198480 RSPA-02-13521-2 13135-N # 45767 add. info

SPACE SYSTEMS LORAL

DOT/RSPA/OHMS

Launch Integration & Operations Department

02 OCT -8 PM 3:17

DX6200-AWE-2002-021
October 3, 2002

To: Associate Administrator for Hazardous Materials Safety
Research and Special programs Administration
U.S. Department of Transportation
400 7th Street, SW
Washington, DC 20590-0001
Attention: Exemptions, DHM-31 (Sandra Cureton)

From: Launch Integration & Operations Department
Space Systems/Loral
3825 Fabian Way; MS G84
Palo Alto, CA 94304-4604

DEPT. OF TRANSPORTATION
02 OCT 23 AM 12:11

Subject: Additional information for Space Systems/Loral's "Request for DOT Exemption for transporting spacecraft with empty pressurized on-board gas tank"

References: (1) DX6200-AWE-2002-016, "Request for DOT Exemption for transporting spacecraft with empty pressurized on-board gas tank", dated August 30, 2002.
(2) Fax, " Signature page for Exemption request, my letter DX6200-AWE-2002-016, dated August 30, 2002" dated October 2, 2002.

Reference (1) provided the application for an Exemption. However, a signature page was omitted, and Reference (2) provided that signature page. Enclosed with this letter is the original signature page that can replace the faxed copy already provided.

Also, the last paragraph of **the Pressurant Tank (Xenon - 82 liter)** section of Reference (1), stated that "*The qualification test report for the 82 liter tank will be provided when received, which is expected in October 2002.*" Enclosed with this letter is also this Qualification Report.

Please contact me if you have any other comments.

Sincerely,

Alan Eft

Alan Eft
Program Safety Manger
Space Systems/Loral
(650) 852-5507
eft.alan@ssd.loral.com

JUSTIFICATION OF EXEMPTION PROPOSAL

107.105(d)(1) Relevant shipping and incident experience.

SS/L has had experience with shipping spacecraft in a spacecraft shipping container, such as these, since 1966. It is estimated that there will be at least ten spacecraft shipments per year (for either testing purposes or to be launched into space). To date there have been no shipping or transporting incidents during this 36 year period.

107.105(d)(2) Statement of increased risk to safety or property.
Not applicable. There is no increased risk of safety or property as a result of granting this exemption.

107.105(d)(3)(i)
As described in section 107.105(c)(3) of this document, each spacecraft pressurant tank is designed to meet MIL-STD-1522A requirements for pressure vessels. Each tank requires Qualification and Acceptance Testing with reports as shown in Attachments (3) and (4). All the information provided within the attachments indicates the pressurant tank designs met all the performance requirements criteria.

107.105(d)(3)(ii)
It is SS/L's intent to ensure that a more stringent level of safety exists with the spacecraft propulsion tanks design, the propulsion tanks shipping and storage pressures and the spacecraft packaging and shipping configuration. All the information provided here is consistent with the approach of an existing SS/L DOT exemption DOT-E 11103 (renewal expires December 31, 2002) and DOT-E 12341 (renewal expires April 30, 2004).

SUMMARY:
All the qualification tanks have successfully demonstrated the leak-before-burst design requirement. As indicated in Tables 1-1 and 1-2, the pressurant tank transportation safety factors for each pressurant tank are greater than 14:1. In the unlikely event of a tank rupture, because of the LBB design, the tank would not shatter and cause shrapnel, thus allowing the inert gas to leak out until ambient pressure is achieved. The spacecraft structures along with the shipping containers environmental conditioning capabilities would contain the flow of gas to the environment. There are no inherent risk or hazard to the public, property or the environment due to tank failure.

Alan Eft
Program Safety Manager
Space Systems/Loral

Report No. 19862-52000-1

DOT/RSPA/OHMS
02 OCT -8 PM 3:17

Qualification Test Report, SS/LORAL E137830-04, S/N 001

Revision NC

September 20, 2002

E13135-N

GENERAL DYNAMICS
Armament and Technical Products

Report No. 19862-52000-1

Qualification Test Report, SS/LORAL E137830-04, S/N 001

Revision NC

September 20, 2002

GENERAL DYNAMICS
Armament and Technical Products

Report Change History:

September 20, 2002 – Initial release.

Prepared by: 9/20/02
Chad Dustin
Originator

Reviewed by: 9/20/02
Gerges Khawand
Design Engineer

Approved by: 9/20/02
Con Murray
Program Manager

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1.0 Introduction

1.1

This report presents the test requirements, test procedures, and test results obtained during the performance of the Qualification Test Program. GDATP Lincoln Operations qualification tested one (1) filament-wound, 5000 cubic inch Xenon Tank Assembly, GDATP Lincoln Operations Part Number 220165-1, Serial Number 001.

1.2

This test program qualifies a tank assembly representative of flight (deliverable) hardware to design requirements.

1.3

The Qualification Test Program demonstrates compliance with the requirements of Space Systems/LORAL Performance Specification Number E245929, Revision 1 (Reference 2.1). The tests were conducted per Lincoln Composites Quality Control Procedure Number QCP-06-766 (Reference 2.2). Tests were performed at General Dynamics ATP - Lincoln Operations in Lincoln, Nebraska and Wyle Laboratories, El Segundo, California and National Technical Systems in Los Angeles, California.

1.4

The Qualification Test Program, shown in the Table 1.4-1 Qualification Test Matrix, is summarized in Paragraph 3.0; detailed test requirements, test procedures and test results are presented in Paragraph 5.0 and attachments to this document

Table 1.4-1, Qualification Test Matrix

Test Title	Sequence Number	Report Paragraph	Ref. 2.1 Paragraph	Ref. 2.2 Paragraph	Ref. 2.4 Paragraph
Acceptance Test	1	5.1	4.3.4.1	5.1	---
Pressure Cycle	2	5.2	4.3.5.1	5.2	---
Helium Leakage Dynamics	4	5.3	4.3.5.2	5.3	All
Helium Leakage Precision	3	5.4	4.3.4.3	5.4	---
Cleaning					
Burst	5	5.6	4.3.5.3	5.5	---

2.0 Reference Documents

2.1

Space Systems/LORAL Performance Specification Document Number E245929, Revision 1 titled: Xenon Tank, Performance Specification

2.2

Lincoln Operations Quality Control Procedure Number QCP-06-766, Revision A, titled: Qualification Test Procedure, Lincoln Composites Part Number 220165-1

2.3

Lincoln Operations Quality Control Procedure Number QCP-06-765, Revision A, titled: Acceptance Test Procedure, Lincoln Composites Part Number 220165-1

2.4

Wyle Laboratories Test Report Number 47039, titled: Report On Qualification Sinusoidal and Random Vibration Tests of One Xenon Storage Tank Assembly, Part Number 220165-1 Serial Number 001

2.5

National Technical Systems Precision Cleaning Document Number 3932, Revision N/C, titled: Cleaning, Inspection and Sealing of Tank Assemblies for Space Systems Loral

3.0 Test Summary

3.1 Description

The Qualification Test Program qualified one (1) filament-wound Xenon Tank assembly, hereafter identified as tank. The GDATP Lincoln Operations Part Number 220165-1, Serial Number 001 is representative of flight (deliverable) hardware. The tank was subjected to testing as summarized in Paragraphs 3.1.1 through 3.1.8.

3.1.1 Acceptance Testing

The tank was subjected to acceptance test procedures in accordance with QCP-06-765 (Reference 2.3) as required by Paragraph 5.1 of QCP-06-766 (Reference 2.2). The acceptance test procedures consisted of proof pressure-volume testing, helium leakage testing, and dimensional inspection. After completion of the acceptance testing, the tank was subjected to pressure cycle testing.

3.1.2 Pressure Cycle Test

The tank was subjected to pressure cycle testing in accordance with Paragraph 5.2 of QCP-06-766 (Reference 2.2). The pressure cycle testing consisted of 7 hydrostatic cycles from 0 to 3375 psig, 8 hydrostatic cycles from 0 to 2970 psig, 46 hydrostatic cycles from 0 to 2700 psig, 3307 hydrostatic cycles from 2100 to 2700 psig, and 3307 hydrostatic cycles from 2100 to 2400 psig. After completion of the pressure cycle testing, the tank was helium leak tested at 2700 psig using 10% helium and 90% nitrogen mixture. The tank was forwarded to Qualification Dynamics Testing.

3.1.3 Qualification Dynamics Testing

The tank was subjected to sinusoidal and random vibration testing as required by Paragraph 5.4 of QCP-06-766 (Reference 2.2). The dynamics testing consisted of sinusoidal and random vibration in the longitudinal and one radial direction while filled with 312 pounds of PF5060 fluid and pressurized to 2700 psig with helium gas. The tank was forwarded to precision cleaning. See Table 3.1-1 for details.

3.1.4 Precision Cleaning and Cleanliness Verification

The tank was precision cleaned to Mil-Std-1246, Level 50A and QCP-06-766 Para 5.4.2.1 – 5.4.2.7. The tank was then sent back to Wyle Laboratories for acceptance level dynamics testing.

3.1.5 Acceptance Dynamics Testing

The tank was subjected to acceptance level random vibration testing in one lateral axis in accordance with Wyle Laboratories Procedure Number 47039 (Reference 2.4) as required by Paragraph 5.4.2.8 of QCP-06-766 (Reference 2.2). The dynamics testing consisted of random vibration in one orthogonal direction only while filled with 2750 psig with helium gas. The tank was forwarded to Cleanliness Verification.

3.1.6 Cleanliness Verification

The tank was precision cleaned per Paragraph 3.1.4 of this document followed by either acceptance level vibration per Paragraph 3.1.5 of this document or pressurization to MEOP then to Cleanliness Verification several times. The purpose of the Precision Cleaning – Acceptance Dynamics – Cleanliness Verification cycle was used to prove that the tank would meet cleanliness requirements after exposure to operating environments. The failure of these tests was proven to be as a result of the use of a filter in testing that was not capable of withstanding the pressurization requirements. The use of a Millipore filter in lieu of a Norman Microporous filter in testing resulted in acceptable cleanliness verification. Similar particle count results following pressurization only and acceptance vibration testing indicate that the operating environment does not affect the cleanliness level of the tank. See Appendix 5 for SS/Loral letter of acceptance of results. See Table 3.1-1 for test details.

Table 3.1-1, Dynamics and Cleaning Record

Date of Pressurization	Medium	Pressure	Vibration	Cleanliness Verification Result [1]	Notes
5/21/02	PF5060	312 lbs at 2700 psig	Reference 2.4, Para 5.2	N/A	Incorrect Input Spectrum
5/23/02	PF5060	312 lbs at 2700 psig	Reference 2.4, Para 5.2	N/A	Boss dislodged from bearing
6/05/02	PF5060	312 lbs at 2700 psig	Reference 2.4, Para 5.5	N/A	Completed Qualification Vibe Testing
6/10/02	GHe	2750 psig	Reference 2.4, Para 5.6	Failed: Did not meet level 100 and 1 metallic Particle > 100 μ	Used Norman Filter (Sintered Element), See Appendix 4 RSI XRF Evaluation
6/25/02	GHe	2750 psig, Held for five minutes	N/A	Did not meet level 100 and 2 metallic particles > 25 μ	Used Norman Filter (mesh Element) Wyle exposed tank to environment. NTS delivered tank without attached bookend
7/03/02	GHe	2750 psig, Held for five minutes	N/A	Failed: Met level 100, but three metallic Particles > 25 μ	Used Norman Filter (mesh element)
7/16/02	GHe	2750 psig, Held for five minutes	N/A	1 Metallic from 25 – 50 μ, Zero Metallics from 50 – 75 μ	Pressurized only, using Millipore Filter
7/23/02	GHe	2750 psig, Held for five minutes	N/A	Zero Metallics from 25 – 50 μ, Zero Metallics from 50 – 75 μ	Repeat: Pressurized only, using Millipore Filter
7/29/02	GHe	2750 psig	Reference 2.4, Para 5.6	Zero Metallics from 25 – 50 μ, Zero Metallics from 50 – 75 μ	Reference Appendix 5, E-Mail from Robert Wolf, Dated 8/14/02

[1] Particle Count and Metallic particle counts are normalized from 1250-ml sample to 100-ml sample by dividing the count by 12.5.

3.1.7 Helium Leakage Test

The tank was helium leak tested at 2700 psig using 10% helium and 90% nitrogen mixture. Following the Helium Leakage Test, the tank was forwarded to Burst Pressure Testing.

3.1.8 Burst Pressure Testing

The tank was subjected to burst-to-rupture testing in accordance with Paragraph 5.5 of QCP-06-766 (Reference 2.2). The burst-to-rupture test consisted of hydrostatically pressurizing the tank from 0 psig to catastrophic failure, with a maximum 5 second hold at 2705 psig. The tank ruptured at 5671 psig

with failure originating in the membrane section of the tank between the port end tangent line and the first girth weld.

3.2

The test program was initiated in March, 2002 and was completed in August, 2002.

3.3

Acceptance Testing Data and Qualification Testing Data is presented in Paragraph 5.0 and attachments to this document.

4.0 Test Conditions and Test Equipment

4.1 Test Conditions

Unless otherwise specified herein, the standard test conditions during the Qualification Test Program were an atmospheric pressure of site ambient, a temperature of 55° to 90° F and uncontrolled relative humidity Test Equipment.

4.2 Test Equipment

All test equipment used in the performance of testing and inspections during the Qualification Test Program, as detailed in Reference 2.2 and 2.3, was calibrated in accordance with ISO 10012-1 requirements relative to measuring, inspection and test equipment. Equipment calibrations were verified as current prior to the performance of tests and inspections.

5.0 Qualification Test Program

5.1 Acceptance Test Procedures

5.1.1 Requirements (Reference 2.1, Paragraph 4.3.4)

Acceptance testing shall be performed in the sequence specified for the tank being employed in the qualification test program. The tank shall pass acceptance testing prior to qualification testing.

The tank shall be subjected to an acceptance test consisting of:

a) Proof pressure/volume
b) Helium leakage
c) Dimensional inspection

5.1.2 Procedures (Reference 2.3, All Paragraphs)

The tank was subjected to the test requirements specified in Paragraph 5.1.1. Lincoln Operations performed these tests at their Main Plant facility.

The tank was subjected to acceptance testing in accordance with Reference 2.2 (QCP-06-766) as required by Reference 2.3 (QCP-06-765) of this document:

a) Proof pressure testing to 3375 psig using deionized water per Paragraph 5.1 of QCP-06-766.
b) Volume measurements using water weight versus temperature to determine volumetric capacity (5000 cubic inches minimum volume) per Paragraph 5.1 of QCP-06-765.
c) External leakage testing using the vacuum chamber method while pressurized to 2700 psig with a 10% helium gas mixture (maximum leakage rate not to exceed 1×10^{-7} scc/sec) per Paragraph 7.1 of QCP-06-765.
d) Visual and dimensional inspection per Manufacturing & Inspection Record (M&IR 175455-1) processing.

5.1.3 Results

The tank complied in all aspects to the requirements of the test procedure.

Acceptance test results.

Table 5.1.3-1, Acceptance Test Results

Max. Proof Press (psig)	Volume @ 0 psig (cu. In.)	Maximum Leakage (scc/sec)	Permanent Set (%)
3380	5034	6.1×10^{-9}	0.45

The test results and proof pressure traces obtained during the performance of the acceptance test procedures are presented in Appendix 1 of the document along with the recorded visual and dimensional data.

5.2 Pressure Cycle Test

5.2.1 Requirements (Reference 2.1, Paragraph 4.3.5.1)

The tank shall be subjected to a total of 8 each 1.25X MEOP cycles, 8 each 1.1X MEOP cycles, 48 each MEOP cycles, and 6614 diurnal cycles including all acceptance and qualification pressurizations prior to burst testing.

The tank shall be subjected to a leakage test at MEOP to verify conformance with requirements. Allowable external leakage including tank joints not exceeding 1×10^{-7} scc/sec when pressurized with 10% helium and 90% nitrogen at MEOP.

5.2.2 Procedures (Reference 2.2, Paragraph 5.2)

The tank was subjected to the test requirements specified in Paragraph 5.2.1. This test was performed at Lincoln Operations at the Main Plant facility.

The tank was hydrostatically pressure cycled using deionized water. The pressures and sequence of application were as shown in Table 5.2.2-1.

The overall length differential growth effected by pressure was measured during one pressure cycle from 0 to 2700 to 0 psig. During the last cycle of pressure from 2700 to 0 psig, the effluent liquid from the tank was captured and weighed. The volume of the effluent water was calculated using water weight versus temperature times the compression factor of water at 2700 psig. The effluent volume was added to the 0 psig volume determined during acceptance testing to determine overall volume of the tank at 2700 psig.

The tank was visually examined for evidence of damage at the completion of the pressure cycles. No damage existed.

Table 5.2.2-1, Pressure Cycle Test Parameters

Sequence	Number of Cycles[1]	Pressure Range (psig)
A	7	0 to 3375 to 0
B	8	0 to 2970 to 0
C	46	0 to 2700 to 0
D	3307	2100 to 2700 to 2100
E	3307	2100 to 2400 to 2100

Tolerances: +50/-0 psig at minimum and maximum pressures
Ramp Rate: 75 to 125 psi per second
Hold Time at Peak: 5 seconds maximum pressure
[1]Number of 2700 psig pressure cycles reduced from 48 in anticipation of expected MEOP cycles to be applied during qualification program.
See Appendix 7 for Table of all pressurization cycles incurred during acceptance and qualification testing

At the completion of pressure cycling, the tank was subjected to an external helium leakage test. The tank was placed in a vacuum chamber that was evacuated and valved into a helium mass spectrometer. The tank was pressurized to 270 (±10) psig with helium gas and then to 2750 (±50) psig with nitrogen gas. The leak detector was monitored for indications of helium leakage for a period of 15 minutes. Procedural requirements state that leakage cannot exceed 1×10^{-7} scc/sec.

5.2.3 Results

The tank complied in all aspects to the requirements of the pressure cycle test.

The tank exhibited no evidence of leakage or visual damage as a result of the cyclic pressurizations.

The overall length differential growth of the tank was 0.328 inches. The effluent volume of the tank, from 2700 psig to 0 psig, was 136.87 cubic inches. The total calculated volume of the tank at 2700 psig was 5125.6 cubic inches.

The tank did not leak in excess of the specification requirements. Actual measured leakage was 1.8 X 10^{-8} scc/sec.

Data obtained during the performance of the pressure cycle test is presented in Appendix 2 of this report.

5.3 Dynamics Testing

5.3.1 Requirements (Reference 2.1, Paragraph 4.3.5.2)

The tank shall be subjected to dynamics testing while filled with a performance fluid and pressurized with helium to MEOP with the tank end bosses attached to a rigid fixture.

a) A vibration survey of the test fixture, with the tank mounted, shall be performed by swept sinusoid or low level random applied in the axial direction and one lateral direction

b) Random vibration shall be applied consecutively in the axial direction and one lateral direction at levels specified in Table VI of Reference 2.1.
c) Sinusoidal vibration shall be applied consecutively in the axial direction and one lateral direction at levels specified in Table VI of Reference 2.1.
d) Sinusoidal vibration in any one axis may immediately be performed following random vibration in that same axis providing no change has been made in the setup.

5.3.2 Procedures (Reference 2.4, All Paragraphs; 2.2, Paragraphs 5.3.2, 5.4.2)

The tank was subjected to the test requirements specified in Paragraph 5.3.1. The vibration testing was performed at and by Wyle Laboratories, El Segundo, California.

NOTE: A comprehensive report detailing the vibration testing is presented in Appendix 8 of this document. The following paragraphs present a brief description of the tests.

A dynamics test fixture was installed on the head of the vibration exciter. The test fixture was designed to simulate spacecraft installation; i.e., the port boss was rigidly restrained from motion in all directions, the blank boss was allowed to rotate about and move in the axial or longitudinal direction but was restrained from any motion in the radial or lateral directions. The tank was then mounted to the dynamics fixture.

A dynamics fixture evaluation was performed in the axial or longitudinal axis and in one lateral axis at -12 dB of the test levels. The tank was at ambient pressure (unpressurized) during the dynamics test fixture evaluations.

The tank was filled with 312 pounds (113 kilograms) of PF 5060 performance fluid and pressurized to 2700 psig with helium gas. The tank was subjected to the following vibration in both the axial or longitudinal axis and one lateral axis.

a) Random vibration from 20 to 2000 Hz at an overall level of 4.6 gRMS for 2 minutes after equalization at -12, -9, -6, and -3 dB.

b) Low-level sinusoidal resonance search from 20 to 2000 Hz at 0.5 g with a sweep rate of 2 octaves per minute.
c) Sinusoidal vibration from 5 to 100 Hz at a sweep rate of 2 octaves per minute.
d) Low-level sinusoidal resonance search from 20 to 2000 Hz at 0.5 g with a sweep rate of 2 octaves per minute.

At the completion of each axis of vibration, the tank was depressurized for axis change. The tank was visually examined after each axis for evidence of damage. The first run of full level Qualification Sinusoidal vibration was performed with the incorrect spectrum and was aborted at 84.5 Hz after 122 seconds (See Reference 2.4, Page 6: Notice of Deviation 1). The correct full level Qualification Spectrum was then applied, but was aborted at 37.8 Hz after 87 seconds due to excessive wear to the test fixture bearing which held the blank end of the tank (See Reference 2.4, Page 7: Notice of Deviation 2 and Page 12, Photograph 5). The tank was returned to Lincoln to evaluate the damage. The damage was deemed to be minor. GDATP Lincoln reworked the boss in accordance with FRR 4858 (See Appendix 6) and returned the tank to Wyle for conclusion of testing. Testing was completed as required without further evidence of damage to the tank. The tank was forwarded to cleaning for precision cleaning – acceptance vibration – cleanliness verification testing.

5.4 Precision Cleaning

5.4.1 Requirements (Reference 2.1, Paragraph 3.4.1.2 and 4.3.5.4)

Cleanliness of the tank shall be cleaned in accordance with the requirements of CPP 3932 (Reference 2.5) and shall meet the requirements of Paragraph 3.4.1.2 of Reference 2.1.

5.4.2 Procedures (Reference 2.2, Paragraph 5.4)

The tank was subjected to the cleaning requirements specified in Paragraph 5.4.1 after qualification level dynamics testing and prior to acceptance level dynamics testing. The cleaning was performed at and by NTS, Los Angeles, California.

The external surfaces of the tank were cleaned to remove dust, grease, oil and other soils.

The internal surfaces of the tank were pre-cleaned using isopropyl alcohol, Turco 4215, deionized water and gaseous nitrogen. After pre-cleaning operations were performed, the internal surfaces were precision cleaned in a Class 10,000 clean room using 0.5 micron filtered isopropyl alcohol. A 1250-milliliter sample of the effluent alcohol was then sampled for particulate.

The tank was dried in a vacuum oven at 140° F at a vacuum of 27 ±2 inches of Mercury for a minimum of 2 hours.

5.4.3 Results

The tank complied in all aspects to the requirements of the cleaning operations. The tank was forwarded to Wyle Laboratories for accomplishment of Acceptance Dynamics Testing before returning to NTS for cleanliness verification.

5.5 Acceptance Vibration Testing – Cleanliness Verification

5.5.1 Requirements

The precision cleaned tank shall be subjected to acceptance level random vibration in one lateral axis while pressurized to 2700 +50/-0 psig with helium gas to levels shown in Table 5.5.1-1

Table 5.5.1-1, Acceptance Random Vibration Test Requirements

Axis	Frequency	Vibratory Level
Orthogonal	20-50 50-300 300-2000	+ 9 dB/octave 0.020 g^2/Hz -6 dB/octave
Overall level = 3.2 g_{rms}		
Duration = 60 seconds		

Following acceptance level vibration testing, the tank shall be subjected to cleanliness verification per ARP-598 and shall meet the requirements as shown in Table 5.5.1-2.

Table 5.5.1-2 Cleanliness Parameters

Size (microns)	Quantity
5 to 10	600
11 to 25	100
26 to 50*	25
51 to 100*	4
Greater than 100*	0
NVR (non-volatile residue)	less than 1 mg/100 ml

*No metallic particles greater than 25 microns

5.5.2 Procedures

5.5.2.1

Random Vibration testing was accomplished per 5.3.2 for requirements given in Table 5.5.1-1 as recorded in Table 3.1-1.

5.5.2.2

Cleanliness verification was accomplished in accordance with ARP-598 at National Technical Services in Los Angeles, CA.

5.5.3 Results

The tank met the cleanliness requirements as given in Table 5.5.1-2 and Reference 2.1, Paragraph 3.4.1.2. The results of all cleanliness verifications are provided in Appendix 3. See Table 5.5.3-1 for results of the last cleanliness verification.

Table 5.5.3-1, Precision Cleaning Results

Size (microns)	Ref. 2.1, Paragraph 3.4.1.2 Requirements	Cleanliness Verification Results (post-vibe)
<5	No Silting	None
5 to 10	600	96
11 to 25	100	34
26 to 50	25	14
51 to 100	4	2
>100	0	0
NVR	<1.0 mg	0.2 mg

5.6 Burst Test

5.6.1 Requirements (Reference 2.1, Paragraph 4.3.5.3)

5.5.1.1

The tank shall be stabilized at ambient temperature and then hydrostatically pressurized to rupture at a uniform rate not to exceed 125 psi per second.

5.5.1.2

The pressure required to rupture the tank shall be recorded.

5.5.1.3

The tank shall achieve design burst pressure (4050 psig) without rupture or leakage. Please note that the successful burst of this tank without leak does not contradict the leak before burst requirement of Reference 2.1, para 3.2.2.2.5. Leak before burst failure design assures that during normal operations, the aluminum liner of the pressure vessel will fail in fatigue with crack propagation resulting in detectable leakage prior to tank rupture.

5.6.2 Procedures (Reference 2.2, Paragraph 5.5)

5.6.2.1

The tank was subjected to the test requirements specified in Paragraph 5.6.1.

5.6.2.2

The tank was filled with deionized water and connected to a burst pressure test system. The burst pressure test system was energized and the tank was pressurized at an approximate linear ramp rate of 75 to 125 psi per second, from 0 psig to rupture of the tank with a maximum 5 second hold at 2700 psig.

5.6.2.3

Test requirements are that the tank exhibits a rupture pressure in excess of 4050 psig at ambient temperature.

5.6.3 Results

5.6.3.1

The tank complied in all aspects to the specification requirements.

The tank ruptured at 5671 psig (2.10 times the MEOP pressure of 2700 psig). Failure originated in the membrane area of the tank, between the port tangent line and the first girth weld.

5.6.3.2

Figure 5.5.3-1 is a photo of the burst pressure test unit after testing.

5.6.3.3

Pressure traces obtained during the performance of the burst pressure testing are presented in Appendix 2 of this document.

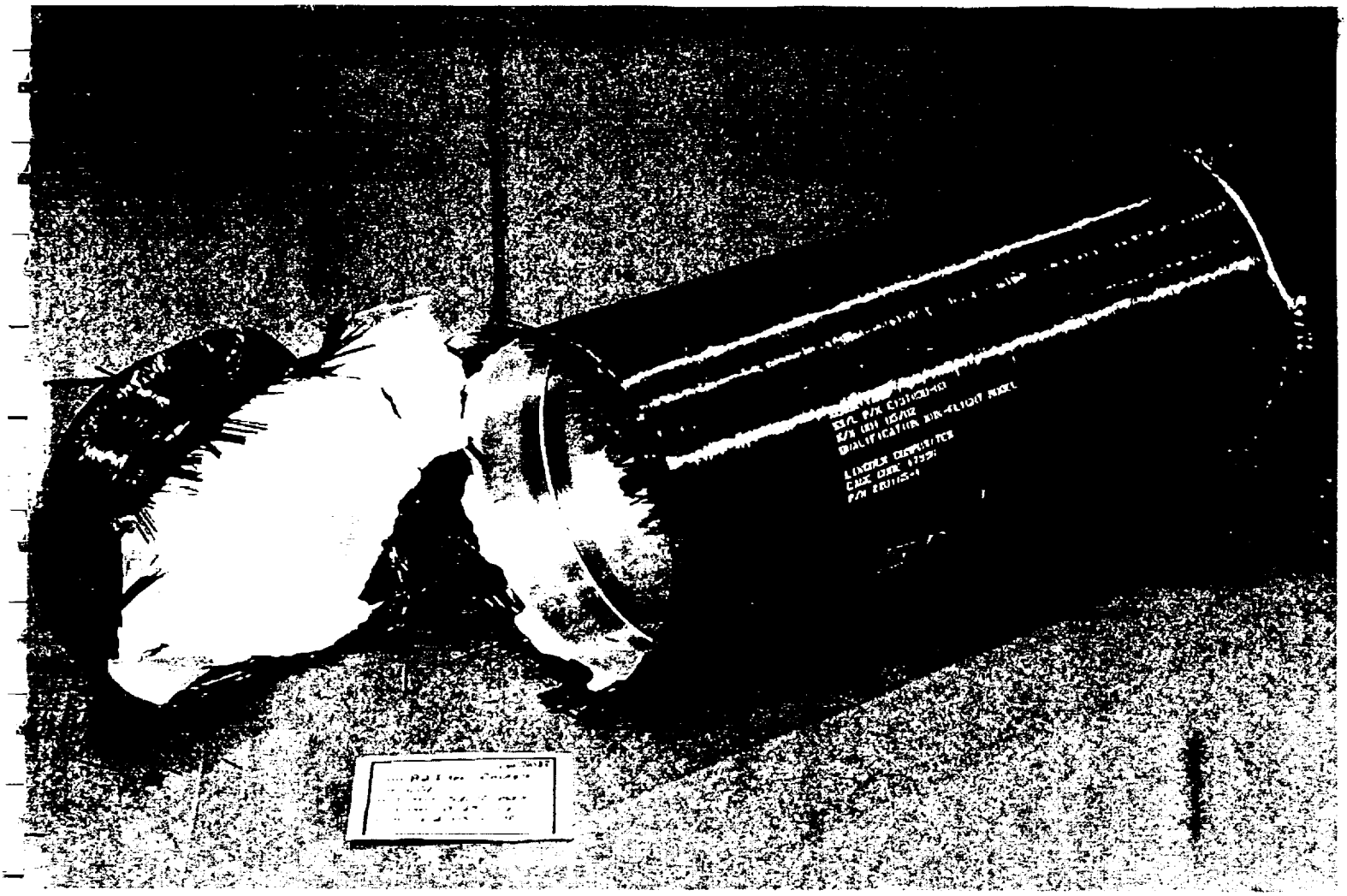


FIGURE 5.5.3-1, BURST TEST

82 LITER XENON

S/N 001

5671 PSIG

8-27-02

TEST REQUEST 02-05-004

APPENDIX 1
ACCEPTANCE TEST DATA

Approvals:
Mfg. Engineer 5-2-02 82L PV — Serial No. [illegible]
Quality Eng. 5/7/02 — Start SN: NA — Batch Qty. One
PM/Supr. 5/7/02 — End SN: NA — Mfg. Order 218165
Rel. Date 05-07-02 CRBD 19862 020218 — Effectivity SIN 001 dup

Traveler PN 175455-1, Rev. NC — Pressure Vessel, Tested, 82 Liter PV

Handling Class: 8 U/M: ea. Shelf Life: Indefinite Storage: Open shelf, dry

Operation		Processing Documents					
Op No	Operation Description	Document Number	Doc Rev	Data Log	Work Cntr	Operator No./Date	Remarks, (FRR No.)
Prolongation Ring Test (ST 980001-4 SN above) must be complete before Proof Test. Customer must witness Proof & Leak							
10	Proof Test *	QCP-06-765		Page 2	AMCJ	QC 33 5/8/02	Customer: N/A
20	Hot Air Dry	QCP-06-765	- -	Page 2	AMCK		
30	Leak Test	QCP-06-765		Page 2	AMCK	QC 13 5/8/02	Customer:
~~40~~	~~Trim Tube~~	~~LPS 9180~~		~~Page 2~~	~~AJCA~~		
~~50~~	~~Final Cleanup~~	~~LPS 9180~~	- -	~~Page 2~~	~~AJCA~~		
60	Final Inspect	Page 3		Page 3	ALBA	QC 13 5-13-02	

5-7-02 5/13/02

Instructions to Production Control:

1. Fill in the serial number of the part being completed in the upper RH corner. The maximum batch size is one each. Lot size is a maximum of 100 each. The data logs do not support larger batches.
2. Attach a single level bill of material with blow-thru to this traveler.
3. The customer must be notified five working days before starting the first operation. Prolongation ring testing must be complete before starting proof test.

5/13/02 QC PLANNING

Operator and Test Technician Instructions:

1. The attached BoM contains the materials required by operation.
2. Document paragraphs are the same as the operation number. Tools and other documents required are listed at the beginning of each operation. Read paragraphs 1.0 through 4.0 prior to using the document for the first time.
3. Fill in the revision level of the document in the column labeled "Doc Rev".
4. Do not use a thread gage inn the port boss threaded inserts.
5. Final assembly dimensions are defined on Product Drawing 220165.

* INSTALL STRAIN GAGES PER ATTACHED SKETCH. MONITOR ON RAMP UP, HOLD & RAMP DOWN.

5/7/02

5/8/02 QC PLANNING

Form No. G1-01/E/36

Traveler PN 175466-1, Rev. NC Page 2 Serial No. 001

TEST DATA / MATERIAL TRACEABILITY LOG

Oper No.	Parameter/ Action	Entry	Parameter/ Action	Entry	Parameter/ Action	Entry
10	PV Serial Number	001	Prolongation Rings Acceptable? Yes/No	Yes	Vessel Weight, Empty, W1	28.81
	Water Fill Start Time/ Date	0800 5-8-02	Vessel Weight, lb. Full (Actual) W2	209.40	Pre-Test Water Temperature, F T1	74°
	Pre-Test Volume @ 0.0 psig V1	5011	Time @ Pressure 5.0 to 10.0 seconds	10.0 3380 psi	Post Test Vessel Weight, lb., Full W3	210.22
	Post-Test Water Temperature, F T2	74°	Water Drain Complete, Date/Time T4	0930 5-8-02	Dry By – Date/Time 12 hrs from T4, Max.	1.5 hrs
	Post-Test Volume @ 0.0 psig 4,000cl Min.,V2	5034.0	Permanent Set , (V2-V1)/V2 1.0% Max.	.45%	Test Tech Accept	LC 08 5/8/02
			Load Cell SN	L45-144	Load Cell Calibration Due Date	6/8/02
			Temperature Gage SN	L67-243	Temperature Gage Calibration Due Date	9/25/02
			Pressure Gage SN	L30-573	Pressure Gage I Calibration Due Date	5/21/02
20	Air Dry Interior, Record Start Time/Date	1000 5-8-02	Air Dry Interior, Record Stop Time/Date	5-8-02 1230	Dry less than or = 12hrs from T4 above Accept	2.5 hrs
30	Standard Leak Calibration Value	6.7×10^{-8}	Leak Rate, Background scc/sec.	9.0×10^{-9}	Helium Pressure 260 to 280 psig	280
	Nitrogen Pressure 2700 to 2800 psig	2780	Indicated Leak Rate, scc/sec.	6.1×10^{-9}	Actual Leak Rate, 1×10^{-7} scc/s Max.	6.1×10^{-9}
	Time @ Pressure 15 minutes Min.	34	Temperature, Degrees F 140F Max.	122	Test Tech Accept	LC 5-8-02
			Pressure Gage SN	L30-124	Pressure Gage I Calibration Due Date	7-11-02
			Leak Detector SN	L72-352	Leak Detector Calibration Due Date	each use
			Standard Leak SN	L72-428	Standard Leak Calibration Due Date	6-21-02
			Digital Thermometer SN	L39-37	Digital Thermometer Calibration Due Date	5-6-02
~~40~~	~~Trim Tube Length to:~~	~~4.39/4.45~~	~~Actual Tube Length~~			
50	Chromate BN		~~Barrier Coat BN~~		End of 45 min. Room Temp Cure Time Date	

LC 5/13/02 QC 5/13/02 IN RANKING

LC 5/8/02 QC IN RANKING

Form No. G1-01/E/96

Operation 60, Inspection Requirements

Item No.	AQL LVL	Parameter	DWG Area	Inspect Method	Record Actual	Accept
1	--	Diameter, Port Tangent Line, 12.94" Max.	E1	Pi-Tape	12.89	LC 13 5-13-02
2	--	Diameter, Port Weld, 12.94" Max.	E3	Pi-Tape	12.940	LC 13
3	--	Diameter, Center Weld, 12.94" Max.	E3	Pi-Tape	12.942	LC 13
4	--	Diameter, Blank Weld, 12.94" Max.	E3	Pi-Tape	12.940	LC 13
5	--	Diameter, Blank Tangent Line, 12.94" Max.	E2	Pi-Tape	12.820	LC 13
6	--	OAL, Shoulder to Shoulder, 45.32" (Ref.).	E2	Calipers	45.381	LC 13
7		~~OAL, Bimetallic Tube~~	~~Operation 40~~	~~Calipers~~		
8		~~Vessel Weigh.~~	~~Operation 10~~	~~Scale~~		
9	--	Vessel Surface Damage, None		Visual	OK	LC 13
10	--	Port Boss Threaded Insert Damage, None	E1	Visual, No gage	OK	LC 13
11	--	Boss Damage, None	E2/E3	Visual	OK	LC 13
12	--	Stencils Complete and Legible	E3	Visual	OK	LC 13
13	--	External Cleanliness		Visual	OK	LC 13
14	--	Tube Protector Installed, Yes		Visual	OK	LC 13 5-13-02

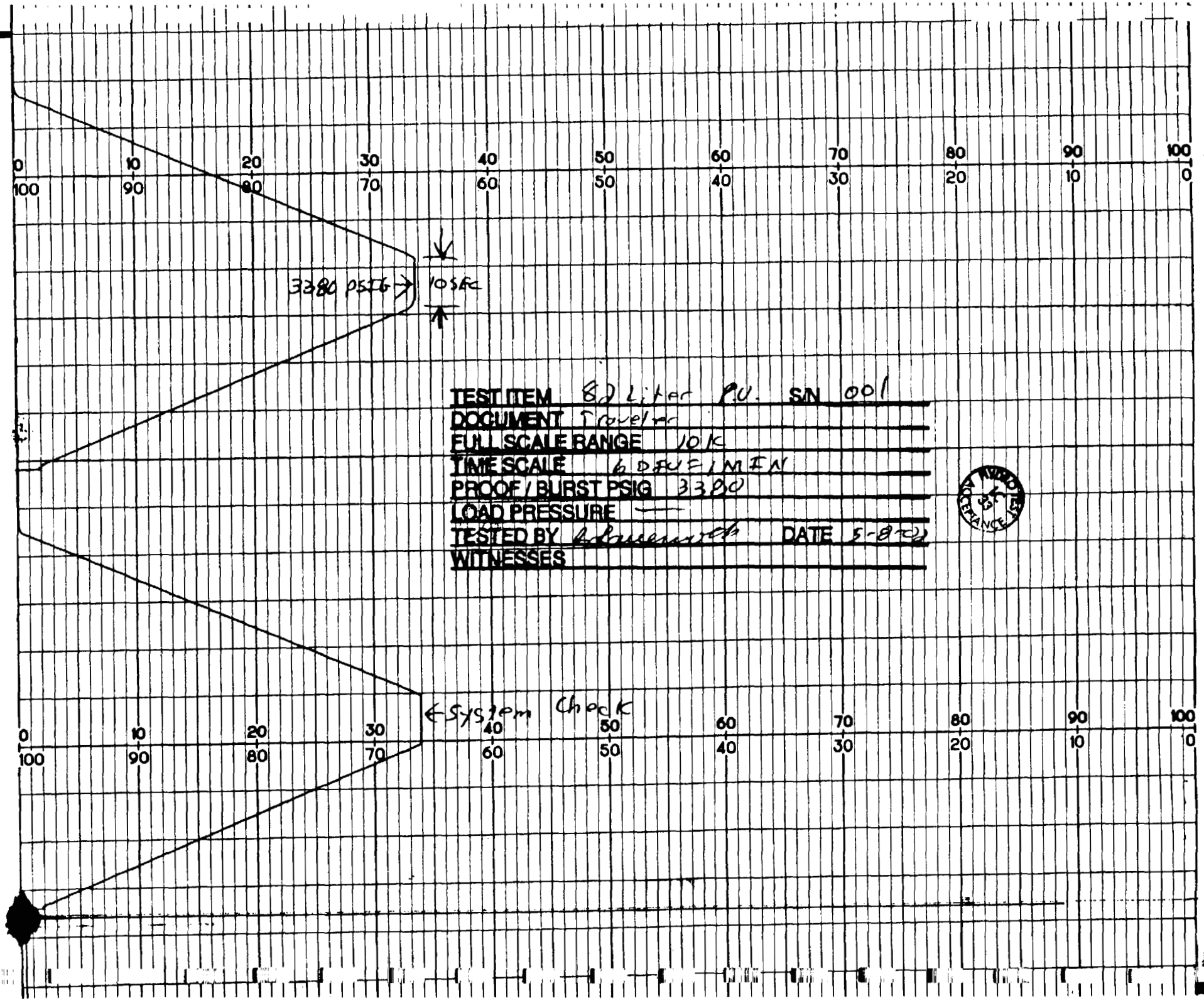
Pi Tape Serial Number: L18-290 Calibration Due Date: 8-2-02

Length Gage Serial Number: L1-211 Calibration Due Date: 1-17-03

Scale, Pennsylvania 5600, Serial No.: N/R Calibration Due Date: N/R

Comments:

END OF DOCUMENT



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Appendix 2

Qualification Test Data Obtained at GDATP Lincoln Operations

PRESS HARD — 4 COPIES

APPROVALS		TEST REQUEST	TR# 02-05-004
PROGRAM	C. Dustin	LINCOLN COMPOSITES, 4300 INDUSTRIAL AVENUE, LINCOLN, NEBRASKA 68504	REL DATE 5-9-2002
QUALITY	5/9/02		PAGE ____ OF ____
TEST	5/9/02		

PART NO.	ITEM DESCRIPTION	QUANTITY/SERIAL NO.
220165-1	82L OMEGA PV	1/001
COST CENTER	DESCRIPTION OF TEST:	
19862-52000	QUALIFICATION TESTS ~~PRESSURE CYCLES~~	

Prepared By C. DUSTIN Date 5-9-2002 Required Completion [redacted]-18-02

TEST WITNESS RQMTS: ORIGINATOR ☐ DCAS ☐ NONE ☐ CUST ☐

PHOTO RQMTS: YES ☐ NO ☐

REPORT RQMTS: DATA ONLY [redacted] SHORT FORM ☐ FORMAL ☒

WHEN COMPLETE RETURN TO DEPT.: 11 ATTENTION: CHAD DUSTIN

TEST FUNCTION REQUIRED:

1. ACCOMPLISH PRESSURE CYCLING PER QCP06-766, TABLE 2.
2. DRY PER QCP06-[redacted], PARA 5.2
3. He LEAK TEST PER QCP 06-766, PARA 5.2
4. DYNAMIC TEST AT OUTSIDE FACILITY PER QCP06-766, PARA 5.3
5. PRECISION CLEAN AT OUTSIDE FACILITY PER QCP 06-766, PARA 5.4
6. RANDOM VIBE TEST AT OUTSIDE FACILITY PER QCP06-766, PARA 5.4
7. CLEANLINESS VERIFICATION AT OUTSIDE FACILITY PER QCP 06-766, PARA 4
8. He LEAK TEST PER QCP 06-766 PARA 5.4
9. BURST TEST PER QCP 06-766, PARA 5.5

PROC/SPEC NO. QCP 06-766 REV NC APPLICABLE PARA. ~~TABLE 2~~ 5.2-5.

SUMMARY OF RESULTS

1. complete 5-15-02 NJ
2. complete 5-15-02 NJ

9 Burst test complete 8-29-02 NJ

DISPOSITION OF TEST ITEM:
RETURN TO ORIGINATOR ☐
DESTROY AND/OR DISPOSE ☐
PUT INTO STORAGE ☐
OTHER ____

NOTE: ORIGINATOR MUST SUPPLY SEALABLE CONTAINER FOR ALL ITEMS TO BE PUT INTO STORAGE.

Conducted by NJ
Start Date 5-15-02
Completion Date 8-29-02

(18862-1)

PART NUMBER 220165-1
82L XENON OMEGA PRESSURE VESSEL
QUALIFICATION TEST LOG

Pressure Cycling Test per QCP 06-766, Para 5.2

Seven Cycles from 0 to 3375 to 0 psig

Vessel S/N	Minimum Pressure	Maximum Pressure	Hold Time	Number of Cycles	QC Accept
001	40.0	3365	1 SEC	7	LC 08 5-13-02

Eight Cycles from 0 to 2970 to 0 psig

Vessel S/N	Minimum Pressure	Maximum Pressure	Hold Time	Number of Cycles	QC Accept
001	30	2965	1 SEC	8	LC 08 5/13/02

43 Cycles from 0 to 2700 to 0 psig

Vessel S/N	Minimum Pressure	Maximum Pressure	Hold Time	Number of Cycles	QC Accept
001	20	2700	1SEC	43	LC 08 5/13/02

3307 Cycles from 2100 to 2700 to 2100 psig

Vessel S/N	Minimum Pressure	Maximum Pressure	Hold Time	Number of Cycles	QC Accept
001	2110 2000	2700 2715	5 sec	3307	LC 08 5/14/02

3307 Cycles from 2100 to 2400 to 2100 psig

Vessel S/N	Minimum Pressure	Maximum Pressure	Hold Time	Number of Cycles	QC Accept
001	2105 2105	2400 2400	5 sec	3307	LC 08 5/15/02

MEOP Pressurized Volume

Vessel S/N	Pressure	Effluent Weight	Effluent Temp.	Effluent Volume	M & IR Volume	Total Pressure Volume	QC Accept
001	2720	4.93	78°	136.87	5034.0	5125.6	LC 08 5/15/02

OAL @ 2700 psig 45.737

OAL @ 0 psig 45.409

* Extra cycles to 2720 psig = 3 5/15/02

5034
137
5171 × .99125
= 5125.6

Helium Leak Test

Vessel S/N	Std. Leak Calib. Value	Background Leak Rate	Helium Pressure	Nitrogen Pressure	Vessel Temperature
001	6.7×10^{-8}	2.6×10^{-8}	280 PSIG	2780 PSIG	129 °F

Indicated Leak Rate	Actual Leak Rate	Time at Pressure	Number of Cycles	QC Accept
1.8×10^{-8}	1.8×10^{-8}	20 MIN	1	LC 5-16-02

Dynamics Testing per QCP 06-766, Para 5.3
Performed outside at independent testing facility

Precision Cleaning per QCP 06-766, Para 5.4
Performed at outside independent cleaning facility

Random Vibration Testing per QCP 06-766, Para 5.4
Performed at outside independent testing facility

Cleanliness Verification per QCP 06-766, Para 5.4
Performed at outside independent cleaning facility

Helium Leak Test (post-dynamics) per QCP 06-766, Para 5.4

Vessel S/N	Std. Leak Calib. Value	Background Leak Rate	Helium Pressure	Nitrogen Pressure	Vessel Temperature
001	6.00×10^{-8}	2.5×10^{-8}	280	2780	124 °F

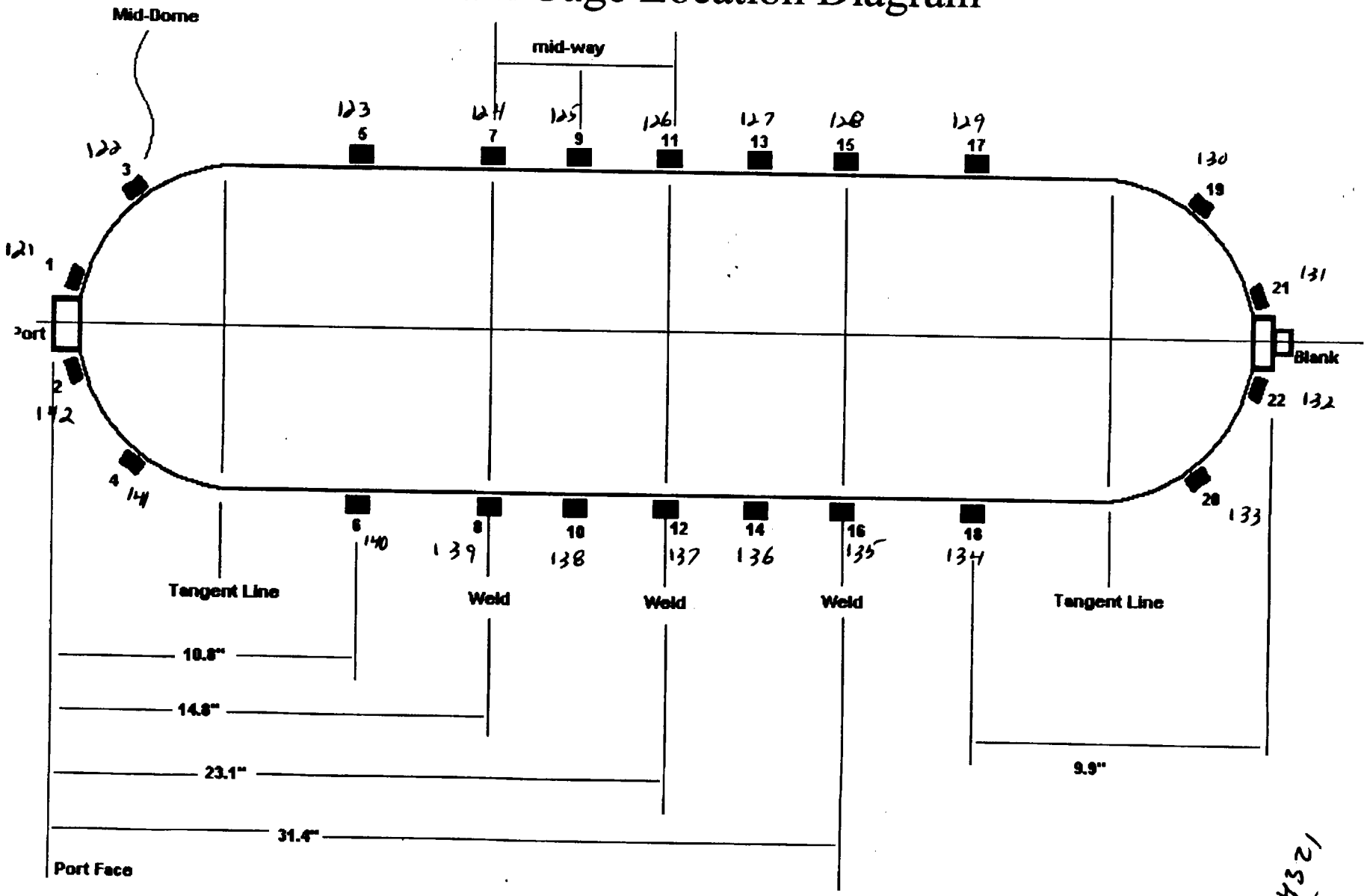
Indicated Leak Rate	Actual Leak Rate	Time at Pressure	Number of Cycles	QC Accept
2.2×10^{-8}	2.2×10^{-8}	16 MIN	1	LC 8-29-02

Burst Test per QCP 06-766, Para 5.5

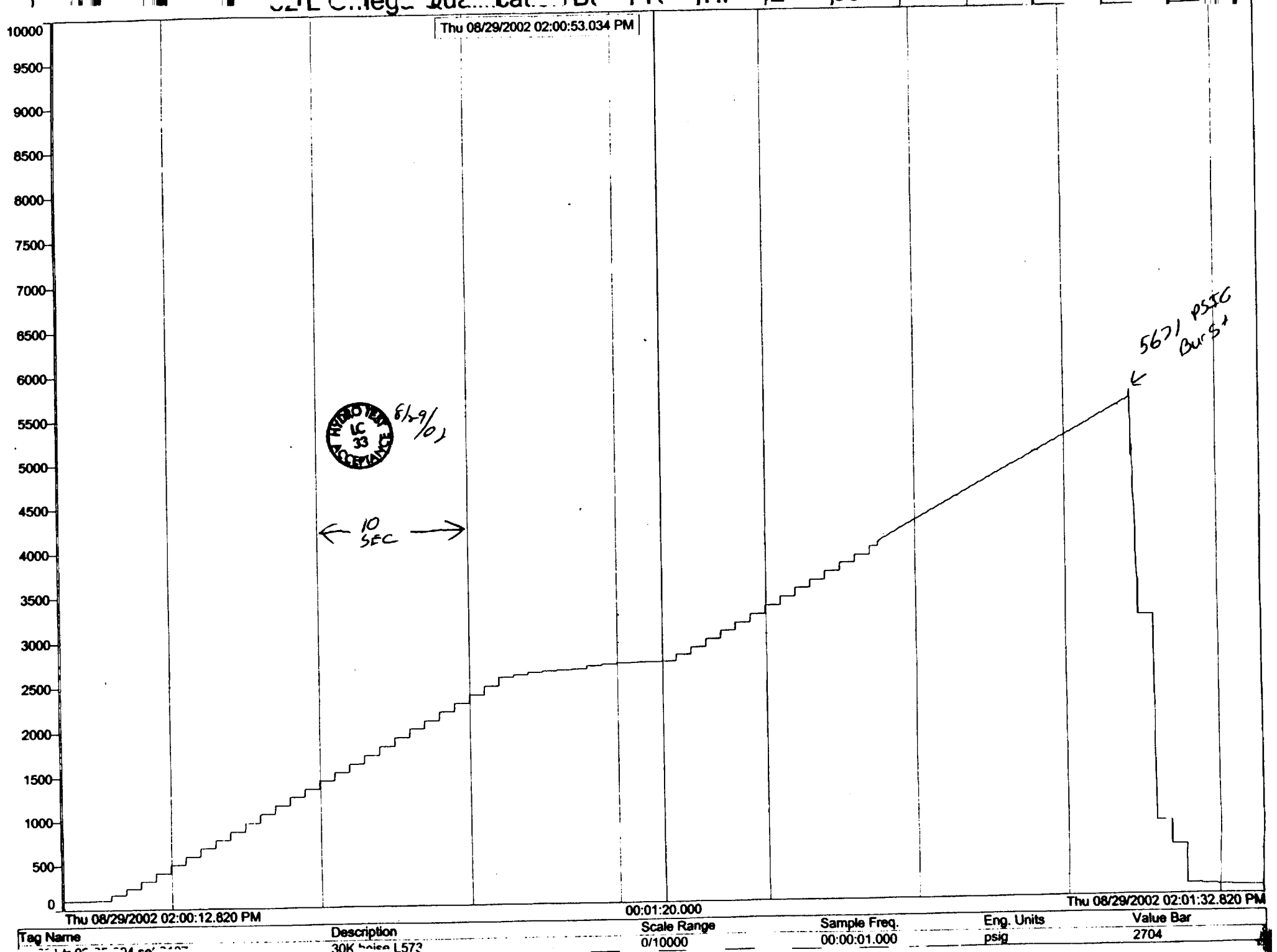
Vessel S/N	Hold Pressure	Hold Time	Burst Pressure	Customer Witness	QC Accept
001	2705	2 SEC	5671		LC 5/9/02

Cylinder Burst Blank end

82 Liter Xenon Pressure Vessel
Strain Gage Location Diagram



(30) 812 4321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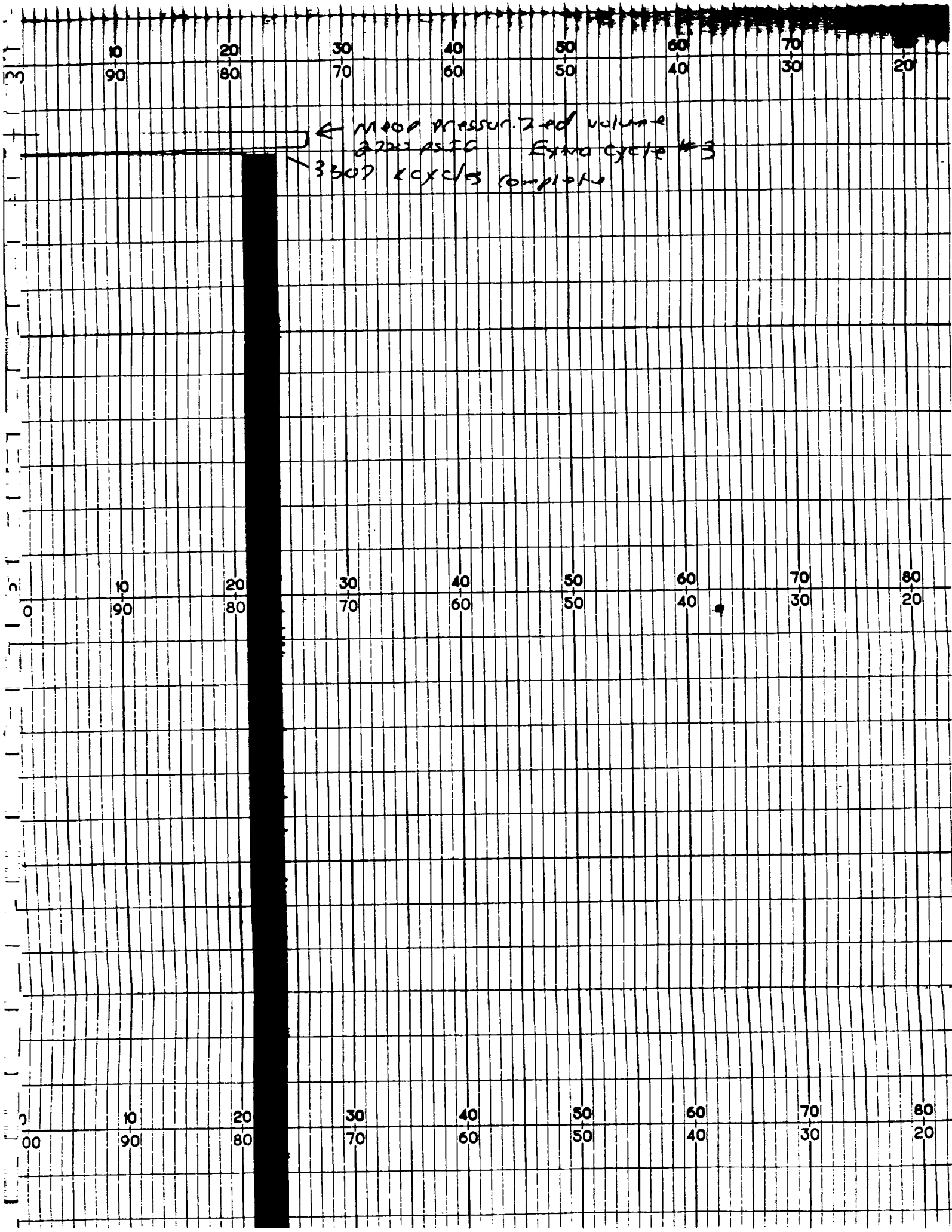
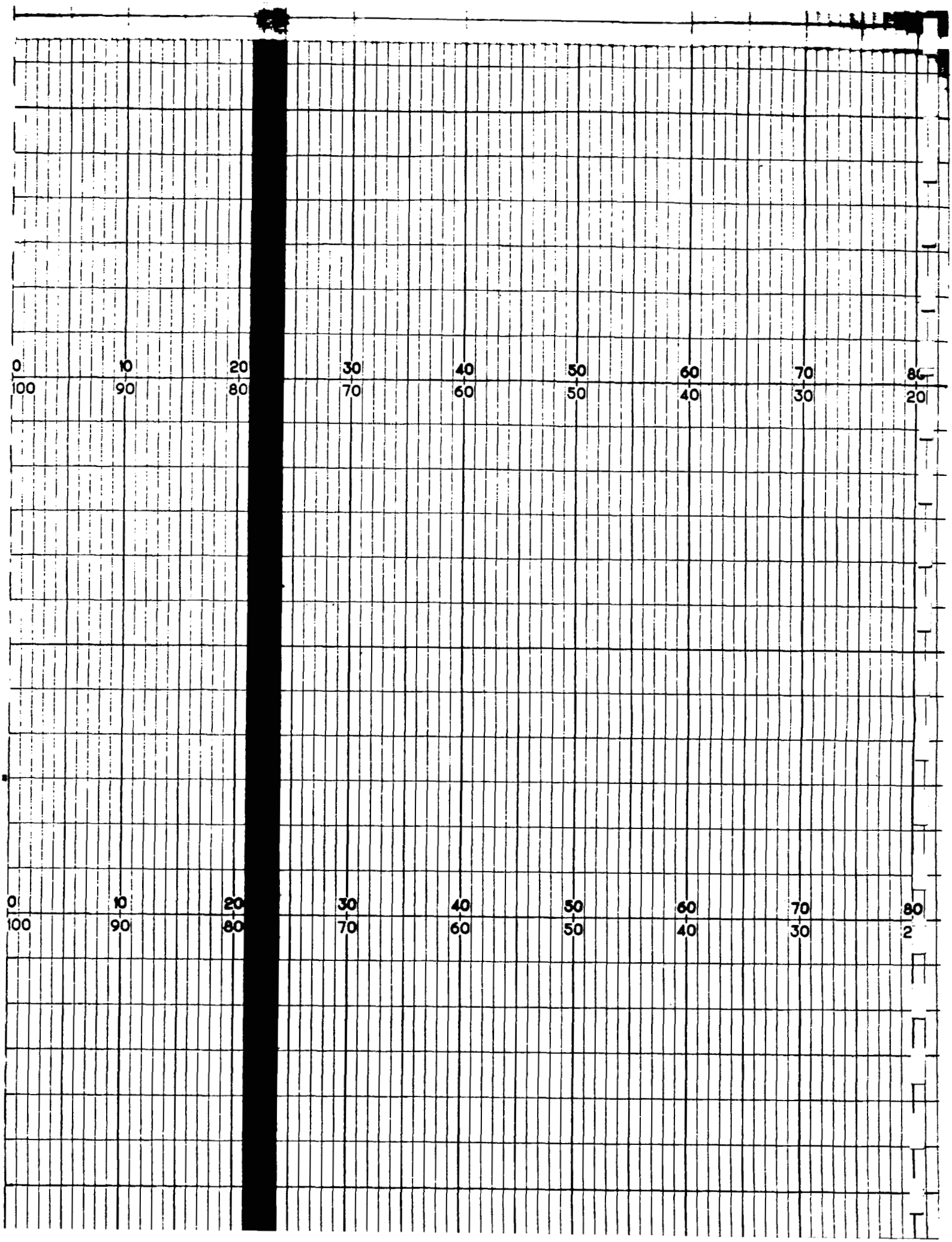
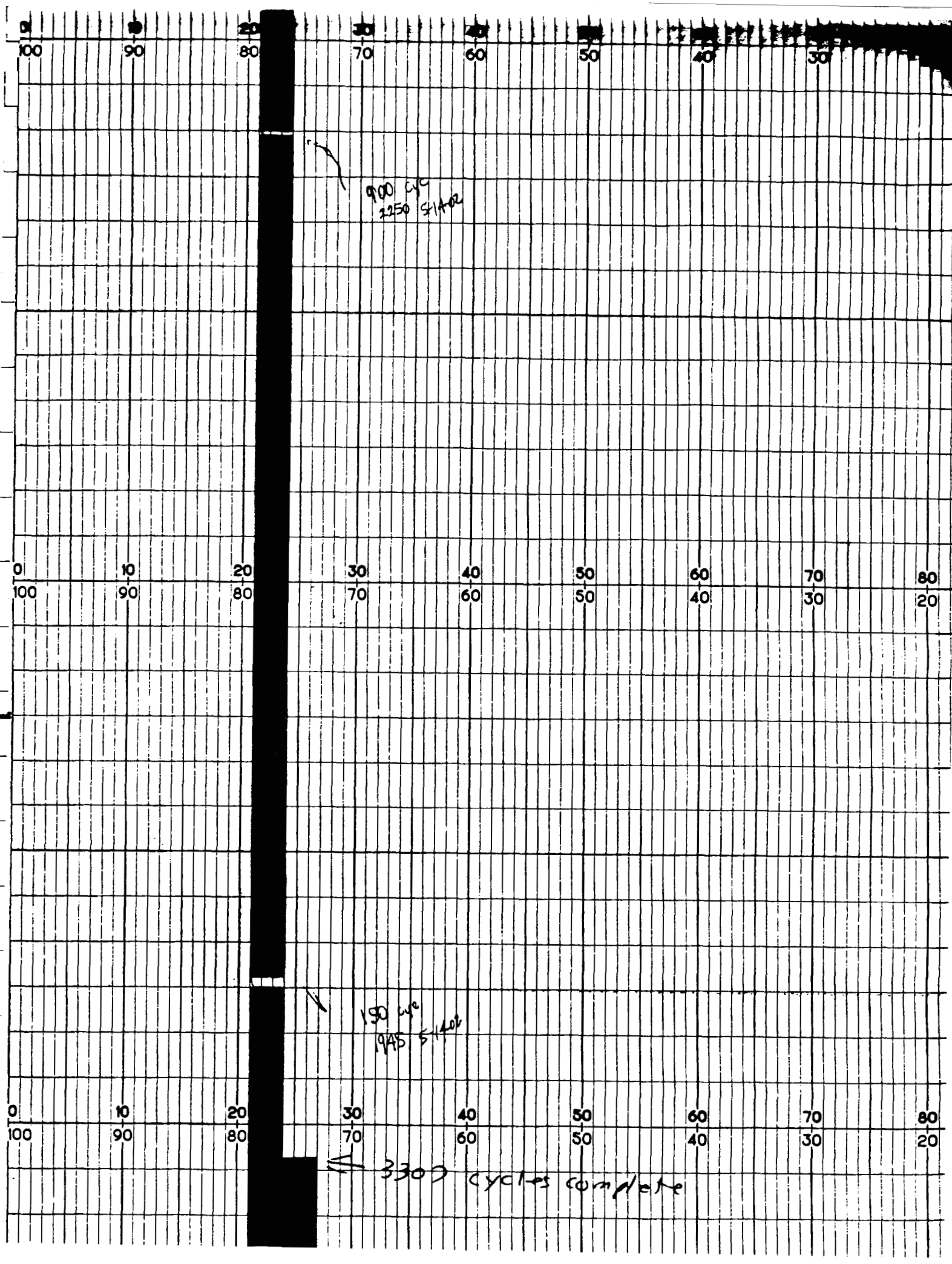
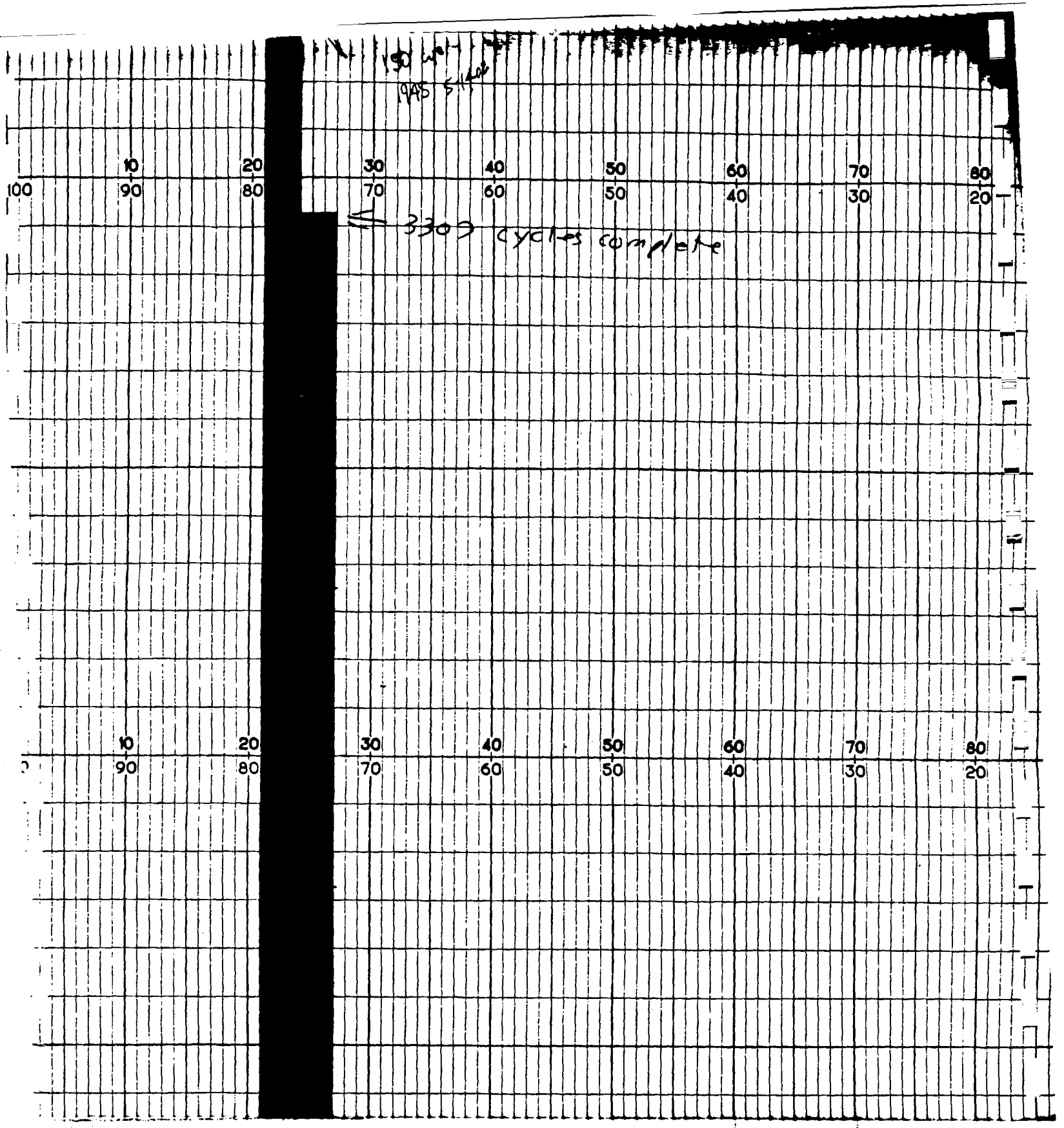
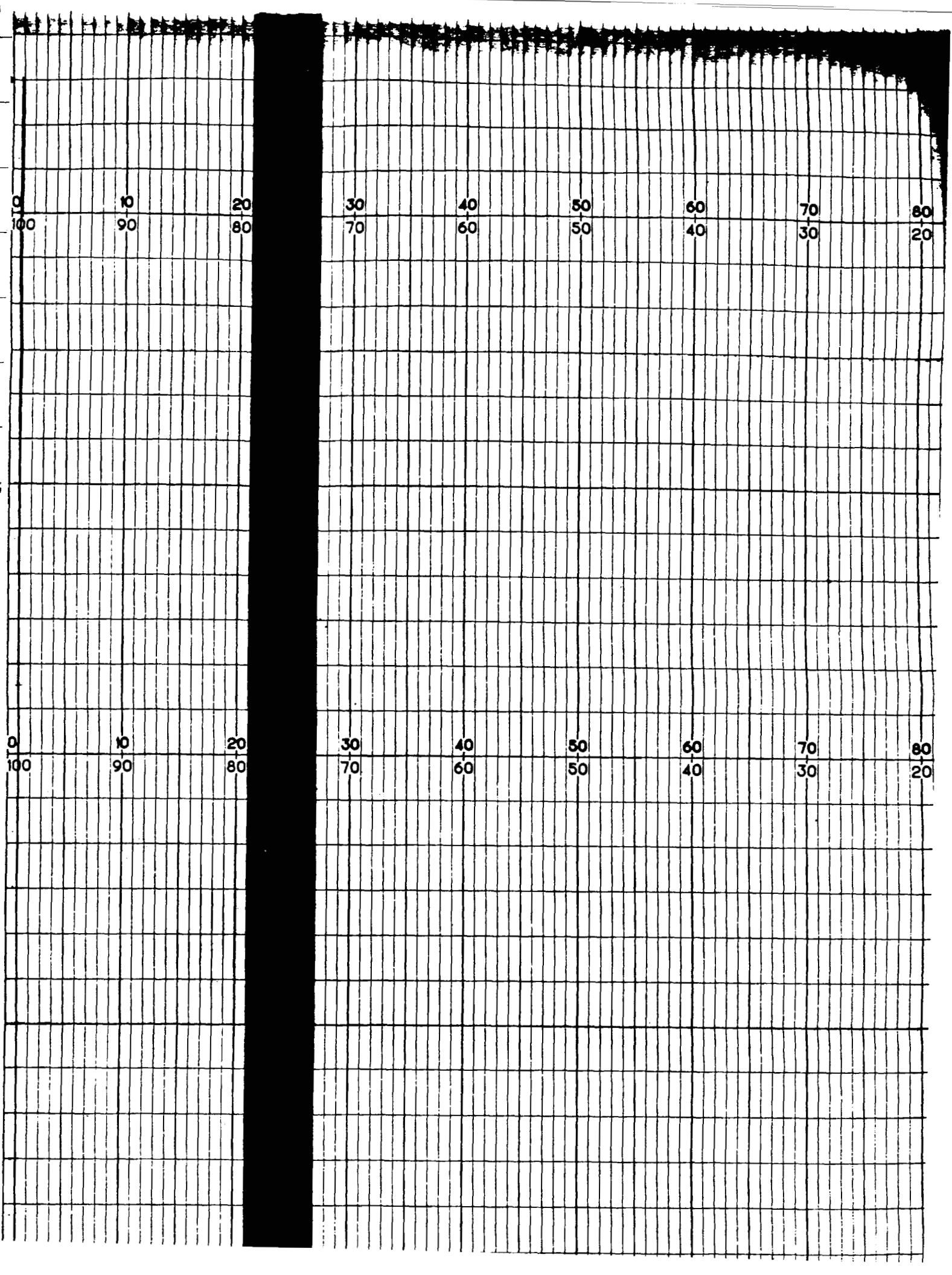
10000
9500
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
5671 PSIG Burst
10 SEC
Thu 08/29/2002 02:00:12.820 PM
00:01:20.000
Thu 08/29/2002 02:01:32.820 PM
Tag Name
Description
Scale Range
Sample Freq.
Eng. Units
Value Bar
30K noise L573
0/10000
00:00:01.000
psig
2704


10 20 30 40 50 60 70
90 80 70 60 50 40 30 20
← MEOP pressurized volume
2200 psig Extra cycle #3
3307 kcycles complete
10 20 30 40 50 60 70 80
0 90 80 70 60 50 40 30 20
10 20 30 40 50 60 70 80
00 90 80 70 60 50 40 30 20


0 10 20 30 40 50 60 70 80
100 90 80 70 60 50 40 30 20
0 10 20 30 40 50 60 70 80
100 90 80 70 60 50 40 30 2


0 10 20 30 40 50 60 70 80
100 90 80 70 60 50 40 30
900 cyc
2250 S1402
0 10 20 30 40 50 60 70 80
100 90 80 70 60 50 40 30 20
150 cyc
1945 S1402
0 10 20 30 40 50 60 70 80
100 90 80 70 60 50 40 30 20
≤ 3300 cycles complete


10 20 30 40 50 60 70 80
100 90 80 70 60 50 40 30 20
≤ 3303 cycles complete
10 20 30 40 50 60 70 80
90 80 70 60 50 40 30 20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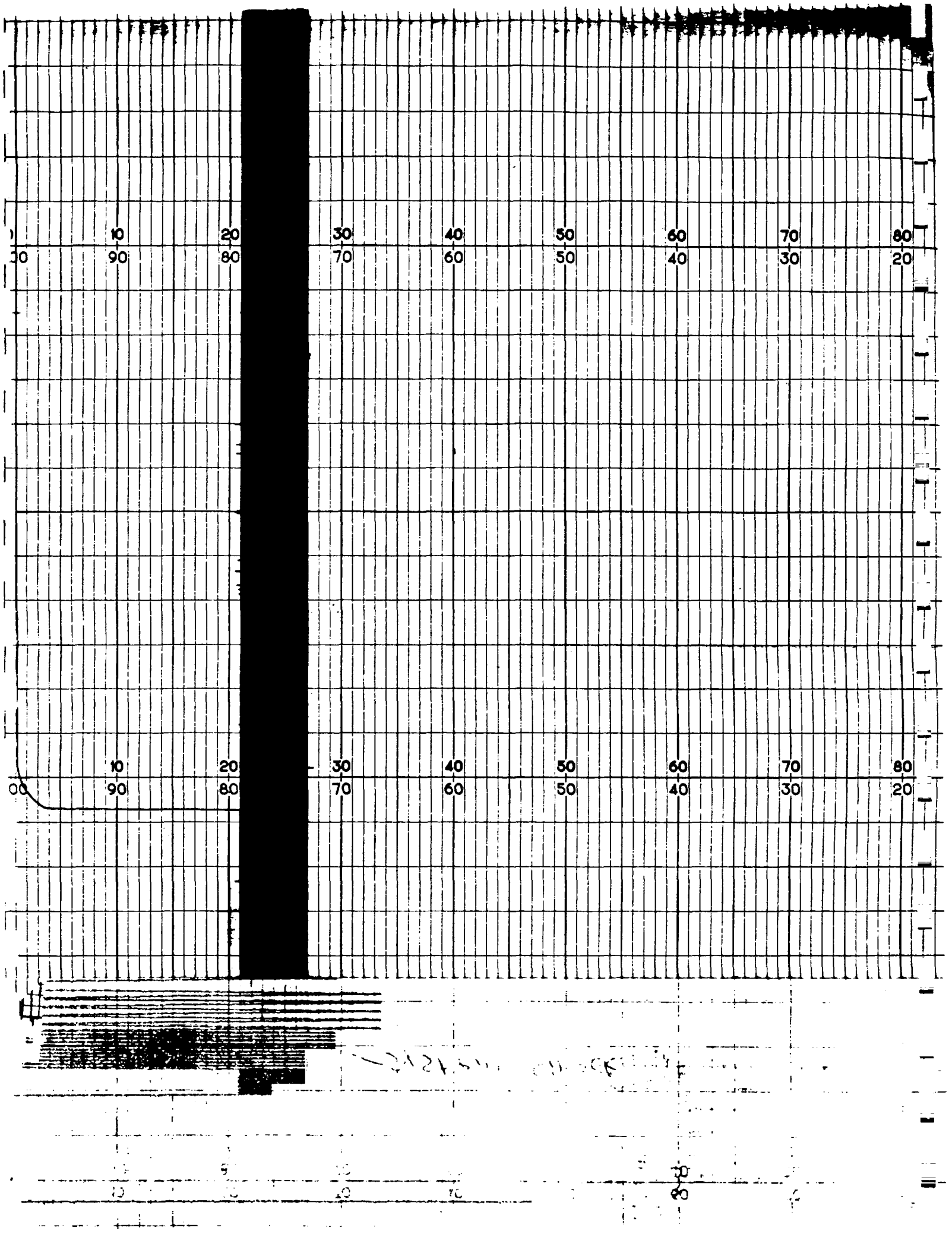
100 90 80 70 60 50 40 30 20
0 10 20 30 40 50 60 70 80
100 90 80 70 60 50 40 30 20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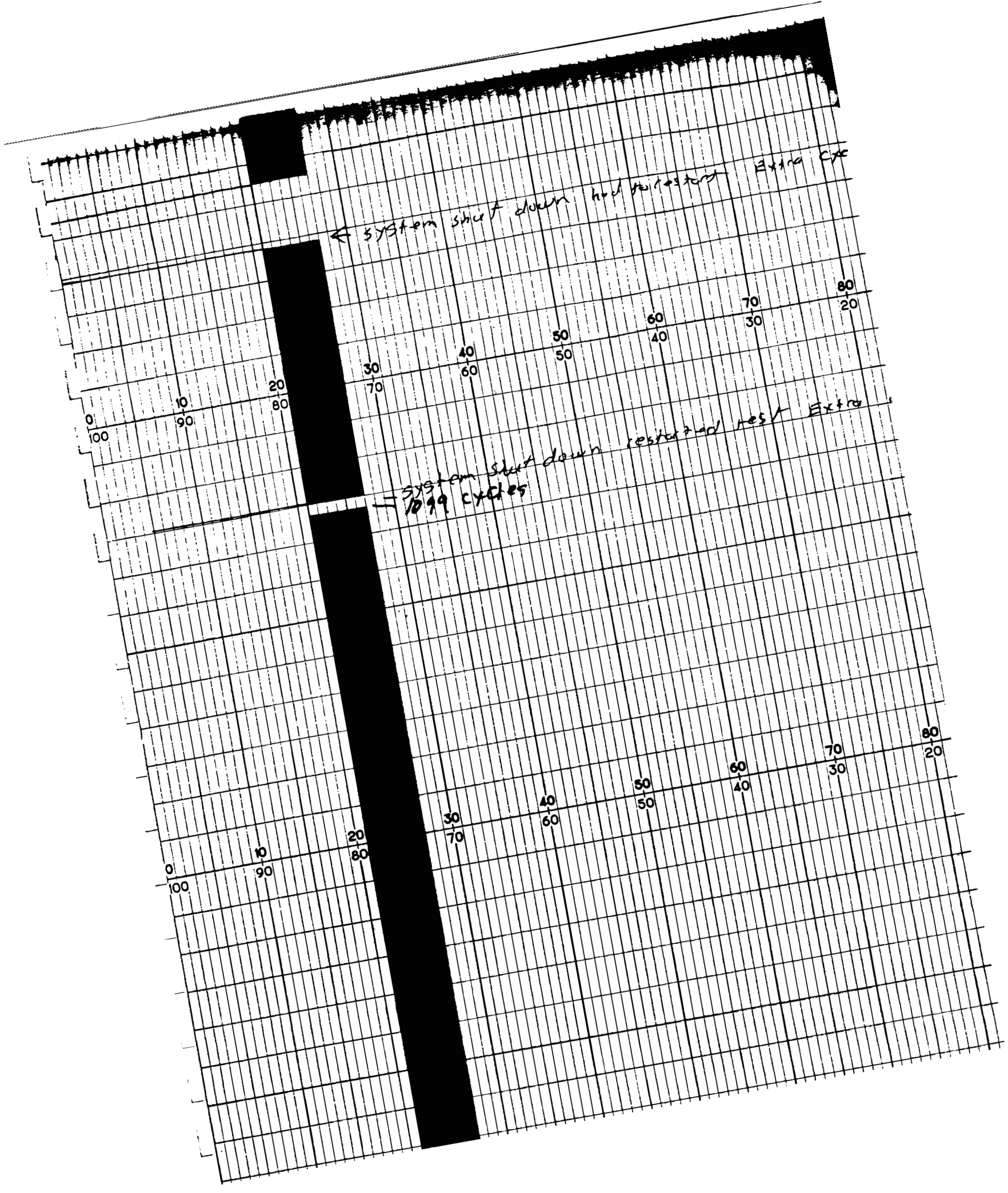
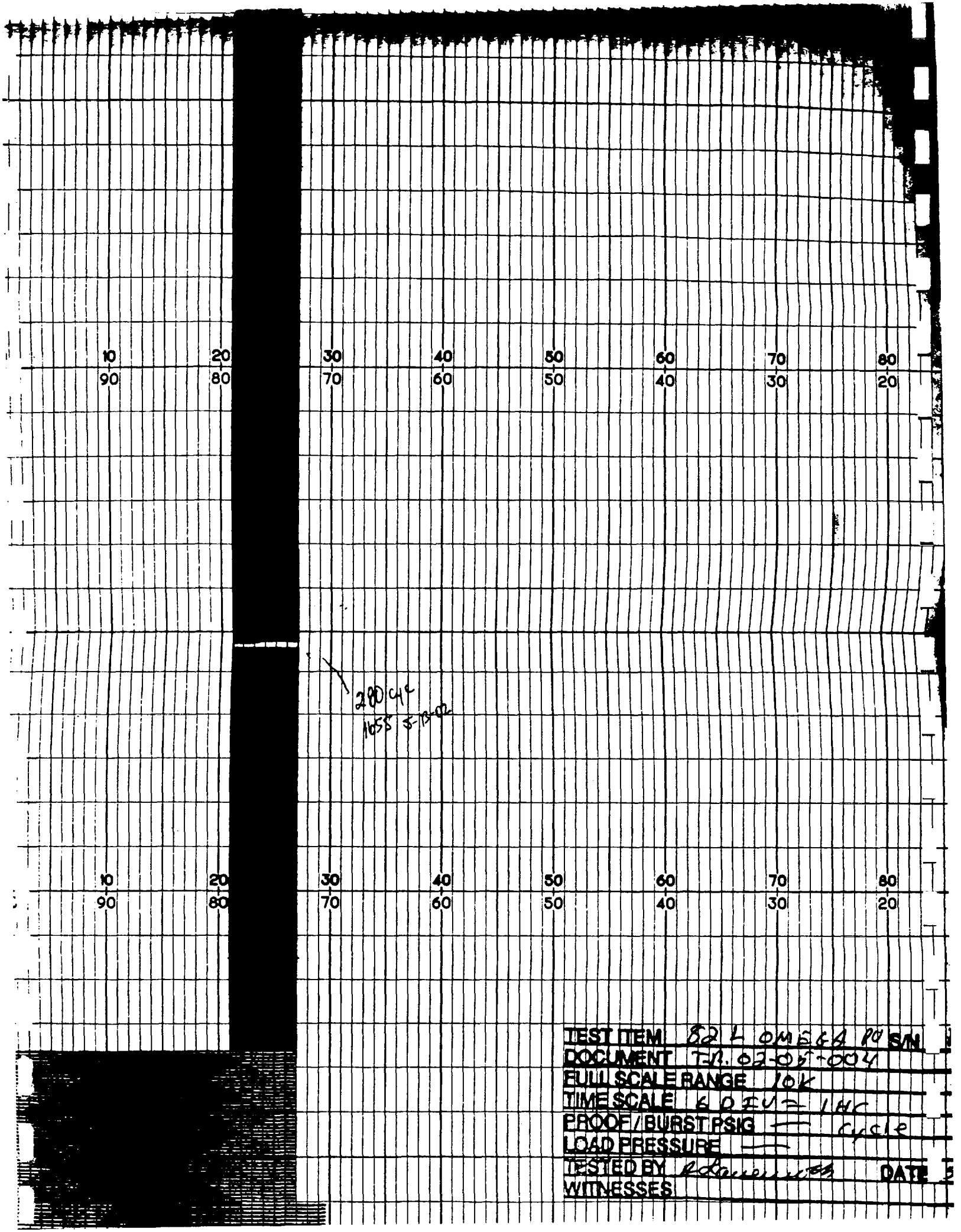
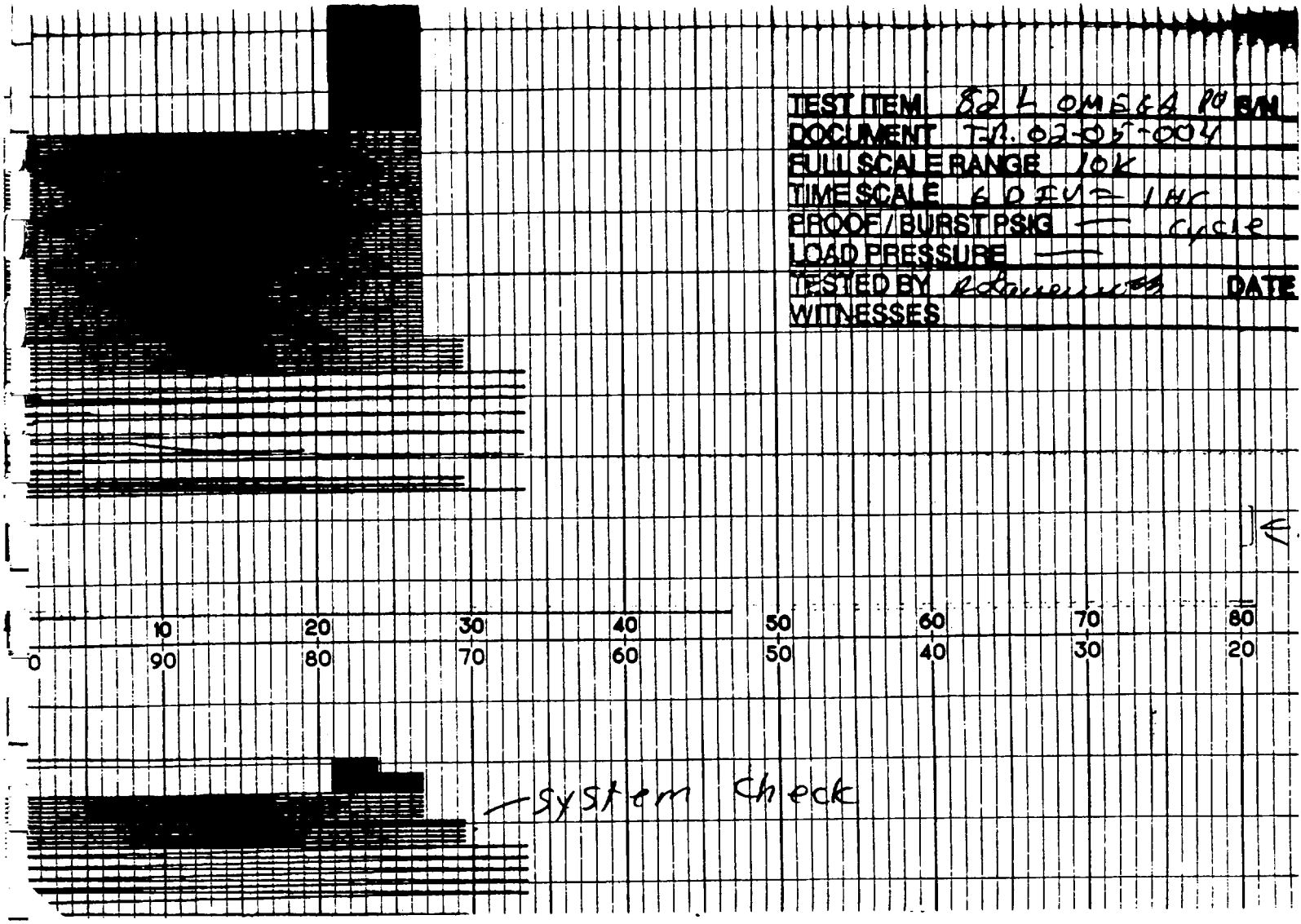
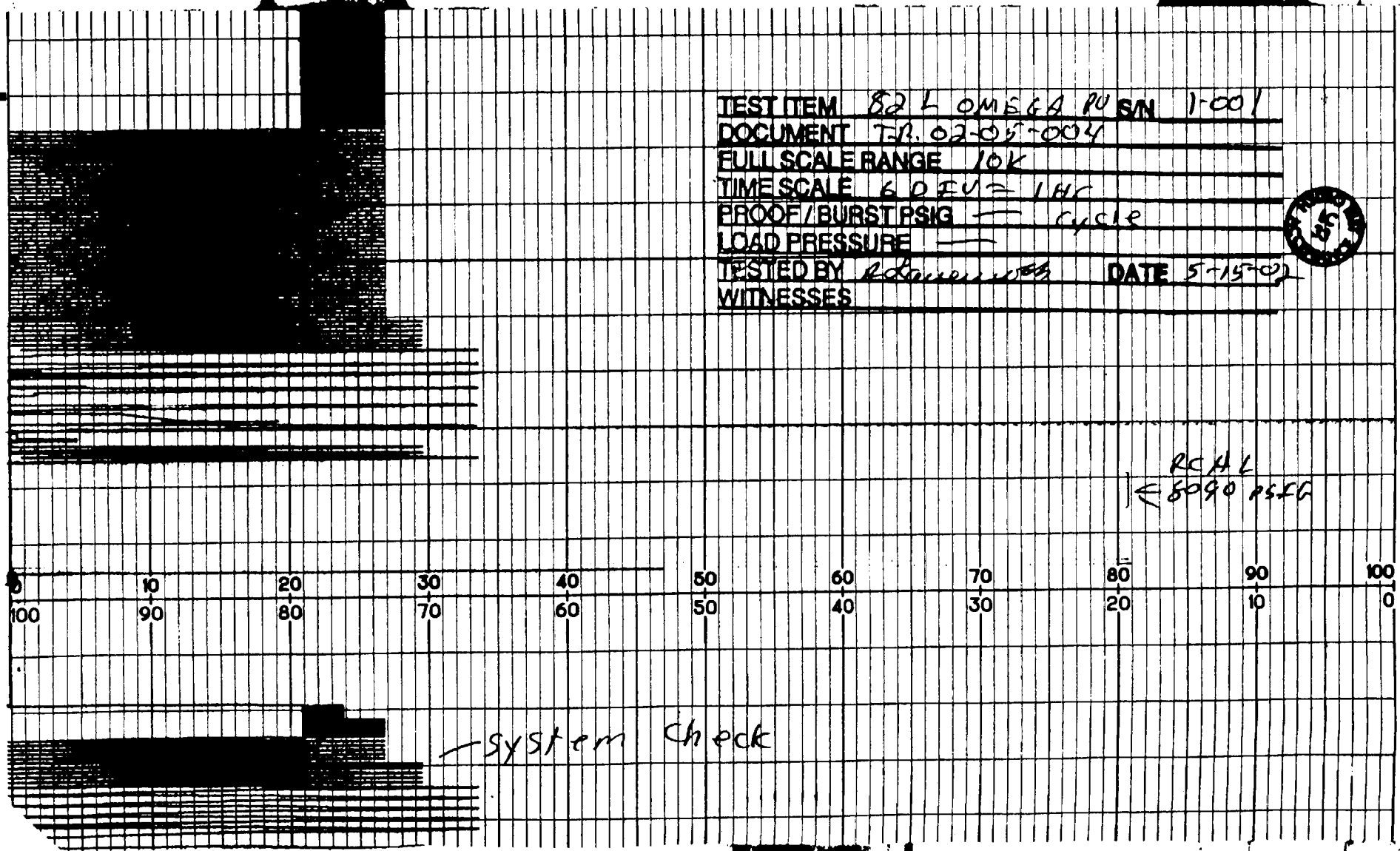
90 80 70 60 50 40 30 20
10 20 30 40 50 60 70 80
90 80 70 60 50 40 30 20


System shut down had restarted
Extra cyc
System shut down restarted rest
Extra
1099 cycles
0 100
10 90
20 80
30 70
40 60
50 50
60 40
70 30
80 20


10 20 30 40 50 60 70 80
90 80 70 60 50 40 30 20
280 psi
1055 5-13-02
10 20 30 40 50 60 70 80
90 80 70 60 50 40 30 20
TEST ITEM 824 OMEGA PO S/N
DOCUMENT TR. 02-05-004
FULL SCALE RANGE 10K
TIME SCALE 60 IN = 1 HR
PROOF/BURST PSIG — cycle
LOAD PRESSURE —
TESTED BY
DATE
WITNESSES


TEST ITEM 82 L OMS 64 PO S/N
DOCUMENT TR. 02-05-004
FULL SCALE RANGE 10K
TIME SCALE 60 IN = 1 HR
PROOF/BURST PSIG — 6 cycle
LOAD PRESSURE —
TESTED BY
DATE
WITNESSES
10 20 30 40 50 60 70 80
0 90 80 70 60 50 40 30 20
System Check



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Appendix 3

Cleanliness Verification Results

NATIONAL TECHNICAL SYSTEMS 5320 W. 104TH STREET LOS ANGELES, CA 90045 (310) 348-0900 / FAX (310) 670-7556

Customer: LINCOLN COMPOSITES M.J.O. 232-5320-1

Specification: [illegible] Level: [illegible] Eshft: 12 5 [illegible] Sample Vol: 25 [illegible] ml

													mg/ft²
	RANGE (microns)	2/5	5/10	11/25	26/50	51/100	100/>						
	ALLOWABLE	NO SPEC.	1,500	1,250	312	50	0					TFS	
		VERIFICATION AFTER VIBRATION											
QTY	P/N S/N	PARTICLE COUNT ANALYSIS RESULTS											NVR
1	220165-1 S/N001	NO SHT.	14,900	1780	141	30	15	125 µm RUST 175 µm POLY 175 µm METALLIC 175 µm METALLIC 100 µm METALLIC 375 µm FIBER 350 µm FIBER 575 µm METALLIC 325 µm ? 500 µm ? 300 µm RUST. 130 µm RUST. 170 µm POLY 125 µm POLY 175 µm RUST.				
		8 METALLICS >75 µm.											
	PER 100ML.	2/5	5/10	11/25	26/50	51/100	100/>						
	ALLOWABLE	NO SHT.	600	100	25	4	0						1.0
		VERIFICATION											
	220165-1 S/N001	NO SHT.	1192	142	11	2	1						0.4mg

All actual data reported per 1250/100 mL

INSPECTOR: [signature] DATE: JUN 12 2002

QC 106 / 4/99

NATIONAL TECHNICAL SYSTEMS 5320 W. 104TH STREET LOS ANGELES, CA 90045 (310) 348-0900 / FAX (310) 670-7550

Customer: LINCOLN COMPOSITES M.J.O. 232-5320

Specification: [illegible] Level: [illegible] Sample Vol: 1250 mL

	RANGE (microns)	<5	5/10	11/25	26/50	51/100	100>						mg/ft²
	ALLOWABLE	[illegible]	750	1,250	312	50	0						
		VERIFICATION AFTER PRESS											
QTY	P/N	S/N	PARTICLE COUNT ANALYSIS RESULTS										NVR
1	220165-1	5/N 001 NO SZLT.	10,300	1460	210	49	15		1 in. 250 µm FIBER 5 in. 50 µm METALLIC 2 in. 875 µm FIBER 3 in. 100 µm METALLIC 1 in. 60 µm. METALLIC 1 in 120 µm RUST 1 in. 675 µm METALLIC 2 in. 150 µm " "			
		22	METALLICS > 25 µm.										
	IFA PER 100ml	<5	5/10	11/25	26/50	51/100	100>		1 in. 750 µm. FIBER 1 in. 70 µm. METALLIC 2 in. 40 µm. " "				
	ALLOWABLE	NO SZLT.	2400	100	25	4	0						
		VERIFICATION											
1	220165-1 5/N 0001	SZLT.	824	117	17	4	1.2		1 in. 200 µm. " " 3 in. 500 µm. " " 1 in. 375 µm. " " 1 in. 80 µm. " " 1 in. 475 µm. " " 1 in. 1,250 µm FIBER				1.0mg 0.3mg

All actual data reported per 1250/100 mL

INSPECTOR: [illegible] DATE: JUN 26 2002

QC 106 / 4/99

Customer: Lincoln Composite M.J.O. 232-5320

Specification			Test Level			Est. ft		Sample Vol: 1250 mL				
RANGE (microns)		<5	5/10	11/25	26/50	51/100	100/>					mg/ft²
ALLOWABLE		No silt	7500	1250	312	50	0					100mL 1.0 g
QTY	P/N	S/N	PARTICLE COUNT ANALYSIS RESULTS									NVR
1	220165-1	S/N 001	No silt	1395	887	191	25	2*				0.3mg
			20	metallic >25— but less than 50—								
			20	metallic >50— but less than 100—								
			2	metallic wire slivers >100—					@ 175—	@ 210—		
			All other contamination A typical for type after cleaning									
	Per 100mL											
	Allowed	No silt	600	100	25	4	0					
1	220165-1	S/N 001	"	112	71	15	2	0*	After Dividing Results by 12.5			

All actual data reported per 1250/100 mL

INSPECTOR: [signature] DATE: 7-3-02

QC 106 / 4/99

Jul-03-2002 04:54pm From-National Technical Systems Los Angeles +3106707556 T-966 P.002/002 F-753

NATIONAL TECHNICAL SYSTEMS 5320 W. 104TH STREET LOS ANGELES, CA 90045 (310) 348-0900 / FAX (310) 670-7556

Customer: Lincoln Composites M.J.O. 232-5320

Specification												
RANGE (microns)		<5	5/15	16/25	26/50	50/>						mg/ft²
ALLOWABLE		No silt	2075	310	91	12						
QTY	P/N S/N	PARTICLE COUNT ANALYSIS RESULTS										INVIZ
1	220165-1 S/N 001	"	743	291	76	11						
			13 metallic >25									
			3 metallic >50									
			0 metallic >100									
	Per 100ml											
	Allowed	No silt	166	25	7.3	1						1.0mg
1	220165-1 S/N 001	"	59	23	6	1						0.2mg

All actual data reported per 1250/100 ml

INSPECTOR: [signature] DATE: 7-16-02

QC 106 / 4/99

Sep-16-2002 11:07am From-National Technical Systems Los Angeles +3106707556 T-485 P.003/006 F-102

NATIONAL TECHNICAL SYSTEMS [illegible] W. 6th STREET LOS ANGELES, CA 90017 (213) 348-0000 / FAX (213) 67[illegible]

Customer: Lincoln Composites M.J.O. 232-5320

Specification	Level					Sample Volume					ml
Rucland RANGE (microns)	<5	5/15	16/25	26/50	50/>						mg/ft²
After 2nd Rerun Test ALLOWABLE	NO SILT	2075	310	91	12						
QTY	P/N	S/N	PARTICLE COUNT ANALYSIS RESULTS								LVDT
1	220165-1	SIN 001	"	718	262	59	7				
			No metallic ores								
	Per 100ml										
	Allowed		NO SILT	166	25	7.3	1				1.0mg
1	220165-1	SIN 001	"	57	21	5	1				0.2mg
	Valve										
	Hose		"	88	39	3	1				0.2mg
	Multiport Holder		No metallic ores								

All actual data reported per 100/100 ml

INSPECTOR: [signature] DATE: 7-17-02

QC 106 / 4/99

NATIONAL TECHNICAL SYSTEMS 5320 W. 104TH STREET LOS ANGELES, CA 90045 (310) 348-0900 / FAX (310) 670-7556

Customer: Lincoln M.J.O. 232-5320

Specification													
RANGE (microns)		<5	5/15	16/25	26/50	50/>							mg/ft²
ALLOWABLE		NO silt	2075	310	91	12							
QTY	P/N S/N												
1	220165-1 S/N 001	NO silt	687	231	43	7							
			5 metallic >25 TO <50										
			2 metallic >50 TO <75										
			0 metallic >75										
	Per 100mL												
	Allowed	NO silt	166	25	7.3	1							1.0 mg
1	220165-1 S/N 001	"	55	19	3	1							0.2 mg

All actual data reported per 1250/100 mL

INSPECTOR: [signature] DATE: 7-23-02

QC 106 / 4/99

Sep-16-2002 11:08am From-National Technical Systems Los Angeles +3106707556 T-485 P.005/006 F-102

NATIONAL TECHNICAL SYSTEMS 5320 W. 104TH STREET LOS ANGELES, CA 90045 (310) 340-0090 / FAX (310) 670-7556

Customer: Lincoln Composites M.J.O. 232-5320

Specification	Level										mg/ft²
RANGE (microns)	<5	5/10	11/25	26/50	51/100	100/>					
ALLOWABLE	No Silt	7500	1250	312	50	0					
QTY	P/N										
1	220165-1 S/N 001	"	1205	430	179	21	0				
			1 metallic @ 30								
			1 metallic @ 35								
			2 metallic @ 50								
			3 metallic @ 60								
			1 metallic @ 65								
	Per 100ml										
	Allowed	No Silt	600	100	25	4	0				1.0g
1	220165-1 S/N 001	"	96	34	14	2	0				0.2g

All actual data reported per 1250/100 mL

INSPECTOR: [signature] DATE: 8-2-02

QC 106 / 4/99

Appendix 4

XRF Analysis – Metallic Particle Element Determination

(RSI Materials Engineering GDATP Report 061902)

RSI Materials Engineering

605 N. 13th St.
Omaha, NE. 68102

(402) 827-9328
(402) 827-9329 FAX

www.railsciences.com

June 19, 2002

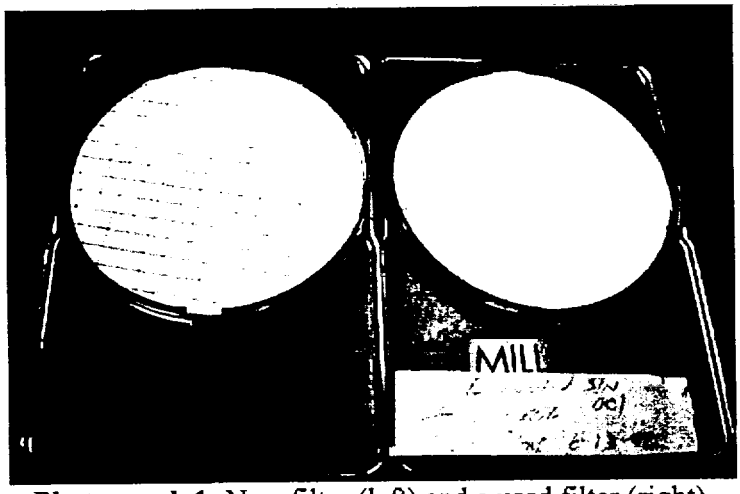
To: Chad Dustin
General Dynamics
Armament and Technical Products
Lincoln Operations
4300 Industrial Ave.
Lincoln, NE 68504

From: John D. Makinson, Ph.D., P.E.
RSI Materials Engineering
605 N 13th Street
Omaha, NE 68102

Re: Non-destructive XRF evaluation of used filter paper.

Background

Three used filter papers were received June 18, 2002 for X-ray Fluorescence (XRF) analysis to determine if any metals were contained in these used filters. A new, un-used filter paper was also analyzed to eliminate consideration of metals that normally exist in the filter paper itself. The new and one of the used filters are shown in Photograph 1.



Photograph 1: New filter (left) and a used filter (right).

Examination and Results

Each sample was measured by XRF that contained a rhodium x-ray source operating at 20 kV and 0.20 mA. Elements higher than sodium on the periodic table will be detected by this method. The resulting XRF spectrum of sample labeled "1st 1250 ml After Vibe" is shown in Figure 1. The new filter contained no detectable levels of elements higher than sodium, therefore, all elements detected in the used filter papers were that of the embedded particles. No elements were detected above background on the other two used filter papers, "1st 1000 ml Filter Forward Flush" and "1st 1000 ml Filter Back Flush".

Elements of iron, nickel, chrome, were detected in the filter paper "1st 1250 ml After Vibe" The source of these elements in this filter paper was most likely from an austenitic stainless steel. A very low copper peak is noted in Figure 1. It is possible that the filter paper contained some copper, however, the intensity is too low to make a positive confirmation. No aluminum was detected in these filter papers.

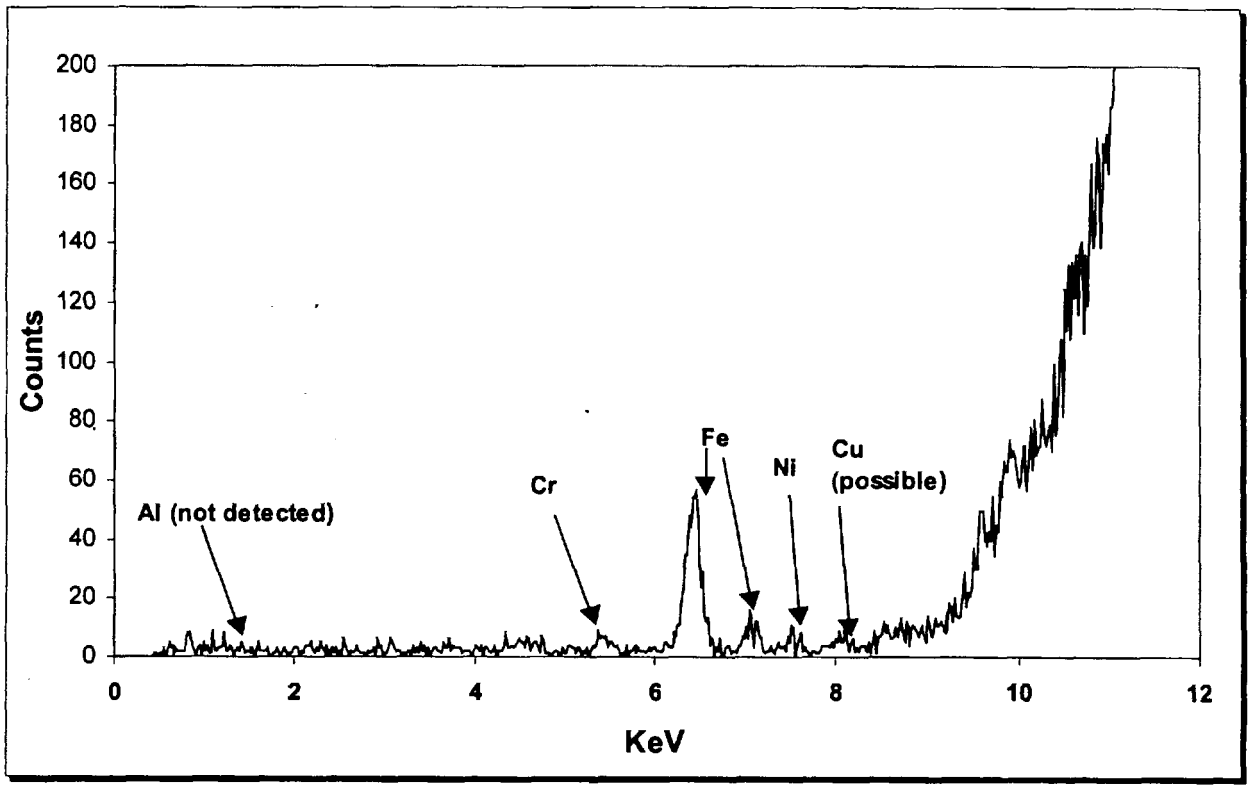


Figure 1: XRF spectrum of the used filter paper "1st 1250 ml After Vibe".

Conclusion

The used filter paper contained iron, chrome, nickel, and possibly copper. The most likely source of the elements iron, chrome, and nickel is a grade of austenitic stainless steel.

Appendix 5

SS/L Letter of Approval for Cleanliness Verification Results

(E-mail from Robert Wolf of SS/L to Bruce Sigrist of GDATP, 8/14/02)

19862(I)

Bruce Sigrist

From: Robert Wolf (SubContracts) [wolf.robert@ssd.loral.com]
Sent: Wednesday, August 14, 2002 4:47 PM
To: Bruce Sigrist
Cc: Con Murray; Jen Lee
Subject: Xe and Pressurant tanks cleanliness verification results

Dear Bruce,

SS/L has reviewed the cleanliness verification results provided by Lincoln
from the 82 liter Xe tank qualification test. After reviewing the data, SS/L has made the following conclusions.

1. SS/L accepted the latest cleanliness verification results after the 82 liter Xe tank was vibrated at the acceptance test level. SS/L will modify the cleanliness requirements in the performance specifications for Xe and He tanks (This covers for 65 Liter and 82 Liter tanks). No additional tests are needed for 65 liter pressurant tanks, SS/L will consider that 65 liter tanks meet our requirements based on the results from 82 liter tank.

2. Lincoln Composites should proceed to complete the 82 liter Xe tank qualification test at its earliest schedule, i.e.., to burst the tank at required level.

3. In parallel, Lincoln Composites should proceed to complete manufacturing two 82 liter flight tanks for earliest delivery.

. Lincoln Composites should start cleaning two 65 liter tanks for delivery. These two tanks have been put on hold pending the cleanliness verification results. SS/L needs these two tanks within 2 weeks.

Please let us know if you have any questions or comments to the above.

Regards,

R. Wolf

Appendix 6

GDATP FRR 4858

Failure & Rejection Report

Lincoln Operations

FRR No.: **4858**

Part Number:	220165-1	***Inspector:***	MILKE	***Open Date:***	05/30/02
Part Name:	PV 13" C/AL CYL 5000 CI XE			***Part S/N:***	001
Part Location:	Penetrant Inspection			***Part L/N:***	
M&IR No.:		***Sequence:***	RECEIVING	***Accepted:***	0
Cost Center:	19862	***Classification:***	Major	***Rejected:***	1
T.W.O.:		***CAR:***	NA		
P.O.:	14526	***Vendor:***	WYLE LABORATORIES		
RR No.:	12343	***Scrap Tkt.:***		***Return No.:***	

Reason For Rejection:

ITEM #1) The pressure vessel was received from Wyle Laboratories with damage present on the blank boss. The blank boss exhibits areas of smeared metal and deformation over the entire surface of the stem.
Note: A preliminary penetrant inspection is inconclusive to identifying defects due to the smeared metal.

Disposition:

Rework the blank boss by taking the following actions:
1. Rework the blank boss to remove the extruded material, chamfer the outside corner and drill a hole in the center of the blank boss stub outer face per the attached sketch.
2. Fabricate a cup per the attached sketch.
3. Install the cup over the boss per the attached Rework Procedure..
4. Return PV to test lab top continue the test.

Engineer:	GLAESEMANN	***Date:***	06/04/02
Design Eng:	KHAWAND	***Date:***	6/4/02
QA:	HLADKY	***Date:***	06/04/02
Purchasing:	NIEMEYER	***Date:***	05/31/02

Production ID: _____ ***Date:*** _____

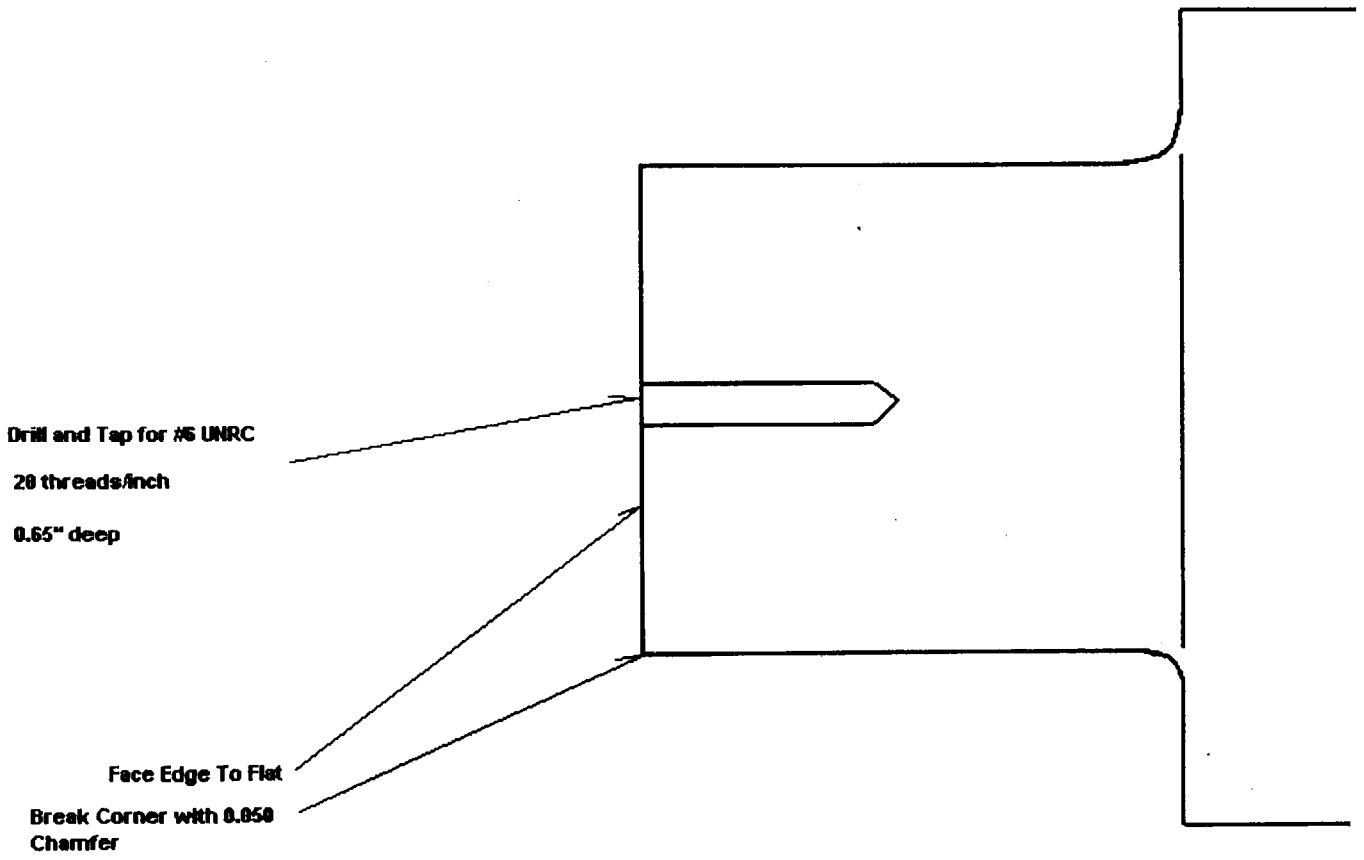
Closed = QC Stamp: _____ ***Date:*** _____

PROCEDURE FOR BONDING CUP TO BLANK BOSS FOR 82L PV PART NUMBER 220165-1, SERIAL NO 001

1. Remove Pressure Vessel from container and place on clean working area. Secure vessel from rolling off table while performing the cup bonding operation. Remove the cup from the blank boss. Set the screw aside for re-installation.
2. Using a clean wiping cloth wipe the blank boss clean using clean acetone from a pour can.
3. Using 80 grit aluminum oxide sand paper, sand the inside cylinder surface of the cup.
4. Using 80 grit aluminum oxide sand paper, sand the outside cylinder surface of the blank boss.
5. Using a clean wiping cloth wipe the interior of the stainless steel cup clean using clean acetone from a pour can. Change to a new cloth frequently. Continue wiping until the cloth remains clean.
6. Using a clean wiping cloth wipe the blank boss clean using clean acetone from a pour can. Change to a new cloth frequently. Continue wiping until the cloth remains clean.
7. Obtain a 100 gram batch of LRF 145. Record Batch No.: _____
8. Apply an even layer of LRF 145 onto the 1.19" diameter cylinder of the blank boss end using a 3/8" acid brush.
9. Install the cup onto the blank boss. Push on until it seats. Reinstall the 8-32 screw.
10. Wipe off any excess LRF 145 that has been squeezed out of the cup. before it sets up.
11. Allow the LRF 0145 to cure a minimum of 120 minutes at room temperature before handling. Record start date and time; stop date and time below.

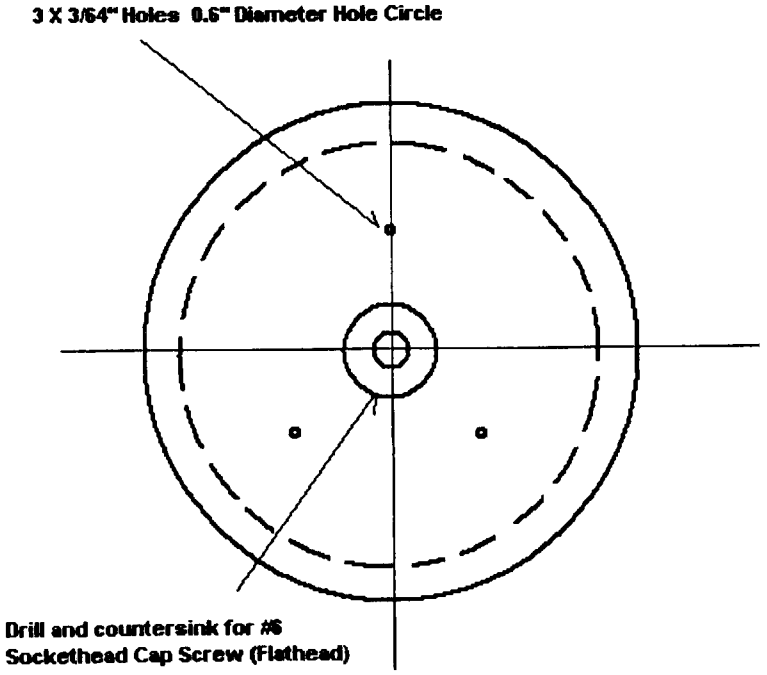
    Cure Start time/date: _____ Cure Stop time/date
12. Place vessel in container and return to stock room for shipment.

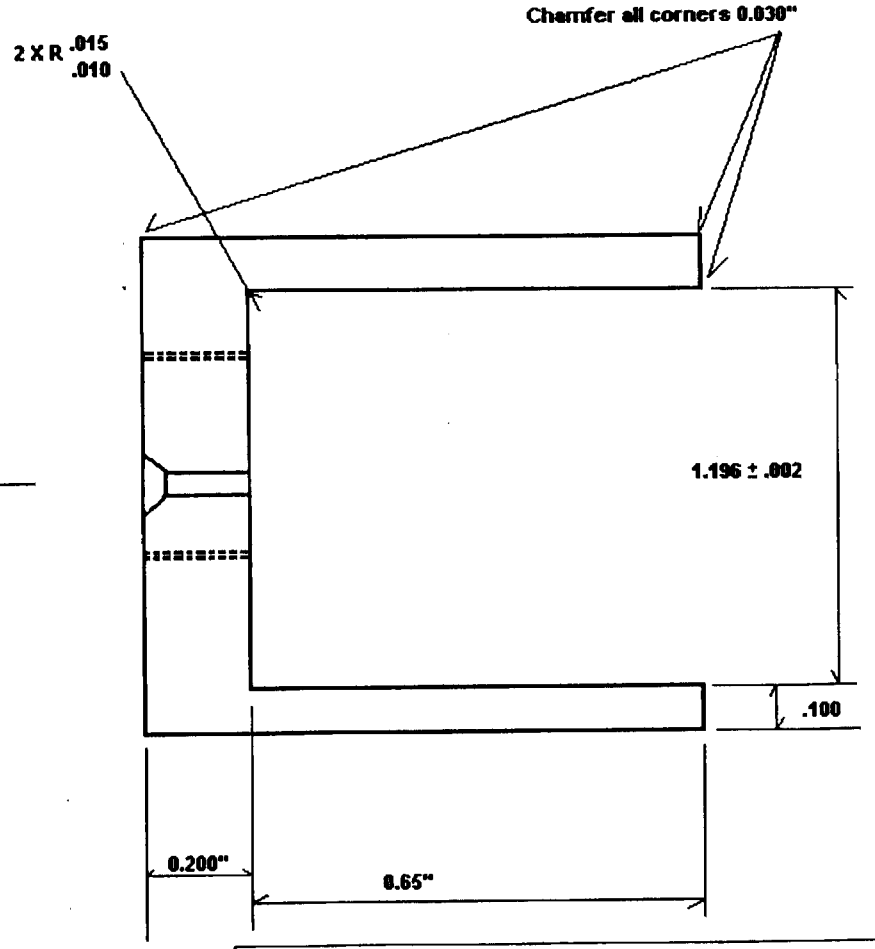
    Production Operator _____ Date _____



Blank Boss Machining

Lincoln Composites
Jacob Moseman
5/31/02
page 1/1





All Dimensions in Inches
Break All Corners
Unless Otherwise Stated, Dimensions to Nearest 0.010"

Blank Boss Cap (To Be Fit On After Machining)

Lincoln Composites
Jake Moseman 5/31/02
Page 1/1

Appendix 7

Table of All Pressurization Cycles Incurred during Acceptance and Qualification Testing

Appendix 7, Table of All Pressurization Incurred During Acceptance and Qualification Testing

Pressure Range (psig)	Acceptance Proof	Acceptance He Leak Test	Qualification Pressure Cycling [1]	Qualification He Leak Test	Qualification Dynamics Testing	Post-dynamics He Leak Test	TOTAL
0-2700-0	0	1	46	1	10	1	59
0-2970-0	0	0	8	0	0		8
0-3375-0	1	0	7	0	0		8
2100-2700-2100	0	0	3307	0	0		3307
2100-2400-2100	0	0	3307	0	0		3307

[1] GDATP Lincoln Operations originally intended to pressurize to MEOP 43 times in anticipation of cycles to be added during Dynamics testing. Two cycles were added due to system shutdown during diurnal cycling, and one cycle was added to obtain overall length and pressurized volume.

Appendix 8

Vibration Test Report

(Wyle Laboratories Report Number 47039)

wyle laboratories

TEST REPORT

REPORT NO.:	47039
OUR JOB NO.:	D47039
CONTRACT:	N. A.
YOUR P.O. NO.:	14526

Lincoln Composites
4300 Industrial Avenue
Lincoln, NE 68504

287 PAGE REPORT

11 September 2002

REPORT

ON QUALIFICATION

SINUSOIDAL AND RANDOM VIBRATION TESTS

OF ONE

XENON STORAGE TANK ASSEMBLY

PART NUMBER 220165-1 SERIAL NUMBER 001

FOR

LINCOLN COMPOSITES
A Division of TECHNICAL PRODUCTS GROUP, Inc.

STATE OF CALIFORNIA
COUNTY OF LOS ANGELES } SS.

R. SMITH, MNGR EL SEGUNDO DYNAMICS, being duly sworn, deposes and says: That the information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

SUBSCRIBED and sworn to before me this 10th day of SEP, 20 02

PRAIRIE WITKAMP
Commission # 1236213
Notary Public - California
Los Angeles County
My Comm. Expires Oct 2, 2003

0906 KCF

DEPARTMENT Dynamics

TEST ENGINEER M. Klicka

TEST WITNESS

(Not Applicable)

DCAS-QAR VERIFICATION

QUALITY ASSURANCE G. Montgomery

W-781-REV 9/00

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1.0 PURPOSE
2.0 REFERENCES
3.0 TEST CONDITIONS AND EQUIPMENT
3.1 Ambient Conditions
3.2 Instrumentation and Equipment
3.3 Test Tolerances
4.0 SPECIMEN DISPOSITION
5.0 SUMMARY

EXHIBIT A NOTICE OF DEVIATION NO. 1
EXHIBIT B NOTICE OF DEVIATION NO. 2

PHOTOGRAPHS

ATTACHMENT DYN-A RANDOM VIBRATION (INITIAL)
ATTACHMENT DYN-B SINUSOIDAL VIBRATION (INITIAL)
ATTACHMENT DYN-C RANDOM VIBRATION (AFTER RE-WORK)
ATTACHMENT DYN-D SINUSOIDAL VIBRATION (AFTER RE-WORK)
ATTACHMENT DYN-E PRESSURIZATIONS
ATTACHMENT DYN-F RANDOM VIBRATION (X AXIS ACCEPTANCE)

1.0 PURPOSE

The purpose of this report is to present the results obtained during Qualification Sinusoidal Vibration, Random Vibration and Pressure Dump Tests of one 13 Inch Xenon Cylinder Assembly, P/N 220165-1, S/N 001.

2.0 REFERENCES

2.1 Lincoln Composites Purchase Order No. 51644.

2.2 Lincoln Composites Qualification Test Procedure, QCP No. 06-766, Revision NC, as red-lined dated 21 May 2002.

2.3 MIL-PRF-27401C, Propellant, Pressurizing Agent, Nitrogen.

2.4 MIL-PRF-27407A(1), Propellant, Pressurizing Agent, Helium.

2.5 ANSI/NCSL Z540-1-1994, Calibration – Calibration Laboratories and Measurement and Test Equipment - General Requirements which supersedes MIL-STD-45662A, Calibration Systems Requirements, 10 June 1980.

2.6 Wyle Laboratories Western Test and Engineering Operation El Segundo Facility Quality Assurance Program Manual for ISO 9002 Compliance, Revision 01, dated 15 January 2002.

3.0 TEST CONDITIONS AND EQUIPMENT

3.1 Ambient Conditions

Unless otherwise specified all tests were performed at a barometric pressure of between 710 and 815 mm (28 to 32 inches) of mercury absolute, a temperature between +55 and 90° F and uncontrolled relative humidity.

3.2 Instrumentation and Equipment

3.2.1 Measuring and test equipment, utilized in the performance of this contract, were calibrated in accordance with ANSI/NCSL Z540-1-1994 and ISO 10.01 9/8/00 by the Wyle Laboratories Standards Laboratory, or a commercial facility, utilizing reference standards (or interim standards) whose calibrations have been certified as being traceable to the National Institute of Standards and Technology. All reference standards, utilized in the above calibration system, are supported by certificates, reports, or data sheets attesting to the date, accuracy, and conditions under which the results furnished were obtained. All subordinate standards and measuring and test equipment are supported by like data when such information is essential to achieve the accuracy control required by the subject contract.

3.2.2 Wyle Laboratories attests that the commercial sources providing calibration services on the above referenced equipment, other than the National Institute of Standards and Technology, are in fact capable of performing the required services to the satisfaction of the Wyle Laboratories Quality Control Department. Certificates an reports of all calibrations performed are retained by Wyle Laboratories and are available for inspection, upon request, by customer representatives.

3.2.3 The test equipment utilized during this program is listed in each attachment.

3.3 **Test Tolerances**

3.3.1 Random Vibration PSD: ±1.5 dB from 20 to 1000 Hz
±3.0 dB from 1000 to 2000 Hz

3.3.2 Sinusoidal Amplitude: ±10%

3.3.3 Sinusoidal Frequency: ±2% or ±1 Hz, whichever is greater

4.0 **SPECIMEN DISPOSITION**

At the conclusion of the Qualification Tests, the 13 Inch Xenon Cylinder Assembly was returned to Lincoln Composites for examination and evaluation.

5.0 **SUMMARY**

5.1 The 13 Inch Xenon Cylinder Assembly specimen S/N 001 was received each time without damage due to shipping and handling. Receiving Inspection records of each receipt are presented in Attachments DYN-A, DYN-C, DYN-E and DYN-F.

5.2 Initial receipt was on 20 May 2002. The specimen was installed in the fixture that rested on a lubricated slip table and was instrumented with response accelerometers R1XYZ, R2XYZ, R3XYZ and in-line R4Y as shown in Photographs 1 through 4 (Photograph 3 shows the fixed end and Photograph 4 shows the sliding end). The fixture was instrumented with two in-line control accelerometers C1 and C2. The specimen was filled with 312 lbs. of PF5060 and pressurized to 2700 psig. For initial testing, only single point control using C1 was used; C2 was for reference only. The specimen was subjected in the Y axis to -12 dB pre-test Random (32 seconds), full level Qualification Random (180 seconds), and -12 dB post-test Random (32 seconds), prior to full level Qualification Sinusoidal with the incorrect spectrum that was aborted at 84.5 Hz after 122 seconds. See Exhibit A, Notice of Deviation No. 1. The correct full level Qualification Sinusoidal spectrum was then applied, and the application was aborted at 37.8 Hz after 87 seconds. It was observed that the specimen free end had dislodged from the fixture. See Exhibit B, Notice of Deviation No. 2, and Photograph 5. After the tank was reinstalled, the -12 dB post-test Random (30 seconds) application was re-applied.

5.3 The initial Sinusoidal spectrum (NOD No. 1) was correct between 22.6 and 50 Hz. Therefore, after the specimen was reseated in the fixture, only the 50 to 100 Hz portion was applied. However, the Sinusoidal application was aborted at 84.22 Hz after 22 seconds. There was no apparent damage to the specimen or other installation anomaly observed. The control strategy was then changed to extremal of C1 and C2. The spectrum was then successfully applied to the specimen between 65 and 100 Hz (to include an overlap) for a duration of 19 seconds for one upsweep. Per Lincoln Composites cognizant personnel, Sinusoidal testing in the Y axis was considered complete given all previous testing. All sinusoidal vibration was applied at 2 octaves/minute. The Y axis test sequence was then completed per Reference 2.2, Paragraph 5.3 and Table 3, with a -12 dB post-sine Random Vibration application (30 seconds) using single point (C1) control. The axis configuration was changed to X, as shown in Photographs 6 through 8, and the same fill and pressure conditions were established. The -12 dB pre-test Random application was successfully applied using average control (of C1 and C2); however, only 63 seconds of the full level Qualification Random Vibration was applied. Instability

was observed and the test was aborted out of safety concerns based on the prior experience in the Y axis and a partial dislodge of the free end was observed (Photograph 9). The specimen was returned to Lincoln Composites for rework.

5.4 All data from initial testing is included in Attachments DYN-A (Random) and DYN-B (Sinusoidal) and include the spectral listings with the durations and control strategy used. Random vibration data is presented as 4 Hz resolution Power Spectral Density (PSD) plots of the control and response accelerometers. The spectral tolerances are superimposed onto each plot as a reference. Sinusoidal data is presented as log-log peak acceleration plots of the control and response accelerometers.

5.5 The specimen was received after re-work on 05 June 2002. The specimen was similarly re-installed into the fixturing to restart the X axis test sequence per Reference 2.2, Paragraph 5.3 and Table 3 as shown in Photographs 10 through 15. The specimen was filled with 312 lbs. of PF5060 and pressurized to 2700 psig. Extremal control was used. **The specimen was subjected in the X axis to -12 dB pre-test Random (30 seconds), notched (per Lincoln Composites) full level Qualification Random (180 seconds), -12 dB post-test Random (30 seconds), full level Qualification Sinusoidal, and -12 dB post-sine Random (26 seconds) without apparent damage.**

5.6 The specimen was sent out for cleaning and received on 07 June 2002 with a filter assembly attached. The specimen was installed into the fixturing for X axis acceptance testing as shown in Photographs 16 through 18, instrumented as before, and pressurized to 2750 psig with gaseous helium (GHe). **It was subjected to the 3.2 gRMS Acceptance Level spectrum per Reference 2.2, Paragraph 5.4.2.8 and Table 5 for 60 seconds without apparent damage.** See Attachments DYN-C (Random) and DYN-D (Sinusoidal) for the post-rework test results.

5.7 A total of four pressurizations (with no vibration testing) were conducted per Lincoln Composites direction. Attachment DYN-E lists the date, temperatures and hold times. See also Photographs 16 through 23.

5.8 The specimen was resubmitted on 26 July 2002 for a repeat Acceptance Test in the X axis per Reference 2.2, Paragraph 5.4.2.8 and Table 5, as described in the above paragraph 5.6 with GHe. See Photographs 24 through 26. **The specimen completed the X axis Acceptance Retest without apparent damage.** See Attachment DYN-F.

5.9 A summary of all pressurizations conducted:

Date	Medium	Pressure
05-21-02	PF5060	312 lbs. at 2700 psig
05-23-02	PF5060	312 lbs. at 2700 psig
06-05-02	PF5060	312 lbs. at 2700 psig
06-10-02	GHe	2750 psig
06-25-02	GHe	2750 psig
07-03-02	GHe	2750 psig
07-16-02	GHe	2750 psig
07-23-02	GHe	2750 psig
07-29-02	GHe	2750 psig

wyle laboratories

Wyle Job No.:	47039
NOD No.:	1
PO No.:	14526
Date:	5-22-02
Gov't Cont. No.:	N.A.

NOTICE OF DEVIATION

TO: Lincoln Composites	**ATTN:** Janet Neimeier	
PART NAME: 82L Tank	**PART NO.:** 220165-1	**SERIAL NO.:** 001
TEST: Sine Vibration	**SPECIFICATION NO.:** QCP 06-766	**PARAGRAPH NO.:** 5.3
CUSTOMER NOTIFICATION: George Khawand	**ON (Date):** 5-21-02	**VIA:** Verbal
NOTIFIED DCAS – QAR (name):	**ON (Date):**	**VIA:**

SPECIFICATION REQUIREMENTS: "5.3.1 c) Sinusoidal vibration shall be applied in the axial direction ... at levels specified [below]..."

5-22.6 Hz .25"SA
22.6-50Hz 13g
50-100Hz 5.2g "

DATE OF DEVIATION: 5-21-02

TYPE OF DEVIATION: Incorrect Input Spectrum

DESCRIPTION OF DEVIATION:

The tank was subjected to the following spectrum:

5-22.6 Hz .6389g [.25"SA @ 5Hz]
22.6-50 Hz 13g
100 Hz 5.2g

Sweep was aborted at 84.6 Hz (approximately 6.58g).

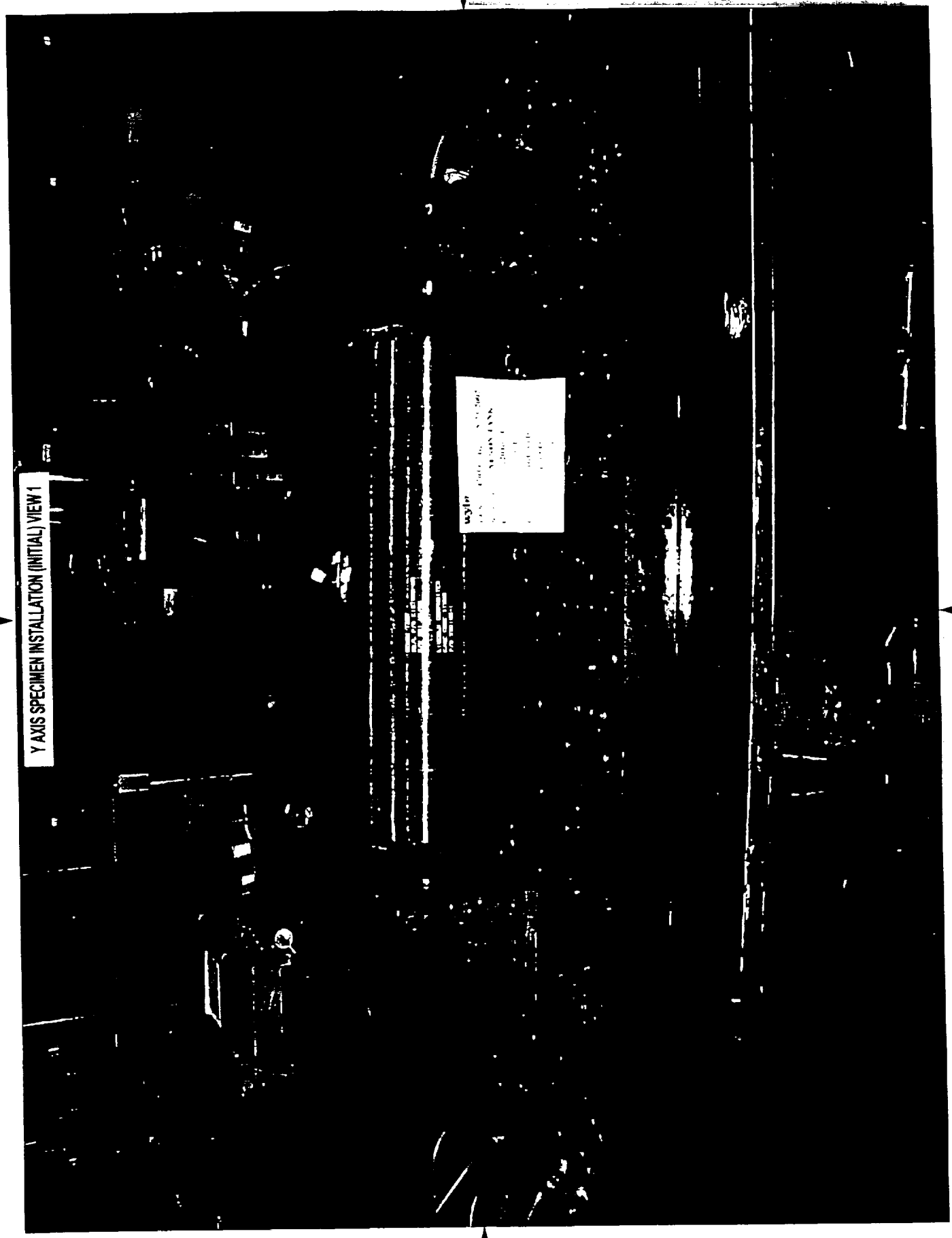
SPECIMEN DISPOSITION: Customer inspected the specimen and found no damage. Per customer, specimen continued with test using the correct spectrum.

COMMENTS: Customer was on-site, monitoring testing in real time and was made aware of the deviation as it was discovered.

DISTRIBUTION	CUSTOMER	WYLE
Original : Department Copies: Customer 1 Copy : Quality Control 1 Copy : Contracts Copies: DCAS-QAR	TEST WITNESS: George Khawand REPRESENTING: Lincoln Composites	TEST ENGINEER: DEPT. MANAGER: S.D. QUALITY ASSURANCE:

PHOTOGRAPH 1

Y AXIS SPECIMEN INSTALLATION (INITIAL) VIEW 1



wyle laboratories

Wyle Job No.:	47039
NOD No.:	2
PO No.:	14526
Date:	5-23-02
Gov't Cont. No.:	N.A.

NOTICE OF DEVIATION

TO: Lincoln Composites	**ATTN:** Janet Neimeier	
PART NAME: 82L Tank	**PART NO.:** 220165-1	**SERIAL NO.:** 001
TEST: Sine Vibration	**SPECIFICATION NO.:** QCP 06-766	**PARAGRAPH NO.:** 5.3
CUSTOMER NOTIFICATION: George Khawand	**ON (Date):** 5-22-02	**VIA:** Verbal
NOTIFIED DCAS – QAR (name):	**ON (Date):**	**VIA:**

SPECIFICATION REQUIREMENTS: "5.3.1 c) Sinusoidal vibration shall be applied in the axial direction ... at levels specified [below]..."

5-22.6 Hz .25"SA
22.6-50Hz 13g
50-100Hz 5.2g "

DATE OF DEVIATION: 5-22-02

TYPE OF DEVIATION: Test Abort

DESCRIPTION OF DEVIATION: During full level sine vibration the test was aborted at 37.8 Hz as the free end became dislodged from its bearing. After disassembly some material wear was noted near the base of the boss radius and boss end. Additional wear was noted at the boss bearing interface surface.

SPECIMEN DISPOSITION: On site customer witness reviewed specimen status and verbally communicated that the damage sustained was considered non-critical. Per customer direction Wyle personnel polished the boss bearing interface. The specimen continued with testing, per customer direction.

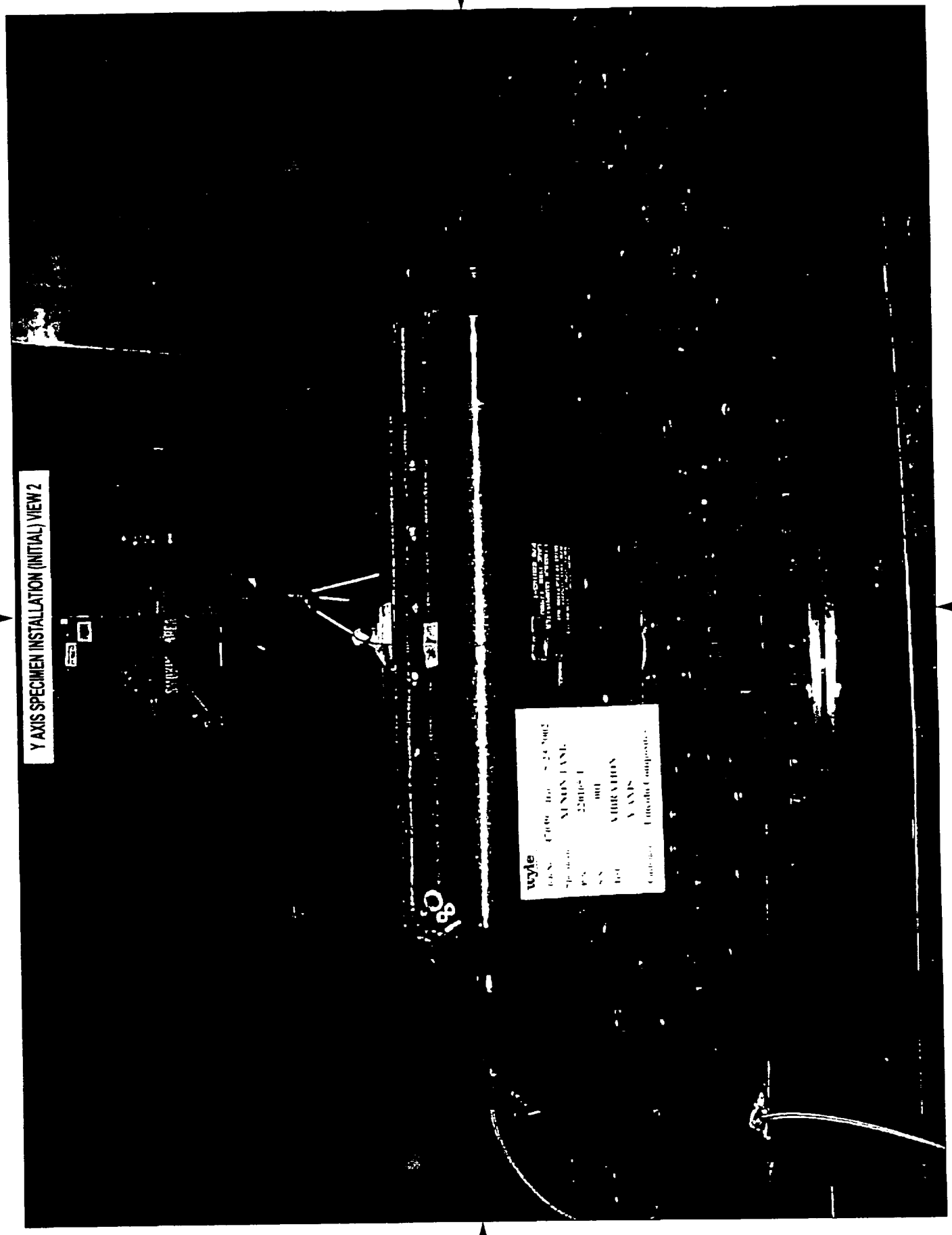
COMMENTS: Additional safety precautions will be taken during all remaining testing on the specimen.

DISTRIBUTION	CUSTOMER	WYLE
Original : Department Copies: Customer 1 Copy : Quality Control 1 Copy : Contracts Copies: DCAS-QAR	TEST WITNESS: Georges Khawand REPRESENTING: Lincoln Composites	TEST ENGINEER: DEPT. MANAGER: S.D. QUALITY ASSURANCE:

W-109 Rev. 4/99

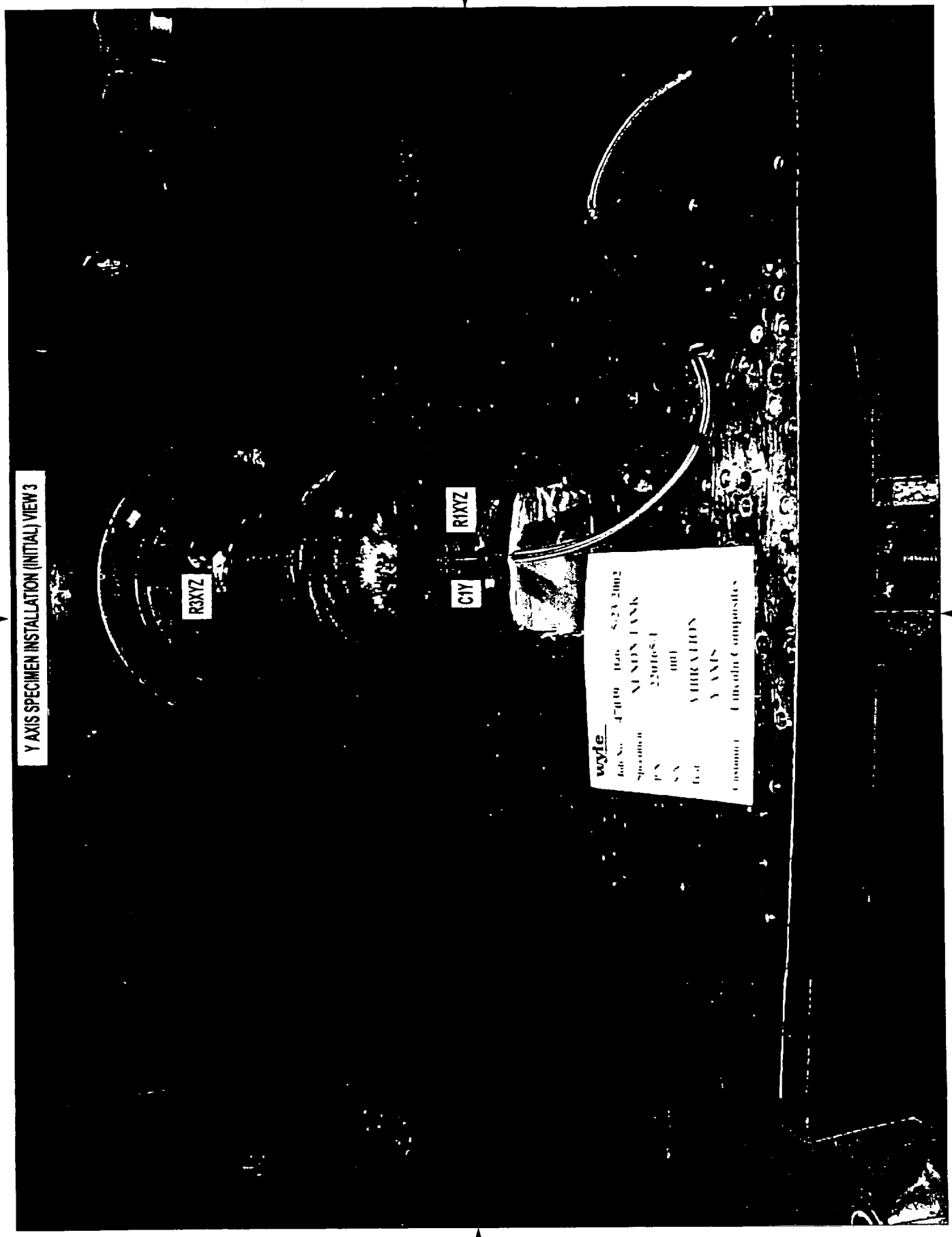
PHOTOGRAPH 2

Y AXIS SPECIMEN INSTALLATION (INITIAL) VIEW 2



PHOTOGRAPH 3

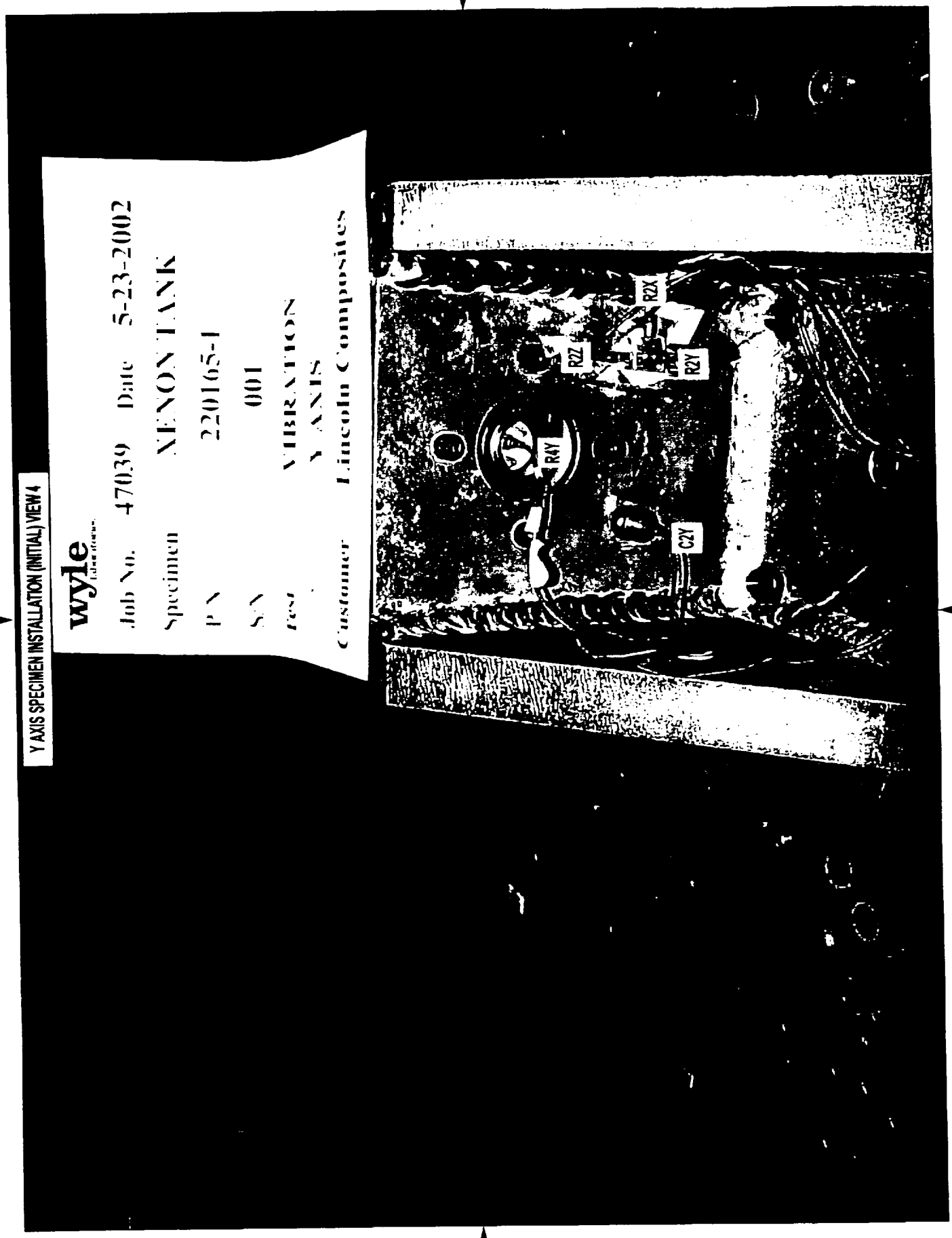
Y AXIS SPECIMEN INSTALLATION (INITIAL) VIEW 3



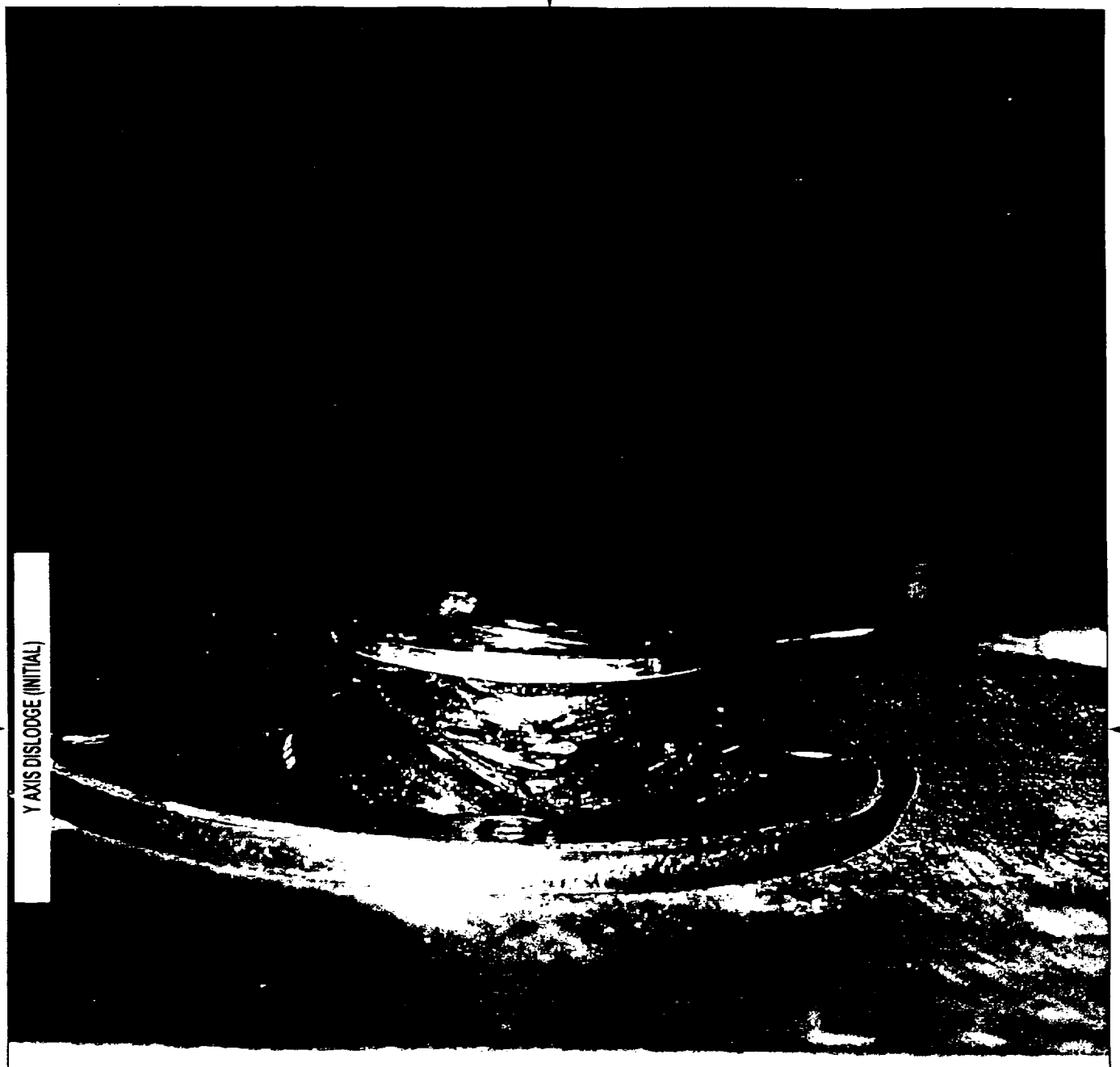
Y AXIS SPECIMEN INSTALLATION (INITIAL) VIEW 3

PHOTOGRAPH 4

Y AXIS SPECIMEN INSTALLATION (INITIAL) VIEW 4

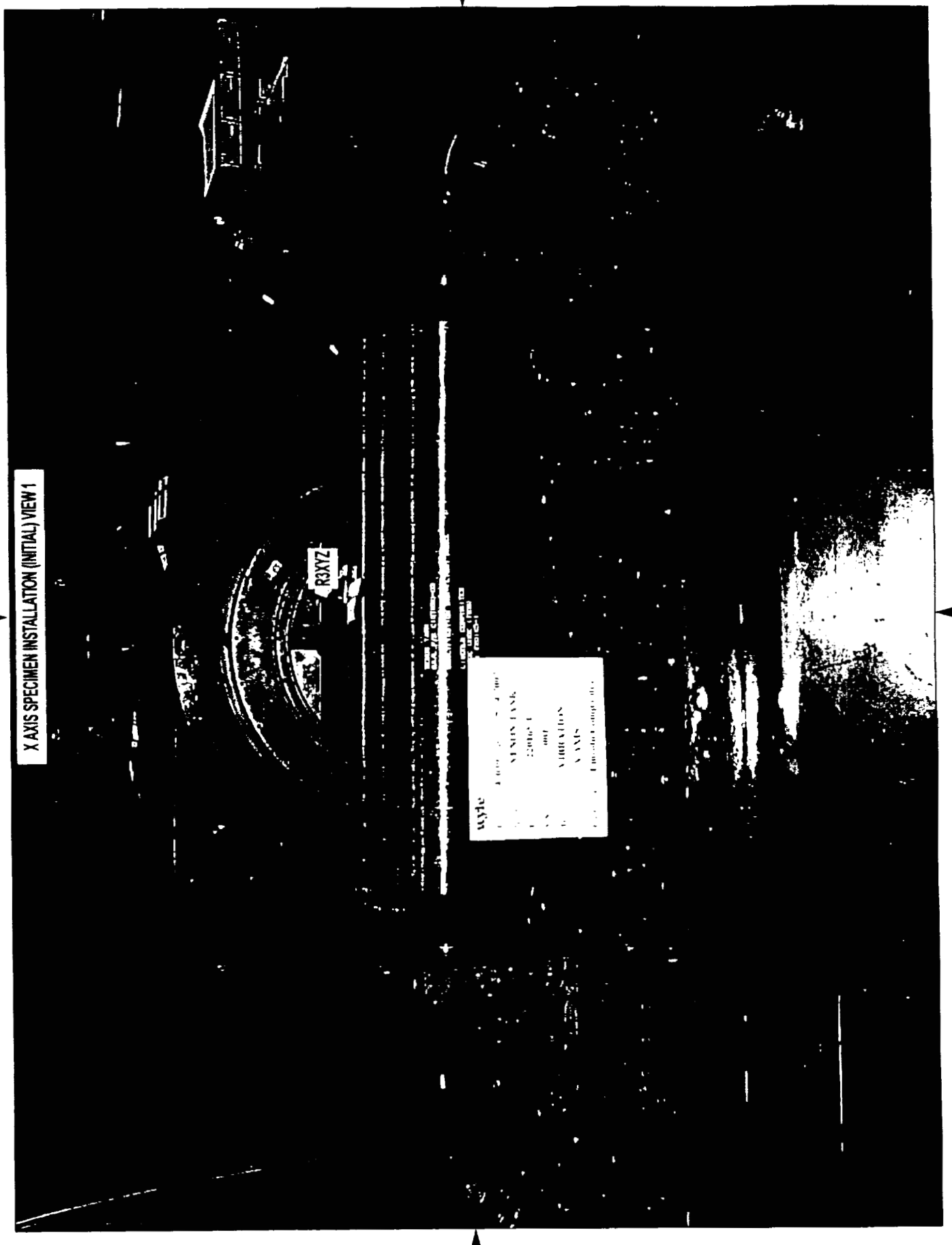


PHOTOGRAPH 5
Y AXIS DISLODGE (INITIAL)



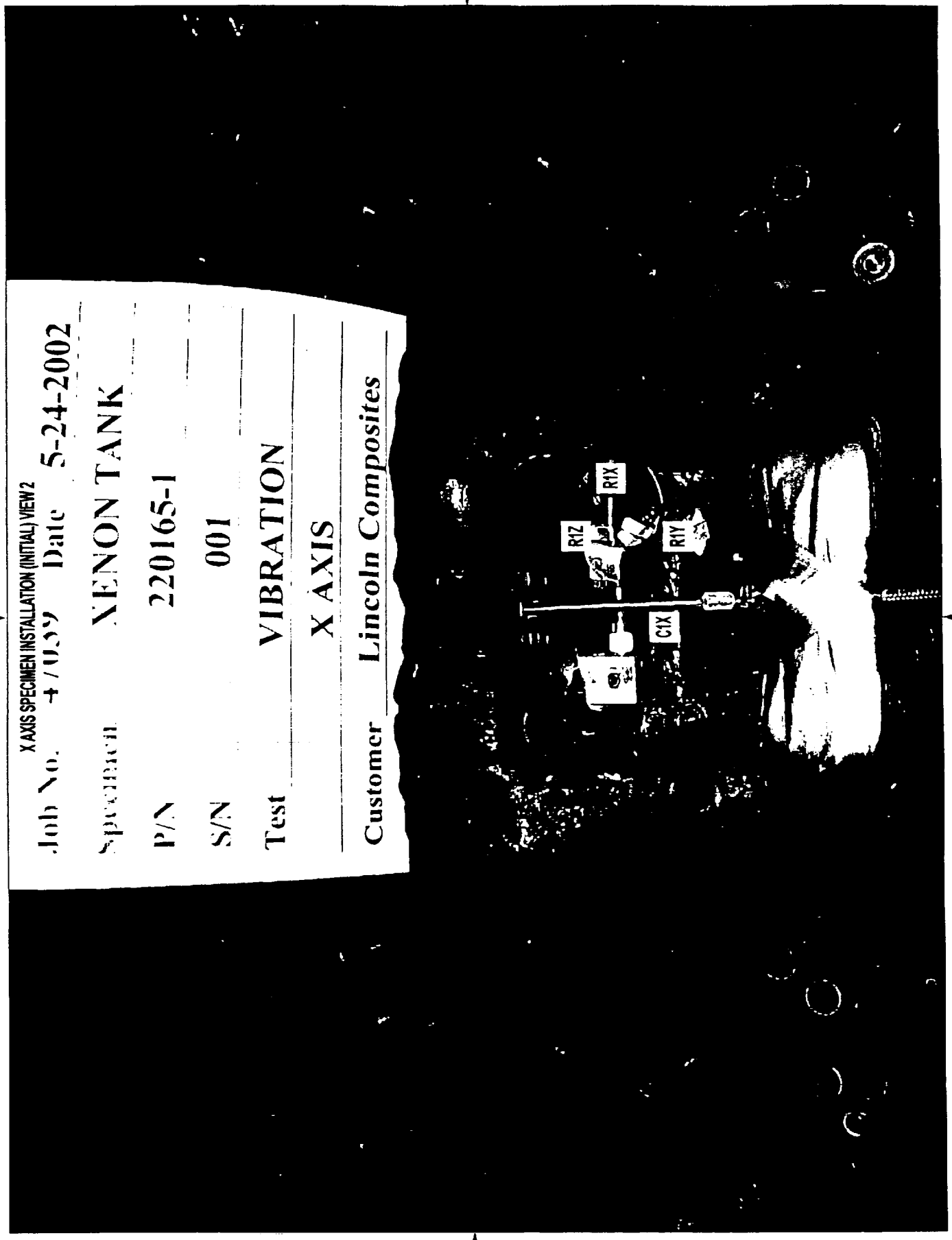
PHOTOGRAPH 6

X AXIS SPECIMEN INSTALLATION (INITIAL) VIEW 1



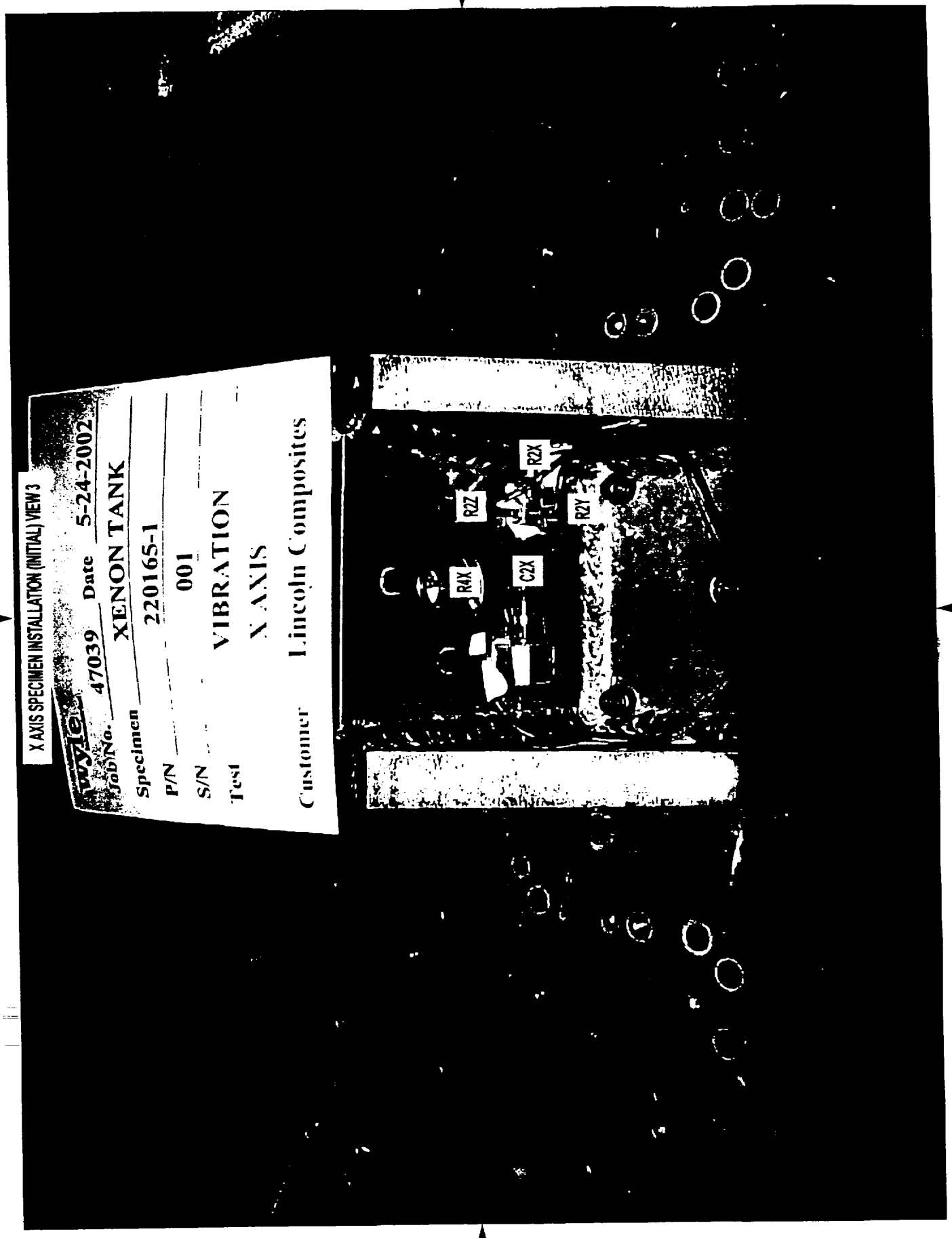
X AXIS SPECIMEN INSTALLATION (INITIAL) VIEW 1

PHOTOGRAPH 7
X AXIS SPECIMEN INSTALLATION (INITIAL) VIEW 2

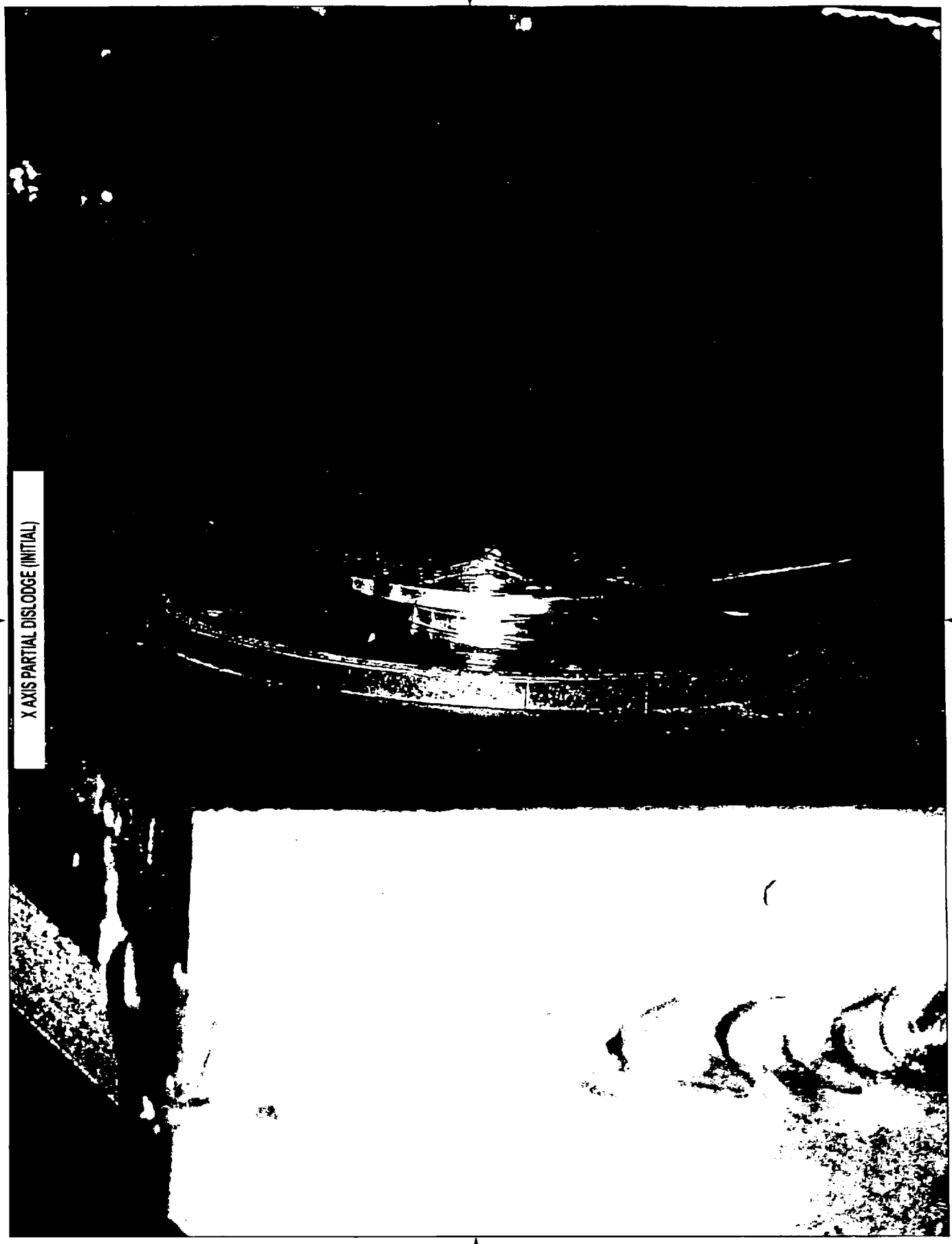


PHOTOGRAPH 8

X AXIS SPECIMEN INSTALLATION (INITIAL) VIEW 3

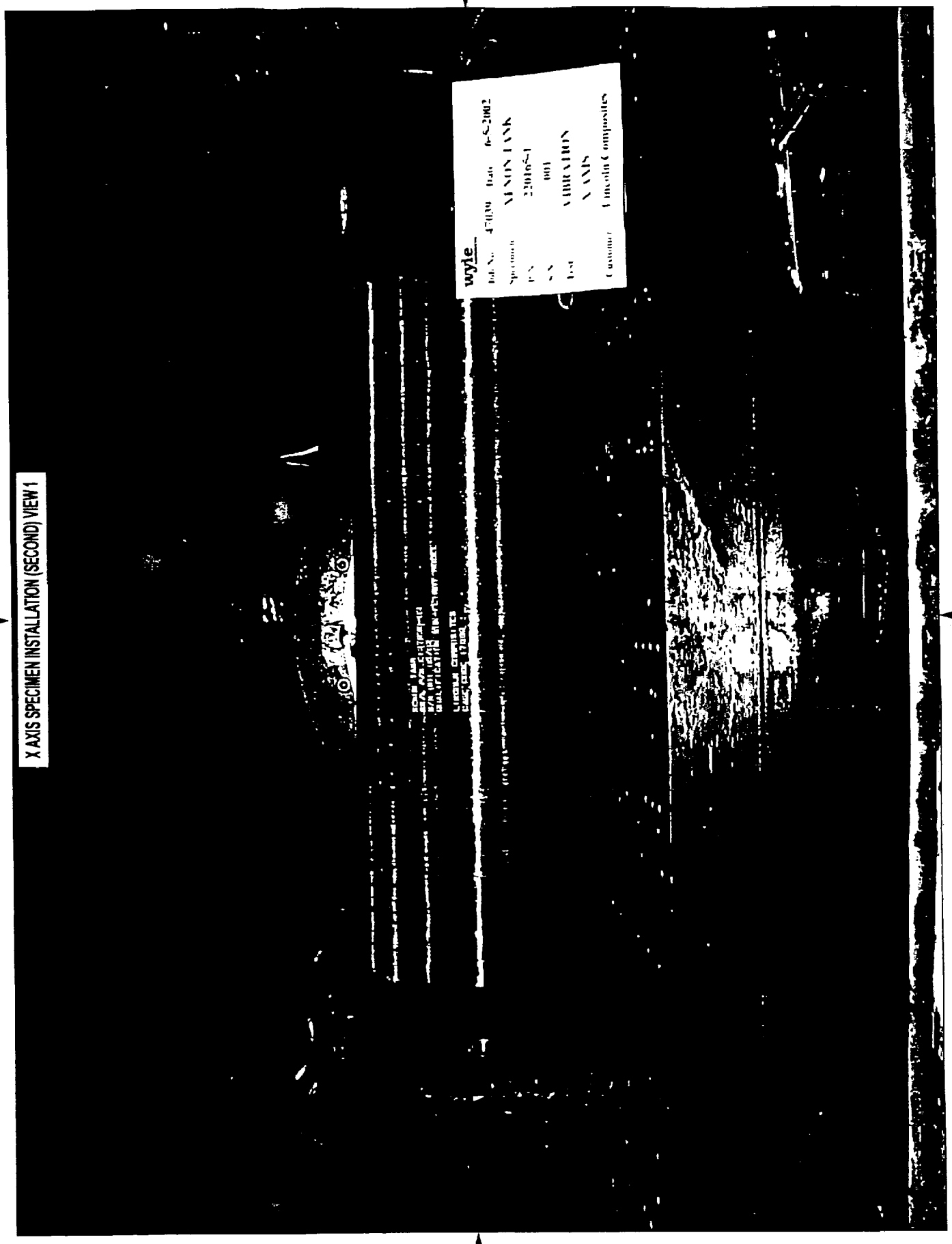


PHOTOGRAPH 9
X AXIS PARTIAL DISLODGE (INITIAL)



PHOTOGRAPH 10

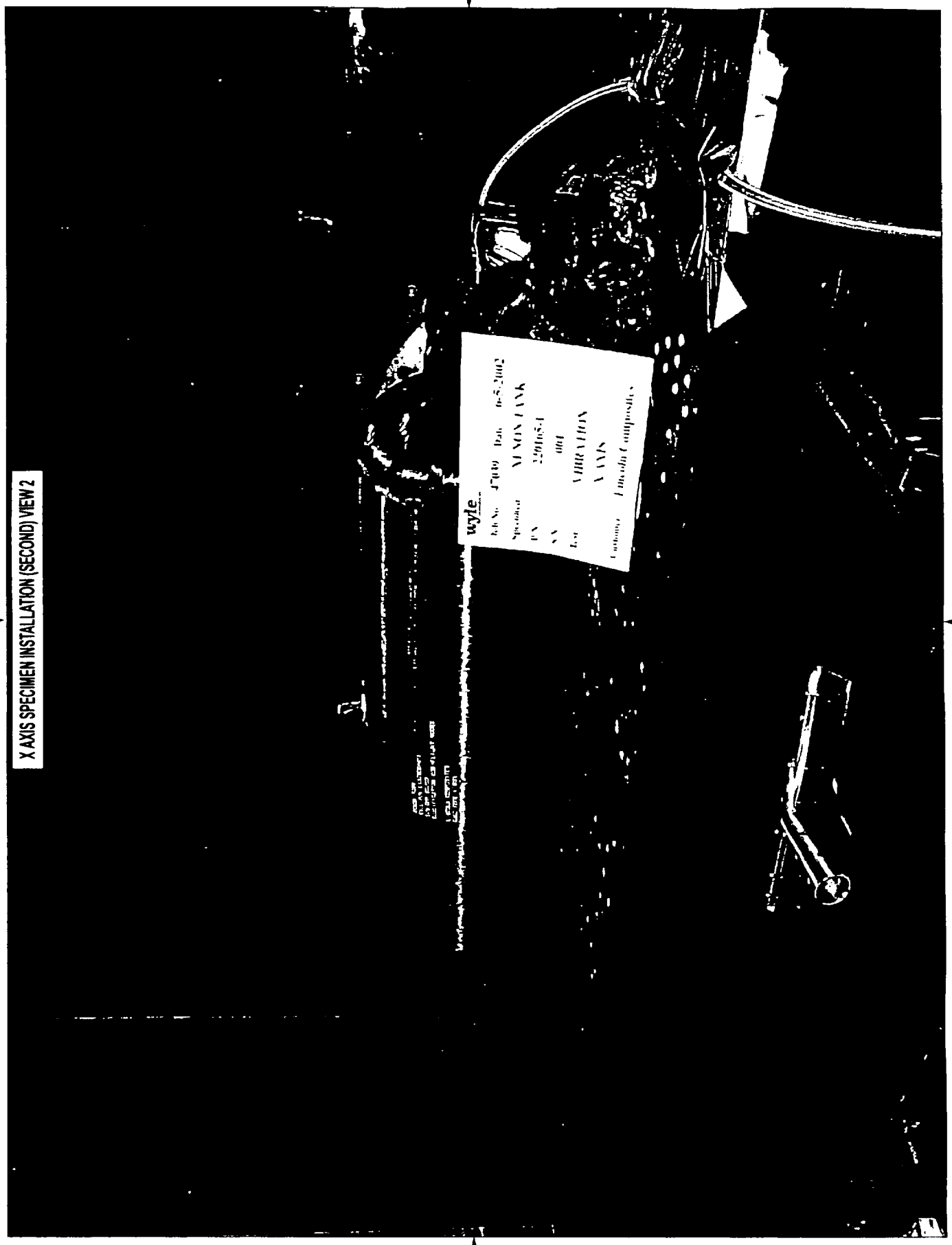
X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 1



X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 1

PHOTOGRAPH 11

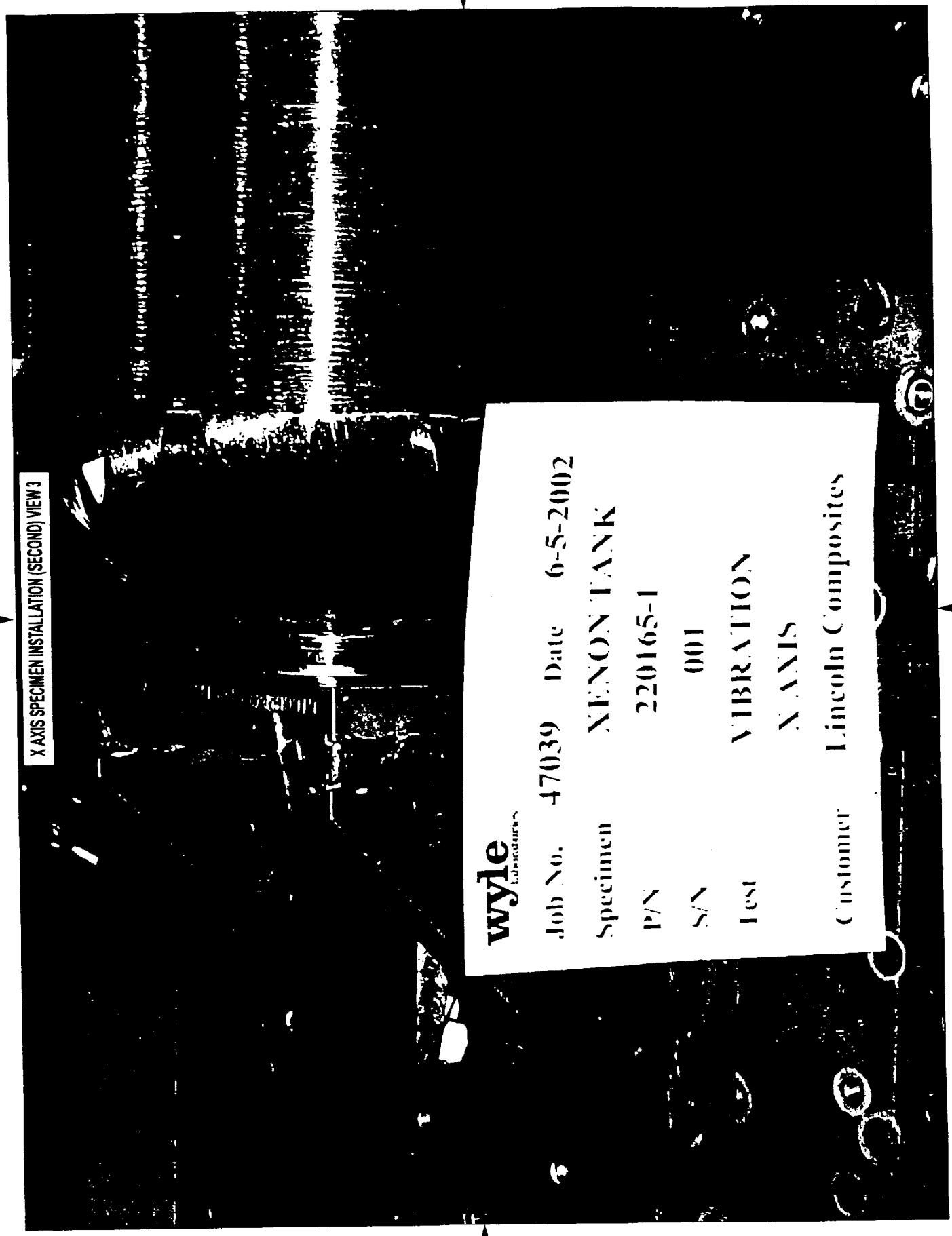
X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 2



X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 2

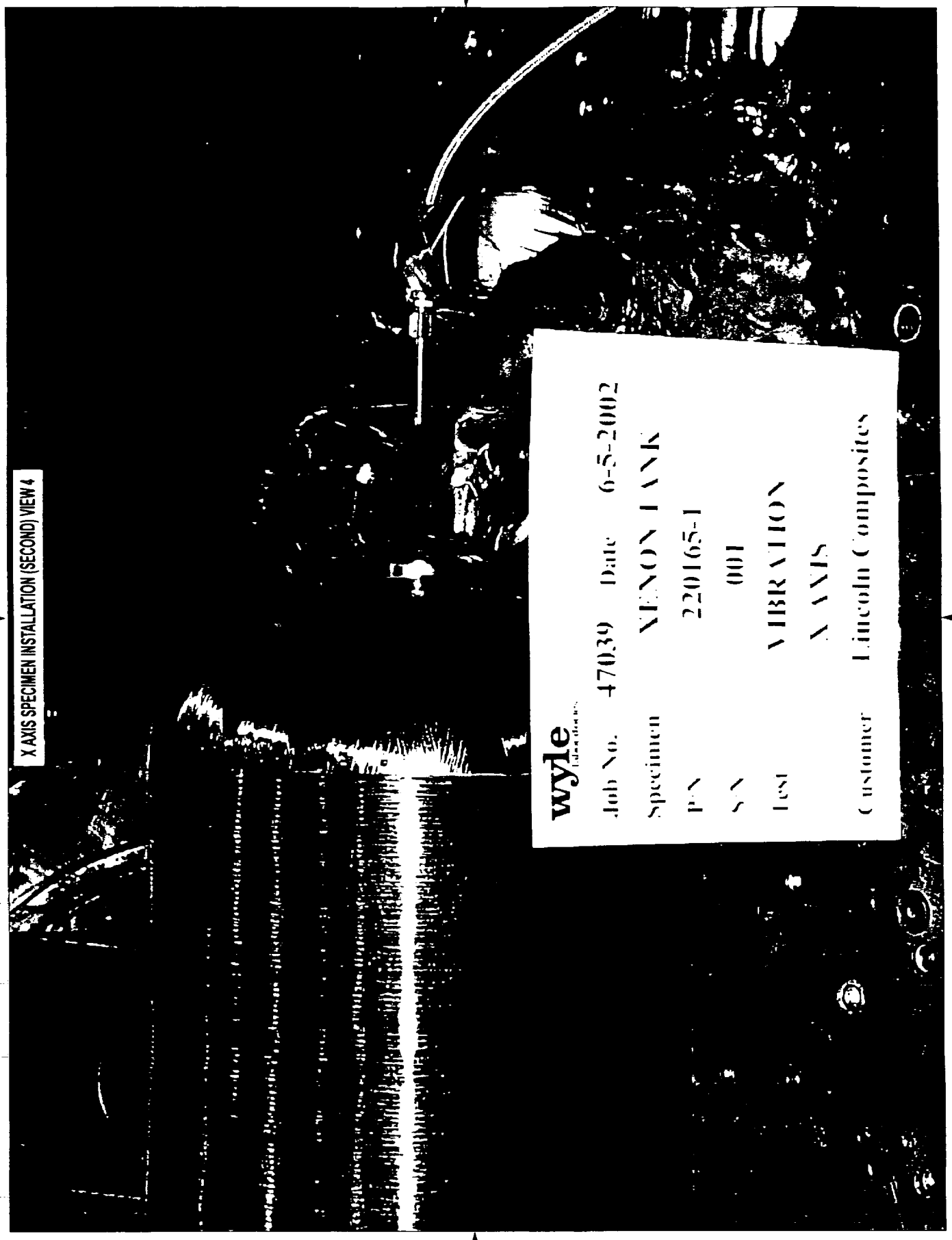
PHOTOGRAPH 12

X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 3



PHOTOGRAPH 13

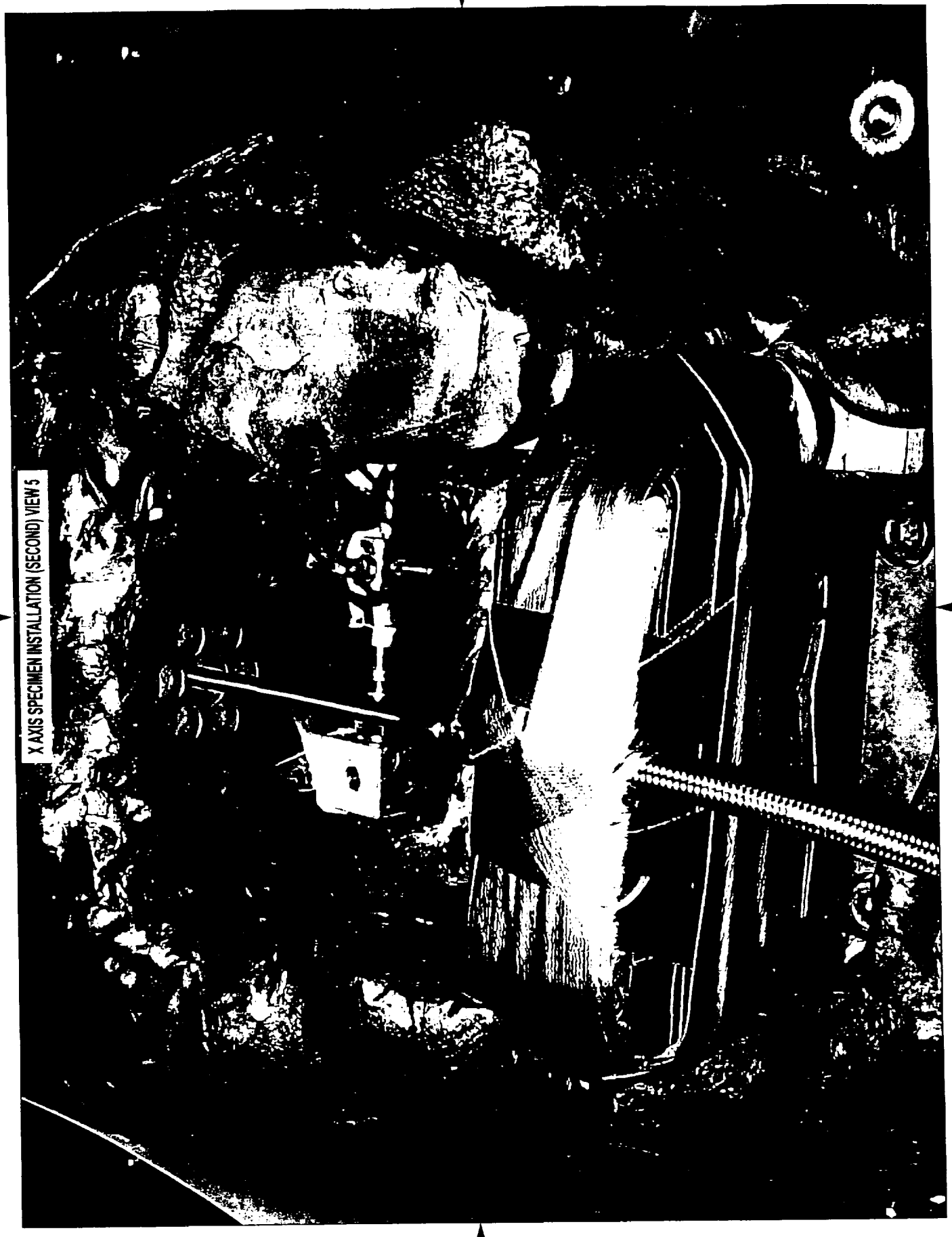
X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 4



X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 4

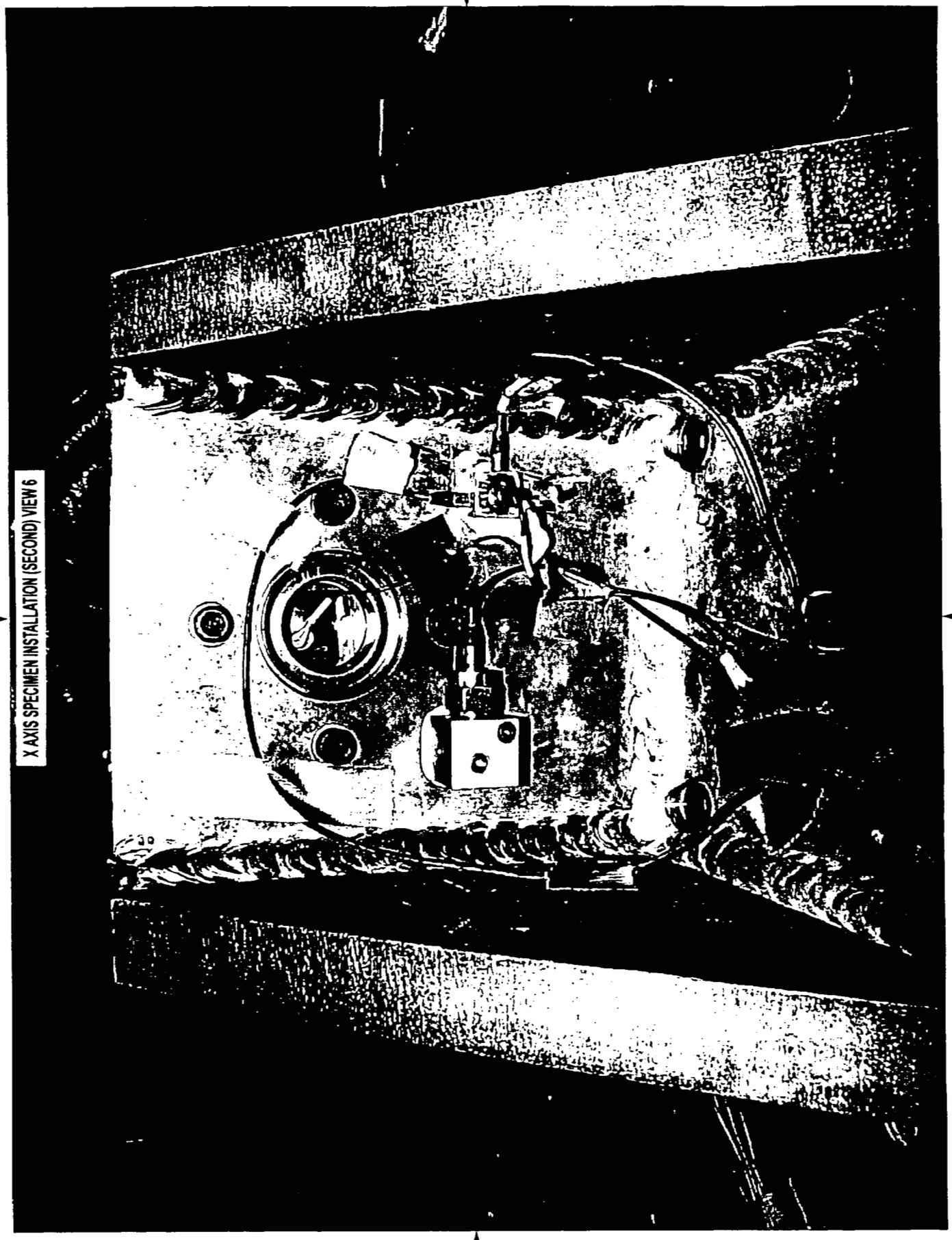
PHOTOGRAPH 14

X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 5



PHOTOGRAPH 15

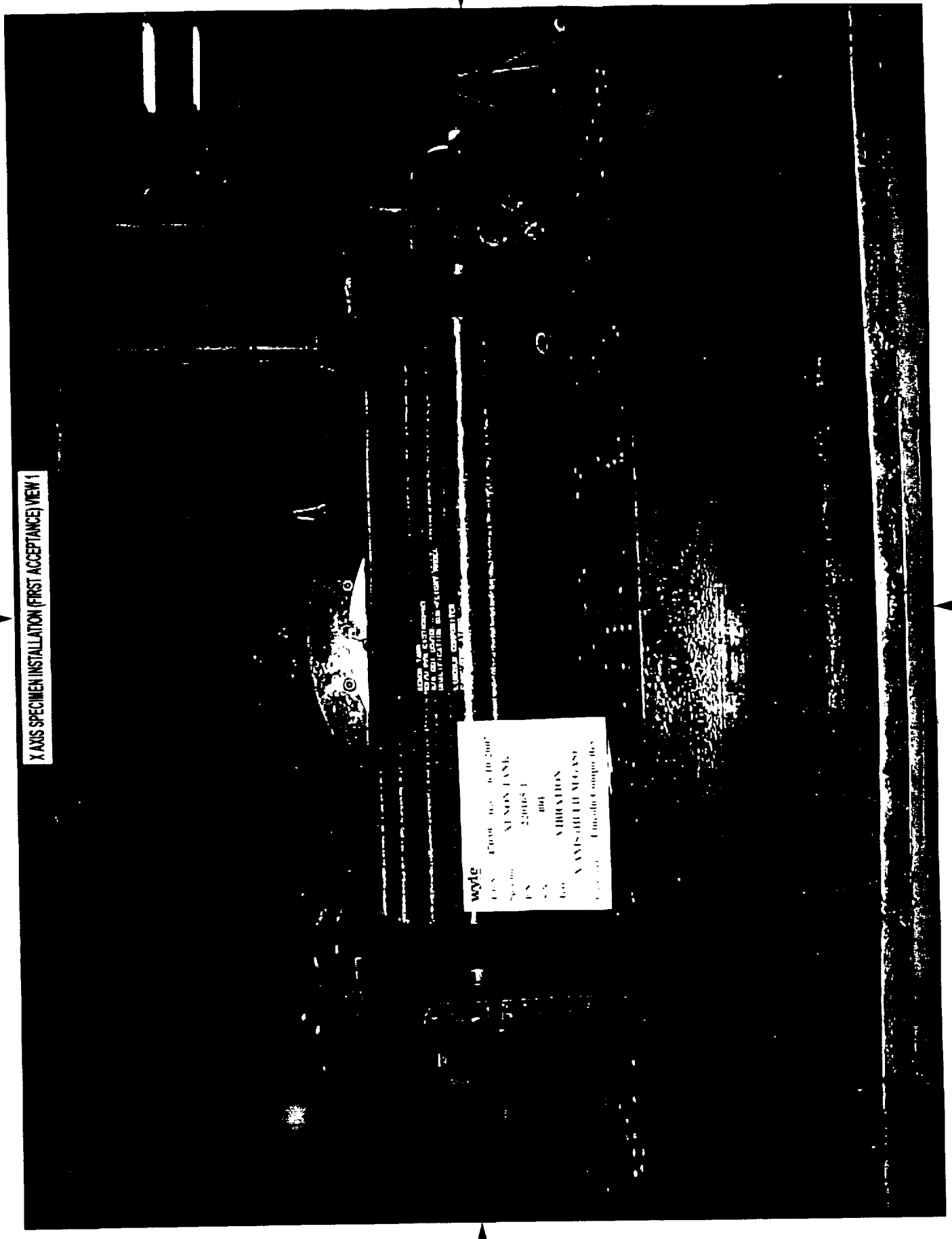
X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 6



X AXIS SPECIMEN INSTALLATION (SECOND) VIEW 6

PHOTOGRAPH 16

X AXIS SPECIMEN INSTALLATION (FIRST ACCEPTANCE) VIEW 1



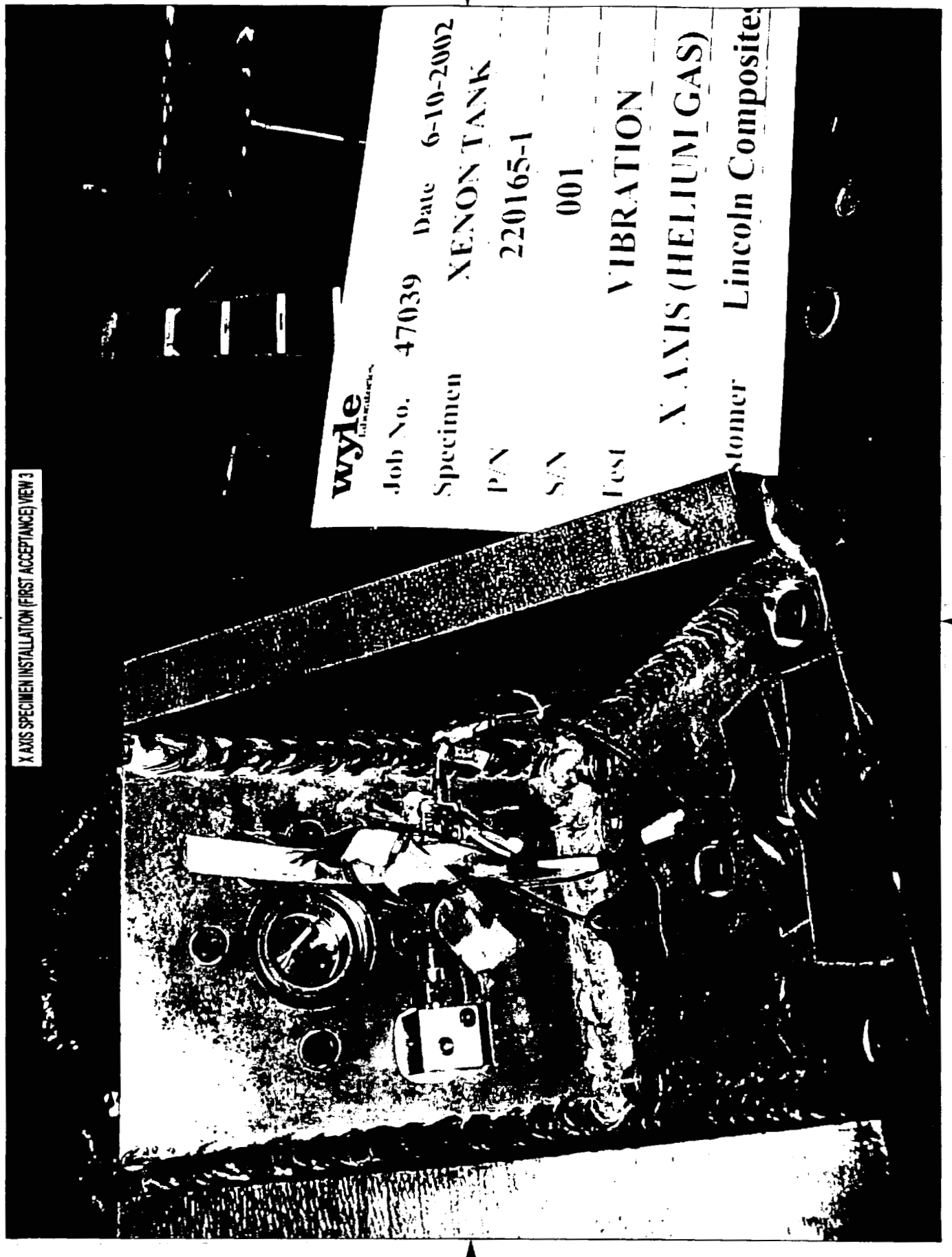
PHOTOGRAPH 17

X AXIS SPECIMEN INSTALLATION (FIRST ACCEPTANCE) VIEW 2

X AXIS SPECIMEN INSTALLATION (FIRST ACCEPTANCE) VIEW 2

PHOTOGRAPH 18

X AXIS SPECIMEN INSTALLATION (FIRST ACCEPTANCE) VIEW 3



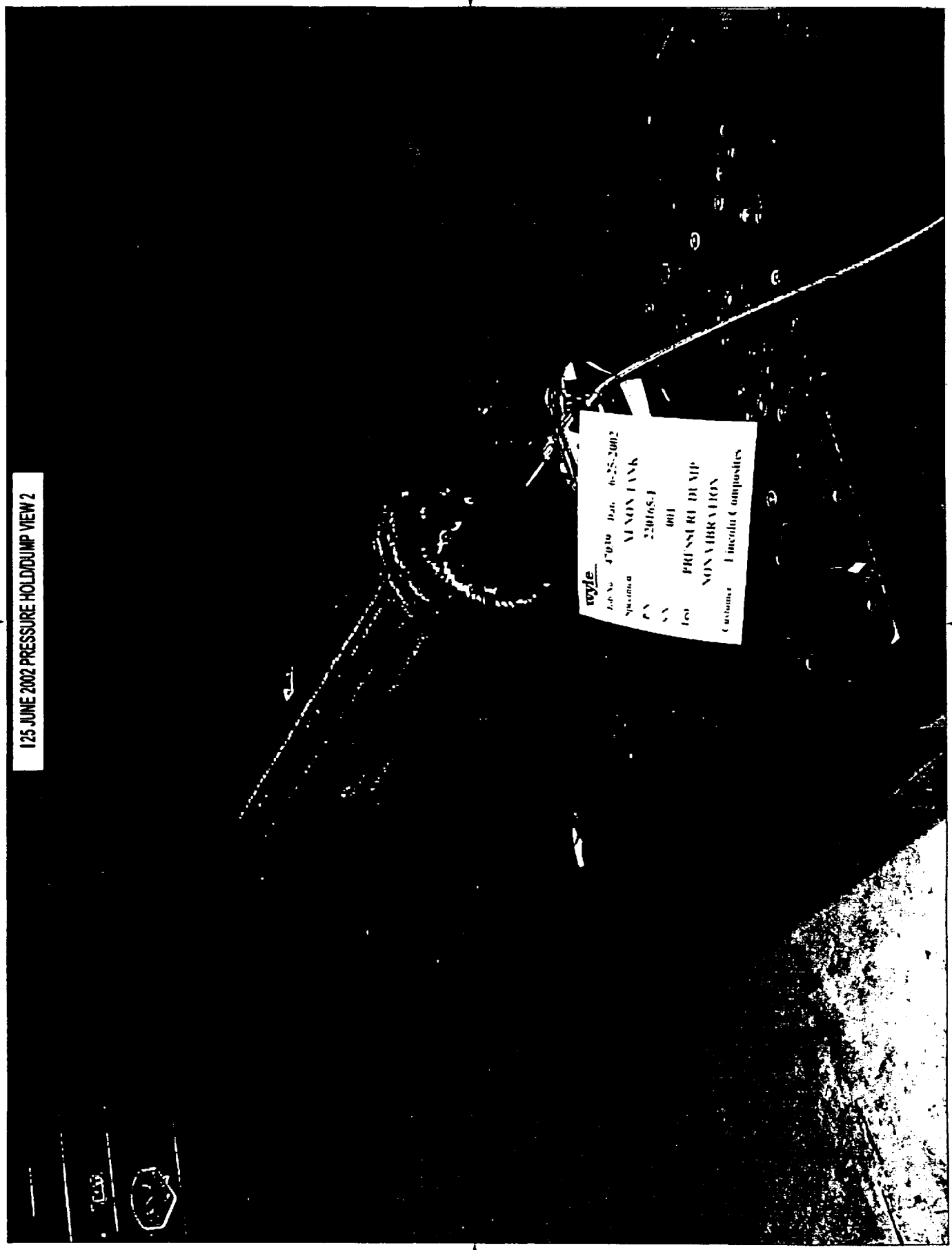
X AXIS SPECIMEN INSTALLATION (FIRST ACCEPTANCE) VIEW 3

PHOTOGRAPH 19

25 JUNE 2002 PRESSURE HOLD/DUMP VIEW 1

PHOTOGRAPH 20

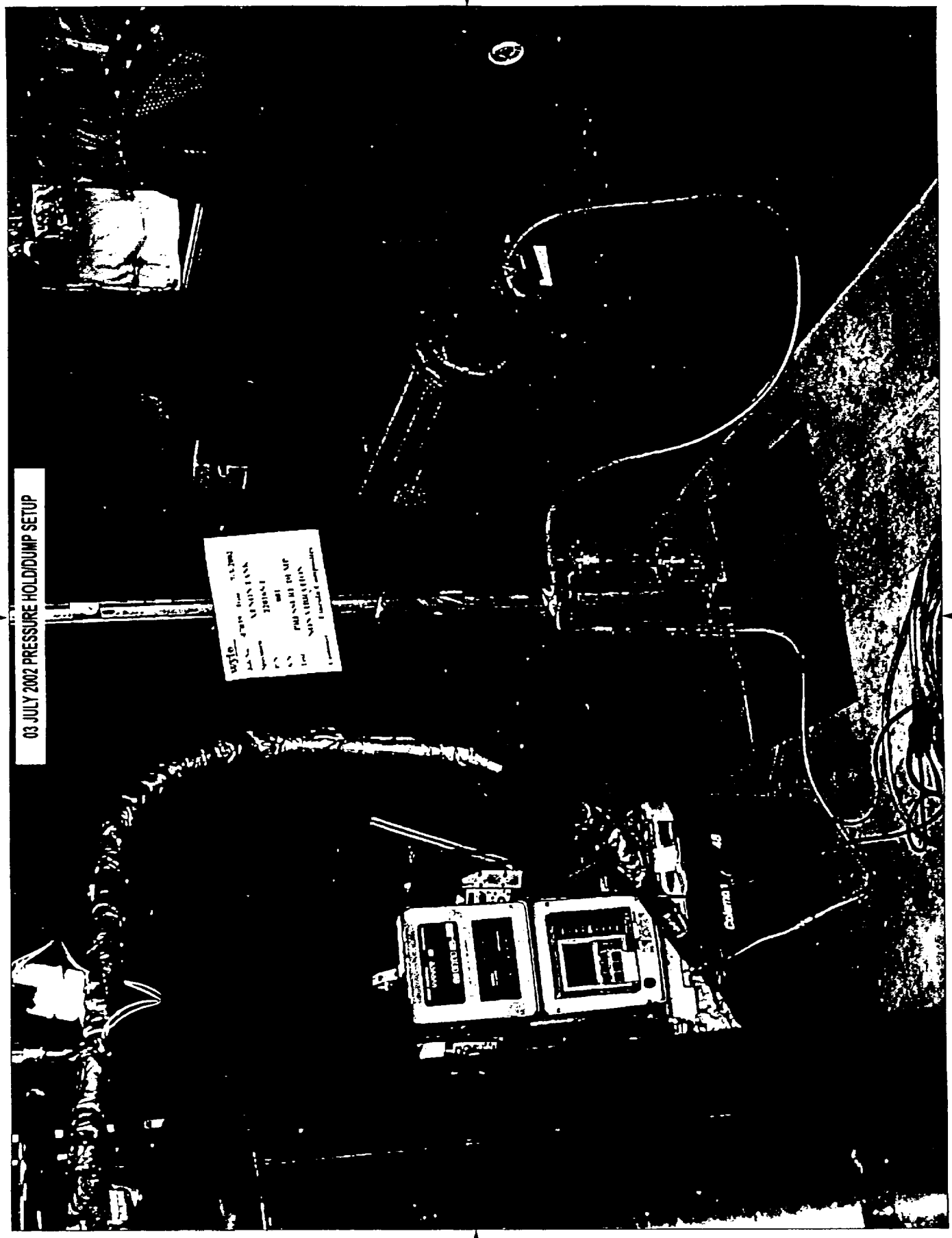
25 JUNE 2002 PRESSURE HOLD/DUMP VIEW 2



125 JUNE 2002 PRESSURE HOLD/DUMP VIEW 2

PHOTOGRAPH 21

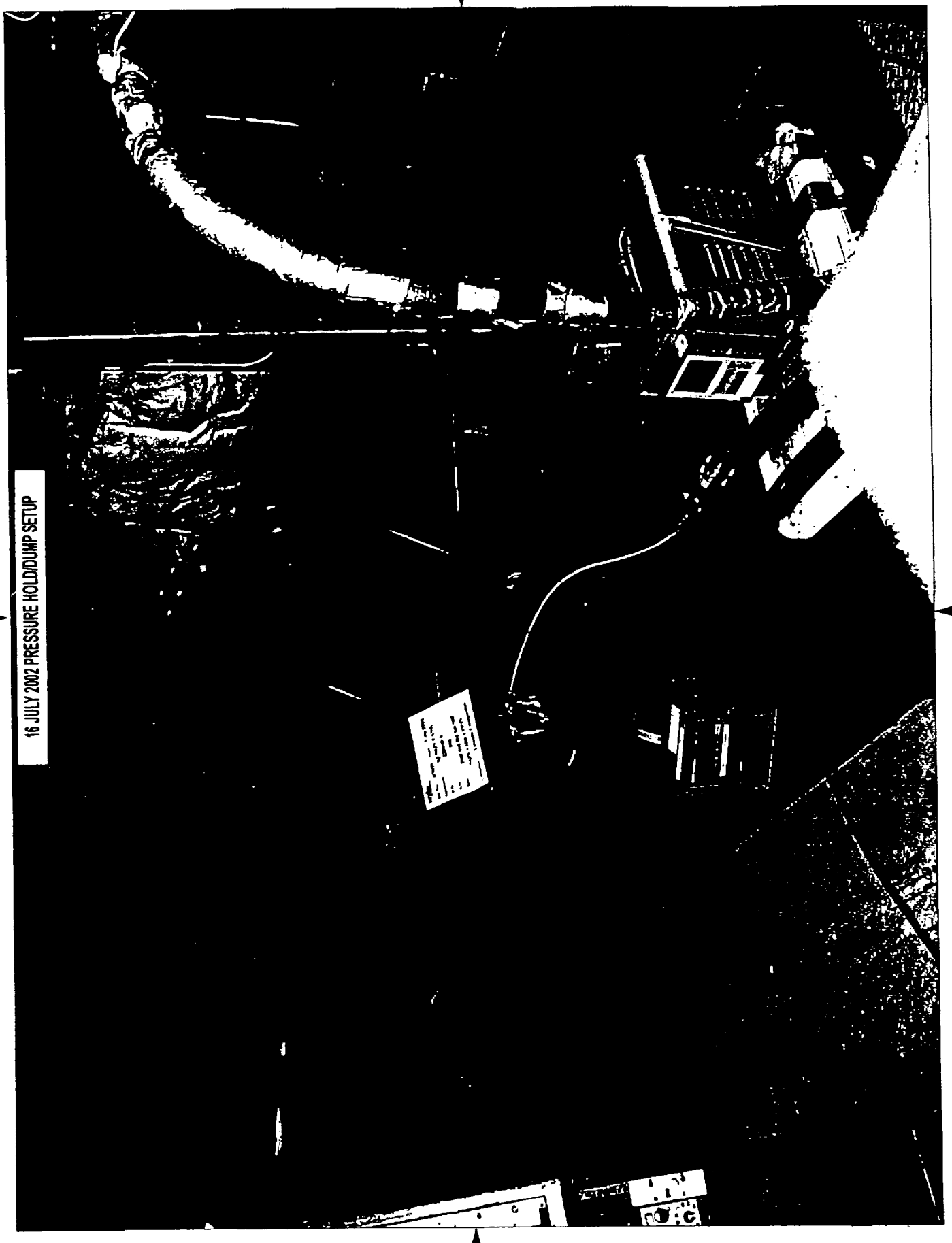
03 JULY 2002 PRESSURE HOLD/DUMP SETUP



03 JULY 2002 PRESSURE HOLD/DUMP SETUP

PHOTOGRAPH 22

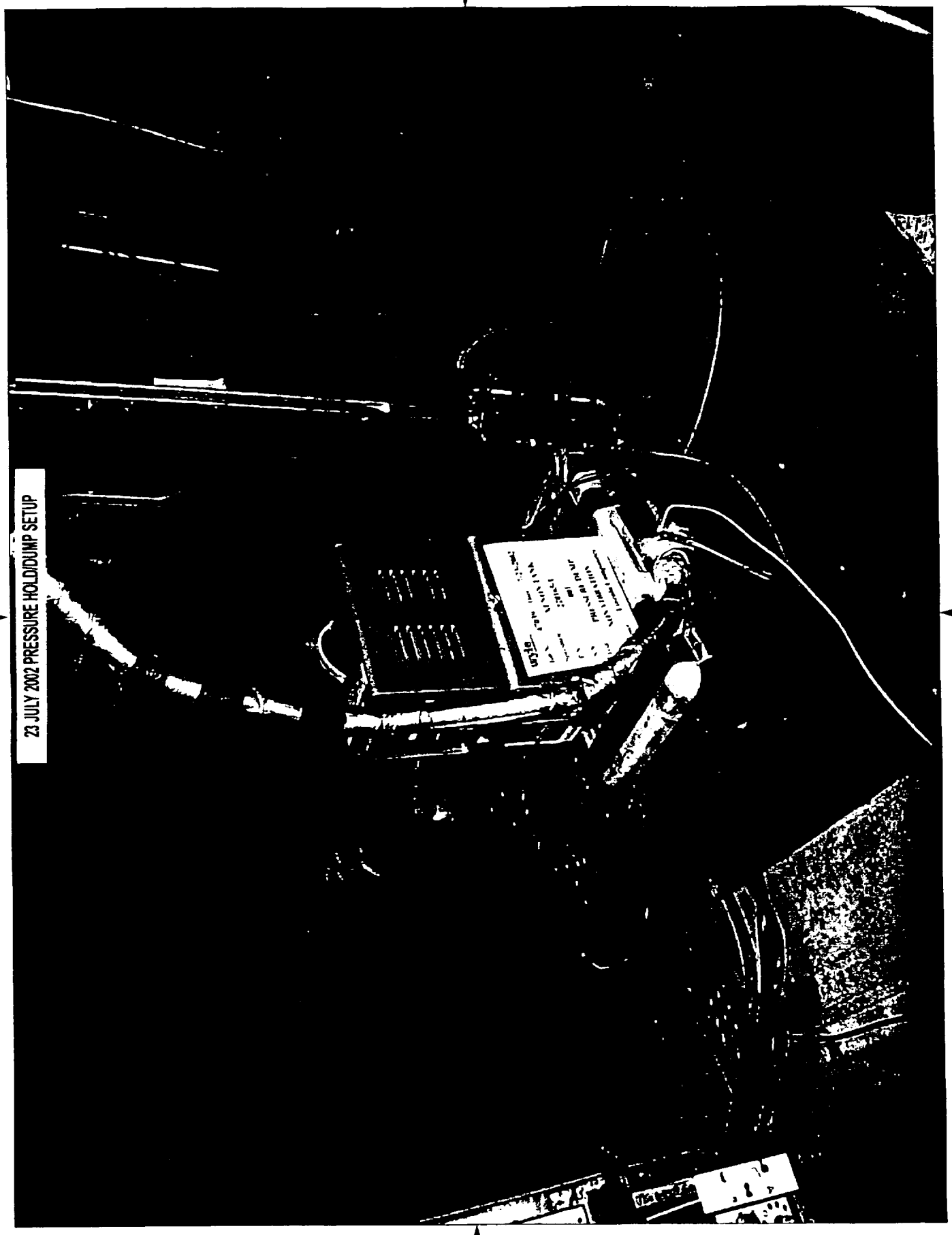
16 JULY 2002 PRESSURE HOLD/DUMP SETUP



16 JULY 2002 PRESSURE HOLD/DUMP SETUP

PHOTOGRAPH 23

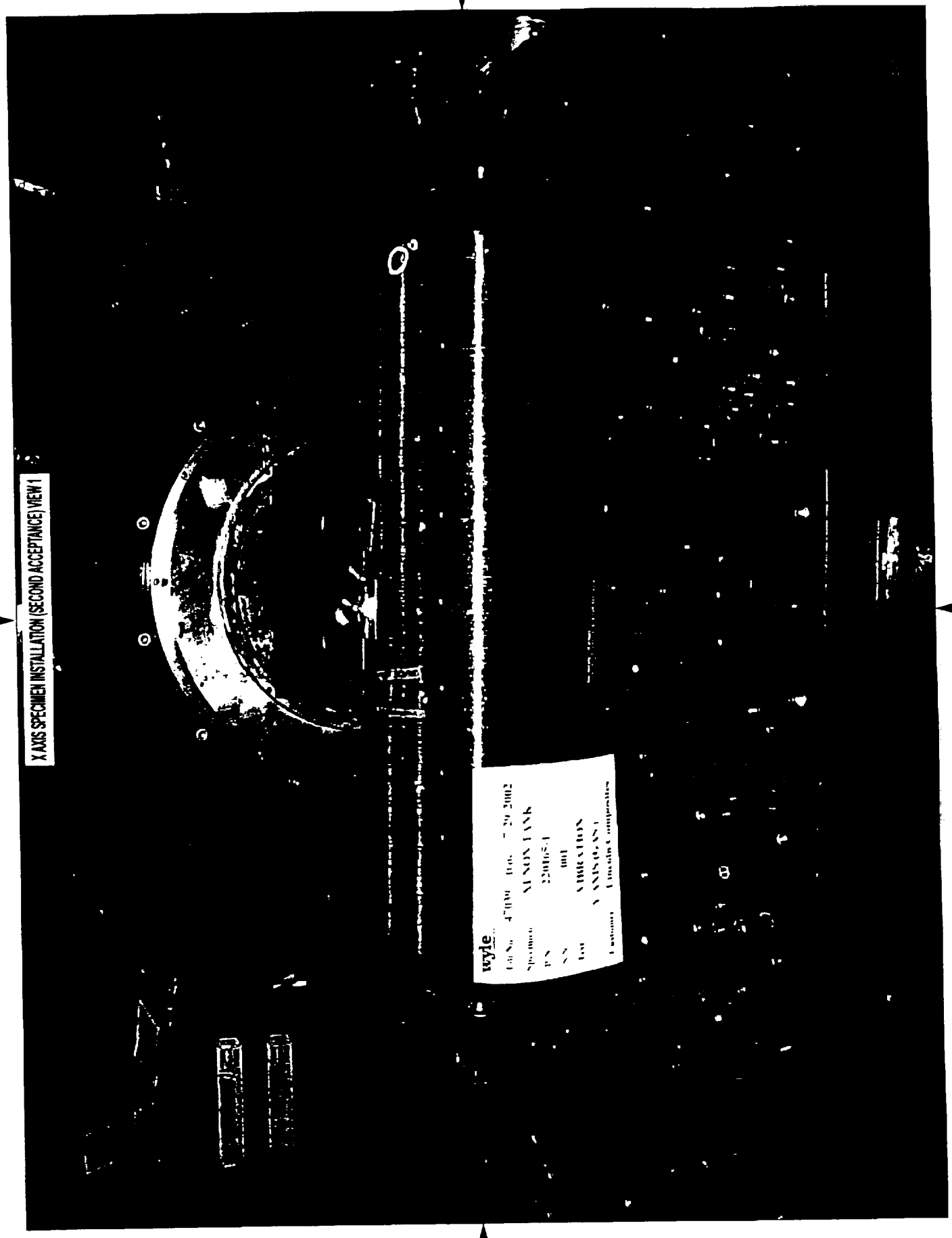
23 JULY 2002 PRESSURE HOLD/DUMP SETUP



23 JULY 2002 PRESSURE HOLD/DUMP SETUP

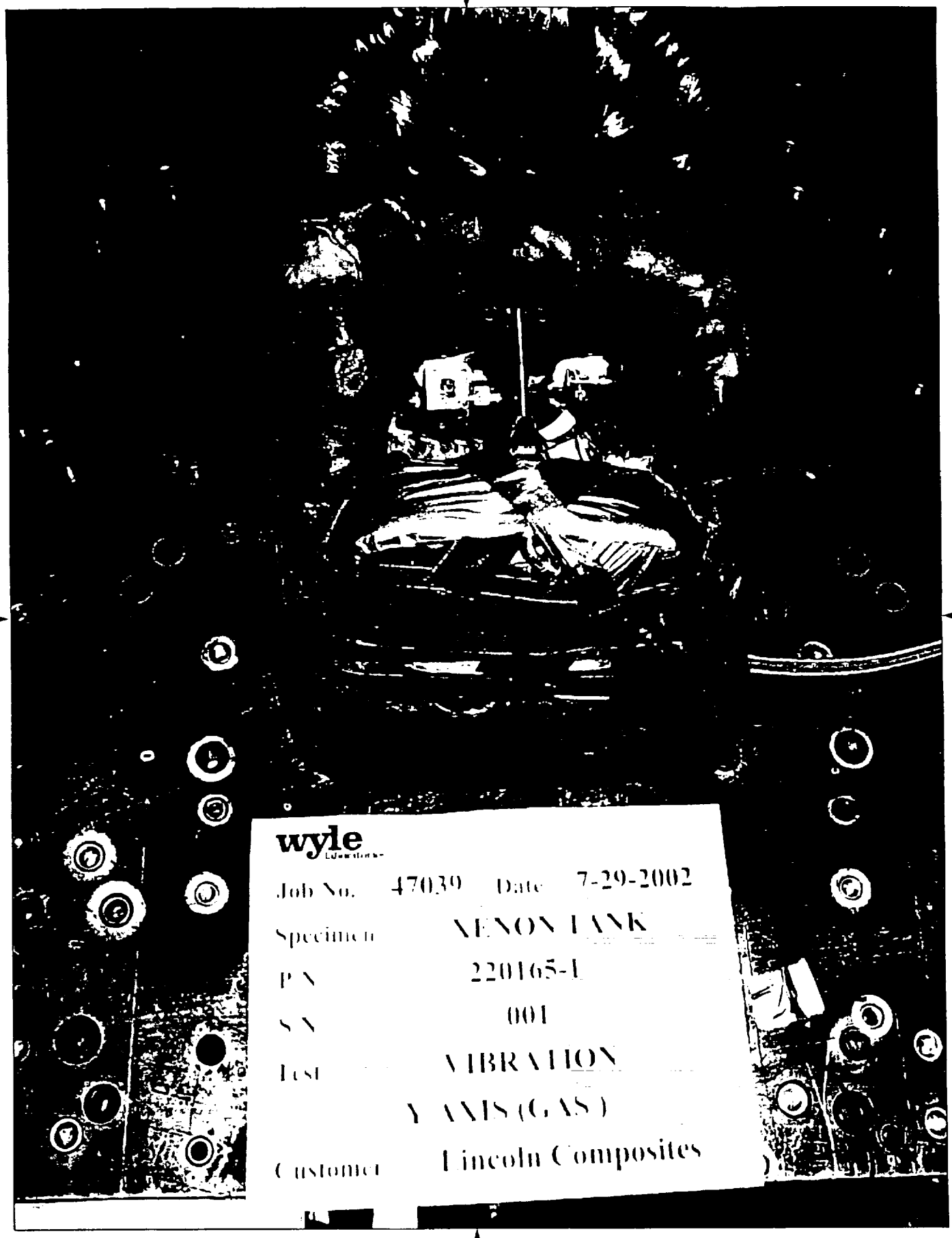
PHOTOGRAPH 24

X AXIS SPECIMEN INSTALLATION (SECOND ACCEPTANCE) VIEW 1



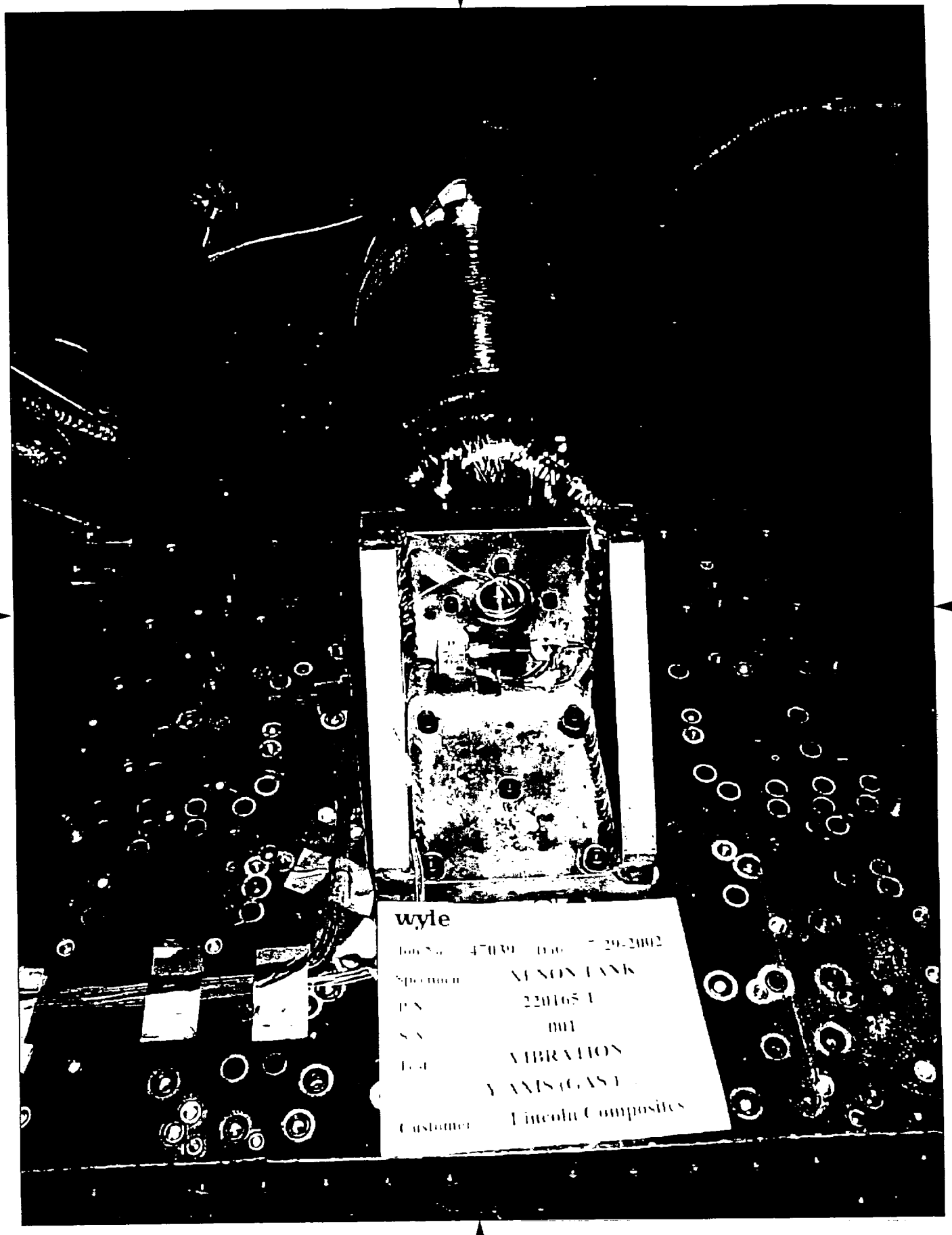
PHOTOGRAPH 25

X AXIS SPECIMEN INSTALLATION (SECOND ACCEPTANCE) VIEW 2



PHOTOGRAPH 26

X AXIS SPECIMEN INSTALLATION (SECOND ACCEPTANCE) VIEW 3



DYN-A

wyle laboratories

RECEIVING INSPECTION DATA SHEET

Customer	LINCOLN COMPOSITES	Date	5-20-2002
Specimen	82 Liter Tank	Job No.	47039

No. of Specimens Received: ONE

Record identification information exactly as it appears on the tag or specimen:

Manufacturer LINCOLN COMPOSITES

P/N's	S/N's
220165-1	001

How Does identification information appear: (e.g. name plate, tag, painted, imprinted, etc) PAINTED

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification

Inspection Results: There was no visible evidence of damage to the specimen(s) unless otherwise noted below.

NO VISIBLE DAMAGE TO SPECIMEN ON RECEIVING OF SPECIMEN

Inspected By R.G.PARAMORE

Sheet Number 1 of 1

Approved [signature] Date 5-20-02

wyle laboratories

Test	RANDOM AND SINUSOIDAL VIBRATION				
Customer	Lincoln Composites	Specimen	82 Liter Pressure Vessel	Date	5/21/02
Part No.	220165-1	S/N	001	Job No.	47039
Test By	Matt Klicka	Witness		Page No.	1 of 1

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION LAST	CALIBRATION DUE	ACCURACY
Vibration Exciter	Ling	340	30 K Force lbs.	10663	NA	NA	NA
Power Amplifier	Unholtz-Dickie	2XSA/120 1/2	120/240 KVA	13756	NA	NA	NA
Automatic Vibration Control System	m+p	VCX900	0.1Hz to 12.8KHz	14004	System Calibration Prior to Use	System Calibration Prior to Use	NA
Sine & Random Software	m+p	Rev. 6.2	NA	NA	NA	NA	NA
Mainframe	Hewlett-Packard	E1421B	5 Slots	14007	NA	NA	NA
Digitizer	Hewlett-Packard	E1432A	16 Channels 51.2 kSa/s	13887	6/11/01	6/11/03	± 1%
Oscilloscope	BK Precision	5105	100 MHz	14181	9/19/01	9/19/02	± 3%
Accelerometer	Endevco	7704A-17	1 Hz to 10 kHz 2.5kG Peak	14334 13396	5/9/02	11/9/02	± 5%
Accelerometer	Endevco	2228	3 Hz to 4 kHz 1k G Peak	12009 12012	5/9/02 12/6/01	11/9/02 6/6/02	± 5%
Accelerometer	Endevco	2228	3 Hz to 4 kHz 1k G Peak	12005	12/6/01	6/6/02	± 5%
Accelerometer	Endevco	2226	3 Hz to 5 kHz 1k G Peak	12277	3/14/02	9/14/02	± 5%
Charge Amplifier	Endevco	2735	2 Hz to 20 kHz 3k G Peak	8124 8127	3/12/02 12/18/01	9/12/02 6/18/02	± 2%
Charge Amplifier	Endevco	2735	2 Hz to 20 kHz 3k G Peak	8662	3/12/02	9/12/02	± 2%
Charge Amplifier	Endevco	133	200 kHz BW 0 to 1k Gain	13793 13794	11/28/01	5/28/02	± .5%
Charge Amplifier	Endevco	133	200 kHz BW 0 to 1k Gain	13795	11/28/01	5/28/02	± .5%
Pressure Gauge	Ashcroft	N/A	0-3000 psig	7551	4/24/02	8/19/02	± .5%
Temp. Indicator	Doric	600	-327/+752 deg. F	13911	4/26/02	10/26/02	± 2.0°F

W614C QA Form Approval

wyle laboratories

DYNAMICS SECTION
VIBRATION TEST DATA SHEET

Customer: Lincoln Composites Job No. 47039

Sheet 1 of 3

Specimen: 82 Liter Pressure Vessel P/N 220165-1 S/N 001

Date	Time	Axis	Temp (°F)	RANDOM SPECTRUM Freq. (Hz)	PSD G^2/Hz	PSD dB/Oct	Overal (G_{rms})	Test Time (Sec.)	Comments	Ref Plot No.
5-21-02	2019	Y	AMB	20	.000164				Completed -12dB (pre) level with no apparent damage.	1-12
				20-50		+ 9			Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				50-300	.0025				Single point control using C1. C2 for reference only.	
				300-2k		- 6				
				2k	.000057		1.15	32		
5-21-02	2051	Y	AMB	20	.0026				Completed Qualification level with no apparent damage.	13-24
				20-50		+ 9			Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				50-300	.04				Single point control using C1. C2 for reference only.	
				300-2K		-6				
				2K	.0009		4.6	180		
5-21-02	2059	Y	AMB	20	.000164				Completed -12dB (post random) level with no apparent	25-36
				20-50		+ 9			damage.	
				50-300	.0025				Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				300-2k		- 6			Single point control using C1. C2 for reference only.	
				2k	.000057		1.15	32		

W603SS-ES

Signed

wyle laboratories

DYNAMICS SECTION
VIBRATION TEST DATA SHEET

Customer: Lincoln Composites Job No. 47039

Sheet 2 of 3

Specimen: 82 Liter Pressure Vessel P/N: 220165-1 S/N: 001

Date	Time	Axis	Temp (°F)	RANDOM SPECTRUM Freq. (Hz)	PSD G^2/Hz	PSD dB/Oct	Overal (G_{rms})	Test Time (Sec.)	Comments	Ref Plot No.
5-23-02	1923	Y	AMB	20	.000164				Completed –12dB (post random) level with no apparent	37-48
				20-50		+ 9			damage (repeated after tank reinstall, see report for details).	
				50-300	.0025				Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				300-2k		- 6			Single point control using C1. C2 for reference only.	
				2k	.000057		1.15	30		
5-23-02	2019	Y	AMB	Same	As	Above	1.15	30	Completed –12dB (post sine) level with no apparent	49-60
									damage.	
									Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
									Single point control using C1. C2 for reference only.	
5-24-02	933	X	AMB	Same	As	Above	1.15	30	Completed –12dB (pre) level with no apparent damage.	61-73
									Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
									Average control using C1and C2.	

W603SS-ES

Signed

wyle laboratories

DYNAMICS SECTION
VIBRATION TEST DATA SHEET

Customer: Lincoln Composites Job No. 47039

Sheet 3 of 3

Specimen: 82 Liter Pressure Vessel P/N: 220165-1 S/N: 001

Date	Time	Axis	Temp (°F)	RANDOM SPECTRUM Freq. (Hz)	PSD G^2/Hz	PSD dB/Oct	Overal (G_{rms})	Test Time (Sec.)	Comments	Ref Plot No.
5-24-02	1025	X	AMB	20	.0026				Completed 63 seconds of Qualification level. Test setup	74-86
				20-50		+ 9			displaying signs of instability. Test aborted due to safety	
				50-300	.04				concerns, see report for details.	
				300-2K		-6			Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				2K	.0009		4.6	63	Average control using C1and C2.	

W603SS-ES

Signed

REPORT NO. 47039
PAGE NO. DYN.A.6

RANDOM PLOT NO. 1

Random Control Channel

LINCOLN 47039 QUAL

Y AXIS -12 PRE4

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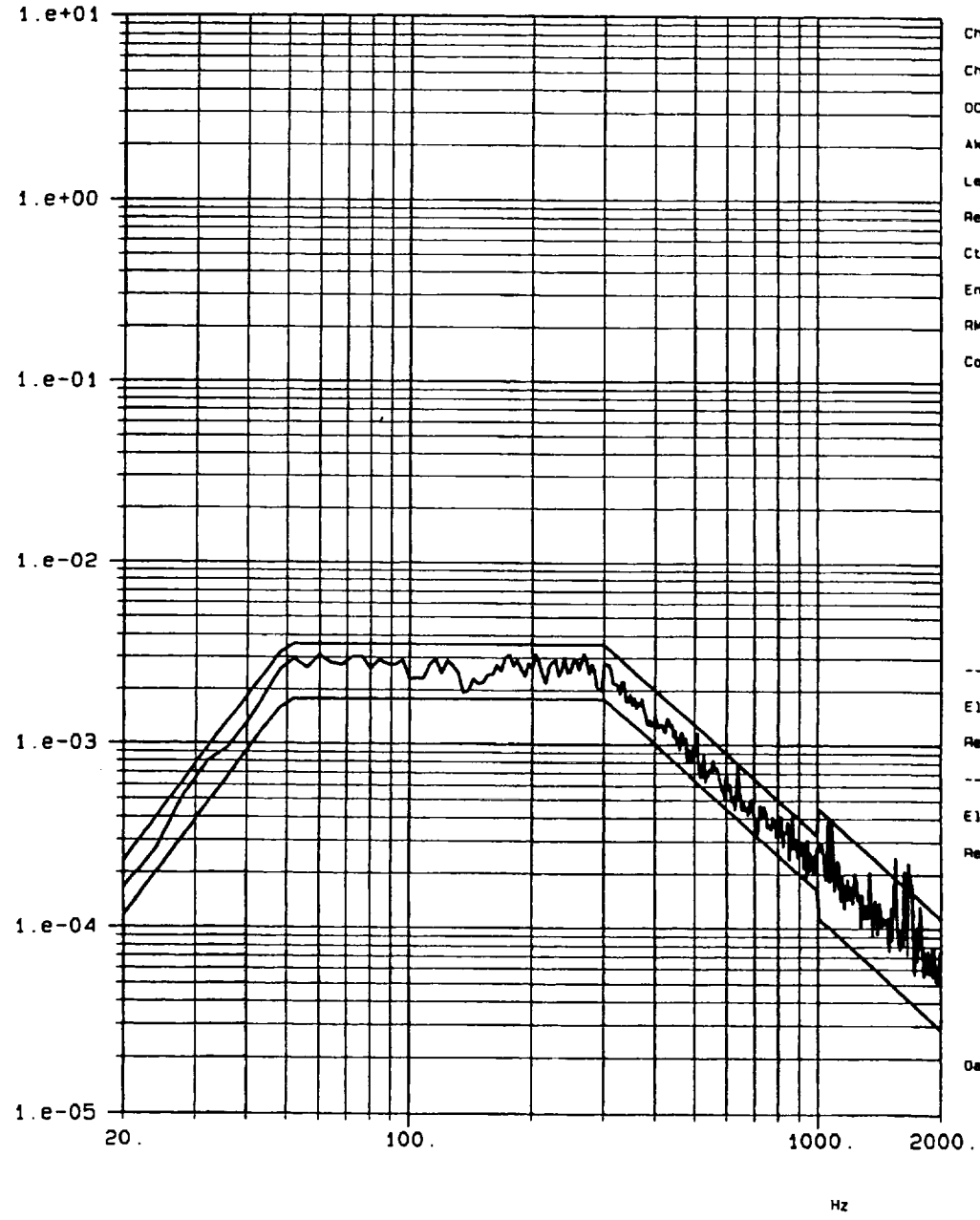
g^2/Hz C1 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No : 1
Chan. Type : C
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat. : Average
Eng. Unit : g
RMS (act.) : 1.1618 g
Contr. Mode: Closed loop

-- Time on act level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:02:18
Remaining : 0:05:28

Date : 5/21/2002
20:19:06

RANDOM PLOT NO. 2

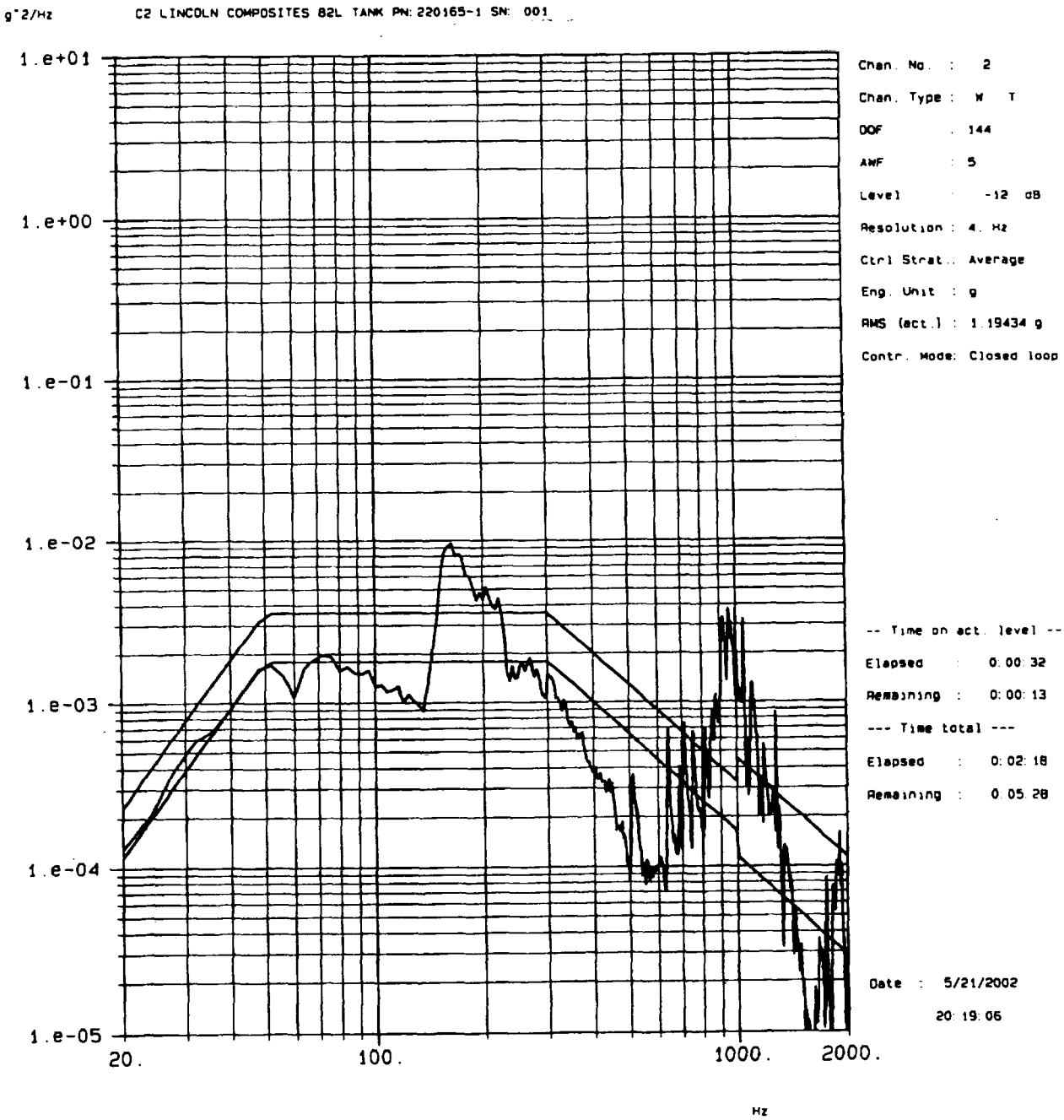
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 PRE4

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 3

Random Limit Channel

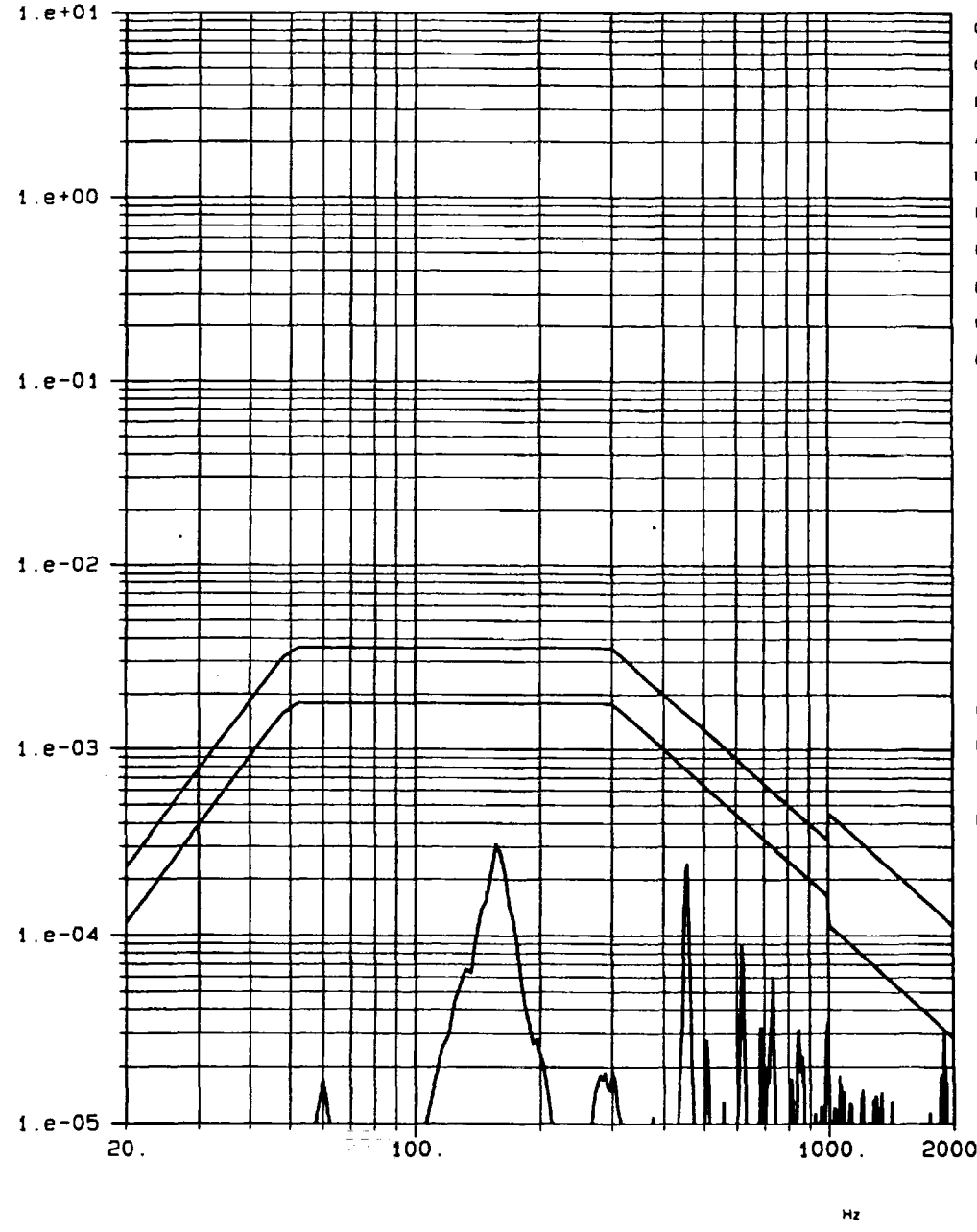
LINCOLN 47039 QUAL

Y AXIS -12 PRE4

Wyle Laboratories

El Segundo, CA

g^2/Hz R1X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 3
Chan. Type : N T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat.. Average
Eng. Unit : g
RMS (act.) : 0.16695 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:02:18
Remaining : 0:05:28

Date 5/21/2002
20:19:06

RANDOM PLOT NO. 4

Random Limit Channel

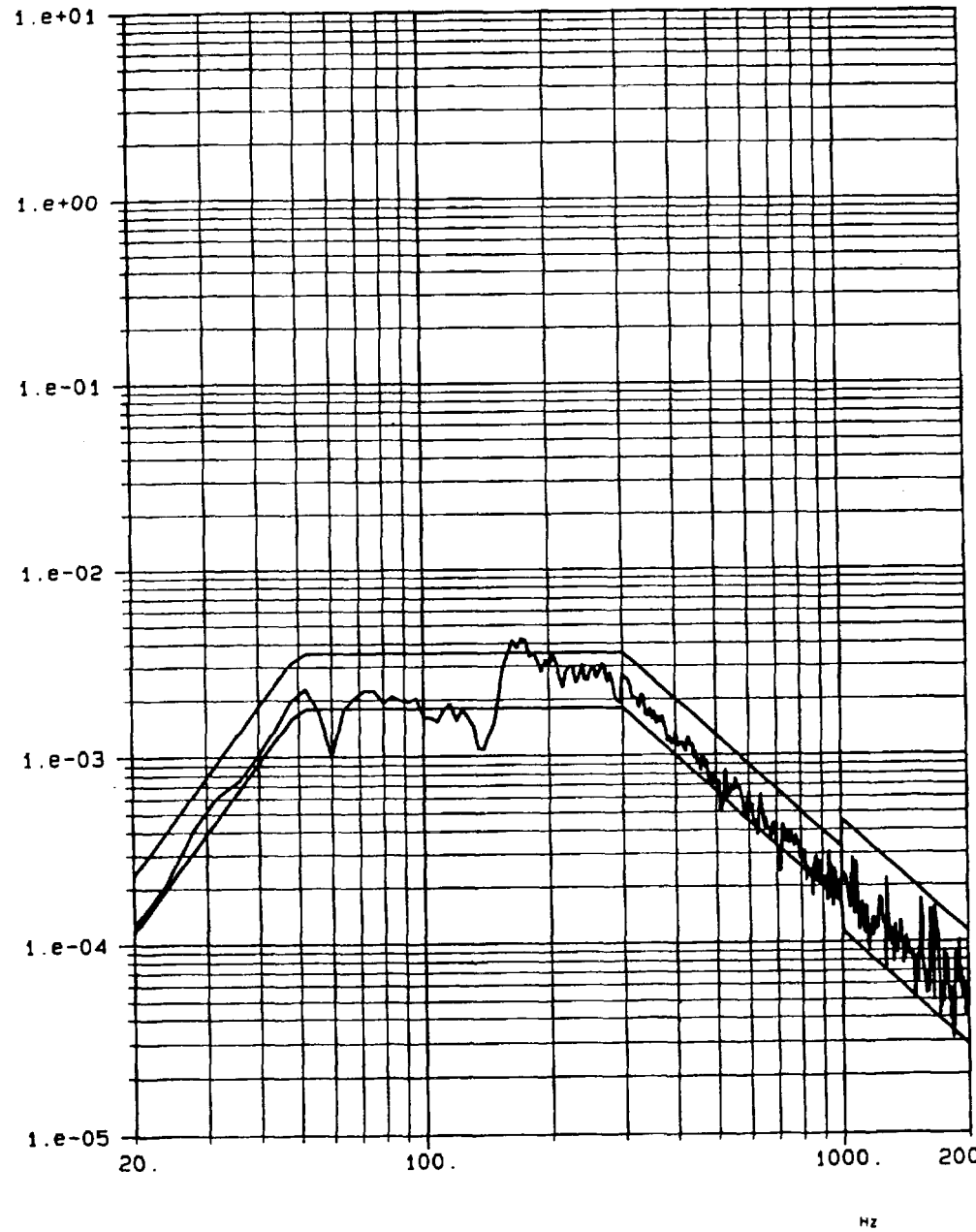
LINCOLN 47039 QUAL

Y AXIS -12 PRE4

Wyle Laboratories

El Segundo, CA

g^2/Hz R1Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 4
Chan. Type : W - T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 1.09744 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:02:18
Remaining : 0:05:28

Date : 5/21/2002
20:19:06

RANDOM PLOT NO. 5

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 PRE4

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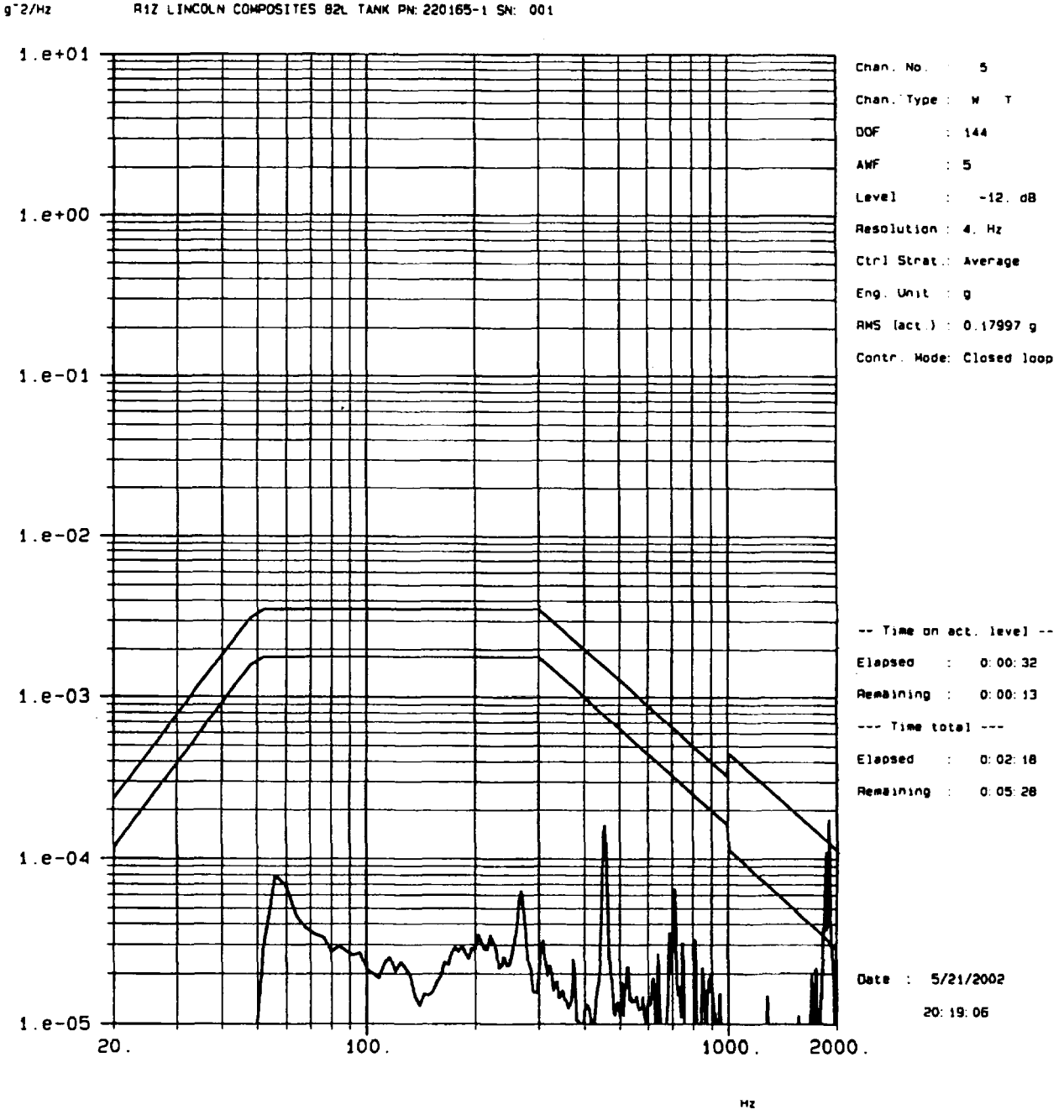

RANDOM PLOT NO. 6

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 PRE4

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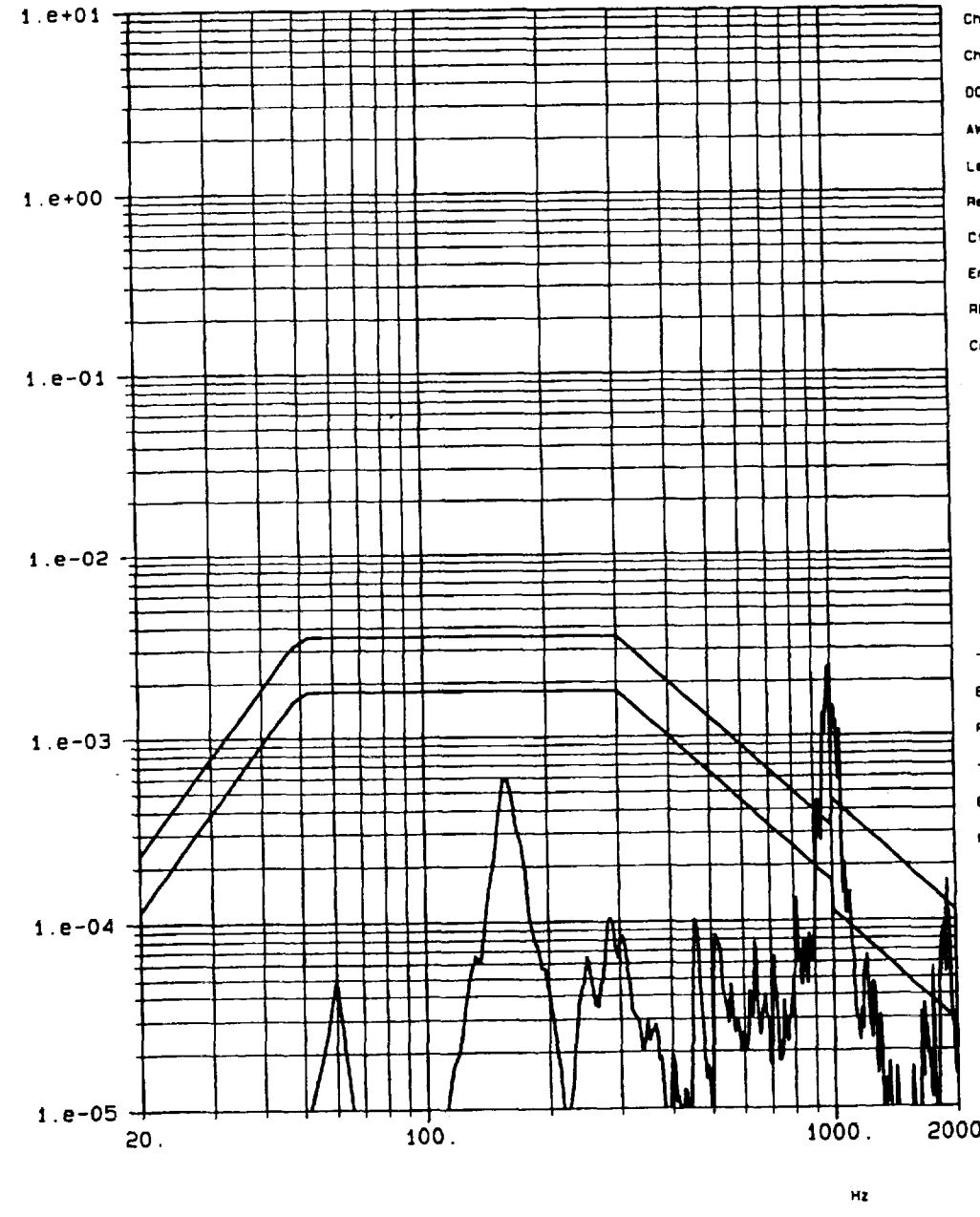
g^2/Hz R2X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 6
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat : Average
Eng. Unit : g
RMS (act.) : 0.472 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:02:18
Remaining : 0:05:28

Date : 5/21/2002
20:19:06

RANDOM PLOT NO. 7

Random Limit Channel

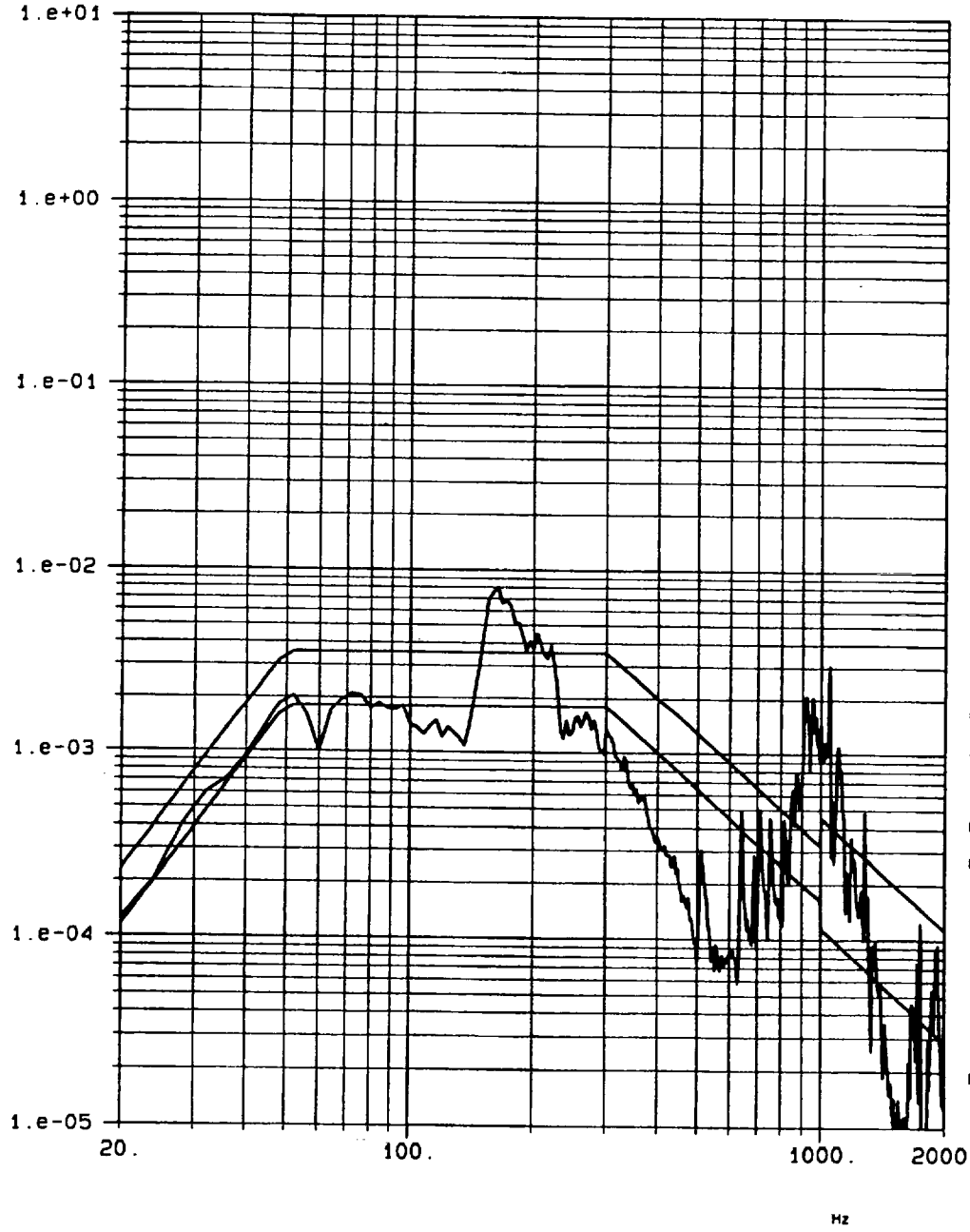
LINCOLN 47039 QUAL

Y AXIS -12 PRE4

Wyle Laboratories

El Segundo, CA

g^2/Hz R2Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 7

Chan. Type : W T

DOF : 144

AWF : 5

Level : -12 dB

Resolution : 4. Hz

Ctrl Strat.: Average

Eng. Unit : g

RMS (act.) : 1.08894 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0:00:32

Remaining : 0:00:13

--- Time total ---

Elapsed : 0:02:18

Remaining : 0:05:28

Date : 5/21/2002

20:19:06

RANDOM PLOT NO. 8

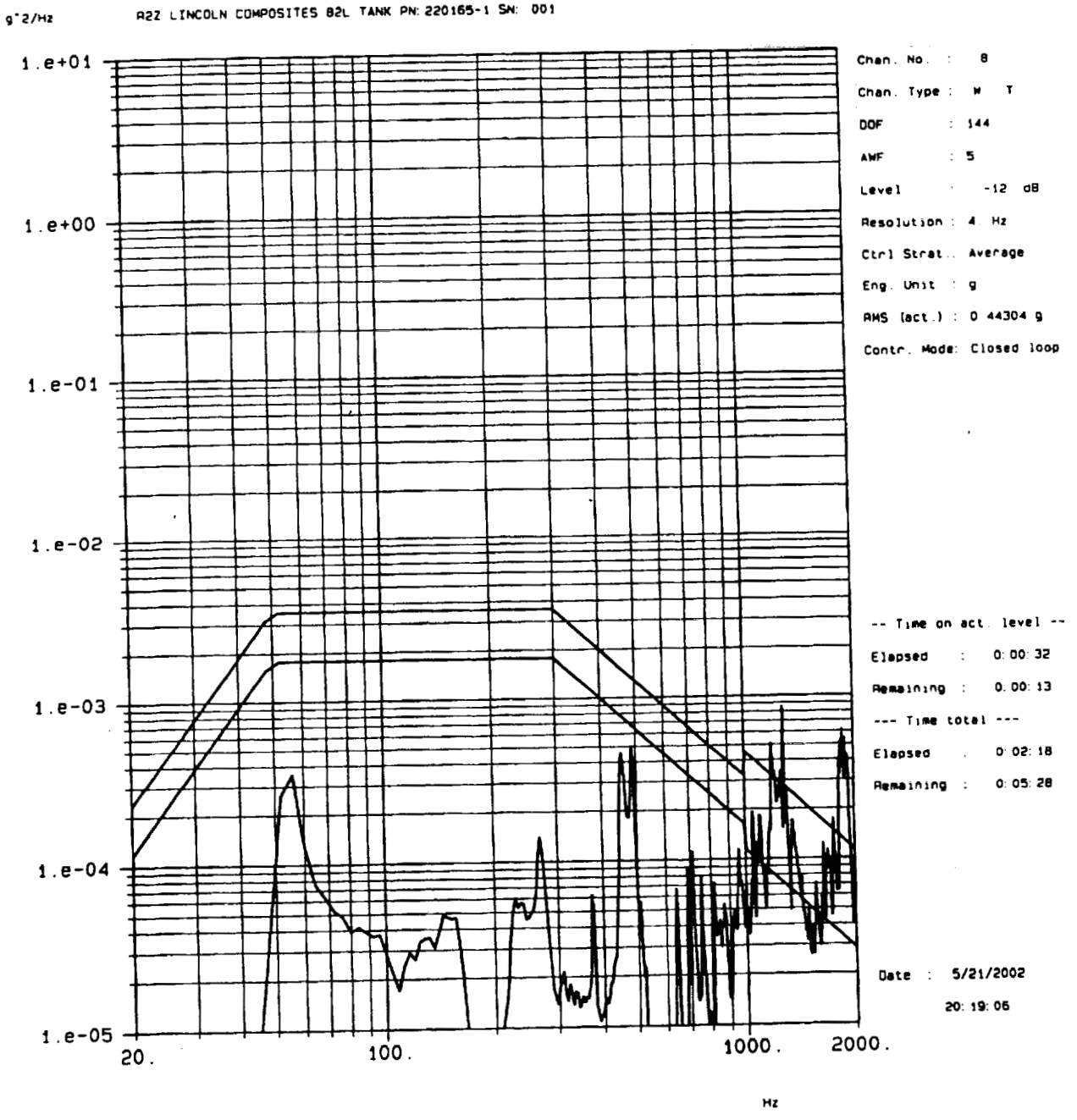
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 PRE4

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 9

Random Limit Channel

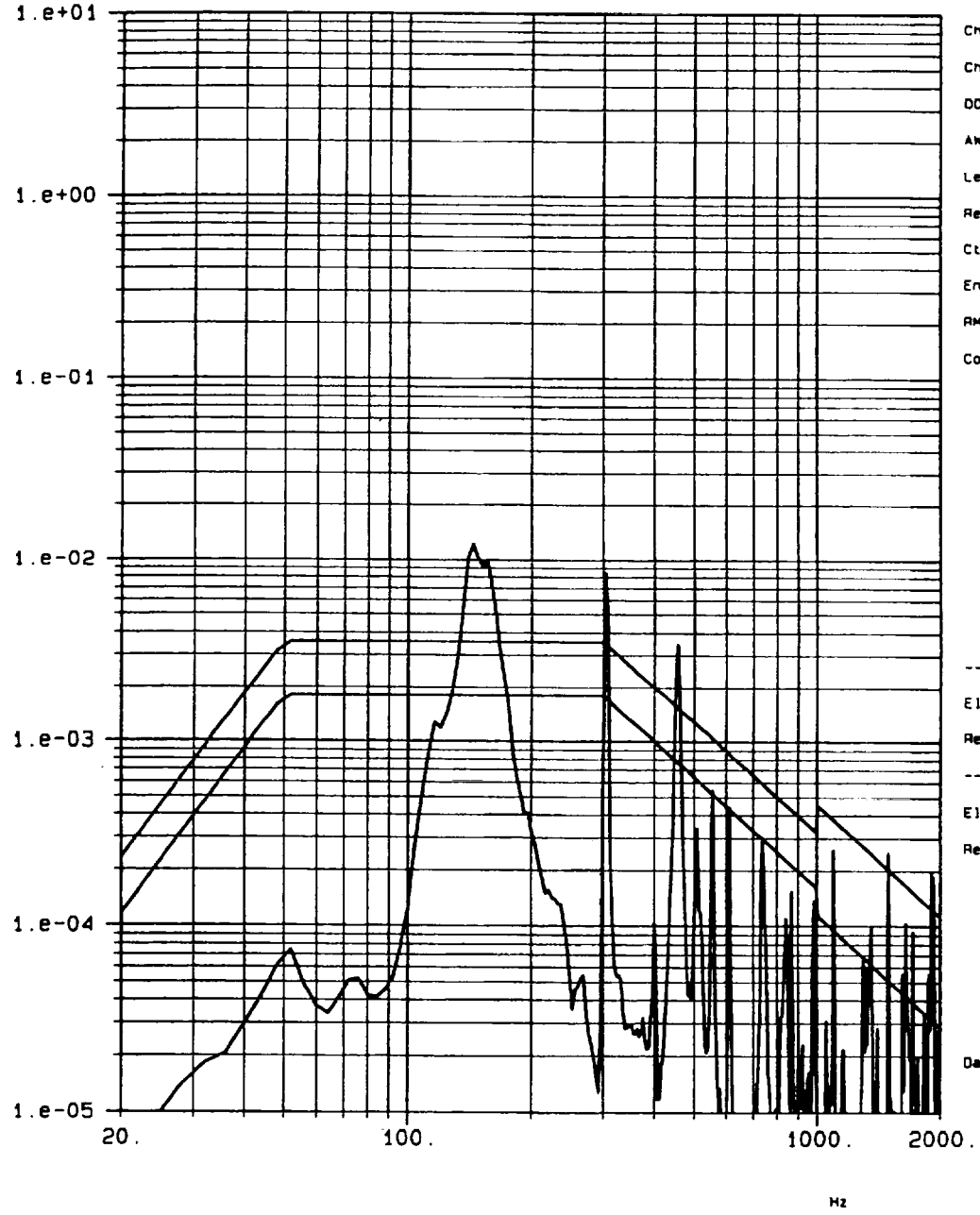
LINCOLN 47039 DUAL

Y AXIS -12 PRE4

Wyle Laboratories

El Segundo, CA

g^2/Hz R3X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : W. T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat : Average
Eng. Unit : g
RMS (act.) : 0.72924 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:02:18
Remaining : 0:05.28

Date : 5/21/2002
20:19:06

RANDOM PLOT NO. 10

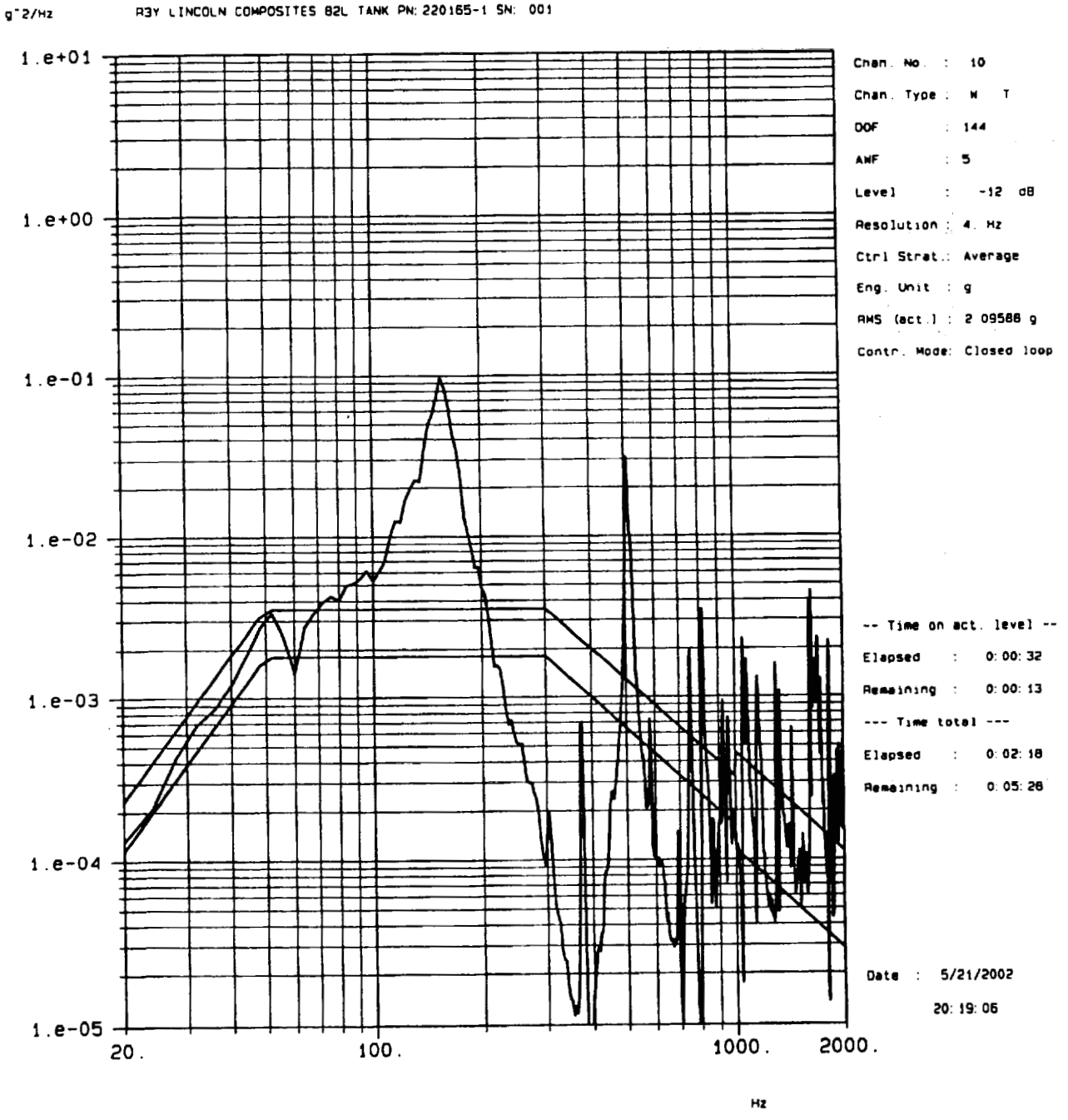
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 PRE4

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 11

Random Limit Channel

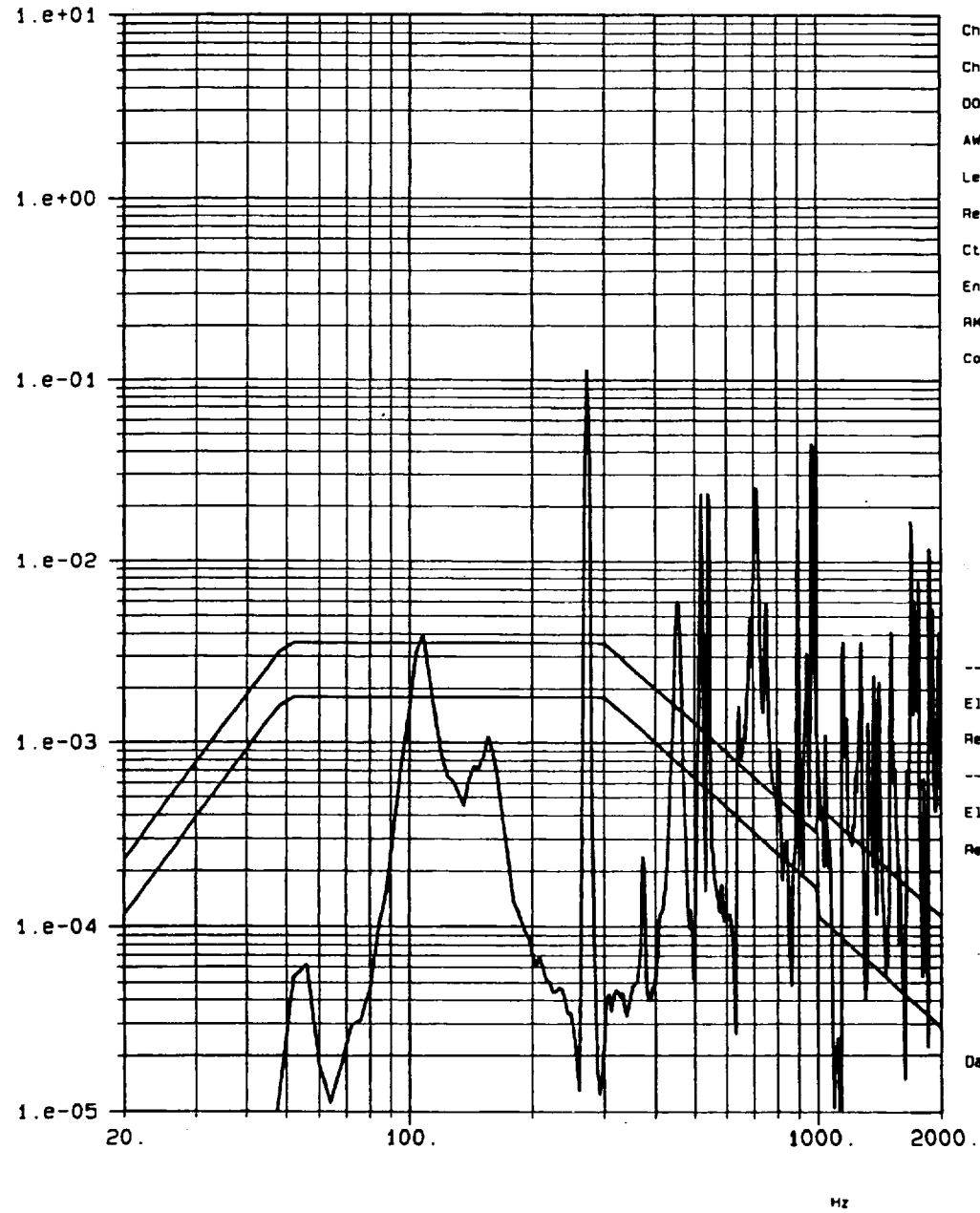
LINCOLN 47039 QUAL

Y AXIS -12 PRE4

Wyle Laboratories

El Segundo, CA

g^2/Hz R3Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 11
Chan. Type : M T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 1.9939 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0: 00: 32
Remaining : 0: 00: 13
--- Time total ---
Elapsed : 0: 02: 18
Remaining : 0: 05: 28

Date : 5/21/2002
20: 19: 06

RANDOM PLOT NO. 12

Random Limit Channel

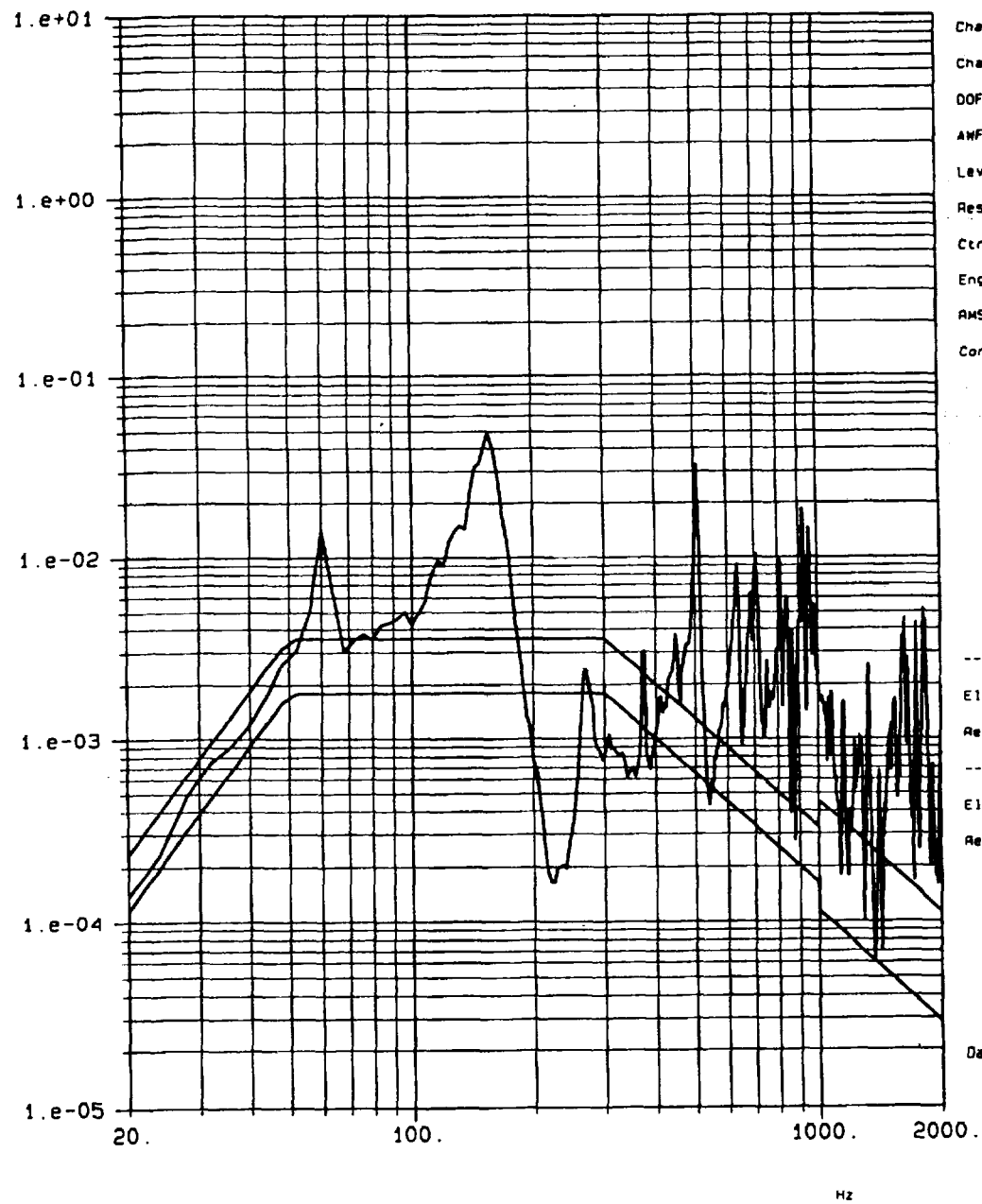
LINCOLN 47039 QUAL

Y AXIS -12 PRE4

Wyle Laboratories

El Segundo, CA

g^2/Hz R4Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 12
Chan. Type : N T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 2.3335 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:02:18
Remaining : 0:05:28

Date : 5/21/2002
20:19:06

RANDOM PLOT NO. 13

Random Control Channel

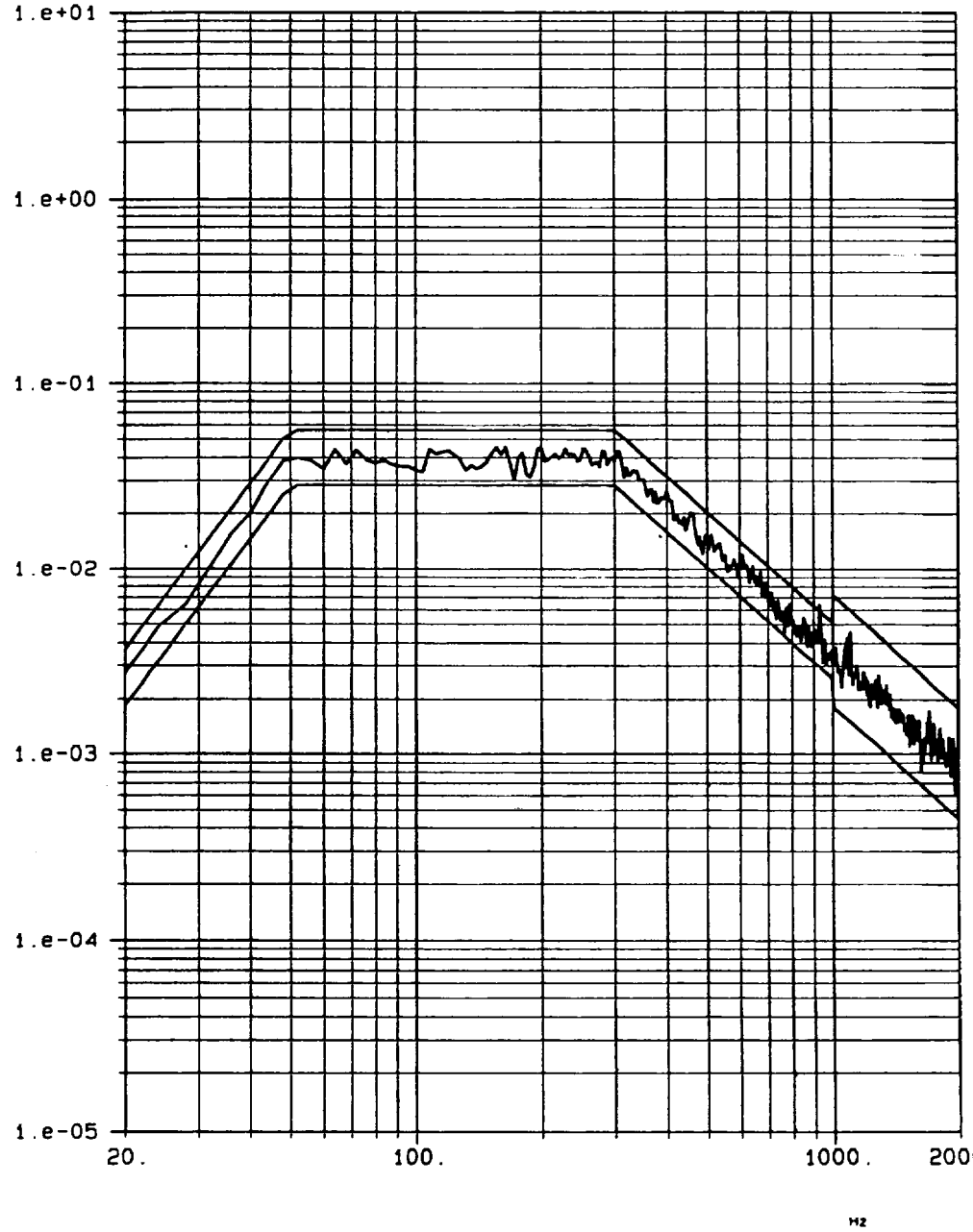
LINCOLN 47039 QUAL

Y AXIS FULL LEVEL 3

Wyle Laboratories

El Segundo, CA

g^2/Hz C1 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 1
Chan. Type : C
DOF : 144
AWF : 5
Level : 0 dB
Resolution : 4. Hz
Ctrl Strat. : Average
Eng. Unit : g
RMS (act.) : 4.52898 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:03:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:06:52
Remaining : 0:00:00

Date : 5/21/2002
20:51:49

RANDOM PLOT NO. 14

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS FULL LEVEL 3

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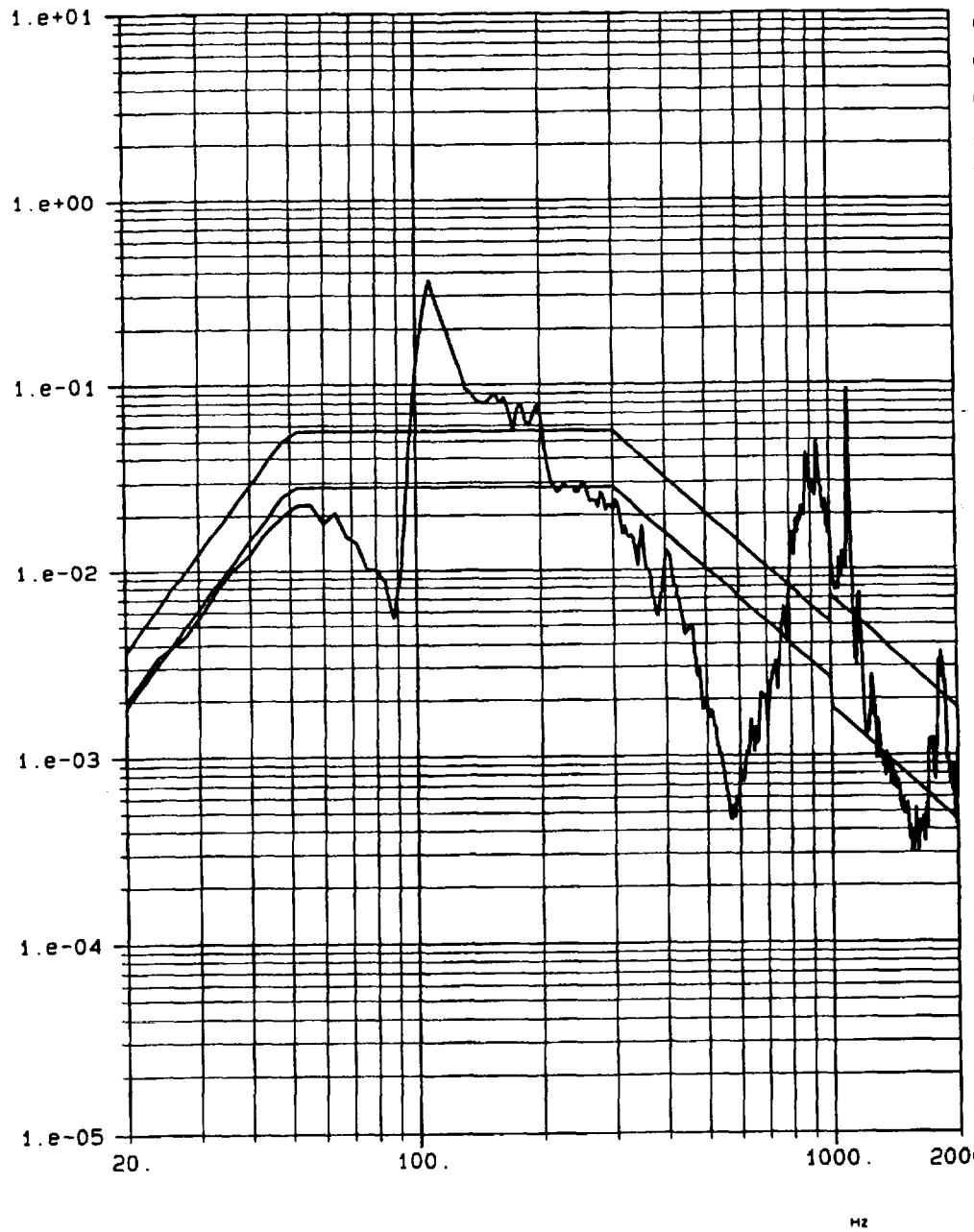
El Segundo, CA

g^2/Hz C2 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 2
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0 dB
Resolution : 4 Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 5.20536 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:03:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:06:52
Remaining : 0:00:00

Date : 5/21/2002
20:51:49

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RANDOM PLOT NO. 15

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS FULL LEVEL 3

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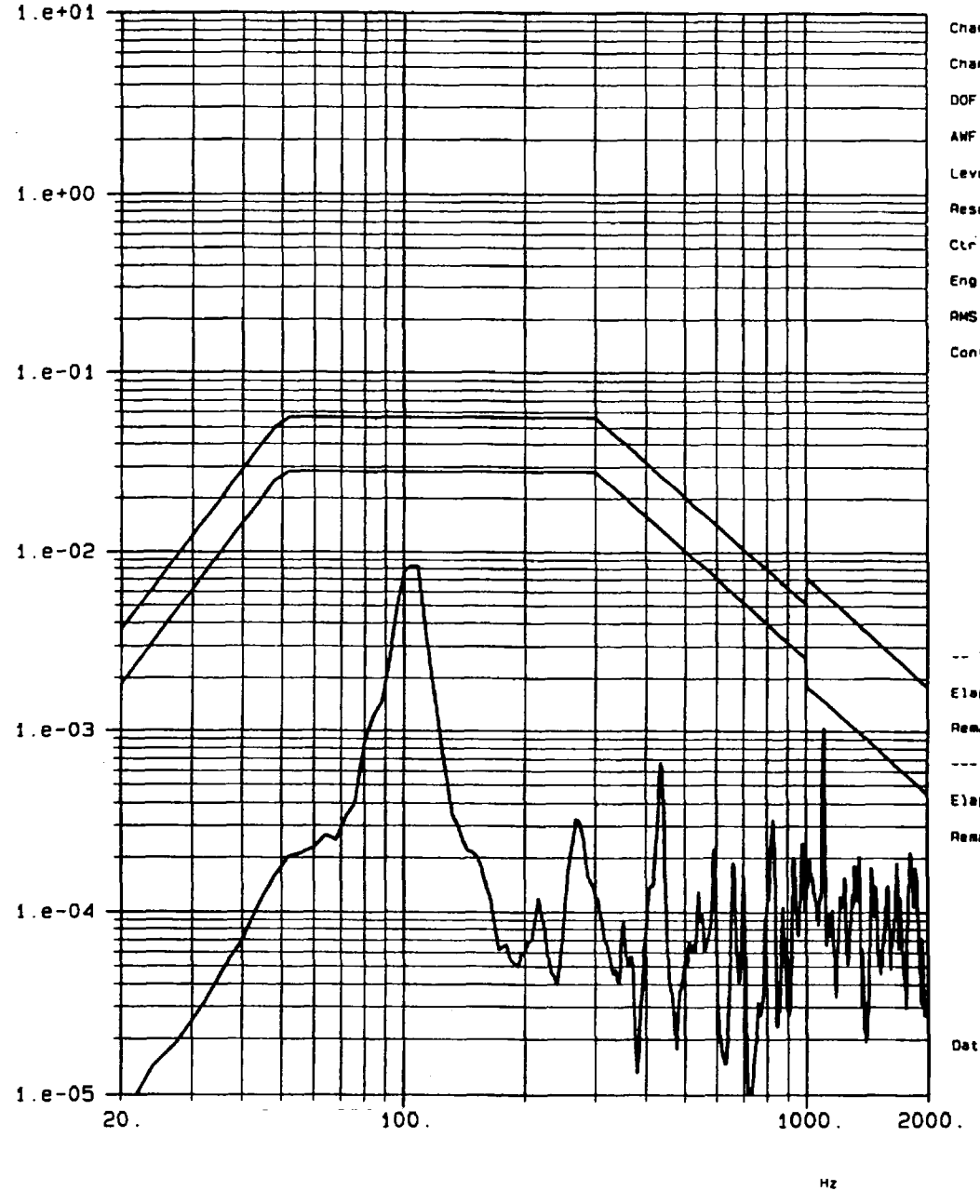
El Segundo, CA

g^2/Hz R1X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 3
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 0.61779 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:03:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:06:52
Remaining : 0:00:00

Date : 5/21/2002
20:51:49

RANDOM PLOT NO. 16

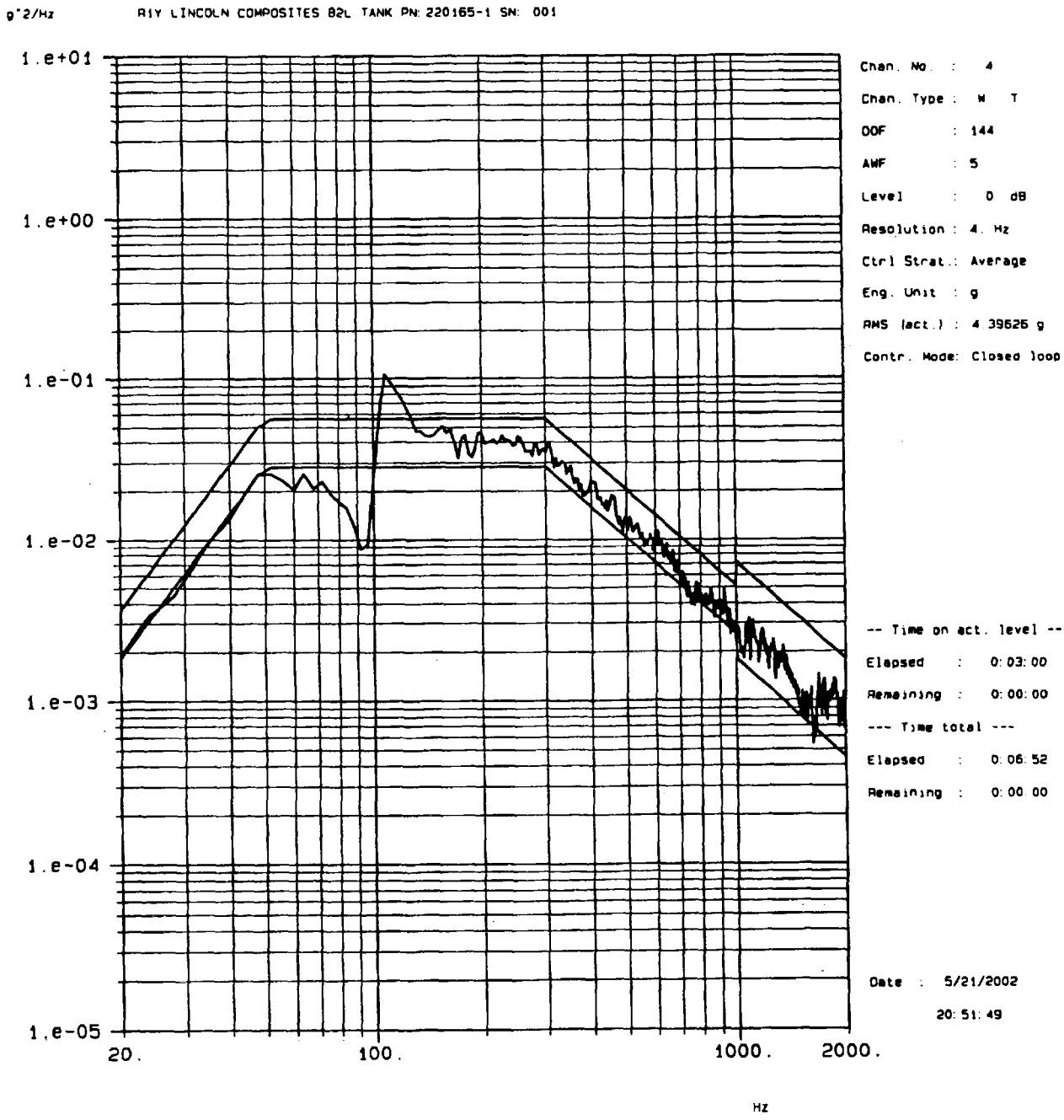
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS FULL LEVEL 3

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 17

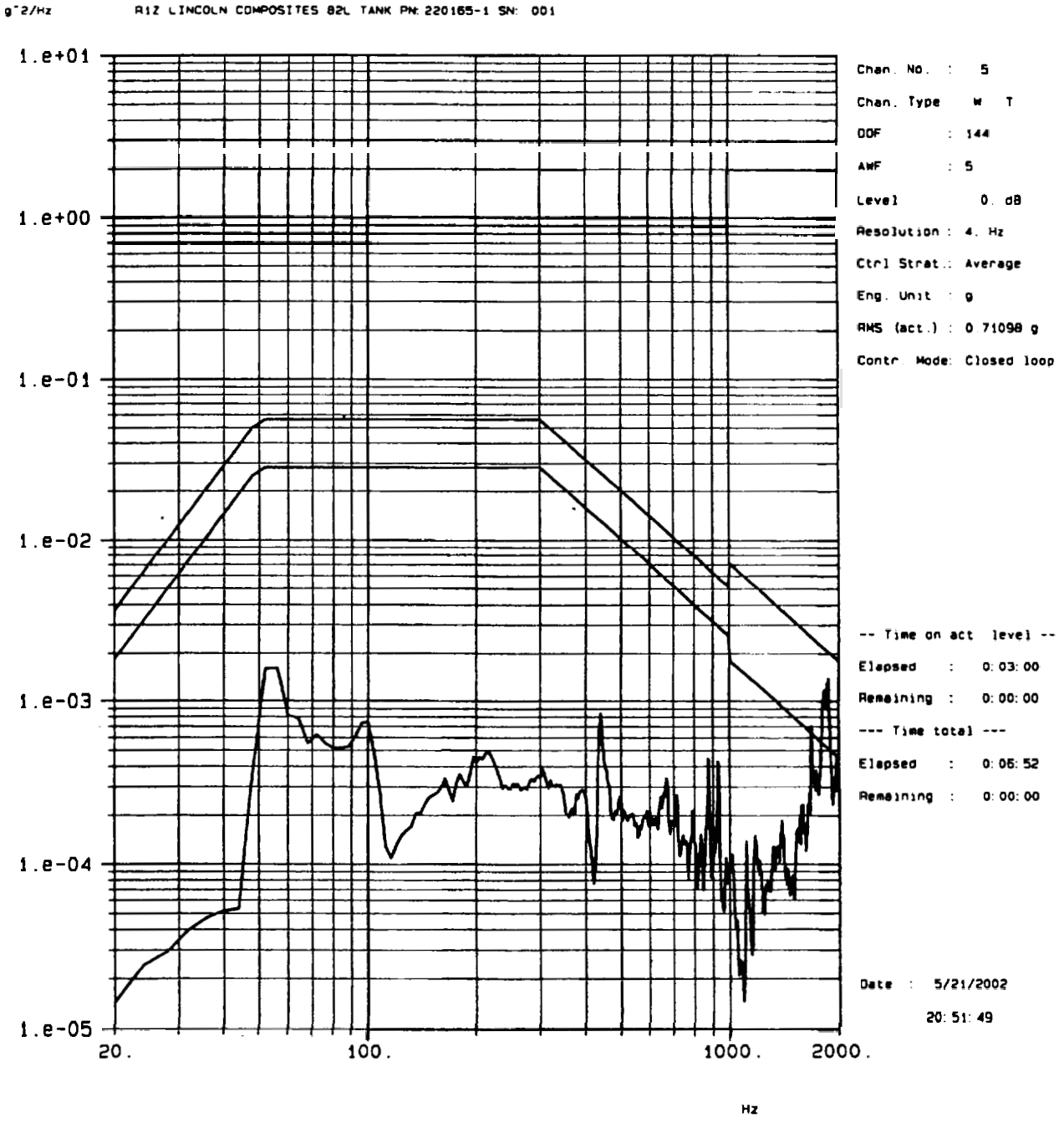
Random Limit Channel

LINCOLN 47039 DUAL

Y AXIS FULL LEVEL 3

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 18

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS FULL LEVEL 3

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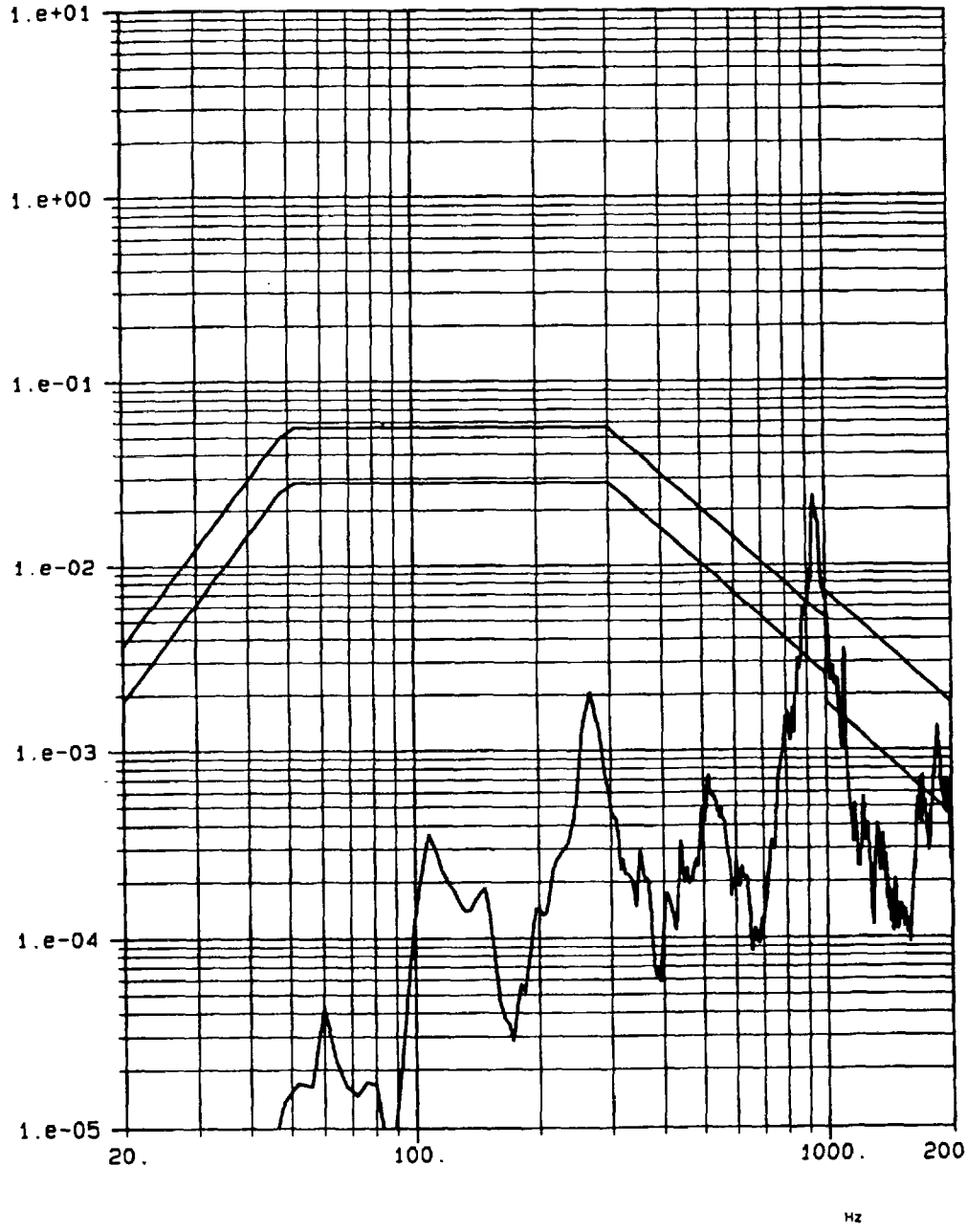
El Segundo, CA

g^2/Hz R2X LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 6

Chan. Type : M T

DOF : 144

AWF : 5

Level : 0 dB

Resolution : 4. Hz

Ctrl Strat.: Average

Eng. Unit : g

RMS (act.) : 1.564 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0:03:00

Remaining : 0:00:00

--- Time total ---

Elapsed : 0:06:52

Remaining : 0:00:00

Date : 5/21/2002

20:51:49

RANDOM PLOT NO. 19

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS FULL LEVEL 3

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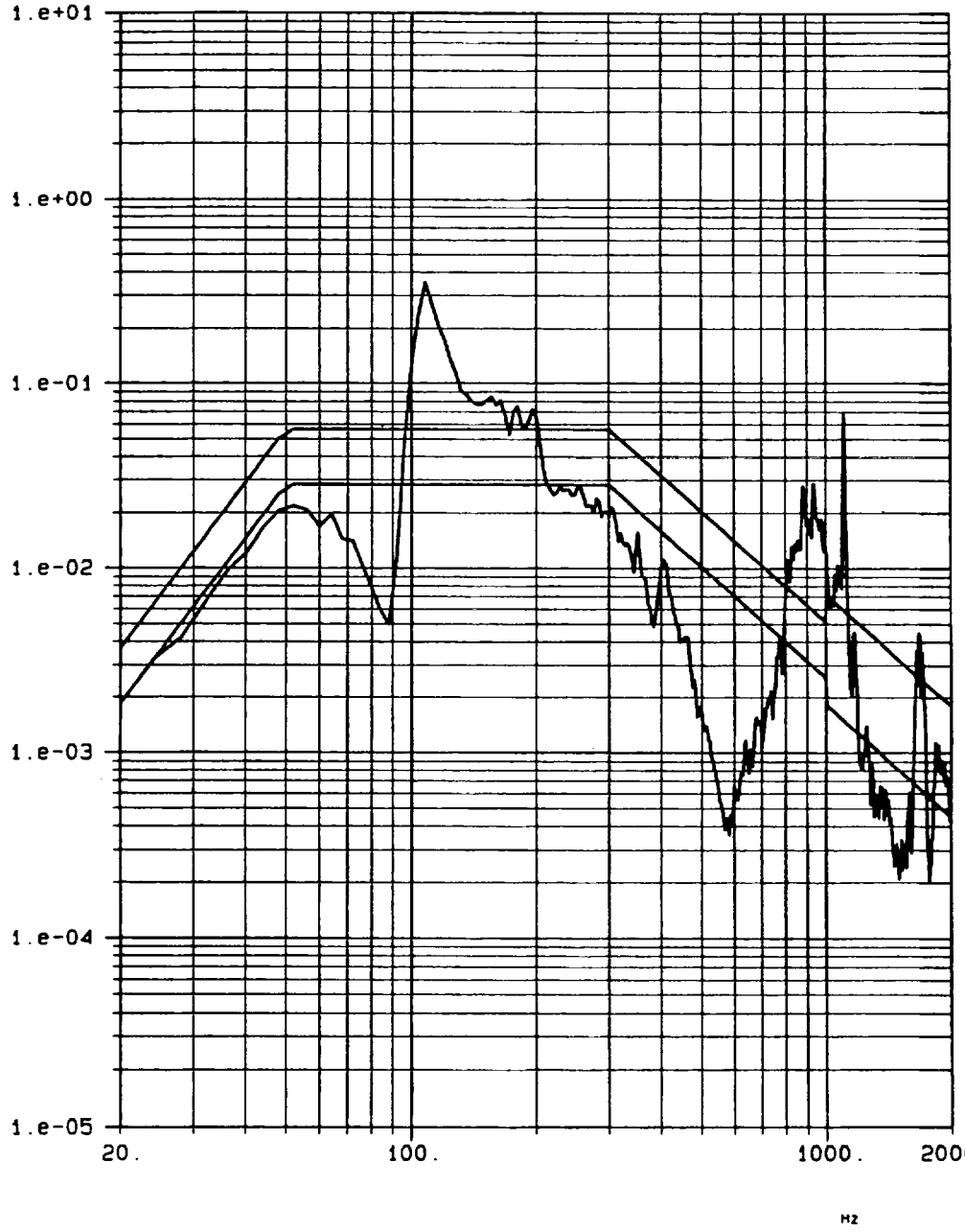
El Segundo, CA

g^2/Hz R2Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 7
Chan. Type : N T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 4.85106 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:03:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:06:52
Remaining : 0:00:00

Date : 5/21/2002
20:51:49

RANDOM PLOT NO. 20

Random Limit Channel

LINCOLN 47039 DUAL

Y AXIS FULL LEVEL 3

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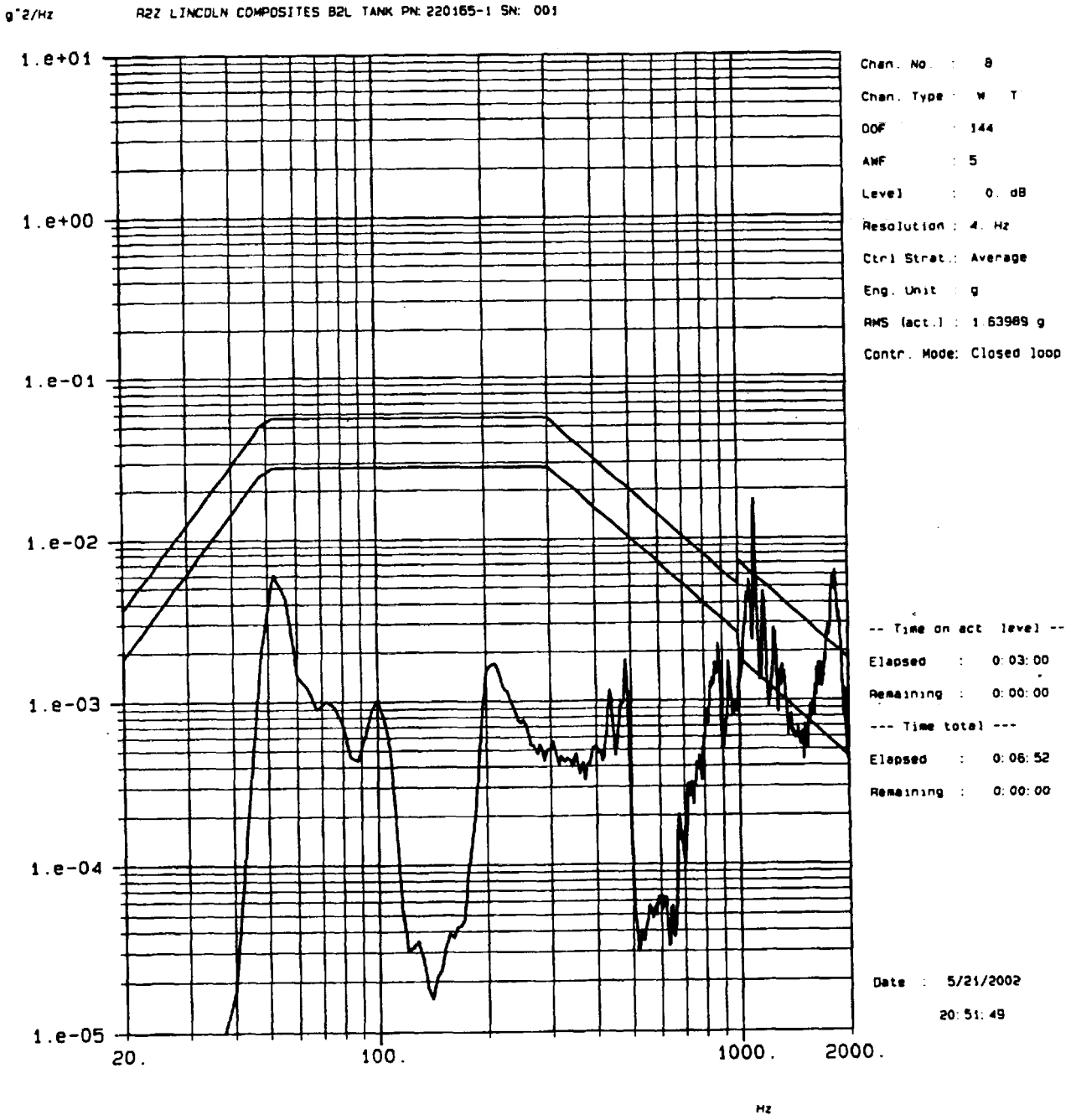
El Segundo, CA



RANDOM PLOT NO. 21

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS FULL LEVEL 3

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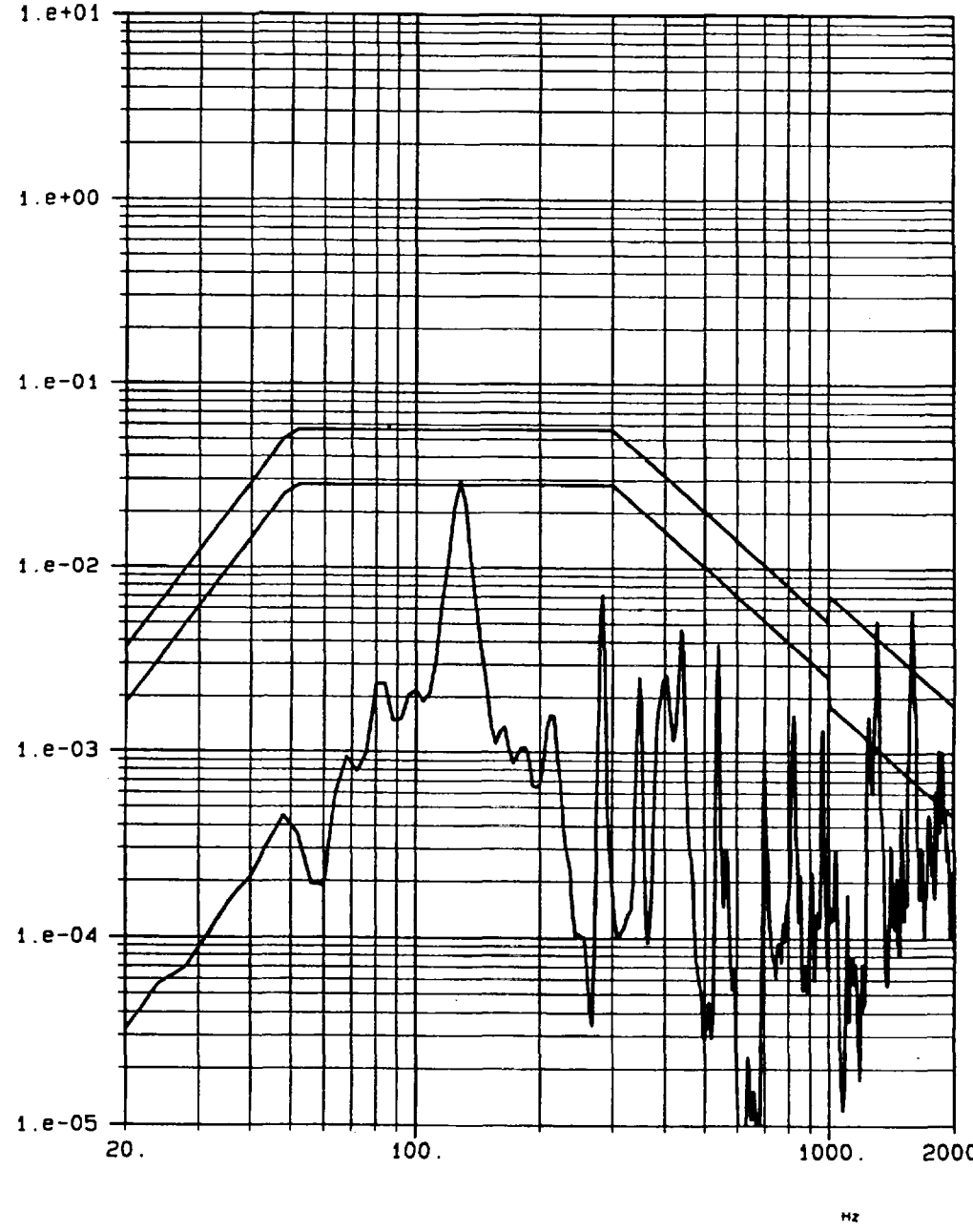
El Segundo, CA

g^2/Hz R3X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 1.26913 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:03:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:06:52
Remaining : 0:00:00

Date : 5/21/2002
20:51:49

RANDOM PLOT NO. 22

Random Limit Channel

LINCOLN 47039 DUAL

Y AXIS FULL LEVEL 3

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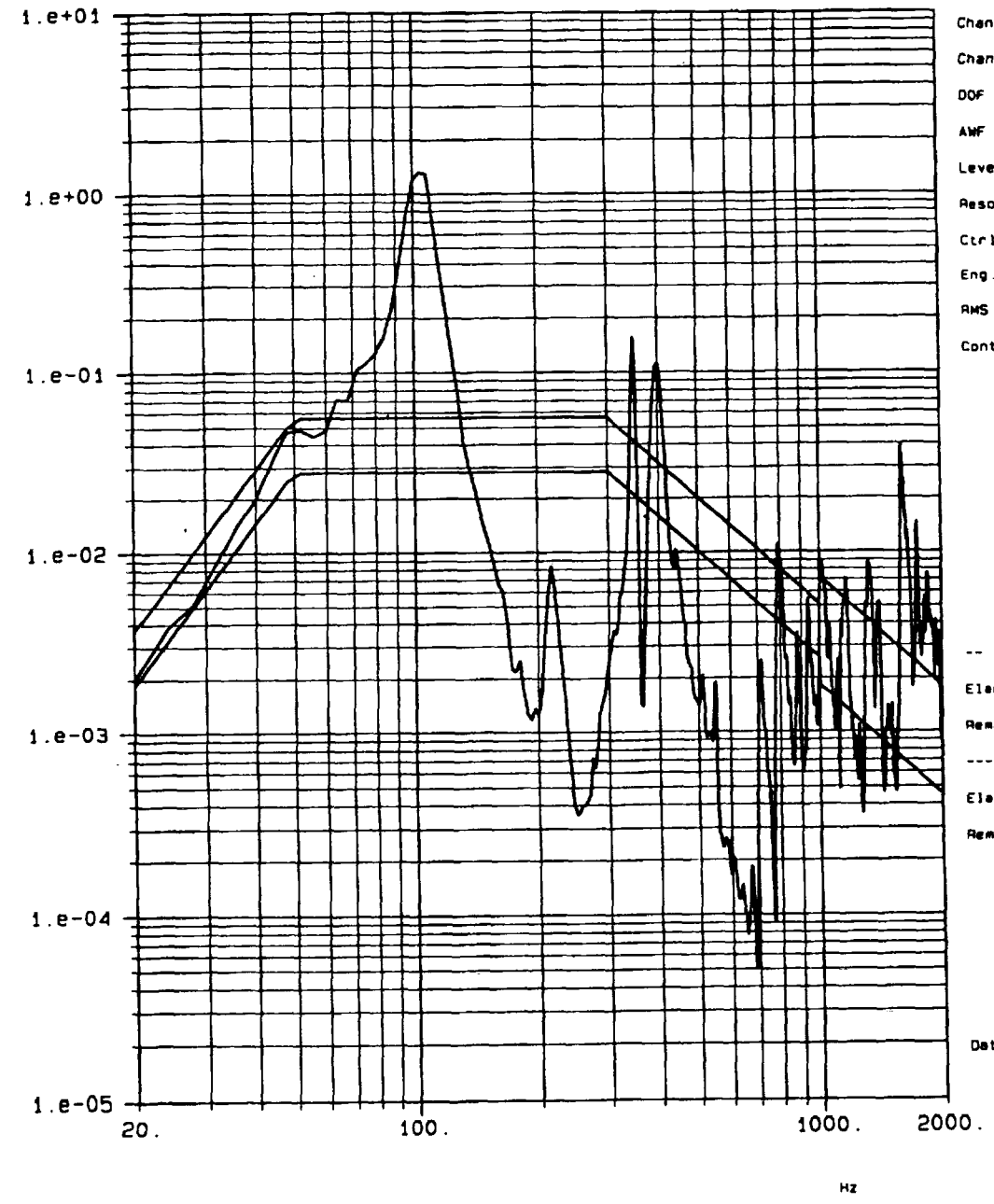
El Segundo, CA

g^2/Hz R3Y LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 10
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 6.50468 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:03:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:06:52
Remaining : 0:00:00

Date : 5/21/2002
20:51:49

RANDOM PLOT NO. 23

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS FULL LEVEL 3

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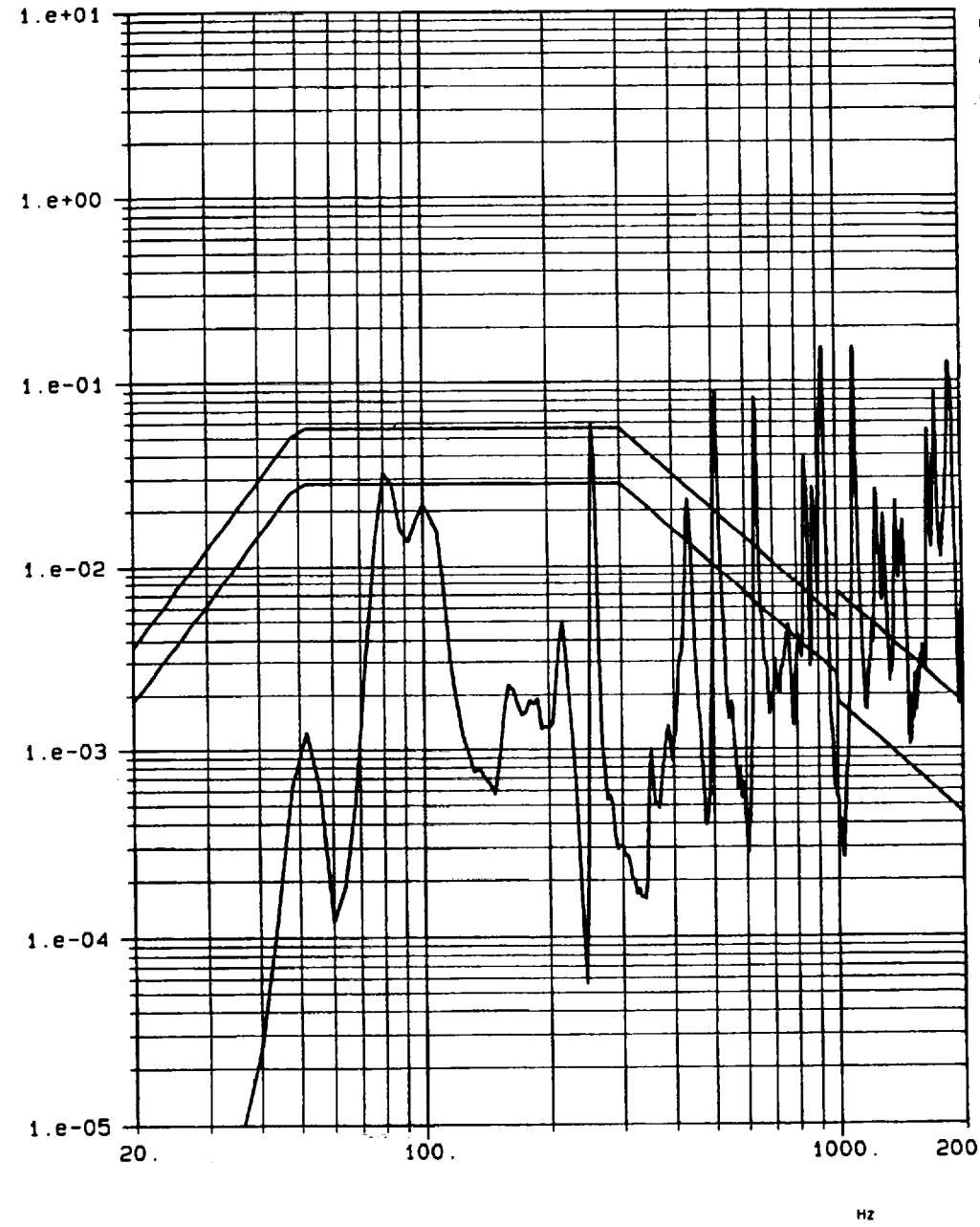
El Segundo, CA

g^2/Hz R3Z LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 11
Chan. Type : W T
DOF 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 5.24194 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:03:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:05:52
Remaining : 0:00:00

Date : 5/21/2002
20:51:49

RANDOM PLOT NO. 24

Random Limit Channel

LINCOLN 47039 DUAL

Y AXIS FULL LEVEL 3

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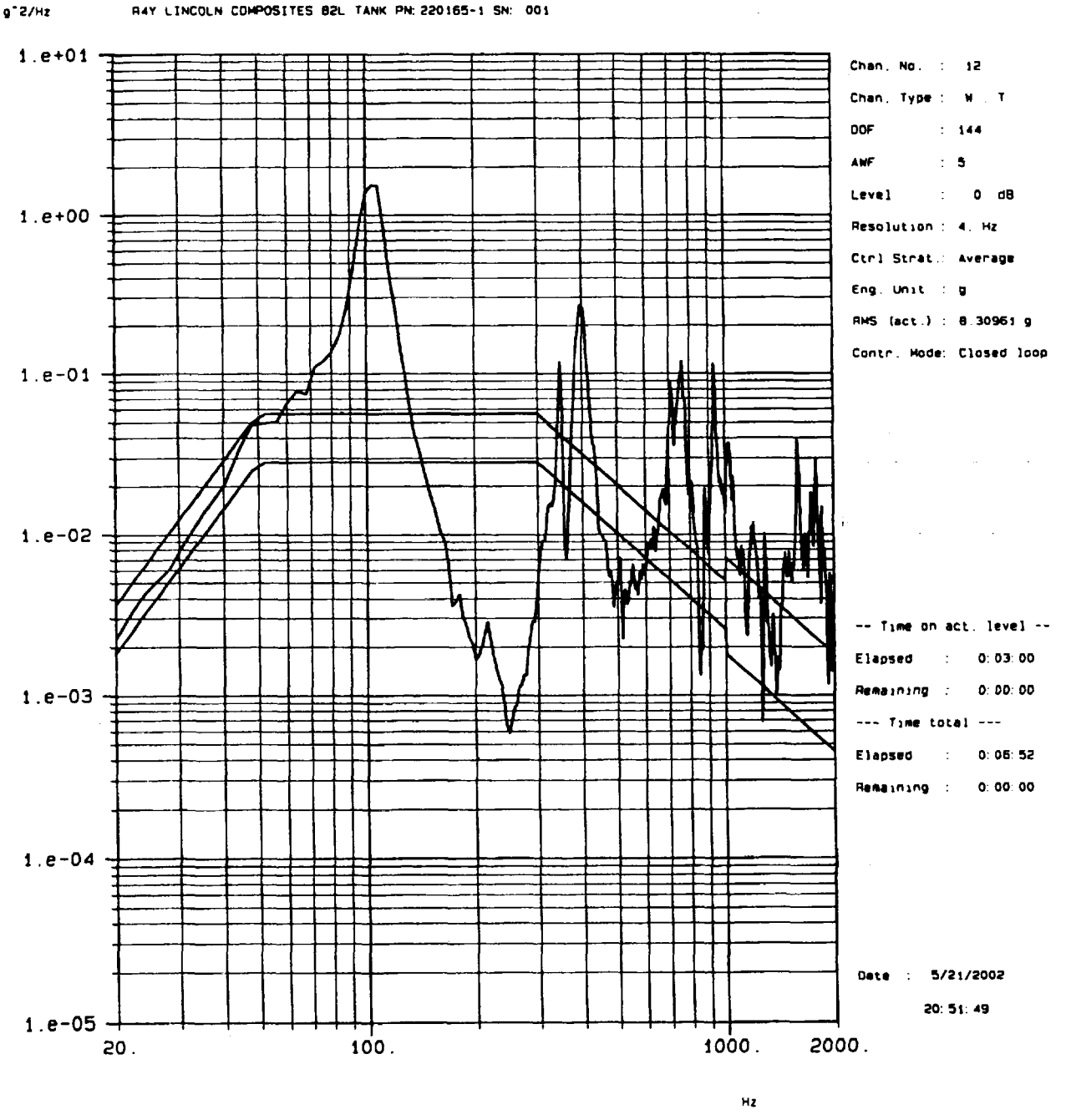
El Segundo, CA



RANDOM PLOT NO. 25

Random Control Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID

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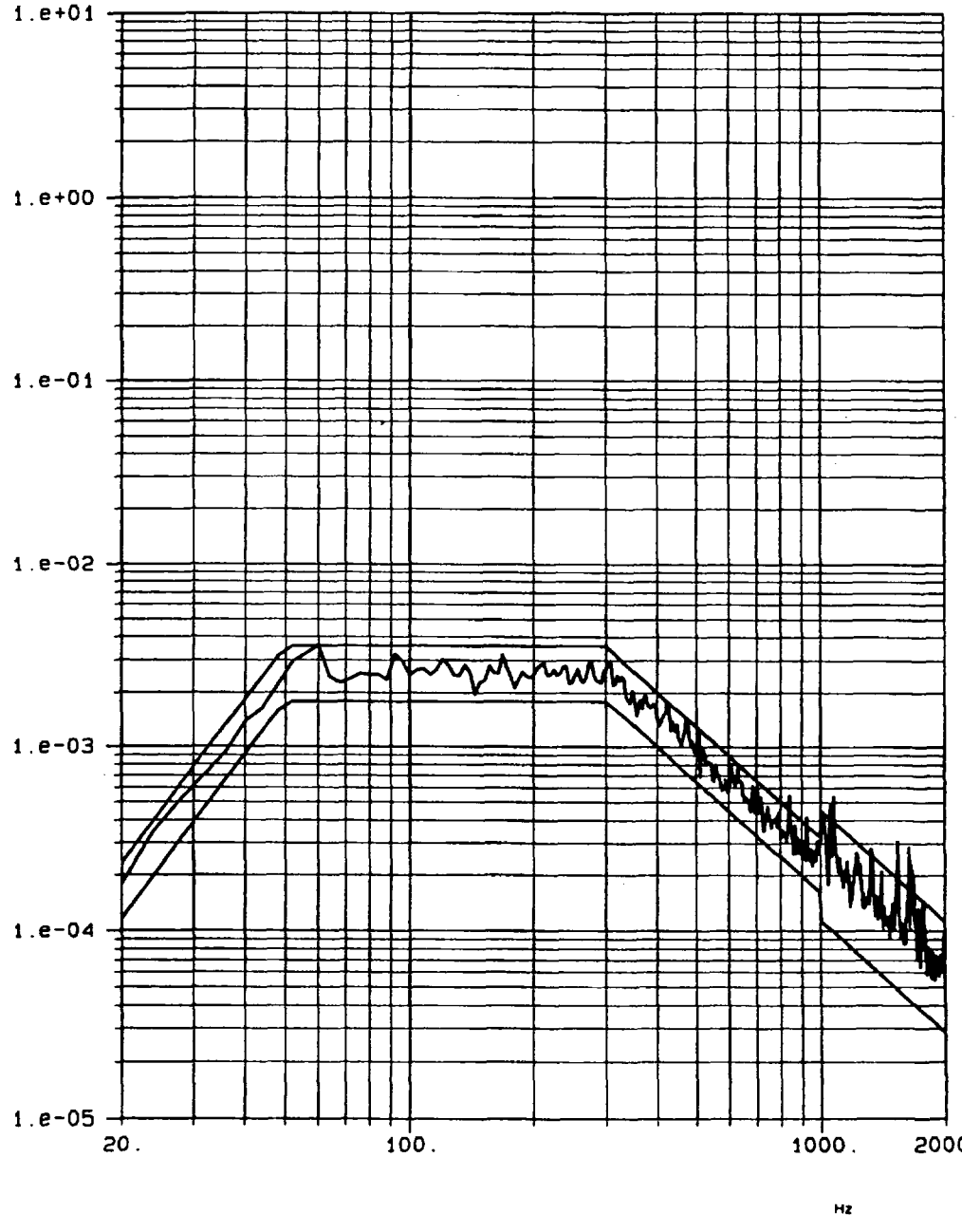
El Segundo, CA

g^2/Hz C1 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 1
Chan. Type : C
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 1.18592 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:01:43
Remaining : 0:05:28

Date : 5/21/2002
20:59:23

RANDOM PLOT NO. 26

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID

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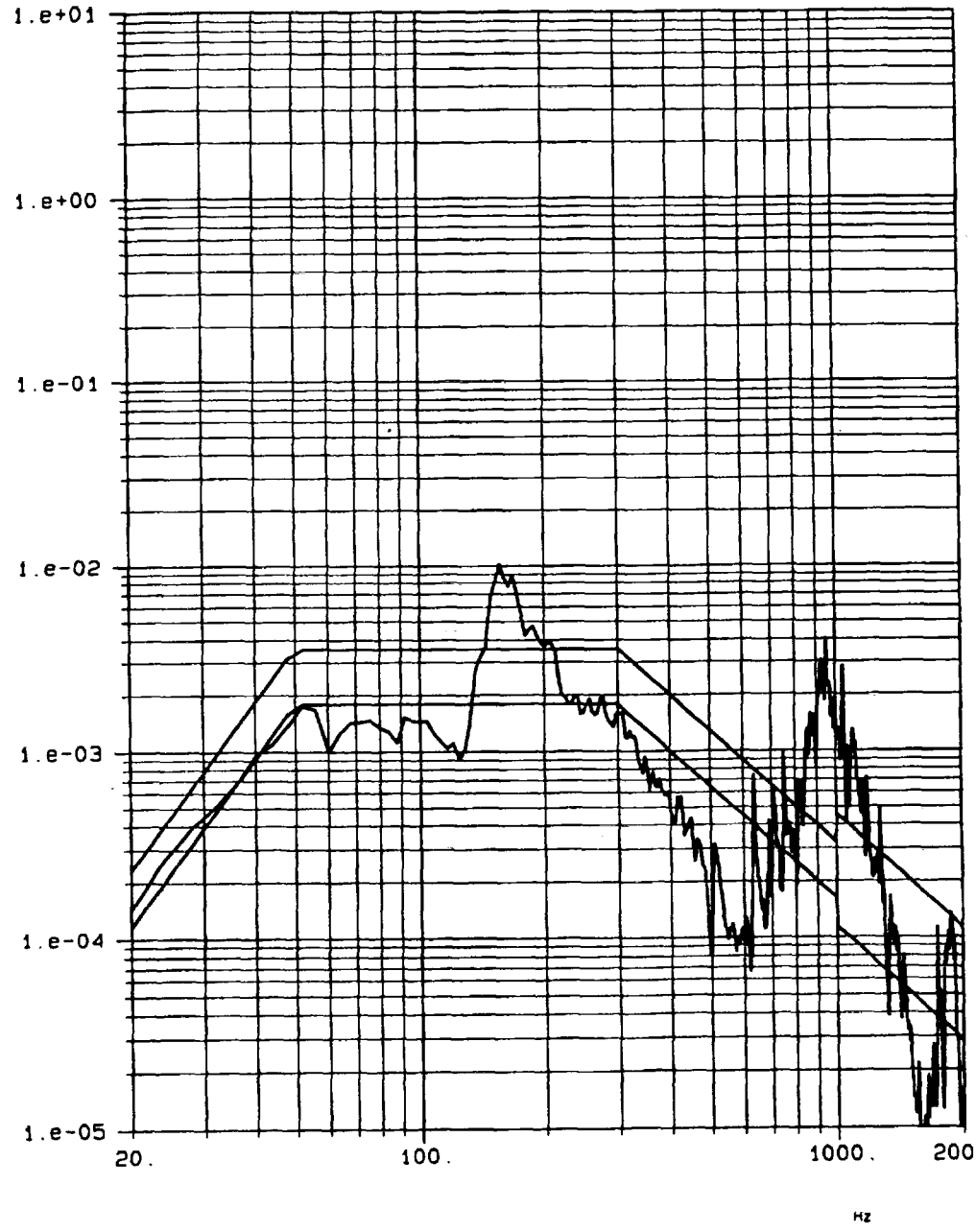
El Segundo, CA

g^2/Hz C2 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 2

Chan. Type : T

DOF : 144

AWF : 5

Level : -12. dB

Resolution : 4. Hz

Ctrl Strat.: Average

Eng. Unit : g

RMS (act.) : 1.20704 g

Contr Mode: Closed loop

-- Time on act. level --

Elapsed : 0:00:32

Remaining : 0:00:13

--- Time total ---

Elapsed : 0:01:43

Remaining : 0:05:28

Date : 5/21/2002

20:59:23

RANDOM PLOT NO. 27

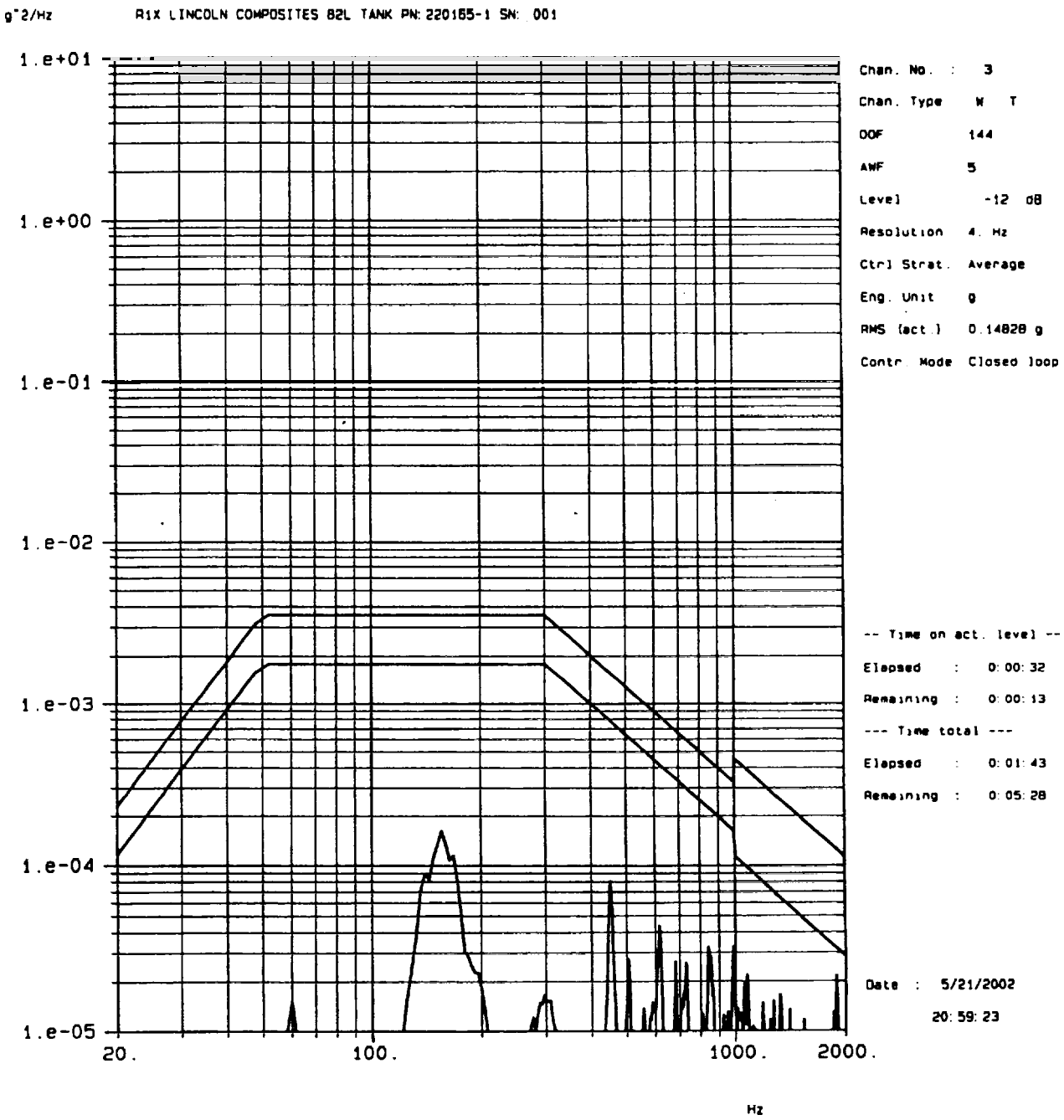
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 28

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID

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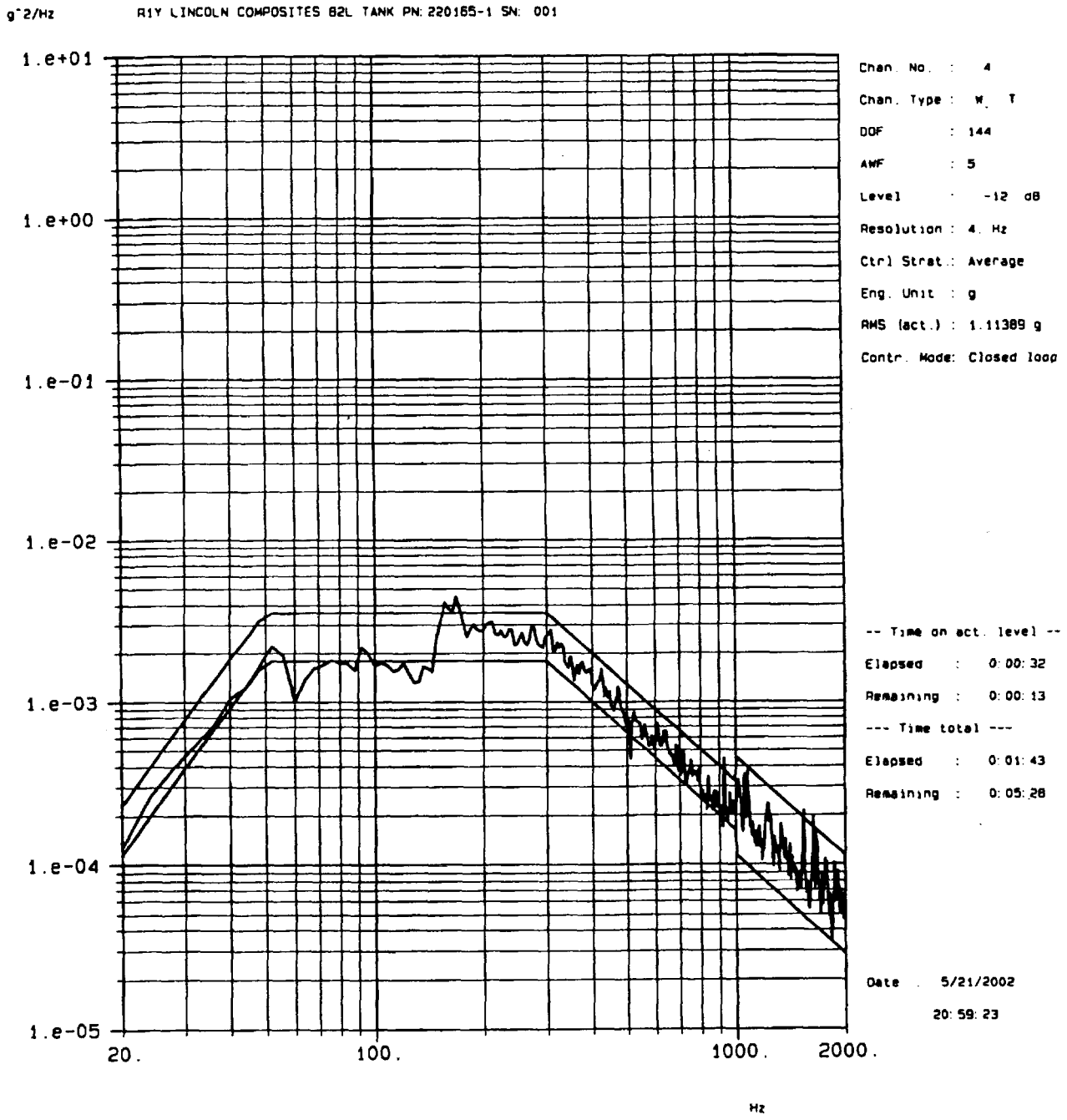
El Segundo, CA



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RANDOM PLOT NO. 29

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID

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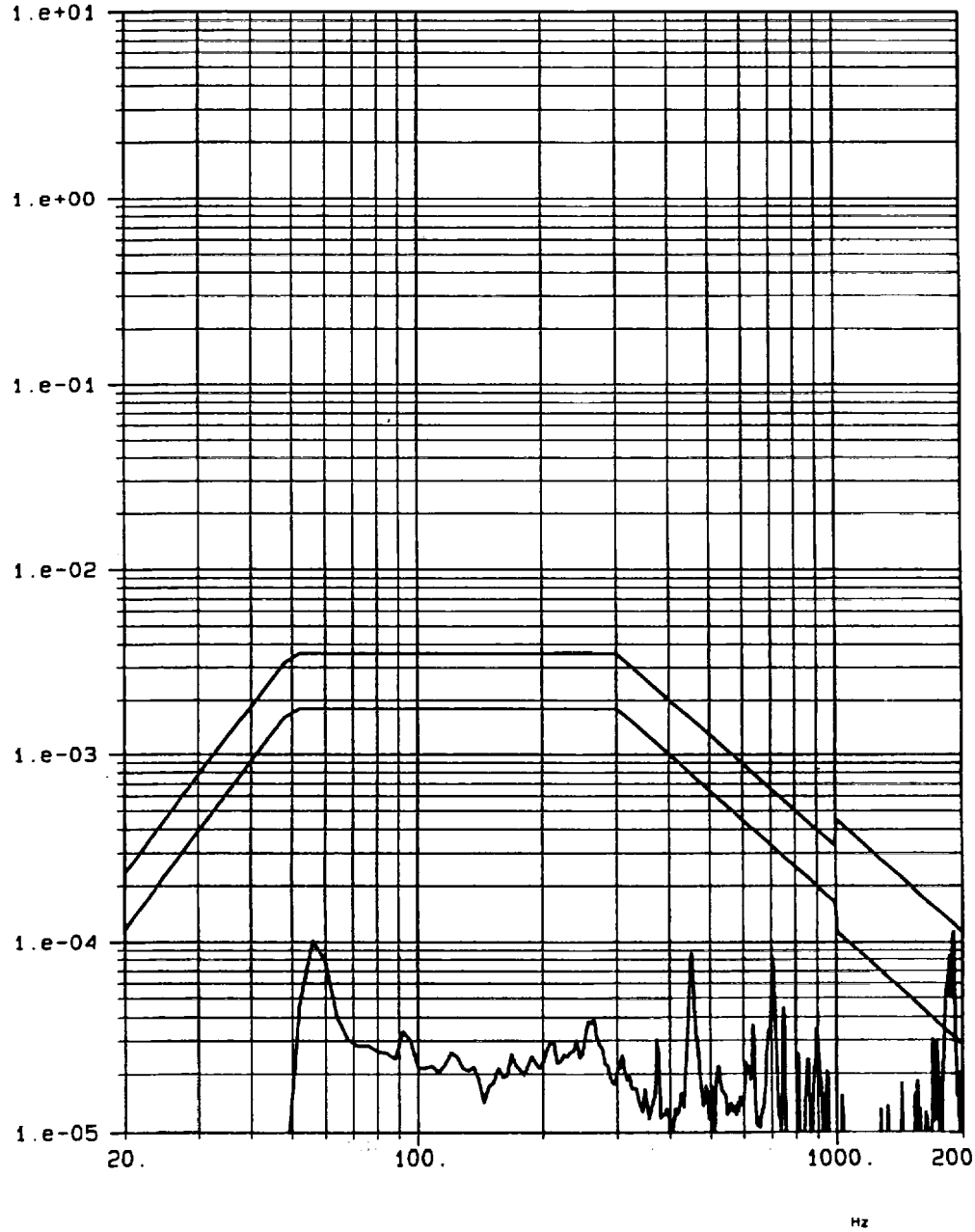
El Segundo, CA

g^2/Hz R1Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 5
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 0.18789 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:01:43
Remaining : 0:05:28

Date : 5/21/2002
20:59:23

RANDOM PLOT NO. 30

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID

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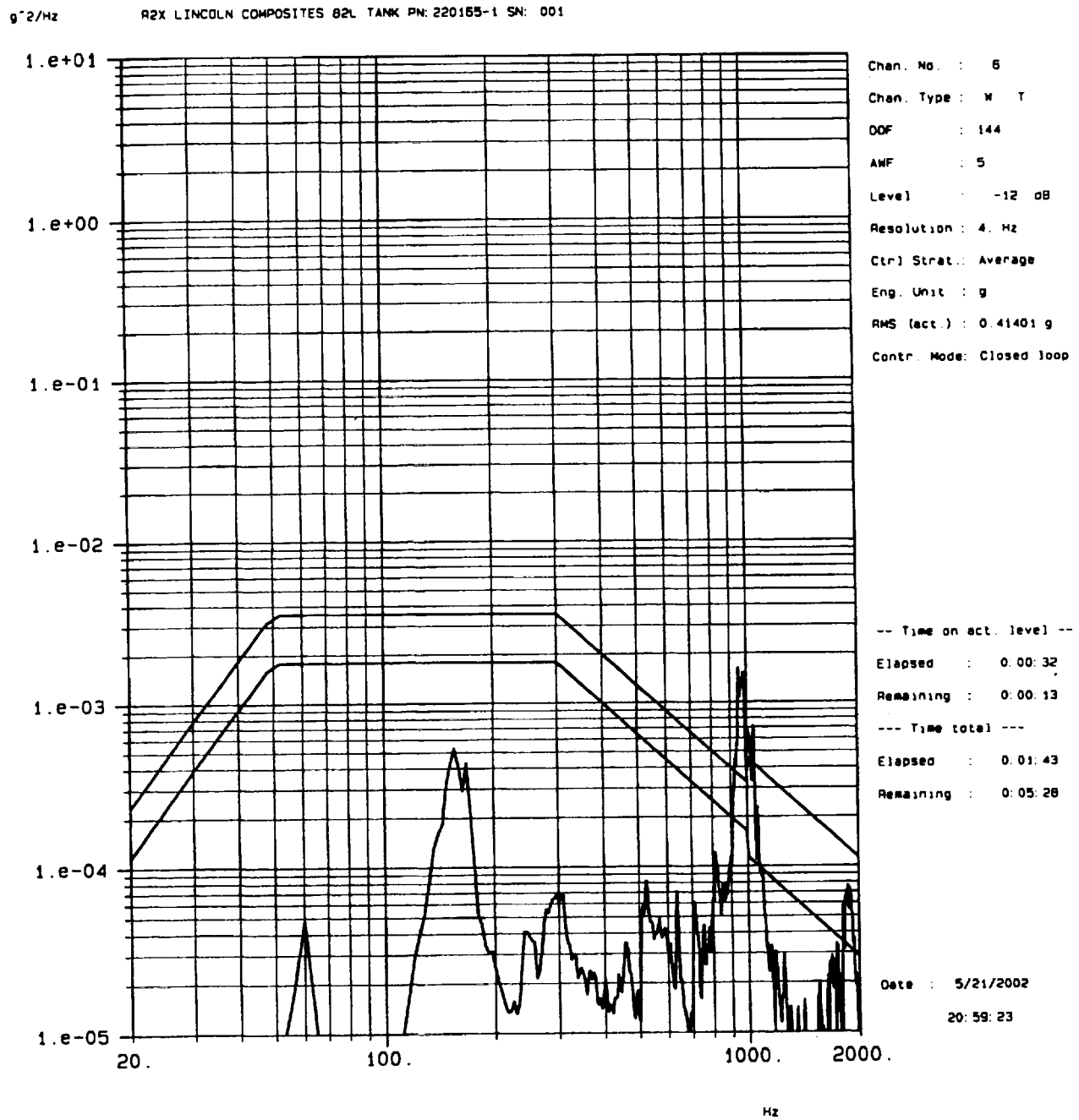
El Segundo, CA



RANDOM PLOT NO. 31

Random Limit Channel

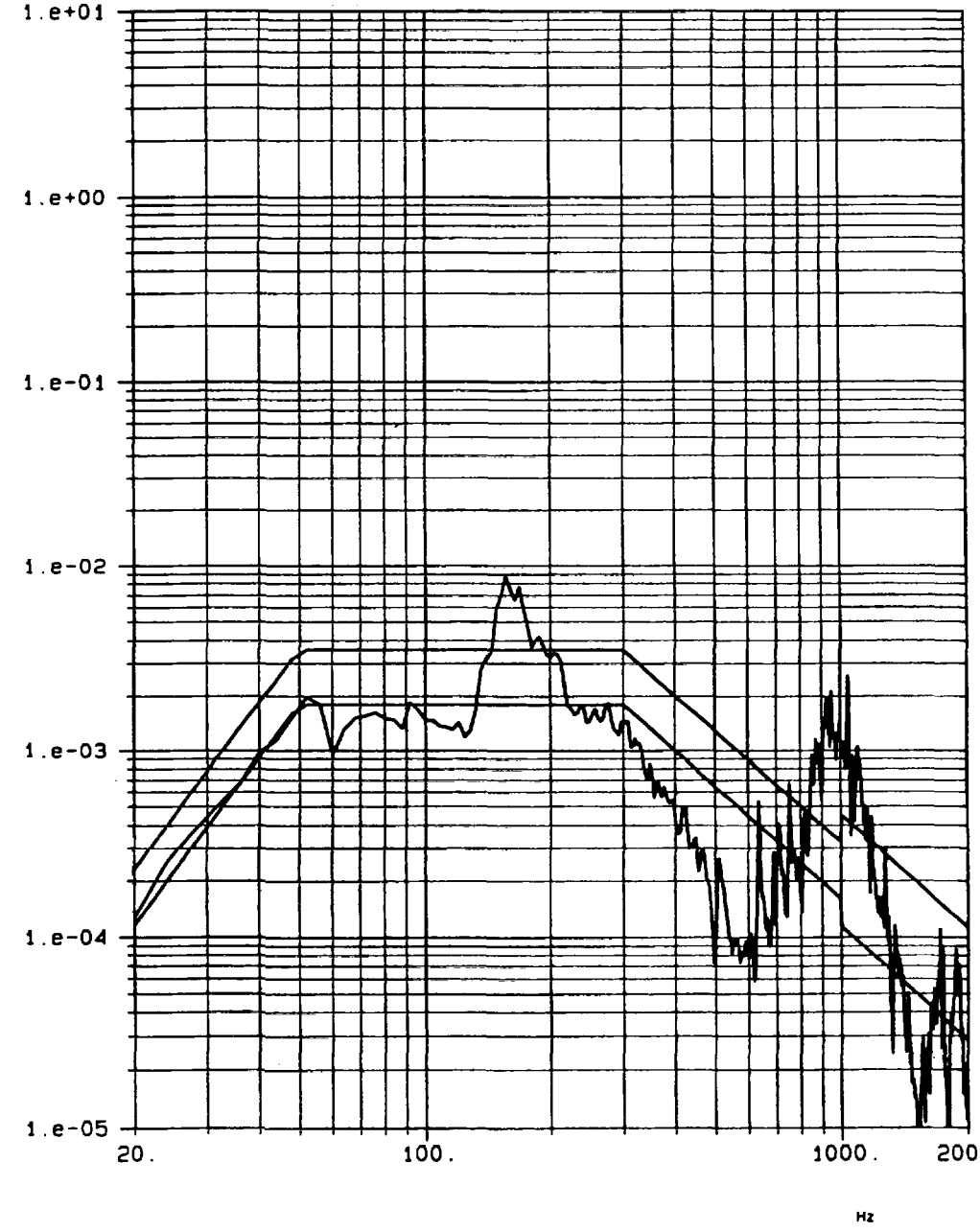
LINCOLN 47039 QUAL

Y AXIS -12 MID

Wyle Laboratories

El Segundo, CA

g^2/Hz R2Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 7
Chan. Type : N T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 1.10165 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:01:43
Remaining : 0:05:28

Date : 5/21/2002
20:59:23

RANDOM PLOT NO. 32

Random Limit Channel

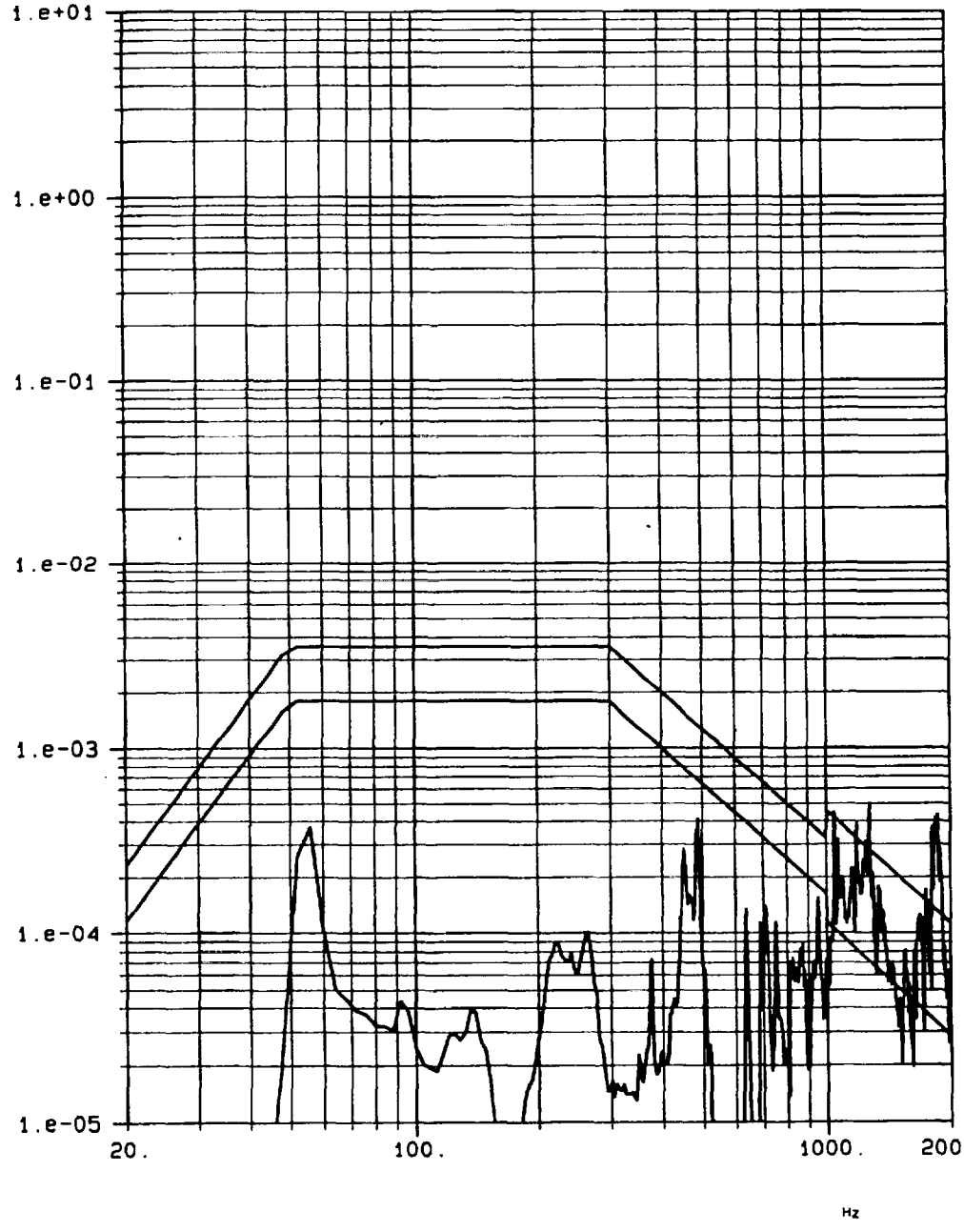
LINCOLN 47039 QUAL

Y AXIS -12 MID

Wyle Laboratories

El Segundo, CA

g^2/Hz R2Z LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : B
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat : Average
Eng. Unit : g
RMS (act.) : 0.4292 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:01:43
Remaining : 0:05:28

Date : 5/21/2002
20:59:23

RANDOM PLOT NO. 33

Random Limit Channel

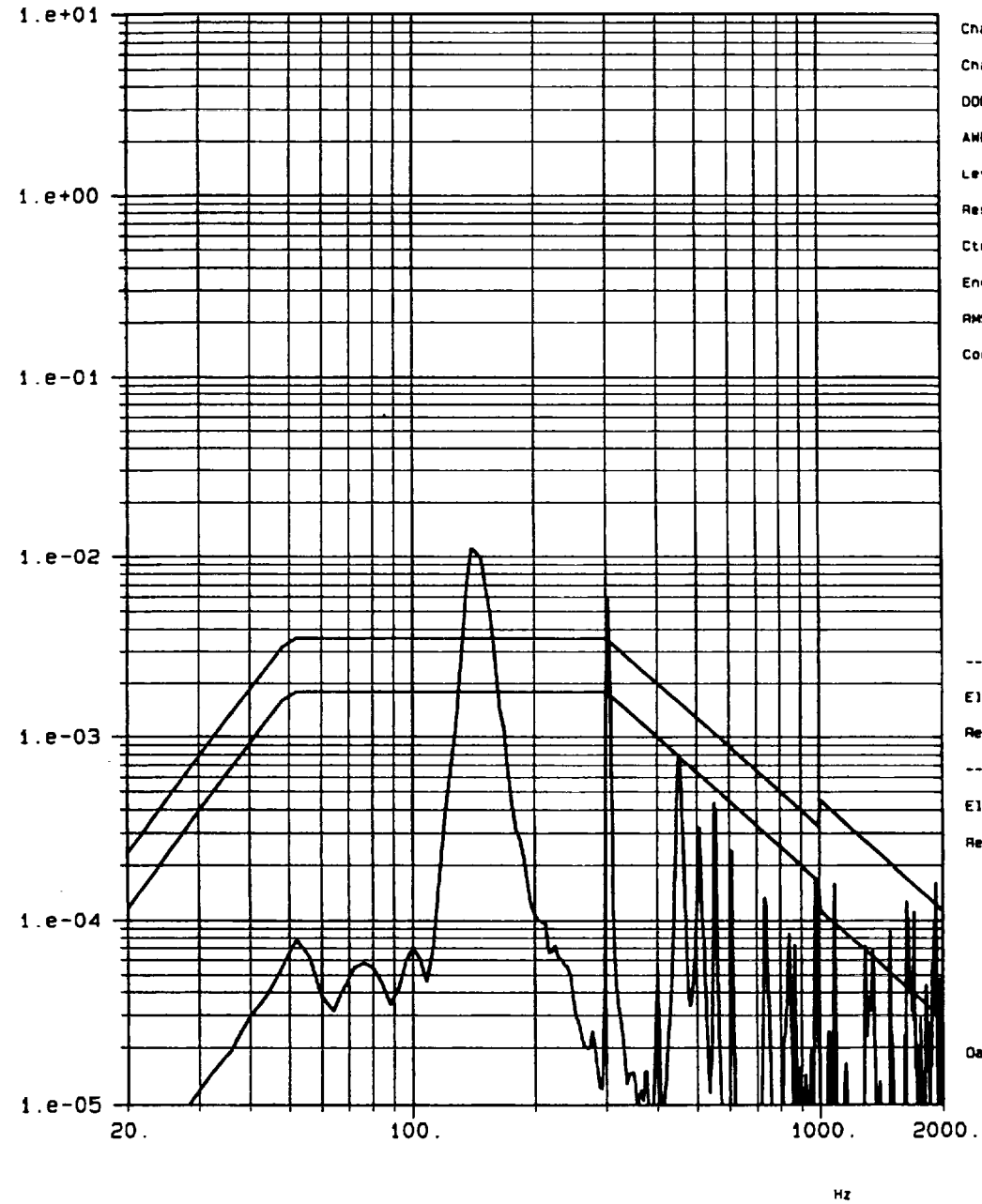
LINCOLN 47039 QUAL

Y AXIS -12 MID

Wyle Laboratories

El Segundo, CA

g^2/Hz R3X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : W. T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 0.59457 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0: 00: 32
Remaining : 0: 00: 13
--- Time total ---
Elapsed : 0: 01: 43
Remaining : 0: 05: 28

Date : 5/21/2002
20: 59: 23

RANDOM PLOT NO. 34

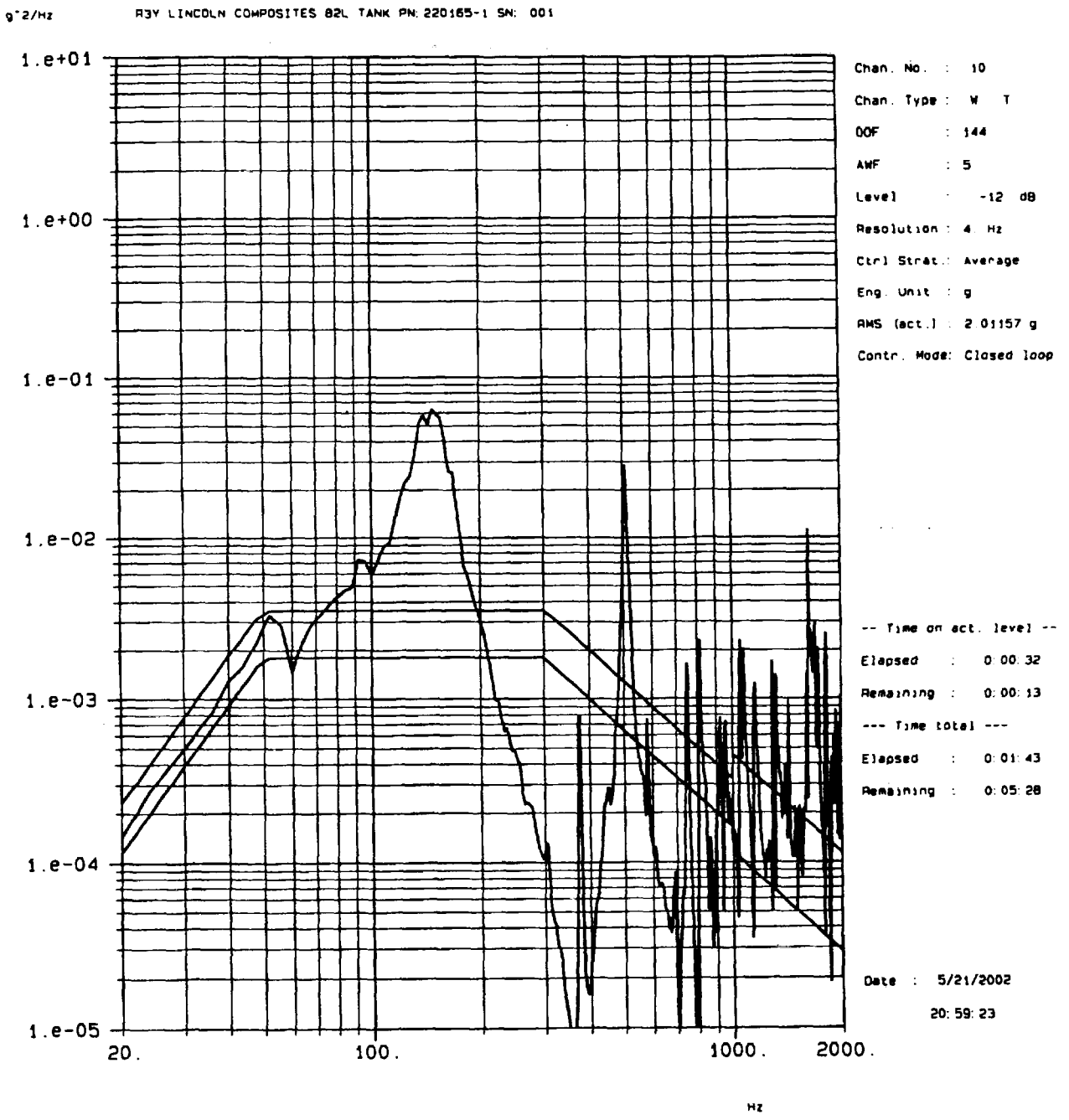
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 35

Random Limit Channel

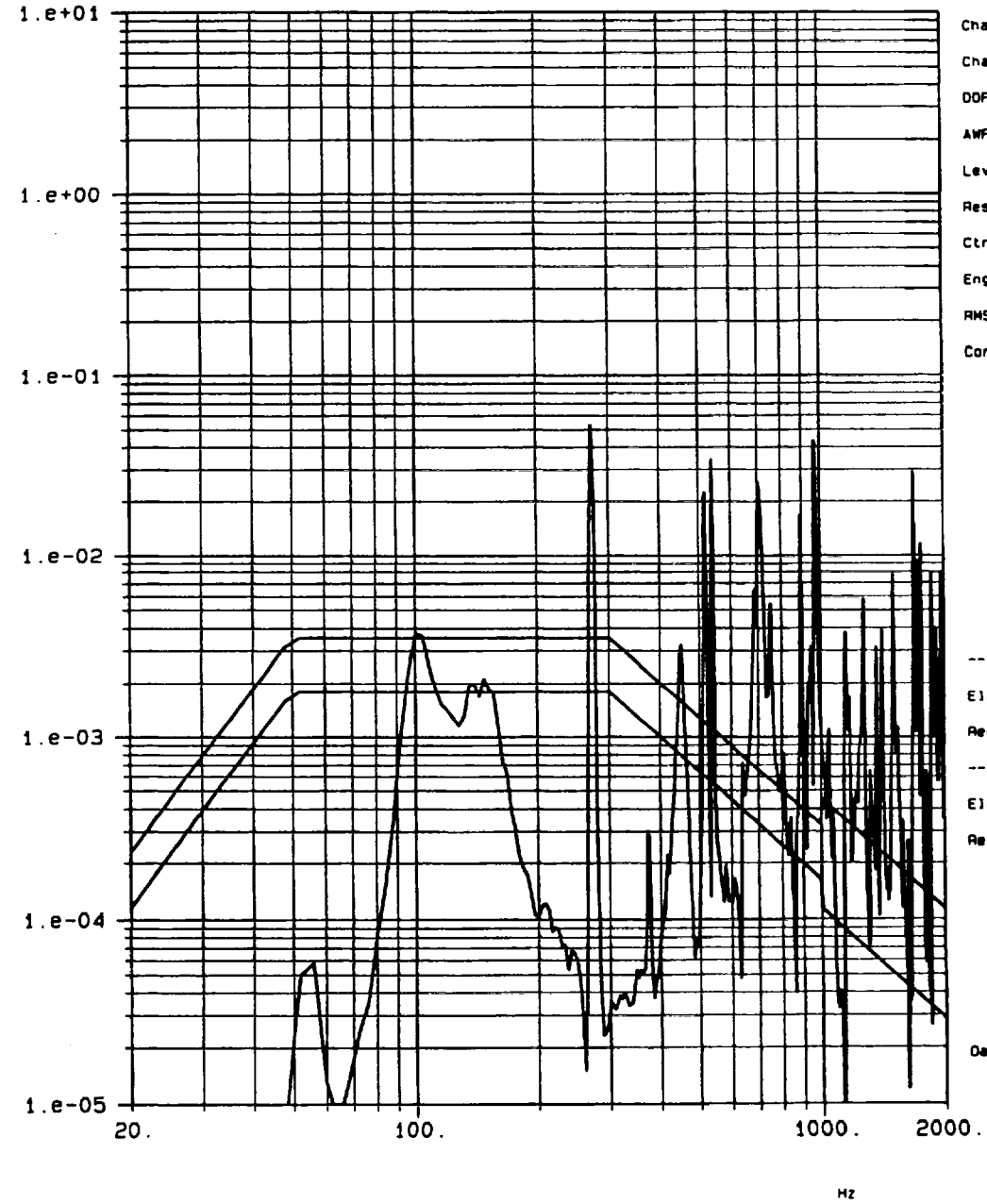
LINCOLN 47039 QUAL

Y AXIS -12 MID

Wyle Laboratories

El Segundo, CA

g^2/Hz R3Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 11
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 2.00962 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:32
Remaining : 0:00:13
--- Time total ---
Elapsed : 0:01:43
Remaining : 0:05:28

Date : 5/21/2002
20:59:23

RANDOM PLOT NO. 36

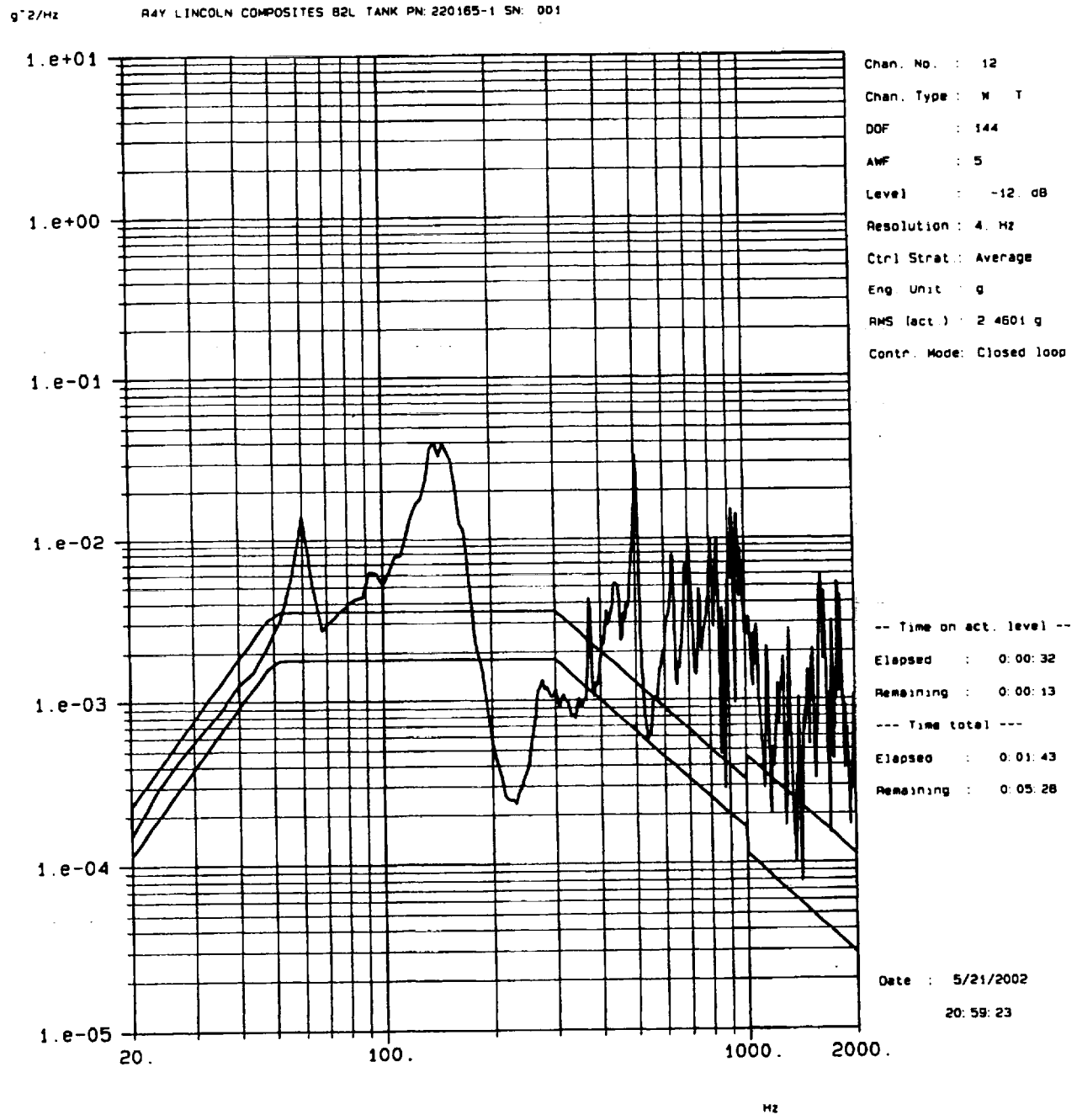
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 37

Random Control Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID2

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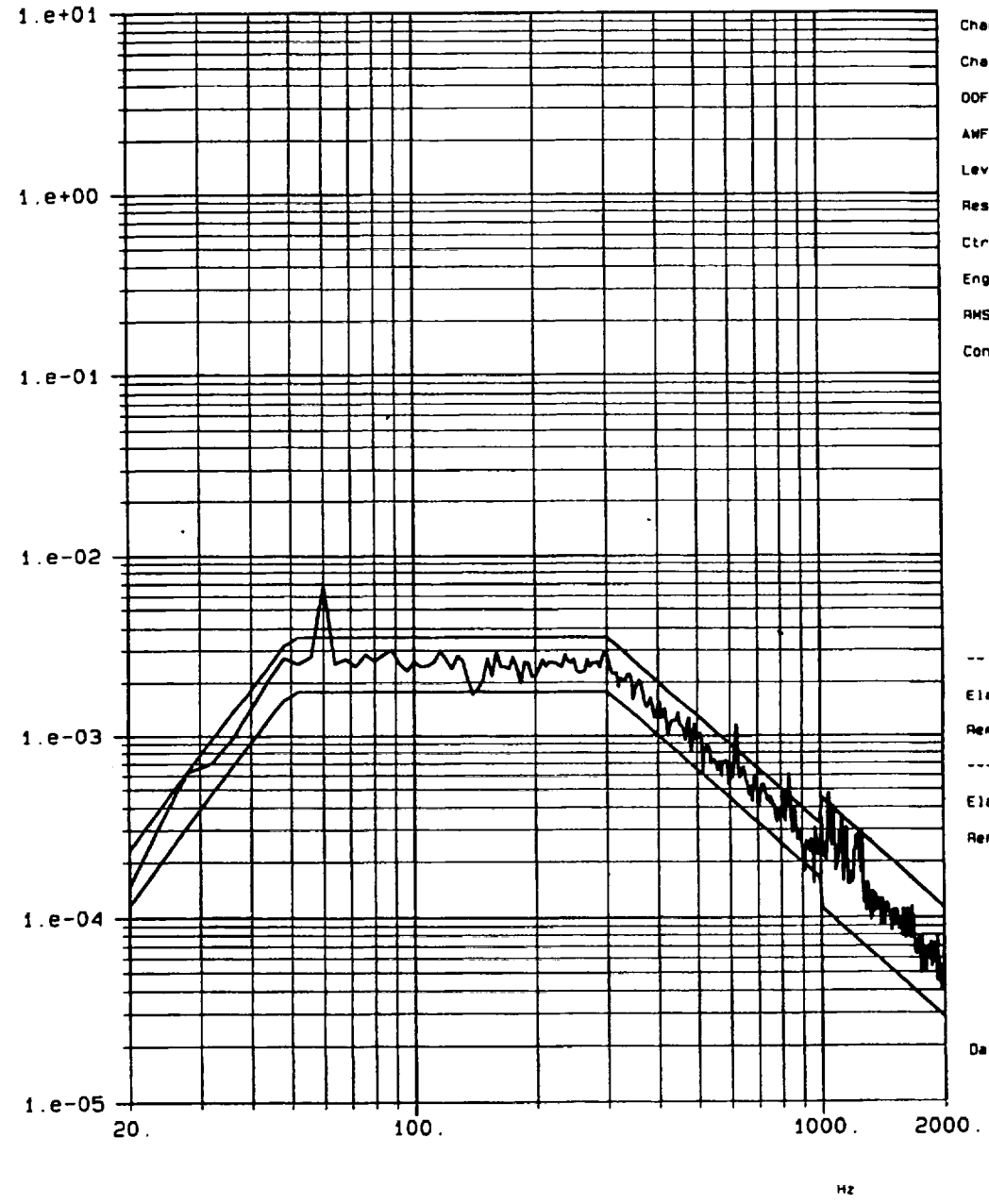
El Segundo, CA

g^2/Hz C1 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 1
Chan. Type : C
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 1.16843 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:11
Remaining : 0:05:30

Date : 5/23/2002
19:23:57

RANDOM PLOT NO. 38

Random Limit Channel

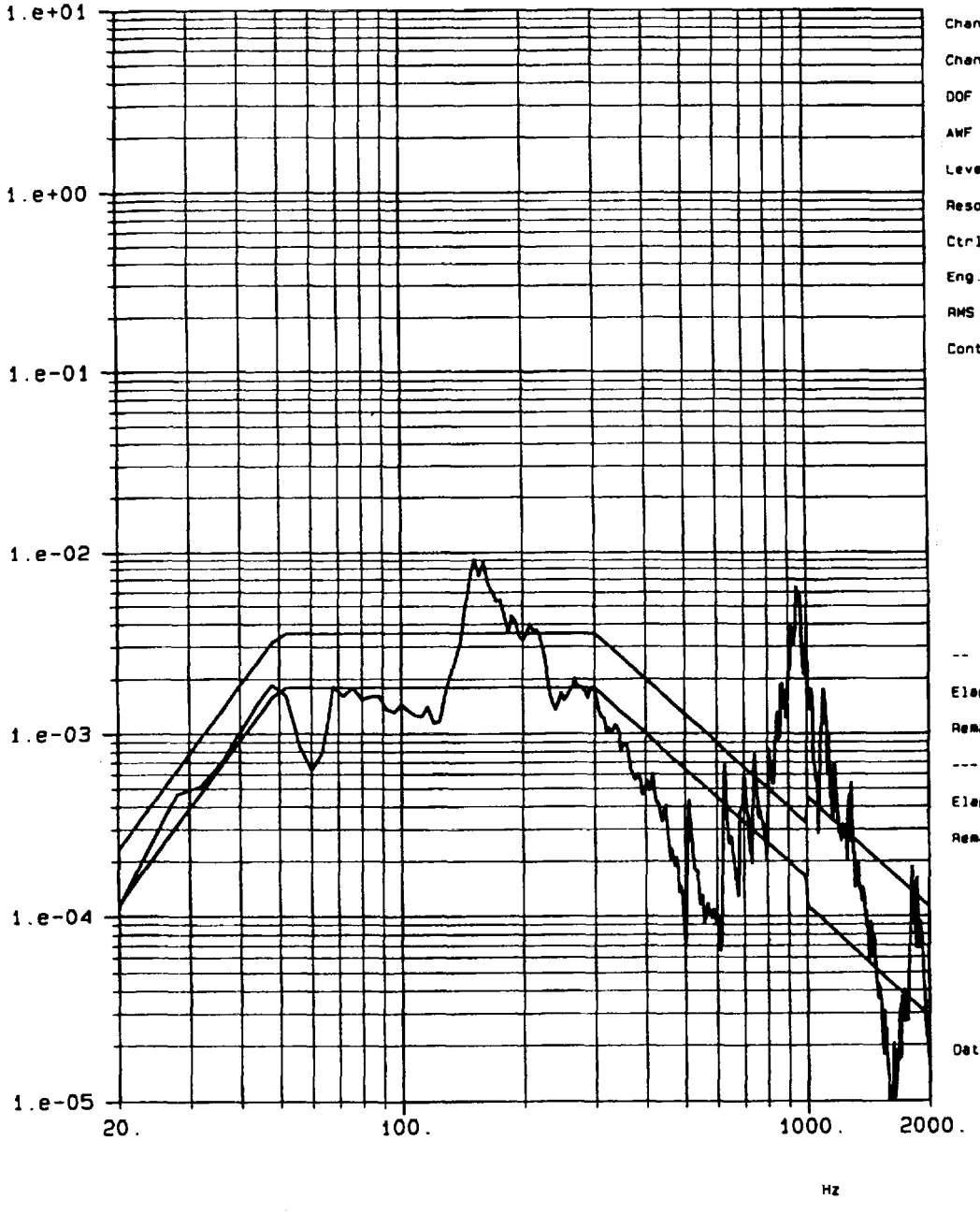
LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA

g^2/Hz C2 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 2
Chan. Type : N . T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 1.2906 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:11
Remaining : 0:05:30

Date : 5/23/2002
19:23:57

RANDOM PLOT NO. 39

Random Limit Channel

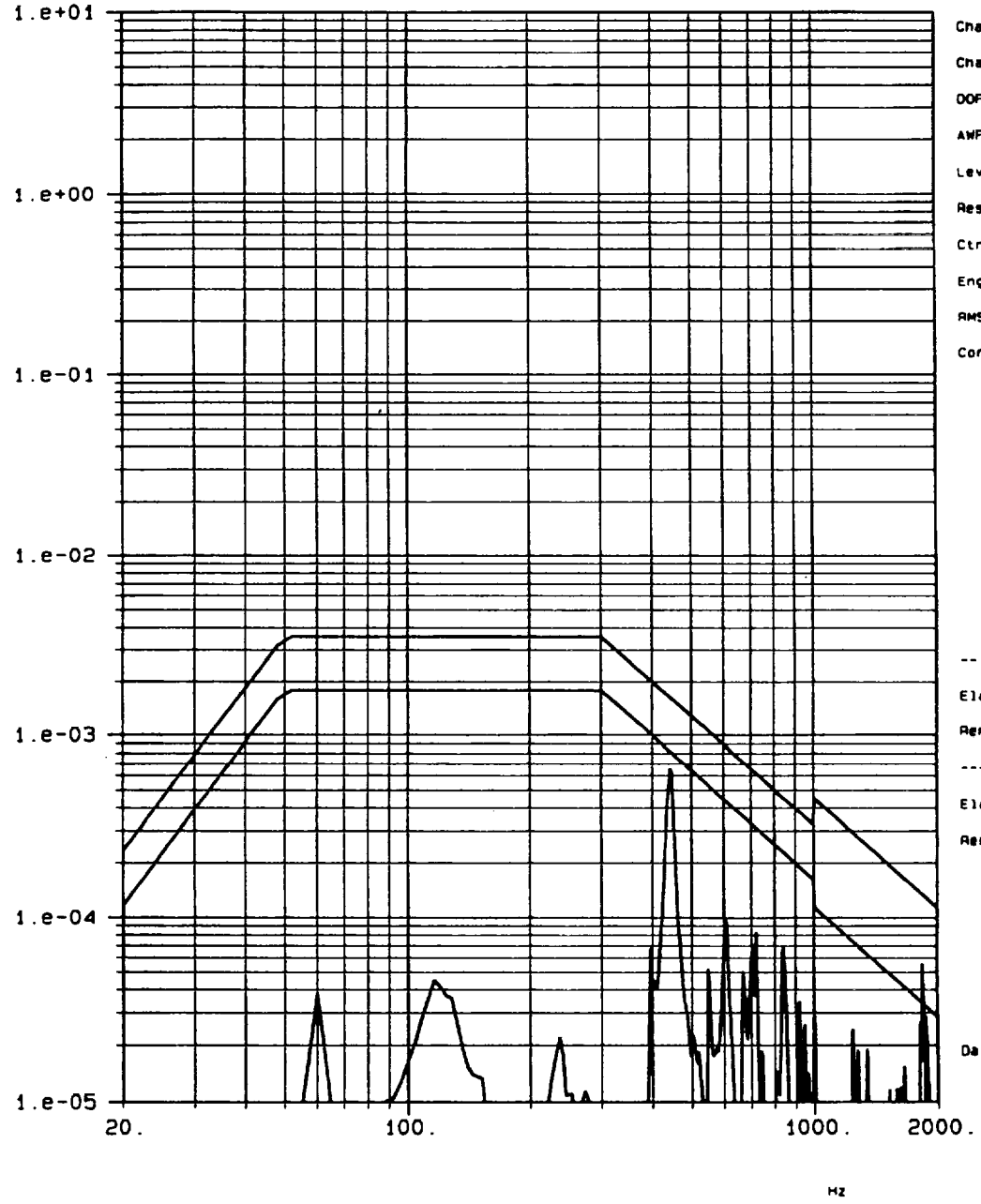
LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA

g^2/Hz R1X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 3

Chan. Type : W T

DOF : 144

AWF : 5

Level : -12 dB

Resolution : 4. Hz

Ctrl Strat.: Average

Eng. Unit : g

RMS (act.) : 0.19725 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0:00:30

Remaining : 0:00:15

--- Time total ---

Elapsed : 0:02:11

Remaining : 0:05:30

Date : 5/23/2002

19:23:57

RANDOM PLOT NO. 40

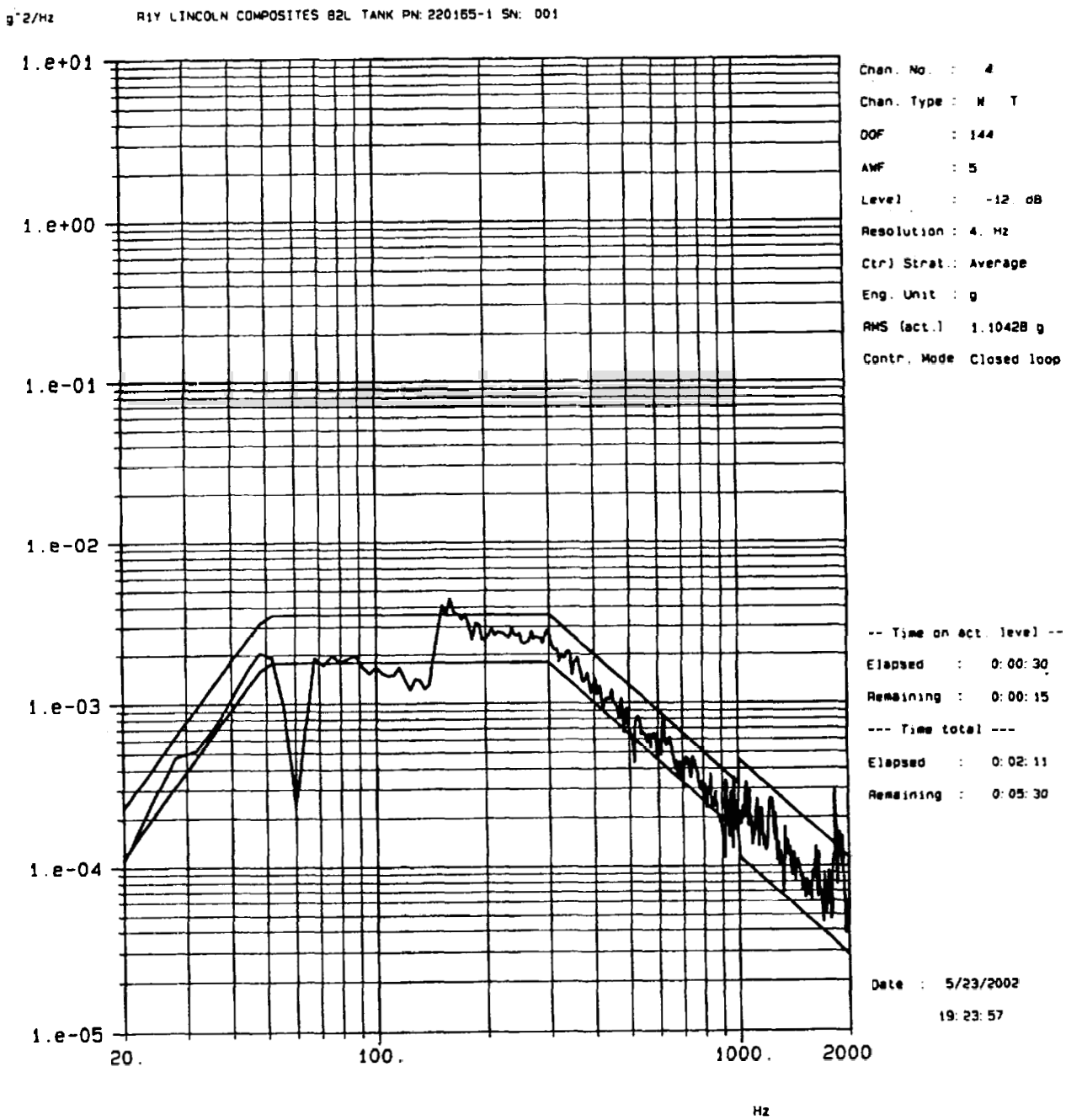
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 41

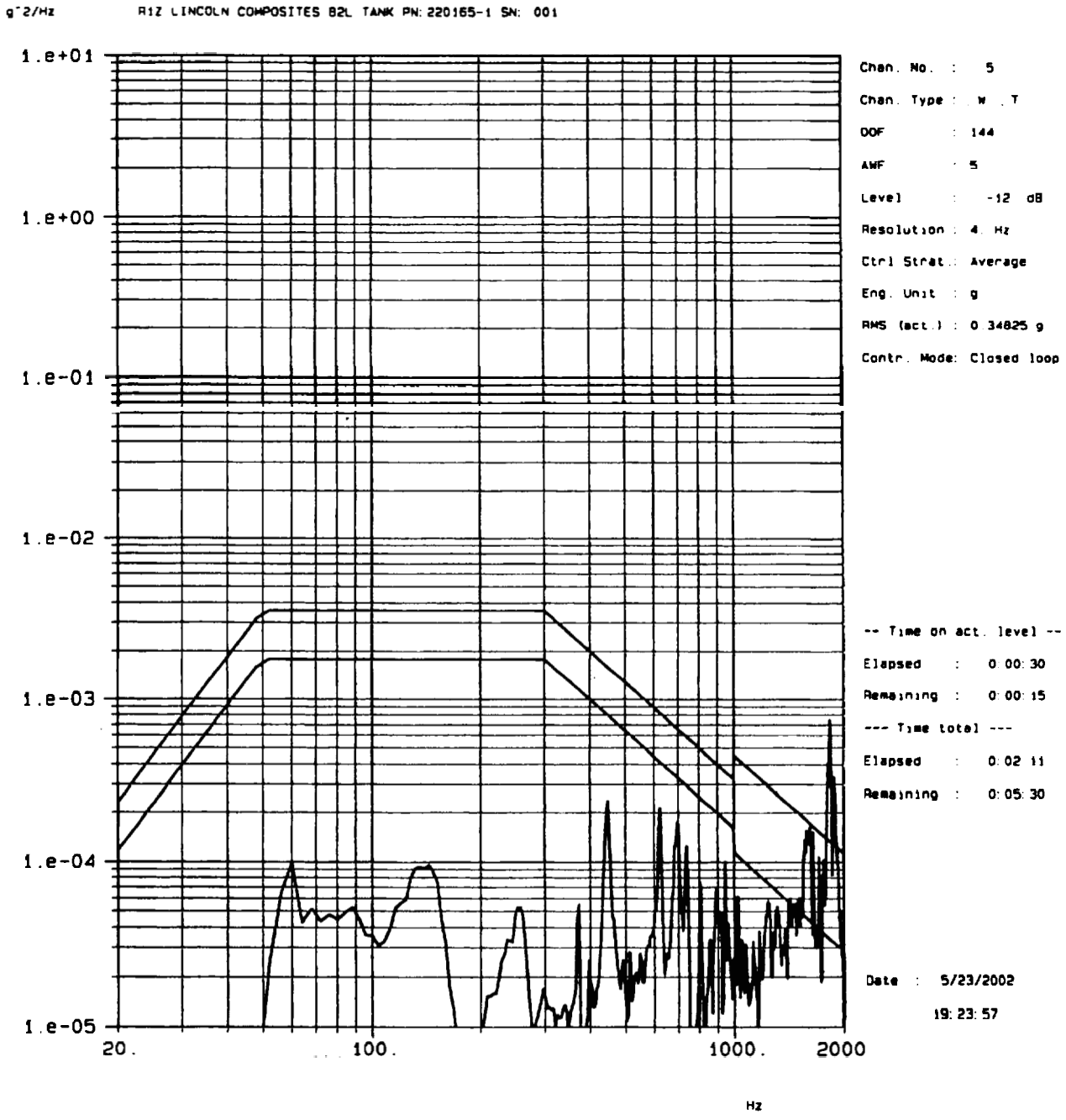
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 44

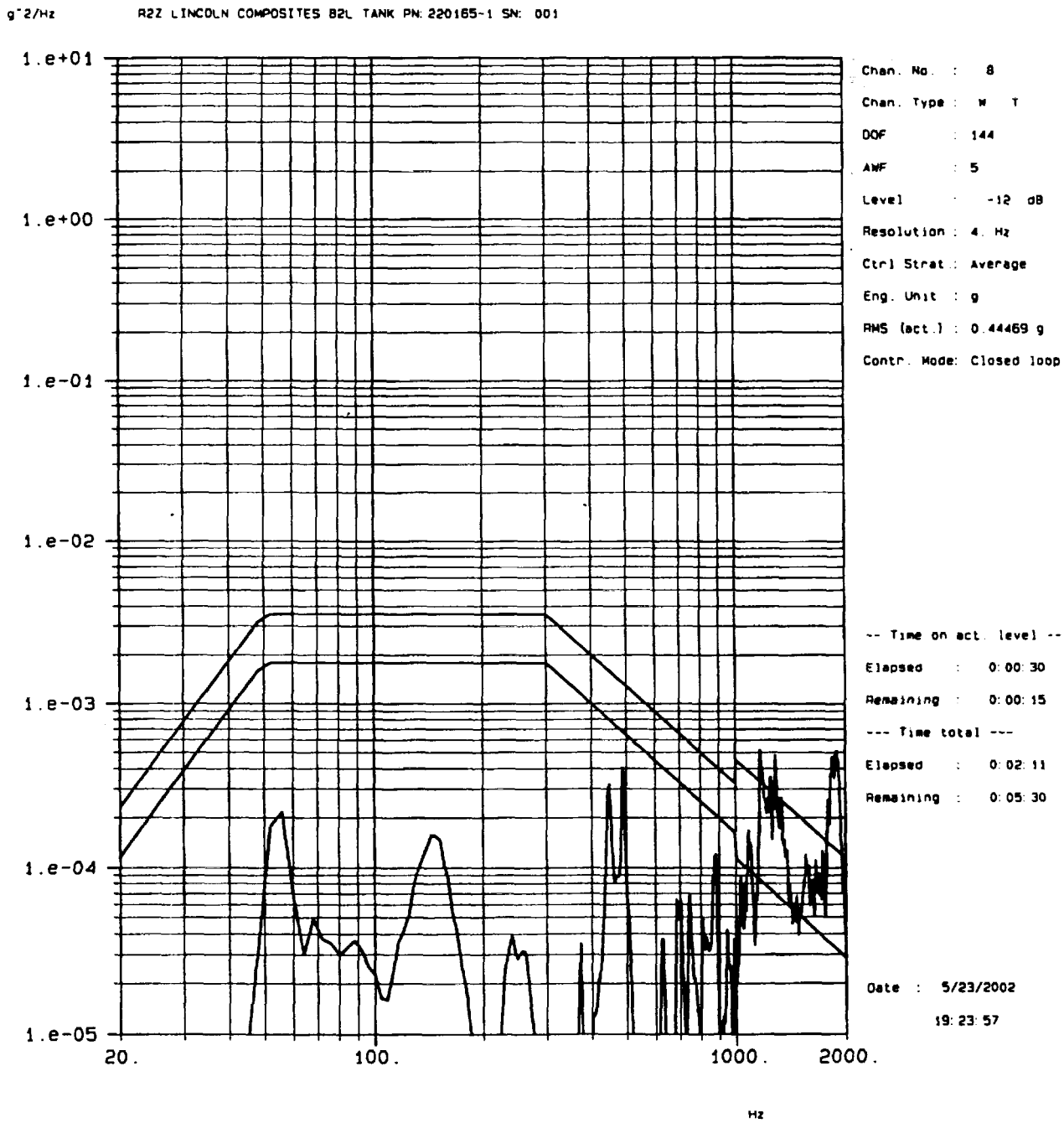
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 43

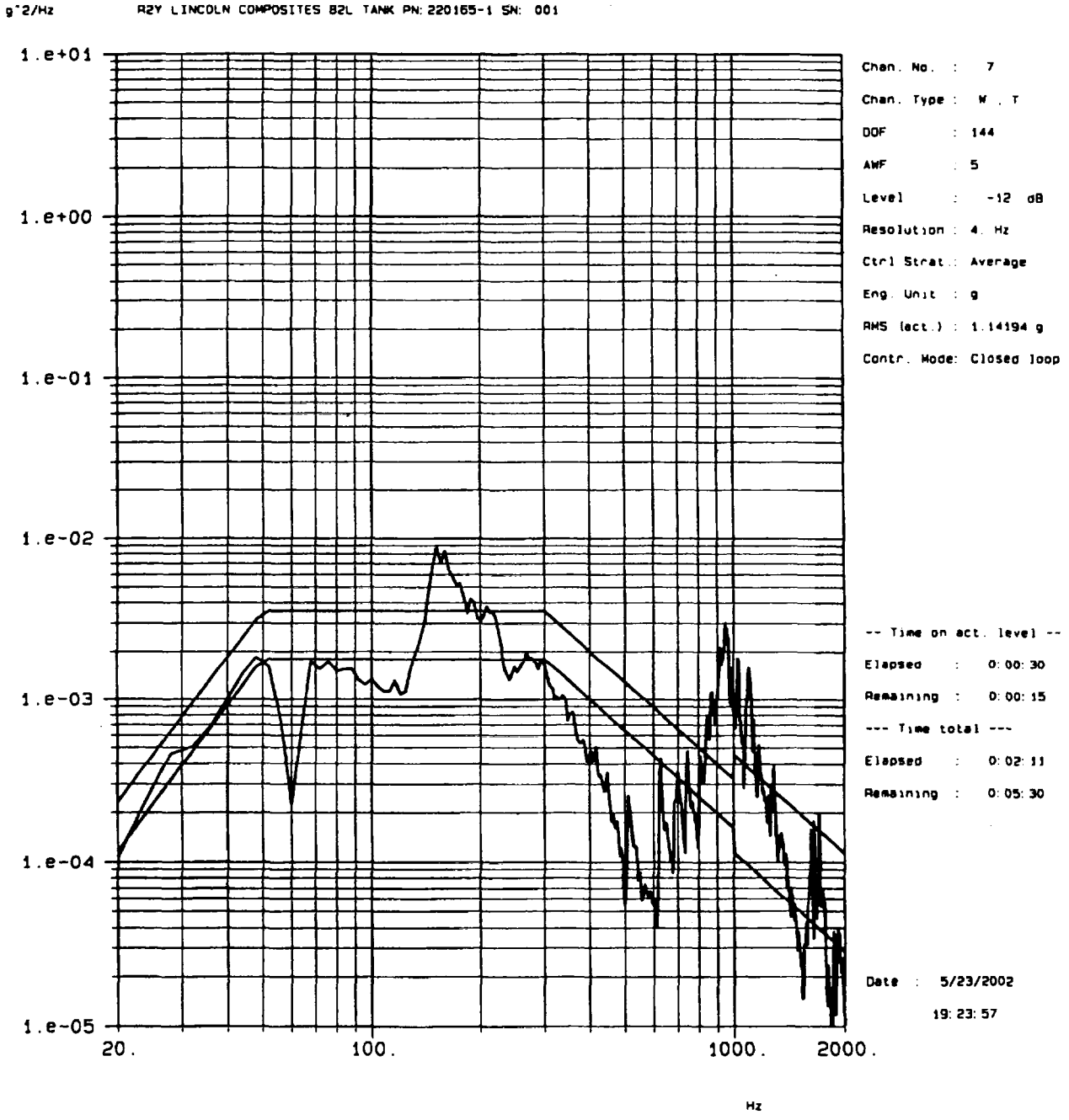
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 42

Random Limit Channel

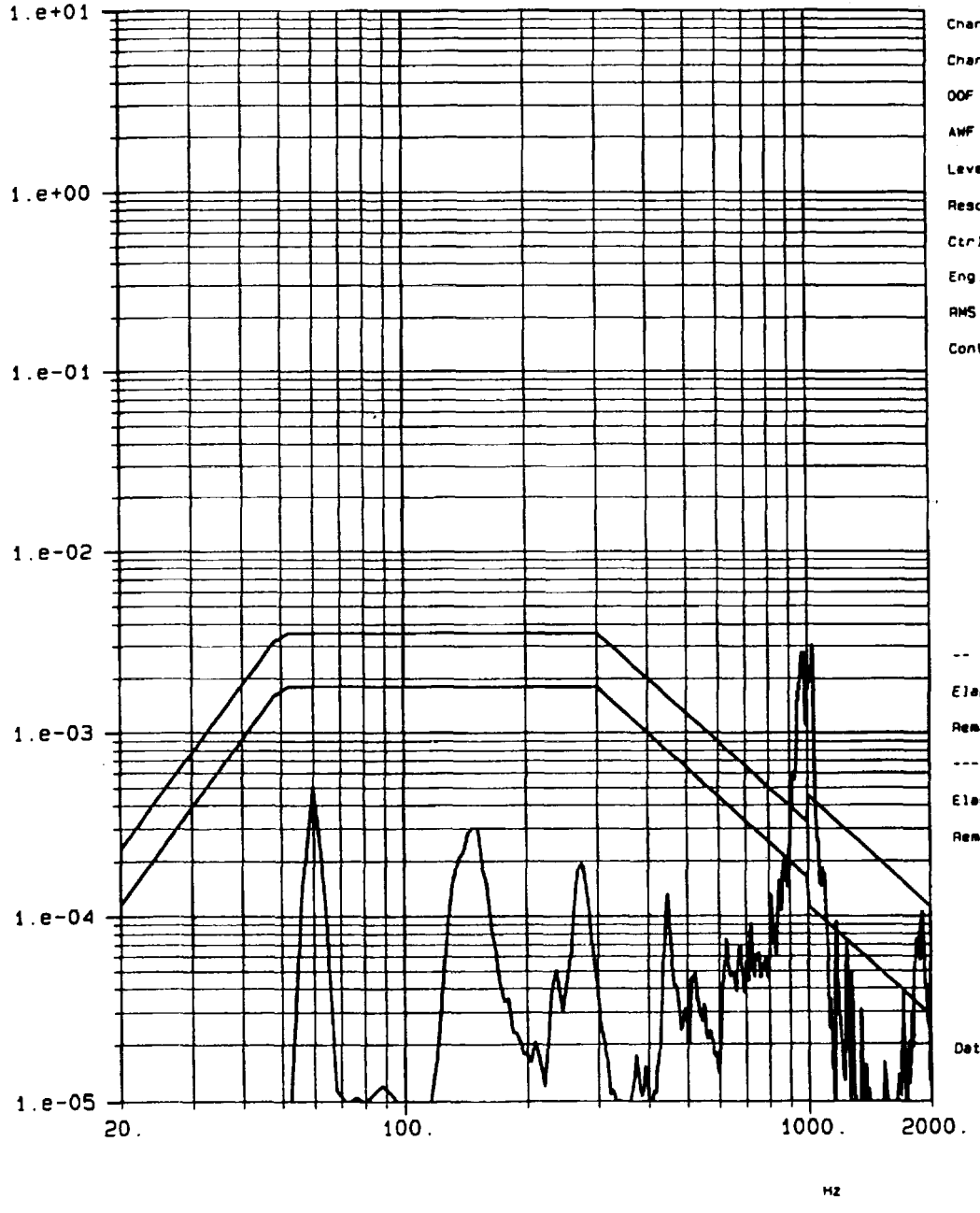
LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA

g^2/Hz R2X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No : 6
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 0.55767 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:11
Remaining : 0:05:30

Date : 5/23/2002
19:23:57

RANDOM PLOT NO. 45

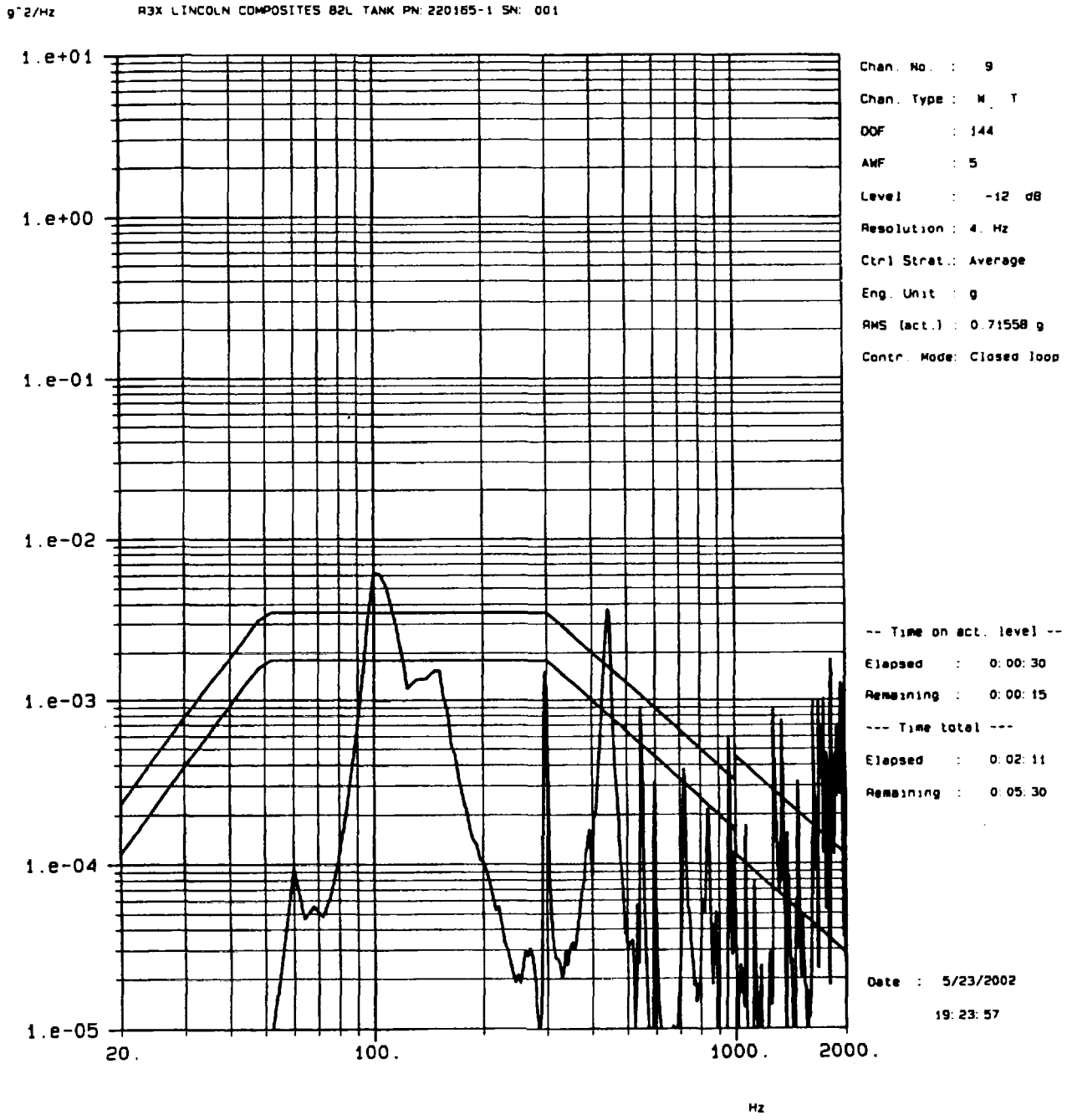
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 46

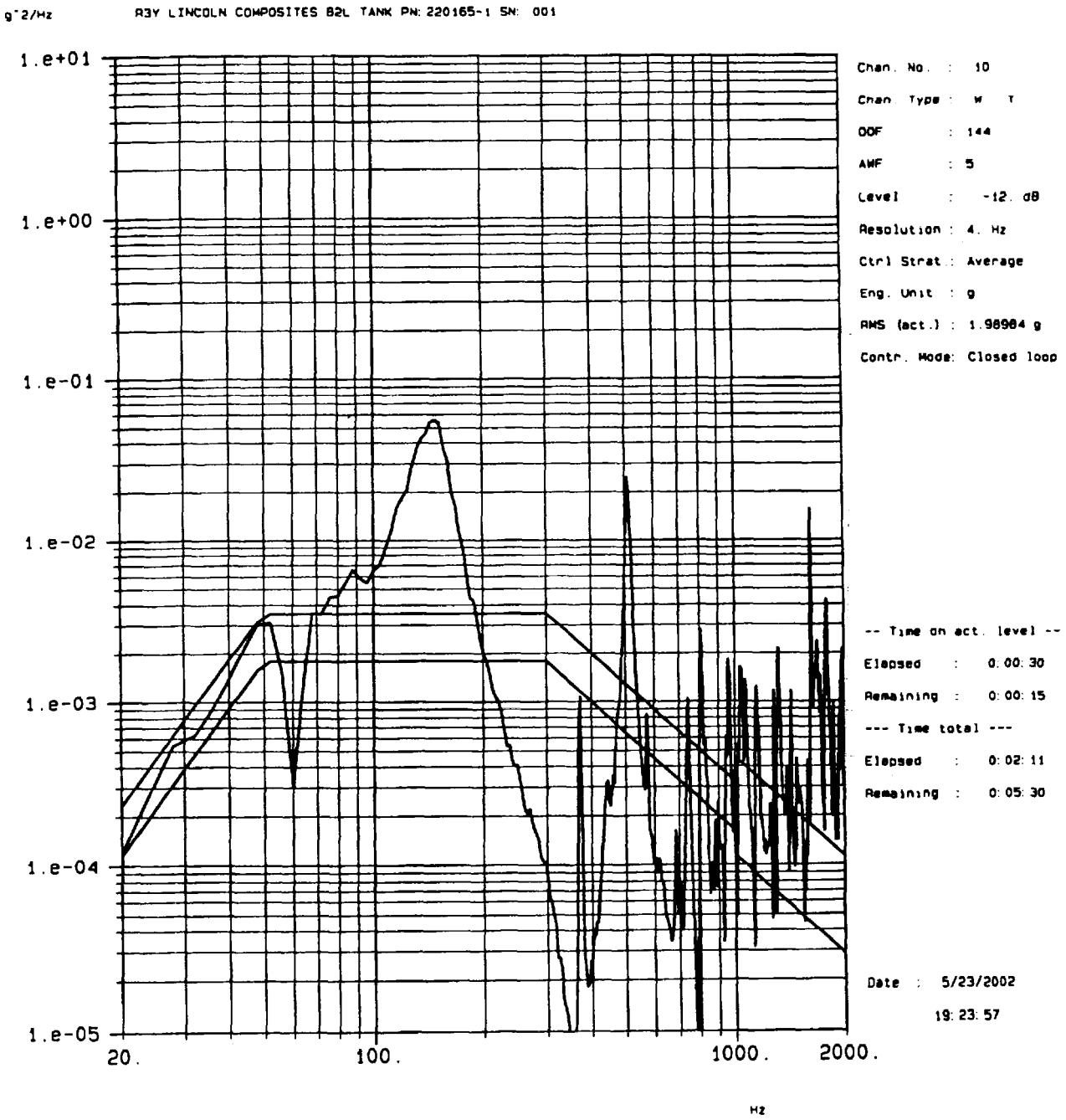
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MI02

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 47

Random Limit Channel

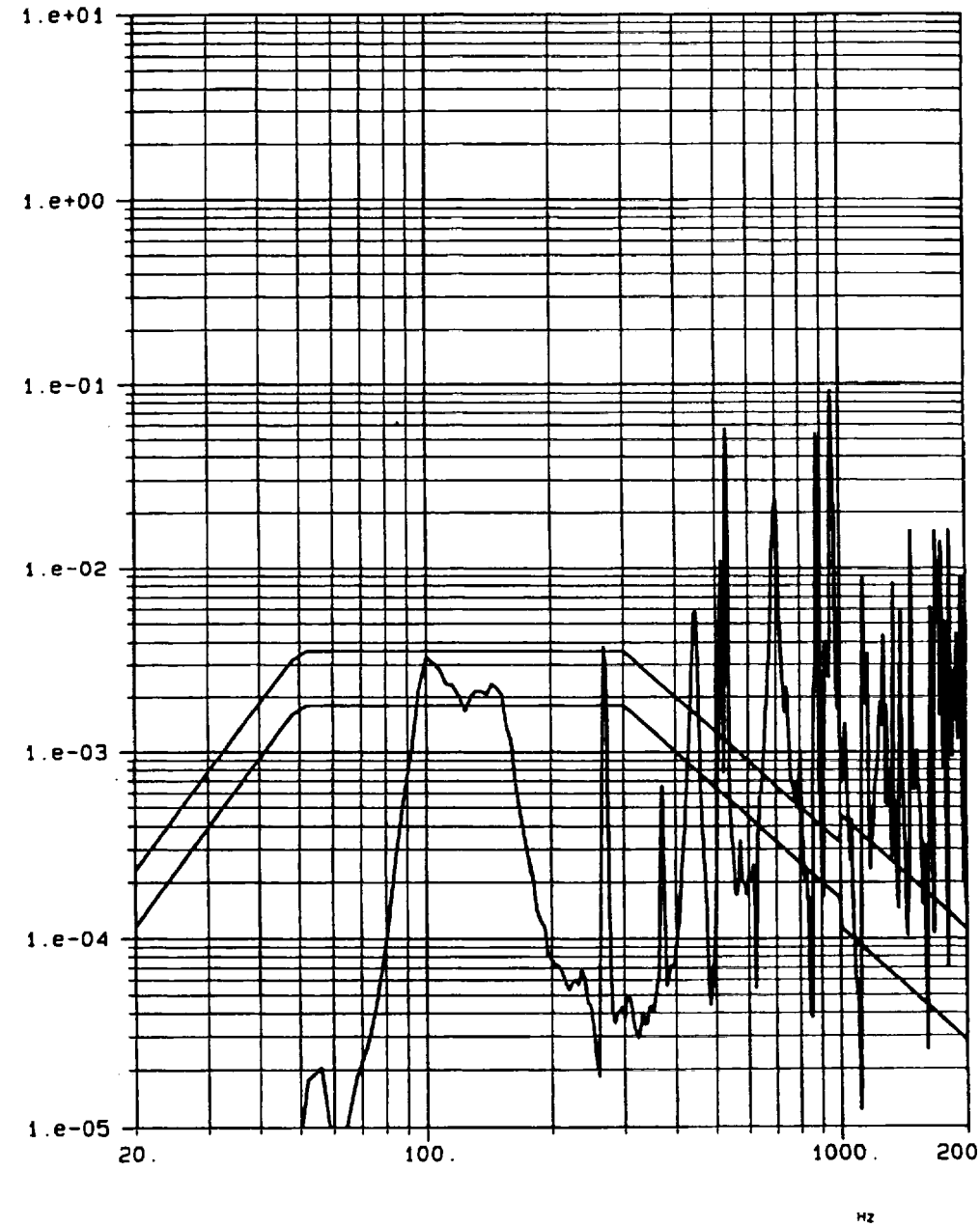
LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA

g^2/Hz R3Z LINCOLN COMPOSITES 82L TANK PN: 220185-1 SN: 001



Chan. No. : 11
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 2.36233 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0: 00: 30
Remaining : 0: 00: 15
--- Time total ---
Elapsed : 0: 02: 11
Remaining : 0: 05: 30

Date : 5/23/2002
19: 23: 57

RANDOM PLOT NO. 48

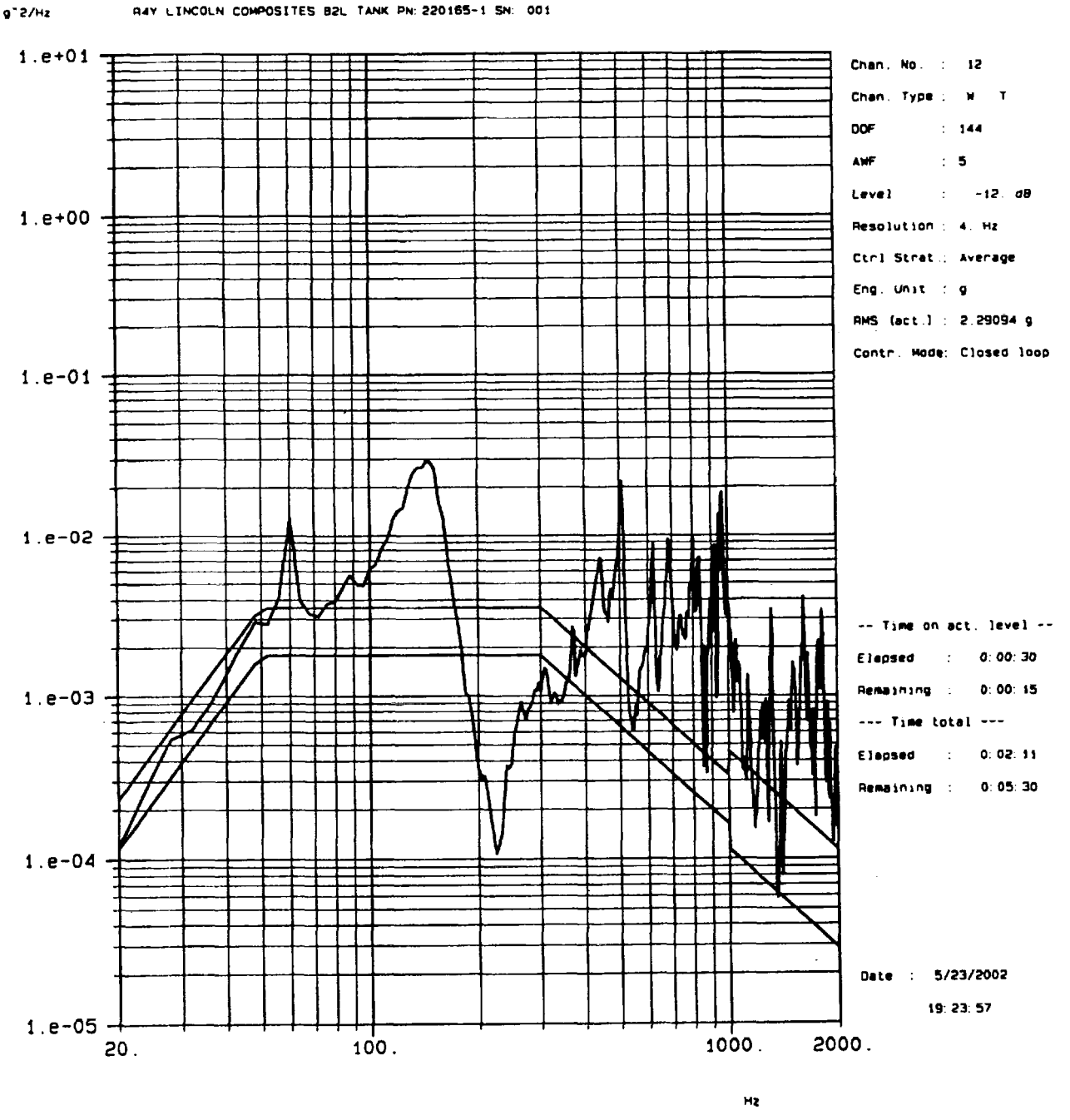
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID2

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 49

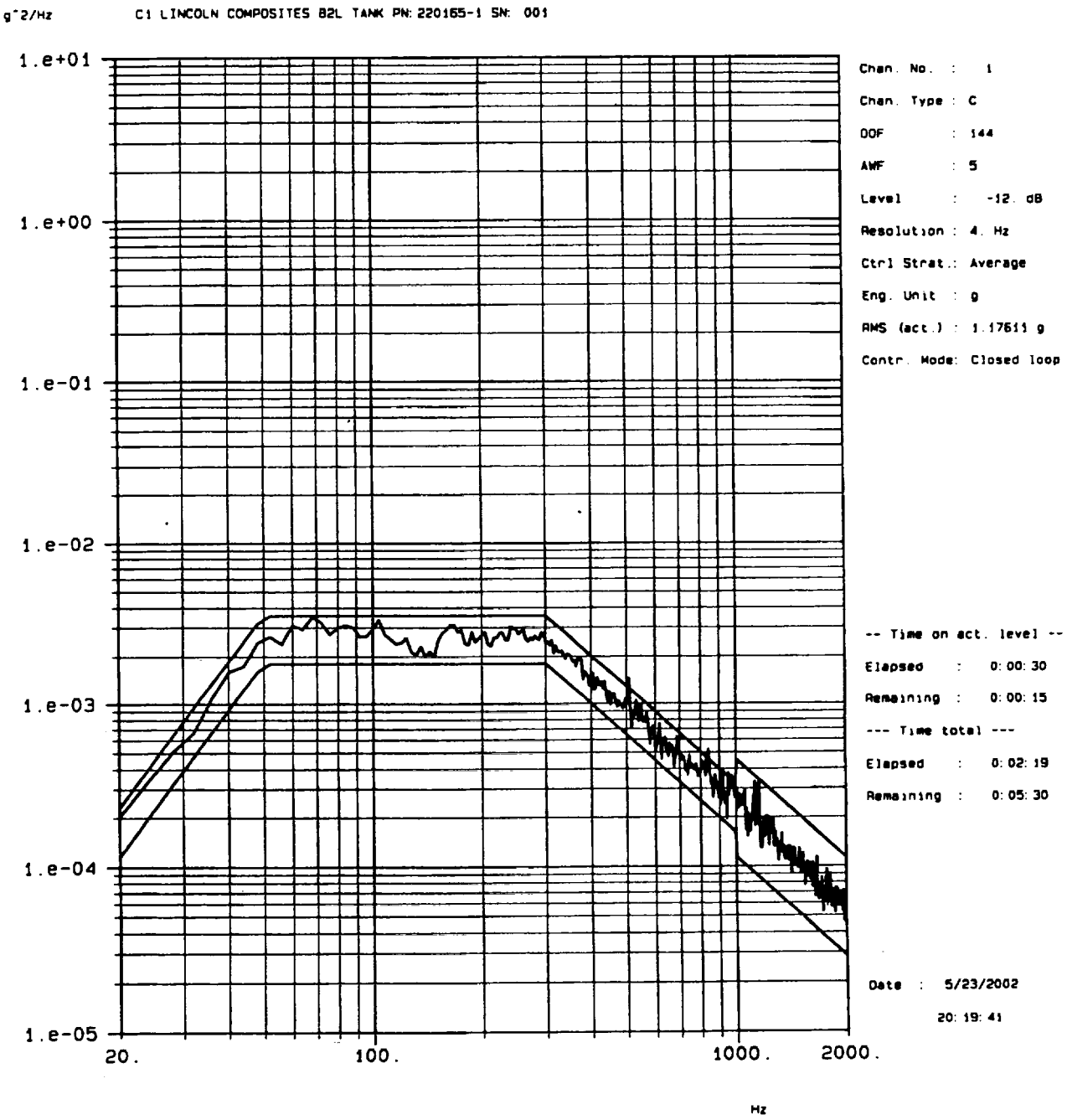
Random Control Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID POST

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 50

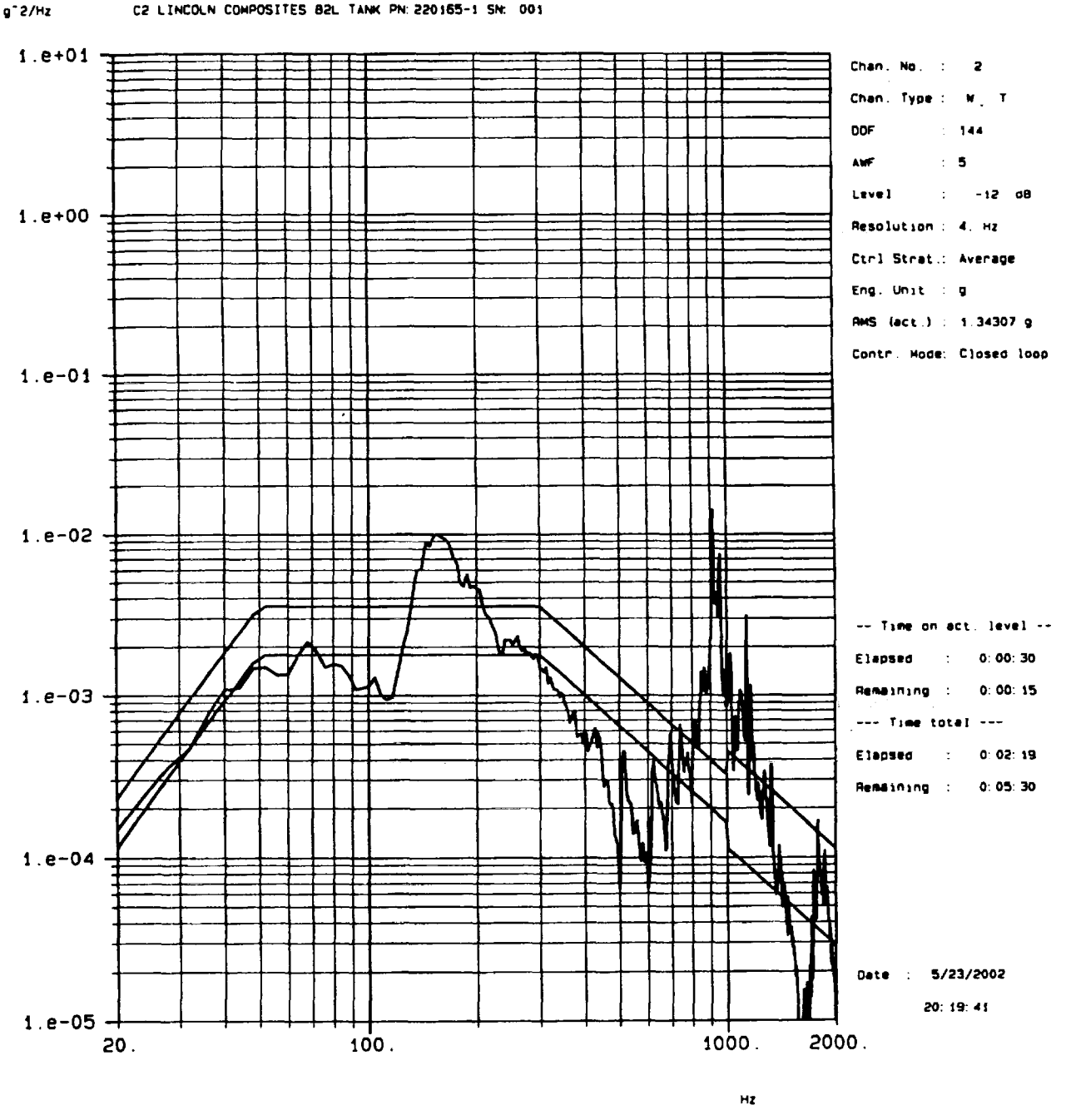
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID POST

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 51

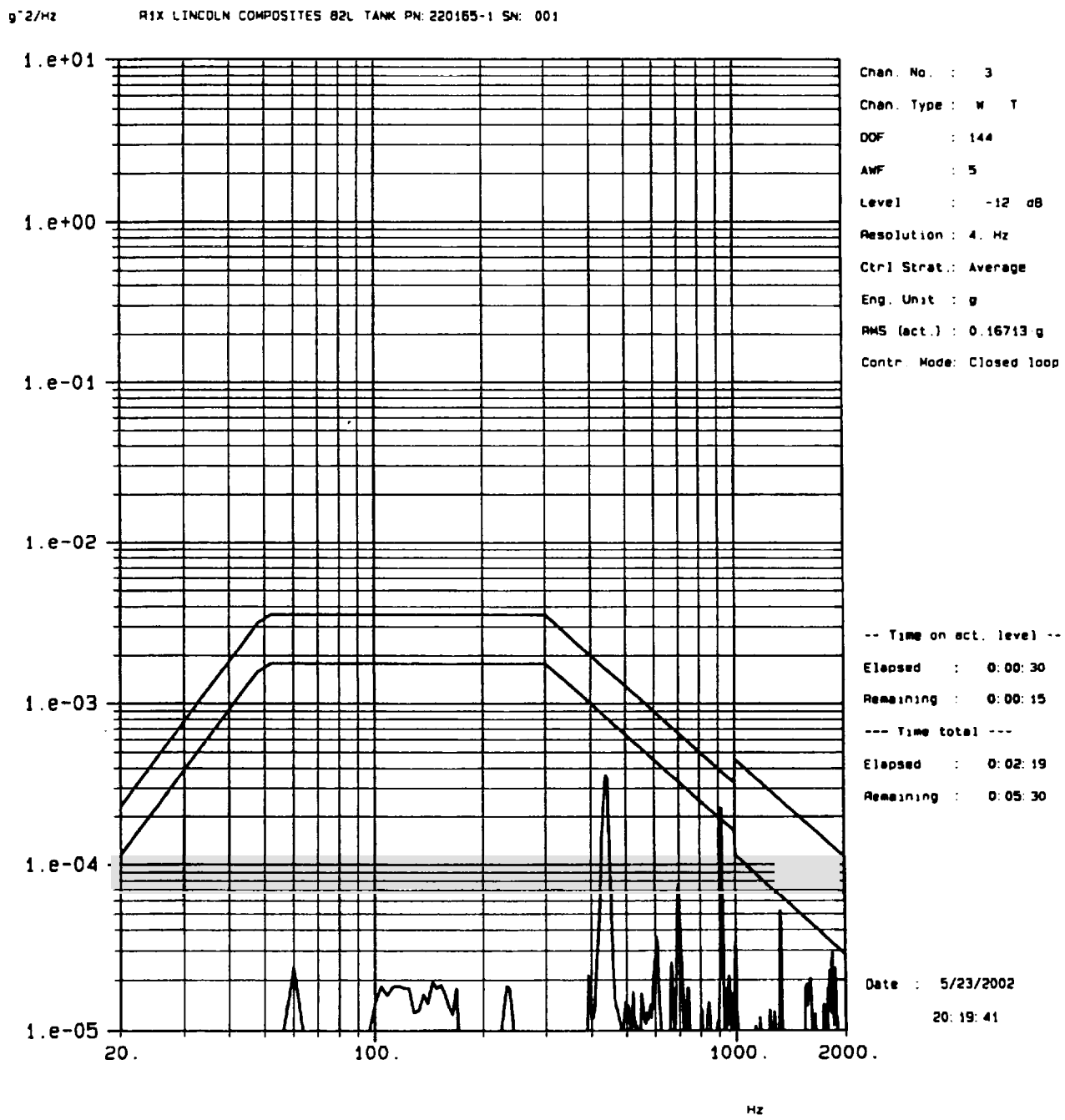
Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID POST

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 52

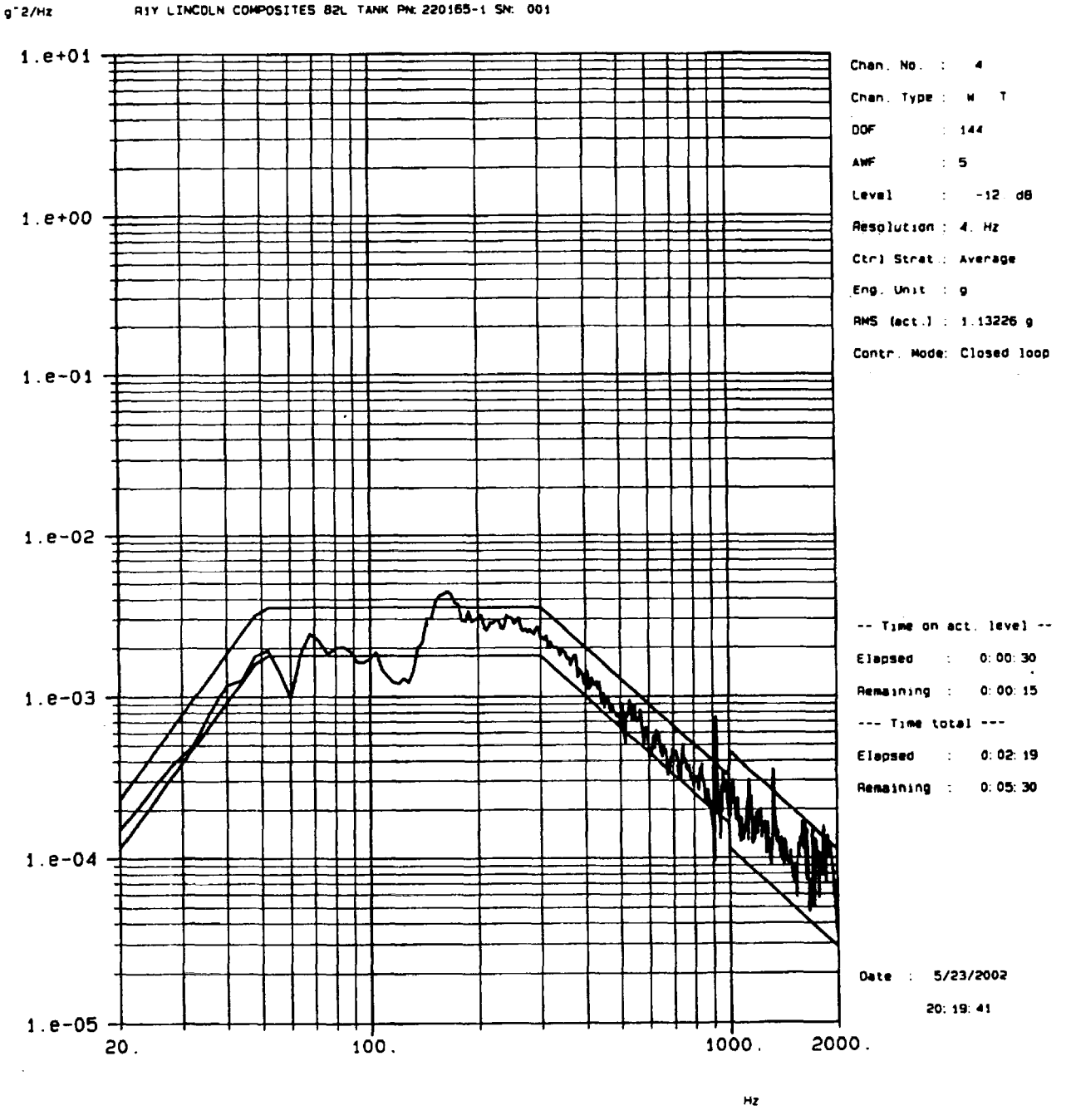
Random Limit Channel

LINCOLN 47039 DUAL

Y AXIS -12 MID POST

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 53

Random Limit Channel

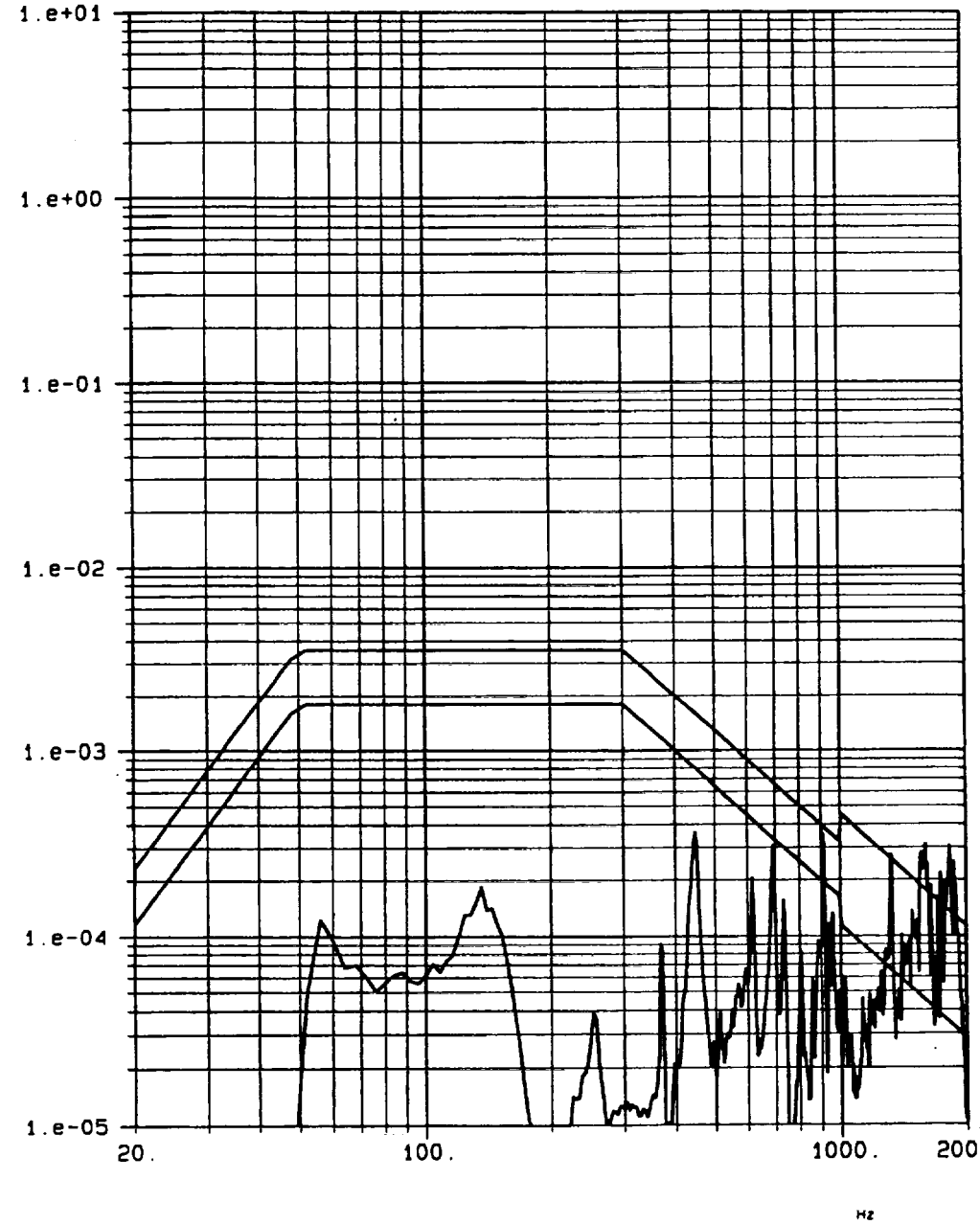
LINCOLN 47039 QUAL

Y AXIS -12 MID POST

Wyle Laboratories

El Segundo, CA

g^2/Hz R1Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 5
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 0.3903 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:19
Remaining : 0:05:30

Date : 5/23/2002
20:19:41

RANDOM PLOT NO. 54

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID POST

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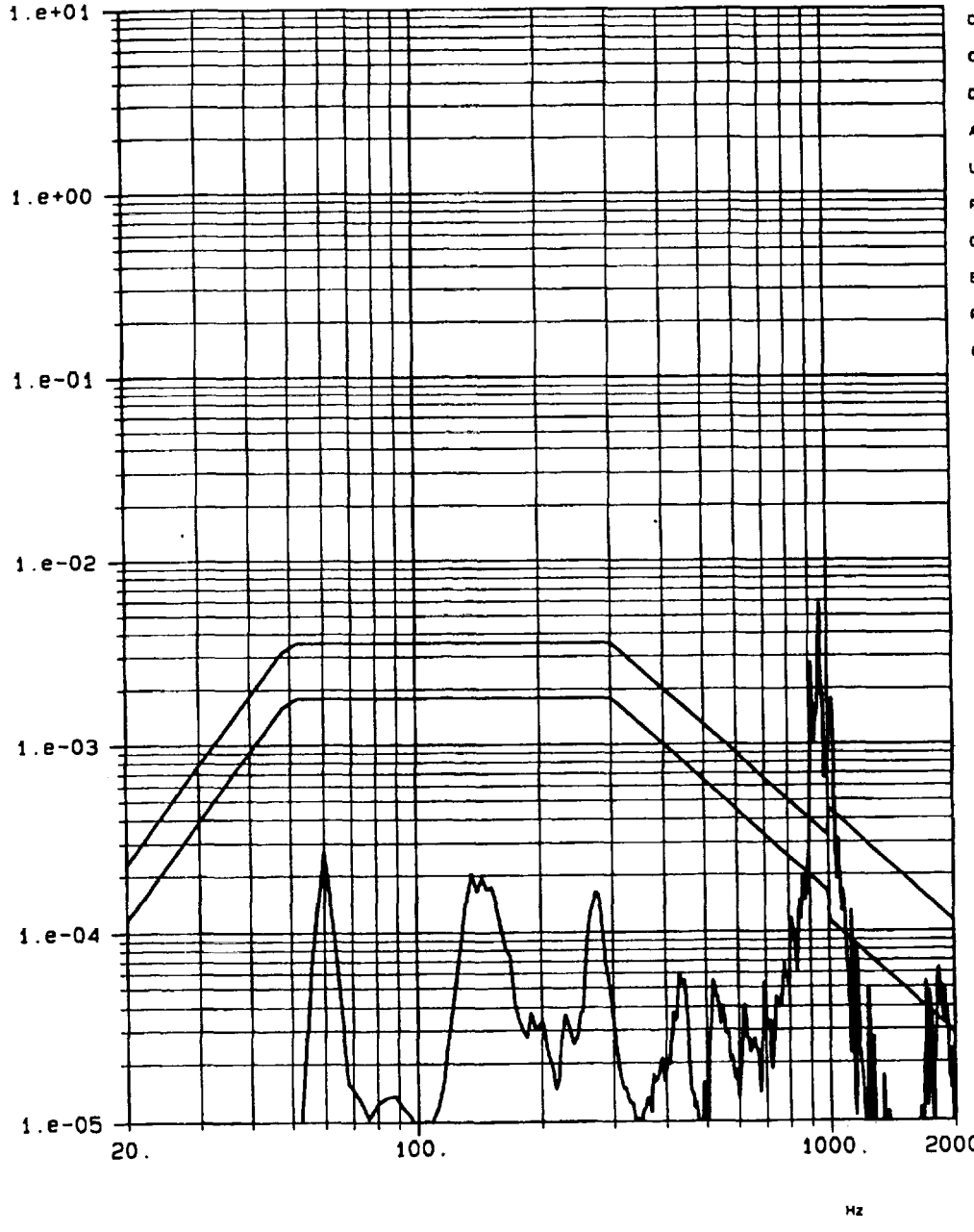
El Segundo, CA

g^2/Hz R2X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 6
Chan. Type : W T
DOF : 144
AWF : 5
Level -12 dB
Resolution : 4. Hz
Ctrl Strat : Average
Eng. Unit : g
RMS (act.) : 0.55469 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:19
Remaining : 0:05:30

Date : 5/23/2002
20:19:41

RANDOM PLOT NO. 55

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID POST

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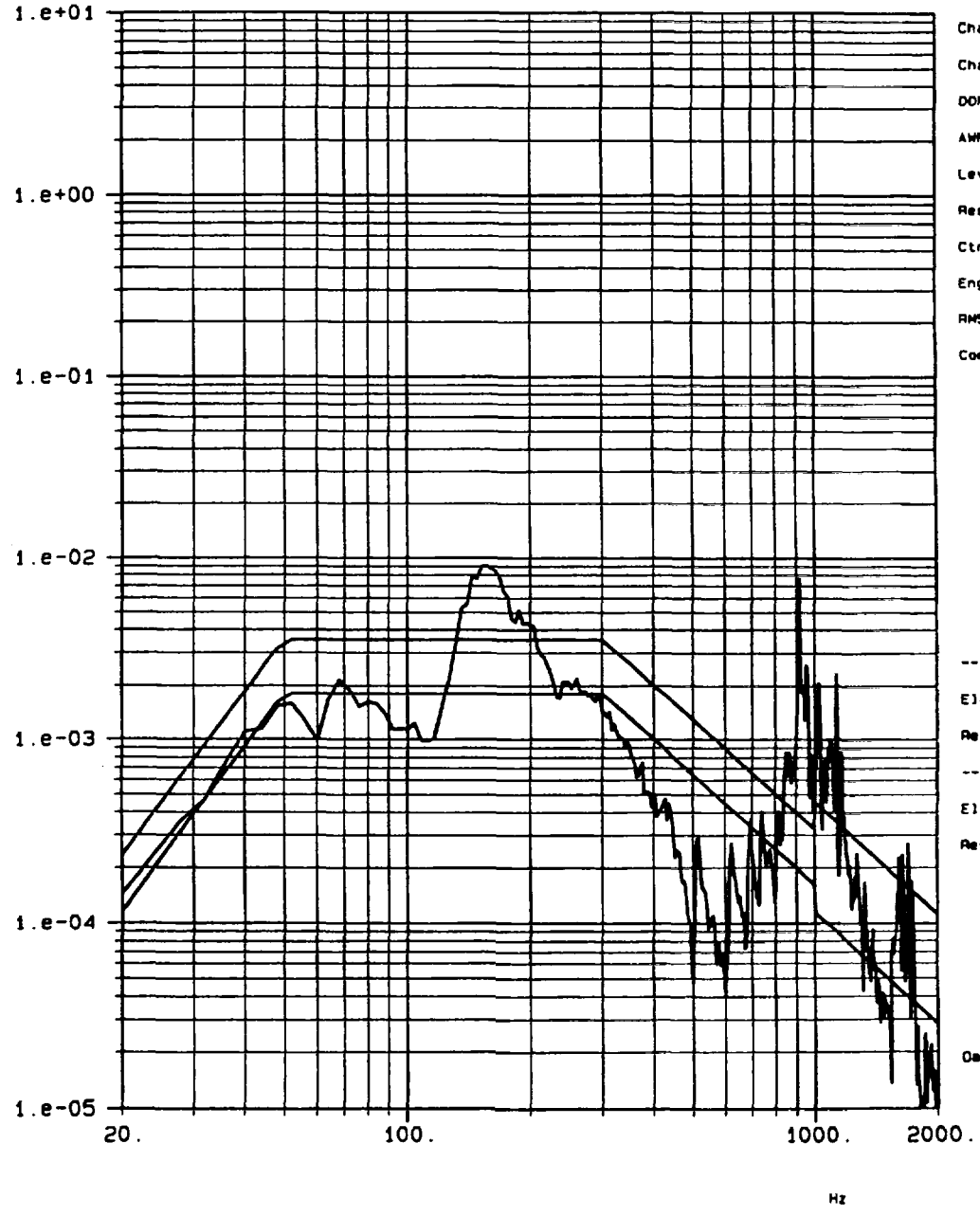
g^2/Hz R2Y LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 7

Chan. Type : W . T

DOF : 144

AWF : 5

Level : -12. dB

Resolution : 4. Hz

Ctrl Strat.: Average

Eng. Unit : g

RMS (act.) : 1.19036 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0: 00: 30

Remaining : 0: 00: 15

--- Time total ---

Elapsed : 0: 02: 19

Remaining : 0: 05: 30

Date : 5/23/2002

20: 19: 41

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RANDOM PLOT NO. 56

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID POST

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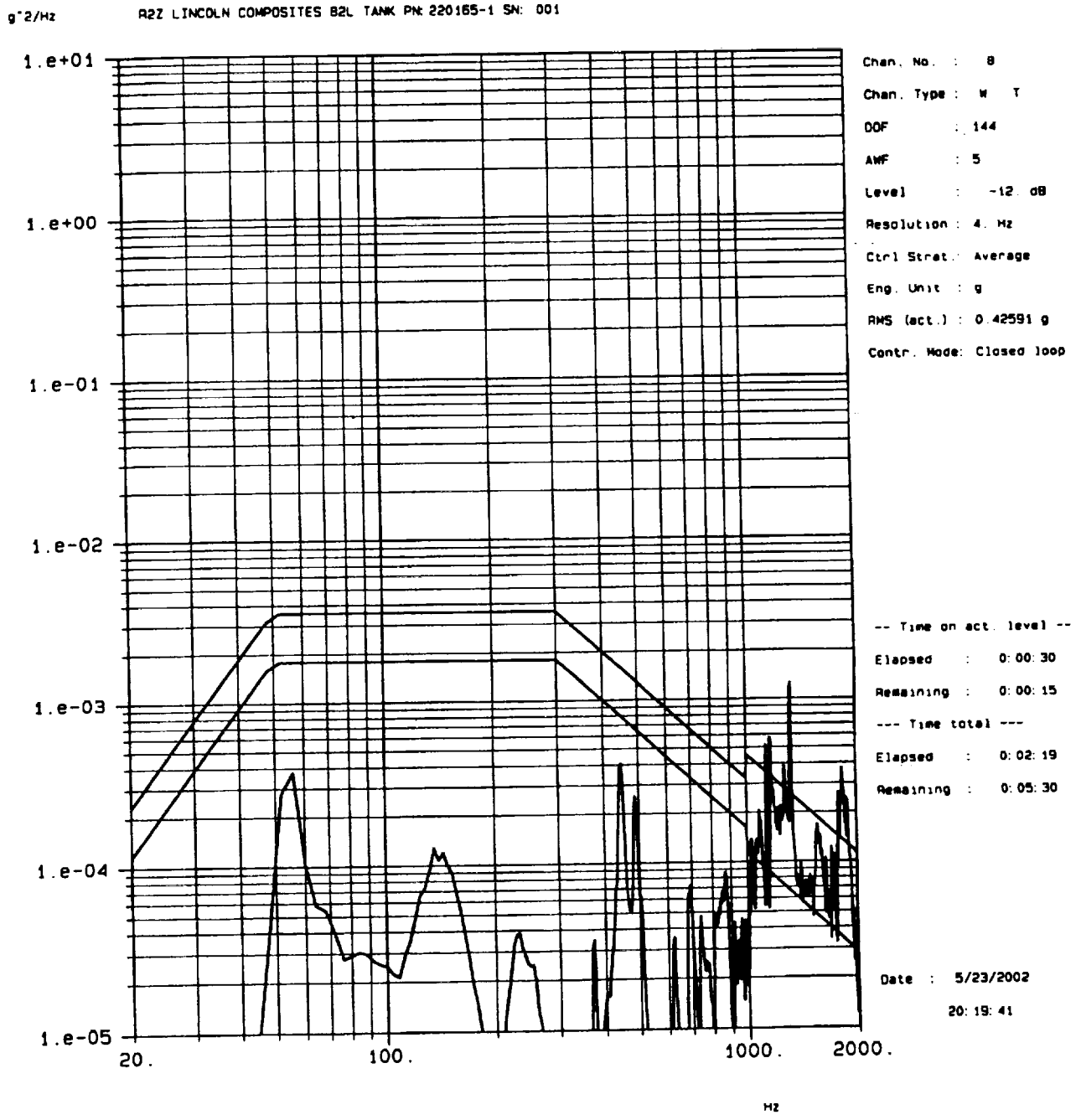
El Segundo, CA



RANDOM PLOT NO. 57

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID POST

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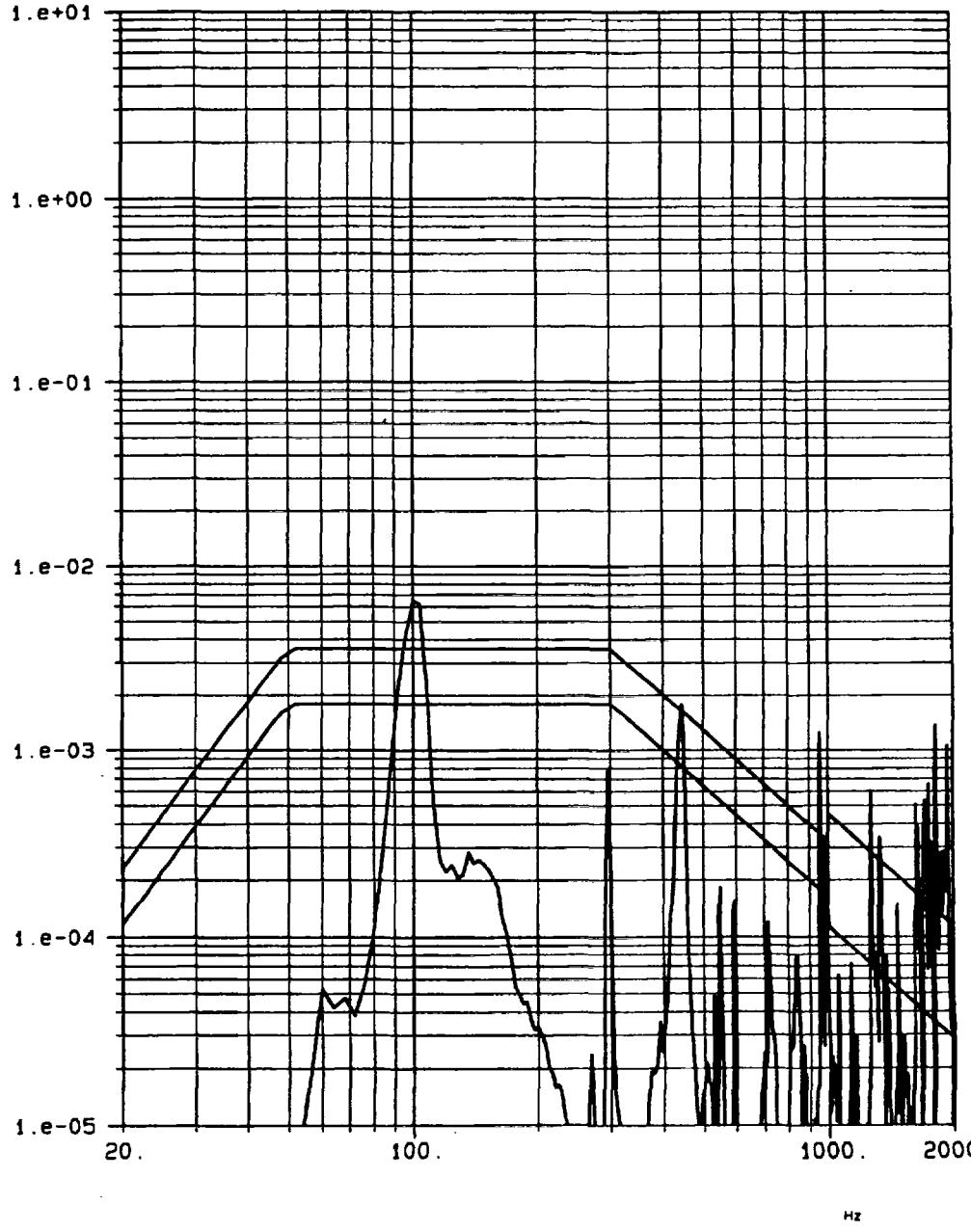
El Segundo, CA

g^2/Hz R3X LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat : Average
Eng. Unit : g
RMS (act.) : 0.53974 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:19
Remaining : 0:05:30

Date : 5/23/2002
20:19:41

RANDOM PLOT NO. 58

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID POST

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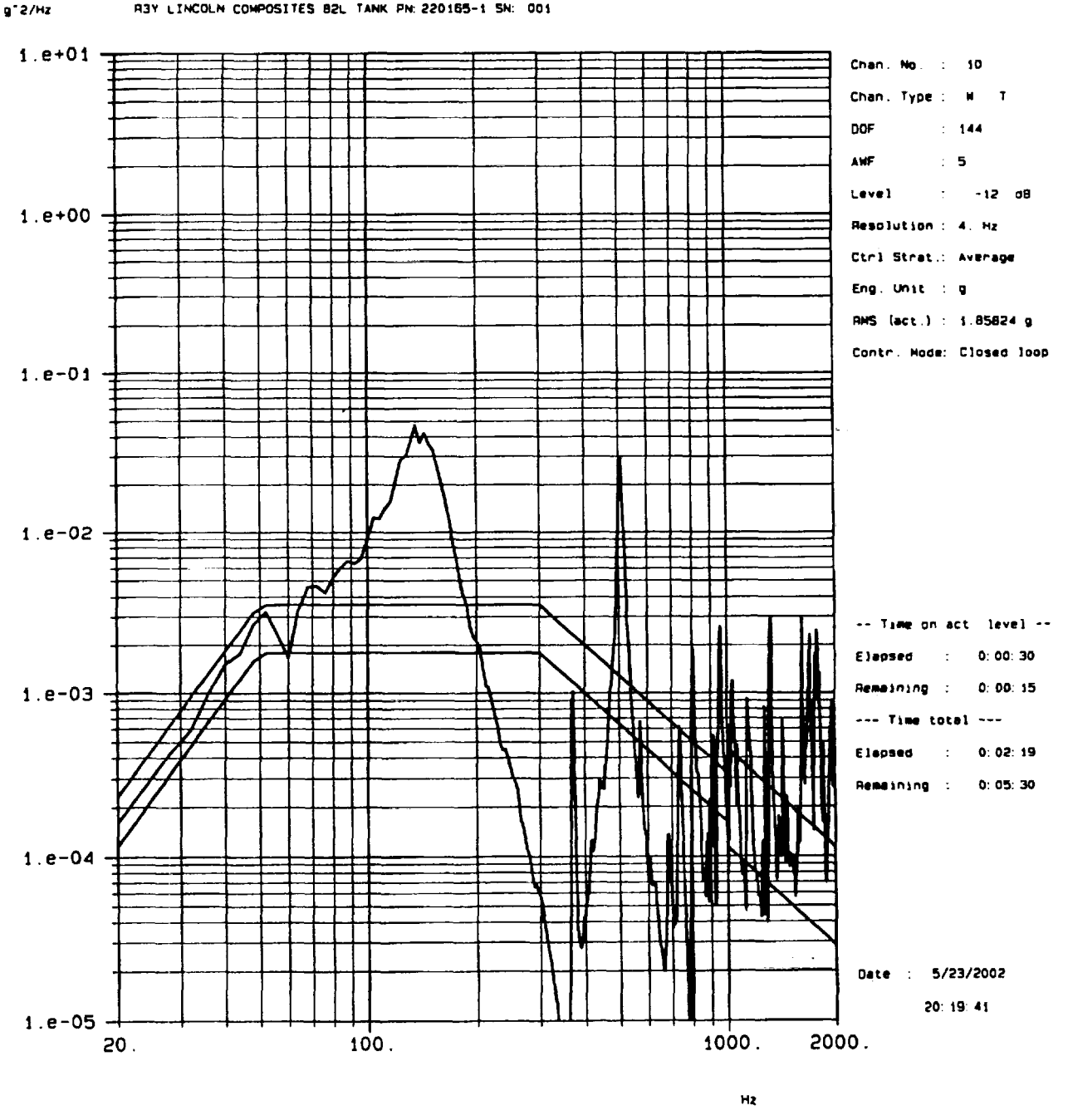
El Segundo, CA



RANDOM PLOT NO. 59

Random Limit Channel

LINCOLN 47039 QUAL

Y AXIS -12 MID POST

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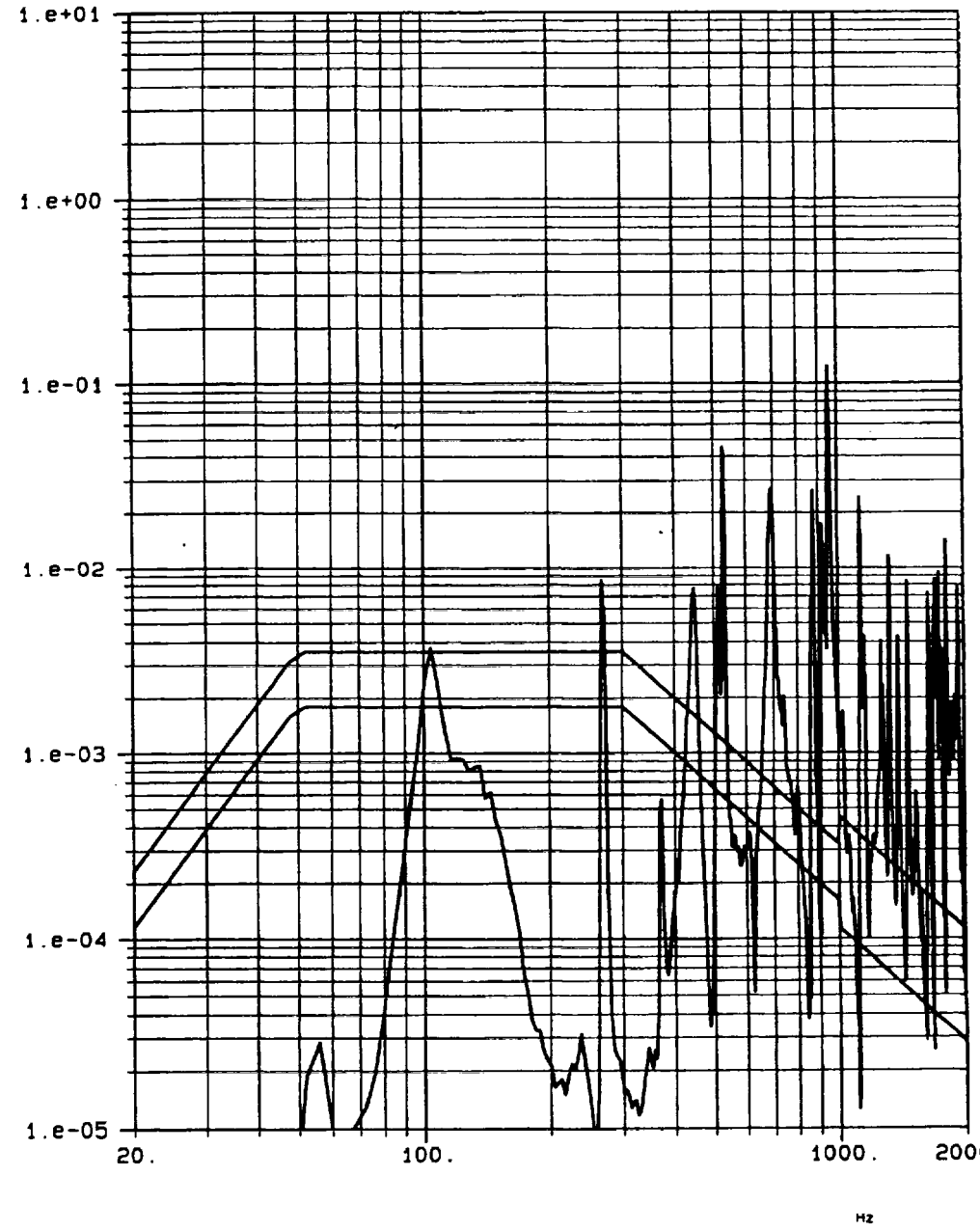
El Segundo, CA

g^2/Hz R3Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 11
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12 dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 2.35196 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:19
Remaining : 0:05:30

Date : 5/23/2002
20:19:41

RANDOM PLOT NO. 60

Random Limit Channel

LINCOLN 47039 DUAL

Y AXIS -12 MID POST

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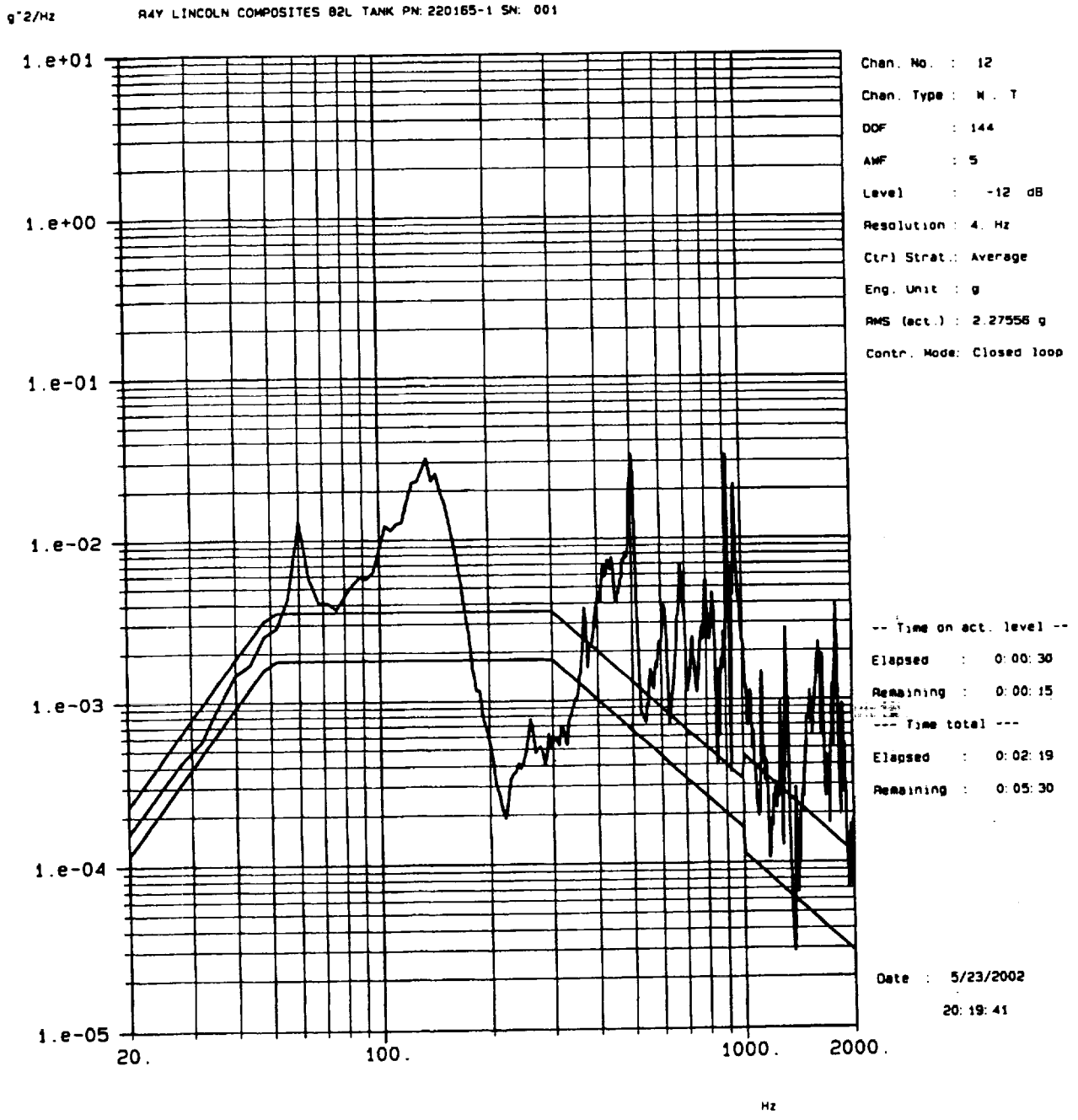
El Segundo, CA



RANDOM PLOT NO. 61

Random Control

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

AVERAGE OF C1 & C2

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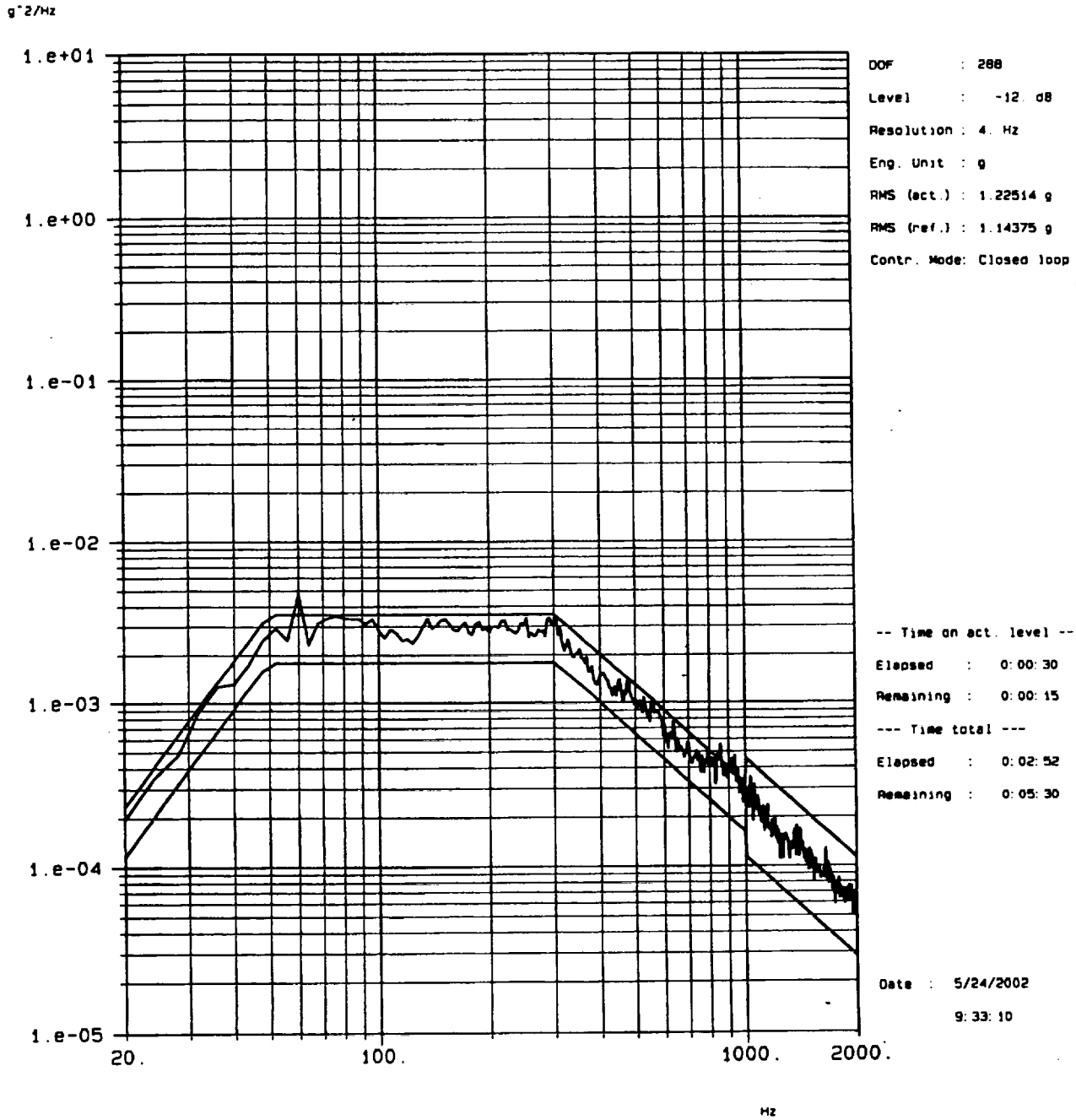

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RANDOM PLOT NO. 62

Random Control Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

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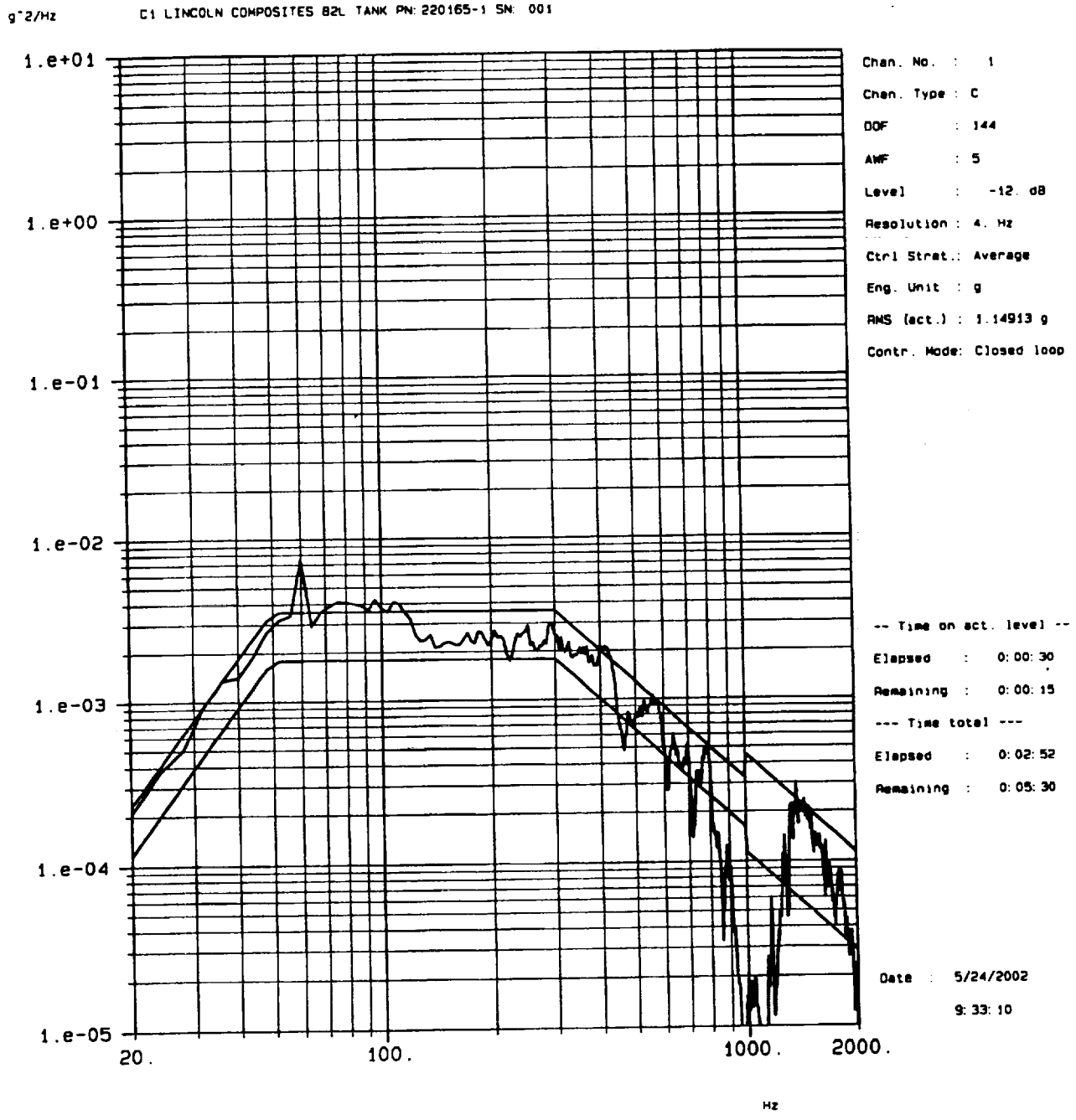

RANDOM PLOT NO. 63

Random Control Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

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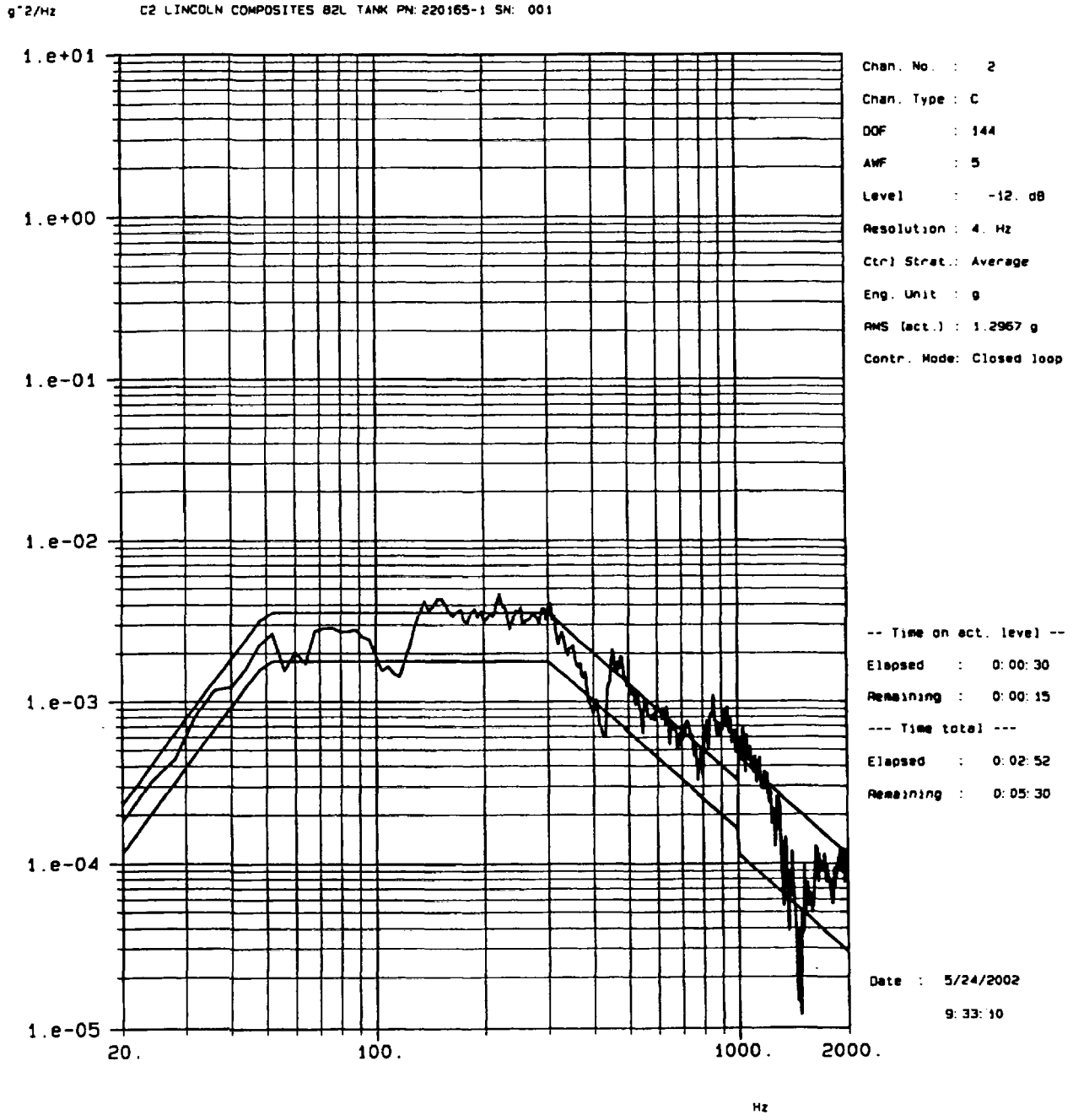
El Segundo, CA



RANDOM PLOT NO. 64

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

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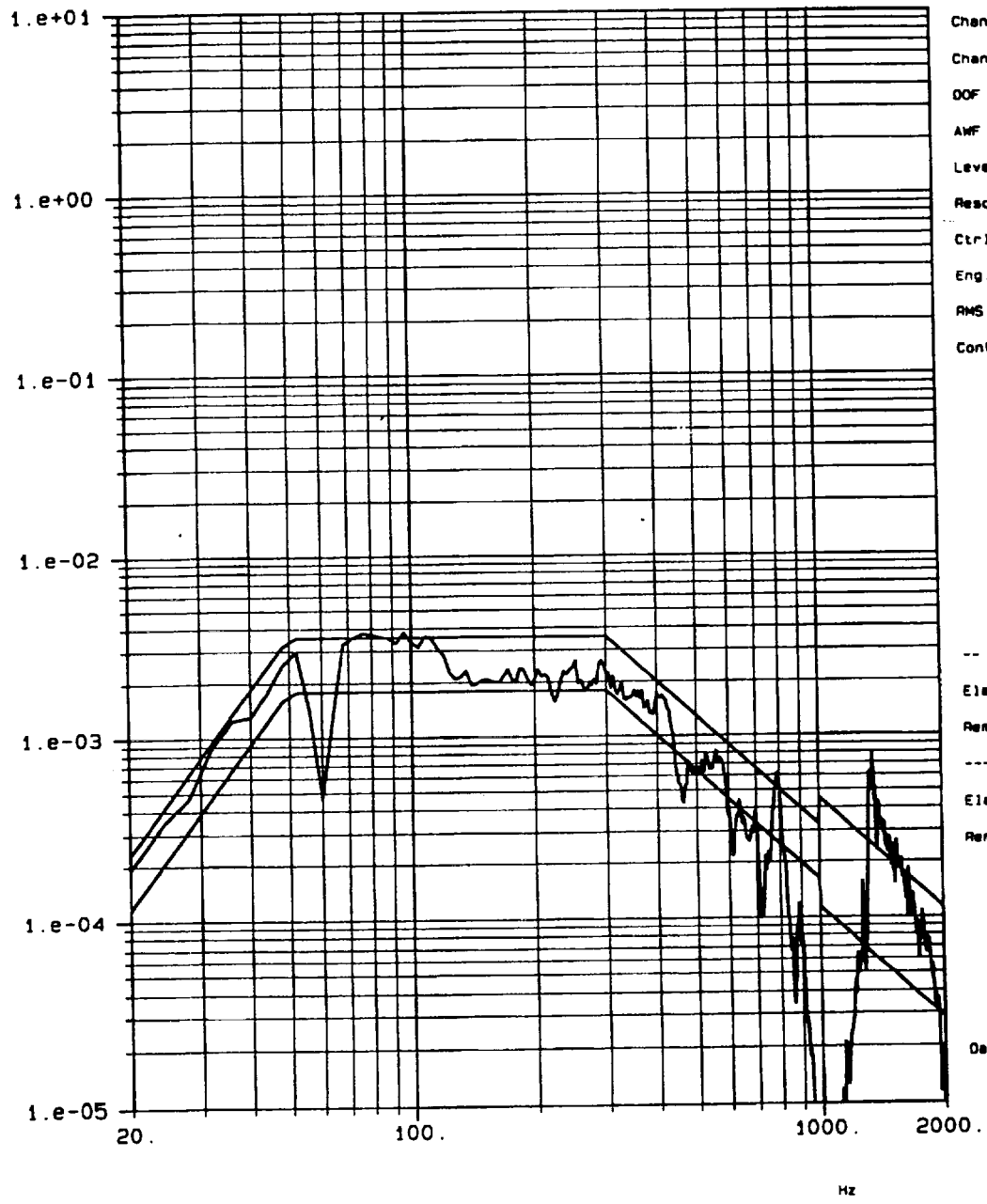
El Segundo, CA

g^2/Hz R1X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 3
Chan. Type : M T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 1.08045 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:52
Remaining : 0:05:30

Date : 5/24/2002
9:33:10

RANDOM PLOT NO. 65

Random Limit Channel

LINCOLN47039 X DUAL

X AXIS PRE -12dB MID

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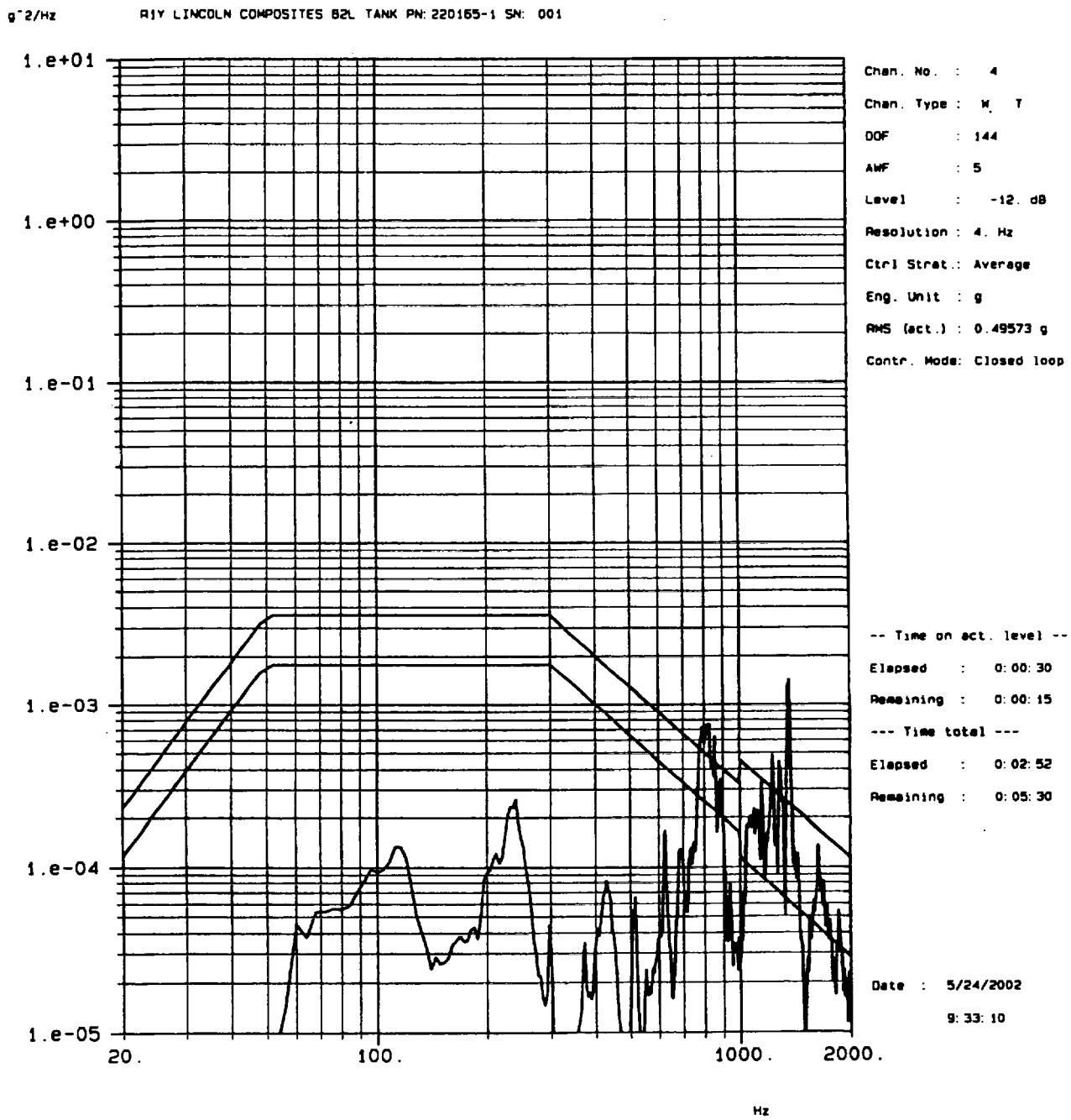
El Segundo, CA



RANDOM PLOT NO. 66

Random Limit Channel

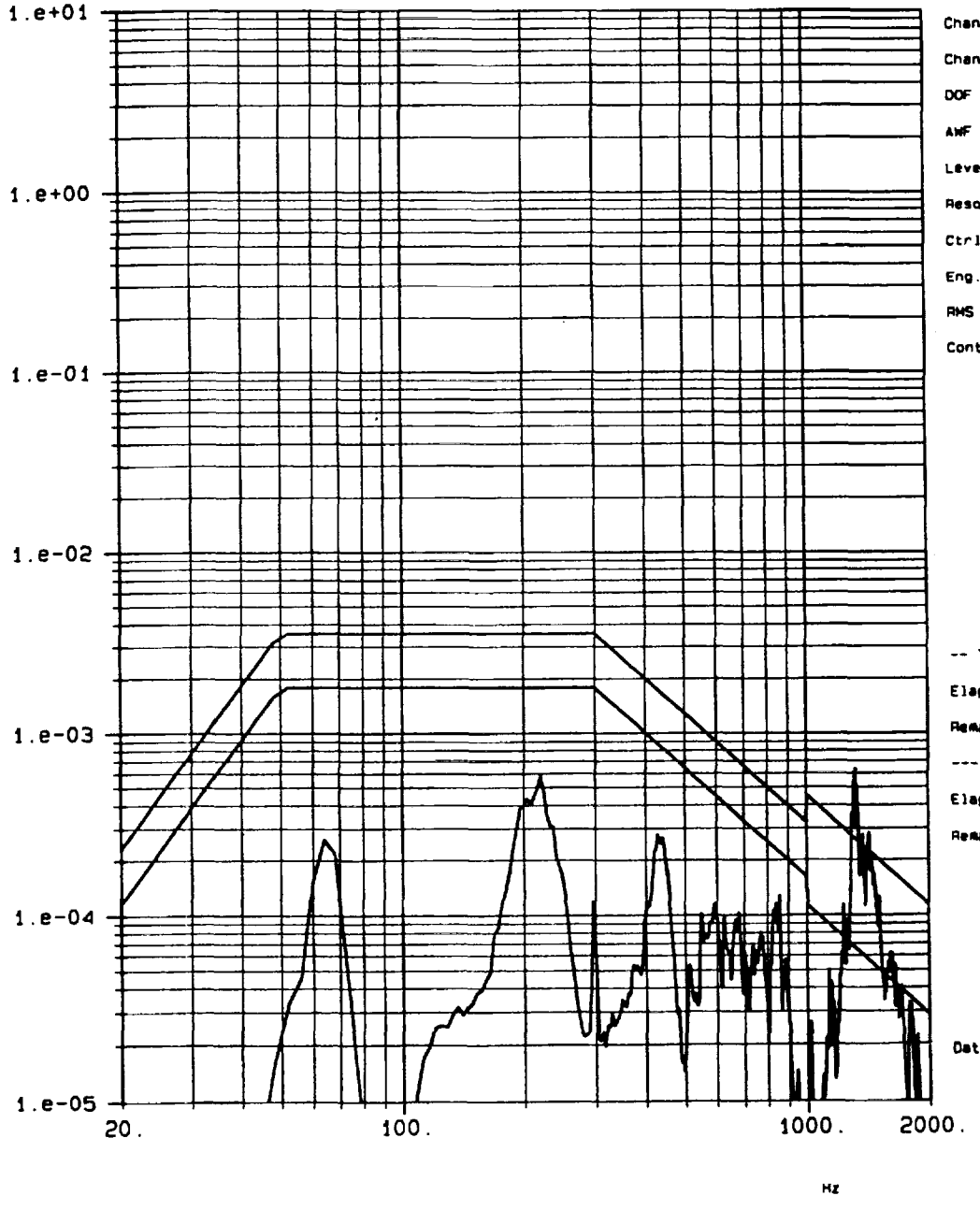
LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

Wyle Laboratories

El Segundo, CA

g^2/Hz R1Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 5
Chan. Type : N T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 0.39416 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:52
Remaining : 0:05:30

Date : 5/24/2002
9:33:10

RANDOM PLOT NO. 67

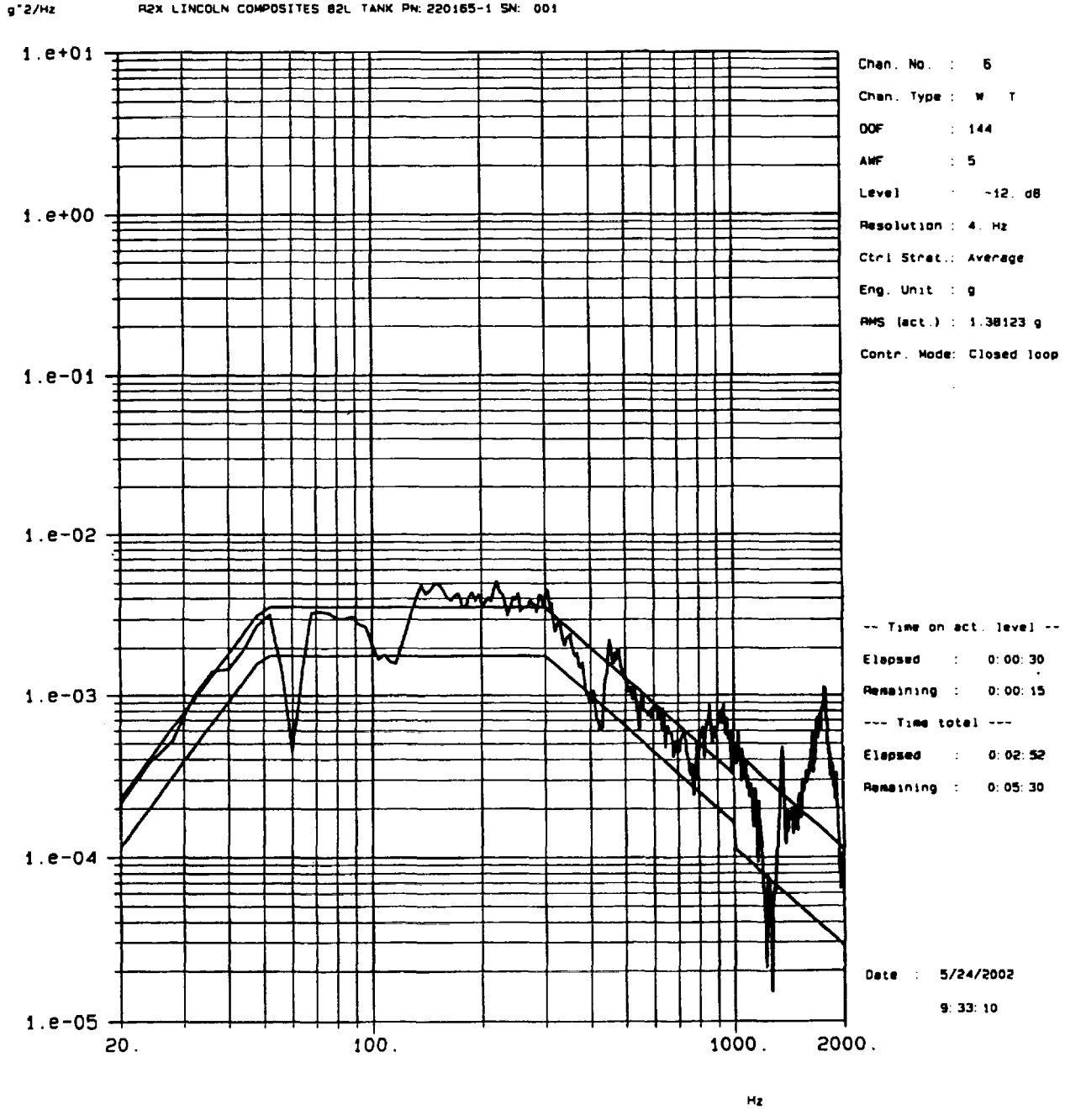
Random Limit Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 69

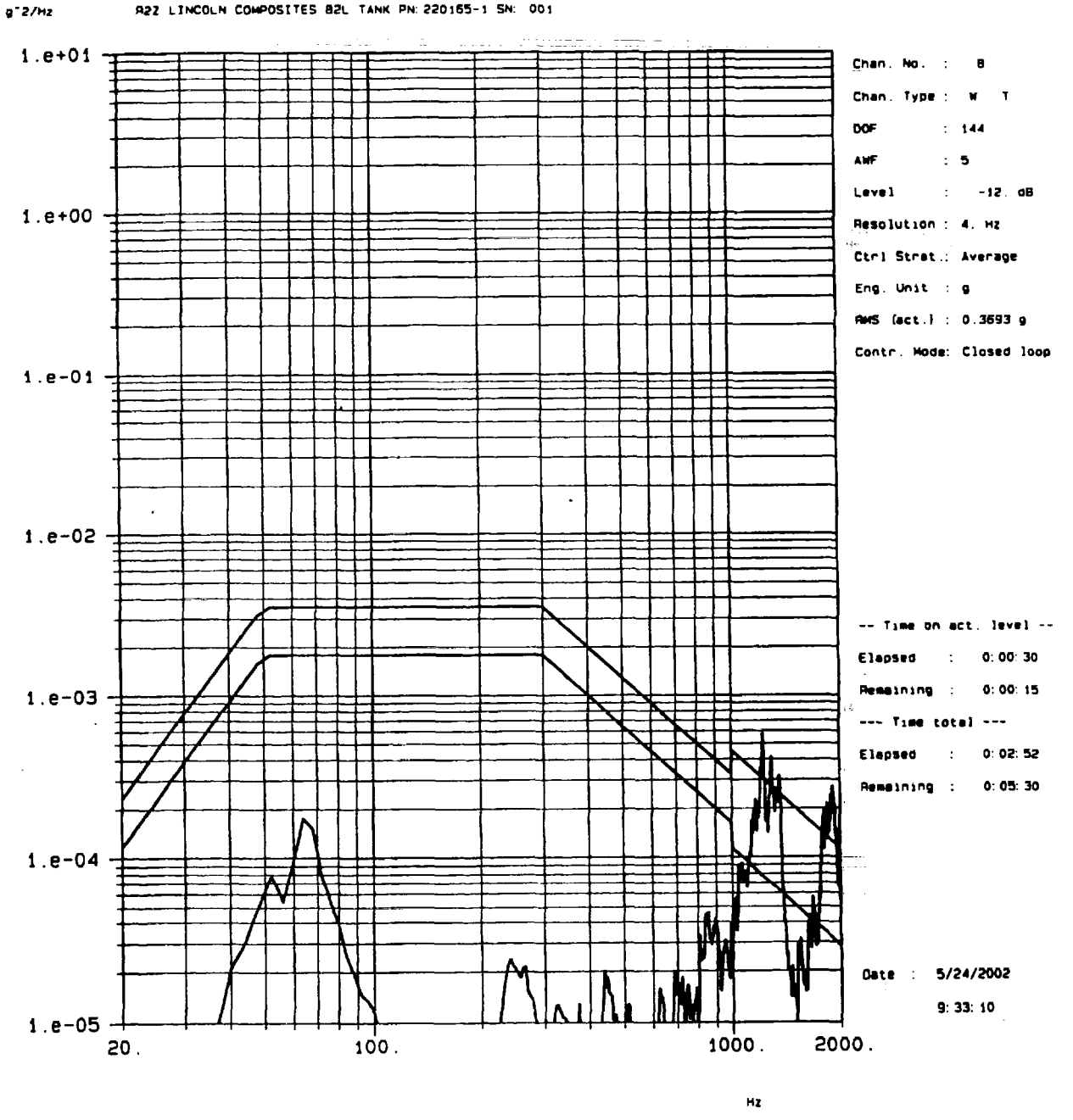
Random Limit Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 68

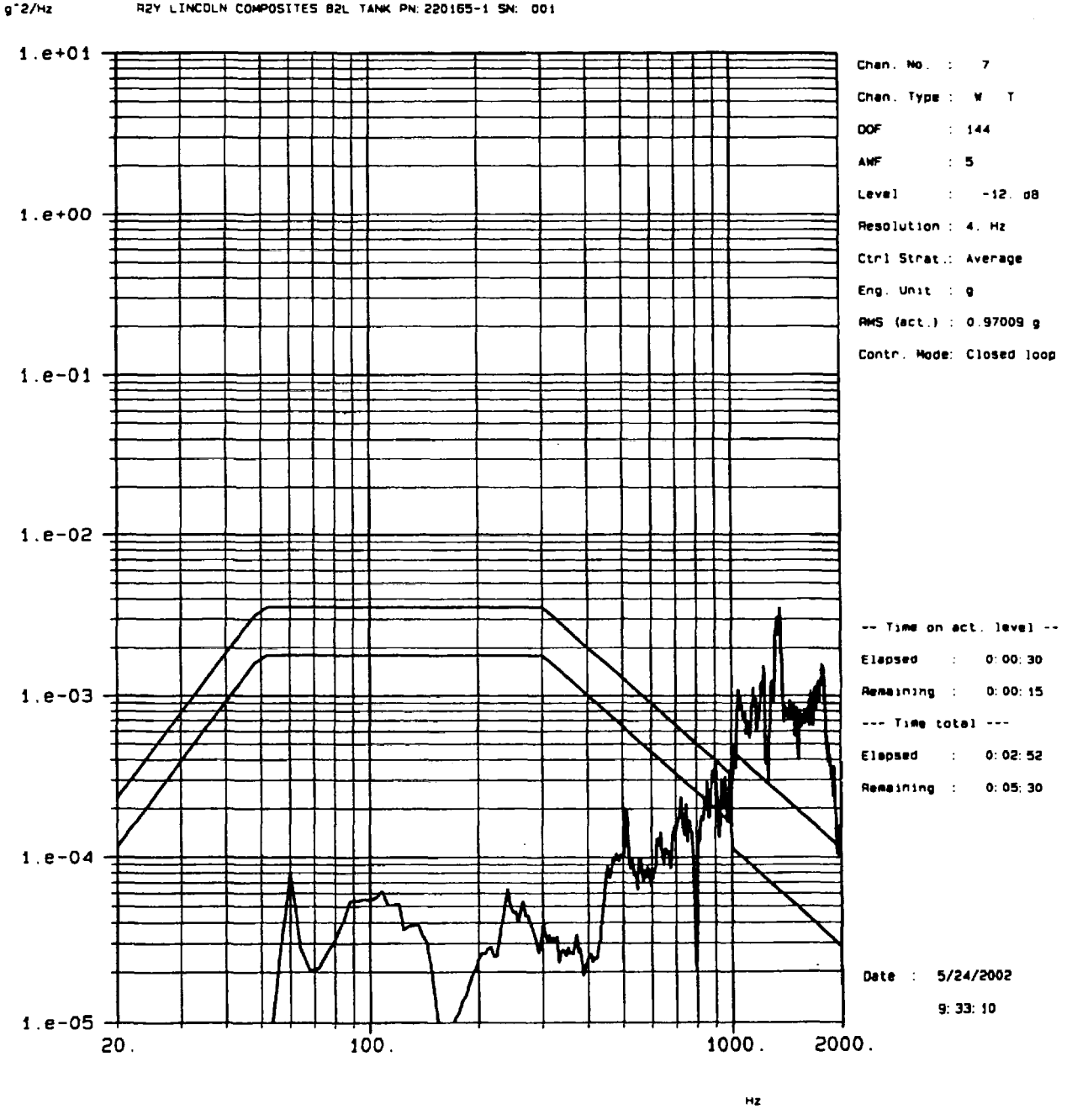
Random Limit Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 70

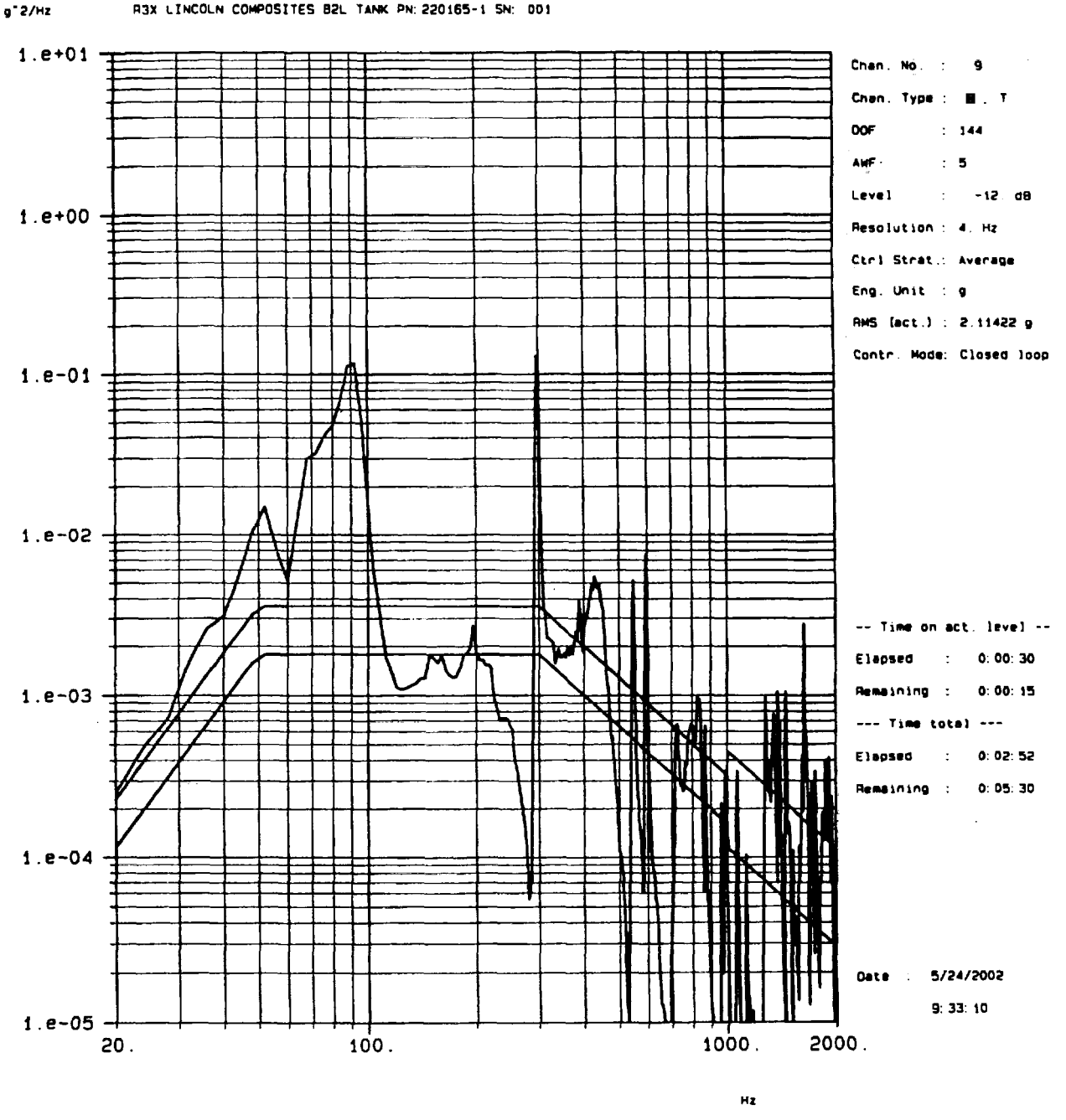
Random Limit Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 71

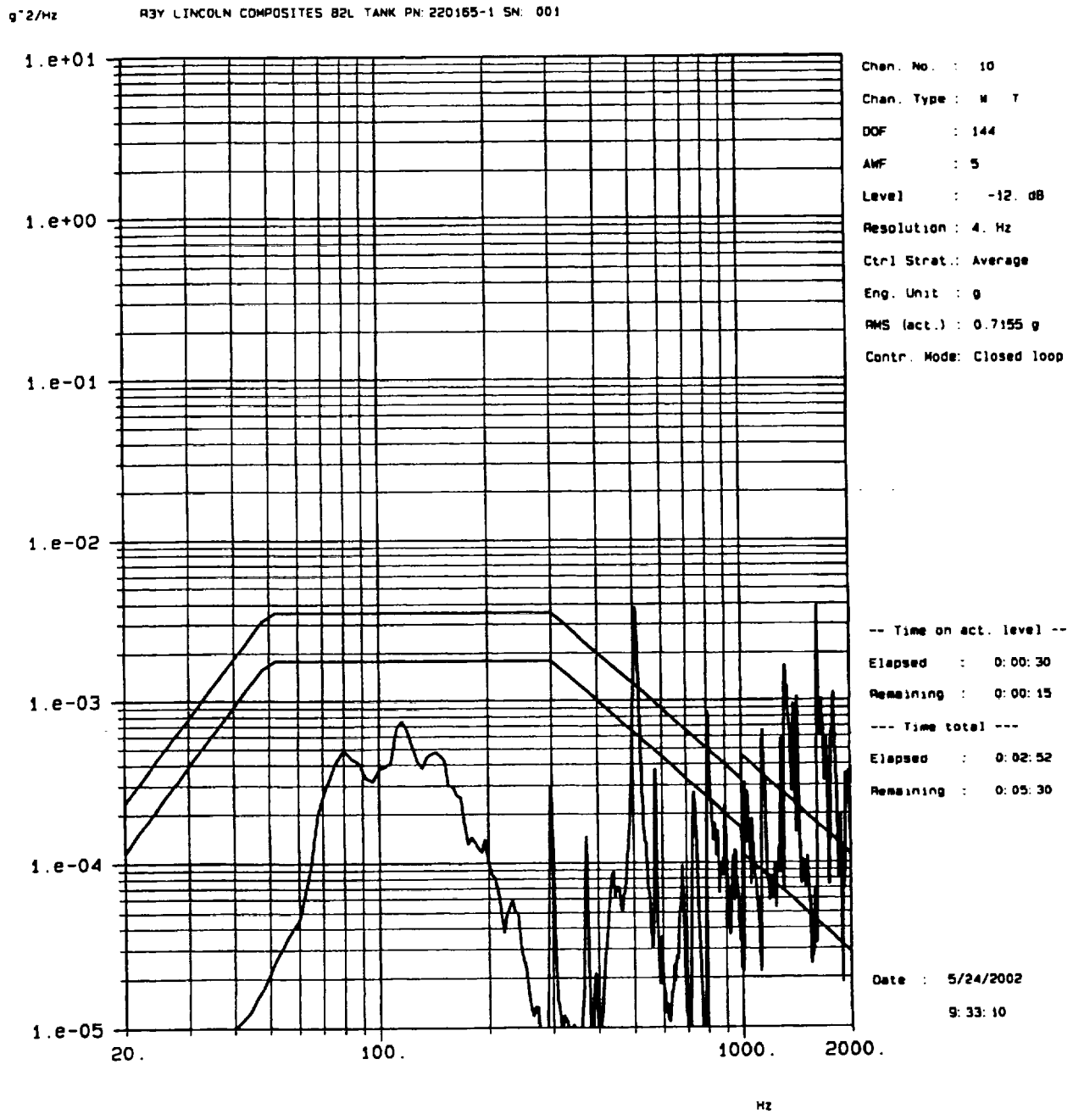
Random Limit Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 72

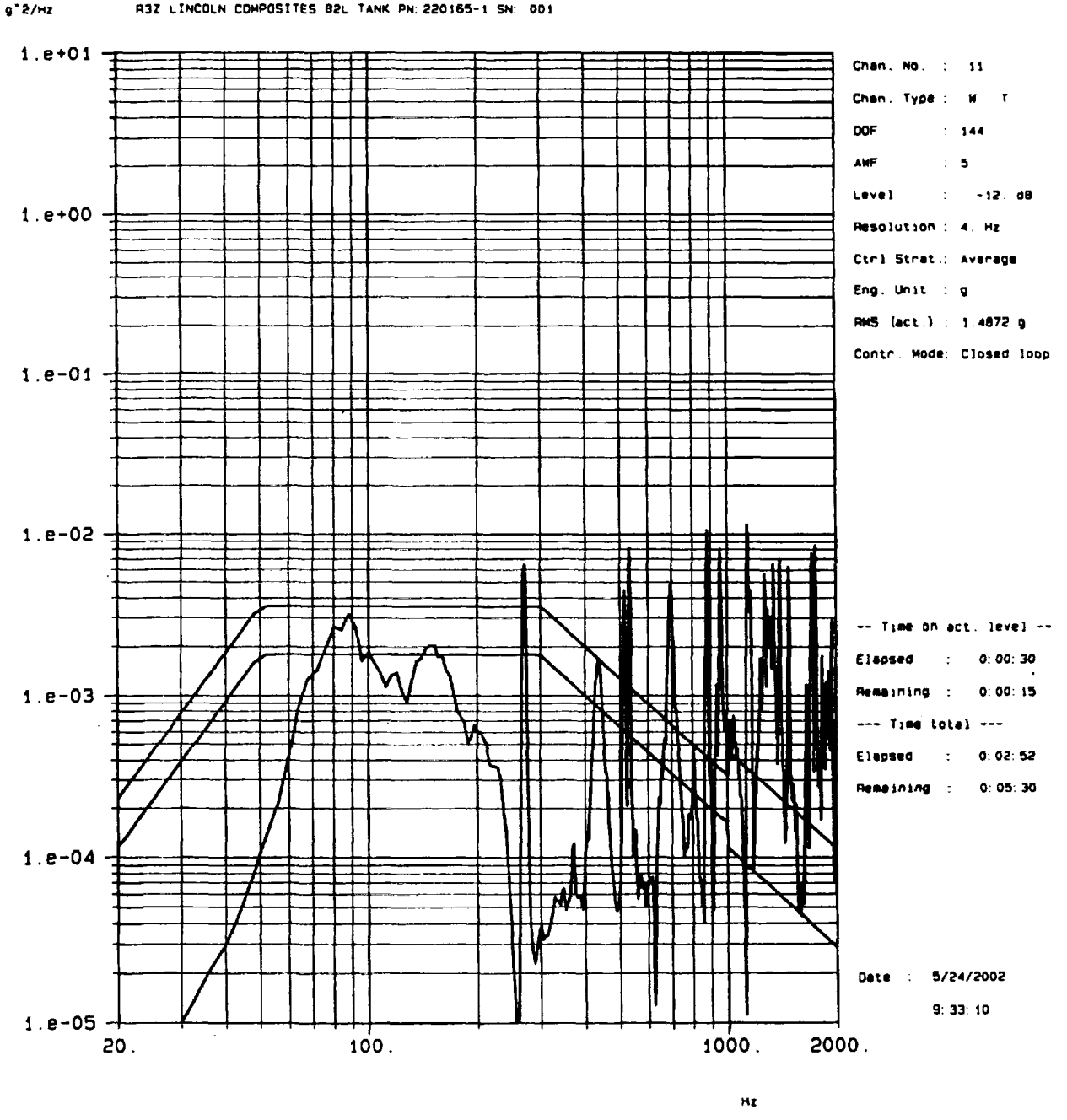
Random Limit Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 73

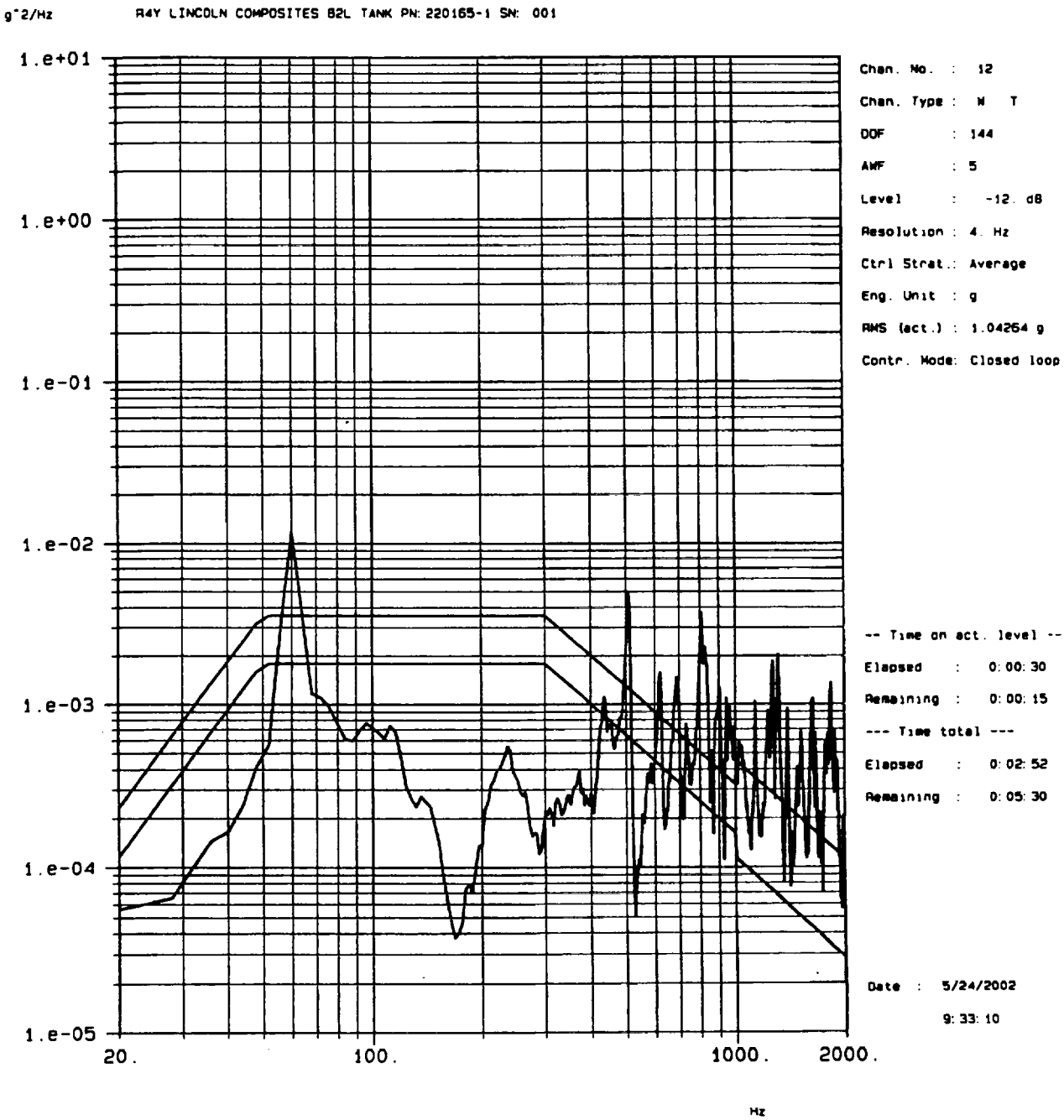
Random Limit Channel

LINCOLN47039 X QUAL

X AXIS PRE -12dB MID

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 74

Random Control

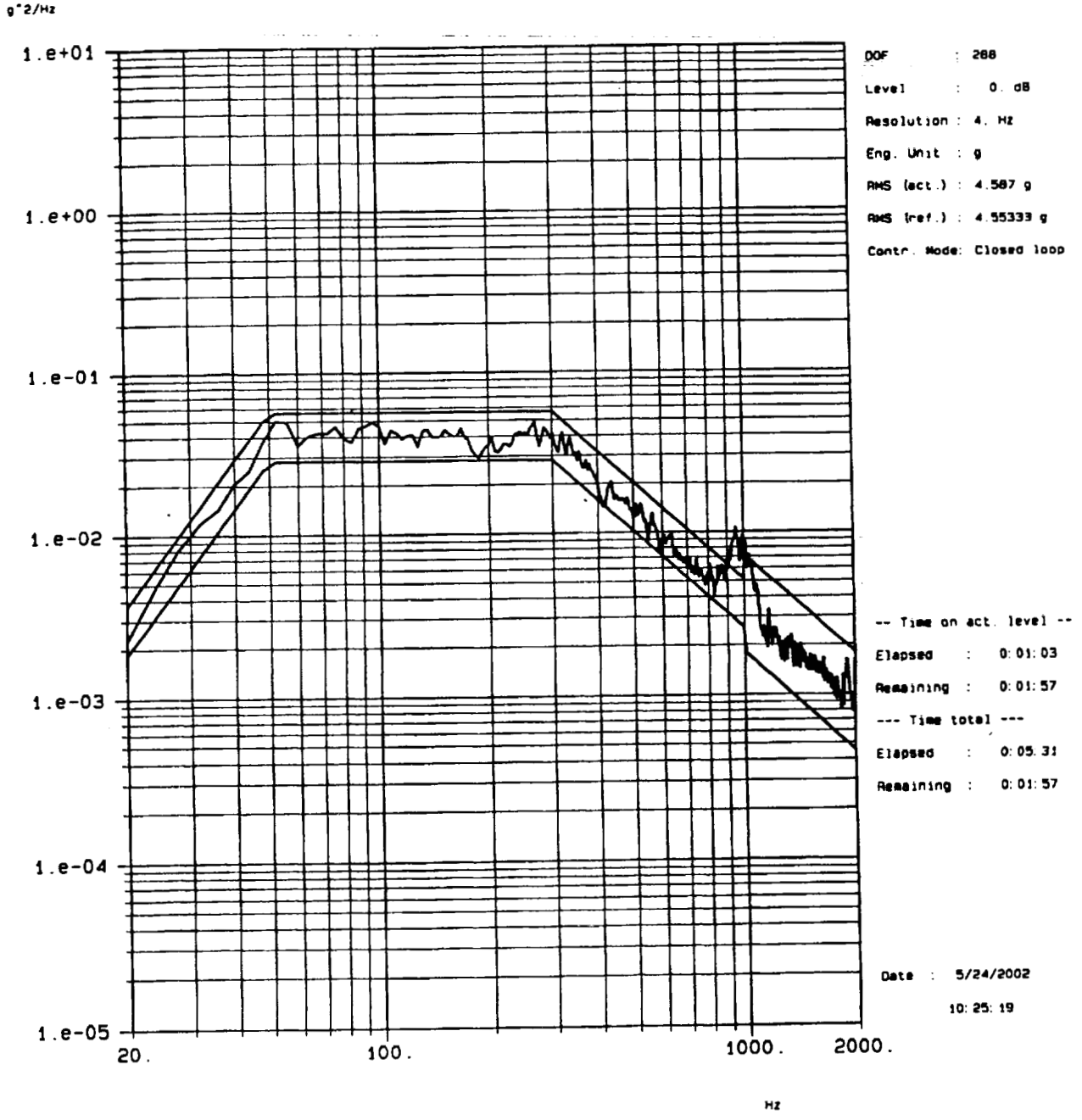
LINCOLN47039 X QUAL

X AXIS QUAL

AVERAGE OF C1 & C2

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 75

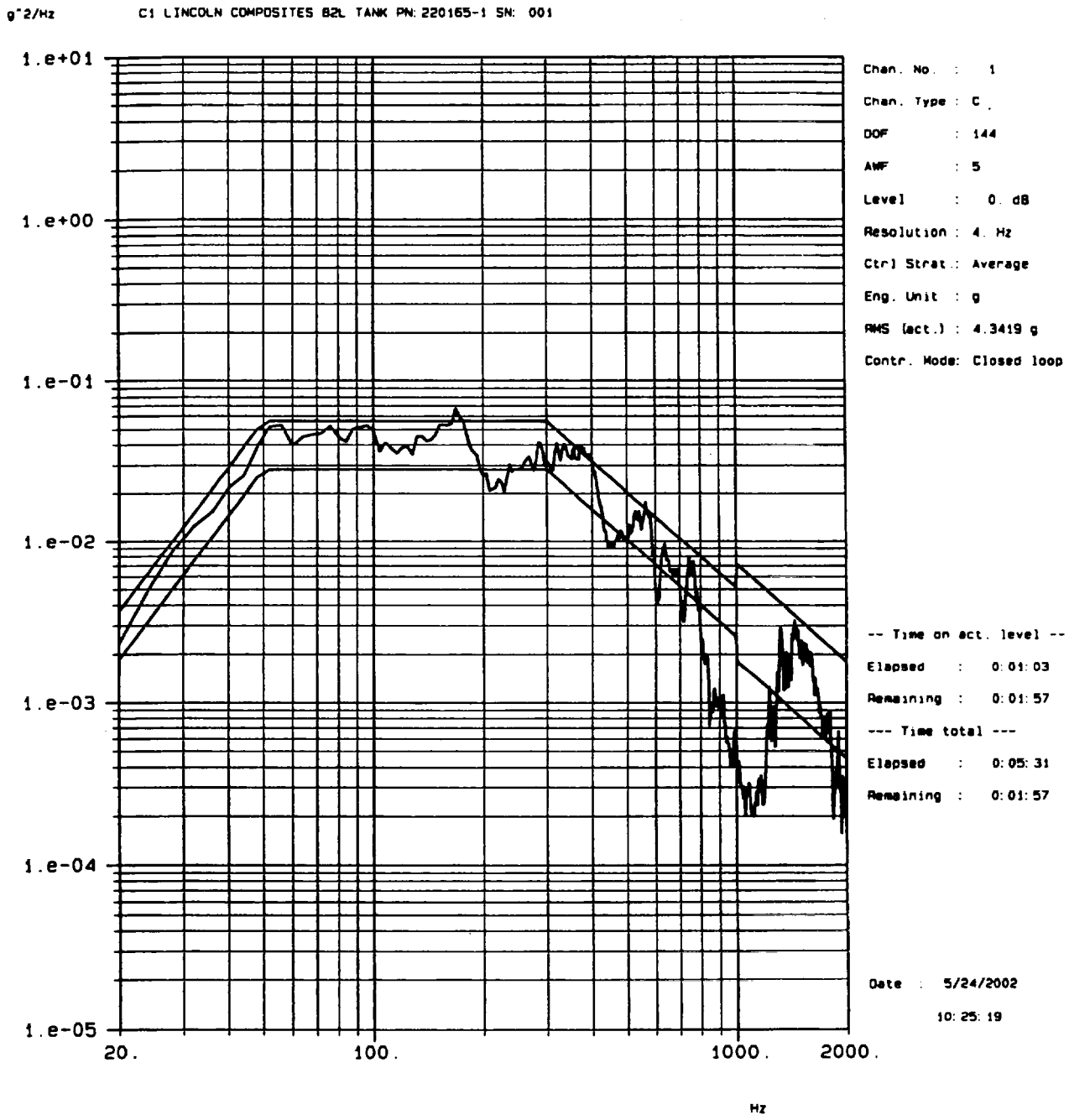
Random Control Channel

LINCOLN47039 X QUAL

X AXIS QUAL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 76

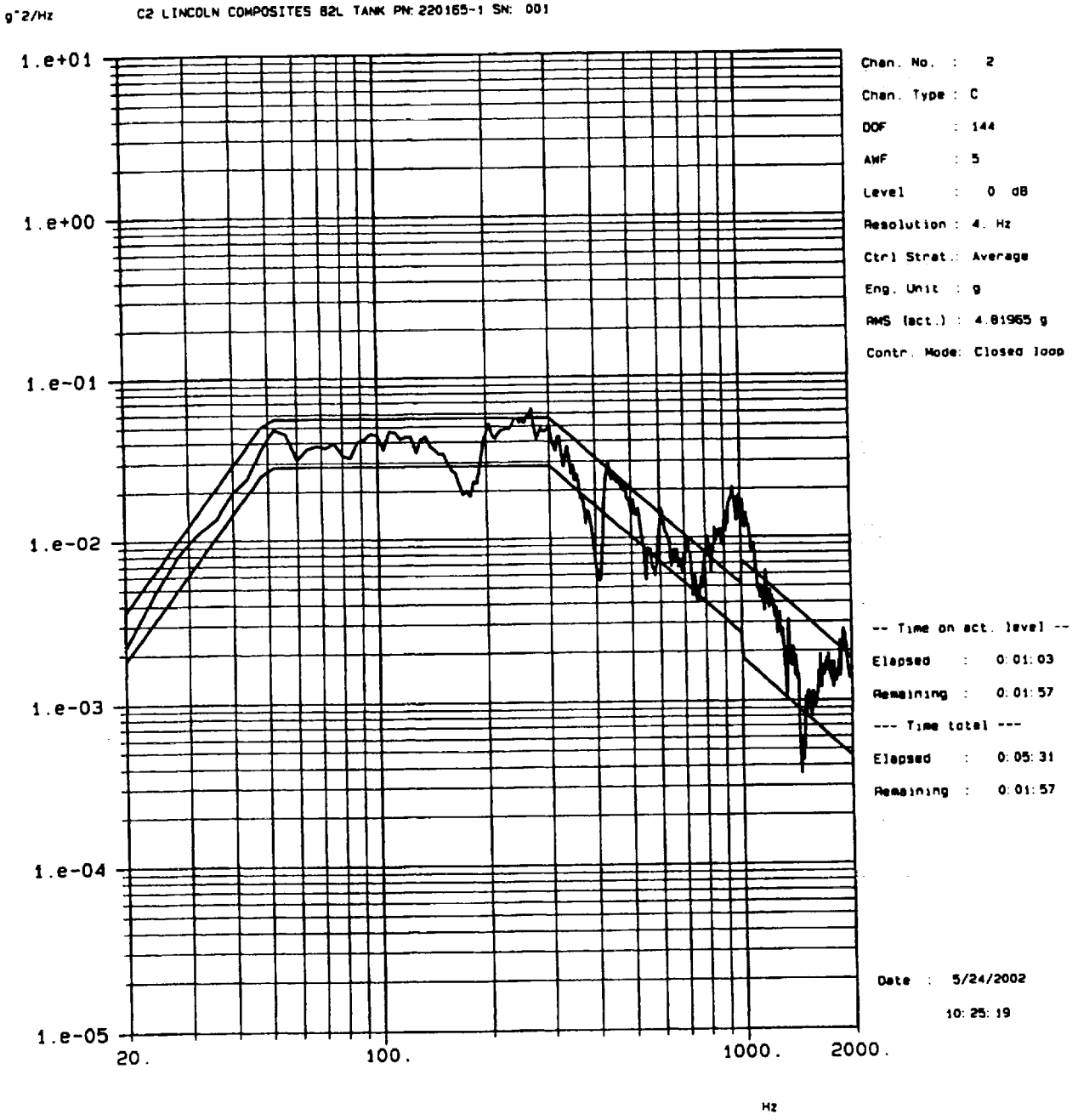
Random Control Channel

LINCOLN47039 X QUAL

X AXIS QUAL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 77

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

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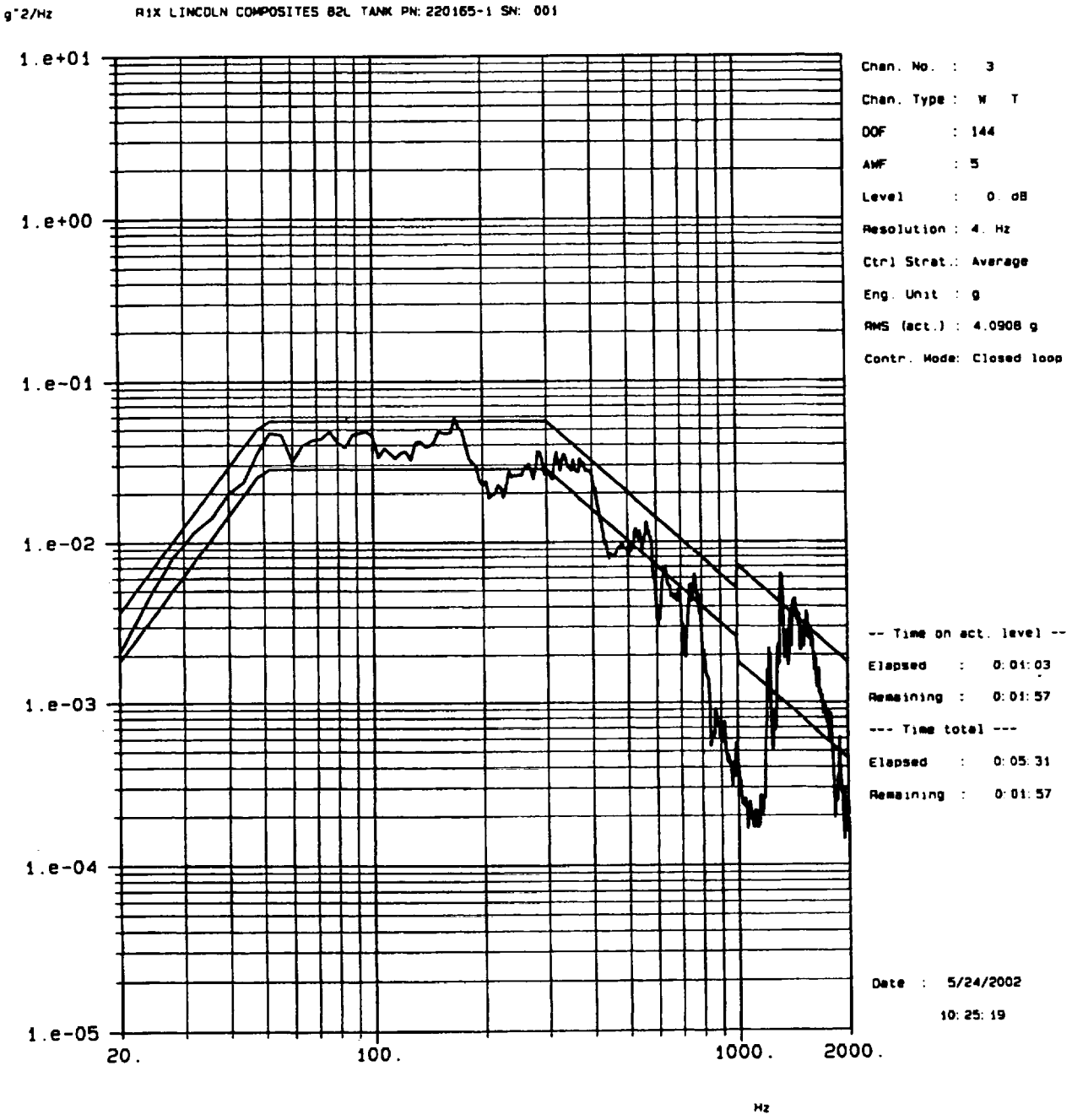
El Segundo, CA



RANDOM PLOT NO. 78

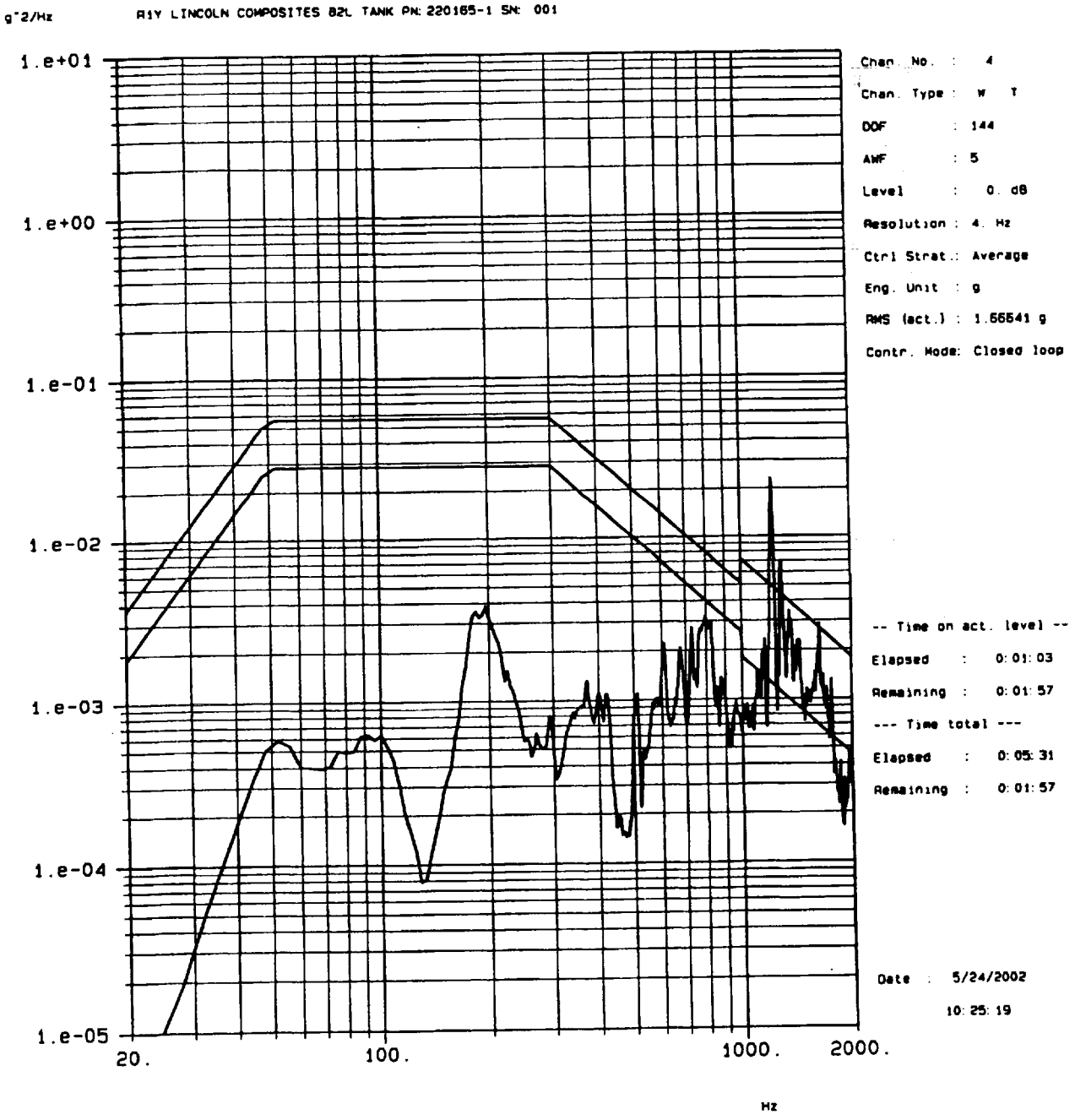
Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 79

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

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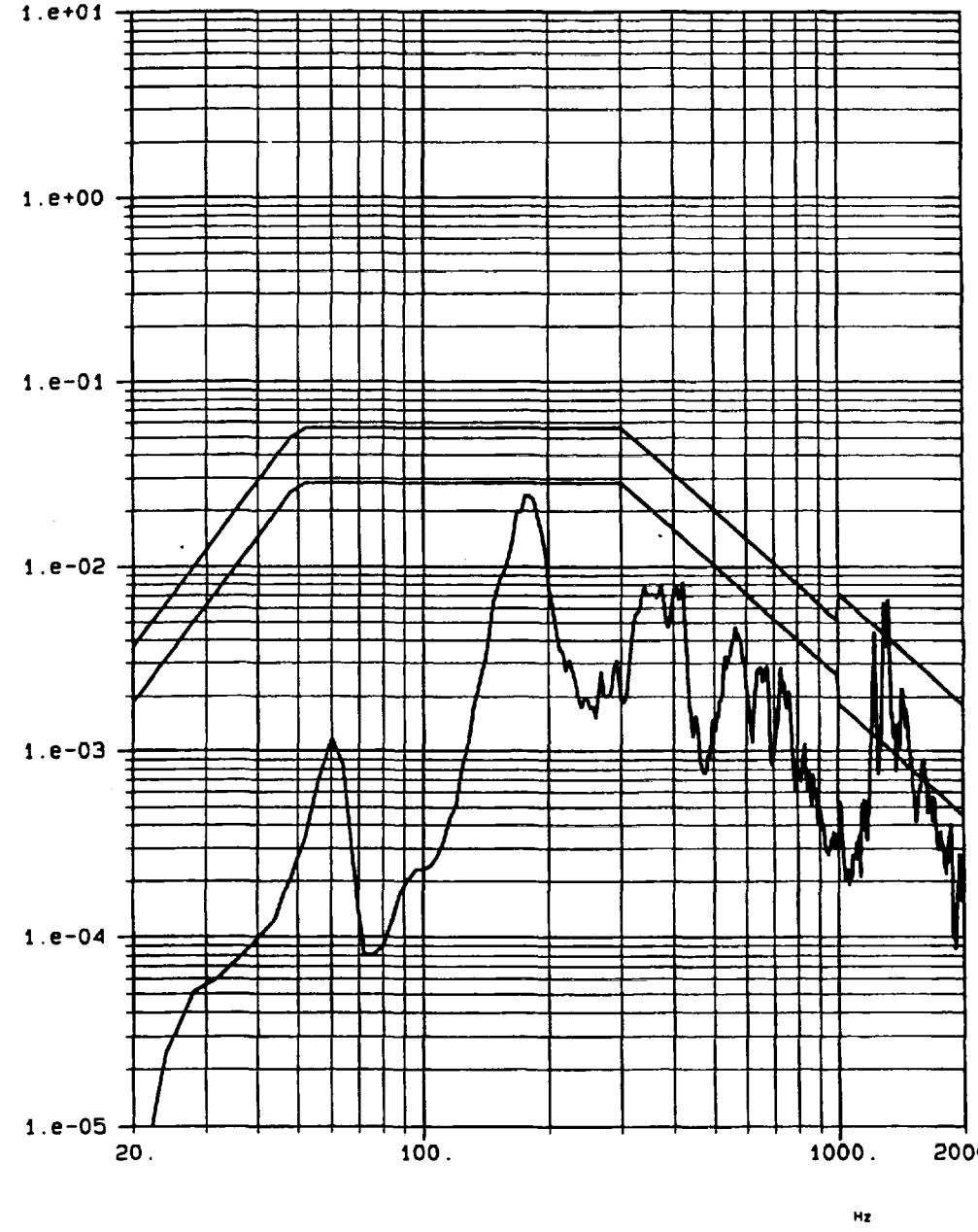
g^2/Hz R1Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 5
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat : Average
Eng. Unit : g
RMS (act.) : 1.93788 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:03
Remaining : 0:01:57
--- Time total ---
Elapsed : 0:05:31
Remaining : 0:01:57

Date : 5/24/2002
10:25:19

RANDOM PLOT NO. 80

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

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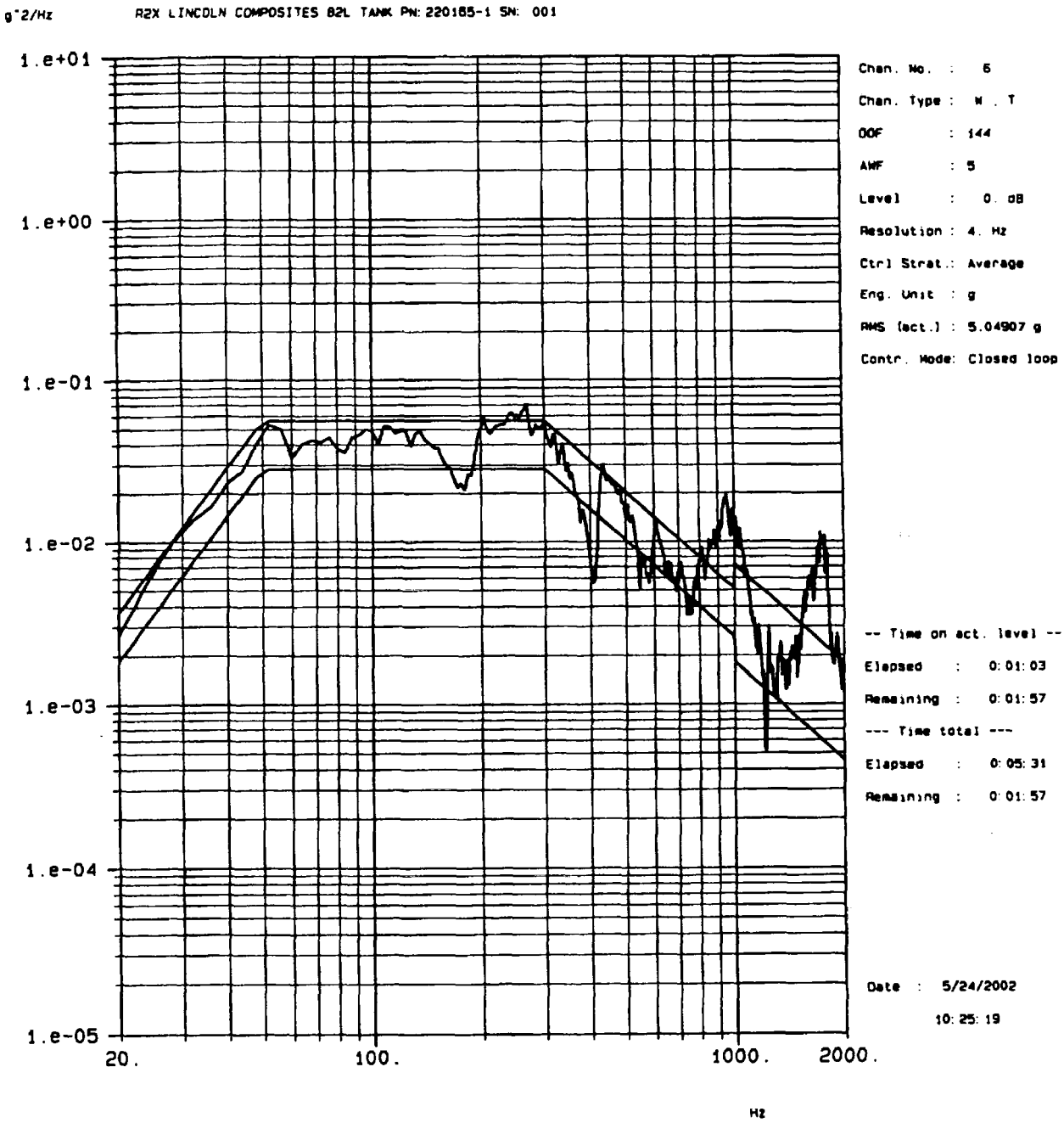

RANDOM PLOT NO. 81

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

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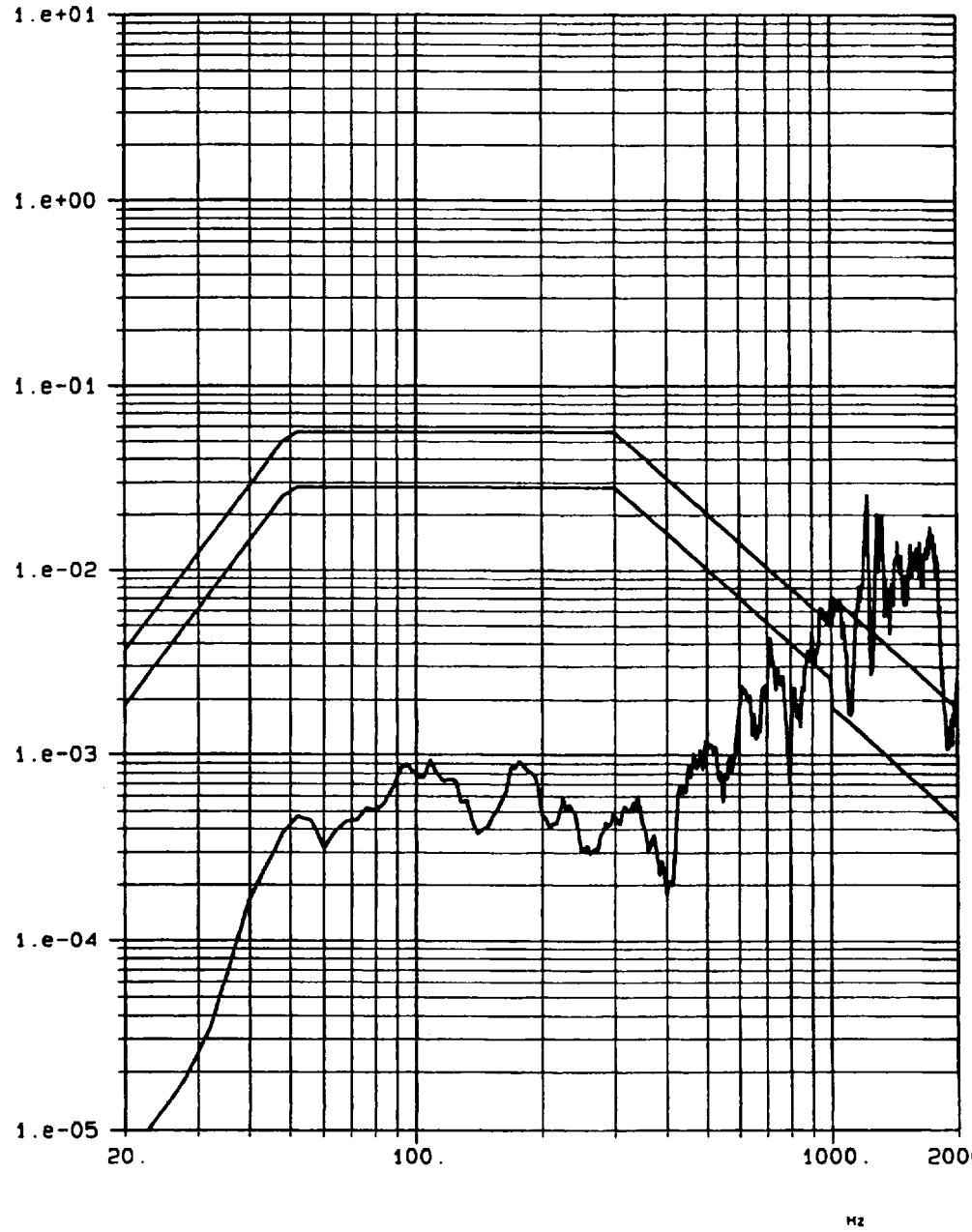
g^2/Hz R2Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 7
Chan. Type : N T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 3.1127 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:03
Remaining : 0:01:57
--- Time total ---
Elapsed : 0:05:31
Remaining : 0:01:57

Date : 5/24/2002
10:25:19

RANDOM PLOT NO. 82

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

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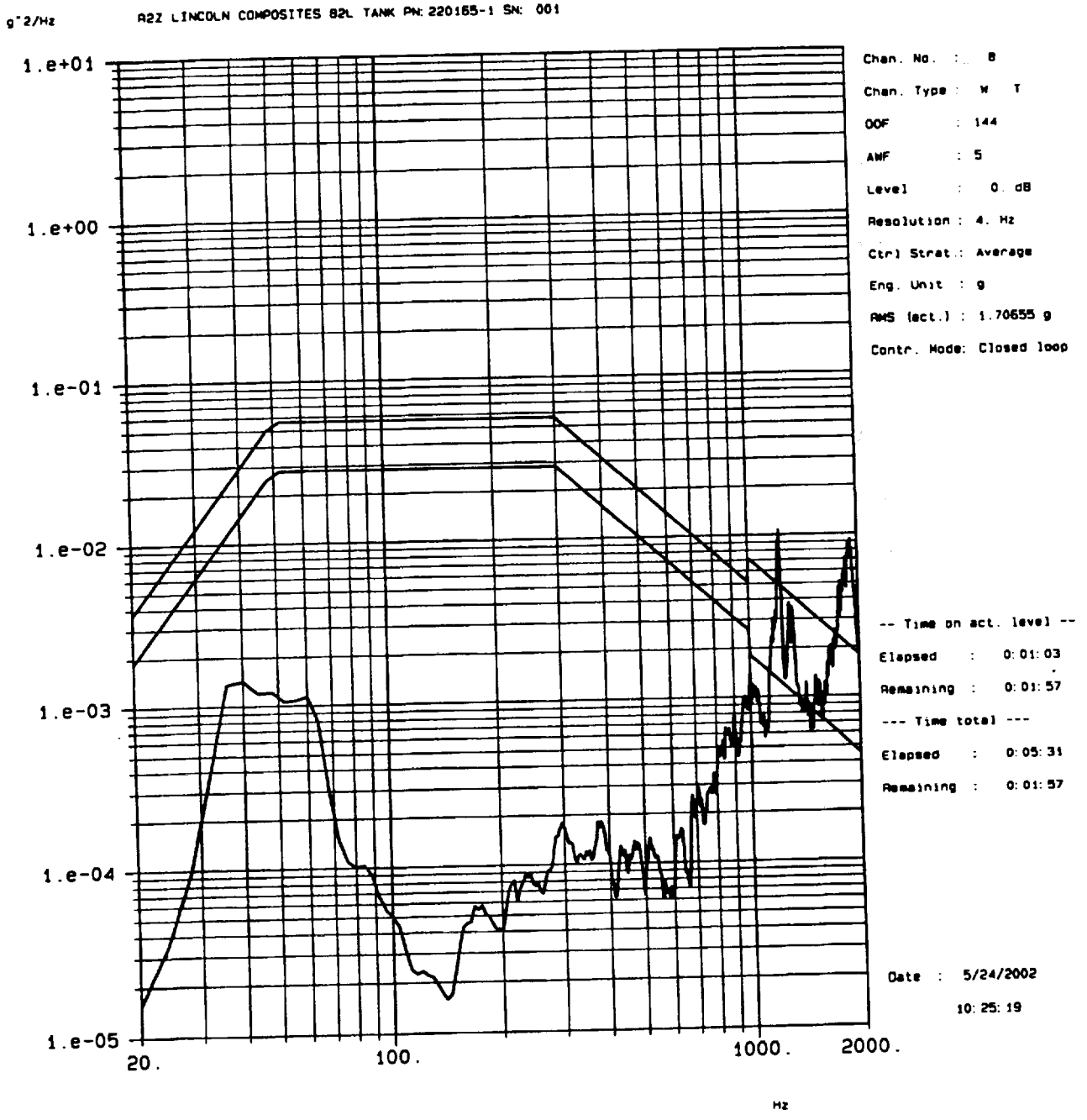

RANDOM PLOT NO. 83

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

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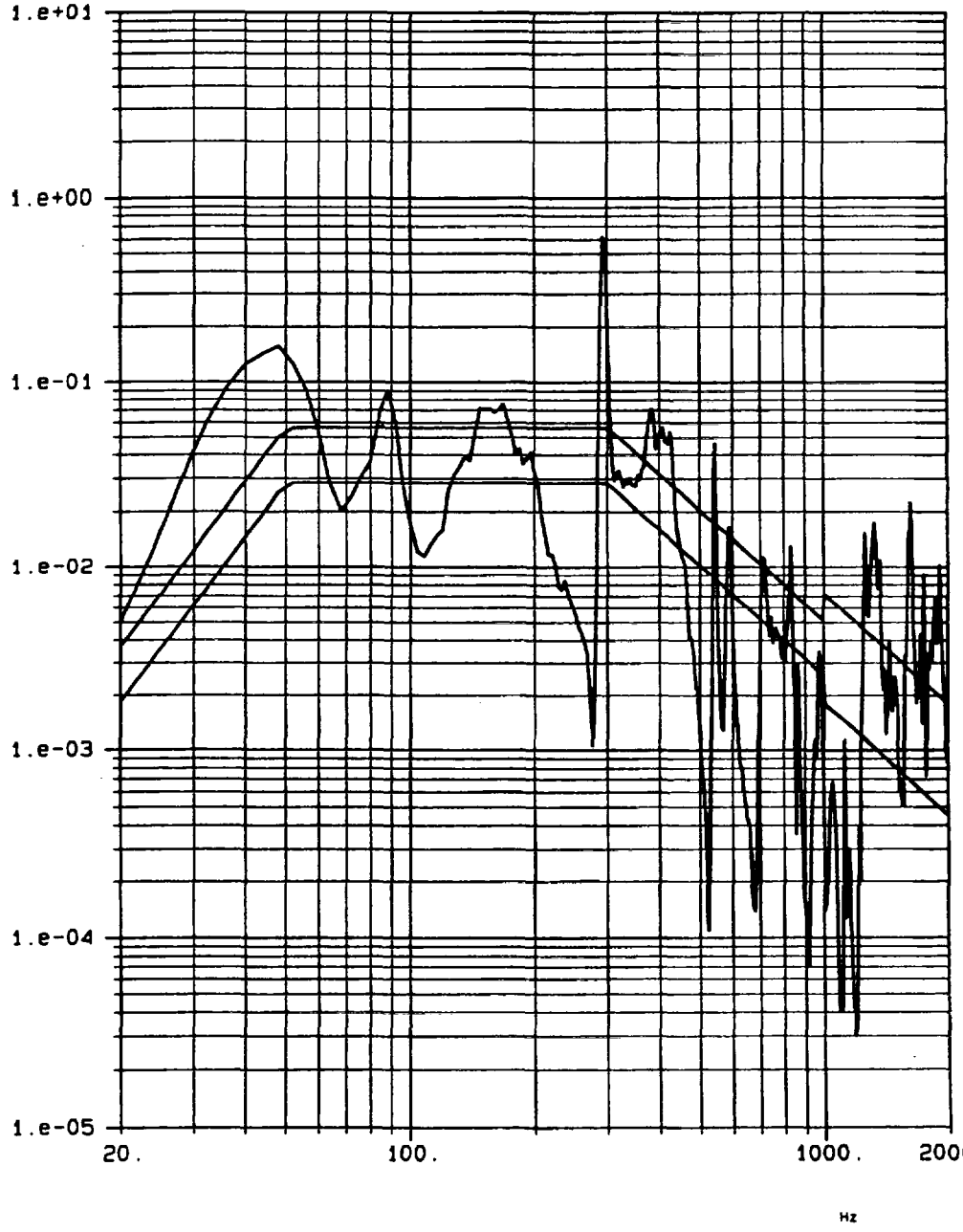
g^2/Hz R3X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 5.35912 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:03
Remaining : 0:01:57
--- Time total ---
Elapsed : 0:05:31
Remaining : 0:01:57

Date : 5/24/2002
10:25:19

RANDOM PLOT NO. 84

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

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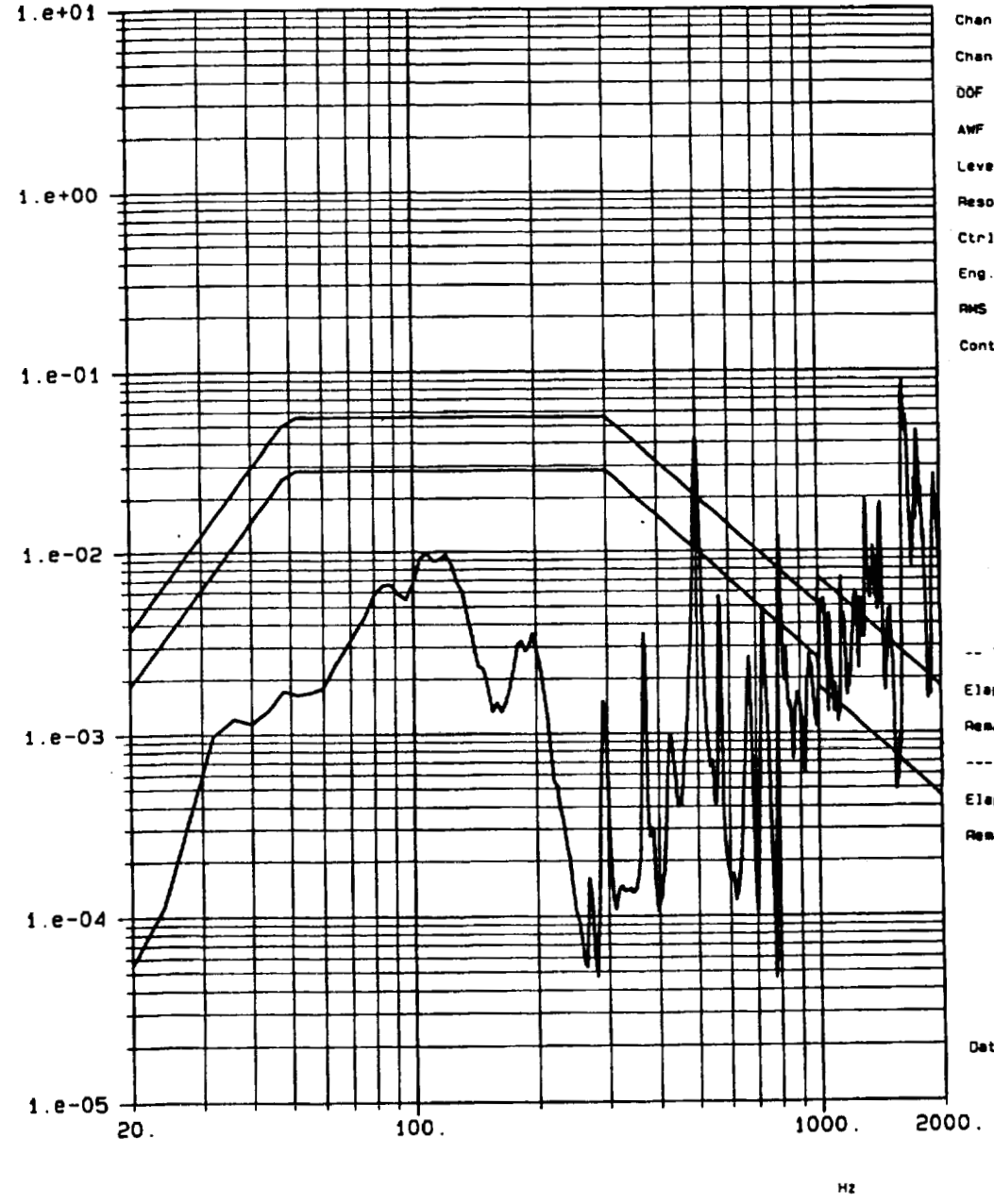
g^2/Hz R3Y LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 10

Chan. Type : W T

DOF : 144

AWF : 5

Level : 0. dB

Resolution : 4. Hz

Ctrl Strat.: Average

Eng. Unit : g

RMS (act.) : 3.67835 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0:01:03

Remaining : 0:01:57

--- Time total ---

Elapsed : 0:05:31

Remaining : 0:01:57

Date : 5/24/2002

10:25:19

RANDOM PLOT NO. 85

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

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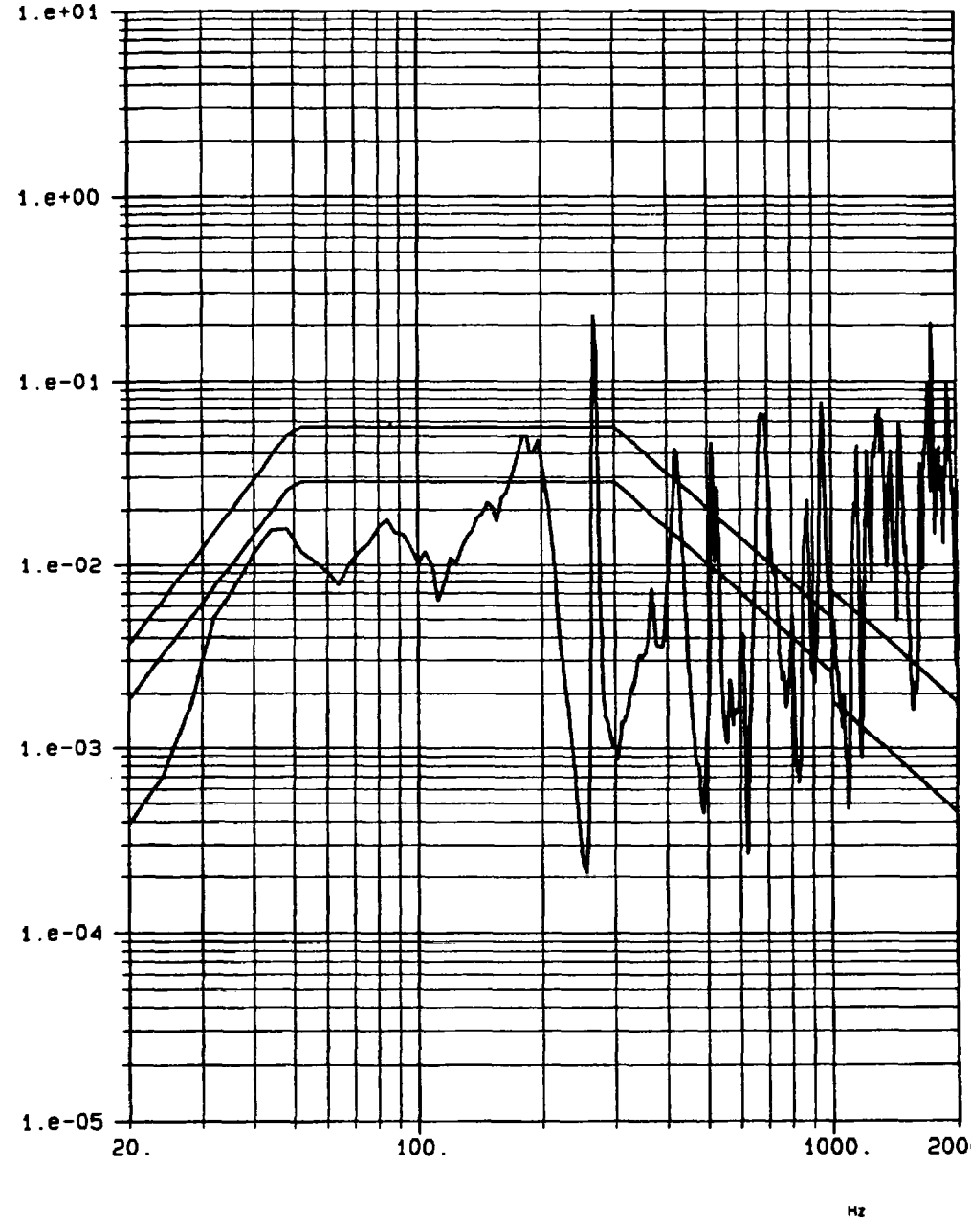
El Segundo, CA

g^2/Hz R3Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 11
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Average
Eng. Unit : g
RMS (act.) : 6.34717 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:03
Remaining : 0:01:57
--- Time total ---
Elapsed : 0:05:31
Remaining : 0:01:57

Date : 5/24/2002
10:25:19

RANDOM PLOT NO. 86

Random Limit Channel

LINCOLN47039 X QUAL

X AXIS QUAL

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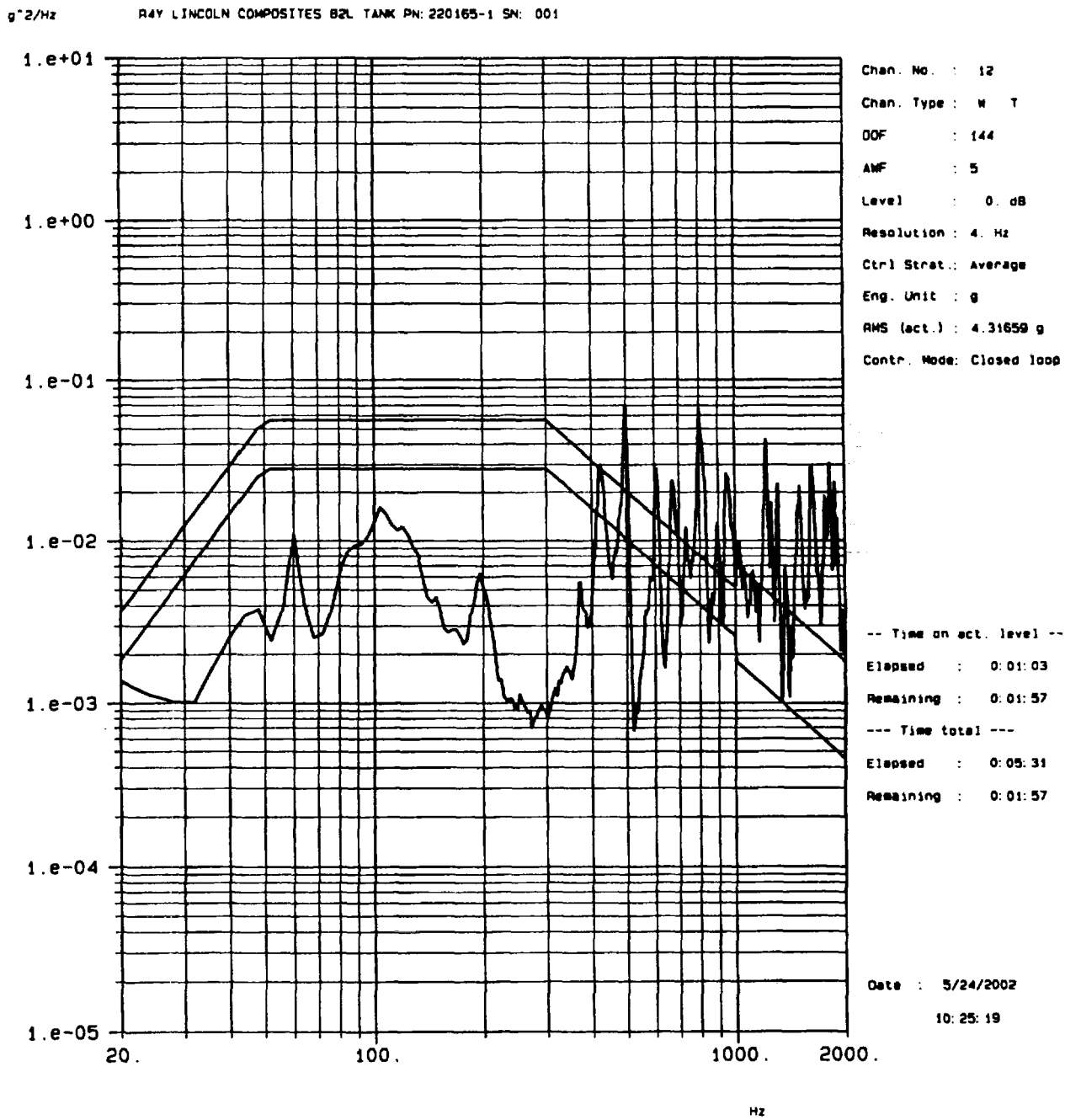


DYN-B

DYNAMICS SECTION
VIBRATION TEST DATA SHEET

Customer Lincoln Composites **Job No.** 47039

Sheet 1 **of** 1

Specimen 82 Liter Pressure Vessel **P/N** 220165-1 **S/N** 0001

Date	Time	Axis	Temp (°F)	SINUSOIDAL Freq. (Hz)	Disp. (inDA)	Accel. (± G)	Test Time (Sec.)	Comments	Plot No.
5-21-02	2128	Y	Amb.	5-22.6		.6389		Qualification Sine to incorrect spectrum, aborted at 84.5 Hz.	1-12
				22.6-50		13		See report and NOD #1 for details.	
				100		5.2	122	Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
								Single point control using C1. C2 for reference only.	
5-22-02	0932	Y	Amb.	5-22.6	.5"			Qualification Sine aborted at 37.8 Hz, specimen dislodged from	13-24
				22.6-50		13		fixture, see report and NOD #2 for details.	
				50-100		5.2	87	Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
								Single point control using C1. C2 for reference only.	
5-23-02	1940	Y	Amb.	50-100		5.2	22	Completed Qualification Sine 50-100Hz, abort at 84.22 Hz.	25-36
								Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
								Single point control using C1. C2 for reference only.	
5-23-02	2006	Y	Amb.	65-100		5.2	19	Completed Qualification Sine 65-100Hz.	37-49
								Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
								Extremal control using C1 and C2.	
								Per Lincoln Composites sum of above testing satisfies	
								Qualification Sine requirement.	

W603SS-ES

Signed [illegible]

wyle laboratories

REPORT NO. 47039
PAGE NO. DYN.B.2

SINUSOIDAL PLOT NO. 1

Sine Control/Limit Channel

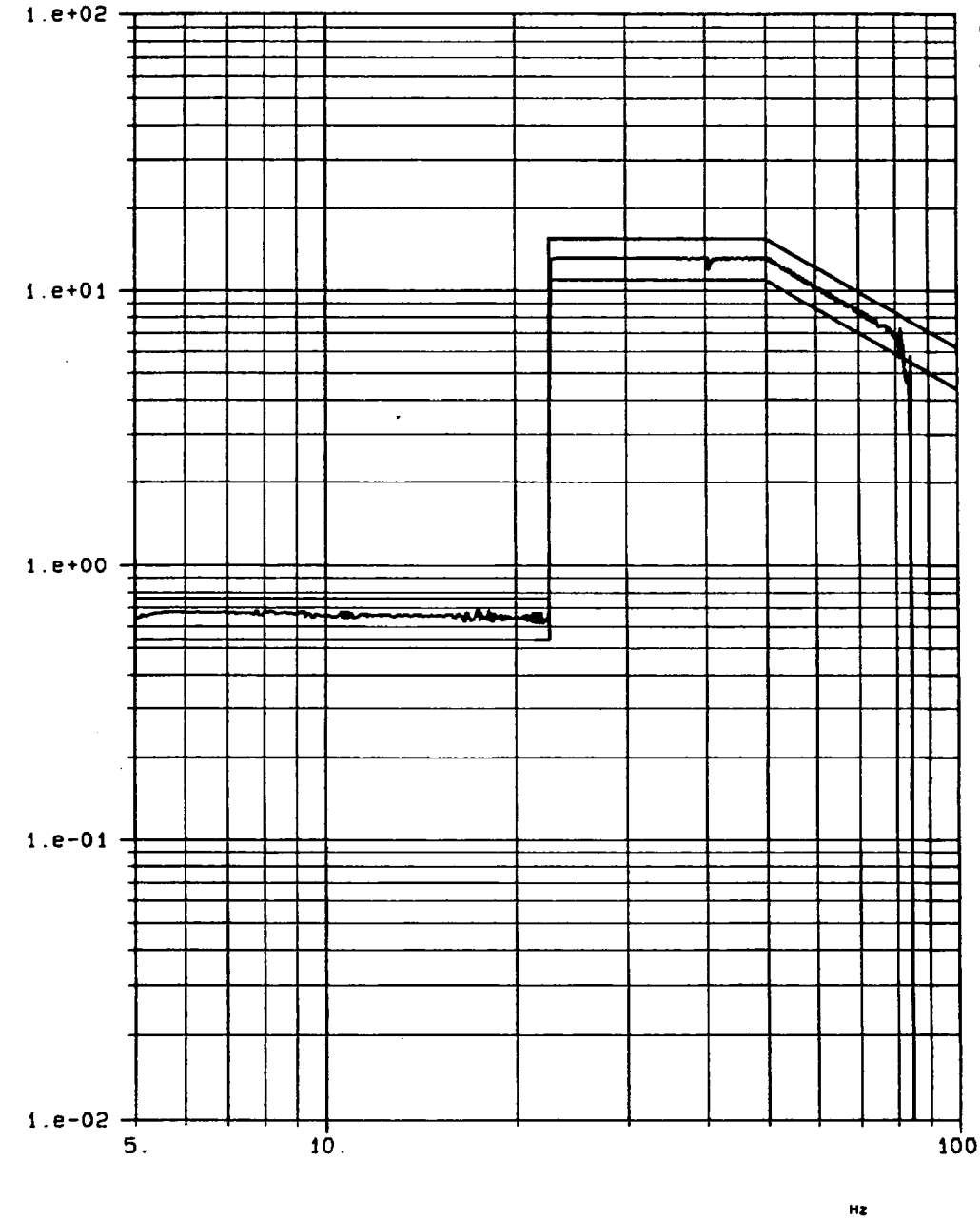
LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA

C1 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 1
Chan. Type : C
Sweep Type : log
Sweeps Done: 0
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Average
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop
Overload

-- Testing time --
Elapsed : 0:02:02
Remaining : 0:00:07

Date : 5/21/2002
21:28:54

SINUSOIDAL PLOT NO. 2

Sine Meas. Channel

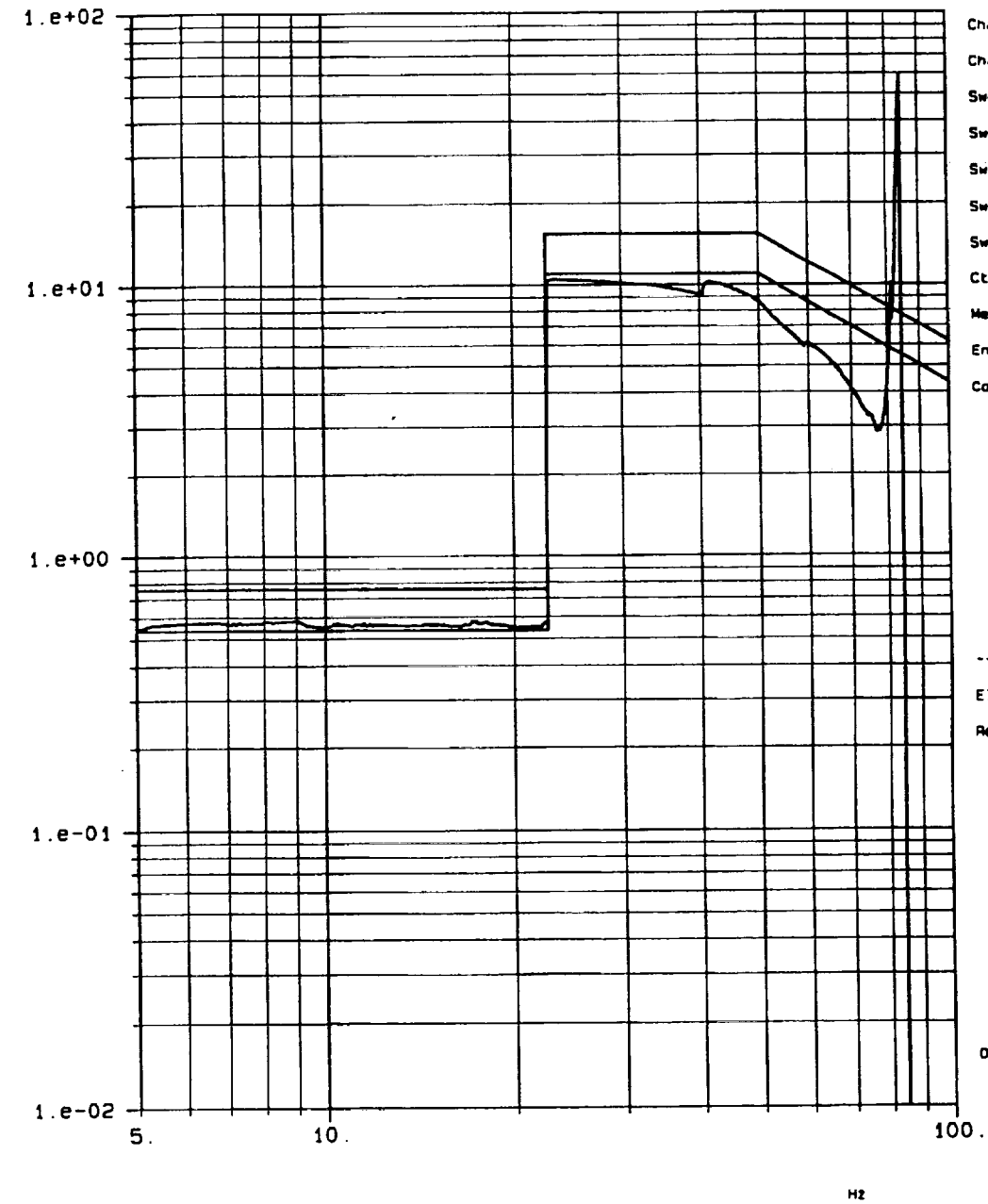
LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA

C2 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 2

Chan. Type : M

Sweep Type : log

Sweeps Done: 0

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2 Oct/min

Ctrl Strat.: Average

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:02:02

Remaining : 0:00:07

Date : 5/21/2002

21:28:54

SINUSOIDAL PLOT NO. 3

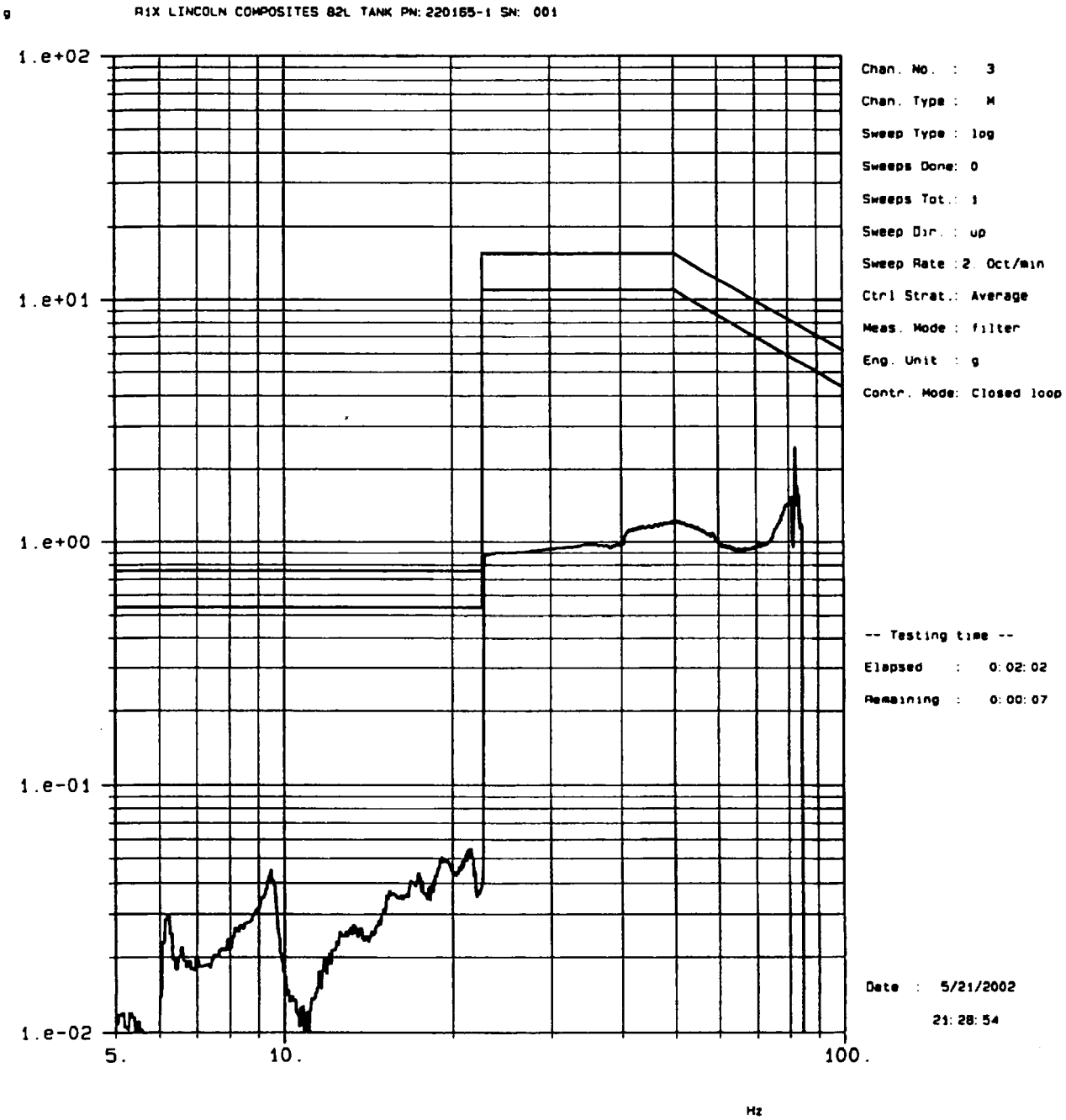
Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA



SINUSOIDAL PLOT NO. 4

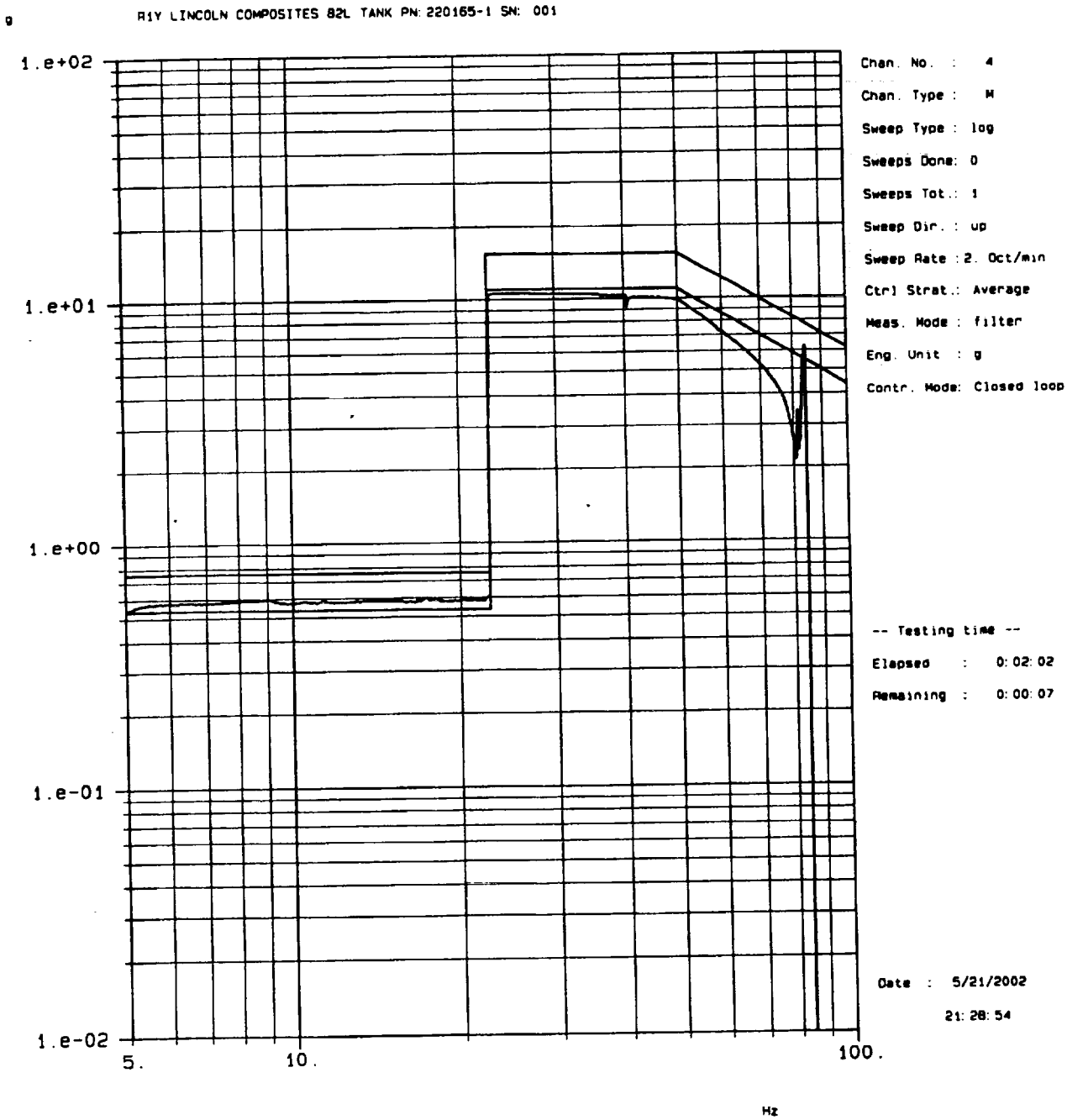
Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA



SINUSOIDAL PLOT NO. 5

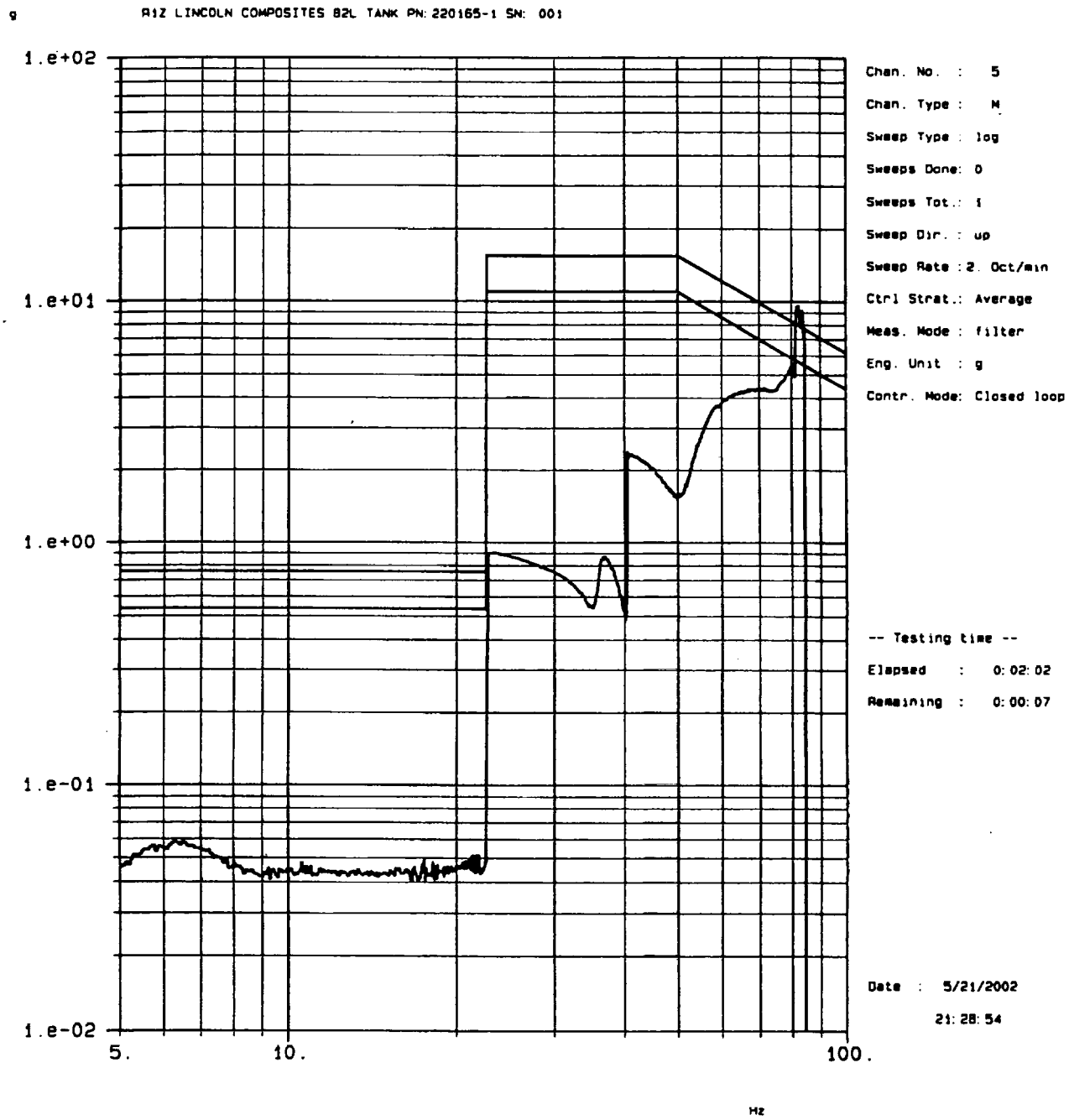
Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA



SINUSOIDAL PLOT NO. 6

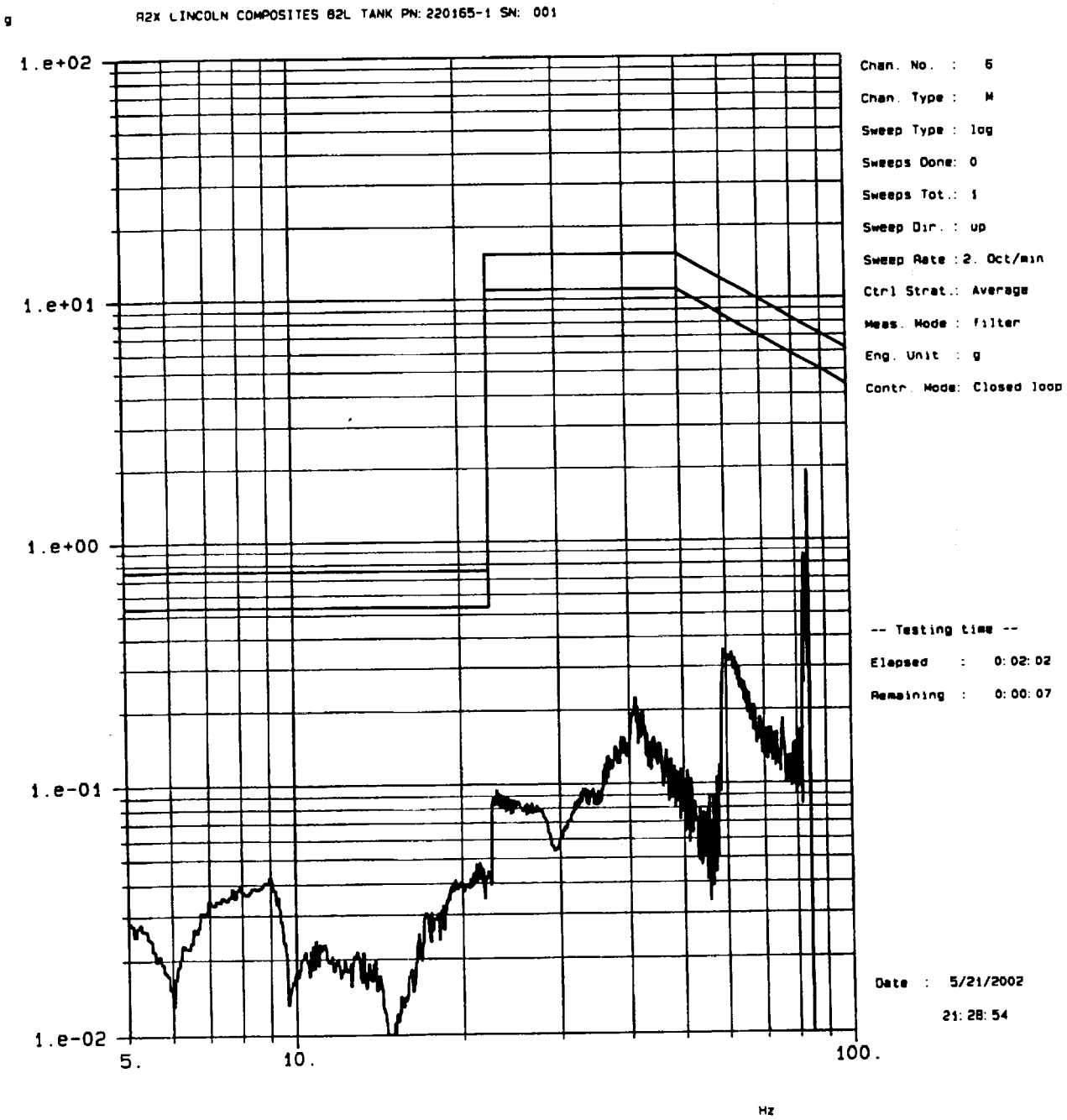
Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA



SINUSOIDAL PLOT NO. 7

Sine Meas. Channel

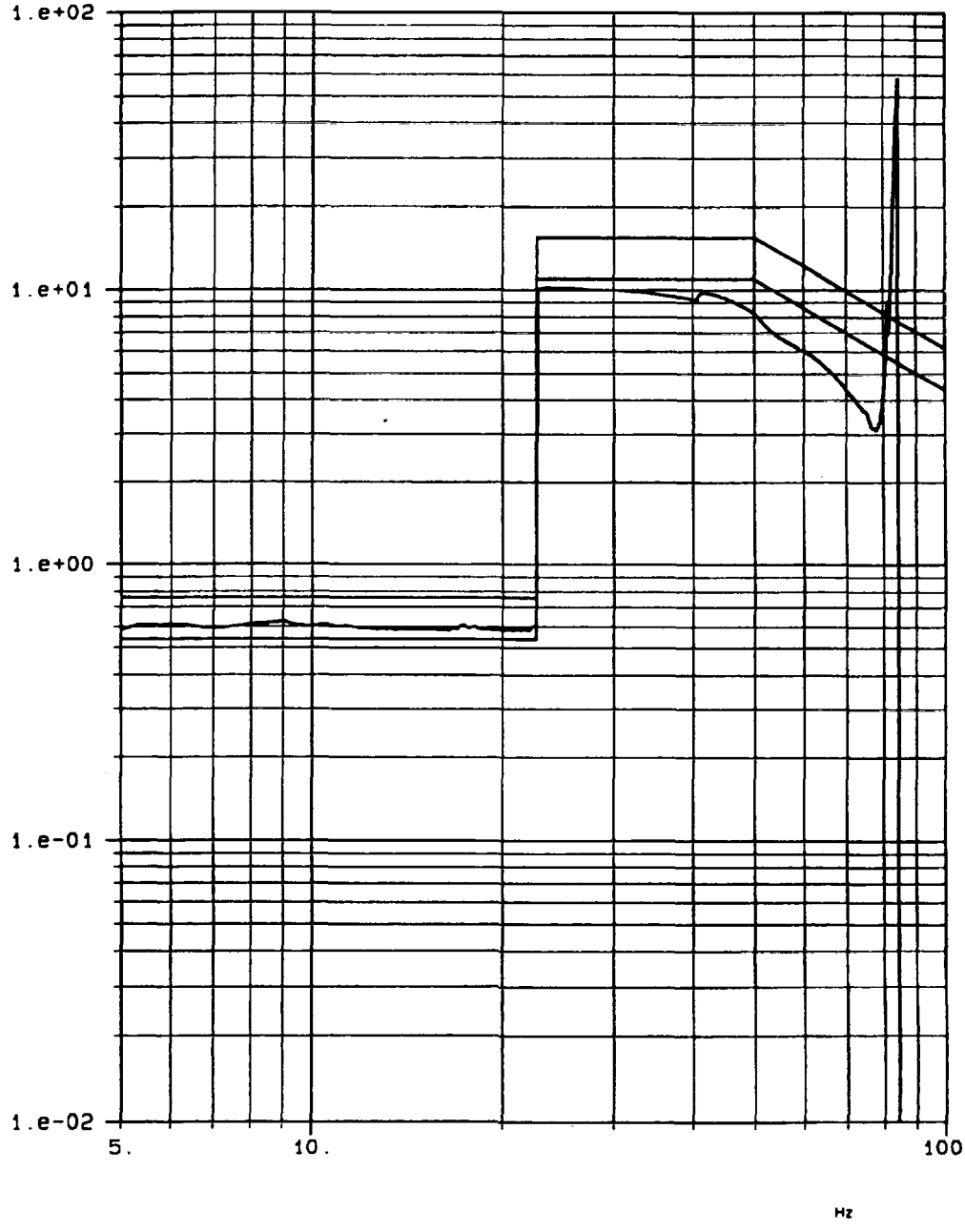
LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA

9 R2Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 7
Chan. Type : M
Sweep Type : log
Sweeps Done: 0
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Average
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop
Overload

-- Testing time --
Elapsed : 0:02:02
Remaining : 0:00:07

Date : 5/21/2002
21:28:54

SINUSOIDAL PLOT NO. 8

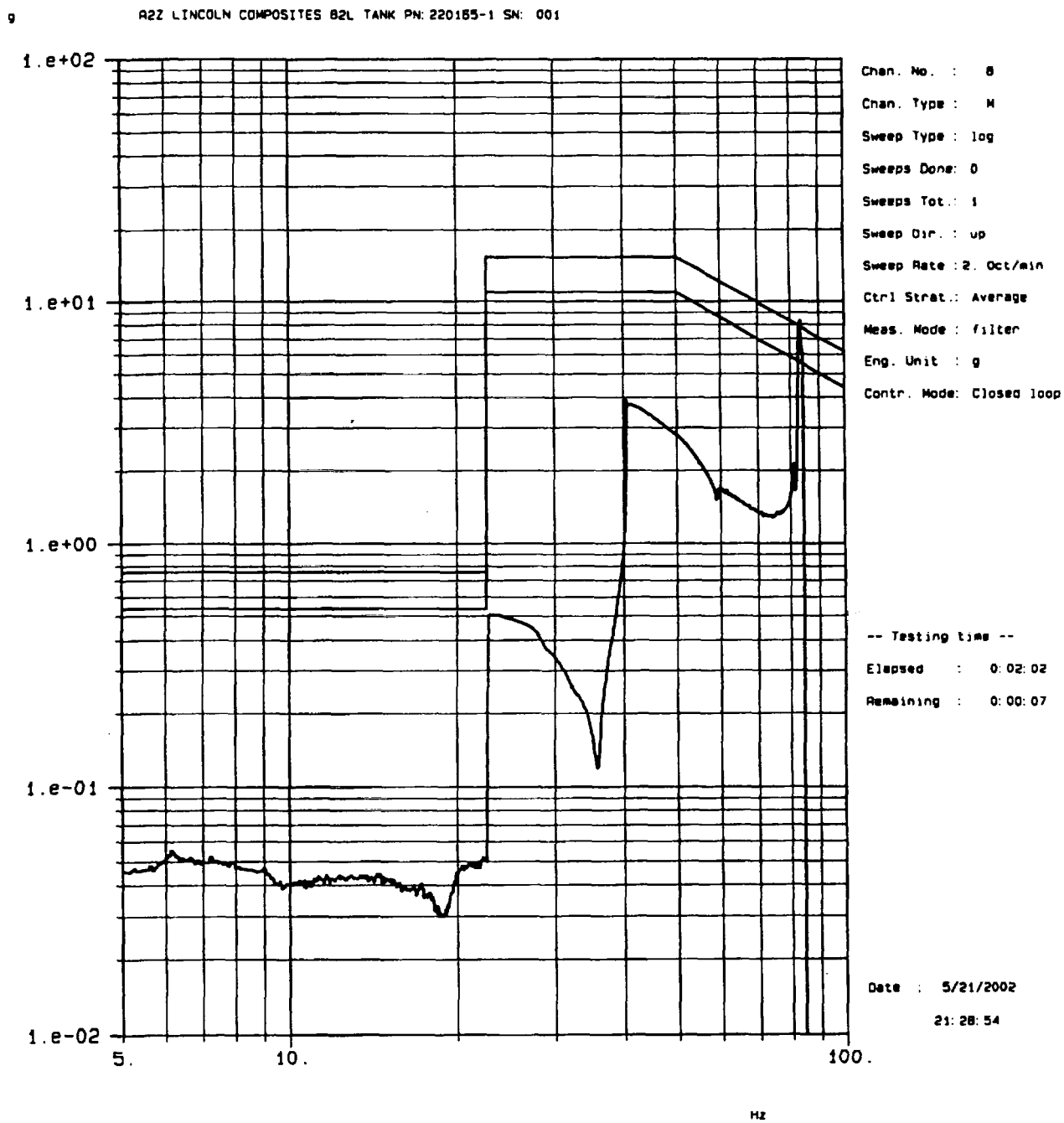
Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA



SINUSOIDAL PLOT NO. 9

Sine Meas. Channel

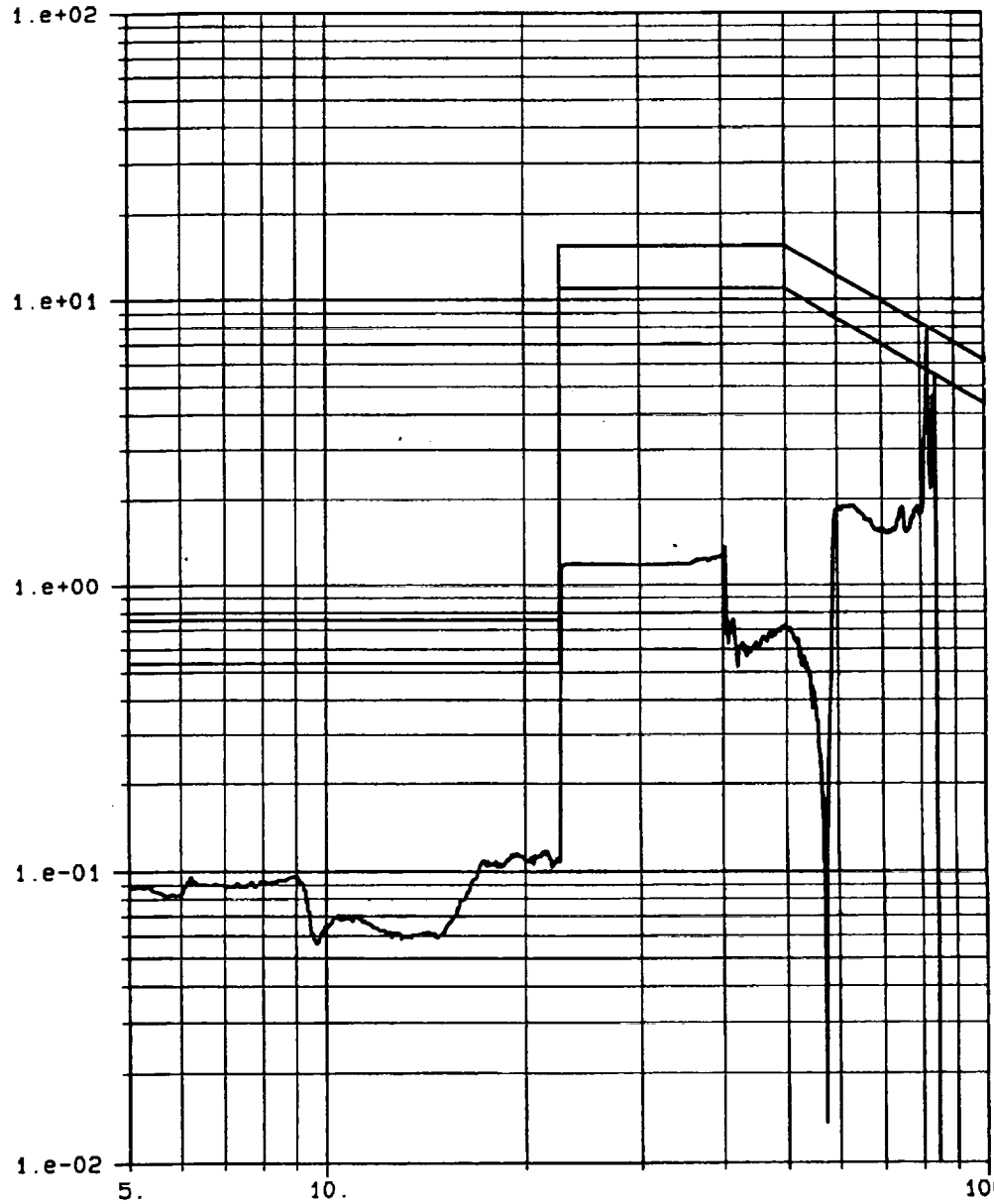
LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA

9 R3X LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : M
Sweep Type : log
Sweeps Done: 0
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Average
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop

-- Testing time --
Elapsed : 0:02:02
Remaining : 0:00:07

Date : 5/21/2002
21:28:54

SINUSOIDAL PLOT NO. 10

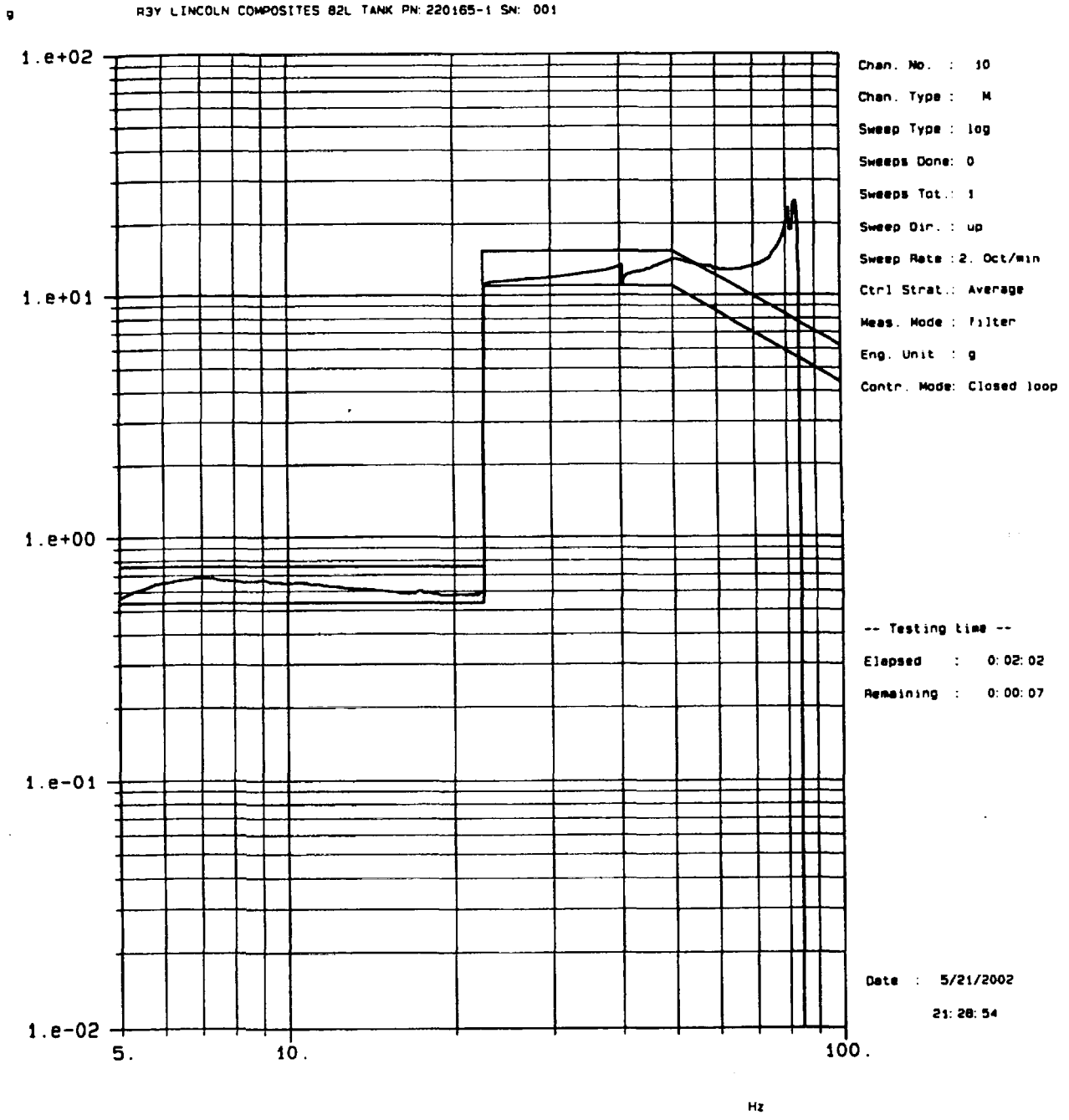
Sine Meas. Channel

LINCOLN 47039 DUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA



SINUSOIDAL PLOT NO. 11

Sine Meas. Channel

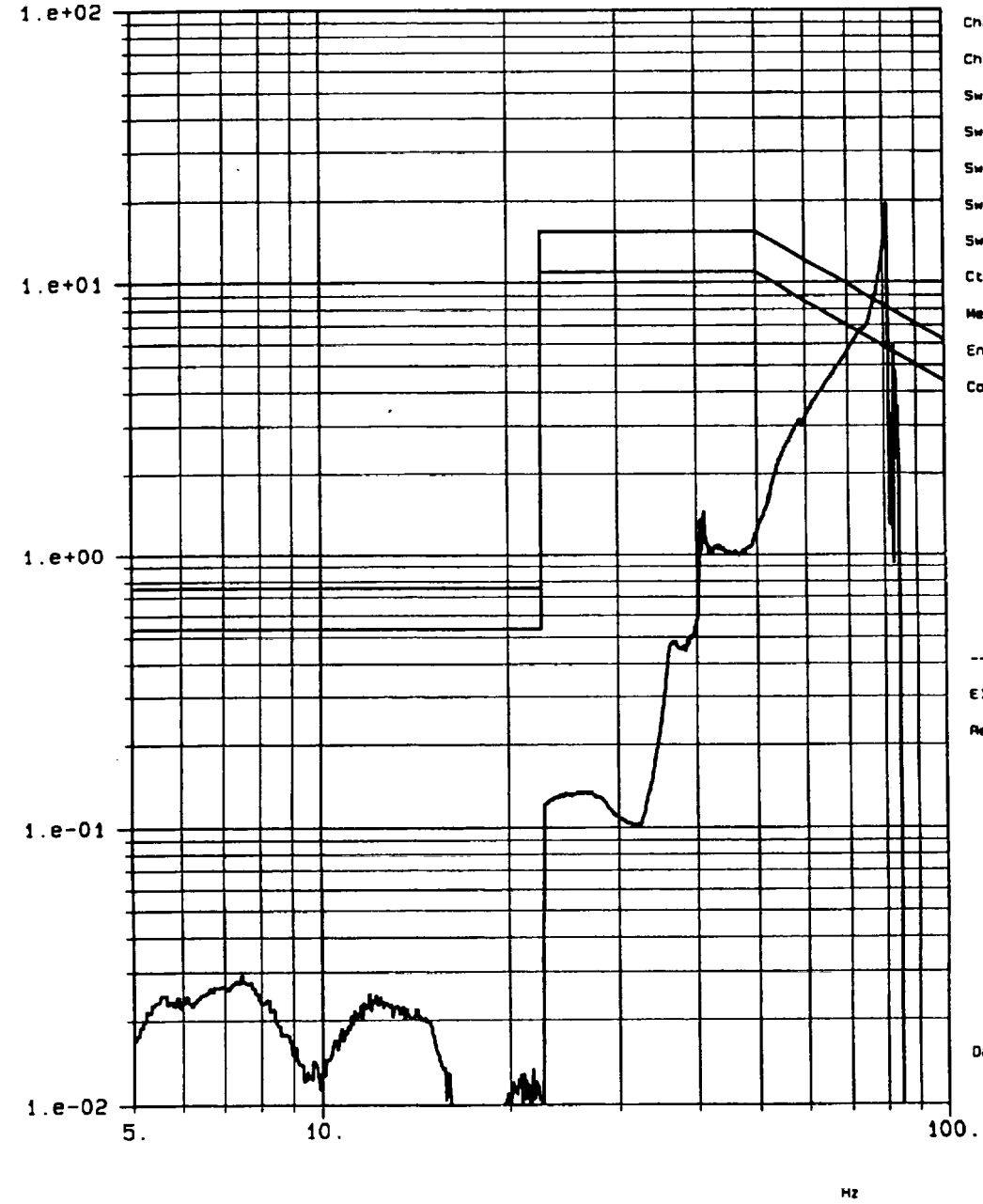
LINCOLN 47039 QUAL

Y AXIS SINE

Wyle Laboratories

El Segundo, CA

R3Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 11
Chan. Type : M
Sweep Type : log
Sweeps Done: 0
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Average
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop

-- Testing time --
Elapsed : 0:02:02
Remaining : 0:00:07

Date . 5/21/2002
21:28:54

SINUSOIDAL PLOT NO. 12

Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE

ACCELEROMETER LOST. NO DATA

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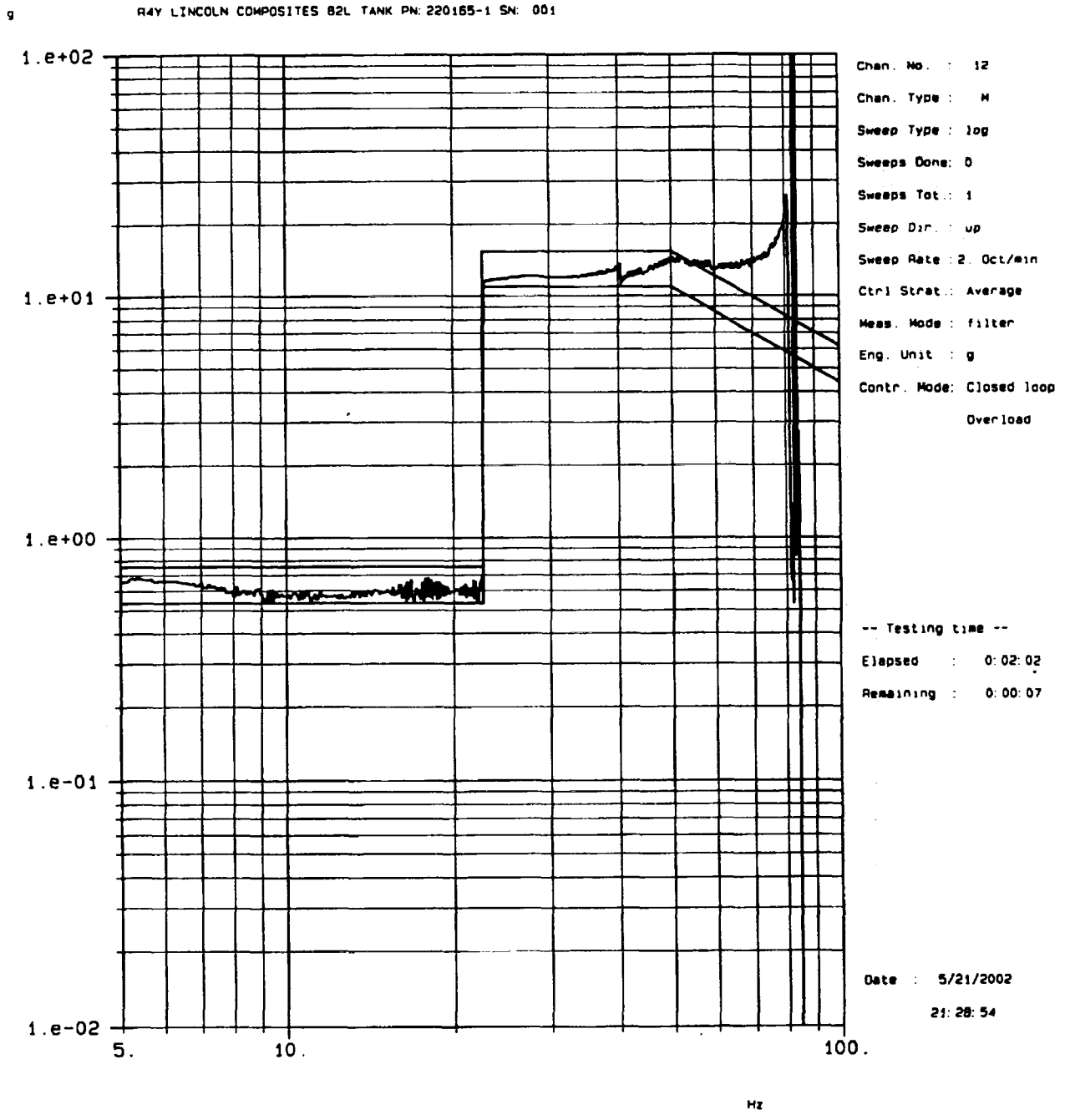

SINUSOIDAL PLOT NO. 13

Sine Control/Limit Channel

LINCOLN 47039 QUAL

Y AXIS SINE2

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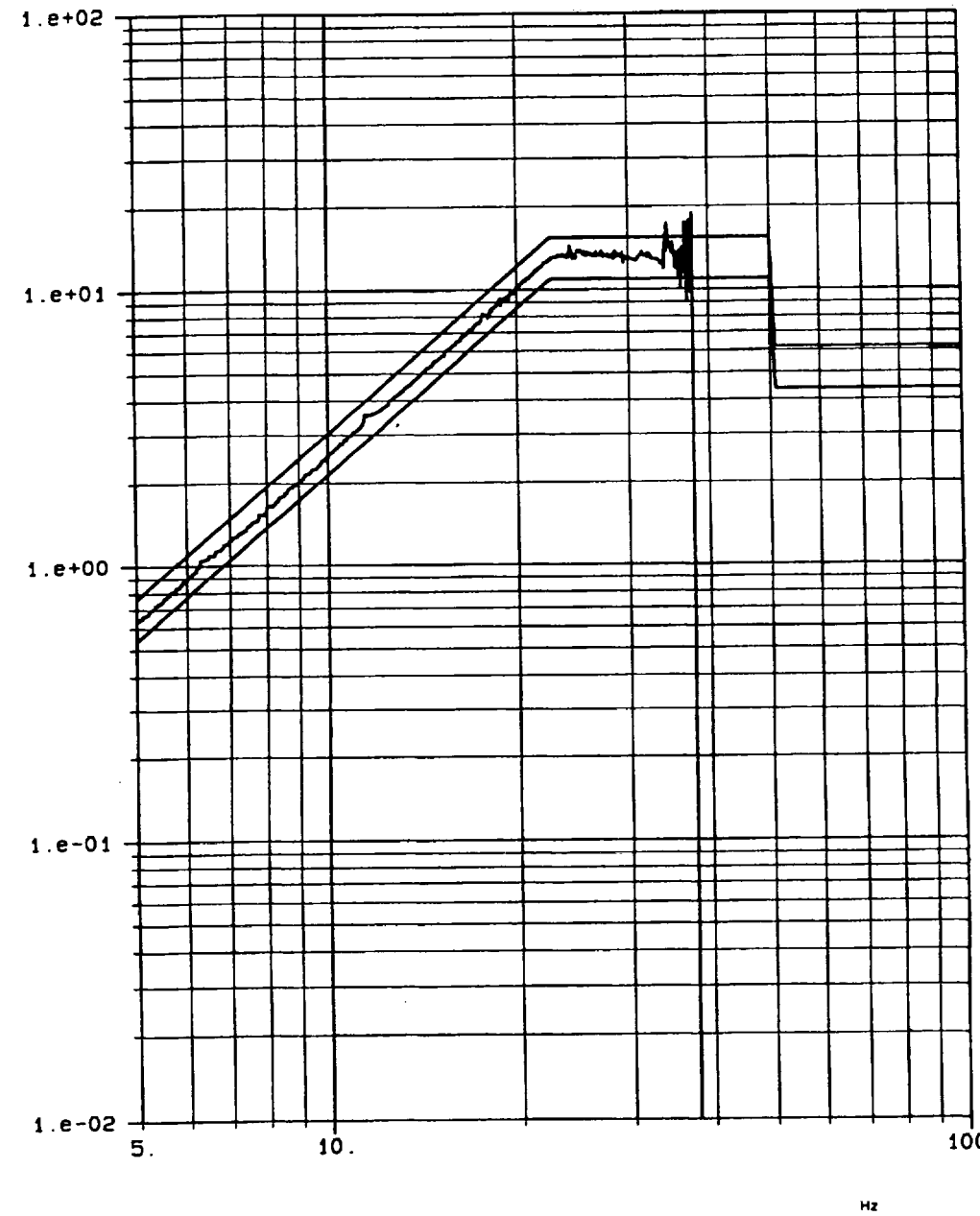
El Segundo, CA

C1 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 1
Chan. Type : C
Sweep Type : log
Sweeps Done: 0
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Average
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop

-- Testing time --
Elapsed : 0:01:27
Remaining : 0:00:42

Date : 5/22/2002
9:32:05

SINUSOIDAL PLOT NO. 14

Sine Meas. Channel

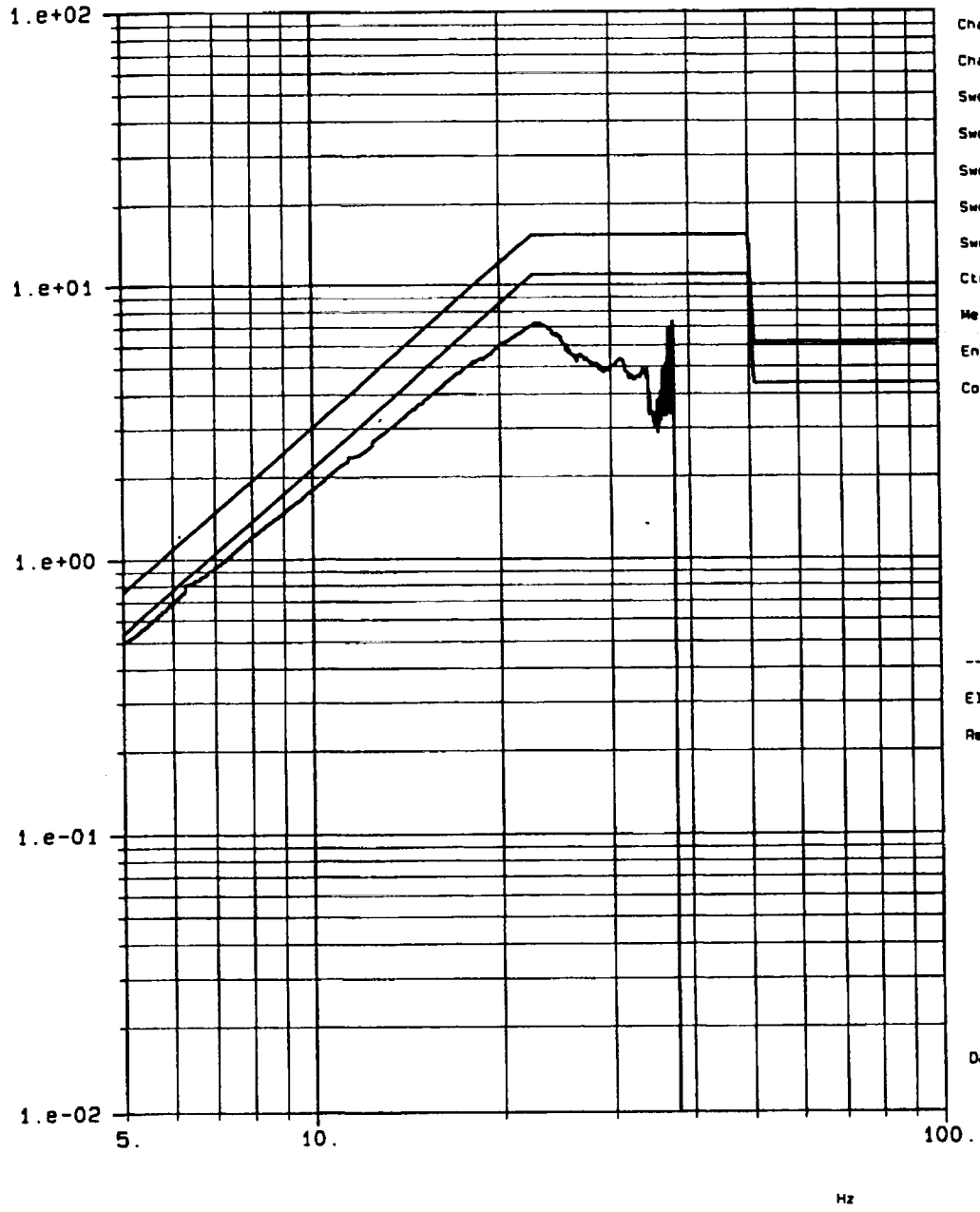
LINCOLN 47039 QUAL

Y AXIS SINE2

Wyle Laboratories

El Segundo, CA

g C2 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 2

Chan. Type : M

Sweep Type : log

Sweeps Done: 0

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2 Oct/min

Ctrl Strat.: Average

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:01:27

Remaining : 0:00:42

Date : 5/22/2002

9:32:05

SINUSOIDAL PLOT NO. 15

Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE2

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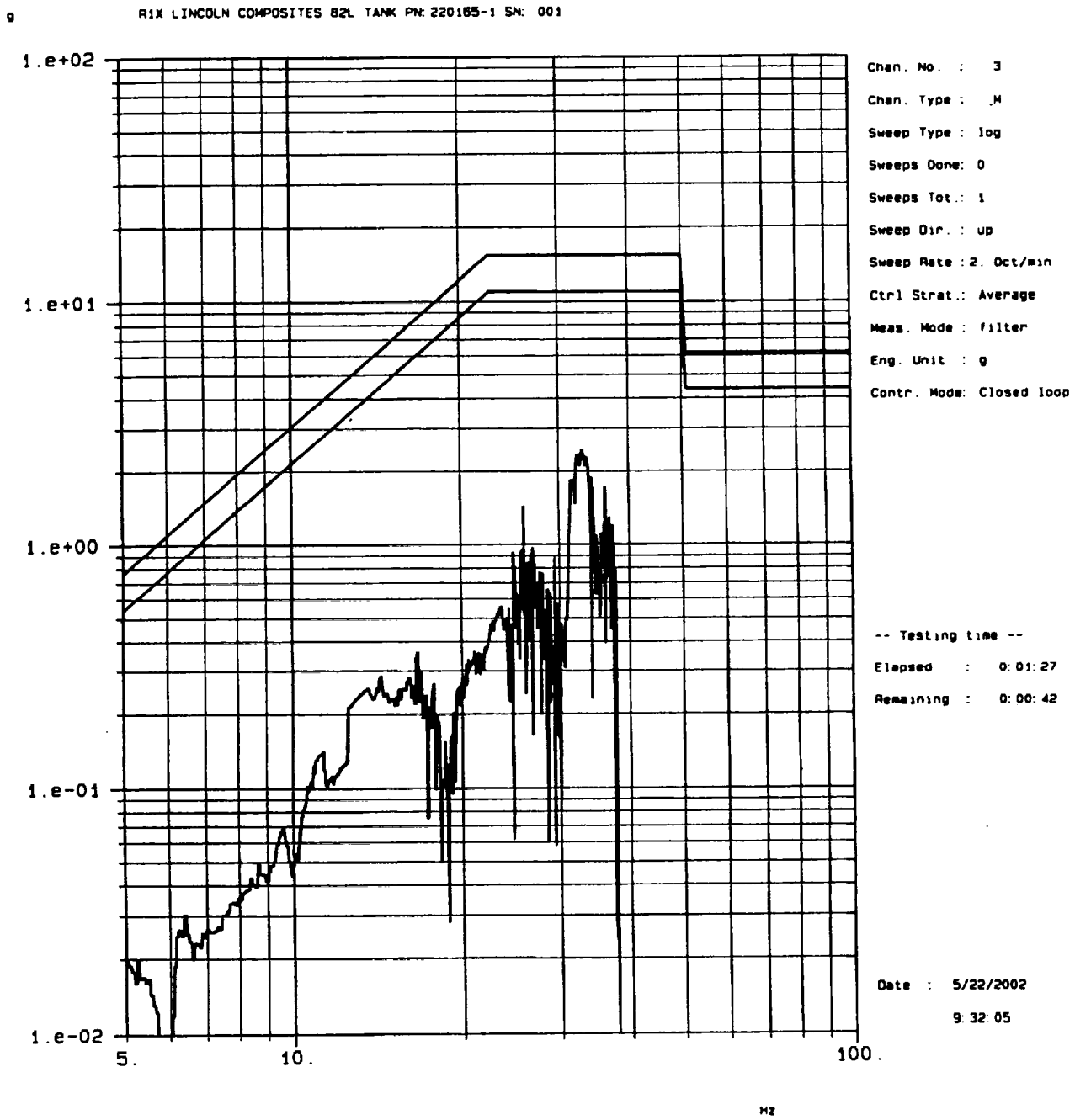
B Segundo, CA



SINUSOIDAL PLOT NO. 16

Sine Meas. Channel

LINCOLN 47039 DUAL

Y AXIS SINE2

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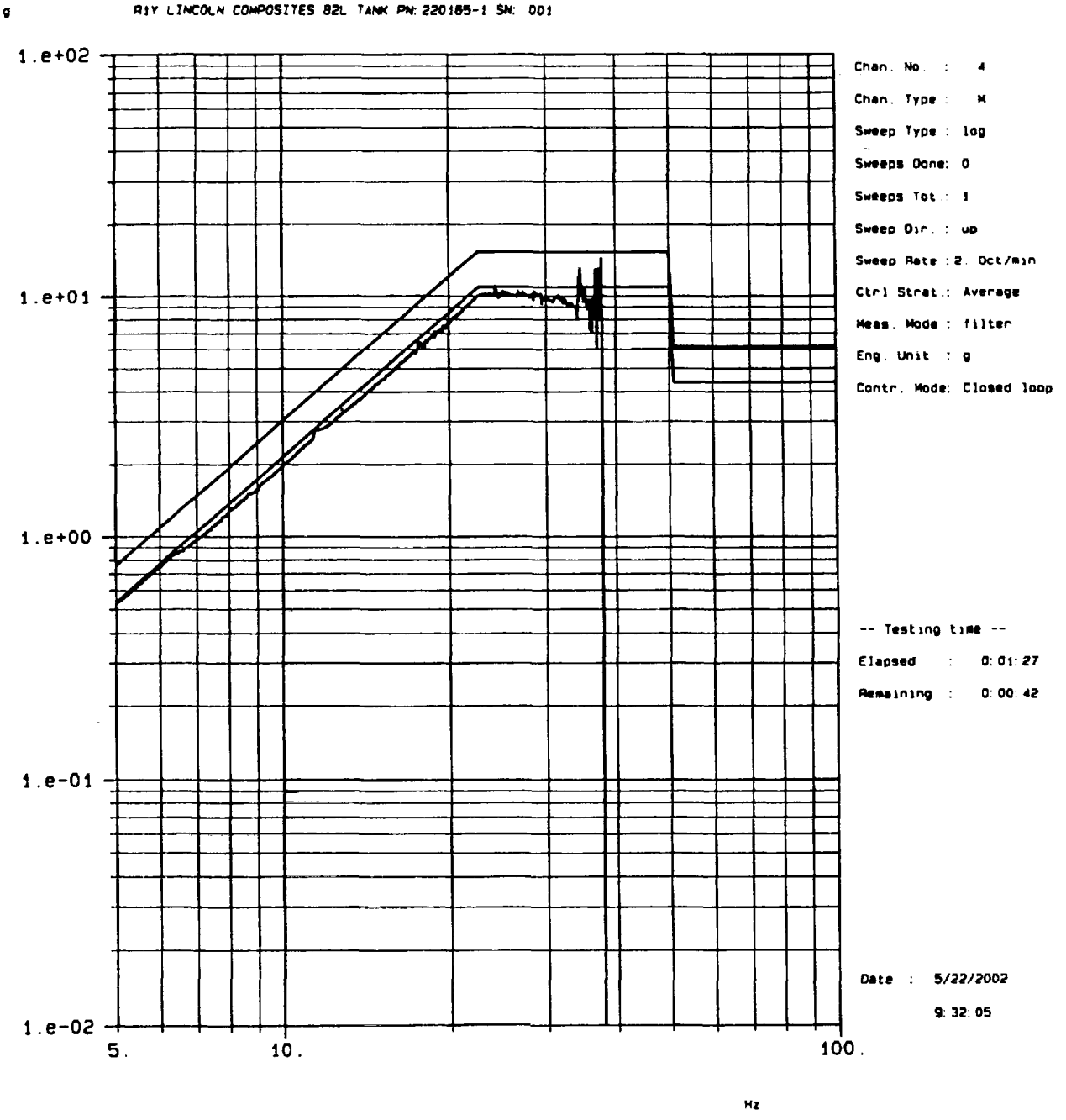
El Segundo, CA



SINUSOIDAL PLOT NO. 17

Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE2

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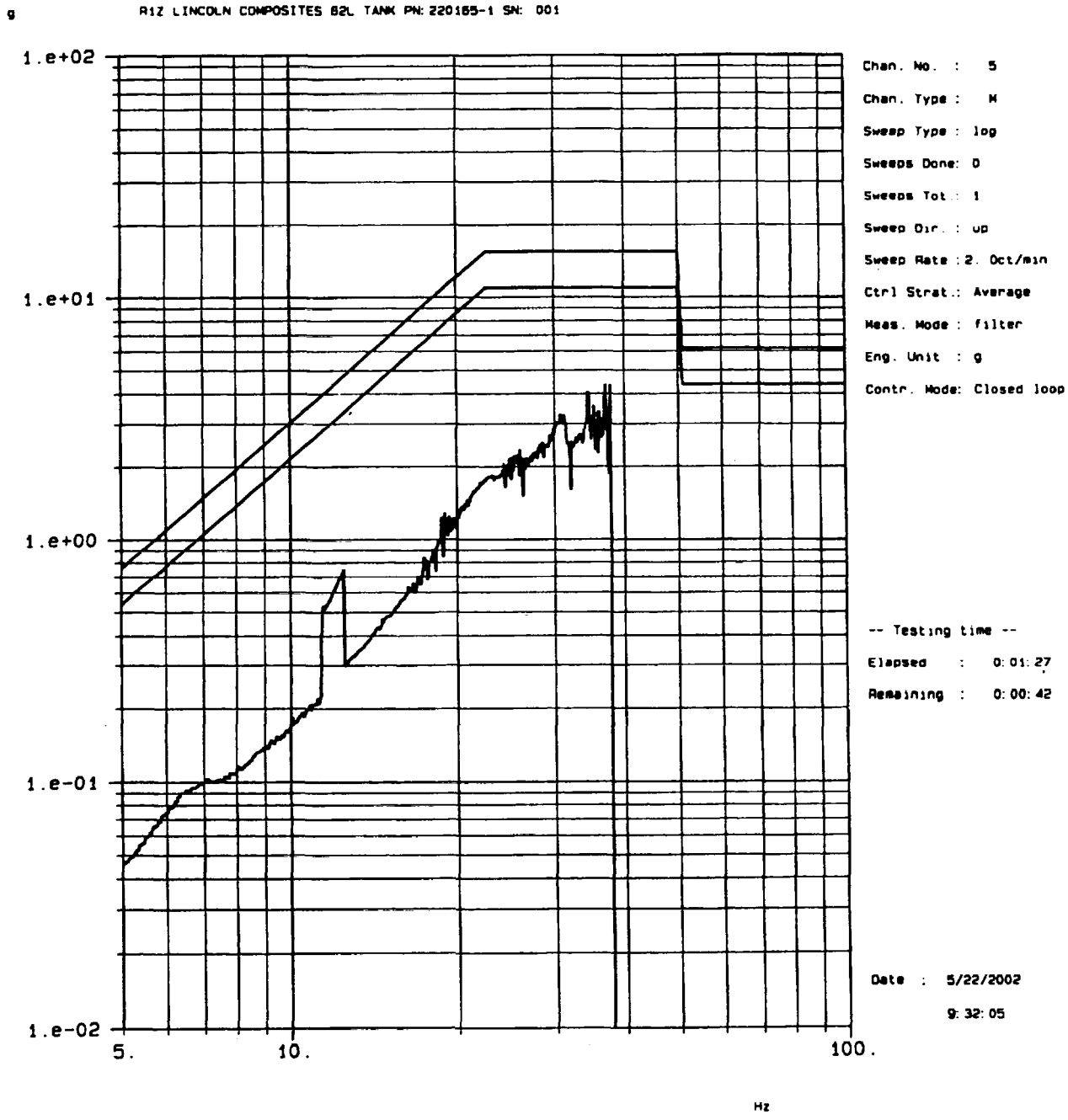

SINUSOIDAL PLOT NO. 18

Sine Meas. Channel

LINCOLN 47039 DUAL

Y AXIS SINE2

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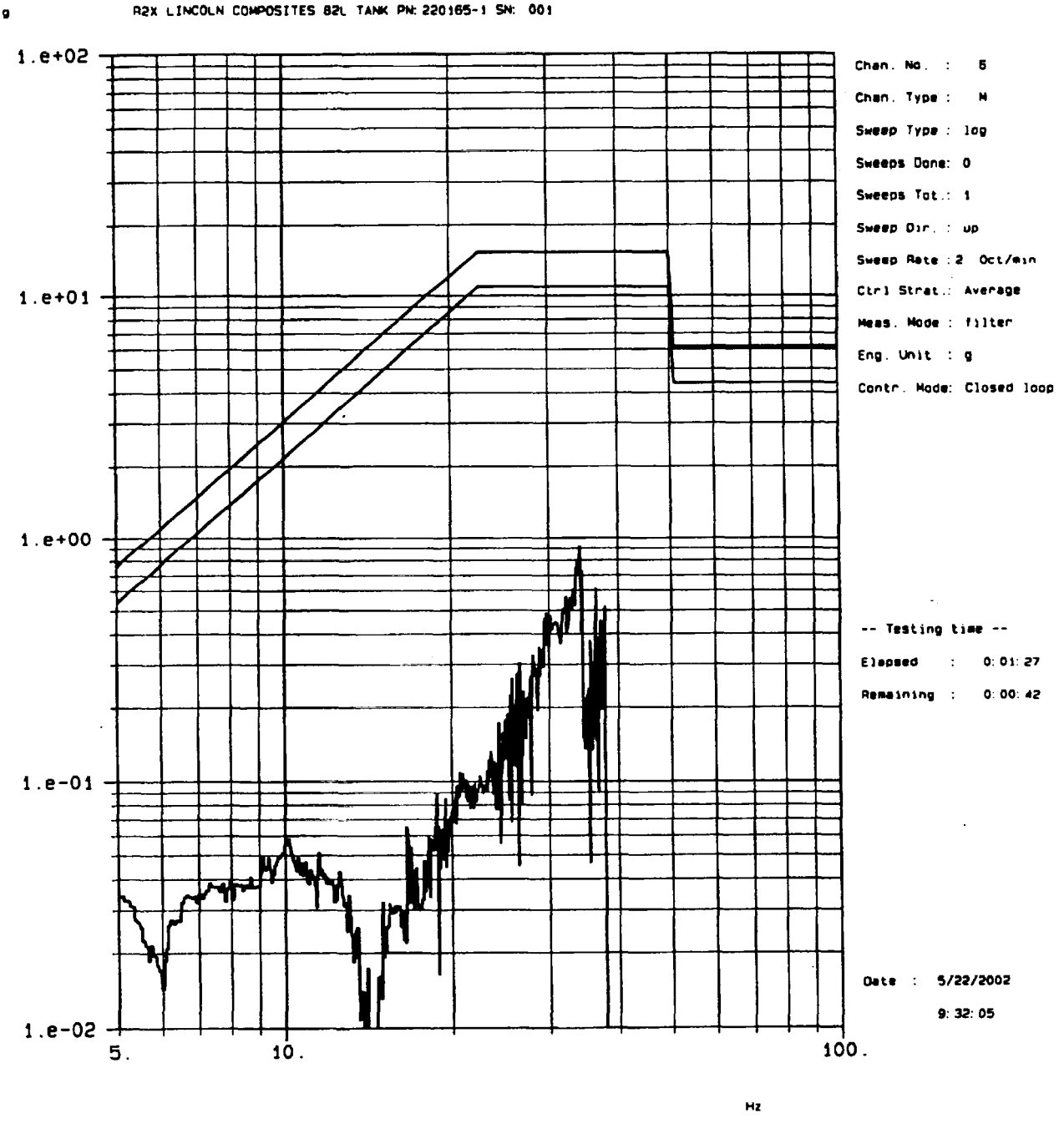

SINUSOIDAL PLOT NO. 19

Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE2

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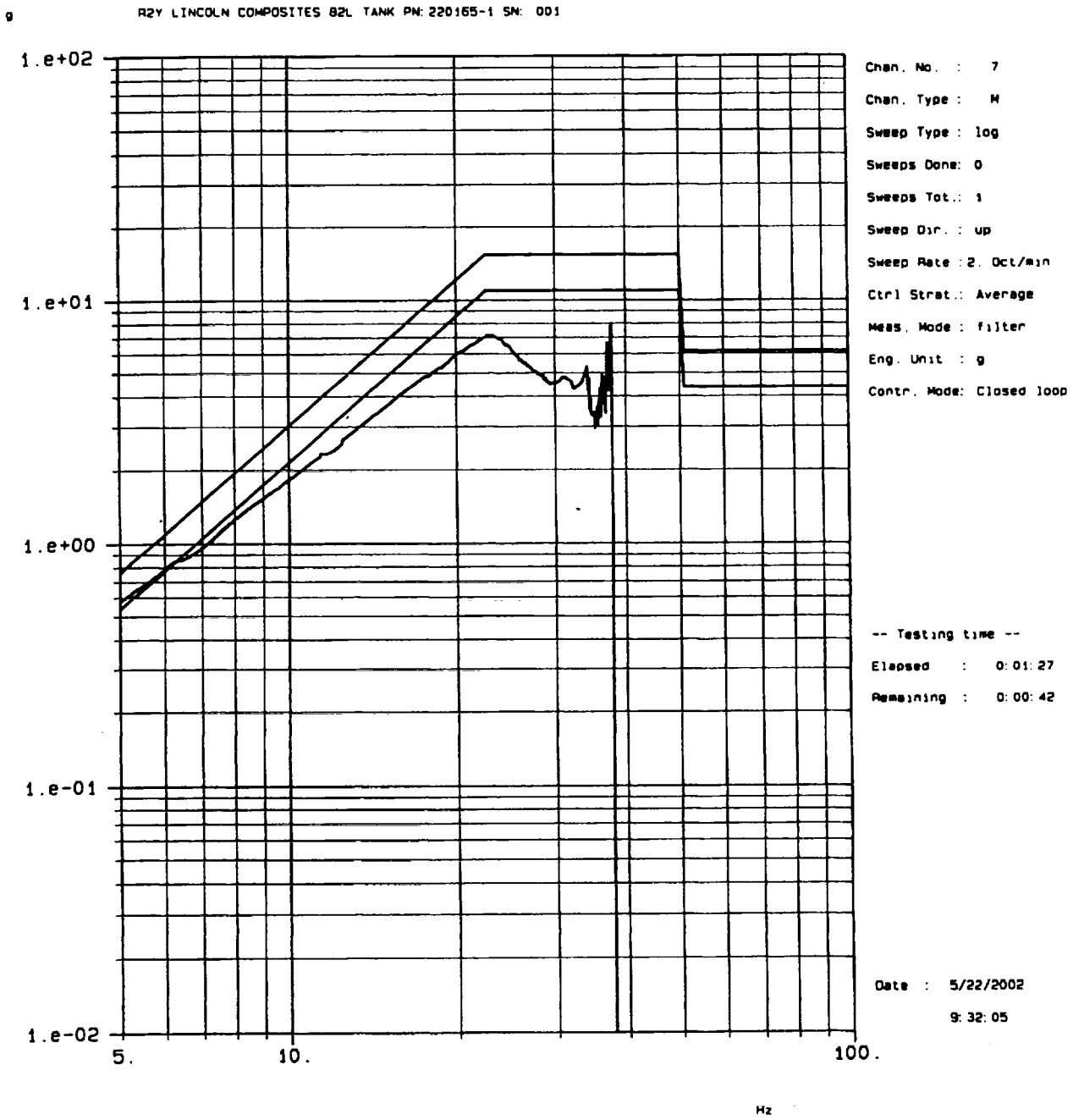
El Segundo, CA



wyle laboratories

SINUSOIDAL PLOT NO. 20

Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE2

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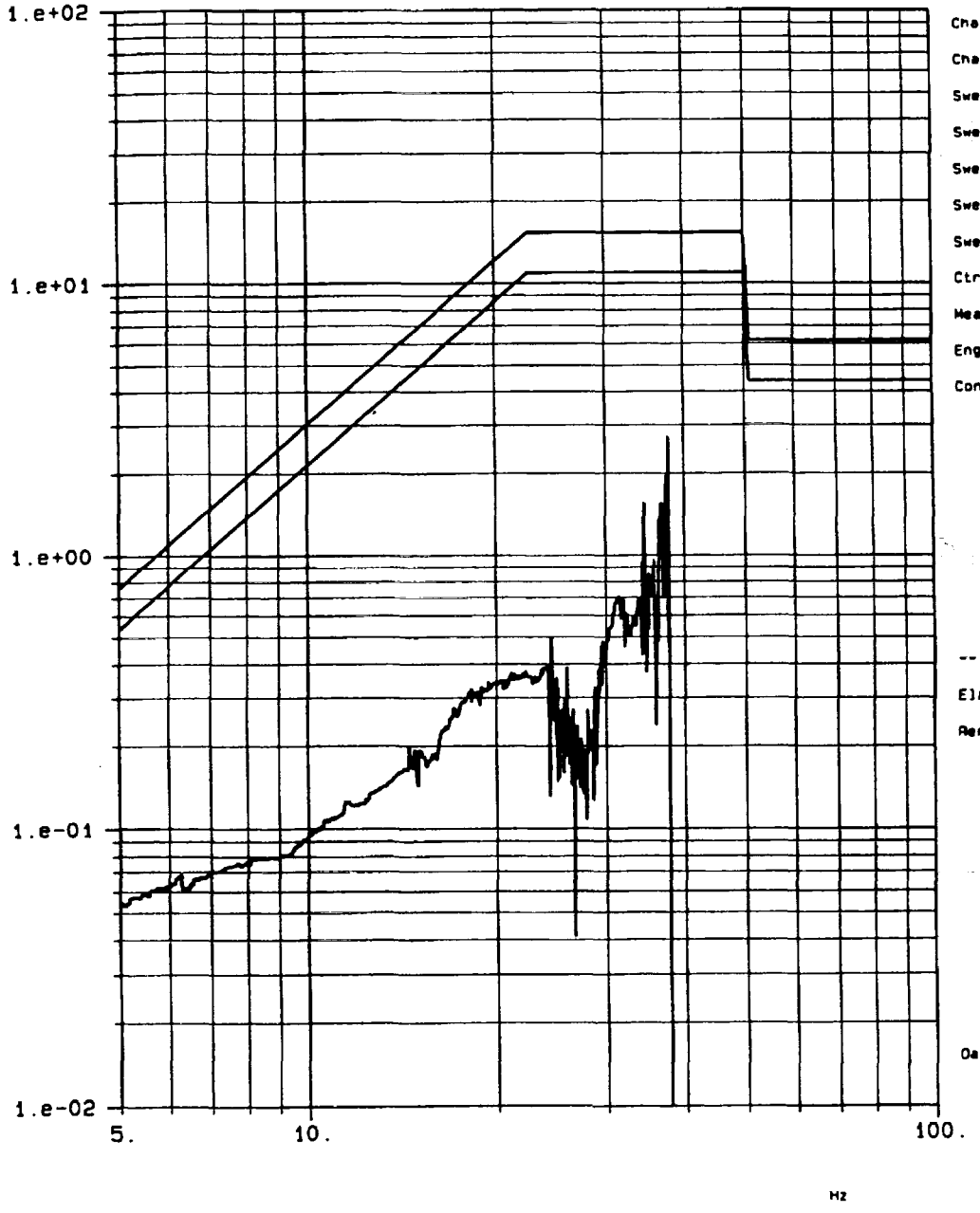
g

A2Z LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 8

Chan. Type : H

Sweep Type : log

Sweeps Done: 0

Sweeps Tot : 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Average

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:01:27

Remaining : 0:00:42

Date : 5/22/2002

9:32:05

SINUSOIDAL PLOT NO. 21

Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE2

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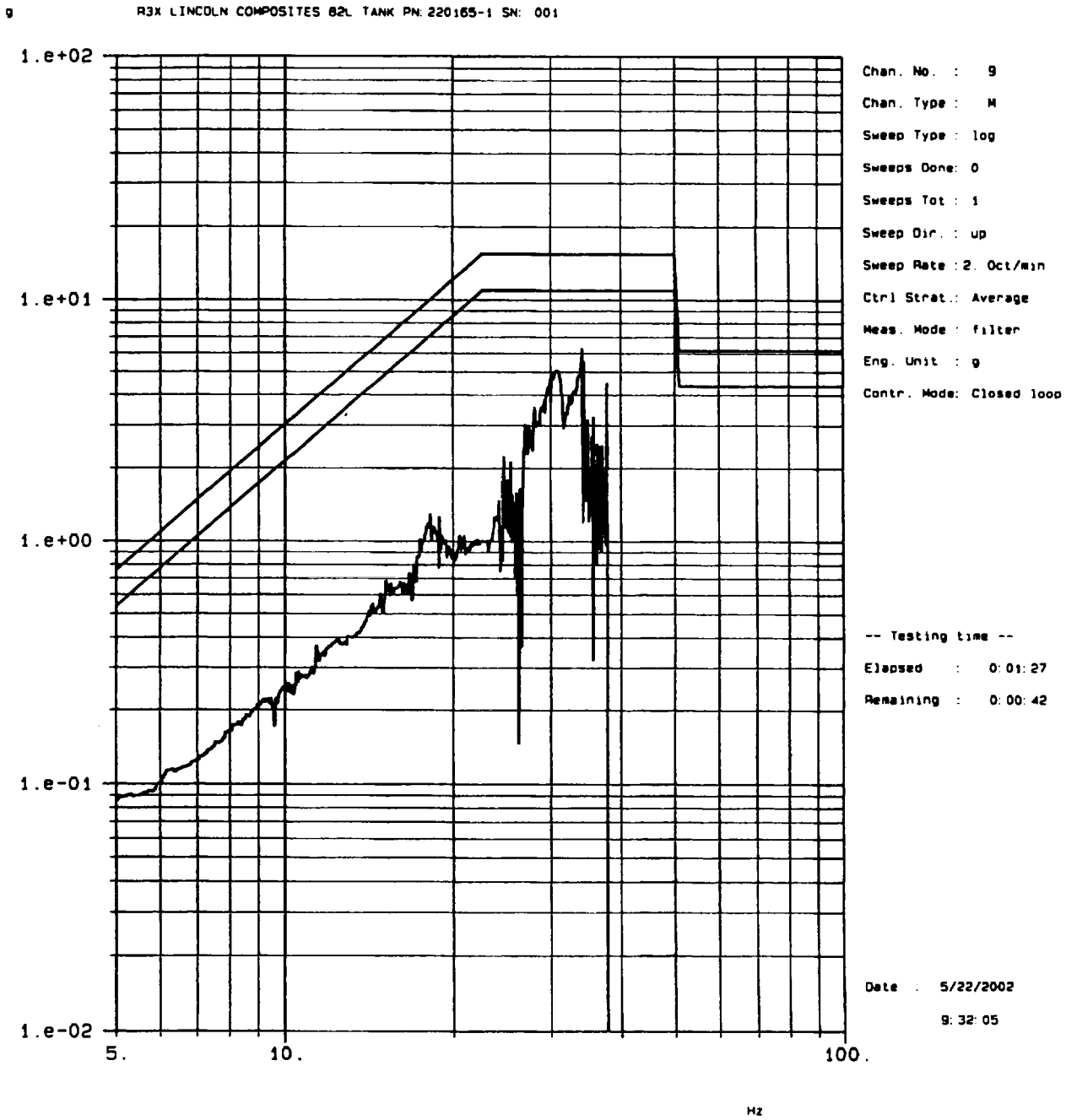

SINUSOIDAL PLOT NO. 22

Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE2

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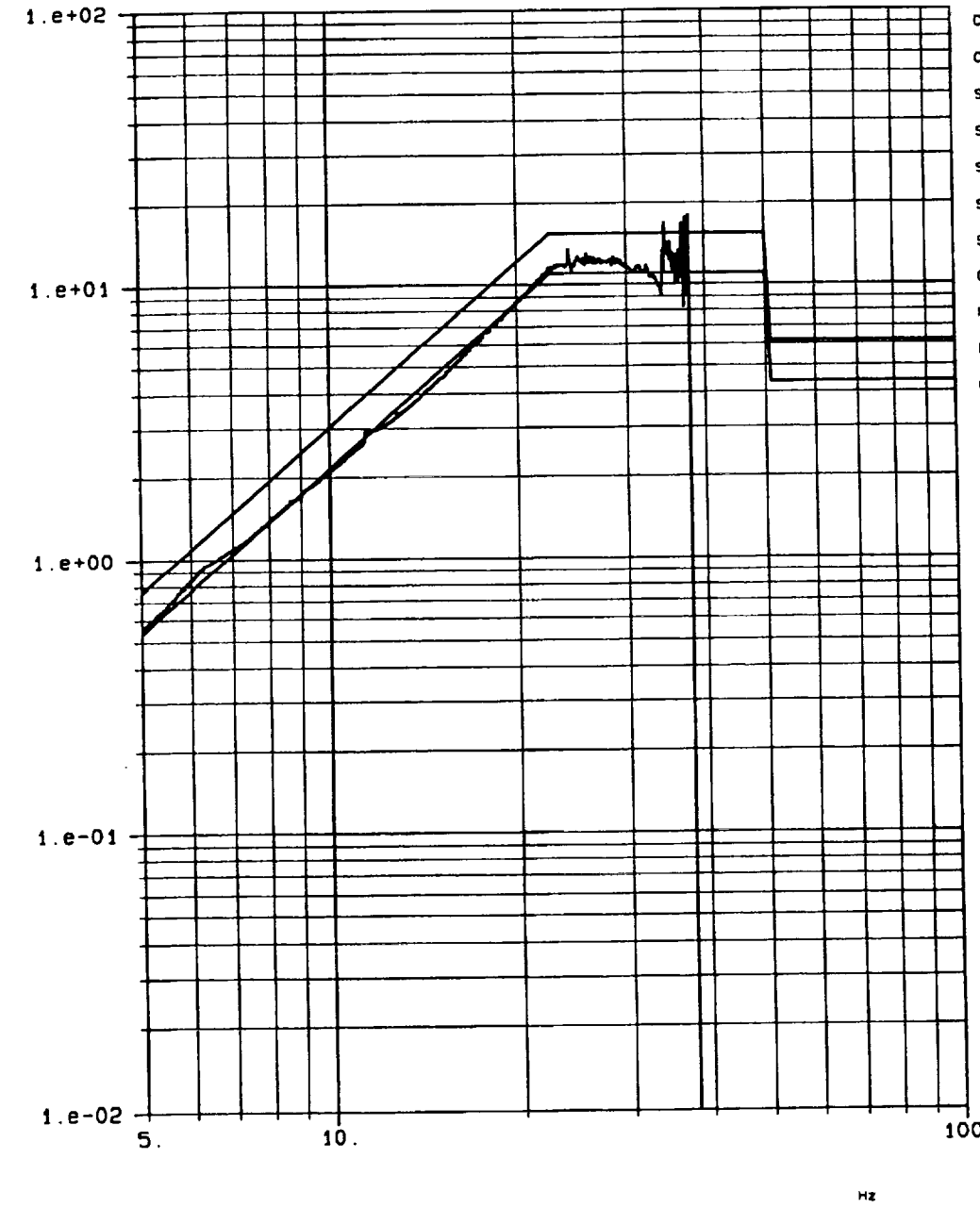
R3Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 10

Chan. Type : M

Sweep Type : log

Sweeps Done: 0

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Average

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:01:27

Remaining : 0:00:42

Date : 5/22/2002

9:32:05

SINUSOIDAL PLOT NO. 23

Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE2

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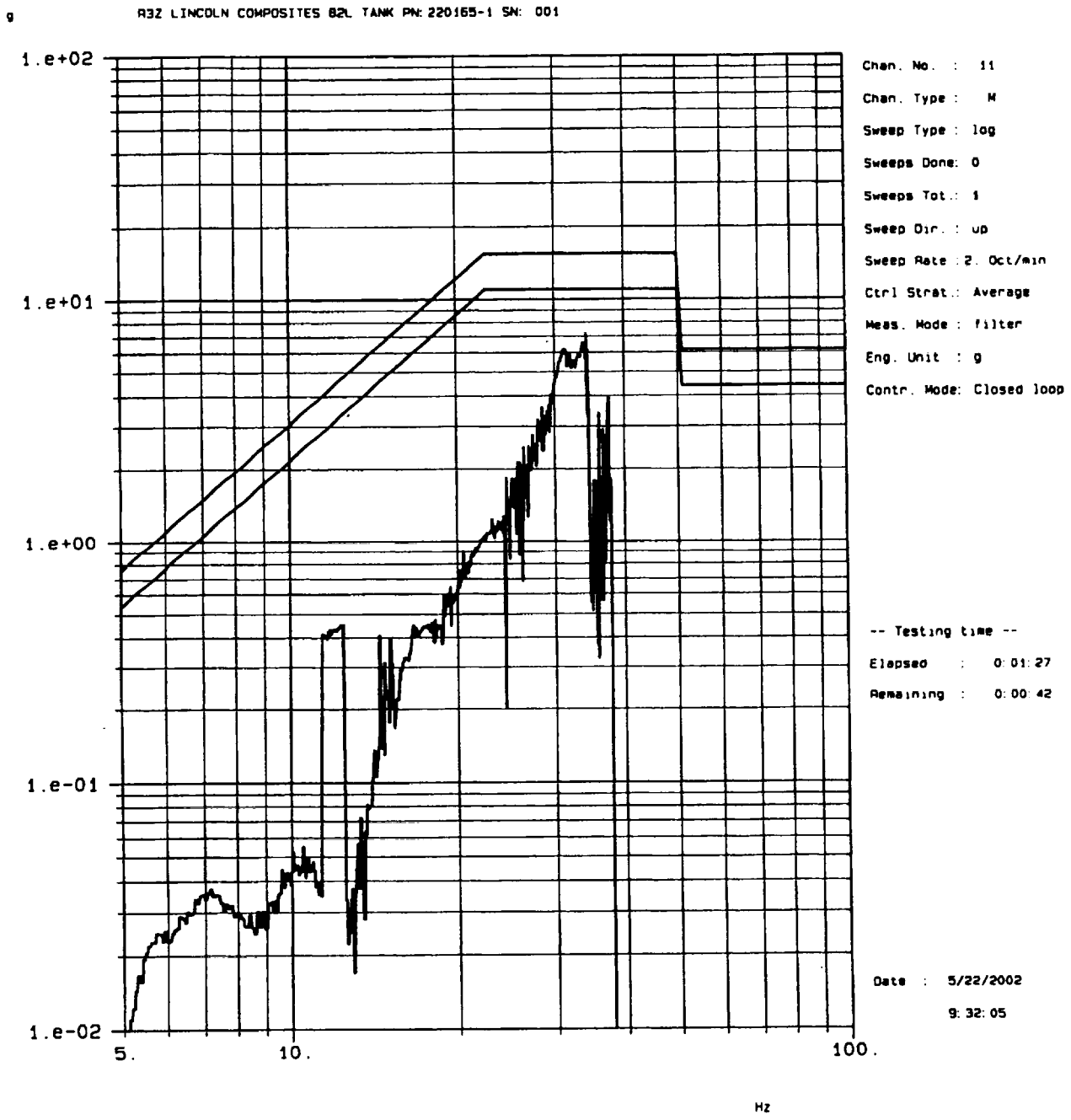

SINUSOIDAL PLOT NO. 24

Sine Meas. Channel

LINCOLN 47039 QUAL

Y AXIS SINE2

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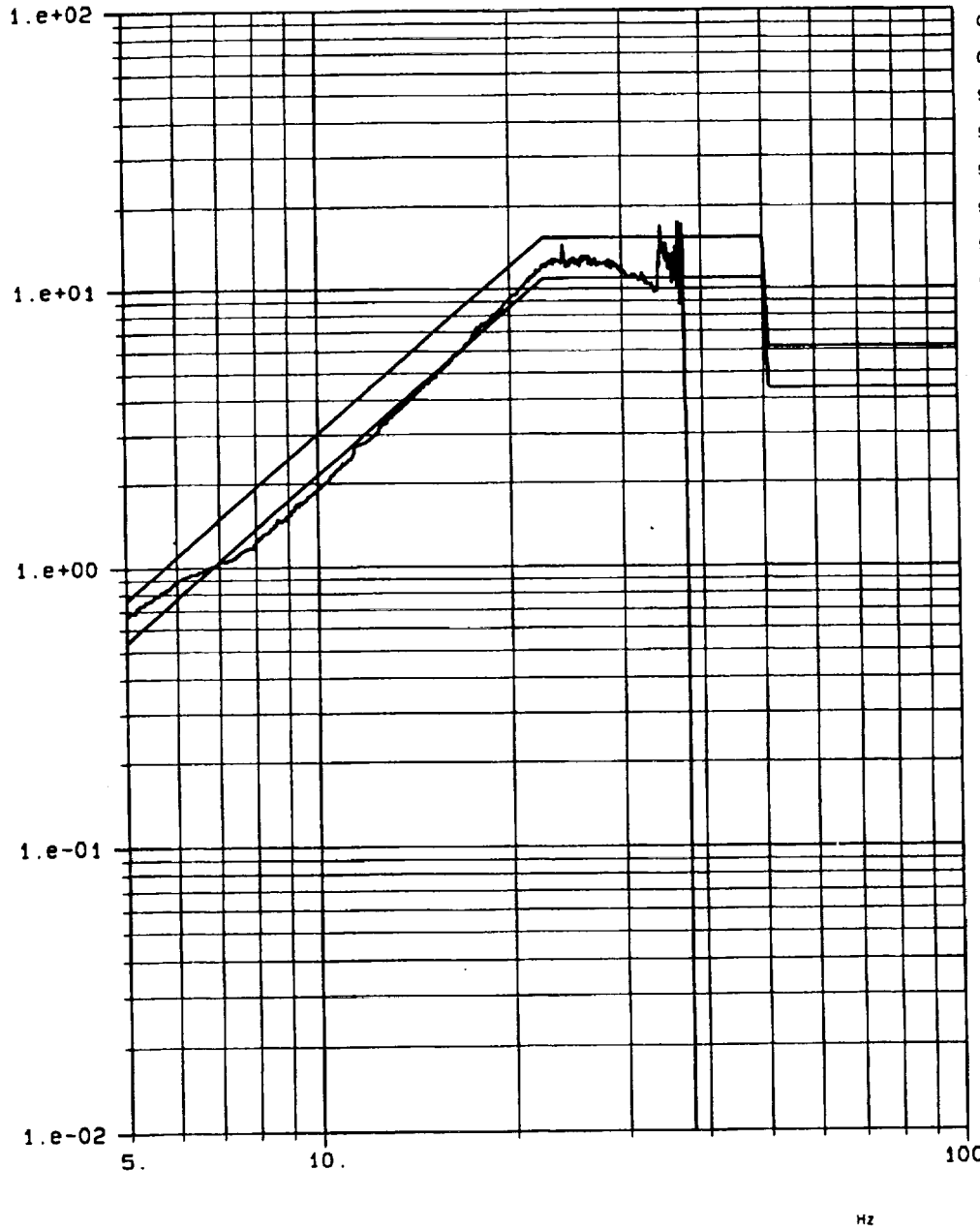
El Segundo, CA

9 R4Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 12

Chan. Type : M

Sweep Type : log

Sweeps Done: 0

Sweeps Tot : 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Average

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:01:27

Remaining : 0:00:42

Date : 5/22/2002

9:32:05

SINUSOIDAL PLOT NO. 25

Sine Control/Limit Channel

LINCOLN 47039 5.2G

Y AXIS 5.2G SWEEP

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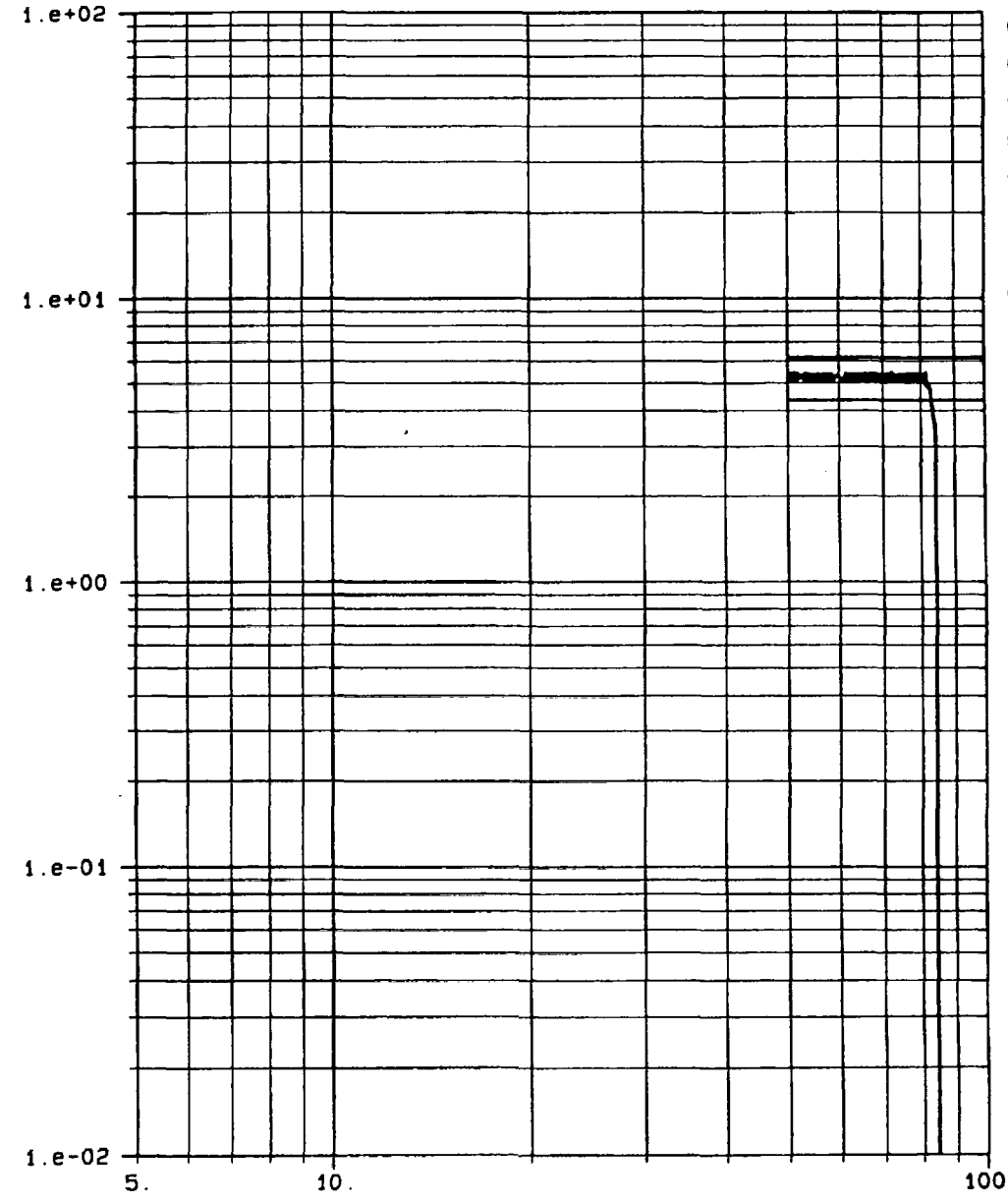
C1 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 1
Chan. Type : C -
Sweep Type : log
Sweeps Done: 0
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Average
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop

-- Testing time --
Elapsed : 0:00:22
Remaining : 0:00:07

Date : 5/23/2002
19:40:39

SINUSOIDAL PLOT NO. 26

Sine Meas. Channel

LINCOLN 47039 5.2G

Y AXIS 5.2G SWEEP

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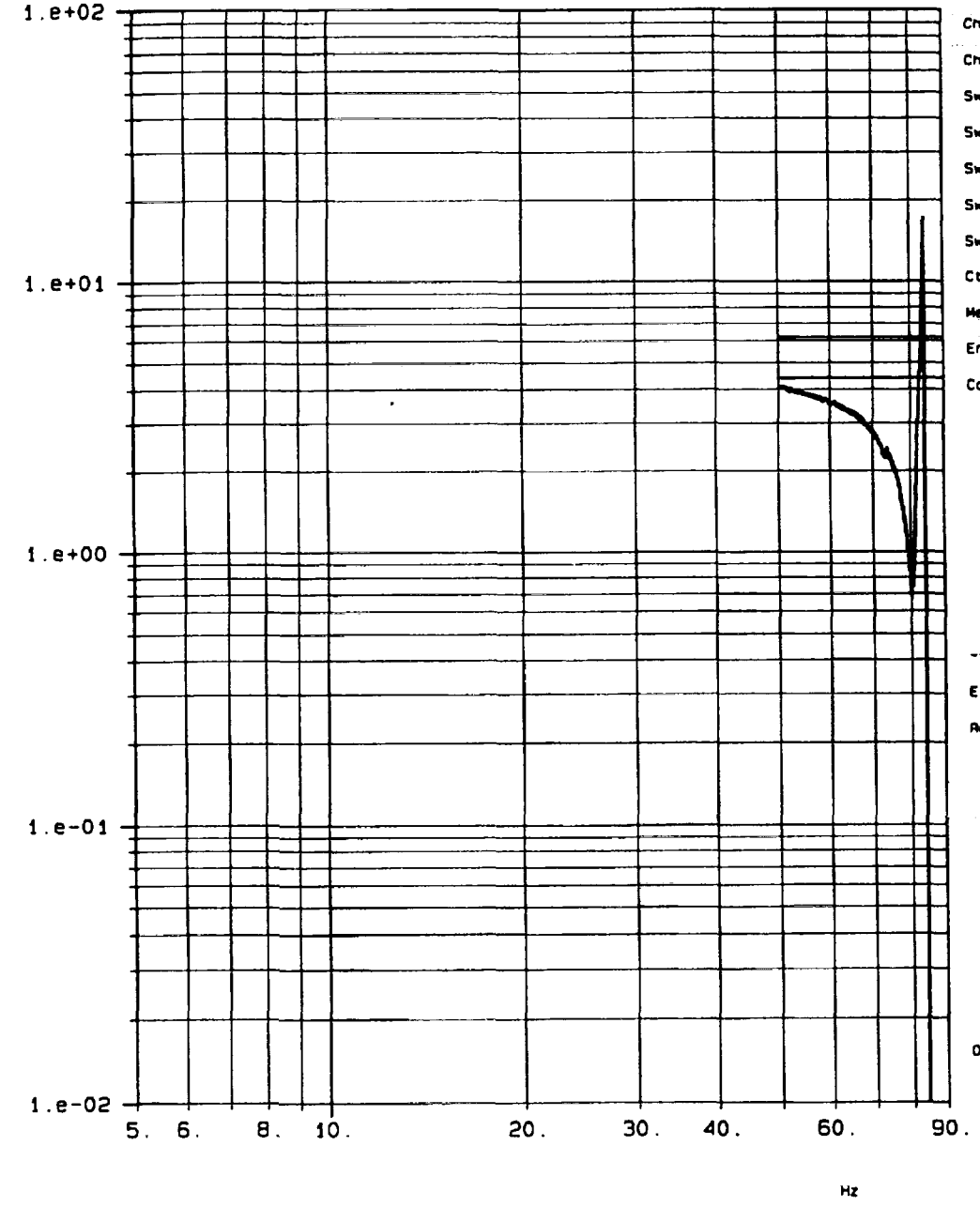
C2 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 2

Chan. Type : M

Sweep Type : log

Sweeps Done: 0

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Average

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:00:22

Remaining : 0:00:07

Date : 5/23/2002

19:40:39

SINUSOIDAL PLOT NO. 27

Sine Meas. Channel

LINCOLN 47039 5.2G

Y AXIS 5.2G SWEEP

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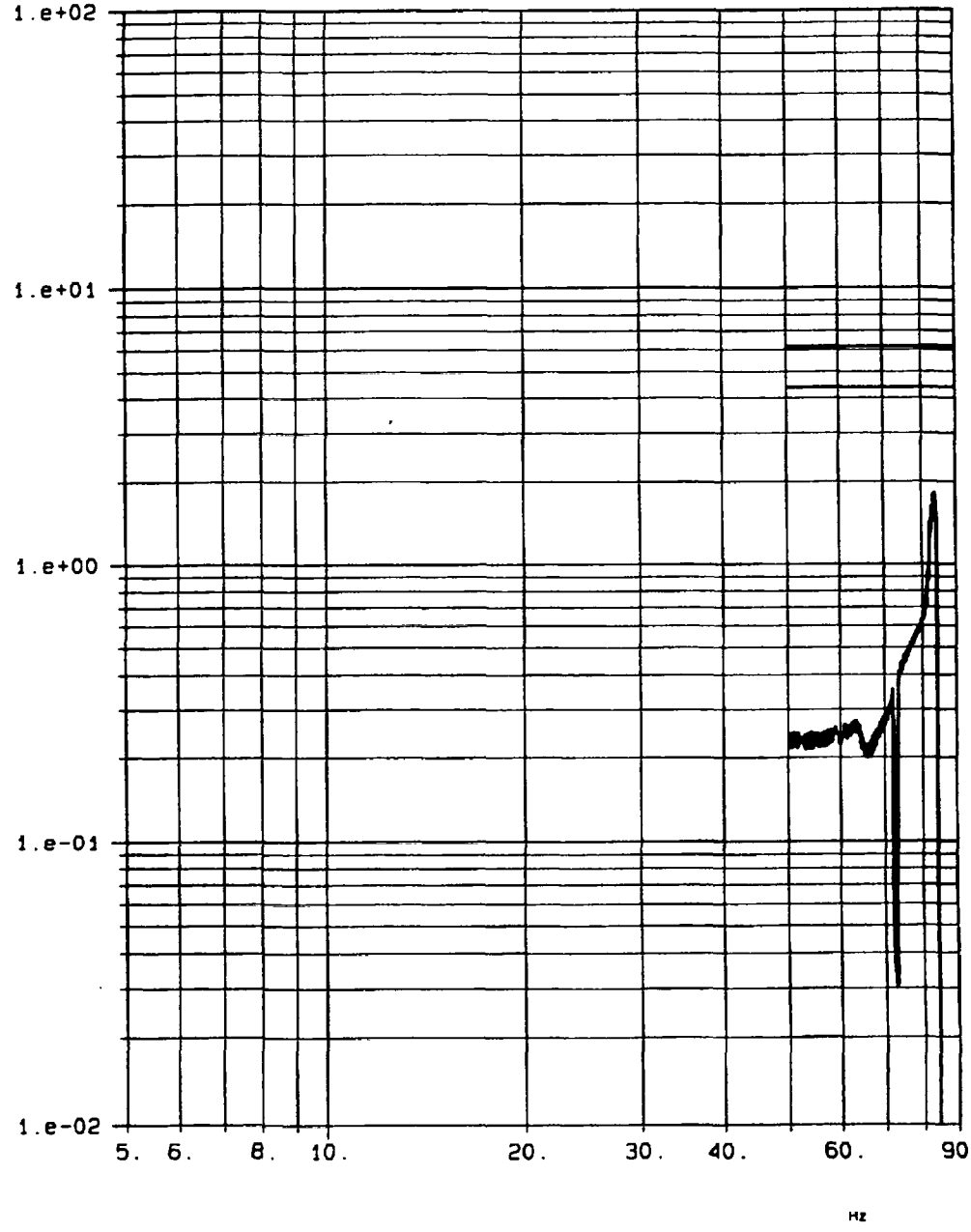
El Segundo, CA

g

R1X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 3

Chan. Type : M

Sweep Type : log

Sweeps Done: 0

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Average

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:00:22

Remaining : 0:00:07

Date 5/23/2002

19:40:39

SINUSOIDAL PLOT NO. 28

Sine Meas. Channel

LINCOLN 47039 5.2G

Y AXIS 5 2G SWEEP

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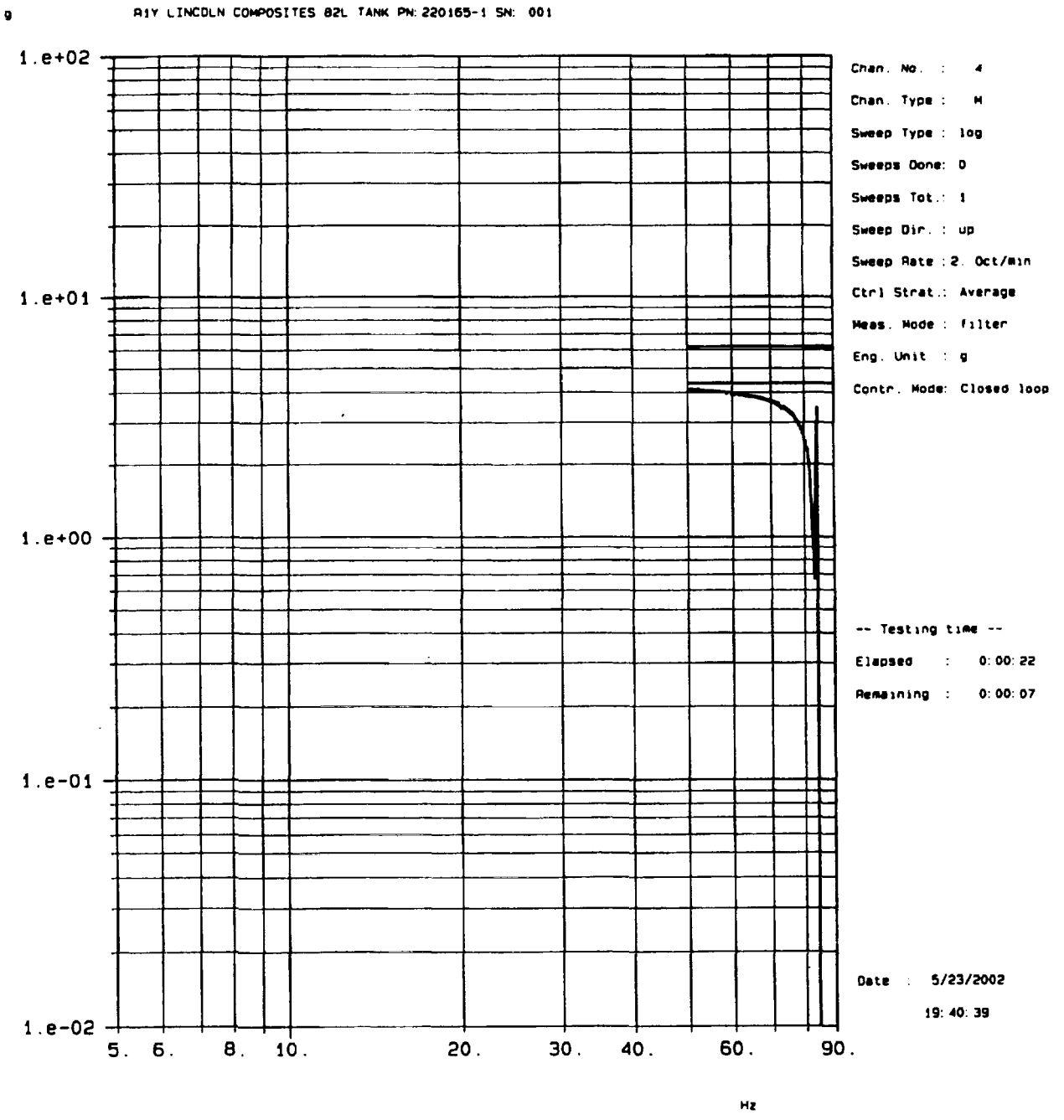

SINUSOIDAL PLOT NO. 29

Sine Meas. Channel

LINCOLN 47039 5.2G

Y AXIS 5.2G SWEEP

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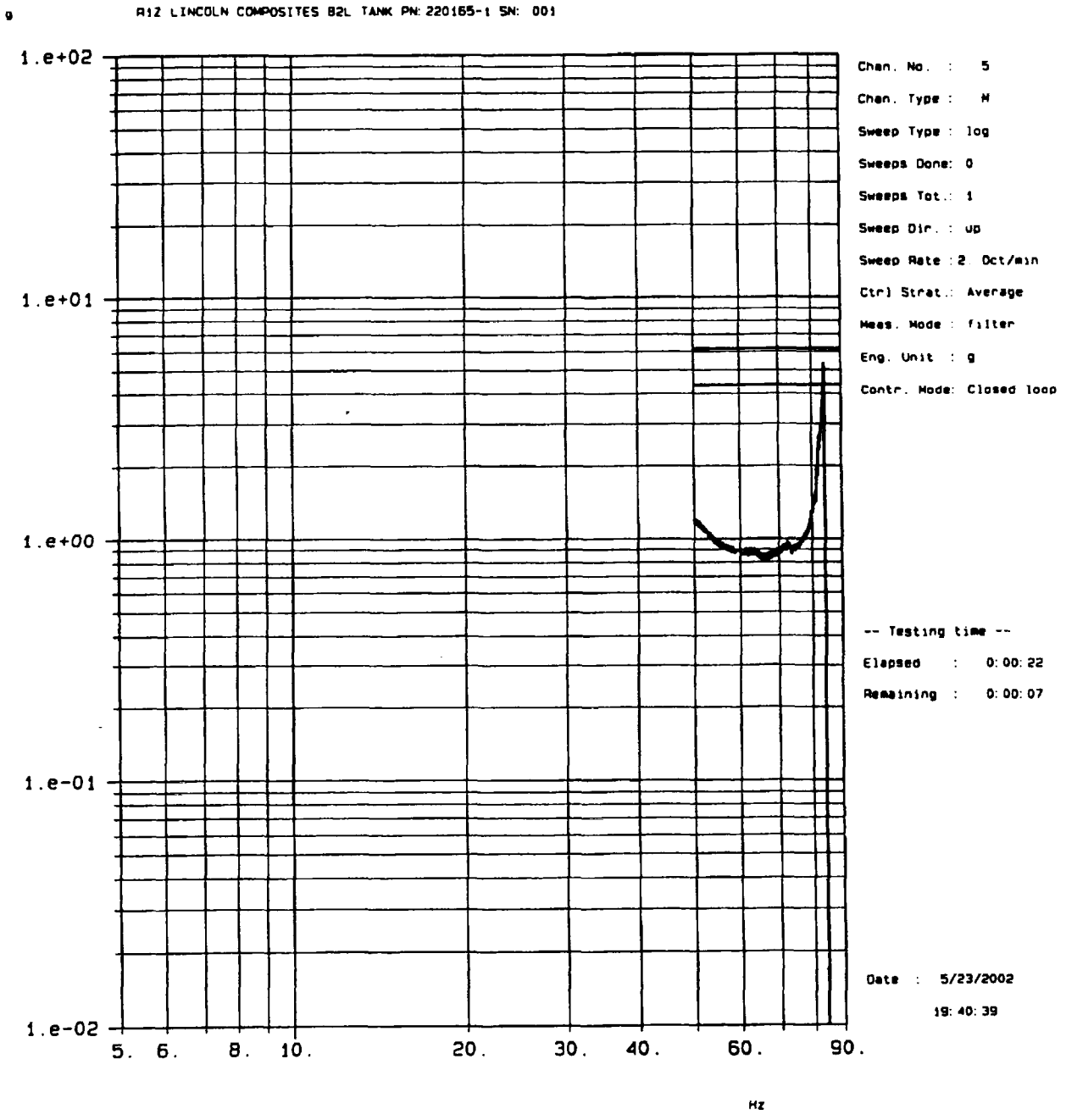

SINUSOIDAL PLOT NO. 30

Sine Meas. Channel

LINCOLN 47039 5.2G

Y AXIS 5.2G SWEEP

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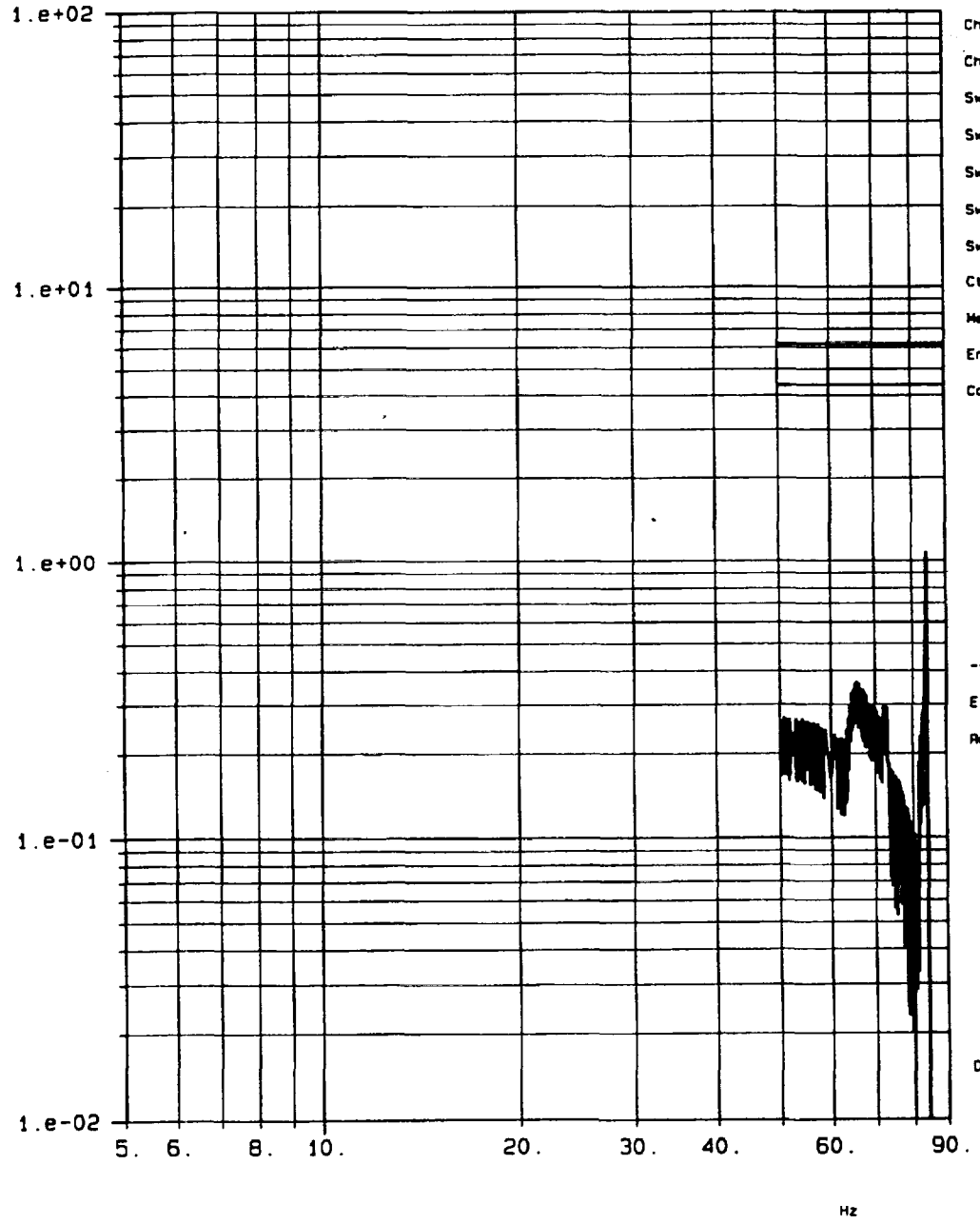
9 R2X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 6
Chan. Type : M
Sweep Type : log
Sweeps Done: 0
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Average
Meas. Mode : Filter
Eng. Unit : g
Contr. Mode: Closed loop

-- Testing time --
Elapsed : 0:00:22
Remaining : 0:00:07

Date : 5/23/2002
19:40:39

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SINUSOIDAL PLOT NO. 31

Sine Meas. Channel

LINCOLN 47039 5 2G

Y AXIS 5.2G SWEEP

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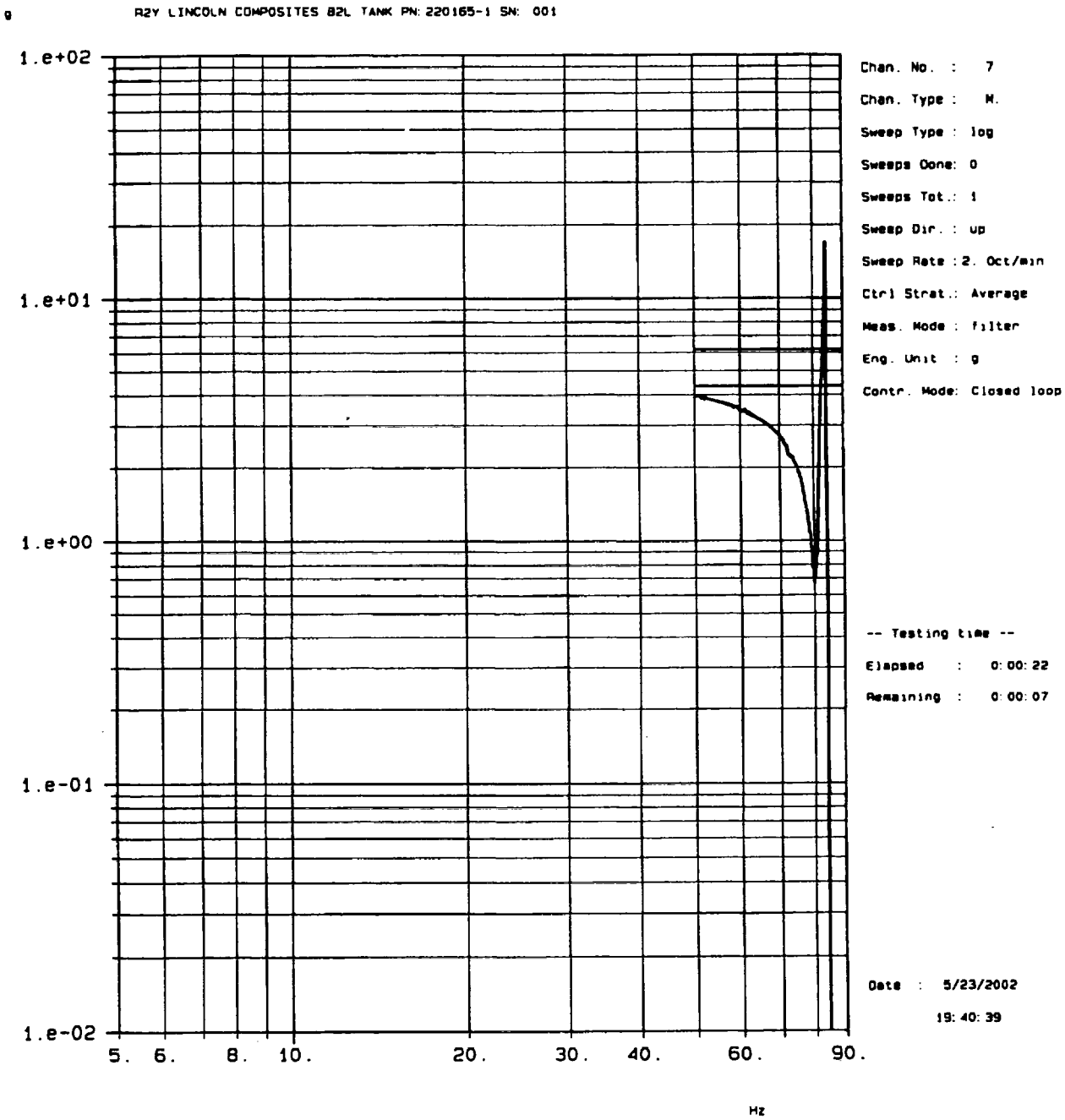

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SINUSOIDAL PLOT NO. 32

Sine Meas. Channel

LINCOLN 47039 5 2G

Y AXIS 5.2G SWEEP

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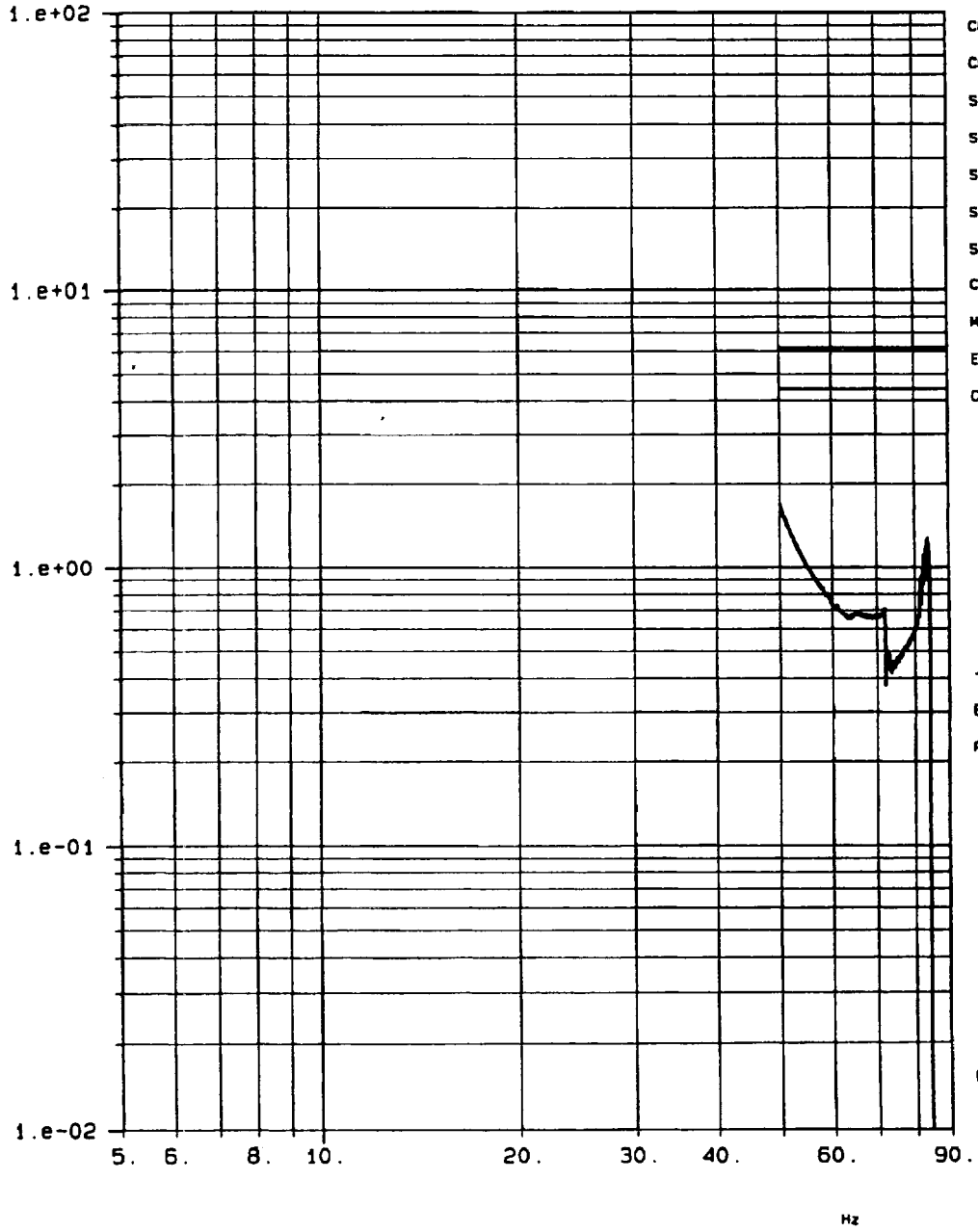
g

R22 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 8

Chan. Type : M

Sweep Type : log

Sweeps Done: 0

Sweeps Tot. : 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Average

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:00:22

Remaining : 0:00:07

Date : 5/23/2002

19:40:39

SINUSOIDAL PLOT NO. 33

Sine Meas. Channel

LINCOLN 47039 5.2G

Y AXIS 5.2G SWEEP

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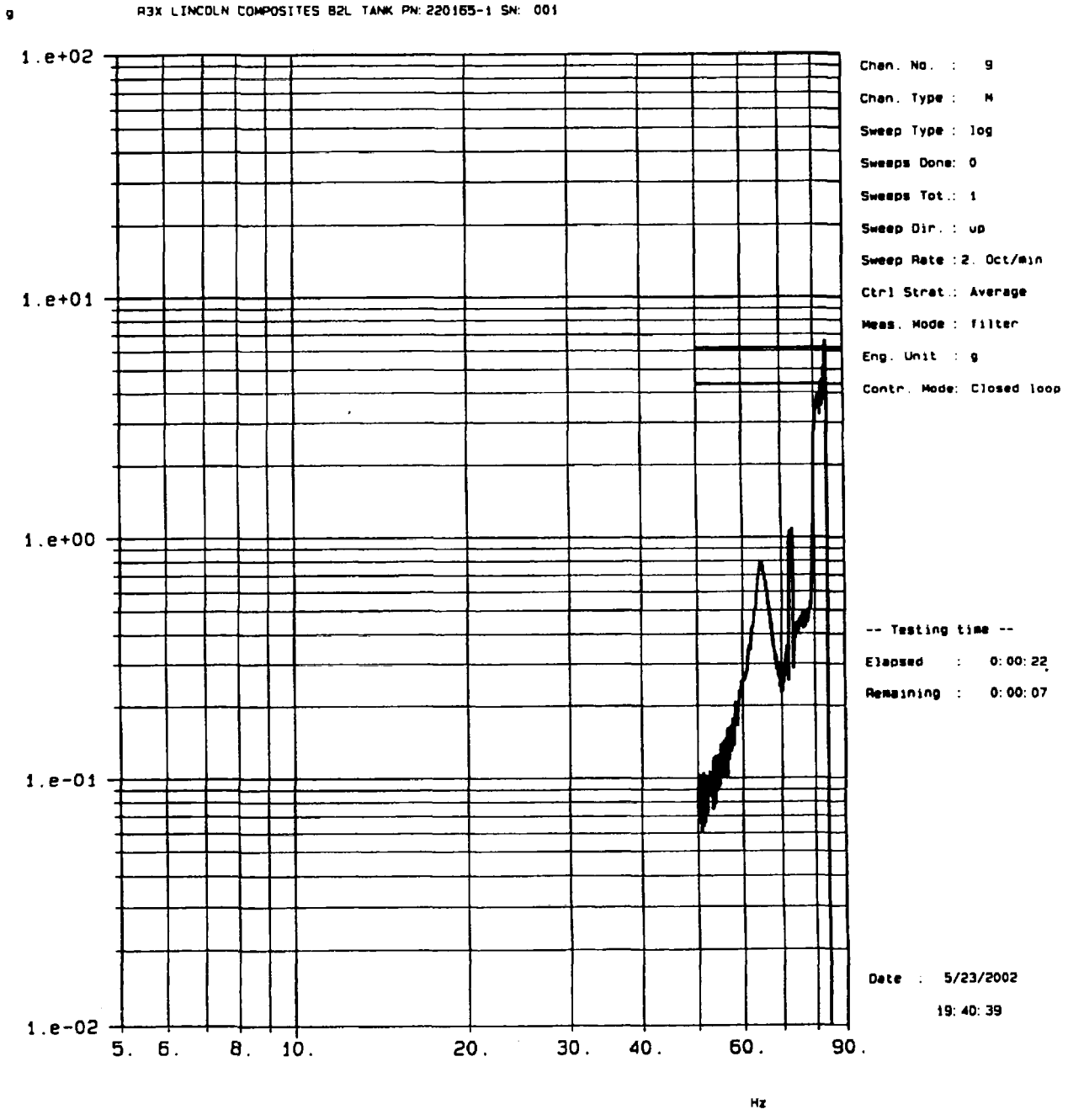

SINUSOIDAL PLOT NO. 34

Sine Meas. Channel

LINCOLN 47039 5 2G

Y AXIS 5.2G SWEEP

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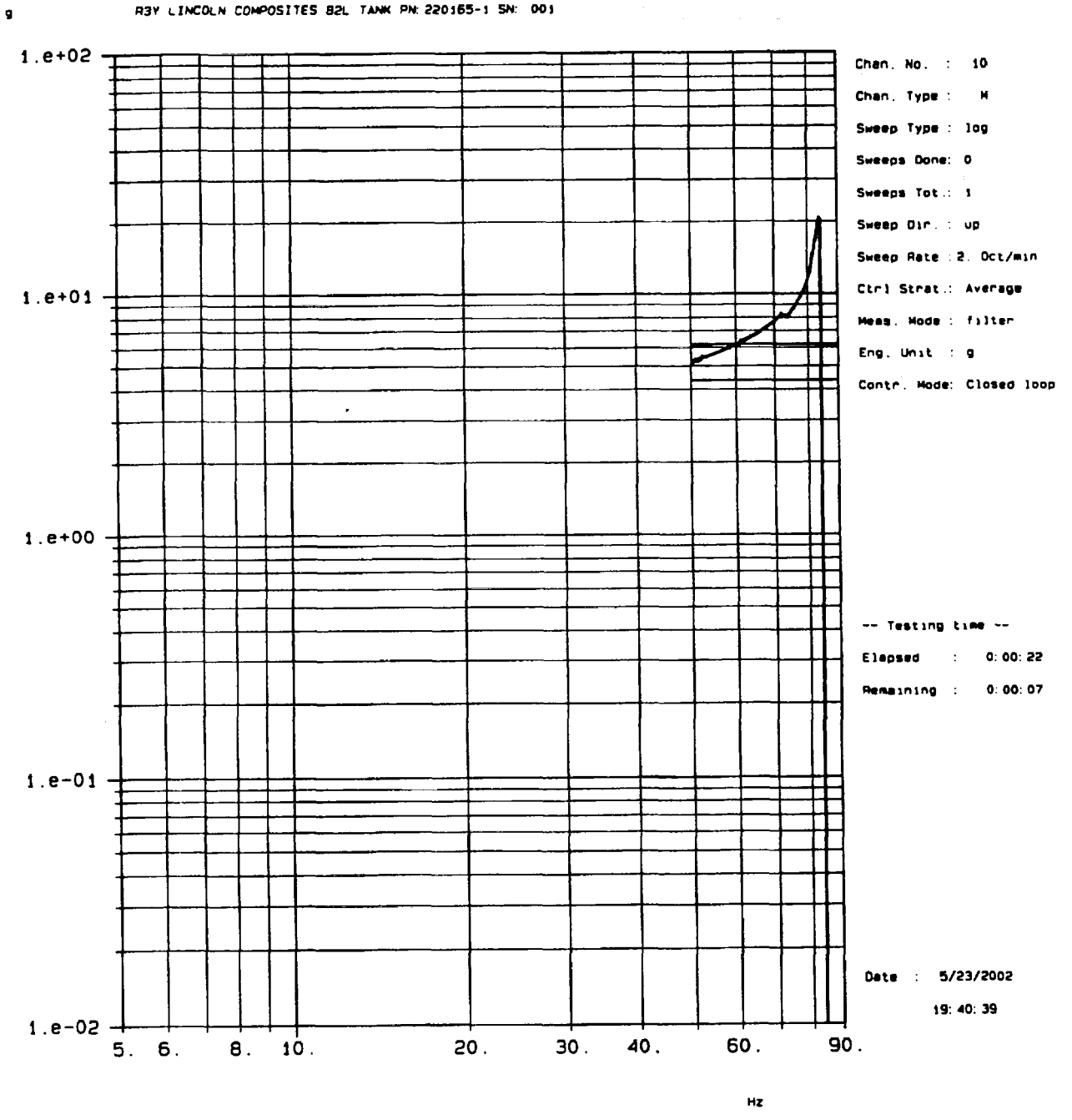
B Segundo, CA



SINUSOIDAL PLOT NO. 35

Sine Meas. Channel

LINCOLN 47039 5.2G

Y AXIS 5.2G SWEEP

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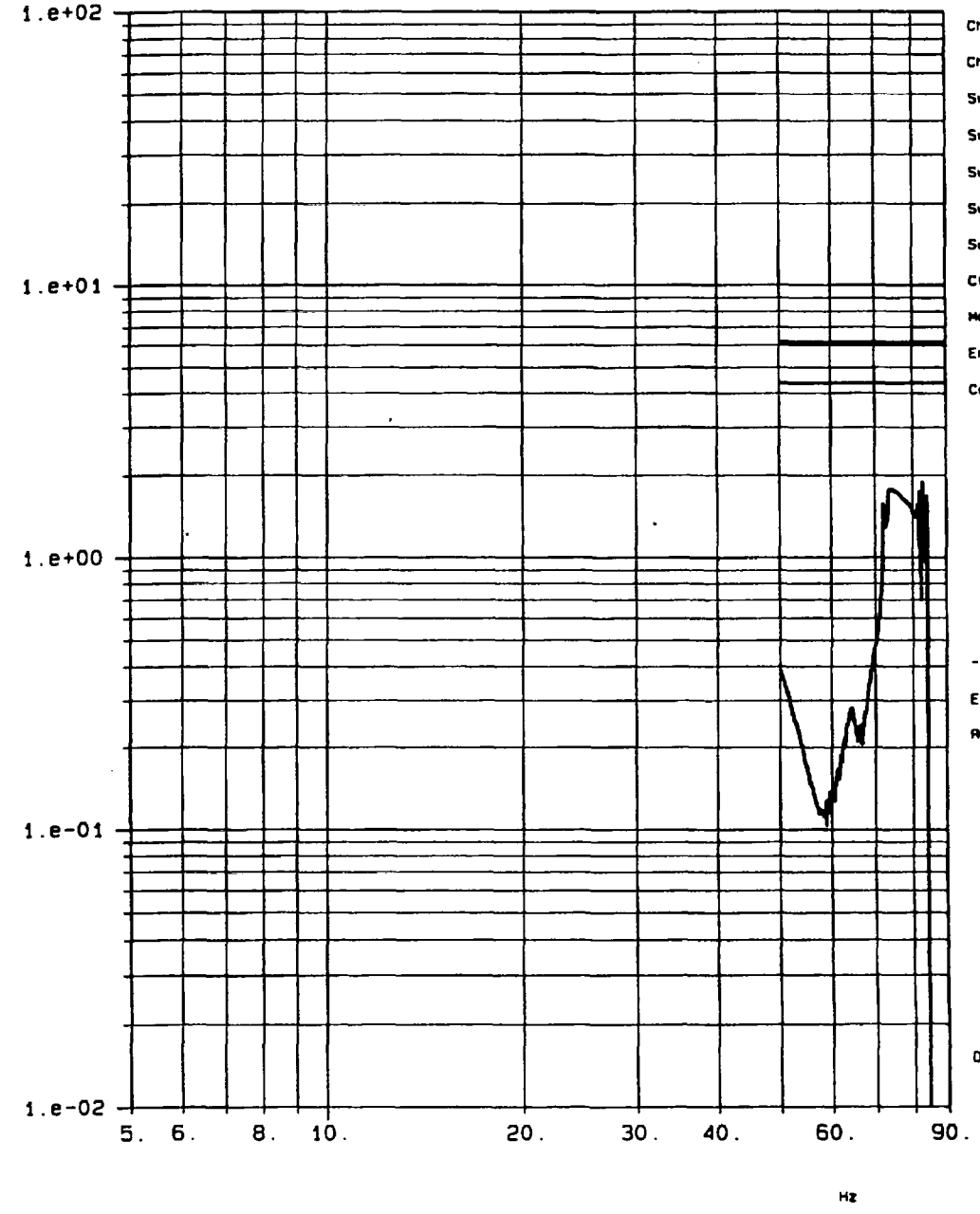
El Segundo, CA

R3Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 11
Chan. Type : H
Sweep Type : log
Sweeps Done: 0
Sweeps Tot : 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Average
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop

-- Testing time --
Elapsed : 0:00:22
Remaining : 0:00:07

Date : 5/23/2002
19:40:39

SINUSOIDAL PLOT NO. 36

Sine Meas. Channel

LINCOLN 47039 5.2G

Y AXIS 5.2G SWEEP

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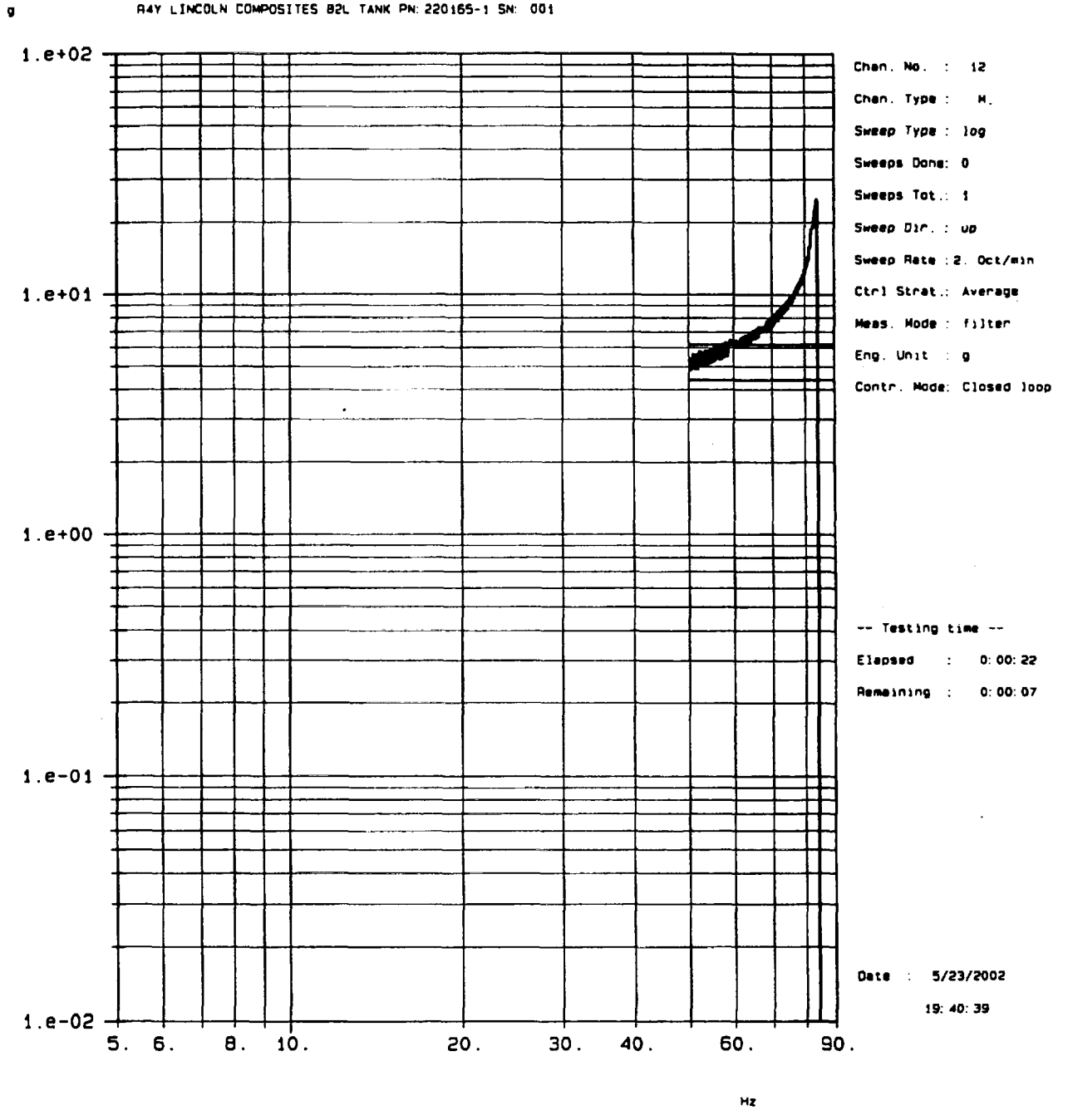

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SINUSOIDAL PLOT NO. 37

Sine Control

LC47039 65-100

Y AXIS 5 2G SWEEP 65-100 HZ

MAXIMUM OF C1 & C2

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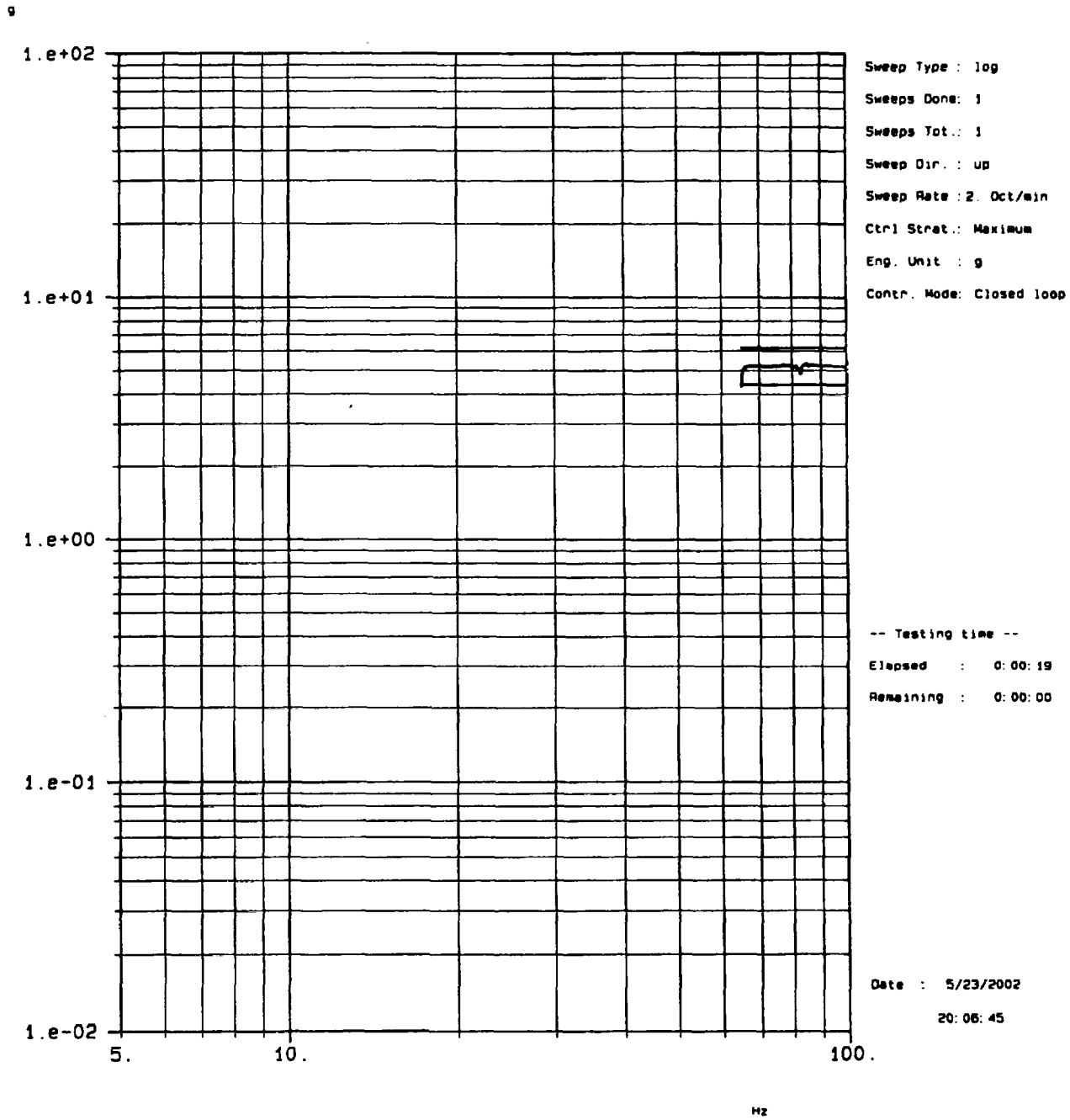

SINUSOIDAL PLOT NO. 38

Sine Control/Limit Channel

LC47039 65-100

Y AXIS 5.2G SWEEP 65-100 HZ

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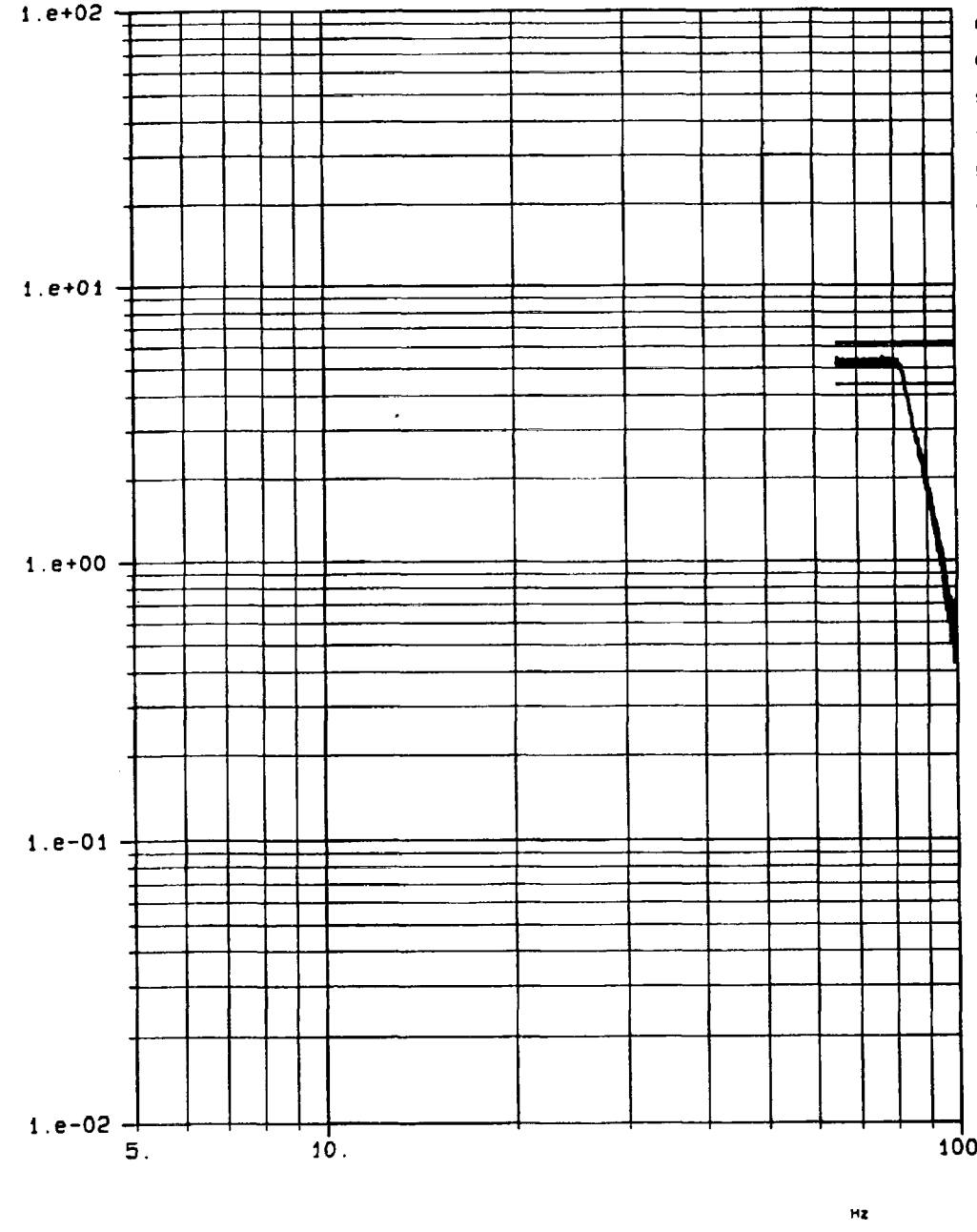
C1 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 1
Chan. Type : C
Sweep Type : log
Sweeps Done: 1
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Maximum
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop

-- Testing time --
Elapsed : 0:00:19
Remaining : 0:00:00

Date : 5/23/2002
20:06:45

SINUSOIDAL PLOT NO. 39

Sine Control/Limit Channel

LC47039 65-100

Y AXIS 5.2G SWEEP 65-100 HZ

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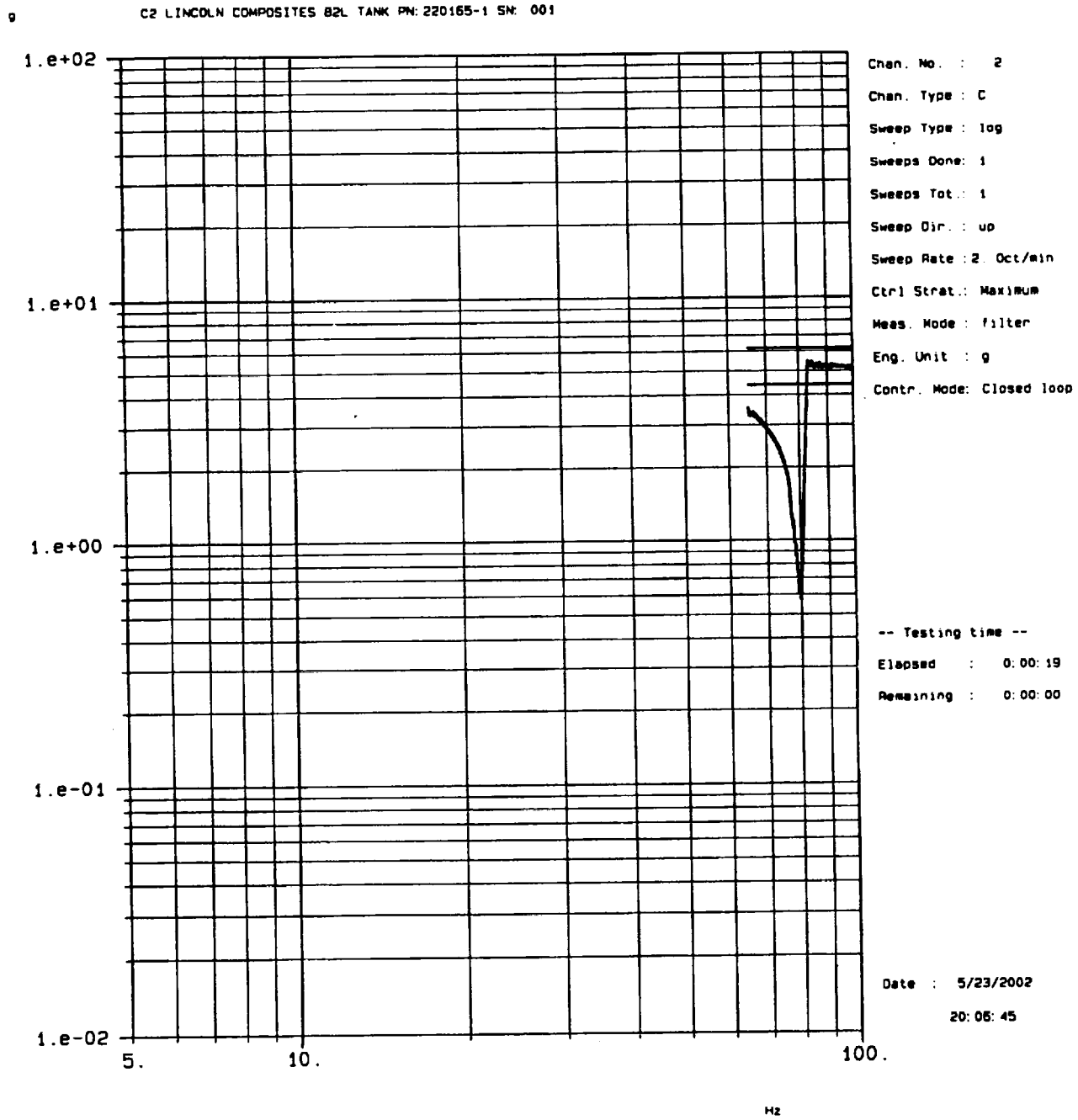
C2 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



SINUSOIDAL PLOT NO. 40

Sine Meas. Channel

LC47039 65-100

Y AXIS 5.2G SWEEP 65-100 HZ

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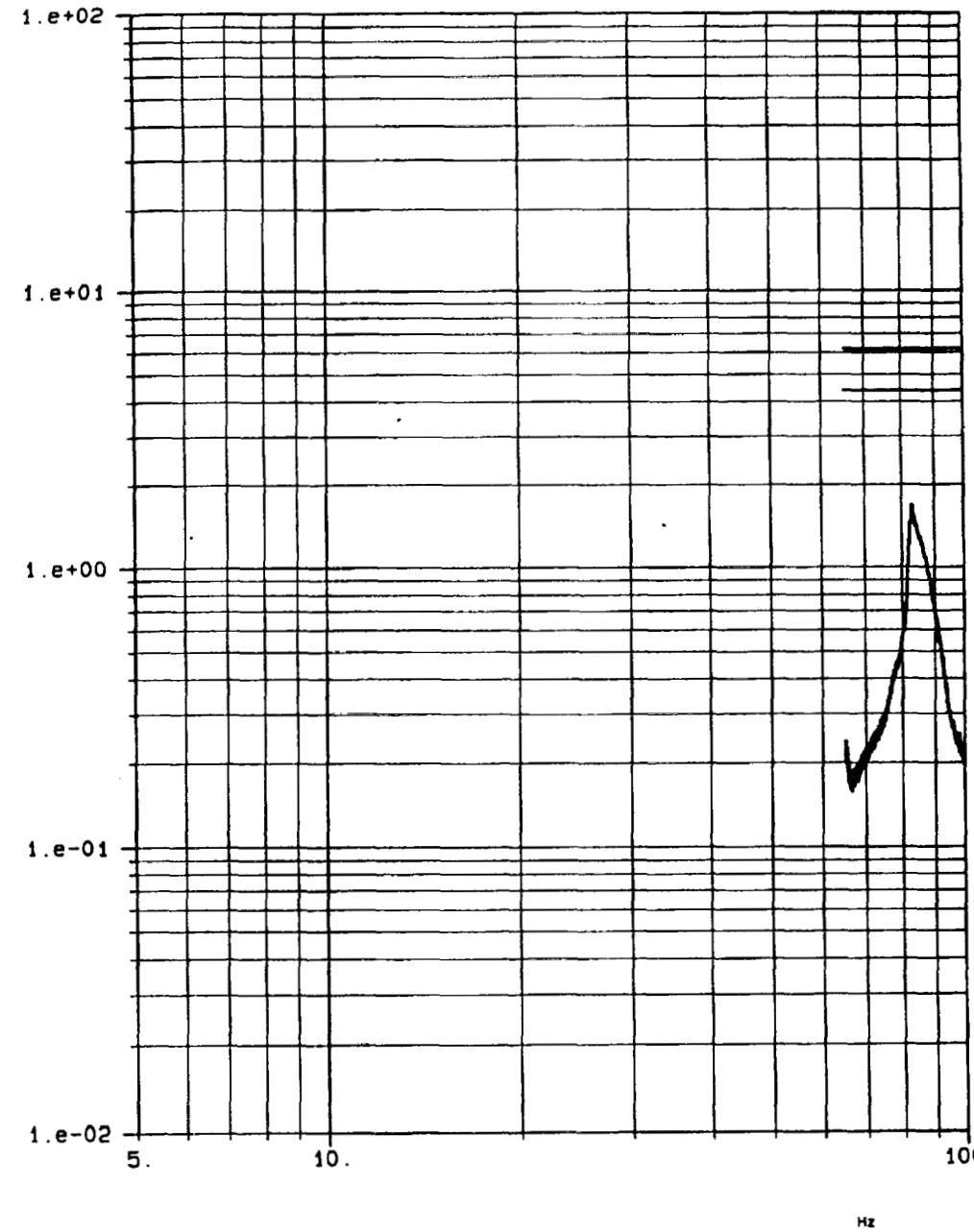
El Segundo, CA

R1X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 3

Chan. Type : N

Sweep Type : log

Sweeps Done: 1

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Maximum

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:00:19

Remaining : 0:00:00

Date : 5/23/2002

20:06:45

SINUSOIDAL PLOT NO. 41

Sine Meas. Channel

LC47039 65-100

Y AXIS 5.2G SWEEP 65-100 HZ

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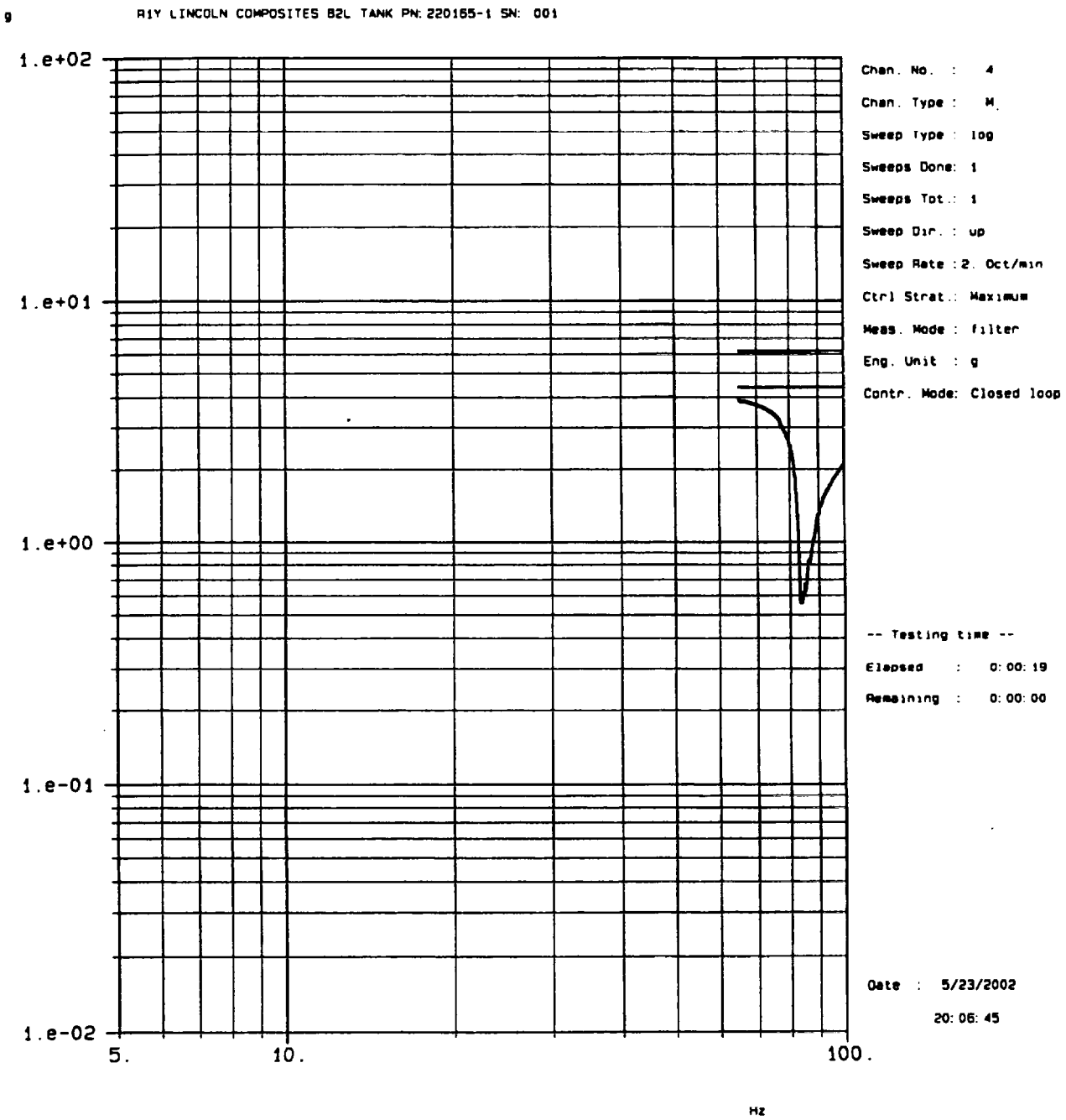

SINUSOIDAL PLOT NO. 42

Sine Meas. Channel

LC47039 65-100

Y AXIS 5 2G SWEEP 65-100 HZ

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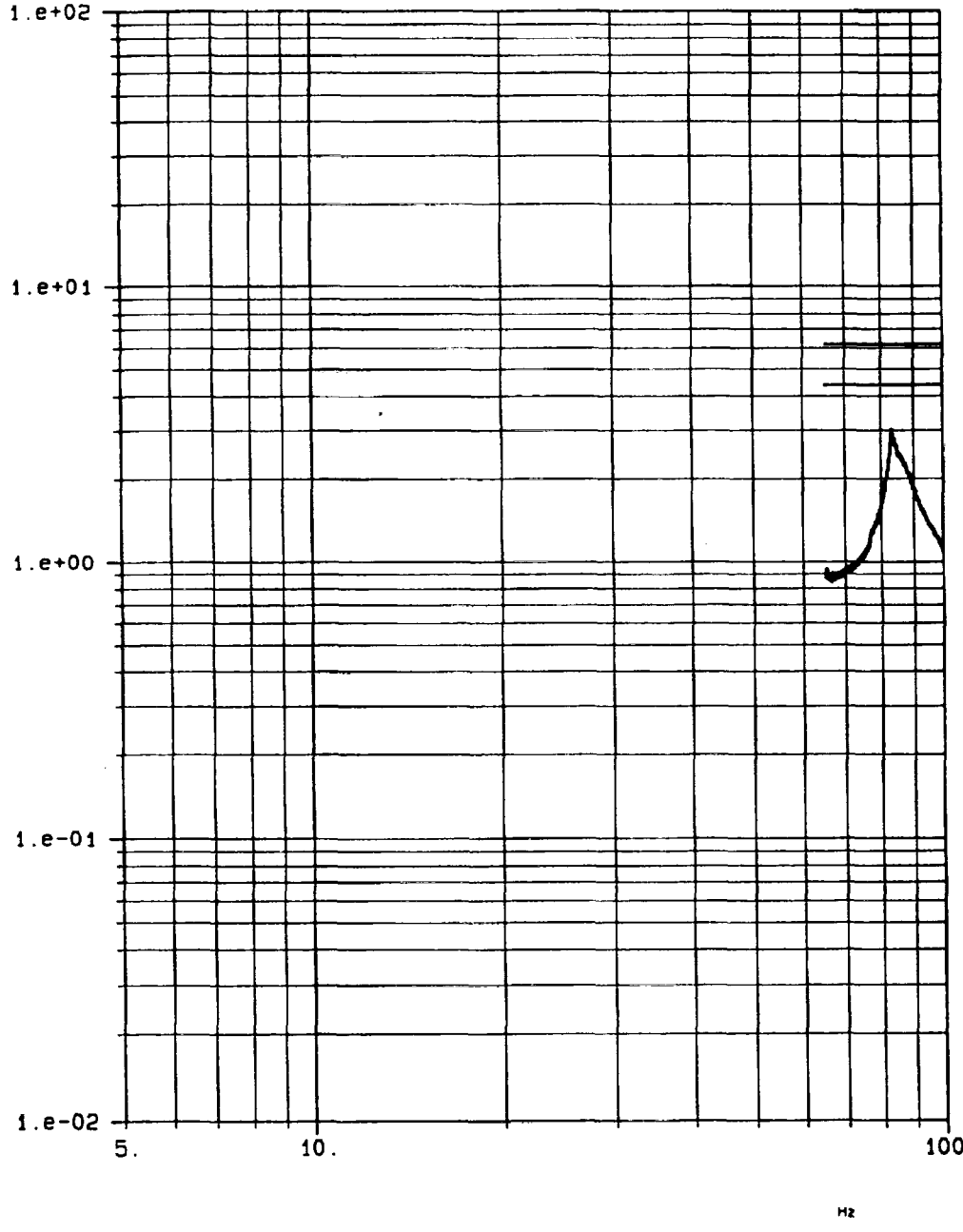
El Segundo, CA

g

R1Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 5

Chan. Type : M

Sweep Type : log

Sweeps Done: 1

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Maximum

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:00:19

Remaining : 0:00:00

Date : 5/23/2002

20:06:45

SINUSOIDAL PLOT NO. 43

Sine Meas. Channel

LC47039 65-100

Y AXIS 5.2G SWEEP 65-100 HZ

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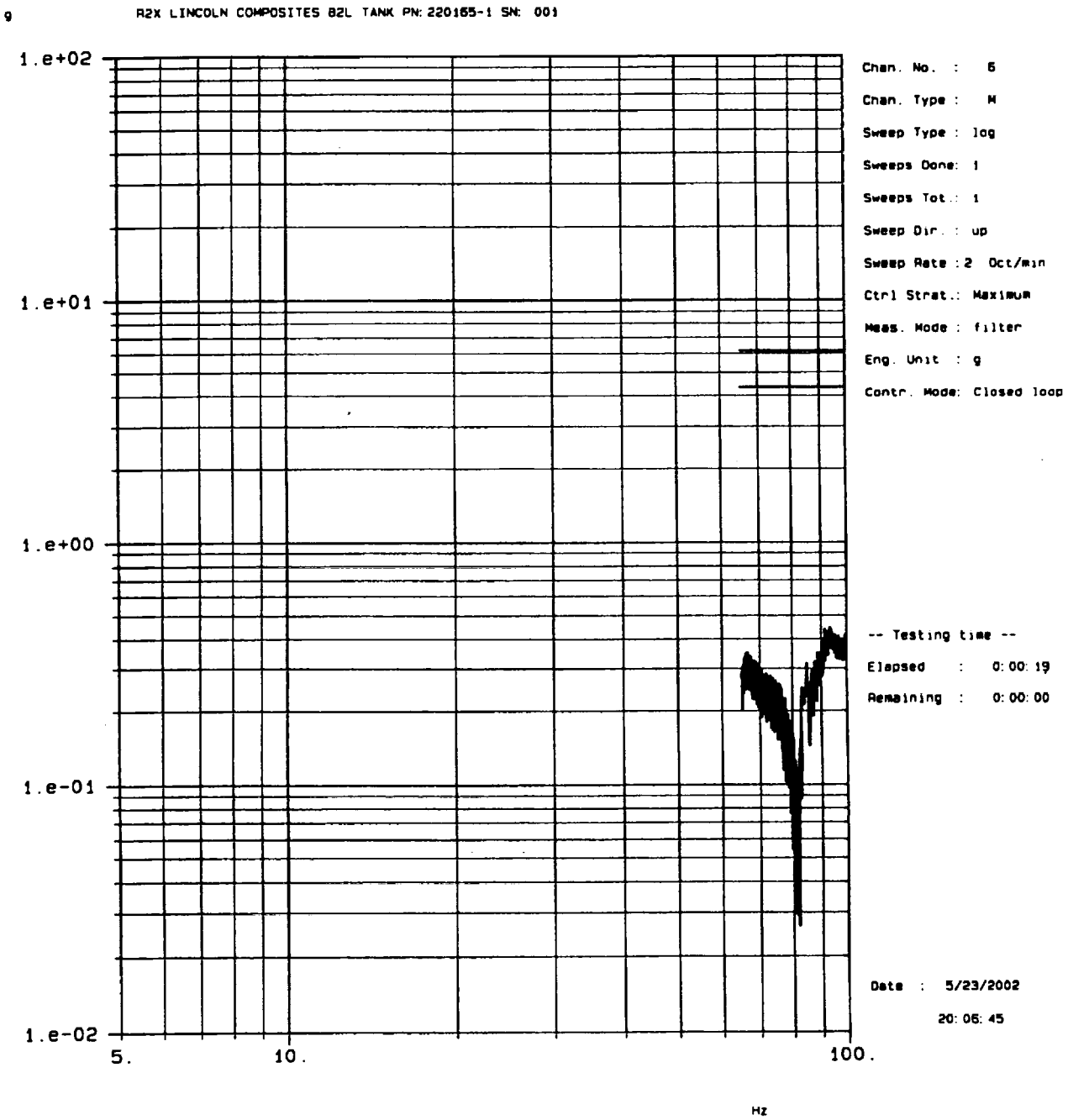
El Segundo, CA



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SINUSOIDAL PLOT NO. 44

Sine Meas. Channel

LC47039 65-100

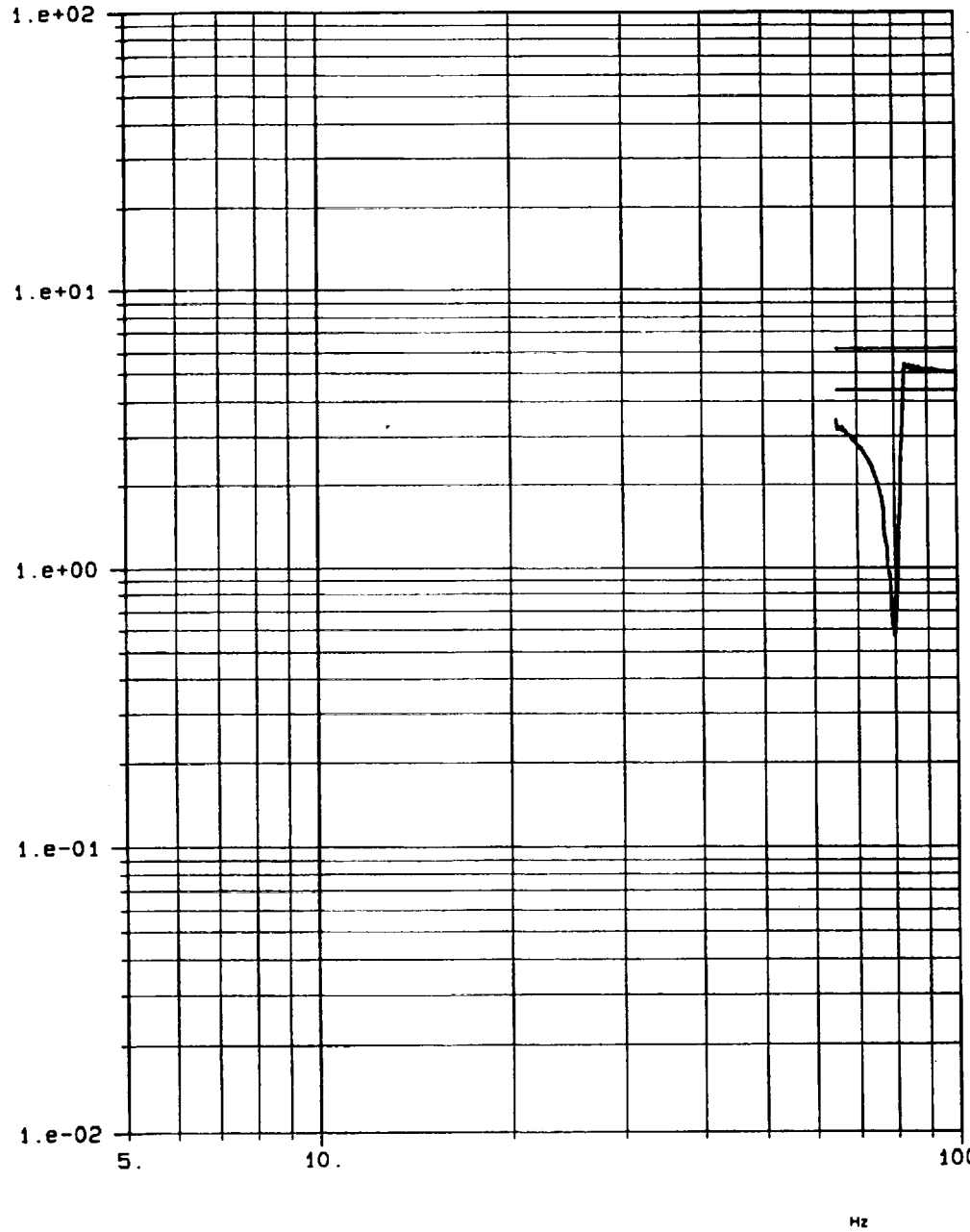
Y AXIS 5.2G SWEEP 65-100 HZ

Wyle Laboratories

El Segundo, CA

g

A2Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 7

Chan. Type : M

Sweep Type : log

Sweeps Done: 1

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Maximum

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:00:19

Remaining : 0:00:00

Date : 5/23/2002

20:06:45

SINUSOIDAL PLOT NO. 45

Sine Meas. Channel

LC47039 65-100

Y AXIS 5.2G SWEEP 65-100 HZ

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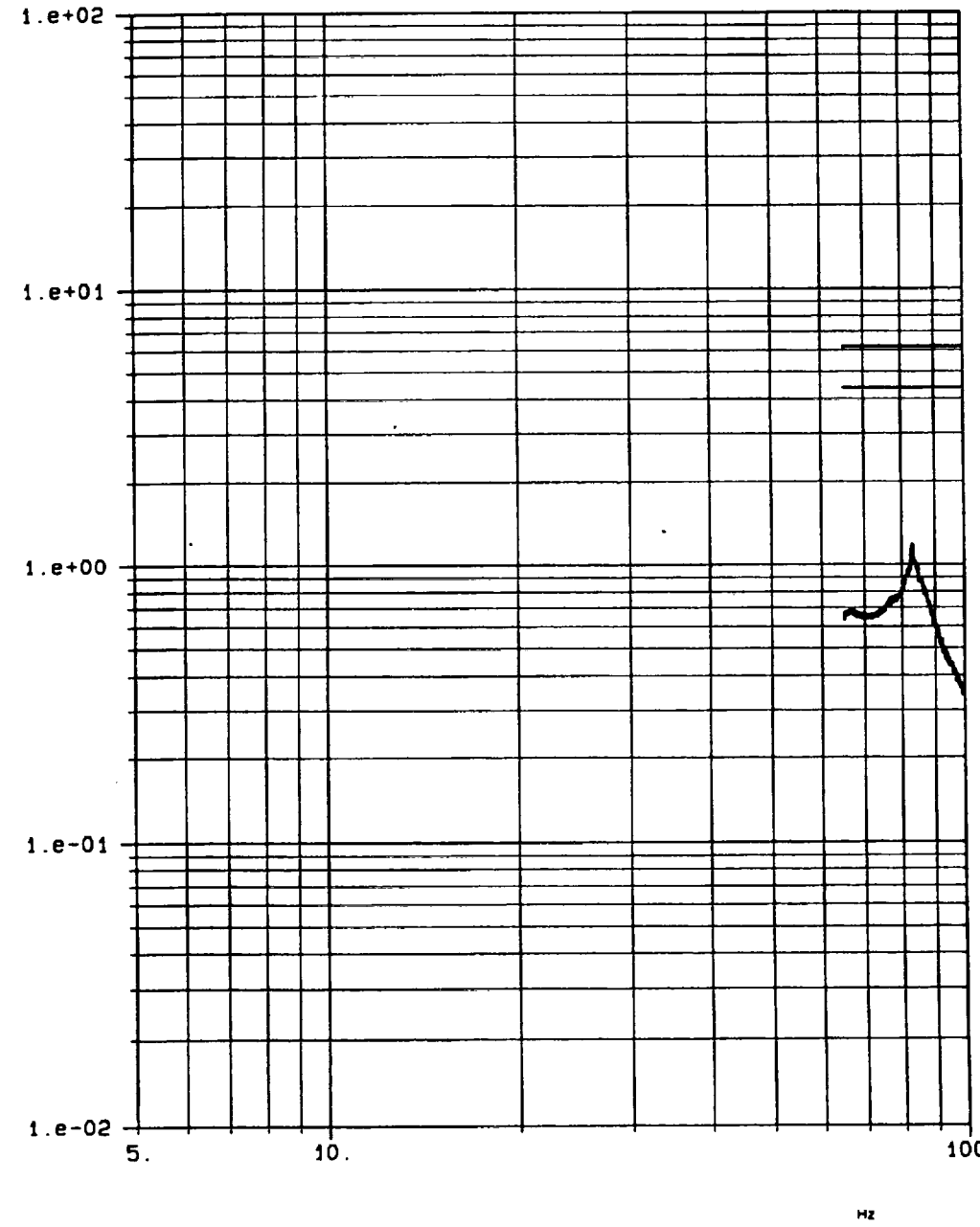
El Segundo, CA

R2Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 8
Chan. Type : M
Sweep Type : log
Sweeps Done: 1
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Maximum
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop

-- Testing time --
Elapsed : 0:00:19
Remaining : 0:00:00

Date : 5/23/2002
20:06:45

SINUSOIDAL PLOT NO. 46

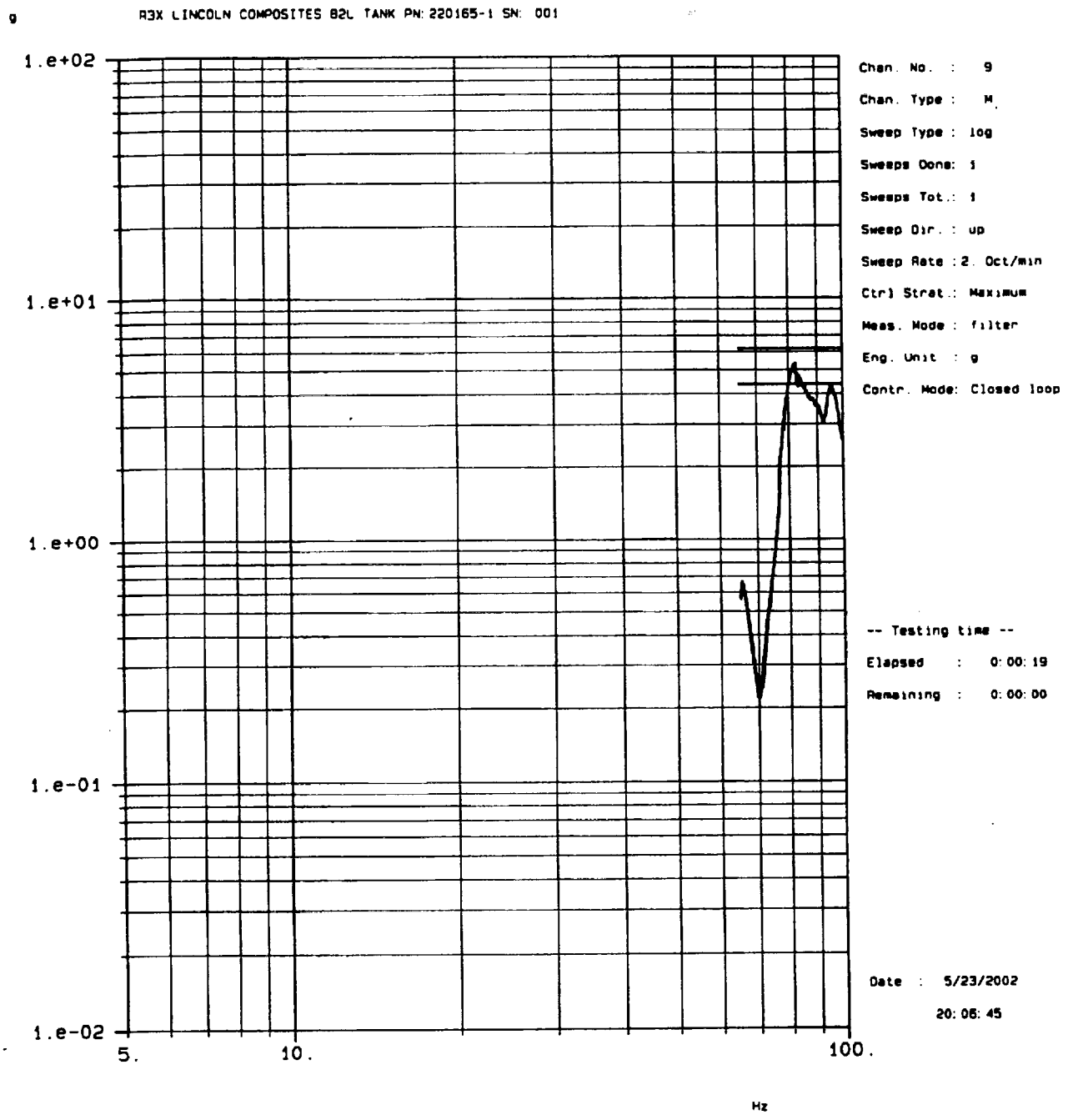
Sine Meas. Channel

LC47039 65-100

Y AXIS 5.2G SWEEP 65-100 HZ

Wyle Laboratories

El Segundo, CA



SINUSOIDAL PLOT NO. 47

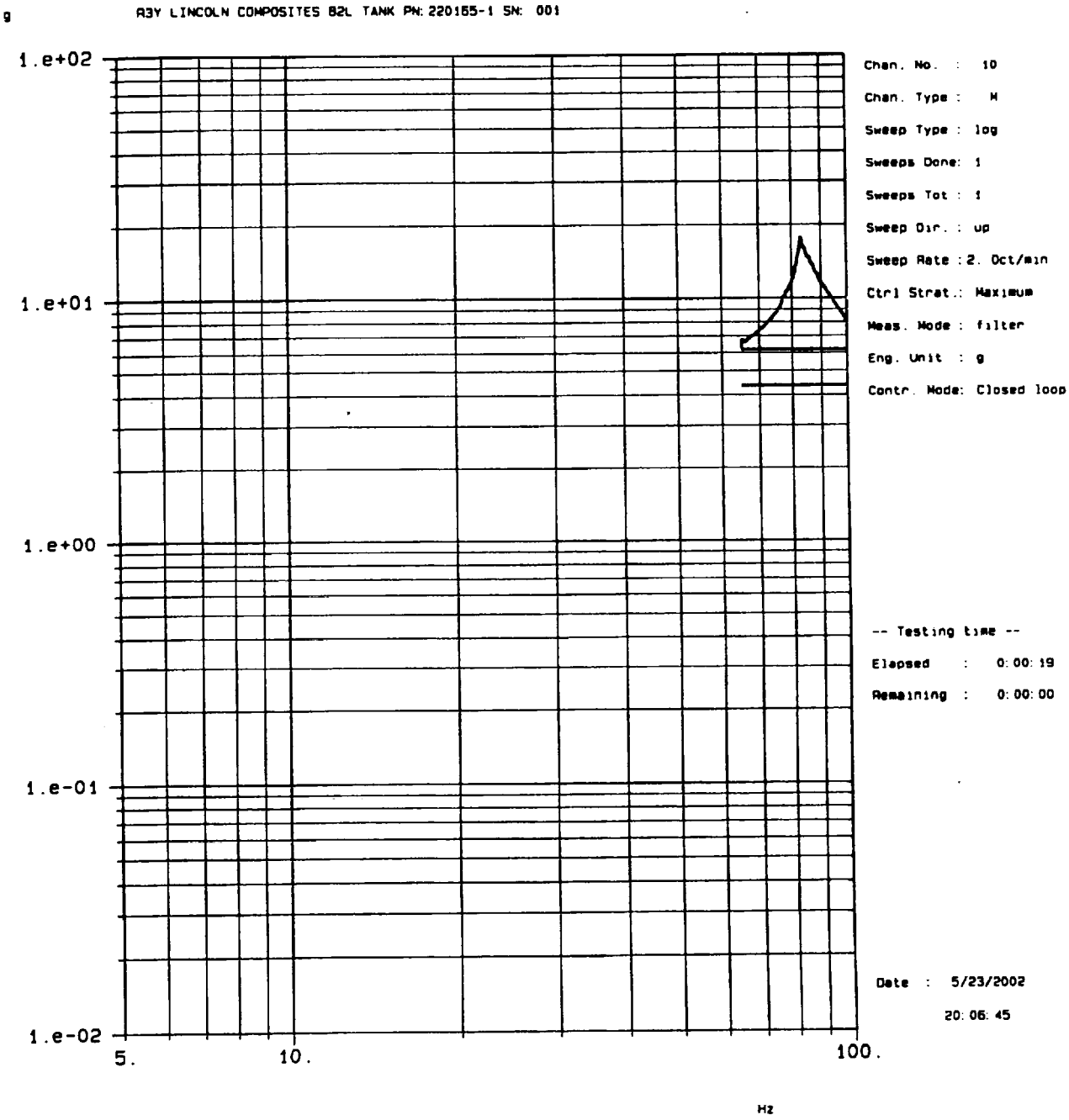
Sine Meas. Channel

LC47039 65-100

Y AXIS 5.2G SWEEP 65-100 HZ

Wyle Laboratories

El Segundo, CA



SINUSOIDAL PLOT NO. 48

Sine Meas. Channel

LC47039 65-100

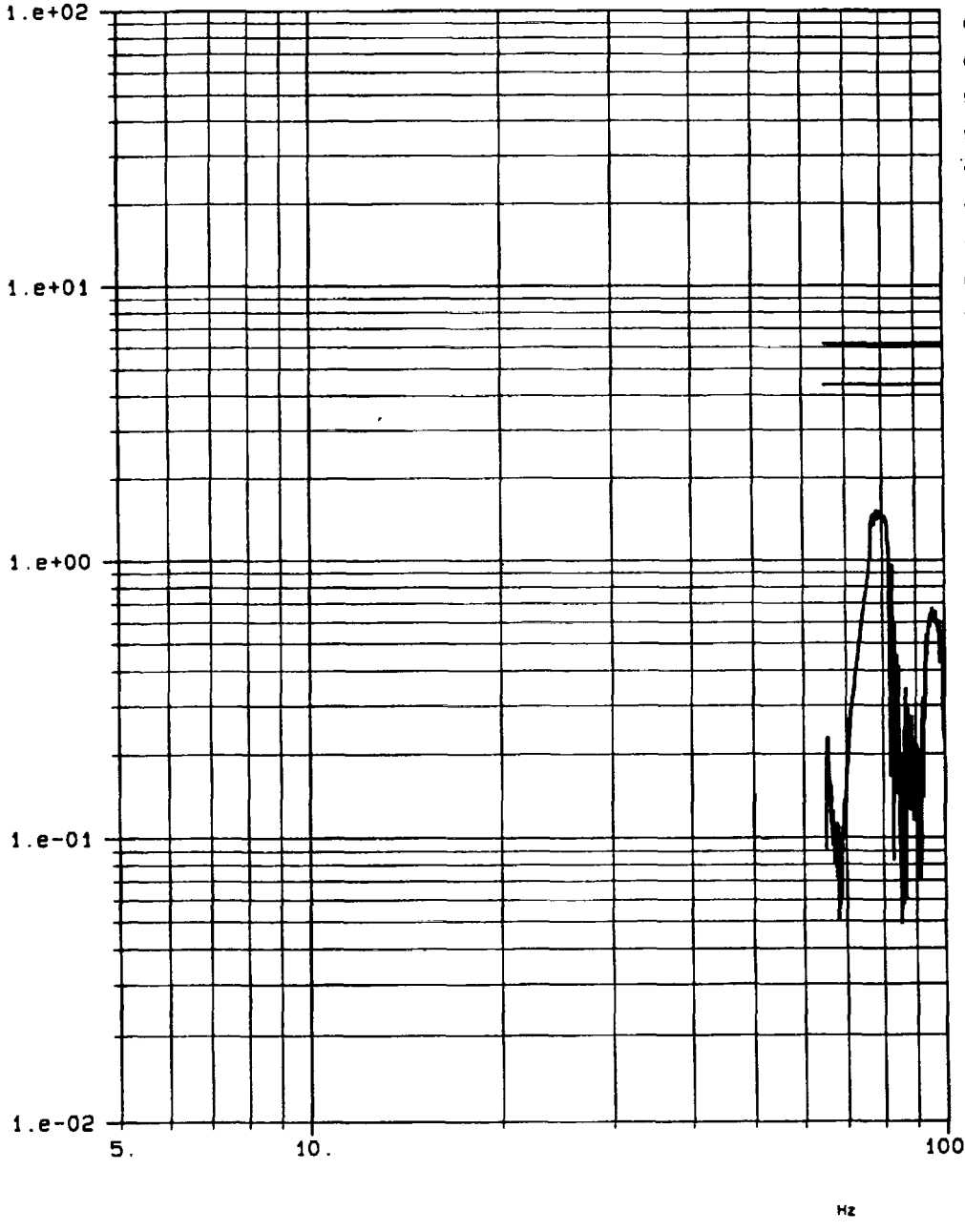
Y AXIS 5.2G SWEEP 65-100 HZ

Wyle Laboratories

El Segundo, CA

g

A3Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 11

Chan. Type : M

Sweep Type : log

Sweeps Done: 1

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Maximum

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:00:19

Remaining : 0:00:00

Date : 5/23/2002

20:06:45

SINUSOIDAL PLOT NO. 49

Sine Meas. Channel

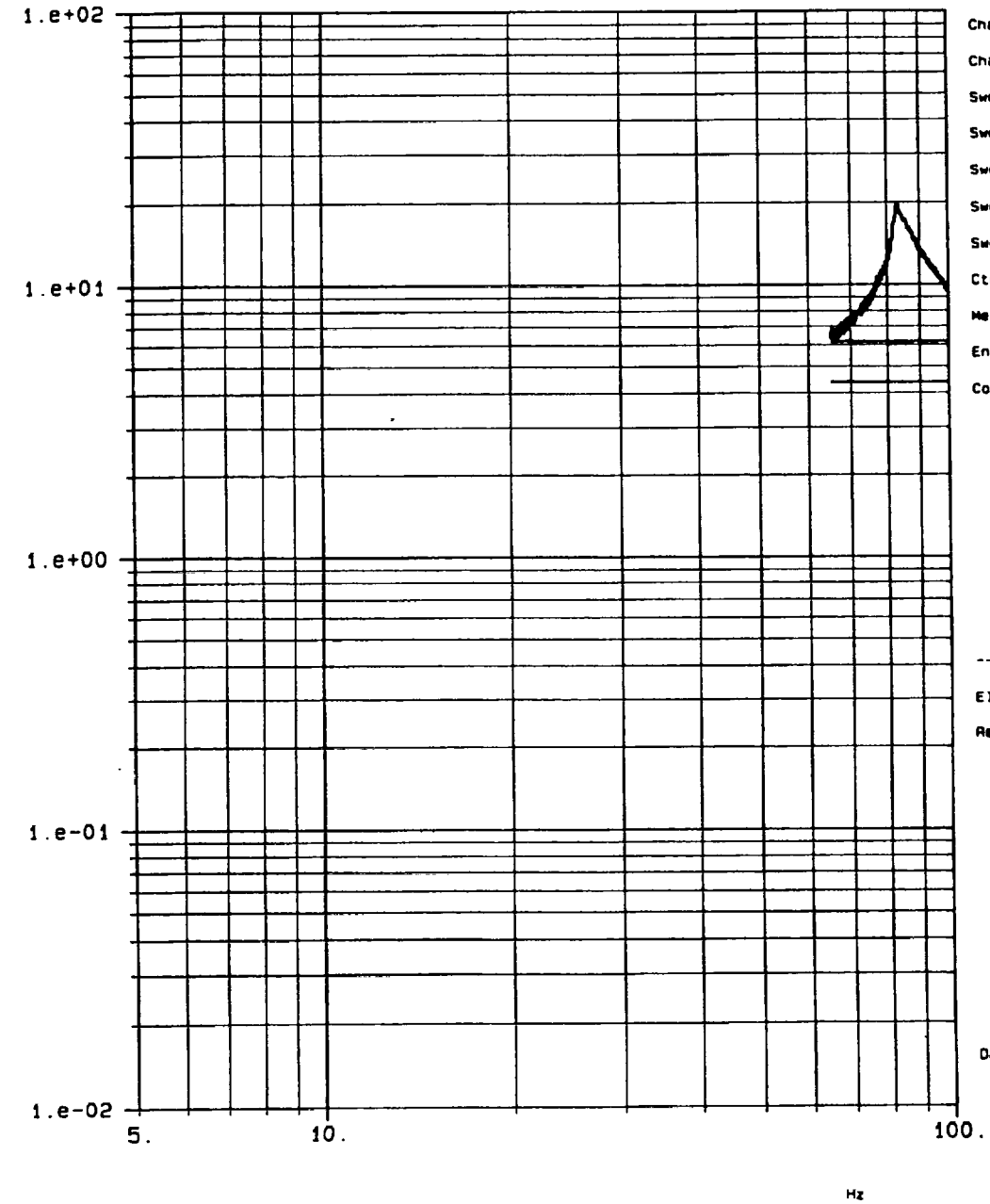
LC47039 65-100

Y AXIS 5.2G SWEEP 65-100 HZ

Wyle Laboratories

El Segundo, CA

R4Y LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 12

Chan. Type : H

Sweep Type : log

Sweeps Done: 1

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Maximum

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:00:19

Remaining : 0:00:00

Date : 5/23/2002

20:06:45

DYN-C

wyle laboratories

RECEIVING INSPECTION DATA SHEET

Customer	LINCOLN COMPOSITES	Date	6-5-2002
Specimen	82 Liter Tank	Job No.	47039

No. of Specimens Received: ONE

Record identification information exactly as it appears on the tag or specimen:

Manufacturer LINCOLN COMPOSITES

P/N's	S/N's
220165-1	001

How Does identification information appear: (e.g. name plate, tag, painted, imprinted, etc) PAINTED

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification

Inspection Results: There was no visible evidence of damage to the specimen(s) unless otherwise noted below.

NO VISIBLE DAMAGE TO SPECIMEN ON RECEIVING OF SPECIMEN

Inspected By R.G.PARAMORE

Sheet Number 1 of 1

Approved [signature] Date 6-5-02

wyle laboratories

RECEIVING INSPECTION DATA SHEET

Customer	LINCOLN COMPOSITES	Date	6-7-2002
Specimen	82 Liter Tank (with Filter Assembly)	Job No.	47039

No. of Specimens Received: ONE

Record identification information exactly as it appears on the tag or specimen:

Manufacturer LINCOLN COMPOSITES

P/N's	S/N's
220165-1	001

How Does identification information appear: (e.g. name plate, tag, painted, imprinted, etc) PAINTED

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification

Inspection Results: There was no visible evidence of damage to the specimen(s) unless otherwise noted below.

NO VISIBLE DAMAGE TO SPECIMEN ON RECEIVING OF SPECIMEN

Inspected By R.G.PARAMORE

Sheet Number 1 of 1

Approved [signature] Date 6-7-02

wyle laboratories

Test	RANDOM AND SINUSOIDAL VIBRATION				
Customer	Lincoln Composites	Specimen	82 Liter Pressure Vessel	Date	6/4/02
Part No.	220165-1	S/N	001	Job No.	47039
Test By	Stafford L. Orong	Witness		Page No.	1 of 2

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION		ACCURACY
					LAST	DUE	
Vibration Exciter	Ling	340	30k Force lbs.	SN 80	NA	NA	NA
Power Amplifier	Unholtz-Dickie	2XSA/120 1/2	120/240 kVA	13756	NA	NA	NA
Automatic Vibration Control System	m+p	VCX900	0.1Hz to 12.8 kHz	14004	System Calibration Prior to Use	System Calibration Prior to Use	NA
Sine & Random Software	m+p	Rev. 6.2	NA	NA	NA	NA	NA
Mainframe	Hewlett-Packard	E1421B	5 Slots	14007	NA	NA	NA
Digitizer	Hewlett-Packard	E1432A	16 Channels 51.2 kSa/s	13887	6/11/01	6/11/03	± 1%
Oscilloscope	BK Precision	5105	100 MHz	14181	9/19/01	9/19/02	± 3%
Accelerometer	Endevco	7704A-17	1 Hz to 10 kHz 2.5kG Peak	14334 13396	5/9/02	11/9/02	± 5%
Accelerometer	Endevco	2228	3 Hz to 4 kHz 1k G Peak	12009 12008	5/9/02 5/15/02	11/9/02 11/15/02	± 5%
Accelerometer	Endevco	2228	3 Hz to 4 kHz 1k G Peak	8946	5/6/02	11/6/02	± 5%
Accelerometer	Endevco	2226	3 Hz to 5 kHz 1k G Peak	12277	3/14/02	9/14/02	± 5%
Accelerometer	Endevco	2226	3 Hz to 5 kHz 1k G Peak	12274	4/10/02	10/10/02	± 5%
Accelerometer	Endevco	2222	5 Hz to 8 kHz 1k G Peak	14474	5/1/02	11/1/02	± 5%
Charge Amplifier	Unholtz-Dickie	D22	2 Hz to 20 kHz 1k G Peak	10696 13702	1/14/02	7/14/02	± 2%
Charge Amplifier	Unholtz-Dickie	D22	2 Hz to 20 kHz 1k G Peak	13706 13703	1/14/02	7/14/02	± 2%
Charge Amplifier	Unholtz-Dickie	D22	2 Hz to 20 kHz 1k G Peak	10697 13701	1/14/02	7/14/02	± 2%
Charge Amplifier	Endevco	133	200 kHz BW 0 to 1k Gain	14113 13791	2/6/02 4/1/02	8/6/02 10/1/02	± .5%

W614C QA Form Approval

wyle laboratories

REPORT NO. 47039
PAGE NO. DYN.C.5

Test	RANDOM AND SINUSOIDAL VIBRATION				
Customer	Lincoln Composites	Specimen	82 Liter Pressure Vessel	Date	6/4/02
Part No.	220165-1	S/N	001	Job No.	47039
Test By	Stafford L. Orong	Witness		Page No.	2 of 2

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION		ACCURACY
					LAST	DUE	
Pressure Gauge	Ashcroft	N/A	0-3000 psig	7551	4/24/02	8/19/02	± .5%
Temp. Indicator	Doric	600	-327/+752°F	13912	5/23/02	9/23/02	± 2.0°F

W614C QA Form Approval

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DYNAMICS SECTION
VIBRATION TEST DATA SHEET

Customer: Lincoln Composites Job No. 47039

Sheet 1 of 2

Specimen: 82 Liter Pressure Vessel P/N 220165-1 S/N 001

Date	Time	Axis	Temp (°F)	RANDOM SPECTRUM Freq. (Hz)	PSD G^2/Hz	PSD dB/Oct	Overal (G_{rms})	Test Time (Sec.)	Comments	Ref Plot No.
6/5/02	1914	X	AMB	20	.000164				Completed –12dB (pre) level with no apparent damage.	1-13
				20-50		+ 9			Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				50-300	.0025				Extremal control using C1 and C2.	
				300-2k		- 6				
				2k	.000057		1.14	30		
6/5/02	1951	X	AMB	20	.0026				Completed Qualification level with no apparent damage.	14-26
				20-50		+ 9			Spectrum was notched per Lincoln Composites direction.	
				50-68	.04				Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				68-70					Extremal control using C1 and C2.	
				70-150	.03					
				150-152						
				152-300	.04					
				300-2k		- 6				
				2k	.0009		4.46	180		

W603SS-ES

Signed [illegible]

DYNAMICS SECTION
VIBRATION TEST DATA SHEET

Customer: Lincoln Composites Job No. 47039

Sheet 2 of 2

Specimen: 82 Liter Pressure Vessel P/N: 220165-1 S/N: 001

Date	Time	Axis	Temp (°F)	RANDOM SPECTRUM Freq. (Hz)	PSD G^2/Hz	PSD dB/Oct	Overal (G_{rms})	Test Time (Sec.)	Comments	Ref Plot No.
6/5/02	2004	X	AMB	20	.000164				Completed –12dB (post random) level with no apparent	27-39
				20-50		+ 9			damage.	
				50-300	.0025				Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				300-2k		- 6			Extremal control using C1 and C2.	
				2k	.000057		1.14	30		
6/5/02	2029	X	AMB	20	.000164				Completed –12dB (post sine) level with no apparent	40-52
				20-50		+ 9			damage.	
				50-300	.0025				Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				300-2k		- 6			Extremal control using C1 and C2.	
				2k	.000057		1.14	26		
6/10/02	1319	X	AMB	20	.0013				Completed Acceptance level with no apparent damage.	53-65
				20-50		+ 9			Tank pressurized with Helium to 2750 psi.	
				50-300	.02				Extremal control using C1 and C2.	
				300-2k		- 6				
				2k	.00046		3.2	60		

W603SS-ES

Signed Stephen L. Ouzy

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REPORT NO. 47039
PAGE NO. DYN.C.7

RANDOM PLOT NO. 1

Random Control

LINCOLN 47039 QUAL

X AXIS -12dB

MAXIMUM OF C1 & C2

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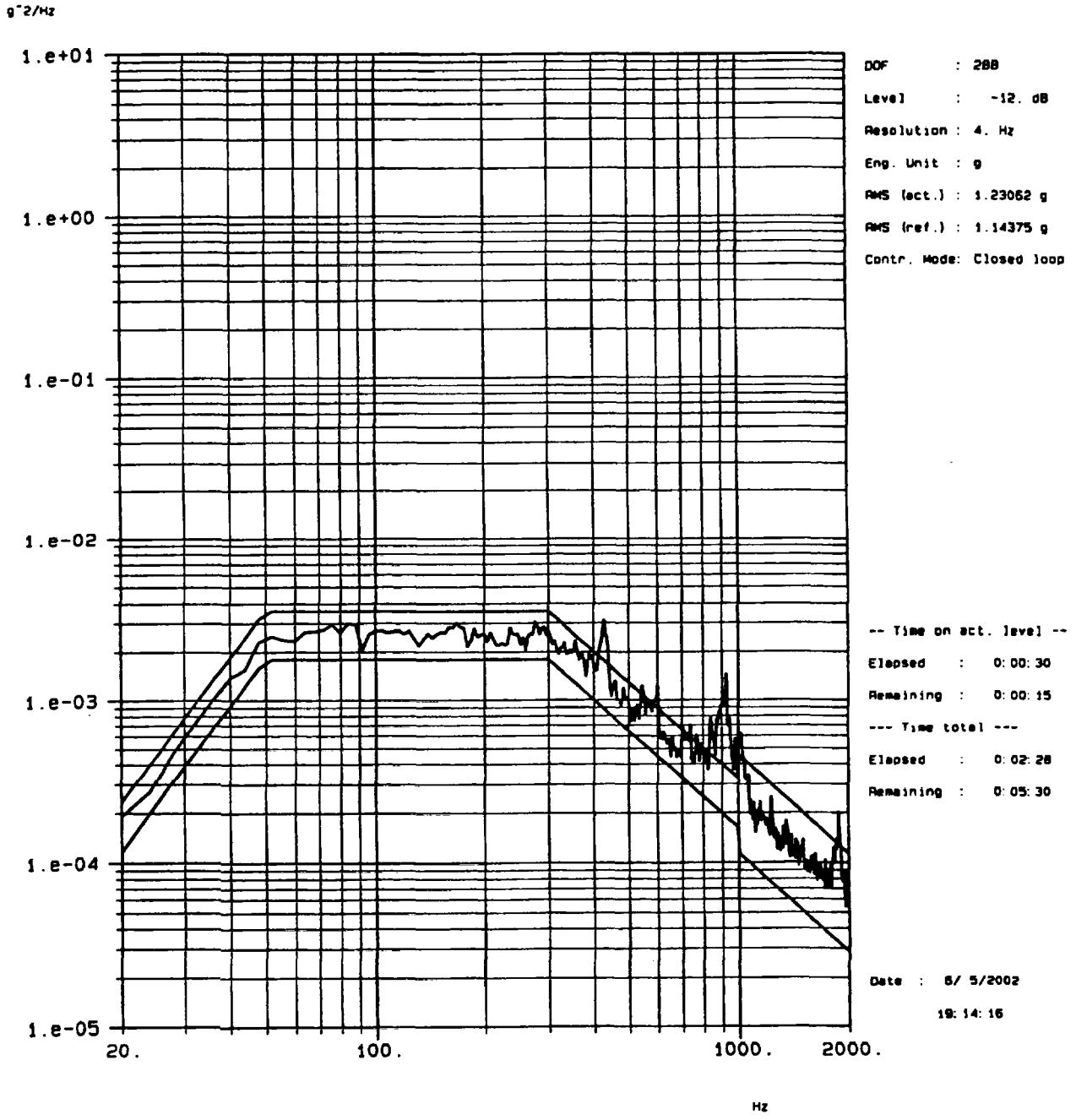


RANDOM PLOT NO. 2

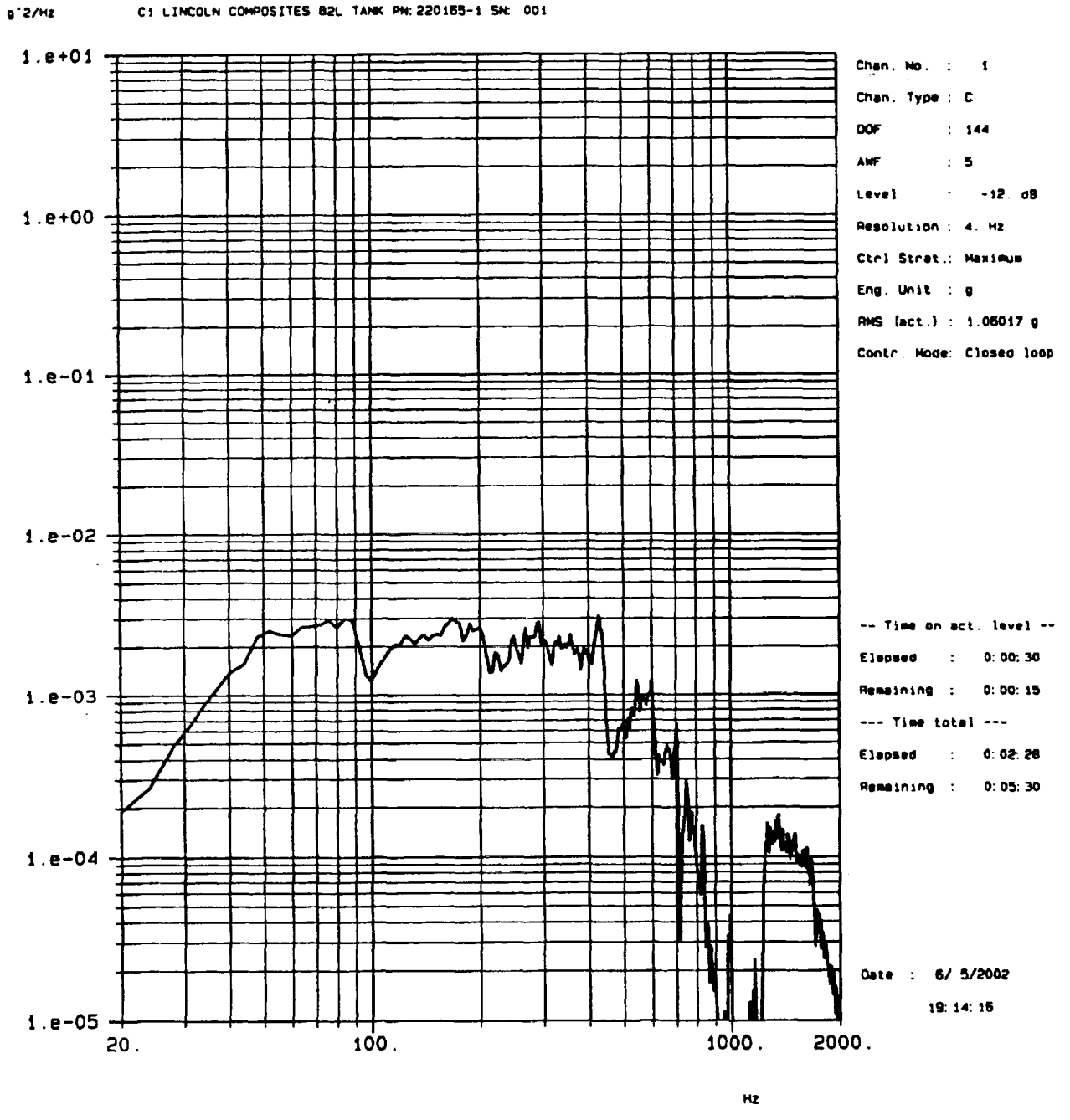
Random Control Channel

LINCOLN 47039 QUAL

X AXIS -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 3

Random Control Channel

LINCOLN 47039 QUAL

X AXIS -12dB

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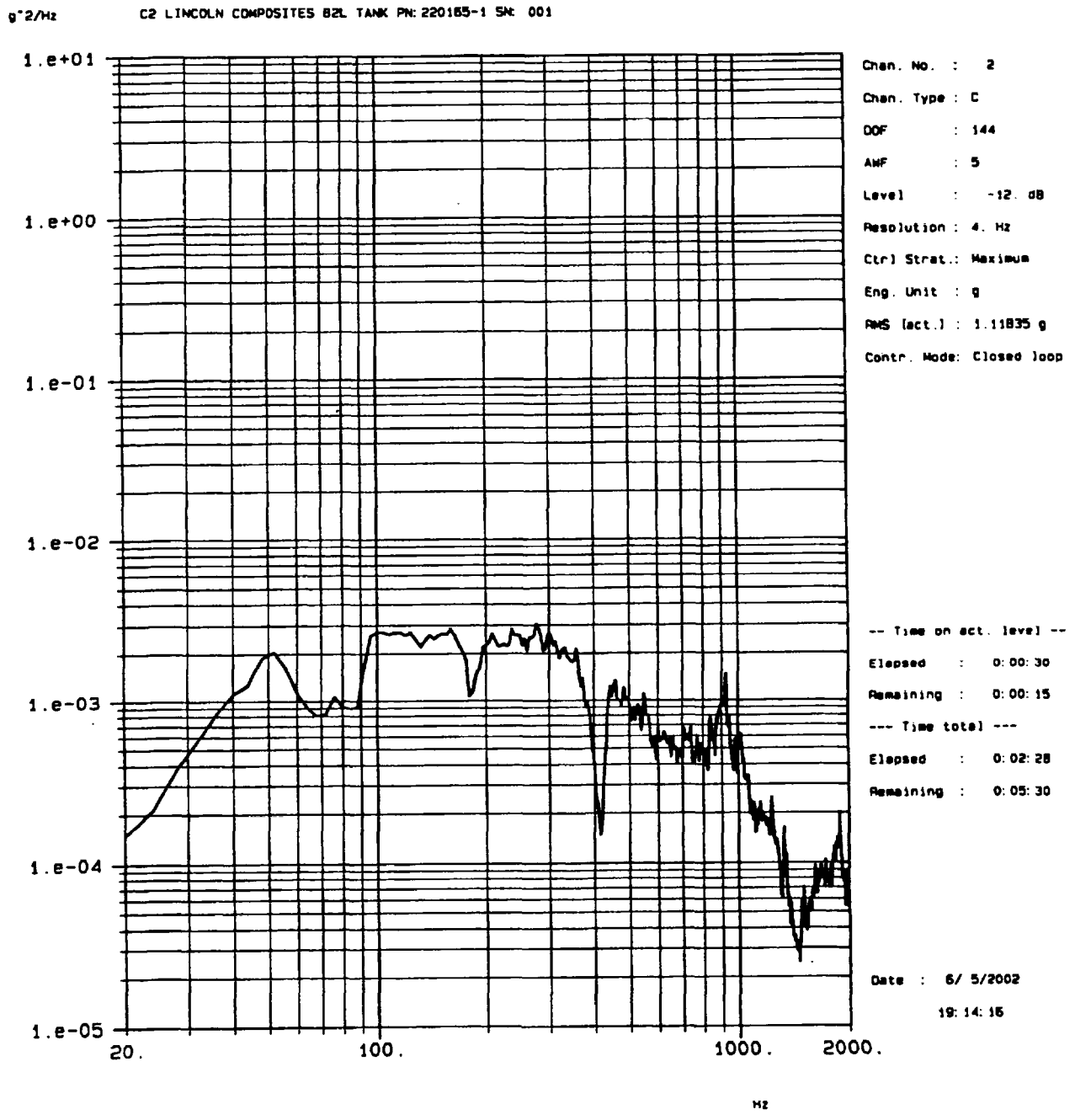
El Segundo, CA



RANDOM PLOT NO. 4

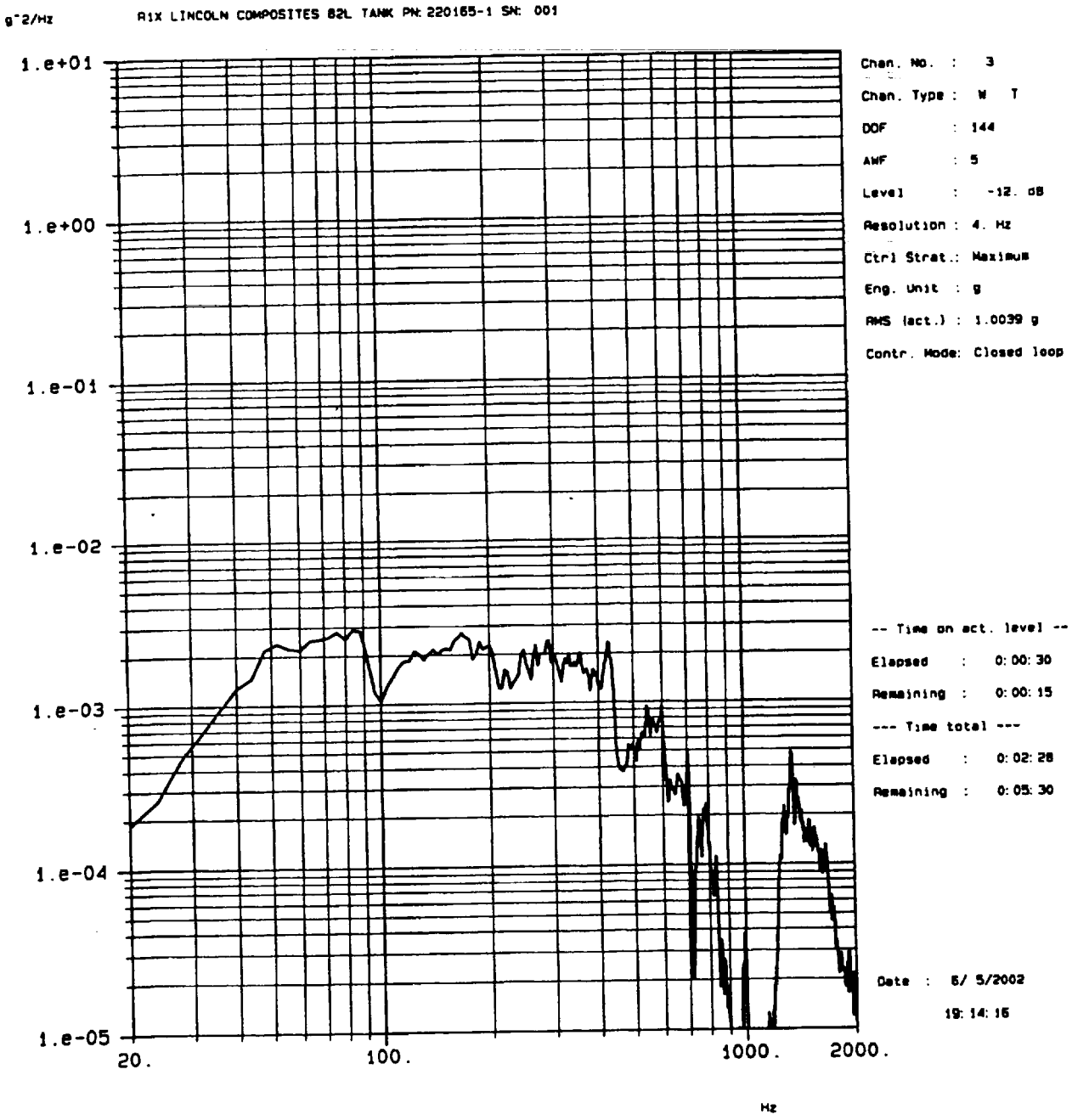
Random Limit Channel

LINCOLN 47039 DUAL

X AXIS -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 5

Random Limit Channel

LINCOLN 47039 QUAL

X AXIS -12dB

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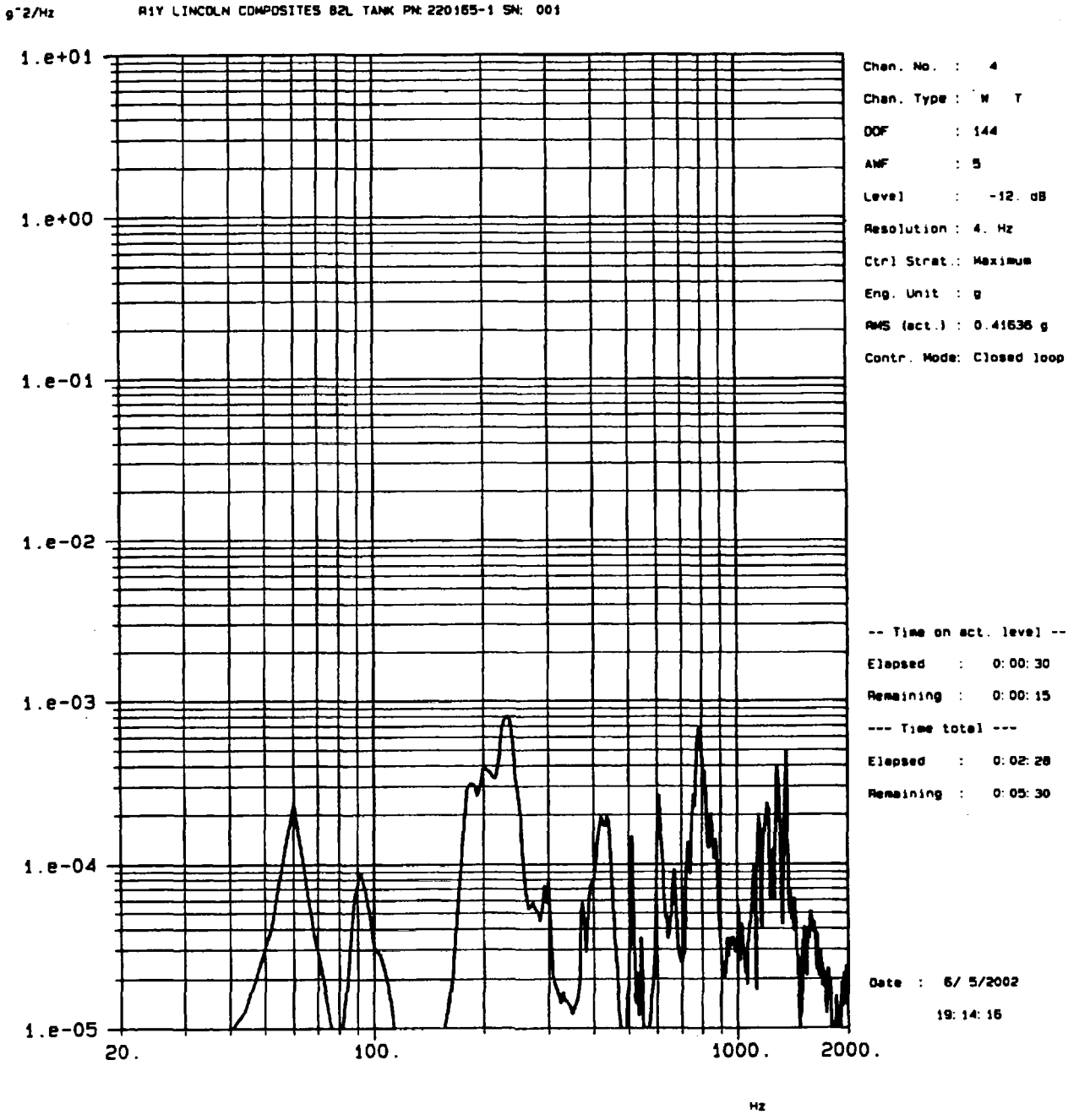

RANDOM PLOT NO. 6

Random Limit Channel

LINCOLN 47039 DUAL

X AXIS -12dB

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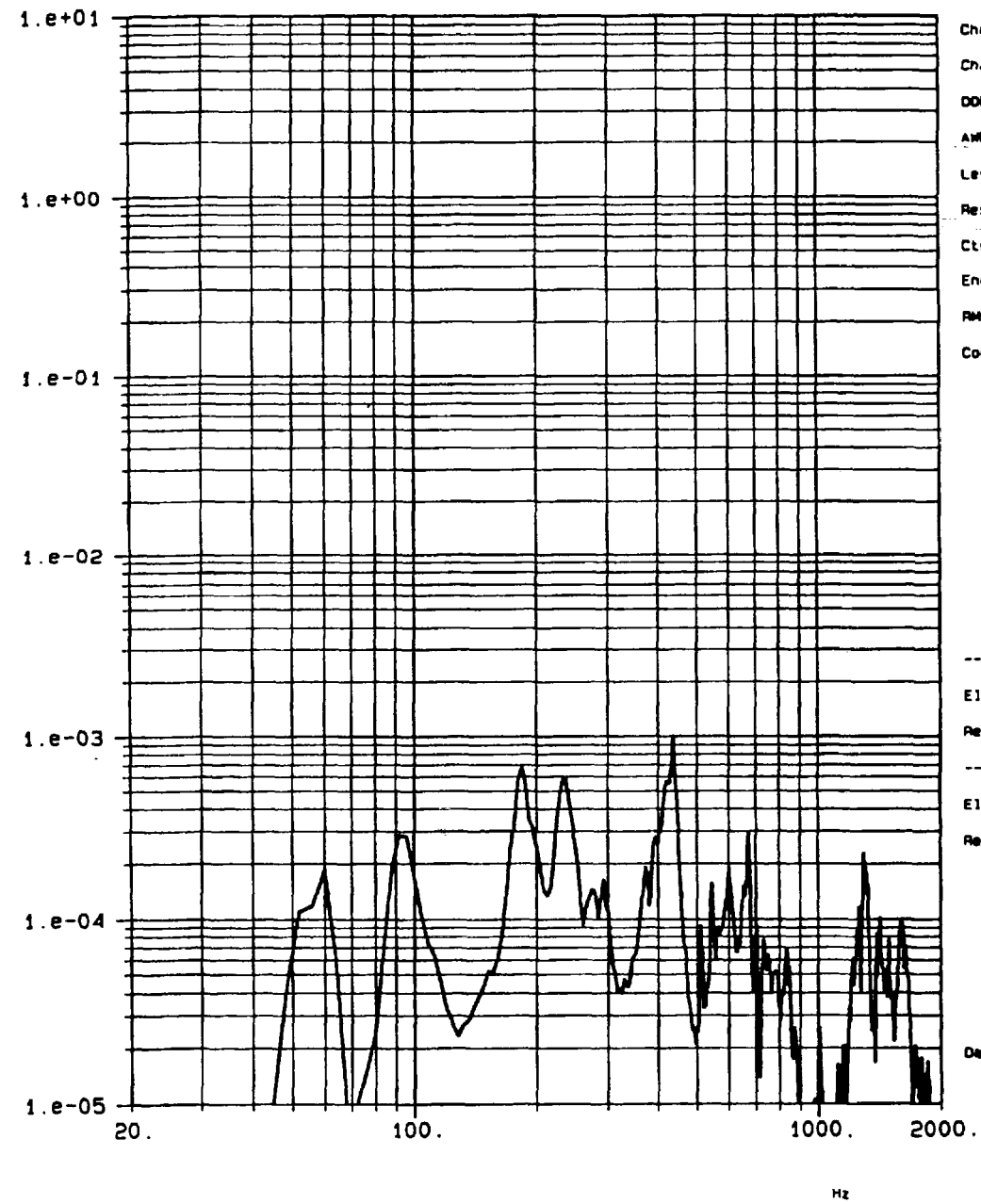
g^2/Hz R1Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 5
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 0.39184 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:28
Remaining : 0:05:30

Date : 6/ 5/2002
19:14:16

RANDOM PLOT NO. 7

Random Limit Channel

LINCOLN 47039 DUAL

X AXIS -12dB

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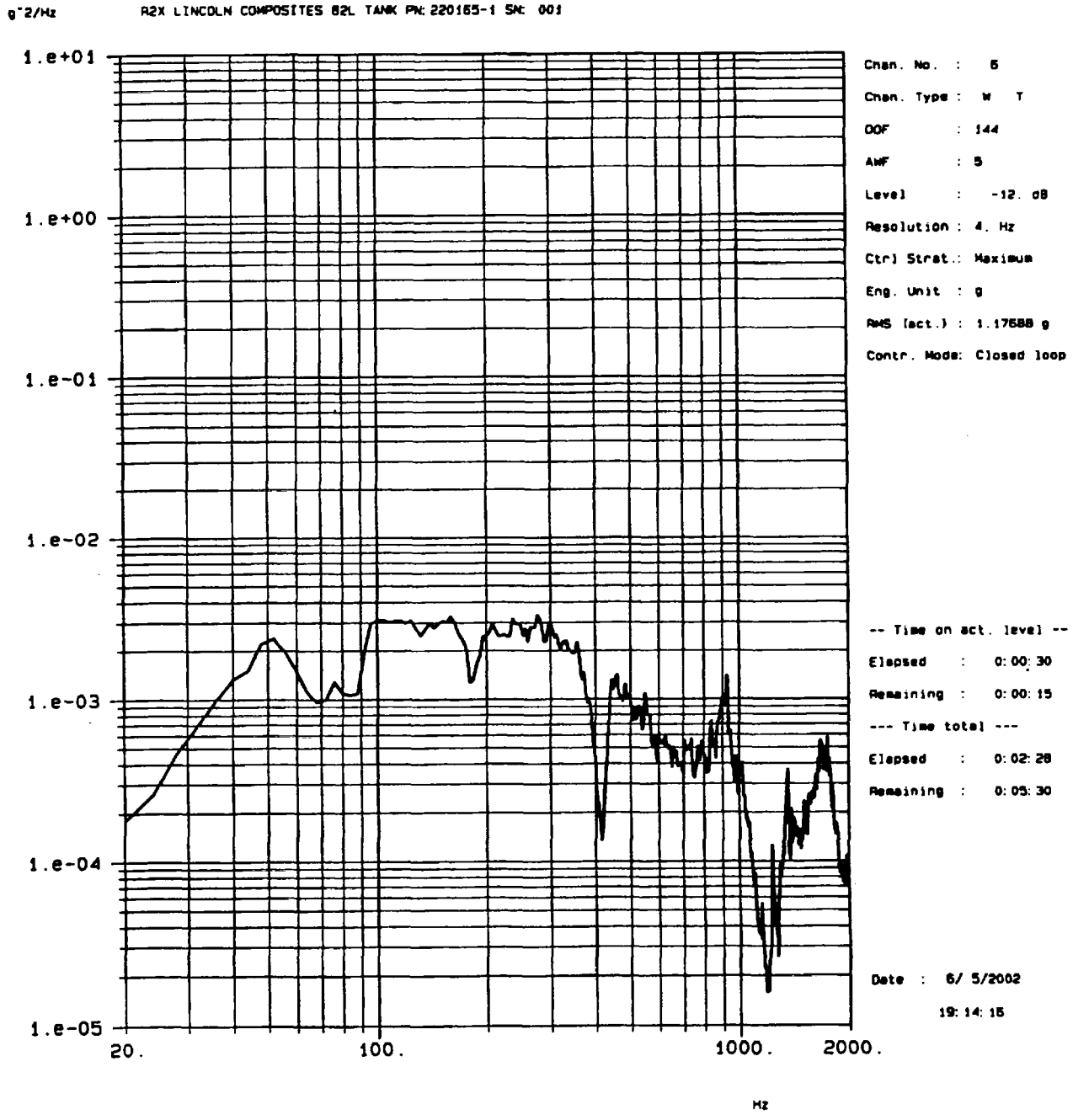

RANDOM PLOT NO. 8

Random Limit Channel

LINCOLN 47039 DUAL

X AXIS -12dB

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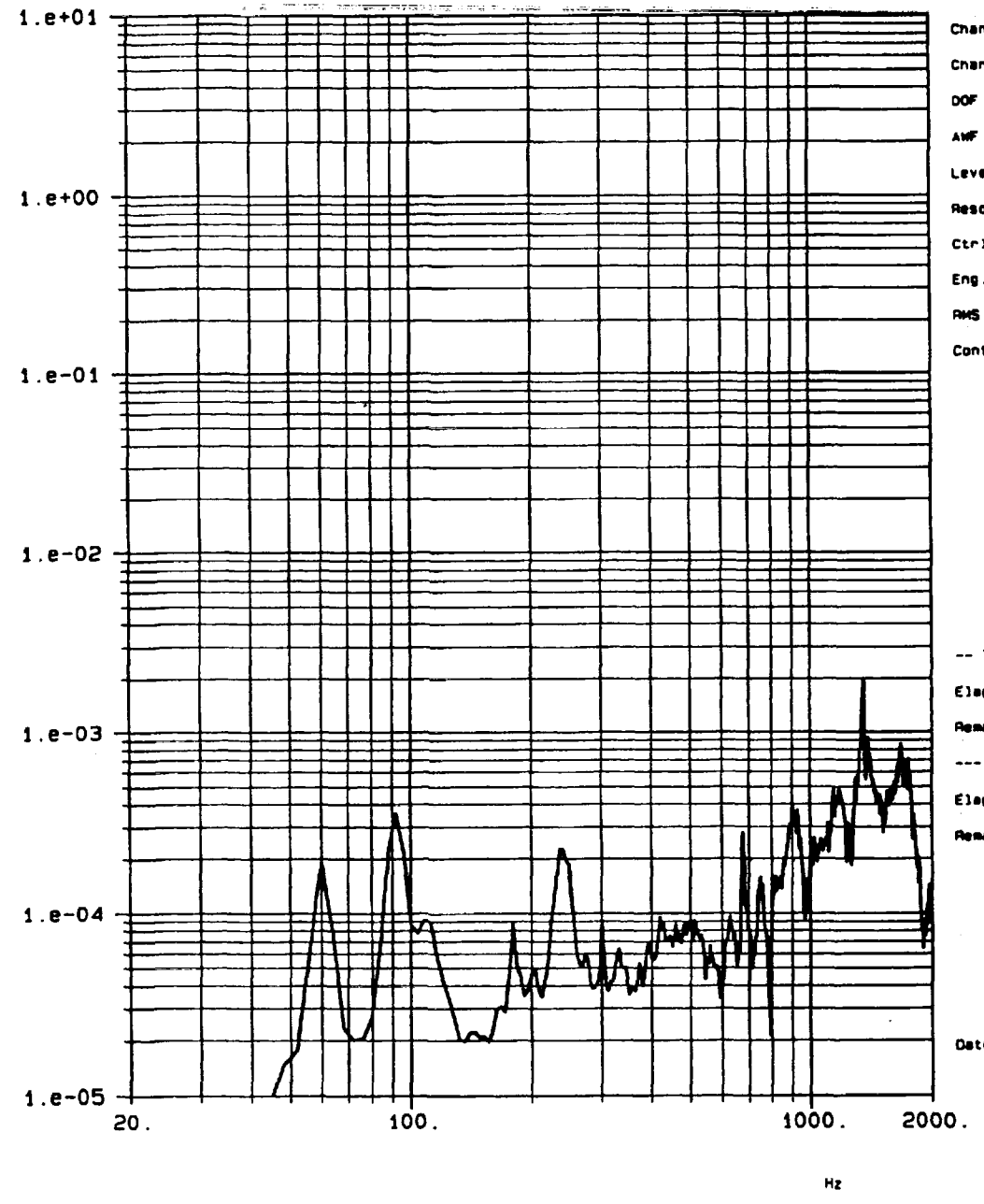
g^2/Hz R2Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 7
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 0.71135 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:28
Remaining : 0:05:30

Date : 6/ 5/2002
19:14:16

RANDOM PLOT NO. 9

Random Limit Channel

LINCOLN 47039 QUAL

X AXIS -12dB

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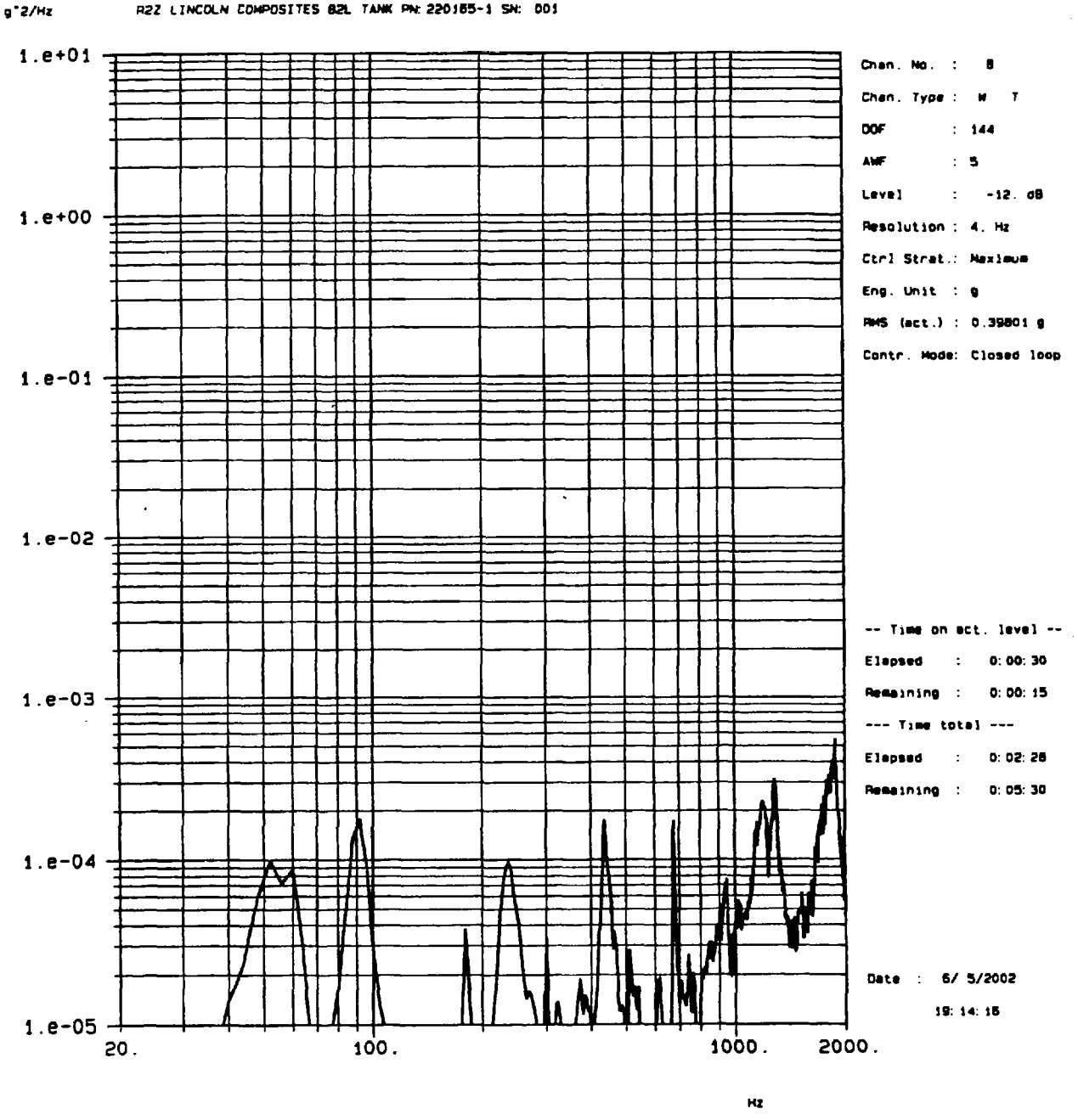

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PAGE NO. DYN.C.17

RANDOM PLOT NO. 10

Random Limit Channel

LINCOLN 47039 QUAL

X AXIS -12dB

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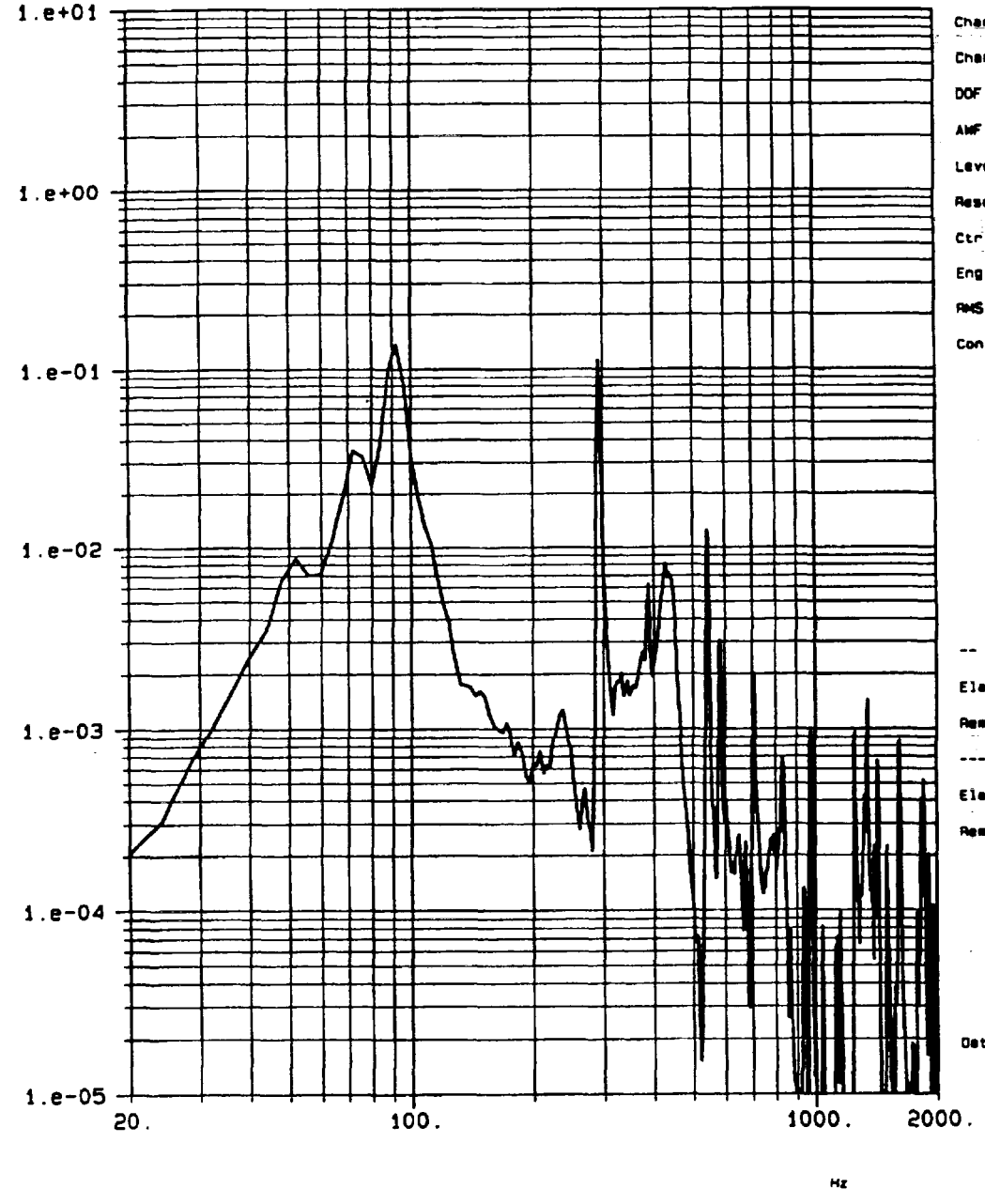
El Segundo, CA

g^2/Hz R3X LINCOLN COMPOSITES 82L TANK PN: 220185-1 SN: 001



Chan. No. : 9
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 2.06151 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:02:28
Remaining : 0:05:30

Date : 6/ 5/2002
19:14:16

RANDOM PLOT NO. 11

Random Limit Channel

LINCOLN 47039 QUAL

X AXIS -12dB

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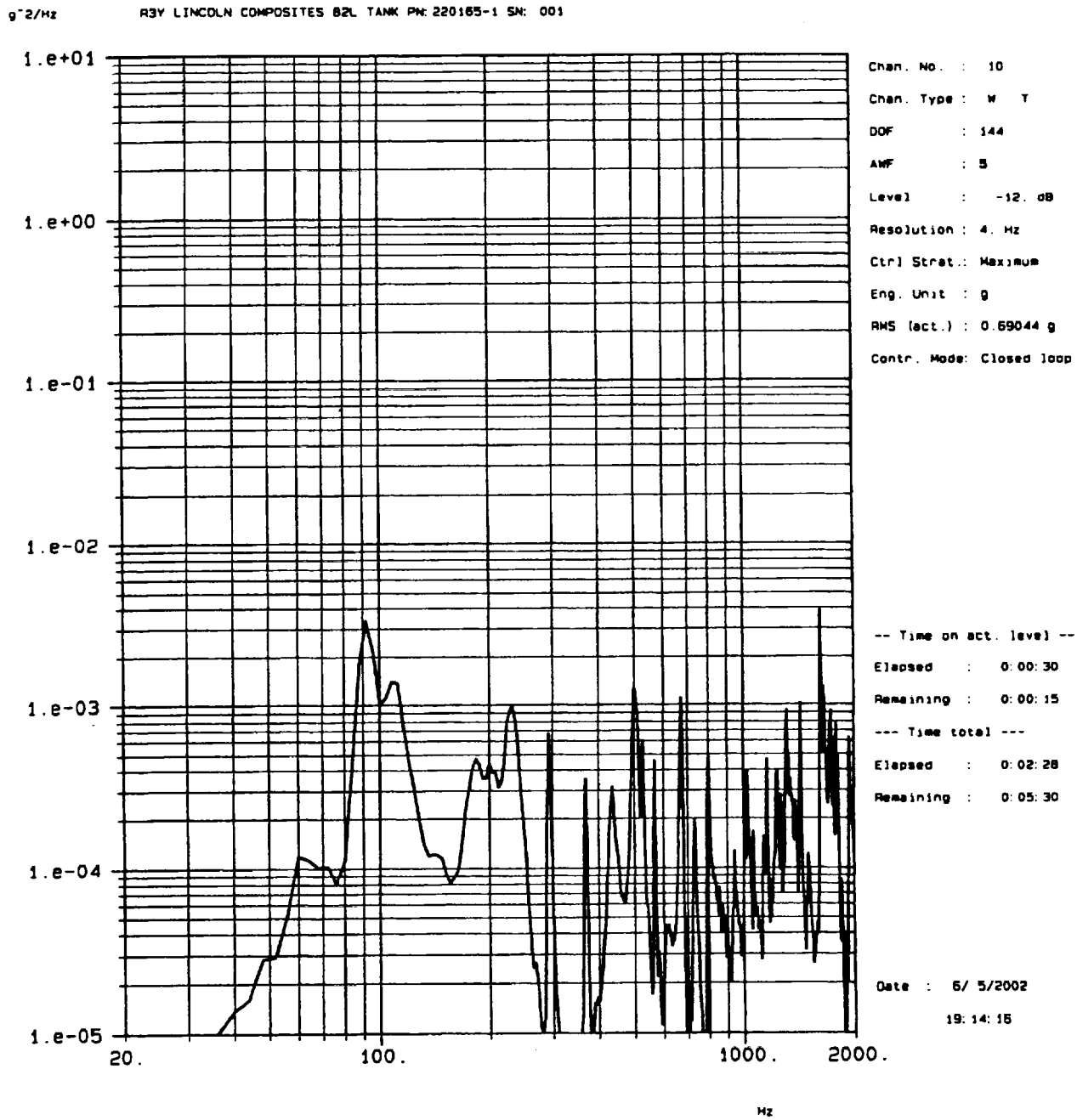

RANDOM PLOT NO. 12

Random Limit Channel

LINCOLN 47039 DUAL

X AXIS -12dB

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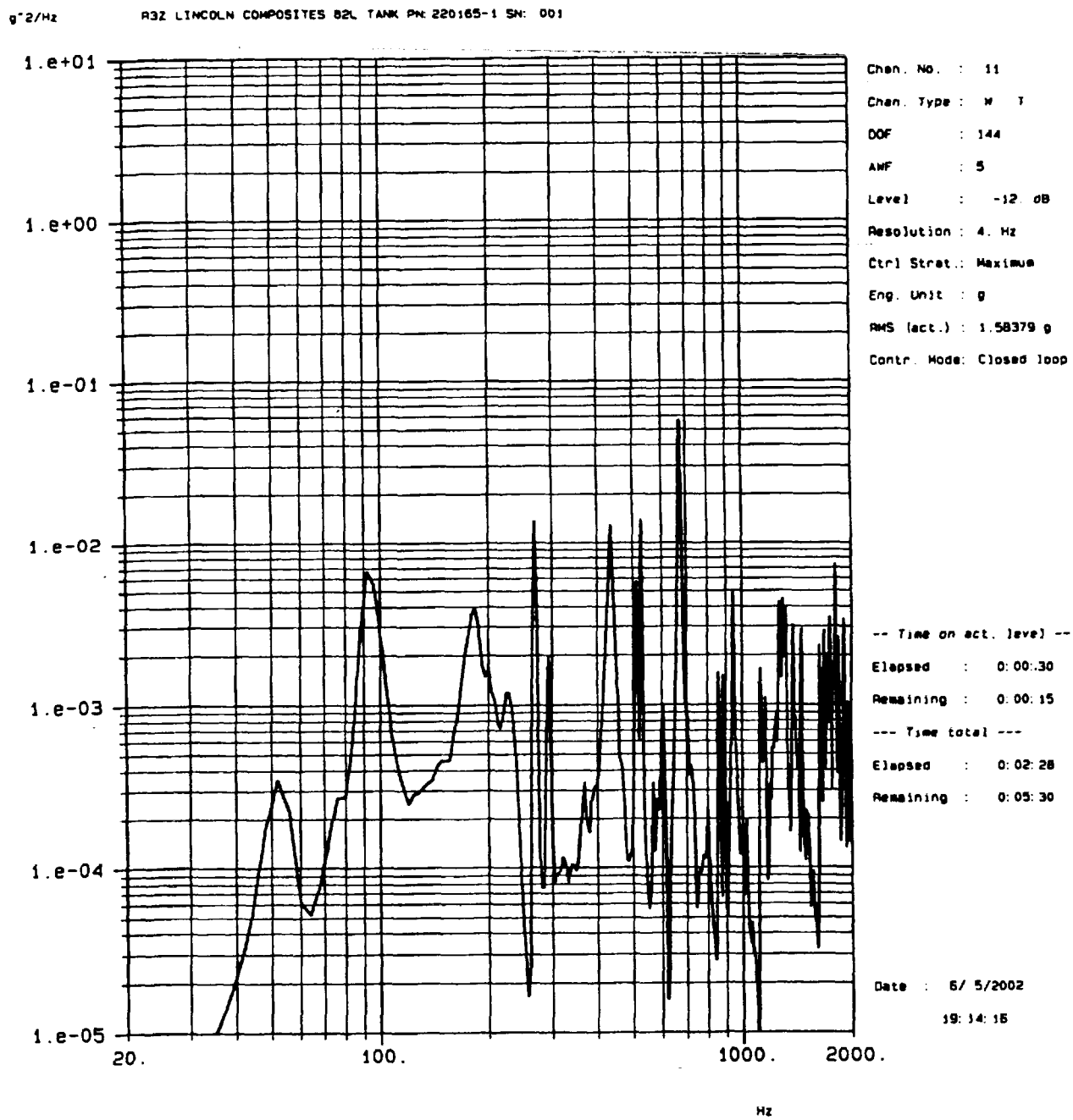
El Segundo, CA



RANDOM PLOT NO. 13

Random Limit Channel

LINCOLN 47039 QUAL

X AXIS -12dB

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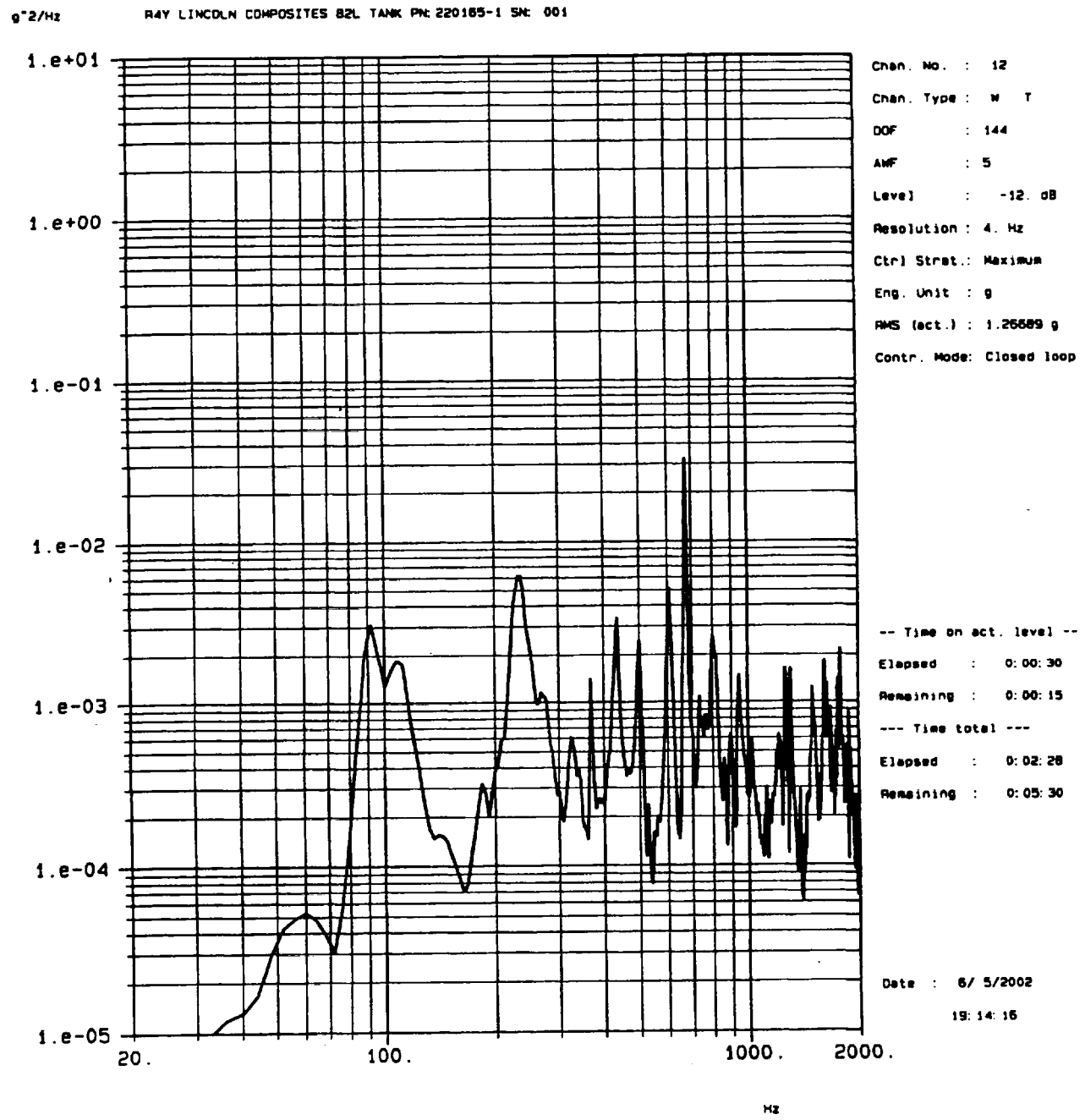
El Segundo, CA



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RANDOM PLOT NO. 14

Random Control

LC47039 X NQUAL

X AXIS NOTCH QUAL.

MAXIMUM OF C1 & C2

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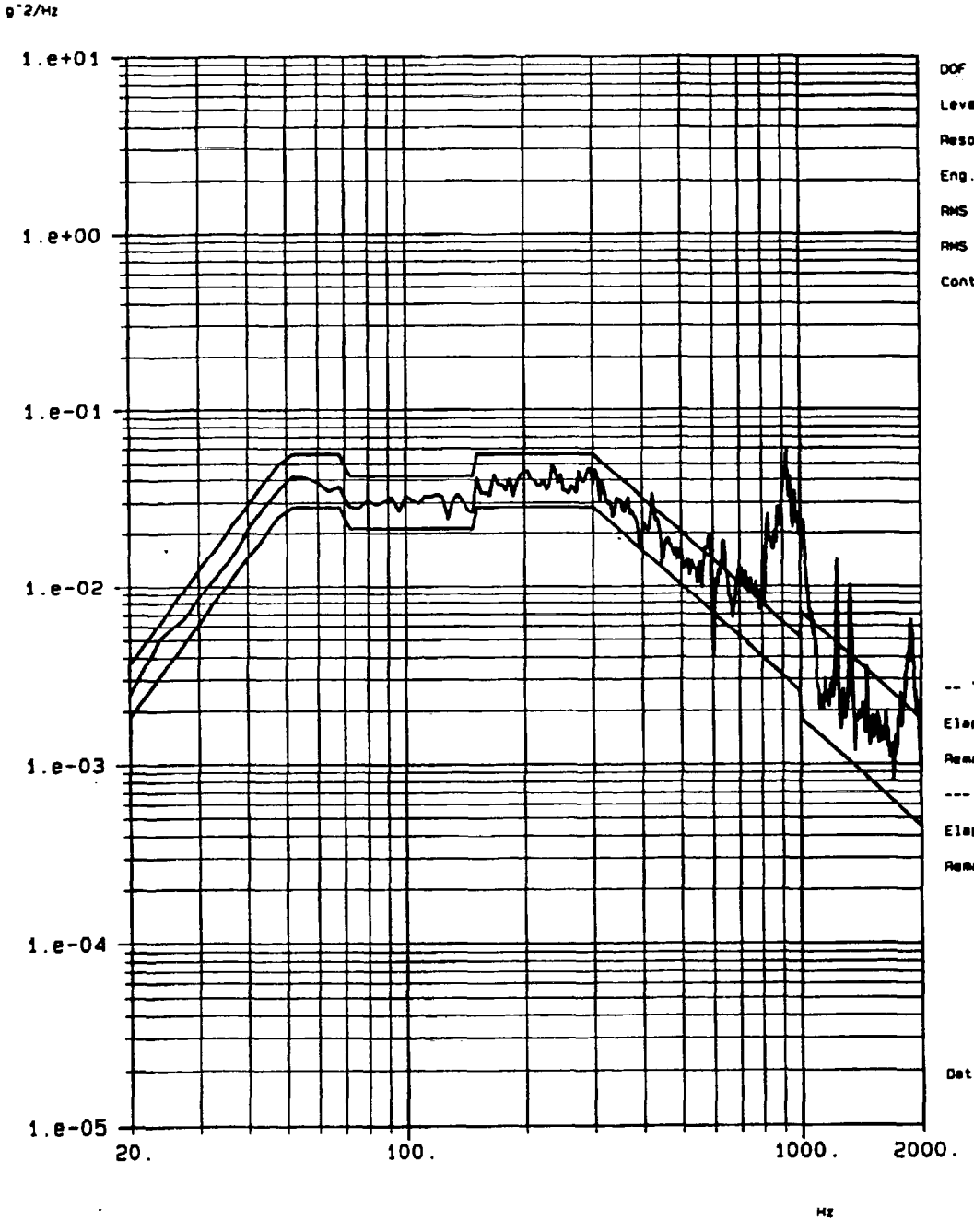

DOF : 288

Level : 0. dB

Resolution : 4. Hz

Eng. Unit : g

RMS (act.) : 5.15311 g

RMS (ref.) : 4.46437 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0:03:00

Remaining : 0:00:00

--- Time total ---

Elapsed : 0:05:16

Remaining : 0:00:00

Date : 6/ 5/2002

19:51:29

RANDOM PLOT NO. 15

Random Control Channel

LC47039 X NOUAL

X AXIS NOTCH QUAL.

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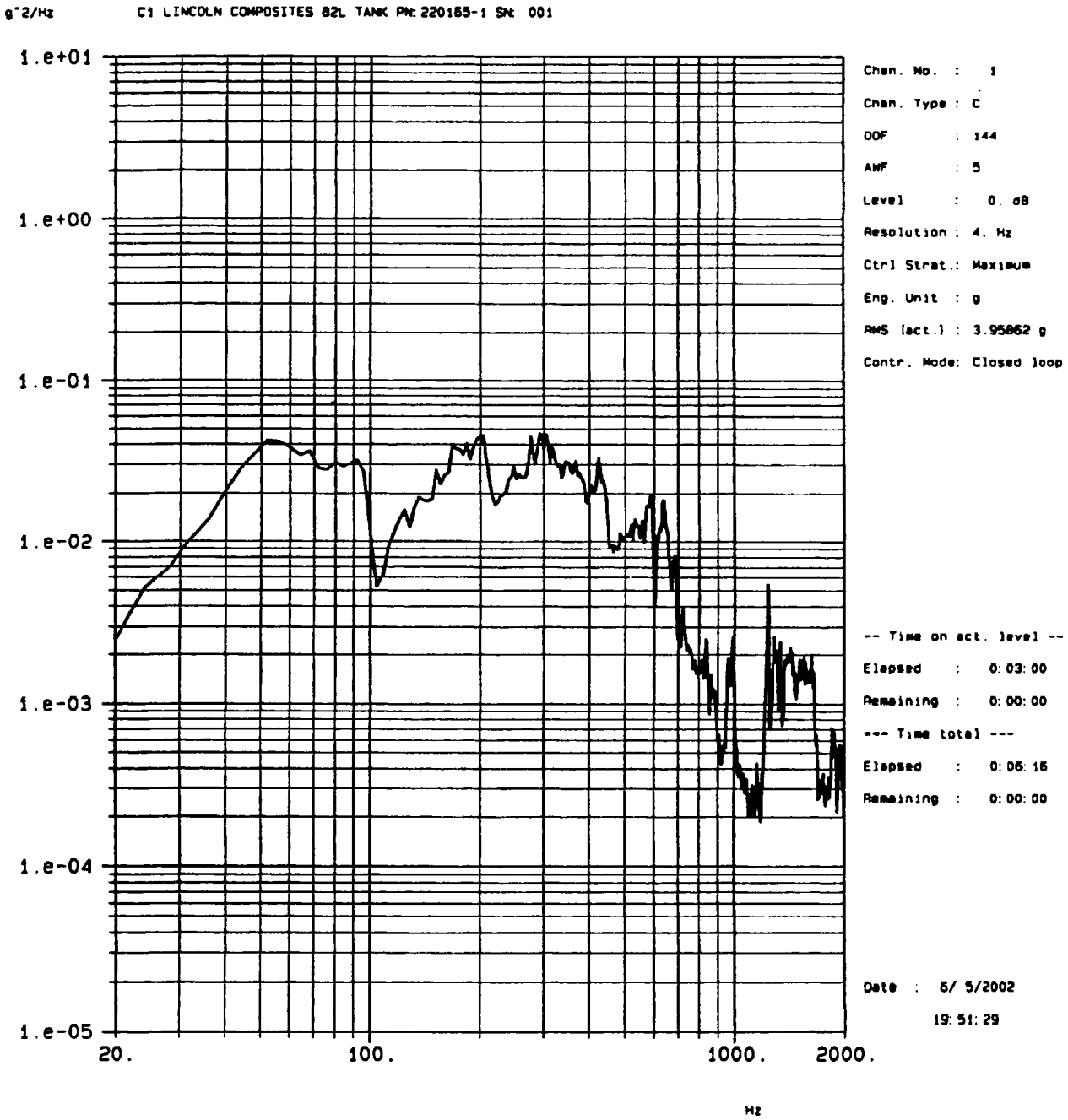

RANDOM PLOT NO. 16

Random Control Channel

LC47039 X NOUAL

X AXIS NOTCH OUAL.

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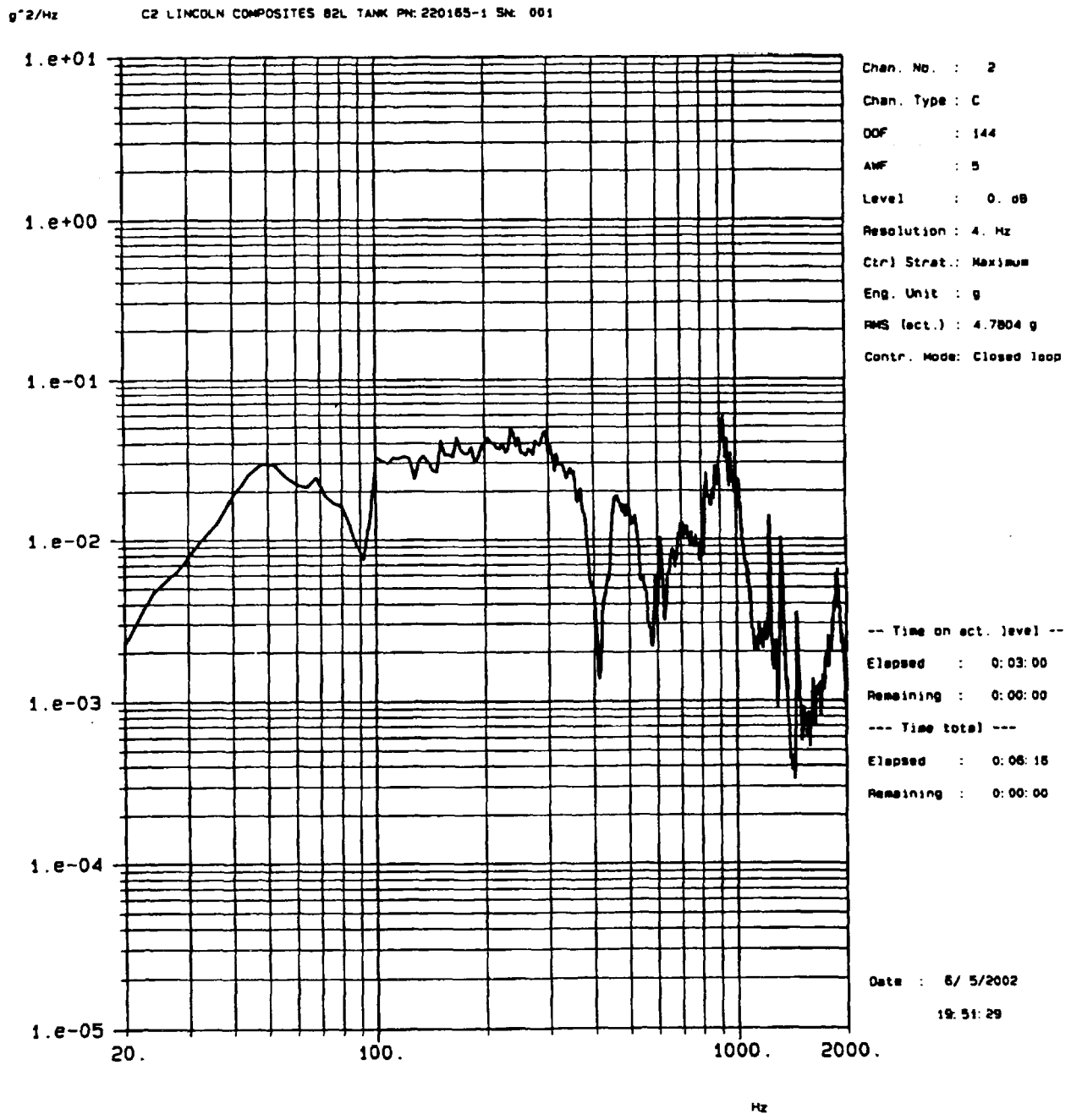

RANDOM PLOT NO. 17

Random Limit Channel

LC47039 X NOUAL

X AXIS NOTCH DUAL.

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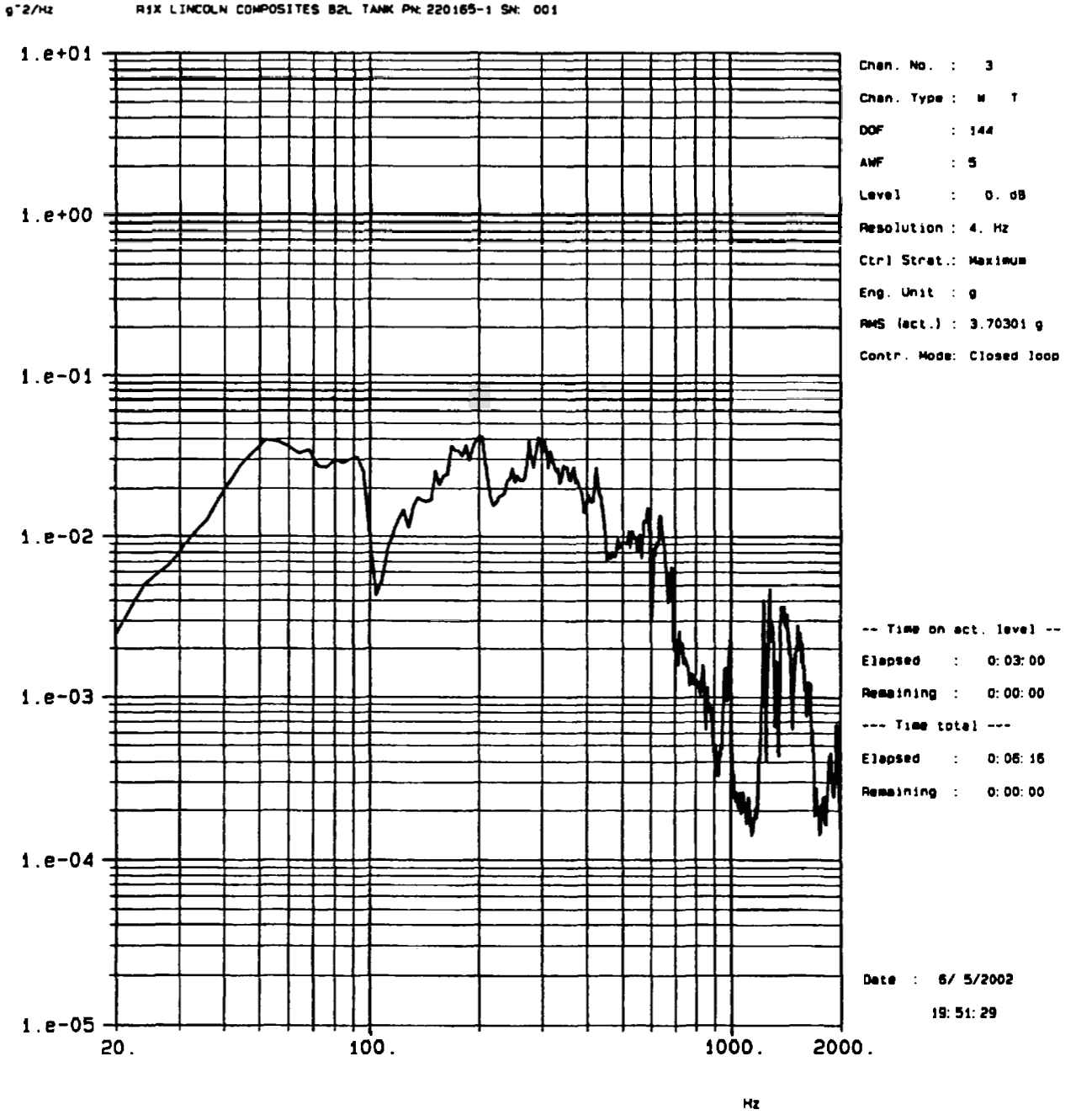
El Segundo, CA



RANDOM PLOT NO. 18

Random Limit Channel

LC47039 X NQUAL

X AXIS NOTCH QUAL.

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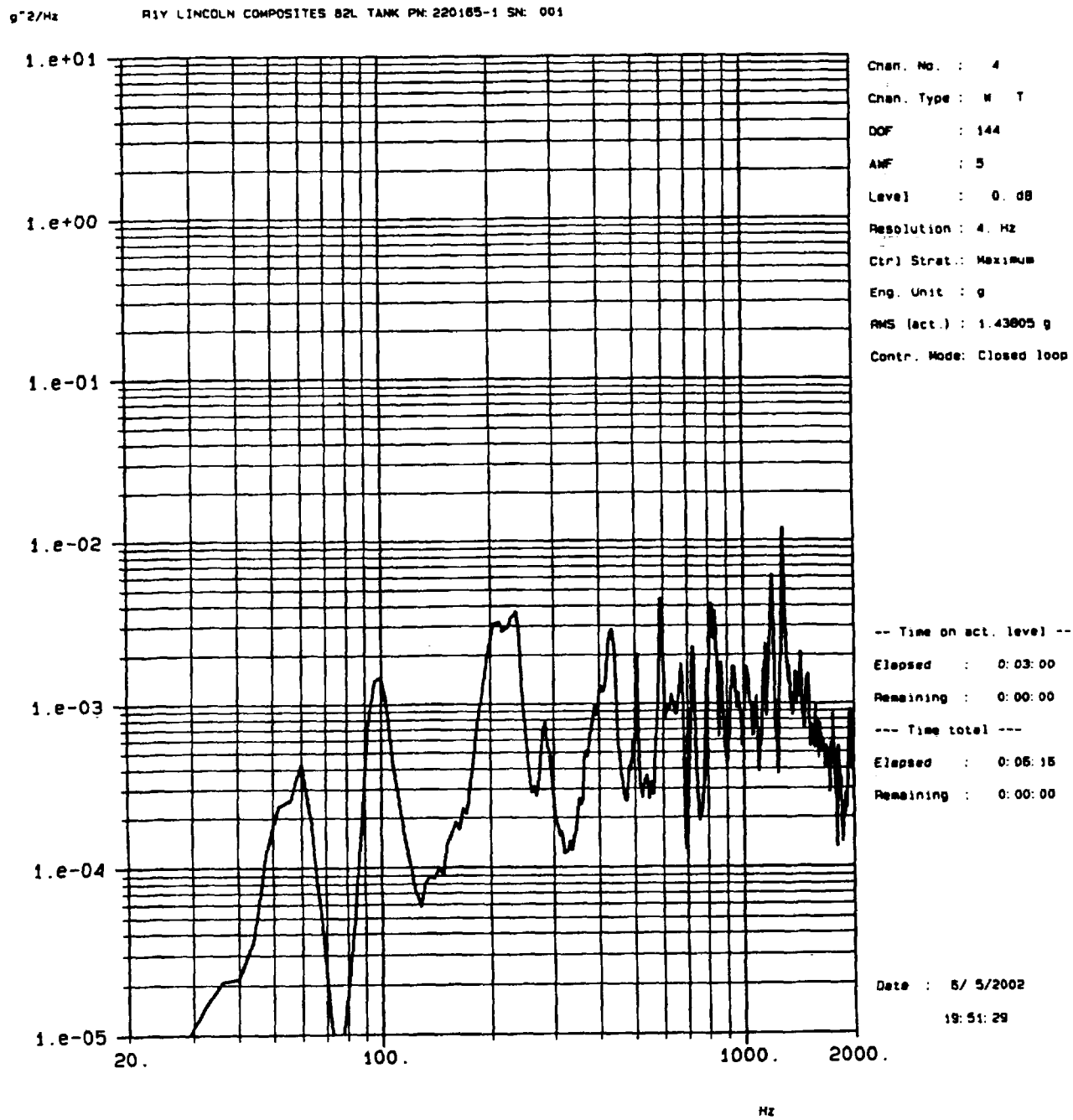
El Segundo, CA



RANDOM PLOT NO. 19

Random Limit Channel

LC47039 X NOUAL

X AXIS NOTCH QUAL.

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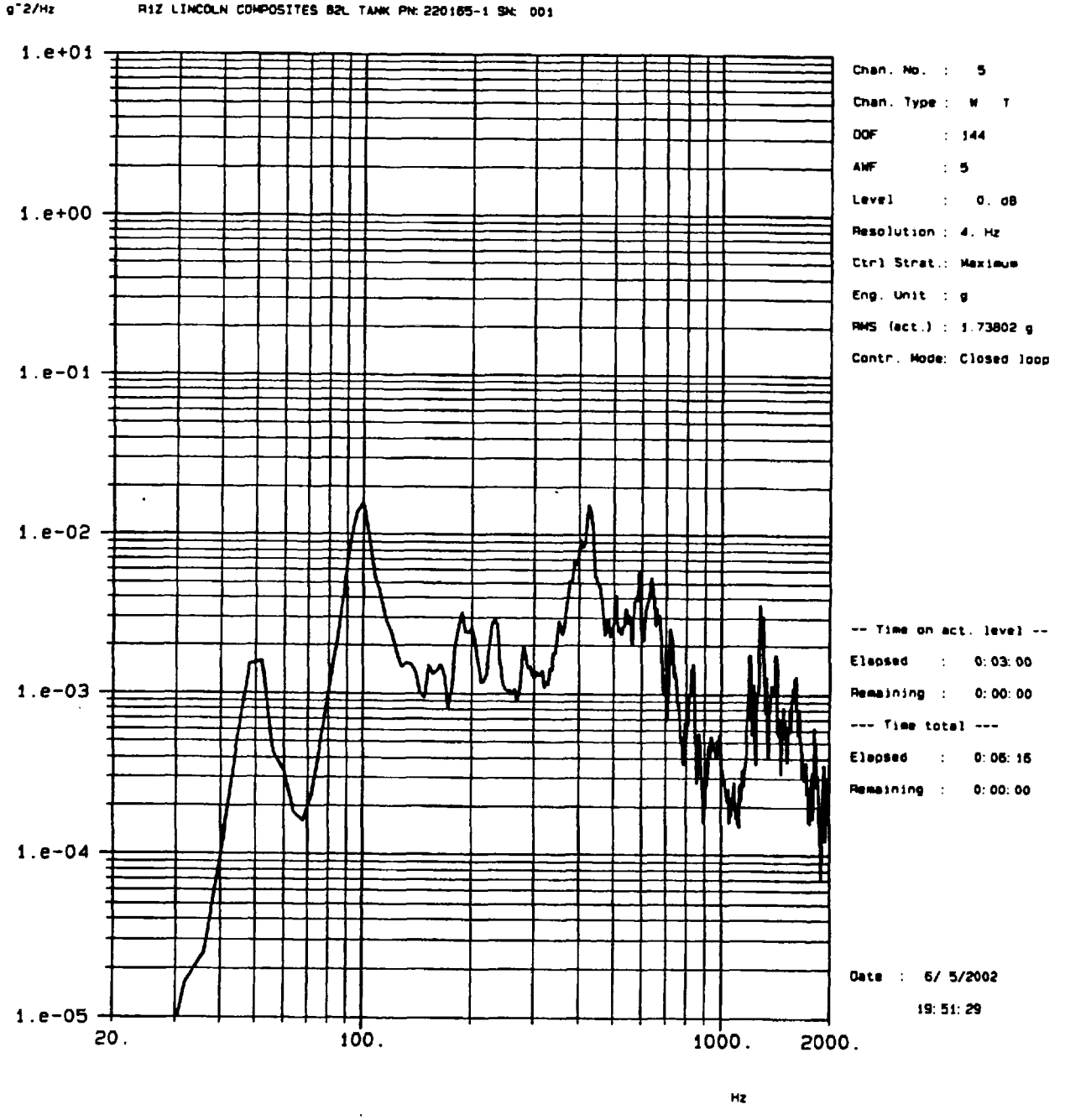

RANDOM PLOT NO. 20

Random Limit Channel

LC47039 X NQUAL

X AXIS NOTCH QUAL.

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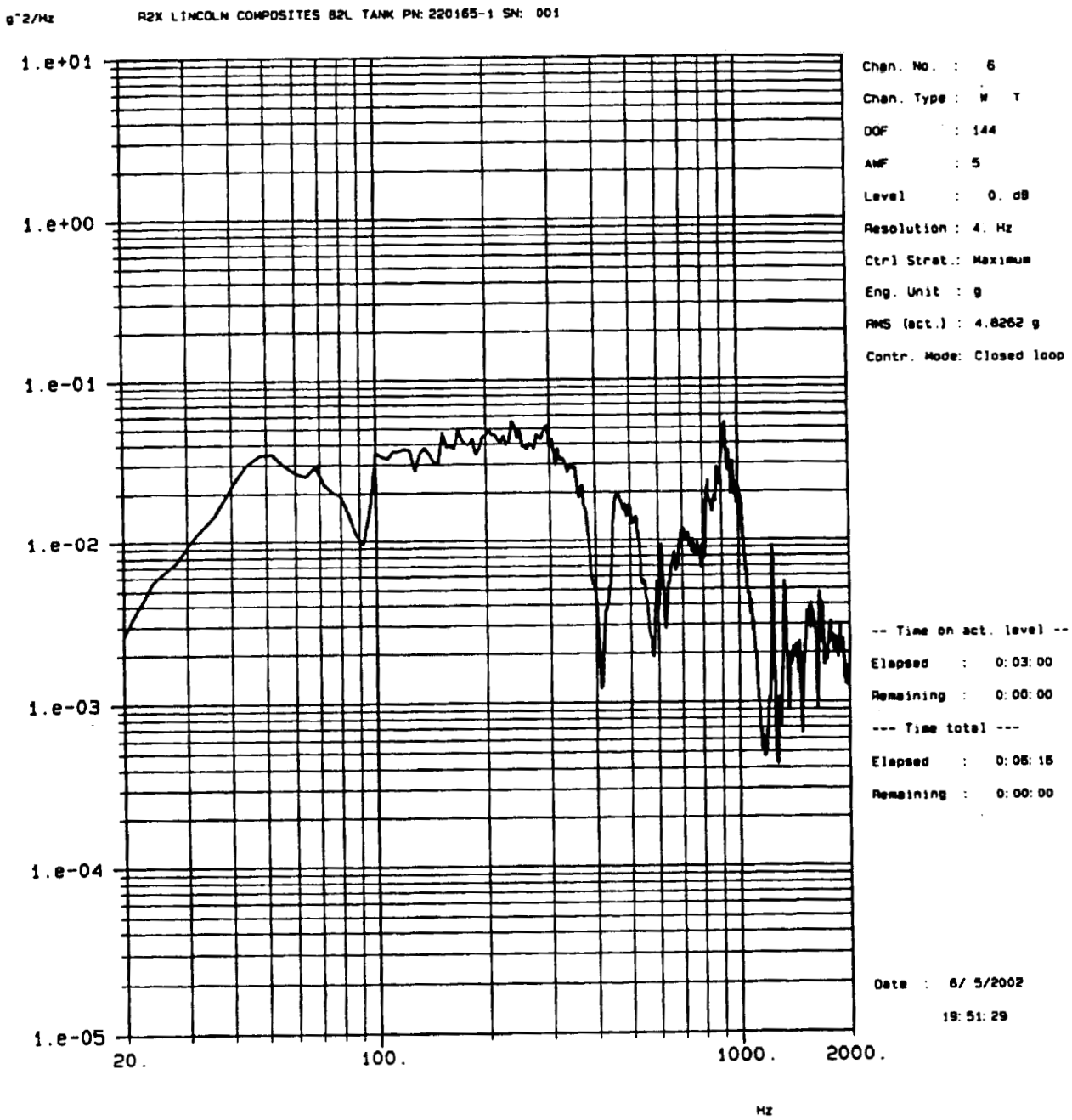

RANDOM PLOT NO. 22

Random Limit Channel

LC47039 X NOUAL

X AXIS NOTCH QUAL.

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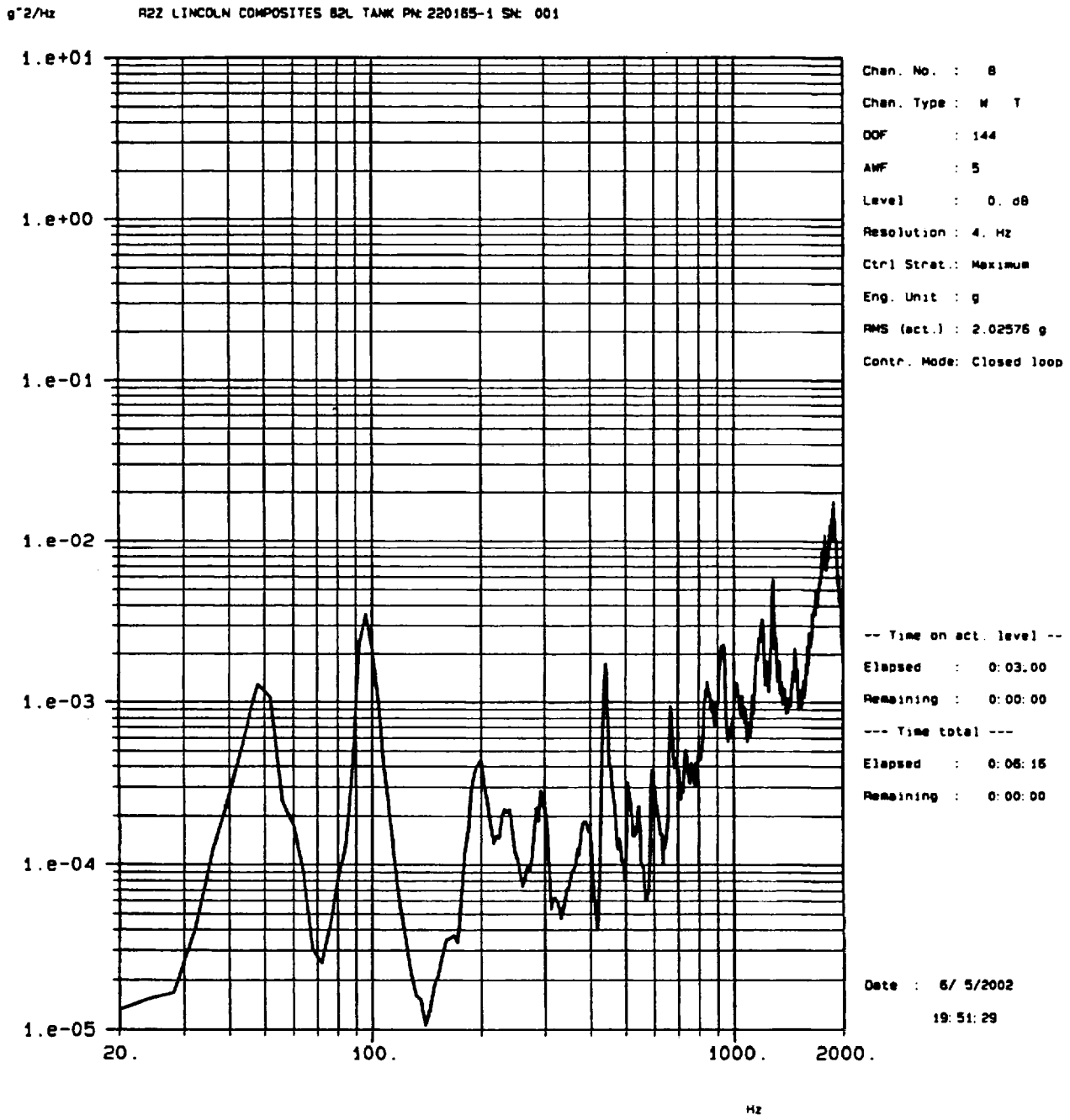

RANDOM PLOT NO. 21

Random Limit Channel

LC47039 X NOUAL

X AXIS NOTCH QUAL.

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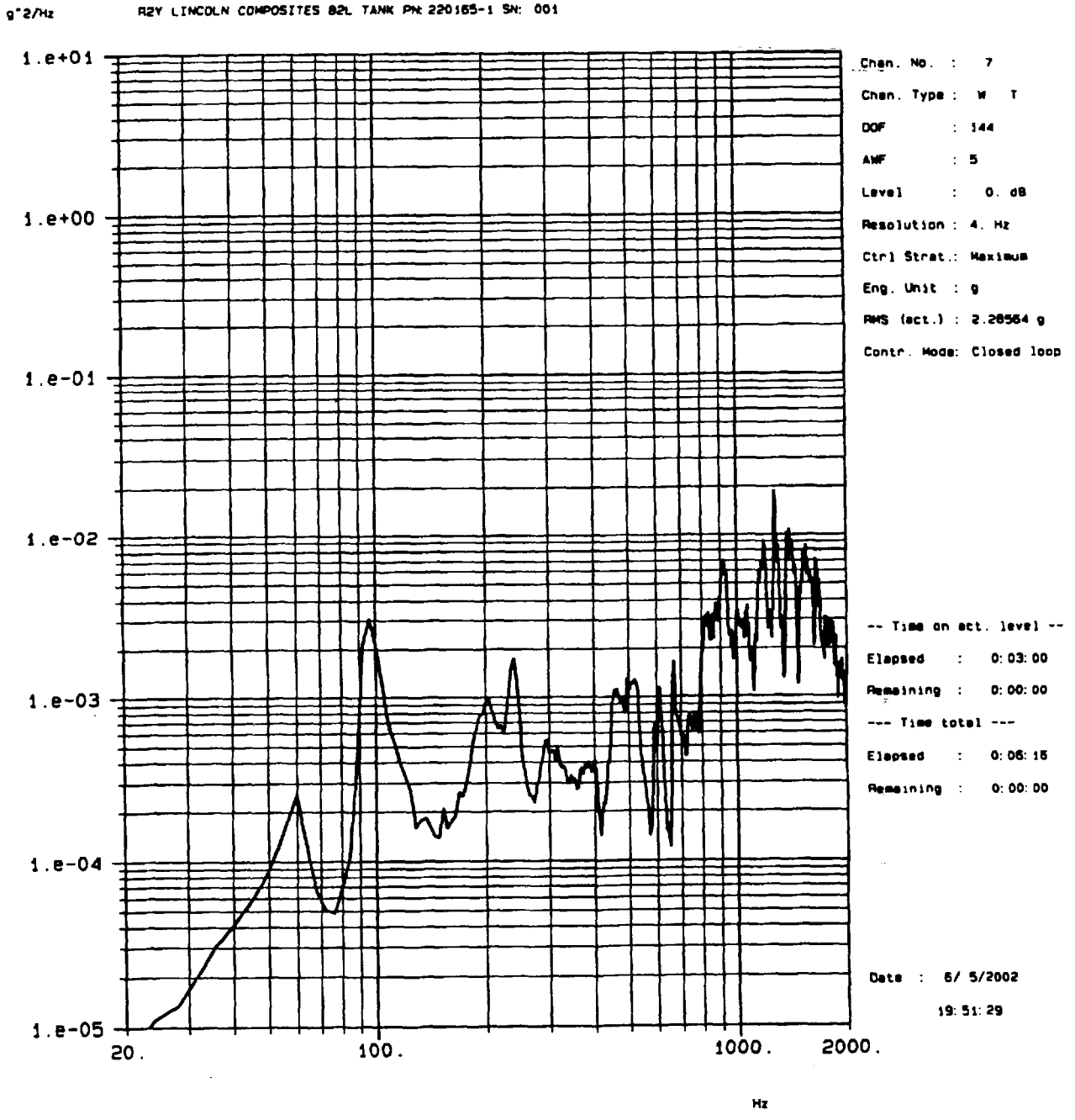
El Segundo, CA



RANDOM PLOT NO. 23

Random Limit Channel

LC47039 X NQUAL

X AXIS NOTCH QUAL.

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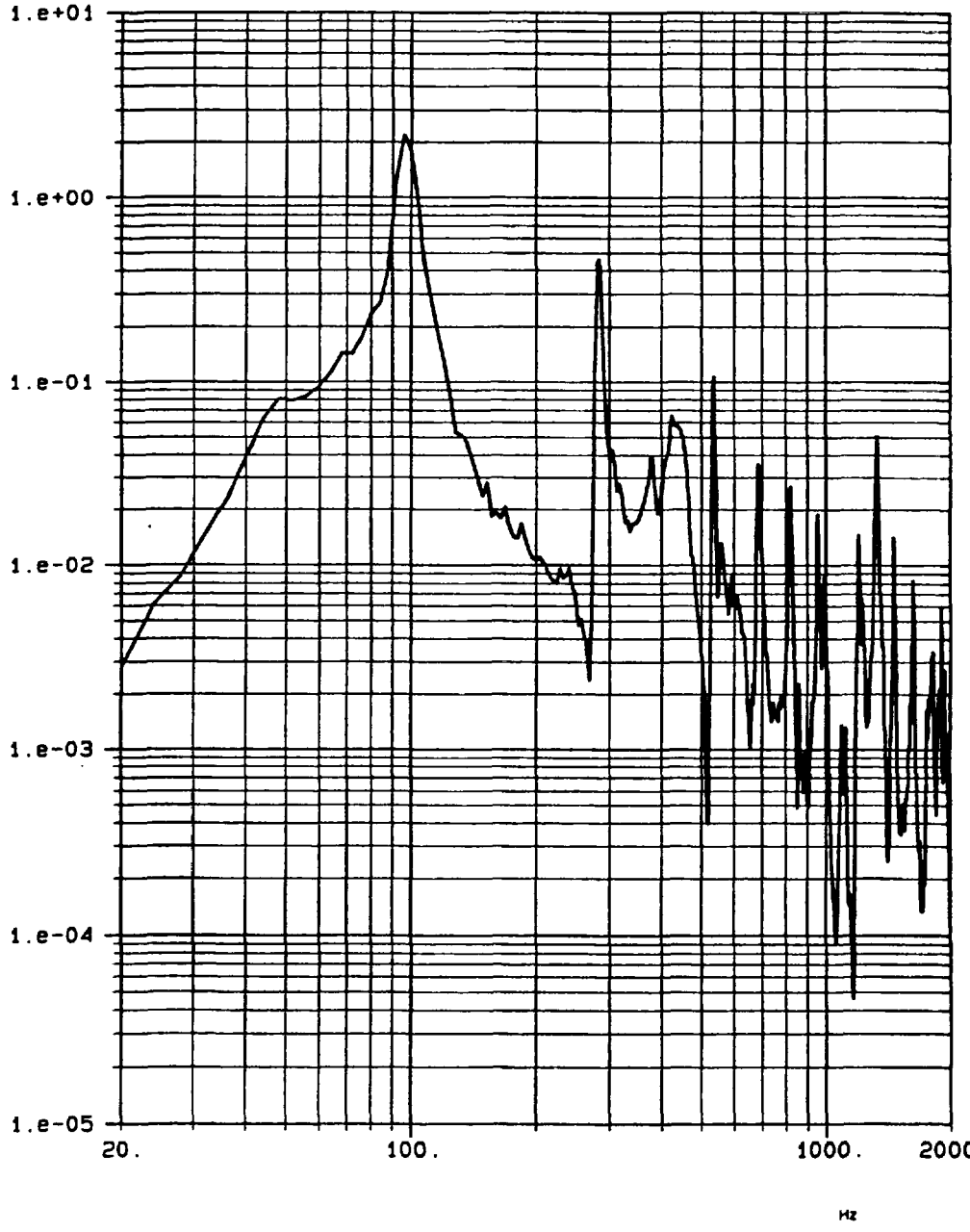
El Segundo, CA

g^2/Hz R3X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 7.56619 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:03:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:06:16
Remaining : 0:00:00

Date : 6/ 5/2002
19:51:29

RANDOM PLOT NO. 24

Random Limit Channel

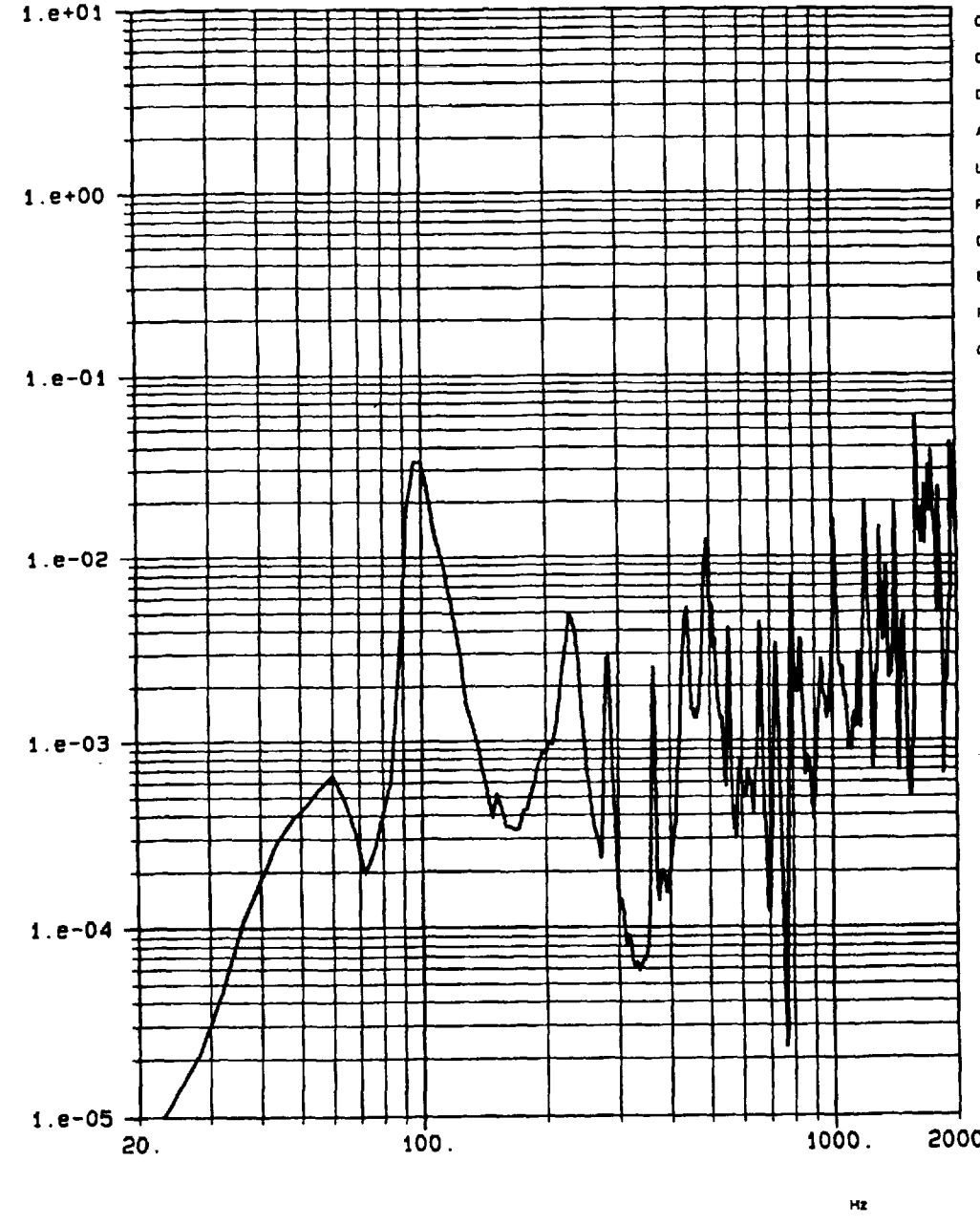
LC47039 X NOUAL

X AXIS NOTCH QUAL.

Wyle Laboratories

El Segundo, CA

R3Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 10
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 3.36252 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:03:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:06:16
Remaining : 0:00:00

Date : 6/ 5/2002
19:51:29

RANDOM PLOT NO. 25

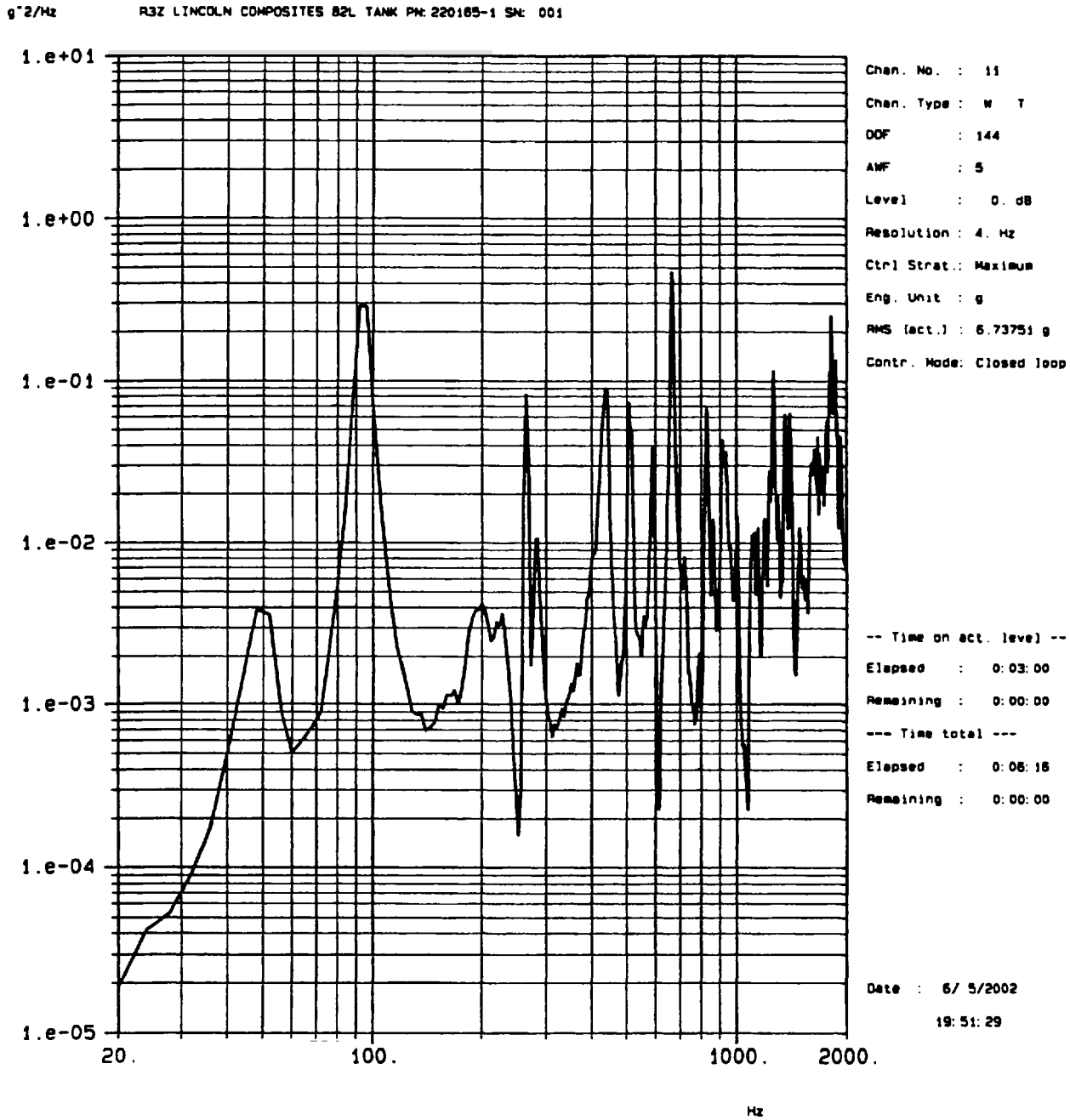
Random Limit Channel

LC47039 X NQUAL

X AXIS NOTCH QUAL.

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 26

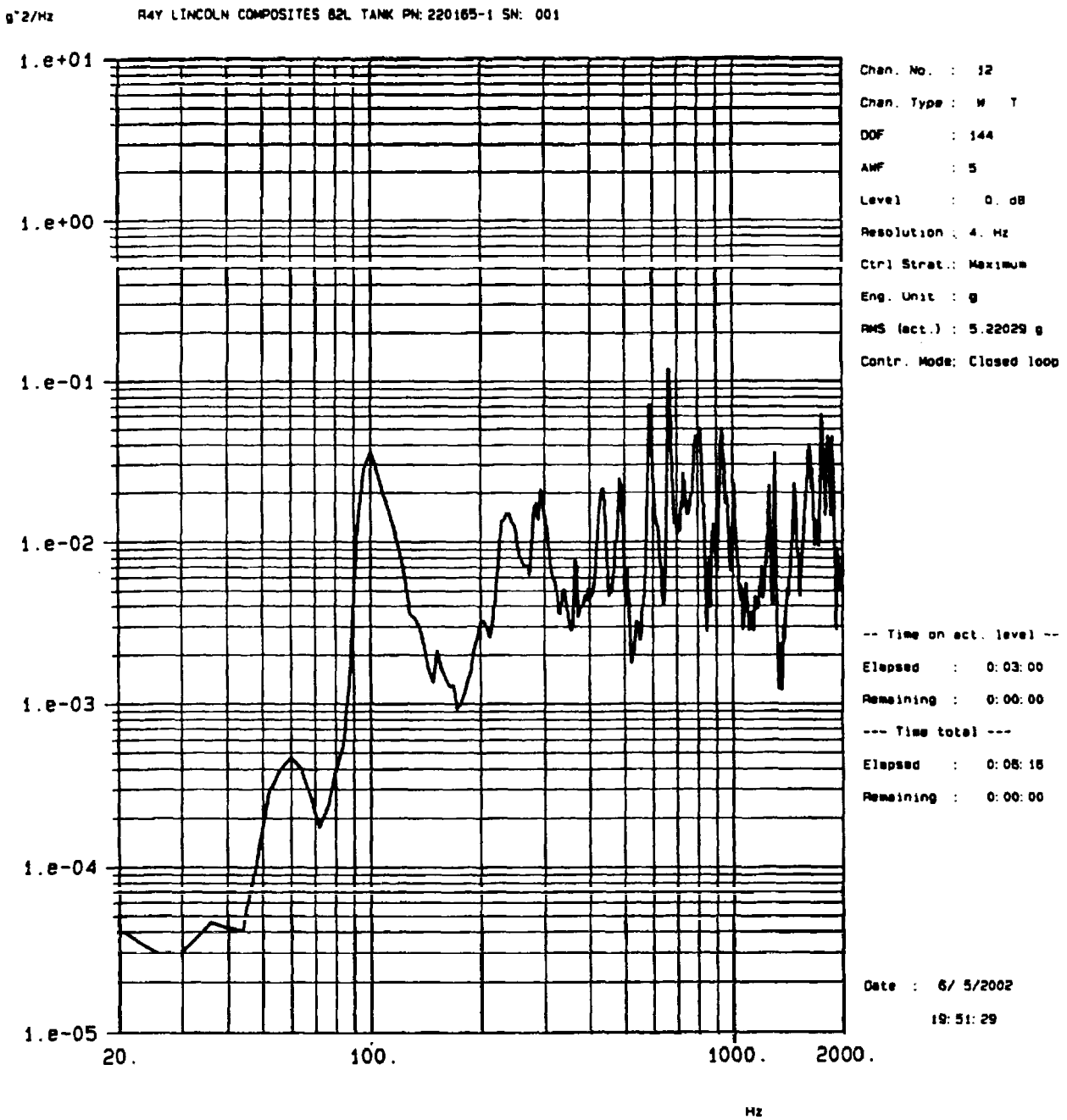
Random Limit Channel

LC47039 X NGUAL

X AXIS NOTCH QUAL.

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 27

Random Control

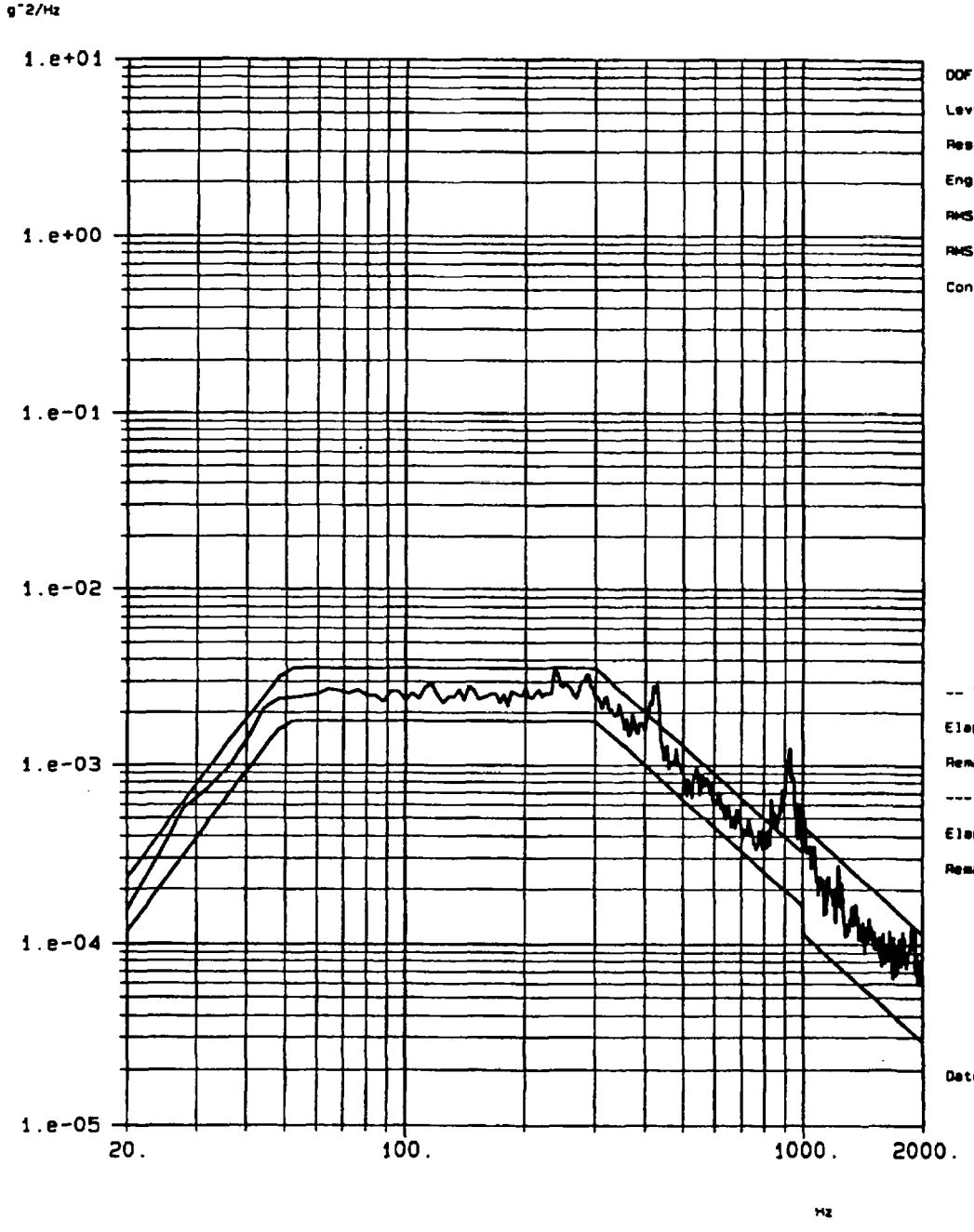
LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

MAXIMUM OF C1 & C2

Wyle Laboratories

El Segundo, CA



DOF : 288

Level : -12. dB

Resolution : 4. Hz

Eng. Unit : g

RMS (act.) : 1.21836 g

RMS (ref.) : 1.14375 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0:00:30

Remaining : 0:00:15

--- Time total ---

Elapsed : 0:01:53

Remaining : 0:05:30

Date : 6/ 5/2002

20:04:10

RANDOM PLOT NO. 28

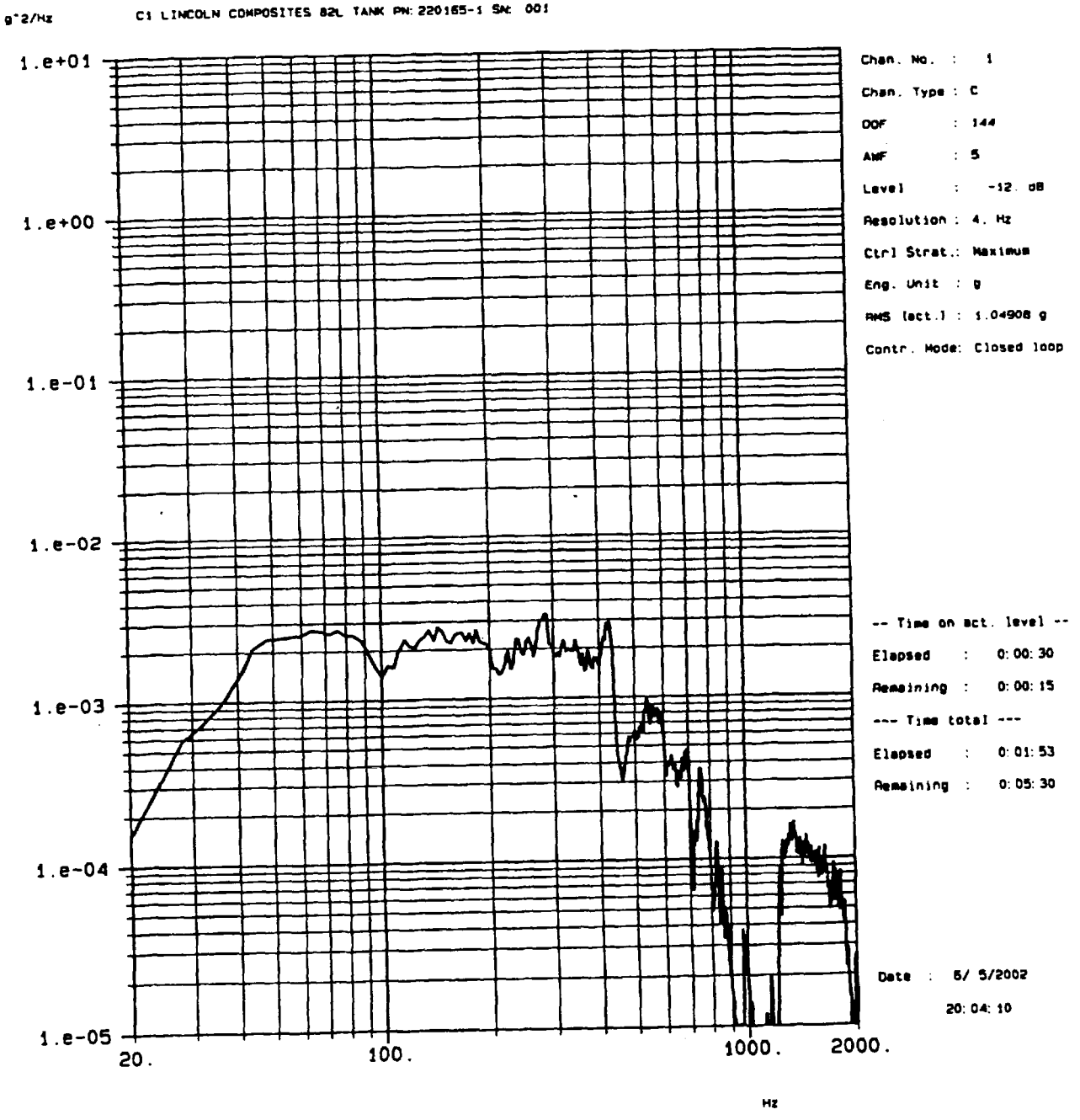
Random Control Channel

LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 29

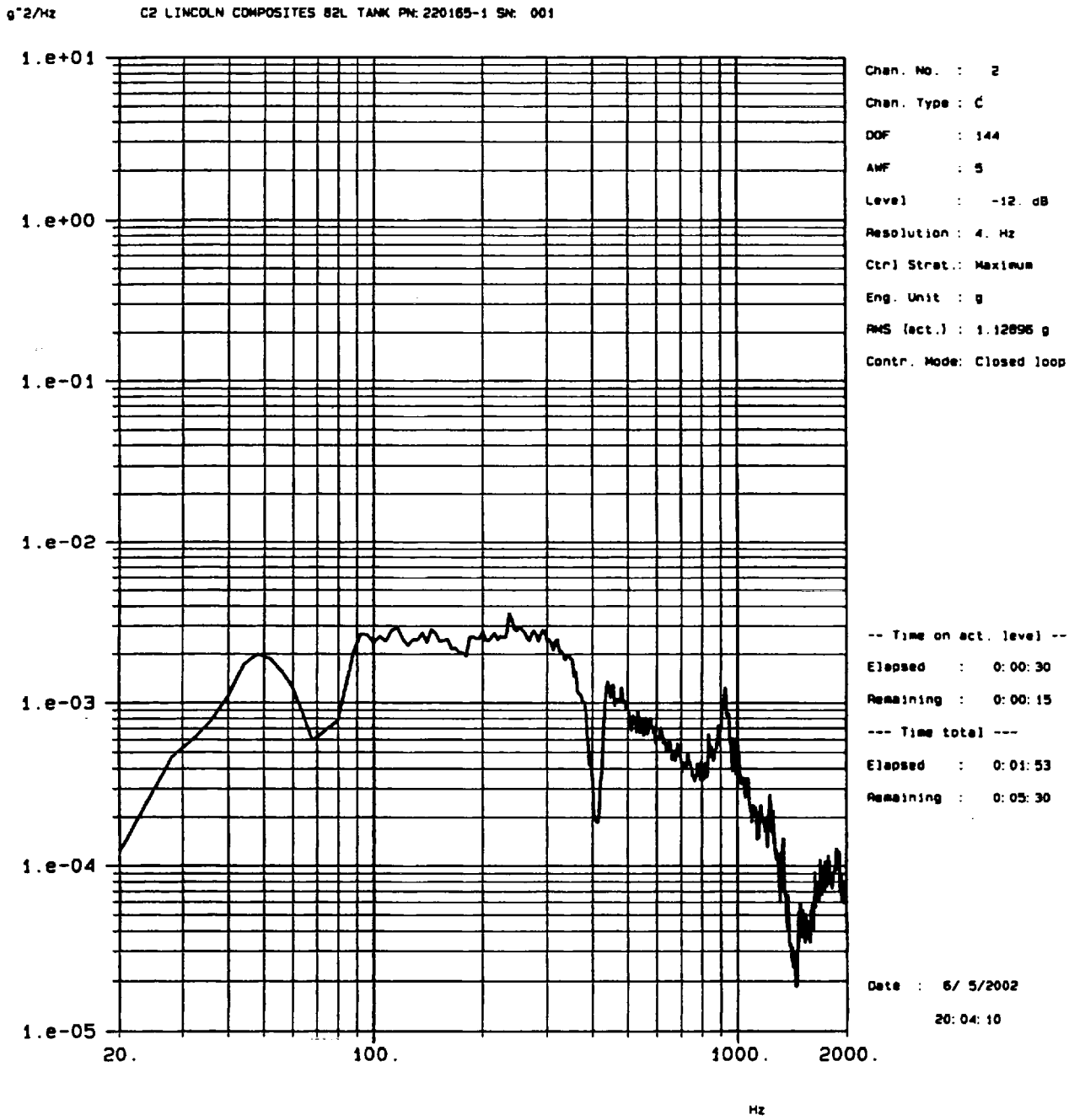
Random Control Channel

LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 30

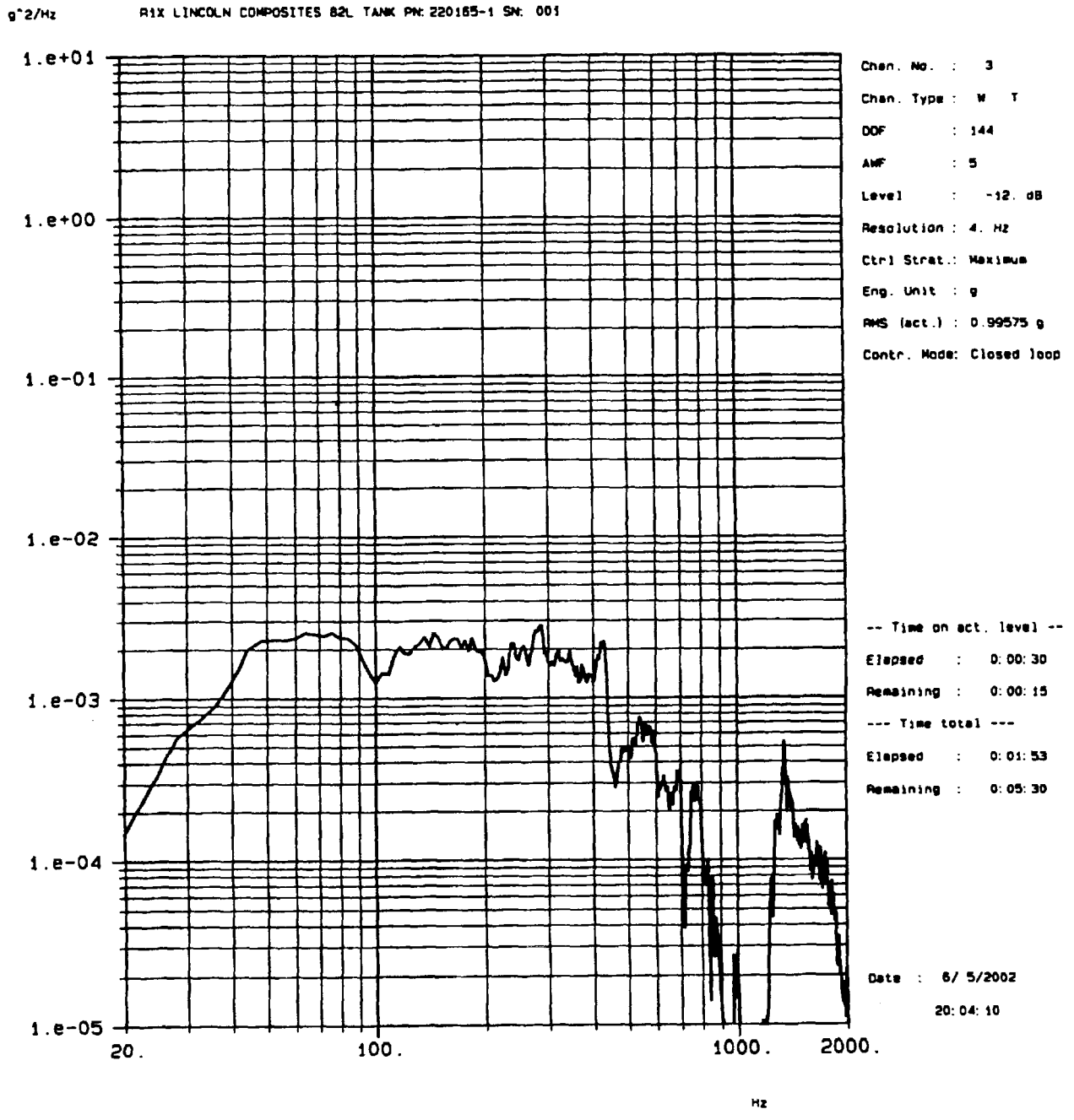
Random Limit Channel

LINCOLN 47039 DUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 31

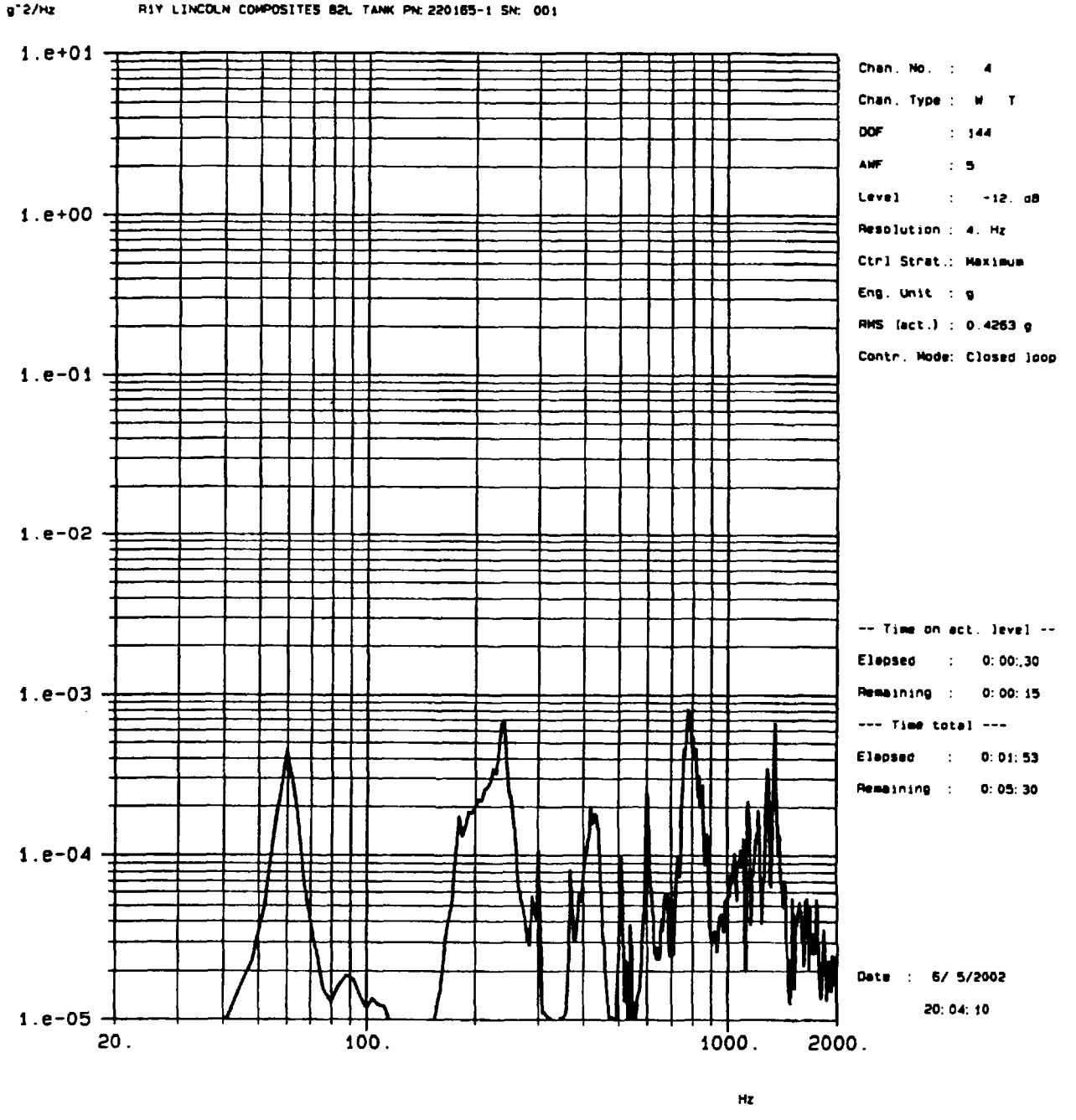
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 32

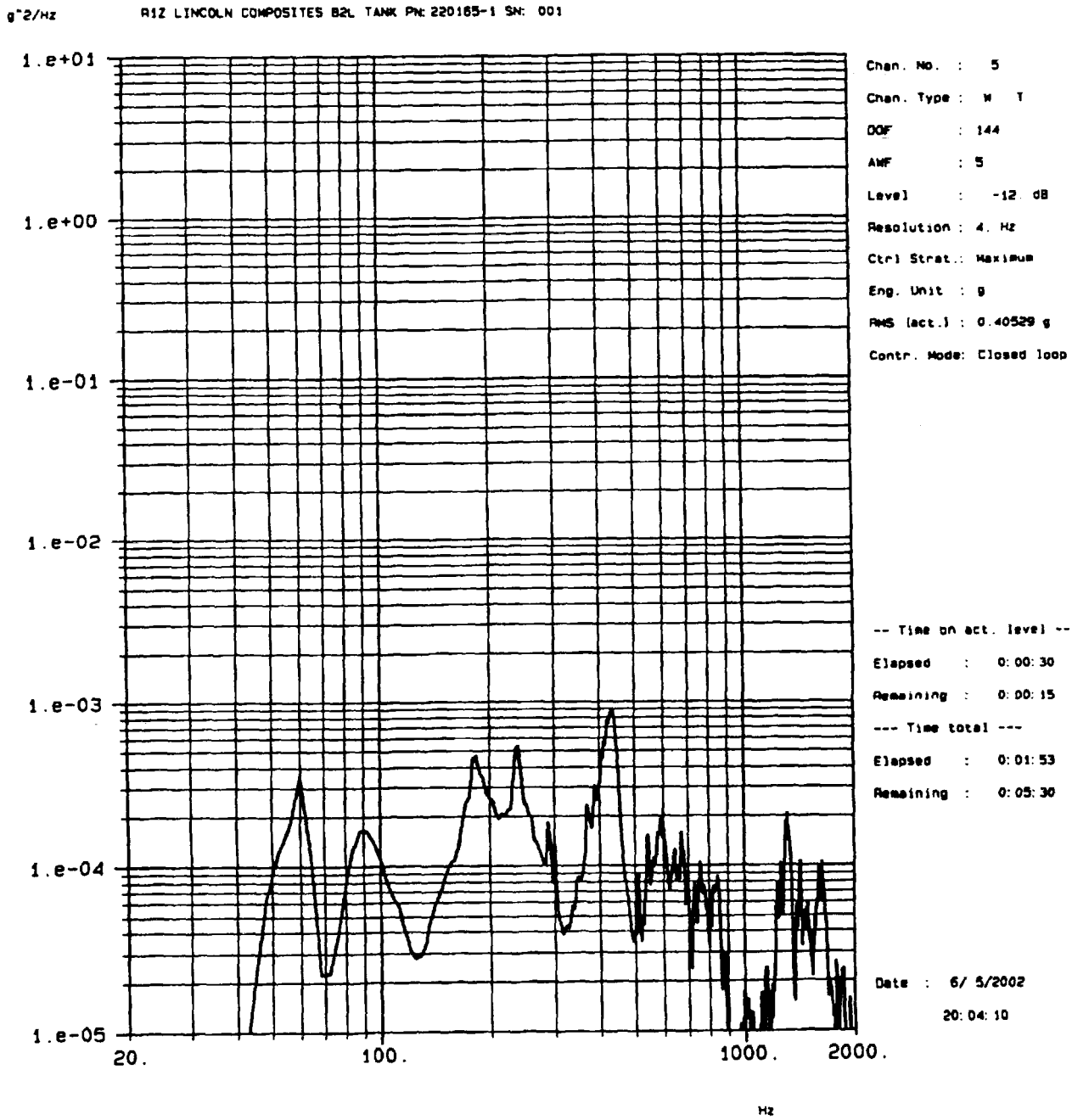
Random Limit Channel

LINCOLN 47039 DUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 33

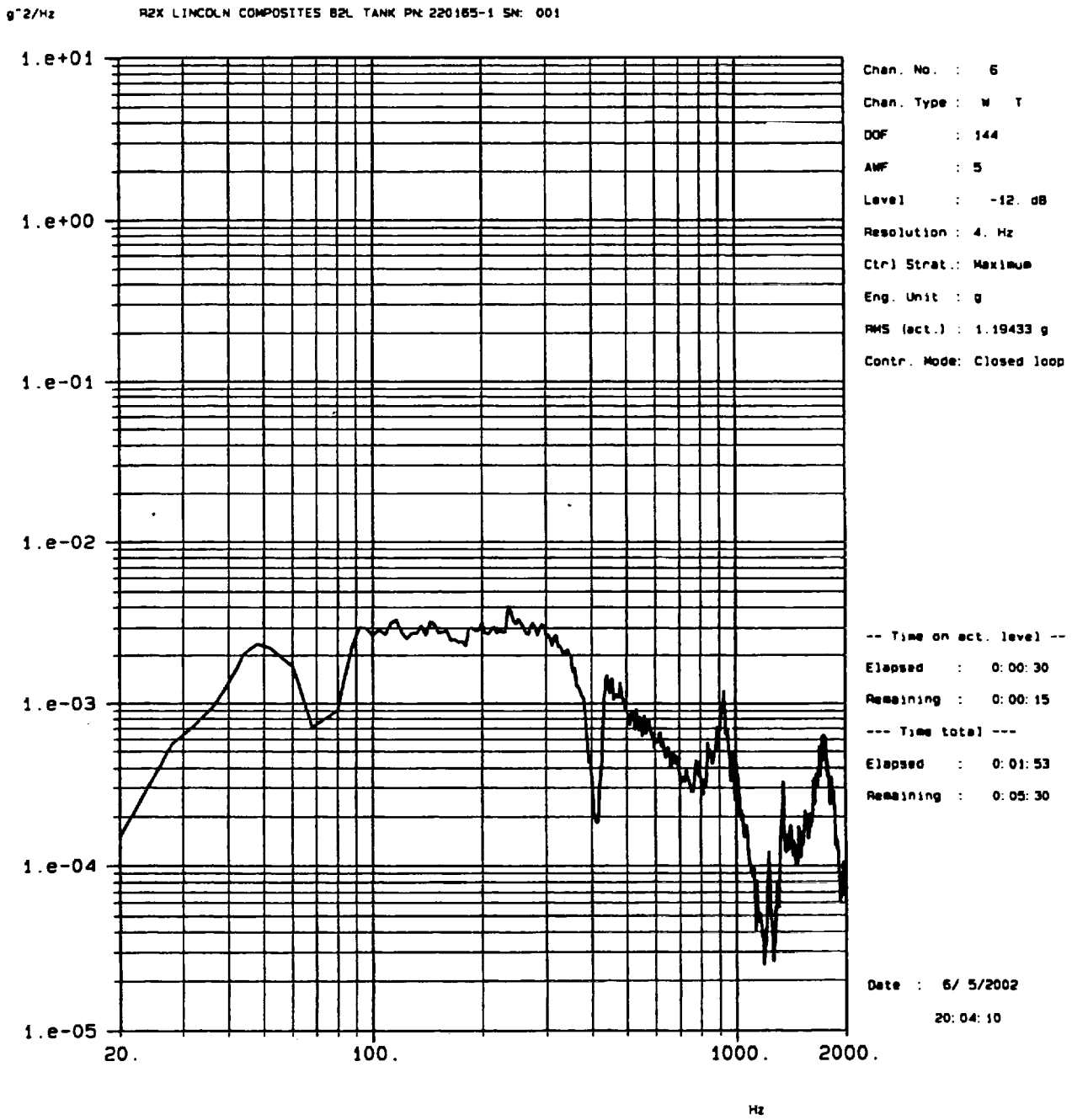
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 34

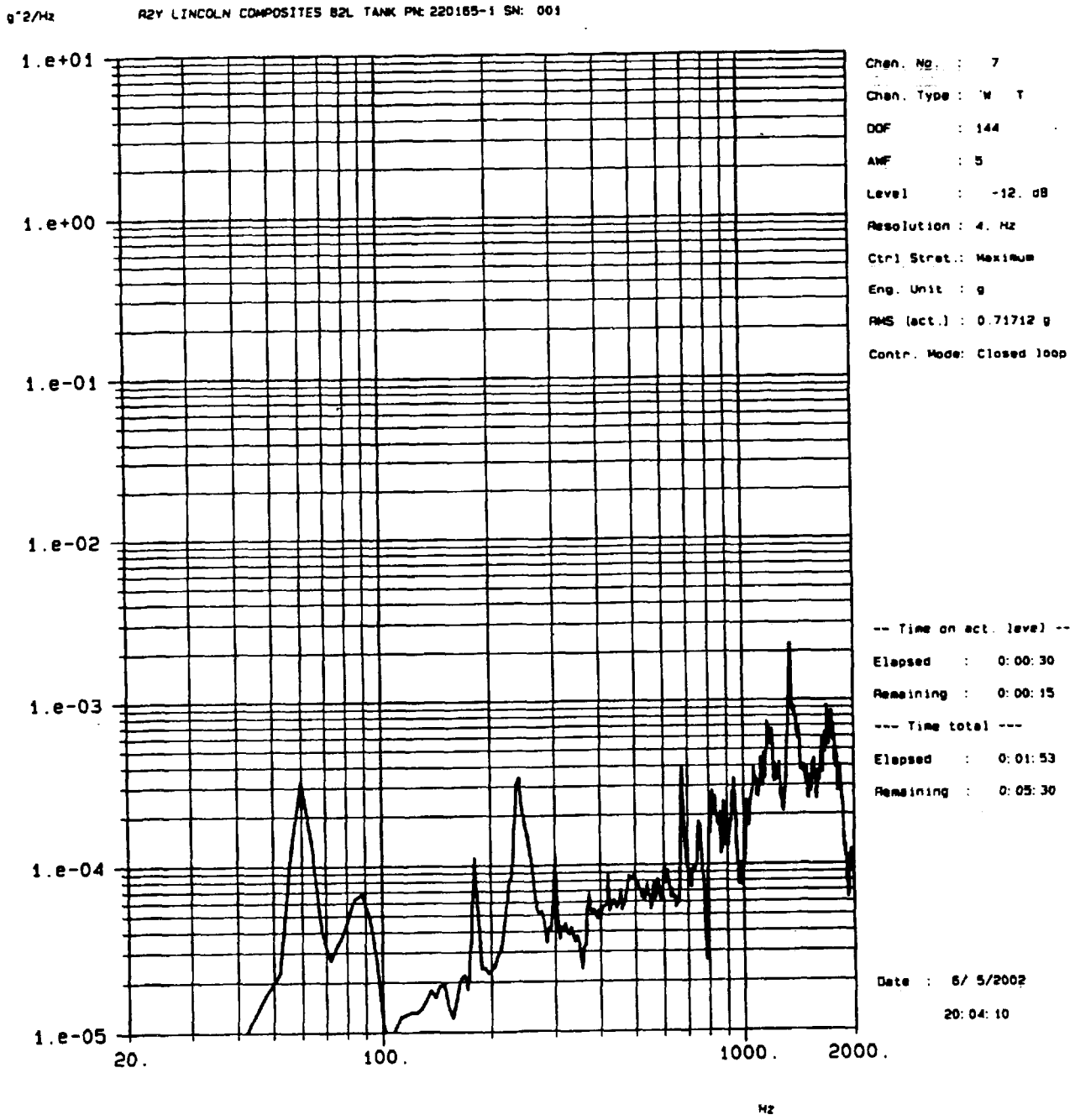
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 35

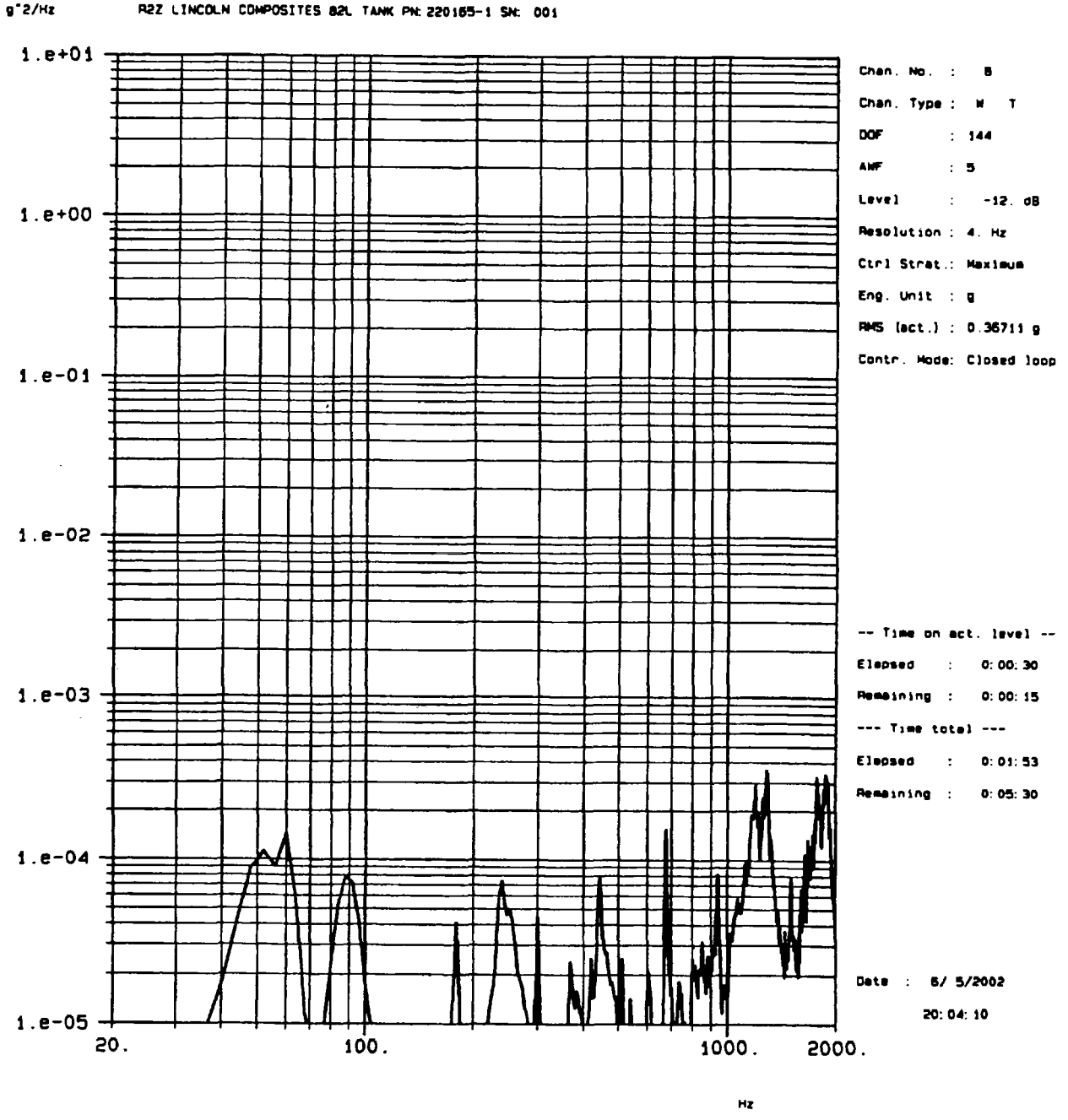
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 36

Random Limit Channel

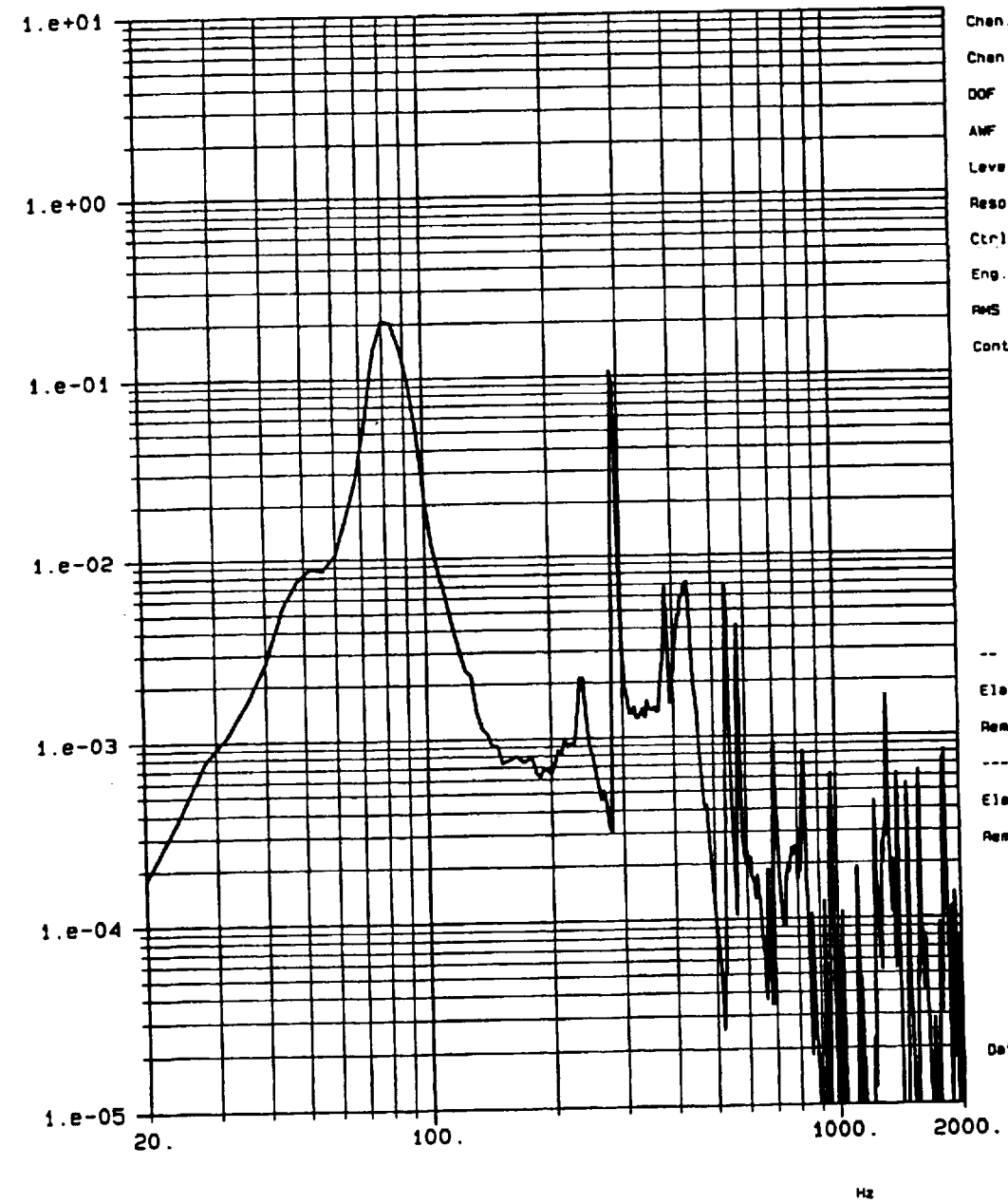
LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA

g^2/Hz R3X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 2.45227 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:30
Remaining : 0:00:15
--- Time total ---
Elapsed : 0:01:53
Remaining : 0:05:30

Date : 6/ 5/2002
20:04:10

RANDOM PLOT NO. 37

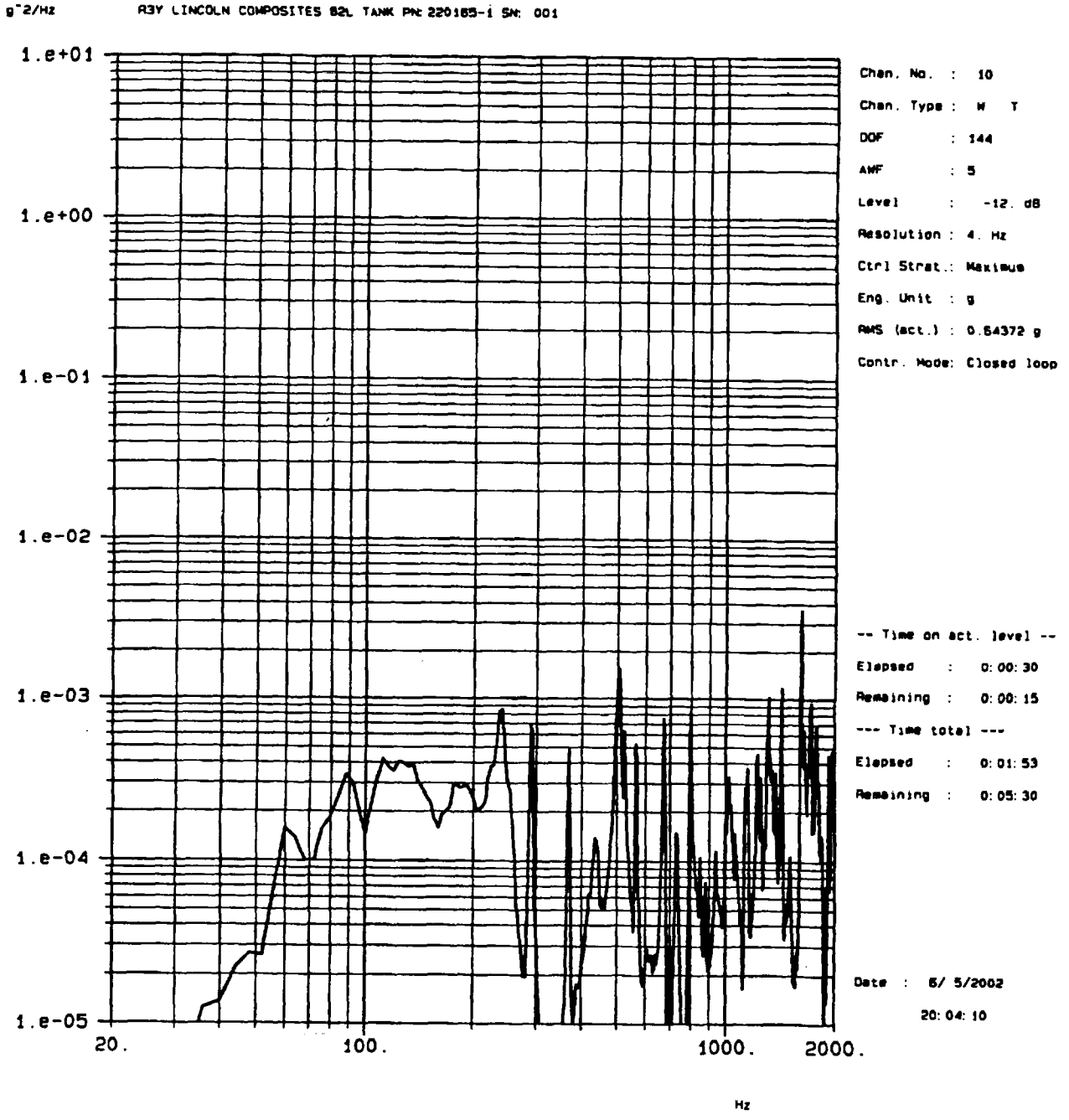
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 38

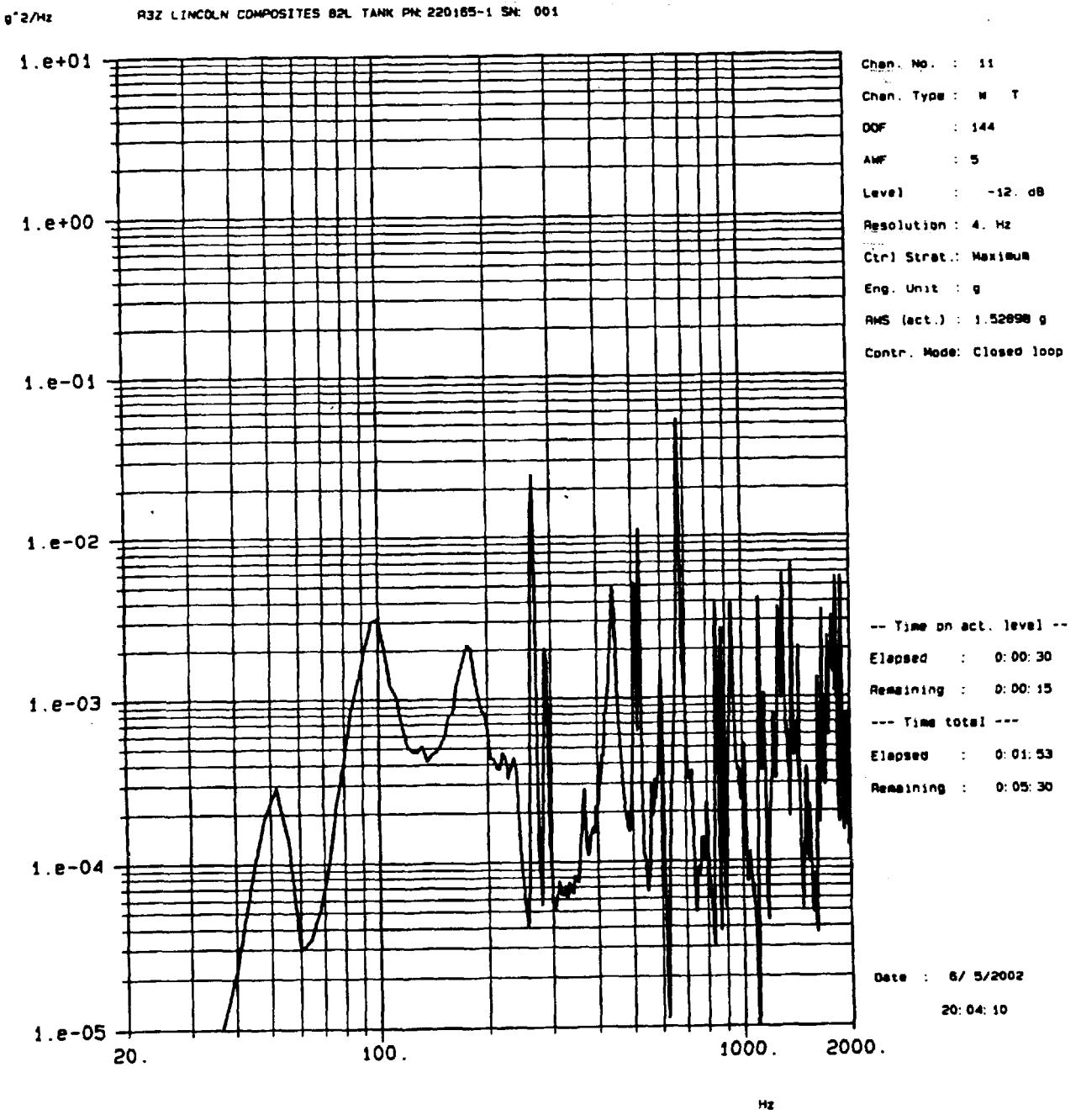
Random Limit Channel

LINCOLN 47039 DUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 39

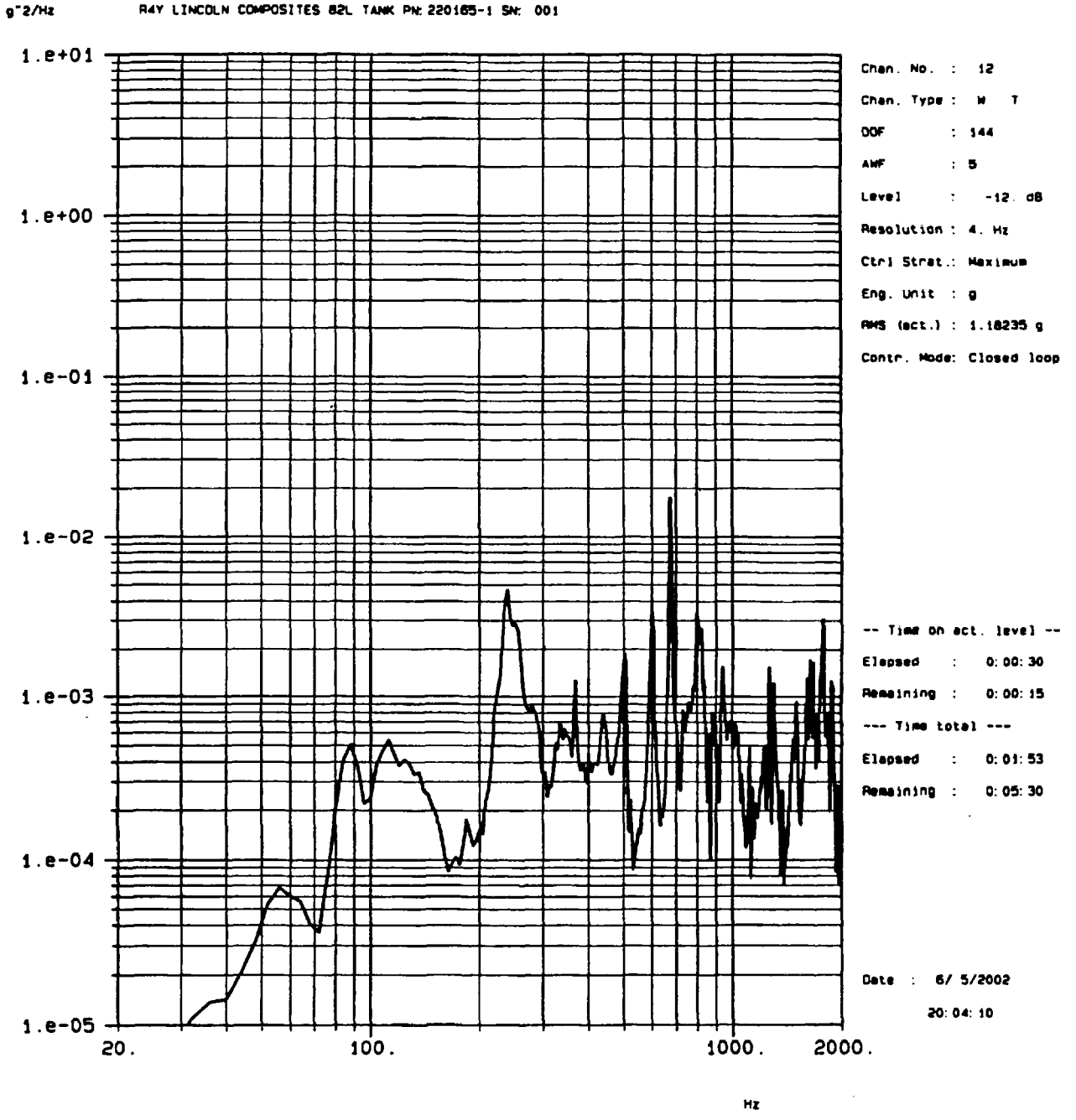
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST RANDOM -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 40

Random Control

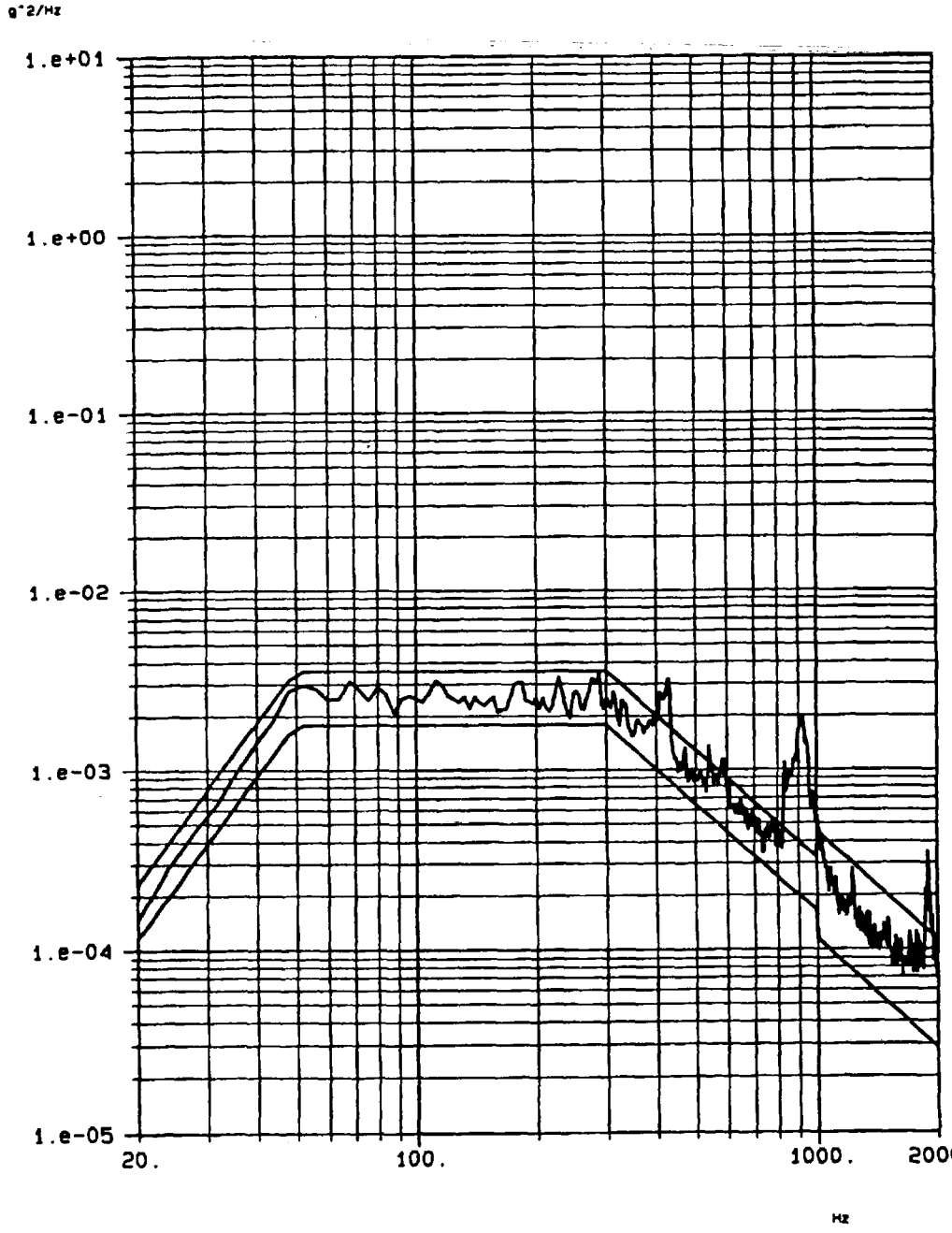
LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

MAXIMUM OF C1 & C2

Wyle Laboratories

El Segundo, CA



DOF : 288

Level : -12. dB

Resolution : 4. Hz

Eng. Unit : g

RMS (act.) : 1.2621 g

RMS (ref.) : 1.14375 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0:00:26

Remaining : 0:00:19

--- Time total ---

Elapsed : 0:01:46

Remaining : 0:05:34

Date : 6/ 5/2002

20:29:27

RANDOM PLOT NO. 41

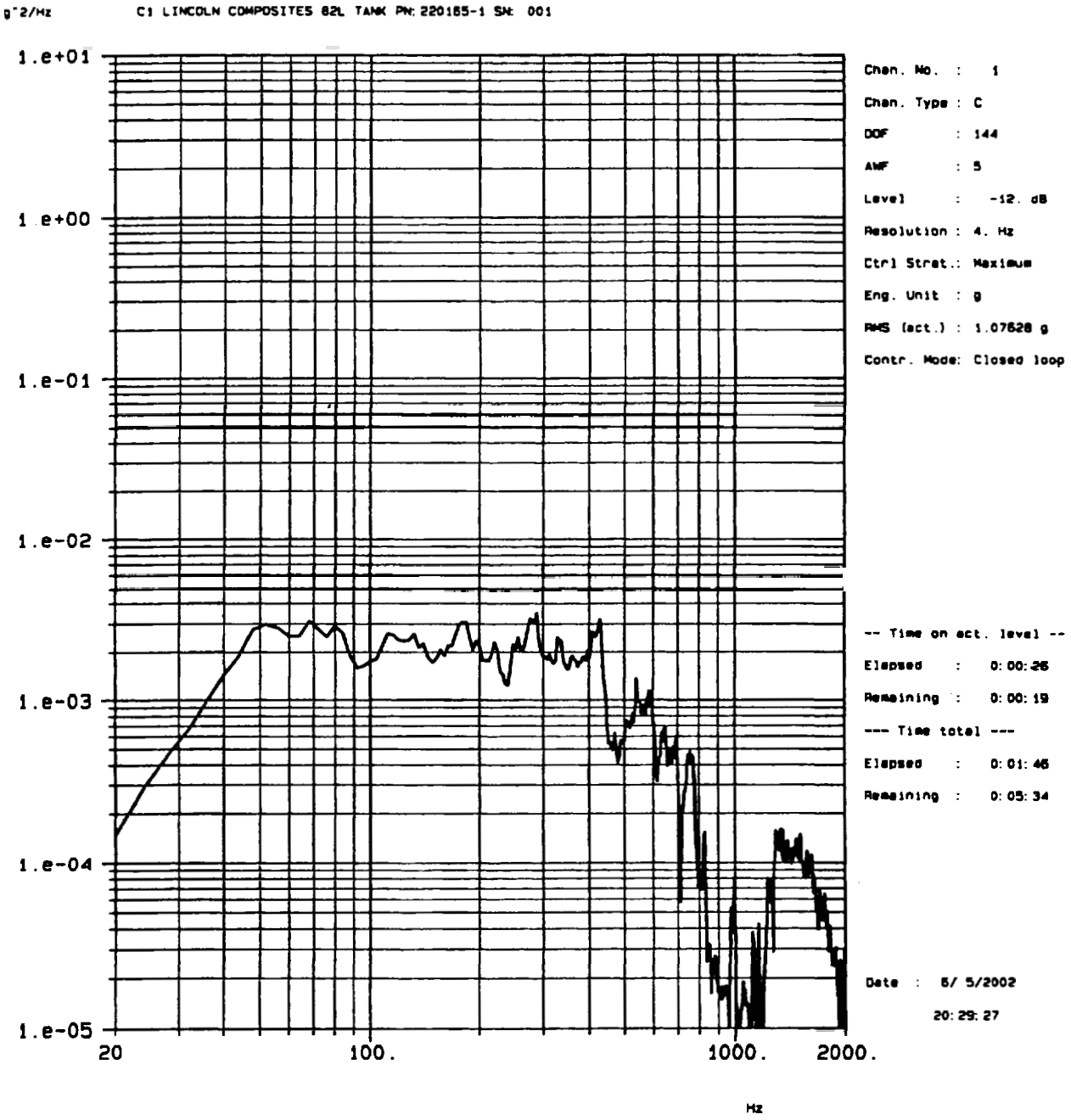
Random Control Channel

LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 42

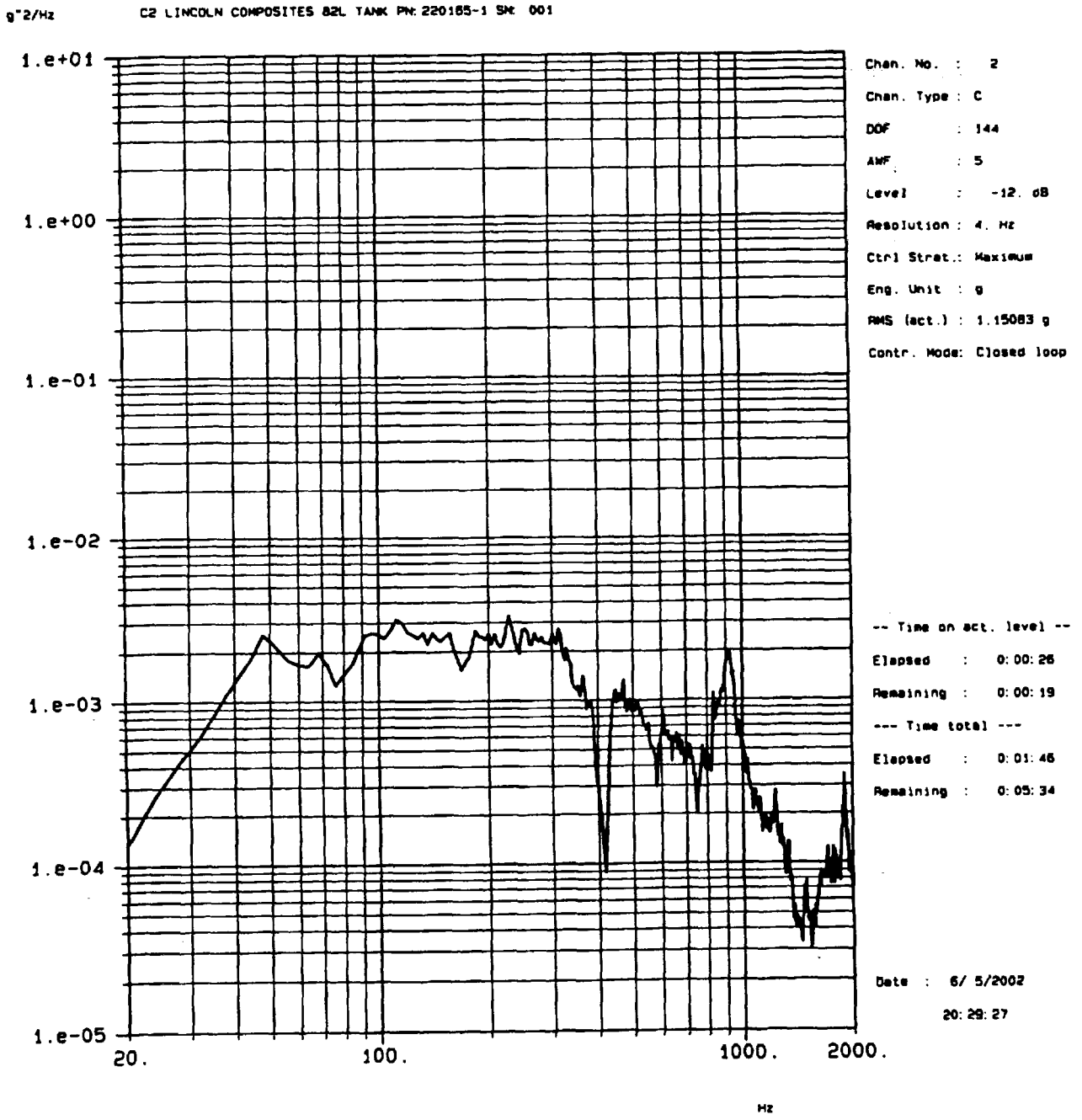
Random Control Channel

LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 43

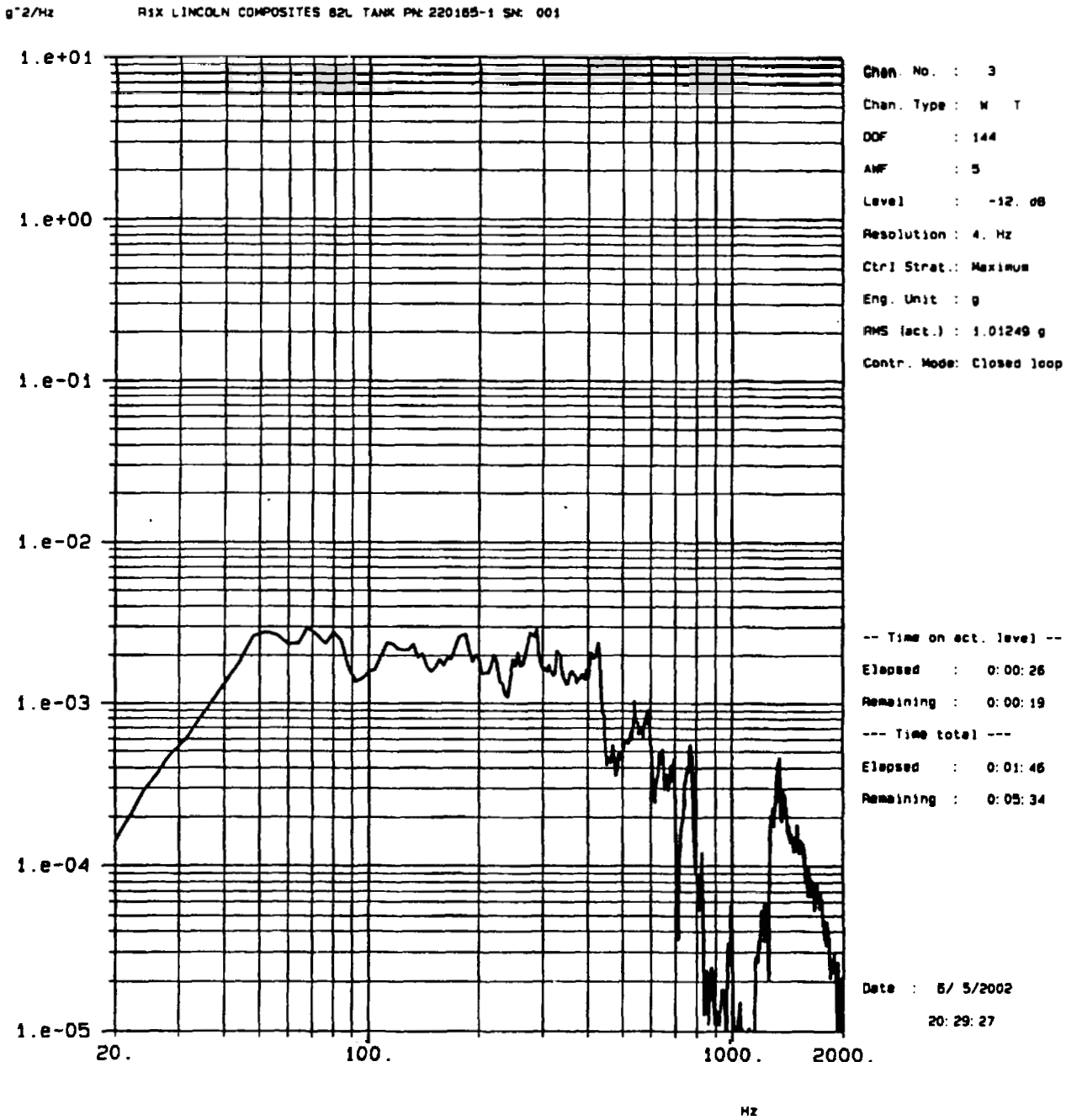
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 44

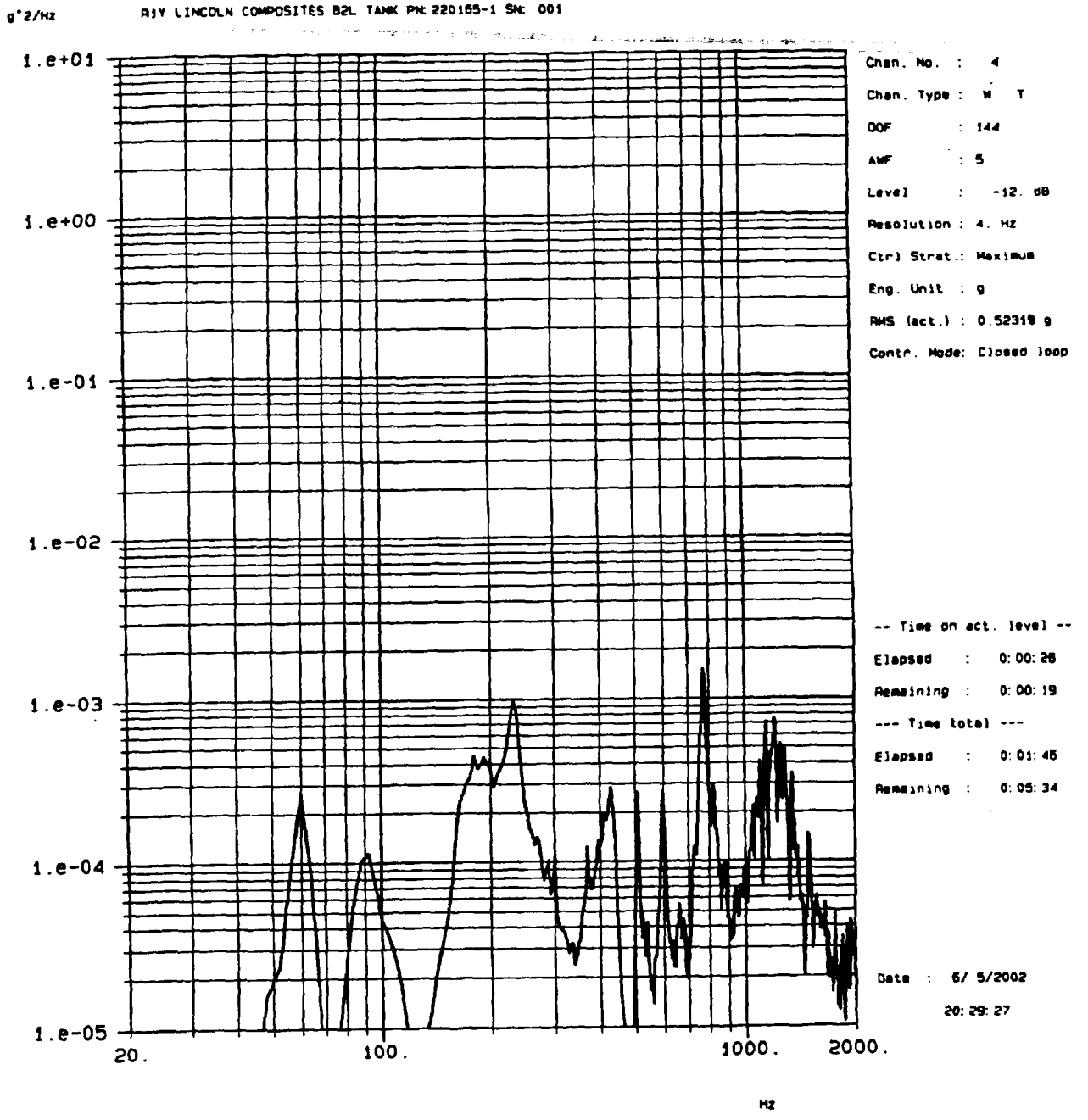
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 45

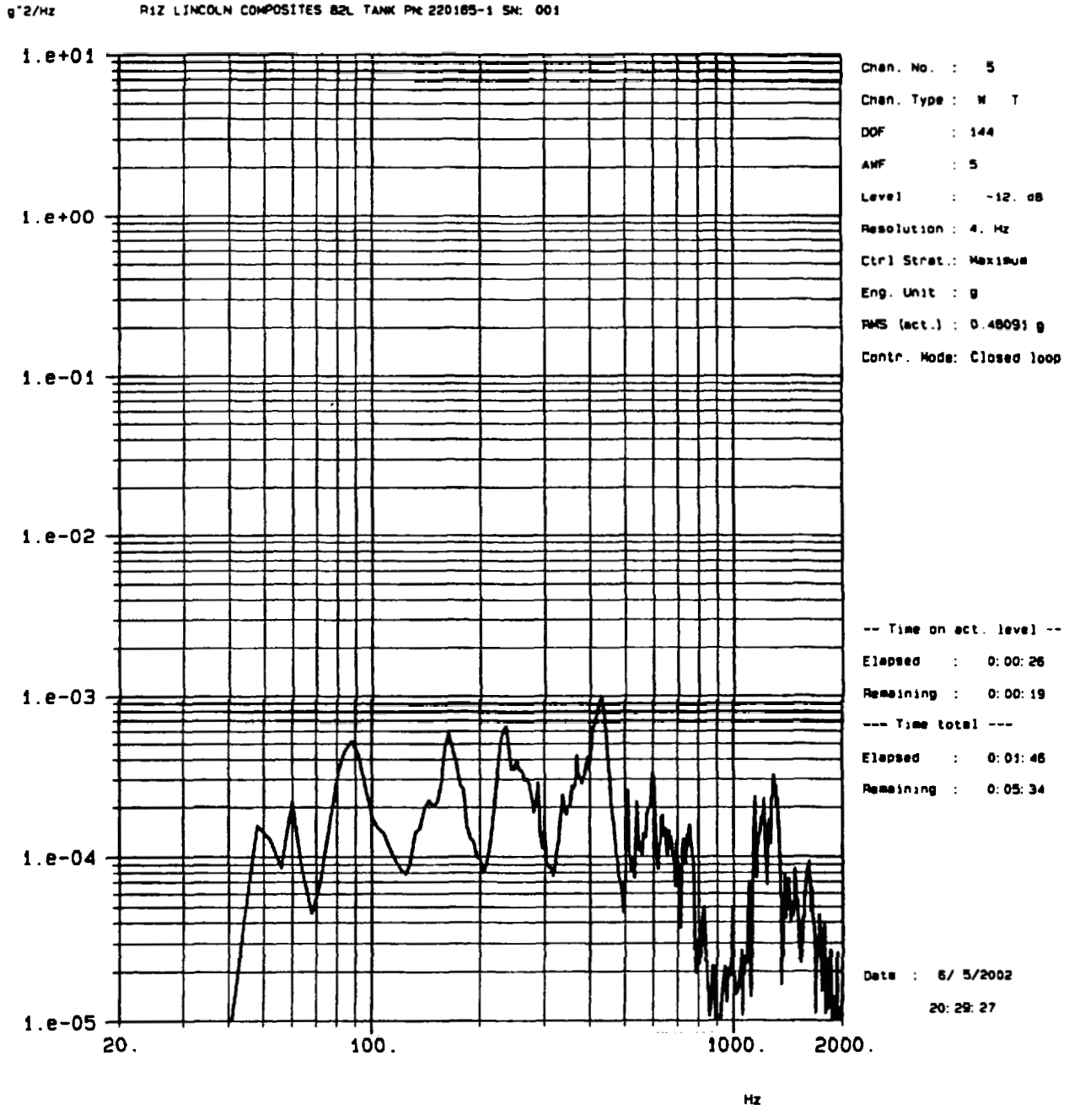
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 46

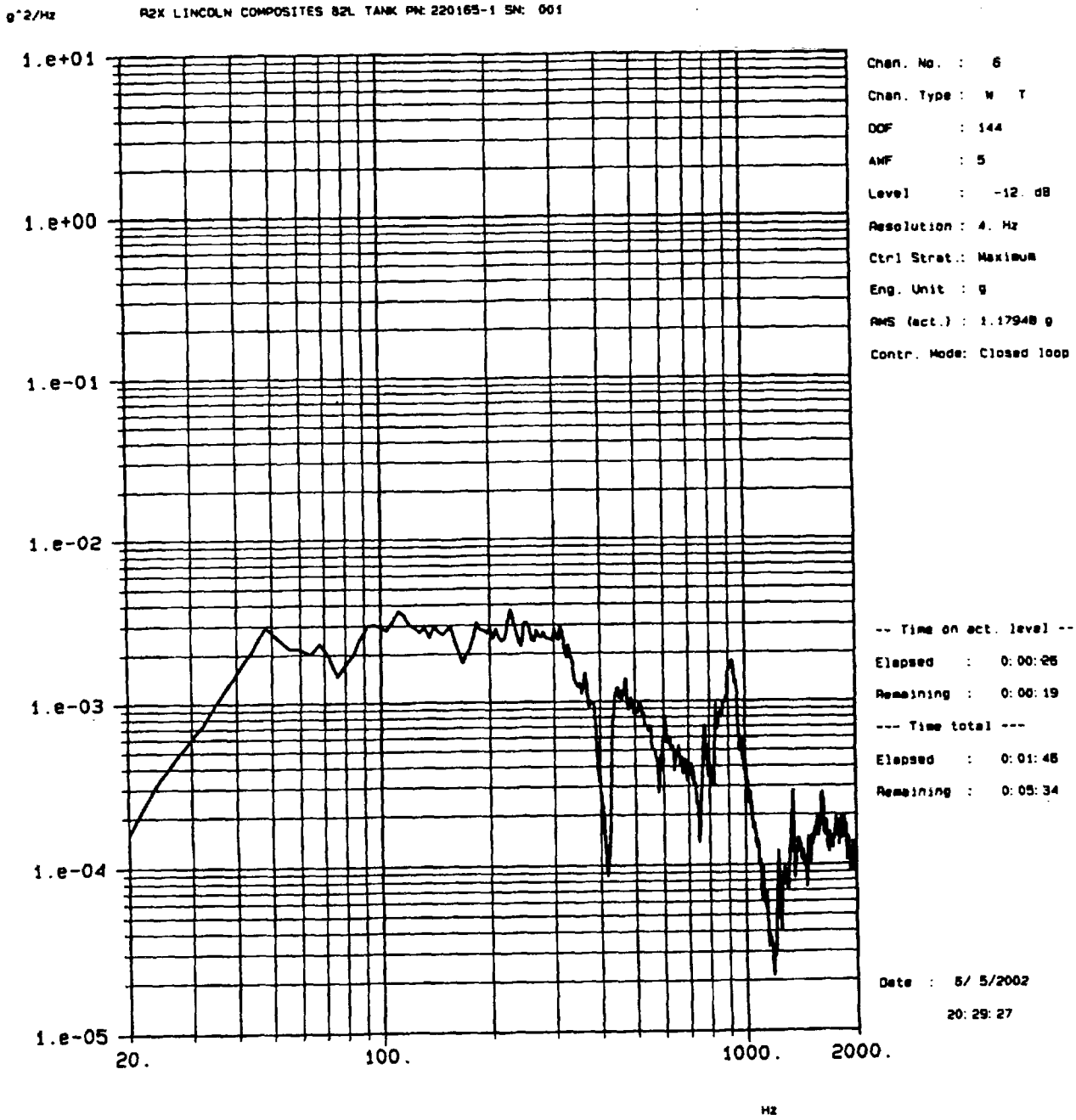
Random Limit Channel

LINCOLN 47039 DUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 47

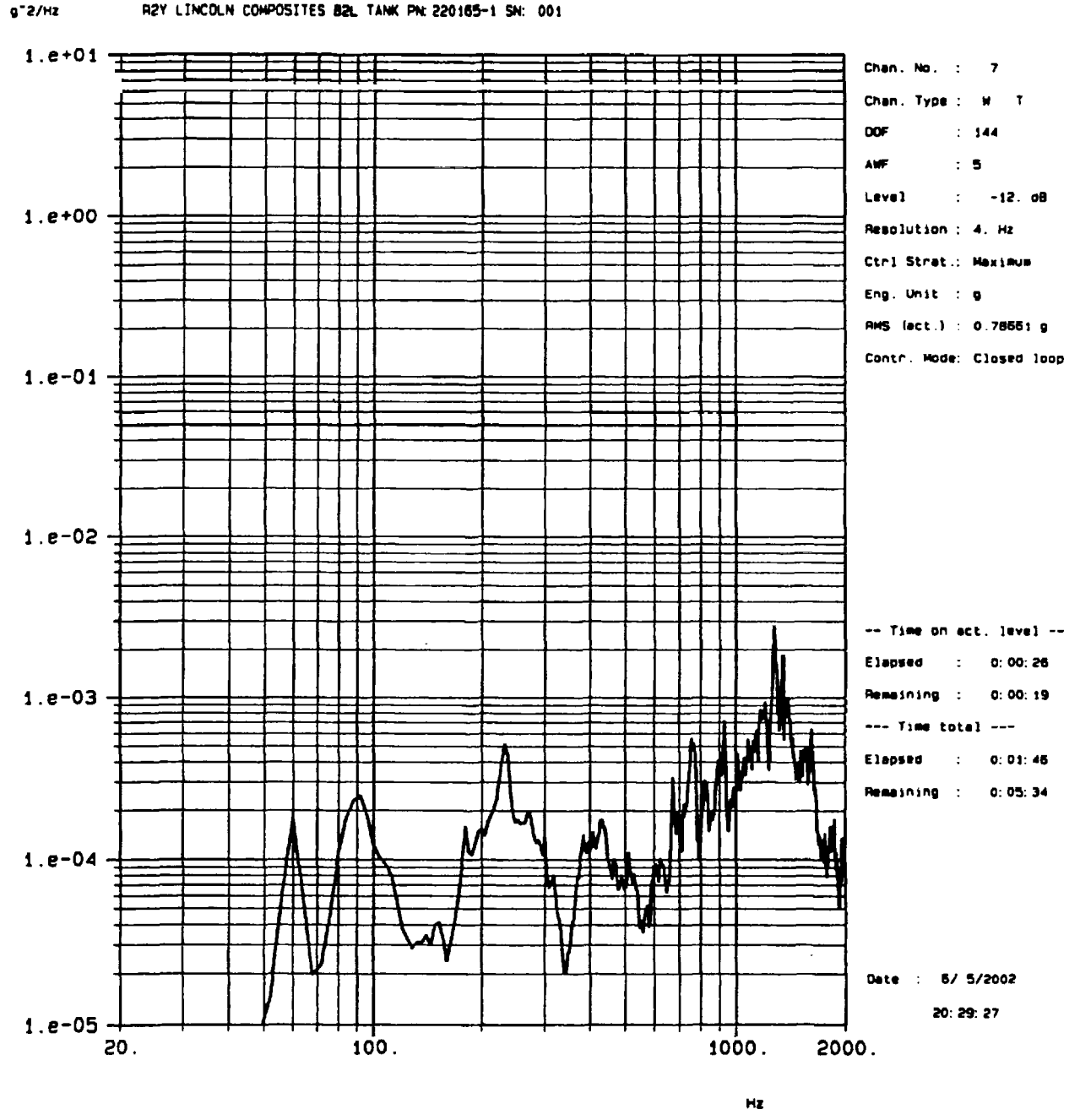
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 48

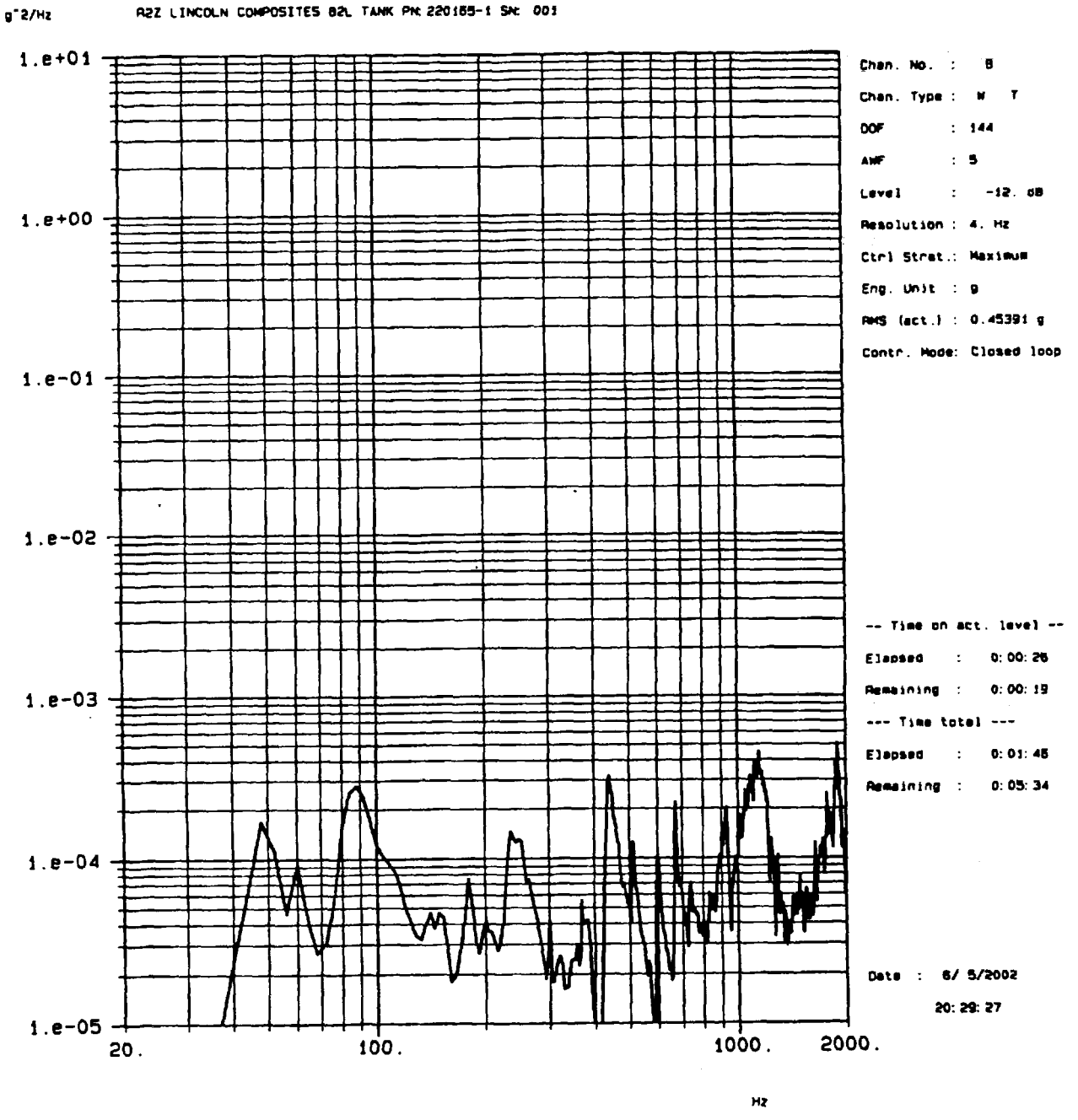
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 49

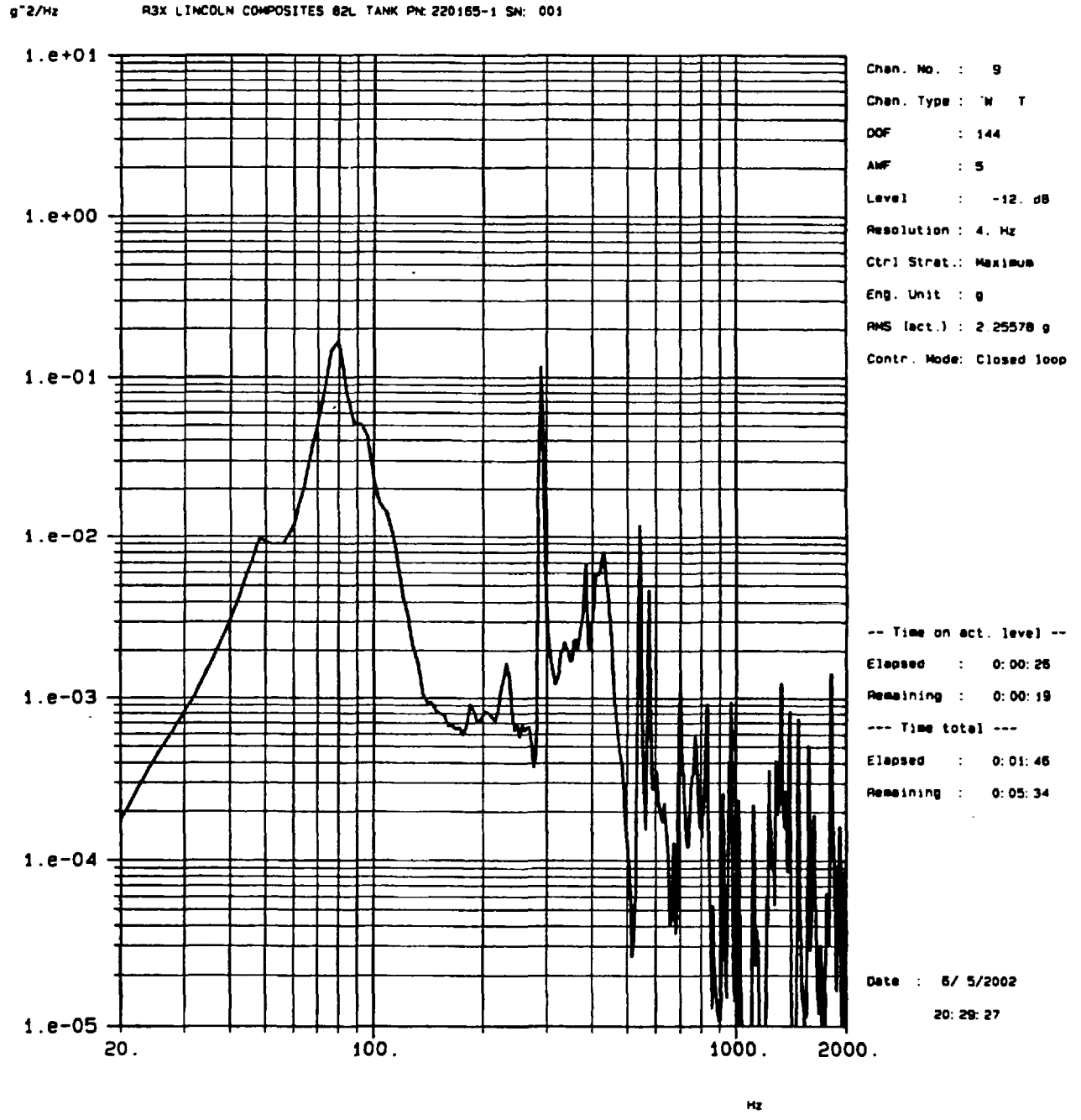
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 50

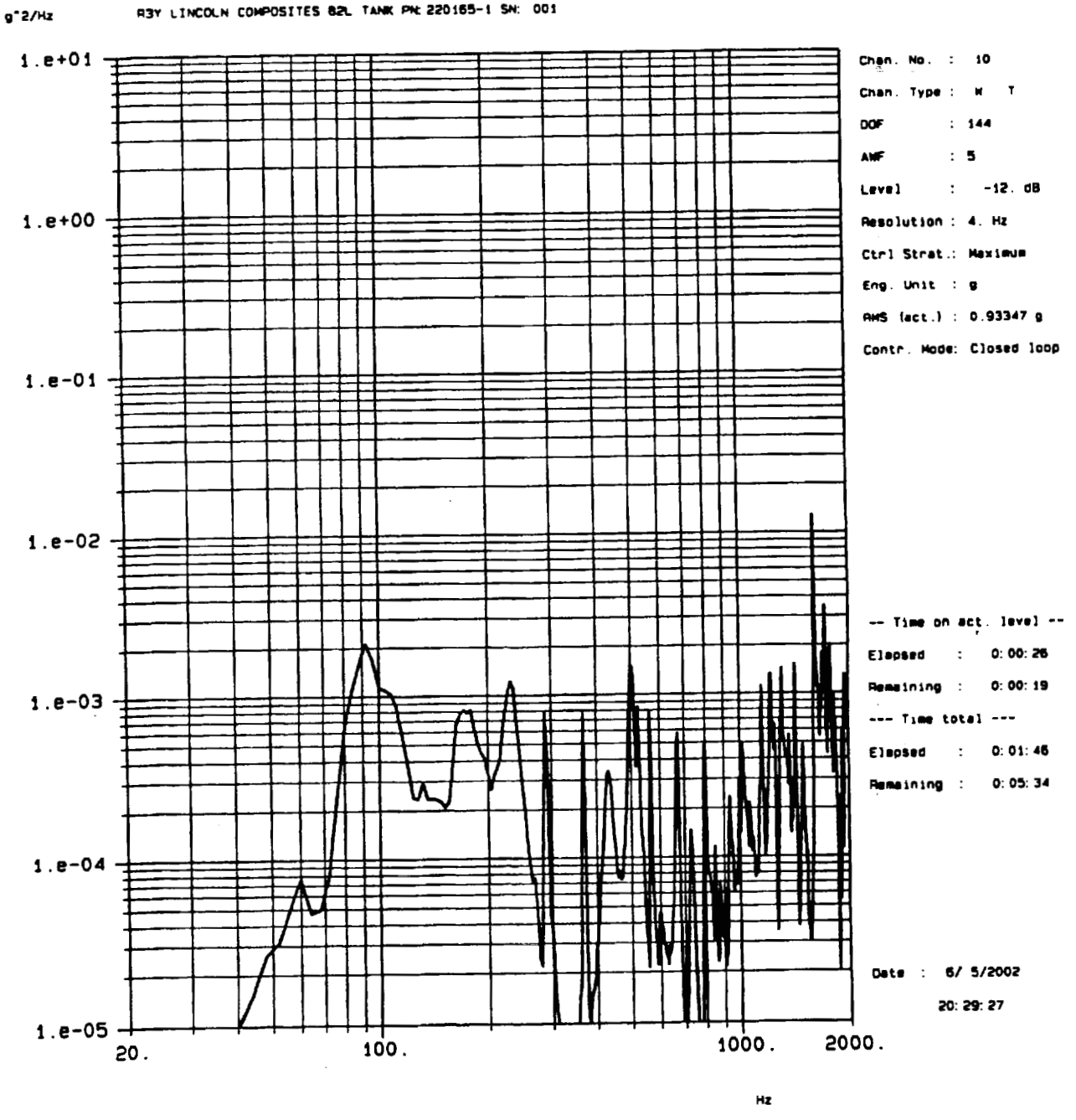
Random Limit Channel

LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 51

Random Limit Channel

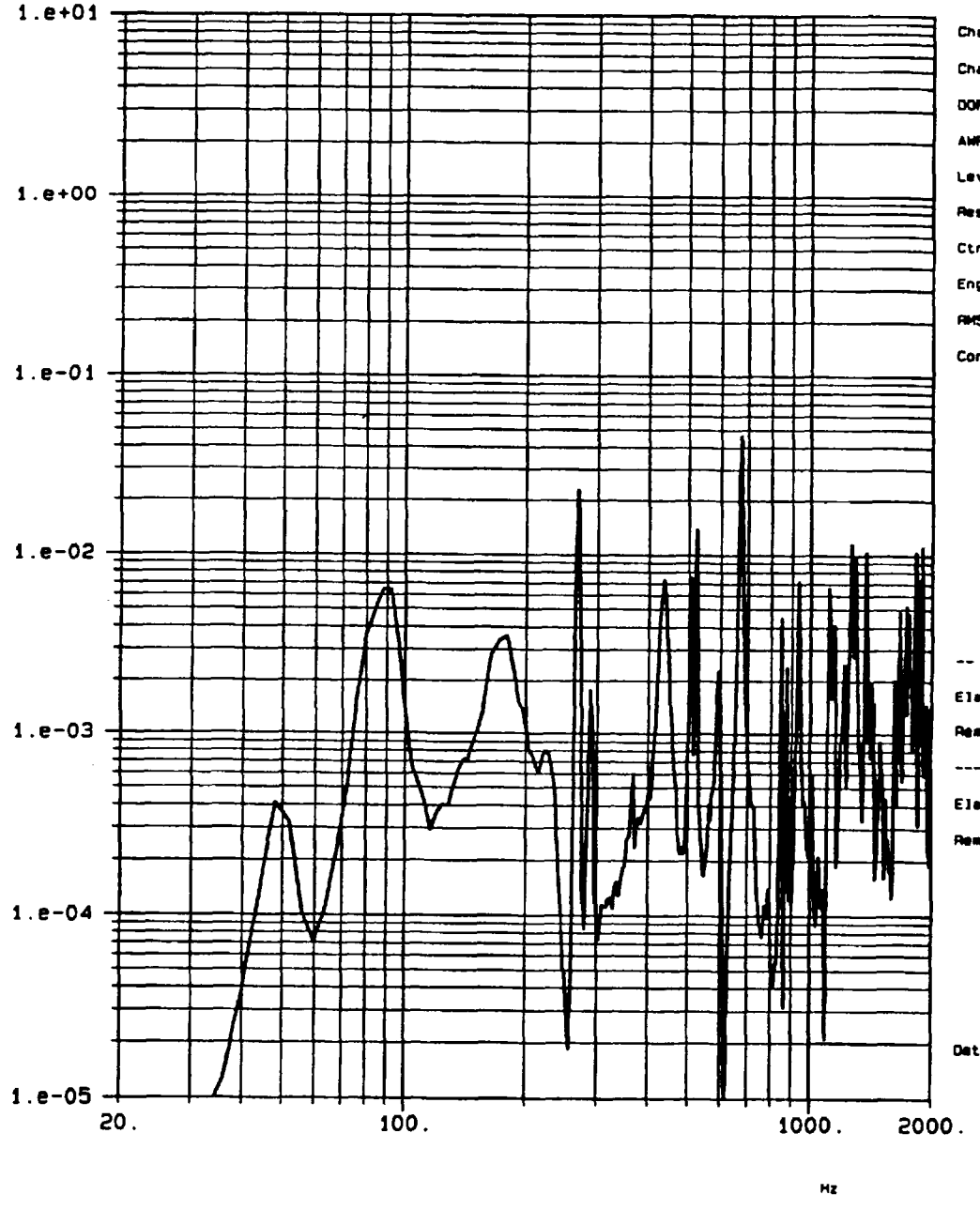
LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA

g^2/Hz R3Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 11
Chan. Type : W T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 1.88564 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:26
Remaining : 0:00:19
--- Time total ---
Elapsed : 0:01:46
Remaining : 0:05:34

Date : 6/ 5/2002
20:29:27

RANDOM PLOT NO. 52

Random Limit Channel

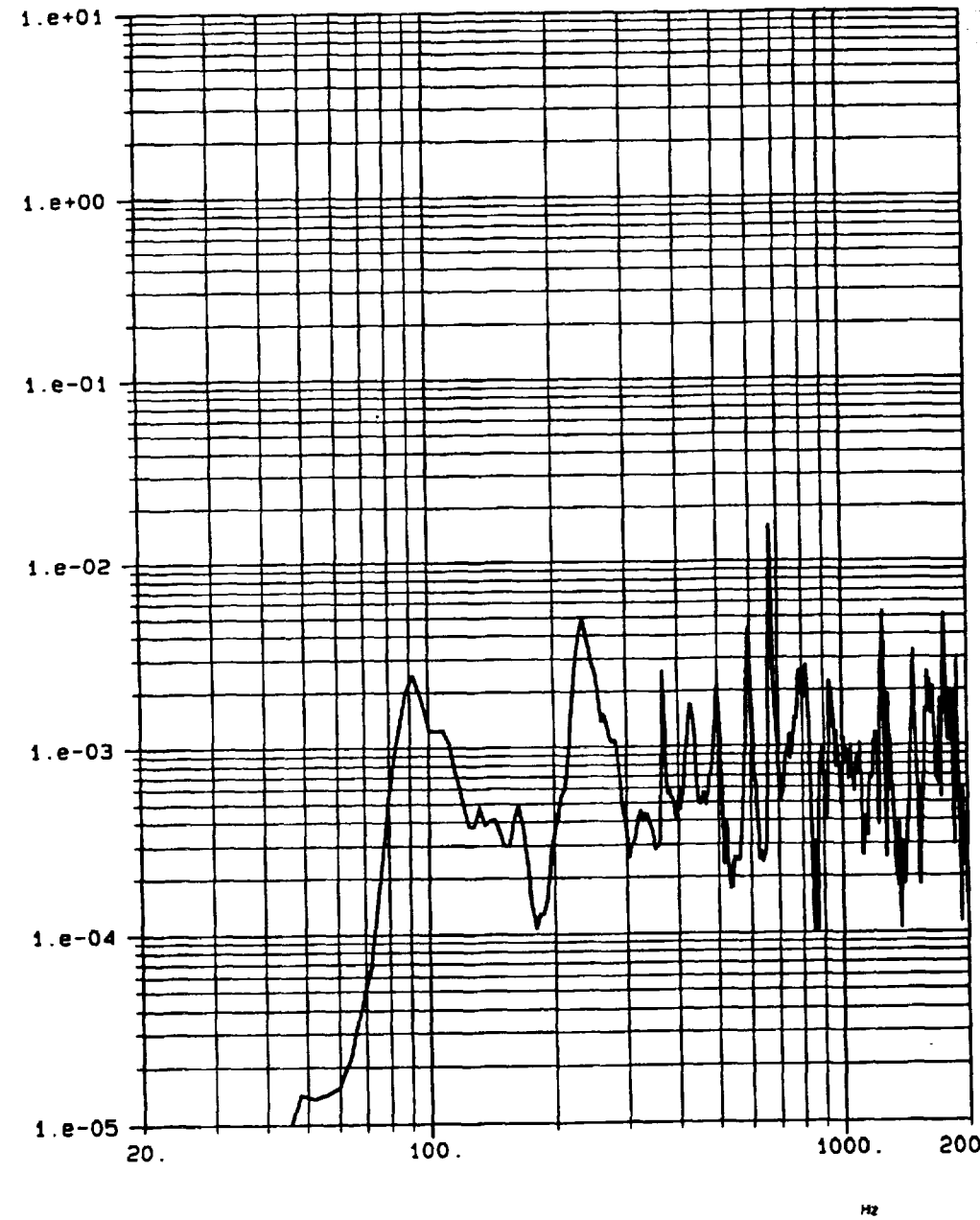
LINCOLN 47039 QUAL

X AXIS POST SINE -12dB

Wyle Laboratories

El Segundo, CA

g^2/Hz R4Y LINCOLN COMPOSITES 82L TANK PN: 220185-1 SN: 001



Chan. No. : 12
Chan. Type : N T
DOF : 144
AWF : 5
Level : -12. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 1.44966 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:00:25
Remaining : 0:00:19
--- Time total ---
Elapsed : 0:01:46
Remaining : 0:05:34

Date : 6/ 5/2002
20:29:27

RANDOM PLOT NO. 53

Random Control

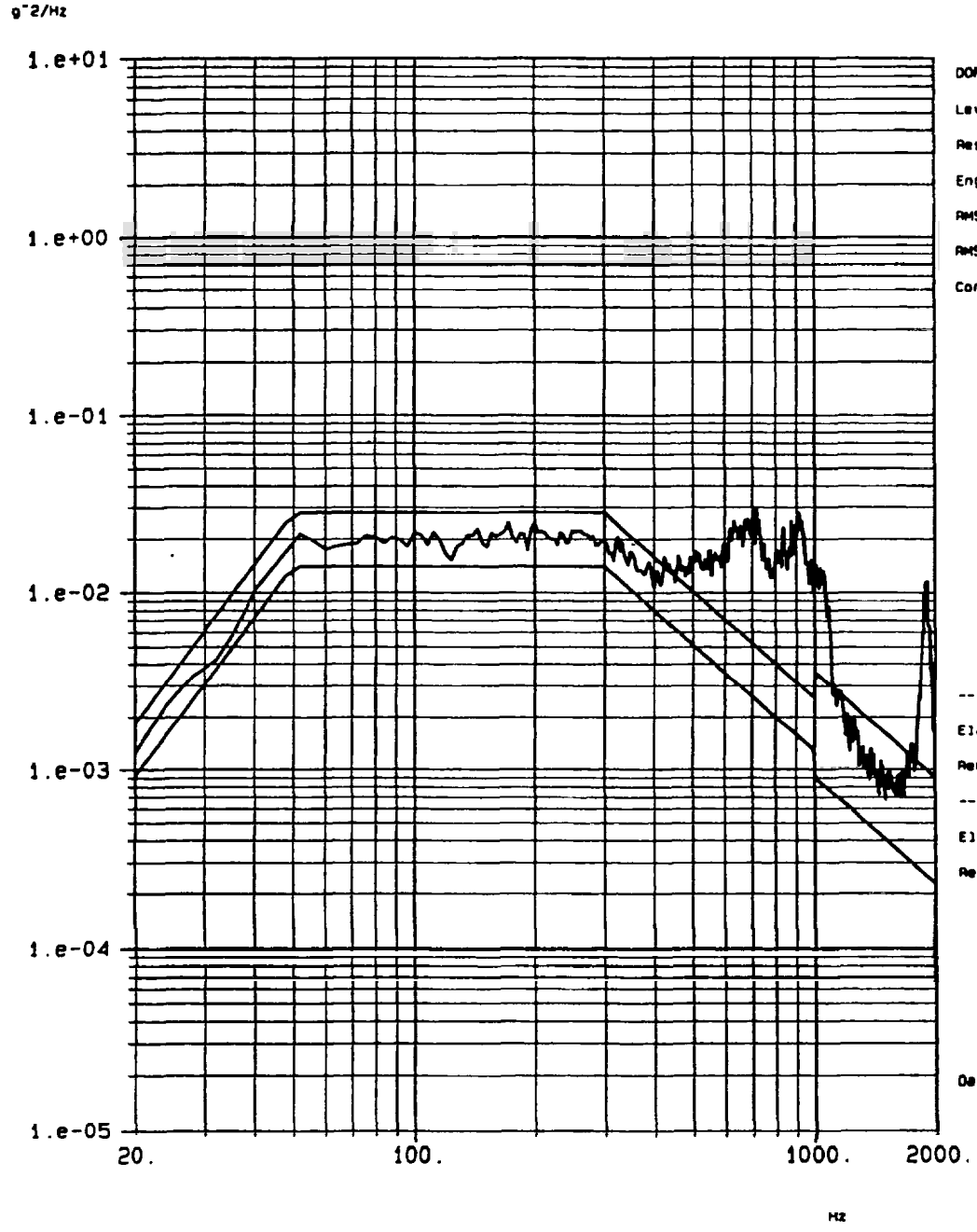
LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

MAXIMUM OF C1 & C2

Wyle Laboratories

El Segundo, CA



DOF : 288

Level : 0. dB

Resolution : 4. Hz

Eng. Unit : g

RMS (act.) : 4.50487 g

RMS (ref.) : 3.22026 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0:01:00

Remaining : 0:00:00

--- Time total ---

Elapsed : 0:04:40

Remaining : 0:00:00

Date : 5/10/2002

13:19:09

RANDOM PLOT NO. 54

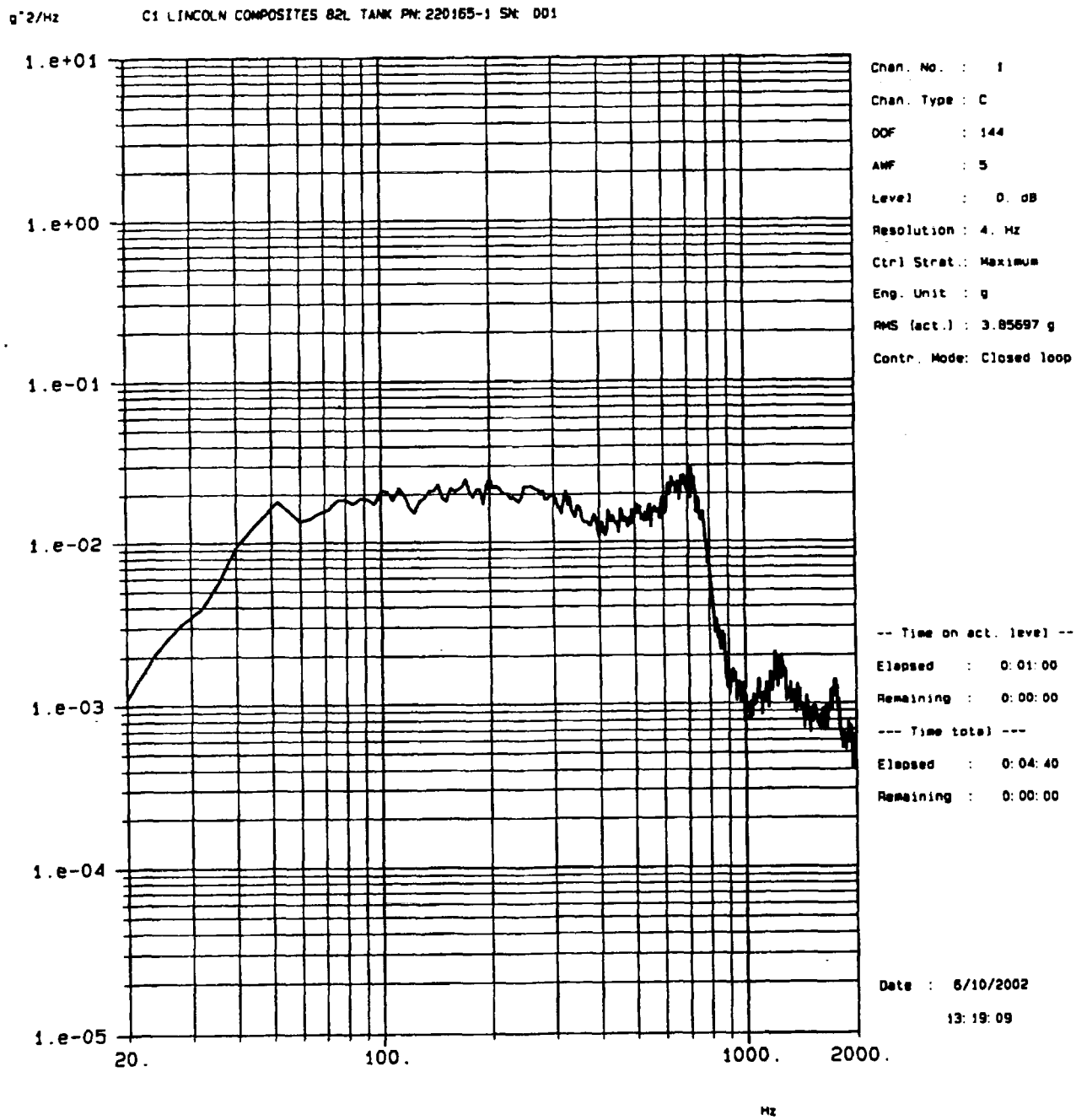
Random Control Channel

LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 55

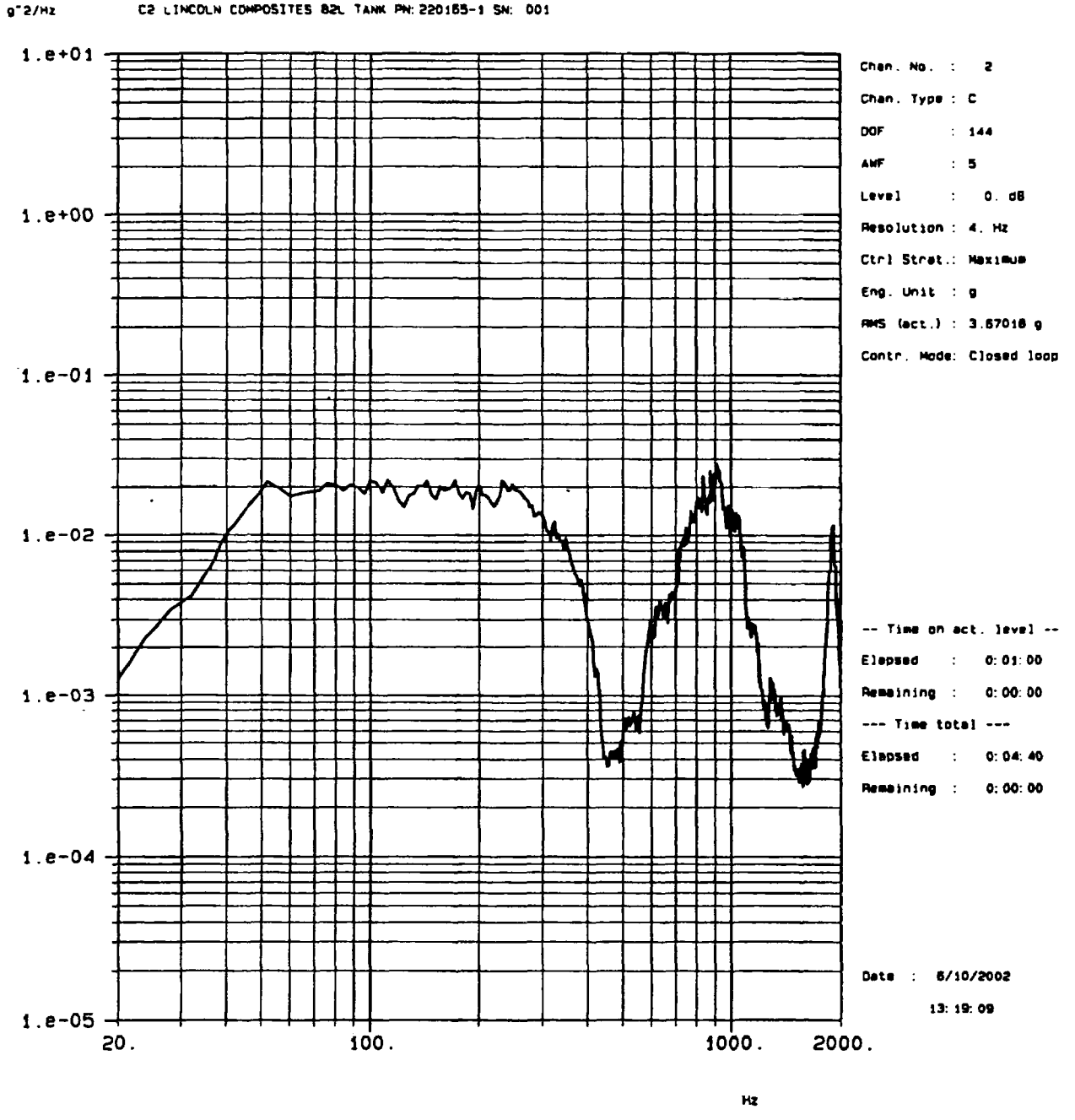
Random Control Channel

LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 56

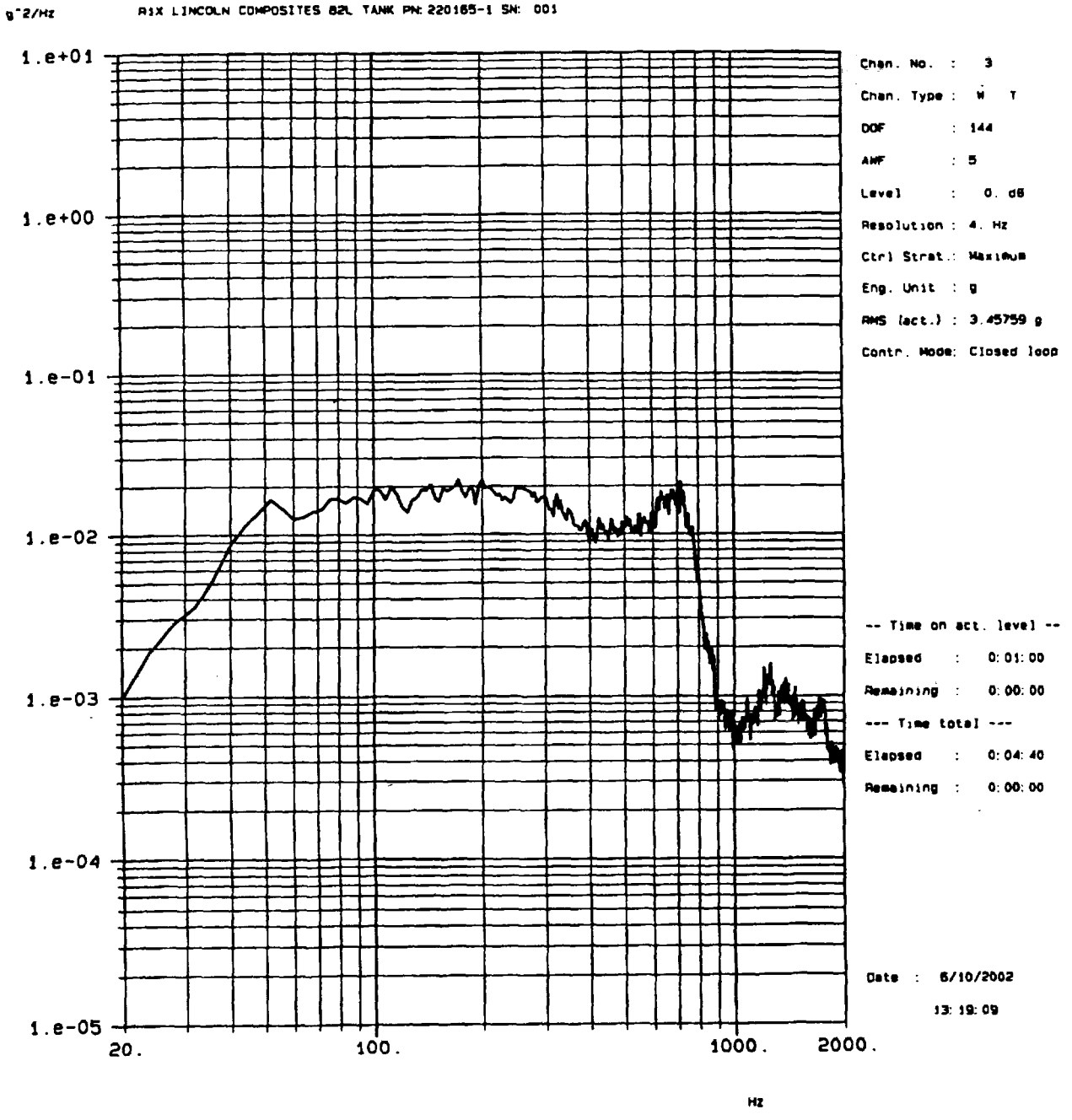
Random Limit Channel

LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 57

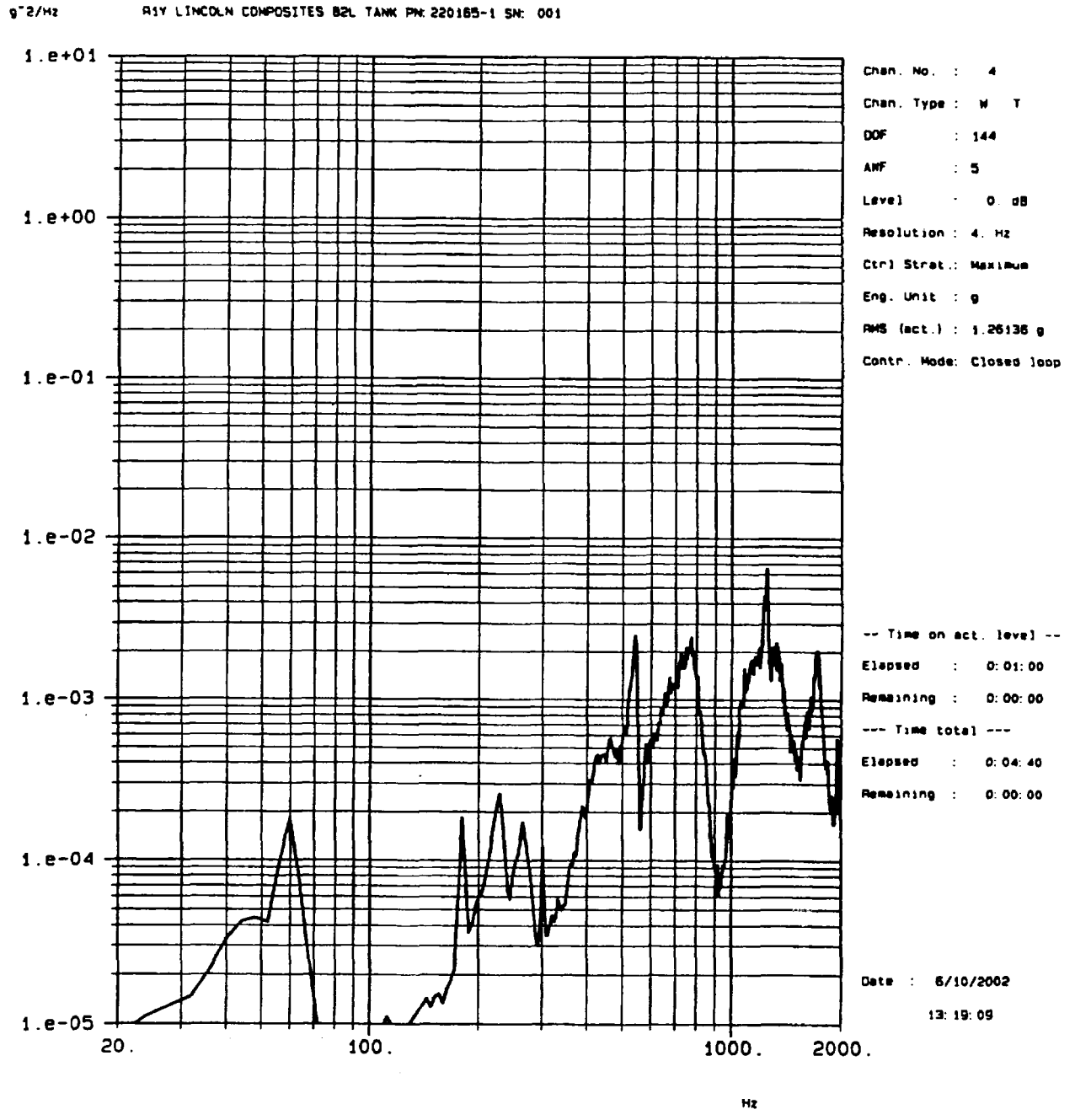
Random Limit Channel

LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 58

Random Limit Channel

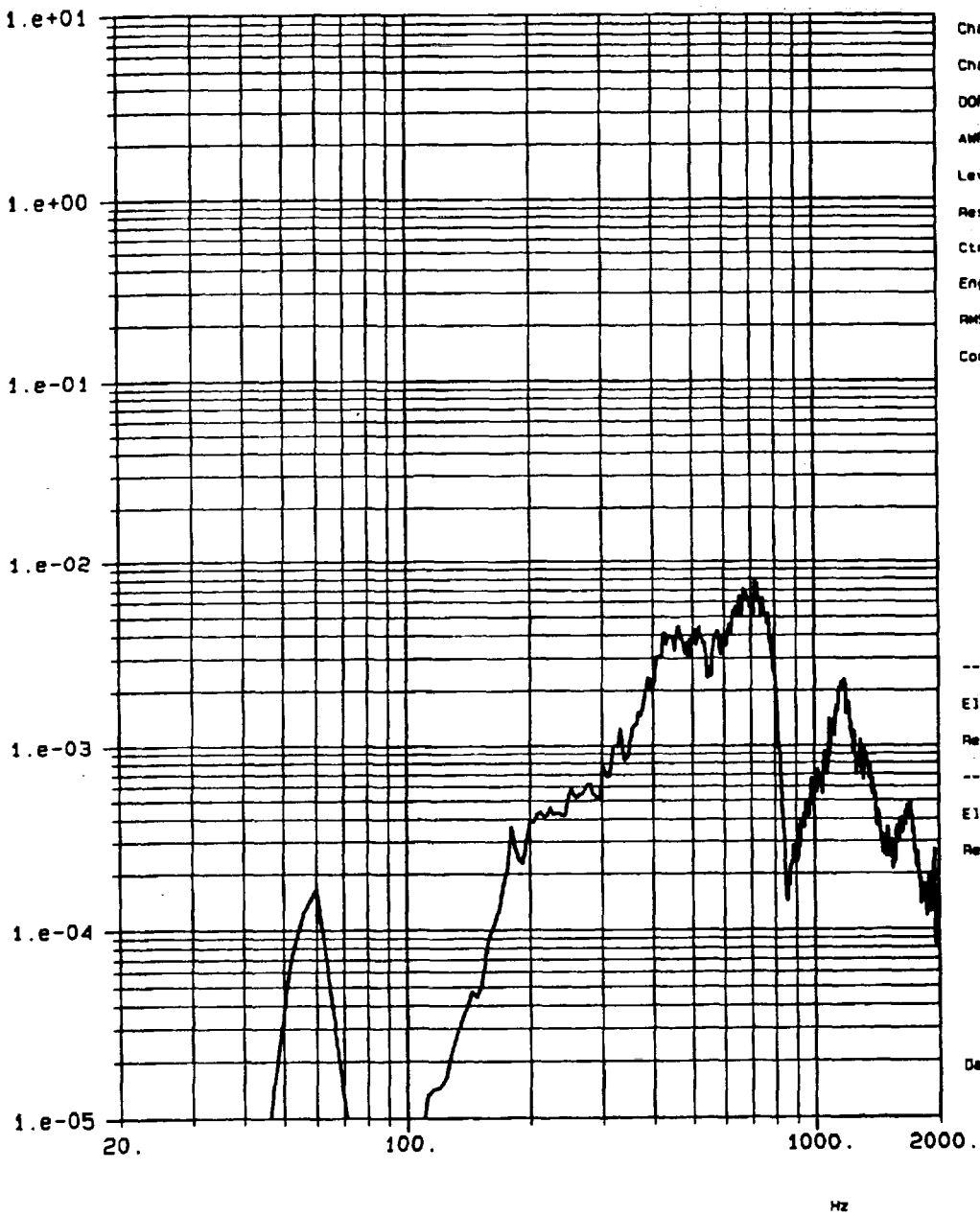
LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA

g^2/Hz R1Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 5
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 1.63248 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:04:40
Remaining : 0:00:00

Date : 6/10/2002
13:19:09

RANDOM PLOT NO. 59

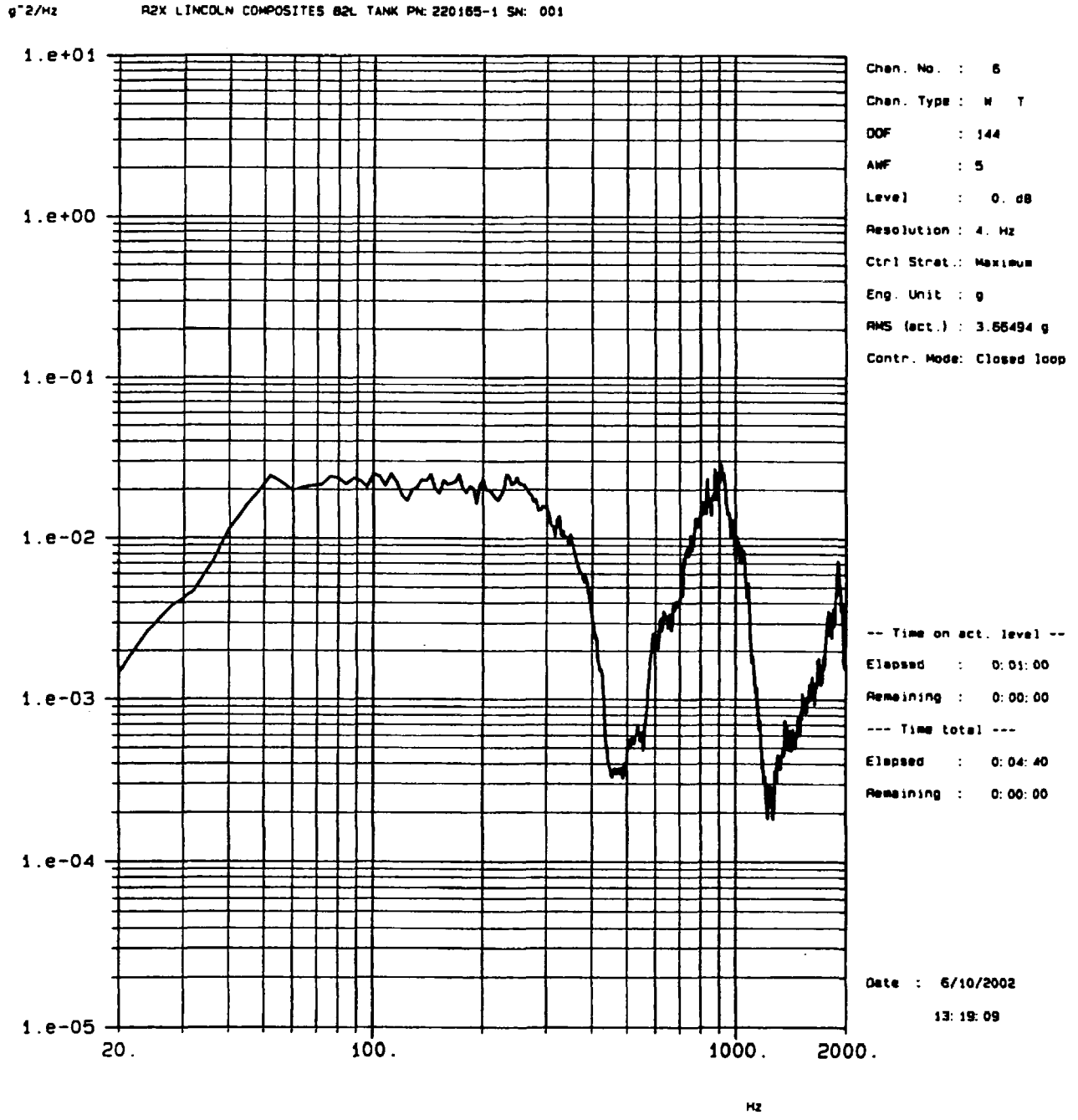
Random Limit Channel

LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 60

Random Limit Channel

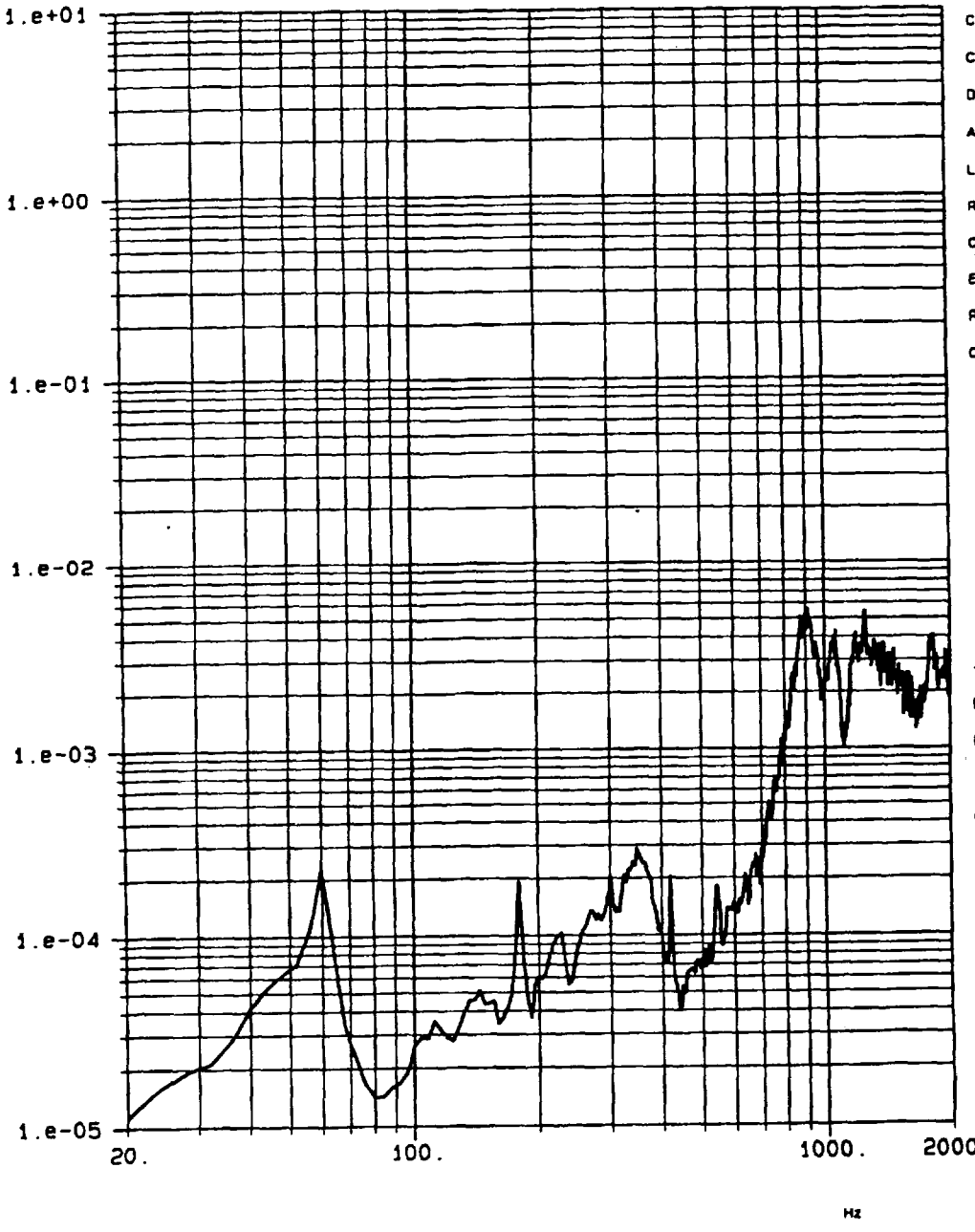
LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA

g^2/Hz R2Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 7
Chan. Type : N T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 1.84652 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:04:40
Remaining : 0:00:00

Date : 6/10/2002
13:19:09

RANDOM PLOT NO. 61

Random Limit Channel

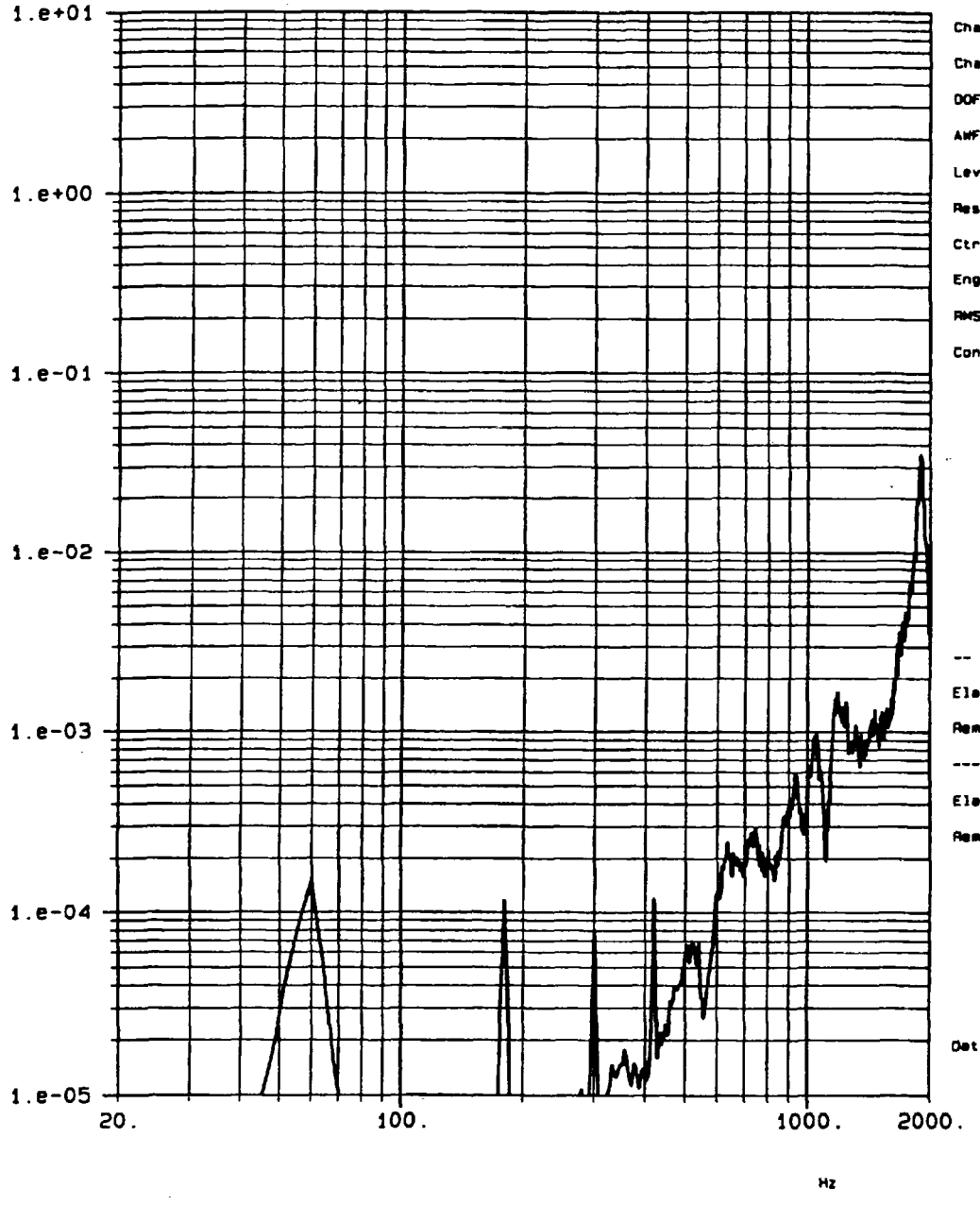
LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA

g^2/Hz R2Z LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 8
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 2.14846 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:04:40
Remaining : 0:00:00

Date : 6/10/2002
13:19:09

RANDOM PLOT NO. 62

Random Limit Channel

LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

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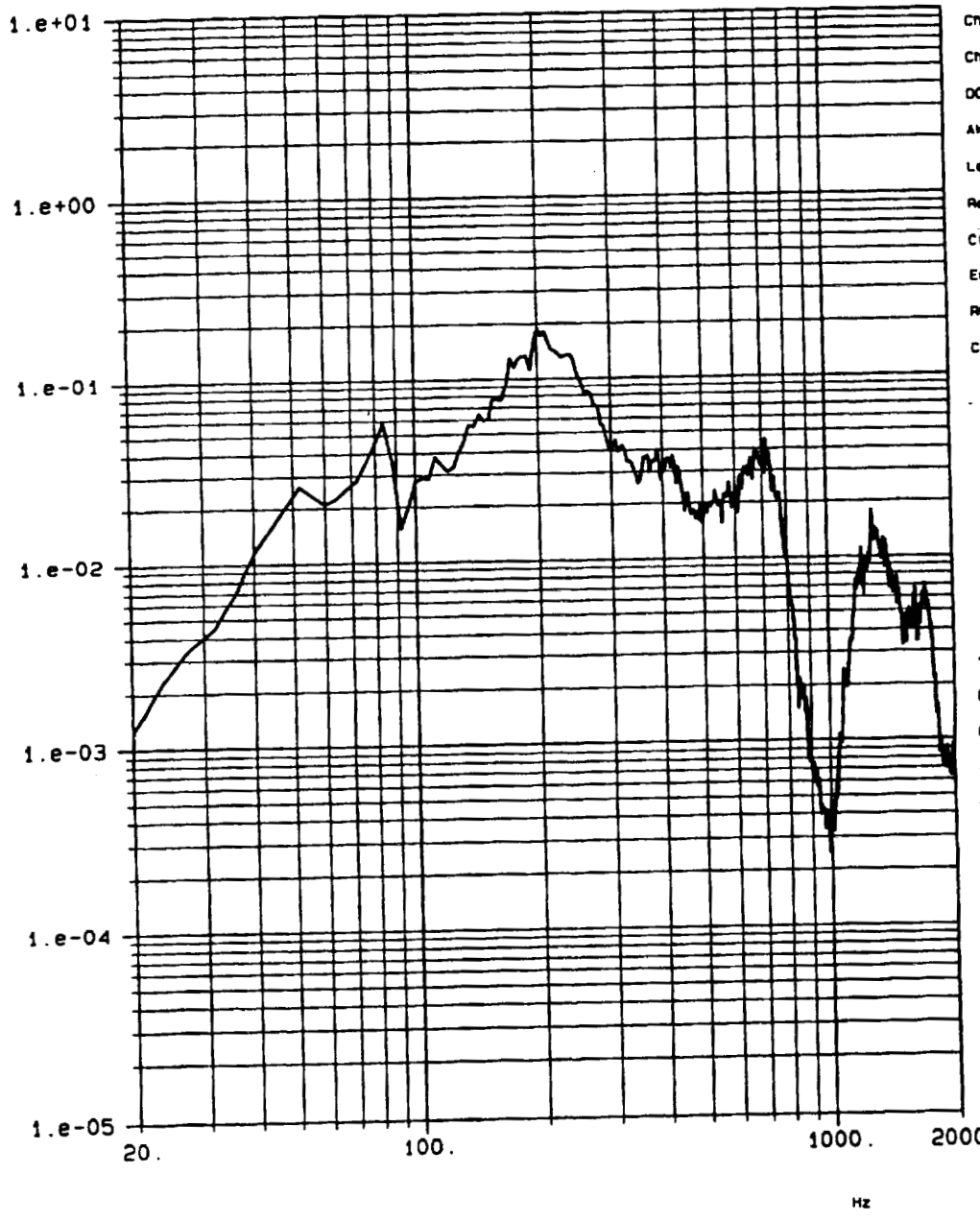
g^2/Hz R3X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 6.24001 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:04:40
Remaining : 0:00:00

Date : 6/10/2002
13:19:09

RANDOM PLOT NO. 63

Random Limit Channel

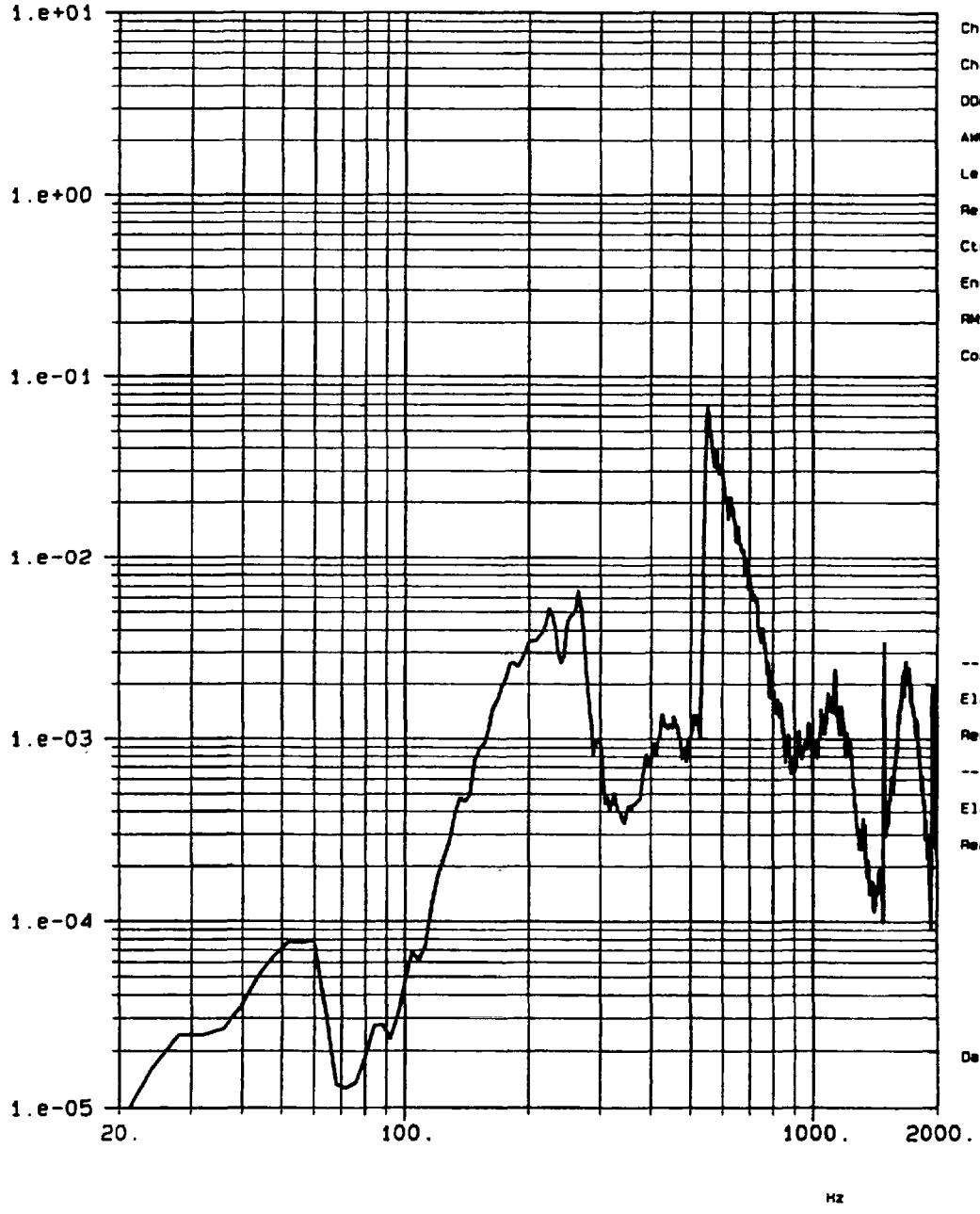
LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA

g^2/Hz R3Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 10
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 2.466 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:04:40
Remaining : 0:00:00

Date : 6/10/2002
13:19:09

RANDOM PLOT NO. 64

Random Limit Channel

LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

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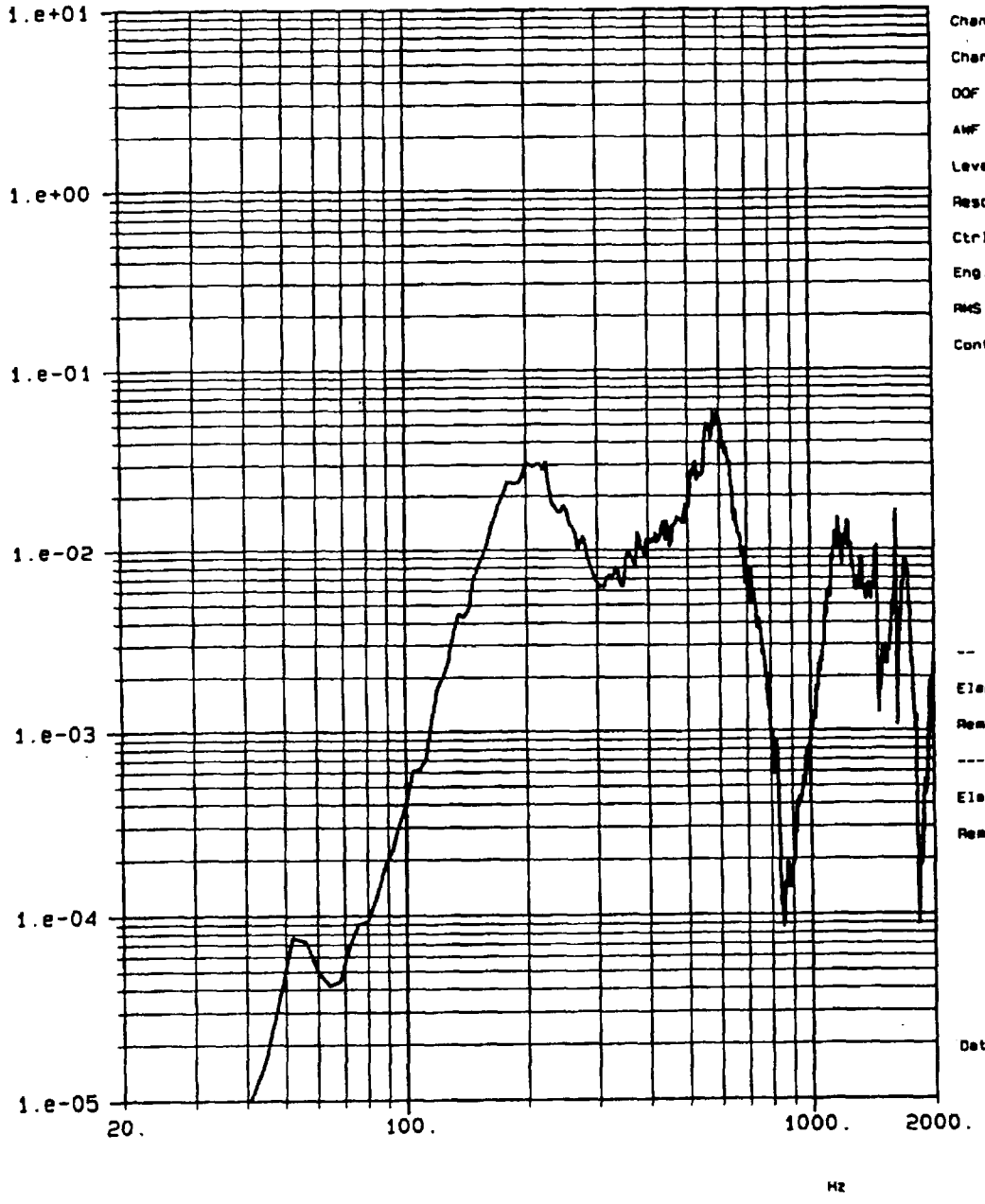
g^2/Hz R3Z LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 11
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 4.05707 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:04:40
Remaining : 0:00:00

Date : 6/10/2002
13:19:09

RANDOM PLOT NO. 65

Random Limit Channel

LINCOLN47039 ACCPT

X/AXIS ACCEPTANCE LEVEL

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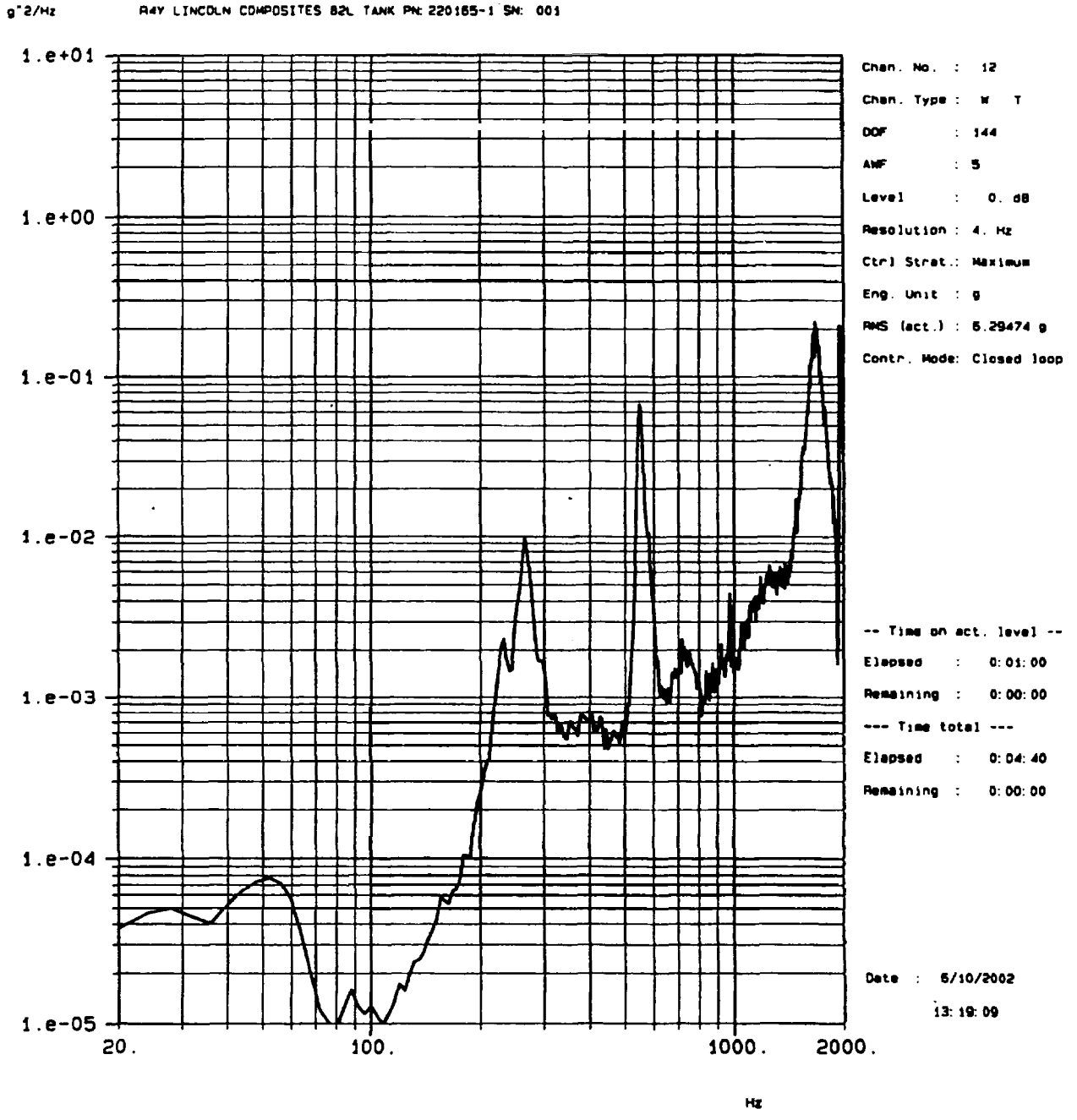

DYN-D

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DYNAMICS SECTION
VIBRATION TEST DATA SHEET

Customer: Lincoln Composites

Job No. 47039

Sheet 1 of 1

Specimen: 82 Liter Pressure Vessel

P/N: 220165-1

S/N: 0001

Date	Time	Axis	Temp (°F)	SINUSOIDAL Freq. (Hz)	SINUSOIDAL Disp. (inDA)	SINUSOIDAL Accel. (± G)	Test Time (Min.)	Comments	Plot No.
6/5/02	2018	X	AMB	5-22.6	.5			Completed Qualification Level Sine with no apparent damage.	1-13
				22.6-50		13		Tank filled with 312 lbs of PF5060, pressure at 2700 psi.	
				50-100		5.2	2.15	Extremal control using C1 and C2.	

W603SS-ES

Signed Stuart L Cross

REPORT NO. 47039
PAGE NO. DYN.D.2

SINUSOIDAL PLOT NO. 1

Sine Control

LINCOLN 47039 QUAL

X AXIS SINE QUAL

MAXIMUM OF C1 & C2

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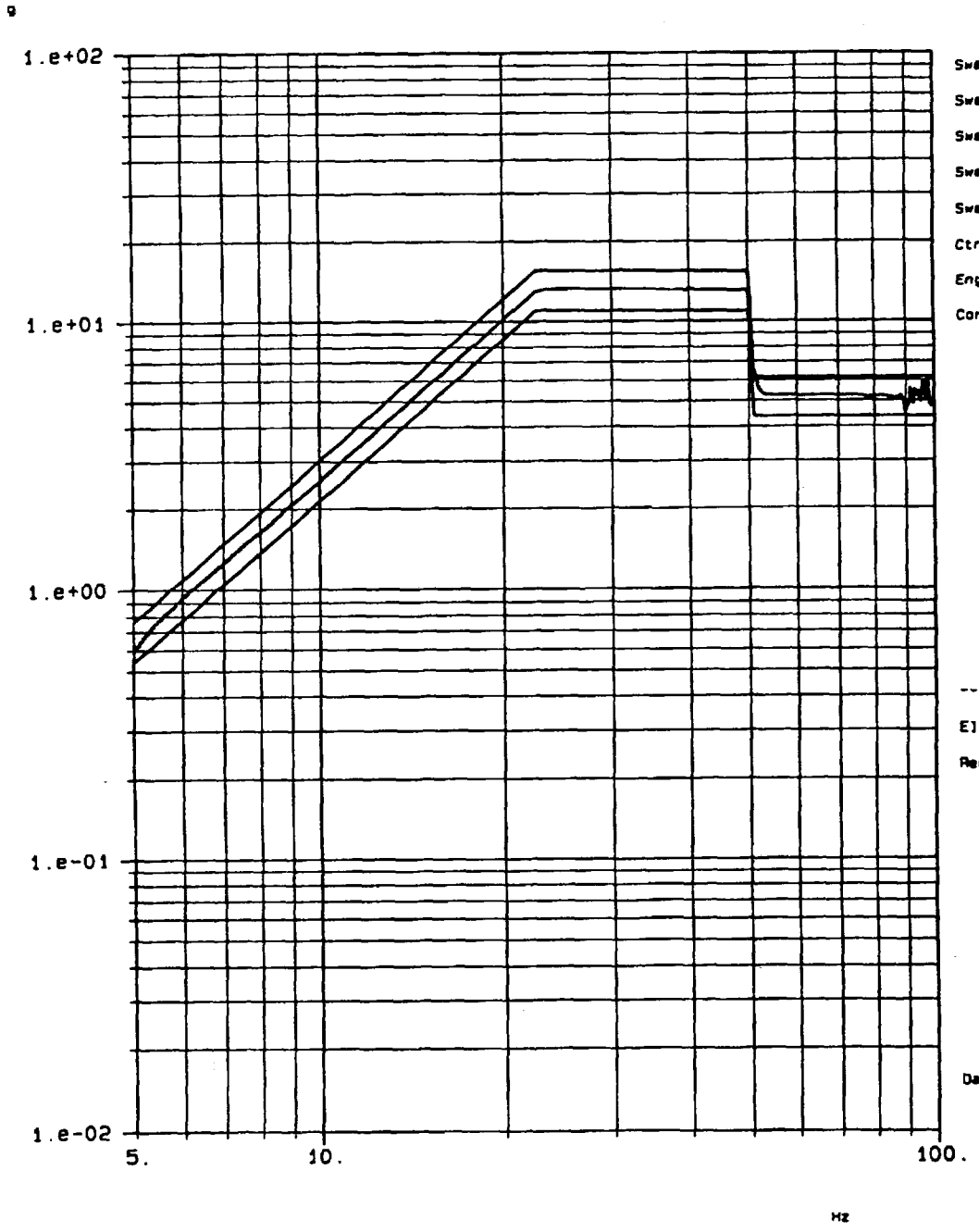

Sweep Type : log

Sweeps Done: 1

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Maximum

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:02:09

Remaining : 0:00:00

Date : 6/ 5/2002

20:18:55

SINUSOIDAL PLOT NO. 2

Sine Control/Limit Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

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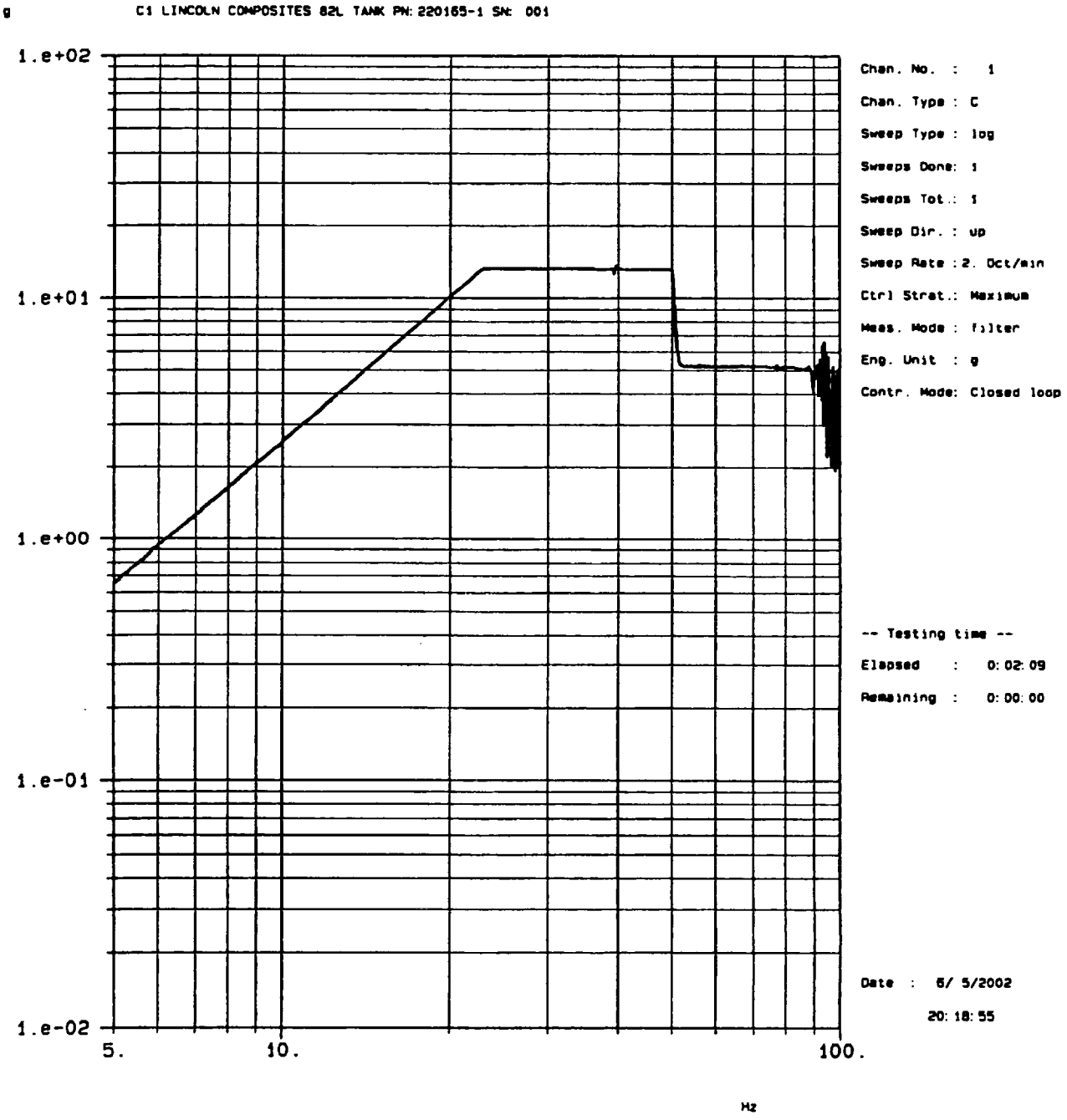

SINUSOIDAL PLOT NO. 3

Sine Control/Limit Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

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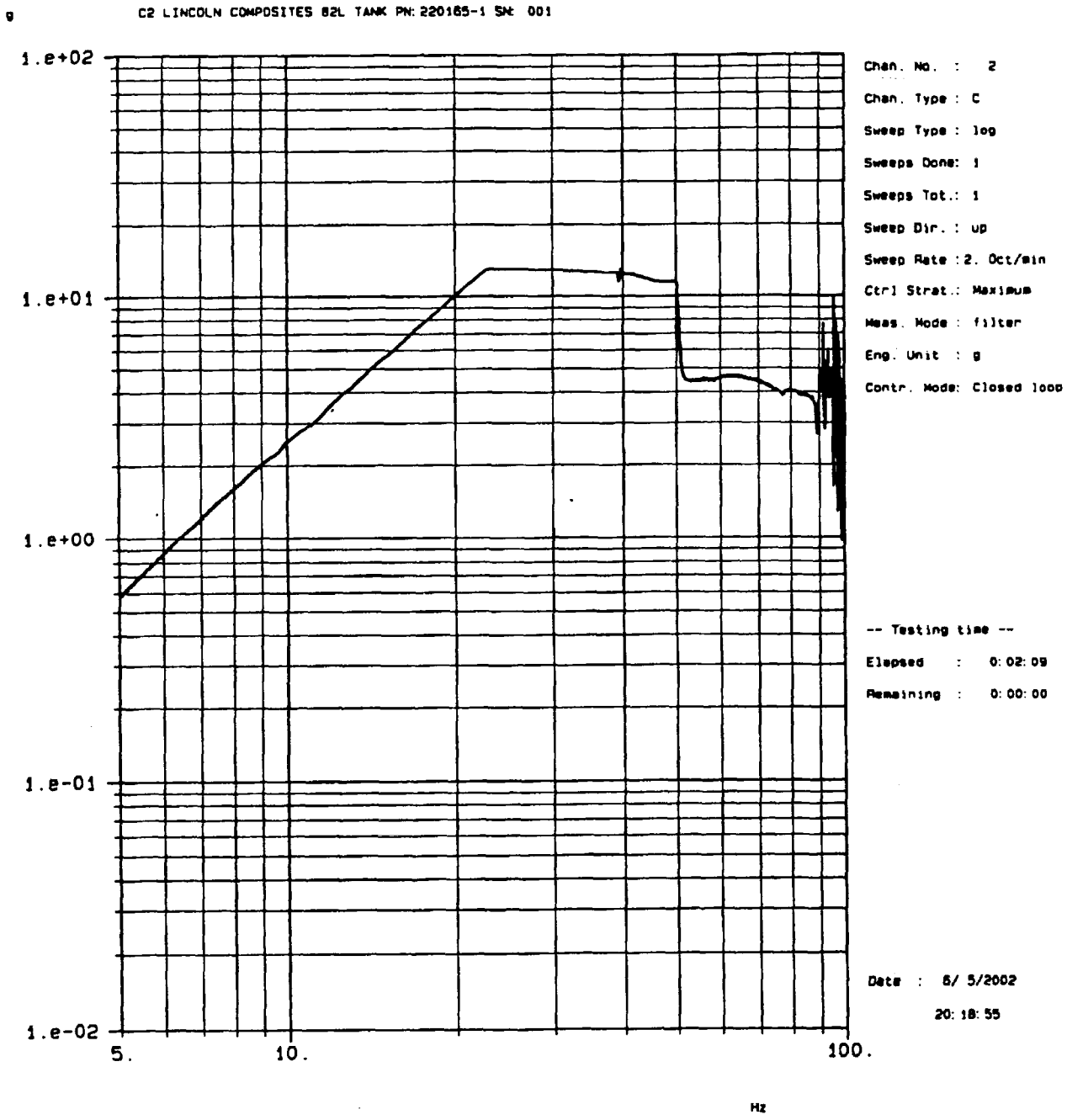
El Segundo, CA



SINUSOIDAL PLOT NO. 4

Sine Meas. Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

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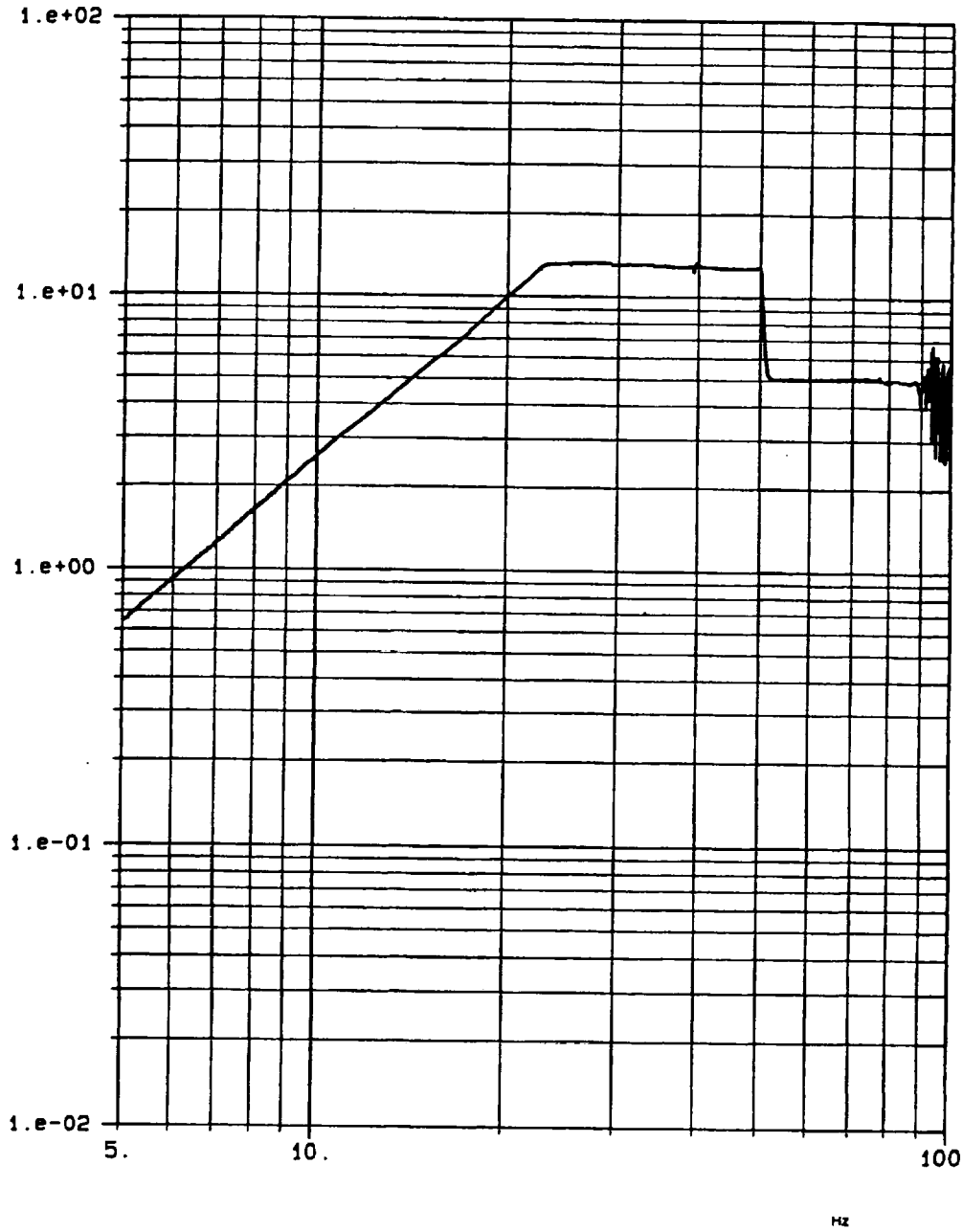
El Segundo, CA

9 R1X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 3
Chan. Type : M
Sweep Type : log
Sweeps Done: 1
Sweeps Tot.: 1
Sweep Dir. : up
Sweep Rate : 2. Oct/min
Ctrl Strat.: Maximum
Meas. Mode : filter
Eng. Unit : g
Contr. Mode: Closed loop

-- Testing time --
Elapsed : 0:02:09
Remaining : 0:00:00

Date : 6/ 5/2002
20:18:55

SINUSOIDAL PLOT NO. 5

Sine Meas. Channel

LINCOLN 47039 DUAL

X AXIS SINE DUAL

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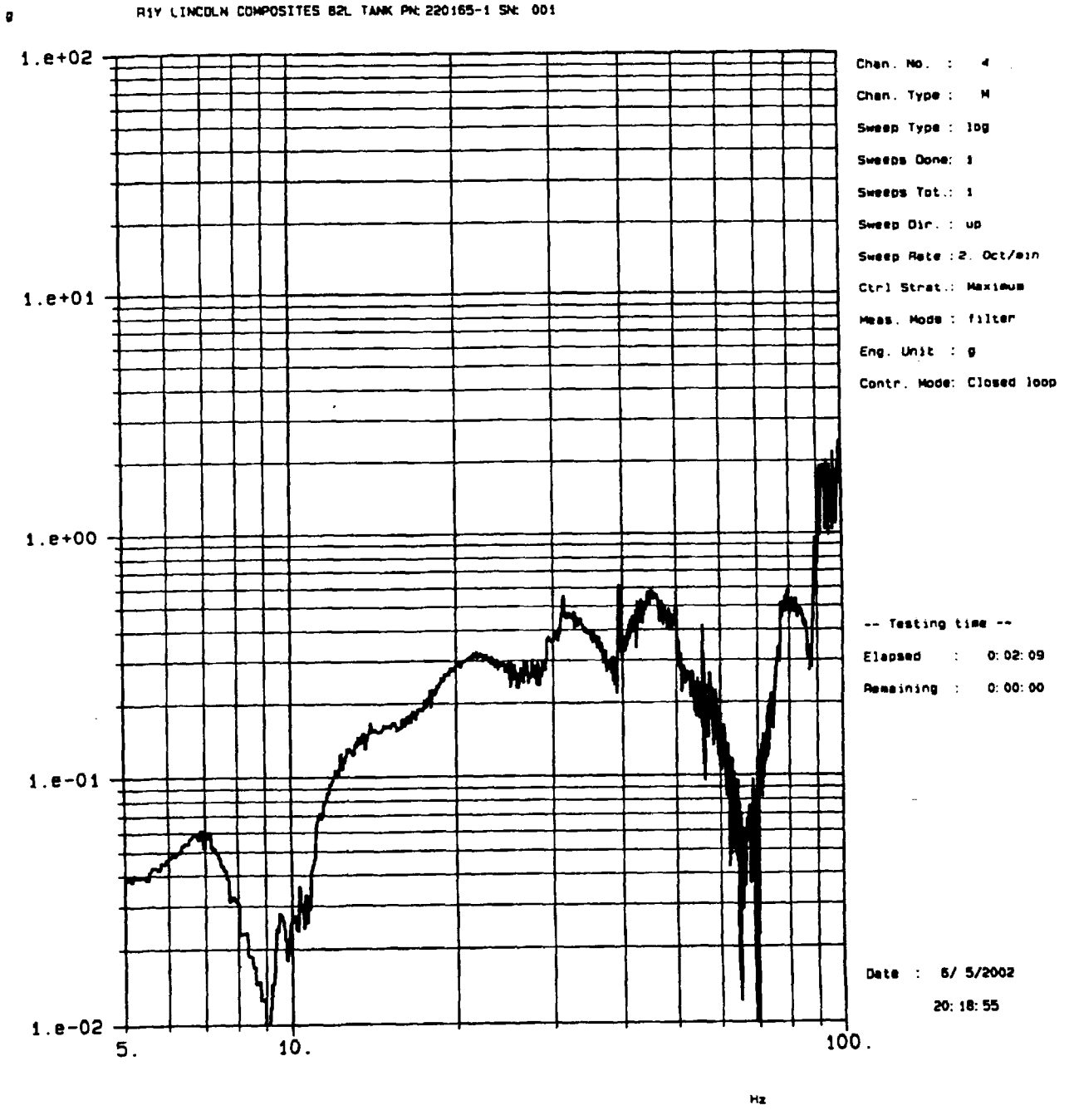


SINUSOIDAL PLOT NO. 6

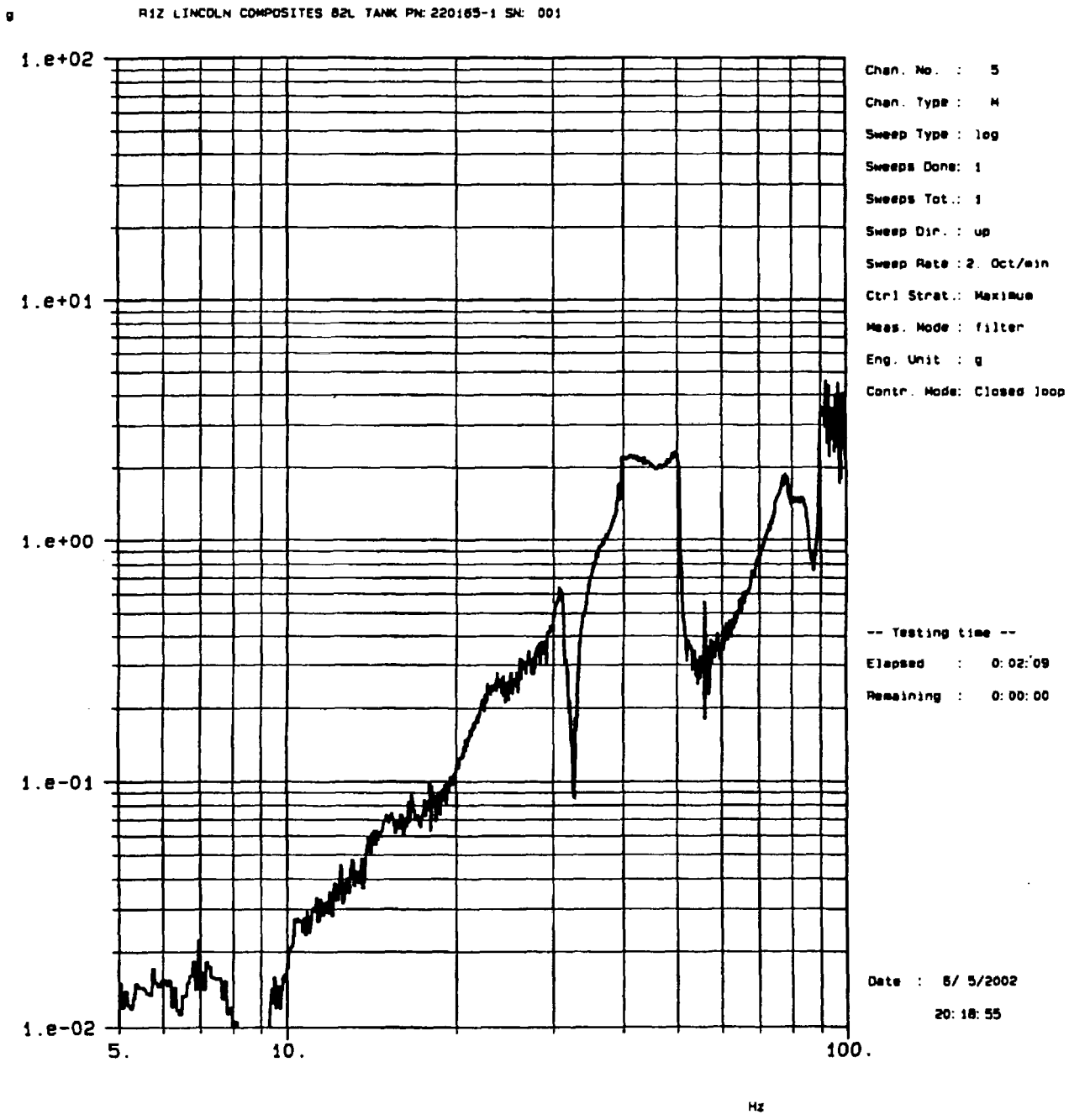
Sine Meas. Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

Wyle Laboratories

El Segundo, CA



SINUSOIDAL PLOT NO. 7

Sine Meas. Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

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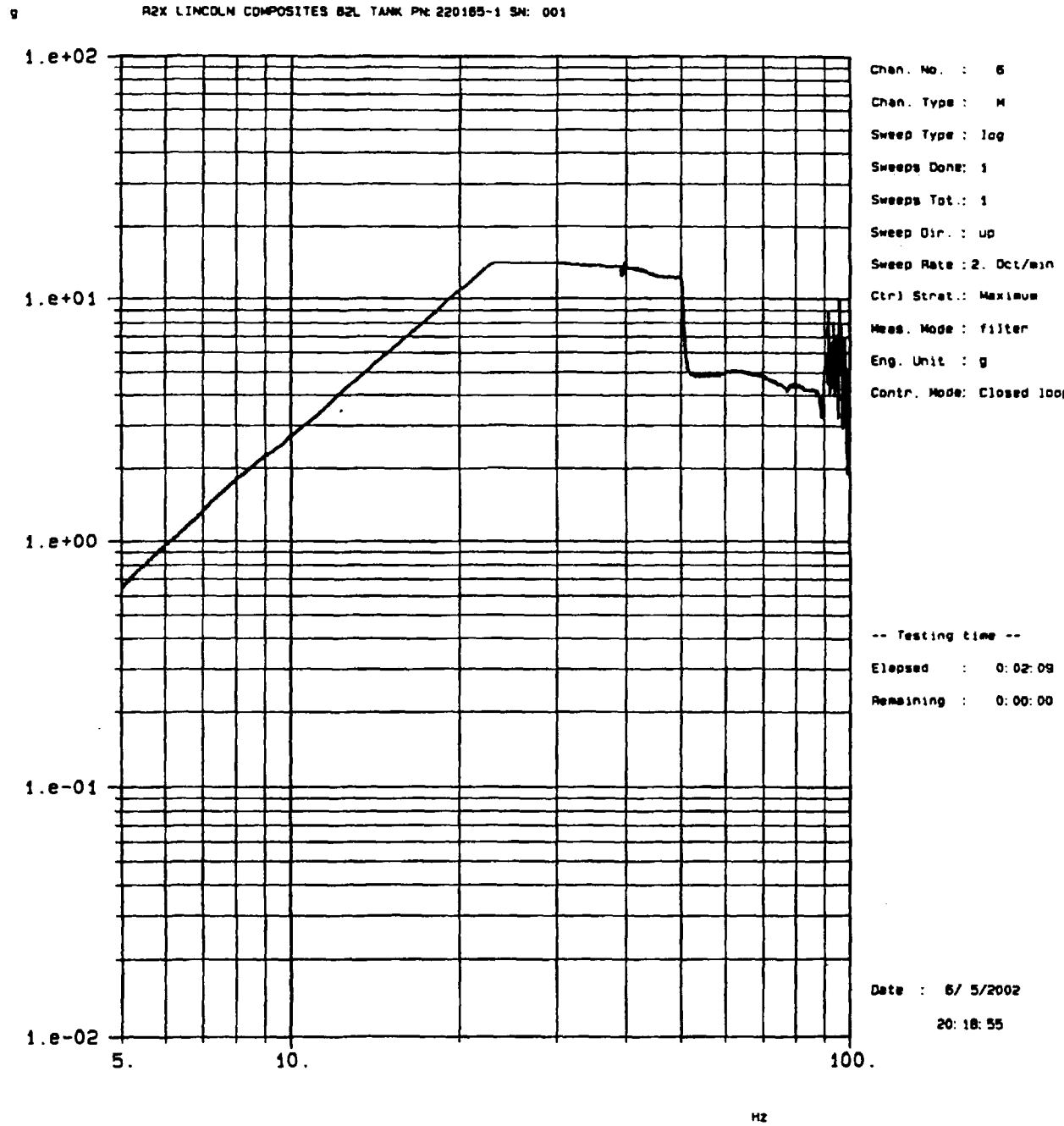
El Segundo, CA



SINUSOIDAL PLOT NO. 8

Sine Meas. Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

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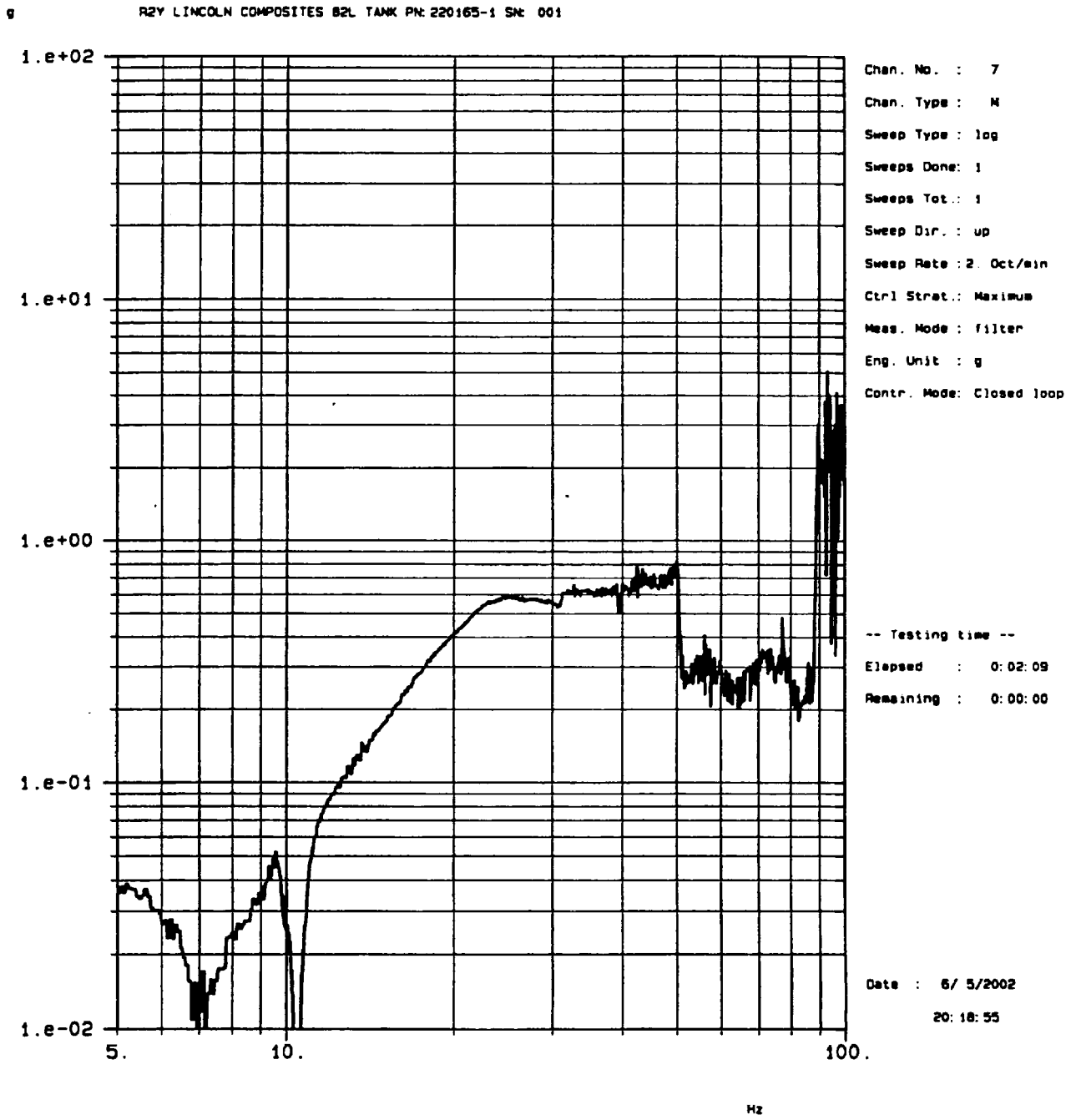
El Segundo, CA



SINUSOIDAL PLOT NO. 9

Sine Meas. Channel

LINCOLN 47039 DUAL

X AXIS SINE DUAL

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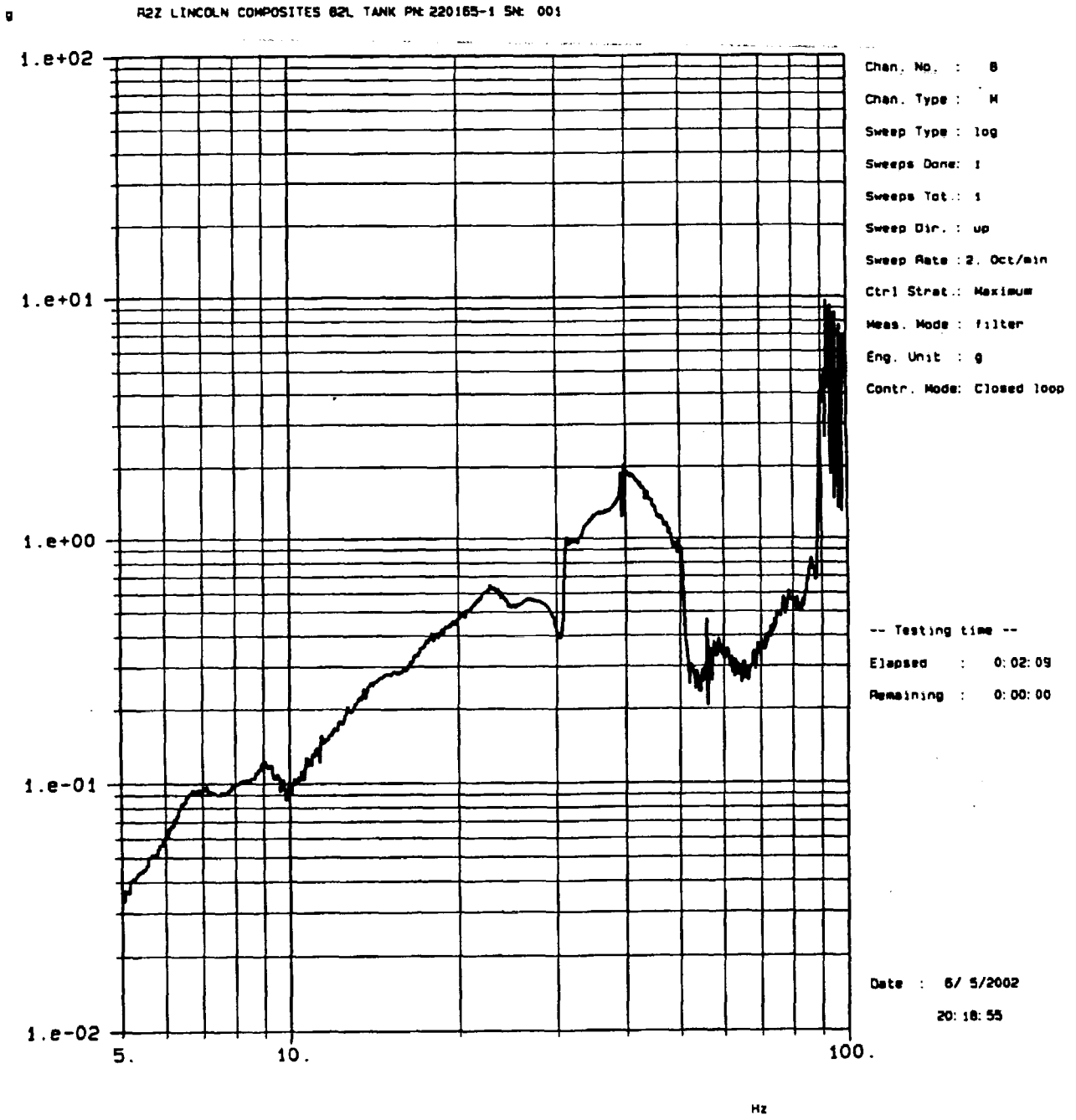
El Segundo, CA



SINUSOIDAL PLOT NO. 10

Sine Meas. Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

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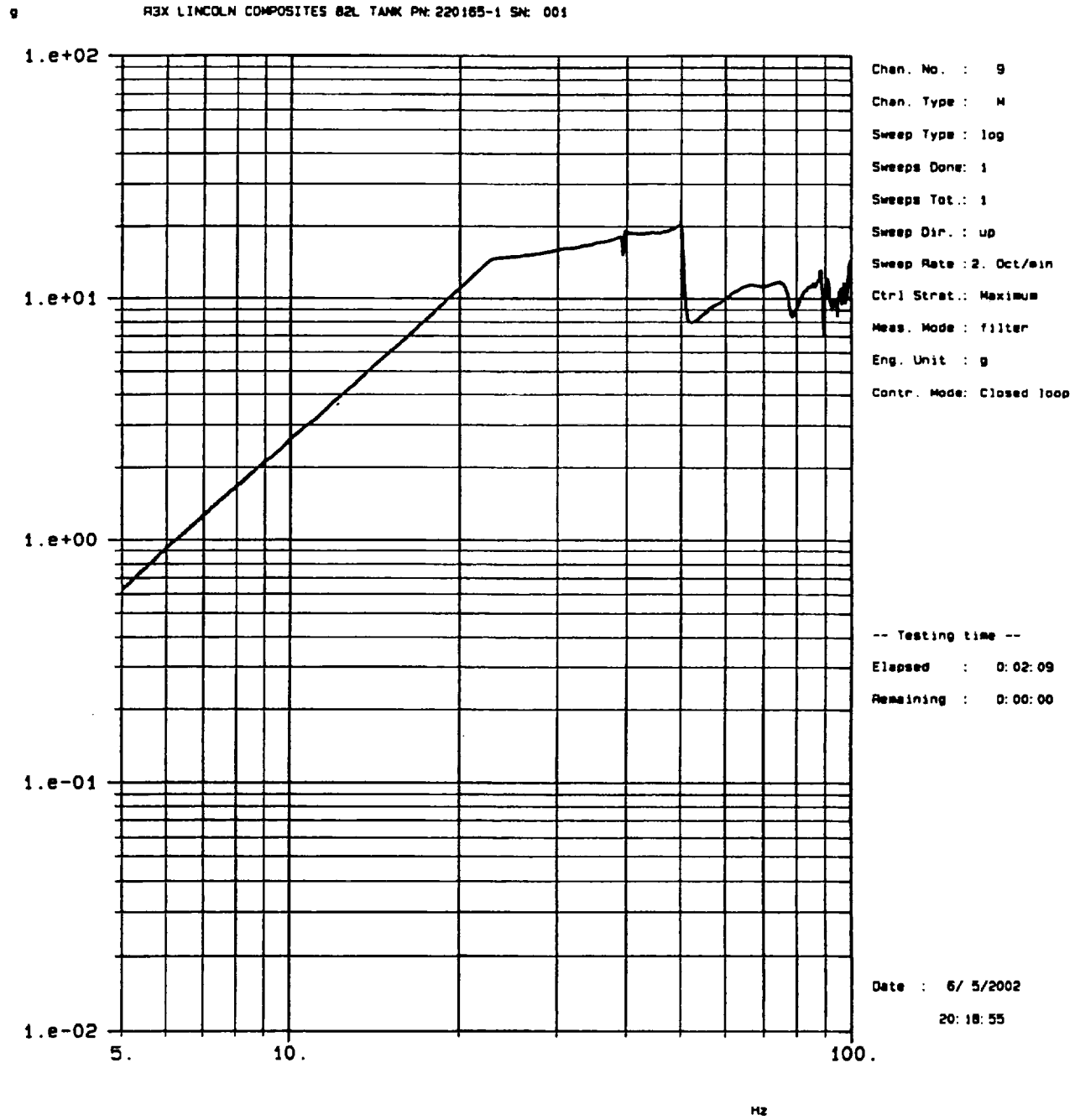
El Segundo, CA



SINUSOIDAL PLOT NO. 11

Sine Meas. Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

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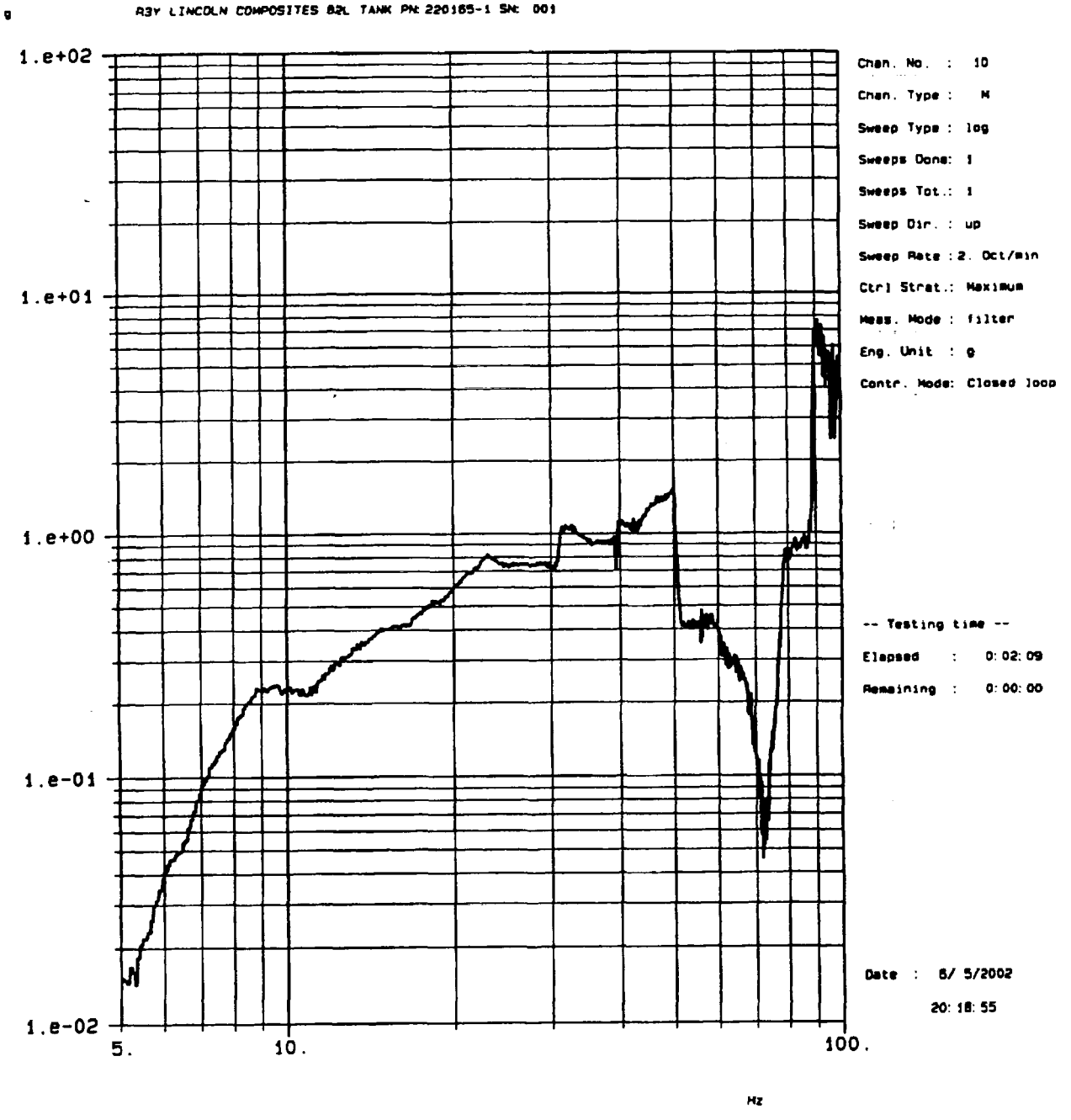
El Segundo, CA



SINUSOIDAL PLOT NO. 12

Sine Meas. Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

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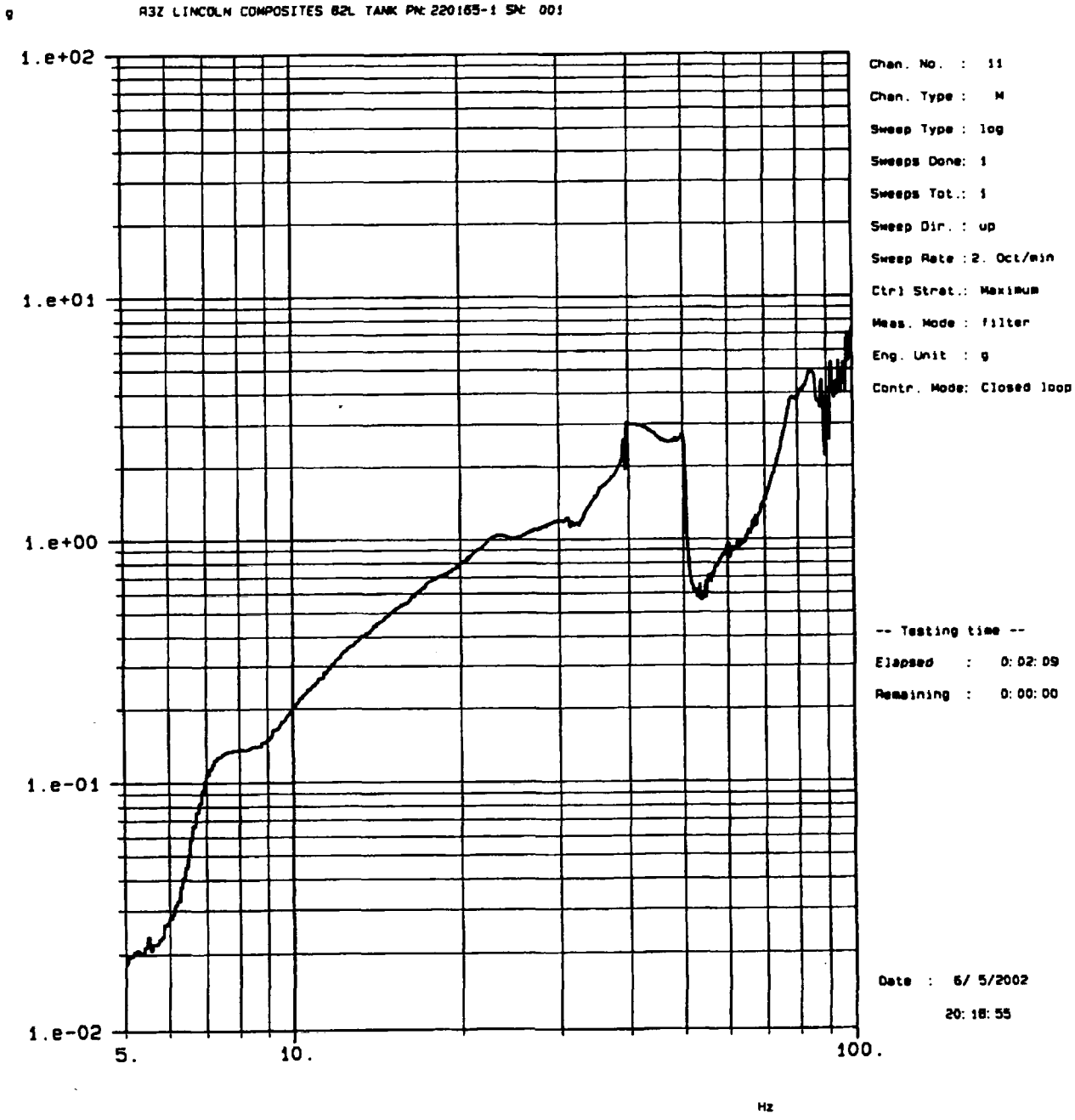
El Segundo, CA



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SINUSOIDAL PLOT NO. 13

Sine Meas. Channel

LINCOLN 47039 QUAL

X AXIS SINE QUAL

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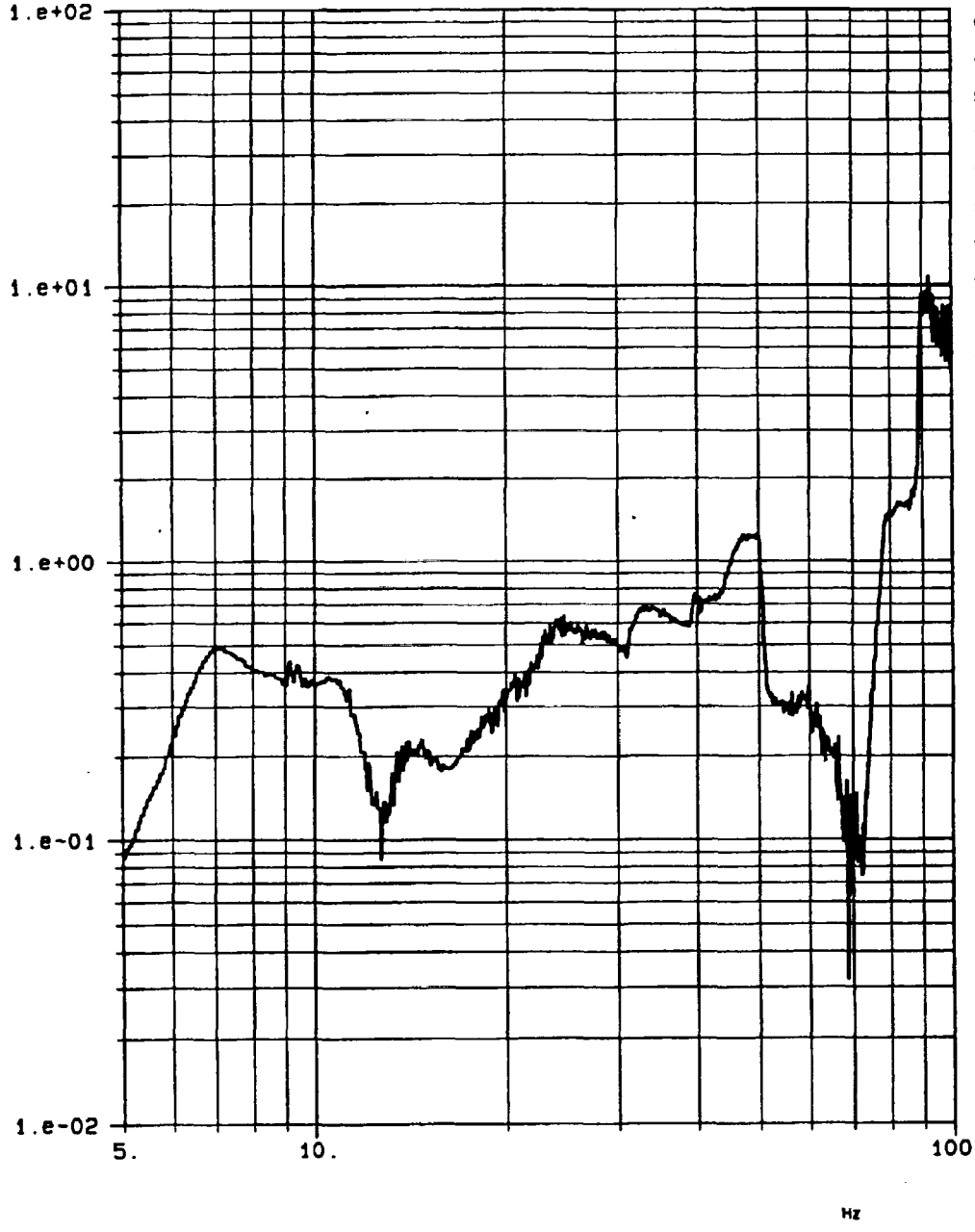
El Segundo, CA

g

R4Y LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 12

Chan. Type : H

Sweep Type : log

Sweeps Done: 1

Sweeps Tot.: 1

Sweep Dir. : up

Sweep Rate : 2. Oct/min

Ctrl Strat.: Maximum

Meas. Mode : filter

Eng. Unit : g

Contr. Mode: Closed loop

-- Testing time --

Elapsed : 0:02:09

Remaining : 0:00:00

Date : 6/ 5/2002

20:18:55

DYN-E

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RECEIVING INSPECTION DATA SHEET

Customer	LINCOLN COMPOSITES	Date	6-25-2002
Specimen	82 Liter Tank (with Filter Assembly)	Job No.	47039

No. of Specimens Received: ONE

Record identification information exactly as it appears on the tag or specimen:

Manufacturer LINCOLN COMPOSITES

P/N's	S/N's
220165-1	001

How Does identification information appear: (e.g. name plate, tag, painted, imprinted, etc) PAINTED

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification

Inspection Results: There was no visible evidence of damage to the specimen(s) unless otherwise noted below.

NO VISIBLE DAMAGE TO SPECIMEN ON RECEIVING OF SPECIMEN

Inspected By R.G.PARAMORE

Sheet Number 1 of 1

Approved [signature] Date 6-25-02

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REPORT NO. 47039
PAGE NO. DYN.E.3

RECEIVING INSPECTION DATA SHEET

Customer	LINCOLN COMPOSITES	Date	7-2-2002
Specimen	82 Liter Tank (with Filter Assembly)	Job No.	47039

No. of Specimens Received: ONE

Record identification information exactly as it appears on the tag or specimen:

Manufacturer LINCOLN COMPOSITES

P/N's	S/N's
220165-1	001

How Does identification information appear: (e.g. name plate, tag, painted, imprinted, etc) PAINTED

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification

Inspection Results: There was no visible evidence of damage to the specimen(s) unless otherwise noted below.

NO VISIBLE DAMAGE TO SPECIMEN ON RECEIVING OF SPECIMEN

Inspected By R.G.PARAMORE

Sheet Number 1 of 1

Approved [signature] Date 7-2-02

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RECEIVING INSPECTION DATA SHEET

Customer	LINCOLN COMPOSITES	Date	7-15-2002
Specimen	82 Liter Tank (with Filter Assembly)	Job No.	47039

No. of Specimens Received: ONE

Record identification information exactly as it appears on the tag or specimen:

Manufacturer LINCOLN COMPOSITES

P/N's	S/N's
220165-1	001

How Does identification information appear: (e.g. name plate, tag, painted, imprinted, etc) PAINTED

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification

Inspection Results: There was no visible evidence of damage to the specimen(s) unless otherwise noted below.

NO VISIBLE DAMAGE TO SPECIMEN ON RECEIVING OF SPECIMEN

Inspected By R.G.PARAMORE

Sheet Number 1 of 1

Approved [signature] Date 7-15-02

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RECEIVING INSPECTION DATA SHEET

Customer	LINCOLN COMPOSITES	Date	7-22-2002
Specimen	82 Liter Tank (with Filter Assembly)	Job No.	47039

No. of Specimens Received: ONE

Record identification information exactly as it appears on the tag or specimen:

Manufacturer LINCOLN COMPOSITES

P/N's	S/N's
220165-1	001

How Does identification information appear: (e.g. name plate, tag, painted, imprinted, etc) PAINTED

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification

Inspection Results: There was no visible evidence of damage to the specimen(s) unless otherwise noted below.

NO VISIBLE DAMAGE TO SPECIMEN ON RECEIVING OF SPECIMEN

Inspected By R.G.PARAMORE

Sheet Number 1 of 1

Approved [signature] Date 7-22-02

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REPORT NO. 47039
PAGE NO. DYN.E.6

Test **PRESSURIZATION**

Customer	Lincoln Composites	**Specimen**	82 Liter Pressure Vessel	**Date**	6/25/02 thru 7/23/02
Part No.	220165-1	**S/N**	001	**Job No.**	47039
Test By	R G Paramore	**Witness**		**Page No.**	1 of 1

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION		ACCURACY
					LAST	DUE	
Pressure Gauge	Ashcroft	N/A	0-3000 psig	7551	4/24/02	8/19/02	± .5%
Temp. Indicator	Doric	600	-327/+752°F	13912	5/23/02	9/23/02	± 2.0°F

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PRESSURE HISTORY LOG

Job No. 47039

Customer LINCOLN COMPOSITES

Page No. 1 of 1

Specimen 82L Pressure Vessel Part No. 220165-1 Serial No. 001

Date	Start Time	PRESSURE PSIG	TEMP. °F	Action and Remarks	Initial
6-25-2002	1902	2750	85°F	PRESSURIZED WITH GHe HELD AT 2750 PSIG FOR 5 MINUTES.	R.G.P.
7-3-2002	0608	2750	85°F	PRESSURIZED WITH GHe HELD AT 2750 PSIG FOR 5 MINUTES.	R.G.P.
7-16-2002	0625	2750	110°F	PRESSURIZED WITH GHe HELD AT 2750 PSIG FOR 5 MINUTES.	R.G.P.
7-23-2002	0621	2750	109°F	PRESSURIZED WITH GHe HELD AT 2750 PSIG FOR 5 MINUTES.	R.G.P.

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REPORT NO. 47039
PAGE NO. DYN.E.7

DYN-F

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REPORT NO. 47039
PAGE NO. DYN.F.2

RECEIVING INSPECTION DATA SHEET

Customer	LINCOLN COMPOSITES	Date	7-26-2002
Specimen	82 Liter Tank (with Filter Assembly)	Job No.	47039

No. of Specimens Received: ONE

Record identification information exactly as it appears on the tag or specimen:

Manufacturer LINCOLN COMPOSITES

P/N's	S/N's
220165-1	001

How Does identification information appear: (e.g. name plate, tag, painted, imprinted, etc) PAINTED

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification

Inspection Results: There was no visible evidence of damage to the specimen(s) unless otherwise noted below.

NO VISIBLE DAMAGE TO SPECIMEN ON RECEIVING OF SPECIMEN

Inspected By R.G.PARAMORE

Sheet Number 1 of 1

Approved [signature] Date 7-26-02

W614 QA Form Approval

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Test	RANDOM AND SINUSOIDAL VIBRATION				
Customer	Lincoln Composite	Specimen	82 Liter Pressure Vessel	Date	7/26/02
Part No.	220165-1	S/N	001	Job No.	47039
Test By	Stafford L. Orong	Witness		Page No.	1 of 1

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION		ACCURACY
					LAST	DUE	
Vibration Exciter	Ling	340	30k Force lbs.	SN 80	NA	NA	NA
Power Amplifier	Unholtz-Dickie	2XSA/120 1/2	120/240 kVA	13756	NA	NA	NA
Automatic Vibration Control System	m+p	VCX900	0.1Hz to 12.8 kHz	14004	System Calibration Prior to Use	System Calibration Prior to Use	NA
Random Software	m+p	Rev. 6.2	NA	NA	NA	NA	NA
Mainframe	Hewlett-Packard	E1421B	5 Slots	14007	NA	NA	NA
Digitizer	Hewlett-Packard	E1432A	16 Channels 51.2 kSa/s	13887	6/11/01	6/11/03	± 1%
Oscilloscope	BK Precision	5105	100 MHz	14181	9/19/01	9/19/02	± 3%
Accelerometer	Endevco	7704A-17	1 Hz to 10 kHz 2.5kG Peak	14334	5/9/02	11/9/02	± 5%
Accelerometer	Endevco	7702-50	1 Hz to 6 kHz 2k G Peak	9181	3/14/02	9/14/02	± 5%
Accelerometer	Endevco	2228	3 Hz to 4 kHz 1k G Peak	12009 13300	5/9/02 6/11/02	11/9/02 12/11/02	± 5%
Accelerometer	Endevco	2228	3 Hz to 4 kHz 1k G Peak	12007	5/6/02	11/6/02	± 5%
Accelerometer	Endevco	2226	3 Hz to 5 kHz 1k G Peak	12272 13011	3/14/02 5/9/02	9/14/02 11/9/02	± 5%
Charge Amplifier	PCB	481A30	.5 Hz to 90 kHz 8 Channels	14461 14462	4/16/02 4/23/02	4/16/03 4/23/03	± 2%
Pressure Gauge	Ashcroft	N/A	0-3000 psig	7551	4/24/02	8/19/02	± .5%
Temp. Indicator	Doric	600	-327/+752°F	13912	5/23/02	9/23/02	± 2.0°F

W614C QA Form Approval

wyle Laboratories

DYNAMICS SECTION
VIBRATION TEST DATA SHEET

Customer: Lincoln Composites Job No. 47039

Sheet 1 of 1

Specimen: 82 Liter Pressure Vessel P/N: 220165-1 S/N: 001

Date	Time	Axis	Temp (°F)	RANDOM SPECTRUM Freq. (Hz)	PSD G^2/Hz	PSD dB/Oct	Overal (G_{rms})	Test Time (Sec.)	Comments	Ref Plot No.
7/29/02	0707	X	AMB	20	.0013				Completed Acceptance level with no apparent damage.	1-13
				20-50		+ 9			Tank pressurized with Helium to 2750 psi.	
				50-300	.02				Extremal control using C1 and C2.	
				300-2k		- 6				
				2k	.00046		3.2	60		

W603SS-ES

Signed Stephen L Orozy

REPORT NO. 47039
PAGE NO. DYN.F.4

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RANDOM PLOT NO. 1

Random Control

LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

MAXIMUM OF C1 & C2

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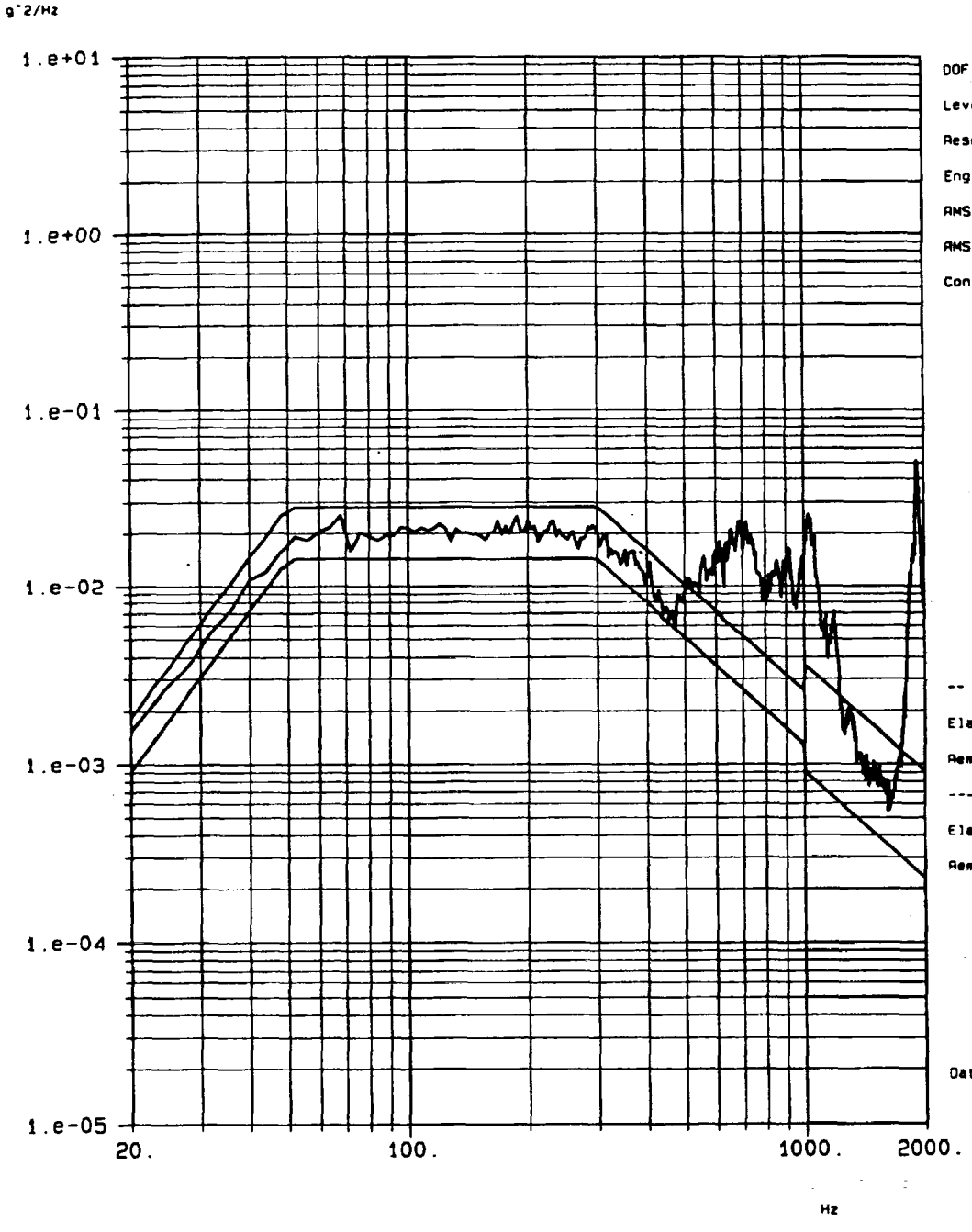


DOF : 288

Level : 0. dB

Resolution : 4. Hz

Eng. Unit : g

RMS (act.) : 4.59415 g

RMS (ref.) : 3.22026 g

Contr. Mode: Closed loop

-- Time on act. level --

Elapsed : 0:01:00

Remaining : 0:00:00

--- Time total ---

Elapsed : 0:07:26

Remaining : 0:00:00

Date : 7/29/2002

7:07:22

RANDOM PLOT NO. 2

Random Control Channel

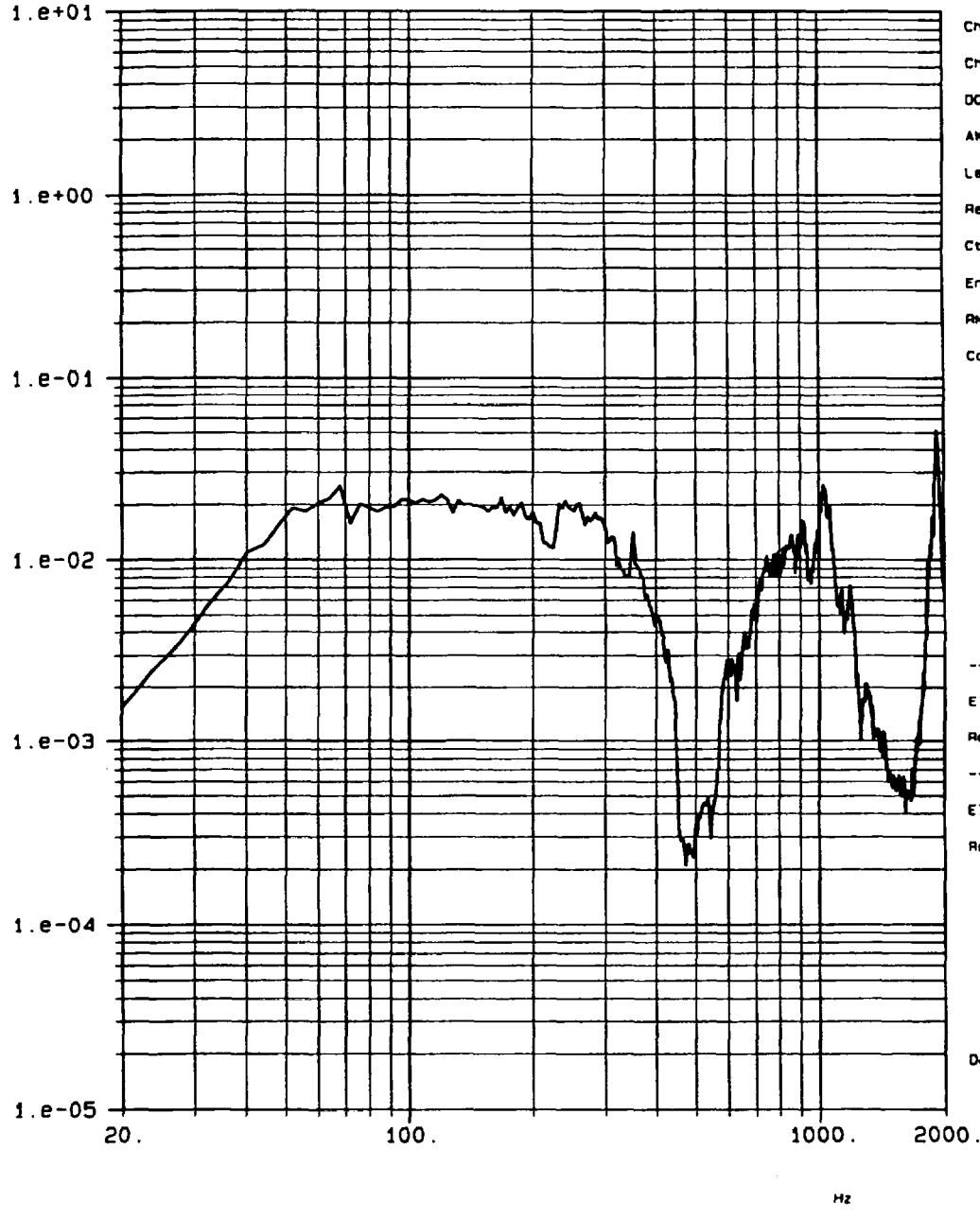
LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA

g^2/Hz C1 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 1
Chan. Type : C
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 4.0273 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:07:26
Remaining : 0:00:00

Date : 7/29/2002
7:07:22

RANDOM PLOT NO. 3

Random Control Channel

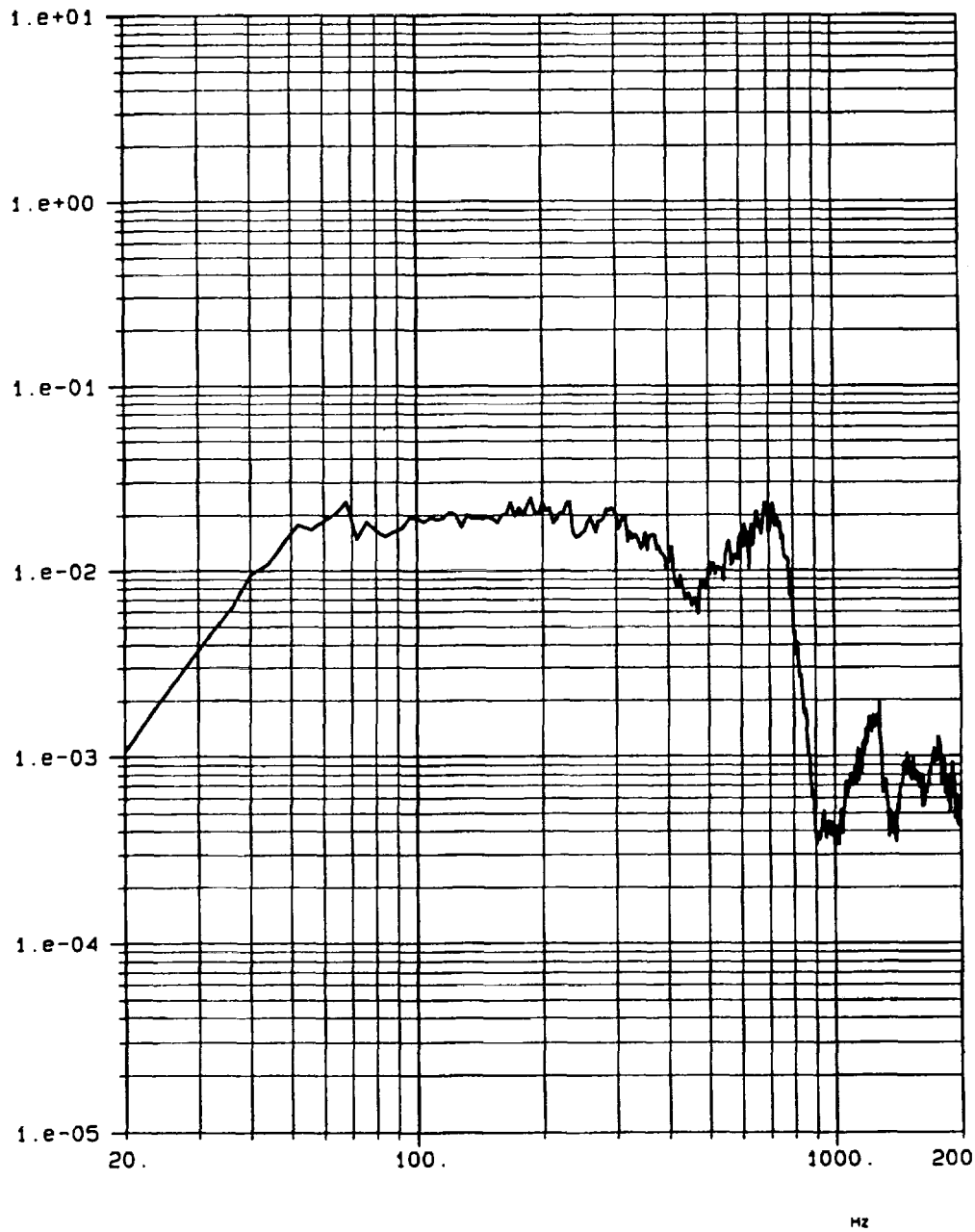
LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA

g^2/Hz C2 LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 2
Chan. Type : C
DOF : 144
AWF : 5
Level : 0 dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 3.58124 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:07:26
Remaining : 0:00:00

Date : 7/29/2002
7:07:22

RANDOM PLOT NO. 4

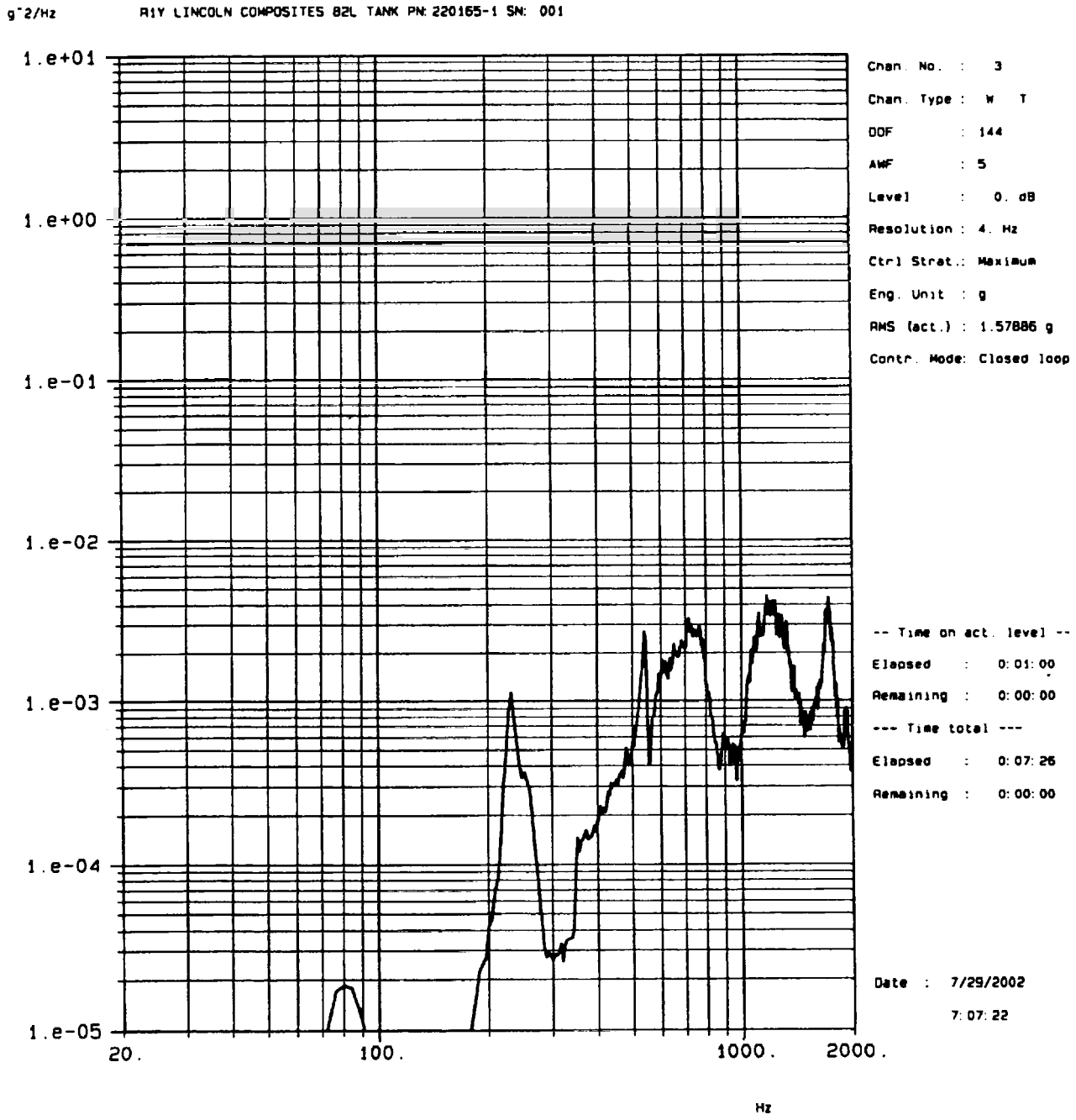
Random Limit Channel

LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 5

Random Limit Channel

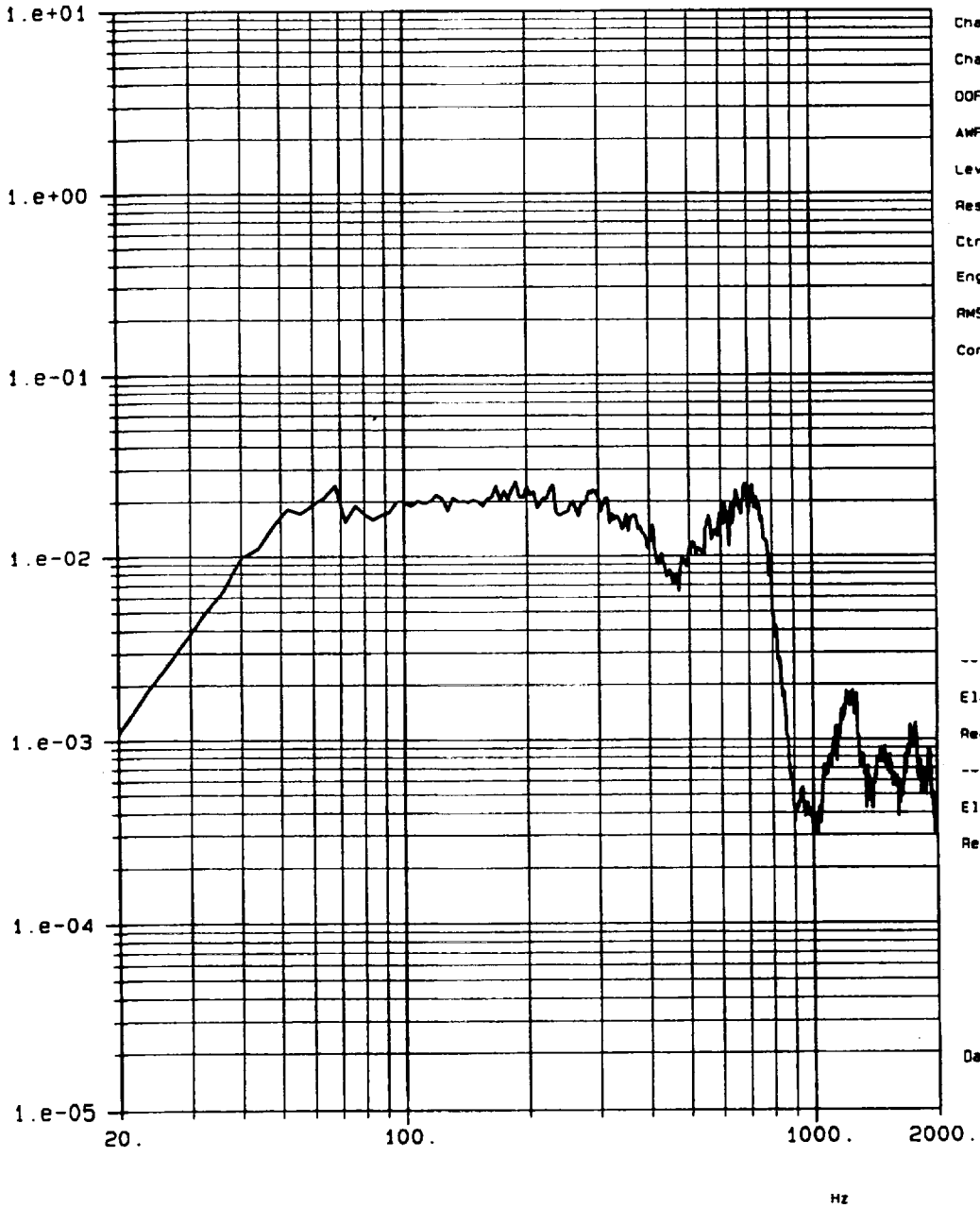
LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA

g^2/Hz R1X LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 4
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 3.67731 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:07:26
Remaining : 0:00:00

Date : 7/29/2002
7:07:22

RANDOM PLOT NO. 6

Random Limit Channel

LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

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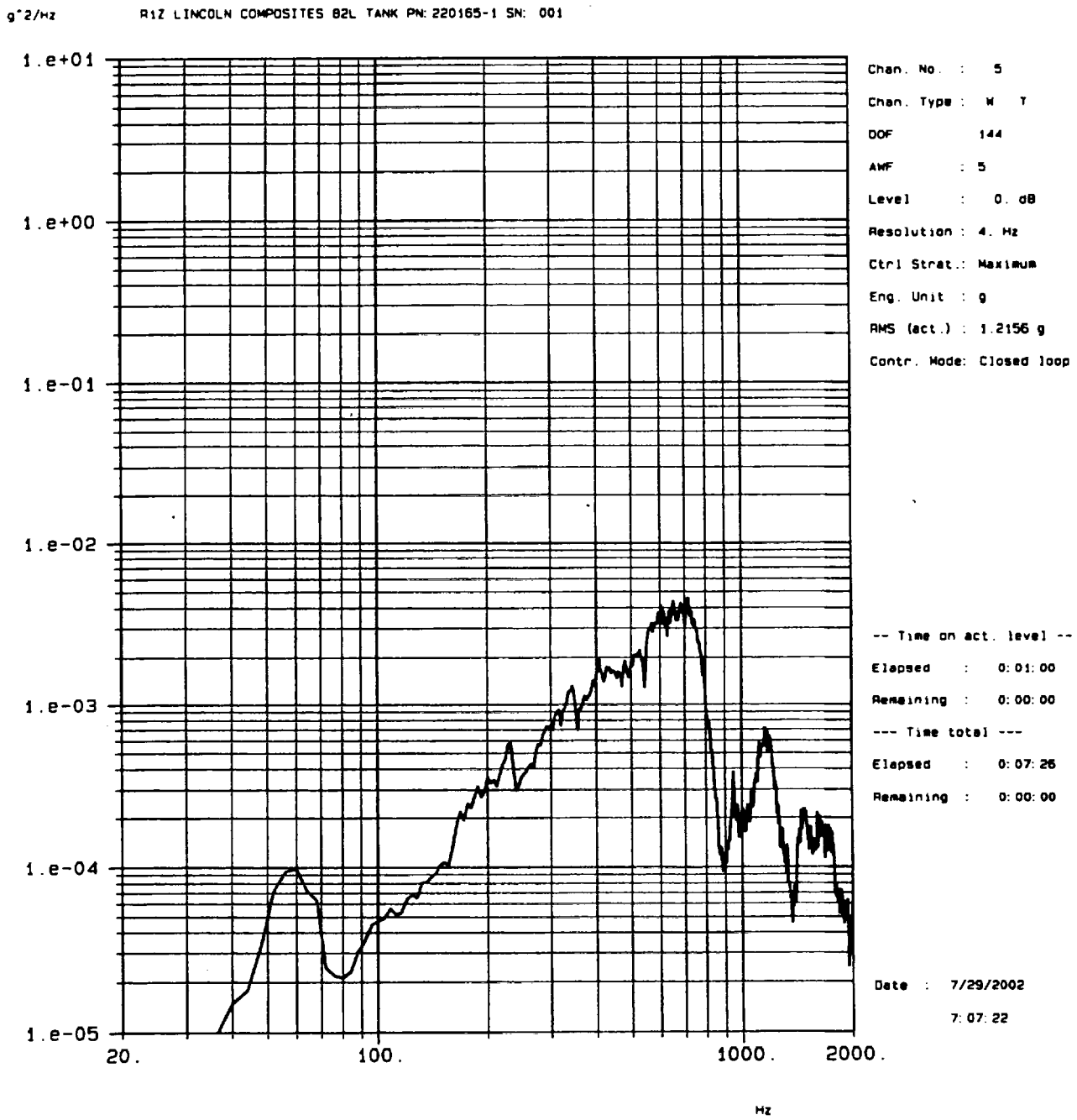
El Segundo, CA



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RANDOM PLOT NO. 7

Random Limit Channel

LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

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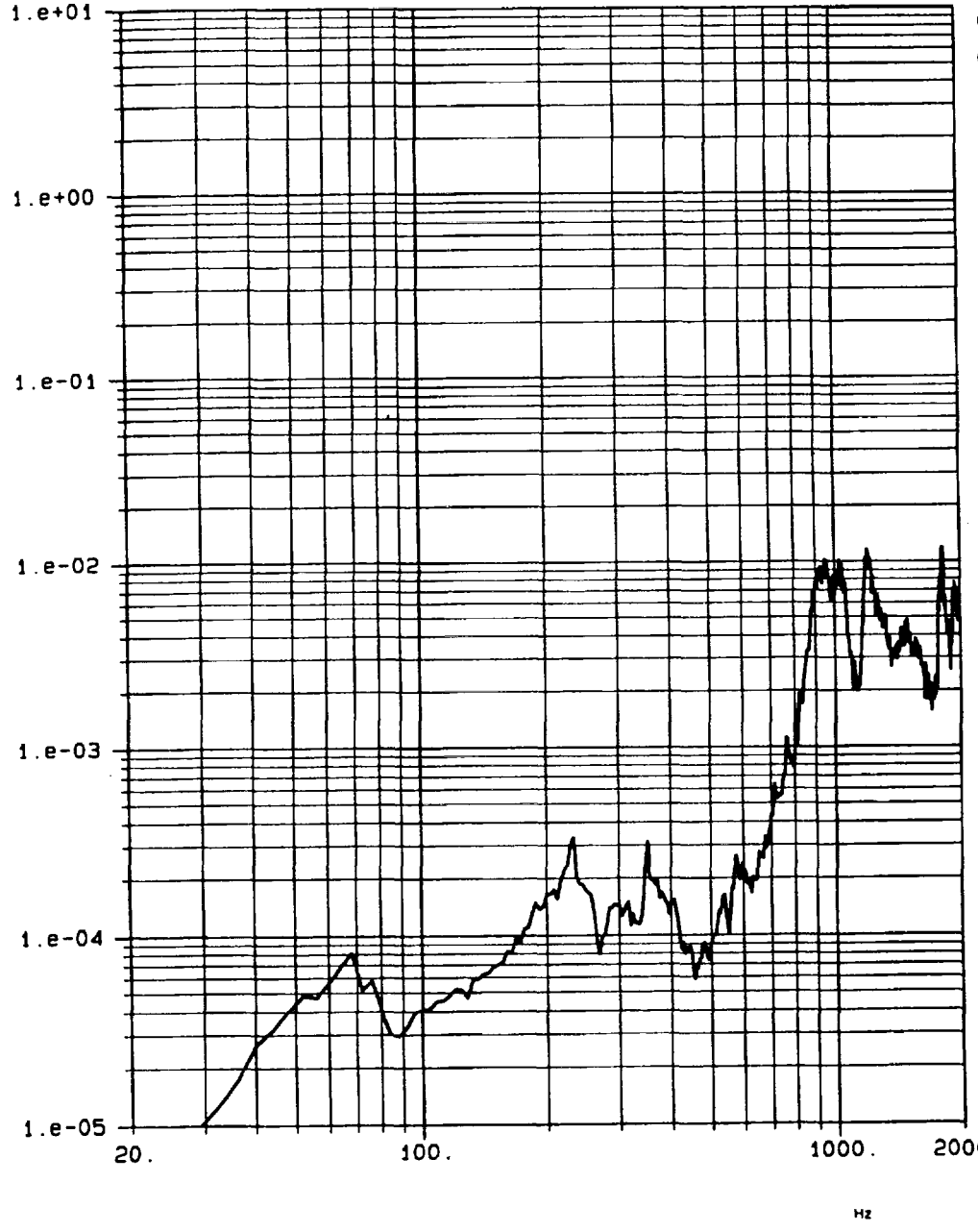
El Segundo, CA

g^2/Hz R2Y LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 5
Chan. Type : W - T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 2.45011 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:07:26
Remaining : 0:00:00

Date : 7/29/2002
7:07:22

RANDOM PLOT NO. 8

Random Limit Channel

LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

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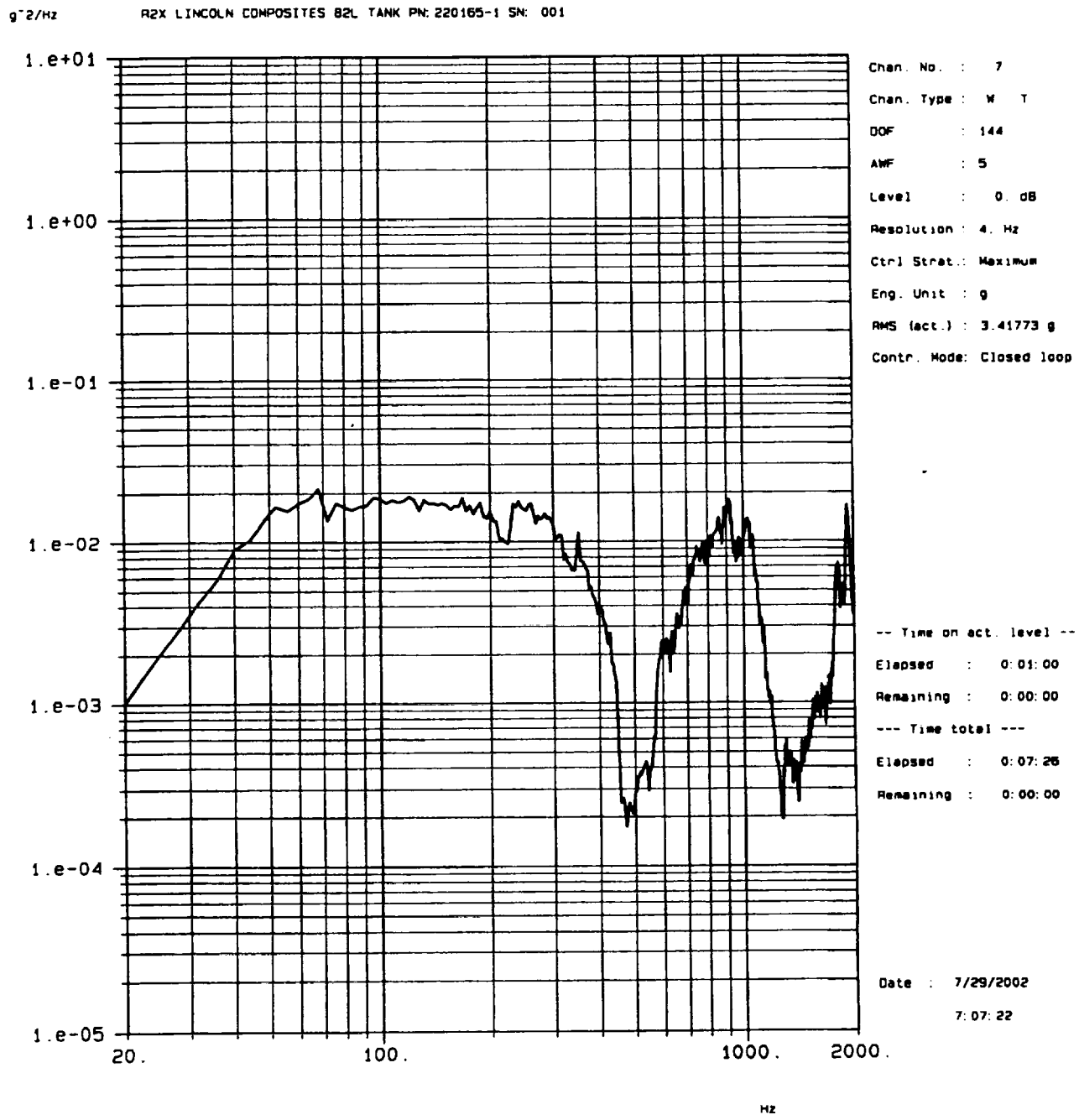
El Segundo, CA



RANDOM PLOT NO. 9

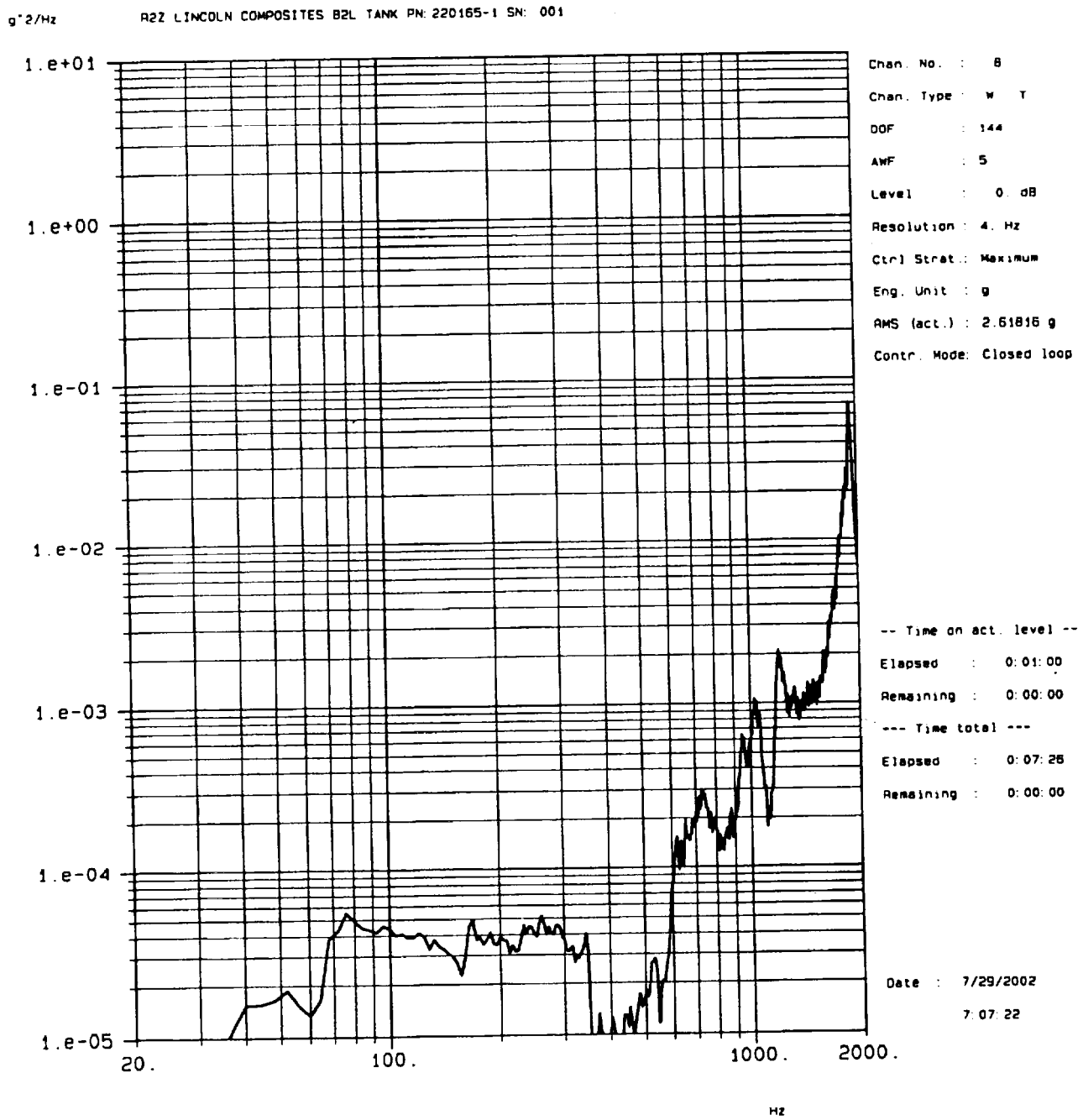
Random Limit Channel

LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 10

Random Limit Channel

LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

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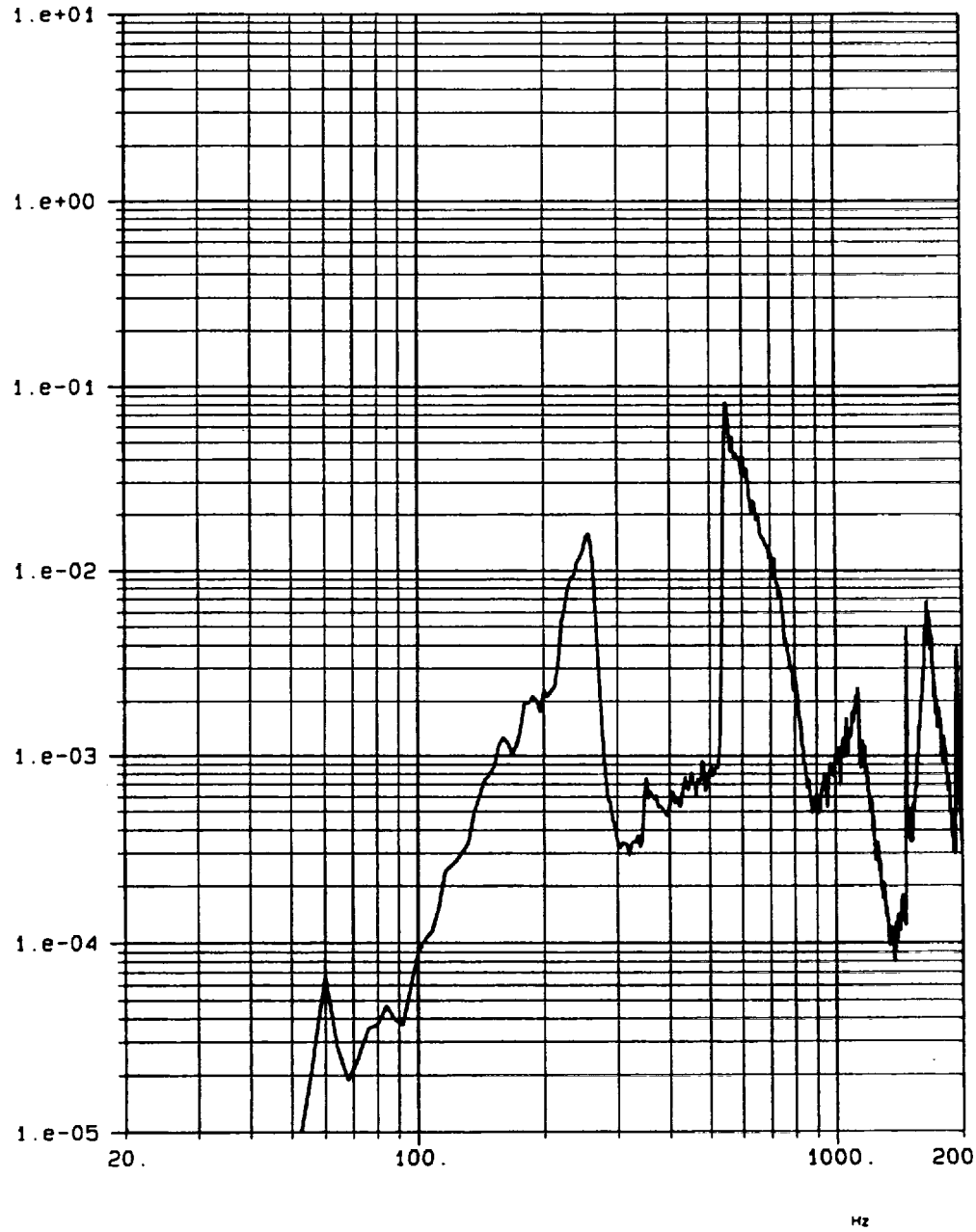
B Segundo, CA

g^2/Hz R3Y LINCOLN COMPOSITES 82L TANK PN: 220165-1 SN: 001



Chan. No. : 9
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 2.82977 g
Contr. Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:07:26
Remaining : 0:00:00

Date : 7/29/2002
7:07:22

RANDOM PLOT NO. 11

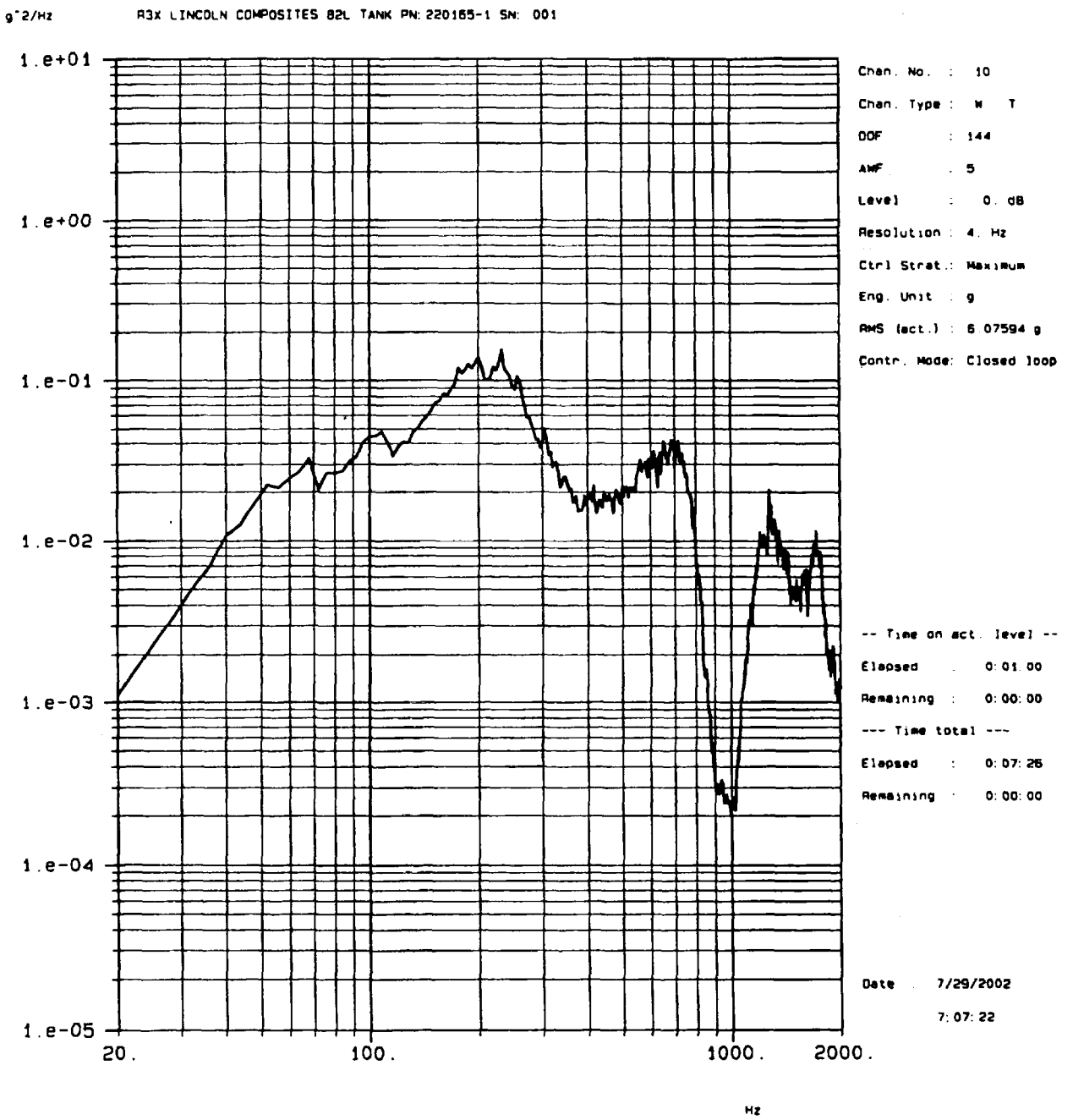
Random Limit Channel

LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 12

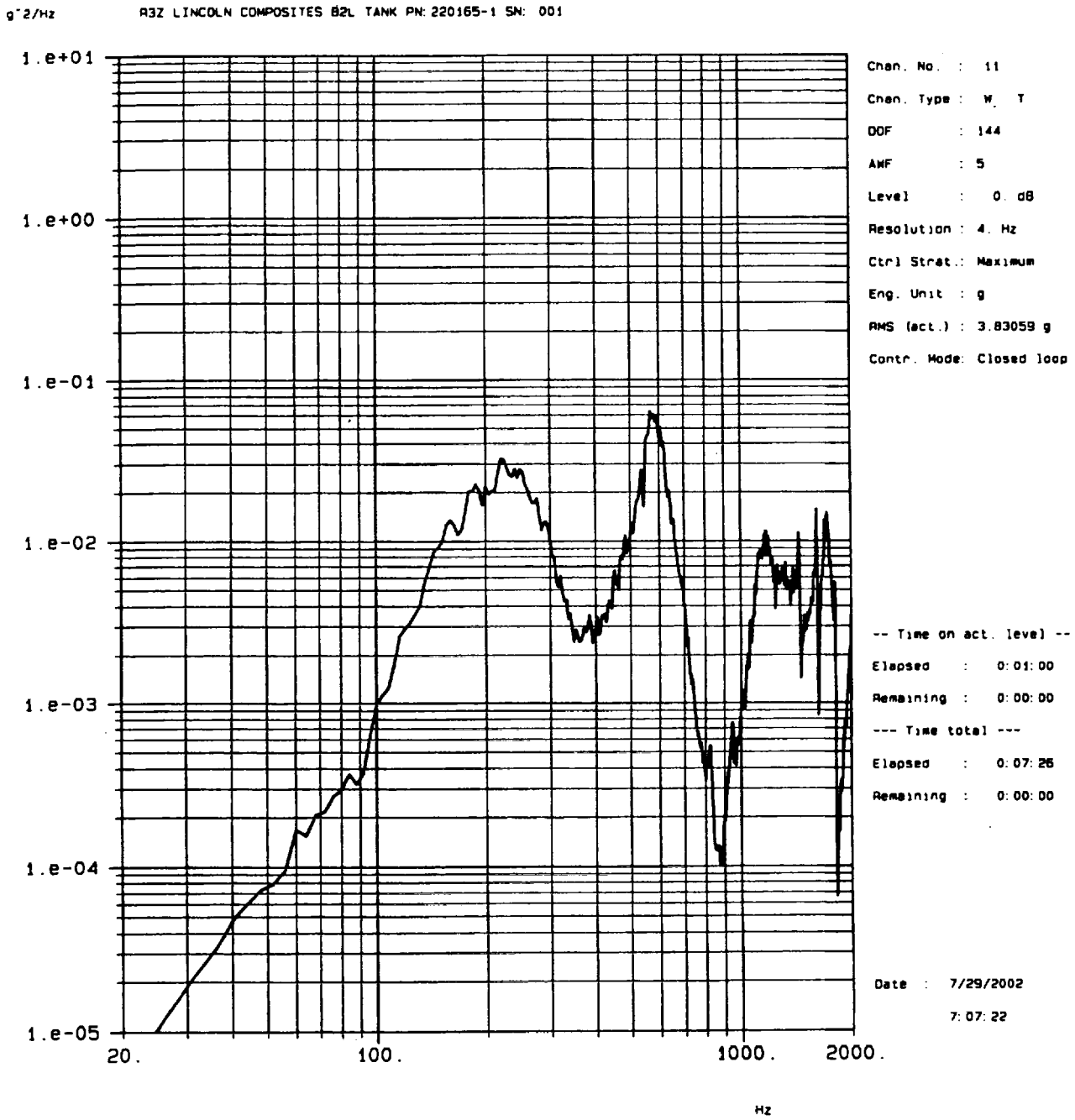
Random Limit Channel

LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA



RANDOM PLOT NO. 13

Random Limit Channel

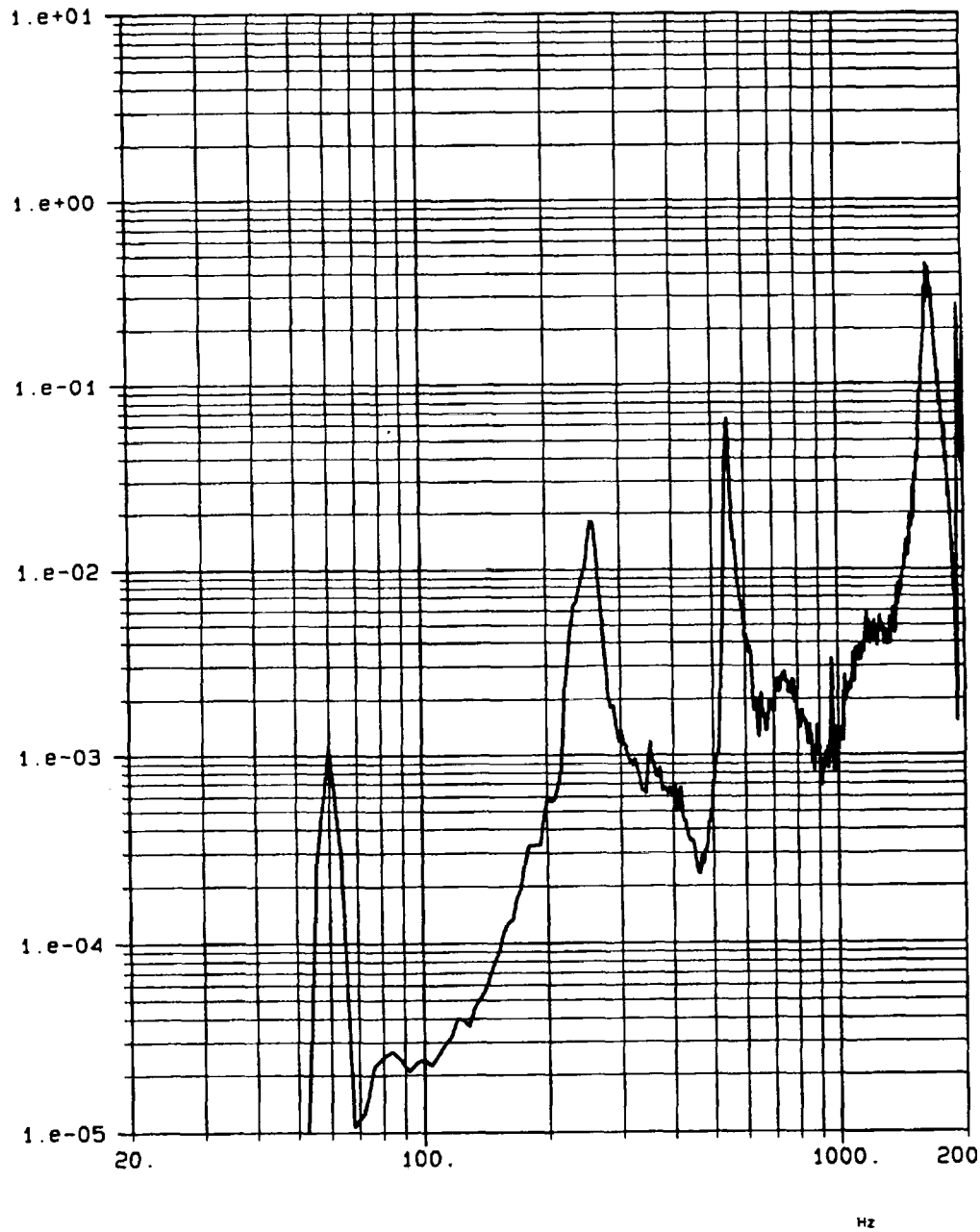
LINCOLN47039 ACCPT

X AXIS ACCEPTANCE LEVEL

Wyle Laboratories

El Segundo, CA

g^2/Hz R4 LINCOLN COMPOSITES B2L TANK PN: 220165-1 SN: 001



Chan. No. : 12
Chan. Type : W T
DOF : 144
AWF : 5
Level : 0. dB
Resolution : 4. Hz
Ctrl Strat.: Maximum
Eng. Unit : g
RMS (act.) : 7.8066 g
Contr Mode: Closed loop

-- Time on act. level --
Elapsed : 0:01:00
Remaining : 0:00:00
--- Time total ---
Elapsed : 0:07:26
Remaining : 0:00:00

Date : 7/29/2002
7:07:22