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**ENVIRONMENTAL TEST
SONY DIR-1000, ID-1 DIGITAL TAPE RECORDER
(VIBRATION, TEMPERATURE AND HUMIDITY)**

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NAVAL AIR WARFARE CENTER — AIRCRAFT DIVISION
Warminster, PA 18974-5000

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Warminster, PA 18974-5000

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13. ABSTRACT (Maximum 200 words) This test was conducted in order to evaluate the suitability of a commercially available tape recorder as a back-up for tape recorders being developed for different military programs. The recorder was subjected to vibration simulating the flight profile of a P3 aircraft, excluding take off and landing. Temperature and humidity simulated the operational envelope of the P3. The commercial Sony DIR-1000 unit held up very well, failing only after the 50°C, 60% Relative Humidity soak point.			
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INTRODUCTION/PURPOSE

This report documents procedures used, and results of, Environmental Testing on a Sony DIR-1000 Digital Tape Recorder. This testing was performed to characterize the recorder's performance, and performance degradation, under prescribed vibration and temperature/humidity profiles. The profiles were developed from environments encountered in P-3C aircraft, as measured by Boeing Aircraft Co.

Environmental testing occurred January 20 through January 24, 1992, at Dayton T. Brown Inc., Bohemia, NY. Dayton T. Brown provided the environmental test fixtures needed: a Shaker Table for vibration, and a Temperature/Humidity Chamber. Performance testing of the Recorder was performed by personnel of the Data Recording Laboratory, Code 5053 at the Naval Air Warfare Center, Warminster, PA. Parameters evaluated under each environmental profile were the Bit Error Rate, and the Recorder's Self-Diagnostics. Details of the actual environmental profiles applied, and the performance test equipment, procedures, and results are provided below.

CONDITIONS

The Environmental testing began with evaluation of the Recorder's performance (Bit Error Rate) under vibration. Both actual flight data and Mil-Std-810E vibration profiles were used as stimuli to the Shaker Table.

After vibration testing was completed, the Sony DIR-1000 was placed in the Temperature/Humidity chamber, and cycled through a series of T/H "dwell points" identical to those contained in the Boeing Acceptance Test Procedure for the Metrum MIL-STD-2179 Digital Recorder for P-3C Update IV. Performance data for the Sony recorder was gathered at each T/H dwell point, with the exception of the extreme high and low temperatures. Note that only vibration (one axis at a time) or Temperature/Humidity was applied — the recorder was not subjected to both simultaneously.

PERFORMANCE TESTING

The Recorder's measured Bit Error Rate, both in the Playback mode (playback of previously recorded data) and the Record mode (Read-After-Write, i.e. simultaneous Record and Reproduce) was used as the principle means of evaluating the Sony DIR-1000's performance. The Error Correction Code (ECC) was ON, for all BER test data recorded. Figure 1 is a block diagram of the Performance Test Fixture. Note that only the Sony recorder was subjected to the Environment, not the peripheral test equipment. Appendix E of this report provides details of the test setup and equipment, as well as strict definitions of the terms **Bit Error Rate**, **E-E Mode**, **ECC ON/OFF**, and **Read-After-Write**, as they are used in this report.

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Throughout all the vibration and T/H testing, the Sony Recorder's Error Correction was "ON". Prior to start of Environmental Testing it was observed that no errors occurred with ECC on. This made it difficult to measure performance degradation with environment. The Uncorrected (Raw) BER would have provided a much better indication of performance degradation, as the environments were varied; however this proved very difficult to implement with the test equipment used.

Using the Corrected Bit Error Rate (CBER) for evaluation gave a clear indication of recorder failure. Since in general, with ECC ON, there were no bit errors, the occurrence of errors indicated that the ECC had been unable to correct for the deteriorating raw BER. The data presented further along in this report shows occasional "one-time" errors, but these were almost certainly caused by test equipment error or tape dropouts. The test personnel's familiarity with the test system allowed that judgment (i.e. were errors caused by test equipment/tape defect or Recorder failure) to be made with confidence.

VIBRATION TESTING

PROCEDURES

Vibration spectra for each of three axes, were provided for this test by Boeing. These spectra were representative of actual Boeing P-3 flight data, and are referred to in this report as the "Boeing (vibration) profiles". Appendix A, figures A-1, A-2 and A-3 show the actual data provided by Boeing. In addition, the Sony was tested to a **modified** Mil-Std-810E spectrum. The Mil-Std-810E spectrum calculated for this test is shown in Figure A-4. During all vibration tests, there was no vibration isolation used. The Sony Recorder was "hard-mounted" to the table. Figure 2 shows the labeling conventions with regard to the orientation axes. There were five separate vibration profiles under which the Sony DIR-1000 was evaluated:

- 1) The Boeing profile, X-axis (Fore/Aft)
- 2) The Boeing profile, Y-axis (Side to Side)
- 3) The Boeing profile, Z-axis (Up and Down)
- 4) Mil-Std-810E, Z-axis, derated 9 dB
- 5) Mil-Std-810E, Z-axis, derated 6 dB

BOEING PROFILE

The plan for testing with the Boeing vibration profile actually consisted of four BER tests (A, B, C, D) *per recorder orientation axis* as follows:

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A) Baseline Record for 30 minutes, with **no vibration**. A Read-After-Write BER Test, with ECC ON was performed during this time.

B) Playback of part of recording made in A), **with vibration applied**, for 10 minutes. A BER Test, with ECC ON, was performed during this "subsequent replay".

The A) and B) tests above simulate in-flight loading of "ground-recorded" data.

C) Record (with Read-After-Write BER , ECC ON) **under vibration**, for 50 minutes.

D) Playback of data recorded in C), **no vibration**, BER evaluated with ECC ON.

The C) and D) tests simulate the case of in-flight data acquisition, with subsequent ground replay.

MIL-STD-810E PROFILE

The guidelines of Mil-Std-810E were used by the personnel at Dayton T. Brown to develop the recommended vibration spectrum, specifically, Method 514.4, Figure 514.4-7a, Table 514.4-II, for equipment mounted "In fuselage or wing aft of propeller". However, because the overall G_{rms} level of the spectrum was about 10 times that of the most severe Boeing profile, it was decided to initially derate the Mil-Std power spectrum amplitude by 9 dB. The plan called for increasing the amplitude in 3 dB steps following performance (BER) evaluation. Since the Z axis was determined to be the most sensitive, only Z-axis vibration was applied for the Mil-Std testing, and only the "-9 dB and -6 dB" levels were applied. For each Mil-Std-810E level, the following tests were conducted:

A) Baseline Record for 30 minutes with **no vibration**. A Read-After-Write BER test with ECC ON.

B) Playback of 10 minutes of recording made in A), with *vibration applied*. The ECC was ON during the BER evaluation. The same Baseline Recording { **A** } above} was played back, as the vibration amplitude was stepped up, rather than make a new Baseline Recording (under no vibration) for each level.

RESULTS

Table I shows the order and results of Vibration Testing. Each Test # listed is a BER Performance Test; vibration was only applied where noted. The Figures referred to in the "VIBRATION PROFILE APPLIED/FIGURE #" column of Table I are plots showing the average Vibration Spectrum seen by two accelerometers mounted on the table (the "CONTROL" plots), and the vibration seen by an accelerometer mounted on the Sony unit itself (the "Channel 3" plots).

The "BER TEST FIGURE #" refers the reader to the appropriate Bit Error Rate listing for that test. The "EVALUATION" column of Table I indicates whether or not the Recorder operated satisfactorily.

ANALYSIS

Referencing Table I, it is seen that the Sony DIR-1000 **successfully** Recorded/Reproduced data over the complete "Boeing" vibration profiles (Tests #1 through #12). Figure B-28 (Test #4) shows large errors occurring at the end of the "-9dB" Mil-Std-810E 10 minute test. It was difficult to determine the cause of these errors (test equipment or "real" failure due to vibration); therefore Test #15, a repeat of Test #14, was run. BER performance during Test #15 (figure B-30) was much better than that of Test #14, although a small amount of errors did occur (160 errors total, for a CBER = 8.0×10^{-9}). It was decided to continue on to the "- 6 dB" Mil-Std shake.

In Figure B-33, the BER plot for Test #16, *all* the BER samples were "Tau-Tron Overflows", or large amounts of errors. However, during Test #16, the Recorder shook itself loose from the mounting spacers (spacers part of Dayton T. Brown's fixture), and therefore the vibration test was not valid. The recorder was remounted, and Test #17, a repeat of #16, was run. **This test showed that the Sony DIR-1000 Failed the- "-6 dB" Mil-Std-810E profile, in the Z (vertical) axis.** The BER data (figure B-36) showed all "Tau-Tron Overflows", and the Recorder's Self-Diagnostics reported "Uncorrected Errors", "Servo Lock Loss", and "Motor FG Defective".

After Test #17, the recorder power was cycled, and all warning messages were extinguished. When powered up, the BET immediately showed no errors, indicating that the test equipment was functional. Then, with no vibration applied, the Sony was briefly put in Record Mode, and performed successfully with no errors/warnings. It is therefore concluded that the errors in Test #17 *were* vibration induced.

TEMPERATURE/HUMIDITY TESTING

PROCEDURES

The Temperature/Humidity evaluation of the Sony DIR-1000 was performed after vibration testing. The recorder was placed in the T/H Chamber, and the conditions inside the chamber were varied over a 27 hour period. The Recorder was not always operating (recording/reproducing), **but at all times during the test, tape was installed, and the unit was "powered up"**.

Figure A-5 shows the T/H "path". Note the nine "test points". Also refer to Table II. The word "TRANSIT" as it appears in the Temp and Rel Hum columns of Table II

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indicates the chamber conditions changing between the prescribed T/H values. The chamber was programmed to take one hour for each TRANSIT, with the exception of that TRANSIT between points #4 and #5, which took two hours. Once the chamber reached each test point, the Temperature and Humidity were held at the values shown, for two hours. With the exception of points #3 and #8, the Sony was placed in Record Test mode (R.A.W.) during the 2nd hour of the dwell, and the BER was evaluated, with ECC ON. One hour was sufficient to achieve temp/hum stability. At points #3 and #8, the Recorder was powered up but not moving tape, for the entire two hour dwell.

RESULTS

Table II shows the results of T/H testing. This table differs from Table I in that the Recorder was only recording at the times indicated in the MODE column; however, it was always "powered up". Table II shows the Temperature and Humidity path followed by the Chamber, the mode of operation, references the BER data obtained, and Pass/Fail Evaluation. Figures C-1 through C-4 are copies of the plots generated by the Temperature and Humidity sensors inside the Chamber.

ANALYSIS

The Sony Recorder operated successfully (see Table II) during the T/H testing, except for the final BER test. This test actually occurred at "Room Temperature" (27C, 30 % RH), T/H Test Point #9, but was run subsequent to the High temperature Test Point #8. Notice that the test did not require BER evaluation while at Test Pt #8 — it was likely that the failure occurred at this time, but was unobservable until the BER evaluation at Test Pt. #9.

Since the tape (Tape #41) was never removed during the T/H tests, perhaps the tape, rather than the Recorder, was sufficiently degraded so as to inhibit data recording and reproduction. Therefore, after the failure at Test Pt #9, the chamber was opened, and a new tape (Tape #46) was loaded in the Recorder. This tape also could not be recorded successfully, therefore indicating a hardware failure. At this point, testing at Dayton T. Brown was complete, and the hardware was returned to NAWC Warminster.

The cause of failure is unknown, but the Recorder recovered, and began to record and reproduce properly, shortly after failure analysis was started at NAWC, Warminster, PA. Details of the Failure Analysis are contained in Appendix D of this report.

SUMMARY

The Sony DIR-1000 Recorder operated satisfactorily throughout the in-flight vibration test spectra provided by Boeing. It failed Playback Performance testing under vibration, to a Mil-Std-810E spectra derated 6 dB, but passed the derated 9 dB test. Vibration isolators are recommended for any installation aboard P-3C aircraft to reduce risk of failure and facilitate installation/removal of this unit.

The Unit failed subsequent to a 50C/122F, 60 % Relative Humidity soak, but this failure was not deemed "serious", in that it appeared to be caused by either a circuit board becoming unseated, or a Head clog, as the tape remained in contact around the Scanner even when not moving; see Appendix D for more detail.

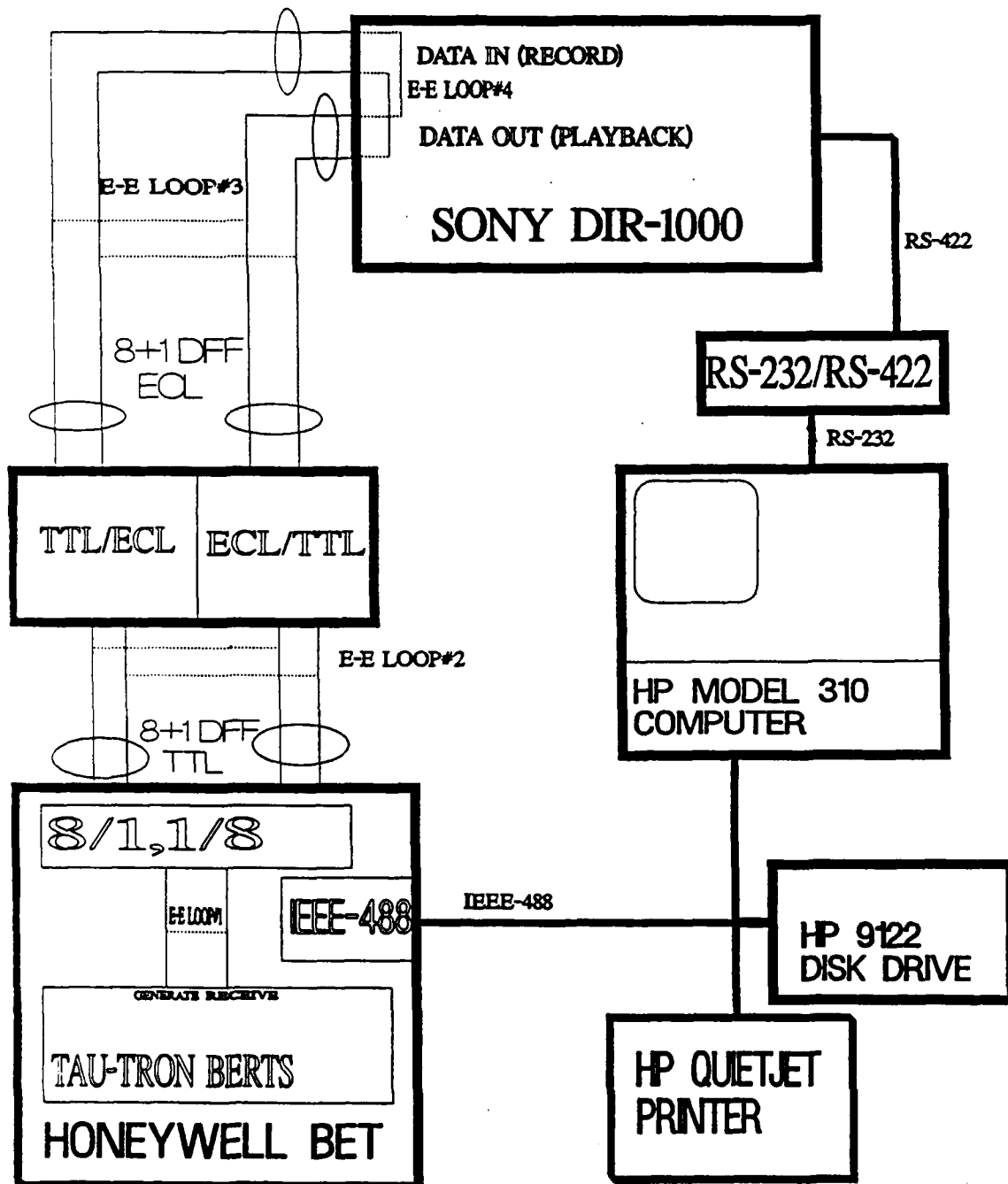


Figure 1. BER Test Block Diagram.

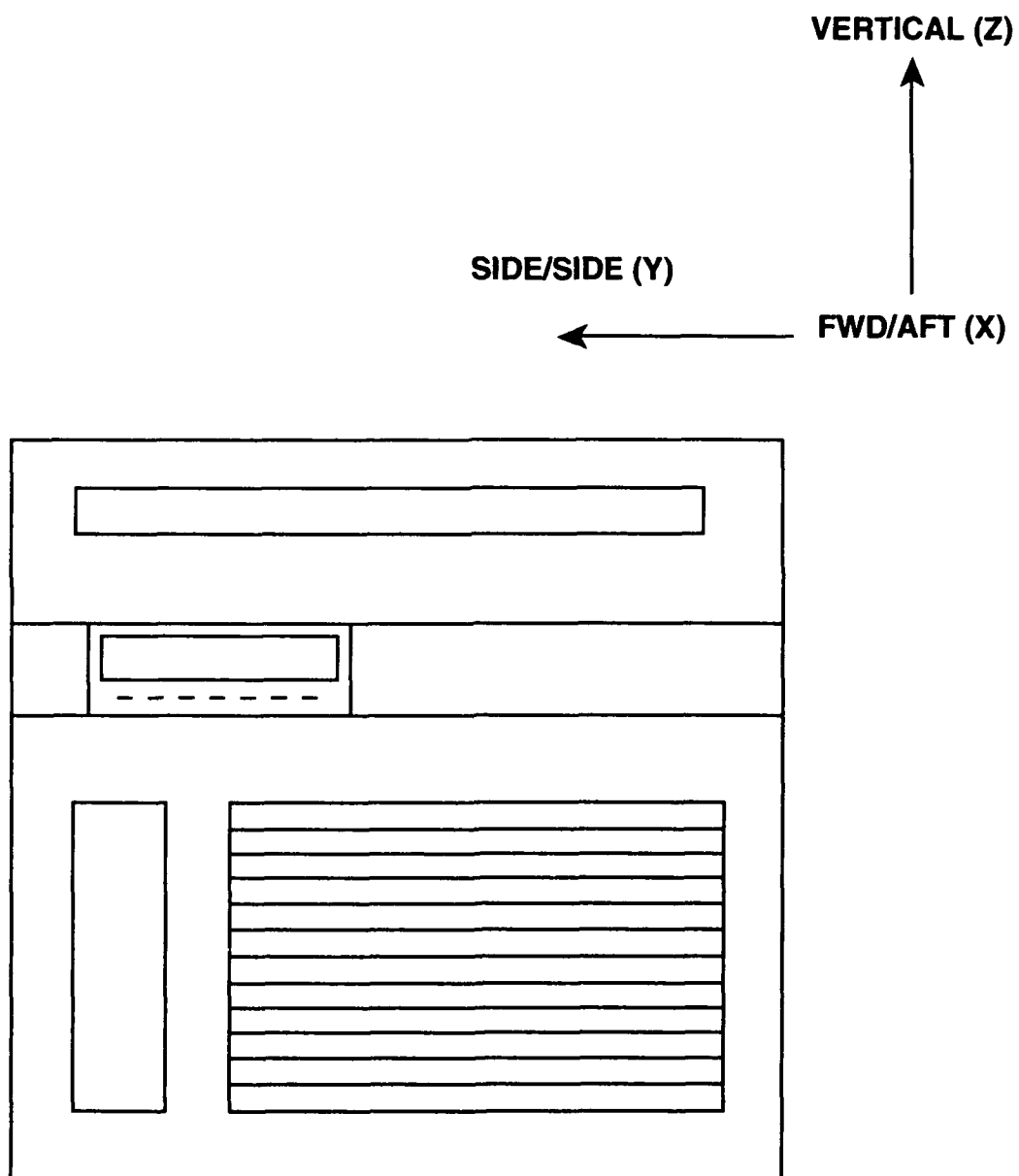


Figure 2. Text Axes Designation Sketch.

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Table I.

Results of Vibration Testing SONY DIR-1000.

VIBRATION TEST#	TAPE #	VIBRATION PROFILE APPLIED [FIGURE#]	AXIS	MODE REC/PLAY	ECC ON/OFF	BER TEST FIGURE #	EVALUATION (PASS/FAIL)
1	45		[X] [F/A]	RECORD	ON	B-1	PASS
2	45	B-2, B-3	[X] [F/A]	PLAYBACK	ON	B-4	PASS
3	45	B-5, B-6	[X] [F/A]	RECORD	ON	B-7	PASS
4	45		[X] [F/A]	PLAYBACK	ON	B-8	PASS
5	44		[Y] [S/S]	RECORD	ON	B-9	PASS
6	44	B-10, B-11	[Y] [S/S]	PLAYBACK	ON	B-12	PASS
7	44	B-13, B-14	[Y] [S/S]	RECORD	ON	B-15	PASS
8	44		[Y] [S/S]	PLAYBACK	ON	B-16	PASS
9	43		[Z] VERT	RECORD	ON	B-17	PASS
10	43	B-18, B-19	[Z] VERT	PLAYBACK	ON	B-20	PASS
11	43	B-21, B-22	[Z] VERT	RECORD	ON	B-23	PASS
12	43		[Z] VERT	PLAYBACK	ON	B-24	PASS
13	42		[Z] VERT	RECORD	ON	B-25	PASS
14	42	B-26, B-27	[Z] VERT	PLAYBACK	ON	B-28	—
15	42	B-29	[Z] VERT	PLAYBACK	ON	B-30	PASS
16	42	B-31, B-32	[Z] VERT	PLAYBACK	ON	B-33	FAIL
17	42	B-34, B-35	[Z] VERT	PLAYBACK	ON	B-36	FAIL

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Table II.

Temperature/Humidity Test Results Sony DIR-1000 Recorder.

T/H TEST PT	TAPE#	HOUR (START)	TEMP (deg)	REL HUMID (%)	MODE	ECC ON/OFF	BER TEST	EVALUATION (PASS/FAIL)
		0	TRANSIT	TRANSIT	PWR ON	—	—	—
1		1	27C/80.6F	30	PWR ON	—	—	—
1	41	2	27C/80.6F	30	RECORD	ON	C-5	PASS
		3	TRANSIT	TRANSIT	PWR ON	—	—	—
2		4	10C/50F	30	PWR ON	—	—	—
2	41	5	10C/50F	30	RECORD	ON	C-6	PASS
		6	TRANSIT	TRANSIT	PWR ON	—	—	—
3		7	-10C/14F	90	PWR ON	—	—	—
3		8	-10C/14F	90	PWR ON	—	—	—
		9	TRANSIT	TRANSIT	PWR ON	—	—	—
4		10	5C/41F	75	PWR ON	—	—	—
4	41	11	5C/41F	75	RECORD	ON	C-7	PASS
INTERMEDIATE		12	TRANSIT	TRANSIT	PWR ON	—	—	—
		13	TRANSIT	TRANSIT	PWR ON	—	—	—
5		14	27C/80.6F	30	PWR ON	—	—	—
5	41	15	27C/80.6F	30	RECORD	ON	C-8	PASS
		16	TRANSIT	TRANSIT	PWR ON	—	—	—
6		17	40C/104F	25	PWR ON	—	—	—
6	41	18	40C/104F	25	RECORD	ON	C-9	PASS
		19	TRANSIT	TRANSIT	PWR ON	—	—	—
7		20	40C/104F	75	PWR ON	—	—	—
7	41	21	40C/104F	75	RECORD	ON	C-10	PASS
		22	TRANSIT	TRANSIT	PWR ON	—	—	—
8		23	50C/122F	60	PWR ON	—	—	—
		24	TRANSIT	TRANSIT	PWR ON	—	—	—
9		25	27C/80.6F	30	PWR ON	—	—	—
9	41	26	27C/80.6F	30	RECORD	ON	C-11	FAIL

APPENDIX A
PROPOSED ENVIRONMENTAL PROFILES

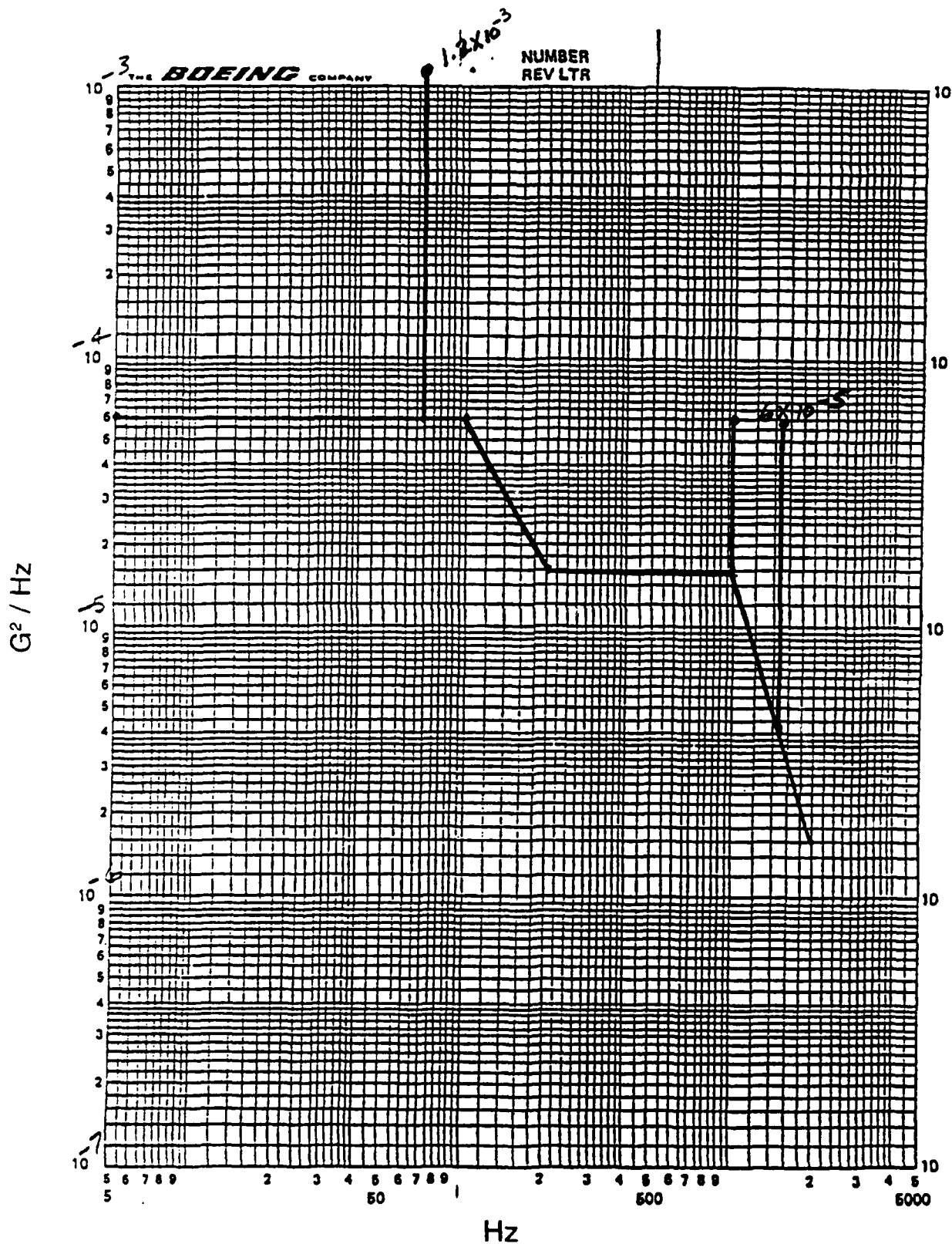
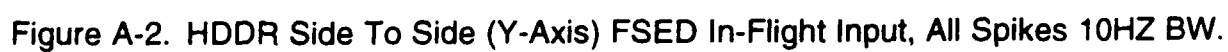


Figure A-1. HDDR Fore/Aft (X-Axis) FSED In-Flight Input, All Spikes 10Hz BW.





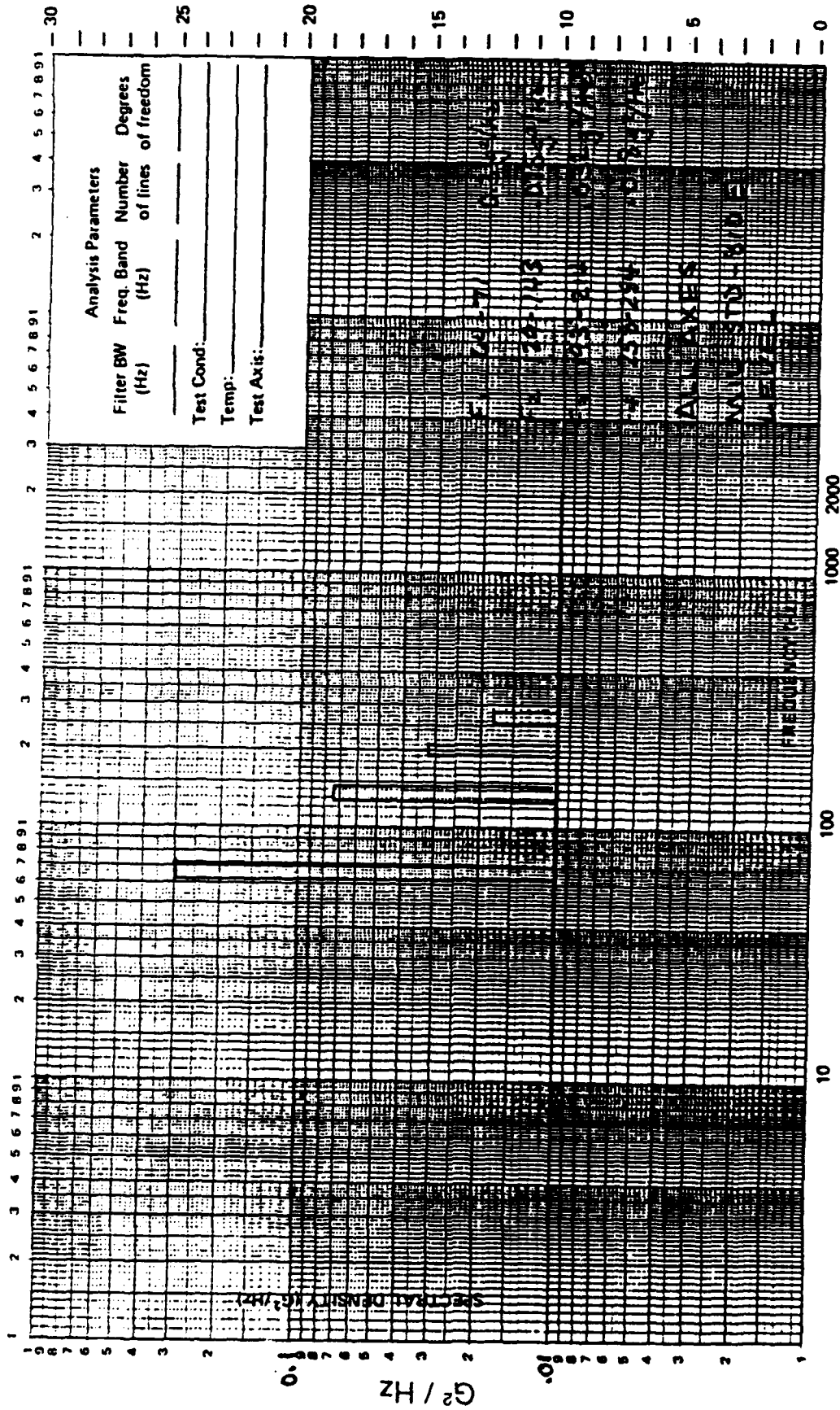


Figure A-4.

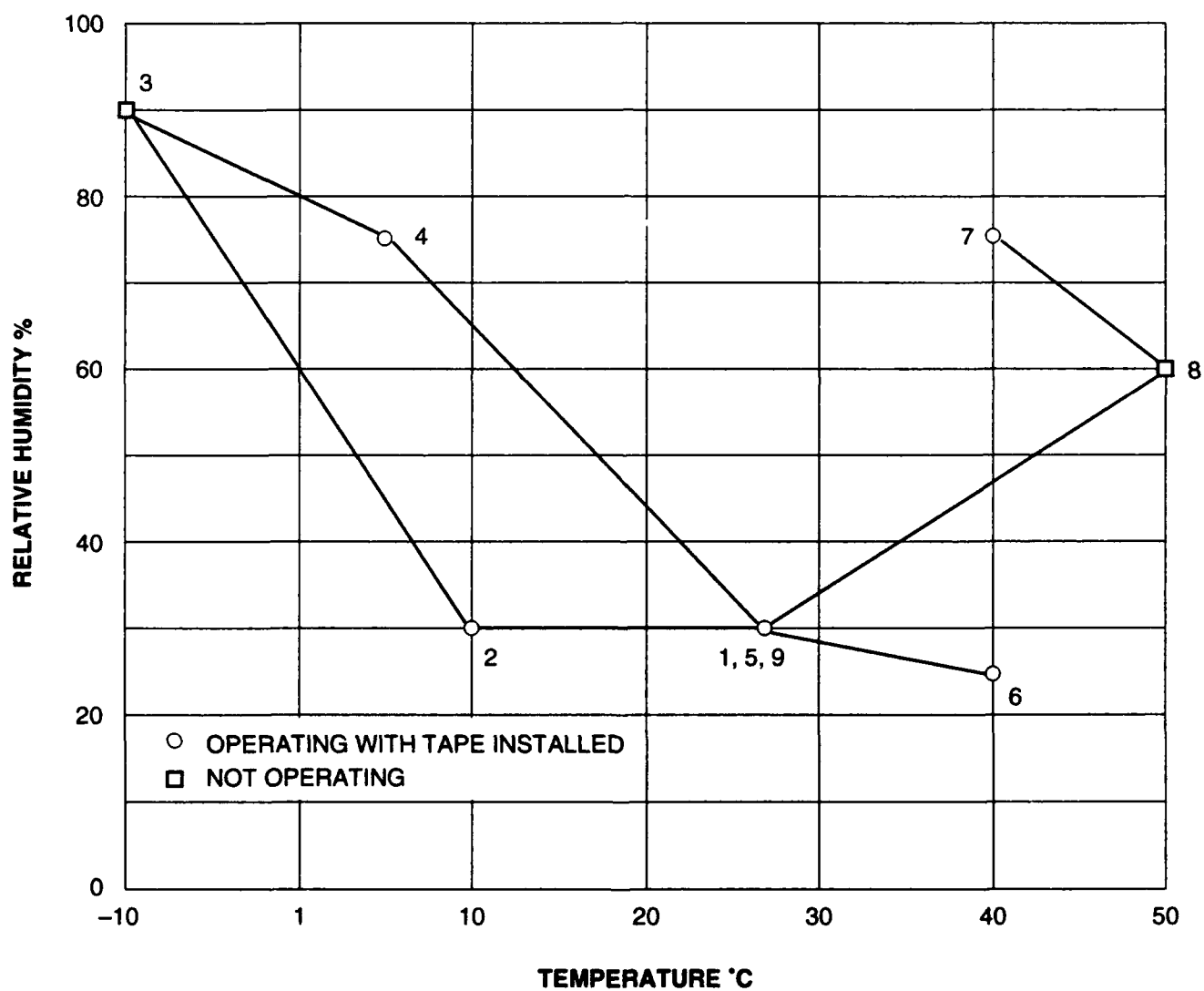


Figure A-5.

APPENDIX B
DATA SHEETS FOR VIBRATION TESTING

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BIT ERROR RATE TEST FOR XXXXXX RECORD Mode
 Date 20 January 1992 Start Time 09:51:07 Finish Time 10:21:36
 Channel Rate - 32Mbps Error Correction ON
 BASELINE FORE/AFT Tape Manufacturer No. B0X45CR

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
874	1 0.00-7	24428	1 0.00-7	47981	1 0.08-7
1746	1 0.00-7	25300	1 0.00-7	48854	1 0.00-7
2619	1 0.00-7	26172	1 0.00-7	49726	1 0.00-7
3491	1 0.00-7	27045	1 0.00-7	50598	1 0.00-7
4363	1 0.00-7	27917	1 0.00-7		
5236	1 0.00-7	28789	1 0.00-7		
6108	1 0.00-7	29662	1 0.00-7		
6981	1 0.00-7	30534	1 0.00-7		
7853	1 0.00-7	31406	1 0.00-7		
8725	1 0.00-7	32279	1 0.00-7		
9598	1 0.00-7	33151	1 0.00-7		
10470	1 0.00-7	34024	1 0.00-7		
11342	1 0.00-7	34896	1 0.00-7		
12215	1 0.00-7	35768	1 0.00-7		
13087	1 0.00-7	36641	1 0.00-7		
13959	1 0.00-7	37513	1 0.00-7		
14832	1 0.00-7	38385	1 0.00-7		
15704	1 0.00-7	39258	1 0.00-7		
16576	1 0.00-7	40130	1 0.00-7		
17449	1 0.00-7	41002	1 0.00-7		
18321	1 0.00-7	41875	1 0.00-7		
19194	1 0.00-7	42747	1 0.00-7		
20066	1 0.00-7	43619	1 0.00-7		
20938	1 0.00-7	44492	1 0.00-7		
21811	1 0.00-7	45364	1 0.08-7		
22683	1 0.00-7	46237	1 0.00-7		
23555	1 0.00-7	47109	1 0.08-7		

TEST PERAMETERS

No Vibration Record (R.A.W.)

ECC ON FORE/AFT (X axis) 32 Mbps Tape #45

Tape Stopped at 50624 count

No. of Sampes = 58

No. of Non-zero Samples = 3

Total Errors = 24

Average Ber/Sample = 4.14E-10

No. of Overflows = 0

Figure B-1.

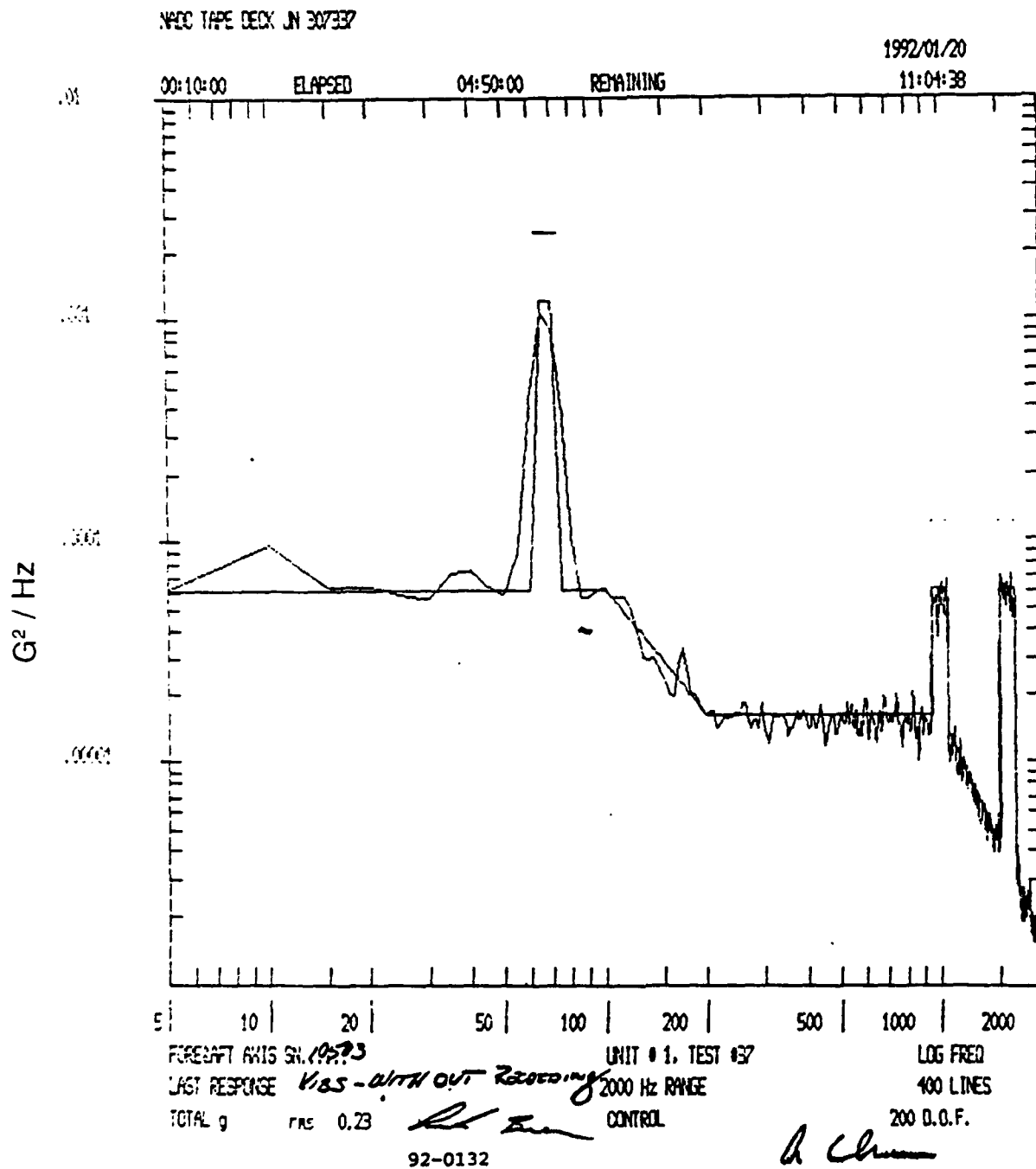


Figure B-2.

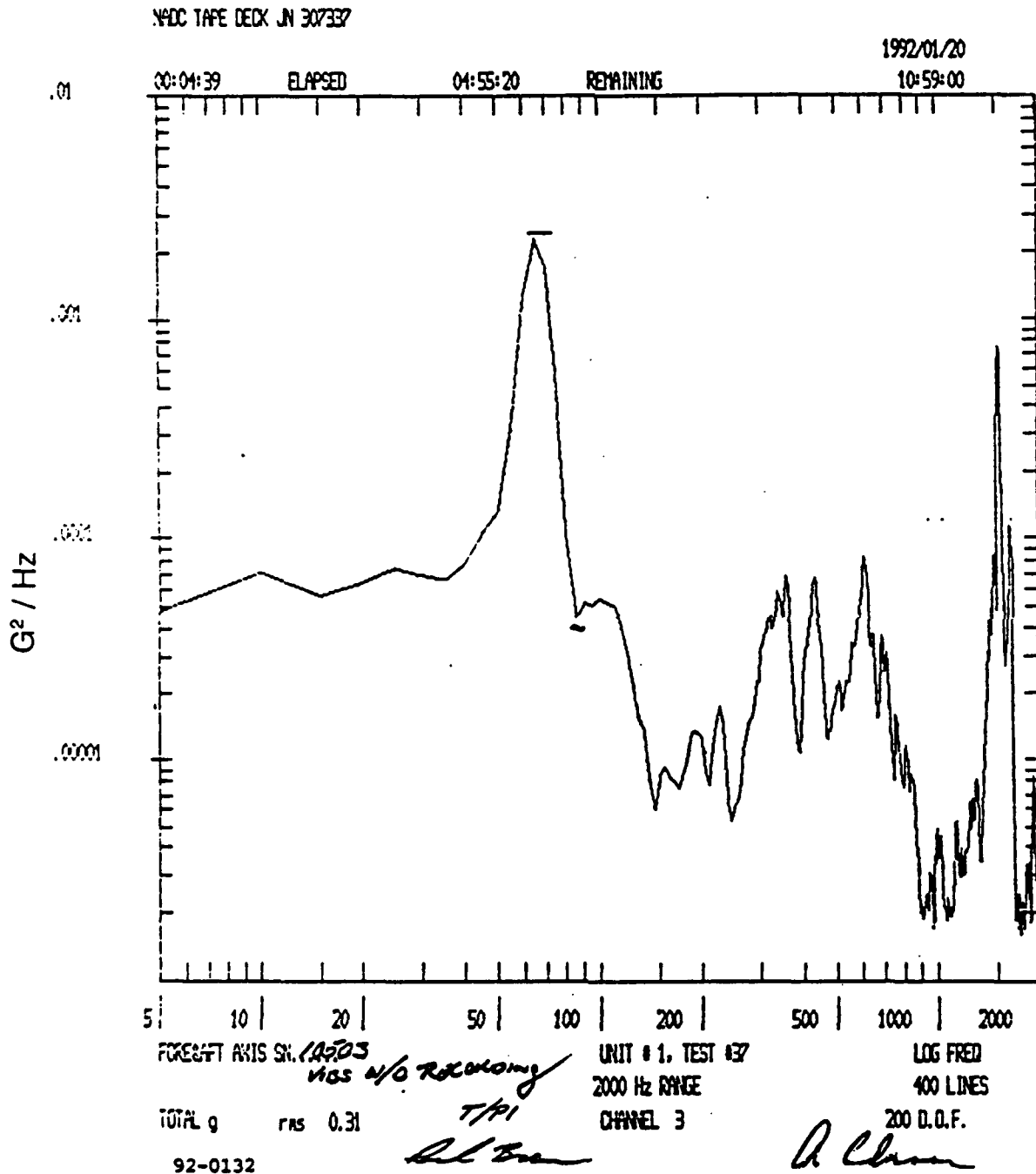


Figure B-3.

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BIT ERROR RATE TEST FOR 45 PLAYBACK Mode
Date 20 January 1992 Start Time 10:55:26 Finish Time 11:06:01
Channel Rate - 32Mbps Error Correction ON
REPLAY OF F/A BASELINE RECORDING 0.23 Grms
Tape Manufacturer No. B0_23X45CP

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
12463 1	0.00-7	18570 1	0.00-7	24676 1	0.00-7
13335 1	0.00-7	19442 1	0.00-7	25548 1	0.00-7
14208 1	0.00-7	20314 1	0.00-7	26421 1	0.00-7
15080 1	0.00-7	21187 1	0.00-7	27293 1	0.00-7
15952 1	0.00-7	22059 1	0.00-7	28165 1	0.00-7
16825 1	0.00-7	22931 1	0.00-7	29038 1	0.00-7
17697 1	0.00-7	23804 1	0.00-7		

TEST PERAMETERS

Vibration: (Boeing Profile) 0.23 Grms (Target) 0.31 (Actual)
ECC ON (FORE/AFT) 32 Mbps Tape #45 Replay of B0X45CR

Tape Stopped at 29054 count	Total Errors = 0
No. of Sampes = 20	Average Ber/Sample = 0.00E+00
No. of Non-zero Samples = 0	No. of Overflows = 0

Figure B-4.

NAWCADWAR-92019-50

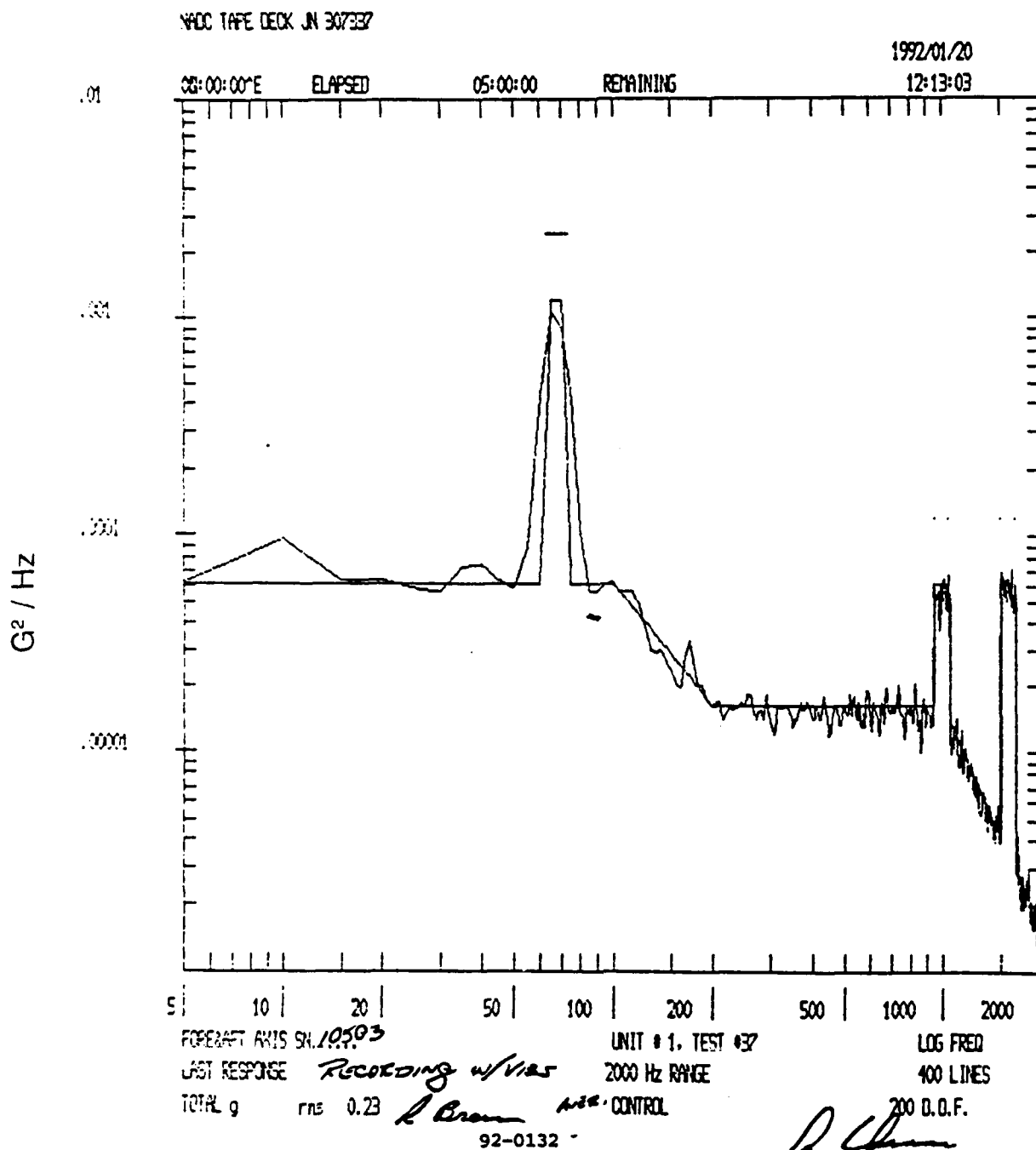


Figure B-5.

NAWCADWAR-92019-50

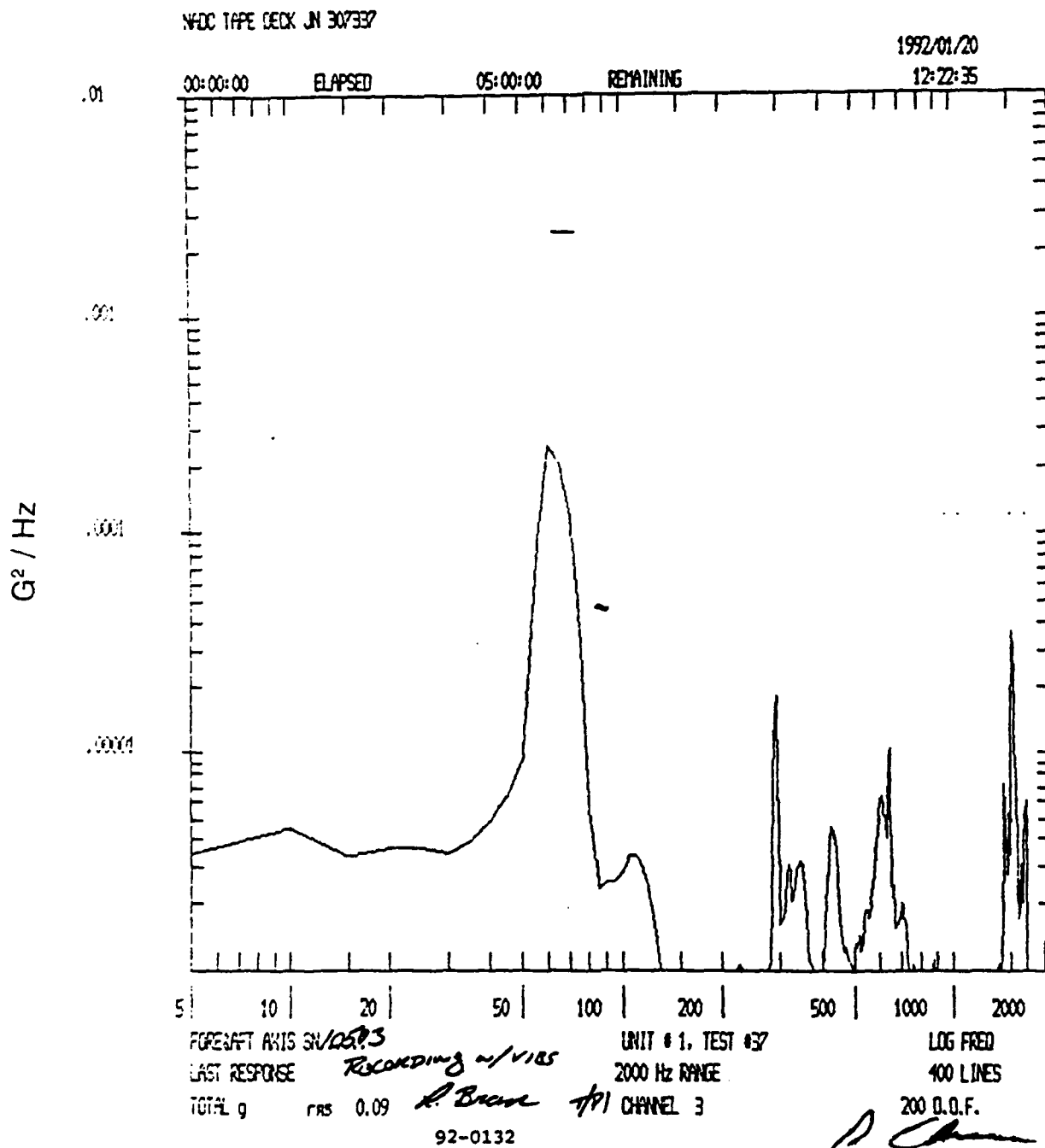


Figure B-6.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 45 RECORD Mode
 Date 20 January 1992 Start Time 11:19:08 Finish Time 12:09:35
 Channel Rate - 32Mbps Error Correction ON
 RECORD W/VIBRATION (0.23 Grms) F/A
 Tape Manufacturer No. B0_23X45CR

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
874	1 0.00-7	28789	1 0.00-7	56705	1 0.00-7
1746	1 0.00-7	29662	1 0.00-7	57577	1 0.00-7
2619	1 0.00-7	30534	1 0.00-7	58449	1 0.00-7
3491	1 0.00-7	31406	1 0.00-7	59322	1 0.00-7
4363	1 0.00-7	32279	1 0.00-7	60194	1 0.00-7
5236	1 0.00-7	33151	1 0.00-7	61066	1 0.00-7
6108	1 0.00-7	34023	1 0.00-7	61939	1 0.00-7
6980	1 0.00-7	34896	1 0.00-7	62811	1 0.00-7
7853	1 0.00-7	35768	1 0.00-7	63683	1 0.00-7
8725	1 0.00-7	36640	1 0.00-7	64556	1 0.00-7
9597	1 0.00-7	37513	1 0.00-7	65428	1 0.00-7
10470	1 0.00-7	38385	1 0.00-7	66301	1 0.00-7
11342	1 0.00-7	39258	1 0.00-7	67173	1 0.00-7
12215	1 0.00-7	40130	1 0.00-7	68045	1 0.00-7
13087	1 0.00-7	41002	1 0.00-7	68918	1 0.00-7
13959	1 0.00-7	41875	1 0.00-7	69790	1 0.00-7
14832	1 0.00-7	42747	1 0.00-7	70662	1 0.00-7
15704	1 0.00-7	43619	1 0.00-7	71535	1 0.00-7
16576	1 0.00-7	44492	1 0.00-7	72407	1 0.00-7
17449	1 0.00-7	45364	1 0.00-7	73279	1 0.00-7
18321	1 0.00-7	46236	1 0.00-7	74152	1 0.00-7
19193	1 0.00-7	47109	1 0.00-7	75024	1 0.00-7
20066	1 0.00-7	47981	1 0.00-7	75896	1 0.00-7
20938	1 0.00-7	48853	1 0.00-7	76769	1 0.00-7
21810	1 0.00-7	49726	1 0.00-7	77641	1 0.00-7
22683	1 0.00-7	50598	1 0.00-7	78514	1 0.00-7
23555	1 0.00-7	51470	1 0.00-7	79386	1 0.00-7
24427	1 0.00-7	52343	1 0.00-7	80258	1 0.00-7
25300	1 0.00-7	53215	1 0.00-7	81131	1 0.00-7
26172	1 0.00-7	54088	1 0.00-7	82003	1 0.00-7
27045	1 0.00-7	54960	1 0.00-7	82875	1 0.00-7
27917	1 0.00-7	55832	1 0.00-7	83748	1 0.00-7

TEST PERAMETERS

Boeing Profile (0.23 Grms Target)
 32 Mbps Tape #45

ECC ON FORE/AFT (F/A)
 Record Under Vibration

Tape Stopped at 83773 count
 No. of Sampes = 96

Total Errors = 211
 Average Ber/Sample = 2.20E-09

Figure B-7.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 45 PLAYBACK Mode
 Date 20 January 1992 Start Time 12:15:29 Finish Time 13:06:30
 Channel Rate - 32Mbps Error Correction ON
 REPLAY OF B0_23X45CR (NO VIBE) Tape Manufacturer No. B0X45CP

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
1424	1 0.00-7	29339	1 0.00-7	57255	1 0.00-7
2296	1 0.00-7	30212	1 0.00-7	58127	1 0.00-7
3169	1 0.00-7	31084	1 0.00-7	58999	1 0.00-7
4041	1 0.00-7	31956	1 0.00-7	59872	1 0.00-7
4913	1 0.00-7	32839	1 0.00-7	60744	1 0.00-7
5786	1 0.00-7	33701	1 0.00-7	61616	1 0.00-7
6658	1 0.00-7	34573	1 0.00-7	62489	1 0.00-7
7530	1 0.00-7	35446	1 0.00-7	63361	1 0.00-7
8403	1 0.00-7	36318	1 0.00-7	64234	1 0.00-7
9275	1 0.00-7	37191	1 0.00-7	65106	1 0.00-7
10148	1 0.00-7	38063	1 0.00-7	65978	1 0.00-7
11020	1 0.00-7	38935	1 0.00-7	66851	1 0.00-7
11892	1 0.00-7	39808	1 0.00-7	67723	1 0.00-7
12765	1 0.00-7	40680	1 0.00-7	68595	1 0.00-7
13637	1 0.00-7	41552	1 0.00-7	69468	1 0.00-7
14509	1 0.00-7	42425	1 0.00-7	70340	1 0.00-7
15382	1 0.00-7	43297	1 0.00-7	71212	1 0.00-7
16254	1 0.00-7	44169	1 0.00-7	72085	1 0.00-7
17126	1 0.00-7	45042	1 0.00-7	72957	1 0.00-7
17999	1 0.00-7	45914	1 0.00-7	73829	1 0.00-7
18871	1 0.00-7	46786	1 0.00-7	74702	1 0.00-7
19743	1 0.00-7	47659	1 0.00-7	75574	1 0.00-7
20616	1 0.00-7	48531	1 0.00-7	76447	1 0.00-7
21488	1 0.00-7	49404	1 0.00-7	77319	1 0.00-7
22361	1 0.00-7	50276	1 0.00-7	78191	1 0.00-7
23233	1 0.00-7	51148	1 0.00-7	79064	1 0.00-7
24105	1 0.00-7	52021	1 0.00-7	79936	1 0.00-7
24978	1 0.00-7	52893	1 0.00-7	80808	1 0.00-7
25850	1 0.00-7	53765	1 0.00-7	81681	1 0.00-7
26722	1 0.00-7	54638	1 0.00-7	82553	1 0.00-7
27595	1 0.00-7	55510	1 0.00-7	83425	1 0.00-7
28467	1 0.00-7	56382	1 0.00-7		

TEST PERAMETERS

Replay of B0_23X45CR
 32 Mbps Tape #45

ECC ON FORE/AFT (= 0 Grms)
 No Vibration

Tape Stopped at 83773 count
 No. of Sampes = 95

Total Errors = 0
 Average Ber/Sample = 0.00E+00

Figure B-8.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 44 RECORD Mode
 Date 20 January 1992 Start Time 14:30:43 Finish Time 15:02:50
 Channel Rate - 32Mbps Error Correction ON
 BASELINE RECORD SIDE TO SIDE Tape Manufacturer No. B0Y44CR

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
3549	1 +6.67-7	27976	1 0.00-7	52401	1 0.00-7
4422	1 0.00-7	28848	1 0.00-7	53274	1 0.00-7
5294	1 0.00-7	29720	1 0.00-7		
6167	1 0.00-7	30593	1 0.00-7		
7039	1 0.00-7	31465	1 0.00-7		
7911	1 0.00-7	32327	1 0.00-7		
8784	1 0.00-7	33210	1 0.00-7		
9656	1 0.00-7	34082	1 0.00-7		
10528	1 0.00-7	34954	1 0.00-7		
11401	1 0.00-7	35827	1 0.00-7		
12273	1 0.00-7	36699	1 0.00-7		
13146	1 0.00-7	37571	1 0.00-7		
14018	1 0.00-7	38444	1 0.00-7		
14890	1 0.00-7	39316	1 0.00-7		
15763	1 0.00-7	40189	1 0.00-7		
16635	1 0.00-7	41061	1 0.00-7		
17507	1 0.00-7	41933	1 0.00-7		
18380	1 0.00-7	42806	1 0.00-7		
19252	1 0.00-7	43678	1 0.00-7		
20124	1 0.00-7	44550	1 0.00-7		
20997	1 0.00-7	45423	1 0.00-7		
21869	1 0.00-7	46295	1 0.00-7		
22741	1 0.00-7	47167	1 0.00-7		
13614	1 0.00-7	48040	1 0.00-7		
24486	1 0.00-7	48912	1 0.00-7		
25358	1 0.00-7	49784	1 0.00-7		
26231	1 0.00-7	50657	1 0.00-7		
27103	1 0.00-7	51529	1 0.00-7		

TEST PERAMETERS

New Recording: B0Y44CR No Vibration (Baseline Side to Side)
 ECC ON "Side to Side" = Y axis 32 Mbps Tape #44

Tape Stopped at 53298 count Total Errors = 0
 No. of Sampes = 58 Average Ber/Sample = 0.00E+00

Figure B-9.

NAWCADWAR-92019-50

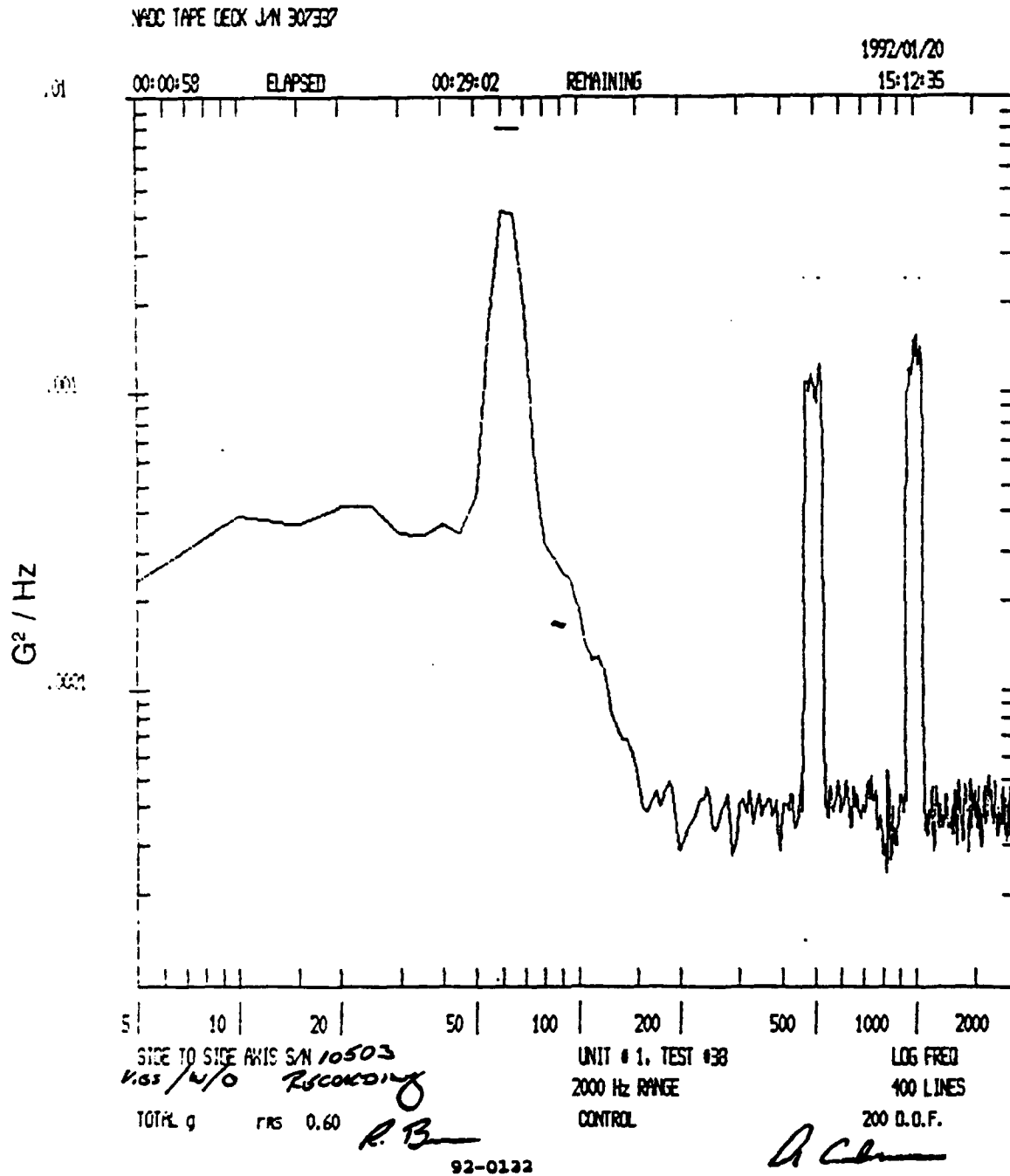


Figure B-10.

NAWCADWAR-92019-50

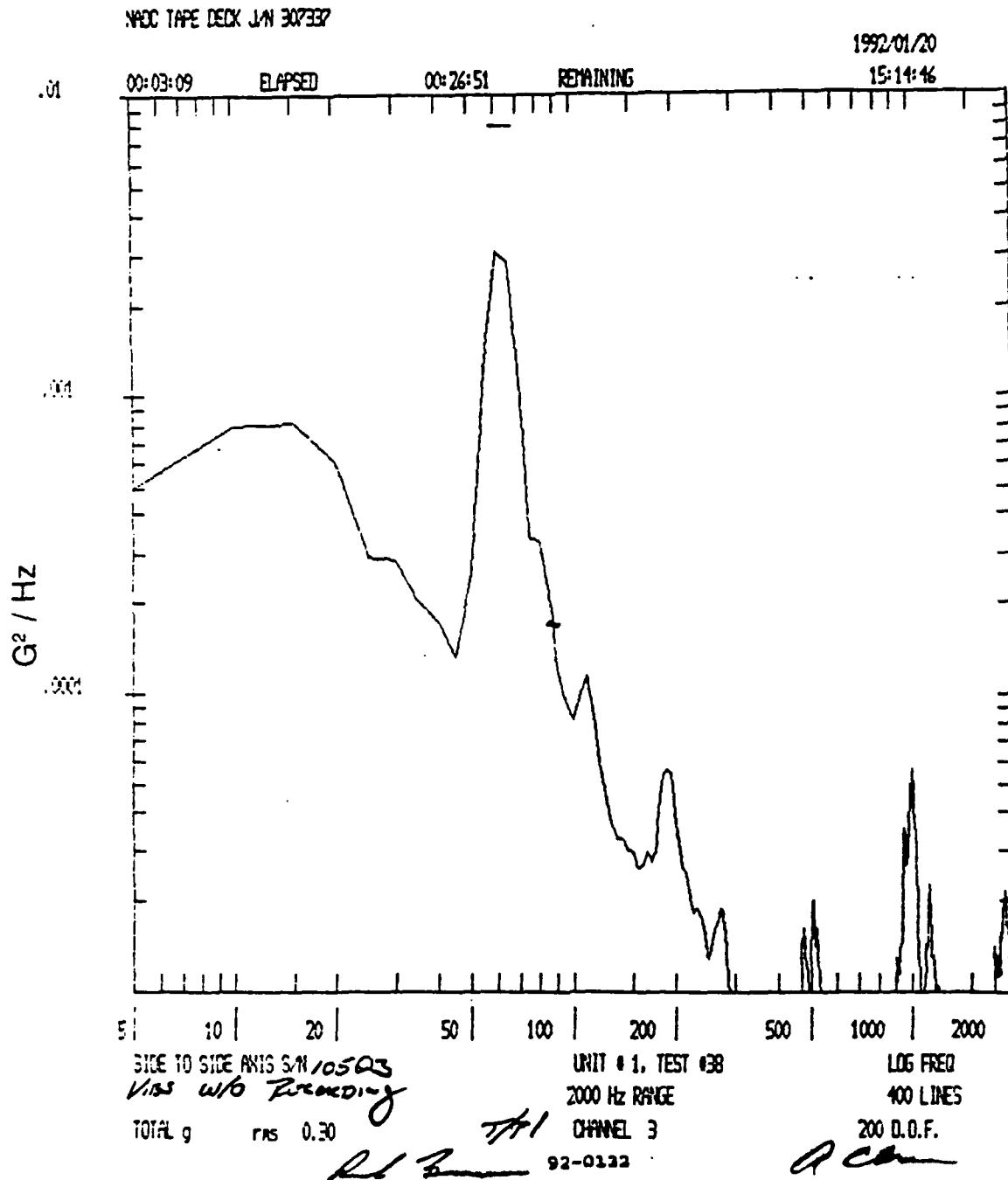


Figure B-11.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 44 PLAYBACK Mode
Date 20 January 1992 Start Time 15:11:58 Finish Time 15:22:30
Channel Rate - 32Mbps Error Correction ON
REPLAY OF S TO S AXIS WITH VIBE
Tape Manufacturer No. B0_23Y44CP

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
13568	1 0.00-7	19675	1 0.00-7	25781	1 0.00-7
14440	1 0.00-7	20547	1 0.00-7	26653	1 0.00-7
15313	1 0.00-7	21419	1 0.00-7	27526	1 0.00-7
16185	1 0.00-7	22292	1 0.00-7	28398	1 0.00-7
17058	1 0.00-7	23164	1 0.00-7	29270	1 0.00-7
17930	1 0.00-7	24036	1 0.00-7	30143	1 0.00-7
18802	1 0.00-7	24909	1 0.00-7		

TEST PERAMETERS

Replay of ⑤ B0Y44CR Vibration: Side to Side (Boeing Profile) 0.58Grms
ECC ON 32 Mbps Tape #44

Tape Stopped at 30160 count

No. of Sampes = 20

No. of Non-zero Samples = 0

Total Errors = 0

Average Ber/Sample = 0.00E+00

No. of Overflows = 0

Figure B-12.

NAWCADWAR-92019-50

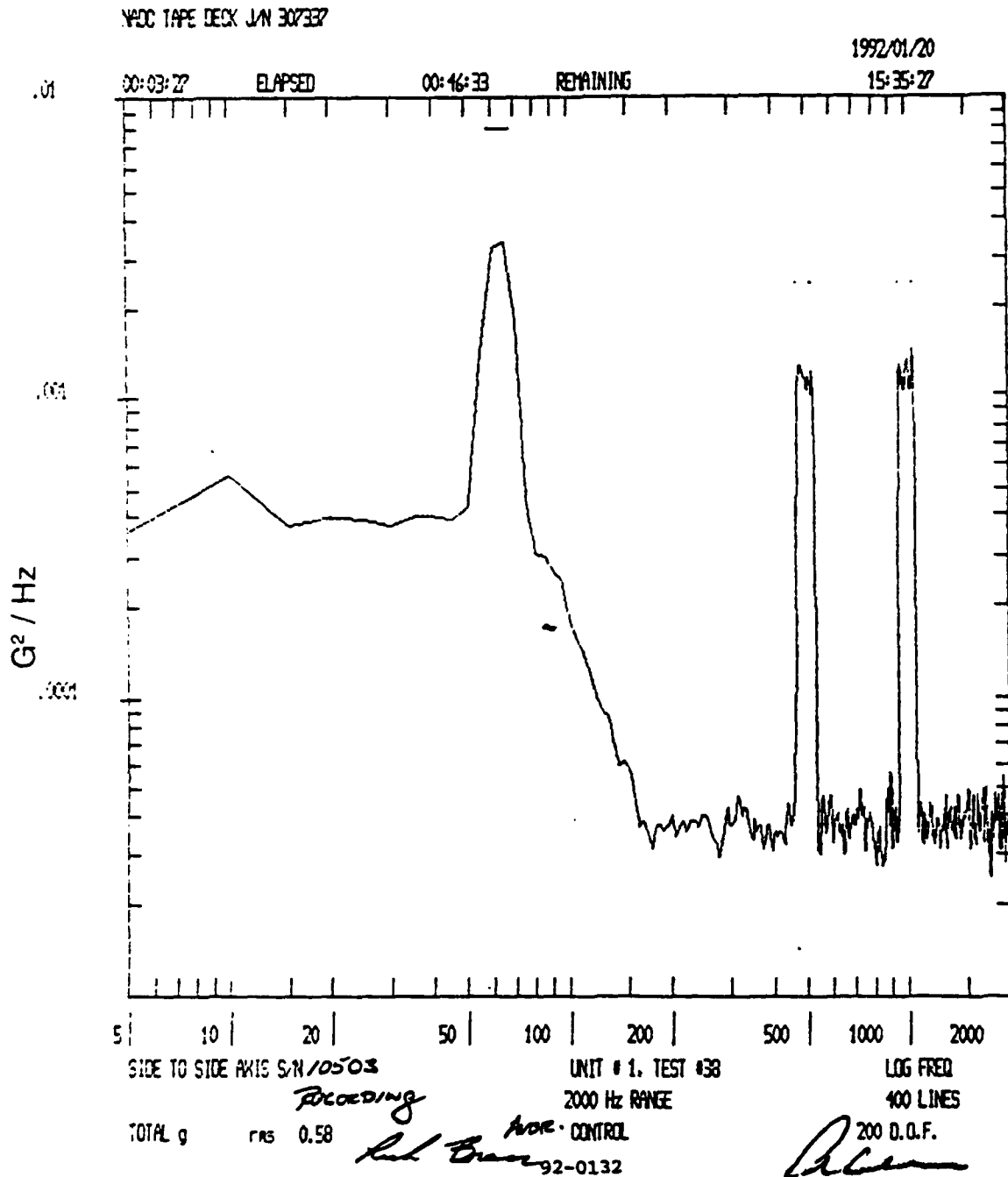


Figure B-13.

NAWCADWAR-92019-50

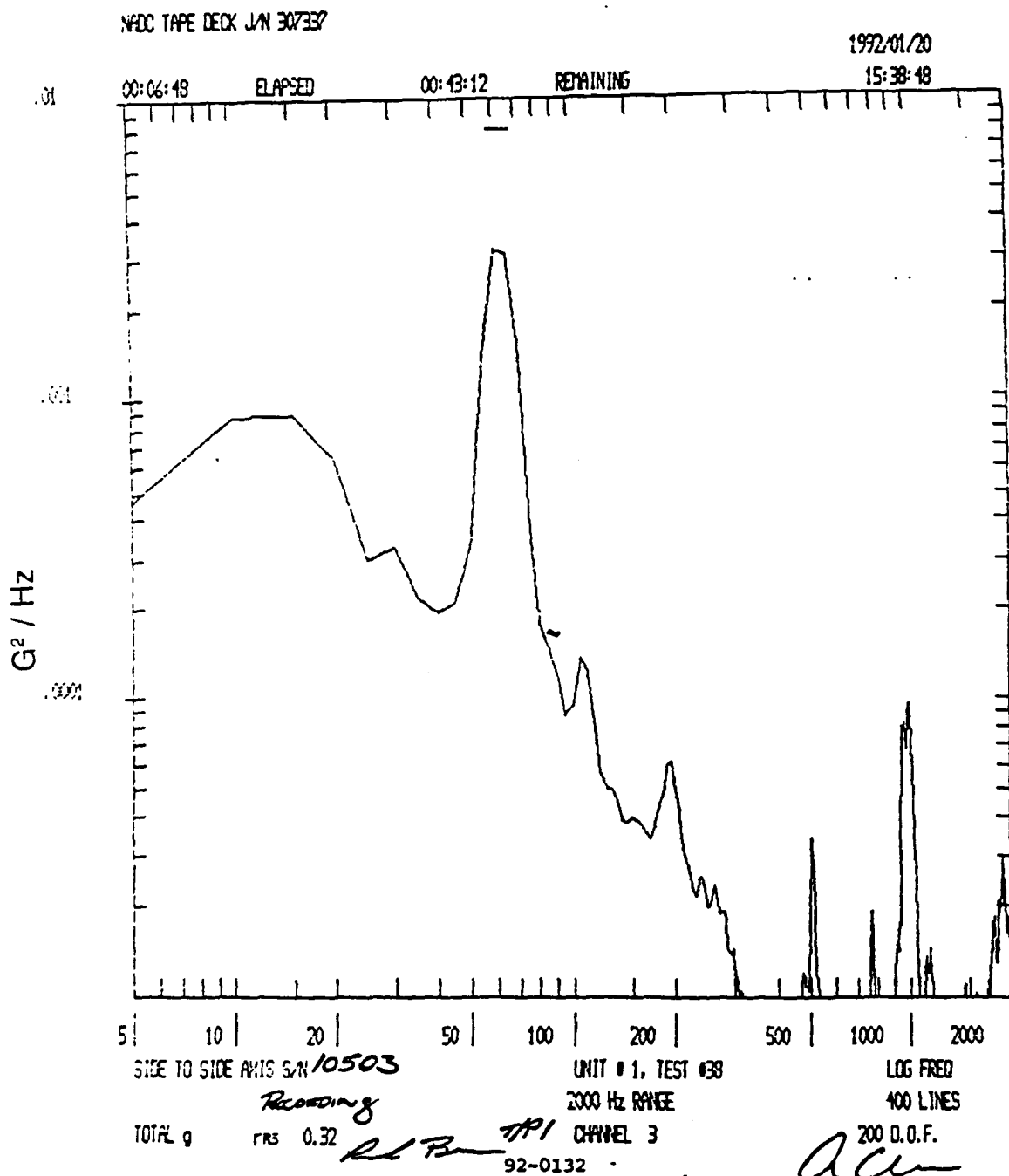


Figure B-14.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 44 RECORD Mode
 Date 20 January 1992 Start Time 15:33:15 Finish Time 16:23:42
 Channel Rate - 32Mbps Error Correction ON
 RECORD UNDER VIBE (Side to Side Boeing) Tape Manufacturer No. B0_23Y44CR

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
875	1 0.00-7	28790	1 0.00-7	56706	1 0.00-7
1747	1 0.00-7	29663	1 0.00-7	57578	1 0.00-7
2620	1 0.00-7	30535	1 0.00-7	58451	1 0.00-7
3492	1 0.00-7	31407	1 0.00-7	59323	1 0.00-7
4364	1 0.00-7	32280	1 0.00-7	60195	1 0.00-7
5237	1 0.00-7	33152	1 0.00-7	61068	1 0.00-7
6109	1 0.00-7	34025	1 0.00-7	61940	1 0.00-7
6982	1 0.00-7	34897	1 0.00-7	62812	1 0.00-7
7854	1 0.00-7	35769	1 0.00-7	63685	1 0.00-7
8726	1 0.00-7	36642	1 0.00-7	64557	1 0.00-7
9599	1 0.00-7	37514	1 0.00-7	65429	1 0.00-7
10471	1 0.00-7	38386	1 0.00-7	66302	1 0.00-7
11343	1 0.00-7	39259	1 0.00-7	67174	1 0.00-7
12216	1 0.00-7	40131	1 0.00-7	68046	1 0.00-7
13088	1 0.00-7	41003	1 0.00-7	68919	1 0.00-7
13960	1 0.00-7	41876	1 0.00-7	69791	1 0.00-7
14833	1 0.00-7	42748	1 0.00-7	70663	1 0.00-7
15705	1 0.00-7	43620	1 0.00-7	71536	1 0.00-7
16577	1 0.00-7	44493	1 0.00-7	72408	1 0.00-7
17450	1 0.00-7	45365	1 0.00-7	73281	1 0.00-7
18322	1 0.00-7	46238	1 0.00-7	74153	1 0.00-7
19195	1 0.00-7	47110	1 0.00-7	75025	1 0.00-7
20067	1 0.00-7	47982	1 0.00-7	75898	1 0.00 7
20939	1 0.00-7	48855	1 0.00-7	76770	1 0.00-7
21812	1 0.00-7	49727	1 0.00-7	77642	1 0.00-7
22684	1 0.00-7	50599	1 0.00-7	78515	1 0.00-7
23556	1 0.00-7	51472	1 0.00-7	79387	1 0.00-7
24429	1 0.00-7	52344	1 0.00-7	80259	1 0.00-7
25301	1 0.00-7	53216	1 0.00-7	81132	1 0.00-7
26173	1 0.00-7	54089	1 0.00-7	82004	1 0.00-7
27046	1 0.00-7	54961	1 0.00-7	82876	1 0.00-7
27918	1 0.00-7	55833	1 0.00-7	83749	1 0.00-7

TEST PERAMETERS

Vibration: Boeing Profile 0.59 Grms (Target) Y axis (Side to Side)

Record (R.A.W.) ECC ON Tape #44 32 Mbps

Tape Stopped at 83774 count

Total Errors = 0

No. of Samps = 96

Average Ber/Sample = 0.00E+00

Figure B-15.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 44 PLAYBACK Mode

Date 20 January 1992 Start Time 16:27:17 Finish Time 17:17:42

Channel Rate - 32Mbps Error Correction ON

REPLAY OF B0_23Y44CR, NO VIBE Tape Manufacturer No. B0Y44CP

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
1166	1 0.00-7	29081	1 0.00-7	56997	1 0.00-7
2038	1 0.00-7	29954	1 0.00-7	57869	1 0.00-7
2911	1 0.00-7	30826	1 0.00-7	58741	1 0.00-7
3783	1 0.00-7	31698	1 0.00-7	59614	1 0.00-7
4655	1 0.00-7	32571	1 0.00-7	60486	1 0.00-7
5528	1 0.00-7	33443	1 0.00-7	61358	1 0.00-7
6400	1 0.00-7	34315	1 0.00-7	62231	1 0.00-7
7272	1 0.00-7	35188	1 0.00-7	63103	1 0.00-7
8145	1 0.00-7	36060	1 0.00-7	63975	1 0.00-7
9017	1 0.00-7	36932	1 0.00-7	64848	1 0.00-7
9889	1 0.00-7	37805	1 0.00-7	65720	1 0.00-7
10762	1 0.00-7	38677	1 0.00-7	66593	1 0.00-7
11634	1 0.00-7	39550	1 0.00-7	67465	1 0.00-7
12506	1 0.00-7	40422	1 0.00-7	68337	1 0.00-7
13379	1 0.00-7	41294	1 0.00-7	69210	1 0.00-7
14251	1 0.00-7	42167	1 0.00-7	70082	1 0.00-7
15124	1 0.00-7	43039	1 0.00-7	70954	1 0.00-7
15996	1 0.00-7	43911	1 0.00-7	71827	1 0.00-7
16868	1 0.00-7	44784	1 0.00-7	72699	1 0.00-7
17741	1 0.00-7	45656	1 0.00-7	73571	1 0.00-7
18613	1 0.00-7	46528	1 0.00-7	74444	1 0.00-7
19485	1 0.00-7	47401	1 0.00-7	75316	1 0.00-7
20358	1 0.00-7	48273	1 0.00-7	76188	1 0.00-7
21230	1 0.00-7	49145	1 0.00-7	77061	1 0.00-7
22102	1 0.00-7	50018	1 0.00-7	77933	1 0.00-7
22975	1 0.00-7	50890	1 0.00-7	78806	1 0.00-7
23847	1 0.00-7	51762	1 0.00-7	79678	1 0.00-7
24719	1 0.00-7	52635	1 0.00-7	80550	1 0.00-7
25592	1 0.00-7	53507	1 0.00-7	81423	1 0.00-7
26464	1 0.00-7	54380	1 0.00-7	82295	1 0.00-7
27337	1 0.00-7	55252	1 0.00-7	83167	1 0.00-7
28209	1 0.00-7	56124	1 0.00-7		

TEST PERAMETERS

Boeing Profile 0.00 Grms (Target) Y axis (Side to Side)

Replay, No Vibration ECC ON Tape #44

Tape Stopped at 83774 count

Total Errors = 0

No. of Sampes = 95

Average Ber/Sample = 0.00E+00

Figure B-16.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 43 RECORD Mode
 Date 21 January 1992 Start Time 08:58:19 Finish Time 09:28:54
 Channel Rate - 32Mbps Error Correction ON
 BASELINE RECORD Z axis Tape Manufacturer No. B043CR

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
1007	1 0.00-7	18454	1 0.00-7	35902	1 0.00-7
1879	1 0.00-7	19327	1 0.00-7	36774	1 0.00-7
2752	1 0.00-7	20199	1 0.00-7	37646	1 0.00-7
3624	1 0.00-7	21071	1 0.00-7	38519	1 0.00-7
4497	1 0.00-7	21944	1 0.00-7	39391	1 0.00-7
5369	1 0.00-7	22816	1 0.00-7	40263	1 0.00-7
6241	1 0.00-7	23689	1 0.00-7	41136	1 0.00-7
7114	1 0.00-7	24561	1 0.00-7	42008	1 0.00-7
7986	1 0.00-7	25433	1 0.00-7	42880	1 0.00-7
8858	1 0.00-7	26306	1 0.00-7	43753	1 0.00-7
9731	1 0.00-7	27178	1 0.00-7	44625	1 0.00-7
10603	1 0.00-7	28050	1 0.00-7	45498	1 0.00-7
11475	1 0.00-7	28923	1 0.00-7	46370	1 0.00-7
12348	1 0.00-7	29795	1 0.00-7	47242	1 0.00-7
13220	1 0.00-7	30667	1 0.00-7	48115	1 0.00-7
14092	1 0.00-7	31540	1 0.00-7	48987	1 0.00-7
14965	1 0.00-7	32412	1 0.00-7	49859	1 0.00-7
15837	1 0.00-7	33285	1 0.00-7	50732	1 0.00-7
16710	1 0.00-7	34157	1 0.00-7		
17582	1 0.00-7	35029	1 0.00-7		

TEST PERAMETERS

No Vibration Z axis Record (R.A.W.)
 ECC ON Tape #43

Tape Stopped at 50756 count
 No. of Sampes = 58

Total Errors = 0
 Average Ber/Sample = 0.00E+00

Figure B-17.

NAWCADWAR-92019-50

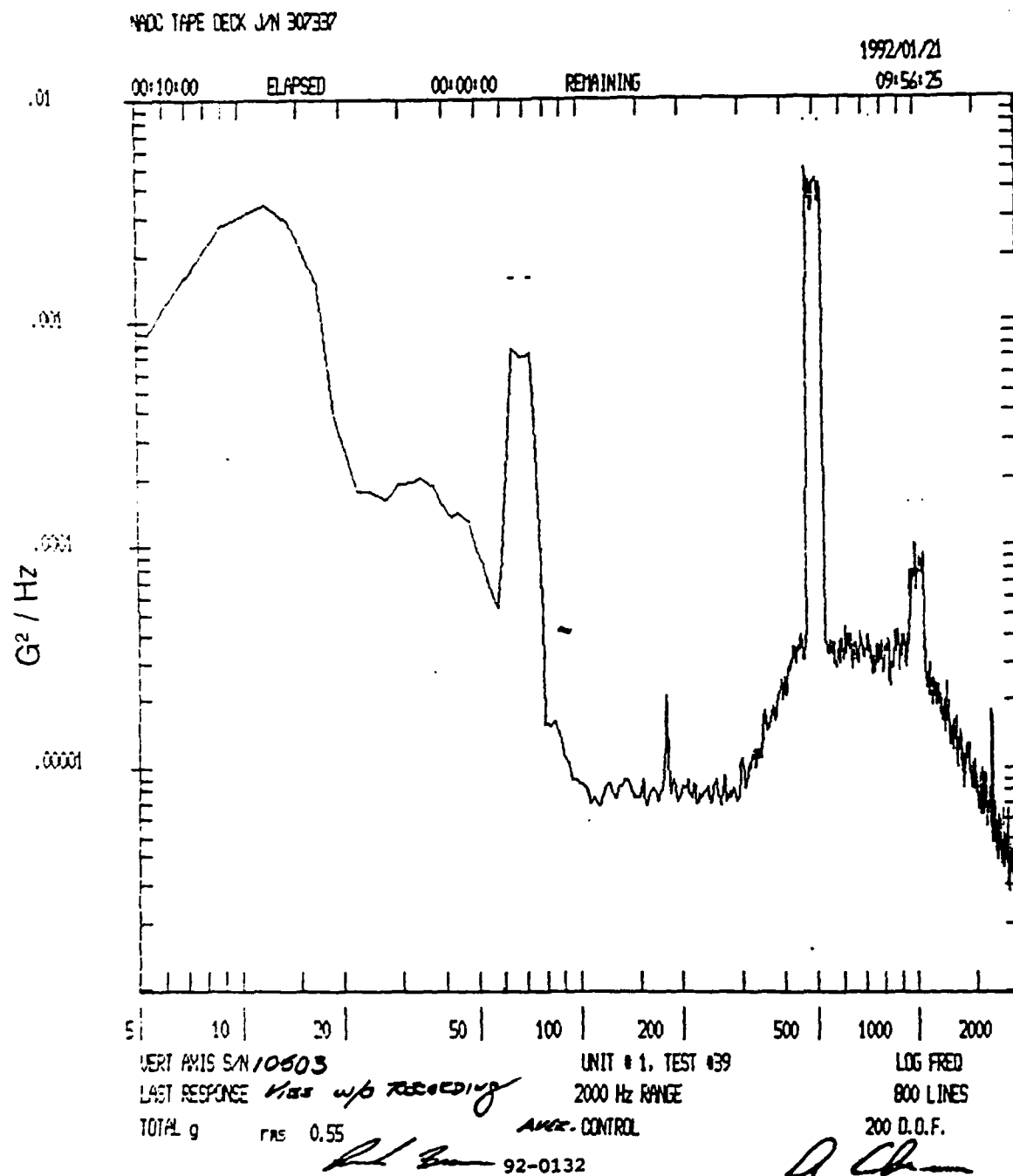


Figure B-18.

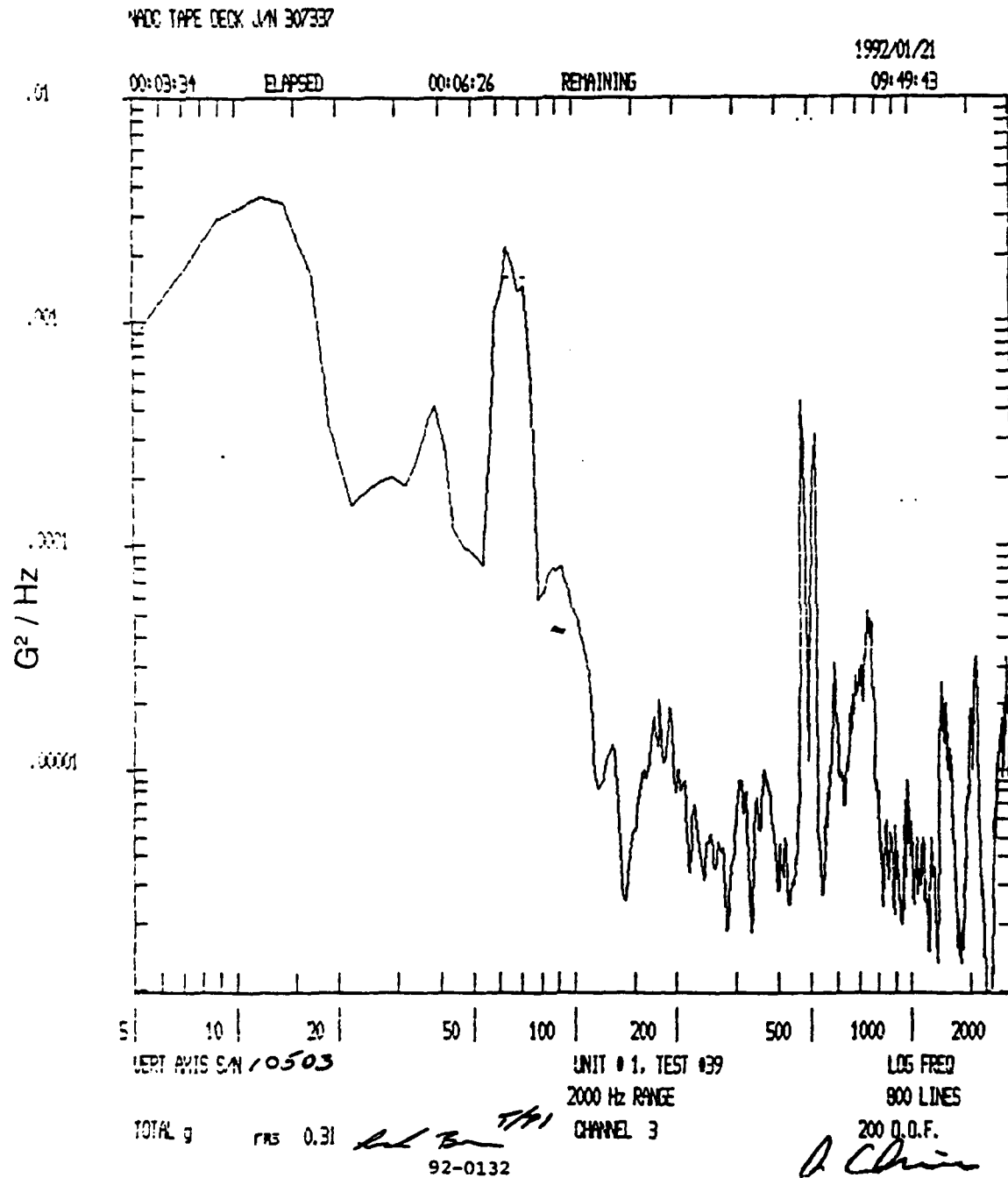


Figure B-19.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 43 PLAYBACK Mode
Date 21 January 1992 Start Time 09:47:43 Finish Time 09:58:20
Channel Rate - 32Mbps Error Correction ON
REPLAY BASELINE, Z AXIS W/VIBE Tape Manufacturer No. B0_23Z43CP

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
3587	1 0.00-7	9694	1 0.00-7	15800	1 0.00-7
4460	1 0.00-7	10566	1 0.00-7	16673	1 0.00-7
5332	1 0.00-7	11439	1 0.00-7	17545	1 0.00-7
6205	1 0.00-7	12311	1 0.00-7	18417	1 0.00-7
7077	1 0.00-7	13183	1 0.00-7	19290	1 0.00-7
7949	1 0.00-7	14056	1 0.00-7	20162	1 0.00-7
8322	1 0.00-7	14928	1 0.00-7		

TEST PERAMETERS

Replay of B0Z43CR Boeing Profile, Z-axis, 0.54 Grms
ECC ON 32Mbps Tape #43

Tape Stopped at 20179 count	Total Errors = 0
No. of Sampes = 20	Average Ber/Sample = 0.00E+00
No. of Non-zero Samples = 0	No. of Overflows = 0

Figure B-20.

NAWCADWAR-92019-50

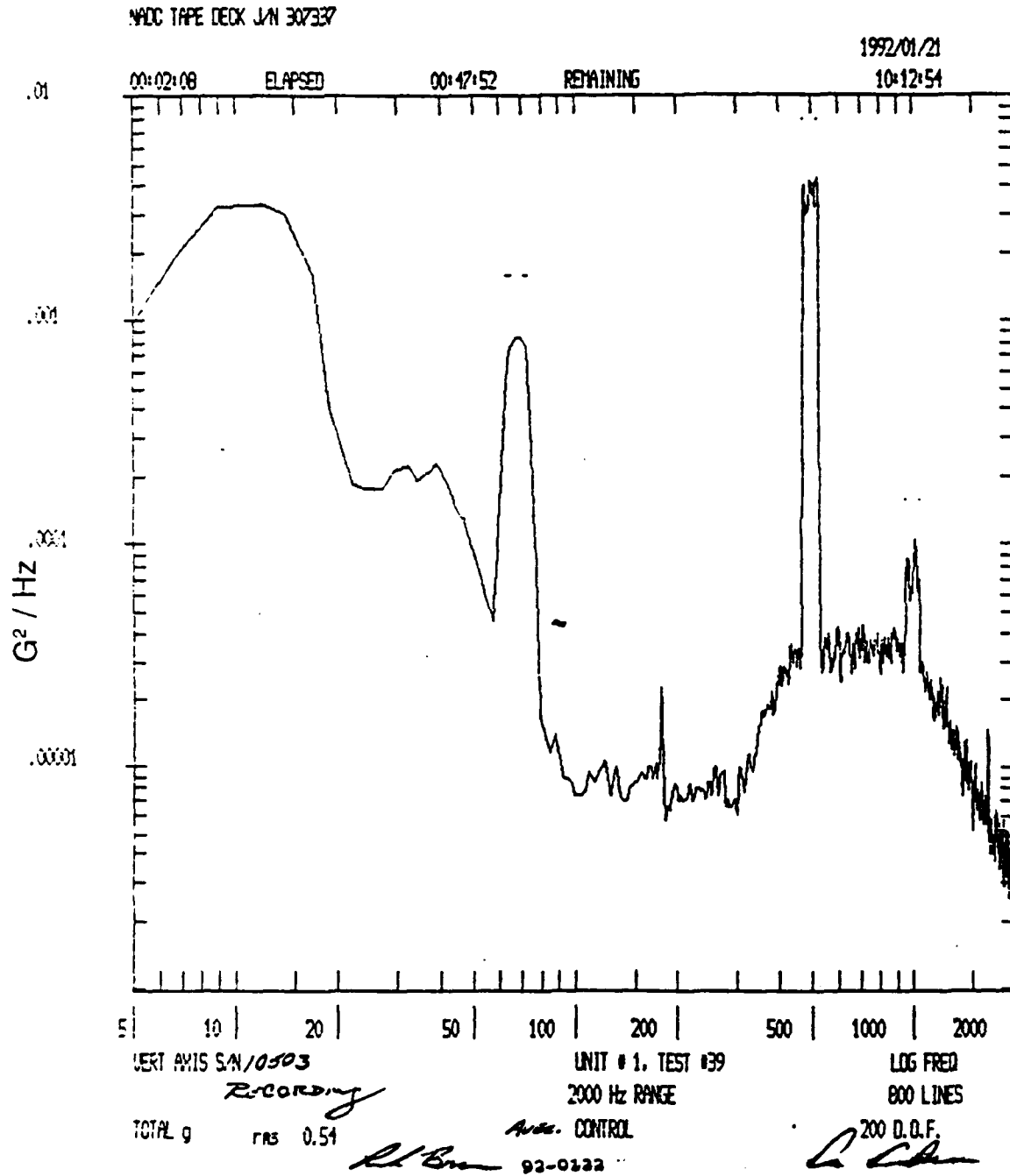


Figure B-21.

NAWCADWAR-92019-50

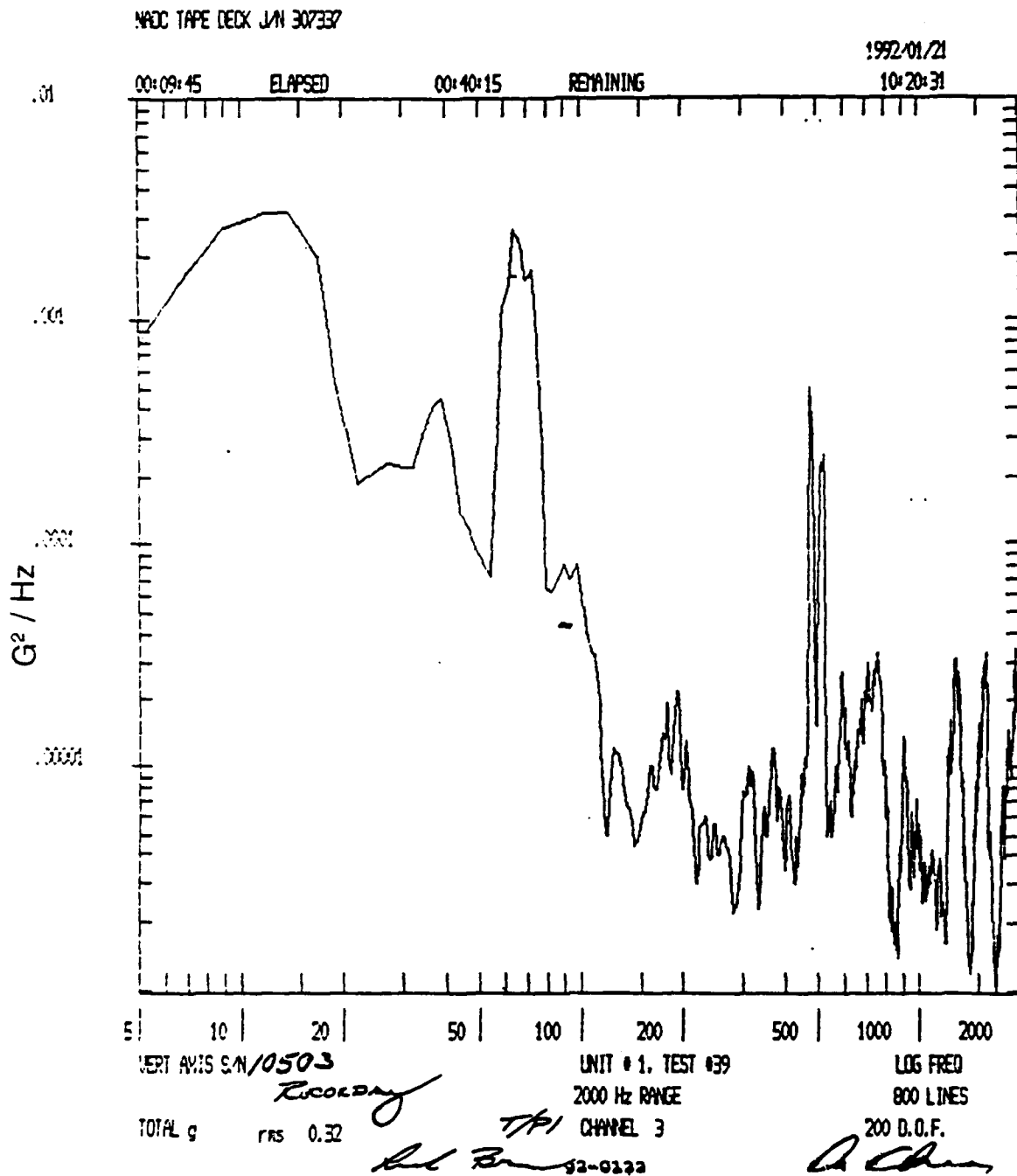


Figure B-22.

NAWCADWAR-92019-50

```

      BIT ERROR RATE TEST FOR 43      RECORD Mode
Date 21 January 1992      Start Time 10:12:22      Finish Time 10:48:07
Channel Rate - 32Mbps      Error Correction ON
RECORD W/VIBRATION Z AXIS      Tape Manufacturer No. B0_23Z43CR

```

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
874	1	3.87-7	24428	1	0.00-7
1746	1	0.00-7	25300	1	0.00-7
2619	1	0.00-7	26172	1	0.00-7
3491	1	0.00-7	27045	1	0.00-7
4363	1	0.00-7	27917	1	0.00-7
5236	1	0.00-7	28789	1	0.00-7
6108	1	0.00-7	29662	1	0.00-7
6980	1	0.00-7	30534	1	0.00-7
7853	1	0.00-7	31406	1	0.00-7
8725	1	0.00-7	32279	1	0.00-7
9597	1	0.00-7	33151	1	0.00-7
10470	1	0.00-7	34023	1	0.00-7
11342	1	0.00-7	34896	1	0.00-7
12215	1	0.00-7	35768	1	0.00-7
13087	1	0.00-7	36640	1	0.00-7
13959	1	0.00-7	37513	1	0.00-7
14832	1	0.00-7	38385	1	0.00-7
15704	1	0.00-7	39258	1	0.00-7
16576	1	0.00-7	40130	1	0.00-7
17449	1	0.00-7	41002	1	0.00-7
18321	1	0.00-7	41875	1	0.00-7
19193	1	0.00-7	42747	1	0.00-7
20066	1	0.00-7	43619	1	0.00-7
20938	1	0.00-7	44492	1	0.00-7
21810	1	0.00-7	45364	1	0.00-7
22683	1	0.00-7	46236	1	0.00-7
23555	1	0.00-7	47109	1	0.00-7
47981	1	0.00-7	48853	1	0.00-7
49726	1	0.00-7	50598	1	0.00-7
51471	1	0.00-7	52343	1	0.00-7
53215	1	0.00-7	54088	1	0.00-7
54960	1	0.00-7	55832	1	0.00-7
56705	1	0.00-7	57577	1	0.00-7
58449	1	0.00-7	59322	1	0.00-7
AT THIS POINT, TEST ABORTED. RESTARTED WITH ECC OFF					

AT THIS POINT,
TEST ABORTED.
RESTARTED WITH
ECC OFF

TEST PARAMETERS

Boeing Profile Z axis, 0.54 Grms
RECORD (R.A.W.) ECC ON 32Mbps

Tape Stopped at 59353 count
No. of Sampes = 68
No. of Non-zero Samples = 1

Total Errors = 387
Average Ber/Sample = 5.69E-09
No. of Overflows = 0

Figure B-23.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 43 PLAYBACK Mode
 Date 21 January 1992 Start Time 11:13:51 Finish Time 11:49:45
 Channel Rate - 32Mbps Error Correction ON
 REPLAY OF B0_23Z43CR, NO VIBE Tape Manufacturer No. B0Z43CP

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
1427	1 0.00-7	25853	1 0.00-7	50279	1 0.00-7
2299	1 0.00-7	26725	1 0.00-7	51151	1 0.00-7
3172	1 0.00-7	27598	1 0.00-7	52024	1 0.00-7
4044	1 0.00-7	28470	1 0.00-7	52896	1 0.00-7
4916	1 0.00-7	29342	1 0.00-7	53768	1 0.00-7
5789	1 0.00-7	30215	1 0.00-7	54641	1 0.00-7
6661	1 0.00-7	31087	1 0.00-7	55513	1 0.00-7
7533	1 0.00-7	31959	1 0.00-7	56385	1 0.00-7
8406	1 0.00-7	32832	1 0.00-7	57258	1 0.00-7
9278	1 0.00-7	33704	1 0.00-7	58130	1 0.00-7
10151	1 0.00-7	34577	1 0.00-7	59002	1 0.00-7
11023	1 0.00-7	35449	1 0.00-7		
11895	1 0.00-7	36321	1 0.00-7		
12768	1 0.00-7	37194	1 0.00-7		
13640	1 0.00-7	38066	1 0.00-7		
14512	1 0.00-7	38938	1 0.00-7		
15385	1 0.00-7	39811	1 0.00-7		
16257	1 0.00-7	40683	1 0.00-7		
17129	1 0.00-7	41555	1 0.00-7		
18002	1 0.00-7	42428	1 0.00-7		
18874	1 0.00-7	43300	1 0.00-7		
19746	1 0.00-7	44172	1 0.00-7		
20619	1 0.00-7	45045	1 0.00-7		
21491	1 0.00-7	45917	1 0.00-7		
22364	1 0.00-7	46789	1 0.00-7		
23236	1 0.00-7	47662	1 0.00-7		
24108	1 0.00-7	48534	1 0.00-7		
24981	1 0.00-7	49407	1 0.00-7		

TEST PARAMETERS

Replay of B0_23Z43CR No Vibration
 ECC ON 32Mbps

Tape Stopped at 611 count
 No. of Samples = 67
 No. of Non-zero Samples = 0

Total Errors = 0
 Average Ber/Sample = 0.00E+00
 No. of Overflows = 0

Figure B-24.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 42 RECORD Mode
 Date 21 January 1992 Start Time 13:32:08 Finish Time 14:02:37
 Channel Rate - 32Mbps Error Correction ON
 BASELINE RECORD (810E/NO VIBRATION) Tape Manufacturer No. S0Z42CR

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
49940	1 0.00-7	74366	1 0.00-7	98792	1 0.00-7
50813	1 0.00-7	75239	1 0.00-7	99665	1 0.00-7
51685	1 0.00-7	76111	1 0.00-7		
52557	1 0.00-7	76983	1 0.00-7		
53430	1 0.00-7	77356	1 0.00-7		
54302	1 0.00-7	78728	1 0.00-7		
55174	1 0.00-7	79600	1 0.00-7		
56047	1 0.00-7	80473	1 0.00-7		
56919	1 0.00-7	81345	1 0.00-7		
57791	1 0.00-7	82217	1 0.00-7		
58664	1 0.00-7	83090	1 0.00-7		
59536	1 0.00-7	83962	1 0.00-7		
60408	1 0.00-7	84834	1 0.00-7		
61281	1 0.00-7	85707	1 0.00-7		
62153	1 0.00-7	86579	1 0.00-7		
63026	1 0.00-7	87452	1 0.00-7		
63898	1 0.00-7	88324	1 0.00-7		
64770	1 0.00-7	89196	1 0.00-7		
65643	1 0.00-7	99069	1 0.00-7		
66515	1 0.00-7	90941	1 0.00-7		
67387	1 0.00-7	91813	1 0.00-7		
68260	1 0.00-7	92686	1 0.00-7		
69132	1 0.00-7	93558	1 0.00-7		
70004	1 0.00-7	94430	1 0.00-7		
70377	1 0.00-7	95303	1 0.00-7		
71749	1 0.00-7	96175	1 0.00-7		
72521	1 0.00-7	97047	1 0.00-7		
73494	1 0.00-7	97920	1 0.00-7		

TEST PERAMETERS

Record W/No Vibration

ECC ON Tape #42 32Mbps

Tape Stopped at 99691 count

No. of Sampes = 58

No. of Non-zero Samples = 0

Total Errors = 0

Average Ber/Sample = 0.00E+00

No. of Overflows = 0

Figure B-25.

NAWCADWAR-92019-50

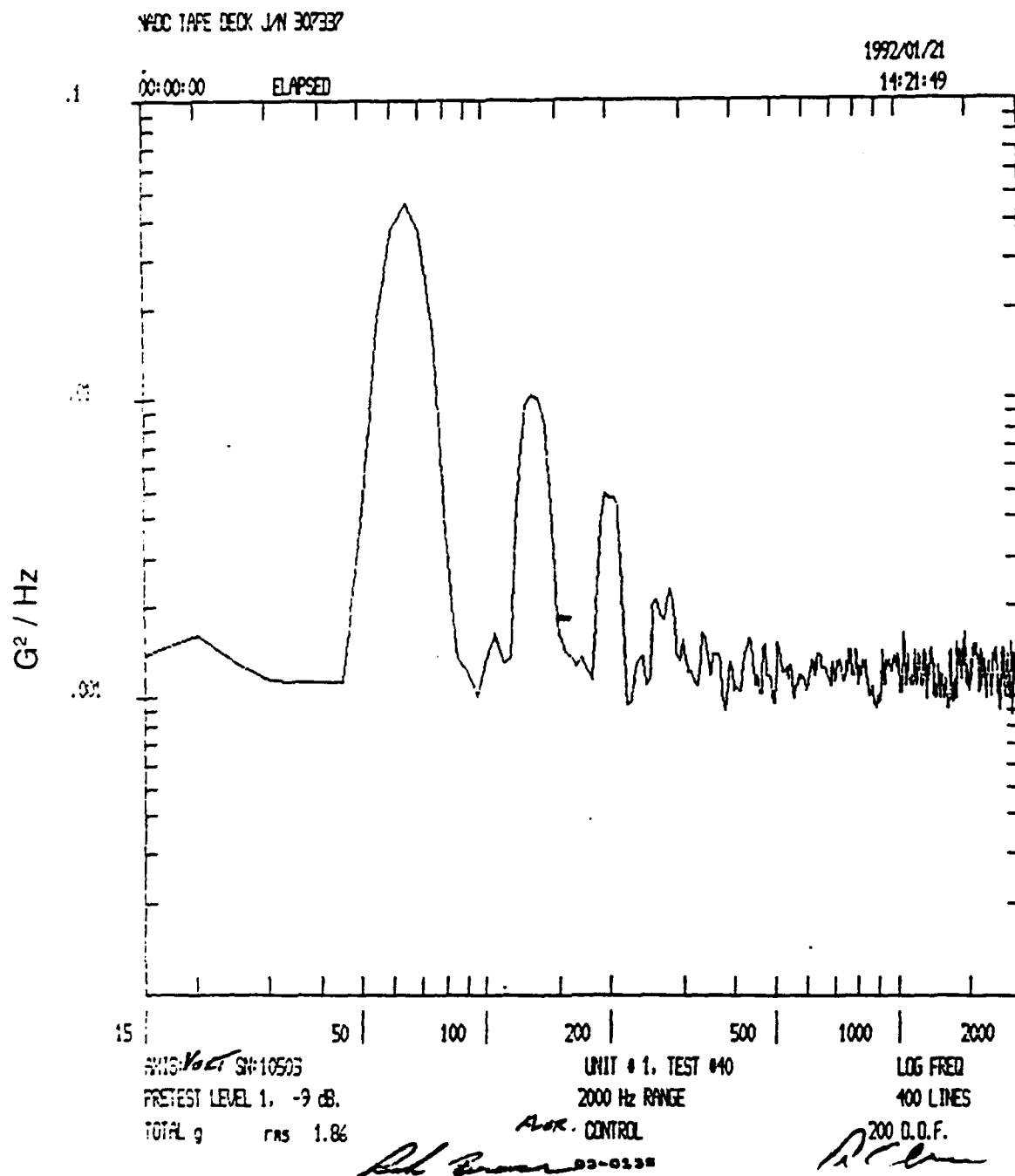


Figure B-26.

NAWCADWAR-92019-50

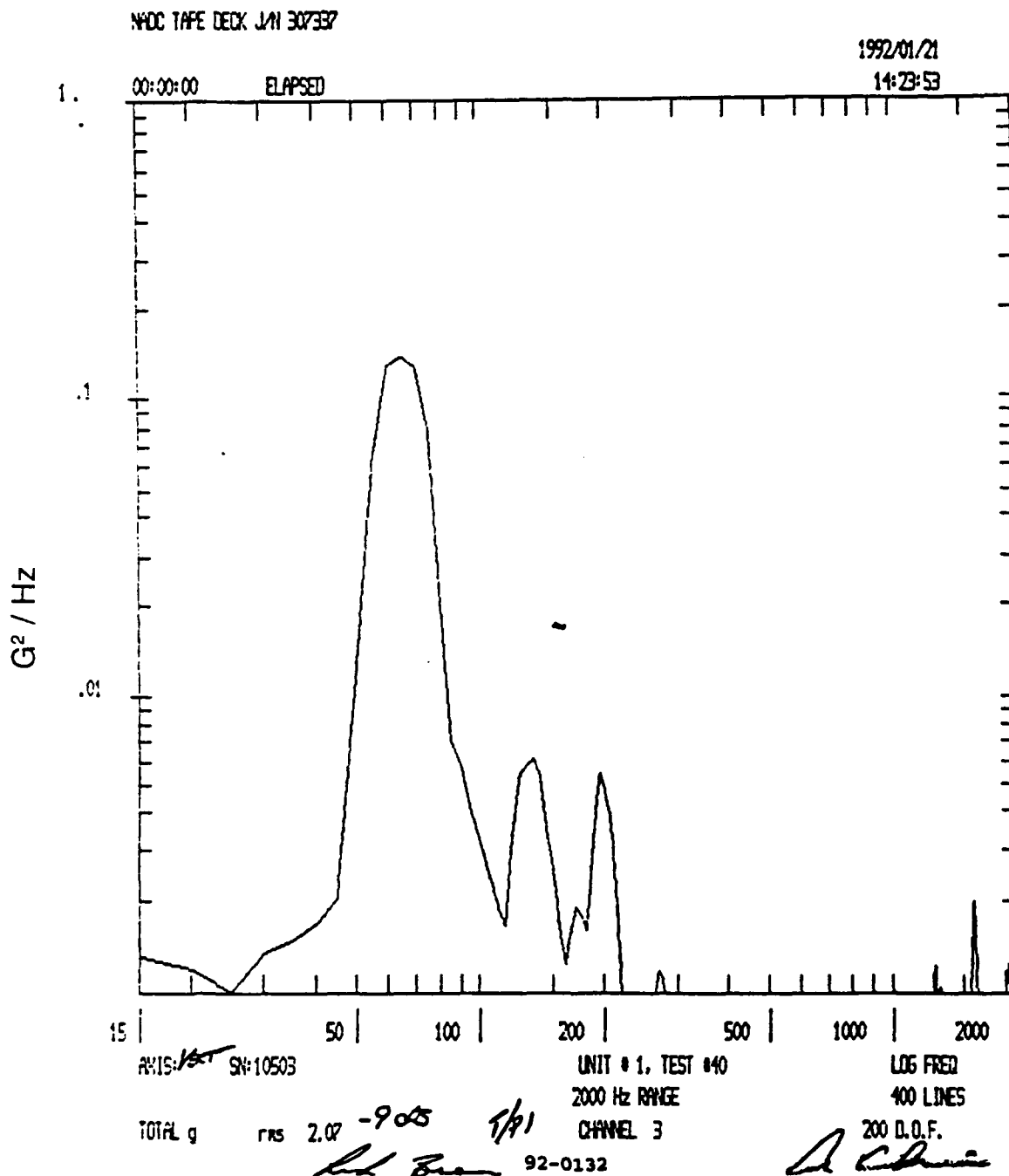


Figure B-27.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 42 PLAYBACK Mode
 Date 21 January 1992 Start Time 14:21:32 Finish Time 14:32:02
 Channel Rate - 32Mbps Error Correction ON
 REPLAY OF S0Z42CR W/VIBE (810E, -9dB) Tape Manufacturer No. S9DBZ42CP

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
52718 1	0.00-7	58825 1	0.00-7	64931 1	0.00-7
53590 1	0.00-7	59697 1	0.00-7	65803 1	3.96-7
54463 1	0.00-7	60569 1	0.00-7	66666 1	+0.94-7
55335 1	0.00-7	61442 1	0.00-7	67526 1	+7.69-7
56207 1	0.00-7	62314 1	0.00-7	68387 1	+1.44-7
57080 1	0.00-7	63186 1	0.00-7	69247 1	+3.39-7
57952 1	0.00-7	64059 1	0.00-7		

TEST PERAMETERS

Replay of ⑬ S0Z42CR W/Vibration Vibration: M-S-810E,
 scaled down 9dB Z axis ECC ON 32Mbps Tape #42

Tape Stopped at 69271 count
 No. of Sampes = 20
 No. of Non-zero Samples = 1

Total Errors = 396
 Average Ber/Sample = 2.48E-08
 No. of Overflows = 4

Figure B-28.

NAWCADWAR-92019-50

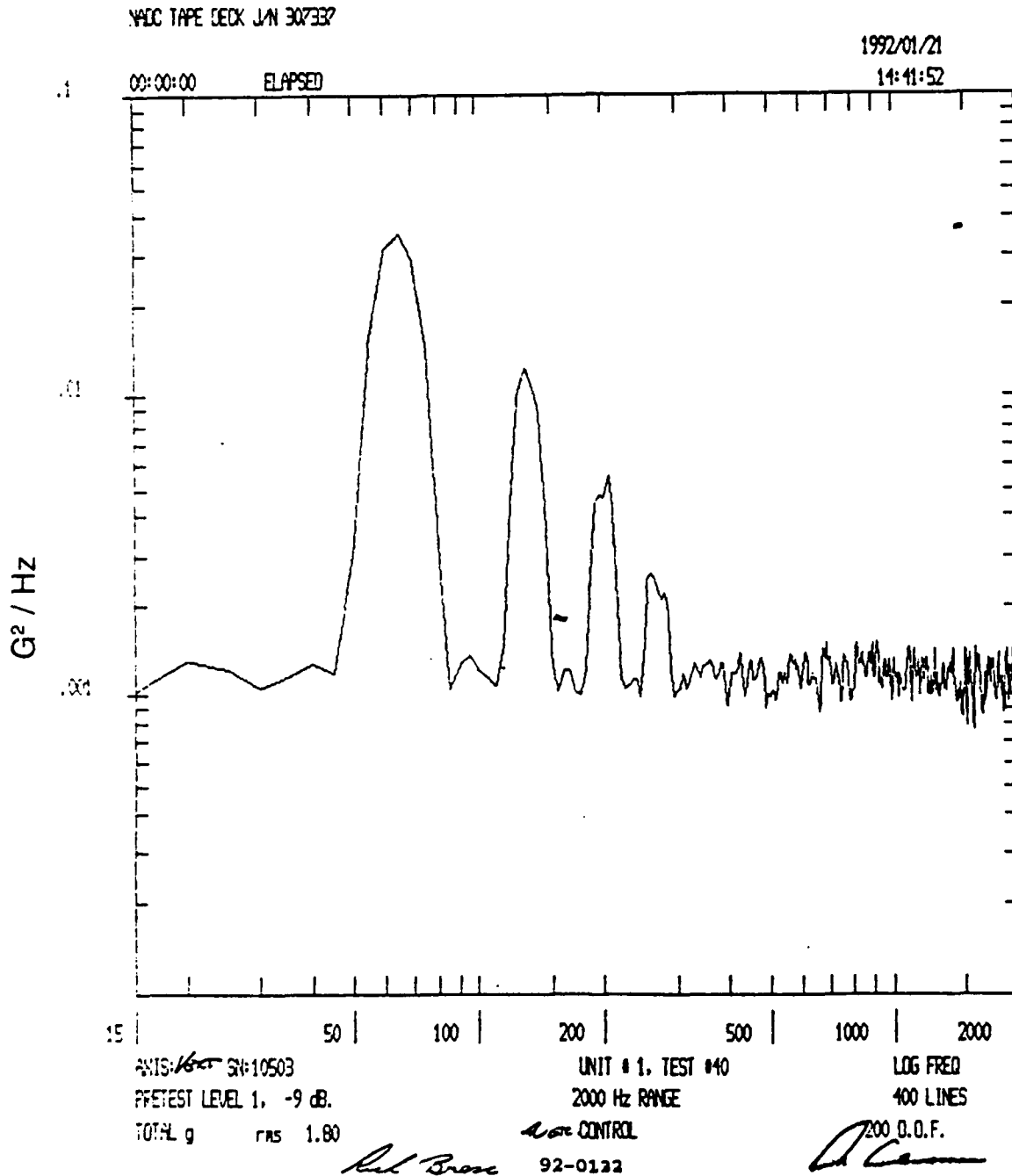


Figure B-29.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 42 PLAYBACK Mode
Date 21 January 1992 Start Time 14:42:36 Finish Time 14:53:08
Channel Rate - 32Mbps Error Correction ON
REPLAY AGAIN -9dB Tape Manufacturer No. S9DB42CPA

ID CNT.		BER	ID CNT.		BER	ID CNT.		BER
78449	1	0.00-7	84555	1	0.00-7	90662	1	0.00-7
79321	1	0.00-7	85428	1	0.00-7	91534	1	0.00-7
80194	1	0.00-7	86300	1	0.00-7	92407	1	0.00-7
81066	1	0.00-7	87173	1	0.00-7	93279	1	0.00-7
81938	1	0.00-7	88045	1	0.00-7	94151	1	1.60-7
82811	1	0.00-7	88917	1	0.00-7	95024	1	0.00-7
83683	1	0.00-7	89790	1	0.00-7			

Tape Stopped at 95040 count
No. of Sampes = 20
No. of Non-zero Samples = 1

Total Errors = 160
Average Ber/Sample = 8.00E-09
No. of Overflows = 0

Figure B-30.

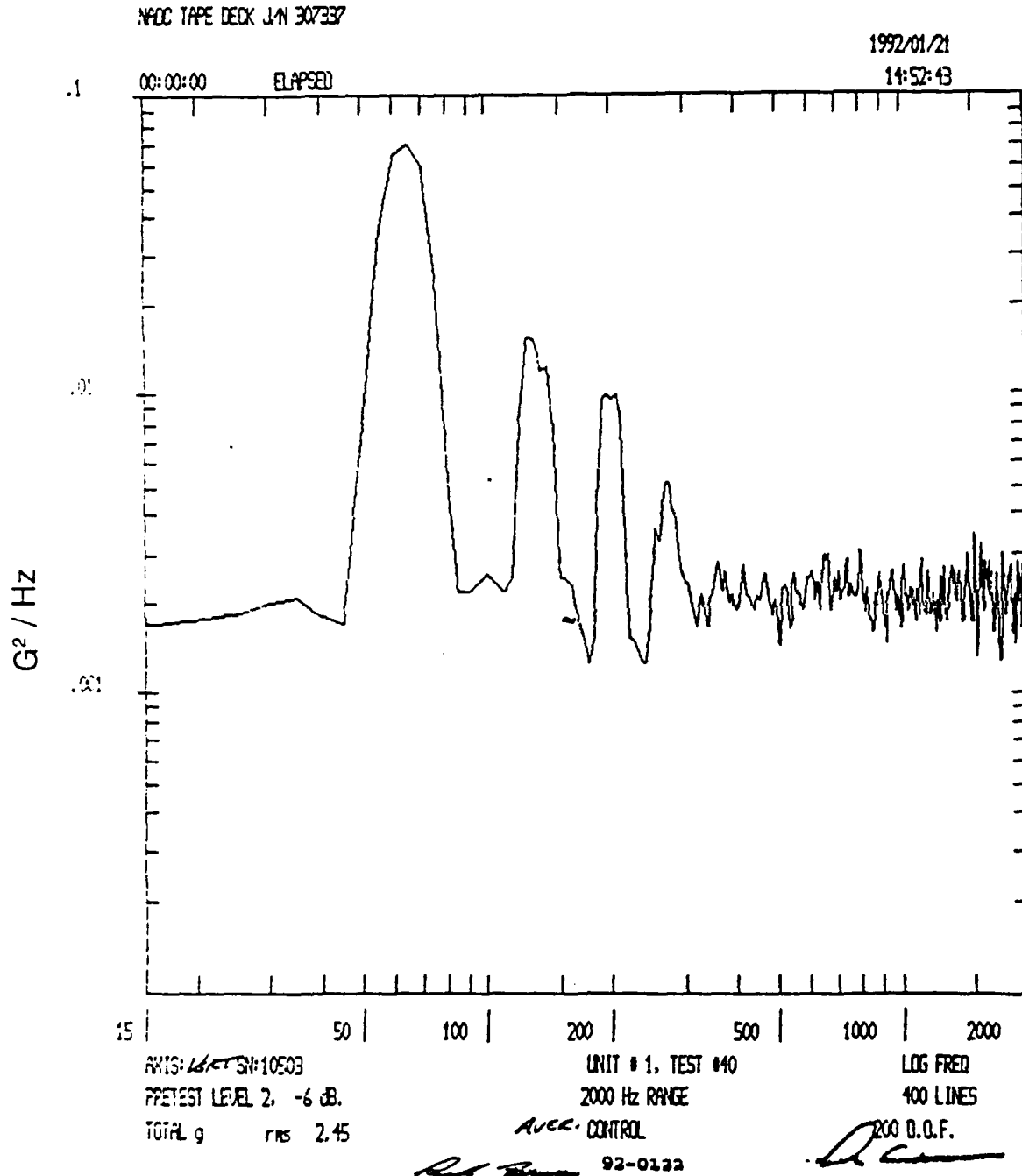


Figure B-31.

NAWCADWAR-92019-50

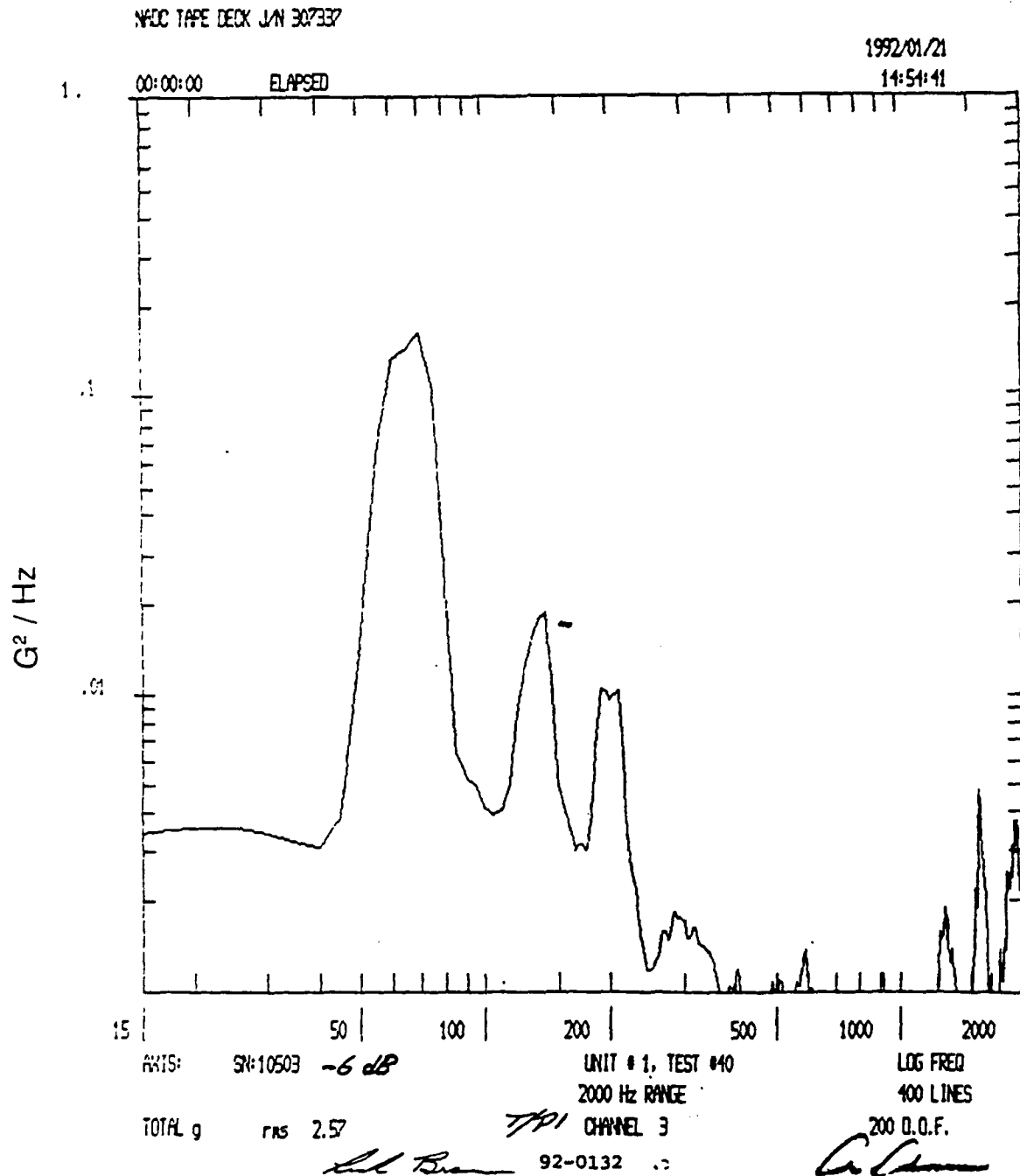


Figure B-32.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR XXXXXX PLAYBACK Mode
Date 21 January 1992 Start Time 14:57:59 Finish Time 15:00:00
Channel Rate - 32Mbps Error Correction ON
Tape Manufacturer No. XXXXXXXXXXXXX

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
76478	1 +2.00-7				
77338	0 +4.07-7				
78198	0 +1.10-7				

↑
THIS IS GOOD SECTION OF TAPE
SEE S9DB42CPA

Tape Stopped at 78833 count

Total Errors = 0

Figure B-33.

NAWCADWAR-92019-50

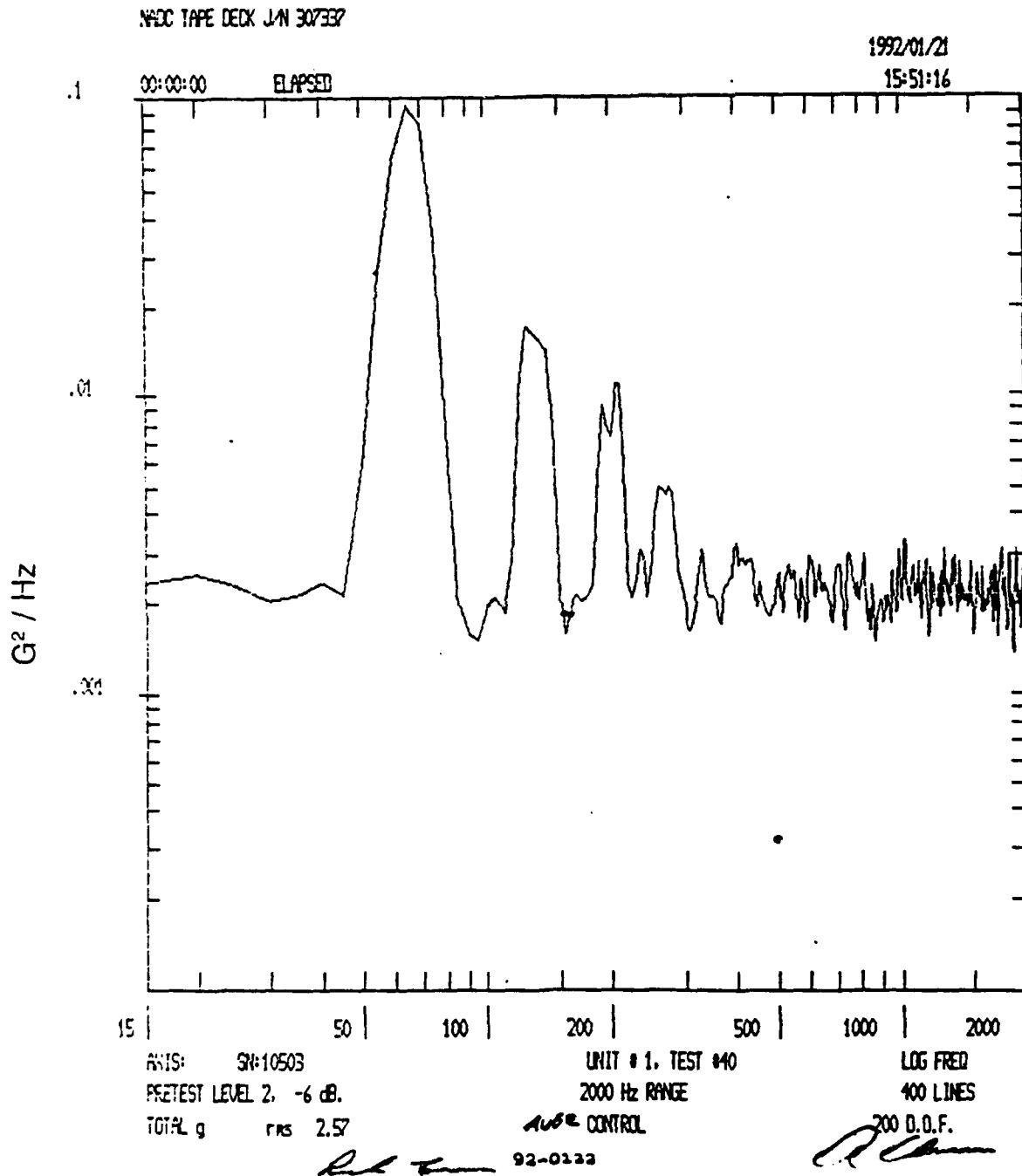


Figure B-34.

NAWCADWAR-92019-50

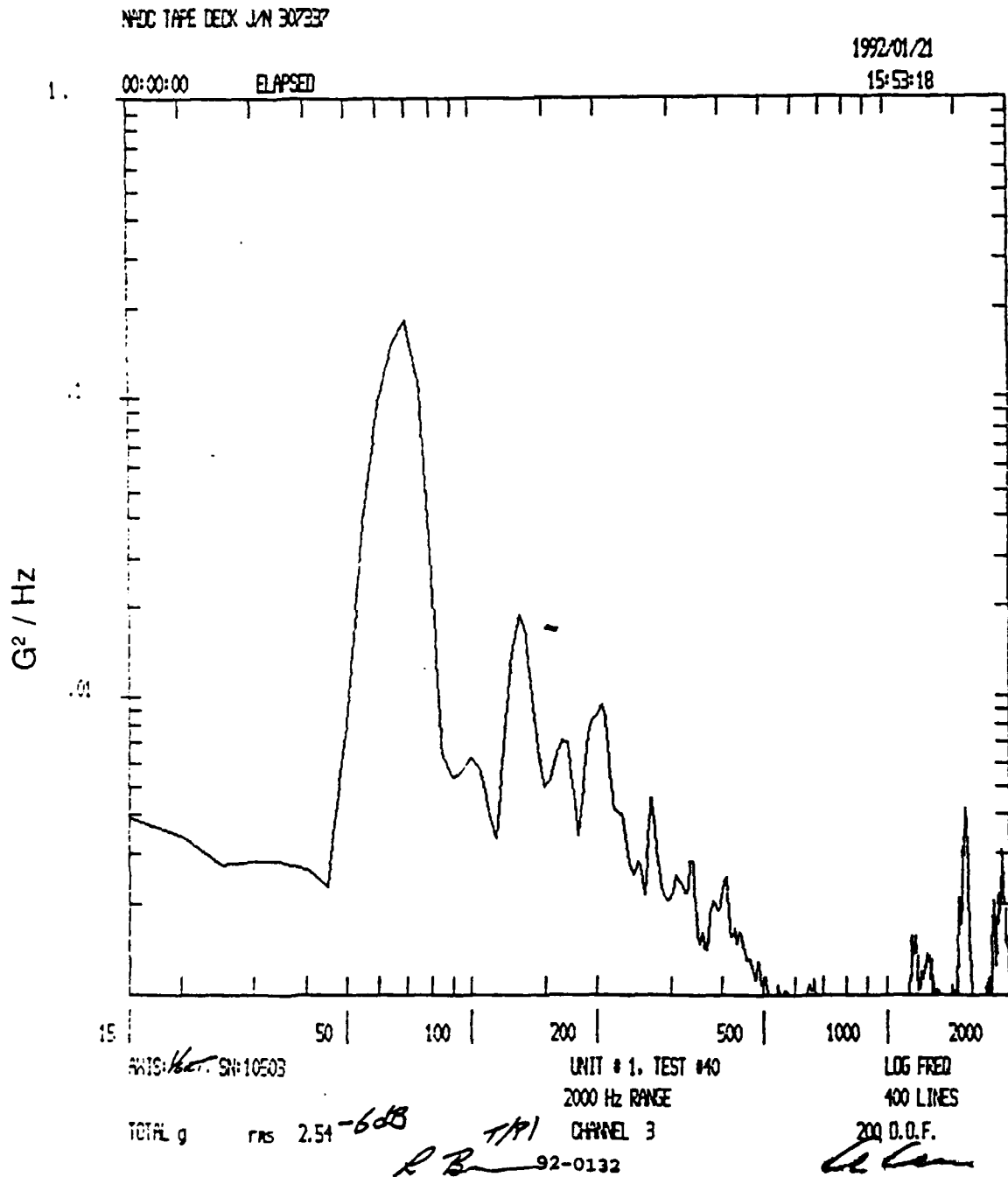


Figure B-35.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 42 PLAYBACK Mode
Date 21 January 1992 Start Time 15:51:52 Finish Time 15:56:17
Channel Rate - 32Mbps Error Correction ON
Replay 6 DB Tape Manufacturer No. S6DBZ42CPA

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
52901	1 +8.37-7				
53761	1 +8.78-7				
54622	1 +7.56-7				
55482	0 +8.88-7				
56342	0 +0.35-7				

Tape Stopped at 56931 count Total Errors = 0

Figure B-36.

APPENDIX C

RESULTS OF TEMPERATURE/HUMIDITY TESTING OF SONY DIR-1000

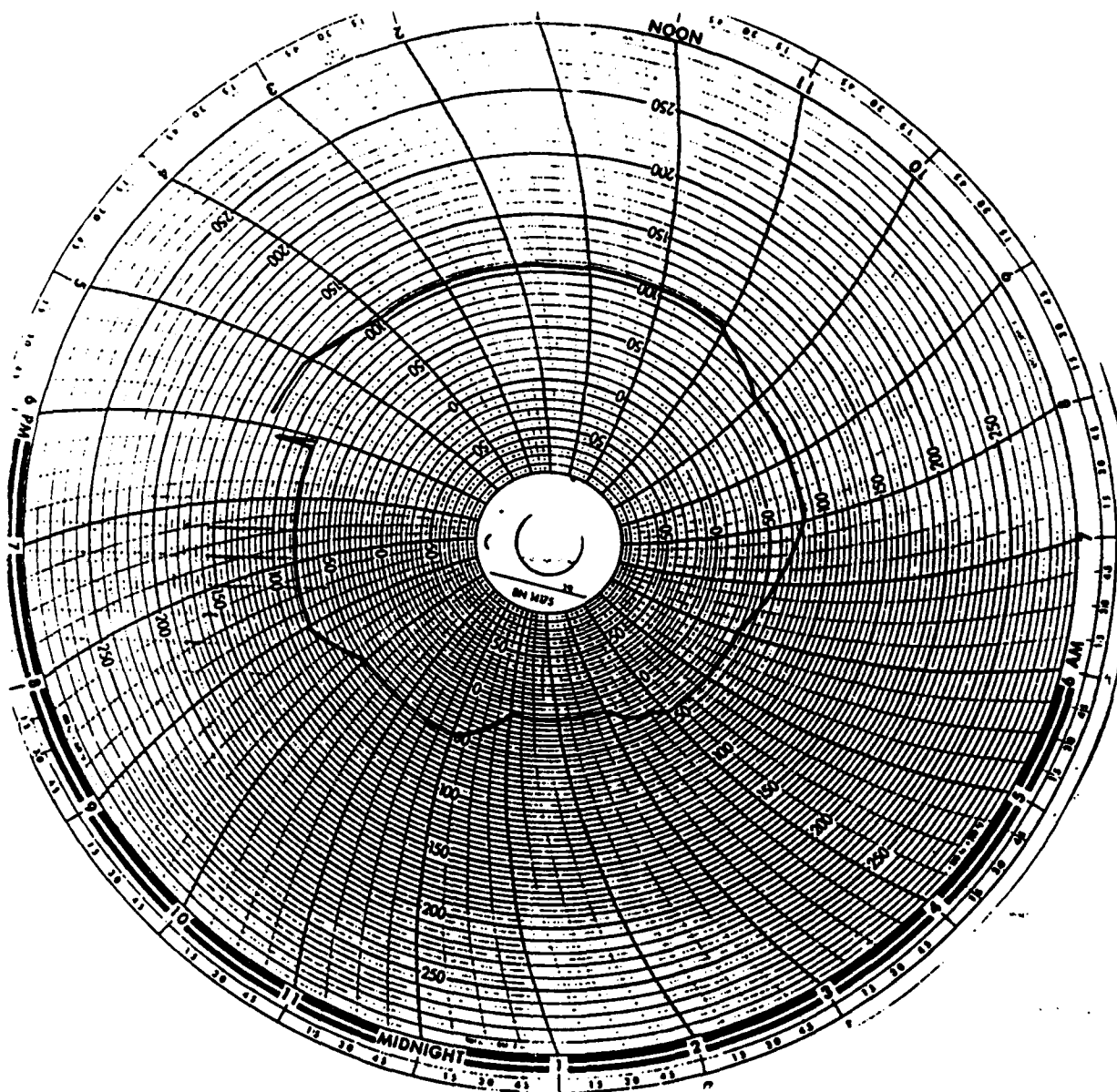


Figure C-1. Preliminary Data Only.
Data: 22 January 1992 — 1600 Hours
23 January 1992 — 1545 Hours
Temperature °F

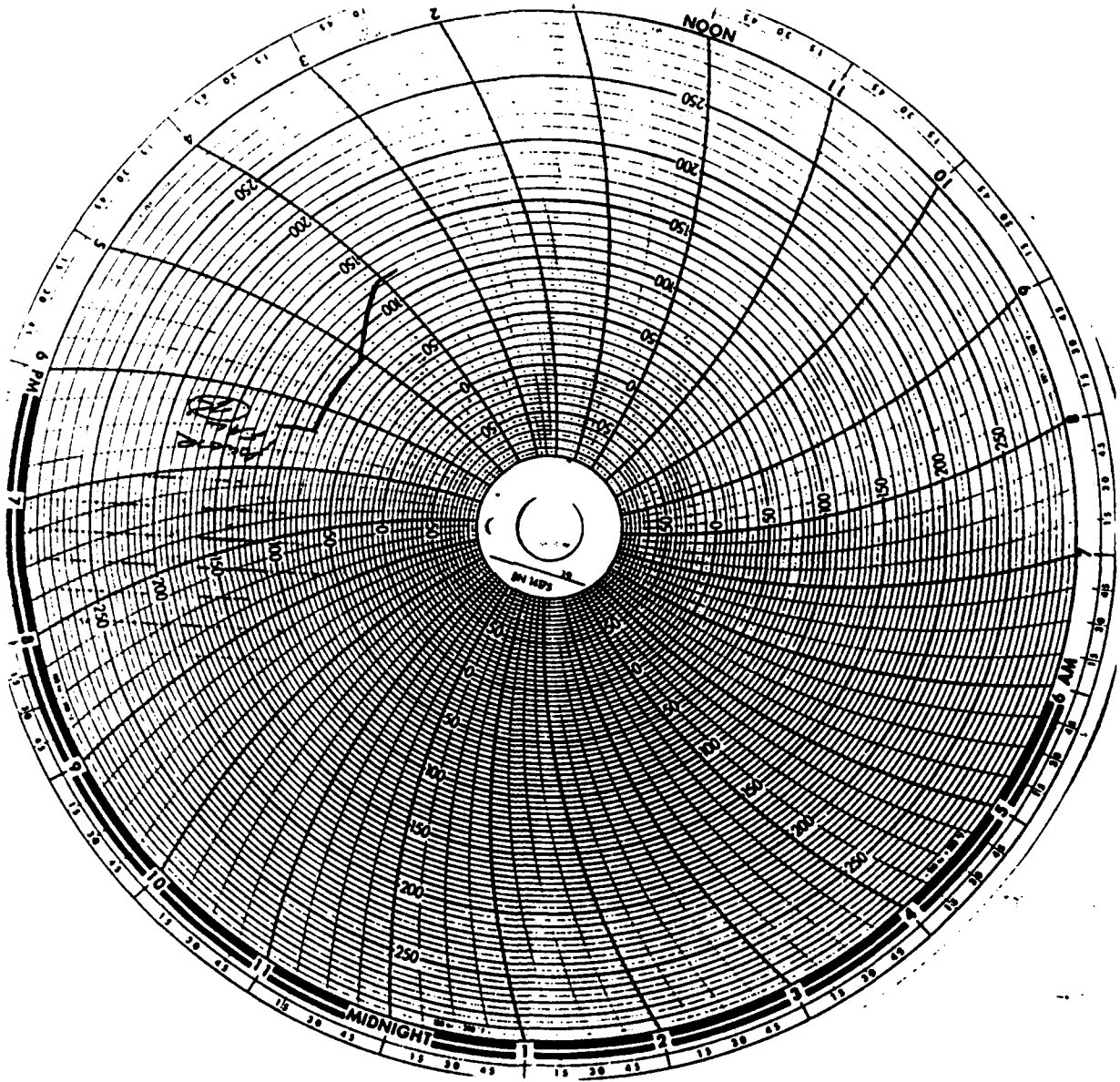


Figure C-2. Preliminary Data Only.
Data: 22 January 1992 — 1545 Hours
23 January 1992 — 1925 Hours
Temperature °F

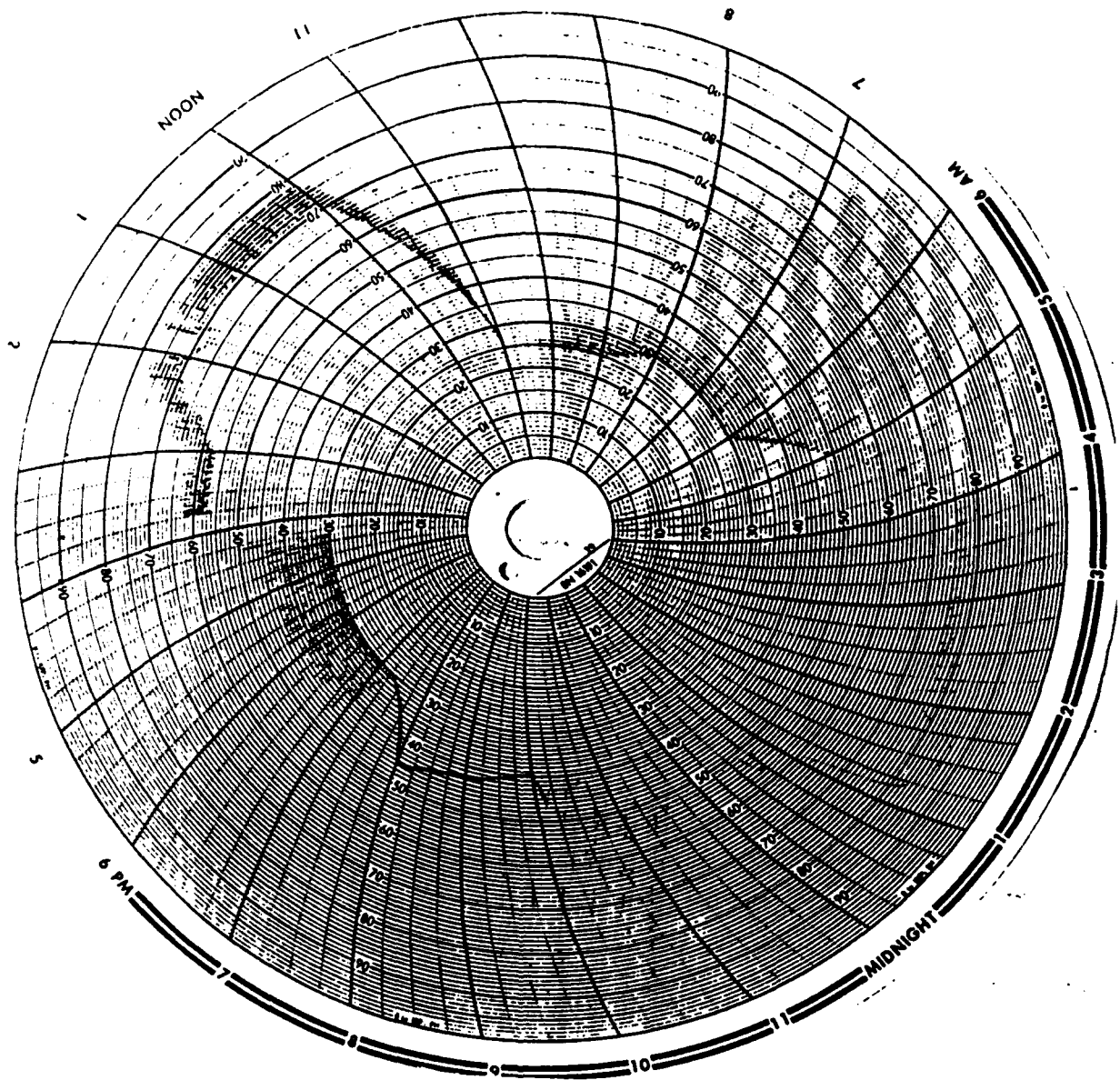


Figure C-3. Preliminary Data Only.
Data: 22 January 1992 — 1600 Hours
23 January 1992 — 1545 Hours
% RH

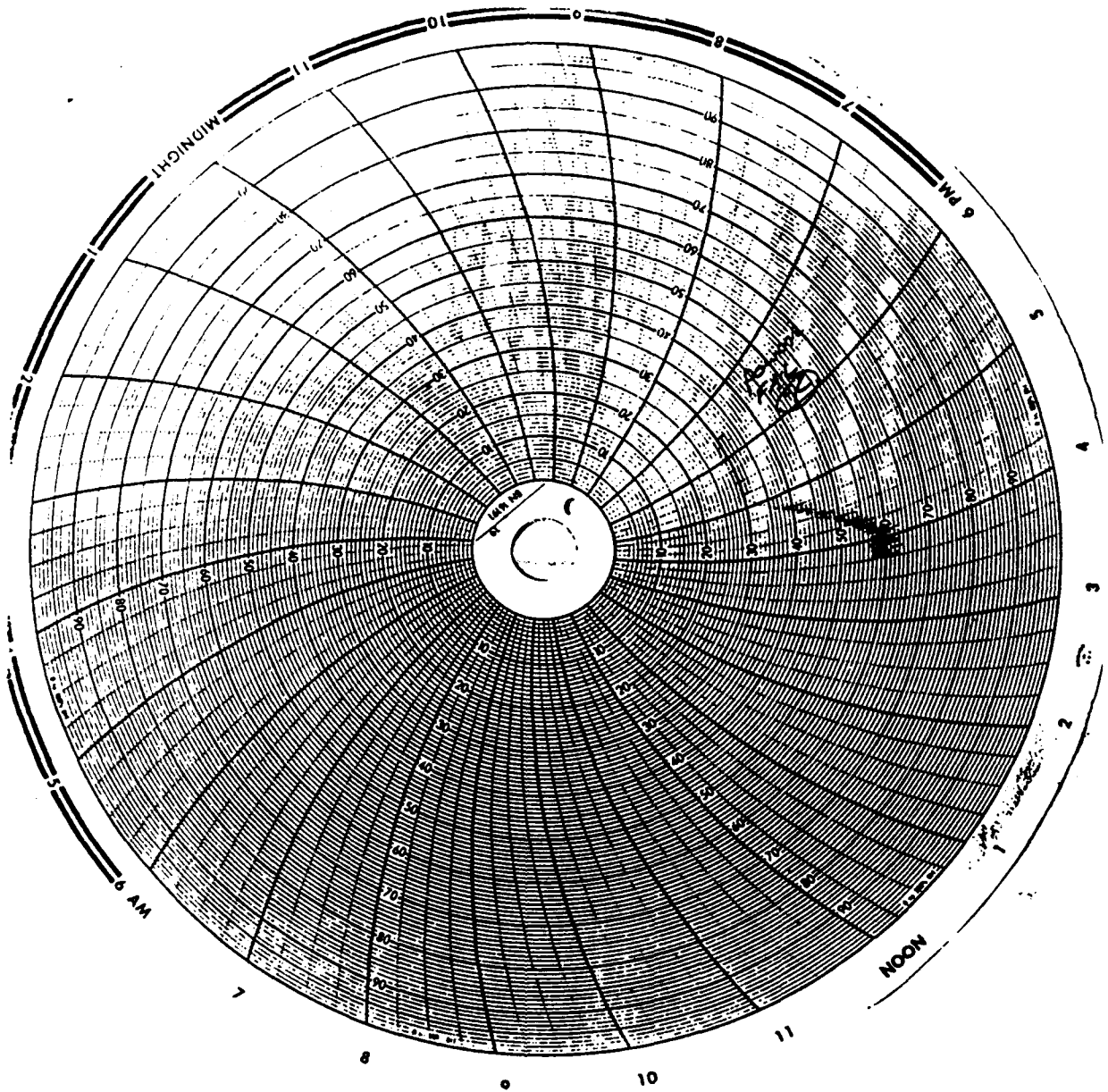


Figure C-4. Preliminary Data Only.
Data: 23 January 1992 — 1545 Hours
23 January 1992 — 1925 Hours
% RH

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 41 RECORD Mode
 Date 22 January 1992 Start Time 17:49:25 Finish Time 18:39:51
 Channel Rate - 32Mbps Error Correction ON
 T = 80 F, RH = 30 TO 40% Tape Manufacturer No. TH_TST_1

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
874	1 0.16-7	28789	1 0.00-7	56705	1 0.00-7
1746	1 0.00-7	29662	1 0.00-7	57577	1 0.00-7
2619	1 0.00-7	30534	1 0.00-7	58449	1 0.00-7
3491	1 0.00-7	31406	1 0.00-7	59322	1 0.00-7
4363	1 0.00-7	32279	1 0.00-7	60194	1 0.00-7
5236	1 0.00-7	33151	1 0.00-7	61066	1 0.00-7
6108	1 0.00-7	34023	1 0.00-7	61939	1 0.00-7
6980	1 0.00-7	34896	1 0.00-7	62811	1 0.00-7
7853	1 0.00-7	35768	1 0.00-7	63684	1 0.00-7
8725	1 0.00-7	36640	1 0.00-7	64556	1 0.00-7
9597	1 0.00-7	37513	1 0.00-7	65428	1 0.00-7
10470	1 0.00-7	38385	1 0.00-7	66301	1 0.00-7
11342	1 0.00-7	39258	1 0.00-7	67173	1 0.00-7
12215	1 0.00-7	40130	1 0.00-7	68045	1 0.00-7
13087	1 0.00-7	41002	1 0.00-7	68918	1 0.00-7
13959	1 0.00-7	41875	1 0.00-7	69790	1 0.00-7
14832	1 0.00-7	42747	1 0.00-7	70662	1 0.00-7
15704	1 0.00-7	43619	1 0.00-7	71535	1 0.00-7
16576	1 0.00-7	44492	1 0.00-7	72407	1 0.00-7
17449	1 0.00-7	45364	1 0.00-7	73279	1 0.00-7
18321	1 0.00-7	46236	1 0.00-7	74152	1 0.00-7
19193	1 0.00-7	47109	1 0.00-7	75024	1 0.00-7
20066	1 0.00-7	47981	1 0.00-7	75896	1 0.00-7
20938	1 0.00-7	48853	1 0.00-7	76769	1 0.00-7
21810	1 0.00-7	49726	1 0.00-7	77641	1 0.00-7
22683	1 0.00-7	50598	1 0.00-7	78514	1 0.00-7
23555	1 0.00-7	51471	1 0.00-7	79386	1 0.00-7
24427	1 0.00-7	52343	1 0.00-7	80258	1 0.00-7
25300	1 0.00-7	53215	1 0.00-7	81131	1 0.00-7
26172	1 0.00-7	54088	1 0.00-7	82003	1 0.00-7
27045	1 0.00-7	54960	1 0.00-7	82875	1 0.00-7
27917	1 0.00-7	55832	1 0.00-7	83748	1 0.00-7

Tape Stopped at 83773 count
 No. of Samples = 96
 No. of Non-zero Samples = 1

Total Errors = 16
 Average Ber/Sample = 1.67E-10
 No. of Overflows = 0

Figure C-5.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 41 RECORD Mode

Date 22 January 1992 Start Time 21:09:35 Finish Time 22:00:02
Channel Rate - 32Mbps Error Correction ON
T = 50 F, H = 41.6 % Tape Manufacturer No. TH_TST_2

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
84657	1 0.00-7	112572	1 0.00-7	140476	1 0.00-7
85529	1 0.00-7	113445	1 0.00-7	141348	1 0.00-7
86402	1 0.00-7	114317	1 0.00-7	142220	1 0.00-7
87274	1 0.00-7	115189	1 0.00-7	143093	1 0.00-7
88146	1 0.00-7	116062	1 0.00-7	143965	1 0.00-7
89019	1 0.00-7	116934	1 0.00-7	144838	1 0.00-7
89891	1 0.00-7	117806	1 0.00-7	145710	1 0.00-7
90763	1 0.00-7	118679	1 0.00-7	146582	1 0.00-7
91636	1 0.00-7	119551	1 0.00-7	147455	1 0.00-7
92508	1 0.00-7	120411	1 +8.68-7	148327	1 0.00-7
93380	1 0.00-7	121284	1 0.00-7	149199	1 0.00-7
94253	1 0.00-7	122156	1 0.00-7	150072	1 0.00-7
95125	1 0.00-7	123029	1 0.00-7	150944	1 0.00-7
95998	1 0.00-7	123901	1 0.00-7	151816	1 0.00-7
96870	1 0.00-7	124773	1 0.00-7	152689	1 0.00-7
97742	1 0.00-7	125646	1 0.00-7	153561	1 0.00-7
98615	1 0.00-7	126518	1 0.00-7	154433	1 0.00-7
99487	1 0.00-7	127390	1 0.00-7	155306	1 0.00-7
100359	1 0.00-7	128263	1 0.00-7	156178	1 0.00-7
101232	1 0.00-7	129135	1 0.00-7	157051	1 0.00-7
102104	1 0.00-7	130007	1 0.00-7	157923	1 0.00-7
102976	1 0.00-7	130880	1 0.00-7	158795	1 0.00-7
103849	1 0.00-7	131752	1 0.00-7	159668	1 0.00-7
104721	1 0.00-7	132625	1 0.00-7	160540	1 0.00-7
105593	1 0.00-7	133497	1 0.00-7	161412	1 0.00-7
106466	1 0.00-7	134369	1 0.00-7	162285	1 0.00-7
107338	1 0.00-7	135242	1 0.00-7	163157	1 0.00-7
108210	1 0.00-7	136114	1 0.00-7	164029	1 0.00-7
109083	1 0.00-7	136986	1 0.00-7	164902	1 0.00-7
109955	1 0.00-7	137859	1 0.00-7	165774	1 0.00-7
110828	1 0.00-7	138731	1 0.00-7	166646	1 0.00-7
111700	1 0.00-7	139603	1 0.00-7	167519	1 0.00-7

Tape Stopped at 167543 count
No. of Samples = 96
No. of Non-zero Samples = 0

Total Errors = 0
Average Ber/Sample = 0.00E+00
No. of Overflows = 1

Figure C-6.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 41 RECORD Mode
 Date 23 January 1992 Start Time 03:25:05 Finish Time 04:15:30
 Channel Rate - 32Mbps Error Correction ON
 T = 40.8, H = 75.9 Tape Manufacturer No. TH_TST_4

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
168467	1 0.00-7	196331	1 0.00-7	224235	1 0.00-7
169229	1 0.00-7	197203	1 0.00-7	225107	1 0.00-7
170172	1 0.00-7	198075	1 0.00-7	225980	1 0.00-7
171044	1 0.00-7	198948	1 0.00-7	226852	1 0.00-7
171916	1 0.00-7	199820	1 0.00-7	227724	1 0.00-7
172789	1 0.00-7	200692	1 0.00-7	228597	1 0.00-7
173661	1 0.00-7	201565	1 0.00-7	229469	1 0.00-7
174533	1 0.00-7	202437	1 0.00-7	230341	1 0.00-7
175406	1 0.00-7	203309	1 0.00-7	231214	1 0.00-7
176278	1 0.00-7	204182	1 0.00-7	232086	1 0.00-7
177150	1 0.00-7	205054	1 0.00-7	232958	1 0.00-7
178023	1 0.00-7	205927	1 0.00-7	233831	1 0.00-7
178895	1 0.00-7	206799	1 0.00-7	234703	1 0.00-7
179767	1 0.00-7	207671	1 0.00-7	235576	1 0.00-7
180640	1 0.00-7	208544	1 0.00-7	236448	1 0.00-7
181512	1 0.00-7	209416	1 0.00-7	237320	1 0.00-7
182385	1 0.00-7	210288	1 0.00-7	238193	1 0.00-7
183257	1 0.00-7	211161	1 0.00-7	239065	1 0.00-7
184129	1 0.00-7	212033	1 0.00-7	239937	1 0.00-7
185002	1 0.00-7	212905	1 0.00-7	240810	1 0.00-7
185874	1 0.00-7	213778	1 0.00-7	241682	1 0.00-7
186734	1 +8.80-7	214650	1 0.00-7	242554	1 0.00-7
187607	1 0.00-7	215522	1 0.00-7	243427	1 0.00-7
188479	1 0.00-7	216395	1 0.00-7	244299	1 0.00-7
189352	1 0.00-7	217267	1 0.00-7	245171	1 0.00-7
190224	1 0.00-7	218140	1 0.00-7	246044	1 0.00-7
191096	1 0.00-7	219012	1 0.00-7	246916	1 0.00-7
191969	1 0.00-7	219884	1 0.00-7	247789	1 0.00 7
192841	1 0.00-7	220745	1 +3.16-7	248661	1 0.00-7
193714	1 0.00-7	221618	1 0.00-7	249533	1 0.00-7
194586	1 0.00-7	222490	1 0.00-7	250406	1 0.00-7
195458	1 0.00-7	223363	1 0.00-7	251266	2 +4.09-7

Tape Stopped at 251299 count
 No. of Sampes = 96
 No. of Non-zero Samples = 0

Total Errors = 0
 Average Ber/Sample = 0.00E+00
 No. of Overflows = 3

Figure C-7.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 41 RECORD Mode
 Date 23 January 1992 Start Time 07:10:37 Finish Time 08:01:04
 Channel Rate - 32Mbps Error Correction ON
 Tape Manufacturer No. TH_TST_5

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
252184	1 0.00-7	280099	1 0.00-7	308015	1 0.00-7
253056	1 0.00-7	280972	1 0.00-7	308887	1 0.00-7
253929	1 0.00-7	281844	1 0.00-7	309759	1 0.00-7
254801	1 0.00-7	282716	1 0.00-7	310632	1 0.00-7
255673	1 0.00-7	283589	1 0.00-7	311504	1 0.00-7
256546	1 0.00-7	284461	1 0.00-7	312376	1 0.00-7
257418	1 0.00-7	285333	1 0.00-7	313249	1 0.00-7
258290	1 0.00-7	286206	1 0.00-7	314121	1 0.00-7
259163	1 0.00-7	287078	1 0.00-7	314994	1 0.00-7
260035	1 0.00-7	287950	1 0.00-7	315866	1 0.00-7
260907	1 0.00-7	288823	1 0.00-7	316738	1 0.00-7
261780	1 0.00-7	289695	1 0.00-7	317611	1 0.00-7
262652	1 0.00-7	290568	1 0.00-7	318483	1 0.00-7
263525	1 0.00-7	291440	1 0.00-7	319355	1 0.00-7
264397	1 0.00-7	292312	1 0.00-7	320228	1 0.00-7
265269	1 0.00-7	293185	1 0.00-7	321100	1 0.00-7
266142	1 0.00-7	294057	1 0.00-7	321972	1 0.00-7
267014	1 0.00-7	294929	1 0.00-7	322845	1 0.00-7
267886	1 0.00-7	295802	1 0.00-7	323717	1 0.00-7
268759	1 0.00-7	296674	1 0.00-7	324589	1 0.00-7
269631	1 0.00-7	297546	1 0.00-7	325462	1 0.00-7
270503	1 0.00-7	298419	1 0.00-7	326334	1 0.00-7
271376	1 0.00-7	299291	1 0.00-7	327206	1 0.00-7
272248	1 0.00-7	300163	1 0.00-7	328079	1 0.00-7
273120	1 0.00-7	301036	1 0.00-7	328951	1 0.00-7
273993	1 0.00-7	301908	1 0.00-7	329824	1 0.00-7
274865	1 0.00-7	302781	1 0.00-7	330696	1 0.00-7
275738	1 0.00-7	303653	1 0.00-7	331568	1 0.00-7
276610	1 0.00-7	304525	1 0.00-7	332441	1 0.00-7
277482	1 0.00-7	305398	1 0.00-7	333313	1 0.00-7
278355	1 0.00-7	306270	1 0.00-7	334185	1 0.00-7
279227	1 0.00-7	307142	1 0.00-7	335058	1 0.00-7

Tape Stopped at 335083 count
 No. of Samples = 96
 No. of Non-zero Samples = 0

Total Errors = 0
 Average Ber/Sample = 0.00E+00
 No. of Overflows = 0

Figure C-8.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 41 RECORD Mode
 Date 23 January 1992 Start Time 10:08:35 Finish Time 10:59:01
 Channel Rate - 32Mbps Error Correction ON
 Tape Manufacturer No. TH_TST_6

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
335967	1 0.00-7	363882	1 0.00-7	391798	1 0.00-7
336839	1 0.00-7	364755	1 0.00-7	392670	1 0.00-7
337712	1 0.00-7	365627	1 0.00-7	393542	1 0.00-7
338584	1 0.00-7	366499	1 0.00-7	394415	1 0.00 7
339456	1 0.00-7	367372	1 0.00-7	395287	1 0.00-7
340329	1 0.00-7	368244	1 0.00-7	396159	1 0.00-7
341201	1 0.00-7	369116	1 0.00-7	397032	1 0.00-7
242073	1 0.00-7	369989	1 0.00-7	397904	1 0.00-7
342946	1 0.00-7	370861	1 0.00-7	398776	1 0.00-7
343818	1 0.00-7	371733	1 0.00-7	399649	1 0.00-7
344690	1 0.00-7	372606	1 0.00-7	400521	1 0.00-7
345563	1 0.00-7	373478	1 0.00-7	401394	1 0.00-7
346435	1 0.00-7	374351	1 0.00-7	402266	1 0.00-7
347307	1 0.00-7	375223	1 0.00-7	403138	1 0.00-7
348180	1 0.00-7	376095	1 0.00-7	404011	1 0.00-7
349052	1 0.00-7	376968	1 0.00-7	404883	1 0.00-7
349925	1 0.00-7	377840	1 0.00-7	405755	1 0.00-7
350797	1 0.00-7	379712	1 0.00-7	406628	1 0.00-7
351669	1 0.00-7	379585	1 0.00-7	407500	1 0.00-7
352542	1 0.00-7	380457	1 0.00-7	408372	1 0.00-7
353414	1 0.00-7	381329	1 0.00-7	409245	1 0.00-7
354286	1 0.00-7	382202	1 0.00-7	410117	1 0.00-7
355159	1 0.00-7	383074	1 0.00-7	410989	1 0.00-7
356031	1 0.00-7	383946	1 0.00-7	411862	1 0.00-7
356903	1 0.00-7	384819	1 0.00-7	412734	1 0.00-7
357776	1 0.00-7	385691	1 0.00-7	413607	1 0.00-7
358648	1 0.00-7	386563	1 0.00-7	414479	1 0.00-7
359520	1 0.00-7	387436	1 0.00-7	415351	1 0.00-7
360393	1 0.00-7	388308	1 0.00-7	416224	1 0.00-7
361265	1 0.00-7	389181	1 0.00-7	417096	1 0.00-7
362138	1 0.00-7	390053	1 0.00-7	417968	1 0.00-7
363010	1 0.00-7	390925	1 0.00-7	418841	1 0.00-7

Tape Stopped at 418866 count
 No. of Sampes = 96
 No. of Non-zero Samples = 0

Total Errors = 0
 Average Ber/Sample = 0.00E+00
 No. of Overflows = 0

Figure C-9.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 41 RECORD Mode
 Date 23 January 1992 Start Time 13:01:53 Finish Time 13:52:19
 Channel Rate - 32Mbps Error Correction ON
 T = 104 F (40 C), RH = 75% Tape Manufacturer No. TH_TST_7

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
419750	1 0.00-7	447666	1 0.00-7	475559	1 0.00-7
420623	1 0.00-7	448538	1 0.00-7	476431	1 0.00-7
421495	1 0.00-7	449399	2 +0.60-7	477304	1 0.00-7
422368	1 0.00-7	450272	1 0.00-7	478176	1 0.00-7
423240	1 0.00-7	451144	1 0.00-7	479049	1 0.00-7
424113	1 0.00-7	452017	1 0.00-7	479921	1 0.00-7
424935	1 0.00-7	452889	1 0.00-7	480793	1 0.00-7
425857	1 0.00-7	453761	1 0.00-7	481666	1 0.00-7
426730	1 0.00-7	454634	1 0.00-7	482538	1 0.00-7
427602	1 0.00-7	455506	1 0.00-7	483410	1 0.00-7
428474	1 0.00-7	456378	1 0.00-7	484283	1 0.00-7
429347	1 0.00-7	457251	1 0.00-7	485155	1 0.00-7
430219	1 0.00-7	458111	3 +0.17-7	486027	1 0.00-7
431091	1 0.00-7	458984	1 0.00-7	486900	1 0.00-7
431964	1 0.00-7	459857	1 0.00-7	487772	1 0.00-7
432836	1 0.00-7	460729	1 0.00-7	488644	1 0.00-7
433708	1 0.00-7	461601	1 0.00-7	489517	1 0.00-7
434581	1 0.00-7	462474	1 0.00-7	490389	1 0.00-7
435453	1 0.00-7	463346	1 0.00-7	491262	1 0.00-7
436326	1 0.00-7	464218	1 0.00-7	492134	1 0.00-7
437198	1 0.00-7	465091	1 0.00-7	493006	1 0.00-7
438070	1 0.00-7	465963	1 0.00-7	493879	t 0.00-7
438943	1 0.00-7	466836	1 0.00-7	494751	1 0.00-7
439815	1 0.00-7	467708	1 0.00-7	495623	1 0.00-7
440687	1 0.00-7	468580	1 0.00-7	496496	1 0.00-7
441560	1 0.00-7	469453	1 0.00-7	497368	1 0.00-7
442432	1 0.00-7	470325	1 0.00-7	498240	1 0.00-7
443304	1 0.00-7	471197	1 0.00-7	499113	1 0.00-7
444177	1 0.00-7	472070	1 0.00-7	499985	1 0.00-7
445049	1 0.00-7	472942	1 0.00-7	500857	1 0.00-7
445921	1 0.00-7	473814	1 0.00-7	501730	1 0.00-7
446794	1 0.00-7	474687	1 0.00-7	502602	1 0.00-7

Tape Stopped at 502628 count
 No. of Sampes = 96
 No. of Non-zero Samples = 0

Total Errors = 0
 Average Ber/Sample = 0.00E+00
 No. of Overflows = 2

Figure C-10.

NAWCADWAR-92019-50

BIT ERROR RATE TEST FOR 41 RECORD Mode
 Date 23 January 1992 Start Time 18:08:03 Finish Time 18:20:12
 Channel Rate - 32Mbps Error Correction ON
 T = 80.6 F (27 C), RH = 30% Tape Manufacturer No. TH_TST_9

ID CNT.	BER	ID CNT.	BER	ID CNT.	BER
504504	2 +2.57-7	513964	0 +0.51-7	523429	0 +3.80-7
505364	2 +8.08-7	514824	0 +0.06-7	524290	2 +7.03-7
506224	0 +0.60-7	515684	2 +0.57-7	525150	0 +4.01-7
507084	2 +2.31-7	516544	0 +0.80-7	526010	2 +0.70-7
507944	2 +0.96-7	517404	0 +2.99-7	526871	2 +0.55-7
508804	0 +9.84-7	518265	1 +7.00-7	527731	2 +5.01-7
509664	2 +8.26-7	519125	2 +0.60-7	528591	2 +7.05-7
510524	2 +6.07-7	519985	2 +0.60-7	529452	2 +1.05-7
511384	0 +9.47-7	520846	2 +2.00-7	530312	0 +0.03-7
512244	2 +0.15-7	521707	0 +2.74-7	531172	0 +9.12-7
513104	2 +9.71-7	522568	2 +3.17-7	532032	0 +3.22-7

Tape Stopped at 532125 count Total Errors = 0

Figure C-11.

APPENDIX D
FAILURE ANALYSIS

APPENDIX D

FAILURE ANALYSIS

After equipment failure subsequent to the T/H testing, the unit was brought back to NAWC, Warminster, PA, where the Failure Analysis could be performed. During this Failure Analysis, it was observed that the Recorder *worked fine in E-E mode*, and that no Self-Diagnostic warnings were present. Tape motion and control appeared to be satisfactory. It was therefore suspected that, since during the entire T/H test (including during Test Pt #8) Recorder Power was On, and therefore the tape remained wrapped around the Scanner (in contact with the Heads, although no tape or head motion) perhaps the high temperature/humidity caused the tape to clog the heads.

In pursuit of this possible cause, two areas were investigated. Initially, the Sony's "Error Monitor" was polled. This Command indicates the activity of the ECC circuitry (shows "how hard the ECC circuits are working") on a per Head Channel basis. It was hoped that this information would point to one, or several poorly operating channels, thereby indicating which heads might be clogged. However, the data returned from this poll proved difficult to interpret.

Therefore, the Sony DIR-1000's "EQ-31" CCA was removed, in order to locate possible test points showing the Playback signal off the Heads. The CCA was removed and inspected for test points, then reinserted. When Power was turned On, and the Unit placed in Record mode, it **immediately** exhibited satisfactory (no bit errors) performance. The CCA may have become unseated or corroded during T/H testing, rather than there being clogged heads. However, since a lot of tape was run while trying to use the Error Monitor information, if there was a clogged head, perhaps the debris finally became dislodged, coincidentally at the same time the CCA was reseated.

Certainly, an unseated CCA seems more likely as the cause of failure, due to the Recorder's immediate recovery upon the card's reinsertion. The Failure Analysis was performed at NAWC after moving the Recorder; this alone may have caused the CCA to become unseated. Perhaps a combination of factors were at play. Whatever phenomenon was at work, it obviously did not irreparably damage the Recorder.

The cause of the temporary failure which occurred subsequent to the T/H testing remains unknown. The unit fully "recovered" prior to positive determination of failure mechanism. Additional testing is recommended to determine any possible T/H effect on long-term use of the unit.

APPENDIX E
PERFORMANCE TESTING

APPENDIX E

PERFORMANCE TESTING

At this point it will be useful to describe the Bit Error Rate testing used to evaluate the Recorder's performance. Figure 1 is a block diagram of the Performance Test Fixture. A Honeywell Bit Error Tester (BET) was used as the Bit Error Rate measuring device. The BET was configured to transmit and receive digital data in an eight bit parallel format, using balanced (differential) **TTL** logic levels. The Sony, however, records and plays back digital data using eight bit parallel, balanced **ECL** levels; therefore a TTL/ECL interface was designed and fabricated to connect the BET to the Sony recorder.

The Hewlett-Packard (HP) Computer Equipment shown in Figure 1 was used to read, display, and store the BER information from the BET. Additionally, control/synchronization of the BET and the Sony recorder was via the IEEE-488 and RS-422 interfaces shown.

DEFINITIONS

BIT ERROR RATE

Bit Error Rate is defined as the number of errors in a given size sample of data, divided by the data sample size. For example, if a sample of 10^8 data bits contained 233 bit errors, then for that 10^8 bit sample

$$\text{BER} = 233/10^8 = 2.33 \times 10^{-6}$$

The Bit Error Tester uses the Tau-Tron "BERTS-325" Bit Error Rate Test Set to generate fixed "pseudorandom" data patterns serially (for this test, the $2^{20} - 1$ pattern was selected), and to receive this data and count the errors. The BER test data shown in Appendices B and C comes from the Tau-Tron unit's IEEE-488 interface. Each BER sample, e.g.,

ID CNT.	BER
874 1	2.45-07

shows the number of individual bit errors (245) in the last 10^9 bit data sample. The **ID CNT** gives the Tape ID Count (location on tape) at the end of the 10^9 bit sample. If greater than 999 errors occur in a sample, a "+" sign appears before the BER mantissa, and the mantissa is meaningless. The single "1" above (could be 2, 3, or 4) is the "Present/Prior State" monitor of the Tau-Tron (see Tau-Tron manual for details).

ECC ON/OFF

The Sony DIR-1000 employs powerful Reed-Solomon Error Correction, whereby additional "check data" is appended to the User's digital data during Record. This check data is then used during Playback to locate and correct errors in the User's data. The Sony always appends this check data when recording, but it is a User option whether or not to use it during playback to correct the data. In general, of course, the User would "Turn ECC ON". For purposes of recorder diagnostics, trouble-shooting, or tape evaluation, it is desirable to "Turn ECC OFF". The Bit Error Rate obtained with ECC ON is known as the Corrected Bit Error Rate (CBER), while the BER with ECC OFF is referred to as the Uncorrected Bit Error Rate (UBER).

BIT ERROR TESTER SETTINGS

The CBER was used for this evaluation because of test equipment limitations. Evaluation of the UBER proved difficult for the following reasons: Recalling that a Tau-Tron overflow occurs when the bit errors in a given sample exceed 1000, an appropriate sample size should have been 10^7 bits or less, in order to avoid overflows, since the typical UBER of the Sony DIR-1000 was on the order of 10^{-5} ($100/10^7 = 10^{-5}$). However, at the 32 Mbps (3.2×10^7 bps) data rate used, a 10^7 bit sample occurred every 312.5 milliseconds — too fast for full real time processing with the current test set/software. A sample size of 10^8 bits, which would allow real time processing, could have been used, but any BER greater (worse) than 9.99×10^{-6} (999 errors out of 10^8 bits) resulted in a Tau-Tron Overflow. With a typical UBER of 1×10^{-5} (or worse, under the environmental stresses) too many overflows occurred to perform meaningful analysis on the data. Therefore, for this testing, the CBER was measured.

READ AFTER WRITE (R.A.W.)

The Sony DIR-1000 tested has eight Record Heads, and eight Playback Heads. The Playback Heads are positioned on the Scanner Wheel just behind the Record Heads; therefore, as data is recorded onto tape, it is immediately read by the Playback Heads, fully processed, Error Corrected (if ECC ON), and placed at the Data Output Connectors of the Recorder. This gives the Sony a "Read-After-Write" (R.A.W.) capability. BER data gathered during Read-After-Write will be referred to in this report as **R.A.W.** performance data (not the same as Raw Bit Error Rate) or **Record Test** data. BER data gathered by recording a section of tape, rewinding to the beginning of that section, and then playing the data back, will be referred to as **Subsequent Playback** data, or just **Playback** data.

E-E MODE

Figure 1 shows four "E-E Test Paths". These paths were used to troubleshoot/verify the Recorder and Test Equipment during the Environmental evaluation. Each path shown bypasses a portion of the test system, but still allows Bit Error Rate patterns to be generated and processed by the Tau-Tron BERTS. In the E-E mode, no errors should occur, if the electronics are in working order. In this manner, unsatisfactory operation could be isolated to: the Tau-Tron, the BET circuitry, the ECL/TTL circuitry, or the Sony DIR-1000. E-E Path #4 traverses some Sony electronics; it certainly does *not* record/reproduce data on/off tape, or move tape. Therefore, Sony mechanical, Head/Scanner, and Tape problems can be isolated from Sony electronic problems.

RECORDER DIAGNOSTICS

Bit Error Rate results were the principal means of evaluating Recorder performance, but occasionally the Sony Status/Diagnostics information was evaluated to verify failure, or data errors. Primarily used were the "Uncorrected Error Report", a report from the recorder's ECC circuitry that indicates a "failure to correct threshold" of the ECC, i.e., the ECC could not correct all the data transmitted; the "Lost Lock Report", an indication that at some point the Scanner/tape/clock Servo circuitry lost phase lock control; and the "System Error Status Report", a report on the static conditions of the circuit cards, sensors, motors, etc.

LIST OF TEST EQUIPMENT

- A) Sony DIR-1000, S/N 10503
- B) Honeywell BET (w/Tau-Tron), S/N 0300112YH86
- C) ECL/TTL Interface Unit, NADC #SB101(V)192
- D) Hewlett-Packard Computer, Model 310, S/N 2630A14610
- E) Hewlett-Packard Printer, QuietJet, S/N 2732S03345
- F) Hewlett-Packard Disc Drive, Model 9122, S/N 2732A04802
- G) BlackBox RS-232/RS-422 Converter, S/N 384665