# DRAFT
## ENVIRONMENTAL QUALIFICATION REPORT

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## 1.0 SCOPE

Tests include:

a. Structureborne Noise
b. Shock
c. EMI
d. Vibration
e. Airborne Noise.

Analysis include:

a. Enclosure
b. Electric field
c. Radiated Susceptibility

### 1.1 Purpose

The purpose of this test report is to provide the results of Environmental Tests performed on to determine if the requirements of common specification for Submarine Sonar, Combat Control and Architecture Subsystems are satisfied

## 2.0 APPLICABLE DOCUMENTS

### 2.1 Government Documents

| | |
|---|---|
| MIL-STD-167 | Mechanical Vibrations of Shipboard Equipment |
| MIL-STD-461C<br>15 October 1987 | Electromagnetic Interference Characteristics, Requirements for Equipment |
| DOD-STD-1399 | Interface Standard for shipboard Systems |
| MIL-S-901C<br>15 January 1963 | Military Specification Sochk Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for |

### 2.2 Non-Government Documents

None.

## 3.0 TEST AND ANALYSIS APPROACH

### 3.1 Vendor Reported Testing

3.1.1 Vibration.

All equipment shall retain structural integrity and meet all performance requirements during and after being subjected to vibration. Characteristics of the shipboard environments that are applicable to the equipment location and mounting arrangement must be designed to meet MIL-STD-167. In no case shall any equipment become a personnel hazard as a result of being subjected to the vibration environment.

3.1.2 Conducted Emissions, AC and DC Power Leads.

The equipment shall not exceed the CE01 and CE03 limits of MIL-STD-461, except as modified below.

The narrowband limitation for CE03 shall be modified to allow for emissions to be 15 dB over the limit for the frequency range from 15 kHz to 100 kHz.

The broadband limitation for CE03 shall be modified to allow for emissions to be 25 dB over the limit for the frequency range for 15 kHz to 25 kHz and 30 dB over the limit for the frequency range for 25 kHz to 100 kHz.

3.1.3 Electric Field Emissions.

To contain radiated emissions from external cabling, overall cable shielding shall be employed as necessary. Where used, this overall shield shall be grounded to chassis ground in a 360-degree termination in the cable backshell at both ends. If single point grounding of an external overall shield is required, this requirement shall have precedence over the overall shield multi-point grounding requirement. In this case, radiated emissions may be contained through use of a filtered pin connector located at the equipment. These shielding requirements shall be reflected in the shipboard cable design information deliveries.

3.1.4 Radiated Susceptibility, AC Magnetic Field.

The equipment shall meet the specified performance requirements in an AC magnetic field per the RS01 and RS02 limits of MIL-STD-461.

3.1.5 Radiated Susceptibility, AC Electric Field.

The equipment shall meet specified performance requirements in an electric field per the RS03 limits of MIL-STD-461.

3.1.6 Radiated Susceptibility, DC Magnetic Field.

The equipment shall be compatible with the magnetic field environment interface constraints of DOD-STD-1399, Section 70, Part 1, except the operational magnetic field shall be 5 oersteds, and the non-operational magnetic field shall be 20 oersteds. All magnetic tape and disk storage media shall be removed and appropriately shielded prior to applying the 20 oersted non-operational field.

3.2 Navy Performed Testing

3.2.1 Shock.

All C3I equipment shall be shock tested in a manner that adequately represents the local shock environment of the unit as installed on the platform.

Non-ship safety/self protect equipment located off the CCSM, on other deck types such as stanchion supported decks, shock-mitigated decks, or mounted to the hull or frames, or mounted internal to the Sphere shall meet Grade B shock requirements as specified in MIL-S-901D. In no case shall any equipment become a personnel hazard as a result of being subjected to a shock environment.

3.2.2 Electromagnetic Environmental Effects.

The equipment shall meet the $E^3$ requirements of MIL-STD-461 for Class A5 (digital equipment and sonar devices) to the extent specified herein. The following subparagraphs shall apply to each new/modified equipment enclosure; and all new design/modified equipment per COTS/NDI requirements shall conform to this specification.

3.2.3 Structureborne Noise.

The equipment structure-borne noise levels shall not exceed 65 dB from 10 Hz to 125 Hz, drop off linearly across the bands by 2 dB to 315 Hz, rise linearly across the bands by 2 dB to 333 Hz and then continue at 65 dB to 10 Hz (vibratory RMS Acceleration 1/3 Octave Band Level in dB//$10^{-3}$cm/sec$^2$.

3.2.4 Airborne Noise.

Radiated airborne noise for inboard equipment shall not exceed the sound pressure limits listed in the acceptance criteria of Common Spec. These requirements do not apply during active sonar transmissions.

## 4.0 VENDOR REPORTED TESTING

### 4.1.1 Vibration

Appendix A reports the enclosure vibration testing. The shock testing information in this appendix is not for shipboard shock, that test will be covered in section 4.2.1. The results of the vibration test generated a design itteration to improve performance such that the unit passed this test.

### 4.1.2 ElectroMagnetic Interface

ELMA certified that ~~the~~ enclosure is designed to meet MIL-STD-461D. See Appendix B. This includes the requirements of Conducted Emissions Radiated Susceptibility, Electric Field and Electromagnetic Environmental Effects.

### 4.2.1 Shock

Shock testing in accordance with MIL-S-901D was performed on a dummy loaded enclosure to verify that the requirements of Grade B, Class I, Type A are met. The lightweight shock test fixture was used. See Appendix C for test results. The unit met the requirements of MIL-S- 901D for Grade B equipment.

### 4.2.2 Structureborne Noise

Two tests were performed in various operating conditions. Modifications to the internal fan mounts were performed (see Appendix D). The fan speed was adjusted to improve the noise performance.

### 4.2.3 Airborne Noise

A noise survey was performed. The noise levels are below the requirements for all platforms identified in Common Spec

# APPENDIX C

# SHOCK (MIL-S-901D)
# 12R2

# LIGHTWEIGHT SHOCK TEST REPORT

By
Gerald J. Messina

June 1999

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## REFERENCES

a. MIL-S-901D, Shock Tests, H.I. (High Impact); Shipboard Machinery, Equipment and Systems, Requirements for

## 2.0 PURPOSE

The purpose of the shock test was to verify the ability of the TARPU to withstand shock loadings which may be incurred during wartime service due to the effects of nuclear or conventional weapons.

# APPENDIX A: FIGURES

**FIGURE A1**

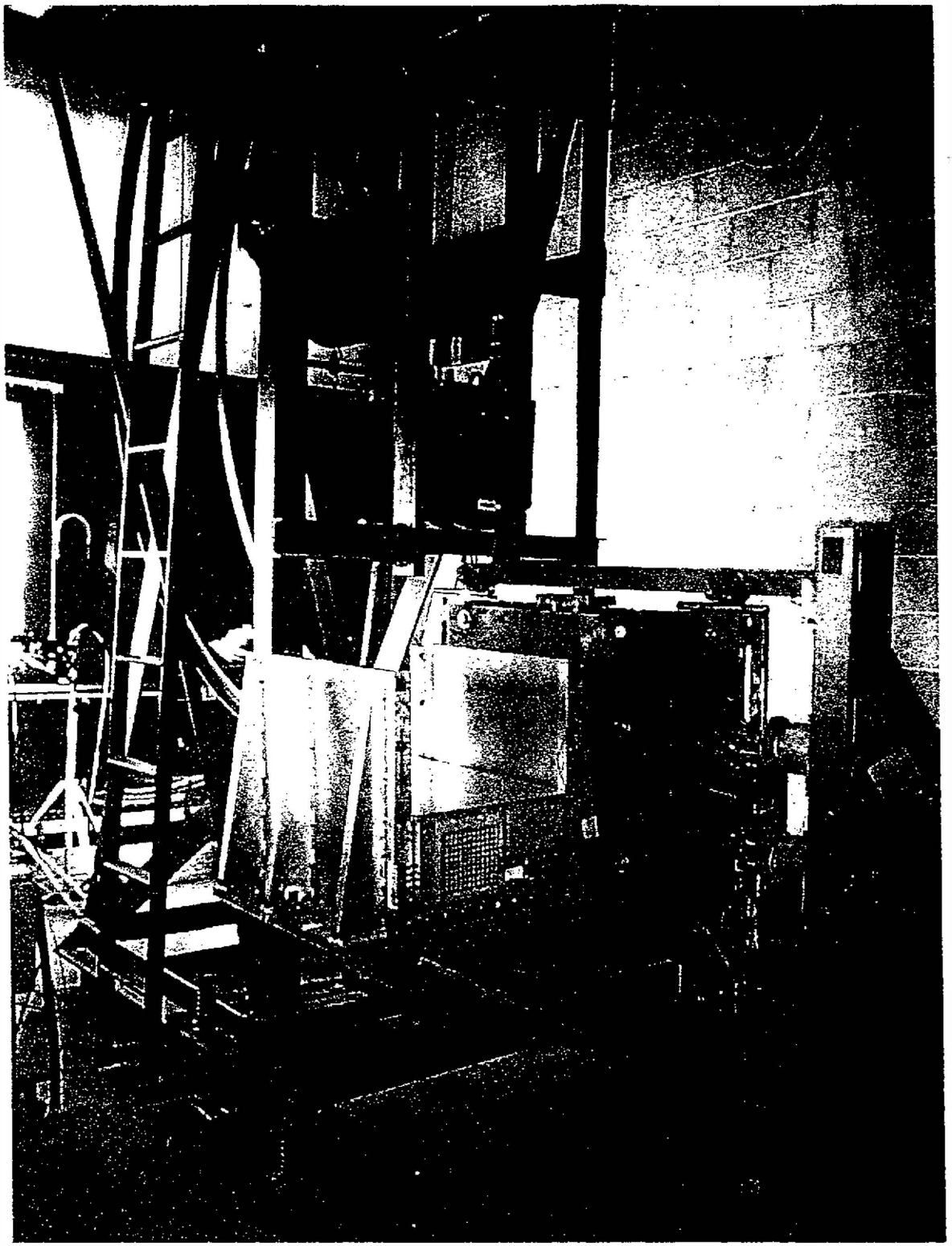


FIGURE A2

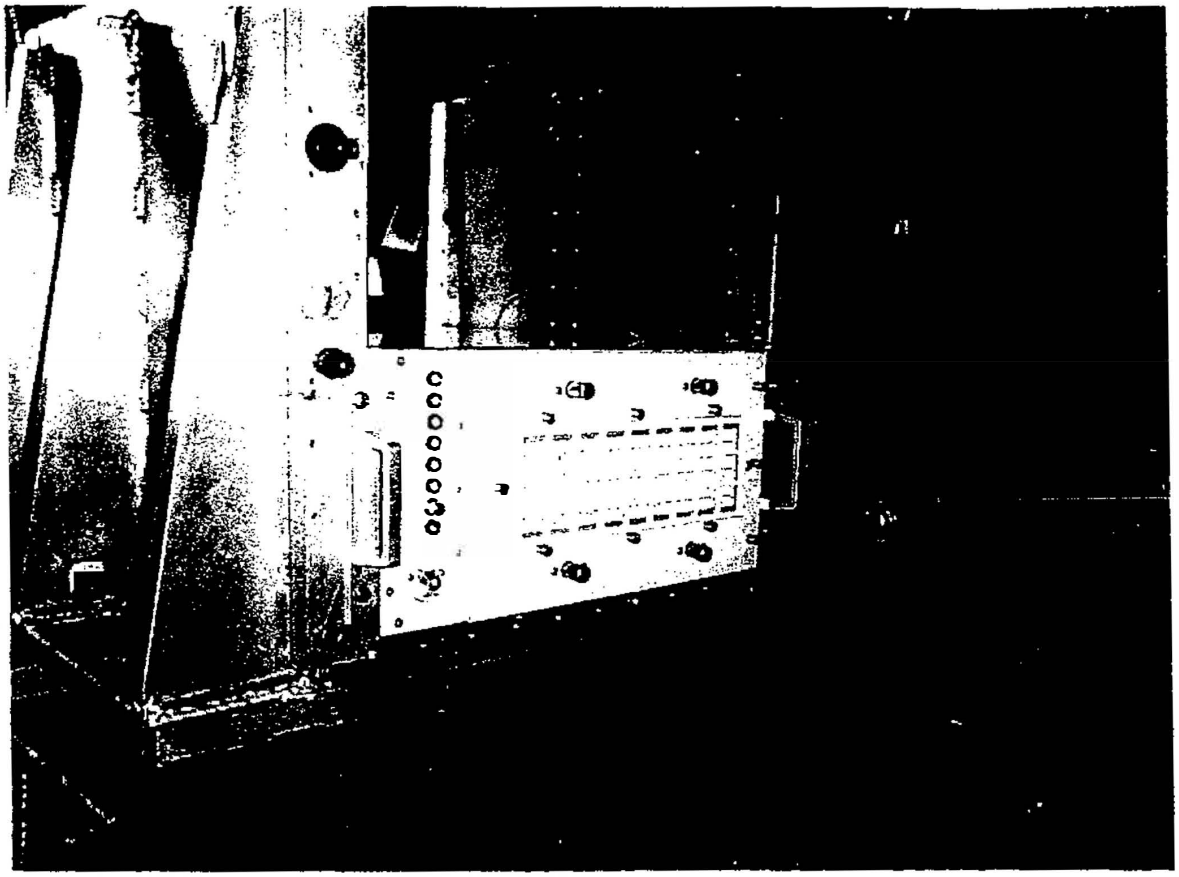
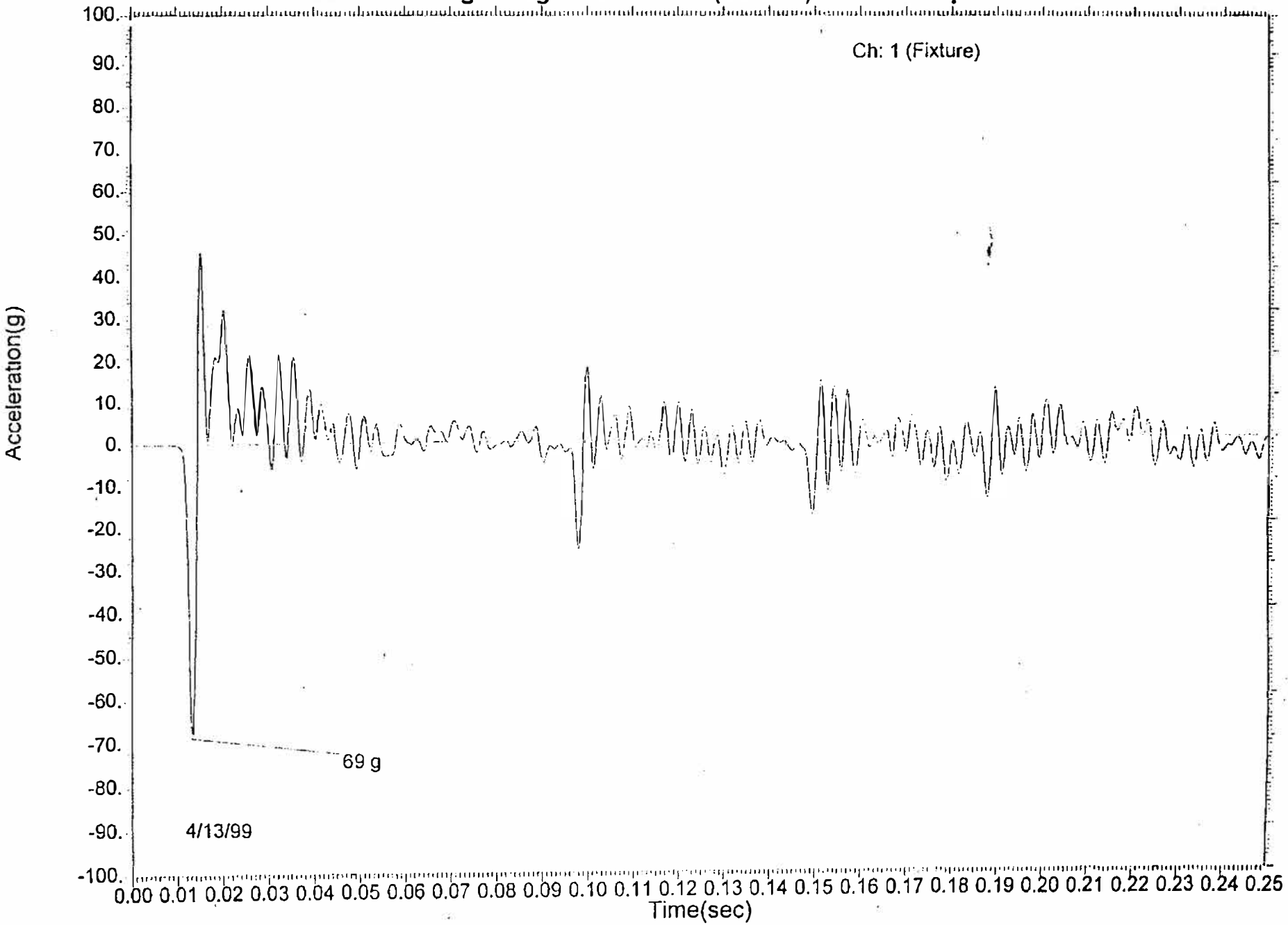
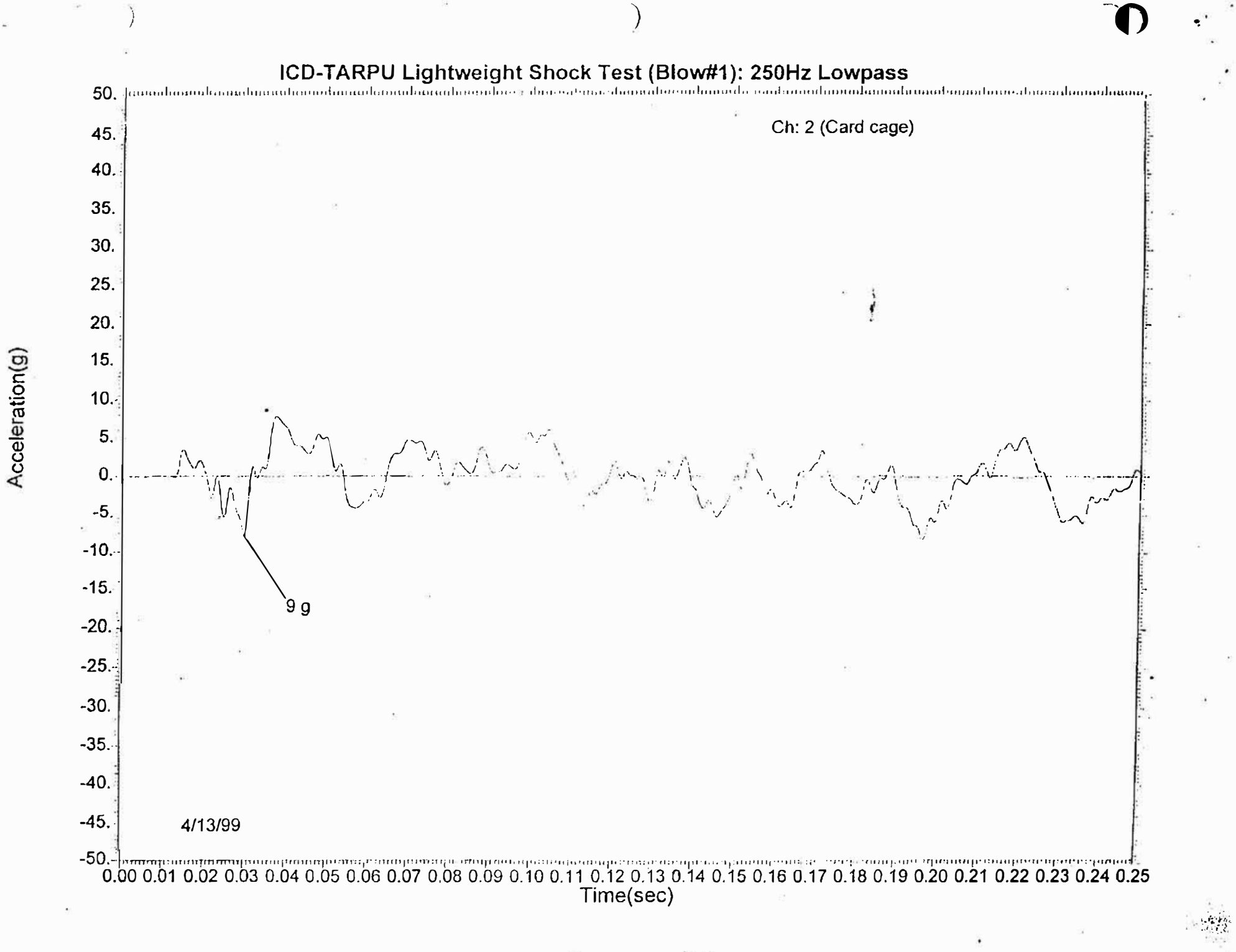
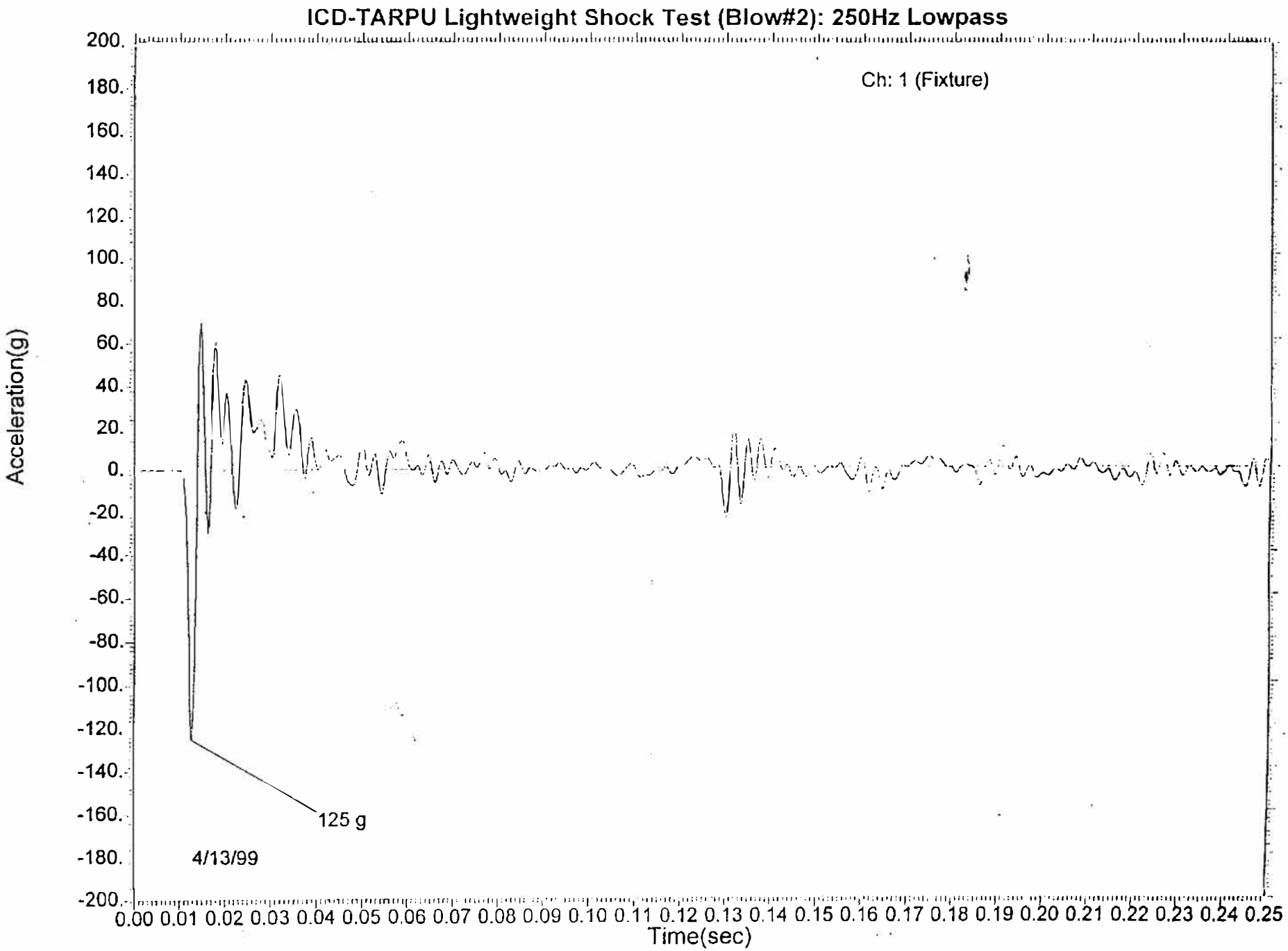


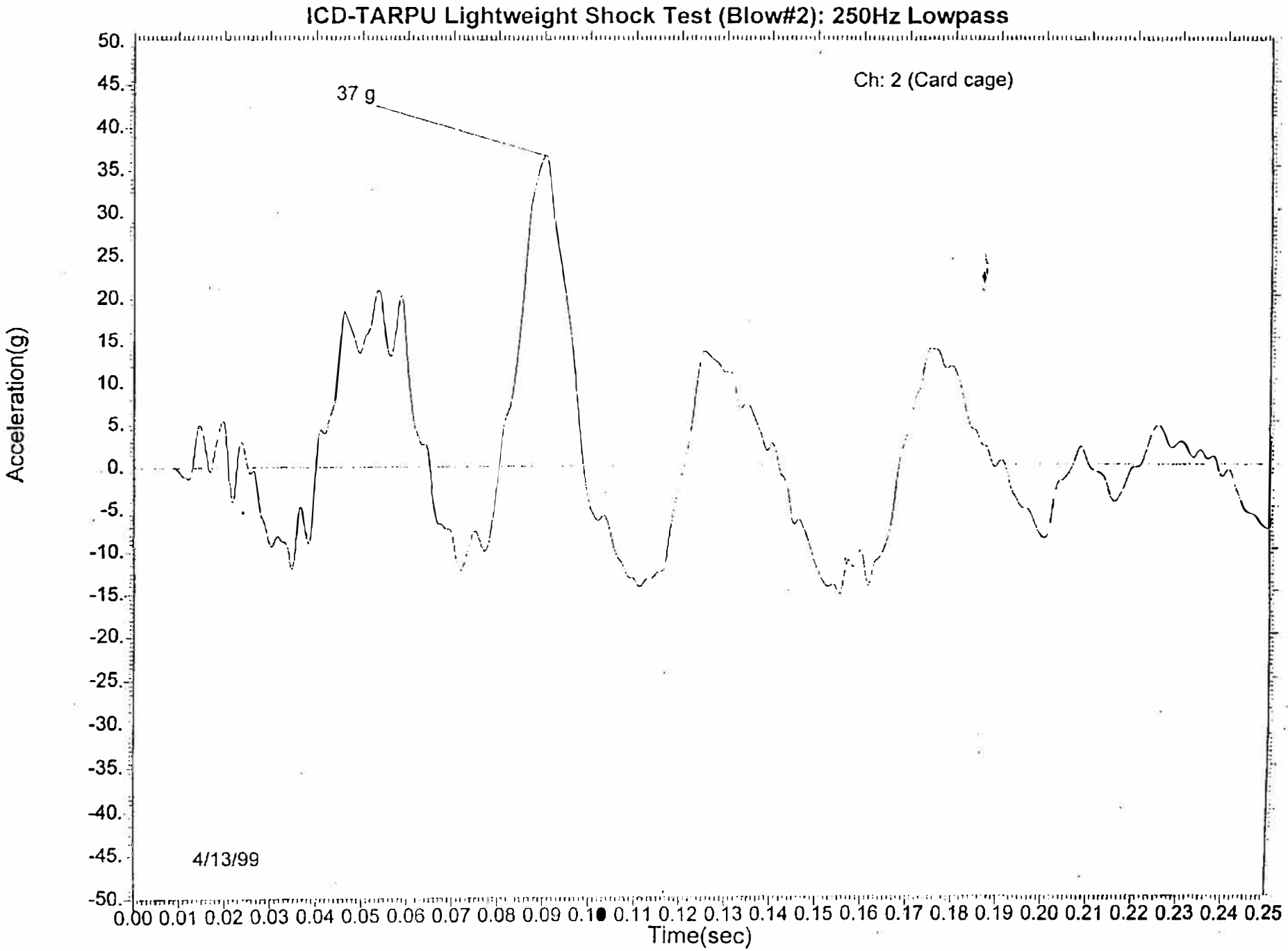
FIGURE A3

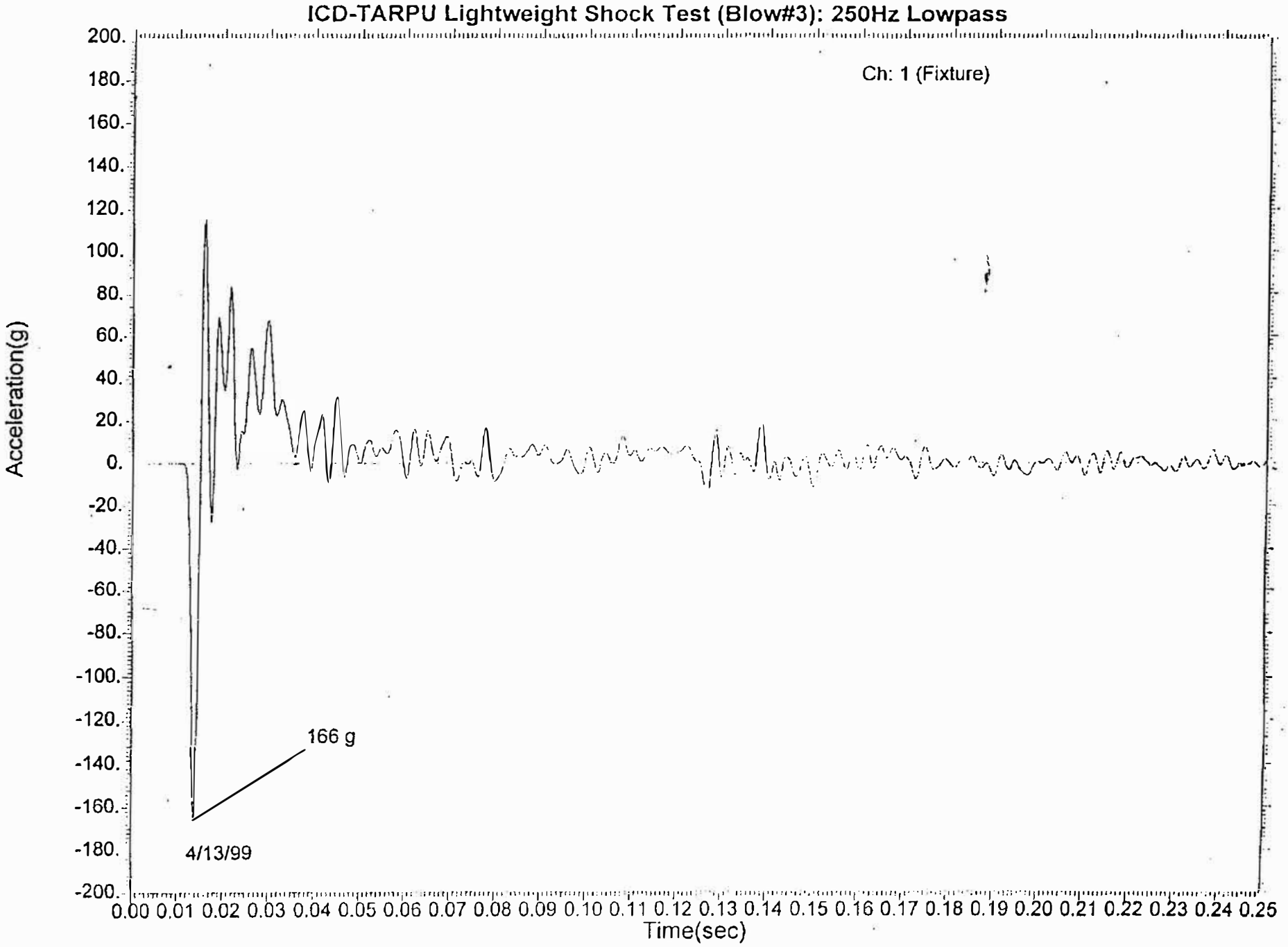
# APPENDIX B: SHOCK DATA


ICD-TARPU Lightweight Shock Test (Blow#1): 250Hz Lowpass
Ch: 1 (Fixture)
Acceleration(g)
100.
90.
80.
70.
60.
50.
40.
30.
20.
10.
0.
-10.
-20.
-30.
-40.
-50.
-60.
-70.
-80.
-90.
-100.
69 g
4/13/99
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)


ICD-TARPU Lightweight Shock Test (Blow#1): 250Hz Lowpass
Ch: 2 (Card cage)
Acceleration(g)
50.
45.
40.
35.
30.
25.
20.
15.
10.
5.
0.
-5.
-10.
-15.
-20.
-25.
-30.
-35.
-40.
-45.
-50.
9 g
4/13/99
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)


ICD-TARPU Lightweight Shock Test (Blow#2): 250Hz Lowpass
Ch: 1 (Fixture)
Acceleration(g)
200.
180.
160.
140.
120.
100.
80.
60.
40.
20.
0.
-20.
-40.
-60.
-80.
-100.
-120.
-140.
-160.
-180.
-200.
125 g
4/13/99
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)


ICD-TARPU Lightweight Shock Test (Blow#2): 250Hz Lowpass
Ch: 2 (Card cage)
37 g
4/13/99
Acceleration(g)
50.
45.
40.
35.
30.
25.
20.
15.
10.
5.
0.
-5.
-10.
-15.
-20.
-25.
-30.
-35.
-40.
-45.
-50.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)


ICD-TARPU Lightweight Shock Test (Blow#3): 250Hz Lowpass
Ch: 1 (Fixture)
Acceleration(g)
200.
180.
160.
140.
120.
100.
80.
60.
40.
20.
0.
-20.
-40.
-60.
-80.
-100.
-120.
-140.
-160.
-180.
-200.
166 g
4/13/99
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)

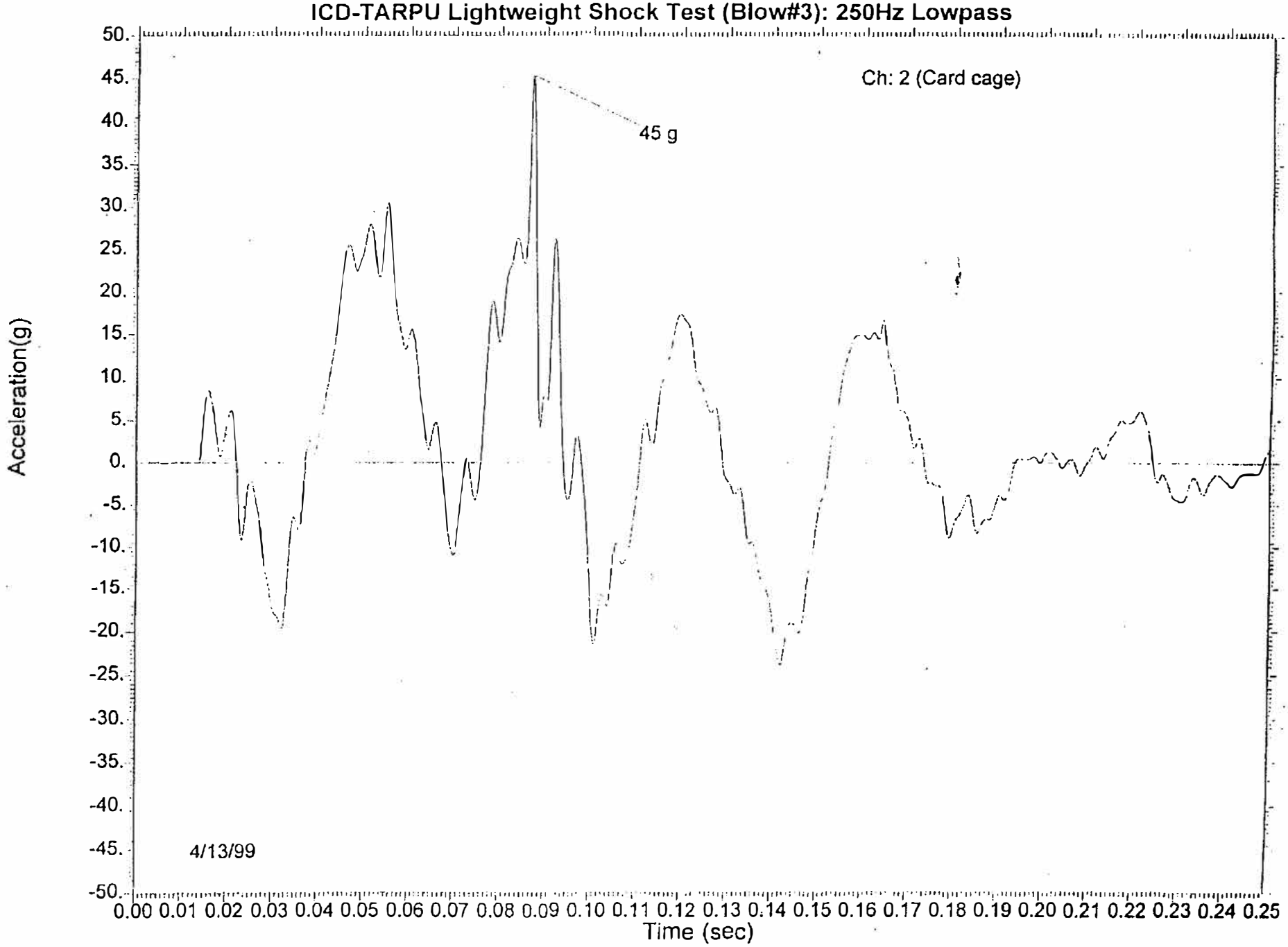

ICD-TARPU Lightweight Shock Test (Blow#3): 250Hz Lowpass
Ch: 2 (Card cage)
45 g
4/13/99
Acceleration(g)
50.
45.
40.
35.
30.
25.
20.
15.
10.
5.
0.
-5.
-10.
-15.
-20.
-25.
-30.
-35.
-40.
-45.
-50.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time (sec)

FIGURE B6

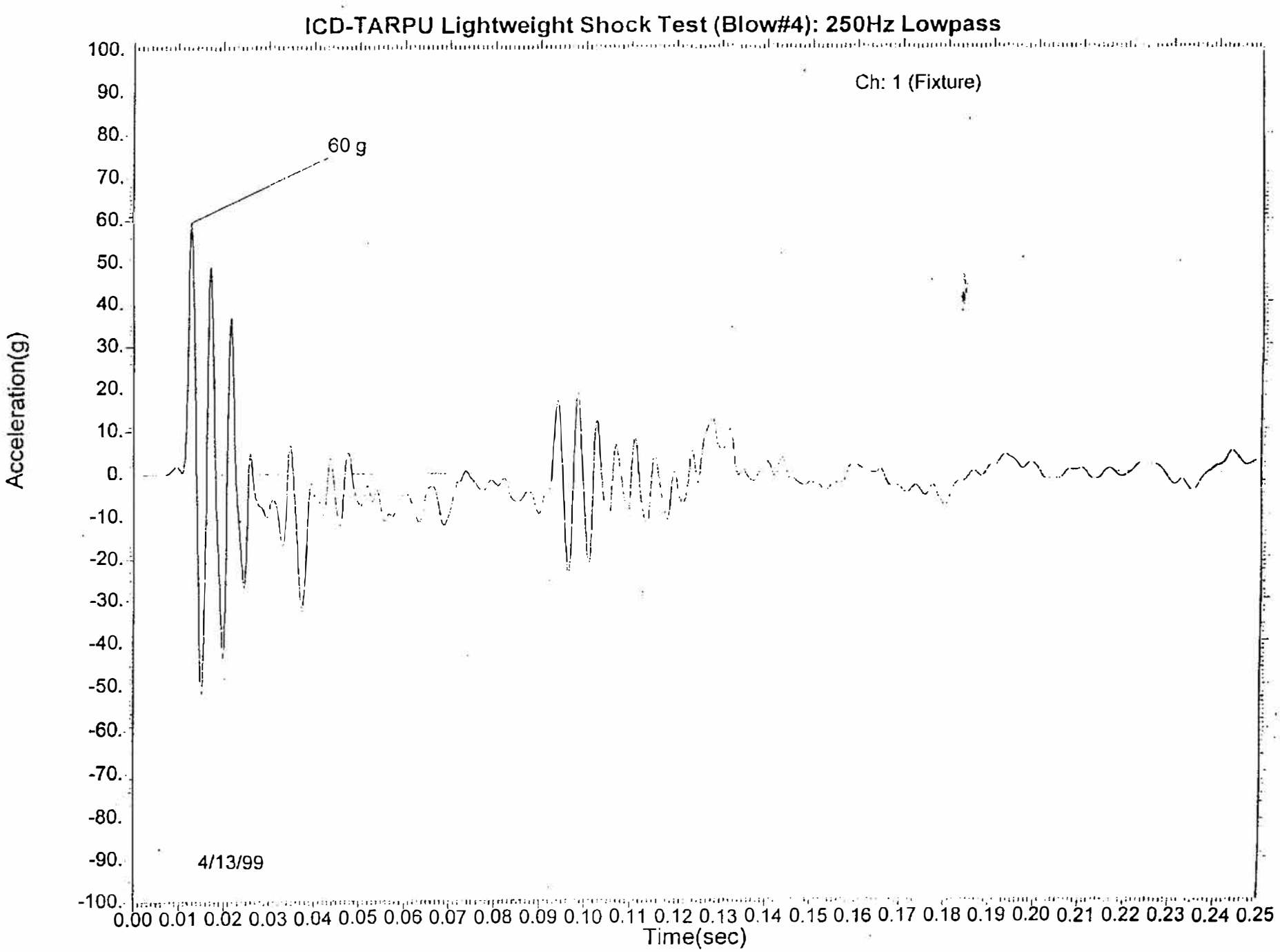
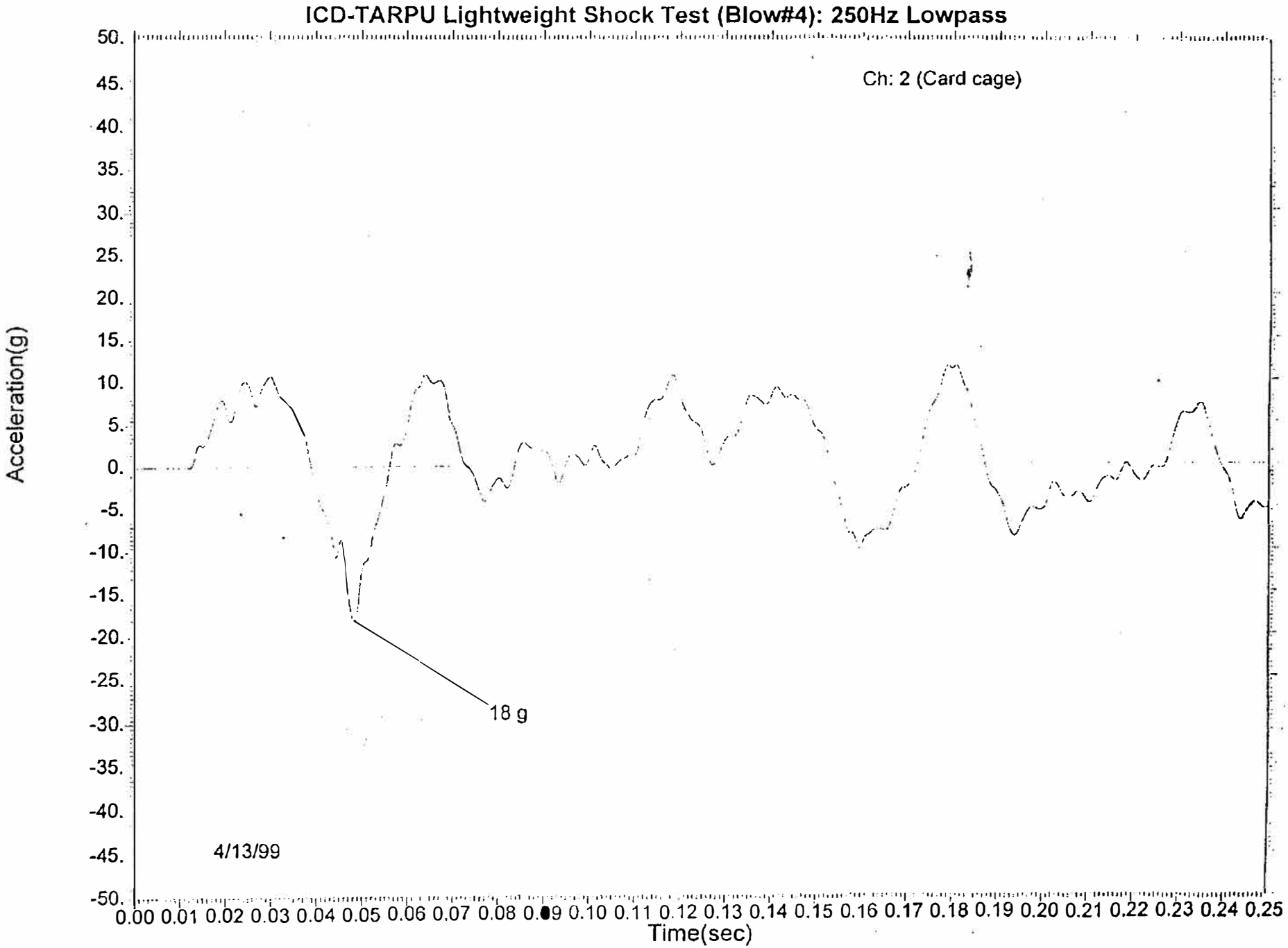
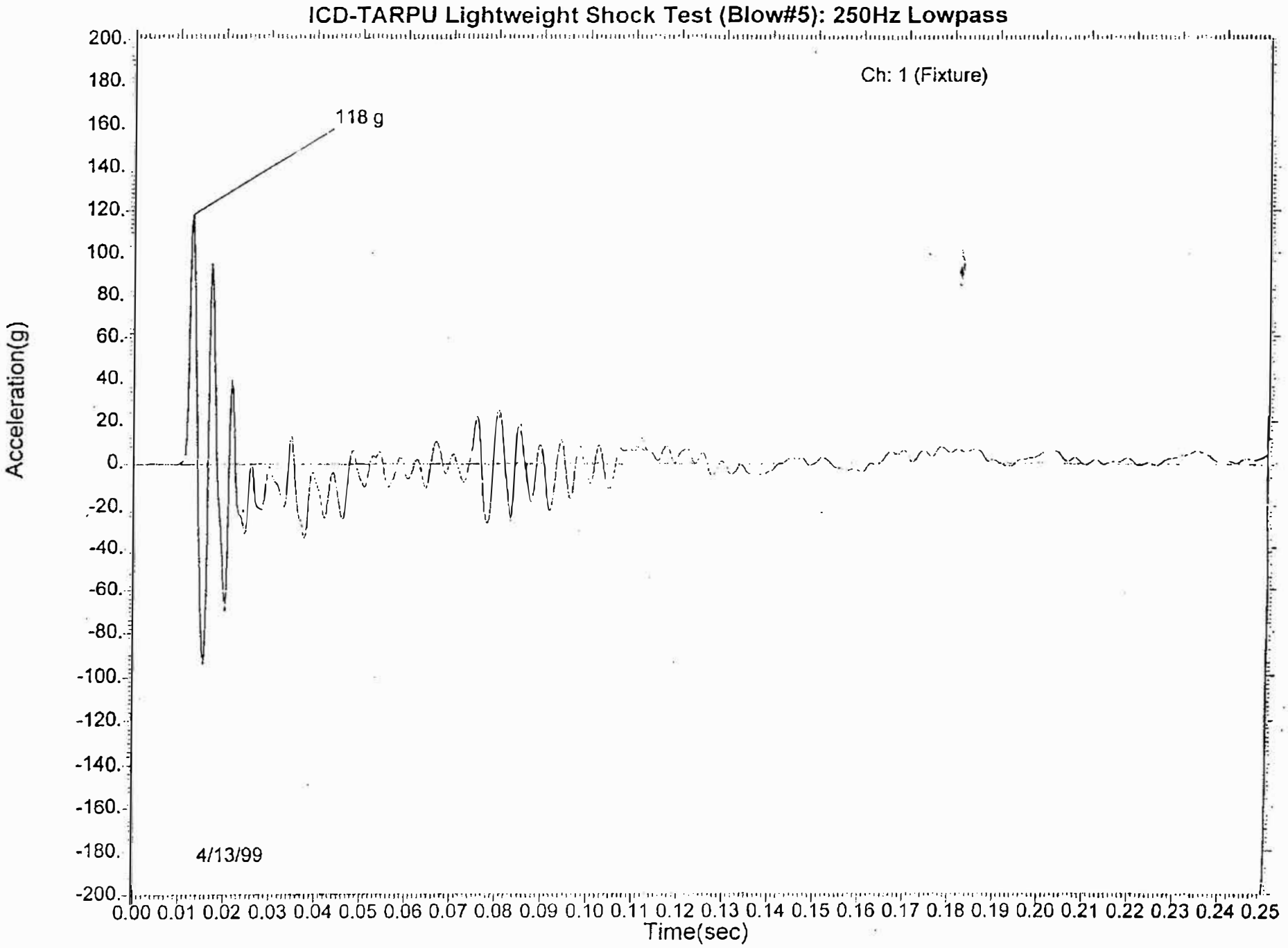
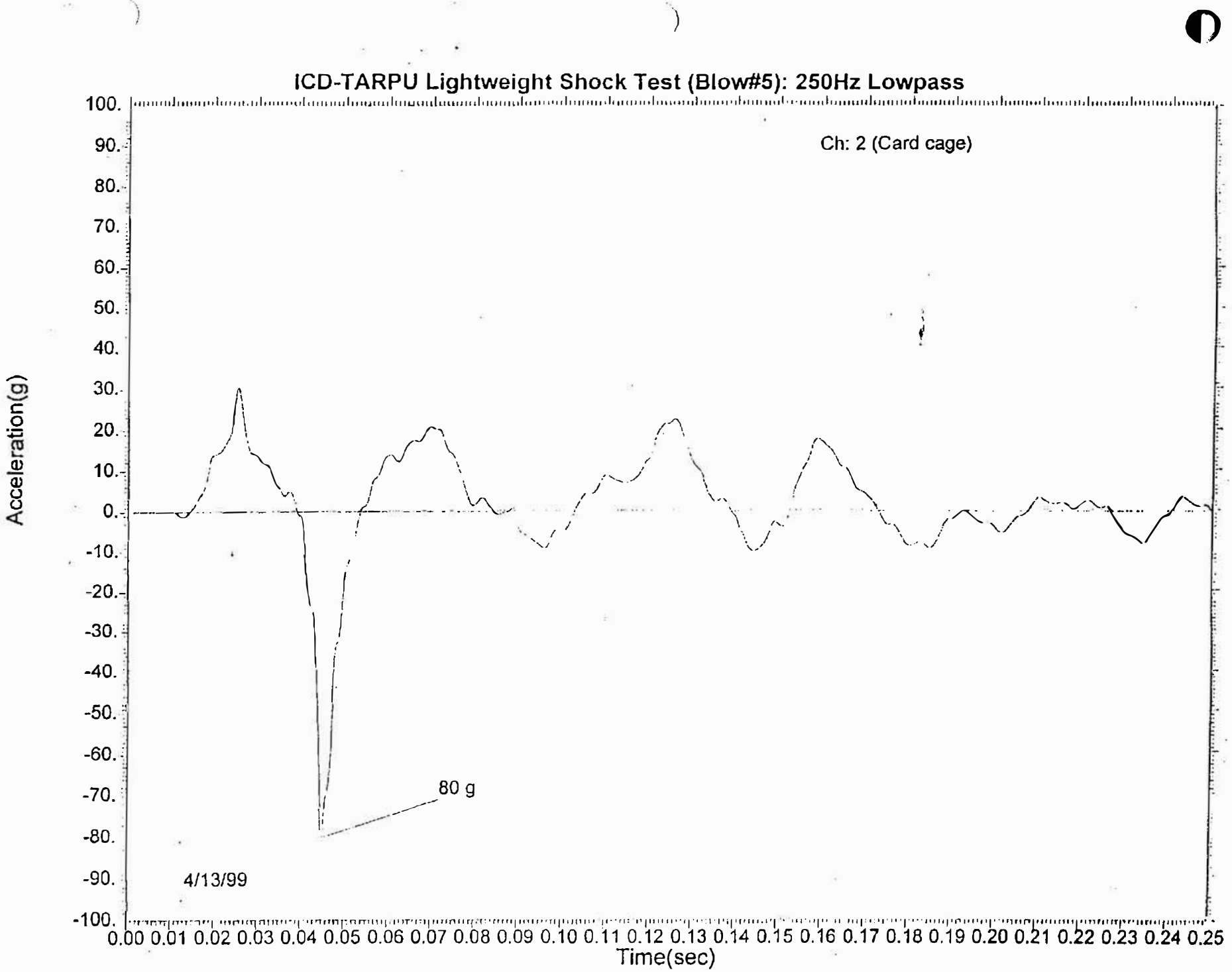
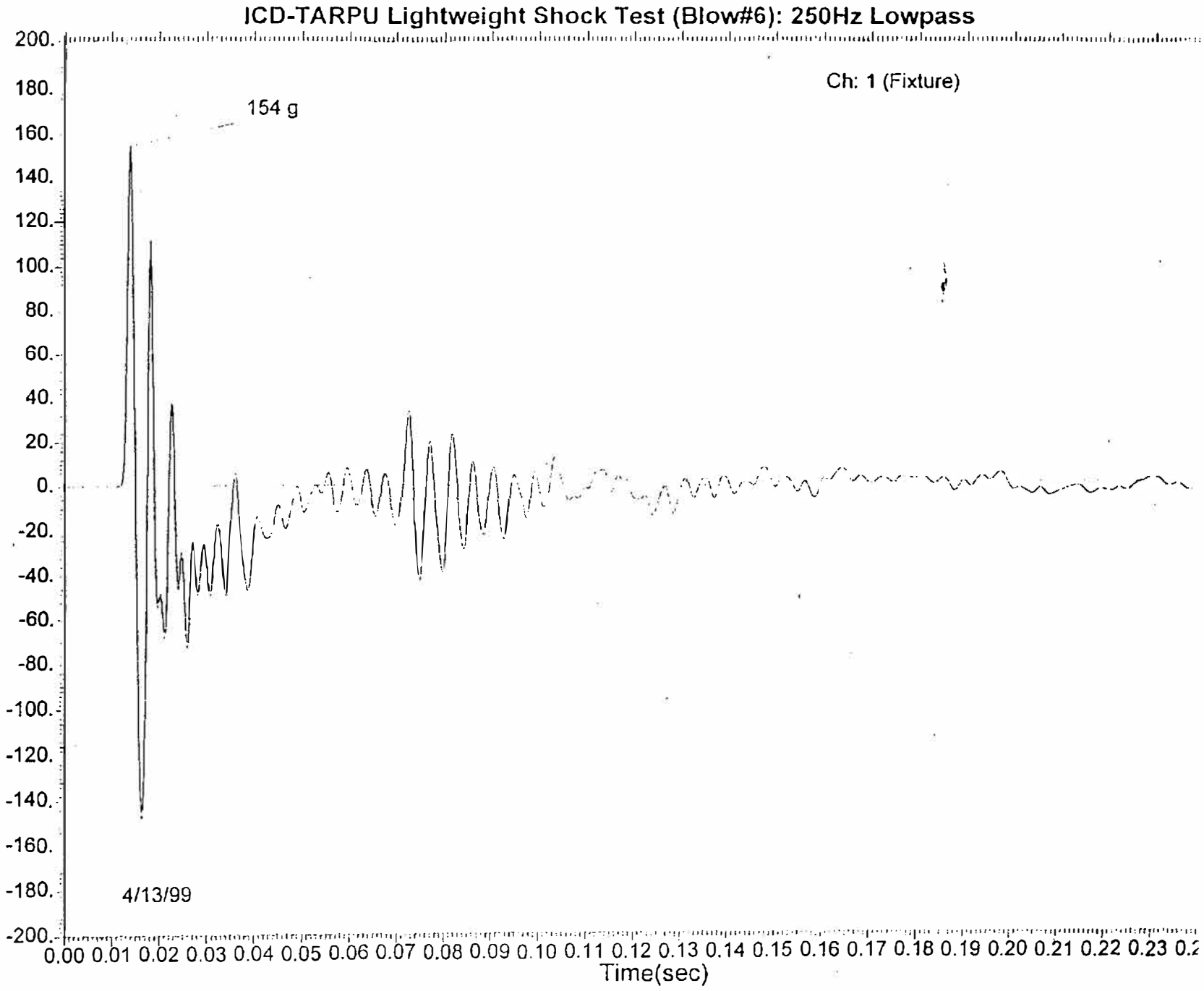

ICD-TARPU Lightweight Shock Test (Blow#4): 250Hz Lowpass
Ch: 1 (Fixture)
60 g
4/13/99
Acceleration(g)
100.
90.
80.
70.
60.
50.
40.
30.
20.
10.
0.
-10.
-20.
-30.
-40.
-50.
-60.
-70.
-80.
-90.
-100.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)

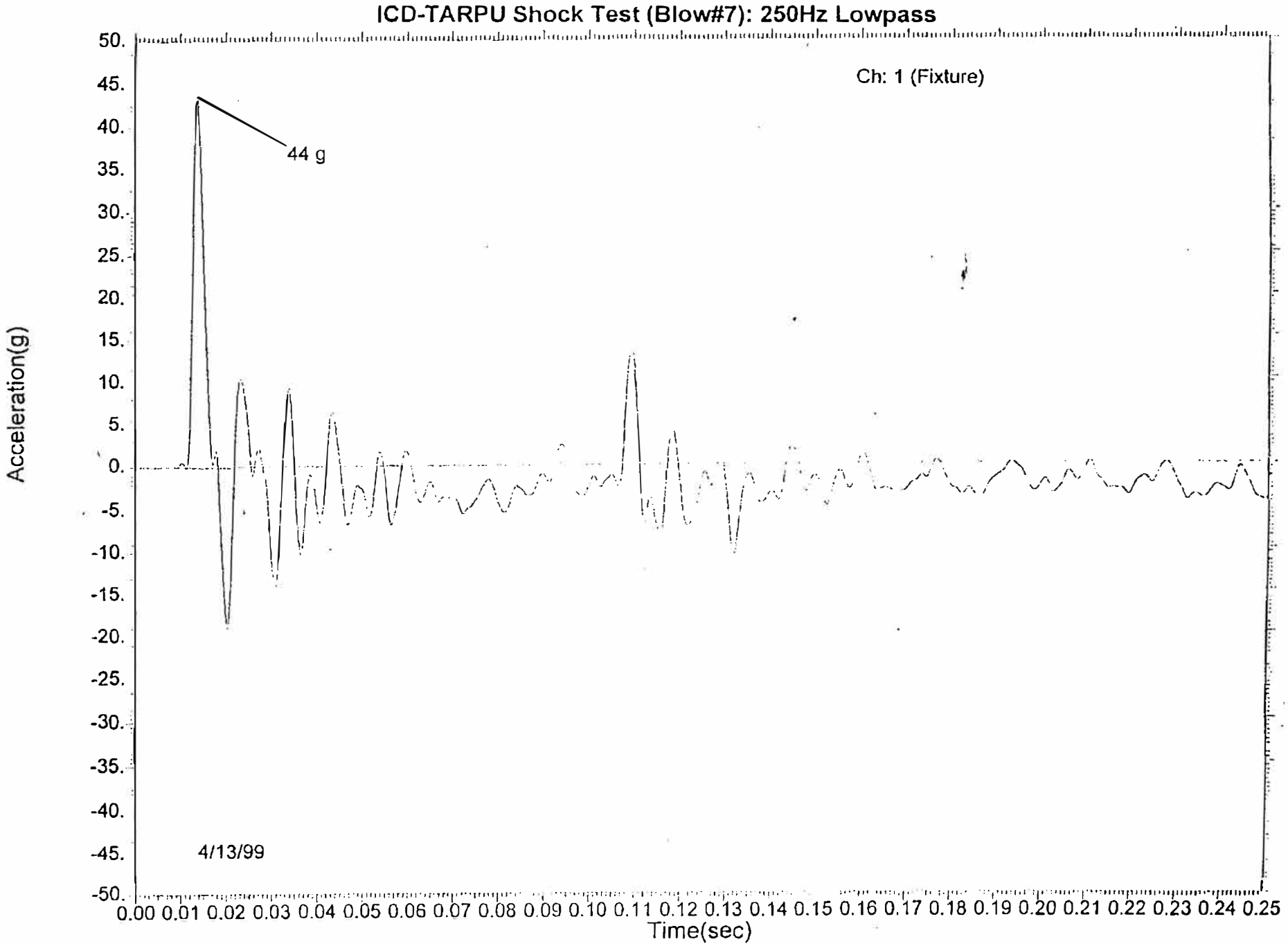
FIGURE B7

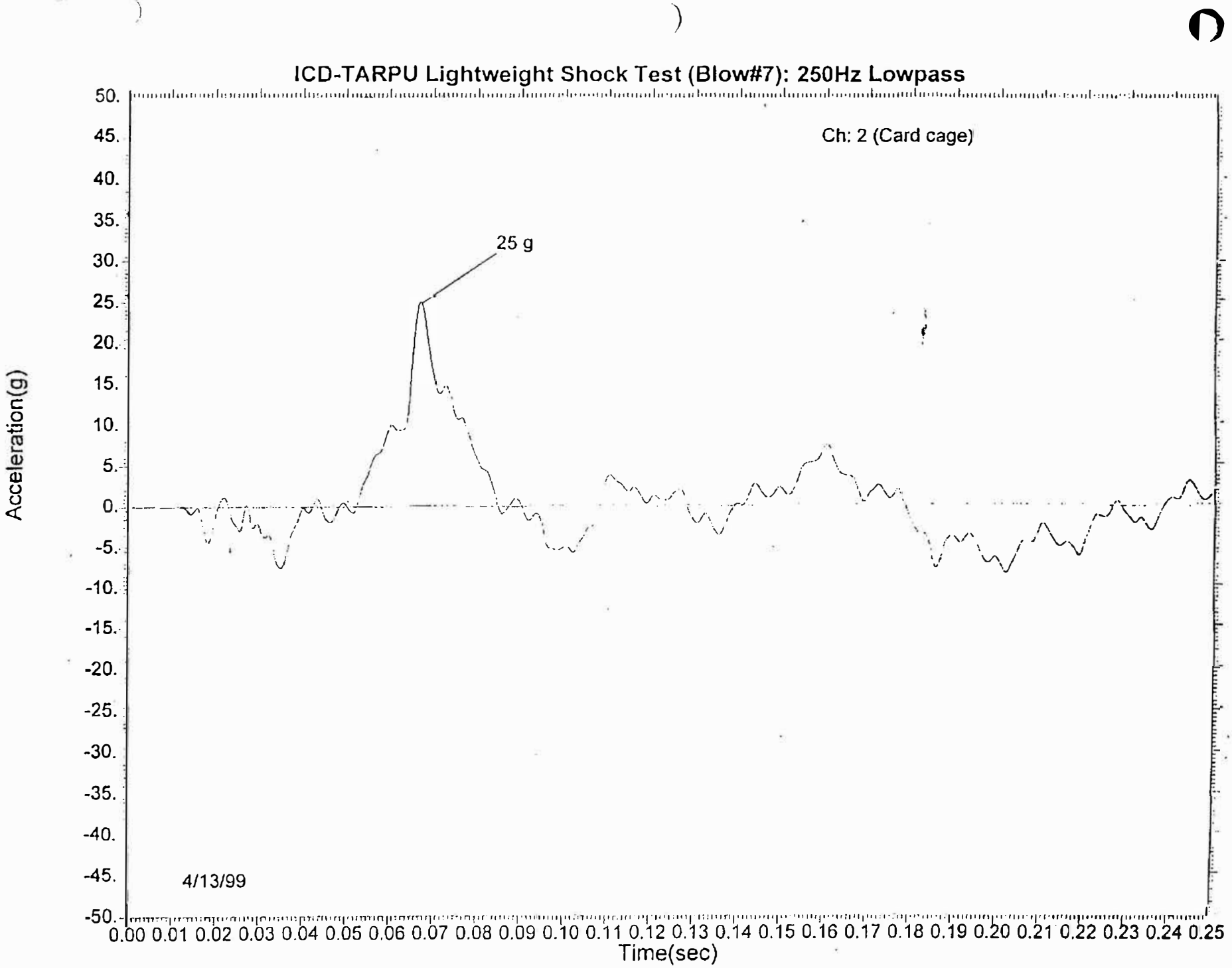

ICD-TARPU Lightweight Shock Test (Blow#4): 250Hz Lowpass
Ch: 2 (Card cage)
Acceleration(g)
50.
45.
40.
35.
30.
25.
20.
15.
10.
5.
0.
-5.
-10.
-15.
-20.
-25.
-30.
-35.
-40.
-45.
-50.
18 g
4/13/99
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)

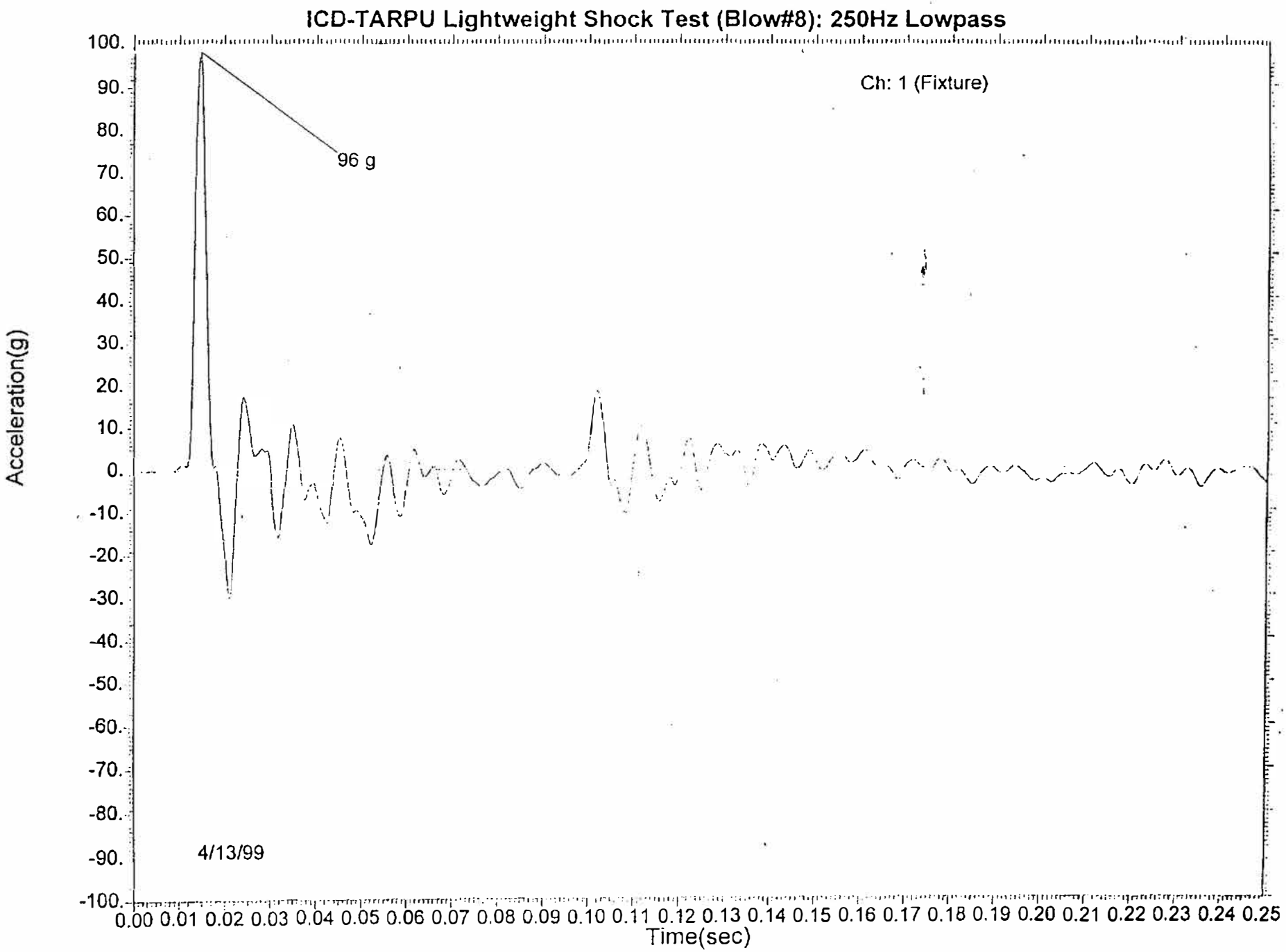

ICD-TARPU Lightweight Shock Test (Blow#5): 250Hz Lowpass
Ch: 1 (Fixture)
118 g
4/13/99
Acceleration(g)
200.
180.
160.
140.
120.
100.
80.
60.
40.
20.
0.
-20.
-40.
-60.
-80.
-100.
-120.
-140.
-160.
-180.
-200.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)

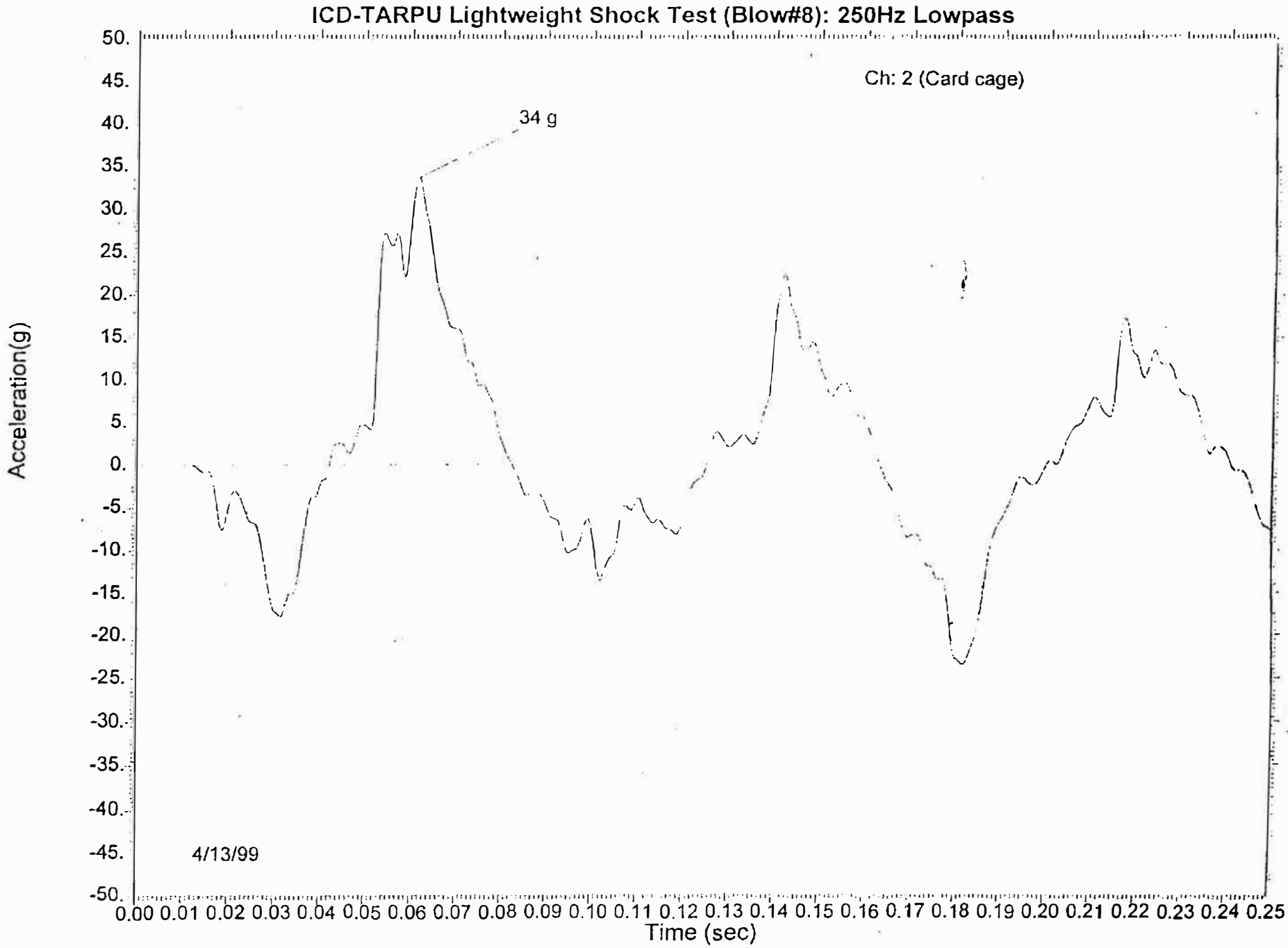

ICD-TARPU Lightweight Shock Test (Blow#5): 250Hz Lowpass
Ch: 2 (Card cage)
Acceleration(g)
100.
90.
80.
70.
60.
50.
40.
30.
20.
10.
0.
-10.
-20.
-30.
-40.
-50.
-60.
-70.
-80.
-90.
-100.
80 g
4/13/99
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)

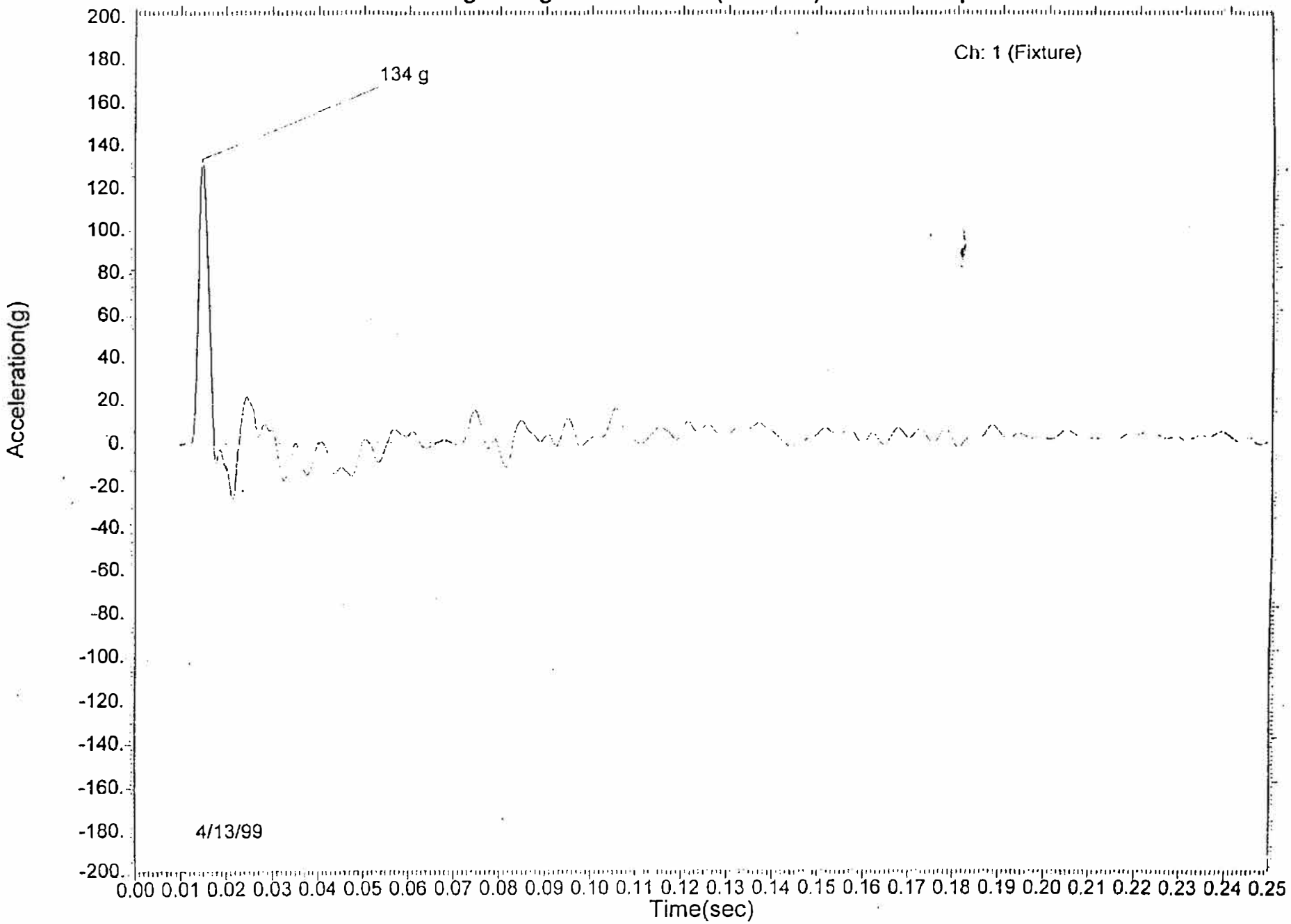

ICD-TARPU Lightweight Shock Test (Blow#6): 250Hz Lowpass
Ch: 1 (Fixture)
154 g
4/13/99
200.
180.
160.
140.
120.
100.
80.
60.
40.
20.
0.
-20.
-40.
-60.
-80.
-100.
-120.
-140.
-160.
-180.
-200.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23
Time(sec)

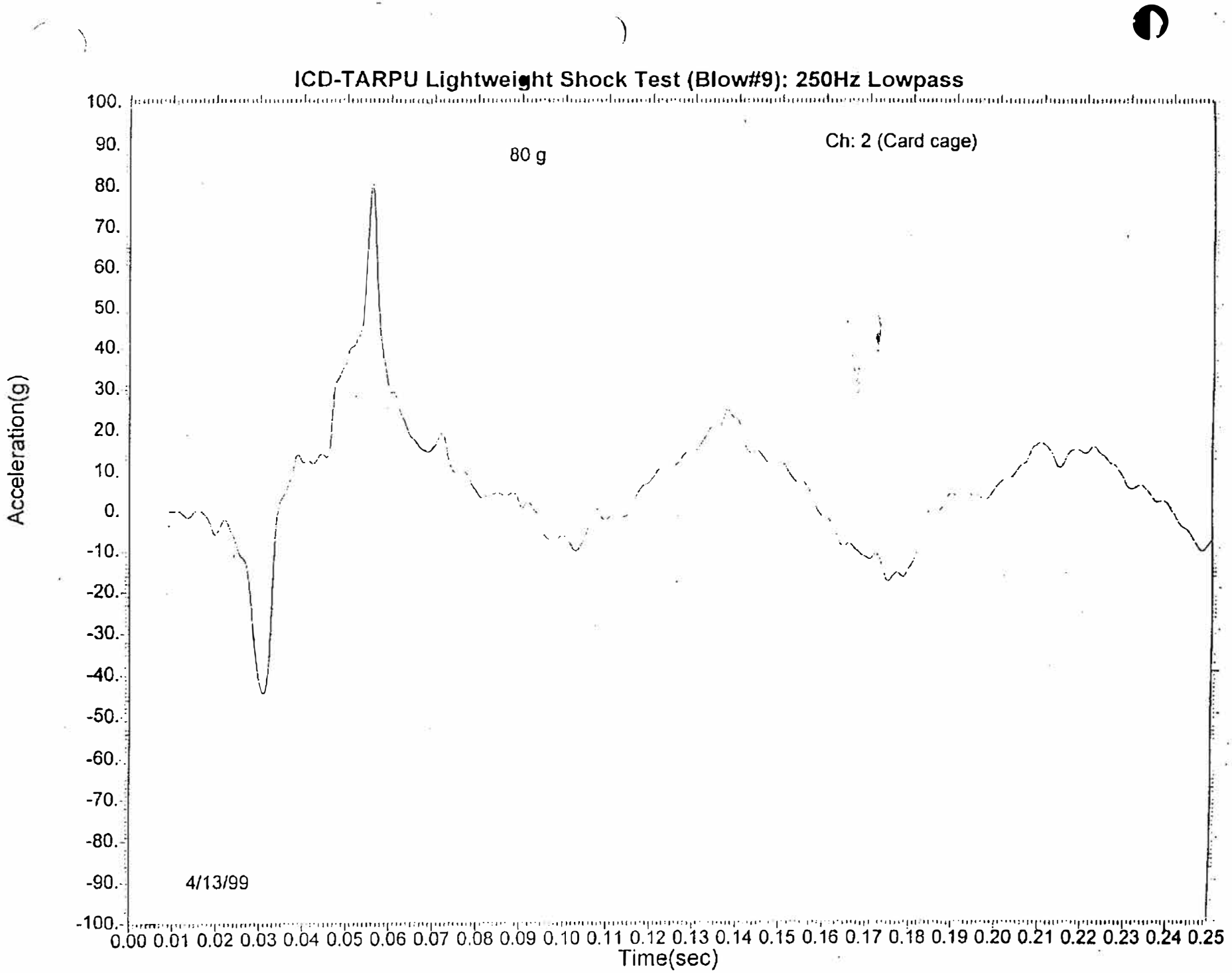

ICD-TARPU Shock Test (Blow#7): 250Hz Lowpass
Ch: 1 (Fixture)
44 g
4/13/99
Acceleration(g)
50.
45.
40.
35.
30.
25.
20.
15.
10.
5.
0.
-5.
-10.
-15.
-20.
-25.
-30.
-35.
-40.
-45.
-50.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)


ICD-TARPU Lightweight Shock Test (Blow#7): 250Hz Lowpass
Ch: 2 (Card cage)
25 g
4/13/99
Acceleration(g)
50.
45.
40.
35.
30.
25.
20.
15.
10.
5.
0.
-5.
-10.
-15.
-20.
-25.
-30.
-35.
-40.
-45.
-50.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)


ICD-TARPU Lightweight Shock Test (Blow#8): 250Hz Lowpass
Ch: 1 (Fixture)
96 g
4/13/99
Acceleration(g)
100.
90.
80.
70.
60.
50.
40.
30.
20.
10.
0.
-10.
-20.
-30.
-40.
-50.
-60.
-70.
-80.
-90.
-100.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)


ICD-TARPU Lightweight Shock Test (Blow#8): 250Hz Lowpass
Ch: 2 (Card cage)
34 g
4/13/99
Acceleration(g)
50.
45.
40.
35.
30.
25.
20.
15.
10.
5.
0.
-5.
-10.
-15.
-20.
-25.
-30.
-35.
-40.
-45.
-50.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time (sec)


ICD-TARPU Lightweight Shock Test (Blow #9): 250Hz Lowpass
Ch: 1 (Fixture)
134 g
4/13/99
Acceleration(g)
200.
180.
160.
140.
120.
100.
80.
60.
40.
20.
0.
-20.
-40.
-60.
-80.
-100.
-120.
-140.
-160.
-180.
-200.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)


ICD-TARPU Lightweight Shock Test (Blow#9): 250Hz Lowpass
80 g
Ch: 2 (Card cage)
4/13/99
Acceleration(g)
100.
90.
80.
70.
60.
50.
40.
30.
20.
10.
0.
-10.
-20.
-30.
-40.
-50.
-60.
-70.
-80.
-90.
-100.
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25
Time(sec)