TEST REPORT

PERFORMANCE TESTING
ON
240 TUBE FITTING CONNECTIONS
FOR
MR. ERAN PINTEL
HAM-LET CORPORATION
WYLE REPORT NO. 50666-01

HAM-LET Advanced Control Technology
5275-B Naiman Parkway
Solon, OH 44136

REVISIONS

wyle laboratories

REVISION A

REPORT NO. 50666-01

DATE August 6, 2004

REV.	DATE	PAGE OR PARAGRAPH AFFECTED	BY	APP'L	DESCRIPTION OF CHANGES
A	08/06/04	Cover	DB 8/9/04	A.M 08/09/04 P/PS/9/4 TRH 8/9/04	Added "Revision A" and date and added "FOR MR. ERAN PINTEL" to the report title.
A	08/06/04	Page 4, Section 1.3	DB 8/9/04	A.M 08/09/04 P/PS/9/4 TRH 8/9/04	Added "(per AISI 316)" after Stainless Steel in first sentence.
A	08/06/04	Pages B-6 through B-9	DB 8/9/04	A.M 08/09/04 P/PS/9/4 TRH 8/9/04	Added column of data titled "@ 1.25 Turns (Ft-lbs) W/O Stop Collar*" and note at bottom of tables for the 3/4-inch and 1-inch tables.
A	08/06/04	Page E-2	DB 8/9/04	A.M 08/09/04 P/PS/9/4 TRH 8/9/04	Added "See summary result." to notes at bottom of table.
A	08/06/04	Page F-2	DB 8/9/04	A.M 08/09/04 P/PS/9/4 TRH 8/9/04	Added "See summary result." to note at bottom of table.

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A

HAM-LET Advanced Control Technology
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STATE OF ALABAMA
COUNTY OF MADISON }

Robert L. Porter, Department Manager, being duly sworn, deposes and says: The information contained in this report is the result of complete and carefully conducted testing and is to the best of his knowledge true and correct in all respects.

Robert L Porter

SUBSCRIBED and sworn to before me this 18th day of June, 2004

Patricia R Phillips
Notary Public in and for the State of Alabama at Large

My Commission expires Jan. 16, 2005

SEAL

Wyle shall have no liability for damages of any kind to person or property, including special or consequential damages, resulting from Wyle's providing the services covered by this report.

TEST BY: David R Bailey 6/17/04
David R. Bailey, Project Engineer Date

APPROVED BY: Anthony Murks 06/18/04
Anthony Murks, Engineer Date

WYLE Q.A.: T R Hamilton 6/18/04
T. R. Hamilton, Quality Assurance Mgr. Date

(pap)

ACCREDITED
Cert No. 845.02

ISO 9001 QMI REGISTERED QUALITY SYSTEM

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1.0 INTRODUCTION

1.1 Scope

This report documents the test procedures followed and the results obtained during Performance Testing of 240 Stainless Steel Compression Style Tube Fitting Connections. Four sizes of Tube Fittings were tested (1/4-inch, ½-inch, ¾-inch and 1-inch). Sixty samples of each size were submitted for testing. Testing was performed at Wyle Laboratories' Huntsville, Alabama, Test Facility from March 8, 2003, to June 10, 2004.

1.2 References

- HAM-LET Purchase Order No. 23880
- Wyle Laboratories' Quotation No. 542/023874/DB
- Wyle Laboratories' Quality Assurance Program Manual, Revision 2
- "Appendix A: Tube Fitting Test Procedure" as an Attachment to "GE Specification 362A2195"
- ANSI/NCSL Z540-1, "Calibration Laboratories and Measuring and Test Equipment, General Requirements"
- ASTM F1387-99
- SAE MA2003, "Rotary Flexure of Hydraulic Tubing Joints and Fittings"
- ISO 10012-1, "Quality Assurance Requirements for Measuring Equipment"
- MIL-STD-45662A, "Calibration System Requirements"

1.3 Test Specimen Description

Test specimens supplied by HAM-LET, were Stainless-Steel (per AISI 316) Mechanically-Attached Hydraulic Tube Fittings – Compression Style. Each specimen consisted of a Nut, a Front Ferrule and a Rear Ferrule. Photographs of the test specimens are presented in Attachment A of this report. **A**

1.4 Summary

The test specimens were successfully subjected to the following environmental conditions.

- Pneumatic Proof Test
- Hydrostatic Proof Test
- Rotary Flex Test

1.0 INTRODUCTION (Continued)

1.4 Summary (Continued)

- Flex Fatigue Test
- Tensile Test
- Temperature Cycling Test
- Elevated Temperature Soak Test
- Vibration Test
- Hydraulic Impulse Test
- Burst Pressure Test
- Repeated Assembly (combined with Impulse and Flex Fatigue)

The sequence of testing was performed in accordance with Flow Chart Rev. 09 presented in Appendix A, Rev. 04, of GE Specification 362A2195, Rev. 0. This Flow Chart, supplied by GE, was derived from the ASTM F1387 test specification.

Changes to the test procedure were incorporated, as discussed with GE, as testing progressed. Each change is discussed as it relates to the specific test it affected. Specimens identified in the following attachments that either did not complete the test or that became inoperative were because of procedural adjustments, with two exceptions. One specimen in the Tensile Test fell short of the minimum yield strength. The second exception occurred as a result of tubing failures during the Burst Test. Test details are reported in that Attachment. After testing, all specimens were returned to HAM-LET for review.

The test results contained herein apply only to the test specimens identified in this report.

2.0 TEST PROCEDURES AND RESULTS

2.1 Pneumatic Test

Prior to performing this test, each specimen was identified and assembled in a manifold configuration. The manifold configuration, which was specified in Appendix A, Rev. 01, of GE Specification 362A2195, Rev. 0, allowed for identification of all test items. The process was repeated for each of the four test sizes.

The assembly process was performed by installing the test specimens onto supplied stainless steel tubing lengths (see Attachment O of this report for the Tubing Material Certifications). The specimens were installed onto mating connectors, including stop collars/rings in accordance with Appendix A of GE Specification 362A2195, Section 6.2.

2.0 TEST PROCEDURES AND RESULTS (Continued)

2.1 Pneumatic Test (Continued)

The installation process included: establishing firm finger-tight conditions, marking the location at that point, tightening the specimen 1.25 turns, and verifying if the stop collar was loose or tight. The torque to achieve this point was recorded. If the stop collar was loose, the specimen was further tightened until the stop collar was captured. The torque value was updated in this event. These measurements were documented and are presented in the Pneumatic Test Data Sheet in Attachment B.

After complete assembly of each manifold, the manifolds were submerged under water and pressurized to 100 psig for a minimum of 5 minutes. No leakage was noted. The pressure was increased to 500 psig and maintained for 5 minutes. No leakage was noted. This test was repeated for each of the four sizes. The manifolds were then disassembled and prepared for the Hydrostatic Test.

Photographs of the test setup and in-process testing are presented in Attachment A. The Instrumentation Equipment Sheets for the test setup are presented in Attachment R.

2.2 Hydrostatic Test

After disassembly, the stop collars were removed from the test setup. The specimens were then re-assembled in accordance with Appendix A of the GE Specification, Section 6.3. This completed the first of many make and break (Repeated Assembly) requirements.

The manifolds were initially pressurized to 100 psig with water for five minutes. No leakage was noted.

Each manifold was then hydrostatically pressurized to 125% rated pressure (11,250 for the 1/4 inch, 7650 for the 1/2 inch, 7350 for the 3/4 inch, and 5400 psig for the 1 inch). Test results are presented in Attachment C.

Photographs of the test setup and in-process testing are presented in Attachment A. The Instrumentation Equipment Sheets for the test setup are presented in Attachment R.

2.3 Rotary Flex Test

Six samples of each size were subjected to the Rotary Flex requirements specified in Appendix A, Rev. 04, of GE Specification 362A2195, Rev. 0. The specimens were tested while pressurized with water to 500 psig. Each specimen was instrumented with two strain gages on the tube at approximately 0.125 inch away from the nut. The gages were located 90 degrees apart.

2.0 TEST PROCEDURES AND RESULTS (Continued)

2.3 Rotary Flex Test (Continued)

With GE approval, an acceptable stress level was reached that was in direct relation to SAE Test Method MA2003, Sections 4.2.2 to 4.2.4, which specifically addresses tube breakage prior to reaching the required number of cycles. This method allowed for reduction of the stress level based on performance achieved. Testing was performed at a minimum of 1750 RPM until 1,000,000 cycles were completed or until the test was halted.

Immediately following the Rotary Flex Testing, the specimens reaching 1,000,000 cycles were subjected to a Hydrostatic Test with no anomalies noted.

The final stress levels applied were (units in micro strain) 760 for the 1/4-inch, 679 for both the 1/2-inch and 3/4-inch, and 810 for the 1-inch.

Typical Stress calculations are presented in Attachment P. The test results for the Rotary Flex specimens are presented in Attachment G.

Photographs of the test setup and in-process testing are presented in Attachment A. The Instrumentation Equipment Sheets for the test setup are presented in Attachment R.

2.4 Flex Fatigue Test

Six samples of each size were subjected to the Flex Fatigue requirements specified in Appendix A of GE Specification 362A2195. The test specimens were tested while pressurized with water. Each specimen was instrumented with two strain gages on the tube at approximately 0.125 inch away from the nut. The gages were located 180 degrees apart.

The specimens were subjected to a preset stress level according to the tube size. The levels were (units in microstrain): 1155 for 1/4-inch, 1098 for 1/2-inch, 823 for 3/4-inch, and 805 for 1-inch. This stress level was established and then the test pressure was applied. Pressure and strain were monitored during the flex cycles and strain was recorded at periodic intervals to verify the stress levels.

The specimens were then exercised in a side-to-side motion, with the maximum strain applied at each endpoint. The return to mid-point passed through null or zero stress before going to the opposite direction. This motion completed one cycle, and 30,000 cycles were performed. The flexure rate was established at one per second.

2.0 TEST PROCEDURES AND RESULTS (Continued)

2.4 Flex Fatigue Test (Continued)

Half of the specimens were also subjected to repeated assembly. After 7500 cycles, testing was stopped and the specimens were disassembled and reassembled two times in accordance with Appendix A of GE Specification 362A2195, Section 6.3. After completion of 30,000 cycles, the specimens were re-subjected to the Hydrostatic Test. Passing the hydrostatic function is noted in the Test Data Sheet in Attachment H.

Immediately following the Flex Fatigue Testing, the specimens reaching 30,000 cycles were subjected to a Hydrostatic Test with no anomalies noted.

Photographs of the test setup and in-process testing are presented in Attachment A. The Instrumentation Equipment Sheets for the test setup are presented in Attachment R.

2.5 Thermal Cycling Test

The test specimens were assembled into a continuous manifold configuration with the permission of GE. This allowed the conditioning fluid to flow completely through the manifold. This assembly was repeated for each of the four sizes. Photographs of the assembly are presented in Attachment A.

Testing was performed in two phases. The first phase subjected the manifold to high temperature (500°F) conditions for two hours followed by a quick (<2 minutes) transient to ambient conditions (70°F). During the entire process, the manifold was pressurized at 700 psig for the high temperature and 200 psig for the ambient temperature. This procedure was repeated for three complete cycles. The manifold was monitored for leakage during the test. For both phases of the test program, a thermocouple was mounted directly to the tube wall mid-way along the manifold length. This thermocouple was used to time the saturation period and to indicate when to begin the transient. A second thermocouple was attached at the discharge nozzle just beyond the outlet to measure the fluid temperature during the test program. This thermocouple was utilized as the indicator for completion of the temperature transient.

The second phase was to subject the manifold to low temperature (0°F) for a period of two hours while pressurized with nitrogen at 200 psig. This was followed by a quick transient to 70°F in less than two minutes, using hot water at a minimum of 200 psig. This process was repeated for three complete cycles. The manifold was monitored for leakage during the temperature exposure periods.

2.0 TEST PROCEDURES AND RESULTS (Continued)

2.5 Thermal Cycling Test (Continued)

After thermal cycling was completed, the manifolds were hydrostatically checked and the results were posted on Test Data Sheets, which are presented in Attachments I and J. No anomalies were noted.

Immediately following the Thermal Cycling Testing, the specimens were subjected to a Hydrostatic Test with no anomalies noted.

Photographs of the test setup and in-process testing are presented in Attachment A. The Instrumentation Equipment Sheets for the test setup are presented in Attachment R.

2.6 Elevated Temperature Soak Test

The test manifolds were re-configured for the proper test specimens in a continuous flow manifold. The specimens were placed in a test chamber and pressurized to 250 psig. This pressure was maintained during the test period. The chamber temperature was elevated to 500°F and maintained for 100 hours. The specimens were checked periodically to verify that no leakage was occurring.

Immediately following the Elevated Temperature Soak Testing, the sections were subjected to a Hydrostatic Test with no anomalies noted.

Photographs of the test setup and in-process testing are presented in Attachment A. Copies of the circular charts for the exposure period are presented in Attachment M. The Instrumentation Equipment Sheets for the test setup are presented in Attachment R.

2.7 Vibration Test

The tubing manifolds were re-configured into three sections in accordance with Figure 7.11A of Appendix A, Rev. 04, of GE Specification 362A2195, Rev. 0. Each size of tubing was mounted to specific dimensions regarding the spacing between centers. Each section contained one union, having two specimens in the middle of the mounting configuration for a total of six specimens per size.

For measurement of specimen vibration characteristics, a miniature accelerometer was mounted to the union in the center of the section. This accelerometer was then rotated each time the vibration was applied in each of the three directions.

2.0 TEST PROCEDURES AND RESULTS (Continued)

2.7 Vibration Test (Continued)

The specimens were pressurized and monitored for leakage during the entire vibration program. The pressure used for the 1/4-inch was 7500 psig, for 1/2-inch was 5100 psig, for the 3/4-inch was 4900 psig, and for the 1-inch was 3600 psig.

The specimens were then subjected to variable frequency vibration from 4 to 60 Hz, at 5 minutes per frequency. The test levels and durations are presented in the Vibration Data Sheets in Attachment L. Immediately following the Variable Frequency Testing, the sections were subjected to a Hydrostatic Test with no anomalies noted.

The specimens were then subjected to Endurance Testing based on any resonance found during the Variable Frequency Test, or a maximum of 60 Hz if none were noted. For this test, there were no resonances noted and all Endurance Testing was performed at 60 Hz. The test levels and durations are presented in the Vibration Data Sheets in Attachment L. Immediately following the Endurance Testing, the sections were subjected to a Hydrostatic Test with no anomalies noted.

Photographs of the test setup and in-process testing are presented in Attachment A. The Instrumentation Equipment Sheets for the test setup are presented in Attachment R.

2.8 Tensile Test

Six specimens of each size were subjected to Tensile Testing after being subjected to Pneumatic and Hydrostatic Testing. Testing was performed under subcontract and details of the test results are presented in Attachment F. One 3/4-inch sample released before achieving the required minimum value and is reported in the Test Data Sheet. All other samples met or exceeded the minimum tensile strength.

2.9 Hydrostatic Burst Test

Eight specimens of each size were subjected to Hydrostatic Burst Testing after having first successfully passed Pneumatic, Hydrostatic, Thermal Cycle and Elevated Temperature Soak Tests.

Four specimens were tested at the same time in accordance with Figure 7.4A of Appendix A, Rev. 04, of GE Specification 362A2195, Rev. 0. This configuration placed two tube sections, with two specimens each, end to end with a union in the middle and a stop plug on one end. The assembly was then pressurized to four times the working pressure of the size being tested.

2.0 TEST PROCEDURES AND RESULTS (Continued)

2.9 Hydrostatic Burst Test (Continued)

- 30,000 psig for the 1/4-inch
- 20,400 psig for the 1/2-inch
- 16,600 psig for the 3/4-inch
- 14,400 psig for the 1-inch

Each assembly was pressurized at a rate not exceeding 25,000 psig/minute. Pressure was then held for one minute.

All components for the 3/4-inch and 1/4-inch sizes passed. The tubing ruptured on one section of the 1/2-inch and 1-inch specimens prior to reaching the required minimum. This test involved 4 of the 8 specimens. Results are indicated in the Test Data Sheets in Attachment E. Tubing Rupture is identified in the results column as Failed* with explanation as to cause.

Photographs of the test setup and in-process testing are presented in Attachment A. The Instrumentation Equipment Sheets for the test setup are presented in Attachment R.

2.10 Hydraulic Impulse Test

Six specimens of each size were subjected to the Hydraulic Impulse Test. Two specimens on a common tube were attached to a manifold block. Three common tubes were attached to the block, making a total of six specimens.

The specimens were filled with MIL-H-5606 hydraulic fluid and subjected to one-million pressure cycles. Pressures were 9975 to 1500 psig for the 1/4-inch, 6783 to 1120 psig for the 1/2-inch, 6517 to 980 psig for the 3/4-inch and 4788 to 720 psig for the 1-inch. The cycle rate was controlled to less than 75 cycles per minute. Half of the specimens were subjected to Repeated Assembly after every 250,000 cycles.

The test specimens met the criteria for no leakage after completing one-million cycles. Results are indicated in the Test Data Sheets in Attachment D.

Photographs of the test setup and in-process testing are presented in Attachment A. The Instrumentation Equipment Sheets for the test setup are presented in Attachment R.

3.0 TEST EQUIPMENT AND INSTRUMENTATION

All instrumentation, measuring, and test equipment used in the performance of this test program were calibrated in accordance with Wyle Laboratories' Quality Assurance Program, which complies with the requirements of ANSI/NCSL Z540-1, ISO 10012-1, and Military Specification MIL-STD-45662A. Standards used in performing all calibrations are traceable to the National Institute of Standards and Technology (NIST) by report number and date. When no national standards exist, the standards are traceable to international standards or the basis for calibration is otherwise documented.

4.0 QUALITY ASSURANCE PROGRAM

All work performed on this test program was completed in accordance with Wyle Laboratories' Quality Assurance Program.

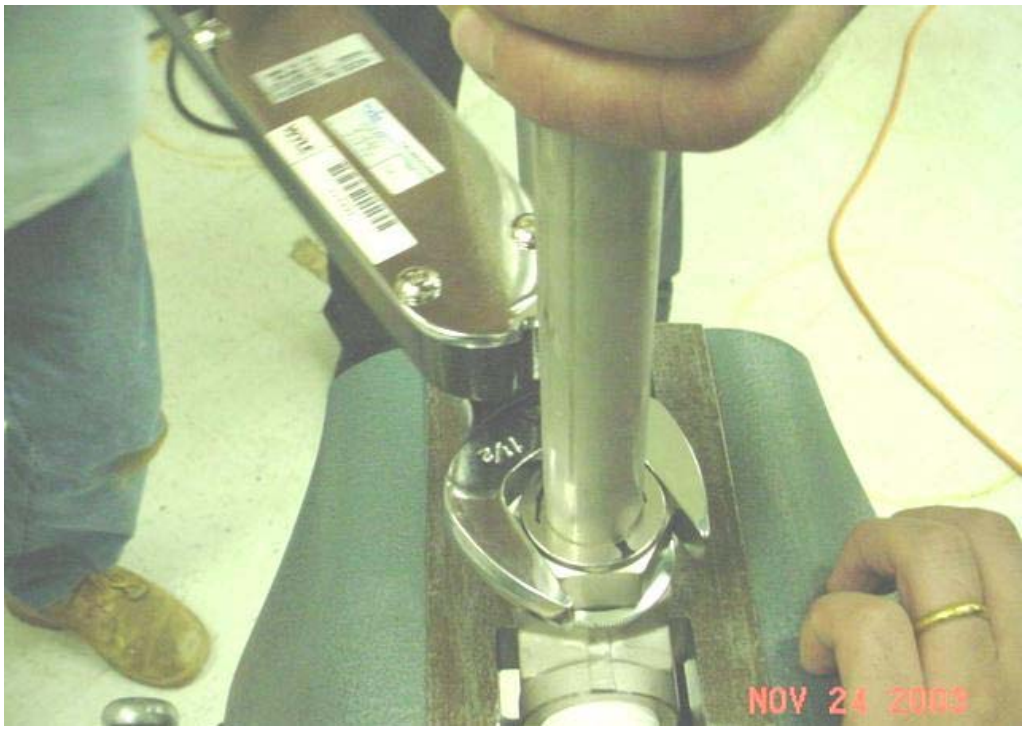
The Wyle Laboratories, Huntsville Facility, Quality Management System is registered in compliance with the ISO-9001 International Quality Standard. Registration has been completed by Quality Management Institute (QMI), a Division of Canadian Standards Association (CSA).

Wyle Laboratories is accredited (Certificate No. 845.02) by the American Association for Laboratory Accreditation (A2LA), and the results shown in this test report have been determined in accordance with Wyle's scope of accreditation unless otherwise stated in the report.

ATTACHMENT A

PHOTOGRAPHS

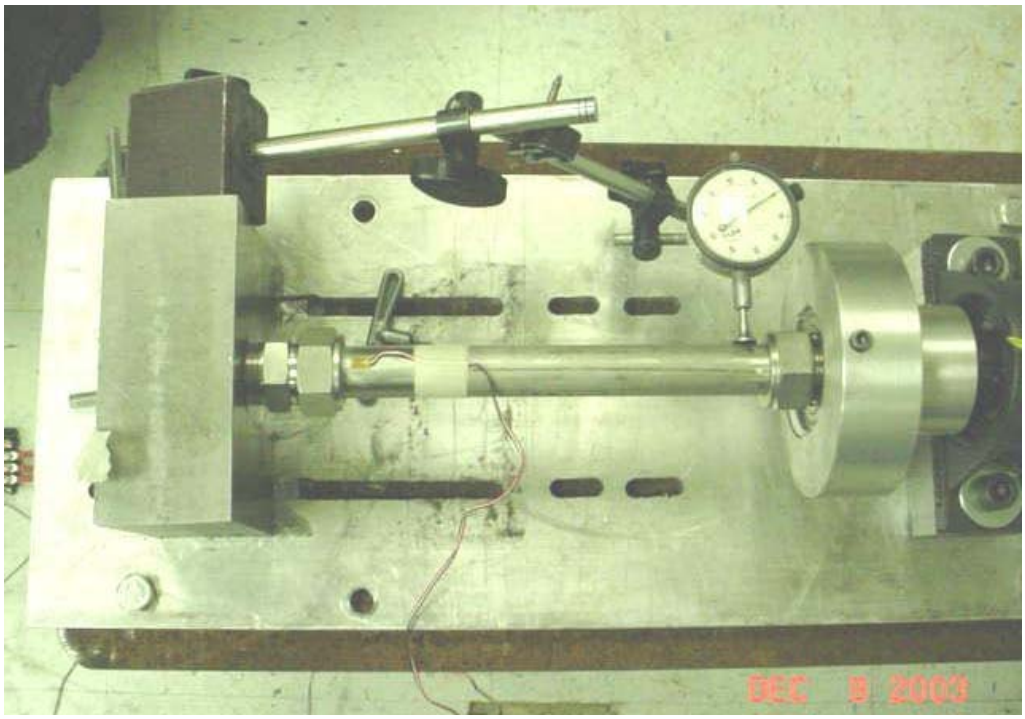
Photograph No. 1. Typical Torque and Assembly Technique



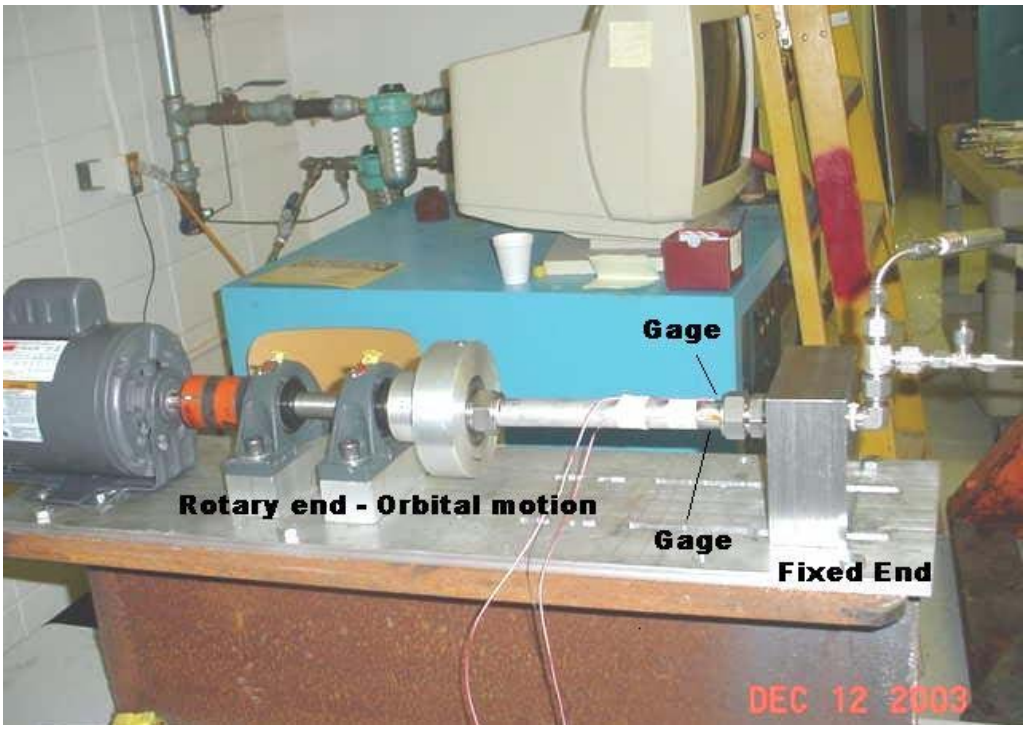
Photograph No. 2. Index Marking for Turn Identification

Photograph No. 3. Verifying Stop Collar Tightness

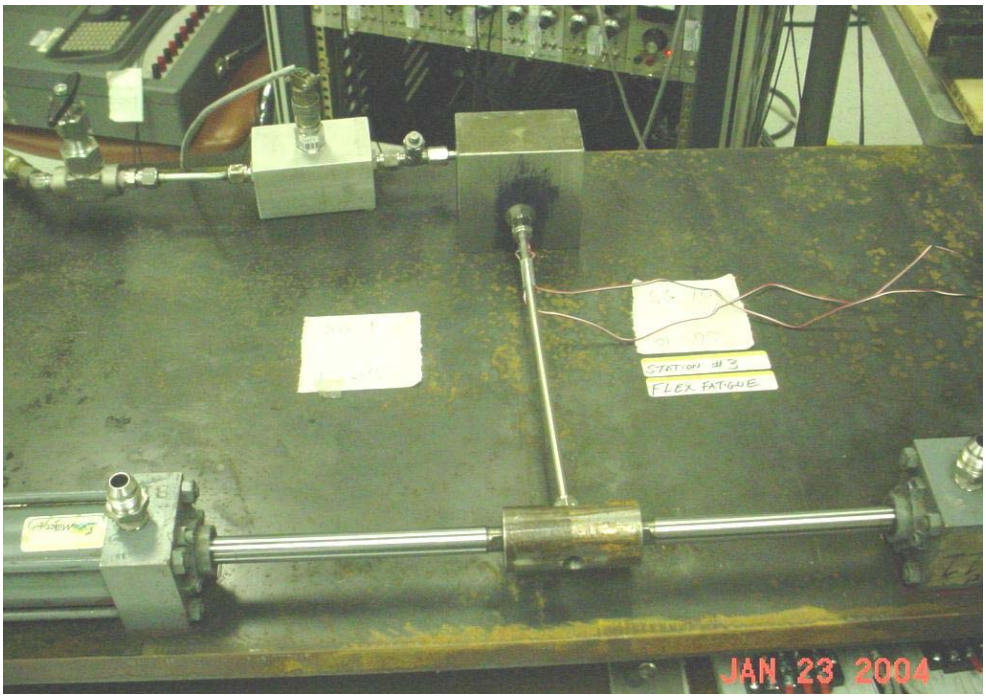
Photograph No. 4. Typical View of Manifold for Pneumatic Proof Test



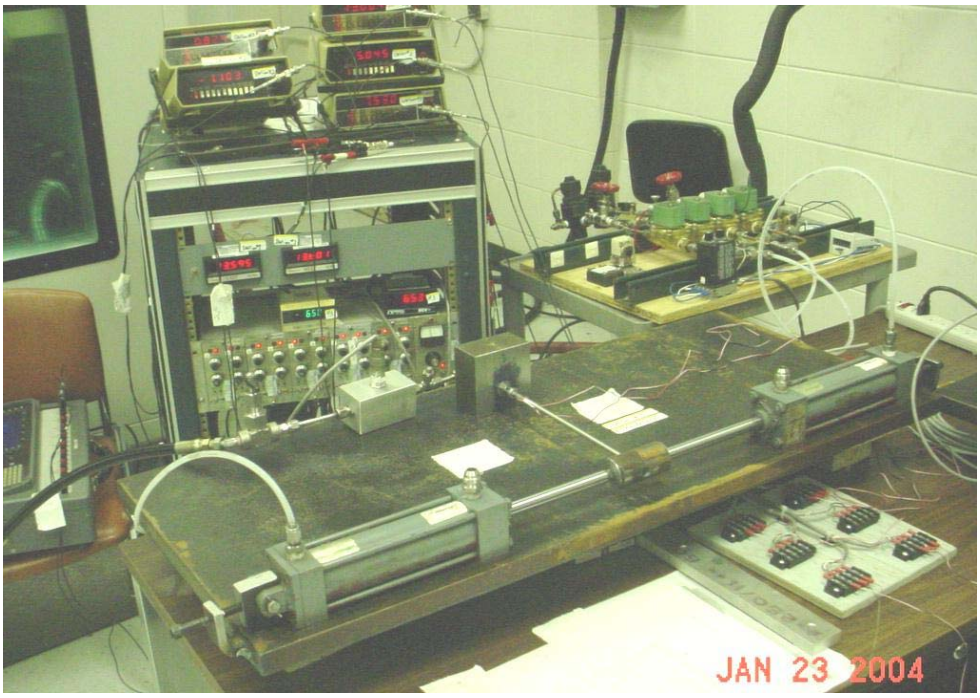
Photograph No. 5. Rotary Flex Setup



Photograph No. 6. Overall View of Rotary Flex Test Setup



Photograph No. 7. Typical Flex Fatigue Mechanical Setup



Photograph No. 8. Complete Setup of Gages, Pressure and Control System

Photograph No. 9. Typical Setup for Temperature Cycle Testing

Photograph No. 10. Low Temperature Condition Setup

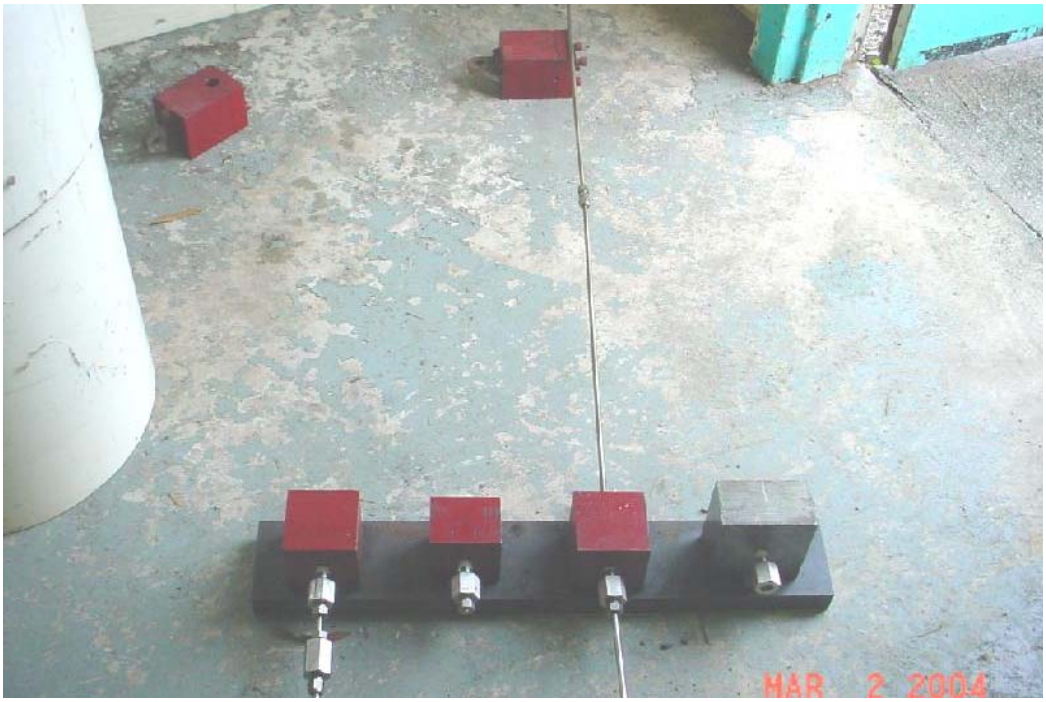
Photograph No. 11. Typical Hydraulic Impulse Mechanical Setup

Photograph No. 12. Hydraulic Impulse Control System

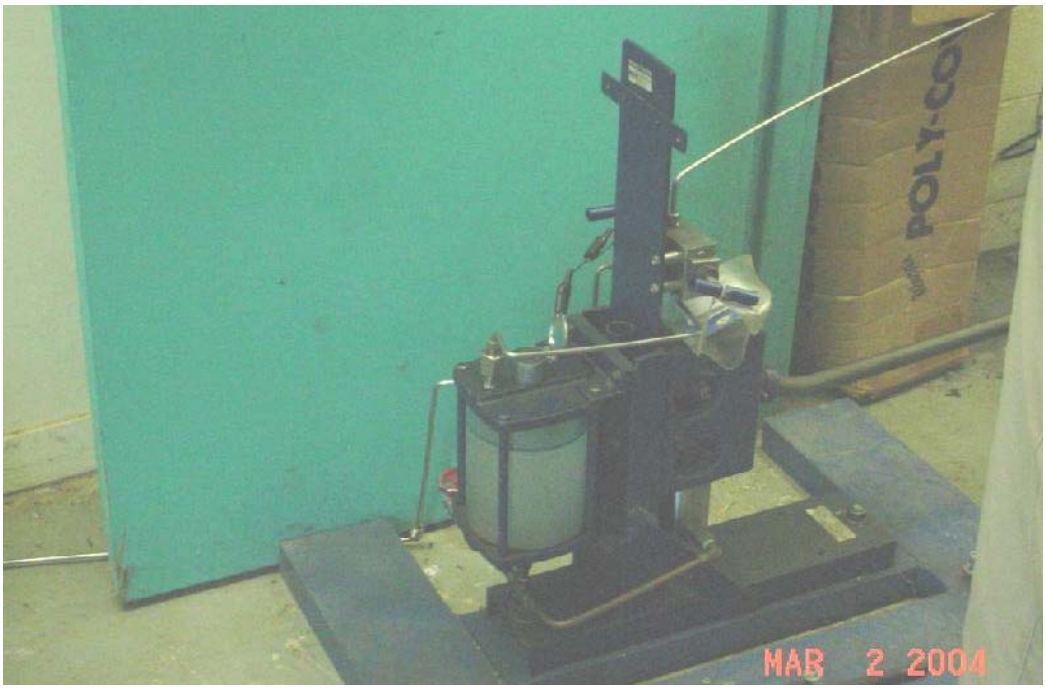
Photograph No. 13. Typical Vibration Test Setup

Photograph No. 14. Test Chamber for Elevated Temperature Test

Photograph No. 15. Manifolds Installed in Test Chamber



Photograph No. 16. Typical Burst Test Manifold Setup



Photograph No. 17. High-Pressure Pump for Burst Test

ATTACHMENT B

PNEUMATIC TEST DATA

TEST NO. 5.1
Data Collection Requirements for Pneumatic Proof Tests

GE Torque Information in ft/lbs: A=1.25 turns; Tube Stickage rating E=easy/M=moderate/D=difficult /F=failure
Comments: Tested @ 125% of Rating

1/4-Inch

New I.D. HAM-LET	Torque Values			
	@ 1.25 Turns Ft-lbs	Seat Collar (Y/N)	If = N, record Ft-lbs	Accept
1	12.63	Y		Pass
2	12.60	Y		Pass
3	16.29	Y		Pass
4	11.38	Y		Pass
5	16.49	Y		Pass
6	13.25	Y		Pass
7	12.57	Y		Pass
8	13.14	Y		Pass
9	14.99	Y		Pass
10	10.66	N	12.87	Pass
11	14.19	Y		Pass
12	11.65	Y		Pass
13	11.26	Y		Pass
14	17.53	Y		Pass
15	10.55	Y		Pass
16	11.89	Y		Pass
17	12.83	Y		Pass
18	12.16	Y		Pass
19	14.00	Y		Pass
20	15.19	Y		Pass
21	15.72	Y		Pass
22	16.71	Y		Pass
23	11.92	Y		Pass
24	12.13	Y		Pass
25	14.81	Y		Pass
26	16.18	Y		Pass
27	15.15	Y		Pass
28	17.02	Y		Pass
29	14.10	Y		Pass
30	13.29	Y		Pass
31	13.07	Y		Pass
32	11.56	Y		Pass
33	15.48	Y		Pass

TEST NO. 5.1 (Continued)
Data Collection Requirements for Pneumatic Proof Tests

GE Torque Information in ft/lbs: A=1.25 turns; Tube Stickage rating E=easy/M=moderate/D=difficult /F=failure
Comments: Tested @ 125% of Rating

1/4-Inch (Continued)

New I.D. HAM-LET	Torque Values			
	@ 1.25 Turns Ft-lbs	Seat Collar (Y/N)	If = N, record Ft-lbs	Accept
34	12.78	Y		Pass
35	12.80	Y		Pass
36	15.19	Y		Pass
37	13.95	Y		Pass
38	12.60	Y		Pass
39	12.60	Y		Pass
40	13.40	Y		Pass
41	14.81	Y		Pass
42	12.19	Y		Pass
43	12.50	Y		Pass
44	12.74	Y		Pass
45	12.29	Y		Pass
46	12.01	Y		Pass
47	10.82	Y		Pass
48	13.10	Y		Pass
49	11.68	Y		Pass
50	13.15	N	15.01	Pass
51	13.82	Y		Pass
52	12.54	Y		Pass
53	14.94	Y		Pass
54	12.68	Y		Pass
55	13.46	Y		Pass
56	13.35	Y		Pass
57	11.54	Y		Pass
58	14.12	Y		Pass
59	12.74	Y		Pass
60	11.27	Y		Pass

TEST NO. 5.1

Data Collection Requirements for Pneumatic Proof Tests

GE Torque Information in ft/lbs: A=1.25 turns; Tube Stickage rating E=easy/M=moderate/D=difficult /F=failure
Comments: Tested @ 125% of Rating

1/2-Inch

New I.D. HAM-LET	Torque Values			
	@ 1.25 Turns Ft-lbs	Seat Collar (Y/N)	If = N, record Ft-lbs	Accept
1	41.60	N	45.50	Pass
2	47.08	Y		Pass
3	35.58	Y		Pass
4	42.44	Y		Pass
5	44.64	N	44.64	Pass
6	46.20	N	49.40	Pass
7	47.00	N	50.45	Pass
8	39.15	N	50.01	Pass
9	40.75	Y		Pass
10	38.65	N	42.72	Pass
11	46.18	Y		Pass
12	42.90	N	49.03	Pass
13	40.66	N	45.42	Pass
14	37.31	Y		Pass
15	39.75	N	43.47	Pass
16	42.75	N	47.47	Pass
17	36.00	N	38.35	Pass
18	38.98	Y		Pass
19	38.16	N	44.75	Pass
20	34.96	N	40.16	Pass
21	35.36	N	38.64	Pass
22	35.76	N	39.64	Pass
23	39.93	Y		Pass
24	39.16	N	40.66	Pass
25	38.04	N	42.93	Pass
26	41.98	Y		Pass
27	40.00	N	41.77	Pass
28	50.16	Y		Pass
29	56.69	Y		Pass
30	42.31	N	49.57	Pass
31	34.75	N	39.04	Pass
32	46.86	N	50.18	Pass
33	39.00	N	39.49	Pass

TEST NO. 5.1 (Continued)

Data Collection Requirements for Pneumatic Proof Tests

GE Torque Information in ft/lbs: A=1.25 turns; Tube Stickage rating E=easy/M=moderate/D=difficult /F=failure
Comments: Tested @ 125% of Rating

1/2-Inch (Continued)

New I.D. HAM-LET	Torque Values			
	@ 1.25 Turns Ft-lbs	Seat Collar (Y/N)	If = N, record Ft-lbs	Accept
34	43.55	N	46.81	Pass
35	35.30	N	39.37	Pass
36	39.25	N	43.53	Pass
37	39.31	N	49.27	Pass
38	39.19	N	48.23	Pass
39	41.29	N	44.46	Pass
40	36.05	N	41.15	Pass
41	50.00	Y		Pass
42	37.54	N	38.92	Pass
43	49.00	N	49.39	Pass
44	43.95	N	48.47	Pass
45	34.72	N	41.26	Pass
46	39.12	N	47.08	Pass
47	36.66	N	43.17	Pass
48	35.58	N	40.76	Pass
49	39.04	N	39.04	Pass
50	36.83	Y		Pass
51	41.66	N	44.27	Pass
52	39.54	N	50.00	Pass
53	46.00	N	47.66	Pass
54	40.87	N	44.55	Pass
55	37.99	N	50.00	Pass
56	37.86	N	45.12	Pass
57	37.98	Y		Pass
58	38.46	N	43.31	Pass
59	37.84	N	44.57	Pass
60	35.61	N	40.04	Pass

TEST NO. 5.1

Data Collection Requirements for Pneumatic Proof Tests

GE Torque Information in ft/lbs: A=1.25 turns; Tube Stickage rating E=easy/M=moderate/D=difficult /F=failure
Comments: Tested @ 125% of Rating

3/4-Inch

New I.D. HAM-LET	Torque Values				
	@ 1.25 Turns Ft-lbs	Seat Collar (Y/N)	If = N, record Ft-lbs	@ 1.25 Turns (Ft-lbs) W/O Stop Collar *	Accept
1	101.9	Y		66.14	Pass
2	110.8	Y		54.70	Pass
3	92.6	Y		41.04	Pass
4	101.7	N	101.7	46.51	Pass
5	94.3	N	94.3	49.68	Pass
6	115.0	Y		66.59	Pass
7	89.9	Y		52.12	Pass
8	90.2	Y		56.10	Pass
9	107.8	Y		73.82	Pass
10	103.5	Y		52.63	Pass
11	105.9	Y		50.86	Pass
12	99.0	Y		83.42	Pass
13	99.0	Y		82.68	Pass
14	98.1	Y		82.24	Pass
15	109.2	Y		51.82	Pass
16	102.0	Y		53.15	Pass
17	128.5	Y		50.79	Pass
18	112.8	Y		59.94	Pass
19	131.0	N	131.0	55.81	Pass
20	115.5	Y		57.28	Pass
21	81.3	Y		51.60	Pass
22	121.4	Y		50.12	Pass
23	106.1	Y		62.82	Pass
24	103.6	Y		58.76	Pass
25	101.5	Y		56.69	Pass
26	120.7	Y		64.96	Pass
27	100.5	Y		50.94	Pass
28	92.8	Y		51.60	Pass
29	92.3	Y		53.59	Pass
30	94.6	Y		53.96	Pass
31	114.3	Y		48.13	Pass
32	124.4	Y		51.45	Pass
33	121.2	N	121.2	56.69	Pass

***Data provided by HAM-LET.**

TEST NO. 5.1 (Continued)

Data Collection Requirements for Pneumatic Proof Tests

GE Torque Information in ft/lbs: A=1.25 turns; Tube Stickage rating E=easy/M=moderate/D=difficult /F=failure
Comments: Tested @ 125% of Rating

3/4-Inch (Continued)

New I.D. HAM-LET	Torque Values				Accept
	@ 1.25 Turns Ft-lbs	Seat Collar (Y/N)	If = N, record Ft-lbs	@ 1.25 Turns (Ft-lbs) W/O Stop Collar *	
34	114.4	Y		56.18	Pass
35	135.9	Y		54.11	Pass
36	100.0	Y		58.61	Pass
37	101.5	Y		74.71	Pass
38	102.3	Y		65.18	Pass
39	82.7	Y		56.32	Pass
40	101.9	Y		57.80	Pass
41	103.2	Y		60.98	Pass
42	102.8	Y		63.71	Pass
43	115.4	Y		57.36	Pass
44	109.1	Y		52.56	Pass
45	94.9	Y		56.77	Pass
46	115.3	Y		63.63	Pass
47	113.6	Y		NA	Pass
48	112.3	Y		NA	Pass
49	119.2	Y		NA	Pass
50	121.4	Y		NA	Pass
51	145.2	Y		NA	Pass
52	123.8	Y		NA	Pass
53	101.2	Y		NA	Pass
54	123.0	Y		NA	Pass
55	97.9	Y		NA	Pass
56	98.3	Y		NA	Pass
57	115.2	N	115.2	NA	Pass
58	117.1	Y		NA	Pass
59	106.4	Y		NA	Pass
60	96.0	N	96.0	NA	Pass

***Data provided by HAM-LET.**

TEST NO. 5.1

Data Collection Requirements for Pneumatic Proof Tests

GE Torque Information in ft/lbs: A=1.25 turns; Tube Stickage rating E=easy/M=moderate/D=difficult /F=failure
Comments: Tested @ 125% of Rating

1-Inch

New I.D. HAM-LET	Torque Values				
	@ 1.25 Turns Ft-lbs	Seat Collar (Y/N)	If = N, record Ft-lbs	@ 1.25 Turns (Ft-lbs) W/O Stop Collar *	Accept
1	133.7	N	133.7	109.55	Pass
2	90.4	N	90.4	108.15	Pass
3	162.7	Y		101.35	Pass
4	158.7	N	158.7	107.04	Pass
5	179.7	Y		95.30	Pass
6	161.7	Y		96.04	Pass
7	170.5	N	170.5	96.19	Pass
8	147.1	Y		107.04	Pass
9	171.1	Y		99.66	Pass
10	180.7	N	180.7	102.02	Pass
11	176.2	N	176.2	95.67	Pass
12	187.4	Y		96.78	Pass
13	157.0	N	157.0	98.33	Pass
14	165.9	N	165.9	95.15	Pass
15	172.2	N	172.2	100.84	Pass
16	148.7	N	148.7	98.40	Pass
17	188.5	N	188.5	97.44	Pass
18	184.9	N	184.9	99.80	Pass
19	172.4	N	172.4	97.59	Pass
20	150.2	N	150.2	96.63	Pass
21	134.2	N	134.2	96.19	Pass
22	97.5	N	97.5	96.19	Pass
23	138.4	N	138.4	99.07	Pass
24	145.0	Y		95.82	Pass
25	152.5	N	152.5	95.30	Pass
26	198.0	Y		96.04	Pass
27	158.2	N	158.2	101.13	Pass
28	119.8	Y		100.10	Pass
29	136.2	Y		97.52	Pass
30	163.1	N	163.1	95.74	Pass
31	134.1	N	134.1	102.83	Pass
32	171.5	N	171.5	102.46	Pass
33	196.6	Y		98.70	Pass

***Data provided by HAM-LET.**

TEST NO. 5.1 (Continued)

Data Collection Requirements for Pneumatic Proof Tests

GE Torque Information in ft/lbs: A=1.25 turns; Tube Stickage rating E=easy/M=moderate/D=difficult /F=failure
Comments: Tested @ 125% of Rating

1-Inch (Continued)

New I.D. HAM-LET	Torque Values				Accept
	@ 1.25 Turns Ft-lbs	Seat Collar (Y/N)	If = N, record Ft-lbs	@ 1.25 Turns (Ft-lbs) W/O Stop Collar *	
34	132.4	Y		96.26	Pass
35	120.0	N	120.0	97.15	Pass
36	155.6	N	155.6	98.11	Pass
37	136.2	Y		102.54	Pass
38	126.1	Y		97.15	Pass
39	163.9	N	163.9	97.81	Pass
40	137.1	N	137.1	96.56	Pass
41	122.5	Y		95.23	Pass
42	134.8	Y		100.54	Pass
43	146.0	Y		99.51	Pass
44	127.6	N	127.6	98.62	Pass
45	156.8	N	156.8	95.08	Pass
46	156.2	Y		NA	Pass
47	187.5	N	187.5	NA	Pass
48	188.1	Y		NA	Pass
49	139.8	Y		NA	Pass
50	143.9	N	143.9	NA	Pass
51	158.1	Y		NA	Pass
52	136.1	N	136.1	NA	Pass
53	170.0	Y		NA	Pass
54	98.9	Y		NA	Pass
55	144.9	N	144.9	NA	Pass
56	136.4	Y		NA	Pass
57	143.4	N	143.4	NA	Pass
58	168.8	Y		NA	Pass
59	148.6	N	148.6	NA	Pass
60	146.1	Y		NA	Pass

***Data provided by HAM-LET.**

ATTACHMENT C

HYDROSTATIC TEST DATA

TEST NO. 5.2

Data Collection Requirements for Hydrostatic Tests
GE Torque Information (Remake Information)

A rating of "M" would describe a disassembly requiring moderate flexing of the tube by hand back and forth in the same plane for removal. A rating of "D" would describe an instance where tools such as pliers, channel locks, vise grips, hammer, vise, etc. would be required for disassembling the connection. A rating of "F" would describe a connection that simply cannot be disassembled even with the aid of tools.

Comments: Tested @ 125% of Rating

1/4-Inch

New I.D. HAM-LET	1st Remake Torque	Tube Stickage	Accept
1	11.42	M	Pass
2	10.97	M	Pass
3	11.54	M	Pass
4	11.98	M	Pass
5	11.81	M	Pass
6	12.92	M	Pass
7	12.46	M	Pass
8	12.41	M	Pass
9	10.97	M	Pass
10	12.46	M	Pass
11	11.35	M	Pass
12	11.18	M	Pass
13	10.48	M	Pass
14	13.01	M	Pass
15	10.42	M	Pass
16	10.55	M	Pass
17	10.45	M	Pass
18	12.68	M	Pass
19	13.13	M	Pass
20	12.77	M	Pass
21	12.25	M	Pass
22	12.17	M	Pass
23	10.52	M	Pass
24	12.37	M	Pass
25	14.46	M	Pass
26	12.77	M	Pass
27	12.96	M	Pass
28	12.17	M	Pass
29	10.36	M	Pass
30	11.03	M	Pass
31	12.80	M	Pass
32	12.66	M	Pass
33	14.34	M	Pass

TEST NO. 5.2 (Continued)

Data Collection Requirements for Hydrostatic Tests

1/4-Inch (Continued)

New I.D. HAM-LET	1st Remake Torque	Tube Stickage	Accept
34	12.19	M	Pass
35	12.13	M	Pass
36	15.09	M	Pass
37	14.10	M	Pass
38	12.66	M	Pass
39	12.35	M	Pass
40	8.85	M	Pass
41	12.40	M	Pass
42	11.99	M	Pass
43	12.83	M	Pass
44	11.89	M	Pass
45	12.20	M	Pass
46	13.25	M	Pass
47	11.29	M	Pass
48	11.83	M	Pass
49	11.44	M	Pass
50	13.04	M	Pass
51	13.53	M	Pass
52	9.52	M	Pass
53	13.08	M	Pass
54	11.78	M	Pass
55	13.70	M	Pass
56	11.78	M	Pass
57	12.01	M	Pass
58	9.96	M	Pass
59	12.49	M	Pass
60	9.49	M	Pass

TEST NO. 5.2 (Continued)

Data Collection Requirements for Hydrostatic Tests

1/2-Inch

New I.D. HAM-LET	1st Remake	Tube Stickage	Accept
1	36.26	M	Pass
2	37.13	M	Pass
3	26.05	M	Pass
4	29.25	M	Pass
5	36.47	M	Pass
6	33.47	M	Pass
7	30.73	M	Pass
8	34.33	M	Pass
9	34.45	M	Pass
10	32.50	M	Pass
11	39.73	M	Pass
12	38.52	M	Pass
13	33.05	M	Pass
14	34.36	M	Pass
15	31.74	M	Pass
16	37.34	M	Pass
17	25.60	M	Pass
18	36.60	M	Pass
19	26.45	M	Pass
20	36.05	M	Pass
21	32.25	M	Pass
22	30.94	M	Pass
23	30.75	M	Pass
24	34.09	M	Pass
25	29.66	M	Pass
26	33.16	M	Pass
27	28.58	M	Pass
28	30.60	M	Pass
29	29.72	M	Pass
30	39.48	M	Pass
31	29.21	M	Pass
32	32.10	M	Pass
33	34.46	M	Pass
34	30.25	M	Pass
35	35.28	M	Pass

TEST NO. 5.2 (Continued)

Data Collection Requirements for Hydrostatic Tests

1/2-Inch (Continued)

New I.D. HAM-LET	1st Remake	Tube Stickage	Accept
36	39.24	M	Pass
37	32.75	M	Pass
38	38.44	M	Pass
39	33.08	M	Pass
40	25.46	M	Pass
41	28.29	M	Pass
42	32.71	M	Pass
43	33.29	M	Pass
44	32.49	M	Pass
45	40.46	M	Pass
46	38.50	M	Pass
47	37.08	M	Pass
48	38.32	M	Pass
49	40.70	M	Pass
50	30.81	M	Pass
51	32.11	M	Pass
52	33.23	M	Pass
53	38.41	M	Pass
54	29.66	M	Pass
55	33.76	M	Pass
56	39.45	M	Pass
57	28.29	M	Pass
58	38.32	M	Pass
59	31.56	M	Pass
60	24.21	M	Pass

TEST NO. 5.2 (Continued)

Data Collection Requirements for Hydrostatic Tests

3/4-Inch

New I.D. HAM-LET	1st Remake	Tube Stickage	Accept
1	77.5	M	Pass
2	86.2	M	Pass
3	69.4	M	Pass
4	82.8	M	Pass
5	75.1	M	Pass
6	101.8	M	Pass
7	65.4	M	Pass
8	80.7	M	Pass
9	91.2	M	Pass
10	82.0	M	Pass
11	69.6	M	Pass
12	82.9	M	Pass
13	59.2	M	Pass
14	69.7	M	Pass
15	75.2	M	Pass
16	79.2	M	Pass
17	61.9	M	Pass
18	53.2	M	Pass
19	63.9	M	Pass
20	64.3	M	Pass
21	79.3	M	Pass
22	71.2	M	Pass
23	73.1	M	Pass
24	85.3	M	Pass
25	74.2	M	Pass
26	74.6	M	Pass
27	58.1	M	Pass
28	65.4	M	Pass
29	70.3	M	Pass
30	64.5	M	Pass
31	64.4	M	Pass
32	73.5	M	Pass
33	75.3	M	Pass
34	73.9	M	Pass
35	55.1	M	Pass
36	67.3	M	Pass
37	63.1	M	Pass

TEST NO. 5.2 (Continued)

Data Collection Requirements for Hydrostatic Tests

3/4-Inch (Continued)

New I.D. HAM-LET	1st Remake	Tube Stickage	Accept
38	63.3	M	Pass
39	61.7	M	Pass
40	67.7	M	Pass
41	65.2	M	Pass
42	68.5	M	Pass
43	66.8	M	Pass
44	55.8	M	Pass
45	69.8	M	Pass
46	72.6	M	Pass
47	64.6	M	Pass
48	84.4	M	Pass
49	71.0	M	Pass
50	65.8	M	Pass
51	67.1	M	Pass
52	50.9	M	Pass
53	62.4	M	Pass
54	60.3	M	Pass
55	66.3	M	Pass
56	71.2	M	Pass
57	65.2	M	Pass
58	80.6	M	Pass
59	75.5	M	Pass
60	57.6	M	Pass

TEST NO. 5.2 (Continued)

Data Collection Requirements for Hydrostatic Tests

1-Inch

New I.D. HAM-LET	1st Remake	Tube Stickage	Accept
1	87.0	M	Pass
2	74.1	M	Pass
3	119.4	M	Pass
4	81.5	M	Pass
5	106.0	M	Pass
6	86.5	M	Pass
7	68.5	M	Pass
8	97.4	M	Pass
9	115.2	M	Pass
10	83.5	M	Pass
11	91.8	M	Pass
12	108.4	M	Pass
13	108.6	M	Pass
14	97.9	M	Pass
15	119.4	M	Pass
16	92.4	M	Pass
17	77.4	M	Pass
18	89.6	M	Pass
19	108.3	M	Pass
20	111.9	M	Pass
21	95.5	M	Pass
22	52.4	M	Pass
23	83.7	M	Pass
24	110.2	M	Pass
25	85.7	M	Pass
26	103.1	M	Pass
27	87.1	M	Pass
28	64.4	M	Pass
29	78.8	M	Pass
30	91.4	M	Pass
31	83.1	M	Pass
32	94.7	M	Pass
33	114.7	M	Pass
34	80.9	M	Pass
35	56.5	M	Pass
36	60.5	M	Pass
37	63.4	M	Pass

TEST NO. 5.2 (Continued)

Data Collection Requirements for Hydrostatic Tests

1-Inch (Continued)

New I.D. HAM-LET	1st Remake	Tube Stickage	Accept
38	73.9	M	Pass
39	88.4	M	Pass
40	54.1	M	Pass
41	60.4	M	Pass
42	105.0	M	Pass
43	87.8	M	Pass
44	59.7	M	Pass
45	92.6	M	Pass
46	87.7	M	Pass
47	76.2	M	Pass
48	90.7	M	Pass
49	88.0	M	Pass
50	78.1	M	Pass
51	78.5	M	Pass
52	70.1	M	Pass
53	97.2	M	Pass
54	63.7	M	Pass
55	80.1	M	Pass
56	91.1	M	Pass
57	86.7	M	Pass
58	81.0	M	Pass
59	85.2	M	Pass
60	80.2	M	Pass

ATTACHMENT D

IMPULSE TEST DATA

TEST NO. 5.3

Data Collection Requirements for Impulse Tests (Repeated Assembly Test Information)

1/4-Inch

New I.D. HAM-LET	0%	25%	50%	75%	100%
1	Pass	Pass	Pass	Pass	Pass
2	Pass	Pass	Pass	Pass	Pass
3	Pass	Pass	Pass	Pass	Pass
4	Pass	Pass	Pass	Pass	Pass
5	Pass	Pass	Pass	Pass	Pass
6	Pass	Pass	Pass	Pass	Pass

1/2-Inch

New I.D. HAM-LET	0%	25%	50%	75%	100%
1	Pass	Pass	Pass	Pass	Pass
2	Pass	Pass	Pass	Pass	Pass
3	Pass	Pass	Pass	Pass	Pass
4	Pass	Pass	Pass	Pass	Pass
5	Pass	Pass	Pass	Pass	Pass
6	Pass	Pass	Pass	Pass	Pass

3/4-Inch

New I.D. HAM-LET	0%	25%	50%	75%	100%
1	Pass	Pass	Pass	Pass	Pass
2	Pass	Pass	Pass	Pass	Pass
3	Pass	Pass	Pass	Pass	Pass
4	Pass	Pass	Pass	Pass	Pass
5	Pass	Pass	Pass	Pass	Pass
6	Pass	Pass	Pass	Pass	Pass

1-Inch

New I.D. HAM-LET	0%	25%	50%	75%	100%
1	Pass	Pass	Pass	Pass	Pass
2	Pass	Pass	Pass	Pass	Pass
3	Pass	Pass	Pass	Pass	Pass
4	Pass	Pass	Pass	Pass	Pass
5	Pass	Pass	Pass	Pass	Pass
6	Pass	Pass	Pass	Pass	Pass

ATTACHMENT E

HYDROSTATIC BURST TEST DATA

TEST NO. 5.4

Data Collection Requirements for Hydrostatic Bursts

Comments: Tested @ 4X Rating

Record Test Information Pressure

New I.D. HAM-LET	1/4-Inch	1/2-Inch	3/4-Inch	1.0-Inch	Comments
25	Pass	Fail*	Pass	Fail**	
26	Pass	Fail*	Pass	Fail**	
27	Pass	Fail*	Pass	Fail**	
28	Pass	Fail*	Pass	Fail**	
29	Pass	Fail*	Pass	Fail**	
30	Pass	Fail*	Pass	Fail**	
31	Pass	Fail*	Pass	Fail**	
32	Pass	Fail*	Pass	Fail**	

* Tubing burst at less than 20,400 psig. See summary result.
** Tubing burst at less than 14,400 psig. See summary result.

A

Thermal Cycling and Elevated Temperature Soak

ATTACHMENT F

TENSILE TEST DATA

TEST NO. 5.5

Data Collection Requirements for Tensile Tests

HAM-LET	1/4-Inch	1/2-Inch	3/4-Inch	1-Inch	Comments
19	Pass	Pass	Pass	Pass	
20	Pass	Pass	Fail*	Pass	
21	Pass	Pass	Pass	Pass	
22	Pass	Pass	Pass	Pass	
23	Pass	Pass	Pass	Pass	
24	Pass	Pass	Pass	Pass	

*Specimen slipped at 5632, Requirement was 5917. See summary result. **A**

ATTACHMENT G

ROTARY FLEX TEST DATA

TEST NO. 5.7

Data Collection Requirements for Rotary Flex Tests

Comments: Tested @ 133% of Rating

1/4-Inch

HAM-LET	Accept	Pressure	Cycles	Hydro
13	Pass	500	1M	Pass
14	Pass	500	1M	Pass
15	Pass	500	1M	Pass
16	Pass	500	1M	Pass
17	Pass	500	1M	Pass
18	Pass	500	1M	Pass

1/2-Inch

HAM-LET	Accept	Pressure	Cycles	Hydro
13	Pass	500	1M	Pass
14	Pass	500	1M	Pass
15	Pass	500	1M	Pass
16	Pass	500	1M	Pass
17	Pass	500	1M	Pass
18	*	500	TBD	*

*Tubing failure based on stress level. Stress level adjusted to 75% of the 35% UT for subseqent samples tested.

3/4-Inch

HAM-LET	Accept	Pressure	Cycles	Hydro
13	Pass	500	1M	Pass
14	Pass	500	1M	Pass
15	Pass	500	1M	Pass
16	Pass	500	1M	Pass
17	Pass	500	1M	Pass
18	Pass	500	1M	Pass

1-Inch

HAM-LET	Accept	Pressure	Cycles	Hydro
13	Pass	500	1M	Pass
14	Pass	500	1M	Pass
15	*	500	1M	*
16	Pass	500	1M	Pass
17	Pass	500	1M	Pass
18	*	500	1M	*

*Tubing failure based on stress level. Stress level adjusted to 75% of the 35% UT for subseqent samples tested.

ATTACHMENT H

FLEX FATIGUE TEST DATA

TEST NO. 5.8

Data Collection Requirements for Flexure Fatigue Tests

Repeated Assembly Test Information

1/4-Inch

HAM-LET	0%	25%	50%	75%	100%	Pressure	Cycles
7	Pass	Pass	Pass	Pass	Pass	7500	30K
8	Pass	Pass	Pass	Pass	Pass	7500	30K
9	Pass	Pass	Pass	Pass	Pass	7500	30K
10	Pass	Pass	Pass	Pass	Pass	7500	30K
11	Pass	Pass	Pass	Pass	Pass	7500	30K
12	Pass	Pass	Pass	Pass	Pass	7500	30K

1/2-Inch

HAM-LET	0%	25%	50%	75%	100%	Pressure	Cycles
7	Pass	Pass	Pass	Pass	Pass	5100	30K
8	Pass	Pass	Pass	Pass	Pass	5100	30K
9	Pass	Pass	Pass	Pass	Pass	5100	30K
10	Pass	Pass	Pass	Pass	Pass	5100	30K
11	Pass	Pass	Pass	Pass	Pass	5100	30K
12	Pass	Pass	Pass	Pass	Pass	5100	30K

3/4-Inch

HAM-LET	0%	25%	50%	75%	100%	Pressure	Cycles
7	Pass	Pass	Pass	Pass	Pass	4900	30K
8	Pass	Pass	Pass	Pass	Pass	4900	30K
9	Pass	Pass	Pass	Pass	Pass	4900	30K
10	Pass	Pass	Pass	Pass	Pass	4900	30K
11	Pass	Pass	Pass	Pass	Pass	4900	30K
12	Pass	Pass	Pass	Pass	Pass	4900	30K

1-Inch

HAM-LET	0%	25%	50%	75%	100%	Pressure	Cycles
7	Pass	Pass	Pass	Pass	Pass	3600	30K
8	Pass	Pass	Pass	Pass	Pass	3600	30K
9	Pass	Pass	Pass	Pass	Pass	3600	30K
10	Pass	Pass	Pass	Pass	Pass	3600	30K
11	Pass	Pass	Pass	Pass	Pass	3600	30K
12	Pass	Pass	Pass	Pass	Pass	3600	30K

ATTACHMENT I

HIGH TEMPERATURE THERMAL CYCLE DATA

TEST NO. 5.9

Data Collection Requirements for Thermal Cycling Tests

High Temperature

HAM-LET	1/4-Inch		1/2-Inch		3/4-Inch		1-Inch	
	5.9 High	5.2	5.9 High	5.2	5.9 High	5.2	5.9 High	5.2
25	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
26	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
27	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
28	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
29	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
30	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
31	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
32	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
33	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
34	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
35	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
36	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
37	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
38	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
39	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
40	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
41	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
42	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
43	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
44	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
45	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
46	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
47	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
48	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
49	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
50	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
51	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
52	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
53	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

ATTACHMENT J

LOW TEMPERATURE THERMAL CYCLE DATA

TEST NO. 5.9

Data Collection Requirements for Thermal Cycling Tests

Low Temperature

HAM-LET	1/4-Inch		1/2-Inch		3/4-Inch		1-Inch	
	5.9 Low	5.2	5.9 Low	5.2	5.9 Low	5.2	5.9 Low	5.2
25	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
26	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
27	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
28	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
29	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
30	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
31	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
32	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
33	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
34	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
35	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
36	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
37	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
38	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
39	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
40	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
41	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
42	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
43	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
44	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
45	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
46	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
47	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
48	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
49	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
50	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
51	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
52	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
53	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

ATTACHMENT K

ELEVATED SOAK TEST DATA

TEST NO. 5.10

Data Collection Requirements for Elevated Soak Tests

HAM-LET	1/4-Inch		1/2-Inch		3/4-Inch		1-Inch	
	5.10	5.2	5.10	5.2	5.10	5.2	5.10	5.2
25	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
26	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
27	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
28	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
29	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
30	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
31	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
32	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
33	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
34	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
35	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
36	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
37	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
38	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
39	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
40	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
41	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
42	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
43	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
44	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
45	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
46	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
47	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

ATTACHMENT L

VIBRATION TEST DATA

TEST NO. 5.11

Data Collection Requirements for Vibration Tests

Variable Frequency

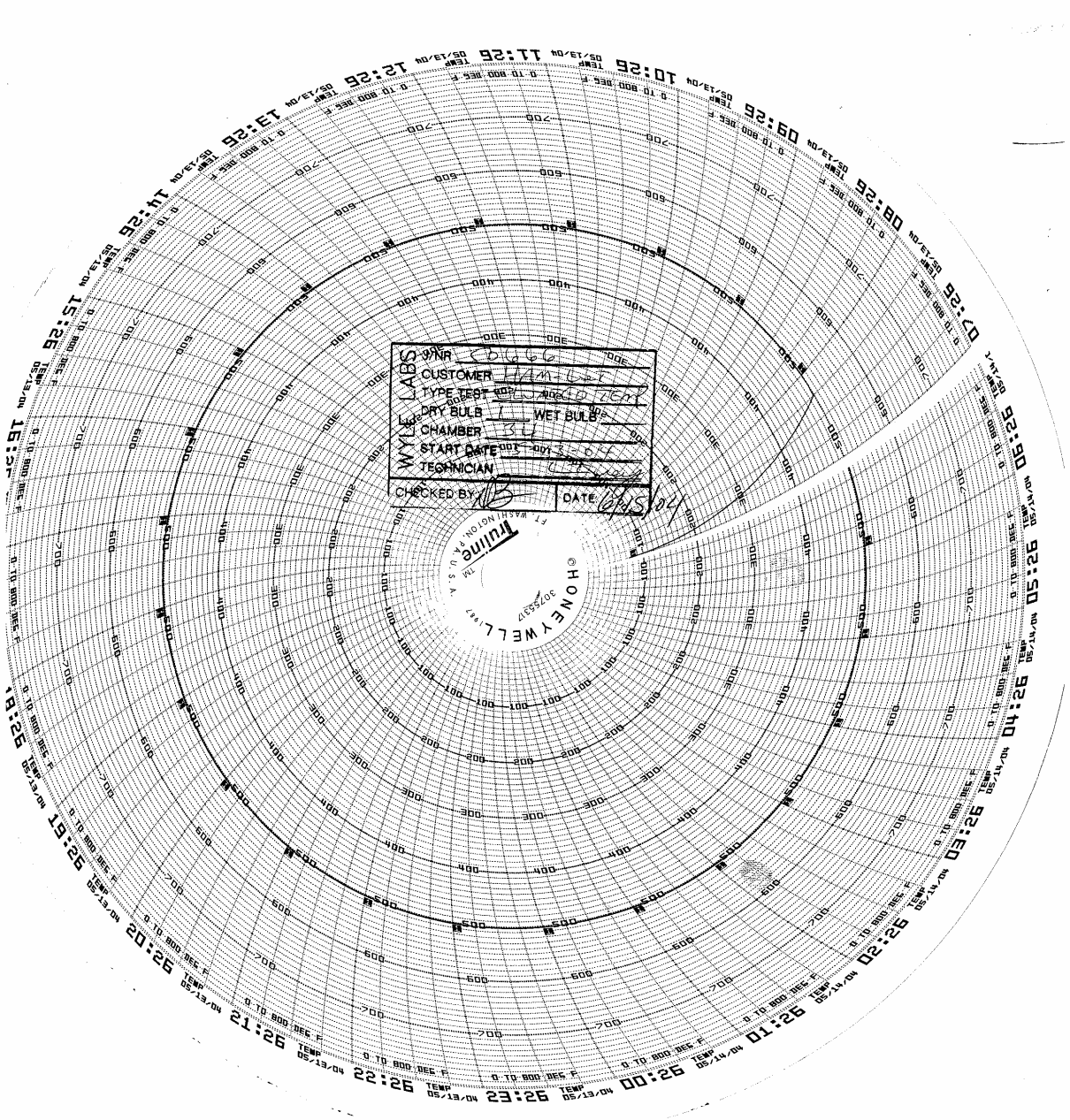
HAM-LET	1/4-Inch		1/2-Inch		3/4-Inch		1-Inch	
	5.11	5.2	5.11	5.2	5.11	5.2	5.11	5.2
33	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
34	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
35	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
36	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
37	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
38	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

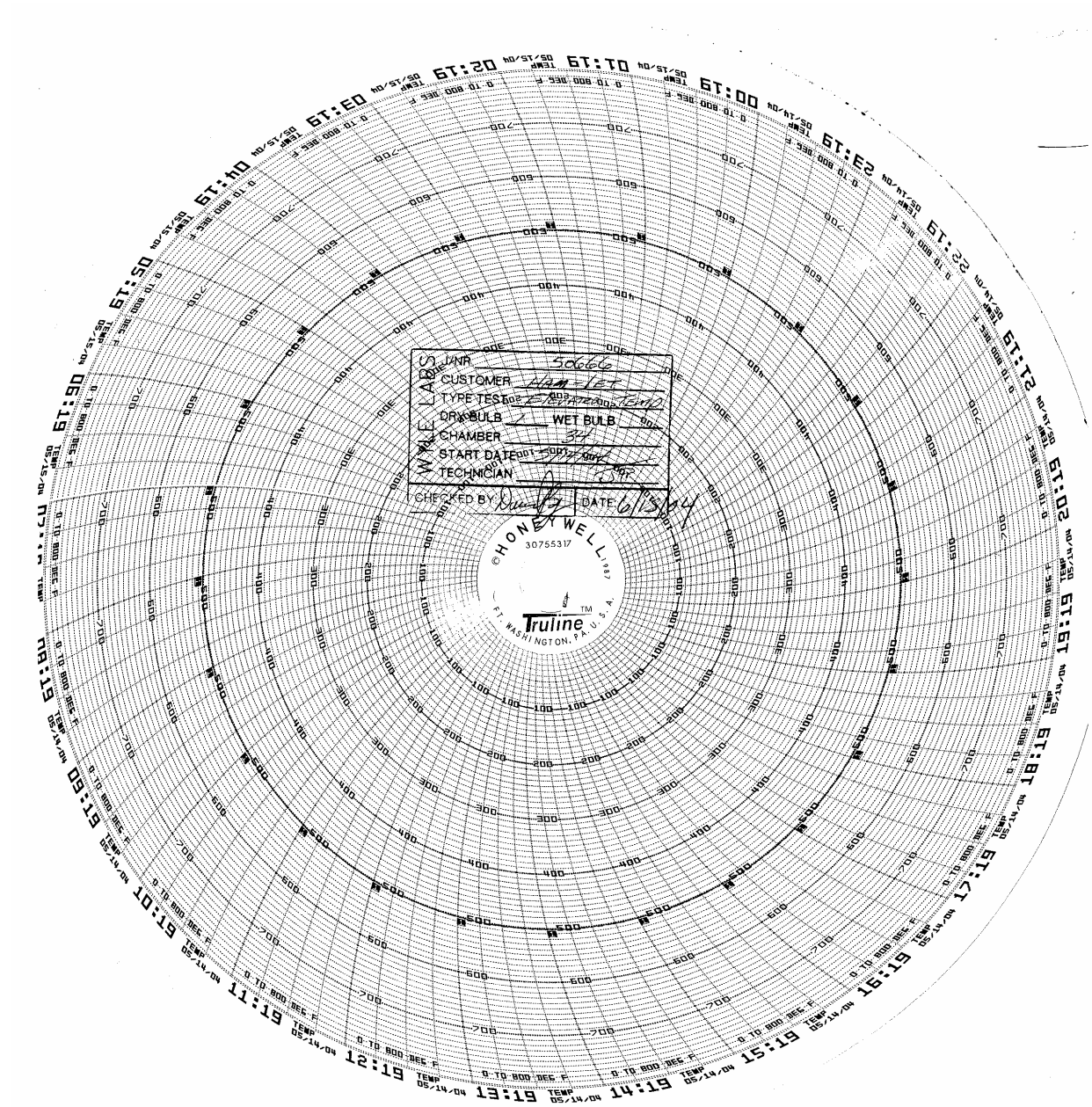
Endurance

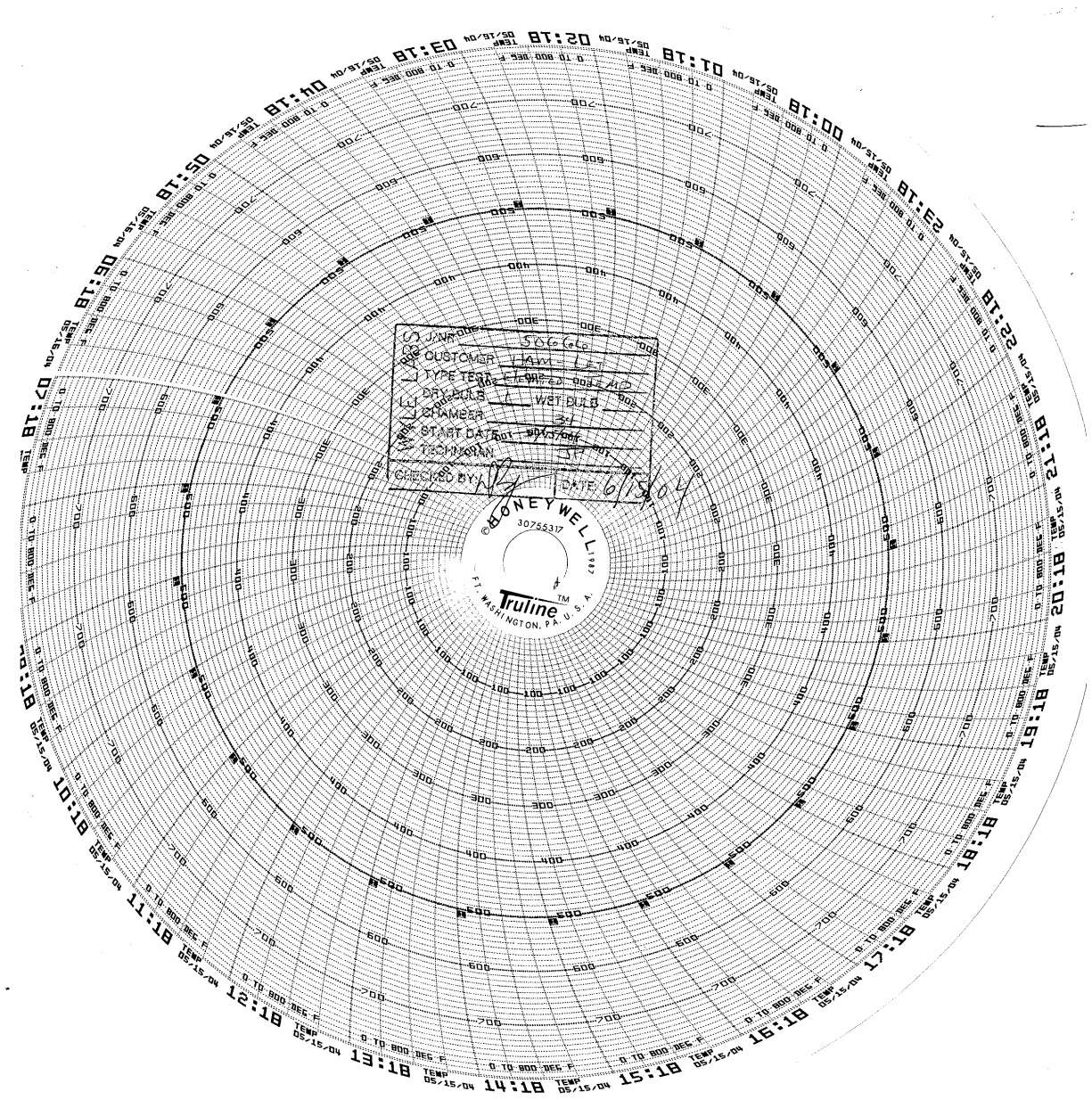
HAM-LET	1/4-Inch		1/2-Inch		3/4-Inch		1-Inch	
	5.11	5.2	5.11	5.2	5.11	5.2	5.11	5.2
33	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
34	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
35	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
36	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
37	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
38	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

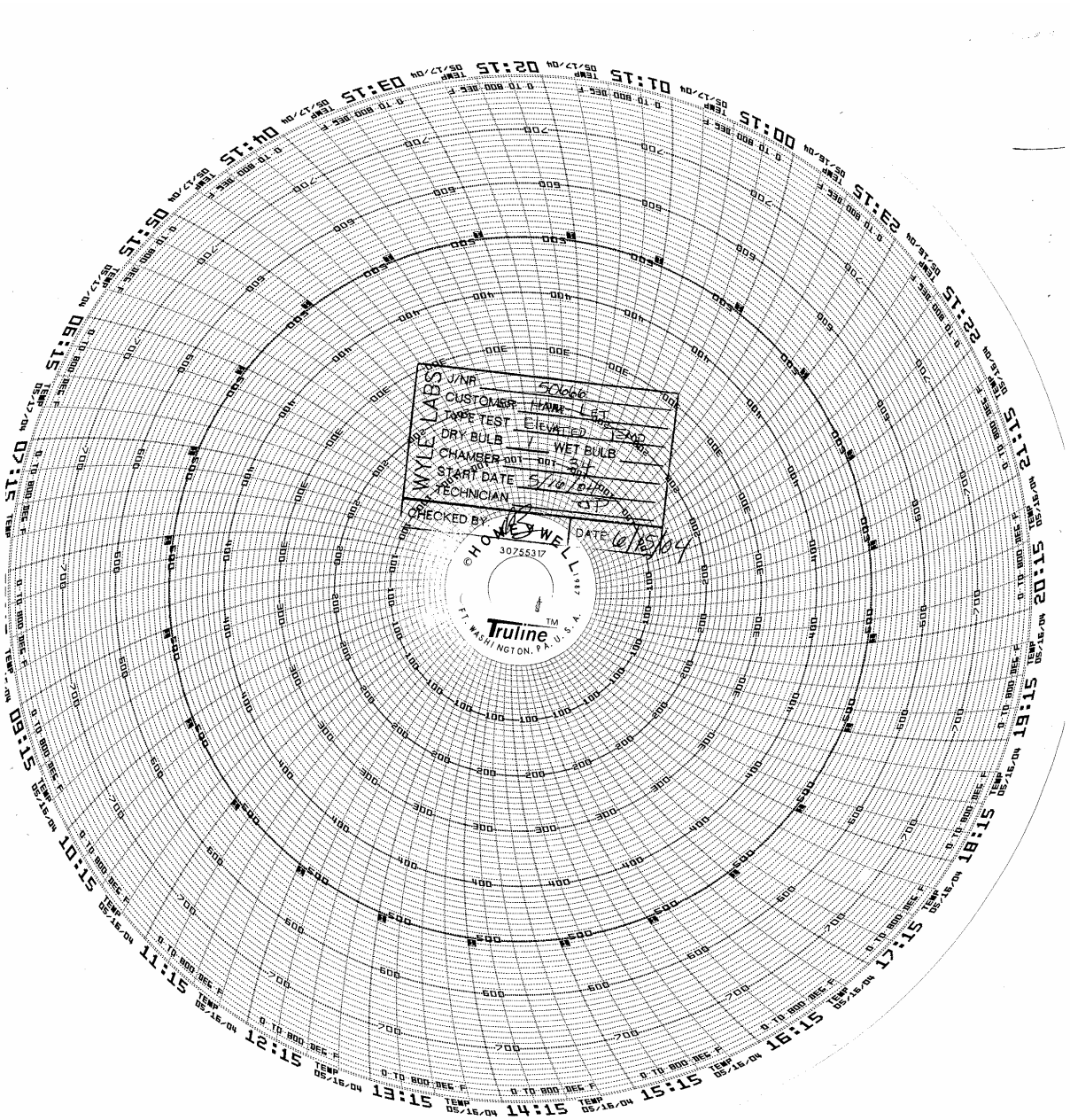
ATTACHMENT M

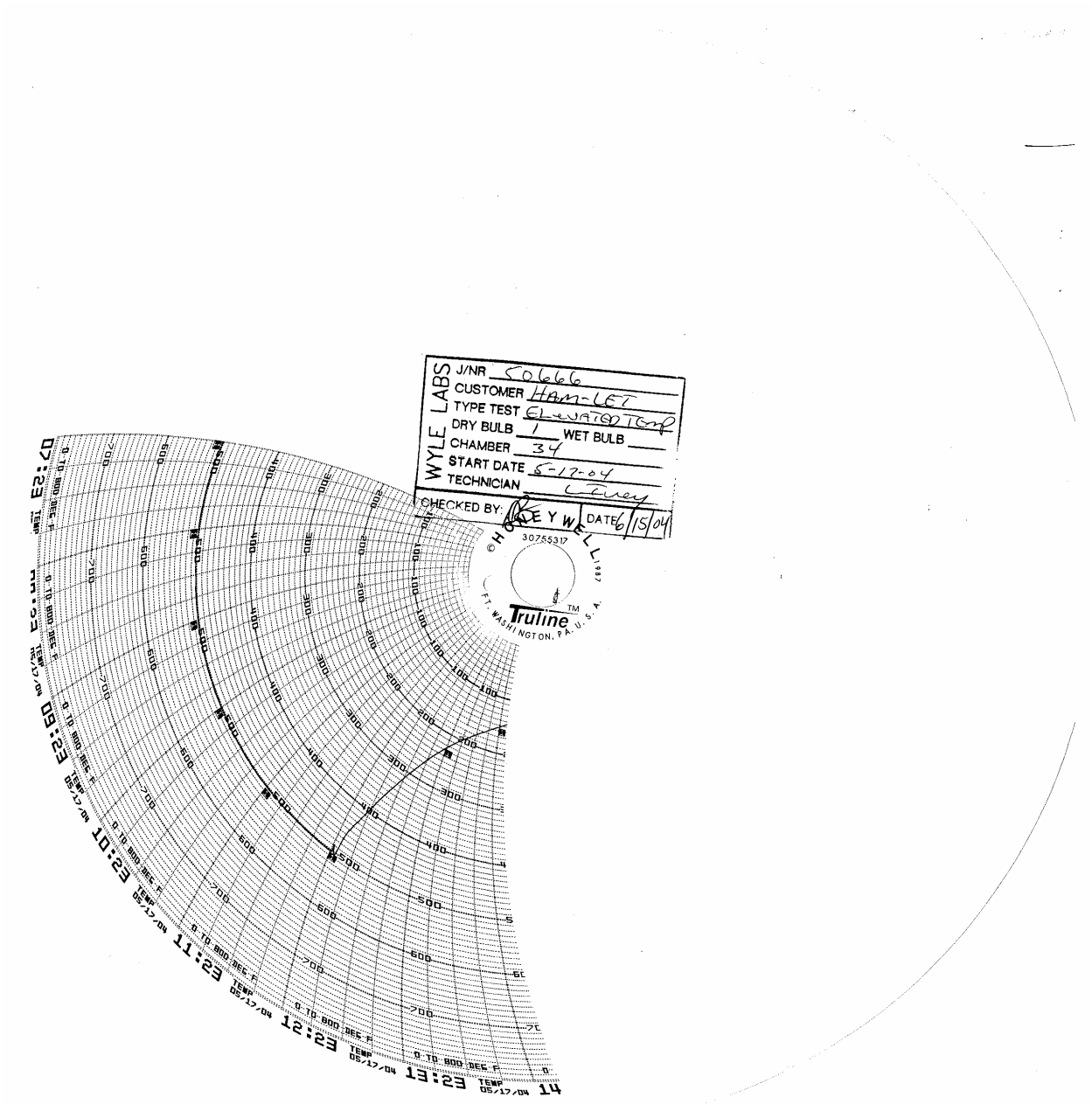
ELEVATED TEMPERATURE CIRCULAR CHARTS


WYLE LABS
S/N
CUSTOMER
TYPE TEST
DRY BULB
WET BULB
CHAMBER
START DATE
TECHNICIAN
CHECKED BY
DATE
HONEYWELL
Infinite
0 TO 800 DEG F
TEMP
05/13/04
05/14/04


WYLE LABS
JOB/NR 50666
CUSTOMER Hamlet
TYPE TEST
DRY BULB
WET BULB
CHAMBER
START DATE
TECHNICIAN
CHECKED BY
DATE 6/15/04
HONEYWELL
Truline
FT. WASHINGTON, PA. U.S.A.


JOB NO. 50666
CUSTOMER HAM-LET
TYPE TEST TEMP CYCLE
DRY BULB WET BULB
CHAMBER 34
START DATE 6/15/04
TECHNICIAN SP
CHECKED BY DATE 6/15/04
HONEYWELL 1987
30755317
Truline
FT. WASHINGTON, PA. U.S.A.


WYLE LABS
J/NR 50666
CUSTOMER HAIER
TYPE TEST Elevated Temp
DRY BULB WET BULB
CHAMBER 001 001 2nd
START DATE 5/16/2004
TECHNICIAN
CHECKED BY
DATE 6/15/04
HOWELL
30755317
Truline
FT. WASHINGTON, PA. U.S.A.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J/NR 50666
CUSTOMER HAM-LET
TYPE TEST ELEVATED TEMP
DRY BULB 1 WET BULB
CHAMBER 34
START DATE 5-17-04
TECHNICIAN
CHECKED BY: DATE 6/15/04
HONEYWELL
30755317
Truline
FT. WASHINGTON, PA. U.S.A.
07:23
08:23
09:23
10:23
11:23
12:23
13:23
14
0 TO 800 DEG. F
TEMP
05/17/04

ATTACHMENT N

VIBRATION TEST DATA SHEETS AND PLOTS

VIBRATION TEST DATA SHEET

Customer HAM-LET Spec. Appendix A REV G/4 Specimen Tube Assemblies 1/4", 1/2", 3/4" + 1"

Job No. 506666 Method NA Part No. N/A Specimen Temp. AMB

GSI Yes ☐ No ☑ Procedure GE362A2195 REV D S/N N/A Photo Yes ☒ No ☐

Test Title Vibration

Date	Time	Axis	Temp (°F)	SINUSOIDAL Freq. (cps)	SINUSOIDAL Disp. ("da)	SINUSOIDAL Accel. (±g)	RANDOM Freq. (cps)	RANDOM PSD (g^2/Hz)	RANDOM Slope (dB/Oct)	TOTAL Accel. (grms)	Test Time (min.)	COMMENTS	NAME
												TEST REQUIREMENT	
6/1/04	1345	X	AMB	4-15	.031							Run #1	
				16-25	.02							1/4" @ 7,500 psi	
				26-33	.01							1/2" @ 5,100 psi	
				34-40	.005								
				41-50	.003								
				51-60	.002						285		
6/2/04	0752	X	AMB	60	.002						120	Run #2 1/4", 1/2"	
												Run #3	
6/2/04	1018	Y	AMB	4-15	.031							1/4" @ 7,500 psi	
				16-25	.02							1/2" @ 5,100 psi	
				26-33	.01								
				34-40	.005								

Job No. 506666
Report No. 50666-01
Date 6/15/04
Page 1 of 3

WH-1028A

Signed [signature] 6/15/04 LEONARD MATHIS Approved [signature] 6/15/04

VIBRATION TEST DATA SHEET

I D No. ——

Date	Time	Axis	Temp (°F)	SINUSOIDAL Freq. (cps)	SINUSOIDAL Disp. ("da)	SINUSOIDAL Accel. (±g)	RANDOM Freq. (cps)	RANDOM PSD (g^2/Hz)	RANDOM Slope (dB/Oct)	TOTAL Accel. (grms)	Test Time (min.)	COMMENTS	NAME
												TEST REQUIREMENT	
				41-50	.003							Run#3 cont.	
				51-60	.002						285		
6/2/04	1510	Y	AMB	60	.002						120	Run#4 1/4", 1/2"	
6/2/04	1732	Z	AMB	4-15	.031							Run#5	
				16-25	.02							1/4" @ 7,500 psi	
				26-33	.01							1/2" @ 5,100 psi	
				34-40	.005								
				41-50	.003								
				51-60	.002						285		
6/3/04	0649	Z		60	.002						120	Run#6 1/4", 1/2"	
6/3/04	1212	Z		4-15	.031							Run#7	
				16-25	.02							3/4" @ 4,900 psi	
				26-33	.01							1" @ 3,600 psi	
				34-40	.005								
				41-50	.003								
				51-60	.002						285		

Job No. 50666
Report No. 50666-01
Date 6/15/04
Page 2 of 3

NH-1028

Signed [signature] 6/15/04 Approved David R Bj 6/15/04

VIBRATION TEST DATA SHEET

I D No. /

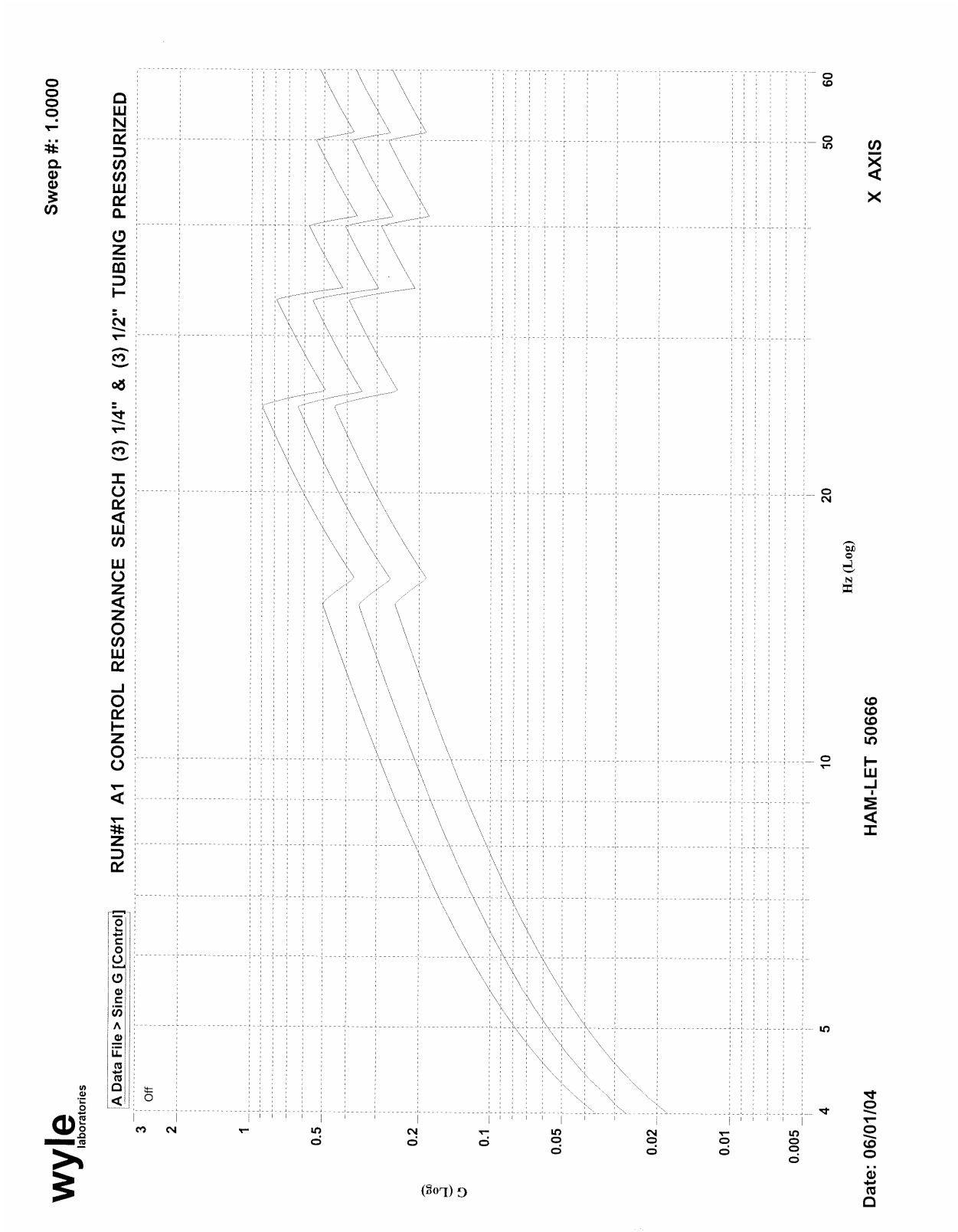
Date	Time	Axis	Temp (°F)	SINUSOIDAL Freq. (cps)	SINUSOIDAL Disp. ("da)	SINUSOIDAL Accel. (±g)	RANDOM Freq. (cps)	RANDOM PSD (g^2/Hz)	RANDOM Slope (dB/Oct)	TOTAL Accel. (grms)	Test Time (min.)	COMMENTS	NAME
												TEST REQUIREMENT	
6/3/04	1704	Z	AMB	60	.002						120	Run #8 3/4", 1"	
6/4/04	0758	Y	AMB	4-15	.031							Run #9	
				16-25	.02							3/4" @ 4,900 psi	
				26-33	.01							1" @ 3,600 psi	
				34-40	.005								
				41-50	.003								
				51-60	.002						285		
6/4/04	1253	Y	AMB	60	.002						120	Run #10 3/4", 1"	
6/4/04	1515	X	AMB	4-15	.031							Run #11	
				16-25	.02							3/4" @ 4,900 psi	
				26-33	.01							1" @ 3,600 psi	
				34-40	.005								
				41-50	.003								
				51-60	.002						285		
6/7/04	0752	X	AMB	60	.002						120	Run #12 3/4", 1"	

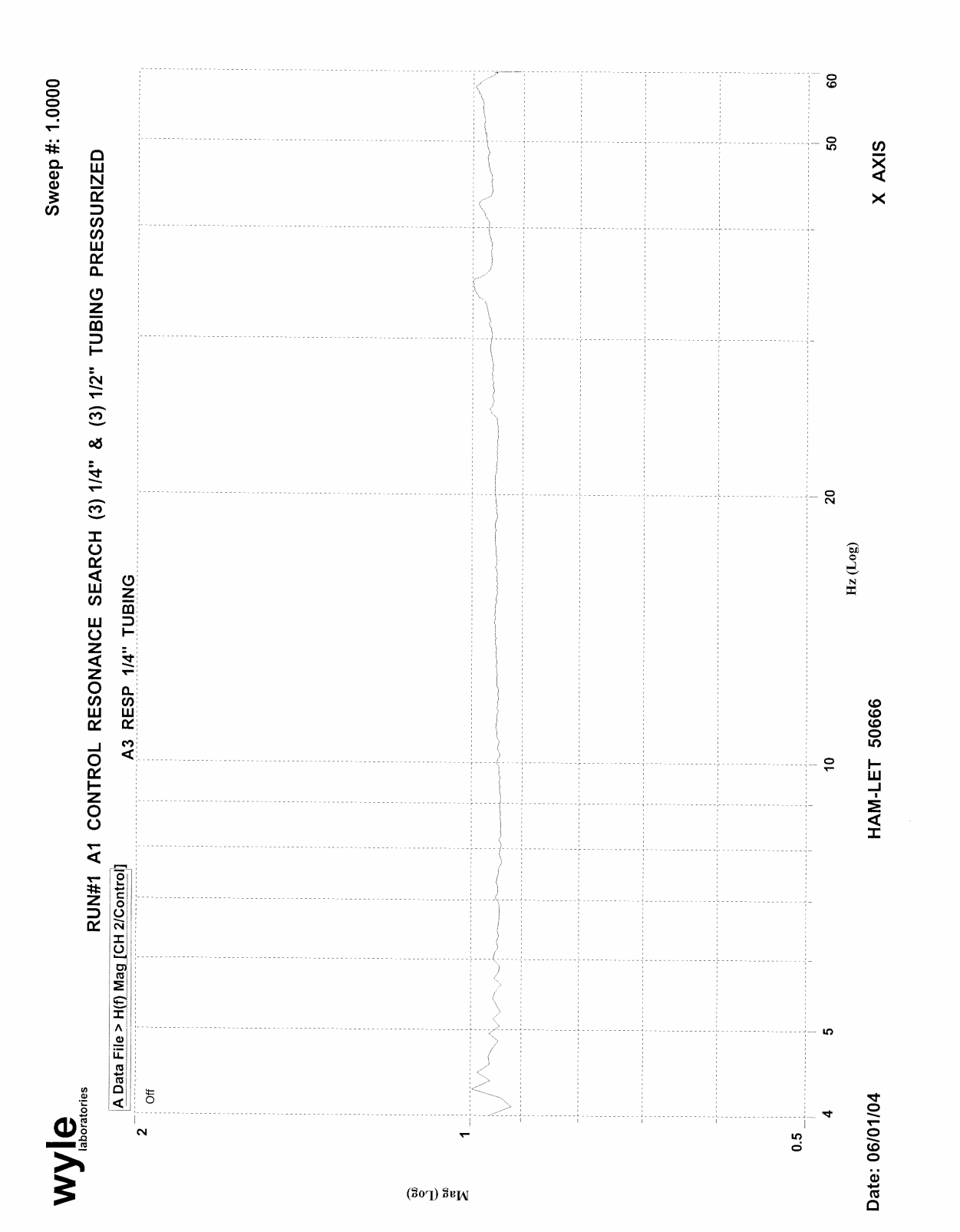
Job No. 50666
Report No. 50666-01
Date 6/15/04
Page 3 of 3

NH-1028

Signed 6/15/04

Approved David CBJ 6/15/04


Sweep #: 1.0000
wyle laboratories
RUN#1 A1 CONTROL RESONANCE SEARCH (3) 1/4" & (3) 1/2" TUBING PRESSURIZED
A Data File > Sine G [Control]
Off
G (Log)
3
2
1
0.5
0.2
0.1
0.05
0.02
0.01
0.005
4
5
10
20
50
60
Hz (Log)
X AXIS
HAM-LET 50666
Date: 06/01/04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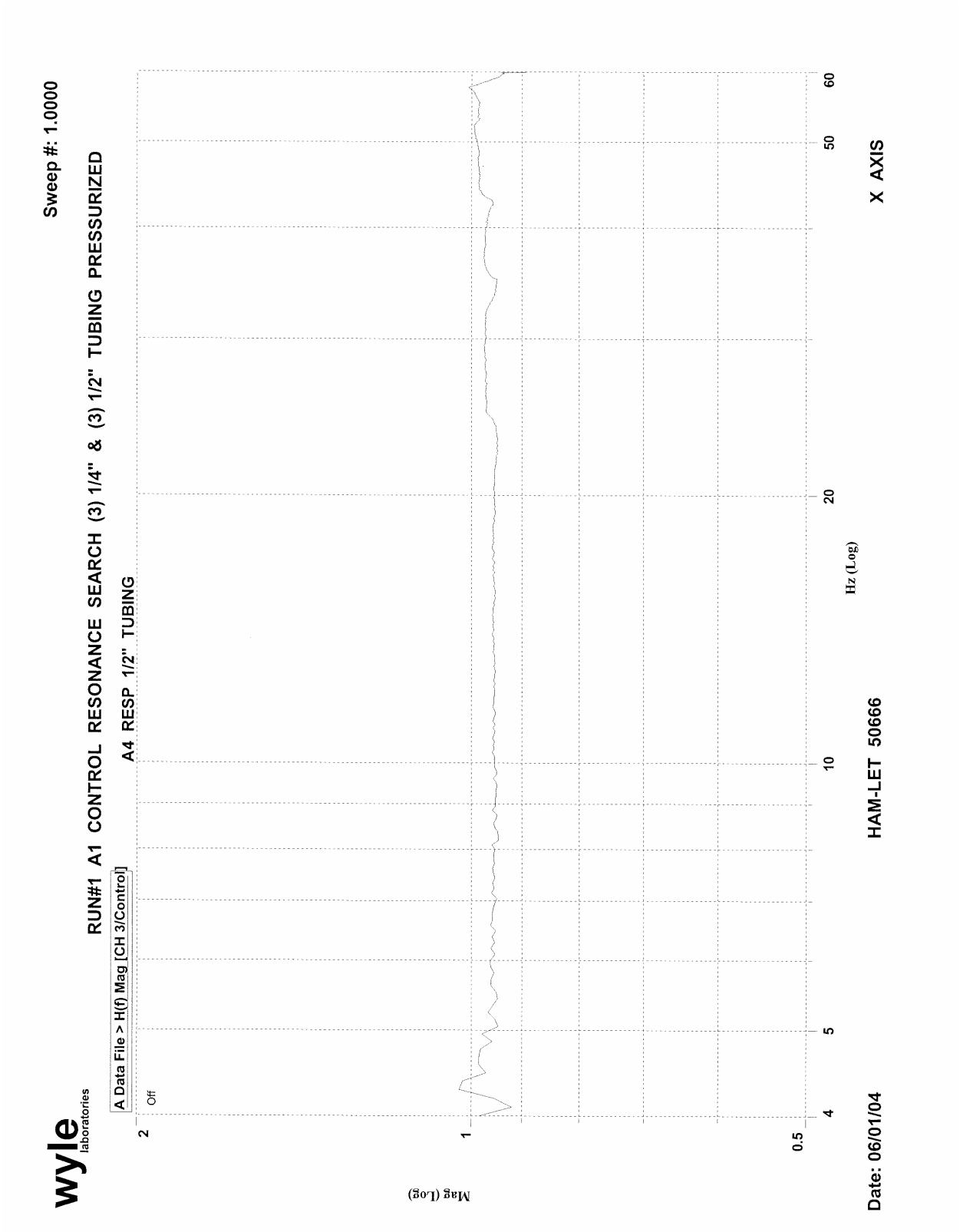
A3 RESP 1/4" TUBING
A Data File > H(f) Mag [CH 2/Control]
Off
wyle laboratories
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
X AXIS
HAM-LET 50666
Date: 06/01/04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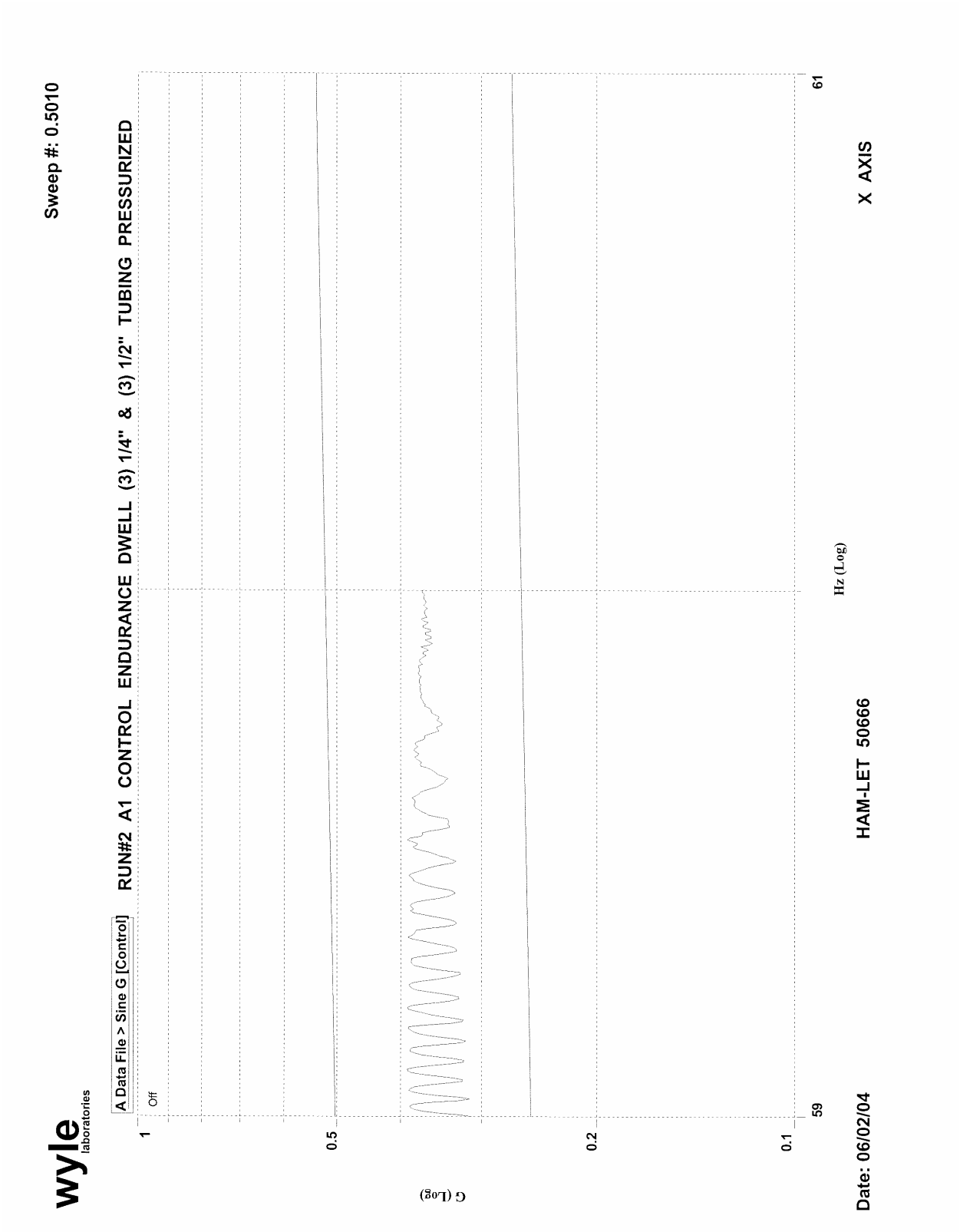
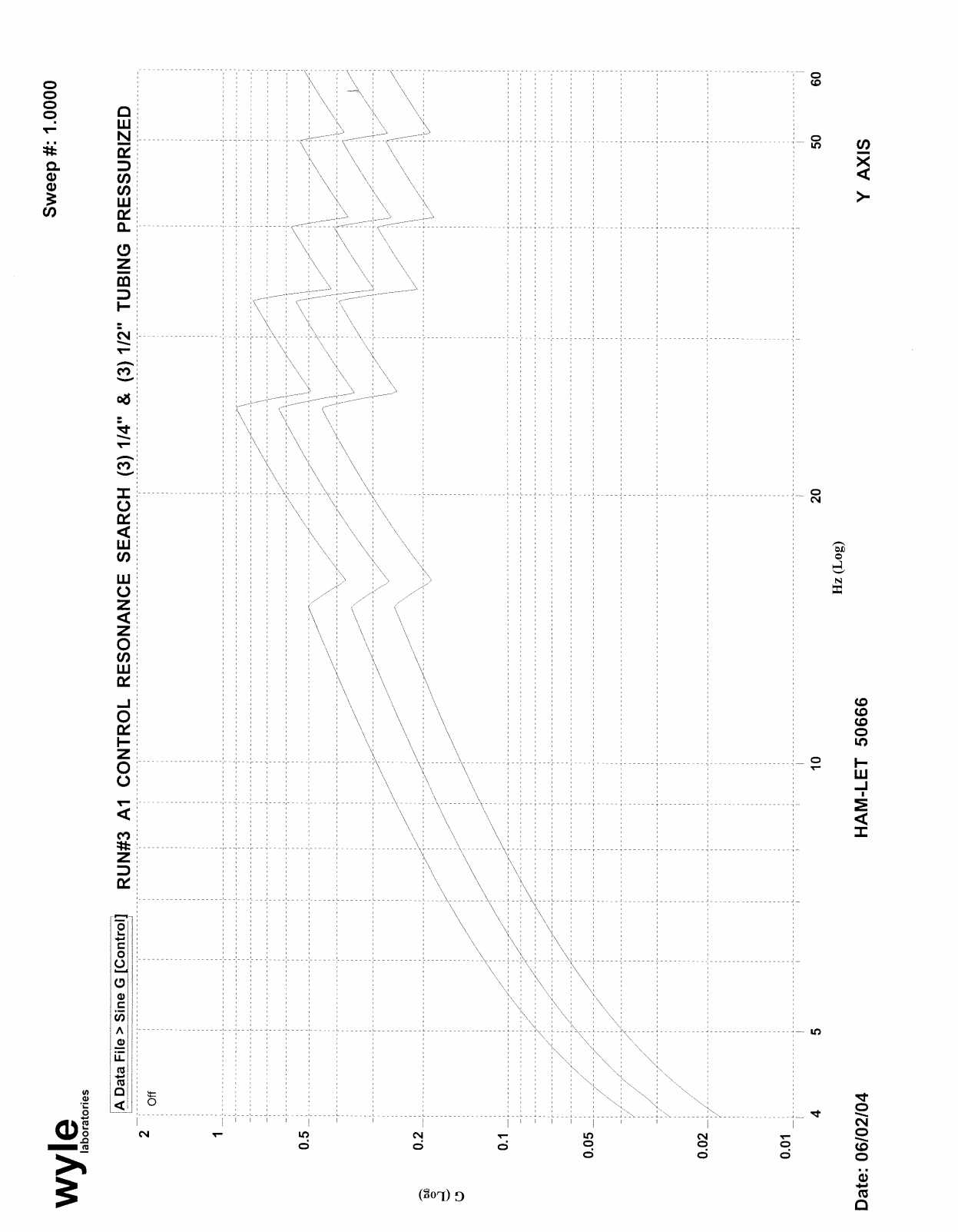
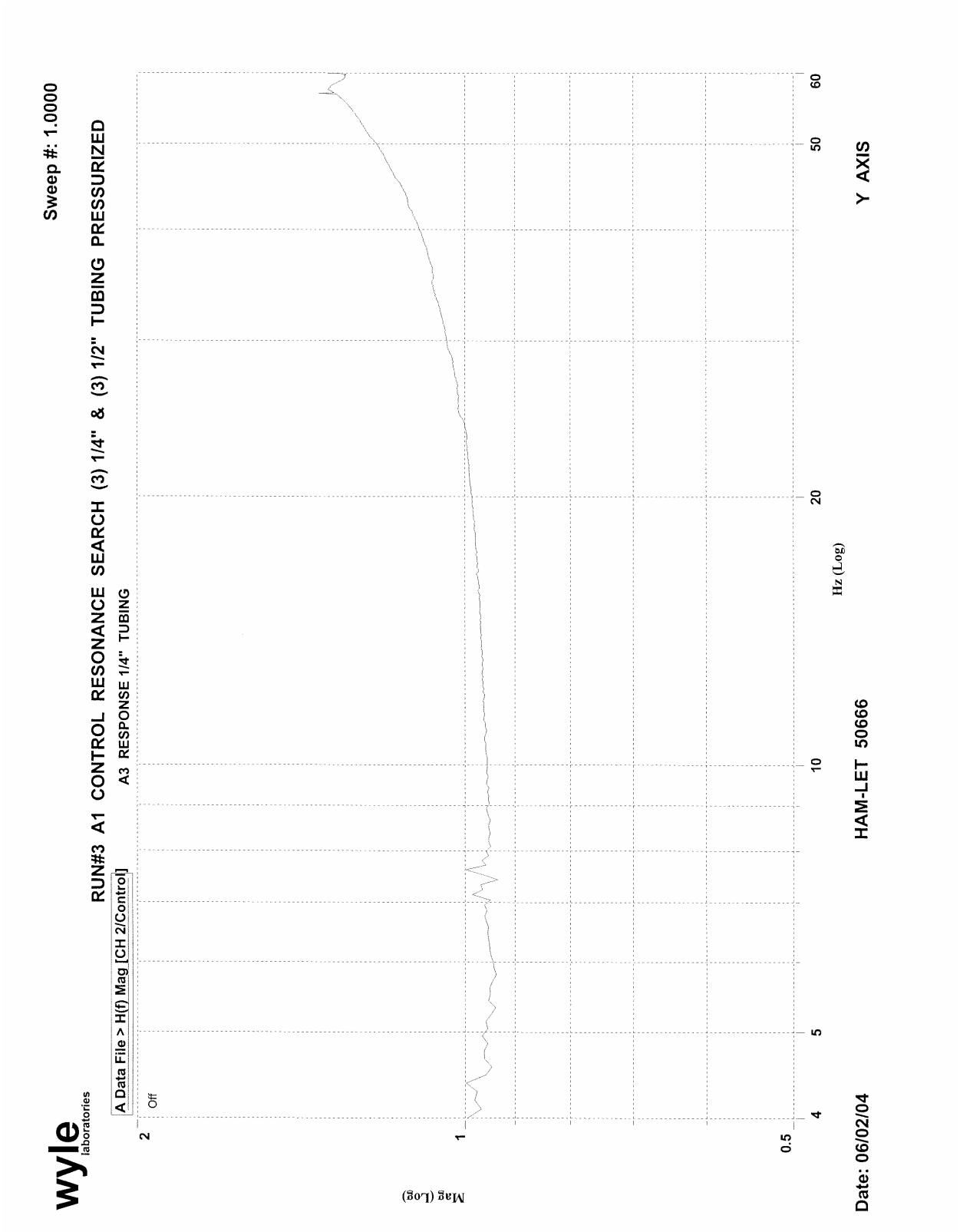
RUN#1 A1 CONTROL RESONANCE SEARCH (3) 1/4" & (3) 1/2" TUBING PRESSURIZED
A4 RESP 1/2" TUBING
A Data File > H(f) Mag [CH 3/Control]
Off
wyle laboratories
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
X AXIS
HAM-LET 50666
Date: 06/01/04


Sweep #: 0.5010
wyle laboratories
A Data File > Sine G [Control]
RUN#2 A1 CONTROL ENDURANCE DWELL (3) 1/4" & (3) 1/2" TUBING PRESSURIZED
Off
1
0.5
0.2
0.1
G (Log)
59
61
Hz (Log)
X AXIS
HAM-LET 50666
Date: 06/02/04


Sweep #: 1.0000
wyle laboratories
A Data File > Sine G [Control]
Off
RUN#3 A1 CONTROL RESONANCE SEARCH (3) 1/4" & (3) 1/2" TUBING PRESSURIZED
G (Log)
2
1
0.5
0.2
0.1
0.05
0.02
0.01
4
5
10
20
50
60
Hz (Log)
Y AXIS
HAM-LET 50666
Date: 06/02/04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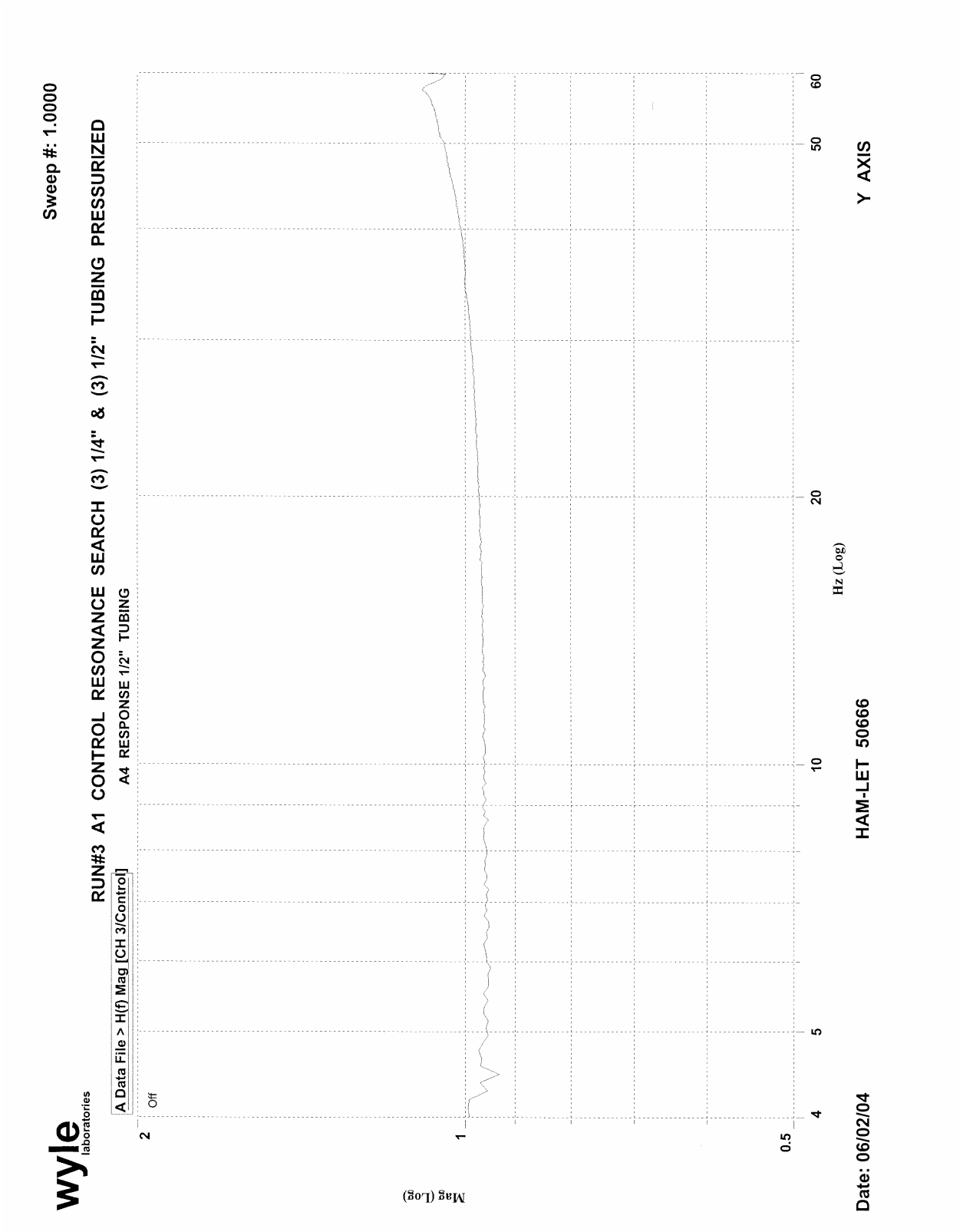
A3 RESPONSE 1/4" TUBING
A Data File > H(f) Mag [CH 2/Control]
Off
wyle laboratories
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
Y AXIS
HAM-LET 50666
Date: 06/02/04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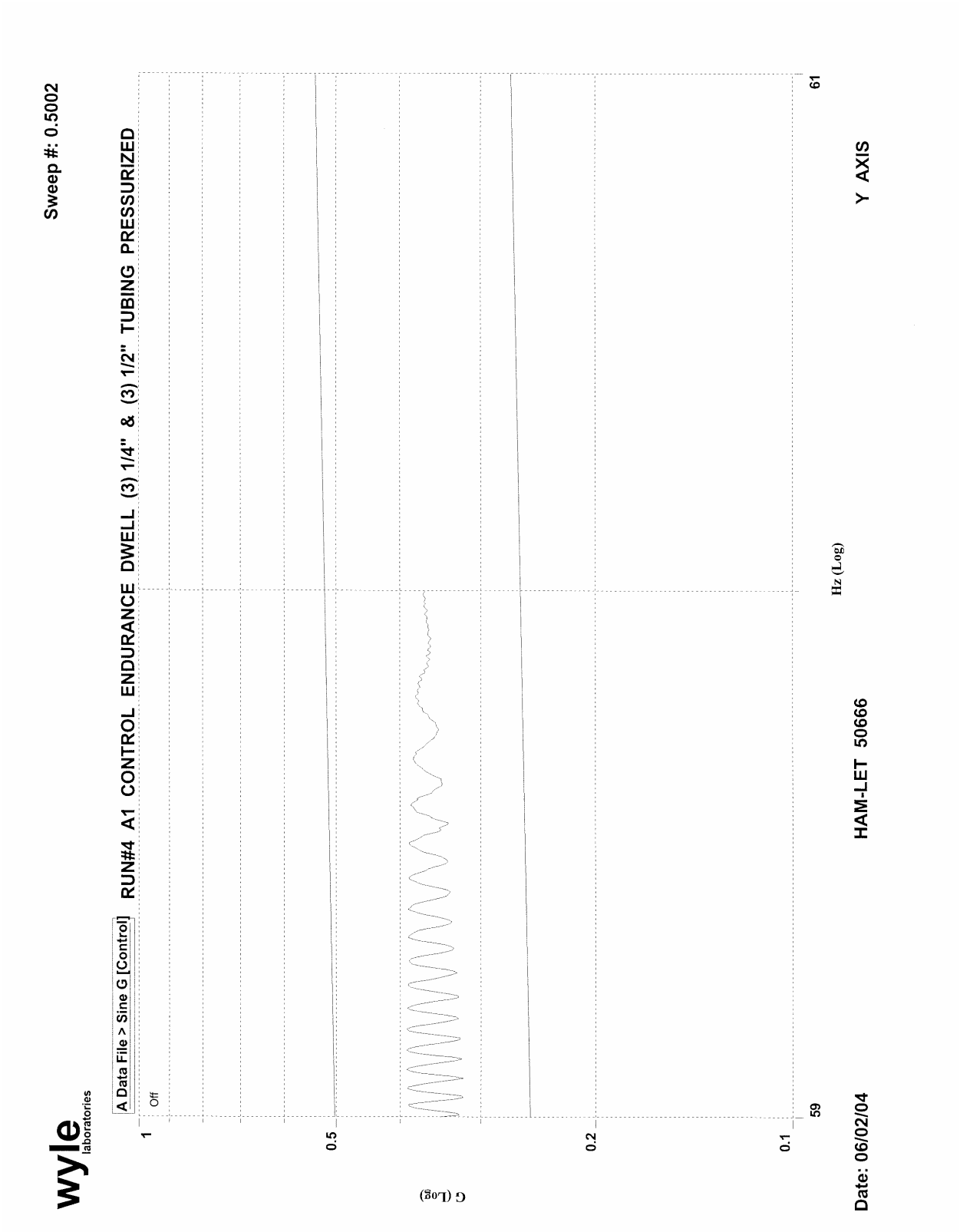
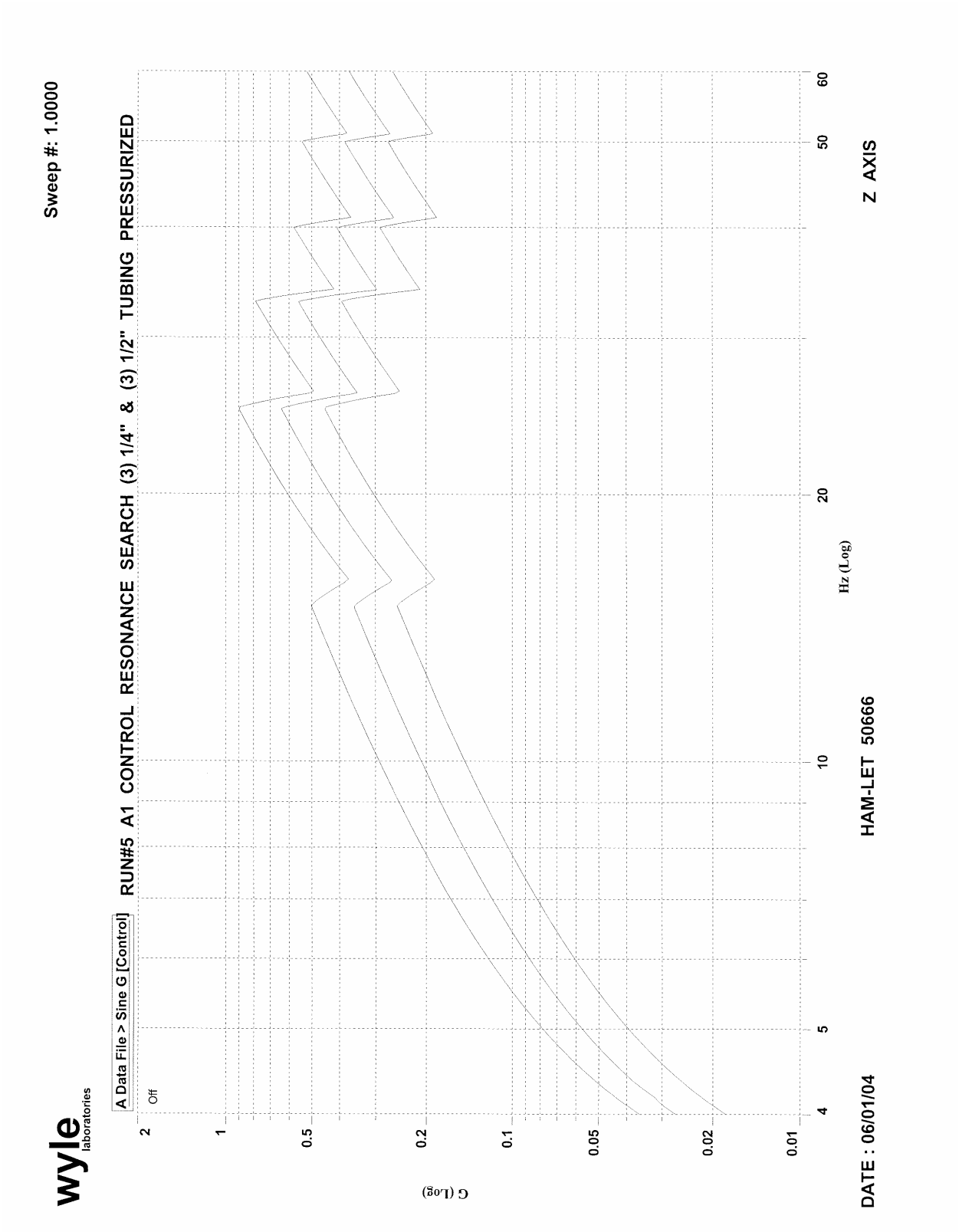
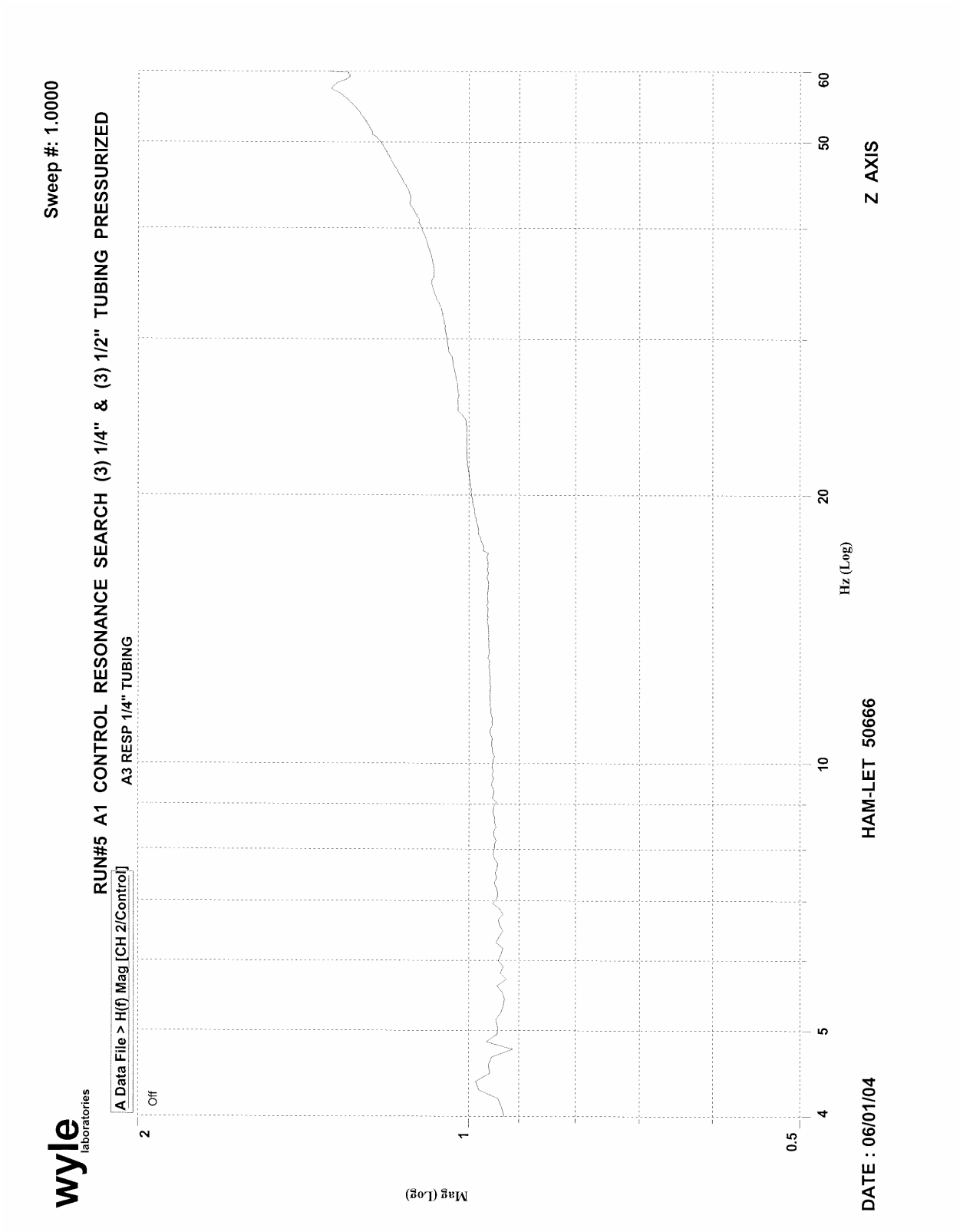
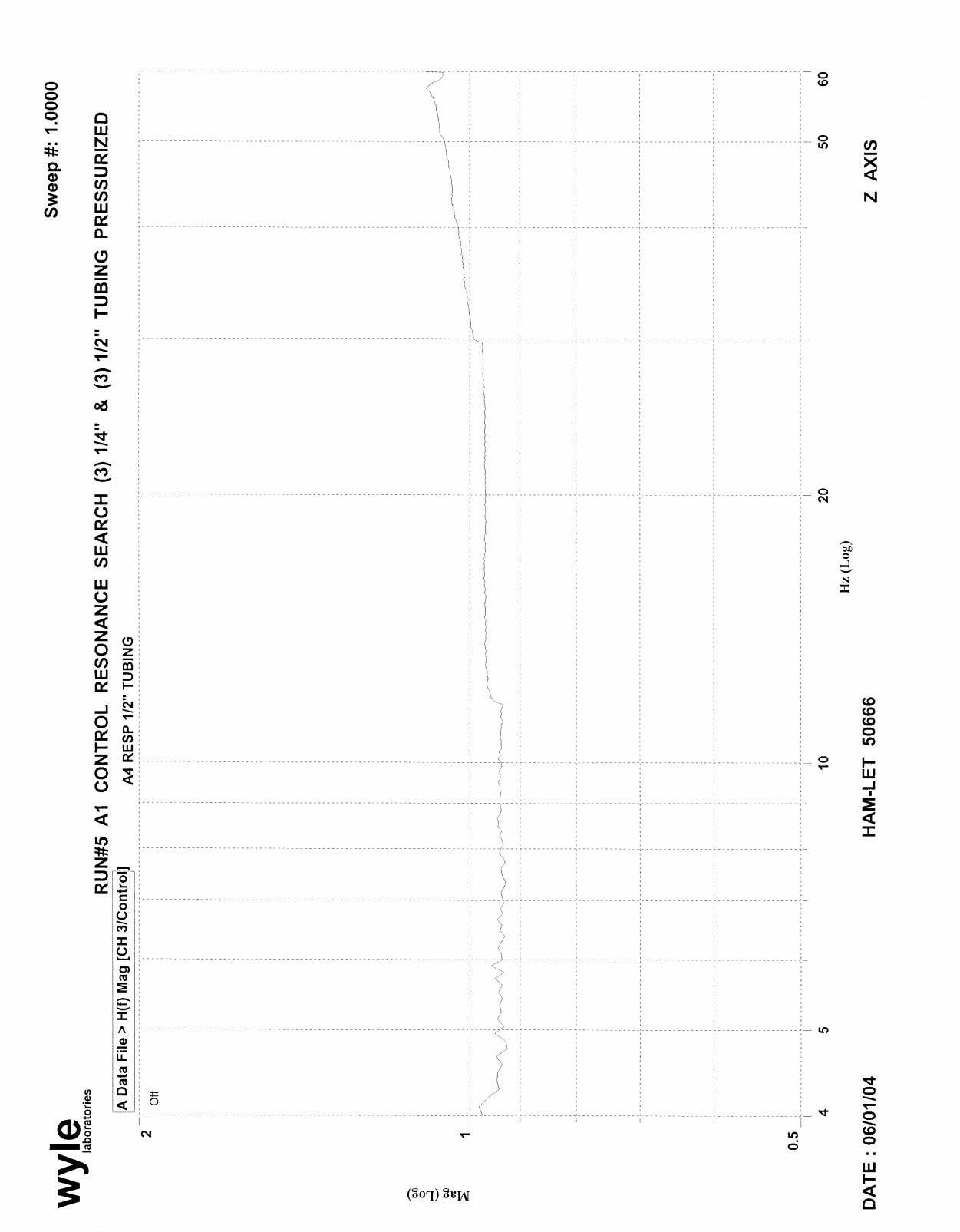
A4 RESPONSE 1/2" TUBING
A Data File > H(f) Mag [CH 3/Control]
Off
wyle laboratories
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
Y AXIS
HAM-LET 50666
Date: 06/02/04


Sweep #: 0.5002
wyle laboratories
A Data File > Sine G [Control]
RUN#4 A1 CONTROL ENDURANCE DWELL (3) 1/4" & (3) 1/2" TUBING PRESSURIZED
1
Off
0.5
0.2
0.1
G (Log)
59
61
Hz (Log)
Y AXIS
HAM-LET 50666
Date: 06/02/04


Sweep #: 1.0000
wyle laboratories
A Data File > Sine G [Control]
RUN#5 A1 CONTROL RESONANCE SEARCH (3) 1/4" & (3) 1/2" TUBING PRESSURIZED
Off
G (Log)
2
1
0.5
0.2
0.1
0.05
0.02
0.01
4
5
10
20
50
60
Hz (Log)
Z AXIS
HAM-LET 50666
DATE : 06/01/04


wyle
laboratories
RUN#5 A1 CONTROL RESONANCE SEARCH (3) 1/4" & (3) 1/2" TUBING PRESSURIZED
Sweep #: 1.0000
A Data File > H(f) Mag [CH 2/Control]
A3 RESP 1/4" TUBING
Off
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
Z AXIS
HAM-LET 50666
DATE : 06/01/04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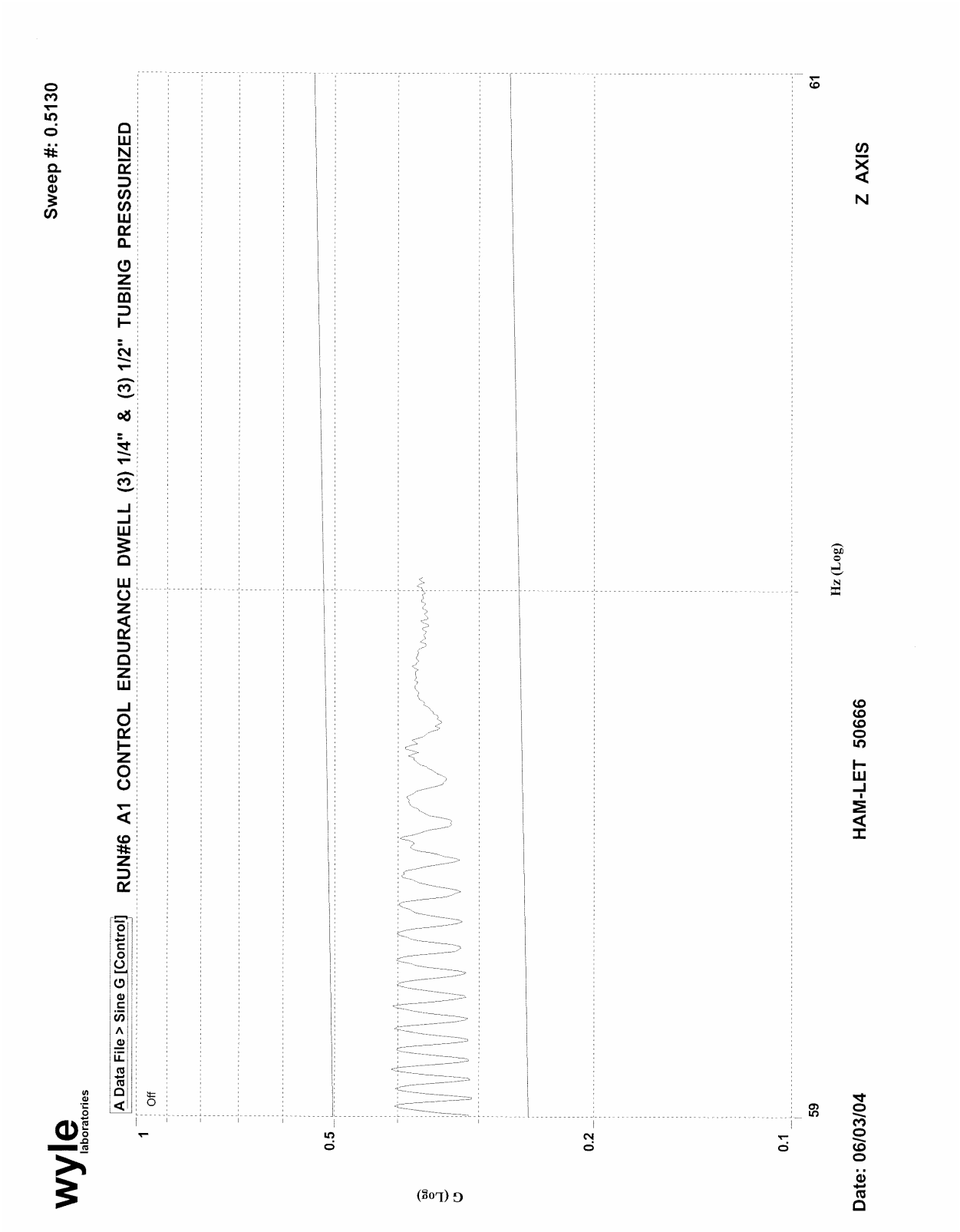
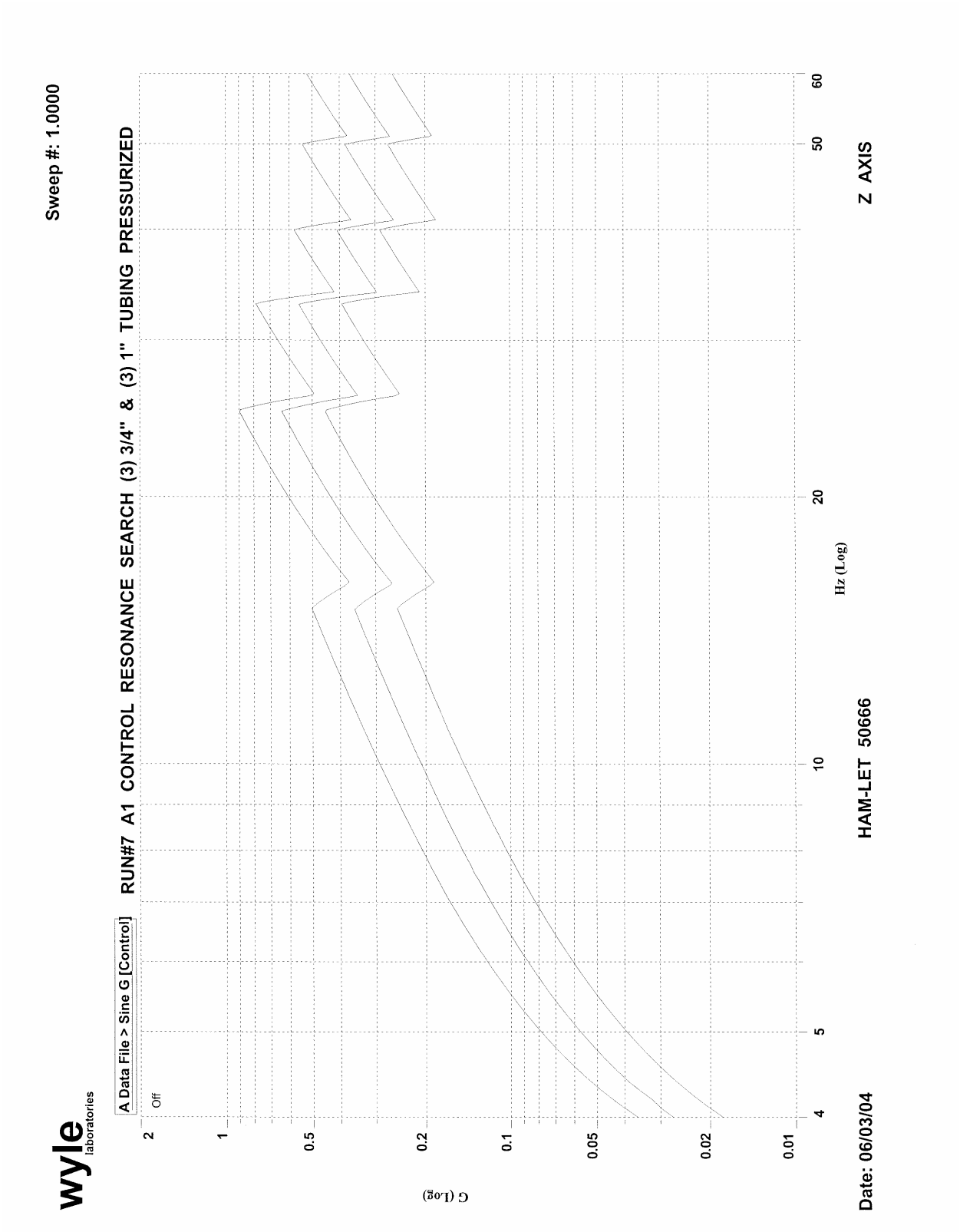
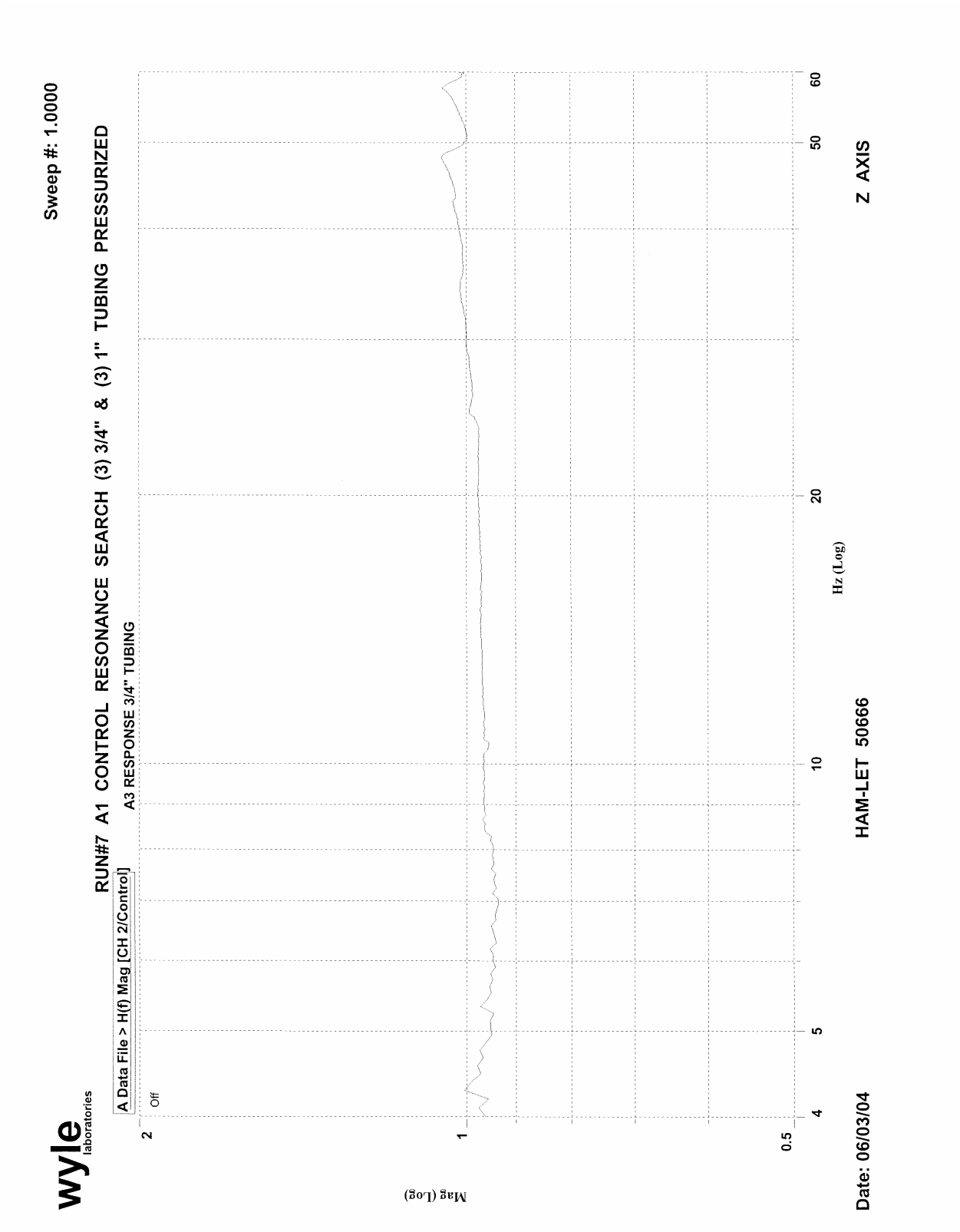
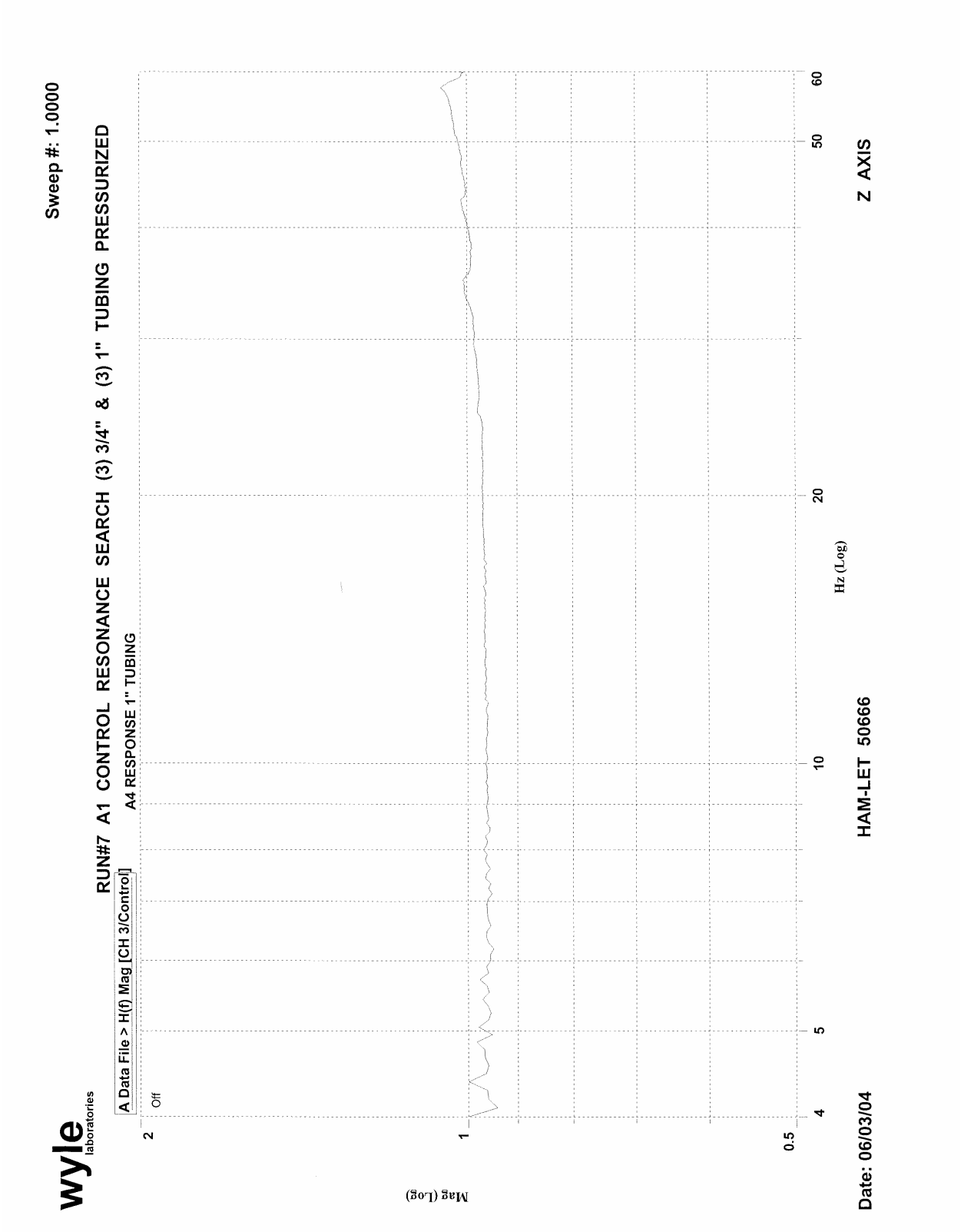
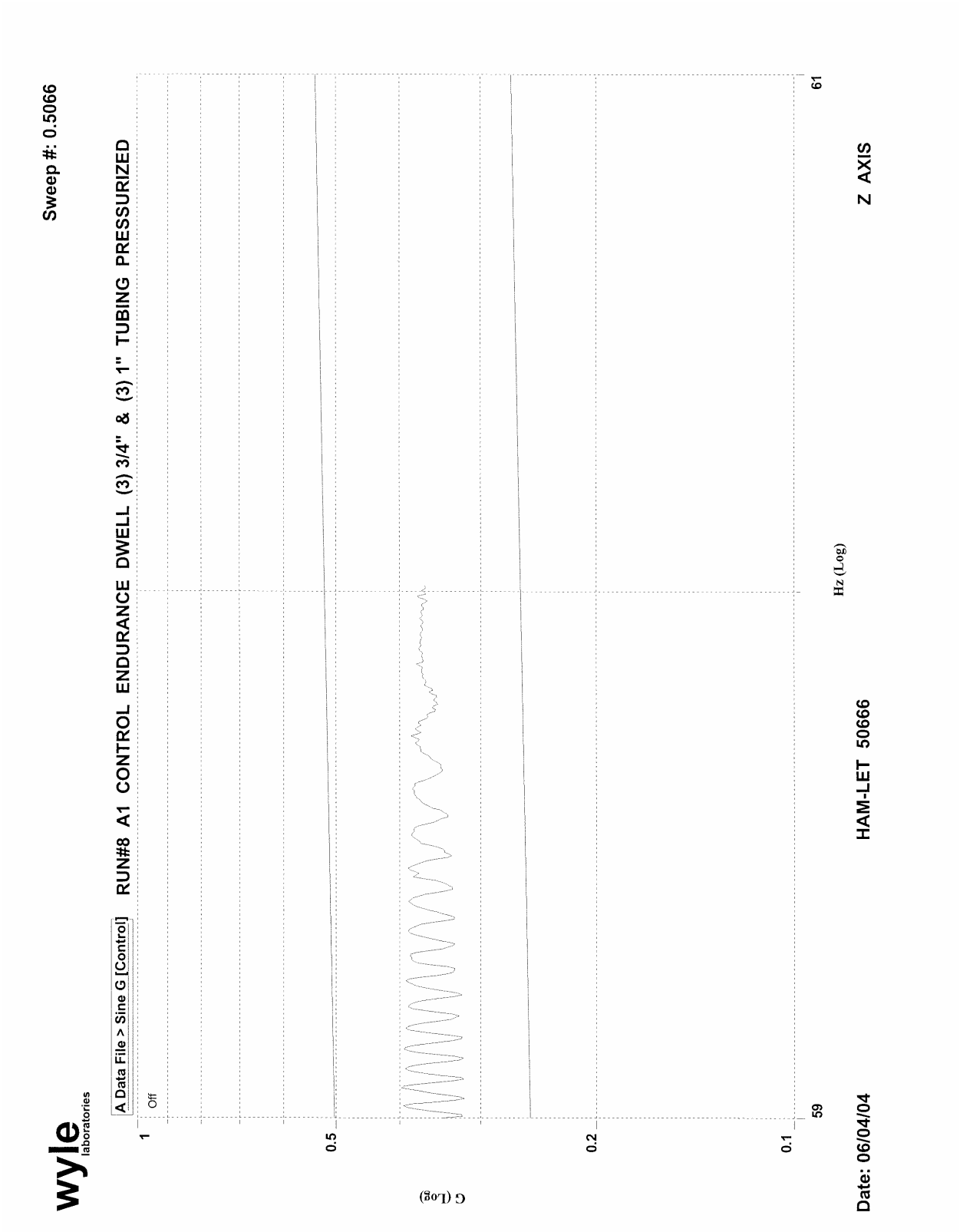
A Data File > H(f) Mag [CH 3/Control]
A4 RESP 1/2" TUBING
Off
wyle laboratories
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
Z AXIS
HAM-LET 50666
DATE : 06/01/04

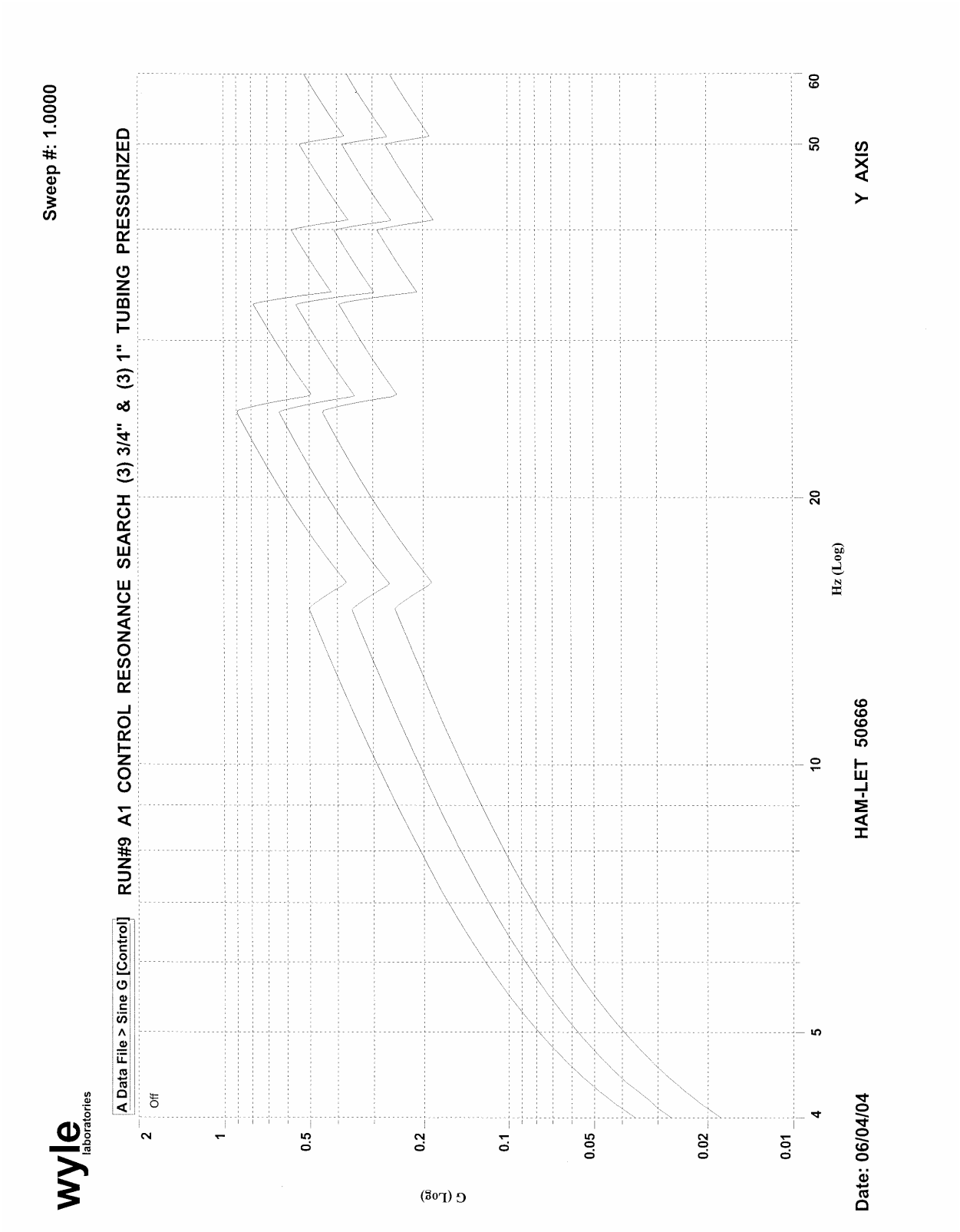

wyle laboratories
A Data File > Sine G [Control]
RUN#6 A1 CONTROL ENDURANCE DWELL (3) 1/4" & (3) 1/2" TUBING PRESSURIZED
Sweep #: 0.5130
Off
1
0.5
0.2
0.1
G (Log)
59
61
Hz (Log)
Z AXIS
HAM-LET 50666
Date: 06/03/04

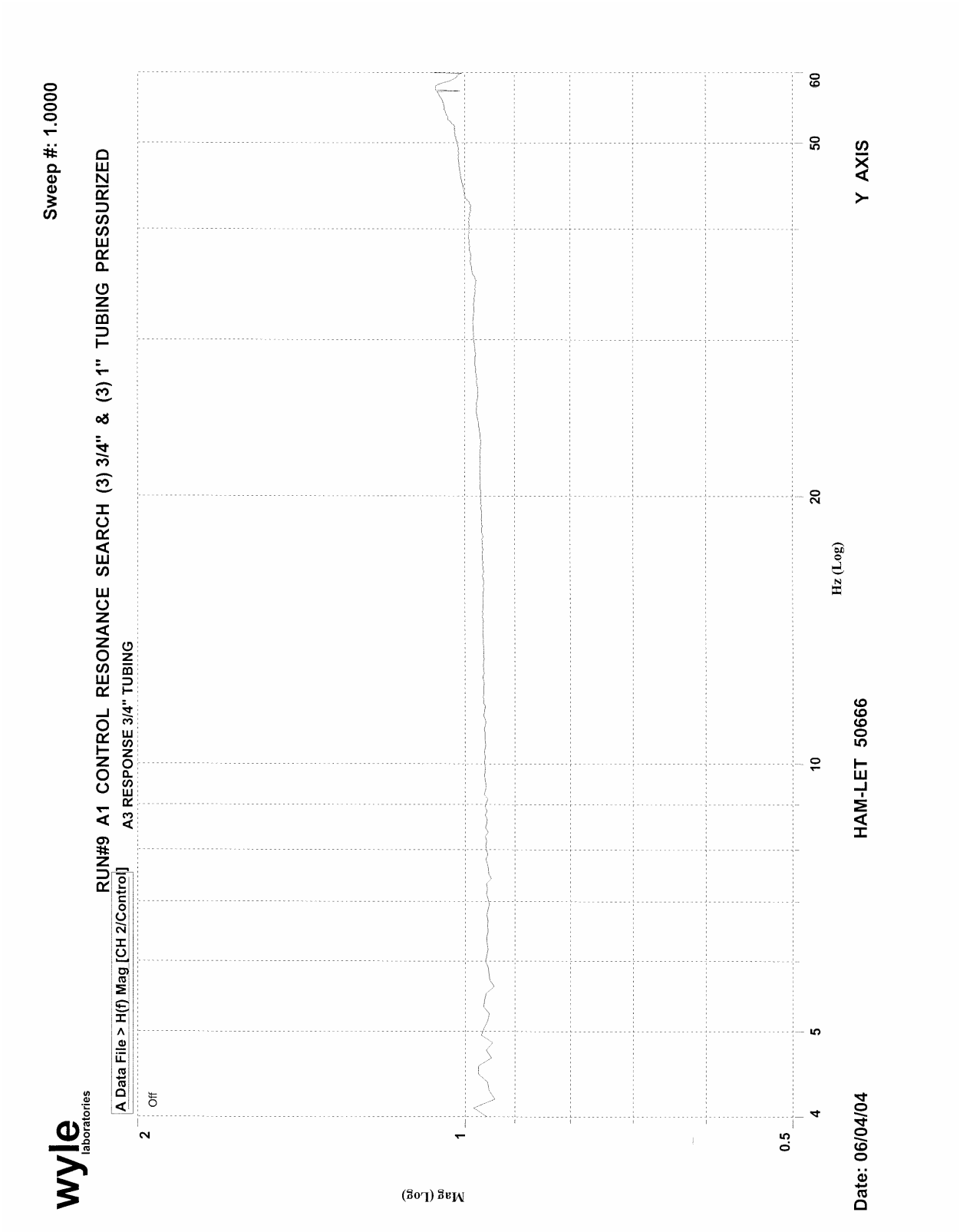

Sweep #: 1.0000
wyle laboratories
A Data File > Sine G [Control]
Off
RUN#7 A1 CONTROL RESONANCE SEARCH (3) 3/4" & (3) 1" TUBING PRESSURIZED
G (Log)
2
1
0.5
0.2
0.1
0.05
0.02
0.01
4
5
10
20
50
60
Hz (Log)
Z AXIS
HAM-LET 50666
Date: 06/03/04

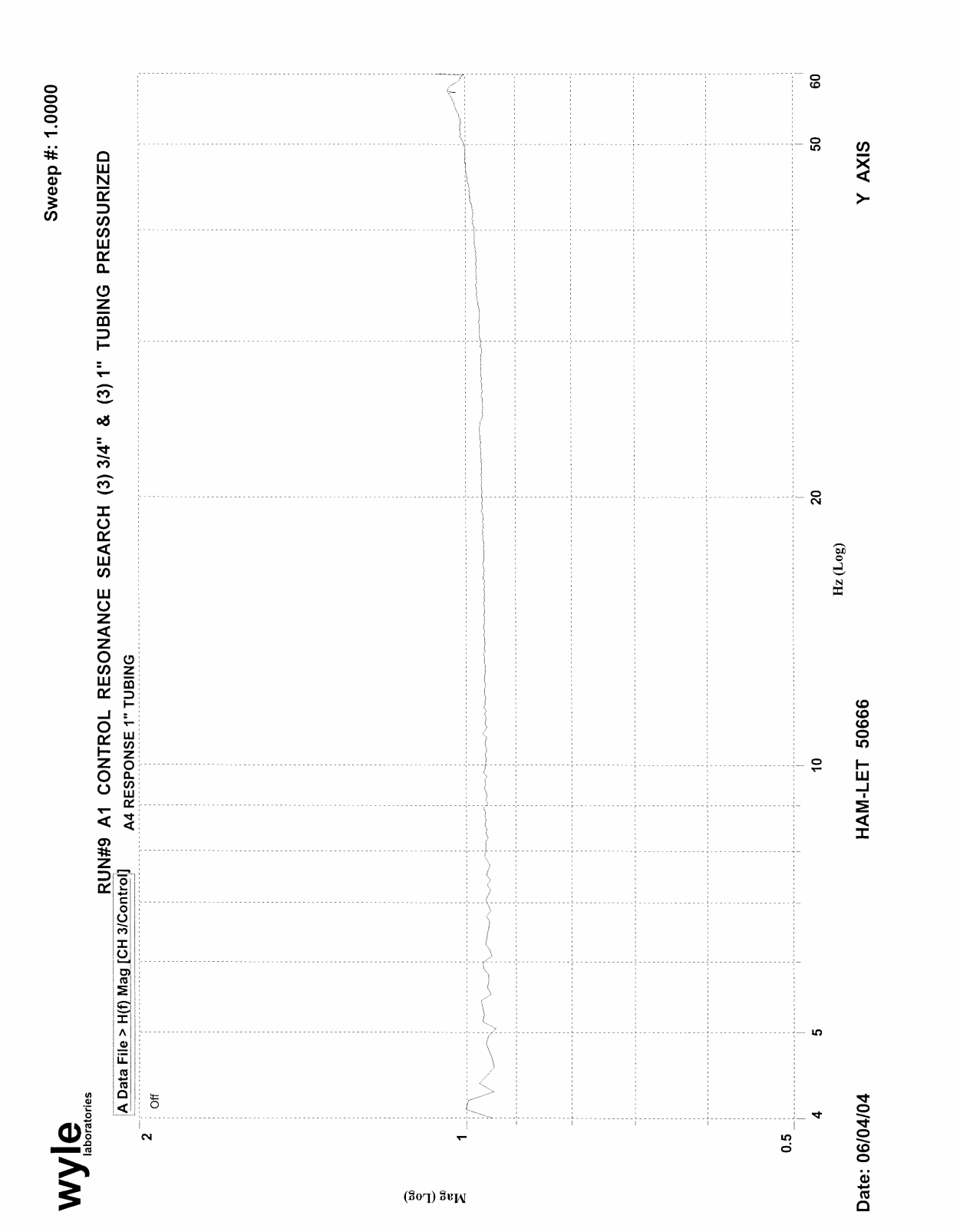

Sweep #: 1.0000
RUN#7 A1 CONTROL RESONANCE SEARCH (3) 3/4" & (3) 1" TUBING PRESSURIZED
A Data File > H(f) Mag [CH 2/Control]
A3 RESPONSE 3/4" TUBING
Off
wyle laboratories
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
Z AXIS
HAM-LET 50666
Date: 06/03/04

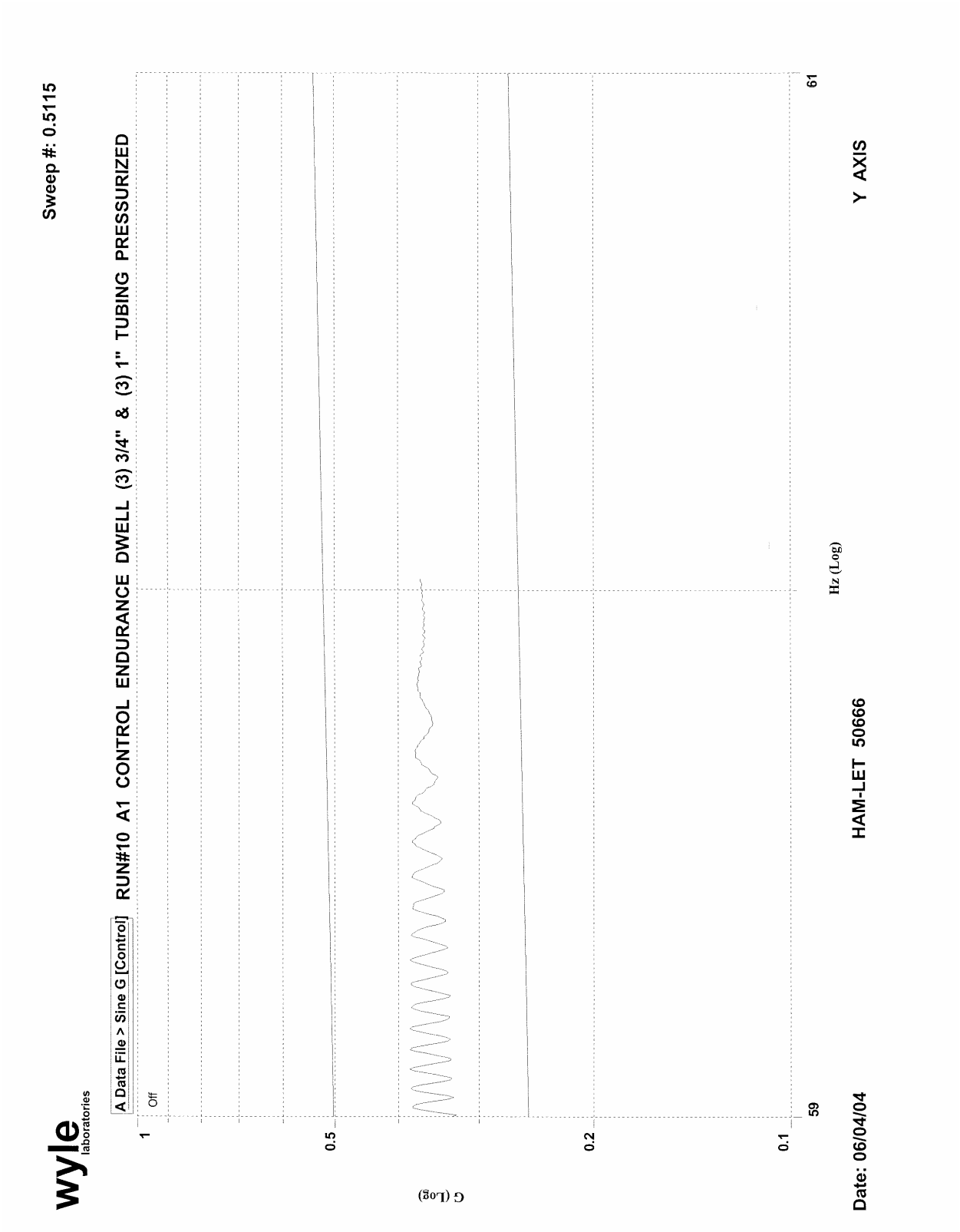

Sweep #: 1.0000
RUN#7 A1 CONTROL RESONANCE SEARCH (3) 3/4" & (3) 1" TUBING PRESSURIZED
wyle laboratories
A Data File > H(f) Mag [CH 3/Control]
A4 RESPONSE 1" TUBING
Off
2
1
0.5
Mag (Log)
4
5
10
20
50
60
Hz (Log)
Z AXIS
HAM-LET 50666
Date: 06/03/04

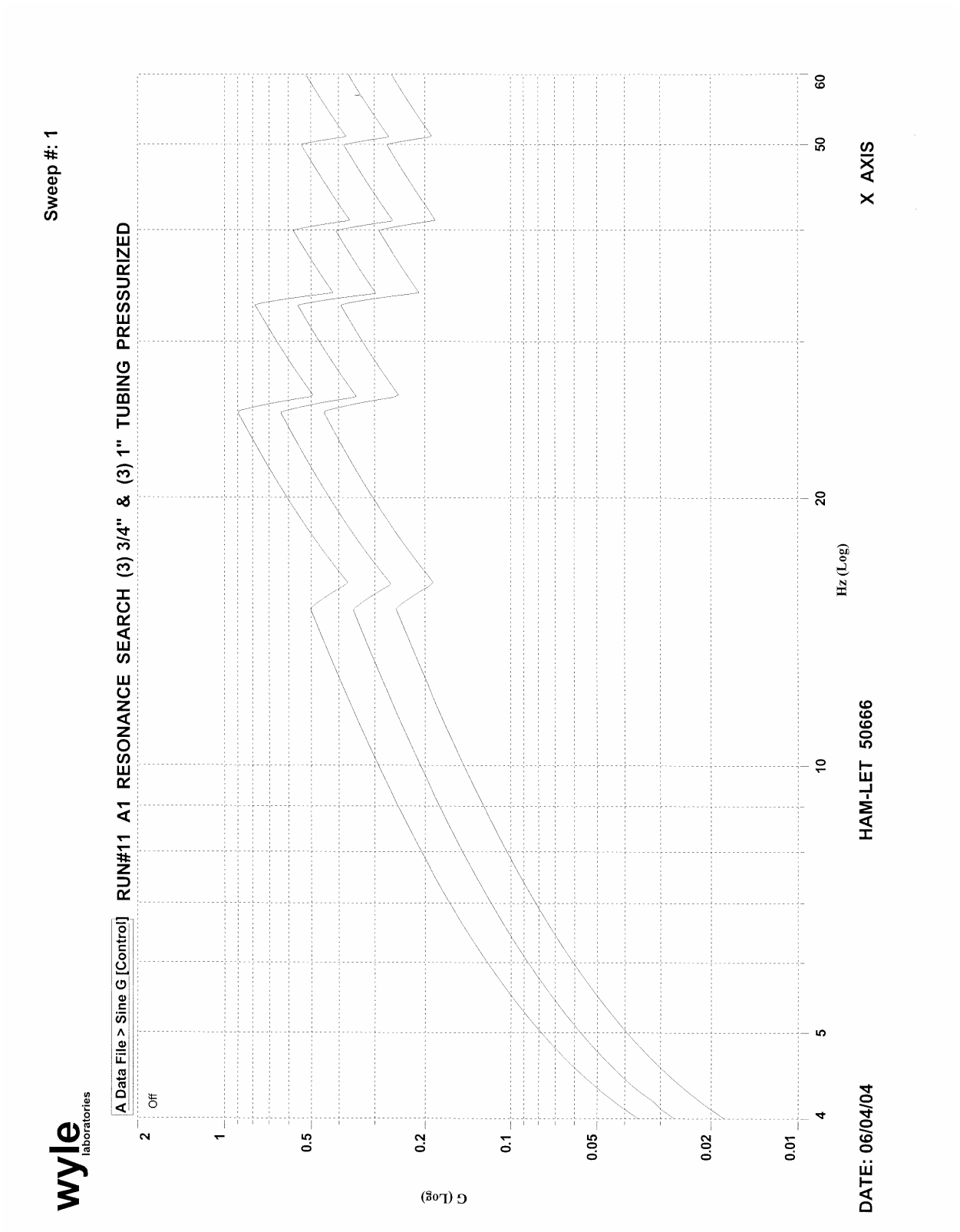

wyle laboratories
A Data File > Sine G [Control]
RUN#8 A1 CONTROL ENDURANCE DWELL (3) 3/4" & (3) 1" TUBING PRESSURIZED
Sweep #: 0.5066
Off
1
0.5
0.2
0.1
G (Log)
59
61
Hz (Log)
Z AXIS
HAM-LET 50666
Date: 06/04/04

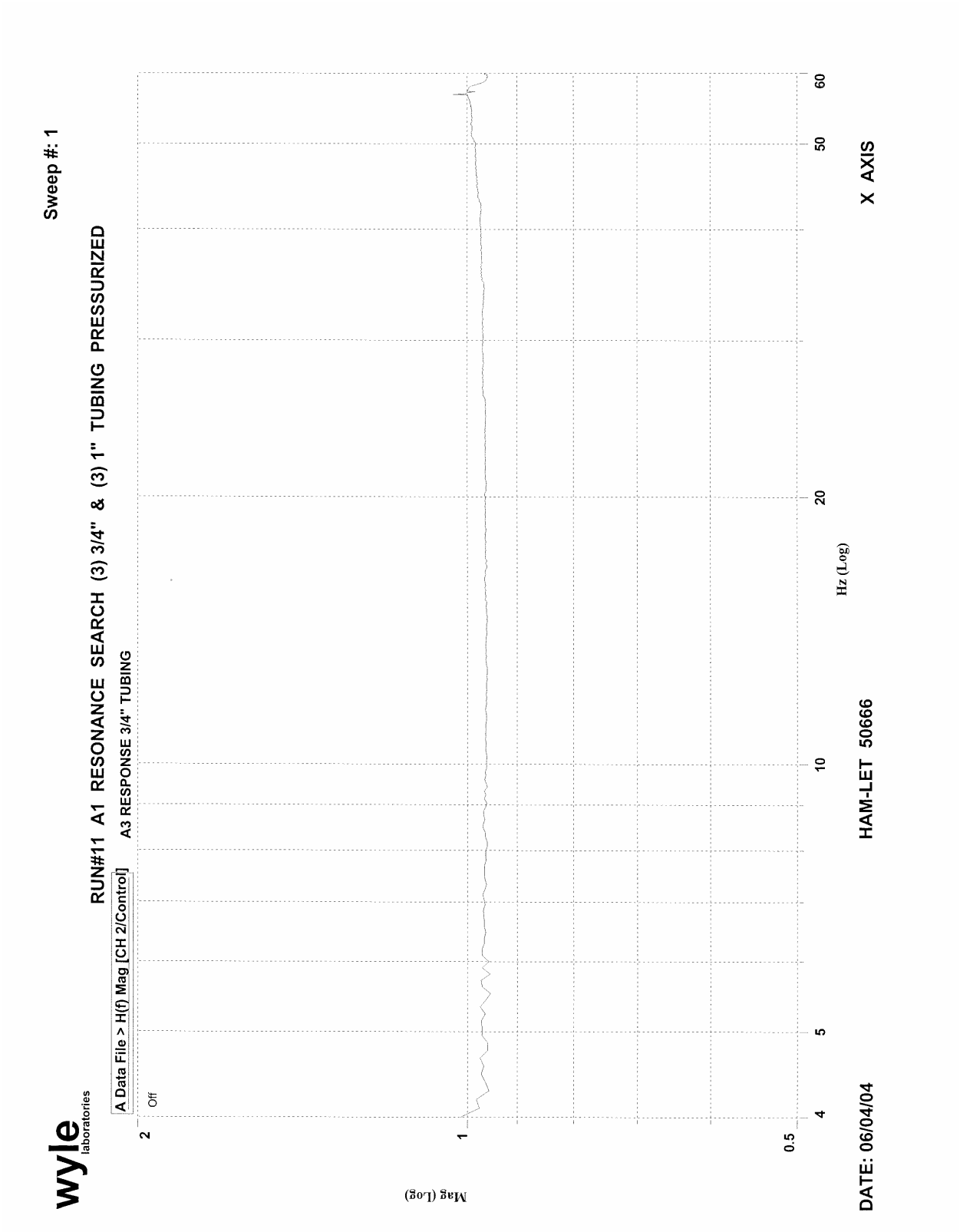

Sweep #: 1.0000
wyle laboratories
A Data File > Sine G [Control]
RUN#9 A1 CONTROL RESONANCE SEARCH (3) 3/4" & (3) 1" TUBING PRESSURIZED
Off
2
1
0.5
0.2
0.1
0.05
0.02
0.01
G (Log)
4
5
10
20
50
60
Hz (Log)
Y AXIS
HAM-LET 50666
Date: 06/04/04

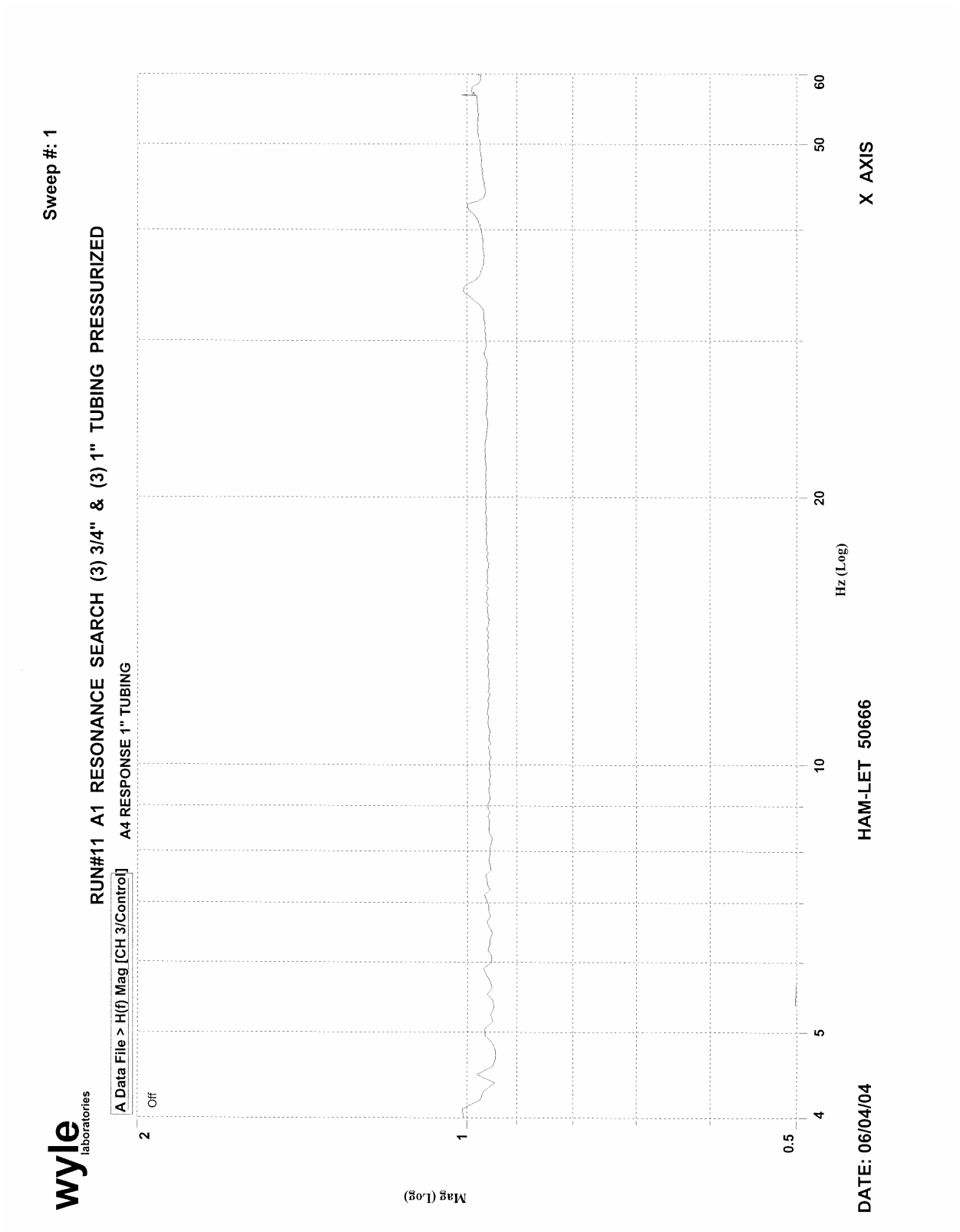

Sweep #: 1.0000
RUN#9 A1 CONTROL RESONANCE SEARCH (3) 3/4" & (3) 1" TUBING PRESSURIZED
A3 RESPONSE 3/4" TUBING
A Data File > H(f) Mag [CH 2/Control]
Off
wyle laboratories
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
Y AXIS
HAM-LET 50666
Date: 06/04/04

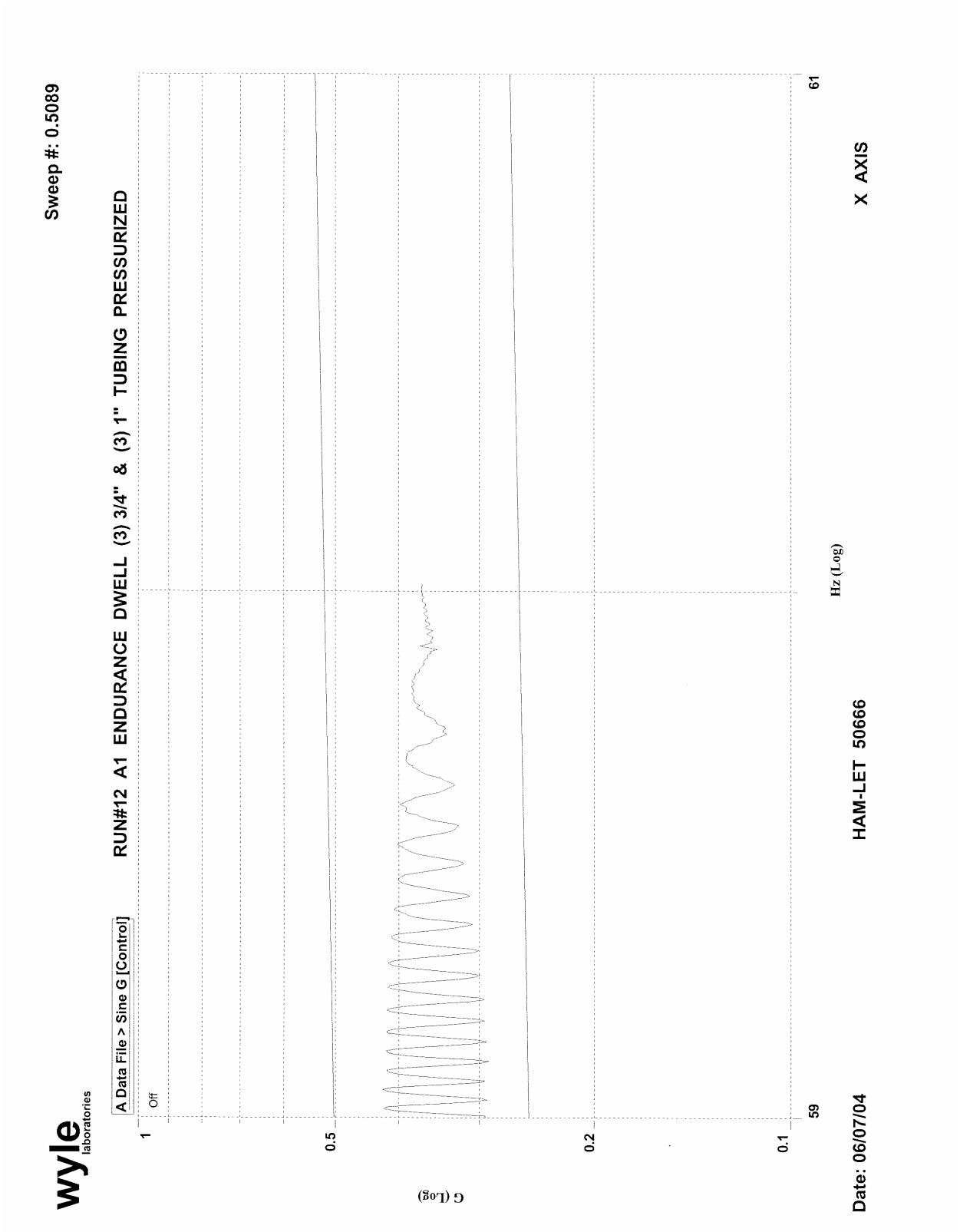

Sweep #: 1.0000
RUN#9 A1 CONTROL RESONANCE SEARCH (3) 3/4" & (3) 1" TUBING PRESSURIZED
A Data File > H(f) Mag [CH 3/Control]
A4 RESPONSE 1" TUBING
wyle laboratories
Off
2
1
0.5
Mag (Log)
4
5
10
20
50
60
Hz (Log)
Y AXIS
HAM-LET 50666
Date: 06/04/04


wyle laboratories
A Data File > Sine G [Control]
RUN#10 A1 CONTROL ENDURANCE DWELL (3) 3/4" & (3) 1" TUBING PRESSURIZED
Sweep #: 0.5115
Off
1
0.5
0.2
0.1
G (Log)
59
61
Hz (Log)
Y AXIS
HAM-LET 50666
Date: 06/04/04


Sweep #: 1
wyle laboratories
A Data File > Sine G [Control]
RUN#11 A1 RESONANCE SEARCH (3) 3/4" & (3) 1" TUBING PRESSURIZED
Off
G (Log)
2
1
0.5
0.2
0.1
0.05
0.02
0.01
4
5
10
20
50
60
Hz (Log)
X AXIS
HAM-LET 50666
DATE: 06/04/04


wyle laboratories
RUN#11 A1 RESONANCE SEARCH (3) 3/4" & (3) 1" TUBING PRESSURIZED
A3 RESPONSE 3/4" TUBING
A Data File > H(f) Mag [CH 2/Control]
Off
Sweep #: 1
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
X AXIS
HAM-LET 50666
DATE: 06/04/04


Sweep #: 1
RUN#11 A1 RESONANCE SEARCH (3) 3/4" & (3) 1" TUBING PRESSURIZED
A4 RESPONSE 1" TUBING
A Data File > H(f) Mag [CH 3/Control]
Off
wyle laboratories
Mag (Log)
2
1
0.5
4
5
10
20
50
60
Hz (Log)
X AXIS
HAM-LET 50666
DATE: 06/04/04


wyle laboratories
A Data File > Sine G [Control]
Off
RUN#12 A1 ENDURANCE DWELL (3) 3/4" & (3) 1" TUBING PRESSURIZED
Sweep #: 0.5089
G (Log)
1
0.5
0.2
0.1
59
61
Hz (Log)
X AXIS
HAM-LET 50666
Date: 06/07/04

ATTACHMENT O

TENSILE TEST DATA SHEET

MTI MATERIALS TECHNOLOGY INCORPORATED

www.TestMetal.com
213 Lyon Lane
Birmingham, AL 35211
205.940.9480
866.RUN.TEST

REPORT OF ANALYSIS

Wyle Labs
Attention: David Bailey
7800 Highway 20 West
Huntsville, AL 35807

Test Date: 05/21/2004
Report Date: 05/25/2004
Lab Number: 41532
P. O. Number: HSV0031509

Submitted Samples: (24) Tube/Fitting Assemblies

		TUBE SIZE			
	Unit	**1/4"**	**1/2"**	**3/4" †**	**1" †**
Tensile Testing – Test No. 7.5					
Calculated Tensile Load	lbf	935	2688	5996	7758
Sample Identification			**Maximum Applied Load**		
Specimen #					
19	lbf	936	2,690	6,001	7,780
20	lbf	936	2,691	5,632*	7,770
21	lbf	937	2,695	6,066	7,801
22	lbf	937	2,690	5,997	7,763
23	lbf	935	2,693	6,010	7,760
24	lbf	937	2,693	6,004	7,760

Notes:
1. Calculated Tensile Load per Section 7.5.4 based on actual cross section of tubes as determined by measurement of Tube OD and wall thickness.
2. Upon attainment of the Calculated Tensile Load, load application ceased and was held for a few seconds prior to removal of load.
3. Observations during testing:

*Base on Load Rate Change, this specimen appeared to begin slipping at approximately 5,400 lbf. The load was continually applied until the dropping load reached 5,000 lbf. Slippage was measured at 0.09".

†With the exception of the 3/4" Tube, Specimen #20, all 3/4" and 1" tubes slipped approximately 1/32" during the test.

Test Method(s): GE Specification 362A2915, Appendix A, Section 7.5

Respectfully Submitted,
Materials Technology, Inc.

Quality Assurance Representative

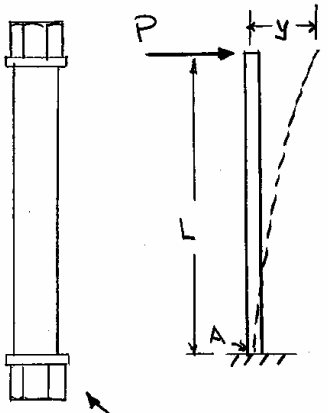
Tests and analysis performed in accordance with procedures derived from methods described and approved by the ASTM and other accepted industry practices. This report shall not be reproduced, except in full, without the prior written approval of Materials Technology, Inc.

Testing efforts were in accordance with MTI QA Program, Rev. 2 –February 15, 2002

ATTACHMENT P

TYPICAL STRAIN CALCULATION DATA SHEETS

wyle laboratories (Eastern Operations)



P ~ applied force, lbs
y ~ deflection, in.
L = free length, 9.0 in.

1) Assume end is fixed - no displacement or rotation.
2) Force P applied at upper end.
3) Maximum stress will be on the outer surface of the tube nearest the fixed end (max. bending moment).

$$y = \frac{PL^3}{3EI} = \frac{ML^2}{3EI}$$

σ_b = max. bending stress = $\frac{Mc}{I} = \frac{3Eyc}{L^2}$

$$y = \frac{\sigma_b L^2}{3Ec}$$

$c = \frac{OD}{2}$, $E = 29{,}000{,}000$ psi

σ_b = 35% of ultimate strength (UTS)
Nominal UTS for 304 is 85,000 psi
Minimum UTS for 304 is 75,000 psi

$$y = \frac{85000(9)^2(2)}{3(29{,}000{,}000)(OD)} = \frac{0.158276}{OD}$$

1/4" ~ y = 0.633"

3/4" ~ y = 0.211"

1/2" ~ y = 0.316"

1" ~ y = 0.158"

Prepared By: J. Roth / 12/1/03 (Date)

Checked By: [signature] 12/2/03 (Date)

1

wyle laboratories (Eastern Operations)

7.8.8 Axial stress in tubes: $S = \frac{P d^2}{D^2 - d^2}$

Tube (D)	wall	d	P, psi	S, psi
0.25	0.049	0.152	7500	4398.4
0.50	0.065	0.370	5100	6173.2
0.75	0.095	0.560	4900	6173.7
1.0	0.095	0.810	3600	6869.2

Tube (D)	I, in^4
0.25	1.6555×10^{-4}
0.50	2.1480×10^{-3}
0.75	1.0704×10^{-2}
1.0	2.7957×10^{-2}

7.8.9 Average bending stress (mid-wall) = 38000 - S

$\sigma_b = \frac{My}{I} = 38000 - S$

Tube (D)	$y = \frac{1}{4}(D+d)$	M, in-lbs.	S_{max}*	ϵ*
0.25	0.1005	55.349	46191	1593
0.50	0.2175	314.315	42756	1474
0.75	0.3275	1040.215	42616	1470
1.0	0.4525	1923.423	41268	1423

* S_{max} = total outer surface (OD) longitudinal stress

$= \frac{MD}{2I} + S$

ϵ = measured strain = $S_{max}/E = S_{max}/29 \times 10^6$ psi, μ in/in

Prepared By: JRoth / 12/11/03 Date

Checked By: 12-12-03 Date

2

wyle laboratories (Eastern Operations)

For P= 500 psig , all sizes:

Tube (D)	S, psi	M, in-lbs.	S_{max}	ϵ
0.25	293.2	62.111	47192	1627
0.50	605.2	369.303	43587	1503
0.75	630.0	1221.408	43420	1497
1.0	953.9	2288.820	41889	1444

Prepared By: JRothy 12/11/03 Date

Checked By: [signature] 12-12-03 Date

ATTACHMENT Q

MATERIAL DATA SHEETS FOR STAINLESS STEEL TUBING

SALEM TUBE, INC.
A SUBSIDIARY OF TUBACEX

CERTIFICATION NUMBER	14336
CERTIFICATION DATE	10/27/2003

Telephone: (724)646-4301
Fax: (724)646-4311

CUSTOMER	OUR ORDER NUMBER: 3J01710	SHIP TO
MARMON KEYSTONE BUTLER	YOUR P.O. NUMBER: 80-5322	MARMON/KEYSTONE EAST BUTLER

FINISH	GRADE	TYPE	DESCRIPTION	CUT LENGTHS	SPECIFICATION
BRIGHT ANNEAL	T304/T304L	S	1.000''OD X .095''AW		ASME-SA213-01 ASTM-A213-01/A269-02 EAW

HEAT NO.	%C	%Mn	%P	%S	%Si	%Ni	%Cr	%Fe	%Ti	%Mo	%Cu	%Co	%Al	%W	%V	$\%N_2$
Ladle	0.0210	1.8000	0.0270	0.0050	0.4200	9.1900	18.0600	0.0000	0.0000	0.2600	0.3500	0.1290	0.0000	0.0000	0.0000	0.0695
Check	0.0240	1.8400	0.0280	0.0040	0.4400	9.1400	18.2200	0.0000	0.0000	0.2500	0.3600	0.1330	0.0000	0.0000	0.0000	0.0775

A54784	LOTS	YIELD (PSI) AVG	TENSILE (PSI) AVG	% ELONGATION (in 2") AVG	HARDNESS (RB) AVG	GRAIN SIZE ASTM #	Ra OD	Ra ID	CORROSION (ASTM PRACTICE)
	2	49655	91432	62	85				

HEAT NO.	%C	%Mn	%P	%S	%Si	%Ni	%Cr	%Fe	%Ti	%Mo	%Cu	%Co	%Al	%W	%V	$\%N_2$
Ladle	0.0160	1.4300	0.0280	0.0040	0.3000	10.1500	18.2600	0.0000	0.0000	0.2200	0.2500	0.0000	0.0000	0.0000	0.0000	0.0470
Check	0.0140	1.4600	0.0260	0.0060	0.3100	10.1000	18.3400	0.0000	0.0000	0.2200	0.2500	0.0000	0.0000	0.0000	0.0000	0.0423

A61916	LOTS	YIELD (PSI) AVG	TENSILE (PSI) AVG	% ELONGATION (in 2") AVG	HARDNESS (RB) AVG	GRAIN SIZE ASTM #	Ra OD	Ra ID	CORROSION (ASTM PRACTICE)
	3	47320	87620	64	80				

HEAT NO.	%C	%Mn	%P	%S	%Si	%Ni	%Cr	%Fe	%Ti	%Mo	%Cu	%Co	%Al	%W	%V	$\%N_2$
Ladle	0.0160	1.6600	0.0290	0.0010	0.3800	9.1600	18.2100	0.0000	0.0000	0.2400	0.2900	0.1300	0.0000	0.0000	0.0000	0.0735
Check	0.0140	1.6700	0.0270	0.0010	0.3700	9.1400	18.2000	0.0000	0.0000	0.2400	0.2900	0.1400	0.0000	0.0000	0.0000	0.0746

A64920	LOTS	YIELD (PSI) AVG	TENSILE (PSI) AVG	% ELONGATION (in 2") AVG	HARDNESS (RB) AVG	GRAIN SIZE ASTM #	Ra OD	Ra ID	CORROSION (ASTM PRACTICE)
	1	48863	88703	58	85				

03/01/2004 From: MARMON/KEYSTONE
M/K OR: 80-004883
C P.O.: VERBAL/DON

To: HAM-LET USA INC
INIT. :CAM

Nov 18, 2003
9:58:20

GWW
Page 1 of 1

M A T E R I A L C E R T I F I C A T E

No. 200341278

Sandvik Materials Technology
P.O. Box 1220, Scranton, PA 18501 PH. (570) 585-7500
Plant Location: 982 Griffin Pond Road, Clarks Summit, PA 18411

Sold To:
MARMON/KEYSTONE CORP. (80)BUTL
BUTLER PA

Ship To:
MARMON/KEYSTONE CORP. (80)
EAST BUTLER PA

Customer Order No: 8000113
Sandvik Order No: 15135/3
Work Order/Lot: 308479

Certification Date: 20031118

ASTM A213-01a, ASTM A269-02, ASME SA-213, ASME Section II
2001 Edition; 2003 Addenda

Cold Finished BRIGHT ANNEALED Seamless Tube
Type MT 304/MT 304L/TP304/TP304L

Size: .250" X .049"
Heat: 459849

ANALYSIS %

	C	Si	Mn	P	S	Cr	Ni
Heat	.016	.40	1.65	.028	.009	18.19	10.10
Prod	.013	.40	1.66	.028	.007	18.13	10.15

	Fe	Cu	Al	Pb
Heat	68.9	.22	.003	
Prod	68.93	.23	.003	

Mechanical Tests:

Yield Strength 0.2%		Yield Strength 1.0%		Tensile Strength		Elongation in %				Reduction Of Area
psi	MPa	psi	MPa	psi	MPa	E2"	E10"	E4d	E5d	%
44000	303.4	N/A		87000	600.0	58	N/A	N/A	N/A	N/A

Hardness Test Results: 74HRB, 73HRB

Flare Test per ASTM A450,
No. samples: 2 Result: Acceptable
Flattening Test per ASTM A450: Acceptable
Tensile Test sample width (1=Full-Size 2=1/2" Strip): 1
Country Of Origin: Canada
All material subjected to a final solution annealing heat treatment with material at a temperature of 1900 deg.F. minimum followed by rapid quenching.
The material has not come in contact with Mercury or Mercury containing compounds.
No welding has been performed on this material.
Material has been eddy current tested in accordance with ASTM A450, ASTM A1016 and is acceptable.
Material has been manufactured/supplied in accordance with Sandvik Materials Technology Quality Manual-Standard Products Revision 6 dated October 9, 2003. Quality system has been approved to ISO 9001:2000.
Certificate produced in accordance with EN 10204 (DIN 50049) 3.1.B.
This is to certify that the contents of this certificate are correct and accurate as contained in Sandvik's records, and that all above test results and operations performed are in compliance with the requirements of the purchase order and the specification(s) listed above.

Q.C. REVIEWED 12/5/03 PJL

Authorized Representative

Kurt Revak, Quality Specialist
10 (MKINST R7) (10) (GWW)

GTC GREENVILLE TUBE™

GREENVILLE TUBE
P.O. Box 30 Greenville, PA 16125
Phone (724)-588-6300
Fax (724)-588-1492

REPORT OF TESTS

Customer Marmon Keystone Corporation Date February 10, 2004

City Butler, PA Our Order GM-619-10 C.P.O. 80 7081

Material: Type TP304/TP304 L (X) Seamless ( ) Welded and Drawn ( ) As Welded

Condition Bright Annealed Finish Cold Drawn, Bright Annealed & Passivated

Spec. ASTM-A-269-02a/A-213-03b/SA-213-01(EAW)/in accordance with EN10204 3.1.B

Ship To
City

Each Tube on this order has been spectrographically checked for

Material on this order was manufactured and shipped from Clarksville, AR.

Heat Number A39180

Size			
O.D.	I.D.	Wall	Length
.750"		.095"	20'0"

Chemical Analysis

	%C	%Mn	%P	%S	%Si	%Ni	%Cr	%Mo	%Ti	%CB+TA	%Fe	%N
Ladle	.016	1.72	.027	.003	.42	9.18	18.42	.503				.0701
Prod.	.019	1.71	.026	.004	.43	9.25	18.54	.500				.0724

	%Cu	%Co	%Al	Nb+TA	%Nb	%TA	%Al+Ti	%Cb+Nb	%Cb			
Ladle	.43	.120										
Prod.	.42	.130										

Mechanical and Non-Destructive Tests

Tensile Strength (PSI)	Yield Strength (PSI)	% Elongation in 2"	Eddy Current	Hydro Test	Air Test
86,171 86,868	40,953 41,043	62 61	PASSED		

Mechanical Destructive and Other Tests

Hardness	Bend	Reverse Bend	Flange	Reverse Flat	Flare	Flat	Grain Size	Other Tests
RB 79/80					Passed	Passed		

ASTM-A-262, Practice Corrosion Tests

(A) _____ (B) _____ (C) _____ (D) _____ (E) _____

"I HEREBY CERTIFY THAT THE HEAT NUMBERS,ANALYSIS AND TESTS DETAILED HEREON, ARE CORRECT AS CONTAINED IN THE RECORDS OF THIS CORPORATION"

Important Notice: Any discrepancy in the amount of tubing must be reported within 24 hours after receipt by customer. Greenville Tube certifies that the material used for the P.O. No. stated above is free from mercury and low melting alloy contamination.

Signed: Cathy Rocole

Robert Ryan
Quality Control Mgr/Metallurgical Eng

Cathy Rocole
Quality Control Asst.

Q.C. REVIEWED
3-2-04 JLC

03/01/2004 From: MARMON/KEYSTONE To: HAM-LET USA INC
M/K OR: 80-004883 INIT. :CAM
C P.O.: VERBAL/DON

GREENVILLE TUBE
P.O. Box 30 Greenville, PA 16125
Phone (724)-588-6300
Fax (724)-588-1492

REPORT OF TESTS

Customer Marmon Keystone Corporation Date October 03, 2003

City Butler, PA Our Order GL-9342-8 C.P.O. 80 49786

Material: Type TP304/TP304 L (X) Seamless ( ) Welded and Drawn ( ) As Welded

Condition Bright Annealed Finish Cold Drawn, Bright Annealed & Passivated

Spec. ASTM-A-269-02a/A-213-03a/SA-213-01(EAW)/in accordance with EN10204 3.1.B

Ship To
City

Each Tube on this order has been spectrographically checked for

Material on this order was manufactured and shipped from Clarksville, AR.

Heat Number 1P667

Size			
O.D.	I.D.	Wall	Length
.500"		.065"	20'0"

Chemical Analysis

	%C	%Mn	%P	%S	%Si	%Ni	%Cr	%Mo	%Ti	%CB+TA	%Fe	%N
Ladle	.026	1.81	.030	.001	.30	9.15	18.11	.115				.029
Prod.	.022	1.82	.031	.003	.33	9.20	18.29	.125				.029

	%Cu	%Co	%Al	Nb+TA	%Nb	%TA	%Al+Ti	%Cb+Nb	%Cb			
Ladle	.185	.172										
Prod.	.200	.166										

Mechanical and Non-Destructive Tests

Tensile Strength (PSI)	Yield Strength (PSI)	% Elongation in 2"	Eddy Current	Hydro Test	Air Test
84,307 86,606	34,661 36,163	60 61	PASSED		

Mechanical Destructive and Other Tests

Hardness	Bend	Reverse Bend	Flange	Reverse Flat	Flare	Flat	Grain Size	Other Tests
*RB 67/69					Passed	Passed		

ASTM-A-262, Practice Corrosion Tests

(A) _____ (B) _____ (C) _____ (D) _____ (E) _____

"I HEREBY CERTIFY THAT THE HEAT NUMBERS,ANALYSIS AND TESTS DETAILED HEREON, ARE CORRECT AS CONTAINED IN THE RECORDS OF THIS CORPORATION"

Important Notice: Any discrepancy in then amount of tubing must be reported within 24 hours after receipt by customer. Greenville Tube certifies that the material used for the P.O. No. stated above is free from mercury and low melting alloy contamination.

Q.C. REVIEWED 10/23/03 PJL

Signed:

Robert Ryan
Quality Control Manager / Metallurgical Engineer

*RB converted from 30-T Scale.

03/01/2004 From: MARMON/KEYSTONE To: HAM-LET USA INC
M/K OR:80-004883 INIT. :CAM
C P.O.:VERBAL/DON

GREENVILLE TUBE
P.O. Box 30 Greenville, PA 16125
Phone (724)-588-6300
Fax (724)-588-1492

REPORT OF TESTS

Customer Marmon Keystone Corporation Date November 7, 2003

City Butler, PA Our Order GL-9638-2 C.P.O. 80 49805

Material: Type TP304/TP304 L (X) Seamless ( ) Welded and Drawn ( ) As Welded

Condition Bright Annealed Finish Cold Drawn, Bright Annealed & Passivated

Spec. ASTM-A-269-02a/A-213-03a/SA-213-01(EAW)/in accordance with EN10204 3.1.B

Ship To Marmon Keystone Corporation
City Pittsburgh, PA

Each Tube on this order has been spectrographically checked for

Material on this order was manufactured and shipped from Clarksville, AR.

Heat Number	Size O.D.	Size I.D.	Size Wall	Length
1Q200	.500"		.065"	20'0"

Chemical Analysis

	%C	%Mn	%P	%S	%Si	%Ni	%Cr	%Mo	%Ti	%CB+TA	%Fe	%N
Ladle	.017	1.63	.024	.001	.41	9.24	18.30	.160				.063
Prod.	.013	1.61	.025	.003	.39	9.32	18.41	.157				

	%Cu	%Co	%Al	Nb+TA	%Nb	%TA	%Al+Ti	%Cb+Nb	%Cb			
Ladle	.300	.180										
Prod.	.286	.171										

Mechanical and Non-Destructive Tests

Tensile Strength (PSI)	Yield Strength (PSI)	% Elongation in 2"	Eddy Current	Hydro Test	Air Test
82,387 83,602	34,027 34,008	62 66	PASSED		

Mechanical Destructive and Other Tests

Hardness	Bend	Reverse Bend	Flange	Reverse Flat	Flare	Flat	Grain Size	Other Tests
RB 74/76					Passed	Passed		

ASTM-A-262, Practice Corrosion Tests

(A) _____ (B) _____ (C) _____ (D) _____ (E) _____

"I HEREBY CERTIFY THAT THE HEAT NUMBERS,ANALYSIS AND TESTS DETAILED HEREON, ARE CORRECT AS CONTAINED IN THE RECORDS OF THIS CORPORATION"

Important Notice: Any discrepancy in then amount of tubing must be reported within 24 hours after receipt by customer. Greenville Tube certifies that the material used for the P.O. No. stated above is free from mercury and low melting alloy contamination.

Q.C. REVIEWED 11/26/03 PJL

Signed:

Robert Ryan
Quality Control Mgr/Metallurgical Eng

Cathy Rocole
Quality Control Asst.

ATTACHMENT R

INSTRUMENTATION EQUIPMENT SHEETS

wyle laboratories

INSTRUMENTATION EQUIPMENT SHEET

DATE: 3/ 8/04 JOB NUMBER: 50666 TEST AREA: ENV WEST 1
TECHNICIAN: J.BRAZIER CUSTOMER: HAM-LET TYPE TEST: TUBE FITTINGS

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	TORQUE WRENCH	CDI	502CF-II	02038118	110121	5 to 50FT/LBS	±1%+5digits	6/10/03	6/ 9/04
2	TORQUE WRENCH	CDI	2503CF-II	08038107	117991	25 to 250 FT/L	±1%+5dig	9/19/03	3/17/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION J. Brazier 3-8-04 CHECKED & RECEIVED BY Dennis Bj 3-8-04

Q.A. 3/8/04

WH-1029A, REV, APR '99

wyle laboratories

INSTRUMENTATION EQUIPMENT SHEET

DATE: 3/11/04 JOB NUMBER: 50666 TEST AREA: PACK TECH 1
TECHNICIAN: J.BRAZIER CUSTOMER: HAM-LET TYPE TEST: TUBE FITTING-PNEUMATI

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	DMM	KEITHLEY	179A	480740	108696	MULTI	MFG	5/ 8/03	5/ 7/04
2	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	979993	110122	10000 PSIG	MFG	11/26/03	11/25/04
3	STOP WATCH	ACCUSPLIT	725MX	N/A	113824	10HR	.5SEC	10/27/03	4/23/04
4	STRAIN PWR	VISHAY	2110	21804	011603	15VDC	1%REG	1/12/04	7/ 9/04
5	COND STRAIN	VISHAY	2120	34430	000420	GAIN	2%	1/12/04	7/ 9/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION [signature] 3/11/04 CHECKED & RECEIVED BY [signature] 3/11/04

Q.A. Brenda Neese 3/11/04

WH-1029A, REV, APR '99

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INSTRUMENTATION EQUIPMENT SHEET

DATE: 3/12/04 JOB NUMBER: 50666 TEST AREA: ENV . WEST 1
TECHNICIAN: H.FOSTER CUSTOMER: HAM-LET TYPE TEST: HYDRO

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	979993	110122	10000 PSIG	MFG	11/26/03	11/25/04
2	STOP WATCH	ACCUSPLIT	725MX	N/A	113824	10HR	.5SEC	10/27/03	4/23/04
3	STRAIN PWR	VISHAY	2110	21804	011603	15VDC	1%REG	1/12/04	7/ 9/04
4	DMM	KEITHLEY	179A	480740	108696	MULTI	MFG	5/ 8/03	5/ 7/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION 3/12/04 CHECKED & RECEIVED BY 3/12/04

Q.A. Brenda Mease 3/12/04

WH-1029A, REV, APR '99

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INSTRUMENTATION EQUIPMENT SHEET

DATE: 3/15/04 JOB NUMBER: 50666 TEST AREA: ENV WEST 1
TECHNICIAN: H.FOSTER CUSTOMER: HAM-LET TYPE TEST: IMPULSE

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	979994	110123	10000 PSIG	MFG	11/26/03	11/25/04
2	COND STRAIN	VISHAY	2120	34430	000420	GAIN	2%	1/12/04	7/ 9/04
3	STRAIN PWR	VISHAY	2110	21804	011603	15VDC	1%REG	1/12/04	7/ 9/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION James Bragin 3-15-04 CHECKED & RECEIVED BY David Berg 3-15-04

Q.A. 3/15/04

WH-1029A, REV, APR '99

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INSTRUMENTATION EQUIPMENT SHEET

DATE: 3/16/04 JOB NUMBER: 50666 TEST AREA: ENV WEST 1
TECHNICIAN: J.BRAZIER CUSTOMER: HAM-LET TYPE TEST: FLEX FATIGUE

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	RECORDER	ASTROMED	DASH10	96B0192	113860	50m-500V	1%FS	12/13/03	6/10/04
2	COND STRAIN	VISHAY	2120	18788	011065	GAIN	2%	12/19/03	6/16/04
3	COND STRAIN	VISHAY	2120	73356	104111	GAIN	2%	12/19/03	6/16/04
4	COND STRAIN	VISHAY	2120	18778	011058	GAIN	2%	12/19/03	6/16/04
5	COND STRAIN	VISHAY	2120	18791	011068	GAIN	2%	12/19/03	6/16/04
6	COND STRAIN	VISHAY	2120	21382	011610	GAIN	2%	12/19/03	6/16/04
7	STRAIN PWR	VISHAY	2110	N/A	096299	15VDC	MFG	12/19/03	6/16/04
8	METER	OMEGA	DP2000A	7360089	116654	DC VOLTS	MFG	1/ 9/04	7/ 7/04
9	METER	DIGITEC	2812A-03	07482238	108006	20VDC	MFG	1/ 9/04	7/ 7/04
10	METER	SIMPSON	2840	4509	114447	20VDC	.02%	1/ 9/04	7/ 7/04
11	METER	SIMPSON	2840	2611	116657	20VDC	.02%	1/ 9/04	7/ 7/04
12	DMM	KEITHLEY	178	10889	011312	MULTI	MFG	12/13/03	12/10/04
13	DMM	KEITHLEY	179	34120	003504	MULTI	MFG	12/22/03	12/21/04
14	DMM	KEITHLEY	178	1261	011478	MULTI	MFG	12/22/03	12/21/04
15	DMM	KEITHLEY	179	31950	000857	MULTI	MFG	12/22/03	12/21/04
16	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	979997	110162	10000 PSIG	MFG	12/29/03	12/28/04
17	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	978581	110163	10000 PSIG	MFG	12/29/03	12/28/04
18	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	847558	110161	10000 PSIG	MFG	12/29/03	12/28/04
19	DMM	KEITHLEY	178	14967	092680	MULTI	MFG	1/ 9/04	7/ 7/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION James Brazier 3-16-04 CHECKED & RECEIVED BY Dawn D Bay 3/16/04

Q.A. [signature] 3/16/04

WH-1029A, REV, APR '99

wyle laboratories

INSTRUMENTATION EQUIPMENT SHEET

1

DATE: 3/16/04 JOB NUMBER: 50666 TEST AREA: ENV. WEST
TECHNICIAN: J.BRAZIER CUSTOMER: HAM-LET TYPE TEST: ROTARY FLEX

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	METER	SIMPSON	2840	002451	100947	20VDC	.02%	3/10/04	9/ 6/04
2	METER	SIMPSON	2840	2875	100945	20VDC	.02%	3/10/04	9/ 6/04
3	METER	SIMPSON	2840	2407	108948	20VDC	.02%	3/10/04	9/ 6/04
4	PRESSURE XDUCE	SENSOTEC	A-10/0287-22G	847568	110160	10000 PSIG	MFG	12/29/03	12/28/04
5	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	979993	110122	10000 PSIG	MFG	11/26/03	11/25/04
6	DMM	KEITHLEY	179	34123	100056	MULTI	MFG	12/13/03	12/10/04
7	DMM	KEITHLEY	178	10829	011313	MULTI	MFG	12/13/03	12/10/04
8	DMM	KEITHLEY	179A	480740	108696	MULTI	MFG	5/ 8/03	5/ 7/04
9	STRAIN PWR	VISHAY	2110A	112620	112829	15 VDC	MFG	12/ 2/03	5/28/04
10	COND STRAIN	VISHAY	2120A	122577	112834	GAIN	MFG	12/ 2/03	5/28/04
11	COND STRAIN	VISHAY	2120A	122588	112831	GAIN	MFG	12/ 2/03	5/28/04
12	COND STRAIN	VISHAY	2120A	122601	112832	GAIN	MFG	12/ 2/03	5/28/04
13	STOP WATCH	ACCUSPLIT	725MX	N/A	113823	10HR	.5SEC	3/12/04	6/10/04
14	TACHOMETER	EXTECH	461895	L548408	113948	5-99.999RPM	.05%+1D	11/12/03	5/10/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION James Brazier 3-16-04 CHECKED & RECEIVED BY Dave Ray 3/16/04

Q.A. [signature] 3/16/04

WH-1029A, REV, APR '99

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INSTRUMENTATION EQUIPMENT SHEET

DATE: 4/15/04 JOB NUMBER: 50666 TEST AREA: ENV WEST 1
TECHNICIAN: J.BRAZIER CUSTOMER: HAM-LET TYPE TEST: PNEUMATIC

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	STOP WATCH	ACCUSPLIT	725MX	N/A	113823	10HR	.5SEC	3/12/04	6/10/04
2	PRESSURE GAGE	DRUCK	DPI260	2604211302	117325	0 to 1000 PSI	±0.25%FS	4/15/04	7/14/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION James Brazie 4-15-04 CHECKED & RECEIVED BY David Bar 4/15/04

Q.A. [signature] 4/15/04

WH-1029A. REV. APR '99

wyle laboratories

INSTRUMENTATION EQUIPMENT SHEET

1

DATE: 4/16/04 JOB NUMBER: 50666 TEST AREA: ENV WEST
TECHNICIAN: J.BRAZIER CUSTOMER: HAMLET TYPE TEST: HYDROSTAT PROOF

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	979993	110122	10000 PSIG	MFG	11/26/03	11/25/04
2	STOP WATCH	ACCUSPLIT	725MX	N/A	113824	10HR	.5SEC	10/27/03	4/23/04
3	DMM	KEITHLEY	179A	480740	108696	MULTI	MFG	5/ 8/03	5/ 7/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION James Brazier 4-16-04 CHECKED & RECEIVED BY [signature] 4/16/04

Q.A. [signature] 4/16/04

WH-1029A, REV, APR '99

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INSTRUMENTATION EQUIPMENT SHEET

1

DATE: 4/19/04 JOB NUMBER: 50666 TEST AREA: ENV WEST
TECHNICIAN: J.BRAZIER CUSTOMER: HAM-LET TYPE TEST: ROTARY FLEX

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	DMM	KEITHLEY	178	10829	011313	MULTI	MFG	12/13/03	12/10/04
2	DMM	KEITHLEY	179	34123	100056	MULTI	MFG	12/13/03	12/10/04
3	COND STRAIN	VISHAY	2120A	122577	112834	GAIN	MFG	12/ 2/03	5/28/04
4	DMM	KEITHLEY	179A	480740	108696	MULTI	MFG	5/ 8/03	5/ 7/04
5	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	979993	110122	10000 PSIG	MFG	11/26/03	11/25/04
6	STOP WATCH	ACCUSPLIT	725MX	N/A	113824	10HR	.5SEC	10/27/03	4/23/04
7	TACHOMETER	EXTECH	461895	L548408	113948	5-99.999RPM	.05%+1D	11/12/03	5/10/04
8	STRAIN PWR	VISHAY	2110A	112620	112829	15 VDC	MFG	12/ 2/03	5/28/04
9	COND STRAIN	VISHAY	2120A	122588	112831	GAIN	MFG	12/ 2/03	5/28/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION James Brazier 4-19-04 CHECKED & RECEIVED BY 4/20/04

Q.A. 4/20/04

WH-1029A, REV, APR '99

wyle laboratories

INSTRUMENTATION EQUIPMENT SHEET

DATE: 4/19/04 JOB NUMBER: 50666 TEST AREA: ENV WEST 1
TECHNICIAN: J.BRAZIER CUSTOMER: HAM-LET TYPE TEST: FLEX FATIGUE

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	978581	110163	10000 PSIG	MFG	12/29/03	12/28/04
2	DMM	KEITHLEY	178	1261	011478	MULTI	MFG	12/22/03	12/21/04
3	DMM	KEITHLEY	178	10889	011312	MULTI	MFG	12/13/03	12/10/04
4	DMM	KEITHLEY	178	14967	092680	MULTI	MFG	1/ 9/04	7/ 7/04
5	RECORDER	ASTROMED	DASH10	96B0192	113860	50m-500V	1%FS	12/13/03	6/10/04
6	COND STRAIN	VISHAY	2120	18791	011068	GAIN	2%	12/19/03	6/16/04
7	COND STRAIN	VISHAY	2120	73356	104111	GAIN	2%	12/19/03	6/16/04
8	STRAIN PWR	VISHAY	2110	N/A	096299	15VDC	MFG	12/19/03	6/16/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION James Brazier 4-19-04 CHECKED & RECEIVED BY 4/19/04

Q.A. 4/20/04

WH-1029A, REV, APR '99

wyle laboratories

INSTRUMENTATION EQUIPMENT SHEET

DATE: 4/21/04 JOB NUMBER: 50666 TEST AREA: ENV WEST 1
TECHNICIAN: J.BRAZIER CUSTOMER: HAM-LET TYPE TEST: IMPULSE 1"&3/4

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	PRESSURE XDUCE	SENSOTEC	A-105/0287-22G	979994	110123	10000 PSIG	MFG	11/26/03	11/25/04
2	COND STRAIN	VISHAY	2120	34430	000420	GAIN	2%	1/12/04	7/ 9/04
3	COND STRAIN	VISHAY	2120	34485	000422	GAIN	2%	1/12/04	7/ 9/04
4	STRAIN PWR	VISHAY	2110	21804	011603	15VDC	1%REG	1/12/04	7/ 9/04
5	PRESSURE XDUCE	SENSOTEC	A-105/0287-23	987644	110227	15000 PSI	±0.1%	1/20/04	1/19/05

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION James Brazier 4-21-04 CHECKED & RECEIVED BY 4/21/04

Q.A. 4/21/04

WH-1029A, REV, APR '99

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INSTRUMENTATION EQUIPMENT SHEET

DATE: 4/23/04 JOB NUMBER: 50666 TEST AREA: HI FLOW 1
TECHNICIAN: M.LUNGHOFER CUSTOMER: HAM-LET TYPE TEST: HIGH TEMP THERMO CYC

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	PRESSURE XDUCE	SENSOTEC	TJE/0743-01TJG	734820	115686	2000PSIG	.1%FS	3/23/04	6/21/04
2	MEGADAC	OPTIM	ADC5616/5414ac	A7563-03	113803	16BITS	.01%FS	12/ 4/03	12/ 3/04
3	T/C MODULE	OPTIM	AD816TC	A6277-08	113739	K TC	1 DEG F	12/ 4/03	12/ 3/04
4	INPUT CARD	OPTIM	AD682SH-1	A3303-07	117167	GAIN	MFG	12/ 4/03	12/ 3/04
5	JACK PANEL	OPTIM	PL2181	A7493-06	113742	TYPE K	.02*C	12/ 4/03	12/ 3/04
6	PRESSURE GAGE	HEISE	ST-2H	50807	116866	MFG	.025%	11/ 3/03	11/ 2/04
7	PRESSURE MODUL	HEISE	HQS-2	19968	116867	3000PSI	.025%	11/ 3/03	11/ 3/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION 16001 CHECKED & RECEIVED BY 4/23/04

Q.A. 4/23/04

WH-1029A, REV, APR '99

wyle laboratories

INSTRUMENTATION EQUIPMENT SHEET

DATE: 5/11/04 JOB NUMBER: 50666 TEST AREA: ENV CH 34 1
TECHNICIAN: J.PATTERSON CUSTOMER: HAM-LET TYPE TEST: ELEVATED TEMP

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	TEMP RECORDER	HONEYWELL	DR450T	903079261800	108673	-200-600°F	.4°F	4/15/04	7/14/04
2	CONTROLLER	WATLOW	945	NA	113655	MFG	MFG	4/15/04	7/14/04
3	TEMP CONTROLLE	WATLOW	942A-2CC2-A00	NA	110129	-328 to 662°F	±0.1%	4/15/04	7/14/04
4	PRESSURE GAGE	HEISE	600	H19689	092513	600PSI	.5%FS	5/10/04	8/ 6/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION 5/11/04 CHECKED & RECEIVED BY Rick Maehlmann 5/12/04

Q.A. 5/12/04

WH-1029A, REV, APR '99

wyle laboratories

INSTRUMENTATION EQUIPMENT SHEET

DATE: 6/ 3/04 JOB NUMBER: 50666 TEST AREA: ENV LAB 1
TECHNICIAN: J.PATTERSON CUSTOMER: HAM-LET TYPE TEST: HYDROSTATIC BURST

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	ACCURACY	CAL DATE	CAL DUE
1	STOP WATCH	VWR	62379-218	230125647	117532	10HR	±0.5SEC	10/ 5/03	10/ 5/04
2	POWER SUPPLY	TOPWARD	2601	936943	109884	60V/1A	.1%REG	1/ 6/04	7/ 2/04
3	DMM	FLUKE	87 III	78370405	116685	4vdc,ac,ohms	.05%,1%,.2%	7/11/03	7/ 9/04

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION J Patterson 6/3/04 CHECKED & RECEIVED BY Rick Machlmann 6/3/04

Q.A. 6/3/04

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