OVERSTRESS QUALIFICATION TEST OF THE MULTIPLE SATELLITE DISPENSER 0.2 LBF ROCKET ENGINE ASSEMBLY REA 10-16

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Hamilton Standard

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Hamilton Standard — Division of United Aircraft Corporation

SVHSER 6305

HAMILTON STANDARD ENGINEERING REPORT

SVHSER 6305

OVERSTRESS QUALIFICATION TEST OF THE MULTIPLE SATELLITE DISPENSER 0.2 LB_F ROCKET ENGINE ASSEMBLY REA 10-16

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N00014-73-C-0322

TABLE OF CONTENTS

I. SUMMARY

This report presents the results of a portion of a Qualification Overstress Test on Hamilton Standard Rocket Engine Assembly, Model 16-10, a nominal 0.2 pound thrust monopropellant engine. The purpose of the tests performed was to establish engine characteristics over extended life and to establish performance parameters over a range of operating conditions.

During the Overstress Life Test the engine accumulated the following operating history:

Accumulated Pulses	375,000
Steady State Time	24 hours
Cumulative Operating Time	30.3 hours

II. INTRODUCTION

This Qualification Overstress Test program was conducted per Department of the Navy, Office of Naval Research, Contract Number N00014-73-C-0322, for the Director of the Naval Research Laboratory (NRL).

The Rocket Engine Assembly (REA) used in this program is Hamilton Standard Model REA 10-16. This engine is a component of the propulsion subsystem of the NRL Multiple Satellite Dispenser (MSD). The engine provides thrust for attitude control and station acquisition on an earth orbiting satellite.

The engine was qualified as reported in Hamilton Standard Report SVHSER 6300. Overstress testing was performed on two engines in two test groups. The qualification test engine was used for $C_d C_f$ verification tests and critical soakback demonstration and the results were reported in SVHSER 6304. A second engine was used for extended life and performance mapping and the results are discussed herein.

III. OBJECTIVE

The objectives of this portion of the Qualification Overstress Tests were to characterize the engine over extended life and at various operating conditions.

IV. CONCLUSIONS

Engine pulsing and steady state characteristics were established at the normal duty cycle for a cumulative operating time of 30.3 hours including 24 hours of steady state operation and 370,000 pulses. Characteristics at four other duty cycles were also determined.

V. DISCUSSION

A. Engine Description

The engine qualified for the Naval Research Laboratories Multiple Satellite Dispenser (NRL/MSD) and used in this test program is Hamilton Standard Model REA 10-16. It is a nominal 0.2 pound thrust rocket engine assembly (REA), employing catalytic decomposition of hydrazine to produce thrust. The Hamilton Standard drawing number is SV755437, with the flight configuration being part number SV755437-1.

The engine consists of a flow control valve and a thrust chamber assembly. The flow control valve is an axial solenoid design using AFE 102 material as the valve seat. The valve is manufactured by Wright Components, Inc., Clifton Springs, New York to their part number 15626-2. The Hamilton Standard part number is SV755439-1. The requirements for the valve are defined by Hamilton Standard Procurement Specification SVHS 6006.

The thrust chamber assembly, manufactured by Hamilton Standard, consists of an injector system, thermal standoffs, pressure and reaction chamber, catalyst bed, and a conical nozzle having an area ratio of 55:1. The catalyst used is Shell 405, procured under Hamilton Standard drawing SV725250. The injector consists of a single .010 diameter tube. The thrust chamber assembly is gold plated for passive thermal control.

The specific engine used in this test program was Hamilton Standard part number SV755437-1, Serial Number 00003. The engine is identical to the flight configuration in function, but differs physically from the flight configuration as listed below:

TABLE I

Qualification/Flight Configuration

Feature	Flight Configuration (SV755437-2)	Qual Configuration (SV755437-2)
Valve	HS P/N SV755439-1	G.F.E.

B. Test Results

Performance

Engine performance was monitored using manual, analog and digital techniques. Digital data was reduced using a Hamilton Standard Reduction Program defined by specification SVHS 5430. The

V. B. Test Results - continued

techniques used to determine thrust and impulse characteristics were compliant with NRL specification. This program specification is available for review by the NRL Scientific Officer at Hamilton Standard.

Combined Life

The performance index of the engine was monitored during combined life testing by periodic basepoints. The data from these basepoints is presented in Appendix C of this report. Where applicable specification limits are shown over the required cumulative operating time of 19.2 hours.

Steady State Thrust

The NRL specification requires that the delivered thrust level lie between the limits of 0.20 and 0.24 lb_f at a nominal supply pressure and fuel temperature of 250 psia and 70°F respectively. Figure 1C shows satisfaction of this requirement over 15 ½ hours of engine cumulative operating time. Delivered thrust after 15½ hours of cumulative operating time falls below the specification minimum of 0.20 lb_f. The specification also requires that the engine perform satisfactorily over a thrust range of 0.10 to 0.22 lb_f. Figure 2C shows calculated thrust as a function of cumulative operating time at a supply pressure of 125 psia. Start of life calculated thrust is 0.11 lb_f and end of life calculated thrust is 0.103 lb_f. This represents a degradation in thrust level of 6.4% over a cumulative operating time of 30.3 hours. Thrust degradation at a supply pressure of 250 psia is 13.8% over the same cumulative operating time. Increased catalyst bed pressure drop as a result of catalyst bed packing during life is the cause of this phenomenon.

Pressure Oscillations

The NRL specification requires that the steady state chamber pressure oscillations not exceed ±10% of nominal chamber pressure. Figures 3C and 4C show steady state oscillations as a function of cumulative operating time at supply pressures of 250 and 125 psia respectively. Inspection of these figures shows erratic behavior of this parameter over life. Steady state oscillations range from 2½ to 40% at a supply pressure of 250 psia and from 2½ to 13½% at a supply pressure of 125 psia. The wide run-to-run variations in steady state oscillations are characteristic of this unit.

V. B. Test Results - continued

Thrust Overshoot

The NRL specification requires that steady state and pulsing first pulse thrust overshoot not exceed 0.57 lb_f at a nominal supply pressure and fuel temperature of 250 psia and 70°F respectively. In addition, pulsing thrust overshoot for pulses 2-N shall not exceed 0.44 lb_f for the same set point conditions. Table 1C presents thrust overshoot data for both steady state and pulsing operation as a function of cumulative operating time. Also tabulated are the fuel temperature ranges for each baseline run. Specification requirements were satisfied throughout the life test.

Steady State Specific Impulse

The NRL specification requires a steady state specific impulse of 215 lb_f-sec/lbm minimum, over a supply pressure range of 125 to 250 psia. Figures 5C and 6C show steady state specific impulse for supply pressures of 250 and 125 psia respectively. Specification requirements were met through 19.2 hours of cumulative operating time at a supply pressure of 250 psia. At a supply pressure of 125 psia several baseline runs did not achieve a specific impulse value of 215 lb_f-sec/lbm. A tabulation of specific impulse for the runs shown graphically on Figure 6C are listed below.

23 Baseline Runs P_I = 125 psia

Run	Cumulative Operating Time (hrs)	Steady State I_{sp} (lb_f/lbm-sec)
2485	0.97000E-01	214.95
2489	0.42700	214.90
2493	0.75700	215.12
2497	1.0870	216.37
2501	1.4170	214.12
2505	1.6470	214.89
2509	7.6470	213.90
2513	7.9770	216.09
2522	8.6370	218.67
2526	8.9760	217.53
2530	9.1970	218.21
2534	15.197	216.42
2539	15.527	218.62
2542	15.857	220.08
2551	16.517	220.45

V. B. Test Results - continued

Run	Cumulative Operating Time (hrs)	Steady State I_{sp} (lb_f/lbm-sec)
2555	16.747	219.85
2559	22.747	210.77
2563	23.077	216.96
2567	23.407	212.34
2571	23.737	212.65
2575	24.067	215.01
2579	24.297	217.40
2584	30.297	214.55

The average value of specific impulse for the 23 baseline runs is 216.1 lb_f-sec/lbm and the standard deviation (one sigma) is 2.5 lb_f-sec/lmb (1.16%).

Pulsing Specific Impulse

The NRL specification requires a pulsing specific impulse of 170 lb_f-sec/lbm minimum, at a nominal supply pressure and fuel temperature of 250 psia and 70°F respectively. This requirement applies to pulse train lengths of 100 at a duty cycle of .060 sec on and .940 sec off. Figure 7C shows compliance with this requirement over 19.2 hours of cumulative operating time. Figures 8C and 9C show pulsing specific impulse at supply pressures of 170 and 125 psia respectively. These figures are shown for information only. Specific impulse values are not presented at a supply pressure of 60 psia due to anomalous flow measurements.

Impulse Repeatability

The NRL specification requires that pulse-to-pulse impulse bits vary by no more than ±10% from the mean impulse bit for pulses 20 through 100 for pulse train lengths of 100. Figures 10C, 11C, 12C and 13C show impulse bit variation as a function of cumulative operating time at supply pressures of 250, 170, 125 and 60 psia respectively. Specification requirements over 19.2 hours of cumulative operating time are satisfied at all supply pressures except 125 and 60 psia. The maximum value of impulse bit variation over 19.2 hours of cumulative operating time at this supply pressure is ±11.6%. Figures 14C, 15C, 16C and 17C show average impulse bit as a function of cumulative operating time at supply pressures of 250, 170, 125 and 60 psia respectively. Impulse bit values degrade over life due to catalyst bed packing. These figures are shown for information only.

V. B. Test Results - continued

Centroid Repeatability

The NRL specification requires that pulse-to-pulse time to centroid vary by no more than ±15 ms from the mean centroid time for pulses 11 through 100 for pulse train lengths of 100. Figures 18C,19C, 20C and 21C show time to centroid variation as a function of cumulative operating time at supply pressures of 250, 170, 125 and 60 psia respectively. Specification requirements over 19.2 hours of cumulative operating time are satisfied at all supply pressures except 125 and 60 psia. The maximum value of centroid time variation over 19.2 hours of cumulative operating time at this supply pressure is ±21 ms. Figures 22C, 23C, 24C and 25C show average centroid time as a function of cumulative operating time at supply pressures of 250, 170, 125 and 60 psia respectively. These figures are shown for information only.

Startup Response

The NRL specification requires that the maximum time to 90% of pulse average chamber pressure not exceed 50 ms for pulses 11 - 100 for pulse train lengths of 100. Figures 26C, 27C, 28C and 29C show time to 90% of pulse average chamber pressure as a function of cumulative operating time at supply pressures of 250, 170, 125 and 60 psia respectively. Specification requirements over 19.2 hours of cumulative operating time are satisfied at all supply pressures.

Shutdown Response

The NRL specification requires that the maximum time to 10% of pulse average chamber pressure not exceed 130 ms for pulses 11 - 100 for pulse train lengths of 100. Figures 30C, 31C, 32C and 33C show time to 10% of average chamber pressure as a function of cumulative operating time at supply pressures of 250, 170, 125, and 60 psia respectively. Specification requirements over 19.2 hours of cumulative operating time are satisfied except at a supply pressure of 60 psia. At this supply pressure the maximum time to 10% of average chamber pressure over 19.2 hours of cumulative operating time is 203 ms.

Steady State Operating Life

The steady state operating life of REA 10-12 is required by NRL specification to be up to 15 hours total. The combined life test series accumulated 24 hours of steady state firing and pressure levels of 250, 210, 170 and 125 psia.

V. B. Test Results - Continued

Pulsing Operating Life

The pulsing life requirement for REA 10-12 is 250,000 pulses at a duty cycle of .060 sec on and .940 sec off. The combined life test series demonstrated a capability of 375,000 pulses.

Performance Map Data

The performance map data presented in this report consists of pulsing runs of pulse train lengths of 100, performed at supply pressures of 250, 170, 125 and 60 psia. Average impulse bit, impulse bit variation, average specific impulse, start response, average centroid time, centroid time variation and shutdown response are presented as a function of supply pressure in Figures 34C through 61C for the following duty cycles:

On Time	Off Time
.045	.955
.060	1.19
.060	.690
.075	.925

This data is presented to show engine performance at duty cycles other than the nominal .060 sec on and .940 sec off.

Propellant

All testing was conducted using particulate clean propellant, per the NRL specification. In addition, a non-flight tophat type 12 micron absolute screen mesh filter was installed throughout the test program. No problems were encountered as a result of this filter.

Supply Pressure

As noted, the engine was tested at supply pressures ranging from 250 to 60 psia. The engine performance at high pressures was better than at low pressures, typical of the relative performance of the Solrad X engines.

Weight, Envelope and Alignment

These dimensional parameters were measured at the start of Acceptance Testing, Appendix A. The weight, well within the specification limit of 0.80 lb including the inlet adapter and test filter, was 0.396 lb. The nozzle alignment was verified within the 1° allowable. The envelope was inspected against Hamilton

V. B. Test Results - continued

Standard Installation Drawing SVHS755437, which reflects the NRL specification envelope requirements.

Vacuum

The engine is required to operate in pressures from sea level to 10^{-11} torr; all performance testing was conducted at vacuum levels of 3.3×10^{-2} torr (.063 psia) maximum. All other non-performance testing, except external leakage was performed at atmospheric pressure.

Vibration

The engine was exposed to Acceptance and Qualification levels of vibration. Vibration test data are given in Appendix D. There were no performance or leakage anomalies attributable to vibration environments in either phase of testing. There was no apparent structural damage.

Leakage

The engine was leak tested during both Acceptance and Qualification phases of the test program. The maximum seat leakage measured was 3.7×10^{-7} scc He/sec against a specification limit of 1.0×10^{-6}. External leakage was 3.2×10^{-5} scc He/sec maximum against a specification limit of 1.0×10^{-4}.

Proof Pressure

The engine was tested for Proof Pressure, 600 psig, during acceptance testing. There was no visible damage and the engine passed its subsequent leakage and performance tests.

APPENDIX A

ACCEPTANCE TEST PROCEDURES

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED
A	1. Updated to Amendment # 3. Made corrections 4.4(4) and 4.5.5	4-24-73	
	2. Added forced cooling to beds.	4-24-73	
	3. Corrected digital channel allocations	4-24-73	
	4. Page 43 - Corrected paragraph number	4-24-73	
	5. Added inspection requirements	4-25-73	
	6. Added pages for interim leakage tests	4-25-73	
	7. Updated to SVHS6007, Rev. A	5-1-73	
B	1. Corrected fuel temperature 2. Corrected Figure 9 3. Updated to Amendment 3	6/6/73	
N/A	UPDATED TO AMENDMENT 4	9/29/73	

ACCEPTANCE TEST PROCEDURE
FOR ROCKET ENGINE ASSEMBLY
REA-NRL-0.2 PER HS SPEC SVHS 6007 REV. A AMEND. 4
HS PART NUMBER SV 755437

Hamilton Standard
WINDSOR LOCKS, CONNECTICUT • U.S.A.

ACCEPTANCE TEST FOR ROCKET ENGINE ASSEMBLY REA-NRL-0.2

PER HS SPEC SVHS 6007

S/N 00003

PREP. BY			QUALITY			SIZE	CODE IDENT NO.	REA -NRL-0.2 ACCEPTANCE
TEST ENG.	5-2-73					A	73030	
ENGR.								SHEET 1 OF 59

1.0 SCOPE

1.1 Objective of this procedure is to define Acceptance Testing of NRL-0.2 lb. thrust - rocket engine. Controlling specification is SVHS 6007.

1.2 Purpose is to define in clear detail tests, test methods, equipment to be used, data to be recorded, data to be reduced and parameter limits to meet SVHS 6007.

2.0 GENERAL NOTES (Unless otherwise specified)

2.1 Handling

NRL engine shall be handled only by personnel wearing lint-free gloves.

2.2 Cleanliness

2.2.1 REA

Precautions shall be taken to insure maintenance of cleanliness of REA. It shall be protected at all times when out of test rigs by taping clean nylon film securely in place over all openings and bagging using polyethylene film.

2.2.2 Test Rig

2.2.2.1 All test rigs used for testing NRL REA's shall be sampled for cleanliness and certified clean per SVP 114, 129, 130, and 133 as applicable. Inspection to verify current status of rig cleanliness prior to performing tests.

2.2.2.2 An 18 micron or less absolute filter shall be installed directly upstream of the NRL engine for all tests during which fluids are introduced to this unit. Removal of filter shall be accomplished in a (Class 10,000) clean work station only. This filter is an integral part of Thrust Control Valve Assembly.

2.3 Failures

2.3.1 In event of a failure, malfunction, or out-of-tolerance condition, test shall be discontinued.

2.3.2 All deficiencies shall be recorded on the Unit History Form (HSF-454) as well as recorded per Hamilton Standard Reliability Data Report (RDR).

2.3.3 Deficiency shall be investigated, analyzed and corrected and REA retested in accordance with Acceptance Test Procedures or authorized deviation.

2.4 Equipment

2.4.1 Substitution of equipment listed herein may be accomplished if range, accuracy, etc. are equal to or better than the item to be replaced.

2.5 Valve Cycles

2.5.1 Valve cycles shall be recorded in each applicable test and summarized in appropriate table. (Table 9)

3.0 Test Sequence

3.1 Tests must be conducted in the sequence specified below:

		Paragraph
	A. Examination of Product	4.1
	B. Proof Pressure	4.2
	C. Leakage	4.3 & 4.4
	D. Vibration	4.5
(A)	E. Leakage (internal)	4.4
	F. Performance	4.6
	G. Leakage	4.3 & 4.4
	H. Post Test Inspection	4.7

3.2 Test Fixtures

A. Proof Pressure

Holding/Firing Fixture SVSK 77657-T-001

B. Leakage

Holding/Firing Fixture SVSK 77657-T-001

C. Random Vibration

Vibration Fixture SVSK 77886

D. Performance Test

1. Holding/Firing Fixture SVSK 77657-T-001

4.0 TEST METHODS

A. The following tests shall be conducted in the sequence listed above. Additional copies of the data sheets may be made for repetitive leakage tests.

B. Points at which acceptantance by Inspection is required are indicated on the log sheets by an asterisk at the detailed step and in the "inspection" block at the lower right hand corner. Other portions of the test are subject to surveillance by Inspection on a non-mandatory basis.

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — Division of United Aircraft Corporation	SER. NO. 0003
4.1	CORR BAR. PRES. (IN.HG)	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-6-73
	TEST RIG		4 OF 5

4.1 Examination of Product

4.1.1 Transcribe the weight of the REA as listed in the Assembly Operations Sheets below.

4.1.2 Transcribe information from the Nozzle Alignment check, to space below.

4.1.3 Inspect REA for compliance with SVHS 755437 as defined by sales order. Record discrepancies below.

* 4.1.4 Examination of Product

(Transcribed data, discrepancies, comments)

A. REA Wt. .47146 lbs. 0.8 lbs. maximum

B. Nozzle Alignment - 1° maximum geometric nozzle centerline from REA mounting surface.

C. No deviations from required dimensions. U/H 5,6

D. Unit must show evidence of good workmanship. U/H 3, 4

E Record throat diameter .0302-.0304

∠AEB IIC = 0°11'

∠AEB IID = 0°18'

WITNESS U/H 7

OPERATOR

INSPECTOR * C. Hastings 7-6-73

HSF-1390 5/67

AT -NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — United Aircraft Corporation	SER. NO.
	72		00003
	CORR BAR. PRES. (IN.HG)		TEST DATE
4.2	29.98	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	7-9-73
	TEST RIG		5 OF 14
	57		

4.2 PROOF PRESSURE

4.2.1 Set up REA as shown schematically in Figure 1 and as described below:

A. Connect REA to the GN_2 source.

B. Connect the Thrust Control Valve (TCV) power electrical connector to a D.C. power supply Valve Connector Pins A positive, B negative, C case ground.

C. Connect a portable voltmeter to the binding posts on the power supply.

D. Install nozzle plug into engine nozzle.

E. Connect a bleed valve to the Pc tap. Verify the valve is closed.

* 4.2.2 Pressurize the engine inlet to 15 ± 5 psig.

* 4.2.3 Energize the TCV by applying 28 ± .5 vdc to the valve using power supply and indicated on voltmeter.

* 4.2.4 Increase the inlet pressure to 600 ± 5 psig.

(Pressurization rate 100 psi/min. max.)

*. 4.2.5 Maintain this pressure for two (2) minutes minimum.

4.2.6 At the end of the 2 minute period, close the supply shutoff valve.

OPERATOR M J SLATTERY 7-9-73

INSPECTOR C Hastings 7-9

(HJ) (SB)

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — U A.	SER. NO.
	72		0005
	CORR BAR. PRES. (IN.HG) 29.98		TEST DATE 7-9-73
4.2	TEST RIG 57	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	6 OF 14

4.2.7 Slowly open bleed valve to relieve the pressure within REA to 0 psig (depressurization rate 100 psi/min. max.).

4.2.8 De-Energize TCV by turning off D.C. power supply.

4.2.9 Back off N_2 regulator to ambient.

4.2.10 Record data as required in Table 1.

* 4.2.11 There shall be no visible evidence of permanent deformation as a result of proof pressure.

NOTE: In the event of leakage at above interface, REA shall be returned to assembly area. Separate thrust chamber assembly from thrust control valve in accordance with appropriate operation sheet procedure.

Examine the interface seal.

A. If seal appears acceptable notify Quality Assurance and Test Engineer for further disposition.

B. If seal is missing, rolled, cut, or gouged, replace seal, reassemble and repeat above Proof Pressure Test.

OPERATOR M. J. Slatesky 7-9 73

INSPECTOR * C. Hastings 7-9

(HJ) (38)

HSF-1300 5/67

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — UA	SER. NO.
4.2	73		00063
	CORR BAR. PRES. (IN.HG) 29.98	SLS ACCEPTANCE TEST	TEST DATE 7-4-73
	TEST RIG 57	OPERATIONS/LOG SHEET	7 OF 12

4.2.12 Remove REA from test setup and transmit to next test area. Record number of valve cycles in appropriate table.

OPERATOR	
M J. SLATOSKY 7-4 7-7	
INSPECTOR C HASTINGS 7-4	

HJ 38

A7

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A®	SER. NO.
4.2	72		00003
	CORR BAR. PRES. (IN.HG) 29.96	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-9-73
	TEST RIG 57		8 OF 54

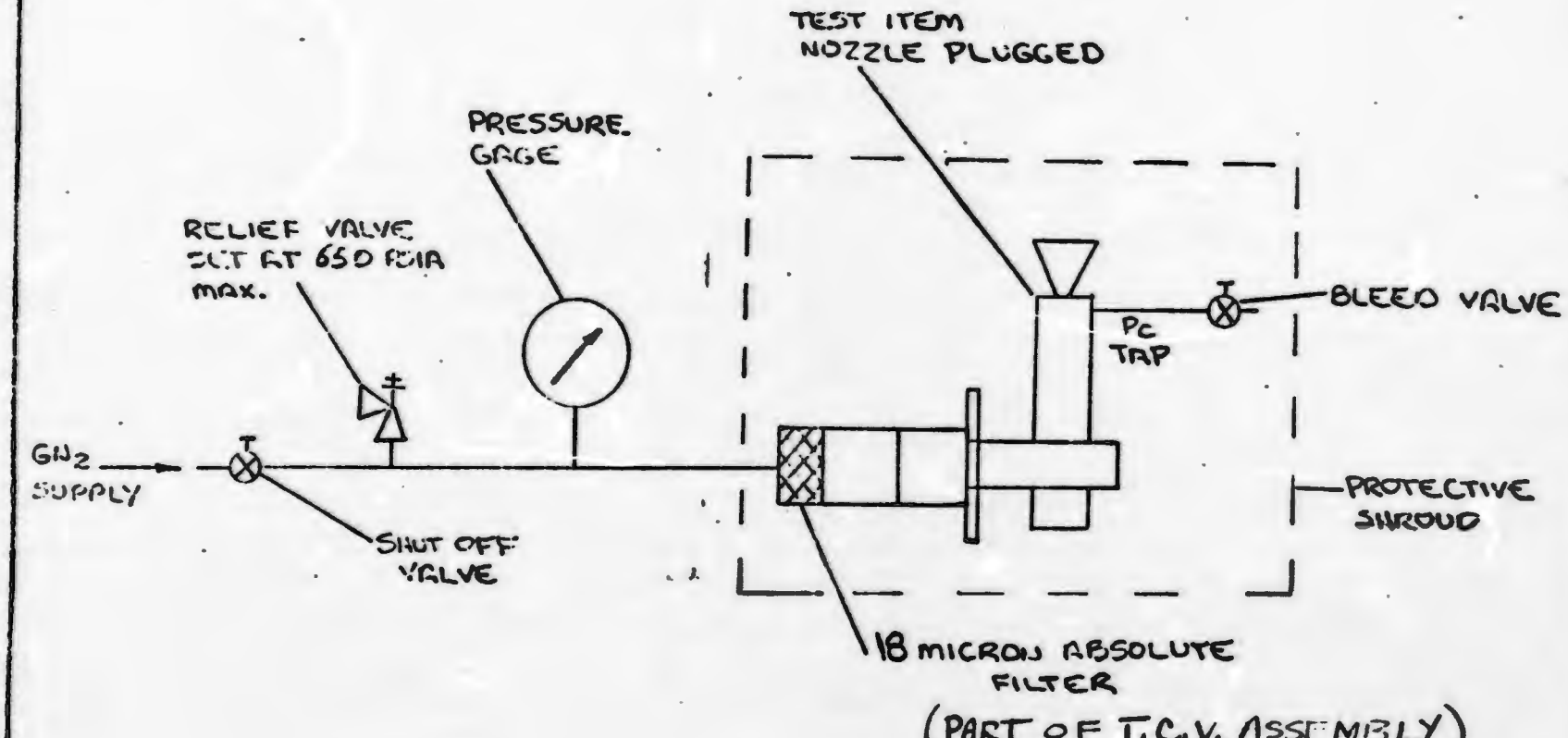


FIGURE 1 – PROOF PRESSURE

OPERATOR	M. J Slatosky 7-9-73
INSPECTOR	C. Hastings 7-9

A8

HSF-1300 5/67

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — UA	SER. NO.
4.2	72	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 29.96		TEST DATE 7-9-73
	TEST RIG 57		9 OF 54

TABLE I PROOF PRESSURE DATA

PARAMETER	UNIT	ACTUAL	SPEC
Preliminary Supply Pressure (prior to energizing valve)	psig	150	10 - 20
Valve Voltage	vdc	28.0	27.5 - 28.5
Test Pressure	psig	600	595 - 605
Time at Pressure	minutes	2 MIN	2 Minimum
Evidence of Damage or Permanent Deformation		NONE	None Allowed
Evidence of Leakage at Interface		NONE	None Allowed

HJ
158

OPERATOR M. J SLATOSKY 7-9-73

INSPECTOR * C HASTINGS 7-9

A9

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard UA	SER. NO.
4.3.2.1	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 29.98		TEST DATE 7-10-73
	TEST RIG NRC 98		10 OF 54

4.3 Leakage

4.3.1 External Leakage

4.3.1.1 Set up and calibrate a mass spectrometer using a maximum helium calibrated leak rate standard of 10^{-4} scc/sec. If direct reading (NRC) mass spectrometer is used, adjust gain control to make meter read value of calibrated leak and record. If indirect reading (VEECO) mass spectrometer is used, record scale reading.

* 4.3.1.2 Install engine in setup as shown schematically in Figure 2 and as described below:

A. Connect supply line to REA inlet (18 micron filter already installed).

B. Connect the Thrust Control Valve (TCV) power electrical connector to a D.C. power supply polarity P_{in} A Pos. P_{in} B Neg. P_{in} C Case GND.

C. Connect a portable voltmeter to the binding posts on the power supply.

D. Install a nozzle plug . into nozzle.

E. Connect bleed valve and line as shown in schematic.

* 4.3.1.3 Energize the TCV by applying 28 ± .5 vdc to the valve using power supply and indicated on voltmeter. Then reduce voltage to 20 ± .5 vdc.

OPERATOR R. Patrick

INSPECTOR * F Hockenberry

P6 S8

A10

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — Division of United Aircraft Corporation	SER. NO.
4.3.2.1	73		00003
	CORR BAR. PRES. (IN.HG) 29.98	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-10-73
	TEST RIG NRC 98		11 OF 5

4.3.1.4 Verify that Rig Valves S01, S03 and S05 are closed. Valves S02 and S04 are to be open.

4.3.1.5 Using the vacuum source evacuate the engine pressure to less than 0.5 psia.

4.3.1.6 Close Rig Valves S02 and S04. Open Valves S01 and S03.

4.3.1.7 Slowly pressurize the engine to 300 psia (pressurization rate 100 psi/min. max.). "SNIFF" all external leakage areas for gross leakage. Correct any test setup leakage found. If any gross engine leakage noted, record location and report failure.

4.3.1.8 Depressurize the system by closing Rig Valve S01 and slowly opening Bleed Valve S05 (depressurization rate 100 psi/min. max.).

4.3.1.9 Place bell jar over engine and evacuate the bell jar to proper operating pressure of mass spectrometer (approximately 0.5 psia). Record background reading. If direct reading (NRC) mass spectrometer is used, adjust zero control to make meter read zero and record. If indirect reading (VEECO) mass spectrometer is used, record scale deflection of meter.

* 4.3.1.10 Open Rig Valve S01 and close Bleed Valve S05. Then slowly pressurize the engine to 300 psia. Record leakage reading at the start and end of a 15 minute test period. If a direct reading (NRC) mass spectrometer is used read and record leakage rate. If an indirect reading (VEECO) mass spectrometer is used, record meter deflection and compute leakage rate as follows and record.

OPERATOR R. Patrick

INSPECTOR * F Hockenberry

A11

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — A Division of United Aircraft Corporation	SER. NO.
4.3.2.1	73		00003
	CORR BAR. PRES. (IN.HG) 29.98	SLS ACCEPTANCE TEST	TEST DATE 2-16 73
	TEST RIG NRC 98	OPERATIONS/LOG SHEET	13 OF 54

4.3.1.10 (Continued)

$$\text{Leak Rate scc/sec} = \frac{\text{Standard Leak Rate (scc/sec)} \times \text{Scale Deflection due to Unknown Leak} - \text{Scale Deflection due to Background}}{\text{Scale Deflection due to Standard Leak Rate}}$$

NOTE: If leakage exceeds specification:

A. Return bell jar to ambient pressure.

B. "SNIFF" all external leakage areas (engine and test setup) for leaks. If leakage was found in setup, depressurize item as described in Paragraph 4.3.1.8, repair leak, reinstall bell jar, evacuate bell jar and repeat Paragraph 4.3.1.10. If leakage was found in engine, terminate test and report failure.

4.3.1.11 Record data as required in Table 2.

4.3.1.12 When testing is completed

A. Close Rig Valve S01 and slowly open Bleed Valve S05 to relieve the pressure within the engine (depressurization rate 100 psi/min. max.).

B. De-energize the TCV by turning off D.C. power supply.

C. Back off regulator to ambient. Shut off vacuum supply.

D. Remove engine from test setup.

P2 S8

OPERATOR R. Patrick

INSPECTOR F. Hockenberry

A12

AT – [illegible]

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A.	SER. NO.
4.3.2.1	73		00003
	CORR BAR. PRES. (IN.HG) 29.98	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7 10 73
	TEST RIG NRC 98		15 OF 54

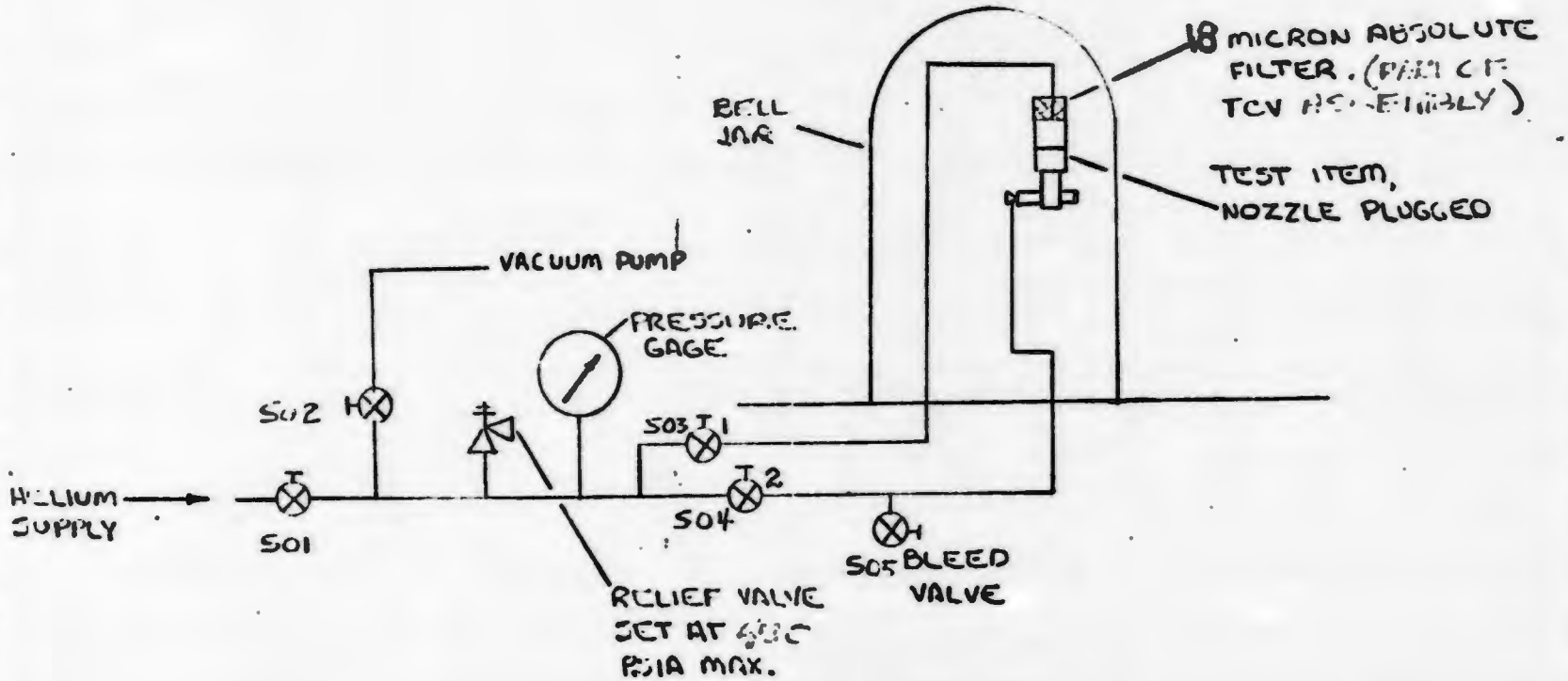


FIGURE 2 – EXTERNAL LEAKAGE

OPERATOR R Patrick

PR 38

INSPECTOR F Hornecker

A13

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A.	SER. NO.
4.3.2.1	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	0003
	CORR BAR. PRES. (IN.HG) 29.98		TEST DATE 7-16-73
	TEST RIG NRC 98		14 OF 54

EXTERNAL LEAKAGE (Continued)

TABLE 2

Complete the following table:

PARAMETER	MINIMUM ALLOWABLE	ACTUAL	MAXIMUM ALLOWABLE
Standard Leakage Rate		$.62 \times 10^{-4}$	
Scale Reading of Standard Leakage Rate		$.62 \times 10^{-4}$	
Scale Reading of Background		0	
Inlet Pressure	300 psia	306	310 psia
Item Helium Rate (Initial)		0	1×10^{-4} scc/sec
Item Helium Rate (Final)		6×10^{-5}	1×10^{-4} scc/sec
Test Duration	15 minutes	15 MINUTES	15.25 minutes
REA Valve Actuation Voltage	27.7 vdc	28.0	28.3 vdc
REA Valve Running Voltage	19.7 vdc	20.0	20.3 vdc
REA Valve Cycles		4	

PR 58

OPERATOR R. PATRICK

INSPECTOR T. F. HOCKENBERRY

A

A14

HSF-1390 5/67

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — U A.	SER. NO.
4.3.2.2	73		0003
	CORR BAR. PRES. (IN.HG) 29.40	SLS ACCEPTANCE TEST	TEST DATE 7-15-73
	TEST RIG NRC 48	OPERATIONS/LOG SHEET	15 OF 54

LEAKAGE (Continued)

4.4 Internal Leakage

1. Set up and calibrate a helium mass spectrometer using a maximum helium calibrated leak rate standard of 10^{-4} scc/sec. If direct reading (NRC) mass spectrometer is used, adjust gain control to make meter read value of calibrated leak and record. If indirect reading (Veeco) mass spectrometer is used record scale reading.

* 2. Install REA in a test setup as shown in Figure 3. REA valve is to be closed for this test.

3. Evacuate the mass spectrometer to its operating pressure.

4. Close helium supply shutoff (SO1) valve, open the vacuum pump shutoff (SO2) and evacuate the pressurization line to less than 0.5 psia. Record background reading.

5. Close vacuum pump shutoff (SO2), open helium supply shutoff valve (SO1) and pressurize the REA inlet to 100 psia by applying GHe pressure to the inlet (pressurization rate 100 psi/minute maximum).

* 6. Record the helium leakage rate at the start and end of a 15 minute minimum period. If direct reading (NRC) mass spectrometer is used, read and record leakage rate. If indirect reading (Veeco) mass spectrometer is used, record scale deflection of meter. If an indirect reading (Veeco) mass

OPERATOR R. Patrick

INSPECTOR * F. Hockenberry

(P8) (S8)

A15

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard UA	SER. NO.
4.3.2.2	73		0003
	CORR BAR. PRES. (IN.HG) 29.98	SLS ACCEPTANCE TEST	TEST DATE 7-10 73
	TEST RIG NRC 98	OPERATIONS/LOG SHEET	16 CT 54

LEAKAGE (Continued)

4.4 Continued

6. spectrometer is used compute leakage rate from meter deflection as follows:

$$\text{Leak Rate scc/sec} = \frac{\text{Standard Leak Rate (scc/sec)} \times \text{Scale Deflection due to Unknown Leak} - \text{Scale Deflection due to Background}}{\text{Scale Deflection due to Standard Leak}}$$

7. Back off regulator to depressurize REA.

OPERATOR	R. PATRICK
INSPECTOR	F HOCKENBERRY

PR 38

A16

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard	SER. NO.
	73		00003
	CORR BAR. PRES. (IN.HG) 29.98		TEST DATE 2-10-73
4.3.2.2	TEST RIG NRC 98	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	PAGE 17 OF 54

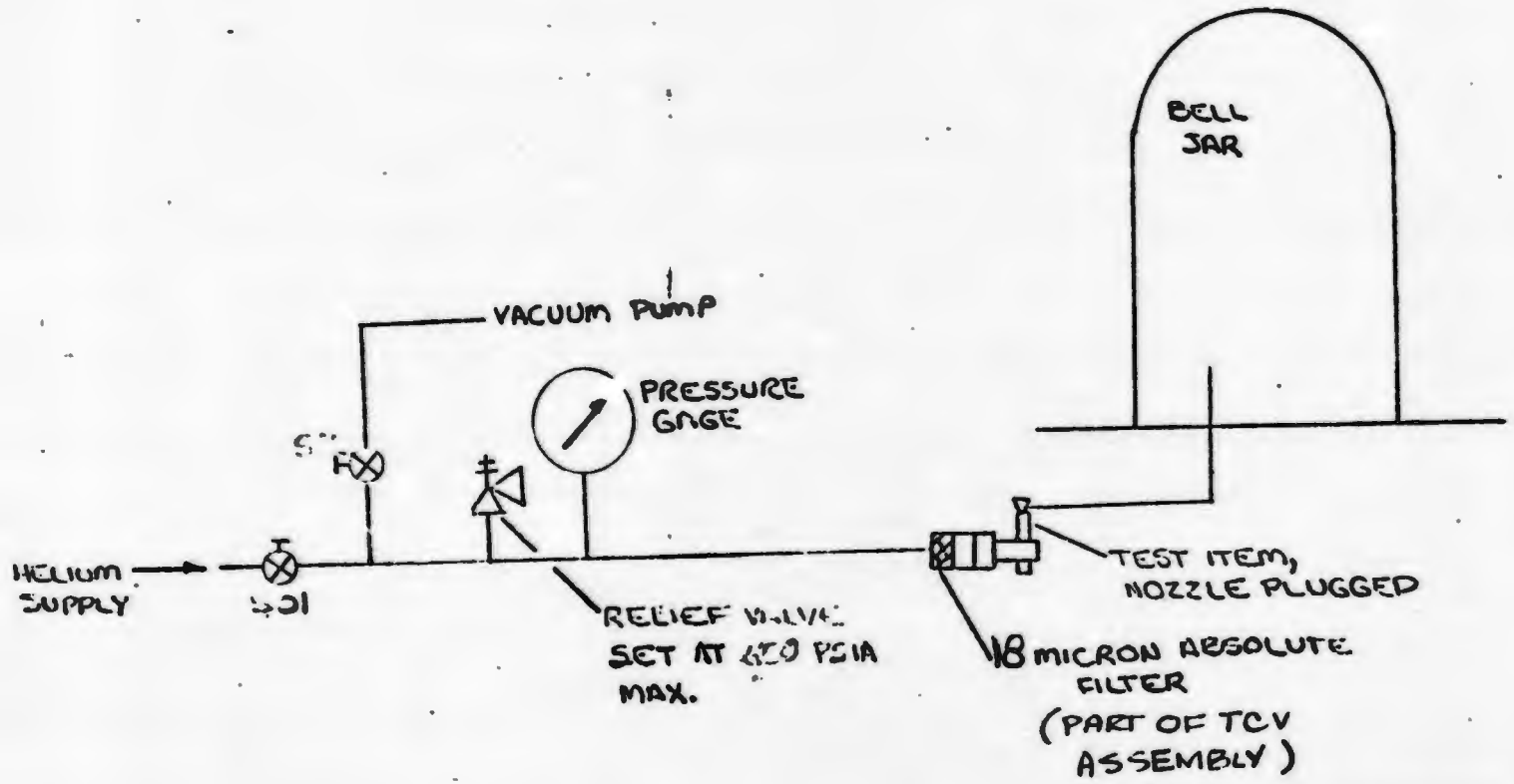


FIGURE 3 – INTERNAL LEAKAGE

OPERATOR R. PATRICK

INSPECTOR F HOCKENBERRY

PP SB

A17

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — UA	SER. NO.
4.3.2.2	73		00003
	CORR BAR. PRES. (IN.Hg) 29.98	SLS ACCEPTANCE TEST	TEST DATE 7-10-73
	TEST RIG NRC 98	OPERATIONS/LOG SHEET	18 OF 54

INTERNAL LEAKAGE (Continued)

4.4 (Continued) TABLE 3

PARAMETER	MINIMUM ALLOWABLE	ACTUAL	MAXIMUM ALLOWABLE
Standard Leakage Rate		$.62 \times 10^{-4}$	
Scale Reading of Standard Leakage Rate		$.62 \times 10^{-4}$	
Scale Reading of Background		0	
Inlet Pressure	100 psia	100	105 psia
Item Helium Leakage Rate (Initial)		0	1×10^{-6} scc/sec
Item Helium Leakage Rate (Final)		$.6 \times 10^{-7}$	1×10^{-6} scc/sec
Duration	15 minutes	15 MINUTES	15.25 minutes

PR SB

OPERATOR R. PATRICK

INSPECTOR * F. HOCKENBERRY

A18

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F) / CORR BAR. PRESS. (IN. HG) / TEST RIG	Hamilton Standard — SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	SER. NO. / TEST DATE
4.4	91		00003 / 7/11/73

4.5 Random Vibration

4.5.1 Prepare REA for vibration test in a clean (Class 10,000) work station.

4.5.2 Tape Pc tube nut to bottom of Pc tube. Cover Pc tube opening with Polyethylene bag and tape on.

4.5.3 Cover nozzle with polyethylene bag

* 4.5.4 Move REA to Vibration Lab area. Bolt REA to Vibration Fixture SVSK77886 and vibration fixture to vibration table.

4.5.5 REA axes orientation are shown in Figure 4.

4.5.6 A triaxial accelerometer shall be used for control and shall be located to provide the following input:

A. Control input shall maintain levels at test frequency within ± 3 db of the requirements. The overall g RMS shall be within ±10% of the nominal specification level.
B. Minimum level at other input locations is within ± 4 db of requirements at test frequency.

* 4.5.7 Vibrate the REA in each axis per the schedule below. Runs shall be conducted at ambient temperature and pressure and may be conducted in any sequence.

Frequency-Hz	Level	Rate or Time
20 - 200	0.1 g^2/Hz	2 minutes minimum
200 - 2000	-6.0 db/oct rolloff	per axis

OPERATOR R. A. Mickey 7/11/73

PR SB INSPECTOR * F Hockenberry

A.T – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — Division of United Aircraft Corporation	SER. NO. 00003
4.4	CORR BAR. PRES. (IN. HG)	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7/11/73
	TEST RIG 91		20 of 54

4.5.8 At conclusion of test remove accelerometer bonding material from REA. Remove Tape Residue.

* 4.5.9 The REA must pass subsequent Leakage and Performance Test. There shall be no damage or deformation.

OPERATOR R.A. Mickey 7/11/73

INSPECTOR * E Hockenberry

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U/A	SER. NO. 00003
4.4	CORR BAR. PRES. (IN.HG)	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7/11/73
	TEST RIG 91		21 OF 54

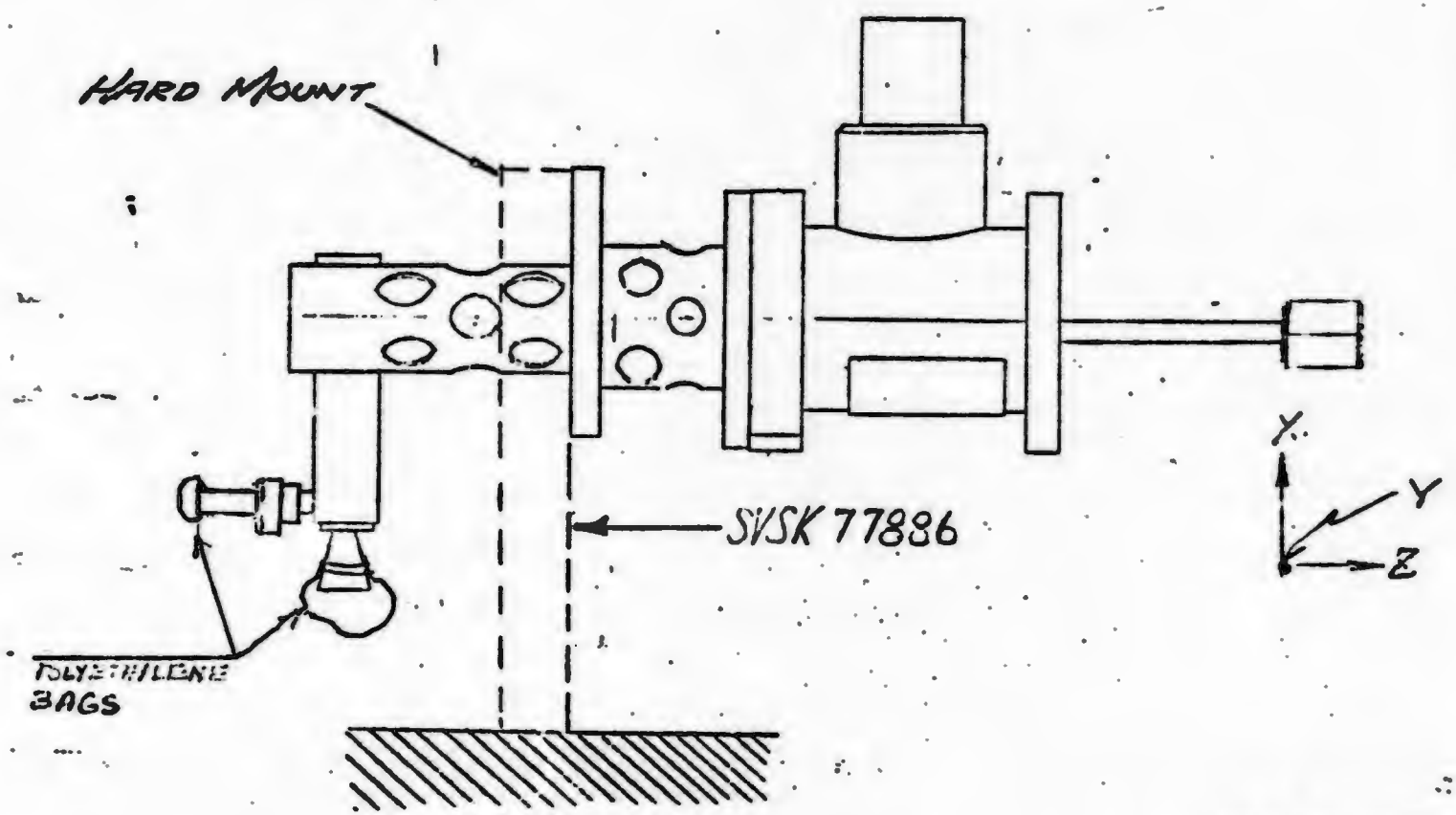


FIGURE 4

AXES ORIENTATION

OPERATOR R.A Mickey 7/11/73

INSPECTOR F. Hockenberry

PR SB

A21

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — UA	SER. NO. C0003
4.4	CORR BAR. PRES. (IN.Hg)	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7/11/73
	TEST RIG		22 OF 54

TABLE 4

VIBRATION DATA

RUN NO.	TEST DURATION	OVERALL GRMS LEVEL	TIME OF DAY	AXIS	EVIDENCE OF DAMAGE
2	2.0	6.0	1105	Z	NONE
3	2.0	6.0	1120	Y	NONE
4	2.0	6.0	1345	X	NONE

OPERATOR R. A. MICKEY 7/11/73

INSPECTOR * F. HOCKENBERRY

A22

HSF 175.1A 1/69

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

UA

SPACE & LIFE SYSTEMS LABORATORY

LOG OF TEST

TYPE OF TEST: QUAL - OST
TEST ENGINEER: K. BRADFORD
NAME OF RIG: 91
PROJECT & ENG ORDER NO: NRL A69-100-300A

SHEET 1 OF
DATE 7-19-73
TEST PLAN NO QT6017
MODEL NO .2LB RFA
PART NO. SV755437-6
SERIAL NO 00003
OPERATORS R. MICKET

RUN	TIME	AXIS	MODE	G_{PK}	OCT/MIN	G_{RMS}	MINS	EVIDENCE OF DAMAGE
2	1400	X	SINE	1	3	-	-	NONE
3	1410	X	SINE	11	1	-	-	NONE
4	1440	X	RAND	-	-	6	2	NONE
5	1520	Y	RAND	-	-	6	2	NONE
6	1525	Y	Sine	11	1	-	-	NONE
7	1545	Z	SINE	11	1	-	-	NONE
8	1555	Z	RAND	-	-	6	2	NONE

Visual Insp.
7-19-73

REMARKS:

10626

A23 A-23

HSP-175.1A 1/68

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

SPACE & LIFE SYSTEMS LABORATORY

LOG OF TEST

TYPE OF TEST: PAT

TEST ENGINEER: K. BRADFORD

NAME OF RIG: 91

PROJECT & ENG. ORDER NO.: A69-100-300A

SHEET 1 OF ____ DATE: 7-11-73

TEST PLAN NO.: AT-NI-0.2

MODEL NO.: .2LB REA

PART NO.: SV755437-6

SERIAL NO.: S/N 00003

OPERATORS: R. MICKET

RUN	TIME	AXIS	LEVEL GRMS	DURATION (MINS)	EVIDENCE OF DAMAGE		
2	1105	Z	6.0	2.0	NONE	(PR)	F Rabinowitz 7/11/73
3	1120	Y	6.0	2.0	NONE		
4	1345	X	6.0	2.0	NONE		

REMARKS:

10617

A24 A-24

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U	SER. NO.
4.3.2.2	73		02003
	CORR BAR. PRES. (IN.HG) 29.82	SLS ACCEPTANCE TEST	TEST DATE 7-12-73
	TEST RIG NRC 98	OPERATIONS/LOG SHEET	23 OF 54

LEAKAGE (Continued)

4.4 Internal Leakage

1. Set up and calibrate a helium mass spectrometer using a maximum helium calibrated leak rate standard of 10^{-4} scc/sec. If direct reading (NRC) mass spectrometer is used, adjust gain control to make meter read value of calibrated leak and record. If indirect reading (Veeco) mass spectrometer is used record scale reading.

* 2. Install REA in a test setup as shown in Figure 3. REA valve is to be closed for this test.

3. Evacuate the mass spectrometer to its operating pressure.

4. Close helium supply shutoff (SO1) valve, open the vacuum pump shutoff (SO2) and evacuate the pressurization line to less than 0.5 psia. Record background reading.

5. Close vacuum pump shutoff (SO2), open helium supply shutoff valve (SO1) and pressurize the REA inlet to 100 psia by applying GH_e pressure to the inlet (pressurization rate 100 psi/minute maximum).

* 6. Record the helium leakage rate at the start and end of a 15 minute minimum period. If direct reading (NRC) mass spectrometer is used, read and record leakage rate. If indirect reading (Veeco) mass spectrometer is used, record scale deflection of meter. If an indirect reading (Veeco) mass

OPERATOR R. Patrick

INSPECTOR E Sheaman 7/12/73

PW S8

A25

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Harrilton Standard UAe	SER. NO.
4.3.2.2	73		00003
	CORR BAR. PRES. (IN.HG) 29.82	SLS ACCEPTANCE TEST	TEST DATE 7-12-73
	TEST RIG NRC 98	OPERATIONS/LOG SHEET	24 OF 54

LEAKAGE (Continued)

4.4 Continued

7. spectrometer is used compute leakage rate from meter deflection as follows:

$$\text{Leak Rate scc/sec} = \frac{\text{Standard Leak Rate (scc/sec)} \times \text{Scale Deflection due to Unknown Leak} - \text{Scale Deflection due to Background}}{\text{Scale Deflection due to Standard Leak}}$$

8. Back off regulator to depressurize REA.

OPERATOR R. PATRICK

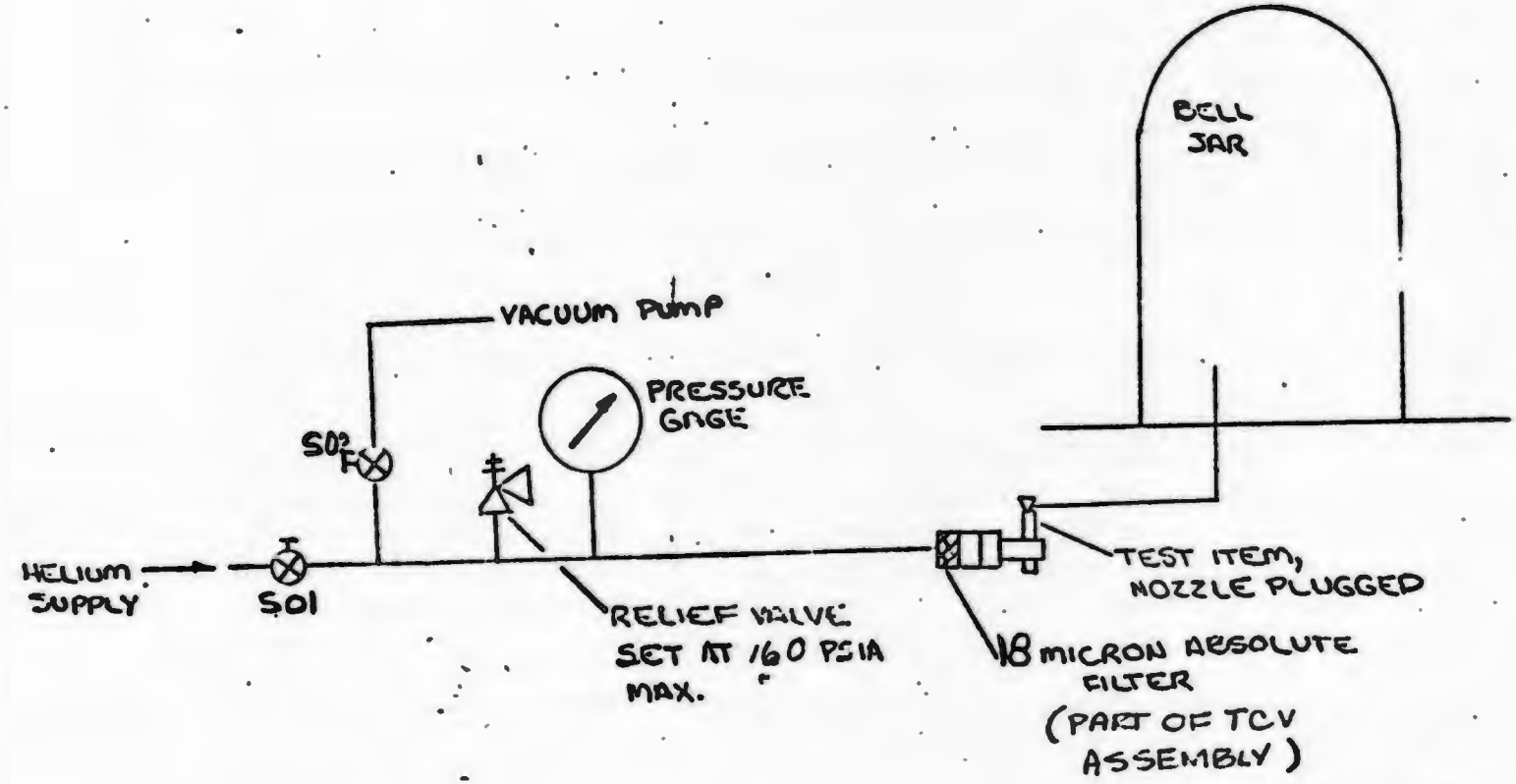
INSPECTOR F. SHERMAN 7/12/73

PW SB

A26

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F) 73	Hamilton Standard	SER. NO. 00003
	CORR BAR. PRES. (IN.HG) 29.82	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-12-73
4.3.2.2	TEST RIG NRC 98		25 OF 54



OPERATOR R. Patrick

INSPECTOR E. Sherman 7/12/73

FIGURE 3 ~ INTERNAL LEAKAGE

A27

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard UA	SER. NO.
4.3.2.2	73		00003
	CORR BAR. PRES. (IN.HG) 29.82	SLS ACCEPTANCE TEST	TEST DATE 7-12-73
	TEST RIG NRC 98	OPERATIONS/LOG SHEET	26 OF 54

INTERNAL LEAKAGE (Continued)

4.4 (Continued) TABLE 3

PARAMETER	MINIMUM ALLOWABLE	ACTUAL	MAXIMUM ALLOWABLE
Standard Leakage Rate		$.62 \times 10^{-4}$	
Scale Reading of Standard Leakage Rate		$.62 \times 10^{-4}$	
Scale Reading of Background		0	
Inlet Pressure	100 psia	104	105 psia
Item Helium Leakage Rate (Initial)		0	1×10^{-6} scc/sec
Item Helium Leakage Rate (Final)		$.4 \times 10^{-7}$	1×10^{-6} scc/sec
Duration	15 minutes	15 MIN.	15.25 minutes

OPERATOR R. Patrick

INSPECTOR * I. Sherman 7/12/73

PWA (3)

HSF-1390 3/67

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — A Division of United Aircraft Corporation	SER. NO.
4.5.2.2	74		0C003
	CORR BAR. PRES. (IN.HG) 29.98	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-13-77
	TEST RIG H-2		ATC-54

4.6 Performance Test

A. Install REA in firing fixture SVSK77657T001.

B. Install K type temperature thermocouple on bed of REA as shown in Figure 5.

C. Install valve temperature (T Type) thermocouple as shown in Figure 5.

D. Install the REA in a simulated Altitude Test Facility (H-2) and connect per Figure 6. Install indirect forced GN_2 cooling over bed.

E. Propellant flow diagram and instrumentation signal routing are shown in Figures 6 and 7.

F. Set up Visicorder in accordance with Figure 8.

G. Set up Digital Instrumentation in accordance with Figure 9.

4.6.1 Sensor Installation Check

Prior to firing test perform following checks:

A. Valve Voltage and Current P_{in} A Pos. P_{in} B Neg. P_{in} C Case GND.

1. Install a 180 ohm (approximate) resistor in test cell at REA valve driver output. Actuate valve driver in pulse mode. Verify that valve voltage and valve current traces are obtained on Visicorder. Measure voltage supplied to valve via a voltage divider using a differential voltmeter, while the valve driver is actuated in Steady State Mode. Set valve supply voltage to 28 ± 2 vdc. Record power supply voltage using Fluke Voltmeter and valve supply voltage on Log Sheet. Use facility driver circuit for all firing tests.

S8 OPERATOR S Kibbe

INSPECTOR

A29

NSF-1310 5/67

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — United Aircraft Corporation	SER. NO.
4.5.2.2	74	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 29.85		TEST DATE 7-13-73
	TEST RIG H-2		28 OF 54

4.6.1 Continued

B. Servomanometer

Measure initial and final voltage level of servomanometer on differential voltmeter for each steady state and pulse run. Record these values on digital data log.

C. REA Chamber Pressure

(A) With the test cell at altitude conditions (8.35 mm Hg vacuum pressure) verify that the reading for chamber pressure is 0 ± 5 psia. Use a differential voltmeter to measure the transducer output.

D. Inlet Pressure

Prior to each steady state run record inlet pressure transducer output on digital data log. Use a differential voltmeter to measure the transducer output (must be ± 3 psi from gage reading).

E. Tank Pressure

Prior to each pulsing run record tank pressure transducer output on digital data log. Use a differential voltmeter to measure the transducer output (must be ± 3 psi from gage reading).

(S8) OPERATOR S Kibbe

INSPECTOR

A30

HSF-1390 5/67

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — UA	SER. NO.
4.5.2.2	CORR BAR. PRES. (IN.HG) 27.05	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-13-73
	TEST RIG H-2		27 OF 54

4.6.1 Continued

F. Excitation Voltage

Measure excitation supply voltage for cell where data is being acquired from and record on digital data log once per cell setup.

G. Fuel Inlet Temperature

Read fuel temperature using differential voltmeter and record on digital data log for each run.

H. Set rig relief valve to 450 psia maximum.

4.6.2 Evacuate propellant system as follows: (See alternate method Step 4.4.2.1 before proceeding)

A. Transfer fuel from servo back to run tank as follows: Close Valves 3, 5 and 6, open Valves 1, 2, 4 and 14. Slowly pressurize servo with GN_2, purge fuel back to run tank. Close Valves 1, 2, 4, and 14.

B. At approximately 15 psig purge fuel from system by opening the following valves: 8, 9, 12, 13, 10.

C. When fuel is no longer observed at the drain line, close Valves 12 and 10, open Valves 1, 2, 4 and 6 and continue to purge remaining fuel back to run tank. Close Valves 1, 2, 4 and 6. Reduce purge pressure to ambient.

D. Open the following valves: 2, 4, 6 and 12. Close all remaining valves.

(28) OPERATOR S Kibbe

INSPECTOR

A31

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — United Aero	SER. NO.
4.5.2.2.	74		00003
	CORR BAR. PRES. (IN.HG) 29.85	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-13-73
	TEST RIG H-2		30 OF 54

4.6.2 Continued

E. Connect outlets of Valve 15 to a vacuum source. Open Valves 11, 13 and 15 and evacuate at less than 1 psia for 30 minutes minimum.

F. Close Valve 15. Shut off vacuum source. Verify Valves 3, 5, 8, 9, 10, 12, 13 and 15 are closed.

G. Pressurize supply tank to approximately 10 psig and open Valve 1 to fill lines with fuel.

H. Open Valves 2, 4 and 14 to fill servo, then close Valves 2 and 4.

I. Open Valves 14 and 6, and all other valves closed pressurize servo to 295 $\pm$ 5 psia. Depressurize servo to ambient pressure and note the difference in output voltage. Voltage change must be less than .24 vdc. (If not, repeat Step 4.6.2 until voltage change is acceptable).

4.6.2.1 Rig evacuation alternate method:

A. This step is to be used only if REA installation takes place within 8 hours of removal of previous REA and test rig valve positions are the same and test rig fuel system has not been broken into.

B. Connect Valves 11, 13 and 15 to a vacuum source. All other valves are closed. OPen Valves 11, 13 and 15 and evacuate at 1 psia or less for 30 minutes minimum.

(8) OPERATOR S KIRK

INSPECTOR

A32

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — Division of United Aircraft Corporation	SER. NO.
4.5.2.2	74		00003
	CORR BAR. PRES. (IN. HG) 29.65		TEST DATE 7-13-73
	TEST RIG H-2	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	31 OF 54

4.6.2.1 Continued

C. Close Valves 11, 13 and 15, open Valves 1, 2, 4 and 6 with N_2H_4 supply tank pressurized to approximately 10 psig. Perform system check per Step 4.6.2(I). If this step is not performed, cross out this step and write "N/A".

4.6.3 Establish the following initial conditions:

A. Fuel temperature - 70 ± 15°F

(A) B. Vacuum pressure - 8.35 mm Hg

C. Valve voltage supply - 26 - 30 vdc

D. P_{TANK} = 250 ± 10 psia. Pressurize by opening tank GN_2 supply valve, Valves 1, 2, 4 and 6. Slowly increase GN_2 pressure using regulator to specified value as indicated by P_{in} transducer output.

4.6.4 Acquire Visicorder data as follows:

A. Pulsing at 2 ips except 20 ips for pulses 1 through 10, 45 through 55, and 90 through 100.

B. For Steady State - first two seconds out of each ten at 20 ips. Remainder at 2 ips. Last two seconds at 20 ips.

4.6.5 All runs are to be made from the Servomanometer (no flowmeters required). To pressurize for run, open Valves 14 and 6 and slowly pressurize to required value (indicated on P_{in} transducer output, for S.S. runs, P_{tank} transducer output for pulse runs.

(B) OPERATOR K1884

INSPECTOR

A33

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — A Unit of United Aircraft Corporation	SER. NO.
4.5.2.2	74	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 29.85		TEST DATE 2-13-73
	TEST RIG H-2		52 OF 54

4.6.6 Acquire all data on digital tape as follows:

A. Steady State runs:

Acquire 3 second lead-in plus entire run plus 11 second trailer.

B. Pulse Runs:

Acquire 3 second lead-in, all pulses from 1 second before to 11 seconds after each pulse train inclusive.

4.6.7 Firing Sequence

RUN	P_T/P_I TRANSDUCER	T_{ON}	T_{OFF}	CHAMBER PRESSURE	T_{FUEL}	T_{BED}	N PULSES	SEQUENCE TAPE
1*	250 ± 5	40	-	8.35 mm Hg	70±15	70±10	1	NRL-LT-1
2	250 ± 5	0.06	0.94	8.35 mm Hg Max.	70±15	70±10	100	NRL-LT-2
3	250 ± 5	60	-	8.35 mm Hg	70±15	70±10	1	NRL-LT-3

A, Bed may be indirectly cooled with GN_2 between runs after temperature has decreased to 600°F.

(SB) OPERATOR K. BEE

INSPECTOR

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — Division of United Aircraft Corporation U A.	SER. NO.
4.5.2.2	74		00003
	CORR BAR. PRES. (IN.HG) 29.85	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-13-73
	TEST RIG		33 OF 54

4.6.8 Test Shutdown

After completion of the firing test, close Valve 7, apply 10-15 psig GN_2 through Valves 8 & 9, open Valves 12 and 13 to drain fuel from rig. Close Valves 12 and 13, and actuate REA valve for 120 seconds followed by 25 pulses 1 second on, 1 second off.

D Bollington 7/13/73 Remove REA from test stand and remove heat shield from REA.

4.6.9 Flush -

1. Install REA in a flush rig as shown in Figure 10.
2. Open H_2O supply valve, pressurize H_2O to 10-15 psig, and actuate the REA at an approximate duty cycle of 50 seconds on, 10 seconds off, for 15 pulses. Apply 28 ± 2 vdc to actuate the valve, Pin A+, Pin B- for Steps 2, 3, and 4.
3. Close H_2O supply valve, open isopropyl alcohol supply valve. Pressurize IPA to 10-15 psig and actuate the REA at an approximate duty cycle of 50 seconds on, 10 seconds off for 5 pulses.
4. Purge REA with GN_2 (valve held open with 20 ± 2 vdc after opening) at 10-15 psig until IPA ceases flowing from valve. Close valve.

D. Bollington 7/13/73

5. Install the REA in a vacuum dessicator and vacuum dry valve at 1500 microns Hg or less for one hour minimum. Record data in the data table.

W Murphy 7/14/73

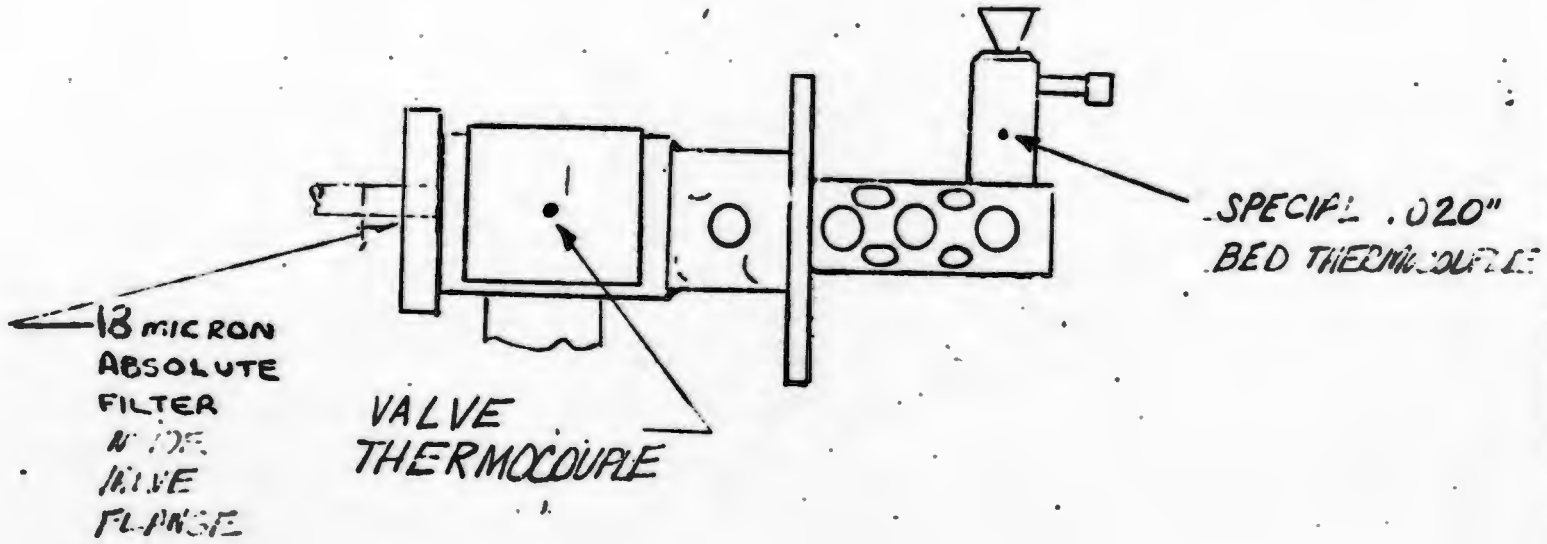
(S8) OPERATOR W. Murphy 7/14

INSPECTOR

A35

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U Ho	SER. NO.
4.5.2.2	74	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 27.85		TEST DATE 2/13/73
	TEST RIG N-2		37 OF 54



THERMOCOUPLE LOCATIONS - FIGURE 5

SB

OPERATOR E LAFFERTY

INSPECTOR

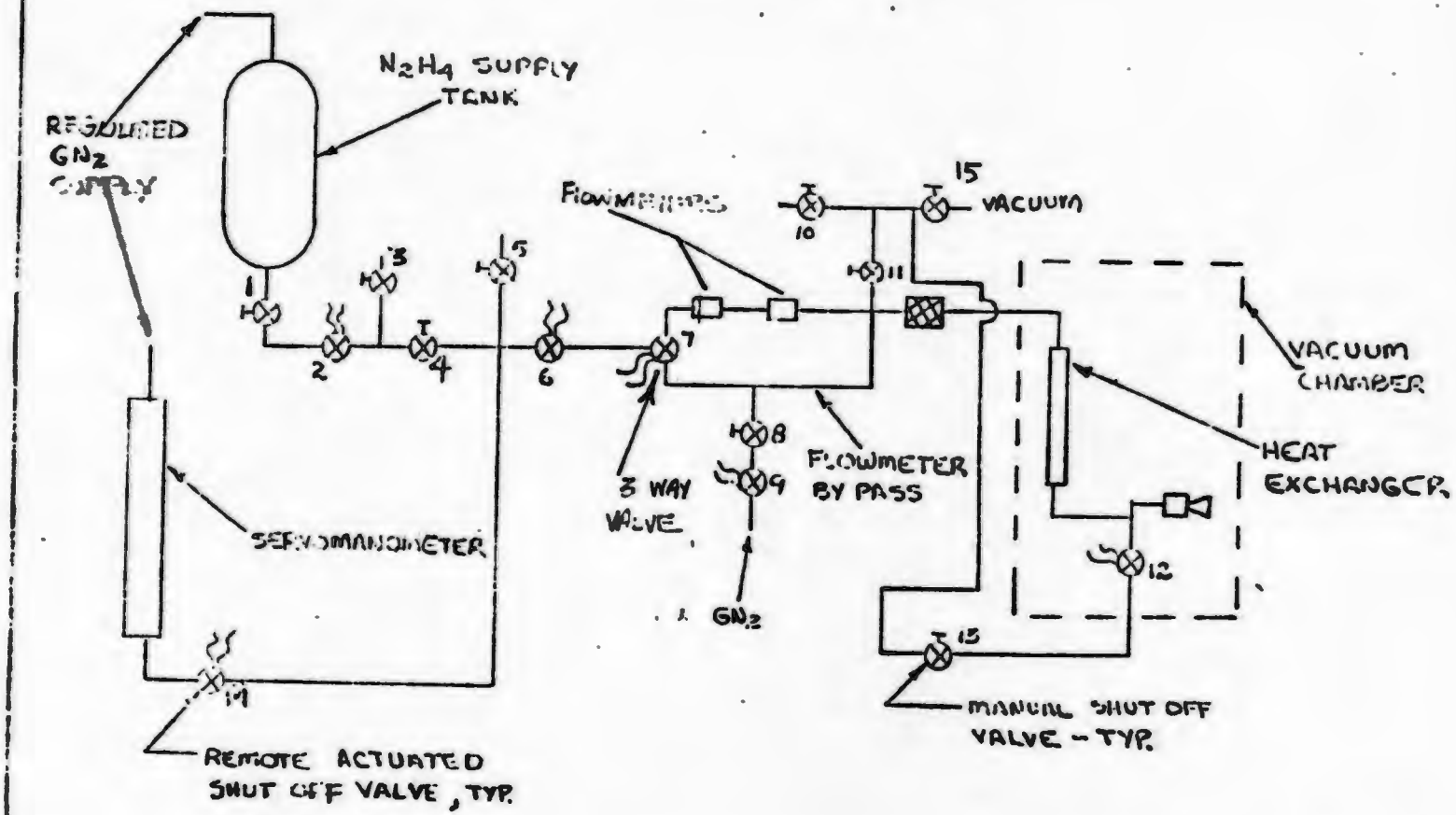
A36

NSFC-1320 5/67

AT – NTL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard (Division of United Aircraft Corporation) U A	SER. NO.
4.5.2.2.	74		00003
	CORR BAR. PRES. (IN.HG) 29.85	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 2-13-73
	TEST RIG H-2		35 31 54

RIG H-2



PROPELLANT FLOW DIAGRAM – FIGURE 6

EW SB

OPERATOR Kibbe

INSPECTOR D Tucker

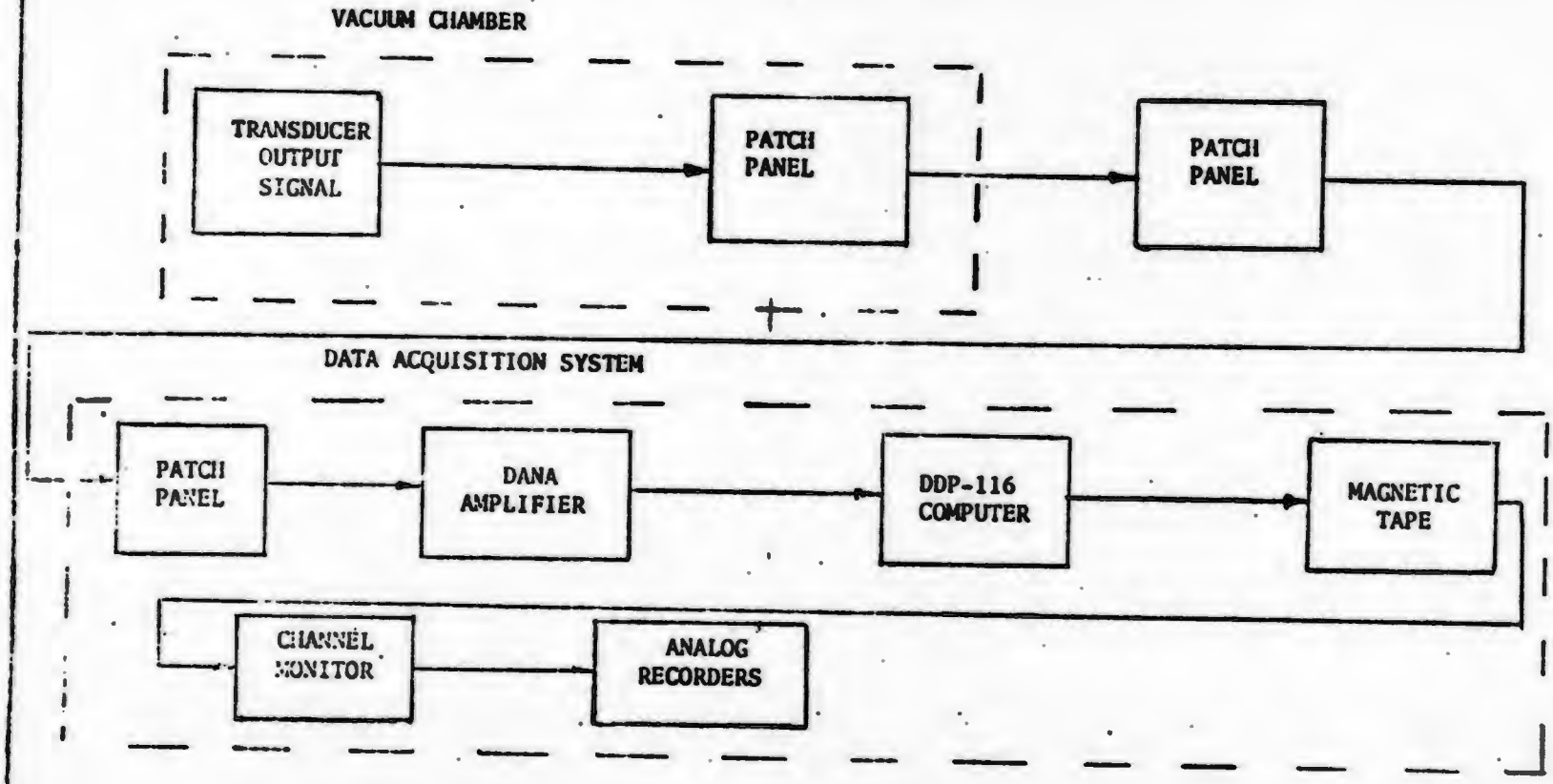
7/13/73

A37

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard	SER. NO.
4.5.2.2	74	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 29.85		TEST DATE 7-13-73
	TEST RIG H-2		36 OF 54

AT – NRL-0.2

PERFORMANCE (Continued)



INSTRUMENTATION SIGNAL ROUTING - FIGURE 7

38

OPERATOR LAFFERT

INSPECTOR D TUCKER (EW)

7/13/73

A38

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U	SER. NO.
4.5.2.2	74		00003
	CORR BAR. PRES. (IN.HG) 29.85	SLS ACCEPTANCE TEST	TEST DATE 7-13-73
	TEST RIG H-2	OPERATIONS/LOG SHEET	27 OF 57

PERFORMANCE (Continued)

VISICORDER SETUP

PARAMETER	CAL RANGE	APPROXIMATE SCALE FACTOR
Valve Voltage	0-30 vdc	3" Span
Valve Current	0-0.5 amp	3" Span
Inlet Pressure	0-300 psia	60 psi/inch
Chamber Pressure	0-450 psia	50 psi/inch
Chamber Temperature	0-1500°F	300°F/inch
Valve Temperature	0-500°F	100°F/inch

FIGURE 8

OPERATOR LAFFERTY

INSPECTOR D TUCKER (EW)

7-13-73

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U/A	SER. NO.
4.5.2.2	74		00003
	CORR BAR. PRES. (IN.HG) 29.85	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-13-73
	TEST RIG H-2		38 OF 54

PERFORMANCE (Continued)

INSTRUMENTATION DIGITAL

PARAMETER	MEASUREMENT DEVICE	MANUFACTURER	MODEL NO.	CAL. RANGE	ACCURACY	CHANNEL 1-20	CHANNEL 20-40	GAIN
Valve Voltage	Divider	HS	SVSK79575	0-30 vdc	-	1	21	5
Fuel Flow	Servomanometer	Exactel	T5 40 in .312" Bore	0-.1 lbm	± 1% R	2	22	1
Inlet Pressure	Transducer	Statham	PA8019 PA850 PA861	0-300 psia	± 1% FS	3	23	200
Chamber Press.	Transducer	Statham	PA8019	0-300 psia	± 0.3% FS	4	24	200
Valve Current	Divider	HS	SVSK79575	0-1 amp	-	5	25	50
Tank Pressure	Transducer	Statham	PA822	0-300 psia	± 1% FS	6	26	200
FLOW METER Temperature	Thermocouple		Type T	0-200°F	± 5°F	7	27	1000
Excitation Volt.				10 vdc nom		11	31	.5
Fuel Temp.	Thermocouple		Type T	0-200°F	± 5°F	12	32	1000

OPERATOR LAFFERTY (SB)

INSPECTOR D TUCKER (EW)

7-13-73

FIGURE 9

A40

AT - .RL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U Ao	SER. NO.
4.5.2.2	74	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	0003
	CORR BAR. PRES. (IN.HG) 29.85		TEST DATE 7-13-73
	TEST RIG H-2		39 OF 54

PERFORMANCE (Continued)

INSTRUMENTATION DIGITAL

PARAMETER	MEASUREMENT DEVICE	MANUFACTURER	MODEL NO.	CAL. RANGE	ACCURACY	CHANNEL 1-20	CHANNEL 20-40	GAIN
Chamber Temperature	Thermocouple		Type K .020"	0-1500°F	± 10°F	14	34	200
Vacuum Pressure	Gage	Hastings	VT-4	0-20 mm Hg	± 2% Ang Def.	8	28	1000
Tank Pressure	Gage	Heise	C	0-300 psia	± .5% FS			
Valve Temp.	Thermocouple		Type T	0-500°F	± 5°F	16	36	1000

FIGURE 9 (Continued)

OPERATOR LAFFERT

INSPECTOR D TUCKER (EW)

7-13-73

A41

AT - .IRL-U.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U	SER. NO.
4.5.2.2	74		00003
	CORR BAR. PRES. (IN.HG) 29.85		TEST DATE 7-13-73
	TEST RIG CWS #4	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	40 OF 54

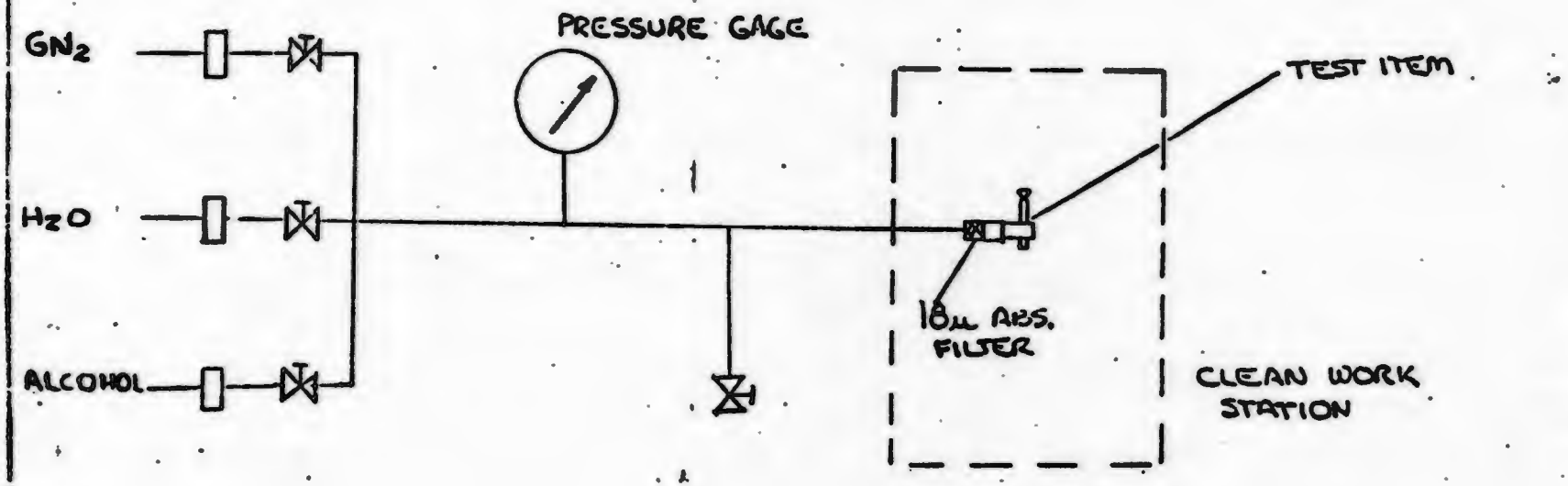


FIGURE 10 - REA FLUSH

OPERATOR	D. BULLINGTON
INSPECTOR	D TUCKER (EW)

7-13-73

A42

HSF-1390 3/67

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard	SER. NO.
4.5.2.2	74		00003
	CORR BAR. PRES. (IN.HG) 29.85	SLS ACCEPTANCE TEST	TEST DATE 7-13-73
	TEST RIG H 2	OPERATIONS/LOG SHEET	41 01 54

TABLE 7

INITIAL PERFORMANCE DATA

PARAMETER	ACTUAL	SPEC
Servo Deflection (vdc)	.19	0.24 Max.
Valve Voltage (vdc)	28.0	26 - 30

OPERATOR Kibbe

(38) INSPECTOR * D. Tucker

WITNESSED 7-13-73

A43

NSP 175 1A 1/66

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

UA

SPACE & LIFE SYSTEMS LABORATORY

LOG OF TEST (TABLE 7)

TYPE OF TEST: BURN-IN/PERFORMANCE
TEST ENGINEER: A. FRANCIS
NAME OF RIG: N-2
PROJECT & ENG. ORDER NO.: A69-100-300A

SHEET OF DATE
TEST PLAN NO: SVHS 6007
MODEL NO.: RL-A-NRL-0.2
PART NO.: 755137-6
SERIAL NO.: 60003
OPERATORS: 7/13/73
Fuel N_2H_4 42 OF 54

Time	Para. No.	Run No.		P_T Gage (psia)		Transducer Static P_{tank}	Transducer Static P_{in}		Readings - psia Dynamic P_{in}	Dynamic P_c		T_{on} sec	T_{off} sec	N Pulses	On Time sec		P_{vac} mm Hg		T_{fuel} °F	T_{bed} °F		
1525	4C7 1	2447		250			247.		250.	182.		40.	*	1	40.							
1623	2	2448		249.			249.		249.	177.		.06	.94	100	6.							
1709	3	2449		250.			247.		248.	185.		60.	*	1.	60.							
1742	4.6.8	N/A		28.			29.					120.	*	1.	120.							
1744		N/A		28.			29.					1.	1.	25.	25.							

REMARKS:

TOTALS:

SB D Tucker 7/13/73
WITNESSED

8251

A44

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

HSP 179 1A

SPACE & LIFE SYSTEMS LABORATORY

LOG OF TEST

TYPE OF TEST: PAT. Performance Test
TEST ENGINEER: W Smith
NAME OF RIG: H-2
PROJECT & ENG. ORDER NO: A69-100-300A

SHEET 1 OF
DATE 2-13-73
TEST PLAN NO. SVHS 6007 Rev A
MODEL NO. HRL
PART NO. SV 755457-6
SERIAL NO. 00003
OPERATOR: Tibbe

Time	P#	Run #	Tank Press PSIA	Transducers PIN Static	PIN Dynamic	Pc Dynamic	TON SEC	TOFF SEC	No. Pulse	Chamber Press in Hg	Fuel °F	Tank °F	Valve °F	Servo Start	Stop	Δ
1528		2447	250	247	250	183	40	—	1	1.5	69	67		3.35	1.65	1.70
1623		2447.	241.	247.	241.	177.	.01	.14	100.	1.75	70.	71.		3.66	3.29	.37
1701.		2447.	250.	247.	247.	185.	60.	—	1	1.6	70.	76.		3.10	1.31	2.59
1742.		—	28.	29.	PURGE		120.	"	1.							
1744.		—	28.	29.			1.	1.	25.							
									128.							

REMARKS: TRANSDUCERS
PI 2834
Pc 147

[illegible] START [illegible] .19 mv

9268

A45

A-45

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A.	SER. NO	
4.5.2.2	74		00003	
	CORR BAR. PRES. (IN.HG) 29.85	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-13-73	
	TEST RIG CWS #4		43 OF 54	

4.6.9 Continued

TABLE 8

VALVE FLUSH

	PARAMETER	MINIMUM ALLOWABLE	ACTUAL	MAXIMUM ALLOWABLE
H_2O Flush	Inlet Pressure	10 psig	12.	15 psig
	Supply Voltage	26 vdc	28.	30 vdc
	No. of Pulses	15	15.	15
	Duration	13 minutes	15.	17 minutes
IPA Flush	Inlet Pressure	10 psig	12.	15 psig
	Supply Voltage	26 vdc	28.	30 vdc
	No. of Pulses	5	5.	5
	Duration	3 minutes	5.	7 minutes
GN_2 Purge	Inlet Pressure	10 psig	12.	15 psig
	Supply Voltage	18 vdc	20.	22 vdc
	Duration		10.	
Vacuum Dry	Vacuum Pressure Start		2230 7-13-73	1500 Hg
	Vacuum Pressure End		0900 7-14-73	1500 Hg
	Duration	1 hour	10.5 7-14-73	

D Tucker 7/13/73 (EW)

D Bullington 7/14/73 (SB)

OPERATOR W Murphy 7-14-73

INSPECTOR C. Hastings 7-14

(HJ) (SB)

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U/A₀	SER. NO.
4.3.2.1	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 29.89		TEST DATE 7-17-73
	TEST RIG NAC 98		44 OF 54

4.3 Leakage

4.3.1 External Leakage

4.3.1.1 Set up and calibrate a mass spectrometer using a maximum helium calibrated leak rate standard of 10^{-4} scc/sec. If direct reading (NRC) mass spectrometer is used, adjust gain control to make meter read value of calibrated leak and record. If indirect reading (VEECO) mass spectrometer is used, record scale reading.

* 4.3.1.2 Install engine in setup as shown schematically in Figure 2 and as described below:

A. Connect supply line to REA inlet (18 micron filter already installed).

B. Connect the Thrust Control Valve (TCV) power electrical connector to a D.C. power supply polarity P_{in} A Pos. P_{in} B Neg. P_{in} C Case GND.

C. Connect a portable voltmeter to the binding posts on the power supply.

D. Install a nozzle plug . . . into nozzle.

E. Connect bleed valve and line as shown in schematic.

* 4.3.1.3 Energize the TCV by applying 28 ± .5 vdc to the valve using power supply and indicated on voltmeter. Then reduce voltage to 20 ± .5 vdc.

OPERATOR E. LASZCZYK

(S8) INSPECTOR (GH) A. CIEL 7-17-73

A47

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A.	SER. NO.
4.3.2.1	73		00003
	CORR BAR. PRES. (IN.HG) 29.69	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-17-73
	TEST RIG NRC 48		45 OF 54

4.3.1.4 Verify that Rig Valves S01, S03 and S05 are closed. Valves S02 and S04 are to be open.

4.3.1.5 Using the vacuum source evacuate the engine pressure to less than 0.5 psia.

4.3.1.6 Close Rig Valves S02 and S04. Open Valves S01 and S03.

4.3.1.7 Slowly pressurize the engine to 300 psia (pressurization rate 100 psi/min. max.). "SNIFF" all external leakage areas for gross leakage. Correct any test setup leakage found. If any gross engine leakage noted, record location and report failure.

4.3.1.8 Depressurize the system by closing Rig Valve S01 and slowly opening Bleed Valve S05 (depressurization rate 100 psi/min. max.).

4.3.1.9 Place bell jar over engine and evacuate the bell jar to proper operating pressure of mass spectrometer (approximately 0.5 psia). Record background reading. If direct reading (NRC) mass spectrometer is used, adjust zero control to make meter read zero and record. If indirect reading (VEECO) mass spectrometer is used, record scale deflection of meter.

* 4.3.1.10 Open Rig Valve S01 and close Bleed Valve S05. Then slowly pressurize the engine to 300 psia. Record leakage reading at the start and end of a 15 minute test period. If a direct reading (NRC) mass spectrometer is used read and record leakage rate. If an indirect reading (VEECO) mass spectrometer is used, record meter deflection and compute leakage rate as follows and record.

OPERATOR E. LASZCZYK

(58) INSPECTOR * (BH) A. GIEL 7-17-73

A48

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard	SER. NO.
4.3.2.1	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 29.89		TEST DATE 2-17-73
	TEST RIG NRC 98		46 OF 54

4.3.1.10 (Continued)

$$\text{Leak Rate scc/sec} = \frac{\text{Standard Leak Rate (scc/sec)} \times \text{Scale Deflection due to Unknown Leak} - \text{Scale Deflection due to Background}}{\text{Scale Deflection due to Standard Leak Rate}}$$

NOTE: If leakage exceeds specification:

A. Return bell jar to ambient pressure.

B. "SNIFF" all external leakage areas (engine and test setup) for leaks. If leakage was found in setup, depressurize item as described in Paragraph 4.3.1.8, repair leak, reinstall bell jar, evacuate bell jar and repeat Paragraph 4.3.1.10. If leakage was found in engine, terminate test and report failure.

4.3.1.11 Record data as required in Table 2.

4.3.1.12 When testing is completed

A. Close Rig Valve S01 and slowly open Bleed Valve S05 to relieve the pressure within the engine (depressurization rate 100 psi/min. max.).

B. De-energize the TCV by turning off D.C. power supply.

C. Back off regulator to ambient. Shut off vacuum supply.

D. Remove engine from test setup.

OPERATOR E. Lasczyk

INSPECTOR (SB) (SN) A. Ciel 2-17-73

AT – NKL-U.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U	SER. NO. 00003
4.3.2.1	CURR BAR. PRES. (IN.HG)	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-12-73
	TEST RIG		47 OF 54

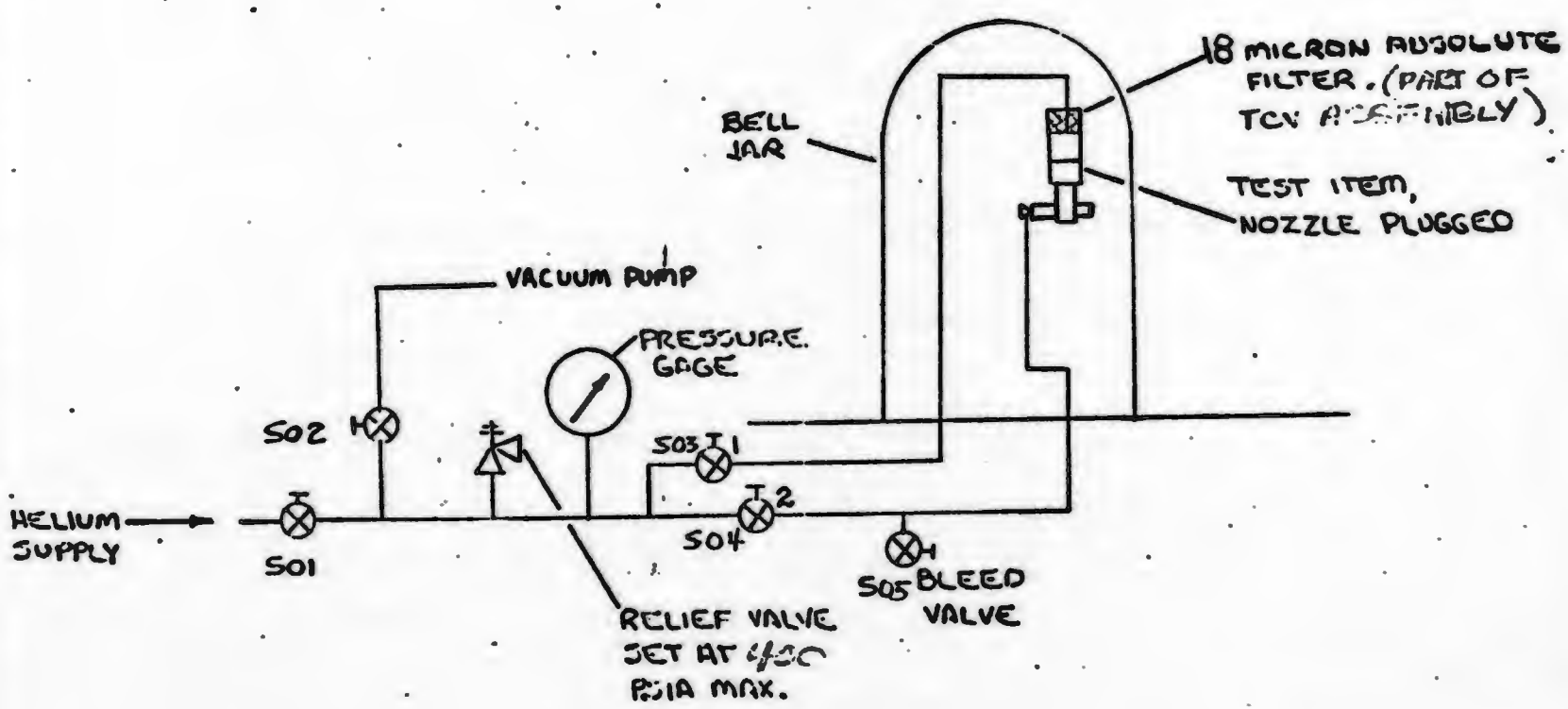


FIGURE 2. – EXTERNAL LEAKAGE

OPERATOR E. Laszczyk

INSPECTOR (IH) A. Ciel 7-12-73

(38)

A50

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U Ao	SER. NO.
4.3.2.1	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 29.84		TEST DATE 7-17 73
	TEST RIG NRC 98		48 OF 54

EXTERNAL LEAKAGE (Continued)

TABLE 2

Complete the following table:

PARAMETER	MINIMUM ALLOWABLE	ACTUAL	MAXIMUM ALLOWABLE
Standard Leakage Rate		$.62 \times 10^{-4}$	
Scale Reading of Standard Leakage Rate		6.2×10^{-5}	
Scale Reading of Background		LESS THAN 2×10^{-7}	
Inlet Pressure	300 psia	300.	310 psia
Item Helium Rate (Inicial)		LESS THAN $.2 \times 10^{-7}$	1×10^{-4} scc/sec
Item Helium Rate (Final)		6.5×10^{-6}	1×10^{-4} scc/sec
Test Duration	15 minutes	15	15.25 minutes
REA Valve Actuation Voltage	27.7 vdc	28.0	28.3 vdc
REA Valve Running Voltage	19.7 vdc	20.0	20.3 vdc
REA Valve Cycles		3	

OPERATOR E. Laszczyk

INSPECTOR (BH) A Ciec 7/17/73

(8)

A51

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — U — Ae	SER. NO.
4.3.2.2	73		C0003
	CORR BAR. PRES. (IN.HG) 29.89	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-17-73
	TEST RIG NRC 98		49 OF 54

LEAKAGE (Continued)

4.4 Internal Leakage

1. Set up and calibrate a helium mass spectrometer using a maximum helium calibrated leak rate standard of 10^{-4} scc/sec. If direct reading (NRC) mass spectrometer is used, adjust gain control to make meter read value of calibrated leak and record. If indirect reading (Veeco) mass spectrometer is used record scale reading.

* 2. Install REA in a test setup as shown in Figure 3. REA valve is to be closed for this test.

3. Evacuate the mass spectrometer to its operating pressure.

4. Close helium supply shutoff (SO1) valve, open the vacuum pump shutoff (SO2) and evacuate the pressurization line to less than 0.5 psia . Record background reading.

5. Close vacuum pump shutoff (SO2), open helium supply shutoff valve (SO1) and pressurize the REA inlet to 100 psia by applying GH_e pressure to the inlet (pressurization rate 100 psi/minute maximum).

* 6. Record the helium leakage rate at the start and end of a 15 minute minimum period. If direct reading (NRC) mass spectrometer is used, read and record leakage rate. If indirect reading (Veeco) mass spectrometer is used, record scale deflection of meter. If an indirect reading (Veeco) mass

OPERATOR R. Patrick

INSPECTOR A. Gill 7-17-73

A52

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Harrington Standard U	SER. NO.
4.3.2.2	73		00003
	CORR BAR. PRES. (IN.HG) 29.89	SLS ACCEPTANCE TEST	TEST DATE 7-12-73
	TEST RIG NRC 98	OPERATIONS/LOG SHEET	50 OF 54

LEAKAGE (Continued)

4.4 Continued

7. spectrometer is used compute leakage rate from meter deflection as follows:

$$\text{Leak Rate scc/sec} = \frac{\text{Standard Leak Rate (scc/sec)} \times \text{Scale Deflection due to Unknown Leak} - \text{Scale Deflection due to Background}}{\text{Scale Deflection due to Standard Leak}}$$

8. Back off regulator to depressurize REA.

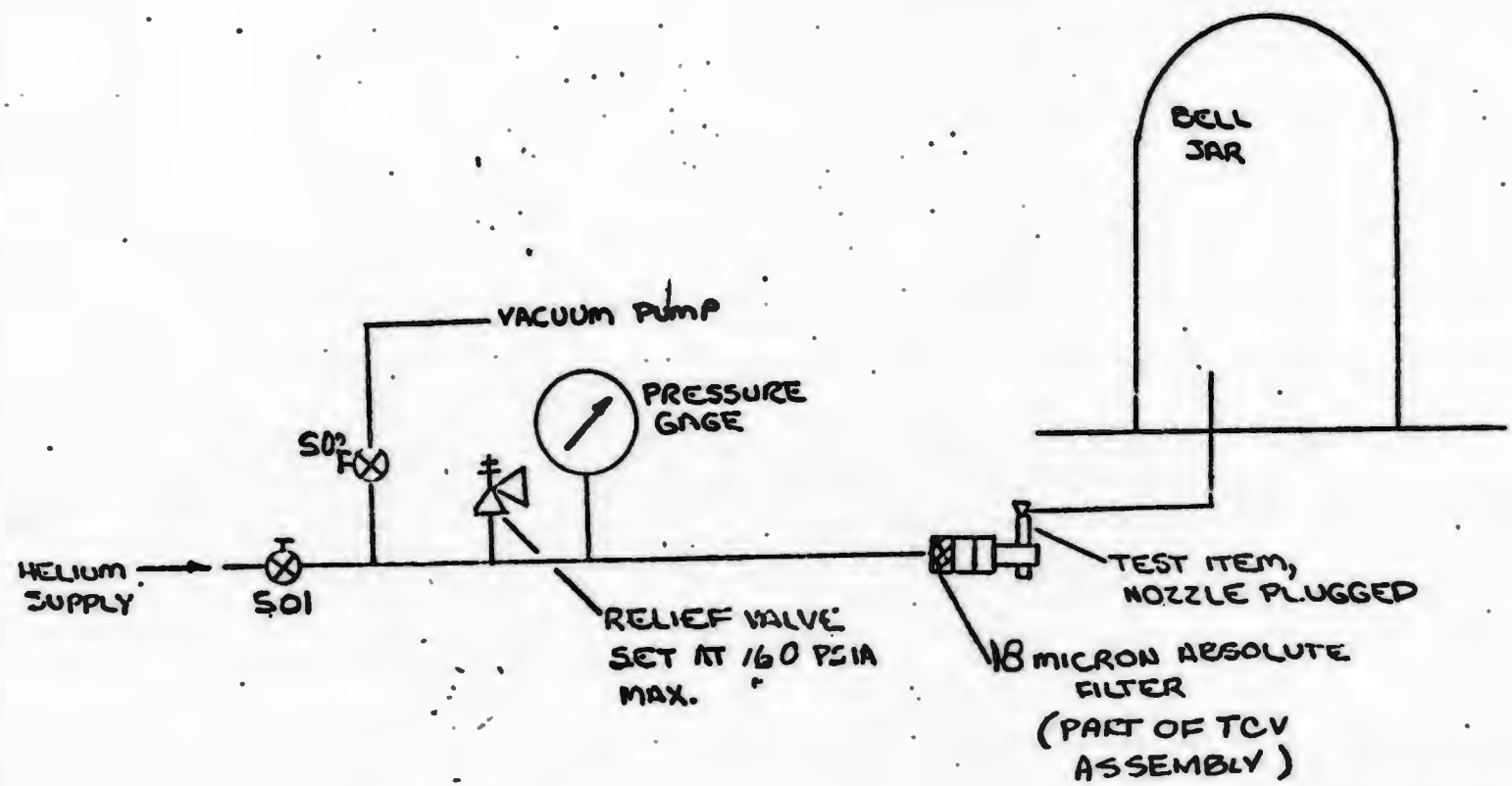
OPERATOR R. Patrick

(S8) INSPECTOR (BH) A Ciel 7-12 73

AS3

AT – NRL-0_2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A	SER. NO.
	73		00003
	CORR BAR. PRES. (IN.HG) 29.89	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-17-73
4.3.2.2	TEST RIG NRC 98		51 OF 54



OPERATOR P. Patrick

(58) INSPECTOR (FH) A. Gill 7-17-73

FIGURE 3 – INTERNAL LEAKAGE

A54

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U P.O	SER. NO.
4.3.2.2	73	SL 3 ACCEPTANCE TEST OPERATIONS/LOG SHEET	0600.3
	CORR BAR. PRES. (IN.HG) 29.84		TEST DATE 7-17-73
	TEST RIG NRC 98		520F54

INTERNAL LEAKAGE (Continued)

4.4 (Continued)

TABLE 3

PARAMETER	MINIMUM ALLOWABLE	ACTUAL	MAXIMUM ALLOWABLE
Standard Leakage Rate		$.62 \times 10^{-4}$	
Scale Reading of Standard Leakage Rate		$.62 \times 10^{-4}$	
Scale Reading of Background		0	
Inlet Pressure	100 psia	100.	105 psia
Item Helium Leakage Rate (Initial)		LESS THAN $.2 \times 10^{-7}$	1×10^{-6} scc/sec
Item Helium Leakage Rate (Final)		LESS THAN $.2 \times 10^{-7}$	1×10^{-6} scc/sec
Duration	15 minutes	15	15.25 minutes

OPERATOR E. Laszczyk

SB INSPECTOR EH A. Cael 7-17-73

AT – NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F) ~	Hamilton Standard — A Division of United Aircraft Corporation	SER. NO. 00003
	CORR BAR. PRES. (IN.HG) ~	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-18-73
4.6	TEST RIG BENCH		53 OF 54

* 4.7 Post Test Inspection

4.7.1 Visually examine the unit for defects.

4.7.2 Damage or discoloration as a result of firing is not permitted with the following exceptions:

A. Nozzle and chamber discoloration as a result of firing is permissible provided it is scale free.

B. Superficial marking of areas immediately around bolt holes is permissible.

C. Wrench marking at the Pc tap is permissible.

4.7.3 Post Test Inspection

List observations and comments below.

LESS NAMEPLATE PER Unit History #2.

OPERATOR	
(B) INSPECTOR *	

A56

AT - NRL-0.2

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — UA	SER. NO.
N/A.	CORR BAR. PRES. (IN.HG)	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE
	TEST RIG		54 OF 54

TABLE 9 VALVE CYCLE SUMMARY

Valve S/N _____

TEST PARA. NO.	VALVE CYCLES	REA STARTS (FIRING)	REA VALVE ON TIME (SEC)
4.2 (Proof)	2	—	120
4.3 (Leakage)*			
4.6 (Performance)	128. 1	102.	151.
4.5 (Flush)			
TOTALS:			

7-9-73

* Total of all valve cycles listed in each external leakage test.

S8

OPERATOR

INSPECTOR

A57

APPENDIX B

QUALIFICATION TEST PROCEDURES

QT6017

APPENDIX A

OVERSTRESS TEST PROGRAM

0.2 lb_f REA

APPROVED BY: [signature] Engineering — Date: 6/_/73

APPROVED BY: [signature] Quality Assurance — Date: 6/6/73

Applicable Spec
SVHS6017 Revision A Amendment #_
SV755437 Revision N/C

Hamilton Standard
WINDSOR LOCKS CONNECTICUT • U.S.A.

QUALIFICATION TEST PROCEDURE
OVERSTRESS TEST PROGRAM
NRL/MSD 0.2 lb_f REA

PREP. BY			QUALITY			SIZE	CODE IDENT NO.	
PROJ ENG						A	73030	QT - 6017 Appendix A
MGR.								SHEET A-1-a

A1.0 SCOPE

This test procedure defines the requirements for overstress tests, supplementing the Qualification Program defined in the basic procedure.

A2.0 GENERAL NOTES

A2.1 Handling

The handling of the REA shall be in such a manner to prevent damage to external surfaces. The REA shall only be handled by personnel wearing white, lint free, dacron, rayon, or cotton gloves.

A2.2 Cleanliness

1. An 18 micron or less absolute filter is installed directly upstream of the REA valve inlet as part of final assembly. This filter shall remain installed for all testing described herein. Removal of the filter shall be accomplished only in a Class 10,000 clean work station.

2. In addition to the filter, the REA shall be protected at all times when out of the test rig by taping clean nylon film securely in place over all openings and double-bagging the unit.

3. Rig cleanliness shall satisfy the requirements of SVP 114, 129, 130, and 133. Inspection shall verify the current status of rig cleanliness prior to performance tests.

A2.3 Retests

In the event of a failure, malfunction or out of tolerance condition during or after a test, the test sequence shall be discontinued and the deficiency shall be documented on a unit history form. The deficiency shall be corrected and the REA shall be retested with the approval of Engineering and Quality Assurance.

A2.4 Installation Check

Prior to firing tests the following checks must be performed:

1. Valve Voltage and Current - Install a 210 ohm (approximate) resistor in the test cell at the REA valve driver output. Actuate the valve driver in pulse mode and verify that valve voltage and current traces are obtained on the visicorder. Measure the voltage supplied to the valve via a voltage divider using a differential voltmeter, while the valve driver is actuated in steady state mode. Set valve supply voltage to 28 ± .25 vdc. Record power supply voltage using Fluke Voltmeter and Valve Supply Voltage on Log Sheet.

NOTE: USE UD2 RIG DRIVER.

A2.4 continued

2. PEA Chamber Pressure - With the test cell at altitude condition (8.12 mmHg vacuum pressure) verify that the reading for chamber pressure is 0 ± 5 psia. Use a differential voltmeter to measure the transducer output.

3. Inlet Pressure - Prior to each steady state run record inlet pressure transducer output on digital data log. Use a differential voltmeter to measure the transducer output (must be ±3 psi from gage reading).

4. Tank Pressure - Prior to each pulsing run record tank pressure transducer output on digital data log. Use a differential voltmeter to measure the transducer output (must be ±3 psi from gage reading).

5. Excitation Voltage - Measure excitation supply voltage for cell where data is being acquired from the record on digital data log once per cell setup.

6. Fuel Inlet Temperature - Read fuel temperature using differential voltmeter and record on digital data log for each run.

7. Chamber Temperature - Read chamber temperature on differential voltmeter. Verify reading is acceptable prior to each run.

A3.0 QUALIFICATION TEST

A3.1 Program Description

Testing shall be conducted on two engines; the Qualification engine and the Reliability engine. The program described below is shown in data sheet Figure DSI . Enter the part number and serial number of the engine at the top of the appropriate sequence. Inspection shall verify that prerequisite testing is complete.

A3.2 Qualification Engine Sequence

The engine previously having completed the basic Qualification Program shall be subjected to these further overstress tests in the sequence indicated.

Test	Reference Para.
Thrust Calibration	A4.2.1
Critical Soakback	A4.2.2

NOTE: Before soakback but after thrust, the engine shall be gold plated per separate instructions.

A3.3 Reliability Engine Sequence

The reliability engine shall have successfully completed Acceptance Tests per SVHS 6001. The engine shall then be subjected to the following overstress tests in the sequence indicated.

A3.3 continued

Test	Reference Para.
Qual Vibration	A4.2.3
Performance Map	A4.2.4
Baseline	4.2.4
Combined Life	A4.2.5

A3.4 Inspection

1. For each test listed above, record number of valve cycles in table at end of this procedure.

2. Points at which acceptance by Inspection is required are indicated on the log sheets by an asterisk (*) at the detailed step and in the "inspection" block at the lower right hand corner. Other portions of the test are subject to surveillance by Inspection on a non-mandatory basis.

QT 17
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A.	SER. NO.
SVHS 6017 4.2.4	75	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	0003
	CORR BAR. PRES. (IN.HG) 29.85		TEST DATE 7/19/73
	TEST RIG 91		

A4.2.3 VIBRATION

A. General

*1. The REA shall be prepared for vibration in a clean work station (Class 10,000).

*2. The pc tap and nozzle shall be taped closed using polyethylene. The inlet tube (SV 755437-CT-001) nut shall be securely taped to the tube and the tube end taped closed with polyethelyne.

*3. Move the REA into the Vibration Lab and install the REA on the test fixture (SVSK 77886) as shown in Figure 3.2.1.

*4. Install accelerometers per Figure 3.2.1.
REA axis orientation is per Figure 3.2.1.

5. A triaxial accelerometer shall be used as the control accelerometer for both sinusoidal and random vibration testing. The control accelerometer shall be located to provide the following input:

(1) The control input shall maintain levels at the test frequency within ± 3 db of the requirements.

(2) The minimum level at other input locations is within ± 4 db of the requirements at the test frequency.

(3) For random inputs the gRMS shall be within ± 10% of the nominal specification level. For sinusoidal inputs the peak G shall be within ± 10% and the frequencies shall be within ± 2%.

OPERATOR [signature] 7-19-73
INSPECTOR

HSF-1288 (10)

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — U A.	SER. NO.
SVHS 6017 4.2.4	75°	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	0003
	COR. BAR. PRES. (IN.HG) 29.85		TEST DATE 7/19/73
	TEST NO. 91		

A4.2.1 (Continued) VIBRATION (Continued)

A. 6. Instrumentation

Indigenous instrumentation of the vibration facility necessary for vibration monitoring.

7. Special Test Equipment

STE	Identification
Vibration Fixture	SVSK 66611/SVSK 77886
Vibration Rig	MB4 or Ling

8. Data Required

a. Response of all accelerometers shall be recorded. The control accelerometer shall be filtered and recorded during all tests, with the initial portions of the run concurrently monitored on a plot of g or g^2/cps, as applicable, vs. frequency. The ambient temperature shall be recorded at the start and end of the test.

b. Response accelerometer reduction shall only be done at Engineering request.

c. Test Set-Up Sketch - In the space provided in HS Form 175.7, a sketch of the test item and fixture shall be made including the definition of the three orthogonal axes. The sketch shall also include location of both control and response accelerometers. Format for the sketch shall be in accordance with Form HSF-175.7.

Witnessed

OPERATOR 7/24/73

INSPECTOR 7-20-73

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F) 75°	Hamilton Standard U A.	SER. NO. 0003
SVHS 6017 4.2.4	CORR BAR. PRES. (IN.HG) 29.85	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7/19/23
	TEST RIG 91		

A4.2.3 (Continued)

VIBRATION (Continued)

A.8. d. Log Sheet - An operator's log sheet, form HSF-175.1A, shall be provided for each run. The log sheet shall contain run number, starting time of run, axis, mode (simusoidal or random), scan rate, 'g's peak and paragraph number of the test specification which delineates the vibration level requirements.

e. Photographs - Photographs shall be taken which clearly illustrate the test item and setup for each orthogonal axis. Polaroids are acceptable.

9. General REA Mounting Requirements - The REA shall be hard mounted on a vibration fixture with control accelerometers located in each of the orthogonal axes near the fixture/engine interface.

The following torque table will be used as a guide when installing an engine on its vibration fixture and when installing the fixture to the exciter.

Bolt Size	Torque, in-lb
#6	15
#8	28
#10	40
1/4	100
5/16	350
3/8	350
1/2	850
3/4	2100

B. Fixture Evaluation and Resonance Search - The location of the control accelerometer shall be determined from a fixture evaluation and resonance search as required by the Initial Acceptance Test of these units. No further test effort shall be required.

Witnessed

OPERATOR [signature] 7/20/23

INSPECTOR [signature] 7-20-23

4-7

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A	SER. NO.
SVHS 6017 4.2.4	75	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. (IN. HG) 29.85		TEST DATE 7/19/73
	TEST RIG 91		

A4.2.3 VIBRATION (Continued)

C. Vibration Levels

Vibrate the REA, each axis, per the schedule below. The sequence of runs shall be dictated by maximum testing efficiency. All testing shall be conducted at ambient temperature and pressure.

	Frequency - Hz	Level	Rate or Time
Sinusoidal	25 - 2000	11 g	1 oct/min (up only)
Random	20 - 200	0.1 g^2/Hz	2 mins. minimum per axis
&	200 - 2000	-6.0 db/oct roll off	

D. Acceptance Criteria

a. The item shall pass a subsequent performance test.

* b. There shall be no damage or permanent deformation.

c. There shall be evidence of catalyst within the valve/thrust chamber interface.

Witnessed

OPERATOR [signature] 7/19/73

INSPECTOR *Q. Gilt 7-20-73

HSF-1398 (Rev)

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Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A.	SER. NO.
SVHS 0017 4.2.4	75	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	0003
	CORR BAR. PRES. (IN. Hg) 29.85		TEST DATE 7/14/73
	TEST RIG 91		

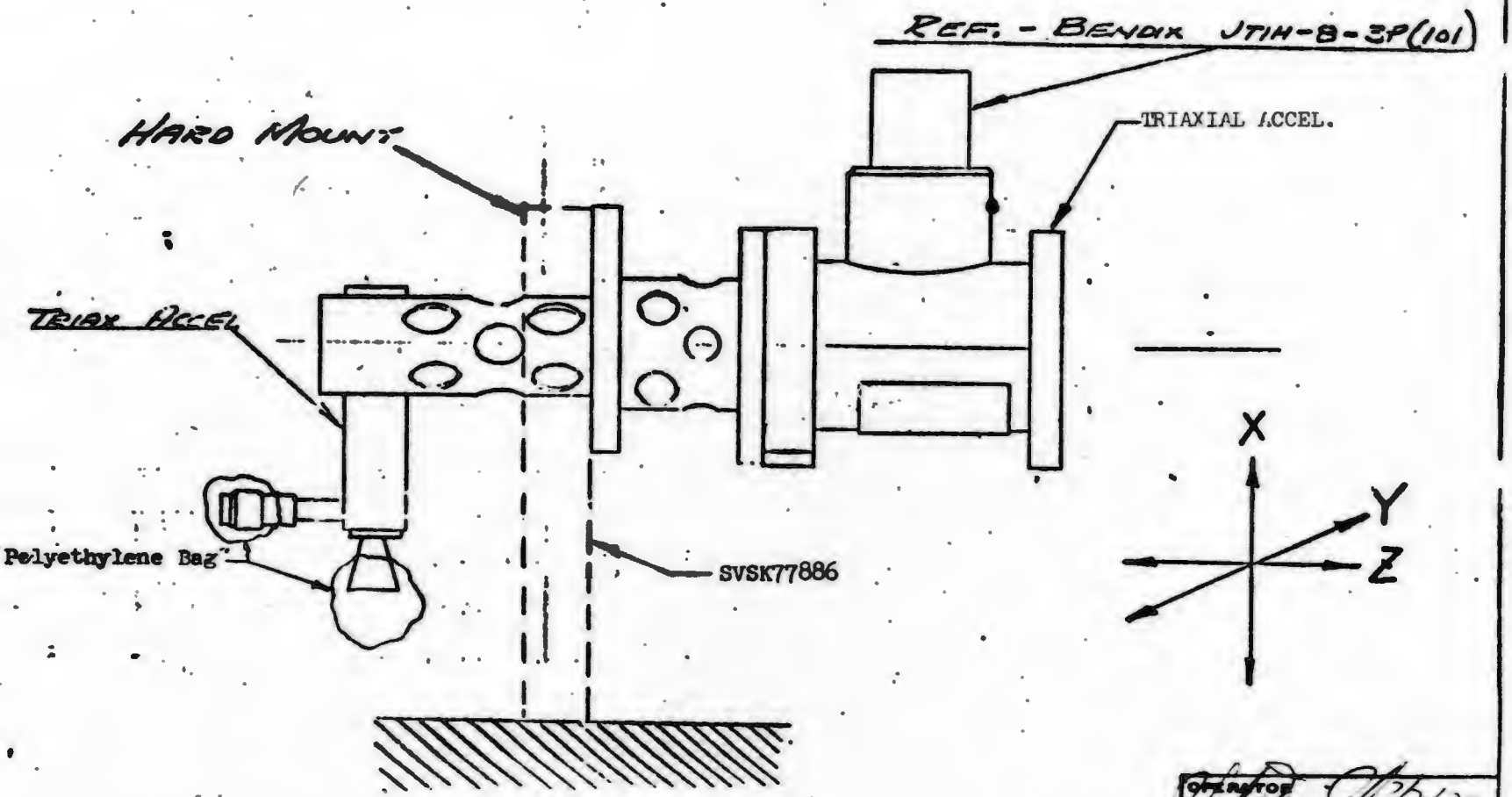

Figure 3.2.1

OPERATOR [signature] 7/30/73

Witnessed

INSPECTOR [signature] 7-30-73

6-8

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QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — United Aerospace Corporation	SER. NO.
SVHS 6017 Appendix A A4.2.4	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	0003
	CORR BAR. PRES. (IN.) 30		TEST DATE 7-23-23
	TEST RIG H2		

A4.4

Performance Map

I. Performance Map (H2)

1. Install the REA in firing fixture P/N SVSK 776571-001 with nozzle plug installed in REA nozzle. Verify that a 10 micron absolute filter has been installed at the REA inlet. Cap the Pc tap.

2. Actuate the REA valve by applying 28 ± 2 vdc to the valve power connector. Pin A+, Pin B-.

3. Pressurize the REA to 50 ± 5 psia and check for external leakage using a leak detecting fluid. If none, write "None".

4. Deactuate the REA valve, bleed pressure through the Pc tap by slowly removing the Pc tap cap. Remove nozzle plug.

5. Install a chamber temperature thermocouple on the REA as shown in Figure A4.3-1. Install valve temperature thermocouple as shown.

* 6. Verify rig cleanliness satisfied HS 3150 CE-5 (no metallic particles over 50 microns) and note this on log sheet.

7. Record throat diameter on the data sheet.

8. Install the REA in a simulated altitude test facility (Cell H3) and instrument per Table A4.3-2 and Figures A4.3-1 and A4.3-4.

9. Set up visicorder per Table A4.3-5.

10. Take a photograph of the unit set up in the test cell.

11. Set rig relief valve to 450 psia maximum.

WITNESSED 7-24-23

WITNESSED

OPERATOR J THORAULT

INSPECTOR

040

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard UA	SER. NO.
SVHS 6017 Appendix A A4.2.4	73.		0003
	CORR BAR. PRES. (IN.HG) 30.	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-23 73
	TEST RIG H-2		

A4.4 I. continued

12. Evacuate and backfill the propellant system as follows: (See Figure A4.3-6).

    a. To purge fuel from the servomanometer, open the fuel bleed, vacuum shutoff, manual bleed, arming, bypass, both flowmeter shutoffs servomanometer supply, servomanometer manual shutoffs, sightglass shutoff, servomanometer pressure and tank pressure valves. All other valves shall be closed. Slowly pressurize the servomanometer until fuel has been removed. Close tank and servomanometer pressure valves, small servo and sight glass manual valves, small servo supply valves.

    b. To evacuate the system, open the vacuum shutoff and turn on the vacuum source. Evacuate to a pressure of 1 psia or less for 30 minutes minimum.

    c. To back fill the system, close the vacuum and manual bleed shutoff valves. Open the tank pressurization valve and slowly pressurize the tank to 20-25 psia. Open the tank (solenoid) shutoff valve. Close the flowmeter shutoff valves as soon as the lines are filled. Open the servomanometer shutoff valve until the servo is filled; then close the supply valve. Close the tank (solenoid) shutoff.

    d. To check for system hardness, open the servo. Pressurization valve and then the servo supply valve. Read and record the servomanometer voltage. Pressurize the system to 270 ± 10 psia at a rate of approx. 100 psi/minute. Read and record the servo voltage. The allowable servo deflection for the propellant system shall not exceed .08 volts. Record on the data sheet.

13. Set the following initial conditions:

    Valve voltage - 28 ± 2 vdc
    Vacuum pressure = 8.12 mmHg maximum
    Fuel temperature = 70 ± 15°F

OPERATOR	
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7-24-73
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11-8

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — United Aircraft Corporation	SER. NO.
SVHS 6017 Appendix A A4.2.4	73.		0003
	CORR BAR. PRES. (IN.HG) 30.	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-23-73
	TEST RIG H-2		

A4.4 I. Continued

14. Acquire all data on digital tape as follows:

Steady state runs: Acquire 3 second lead-in, plus entire run, plus 11 second trailer.

Pulse runs: Acquire 3 second lead-in, all pulses and 11 second trailer.

15. Acquire visicorder data as follows:

Steady state runs: Acquire 0-2, 18-20, 28-30, 38-40, 48-50, 58-60 seconds at 20 ips. Remainder at 2 ips.

Pulse runs: Acquire pulses 1-10, 45-55, 90-100 at 20 ips. Remainder at 2 ips.

16. Fire the REA to the duty cycles specified in Table A-4.3-7 with the following stipulations:

a. The nozzle diameter shall be transcribed on the data log sheet from the Acceptance Test Data.

b. The fuel inlet pressure shall be within 3 psi of the tank pressure, prior to running.

c. The test sequence for the performance map test is defined in Table A4.3-7.

d. The analog data shall be reviewed after each firing for potential problems in instrumentation or engine performance.

e. The map test shall be immediately followed by a baseline test per para. A4.2.4
Record data on log sheet provided. Record initial pressure and chamber temperature prior to each part run.

17. After completion of the firing test, close the arming valve, apply 10-15 psig GN_2, purge pressure. With REA valve shut drain fuel from rig. Close drain valve and actuate REA valve for 120 seconds followed by 25 pulses - 1 second on, 1 second off. (Reference Figure A4.3-6).

N/A 7-24-73

OPERATOR J. Thigpen

INSPECTOR

WITNESSED 7-24-73

HSP-1398 5/81

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard	SER. NO.
SVHS 6017 Appendix A A4.2.4	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	0003
	CORR BAR. PRES. (IN.HG) 30.		TEST DATE 7.23.73
	TEST RIG H2		

A4.4 continued

II. Flush

1. Install the REA in a flush rig as shown in Figure A4.3-8.

2. Open the H_2O supply valve, pressurize H_2O to 10-15 psig, and actuate the REA valve at an approximate duty cycle of 50 seconds on, 10 seconds off, for 15 pulses. Apply 28 ± 2 vdc to actuate the valve, Pin A+, Pin B- for Steps 2, 3 and 4.

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3. Close H_2O supply valve, open isopropyl alcohol supply valve. Pressurize IPA to 10-15 psig and actuate the REA valve at an approximate duty cycle of 50 seconds on, 10 seconds off for 5 pulses.

4. Purge REA with GN_2 (REA valve held open with 20 ± 2 vdc after opening) at 10-15 psig until IPA ceases flowing from REA. Close REA valve.

5. Install the REA in a vacuum dessicator and vacuum dry the REA at 1500 microns Hg or less for one hour minimum. Record data in the data table.

III. Complete valve cycle record for Performance Map test.

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OPERATOR	
INSPECTOR	

QT-6017
Appendix A

SER. NO. 20063

TEST DATE 7.23.73

Hamilton Standard U A.

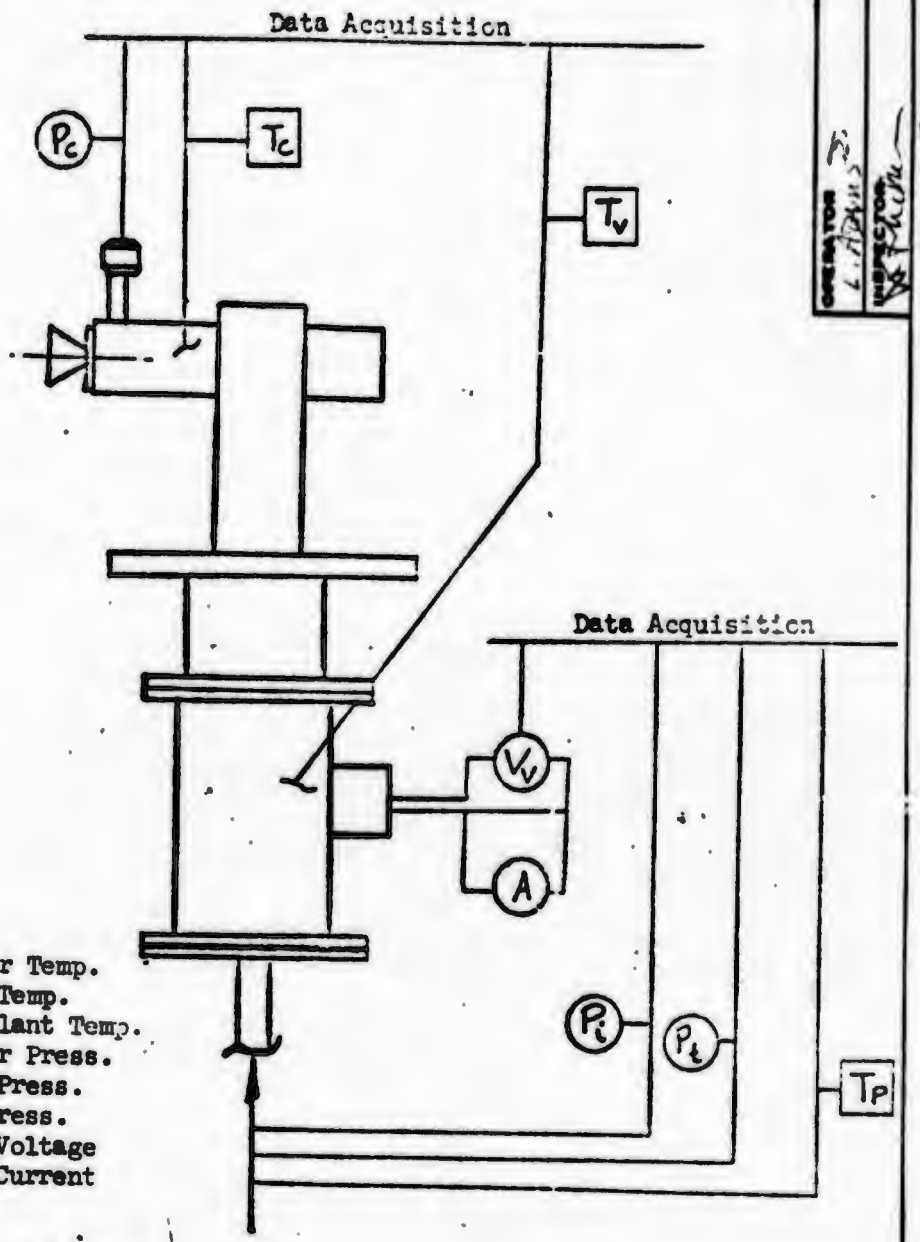
SLS ACCEPTANCE TEST
OPERATIONS/LOG SHEET

ROOM TEMP (°F) 73

CORR BAR. PRES. (in. Hg) 30.

TEST RIG H-2

REF. SPEC. PARA.
SVHS 6017
Appendix A
A4.2.1



T_c = Chamber Temp.
T_v = Valve Temp.
T_p = Propellant Temp.
P_c = Chamber Press.
P_i = Inlet Press.
P_t = Tank Press.
V_v = Valve Voltage
A = Valve Current

MS33584 1/4 in.
Tube Flare Joint

Connector
Bendix JTIH-8-3P (101)
Pin A+
Pin B-
Pin C Case Ground

FIGURE A4.3-1

PERFORMANCE MAP TEST SETUP AND INSTRUMENTATION

OPERATOR
INSPECTOR
7-24-73

B 14

HSFC-350 3/67

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — U	SER. NO.
SVHS 6017 Appendix A A4.2.4	73		0003
	CORR BAR. PRES. (IN.HG) 30.	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-23-73
	TEST RIG H2		

PERFORMANCE MAP
INSTRUMENTATION TABLE A4.3-2

PARAMETER	MEASUREMENT DEVICE	MANUFACTURER	MODEL NO.	CAL. RANGE	ACCURACY	CHANNEL 1-20	CHANNEL 20-40	GAIN
Valve Voltage	Divider	HSD	SVSK79575	0-30 vdc	-	1	21	5
Fuel Flow	Servomanometer	Bxactel	T5 40 in .312" Bore	0-.1 lmb	± 1% R	2	22	1
Inlet Pressure	Transducer	Statham	PA822	0-300 psia	± 1% FS	3	23	200
Chamber Press.	Transducer	Statham	PA8019	0-250 psia	± 0.3%	4	24	200
Valve Current	Divider	HSD	SVSK79575	0-1 amp	-	5	25	50
Tank Pressure	Transducer	Statham	PA822	0-300 psia	± 1% FS	18	38	200
Inlet Prop. Temp.	Thermocouple	—	Type T	0-200°F	± 5°F	7	27	1000
Excitation Volt.	—	—	—	10 vdc nom.	—	11	31	.5
Fuel Temp. (Tank)	Thermocouple	—	Type T	0-200°F	± 5°F	8	28	1000
Chamber Temperature	Thermocouple	—	Type K .020"	0-1500°F	± 10°F	14	34	200

OPERATOR L Adams JB

INSPECTOR F Tucker

7-24-73 0800

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U	SER. NO.
SCIS 6017 Appendix A A4.2.4	73		0003
	COAR BAR. PRES. (IN.HG) 30	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-23-13
	TEST RIG H 2-		

PERFORMANCE MAP
INSTRUMENTATION TABLE A4.3-2 (Concluded)

PARAMETER	MEASUREMENT DEVICE	MANUFACTURER	MODEL NO.	CAL. RANGE	ACCURACY	CHANNEL 1-20	CHANNEL 20-40	GAIN
Vacuum Pressure	Gage	Hastings	VT-4	0-20 mmHg	± 2% Ang Def.	19	39	1000
Tank Pressure	Gage	Weise	C	0-300 psia	± 5% FS	--	--	--
Valve Temp.	Thermocouple	--	Type T	0-500°F	± 5°F	16	36	1000

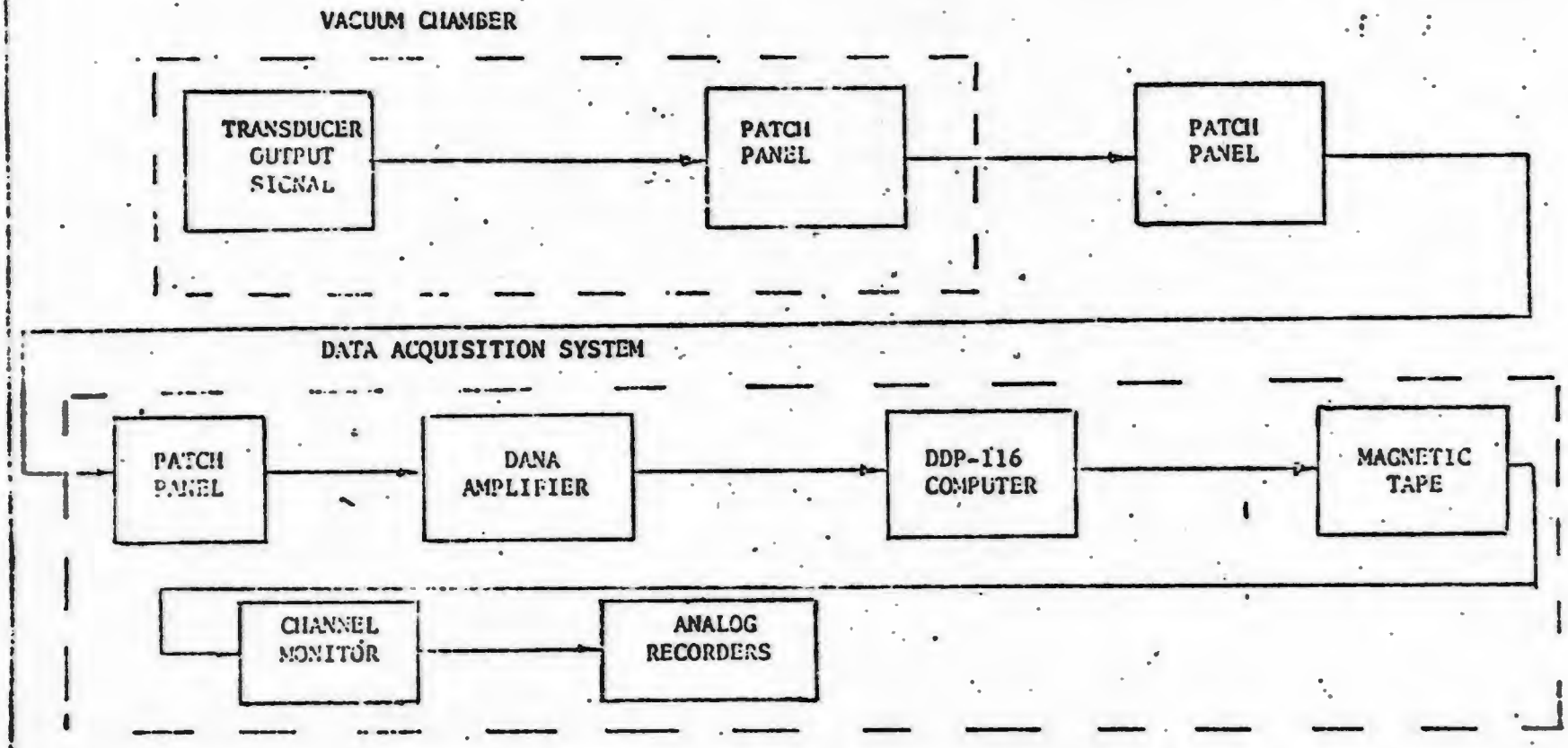
Do not install a throat temperature thermocouple on the REA.

7-24-13

OPERATOR
INSPECTOR

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U	SCR. NO.
SVHS 6017 Appendix A A4.2.4	73		
	CORR BAR. PRES. (IN.HG) 30		TEST DATE 7-23-73
	TEST RIG H 2-	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	14 of 50

PERFORMANCE MAP



INSTRUMENTATION SIGNAL ROUTING - FIGURE A4.3-4

1-24-73

OPERATOR C Andrews

INSPECTOR

HSF-1300 5/67

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — UA	SER. NO.
SVHS 6017 Appendix A A4.2.4	73.	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-23-73
	CORR BAR. PRES. (IN.HG) 30.		
	TEST R.G 1.2		

PERFORMANCE MAP
VISICORDER SET-UP

Parameter	Cal. Range	Approx. Scale Factor
Valve Voltage	0 - 30 v'c	3" span
Valve Current	0 - 0.5 amp	2" span
Inlet Pressure	0 - 300 psia	60 psi/in.
Chamber Pressure	0 - 250 psia	50 psi/in.
Chamber Temperature	0 - 1500°F	300°F/in.
Valve Temperature	0 - 500°F	100°F/in.

TABLE A4.3-5

7-24-73

OPERATOR
INSPECTOR

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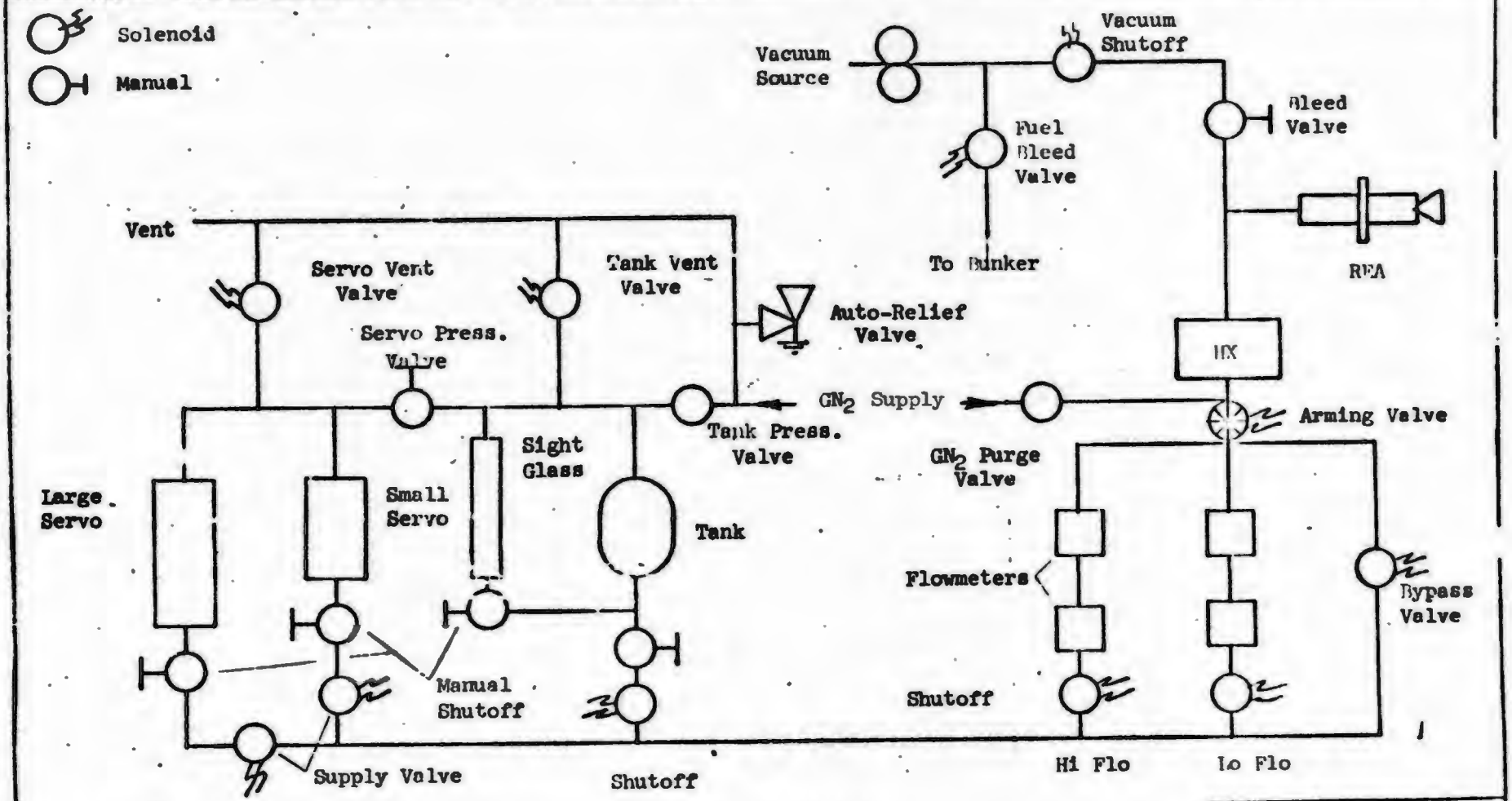
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F) 73	Hamilton Standard	SER. NO.
SVHS 6017 Appendix A A4.2.4	CORR BAR. PRES. (IN.HG) 30.	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-23-73
	TEST RIG H-2		



Rig H2 Propellant Flow Diagram

Figure A4.3-6

OPERATOR

INSPECTOR

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61-8

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A	SER. NO.
SVHS 6017 Appendix A A4.2.4	CORR BAR. PRES. (in Hg)	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE
	TEST RIG		

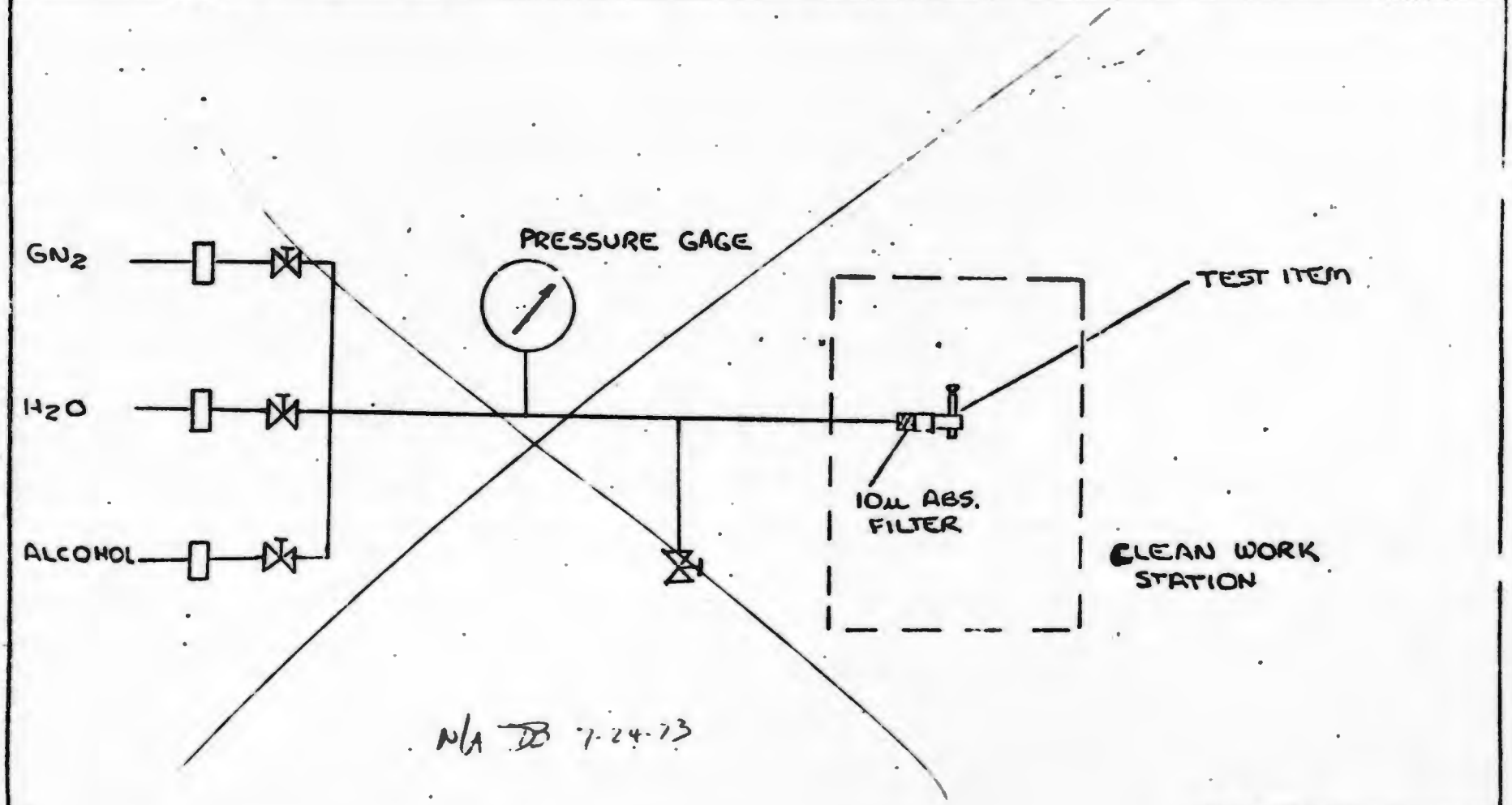

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FIGURE A4.3-8 — REA FLUSH

OPERATOR
INSPECTOR

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QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP. (°F)	Hamilton Standard — UA	SLR. NO
SVHS 6017	CORR. BAR. PRES. (IN.HG)	SLS ACCEPTANCE TEST	TEST DATE 7.24.73
4.2.4	TEST RIG H2	OPERATIONS/LOG SHEET	

4.2.4 BASELINE PERFORMANCE

A. Performance Test (H2)

* 1. Install the REA in firing fixture P/N SVSK 77657-T-001 with nozzle plug installed in REA nozzle. Cap the Pc tap.

2. Actuate the REA valve by applying 28 ± 2 vdc to the valve power connector. Pin A+, Pin B-.

* 3. Pressurize the REA to 50 ± 5 psia and check for external leakage using a leak detecting fluid. If none, write "None".

4. Deactuate the REA valve, bleed pressure through the Pc tap by slowly removing the Pc tap cap. Remove nozzle plug.

* 5. Install a chamber temperature thermocouple on the REA as shown in Figure 3.3.2. Install valve temperature thermocouple as shown.

* 6. Verify rig cleanliness satisfied HS 3150 CE-5 (no metallic particles over 50 microns) and note this on log sheet.

7. Record throat diameter on the data sheet.

* 8. Install the REA in a simulated altitude test facility (Cell H-3) and instrument per Table 4.4.1 and Figures 4.4.2 and 4.4.3.

9. Set up visicorder per Table 4.4.4.

10. Take a photograph of the unit set up in the test cell.

A NOTE: Bed may be indirectly cooled with GN_2 between runs after temperature has decreased to 600°F.

12-8

7-14-73

OPERATOR

INSPECTOR

HSP-1310

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A.	SER. NO.
SVHS 6017 4.2.4	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7.24.73
	CORR BAR. PRES. (IN.HG) 30		
	TEST RIG 1 & 2		

A4.2.4 continued

BASELINE PERFORMANCE (continued)

A. 11. Set rig relief valve to 450 psia maximum.

12. Evacuate and backfill the propellant system as follows: (See Figure 4.4.5 and Note Step 13 before proceeding).

a. With valves 3, 5 and 6 closed, open valves 1, 2, 4 and 14. Slowly pressurize the servomanometer with GN_2 to purge the fuel back into the supply tank. Close valves 1, 2, 4 and 14.

b. To purge fuel from the downstream system, open valves 10, 12, 13, 8 and 9. Valves 11 and 15 must be closed. Gradually apply approximately 15 psig GN_2 to valve 9. When fuel is no longer observed at the drain, close valve 12 and 10 and depressurize.

c. To purge fuel from the upstream system, open valves 1, 2, 4 and 6. Gradually apply approximately 15 psig GN_2 to valve9 until remaining fuel has been purged. Depressurize.

d. To evacuate the system, open valves 2, 4, 6, 11, 12 and 13. Valves 3, 5, 14, 8, 9 and 10 must be closed. Open valve 15 and evacuate at less than 1 psia for 30 minutes minimum. Close valve 15.

e. To backfill the system, valves 2, 4, 6 and 12 should be open. Valves 3, 5, 8, 9, 10, 12, 13 and 15 must be closed. Gradually pressurize the supply tank to approximately 10 psig. Open valve 1. Cycle valve 7.

f. To backfill the servomanometer, open valve 14. When filled, close valves 1, 2 and 4.

g. Verify hardness of the backfill by recording output voltage and pressurizing the servomanometer to 295 ± 5 psia. Depressurize the servomanometer to ambient pressure. Note the output voltage. The voltage change must be less than 0.24 vdc. (If not, repeat step 12 until voltage change is acceptable).

NOTE: If propellant system is filled up to arming valve, evacuate and backfill only the portion of the system downstream of the arming valve.

OPERATOR Billington

INSPECTOR [illegible]

7-24-73

WITNESSED

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F):	Hamilton Standard U/A	SER. NO.
SVHS 6017 4.2.4	73		0003
	CORR BAR. PRES. (IN.HG) 30.	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 1-24-73
	TEST NO. H 2		

A4.2.4 (Continued) BASELINE PERFORMANCE (Continued)

A. 13. Rig evacuation alternate method:

a. This step is to be used only if REA installation takes place within 8 hours of removal of previous REA and test rig valve positions are the same and test rig fuel system has not been broken into.

b. Connect Valves 11 and 13 to a vacuum source. All other valves are closed. Open Valves 11 and 13 and evacuate at 1 psia or less for 30 minutes maximum.

c. Close Valves 11 and 13, open Valves 1, 2, 4 and 6 with N_2H_4 supply tank pressurized to approximately 10 psig. Perform system check per Step 12g. If this step (16) is not performed, cross out this step and write "N/A."

14. Set the following initial conditions:

Valve Voltage = 28 ± 2 vdc
Vacuum Pressure = 8.35 mm Hg maximum
Fuel Temperature = 70 ± 15°F

15. Fire the REA to the duty cycles specified below with the following stipulations:

B a. Use UD2 rig driver circuit to fire the REA. Record driver identification on Log Sheet.

b. Runs are to be made using the servomanometer (flowmeters not required - valve 7 deactuated). Verify that the tank pressure gage and inlet pressure transducer agree within ± 3 psi prior to running.

c. To pressurize the system for a run, open valves 14 and 6 and slowly increase the regulated GN_2 supply to the servomanometer, as indicated by the inlet pressure transducer.

d. Use the firing sequence tape designated for each run.

B-23

OPERATOR Bullington
INSPECTOR [signature]
WITNESS(?)
7-24-73

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — U — A_0	SER. NO.
SVHS 6017 4.2.4	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 1-24-13
	CORR AR. PRES. (IN.HG) 30		
	TEST R.H. H2		

A4.2.4 (Continued) BASELINE PERFORMANCE (Continued)

A.15 e. Acquire all data on digital tape as follows:

Steady state runs: Acquire 3 second lead-in, plus entire run, plus 11 second trailer.
Pulse runs: Acquire 3 second lead-in, all pulses and 11 second trailer.

f. Acquire visicorder data as follows:

Steady state runs: Acquire 0-2, 18-20, 28-30, 38-40, 48-50, 58-60 seconds at 20 ips. Remainder at 2 ips.

Pulse runs: Acquire pulses 10-10, 45-55, and 90-100 at 20 ips. Remainder at 2 ips.

g. Pulse and steady state firings at the same inlet pressure will be fired as a continuous run. Combine the two sequences with a five minute delay between sequences to adjust pressure and switch from tank to servo as follows:

NRL-LT-2 100 pulses

NRL-LT-3 60 second steady state

Acquire data as defined in Steps 15(e) and 15(f) above.

h. Firing Sequence - Fire runs per Table 4.4.6.

Record data in Log sheet provided. Record initial pressure and chamber temperature prior to each part run.

OPERATOR Dillington
INSPECTOR [illegible]

1-24-13

B-24

HSF-1390 5/67

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F) 73	Hamilton Standard	SER. NO. 00003
SVHS 6017 4.2.4	CORR BAR. PRES. (IN.HG) 30.	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-24-73
	TEST RIG H2		

A4.2.4 Continued)

BASELINE PERFORMANCE (Continued)

16. After completion of the firing test, close Valve 6, apply 10-15 psig GN_2 through Valves 8 and 9, open Valves 12 and 13 to drain fuel from rig. Close Valves 12 and 13, and actuate REA valve for 120 seconds followed by 25 pulses - 1 second on, 1 second off. (Reference Figure 4.4.5).

B. Flush

1. Install the REA in a flush rig as shown in Figure 4.4.7.

2. Open the H_2O supply valve, pressurize H_2O to 10-15 psig, and actuate the REA valve at an approximate duty cycle of 50 seconds on, 10 seconds off, for 15 pulses. Apply 28 ± 2 vdc to actuate the valve, Pin A+, Pin B- for Steps 2, 3 and 4.

3. Close H_2O supply valve, open isopropyl alcohol supply valve. Pressurize IPA to 10-15 psig and actuate the REA valve at an approximate duty cycle of 50 seconds on, 10 seconds off for 5 pulses.

4. Purge REA with GN_2 (REA valve held open with 20 ± 2 vdc after opening) at 10-15 psig until IPA ceases flowing from REA. Close REA valve.

5. Install the REA in a vacuum dessicator and vacuum dry the REA at 1500 microns Hg or less for one hour minimum. Record data in the data table.

C. Complete valve cycle record for Baseline Performance test.

N/A 7-24-73

OPERATOR: Bullington
INSPECTOR: 7-24-73

OT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U / P_o	SER. NO.
SVHS 6017 4.2.4	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	00003
	CORR BAR. PRES. (IN.HG) 30.		TEST DATE 7 24 73
	TEST RIG H2		

BASELINE PERFORMANCE
INSTRUMENTATION TABLE 4.4.1

PARAMETER	MEASUREMENT DEVICE	MANUFACTURER	MODEL NO.	CAL. RANGE	ACCURACY	CHANNEL 1-20	CHANNEL 20-40	GAIN
Valve Voltage	Divider	HSD	SVSK79575	0-30 vdc	-	1	21	5
Fuel Flow	Servomanometer	Exactel	T5 40 in .312" Bore	0-.1 lmb	± 1% R	2	22	1
Inlet Pressure	Transducer	Statham	PA822	0-300 psia	± 1% FS	3	23	200
Chamber Press.	Transducer	Statham	PA822	0-500 psia	± 0.3%	4	24	200
Valve Current	Divider	HSD	SVSK79575	0-1 amp	-	5	25	50
Tank Pressure	Transducer	Statham	PA822	0-300 psia	± 1% FS	6	26	200
Inlet Prop. Temp.	Thermocouple	—	Type T	0-200°F	± 5°F	7	27	1000
Excitation Volt.	—	—	—	10 vdc nom.	—	11	31	.5
Fuel Temp. (Tank)	Thermocouple	—	Type T	0-200°F	± 5°F	12	32	1000
Chamber Temperature	Thermocouple	—	Type K .020"	0-1500°F	± 10°F	14	34	200

OPERATOR E. Calfee B
INSPECTOR [signature]
7-24-73

B-25

HSP-1300 1/67

CL-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A6	SER. NO.
SVHS 6017 4.2.4	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-24-73
	CORR BAR. PRES. (IN.HG) 30		
	TEST RIG H.L		

BASELINE PERFORMANCE
INSTRUMENTATION TABLE 4.4.1 (Concluded)

PARAMETER	MEASUREMENT DEVICE	MANUFACTURER	MODEL NO.	CAL. RANGE	ACCURACY	CHANNEL 1-20	CHANNEL 20-40	GAIN
Vacuum Pressure	Gage	Hastings	VT-4	0-20 mmHg	± 2% Ang Def.	8	28	1000
Tank Pressure	Gage	Heise	C	0-300 psia	± 5% FS	--	--	--
Valve Temp.	Thermocouple	--	Type T	0-500°F	± 5°F	16	36	1000

OPERATOR E. Cafferty
INSPECTOR A Thacker

7-24-73

027

QT6017 Appendix A

SER. NO. P0003

TEST DATE 7-24-73

Hamilton Standard U A.

SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET

ROOM TEMP (°F) 73

CORR AIR PRES. (IN. HG) 30.

TEST RIG H-2

REF. SPEC. PARA. SVHS6017 Appendix A A4.2.3

7-24-73

TABLE A 4.3.7

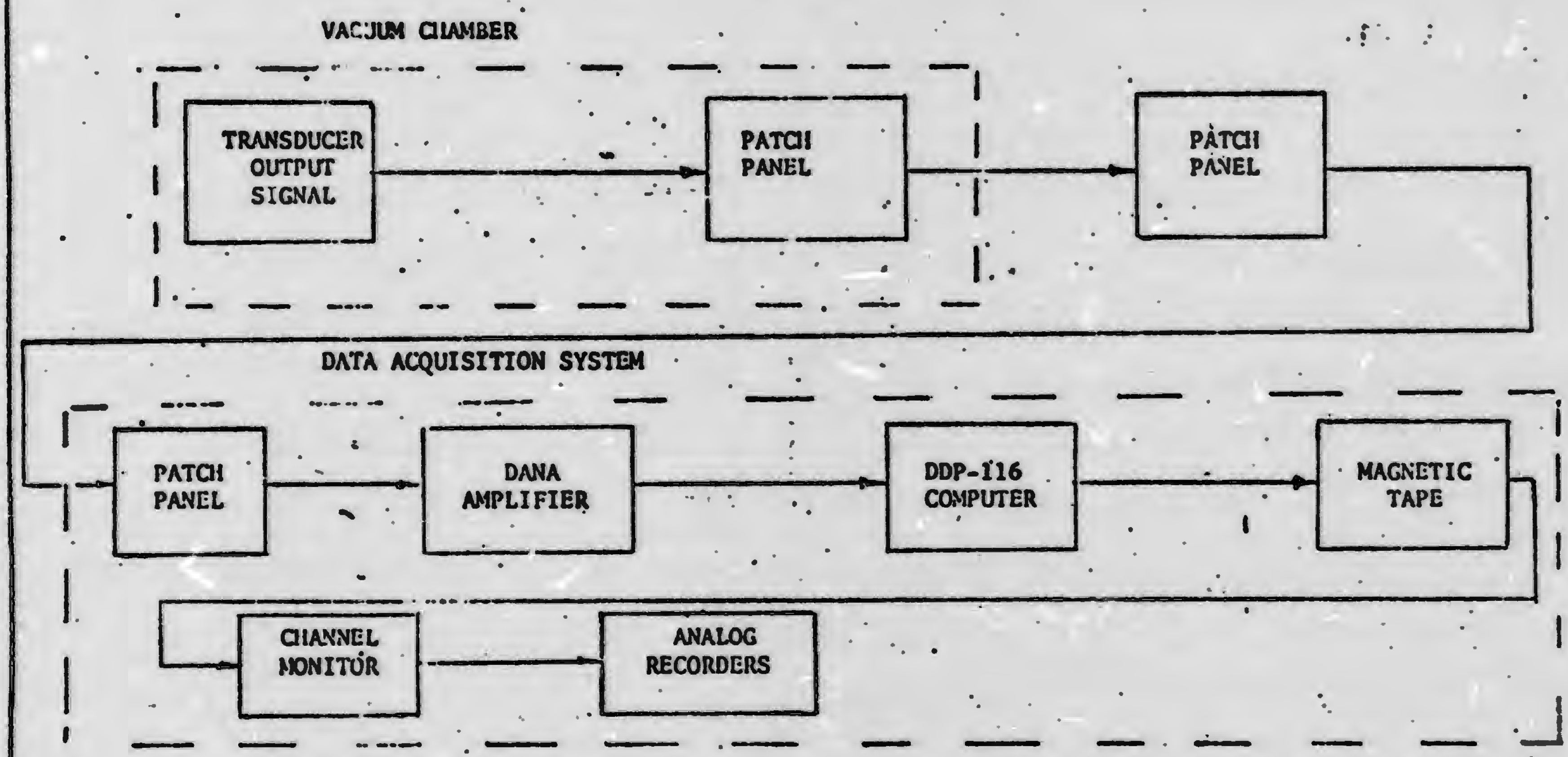
PERFORMANCE MAP TEST CONDITIONS

Run Ident.	Pin psia ± 5	t_{on} Seconds	t_{off}	N Pulses	Pulse Pend Seconds	Tape Des. (HRL-LTX
A ✓	315	0.06	0.94	100	1.00	2
B ✓	315	60.0	-	1	-	3
C ✓	250	0.06	1.19	100	1.25	10
D ✓	250	0.06	0.69	100	0.75	11
E ✓	250	0.075	0.925	100	1.00	12
F ✓	250	.045	0.955	100	1.00	13
G ✓	170	0.06	1.19	100	1.25	10
H ✓	170	0.06	0.69	100	0.75	11
I ✓	170	0.075	0.925	100	1.00	12
J ✓	170	0.045	0.955	100	1.00	13
K ✓	125	0.06	1.19	100	1.25	10
L ✓	125	0.06	0.69	100	0.75	11
M ✓	125	0.075	0.925	100	1.00	12
N ✓	125	0.045	0.955	100	1.00	13
O ✓	95	0.06	0.94	100	1.00	2
P ✓	95	60.0	-	1	-	3
Q ✓	60	0.06	1.19	100	1.25	10
R ✓	60	0.06	0.69	100	0.75	11
S ✓	60	0.075	0.925	100	1.00	12
T	60	0.045	0.955	100	1.00	13

Note: Initial chamber temperature shall be 90° ± 10° F. Artificial cooling is permissible after chamber reaches 600° max.

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard	SER. NO.
SVHS 6017 A4.2.4	73	SLS ACCEPTANCE TEST	
	CORR BAR. PRES. (IN.HG) 30	OPERATIONS/LOG SHEET	TEST DATE 7-24-73
	TEST RIG H 2		

BASELINE PERFORMANCE (Continued)



INSTRUMENTATION SIGNAL ROUTING - FIGURE 4.4.3.

7-24-73

OPERATOR
INSPECTOR

HSF-1398 3/67

QT-6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A	SER. NO.
SVHS 6017 A4.2.4	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-24-73
	CORR BAR. PRES. (IN.HG) 30.		
	TEST RIG H2		

BASELINE PERFORMANCE
VISICORDER SETUP TABLE A4.4.4

PARAMETER	CAL RANGE	APPROXIMATE SCALE FACTOR
Valve Voltage	0-30 vdc	2" Span
Valve Current	0-0.5 amps	2" Span
Inlet Pressure	0-300 psia	60 psi/inch
Chamber Pressure	0-250 psia	50 psi/inch
Chamber Temperature	0-1500°F	300°F/inch
Valve Temperature	0-500°F	100°F/inch

1-24-73

OPERATOR J. Lorenz

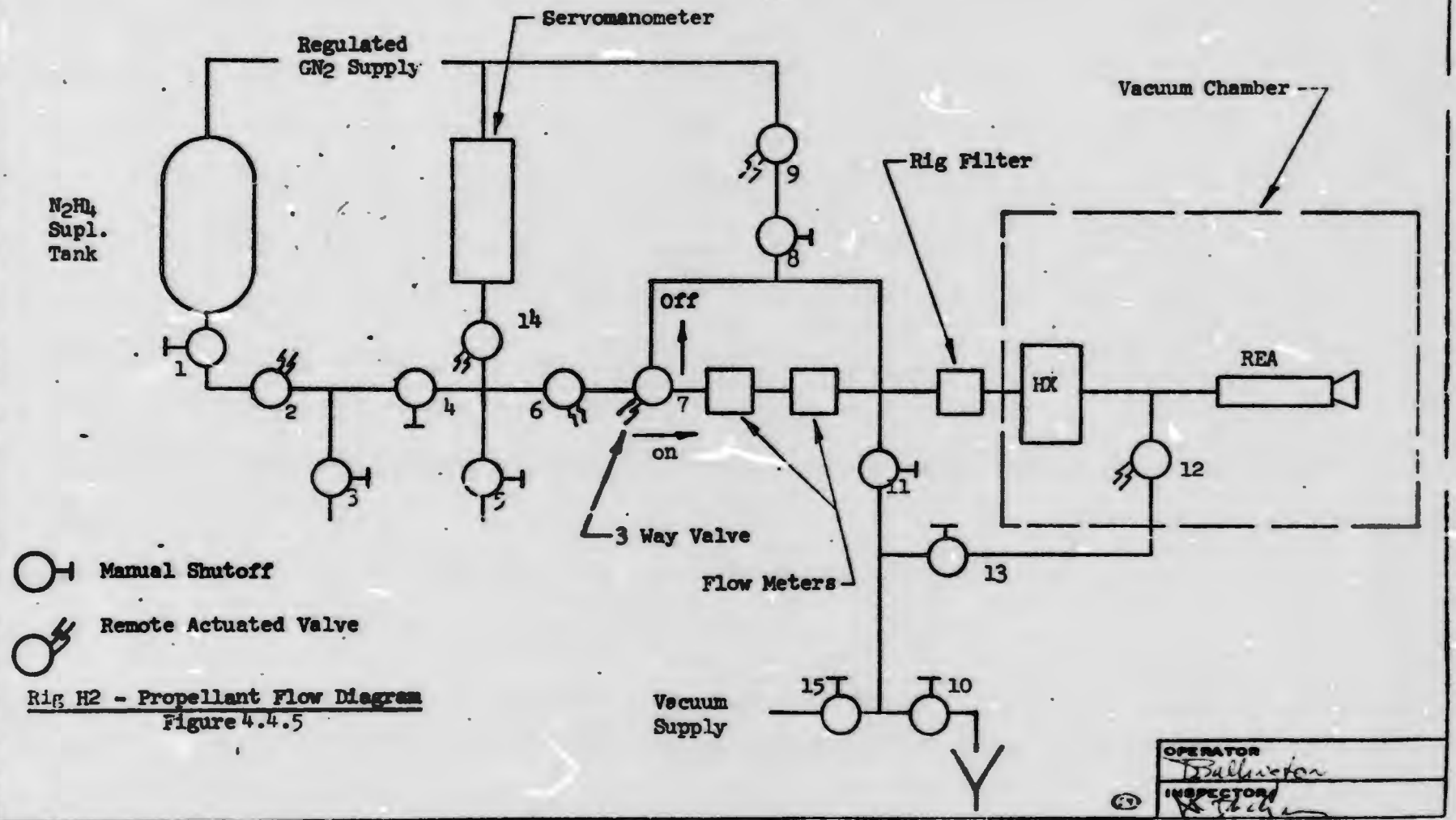
INSPECTOR

8-30

HSP-1200 (Rev.)

QT 127
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard	SER. NO.
SVHS 6017 4.2.4	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE 7-24-73
	CORR BAR. PRES. (IN.HG) 30.		
	TEST RIG H2		



Rig H2 - Propellant Flow Diagram
Figure 4.4.5

OPERATOR Ballington
INSPECTOR
7-24-73

16-0

QT6017
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A.	SER. NO. CO1-A3
SVHS6017	73.		TEST DATE 7-24-73
para.4.2.5	CORR BAR. PRES (IN.HG) 30.	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	
	TEST RIG H2		

FIRING SEQUENCE - TABLE 4.4.6

Run	Pt P_1 Transducer (psia)	τ_{on} (sec)	T_{off} (sec)	N Pulses	Sequence Tape	Notes
1	250 ± 5	0.06	0.94	100	NRL-LT-2	
2	250 ± 5	60	--	1	NRL-LT-3	Acceptable to combine with run 1
3	170 ± 5	0.06	0.94	100	NRL-LT-2	
4	125 ± 5	0.06	0.94	100	NRL-LT-2	
5	125 ± 5	60	--	1	NRL-LT-3	Acceptable to combine with run 4
6	60 ± 5	0.06	0.94	100	NRL-LT-2	

NOTES: Initial chamber wall temperature 90 ± 10°F Artificial cooling is permissible after chamber reaches 600° max.

OPERATOR Bullington

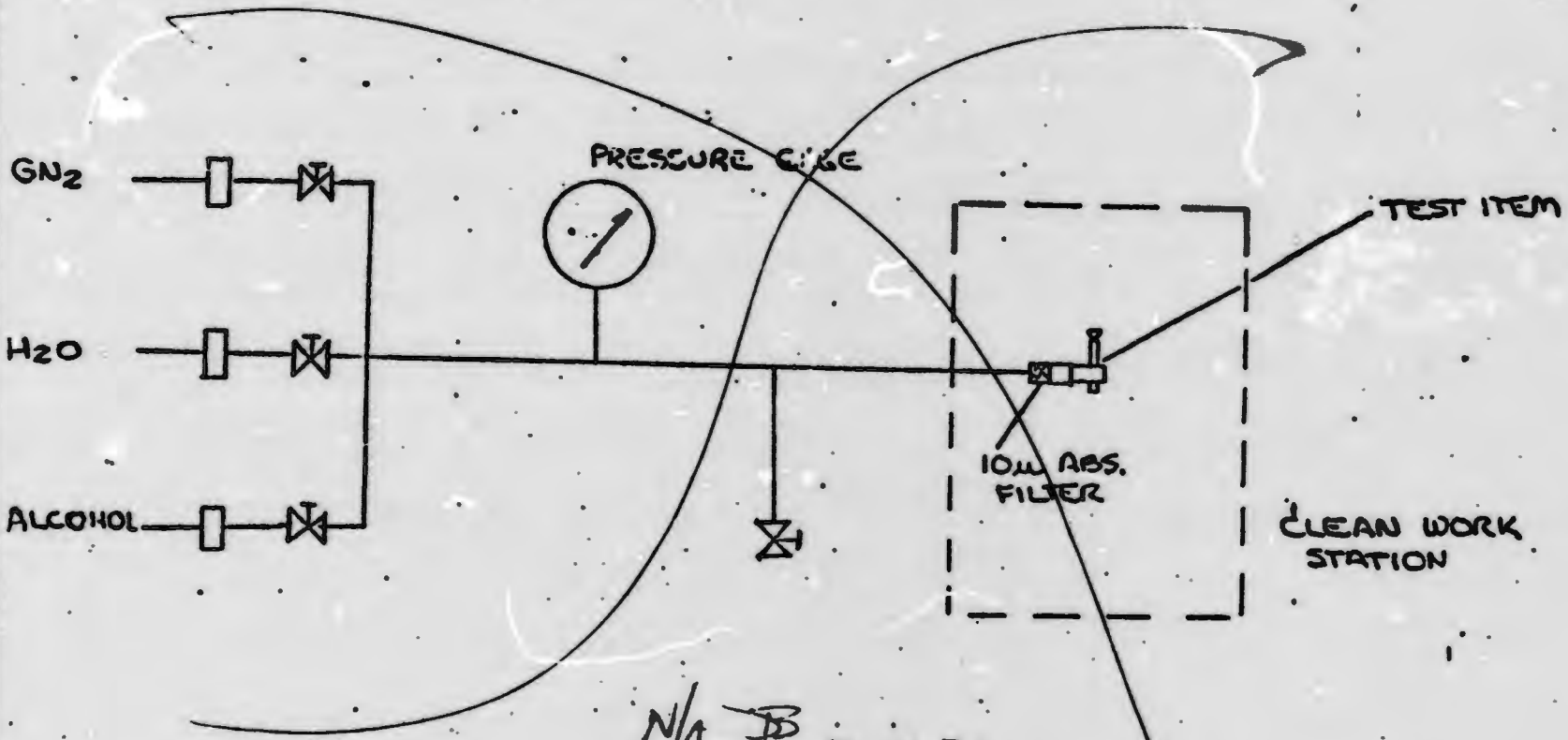
INSPECTOR [illegible]

7-24-73

B 32

E

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U	SER. NO.
SMS 6017	CORR BAR. PRES. (IN.HG)	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	TEST DATE
	TEST RIG		



N/A JD 7-24-73

OPERATOR
INSPECTOR

FIGURE 4.4.6 - REA FLUSH

HSF-1300 5/67

QT 17
Appendix A

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard U A.	SER. NO.
SVHS 6017 Appendix A A4.2.5	73	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	0003
	CORR BAR. PRES. (IN.HG) 30.		TEST DATE 1-15-73
	TEST RIG H-2		

A4.2.5

COMBINED LIFE

A. Performance Test (H2)

1. Install the REA in firing fixture P/N SVSK 77657-T-001 with nozzle plug installed in REA nozzle. Verify that a 10 micron absolute filter has been installed at the REA inlet. Cap the Pc tap.

2. Actuate the REA valve by applying 28 ± 2 vdc to the valve power connector. Pin A+, Pin B-.

* 3. Pressurize the REA to 50 ± 5 psia and check for external leakage using a leak detecting fluid. If none, write "None". 1-15-73

4. Deactuate the REA valve, bleed pressure through the Pc tap by slowly removing the Pc tap cap. Remove nozzle plug.

* 5. Install a chamber temperature thermocouple on the REA as shown in Figure 4-1. Install valve temperature thermocouple as shown. 1-15-73

6. Verify rig cleanliness satisfies HS 3150 CE-5 (no metallic particles over 50 microns) and note this on log sheet.

7. Record throat diameter on the data sheet.

* 8. Install the REA in a simulated altitude test facility (Cell H2) and instrument per Table A4.4.1 and Figures A4.4.2 and A4.4.3. 1-15-73

9. Set up visicorder per Table A4.4.4

10. Take a photograph of the unit set up in the test cell.

11. Set rig relief valve to 450 psia maximum.

OPERATOR [signature]

INSPECTOR * [signature]

1-15-73

REF. SPEC. PARA.	ROOM TEMP (°F)	Hamilton Standard — UA	SER. NO.
SVHS 6017 Appendix A A4.2.5	73 CORR BAR. PRES. (IN.HG) 30. TEST RIG H2	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	0003 TEST DATE 7-25-73

A4.2.5 continued

COMBINED LIFE (continued)

A. 12. Evacuate and backfill the propellant system per standard rig operating proceedures including hardness check.

13. a. Acquire baseline data only on digital tape as follows:

Steady state runs: Acquire 3 second lead-in, plus 3 sec/100 sec, plus 11 second trailer.

b. Acquire baseline data only on visicorder as follows:

Steady state runs: Acquire at 0.1 ips except 20 ips for 1 second out of each 150 seconds.

OPERATOR	D Bullington
INSPECTOR	

SE-88-35

NSF-1300 5/67

QT-6017
Appendix A

REF. SPEC. PARA	ROOM TEMP (°F)	Hamilton Standard	SER. NO.
SVHS 6017 Appendix A A4.2.5	73.	SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET	005613
	CORR BAR. PRES. (IN.HG) 30.		TEST DATE 7-25-73
	TEST RIG H-2		

A4.2.5 continued

COMBINED LIFE (continued)

A. 15. c. To pressurize the system for a run, open the servomanometer and tank pressure valves and slowly increase the regulated GN_2 supply to the servomanometer, as indicated by the inlet pressure transducer.

d. Use the firing sequence tape designated for each run.

INTERIM PURGE 7-27-73 DD 1814 MRS

16. After completion of the firing test, close the arming valve. Apply 10-15 psig GN_2 through the GH_2 source to HX valve. Open bleed, vacuum and fuel bleed valves to drain fuel from the rig. Close both bleed and the vacuum valves and actuate the REA valve for 120 seconds followed by 25 pulses - 1 second on, 1 second off (Reference Figure 4.5.1).

Shut Down

B. **Flush**

INTERIM FLUSH 7-27-73 DD —

Shut Down

1. Install the REA in a flush rig as shown in Figure A4.4.6

2. Open the H_2O supply valve, pressurize H_2O to 10-15 psig, and actuate the REA valve at an approximate duty cycle of 50 seconds on, 10 seconds off, for 15 pulses. Apply 28 ± 2 vdc to actuate the valve, Pin A+, Pin B- for Steps 2, 3 and 4.

3. Close H_2O supply valve, open isopropyl alcohol supply valve. Pressurize IPA to 10-15 psig and actuate the REA valve at an approximate duty cycle of 50 seconds on, 10 seconds off for 5 pulses.

4. Purge REA with GN_2 (REA valve held open with 20 ± 2 vdc after opening) at 10-15 psig until IPA ceases flowing from REA. Close REA valve.

7-27-73

5. Install the REA in a vacuum dessicator and vacuum dry the REA at 1500 microns Hg or less for one hour minimum. Record data in the data table.

OPERATOR 5-23-73

INSPECTOR 5-23-73

QT-6017 Appendix A

SER. NO. 0000-3

TEST DATE 7.25.73

OPERATOR

INSPECTOR

Hamilton Standard U A.

SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET

ROOM TEMP (°F) -73

CORR BAR. PRES. (in Hg) 30

TEST RIG H 25

REF. SPEC. PARA. SVHS 6017 Appendix A A4.2.5

TABLE 4.5.1 - COMBINED LIFE TEST CONDITIONS

Pressure psia ± 5	Mode Pulse/S.S.	t	Tape Designation	Runs
Comp 250	20K pulses	-	NRL-LT-14	1
	Baseline Test	-	-	-
Comp 7-25-73 Comp 7-26-73 250	20K pulses	-	NRL-LT-14	1
Comp 7-26-73 thru	Baseline Test	-	-	-
250 Comp 7-26-73	20K pulses	-	NRL-LT-14	1
Comp 7-26-73	Baseline Test	-	-	-
Comp 7-27-73 250	20K pulses	-	NRL-LT-14	1
Comp 7-27-73	Baseline Test	-	-	-
250 Comp 7-27-73	13.75K pulses	-	NRL-LT-15	1
Comp 7-27-73	Baseline Test	-	-	-
Comp 250 8-13-73	S.S.	2 hr	NRL-LT-16	3
Comp - 8-13-73	Baseline Test	-	-	- 2 hrs.
Comp 8-14-73 210	20K pulses	-	NRL-LT-15	1 5.5 hrs
Comp 8-15-73	Baseline Test	-	-	- 2 hr. 5.5 hrs
Comp 210 8/15/73	20K pulses	-	NRL-LT-15	1
Comp 8-15-73	Baseline Test	-	-	-
210 Comp 8-15-73	20K pulses	-	NRL-LT-15	1
Comp 8-16-73	Baseline Test	-	-	-
Comp 8/16/73 210	20K pulses	-	NRL-LT-15	1
Comp - 8/16/73	Baseline Test	-	-	-

22 ± 5 4K/26

B-37

QT-6017 Appendix A

SER. NO.

TEST DATE

OPERATOR

INSPECTOR

Hamilton Standard

SLS ACCEPTANCE TEST OPERATIONS/LOG SHEET

ROOM TEMP (°F)

CORR BAR. PRES. (IN. Hg)

TEST RIG

REF. SPEC. PARA. SVHS 6017 Appendix A A4.2.5

TABLE 4.5.1 (continued)

Pressure psia ± 5	Mode Pulse/S.S.	t	Tape Designation	Runs	
Comp 210 8-16-73	13.75K pulses	-	NRL-LT-15	1	
Comp 8-16-73	Baseline Test	-	-	-	
Comp 210 8-16-73	S.S.	2 hr.	NRL-LT-16	3	
Comp - 8-16-73	Baseline Test	-	-	-	2
Comp. 170 8/17/73	20K pulses	-	NRL-LT-14	1	55
Comp. - 8/17/73	Baseline Test	-	-	-	2
Comp 170 8-17-73	20K pulses	-	NRL-LT-14	1	55
Comp. 8-17-73	Baseline Test	-	-	-	2.
Comp 170 8-17-73 B	20K pulses	-	NRL-LT-14	1	55
Comp - 8-18-73 B	Baseline Test	-	-	-	2
Comp 170 8-18-73	20K pulses	-	NRL-LT-14	1	55
Comp 8-18-73	Baseline Test	-	-	-	2.
Comp 170 8-18-73 B	13.75K pulses	-	NRL-LT-15	1	3
Comp - 8-18-73 B	Baseline Test	-	-	-	2.
Comp 170 8-19-73 B	S.S.	2 hrs	NRL-LT-16	3	7.
Comp - 8/20/73	Baseline	-	-	-	2
Comp 125 8-20-73	20K pulses	-	NRL-LT-14	1	55
Comp 8-20-73	Baseline Test	-	-	-	2.
Comp 125 8-20-73 B	20K pulses	-	NRL-LT-14	1	55
Comp - 8-20-73 B	Baseline Test	-	-	-	2

QT-6017
Appendix A

SER. NO.

TEST DATE

OPERATOR

INSPECTOR

Hamilton Standard — U A.

SLS ACCEPTANCE TEST
OPERATIONS/LOG SHEET

TABLE 4.5.1 (continued)

Pressure psia ± 5	Mode Pulse/S.S.	t minutes	Tape Designation	Runs	
125 comp 8/21/73	20K pulses	-	NRL-LT-14	1	5.5
Comp 8/21/73	Baseline Test	-	-	-	2.
Comp 8-21-73	20K pulses	-	NRL-LT-14	1	5.5
Comp. 8-21-73	Baseline Test	-	-	-	2
Comp 125 8-21-73	13.75K pulses	-	NRL-LT-15	1	3
Comp 8-21-73	Baseline Test	-	-	-	2.
125 Comp 8/22/73	S.S.	2 hr.	NRL-LT-6	3	7.
Comp 8/22/73	Baseline Test	-	-	-	2
					29.0

ROOM TEMP (°F)

CORR BAR. PRES. (.HG)

TEST RIG

REF. SPEC. PARA.
SVHS 6017
Appendix A
A4.2.5

B-39

APPENDIX C

QUALIFICATION DATA CURVES

TABLE IC

Thrust Overshoot
S/N 00003
Inlet Pressure = 250 psia

Run Number	Cumulative Operating Time (hours)	Thrust Overshoot (lb_f) 1. Steady State	2. Pulse 1	3. Pulses 2 - 100	Fuel Temperature (°F)
2483	.097	0.22	0.41	0.24	68.5 - 70.2
2487	.427	0.22	0.41	0.24	68.7 - 70.2
2491	.757	0.22	0.41	0.27	68.6 - 70.3
2495	1.087	0.23	0.41	0.25	68.8 - 70.5
2499	1.417	0.22	0.37	0.22	68.1 - 69.5
2503	1.647	0.22	0.37	0.23	68.4 - 70.6
2507	7.647	0.22	0.38	0.24	74.0 - 75.6
2511	7.977	0.21	0.37	0.25	77.6 - 78.2
2516	8.307	0.21	0.37	0.23	76.0 - 77.2
2520	8.637	0.21	0.37	0.22	75.1 - 76.1
2524	8.967	0.23	0.37	0.25	75.1 - 76.5
2528	9.197	0.23	0.36	0.25	75.4 - 76.4
2532	15.197	0.22	0.37	0.24	75.4 - 77.2
2536	15.527	0.21	0.37	0.23	75.3 - 76.4
2540	15.857	0.21	0.37	0.22	74.9 - 79.7
2544	16.187	0.20	0.37	0.32	76.5 - 77.6
2548-9	16.517	0.22	0.37	0.26	75.6 - 76.5
2553	16.747	0.20	0.37	0.24	75.7 - 77.3
2557	22.747	0.20	0.25	0.28	75.7 - 77.4
2561	23.077	0.20	0.30	0.25	75.5 - 76.9
2565	23.407	0.20	0.32	0.21	76.4 - 77.3
2569	23.737	0.20	*	*	75.5 - 77.2
2573	24.067	0.21	0.35	0.25	76.3 - 77.3
2577	24.297	0.20	0.37	0.23	75.6 - 77.0
2582	30.297	0.20	0.0	0.23	75.5 - 77.0

1. Specification requires that steady state thrust overshoot not exceed 0.57 lb_f.
2. Specification requires that first pulse thrust overshoot not exceed 0.57 lb_f.
3. Specification requires that thrust overshoot for pulses 2-N not exceed 0.44 lb_f.

* Digital data not available.

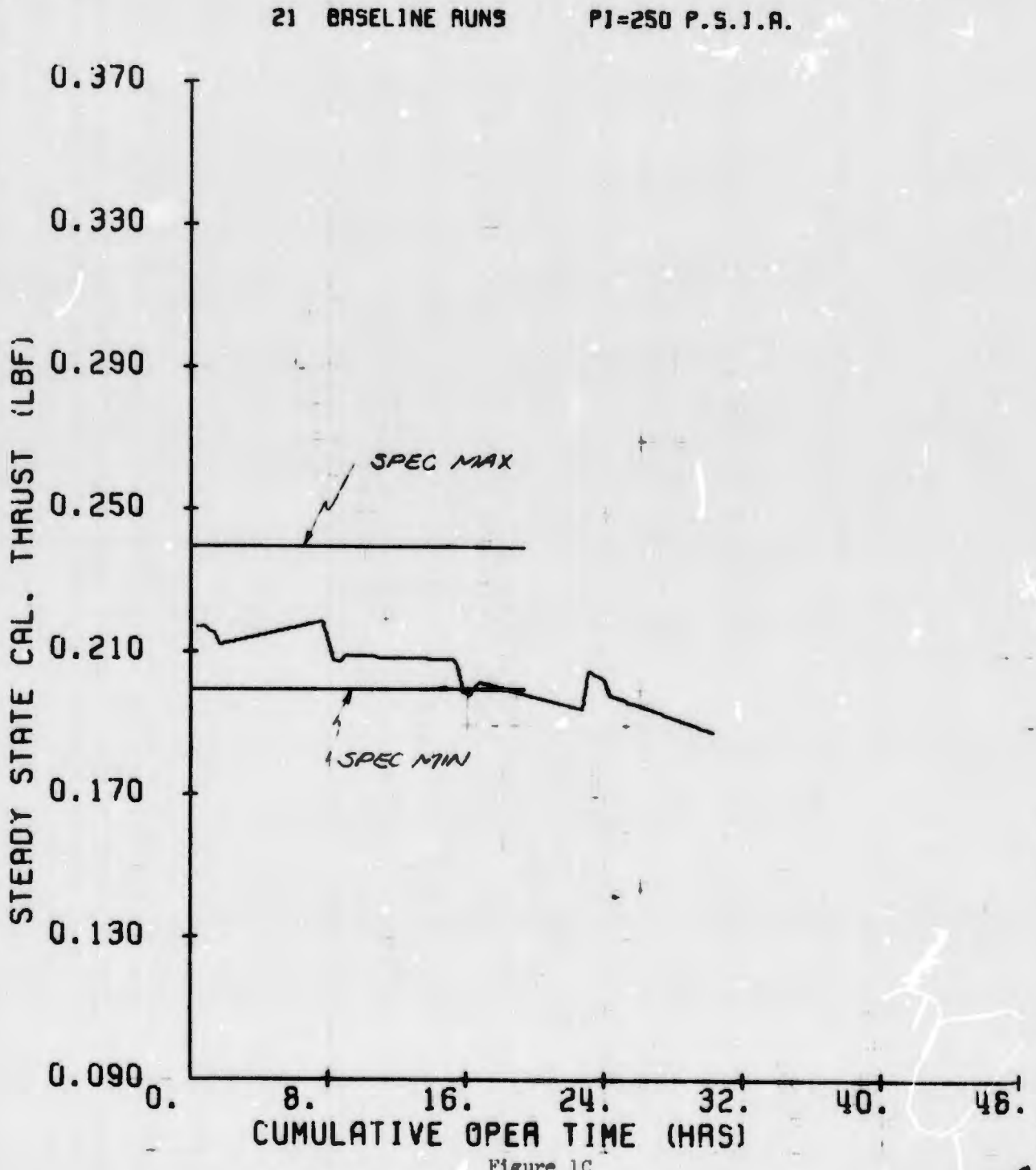

21 BASELINE RUNS P1=250 P.S.I.A.
0.370
0.330
0.290
0.250
0.210
0.170
0.130
0.090
STEADY STATE CAL. THRUST (LBF)
SPEC MAX
SPEC MIN
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 1C

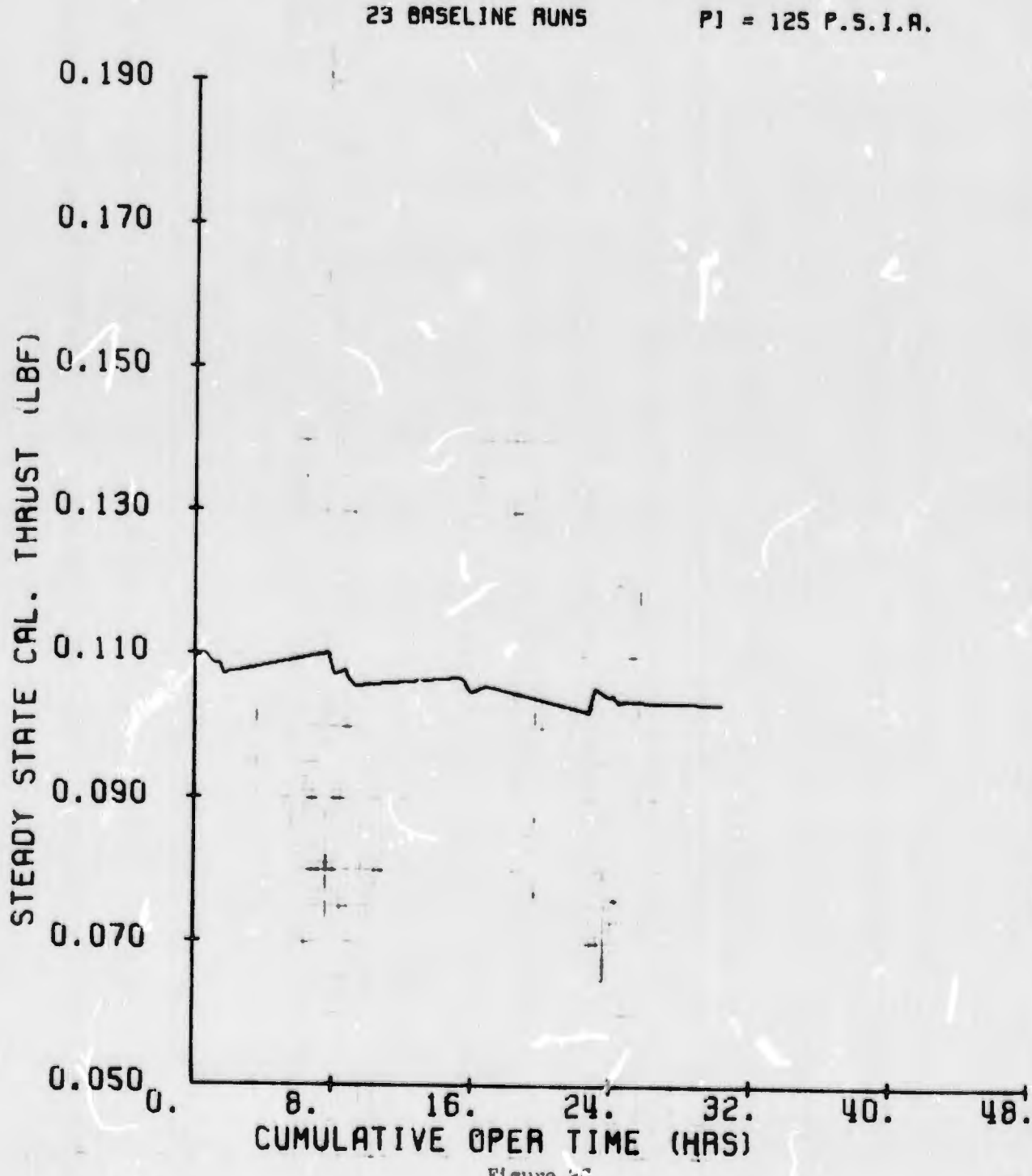

23 BASELINE RUNS
PI = 125 P.S.I.A.
0.190
0.170
0.150
0.130
0.110
0.090
0.070
0.050
STEADY STATE CAL. THRUST (LBF)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 2C

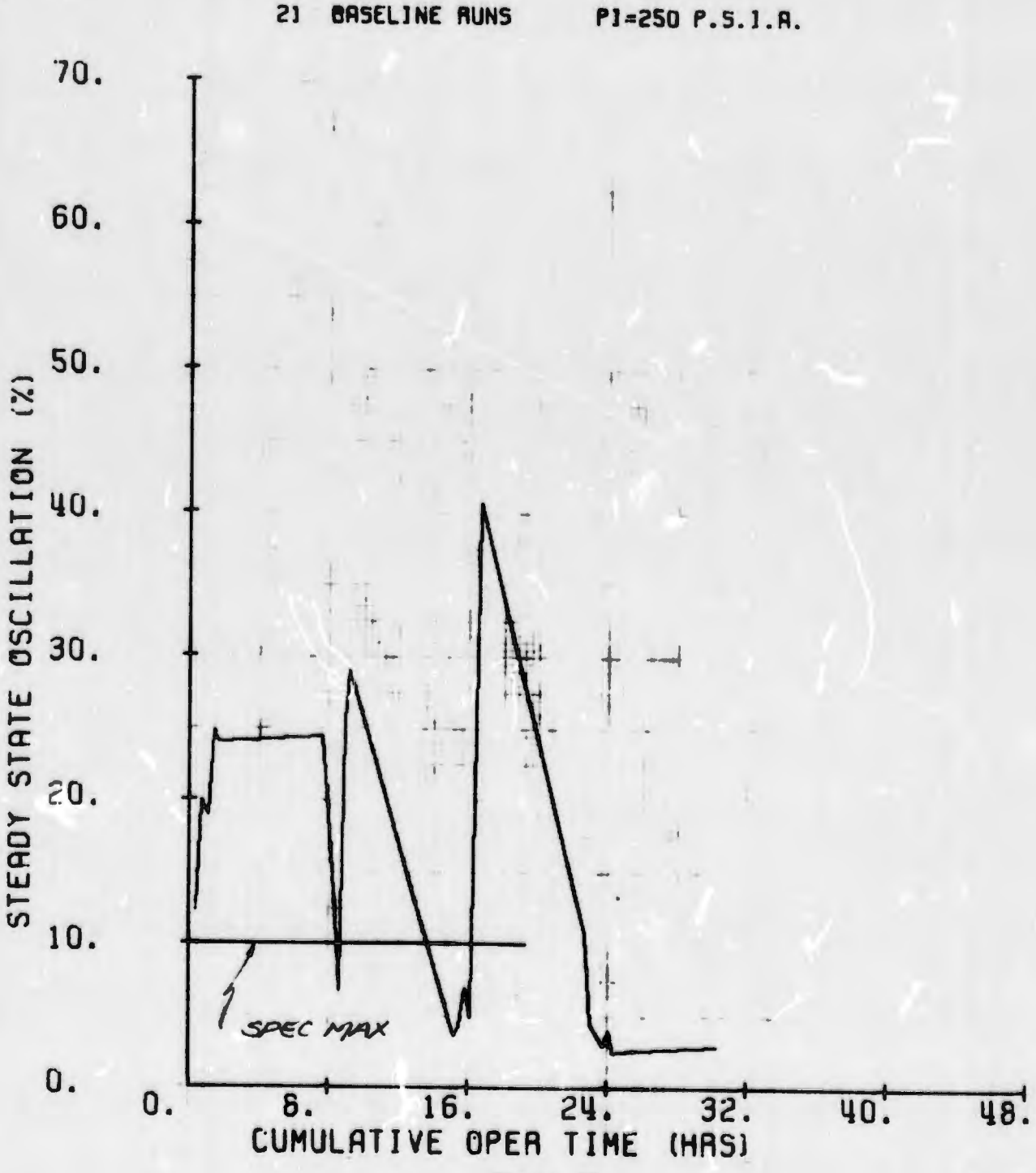

21 BASELINE RUNS
PI=250 P.S.I.A.
70.
60.
50.
40.
30.
20.
10.
0.
STEADY STATE OSCILLATION (%)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 3C

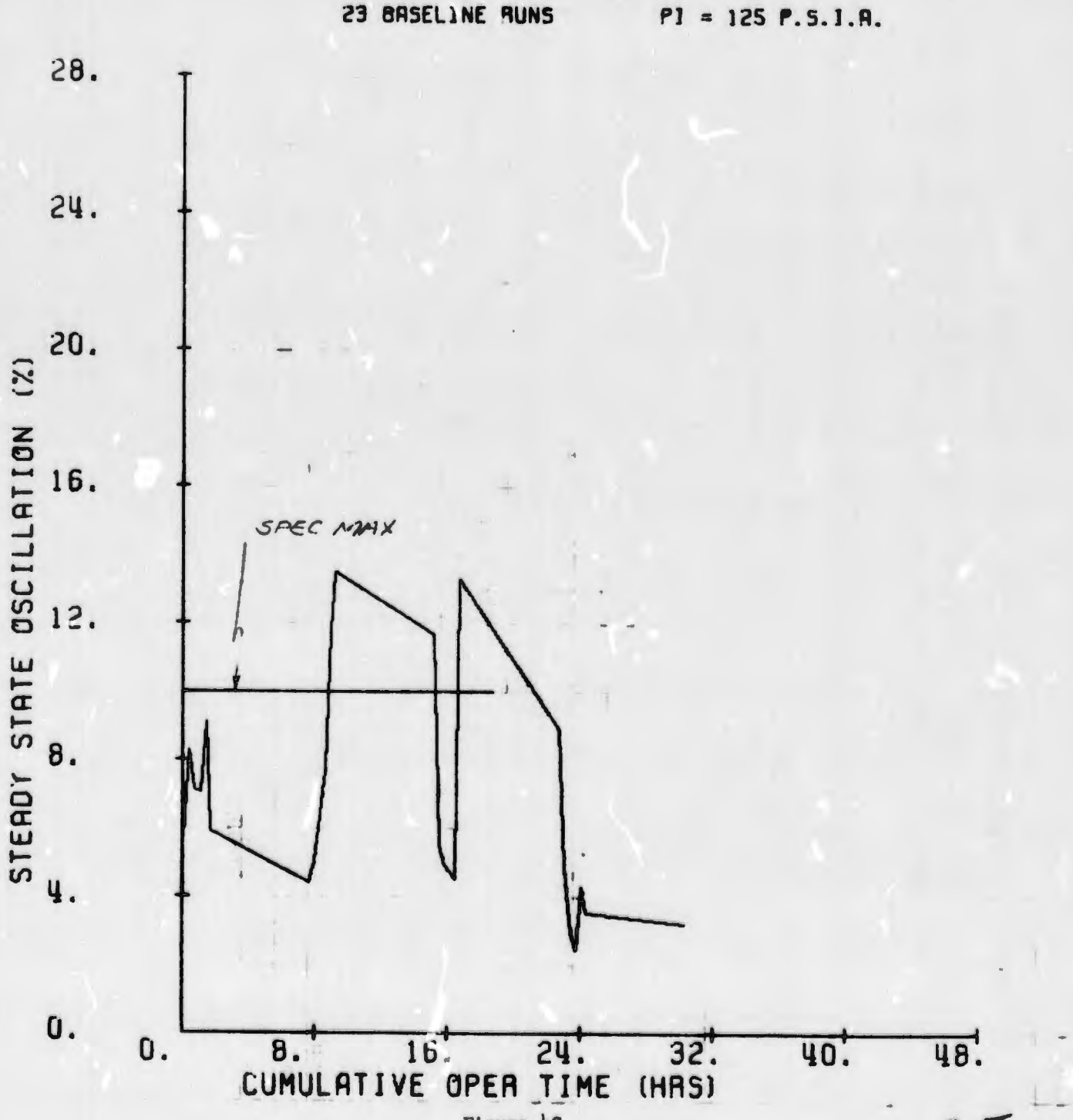

23 BASELINE RUNS
PI = 125 P.S.I.A.
28.
24.
20.
16.
12.
8.
4.
0.
STEADY STATE OSCILLATION (%)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 4C

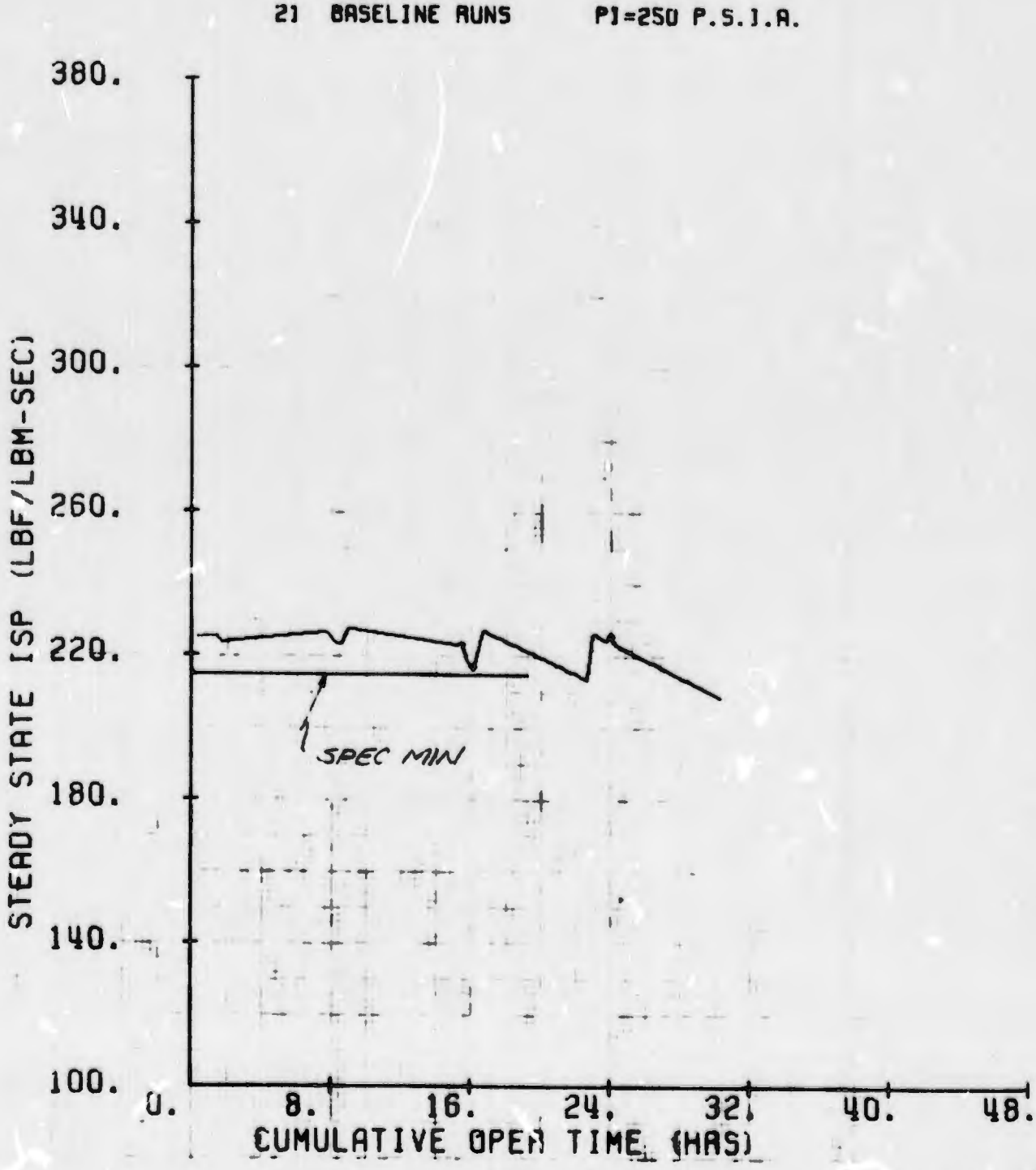

21 BASELINE RUNS PI=250 P.S.I.A.
380.
340.
300.
260.
220.
180.
140.
100.
STEADY STATE ISP (LBF/LBM-SEC)
SPEC MIN
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPEN TIME (HRS)

Figure 5C

C-6

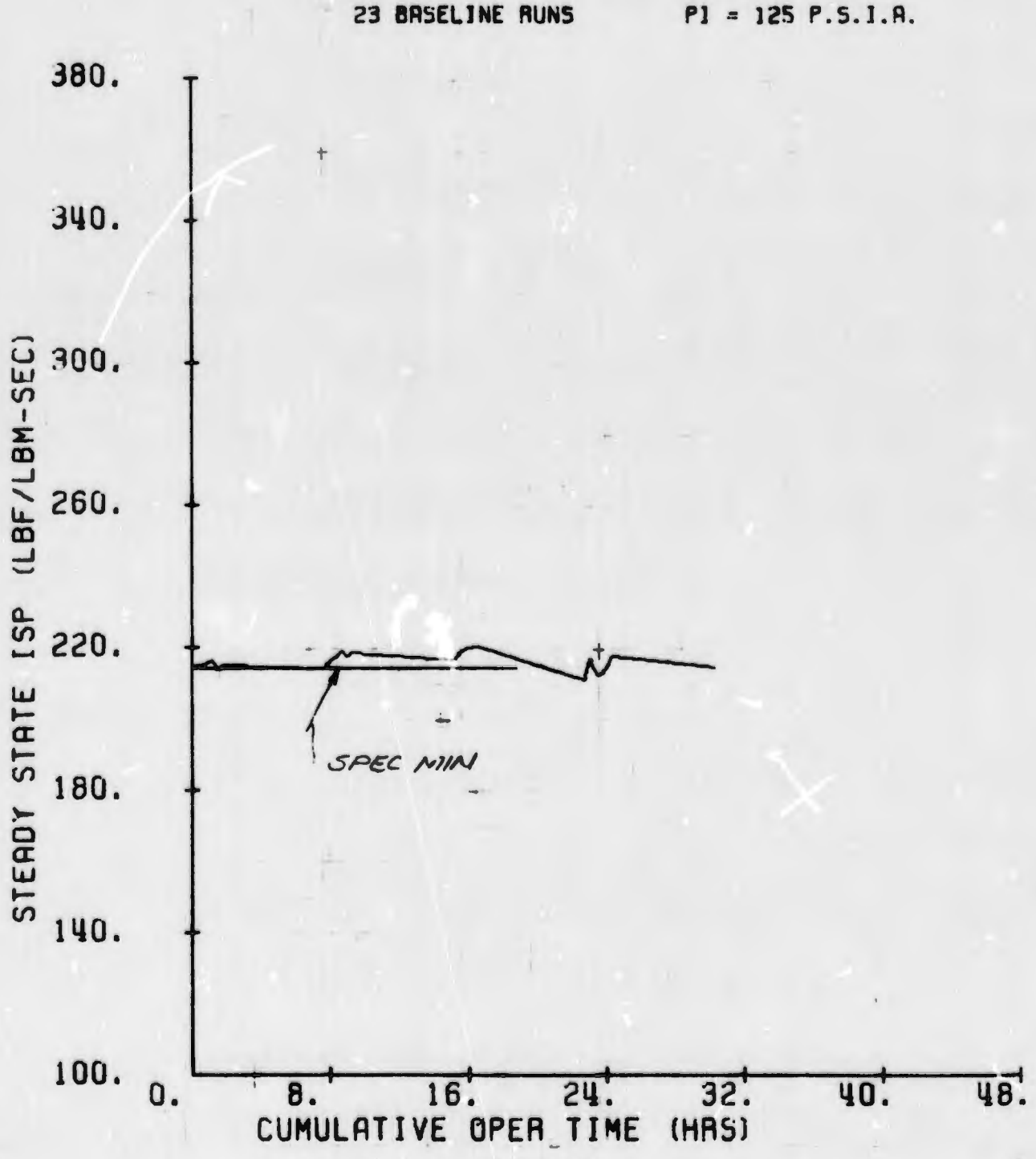

23 BASELINE RUNS
PI = 125 P.S.I.A.
380.
340.
300.
260.
220.
180.
140.
100.
STEADY STATE ISP (LBF/LBM-SEC)
SPEC MIN
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 6C

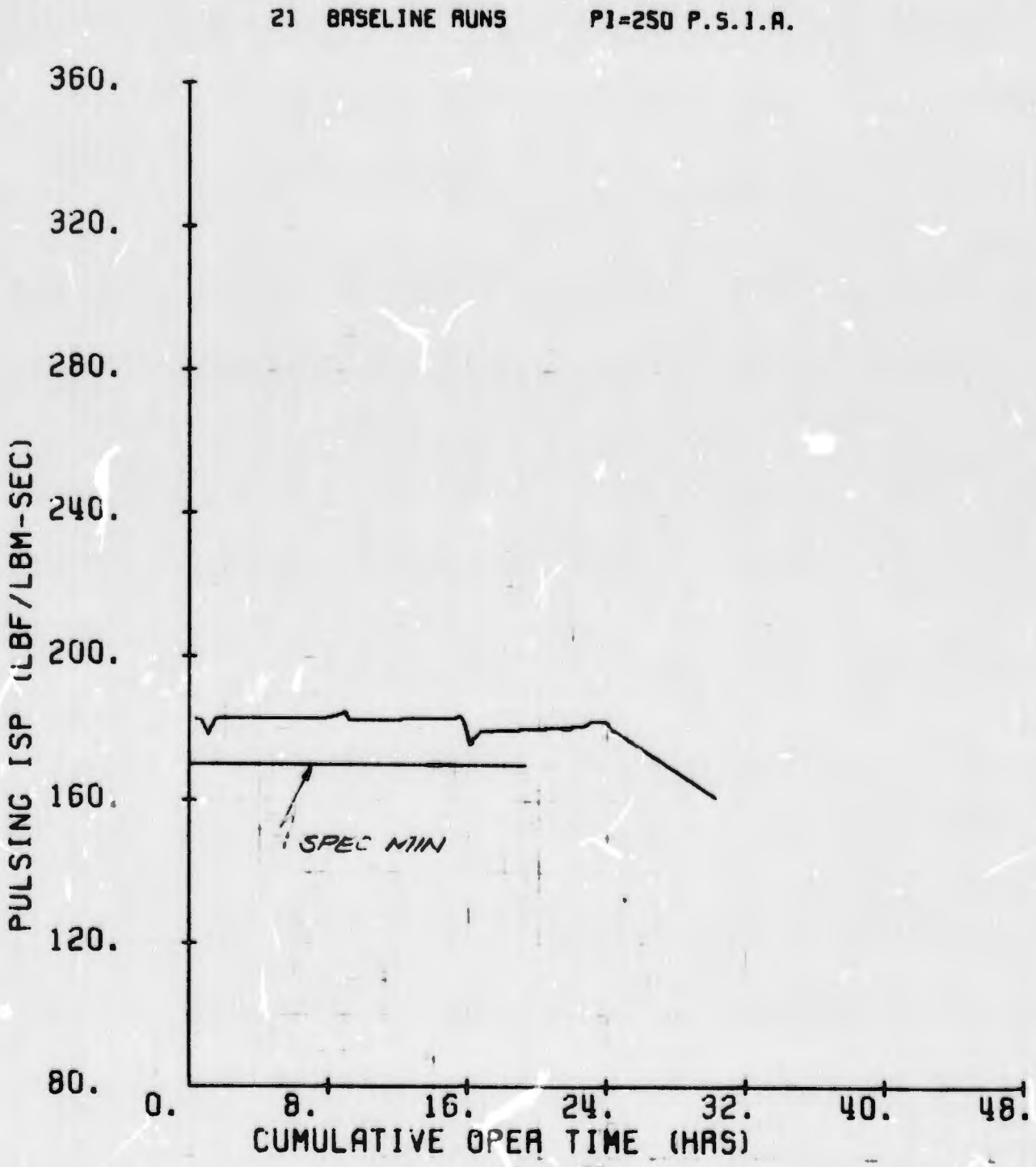

21 BASELINE RUNS P1=250 P.S.I.A.
360.
320.
280.
240.
200.
160.
120.
80.
PULSING ISP (LBF/LBM-SEC)
SPEC MIN
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 7C

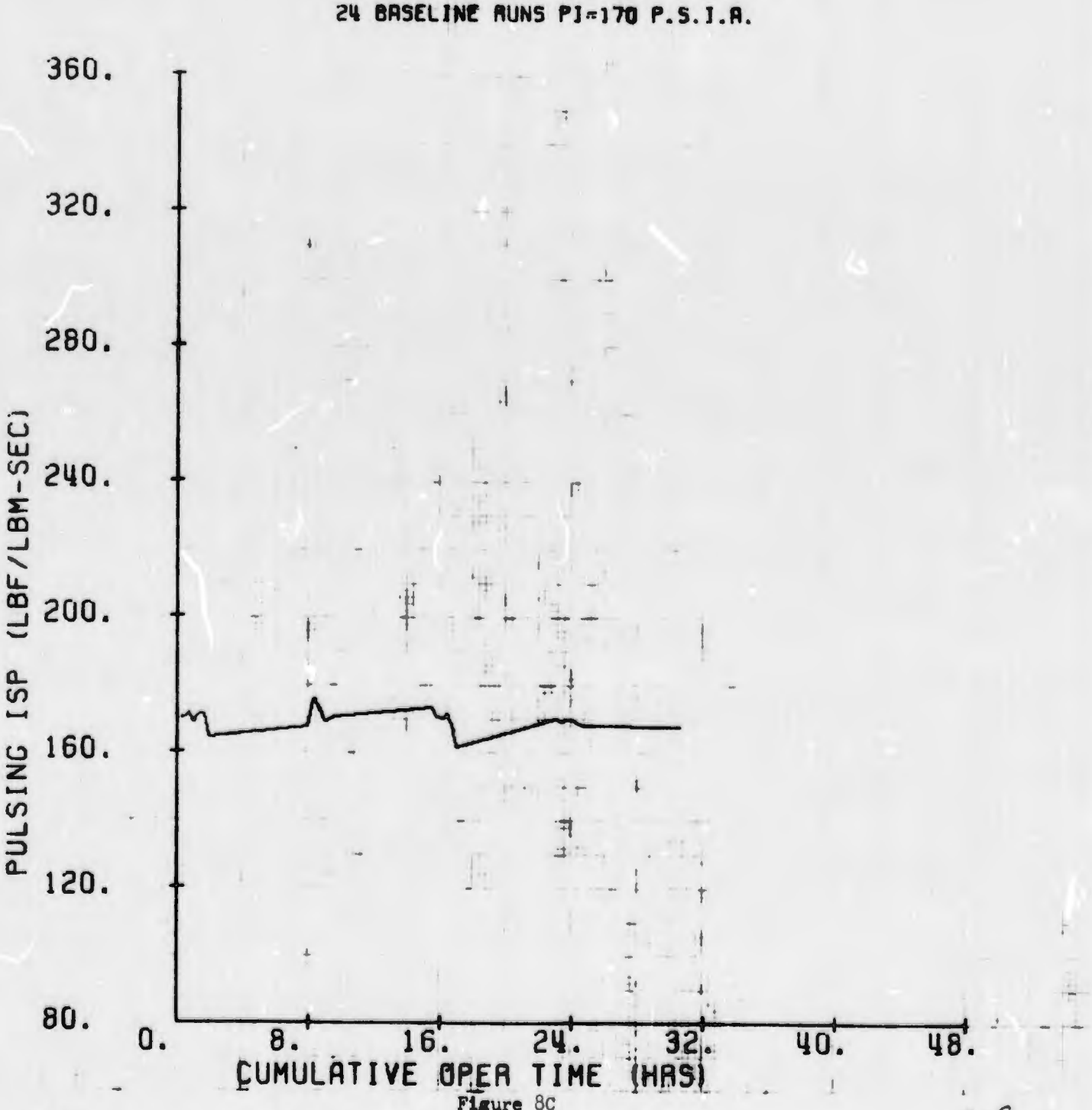

24 BASELINE RUNS PI=170 P.S.I.A.
360.
320.
280.
240.
200.
160.
120.
80.
PULSING ISP (LBF/LBM-SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 8C

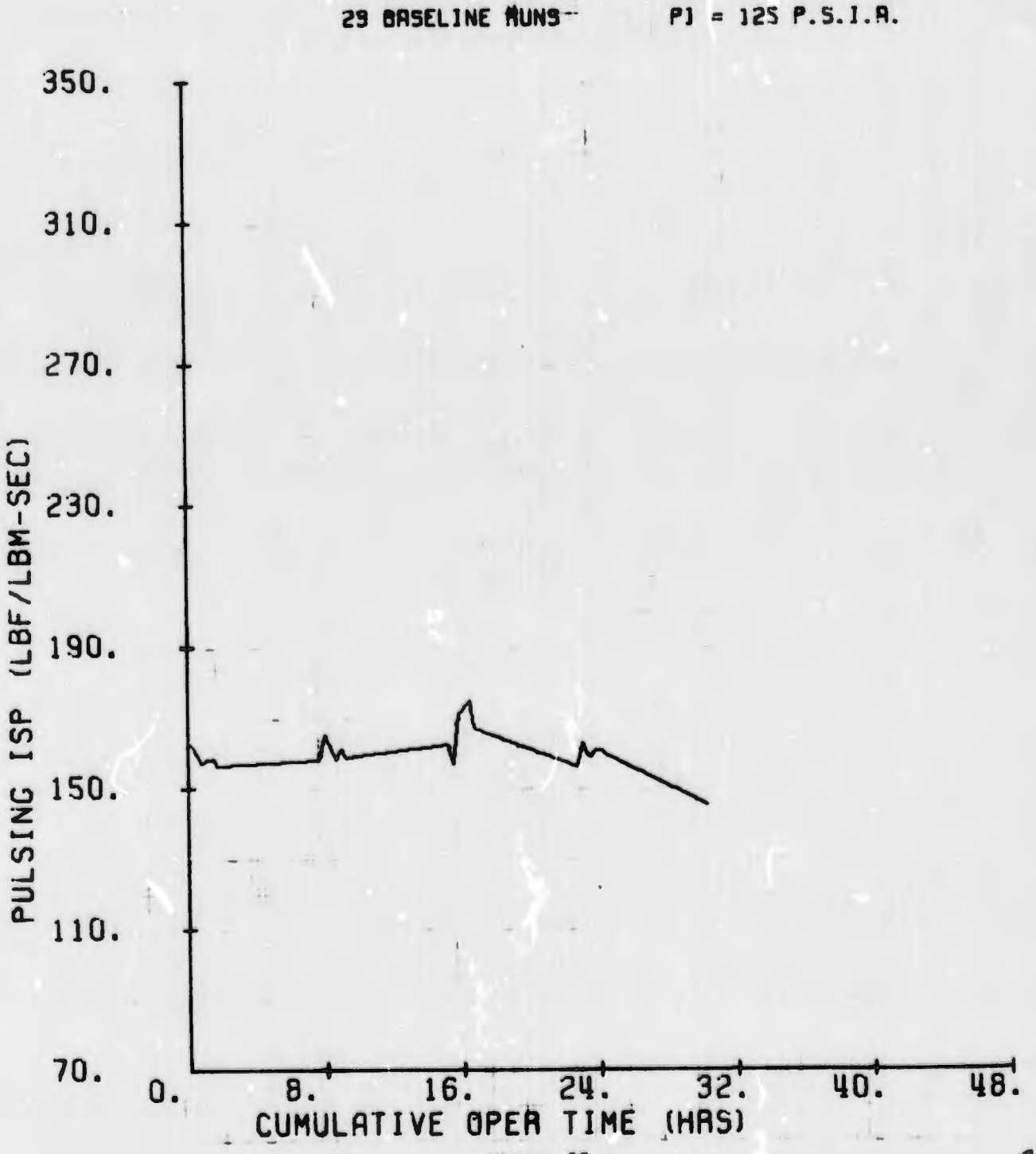

29 BASELINE RUNS
PJ = 125 P.S.I.A.
350.
310.
270.
230.
190.
150.
110.
70.
PULSING ISP (LBF/LBM-SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 9C

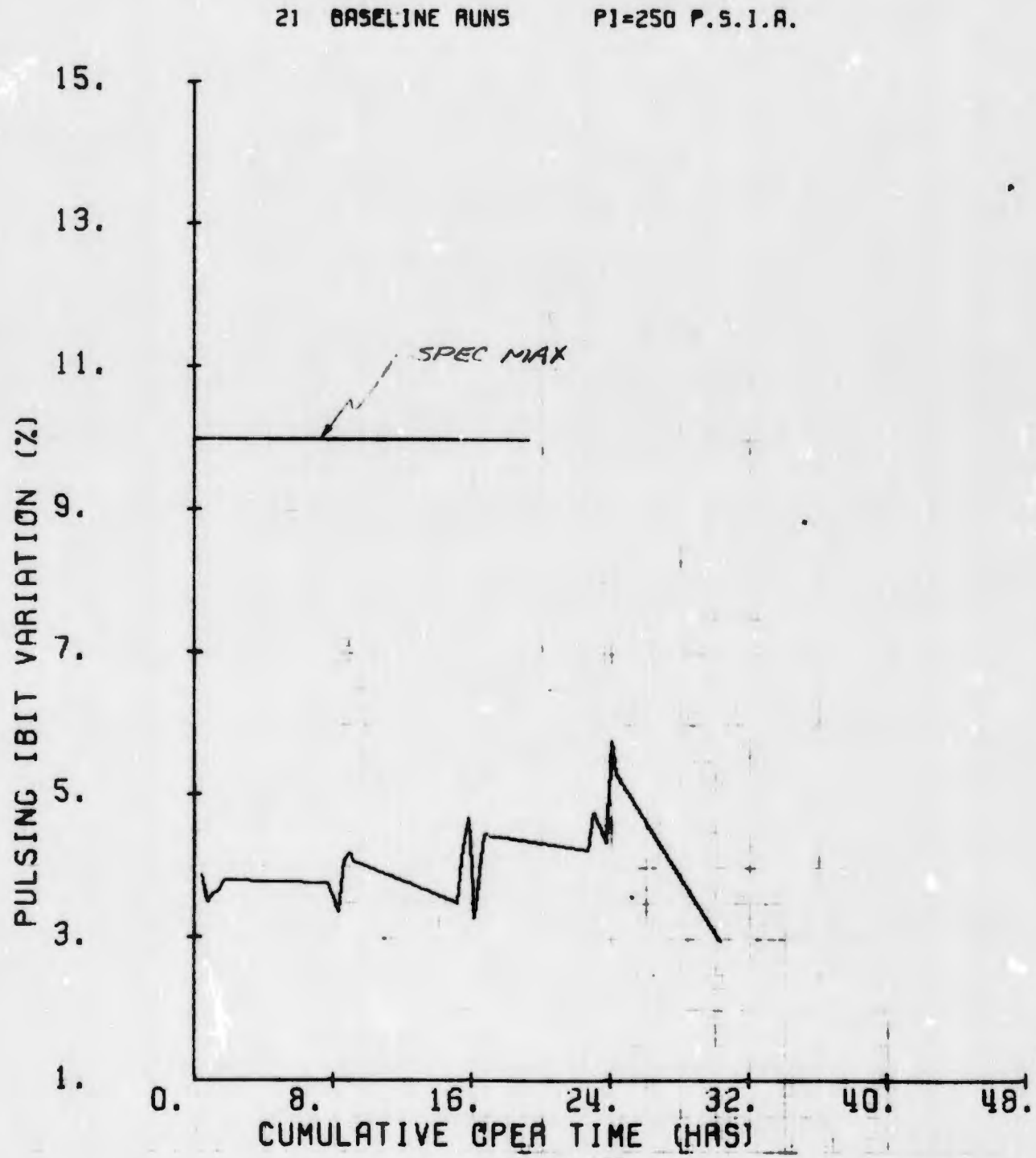

21 BASELINE RUNS P1=250 P.S.I.A.
15.
13.
11.
9.
7.
5.
3.
1.
SPEC MAX
PULSING IBIT VARIATION (%)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 10C

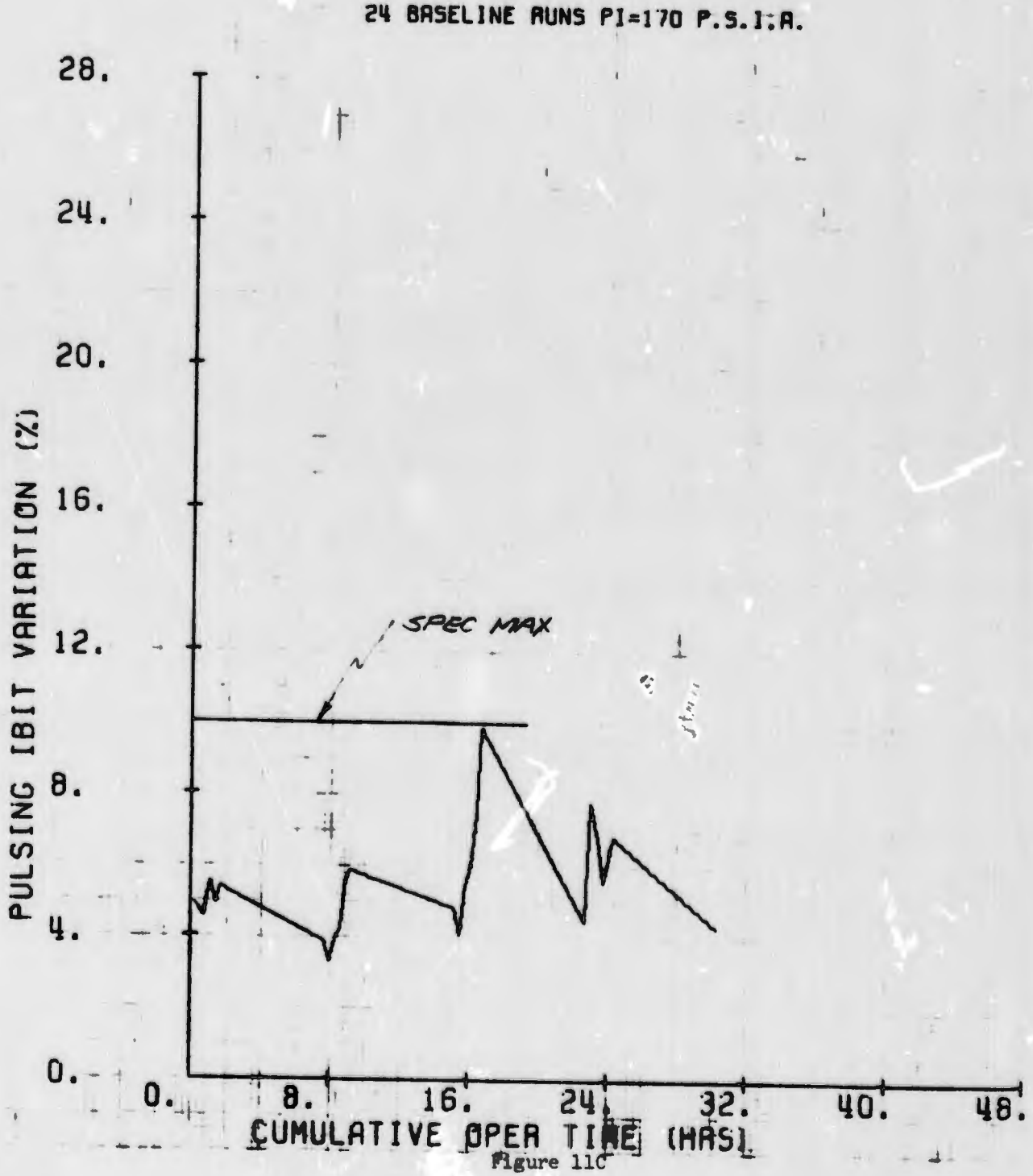

24 BASELINE RUNS PI=170 P.S.I.A.
28.
24.
20.
16.
12.
8.
4.
0.
PULSING IBIT VARIATION (%)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 11C

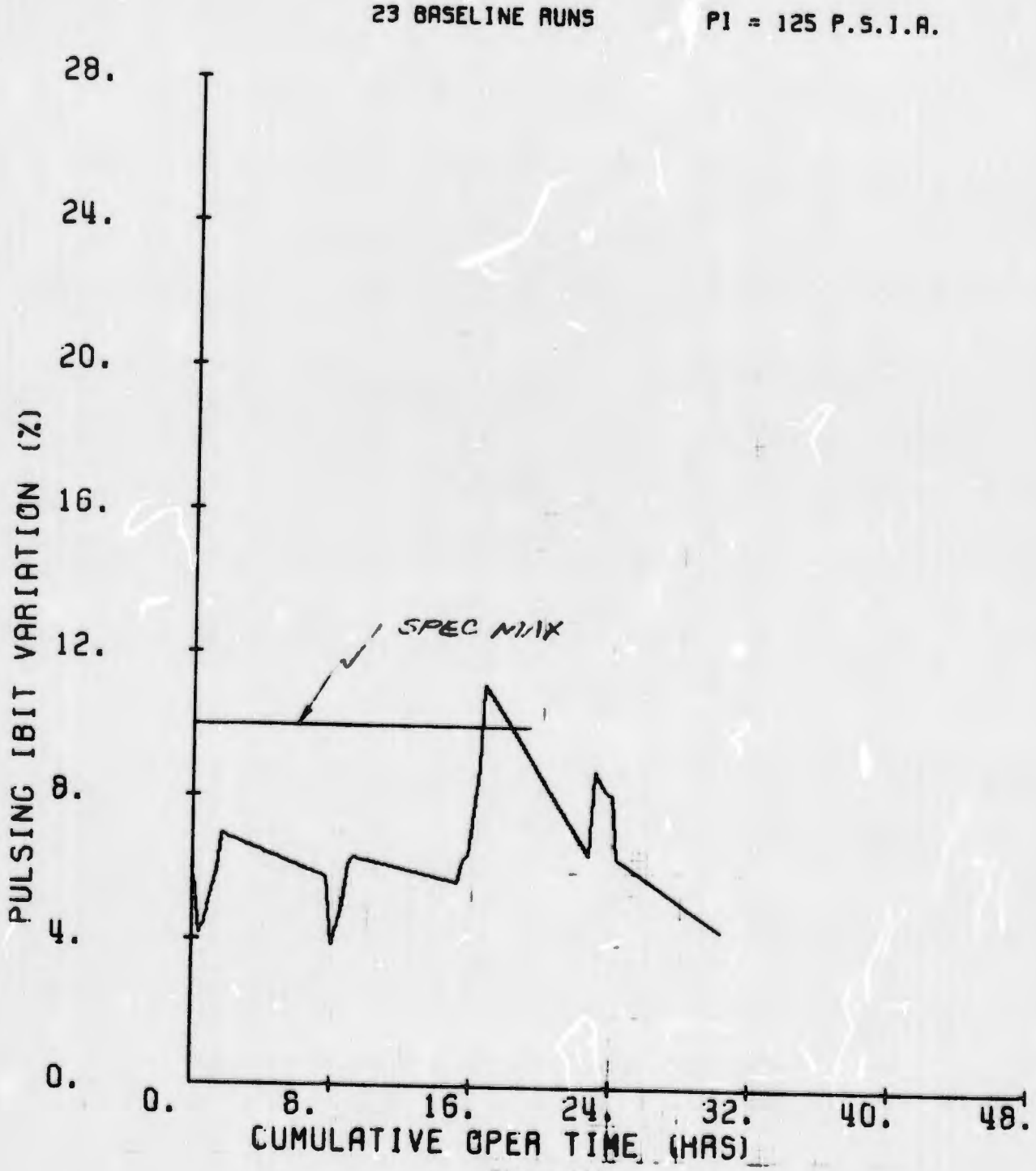

23 BASELINE RUNS
PI = 125 P.S.I.A.
28.
24.
20.
16.
12.
8.
4.
0.
PULSING IBIT VARIATION (%)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 12C

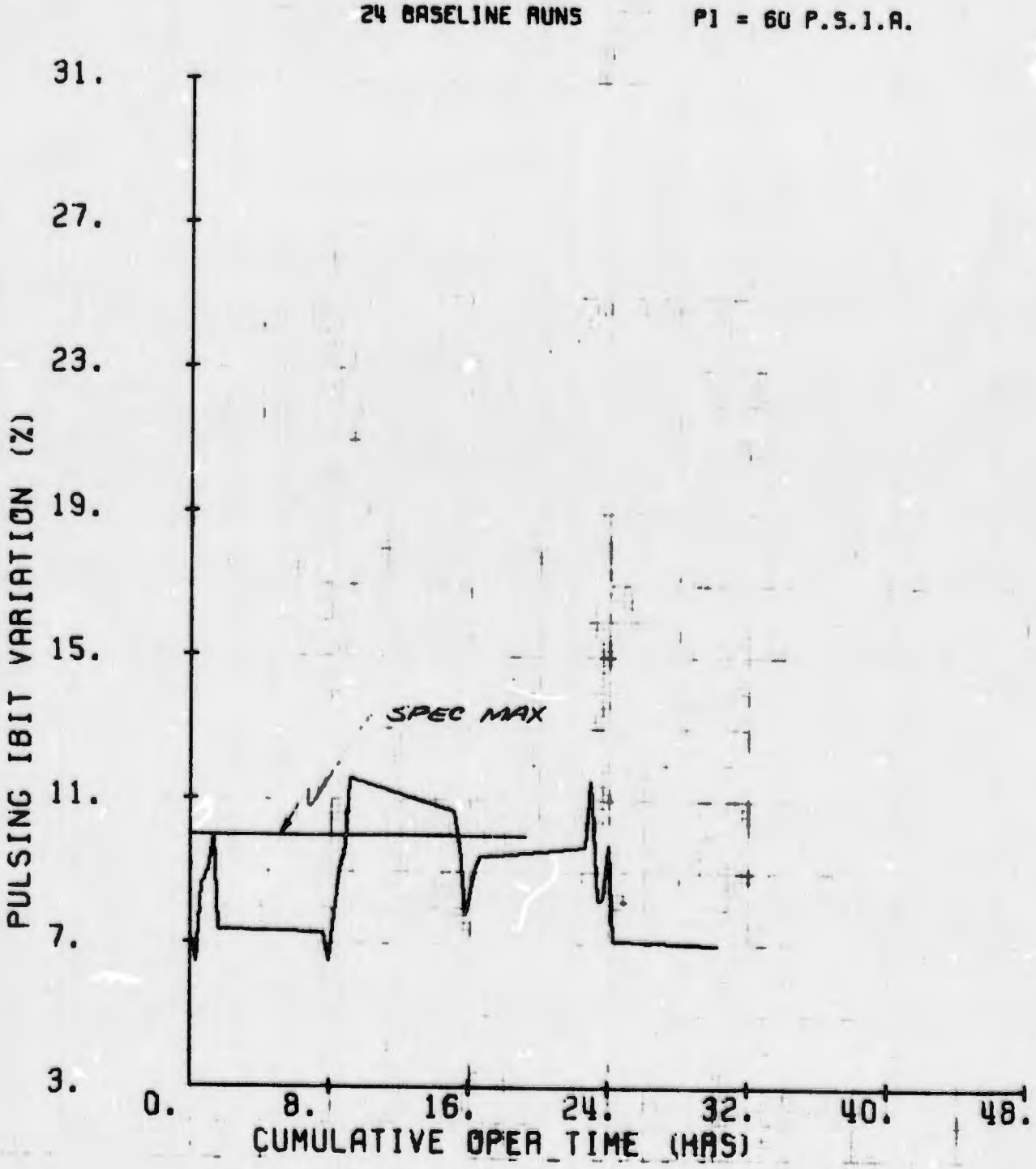

24 BASELINE RUNS
P1 = 60 P.S.I.A.
31.
27.
23.
19.
15.
11.
7.
3.
PULSING IBIT VARIATION (%)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER_TIME (HRS)

Figure 13C

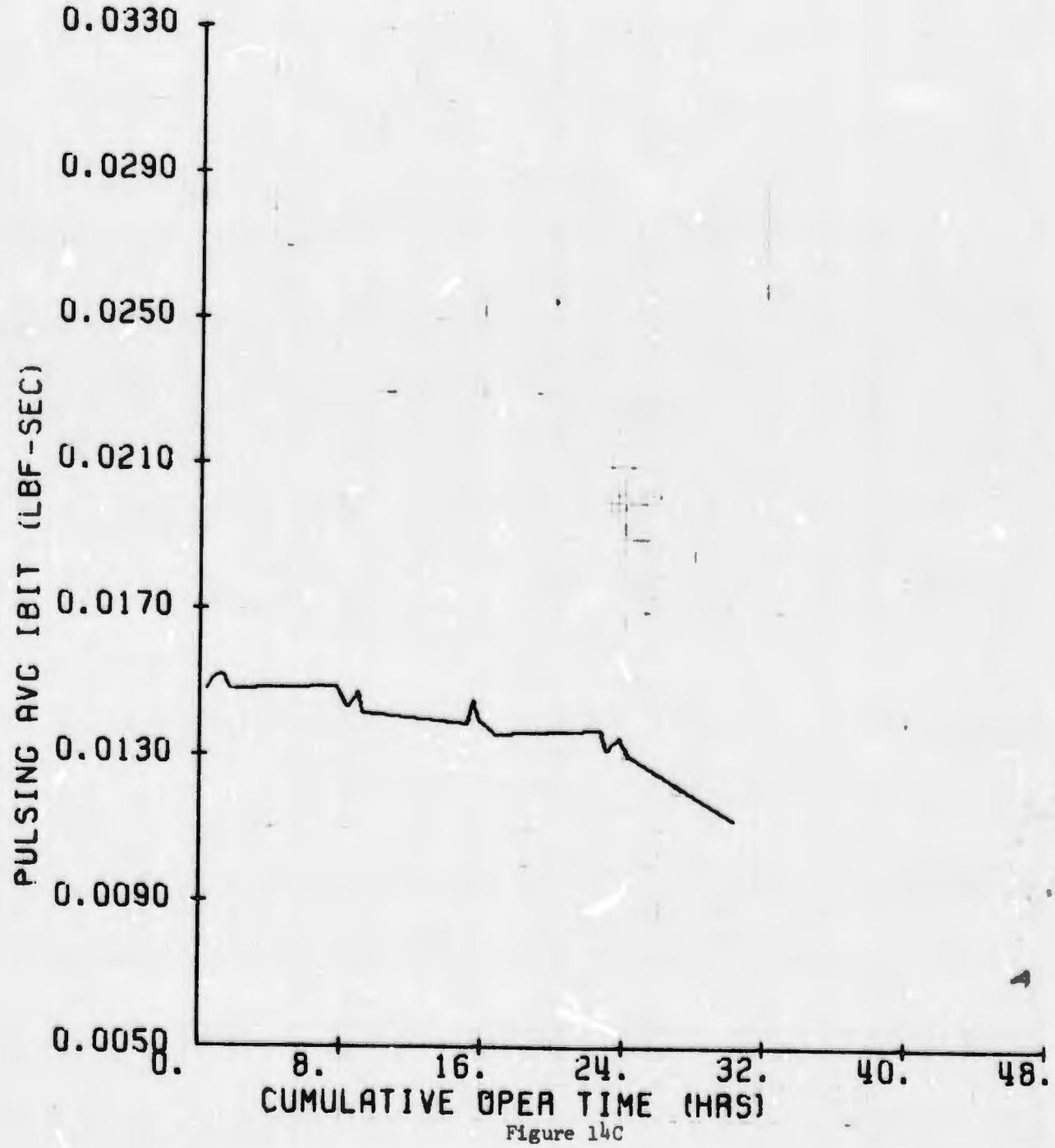

21 BASELINE RUNS
PI=250 P.S.I.A.
0.0330
0.0290
0.0250
0.0210
0.0170
0.0130
0.0090
0.0050
PULSING AVG IBIT (LBF-SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 14C

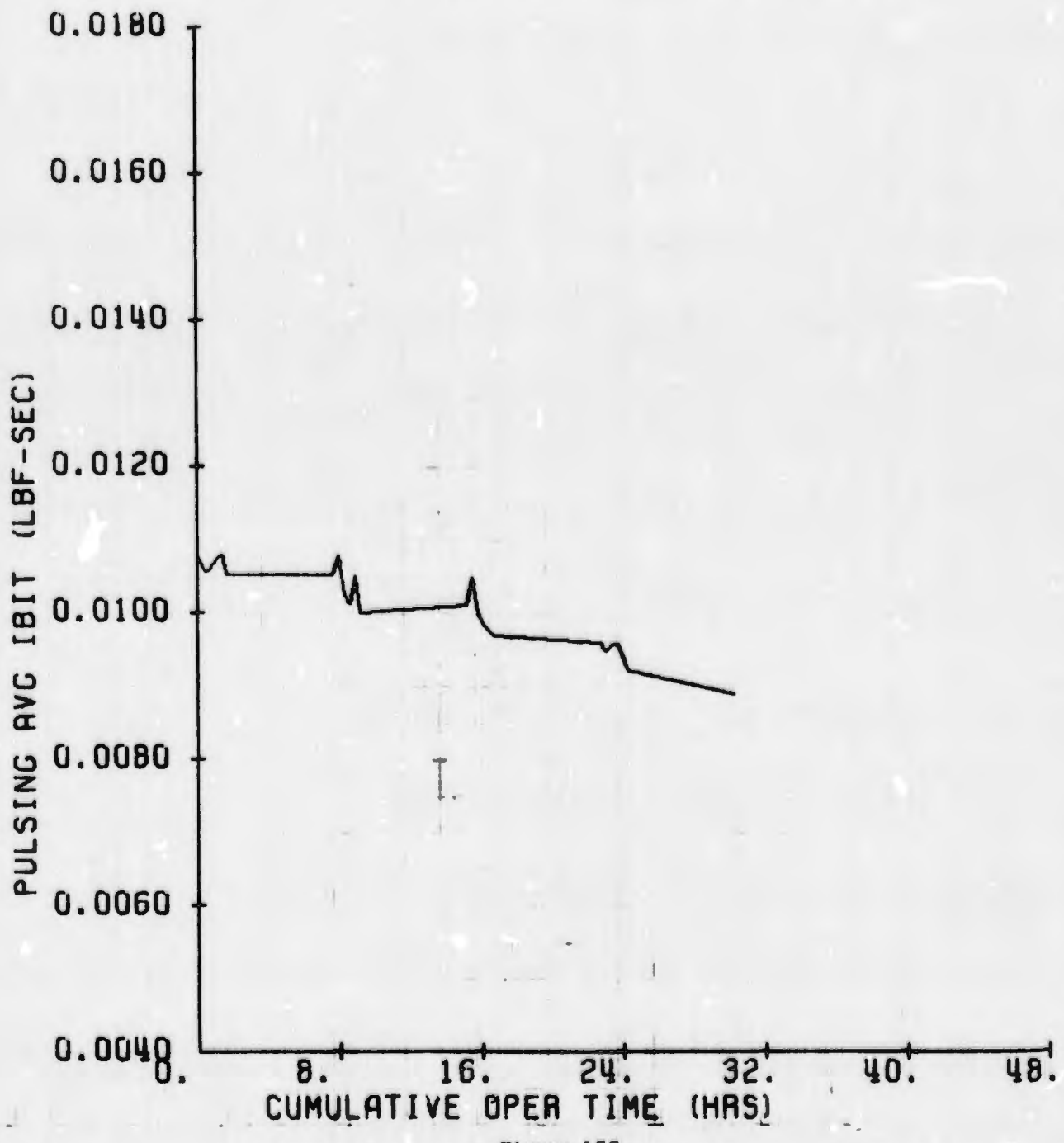

24 BASELINE RUNS
PI = 170 P.S.I.A.
0.0180
0.0160
0.0140
0.0120
0.0100
0.0080
0.0060
0.0040
PULSING AVG IBIT (LBF-SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 15C

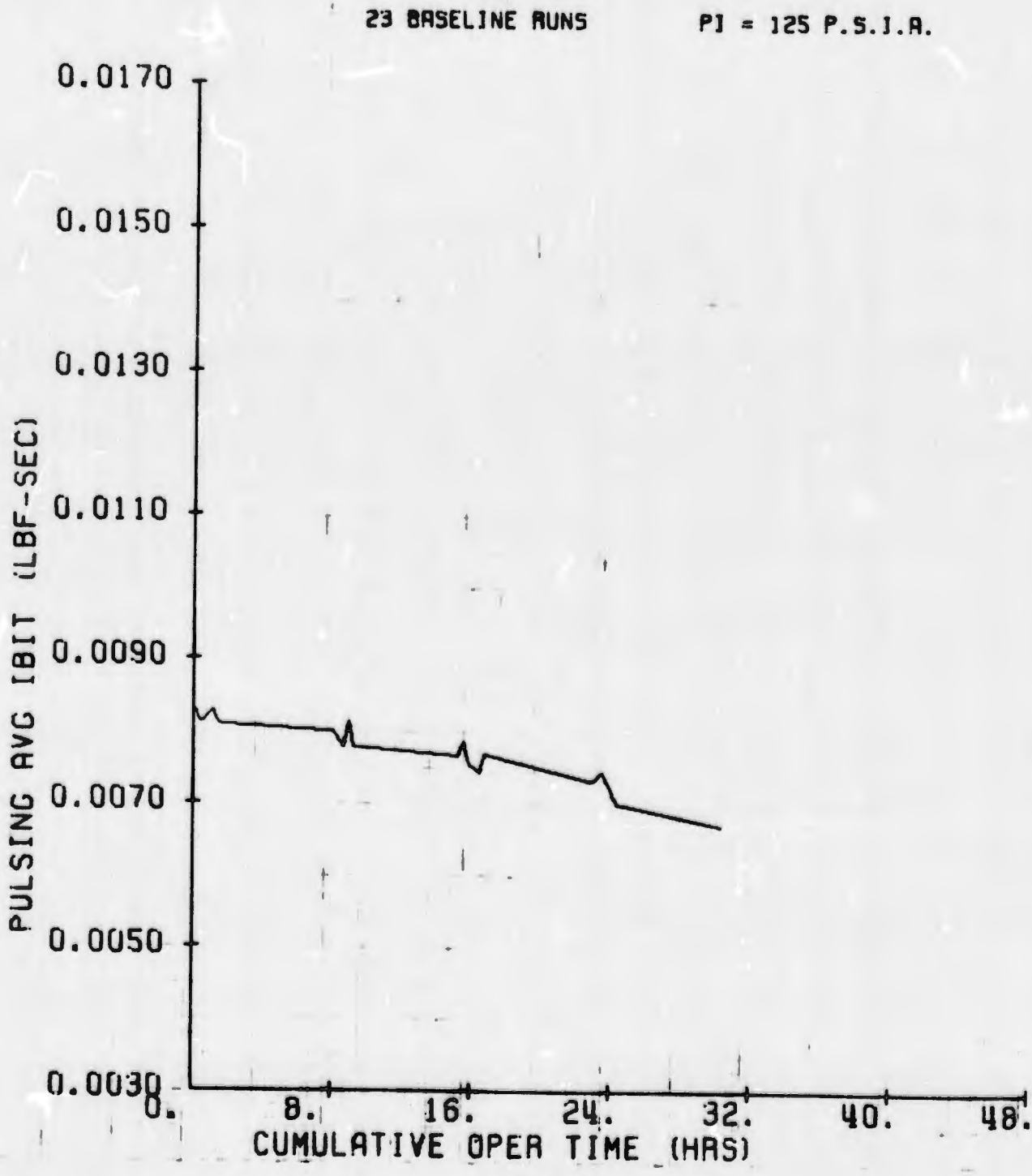

23 BASELINE RUNS
PI = 125 P.S.I.A.
0.0170
0.0150
0.0130
0.0110
0.0090
0.0070
0.0050
0.0030
PULSING AVG IBIT (LBF-SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 16C

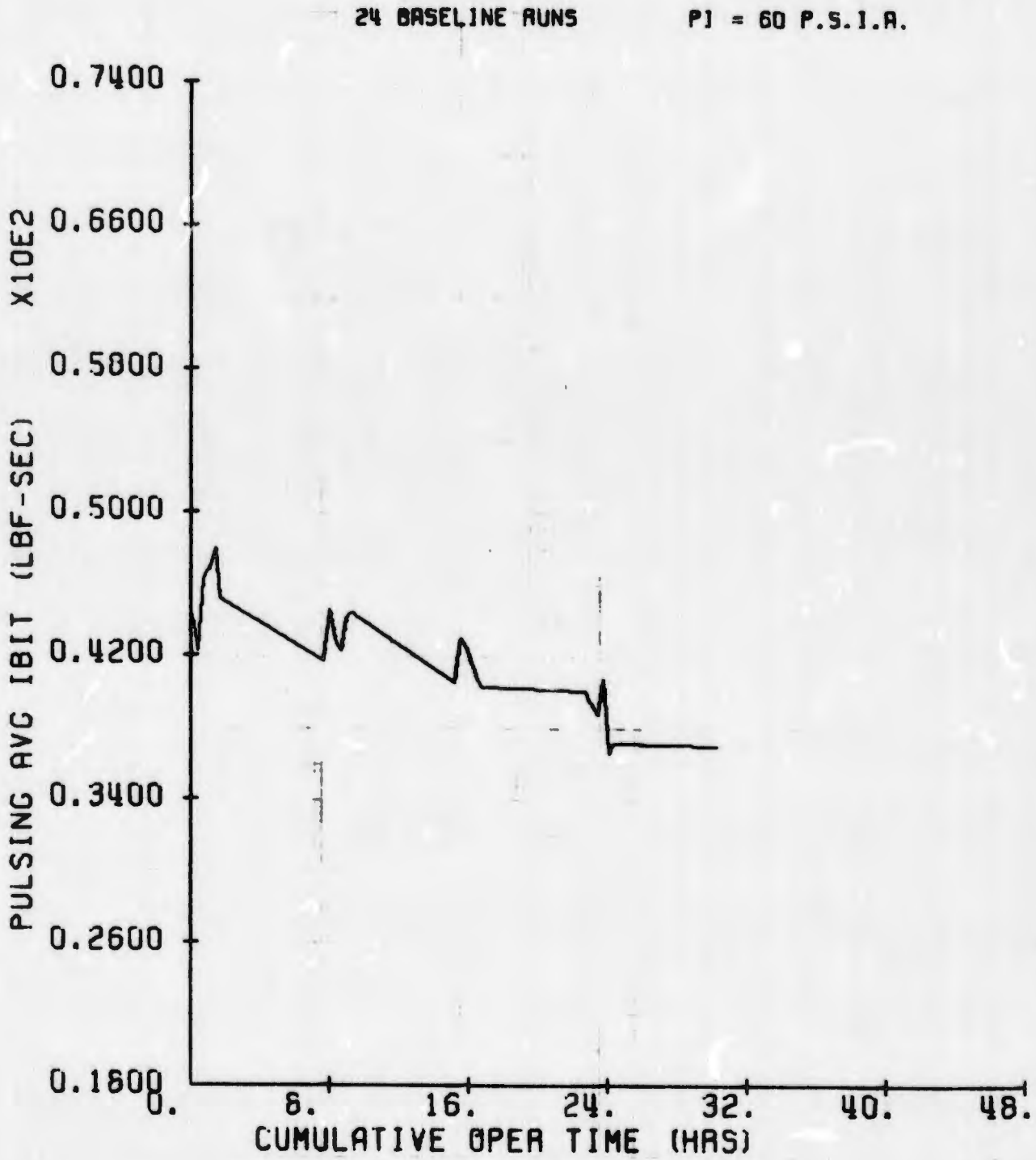

24 BASELINE RUNS
PI = 60 P.S.I.A.
PULSING AVG IBIT (LBF-SEC) X10E2
0.7400
0.6600
0.5800
0.5000
0.4200
0.3400
0.2600
0.1800
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 17C

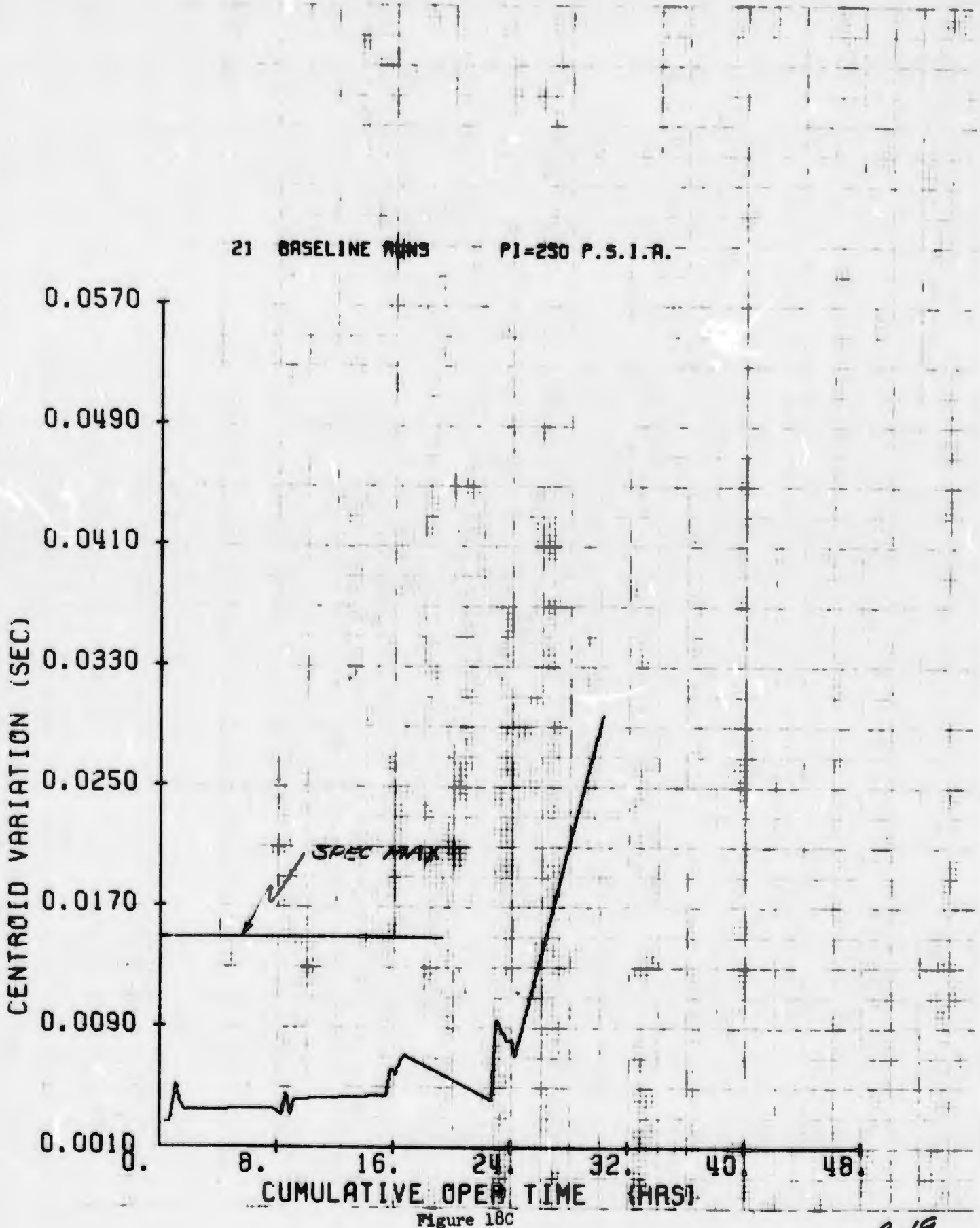

21 BASELINE RUNS - PI=250 P.S.I.A.
0.0570
0.0490
0.0410
0.0330
0.0250
0.0170
0.0090
0.0010
CENTROID VARIATION (SEC)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPEN TIME (HRS)

Figure 18C

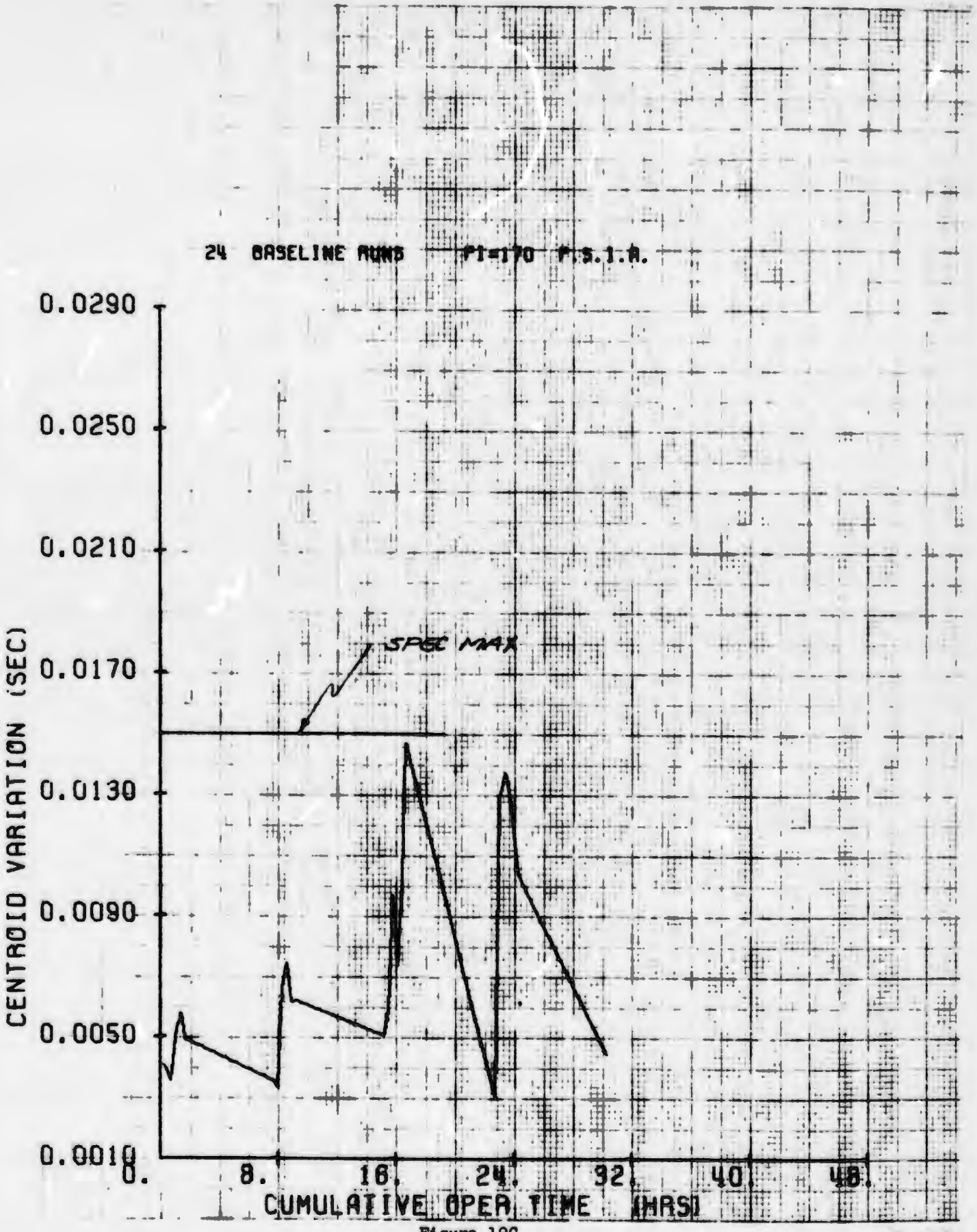

24 BASELINE RUNS PI=170 P.S.1.A.
0.0290
0.0250
0.0210
0.0170
0.0130
0.0090
0.0050
0.0010
SPEC MAX
CENTROID VARIATION (SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 19C

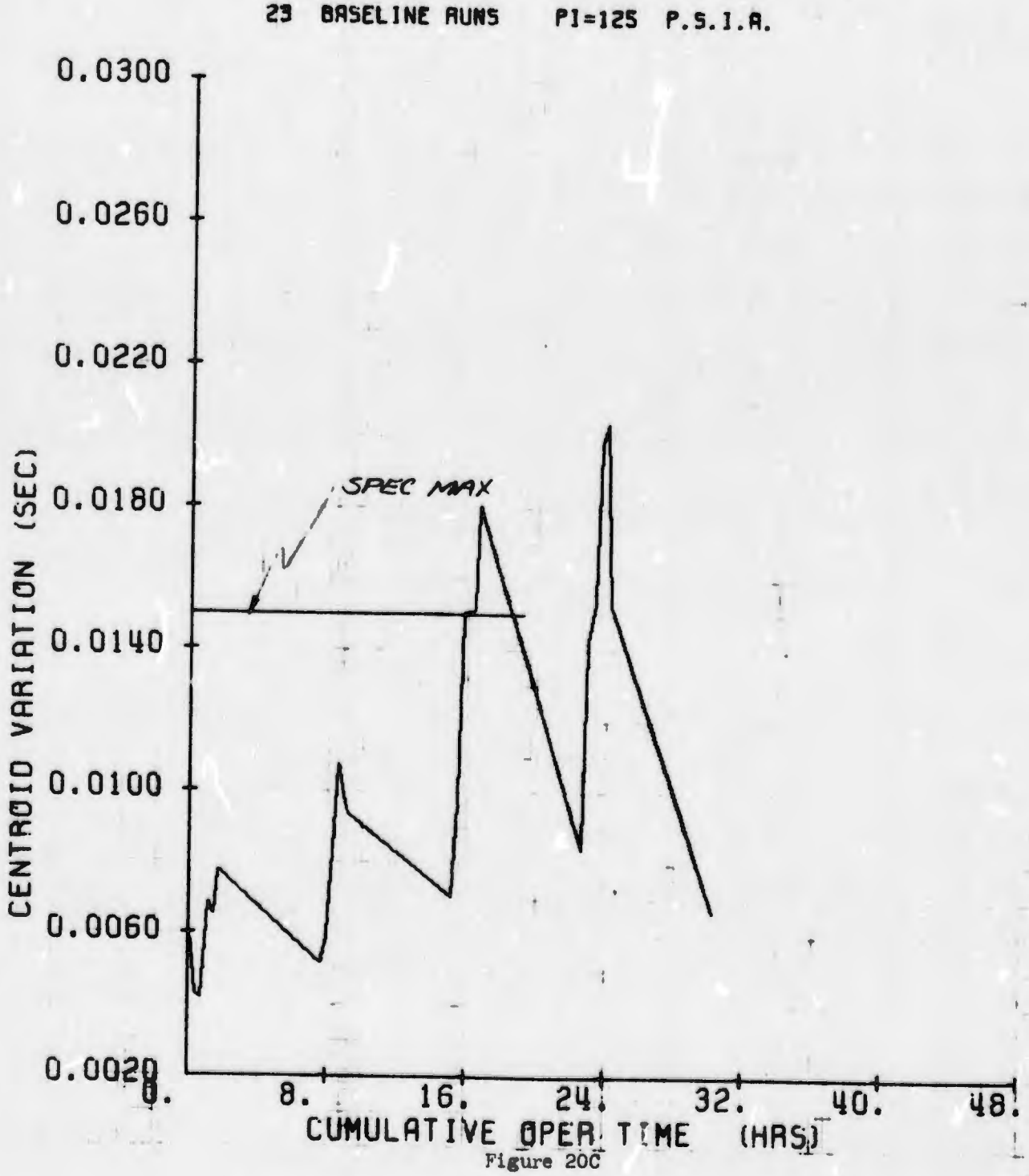

23 BASELINE RUNS P1=125 P.S.I.A.
0.0300
0.0260
0.0220
0.0180
0.0140
0.0100
0.0060
0.0020
CENTROID VARIATION (SEC)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 20C

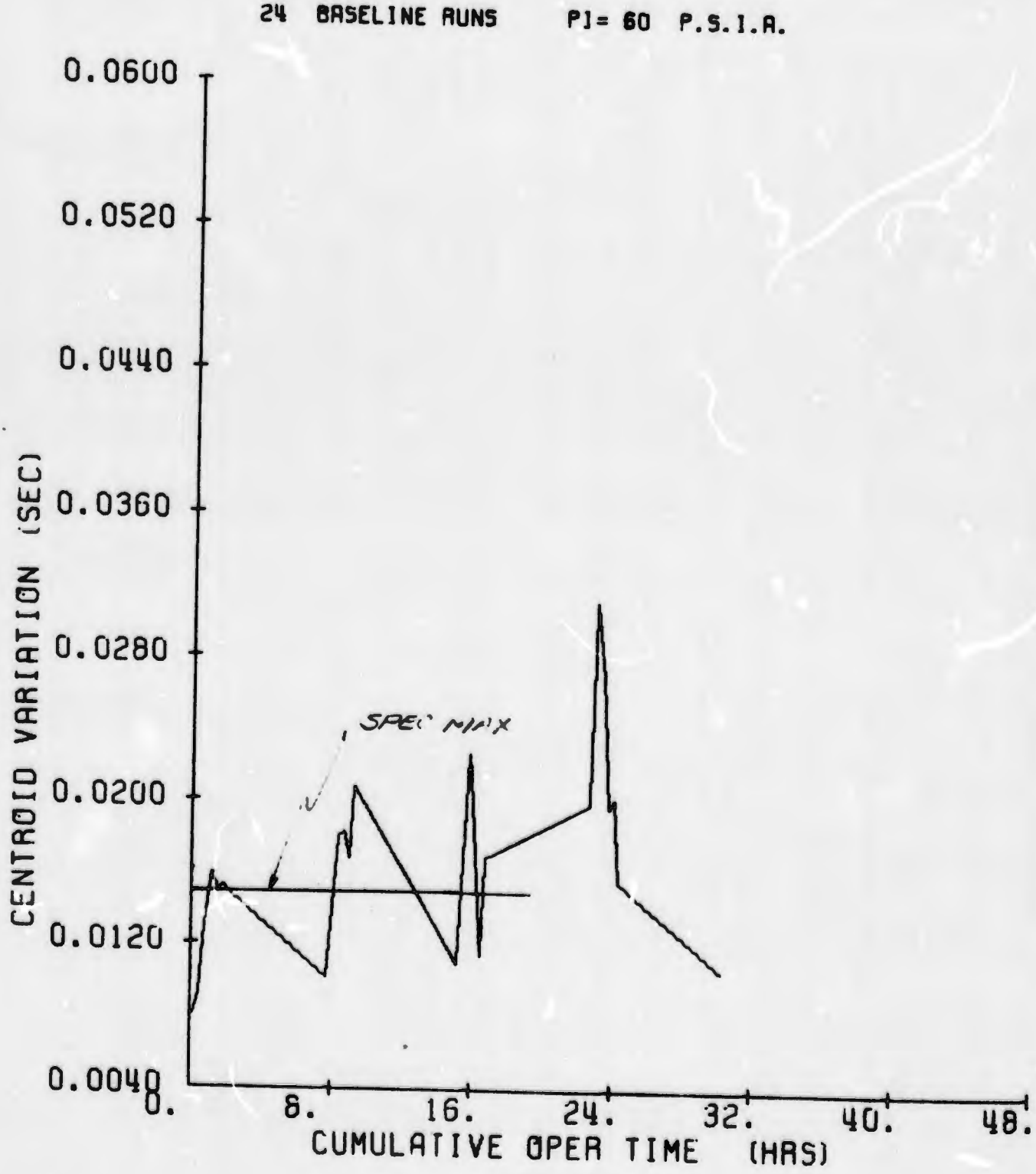

24 BASELINE RUNS P1= 60 P.S.I.A.
0.0600
0.0520
0.0440
0.0360
0.0280
0.0200
0.0120
0.0040
CENTROID VARIATION (SEC)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 21C

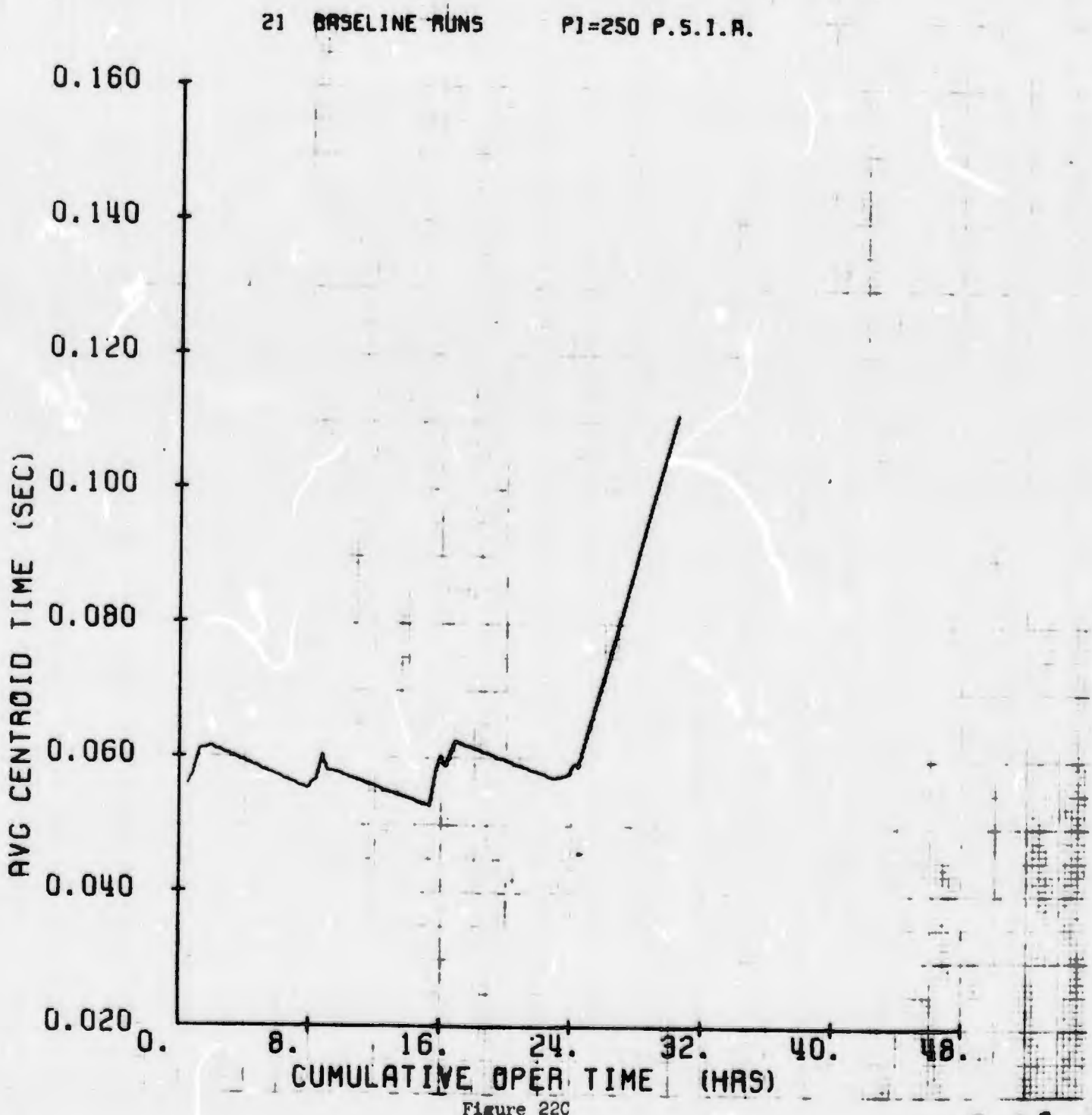

21 BASELINE RUNS P1=250 P.S.I.A.
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
AVG CENTROID TIME (SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 22C

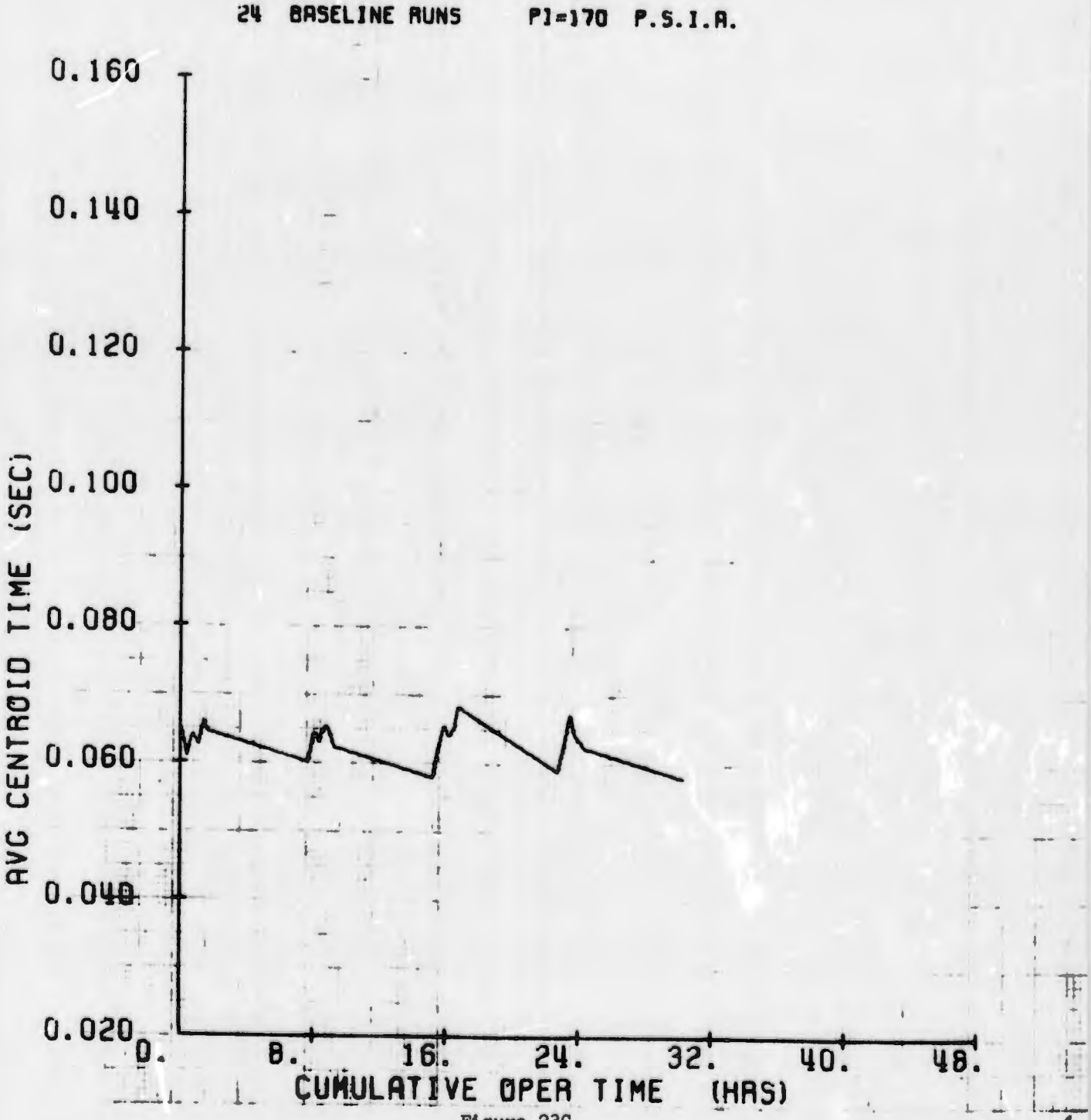

24 BASELINE RUNS P1=170 P.S.I.A.
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
AVG CENTROID TIME (SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 23C

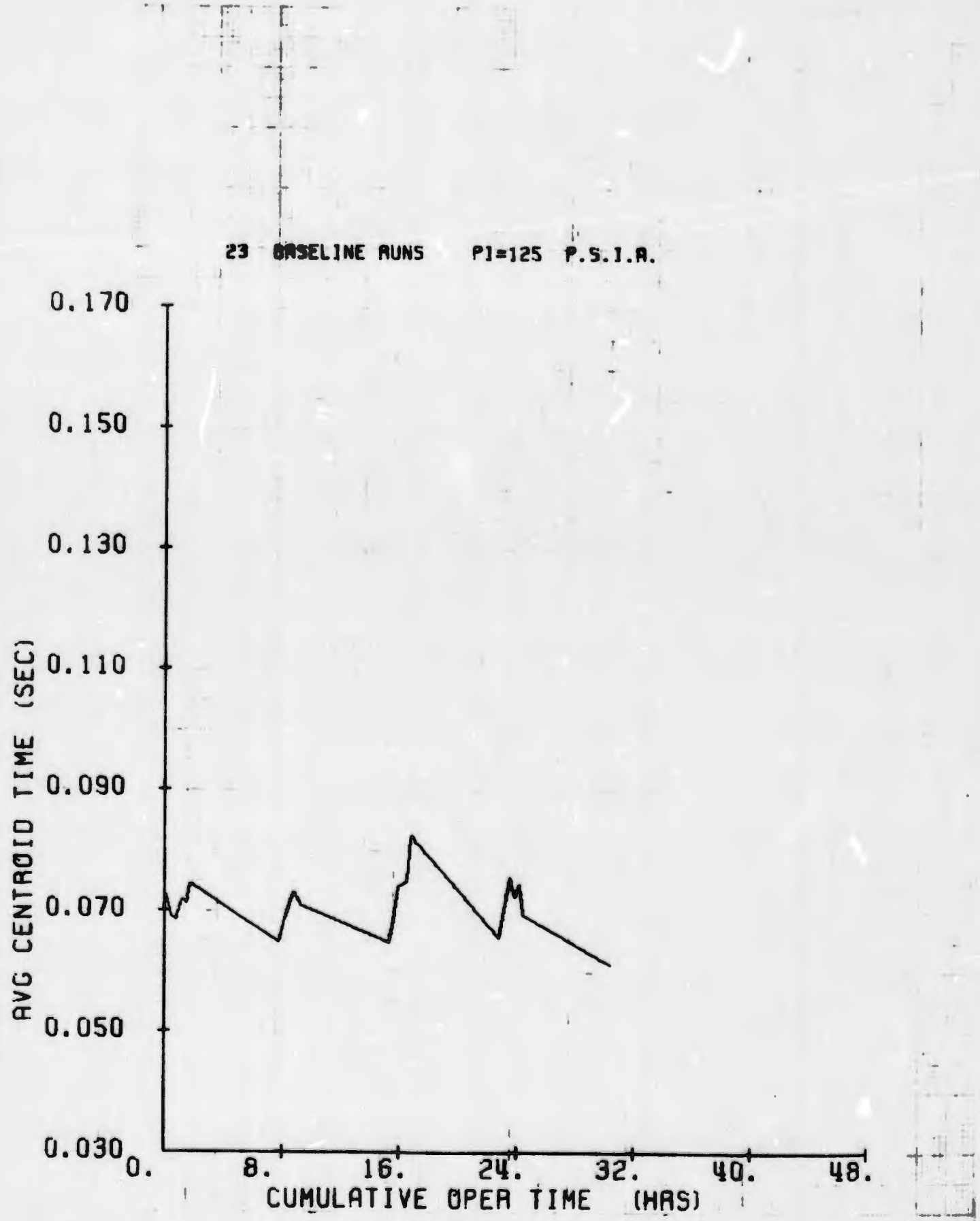

23 BASELINE RUNS P1=125 P.S.I.A.
0.170
0.150
0.130
0.110
0.090
0.070
0.050
0.030
AVG CENTROID TIME (SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 24C

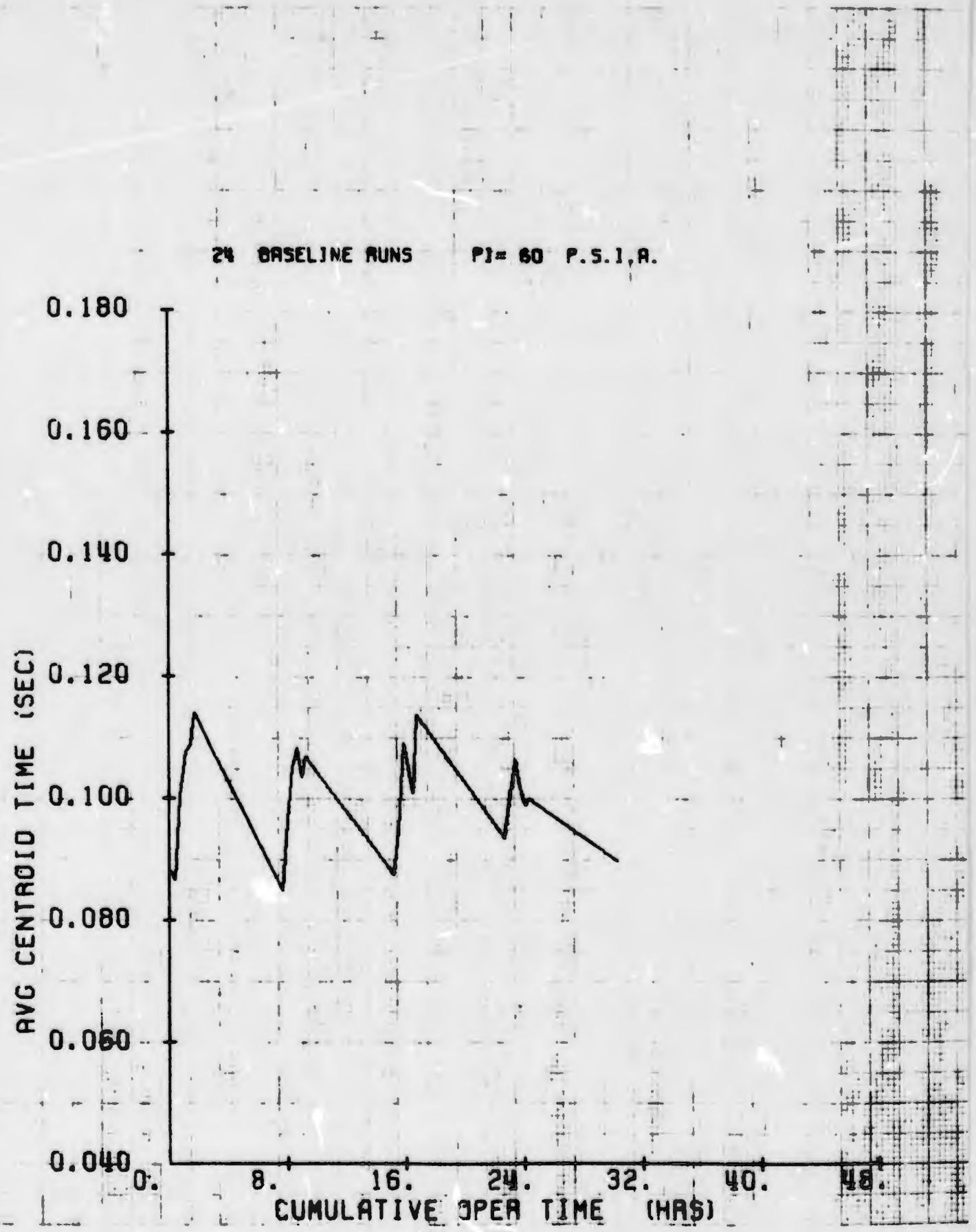

24 BASELINE RUNS P1= 60 P.S.I.A.
0.180
0.160
0.140
0.120
0.100
0.080
0.060
0.040
AVG CENTROID TIME (SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 25C

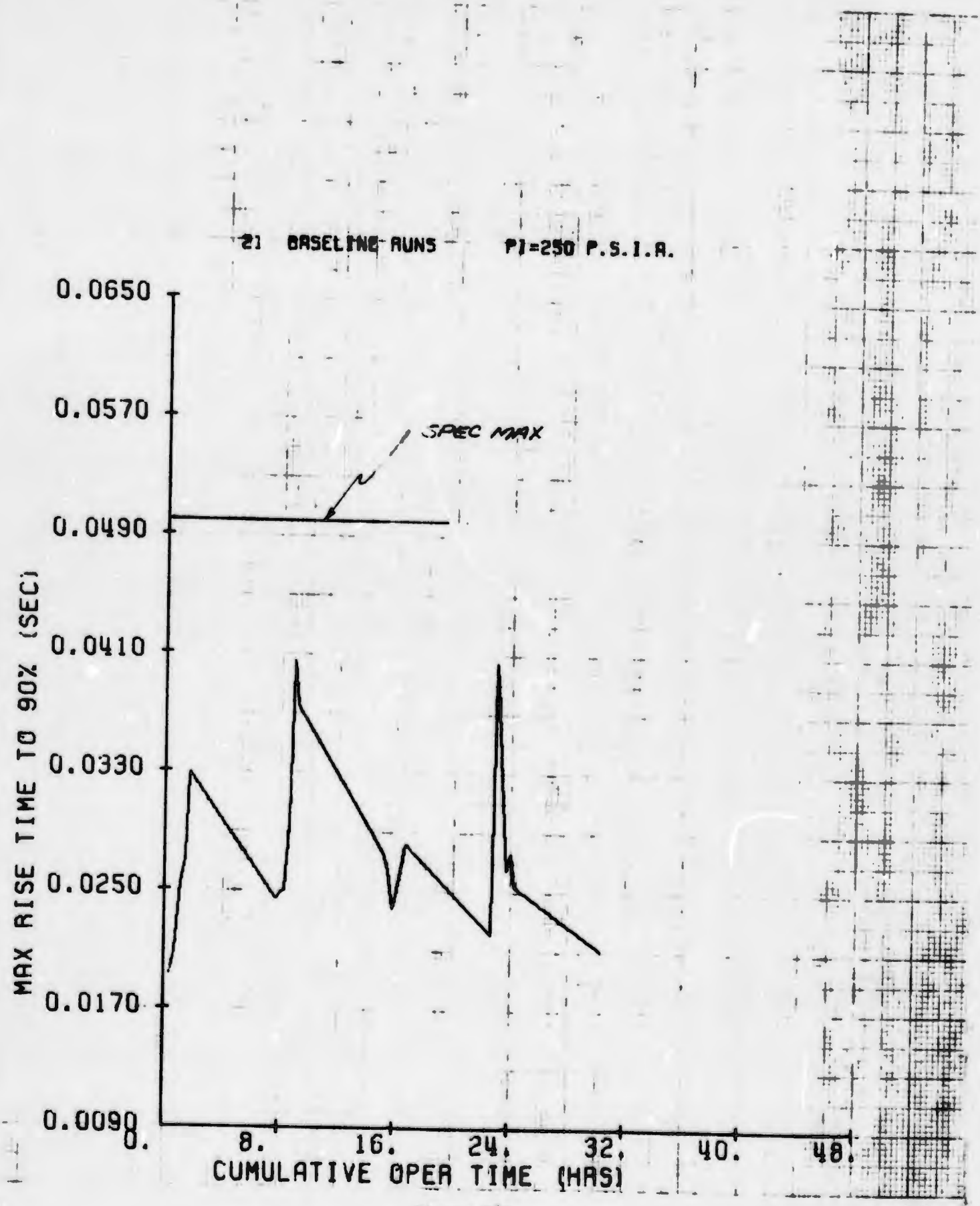

21 BASELINE RUNS
PI=250 P.S.I.A.
0.0650
0.0570
0.0490
0.0410
0.0330
0.0250
0.0170
0.0090
SPEC MAX
MAX RISE TIME TO 90% (SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 26C

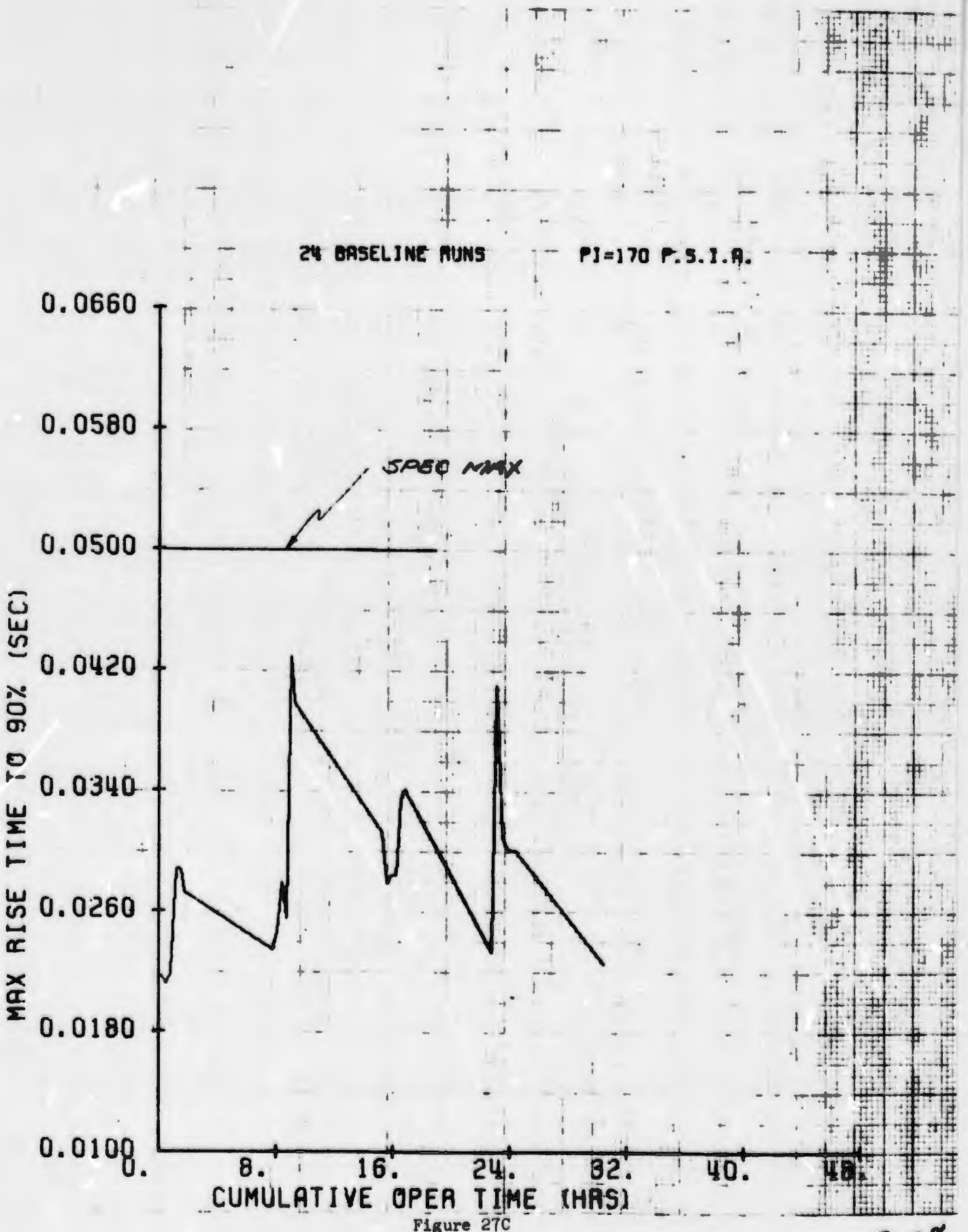

24 BASELINE RUNS
PI=170 P.S.I.A.
0.0660
0.0580
0.0500
0.0420
0.0340
0.0260
0.0180
0.0100
SPEC MAX
MAX RISE TIME TO 90% (SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 27C

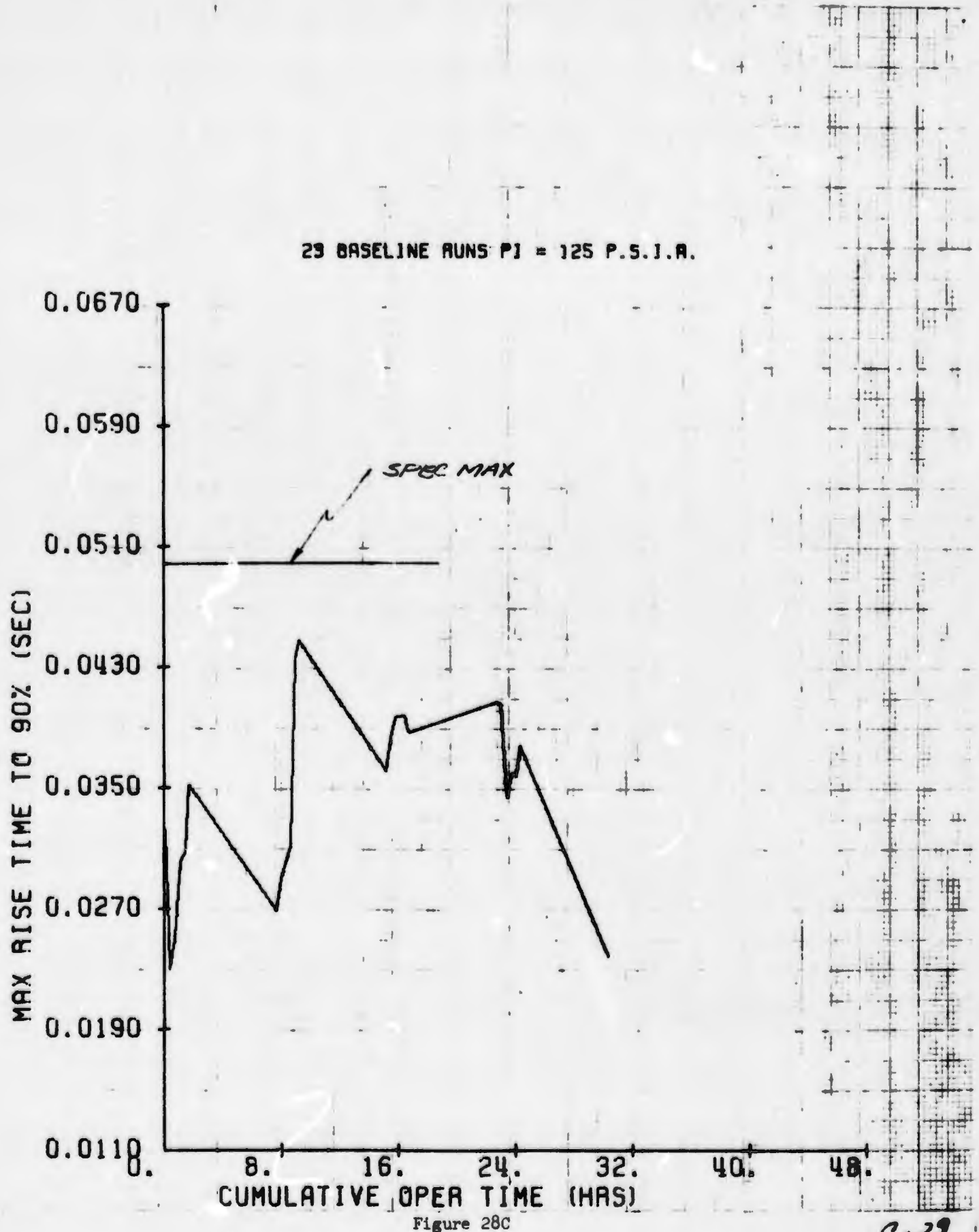


Figure 28C

C-29

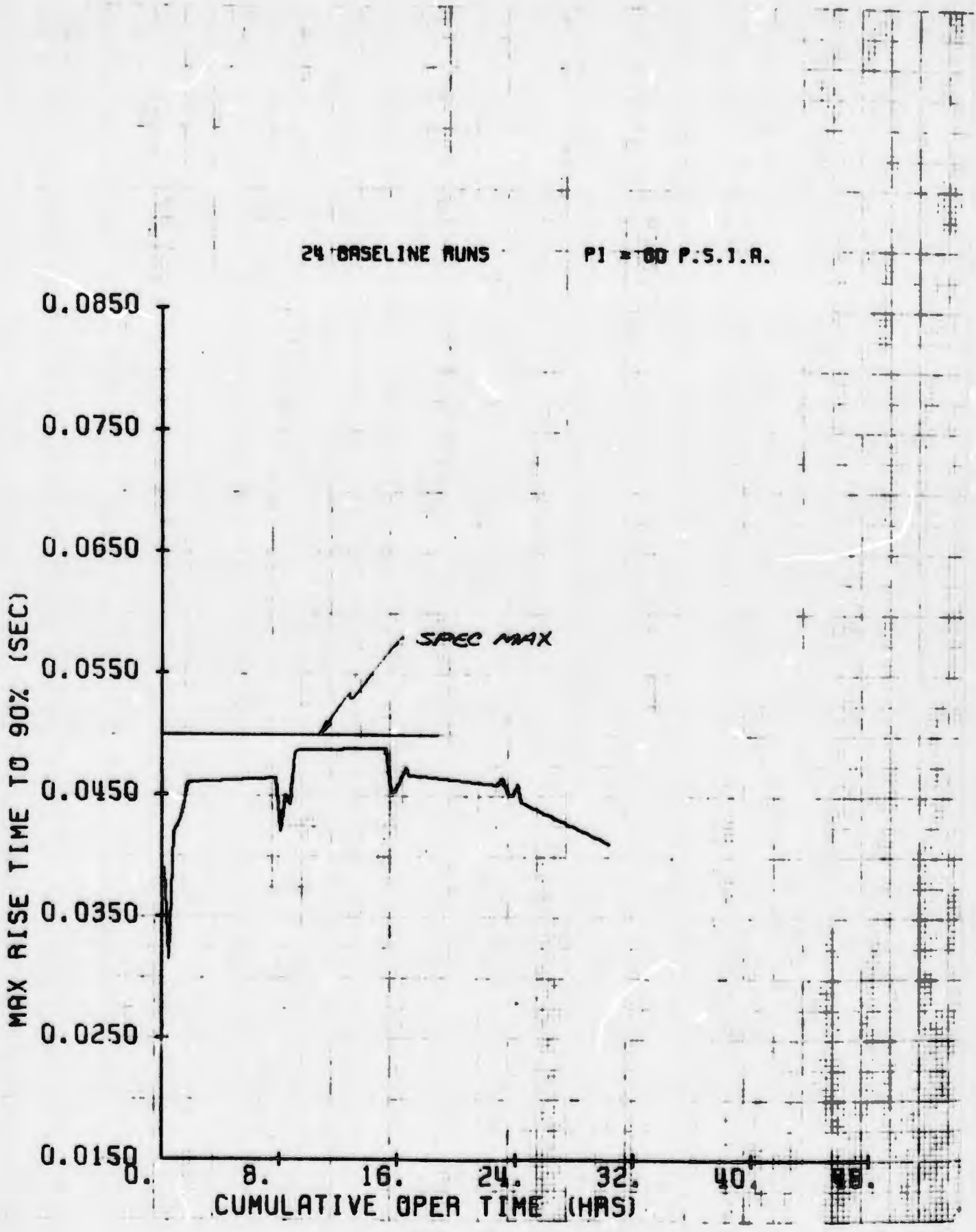

24 BASELINE RUNS
PI = 60 P.S.I.A.
0.0850
0.0750
0.0650
0.0550
0.0450
0.0350
0.0250
0.0150
SPEC MAX
MAX RISE TIME TO 90% (SEC)
0.
8.
16.
24.
32.
40.
CUMULATIVE OPER TIME (HRS)

Figure 29C

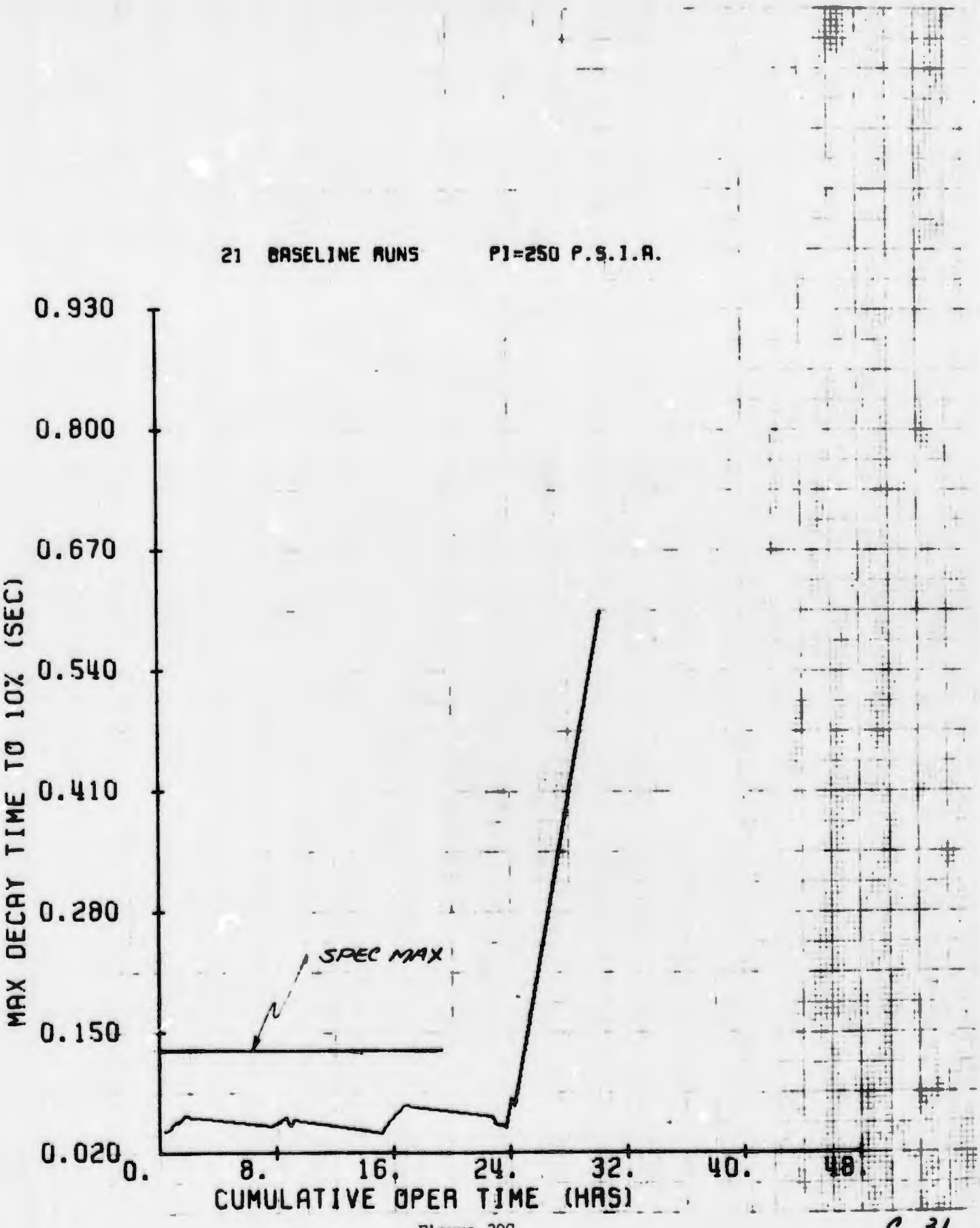

21 BASELINE RUNS P1=250 P.S.I.A.
0.930
0.800
0.670
0.540
0.410
0.280
0.150
0.020
MAX DECAY TIME TO 10% (SEC)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 30C

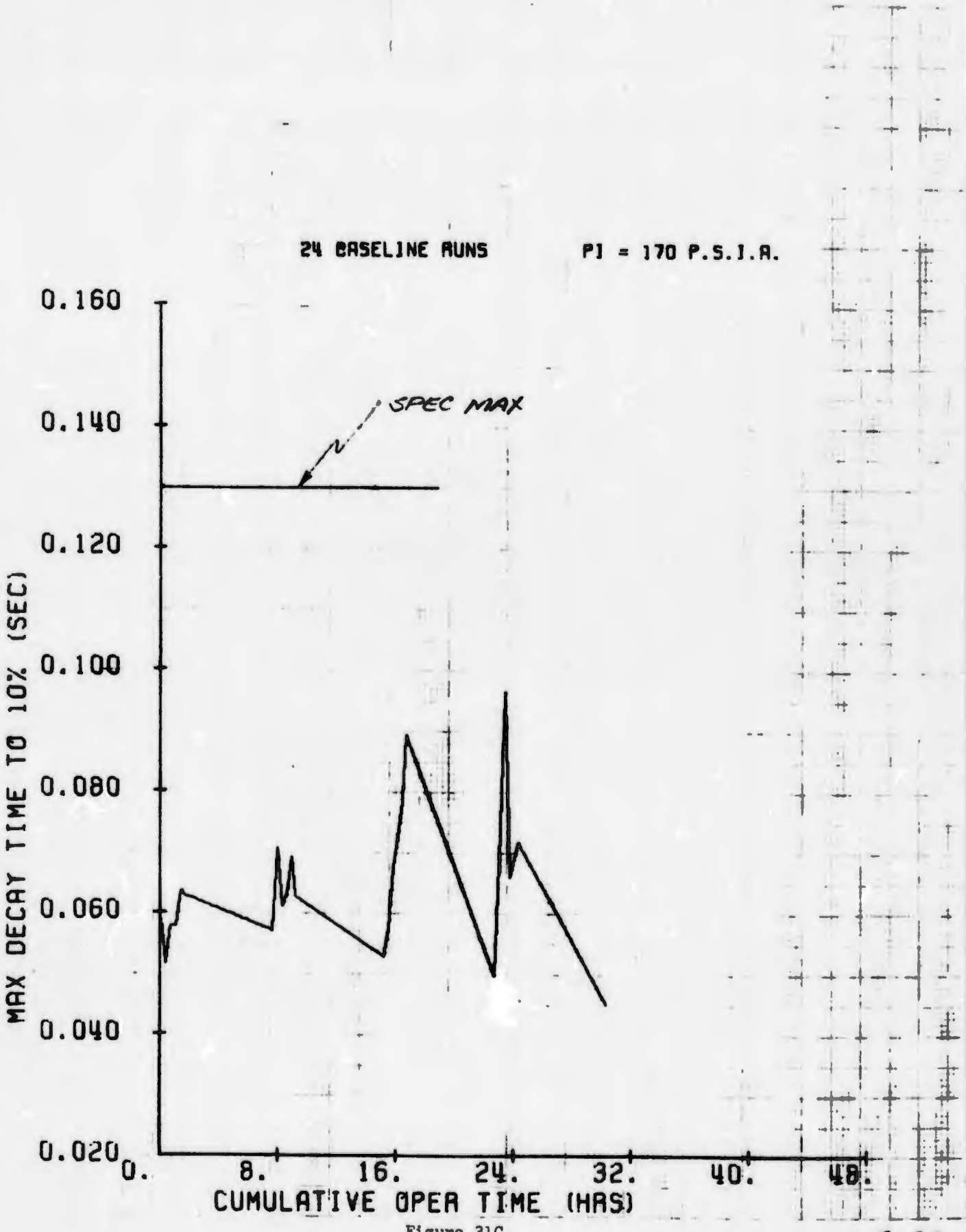

24 BASELINE RUNS
PI = 170 P.S.I.A.
SPEC MAX
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
MAX DECAY TIME TO 10% (SEC)
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 31C

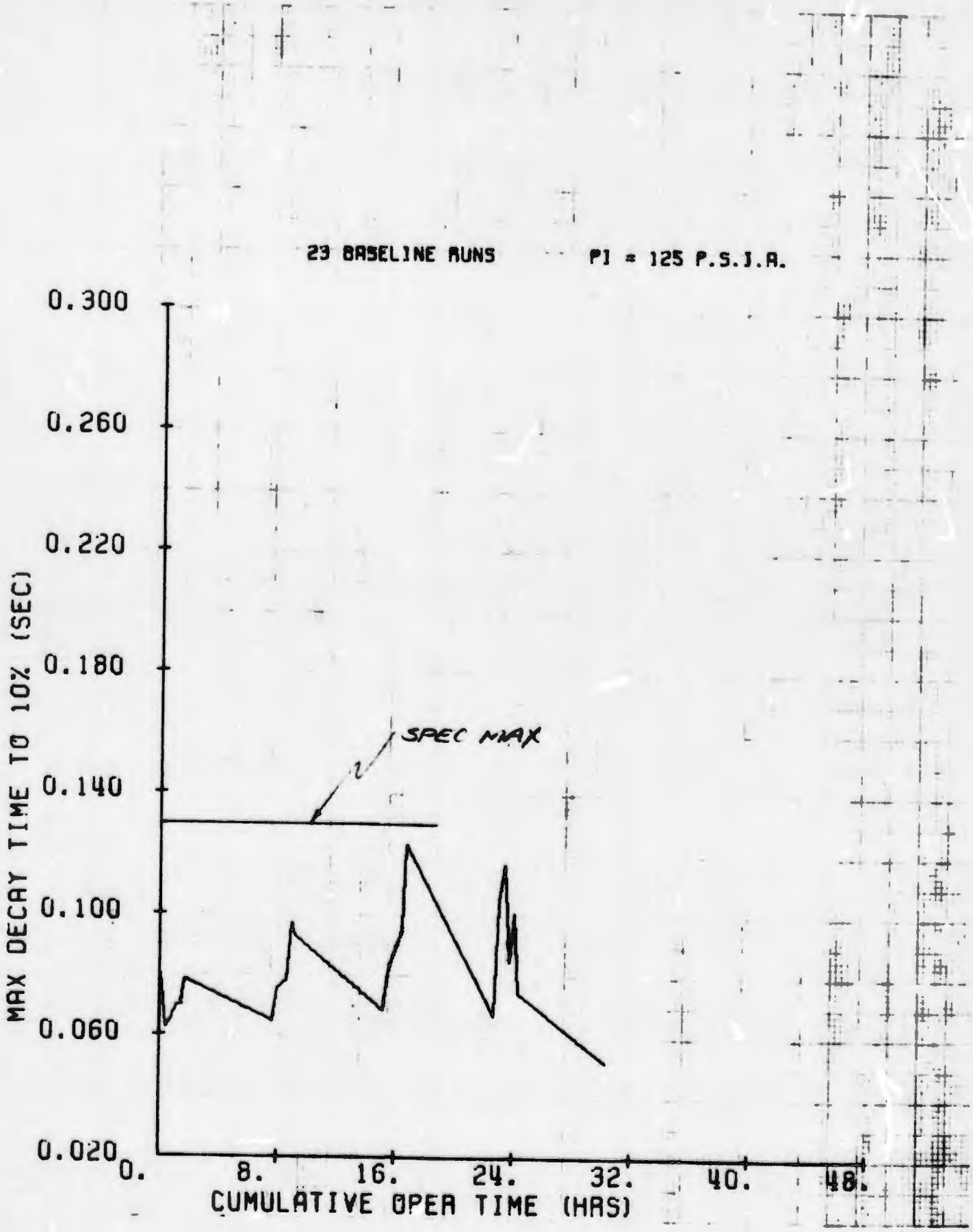

23 BASELINE RUNS
PI = 125 P.S.I.A.
0.300
0.260
0.220
0.180
0.140
0.100
0.060
0.020
MAX DECAY TIME TO 10% (SEC)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 32C

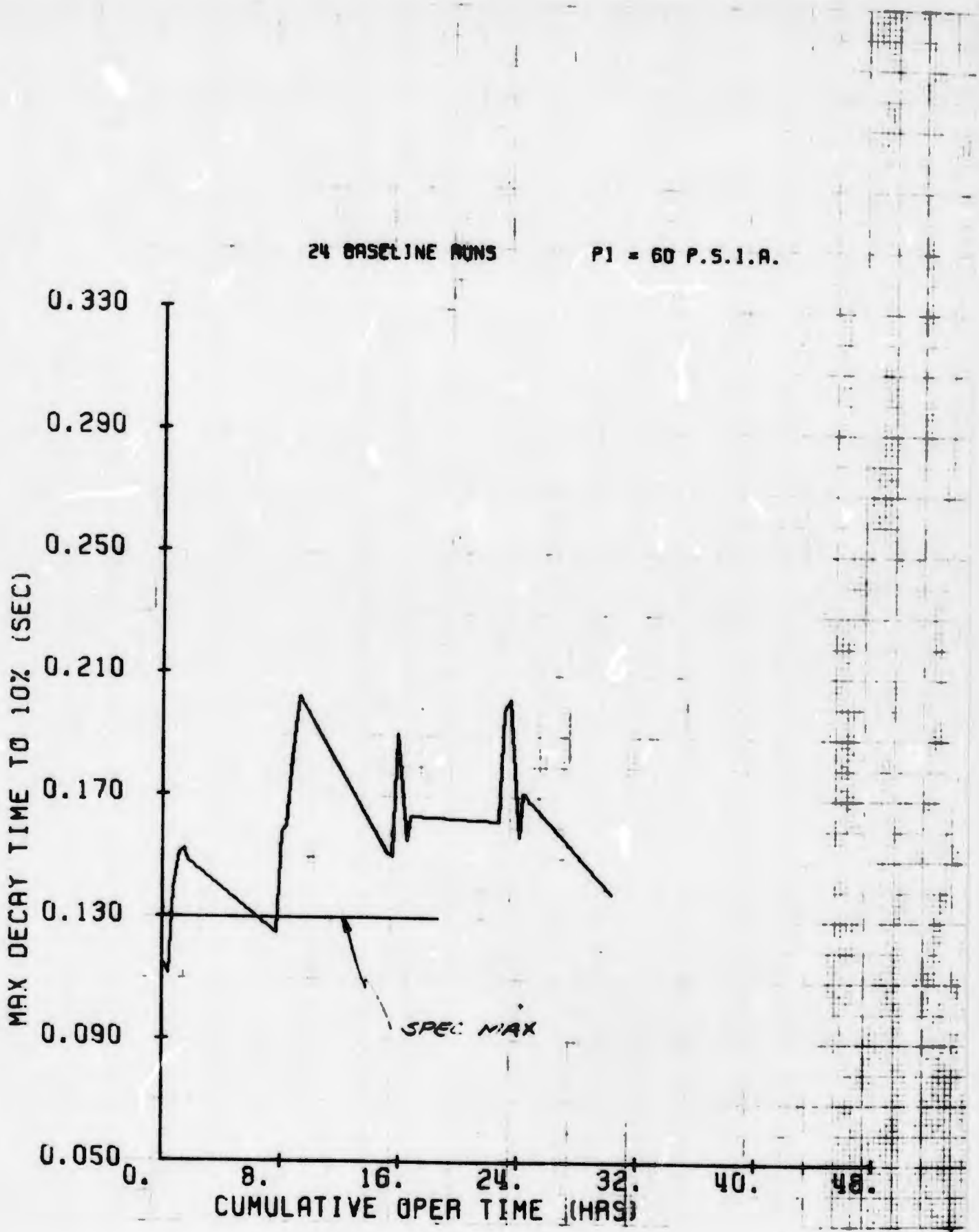

24 BASELINE RUNS
P1 = 60 P.S.I.A.
0.330
0.290
0.250
0.210
0.170
0.130
0.090
0.050
MAX DECAY TIME TO 10% (SEC)
SPEC MAX
0.
8.
16.
24.
32.
40.
48.
CUMULATIVE OPER TIME (HRS)

Figure 33C

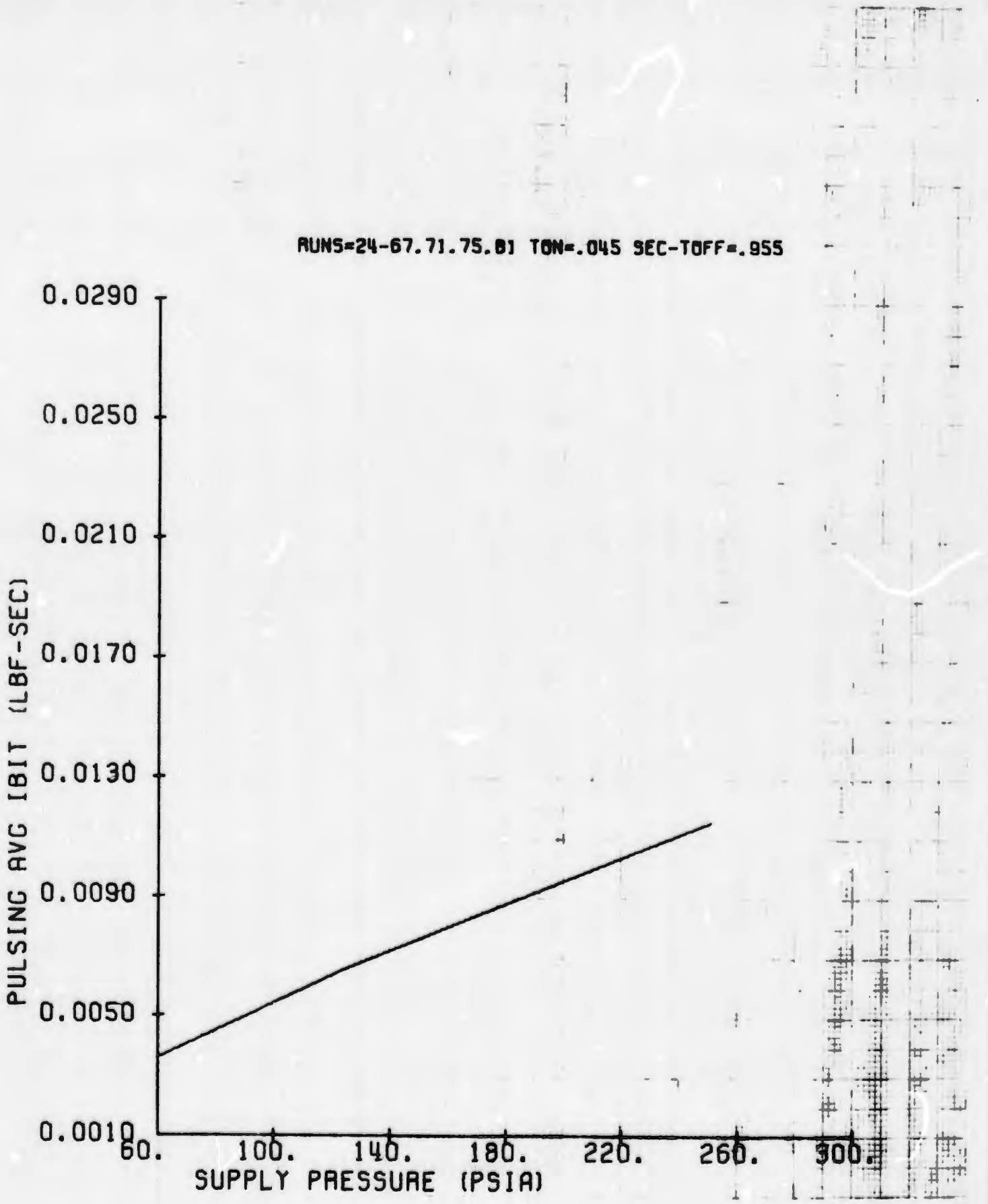

RUNS=24-67.71.75.81 TON=.045 SEC-TOFF=.955
0.0290
0.0250
0.0210
0.0170
0.0130
0.0090
0.0050
0.0010
PULSING AVG IBIT (LBF-SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 34C

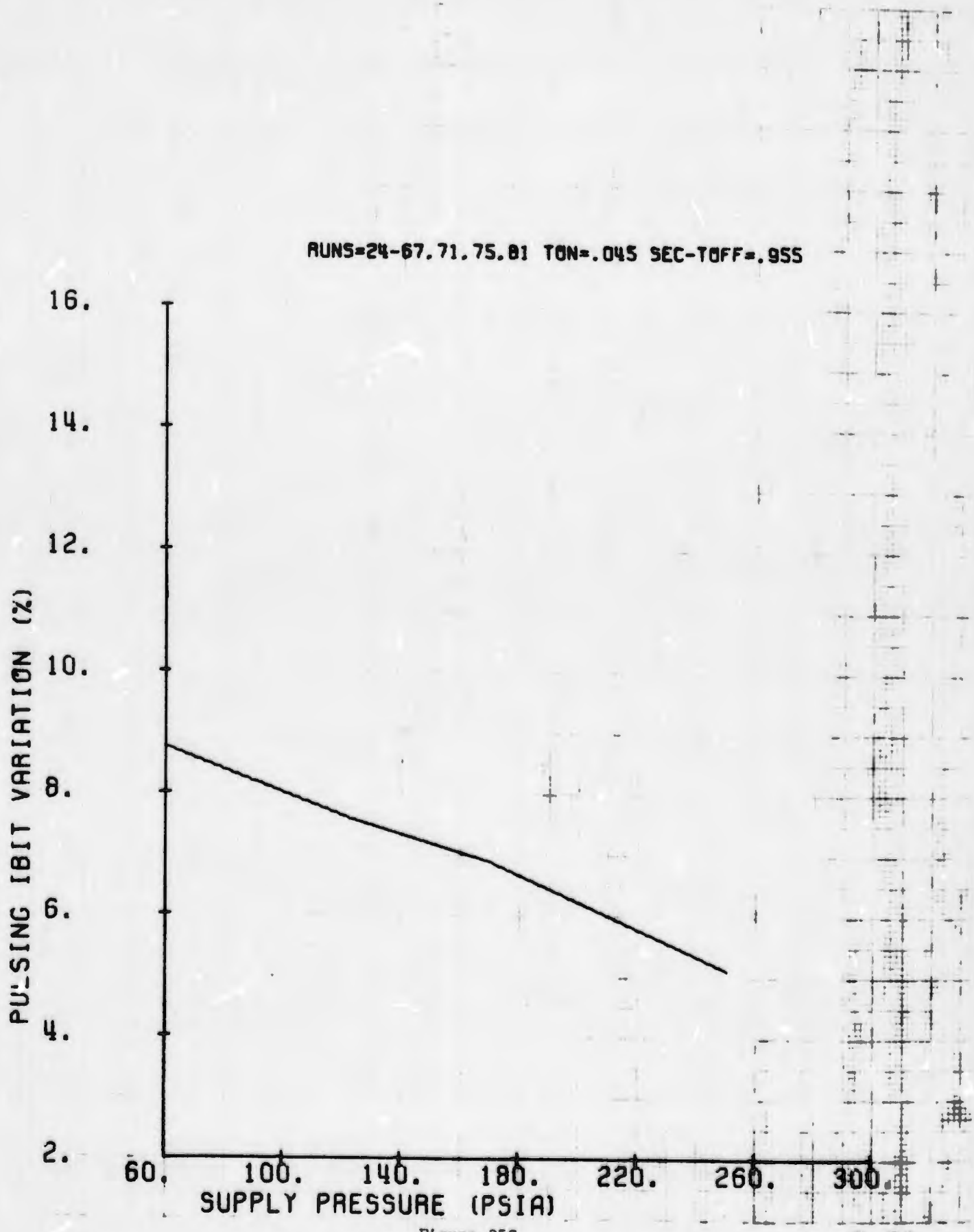

RUNS=24-67,71,75,81 TON=.045 SEC-TOFF=.955
16.
14.
12.
10.
8.
6.
4.
2.
PULSING IBIT VARIATION (%)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 35C

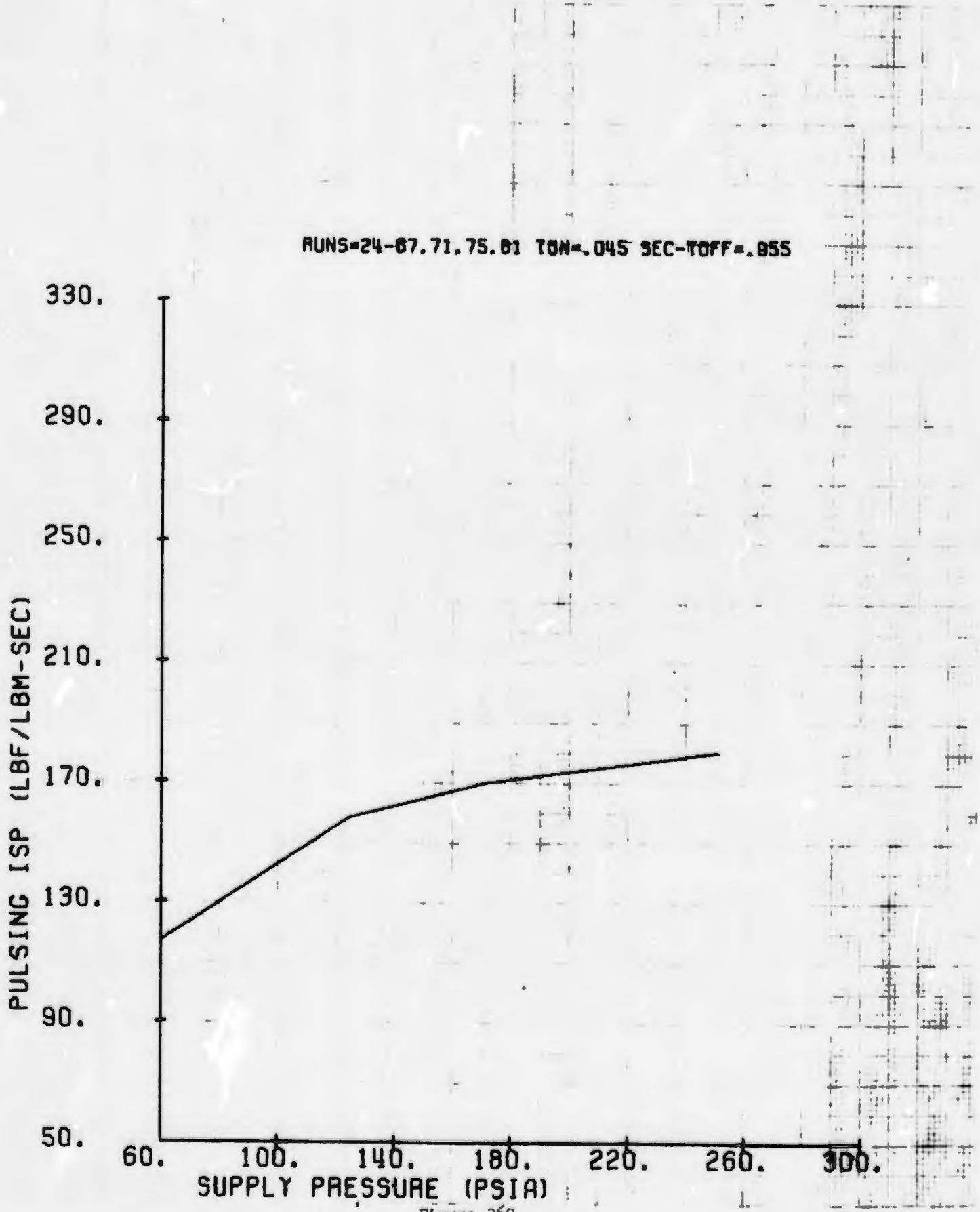

RUNS=24-67,71,75,81 TON=.045 SEC-TOFF=.955
330.
290.
250.
210.
170.
130.
90.
50.
PULSING ISP (LBF/LBM-SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 36C

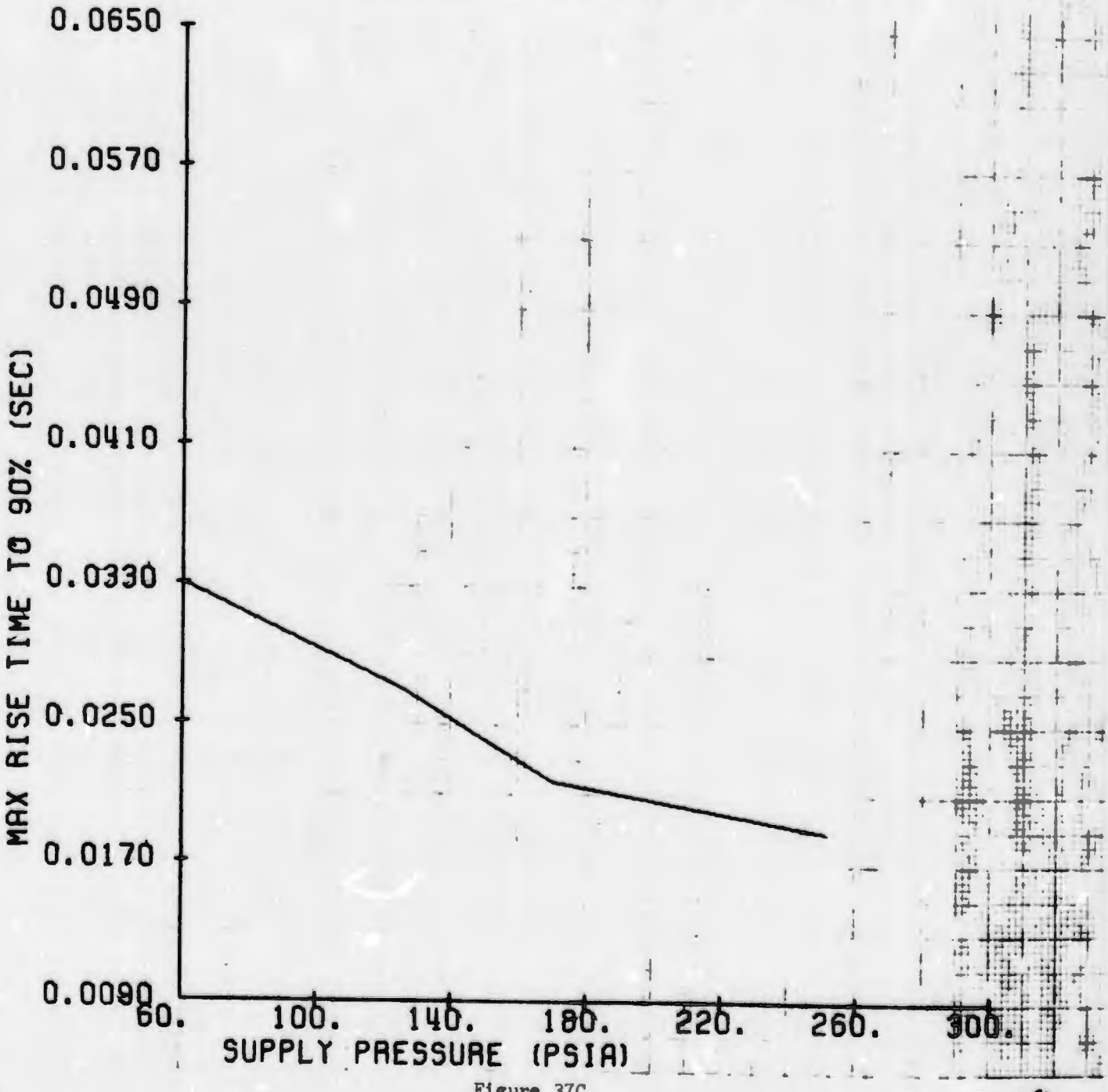

RUNS=24-67.71.75.81 TON=.045 SEC-TOFF=.955
0.0650
0.0570
0.0490
0.0410
0.0330
0.0250
0.0170
0.0090
MAX RISE TIME TO 90% (SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 37C

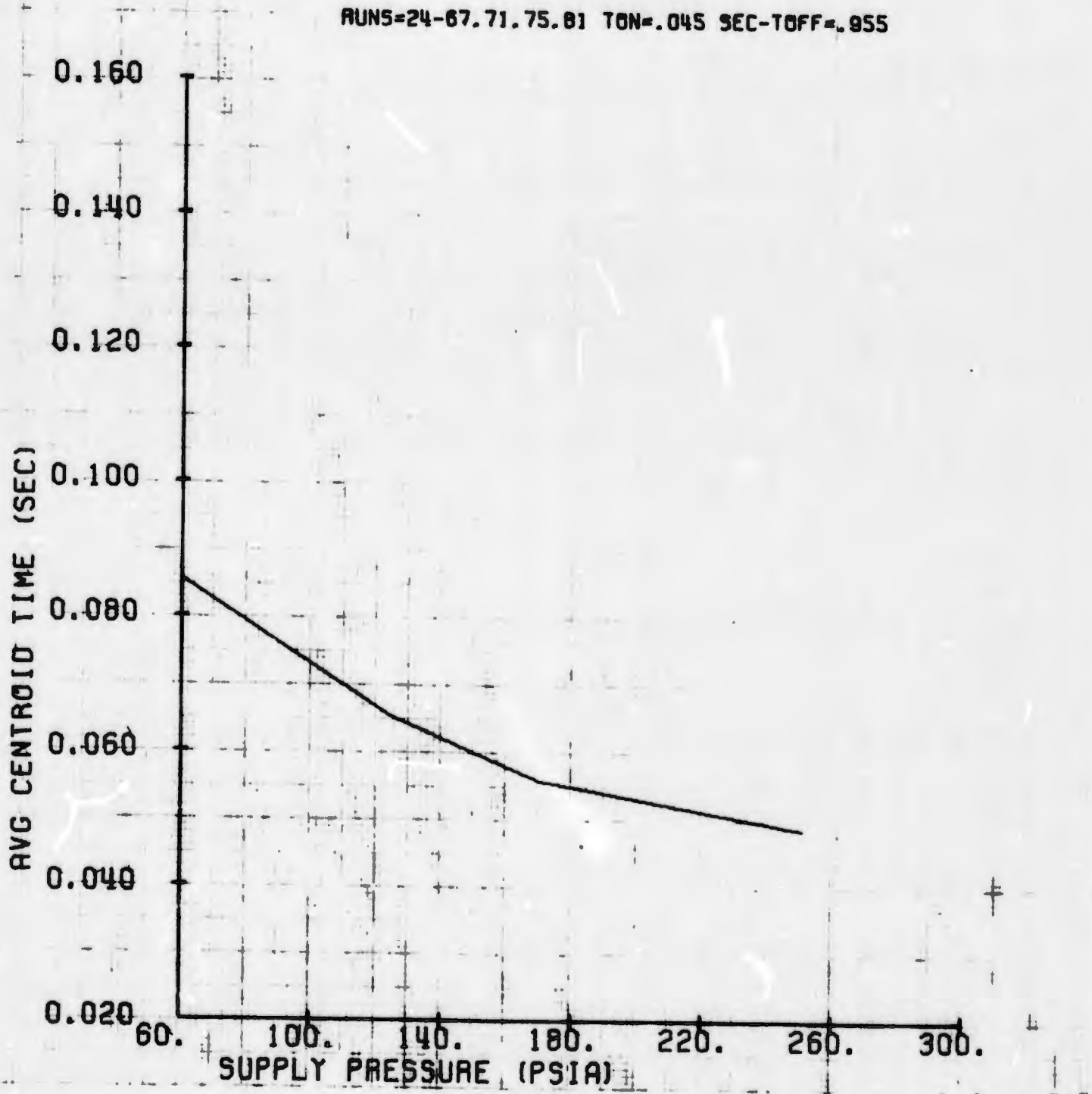

RUNS=24-67.71.75.81 TON=.045 SEC-TOFF=.955
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
AVG CENTROID TIME (SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 38C

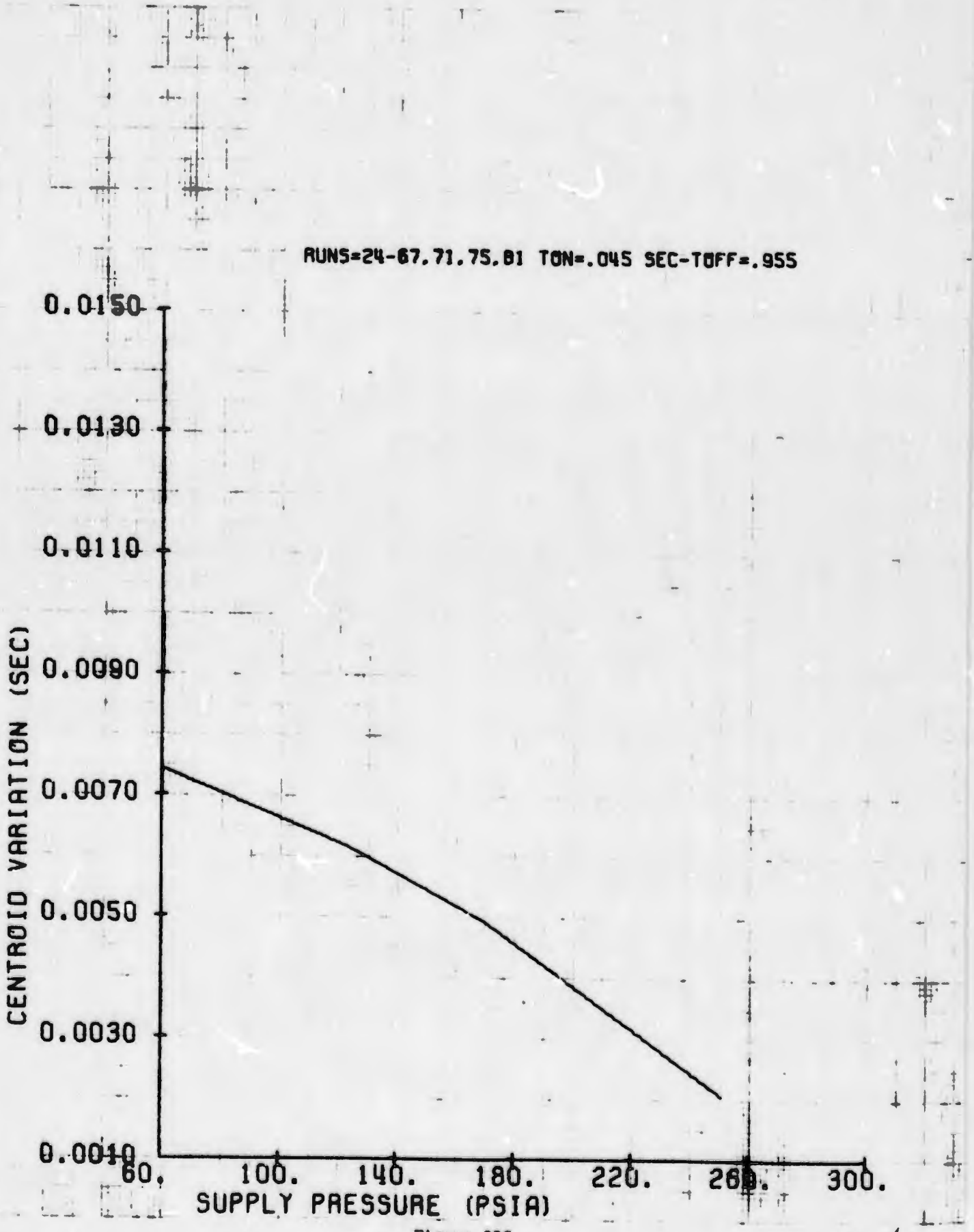

RUNS=24-67,71,75,81 TON=.045 SEC-TOFF=.955
0.0150
0.0130
0.0110
0.0090
0.0070
0.0050
0.0030
0.0010
CENTROID VARIATION (SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 39C

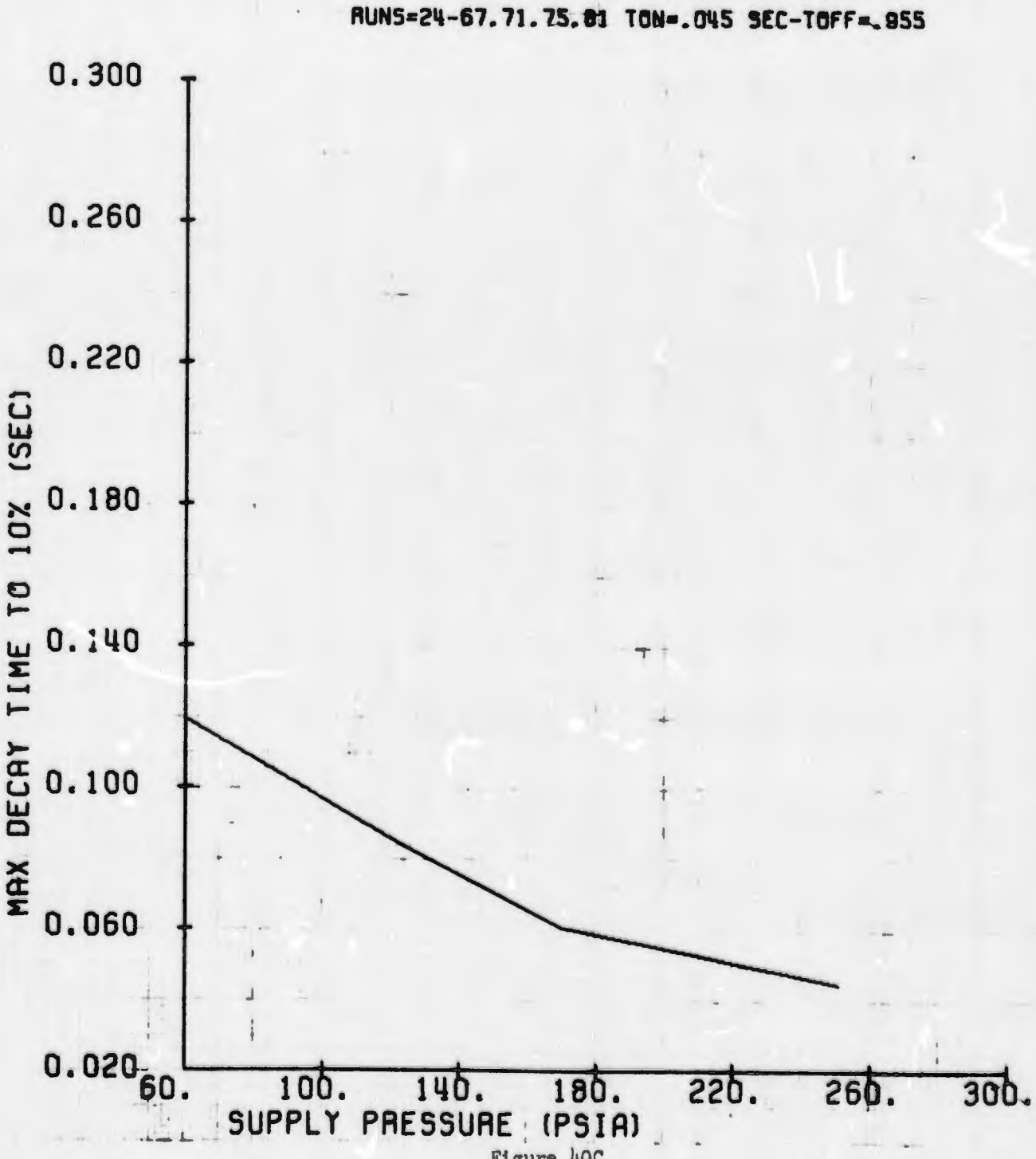

RUNS=24-67.71.75.81 TON=.045 SEC-TOFF=.855
0.300
0.260
0.220
0.180
0.140
0.100
0.060
0.020
MAX DECAY TIME TO 10% (SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 40C

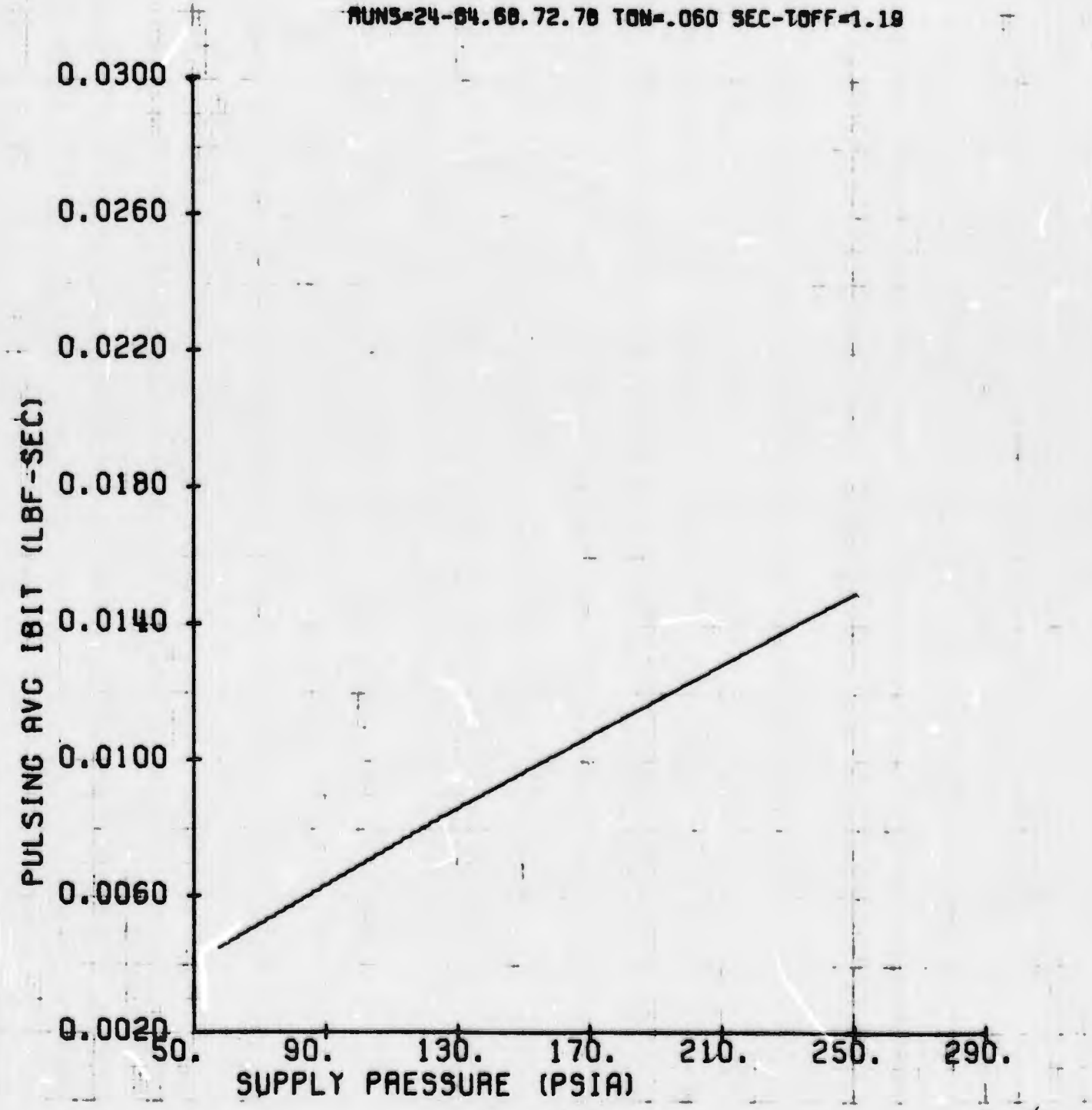

RUNS=24-64.68.72.78 TON=.060 SEC-TOFF=1.19
0.0300
0.0260
0.0220
0.0180
0.0140
0.0100
0.0060
0.0020
PULSING AVG IBIT (LBF-SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 41C

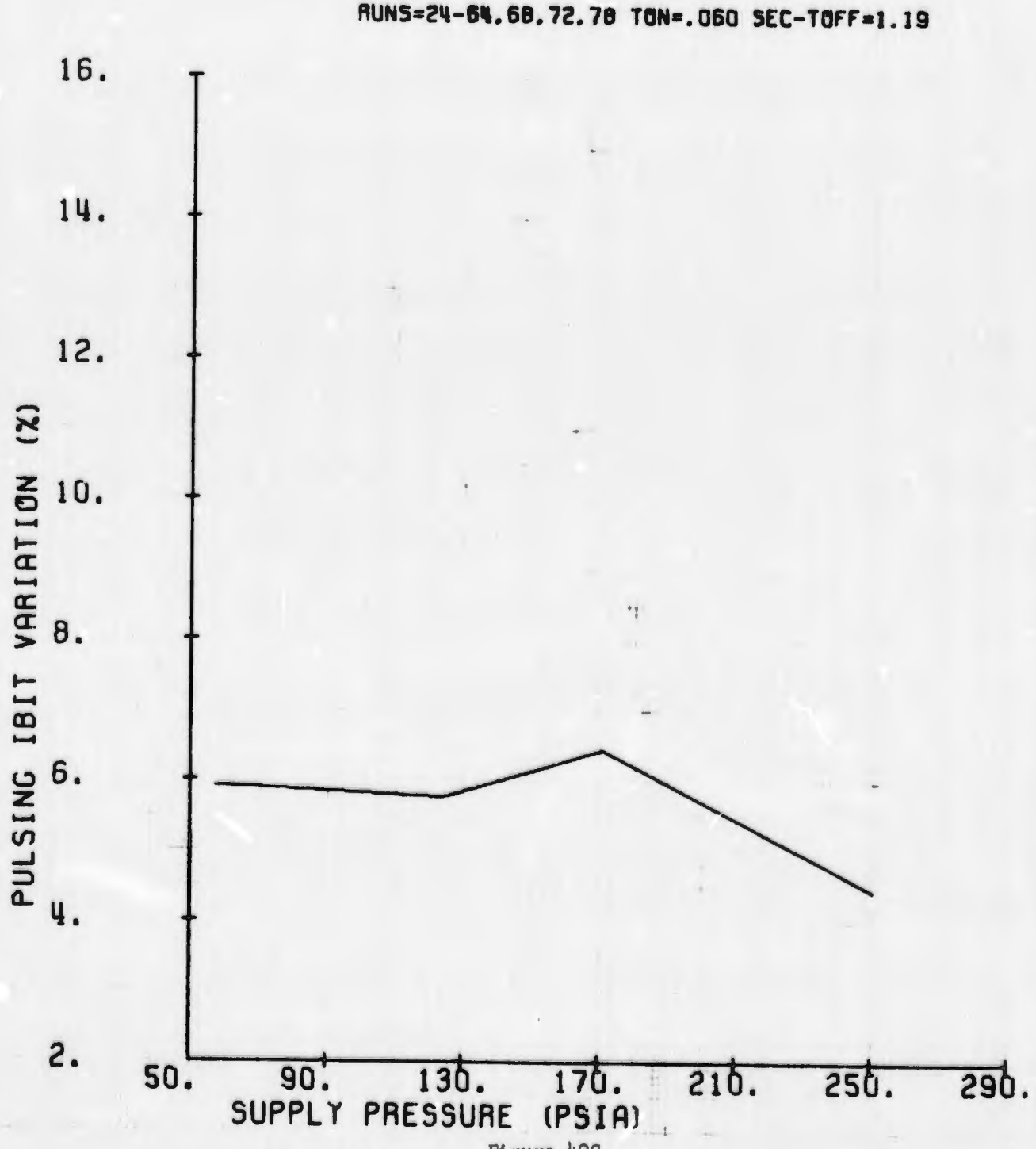

RUNS=24-64.68.72.78 TON=.060 SEC-TOFF=1.19
16.
14.
12.
10.
8.
6.
4.
2.
PULSING IBIT VARIATION (%)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 42C

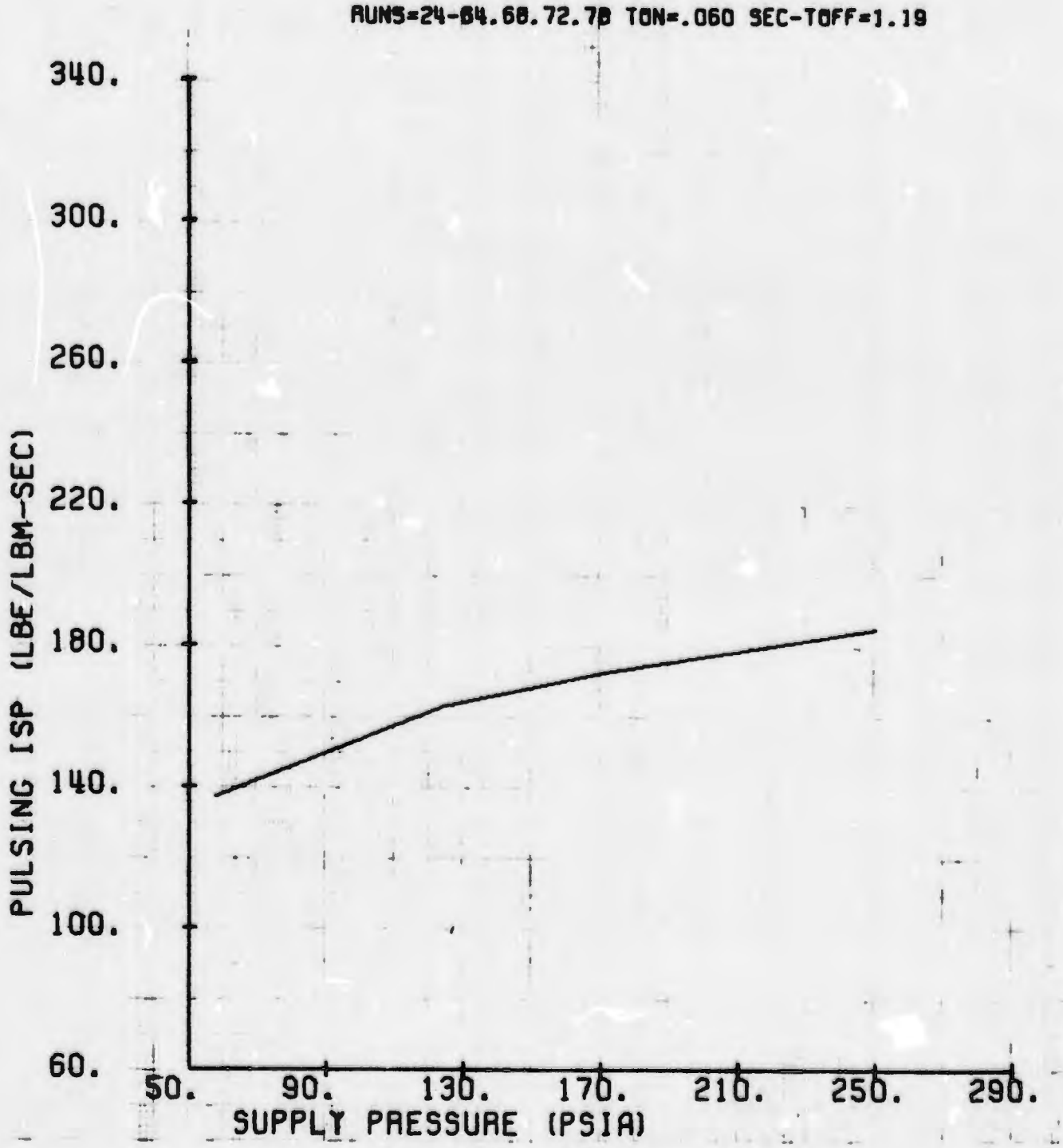

RUNS=24-64.68.72.78 TON=.060 SEC-TOFF=1.19
340.
300.
260.
220.
180.
140.
100.
60.
PULSING ISP (LBF/LBM-SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 43C

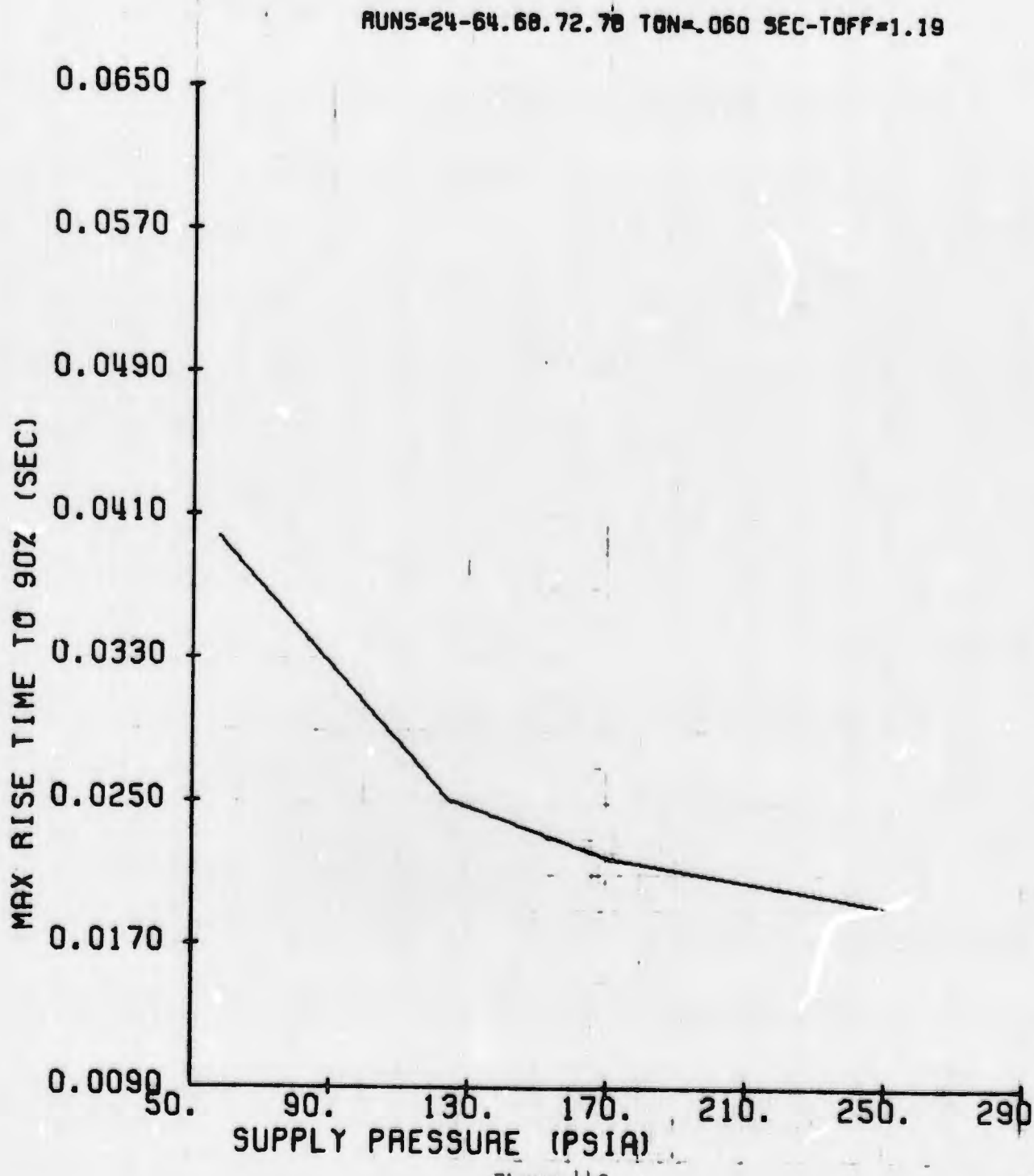

RUNS=24-64.68.72.78 TON=.060 SEC-TOFF=1.19
0.0650
0.0570
0.0490
0.0410
0.0330
0.0250
0.0170
0.0090
MAX RISE TIME TO 90% (SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 44C

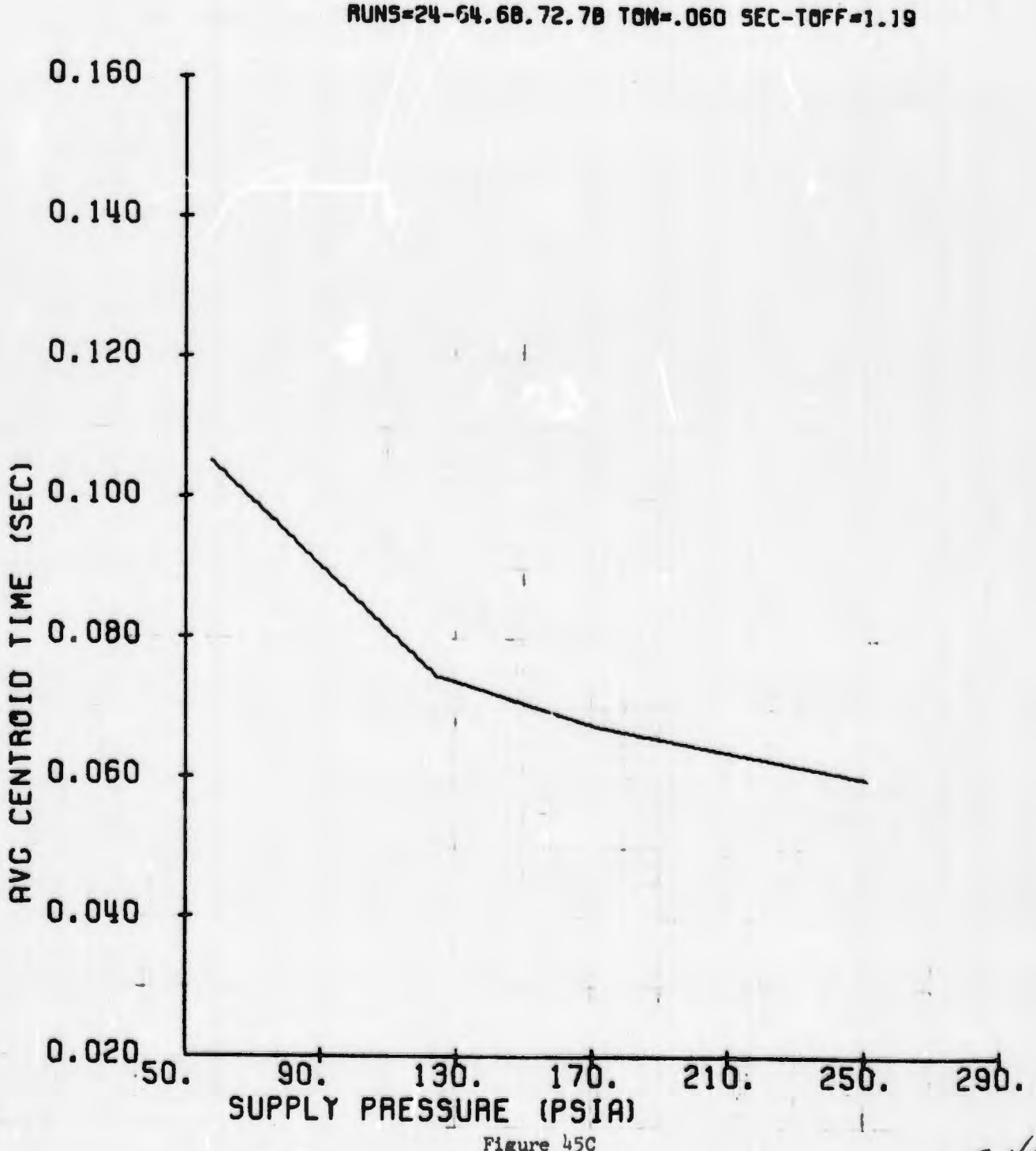

RUNS=24-64.68.72.78 TON=.060 SEC-TOFF=1.19
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
AVG CENTROID TIME (SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 45C

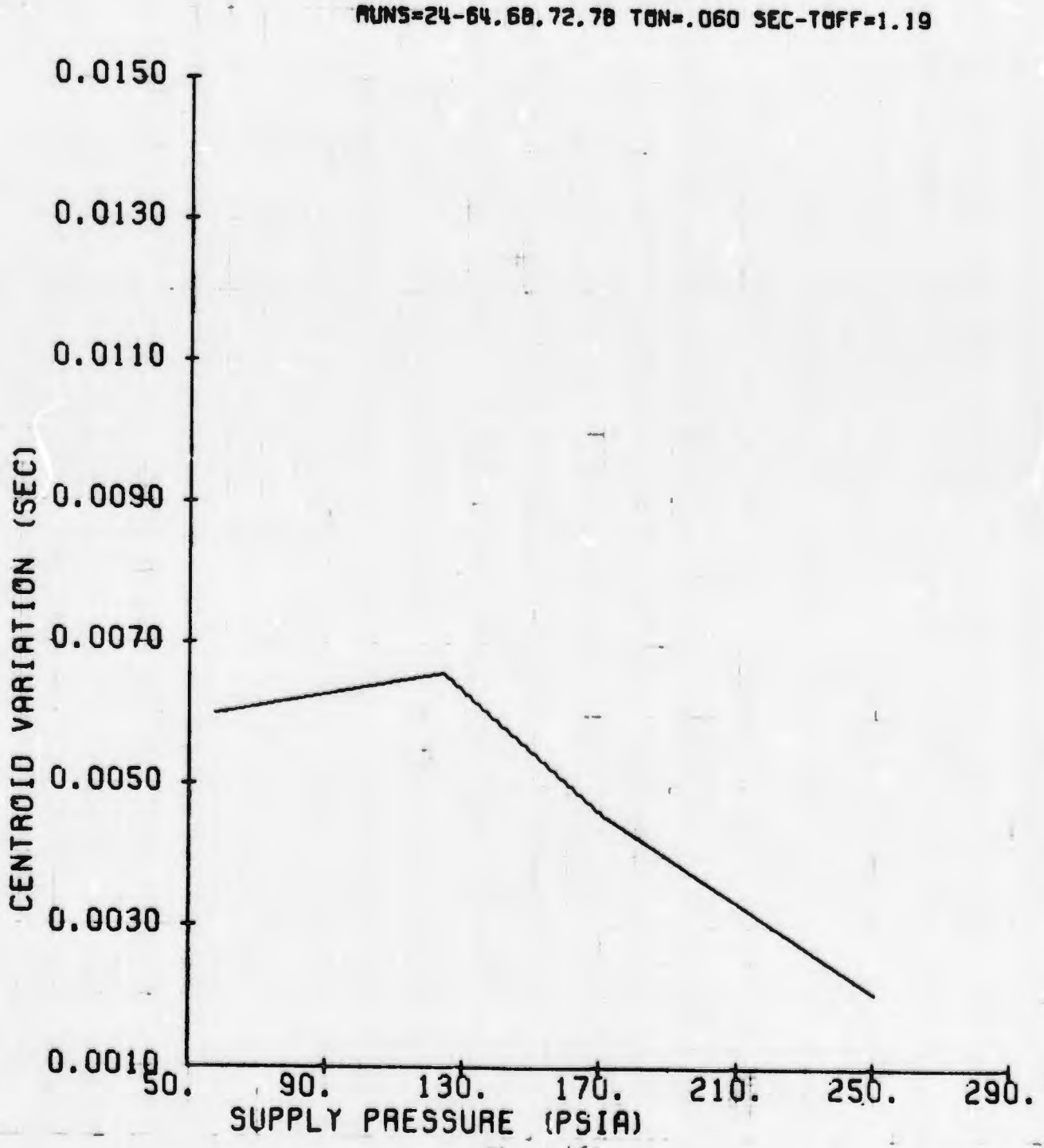

RUNS=24-64.68.72.78 TON=.060 SEC-TOFF=1.19
0.0150
0.0130
0.0110
0.0090
0.0070
0.0050
0.0030
0.0010
CENTROID VARIATION (SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 46C

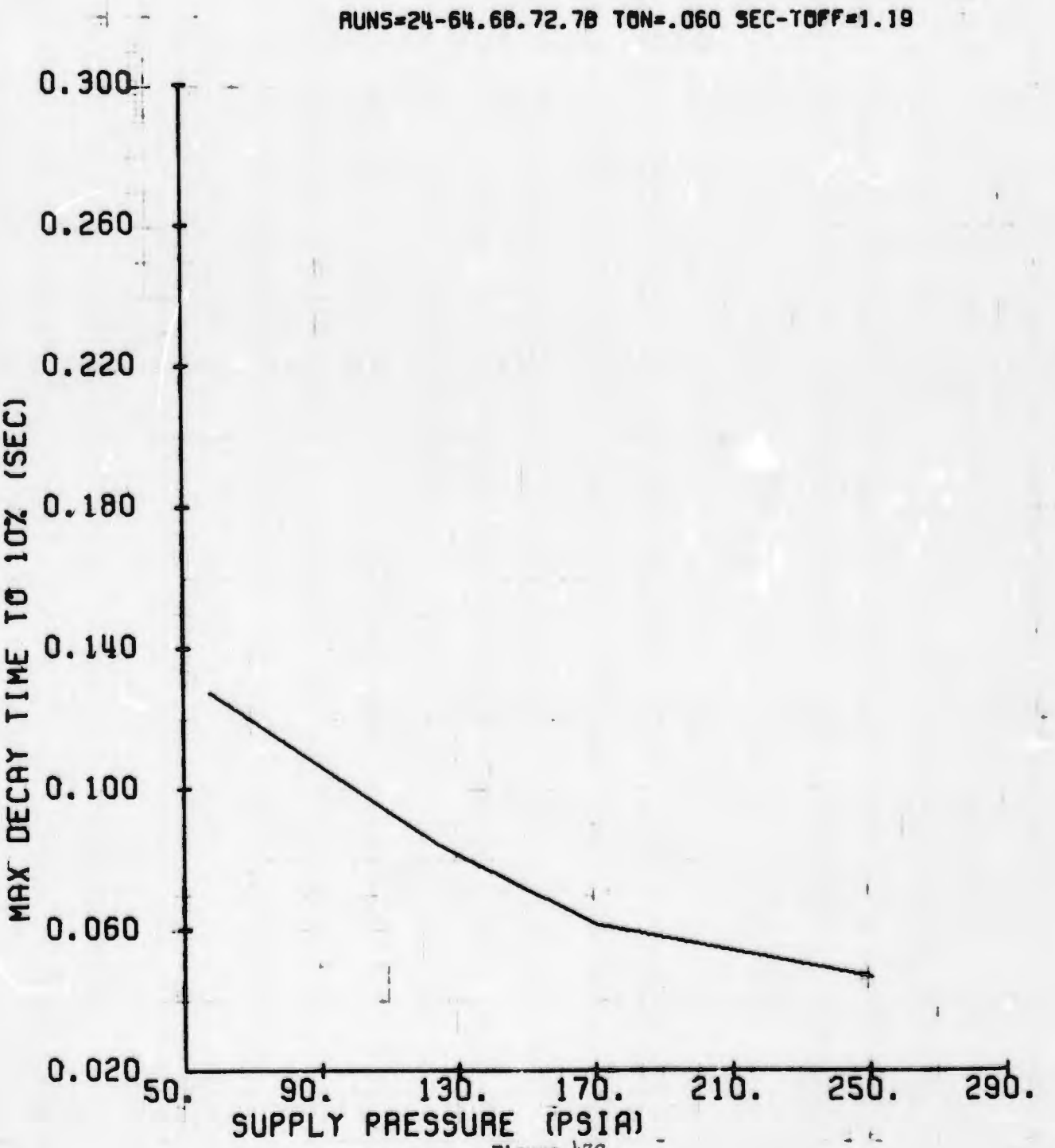

RUNS=24-64.68.72.78 TON=.060 SEC-TOFF=1.19
0.300
0.260
0.220
0.180
0.140
0.100
0.060
0.020
MAX DECAY TIME TO 10% (SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 47C

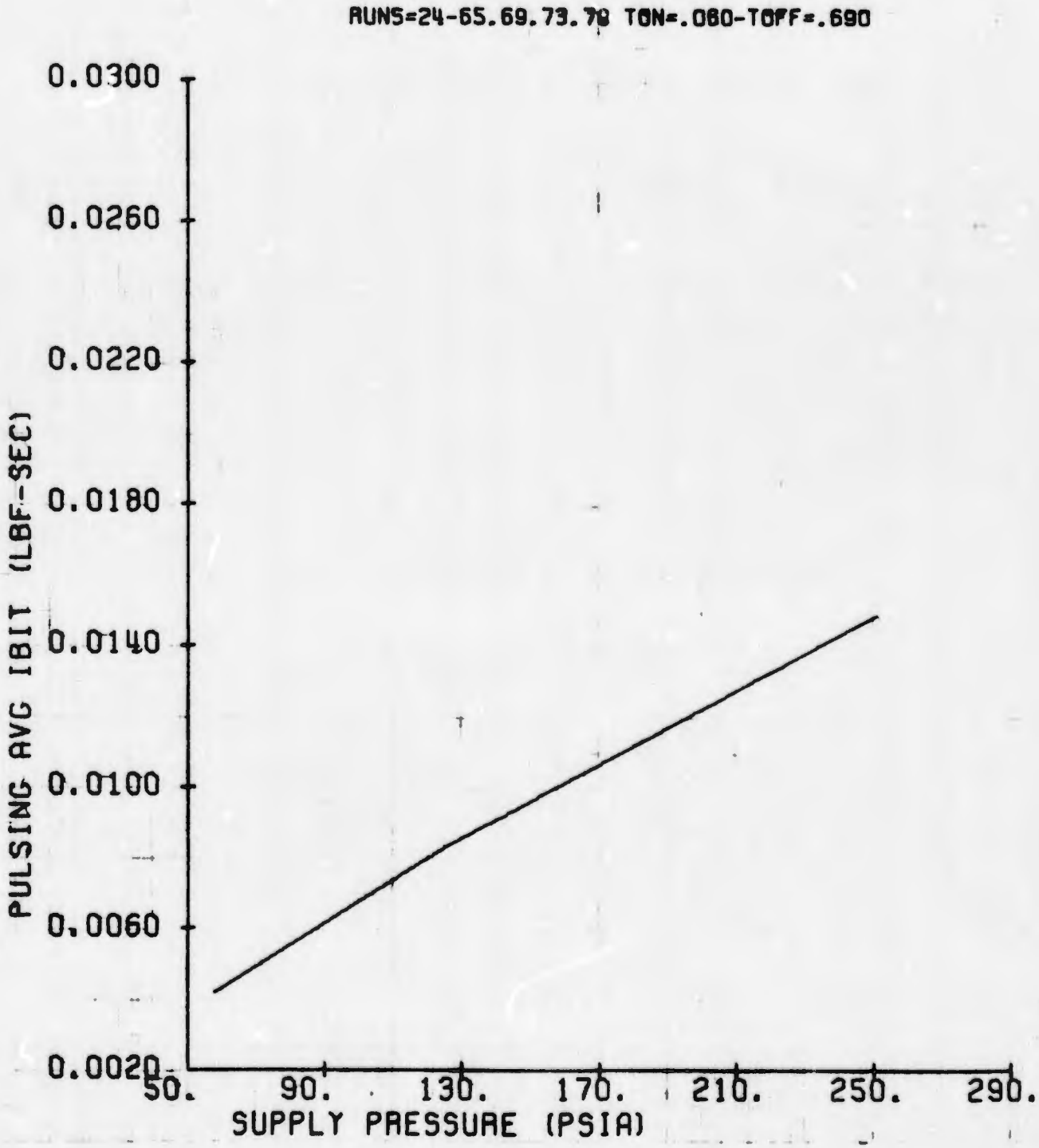

RUNS=24-65.69.73.78 TON=.080-TOFF=.690
0.0300
0.0260
0.0220
0.0180
0.0140
0.0100
0.0060
0.0020
PULSING AVG IBIT (LBF-SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 48C

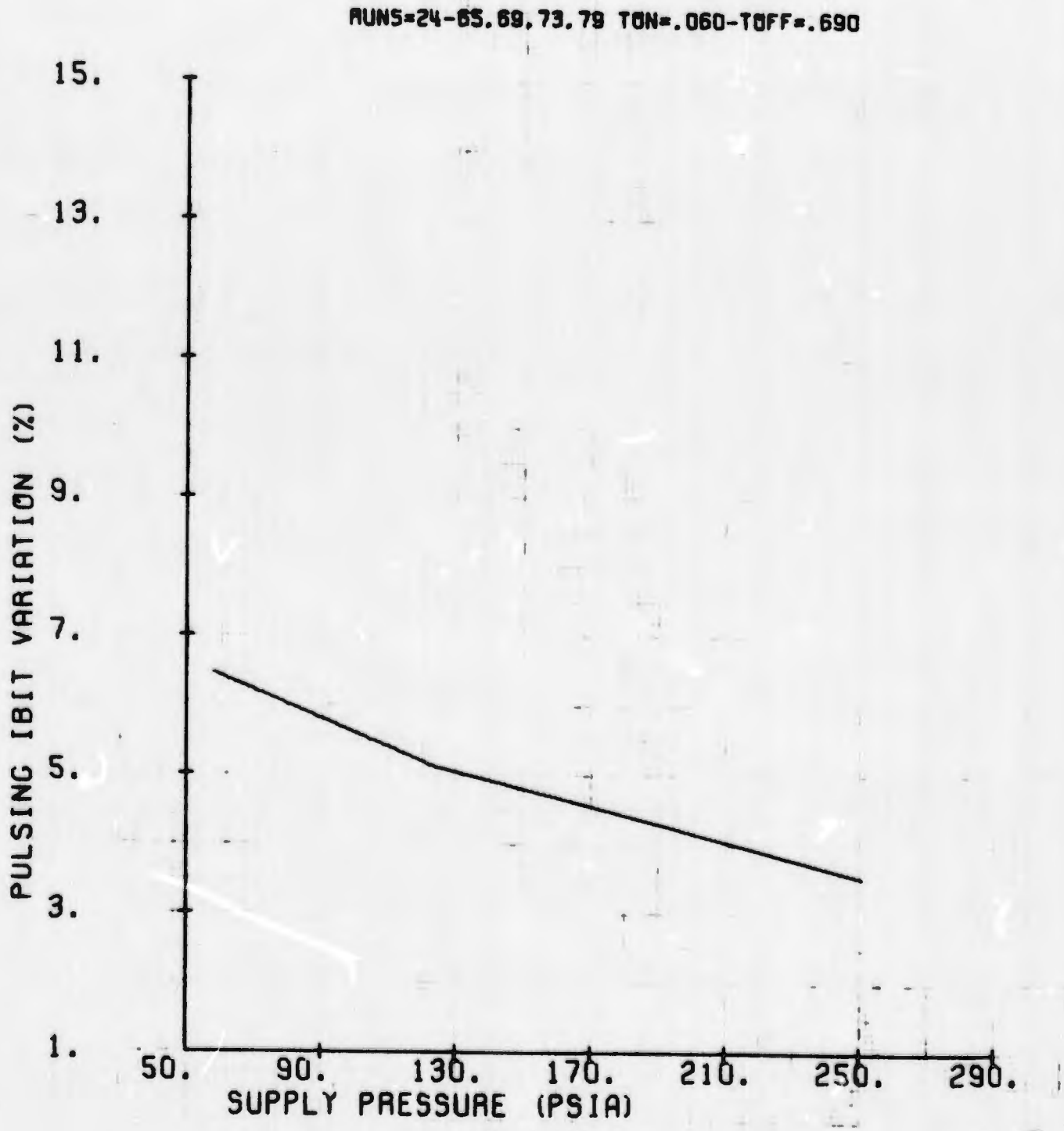

RUNS=24-65,69,73,78 TON=.060-TOFF=.690
15.
13.
11.
9.
7.
5.
3.
1.
PULSING IBIT VARIATION (%)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 49C

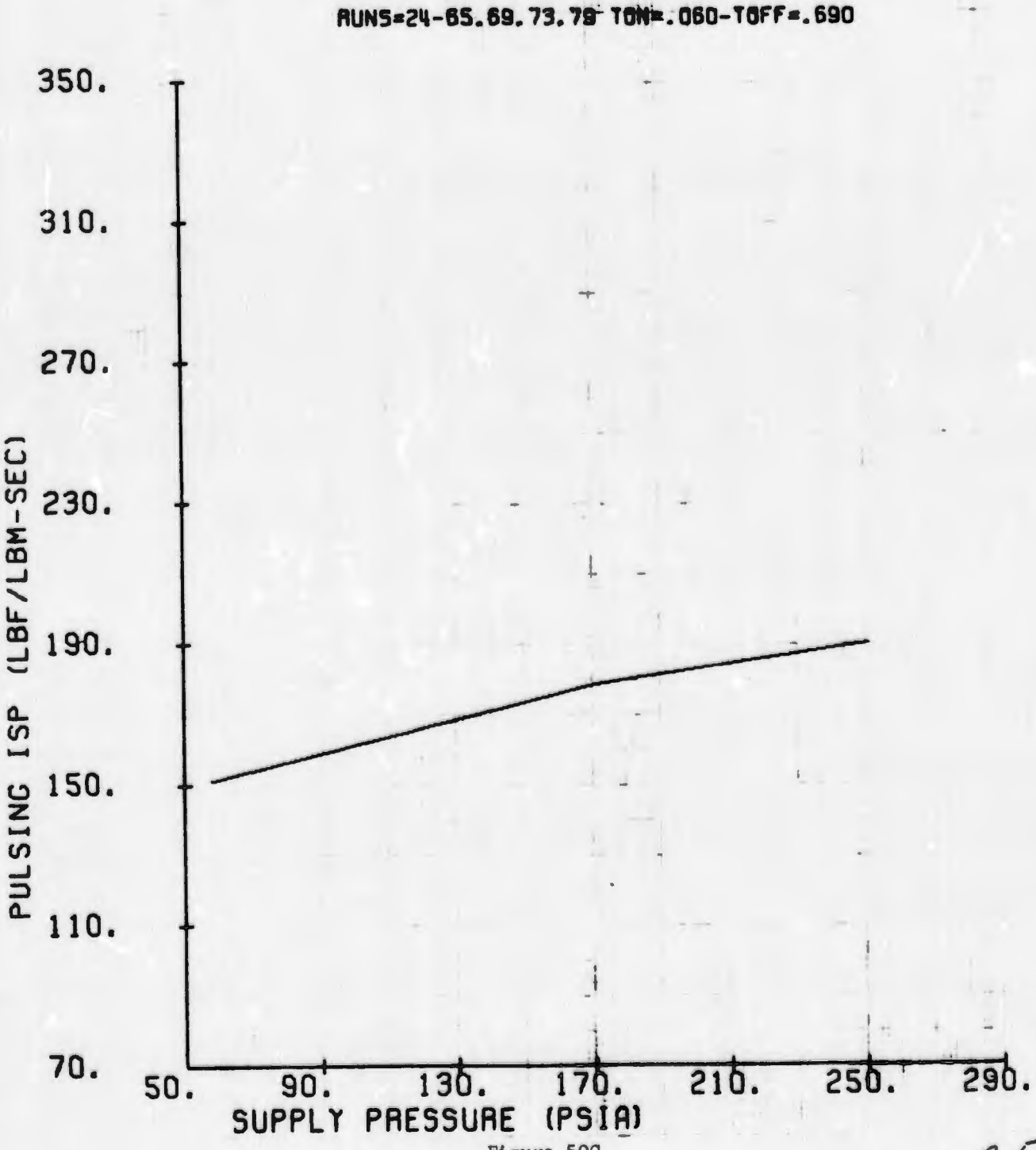

RUNS=24-65.69.73.79 TON=.060-TOFF=.690
350.
310.
270.
230.
190.
150.
110.
70.
PULSING ISP (LBF/LBM-SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 50C

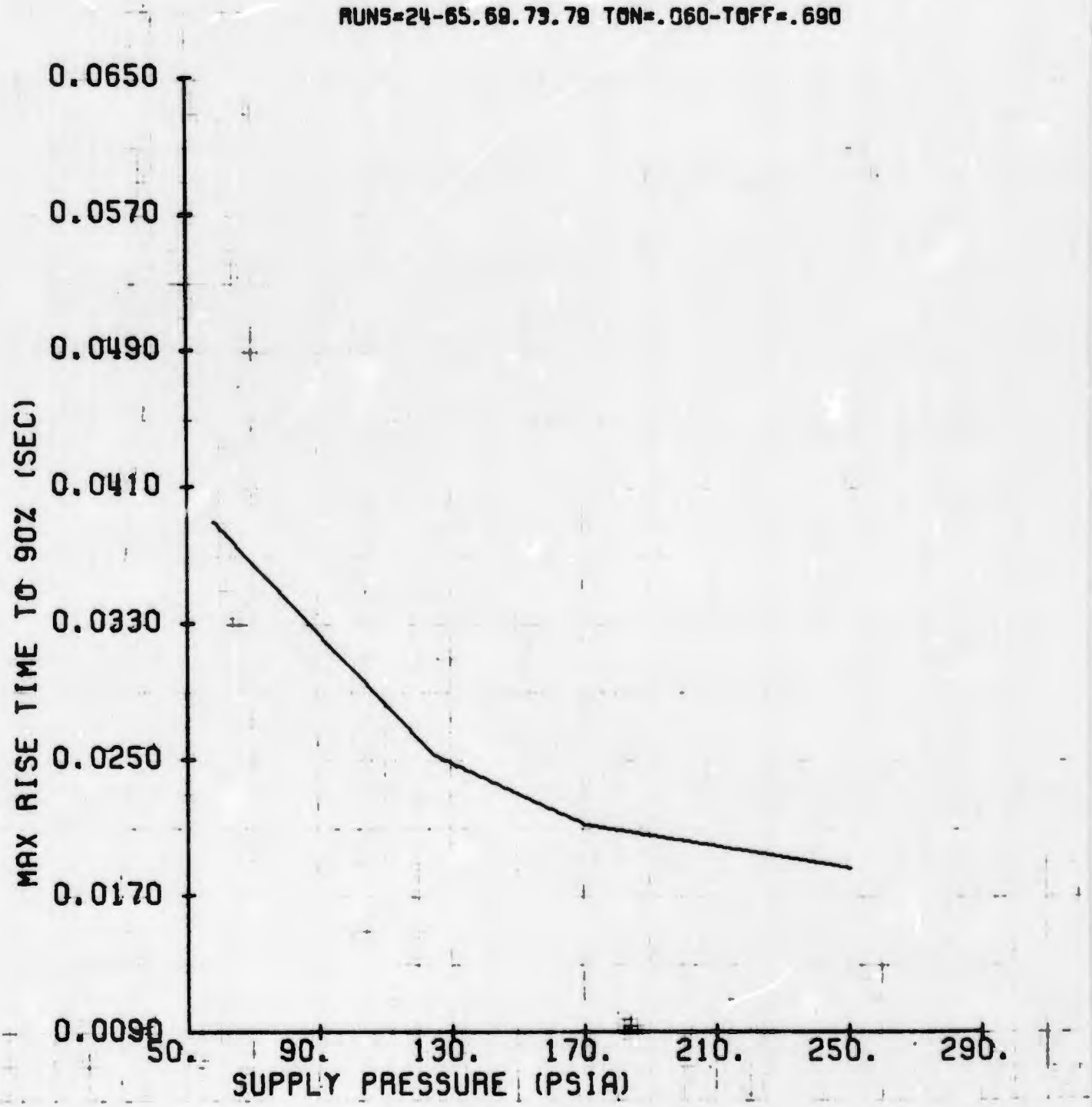

RUNS=24-65.68.73.78 TON=.060-TOFF=.690
0.0650
0.0570
0.0490
0.0410
0.0330
0.0250
0.0170
0.0090
MAX RISE TIME TO 90% (SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 51C

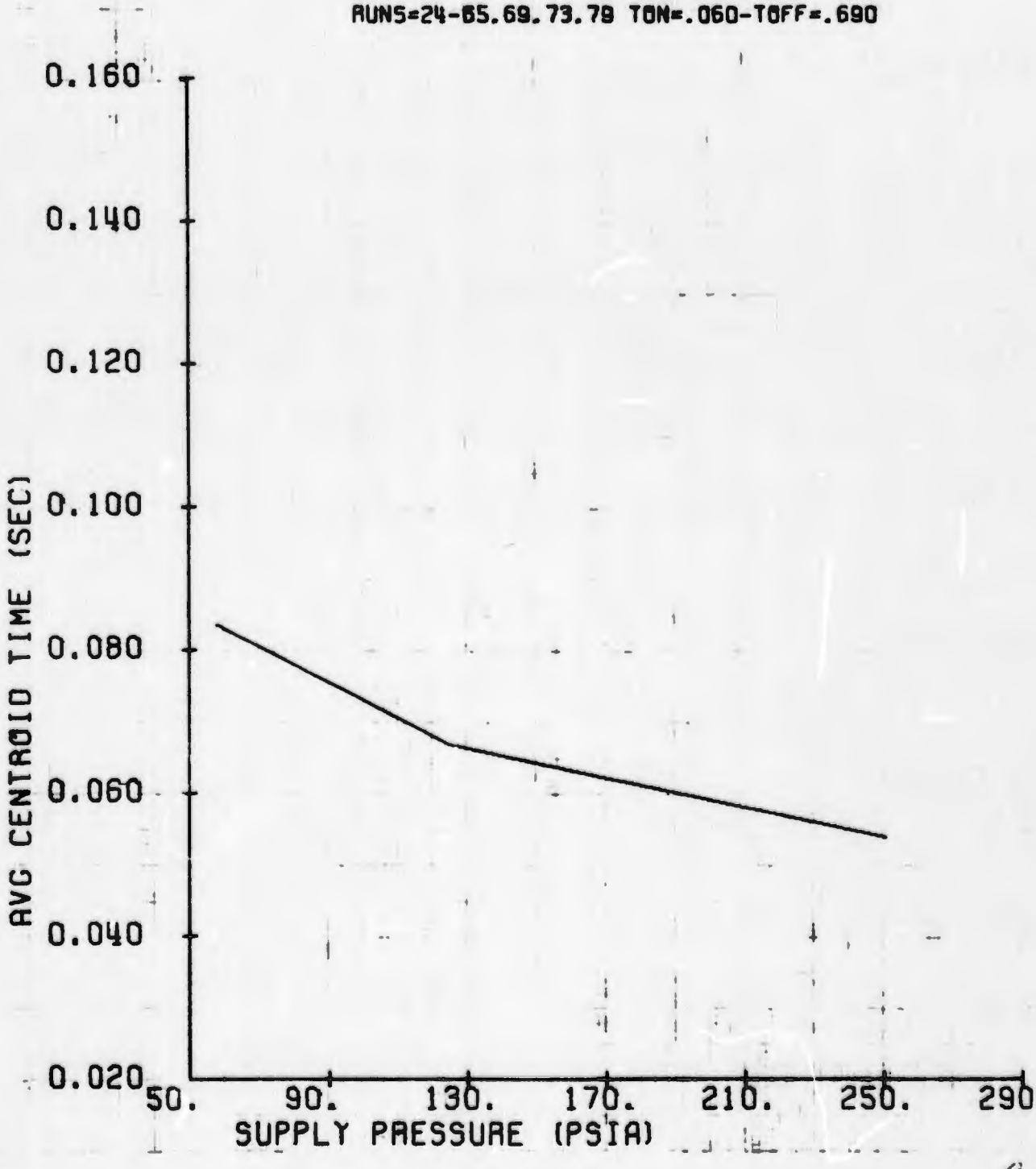

RUNS=24-65.69.73.78 TON=.060-TOFF=.690
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
AVG CENTROID TIME (SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 52C

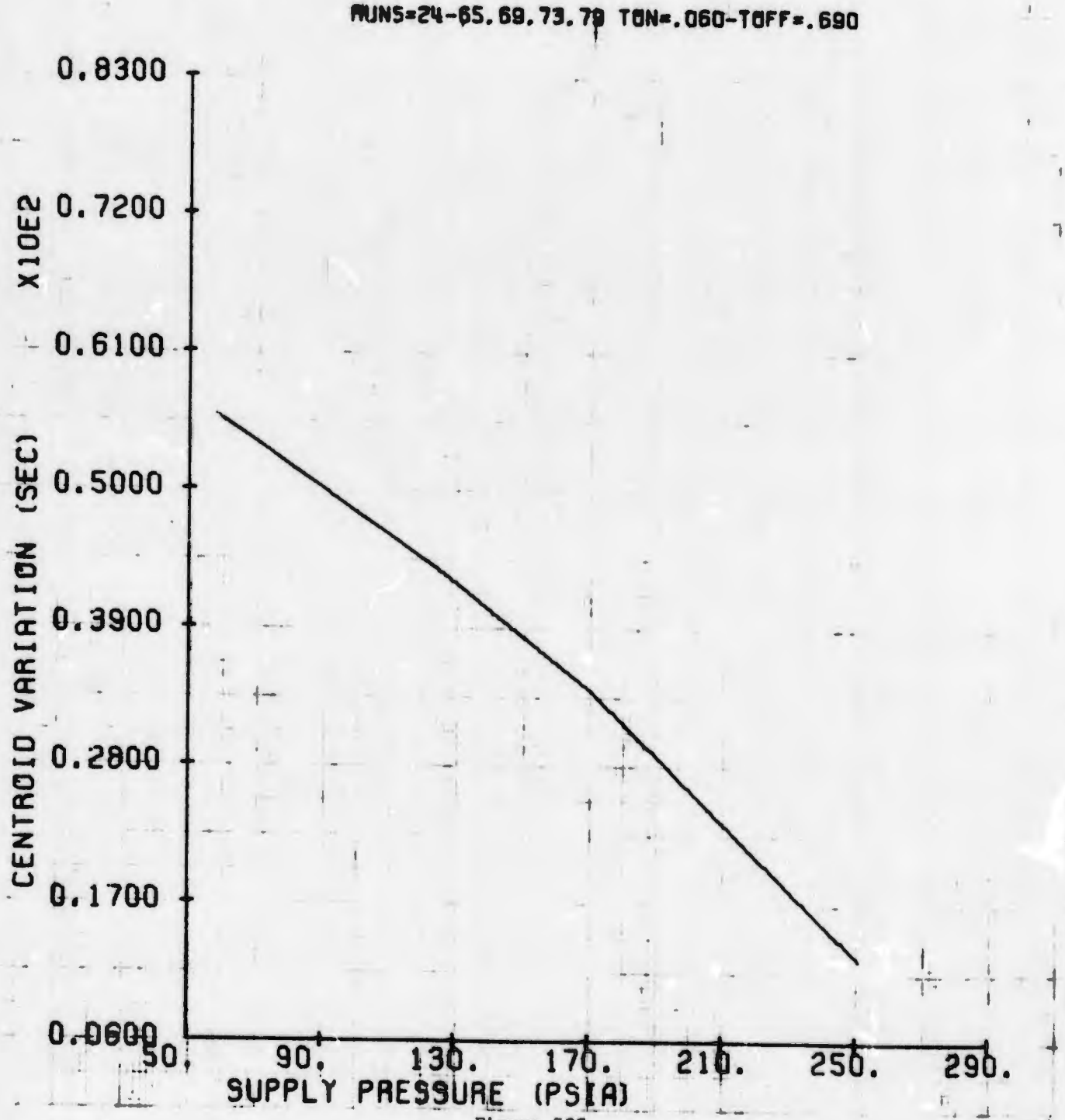

RUNS=24-65.69.73.78 TON=.060-TOFF=.690
0.8300
0.7200
0.6100
0.5000
0.3900
0.2800
0.1700
0.0600
X10E2
CENTROID VARIATION (SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 53C

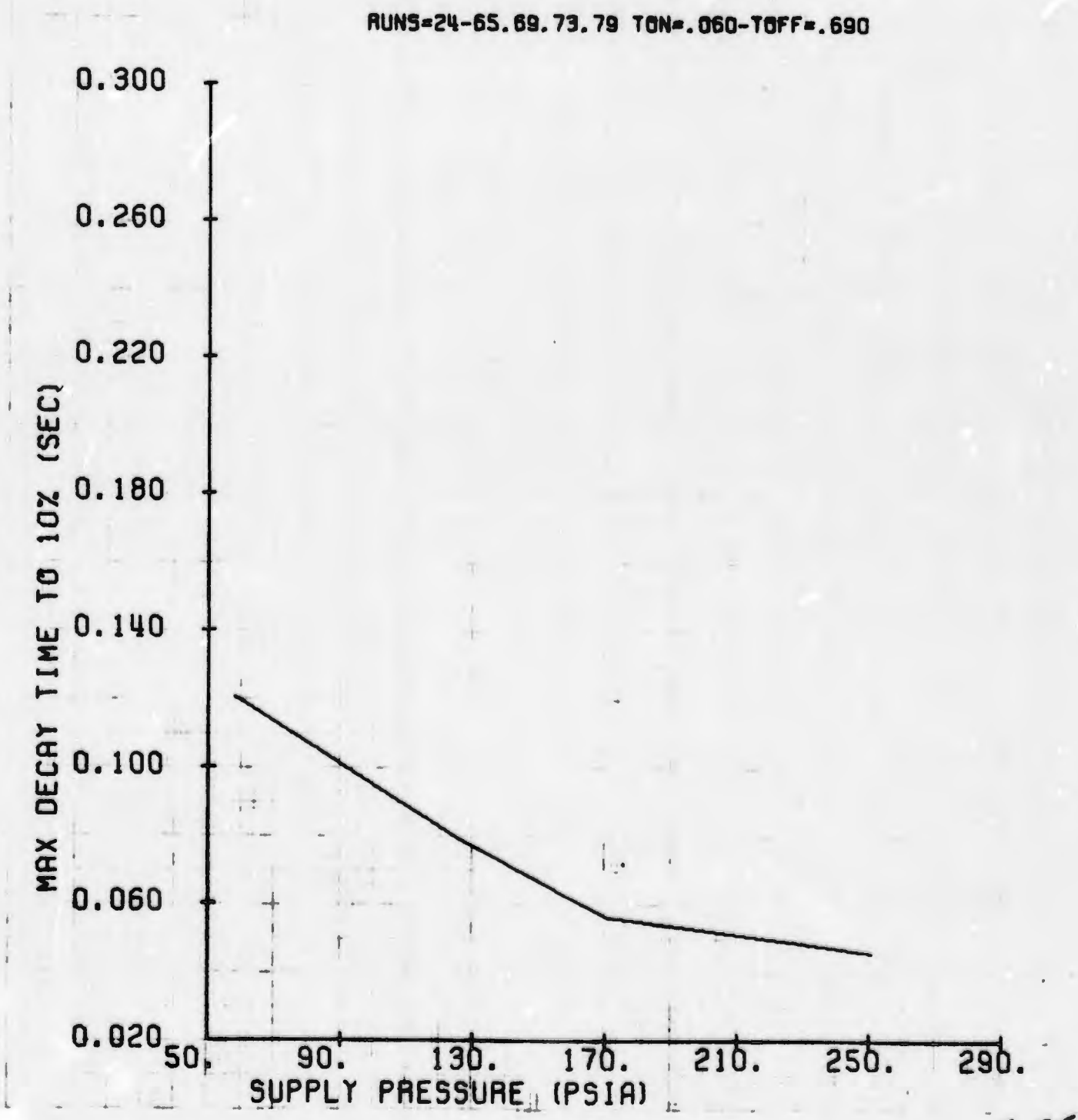

RUNS=24-65.69.73.79 TON=.060-TOFF=.690
0.300
0.260
0.220
0.180
0.140
0.100
0.060
0.020
MAX DECAY TIME TO 10% (SEC)
50.
90.
130.
170.
210.
250.
290.
SUPPLY PRESSURE (PSIA)

Figure 54C

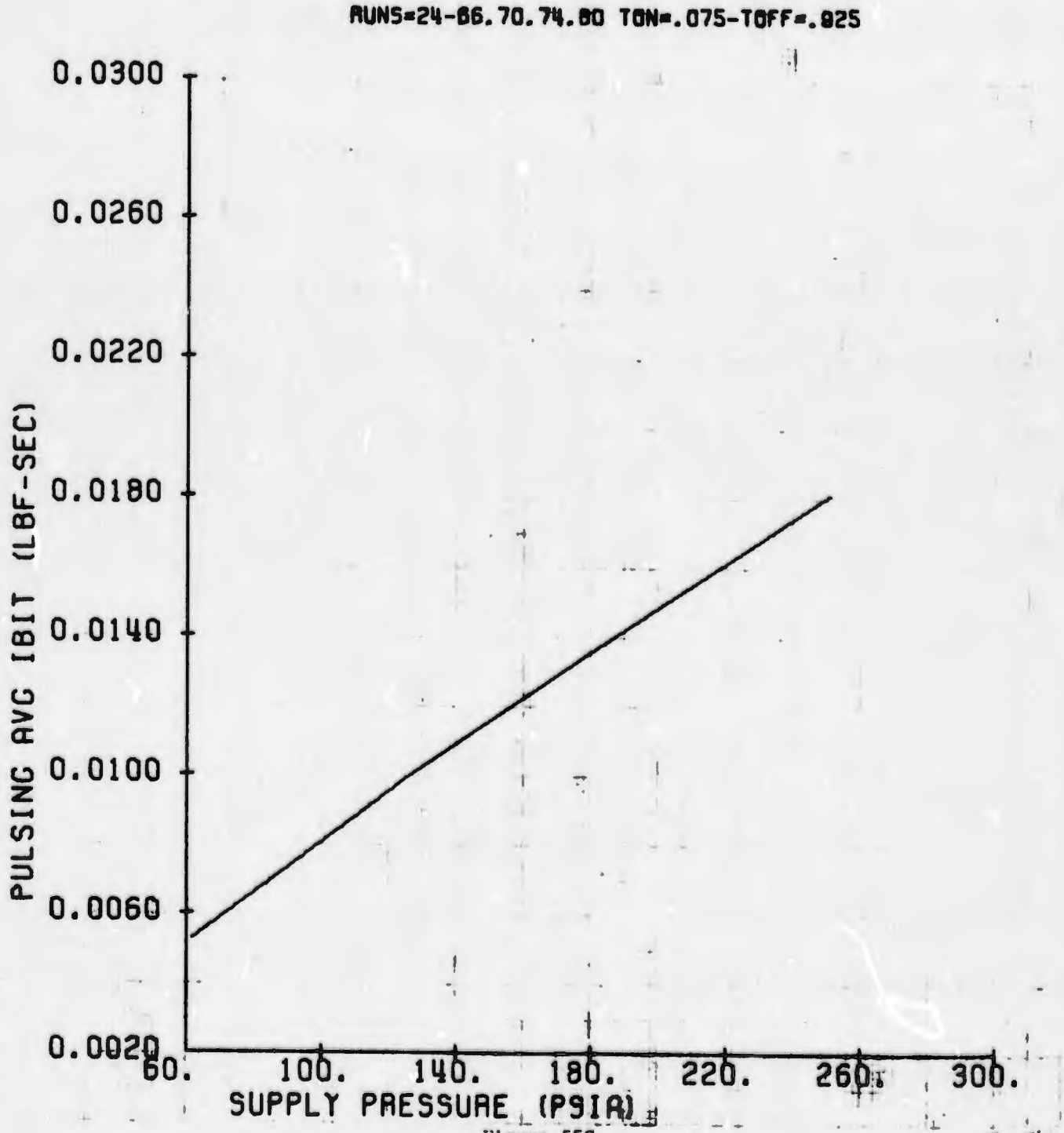

RUNS=24-66.70.74.80 TON=.075-TOFF=.925
0.0300
0.0260
0.0220
0.0180
0.0140
0.0100
0.0060
0.0020
PULSING AVG IBIT (LBF-SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 55C

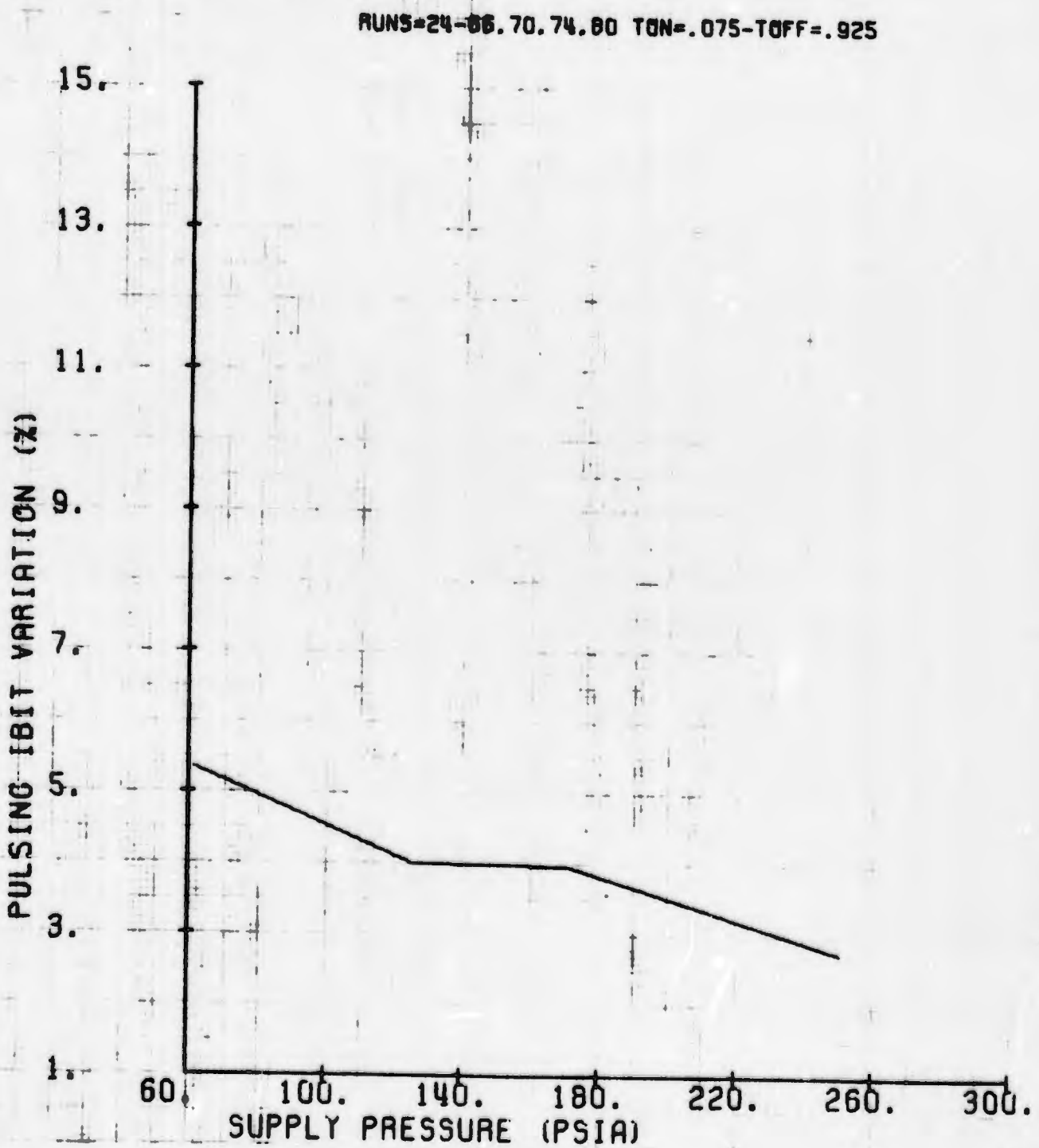

RUNS=24-66.70.74.80 TON=.075-TOFF=.925
15.
13.
11.
9.
7.
5.
3.
1.
PULSING IBIT VARIATION (%)
60
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 56C

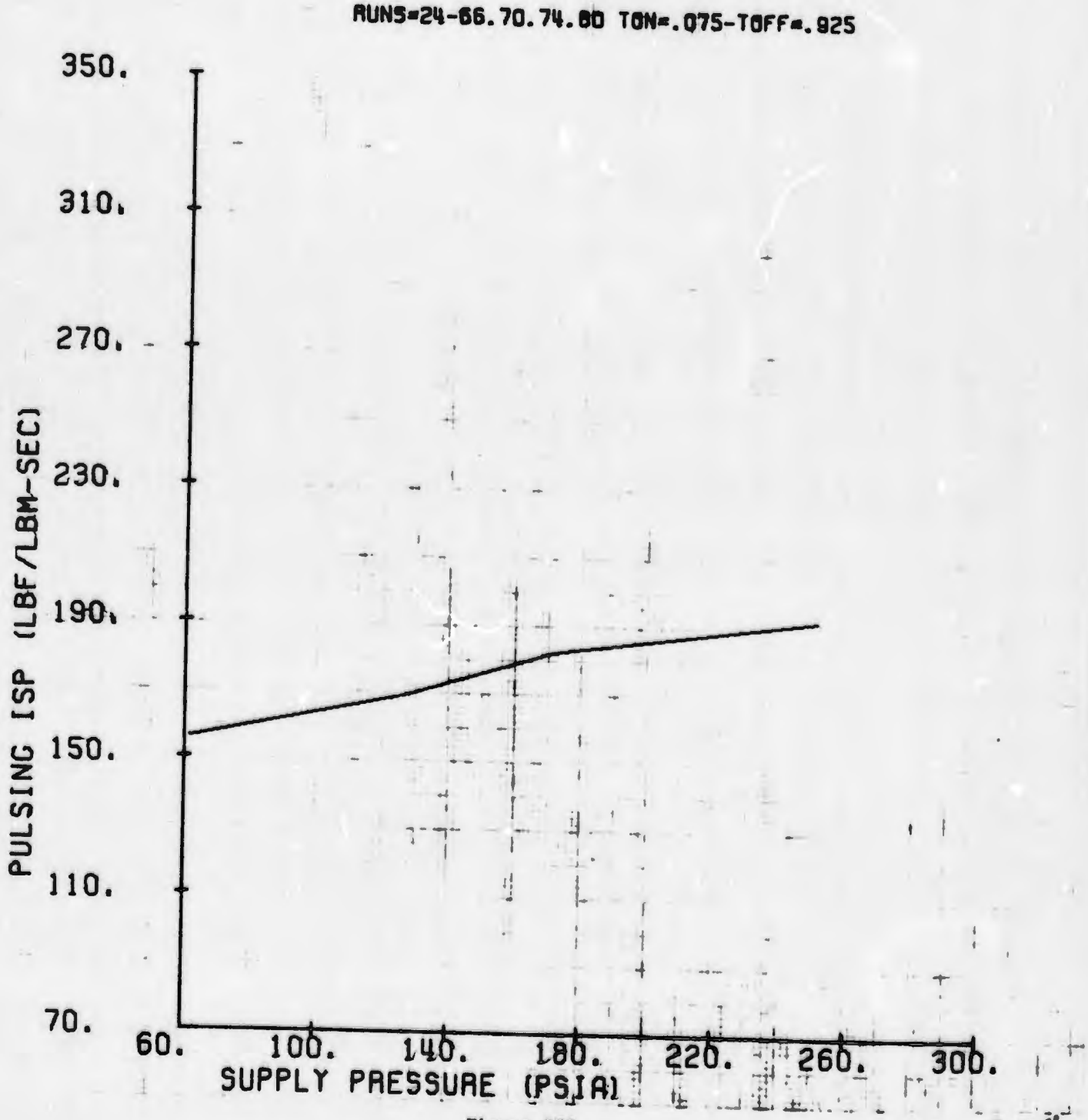

RUNS=24-66.70.74.80 TON=.075-TOFF=.925
350.
310.
270.
230.
190.
150.
110.
70.
PULSING ISP (LBF/LBM-SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 57C

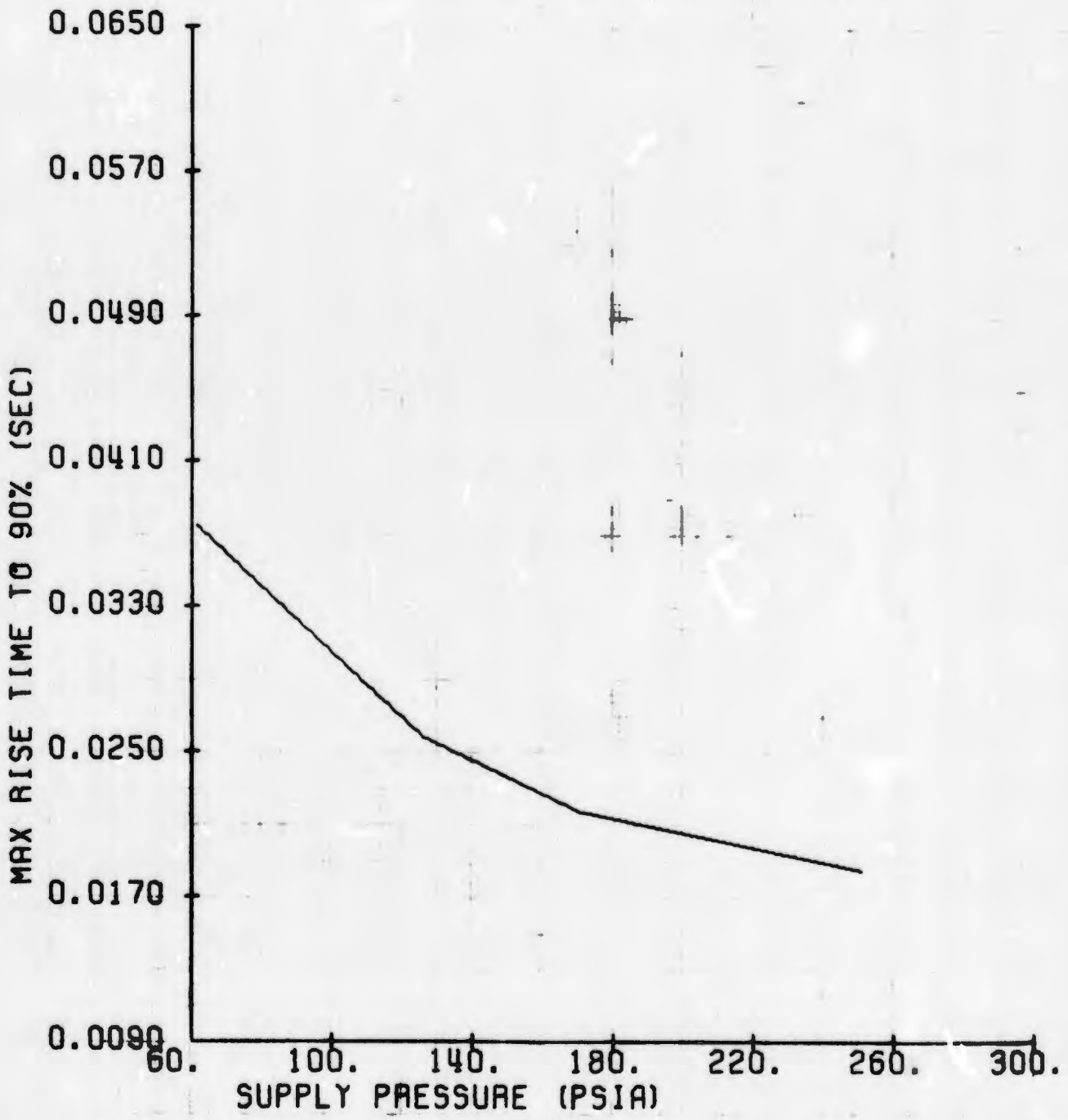

RUNS=24-66.70.74.80 TON=.075-TOFF=.925
0.0650
0.0570
0.0490
0.0410
0.0330
0.0250
0.0170
0.0090
MAX RISE TIME TO 90% (SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 58C

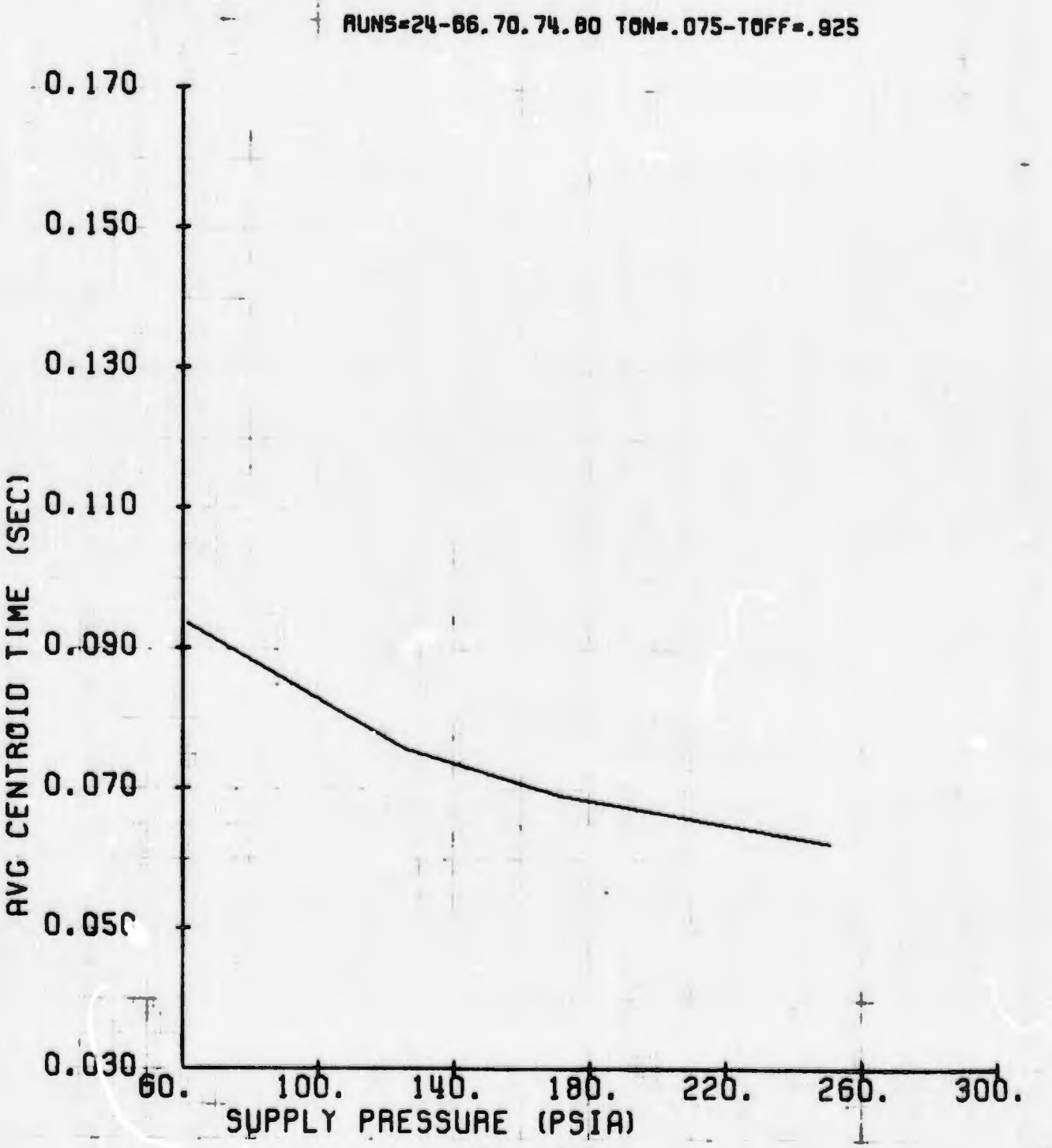

RUNS=24-66.70.74.80 TON=.075-TOFF=.925
0.170
0.150
0.130
0.110
0.090
0.070
0.050
0.030
AVG CENTROID TIME (SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 59C

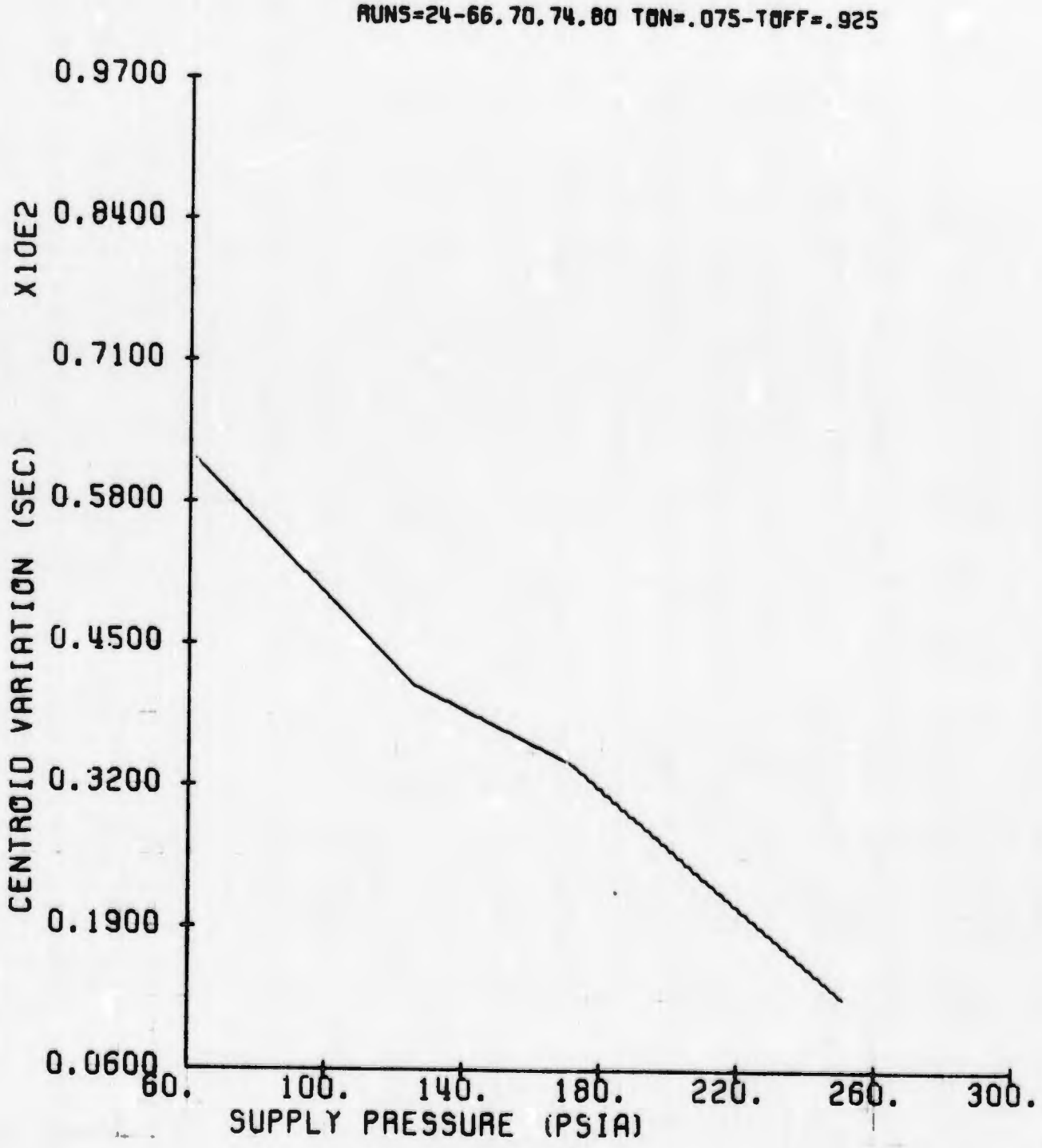

RUNS=24-66.70.74.80 TON=.075-TOFF=.925
0.9700
0.8400
0.7100
0.5800
0.4500
0.3200
0.1900
0.0600
X10E2
CENTROID VARIATION (SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 60C

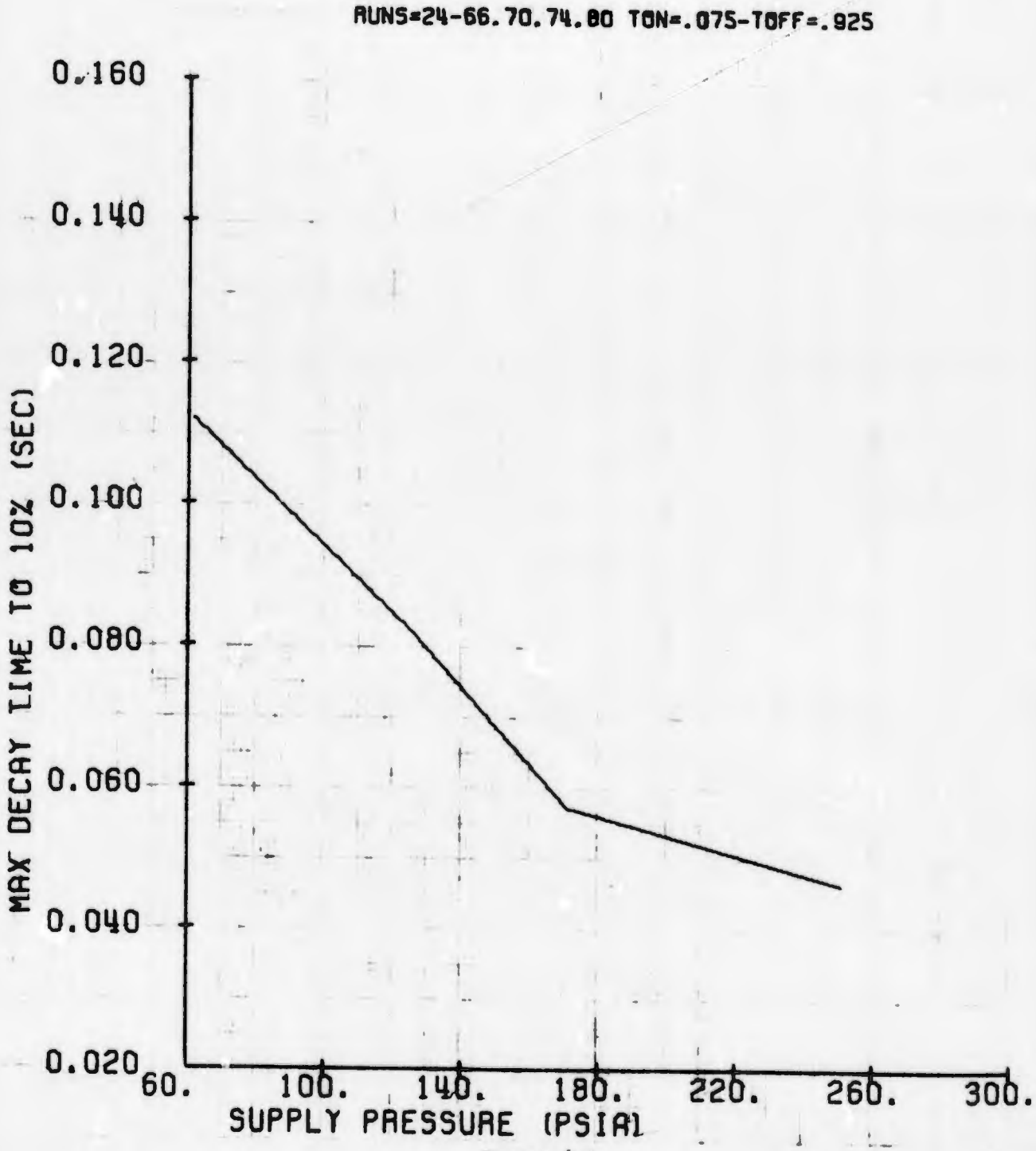

RUNS=24-66.70.74.80 TON=.075-TOFF=.925
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
MAX DECAY TIME TO 10% (SEC)
60.
100.
140.
180.
220.
260.
300.
SUPPLY PRESSURE (PSIA)

Figure 61C

APPENDIX D

VIBRATION TEST REPORTS

SSD Vib. 18

APPEN D

Memo No. NRL-2LB-1244

Page No. 3 of 3

Memorandum to: Structures Group

Date of Test: 7-19-73

Date of Memo: 11-12-73

Program: NRL

Type of Test: QUAL - OST

Test Item(s): .2LB REA

S/N: 00003

Remarks:

Short Form No Data in ... 11/12/73

Operational Test Engineer

Date

Received - Date

TER No.

Returned to S. Mehmed Jr.

Action Taken - Date

PROGRAM	N.R.L
TEST	QUAL
UNIT	.2LB REA
S/N	00003
DATE	11-12-73

D-1-b

SSD Vib. 17

Memo File Code NRL-2LB-1294

Memorandum to: EARL K. MOORE

Page 1 of 3

Program N.R.L

Test Item(s) .2LB REA

Date of Test 7-19-73

Serial No.(s) 00003

Name of Test QUAL-OST

Specification QT 6017

Subject:

THE TEST UNIT WAS MOUNTED TO VIBRATION FIXTURE SVSK 77886 WHICH IN TURN WAS SECURED TO THE VIBRATION GENERATOR.

SINUSOIDAL AND RANDOM TESTING WAS PERFORMED PER THE ABOVE SPECIFIED SPECIFICATION.

TEST DEVIATIONS

1) CONDITION — UNDER TEST FROM 1800 - 2000HZ DURING SINUSOIDAL RUN 7 IN THE Z AXIS

REASON — LACK OF CONTROL

CAUSE — COMPRESSOR SETTING ON SERVO CONTROL UNIT WAS NOT PROPERLY ADJUSTED.

CON'T

Test Engineer S. MEHMED JR

Signature Sami Mehmed Jr

Date of Report 11-12-73

Approved Sam J. Mehmed Date 11/13/73

D.21

RESULTS

THE TEST UNIT CAN WITHSTAND THE EXPECTED VIBRATIONAL STRESS LEVELS WITHOUT EXPERIENCING ANY STRUCTURAL DAMAGE.

Table of Contents

Section I

Test Background

A) Instrumentation and Calibration List

B) Block Diagram of Test System

C) Illustration of Item 2 Transducer Location

D) Random Analysis Outline

Hamilton Standard — DIVISION OF UNITED AIRCRAFT CORP

Laboratory Operations Engineering

TEST EQUIPMENT

Item	Manufacturer	Accuracy	Model	S/N	Calibrated	
Accelerometer	Endevco	±2%	2222	AC13	5-28-73	A
Accelerometer	Endevco	±2%	2222	AC26	5-28-73	A
Accelerometer	Endevco	±2%	2222	BJ30	5-28-73	
Accelerometer	Endevco	±2%	2222	BJ66	5-28-73	A
Accelerometer	Endevco	±2%	2222	BJ69	5-28-73	A
Accelerometer	Endevco	±2%	2222	BJ70	5-28-73	A
Accelerometer	Endevco	±2%	2222	BJ72	5-28-73	A
Accelerometer	Endevco	±2%	2226	PC37	5-28-73	A
Accelerometer	Endevco	±2%	2226	TD35	5-28-73	A
Accelerometer	Endevco	±2%	2226	TD36	5-28-73	A

Standard calibration period is 2 months.

A = Used for this test.

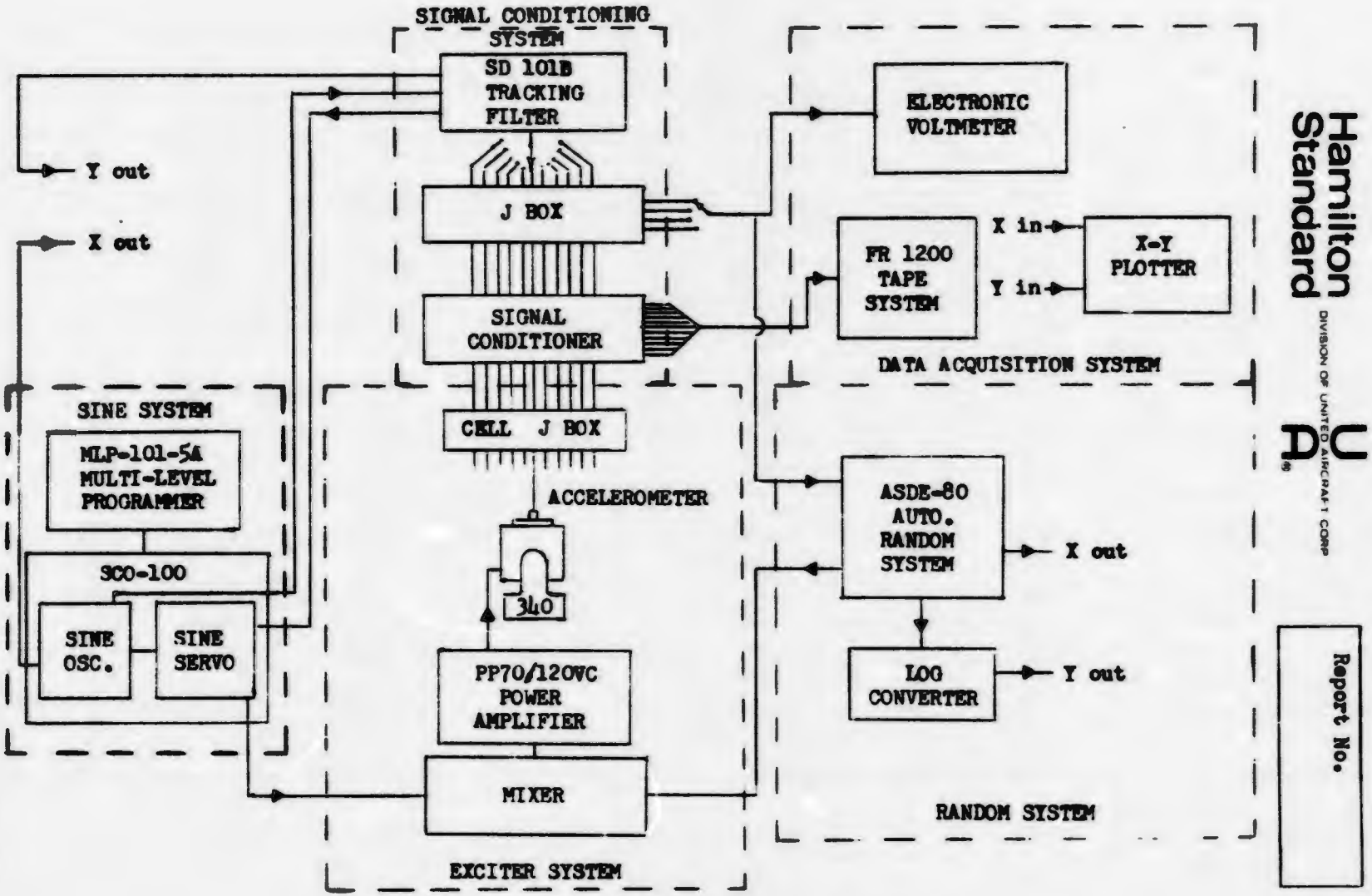
TEST EQUIPMENT
RIG 91 LING 340 (continued)

ITEM	MANUFACTURER	MODEL	S/N
Multi-Level Programmer	Ling Electronics	MLP-101-5A	164
Manual Selector Switch	Ling Electronics	SSM-100A	113
Low Frequency Equalizer	Ling Electronics	5LF-80A	175
Control Panel	Ling Electronics	CP-10B	175
Channel Mode Selector	Ling Electronics	CM-40B	276
Channel Mode Selector	Ling Electronics	CM-40B	281
Spectrum Equalizer	Ling Electronics	SE-80C	116
Spectrum Equalizer	Ling Electronics	SE-80D	116
Meter Range Selector	Ling Electronics	MR-40B	254
Meter Range Selector	Ling Electronics	MR-40B	290
Power Distribution	Ling Electronics	PB10	176
Shaker	Ling Electronics	340	12
Heat Exchanger	Ling Electronics	279	13
Power Amplifier	Ling Electronics	PP70/120VC	12
Console	Ling Electronics	RC-120	80
Auto Tape Degausser	Hewlett-Packard	3603A	644-00193
Remote Control	Ling Electronics	RCP-100	
Random Console	Ling Electronics	ASDE-80	164
Slip Table	Ling Electronics	4348-DS-8	34

LABORATORY OPERATIONS ENGINEERING
TEST EQUIPMENT
RIG 91 LING 340

ITEM	MANUFACTURER	ACCURACY	MODEL	S/N
Driver Amplifier	Ling Electronics		A-10	172
Dual Noise Generator	Ling Electronics		GRN200B	164
Spectrum Analyzer	Ling Electronics		SA100	A-295-66
Spectrum Analyzer	Ling Electronics		SA100	A-324-66
Power Supply	Ling Electronics		APS102	37
Power Supply	Ling Electronics		APS10A	175
Power Supply	Ling Electronics		APS1130	114
Power Supply	Ling Electronics		APS103	29
Sine Wave Center	Ling Electronics		SCO-100	27
Tape Recorder	Ampex		FR1200	185
Line Amplifier	Ling Electronics		LA-102	18
X-Y Recorder	Hewlett-Packard	±5%	7030A	823-D1267
Log Converter	Hewlett-Packard	±5%	7561A	825-00940
Log Converter	Hewlett-Packard	±5%	7561A	825-00944
Tracking Filter	Spectral Dynamics		SD101-B-1	19
Tracking Filter	Spectral Dynamics		SD101-B-1	242
*Voltmeter	B&K	±1% F.S.	VTVM-Z	186525
Charge Amplifier	Unholtz-Dickie		8PMCUA	405
Oscilloscope	Hewlett-Packard	±5%	122AR	141-04179
*Counter	Anadex	±1 count	CF600R	30952

Standard calibration period - Entire system 2 months and also item * are 4 months.



SSD VIBRATION GENERATING SYSTEM RIG 91 / LING 340

RANDOM VIBRATION ANALYSIS

METHOD A

The power spectrum density analyzer consists of one, eighty-five (85) channel filter system - Ling Electronics Model ASDE-80.

1. FILTER BANDWIDTHS

Frequency Range	Bandwidth
10-20 cps	10 cps
20-31	11
31-43	12
43-56	13
56-70	14
70-84	14
84-99	15
99-115	16
115-132	17
132-150	18
150-175	25
175-2025	25 cps each

2. DETECTOR TIME CONSTANT

RC = 5 seconds (average of combined operating modes)

3. SWEEP RATES

The sweep rate is variable.

Minimum Sweep Time - 36 seconds
Maximum Sweep Time - Infinity

4. DEGREES OF FREEDOM

$N = 4 \times (BW) \times (RC)$

10 cps BW; N = 200 Minimum average
25 cps BW; N = 500 Maximum average

5. CONFIDENCE LEVEL

At 25 cps BW: Confidence level = 95%
Error = 20%

Section II

X - Axis

A) Sine Data

B) Random Data

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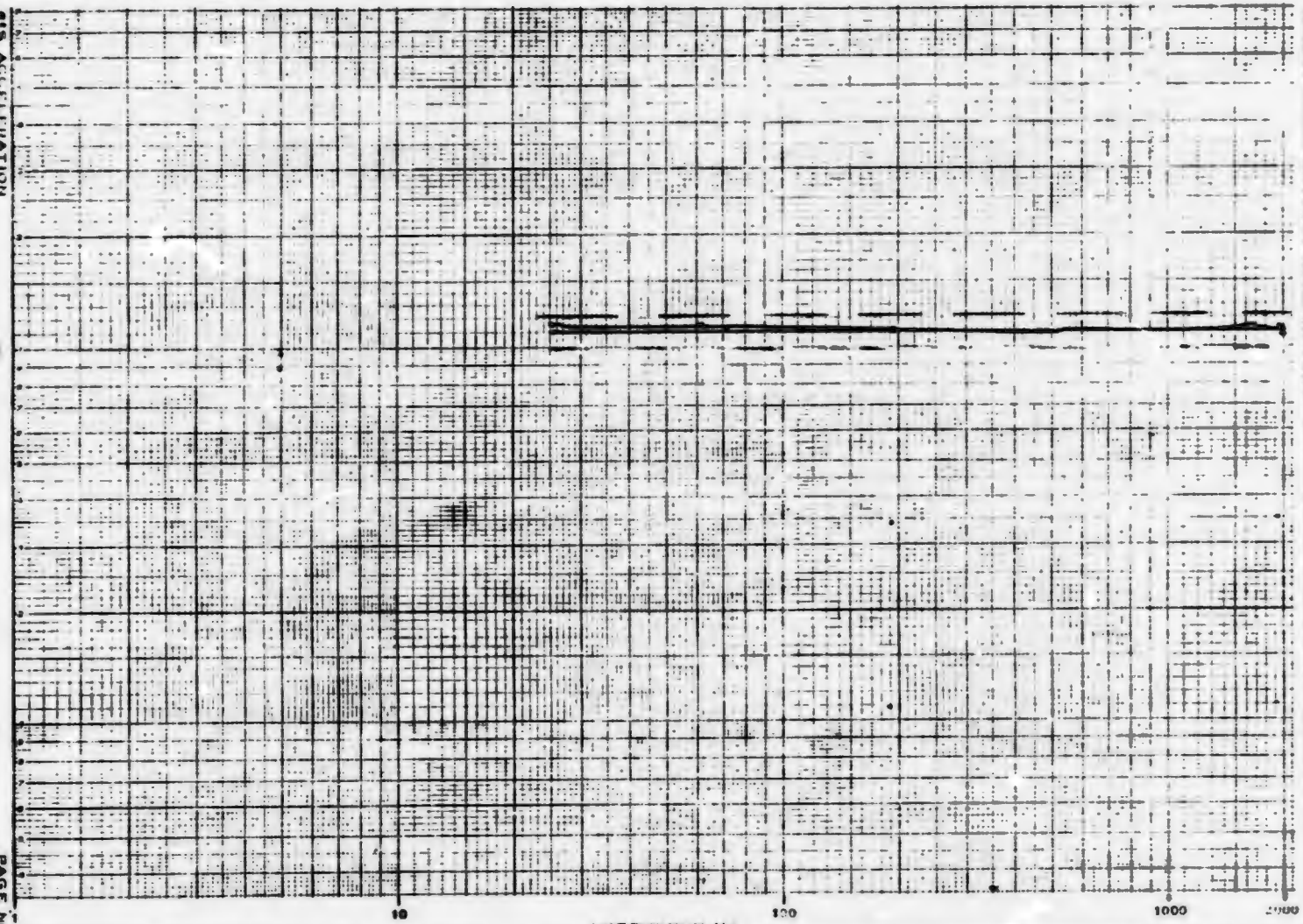
SINE VIBRATION TEST

RIG	OPERATOR	WITNESS	WITNESS	TEST NO.
91	R. MICKET		A. Gil 7-19-73	3
TEST ENGINEER	**CHECKED BY**	**PROJECT**	**DATE**	**TIME**
K. BRADFORD		NRL	7-19-73	1410



INPUT LEVEL: 11 g	EXCIT. AXIS: X
ACCEL S/N: TD35	SENSING AXIS: X
ACCEL SENSITIVITY: — MV RMS / GP; 2.655 COL / GP	
FILTER: 10-100-200 HZ B.W.	
FILTER CROSSOVER: 70-700 HZ	
SWEEP RATE: 1 OCT/MIN	
TAPE REEL NO.: 041447	[X] LIVE [ ] FROM TAPE
COMPR. SPEED: VAR DB/SEC.	
CHG. @ — HZ TO — DB/SEC.	
CHG. @ — HZ TO — DB/SEC.	
NON OPERATING TEMP. 75 °F	[X] CONTROL [ ] RESPONSE
LOCATION: AX	
SPECIAL CONDITIONS	REPORT NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	SPEC.	PARA.	ASSY NO.
25-2000 HZ	.2 LB REA	—	00003	QT-6017	4.2.3	—
ACTION SHEET NO.	**ATA NO.**	**TYPE OF TEST**		**NAME OF TEST**		
—	—	QUAL - OST		SINE		

PAGE NO. D-12

Hamilton Standard — DIVISION OF UNITED AIRCRAFT CORPORATION

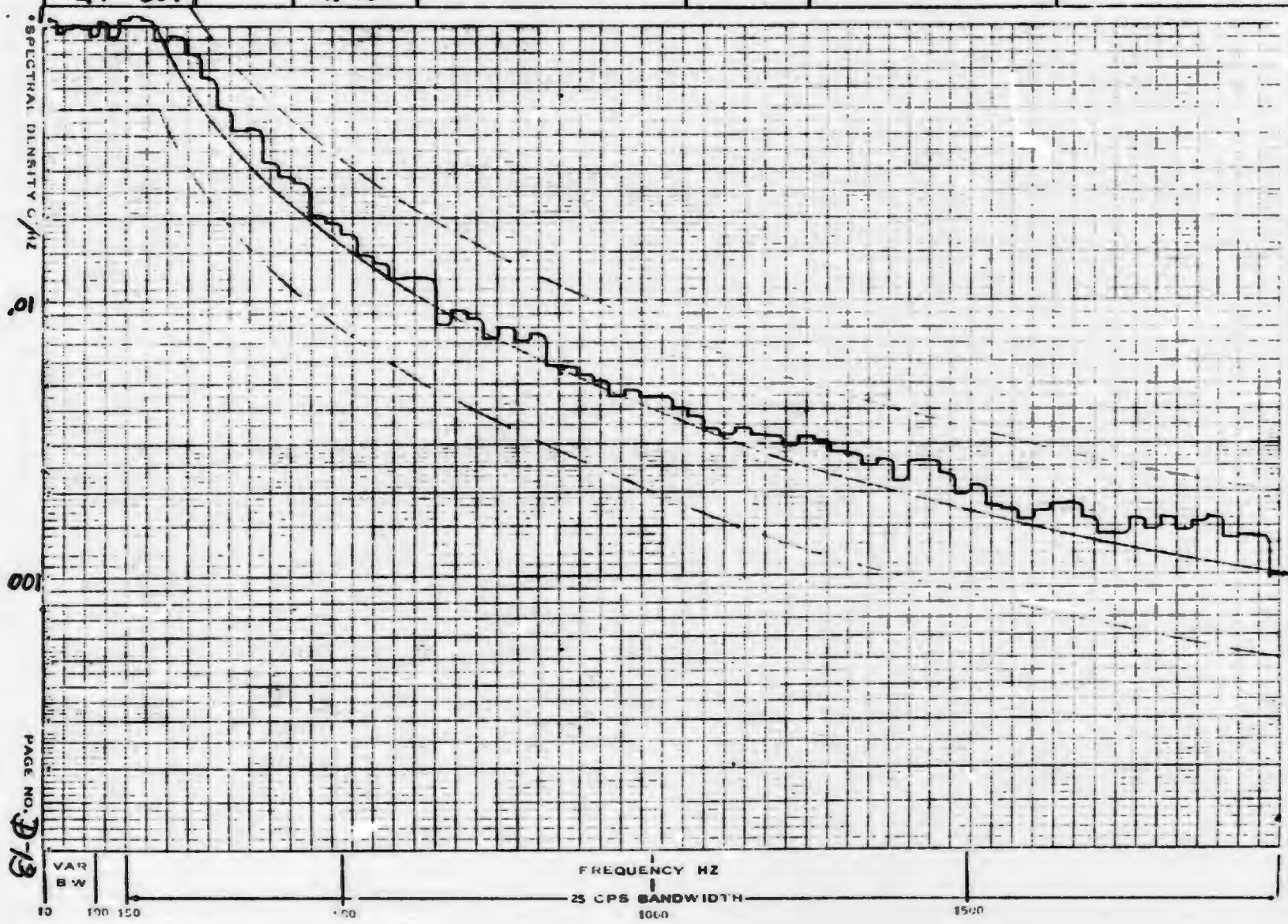
HSF-1634A

RANDOM VIBRATION TEST
ANALYSIS METHOD A

PLOTTED BY	CHECKED BY	TEST ENGINEER	RIG NO.	WITNESS	WITNESS
R. MICKET		K. BRADFORD	91		R. Heil 7-19-73

PROJECT	ITEM	CODE	SERIAL NO.	TYPE OF TEST
NRL	.2LB REA	—	00003	QUAL-OST

SPEC.	PARA.	PHASE	ATA NO.	ACTION SHEET NO.	DATE	TEST NO.
QT-6017	4.2.3	—	—	—	7-19-73	3



EXCITATION ALONG: X AXIS

G INPUT: 6.0

NON-OPERATING

TEMP.: 75 °F

PERIOD OF TEST: [X] START [ ] END

DURATION OF TEST: 2 MIN.

ACCEL. SERIAL NO.: TD35

ACCEL. SENSITIVITY: — MV RMS/GP; 2.655 COL/GP

ACCEL. SENSING: X AXIS

ACCEL. LOCATION: AX

SPECIAL CONDITIONS

REPORT NO.

PAGE NO. 3-13

Section III

Y - Axis

A) Sine Data

B) Random Data

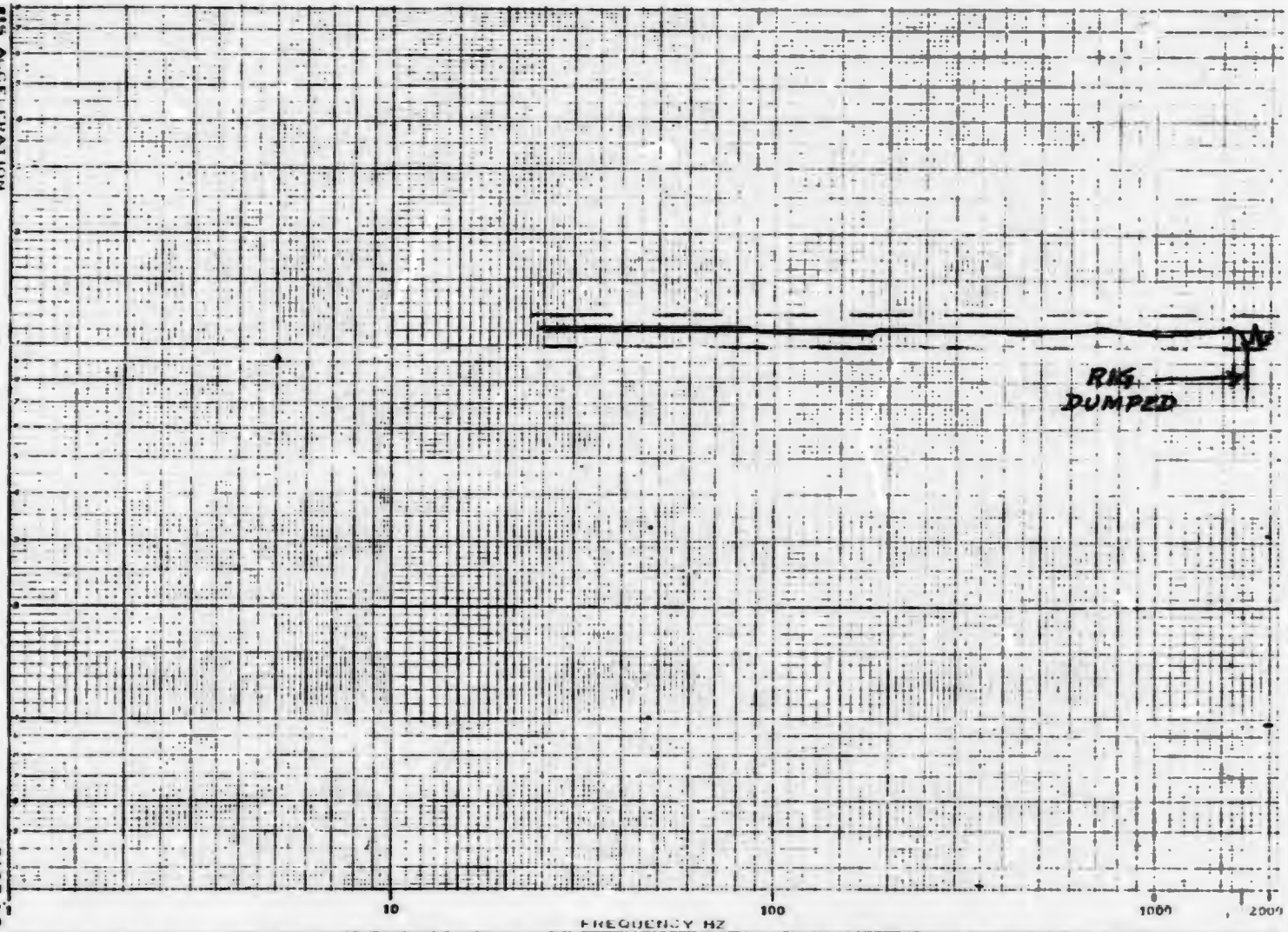
Hamilton Standard — Division of United Aircraft Corporation

HSF-1633.1 2/69

SINE VIBRATION TEST

RIG	OPERATOR	WITNESS	WITNESS	TEST NO.
91	R. MICKET		A. Gual 7-19-73	6

TEST ENGINEER	CHECKED BY	PROJECT	DATE	TIME
K. BRADFORD		NRL	7-19-73	1525



INPUT LEVEL	EXCIT. AXIS
11	Y

ACCEL S/N	SENSING AXIS
TD36	Y

ACCEL SENSITIVITY — MV RMS / GP — COL / GP: 2.785

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

FILTER CROSSOVER: 70-700 HZ

SWEEP RATE: 1 OCT/MIN

TAPE REEL NO. — [X] LIVE [ ] FROM TAPE

COMPR. SPEED: VAR DB/SEC.

ENG.① — HZ TO — DB/SEC.

ENG.② — HZ TO — DB/SEC.

NON OPERATING TEMP. 75 °F — [X] CONTROL [ ] RESPONSE

LOCATION: AY

SPECIAL CONDITIONS

RECUT NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	SPEC.	PARA.	AMEND.
25-2000 HZ	.2LB REA	—	00003	QT-6017	4.2.3	—

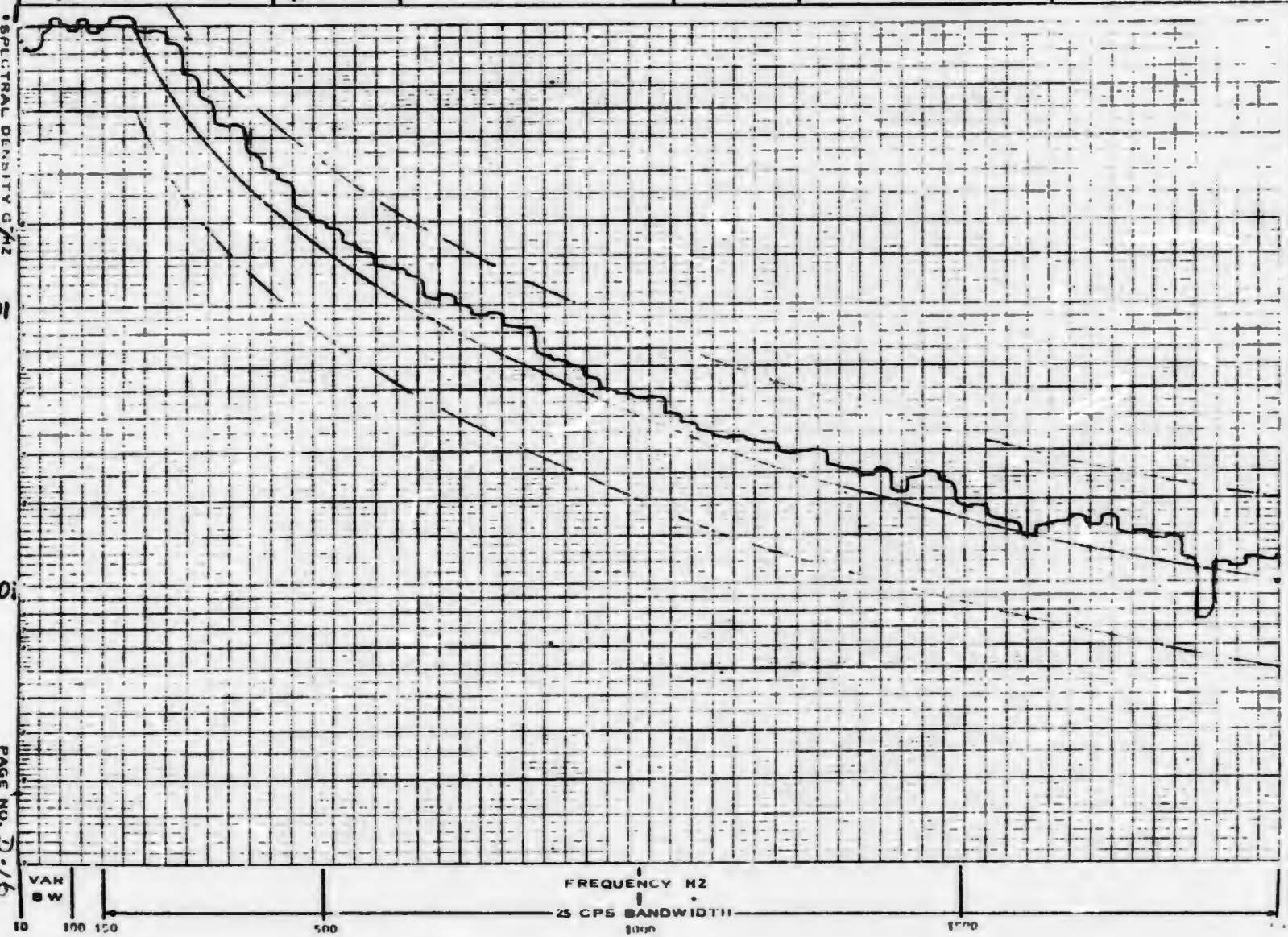
ACTION SHEET NO.	ATA NO.	TYPE OF TEST	NAME OF TEST
—	—	QUAL - OST	SINE

Hamilton Standard — Division of United Aircraft Corporation

HSF-1634A

RANDOM VIBRATION TEST
ANALYSIS METHOD A

PLOTTED BY: R. MICKET	CHECKED BY:	TEST ENGINEER: K. BRADFORD	RIG NO.: 91	WITNESS:	WITNESS: R. Gil 7-19-73
PROJECT: NRL	ITEM: .2LB REA	CODE: —	SERIAL NO.: 00003	TYPE OF TEST: QUAL - OST	
SPEC.: QT-6017	PARA.: 4.2.3	PHASE: —	ATA NO.: —	ACTION SHEET NO.: —	DATE: 7-19-73
					TEST NO.: 5



ROTATION ALONG	Y AXIS
GRMS INPUT	6.0
NON-OPERATING TEMP.	75 °F
PERIOD OF TEST	☒ START ☐ END
DURATION OF TEST	2 MIN.
ACCEL. SERIAL NO.	TD36
ACCEL. SENSITIVITY	— MV RMS / GP ; 2.785 COL / GP
ACCEL. SENSING	Y AXIS
ACCEL. LOCATION	AY
SPECIAL CONDITIONS	
REPORT NO.	

PAGE NO. D-16

Section IV

Z - Axis

A) Sine Data

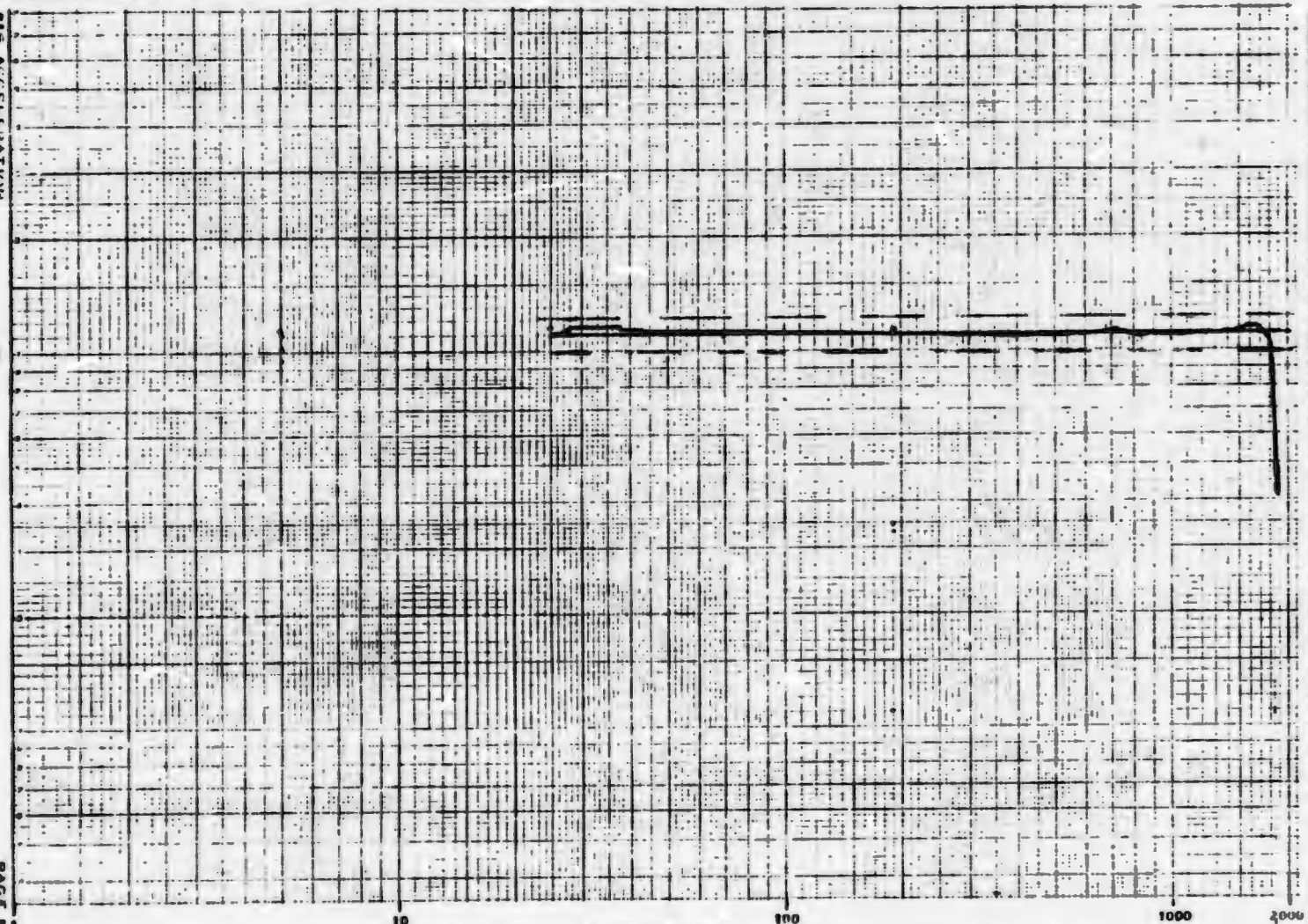
B) Random Data

Hamilton Standard — Division of United Aircraft Corporation

HSF-1633.1 2/69

SINE VIBRATION TEST

RIG	OPERATOR	WITNESS	WITNESS 7-19-73	TEST NO.
91	R. MICKET		A. Gil	7
TEST ENGINEER	**CHECKED BY**	**PROJECT**	**DATE**	**TIME**
K. BRADFORD		NRL	7-19-73	1545



INPUT LEVEL	EXCIT. AXIS
11 g	Z
ACCEL S/N	**SENSING AXIS**
PC37	Z

ACCEL SENSITIVITY — MV RMS / GP — 2.615 — COL / GP

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

FILTER CROSSOVER: 70-700 HZ

SWEEP RATE: 1 OCT/MIN

TAPE REEL NO.: 041447 — [X] LIVE [ ] FROM TAPE

COMPR. SPEED: VAR DB/SEC.

CHG.@ — HZ TO — DB/SEC.

CHG.@ — HZ TO — DB/SEC.

NON OPERATING — TEMP. 75 °F — [X] CONTROL [ ] RESPONSE

LOCATION: AZ

SPECIAL CONDITIONS

RECORD NO.

FREQ. RANGE & DIRECTION	ITEM	CODE	SERIAL NO.	SPEC.	PARA.	AMEND.
25-2000 HZ	.2LB REA	—	00003	QT-6017	4.2.3	—
ACTION SHEET NO.	**ATA NO.**	**TYPE OF TEST**		**NAME OF TEST**		
—	—	QUAL - OST		SINE		

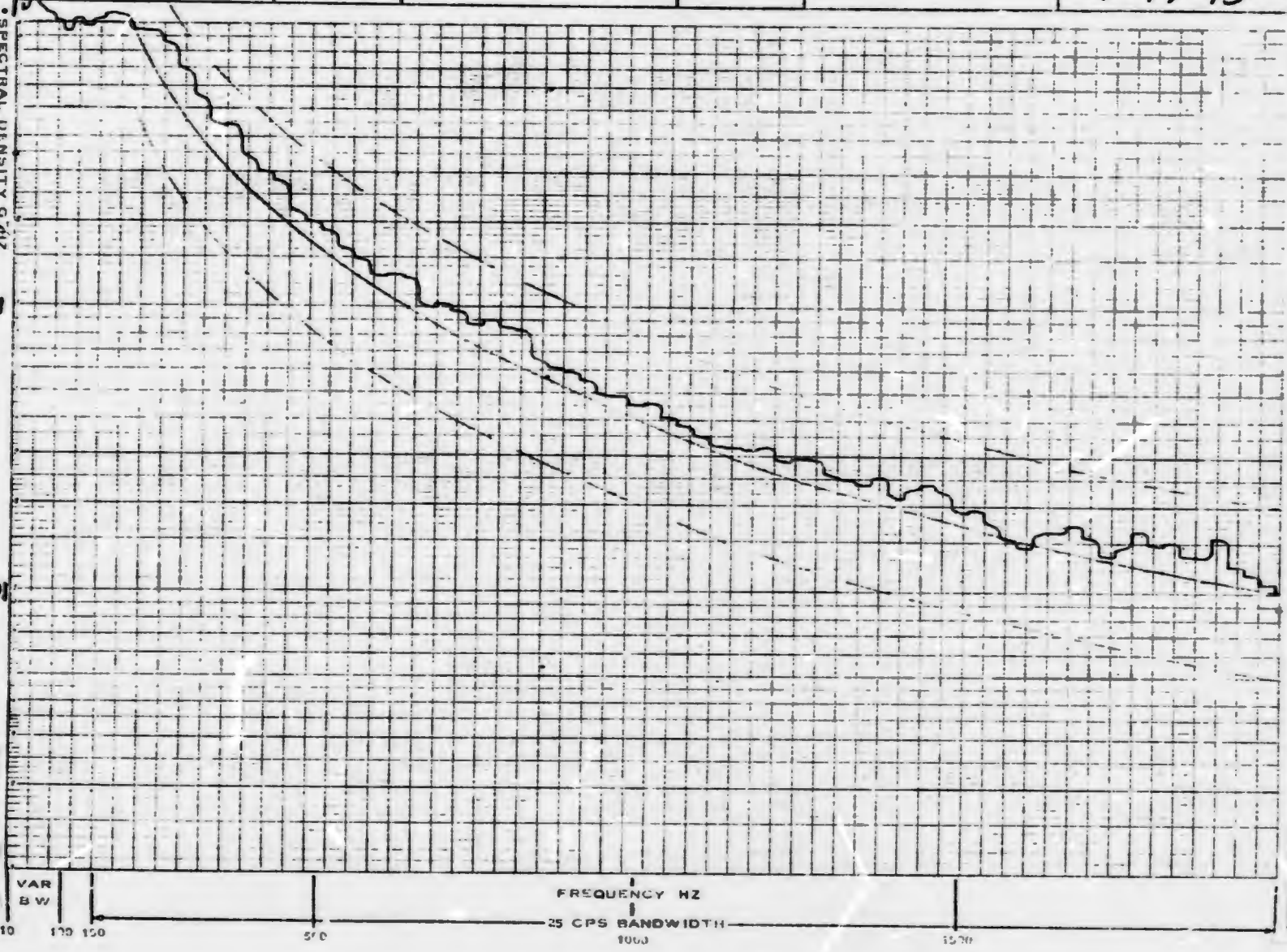
Hamilton Standard — DIVISION OF UNITED AIRCRAFT CORPORATION — U A

HSF-1034A

RANDOM VIBRATION TEST
ANALYSIS METHOD A

PLOTTED BY: R. MICKET	CHECKED BY:	TEST ENGINEER: K. BRADFORD	RIG NO.: 91	WITNESS:	WITNESS: 7-19-73
PROJECT: NRL	ITEM: .2LB REA	CODE:	SERIAL NO.: 00003	TYPE OF TEST: QUAL-OST	
SPEC.: QT-OST	PARA.: 4.2.3	PHASE:	ATA NO.:	ACTION SHEET NO.:	DATE: 7-19-73

TEST NO.: 8



EXCITATION ALONG: Z AXIS

GRMS INPUT: 6.6

SCANNING RATING:

TEMP.: 75 °F

PERIOD OF TEST: ☒ START ☐ END

DURATION OF TEST: 2 MIN.

ACCEL. SERIAL NO.: PC37

ACCEL. SENSITIVITY: — MV RMS/GP ; 2.615 COL/GP

ACCEL. SENSING: Z AXIS

ACCEL. LOCATION: AZ

SPECIAL CONDITIONS

REPORT NO.

PAGE NO. D-19

Section V

Logs

A) Operator Log

B) Instrumentation Master & Running Log

C) Data Reduction Log

CONTROL DATA CORPORATION, HARTFORD, CONN.

HSP-175.1A 1/68

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

UA

SPACE & LIFE SYSTEMS LABORATORY

LOG OF TEST

TYPE OF TEST: QUAL-OST
TEST ENGINEER: K. BRADFORD
NAME OF RIG: 91
PROJECT & ENG. ORDER NO.: NRL A69-100-300A

SHEET 1 OF DATE 7-19-73
TEST PLAN NO. QT6017
MODEL NO. .2LB REA
PART NO. SV755437-6
SERIAL NO. 00003
OPERATORS R. MICKET

RUN	TIME	AXIS	MODE	G PK	OCT/MIN	G RMS	MINS	EVIDENCE OF DAMAGE
2	1400	X	SINE	1	3	-	-	NONE
3	1410	X	SINE	11	1	-	-	NONE
4	1440	X	RAND	--	-	6	2	NONE
5	1520	Y	RAND	-	-	6	2	NONE
6	1525	Y	Sine	11	1	-	-	NONE
7	1545	Z	SINE	11	1	-	-	NONE
8	1555	Z	RAND	-	-	6	2	NONE

Witnessed C. Kiel
7-19-73

REMARKS:

D-21

10626

MASTER VIBRATION LOG

DATE 7-19-73
PROJECT NRL — ITEM 0.2 LB REA S/N 0003 — CODE —— — WPIA 69-100-300A RIG 91 — MASTER PAGE NO 1910 — LOG PAGE NO 21/25
TEST TITLE QUAL - OST — ENGINEER MR. K BRADFord — OPERATOR R MICKET

ID NO	Measurement: Variable	Unit	Loc	Transducer: Type	S/N	Cont Volts	Sens	Full Scale Equivalent	Vibcorder: Scale	Length	Junction Unit: Signal Conditioning	S/N	Record Amp: Type	S/N	Preamp: Type	S/N	LP Filter	Remarks
1																		
2	Accel	Cal	AX	2226	TO35	—	.655 2.[illegible]											
3	"	Cal	AY	2226	TO36		2.785											
4	"	Cal	AZ	2226	AC37		2.615											
5																		
6	Accel	Cal	BX	2222	BJ[illegible]		1.190	2.380										
7	— AC COLA —																	
8																		
9	Accel	Cal	BY	2222	BJ69		1.096	2.192										
10	Accel	Cal	BZ	2222	BJ70		1.199	2.398										} Dialed In
11	"	"	CX	2222	AC13		1.218	2.436										
12	"	"	CY	2222	AC26		1.427	2.854										
13	"	"	CZ	2222	BJ44		1.288	2.576										
2																		
3																		
4																		
5																		
6																		
7																		
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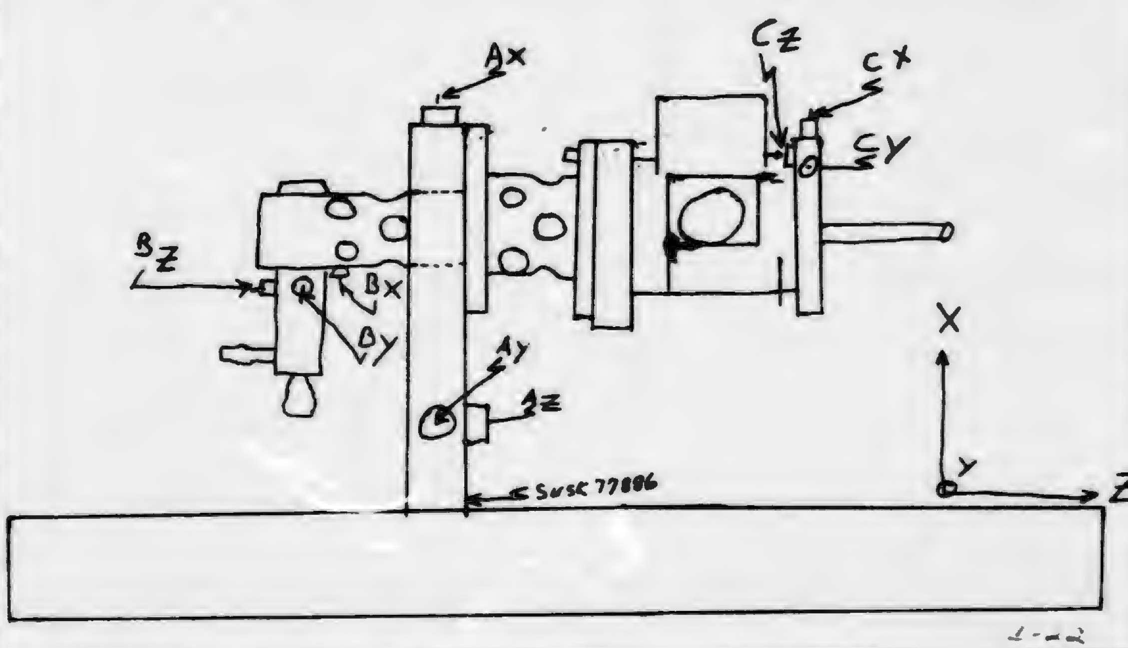
10																		
11																		
12																		

SKETCH TEST SETUP



VIBRATION TEST LOG

MASTER PAGE NO 1910

PROJECT NRL ITEM 0.2 LB REA S/N 00003 CODE ____ DATE 7-19-73 LOG PAGE NO 2425

TEST TITLE Qual - OST ENGINEER R K Bradford OPERATOR R Mickat

RUN NO	TIME	TEST CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	INPUT LEVEL	OCT/MIN	COMP SPEED	CONTROL PILOTED	TAPE SPEED	TAPE TIME	VIB CONTROL SPEED	RUN	REMARKS
1		CAL		1000	1000	1000		1000	A		1000	1000	1000	1000	1000					15			91	.707 VRMS @ 200 HZ
2	1400	RUN		3 ~~30~~	10 ~~20~~	10 ~~30~~		10 ~~100~~	C		10	10	10	10	10	X 1G PK	3	VAR	10/100/200	IPS	2.8	-		5-2000 HZ SINE SCAN
3	1410	RUN		30	30	30		100	C Q L		100	100	100	100	100	X 11G PK	1	VAR	10/100/200	INTER	6.2			25-2000 HZ SINE
4	1440	RUN	-	30	10	10	-	30	A	-	30	30	30	30	30	X 6G RMS	-	-	-	BA	2.0			20-2000 HZ RANDOM
5	1520	RUN	-	10	30	10	-	30		-	30	30	30	30		Y 6G RMS	-	-	-	ND	2.0			20-2000 HZ RANDOM
6	1525	RUN	-	30	30	30	-	100		-	100	100	100	100	100	Y 11G PK	1	VAR	10/100/200		6.2			25-2000 HZ SINE
7	1545	RUN	-	10	10	30	-	100		-	100	100	100	100	100	Z 11G PK	1	VAR	10/100/200		6.2			25-2000 HZ SINE
8	1555	RUN	-	10	10	30	-	30		-	10	30	~~30~~ 10 1 MIN	~~30~~ 10	30	Z 6G RMS	-	-	-		2.0			20-2000 HZ RANDOM
9		CAL		100	1000	1000		1000			1000	1000	1000	1000	1000									.707 VRMS @ 200 HZ

0414 43

D-23

D-...2