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OUTER PLANET PROBE ENGINEERING MODEL STRUCTURAL TESTS

By J. A. Smittkamp, W. H. Gustin, and M. W. Griffin

Prepared by

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY-EAST

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for Ames Research Center
Moffett Field, California 94035

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Outer Planet Atmospheric Entry Probe

By

J. A. Smittkamp, W. H. Gustin, and M. W. Griffin

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ABSTRACT

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16. Abstract

A series of proof-of-concept structural tests was performed on an engineering model of the Outer Planets Atmospheric Entry Probe. The tests consisted of pyrotechnic shock, dynamic and static loadings. The tests have partially verified the structural concept.

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OUTER PLANET PROBE ENGINEERING MODEL STRUCTURAL TESTS

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SUMMARY

A series of proof-of-concept tests have partially verified the structural and thermal design concepts of the Outer Planets Probe. The tests were performed at NASA Ames Research Center (ARC) and engineering support was provided by MDAC-EAST under NASA contract NAS2-9027.

Tests simulated shock loads resulting from booster separation, launch dynamic environment, and 800 g_e's deceleration loads resulting from planetary atmospheric entry. Prior to testing, spin balance and weight measurements were made on the full scale engineering Model test article. Preliminary analytical prediction of structure response to the 800 g_e's deceleration loads is compared to test data.

INTRODUCTION

An atmospheric entry Probe is being developed by NASA Ames Research Center (ARC) to conduct in situ scientific investigations in the atmospheres of the outer planets. Launch is followed by interplanetary cruise when the Probe is attached to the spacecraft bus. The Probe is released by the bus close to the outer planet and functions autonomously thereafter. The Probe enters the planet's atmosphere on a ballistic trajectory, decelerates in the atmosphere, and during subsonic freefall collects and transmits data about the atmosphere.

McDonnell Douglas Astronautics Company-East (MDAC-EAST) designed a Probe for Saturn and Uranus under NASA contract NAS 2-7328 (Reference 1)and supported ARC in the fabrication of a full scale engineering Model of the Probe (Reference 2).

A series of proof-of-concept tests, listed in Figure 1, were conducted at ARC using the Model as the test article to verify the structural and thermal design concepts of the Probe. MDAC-EAST supported these tests under contract NAS 2-9027.

This report describes the structural tests. The results of the thermal test are presented in Reference 3.

TEST	SIMULATED FLIGHT ENVIRONMENT
SHOCK	RELEASE OF PROBE FROM BOOSTER
DYNAMIC	LAUNCH VEHICLE BOOST VIBRATIONS BASED ON TITAN IIIE DATA
STATIC	800 g's ATMOSPHERIC ENTRY DECELERATION
THERMAL VACUUM	INTERPLANETARY CRUISE
SPIN BALANCE WEIGHT	NONE

TEST PLAN SUMMARY

FIGURE 1

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TEST PLAN

Tests were designed to provide a data base which would build confidence in the Probe structural design. Proof-of-concept tests which utilized a full scale Probe engineering Model as the test structure were planned and maximum use was made of NASA ARC facilities.

Mission events which are critical to the Probe structural design were selected for test simulation. Four tests were planned: structural tests to evaluate the effect of shock, dynamic, and static loads and a spin balance and weight test. The structural tests series was based on a Saturn/Uranus Probe mission with a Titan III launch vehicle. Although the Shuttle is prime launch vehicle, the Titan III was chosen as being representative of launch vehicles. In addition, a Titan adapter and hardware were available for testing and the launch environment was defined.

The shock test subjected the Model to pyrotechnic shock environment resulting from simulated separation from the boost vehicle.

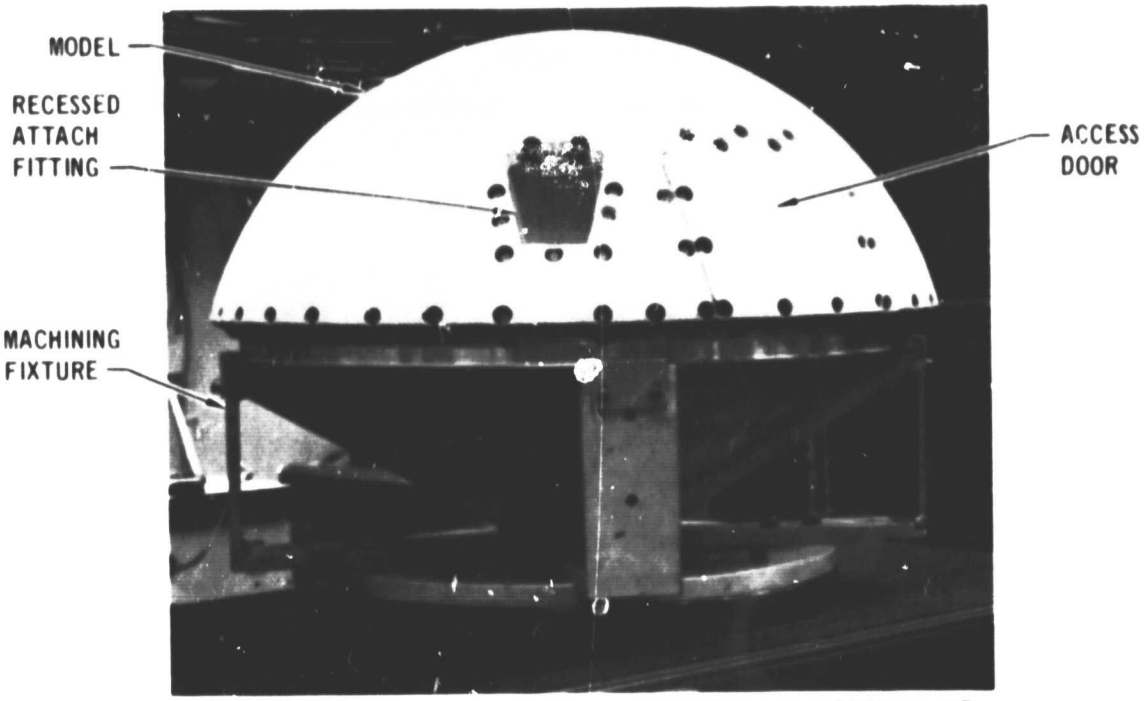
The dynamic test subjected the Model to the simulated dynamic environment of launch.

The static tests simulated up to 125 percent of quasi-static loading expected during an 800 g_E deceleration during planet atmospheric entry.

The spin balance and weight test was conducted to obtain preliminary mass properties of the Model.

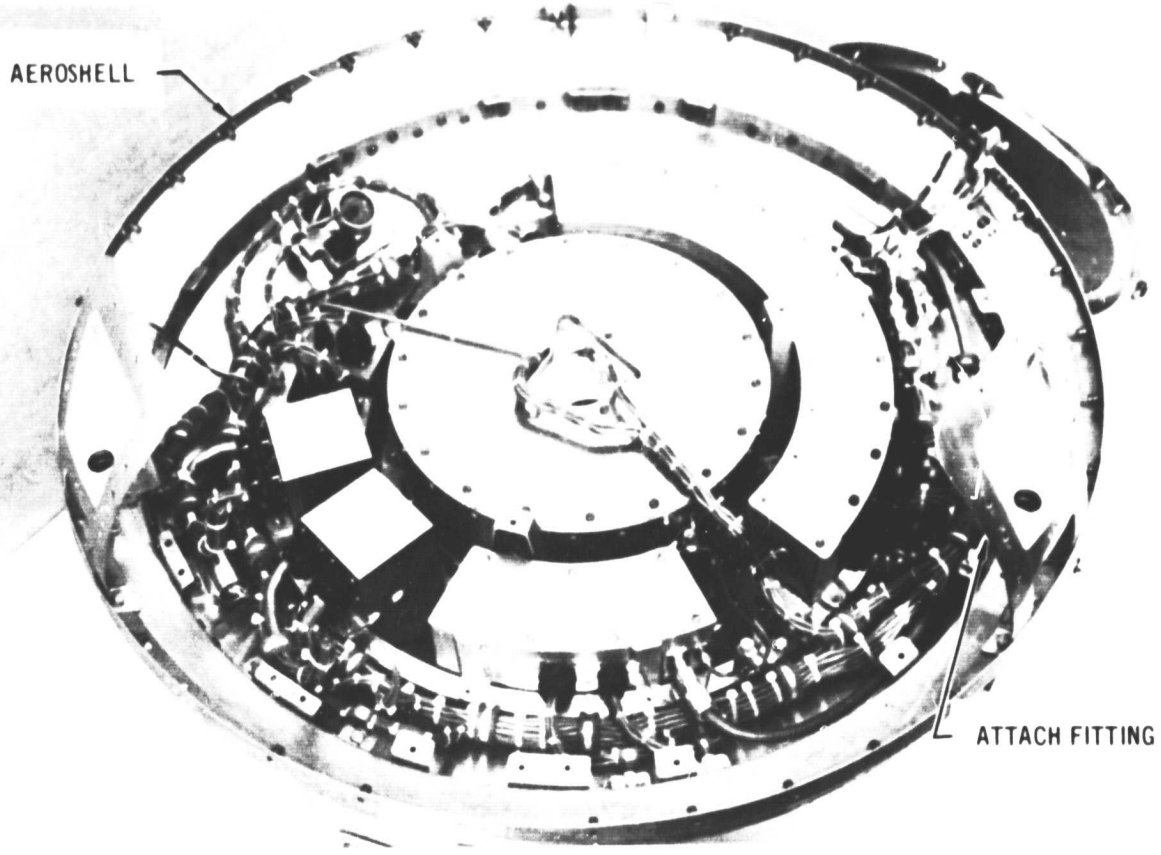
TEST MODEL

A full scale engineering Model of the Probe was fabricated by NASA ARC to serve as the test structure. The Model was fabricated per engineering drawings of a MDAC-EAST Probe designed during a preliminary definition study for NASA ARC (Reference 1). An external view of the partially assembled Model supported by a machining fixture is shown in Figure 2. The Model has a spherically blunted conical forebody, a hemispherical afterbody, a maximum diameter of 35 inches and a bogey weight of 250 pounds. The afterbody has an access door (shown in the figure) and three recessed attach fittings (one of which is shown in the figure) which allow attachment of the Probe to the spacecraft bus conical adapter. Simulated equipment was also fabricated and is shown in Figure 3 installed on the equipment support rings of the Model. The simulated equipment approximated the shape, size, mass and attachment pattern of anticipated equipment. Figure 3 also shows the three attach fittings in more detail.



PROBE ENGINEERING MODEL – PARTIALLY ASSEMBLED

FIGURE 2

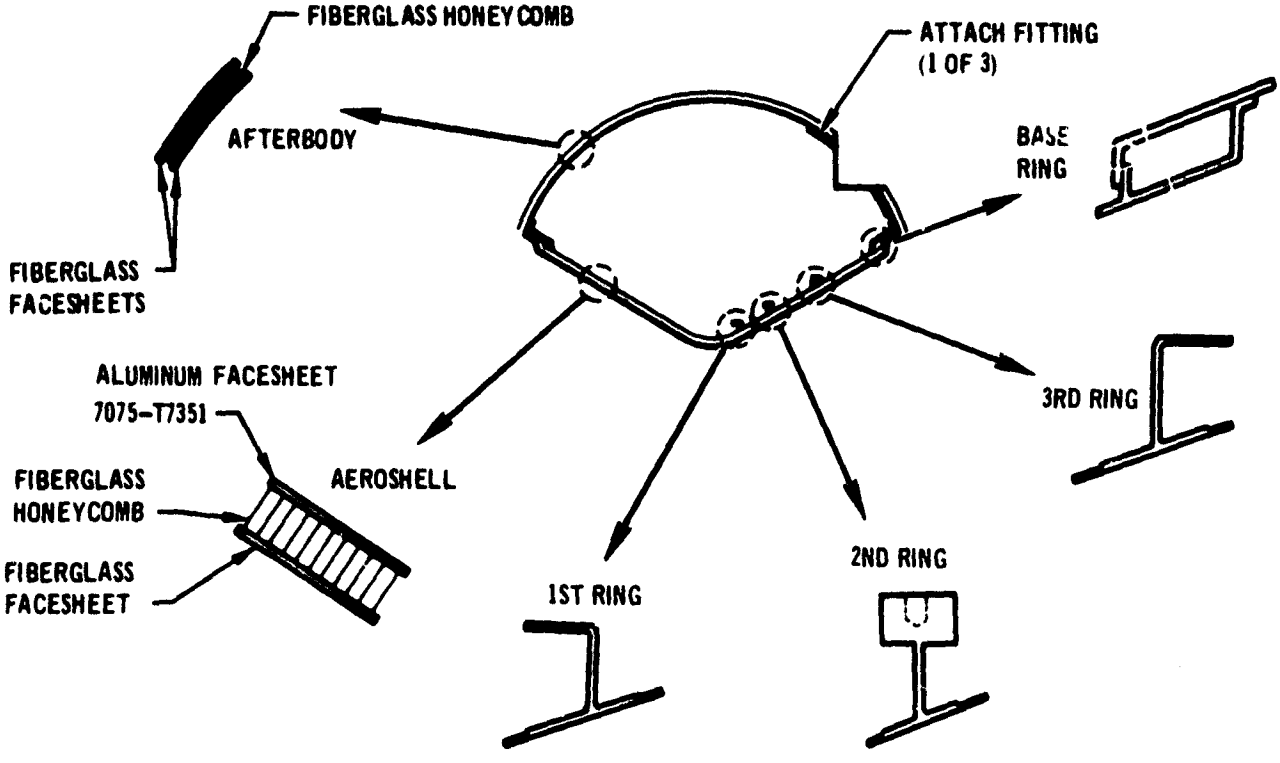


SIMULATED EQUIPMENT IN AEROSHELL

FIGURE 3

STRUCTURAL CONFIGURATION

The structural subsystem of the Probe is schematically illustrated in Figure 4. The primary structure consists of a honeycomb sandwich aeroshell having a fiberglass outer facesheet and an aluminum inner facesheet. Four equipment support rings are integrally machined with the aluminum facesheet. The aeroshell acts as a decelerator, protects the equipment during 800 g_E's ballistic deceleration and provides continuous support for the forward heat shield. The rings distribute concentrated equipment inertia loads into the aeroshell. Three attach fittings located in the afterbody provide for attachment of the Probe to the spacecraft conical adapter. The fittings attach to the base ring and afterbody and transfer all Probe launch loads to the spacecraft conical adapter. The fittings were fabricated of steel for the Model. The afterbody is a fiberglass honeycomb sandwich structure. It has cutouts for the attach fittings and an access door. The afterbody supports the aft heat shield and is mechanically attached to the base ring.



STRUCTURAL CONFIGURATION

FIGURE 4

SHOCK TESTS

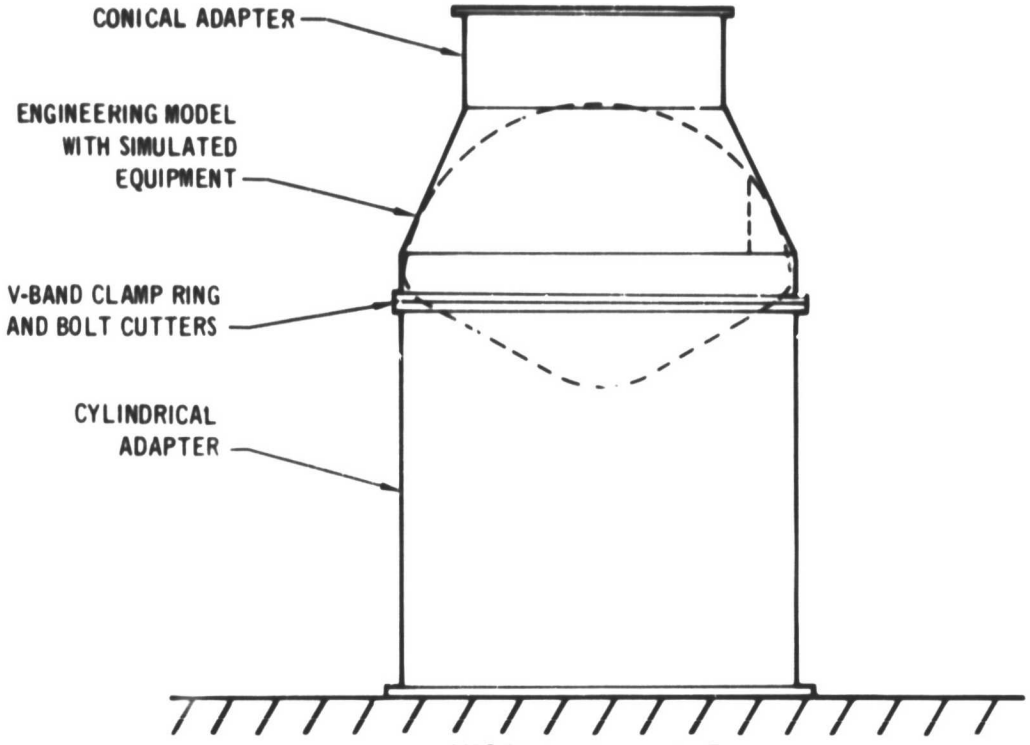
Separation of the Probe and spacecraft from the last stage of the launch vehicle is accomplished by the release of a V-band clamp ring attaching the spacecraft conical adapter to the launch vehicle. The clamp ring disengages when two diametrically opposite preload bolts are cut by pyro actuated bolt cutters. The resulting shock could be critical on the ball lock bolts which attach the Probe to the conical adapter at the attach fittings. The ball lock bolts are actuated by pyro generated pressure allowing the Probe to separate from the conical adapter, and could be sensitive to shock loads. The primary objective of the shock test was, therefore, to determine the effect of shock on the operation of the ball lock bolts. Two shock tests were conducted and provided test data for the extreme positions of bolt cutters relative to the ball lock bolts.

The shock test setup is schematically illustrated in Figure 5. The Model with simulated equipment was mounted in the conical adapter. This subassembly was then attached to the cylindrical adapter of the Titan III with a V-band clamp ring.

A closeup photograph of the test hardware is shown in Figure 6. The photograph shows the conical adapter, the cylindrical adapter, the V-band clamp ring, one of the pyro actuated bolt cutters and one of the three ball lock bolts. Two 3-axis accelerometers are shown, one directly above the bolt cutter and the other by the ball lock bolt. Also shown are air pressure lines connected to the ball lock bolt. These lines were used to provide air pressure to actuate the bolts in lieu of pyrotechnic pressurization.

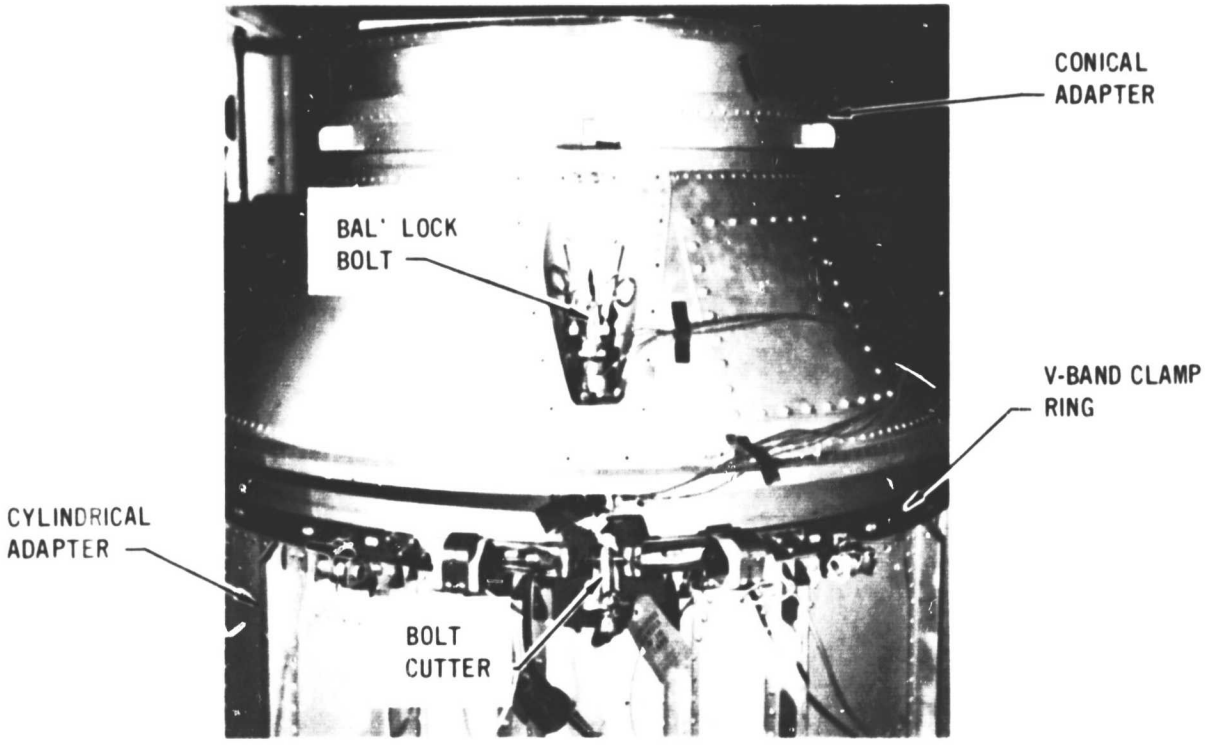
Accelerometer locations are shown in Figure 7. A total of seven 3-axes accelerometers were used. Accelerometers were located to monitor the bolt cutting shock, structural response on both sides of the Probe/conical adapter attach fitting interface and response of one of the equipment support rings.

The first test was conducted with the bolt cutters rotated a minimum of 30° away from the nearest ball lock bolt. The bolt cutters were actuated and the V-band



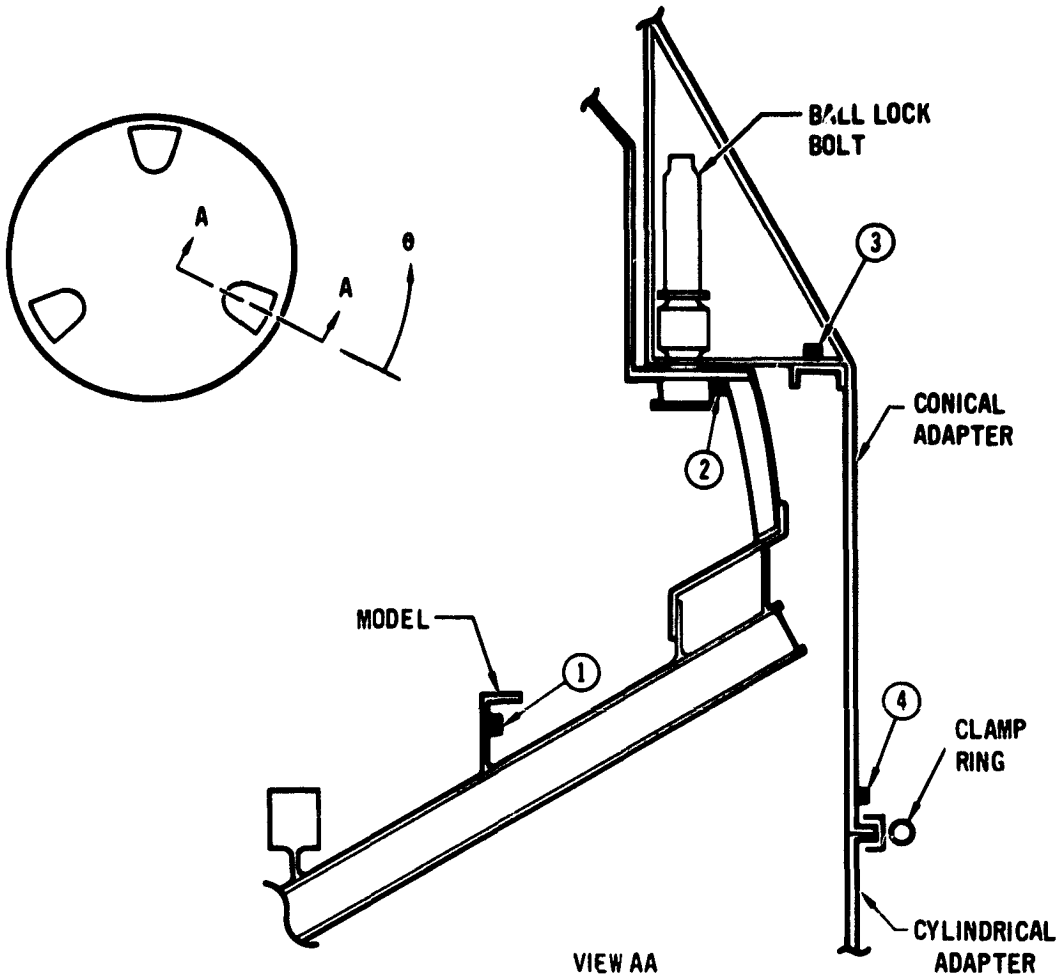
SHOCK TEST SETUP

FIGURE 5



PHOTOGRAPH OF SHOCK TEST HARDWARE

FIGURE 6



INSTRUMENTATION

GAGE NO.	LOCATION		ORIENTATION
	NO.	θ°	
1	1	0	3 AXIS
2	2	0	3 AXIS
3	3	0	3 AXIS
4	4	0	3 AXIS
5	1	120	3 AXIS
6	1	240	3 AXIS
7	3	120	3 AXIS

CLAMP RING BOLTS	
TEST NO.	CIRCUMFERENTIAL LOCATION
1	$\theta = 30^0$ & 210^0
2	$\theta = 0^0$ & 180^0

SHOCK TEST ACCELEROMETER LOCATIONS

FIGURE 7

clamp ring disengaged. Accelerations at all of the gages were continuously recorded. After all structural response to the shock had died down, a Model/conical adapter separation test was conducted and the three ball lock bolts operated successfully allowing separation. The Model and conical adapter were then rotated so that one of the bolt cutters was aligned directly beneath a ball lock bolt and the second test was conducted.

Maximum accelerations recorded at each location for each test are given in Figure 8. Maximum acceleration of 1920 g's was recorded at an attach fitting during the second test. Maximum acceleration at the ball lock bolts was 800 g's recorded during the first test. Accelerations at the equipment support ring were very small for both tests. These accelerations are acceptable.

In addition to supplying the acceleration data which can be used to aid definition of payload structural specifications, these tests demonstrated proof-of-concept:

(1) The two pyro bolt cutters actuated successfully allowing the V-band clamp ring to properly disengage.

(2) Following each shock test, the three ball lock bolts were successfully actuated and the Model separated from the conical adapter.

(3) No structural failures occurred and the structure significantly attenuates the shock loads and significantly reduces shock requirements for equipment.

Shock test data are presented in Appendix A.

GAGE NUMBER	TEST 1 LINEAR ACCELERATIONS (gs)			TEST 2 LINEAR ACCELERATIONS (gs)		
	VERTICAL	RADIAL	TANGENTIAL	VERTICAL	RADIAL	TANGENTIAL
1	25	32	22	—	—	—
2	122	65	90	—	—	—
3	800	3[illegible]	350	650	625	350
4	920	50[illegible]	1300	680	530	850
5	15	15	15	—	—	—
6	15	15	25	—	—	—
7	580	575	475	1920	1350	1400

SHOCK TEST DATA

FIGURE 8

DYNAMIC TESTS

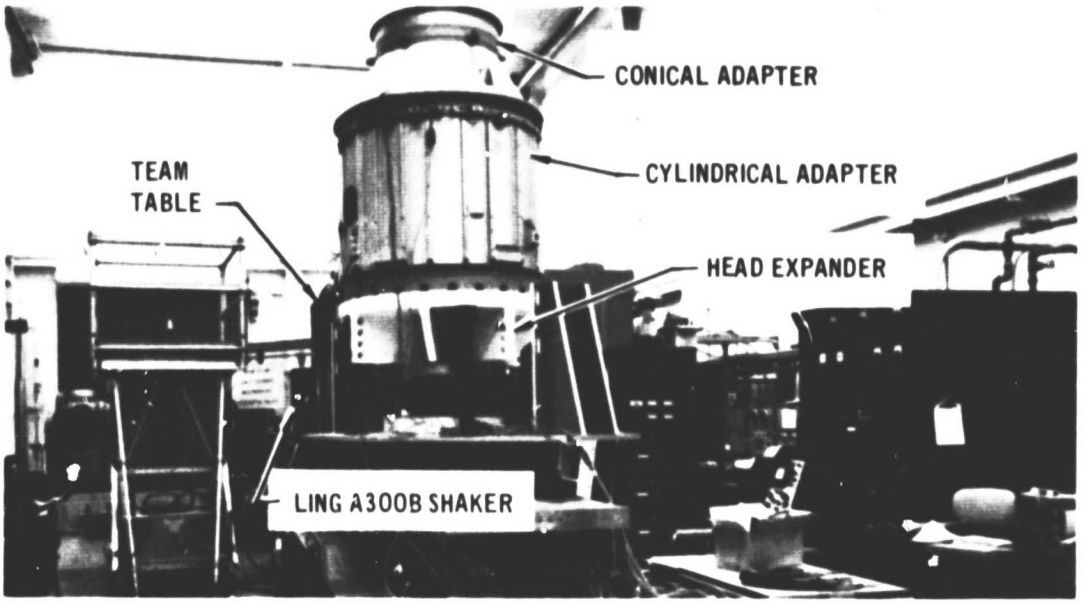
The launch dynamic environment may be critical for the attach fittings which transmit launch accelerations and environments to the Probe. The primary objective of the test was to determine the structural response of the attach fittings to simulated launch dynamic environment. A secondary objective was to obtain qualitative information on the dynamic characteristics of the structural design.

A photograph of the longitudinal test setup is shown in Figure 9. The setup was similar to that of the shock tests except that aircraft bolts were used in lieu of the ball lock bolts and V-band clamp ring preload bolts. The setup used a LING A300B shaker, a head expander to accommodate the large diameter cylindrical adapter and team tables to ensure that only longitudinal (vertical) motion occurred.

Instrumentation consisted of eight 3-axis accelerometers. Locations of the accelerometers on the Model are schematically shown in Figure 10.

Six tests were conducted; sinusoidal and random along each of the Model orthogonal axis. The longitudinal axis was tested first with the setup shown in Figure 9. The shaker table was then rotated to a horizontal position, the vertical team tables were removed and tests of the two lateral axes of the Model were conducted. Input environment was controlled at the head expander. The input environments were those given in Figure 11 with one exception. Due to equipment limitations (primarily shaker output capability vs mass of the test specimen and fixtures) the test level obtained for the longitudinal axis was down approximately 8 dB, 3.16g rms instead of 8.16g rms for the overall random vibration.

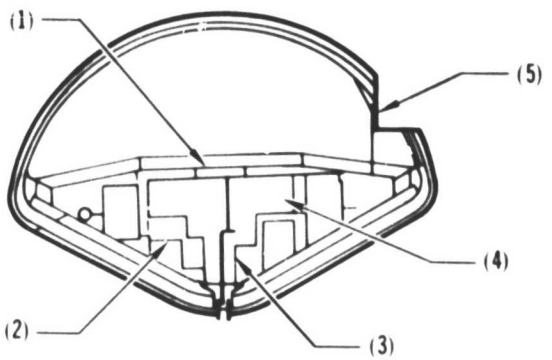
The structure appears to have good dynamic characteristics. No major problems were detected. The only significant amplifications (greater than 10) of the input environments occurred at the simulated relay box and simulated antenna. A maximum amplification of 34 at 12 Hz occurred at the relay box during lateral sinusoidal vibration and an amplification of 18 at 86 Hz occurred at the antenna during the longitudinal axis sinusoidal vibration. Close attention to the designs of the actual relay box and antenna will be required to reduce these amplifications.



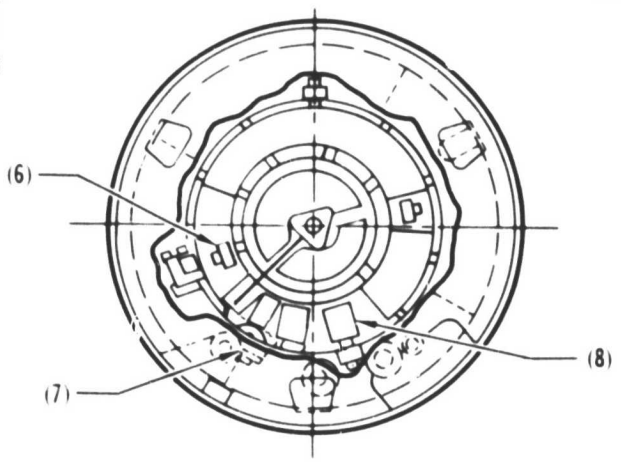
PHOTOGRAPH OF DYNAMIC TEST HARDWARE

FIGURE 9

(1) ANTENNA
(2) BOOTSTRAP BATTERY
(3) NOSE PROBE
(4) MASS SPECTROMETER
(5) ATTACH FITTING
(6) PRESSURE GAGE
(7) NEPHELOMETER
(8) RELAY BOX



ACCELEROMETER LOCATIONS



DYNAMIC TEST ACCELEROMETER LOCATIONS

FIGURE 10

VIBRATION AXIS	SWEEP RATE	FREQUENCY (Hz)	ACCELERATION (g's 0-PEAK)
LONGITUDINAL	1 OCTAVE/MIN	5–12	3.0
		12–50	3.0
		50–200	2.25
BOTH LATERAL	1 OCTAVE/MIN	5–10	1.95
		10–22	1.95
		22–200	1.50

Sinusoidal Test Vibration Schedule

VIBRATION AXIS	TEST DURATION (MIN. EACH AXIS)	FREQUENCY (Hz)	POWER SPECTRAL DENSITY (PSD) LEVEL (g^2/Hz)
ALL 3 AXIS	4	20–100	0.056 AT 100 Hz INCREASE BY 6 dB PER OCTAVE FROM 20–100 Hz
		100–1000	0.056
		1000–2000	0.056 AT 1000 Hz WITH ROLL OFF OF 12 dB PER OCTAVE FROM 1000-2000 Hz

Random Vibration Test Spectrum and Duration

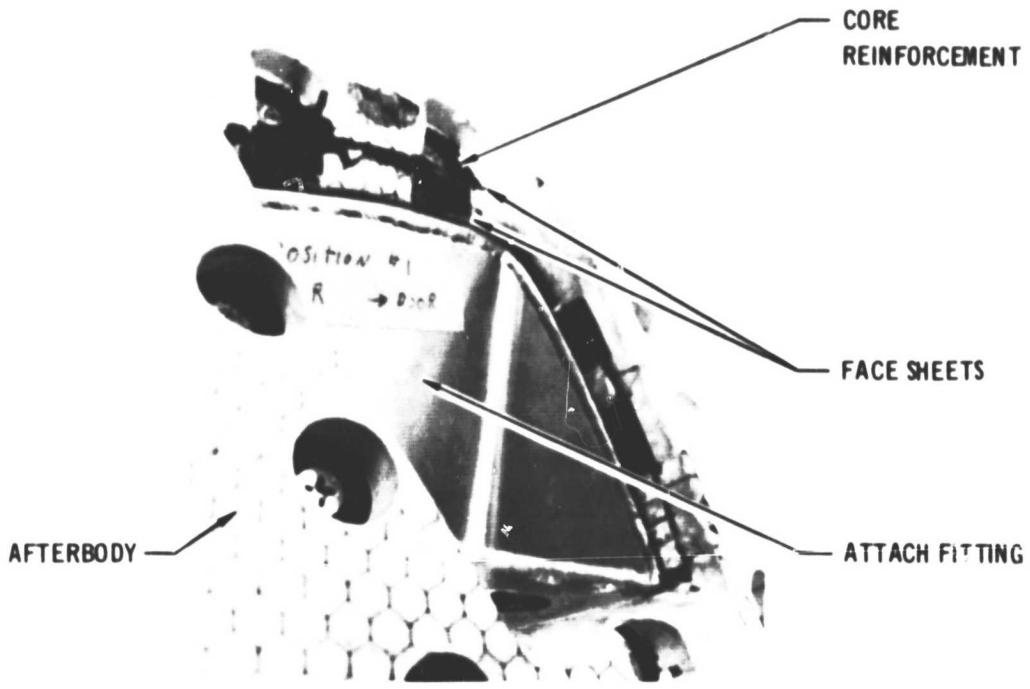
DYNAMIC TEST LEVELS

FIGURE 11

Dynamic test data are given in Appendix B.

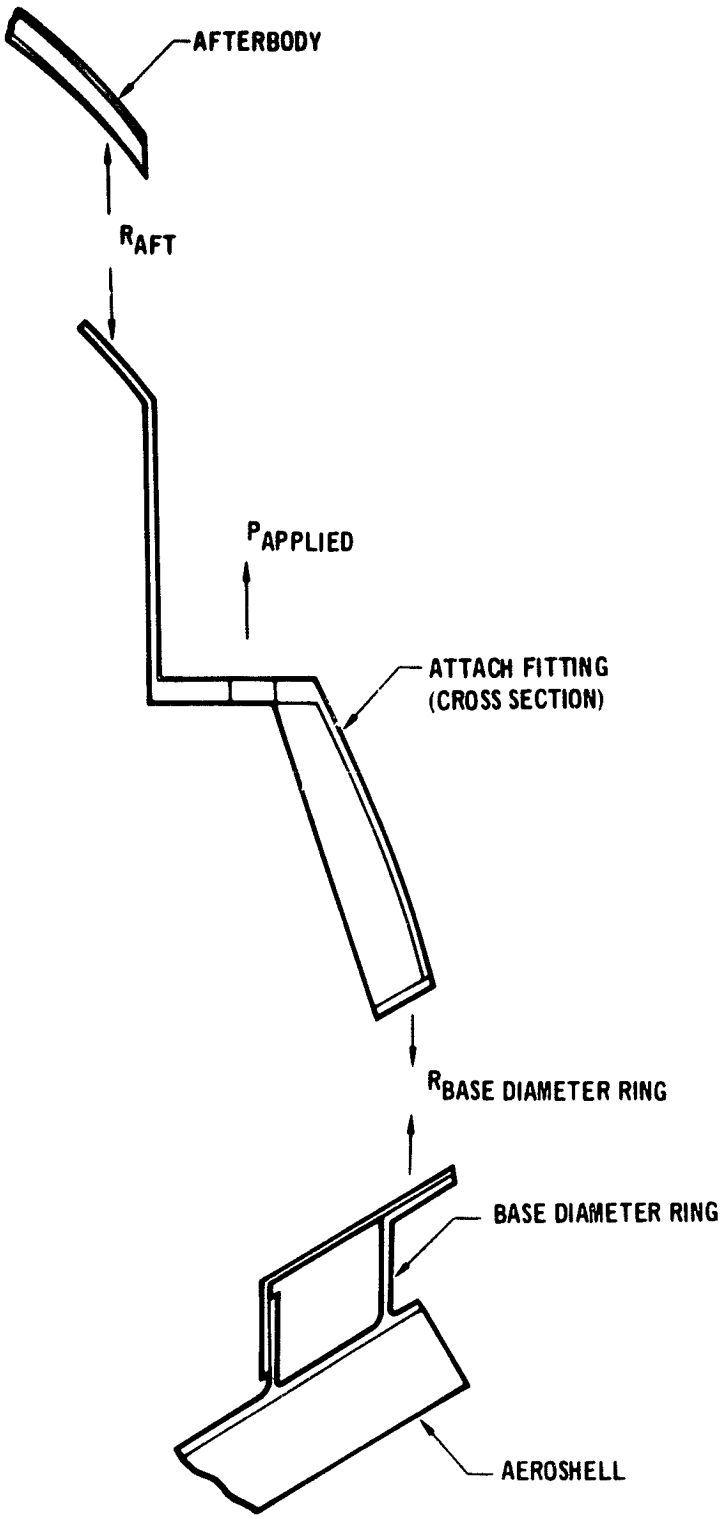
During testing, local structural failures occurred in the afterbody near the cutouts for two of the three attach fittings. The failures were minor and were not detected until all six tests were completed. It is not known which test initiated the failures. One of the failures is shown in the photograph of Figure 12. The afterbody honeycomb sandwich facesheets separated from the core near the core reinforcements. The failures are primarily attributed to the cantilever design of the attach fittings. As illustrated in Figure 13 the fittings require a reaction at the afterbody (R_{AFT}) to be in static equilibrium when an attach load ($P_{APPLIED}$) is applied. The load induced in the afterbody may have caused the local structural failures.

A modified attach fitting design shown in Figure 14 is recommended. The modified design provides adequate load paths so that all applied loads can be reacted at the base diameter ring. A fiberglass shell is used to close out the cutout in the afterbody.



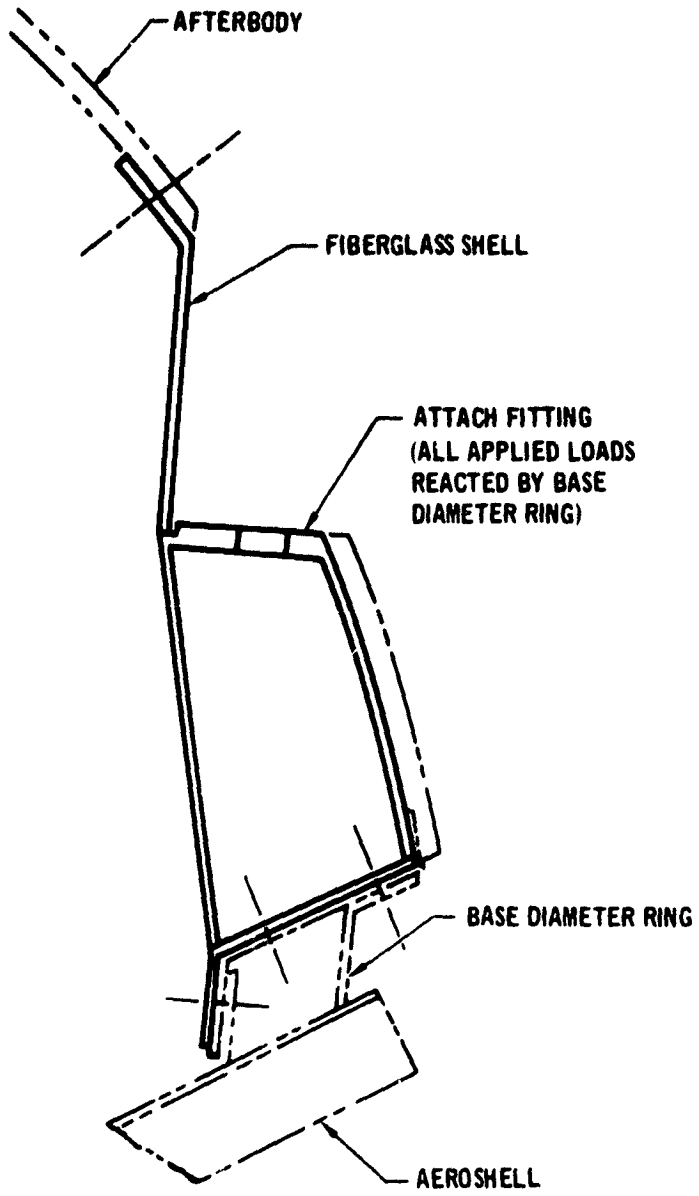
AFTERBODY LOCAL FAILURE – DYNAMIC TEST

FIGURE 12



ORIGINAL ATTACH FITTING CANTILEVER DESIGN

FIGURE 13



MODIFIED ATTACH FITTING DESIGN

FIGURE 14

STATIC TEST

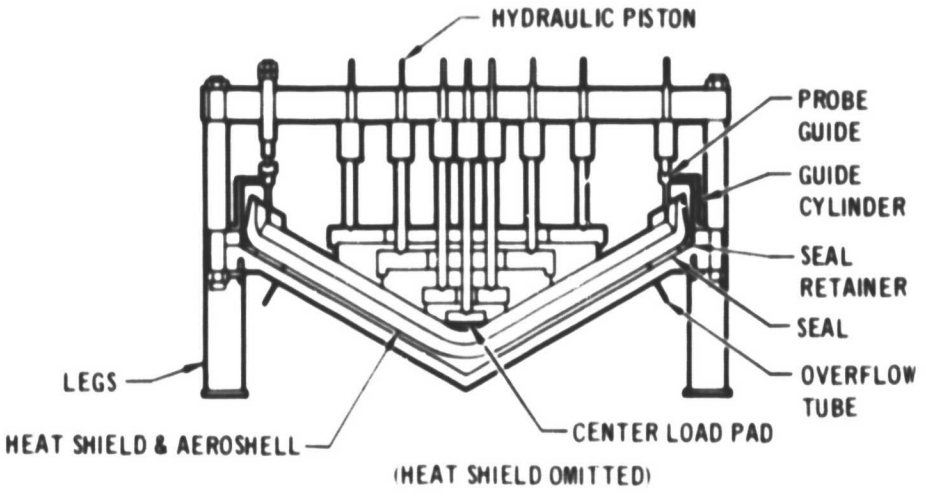
The aeroshell supports the equipment under 800 g_E's inertia loading balanced by the forebody aerodynamic pressure during planetary atmospheric entry. Primary objective of the static tests was to verify strength of the aeroshell under this loading. Secondary objective was to compare test results with preliminary analytical predictions.

The static test setup is schematically illustrated in Figure 15. The Model aeroshell and an especially designed static test fixture were used. The fixture was designed and fabricated by NASA ARC.

The fixture applied hydrostatic pressure to the forward side of the aeroshell to simulate atmospheric deceleration pressure. Loads to balance the pressure were applied by hydraulic pistons to the aeroshell equipment support rings to simulate inertia loads of equipment. All loading simulated loads at zero angle of attack (i.e., no lateral loads). The aeroshell was centered in the fixture by a guide ring. Thick plates distributed the hydraulic piston loads to the aeroshell rings. Linear bearing assemblies were placed between the plates and rings to prevent radial restraint of the rings by the plates. A photograph of the linear bearing assemblies used on the first ring is given in Figure 16. The assemblies are mounted on the thick plate used to distribute load to the first ring.

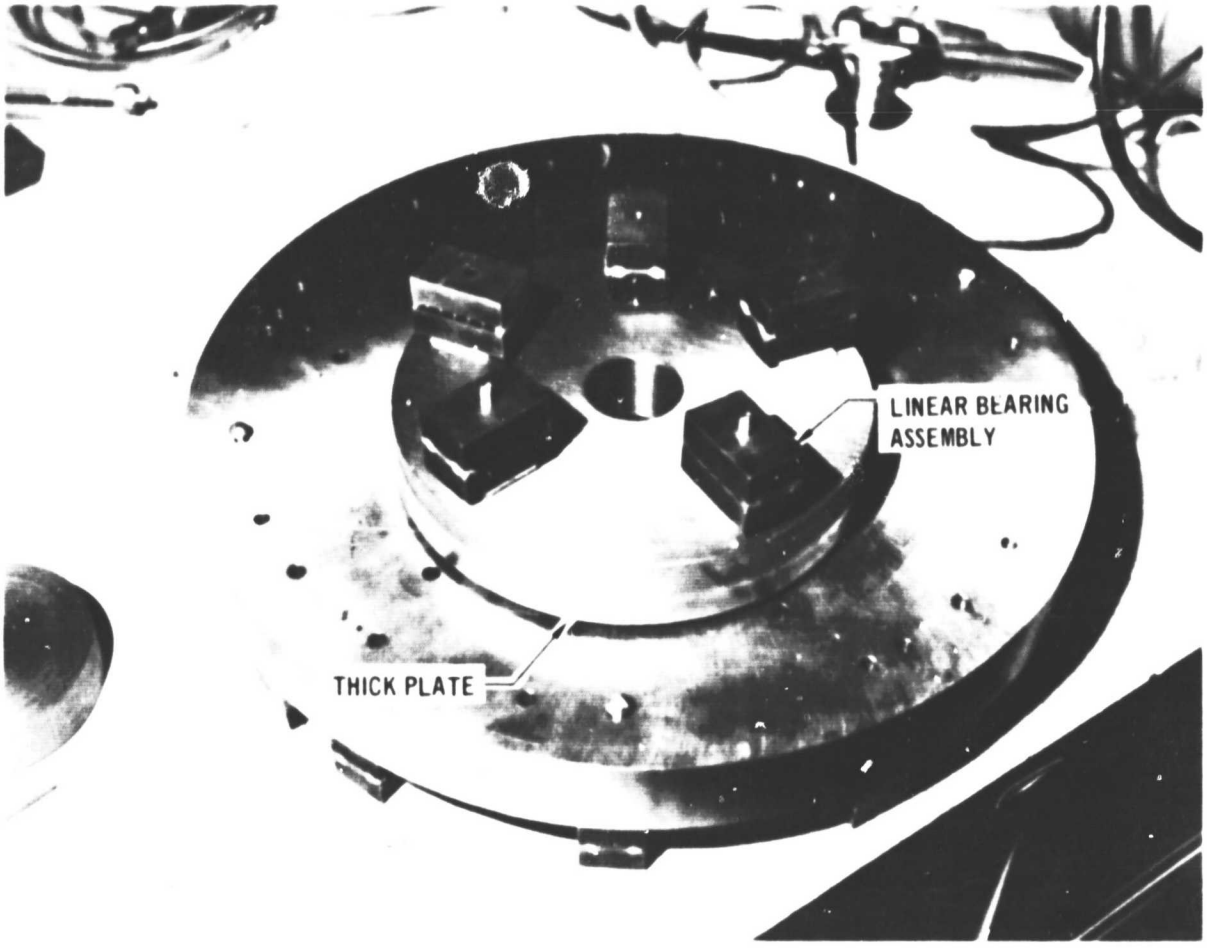
A photograph of the test setup is given in Figure 17. The aeroshell is mounted inside the test fixture and is not visible in the photograph. All of the hydraulic piston lines are connected to a common reservoir and pump. The fluid for pressurizing the forward surface has a separate pump. All instrumentation wiring is connected to a Hewlett-Packard digital recorder as illustrated in Figure 18.

Instrumentation of the aeroshell consisted of 10 deflectometers, 19 biaxial strain gages and 16 uniaxial strain gages. Locations of the deflectometers are given in Figure 19 and locations of strain gages are given in Figure 20. In addition 16 of the hydraulic piston load rods were instrumented with uniaxial gages to monitor applied loads.



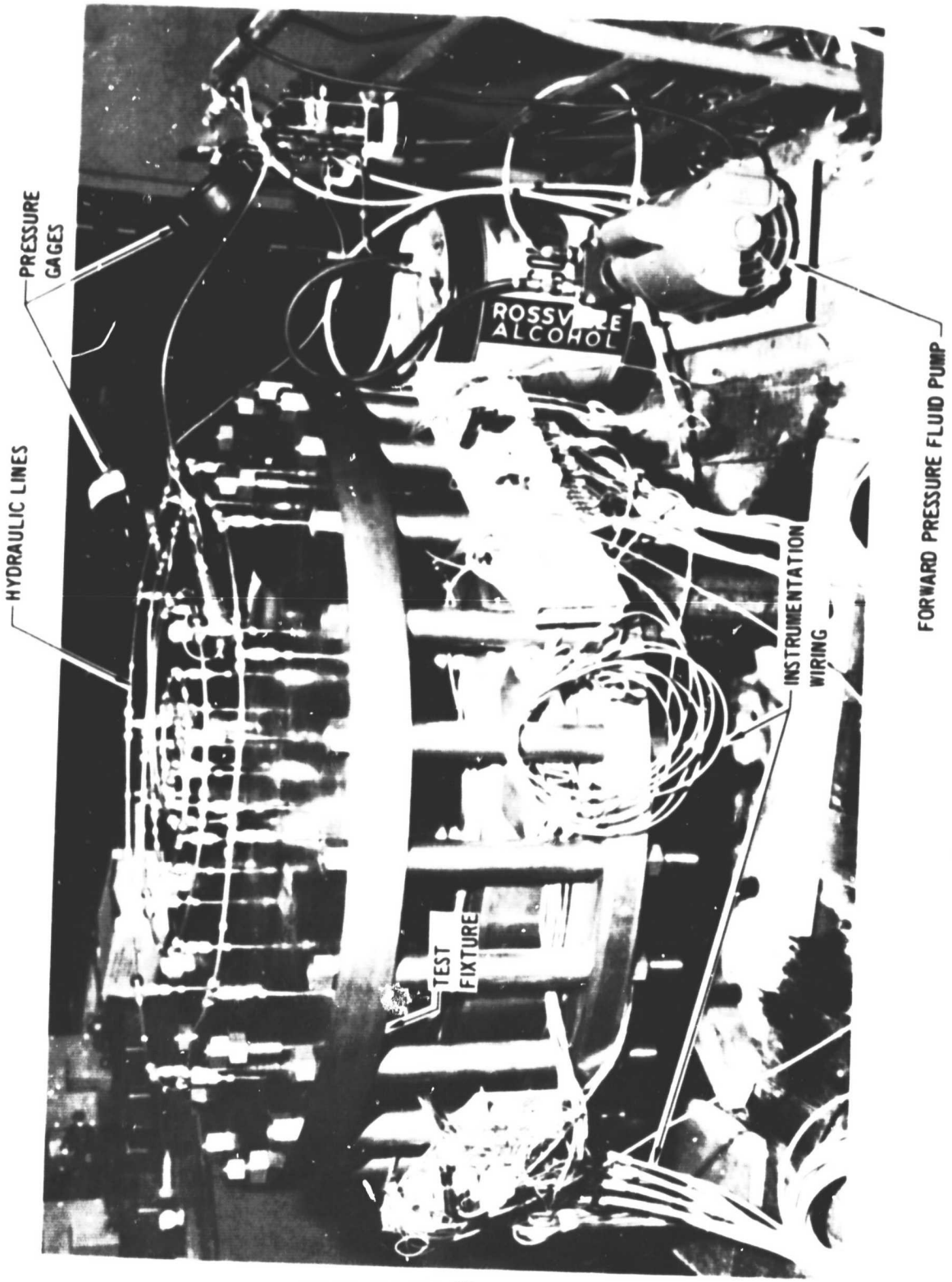
STATIC TEST SETUP

FIGURE 15



LINEAR BEARING ASSEMBLIES

FIGURE 16



PHOTOGRAPH STATIC TEST SETUP

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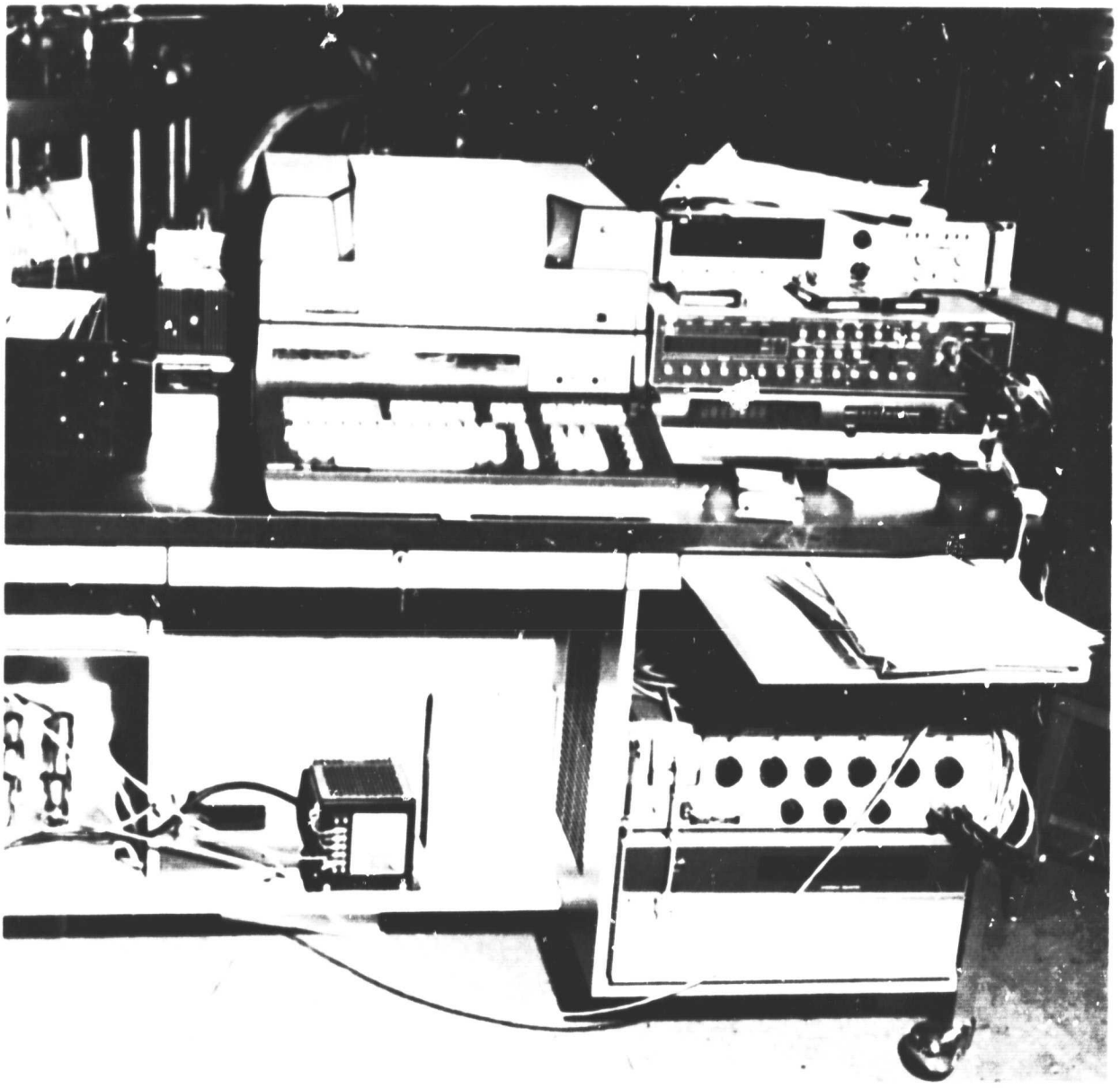
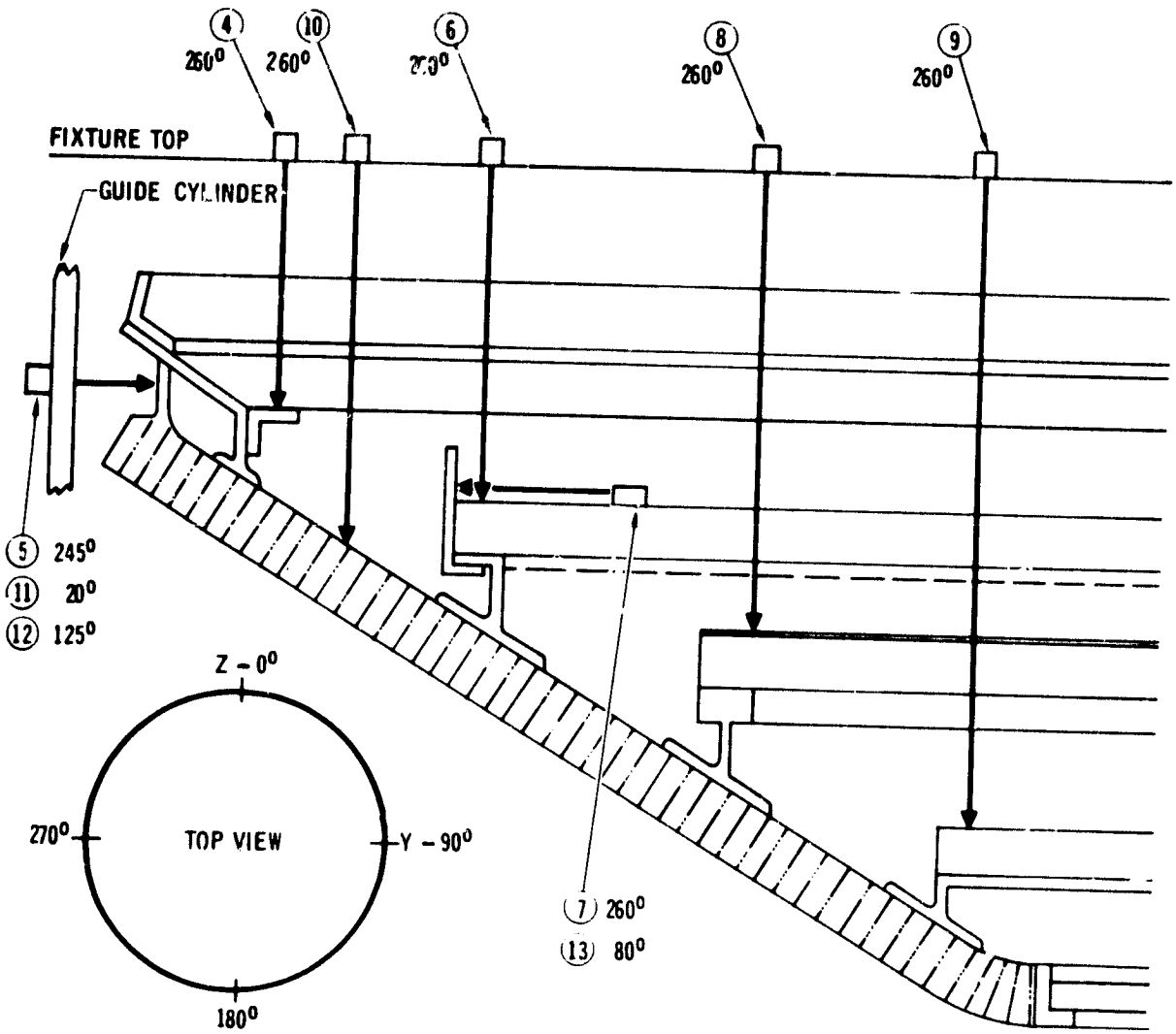
OF POOR QUALITY

FIGURE 17



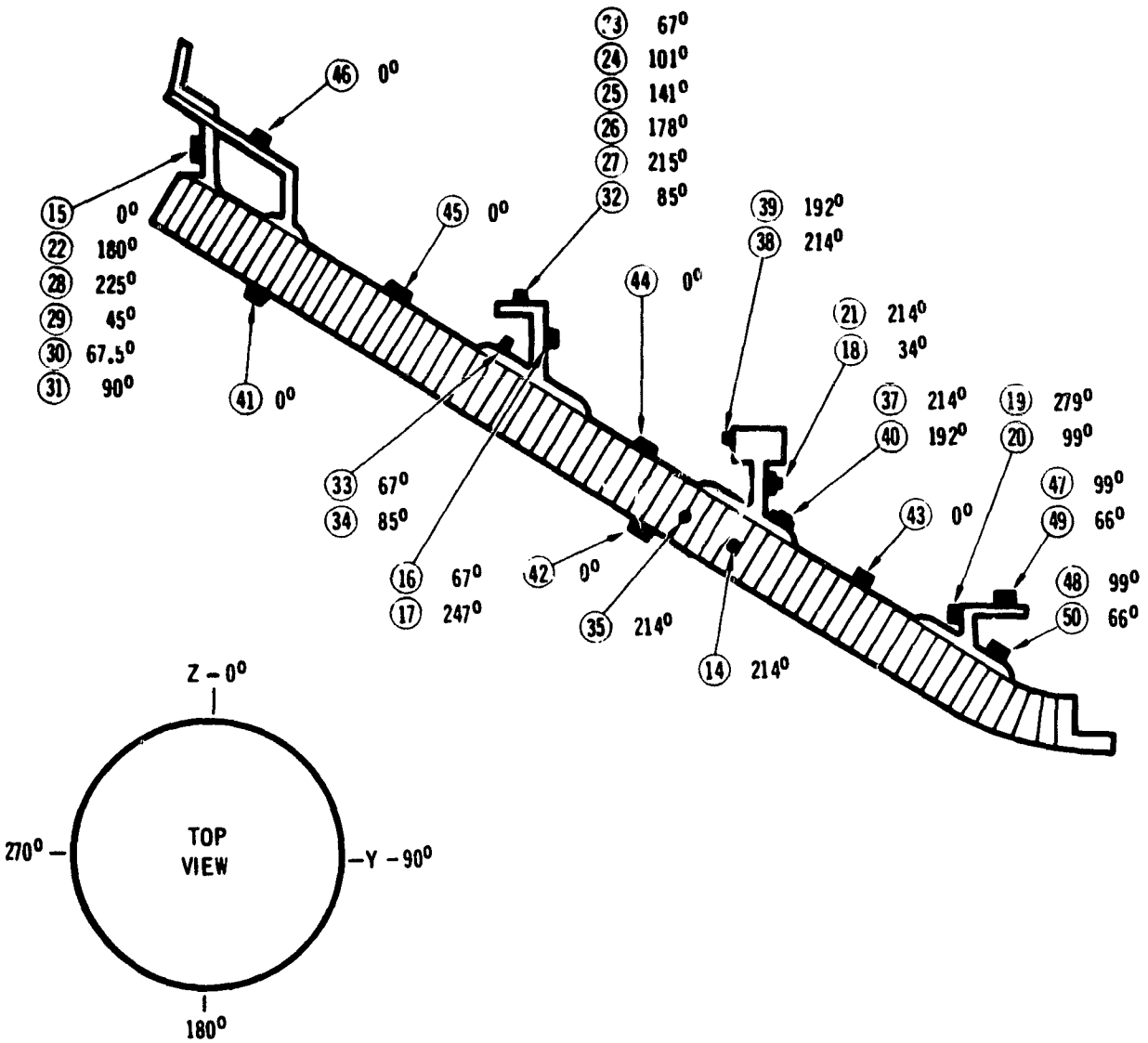
HEWLETT PACKARD RECORDER

FIGURE 18



STATIC TEST DEFLECTOMETER LOCATIONS

FIGURE 19



STATIC TEST STRAIN GAGE LOCATIONS

FIGURE 20

A total of three test loadings of the aeroshell were completed and are summarized in Figure 21. The first test utilized multipoint loading of the rings not exceeding limit load. The positions of the linear bearing assemblies on each ring are shown in Figure 22. The first test closely simulated axisymmetric uniform loads and test results are compared with preliminary structural analysis predictions later in this section.

The other two tests were at limit and ultimate (ultimate = 1.25 x limit) load respectively and utilized more discrete loading of the rings by grouping the linear bearing assemblies as shown in Figure 23. These tests closely simulated the discrete ring loading conditions expected during flight.

The ultimate load applied to each ring is given in Figure 24. The load distribution corresponded to the payload weight distribution given by Reference 1. Load corresponding to a total weight of 134.8 pounds was simulated and is representative of the Reference 1 design without the forward heat shield material and insulation blanket.

The aeroshell withstood limit loads without detrimental deformation and ultimate loads without failure. Complete test data is given in Appendix C. Significant data and results are discussed here.

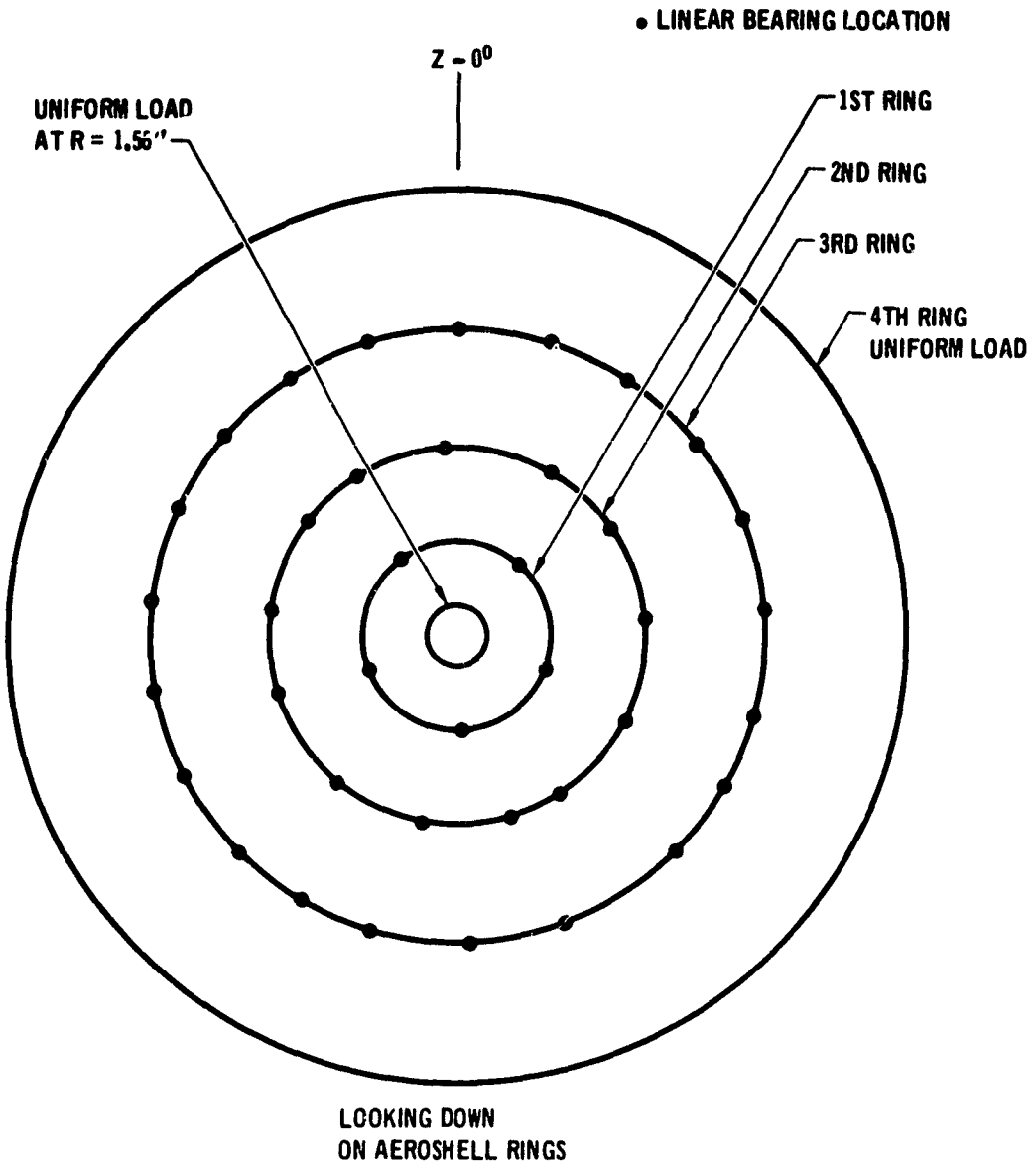
Maximum measured aeroshell strains as a function of load are presented in Figures 25 to 27. The maximum strain of the aluminum skin was at the base of the third ring where limit strain of -0.166% was measured during the second test as shown in Figure 25. The strain did not change appreciable between the first and second test and was linear with applied load. A strain of -0.21% was measured at ultimate load.

The maximum strain of the fiberglass skin was under the second ring where limit strain of +0.292% was measured during the first test as shown in Figure 26. The strain did not change appreciable between the first and second tests. Slight nonlinearity of measured strain with applied load is evident. A strain of +0.356% was measured at ultimate load.

TEST NUMBER	LOAD TYPE	MAXIMUM LOAD
1	SEE FIGURE 22	LIMIT
2	SEE FIGURE 23	LIMIT
3	SEE FIGURE 23	ULTIMATE

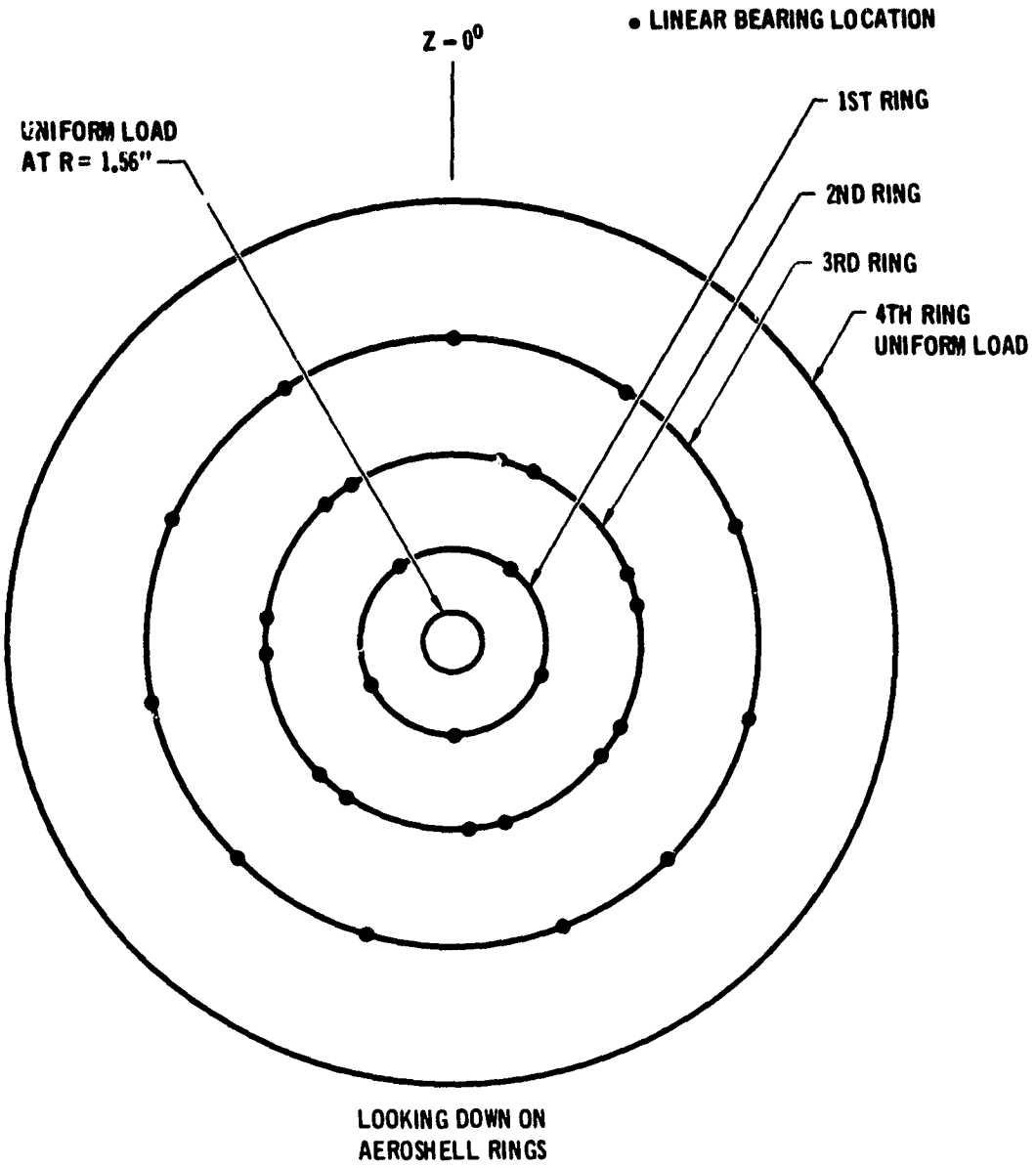
STATIC TEST RUNS

FIGURE 21



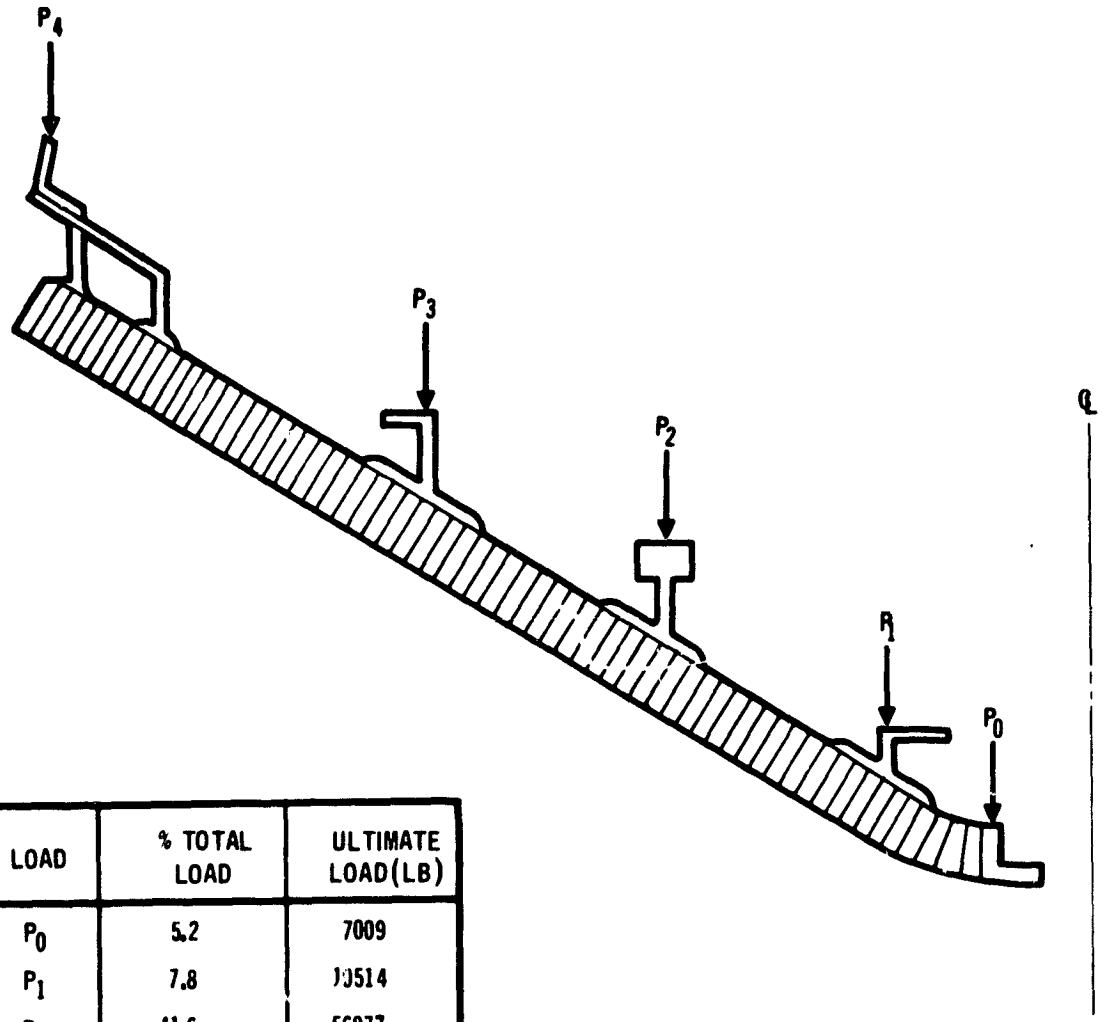
RING LOAD POINTS TEST 1

FIGURE 22



RING LOAD POINTS FOR TESTS 2 AND 3

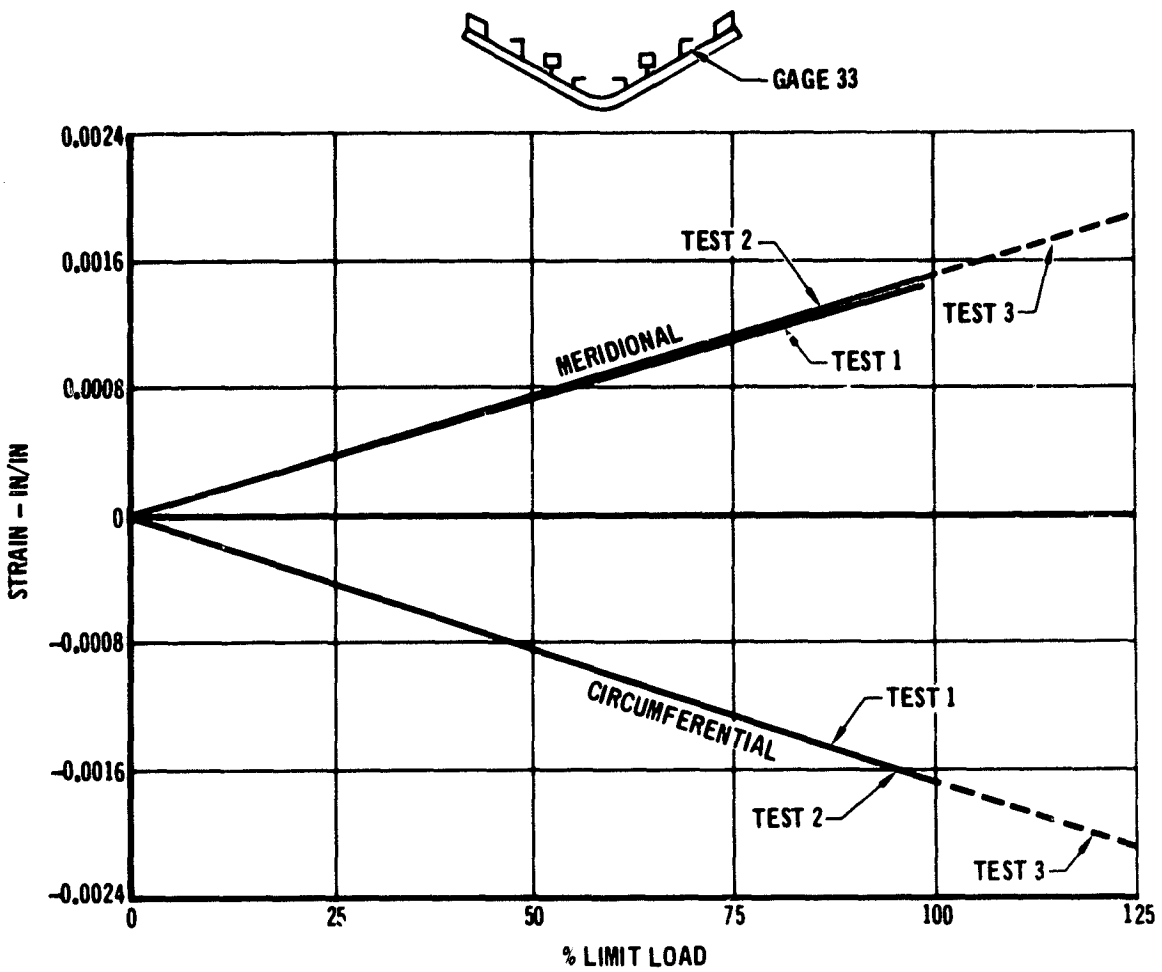
FIGURE 23



LOAD	% TOTAL LOAD	ULTIMATE LOAD(LB)
P_0	5.2	7009
P_1	7.8	10514
P_2	41.6	56077
P_3	19.1	25747
P_4	26.3	35452

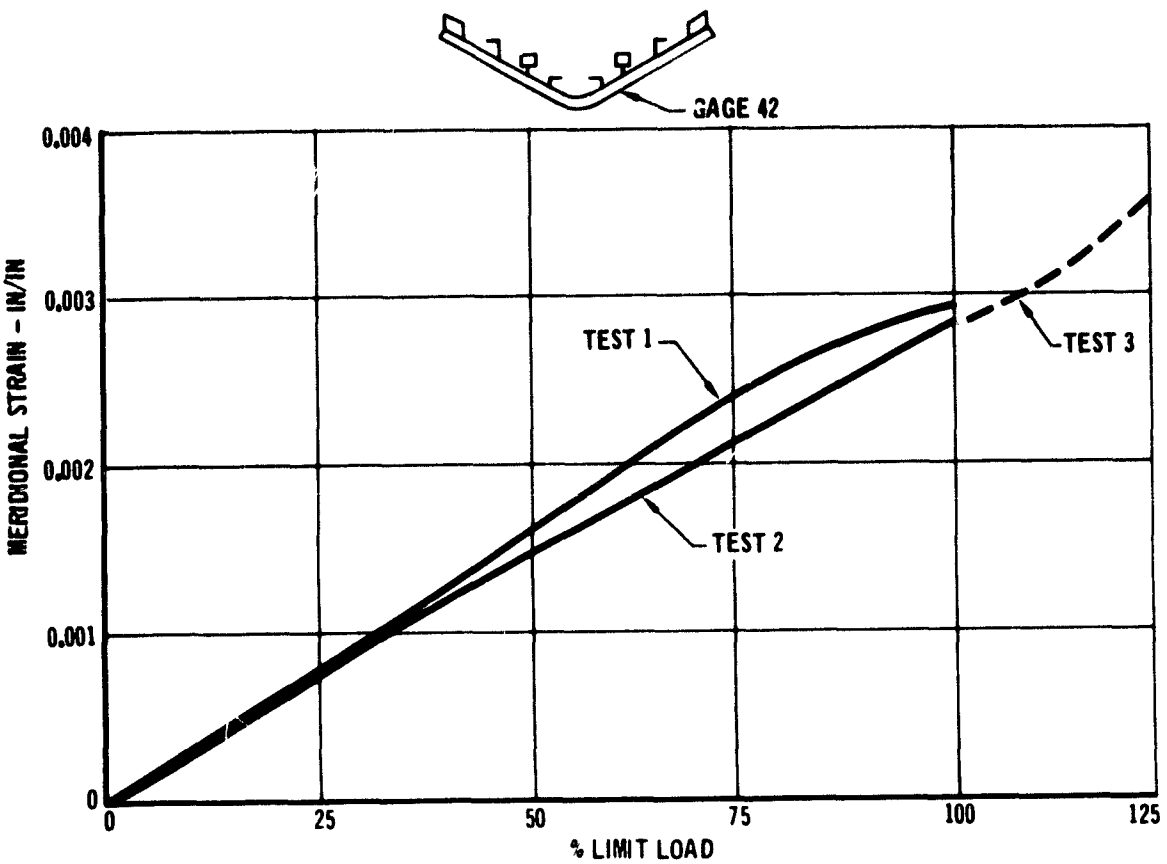
RING LOAD DISTRIBUTION

FIGURE 24



ALUMINUM SKIN MAXIMUM STRAINS VS LOAD

FIGURE 25



FIBERGLASS SKIN MAXIMUM STRAIN VS LOAD

FIGURE 26

The honeycomb core cell wall compression maximum strain was under the second ring where limit strain of -0.205% was measured as shown in Figure 27. An increase in strain of about 10% is evident between the first and second tests and is attributed to higher local loads present in the second test. Slight nonlinearity of measured strain with applied load is also evident in this fiberglass core. A strain of -0.254% was measured at ultimate load.

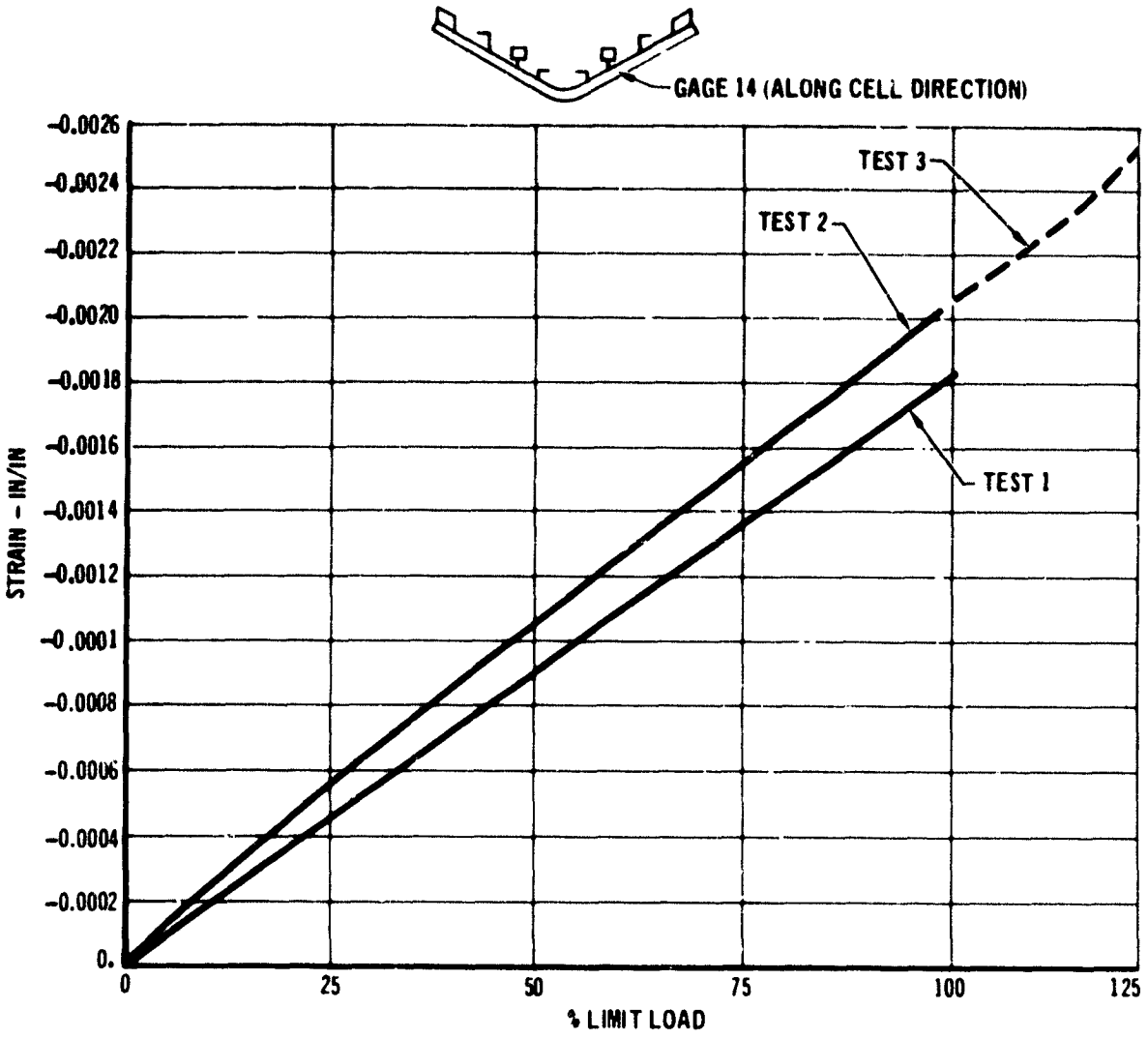
The largest strain recorded occurred on the outboard side of the first ring stem and was +0.477% in the vertical direction at ultimate load. The ring was theoretically loaded as shown in Figure 28(a). This loading would result in vertical compression strains in the stem. The actual ring loading may have been as shown in Figure 28(b). The offset loading results in vertical tensile strains on the outboard side of the stem as measured in the test. A permanent strain of +0.03% resulted.

Test data indicates that the more discrete ring loads present in the second and third test generally did not result in significant additional strains over strains present in the first test.

Deflections measured during the tests are given in Appendix C but are not considered to be reliable. As shown in Figure 29 the base ring vertical deflection as a function of applied load was not repeatable. Deflections have not been further evaluated.

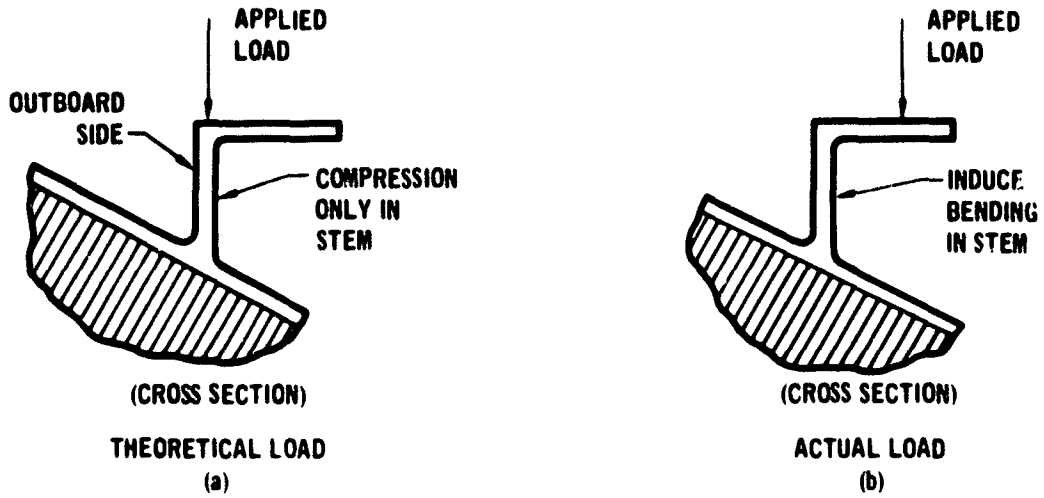
Photographs of the aeroshell after testing are presented in Figures 30 and 31. Figure 30 shows the fiberglass skin side of the aeroshell. The strain gages on the skin are shown and two plugs at circular cutouts in the aeroshell are visible. No failures of the skin were detected. Figure 31 shows the aluminum skin side of the aeroshell. The four equipment support rings are shown. Strain gages and wiring are still on the aeroshell. No failures of skin or rings were detected.

Preliminary predictions of aeroshell internal strains were completed for comparison with test data. An analytical model formulated for the Structural Analysis



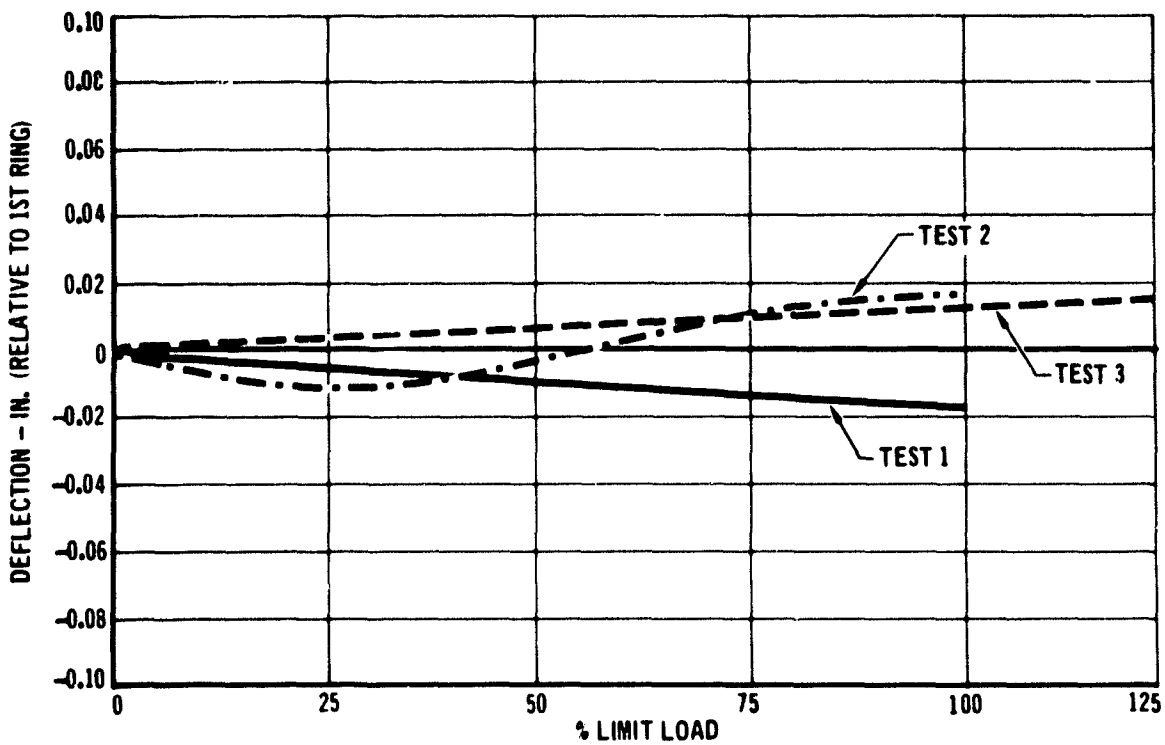
FIBERGLASS CORE MAXIMUM STRAiN VS LOAD

FIGURE 27



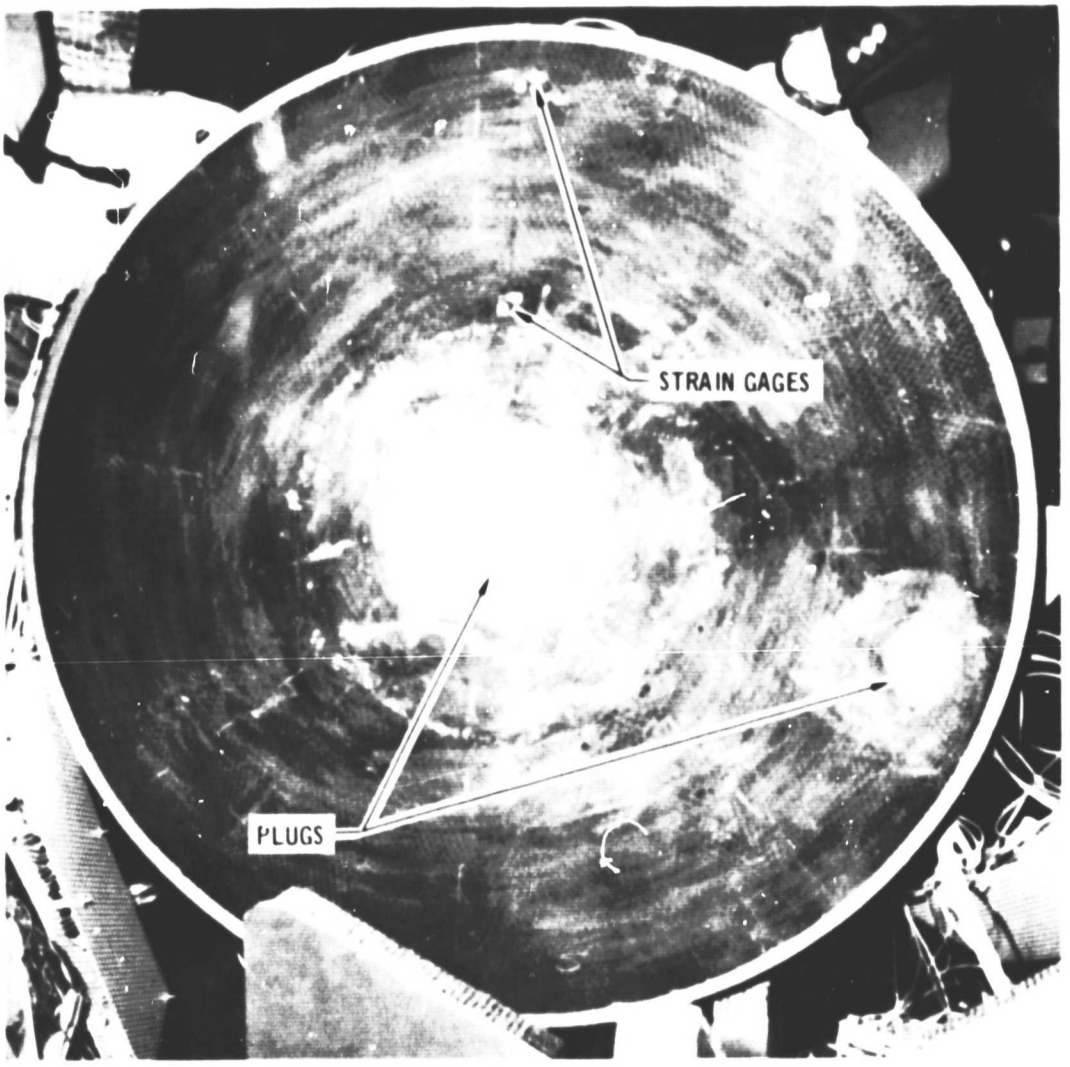
FIRST RING LOADING

FIGURE 28



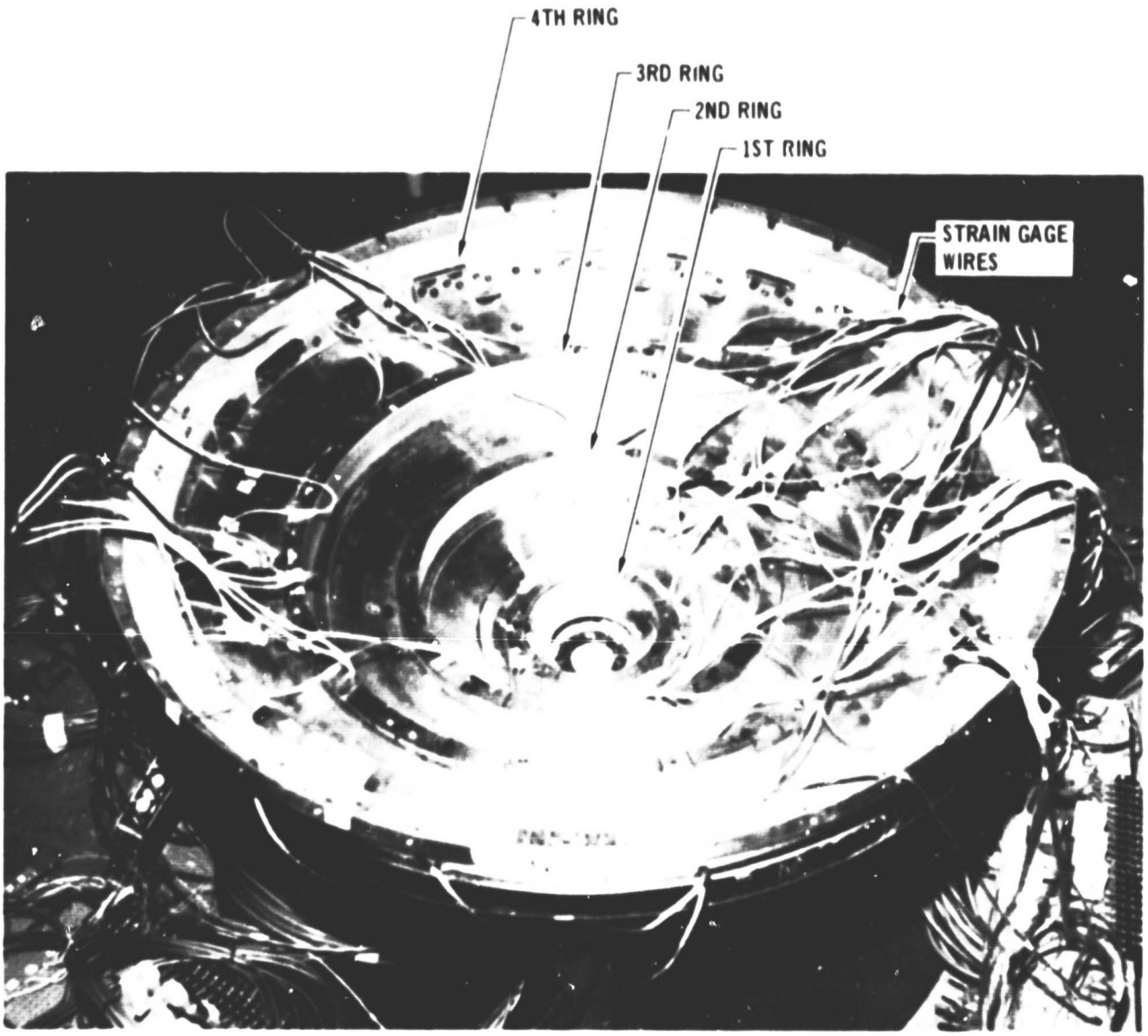
BASE RING VERTICAL DEFLECTION VS LOAD

FIGURE 29



AEROSHELL FIBERGLASS SKIN AFTER TEST

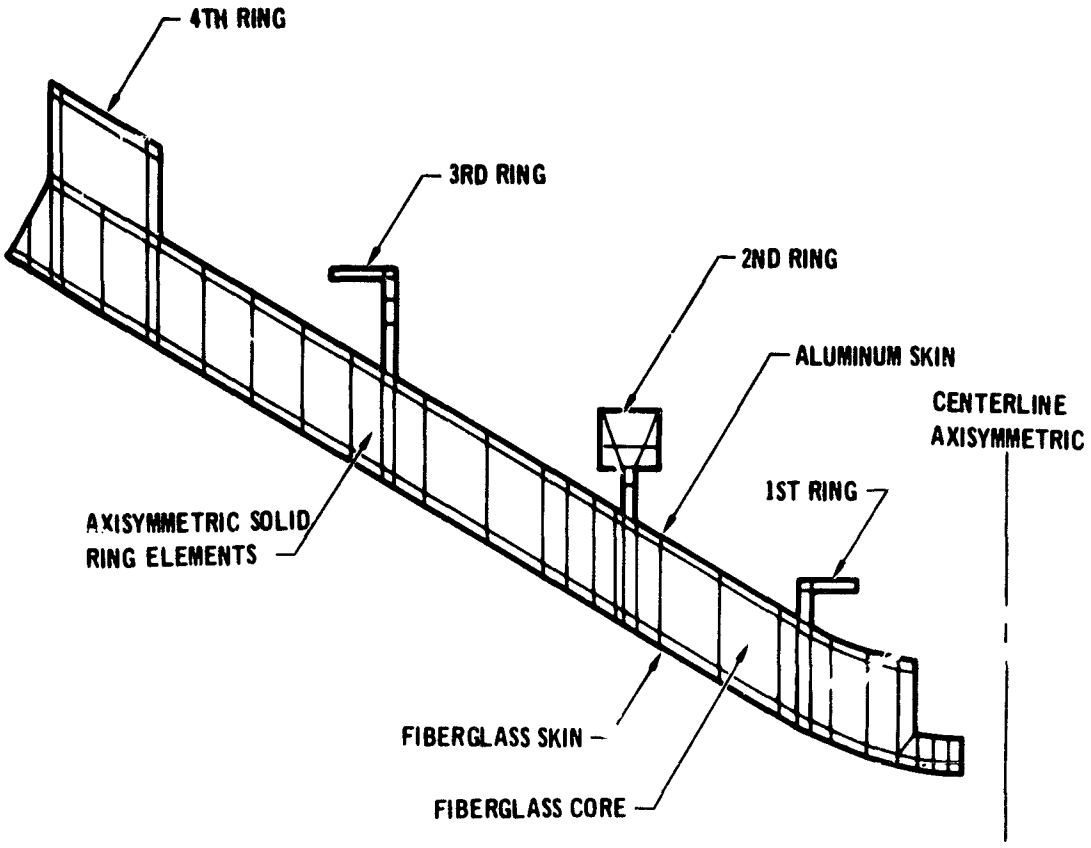
FIGURE 30



AEROSHELL ALUMINUM SKIN AFTER TEST

FIGURE 31

of Axisymmetric Solids (SAAS III) computer program was utilized and is illustrated in Figure 32. Axisymmetric solid ring elements represented the isotropic fiberglass skin, orthotropic fiberglass honeycomb core, isotropic aluminum skin and aluminum rings. Linear mechanical properties were utilized. Axisymmetric loads representative of the first test were applied to the model and internal strains obtained. The predicted limit strains and strains measured during the first test at selected locations are given in Figure 33. The aluminum skin and fiberglass skin strains are in fairly good agreement. The honeycomb core cell wall strains are in poor agreement. The core cell wall test strain possibly included axial strain plus wall bending strain resulting in substantially less strain than predicted. Back to back strain gages should be used in future measurements of core cell wall strains.



ANALYTICAL MODEL OF AEROSHELL

FIGURE 32

STRUCTURAL COMPONENT	CRITICAL LOCATION	STRAIN DIRECTION	TEST STRAIN	PREDICTED STRAIN
ALUMINUM SKIN	SEE FIG. 25	MERIDIONAL HOOP	+0.0014 -0.0016	+0.0017 -0.0018
FIBERGLASS SKIN	SEE FIG. 26	MERIODIONAL	+0.0029	+0.0021
FIBERGLASS CORE	SEE FIG. 27	ALONG CELL WALL	-0.0018	-0.0034

COMPARISON OF LIMIT TEST STRAINS AND PREDICTED STRAINS

FIGURE 33

SPIN BALANCE AND WEIGHT TEST

A spin balance and weight test of the engineering Model was conducted to verify the Model mass properties prior to the other three structural tests. Testing measured the weight, center of gravity location, the spin axis moment of inertia and defined mass requirements to null the spin axis cross products of inertia. The partially fabricated Model was tested without the soft ablator in the aft heat shield, forward subassembly of fiberglass honeycomb core and facesheet, and forward heat shield; none of which were available at time of testing. The simulated equipments were mounted inside the Model.

Figure 34 shows the spin balance test setup used to determine lateral c.g. and cross products of inertia. The Model is attached to a tooling fixture which in turn is attached to the Treble spin balance table. The tooling fixture was balanced prior to the test.

The moment of inertia test setup is shown in Figure 35. The tooling fixture was used to interface between the Model and mass inertia table. The mass inertia of the tooling fixture was measured prior to the Model test.

Results of the mass properties tests are given in Figure 36. Measured test data is listed under "AS MEASURED". Test results agree well with predictions. Addition of 3.39 pounds of ballast to the Model as shown in the figure was calculated to null the cross products of inertia. The values given under "CALCULATED FROM TEST DATA WITH BALLAST" and under "PRELIMINARY REQUIREMENT" indicate that preliminary mass property requirements are met with the possible exception of the x c.g. location. However, as noted on the chart the 9.53 inch value given for the x c.g. location is predicted to change to 8.64 inch when the fiberglass core and facesheet and heat shields (i.e., a complete Model) are present on the Model.

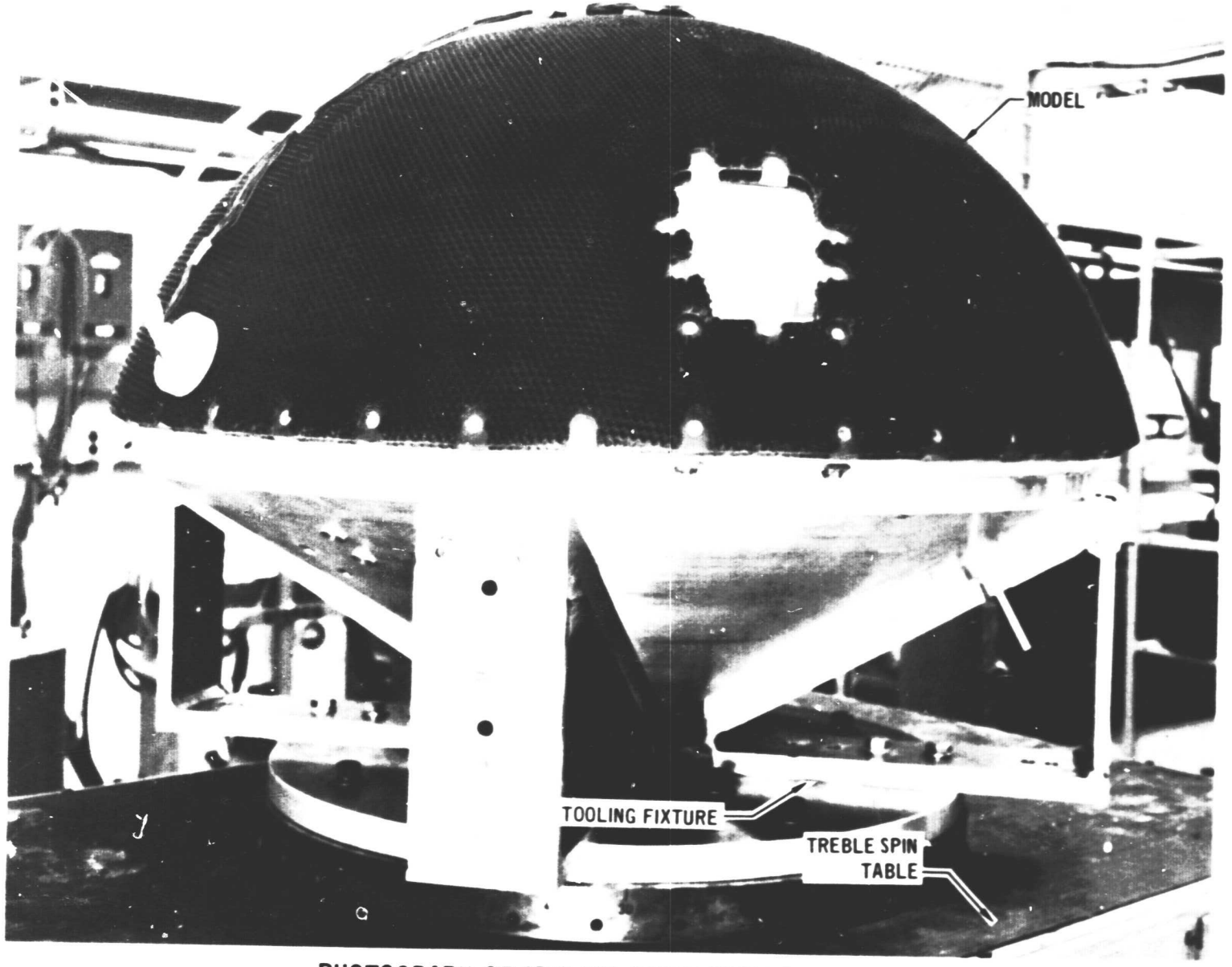
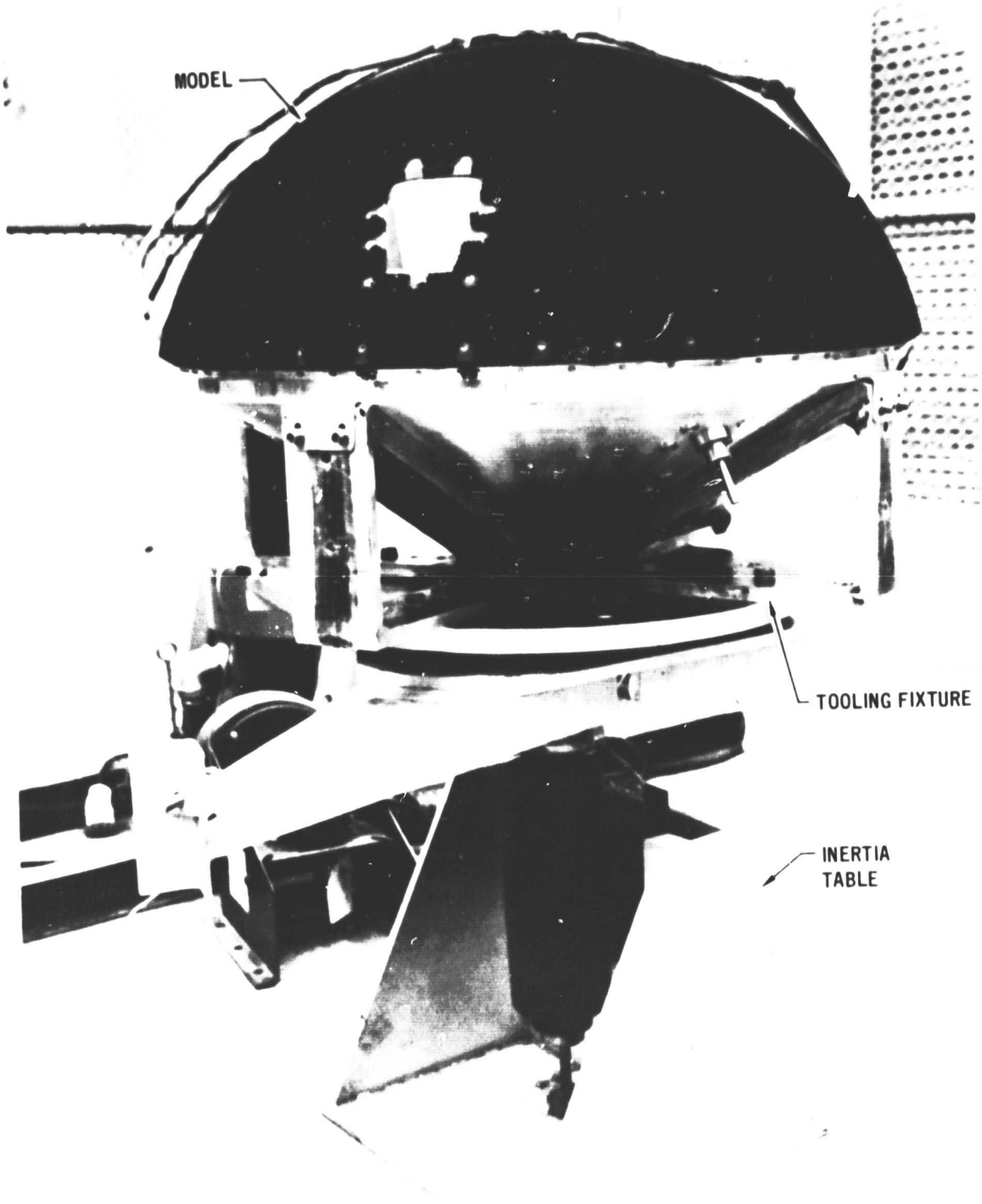


FIGURE 34

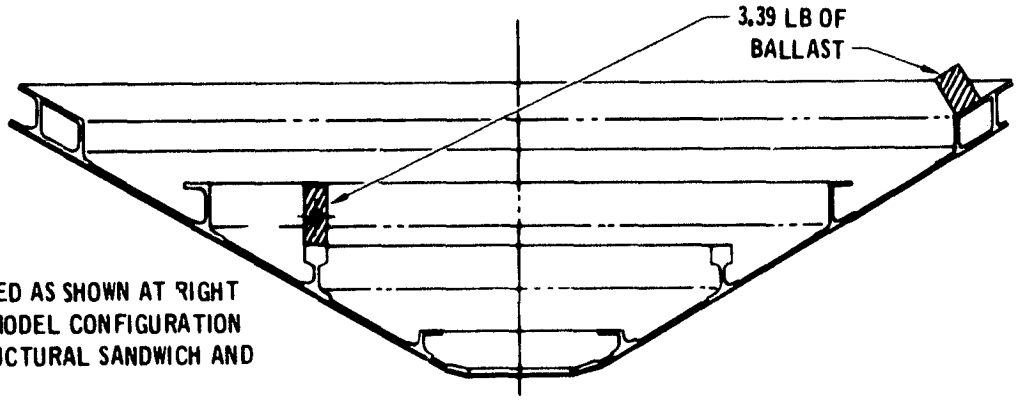
PHOTOGRAPH OF SPIN BALANCE TEST HARDWARE



PHOTOGRAPH OF MASS INERTIA TEST HARDWARE

FIGURE 35

MASS PROPERTY		PREDICTED	AS MEASURED	CALCULATED FROM TEST DATA WITH BALLAST*	PRELIMINARY REQUIREMENT
WEIGHT (LB)		96.06**	94.6	95.5	171
X C.G.	(IN.)	9.42***	9.56	9.53****	8.78
Y C.G.	(IN.)	0.04	0.06	0	~0
Z C.G.	(IN.)	-0.20	-0.09	0	~0
I_x	(SLUG FT^2)	2.055	1.877	1.926	
I_y	(SLUG FT^2)	1.361	N.M.	N.M. (NOT MEASURED)	$I_x \cdot 1.1\ I_y, I_z$
I_z	(SLUG FT^2)	1.280	N.M.	N.M.	
PXY	(SLUG FT^2)	0.000	0.000	0	~0
PXZ	(SLUG FT^2)	-0.023	0.012	0	~0



* BALLAST ADDED AS SHOWN AT RIGHT
** INCOMPLETE MODEL CONFIGURATION
*** 8.58 WITH STRUCTURAL SANDWICH AND HEAT SHIELDS
**** 8.64 WITH STRUCTURAL SANDWICH AND HEAT SHIELDS

MASS PROPERTIES MEET REQUIREMENTS

FIGURE 36

ADVANCED TEST PLANNING

This completed series of structural tests have partially verified and enhanced confidence in the probe structural concept; no further early developmental tests of the engineering Model are recommended. However, additional structural tests beyond the scope of these proof-of-concept tests are required to fully verify the probe structural integrity and should be conducted on a full scale engineering Model of the final probe flight hardware design. A brief summary of future structural tests and recommended test fixtures is given in Figure 37.

TEST	COMPONENT	TEST FIXTURE
STATIC	FORWARD AEROSHELL	CENTRIFUGE OR SR&T TYPE FIXTURE EXCEPT USE FLUID BAGS FOR FOREBODY PRESSURE APPLICATION
	AFT AEROSHELL	CENTRIFUGE OR FLUID BAGS/FIXTURE
	EQUIPMENT	CENTRIFUGE
DYNAMIC	COMPLETE PROBE ASSEMBLY	SHAKE TABLE WITH APPROPRIATE LOAD/MASS CAPABILITY
SHOCK	COMPLETE PROBE ASSEMBLY	NONE REQUIRED

RECOMMENDED FIXTURES FOR FUTURE TESTS

FIGURE 37

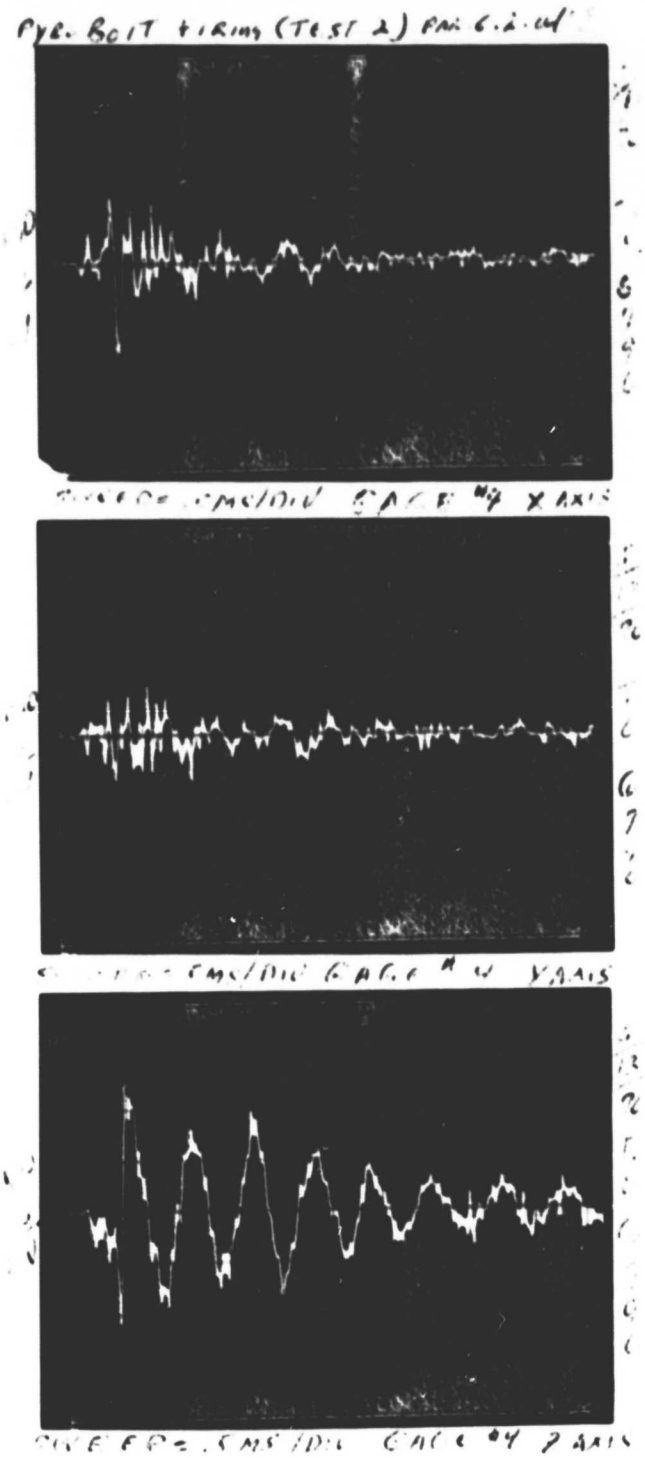
ACKNOWLEDGEMENTS

Mr. J. A. Smittkamp (senior engineer-technology) was responsible for coordination of the test program and for static tests. Mr. W. H. Gustin (senior engineer-technology) was responsible for the spin balance and weight tests. Mr. M. W. Griffin (senior technical specialist) was responsible for the shock and dynamic tests.

The authors are grateful to Mr. T. M. Edwards (NASA-ARC Contract Monitor) for his advice and work in supervising the ARC testing effort during this program.

APPENDIX A

SHOCK TEST DATA



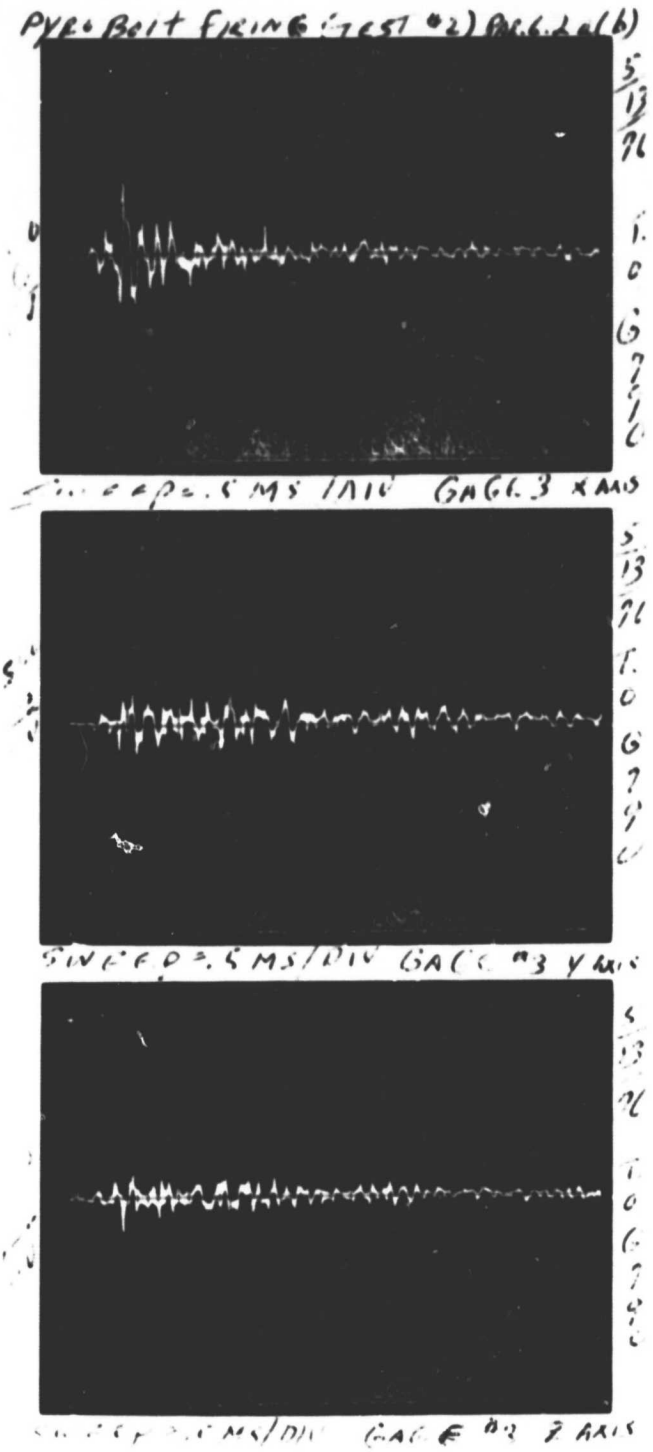
X AXIS

Y AXIS

Z AXIS

Shock at Clamp Band, Test 2, Position 4, at 0°
500g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 1



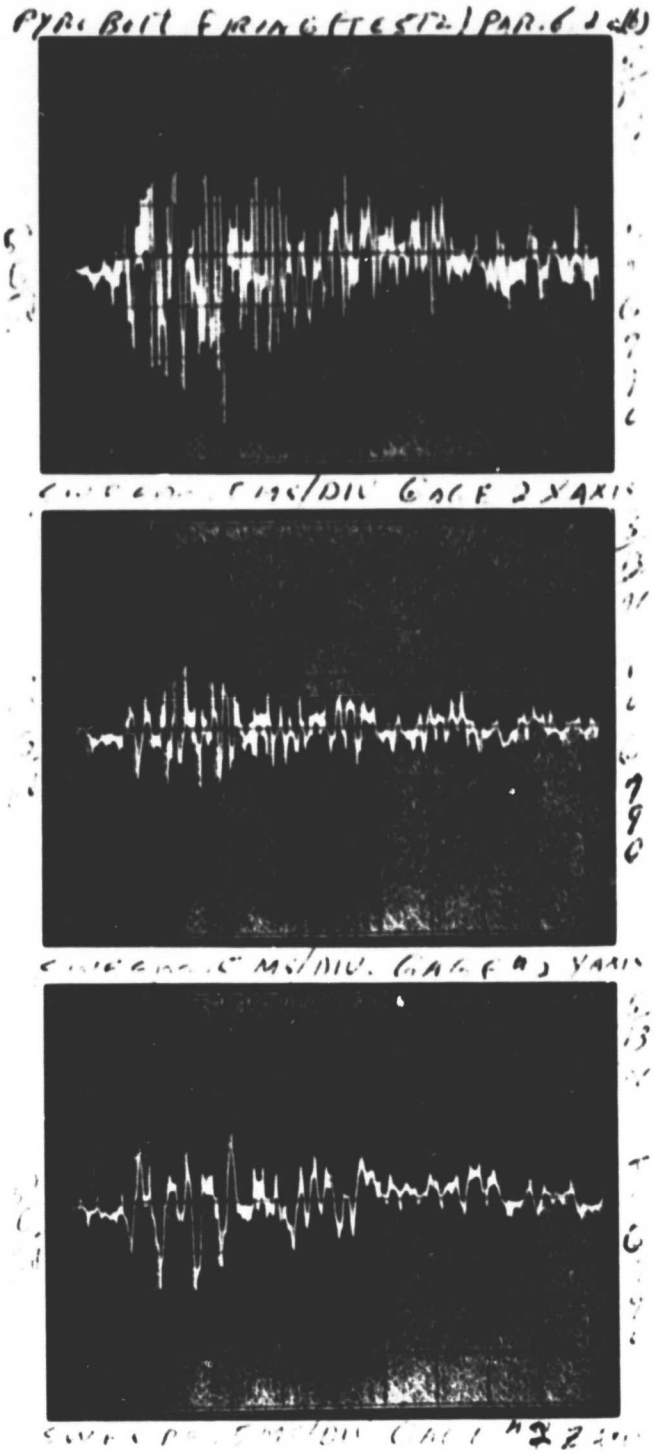
X AXIS

Y AXIS

Z AXIS

Shock at Pelmac Bolt, Test 2, Position 3, at 0°
500g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 2



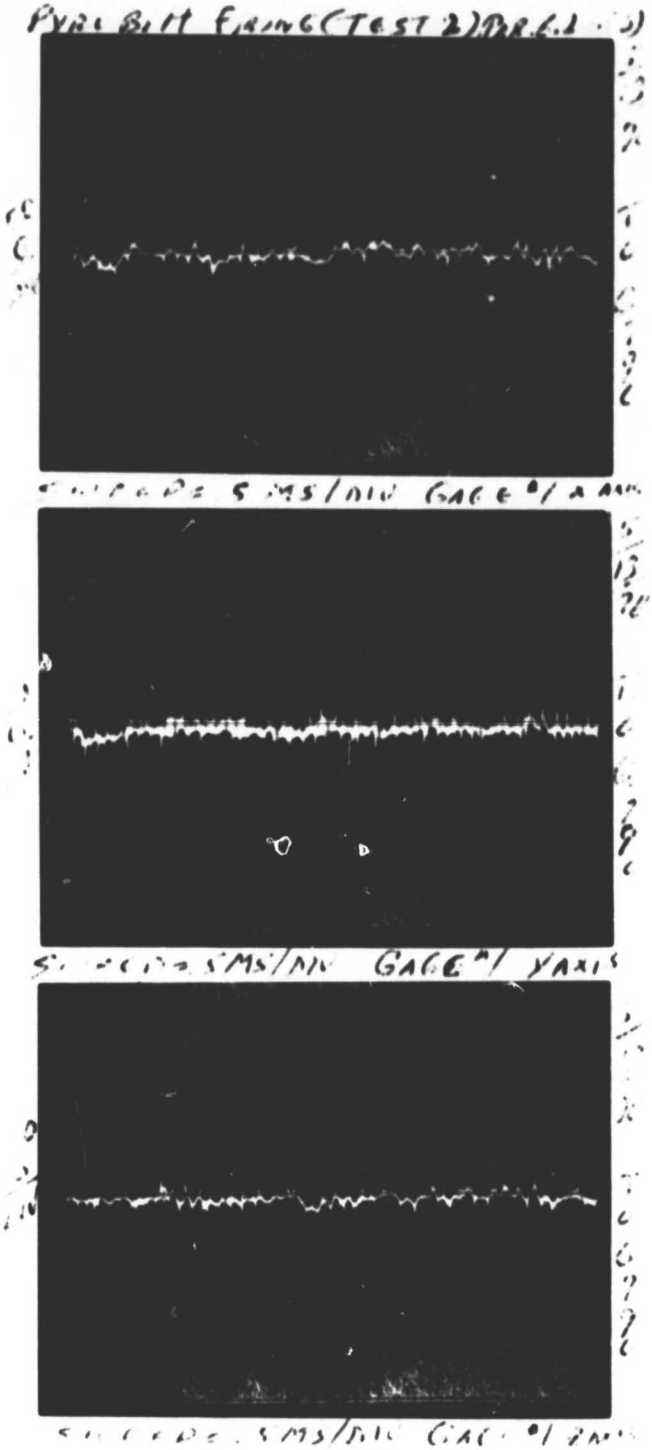
X AXIS

Y AXIS

Z AXIS

Shock on Probe at Pelmac Bolt, Position 2, 0°, Test 2
50g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 3



X AXIS

Y AXIS

Z AXIS

Shock on Probe Instrument Mounting Ring, Position 1, 0°, Test 2
50g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 4

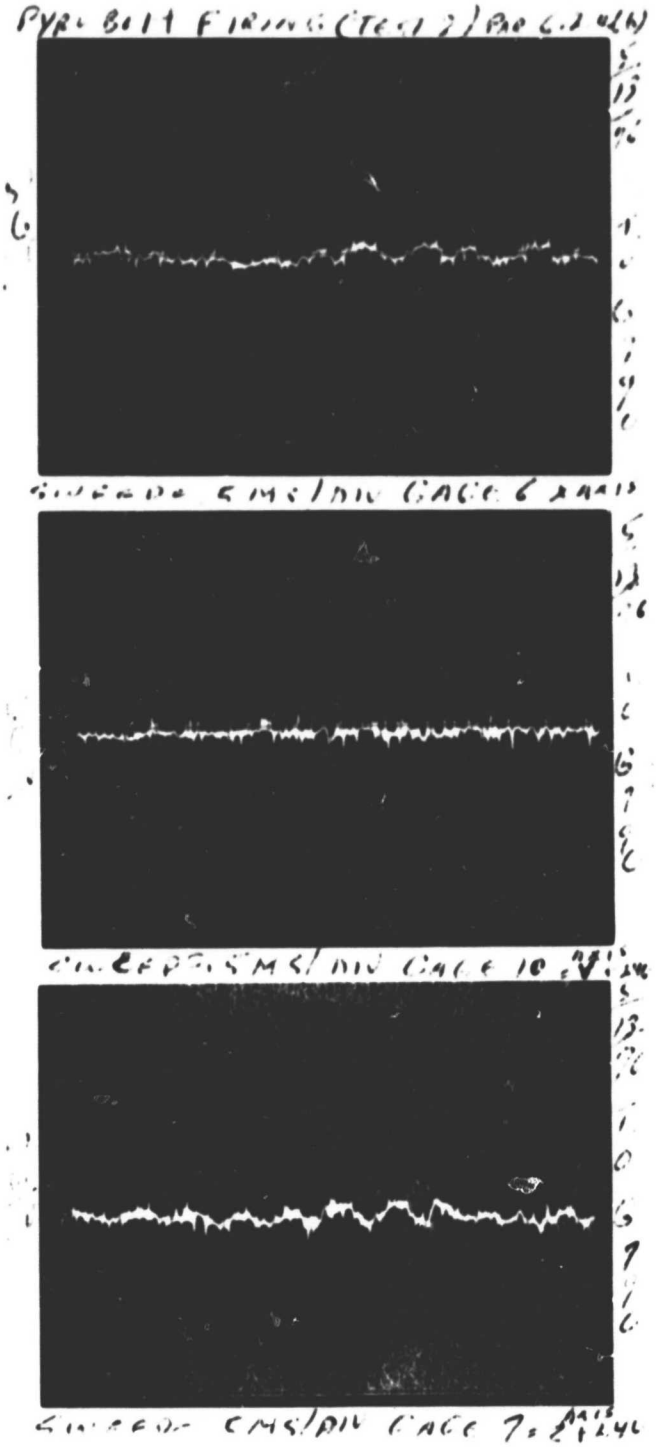
X AXIS

TANGENTIAL

RADIAL

Shock on Probe Instrument Mounting Ring, Position 1, 120°, Test 2
50g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 5



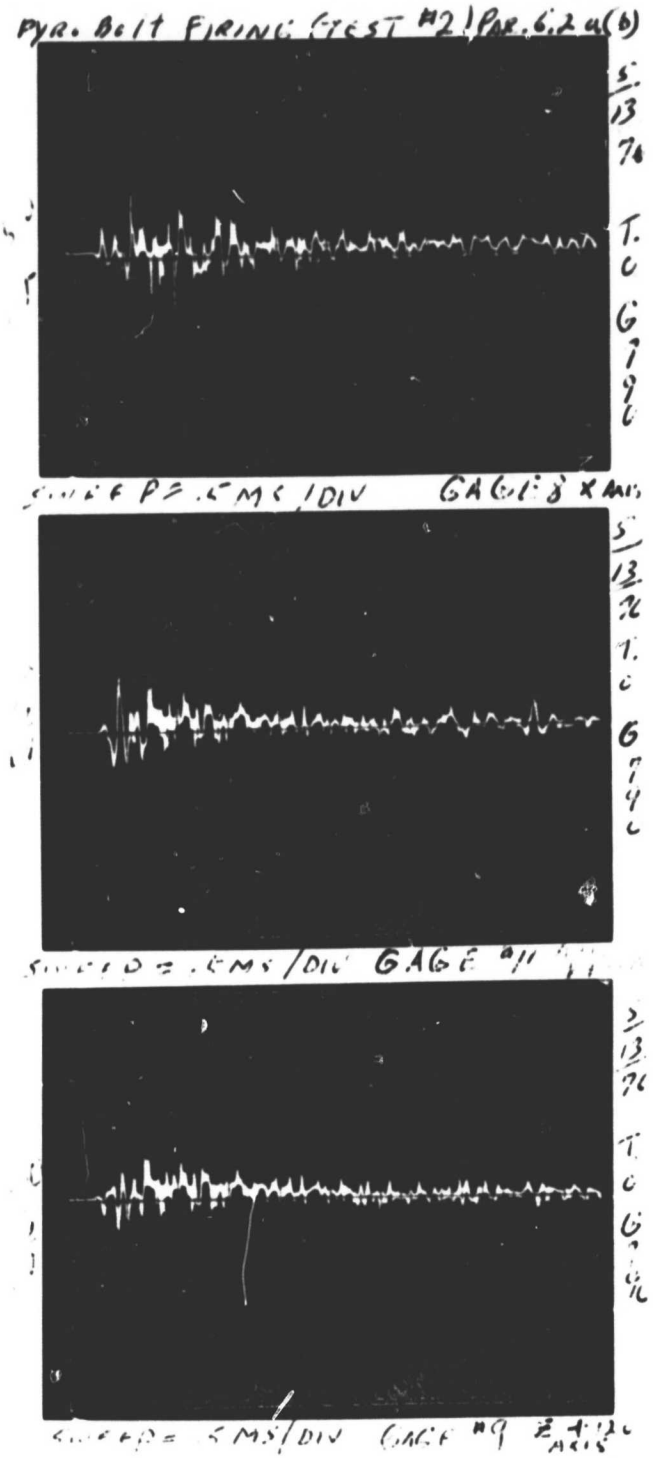
X AXIS

TANGENTIAL

RADIAL

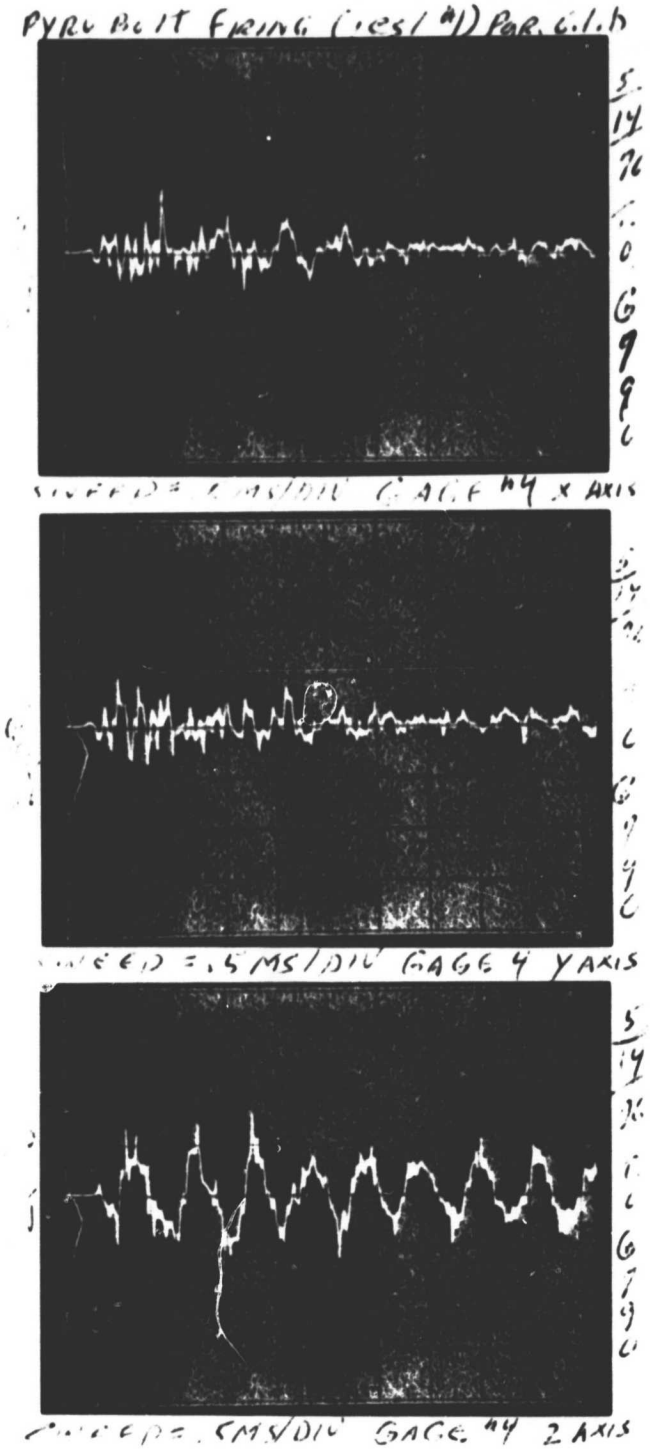
Shock on Probe Instrument Mounting Ring, Position 1, 240°, Test 2
50g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 6



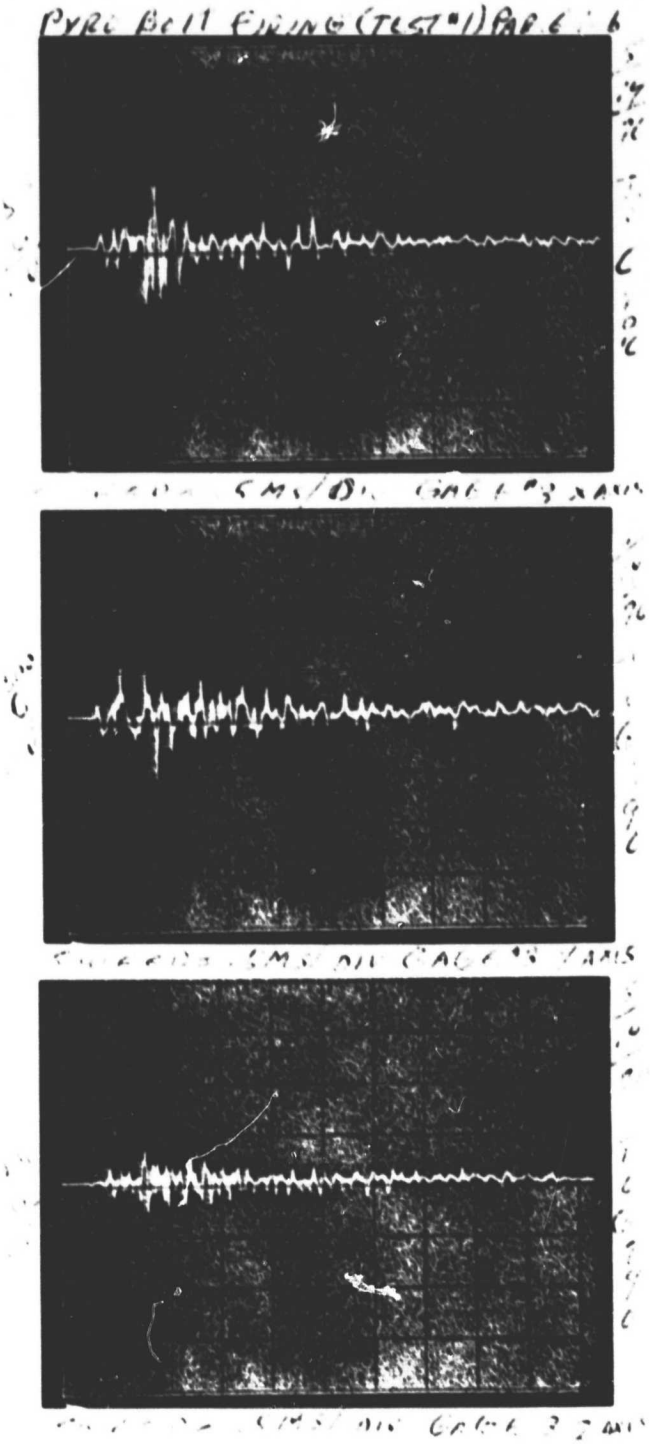
Shock on Adapter at Pelmac Bolt, Position 3, 120°, Test 2
500g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 7



Shock on Adapter at Clamp Band, Position 4, 0°, Test 1
500g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 8



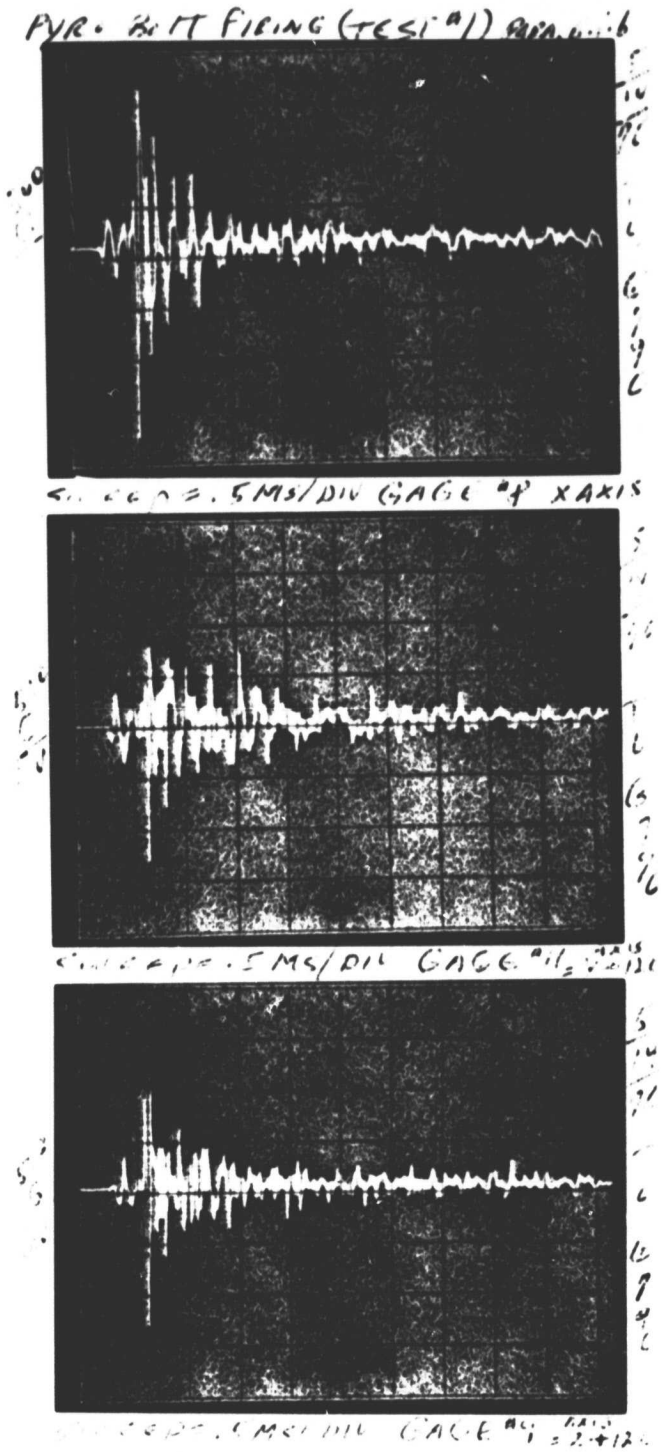
X AXIS

Y AXIS

Z AXIS

Shock on Adapter at Pelmac Bolt, Position 3, 0°, Test 1
500g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 9



X AXIS

TANGENTIAL

RADIAL

Shock on Adapter at Pelmac Bolt, Test 1, Position 3, 120°
500g per Vertical Division, 0.5ms per Horizontal Division

FIGURE 10

APPENDIX B

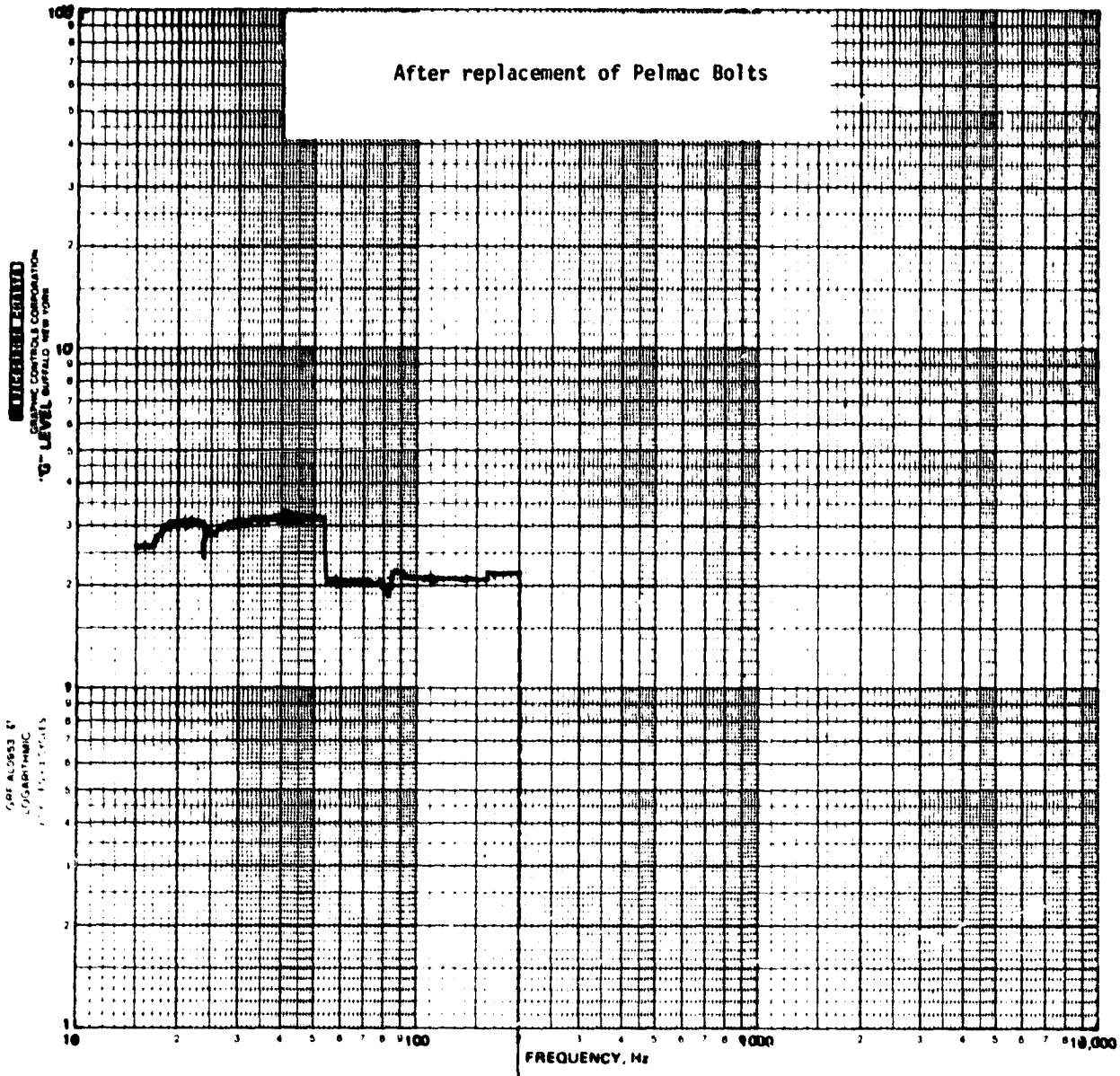
DYNAMIC TEST DATA

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME HOURS/MINUTES/SECONDS
T. McCANN	G790	T60P3	5-27-76	

TYPE OF TEST:	TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION	T. EDWARDS	1

TEST ITEM:	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
NC39	CONTROL - UNDERSIDE OF HEAD EXPANDER (Z AXIS)	1	NC39

VIBRATION DIRECTION	INPUT LEVEL
VERTICAL (Z AXIS)	SEE TABLE 2 OF TEST PROCEDURE

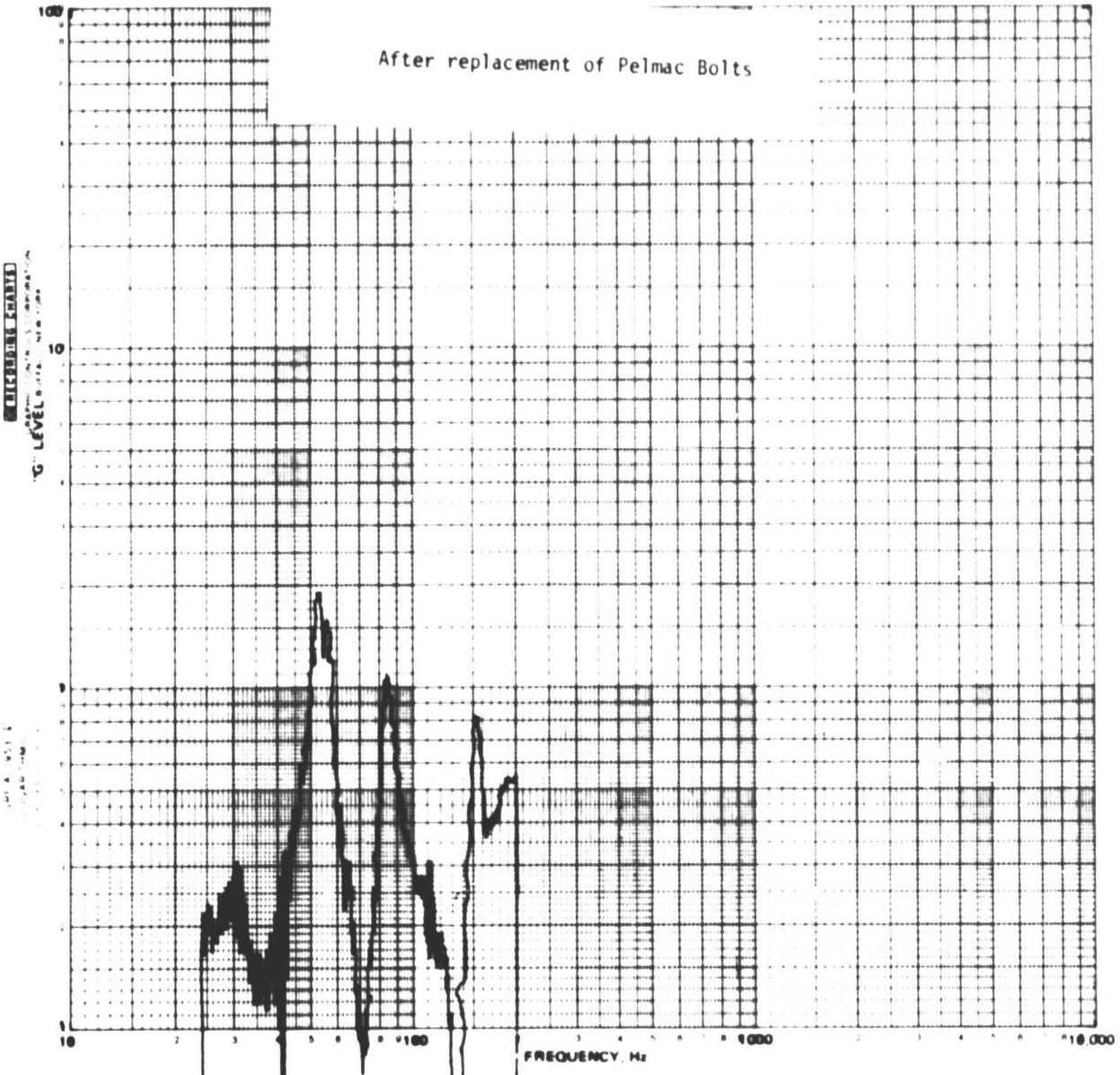
TAPE REEL IDENT NO.	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	0230TO2400	7½	CH2	CH1

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
T. McCANN	G790	T6083	5-27-76	HOURS&MINUTES&SECONDS

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		T. EDWARDS	2

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
JA88	BOOT STRAP BATTERY - TOP SURFACE/RADIAL AXIS	7	NC 39

VIBRATION DIRECTION	INPUT LEVEL
VERTICAL (Z AXIS)	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL ID NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2230 TO 2400	7½	CH 2	CH 2

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
J. McCANN	G 790	T6083	5-27-76	HOURS&MINUTES&SECONDS
TYPE OF TEST: VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 2
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		S/N		QUALITY ASSURANCE

After replacement of Pelmac Bolts

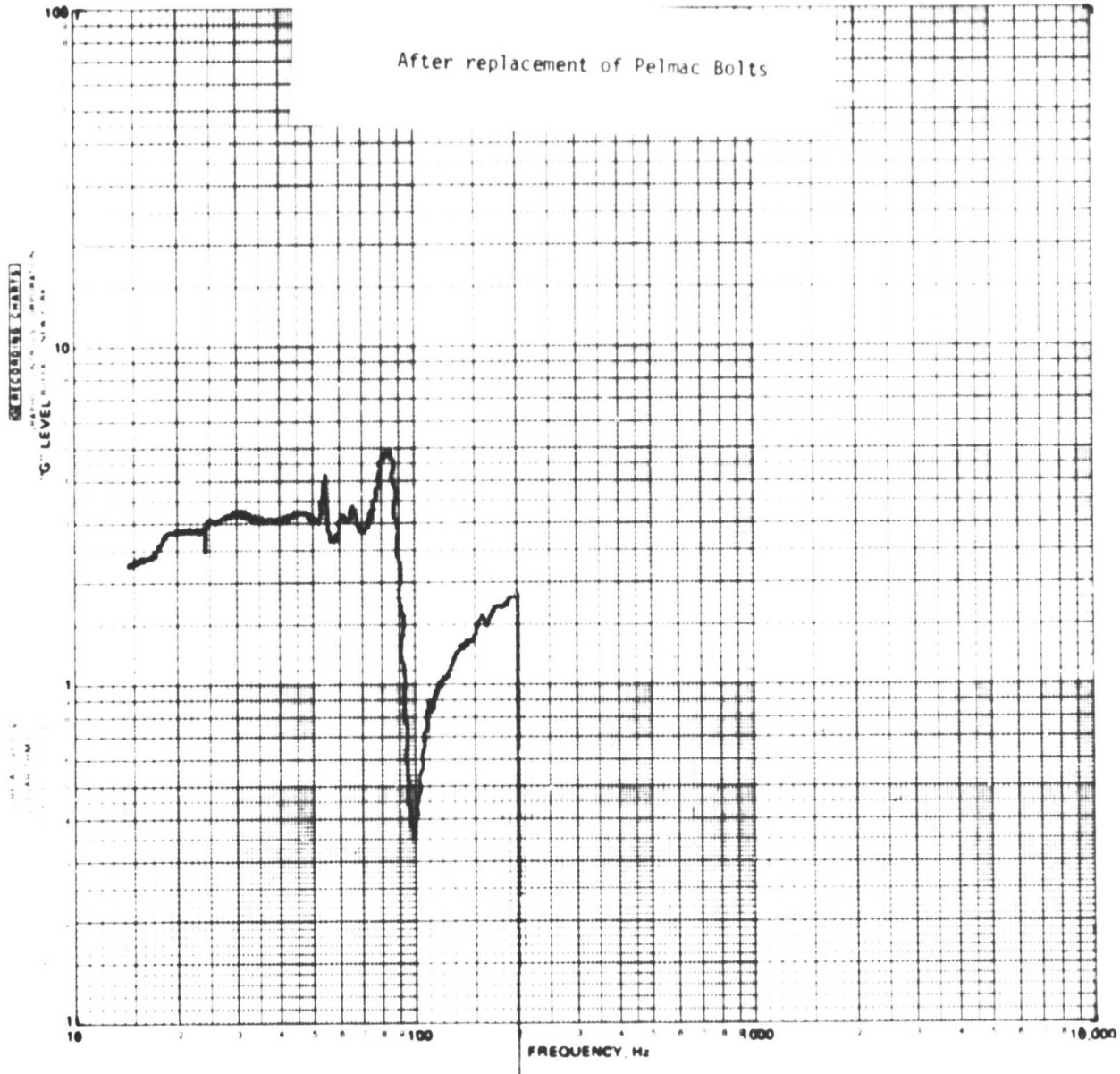
"G" LEVEL

FREQUENCY, Hz

ACCELEROMETER LOCATION				OCT/MIN	CONTROL ACCELER
JA18	BOOT	STRAP	BOTTOM - TOP SURFACE CENTERLINE AFT	1	NC 39
VIBRATION DIRECTION: VERTICAL (Y AXIS)			INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE		
TAPE REEL ID: FOUR	TAPE REEL LOCATION: 2230 TO 2400		TAPE SPEED: 7½	TAPE CHANNEL: CH 3	PRE AMP CHANNEL: CN 3

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

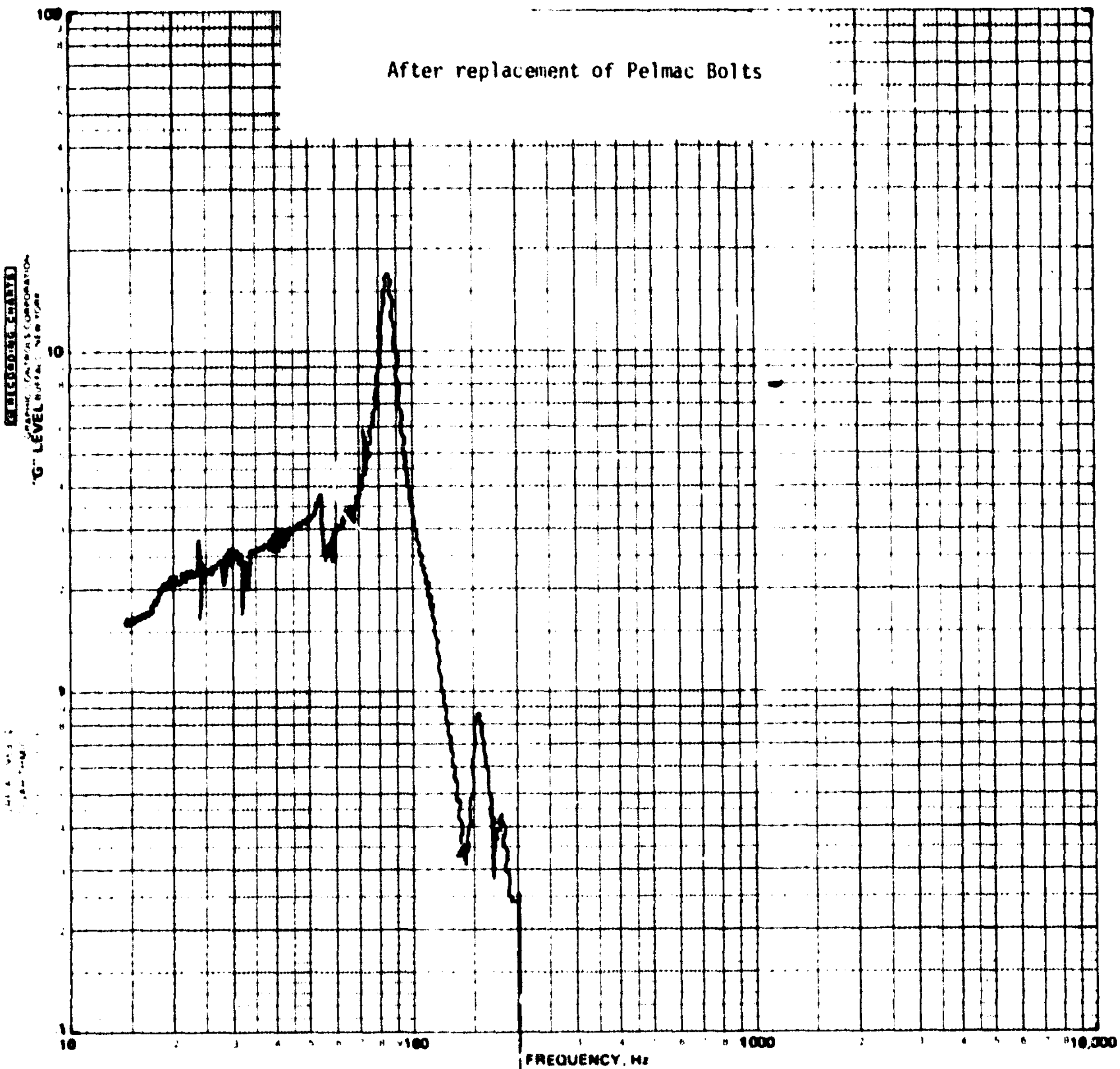
EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
T. McCANN	G790	T6083	5-27-76	HOURS MINUTES SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 2
TEST ITEM: SATURN/URANUS ENGINEERING				QUALITY ASSURANCE
PROTOTYPE THERMAL PROBE		S/N		



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
NC03	PELMAC BOLT (X AXIS)	1	NC 39
VIBRATION DIRECTION: VERTICAL (X AXIS)		INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	
TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SNT/UR	2230 TO 2400	7½	CH 4	CH 4

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
T. McCANN	G790	T6083	5-27-76	HOURS-MINUTES-SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 2
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		S/N		QUALITY ASSURANCE



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
[illegible]	NOSE PROBE-BOTTOM CENTER (X AXIS)	1	NC 39

VIBRATION DIRECTION	INPUT LEVEL
VERTICAL (X AXIS)	SEE TABLE 2 OF TEST PROCEDURE

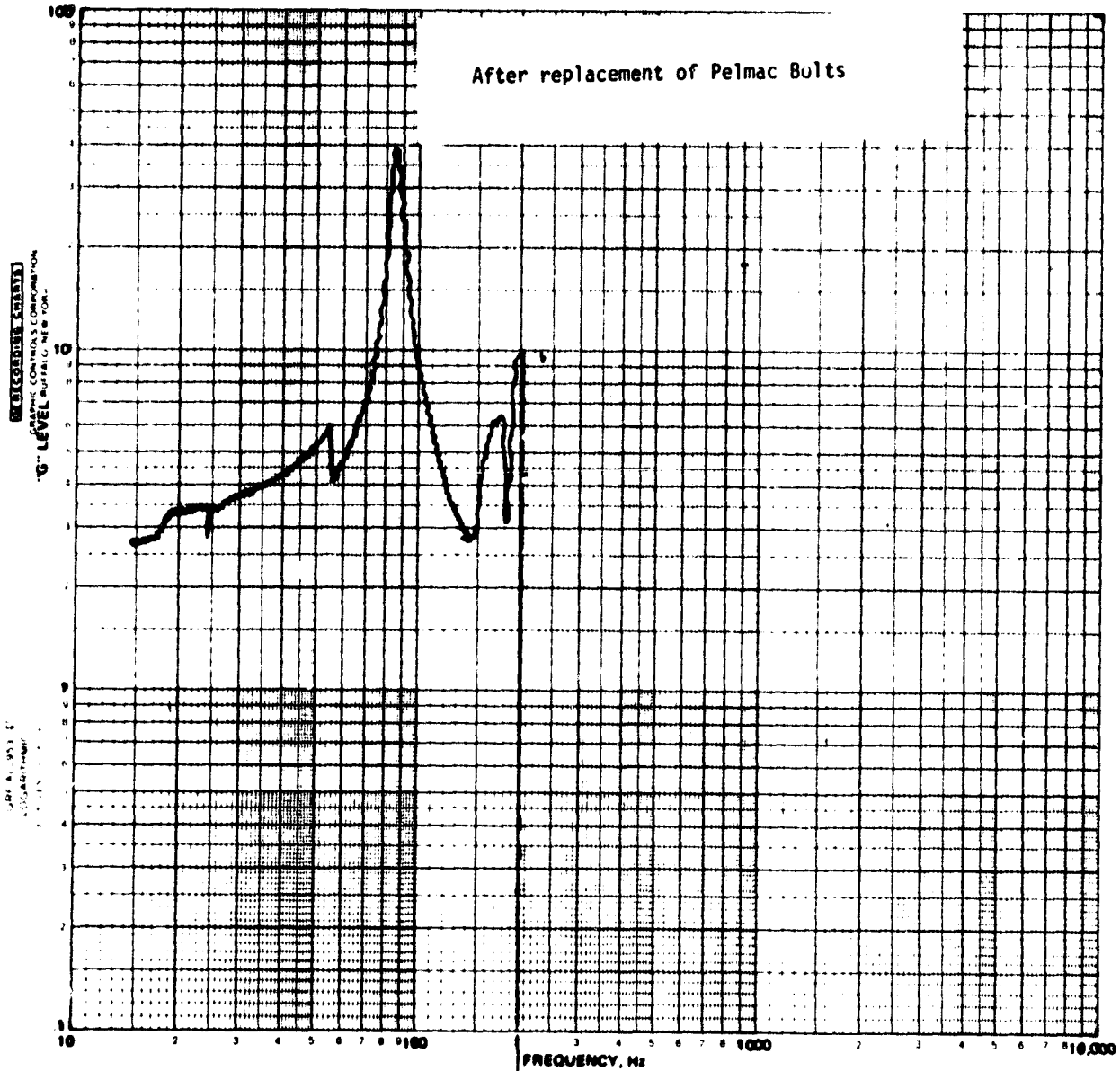
TAPE REEL IDENT NO.	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2230 TO 2400	7½	CH5	CH5

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
T. McCANN	G790	T6083	5-27-76	HOURS&MINUTES&SECONDS

TYPE OF TEST:	TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION	T. EDWARDS	2

TEST ITEM:	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



ACCELEROMETER	LOCATION:	OCT/MIN.	CONTROL ACCELER
RA46	EQUIPMENT COVER-TOP CENTER (X AXIS)	1	NC 3.9

VIBRATION DIRECTION:	INPUT LEVEL
VERTICAL (X AXIS)	SEE TABLE 2 OF TEST PROCEDURE

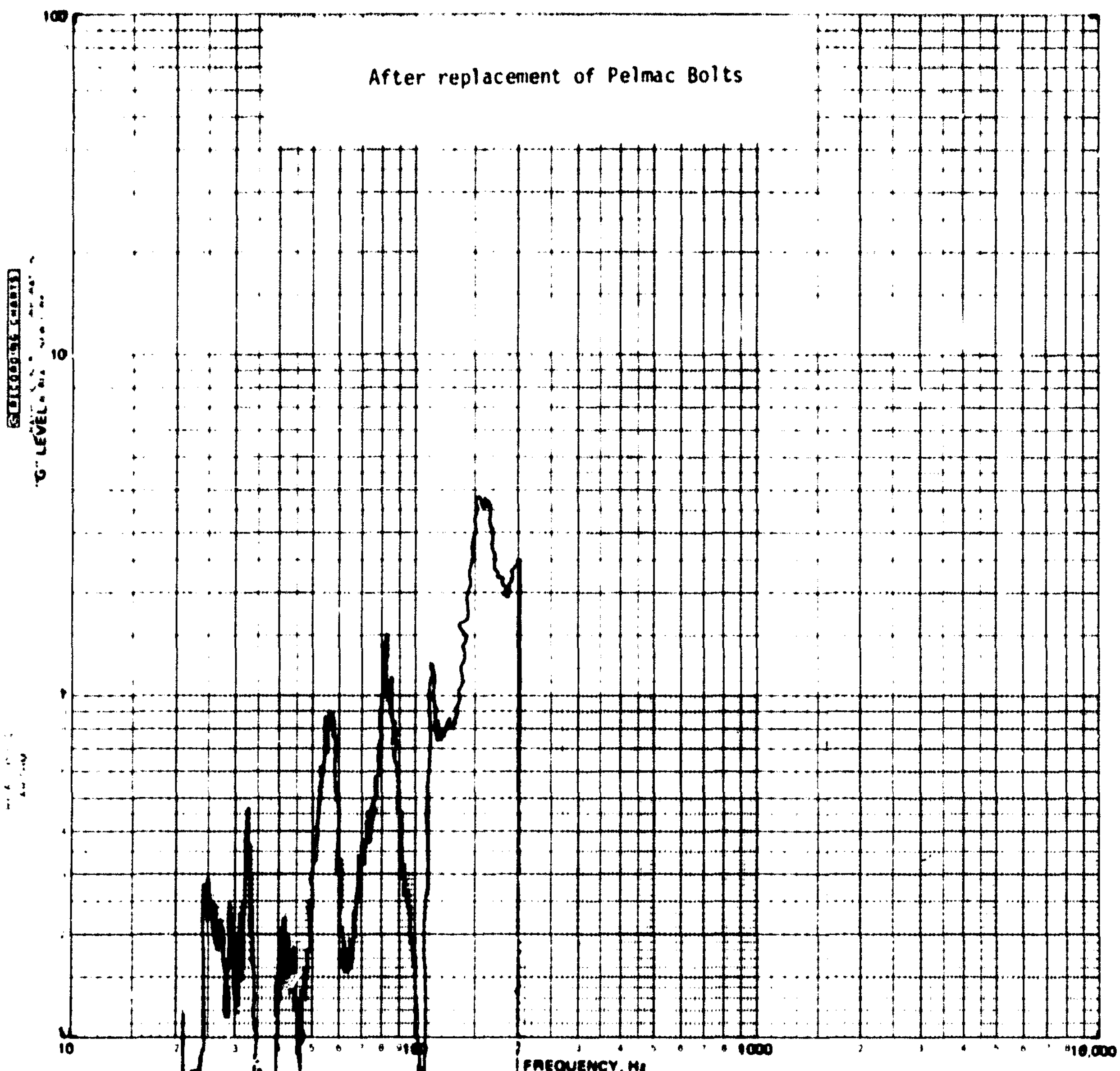
TAPE REEL IDENT. NO.	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE-AMP CHANNEL
SAT/UR	2230 TO 2400	7½	CH 6	CH 6

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME (HOURS/MINUTES/SECONDS)
T. McCANN	6290	T60P3	5-27-76	

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		T. EDWARDS	2

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



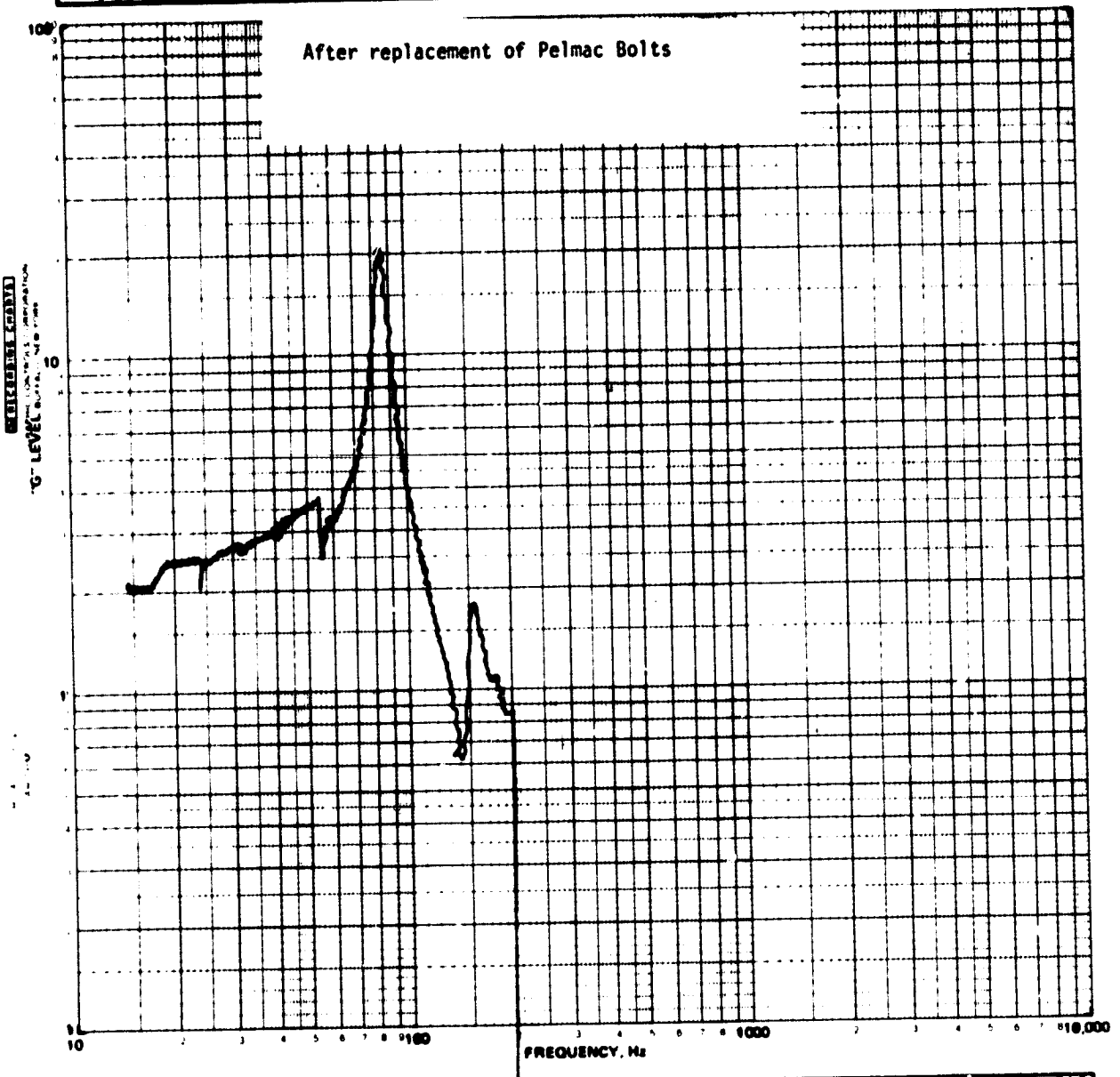
ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
S/N	NEPHELOMETER-TOP SURFACE (TANGENTIAL AXIS)	1	NC 39

VIBRATION DIRECTION	INPUT LEVEL
VERTICAL (X AXIS)	SEE TABLE 2 of TEST PROCEDURE

TAPE REEL IDENT NO.	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE-AMP CHANNEL
SSTR...	2230 TO 2460	7½	CH 7	CH 7

AMES RESEARCH CENTER
RSQA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
T. M°CANN	G790	T60F3	5-27-76	HOURS/MINUTES/SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR T. EDWARDS		RUN NUMBER 2
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		SN		QUALITY ASSURANCE



ACCELEROMETER	LOCATION		OCT/MIN.	CONTROL ACCELER
5747	MASS SPECTROMETER-SIDE NEAR CENTERLINE	(X AXIS)	1	NC 39
VIBRATION DIRECTION: VERTICAL (Z AXIS)			INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	
TAPE REEL IDENT NO: SAT/UR	TAPE REEL LOCATION: 2230 TO 2400	TAPE SPEED: 7½	TAPE CHANNEL: CH 8	PRE-AMP CHANNEL: CH 8

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SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
T. McCANN	G790	T6483	5-27-76	HOUR/MIN/TENTH SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 2
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		S/N		QUALITY ASSURANCE

After replacement of Pelmac Bolts

'G' LEVEL

100
10
1

10 100 1000 10,000

FREQUENCY, Hz

ACCELEROMETER	LOCATION		OCT/MIN	CONTROL ACCELER
1A57	RELAY BOX - SIDE	TOWARD CENTER (X AXIS)	1	NC 29
VIBRATION DIRECTION: VERTICAL (X AXIS)			INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	
TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/MR	2230 TO 2400	7½	CH 9	CH 9

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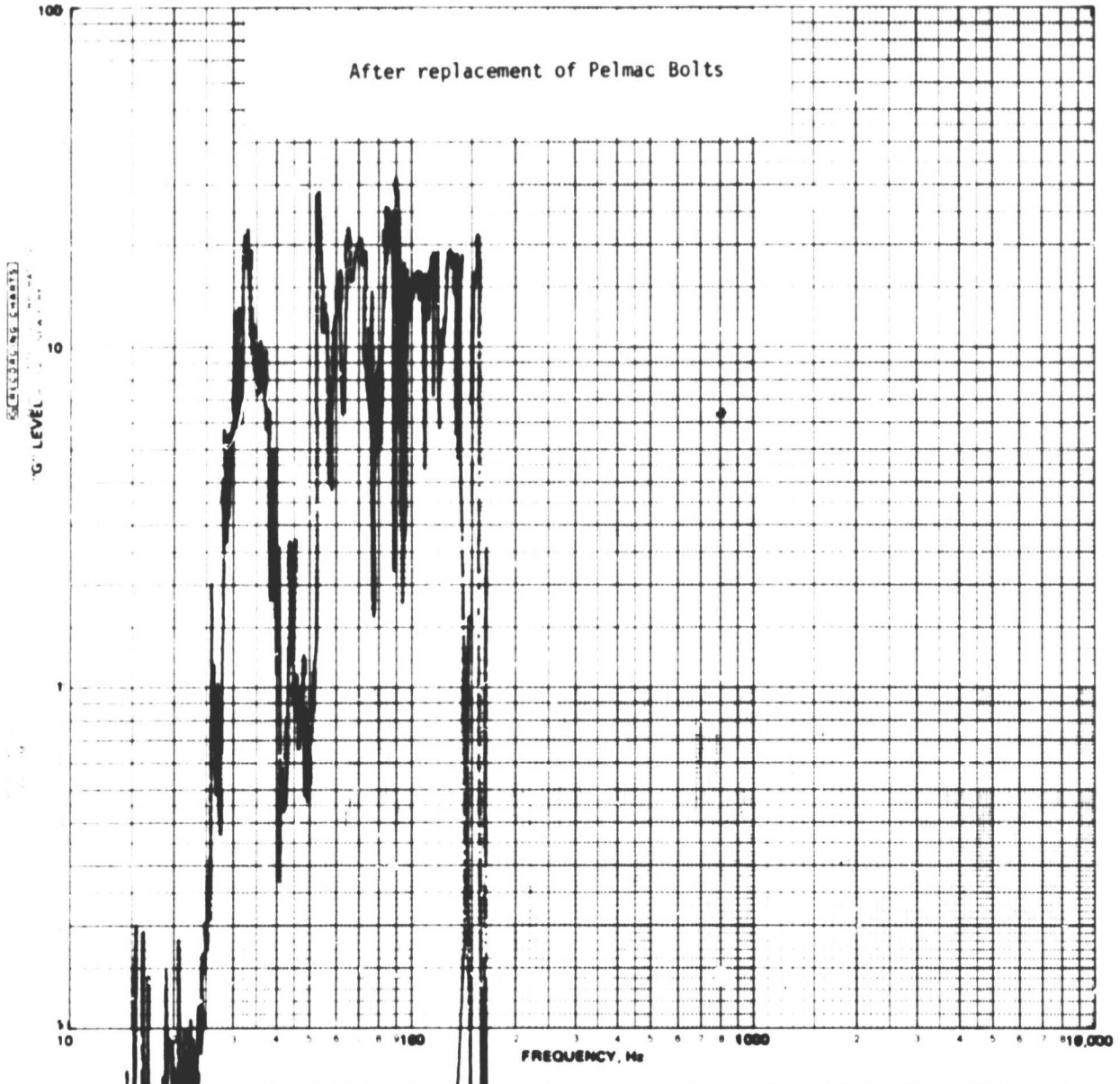
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
T. McCANN	G790	T6083	5-27-76	HOURS•MINUTES•SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 2
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE		S/N		QUALITY ASSURANCE
THERMAL PROBE				



ACCEL	LOCATION	OCT/MIN	CONTROL ACCELER
LATY	RCAY BOX - TOP SURFACE (RADIAL AXIS)	1	NC 39
VIBRA	DIRECTION: VERTICAL (X AXIS)	INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	
TAPE	IDENT NO: SAT/UR	TAPE REEL LOCATION: 2230 TO 2400	TAPE SPEED: 7½
TAPE CHANNEL: CH 10	PRE AMP CHANNEL: CH 10		

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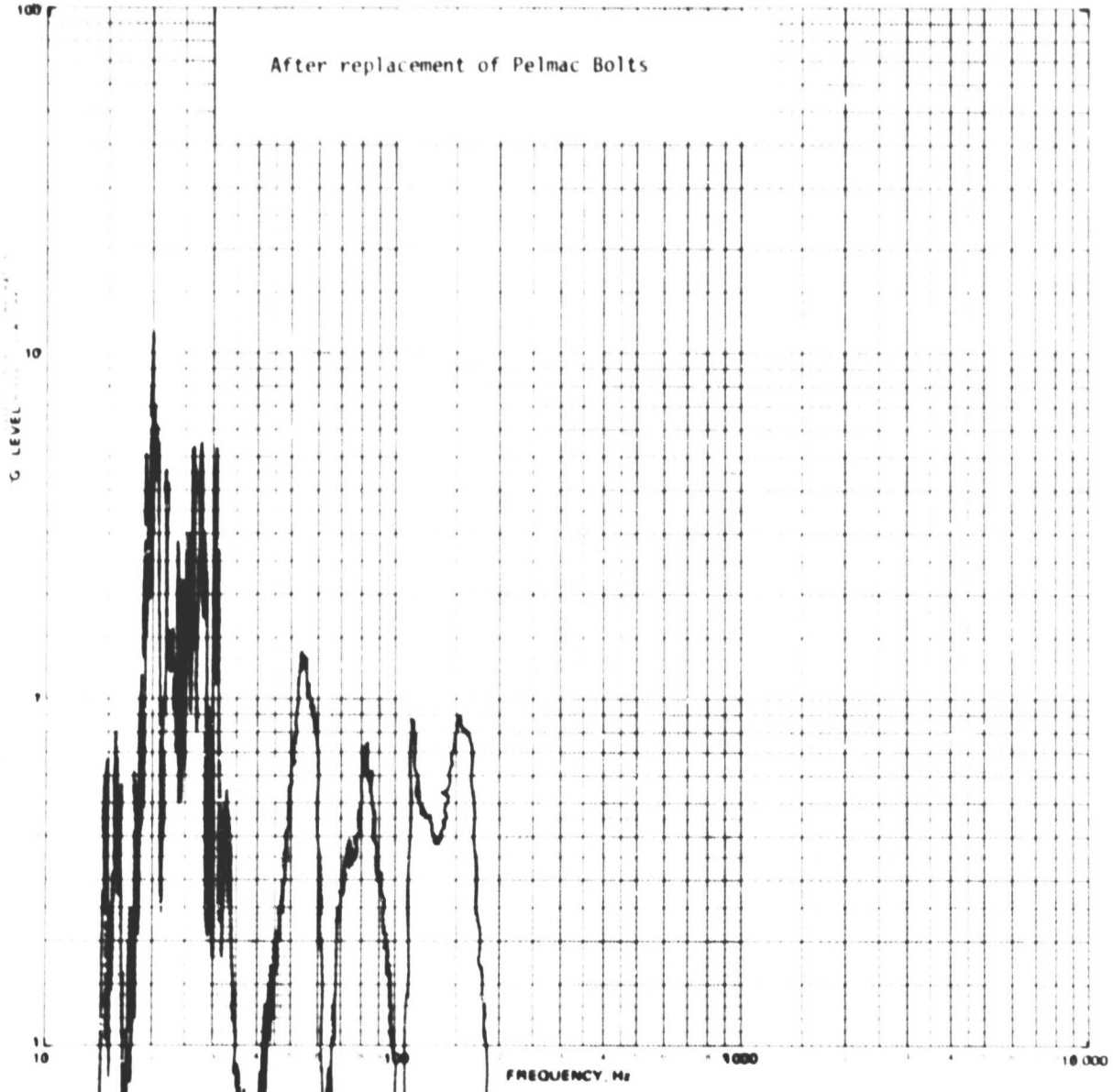
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
T. McCONN	G790	T6083	5-27-76	HOURS/MINUTES/SECONDS

TYPE OF TEST	TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		2

TEST ITEM	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE S/N	



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
4474	RELAY BOX TOP SURFACE (TANGENTIAL AXIS)	/	39

VIBRATION DIRECTION	INPUT LEVEL
VERTICAL AXIS (Z AXIS)	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/LCK	2230TO 2400	14		

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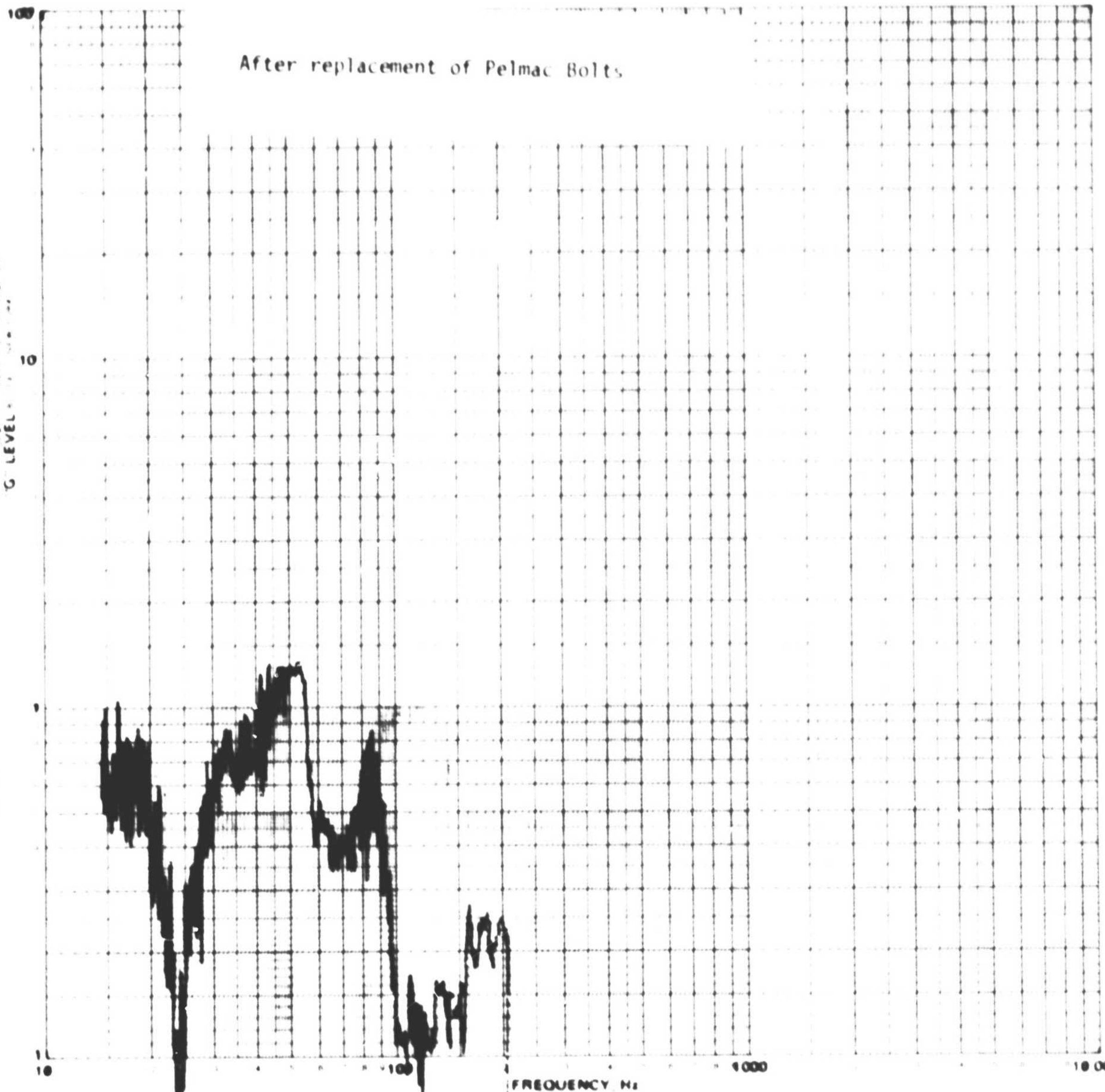
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
T. McCANN	G290	T60PS	5-27-76	HOURS-MINUTES-SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 2
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		S/N		QUALITY ASSURANCE



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
	PRESSURE GAGE - TOP SURFACE NEAR PNEUMATIC CONNECTION (TANGENTIAL AXIS)	1	
VIBRATION DIRECTION: VERTICAL (X AXIS)		INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	

TAPE REEL IDENT. NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2230 TO 2400	7½		

ORIGINAL PAGE IS OF POOR QUALITY

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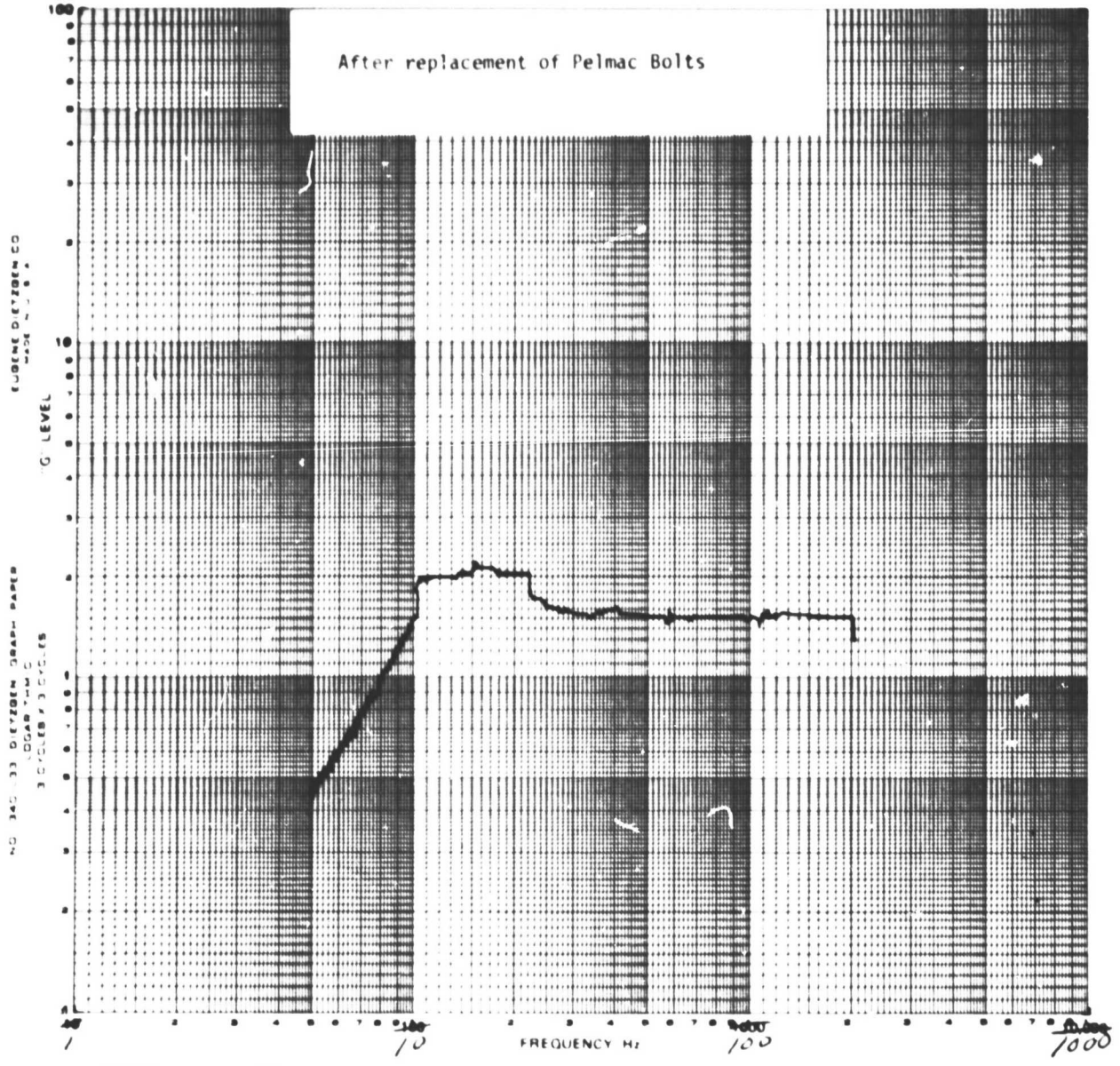
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G790	T6086	5-28-76	HOURS&MINUTES&SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 3
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		S/N		QUALITY ASSURANCE



ACCELEROMETER	LOCATION		CONTROL ACCELER
AC 37	[illegible] (Z AXIS)	[illegible]	AC 39
VIBRATION DIRECTION: Z AXIS		INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	
TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2.80-2822	7½	1	1

PR 049 (JAN 73)

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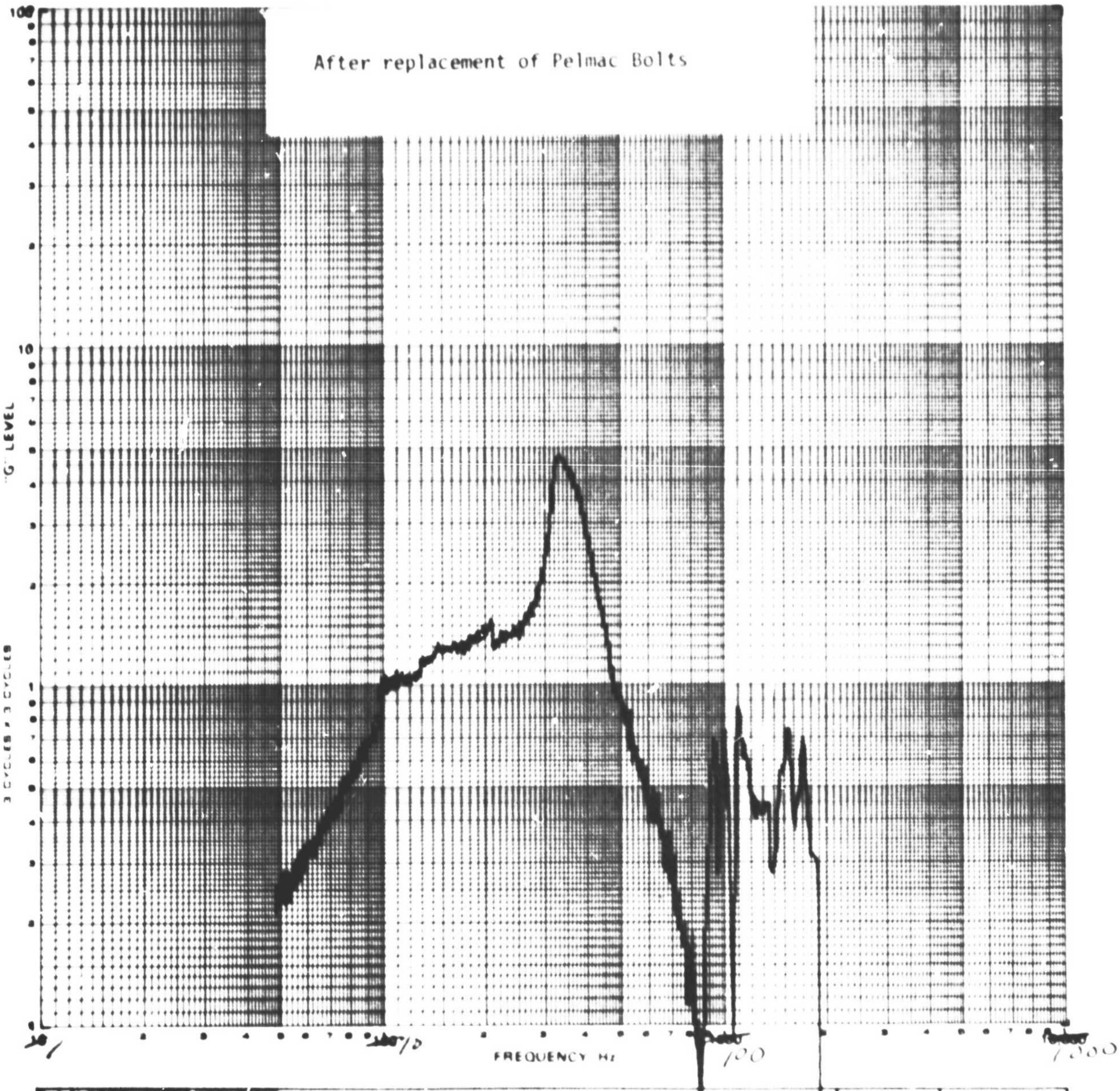
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	6790	T6086	5-28-76	HOURS-MINUTES-SECONDS

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		J. EDWARDS	3

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



ACCELEROMETER	LOCATION	OCT MIN	CONTROL
JA88	BOOT STRAP BATTERY - TOP SURFACE (RADIAL AXIS)	1	N.C. ACCELER 39

VIBRATION DIRECTION	INPUT LEVEL
Z AXIS	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2580-2022	7½	2	2

PR 049 (JAN 73)

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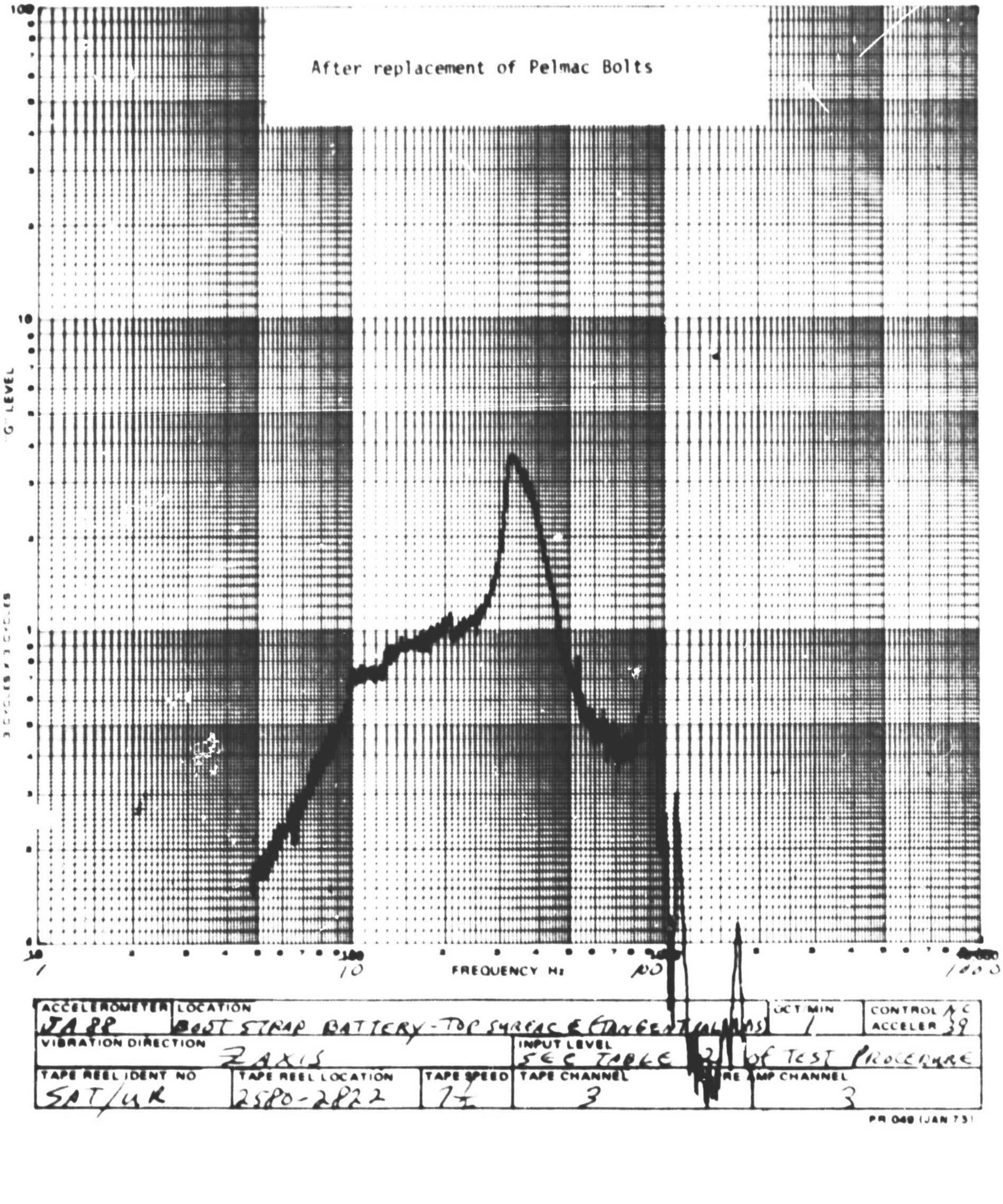
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHC	G770	T 6086	5-28-76	HOURS&MINUTES&SECONDS

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		T EDWARDS	23

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL A/C ACCELER
JA 88	BOOT STRAP BATTERY - TOP SURFACE (TANGENTIAL AXIS)	1	39

VIBRATION DIRECTION	INPUT LEVEL
Z AXIS	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2580-2822	7½	3	3

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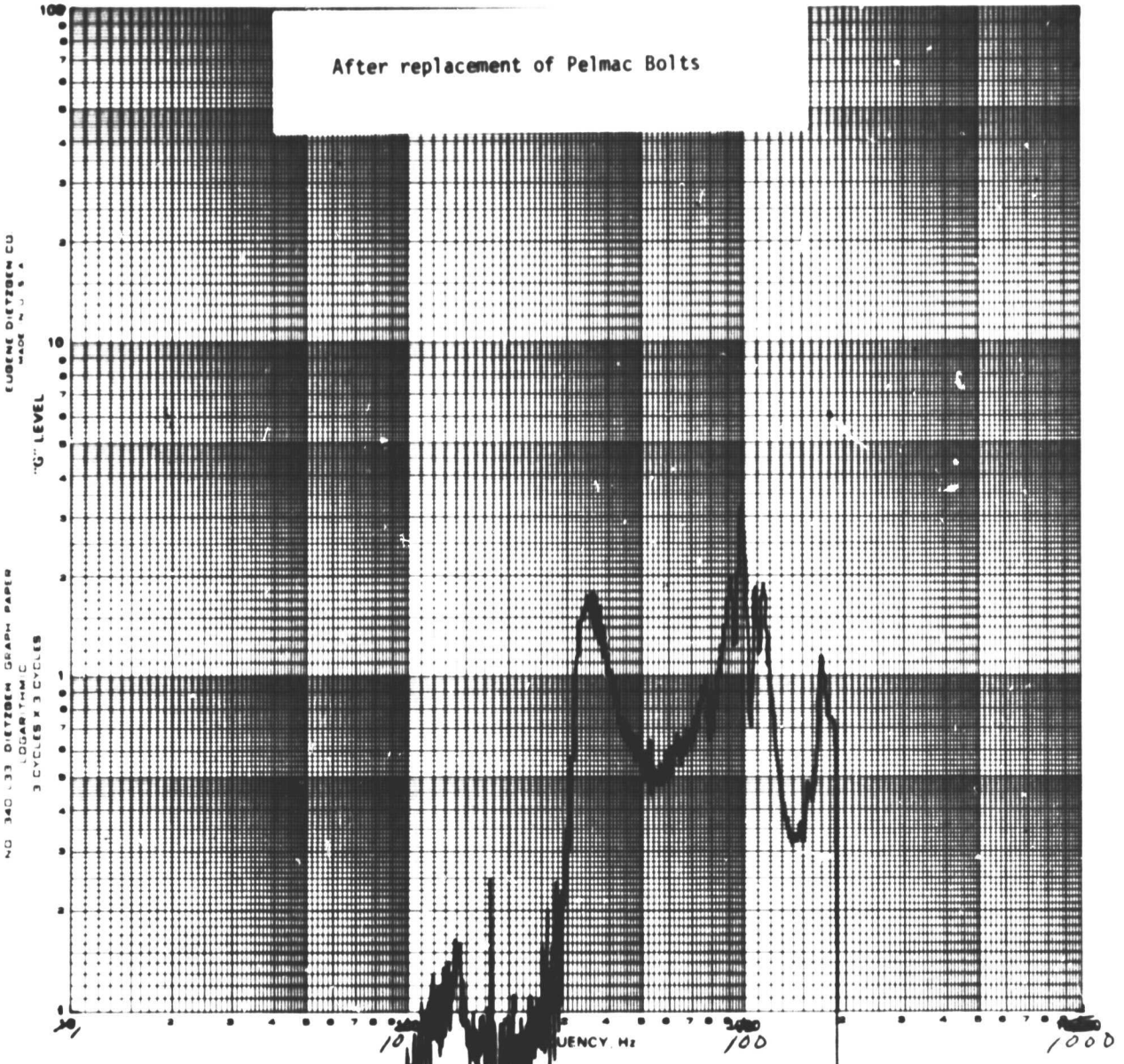
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	WORK ORDER	JOB NUMBER	DATE	TIME
K. MENCHE	6790	T60P6	5-28-96	HOURS/MINUTES/SECONDS

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		T. EDWARDS	3

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



ACCELEROMETER	LOCATION		OCT/MIN	CONTROL ACCELER
NC03	PELMAC BOLT	(X-AXIS) [redacted]	1	NC 39

VIBRATION DIRECTION	INPUT LEVEL
Z AXIS	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT NO.	TAPE DESIGNATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2580-2822	7½	4	4

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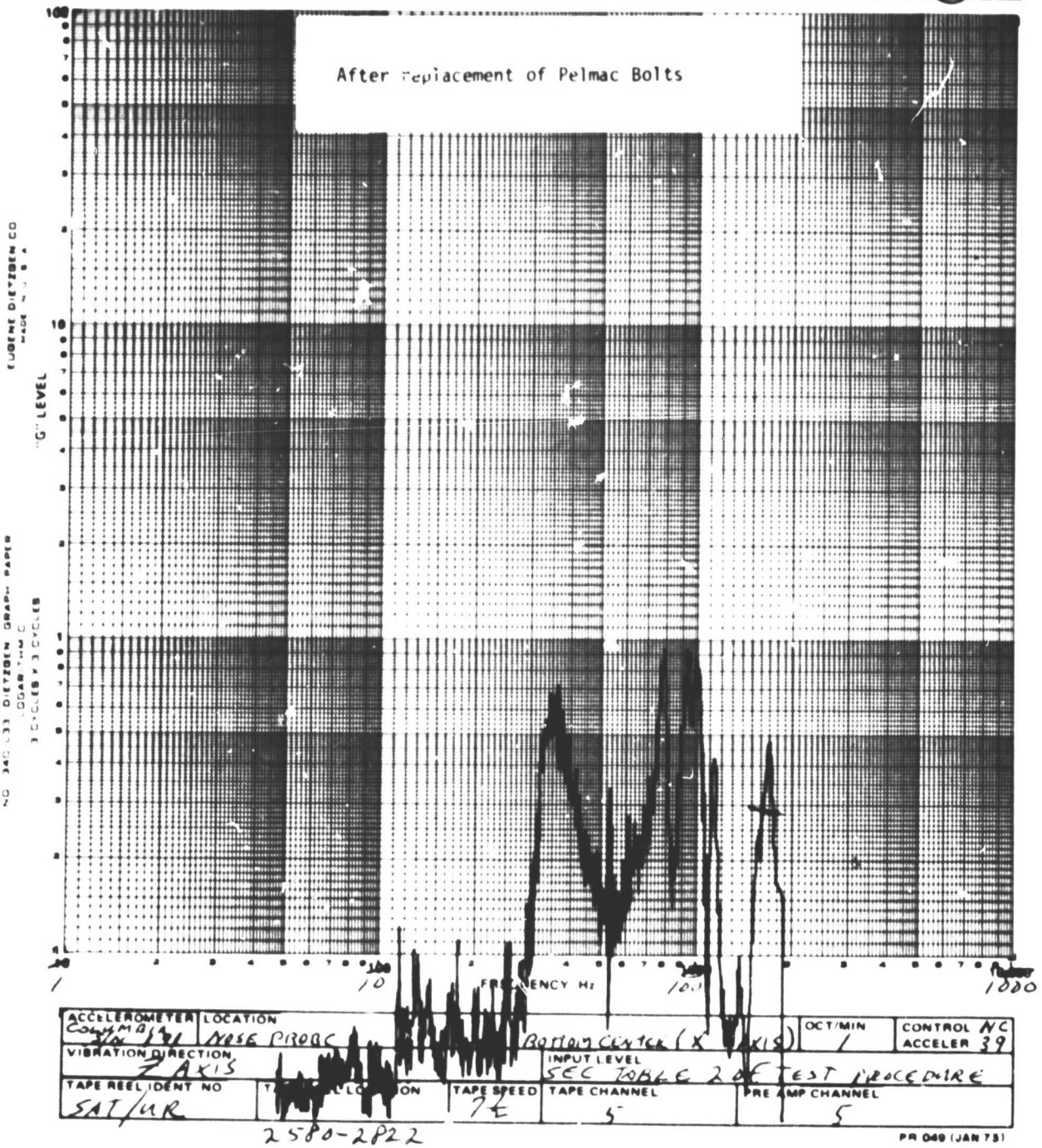
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCAG	G790	T6086	5-24-76	HOURS/MINUTES/SECONDS

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		T. EDWARDS	3

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



ACCELEROMETER	LOCATION		OCT/MIN	CONTROL
Command S/N 131	NOSE PROBE	BOTTOM CENTER (X AXIS)	1	NC ACCELER 39

VIBRATION DIRECTION	INPUT LEVEL
Z AXIS	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT NO	TAPE LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2580-2822	7½	5	5

PR 049 (JAN 73)

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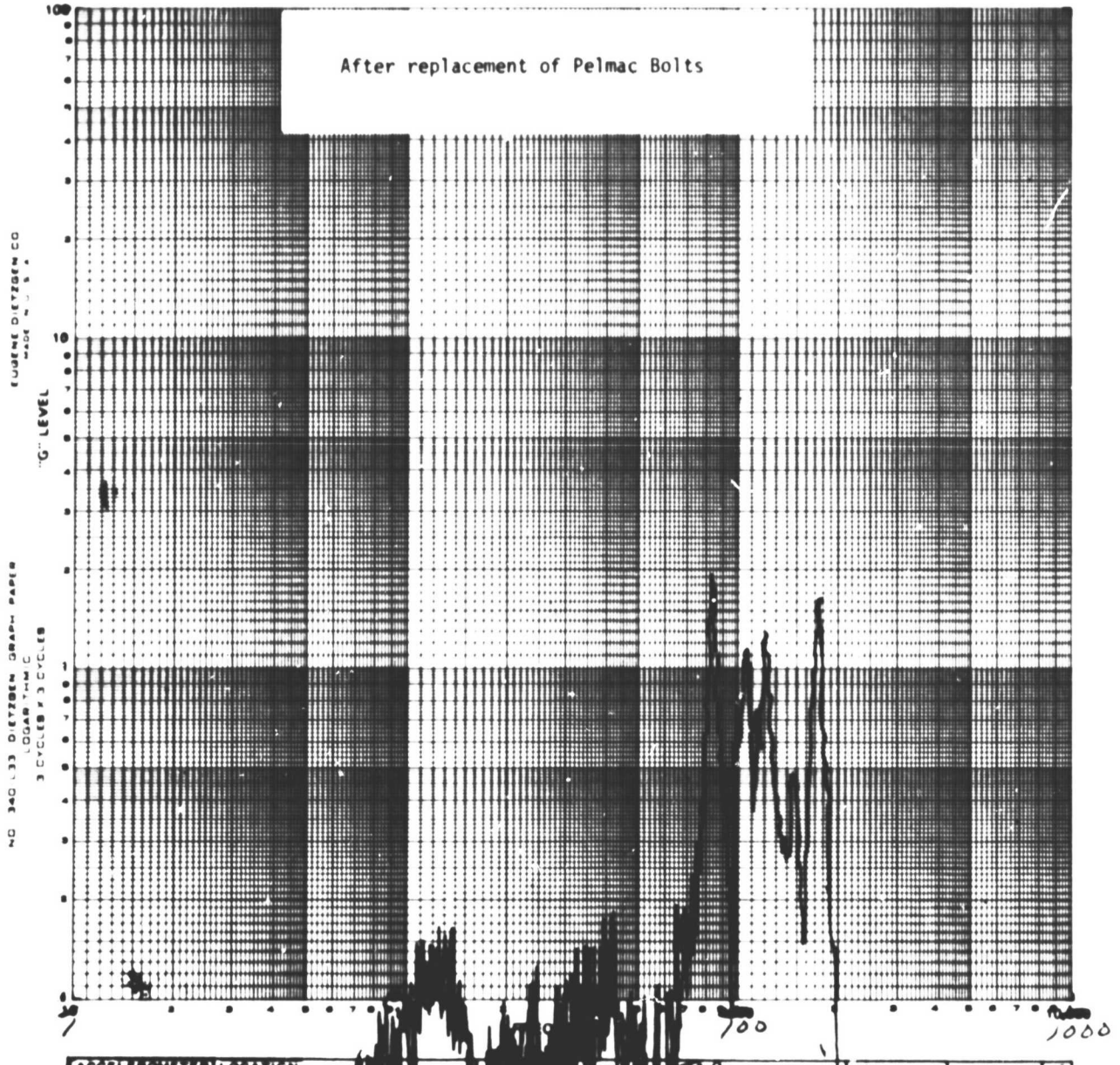
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G790	I6086	5-20-76	HOURS/MINUTES/SECONDS

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		I. EDWARDS	3

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTO TYPE THERMAL PROBE		



ACCELEROMETER	LOCATION		OCT/MIN	CONTROL ACCELER
RA46	EQUIPMENT [illegible] CENTER (X AXIS)		1	NC 39

VIBRATION DIRECTION	INPUT LEVEL
2 AXIS	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/Jun	2580-2822	2	6	6

PR 040 (JAN 75)

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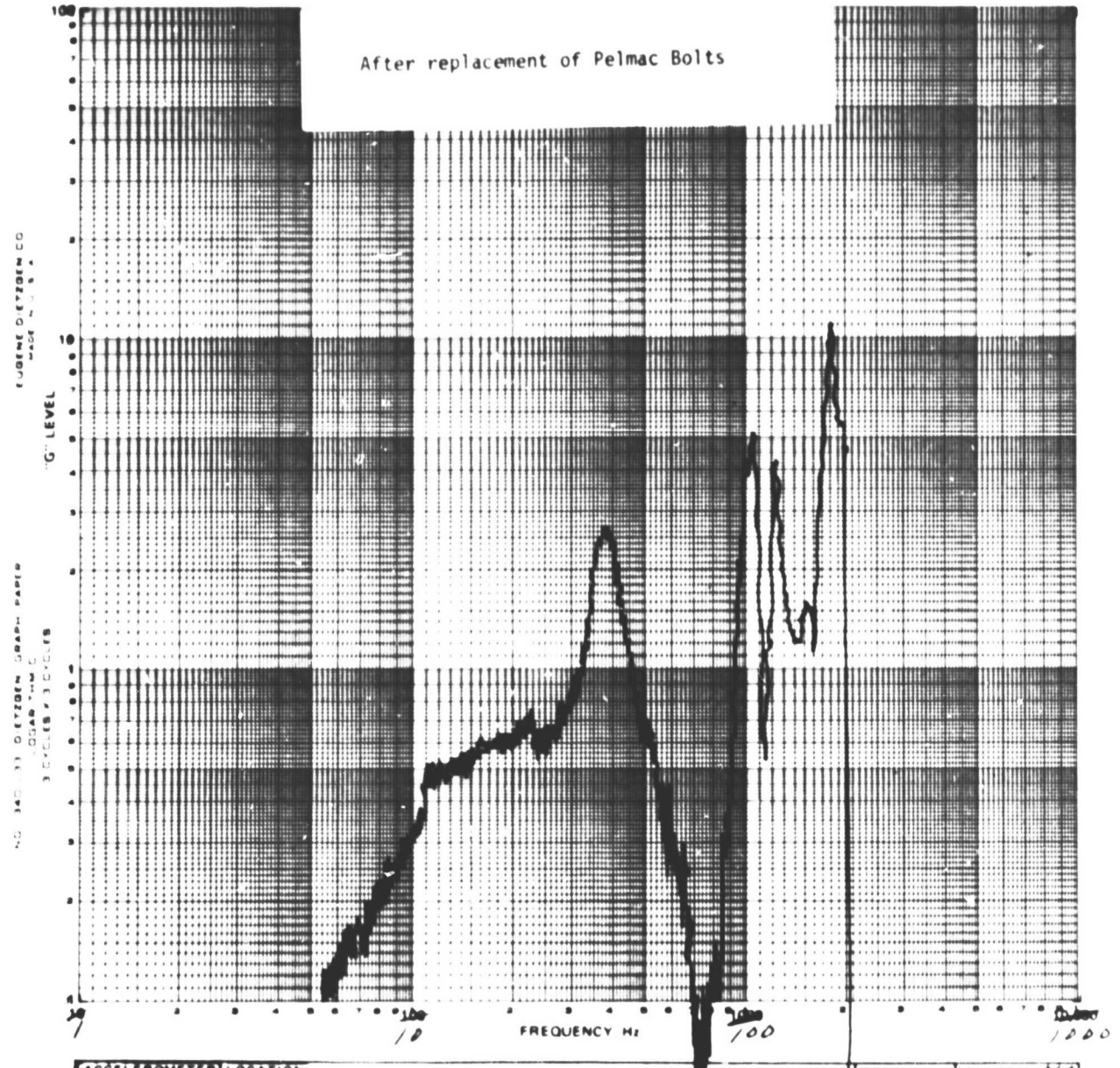
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G 790	T 6086	5-28-96	HOURS&MINUTES&SECONDS

TYPE OF TEST	TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION	T. EDWARDS	3

TEST ITEM	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE	



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
Columbia 342	NEPHELOMETER-TOP SURFACE (TANGENTIAL AXIS	1	NC 39

VIBRATION DIRECTION	INPUT LEVEL
Z AXIS	SEE TABLE 2 OF ICST PROCEDURE

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2580-2822	7½	7	7

PR 049 (JAN '73)

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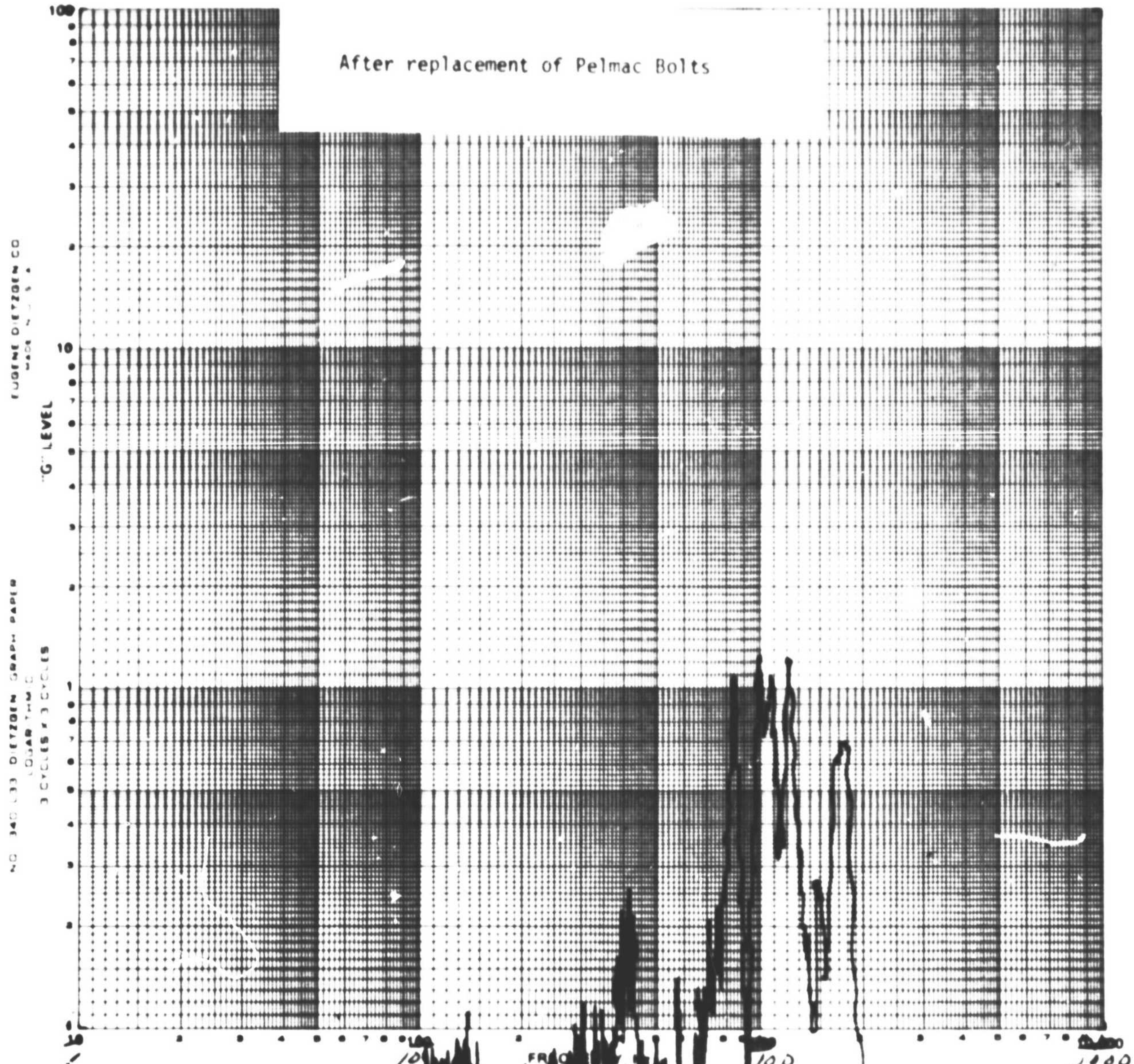
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MCACHE	6790	T6086	5-28-76	HOURS&MINUTES&SECONDS

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		T. EDWARDS	3

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		

After replacement of Pelmac Bolts



ACCELEROMETER	LOCATION		OCT/MIN	CONTROL
CAHK1379A	MASS SPECTROMETER	SIDE NEAR CENTERLINE (X AXIS)	1	NC ACCELER 39

VIBRATION DIRECTION	INPUT
Z AXIS	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2580-2822	7½	8	8

PR 049 (JAN 73)

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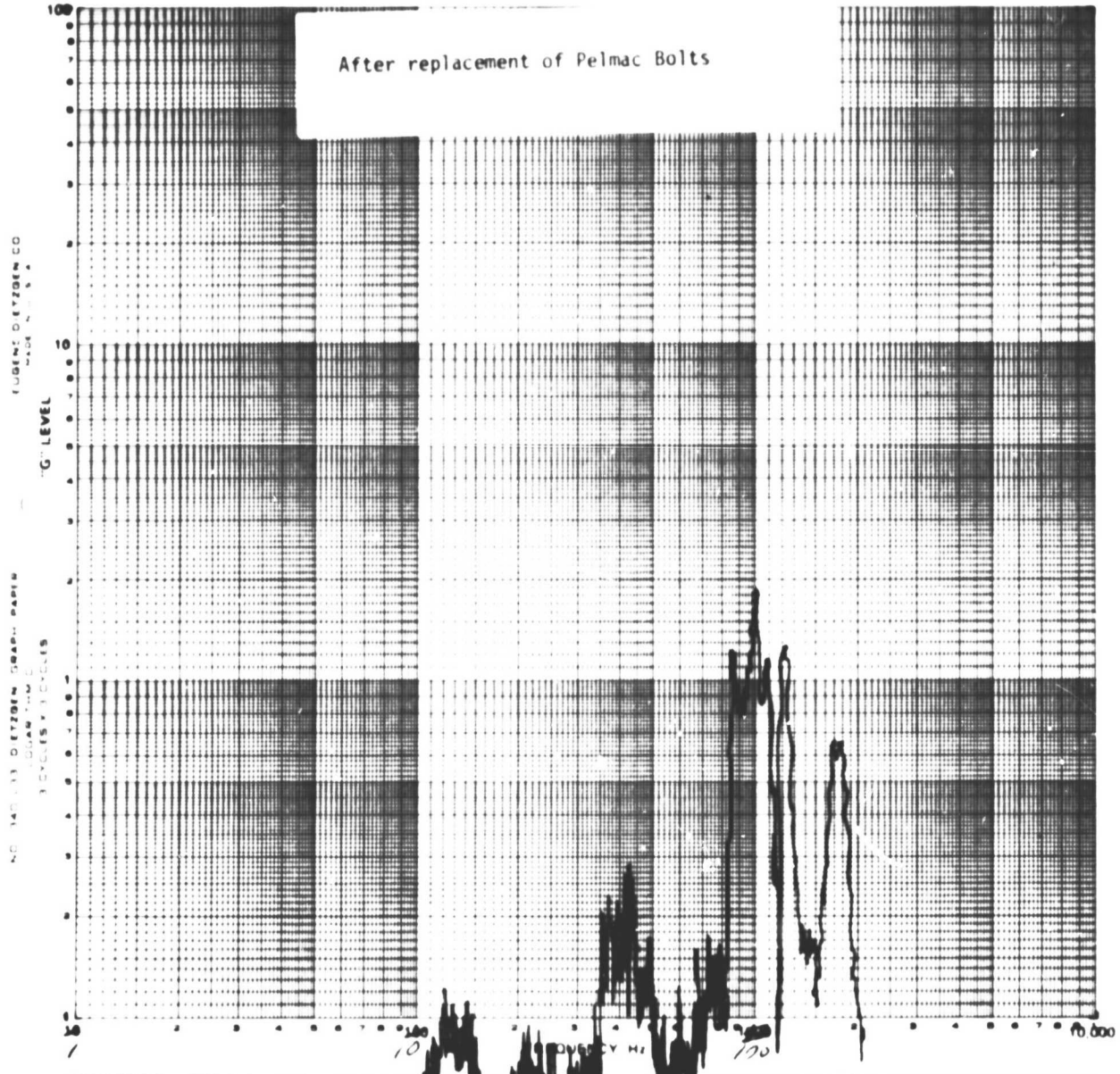
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G790	T6096	5-28-76	HOURS/MINUTES/SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 3
TEST ITEM: SATURN/URANUS ENGINEERING PROTO TYPE THERMAL PROBE		S/N		QUALITY ASSURANCE



ACCELEROMETER	LOCATION		OCT/MIN	CONTROL ACCELER
LAST	RELAY BOX	SIDE TOWARD CENTER (X AXIS)	1	NC 37
VIBRATION DIRECTION: Z AXIS		INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE		
TAPE REEL IDENT NO	TAPE LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2550 - 2822	7½	9	9

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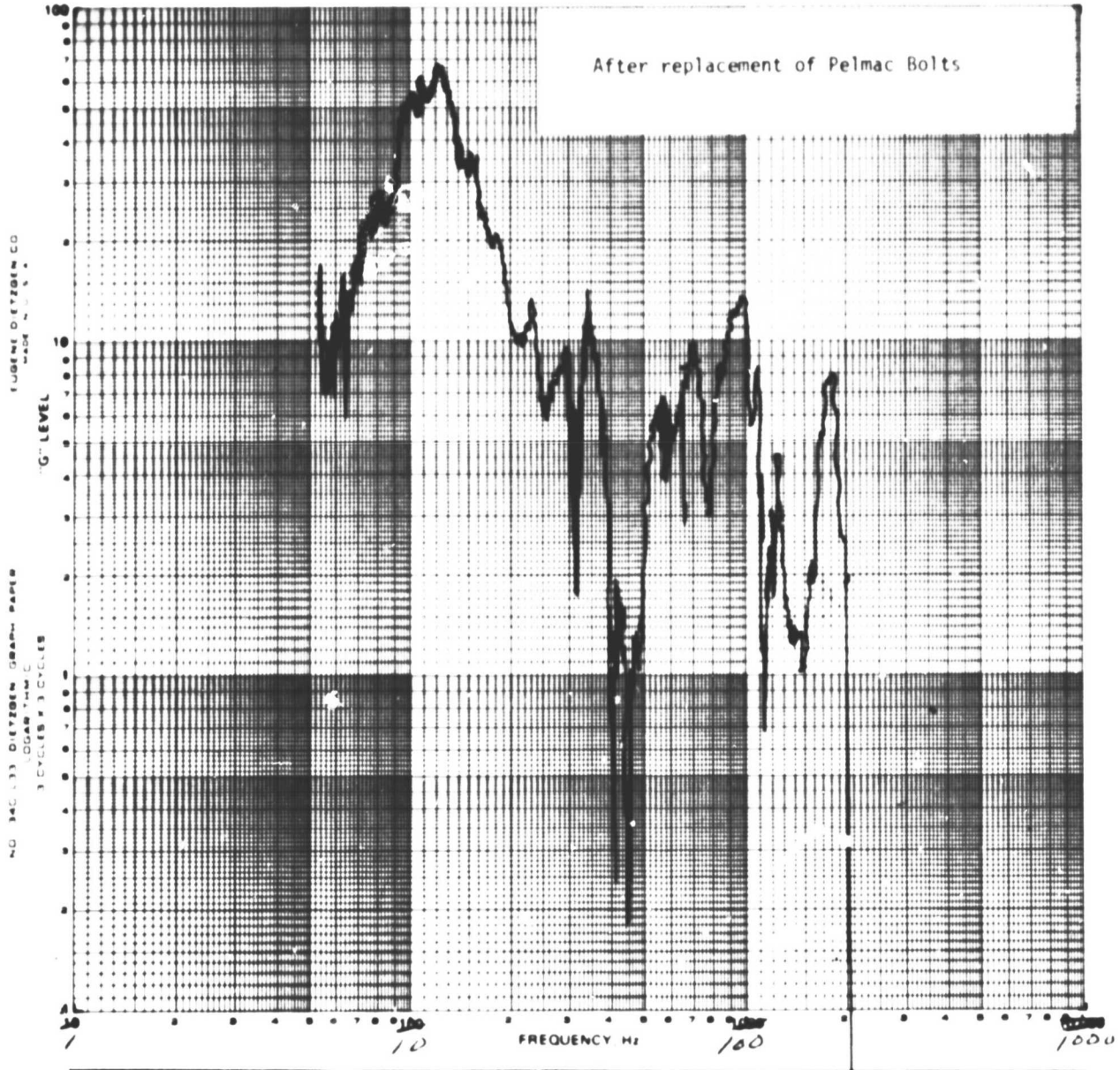
EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G790	T6086	5-28-76	HOURS/MINUTES/SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T EDWARDS		RUN NUMBER: 3
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE				QUALITY ASSURANCE
THERMAL PROBE		S/N		



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
LA74	RELAY BOX - TOP SURFACE (RADIAL AXIS)	7	37
VIBRATION DIRECTION: Z AXIS		INPUT LEVEL: SEE INDEX 2 OF TEST PROCEDURE	

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2SP0-2P22	7½	10	10

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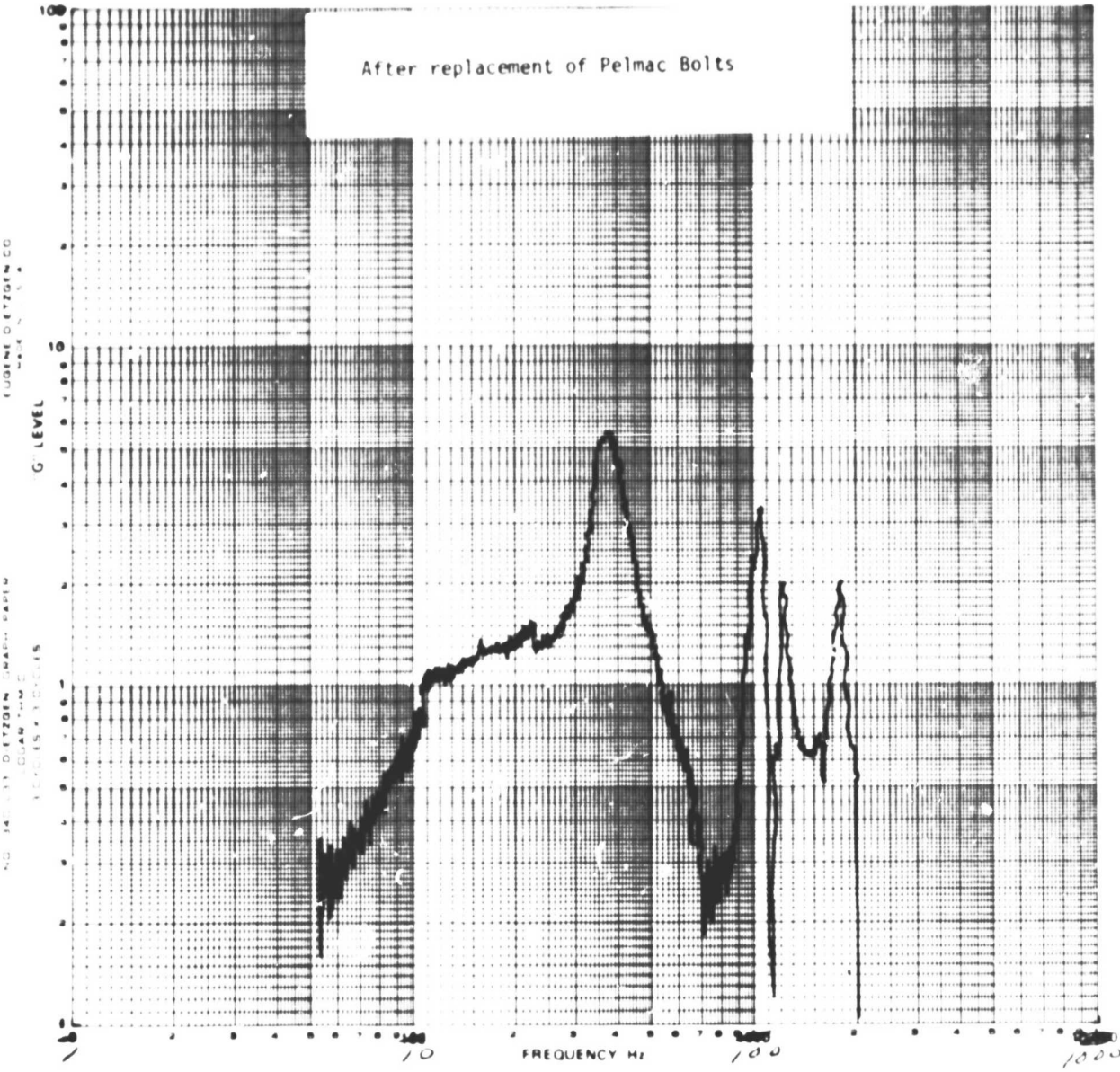
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G790	T6086	5-28-76	HOURS&MINUTES&SECONDS
TYPE OF TEST		TEST CONDUCTOR		RUN NUMBER
SINE VIBRATION		T. EDWARDS		3
TEST ITEM	SATURN/URANUS ENGINEERING PROTO TYPE			QUALITY ASSURANCE
THERMAL PROBE		S/N		



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
LA74	RCAV BOX - TOP SURFACE (TANGENTIAL AXIS)	1	32
VIBRATION DIRECTION		INPUT LEVEL	
Z AXIS		SEE TABLE 2 OF TEST PROCEDURE	

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2580-2822	7½	11	11

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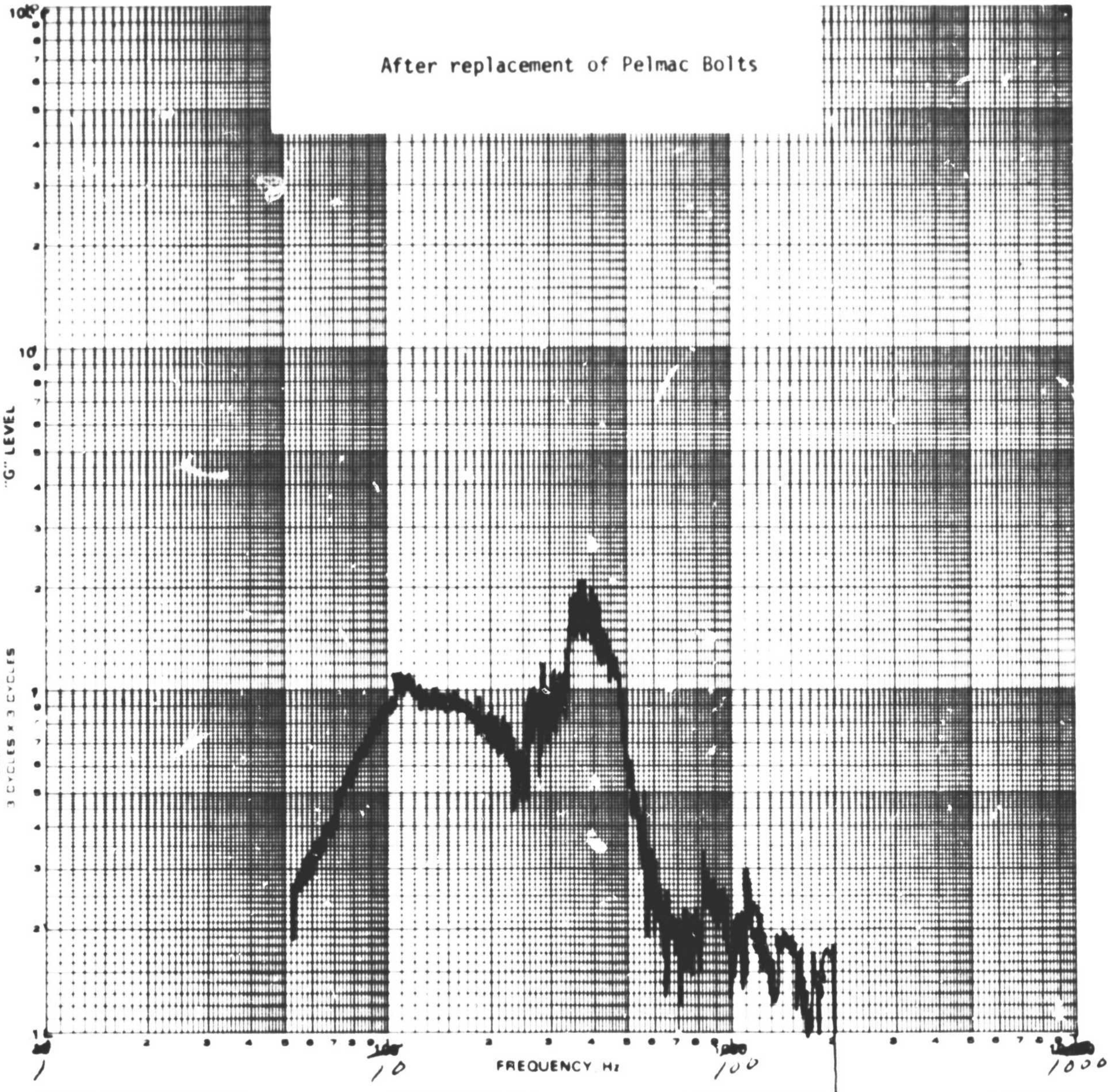
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME HOURS&MINUTES&SECONDS
H. Menache	G790	T6086	5-28-96	

TYPE OF TEST	TEST CONDUCTOR	RUN NUMBER
Sine Vibration		43

TEST ITEM	S/N	QUALITY ASSURANCE
Saturn/Uranus Engineering Prototype Thermal Probe		



ACCELEROMETER	LOCATION	AXIS	OCT/MIN	CONTROL ACCELER
Columbia S/N 179	Pressure Gage - top surface near pneumatic connection (tangential)		1	NC 39

VIBRATION DIRECTION	INPUT LEVEL
Z AXIS	See Table 2 of Test Procedure

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	2580-2822	7½	12	12

PR 049 (JAN 73)

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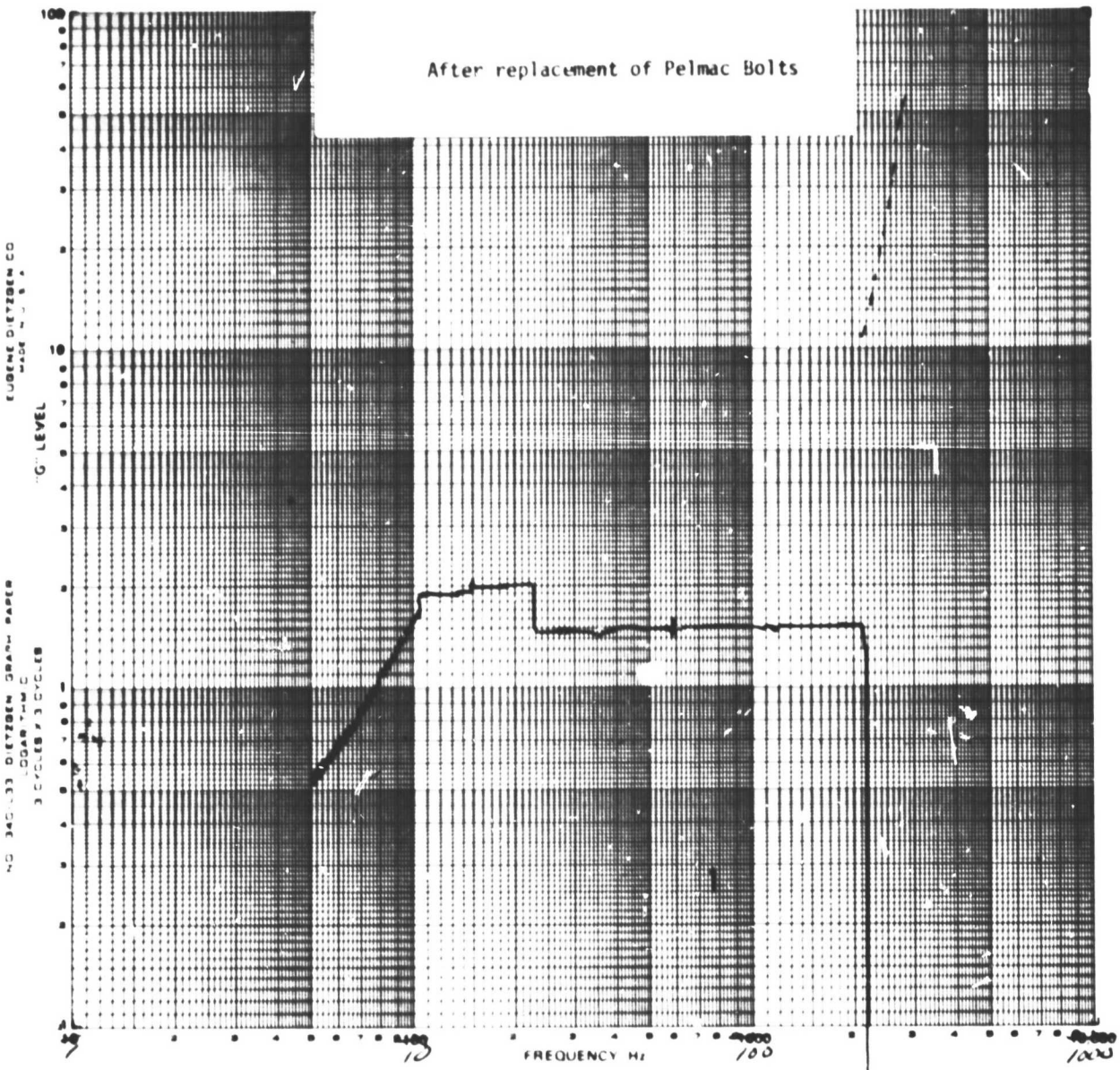
EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G 790	T 6086	5/28/76	HOURS&MINUTES&SECONDS

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		T. EDWARDS	4

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
NC39	CONTROL - END OF SLIP TABLE (Y AXIS)	/	NC 39

VIBRATION DIRECTION		INPUT LEVEL
A X I S		SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT NO	REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/URR	[illegible]	7½	1	/

- 3243

PR 049 (JAN 73)

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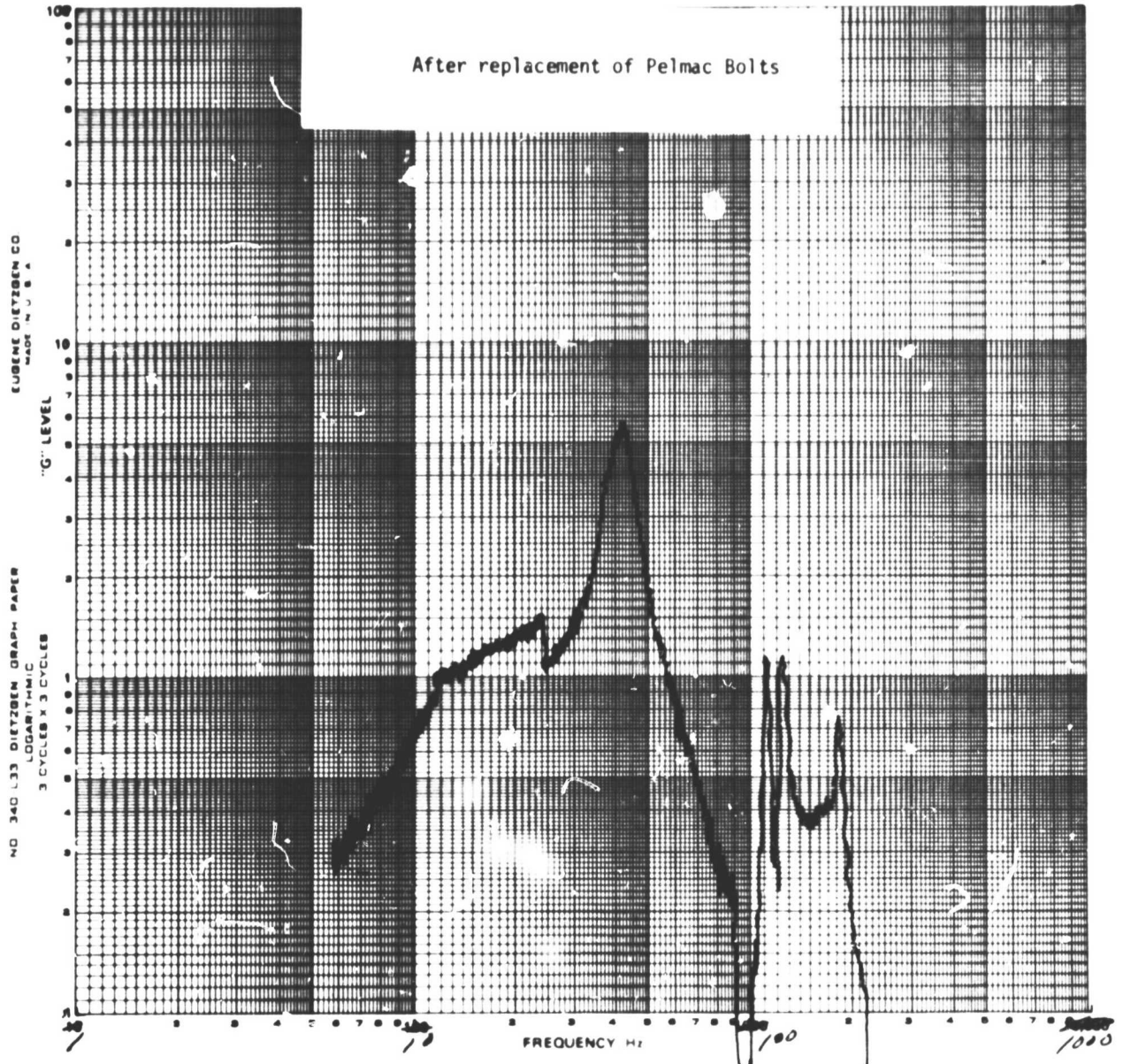
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHC	G790	T60P6	3-28-76	HOURS&MINUTES&SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 4
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE				QUALITY ASSURANCE: B
THERMAL PROBE		S/N		



ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
JAB	BOLT STRAP BATTERY-TOP SURFACE (RADIAL AXIS)	1	NC 39
VIBRATION DIRECTION: Y AXIS		INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	

TAPE REEL IDENT NO.	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	3005-3243	7½	2	2

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SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MCMICHAEL	G790	T6086	5-28-96	HOURS/MINUTES/SECONDS

TYPE OF TEST	TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION	T. EDWARDS	4

TEST ITEM	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		

After replacement of Pelmac Bolts

EUGENE DIETZGEN CO
NO 340-33 DIETZGEN GRAPH PAPER
LOGARITHMIC
3 CYCLES X 3 CYCLES
"G" LEVEL

FREQUENCY Hz

ACCELEROMETER	LOCATION	AXIS	OCT/MIN	CONTROL ACCELER
JA88	BOOT STRAP BATTERY - TOP SURFACE (TANGENTIAL)	Y	1	39

VIBRATION DIRECTION	INPUT LEVEL
Y AXIS	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	3005-3243	7½	3	3

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R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G790	T60P6	5-22-76	HOURS/MINUTES/SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 4
TEST ITEM: SATURN/URANUS ENGINEERING Prototype THERMAL PROBE		S/N		QUALITY ASSURANCE

After replacement of Pelmac Bolts

EUGENE DIETZGEN CO
MADE IN U.S.A.
NO. 340 L 33 DIETZGEN GRAPH PAPER
LOGARITHMIC
3 CYCLES x 3 CYCLES

"G" LEVEL

100
10
1

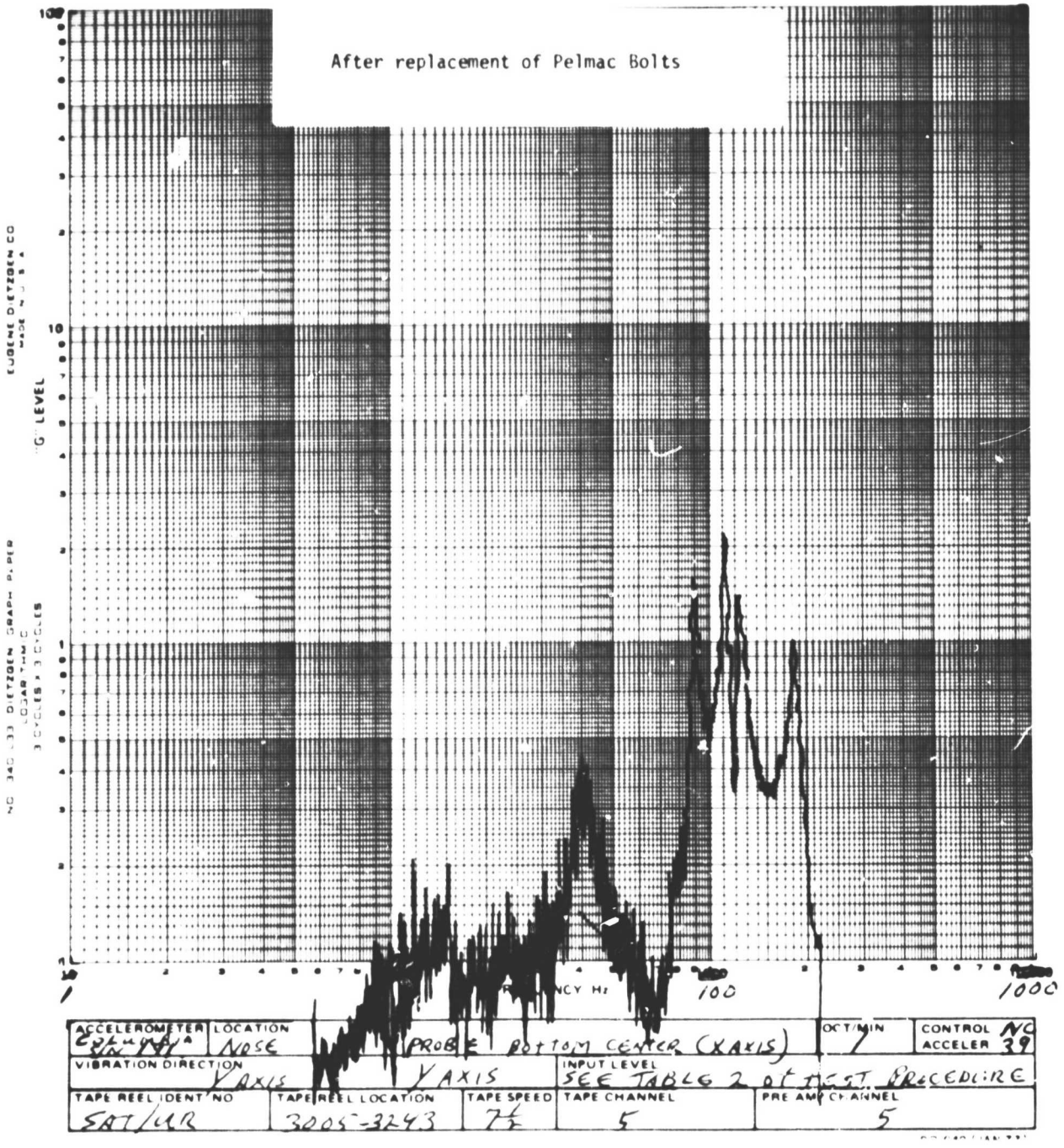
1 100 1000

FREQUENCY, Hz

ACCELEROMETER	LOCATION			OCT/MIN	CONTROL ACCELER
NC03	PELMIC	BOLT	(X-AXIS)	1	NC 39
VIBRATION DIRECTION: Y AXIS			INPUT LEVEL: SEE TABLE 2 of TEST PROCEDURE		
TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL	
SAT/UR	3005-3243	7½	4	4	

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME HOURS/MINUTES/SECONDS
H. MENCHE	G790	T 6096	5-28-76	
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 4
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		S/N		QUALITY ASSURANCE



ACCELEROMETER	LOCATION		OCT/MIN	CONTROL ACCELER
SN MM	NOSE	PROBE BOTTOM CENTER (X AXIS)	1	NC 39
VIBRATION DIRECTION: Y AXIS		Y AXIS	INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	
TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	3005-3243	7½	5	5

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G 790	T 60P6	5-28-96	HOURS/MINUTES/SECONDS

TYPE OF TEST:	TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION	T. EDWARDS	4

TEST ITEM:	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		

After replacement of Pelmac Bolts

EUGENE DIETZGEN CO. MADE IN U.S.A.
NO. 340-L33 DIETZGEN GRAPH PAPER
LOGARITHMIC
3 CYCLES X 3 CYCLES
"G" LEVEL
100
10
1
100
1000
H.

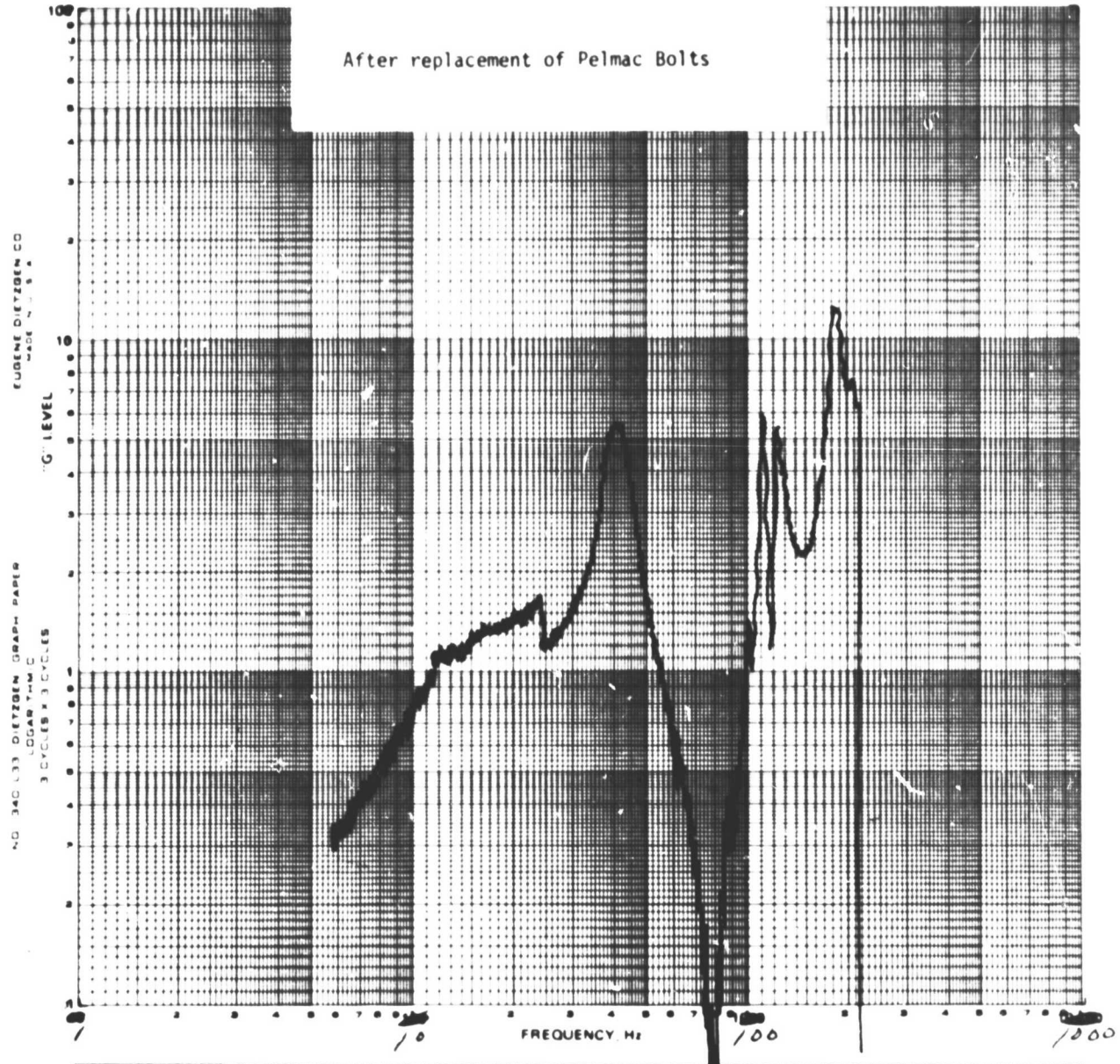
ACCELEROMETER	LOCATION		OCT/MIN.	CONTROL ACCELER
RA46	EQUIPMENT COVER	TOP CENTER (X AXIS)	1	NC 39

VIBRATION DIRECTION	INPUT LEVEL
V AXIS	SEE TABLE 2 OF TEST PROCEDURE

TAPE REEL IDENT. NO.	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	3005-3243	7½	6	6

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G770	T6086	5-28-96	HOURS&MINUTES&SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 4
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		S/N		QUALITY ASSURANCE

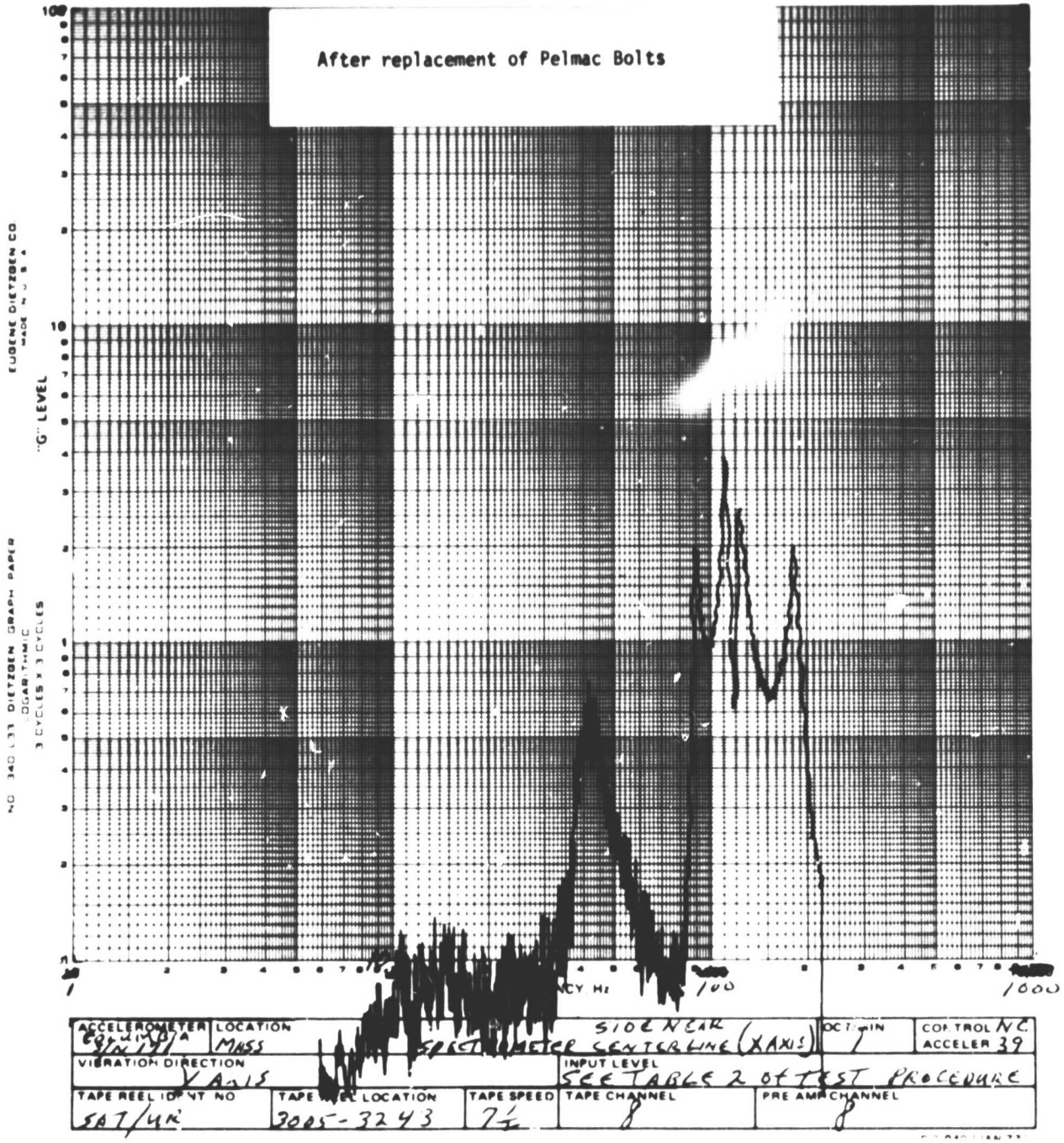


ACCELEROMETER	LOCATION	OCT/MIN	CONTROL ACCELER
S/N 192	NEPHELOMETER - TOP SURFACE (TANGENTIAL AXIS)	1	NC 3 9
VIBRATION DIRECTION: Y AXIS		INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	

TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	3005-3243	7½	7	7

AMES RESEARCH CENTER
RSQA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

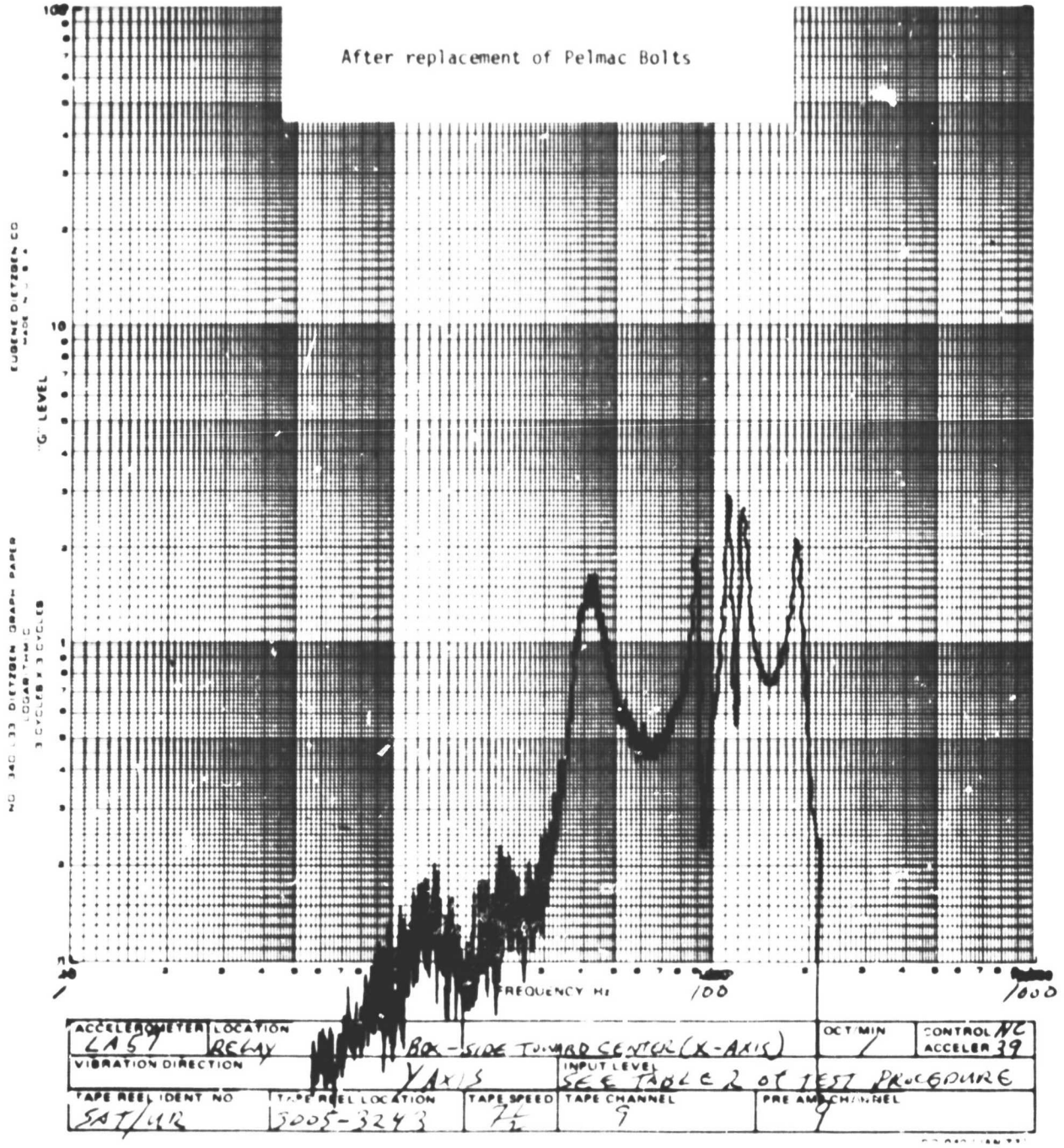
EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
H. MENCHE	G 790	T60P6	5-28-76	HOURS/MINUTES/SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: T. EDWARDS		AL'N NUMBER: 4
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		S/N		QUALITY ASSURANCE



ACCELEROMETER	LOCATION		OCTAVE/MIN	CONTROL ACCELER
ENDEVCO S/N 191 A	MASS SPECTROMETER	SIDE NEAR CENTERLINE (X AXIS)	1	NC 39
VIBRATION DIRECTION: Y AXIS		INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE		
TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/4R	3005-3243	7½	8	8

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
HARRISON	G790	T6086	5-28-76	HOURS/MINUTES/SECONDS
TYPE OF TEST: ENV VIBRATION		TEST CONDUCTOR: T. EDWARDS		RUN NUMBER: 4
TEST ITEM: SATURN/URAIUS ENGINEERING PROTOTYPE				QUALITY ASSURANCE
THERMAL PROBE		S/N		



ACCELEROMETER	LOCATION		OCT/MIN	CONTROL
LA57	RELAY BOX - SIDE TOWARD CENTER (X-AXIS)		1	NC ACCELER 39
VIBRATION DIRECTION: Y AXIS		INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE		
TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	5005-3243	7½	9	9

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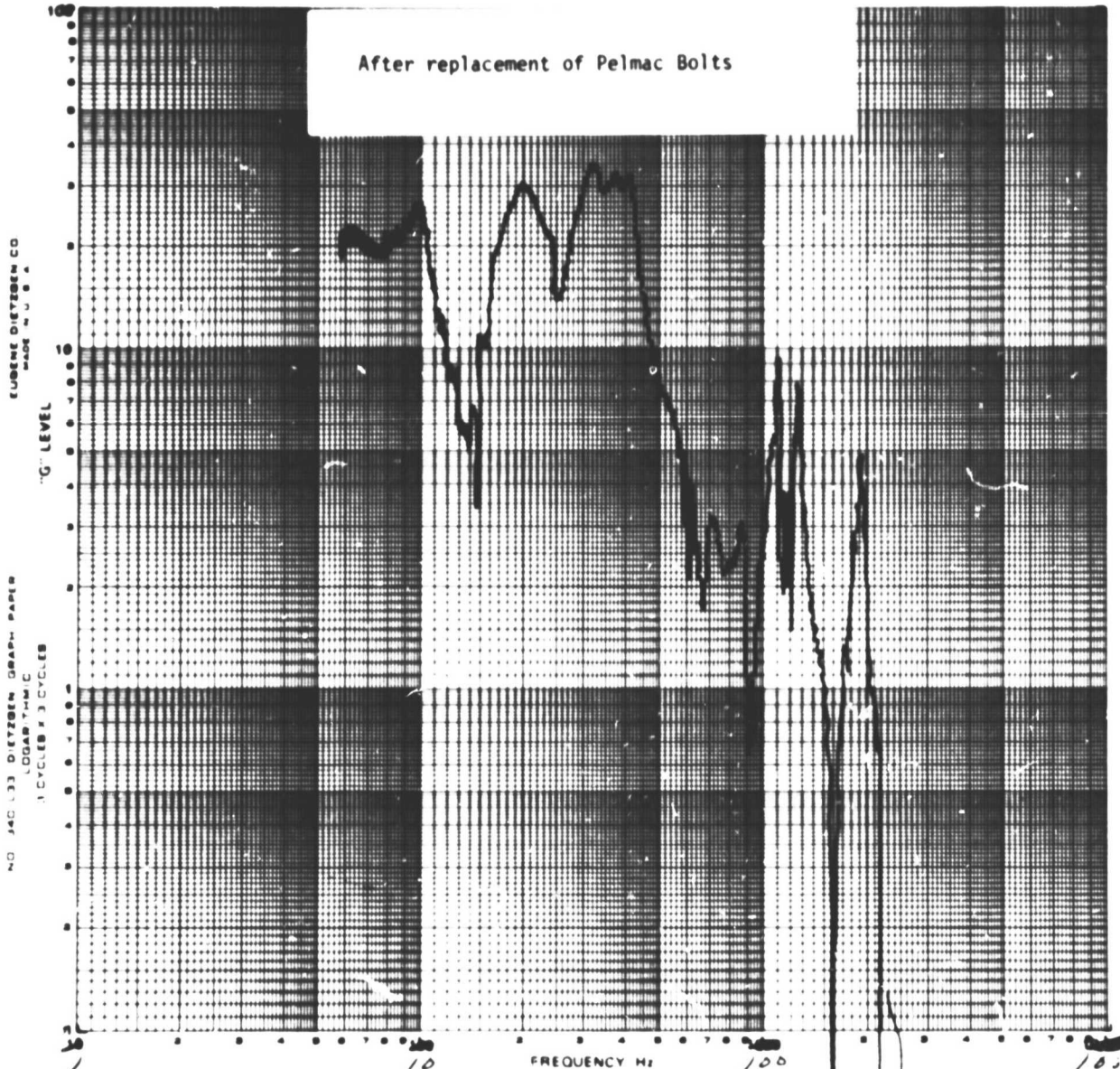
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TASK ORDER	JOB NUMBER	DATE	TIME
A. MENCHAC	G790	T6486	5-22-96	HOURS/MINUTES/SECONDS

TYPE OF TEST		TEST CONDUCTOR	RUN NUMBER
SINE VIBRATION		T. EDWARDS	4

TEST ITEM		QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE	S/N	



ACCELEROMETER	LOCATION		OCT/MIN	CONTROL ACCELER
LA 74	RELAY BOX TOP SURFACE (RADIAL AXIS)			NC 39
VIBRATION DIRECTION	Y AXIS	INPUT LEVEL	SEE TABLE 2 OF TEST PROCEDURE	

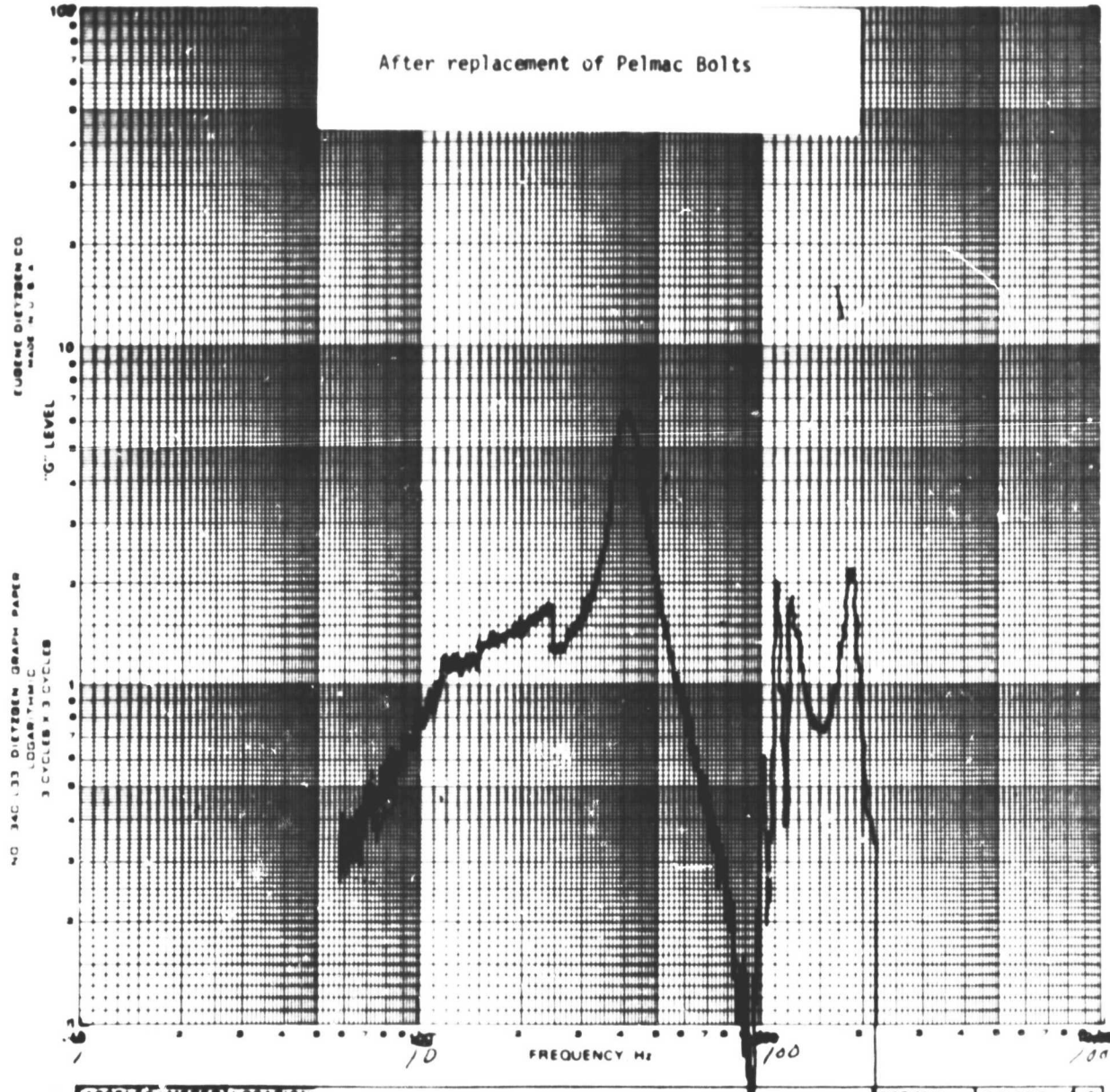
TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	3005-3243	7½	10	10

AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

EQUIPMENT OPERATOR	TAPE ORDER	JOB NUMBER	DATE	TIME
A. MENCHACA	G790	T60P6	5-28-96	HOUR/MINUTES/SECONDS

TYPE OF TEST		TEST CONDUCTED BY	RUN NUMBER
SINE VIBRATION		T. EDWARDS	4

TEST NAME	S/N	QUALITY ASSURANCE
SATURN/URANUS ENGINEERING PROTOTYPE THERMAL PROBE		



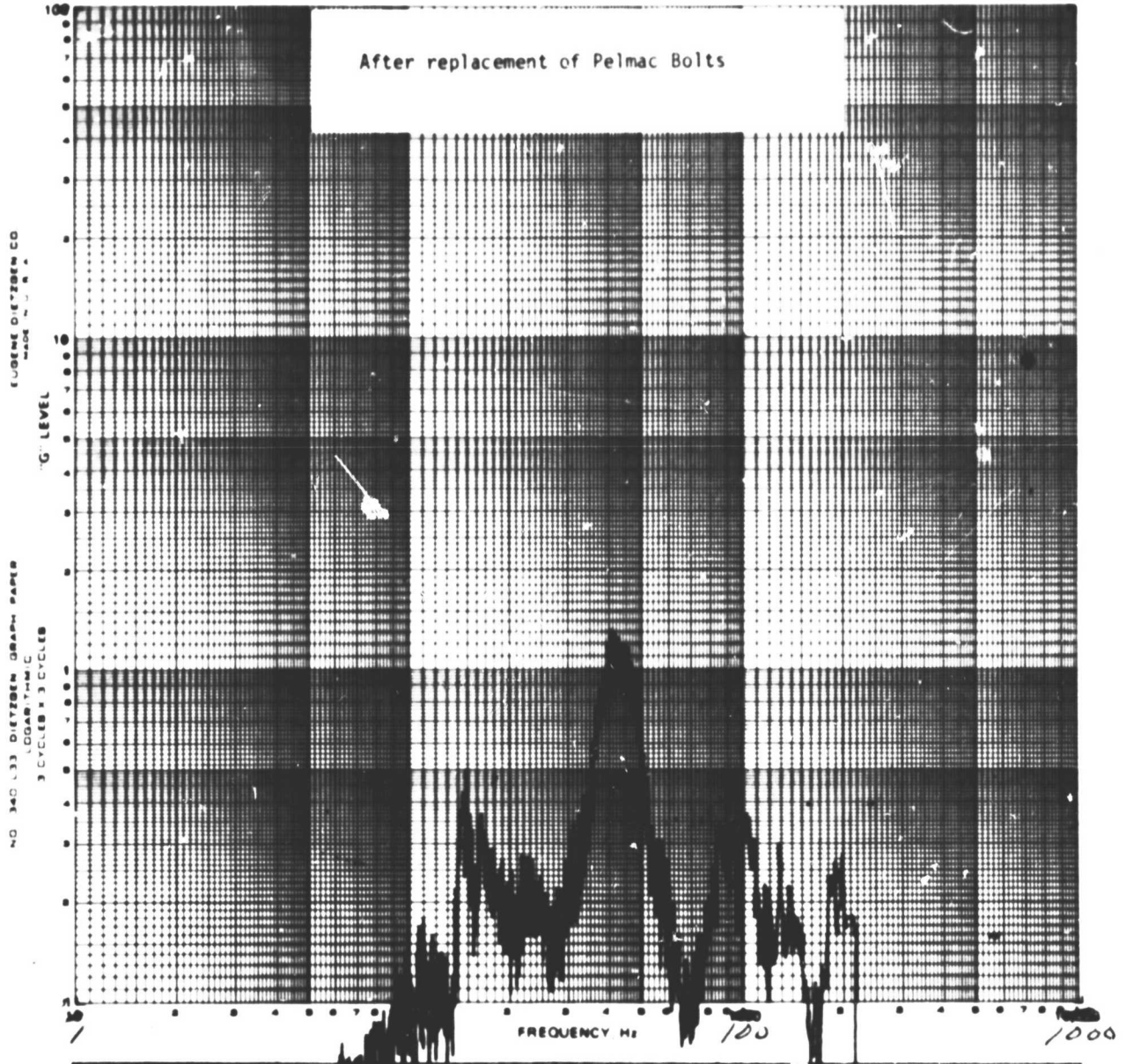
ACCELER. METER	LOCATION	OCT/MIN	CONTROL ACCELER
LA 24	RELAY BOX - TOP SURFACE (TANGENTIAL AXIS)	1	N C 39

VIBRATION DIRECTION	INPUT LEVEL
Y AXIS	SEE TABLE 2 of TEST PROCEDURE

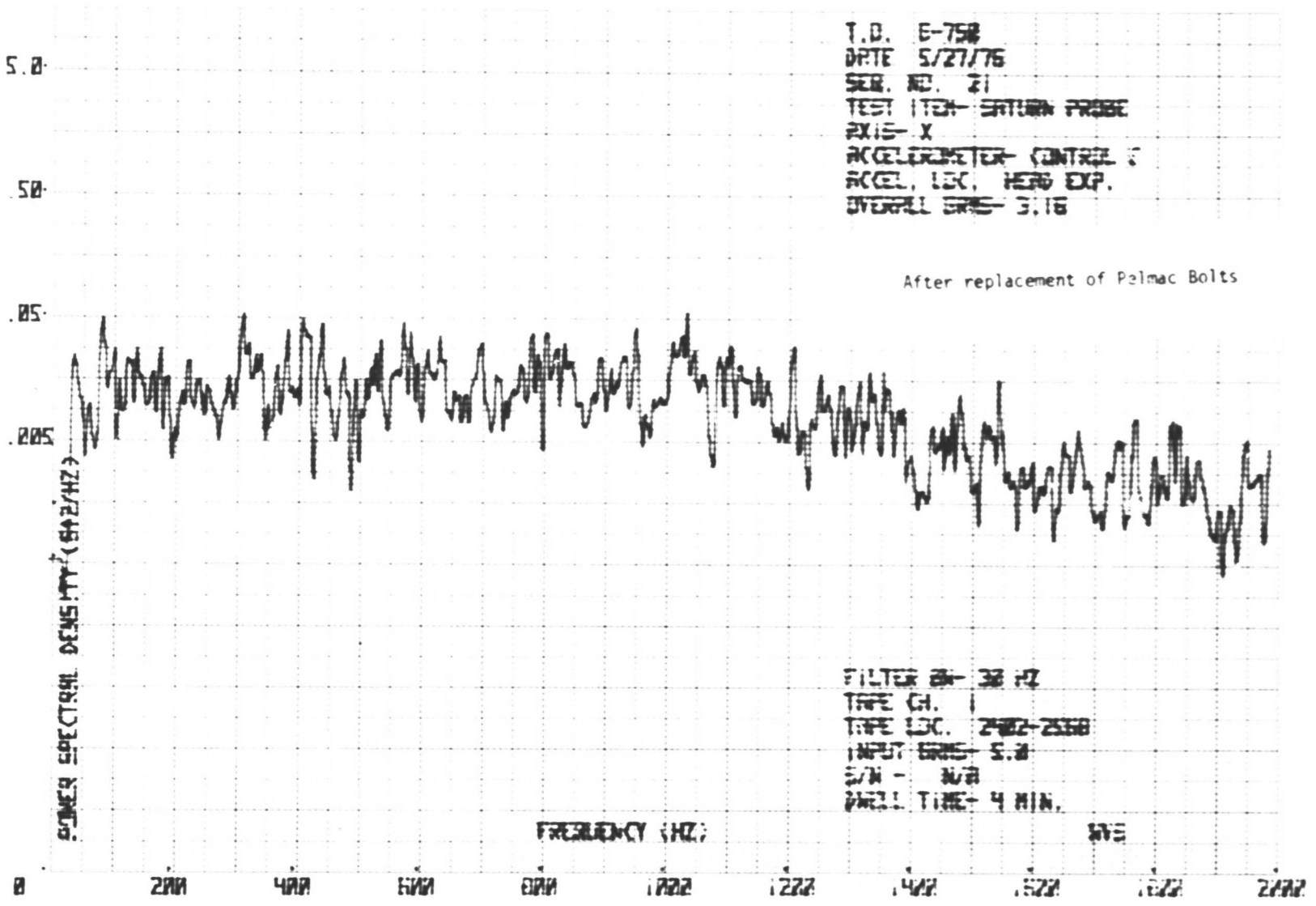
TAPE REEL IDENT NO	TAPE REEL LOCATION	TAPE SPEED	TAPE CHANNEL	PRE AMP CHANNEL
SAT/UR	3005-3243	7½	11	11

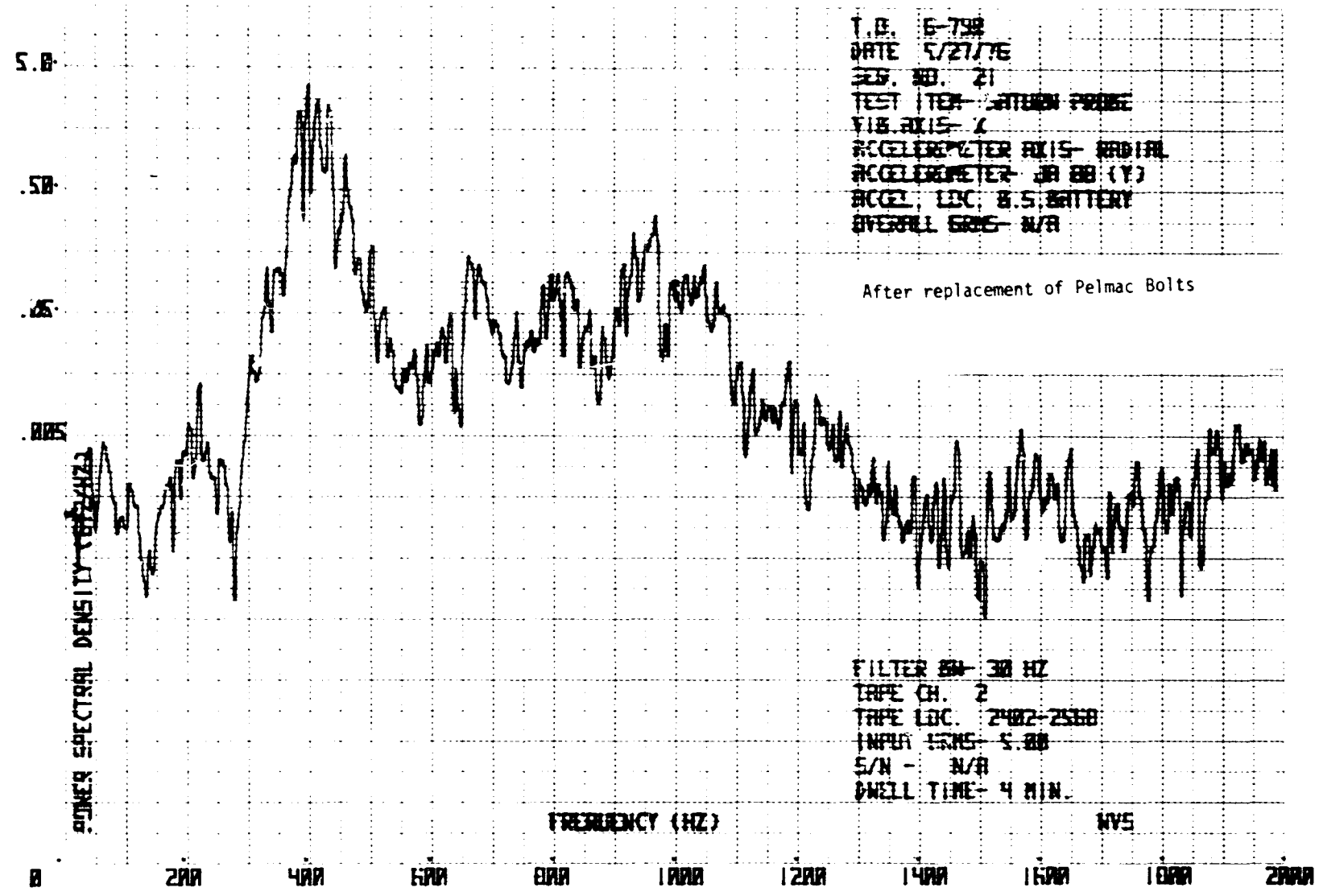
AMES RESEARCH CENTER
R&QA ENVIRONMENTAL LABORATORY
SINE VIBRATION DATA SHEET

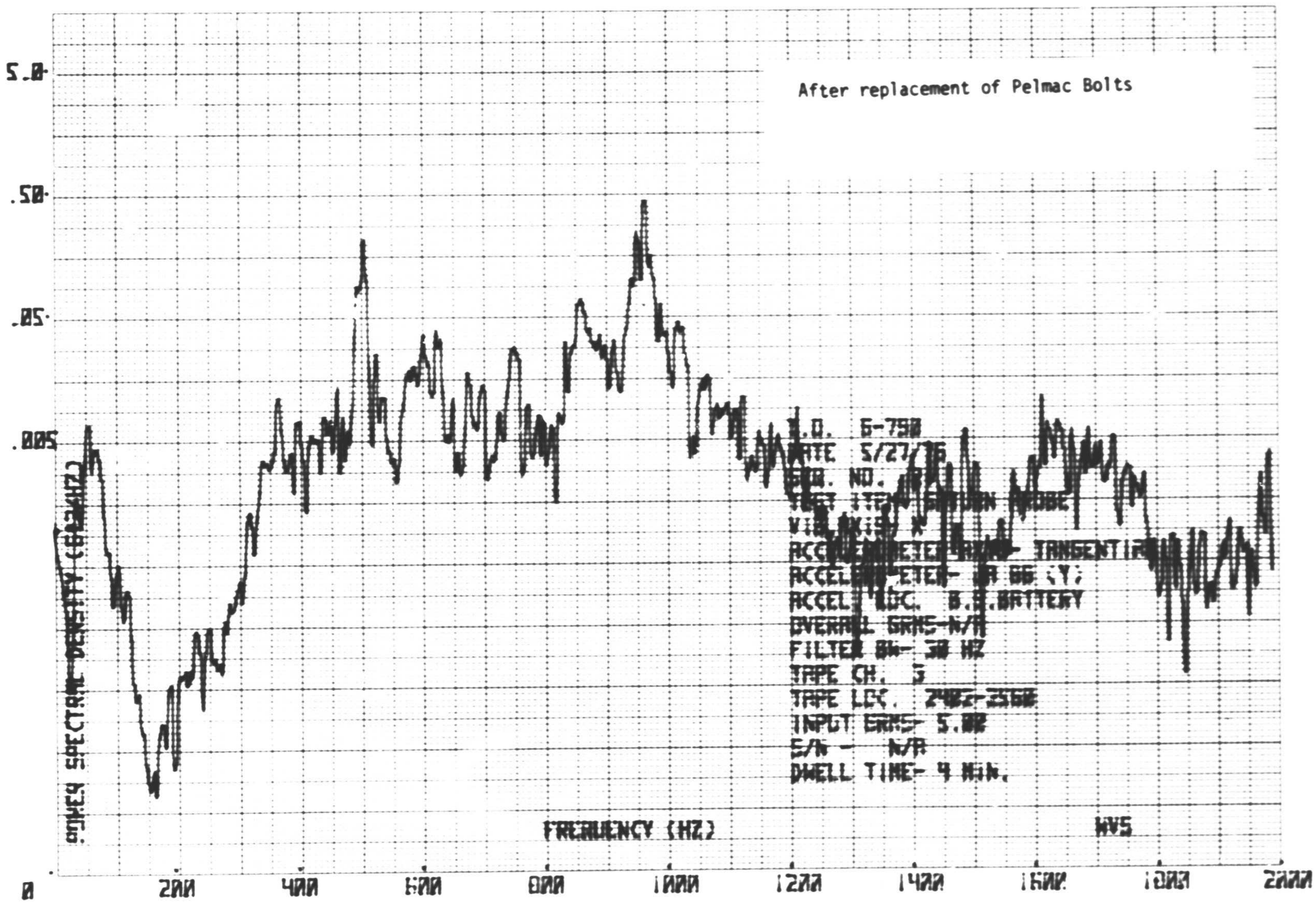
EQUIPMENT OPERATOR	YAES ORDER	JOB NUMBER	DATE	TIME
A. MENCHE	G 790	1 of 1	5-24-78	HOURS/MINUTES/SECONDS
TYPE OF TEST: SINE VIBRATION		TEST CONDUCTOR: J EDWARDS		RUN NUMBER: 4
TEST ITEM: SATURN/URANUS ENGINEERING PROTOTYPE				QUALITY ASSURANCE
THERMAL PROBE		S/N		

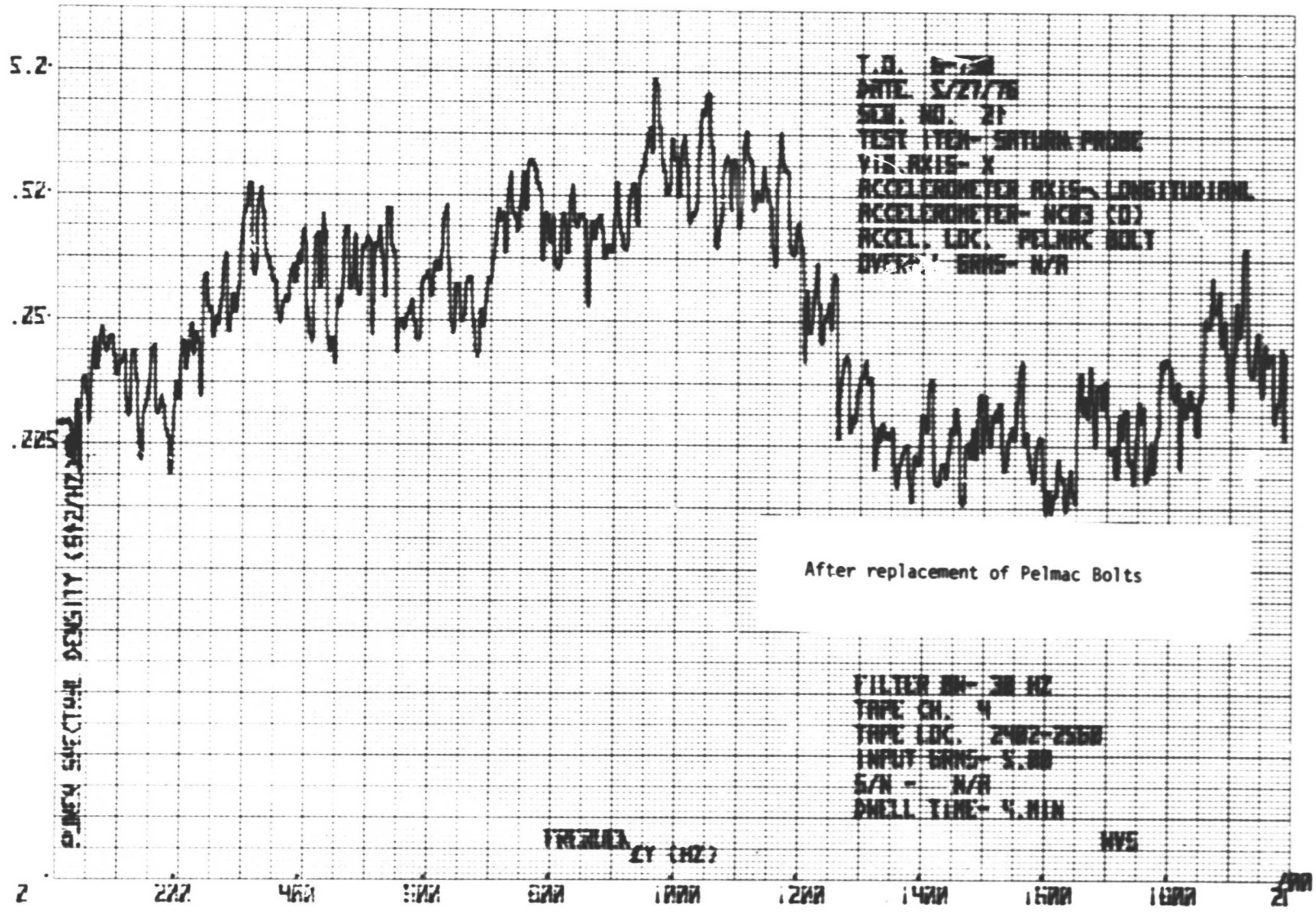


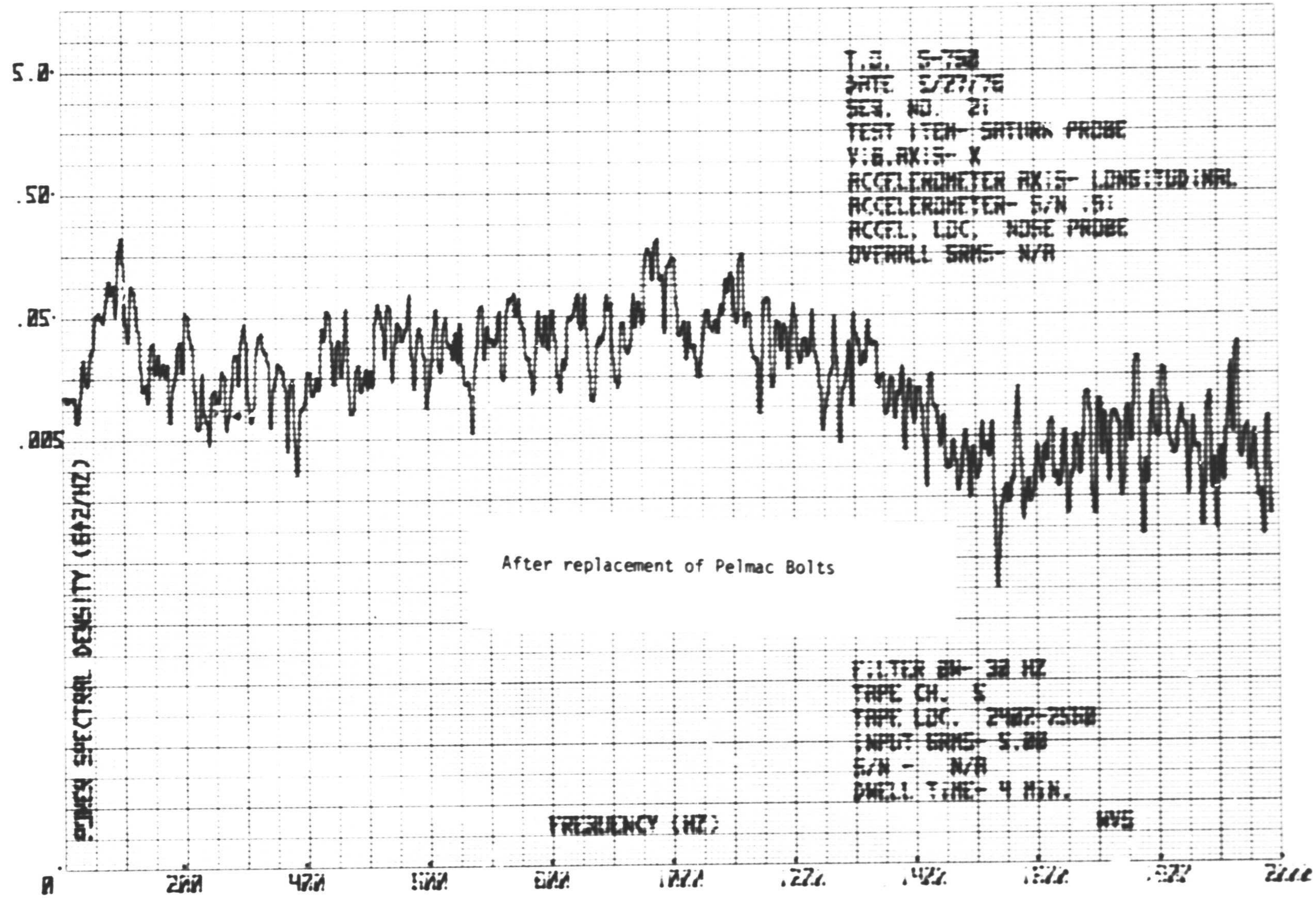
ACCELEROMETER: CONTROL 39	LOCATION: PRESSURE GAGE - TOP SURFACE NEAR PNEUMATIC CONNECTION TANGENTIAL AXIS	OCT/MIN: 1	CONTROL ACCELER: NC 39
VIBRATION DIRECTION: Y AXIS		INPUT LEVEL: SEE TABLE 2 OF TEST PROCEDURE	
TAPE REEL IDENT NO: SAT/UR	TAPE REEL LOCATION: 3005-3243	TAPE SPEED: 7E	TAPE CHANNEL: 12
PRE AMP CHANNEL: 12			

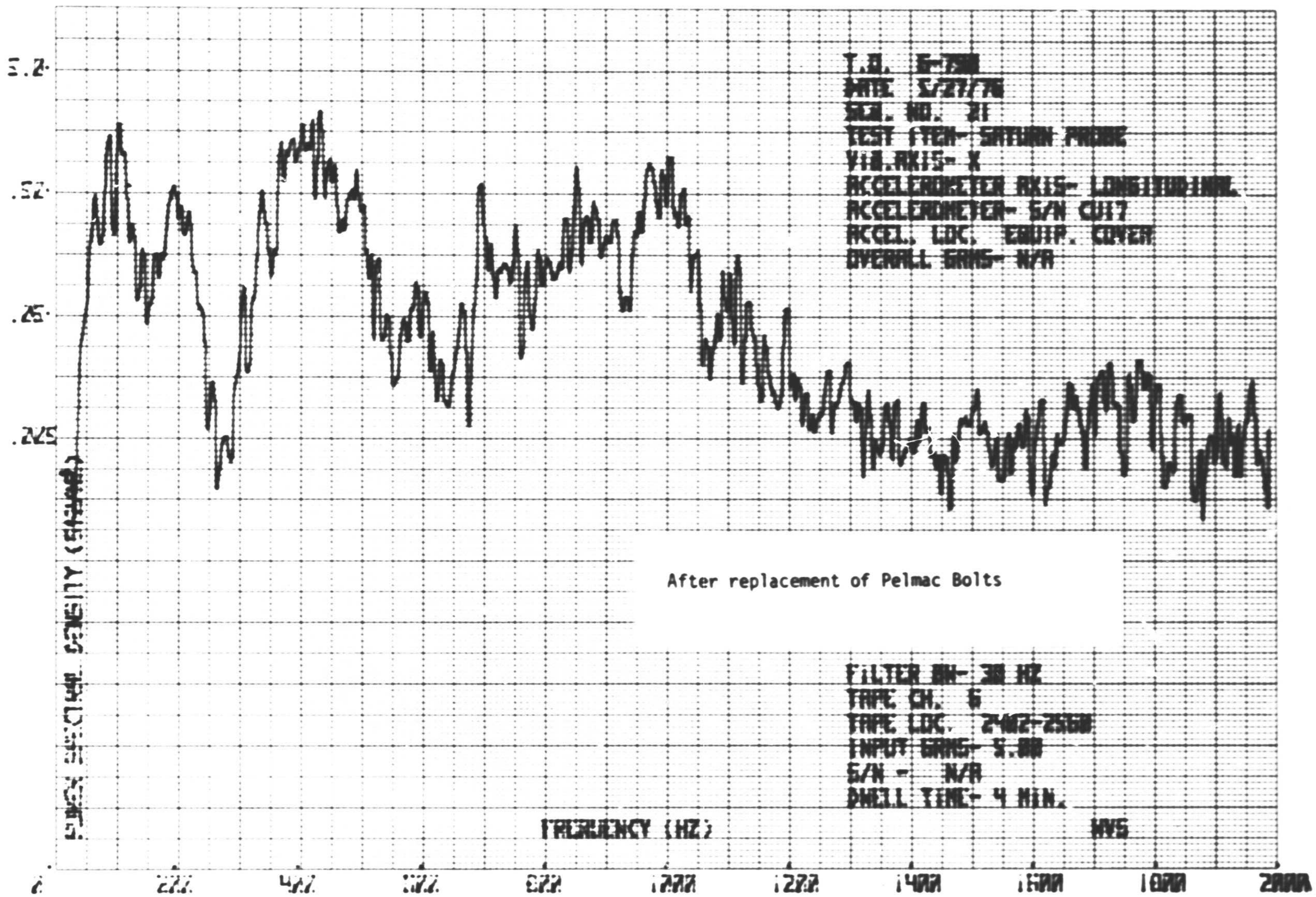

T.D. E-758
DATE 5/27/76
SER. NO. 21
TEST ITEM- SATURN PROBE
AXIS- X
ACCELEROMETER CONTROL
ACCEL. LOC. HERO EXP.
OVERALL GRMS- 3.16
After replacement of Palmac Bolts
FILTER ON- 30 HZ
TAPE CH. 1
TAPE LOC. 2402-2558
INPUT GRMS- 5.0
S/N - N/A
SWEEP TIME- 4 MIN.
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000


T.B. 6-79R
DATE 5/27/76
SEQ. NO. 21
TEST ITEM- ATTUDE PROBE
VIB.AXIS- Z
ACCELEROMETER AXIS- RADIAL
ACCELEROMETER- 00 00 (Y)
ACCEL. LOC. B.S.BATTERY
OVERALL GRMS- N/A
After replacement of Pelmac Bolts
FILTER BW- 30 HZ
TAPE CH. 2
TAPE LOC. 2402-2516
INPUT GRMS- 5.00
S/N - N/A
DWELL TIME- 4 MIN.
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
WVS
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

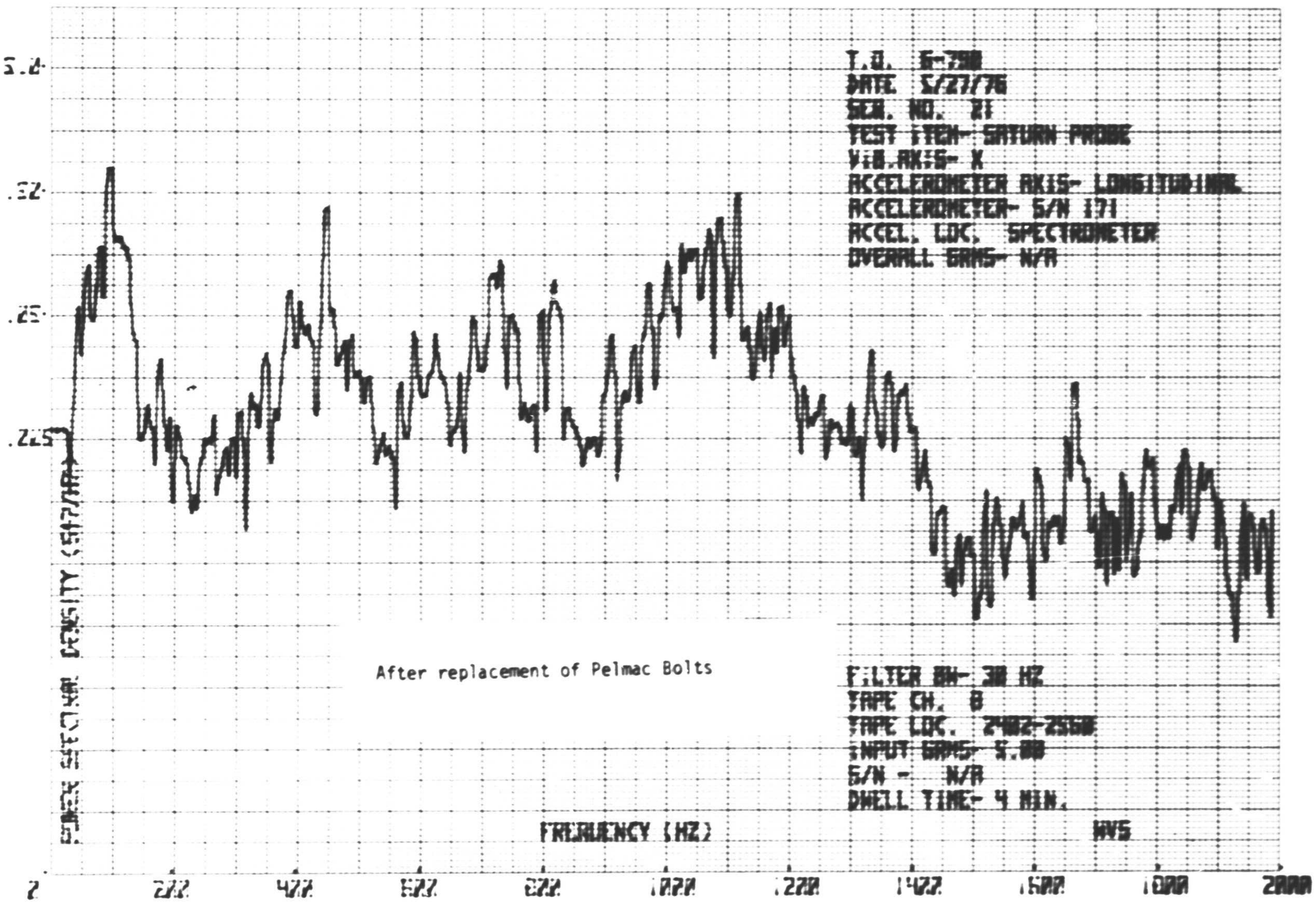

After replacement of Pelmac Bolts
5.0
.50
.05
.005
0
200
400
600
1000
1200
1400
1600
2000
FREQUENCY (HZ)
OVERALL GRMS-N/A
FILTER BW- 30 HZ
INPUT GRMS- 5.00
S/N - N/A
DWELL TIME- 4 MIN.
WVS

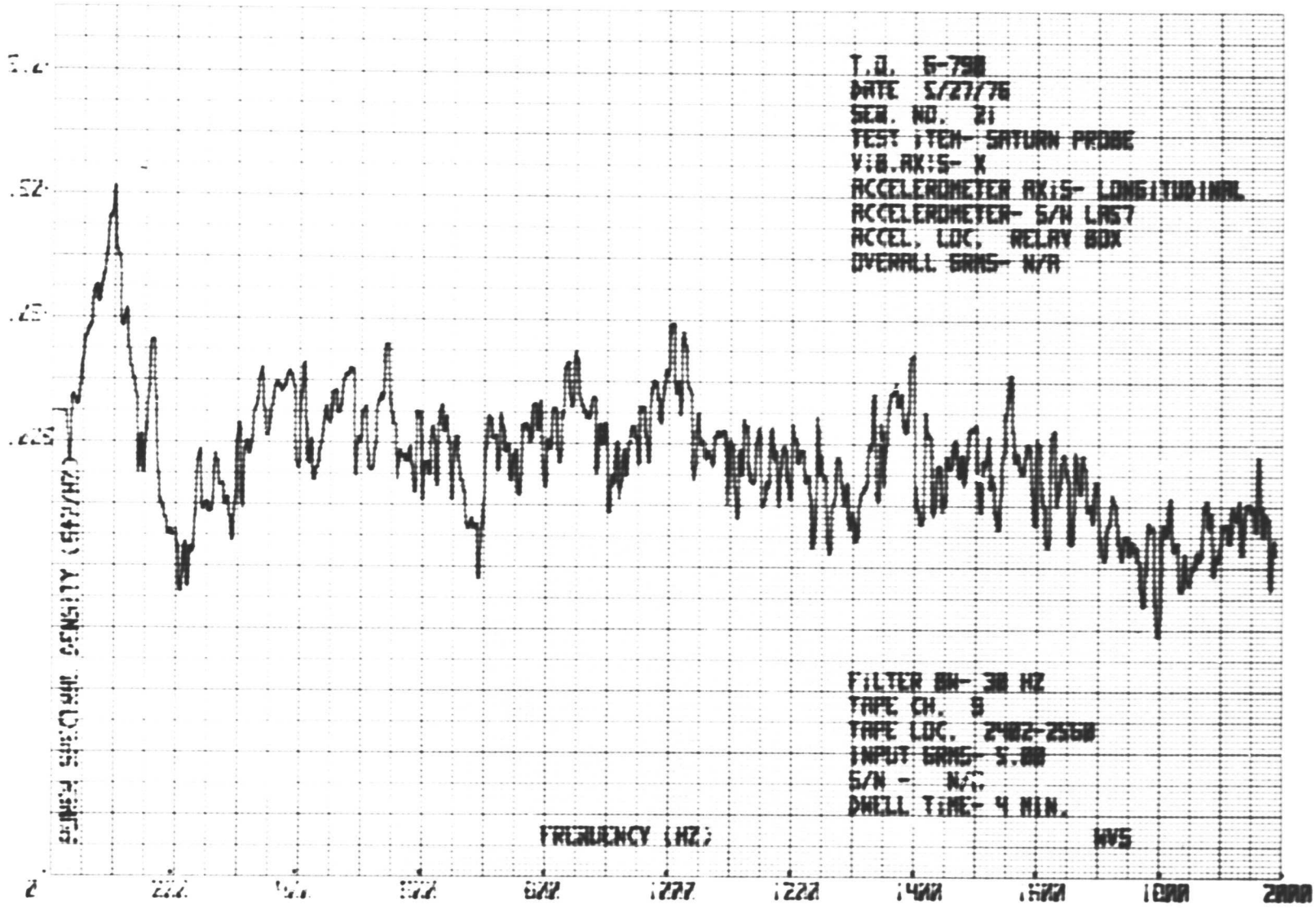

5.2
.52
.25
.225
2
After replacement of Pelmac Bolts

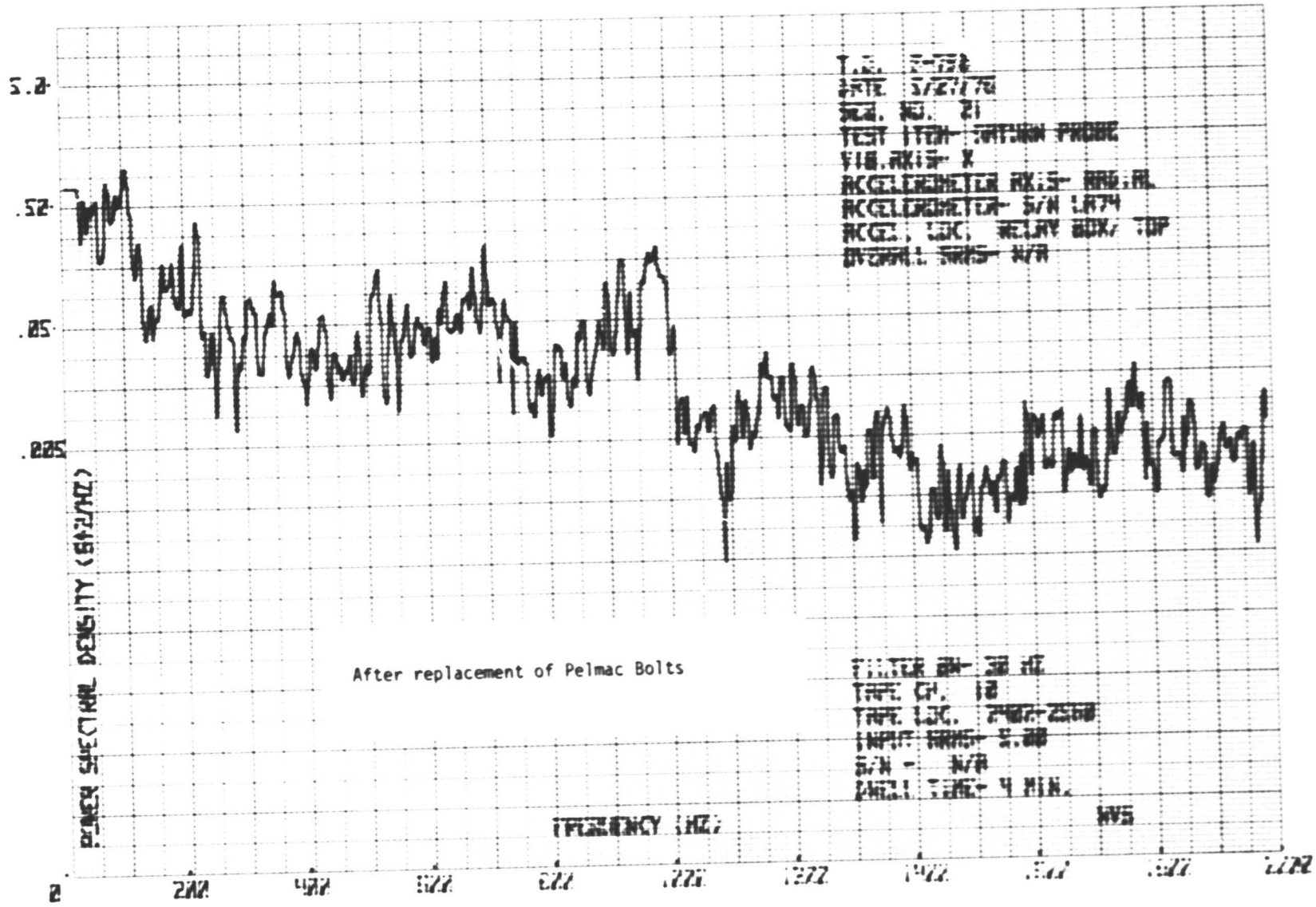

DATE 5/27/76
SEQ. NO. 21
TEST ITEM- SATURN PROBE
VIB.AXIS- X
ACCELEROMETER AXIS- LONGITUDINAL
ACCEL. LOC. NOSE PROBE
OVERALL GRMS- N/A
After replacement of Pelmac Bolts
FILTER BW- 30 HZ
TAPE CH. 5
INPUT GRMS- 5.00
S/N - N/A
DWELL TIME- 4 MIN.
WVS
POWER SPECTRAL DENSITY (G↑2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400


T.O. 6-790
DATE 5/27/76
SEQ. NO. 21
TEST ITEM- SATURN PROBE
VIB.AXIS- X
ACCELEROMETER AXIS- LONGITUDINAL
ACCELEROMETER- S/N CU17
ACCEL. LOC. EQUIP. COVER
OVERALL GRMS- N/A
After replacement of Pelmac Bolts
FILTER BW- 30 HZ
TAPE CH. 6
TAPE LOC. 2402-2500
INPUT GRMS- 5.00
S/N - N/A
DWELL TIME- 4 MIN.
FREQUENCY (HZ)
HVS

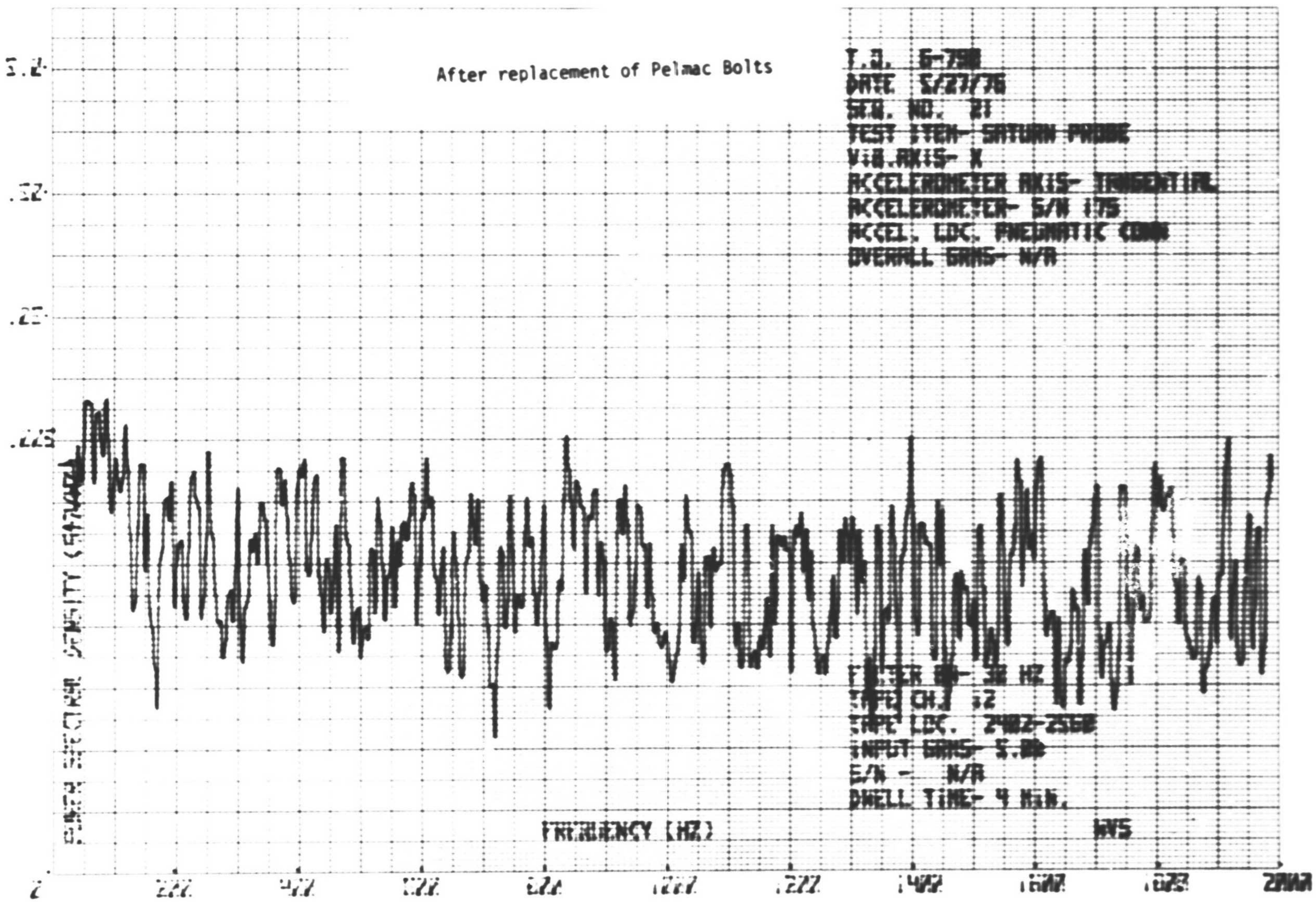
POWER SPECTRAL DENSITY (g²/Hz)
FREQUENCY (Hz)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000
RMS

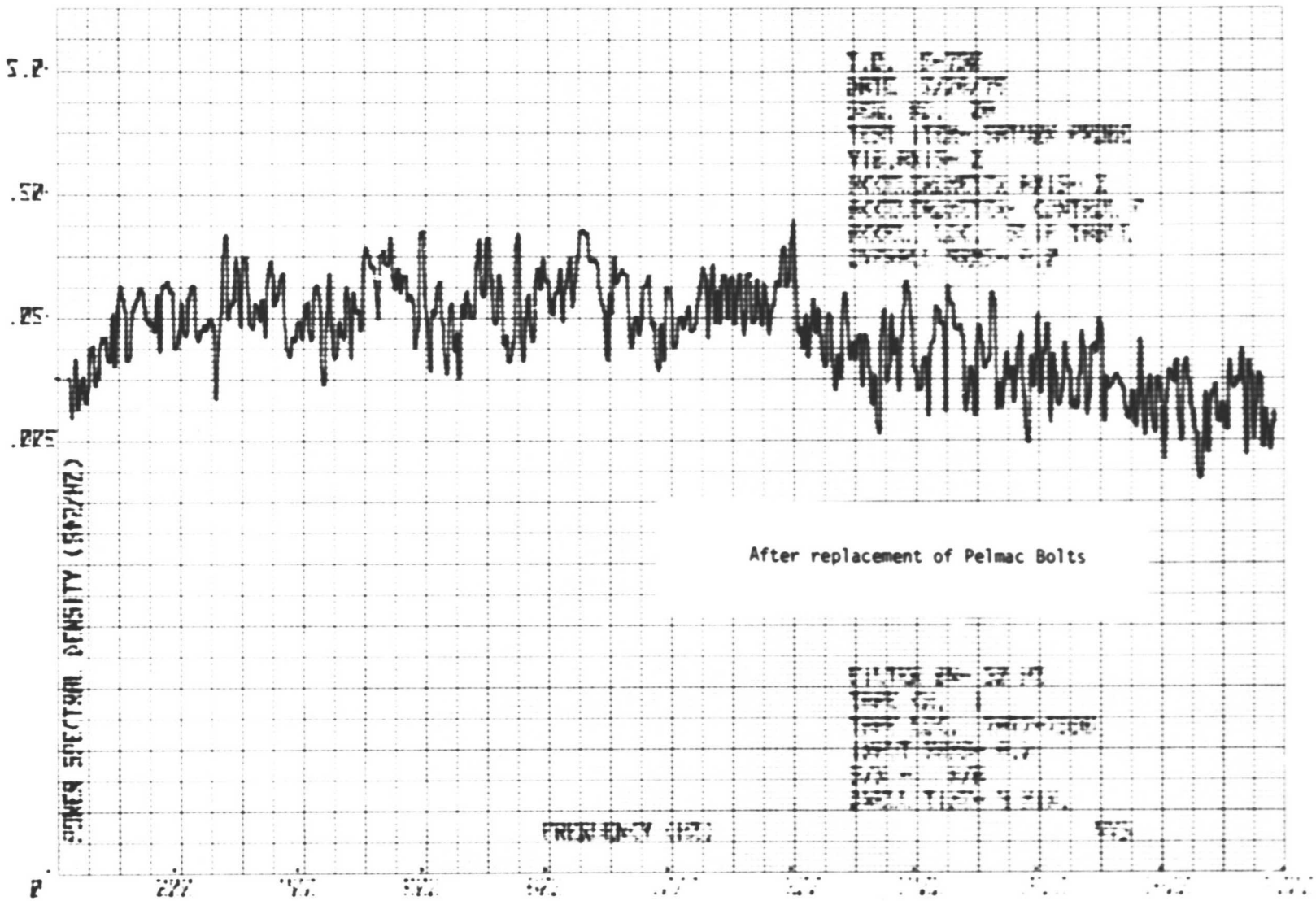

DATE 5/27/76
TEST ITEM- SATURN PROBE
ACCELEROMETER AXIS- LONGITUDINAL
ACCELEROMETER- S/N 171
ACCEL. LOC. SPECTROMETER
OVERALL GRMS- N/A
FILTER BW- 30 HZ
TAPE CH. 8
INPUT GRMS- 5.00
S/N - N/A
DWELL TIME- 4 MIN.
After replacement of Pelmac Bolts
FREQUENCY (HZ)
POWER SPECTRAL DENSITY (G²/HZ)
2000

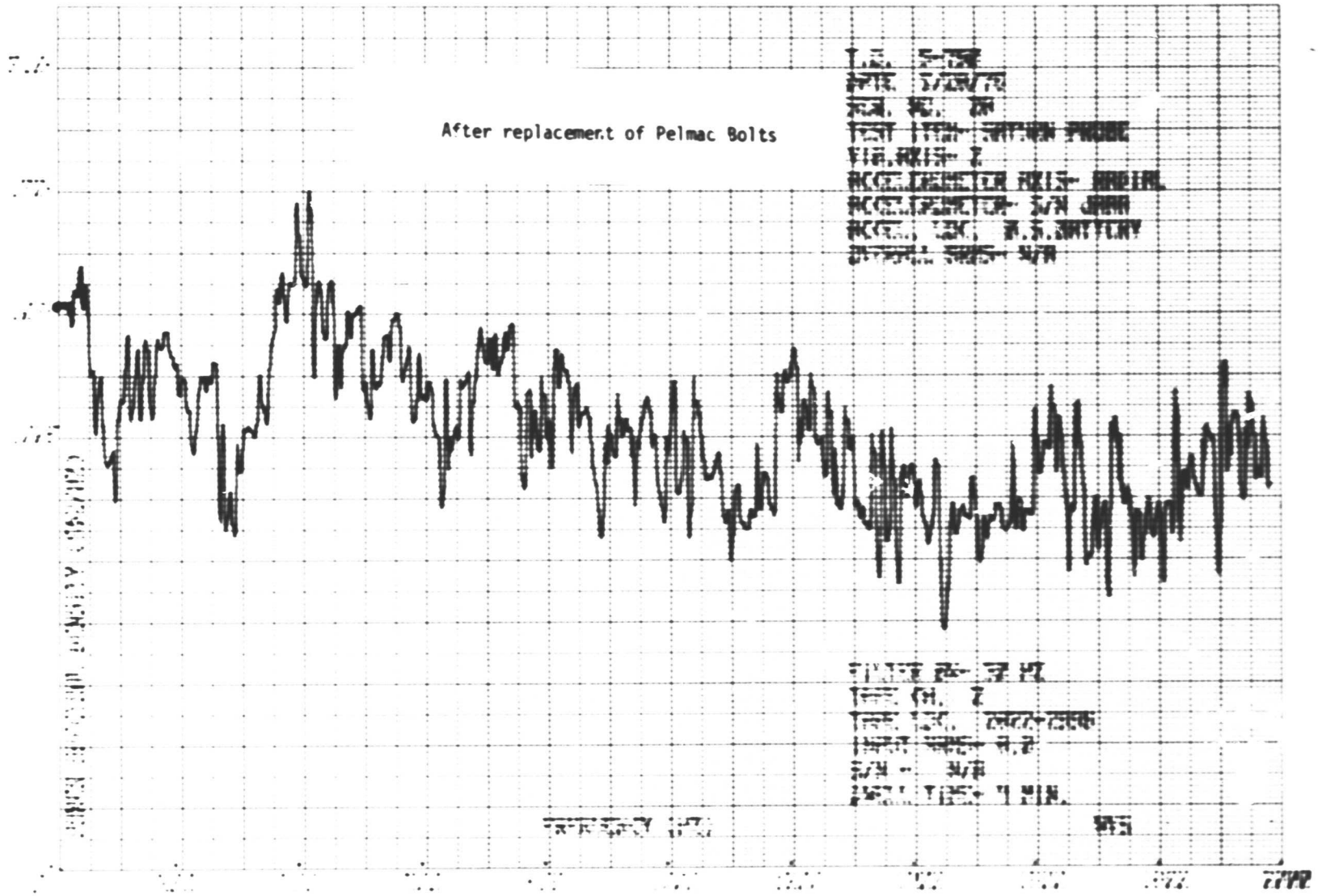

T.D. 6-798
DATE 5/27/76
SER. NO. 21
TEST ITEM- SATURN PROBE
V:B.AXIS- X
ACCELEROMETER AXIS- LONGITUDINAL
ACCELEROMETER- S/N LA57
ACCEL. LOC. RELAY BOX
OVERALL GRMS- N/A
FILTER BW- 30 HZ
TAPE CH. 8
TAPE LOC. 2402-2568
INPUT GRMS- 5.00
S/N - N/A
DWELL TIME- 4 MIN.
FREQUENCY (HZ)
HWS

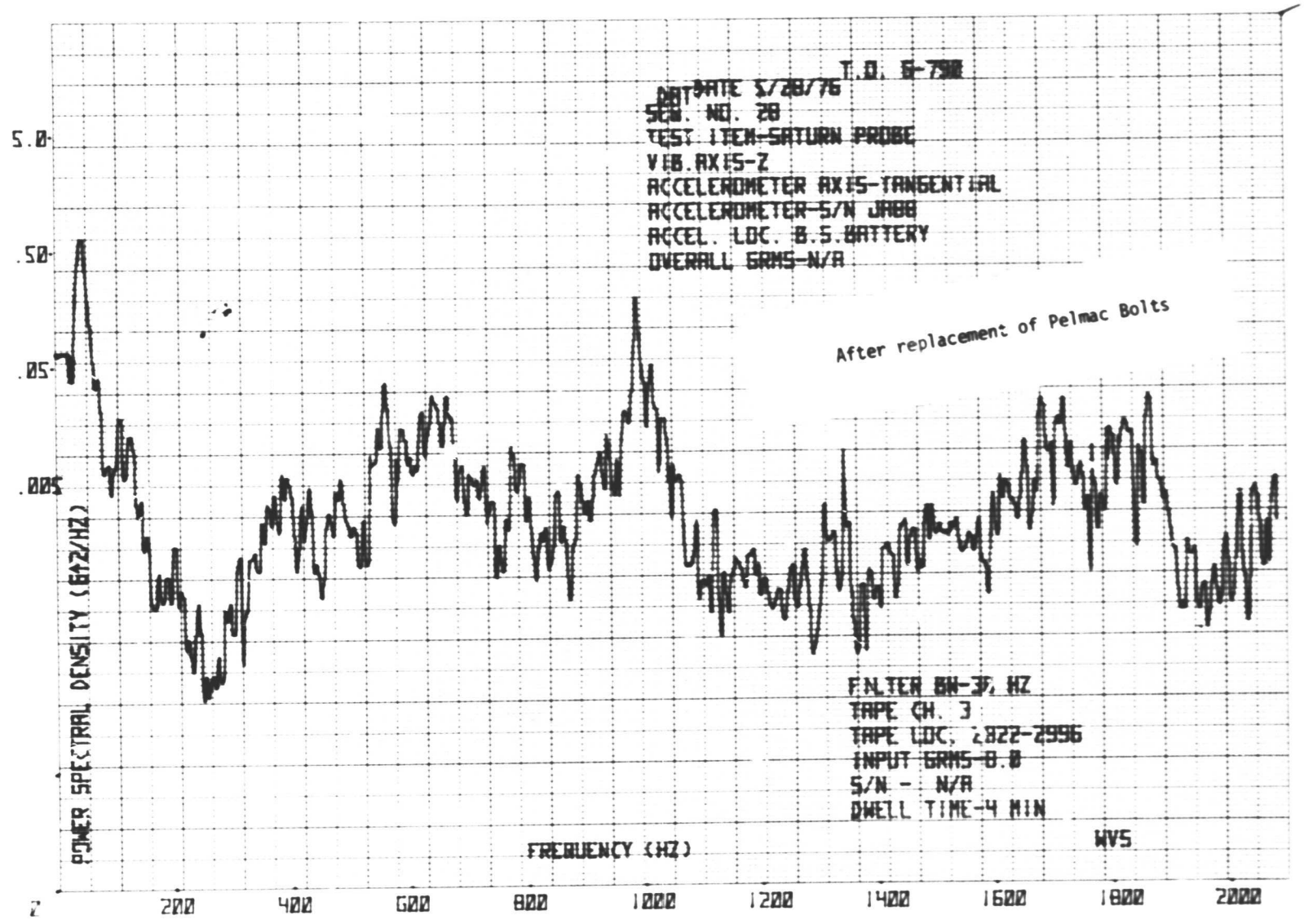

.52
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
After replacement of Pelmac Bolts

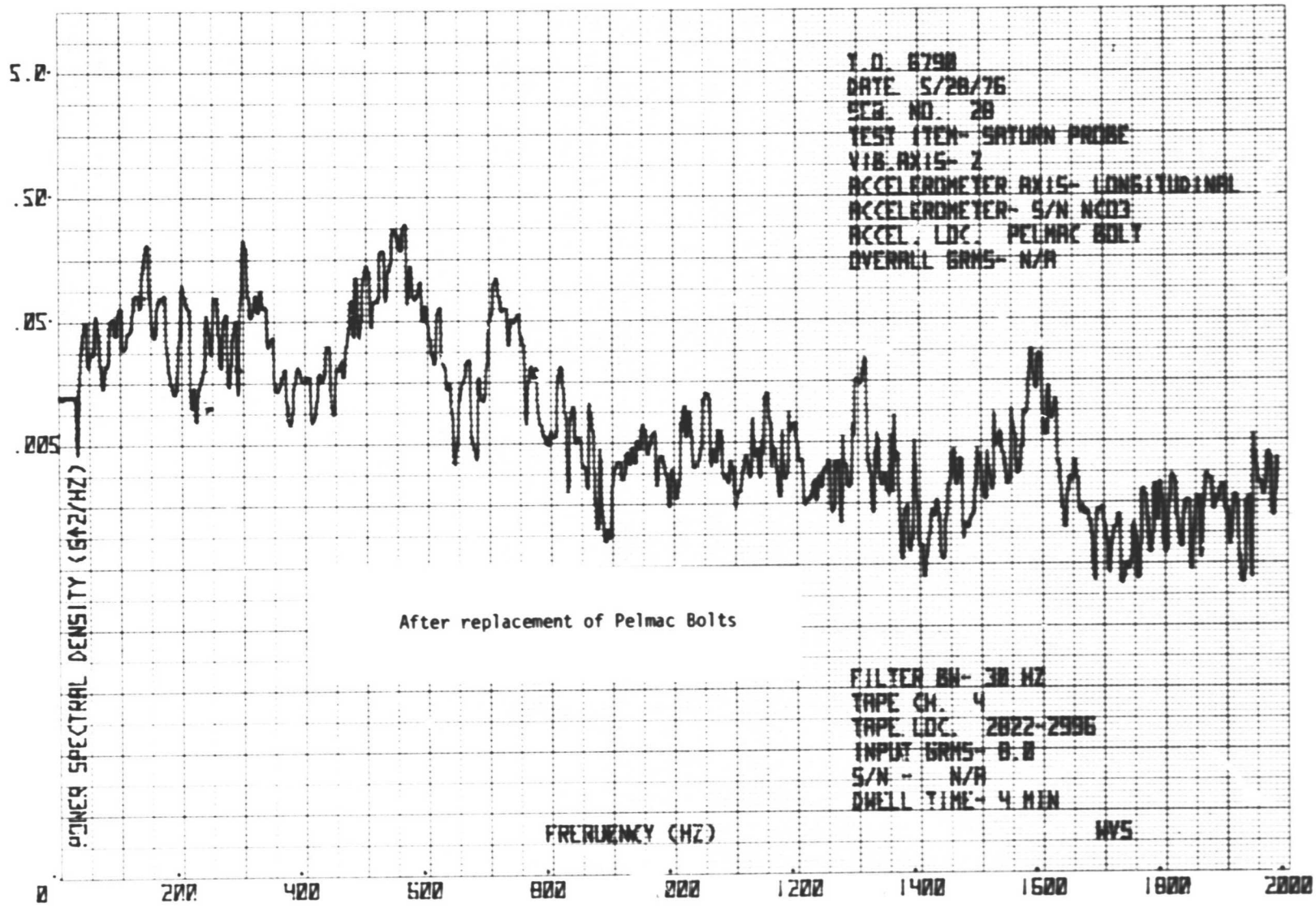
After replacement of Pelmac Bolts

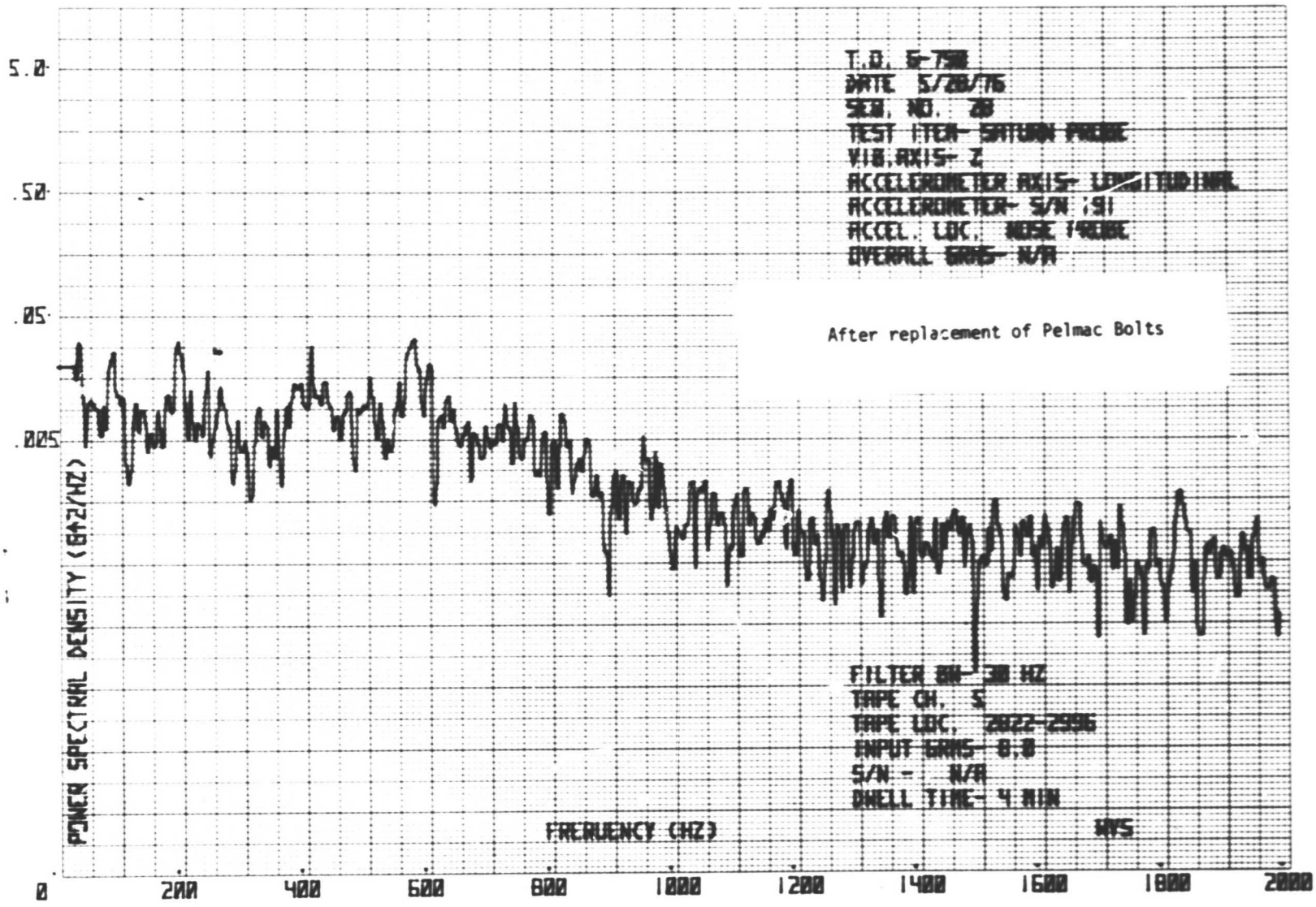

After replacement of Pelmac Bolts
DATE 5/27/76
TEST ITEM- SATURN PROBE
VIB.AXIS- X
ACCELEROMETER AXIS- TANGENTIAL
ACCELEROMETER- S/N 175
ACCEL. LOC. PNEUMATIC CONN
OVERALL GRMS- N/A
S/N - N/A
DWELL TIME- 4 MIN.
FREQUENCY (HZ)
2000

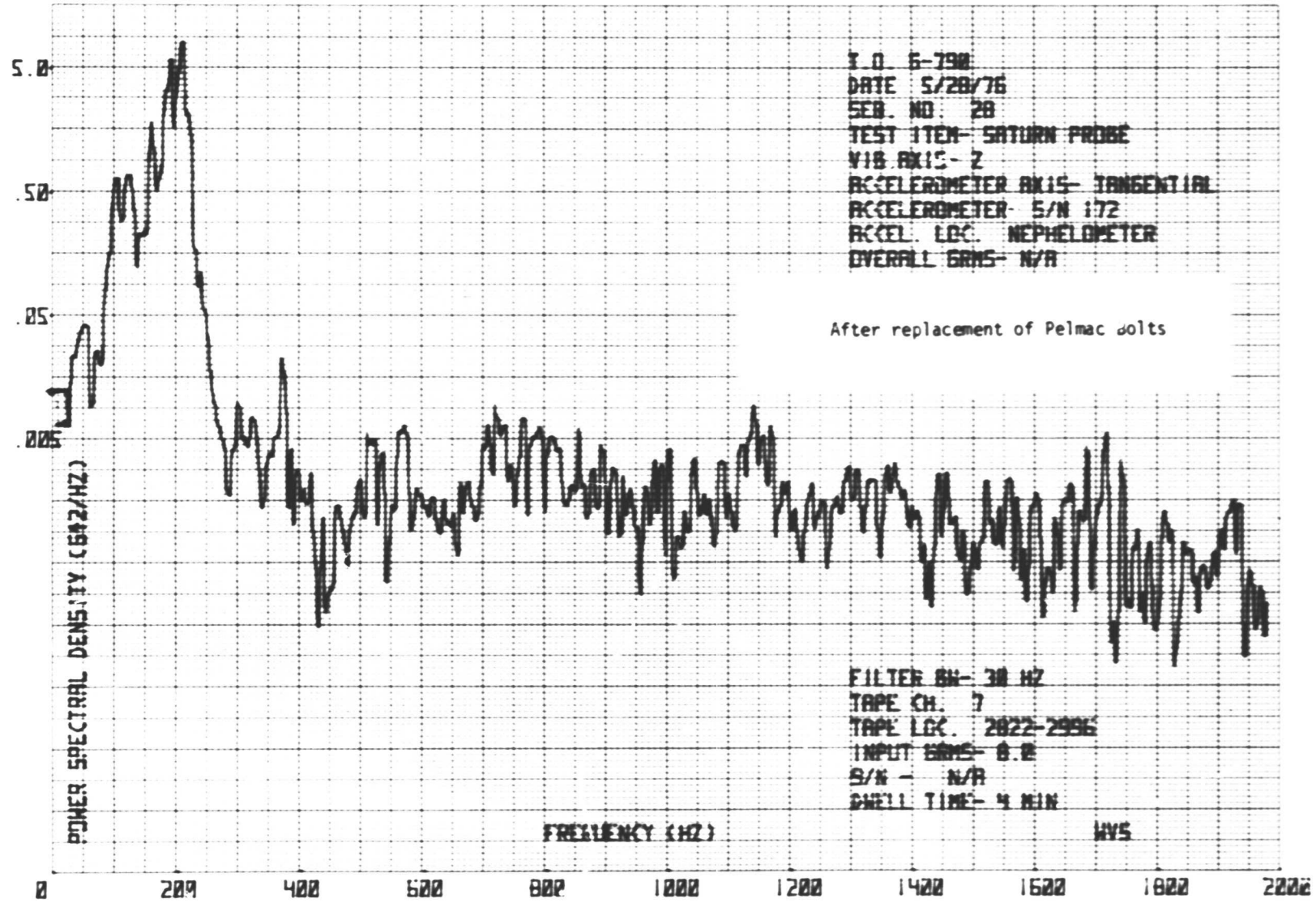

5.0
.50
.25
.025
POWER SPECTRAL DENSITY (G**2/HZ)
0
After replacement of Pelmac Bolts

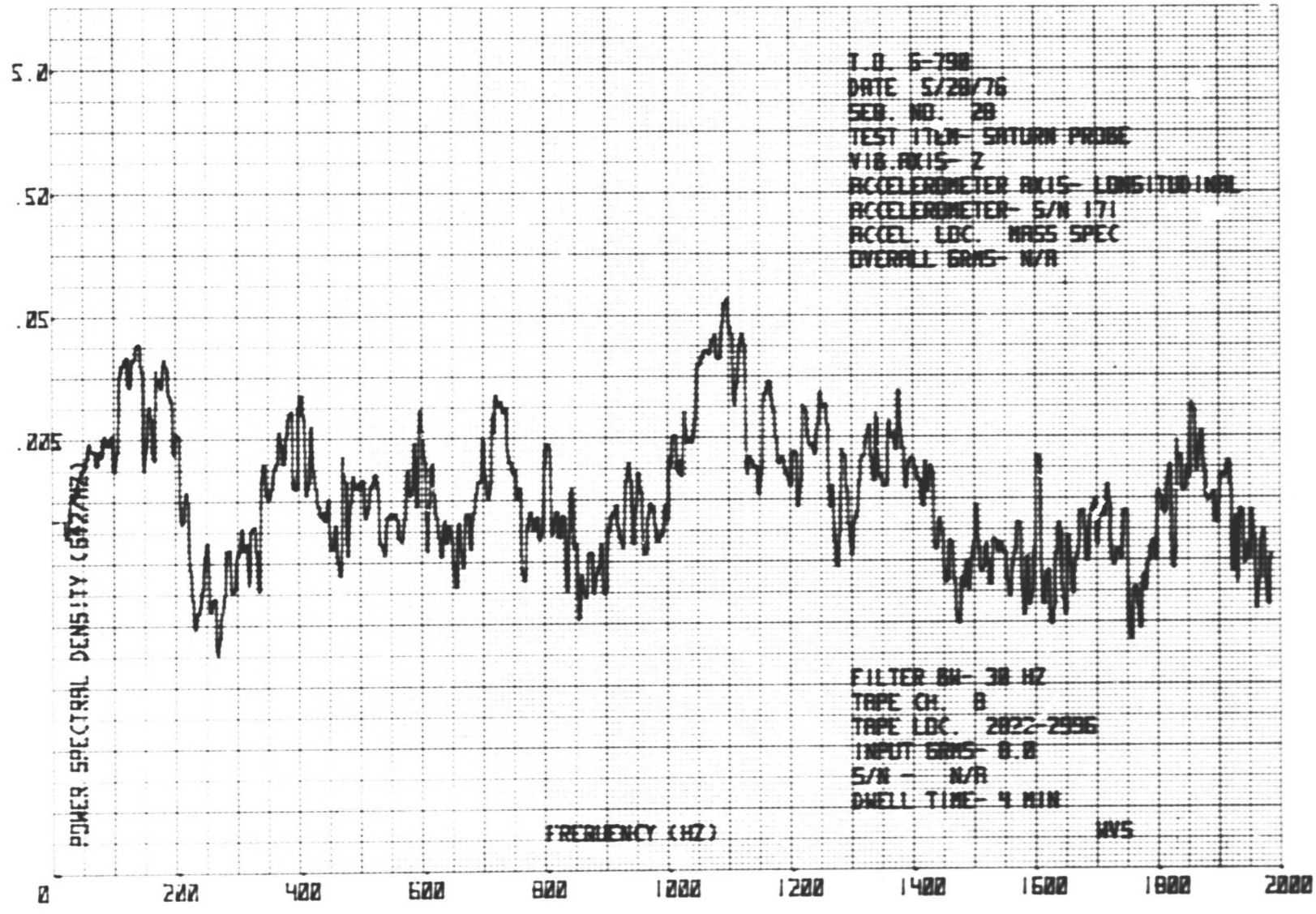

After replacement of Pelmac Bolts

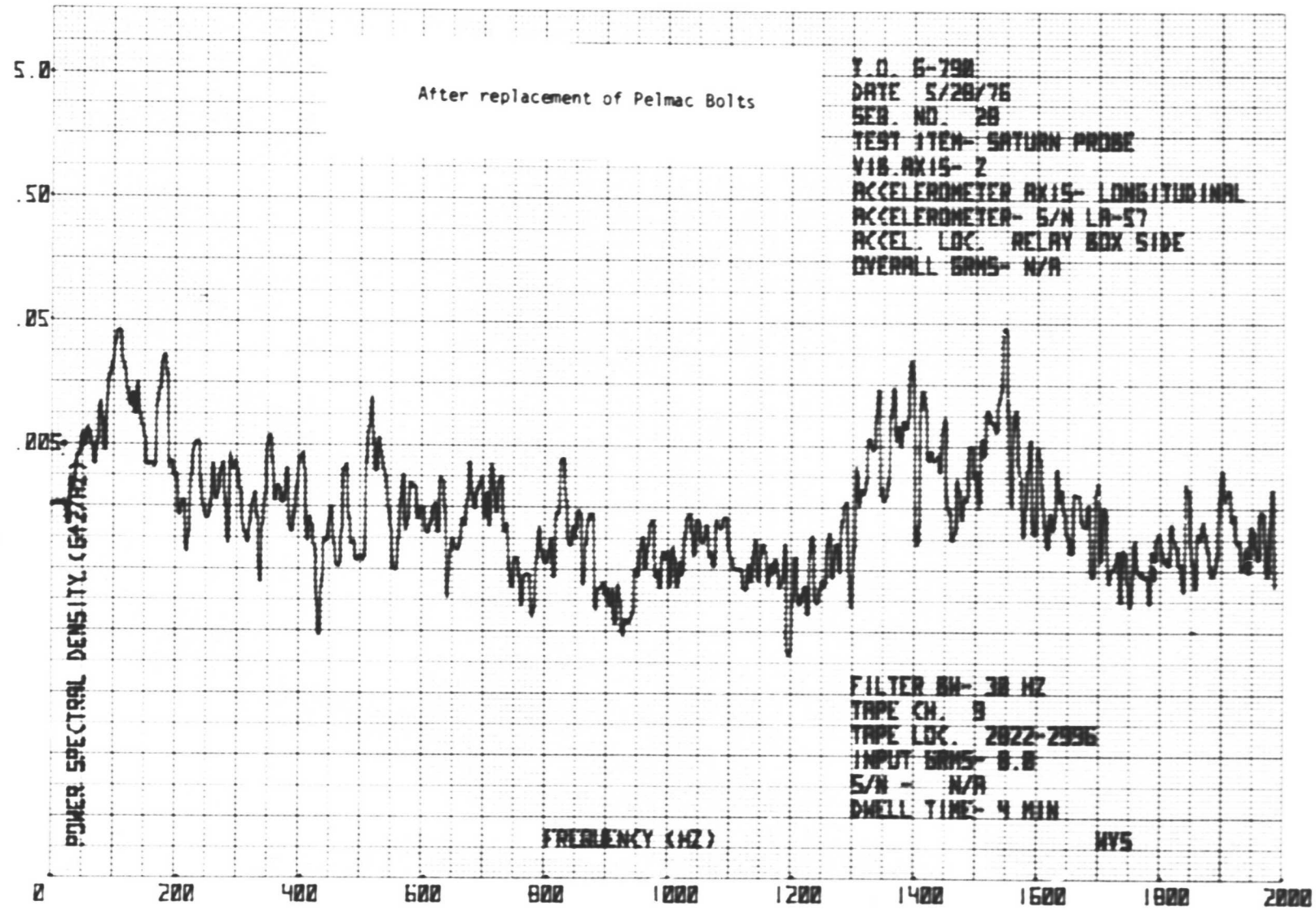

T.D. S-750
DATE 5/28/76
SER. NO. 28
TEST ITEM-SATURN PROBE
VIB. AXIS-Z
ACCELEROMETER AXIS-TANGENTIAL
ACCELEROMETER-S/N JA88
ACCEL. LOC. B.S.BATTERY
OVERALL GRMS-N/A
After replacement of Pelmac Bolts
FILTER BW-3, HZ
TAPE CH. 3
TAPE LOC; 2822-2996
INPUT GRMS-8.8
S/N - N/A
DWELL TIME-4 MIN
WVS
POWER SPECTRAL DENSITY (G**2/HZ)
5.0
.50
.05
.005
FREQUENCY (HZ)
200
400
600
800
1000
1200
1400
1600
1800
2000

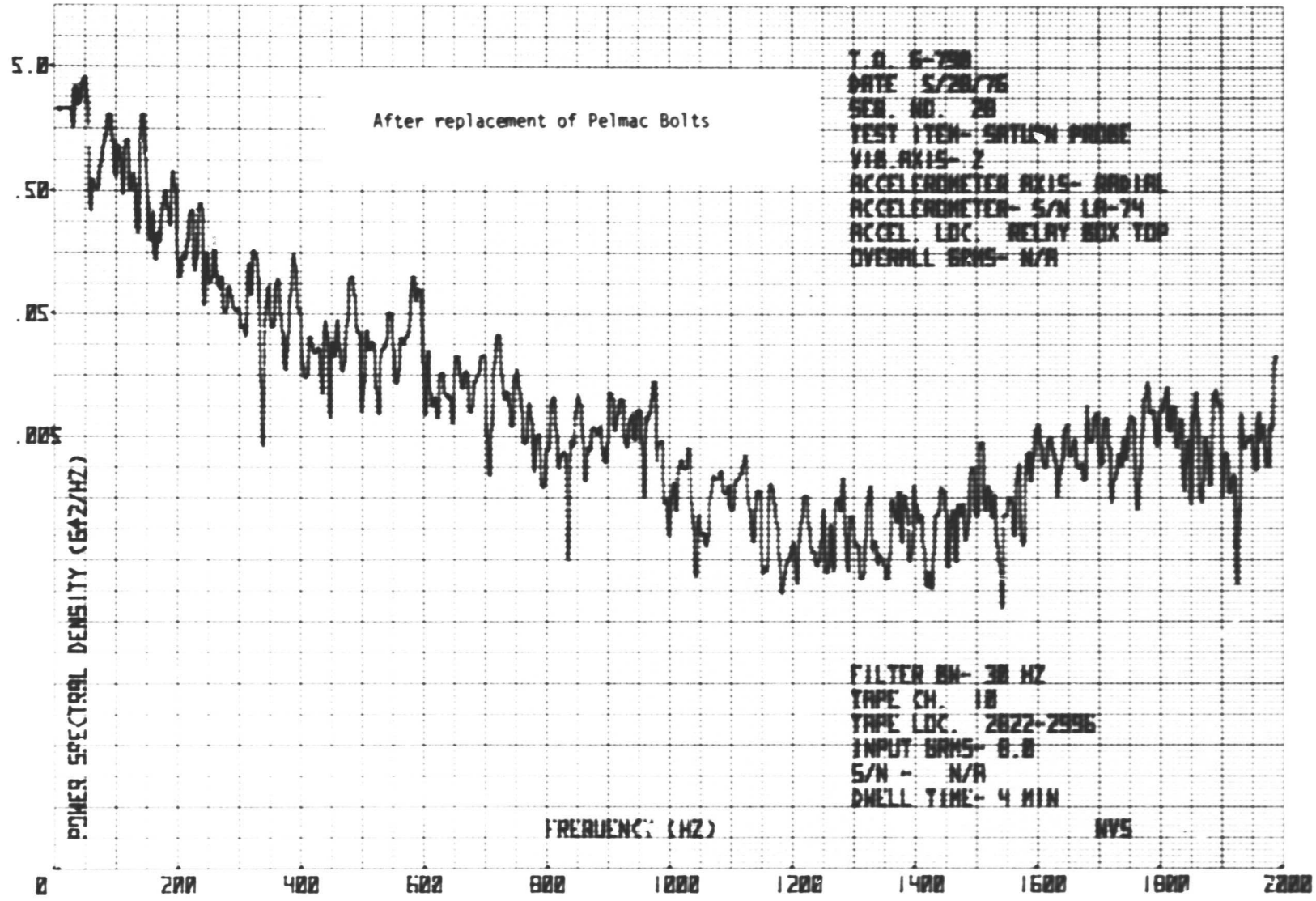

I.D. 6798
DATE 5/28/76
SEQ. NO. 28
TEST ITEM- SATURN PROBE
VIB.AXIS- Z
ACCELEROMETER AXIS- LONGITUDINAL
ACCELEROMETER- S/N N603
ACCEL. LOC. PELMAC BOLT
OVERALL GRMS- N/A
After replacement of Pelmac Bolts
FILTER BW- 30 HZ
TAPE CH. 4
TAPE LOC. 2822-2906
INPUT GRMS- 8.8
S/N - N/A
DWELL TIME- 4 MIN
MMS
POWER SPECTRAL DENSITY (G^2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
000
1200
1400
1600
1800
2000

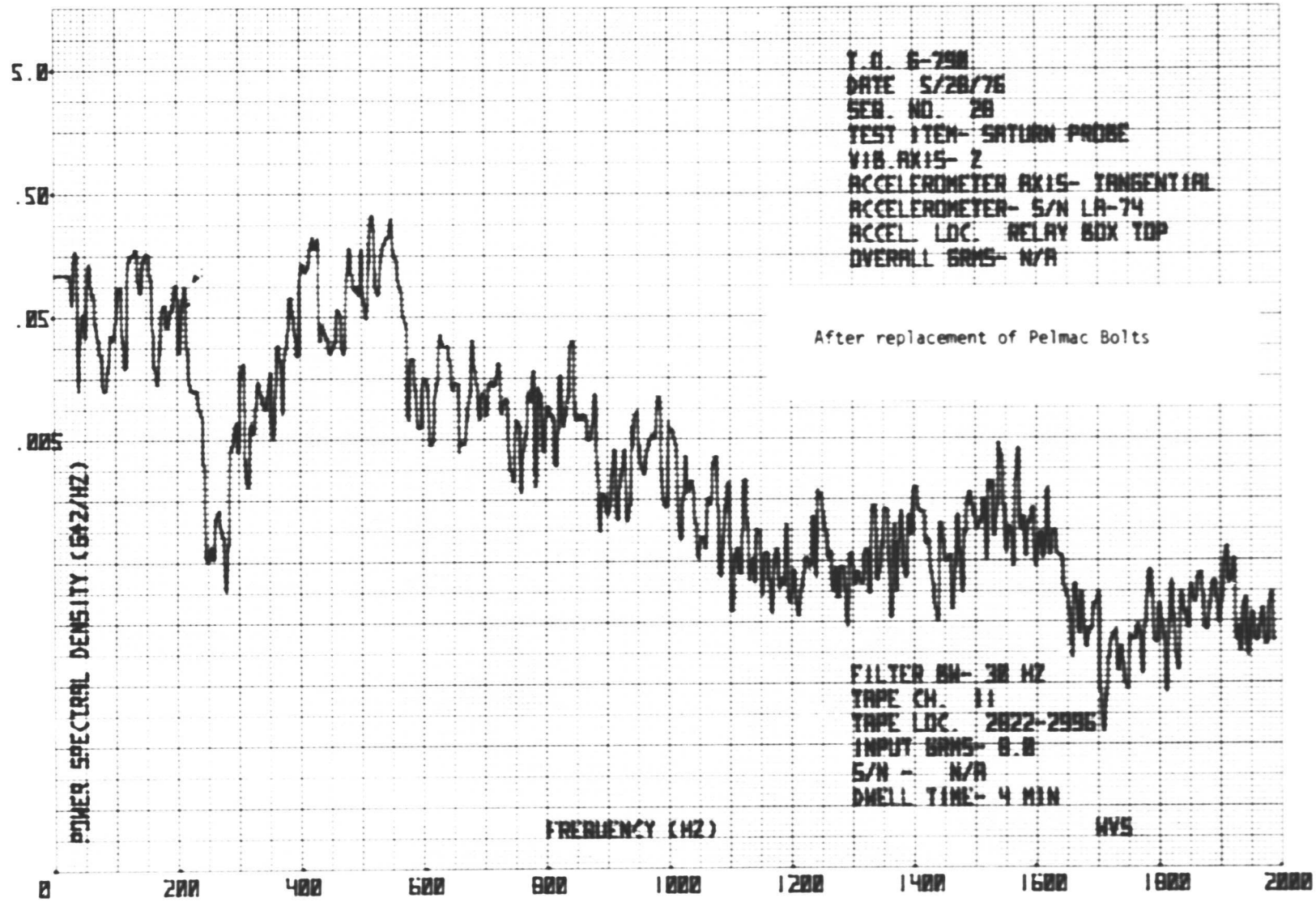

T.D. S-7SB
DATE 5/28/76
SER. NO. 2B
TEST ITEM- SATURN PROBE
VIB.AXIS- Z
ACCELEROMETER AXIS- LONGITUDINAL
ACCELEROMETER- S/N 191
ACCEL. LOC. NOSE PROBE
OVERALL GRMS- N/A
After replacement of Pelmac Bolts
FILTER 80-300 HZ
TAPE CH. 5
TAPE LOC. 2022-2596
INPUT GRMS- 8.8
S/N - N/A
DWELL TIME- 4 MIN
MMS
POWER SPECTRAL DENSITY (G^2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

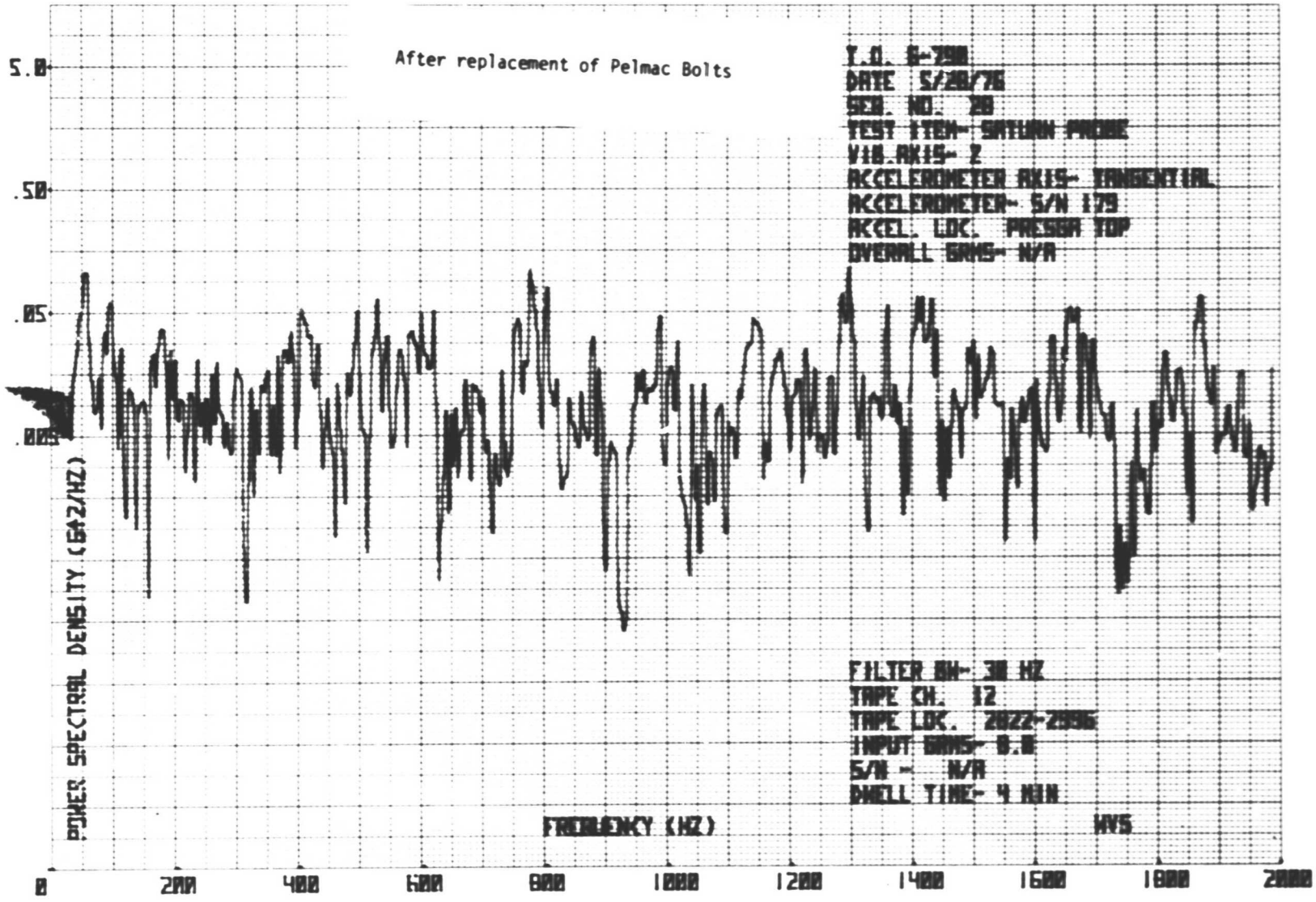

T.O. 6-790
DATE 5/28/76
SEB. NO. 28
TEST ITEM- SATURN PROBE
VIB AXIS- Z
ACCELEROMETER AXIS- TANGENTIAL
ACCELEROMETER- S/N 172
ACCEL. LOC. NEPHELOMETER
OVERALL GRMS- N/A
After replacement of Pelmac bolts
FILTER BW- 30 HZ
TAPE CH. 7
TAPE LOC. 2022-2956
INPUT GRMS- 0.2
S/N - N/A
DWELL TIME- 4 MIN
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
WVS
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

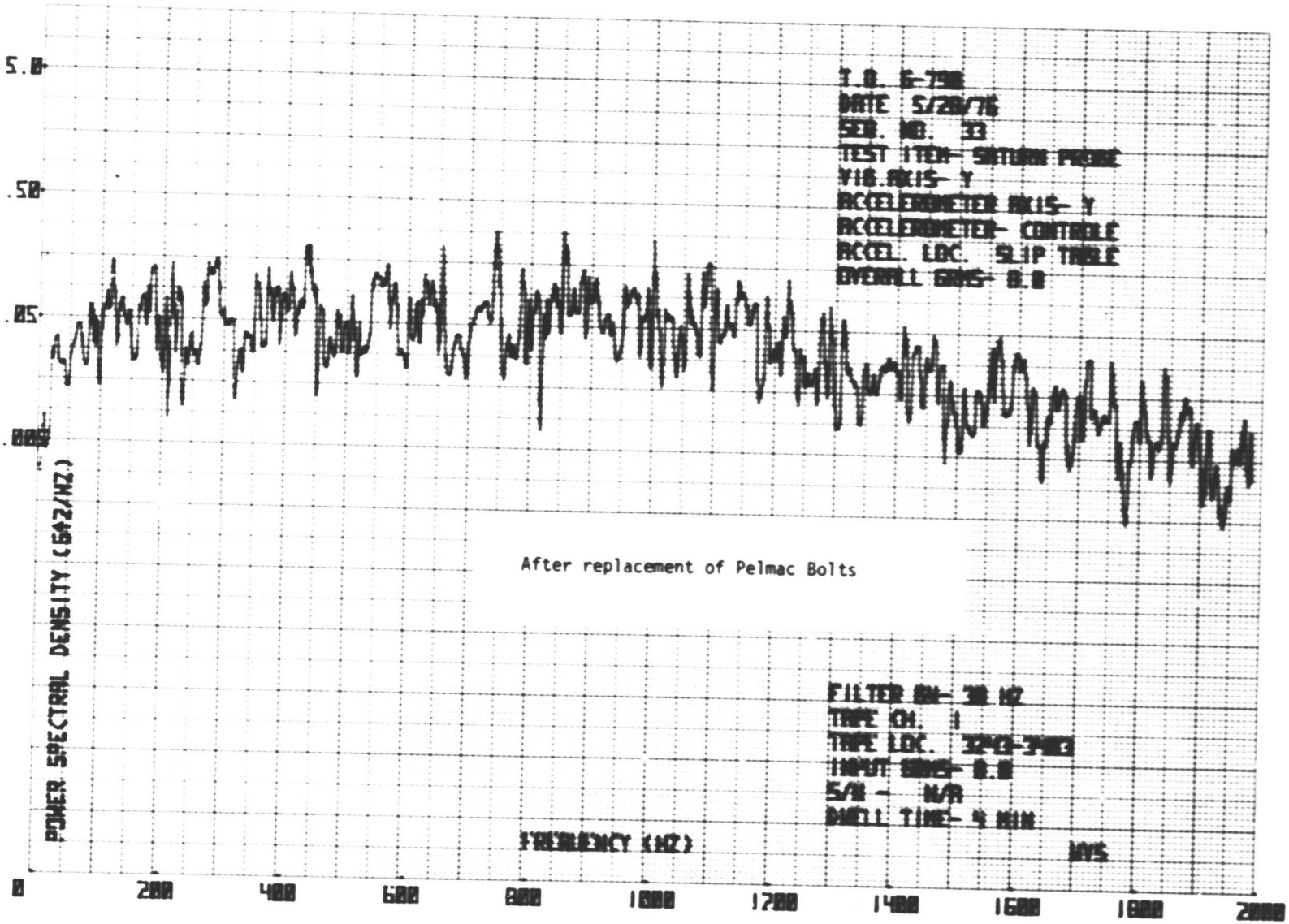

T.O. 6-798
DATE 5/28/76
SEQ. NO. 28
TEST TITLE- SATURN PROBE
VIB.AXIS- Z
ACCELEROMETER AXIS- LONGITUDINAL
ACCELEROMETER- S/N 171
ACCEL. LOC. MASS SPEC
OVERALL GRMS- N/A
FILTER BW- 30 HZ
TAPE CH. 8
TAPE LOC. 2022-2956
INPUT GRMS- 8.8
S/N - N/A
DWELL TIME- 4 MIN
WVS
POWER SPECTRAL DENSITY (G²/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

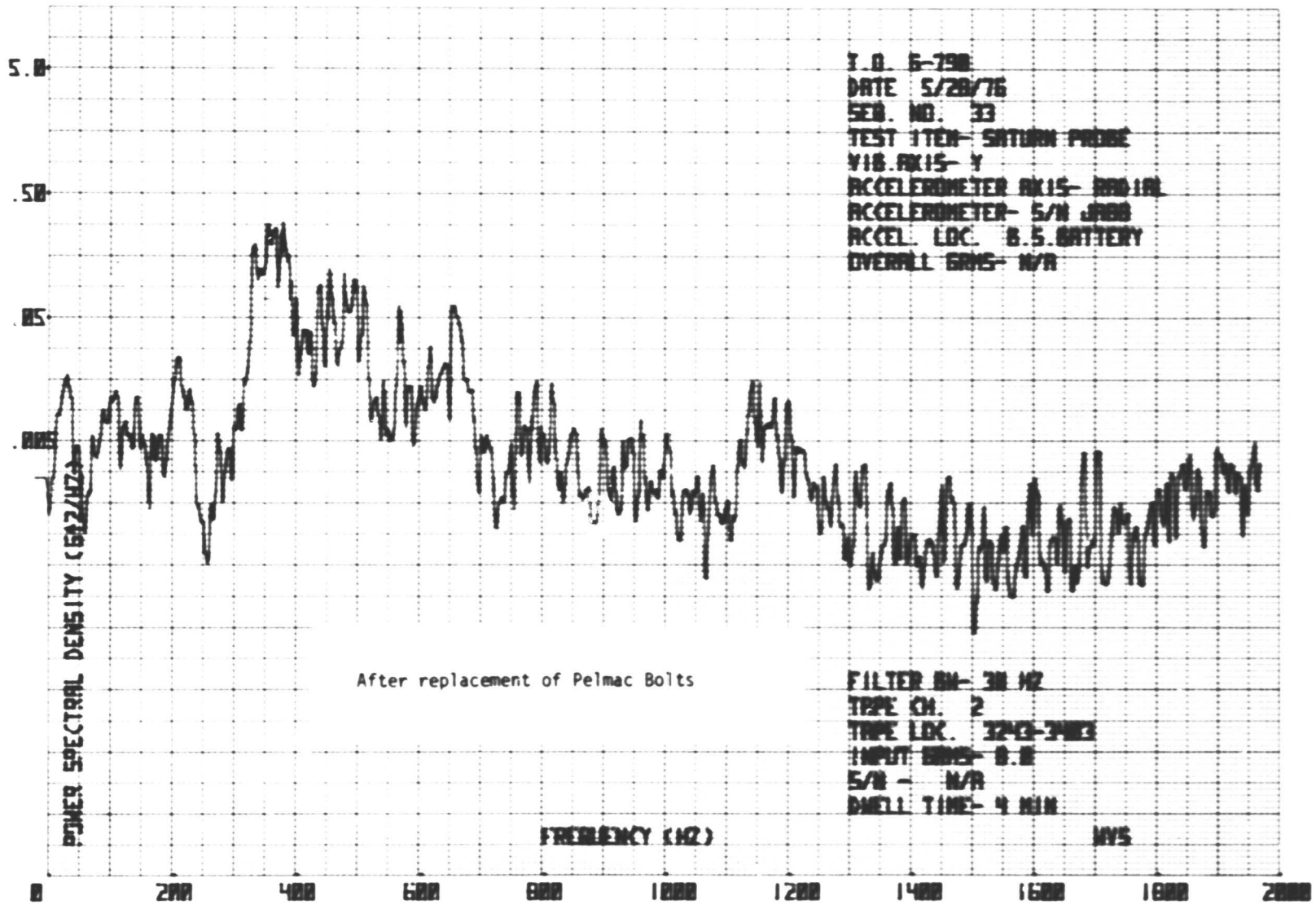

After replacement of Pelmac Bolts
T.O. 6-798
DATE 5/28/76
SEQ. NO. 28
TEST ITEM- SATURN PROBE
V18.AXIS- Z
ACCELEROMETER AXIS- LONGITUDINAL
ACCELEROMETER- S/N LA-57
ACCEL. LOC. RELAY BOX SIDE
OVERALL GRMS- N/A
FILTER BW- 30 HZ
TAPE CH. 9
TAPE LOC. 2022-2956
INPUT GRMS- 8.8
S/N - N/A
DWELL TIME- 4 MIN
MY5
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

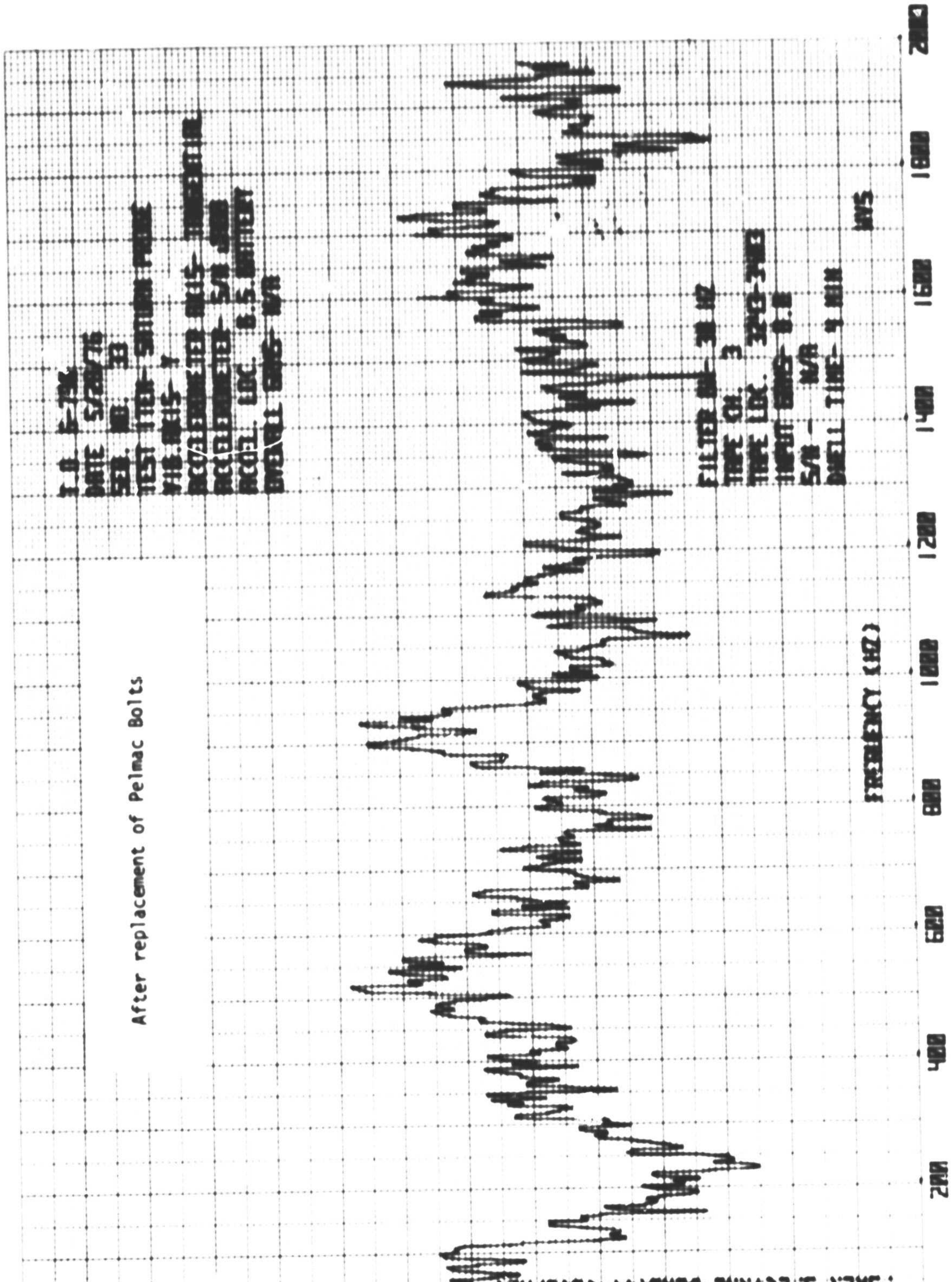

After replacement of Pelmac Bolts
T.A. 6-79B
DATE 5/28/76
SER. NO. 2B
TEST ITEM- SATURN PROBE
VIB.AXIS- Z
ACCELEROMETER AXIS- ORBITAL
ACCELEROMETER- S/N LA-74
ACCEL. LOC. RELAY BOX TOP
OVERALL GRMS- N/A
FILTER BW- 30 HZ
TAPE CH. 18
TAPE LOC. 2822-2996
INPUT GRMS- 0.0
S/N - N/A
DWELL TIME- 4 MIN
MVS
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

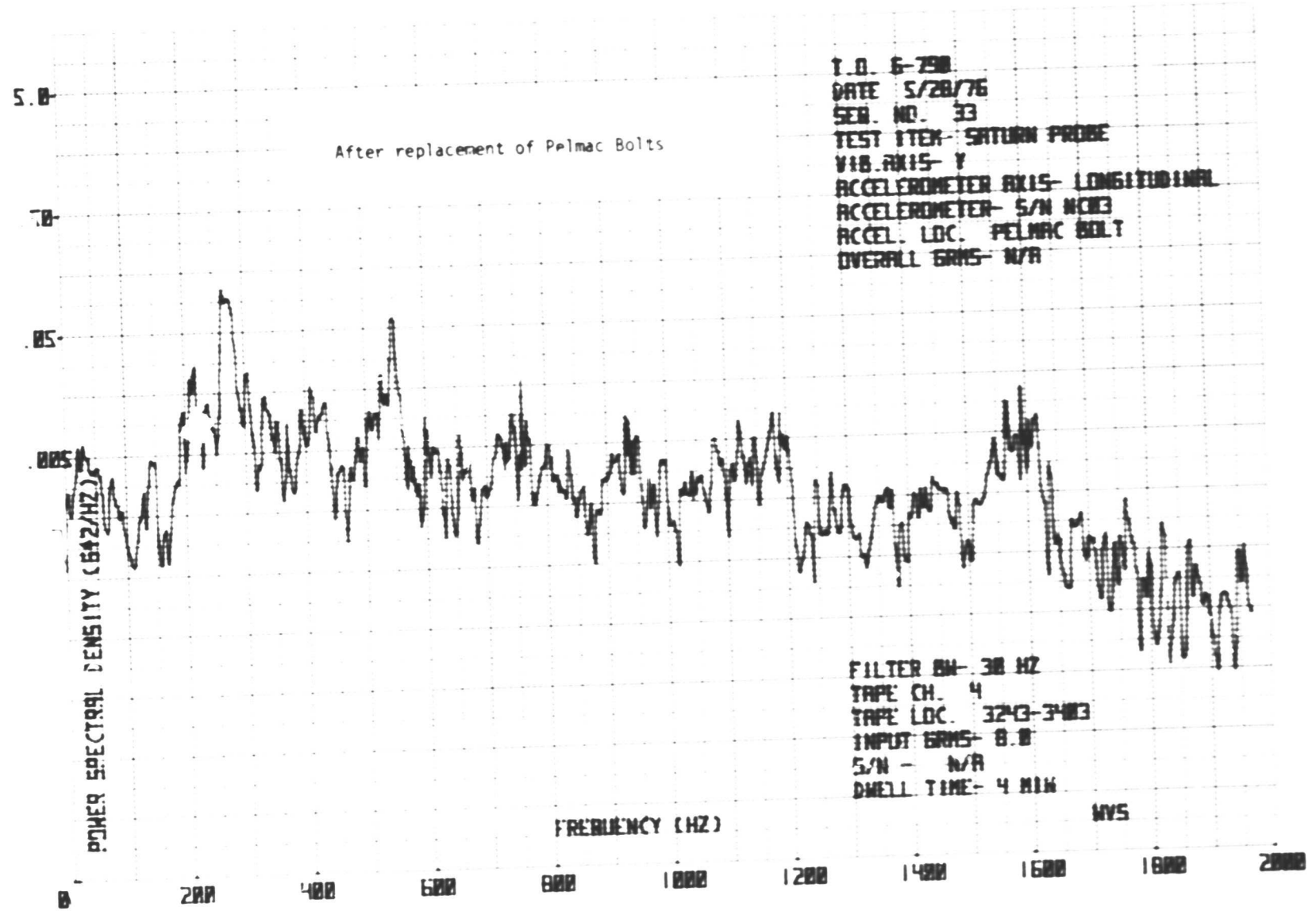

T.O. 6-298
DATE 5/28/76
SEQ. NO. 28
TEST ITEM- SATURN PROBE
VIB.AXIS- Z
ACCELEROMETER AXIS- TANGENTIAL
ACCELEROMETER- S/N LA-74
ACCEL. LOC. RELAY BOX TOP
OVERALL GRMS- N/A
After replacement of Pelmac Bolts
FILTER BW- 30 HZ
TAPE CH. 11
TAPE LOC. 2022-2996
INPUT GRMS- 0.8
S/N - N/A
DWELL TIME- 4 MIN
MVS
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

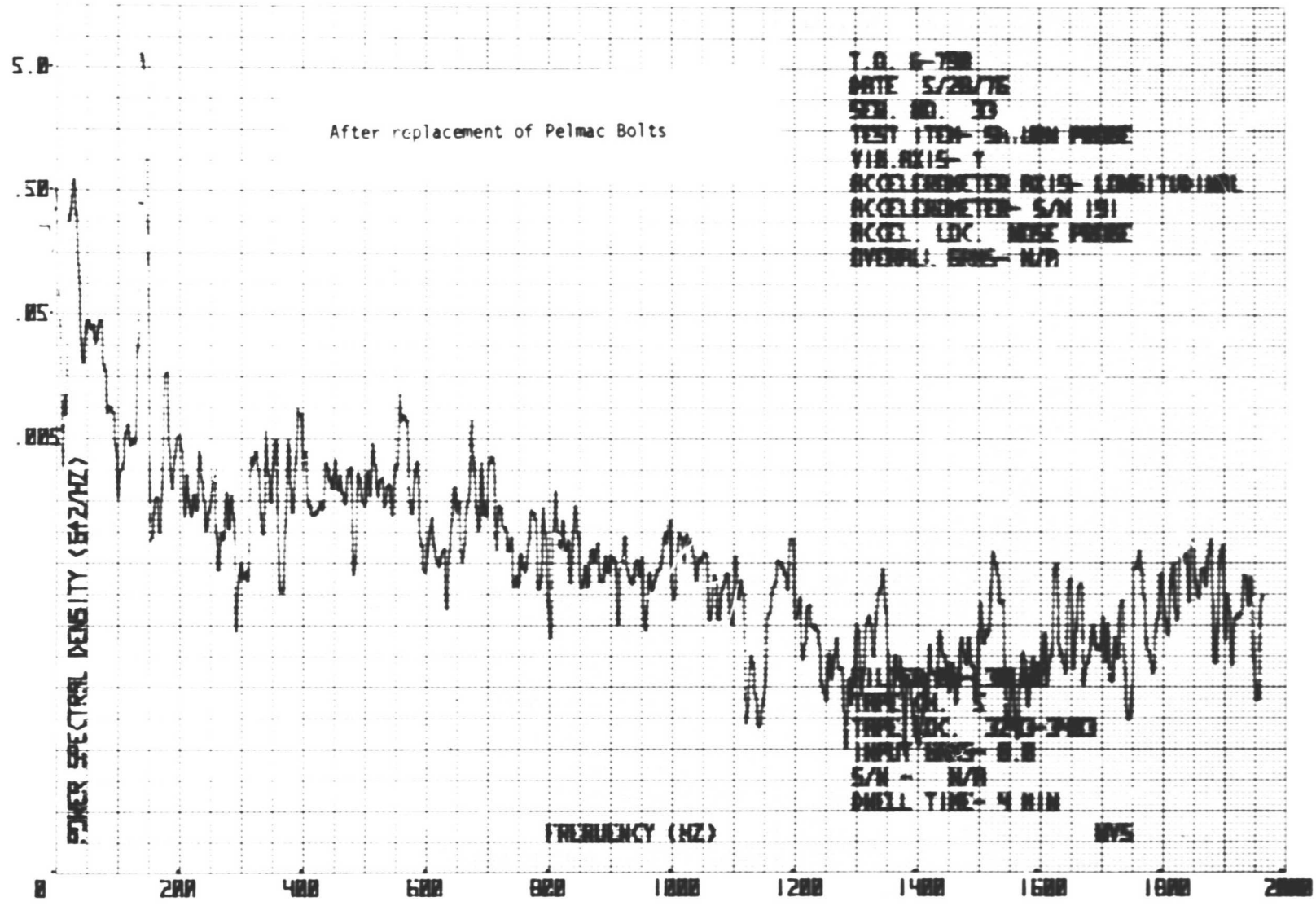

After replacement of Pelmac Bolts
T.O. G-7SB
DATE 5/28/76
SER. NO. 2B
TEST ITEM- SATURN PROBE
VIB.AXIS- Z
ACCELEROMETER AXIS- TANGENTIAL
ACCELEROMETER- S/N 179
ACCEL. LOC. PRESSR TOP
OVERALL GRMS- N/A
FILTER BW- 3B HZ
TAPE CH. 12
TAPE LOC. 2022-2086
INPUT GRMS- 0.0
S/N - N/A
DWELL TIME- 4 MIN
HVS
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

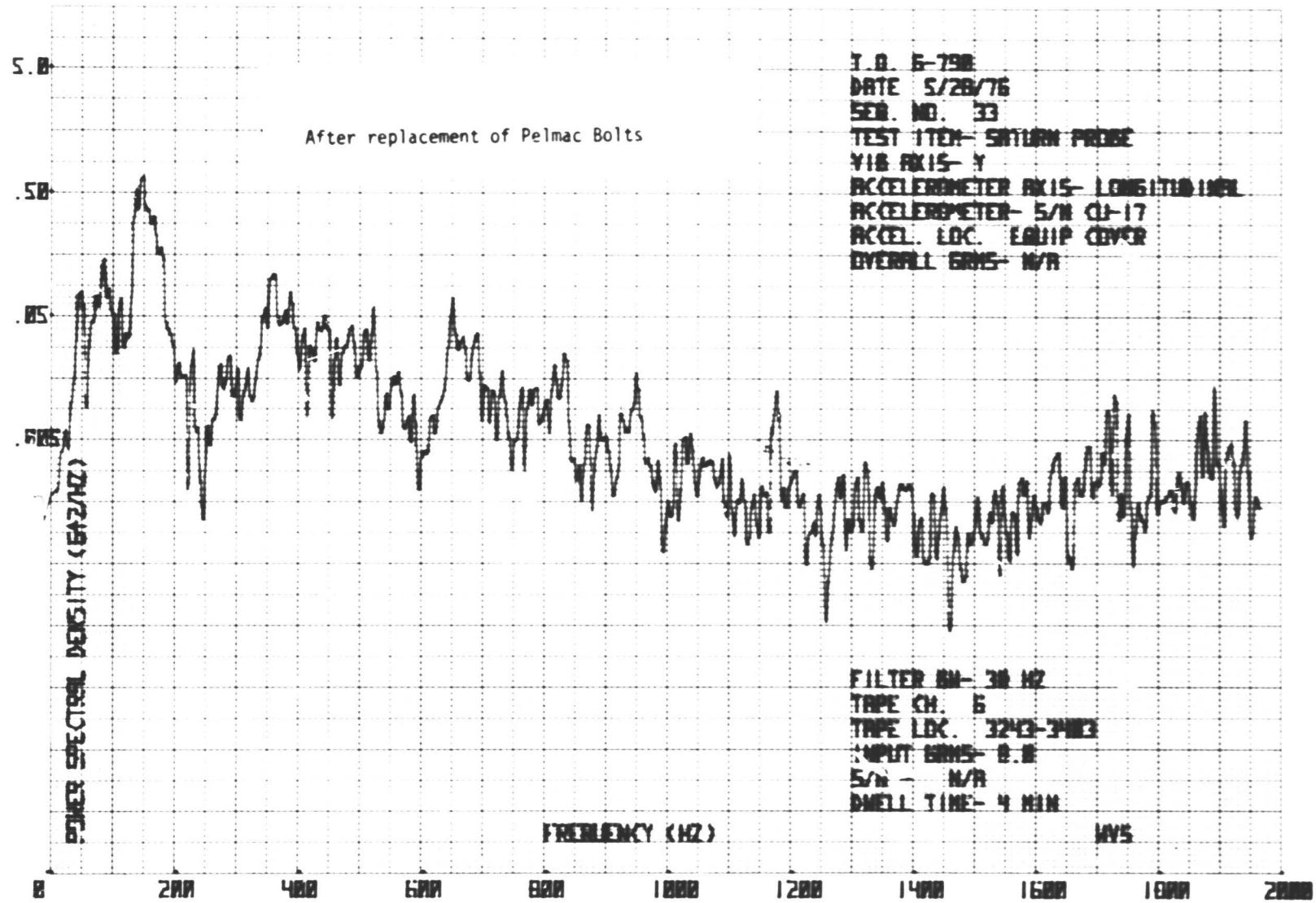

5.0
.50
.05
.005
POWER SPECTRAL DENSITY (G**2/HZ)
T.O. F-798
DATE 5/20/76
SER. NO. 33
TEST ITEM- SATURN PROBE
VIB.AXIS- Y
ACCELEROMETER AXIS- Y
ACCELEROMETER- CONTROLE
ACCEL. LOC. SLIP TABLE
OVERALL GRMS- 8.8
After replacement of Pelmac Bolts
FILTER BW- 30 HZ
TAPE CH. 1
TAPE LOC. 3243-3483
INPUT GRMS- 8.8
5/8 - N/R
DWELL TIME- 4 MIN
NAS
FREQUENCY (HZ)
0
200
400
600
800
1000
1200
1400
1600
1800
2000

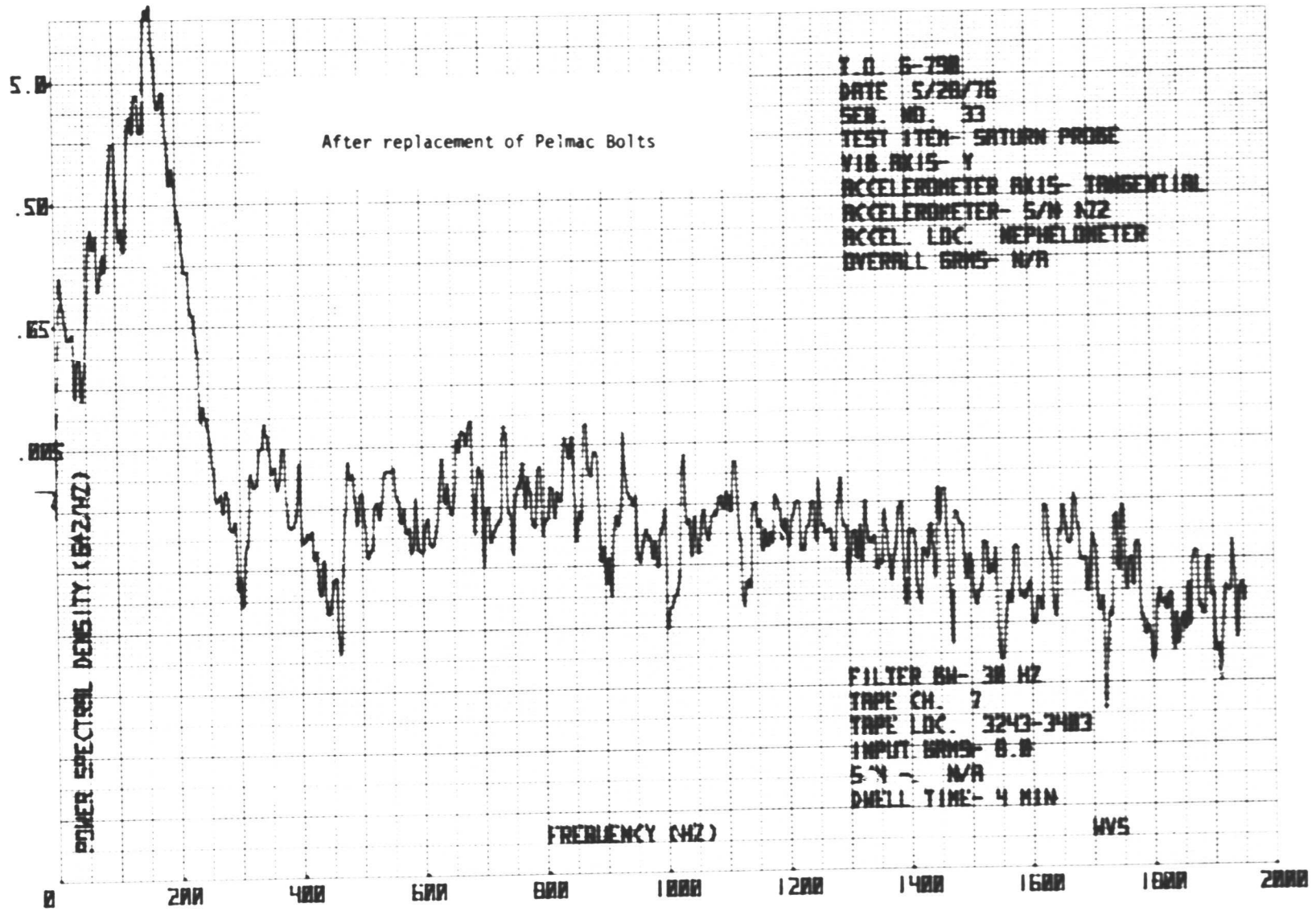

T.O. 6-730
DATE 5/28/76
SEQ. NO. 33
TEST ITEM- SATURN PROBE
VIB.AXIS- Y
ACCELEROMETER AXIS- RADIAL
ACCELEROMETER- S/N 4888
ACCEL. LOC. B.S.BATTERY
OVERALL GRMS- N/R
5.0
.50
.05
.005
POWER SPECTRAL DENSITY (G**2/HZ)
After replacement of Pelmac Bolts
FILTER BW- 30 HZ
TAPE CH. 2
TAPE LOC. 3240-3480
INPUT GRMS- 8.0
S/N - N/R
DWELL TIME- 4 MIN
FREQUENCY (HZ)
NAS
0
200
400
600
800
1000
1200
1400
1600
1800
2000

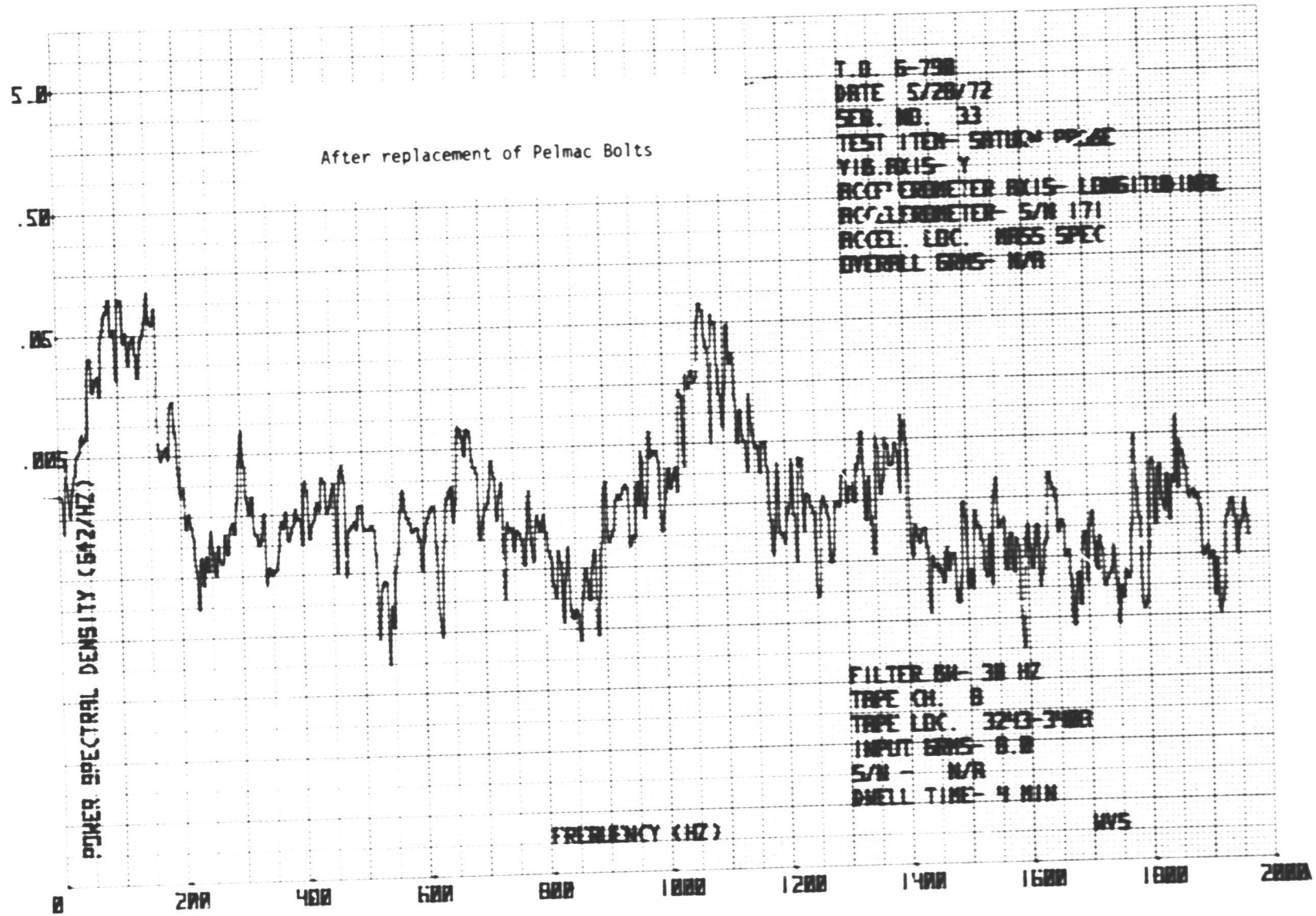

After replacement of Pelmac Bolts
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
0
200
400
600
800
1000
1200
1400
1600
1800
2000

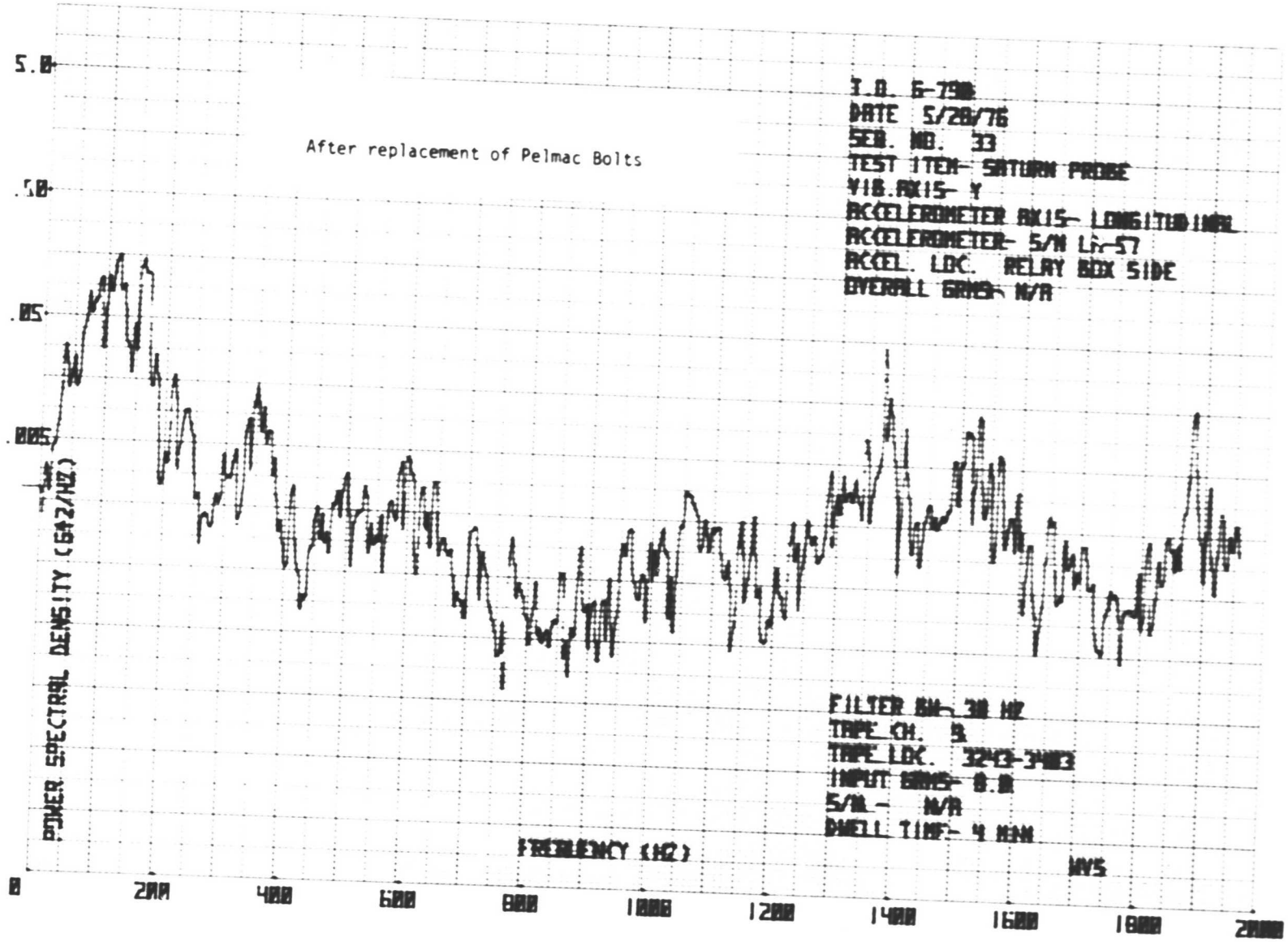

After replacement of Pelmac Bolts
T.O. 6-298
DATE 5/28/76
SER. NO. 33
TEST ITEM- SATURN PROBE
VIB.AXIS- Y
ACCELEROMETER AXIS- LONGITUDINAL
ACCELEROMETER- S/N HC03
ACCEL. LOC. PELMAC BOLT
OVERALL GRMS- N/A
FILTER BW- 30 HZ
TAPE CH. 4
TAPE LOC. 3243-3403
INPUT GRMS- 8.0
S/N - N/A
DWELL TIME- 4 MIN
WVS
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
5.0
.10
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

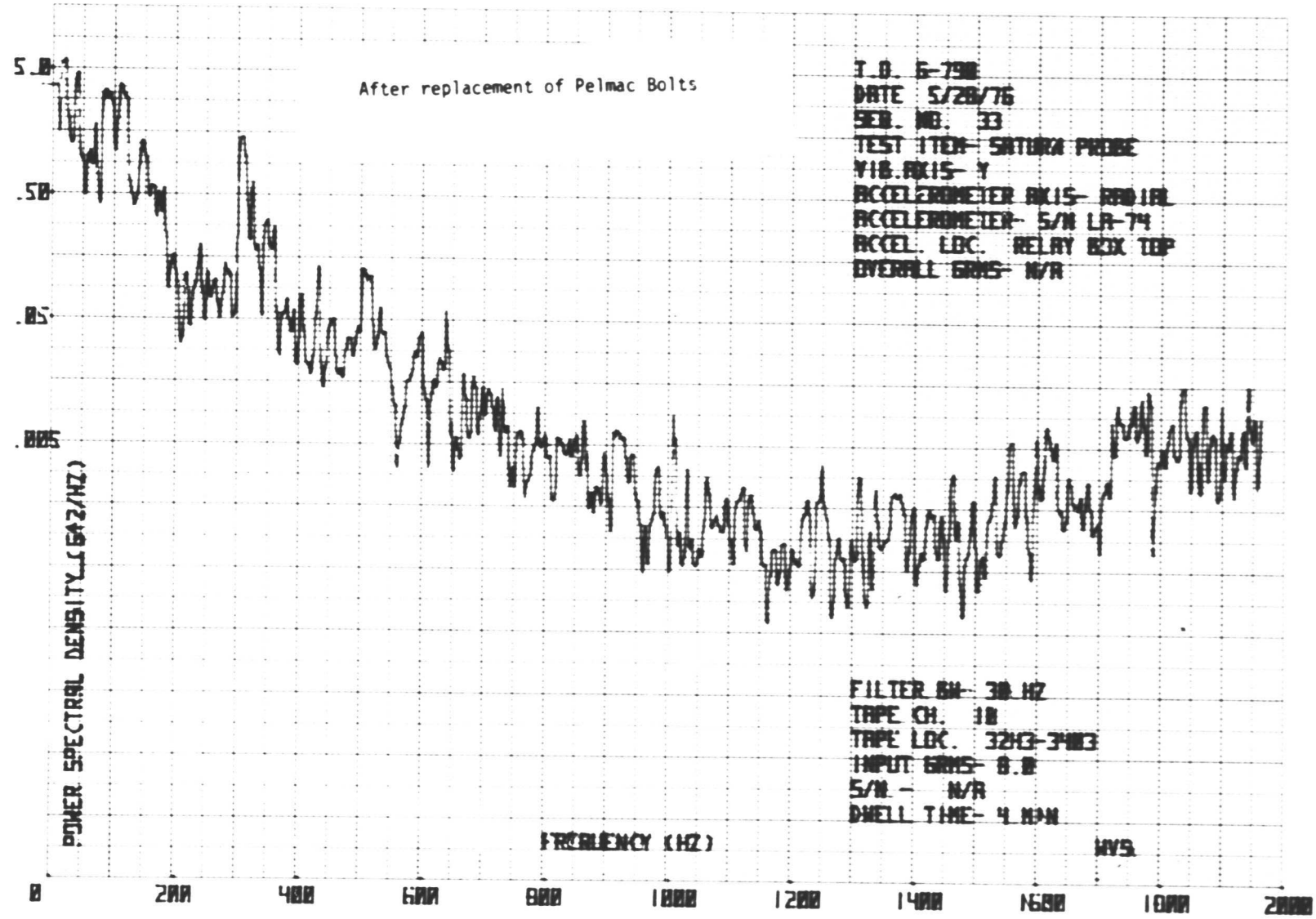

After replacement of Pelmac Bolts
5.0
.50
.05
.005
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
0
200
400
600
800
1000
1200
1400
1600
1800
2000

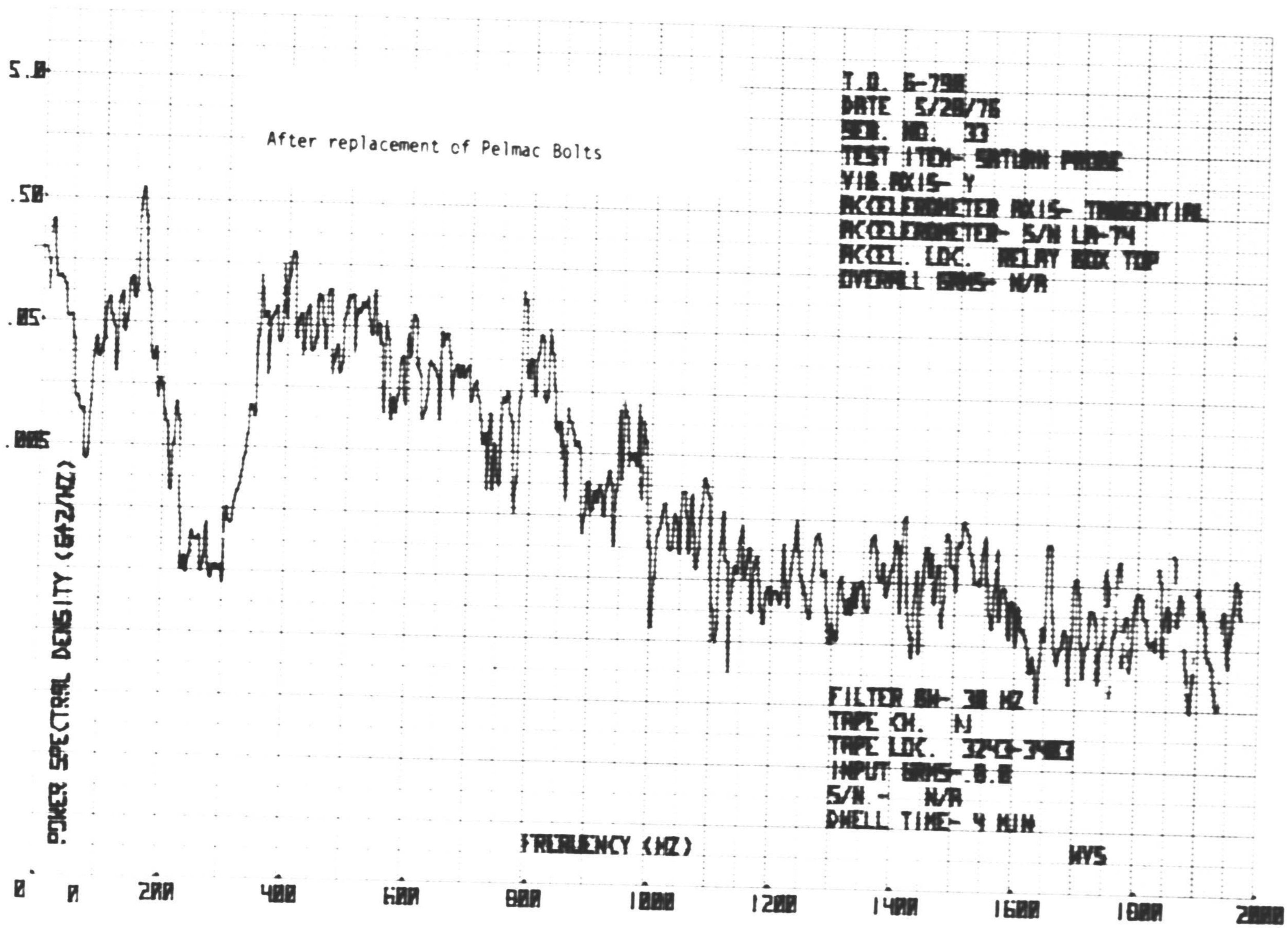

After replacement of Pelmac Bolts
T.O. 6-798
DATE 5/28/76
SER. NO. 33
TEST ITEM- SATURN PROBE
VIB AXIS- Y
ACCELEROMETER AXIS- LONGITUDINAL
ACCELEROMETER- S/N CU-17
ACCEL. LOC. EQUIP COVER
OVERALL GRMS- N/R
FILTER BW- 30 HZ
TAPE CH. 6
TAPE LOC. 3243-3483
INPUT GRMS- 0.8
S/N - N/R
DWELL TIME- 4 MIN
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
0
200
400
600
800
1000
1200
1400
1600
1800
2000

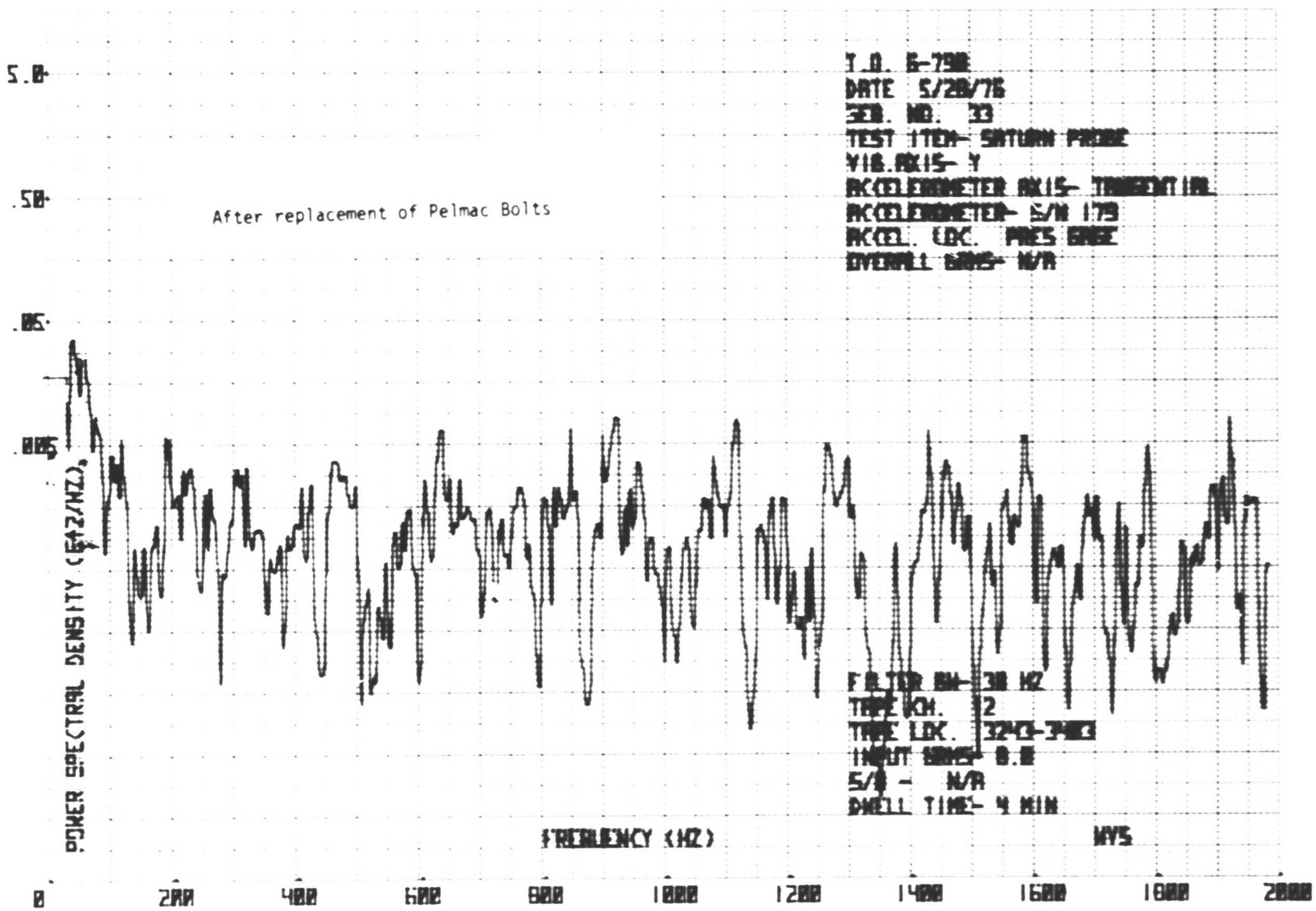

After replacement of Pelmac Bolts
T.O. G-7SB
DATE 5/28/76
SER. NO. 33
TEST ITEM- SATURN PROBE
VIB.AXIS- Y
ACCELEROMETER AXIS- TANGENTIAL
ACCELEROMETER- S/N NZZ
ACCEL. LOC. NEPHELOMETER
OVERALL GRMS- N/R
FILTER BW- 3B HZ
TAPE CH. 7
TAPE LOC. 3243-3483
INPUT GRMS- 8.B
S/N - N/R
DWELL TIME- 4 MIN
WVS
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000


After replacement of Pelmac Bolts
T.B. 6-79B
DATE 5/28/72
SER. NO. 33
Y18.AXIS- Y
ACCEL. LOC. NRDS SPEC
OVERALL GRMS- N/R
FILTER BW- 30 HZ
TAPE CH. 8
INPUT GRMS- 8.0
S/N - N/R
DWELL TIME- 4 MIN
5.0
.50
.05
.005
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
0
200
400
600
800
1000
1200
1400
1600
1800
2000


After replacement of Pelmac Bolts
T.D. 6-798
DATE 5/28/76
SER. NO. 33
TEST ITEM- SATURN PROBE
Y18.AX15- Y
ACCELEROMETER AX15- LONGITUDINAL
ACCELEROMETER- S/N LA-57
ACCEL. LOC. RELAY BOX SIDE
OVERALL GRMS- N/A
FILTER BW- 30 HZ
TAPE CH. 5
TAPE LOC. 3243-3483
INPUT GRMS- 0.0
S/N - N/A
DWELL TIME- 4 MIN
WVS
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
5.0
.10
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000


After replacement of Pelmac Bolts
T.D. 6-798
DATE 5/28/76
SER. NO. 33
TEST ITEM- SATURN PROBE
VIB.AXIS- Y
ACCELEROMETER AXIS- RADIAL
ACCELEROMETER- S/N LA-74
ACCEL. LOC. RELAY BOX TOP
OVERALL GRMS- N/A
FILTER BW- 30 HZ
TAPE CH. 18
TAPE LOC. 3243-3483
INPUT GRMS- 8.8
S/N - N/A
DWELL TIME- 4 MIN
HYS.
POWER SPECTRAL DENSITY (G**2/HZ)
FREQUENCY (HZ)
.5
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000


After replacement of Pelmac Bolts
POWER SPECTRAL DENSITY (G↑2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
2000


After replacement of Pelmac Bolts
SEQ. NO. 33
TEST ITEM- SATURN PROBE
VIB.AXIS- Y
ACCELEROMETER- S/N 179
OVERALL GRMS- N/A
FILTER BW- 30 HZ
TAPE CH. 2
DWELL TIME- 4 MIN
POWER SPECTRAL DENSITY (G†2/HZ)
FREQUENCY (HZ)
5.0
.50
.05
.005
0
200
400
600
800
1000
1200
1400
1600
1800
2000

APPENDIX C

STATIC TEST DATA

This appendix contains the test data recorded during the three static tests. The data for each test consists of several "RUN" data groups which correspond to various load levels. The load level is given by the value of "P2" which is the pressure applied to the forebody. The value of P2 at limit load is 127 PSI. Within a RUN data group is given: (1) the time of the data recording, (2) the hydraulic pressure (P1) in PSI, (3) the hydrostatic pressure (P2) in PSI, (4) hydraulic actuated rod loads in pounds, (5) deflections of the deflectometer in inches, (6) and strains measured by the strain gages. The rod loads, deflections and strains are preceeded by a channel number which corresponds to gage numbers as given in Figure C1. The locations of gages are given in the main report (except no gages are shown for the rods).

GAGE NUMBER VS CHANNEL NUMBER

GAGE NUMBER	CHANNEL NUMBER	GAGE NUMBER	CHANNEL NUMBER
4	78	30	22
5	30	31	62
6	68	32	61
7	11	33	20
8	10		60
9	51	34	21
10	42		26
11	70	35	39
12	31	37	5
13	50		41
14	79	39	1
15	74	40	48
	34		45
16	24	41	73
	63		6
17	40	42	49
	43		8
18	23	43	47
	64		9
19	44	44	72
	2		4
20	3	45	71
	35		32
21	76	46	33
	28	47	75
22	67	48	69
	27		37
23	25	49	0
24	65	50	29
25	66		36
27	38	51	77
28	46		
29	7		

Channels 12 to 19 and 52 to 59 for load rods

FIGURE C-1

RUN 1

TIME 05:05:13:21:23 P1= 7 P2= 1

POD LOADS IN LBS

15	0	16	0	56	0	55	0	52	0
12	0	53	0	13	0	54	0	14	0
18	0	19	0	59	0	58	0	57	0
17	0								

DEFLECTIONS INCHES +INTO SENSOR

30	0.000	70	0.000	31	0.000	11	0.000	50	0.000
42	0.000	51	0.000	10	0.000	68	0.000	78	0.000

STRAINS IN/IN

79	0.000000	39	0.000000	74	0.000000	34	0.000000	24	0.000000
63	0.000000	40	0.000000	43	0.000000	33	0.000000	64	0.000000
44	0.000000	2	0.000000	3	0.000000	25	0.000000	76	0.000000
38	0.000000	67	0.000000	27	0.000000	35	0.000000	65	0.000000
66	0.000000	38	0.000000	5	0.000000	41	0.000000	75	0.000000
69	0.000000	37	0.000000	73	0.000000	6	0.000000	49	0.000000
8	0.000000	47	0.000000	9	0.000000	72	0.000000	4	0.000000
71	0.000000	32	0.000000	33	0.000000	20	0.000000	60	0.000000
61	0.000000	21	0.000000	26	0.000000	1	0.000000	48	0.000000
45	0.000000	0	0.000000	29	0.000000	36	0.000000	46	0.000000
7	0.000000	22	0.000000	62	0.000000	17	0.000000		

RUN 2

TIME 05:05:13:22:08 P1= 6 P2= 1

POD LOADS IN LBS

15	-16	16	-10	56	-7	55	13	52	10
12	3	53	7	13	-7	54	13	14	-13
18	20	19	-13	59	-20	58	-13	57	-7
17	3								

DEFLECTIONS INCHES +INTO SENSOR

30	0.000	70	0.000	31	0.000	11	0.000	50	0.000
42	0.000	51	0.000	10	-0.000	68	0.000	78	0.000

STRAINS IN IN

79	0.000001	39	0.000001	74	-0.000001	34	0.000003	24	0.000002
63	0.000003	40	-0.000001	43	-0.000009	33	-0.000001	64	0.000002
44	0.000001	2	-0.000017	3	0.000001	25	-0.000004	76	-0.000001
38	0.000003	67	-0.000009	27	0.000007	35	0.000007	65	-0.000001
66	-0.000003	38	-0.000003	5	-0.000008	41	-0.000008	75	0.000002
69	0.000009	37	0.000003	73	0.000006	6	0.000009	49	0.000003
8	-0.000007	47	-0.000001	9	-0.000007	72	0.000001	4	-0.000001
71	0.000003	32	0.000008	33	-0.000012	20	0.000003	60	0.000001
61	0.000004	21	0.000000	26	-0.000001	1	0.000001	48	-0.000002
45	0.000009	0	0.000000	29	-0.000001	36	0.000010	46	0.000001
7	0.000000	22	0.000000	62	-0.000001	17	-0.000002		

RUN 3

TIME 05:05:13:24:13 P1= 429 P2= 44

POD LOADS IN LBS

15	1478	16	909	56	696	55	988	52	2713
12	2156	53	2243	13	2347	54	2819	14	2296
18	1258	19	1148	59	1253	58	1228	57	1168
17	1151								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.002	70	-0.009	31	-0.007	11	-0.001	50	-0.011
42	0.023	51	0.024	10	0.025	68	0.025	78	0.015

TEST 1 DATA

STRAINS IN/IN

79 -0.000654	39 -0.001500	74 -0.000077	34 0.000487	24 -0.000007
61 -0.000237	40 -0.000209	43 0.000025	23 -0.000072	64 -0.000079
44 0.000016	2 0.000509	3 -0.000463	35 0.001158	76 0.000071
28 0.000241	67 -0.000171	27 -0.000489	25 0.000510	65 0.000139
66 -0.000142	38 0.000230	5 0.000085	41 -0.000009	75 -0.000543
69 0.000628	37 0.000273	73 -0.000431	6 0.000132	49 0.000237
8 0.001139	47 0.000025	9 0.000147	72 -0.000366	4 0.000388
71 -0.000712	32 0.000148	33 0.000280	20 -0.000574	60 0.000491
61 -0.000029	21 -0.000571	26 0.000457	1 0.000142	48 0.000112
45 0.000021	0 -0.000026	29 0.000050	36 0.000159	46 -0.000063
7 0.000065	22 -0.000093	62 -0.000085	77 0.000153	

RUN 4

TIME 05:05:13:25:05 P1= 426 P2= 40

POD LOADS IN LBS

15 1721	16 894	56 871	55 884	52 2203
12 2499	53 2243	13 2309	54 2289	14 2266
18 1475	19 1128	59 1215	58 1208	57 1135
17 1125				

DEFLECTIONS INCHES +INTO SENSOR

30 -0.042	70 -0.009	31 -0.007	11 -0.000	50 -0.011
42 0.050	51 0.025	10 0.025	60 0.025	70 0.015

STRAINS IN/IN

79 -0.000652	39 -0.000298	74 -0.000077	34 -0.000483	24 -0.000006
61 -0.000224	40 -0.000203	43 0.000031	23 -0.000073	64 -0.000079
44 -0.000046	2 0.000512	3 -0.000261	35 0.001195	76 0.000070
28 0.000231	67 -0.000171	27 -0.000187	25 0.000511	65 0.000141
66 -0.000149	38 0.000231	5 0.000006	41 -0.000009	75 -0.000549
69 0.000628	37 0.000273	73 -0.000402	6 -0.000430	49 0.000237
8 0.001126	47 0.000022	9 0.000106	72 -0.000360	4 0.000385
71 -0.000705	32 0.000147	33 0.000281	20 -0.000568	60 0.000487
61 -0.000020	21 -0.000566	26 0.000455	1 0.000140	48 0.000110
45 0.000021	0 -0.000029	29 0.000052	36 0.000159	46 -0.000063
7 0.000066	22 -0.000095	62 -0.000084	77 0.000150	

RUN 5

TIME 05:05:13:26:56 P1= 000 P2= 81

POD LOADS IN LBS

15 3285	16 1654	56 1652	55 1655	52 4295
12 4235	53 4272	13 4238	54 4322	14 4295
18 2273	19 2089	59 2219	58 2306	57 2115
17 2106				

DEFLECTIONS INCHES +INTO SENSOR

30 -0.042	70 -0.011	31 -0.007	11 -0.004	50 -0.014
42 0.042	51 0.033	10 0.030	60 0.034	70 0.022

STRAINS IN/IN

79 -0.001184	39 -0.000536	74 -0.000165	34 -0.000956	24 -0.000013
61 -0.000556	40 -0.000276	43 -0.000086	23 -0.000193	64 -0.000073
44 0.000092	2 0.000971	3 -0.000470	35 0.001702	76 0.000185
28 0.000235	67 -0.000245	27 -0.000805	25 0.000545	65 0.000201
66 -0.000153	38 0.000269	5 0.000214	41 -0.000022	75 -0.000937
69 0.000075	37 0.000436	73 -0.000734	6 -0.000806	49 0.000512
8 0.002042	47 0.000071	9 0.000192	72 -0.000682	4 0.000740
71 -0.001326	32 0.000274	33 0.000484	20 -0.001045	60 0.000903
61 -0.000005	21 -0.001045	26 0.000855	1 0.000229	48 0.000247
45 0.000034	0 -0.000032	29 0.000099	36 0.000288	46 -0.000150
7 -0.000108	22 -0.000156	62 -0.000134	77 0.000218	

TEST 1 DATA (CONTINUED)

RUN 6

TIME 05:05:13:27:45 P1= 792 P2= 81

POD LOADS IN LBS

[illegible]							
[illegible]							
[illegible]							
17 2062							

DEFLECTIONS INCHES +INTO SENSOR

30	-0.003	70	-0.011	31	-0.007	11	-0.005	50	-0.015
42	0.042	51	0.033	10	0.031	60	0.034	78	0.022

STRAINS IN/IN

[illegible]	-0.001173	39	-0.000532	74	-0.000165	34	-0.000950	24	-0.000309
63	-0.000513	40	-0.000374	43	-0.000066	23	-0.000150	64	-0.000073
44	-0.000095	2	0.000101	3	-0.000467	35	0.001752	76	0.000184
28	0.000242	67	-0.000241	27	-0.000500	25	0.000552	65	0.000201
66	-0.000160	33	0.000271	5	0.000211	41	-0.000021	75	-0.000951
69	0.000073	37	0.000432	73	-0.000726	6	-0.000357	49	0.000506
8	0.002019	47	0.000069	9	0.000191	72	-0.000676	4	0.000733
71	-0.001314	32	0.000271	33	0.000481	20	-0.001033	60	0.000893
61	-0.000009	21	-0.001032	26	0.000847	1	0.000225	48	0.000245
15	0.000032	0	-0.000038	29	0.000101	36	0.000283	46	-0.000148
7	-0.000107	22	-0.000153	62	-0.000133	77	0.000222		

RUN 7

TIME 05:05:13:29:53 P1= 1009 P2= 103

POD LOADS IN LBS

15	4135	16	2056	56	2086	55	2062	52	5426
12	5426	53	5400	13	5460	54	5450	14	5430
18	2743	19	2670	59	2797	58	2697	57	2613
17	2016								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.004	70	-0.009	31	-0.008	11	-0.009	50	-0.020
42	0.052	51	0.040	10	0.036	60	0.041	78	0.027

STRAINS IN IN

[illegible]	-0.001120	39	-0.000660	74	-0.000217	34	0.001334	24	-0.000022
63	0.000611	40	0.000471	43	-0.000130	23	-0.000181	64	-0.000006
44	0.000128	2	0.001308	3	-0.000638	35	0.002242	76	0.000241
28	0.000266	67	-0.000276	27	-0.000682	25	0.000673	65	0.000209
66	-0.000169	33	0.000302	5	0.000279	41	-0.000028	75	-0.001245
69	0.000104	37	0.000526	73	-0.000858	6	-0.001098	49	0.000644
8	0.001952	47	0.000085	9	0.000244	72	-0.000874	4	0.000939
71	-0.001681	32	0.000344	33	0.000592	20	-0.001314	60	0.001140
61	0.000022	21	-0.001312	26	0.001081	1	0.000273	48	0.000322
15	0.000042	0	-0.000048	29	0.000136	36	0.000354	46	-0.000201
7	-0.000127	22	-0.000176	62	-0.000138	77	0.000273		

RUN 8

TIME 05:05:13:30:43 P1= 1022 P2 104

POD LOADS IN LBS

15	4140	16	2096	56	2089	55	2096	52	5463
12	5426	53	5450	13	5460	54	5486	14	5433
18	2773	19	2716	59	2823	58	2930	57	2683
17	2640								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.004	70	-0.009	31	-0.008	11	-0.009	50	-0.020
42	0.052	51	0.040	10	0.036	60	0.042	78	0.027

TEST 1 DATA (CONTINUED)

STRAINS IN/IN

79 -0.001496	39 -0.000663	74 -0.000216	34 -0.001214	24 -0.000019
63 -0.000617	40 -0.000476	43 -0.000121	23 -0.000181	64 -0.000066
44 -0.000141	2 0.001239	3 -0.000582	35 0.002299	76 0.000240
28 0.000264	67 -0.000275	27 -0.000986	25 0.000640	65 0.000211
66 -0.000174	38 0.000307	5 0.000277	41 -0.000029	75 -0.001271
69 0.000103	37 0.000528	73 -0.000896	6 -0.001105	49 0.000648
9 0.002522	47 0.000082	9 0.000243	72 -0.000884	4 0.000938
71 -0.001698	32 0.000347	33 0.000558	20 -0.001319	60 0.001151
61 0.000023	21 -0.001317	26 0.001085	1 0.000271	48 0.000319
45 0.000041	0 -0.000065	29 0.000136	36 0.000355	46 -0.000201
7 -0.000124	22 -0.000174	62 -0.000138	77 0.000277	

RUN 9

TIME 05:05:13:32:15 P1= 1124 P2= 114

ROD LOADS IN LBS

15 4547	16 2293	56 2276	55 2286	52 6017
12 6014	53 6014	13 6020	54 6037	14 5990
18 3020	19 3147	59 3054	58 3217	57 2770
17 2787				

DEFLECTIONS INCHES +INTO SENSOR

30 -0.004	70 -0.009	31 -0.008	11 -0.010	50 -0.023
42 0.057	51 0.044	10 0.039	68 0.045	78 0.029

STRAINS IN/IN

79 -0.001643	39 -0.000726	74 -0.000237	34 -0.001321	24 -0.000033
63 -0.000672	40 -0.000518	43 -0.000132	23 -0.000189	64 -0.000065
44 -0.000157	2 0.001363	3 -0.000639	35 0.002506	76 0.000262
28 0.000292	67 -0.000276	27 -0.001033	25 0.000674	65 0.000228
66 -0.000156	38 0.000313	5 0.000307	41 -0.000037	75 -0.001404
69 0.000112	37 0.000572	73 -0.000976	6 -0.001220	49 0.000716
9 0.002763	47 0.000087	9 0.000267	72 -0.000976	4 0.001035
71 -0.001871	32 0.000381	33 0.000586	20 -0.001446	60 0.001264
61 0.000030	21 -0.001447	26 0.001197	1 0.000293	48 0.000352
45 0.000044	0 -0.000071	29 0.000148	36 0.000387	46 -0.000224
7 -0.000134	22 -0.000188	62 -0.000145	77 0.000304	

RUN 10

TIME 05:05:13:33:12 P1= 1121 P2= 114

ROD LOADS IN LBS

15 4557	16 2313	56 2306	55 2311	52 5997
12 6007	53 5997	13 6007	54 6027	14 5990
18 3027	19 3167	59 3037	58 3210	57 2780
17 2800				

DEFLECTIONS INCHES +INTO SENSOR

30 -0.004	70 -0.008	31 -0.003	11 -0.010	50 -0.024
42 0.057	51 0.045	10 0.040	68 0.046	78 0.029

STRAINS IN/IN

79 -0.001639	39 -0.000727	74 -0.000235	34 -0.001334	24 -0.000021
63 -0.000642	40 -0.000517	43 -0.000138	23 -0.000188	64 -0.000063
44 -0.000161	2 0.001419	3 -0.000645	35 0.002611	76 0.000260
28 0.000292	67 -0.000274	27 -0.001054	25 0.000693	65 0.000230
66 -0.000160	38 0.000319	5 0.000304	41 -0.000035	75 -0.001436
69 0.000115	37 0.000570	73 -0.000936	6 -0.001224	49 0.000696
9 0.002760	47 0.000089	9 0.000272	72 -0.000973	4 0.001038
71 -0.001867	32 0.000381	33 0.000587	20 -0.001448	60 0.001264
61 0.000028	21 -0.001440	26 0.001198	1 0.000290	48 0.000352
45 0.000044	0 -0.000079	29 0.000153	36 0.000383	46 -0.000224
7 -0.000129	22 -0.000184	62 -0.000140	77 0.000309	

TEST 1 DATA (CONTINUED)

RUN 11

TIME 05:05:13:34:45 P1= 1255 P2= 126

ROD LOADS IN LBS

15	5100	16	2560	56	2566	55	2580	52	6721
12	6748	53	6714	13	6735	54	6748	14	6718
18	3314	19	3374	59	3477	58	3611	57	2970
17	2997								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.006	70	-0.006	31	-0.008	11	-0.012	50	-0.028
42	0.062	51	0.049	10	0.042	68	0.050	78	0.032

STRAINS IN/IN

79	-0.001824	39	-0.000801	74	-0.000261	34	-0.001502	24	-0.000037
63	-0.000679	40	-0.000571	43	-0.000161	23	-0.000194	64	-0.000063
44	-0.000188	2	0.001603	3	-0.000715	35	0.002956	76	0.000298
26	0.000318	67	-0.000290	27	-0.001162	25	0.000736	65	0.000231
66	-0.000122	38	0.000343	5	0.000346	41	-0.000026	75	-0.001623
69	0.000135	37	0.000029	73	-0.001108	6	-0.001385	49	0.000678
8	0.002954	47	0.000105	9	0.000311	72	-0.001089	4	0.001173
71	-0.002079	32	0.000423	33	-0.012629	20	-0.001522	60	0.001422
61	0.000033	21	-0.001630	26	0.001044	1	0.000321	48	0.000402
45	0.000060	0	-0.000088	29	0.000175	36	0.000432	46	-0.000251
7	-0.000145	22	-0.000209	62	-0.000196	77	0.000351		

RUN 12

TIME 05:05:13:35:43 P1= 1253 P2= 126

ROD LOADS IN LBS

15	5089	16	2580	56	2566	55	2590	52	6731
12	6765	53	6738	13	6728	54	6738	14	6721
18	3307	19	3381	59	3491	58	3598	57	2980
17	3040								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.006	70	-0.006	31	-0.006	11	-0.012	50	-0.029
42	0.063	51	0.051	10	0.044	68	0.051	78	0.032

STRAINS IN/IN

79	-0.001821	39	-0.000680	74	-0.000262	34	-0.001520	24	-0.000037
63	-0.000647	40	-0.000569	43	-0.000119	23	-0.000192	64	-0.000065
44	-0.000196	2	0.001687	3	-0.000723	35	0.003117	76	0.000298
26	0.000317	67	-0.000297	27	-0.001160	25	0.000754	65	0.000232
66	-0.000121	38	0.000358	5	0.000342	41	-0.000025	75	-0.001672
69	0.000135	37	0.000034	73	-0.001117	6	-0.001415	49	0.000687
8	0.002867	47	0.000101	9	0.000314	72	-0.001090	4	0.001172
71	-0.002074	32	0.000425	33	0.012643	20	-0.001631	60	0.001425
61	0.000028	21	-0.001629	26	0.001050	1	0.000321	48	0.000402
45	0.000062	0	-0.000103	29	0.000178	36	0.000433	46	-0.000251
7	-0.000139	22	-0.000209	62	-0.000154	77	0.000361		

RUN 13

TIME 05:05:13:39:24 P1= 16 P2= 2

ROD LOADS IN LBS

15	57	16	30	56	37	55	40	52	40
12	67	53	77	13	70	54	60	14	70
18	37	19	27	59	23	58	10	57	23
17	37								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.002	70	-0.003	31	-0.007	11	0.001	50	-0.009
42	0.004	51	0.002	10	0.002	68	0.002	78	0.002

TEST 1 DATA (CONTINUED)

STRAINS IN/IN

79 -0.000016	39 -0.000614	74 -0.000004	24 -0.000009	24 -0.000010
63 0.000002	40 0.000006	43 0.000093	22 0.000013	64 -0.000019
44 -0.000019	2 0.000171	3 -0.000015	35 0.000258	76 0.000006
28 0.000003	67 -0.000526	27 -0.000057	25 0.000047	65 -0.000001
66 -0.000031	38 0.000022	5 0.000007	41 0.000009	75 -0.000096
69 0.000002	37 0.000017	73 -0.000109	6 -0.000044	49 -0.000013
8 0.000036	47 0.000000	9 0.000008	72 -0.000003	4 0.000023
71 -0.000006	32 0.000003	33 0.002019	20 -0.000018	60 0.000018
61 -0.000008	21 -0.000016	26 0.000016	1 0.000012	48 0.000013
45 0.000006	0 -0.000015	29 0.000011	36 0.000003	46 -0.000004
7 -0.000018	22 -0.000014	62 -0.000001	77 0.000015	

RUN 14

TIME 05:05:13:41:02 P1= 9 P2= 1

ROD LOADS IN LBS

15	10	16	3	56	17	55	20	52	20
12	23	53	27	13	20	54	23	14	20
18	17	19	10	59	-3	58	-7	57	20
17	13								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.001	70	-0.001	31	-0.006	11	-0.002	50	-0.006
42	0.002	51	0.001	10	0.000	68	0.001	78	0.001

STRAINS IN/IN

79 -0.000007	39 -0.000006	74 -0.000004	24 -0.000015	24 0.000000
63 0.000013	40 0.000005	43 0.000018	23 0.000007	64 -0.000005
44 -0.000009	2 0.000070	3 -0.000006	35 0.000108	76 0.000004
28 -0.000006	67 -0.000591	27 -0.000017	25 0.000007	65 -0.000005
66 -0.000003	38 0.000015	5 0.000004	41 0.000006	75 -0.000013
69 -0.000001	37 0.000006	73 -0.000072	6 -0.000035	49 0.000002
8 0.000006	47 -0.000001	9 0.000013	72 0.000002	4 0.000009
71 -0.000000	32 0.000000	33 0.000007	20 -0.000014	60 0.000009
61 0.000000	21 -0.000003	26 0.000006	1 0.000006	48 0.000008
45 0.000004	0 -0.000005	29 0.000002	36 0.000001	46 -0.000004
7 -0.000009	22 -0.000008	62 -0.000007	77 0.000002	

RUN 15

TIME 05:05:13:42:24 P1= 7 P2= 1

ROD LOADS IN LBS

15	10	16	3	56	3	55	10	52	17
12	27	53	10	13	7	54	10	14	10
18	10	19	-10	59	-13	58	-13	57	7
17	13								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.000	70	-0.001	31	-0.005	11	-0.002	50	-0.005
42	0.001	51	-0.000	10	-0.001	68	0.000	78	0.000

STRAINS IN/IN

79 -0.000005	39 -0.000004	74 -0.000005	24 -0.000018	24 0.000007
63 -0.000009	40 0.000005	43 0.000004	23 0.000003	64 0.000001
44 0.000004	2 0.000042	3 -0.000007	35 0.000065	76 0.000004
28 -0.000003	67 -0.000634	27 -0.000011	25 -0.000012	65 -0.000011
66 -0.000004	38 -0.000001	5 0.000003	41 0.000004	75 0.000032
69 -0.000003	37 0.000005	73 -0.000049	6 0.000030	49 0.000009
8 -0.000016	47 -0.000001	9 -0.000006	72 0.000001	4 0.000003
71 0.000003	32 0.000001	33 0.000015	20 0.000000	60 0.000006
61 0.000007	21 0.000001	26 0.000003	1 0.000004	48 0.000005
45 0.000004	0 0.000003	29 -0.000001	36 0.000002	46 -0.000005
7 -0.000007	22 -0.000003	62 -0.000007	77 0.000002	

TEST 1 DATA (CONTINUED)

RUN 16

TIME 05:05:13:44:09 P1= 5 P2= 1

ROD LOADS IN LBS

15	5	16	-10	56	-10	55	17	52	0
12	7	53	10	13	-23	54	-3	14	0
18	10	19	-17	59	-27	58	-30	57	-3
17	3								

DEFLECTIONS INCHES +INTO SENSOR

30	0.001	70	-0.001	31	-0.004	11	-0.002	50	-0.004
42	0.001	51	-0.000	10	-0.001	68	-0.001	78	0.000

STRAINS IN/IN

79	-0.000003	39	-0.000002	74	-0.000007	34	-0.000016	24	0.000009
63	-0.000025	40	0.000003	43	-0.000013	23	0.000000	64	0.000004
44	0.000000	2	-0.000014	3	-0.000001	35	0.000035	76	0.000003
28	-0.000009	67	-0.000769	27	-0.000006	25	-0.000027	65	-0.000013
66	-0.000006	38	-0.000006	5	0.000003	41	0.000005	75	0.000023
69	-0.000003	37	-0.000041	73	-0.000028	6	-0.000024	49	0.000012
8	-0.000016	47	-0.000002	9	-0.000001	72	0.000000	4	-0.000001
71	0.000003	32	-0.000000	33	0.000002	20	0.000002	60	0.000004
61	0.000015	21	0.000005	26	0.000001	1	0.000003	48	0.000003
45	0.000005	0	0.000004	29	-0.000002	36	0.000001	46	-0.000004
7	-0.000003	22	0.000001	62	0.000000	77	-0.000004		

RUN 17

TIME 05:05:13:48:22 P1= 1 P2= 0

ROD LOADS IN LBS

15	-10	16	-17	56	7	55	3	52	-13
12	-13	53	-23	13	-27	54	-13	14	-30
18	3	19	-17	59	-27	58	-33	57	-7
17	-7								

DEFLECTIONS INCHES +INTO SENSOR

30	0.002	70	-0.000	31	-0.002	11	-0.003	50	-0.002
42	0.000	51	-0.001	10	-0.002	68	-0.001	78	-0.000

STRAINS IN/IN

79	-0.000000	39	0.000000	74	-0.000005	34	-0.000015	24	0.000012
63	-0.000043	40	0.000002	43	-0.000038	23	-0.000005	64	0.000008
44	0.000006	2	-0.000055	3	0.000000	35	0.000022	76	0.000002
28	-0.000010	67	-0.001361	27	0.000002	25	-0.000047	65	-0.000022
66	-0.000009	38	-0.000013	5	0.000001	41	0.000003	75	0.000033
69	-0.000001	37	-0.000006	73	-0.000003	6	-0.000014	49	0.000016
8	-0.000023	47	-0.000001	9	-0.000003	72	0.000001	4	-0.000004
71	0.000006	32	-0.000000	33	0.000000	20	0.000006	60	-0.000001
61	0.000043	21	0.000007	26	-0.000003	1	0.000003	48	0.000001
45	0.000005	0	0.000006	29	-0.000004	36	-0.000001	46	-0.000002
7	0.000001	22	0.000007	62	0.000000	77	-0.000006		

RUN 18

TIME 05:05:14:18:27 P1= 1 P2= 0

ROD LOADS IN LBS

15	0	16	-3	56	3	55	-3	52	-13
12	-17	53	-50	13	-17	54	-33	14	-13
18	-13	19	-17	59	-17	58	-17	57	-3
17	10								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.015	70	0.005	31	-0.002	11	-0.007	50	0.009
42	0.000	51	-0.006	10	-0.001	68	-0.001	78	-0.000

TEST 1 DATA (CONTINUED)

STRAINS IN/IN

79	-0.000003	39	0.000002	78	0.000006	34	0.000002	24	0.000007
63	-0.000048	40	-0.000004	43	-0.000029	23	-0.000010	64	0.000003
44	-0.000001	2	0.000001	3	0.000003	35	-0.000003	76	0.000001
28	-0.000004	47	-0.000004	27	0.000010	25	-0.000051	65	-0.000028
66	0.000036	38	-0.000013	5	-0.000003	41	0.000001	75	0.000040
69	-0.000000	37	-0.000010	73	0.000010	6	-0.000001	49	0.000009
8	-0.000010	47	-0.000004	9	0.000000	72	0.000005	4	-0.000007
71	0.000007	32	-0.000001	33	0.000007	20	0.000001	60	-0.000005
61	0.000059	21	0.000006	26	-0.000008	1	-0.000001	48	-0.000001
45	0.000004	0	-0.000001	29	-0.000001	36	-0.000002	46	0.000004
7	0.000004	22	-0.000004	62	0.000008	77	-0.000005		

TEST 1 DATA (CONTINUED)

RUN 1

TIME 05:13:12:30:38 **P1 = 0 P2 = 0**

ROD LOADS IN LBS

15	0	16	0	56	0	55	0	52	0
12	0	53	0	13	0	54	0	14	0
18	0	19	0	59	0	58	0	57	0
17	0								

DEFLECTIONS INCHES +INTO SENSOR

30	0.000	70	0.000	31	0.000	11	0.000	50	0.000
42	0.000	51	0.000	10	0.000	68	0.000	78	0.000

STRAINS IN/IN

79	0.000000	39	0.000000	74	0.000000	34	0.000000	24	0.000000
63	0.000000	40	0.000000	43	0.000000	23	0.000000	64	0.000000
44	0.000000	2	0.000000	3	0.000000	35	0.000000	76	0.000000
28	0.000000	67	0.000000	27	0.000000	25	0.000000	65	0.000000
66	0.000000	38	0.000000	5	0.000000	41	0.000000	75	0.000000
69	0.000000	37	0.000000	73	0.000000	6	0.000000	49	0.000000
8	0.000000	47	0.000000	9	0.000000	72	0.000000	4	0.000000
71	0.000000	32	0.000000	33	0.000000	20	0.000000	60	0.000000
61	0.000000	21	0.000000	26	0.000000	1	0.000000	48	0.000000
45	0.000000	0	0.000000	29	0.000000	36	0.000000	46	0.000000
7	0.000000	22	0.000000	62	0.000000	77	0.000000		

RUN 2

TIME 05:13:12:30:38 **P1 = 0 P2 = 0**

ROD LOADS IN LBS

15	16	16	10	56	-10	55	-3	52	-7
12	0	53	0	13	3	54	-10	14	0
18	-20	19	3	59	17	58	0	57	0
17	10								

DEFLECTIONS INCHES +INTO SENSOR

30	0.000	70	0.000	31	-0.000	11	-0.000	50	0.000
42	0.000	51	0.000	10	0.000	68	-0.000	78	-0.000

STRAINS IN/IN

79	0.000000	39	0.000000	74	-0.000001	34	0.000000	24	0.000000
63	-0.000003	40	0.000001	43	0.000001	23	-0.000001	64	-0.000001
44	0.000001	2	-0.000001	3	-0.000001	35	0.000002	76	-0.000000
28	-0.000001	67	0.000000	27	0.000000	25	-0.000001	65	-0.000000
66	0.000001	38	-0.000000	5	0.000001	41	0.000002	75	0.000000
69	0.000000	37	0.000001	73	0.000000	6	-0.000001	49	0.000000
8	0.000000	47	0.000001	9	0.000000	72	-0.000001	4	-0.000001
71	-0.000001	32	0.000000	33	0.000000	20	0.000002	60	-0.000000
61	0.000000	21	0.000002	26	-0.000001	1	-0.000002	48	0.000000
45	-0.000000	0	0.000000	29	0.000001	36	0.000001	46	0.000001
7	-0.000001	22	0.000000	62	-0.000002	77	0.000002		

RUN 3

TIME 05:13:12:30:38 **P1 = 416 P2 = 43**

ROD LOADS IN LBS

15	1726	16	901	56	841	55	868	52	2243
12	2249	53	2233	13	2243	54	2219	14	2269
18	1085	19	1048	59	1065	58	1118	57	1095
17	1078								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.001	70	-0.008	31	-0.000	11	-0.019	50	-0.023
42	0.031	51	0.022	10	0.018	68	0.025	78	0.011

TEST 2 DATA

STRAINS IN/IN

79 -0.000746	39 -0.000327	74 -0.000046	34 -0.000418	24 -0.000049
63 -0.000689	40 -0.000040	43 0.000605	33 -0.000022	64 -0.000052
44 -0.000071	2 0.000579	3 -0.000239	35 0.001150	76 0.000176
28 0.000103	67 -0.000133	27 -0.000384	25 0.000305	65 0.000135
66 0.000093	38 0.000378	5 0.000171	41 -0.000053	75 -0.000499
69 0.000038	37 0.000153	73 -0.000526	6 -0.000411	49 0.000173
8 0.001066	47 0.000026	9 0.000116	72 -0.000350	4 0.000351
71 -0.000700	32 0.000148	33 0.000300	20 -0.000557	60 0.000492
61 0.000199	21 -0.000559	26 0.000427	1 -0.000076	48 0.000090
45 0.000037	0 0.000002	29 0.000074	36 0.000070	46 -0.000037
7 -0.000056	22 -0.000058	62 -0.000056	77 0.000166	

RUN 4

TIME 05:13:12:30:38 **P1 = 417 P2 = 43**

ROD LOADS IN LBS

15 1747	16 904	56 851	55 871	52 2263
12 2256	53 2256	13 2246	54 2223	14 2283
18 1098	19 1045	59 1081	58 1125	57 1101
17 1085				

DEFLECTIONS INCHES +INTO SENSOR

30 -0.001	70 -0.008	31 -0.000	11 -0.019	50 -0.024
42 0.031	51 0.022	10 0.018	68 0.025	78 0.011

STRAINS IN/IN

79 -0.000747	39 -0.000329	74 -0.000046	34 -0.000423	24 -0.000049
63 -0.000675	40 -0.000045	43 0.000624	33 -0.000025	64 -0.000051
44 -0.000072	2 0.000589	3 -0.000243	35 0.001195	76 0.000177
28 0.000100	67 -0.000134	27 -0.000387	25 0.000310	65 0.000135
66 0.000097	38 0.000386	5 0.000172	41 -0.000053	75 -0.000508
69 0.000038	37 0.000157	73 -0.000527	6 -0.000416	49 0.000176
8 0.001072	47 0.000024	9 0.000119	72 -0.000352	4 0.000357
71 -0.000703	32 0.000150	33 0.000302	20 -0.000563	60 0.000495
61 0.000202	21 -0.000565	26 0.000430	1 -0.000077	48 0.000088
45 0.000038	0 0.000001	29 0.000073	36 0.000071	46 -0.000037
7 -0.000056	22 -0.000058	62 -0.000056	77 0.000170	

RUN 5

TIME 05:13:12:30:38 **P1 = 800 P2 = 81**

ROD LOADS IN LBS

15 3311	16 1655	56 1635	55 1642	52 4288
12 4305	53 4275	13 4235	54 4188	14 4332
18 1855	19 2026	59 2059	58 2129	57 1942
17 1992				

DEFLECTIONS INCHES +INTO SENSOR

30 -0.001	70 -0.010	31 -0.001	11 -0.043	50 -0.044
42 0.042	51 0.016	10 0.014	68 0.038	78 0.018

STRAINS IN/IN

79 -0.001350	39 -0.000567	74 -0.000115	34 -0.000900	24 -0.000151
63 -0.000880	40 -0.000184	43 0.001088	33 -0.000072	64 -0.000041
44 -0.000131	2 0.000951	3 -0.000437	35 0.001786	76 0.000356
28 0.000054	67 -0.000207	27 -0.000686	25 0.000466	65 0.000160
66 0.000239	38 0.000590	5 0.000348	41 -0.000084	75 -0.000928
69 0.000065	37 0.000314	73 -0.000789	6 -0.000850	49 0.000366
8 0.001858	47 0.000054	9 0.000204	72 -0.000691	4 0.000683
71 -0.001343	32 0.000276	33 0.000524	20 -0.001047	60 0.000944
61 0.000364	21 -0.001051	26 0.000831	1 -0.000138	48 0.000181
45 0.000087	0 -0.000003	29 0.000120	36 0.000165	46 -0.000106
7 -0.000078	22 -0.000104	62 -0.000089	77 0.000290	

TEST 2 DATA (CONTINUED)

RUN 6

TIME 05:13:12:30:38 **P1 = 799** **P2 = 81**

ROD LOADS IN LBS

15	3322	16	1665	56	1629	55	1665	52	4315
12	4325	53	4295	13	4258	54	4215	14	4352
18	1886	19	2056	59	2046	58	2122	57	1942
17	1989								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.001	70	-0.010	31	-0.001	11	-0.045	50	-0.045
42	0.043	51	0.015	10	0.014	68	0.028	78	0.018

STRAINS IN/IN

79	-0.001352	39	-0.000574	74	-0.000115	34	-0.000906	24	-0.000153
63	-0.000831	40	-0.000194	43	0.001154	23	-0.000074	64	-0.000040
44	-0.000135	2	0.001001	3	-0.000443	35	0.001880	76	0.000354
28	0.000047	67	-0.000208	27	-0.000696	25	0.000479	65	0.000160
66	0.000248	38	0.000617	5	0.000349	41	-0.000090	75	-0.000963
69	0.000063	37	0.000318	73	-0.000793	6	-0.000856	49	0.000370
8	0.001867	47	0.000053	9	0.000206	72	-0.000693	4	0.000686
71	-0.001346	32	0.000279	33	0.000525	20	-0.001057	60	0.000950
61	0.000384	21	-0.001061	26	0.000837	1	-0.000140	48	0.000177
45	0.000083	0	-0.000016	29	0.000116	36	0.000167	46	-0.000107
7	-0.000077	22	-0.000107	62	-0.000090	77	0.000303		

RUN 7

TIME 05:13:12:30:38 **P1 = 1021** **P2 = 103**

ROD LOADS IN LBS

15	4245	16	2126	56	2102	55	2102	52	5486
12	5540	53	5480	13	5480	54	5433	14	5570
18	2369	19	2610	59	2630	58	2719	57	2503
17	2553								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.001	70	-0.010	31	-0.001	11	-0.052	50	-0.055
42	0.050	51	0.010	10	0.011	68	0.028	78	0.022

STRAINS IN/IN

79	-0.001703	39	-0.000703	74	-0.000155	34	-0.001166	24	-0.000207
63	-0.000872	40	-0.000282	43	0.001492	23	-0.000089	64	-0.000033
44	-0.000174	2	0.001263	3	-0.000554	35	0.002335	76	0.000464
28	0.000055	67	-0.000249	27	-0.000875	25	0.000574	65	0.000108
66	0.000342	38	0.000775	5	0.000457	41	-0.000109	75	-0.001250
69	0.000091	37	0.000406	73	-0.000959	6	-0.001107	49	0.000481
8	0.003339	47	0.000072	9	0.000257	72	-0.000895	4	0.000882
71	0.001728	32	0.000355	33	0.000611	20	-0.001352	60	0.001210
61	0.000483	21	0.001355	26	0.001076	1	-0.000172	48	0.000238
45	0.000113	0	-0.000025	29	0.000150	36	0.000216	46	-0.000153
7	-0.000087	22	-0.000138	62	-0.000095	77	0.000406		

RUN 8

TIME 05:13:12:30:38 **P1 = 1017** **P2 = 103**

ROD LOADS IN LBS

15	4250	16	2119	56	2089	55	2109	52	5483
12	5510	53	5466	13	5450	54	5423	14	5543
18	2356	19	2583	59	2636	58	2686	57	2493
17	2526								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.001	70	-0.010	31	-0.001	11	-0.052	50	-0.056
42	0.050	51	0.010	10	0.011	68	0.028	78	0.022

TEST 2 DATA (CONTINUED)

STRAINS IN/IN

79 -0.001696	39 -0.000703	74 -0.000154	34 -0.001166	24 -0.000203
63 -0.000822	40 -0.000288	43 0.001559	23 -0.000091	64 -0.000030
44 -0.000179	2 0.001317	3 -0.000558	35 0.002438	76 0.000461
28 0.000030	67 -0.000249	27 -0.000875	25 0.000587	65 0.000101
66 0.000351	38 0.000801	5 0.000457	41 -0.000110	75 -0.001283
69 0.000089	37 0.000407	73 -0.000960	6 -0.001101	49 0.000480
8 0.002332	47 0.000069	9 0.000258	72 -0.000895	4 0.000882
71 -0.001726	32 0.000354	33 0.000612	20 -0.001347	60 0.001212
61 0.000499	21 -0.001350	26 0.001073	1 -0.000173	48 0.000234
45 0.000110	0 -0.000038	29 0.000151	36 0.000213	46 -0.000149
7 -0.000085	22 -0.000128	62 -0.000095	77 0.000422	

RUN 9

TIME 05:13:12:30:38 **P1 = 1133 P2 = 114**

ROD LOADS IN LBS

15 4677	16 2326	56 2299	55 2323	52 6097
12 6114	53 6080	13 6064	54 6044	14 6161
18 2586	19 2930	59 2927	58 2997	57 2790
17 2810				

DEFLECTIONS INCHES +INTO SENSOR

30 -0.001	70 -0.010	31 -0.001	11 -0.055	50 -0.058
42 0.053	51 0.010	10 0.010	68 0.029	78 0.024

STRAINS IN/IN

79 -0.001874	39 -0.000766	74 -0.000178	34 -0.001301	24 -0.000242
63 -0.000865	40 -0.000335	43 0.001720	23 -0.000089	64 -0.000031
44 -0.000200	2 0.001469	3 -0.000613	35 0.002696	76 0.000517
28 0.000029	67 -0.000265	27 -0.000960	25 0.000635	65 0.000048
66 0.000386	38 0.000881	5 0.000514	41 -0.000114	75 -0.001439
69 0.000106	37 0.000457	73 -0.001054	6 -0.001227	49 0.000540
8 0.002572	47 0.000077	9 0.000282	72 -0.001000	4 0.000983
71 -0.001922	32 0.000392	33 0.000650	20 -0.001497	60 0.001348
61 0.000543	21 -0.001500	26 0.001198	1 -0.000189	48 0.000264
45 0.000129	0 -0.000046	29 0.000170	36 0.000242	46 -0.000172
7 -0.000094	22 -0.000142	62 -0.000102	77 0.000475	

RUN 10

TIME 05:13:12:30:38 **P1 = 1134 P2 = 114**

ROD LOADS IN LBS

15 4698	16 2343	56 2323	55 2333	52 6110
12 6124	53 6100	13 6077	54 6064	14 6167
18 2573	19 2950	59 2927	58 2980	57 2797
17 2817				

DEFLECTIONS INCHES +INTO SENSOR

30 -0.001	70 -0.010	31 -0.001	11 -0.055	50 -0.058
42 0.067	51 0.010	10 0.010	68 0.029	78 0.024

STRAINS IN/IN

79 -0.001874	39 -0.000770	74 -0.000178	34 -0.001306	24 -0.000244
63 -0.000818	40 -0.000343	43 0.001787	23 -0.000088	64 -0.000030
44 -0.000207	2 0.001530	3 -0.000619	35 0.002809	76 0.000518
28 0.000022	67 -0.000267	27 -0.000969	25 0.000644	65 0.000041
66 0.000391	38 0.000908	5 0.000514	41 -0.000112	75 -0.001475
69 0.000105	37 0.000461	73 -0.001059	6 -0.001229	49 0.000540
8 0.002571	47 0.000077	9 0.000285	72 -0.001004	4 0.000983
71 -0.001927	32 0.000393	33 0.000652	20 -0.001502	60 0.001352
61 0.000556	21 -0.001504	26 0.001199	1 -0.000189	48 0.000264
45 0.000129	0 -0.000057	29 0.000172	36 0.000241	46 -0.000172
7 -0.000093	22 -0.000145	62 -0.000104	77 0.000497	

TEST 2 DATA (CONTINUED)

RUN 11

TIME 05:12:12:30:38 **P1 = 1256 P2 = 126**

ROD LOADS IN LBS

15	5188	16	2566	56	2570	55	2553	52	6758
12	6771	53	6755	13	6725	54	6714	14	6821
18	2900	19	3294	59	3294	58	3301	57	3134
17	3117								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.001	70	-0.010	31	-0.006	11	-0.057	50	-0.060
42	0.058	51	0.010	10	0.010	69	0.031	78	0.026

STRAINS IN/IN

79	-0.002060	39	-0.000828	74	-0.000202	34	-0.001446	24	-0.000271
63	-0.000958	40	-0.000387	43	0.001913	23	-0.000005	64	-0.000031
44	-0.000228	2	0.001655	3	-0.000679	35	0.003048	76	0.000577
28	0.000015	67	-0.000286	27	-0 001052	25	0.000621	65	-0.000003
66	0.000381	38	0.000973	5	0.000568	41	-0.000120	75	-0.001633
69	0.000110	37	0.000508	73	-0.001160	6	-0.001365	49	0.000611
8	0.002825	47	0.000082	9	0.000310	72	-0.001114	4	0.001085
71	-0.002140	32	0.000433	33	0.000691	20	-0.001653	60	0.001495
61	0.000575	21	-0.001659	26	0.001324	1	-0.000204	48	0.000288
45	0.000142	0	-0.000061	29	0.000185	36	0.000270	46	-0.000194
7	-0.000102	22	-0.000160	62	-0.000109	77	0.000376		

RUN 12

TIME 05:13:12:30:38 **P1 = 1255 P2 = 125**

ROD LOADS IN LBS

15	5167	16	2576	56	2576	55	2573	52	6745
12	6748	53	6731	13	6701	54	6698	14	6795
18	2903	19	3247	59	3284	58	3267	57	3104
17	3104								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.001	70	-0.010	31	-0.007	11	-0.057	50	-0.060
42	0.058	51	0.010	10	0.010	69	0.031	78	0.026

STRAINS IN/IN

79	-0.002052	39	-0.000830	74	-0.000202	34	-0.001452	24	-0.000263
63	-0.000921	40	-0.000401	43	0.001983	23	-0.000082	64	-0.000030
44	-0.000235	2	0.001726	3	-0.000687	35	0.003179	76	0.000577
28	0.000012	67	-0.000288	27	-0.001059	25	0.000618	65	0.000005
66	0.000378	38	0.000995	5	0.000568	41	0.000116	75	-0.001671
69	0.000112	37	0.000509	73	-0.001161	6	-0.001365	49	0.000609
8	0.002824	47	0.000082	9	0.000312	72	-0.001113	4	0.001036
71	-0.002138	32	0.000432	33	0.000692	20	-0.001650	60	0.001495
61	0.000583	21	-0.001656	26	0.001328	1	-0.000207	48	0.000291
45	0.000144	0	0.000075	29	0.000190	36	0.000269	46	-0.000196
7	-0.000100	22	-0.000163	62	-0.000108	77	0.000378		

RUN 13

TIME 05:13:12:30:38 **P1 = -0 P2 = 1**

ROD LOADS IN LBS

15	5	16	23	56	17	55	33	52	30
12	20	53	47	13	27	54	10	14	23
18	0	19	23	59	40	58	17	57	10
17	10								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.000	70	-0.010	31	-0.004	11	-0.013	50	-0.012
42	0.005	51	0.010	10	0.004	68	0.006	78	0.003

TEST 2 DATA (CONTINUED)

STRAINS IN/IN

79	-0.000002	39	-0.000009	74	0.000013	34	0.000012	24	-0.000001
63	0.000021	40	0.000007	43	0.000039	23	0.000003	64	-0.000012
44	-0.000012	2	0.000127	3	-0.000007	35	0.000159	76	0.000008
28	-0.000010	67	-0.000013	27	-0.000036	25	0.000029	65	0.000014
66	0.000001	38	0.000026	5	0.000009	41	0.000015	75	-0.000070
69	0.000003	37	0.000007	73	-0.000075	6	-0.000008	49	-0.000025
8	0.000039	47	-0.000004	9	0.000009	72	-0.000006	4	0.000011
71	0.000006	32	0.000001	33	0.000014	20	-0.000010	60	0.000012
61	0.000026	21	-0.000007	26	0.000009	1	-0.000007	48	0.000008
45	0.000009	0	-0.000007	29	0.000007	36	0.000000	46	0.000009
7	-0.000007	22	-0.000009	62	-0.000007	77	-0.000005		

RUN 14

TIME 05:13:12:30:38 **P1 = -1** **P2 = 1**

POD LOADS IN LBS

15	10	16	13	56	0	55	17	52	13
12	3	53	33	13	10	54	17	14	17
18	-10	19	13	59	27	58	7	57	-3
17	-13								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.000	70	-0.010	31	-0.004	11	-0.012	50	-0.011
42	0.005	51	0.010	10	0.004	68	0.005	78	0.003

STRAINS IN/IN

79	-0.000000	39	-0.000009	74	0.000011	34	0.000007	24	0.000000
63	-0.000002	40	0.000005	43	0.000016	23	0.000003	64	-0.000010
44	-0.000004	2	0.000061	3	0.000001	35	0.000035	76	0.000008
28	-0.000011	67	-0.000009	27	-0.000025	25	0.000012	65	0.000011
66	0.000003	38	0.000009	5	0.000007	41	0.000012	75	0.000000
69	-0.000000	37	0.000005	73	-0.000065	6	-0.000009	49	-0.000022
8	0.000021	47	-0.000004	9	0.000006	72	-0.000004	4	0.000007
71	-0.000002	32	-0.000001	33	0.000010	20	-0.000007	60	0.000007
61	0.000016	21	-0.000003	26	0.000005	1	-0.000006	48	0.000007
45	0.000006	0	0.000001	29	0.000002	36	0.000001	46	0.000007
7	-0.000006	22	-0.000007	62	-0.000006	77	-0.000010		

RUN 15

TIME 05:13:12:30:38 **P1 = -0** **P2 = 1**

POD LOADS IN LBS

15	10	16	13	56	7	55	23	52	7
12	-7	53	13	13	7	54	17	14	10
18	-10	19	0	59	13	58	10	57	0
17	-10								

DEFLECTIONS INCHES +INTO SENSOR

30	0.000	70	-0.010	31	-0.002	11	-0.011	50	-0.008
42	0.004	51	0.010	10	0.003	68	0.004	78	0.003

STRAINS IN/IN

79	-0.000001	39	0.000007	74	0.000010	34	0.000007	24	0.000003
63	-0.000038	40	0.000004	43	0.000010	23	0.000002	64	-0.000006
44	-0.000001	2	0.000005	3	0.000002	35	-0.000002	76	0.000005
28	-0.000006	67	-0.000003	27	-0.000012	25	0.000004	65	0.000000
66	0.000001	38	0.000002	5	0.000004	41	0.000007	75	0.000015
69	-0.000002	37	0.000003	73	-0.000046	6	0.000007	49	-0.000015
8	0.000017	47	-0.000002	9	0.000004	72	-0.000003	4	0.000003
71	-0.000001	32	-0.000001	33	0.000007	20	-0.000006	60	0.000002
61	0.000001	21	-0.000002	26	-0.000000	1	-0.000003	48	0.000003
45	0.000003	0	0.000003	29	0.000000	36	0.000001	46	0.000009
7	-0.000002	22	-0.000002	62	0.000000	77	-0.000015		

TEST 2 DATA (CONTINUED)

RUN 16

TIME 05:13:12:30:30 **P1 = -0 P2 = 1**

ROD LOADS IN LBS

15	10	16	10	56	3	55	13	52	13
12	10	53	30	13	13	54	20	14	27
18	-17	19	9	59	3	58	3	57	3
17	-10								

DEFLECTIONS INCHES +INTO SENSOR

30	0.000	70	-0.010	31	-0.002	11	-0.011	50	-0.008
42	0.004	51	0.010	10	0.003	68	0.004	78	0.003

STRAINS IN/IN

79	0.000000	39	-0.000007	74	0.000010	34	0.000017	24	0.000003
63	-0.000038	40	0.000004	43	0.000009	23	0.000002	64	-0.000008
44	-0.000001	2	0.000004	3	0.000001	35	-0.000003	76	0.000004
28	-0.000006	67	-0.000004	27	-0.000012	25	-0.000006	65	-0.000000
66	0.000001	38	0.000003	5	0.000003	41	0.000007	75	0.000016
69	-0.000003	37	0.000003	73	-0.000045	6	0.000006	49	-0.000015
8	0.000018	47	-0.000001	9	0.000003	72	-0.000004	4	0.000003
71	-0.000001	32	0.000000	33	0.000007	20	-0.000007	60	0.000003
61	0.000002	21	-0.000002	26	-0.000000	1	-0.000002	48	0.000002
45	0.000001	0	0.000001	29	0.000000	36	0.000001	46	0.000009
7	-0.000000	22	-0.000001	62	0.000001	77	-0.000015		

RUN 17

TIME 05:13:12:30:38 **P1= -0 P2 = 0**

ROD LOADS IN LBS

15	16	16	10	56	3	55	13	52	10
12	-13	53	3	13	3	54	17	14	7
18	0	19	3	59	20	58	20	57	23
17	-10								

DEFLECTIONS INCHES +INTO SENSOR

30	0.000	70	-0.011	31	-0.000	11	-0.011	50	-0.007
42	0.004	51	0.010	10	0.003	68	0.004	78	0.003

STRAINS IN/IN

79	-0.000001	39	-0.000008	74	0.000010	34	0.000017	24	0.000006
63	0.000041	40	0.000003	43	0.000009	23	0.000003	64	-0.000006
44	0.000000	2	0.000002	3	0.000000	35	-0.000004	76	0.000003
28	-0.000004	67	-0.000003	27	-0.000011	25	-0.000007	65	0.000002
66	0.000004	38	0.000000	5	0.000004	41	0.000007	75	0.000014
69	-0.000001	37	0.000001	73	-0.000032	6	-0.000002	49	-0.000011
8	0.000017	47	-0.000003	9	0.000003	72	-0.000006	4	0.000003
71	-0.000003	32	-0.000000	33	0.000006	20	-0.000007	60	0.000001
61	0.000000	21	-0.000003	26	-0.000001	1	-0.000003	48	0.000003
45	0.000000	0	0.000002	29	0.000001	36	-0.000001	46	0.000009
7	-0.000001	22	0.000000	62	0.000000	77	-0.000015		

RUN 18

TIME 05:13:12:30:38 **P1 = 0 P2 = 0**

ROD LOADS IN LBS

15	16	16	7	56	-7	55	-3	52	3
12	-7	53	3	13	7	54	-3	14	13
18	-13	19	13	59	7	58	20	57	-7
17	-3								

DEFLECTIONS INCHES +INTO SENSOR

30	0.000	70	-0.011	31	-0.000	11	-0.011	50	-0.007
42	0.004	51	0.010	10	0.003	68	0.004	78	0.003

TEST 2 DATA (CONTINUED)

STRAINS IN-IN

79	-0.000000	39	-0.000008	74	0.000010	34	0.000007	24	0.000004
69	-0.000042	40	0.000001	43	0.000009	23	0.000003	64	-0.000006
44	0.000001	2	0.000001	3	-0.000000	35	-0.000004	76	0.000003
28	-0.000006	67	-0.000003	27	-0.000011	25	-0.000006	65	0.000002
66	0.000004	38	0.000000	5	0.000004	41	0.000007	75	0.000013
70	-0.000002	37	0.000002	73	-0.000032	6	-0.000003	49	-0.000010
8	0.000010	47	-0.000003	9	0.000004	12	-0.000006	4	0.000000
71	-0.000003	32	-0.000001	33	0.000006	20	-0.000008	60	0.000000
61	0.000000	21	-0.000003	26	-0.000001	1	-0.000003	48	0.000002
45	0.000002	0	0.000003	29	0.000000	36	-0.000001	46	0.000008
7	0.000000	22	-0.000001	62	0.000001	77	-0.000013		

TEST 2 DATA (CONTINUED)

RUN 1

TIME 05:16:09:18:02 P1 = 1 P2 = 0

ROD LOADS IN LBS

15	0	16	0	56	0	55	0	52	0
12	0	53	0	13	0	54	0	14	0
18	0	19	0	59	0	58	0	57	0
17	0								

DEFLECTIONS INCHES +INTO SENSOR

30	0.000	70	0.000	31	0.000	11	0.000	50	0.000
42	0.000	51	0.000	10	0.000	69	0.000	79	0.000

STRAINS IN/IN

79	0.000000	39	0.000000	74	0.000000	34	0.000000	24	0.000000
69	0.000000	40	0.000000	43	0.000000	23	0.000000	64	0.000000
44	0.000000	2	0.000000	3	0.000000	35	0.000000	76	0.000000
25	0.000000	67	0.000000	27	0.000000	25	0.000000	65	0.000000
66	0.000000	38	0.000000	5	0.000000	41	0.000000	75	0.000000
69	0.000000	37	0.000000	73	0.000000	6	0.000000	49	0.000000
8	0.000000	47	0.000000	9	0.000000	72	0.000000	4	0.000000
71	0.000000	32	0.000000	33	0.000000	20	0.000000	60	0.000000
61	0.000000	21	0.000000	26	0.000000	1	0.000000	48	0.000000
45	0.000000	0	0.000000	29	0.000000	36	0.000000	46	0.000000
7	0.000000	22	0.000000	62	0.000000	77	0.000000		

RUN 2

TIME 05:16:09:18:02 P1 = 1 P2 = 0

ROD LOADS IN LBS

15	16	16	0	56	-3	55	7	52	-7
12	0	53	17	13	3	54	-13	14	3
18	13	19	-17	59	0	58	0	57	-7
17	3								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.000	70	0.000	31	-0.000	11	0.000	50	-0.000
42	0.000	51	0.000	10	-0.000	69	0.000	79	-0.000

STRAINS IN/IN

79	0.000000	39	0.000000	74	-0.000001	34	0.000001	24	-0.000000
69	-0.000001	40	0.000000	43	-0.000001	23	0.000000	64	0.000001
44	0.000000	2	-0.000001	3	-0.000001	35	0.000001	76	-0.000001
25	0.000000	67	-0.000000	27	0.000001	25	0.000001	65	0.000000
66	-0.000000	38	0.000001	5	-0.000001	41	0.000001	75	-0.000001
69	0.000002	37	0.000001	73	-0.000002	6	-0.000001	49	0.000000
8	-0.000001	47	0.000000	9	-0.000001	72	0.000001	4	0.000000
71	0.000000	32	-0.000001	33	-0.000001	20	0.000002	60	0.000000
61	0.000001	21	0.000000	26	0.000000	1	0.000001	48	0.000001
45	0.000001	0	-0.000003	29	0.000001	36	0.000001	46	0.000002
7	-0.000001	22	0.000000	62	-0.000001	77	-0.000001		

RUN 3

TIME 05:16:09:18:02 P1 = 1263 P2 = 127

ROD LOADS IN LBS

15	5204	16	2600	56	2573	55	2590	52	6731
12	6770	53	6731	13	6758	54	6731	14	6820
18	3110	19	3301	59	3314	58	3434	57	3214
17	3234								

DEFLECTIONS INCHES +INTO SENSOR

30	-0.000	70	0.006	31	-0.023	11	-0.052	50	-0.057
42	0.058	51	0.012	10	0.019	69	0.045	79	0.045

TEST 3 DATA

STRAINS IN/IN

79 -0.002063	39 -0.000843	74 -0.000209	34 -0.001455	24 -0.000269
63 -0.000890	40 -0.001849	43 0.002080	23 -0.000125	64 -0.000011
44 -0.000224	2 0.001564	3 -0.000693	35 0.002998	76 0.000564
28 0.000049	67 -0.000279	27 -0.001055	25 0.000620	65 -0.000001
66 0.000393	38 0.001023	5 0.000549	41 -0.000132	75 -0.001574
69 0.000112	37 0.000474	73 -0.001102	6 -0.001331	49 0.000637
8 0.002860	47 0.000084	9 0.000314	72 -0.001105	4 0.001074
71 -0.002134	32 0.000439	33 0.000671	20 -0.001656	60 0.001490
61 0.000598	21 -0.001664	26 0.001321	1 -0.000205	48 0.000269
45 0.000129	0 -0.000067	29 0.000176	36 0.000280	46 -0.000198
7 -0.000096	22 -0.000156	62 -0.000089	77 0.000357	

RUN 4

TIME 05:16:09:10:02 P1 = 1262 P2 = 127

ROD LOADS IN LBS

15 5194	16 2600	56 2573	55 2590	52 6751
12 6775	53 6741	13 6751	54 6741	14 6835
18 3114	19 3277	59 3327	58 3417	57 3217
17 3230				

DEFLECTIONS INCHES +INTO SENSOR

30 -0.000	70 0.006	31 -0.028	11 -0.052	50 -0.057
42 0.058	51 0.013	10 0.020	68 0.035	78 0.025

STRAINS IN/IN

79 -0.002068	39 -0.000841	74 -0.000212	34 -0.001461	24 -0.000266
63 -0.000874	40 -0.000415	43 0.002173	23 -0.000118	64 -0.000012
44 -0.000234	2 0.001695	3 -0.000699	35 0.003222	76 0.000570
28 0.000031	67 -0.000281	27 -0.001060	25 0.000613	65 -0.000005
66 0.000383	38 0.001058	5 0.000556	41 -0.000125	75 -0.001646
69 0.000114	37 0.000480	73 -0.001109	6 -0.001335	49 0.000643
8 0.002864	47 0.000082	9 0.000318	72 -0.001111	4 0.001077
71 -0.002145	32 0.000438	33 0.000672	20 -0.001656	60 0.001497
61 0.000605	21 -0.001667	26 0.001325	1 -0.000203	48 0.000273
45 0.000132	0 -0.000093	29 0.000183	36 0.000281	46 -0.000199
7 -0.000096	22 -0.000157	62 -0.000090	77 0.000366	

RUN 5

TIME 05:16:09:18:02 P1 = 1426 P2 = 148

ROD LOADS IN LBS

15 5793	16 2907	56 2903	55 2883	52 7632
12 7636	53 7629	13 7606	54 7622	14 7702
18 3504	19 3711	59 3744	58 3885	57 3631
17 3641				

DEFLECTIONS INCHES +INTO SENSOR

30 0.007	70 0.006	31 -0.028	11 -0.053	50 -0.059
42 0.064	51 0.015	10 0.020	68 0.038	78 0.029

STRAINS IN/IN

79 -0.002316	39 -0.000913	74 -0.000246	34 -0.001669	24 -0.000290
63 -0.001055	40 -0.000499	43 0.002317	23 -0.000121	64 -0.000008
44 -0.000260	2 0.001979	3 -0.000775	35 0.003865	76 0.000655
28 -0.000012	67 -0.000302	27 -0.001190	25 0.000576	65 -0.000041
66 0.000339	38 0.001119	5 0.000638	41 -0.000143	75 -0.001929
69 0.000126	37 0.000543	73 -0.001227	6 -0.001516	49 0.000729
8 0.003183	47 0.000095	9 0.000343	72 -0.001257	4 0.001212
71 -0.002419	32 0.000493	33 0.000729	20 -0.001864	60 0.001689
61 0.000636	21 -0.001878	26 0.001490	1 -0.000217	48 0.000313
45 0.000145	0 -0.000117	29 0.000204	36 0.000317	46 -0.000219
7 -0.000093	22 -0.000181	62 -0.000087	77 0.000382	

TEST 3 DATA (CONTINUED)

RUN 6

TIME 05:16:09:10:02 P1 = 1424 P2 = 148

ROD LOADS IN LBS

15	5824	16	2920	56	2897	55	2893	52	7592
12	7636	53	7575	13	7596	54	7592	14	7702
18	3491	19	3684	59	3758	58	3878	57	3604
17	3624								

DEFLECTIONS INCHES +INTO SENSOR

30	0.007	70	0.006	31	-0.028	11	-0.054	50	-0.059
42	0.064	51	0.015	10	0.020	68	0.038	78	0.029

STRAINS IN/IN

79	-0.002317	39	-0.000925	74	-0.000248	34	-0.001676	24	-0.000291
63	-0.001042	40	-0.000511	43	0.002402	23	-0.000120	64	-0.000008
44	-0.000262	2	0.002057	3	-0.000786	35	0.004052	76	0.000659
28	-0.000014	67	-0.000304	27	-0.001203	25	0.000575	65	-0.000040
66	0.000339	38	0.001145	5	0.000641	41	-0.000121	75	-0.001976
69	0.000126	37	0.000548	73	-0.001242	6	-0.001516	49	0.000744
8	0.003194	47	0.000095	9	0.000347	72	-0.001258	4	0.001215
71	-0.002423	32	0.000490	33	0.000730	30	-0.001865	60	0.001690
61	0.000642	21	-0.001879	26	0.001493	1	-0.000218	48	0.000319
45	0.000152	0	-0.000125	29	0.000210	36	0.000318	46	-0.000223
7	-0.000092	22	-0.000185	62	-0.000087	77	0.000335		

RUN 7

TIME 05:16:09:18:02 P1 = 1546 P2 = 155

ROD LOADS IN LBS

15	6482	16	3247	56	3244	55	3234	52	8537
12	8523	53	8513	13	8457	54	8500	14	8583
18	3878	19	4135	59	4195	58	4338	57	4055
17	4048								

DEFLECTIONS INCHES +INTO SENSOR

30	0.007	70	0.006	31	-0.028	11	-0.056	50	-0.061
42	0.069	51	0.015	10	0.018	68	0.038	78	0.031

STRAINS IN/IN

79	-0.002568	39	-0.001006	74	-0.000283	34	-0.001909	24	-0.000325
63	-0.001275	40	-0.000585	43	0.002540	23	-0.000117	64	-0.000008
44	0.000273	2	0.002210	3	-0.000863	35	0.004501	76	0.000742
28	-0.000015	67	-0.000471	27	-0.001355	25	0.000585	65	-0.000086
66	0.000307	38	0.001191	5	0.000715	41	0.000114	75	-0.002182
69	0.000132	37	0.000611	73	-0.001380	6	0.001703	49	0.000847
8	0.003550	47	0.000093	9	0.000384	72	-0.001412	4	0.001355
71	0.002714	32	0.000547	33	0.000803	30	-0.002078	60	0.001889
61	0.000655	21	-0.002095	26	0.001666	1	-0.000238	48	0.000356
45	0.000175	0	-0.000107	29	0.000221	36	0.000359	46	-0.000250
7	-0.000095	22	-0.000217	62	-0.000097	77	0.000322		

RUN 8

TIME 05:16:09:18:02 P1 = 1546 P2 = 155

ROD LOADS IN LBS

15	6539	16	3267	56	3234	55	3244	52	8523
12	8560	53	8500	13	8510	54	8480	14	8633
18	3905	19	4135	59	4162	58	4332	57	4028
17	4081								

DEFLECTIONS INCHES +INTO SENSOR

30	0.007	70	0.006	31	-0.028	11	-0.056	50	-0.061
42	0.066	51	0.015	10	0.005	68	0.031	78	0.031

TEST 3 DATA (CONTINUED)

STRAINS IN/IN

1	79	-0.002558	39	-0.001017	74	-0.000287	34	-0.001923	24	-0.000319
6	69	-0.001242	40	-0.000599	43	0.002650	44	-0.000112	64	-0.000010
11	14	-0.000274	2	0.002274	3	-0.000877	25	0.004770	76	0.000743
16	28	-0.000021	67	-0.000852	27	-0.001369	45	0.006536	65	-0.000081
21	64	0.000211	38	0.001220	5	0.000720	41	-0.001101	75	-0.002247
26	69	0.000133	37	0.000616	73	-0.001367	8	-0.001704	49	0.000851
31	8	0.003571	47	0.000100	9	0.000389	72	-0.001405	4	0.001362
36	71	-0.002702	32	0.000546	33	0.000807	20	-0.002084	60	0.001806
41	61	0.000661	21	-0.002101	26	0.001675	1	-0.000240	48	0.000362
46	45	0.000184	0	-0.000114	29	0.000228	36	0.000360	46	-0.000255
51	7	-0.000097	22	-0.000225	62	-0.000102	77	0.000329		

RUN 9

TIME 05:16:09:18:02 P1 = C P2 = C

ROD LOADS IN LBS

15	5	16	3	56	7	55	0	52	17
12	13	53	10	13	13	54	-20	14	-3
18	14	19	-13	59	5	58	10	57	-3
17	0								

DEFLECTIONS INCHES FINTO SENSOR

10	0.008	70	-0.007	31	-0.039	11	0.016	50	-0.011
	0.004	51	-0.222	10	0.007	69	0.006	78	0.004

STRAINS IN/IN

79	0.000004	39	-0.000018	74	0.000015	34	0.000002	24	0.000003
69	-0.000059	40	-0.000007	43	0.000017	44	-0.000002	64	-0.000004
14	-0.000007	2	0.000064	3	0.000001	25	0.000205	76	0.000017
28	0.000010	67	0.000132	27	-0.000040	45	0.000001	65	-0.000009
64	0.000012	38	0.000024	5	0.000017	41	0.000020	75	-0.000041
69	0.000003	37	0.000005	73	-0.000020	8	0.000005	49	0.000039
8	0.000070	47	0.000011	9	0.000010	72	0.000010	4	0.000011
71	-0.000003	32	-0.000003	33	0.000024	20	-0.000007	60	0.000006
61	0.000007	21	-0.000003	26	0.000002	1	0.000001	48	0.000011
45	0.000015	0	-0.000000	29	0.000001	36	0.000006	46	0.000022
7	0.000017	22	0.000005	62	0.000012	77	-0.000010		

RUN 10

TIME 05:16:09:19:02 P1 = C P2 = C

ROD LOADS IN LBS

15	10	16	10	56	12	55	13	52	13
12	13	53	13	13	7	54	-17	14	0
18	20	19	-10	59	13	58	27	57	20
17	3								

DEFLECTIONS INCHES FINTO SENSOR

10	0.008	70	-0.010	31	-0.042	11	0.014	50	-0.009
42	0.004	51	-0.223	10	0.005	69	0.005	78	0.003

STRAINS IN/IN

79	0.000002	39	-0.000018	74	0.000015	34	-0.000001	24	0.000007
69	-0.000060	40	-0.000007	43	0.000012	44	-0.000001	64	-0.000004
14	0.000010	2	0.000066	3	0.000001	25	0.000276	76	0.000015
28	0.000010	67	-0.000158	27	-0.000053	45	-0.000001	65	-0.000007
64	0.000008	38	0.000023	5	0.000012	41	0.000025	75	-0.000033
69	0.000004	37	0.000004	73	-0.000003	8	0.000026	49	0.000046
8	0.000064	47	-0.000008	9	0.000006	72	-0.000010	4	0.000010
71	0.000003	32	-0.000001	33	0.000021	20	-0.000007	60	0.000006
61	0.000007	21	-0.000002	26	0.000002	1	0.000004	48	0.000010
45	0.000014	0	0.000000	29	0.000001	36	0.000005	46	0.000019
7	0.000016	22	0.000003	62	0.000011	77	-0.000010		

TEST 3 DATA (CONTINUED)

RUN 11

TIME 05:16:09:18:02 P1=0 P2=0

ROD LOADS IN LBS

15	16	16	20	56	17	55	10	52	17
12	13	53	3	13	17	54	-10	14	3
19	17	19	-3	59	3	58	20	57	3
17	7								

DEFLECTIONS INCHES +INTO SENSOR

30	0.007	70	-0.002	31	0.001	11	0.003	50	0.006
42	0.003	51	-0.323	10	0.003	68	0.003	78	0.003

STRAINS IN/IN

79	0.000007	39	-0.000011	74	-0.000003	34	-0.000019	24	0.000010
63	-0.000059	40	-0.000010	43	0.000010	23	-0.000004	64	-0.000000
44	-0.000007	2	0.000065	3	0.000000	35	0.000288	76	0.000014
28	-0.000008	67	-0.000073	27	-0.000023	25	0.000001	65	-0.000003
66	-0.000007	38	0.000016	5	0.000010	41	0.000021	75	-0.000037
69	0.000004	37	0.000002	73	-0.000012	6	0.000003	49	0.000069
8	0.000082	47	-0.000004	9	0.000001	72	0.000010	4	0.000004
71	0.000001	32	-0.000001	33	0.000017	20	-0.000005	60	0.000062
61	0.000007	21	0.000001	26	0.000000	1	0.000007	48	0.000010
45	0.000007	0	-0.000001	29	0.000003	36	0.000004	46	0.000045
7	0.000005	22	0.000003	62	0.000004	77	-0.000009		

RUN 12

TIME 05:16:09:18:02 P1=0 P2=-1

ROD LOADS IN LBS

15	0	16	17	56	13	55	10	52	13
12	20	53	7	13	17	54	-20	14	10
19	7	19	-3	59	-10	58	7	57	-7
17	10								

DEFLECTIONS INCHES +INTO SENSOR

30	0.007	70	-0.002	31	0.001	11	0.003	50	-0.006
42	0.003	51	-0.323	10	0.003	68	0.003	78	0.003

STRAINS IN/IN

79	0.000007	39	-0.000011	74	-0.000006	34	-0.000019	24	0.000009
63	-0.000059	40	-0.000012	43	0.000009	23	-0.000005	64	-0.000002
44	-0.000007	2	0.000063	3	-0.000001	35	0.000294	76	0.000013
28	-0.000010	67	-0.000069	27	-0.000020	25	-0.000001	65	-0.000004
66	-0.000008	38	0.000016	5	0.000011	41	0.000021	75	-0.000038
69	0.000004	37	0.000003	73	-0.000013	6	0.000000	49	0.000041
8	0.000062	47	-0.000003	9	0.000003	72	-0.000010	4	0.000003
71	-0.000001	32	-0.000001	33	0.000018	20	-0.000006	60	0.000004
61	0.000007	21	0.000000	26	-0.000000	1	0.000006	48	0.000009
45	0.000011	0	-0.000002	29	0.000002	36	0.000004	46	0.000003
7	0.000005	22	0.000001	62	0.000003	77	-0.000009		

TEST 3 DATA (CONTINUED)

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