.

PAGE NO.

C123

204<

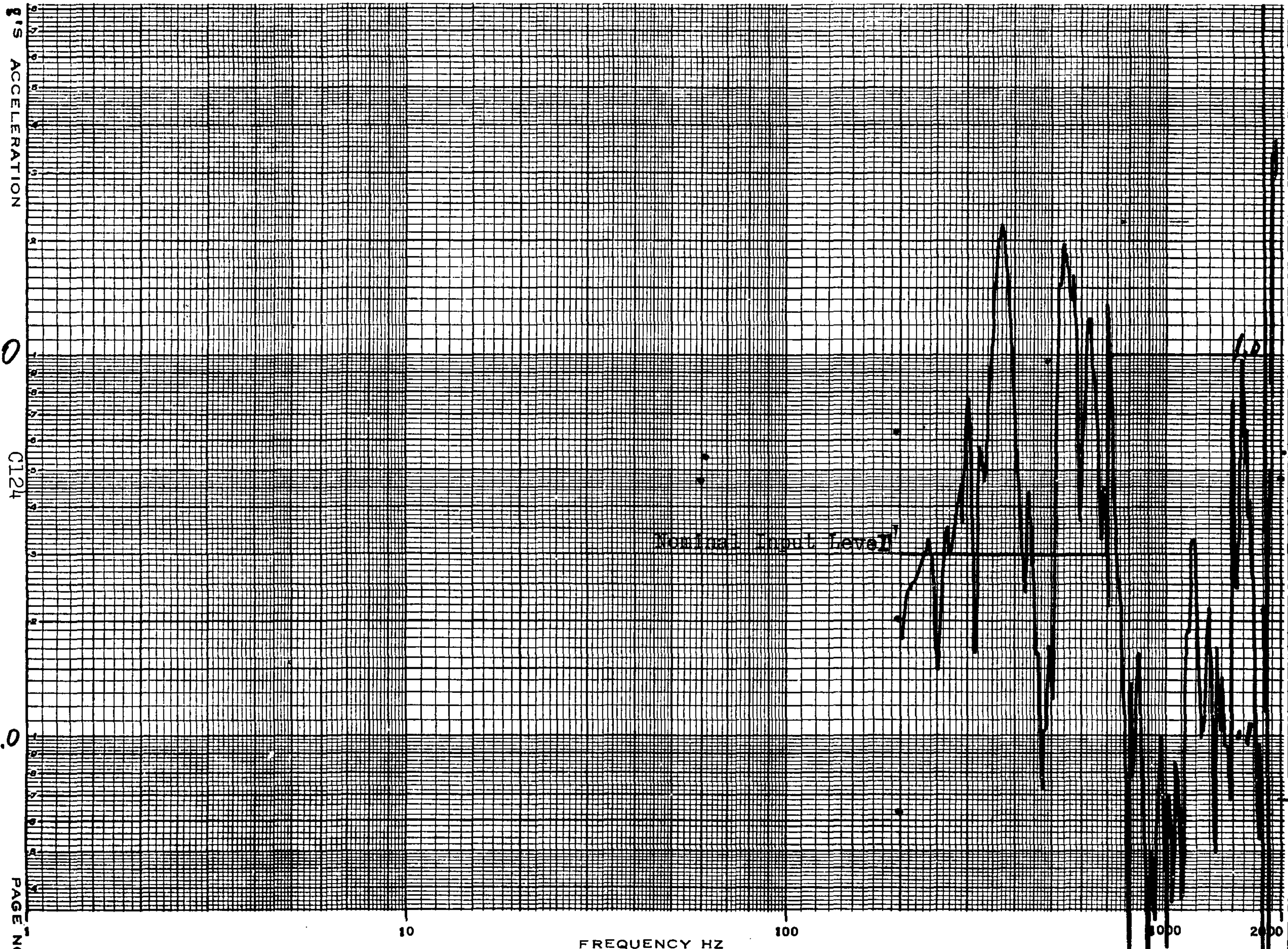
FREQ. RANGE & DIRECTION 200-2000HZ	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 2	PHASE VCPS ONLY	NAME OF TEST SINUSOIDAL VIBRATION

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26
OPERATOR: P. J
PLOTTED BY: P. J
TRACE NO.: 44
TEST NO.: 14
TEST ENGINEER: S. M
CHECKED BY: T. G
PROJECT: PAE-D
DATE: 4-18-72
TIME: 1705



C124

INPUT LEVEL: ± 10 g
EXCIT. AXIS: Z
ACCEL S/N: YK20
SENSING AXIS:
ACCEL SENSITIVITY: — MV RMS / GP; 1.596 COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER: @ 700 HZ
TAPE REEL NO.: 012296
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION: EZ TANK MOUNT HOOK-UP # 3
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
REPORT NO.

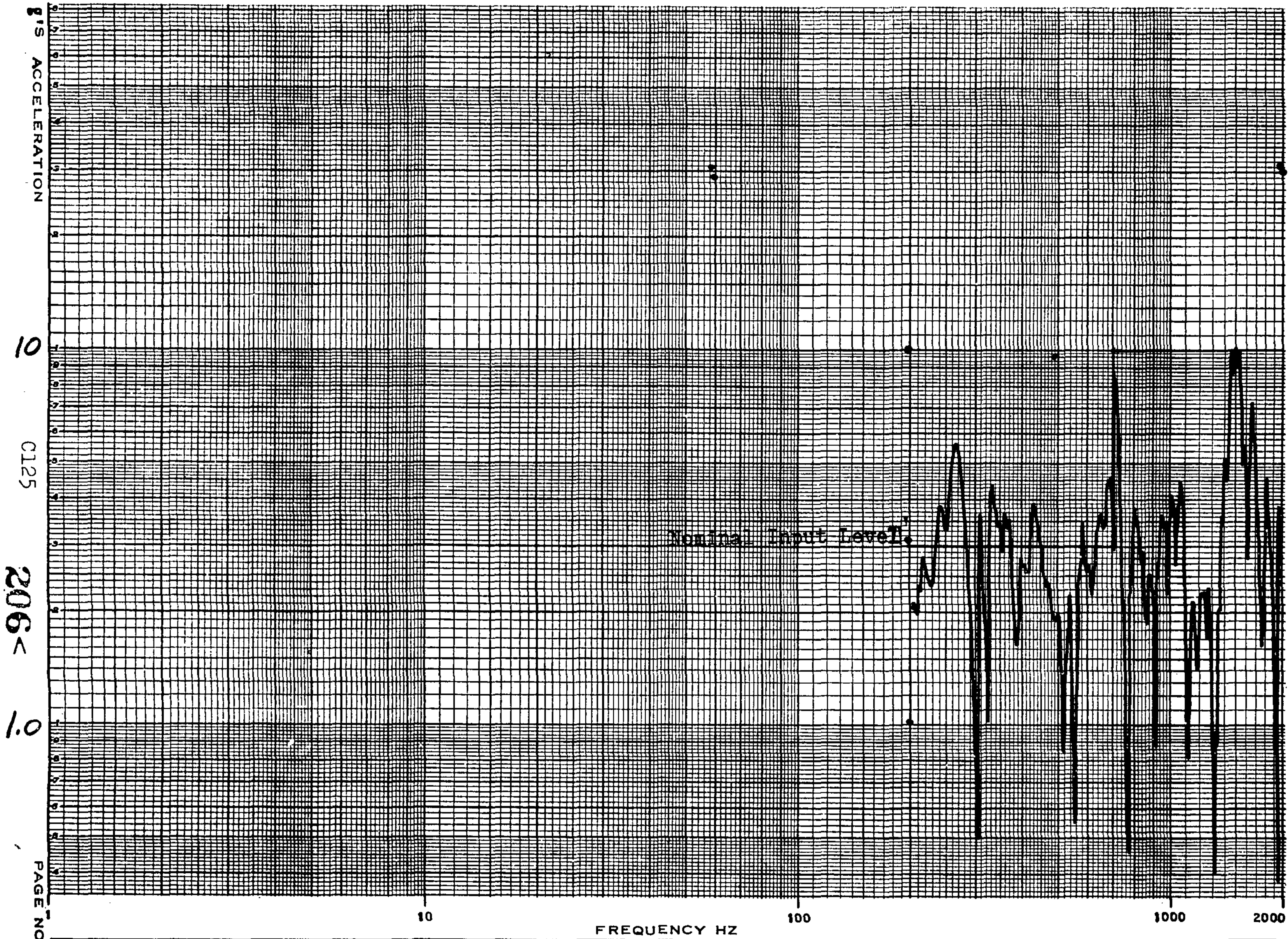
FREQ. RANGE & DIRECTION: 200 - 2000Hz
ITEM: VCPS
CODE SV: 748720-1
SERIAL NO.: 0.0001
TYPE OF TEST: QUAL

HSF 1633 A 2/69 **Standard** H®

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	P. J	P. J	47	14

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
S. M	T. G	[illegible]	4-18-72	1705



C125

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PAGE NO.

INPUT LEVEL ± 10 g

EXCIT. AXIS Z

ACCEL S/N WF75

SENSING AXIS Z

ACCEL SENSITIVITY 1.001 MV RMS / GP

— COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPE REEL NO. 012296

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 74 °F

☐ CONTROL

☒ RESPONSE

LOCATION FZ LATCH VALVE MT HOOK-UP #3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

REPORT NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	TYPE OF TEST
200-2000 HZ	VCPS	SV 748720-1	00001	QUAL

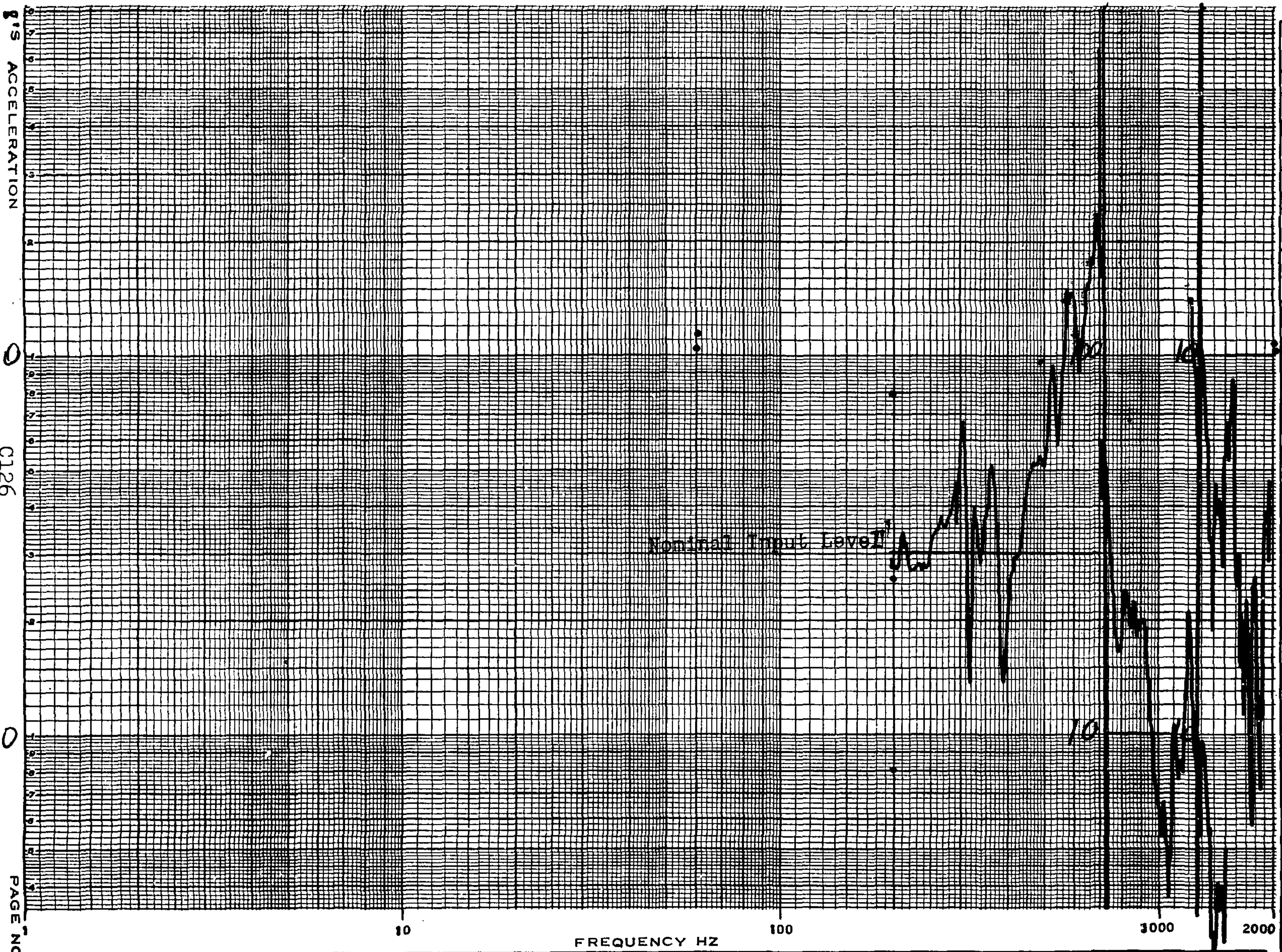
SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
AT-VCPS	4.3.7.5	NOTE 2	VCPS ONLY	SINUSOIDAL VIBRATION

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION UA®

SINE VIBRATION TEST

RIG: 26
OPERATOR: P. J
PLOTTED BY: P. J
TRACE NO.: 48
TEST NO.: 14
TEST ENGINEER: S.M
CHECKED BY: T.G
PROJECT: [illegible]
DATE: 4-18-72
TIME: 1705



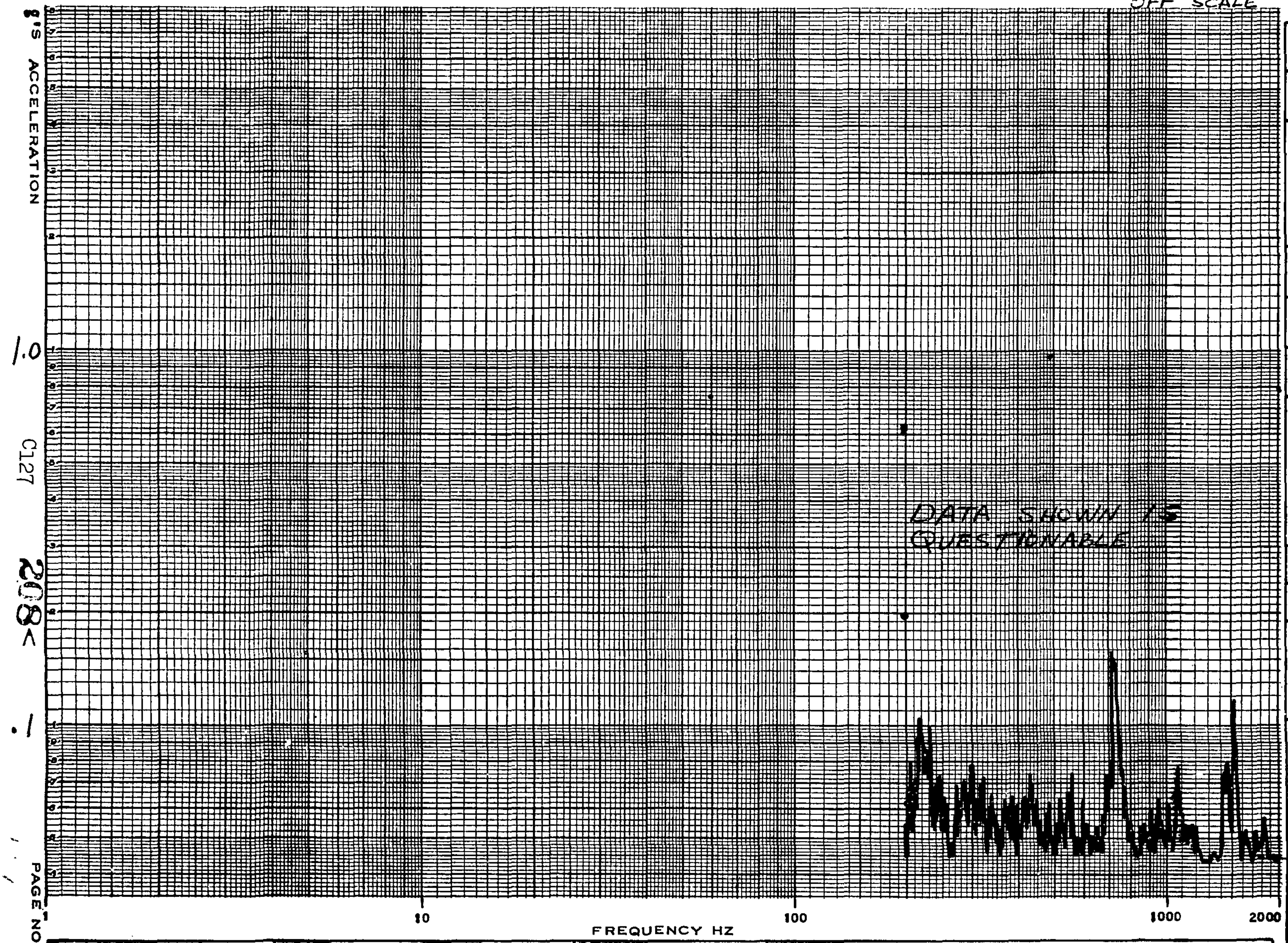
INPUT LEVEL: ± 10 g
EXCIT. AXIS: Z
ACCEL S/N: XN32
SENSING AXIS: Z
ACCEL SENSITIVITY: 1.261 MV RMS / GP
— COL / GP
FILTER: 100/200 HZ B.W.
FILTER CROSSOVER: @ 700 HZ
TAPE REEL NO.: 012296
SWEEP RATE: 4 OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION: GZ
JUNCTION BOX MOUNT
HOOK-UP # 3
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
REPORT NO.

FREQ. RANGE & DIRECTION: 200-2000HZ
ITEM: VCPS
CODE SV: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL

C126

HSF 1633 A 2/69 **Standard H®**

RIG 26	OPERATOR P. J	PLOTTED BY P. J	TRACE NO. 49	TEST NO. 14
TEST ENGINEER S. M	CHECKED BY T. G	PROJECT RAE-B	DATE 4-18-72	TIME 1705



INPUT LEVEL ± 10 g

EXCIT. AXIS Z

ACCEL S/N XJ29

SENSING AXIS Z

ACCEL SENSITIVITY 1.636 MV RMS / GP

— COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPEREELNO. 012296

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 74 °F

☐ CONTROL

☐ RESPONSE

LOCATION HZ PRESSURE XDUCER MT HOOK-UP # 3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.

REPORT NO.

PAGE NO.

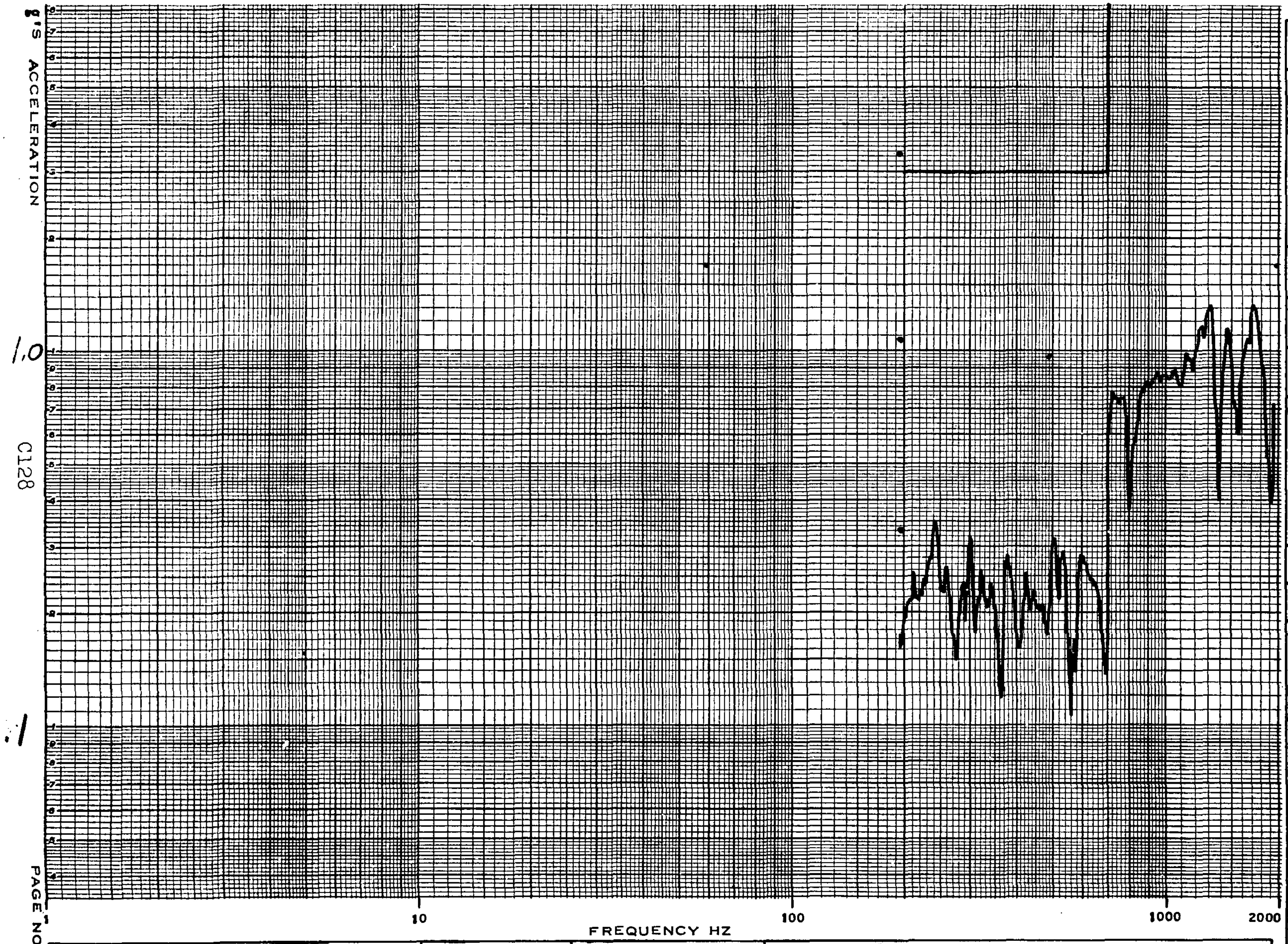
FREQ. RANGE & DIRECTION 200-2000 HZ	ITEM VCPS	CODE SY 748720-1	SERIAL NO. 0000/	TYPE OF TEST QUAL
SPECIFICATION AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 2	PHASE VCPS ONLY	NAME OF TEST SINUSOIDAL VIBRATION

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 2C	OPERATOR P. J	PLOTTED BY P. J	TRACE NO. 46	TEST NO. 14
TEST ENGINEER S.M	CHECKED BY T. G	PROJECT RAE-B	DATE 4-18-72	TIME 1705



INPUT LEVEL ± 10 g	EXCIT. AXIS Z
ACCEL S/N TE83	SENSING AXIS Y
ACCEL SENSITIVITY 2.979 MV RMS / GP — COL / GP	
FILTER 100/200 HZ B.W.	
FILTER CROSSOVER @ 700 HZ	
TAPE REEL NO. 012296	SWEEP RATE 4 OCT/MIN
COMPR. SPEED VAR DB/SEC CHG@ — HZ TO — DB/SEC CHG@ — HZ TO - DB/SEC	
NON-OPERATING TEMP. 74 °F	☐ CONTROL ☒ RESPONSE
LOCATION A1Y HOOK-UP # 3	
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.	

REPORT NO.

FREQ. RANGE & DIRECTION 200-2000 HZ	ITEM VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL

C128

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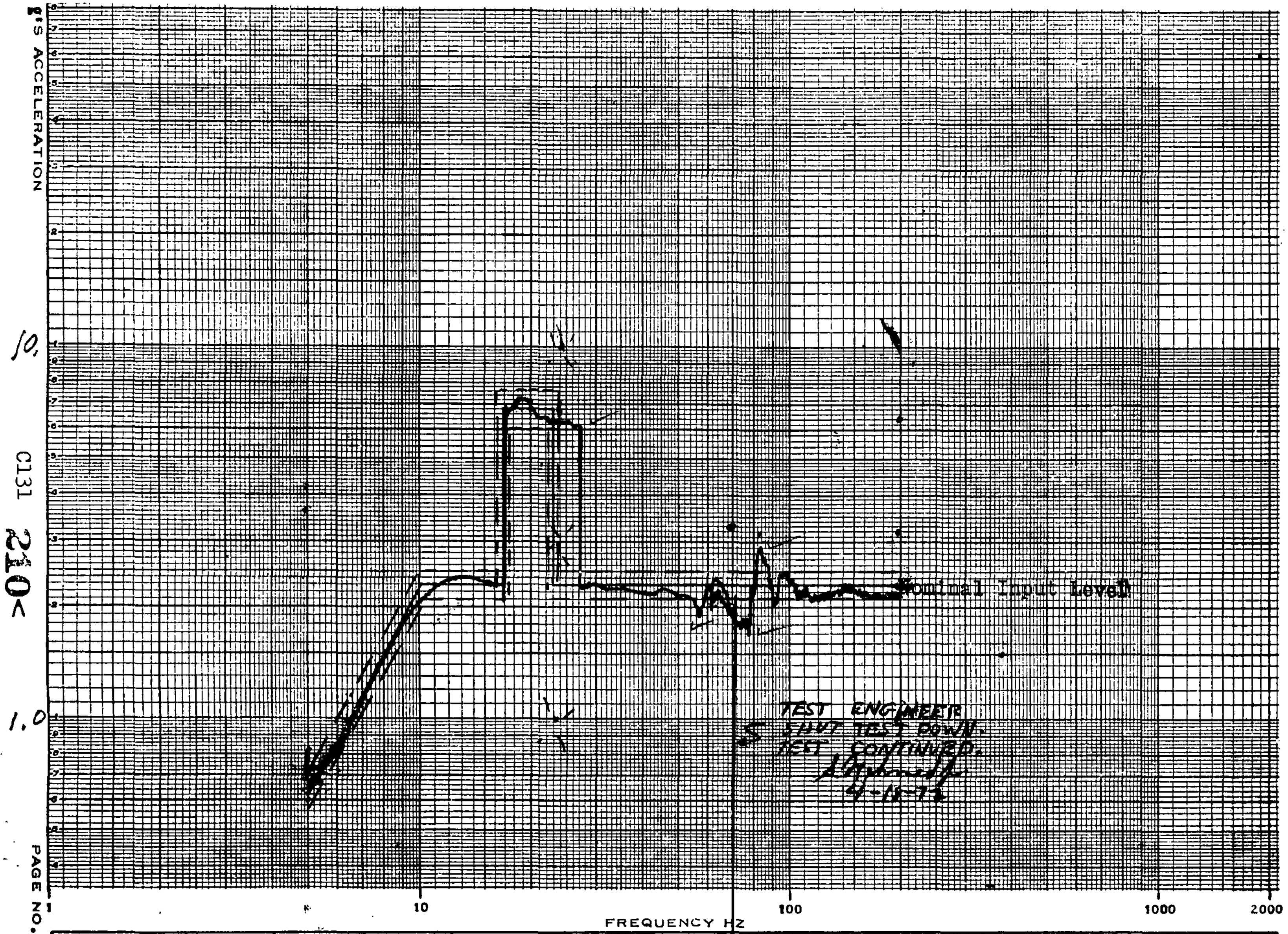
Standard H® HSF-1633.1 2/69

RIG 26	OPERATOR P. J.	WITNESS —	WITNESS M. Quinn 4-19	TEST NO. 16
TEST ENGINEER T.G.	CHECKED BY MEHMED	PROJECT RAE-B	DATE 4-19	TIME 0930



INPUT LEVEL 6.8 g	EXCIT. AXIS Z
ACCEL S/N ND62	SENSING AXIS Z

ACCEL SENSITIVITY — MV RMS / GP
2.698 COL / GP

FILTER 10-100 HZ B.W.

FILTER CROSSOVER @ 76 HZ

SWEEP RATE 3 OCT/MIN 14-23 HZ
4.0 OCT/MIN

TAPEREEL NO. 01296 ☑ LIVE ☐ FROM TAPE

COMPR. SPEED Var. DB/SEC.

CHG.@ — HZ TO — DB/SEC.

CHG.@ — HZ TO — DB/SEC.

NON OPERATING ☑ CONTROL ☐ RESPONSE

TEMP. 74 °F

LOCATION A / Z

SPECIAL CONDITIONS
VCPS WITH SPACECRAFT
VCPS LOADED AND PRESSURIZED

REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-200 HZ	ITEM VCPS Complete PKG	CODE SV 748720-1	SERIAL NO. 00001	SPEC. AT-VCPS	PARA. 4.3.7.5	AMEND. —
ACTION SHEET NO. —	ATA NO. —	TYPE OF TEST Qual		NAME OF TEST Sine Scan - COMPLETE PKG.		

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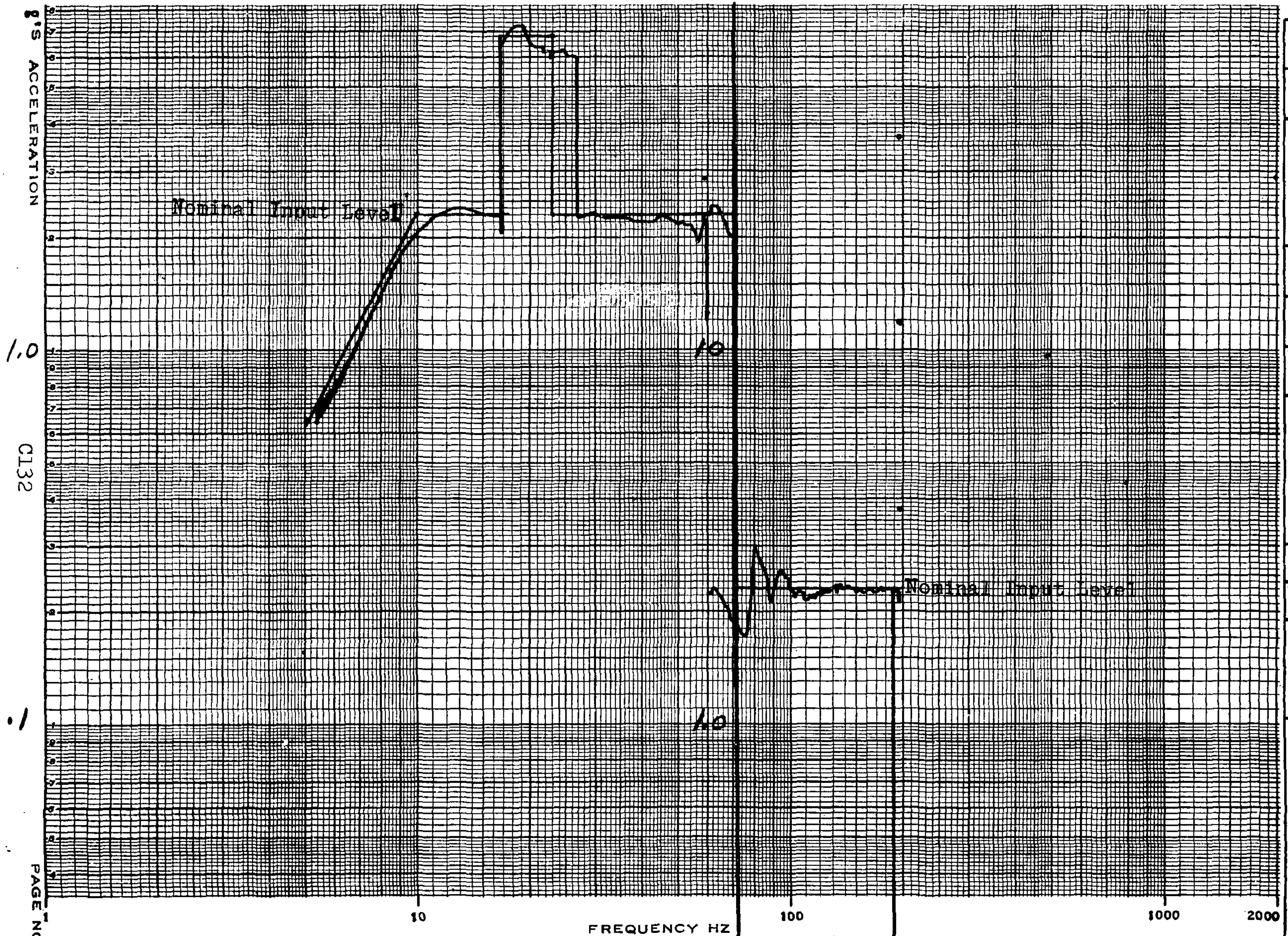
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG Z6	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 50	TEST NO. 16
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-B	DATE 4-19-72	TIME 0930



INPUT LEVEL ± 6.8 g	EXCIT. AXIS Z
ACCEL S/N NB62	SENSING AXIS Z
ACCEL SENSITIVITY — MV RMS / GP 2.698 COL / GP	
FILTER 10/100 HZ B.W.	
FILTER CROSSOVER @ 70 HZ	
TAPE REEL NO. 012296	SWEEP RATE 4 (3)-17-23HZ OCT/MIN
COMPR. SPEED VAR DB/SEC CHG@ — HZ TO — DB/SEC CHG@ — HZ TO — DB/SEC	
NON-OPERATING	☒ CONTROL ☐ RESPONSE
TEMP. 74 °F	
LOCATION A1Z HOOK-UP #3	
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED	

REPORT NO.

FREQ. RANGE & DIRECTION 5-200HZ	ITEM RAE-B VCPS	CODE SV 748720-1	SERIAL NO. 0000/	TYPE OF TEST QUAL

PAGE NO.

C132

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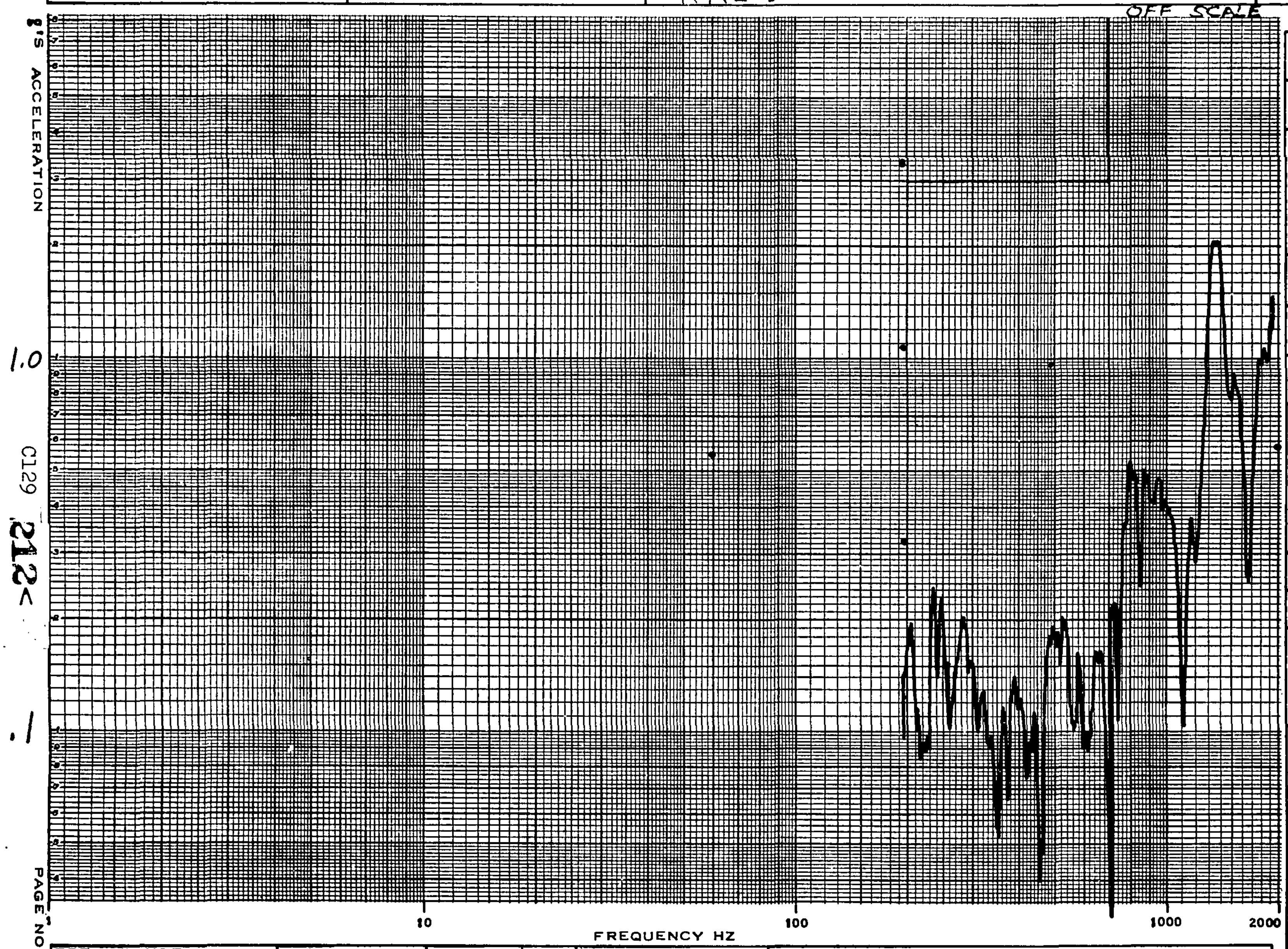
HSF 1633 A 2/69 **Standard** H®

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	P. J	P. J	45	14

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
S. M	T. G	RAE-B	4-18-72	1705



INPUT LEVEL ± 10 g

EXCIT. AXIS Z

ACCEL S/N TD40

SENSING AXIS X

ACCEL SENSITIVITY 3.005 MV RMS / GP

— COL / GP

FILTER 100/200 HZ B.W.

FILTER CROSSOVER @ 700 HZ

TAPEREELNO. 012296

SWEEP RATE 4 OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 74 °F

☐ CONTROL

☒ RESPONSE

LOCATION A1X

HOOK-UP #3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

REPORT NO.

FREQ. RANGE & DIRECTION	ITEM	CODE SV	SERIAL NO.	TYPE OF TEST
200-2000Hz	VCPS	748720-1	00001	QUAL

SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
AT-VCPS	4.3.7.5	NOTE 2	VCPS ONLY	SINUSOIDAL VIBRATION

PAGE NO.

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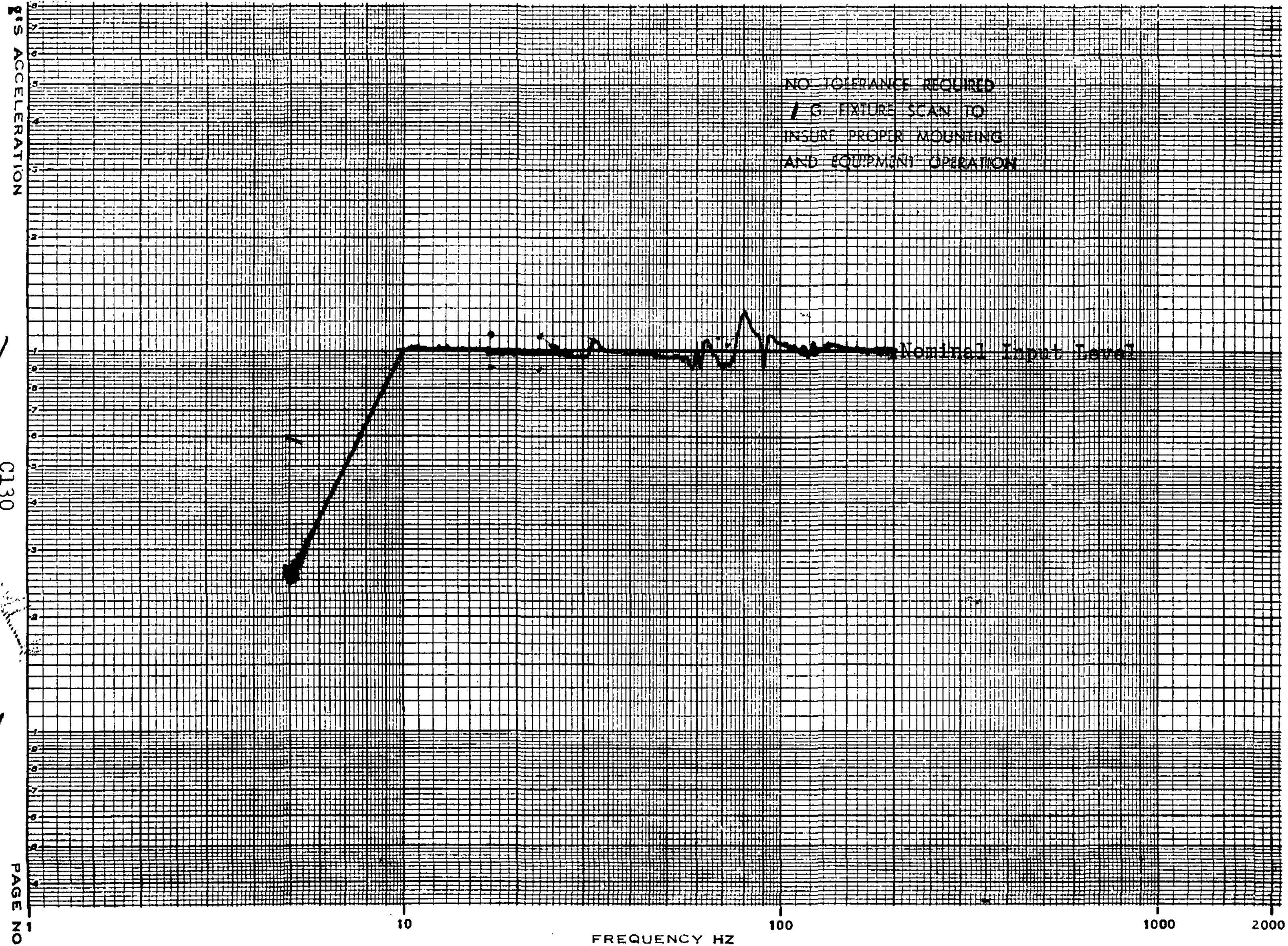
DIVISION OF UNITED AIRCRAFT CORPORATION
HSF-1633.1 2/69

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	WITNESS —	WITNESS —		TEST NO. 15
TEST ENGINEER MEHMED	CHECKED BY MEHMED	PROJECT RAE-B		DATE 4-19-72	TIME 0905



NO TOLERANCE REQUIRED
1 G FIXTURE SCAN TO
INSURE PROPER MOUNTING
AND EQUIPMENT OPERATION

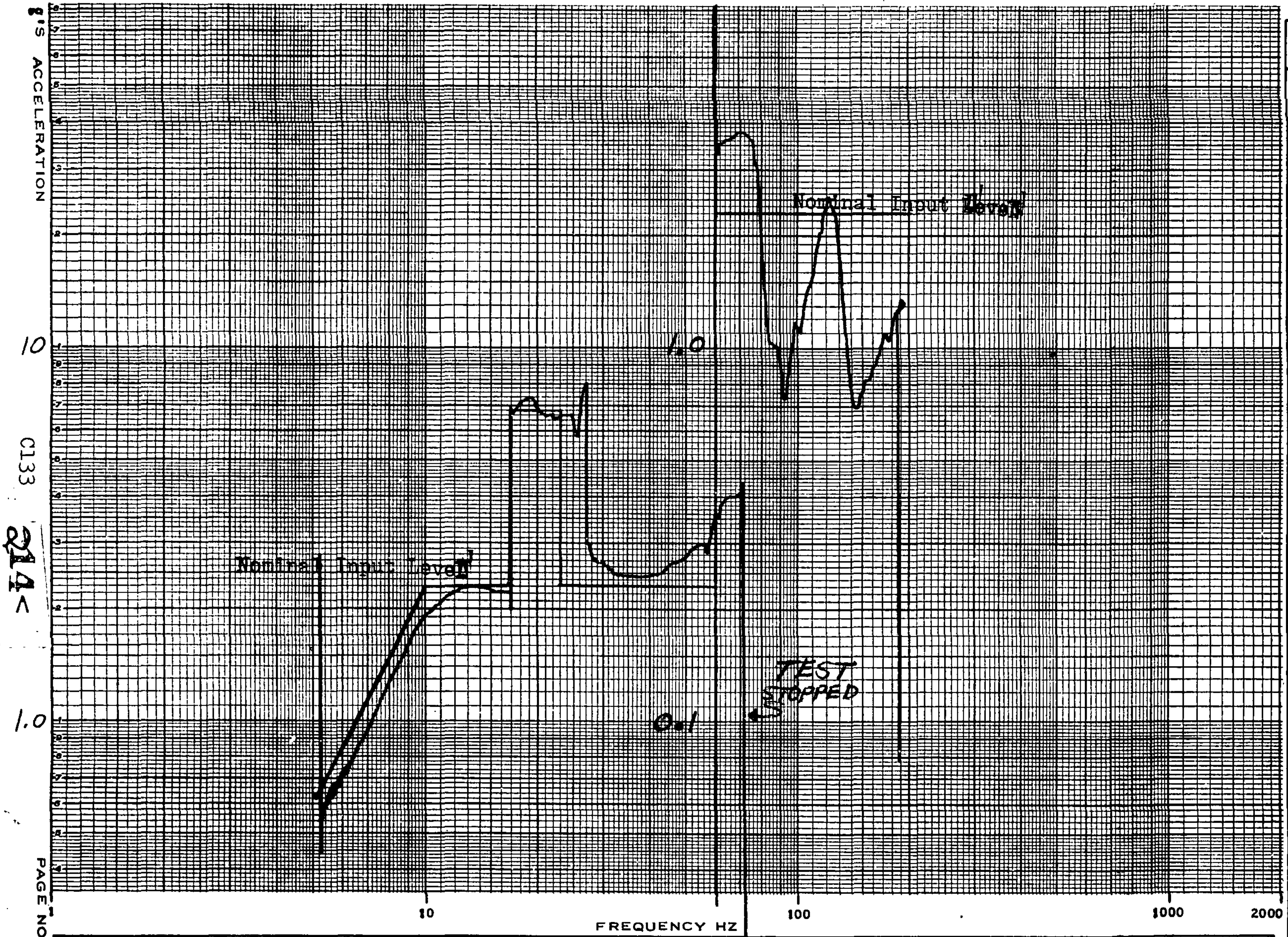
INPUT LEVEL 1 g	EXCIT. AXIS Z
ACCEL S/N NB62	SENSING AXIS Z
ACCEL. SENSITIVITY — MV RMS / GP 2.698 COL / GP	
FILTER 10/100/[redacted] HZ B.W.	
FILTER CROSSOVER @ 70/[redacted] HZ	
SWEEP RATE 3.0 OCT/MIN 17-23HZ 4.0 OCT/MIN	
TAPEREEL NO. 012296	☒ LIVE ☐ FROM TAPE
COMPR. SPEED VAR DB/SEC.	
CHG.@ — HZ TO — DB/SEC.	
CHG.@ — HZ TO — DB/SEC.	
NON OPERATING	☒ CONTROL
TEMP. 75 °F	☐ RESPONSE
LOCATION A1Z	
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED. SPACECRAFT MOUNTED.	REPORT NO.

PAGE NO.

FREQ. RANGE & DIRECTION 5-200HZ	ITEM VCPS	CODE SV 7487201	SERIAL NO. 00001	SPEC. AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 1
ACTION SHEET NO.	ATA NO.	TYPE OF TEST		NAME OF TEST SINUSOIDAL VIBRATION		

HSF 1633 A 2/69 Standard

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 51	TEST NO. 16
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT	DATE 4-19-72	TIME 0930



INPUT LEVEL ± 6.8 g

EXCIT. AXIS Z

ACCEL S/N TG75

SENSING AXIS Z

ACCEL SENSITIVITY — MV RMS / GP

2.791 COL / GP

FILTER 10/100 HZ B.W.

FILTER CROSSOVER @ 70 HZ

TAPEREELNO. 012296

SWEEP RATE 4 (3) 17-23HZ OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 74 °F

☐ CONTROL

☒ RESPONSE

LOCATION 8Z HUB HOOK-UP #3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

REPORT NO.

FREQ. RANGE & DIRECTION 5-200HZ	ITEM ~~RAE-D~~ VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL
SPECIFICATION AT-VCPS	PARA. 4.3.7.5	AMEND. NOTE 1	PHASE VCPS AND SPACECRAFT	NAME OF TEST SINUSOIDAL VIBRATION

C133

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HSF 1633 A 2/69

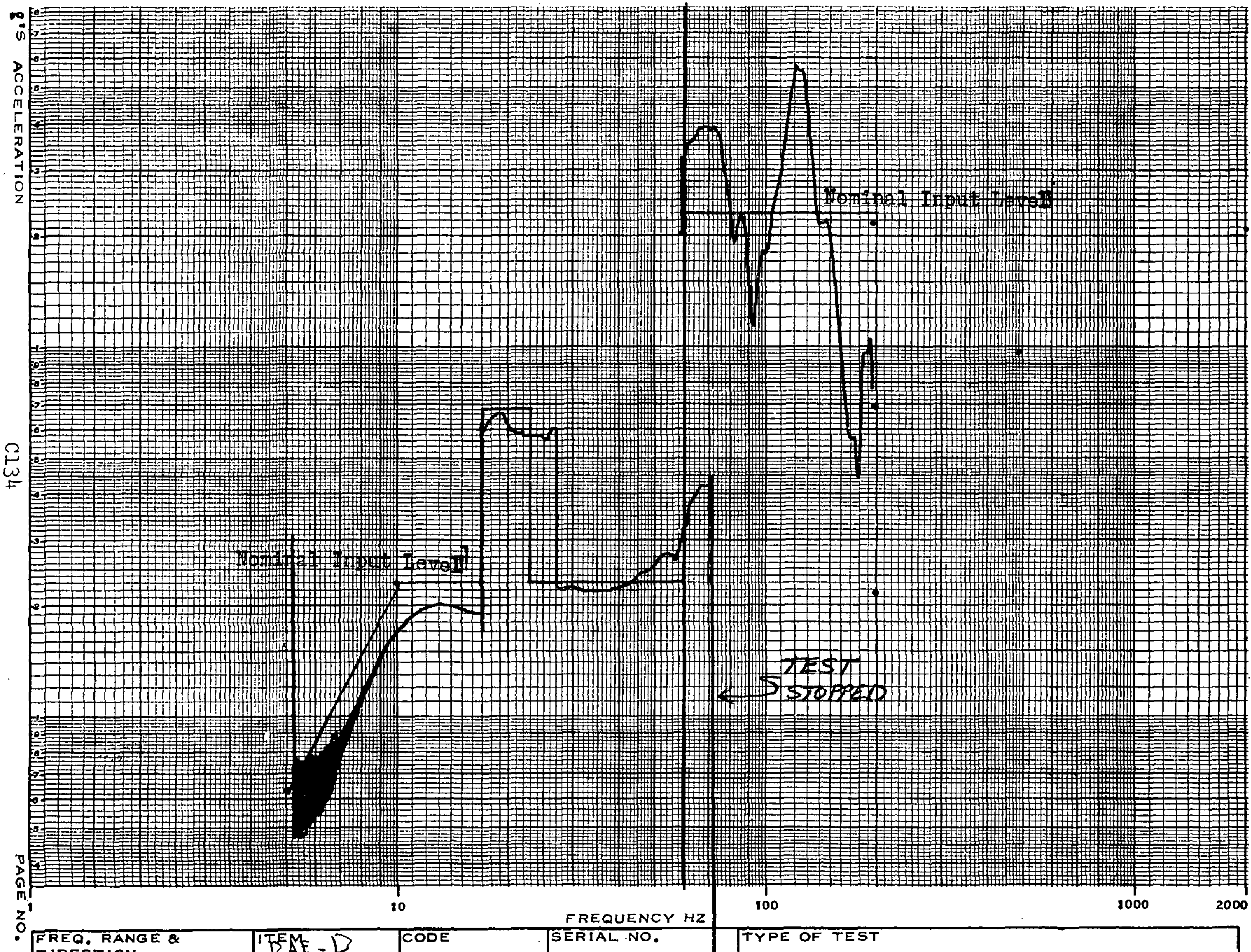
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 52	TEST NO. 16
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT [illegible]	DATE 4-19-72	TIME 0930

INPUT LEVEL ± 6.8 g
EXCIT. AXIS Z
ACCEL S/N
SENSING AXIS
ACCEL SENSITIVITY ____ MV RMS / GP
____ COL / GP
FILTER 10/100 HZ B.W.
FILTER CROSSOVER @ 70 HZ
TAPE REEL NO. 012296
SWEEP RATE (3)17-23Hz 4 OCT/MIN
COMPR. SPEED VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION DZ
REA MOUNT
HOOK-UP #3
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

REPORT NO.



PAGE NO.

FREQ. RANGE & DIRECTION	ITEM RAE-D VCPS	CODE	SERIAL NO.	TYPE OF TEST

HSF 1633 A 2/69 **Standard** H®

RIG 26

OPERATOR JODOIN

PLOTTED BY JODOIN

TRACE NO. 53

TEST NO. 16

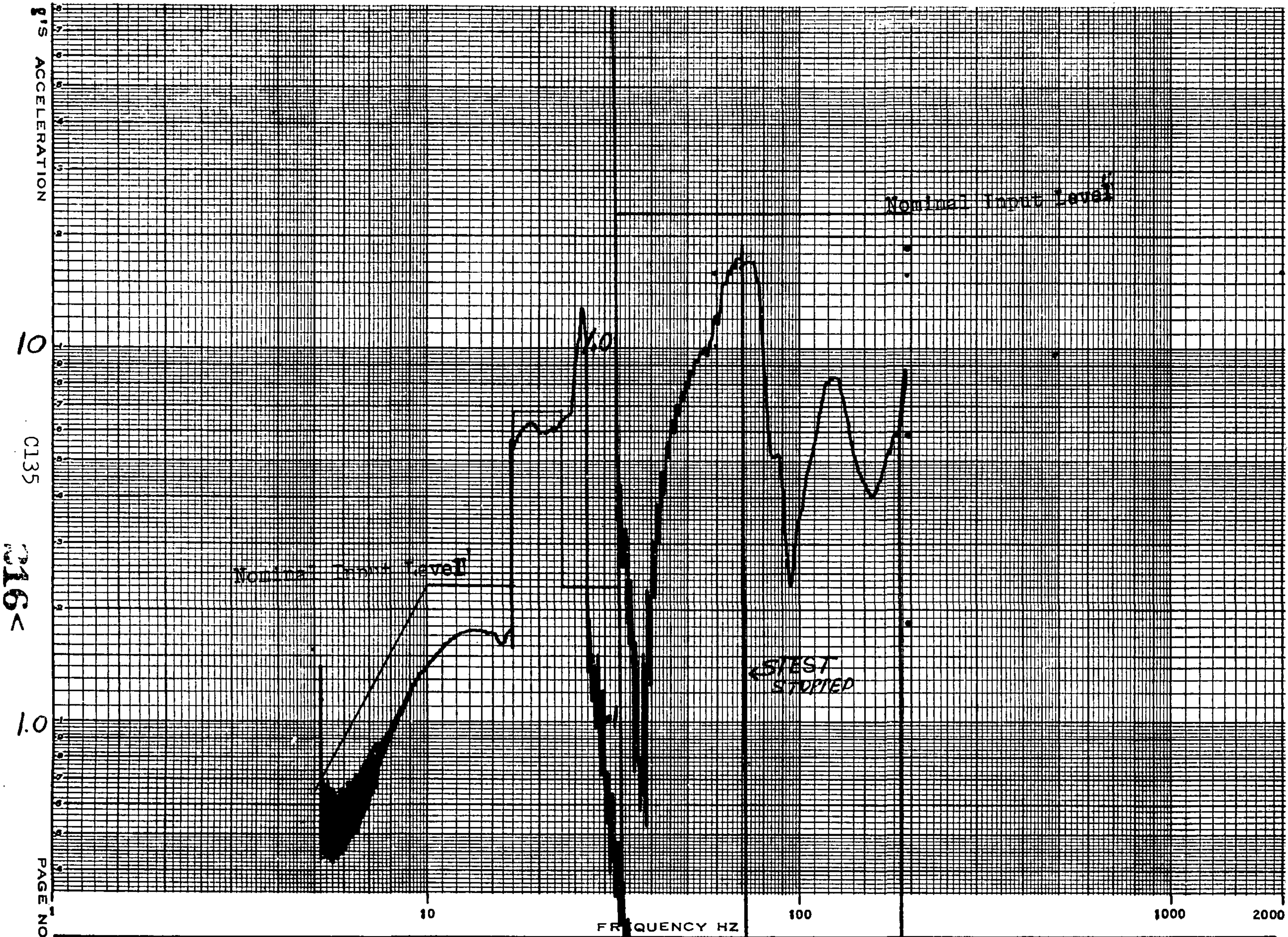
TEST ENGINEER MEHMED

CHECKED BY GEIB

PROJECT RAE-B

DATE 4-19-72

TIME 0930



INPUT LEVEL ± 6.8 g

EXCIT. AXIS Z

ACCEL S/N YK20

SENSING AXIS Z

ACCEL SENSITIVITY — MV RMS / GP

1.596 COL / GP

FILTER 10/100 HZ B.W.

FILTER CROSSOVER @ 70 HZ

TAPE REEL NO. 012296

SWEEP RATE 4 (3) 17-23Hz OCT/MIN

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 74 °F

LOCATION Ez TANK MOUNT HOOK-UP #3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

REPORT NO.

FREQ. RANGE & DIRECTION 5-200HZ

ITEM RAE-B VCPS

CODE SV 748720-1

SERIAL NO. 00001

TYPE OF TEST QUAL

SPECIFICATION AT-VCPS

PARA. 4.3.7.5

AMEND. NOTE 1

PHASE VCPS AND SPACECRAFT

NAME OF TEST SINUSOIDAL VIBRATION

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	JODOIN	58	16

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	RAE-B	4-19-72	0930

INPUT LEVEL ± 6.8 g

EXCIT. AXIS Z

ACCEL S/N WF75

SENSING AXIS Z

ACCEL SENSITIVITY 1.001 MV RMS / GP

— COL / GP

FILTER 10/100 HZ B.W.

FILTER CROSSOVER @ 70 HZ

TAPE REEL NO. 012296

SWEEP RATE 4 OCT/MIN (3) 17-23Hz

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

TEMP. 74 °F

☐ CONTROL

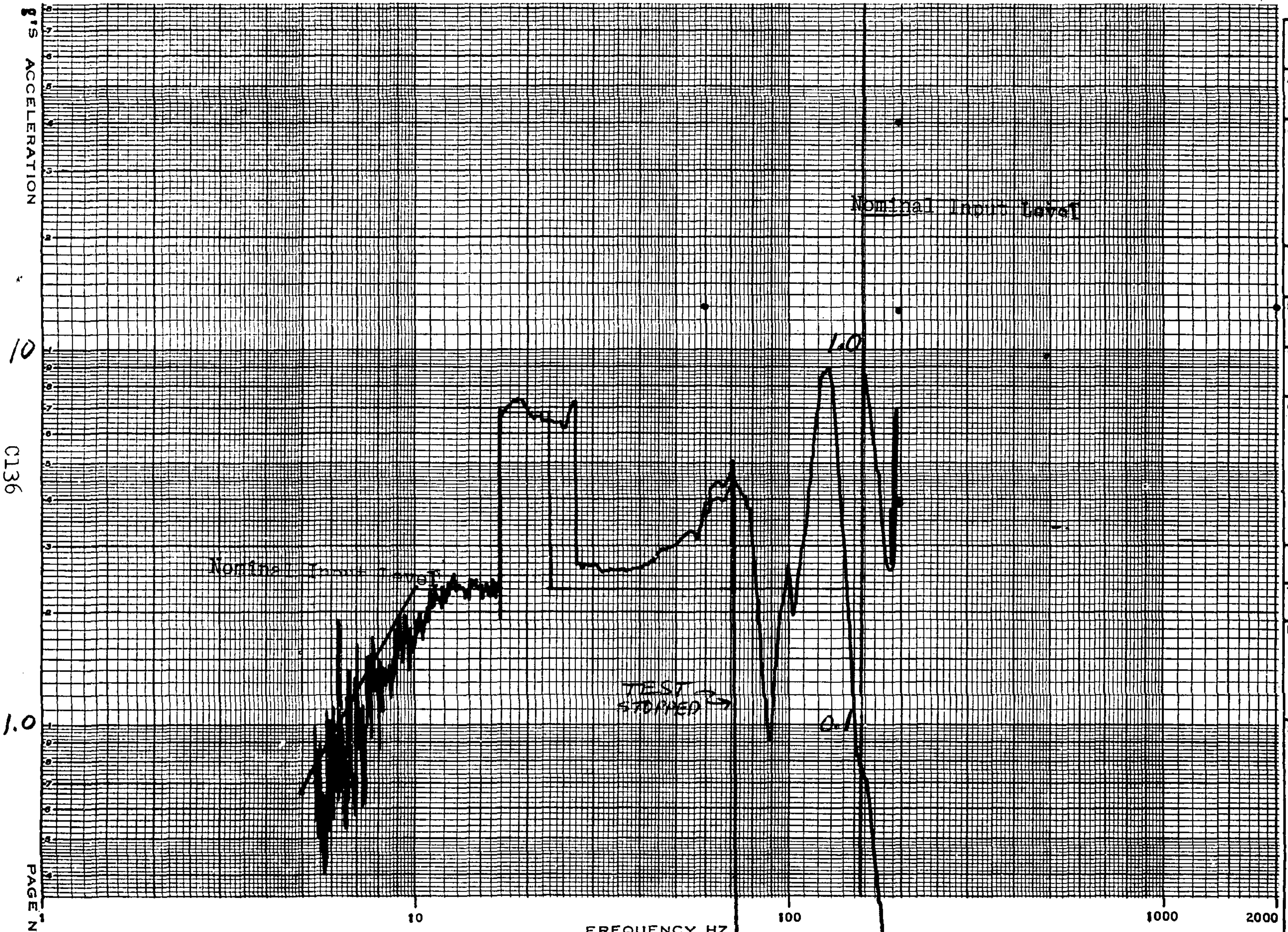
☒ RESPONSE

LOCATION FZ

LATCH VALVE MOUNT Hookup #3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

REPORT NO.



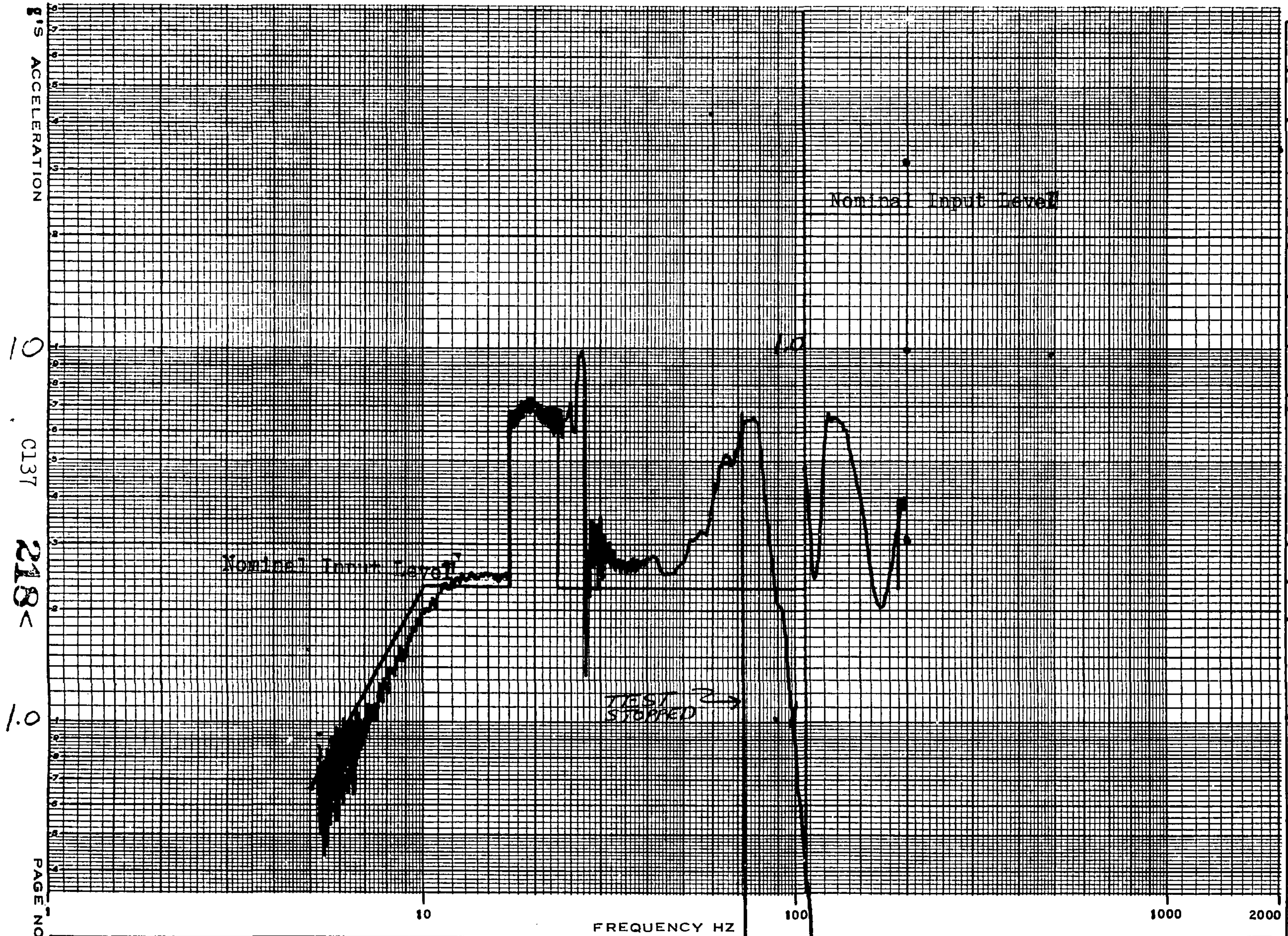
PAGE NO.

FREQ. RANGE & DIRECTION	ITEM	CODE SV	SERIAL NO.	TYPE OF TEST
5-200Hz	RAE-B VCPS	748720-1	00001	QUAL

HSF 1633 A 2/69 **Standard** A®

SINE VIBRATION TEST

RIG 26
OPERATOR JODOIN
PLOTTED BY JODOIN
TRACE NO. 59
TEST NO. 16
TEST ENGINEER MEHMED
CHECKED BY GEIB
PROJECT [illegible]
DATE 4-19-72
TIME 0930



INPUT LEVEL ± 6.8 g
EXCIT. AXIS Z
ACCEL S/N XN32
SENSING AXIS Z
ACCEL SENSITIVITY 1.261 MV RMS / GP
— COL / GP
FILTER 10/100 HZ B.W.
FILTER CROSSOVER @ 70 HZ
TAPE REEL NO. 012296
SWEEP RATE 4 (3)-17-23Hz OCT/MIN
COMPR. SPEED VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION GZ
JUNCTION BOX MOUNT
HOOK-UP #3
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.
REPORT NO.

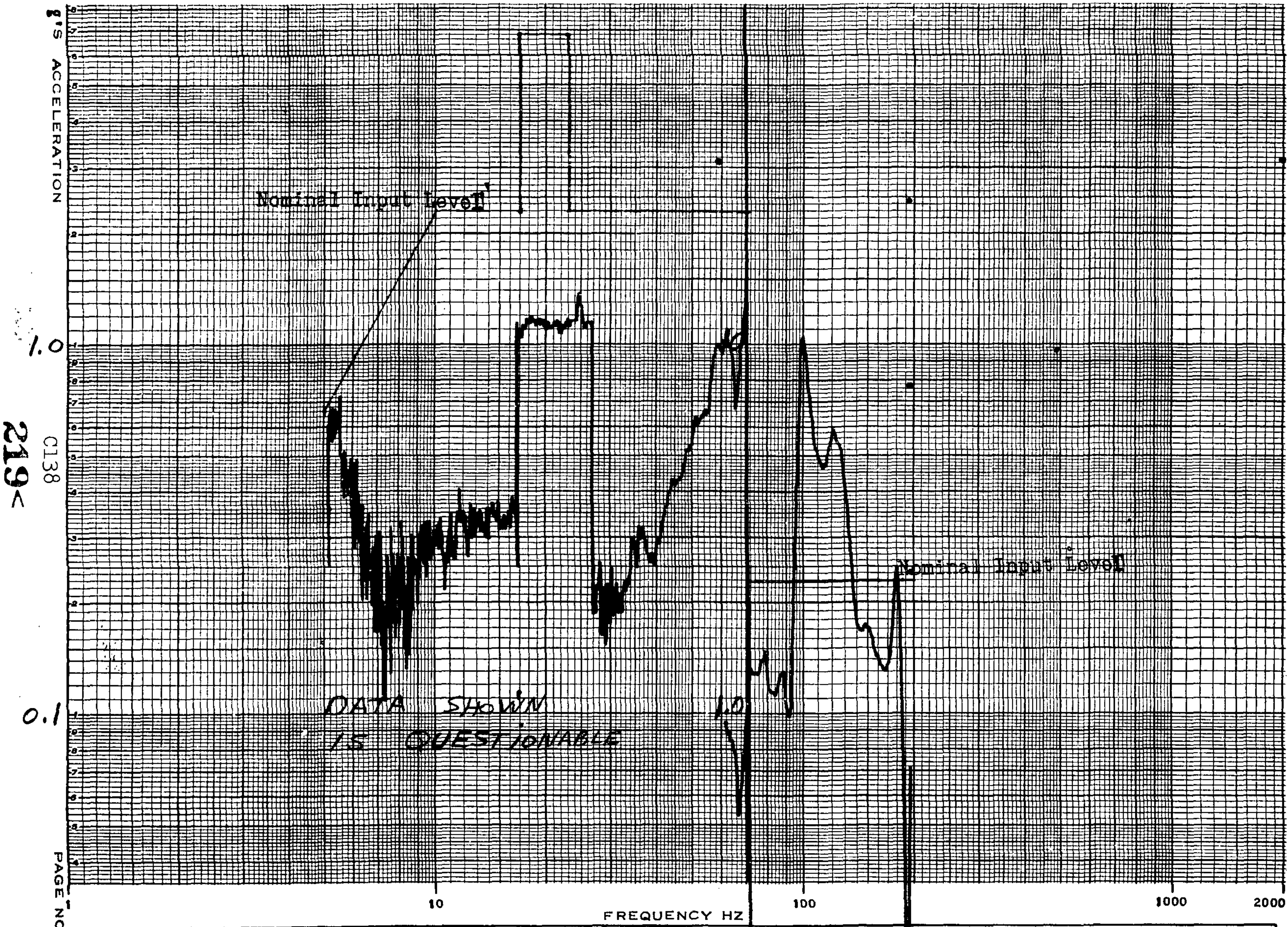
FREQ. RANGE & DIRECTION 5-200Hz
ITEM ~~RAE-A~~ RAE-B VCPS
CODE SV 748720-1
SERIAL NO. 00001
TYPE OF TEST QUAL
SPECIFICATION AT-VCPS
PARA. 4.3.7.5
AMEND. NOTE 1
PHASE VCPS AND SPACE CRAFT
NAME OF TEST SINUSOIDAL VIBRATION

HSF 1633 A 2/69

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 60	TEST NO. 16
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-D	DATE 4-19-72	TIME 0930



INPUT LEVEL ± 6.8 g

EXCIT. AXIS Z

ACCEL S/N XJ29

SENSING AXIS Z

ACCEL SENSITIVITY 1.636 MV RMS / GP

— COL / GP

FILTER 10/100 HZ B.W.

FILTER CROSSOVER @ 70 HZ

TAPE REEL NO. 012296

SWEEP RATE 4 OCT/MIN (3)-17-23HZ

COMPR. SPEED VAR DB/SEC

CHG@ — HZ TO — DB/SEC

CHG@ — HZ TO — DB/SEC

NON-OPERATING

☐ CONTROL

☒ RESPONSE

TEMP. 74 °F

LOCATION HZ

PRESSURE XDUCER HOOK-UP # 3

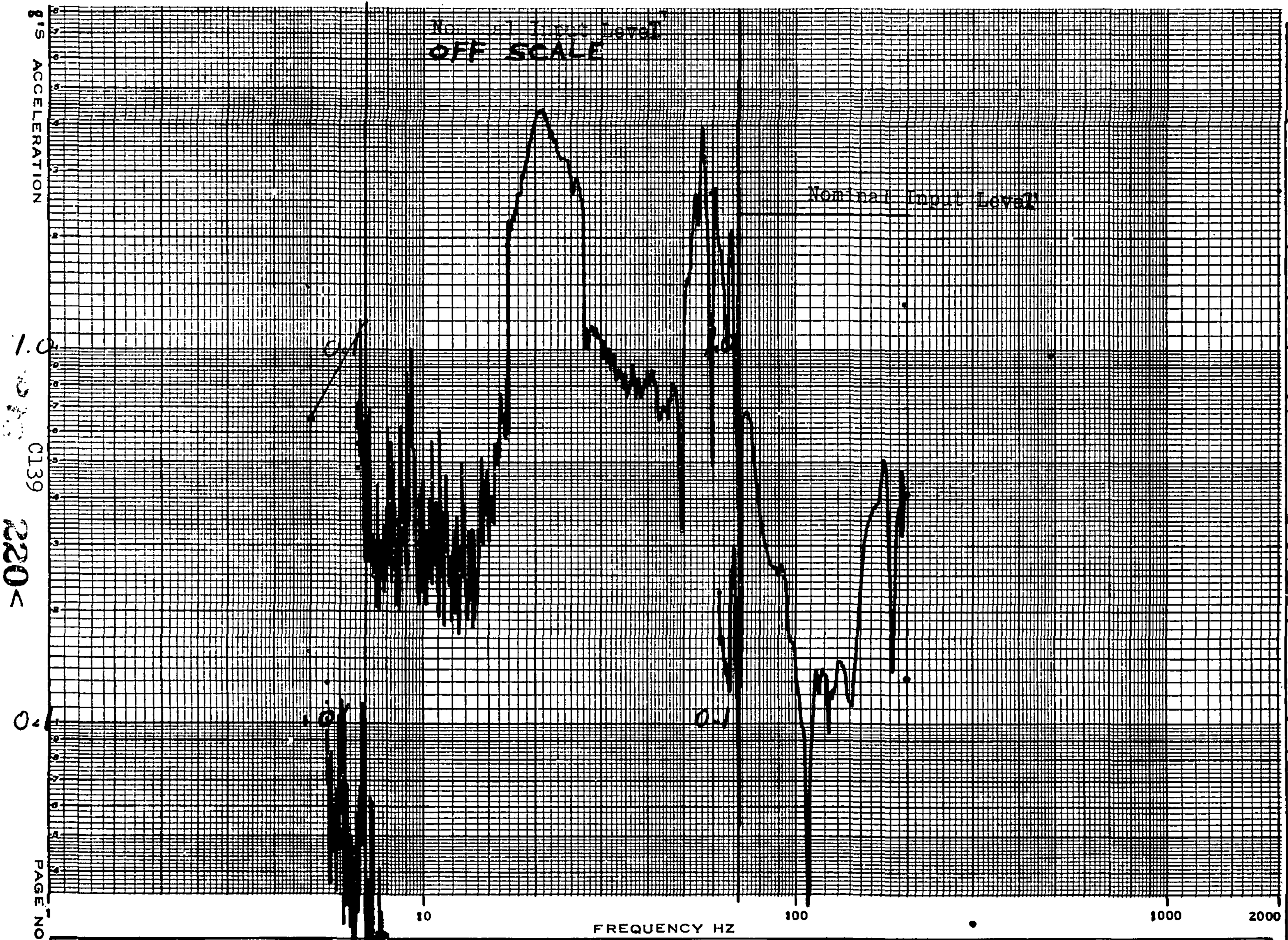
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.

REPORT NO. ?

FREQ. RANGE & DIRECTION 5-200HZ	ITEM RAE-D VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL

HSF 1633 A 2/69 **Standard**

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 56
TEST NO.: 16
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: RAE-B
DATE: 4-19-72
TIME: 0930



INPUT LEVEL: ± 6.8 g
EXCIT. AXIS: Z
ACCEL S/N: TD40
SENSING AXIS: X
ACCEL SENSITIVITY: 3.005 MV RMS / GP
— COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPE REEL NO.: 012296
SWEEP RATE: 4 OCT/MIN (3)-17-23Hz
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
TEMP. 74 °F
☐ CONTROL
☒ RESPONSE
LOCATION: AIX
HOOK-UP # 3
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED.
REPORT NO.

FREQ. RANGE & DIRECTION: 5- 200HZ
ITEM: RAE-B VCPS
CODE SV: 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL
SPECIFICATION: AT-VCPS
PARA.: 4.3.7.5
AMEND.: NOTE 1
PHASE: VCPS AND SPACECRAFT
NAME OF TEST: SINUSOIDAL VIBRATION

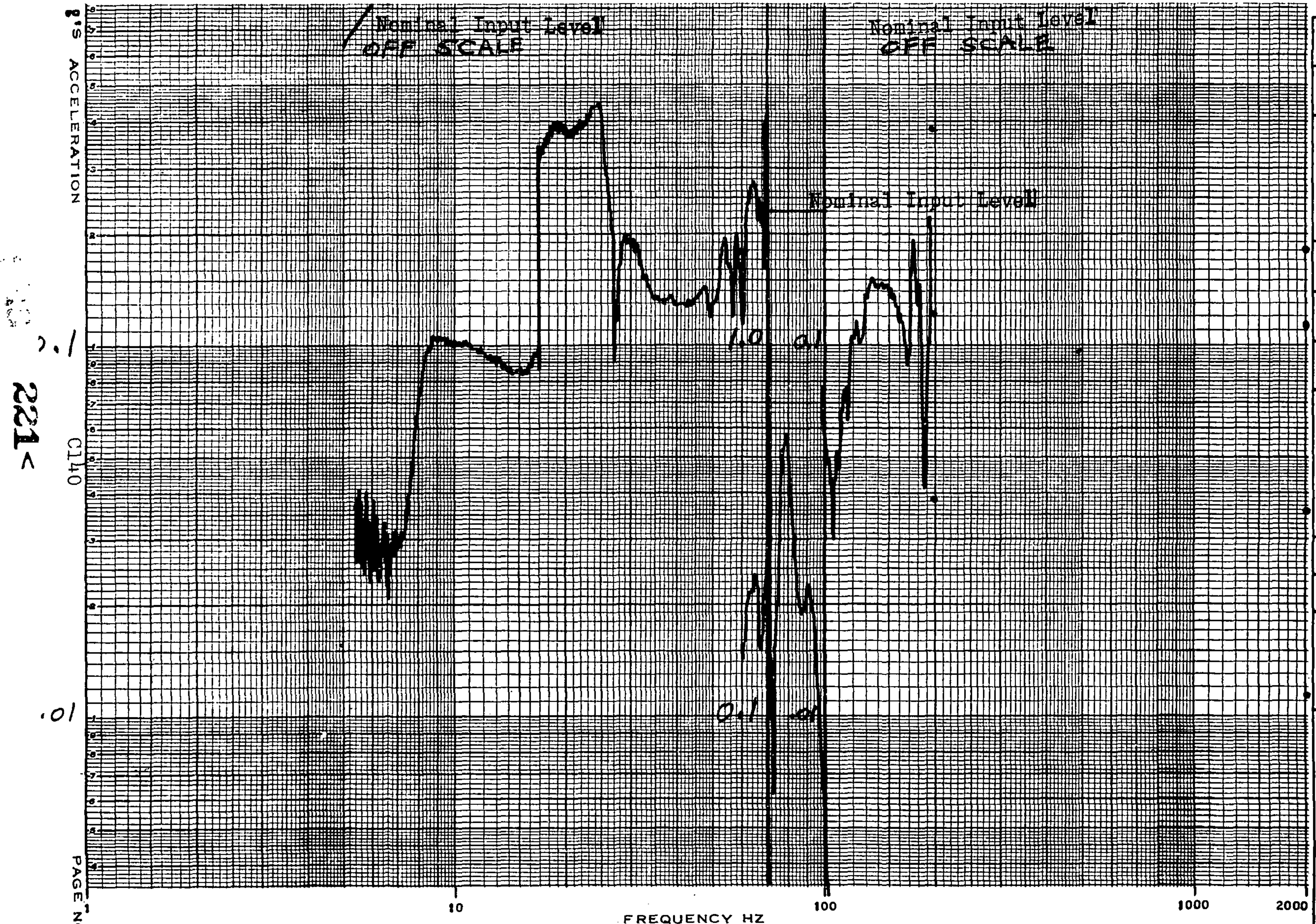
C139

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

HSF 1633 A 2/69

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	PLOTTED BY JODOIN	TRACE NO. 54	TEST NO. 16
TEST ENGINEER MEHMED	CHECKED BY GEIB	PROJECT RAE-D	DATE 4-19-72	TIME 0930



INPUT LEVEL ± 6.8 g	EXCIT. AXIS Z
ACCEL S/N TD45	SENSING AXIS X
ACCEL SENSITIVITY — MV RMS / GP 2.650 COL / GP	
FILTER 10/100 HZ B.W.	
FILTER CROSSOVER @ 70 HZ	
TAPE REEL NO. 0/2296	SWEEP RATE (3) 17-23Hz 4 OCT/MIN
COMPR. SPEED VAR DB/SEC CHG@ — HZ TO — DB/SEC CHG@ — HZ TO — DB/SEC	
NON-OPERATING TEMP. 74 °F	☐ CONTROL ☒ RESPONSE
LOCATION CX SPACECRAFT C.G. HOOK-UP # 3	
SPECIAL ~~CONDITIONS~~ VCPS LOADED AND PRESSURIZED	

REPORT NO.

PAGE NO.

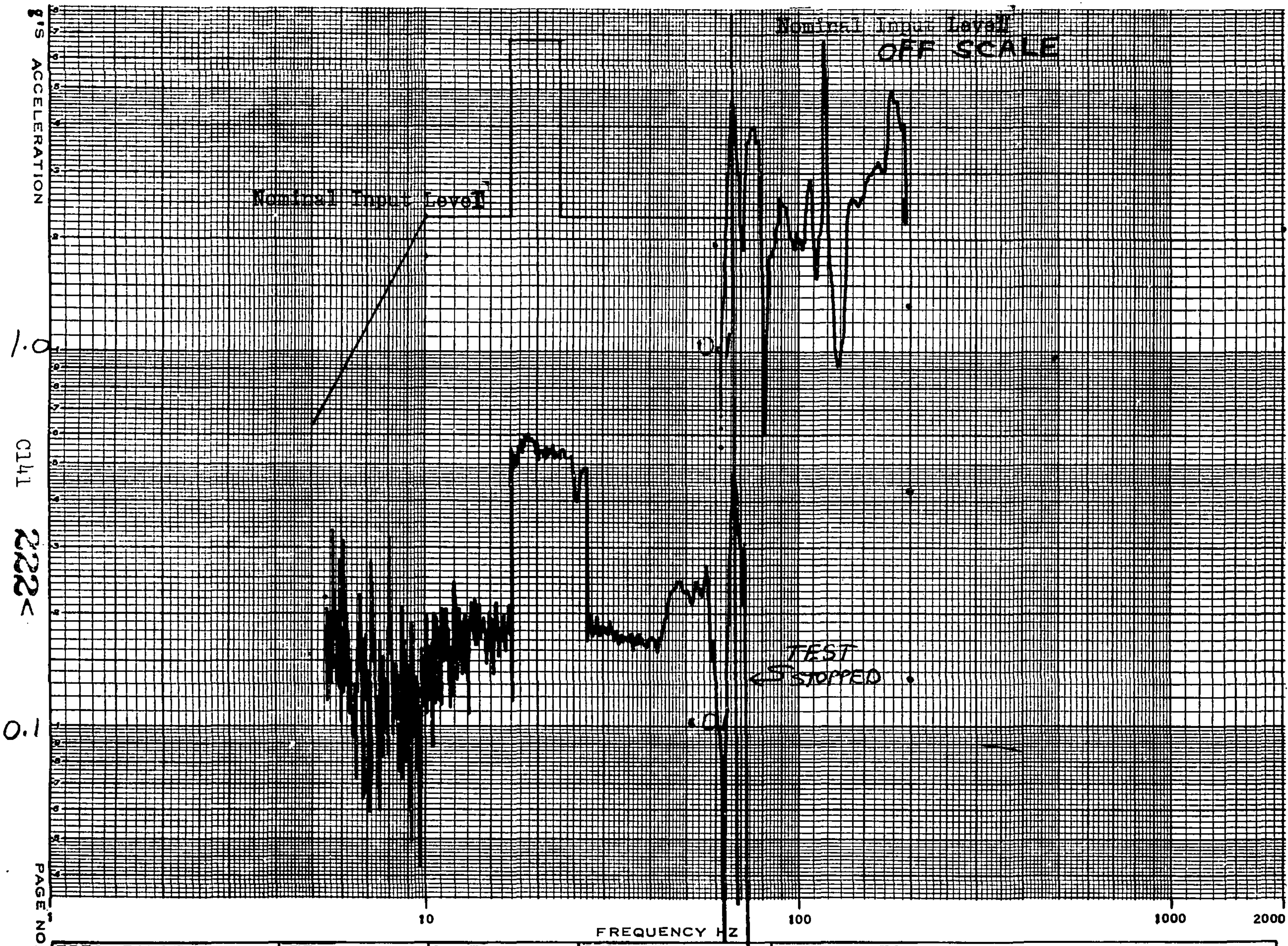
FREQ. RANGE & DIRECTION 5-200Hz	ITEM RAE-D VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL

C140

HSF 1633 A 2/69 **Standard**

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	JODOIN	JODOIN	57	16

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
MEHMED	GEIB	PAE-F	4-19-72	0930



INPUT LEVEL: ± 6.8 g
EXCIT. AXIS: Z
ACCEL S/N: TE83
SENSING AXIS: Y
ACCEL SENSITIVITY: 2.979 MV RMS / GP
— COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPEREEL NO.: 012296
SWEEP RATE: OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION: A1Y
HOOK-UP # 3
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
REPORT NO.

FREQ. RANGE & DIRECTION	ITEM	CODE SV	SERIAL NO.	TYPE OF TEST
5-200 HZ	PAE-D VCPS	748720-1	00001	QUAL

SPECIFICATION	PARA.	AMEND.	PHASE	NAME OF TEST
AT-VCPS	4.3.7.5	NOTE 1	VCPS AND SPACE CRAFT	SINUSOIDAL VIBRATION

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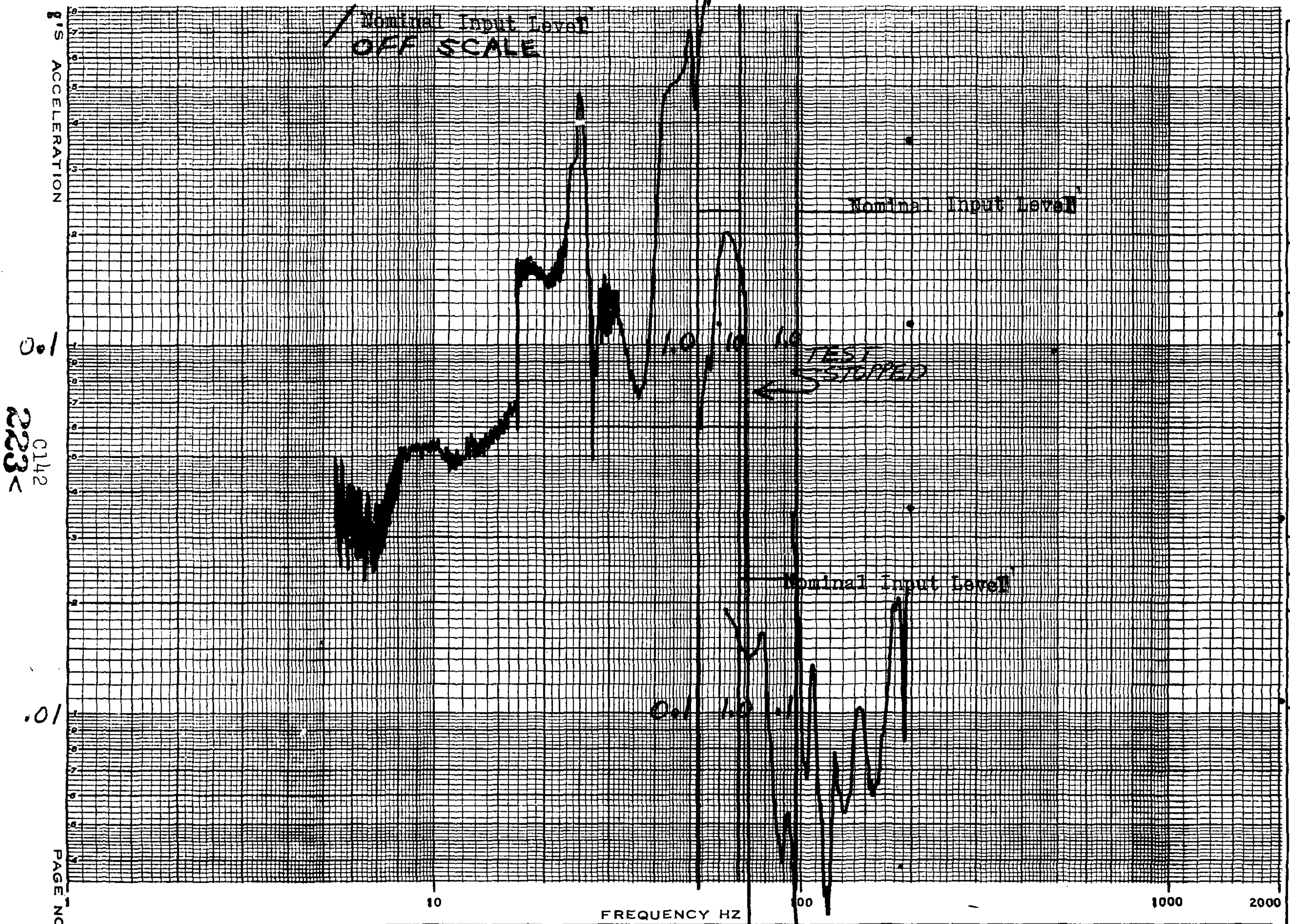
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODOIN
PLOTTED BY: JODOIN
TRACE NO.: 53
TEST NO.: 16
TEST ENGINEER: MEHMED
CHECKED BY: GEIB
PROJECT: PRE-L
DATE: 4-19-72
TIME: 0930



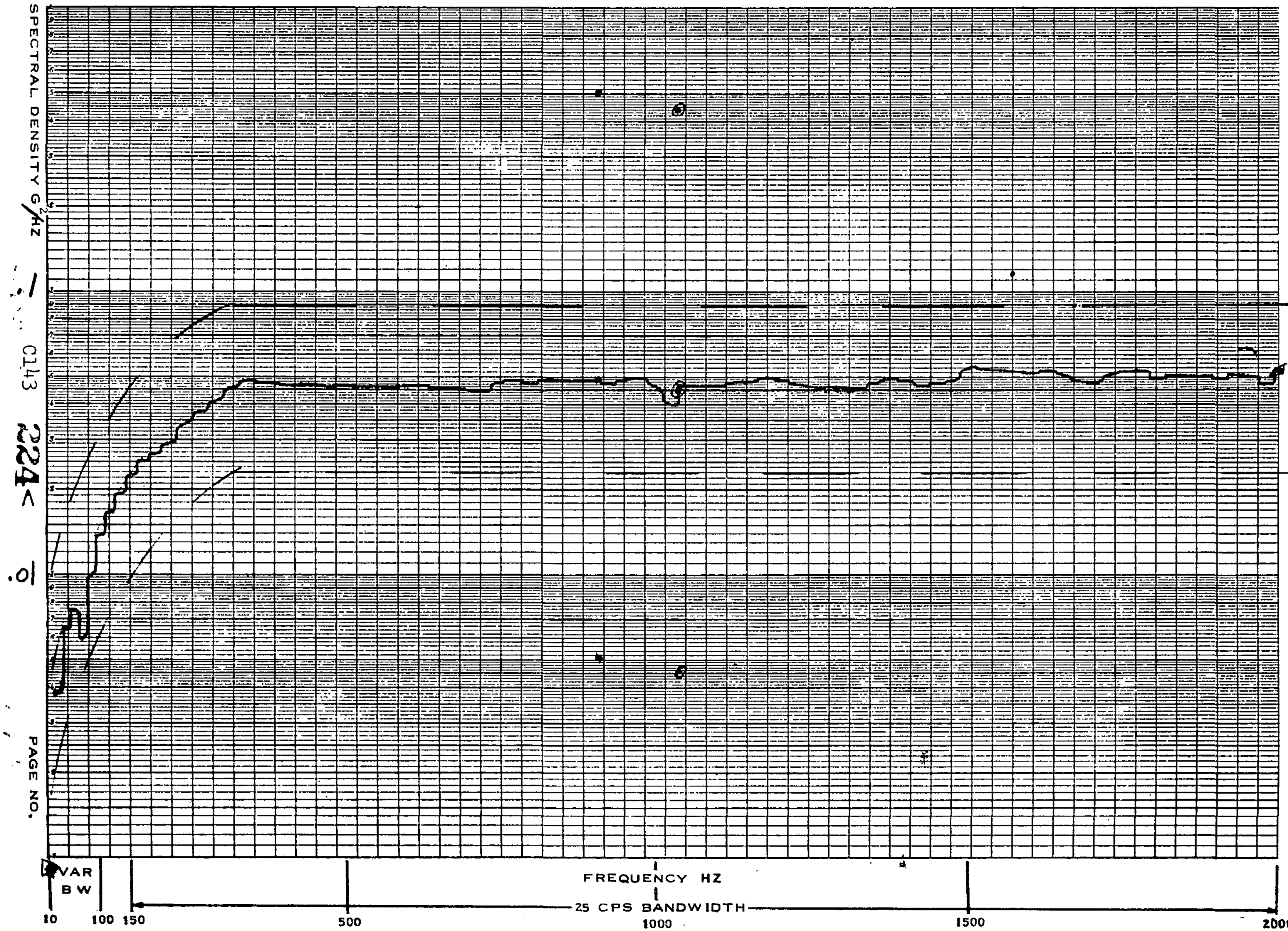
INPUT LEVEL: ± 6.8 g
EXCIT. AXIS: Z
ACCEL S/N: TD48
SENSING AXIS: Y
ACCEL SENSITIVITY: — MV RMS / GP
2.788 COL / GP
FILTER: 10/100 HZ B.W.
FILTER CROSSOVER: @ 70 HZ
TAPEREEL NO.: 012296
SWEEP RATE: OCT/MIN
COMPR. SPEED: VAR DB/SEC
CHG@ — HZ TO — DB/SEC
CHG@ — HZ TO — DB/SEC
NON-OPERATING
☐ CONTROL
☒ RESPONSE
TEMP. 74 °F
LOCATION: CY SPACECRAFT C.G. HOOK-UP # 3
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED
REPORT NO.
PAGE NO.

FREQ. RANGE & DIRECTION: 5-200Hz
ITEM: PRE-B VCPS
CODE: SV 748720-1
SERIAL NO.: 00001
TYPE OF TEST: QUAL

HSF-1634A **Standard** A®

ANALYSIS METHOD A

PLOTTED BY MICKET	CHECKED BY GE113	TEST ENGINEER MR. MEHMED	RIG NO. 26	WITNESS M C 4-1972	WITNESS
PROJECT RAE B	ITEM RAEB/VCPS	CODE SV 748720-1	SERIAL NO. 00001	TYPE OF TEST QUAL	
SPEC. AT-VCPS	PARA. 4.3.7 / PHASE RAND	ATA NO. —	ACTION SHEET NO. —	DATE 4/19/72	TEST NO. 17



C143

224<

EXCITATION ALONG Z AXIS

GRMS INPUT 9.2

NON-OPERATING

TEMP. 77 °F

PERIOD OF TEST ☒ START ☐ END

DURATION OF TEST 2.0 MIN.

ACCEL. SERIAL NO. NB62

ACCEL. SENSITIVITY — MV RMS / GP

2.698 COL / GP

ACCEL. SENSING Z AXIS

ACCEL. LOCATION A1z

TAPEREELNO. 012296

SPECIAL CONDITIONS
QUAL LEVEL
COMP. PKG.
ITEM PRESSURIZED.

REPORT NO.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

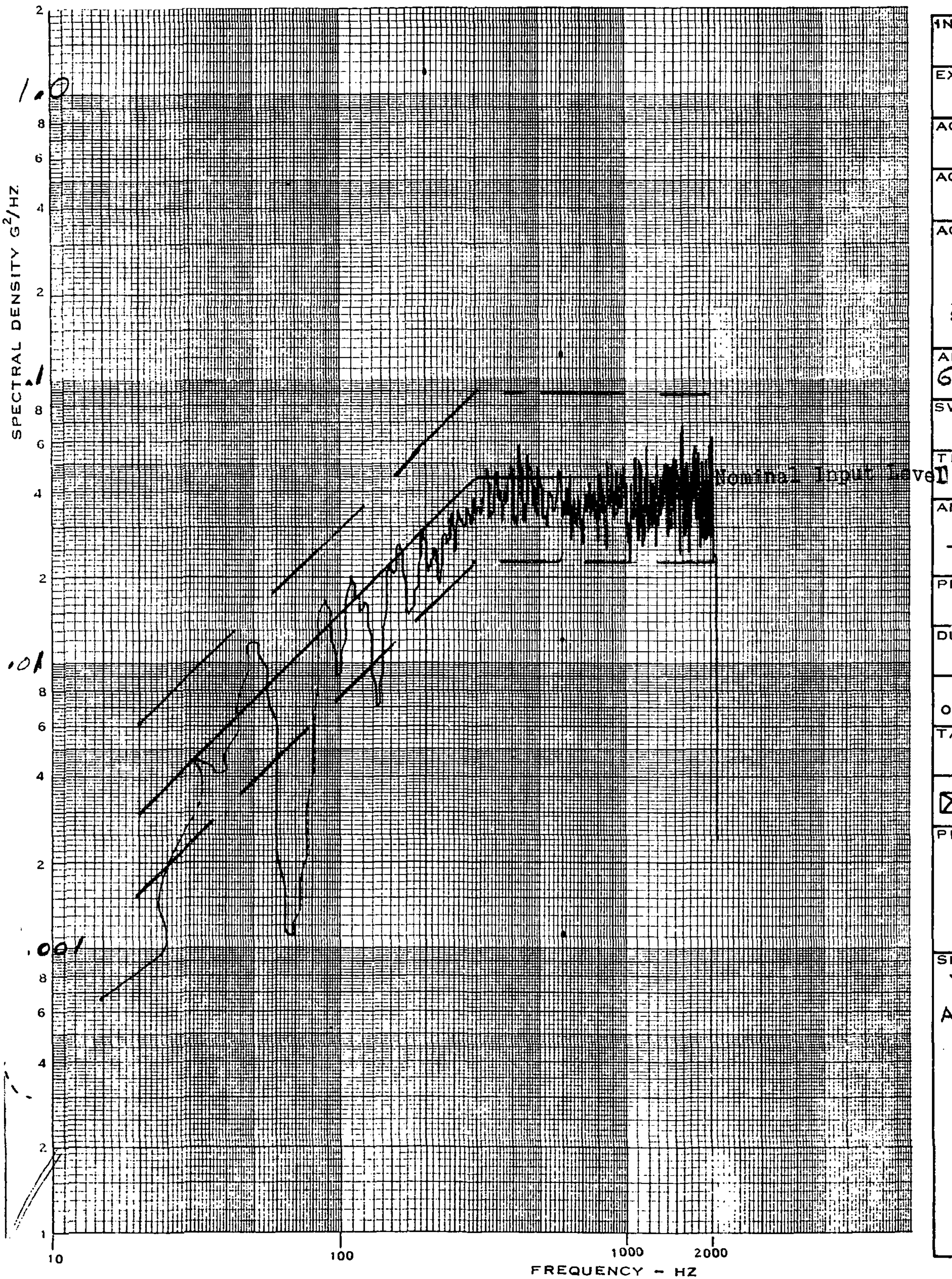
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	L. M	S. M.	24	17

TEST ENGINEER	CHECKED BY	DATE	TIME
S. M.	T. G.	4-19-72	1015



INPUT LEVEL 9.2 GRM

EXCITATION AXIS Z

ACCEL SERIAL NUMBER NB62

ACCEL SENSING AXIS Z

ACCEL SENSITIVITY
—— MV RMS / GP
2.698 COL / GP

ANAL FILTER - HZ B.W 6 | |

SWEEP SPEED - OCT/MI

TIME CONSTANT - SEC

ANNAL. CALIBRATION 12.14 g^2/HZ F.S.

PERIOD OF TEST ☒ START ☐ END

DURATION 2.0 MI

NON OPERATING

TEMP. 74 °

TAPE REEL NO. 012296

☒ CONTROL ☐ RESPONS

PICKUP LOCATION A1Z

Hook-up #3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.

PROJECT	ITEM	CODE SV	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	748720-1	00001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7	NOTE 1 & 4	VCPS AND SPACECRAFT	——	

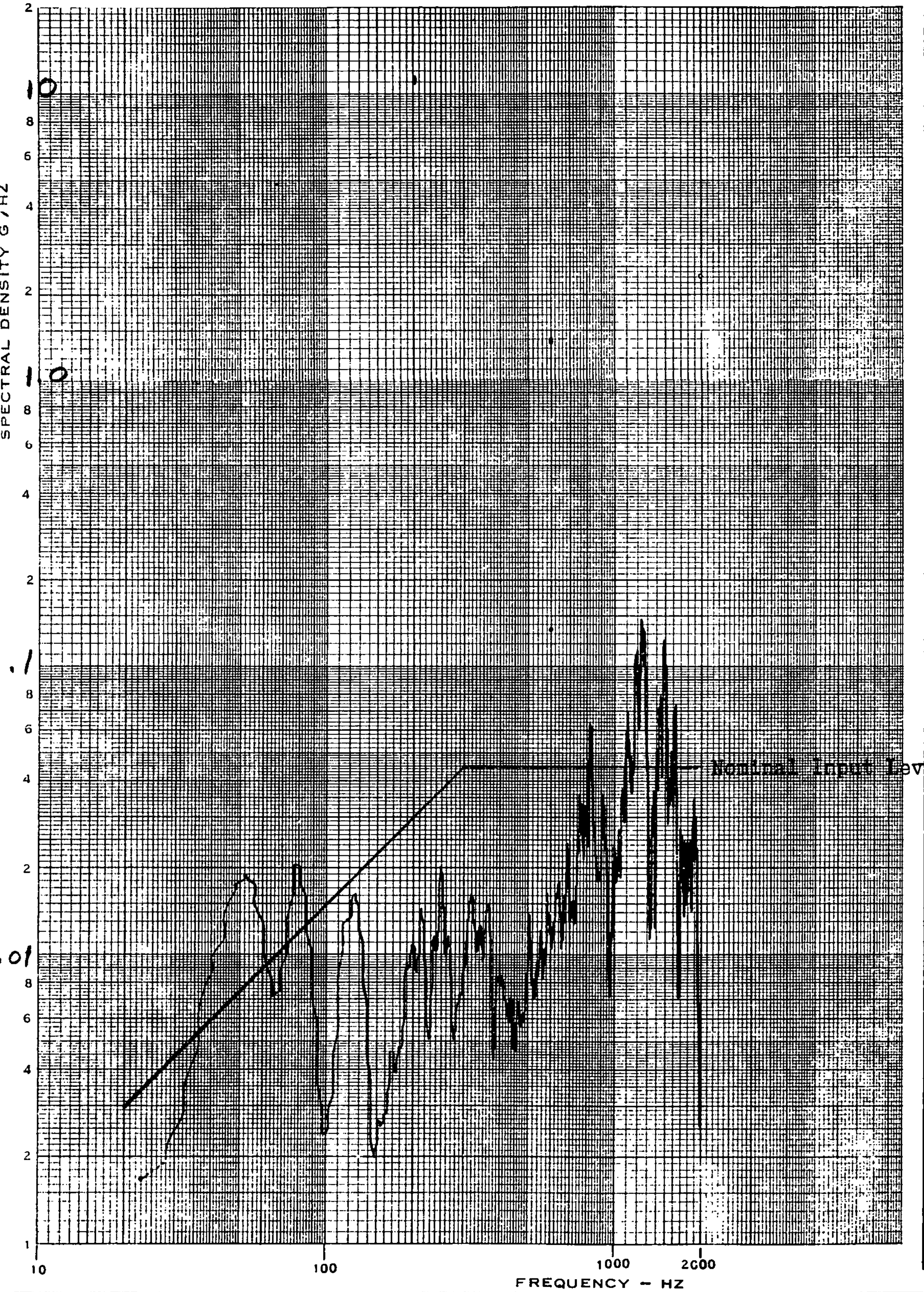
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26	OPERATOR B.M.	PLOTTED BY S.M	TRACE NO. 25	TEST NO. 17
TEST ENGINEER S.M.	CHECKED BY T.G.		DATE 4-19-72	TIME 1015



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS Z

ACCEL SERIAL NUMBER TG75

ACCEL SENSING AXIS Z

ACCEL SENSITIVITY — MV RMS / GP; 2.791 COL / GP

ANAL FILTER – HZ B.W. 6 — | — | —

SWEEP SPEED – OCT/MIN. — | — | —

TIME CONSTANT – SEC — | — | —

ANNAL. CALIBRATION 11.34 g^2/HZ F.S.

PERIOD OF TEST ☒ START ☐ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012296

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION B_z HUB Hook-up # 3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED.

PROJECT RAE-B	ITEM VCRS	CODE SV 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL
SPEC. AT-VCPS	PARA. 4.3.7	AMEND. NOTE 1 & 4	PHASE VCPS AND SPACECRAFT	RANDOM —

PAGE NO.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

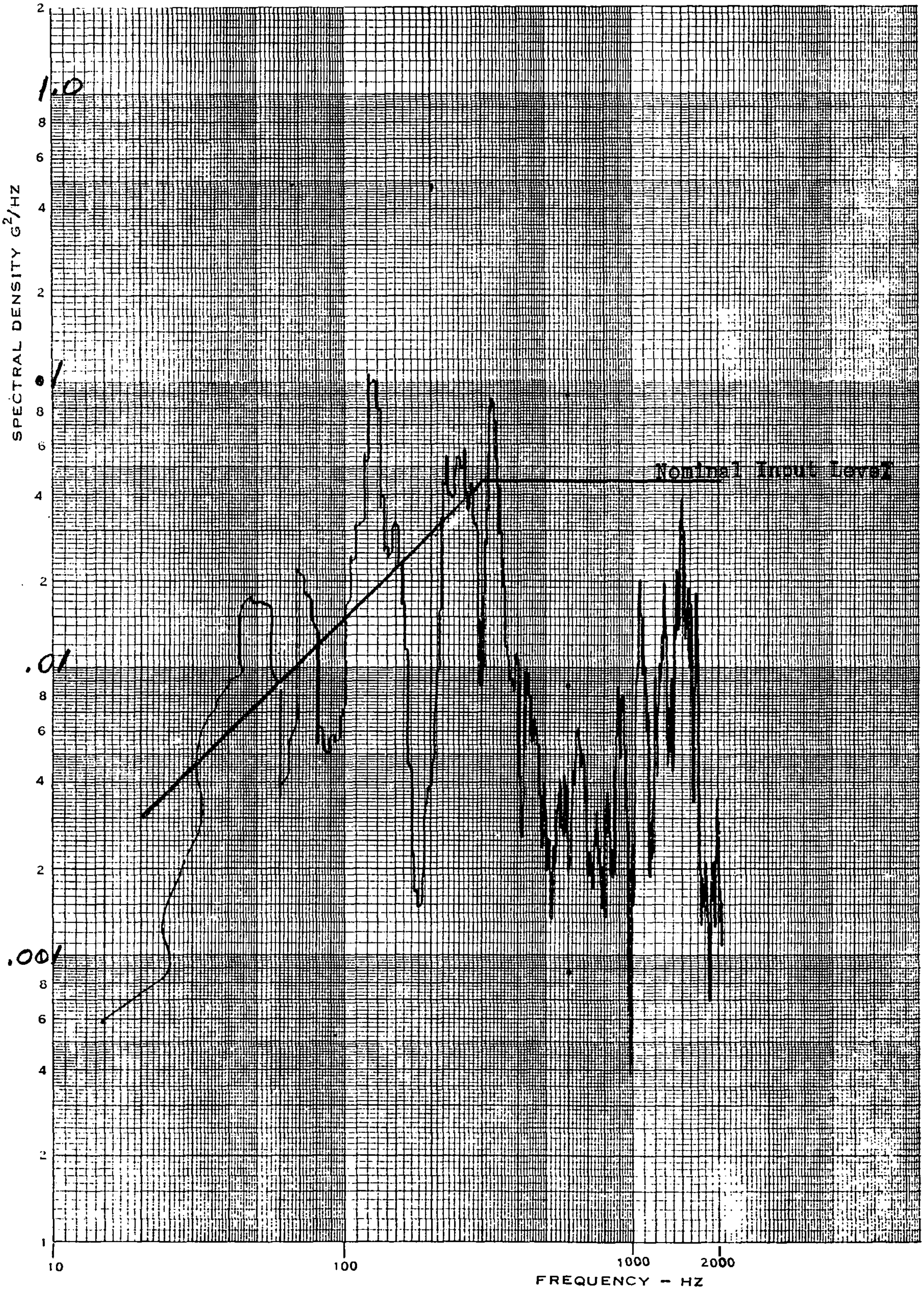
RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	B.M.	S.M	26	17

TEST ENGINEER	CHECKED BY	DATE	TIME
S.M	T.G.	4-19-72	1015



INPUT LEVEL: 9.2 GRM

EXCITATION AXIS: Z

ACCEL SERIAL NUMBER: XM21

ACCEL SENSING AXIS: Z

ACCEL SENSITIVITY: — MV RMS / GP; 1.370 COL / GP

ANAL FILTER - HZ B.W.: 6 | |

SWEEP SPEED - OCT/MI

TIME CONSTANT - SEC

ANNAL. CALIBRATION: 47.08 g^2/HZ F.S.

PERIOD OF TEST: ☒ START ☐ END

DURATION: 2.0 MIN

NON OPERATING

TEMP.: 74 °F

TAPE REEL NO.: 012296

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION:
Dz
REA MOUNT
HOOK-UP #3

SPECIAL CONDITIONS:
VCPS LOADED
AND PRESSURIZED

PROJECT	ITEM	CODE	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	SV 748720-1	00001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7	NOTE 1 & 4	VCPS AND SPACECRAFT	—	

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Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

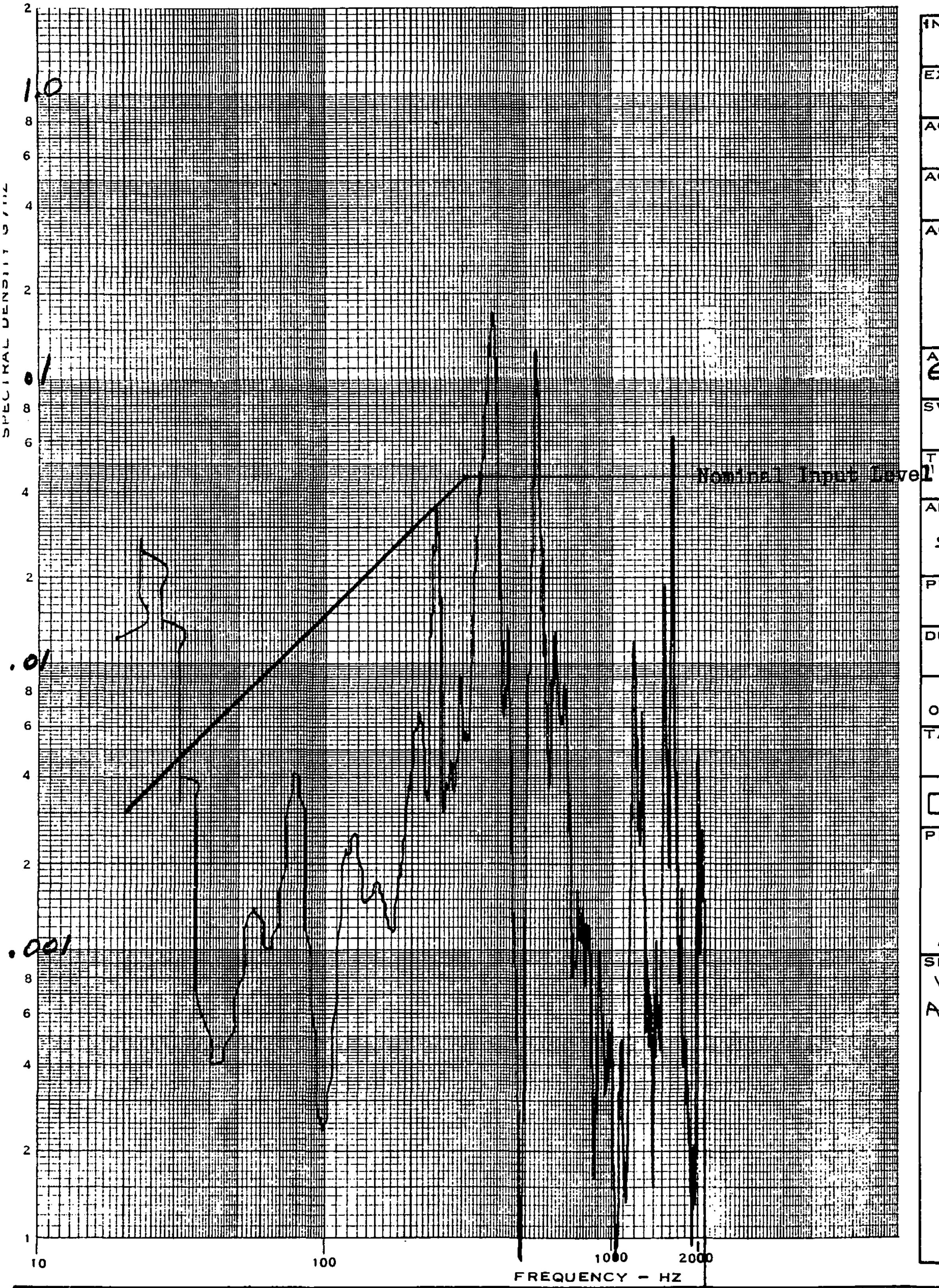
RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	B. M	S. M	27	17

TEST ENGINEER	CHECKED BY	DATE	TIME
S. M	T. G.	4-19-72	1015



INPUT LEVEL 9.2 GRMS

EXCITATION AXIS Z

ACCEL SERIAL NUMBER YK20

ACCEL SENSING AXIS Z

ACCEL SENSITIVITY MV RMS / GP; 1.596 COL / GP

ANAL FILTER - HZ B.W. 6

SWEEP SPEED - OCT/MIN

TIME CONSTANT - SEC

ANNAL. CALIBRATION 34.69 g^2/HZ F.S.

PERIOD OF TEST ☒ START ☐ END

DURATION 2.0 MIN

NON OPERATING

TEMP. 74 °F

TAPE REEL NO. 012296

☐ CONTROL ☒ RESPONSE

PICKUP LOCATION EZ
TANK MOUNT
HOOKUP #3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT	ITEM	CODE SV	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	748720-1	00001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7	NOTE 1, 4	VCPS AND SPACECRAFT	—	

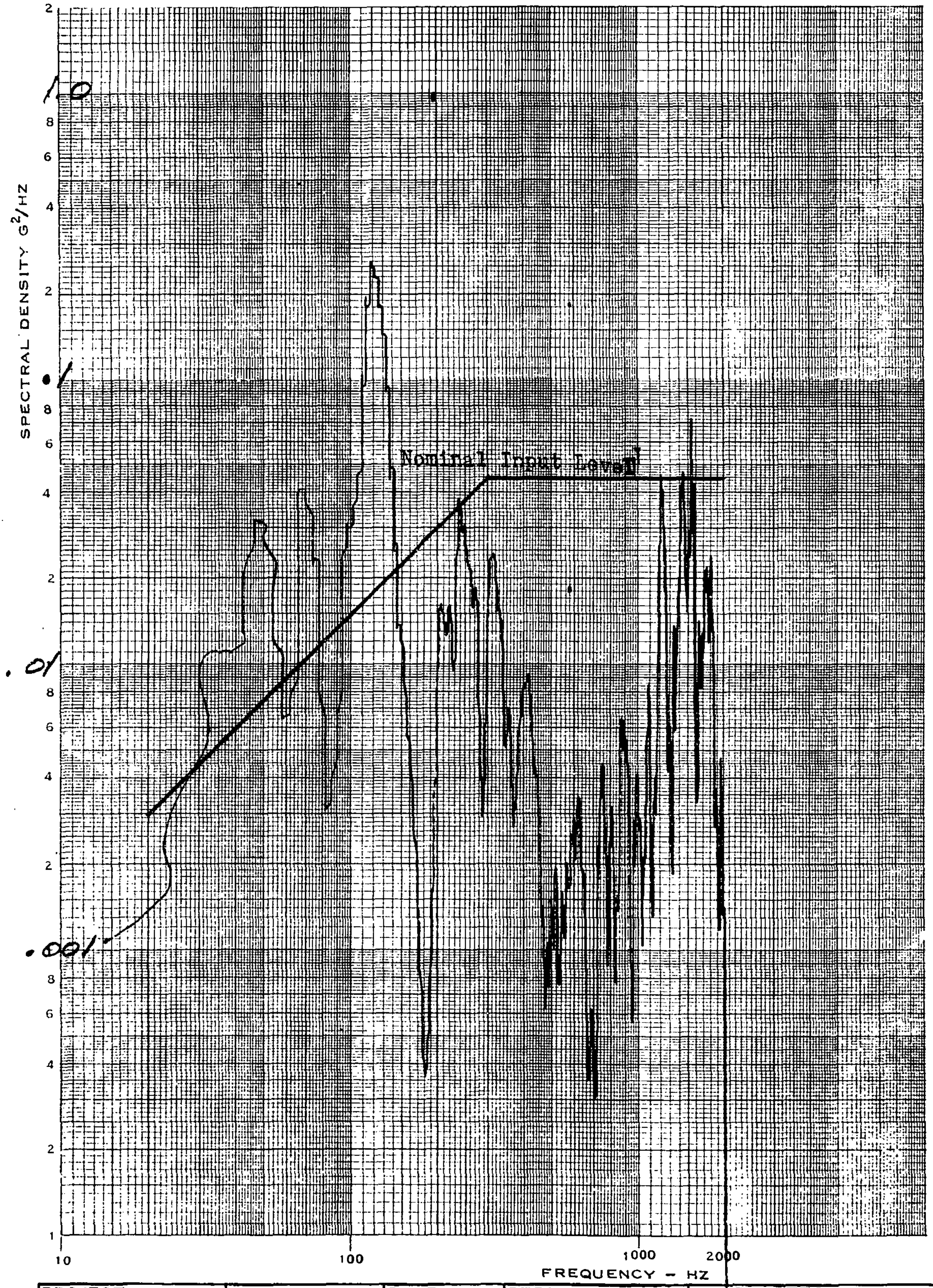
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG 26
OPERATOR MICKET
PLOTTED BY S.M.
TRACE NO. 32
TEST NO. 17
TEST ENGINEER S. M.
CHECKED BY T.G.
DATE 4-19-72
TIME 1015



INPUT LEVEL 9.2 GR
EXCITATION AXIS Z
ACCEL SERIAL NUMBE WF75
ACCEL SENSING AXIS Z
ACCEL SENSITIVITY 1.001 MV RMS
GP
— COL
GP
ANAL FILTER - HZ B.V 6
SWEEP SPEED - OCT/M
TIME CONSTANT - SEC
ANNAL. CALIBRATION 995.2 g^2/HZ F.S.
PERIOD OF TEST ☒ START ☐ END
DURATION 2.0 M
NON OPERATING
TEMP. 74
TAPE REEL NO. 012296
☐ CONTROL ☒ RESPON
PICKUP LOCATION FZ
LATCH VALVE MT
HOOK-UP #3
SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZE

PROJECT RAE-B
ITEM RAE-B
CODE SV 748720-1
SERIAL NUMBER 00001
TYPE OF TEST QUAL
SPEC. AT-VCPS
PARA. 4.3.7
AMEND. NOTE 1&4
PHASE AND VCPS SPACECRAFT
RANDOM —
PAGE NO.

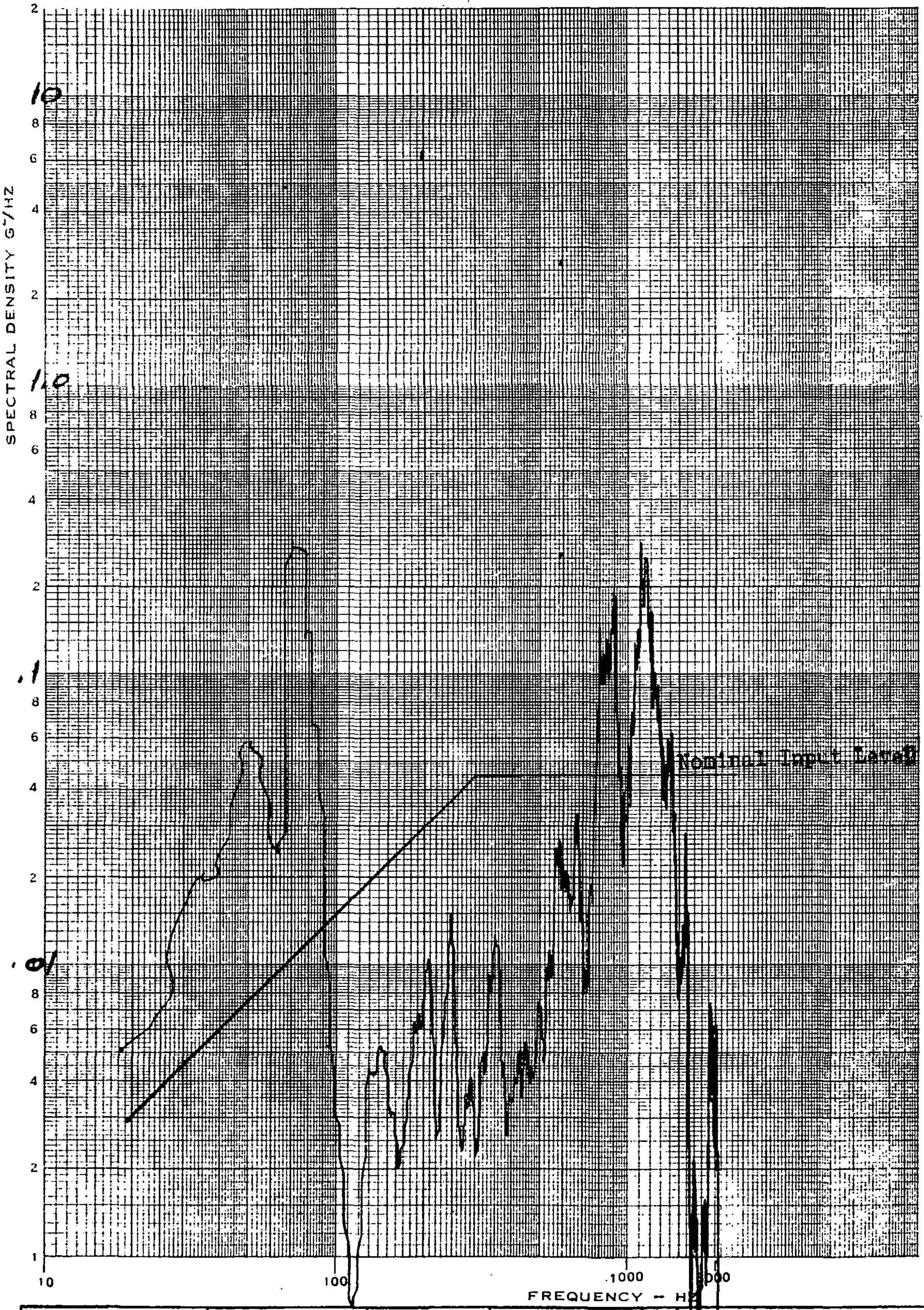
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG: 26
OPERATOR: B. M.
PLOTTED BY: S. M
TRACE NO.: 33
TEST NO.: 17
TEST ENGINEER: S. M
CHECKED BY: T. G
DATE: 4-19-72
TIME: 1015



INPUT LEVEL: 9.2 GRMS
EXCITATION AXIS: Z
ACCEL SERIAL NUMBER: XN32
ACCEL SENSING AXIS: Z
ACCEL SENSITIVITY: 1.261 MV RMS / GP; — COL / GP
ANAL FILTER – HZ B.W.: 6
SWEEP SPEED – OCT/MIN
TIME CONSTANT – SEC
ANNAL. CALIBRATION: 627.1 g^2/HZ F.S.
PERIOD OF TEST: ☒ START ☐ END
DURATION: 2.0 MIN
NON OPERATING
TEMP.: 74 °F
TAPE REEL NO.: 012296
☐ CONTROL ☒ RESPONSE
PICKUP LOCATION: GZ JUNCTION BOX MT HOOK-UP #3
SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED.

PROJECT: RAE-B
ITEM: VCPS
CODE S\I: 748720-1
SERIAL NUMBER: 00001
TYPE OF TEST: QUAL
SPEC.: AT-VCPS
PARA.: 4.3.7
AMEND.: NOTE 1 & 4
PHASE: VCPS AND SPACECRAFT
RANDOM: —
PAGE NO.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

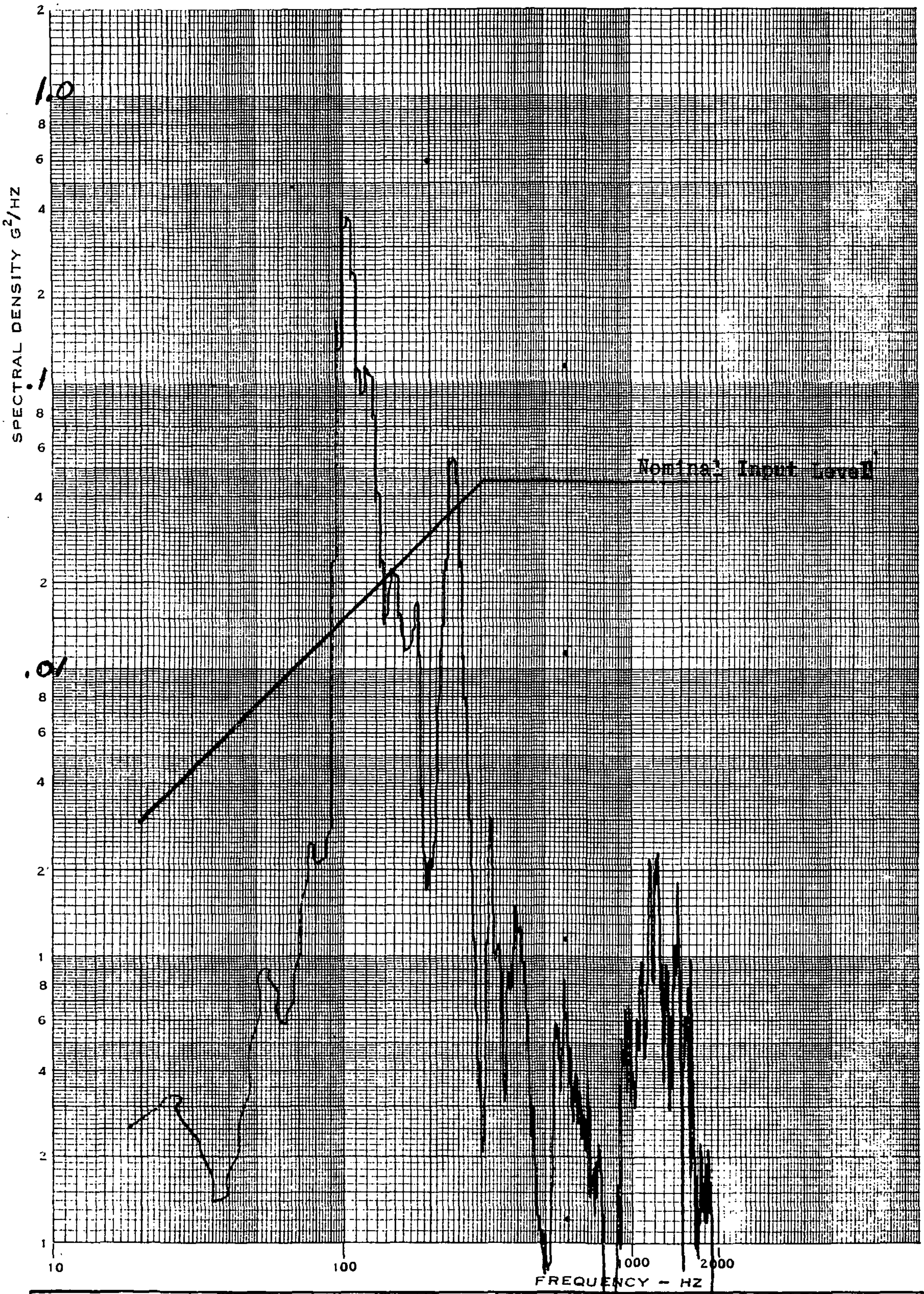
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	MICKET	S.M	34	17

TEST ENGINEER	CHECKED BY	DATE	TIME
S.M	T.G	4-19-72	1015



INPUT LEVEL 9.2 GRI

EXCITATION AXIS Z

ACCEL SERIAL NUMBEI XJ29

ACCEL SENSING AXIS Z

ACCEL SENSITIVITY 1.636 MV RMS / GP

— COL / GP

ANAL FILTER – HZ B.V 6

SWEEP SPEED – OCT/M

TIME CONSTANT – SEC

ANNAL. CALIBRATION 59.6 g²/HZ F.S.

PERIOD OF TEST ☒ START ☐ END

DURATION 2.0 M

NON OPERATING

TEMP. 74

TAPE REEL NO. 012296

☐ CONTROL ☒ RESPONS

PICKUP LOCATION HZ

PRESSURE TRANSDUC

HOOK-UP #3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT	ITEM	CODE SY	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	748720-1	0001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7	NOTE 1 & 4	VCPS AND SPACECRAFT	—	

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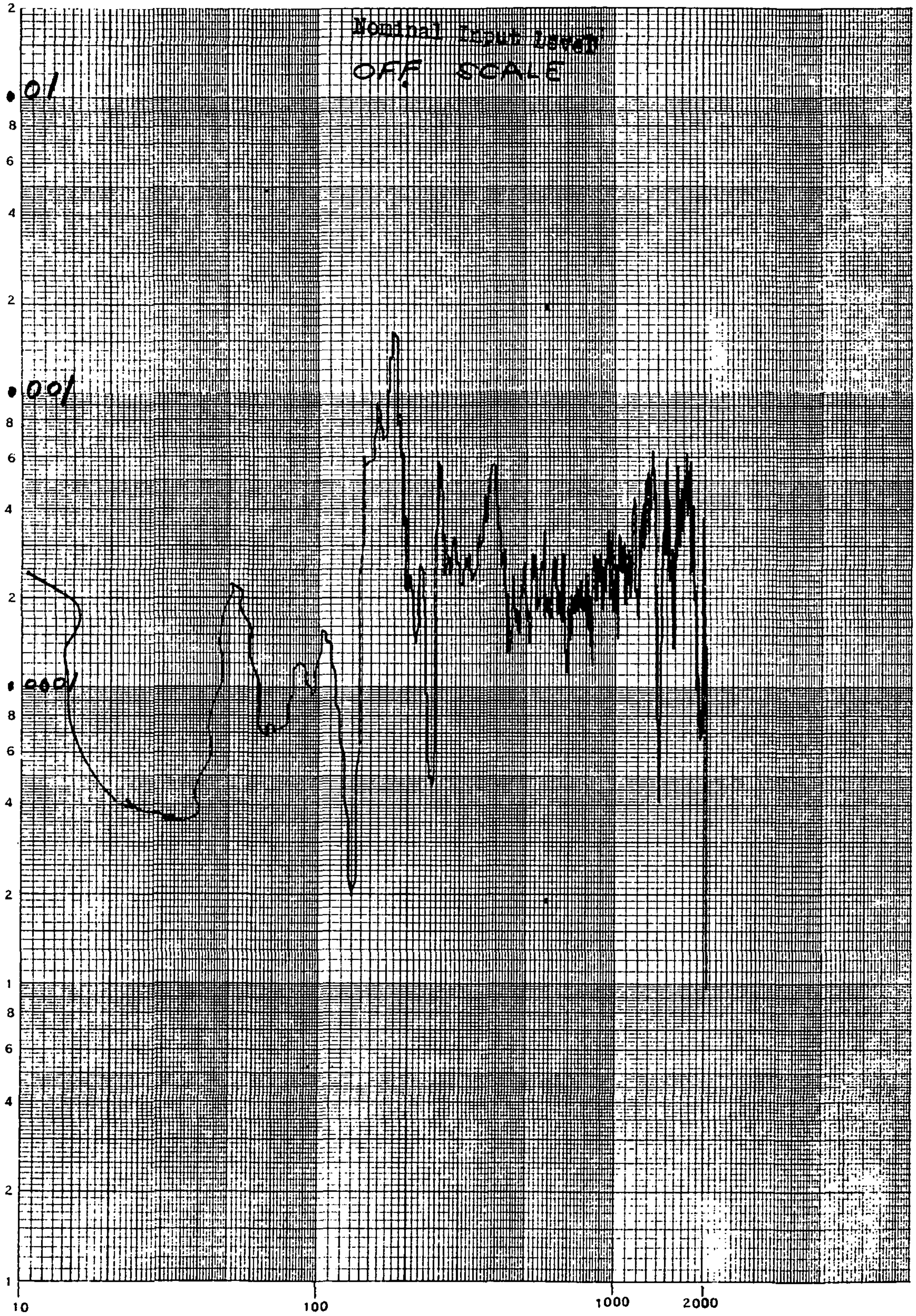
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG: 26
OPERATOR: MICKET
PLOTTED BY: S.M
TRACE NO.: 31
TEST NO.: 17
TEST ENGINEER: S.M.
CHECKED BY: T.G
DATE: 4-19-72
TIME: 1015



INPUT LEVEL: 9.2 GRMS
EXCITATION AXIS: Z
ACCEL SERIAL NUMBER: TE83
ACCEL SENSING AXIS: Y
ACCEL SENSITIVITY: 2.979 MV RMS / GP
— COL / GP
ANAL FILTER – HZ B.W.: 6 [redacted] | [redacted] | [redacted]
SWEEP SPEED – OCT/MIN: [redacted] | [redacted] | [redacted]
TIME CONSTANT – SEC: [redacted] | [redacted] | [redacted]
ANNAL. CALIBRATION: 112.3 g^2/HZ F.S.
PERIOD OF TEST: ☒ START ☐ END
DURATION: 2.0 MIN
NON OPERATING
TEMP.: 74 °F
TAPE REEL NO.: 012296
☐ CONTROL ☒ RESPONSE
PICKUP LOCATION: A1Y

HOOK-UP #3

SPECIAL CONDITIONS: VCPS LOADED AND PRESSURIZED

PROJECT: RAE-B
ITEM: VCPS
CODE SY: 748720-1
SERIAL NUMBER: 00001
TYPE OF TEST: QUAL
SPEC.: AT-VCPS
PARA.: 4.3.7
AMEND: NOTE 1&4
PHASE: VCPS AND SPACECRAFT
RANDOM: —
PAGE NO.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

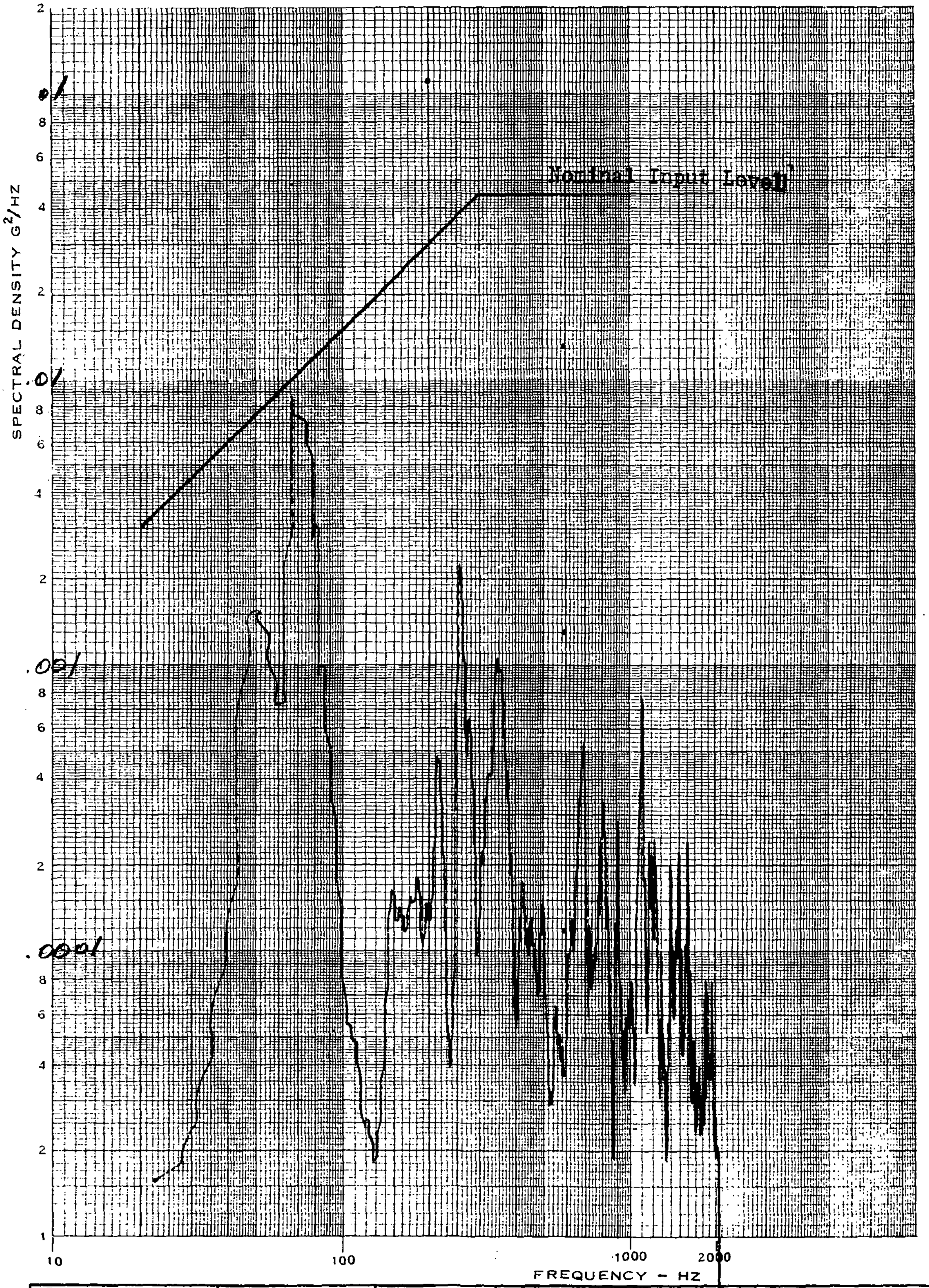
RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	B M	S. M	29	17

TEST ENGINEER	CHECKED BY	DATE	TIME
S. M	T. G	4-19-72	1015



INPUT LEVEL 9.2 GR

EXCITATION AXIS Z

ACCEL SERIAL NUMBE TD48

ACCEL SENSING AXIS Y

ACCEL SENSITIVITY — MV RMS / GP

2.788 COL / GP

ANAL FILTER - HZ B.V 6 — | — | —

SWEEP SPEED - OCT/M — | — | —

TIME CONSTANT - SEC — | — | —

ANNAL. CALIBRATION 11.37 g^2/HZ F.S.

PERIOD OF TEST ☒ START ☐ END

DURATION 2.0 MI

NON OPERATING

TEMP. 74

TAPE REEL NO. 012296

☐ CONTROL ☒ RESPONS

PICKUP LOCATION CY

SPACECRAFT C.G.

Hook-up #3

SPECIAL CONDITIONS VCPS LOADED AND PRESSURIZED

PROJECT	ITEM	CODE SV	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	748720-1	00001	QUAL

SPEC.	PARA.	AMEND.	PHASE	RANDOM	PAGE NO.
AT-VCPS	4.3.7	NOTE 1 5 4	VCPS AND SPACECRAFT	—	

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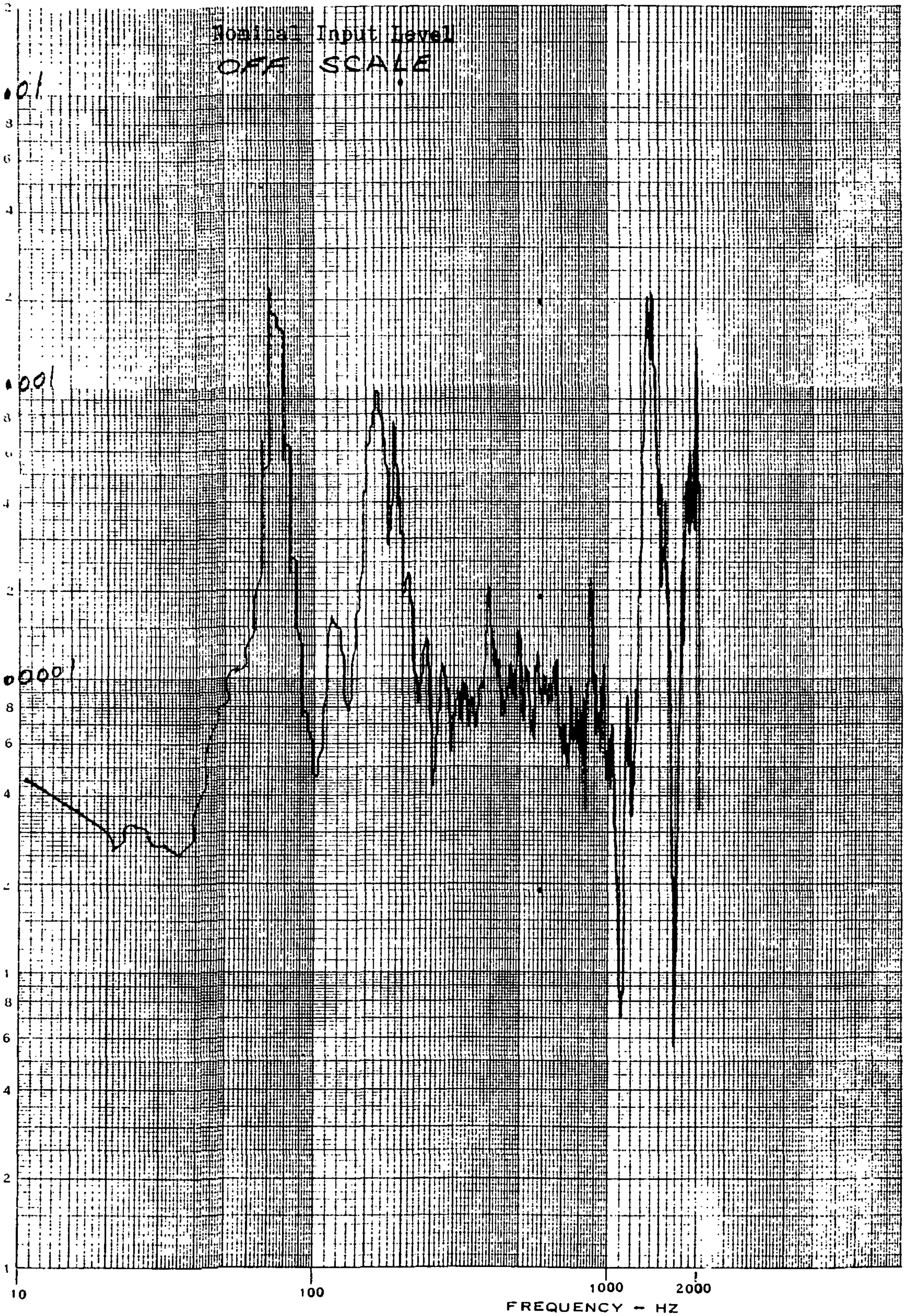
Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION UA®

RANDOM VIBRATION TEST ANALYSIS METHOD B

HSF-1635 B

REPORT NO.				
RIG 26	OPERATOR S. M	PLOTTED BY S. M	TRACE NO. 30	TEST NO. 17
TEST ENGINEER S. M	CHECKED BY T. G		DATE 4-19-72	TIME 1015



INPUT LEVEL	9.2 GRMS
EXCITATION AXIS	Z
ACCEL SERIAL NUMBER	TD40
ACCEL SENSING AXIS	X
ACCEL SENSITIVITY	3.005 MV RMS / GP — COL / GP
ANAL FILTER – HZ B.W.	6
SWEEP SPEED – OCT/MIN	
TIME CONSTANT – SEC	
ANNAL. CALIBRATION	110.4 g^2/HZ F.S.
PERIOD OF TEST	☒ START ☐ END
DURATION	2.0 MIN
NON OPERATING	TEMP. 74 °F
TAPE REEL NO.	012296
☐ CONTROL	☒ RESPONSE
PICKUP LOCATION	A1X' Hook-up #3
SPECIAL CONDITIONS	VCPS LOADED AND PRESSURIZED

PROJECT RAE-B	ITEM VCPS	CODE SV 748720-1	SERIAL NUMBER 00001	TYPE OF TEST QUAL	
SPEC. AT-VCPS	PARA. 4.3.7	AMEND. NOTE 1 & 4	PHASE VCPS AND SPACECRAFT	RANDOM —	PAGE NO.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

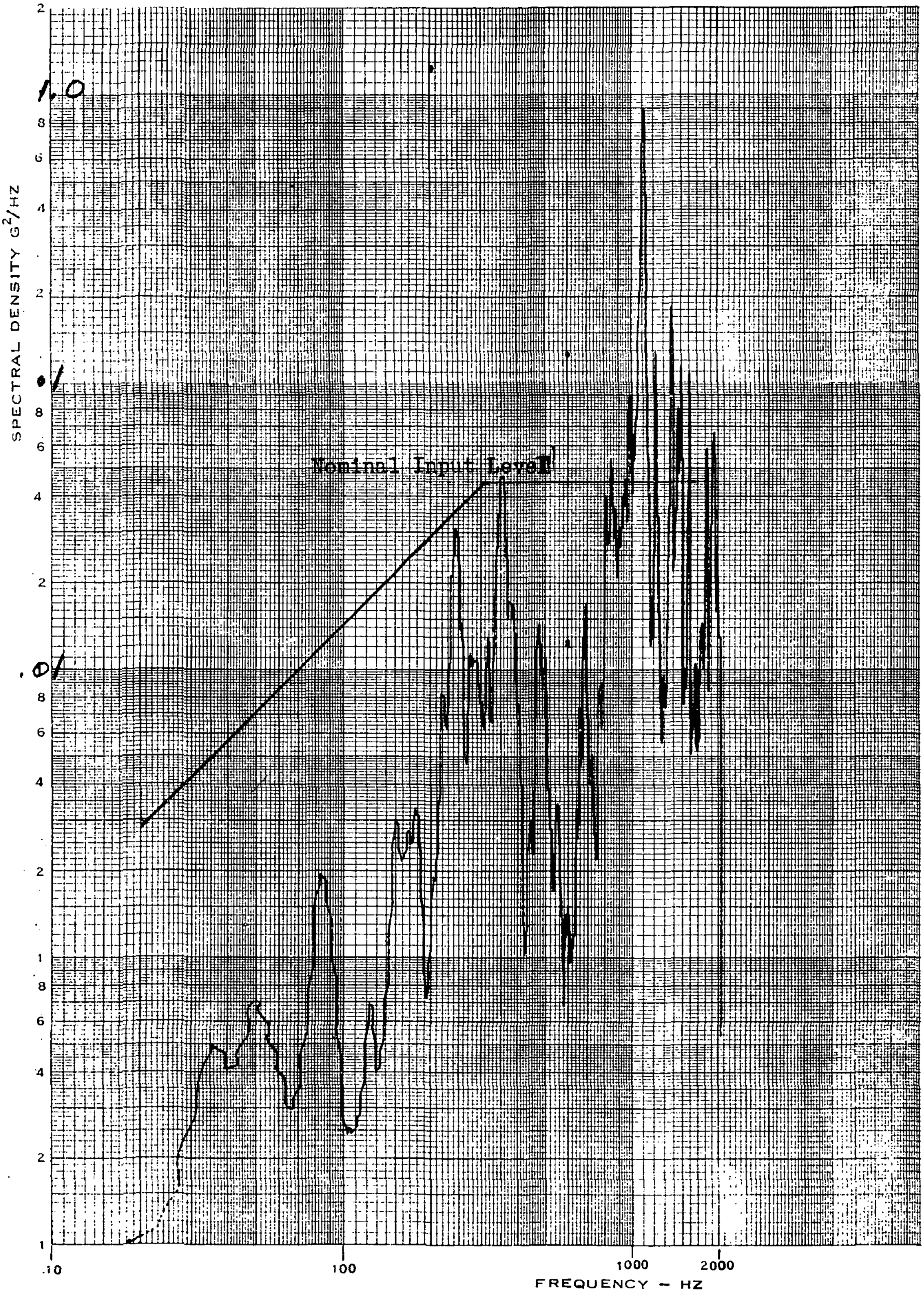
RANDOM VIBRATION TEST
ANALYSIS METHOD B

HSF-1635 B

REPORT NO.

RIG	OPERATOR	PLOTTED BY	TRACE NO.	TEST NO.
26	MICKET	S.M	28	17

TEST ENGINEER	CHECKED BY	DATE	TIME
S.M	T.G.	4-19-72	1015



INPUT LEVEL
9.2 GR

EXCITATION AXIS
Z

ACCEL SERIAL NUMBE
TD45

ACCEL SENSING AXIS

ACCEL SENSITIVITY
— MV RM
GP
2.650 COL
GP

ANAL FILTER – HZ B.
6 — | — | —

SWEEP SPEED – OCT/
— | — | —

TIME CONSTANT – SE
— | — | —

ANNAL. CALIBRATION
12.58 g²/HZ F.S

PERIOD OF TEST
☒ START ☐ END

DURATION
2.0

NON OPERATING
TEMP.
74

TAPE REEL NO.
012296

☐ CONTROL ☒ RESPON

PICKUP LOCATION
CX
SPACECRAFT C.G
Hook UP #3

SPECIAL CONDITIONS
VCPS LOADED
AND PRESSURIZE

PROJECT	ITEM	CODE SV	SERIAL NUMBER	TYPE OF TEST
RAE-B	VCPS	748720-1	00001	QUAL

SPEC.	PARA.	AMEND.	PHASE VCPS AND SPACECRAFT	RANDOM	PAGE NO.
AT-VCPS	4.3.7	NOTE 154		—	

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Section V

Logs

A) Operator Log

B) Instrumentation Master & Running Log

C) Data Reduction Log

HSF-175.1A 1/66

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION
WINDSOR LOCKS, CONNECTICUT 06096

SPACE & LIFE SYSTEMS LABORATORY

LOG OF TEST

TYPE OF TEST Vib. Acc. I. TesT

TEST ENGINEER S. Mehmed

NAME OF RIG # 26

PROJECT & ENG. ORDER NO. RAE-B

SHEET 1 OF 1 DATE '' -12-72

TEST PLAN NO. AT- VCPS

MODEL NO. RAE-B VCPS

PART NO. SVSK 79495

SERIAL NO. ——

OPERATORS P Jodoin

	Run #	Time Start		Axis	mode		G's Peak	Scan Rate oct/min.				
	3	1000		Z	Sine		1.0	4.0	Bare	Fixture		Scan
	4	1515		y	Sine		1.0	4.0	Bare	Fixture		Scan
	5	1540		y	Sine		1.0	4.0	Bare	Fixture		Scan
4-14	6	1010		x	Sine		1.0	4.0	"	"		"
	7	1120		x	Sine		1.0	4.0	"	"		"

REMARKS:

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HSF-175.1A 1/66

Hamiltc. . Standard DIVISION OF UNITED AIRCRAFT CORPORATION
WINDSOR LOCKS, CONNECTICUT 06096

UA

SPACE & LIFE SYSTEMS LABORATORY

LOG OF TEST

TYPE OF TEST Qual Vib. Test
TEST ENGINEER S. Mehmed Jr.
NAME OF RIG # 26
PROJECT & ENG. ORDER NO. A51-103-101A

SHEET 2 OF DATE 4-15-72
TEST PLAN NO. AT-VCPS
MODEL NO. VCPS, RAE-B
PART NO. SV 748720-1
SERIAL NO. 00001
OPERATORS P. Jodoin

	Run #	Time Start	Axis	mode	G's Peak	Scan Rate oct/min	P	G Rms	Time in min's	
	2	1410	x	Sine	1.0	4.0	4.3.7			
	3	1420	x	Sine	7.5	4.0	4.3.7			200-2000 HZ VCPS ONLY
	5	1545	y	Sine	7.5	4.0	4.3.7			200-2000 HZ VCPS ONLY
4-17	7	1145	y	Sine	3.0	4.0	4.3.7			5-200 HZ Complete PKG.
	9	1700	y	Rand	~~9.2~~	–	4.3.7	9.2	2.0	* ← Witnessed: 4-17-72
4/18	10	0650	X	RAND	–	–	4.3.7	9.2	2.0	* Hv #1
	11	0715	X	SINE	1.5	4.0	4.3.7	–	–	Hv #1
	13	1650	Z.	Sine	1.0	4.0	4.3.7			Hq-#3
	14	1705	Z	Sine	10.0	4.0	4.3.7.5			Hq #3 200-2K HZ VCPS ONLY
4-19	15	0905	Z	Sine	1.0	4.0				Hq #3 5-200 HZ. COMPLETE PKG
	16	0930	Z	Sine	6.8	4.0	4.3.7.5			Hq #3 5-200 HZ. Comp. PKG.
	17	1015	Z	RAND	–	–	4.3.7.5	9.2	2.0	Hv #3 COMP PKG

witnessed 4-19-72

REMARKS: * Random, Complete PKG.

3647

VIBRATION TEST LOG

MASTER PAGE NO 1775

PROJECT RAE-B **ITEM** VCPS **S/N** 0001/S07-48720-1 **CODE** **DATE** 4/19/72 **LOG PAGE NO.** 1999

TEST TITLE QUAL **ENGINEER** MR MEHMED **OPERATOR** JODOIN/MICKEY

REEL	RUN NO	TIME	TEST CODE	PREAMPLIFIER SETTINGS 1	2	3	4	5	6	7	8	9	10	11	12	VIB AXIS	INPUT LEVEL	SCAN RATE	COMP SPEED	CONTROL FILTER	TAPE SPEED	TAPE TIME	VISI-CORDER SPEED	RIG	REMARKS
0 1	16	0930	RUN	10	38	30	30	10/30 AT 72HZ	10/30	20	20	20	20	A	20	Z	6.8 GS PK	4.0	VAR.	10/100	15 IP	~~[illegible]~~ 4.0	.4/1PS	26	5/200HZ QUAL HV #3 COMP PKG + PRESSURIZED SHUT DOWN @ 92HZ + CONTINUED ON FROM 60HZ
2 2	17	1015	Run	30	30	30	30	30	30	50	50	50	50	C	20	Z	9.2 GRMS	-	>	>	S 'N	2.0	-	↓	Complete PKG ITem Press. Random QuaL Run. HV#3
9 6														C							'ER MED				
														O /											
														A										↓	

HSF 175.8

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VIBRATION TEST LOG

MASTER PAGE NO. 1775

PROJECT RAE-B **ITEM** VCPS **S/N** 00001 5V748720-1 **CODE** **DATE** 4/15/72 **LOG PAGE NO.** 1998

TEST TITLE QUAL **ENGINEER** MEHMED **OPERATOR** Jodoin/Mickat

	RUN NO	TIME	TEST CODE	PREAMPLIFIER SETTINGS 1	2	3	4	5	6	7	8	9	10	11	12	VIB. AXIS	INPUT LEVEL	SCAN RATE OCT/MIN	COMP SPEED	CONTROL FILTER	TAPE SPEED	TAPE TIME MIN	VISI-CORDER SPEED	RIG	REMARKS
0	4-15-72 1	0930	CAl	1000	1000	1000	1000	1000	1000	100	100	100	100		100	-	-	-	-	-	15	1.0	-	26	1.0 VPK CAL @ 200 HZ CH # 1 TO 6 HU#1 200MV RMS @ 200 HZ ch # 7 TO 12
1 2	2	1410	RUN	10	3	10	10	—	—	50	20	20	50	A	50	X	1G	4.0	VAR	10/100/200	I	1.0	-		ITEM/FIXTURE SCAN 200-2000HZ HOOK-UP#1 PRESSURE RECORDED ON SANDBORN. VCPS ONLY
2 9	3	1420	RUN	30	10	100	30*	—	—	100	50	50	100*	C	50	X	7.5G	4.0	VAR	10/100/200	P S	1.0	-		QUAL LEVEL * HIGH RESPONSE ON CHAN #4 & 10. 200-2000HZ VCPS ONLY
5	4	1500	CAL	1000	1000	1000	1000	1000	1000	—	—	—	—		—	—	—	—	—			1.0	-		1.0VPK CAL @ 200HZ FOR CHANNEL No 3 AND 4 HOOK-UP No 2
	5	1545	RUN	10	30	100	30	—	—	100	50	50	100	C O	50	Y	7.5G	4.0	VAR	10/100/200	INTER	1.0	-		HOOK-UP No 2 QUAL LEVEL 200-2000HZ VCPS ONLY
	4-17-72 6	0910	CAl	1000	1000	1000	1000	1000	1000	-	-	-	-	I	-	-	-	-	-	- OUT	MED	1.3	-		1.0 VOLT PK CAL @ 200 HZ HU#2 Ch # 1 TO 6 FOR ACCEL CHANNEL #6
	6A		RESONANCE RUN	10	10/3	30	30	10	~~10/3/10~~	30	20	20	50	A	50	Y	≈1.0G's TO ≈1.4G's	MANUAL	VAR.	10	BAND	4.5	-		RESONANCE SEARCH HU#2
	7	1145	RUN	10	10	30	30	10	10	50	20	20	50		50	Y	3.0	4.0	VAR.	10/100/200		2.0	-		5/200HZ QUAL LEVEL HU#2 CNTRL Ch#2 COMPLETE PKG. ITEM PRESSURIZED
	9	1700	Run	10	30	10	30	10	10	50/20*	50/20*	50/20*	50/20*		50/20*	Y	9.16 GRMS	-	-	-		3.0 ~~2.0~~	-		Complete Pkg, Item Pressurized Random Qual. Run Hu#2
	8A		Run	100	30	100	100	100	100	100	50	50	100		100		2.5 GRMS	—	—	—		11.0			Complete Pkg. Item Pressurized Equalizing Hu#2
	10	4-18-72 0650	RUN	30	30	30	30	10	10	50	50	50	50		50	X	9.16	—	—	-		2.0			COMPLETE PKG HU#1 ITEM PRESSURIZED. EQUALIZATION TIME NOT NOTED.
	11	4-18-72 0715	RUN	10	10	30	30	10	10	50	20	20	50		50	X	1.5	4.0	VAR	10/100/200		1.0			COMPLETE PKG ITEM PRESSURIZED HU #1 QUAL SINE
[illegible]	12	1015	CAl	1000	1000	1000	1000	1000	1000	100	100	100	100		100	FOR Z	1.0V PK 1-6 200mVRMS-7-12	-	OUT	OUT		2.0	-		1.0VPK @ 200 HZ Ch # 1 TO 6 HU# 3 200 MV RMS @ 200 HZ Ch # 7 to 12
	~~13~~		~~CAl~~	~~-~~	~~—~~	~~—~~	~~—~~	~~—~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	VOID		N/R	" ~~200mvRMS ch#12~~	-	-	OUT					~~200 mV RMS @ 200 HZ FOR ACCEL~~ ~~CHANGE ON Ch#12 HU#3~~
	13	1650	RUN	3	3/10	3/10	3/10	-	-	50	50	50	50		50	Z	1.0g's PK	4.0	VAR	10/100/200		1.0	0.2"/SEC		VCPS ONLY H.U.#3 PRESSURIZED
	14	1705	RUN	30	100	100	100	~~10~~	—	50	50	50	50		50	Z	10. g's PK	4.0	VAR	10/100/200		1.0	0.4"/SEC		VCPS ONLY H.U.#3 PRESSURIZED
	4/19/72 15	0905	Run	10	10	10	10	10	10	20	20	20	20		20	Z	1.0 G PK	4.0	VAR.	10/100		2.0	.4"/SEC		
			NEXT	SHEET #1998																				26	5/200 HZ ITEM/FIXTURE SCAN HU#3 COMP PKG, ITEM PRESSURIZED

0 1 2 2 9 5

* CHANGED ATTEN TO 20 @ 1 MIN.

* " " @ 300 HZ

VIBRATION TEST LOG

MASTER PAGE NO 1774

PROJECT RAE-B **ITEM** VCPS **S/N** **CODE** **DATE** 4-13-72 **LOG PAGE NO.** 1997

TEST TITLE AccepTance TesT **ENGINEER** S. Mehmed **OPERATOR** P. Jodoin

SEL NO	RUN NO	TIME	TEST CODE	PREAMPLIFIER SETTINGS												VIB AXIS	INPUT LEVEL	SCAN RATE	COMP SPEED	CONTROL FILTER	TAPE		VISI-CORDER SPEED	RIG	REMARKS
				1	2	3	4	5	6	7	8	9	10	11	12						SPEED	TIME / mins			
0	1	1535	CaL	1000	1000	1000	1000	1000	1000					A		-	-	-	-	-	15	1.5	-	H 26	Hu #1 1 VOLT PK. CaL @ 200 HZ
1 2	2	0930	CaL	-	-	-	-	-	-	100				c		-	-	-	-	-	i Ps	1.0	-		200 M.V. CaL @ 200 HZ
2	3	1000	RUN	3	3	3	10	10	10	10				C		Z	1G	4 oct/MIN	VAR	10/100/200	1	2.1	.4"/SEC		S-2000Hz BARE FIXTURE SCAN HOOK-UP #1
9 4	4	1515	RUN	3	3	3	3	3	3	20	-	-	-	o L		Y	1.G	4 oct/MIN	VAR.	10/100/200	n T	2.1	.4"/SEC		5/2k BARE FIXTURE SCAN HU #2 Ch #3 CNTRL, Loc # A1Y
	5	1540	RUN	3	3	3	3	3	3	20				d		Y	1.6G	4 oct/min	VAR.	10/100/200	e R	2.1	.4"/SEC.		5/2K BAREFIXTURE SCAN HU #2 Ch #3 CNTRL Loc # A1Y (* EXCEPT Ch #6 NON-PRIMARY)
4-14-72	6	1010	RUN	3	3	3	3 OVRID	3	3	20 OVRID						X	1 G PK	4 oct/min	VAR.	10/100/200	m e d	2.1	.4"/SEC		5/2k BARE FIXTURE SCAN HU #3 Ch #2 CNTRL Loc * A1X
	7	1120	RUN	3	3	3	10	3	3	50						.X	1. G PK	4 oct/min	VAR.	10/100/200	i	2.1	.4"/SEC		5/2k BAREFIXTURE SCAN HU #3 ch #2 CNTRL Loc # A1X'
																					a T e				
																					B a n d				

HSF 175.0

C160

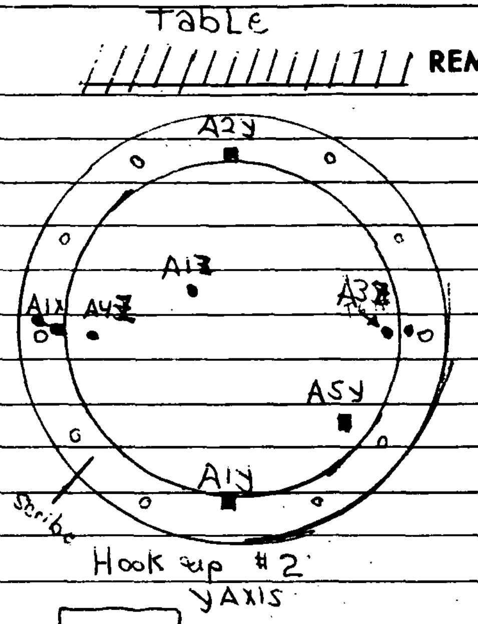
DATE 4-13-72 **MASTER VIBRATION LOG** **MASTER PAGE NO** 774

PROJECT RAE-B **ITEM** VCPS **S/N** **CODE** **WPI** AS2-102-124A **RIG** 26 **LOG PAGE NO.** 1997

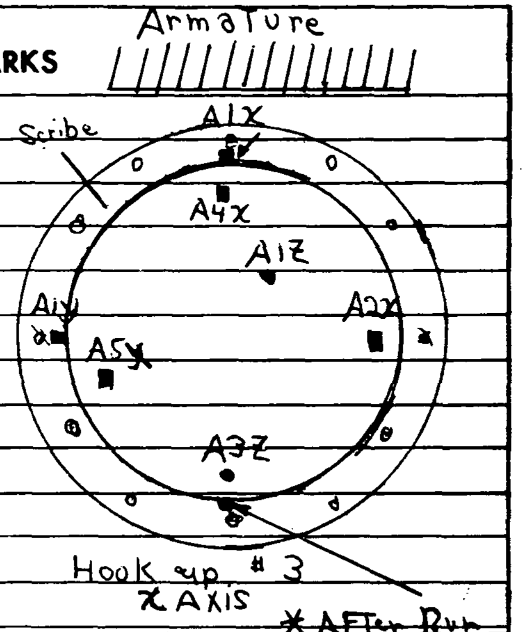
TEST TITLE ACCEPTANCE TEST **ENGINEER** S Mehmed **OPERATOR** P. Vadein

CH. NO.	MEASUREMENT VARIABLE	UD/EF	LOC.	TRANSDUCER TYPE	S/N	EXCITE VOLTS	SENS	FULL SCALE EQUIVALENT	VISICORDER TRACE	G/INCH	JUNCTION UNIT ATTn SIGNAL CONDITIONER	S/N	RECORD AMP TYPE	S/N	PREAMP TYPE	S/N	LP. FILTER
1	Accel	Cd 1	A1z	2226	NB62	CHARGE	2.698		1	10	10	1					
2	"	Cd 2	A1x	2226	TD40		2.805		2	10	10	2					
3	"	Cd 3	A1y	2226	TE83		2.722		3	10	10	3					
4	"	Cd 4	A2z	2226	TD44		2.773		4	10	10	4					
5	"	Cd 5	A3z	2226	TG75		2.791		5	10	10	5					
6	"	Cd 6	A4z	2226	WR11		2.956	Hu #1	6	10	10	6					
7	"	EF 7	A5z	2215	VG57	VOLTAGE	10.886						TP-A	59	TC-A	20	OUT
8																	
9																	
10																	
11	Ac Cold																
12																	
1	Accel	Cd 1	A1z	2226	NB62		2.698		1	10	ATTn.						
2	"	Cd 2	A1x	2226	TD40		2.805		2	10	10						
3	"	Cd 3	A1y	2226	TE83		2.722		3	10	10						
4	"	Cd 4	A2y	2226	TD44		2.773		4	10	10						
5	"	Cd 5	A3z	2226	TG75		2.791		5	10	10						
6	"	Cd 6	A4z	2226	WR11		2.956	Changed To y Axis Run #5	6	10	10						
7	Accel	EF 7	A5y	2215	VG57	VOLTS	10.886	Hu #2									
8																	
9																	
10																	
11	Ac Cold																
12																	
1	Accel	Cd 1	A1z	2226	NB62		2.698		1	10	10 ATTn.						
2	"	Cd 2	A1~~y~~x*	2226	TD40		9.805	CHANGED TO A1X'	2	10	10						
3	"	Cd 3	A1y	2226	TE83		2.722		3	10	10						
4	"	Cd 4	A2x	2226	TD44		2.773		4	10	10						
5	"	Cd 5	A3z	2226	TG75		2.791		5	10	10						
6	"	Cd 6	A4x	2226	WR11		2.956	Hu #3	6	10	10						
7	Accel	EF 7	A5x	2226	VG57	VOLTS	10.886										
8																	
9																	
10																	
11	Ac. Cold																
12																	

REMARKS



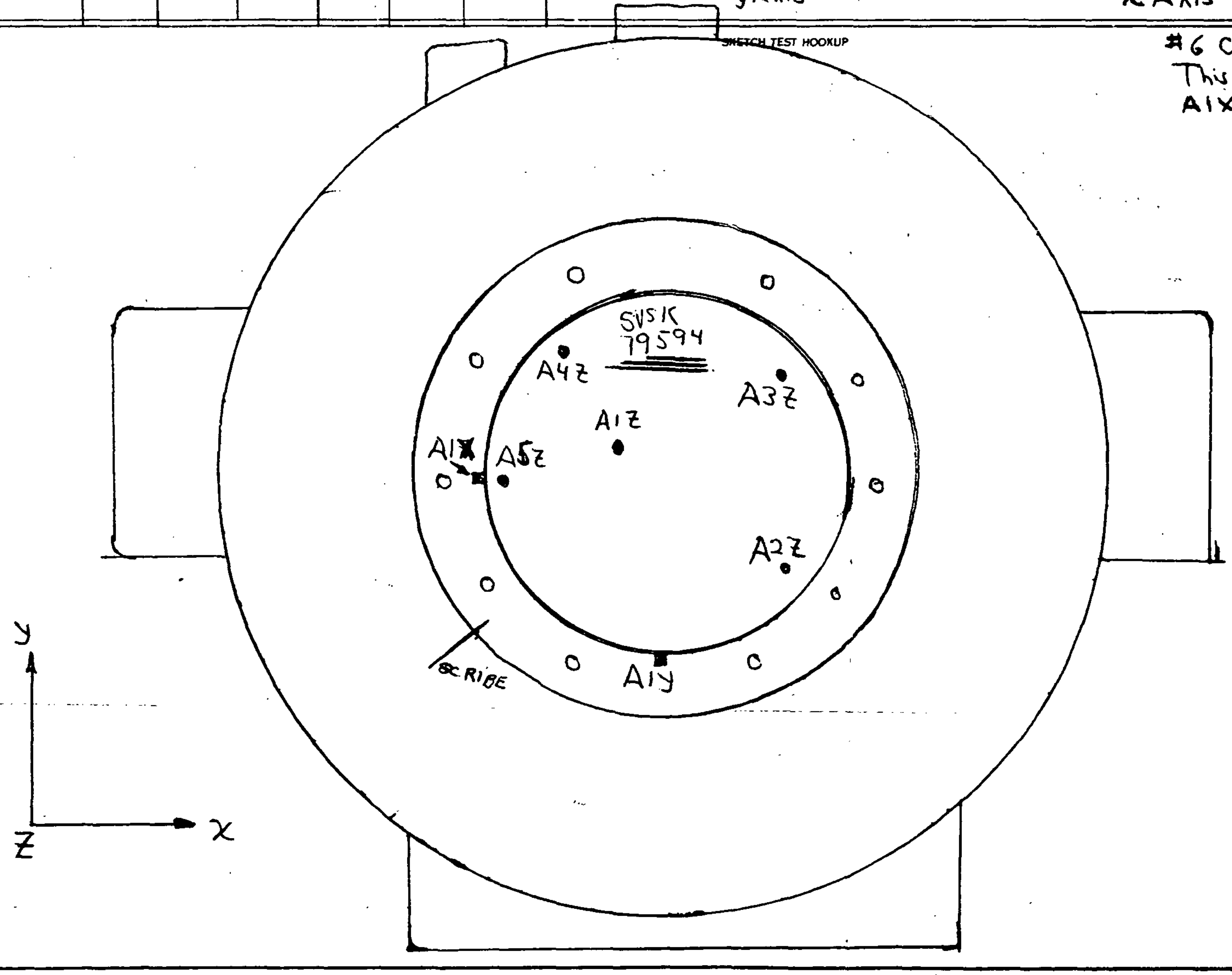
Hook up #2
y AXIS



Hook up # 3
x AXIS

*AFTer Run #6 Chansed A1X To This Location, called A1X'

SKETCH TEST HOOKUP



NSF 175.7

DATE 4/15/72

MASTER VIBRATION LOG

MASTER PAGE NO 1775

PROJECT RAE-B ITEM VCPS S/N 00001 SV748720 I CODE WPI A51-103-101A RIG 26 LOG PAGE NO. 1998

TEST TITLE QUAL ENGINEER MR. MEHMED OPERATOR JODOIN/MICKET

CH. NO.	MEASUREMENT			TRANSDUCER					FULL SCALE EQUIVALENT CAL ATT	VISICORDER		JUNCTION UNIT		RECORD AMP		PREAMP		L.P. FILTER	REMARKS
	VARIABLE	UD/EF	LOC.	TYPE	S/N	SENS VOLTS	CHARGE SENS			TRACE	G/INCH	SIGNAL CONDITIONER	S/N	TYPE	S/N	TYPE	S/N	FILTER	
1	ACCEL	CA1	A1X'	2226	TD40	-	2.805		10	1	10								
2	"	CA2	A1Y	2226	TE83	-	2.722		10	2	10								
3	"	CA3	DX	2222	XM21	-	1.370		10	3	10								
4	"	CA4	EX	2222	WF75	-	1.031		10	4	10								
5	"	CA5	CX	2226	TD45	-	2.650		10	5	10								
6	"	CA6	CY**	2226	TG74	-	2.798	HU #1	10	6	10	** CHANGE TO TD48, SENS 2.788 Pc/Gpk							
7	"	EF7	A1Z	2226	NB62	3.052	-												
8	"	EF8	DY	2222	YK20	1.523	-												
9	"	EF9	EY	2222	XN32	1.261	-												
10	ACCEL	EF10	BX	2226	TD44	3.035	-		50	7	10.0								
11	AC COLA			AC	COLA		-			AC COLA									
12	ACCEL	EF11	BY	2226	WR11	3.016	-												
1	ACCEL	CA1	A1X'	2226	TD40		2.805		10	1	10								
2	"	CA2	A1Y	2226	TE83		2.722		10	2	10								
3	"	CA3	DY	2222	YK20		1.596		10	3	10								
	"	CA4	EY	2222	XN32		1.297		10	4	10								
	"	CA5	CX	2226	TD45		2.650	HU	10	5	10								
6*	"	CA6	CY	2226	TG75		2.791	#2	10	6	10								
7	"	EF7	A1Z	2226	NB62	3.052													
8	"	EF8	DX	2222	XM21	1.325													
9	"	EF9	EX	2222	WF75	1.001													
10	ACCEL	EF10	BX	2226	TD44	3.035													
11	AC COLA			AC	COLA														
12	ACCEL	EF11	BY	2226	WR11	3.016			20	7	10.0								
1	ACCEL	CA1	A1Z	2226	NB62	-	2.698		10	1	10								
2	ACCEL	CA2	BZ	2226	TG75	-	2.791		10	2	10								
3	ACCEL	CA3	DZ	2222	XM21	-	1.370		10	3	10								
4	ACCEL	CA4	EZ	2222	YK20	-	1.596		10	4	10								
5	ACCEL	CA5	CX	2226	TD45	-	2.650	HU	10	5	10								
6	ACCEL	CA6	CY	2226	TD48	-	2.788	#3	10	6	10								
7	ACCEL	EF7	A1X'	2226	TD40	3.005	-		-	-	.								
8	ACCEL	EF8	A1Y	2226	TE83	2.979	-		-	-	.								
9	ACCEL	EF9	FZ	2222	WF75	1.001	-		10	7	10								
10	ACCEL	EF10	GZ	2222	XN32	1.261	-		10	8	10								
11	AC COLA.																		
12	ACCEL	~~EF13~~ *	HZ	2222	XJ29	1.636	-		~~10~~	~~9~~	~~10~~	CHANGED TO RN81 STARTING w/RUN# 13 * VOLT SENS .388							
		EF12							20	9	100	} RN81 VISI CAL. DATA. Loc HZ							

SKETCH TEST HOOKUP

REFERENCE PHOTO'S

(*) CHANGED TO TD48
CHARGE SENS = 2.788 Pc/Gpk
~~[illegible]~~ STARTING WITH
RUN 6

HSF 1757

SINUSOIDAL DATA REDUCTION LOG

MASTER PAGE NO. 1774 PROJECT RAE-B QUAL TEST DATE 4-13-72 D.R. DATE 4-13-72

TAPE REEL NO 01997 ITEM FIXTURE 5VSK79594 SERIAL NO. ____________ W.P.I. A52-102-124A

CAL VOLTAGE 200 MVrms OR 1000 MVpk (AT 200 Hz)

TAPE REEL
012294

CALCULATION

$$\text{CALpt} = \frac{\text{RUN}}{\text{CAL}} \times \frac{\text{CAL VOLTAGE}}{\text{ACCEL SENS}} \qquad \frac{\text{MVrms}}{\text{MVrms/Gpk}} \qquad \text{OR} \qquad \frac{\text{MVpk}}{\frac{\text{Coul}}{\text{Gpk}}}$$

-72 TRACE	RUN	CHAN	S/N ACCEL	SENS ACCEL	RUN/CAL ATT	(RUN/CAL) × VOLT / (ACCEL SENS)	CAL/RUN LOG ATT	CAL/RUN RANGE ATT	CAL PT	F.S. ✓
A1Z 1	3	1	NB62	2.698	3/1000	3/2.698	20/20	1/1	1.12	1
41X 2		2	TD40	2.805	3/1000	3/2.805	20/20	1/.1	1.07	.1
11Y 3		3	TE83	2.722	3/1000	3/2.722	20/20	1/.1	1.10	.1
2Z 4		4	TD44	2.773	10/1000	10/2.773	20/20	1/1	3.6	1
3Z 5		5	TG75	2.791	10/1000	10/2.791	20/20	1/1	3.45	1
4Z 6		6	WR11	2.956	10/1000	10/2.956	20/20	1/1	3.4	1
5Z 7	↓	7	VG57	10.886	10/100	$\frac{10/100 \times 200}{10.886}$	20/20	10/10	1.85	1
-72										
1Z 8	5	1			3/1000		20/20	10/1	1.12	.1
1X 9		2			3/1000		20/20	10/1	1.07	.1
1Y 10		3			3/1000		20/20	10/10	1.10	1
2Y 11		4			3/1000	3/2.773	20/20	10/10	1.08	1
3Z 12		5			3/1000	3/2.791	20/20	10/1	1.07	.1
4Y 13		6			3/1000	3/2.956	20/20	10/10	1.02	1
5Y 14	↓	7	↓	↓	20/100	$\frac{20/100 \times 200}{10.886}$	20/20	10/10	3.68	1
Z 15	7	1			3/1000		20/20	10/1	1.12	.1
X' 16		2			3/1000		20/20	10/10	1.07	1.
'Y 17		3			3/1000		20/20	10/1	1.10	.1
X 18		4			10/1000		20/20	10/10	3.6	1
Z 19		5			3/1000		20/20	10/1	1.07	.1
X 20		6			3/1000		20/20	10/10	1.07	1.
X 21	↓	7	↓	↓	50/100	$\frac{50/100 \times 200}{10.886}$	20/20	10/1	9.25	1

RANDOM DATA REDUCTION LOG

MASTER PAGE NO. 1775 PROJECT RAE-P TEST DATE 4-11-72 D.R. DATE

TAPE REEL NO. 012295 & 012296 ITEM VCPS SERIAL NO. 00001 W.P.I.

CAL VOLTAGE 200 MVrms OR 1000MVpk (AT 200Hz) DEG. OF FREE. 128

CALCULATION CONST. 3989 $\frac{MV^2 rms (Grms)^2}{HZ (Gpk)^2}$ OR $9.82(10)^4$ $\frac{MV^2 pk \ (Grms)^2}{HZ \ (Gpk)2}$ Based on E.BW=6.

CALCULATION CONST. ~~1595.6~~ OR ~~5.928 (10)^4 Based on E.BW=16~~

012295 HU #2 CAL RUN No 1

HU #1 CAL No 1

TRACE	RUN	CHAN	S/N ACCEL	SENS. ACCEL	RUN/CAL ATT.	$\frac{(RUN/CAL)^2}{(ACCEL\ SENS)^2}$	CAL/RUN INPUT ATT.	CAL/RUN OUTPUT ATT.	CAL PT
9 DX	9	8	YK20	1.523	20 / 100	$\frac{4\times10^{-2}}{(1.523)^2}$	20 ③ / 10 ②	0 / 10	68.78
10 EX		9	XN32	1.261	20 / 100	$\frac{4\times10^{-2}}{(1.261)^2}$	20 ③ / 10	0 / 20	100.3
11 BX		10	TD44	3.035	20 / 100	$\frac{4\times10^{-2}}{(3.035)^2}$	20 ③ / 20	0 / 20	17.32
12 BY		12	WR11	3.016	20 / 100	$\frac{4\times10^{-2}}{(3.016)^2}$	20 ③ / 30	0 / 20	17.54
							④	⓪	
A1X 13	10	1	TD40	2.805	30 / 1000	$\frac{9\times10^{-4}}{(2.805)^2}$	20 ⓪ / 30 ⓪	0 / 20	11.23
14 A1Y		2	TE83	2.722	30 / 1000	$\frac{9\times10^{-4}}{(2.722)^2}$	10 ⑧ / 10 ⑧	0 / 20	11.92
DX 15 ✓		3	XM21	1.370	30 / 1000	$\frac{9\times10^{-4}}{(1.37)^2}$	20 ⑤ / 20 ⑤	0 / 20	47.08
EX 16 ✓		4	WF75	1.051	30 / 1000	$\frac{9\times10^{-4}}{(1.051)^2}$	20 ⑥ / 10	0 / 10	80.01
CX 17 ✓		5	TD45	2.650	10 / 1000	$\frac{1\times10^{-4}}{(2.650)^2}$	10 ⑧ / 20	0 / 20	1.398
CY 18 ✓		6	TD48	2.788	10 / 1000	$\frac{1\times10^{-4}}{(2.788)^2}$	10 ⑦ / 10	0 / 20	1.263
A1Z 19 ✓		7	NB62	3.052	50 / 100	$\frac{.25}{(3.052)^2}$	20 ⑥ / 10	0 / 20	107.06
DY 20 ✓		8	YK20	1.523	50 / 100	$\frac{.25}{(1.523)^2}$	30 ② / 0	0 / 10	429.9
EY 21 ✓		9	XN32	1.261	50 / 100	$\frac{.25}{(1.261)^2}$	20 ② / 0	0 / 10	627.1
BX 22 ✓		10	TD44	3.035	50 / 100	$\frac{.25}{(3.035)^2}$	20 ② / 10	0 / 10	108.26
BY 23		12	WR11	3.016	50 / 100	$\frac{.25}{(3.016)^2}$ N/0	20 ② DATA -	0 ACCEL FELL OFF	109.63

April 24th

RANDOM DATA REDUCTION LOG

MASTER PAGE NO. 1775 PROJECT RAE-B TEST DATE 4-18-72 D.R. DATE

TAPE REEL NO. 012296 ITEM VCPS SERIAL NO. 00001 W.P.I.

CAL VOLTAGE 200 MVrms OR 1000MVpk (AT 200Hz) DEG. OF FREE. 128

CALCULATION CONST. 3989 $\frac{MV^2 rms (Grms)^2}{HZ (Gpk)^2}$ OR $9.82(10)^4$ $\frac{MV^2 pk\ (Grms)^2}{HZ\ (Gpk)^2}$ Based on E.BW=6.4

CALCULATION CONST. ~~1595.6~~ OR ~~$3.928\ (10)^4$~~ ~~Based on E.BW=16~~

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w12

TRACE	RUN	CHAN	S/N ACCEL	SENS. ACCEL	RUN/CAL ATT.	$\frac{(RUN/CAL)^2}{(ACCEL\ SENS)^2}$	CAL/RUN INPUT ATT.	CAL/RUN OUTPUT ATT.	CAL PT	F.S.
24	17	1	NB62	2.698	30 / 1000	$\frac{9\times10^{-4}}{(2.698)^2}$	10 ⑨ / 20	0 / 20	12.14	1.0
25	✓	2	TG75	2.791	30 / 1000	$\frac{9\times10^{-4}}{(2.791)^2}$	10 ⑧ / 20	0 / 10	11.34	10
26	✓	3	XM21	1.370	30 / 1000	$\frac{9\times10^{-4}}{(1.370)^2}$	20 ⑤ / 20	0 / 20	47.08	100 1.0
27	✓	4	YK20	1.596	30 / 1000	$\frac{9\times10^{-4}}{(1.596)^2}$	20 ② / 20	0 / 20	34.69	100 1.0
28		5	TD45	2.650	30 / 1000	$\frac{9\times10^{-4}}{(2.650)^2}$	10 ⑧ / 10 ⑧	0 / 20	12.58	1.0
29		6	TD48	2.788	30 / 1000	$\frac{9\times10^{-4}}{(2.788)^2}$	10 ⑧ / 0	0 / 10	11.37	.1
30		7	TD40	3.005	50 / 100	$\frac{.25}{(3.005)^2}$	20 ⑥ / 0	0 / 20	110.4	100 .01
31 ✓		8	TE83	2.979	50 / 100	$\frac{.25}{(2.979)^2}$	20 ⑥ / 0	0 / 20	112.3	100 .01
✓ 32 [illegible]		9	WF75	1.001	50 / 100	$\frac{.25}{(1.001)^2}$	20 ⑥ / 10	0 / 20	995.2	1000 1.0
✓ 33 [illegible]		10	XN32	1.261	50 / 100	$\frac{.25}{(1.261)^2}$	20 ② / 10	0 / 10	627.1	1000 10
✓ 34 [illegible]		12	XJ29	1.636	20 / 100	$\frac{.04}{(1.636)^2}$	20 ⑤ / 10	0 / 10	59.6	1.00

RANDOM DATA REDUCTION LOG

MASTER PAGE NO. 1775 PROJECT RAE-B TEST DATE 4/17/72 D.R. DATE 4/17/72

REEL NO. 012295 ITEM VCPS SERIAL NO. 00001 W.P.I. AS2-102-12

CAL VOLTAGE ~~200 MVrms~~ OR 1000MVpk (AT 200Hz) DEG. OF FREE. 128

CALCULATION CONST. 3989 ~~$\frac{MV^2 rms (Grms)^2}{HZ (Gpk)^2}$~~ OR 9.82(10)^4 $\frac{MV^2 pk\ (Grms)^2}{HZ\ (Gpk)^2}$ Based on E.BW=6.4

CALCULATION CONST. 1595.6 OR 3.928 (10)^4 Based on E.BW=16

TRACE	RUN	CHAN	S/N ACCEL	SENS. ACCEL	RUN/CAL ATT.	$\frac{(RUN/CAL)^2}{(ACCEL\ SENS)^2}$	CAL/RUN INPUT ATT.	CAL/RUN OUTPUT ATT.	CAL PT	F.
1	9	1	TD40	2.805	10 / 1000	$\frac{1\times10^{-4}}{7.88} = .127\times10^{-4}$	④ 10 / ④ 10	0 / 20	1.25	0,
2 & 2A		2	TE13	2.72	30 / 1000	$\frac{9\times10^{-4}}{7.39} = 1.22\times10^{-4}$	④ / ④ 20	0 / 20	12.1	1
3		3	YK20	1.596	10 / 1000	$\frac{1\times10^{-4}}{2.54} = .394\times10^{-4}$	④ 20 / ④ 20	0 / 10	387	1,
4		4	XN32	1.297	30 / 1000	$\frac{9\times10^{-4}}{1.68} = 5.35\times10^{-4}$	④ 20 / ④ 20	0 / 20	525	1/
5		5	TD45	2.650	10 / 1000	$\frac{1\times10^{-4}}{7.0} = .143\times10^{-4}$	④ 10 / ④ 20	0 / 20	141	0,
6		6	TD48	2.788	10 / 1000	$\frac{1\times10^{-4}}{7.78} = .129\times10^{-4}$	④ 10 / ④ 20	0 / 20	1.27	0,
7	↓	7	NB62	MV/G 3.052	20 / 100	$\frac{4\times10^{-2}}{9.3} = .43\times10^{-2}$	⑥ 20 / ⑥ 20	0 / 20	122	8.
8	10	1	TD40	2.805	30 / 1000	$\frac{9\times10^{-4}}{7.88}$ [illegible]^4	④ 10 / 20	0 / 20	11.2	1
9	9	8								
10		9								
11		10								
12	↓	12								

C166

SINUSOIDAL DATA REDUCTION LOG

MASTER PAGE NO. 1775 PROJECT RAE-B TEST DATE 4-15/4-19 D.R. DATE

TAPE REEL NO. 012295 ITEM VCPS SERIAL NO. 00001 W.P.I. ASI-103-101A

CAL VOLTAGE 200 MVrms OR 1000 MVpk (AT 200 Hz)

CALCULATION USE RUN #1 OR 6 FOR CAL, MU#1 & #2 RESPECTIVEL. For channel #1-6
CAL RUN #1 FOR CHAN 7-12

$$CALpt = \frac{RUN}{CAL} \times \frac{CAL\ VOLTAGE}{ACCEL\ SENS} \quad \frac{MVrms}{MVrms/Gpk} \quad OR \quad \frac{MVpk}{\frac{Coul}{Gpk}}$$

TRACE	RUN	CHAN	S/N ACCEL	SENS ACCEL	RUN/CAL ATT	(RUN/CAL)× CAL/VOLTAGE (ACCEL SENS)	CAL/RUN LOG ATT	CAL/RUN RANGE ATT	CAL PT	F.S.
1	3	1 ✓	TD40	2.805	30/1000	30/2.805	20/20	1/1	10.7	10.0
2		2 ✓	TE83	2.722	10/1000	10/2.722	20/20	1/1	3.68	1.0
3		3 ✓	XM21	1.370	100/1000	100/1.370	20/20/0	1/1/1	73	100/10/1
4		4 ✓	WF75	1.051	30/1000	30/1.051	20/20/0	1/1	30	10/1
5		7 ✓	NB62	3.052	100/100	200/3.052	20/0	10/10	65.7	10
6		8 ✓	YK20	1.523	50/100	100/1.523	20/20/0	10/1	65.5	10/1.0
7		9 ✓	XN32	1.261	50/100	100/1.261	20/0/20/0	10/1	79.5	1.0/10/1.0
8		10 ✓	TD44	3.035	100/100	200/3.035	20/20	10/10/1	66.6	100/10
9	↓	12 ✓	WR11	3.016	50/100	100/3.016	20/20	10/1	33.2	1.0
10 ✓	5	1	TD40	2.805	10/1000	10/2.805	20/20	10/10	3.58	1.0
11 ✓		2	TE83	2.722	30/1000	30/2.722	20/20	10/10	11	10
12 ✓		3	YK20	1.596	100/1000	100/1.596	20/20/0	10/10/1	62.9	100/10/1.0
13 ✓		4	XN32	1.297	30/1000	30/1.297	20/20/0	10/10	23.2	10/1.0
14 ✓		7	NB62	3.052	100/100	200/3.052	20/0	10/1	65.7	1.0
15 ✓		8	XM21	1.325	50/100	100/1.325	20/20	10/1	75.8	10.0
16		9	WF75	1.001	50/100	100/1.001	20/0/20/0	10/1	100	1.0/10/1.0
17 ✓		10	TD44	3.035	100/100	200/3.035	20/20/0	10/1	66.6	10.0/1.0
18 ✓	↓	12	WR11	3.016	50/100	100/3.016	20/20	10/10	33.2	10.0

SINUSOIDAL DATA REDUCTION LOG

MASTER PAGE NO. 1775 PROJECT RAE-B TEST DATE 4-15/4-19 D.R. DATE

TAPE REEL NO. 012295 ITEM VCPS SERIAL NO. 00001 W.P.I. A51-103-

CAL VOLTAGE 200 MVrms OR 1000 MVpk (AT 200 Hz)
USE CAL RUN #1 OR 6 FOR HU#1 & 2 RESPECTIVELY for channel #1-6

CALCULATION CAL RUN #1 for CH 7-12

$$\text{CALpt} = \frac{\text{RUN}}{\text{CAL}} \times \frac{\text{CAL VOLTAGE}}{\text{ACCEL SENS}} \quad \frac{\text{MVrms}}{\text{MVrms/Gpk}} \quad \text{OR} \quad \frac{\text{MVpk}}{\frac{\text{Coul}}{\text{Gpk}}}$$

	TRACE	RUN	CHAN	S/N ACCEL	SENS ACCEL	RUN/CAL ATT	(RUN/CAL) x CAL VOLTAGE / (ACCEL SENS)	CAL/RUN LOG ATT	CAL/RUN RANGE ATT	CAL PT	F.S.
HU#2 AIX	19✓	7	1	TD40	2.805	10/1000	10/2.805	20/0	1/1	3.58	.1
AIY	20	↓	2	TE83	2.722	10/1000	10/2.722	20/0	1/1	3.68	.1
DY	21✓		3	YK20	1.596	30/1000	30/1.596	20/20/0	1/1	18.8	10.0/1
EY	22✓		4	XN32	1.297	30/1000	30/1.297	20/20/0	1/1	23.2	10.0/1.
CX	23✓		5	TD45	2.650	10/1000	10/2.650	20/0	1/1	3.77	.1
CY	24✓		6	TD48	2.788	10/1000	10/2.788	20/20/0/20	1/1	3.6	1.0/.1
AIZ	25✓		7	NB62	3.052	50/100	100/3.052	20/20	10/1	33.2	1.0
DX	26✓		8	XM21	1.325	20/100	40/1.325	20/20	10/1	30.5	1.0
EX	27✓		9	WF75	1.001	20/100	40/1.001	20/20/0	10/1	40	1.0/.1
BX	28✓		10	TD44	3.035	50/100	100/3.035	20/20/0/20	10/1	33.4	1.0/.1
BY	29✓	↓	12	WR11	3.016	50/100	100/3.016	20/20	10/1	33.3	1.0
HU#1 AIX	30	11	1✓	TD40	2.805	10/1000		20/20	1/1	3.58	1.0
AIY	31	↓	2✓	TE83	2.722	10/1000		20/20	1/1	3.68	.1
DX	32		3✓	XM21	1.370	30/1000	30/1.370	20/20	10/1	21.9	1.0
EX	33		4✓	WF75	1.051	30/1000	30/1.051	20/20	10/1	30	1.0
CX	34		5✓	TD45	2.650	10/1000	10/2.65	20/20	1/1	3.77	1.0
CY	35		6✓	TD48	2.788	10/1000		20/0	1/1	3.6	.1
AIZ	36		7	NB62	3.052	50/100	100/3.052	20/20	10/1	33.2	1.0
DY	37		8✓	YK20	1.523	20/100	40/1.523	20/20/0/20	10/1	26.3	1.0/.1
EY	38		9✓	XN32	1.261	20/100	40/1.261	20/20/0	10/1	31.7	1.0/.
BX	39		10✓	TD44	3.035	50/100	100/3.035	20/20	10/10	33.2	10
BY	40	↓	12	WR11	3.016	50/100	100/3.016	20/20	10/1	33.4	1.0

MASTER PAGE NO. 1775 PROJECT RAE-B TEST DATE 4-19-72 D.R. DATE 4-21-72

TAPE REEL NO. 012296 ITEM VCPS SERIAL NO. 00001 W.P.I. A51-103-104

CAL VOLTAGE 200 MVrms OR 1000 MVpk (AT 200 Hz)

CAL RUN #12

CALCULATION

$$CALpt = \frac{RUN}{CAL} \times \frac{CAL\ VOLTAGE}{ACCEL\ SENS} \quad \frac{MVrms}{MVrms/Gpk} \quad OR \quad \frac{MVpk}{\frac{Coul}{Gpk}}$$

TRACE	RUN	CHAN	S/N ACCEL	SENS ACCEL	RUN/CAL ATT	(RUN/CAL) x CAL VOLTAGE / (ACCEL SENS)	CAL/RUN LOG ATT	CAL/RUN RANGE ATT	CAL PT	F.S.
41	14	1	NB62	2.698	30/1000	30/2.698	20/20	1/1	11.3	10.0
42		2	TG75	2.791	100/1000	100/2.791	20/20	1/1	35.7	10.0
43		3	XM21	1.370	100/1000	100/1.37	20/20	10/1	73	10.0
44		4	YK20	1.596	100/1000	100/1.596	20/20/0	10/1	62.7	10.0/1.0
45		7	TD40	3.005	50/100	100/3.005	20/20	10/1	33.4	1.0
46		8	TE83	2.979	50/100	100/2.979	20/20	10/1	33.4	1.0
47		9	WF75	1.001	50/100	100/1.001	20/20	10/1	100	10.0
48		10	XN32	1.261	50/100	100/1.261	20/20	10/1/10/1	79.5	10.0/100/10.0
49		12	XJ29	1.636	50/100	100/1.636	20/0	10/1	61.3	1.0
50	16	1	NB62	2.698	10/1000	10/2.698	20/20/40	1/1	3.72	1.0/10.0
51		2	TG75	2.791	30/1000	30/2.791	20/20/0	1/1	10.8	10/1.0
52		3	XM21	1.370	30/1000	30/1.37	20/20/0	10/10	21.9	10.0/1.0
53		4	YK20	1.596	30/1000	30/1.596	20/20	10/10/1	18.8	10.0/1.0
54		5	TD45	2.650	10/30/1000	10/2.65 | 30/2.65	20/0/20	1/1/.1	3.78/11.3	.1/1.0/.1
55		6	TD48	2.788	10/30/1000	10/2.788 | 30/2.788	20/0/20/20/0	1/1/1	3.6/10.7	.1/1.0/10/1.0
56		7	TD40	3.005	20/100	40/3.005	20/20/0/20	10/1	13.3	1.0/.1/1.0
57		8	TE83	2.979	20/100	40/2.979	20/20/0	10/1	13.4	1.0/.1
58		9	WF75	1.001	20/100	40/1.001	20/20/0	10/10	40	10/1.0
59		10	XN32	1.261	20/100	40/1.261	20/20/0	10/10	31.7	10.0/1.0
60		12	XJ29	1.636	20/100	40/1.636	20/20/40	10/1	24.4	1.0/10

APPENDIX D

GSFC MASS PROPERTIES REPORT

V.C.P.S. MASS PROPERTIES

BALANCE

NOTE: ALL ANGLES ARE REFERENCED AS FOLLOWS. THE S/C +X AXIS IS DEFINED AS 0°. ANGLES INCREASE C.W. LOOKING DOWN ON THE TOP OF THE V.C.P.S.

A SINGLE BALANCE WT WAS MOUNTED ON THE UPPER RIM OF THE VCPS INTERIOR STRUCTURE. THE WT TOTALED 426 gm, WAS LOCATED 8.29" FROM THE GEOMETRIC CENTER OF THE VCPS, AND AT AN ANGLE OF 220°.

AFTER THE ADDITION OF THE ABOVE WT. THE RESIDUAL IMBALANCE LEVELS WERE DETERMINED TO BE AS FOLLOWS:

RESIDUAL IMBALANCE (LIGHT SPOTS)

	ZERO FUEL CONDITION	FULL FUEL CONDITION
TATIC	20.8 oz-in $\angle 62°$	14.4 oz-in $\angle 15°$
YNAMIC	605:6 oz-in^2 $\angle 115°$	454.2 oz-in^2 $\angle 123°$

V.C.P.S. MASS PROPERTIES

WT, M.I., C.G., (ZERO FUEL CONDITION)

NOTE: ALL MEASUREMENTS MADE WITH BALANCE WT ADDED

TOTAL WEIGHT = 41.6 LBS.

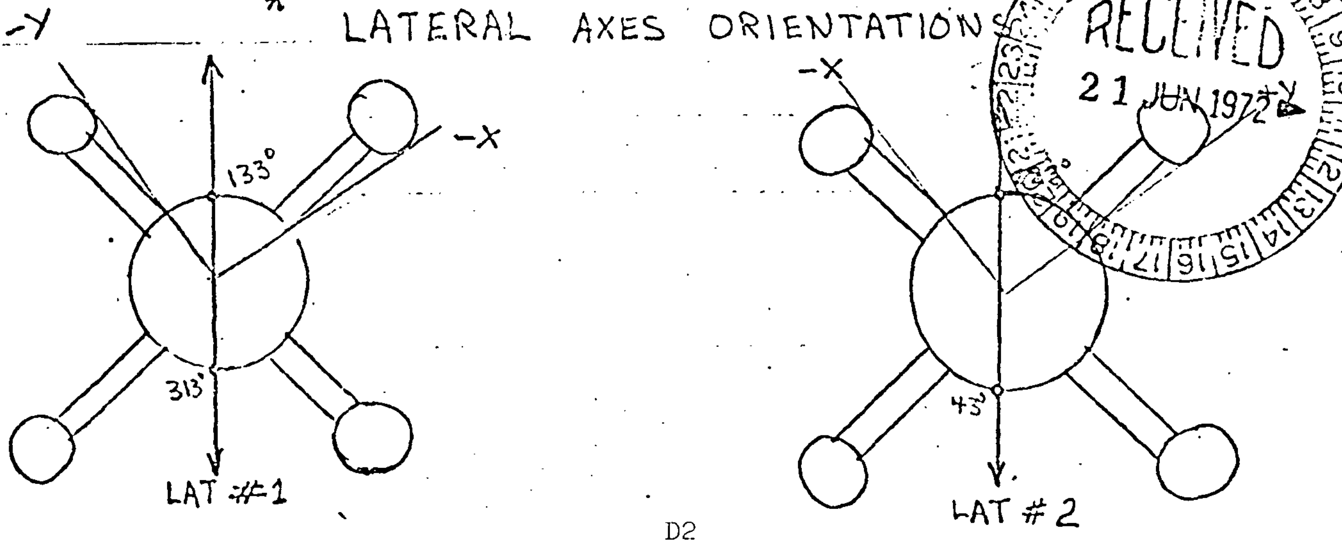
SPIN M.I. = ····· 1.703 SLUG-FT^2

LATERAL #1* MI = ·· 0.925 SLUG-FT^2

LATERAL #2* MI = ·· 0.883 SLUG-FT^2

C.G. LOCATION = ··· 4.33" (FORWARD OF THE AFT SEPARATION INTERFACE)

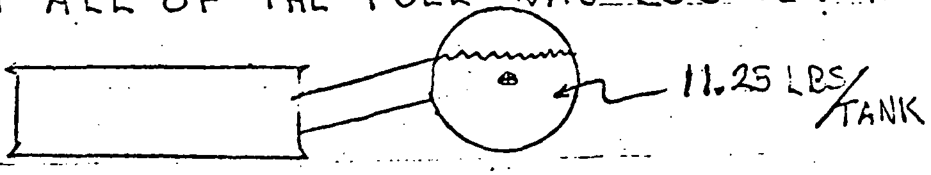
* LATERAL AXES ORIENTATIONS



V.C.P.S. MASS PROPERTIES

WT, M.I., C.G., (FULL FUEL CONDITION)

NOTE: ALL OF THE VALUES FOR THE FULL FUEL CONDITION WERE OBTAINED BY ANALYTICALLY ADDING 45 LBS OF HYDRAZINE TO THE ZERO FUEL CONDITION. IT WAS ASSUMED THAT ALL OF THE FUEL WAS LOCATED IN THE TANKS.



THIS CREATES A SLIGHT ERROR DUE TO THE PRESENCE OF A CERTAIN AMOUNT OF FUEL IN THE FEED LINES.

TOTAL WEIGHT = 86.6 LBS.

SPIN M.I. = 7.2 SLUG-FT^2

LATERAL #1 M.I. = 3.7 SLUG-FT^2

LATERAL #2 M.I. = 3.7 SLUG-FT^2

C.G. LOCATION = 5.11" (FORWARD OF THE AFT SEPARATION INTERFACE)

APPENDIX E

SVHSER 6184 - RAE-B

GAS MANIFOLD MODIFICATION REPORT

Hamilton Standard
DIVISION OF UNITED AIRCRAFT CORPORATION
UA®

SVHSER 6184

RAE-B VCPS GAS MANIFOLD

MODIFICATION REPORT

Prepared by:
E. K. Moore
RAE-B Project Manager

Approved by:
R. L. Steinberg
RAE-B Program Manager

Date: 15 March 1973

INTRODUCTION

This report summarizes the program undertaken by Hamilton Standard in response to contract change order #18 to modify the Radio Astronomer Explorer -B, Velocity Control Propulsion Subsystem (RAE-B, VCPS) to offset intertank transfer of fluids.

The need for such a modification was revealed during a Goddard Space Flight Center (GSFC) system analysis wherein it was shown that an initial minor VCPS fluid unbalance would ultimately cause major unbalance and vehicle Z axis perturbation.

The program at Hamilton Standard included a study of various methods to eliminate intertank transfer of fluids, the implementation of the selected system and acceptance testing to confirm system leakage and cleanliness integrity.

OBJECTIVE

To select and implement a method of preventing intertank transfer of fluids in the RAE-B VCPS with minimum impact on weight, reliability, schedule and the Propellant Servicing Cart (PSC) configuration.

CONCLUSIONS

1. A method was selected which did not require changes in basic loading and pressurizing procedures.

2. The method was implemented without sacrifice of system cleanliness or leakage as evidenced by acceptance testing.

3. Weight increase was minimal at plus 0.4 pounds.

4. The modification to the subsystem requires rebalancing and redetermination of mass properties.

5. The VCPS modification was accomplished within the time period allotted.

RECOMMENDATIONS

It is recommended that:

1. The VCPS be rebalanced and mass properties be redetermined by the NASA.
2. Liquid and gas loading procedures be reexamined including both vacuum and pressure fill methods.

DISCUSSION

I. Study Phase

A number of candidate methods to prevent intertank transfer of fluids were studied and were previously reported. See Appendix A, "RAE-B VCPS Intertank Propellant Transfer Modification Report". The report suggested either of two methods be used.

Method IV-B provided a weight saving but required new fluid and gas loading procedures. Method III added a small amount of weight but did not require new liquid and gas loading procedures. GSFC elected to use Method III.

II. Design Phase

The design requirements for implementing Method III, which utilizes four Fill and Vent Valves instead of a single Fill and Vent Valve, consisted of:

> Establishing locations for four fill and vent valves so that; one common mounting bracket design could be used, pressurizing hoses could be installed without interference with each other or space vehicle components, weight increase was minimized and finally, unbalance was held to a minimum.

It was determined that two brackets and valves could be attached to the hub in quadrant + x-y and two in quadrant - x+y. In each quadrant the valves would face one another but be offset along the Z axis for hose clearance. The new gas lines from tanks to valves utilized existing arm mounted tube clamps to minimize new hardware and reduce hole drilling requirements. Page 2 of drawing SV748720 Appendix B, shows the new valve, bracket and gas line locations.

The new bracket is similar in design to other brackets, but is covered with aluminized mylar tape instead of gold plate as a procurement expediency. Drawing SV755431, Appendix B, shows the new valve bracket.

The bracket used to locate the original Fill and Vent Valve was left attached to the +x arm so that the arm would not have to be detached to remove the loose rivet segments from the interior of the arm which would have resulted if the bracket were removed.

III. Qualification Test Phase

The valve and bracket were assembled and subjected to a qualification test per specification SVHS 5997 (See Appendix C).

The valve which was planned to be used for the test was the VCPS spare (GFE) Fill and Vent Valve. This valve leaked excessively when tested and rather than delay testing pending disposition of the valve by GSFC, a new valve was substituted and the test resumed.

The qualification test was completed without incident except that the test unit was misindexed relative to the X-Y axis by 36°. Since the misindexing resulting in higher effective loadings to the test unit than the true position, GSFC agreed that the outage was acceptable.

The leaking valve was delivered to GSFC for failure analysis. The bracket was delivered to government stores as a VCPS spare and the qualification valve was installed as one of the four on the VCPS.

The qualification test report is in Appendix D.

IV. VCPS Modification Phase

The VCPS modification was accomplished in several steps:

1. Gas manifold removal
2. Bracket and valve installation
3. Tube fit-up, cleaning and passivation
4. Tube welding
5. In process inspection

Step 1. To accomplish gas manifold removal without system contamination, the following procedure was used for each tubing cut:

a. Pressurize system to 5 psig using dry filtered nitrogen.

b. Slowly cut tubing using "chipless" tube cutter.

c. Install squaring tool and square end of cut tube using fine cut file.

d. Ream tube I.D. and remove burrs.

e. Remove squaring tool and flood area with clean Isopropyl Alcohol to remove all visible particles. Allow to dry.

f. Tape tube end.

Step 2. The hub bracket mounting holes were drilled and burred using the following procedure:

a. Remove insulation blanket from hub.

b. Establish hole locations

c. Set up shop vacuum to catch drill chips

d. Drill and burr holes

e. Assure all chips have been collected

After hole drilling and burring, the brackets were mounted to the hub, then the valves were mounted to the brackets using required bolts, washers and nuts. The brackets were taped with aluminized mylar tape before installation.

Step 3. After the valves had been installed, each tube which had been prebent to design layouts, was fitted and cut to length, following which it was cleaned to specification HS 3150 level CE-5. (See Appendix E for CE-5 level).

Following cleaning, the tubes and valves were passivated per note 68 of drawing SV748720 except pressure was 15 psia. The passivation procedure is as follows:

a. One hour application of a 30-35% N_2H_4 - remainder H_2O solution at 73 ± 10°F with wetted interior portions of the tubes and valves completely filled.

b. Fill completely as in step (a) with 100% N_2H_4 and attach an external ullage volume of 30 ± 2 cu. in. With the system vented, raise the temperature to 120 ± 5°F. After 4 hours, close the vent and maintain temperature for 24 hours while monitoring pressure. Pressure rise shall not exceed 7 psid in 24 hours. Note: If pressure rise does exceed 7 psid, terminate test.

No pressure rise was observed in the 24 hour period.

Following passivation, tube cleanliness was again verified to the CE-5 level.

Step 4. Prior to tube welding, the tubes were taped with aluminized mylar to within approximately 1 1/2 inches of the tube ends. The tubes were then held in position by a fixture clamp at one end and by the Astro-Arc welding head at the other. Each weld was made automatically using previously established machine settings. Two weld samples were made prior to welding and two additional samples were made after all welding was complete. All weld samples were radiographically examined.

Step 5. Following welding, each of the eight welds was die penetrant inspected and "snoop" checked at 300 psig. The system was then checked for cleanliness per HS 3150 using isopropyl alcohol.

Finally the insulating blanket was reinstalled and the VCPS released for Acceptance Testing.

V. Acceptance Test Phase

Following the modifications and in-process inspections (Phase IV), the unit was acceptance tested per SVHS 5618 ATA No. 2 (See Appendix F). The acceptance test consisted of the following individual tests:

Examination of Product
Weight
Proof Pressure
External Leakage
Contamination Check
Post Test Inspection

Following completion of the contamination check, and before Post Test Inspection, taping with aluminized mylar tape was completed.

All tests were completed in accordance with acceptance criteria.

VI. Schedule

The VCPS was modified in accordance with the plan and schedule of Appendix G.

APPENDIX

Intertank Propellant Transfer Modification Report

Hamilton Standard
DIVISION OF UNITED AIRCRAFT CORPORATION
UA®

RAE-B VCPS

INTERTANK PROPELLANT TRANSFER MODIFICATION REPORT

PREPARED BY: Thomas Marotta
Thomas Marotta

Carl Arvidson

APPROVED BY:
Earl K. Moore

CONTENTS

INTRODUCTION

At the direction of NASA/Goddard Space Flight Center to modify the VCPS to prevent intertank propellant transfer, a study of various system modifications was undertaken to decide which changes would have the least impact (manufacturing, weight and cost) to the subsystem. Also, a flow analysis of the selected tank isolation methods was prepared to further substantiate the choice. This report includes both the various system tradeoffs and the flow analysis associated with the VCPS modifications.

SUMMARY

After reviewing the various modification options which could be incorporated on the VCPS, the analysis associated with modification Method IV-B, and the demonstration flow test, changing the VCPS propellant feed system to the configuration illustrated in the Method IV-B schematic appears to be the best approach for retrofitting the VCPS. This method offers the advantages of lighter weight and minimum impact on mechanical changes to the VCPS and GSE Cart.

The addition of individual fill and drain valves for each tank is also an acceptable approach but results in additional VCPS weight and a more complex VCPS rework. This approach, Method III, was not analyzed since the fill procedure is identical to that used for the present system except for manifolding the four pressurant fill and drain valves together. This permits simultaneous gas pressurization of the tanks from a single source on the GSE Cart.

RAE-B VCPS PROPELLANT FEED SYSTEM MODIFICATION TRADEOFF

The following propellant feed system schematics represent methods of accomplishing prevention of intertank propellant transfer. Each schematic modification has comments regarding the impact of the change to the VCPS, to the RAE-B spacecraft, or to the GSE.

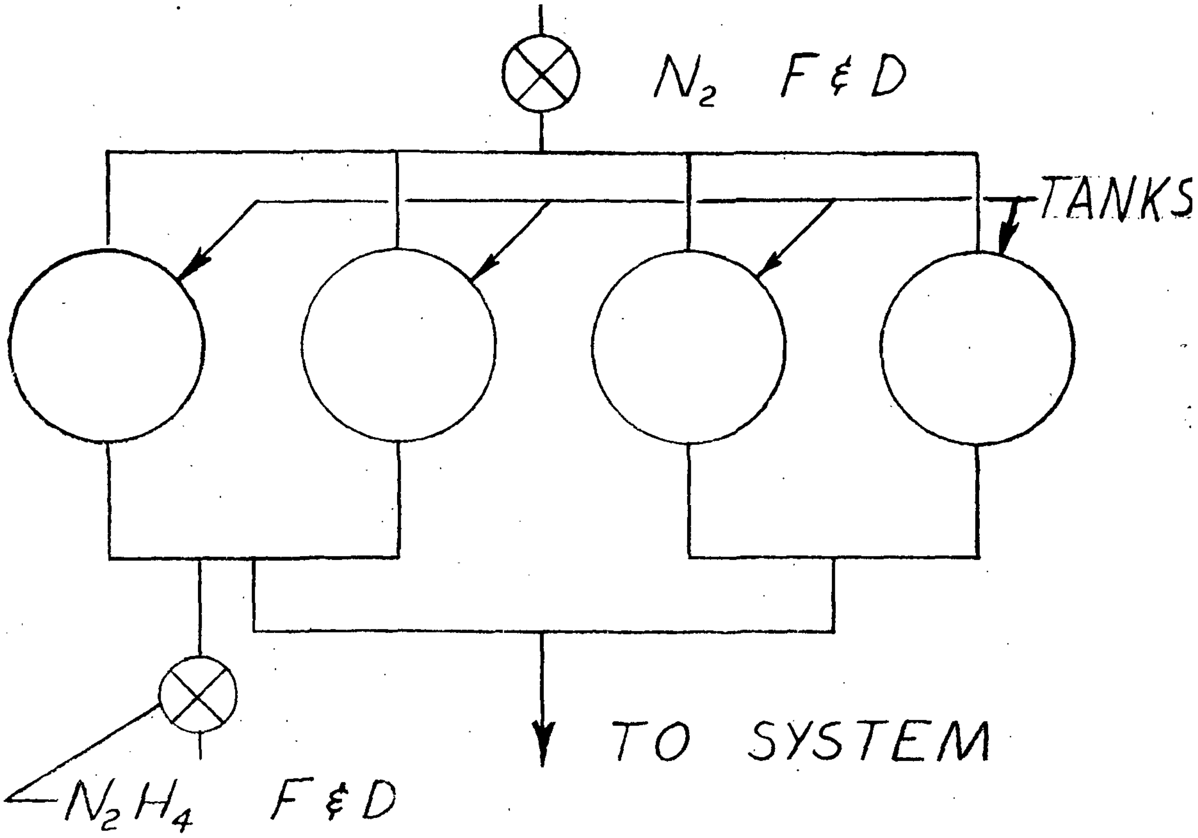
After reviewing the various options available to prevent intertank propellant transfer, the subsystem modification which appears to offer the greatest advantages is Method IV-B. This change offers the least impact to the system while providing a subsystem of lighter weight. The second choice would be Method III where the use of RAE-B qualified hardware could be utilized with no restraints on the spacecraft other than additional weight of the VCPS. The flow analysis which is in the following section is for Method IV-B.

The weight impact of the two modification methods considered is as follows. The results are for the worst case which assumes the VCPS balance weight to be in the region of the existing gas manifold.

Delta Weight

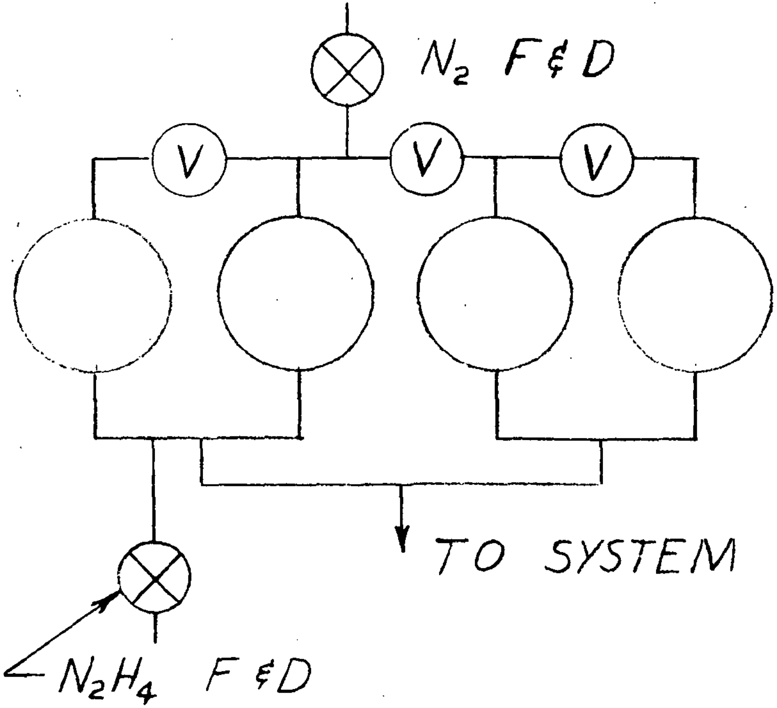
Method IV-B	≈ .411 lbs reduction
Method III	≈ 1.18 lbs additional

PRESENT VCPS CONFIGURATION



INTERTANK ISOLATION CONFIGURATIONS

METHOD I

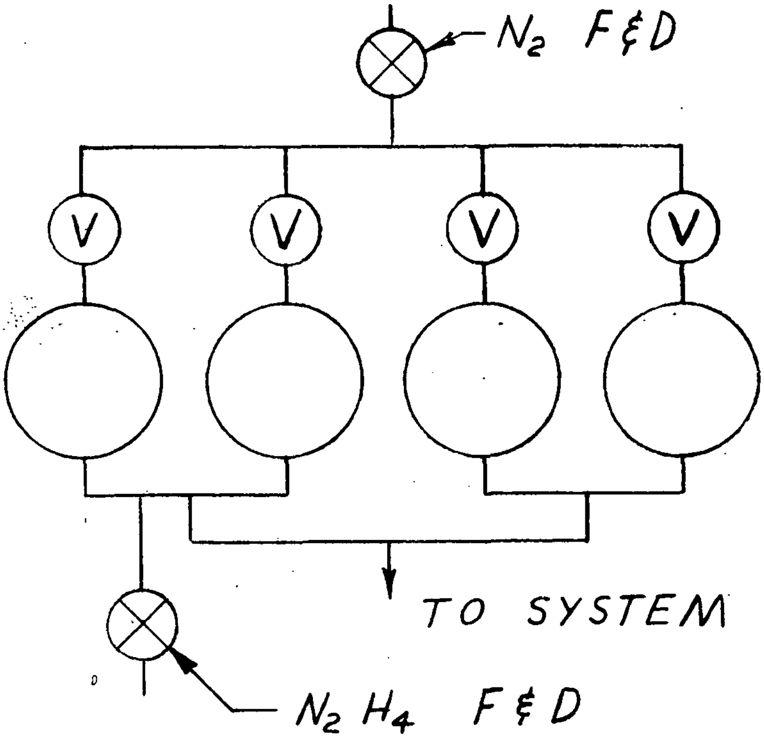


COMMENTS:

- VALVES ISOLATE TANKS ON GAS SIDE BUT PROVIDE NO REDUNDANCY
- NO VEHICLE POWER REQUIRED.
- NO EFFECT ON PROPELLANT FLOW.
- AVAILABILITY OF QUALIFIED VALVE IS QUESTIONABLE.
- SYSTEM WEIGHT INCREASE.

Ⓥ VALVE (TYPE NOT ESTABLISHED)

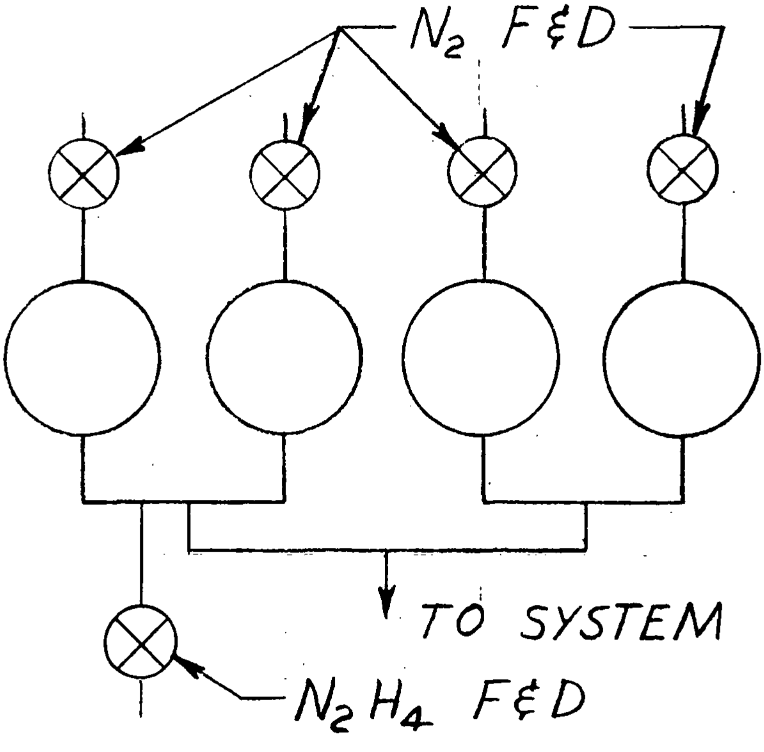
METHOD II



COMMENTS:

- VALVES ISOLATE TANKS ON GAS SIDE AND PROVIDE REDUNDANCY.
- NO VEHICLE POWER REQUIRED.
- NO EFFECT ON PROPELLANT FLOW.
- AVAILABILITY OF QUALIFIED VALVE QUESTIONABLE.
- SYSTEM WEIGHT INCREASE.

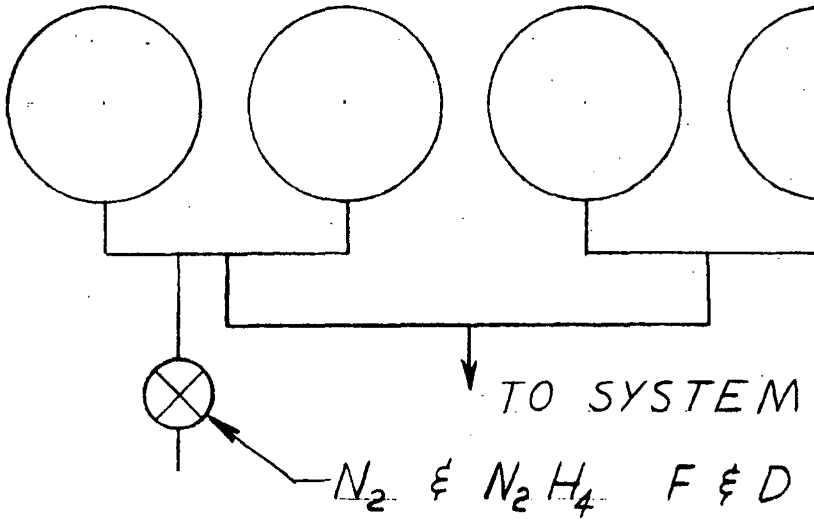
METHOD III



COMMENTS:

- VALVES ISOLATE TANKS – NO POSSIBILITY OF INTERNAL LEAKAGE
- NO VEHICLE POWER REQUIRED.
- NO G.S.E. POWER REQ'D.
- NO EFFECT ON PROPELLANT FLOW.
- USE OF RAE-B QUALIFIED HARDWARE
- FOUR POTENTIAL OVERBOARD LEAK SOURCES
- SYSTEM WEIGHT INCREASES.

METHOD IV A & B



A – LOAD N_2H_4 UNDER PRESSURE.

B – LOAD N_2H_4 UNDER LOW PRESSURE – THEN PRESSURIZE WITH N_2 TO OPERATING PRESSURE.

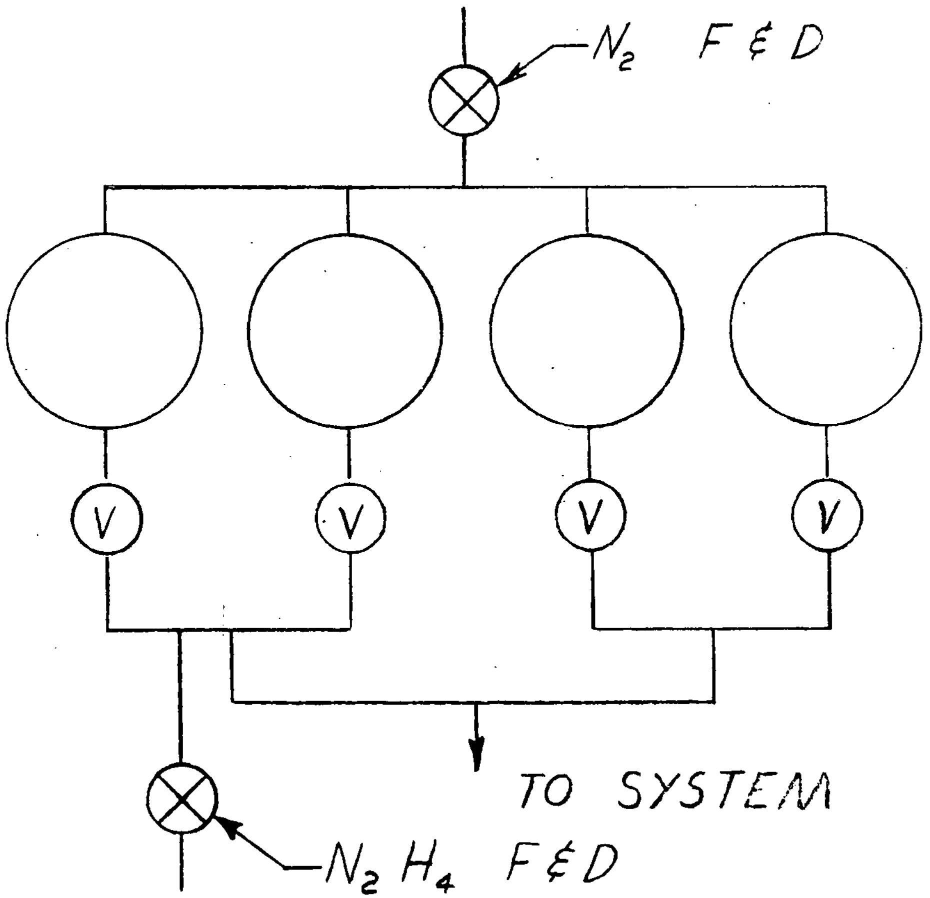
COMMENTS:

A & B
- VCPS CANNOT BE THRU FLUSHED, CLEANED OR PURGED.
- NO VEHICLE OR G.S.E. POWER REQUIRED.
- SYSTEM WEIGHT DECREASE
- FILL OF DEAD-ENDED TANK CRITICAL SINCE OVER PRESSURIZATION CANNOT BE **VENTED.**

A
- GSE CART CANNOT LOAD N_2H_4 UNDER REQUIRED PRESSURE WITHOUT CONSIDERABLE CART MODIFICATION.

B
- DO TANKS LOAD EQUALLY?

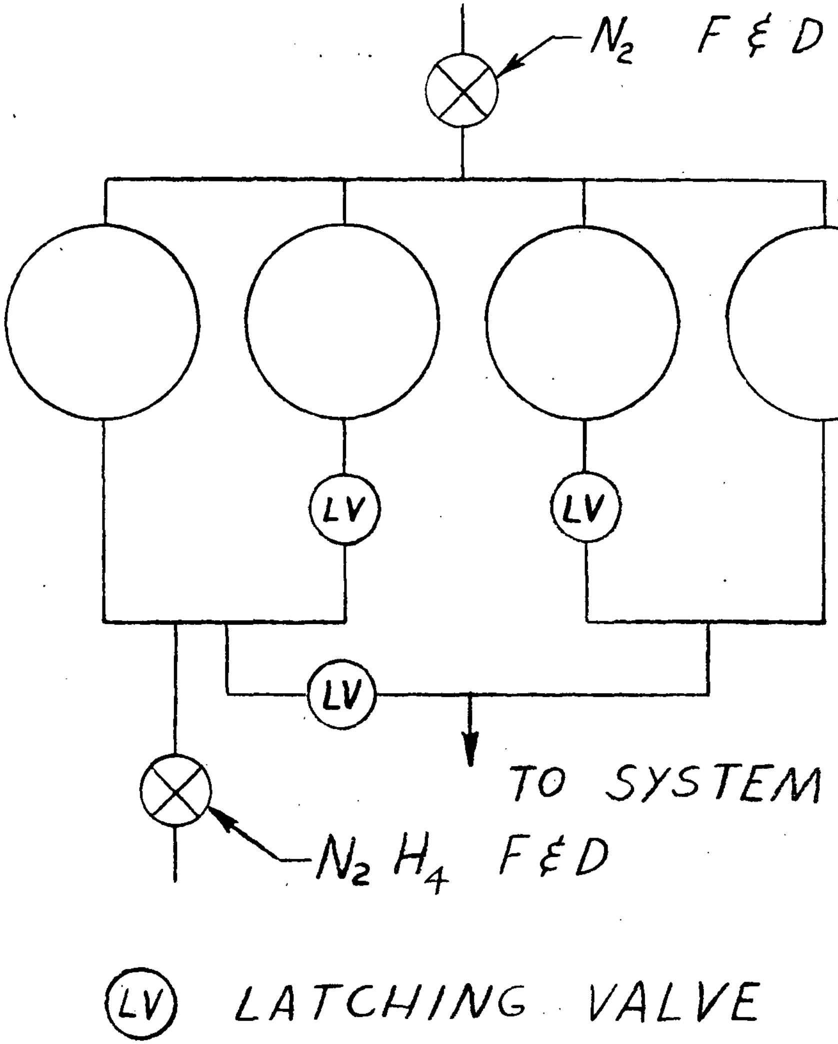
METHOD V



COMMENTS:

- VALVES ISOLATE TANKS AND PROVIDE REDUNDANCY
- VEHICLE POWER REQUIRED
- ADDITIONAL TELEMETRY CHANNELS PROBABLY REQUIRED.
- IMPACTS SPACECRAFT ELECTRICAL EQUIPMENT.
- FAILED CLOSED POSITION CAN CAUSE LOSS OF MISSION.
- VALVES HAVE THERMAL IMPACT ON LINE THERMAL ANALYSIS AND MAY REQUIRE HEATERS.
- SYSTEM WEIGHT INCREASES
- AVAILABILITY OF QUALIFIED VALVE IS QUESTIONABLE.

METHOD VI



COMMENTS:

- VALVES ISOLATE TANKS BUT PROVIDE NO REDUNDANCY.
- REMOVAL OF TWO EXISTING LATCHING VALVES FROM SYSTEM CHANGES ORIGINAL PHILOSOPHY OF SYSTEM.
- LATCHING VALVE CIRCUIT REQUIRES ADDITIONAL POWER.
- IMPACT ON SPACECRAFT ELECTRICAL EQUIPMENT
- FAILED CLOSED POSITION OF ANY LATCHING VALVE CAN CAUSE LOSS OF MISSION.
- VALVES HAVE THERMAL IMPACT ON LINE THERMAL ANALYSIS AND MAY REQUIRE HEATERS.
- SYSTEM WEIGHT INCREASE.

FLOW ANALYSIS OF HS SELECTED MODIFICATION

The flow analysis presented in this section is prepared against propellant feed system modification Method IV-B. The analysis is divided into the following three sections:

Propellant Fill

Pressurant Fill

Propellant Withdrawal

The primary objective of these analyses is to determine the unbalance effects, if any, on the VCPS.

The propellant fill case is not of primary concern other than assuring that propellant flows to all tanks equally with the exception of the line volume effects. The primary goal of the pressurant fill analysis is to determine the degree of unbalance that exists between propellant tanks after pressurant fill and the system pressure has stabilized -- equal pressure in all tanks. The objective of the propellant withdrawal analysis is to determine the propellant expulsion efficiency. Without the tank pressurant manifold, each tank blows down independently where it is possible for one tank to ingest pressurant just before the others because of slightly different initial pressurant volumes.

The analysis indicates that an unbalance of 13 oz-in may exist after propellant and pressurant loading without adjustment of the balance weight. To assure that the system does fill as predicted for Method IV-B, an evaluation of the fill process would be demonstrated using the actual VCPS. This would be accomplished by cutting into the pressurant manifold at discreet positions, which would not affect the final direction of the modification, and sealing off these lines.

The propellant "blow-down" analysis indicates that the expulsion efficiency will be 99.83 percent instead of 99.98 percent which was initially predicted.

T.Mi

CASE I – UNBALANCE DUE TO LIQUID FILLING

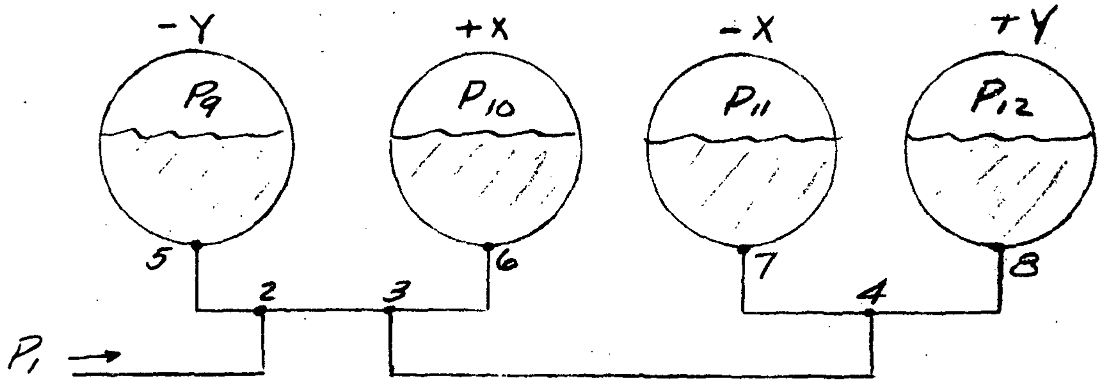


FIG. I

STATEMENT OF PROBLEM

THE PROBLEM IS TO DETERMINE ANY UNBALANCE RESULTING FROM INITITIAL LIQUID FILL. THE PROBLEM STEMS FROM THE INITIAL GAS VOLUM IN THE TANKS AND PARTICULARLY IN THE SYSTEM LINES. DURING THE FILLING PROCESS, THE GAS IN THE LINES IS DISPLACED TO THE TANKS AND COMBINES WITH THE GAS ALREADY IN THE TANKS TO BECOME COMPRESSED. THE FACT THAT THE TANKS WILL HAVE A DIFFERENT AMOUNT OF GAS, BECAUSE OF THE DISTRIBUTION OF THE PLUMBING, WILL RESULT IN SOME PROPELLAN MASS UNBALANCE UPON PRESSURE EQUALIZATION IN THE SYSTEM

ANALYSIS

- ASSUME AT END CONDITIONS $P_9 = P_{10} = P_{11} = P_{12}$
- ASSUME THAT DURING LIQUID FILLING, VAPOR LIQU INTERFACE IS MAINTAINED SUCH THAT GAS IN LINES IS COMPLETELY DISPLACED INTO THE TANKS (ASSUMPTION VISUALLY CONFIRMED

• ASSUME DISTRIBUTION OF GAS IN SYSYEM RESULTS AS FOLLOWS

TANK 9: $\bar{V}_9 = 25\% V_{1-2} + V_{2-5} + V_{9\,INITIAL}$

TANK 10: $\bar{V}_{10} = 25\% V_{1-2} + 33\% V_{2-3} + V_{3-6} + V_{10\,INITIAL}$

TANK 11: $\bar{V}_{11} = 25\% V_{1-2} + 33\% V_{2-3} + 50\% V_{3-4} + V_{4-7} + V_{11\,INITIAL}$

TANK 12: $\bar{V}_{12} = 25\% V_{1-2} + 33\% V_{2\cdot3} + 50\% V_{3-4} + V_{4-8} + V_{12\,INITIAL}$

WHERE $\underline{V}$ IS THE VOLUME ASSOCIATED WITH THE DIFFERENT COMPONENTS SHOWN IN FIG. I

A. • <u>CONSIDER NOMINAL CASE</u>

FROM TABLE I

<u>LINES</u>

$V_{1-2} = .4362 \text{ IN}^3$

$V_{2-5} = .8376 \text{ IN}^3$

$V_{2\cdot3} = .1919 \text{ IN}^3$

$V_{3-6} = 1.0295 \text{ IN}^3$

$V_{3-4} = 1.1168 \text{ IN}^3$

$V_{4-7} = 1.0295 \text{ IN}^3$

$V_{4-8} = 1.0295 \text{ IN}^3$

<u>TANKS</u>

$V_{9\,INIT} = 508.90 \text{ IN}^3$

$V_{10\,INIT} = 509.46 \text{ IN}^3$

$V_{11\,INIT} = 508.63 \text{ IN}^3$

$V_{12\,INIT} = 510.01 \text{ IN}^3$

<u>INTITAL GAS VOLUMES</u>

$\bar{V}_9 = (.25 \times .4362) + (.8376) + 508.90$

$\bar{V}_{10} = (.25 \times .4362) + (.33 \times .1919) + (1.0295) + 509.46$

$\bar{V}_{11} = (.25 \times .4362) + (.33 \times .1919) + (.50 \times 1.1168) + 1.0295 + 508.63$

$\bar{V}_{12} = (.25 \times .4362) + (.33 \times .1919) + (.50 \times 1.1168) + 1.0295 + 510.01$

$\therefore \quad \bar{V}_9 = 509.847 \text{ IN}^3$

$\bar{V}_{10} = 510.662 \text{ IN}^3$

$\bar{V}_{11} = 510.390 \text{ IN}^3$

$\bar{V}_{12} = 511.770 \text{ IN}^3$

$\bar{V}_T$ = TOTAL INITIAL GAS VOLUME IN SYSTEM = $\bar{V}_9 + \bar{V}_{10} + \bar{V}_{11} + \bar{V}_{12}$

$= 2042.669 \text{ IN}^3$

ASSUME INITIAL PRESSURE OF SYSTEM = 15 PSIA

ASSUME ADDITION OF 45 lbs OF PROPELLANT TO THE SYSTEM

$$V_P = \frac{45}{\rho} = \frac{45\ lbm}{.036\ \frac{lbm}{IN^3}} = 1250\ IN^3$$

$\therefore$ FINAL GAS VOLUME OF SYSTEM = $\overline{V_T} - V_P$

$$\overline{V}_{FIN} = 2042.669 - 1250 = 792.669\ IN^3$$

ASSUME AN ISOTHERMAL FILL PROCESS

$$P_{FINAL} = \frac{P_{INITIAL} \times \overline{V}_T}{\overline{V}_{FIN}}$$

$$P_{FINAL} = \frac{15 \times 2042.669}{792.669} = 38.654\ psia$$

WITH THIS FINAL PRESSURE IN EACH TANK, DETERM
THE FINAL GAS VOLUMES IN EACH TANK:

GAS VOLUMES, FINAL

$$V_9 = \frac{15 \times 509.847}{38.654} = 197.850\ IN^3$$

$$V_{10} = \frac{15 \times 510.662}{38.654} = 198.164\ IN^3$$

$$V_{11} = \frac{15 \times 510.390}{38.654} = 198.061\ IN^3$$

$$V_{12} = \frac{15 \times 511.770}{38.654} = 198.594\ IN^3$$

TANK PROPELLANT VOLUMES, FINAL

$$V_{P_9} = 508.90 - 197.850 = 311.050\ IN$$

$$V_{P_{10}} = 509.46 - 198.164 = 311.298\ I$$

$$V_{P_{11}} = 508.63 - 198.061 = 310.569\ I$$

$$V_{P_{12}} = 510.01 - 198.594 = 311.416\ I$$

MASS OF PROPELLANT IN TANKS

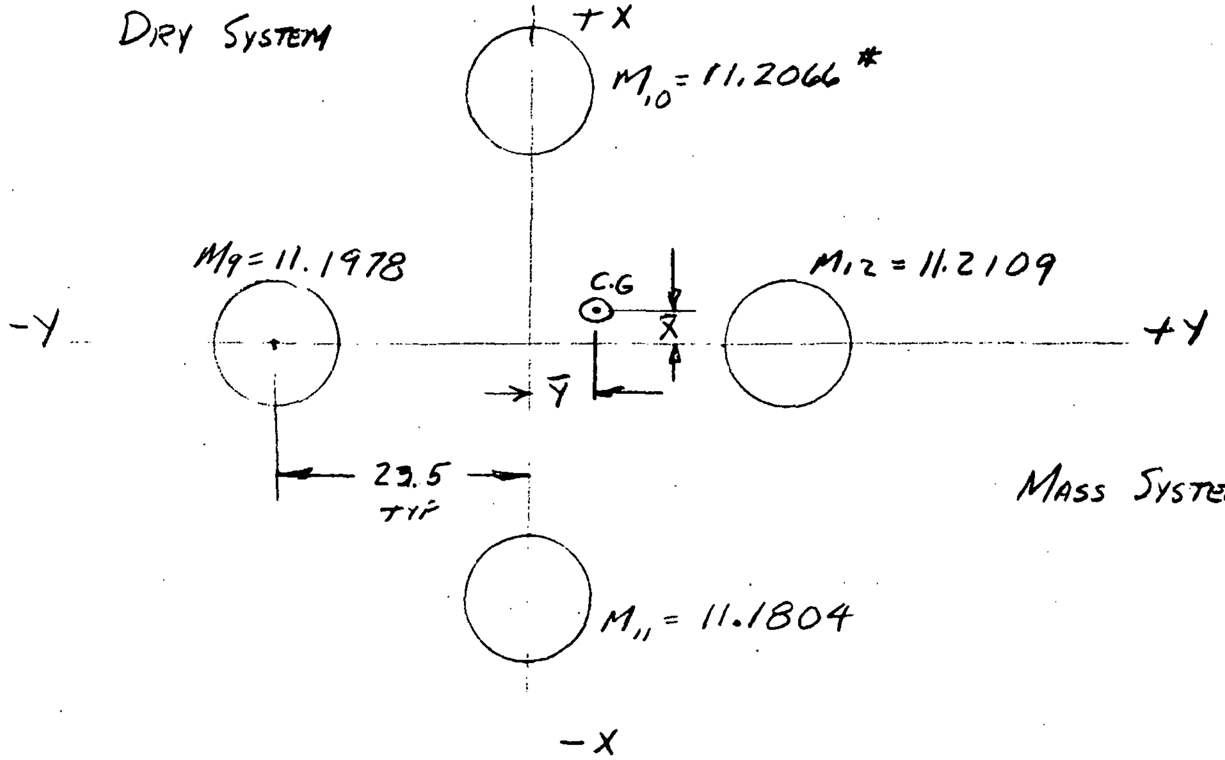
$M_9 = 11.1978$ lbms

$M_{10} = 11.2066$ lbms

$M_{11} = 11.1804$ lbms

$M_{12} = 11.2109$ lbms

LOOK AT SYSTEM UNBALANCE DUE TO THE ABOVE PROPELLANT DISTRIBUTION – ASSUME A BALANCED DRY SYSTEM



MASS SYSTEM = 65 lbs

C.G. SHIFT

$$\bar{Y} = \frac{(11.2109 - 11.1978) \times 23.5}{65}$$

$$\bar{Y} = +.00473$$

$$\bar{X} = \frac{(11.2066 - 11.1804) \times 235}{65}$$

$$\bar{X} = +.00946 \text{ IN}$$

TORQUE DUE TO C.G. SHIFT:

$$T = \text{Mass}_{sys} \times \sqrt{\bar{X}^2 + \bar{Y}^2}$$

$$T = 65 \text{ lbs} \times \frac{16 oz}{lbs} \times \sqrt{.00473^2 + .00946^2} = 65 \times 16 \times .0105$$

$$\underline{T = 11.00 \text{ IN-oz}}$$

B. CONSIDER AN EXTREME CASE, WHERE THE TOLERANCES OF THE TANKS & LINES ARE IN A CONDITION THAT WILL MAKE THE UNBALANCE A MAXIMUM. INVESTIGATE EFFEC OF HAVING LINES IN MIN & MAX CONDITIO

ASSUME THE FOLLOWING ~ (APPARENT WORST CONDIT

V_{2-5} IS MAXIMUM

V_{1-2} IS NOMINAL

V_{2-3} IS NOMINAL

V_{3-4} IS MINIMUM

V_{4-7} IS MAXIMUM

V_{4-8} IS MINIMUM

V_{3-6} = MINIMUM

$V_{9\,INIT}$, $V_{10\,INIT}$, $V_{11\,INIT}$, $V_{12\,INIT}$ } ACTUALS

- FROM TABLE I

$V_{2-5\,MAX} = .9741$ IN^3

$V_{1-2\,NOM} = .4362$

$V_{2-3\,NOM} = .1919$

$V_{3-4\,MIN} = .9583$

$V_{4-7\,MAX} = 1.1973$

$V_{4-8\,MIN} = .8841$

$V_{3-6\,MIN} = .8841$ IN^3

$V_{9\,IN} = 508.90$ IN^3

$V_{10\,IN} = 509.46$ IN^3

$V_{11\,IN} = 508.63$ IN^3

$V_{12\,IN} = 510.01$ IN^3

GAS VOLUME BEFORE LIQUID FILLING

TANK 9 $\bar{V}_9 = (.25 \times .4362) + (.9741) + 508.90 = 509.983$ IN^3

" 10 $\bar{V}_{10} = (.25 \times .4362) + (.33 \times .1919) + .8841 + 509.46 = 510.516$ IN

" 11 $\bar{V}_{11} = (.25 \times .4362) + (.33 \times .1919) + (.50 \times .9583) + 1.1973 + 508.63 = 510$

" 12 $\bar{V}_{12} = (.25 \times .4362) + (.33 \times .1919) + (.50 \times .9583) + .8841 + 510.01 = 51$

$\bar{V}_T$ = TOTAL INITIAL GAS VOLUME IN SYSTEM = 2042.523 IN

ASSUME INITIAL PRESSURE OF SYSTEM = 15 PSIA

AFTER ADDING 45 lbs PROPELLANT WHAT IS GAS VOL

$$V_{g\,FINAL} = 2042.523 - \frac{45}{.036} = 792.523 \text{ IN}^3$$

FINAL PRESSURE IN EACH TANK

$$P_{FINAL} = \frac{15 \times 2042.523}{792.523} = 38.659 \text{ PSIA}$$

TANK GAS VOLUMES, FINAL

$$V_9 = \frac{15 \times 509.983}{38.659} = 197.887 \text{ IN}^3$$

$$V_{10} = \frac{15 \times 510.516}{38.659} = 198.084$$

$$V_{11} = \frac{15 \times 510.479}{38.659} = 198.069$$

$$V_{12} = \frac{15 \times 511.545}{38.659} = 198.483$$

TANK PROPELLANT VOLUMES, FINAL

$$V_{P9} = 508.90 - 197.887 = 311.013 \text{ IN}^3$$

$$V_{P10} = 509.46 - 198.084 = 311.376$$

$$V_{P11} = 508.63 - 198.069 = 310.561$$

$$V_{P12} = 510.01 - 198.483 = 311.527$$

MASS OF PROPELLANT IN EACH TANK

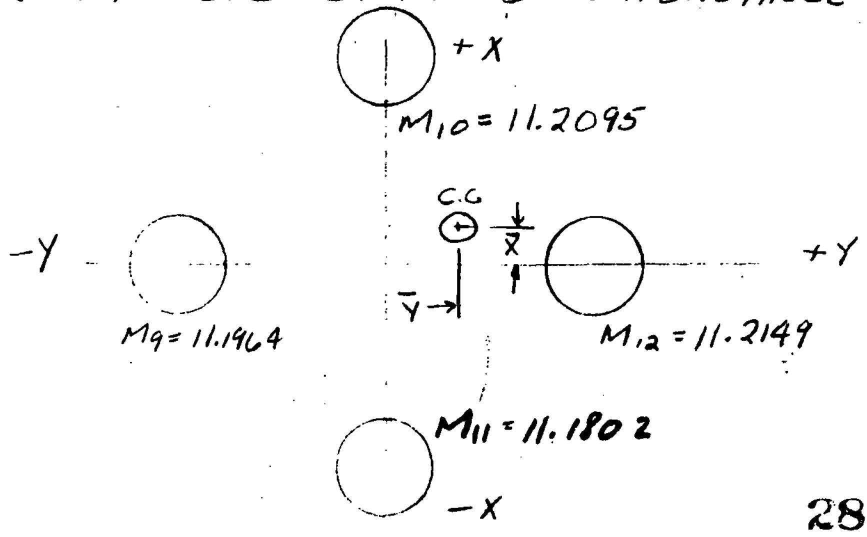
$M_9 = 11.1964$ lbm

$M_{10} = 11.2095$ lbm

$M_{11} = 11.1802$ lbm

$M_{12} = 11.2149$ lbm

LOOK AT C.G. SHIFT & UNBALANCE



C. G SHIFT

$$\bar{Y} = \frac{(11.2149 - 11.1964) \times 23.5}{65} = +.00668$$

$$\bar{X} = \frac{(11.2095 - 11.1802) \times 23.5}{65} = +.01059$$

STATIC UNBALANCE (.0125)

$$T = 65 \times 16 \sqrt{.00668^2 + .01059^2} = \underline{\underline{13.024}} \text{ IN-OZ}$$

CONCLUSION: THE STATIC UNBALANCE RESULTING FROM THE LIQUID FILL PROCESS IS ESTIMATED TO BE 13.0 IN-OZ MAX, HOWEVER, THIS CONDITION WILL CHANGE DURING THE PRESSURIZATION PROCESS, REFERENCE CASE II

TABLE I

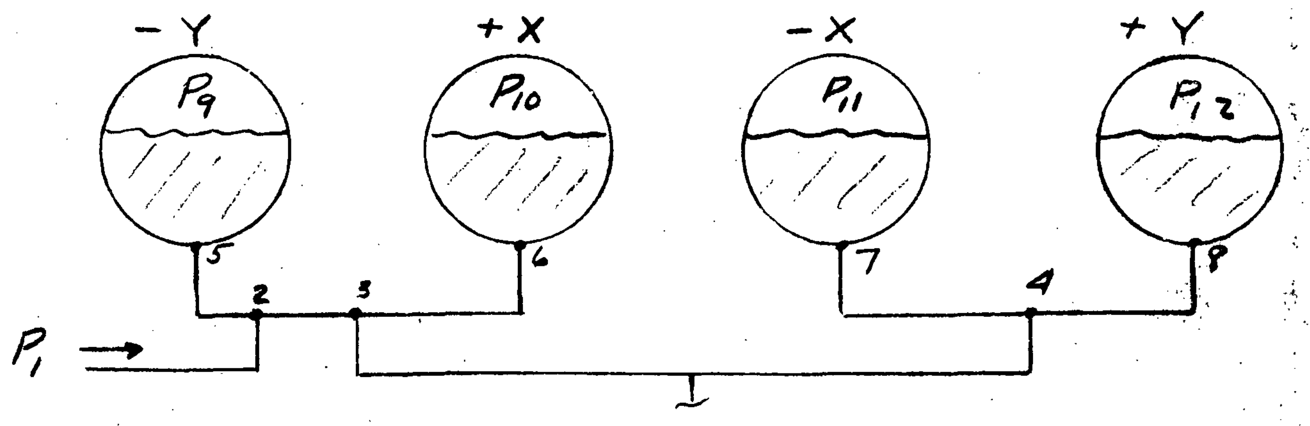
LINE VOLUME SUMMARY

LINE	VOL_{NOM} (IN^3)	VOL_{MAX} (IN^3)	VOL_{MIN} (IN^3)
1-2	.4362	.5074	.3746
2-5	.8376	.9741	.7193
2-3	.1919	.2231	.1648
3-6	1.0295	1.1973	.8841
3-4	1.1168	1.2988	.9583
4-7	1.0295	1.1973	.8841
4-8	1.0295	1.1973	.8841

TANK VOLUME SUMMARY

TANK	AXIS	(ACTUALS) VOLUME IN^3	
9	-Y	508.90	REF ACCEPTANCE TEST DATA
10	+X	509.46	
11	-X	508.63	
12	+Y	510.01	

Case II ~ Unbalance Due To Gas Filling



Statement Of Problem

Determine What Unbalance Will Result From The Gas Pressurization Process And Subsequent Stabilization Of Liquid

Analysis

The Approach Will Be To Take The Results Of The Mass Distribution Determined In Case I-B And Determin What The Final Distribution Of Propellant Will Be With The System Fully Pressurized.

II • Assume That Initially, The Propellant Distribution Is The Same As Case I-b

Vol. Of Propellant In Each Tank Initial

$$\left.\begin{array}{l} V_{P_9} = 311.013 \text{ in}^3 \\ V_{P_{10}} = 311.376 \text{ in}^3 \\ V_{P_{11}} = 310.561 \text{ in}^3 \\ P_{P_{12}} = 311.527 \text{ in}^3 \end{array}\right\} \quad \text{Ref Pg. 6}$$

- ASSUME THAT UPON INITIATION OF GAS FLOW, ALL THE PROPELLANT IN THE LINES FLOWS INTO THE TANKS AND REMAINS IN THE TANKS DURING & AFTER FILLING OF GAS. (ASSUMPTION VISUALLY CONFIRMED)

- ASSUME THAT EQUALIZATION OF PRESSURES OCCURS WITHOUT THE FLOW OF PROPELLANT FROM TANK TO TANK. (ASSUMPTION VISUALLY CONFIRMED)

FINAL VOLUMES OF PROPELLANT IN EACH TANK:

$\overline{V}_{P9} = V_{P9} + 25\% \, V_{1-2} + V_{2-5}$

$\overline{V}_{P10} = V_{P10} + 25\% \, V_{1-2} + 33\% \, V_{2-3} + V_{3-6}$

$\overline{V}_{P11} = V_{P11} + 25\% \, V_{1-2} + 33\% \, V_{2-3} + 50\% \, V_{3-4} + V_{4-7}$

$\overline{V}_{P12} = V_{P12} + 25\% \, V_{1-2} + 33\% \, V_{2-3} + 50\% \, V_{3-4} + V_{4-8}$

USING THE SAME CONDITIONS AS CASE I-B (pg. 5)

$\overline{V}_{P9} = 311.013 + (.25 \times .4362) + (.9741) = 312.0961 \text{ IN}^3$

$\overline{V}_{P10} = 311.376 + (.25 \times .4362) + (.33 \times .1919) + .8841 = 312.4325$

$\overline{V}_{P11} = 310.561 + (.25 \times .4362) + (.33 \times .1919) + (.50 \times .9583) + 1.1973 = 312.4098$

$\overline{V}_{P12} = 311.527 + (.25 \times .4362) + (.33 \times .1919) + (.50 \times .9583) + .8841 = 313.0626$

ASSUMING THAT THESE CONDITIONS ARE MAINTAINED AFTER PRESSURE EQUALIZATION, THE FINAL MASS OF PROPELLANT IN EACH OF THE TANKS IS

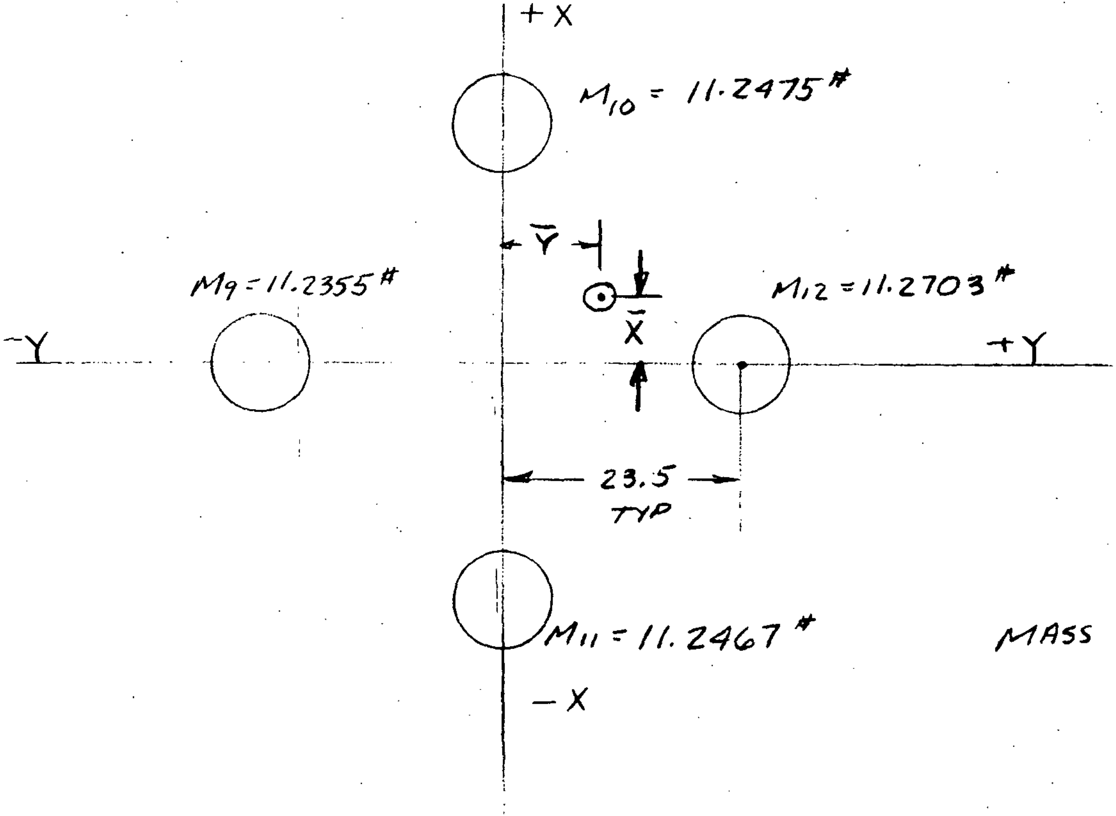
$$M_{9_{FINAL}} = 312.0961 \times .036 = 11.2355 \text{ lbm}$$

$$M_{10_{FINAL}} = 312.4325 \times .036 = 11.2475 \text{ lbm}$$

$$M_{11_{FINAL}} = 312.4098 \times .036 = 11.2467 \text{ lbm}$$

$$M_{12_{FINAL}} = 313.0626 \times .036 = 11.2703 \text{ lbm}$$

LOOK AT C.G. SHIFT & UNBALANCE



MASS SYSTEM =6

C.G. SHIFT

$$\overline{Y} = \frac{(11.2703 - 11.2355)(23.5)}{65}$$

$$\overline{X} = \frac{(11.2475 - 11.2467)\times}{65}$$

$$\overline{Y} = +.0125$$

$$\overline{X} = +.000289$$

TORQUE DUE TO C.G. SHIFT

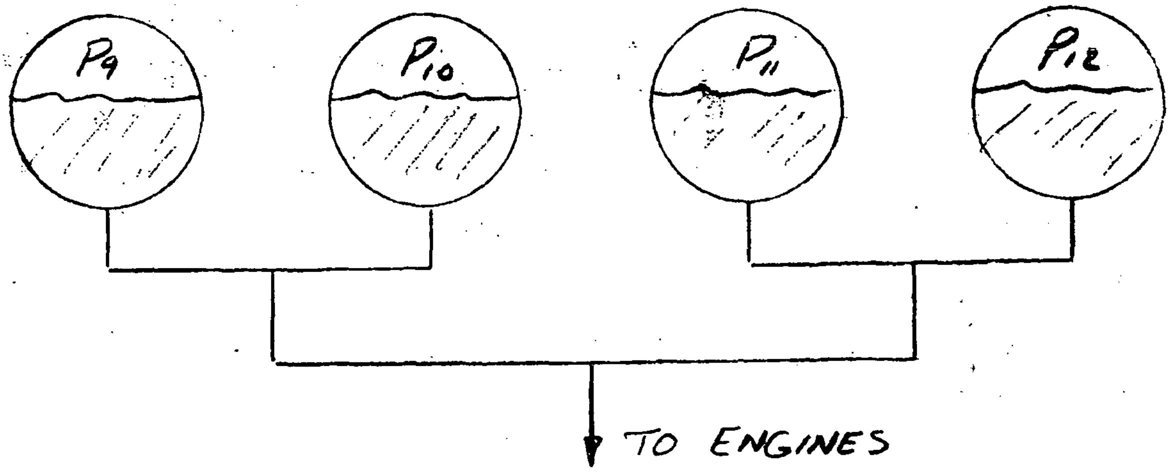
$$T = 65 \times 16 \sqrt{.0125^2 + .000289^2}$$

$$T = \underline{\underline{13.0 \text{ IN-OZ}}}$$

← NO CHANGE FROM C

I-B.

CASE III - UNBALANCE DUE TO LIQUID WITHDRAWAL



STATEMENT OF PROBLEM

- DETERMINE UNBALANCE RESULTING DURING LIQUID WITHDRAWAL FROM THE SYSTEM. USING A SYSTEM WHERE THE TANKS ARE NOT JOINED TO A COMMON GAS MANIFOLD. THE FACT THAT THERE ARE INITIALLY DIFFERENT VOLUMES OF GAS AND PROPELLANT IN EACH TANK (AT THE SAME INITIAL PRESSURE) MEANS THAT EACH TANK WILL EXPELL PROPELLANT AT DIFFERANT RATES IN ORDER TO MAINTAIN A PRESSURE BALANCED SYSTEM. THE NET RESULT IS PROPELLANT MASS UNBALANCE IN THE VARIOUS TANKS.
- DETERMINE EFFECT ON EXPUSION EFFICIENCY.

ANALYSIS

THE APPROACH WILL BE TO ASSUME THAT THERE IS SOME PROPELLANT MASS AND GAS VOLUME DISTRIBUTION (BASED ON RESULTS OF CASE I & II ANALYSIS). REMOVING PROPELLANT FROM THE SYSTEM WILL PRODUCE A FINAL

CONDITION IN THE SYSTEM ($P_9 = P_{10} = P_{11} = P_{12}$) WHEREBY THE FINAL GAS VOLUMES AND PROPELLANT MASSES IN EACH TANK CAN BE ESTIMATED AND RELATED TO UNBALANCE AND EXPULSION EFFICIENCY.

- ASSUME A MASS DISTRIBUTION AS DETERMINED IN CASE II FOR INITIAL CONDITIONS

VOL. OF PROPELLANT IN EACH TANK:

$\bar{V}_{P_9} = 312.0961$ IN^3
$\bar{V}_{P_{10}} = 312.4325$ IN^3
$\bar{V}_{P_{11}} = 312.4098$ IN^3
$\bar{V}_{P_{12}} = 313.0626$ IN^3

} REF. Pg 10

∴ THE VOLUME OF GAS IN EACH TANK IS

$\bar{V}_{g_9} = 508.90 - 312.0961 = 196.8039$ IN^3
$\bar{V}_{g_{10}} = 509.46 - 312.4325 = 197.0275$
$\bar{V}_{g_{11}} = 508.63 - 312.4098 = 196.2202$
$\bar{V}_{g_{12}} = 510.01 - 313.0626 = \underline{196.9474}$

TOTAL GAS VOL = 786.999 IN^3

ASSUME INITIAL PRESSURE IN EACH TANK = 275 psia

AFTER 1ST MIDCOURSE CORRECTION, $\Delta M = 31.4$ lbm

$$\Delta V_P = \frac{31.4}{.036} = 872 \text{ IN}^3$$

$$\therefore \quad P = \frac{275 \times 786.999}{872 + 786.999} = 130.455 \text{ PSIA}$$

VOLUMES OF GAS IN EACH TANK AFTER 1ST MID-COURSE CORRECTION

$$V_{g_9} = \frac{275 \times 196.8039}{130.455} = 414.8639 \text{ IN}^3$$

$$V_{g_{10}} = \frac{275 \times 197.0275}{130.455} = 415.3353 \text{ IN}^3$$

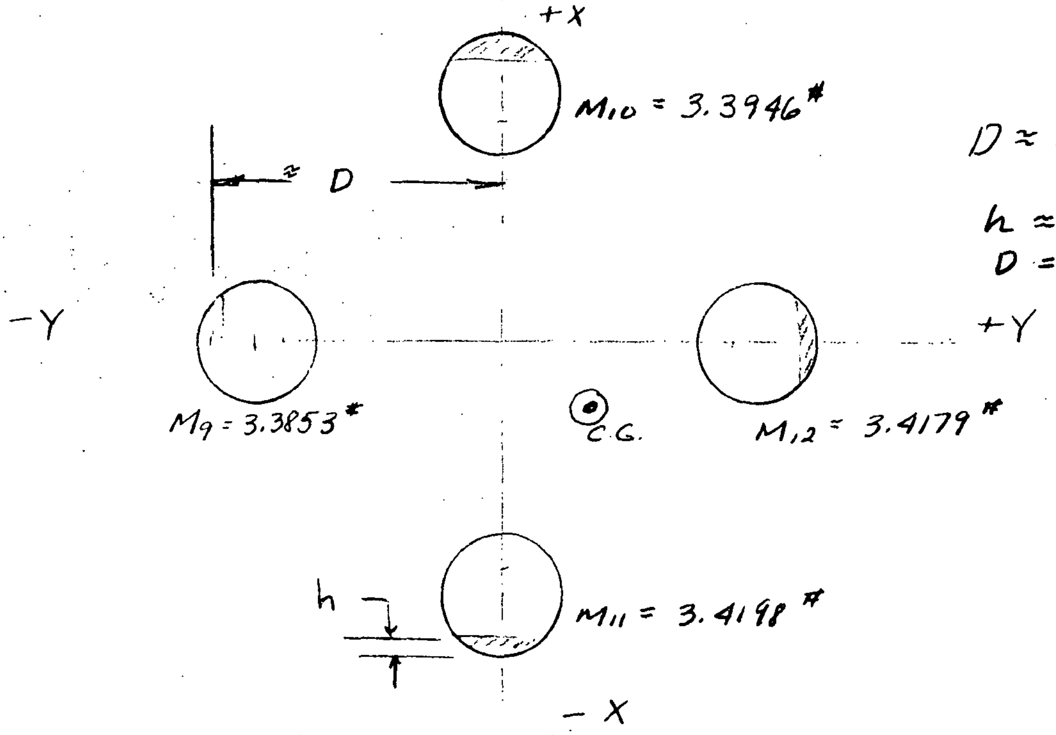
$$V_{g_{11}} = \frac{275 \times 196.2202}{130.455} = 413.6333 \text{ IN}^3$$

$$V_{g_{12}} = \frac{275 \times 196.9474}{130.455} = 415.1664$$

THEREFORE THE MASS OF PROPELLANT IN EACH OF THE TANKS AT THE END OF THE 1ST MIDCOURSE CORRECTION IS:

$$M_9 = (508.90 - 414.8639) \times .036 = 3.3853 \text{ lbm}$$
$$M_{10} = (509.46 - 415.3353) \times .036 = 3.3946$$
$$M_{11} = (508.63 - 413.6333) \times .036 = 3.4198$$
$$M_{12} = (510.01 - 415.1664) \times .036 = 3.4179$$

LOOK @ C.G. SHIFT & STATIC UNBALANCE



$D \approx 28.5 - \frac{h}{2}$

$h \approx 2.8$

$D = 27.1$

$$\bar{Y} = \frac{(3.4179 - 3.3853)(27.1)}{65 - 31.40} = +.0263 \text{ IN}$$

$$\bar{X} = \frac{(3.3946 - 3.4198)(27.1)}{65 - 31.40} = -.0203 \text{ IN}$$

$$\text{STATIC UNBALANCE} = (65 - 31.40)(16)\sqrt{.0263^2 + .0203^2}$$
$$= \underline{\underline{17.86 \text{ IN-OZ}}}$$

NOW LOOK AT END OF MISSION WHERE GAS INGESTION INTO THE LINES OCCURS: AT THE TIME OF GAS INGESTION, ASSUME THAT THE VOLUME OF PROPELLANT IN THE TANK AT WHICH INGESTION OCCURS IS

$$V_P = .031 \text{ IN}^3$$

(THIS QUANTITY HAS BEEN DETERMINED FROM PREVIOUS ANALYSIS DATED 7-71 BY P. FALK)

AS A FIRST GUESS, ASSUME THAT INGESTION OCCURS AT TANK 9.

$$\therefore \text{FINAL PRESSURE} = \frac{275 \times 196.8039}{(508.90 - .031)} = 106.355_{\text{psiA}}$$

∴ FINAL VOLUME OF PROPELLANT IN OTHER TANKS IS

$$V_{P_9} = .031 \text{ IN}^3$$

$$V_{P_{10}} = 509.46 - \frac{275 \times 197.0275}{106.355} = .010 \text{ IN}^3$$

$$V_{P_{11}} = 508.63 - \frac{275 \times 196.2202}{106.355} = 1.263 \text{ IN}^3$$

$$V_{P_{12}} = 510.01 - \frac{275 \times 196.9474}{106.355} = .755 \text{ IN}^3$$

NOTE: SINCE $V_{P_{10}} < V_{P_9}$ INGESTION WILL OCCUR IN TANK 10

FOR THIS CONDITION THEN, THE FINAL PRESSURE BECOMES

$$P_F = \frac{275 \times 197.0275}{(509.46 - .031)} = 106.360$$

$$\therefore M_{P_9} = \left(508.90 - \frac{275 \times 196.8039}{106.360}\right) \times .036 = .00173 \text{ lb}_m$$

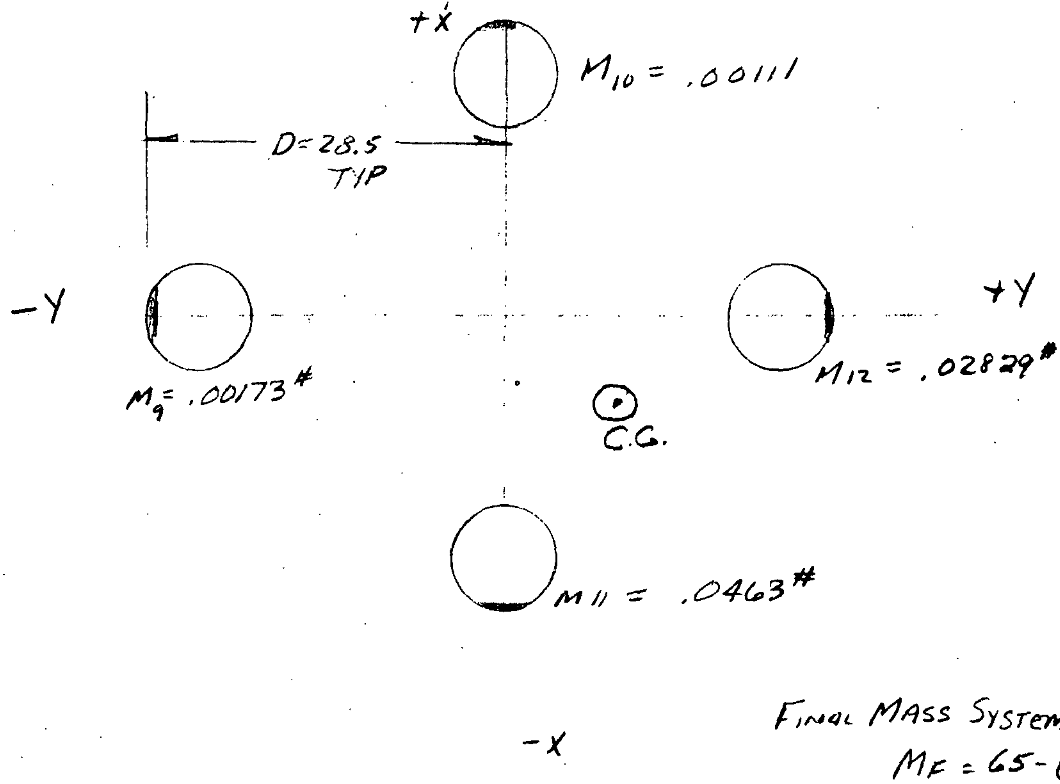
$$M_{P_{10}} = .031 \times .036 = .00111 \#_m$$

$$M_{P_{11}} = \left(508.63 - \frac{275 \times 196.2202}{106.360}\right) \times .036 = .04630$$

$$M_{P_{12}} = \left(510.01 - \frac{275 \times 196.9474}{106.360}\right) \times .036 = .02829$$

TOTAL PROPELLANT MASS IN TANK = .07743 lbm

LOOK AT C.G. SHIFT & STATIC UNBALANCE



FINAL MASS SYSTEM :

$M_F = 65-(45-.077$

$= 20,077$#

$$\overline{Y} = \frac{(.02829-.00173)\times 28.5}{20.077} = {}^{+}.0377 \text{ IN}$$

$$\overline{X} = \frac{(.00111-.0463)\times 28.5}{20.077} = -.0641 \text{ IN}$$

STATIC UNBALANCE = $20.077 \times 16 \times \sqrt{.0377^2 + .0641^2}$

= 23.9 IN-oz

EXPULSION EFFICIENCY = $\left(\frac{45-.07743}{45}\right) \times 100 = 99.83$

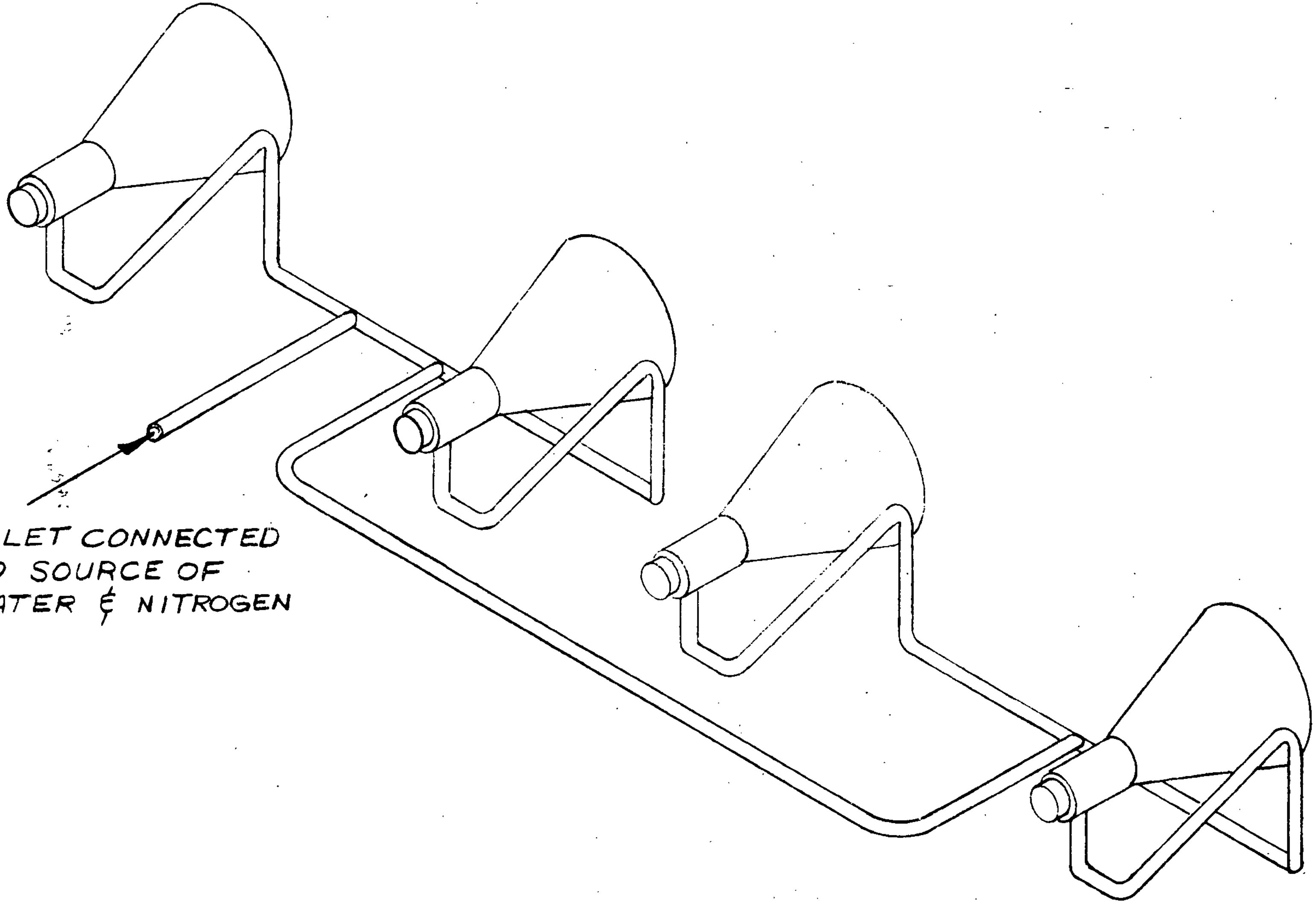
CONCLUSIONS/SUMMARY :

- STATIC UNBALANCE AT START OF LIQ. WITHDRAWAL = 13.0
- STATIC UNBALANCE AT END OF 1ST MIDCOURSE CORRECTION = 17.8
- " " " TIME OF GAS INGESTION = 23.9
- EXPULSION EFFICIENCY = 99.83%

SUMMARY OF FLOW DEMONSTRATION TEST

Prior to preparing the flow analysis for Method IV-B a laboratory test set-up was made of the system to demonstrate physically how the liquid and gas flowed in this configuration. Using flasks and tubing the conceptual arrangement of the VCPS tanks and lines was simulated. This set-up was then connected to a source of water and nitrogen to demonstrate the liquid and gas fill procedure. A sketch of the demonstration set-up is included.

The fill procedure was that which would be required to fill the arrangement as shown in Method IV-B where the propellant must be loaded prior to final pressurization thru the single fill and drain port. Water was introduced into the system and the flow observed as each of the line and flasks filled. As expected, the line to the flask closest to the fill port started to fill first with flow continuing to the remaining flasks. This filling sequence results because the gas remaining in the lines is displaced and compressed into each of the flasks. In the actual system this procedure will occur and the first part of the preceding flow analysis shows the magnitude of this effect. After partially filling the flasks with water, nitrogen was introduced slowly into the set-up and the flow visually observed. Again the fluid in the line closest the fill port was displaced first with the longest lines filling last. As the flasks were pressurized with nitrogen there was no evidence that any uneven flow condition existed other than the initial distribution of fluid within the feed lines to the flasks. The magnitude of the propellant quantity differences between tanks after final pressurization and stabilization is shown in the previous analysis section. As a part of the flow demonstration test, the flasks closest and farthest from the fill port were weighed prior to and after filling and pressurization. The difference in weight was that attributable to the fluid displaced in the manifold. The fluid flow analysis and demonstration test appear to indicate that the tanks will fill equally by Method IV-B with any propellant unbalance being the result of tank geometry tolerances and propellant displaced from the feed lines.



INLET CONNECTED
TO SOURCE OF
WATER & NITROGEN

METHOD IV-B TEST CONFIGURATION

APPENDIX

Specification SVHS 5997

"Valve and Bracket, Qualification Test Plan For"

HSF-755K 4-70

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION
WINDSOR LOCKS, CONNECTICUT · U.S.A.

CODE IDENT NO.	SPECIFICATION NO.	REV
73030	SVHS 5997	

PAGE 1 OF 6

SPECIFICATION TITLE VALVE AND BRACKET,
QUALIFICATION TEST PLAN FOR

PREPARED BY E.K. Moore DATE
APPROVED BY 1/29/7 QUALITY DATE

APPROVED BY 1/25/73 PROJECT DATE
APPROVED BY PURCHASING DATE

APPROVED BY TECH. STANDARDS DATE
APPROVED BY MANUFACTURING DATE

APPROVED BY MATERIALS DATE
APPROVED BY 1-3 DESIGN DATE

APPROVED BY SPEC. CONTROL DATE
APPROVED BY RELIABILITY DATE

APPROVED BY DATE
APPROVED BY 1/31 Operations DATE

APPROVED BY DATE
APPROVED BY DATE

CUSTODIAN

EXP. RELEASE D.J. Gonyea 2/6/73 DATE PROD. RELEASE DATE

E42

1.0 SCOPE

This document specifies the Qualification Testing to be performed on the Valve and Bracket to be used on the RAE-B VCPS. The valve and bracket will be added to the VCPS subsequent to its qualification tests and the tests required herein will demonstrate the suitability of the valve and bracket for use on the qualified subsystem.

2.0 GENERAL

2.1 Applicable Documents

2.1.1 Military

MIL-STD-810	Environmental Test Methods

2.1.2 Others

S-723-P-19	Subsystem Specification, VCPS
S-320-G-1	General Environmental Test Specification for Spacecraft and Components
S-320-RAE-3	Subsystem Test Specification for RAE-B
NHB 5300.4 (1B)	Quality Program Provisions for Space Systems Contractors
NPC 200-3	Inspection, System Provisions for Suppliers of Space Components
NPC 250-1	Reliability Program Provisions for Space Systems Contractors

3.0 TEST OBJECTIVE

The purpose of this qualification test is to demonstrate the suitability of a Fill and Vent Valve and Bracket subassembly for use on the qualified RAE-B VCPS.

4.0 TEST PROGRAM

The test program shall consist of the following tests:

Test	Test Paragraph
Leakage	4.1.1
Vibration	4.1.2
Leakage	4.1.1

4.1 Test Descriptions

4.1.1 Leakage

4.1.1.1 Objective - The purpose of the leakage test is to demonstrate leakage integrity of the valve before and after being subjected to vibration.

4.1.1.2 Facilities - The leakage test shall be performed using standard helium leak test equipment, such as the Veeco leak detector.

4.1.1.3 Test Setup - The leakage test shall be setup and tested per Figure 1.

4.1.1.4 Test Procedure

a. Mount the valve per Figure 1.

b. Calibrate the helium leak detector.

c. Pressurize the valve to 300 ± 5 psia with helium with the cap off.

d. Record valve leakage rate for 3 minutes.

e. Depressurize and cap the valve.

f. Pressurize the valve to 300 ± 5 psia with helium.

g. Record valve leakage for 3 minutes.

h. Shut off helium supply and depressurize.

NOTE: To close fill and vent valves, torque nut to 25 ± 2 in-lbs above running torque. (Running torque is that torque required to turn nut before valve bottoms out). To open fill and vent valves, turn nut 1 1/2 turns in opening direction from closed position. When caps are installed, torque to 45 - 60 in-lbs.

4.1.1.5 Acceptance Criteria

a. Leakage in the uncapped condition shall not exceed 1.0×10^{-4} scc helium.

b. Leakage in the capped condition shall not exceed 1.0×10^{-6} scc helium

4.1.2 Vibration

4.1.2.1 Objective - The purpose of the vibration test is to demonstrate the capability of the valve and bracket to withstand without deleterious effects, the vibration requirement of SP-723-P-19.

4.1.2.2 Facilities - The vibration test shall be performed at Hamilton Standard in the Space Systems Laboratory.

4.1.2.3 Test Setup - The valve and bracket shall be hard mounted to a fixture per Figure 2. Accelerometers shall be installed per Figure 2. The valve shall be closed and capped (see note paragraph 4.1.1.4). For axis definition see SV748720.

4.1.2.4 Test Procedure - Subject the valve and bracket to the vibration levels below.

Sinusoidal

Axis	Frequency (Hz)	Level	Sweep Rate Octave/Min.
Z	5-11	.48 in. DA	2.0
	11-17	± 2.3 gpk	2.0
	17-23	± 6.8 gpk	1.5
	23-200	± 2.3 gpk	2.0
	200-700	± 3.0 gpk	2.0
	700-2000	± 10.0 gpk	2.0
X & Y	6-8.9	.75 in. DA	2.0
	8.9-14	± 3.0 gpk	2.0
	14-200	± 1.5 gpk	2.0
	200-600	± 5.0 gpk	2.0
	600-2000	± 7.5 gpk	2.0

Random

Axis	Frequency (Hz)	PSD	Grms	Duration
X, Y, Z	20	.0029 g^2/Hz	9.16	4 min. per axis
	20-500	+3 db/oct		
	300-2000	.045 g^2/Hz		

NOTE: The filter roll off characteristic above 2000 Hz shall be at a minimum rate of 40 db/octave or greater.

4.1.2.5 Acceptance Criteria - Visual examination shall reveal no permanent damage.

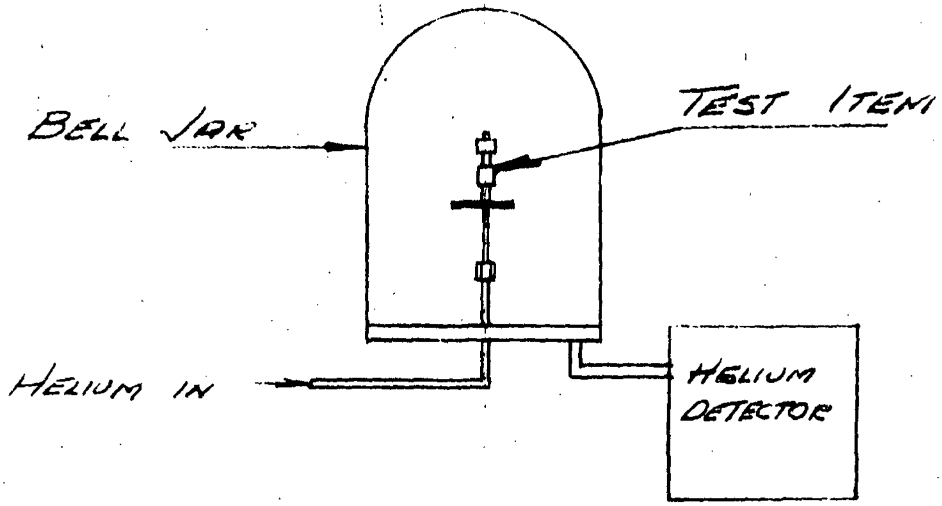


FIGURE 1

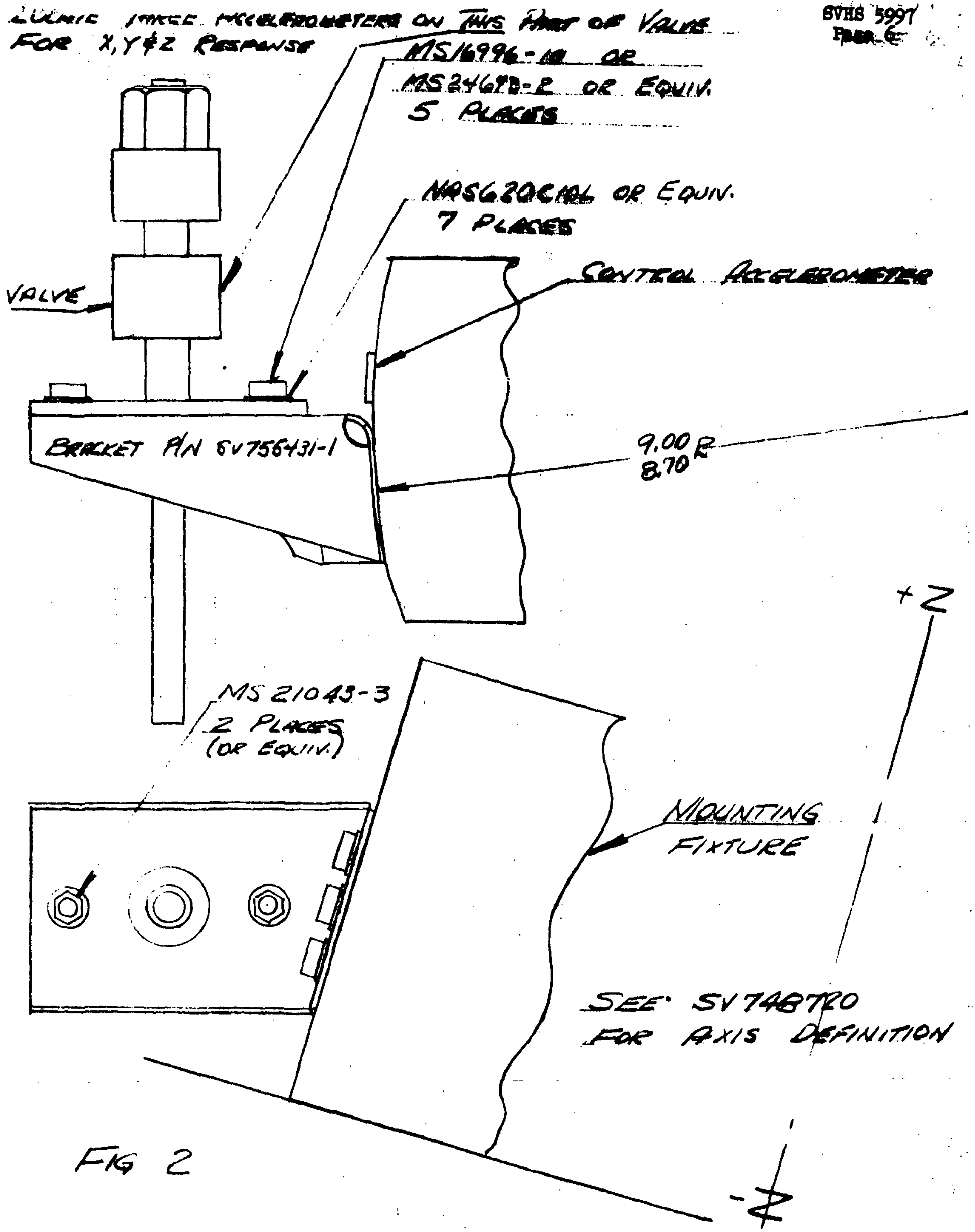

LOCATE THREE ACCELEROMETERS ON THIS PART OF VALVE FOR X,Y&Z RESPONSE
MS16996-10 OR MS24693-2 OR EQUIV. 5 PLACES
NAS620C10L OR EQUIV. 7 PLACES
VALVE
CONTROL ACCELEROMETER
BRACKET P/N SV756431-1
9.00 R
8.70
+Z
MS 21043-3 2 PLACES (OR EQUIV.)
MOUNTING FIXTURE
SEE SV748720 FOR AXIS DEFINITION
-Z

FIG 2

SVHSER 6184

APPENDIX

Qualification Test Report

SLS TEST ENGINEERING
TEST REPORT

FILE CODE TER 2769
DATE 3/30/73

ROGRAM RAE-B TEST ITEM VALVE & BRACKET S/N

AME OF TEST QUALIFICATION DATE OF TEST 2/12 - 2/21/73

EST SPECIFICATION SVHS5997 TEST PLAN —

ONCLUSIONS THE FILL AND VENT VALVE SATISFIED LEAKAGE TEST REQUIREMENTS BEFORE AND AFTER BEING SUBJECTED TO THE VIBRATION TEST ENVIRONMENT. NO STRUCTURAL DAMAGE WAS OBSERVED ON THE VALVE OR BRACKET AS A RESULT OF VIBRATION.

ECOMMENDATIONS (OPTIONAL)

BSERVATIONS (OPTIONAL) THE ITEM WHICH SUCCESSFULLY COMPLETED THE QUALIFICATION TEST INCLUDED BRACKET, P/N SV750431-1 AND FILL & VENT VALVE P/N SV722430-1, S/N 31713-2 COPIES OF THE VIBRATION TEST CONTROL CURVES AND A SUMMARY OF THE LEAKAGE TEST RESULTS ARE INCLUDED. VALVE S/N 24512-2 FAILED LEAKAGE BEFORE VIBRATION. THE VALVE WAS FLUSHED WITH I.PA AND RETESTED, RESULTING IN ANOTHER LEAK TEST FAILURE THE VALVE WAS SHIPPED TO NASA FOR ANALYSIS AND REPLACED WITH S/N 31713-2.

OTAL TEST TIME

NDURANCE CYCLES NONE

RIGINAL COPY

C: CHIEF OF RELIAB./CHIEF OF DESIGN
EST ENGINEERING FILE

EST ENGINEER WALTER E. SMITH APPROVED/DATE Robert R Mero 3/30/73

IGNATURE W. E. Smith

ATE 3/30/73

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION
WINDSOR LOCKS, CONNECTICUT

TEST SUMMARY SHEET

TEST ITEM FILL & VENT VALVE

P/N SV722930-1 S/N 31713-2

P.O. 2-18828-c

MANUFACTURER VACCO

USED ON VCPS

W E Smith 3/30/73
PREPARED BY

APPROVED BY

TEST DATE	LOG SHEET	P.O.T. REF.	SPEC. REF.	TEST TITLE TEST CONDITIONS	SPEC. LIMITS	MEASURED VALUES		NO. SAMPLES		REMARKS CURVES NO. DATA SHEET
						MIN.	MAX.	TESTED	PASSED	
2/16/73			SVHS 5497	LEAKAGE BEFORE VIBRATION						
				CAPPED	1×10^{-6} SCC/SEC. MAX		$.6 \times 10^{-7}$			
				UNCAPPED	1×10^{-4} SCC/SEC MAX		$.2 \times 10^{-7}$			
2/21/73				LEAKAGE AFTER VIBRATION						
				CAPPED	SAME AS ABOVE		1.2×10^{-7}			
				UNCAPPED			$.8 \times 10^{-7}$			

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION
WINDSOR LOCKS, CONNECTICUT 06096

SPACE & LIFE SYSTEMS LABORATORY

LOG OF TEST

Qual. Vib. Test

TEST ENGINEER K. Bradford

NAME OF RIG #26

PROJECT & ENG. ORDER NO. A51-RLS-001A

TEST PLAN NO. SVHS 5997

MODEL NO. FILL & VenT Valve

PART NO. SV755431-1 BrackeT

SERIAL NO. SV222930-1 Valve 21773-2

OPERATORS Jodoin, Cove

QCY

Run #	Time Start	Axis	mode	G's Pk	min Scan rate	G's Rms	Time in min's	P	
2	1405	x	Sine	1.0	3.0	–	.	4.1.2-4	
3	1425	x	Sine	7.5	2.0	–	.	4.1.2-5	
4	1505	y	Sine	1.0	3.0			4.1.2-4	
5	1520	y	Sine	7.5	2.0	-	-	4.1.2-5	A. McCarthy 2/19/73
7	1820	y	RAND	–	–	9.16	4.0	4.1.2-5	(KC) 2-19-73.
8	1915	X	RAND	–	–	9.16	4.0	4.1.2-5	
2-20-73									
10	1035	Z	RAND	—	–	9.16	4.0	4.1.2-5	Pauly 2/20/73
11	1110	Z	SINE	1	3.0	—	—	4.1.2-4	
12	1135	Z	SINE	10	2.0 1.5	—	—	4.1.2.5	

FOR RUN 2-8 the X & Y axis were misoriented by 36°
SEE FIG. 2 FOR ACTUAL ORIENTATION

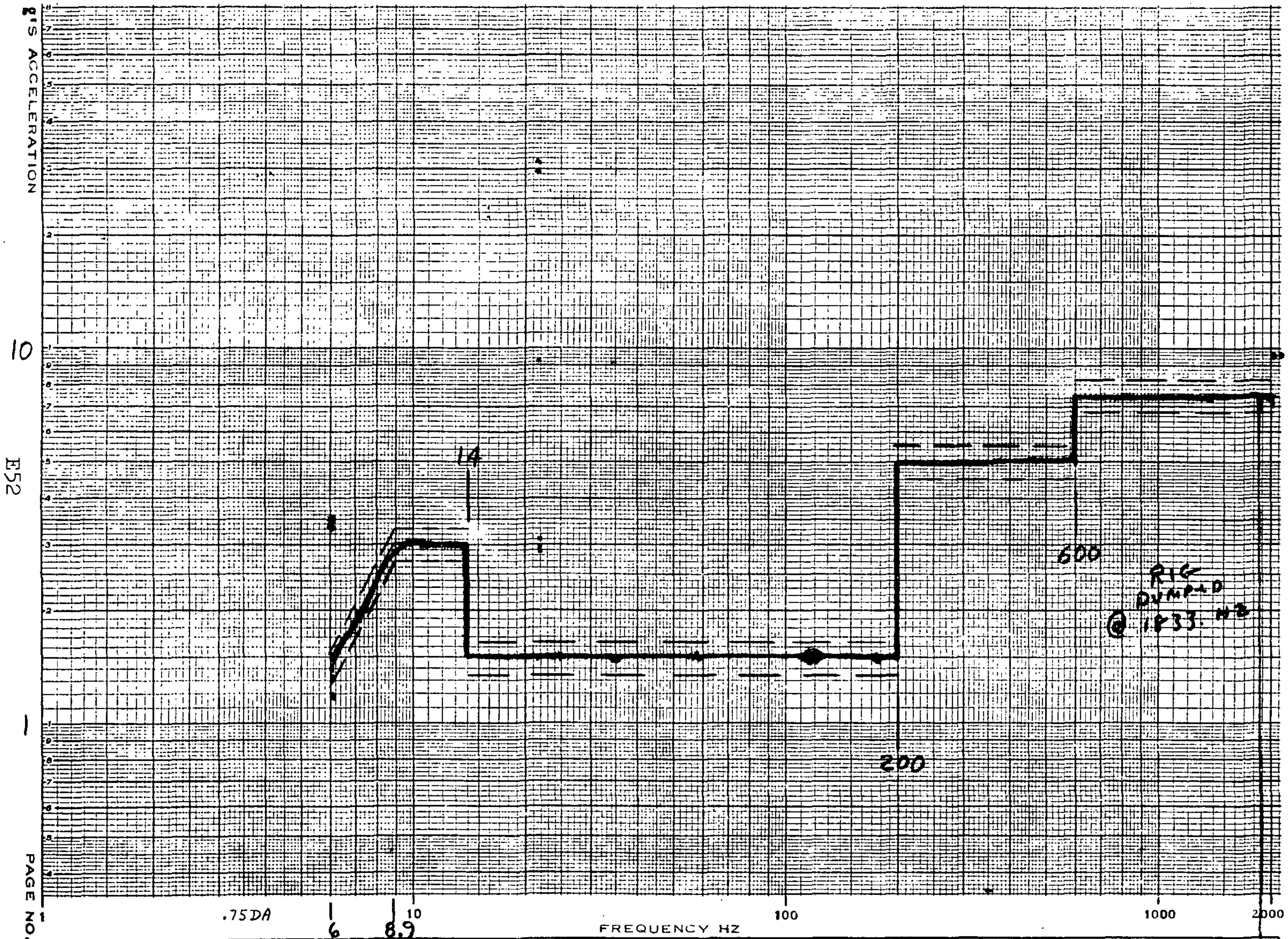
REMARKS: DCAS present at start of runs - A. McCarthy 2-19-73

8352

Hamilton Standard — DIVISION OF UNITED AIRCRAFT CORPORATION   HSF-1633.1 2/69

SINE VIBRATION TEST

RIG: 26
OPERATOR: JODIN-COVE
WITNESS:
WITNESS: Note Unit History #1 A. McCarthy 7/19/73
TEST NO.: 3
TEST ENGINEER: K. BRADFORD
CHECKED BY:
PROJECT: RAE-B
DATE: 2/19/73
TIME: 1425



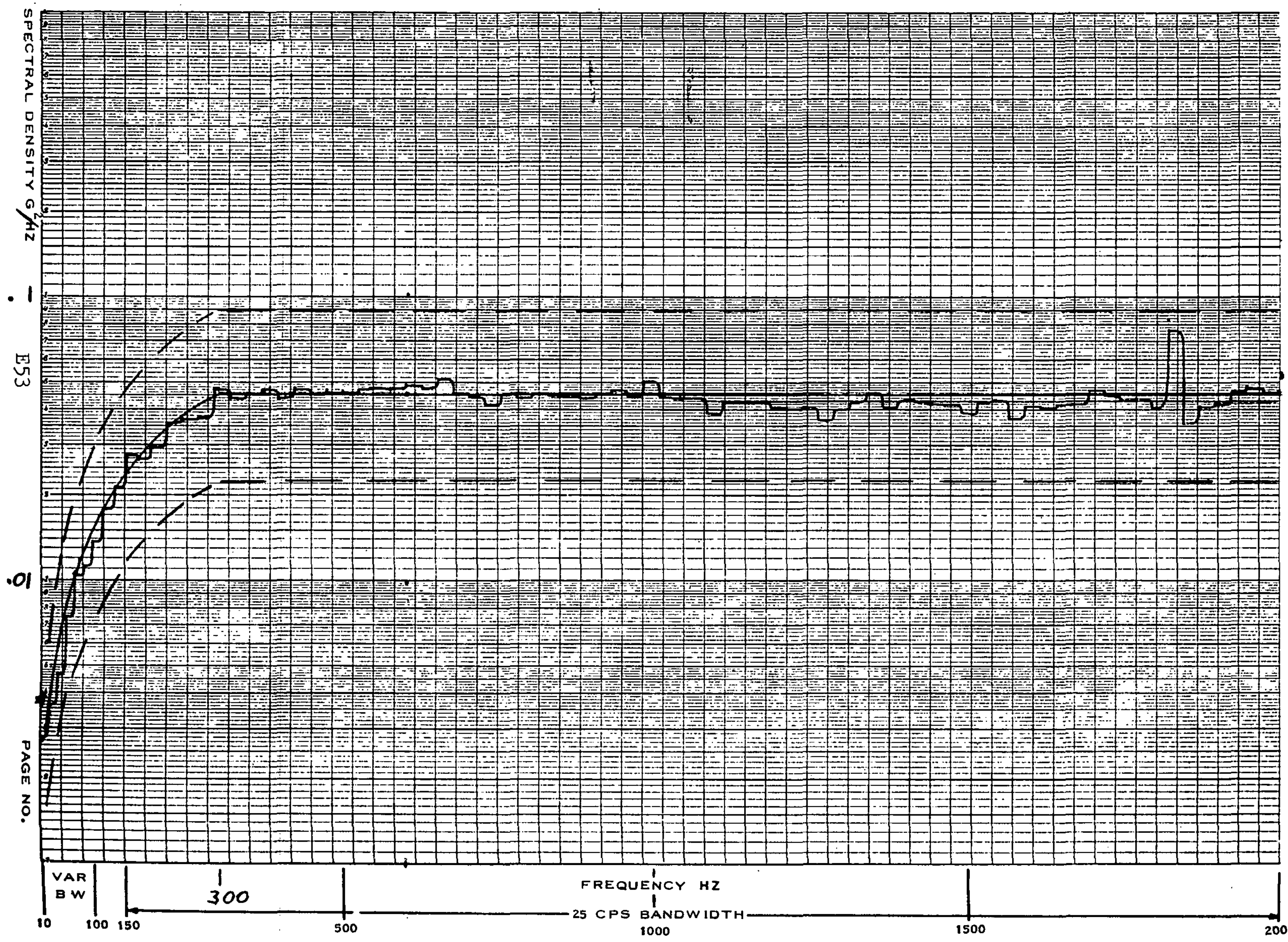
INPUT LEVEL: 7.5 g
EXCIT. AXIS: X
ACCEL S/N: TG17
SENSING AXIS: X
ACCEL SENSITIVITY: — MV RMS / GP; 2.706 COL / GP
FILTER: 10-20-100 HZ B.W.
FILTER CROSSOVER @ 70-700 HZ
SWEEP RATE: 2 OCT/MIN
TAPEREEL NO.: 021504
☑ LIVE
☐ FROM TAPE
COMPR. SPEED: VAR DB/SEC.
CHG.@ HZ TO DB/SEC.
CHG.@ HZ TO DB/SEC.
NON OPERATING ✓
☒ CONTROL
☐ RESPONSE
TEMP. 75 °F
LOCATION: AX
SPECIAL CONDITIONS:
REPORT NO.:

FREQ. RANGE & DIRECTION: 6-2000
ITEM: RAE-B VALVE
CODE:
SERIAL NO.: 31713.2
SPEC.: SVHS5997
PARA.: 4.1.2.4
AMEND.: —
ACTION SHEET NO.: —
ATA NO.: —
TYPE OF TEST: QUAL SINE
NAME OF TEST: QUAL

HSF-1634A **Hamilton Standard** DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD A

PLOTTED BY P. JODOIN	CHECKED BY	TEST ENGINEER K. BRADFORD	RIG NO. 26	WITNESS Hiles (KG) 2-19-73	WITNESS
PROJECT RAE-B	ITEM FILL & VENT VALVE	CODE —	SERIAL NO. 31713.2	TYPE OF TEST QUAL	
SPEC. SVHS 5997	PARA. 4.1.2-5 / PHASE —	ATA NO. —	ACTION SHEET NO. —	DATE 2-19-73	TEST NO. 8



EXCITATION ALONG X AXIS

GRMS INPUT 9.16

NON-OPERATING

TEMP. 75 °F

PERIOD OF TEST ☒ START ☐ END

DURATION OF TEST 4.0 MIN.

ACCEL. SERIAL NO. TG17

ACCEL. SENSITIVITY — MV RMS/GP

2.706 COL/GP

ACCEL. SENSING X AXIS

ACCEL. LOCATION AX

SPECIAL CONDITIONS

REPORT NO.

E53

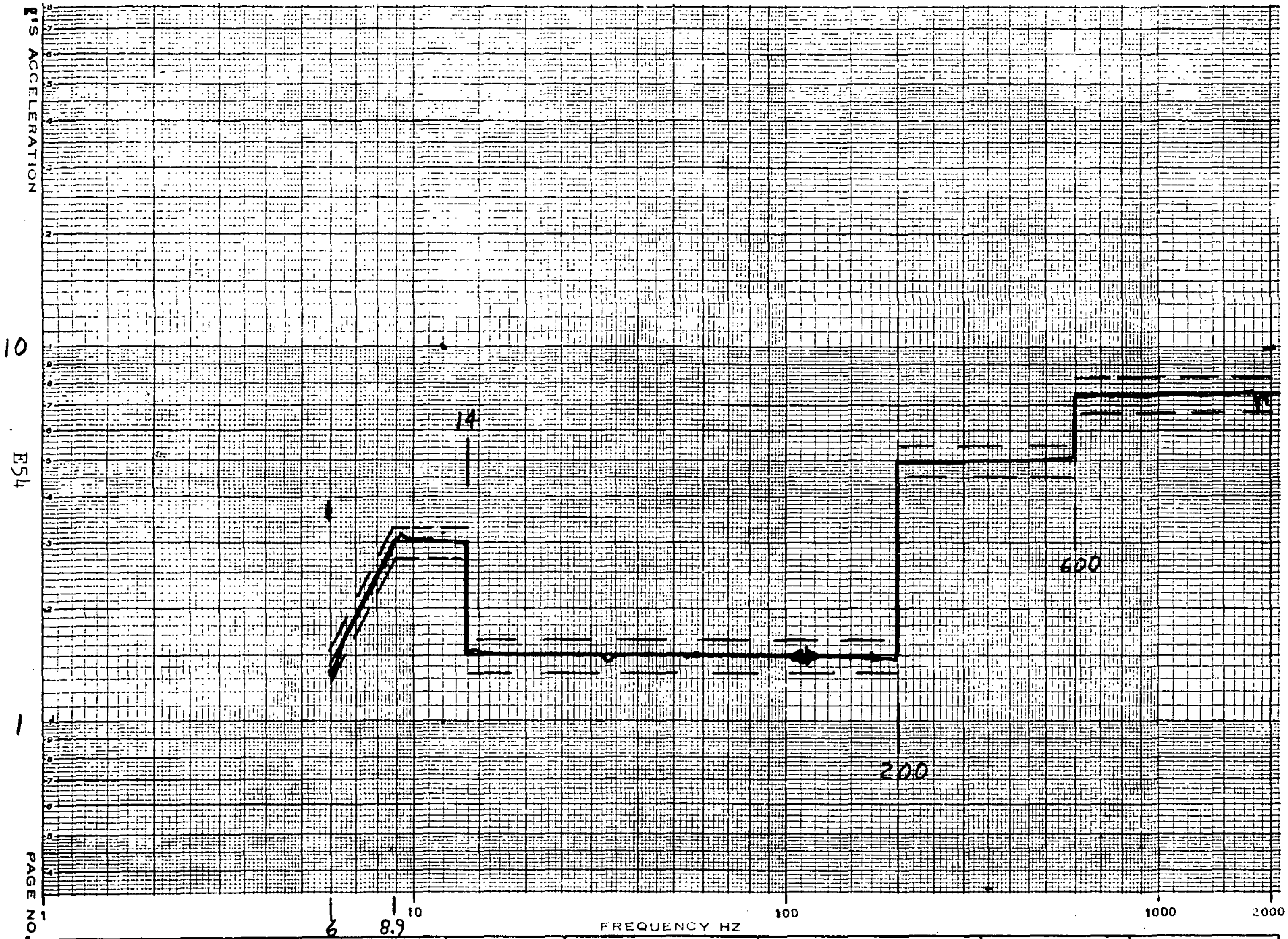
308<

Hamilton Standard
DIVISION OF UNITED AIRCRAFT CORPORATION

HSF-1633.1 2/69

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN - COUVE	WITNESS	WITNESS 2/19/73	TEST NO. 5
TEST ENGINEER K BRADFORD	CHECKED BY	PROJECT RAE - B	DATE 2-19-73	TIME 1520



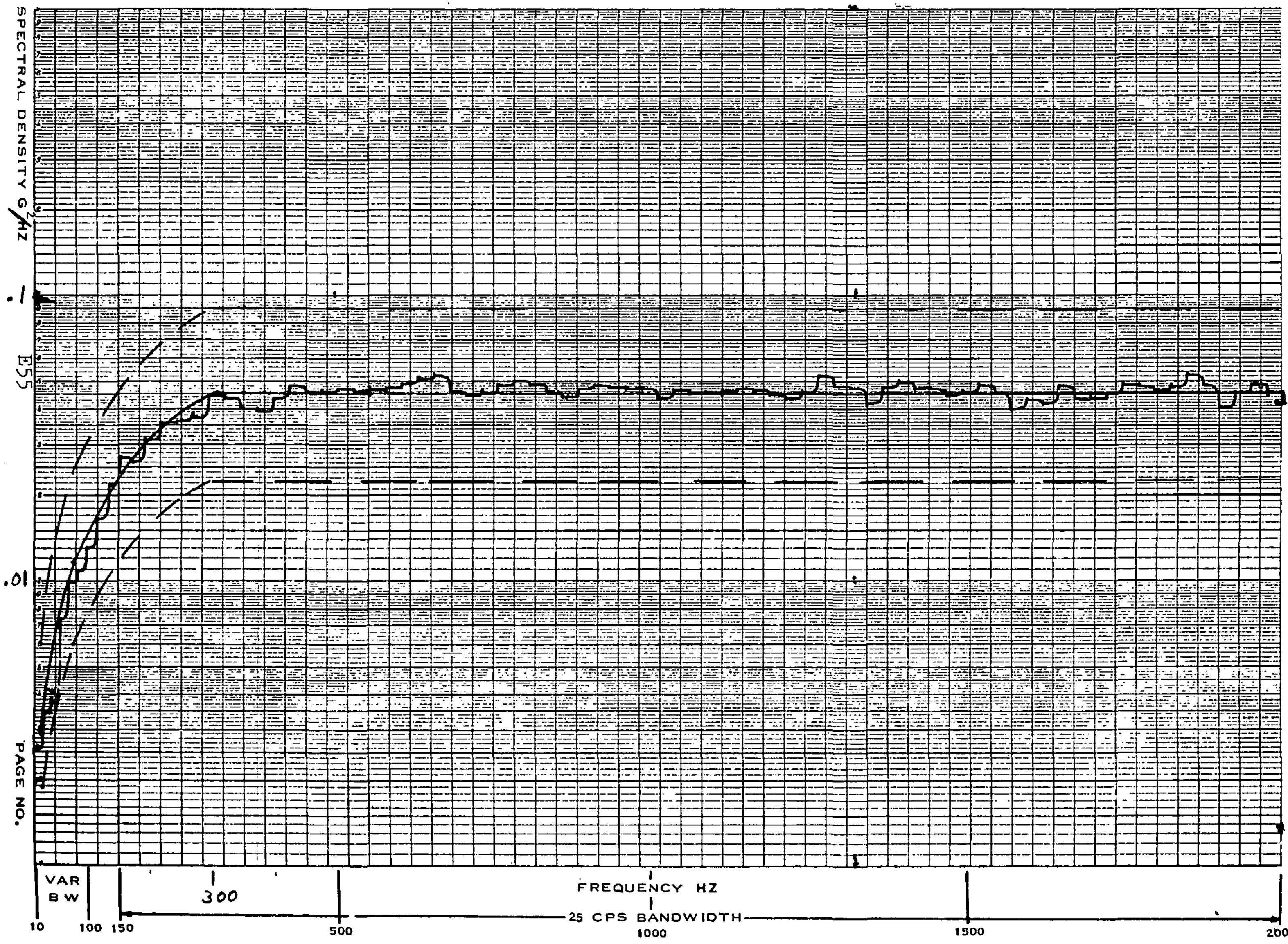
INPUT LEVEL 7.5 g	EXCIT. AXIS Y
ACCEL S/N UJ78	SENSING AXIS Y
ACCEL SENSITIVITY — 2.961	MV RMS / GP COL / GP
FILTER 10-20-10U HZ B.W.	
FILTER CROSSOVER @ 70-700 HZ	
SWEEP RATE 2 OCT/MIN	
TAPEREEL NO. 021504	☐ LIVE ☐ FROM TAPE
COMPR. SPEED VAR DB/SEC.	
CHG.@ HZ TO DB/SEC.	
CHG.@ HZ TO DB/SEC.	
NON OPERATING	☐ CONTROL
TEMP. 74 °F	☐ RESPONSE
LOCATION A Y	
SPECIAL CONDITIONS	REPORT NO.

FREQ. RANGE & DIRECTION 6-2000	ITEM RAE-B VALVE	CODE	SERIAL NO. 31713.2	SPEC. SVHS5997	PARA. 4.1.2.4	AMEND.
ACTION SHEET NO.	ATA NO.	TYPE OF TEST SINE		NAME OF TEST QUAL		

HSF-1634A **Hamilton Standard** DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD A

PLOTTED BY P. JODOIN	CHECKED BY	TEST ENGINEER K. BRADFORD	RIG NO. 26	WITNESS 2-19-73	WITNESS
PROJECT RAE-B	ITEM FILL & VENT VALVE	CODE —	SERIAL NO. 31713.2	TYPE OF TEST QUAL	
SPEC. SVHS 5997	PARA. 4.1.2-5	PHASE — / ATA NO. —	ACTION SHEET NO. —	DATE 2-19-73	TEST NO. 7



EXCITATION ALONG Y AXIS

GRMS INPUT 9.16

NON-OPERATING

TEMP. 75 °F

PERIOD OF TEST ☒ START ☐ END

DURATION OF TEST 4.0 MIN.

ACCEL. SERIAL NO. UJ78

ACCEL. SENSITIVITY — MV RMS/GP

2.961 COL/GP

ACCEL. SENSING Y AXIS

ACCEL. LOCATION AY

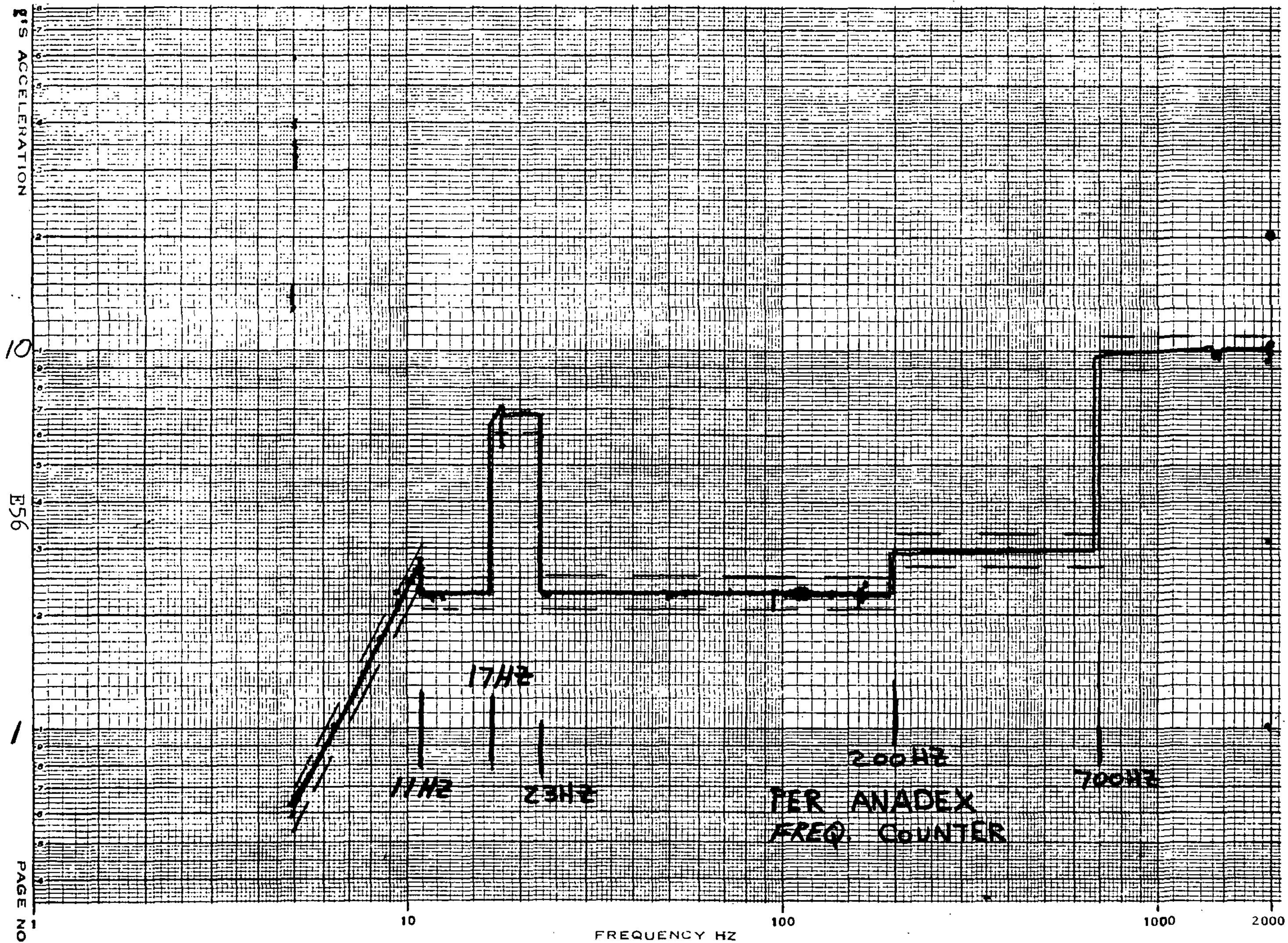
SPECIAL CONDITIONS

REPORT NO.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION HSF-1633.1 2/69

SINE VIBRATION TEST

RIG 26	OPERATOR JODOIN	WITNESS 2/20/73	WITNESS		TEST NO. 12
TEST ENGINEER MEHMED	CHECKED BY	PROJECT RAE-B		DATE 2-20-73	TIME 1135



INPUT LEVEL 10 g

EXCIT. AXIS Z

ACCEL S/N VL29

SENSING AXIS Z

ACCEL SENSITIVITY —— MV RMS / GP

2.687 COL / GP

FILTER 10/20/100 HZ B.W.

FILTER CROSSOVER @ 70/140 HZ

SWEEP RATE 2.0 EXCEPT 1.5 BETWEEN 17 & 23HZ OCT/MIN

TAPEREEL NO.

☒ LIVE

☐ FROM TAPE

COMPR. SPEED VARI DB/SEC.

CHG.@ — HZ TO — DB/SEC.

CHG.@ — HZ TO — DB/SEC.

NON OPERATING

☒ CONTROL

☐ RESPONSE

TEMP. 73 °F

LOCATION Az

SPECIAL CONDITIONS

REPORT NO.

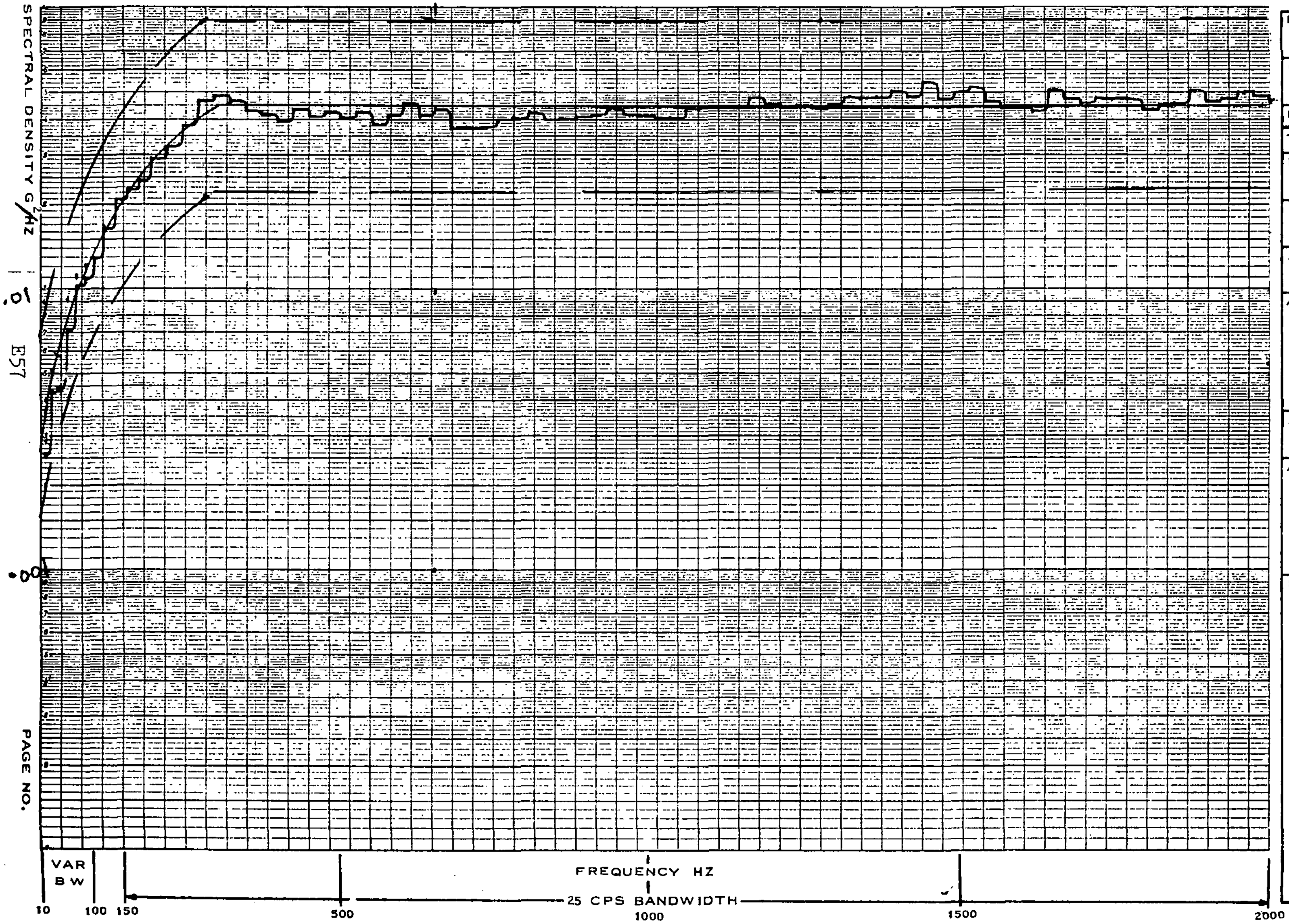
PAGE NO.

FREQ. RANGE & DIRECTION 5-2000	ITEM F/V	CODE	SERIAL NO. 31713-2	SPEC. SVHS 5997 AT-F/V	PARA. 4.1.2
ACTION SHEET NO. —	ATA NO. —	TYPE OF TEST QUAL		NAME OF TEST SINUSOIDAL	AMEND.

HSF-1534A amilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

RANDOM VIBRATION TEST
ANALYSIS METHOD A

PLOTTED BY P. JODOIN	CHECKED BY	TEST ENGINEER MEHMED	RIG NO. 26	WITNESS	WITNESS
PROJECT RAE-B	ITEM FILL & VENT VALVE	CODE —	SERIAL NO. 31713.2	TYPE OF TEST QUAL	
SPEC. AT-P/V SVHS5997	PARA. 4.1.2.5	PHASE RAND.	ATA NO. —	ACTION SHEET NO. —	DATE 2-20-73
					TEST NO. 10



EXCITATION ALONG Z AXIS

GRMS INPUT 9.16

NON-OPERATING

TEMP. 74 °F

PERIOD OF TEST ☒ START ☐ END

DURATION OF TEST 4 MIN.

ACCEL. SERIAL NO. VL29

ACCEL. SENSITIVITY — MV RMS/GP

2.687 COL/GP

ACCEL. SENSING Z AXIS

ACCEL. LOCATION Az

SPECIAL CONDITIONS TIME OF DAY 1035

REPORT NO.

E57

APPENDIX

CE-5 CLEANLINESS LEVEL

CE-5 Cleanliness Level

Particle Size (Microns)	Particle Count (Particles/ft^2)	Non-Volatile Residue (grams)	Visual Inspection
5-10*	1200	N/A	Required
10-25	200		
25-50	50		
50-100	5**		
100	0		

*Particles below listed ranges shall cause no discoloration of membrane filters.

**Metal particles larger than 50 microns in size, shall not be allowed.

APPENDIX

Acceptance Test Plan

4C 3/69

milton Standard DIVISION OF UNITED AIRCRAFT CORPORATION
SOR LOCKS, CONNECTICUT 06096

THORITY FOR TEMPORARY ALTERATION OF SPECIFICATION REQUIREMENTS

SPECIFICATION NUMBER SV HS 5618
ATA NUMBER 2
CODE IDENT NO. 73030
SHEET 1 OF 3

EN BY E. K. Moore
CUSTOMER Goddard Space Flight Center

ATA AUTHORIZED THE FOLLOWING ALTERATIONS FROM THE REFERENCED SPECIFICATION

See attachment

N

A modification to the VCPS requires that only a portion of the Production Acceptance Test be repeated.

IBLY/TEST RECORDING ☒ YES ☐ NO

. OR ASSEMBLY
VCPS P/N SV748720-1

FICATION OF PARTS OR ASSEMBLIES INVOLVED

No

S OF MARKING
N/A

L INSTRUCTIONS

None

UTHORIZATION EXPIRES ______ DATE AND/OR 1 NUMBER UNITS

SERIAL NUMBER RECORD REQUIRED ☐ YES ☒ NO

IORIZATION:

LIAISON ENGINEER

PROJECT/SENIOR PROJECT ENGINEER
E K Moore

CUSTOMER
M. B. Lund

OTHER
QA. 1/19/73

GOVERNMENT

SPECIFICATIONS CONTROL
1-19-73

SPECIFICATION CUSTODIAN
RE-ISSUE MARCH 8 1973

RELEASE DATE
EA Feb 9 1973

E61

3.0 Change to read: "The PAT is conducted to verify the leakage integrity of the VCPS."

4.3 Add - Isopropyl alcohol per TT-I-735

4.4 Change to read: "The Acceptance Test shall be conducted in the following sequence:

Test	Ref. Paragraph
Examination of Product	4.5.1
Weight	4.5.3
Proof Pressure	4.5.4
External Leakage	4.5.6
Contamination Check	4.5.8
Post Test Inspection	4.5.7

4.5.2 Delete.

4.5.3.4 Change to read, "The dry weight of the completed VCPS shall be noted."

4.5.4.2 Add to end of sentence, "or equivalent."

4.5.4.3 Change to read:

"b. Connect the gas fill and vent valves to the gas manifold and open the four pressurant fill valves."
c. Delete
f. Delete
g. Delete "using GN_2"

4.5.5 Delete.

4.5.6.3 Change to read: "a." delete

Figure I Delete
Figure II Delete

ADD

4.5.8 Contamination Check

4.5.8.1 Objective: To demonstrate that the VCPS modification has not contaminated the VCPS.

4.5.8.2 Description of Test

4.5.8.2.1 Test Facilities - The contamination check shall be performed using the Flush Rig 100 and shall be performed in the Hamilton Standard clean room facilities.

4.5.8.2.2 Test Instrumentation - Instrumentation shall be as required by SVP 161.

4.5.8.2.3 Procedure

a. With the four fill and vent valves open, load isopropyl alcohol into the VCPS until alcohol discharges from each of the four vent valves.

b. Close the vent valves and rotate the VCPS to wet tank internal surfaces.

c. Open the vent valves and drain the VCPS, collecting an effluent sample and verify the VCPS cleanliness as directed by SVP 161.

d. Vacuum dry the VCPS at 2000 microns until the VCPS does not exhibit a pressure rise to the vapor pressure of IPA after removing the vacuum source.

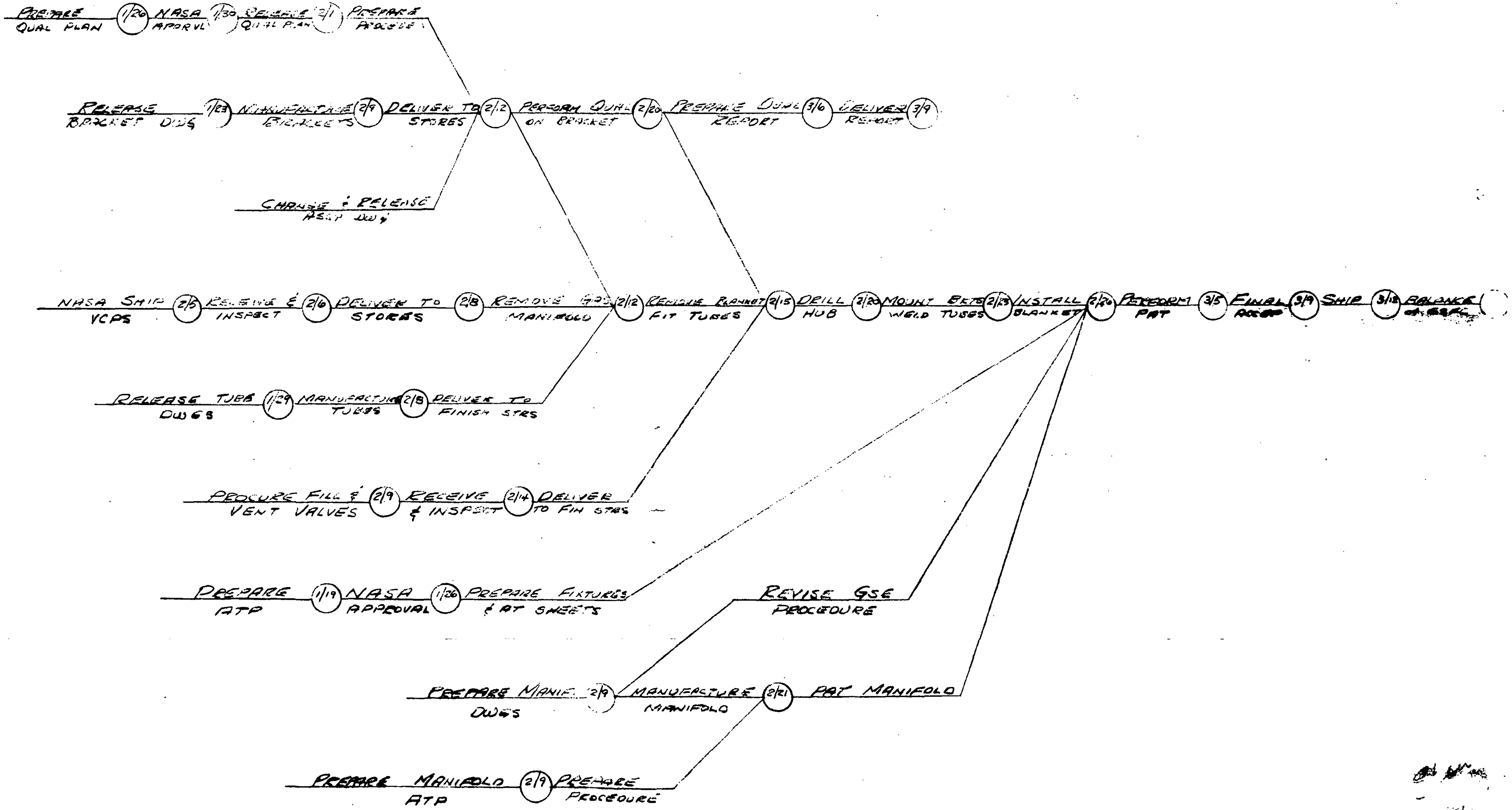
4.5.8.3 Acceptance Criterion - The effluent sample checked shall meet the cleanliness level of CE-5 per SVHS 3150.

APPENDIX

SCHEDULE

SVHSER6184

RAE-B
GAS MANIFOLD MODIFICATION



E65 320<