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16. Abstract

The calibration procedures specified for the Part 572 3-year-old-child test dummy were used to establish the performance characteristics of the ECE 9-month-old-child test dummy. In addition, head drop tests and sled impact tests utilizing child restraint systems were conducted.

The Part 572 calibration requirements are listed for comparison with the ECE dummy response data.

Assembly and adjustment problem areas of the ECE dummy were noted.

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1.0 INTRODUCTION

The purpose of this project was to determine the response characteristics of the Economic Commission of Europe (ECE) 9-month-old test dummy. The calibration techniques utilized were based on the requirements in the NHTSA Enforcement publication, Part 572 Three-Year-Old-Child Test Dummy Performance Calibration Test Procedure. Modifications were made to the test equipment and procedures whenever necessary to accommodate the smaller size and different design characteristics of the ECE dummy.

Head impact, head-neck pendulum, chest impact, lumbar flexion, and head drop tests were performed. In addition, four sled impact tests were conducted with the ECE dummy using commercially available child restraint systems.

Assembly and joint adjustment difficulties encountered in the course of testing were noted.

2.0 METHODOLOGY

2.1 Instrumentation

2.1.1 Transducers

Triaxial accelerometer mounts were designed and fabricated for instrumenting the dummy's head and chest utilizing Endevco 2264-2000 accelerometers.

All velocity measurements were made with magnetic-pickup devices which sensed probes on the test device.

Pendulum deceleration was measured with an Endevco 2264-2000 accelerometer. Sled deceleration was measured with an Endevco 7232C-750 accelerometer.

Dummy head trajectory during pendulum tests was measured with two rotary and one linear potentiometer as specified in the Part 572 Three-Year-Old-Child Test Dummy Performance Calibration Test Procedure.

Type I lap belt preload forces before sled impact tests were measured with GSE type 2500 seat belt webbing transducers.

2.1.2 Signal Conditioning

Accelerometer, seat belt load cell, and potentiometer signals were conditioned with Honeywell Model 105 bridge units and Model 120 amplifiers. Velocity signals were recorded without amplification.

2.1.3 Data Recording and Processing

The lumbar bending test signals were recorded on a Brush Model 260, six-channel strip-chart recorder. All other tests were recorded on a Honeywell Model 7600 14-channel tape recorder.

The data was digitized on a PDP 11/45 computer and analyzed on the Amdahl 470V/6 computer of the MTS system.

2.1.4 Photo-Instrumentation

High-speed movies of the sled impact tests were obtained with two Photosonics 1B cameras operated at 1000 frames per second and a Graph Check 300 Polaroid sequence camera.

2.2 Test Procedures

2.2.1 Head Impact Tests

The ECE dummy was fully assembled and all joint and spine adjustments performed per the instruction manual. The dummy head was instrumented with a triaxial accelerometer array. The ten pound, six ounce wire-suspended piston specified in the test procedure for calibration of the Part 572 three-year-old-child dummy was used as the impact device. A smaller seating platform and 10.3 inch high backrest was constructed to accomodate the ECE dummy proportions. Figure 2.1 shows the test setup. The test data is presented in section 4.

2.2.2 Head-Neck Pendulum Tests

The pendulum specified for calibration of the Part 572 three-yearold child dummy was used to test the ECE dummy. The base was modified to allow attachment of the ECE neck, with the spine cable extending up into the pendulum tube. The right side dummy head accelerometer mounting block bolt was extended and used to attach the rotary potentiometer assembly for head motion analysis. Aluminum hexcell was used to decelerate the pendulum as specified in the Part 572 procedure.

Figure 2.2 shows the test setup. The test data is presented in section 4.

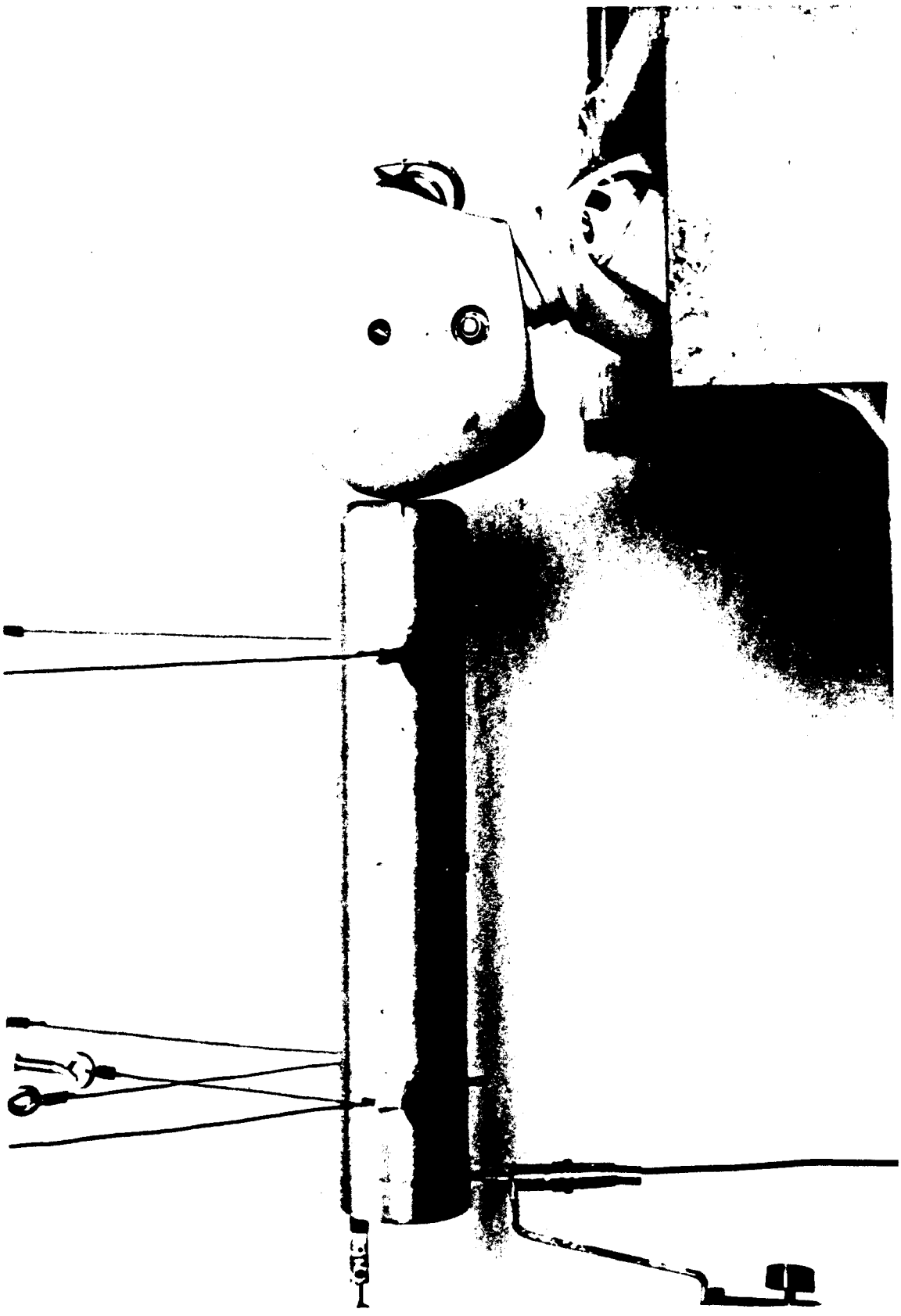
2.2.3 Chest Impact Tests

The fully assembled and adjusted ECE dummy was instrumented with a triaxial accelerometer array in its chest cavity. The ten pound, six ounce wire-suspended piston was adjusted to strike the chest 8.2 inches above the dummy seating surface. This dimension provides for the same effective chest impact height on the ECE dummy as specified for the Part 572 three-year-old-child dummy.

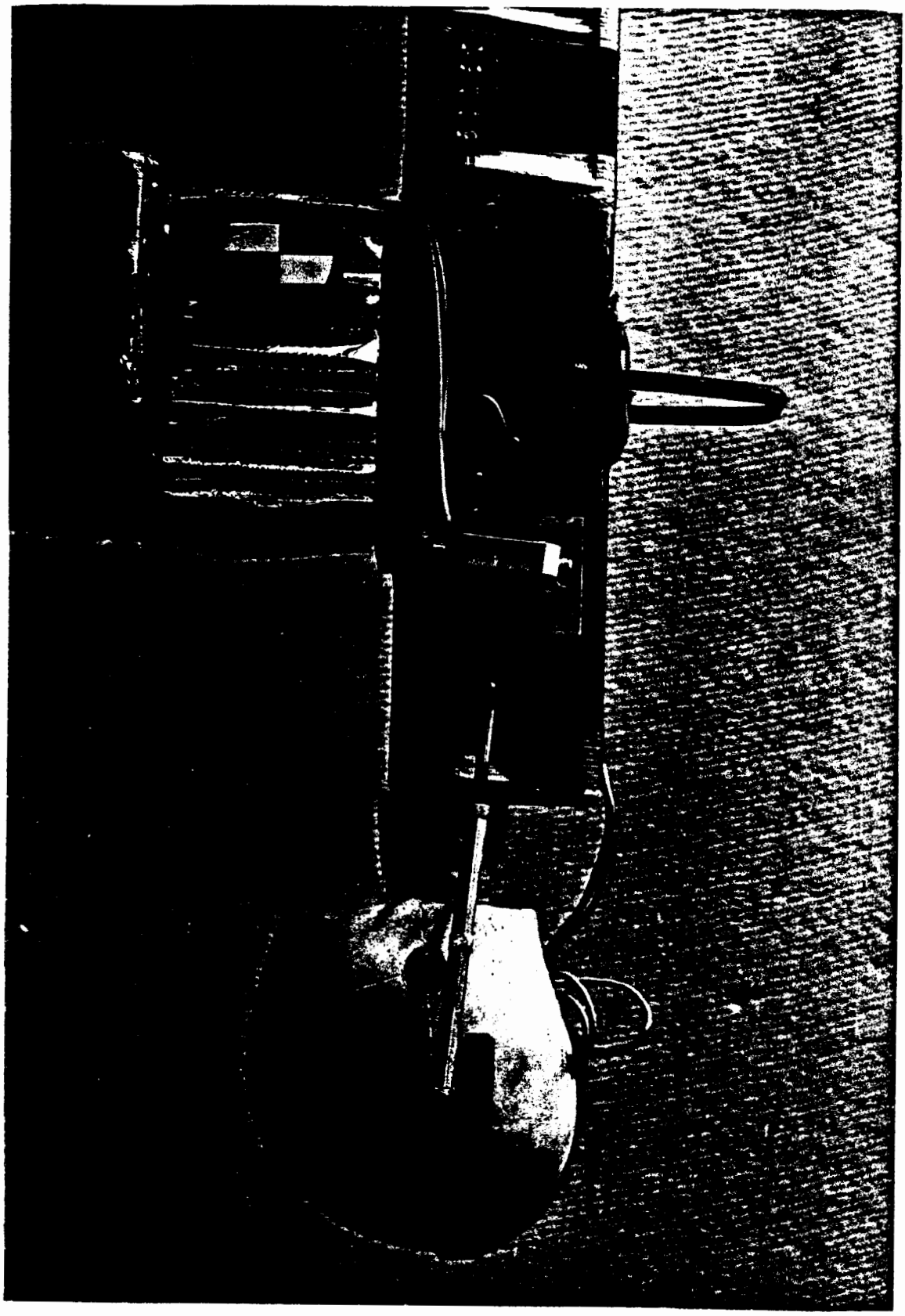
Figures 2.3 and 2.4 show the test setup,and test data is presented in section 4.

2.2.4 Lumbar Bending Tests

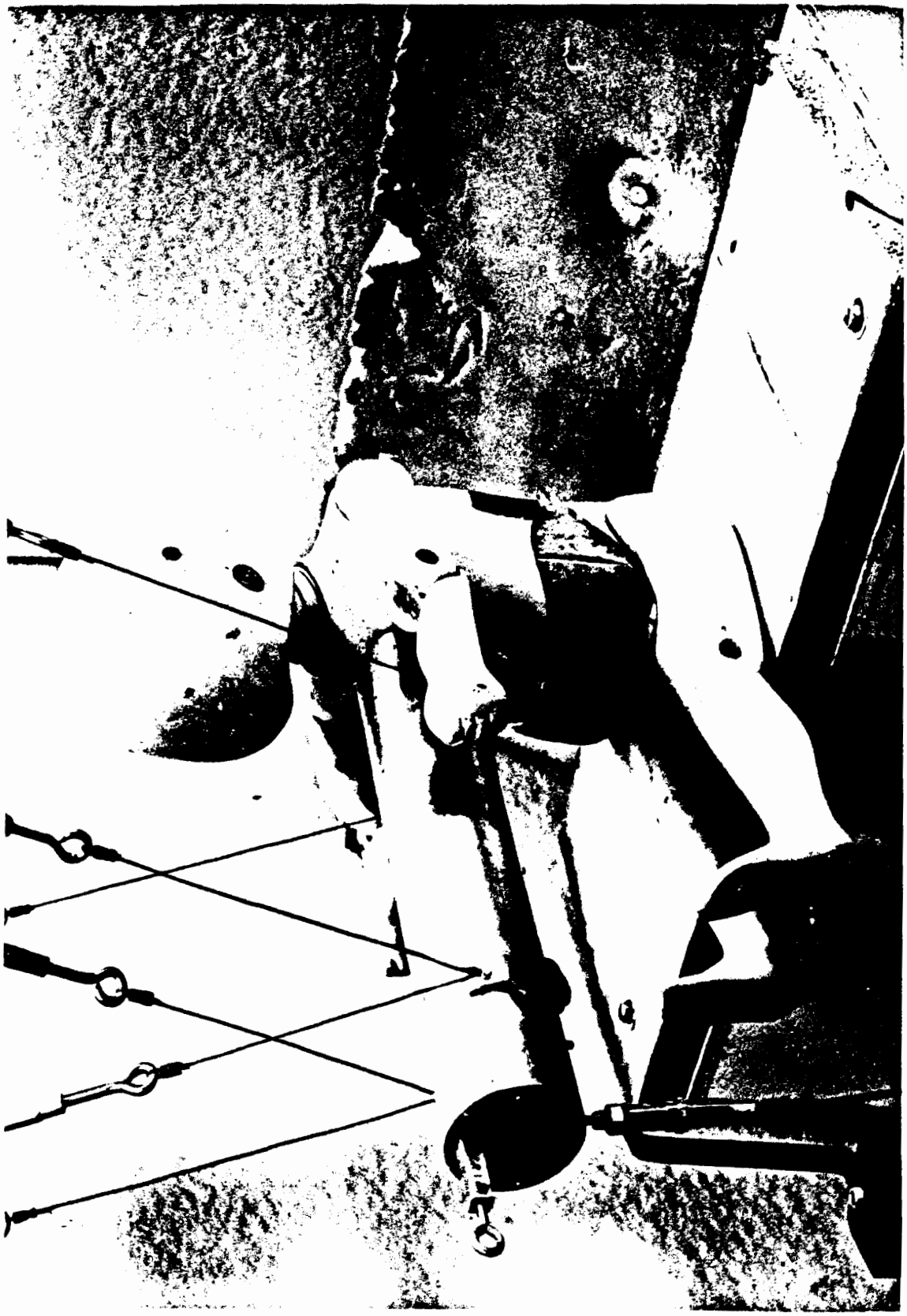
The ECE dummy was securely fastened to a flat surface in a seated position for the lumbar bending test. Attachment was by a rod



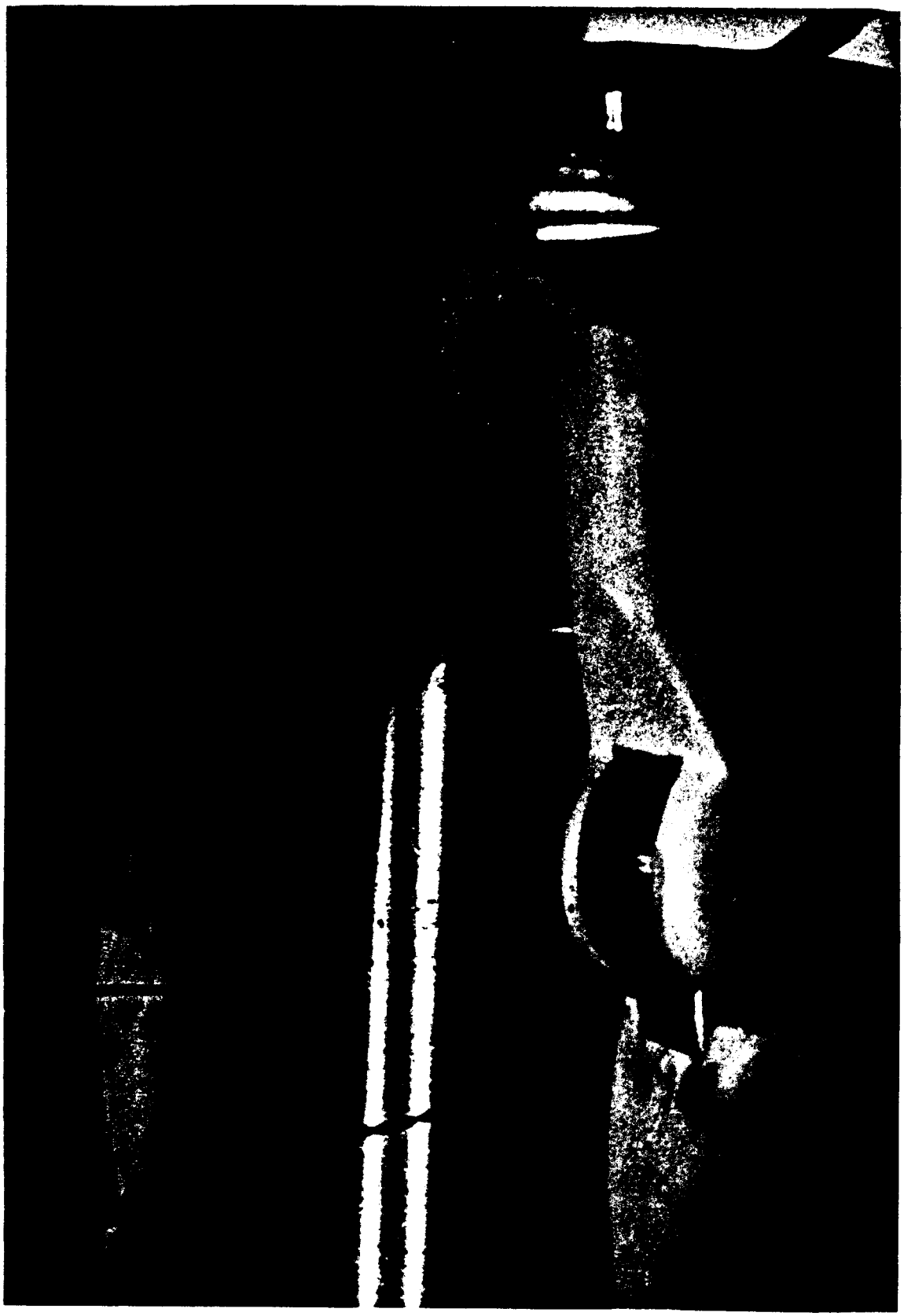
2.1 Head Impact Test Setup



2.2 Head-Neck Pendulum Test Setup



2.3 Chest Impact Test Setup



2.4 Close-up of Chest Impact Site

through the knee pivot holes and by clamping rods that hooked around the dummy femur near the hip joint.

The head, head mounting block, and neck vertebra elements were removed. A spacer tube was fabricated to provide a rigid neck similar to that used for lumbar bending tests on the three-year-old dummy. Provisions were made on the spacer tube for a rotary potentiometer angle transducer and an attachment point for the bending load. The bending load was applied at the top of the rigid neck.

A hand winch provided the loading force on the dummy. A section of seat belt webbing and GSE seat belt webbing force transducer was used to monitor the bending force applied to the dummy. Figure 2.5 shows the test setup for the lumbar bending evaluation. Test data is presented in section 4.

2.2.5 Head Drop Tests

The ECE dummy head instrumented with a triaxial accelerometer array was dropped on a steel plate from a height of 7 inches as specified in Part 572 Regulation - Subpart B. The head was suspended with the Z-axis 25° below horizontal. Figure 2.6 shows the test setup. The test data is presented in section 4.

2.2.6 Sled Tests

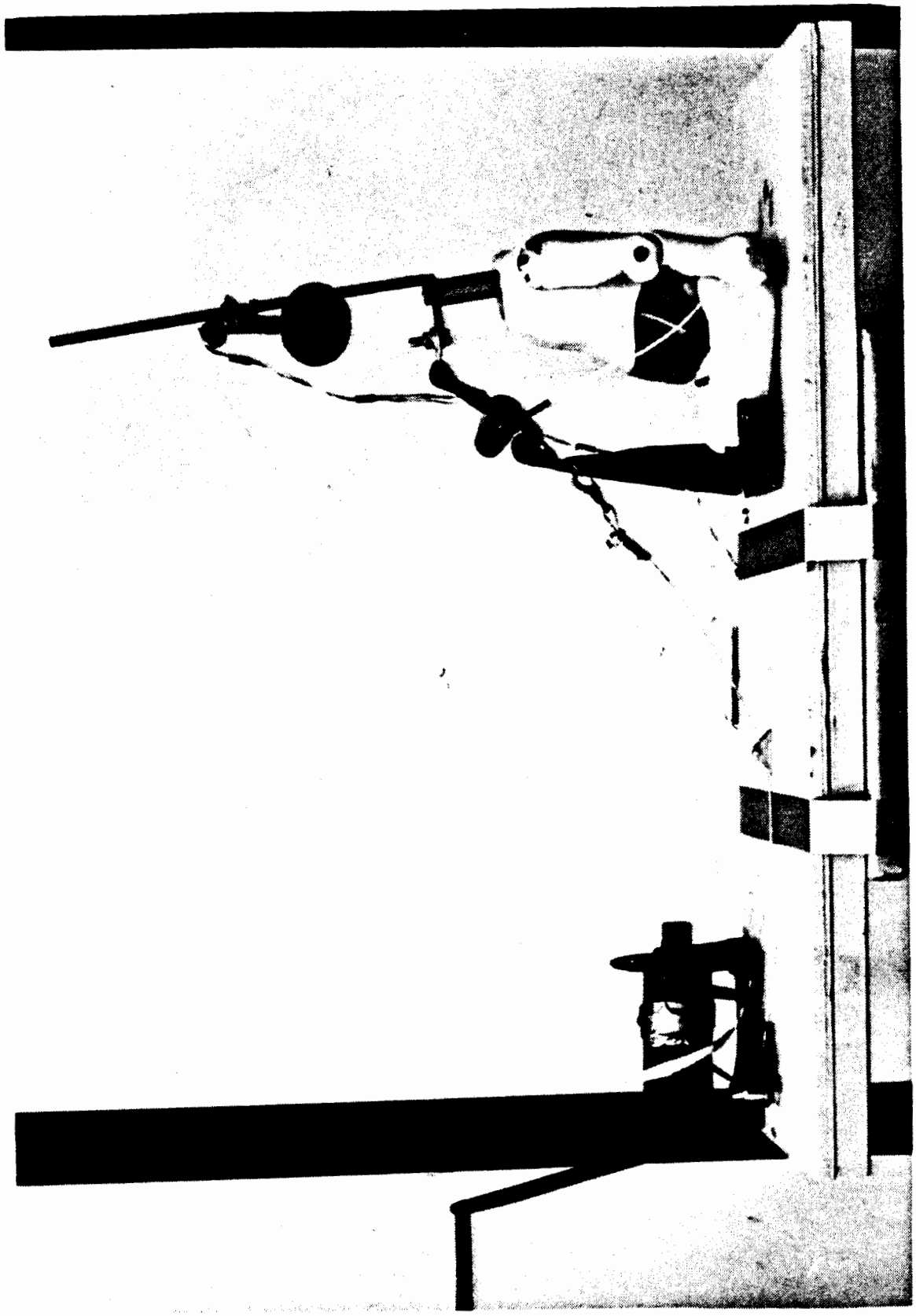
Four sled tests were conducted with the ECE dummy to evaluate its performance in production child restraint systems. The impacts approximated the Configuration I compliance test requirements with nominal parameters of 30 mph and 20 g.

The following child restraint systems were used for the evaluation:

Kantwet DYN-O-MITE - Two restraints tested in the rear-facing, infant configuration.

Strolee Model 599 - Two restraints tested, one in the rear-facing configuration and one in the forward-facing configuration.

Setup, graph check, and post-test photos of the sled tests are in section 4 with the test data.



2.5 Lumbar Flexion Test Setup

2.6 Head Drop Test Setup

3.0 DUMMY PROBLEM AREAS

3.1 Neck Configuration

A slit tygon sleeve is used around the woven steel cable portion of the lumbar spine. This sleeve serves to bring the cable portion up to the diameter of the threaded ends and also keeps the spinal elements centered.

As received, the dummy neck was lacking such a tygon sleeve. Adjusting the neck tension would cause the neck elements to become staggered. The manual supplied with the dummy did not provide sufficient information to determine if the tygon sleeves were to be used at either location.

With the consent of the CTM, a tygon sleeve was fabricated for the neck cable. The sleeve was in place for all subsequent testing at HSRI.

3.2 Neck Tension Adjustment

The specified neck tension adjustment procedure uses a force-deflection approach. The tension nut is first overtightened. The dummy is placed on its back on a horizontal surface and a 50 N vertical load applied to the head-attaching bolt in the Atlas-Axis block. The nut is then gradually loosened until the bolt is lowered by 10 $\pm$ 1 mm.

The accuracy of the 10 mm drop measurement is reduced by the compliance and flexibility of the dummy torso against the table surface. In addition, the force required to loosen the tension nut disturbs the vertical positioning of the neck assembly. A simple torque requirement on the neck-tension nut might be considered to give a more consistent neck tension adjustment plus an easier procedure.

3.3 Joint Tension Adjustment

The elbow and knee joints utilize the tightness of their pivot bolts for tension adjustment. Rotation of a limb, however, would change the joint tension. Typically, when moved through its range of motion, the joint tension will vary from specified adjustment to almost free rotation. The use of a resilient washer or other elastic element in the joint should produce a more consistent joint tension.

The shoulder joints were impossible to adjust to specification. Friction between the flesh of the upper arm and the torso was excessive. With the shoulder joint tension adjustment fully loosened, the arm would stay firmly in position.

The hip joints required the use of a special spanner tool for adjustment. The specified joint tension was easily set and was not affected by joint rotation or dummy flesh interaction.

3.4 Spine

The spine tension adjustment is made by tightening a nut at the lower end of the spine cable against a small coil spring. The correct setting is when the coil spring has been compressed to 2/3 of its unloaded length.

The coil spring has unfinished ends that do not provide a flat, planar surface. As a result, the unloaded, installed length is difficult to determine accurately. The use of a tension spring with finished, flat ends would greatly improve the repeatability of the spine tension adjustment.

3.5 Head

The tension of the head-bolt through the Atlas-Axis block is used to set the head adjustment. Once set, this adjustment was very consistent through the range of motion.

When conducting the pendulum head/neck test, it was necessary to tighten the head-bolt above specification. This greatly reduced head rotation as the pendulum descended and during the impact event, and more closely duplicated the Part 572 three-year-old child dummy head/neck junction.

4.0 RESULTS

4.1 Head Impact Tests

The head impact test results are presented in the following sequence:

Summary of TEST AVERAGE
Data Plot Overlay
Summary of TEST 81D005
Data Plot of TEST 81D005
Summary of TEST 81D006
Data Plot of TEST 81D006
Summary of TEST 81D007
Data Plot of Test 81D007
Summary of Test 81D008
Data Plot of Test 81D008

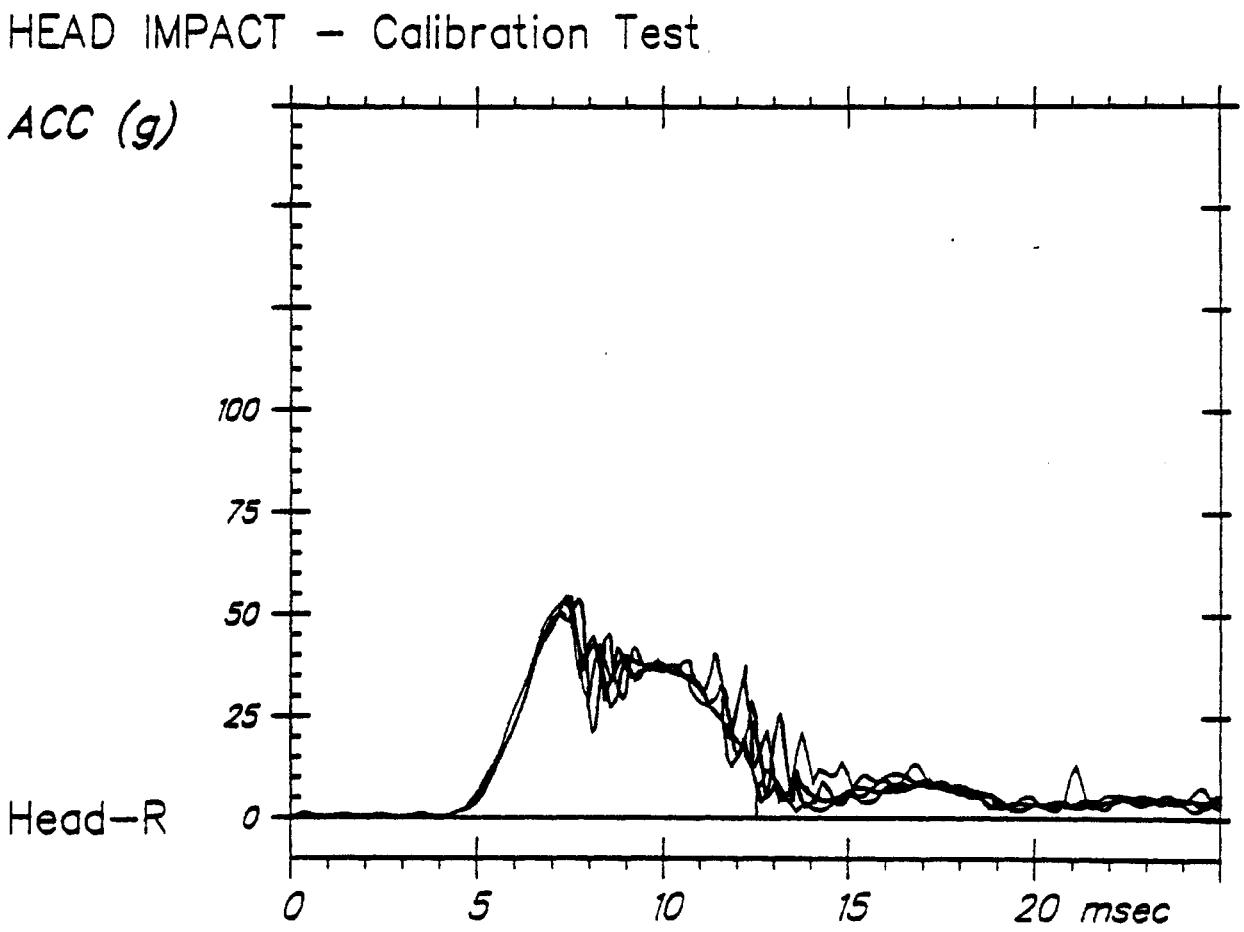
SUMMARY OF HEAD IMPACT TEST CALIBRATION DATA

ECE DUMMY

TEST MEASUREMENT:	AVERAGE RESULTS	PART 572 REQMT.
TEST PROBE IMPACT VELOCITY, fps	6.92	6.86 to 7.14 fps
PEAK HEAD RESULTANT ACCEL., g	54.1	95-118g
PEAK HEAD LATERAL ACCEL., g	4.3	≤ 7g
PULSE △TIME @ 50g, ms	0.4	2-3 ms

HEAD IMPACT TEST SUMMARY

RESULTANT ACCELERATION OVERLAY

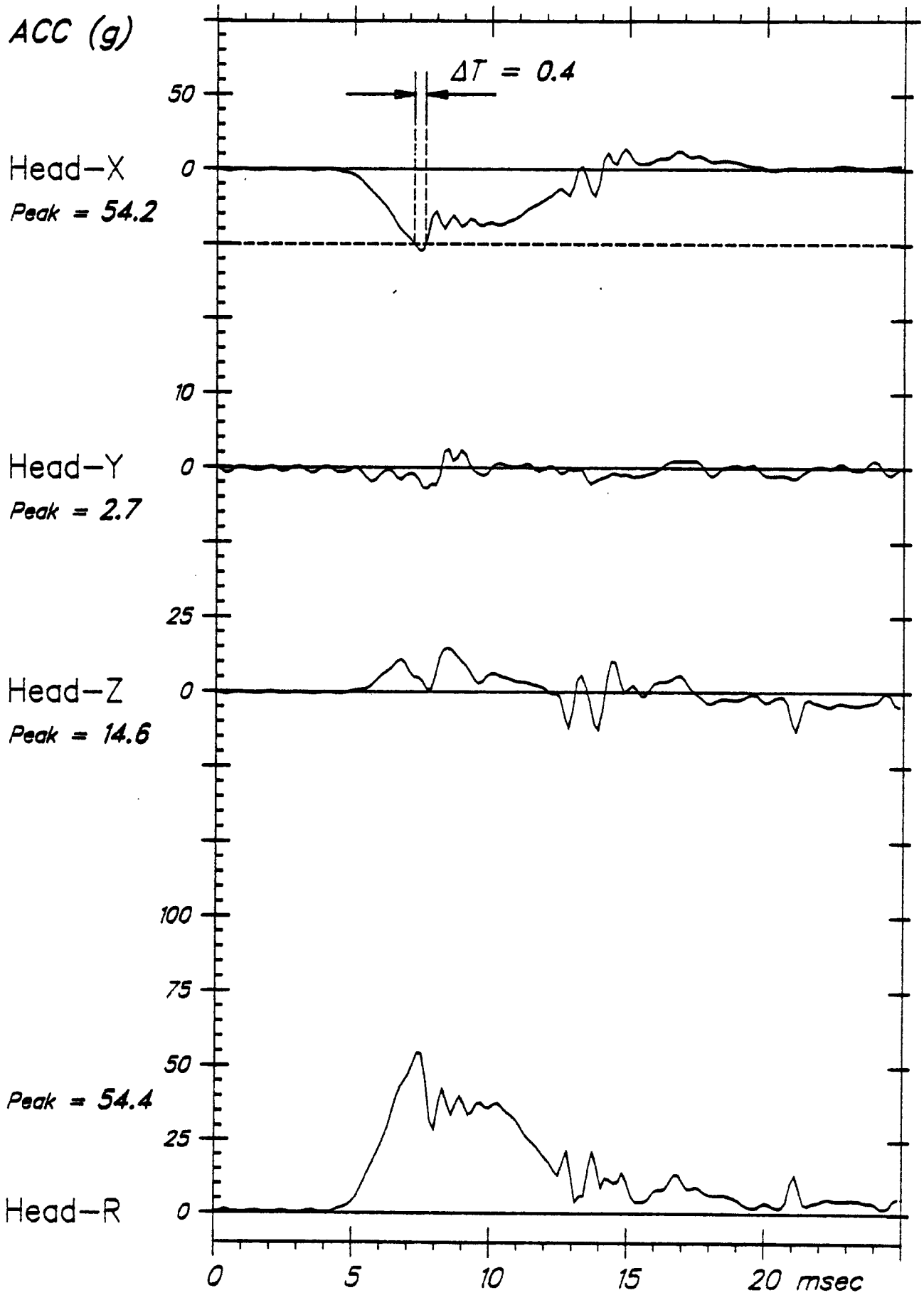


SUMMARY OF HEAD IMPACT TEST CALIBRATION DATA

ECE DUMMY

TEST MEASUREMENT:	TEST 81D005	PART 572 REQMT.
TEST PROBE IMPACT VELOCITY, fps	6.92	6.86 to 7.14 fps
PEAK HEAD RESULTANT ACCEL., g	54.4	95-118g
PEAK HEAD LATERAL ACCEL., g	2.7	≤ 7g
PULSE △TIME @ 50g, ms	0.4	2-3 ms

HEAD IMPACT – Calibration Test 81D005

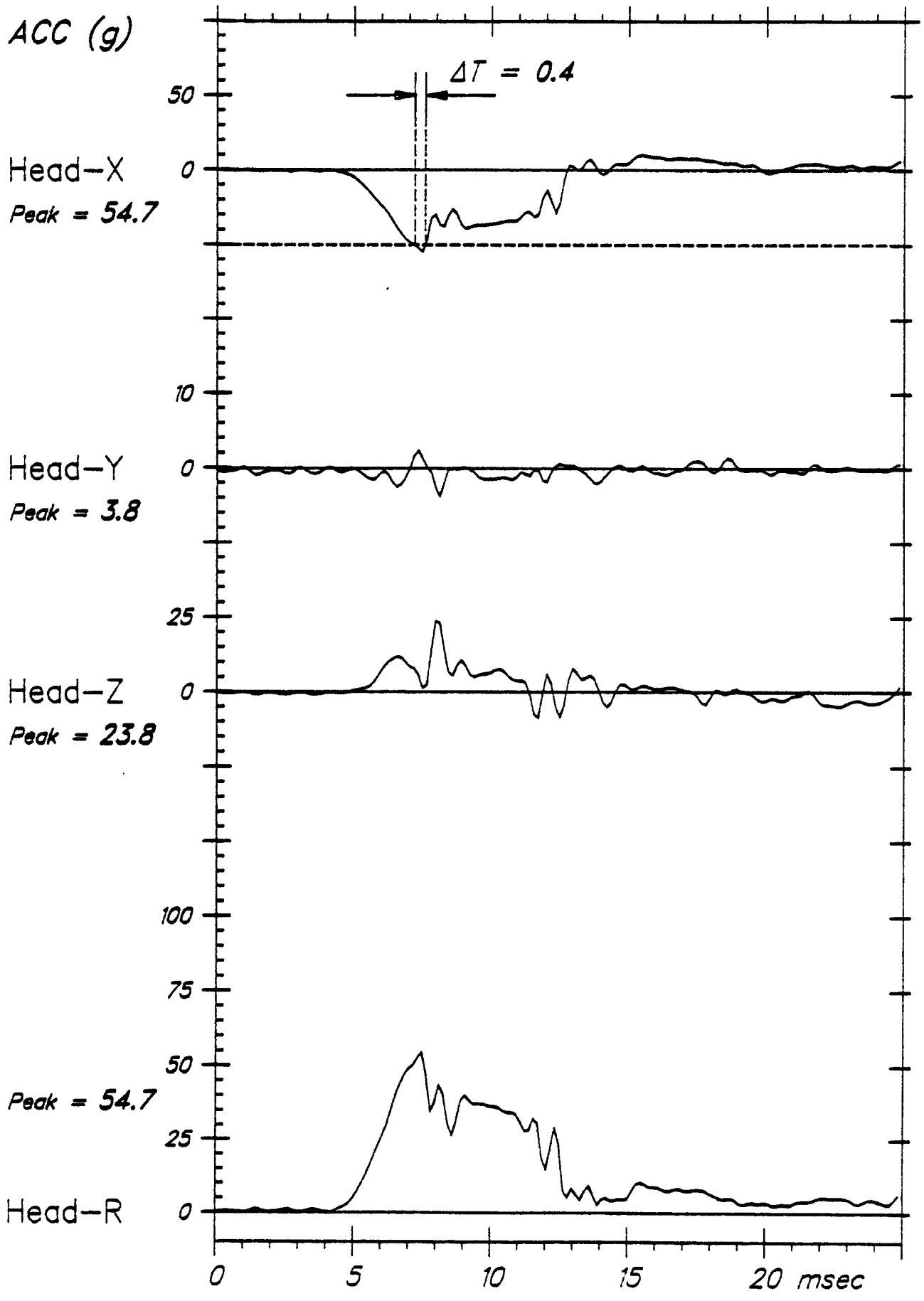


SUMMARY OF HEAD IMPACT TEST CALIBRATION DATA

ECE DUMMY

TEST MEASUREMENT:	TEST 81D006	PART 572 REQMT.
TEST PROBE IMPACT VELOCITY, fps	6.92	6.86 to 7.14 fps
PEAK HEAD RESULTANT ACCEL., g	54.7	95-118g
PEAK HEAD LATERAL ACCEL., g	3.8	≤ 7g
PULSE ΔTIME @ 50g, ms	0.4	2-3 ms

HEAD IMPACT – Calibration Test 81D006

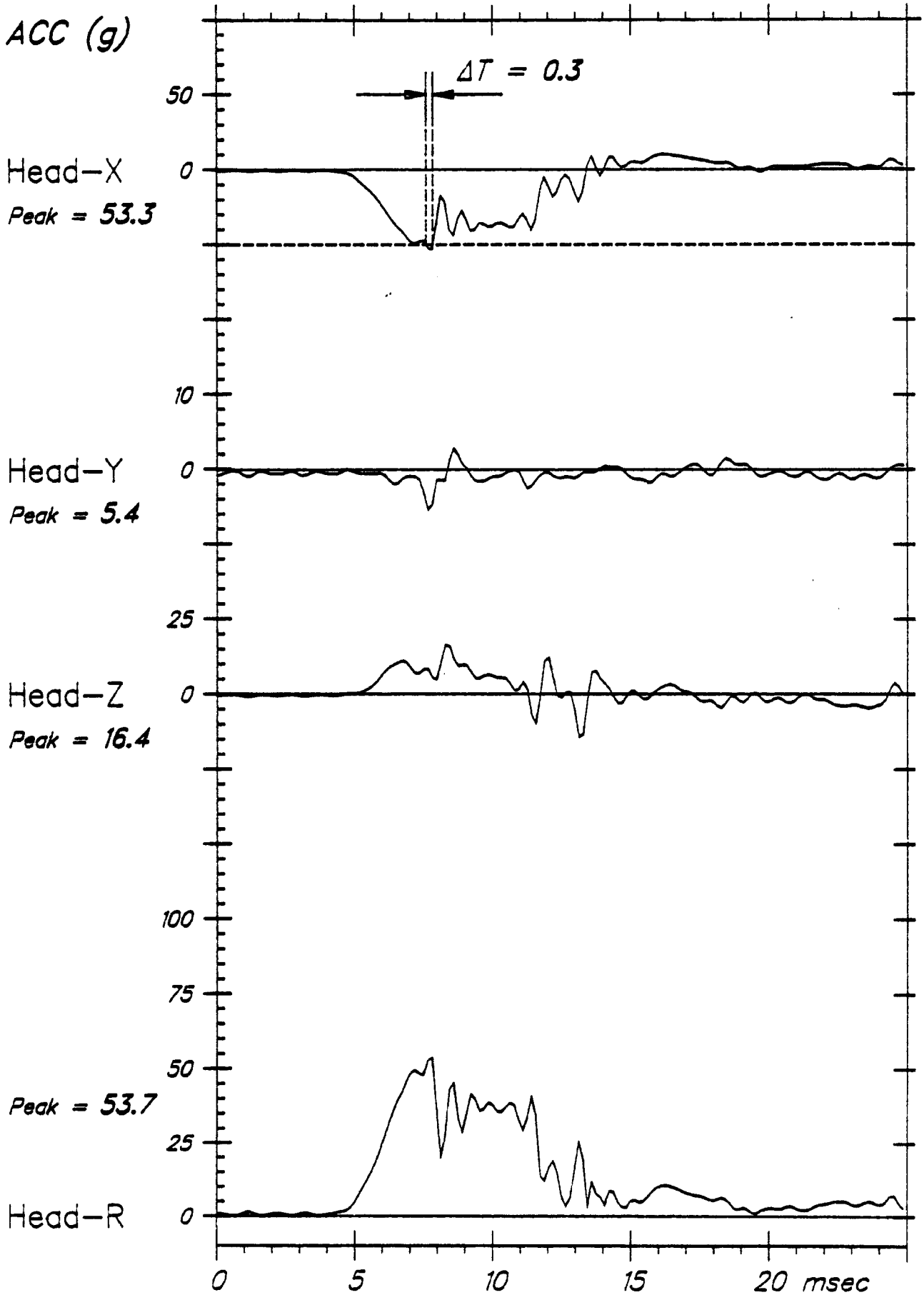


SUMMARY OF HEAD IMPACT TEST CALIBRATION DATA

ECE DUMMY

TEST MEASUREMENT:	TEST 81D007	PART 572 REQMT.
TEST PROBE IMPACT VELOCITY, fps	6.92	6.86 to 7.14 fps
PEAK HEAD RESULTANT ACCEL., g	53.7	95-118g
PEAK HEAD LATERAL ACCEL., g	5.4	≤ 7g
PULSE △TIME @ 50g, ms	0.3	2-3 ms

HEAD IMPACT – Calibration Test 81D007

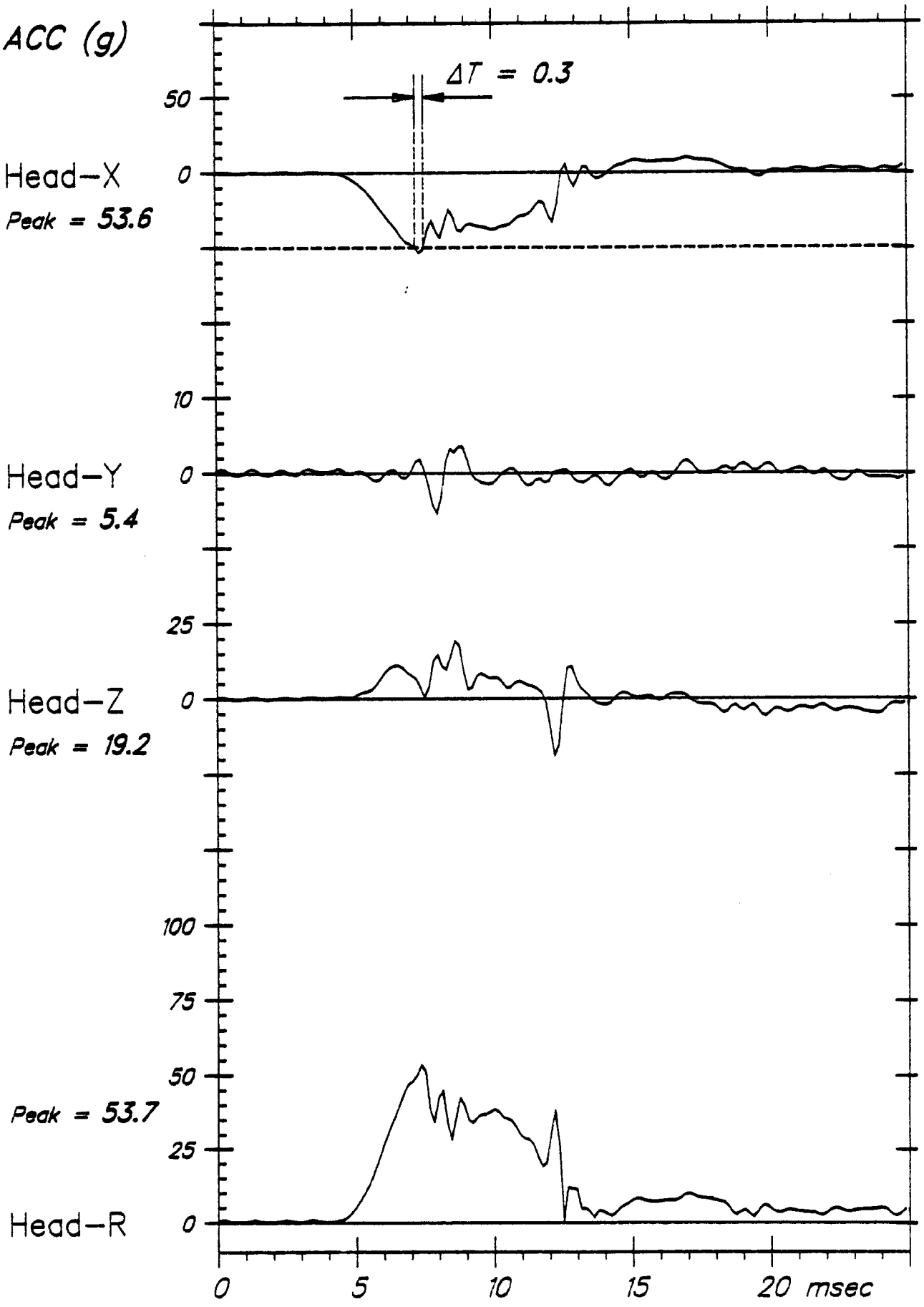


SUMMARY OF HEAD IMPACT TEST CALIBRATION DATA

ECE DUMMY

TEST MEASUREMENT:	TEST 81D008	PART 572 REQMT.
TEST PROBE IMPACT VELOCITY, fps	6.92	6.86 to 7.14 fps
PEAK HEAD RESULTANT ACCEL., g	53.7	95-118g
PEAK HEAD LATERAL ACCEL., g	5.4	≤ 7g
PULSE △TIME @ 50g, ms	0.3	2-3 ms

HEAD IMPACT – Calibration Test 81D0008



4.2 Head-Neck Pendulum Tests

The head-neck pendulum test results are presented in the following sequence:

Summary of TEST 81D014
Data Plot of TEST 81D014
Summary of TEST 81D015
Data Plot of TEST 81D015
Summary of TEST 81D016
Data Plot of TEST 81D016

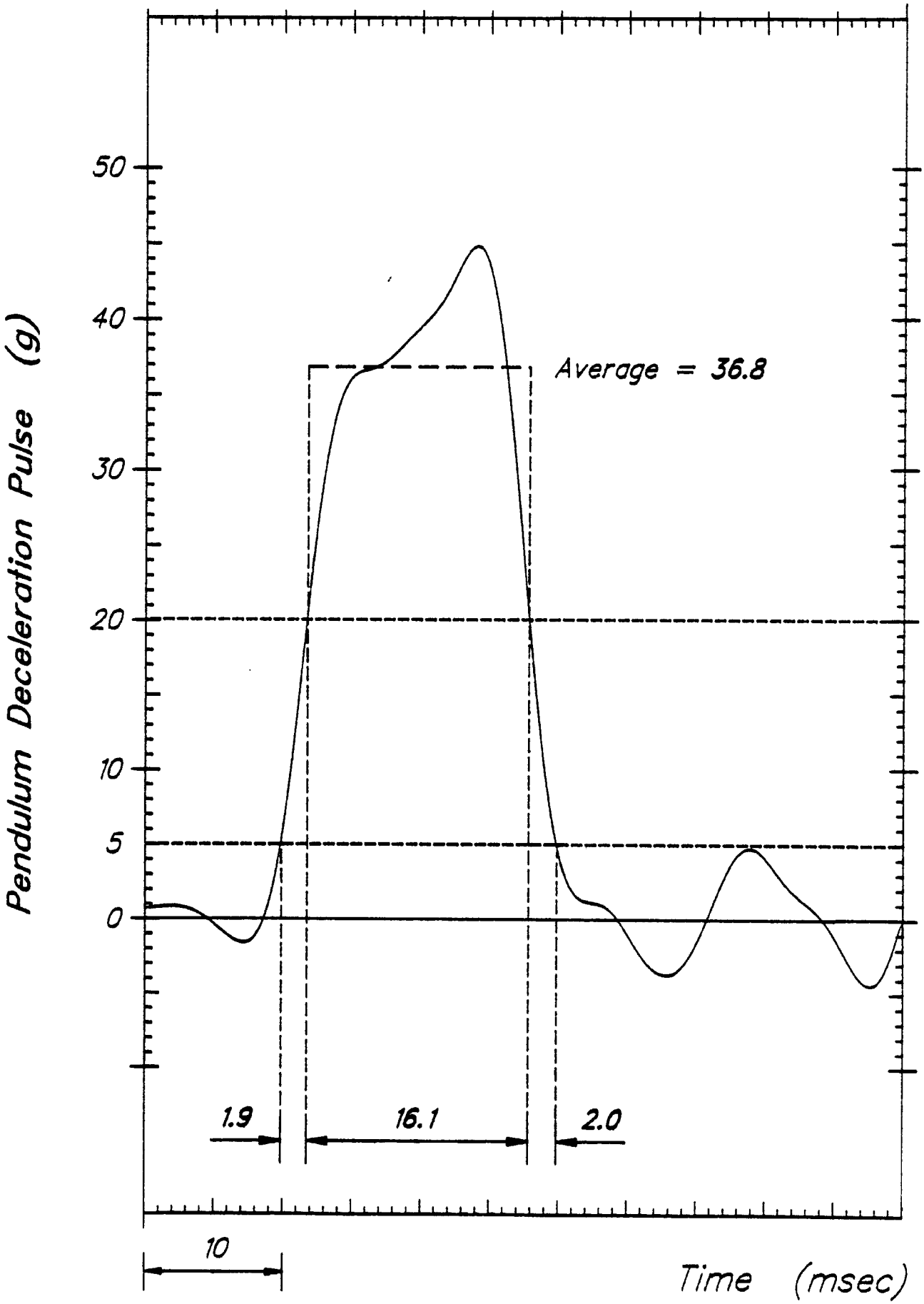
SUMMARY OF HEAD-NECK PENDULUM TEST DATA

ECE DUMMY

TEST MEASUREMENT:	TEST 81D014	PART 572 REQMT.
PENDULUM IMPACT VELOCITY, fps	16.5	16-18 fps
PEND. MIN./MAX. DECEL. OVER (t_3-t_2), g	36.8 AVERAGE	20-34g
PEAK HEAD RESULTANT ACCEL., g	53.4	≤ 30g
PEND. DECEL. PULSE △TIME (t_2-t_1), ms	1.9	≤ 4 ms
PEND. DECEL. PULSE △TIME (t_3-t_2), ms	16.1	18-21 ms
PEND. DECEL. PULSE △TIME (t_4-t_3), ms	2.0	≤ 5 ms
HEAD ZERO POSITION TIME/ PEND. REVERSAL TIME		-/-
HEAD MAX. ROTATION ANGLE, °	88°	76-92°
TIME (ms) @ HEAD ROT. ANGLE-- 0°	0.0	-2-+2ms
30°	13.8	17.3-24.7ms
60°	22.6	31.1-40.9ms
Max.	44.8	55.0-69.0ms
60°	74.6	81.7-100.3ms
30°	94.8	97.4-118.6ms
0°	110.9	111.2-134.8ms
CHORDAL DISPLACEMENT (In.) @ HEAD ROTATION ANGLE OF-----0°	0.10	-0.8-+0.8"
30°	2.07	1.4-3.0"
60°	3.02	3.5-5.1"
Max.	5.25	5.0-6.6"
60°	3.08	3.5-5.1"
30°	1.23	1.4-3.0"
0°	0.24	-0.8-+0.8"

COMMENT: The aluminum hexcell used for this test was stiffer than specified for Part 572 calibration.

PENDULUM IMPACT – Calibration Test 81D014



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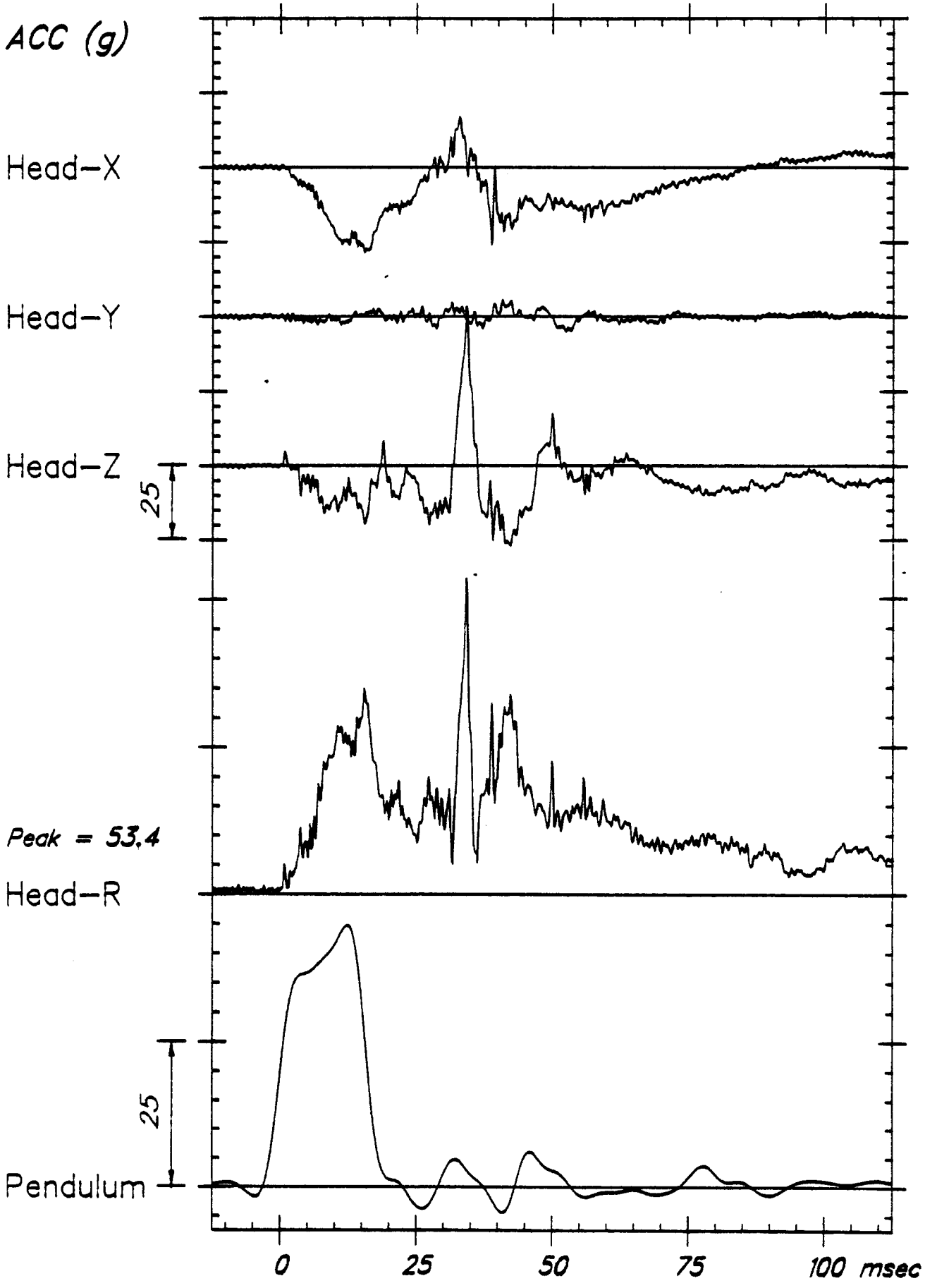
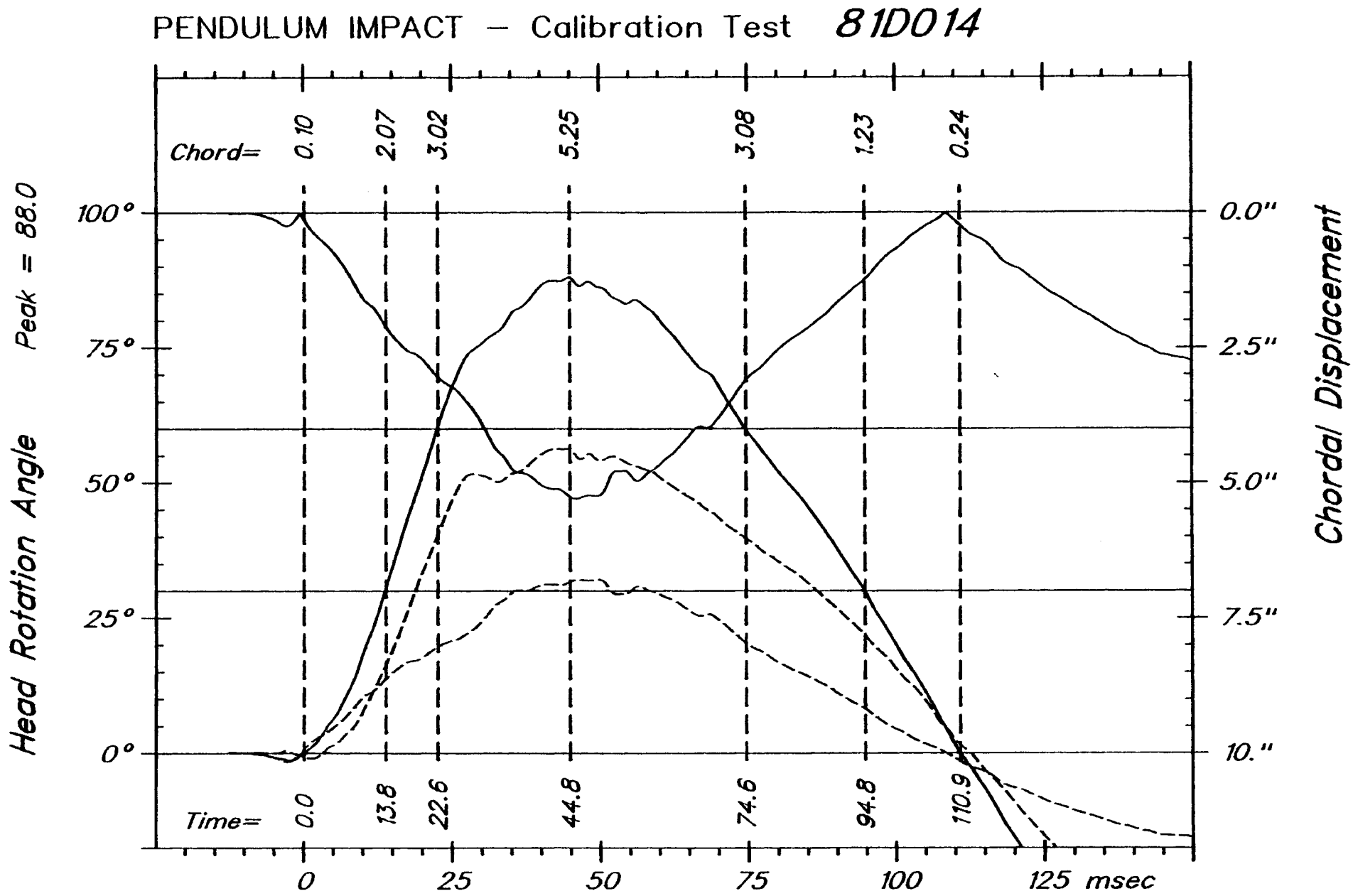



PENDULUM IMPACT – Calibration Test 81D014
Chord= 0.10 2.07 3.02 5.25 3.08 1.23 0.24
Time= 0.0 13.8 22.6 44.8 74.6 94.8 110.9
Head Rotation Angle
Peak = 88.0
100°
75°
50°
25°
0°
Chordal Displacement
0.0"
2.5"
5.0"
7.5"
10."
0
25
50
75
100
125 msec

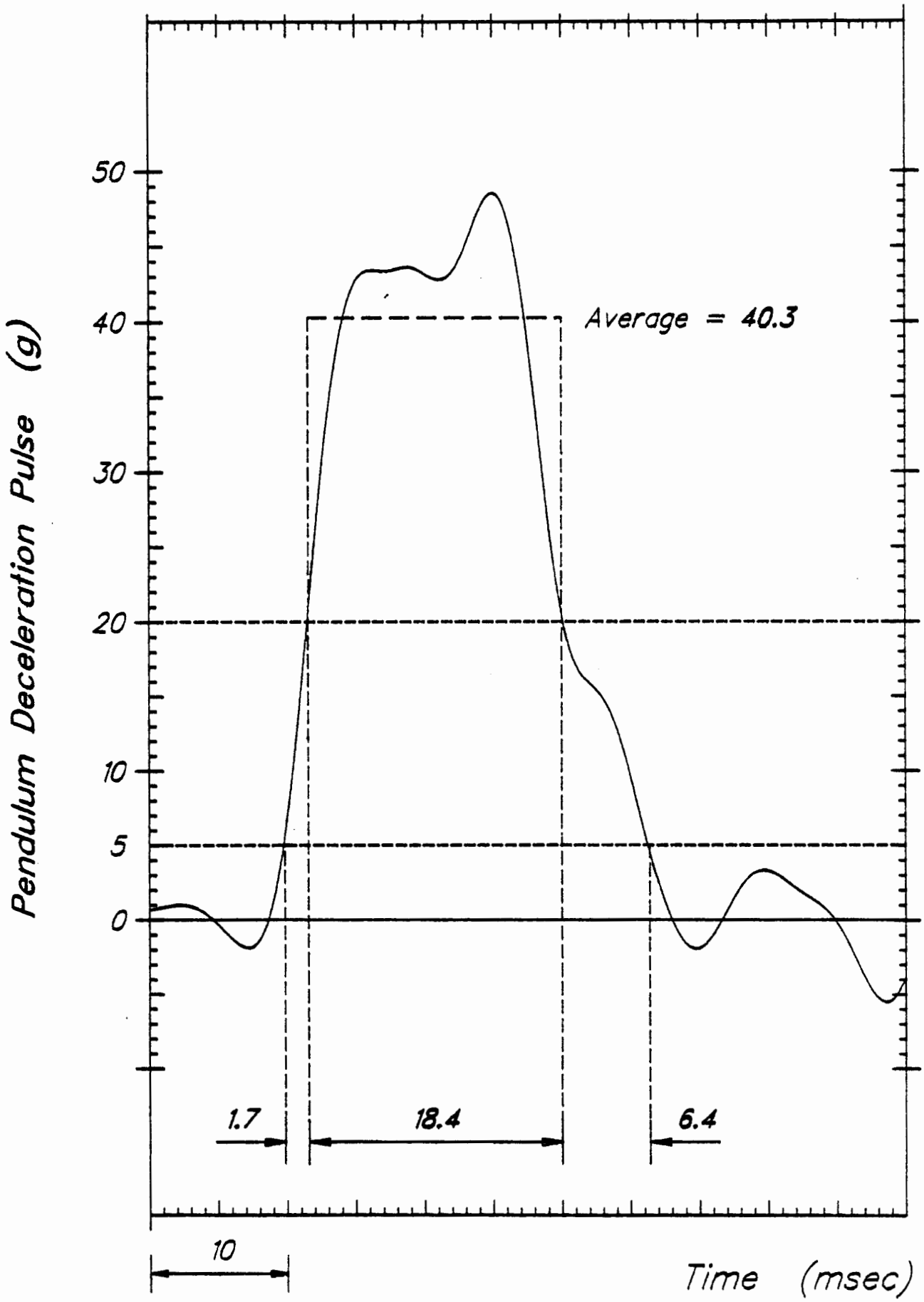
SUMMARY OF HEAD-NECK PENDULUM TEST DATA

ECE DUMMY

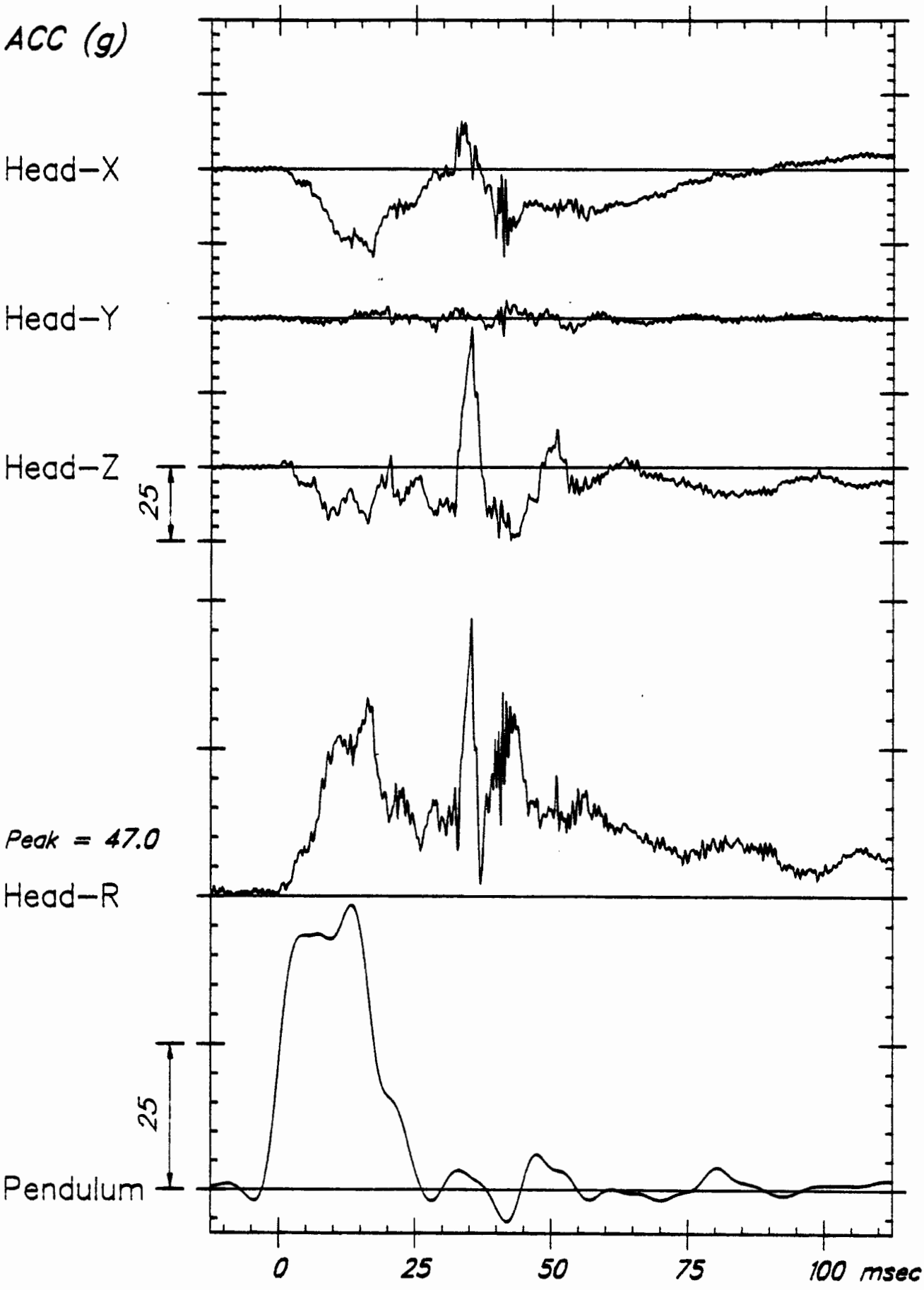
TEST MEASUREMENT:	TEST 81D015	PART 572 REQMT.
PENDULUM IMPACT VELOCITY, fps	16.5	16-18 fps
PEND. MIN./MAX. DECEL. OVER (t_3-t_2), g	40.3 AVERAGE	20-34g
PEAK HEAD RESULTANT ACCEL., g	47.0	$\leq$ 30g
PEND. DECEL. PULSE Δ TIME (t_2-t_1), ms	1.7	$\leq$ 4 ms
PEND. DECEL. PULSE Δ TIME (t_3-t_2), ms	18.4	18-21 ms
PEND. DECEL. PULSE Δ TIME (t_4-t_3), ms	6.4	$\leq$ 5 ms
HEAD ZERO POSITION TIME/ PEND. REVERSAL TIME		-/-
HEAD MAX. ROTATION ANGLE, °	85°	76-92°
TIME (ms) @ HEAD ROT. ANGLE-- 0°	0.0	-2-+2ms
30°	13.7	17.3-24.7ms
60°	22.6	31.1-40.9ms
Max.	45.0	55.0-69.0ms
60°	73.7	81.7-100.3ms
30°	94.4	97.4-118.6ms
0°	110.3	111.2-134.8ms
CHORDAL DISPLACEMENT (In.) @ HEAD ROTATION ANGLE OF-----0°	0.19	-0.8-+0.8"
30°	2.00	1.4-3.0"
60°	2.97	3.5-5.1"
Max.	4.82	5.0-6.6"
60°	2.88	3.5-5.1"
30°	1.10	1.4-3.0"
0°	0.42	-0.8-+0.8"

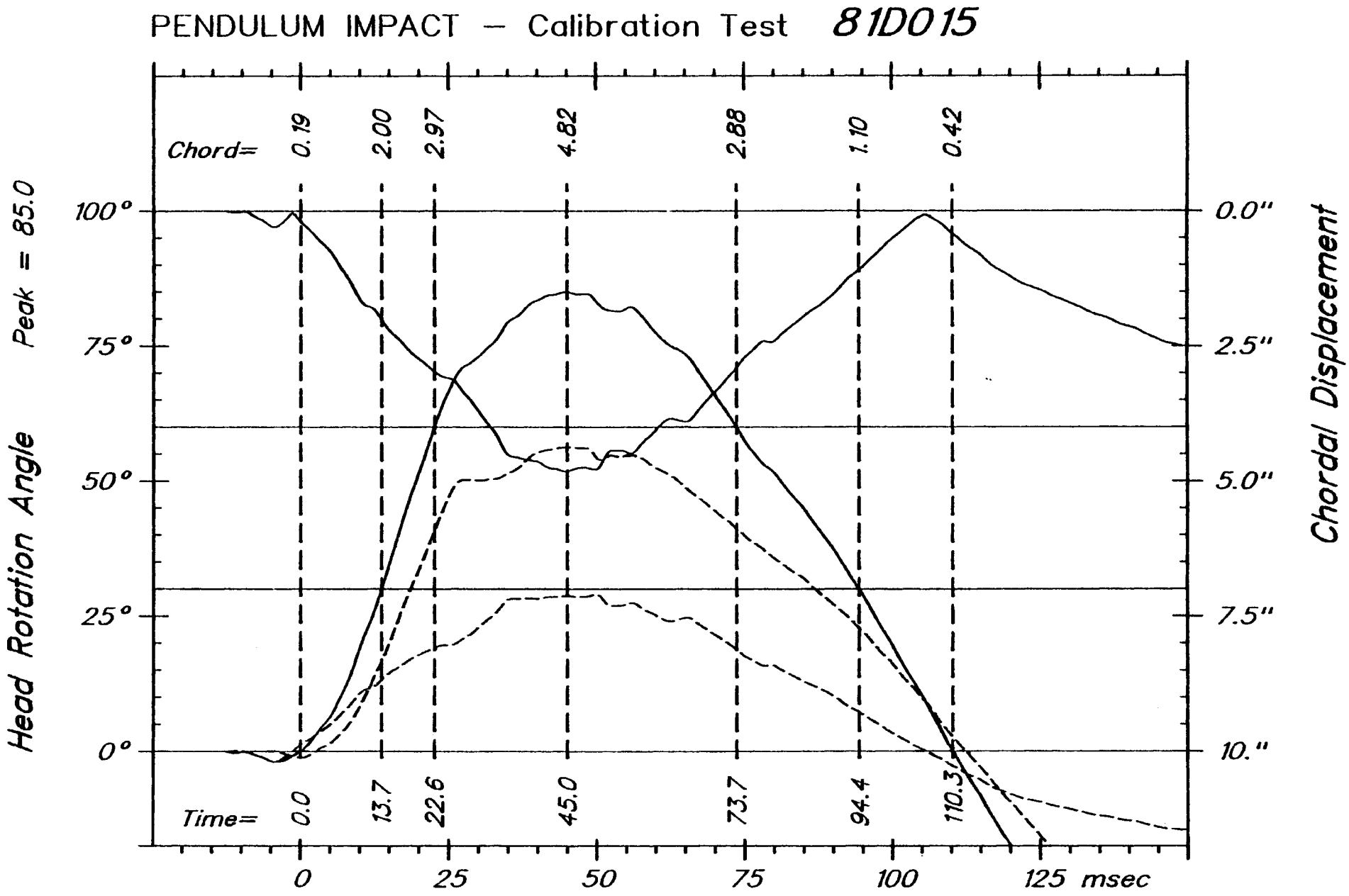
COMMENT: The aluminum hexcell used for this test was stiffer than specified for Part 572 calibration.

PENDULUM IMPACT – Calibration Test 81D015



PENDULUM IMPACT – Calibration Test 81D015




PENDULUM IMPACT – Calibration Test 81D015
Chord= 0.19 2.00 2.97 4.82 2.88 1.10 0.42
Head Rotation Angle
Peak = 85.0
100°
75°
50°
25°
0°
Chordal Displacement
0.0"
2.5"
5.0"
7.5"
10."
Time= 0.0 13.7 22.6 45.0 73.7 94.4 110.3
0 25 50 75 100 125 msec

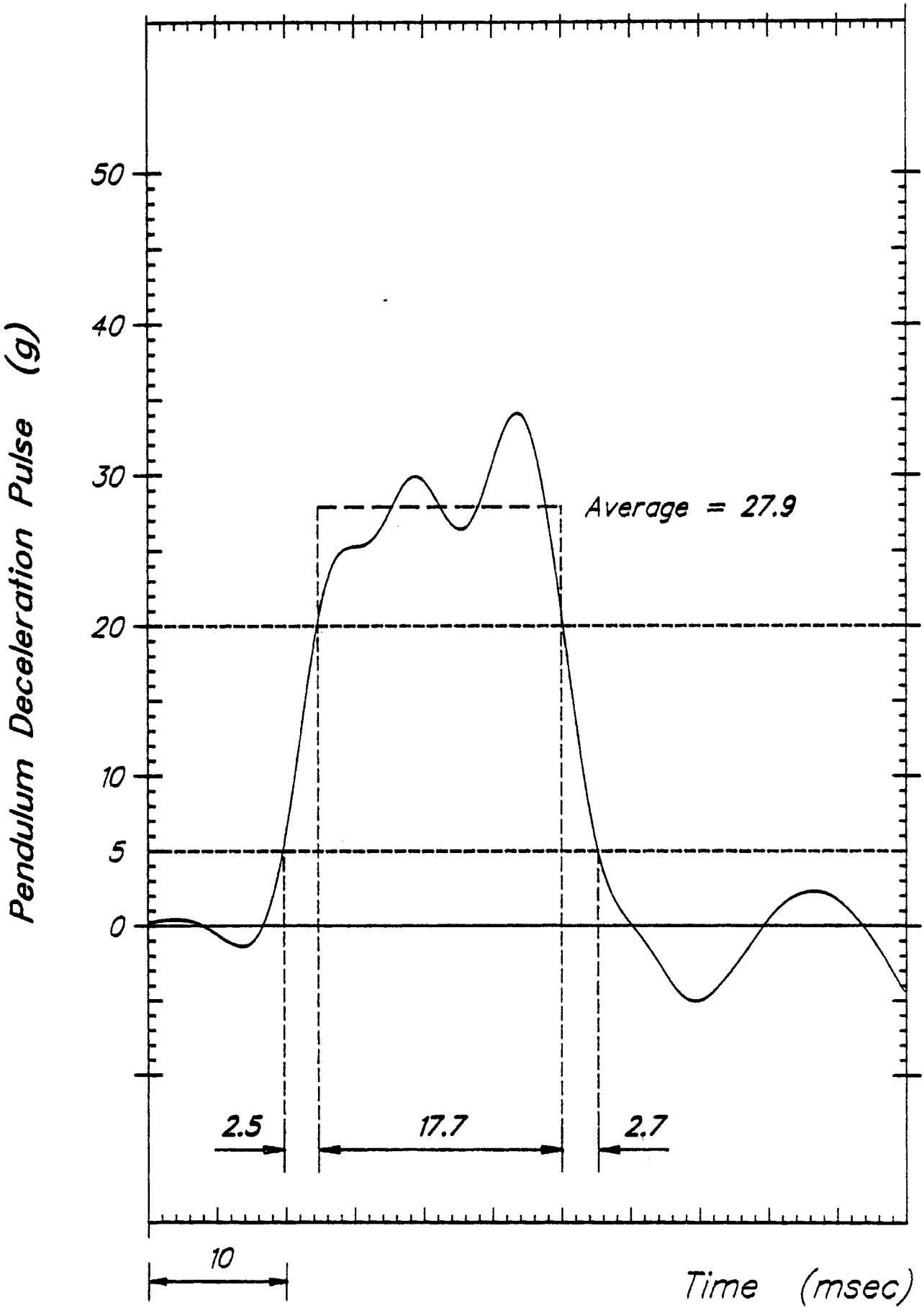
SUMMARY OF HEAD-NECK PENDULUM TEST DATA

ECE DUMMY

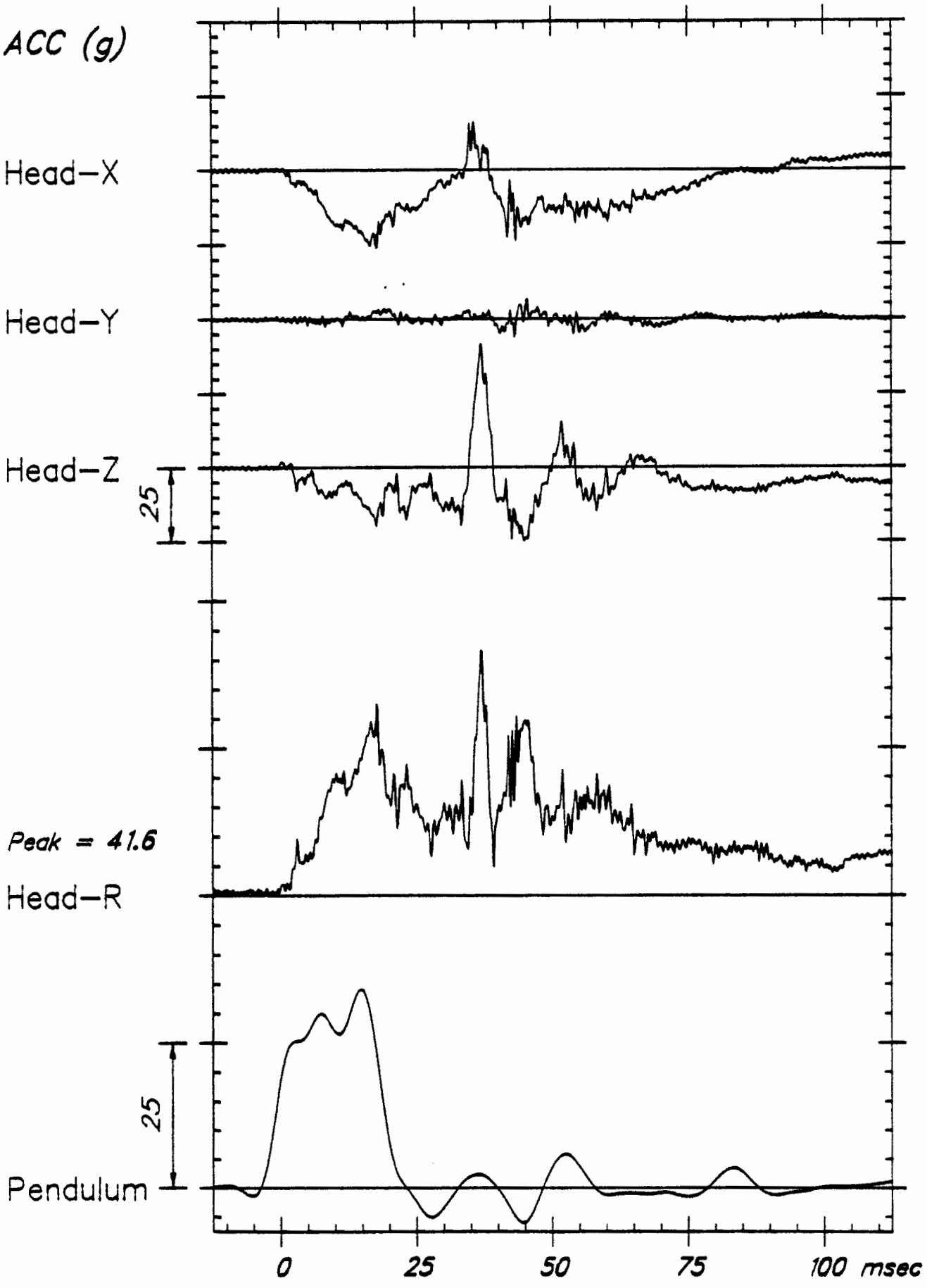
TEST MEASUREMENT:	TEST 81D016	PART 572 REQMT.
PENDULUM IMPACT VELOCITY, fps	16.5	16-18 fps
PEND. MIN./MAX. DECEL. OVER (t_3-t_2), g	27.9 AVERAGE	20-34g
PEAK HEAD RESULTANT ACCEL., g	41.6	$\leq$ 30g
PEND. DECEL. PULSE Δ TIME (t_2-t_1), ms	2.5	$\leq$ 4 ms
PEND. DECEL. PULSE Δ TIME (t_3-t_2), ms	17.7	18-21 ms
PEND. DECEL. PULSE Δ TIME (t_4-t_3), ms	2.7	$\leq$ 5 ms
HEAD ZERO POSITION TIME/ PEND. REVERSAL TIME		-/-
HEAD MAX. ROTATION ANGLE, °	82.9°	76-92°
TIME (ms) @ HEAD ROT. ANGLE-- 0°	0.0	-2-+2ms
30°	14.1	17.3-24.7ms
60°	24.2	31.1-40.9ms
Max.	46.3	55.0-69.0ms
60°	75.1	81.7-100.3ms
30°	96.5	97.4-118.6ms
0°	113.1	111.2-134.8ms
CHORDAL DISPLACEMENT (In.) @ HEAD ROTATION ANGLE OF-----0°	0.20	-0.8-+0.8"
30°	1.98	1.4-3.0"
60°	2.79	3.5-5.1"
Max.	4.37	5.0-6.6"
60°	2.64	3.5-5.1"
30°	1.04	1.4-3.0"
0°	0.38	-0.8-+0.8"

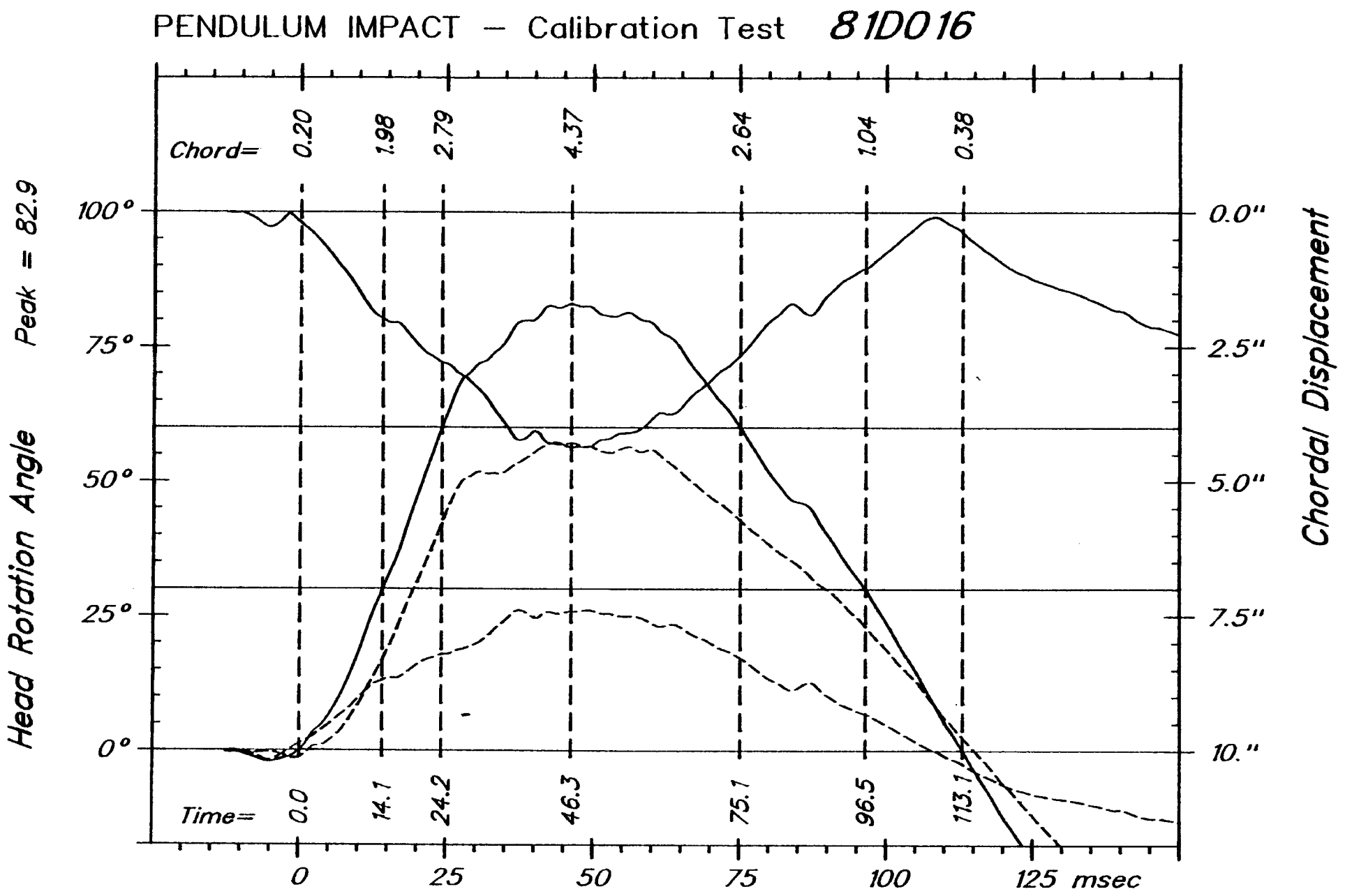
COMMENT: This test utilized the correct aluminum hexcell specified for Part 572 calibration.

PENDULUM IMPACT – Calibration Test 81D016



PENDULUM IMPACT – Calibration Test 81D016




PENDULUM IMPACT — Calibration Test 81D016
Chord= 0.20 1.98 2.79 4.37 2.64 1.04 0.38
Time= 0.0 14.1 24.2 46.3 75.1 96.5 113.1
Head Rotation Angle
Peak = 82.9
100°
75°
50°
25°
0°
0.0"
2.5"
5.0"
7.5"
10."
Chordal Displacement
0 25 50 75 100 125 msec

4.3 Chest Impact Tests

The chest impact test results are presented in the following sequence:

Summary of TEST AVERAGE
Data Plot Overlay
Summary of TEST 81D001
Data Plot of TEST 81D001
Summary of TEST 81D002
Data Plot of TEST 81D002
Summary of TEST 81D003
Data Plot of TEST 81D003
Summary of TEST 81D004
Data Plot TEST 81D004

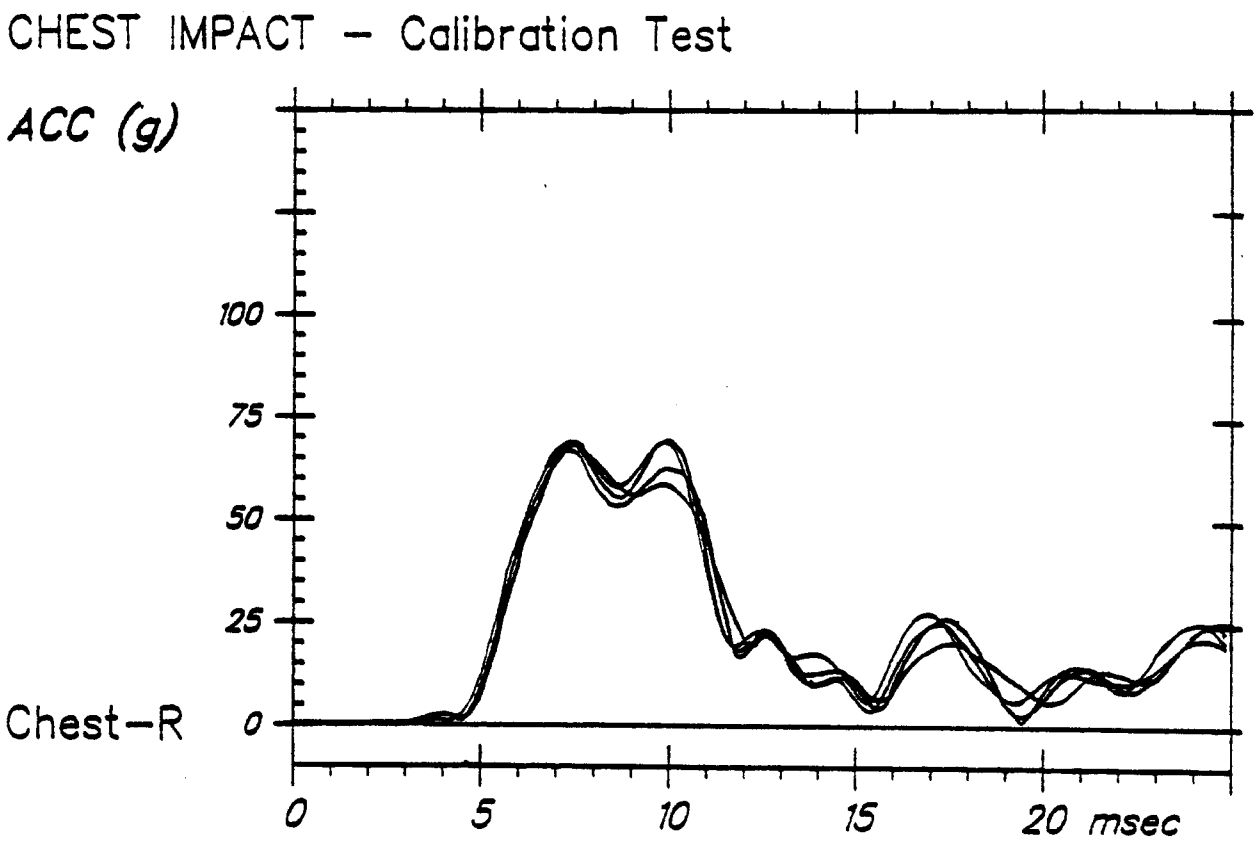
SUMMARY OF CHEST IMPACT TEST DATA

ECE DUMMY

TEST MEASUREMENT:	AVERAGE RESULTS	PART 572 REQMTS.
TEST PROBE IMPACT VELOCITY, fps	12.98	12.87-13.13
PEAK CHEST RESULT. ACCEL., g	68.9	50-70g
PEAK CHEST LATERAL ACCEL., g	5.2	$\leq$ 5g
PULSE Δ TIME @ 30g, ms	5.6	2.5-4.0ms

CHEST IMPACT TEST SUMMARY

RESULTANT ACCELERATION OVERLAY

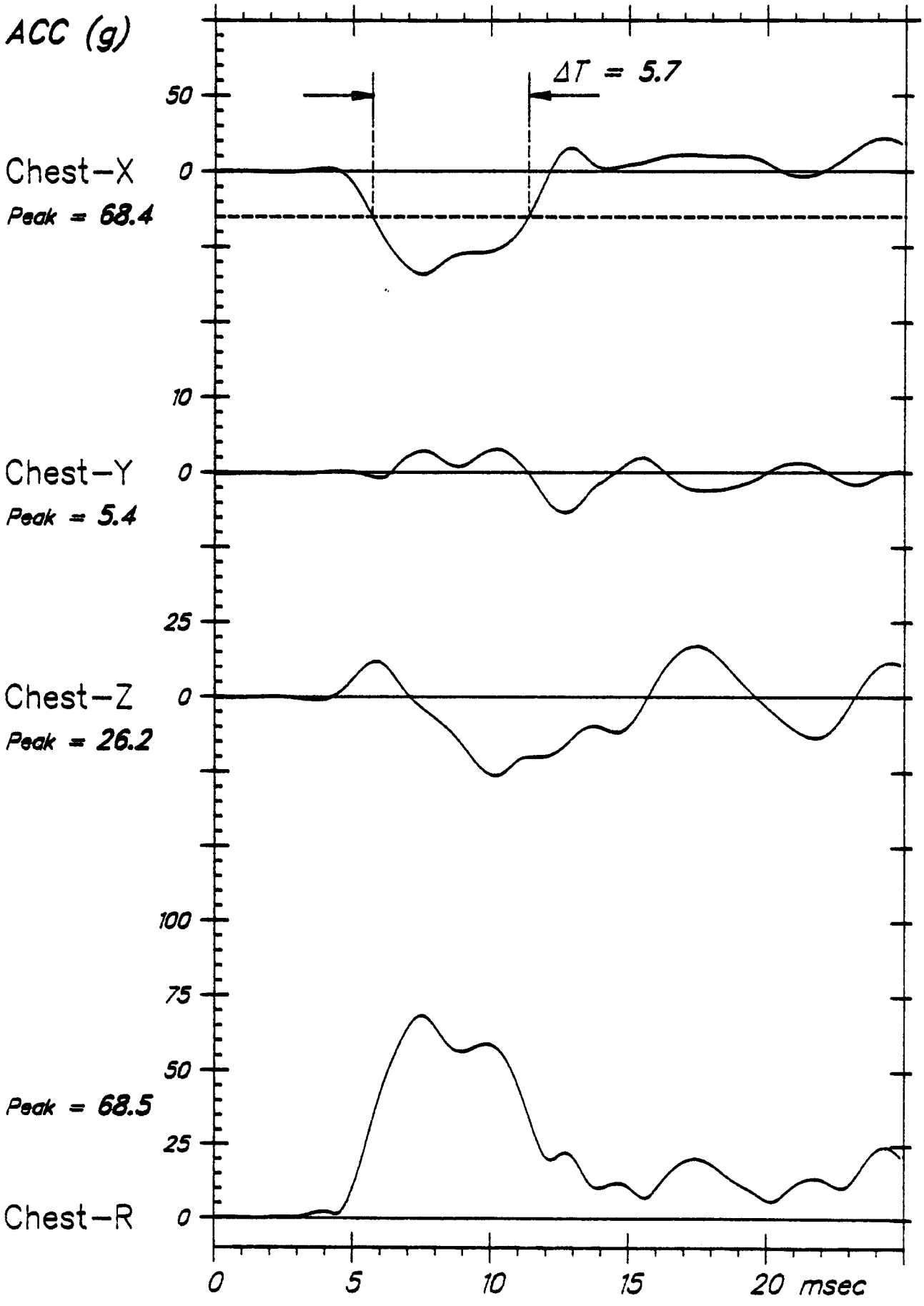


SUMMARY OF CHEST IMPACT TEST DATA

ECE DUMMY

TEST MEASUREMENT:	TEST 81D001	PART 572 REQMTS.
TEST PROBE IMPACT VELOCITY, fps	12.98	12.87-13.13
PEAK CHEST RESULT. ACCEL., g	68.5	50-70g
PEAK CHEST LATERAL ACCEL., g	5.4	$\leq$ 5g
PULSE Δ TIME @ 30g, ms	5.7	2.5-4.0ms

CHEST IMPACT – Calibration Test 81D001

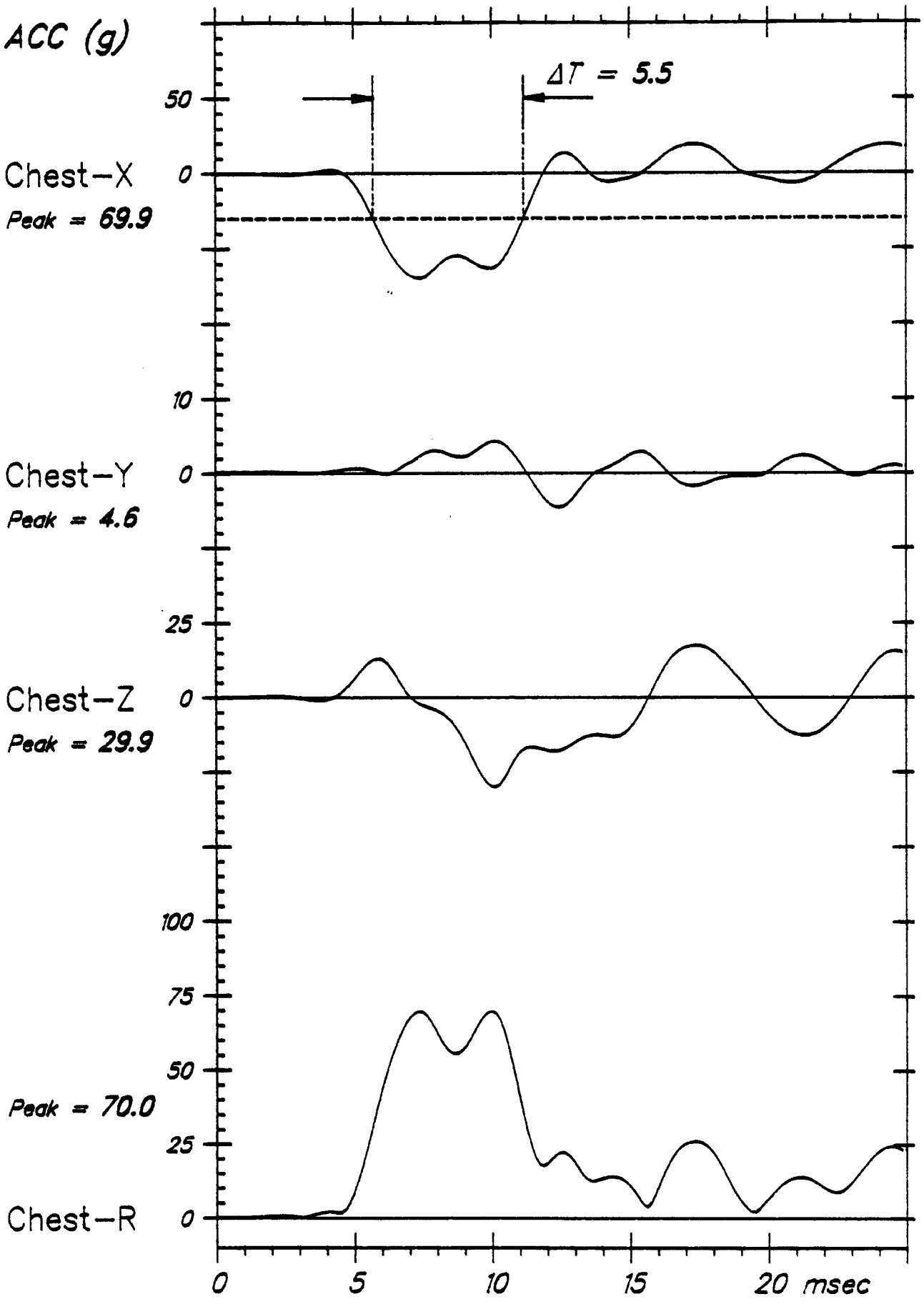


SUMMARY OF CHEST IMPACT TEST DATA

ECE DUMMY

TEST MEASUREMENT:	TEST 81D002	PART 572 REQMTS.
TEST PROBE IMPACT VELOCITY, fps	12.98	12.87-13.13
PEAK CHEST RESULT. ACCEL., g	70.0	50-70g
PEAK CHEST LATERAL ACCEL., g	4.6	$\leq$ 5g
PULSE Δ TIME @ 30g, ms	5.5	2.5-4.0ms

CHEST IMPACT – Calibration Test 81D002

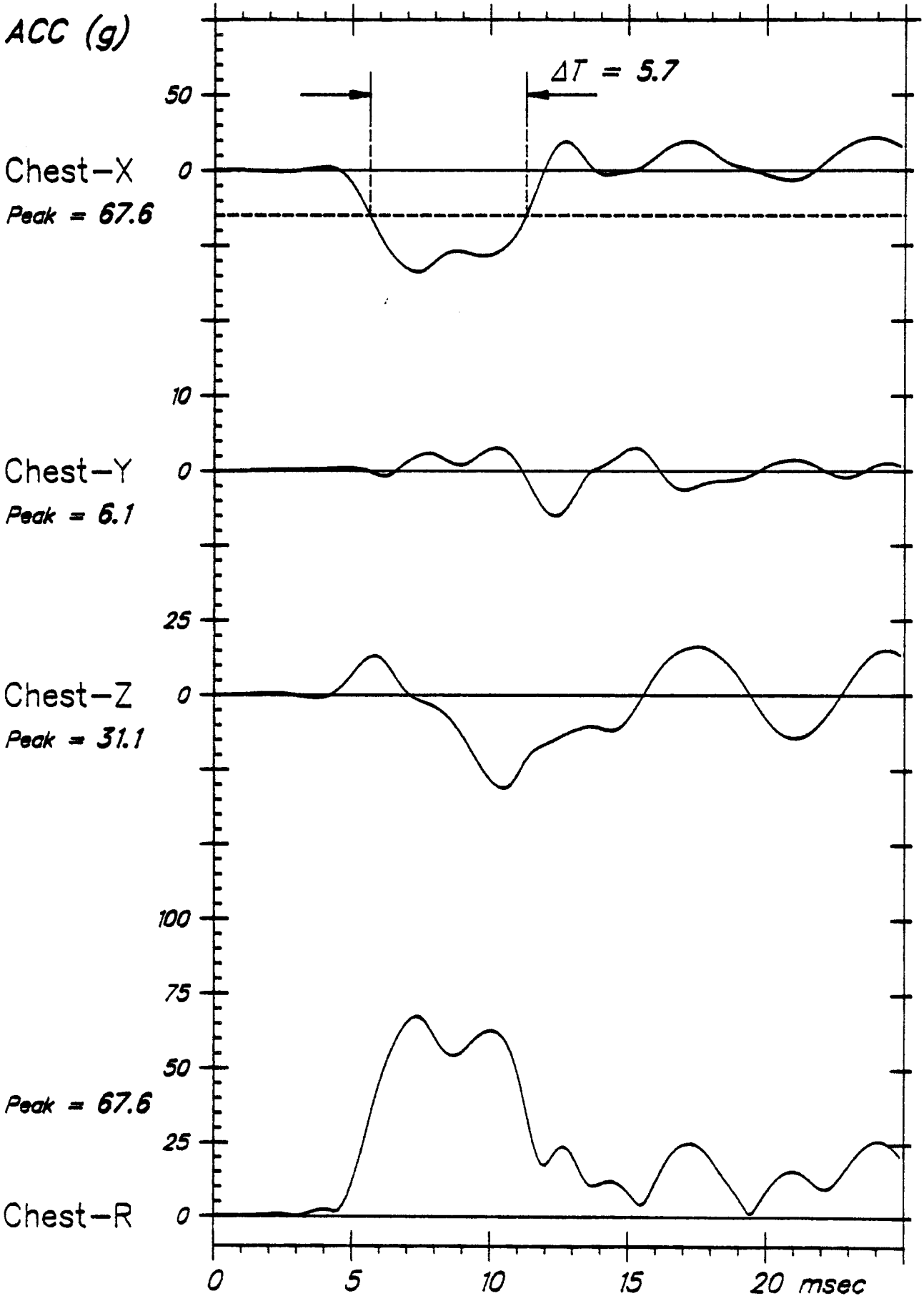


SUMMARY OF CHEST IMPACT TEST DATA

ECE DUMMY

TEST MEASUREMENT:	TEST 81D003	PART 572 REQMTS.
TEST PROBE IMPACT VELOCITY, fps	12.98	12.87-13.13
PEAK CHEST RESULT. ACCEL., g	67.6	50-70g
PEAK CHEST LATERAL ACCEL., g	6.1	$\leq$ 5g
PULSE Δ TIME @ 30g, ms	5.7	2.5-4.0ms

CHEST IMPACT – Calibration Test 81D003

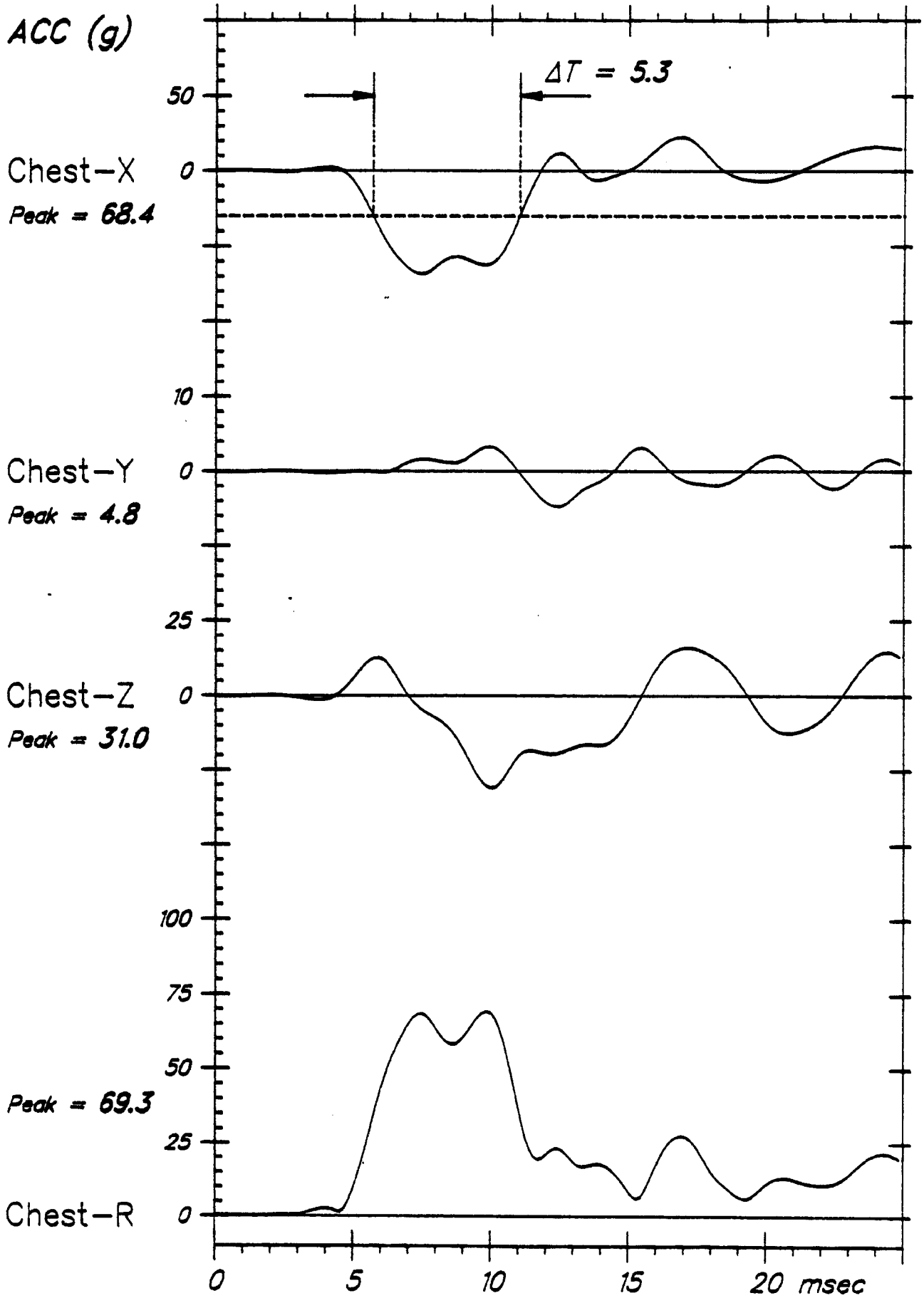


SUMMARY OF CHEST IMPACT TEST DATA

ECE DUMMY

TEST MEASUREMENT:	TEST 81D004	PART 572 REQMTS.
TEST PROBE IMPACT VELOCITY, fps	12.98	12.87-13.13
PEAK CHEST RESULT. ACCEL., g	69.3	50-70g
PEAK CHEST LATERAL ACCEL., g	4.8	$\leq$ 5g
PULSE Δ TIME @ 30g, ms	5.3	2.5-4.0ms

CHEST IMPACT – Calibration Test 81D004



4.4 Lumbar Flexion Tests

The lumbar flexion test results are presented in the following sequence:

Summary of TEST AVERAGE
Summary of TEST 81D009
Data Plot of TEST 81D009
Summary of TEST 81D010
Data Plot of TEST 81D010
Summary of TEST 81D011
Data Plot of TEST 81D011

SUMMARY OF LUMBAR FLEXION TEST DATA

ECE DUMMY

TEST MEASUREMENT:	AVERAGE RESULTS	PART 572 REQMT.
FORCE @ 40° FLEXION ANGLE, lbs.	20.3	34-47 lbs.
SPINAL COLUMN ANGLE @ 3 MIN. POST TEST, °	0.0	≤ 5°

SUMMARY OF LUMBAR FLEXION TEST DATA

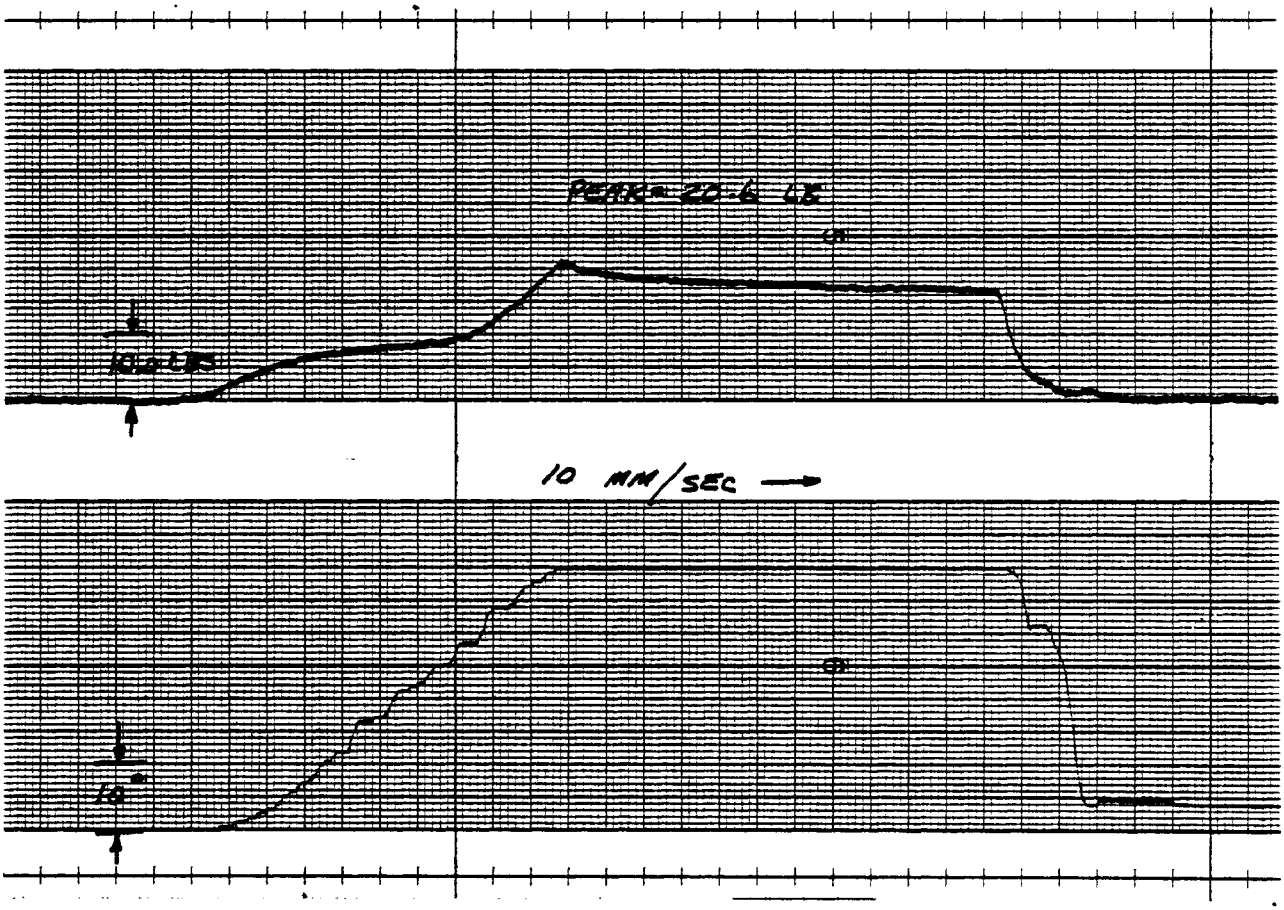
ECE DUMMY

TEST MEASUREMENT:	TEST 81D009	PART 572 REQMT.
FORCE @ 40° FLEXION ANGLE, lbs.	20.6	34-47 lbs.
SPINAL COLUMN ANGLE @ 3 MIN. POST TEST, °	0.0	≤ 5°

LUMBAR FLEXION TEST

ECE DUMMY

TEST # 81D009



SUMMARY OF LUMBAR FLEXION TEST DATA

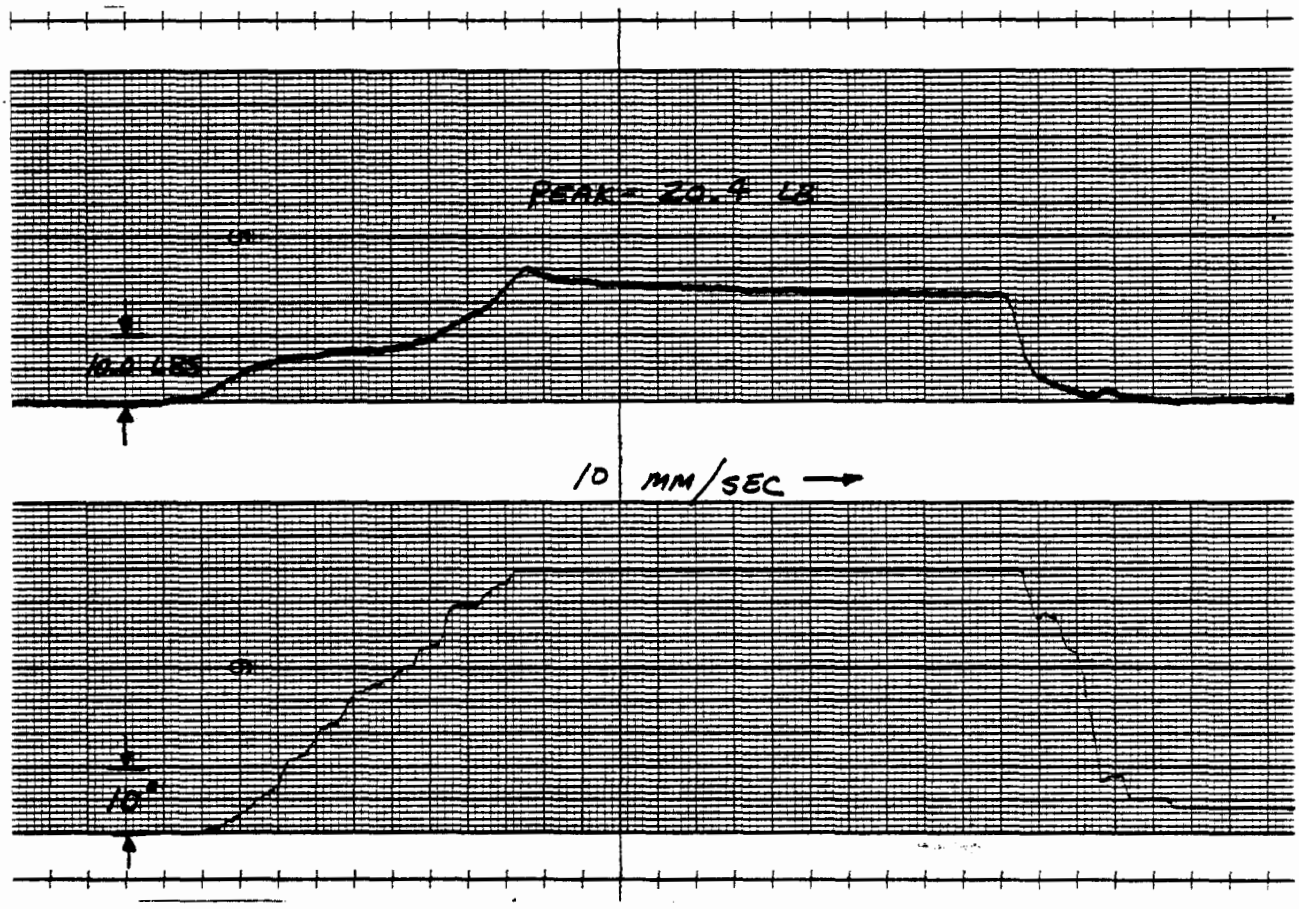
ECE DUMMY

TEST MEASUREMENT:	TEST 81D010	PART 572 REQMT.
FORCE @ 40° FLEXION ANGLE, lbs.	20.4	34-47 lbs.
SPINAL COLUMN ANGLE @ 3 MIN. POST TEST, °	0.0	≤ 5°

LUMBAR FLEXION TEST

ECE DUMMY

TEST # 81D010



SUMMARY OF LUMBAR FLEXION TEST DATA

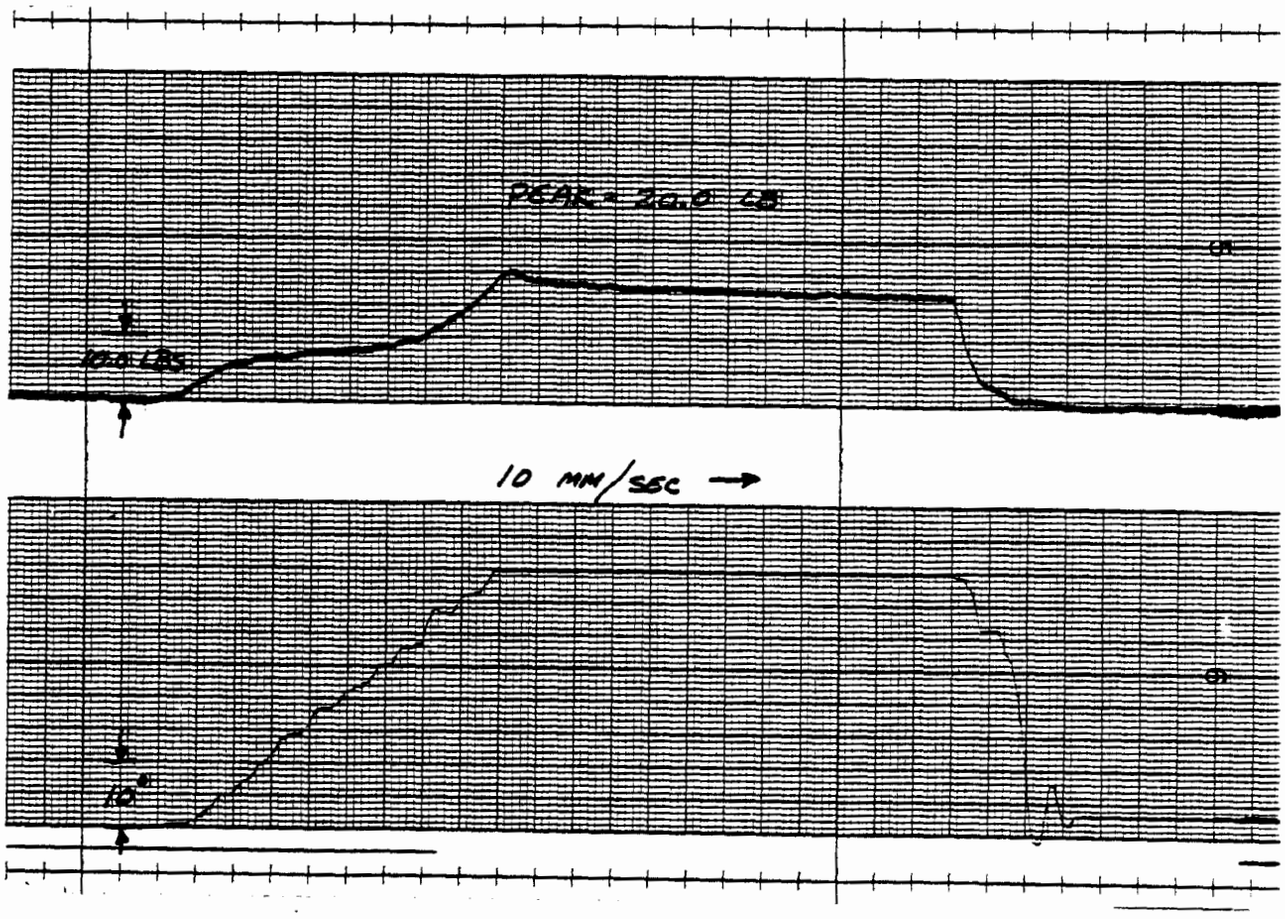
ECE DUMMY

TEST MEASUREMENT:	TEST 81D011	PART 572 REQMT.
FORCE @ 40° FLEXION ANGLE, lbs.	20.0	34-47 lbs.
SPINAL COLUMN ANGLE @ 3 MIN. POST TEST, °	0.0	≤ 5°

LUMBAR FLEXION TEST

ECE DUMMY

TEST # 81D011



4.5 Head Drop Tests

The head drop test results are presented in the following sequence:

Summary of TEST AVERAGE
Data Plot Overlay
Summary of TEST 81D028
Data Plot of TEST 81D028
Summary of TEST 81D029
Data Plot of TEST 81D029
Summary of TEST 81D030
Data Plot of TEST 81D030

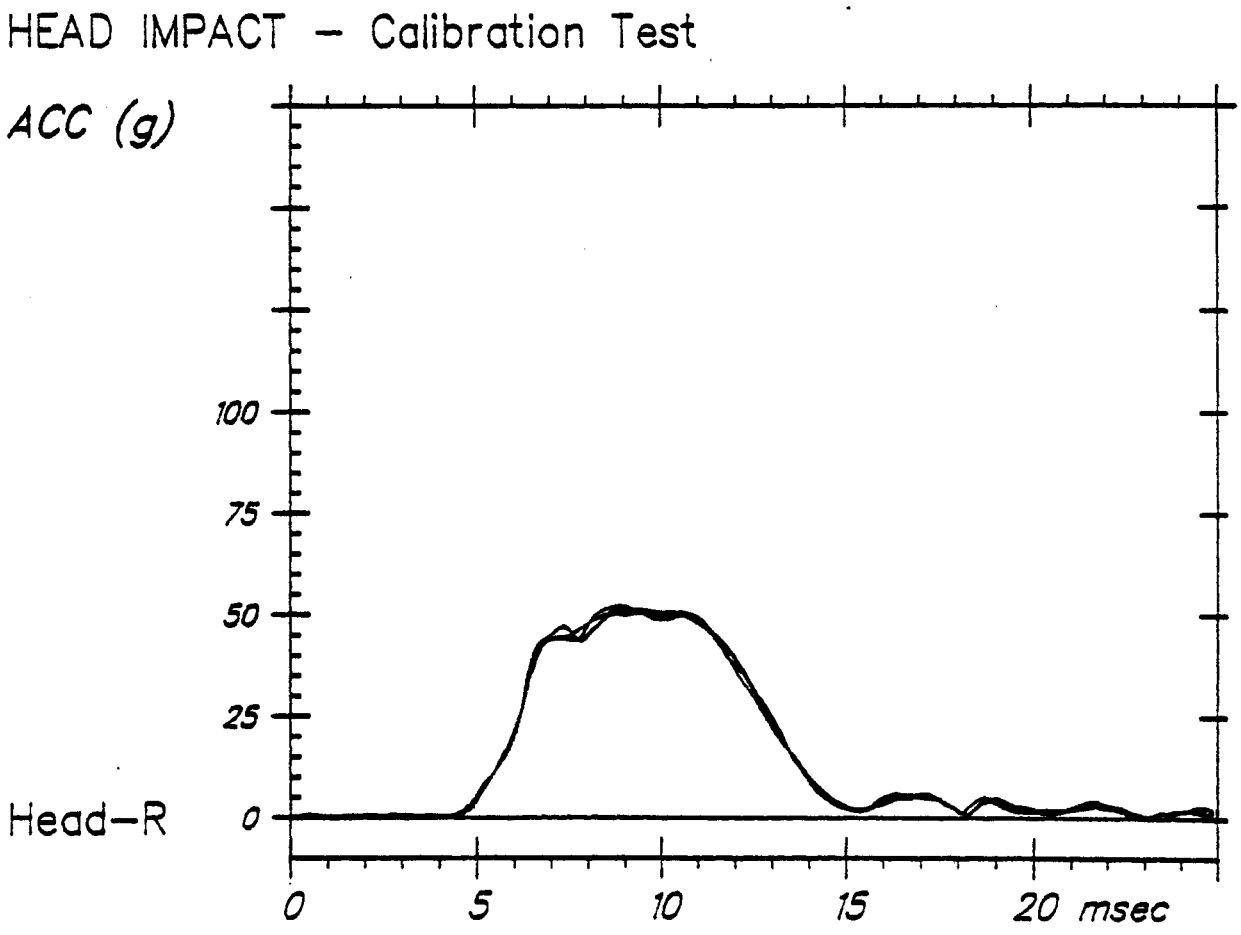
SUMMARY OF HEAD DROP TEST DUMMY

ECE DUMMY

TEST MESUREMENT:	TEST AVERAGE	REQMTS.
HEAD DROP HEIGHT, in	7.0	7.0
PEAK HEAD RESULT. ACCEL., g	51.4	-
PEAK HEAD LATERAL ACCEL., g	5.8	-
PULSE Δ TIME @ 50 g, ms	1.2	-

HEAD DROP TEST SUMMARY

RESULTANT ACCELERATION OVERLAY

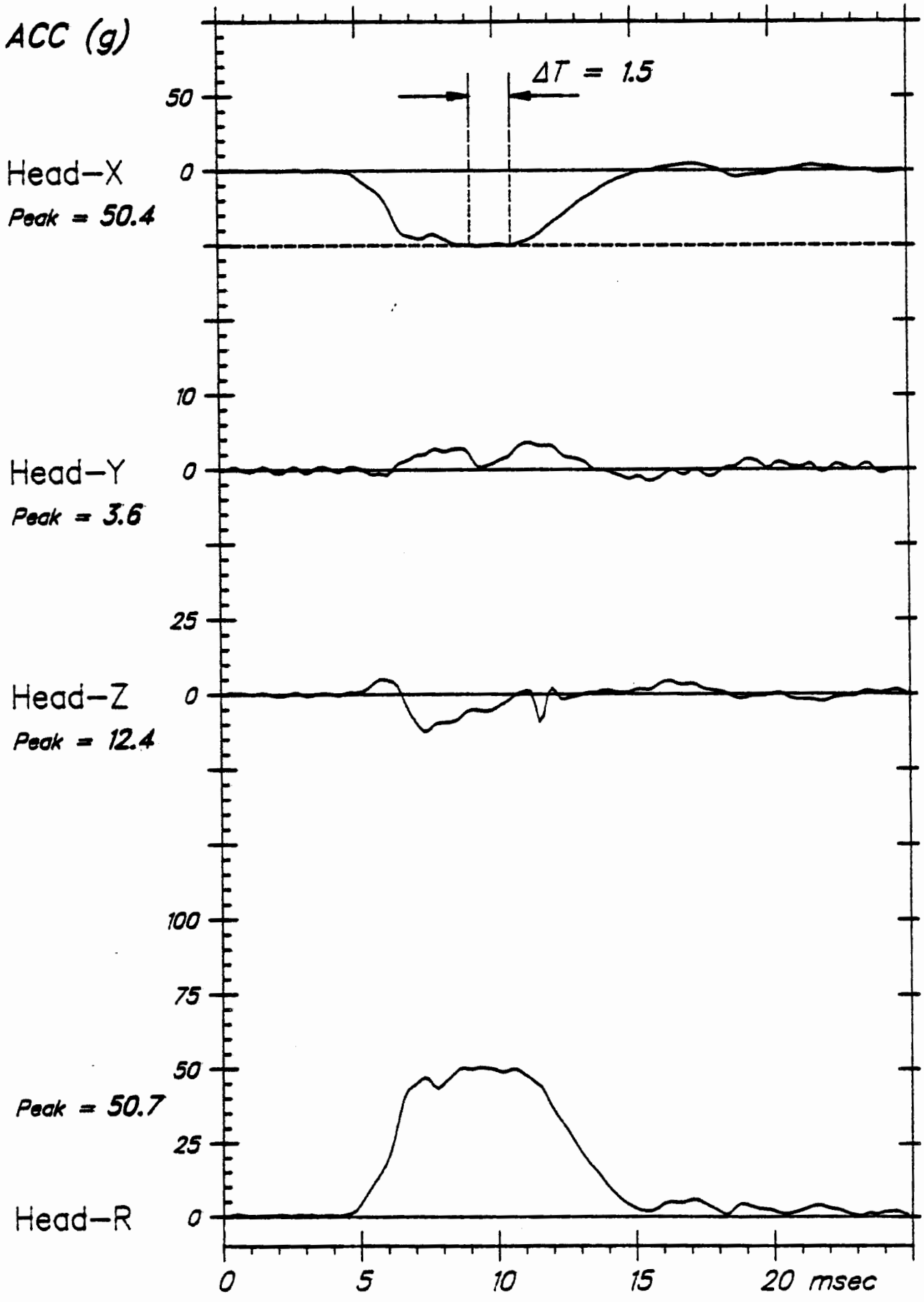


SUMMARY OF HEAD DROP TEST DUMMY

ECE DUMMY

TEST MESUREMENT:	TEST 81 D 028	REQMTS.
HEAD DROP HEIGHT, in	7.0	7.0
PEAK HEAD RESULT. ACCEL., g	50.7	-
PEAK HEAD LATERAL ACCEL., g	3.6	-
PULSE Δ TIME @ 50 g, ms	1.5	-

HEAD IMPACT – Calibration Test 81D028

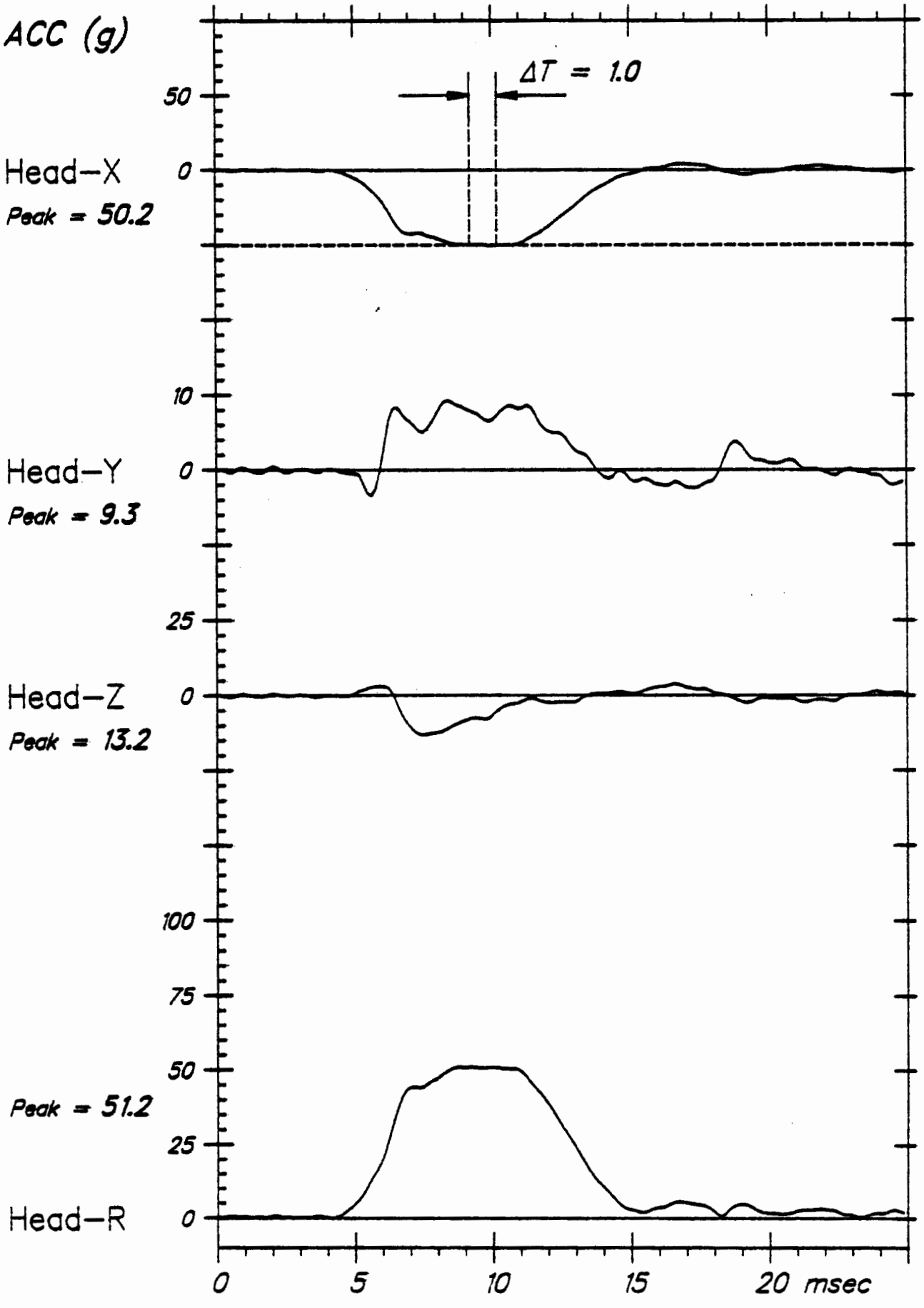


SUMMARY OF HEAD DROP TEST DUMMY

ECE DUMMY

TEST MESUREMENT:	TEST 81 D 029	REQMTS.
HEAD DROP HEIGHT, in	7.0	7.0
PEAK HEAD RESULT. ACCEL., g	51.2	-
PEAK HEAD LATERAL ACCEL., g	9.3	-
PULSE Δ TIME @ 50 g, ms	1.0	-

HEAD IMPACT – Calibration Test 81D029

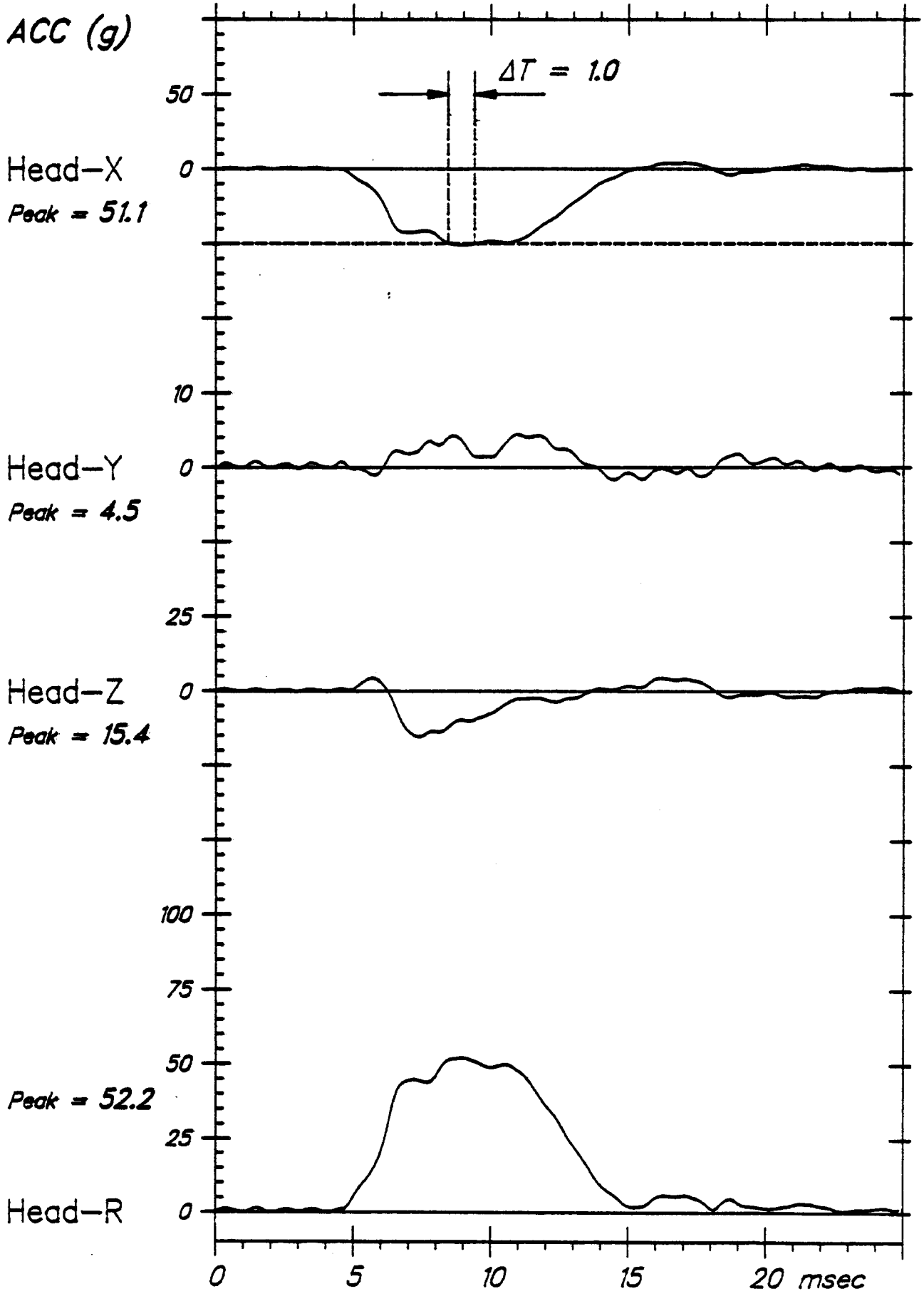


SUMMARY OF HEAD DROP TEST DUMMY

ECE DUMMY

TEST MESUREMENT:	TEST 81D030	REQMTS.
HEAD DROP HEIGHT, in	7.0	7.0
PEAK HEAD RESULT. ACCEL., g	52.2	-
PEAK HEAD LATERAL ACCEL., g	4.5	-
PULSE Δ TIME @ 50 g, ms	1.0	-

HEAD IMPACT – Calibration Test 81D030



4.6 Sled Impact Tests

The sled impact test results are presented in the following sequence for each sled test:

Summary of Sled Impact Test
Sled Test Set-up Photograph
Sled Test Graph-Check Photograph
Sled Test Post-Test Photograph
Data Plots

SUMMARY OF SLED TEST DATA

ECE DUMMY

SETUP

RESTRAINT MODEL QUESTOR DYN-O-MITE INFANSEAT MODEL 441

PRODUCTION DATE 6-5-81 TETHER NO SHIELD NO

ORIENTATION REAR FACING SEATING POSITION CENTER

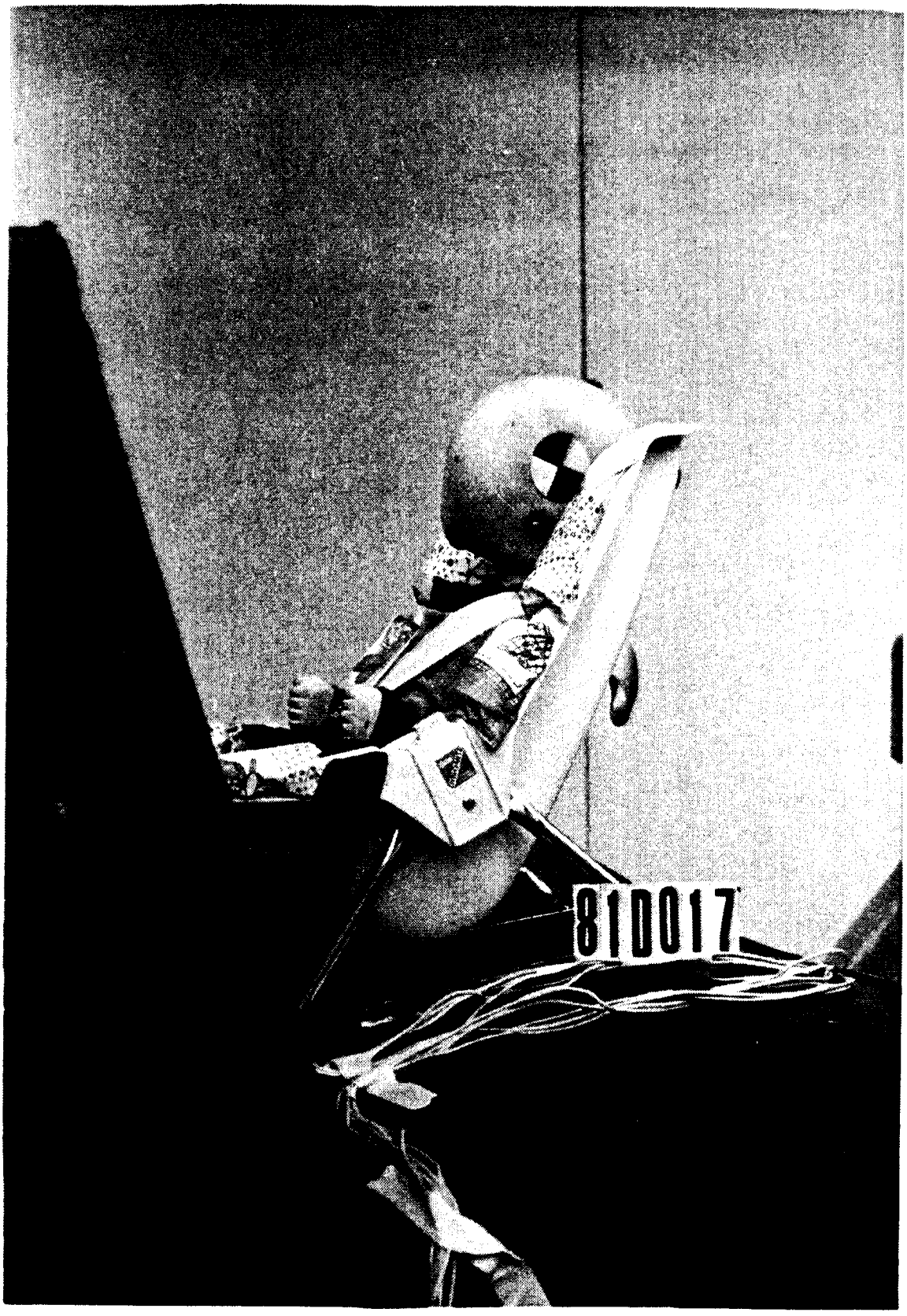
ANGLE ADJUSTMENT RECLINE

RESULTS

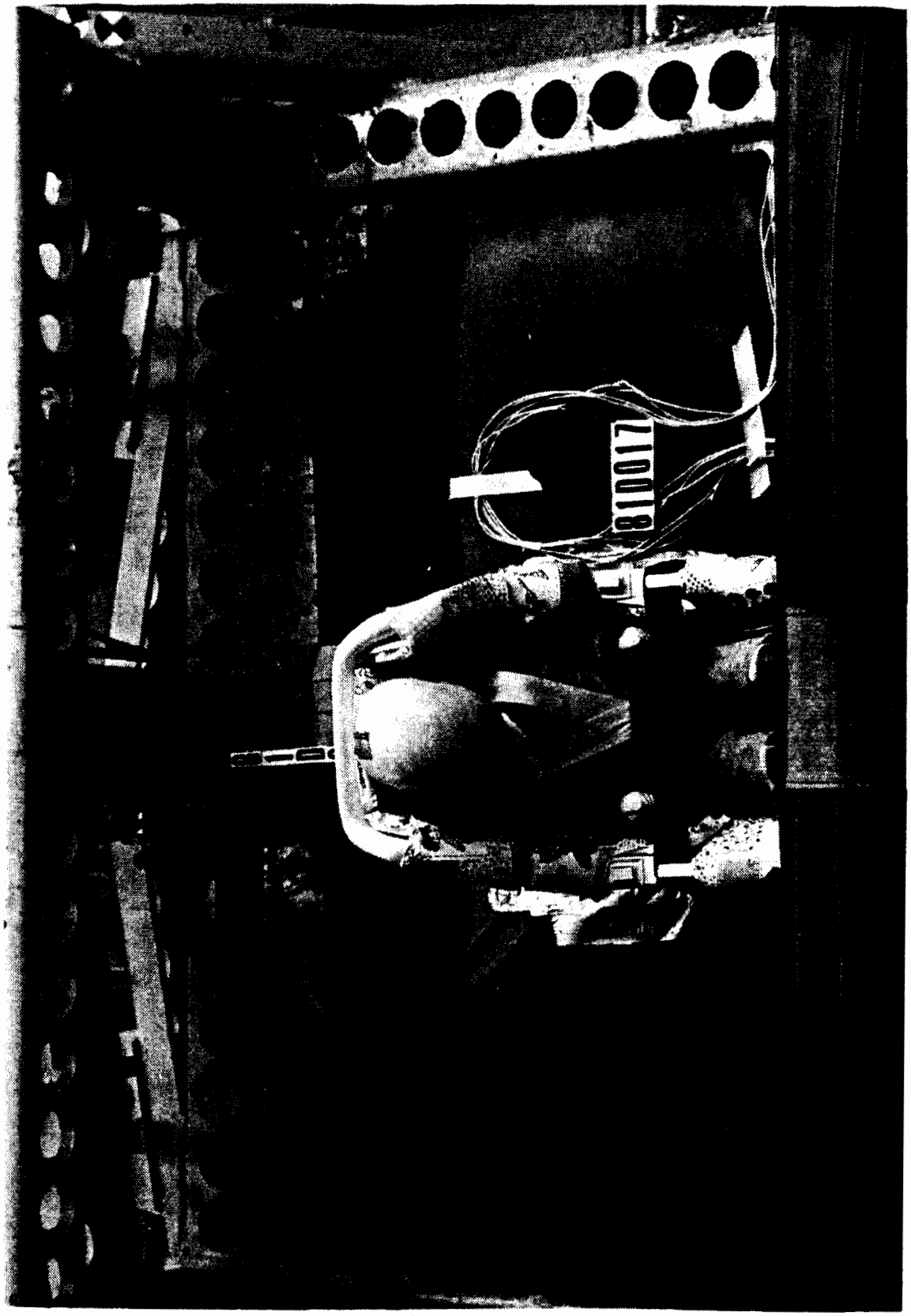
TEST MEASUREMENT	TEST 81D017	PART 572 REQMTS.
SLED VELOCITY, mph	28.8	30 $^{+0}_{-3}$ mph
SLED ACCELERATION, g	N.A	CONFIGURATION I CURVE
HEAD EXCURSION, in	—	≤ 32 in
HEAD INJURY CRITERION	271.	≤ 1000
KNEE EXCURSION, in	—	≤ 36 in
CHEST PEAK RESULTANT, g	35.0	≤ 60 g
CHEST ΔT @ 60 g, ms	0.0	≤ 3 ms
PRE-IMPACT BACK ANGLE, deg	24.°	-
MAX. IMPACT BACK ANGLE, deg	59.°	≤ 70°
TORSO RETENTION	YES	YES
HEAD TARGET RETENTION	YES	YES
RESTRAINT SYSTEM INTEGRITY	NO	YES

COMMENTS: RESTRAINT'S PASSENGER-SIDE BELT TAB FAILED.

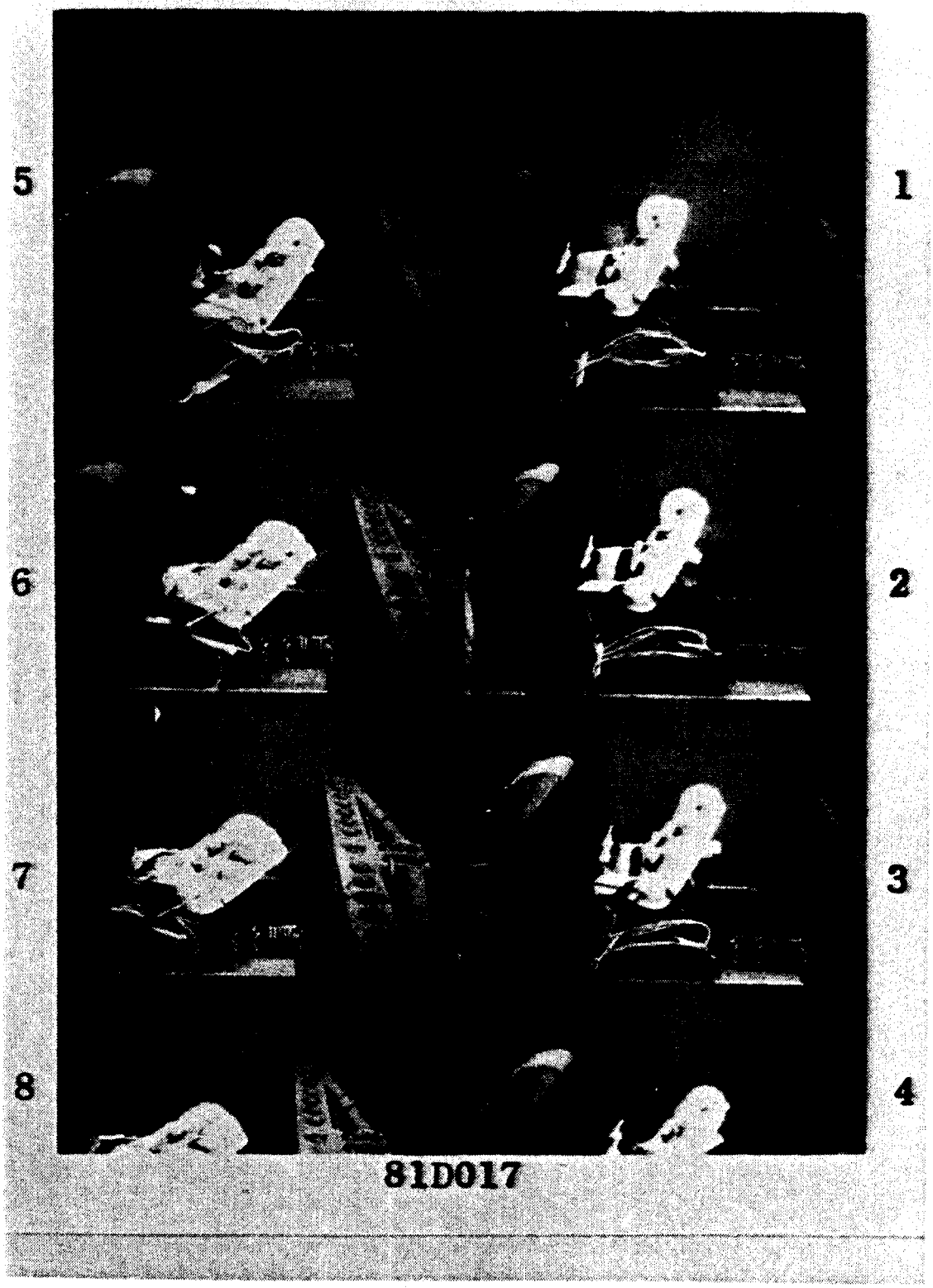
DUMMY WEIGHT = 19# 11 3/4 oz. UNCLOTHED, 20# 3/4 oz. CLOTHED



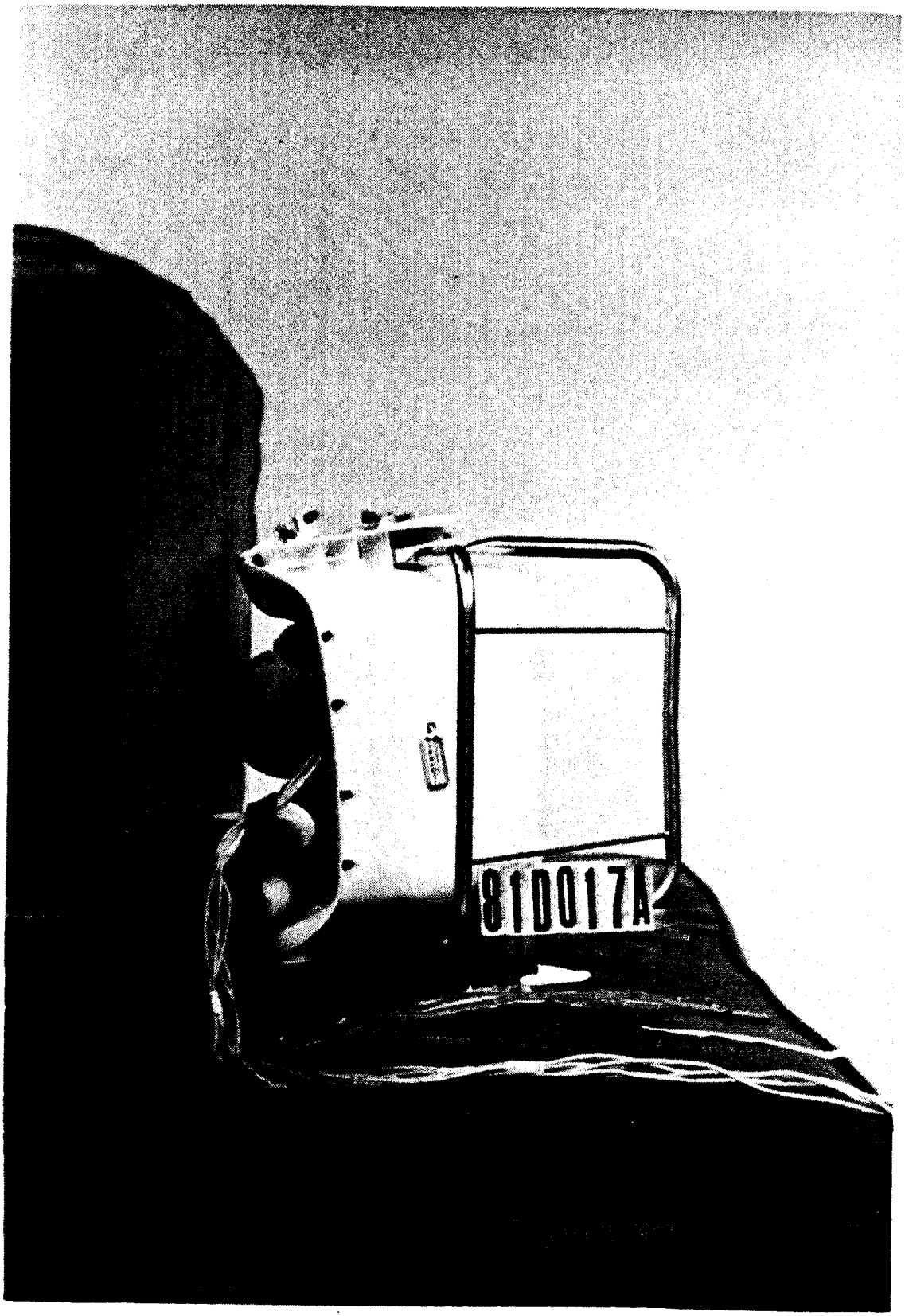
4.1 Test Setup of 810017



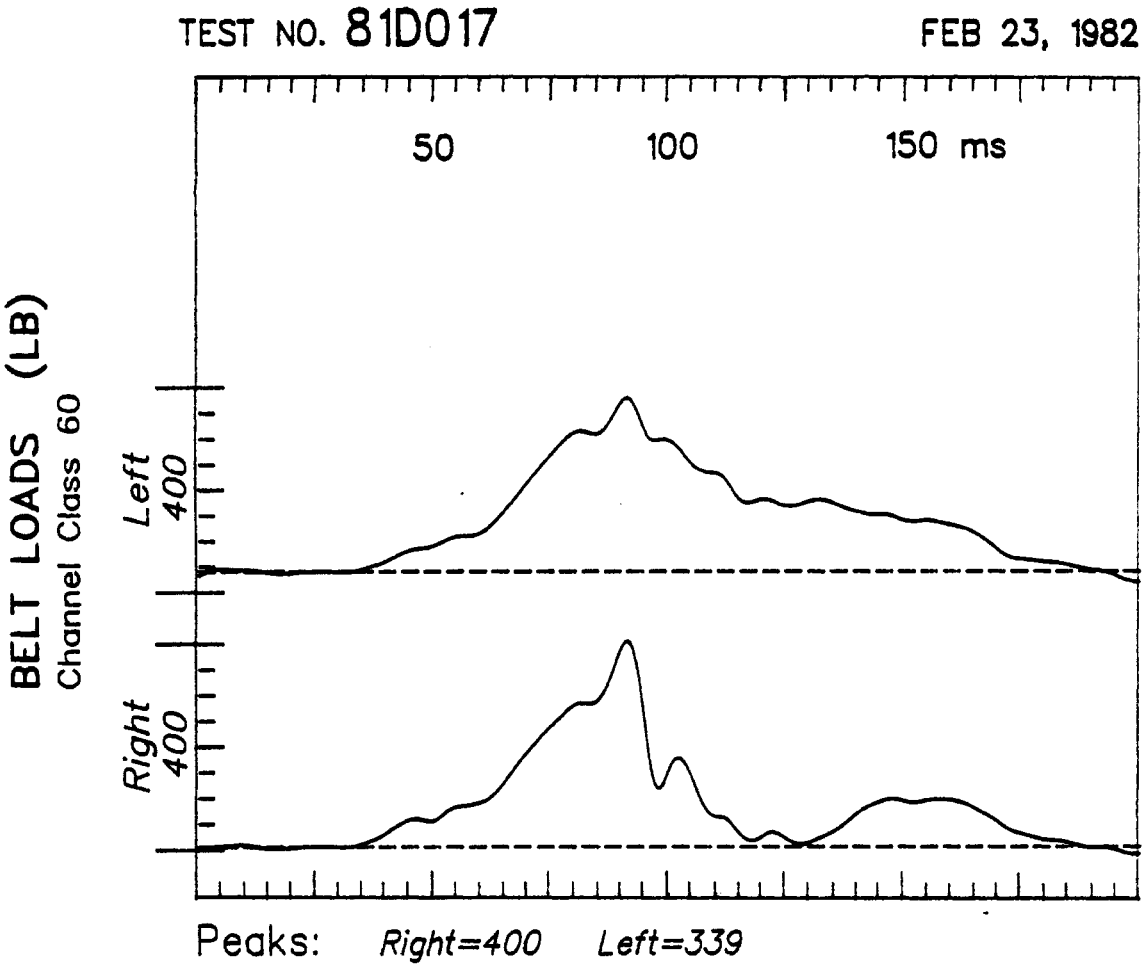
4.2 Test Setup of 81D017

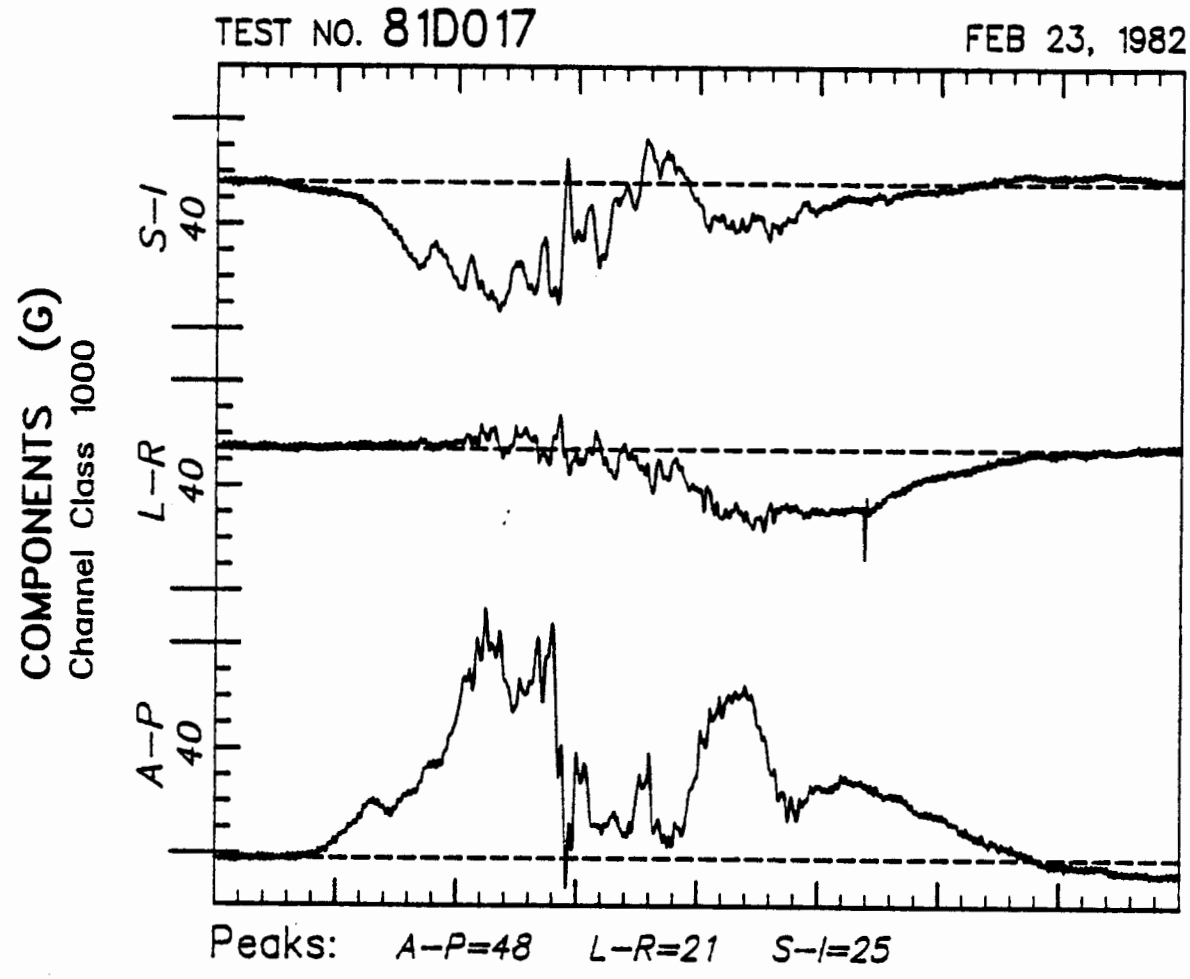


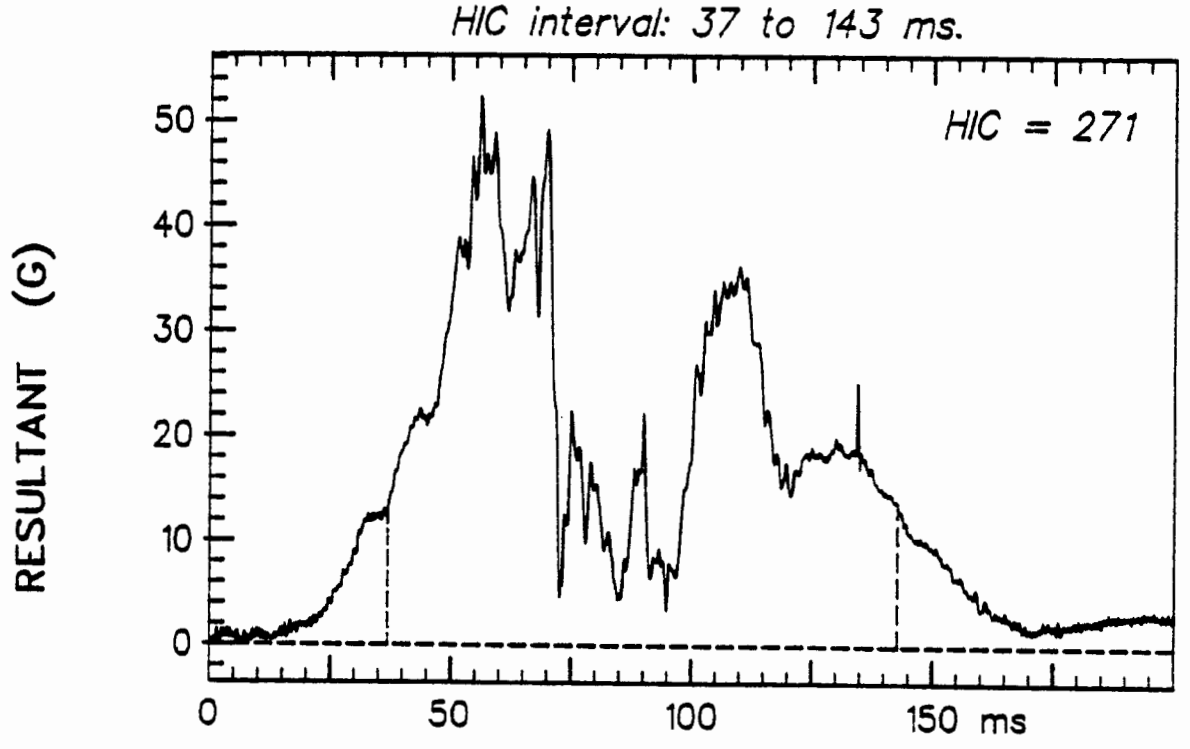
4.3 Graph-Check of 81D017



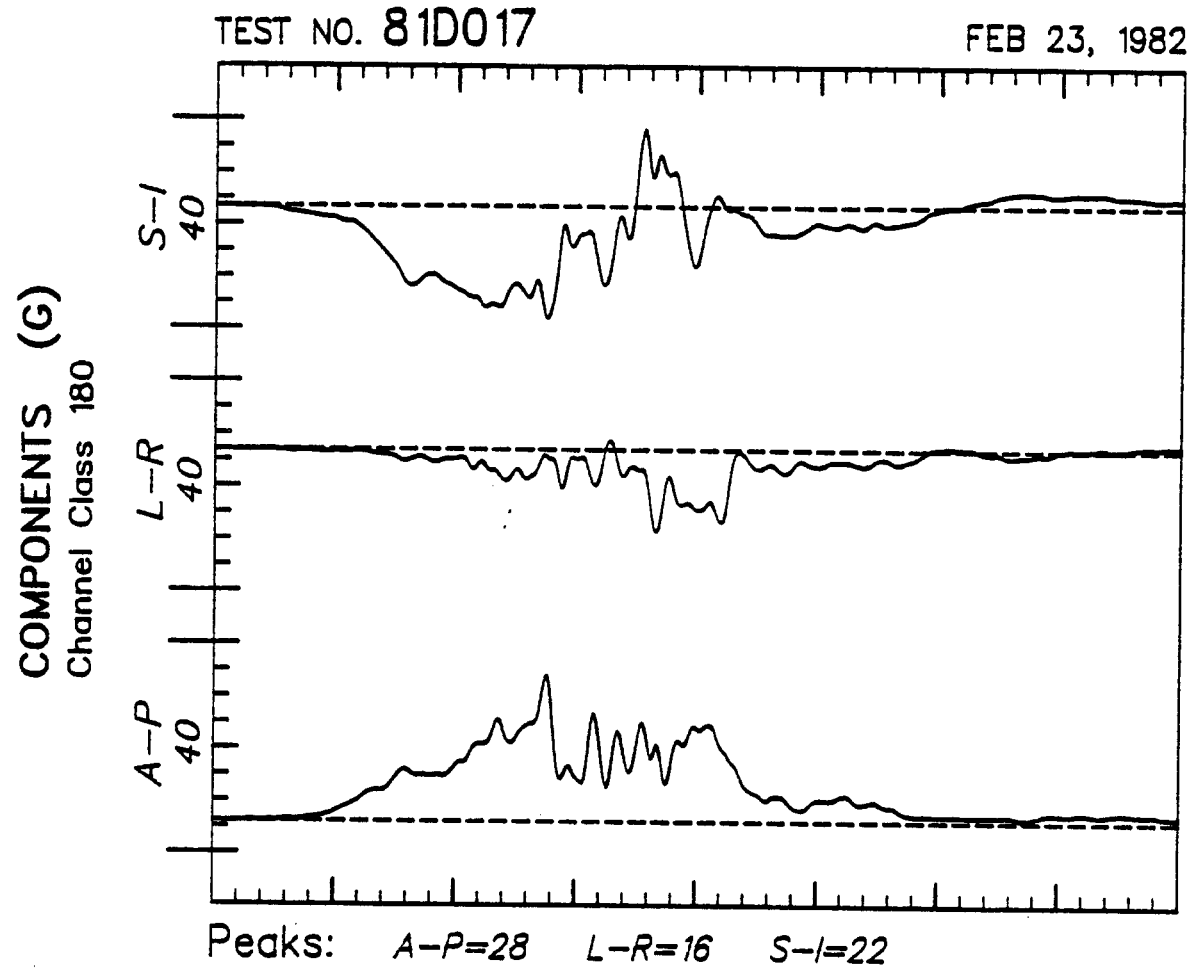
4.4 Post-Test of 81D017

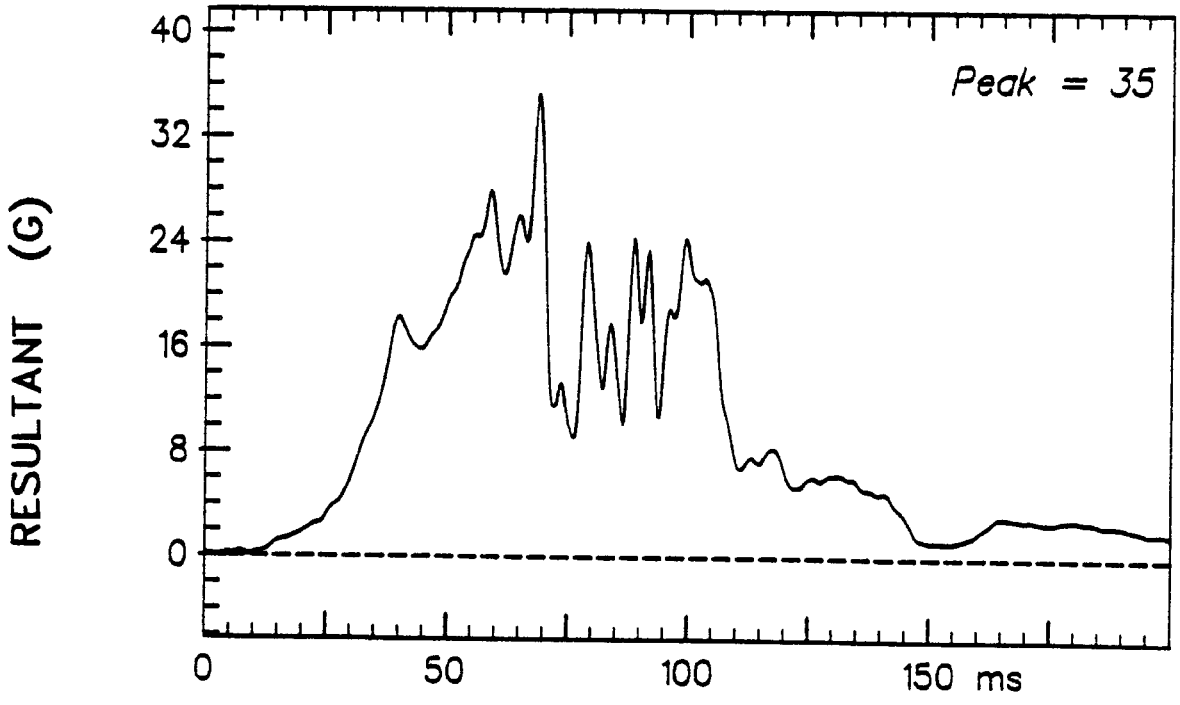

TEST NO. 81D017
FEB 23, 1982
50
100
150 ms
BELT LOADS (LB)
Channel Class 60
Left
400
Right
400
Peaks: Right=400 Left=339





Head Accelerations





Chest Accelerations

SUMMARY OF SLED TEST DATA

ECE DUMMY

SETUP

RESTRAINT MODEL QUESTOR DYN-O-MITE INFANSEAT MODEL 441

PRODUCTION DATE 6-5-81 TETHER NO SHIELD NO

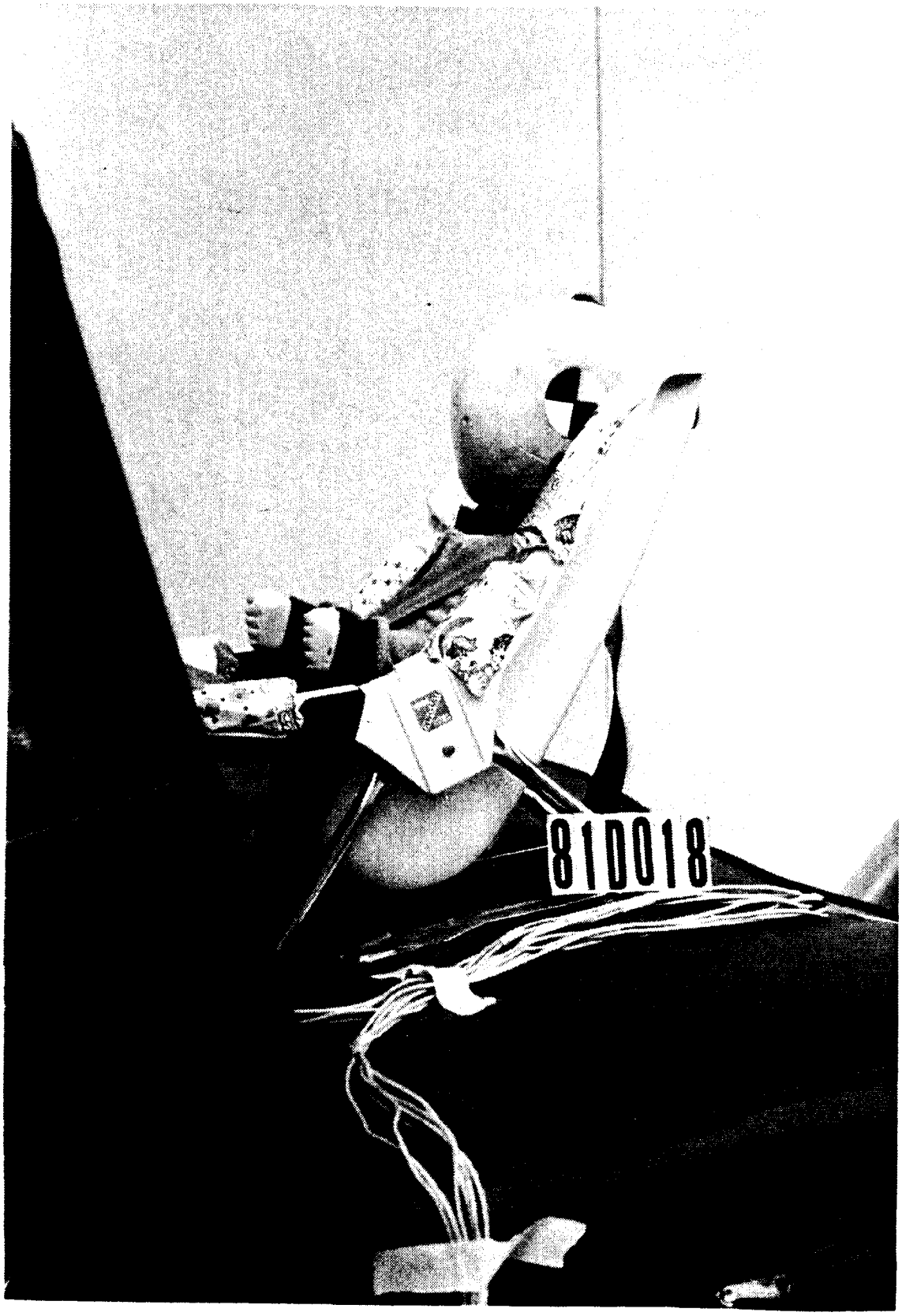
ORIENTATION REAR FACING SEATING POSITION CENTER

ANGLE ADJUSTMENT RECLINE

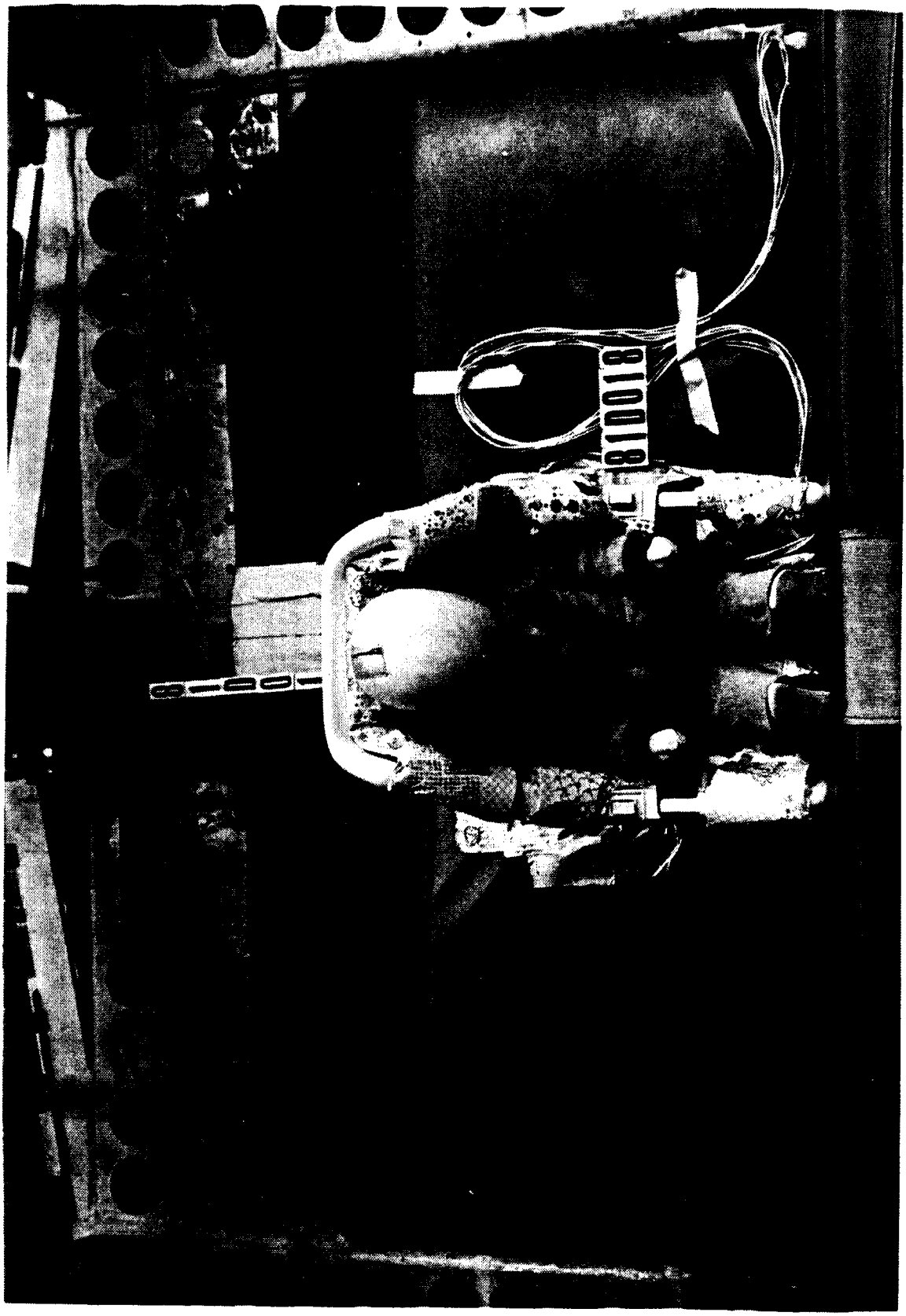
RESULTS

TEST MEASUREMENT	TEST 81D018	PART 572 REQMTS.
SLED VELOCITY, mph	29.7	+ 0 30 -3 mph
SLED ACCELERATION, g	19.9 AVG.	CONFIGURATION I CURVE
HEAD EXCURSION, in	/	≤ 32 in
HEAD INJURY CRITERION	88.	≤ 1000
KNEE EXCURSION, in	/	≤ 36 in
CHEST PEAK RESULTANT, g	35.	≤ 60 g
CHEST ΔT @ 60 g, ms	0.0	≤ 3 ms
PRE-IMPACT BACK ANGLE, deg	25.°	-
MAX. IMPACT BACK ANGLE, deg	58.°	≤ 70°
TORSO RETENTION	YES	YES
HEAD TARGET RETENTION	YES	YES
RESTRAINT SYSTEM INTEGRITY	NO	YES

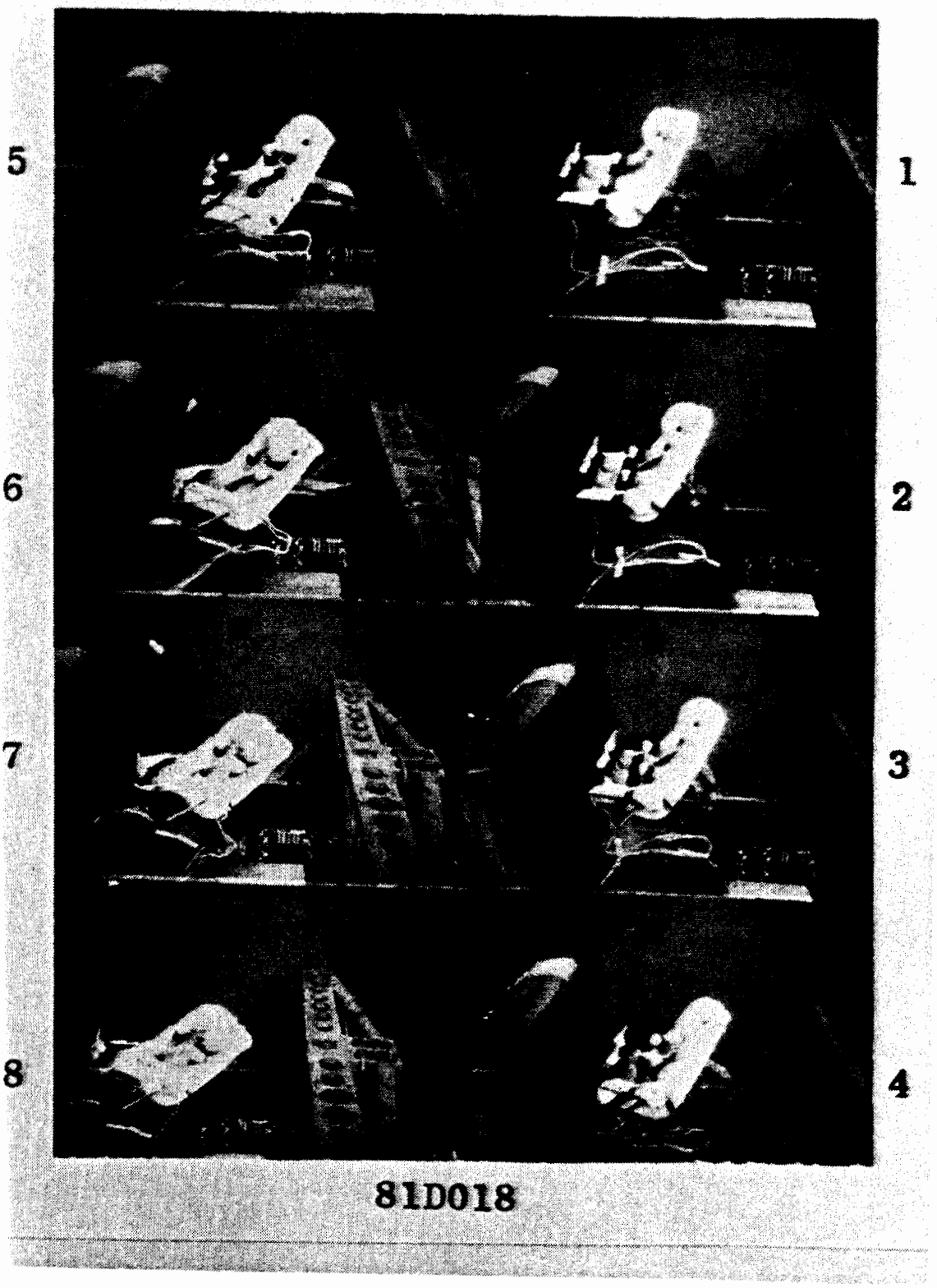
COMMENTS: RESTRAINT'S PASSENGER-SIDE BELT TAB FAILED.



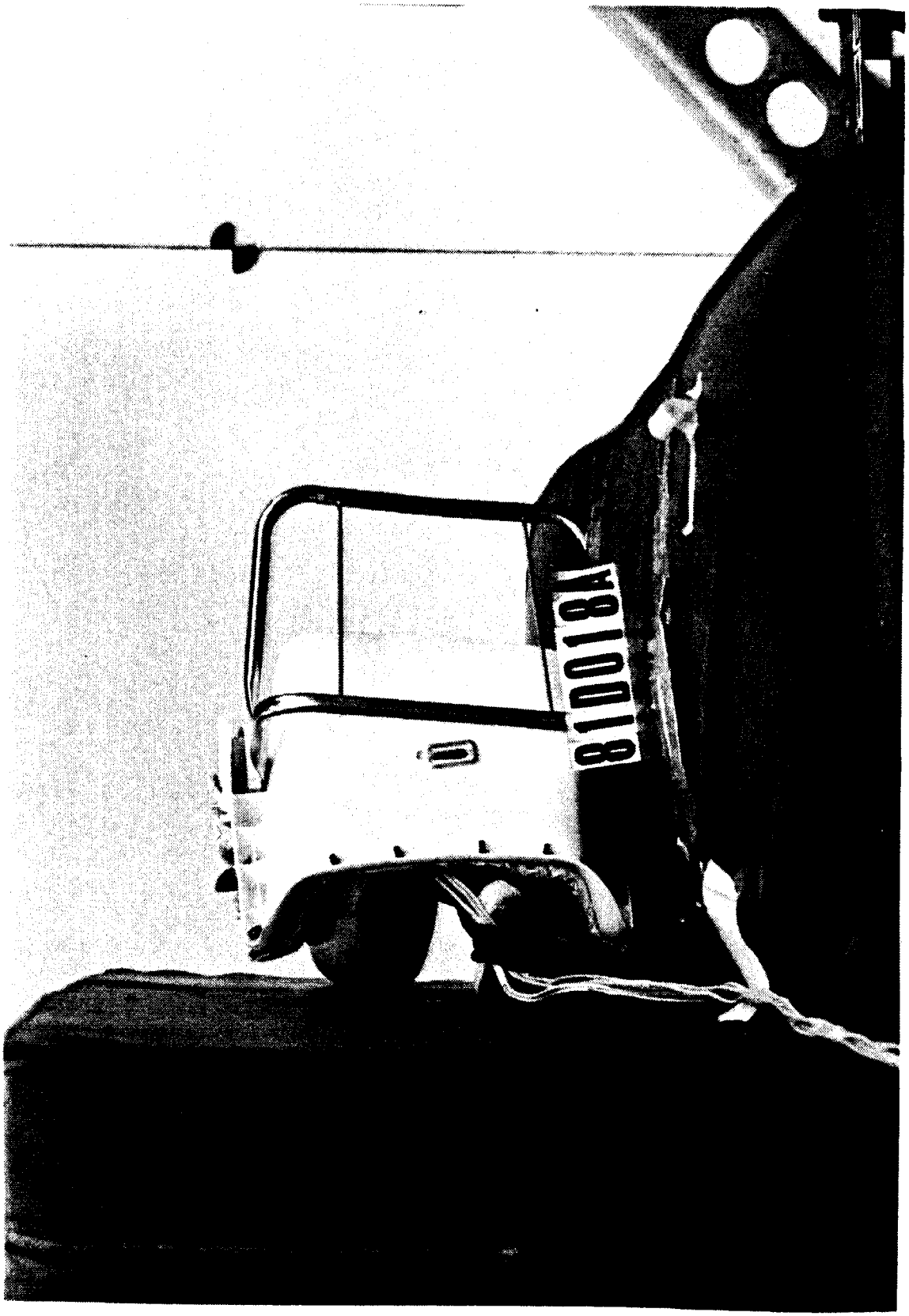
4.5 Test Setup of 81D018



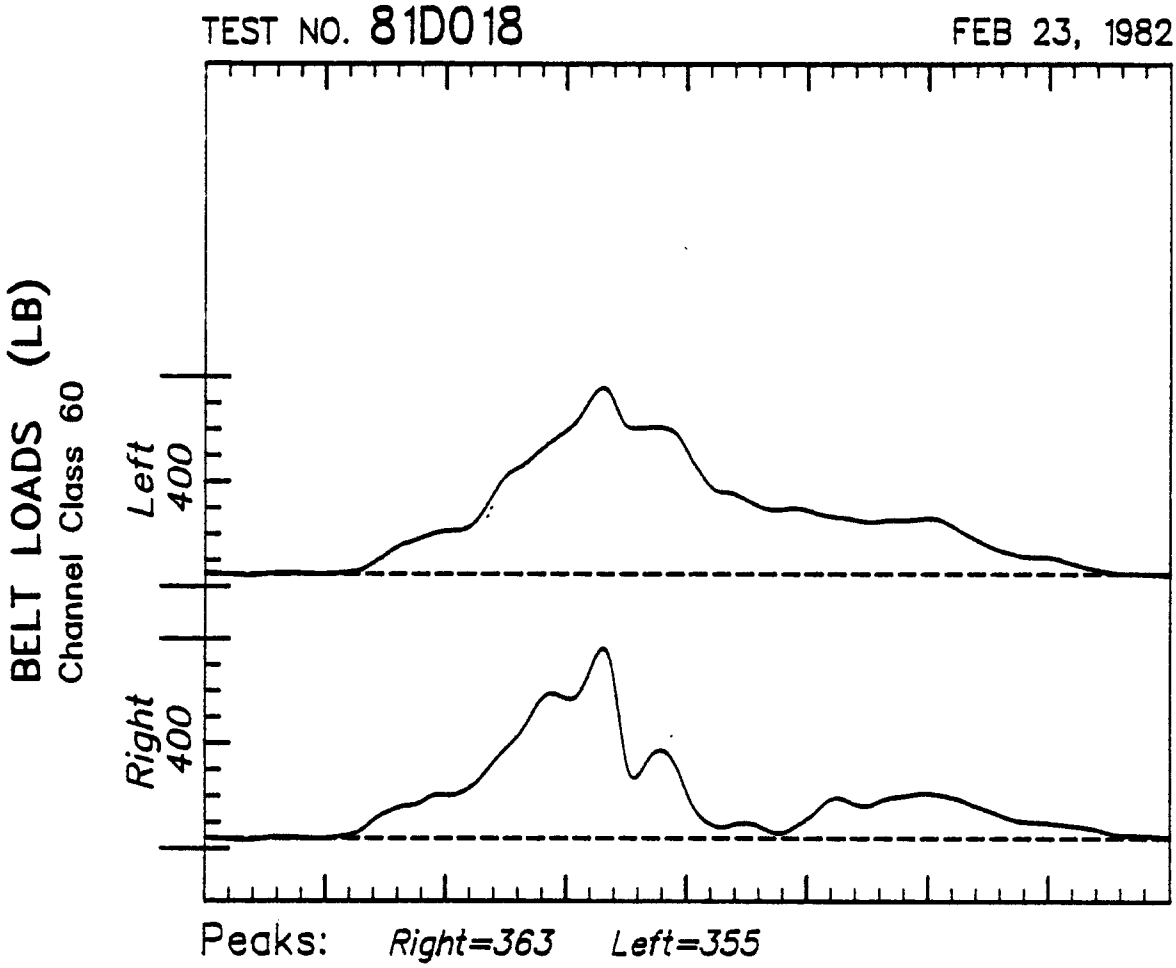
4.6 Test Setup of 81D018

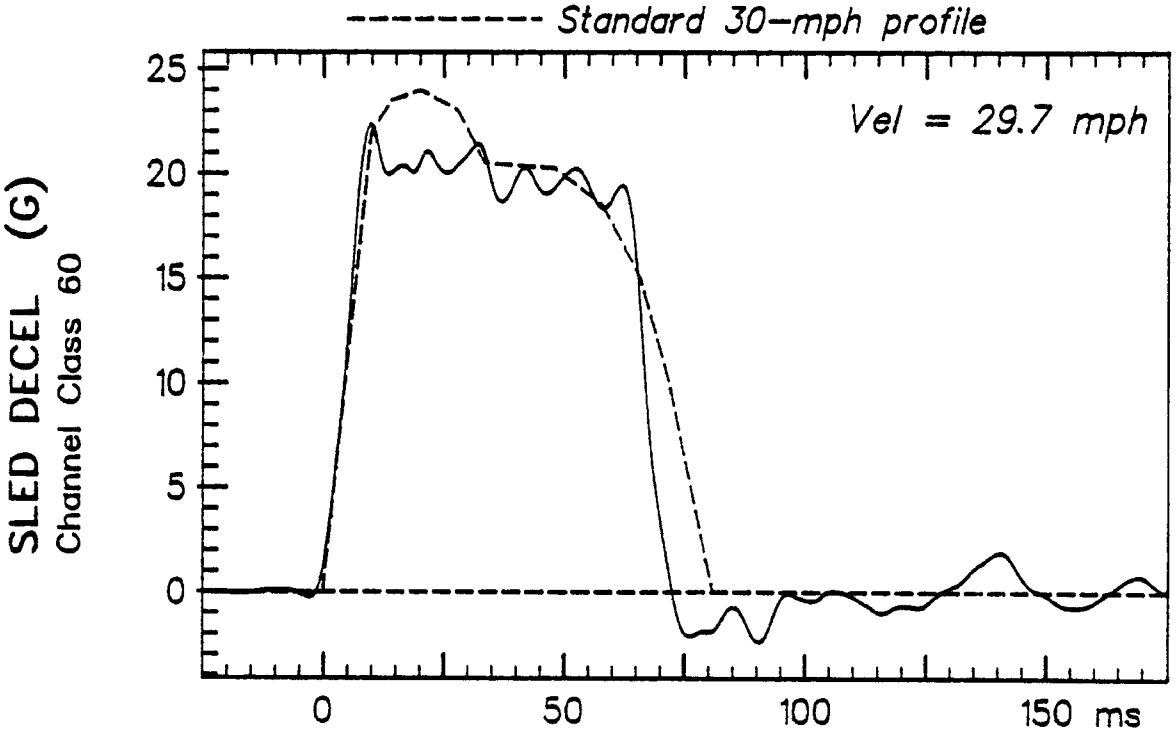


4.7 Graph-Check of 81D018

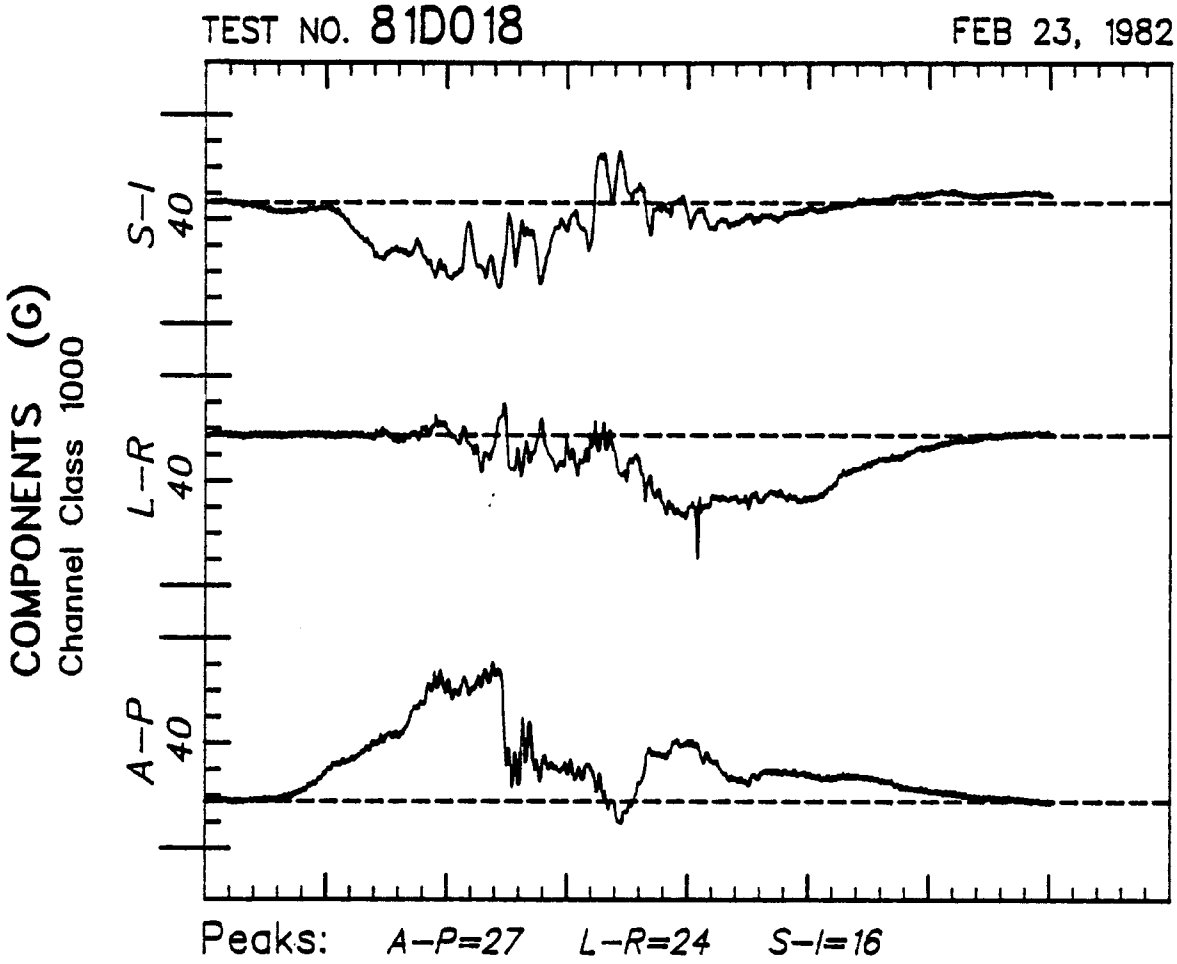


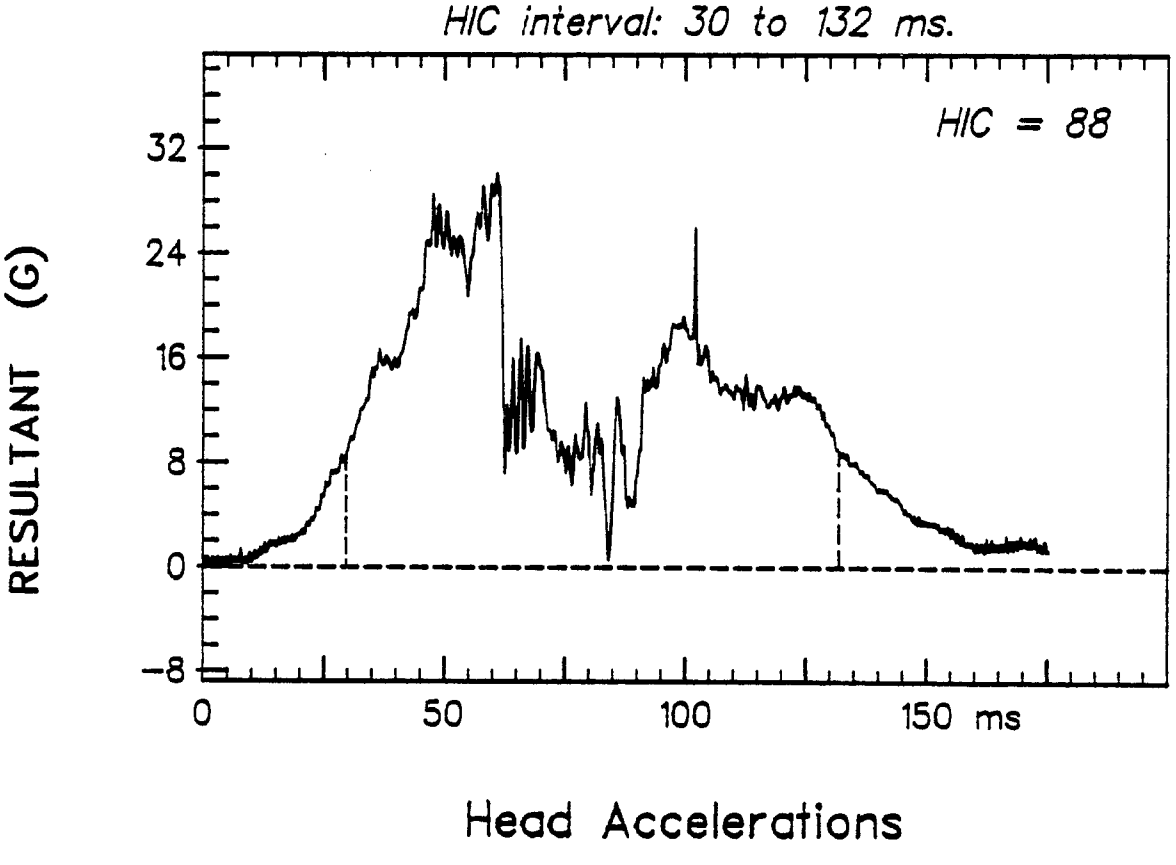
4.8 Post-Test of 81D018



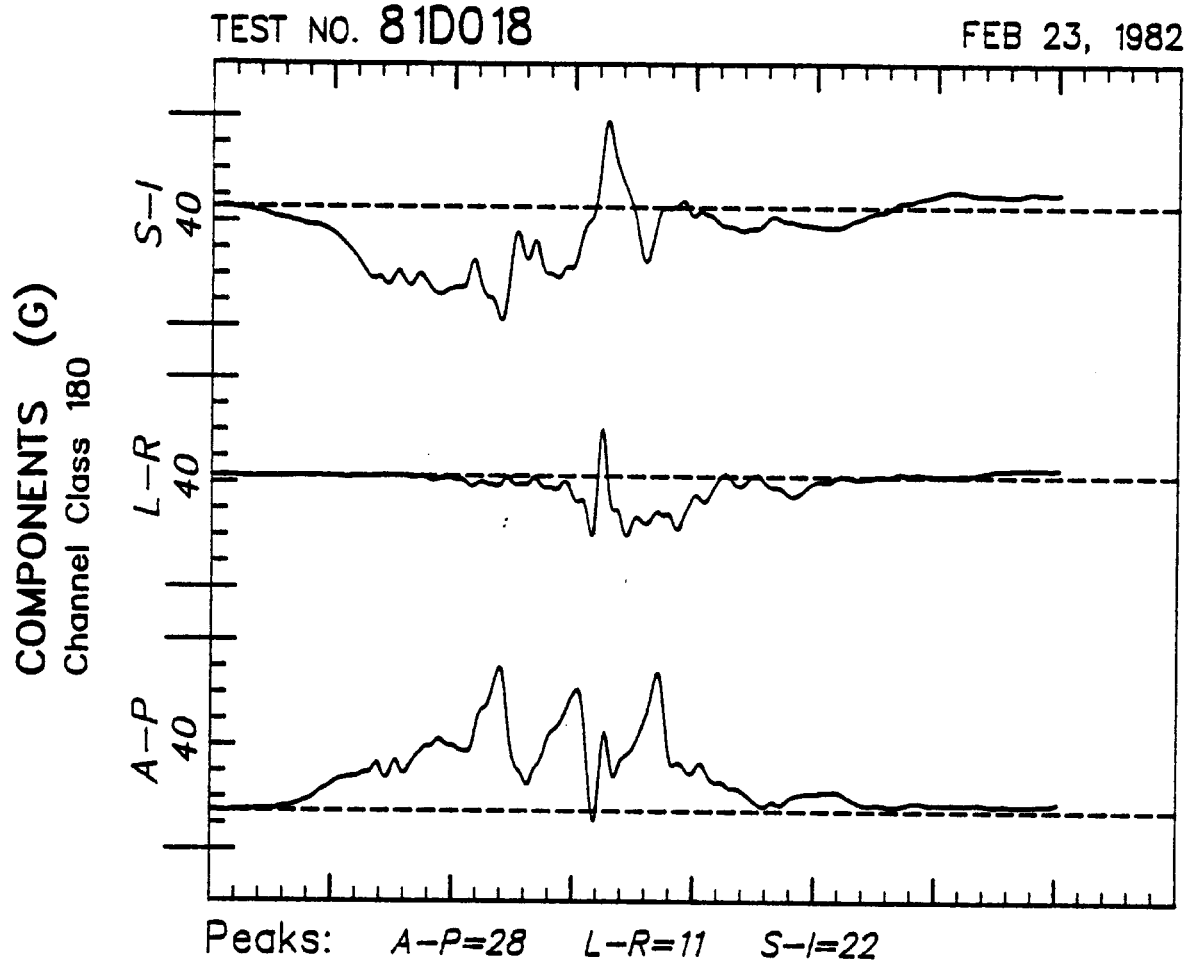


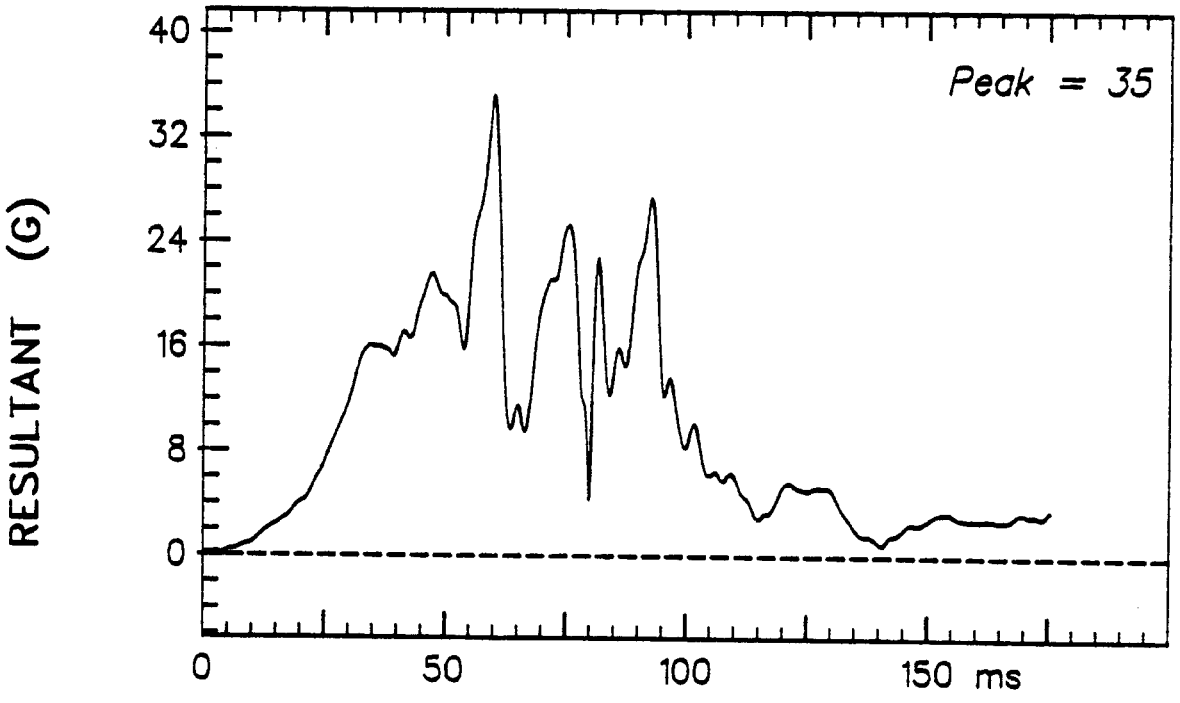
Belt Loads & Sled Profile





Head Accelerations





Chest Accelerations

SUMMARY OF SLED TEST DATA

ECE DUMMY

SETUP

RESTRAINT MODEL STROLEE MODEL 599

PRODUCTION DATE MARCH, 1981 TETHER NO SHIELD YES

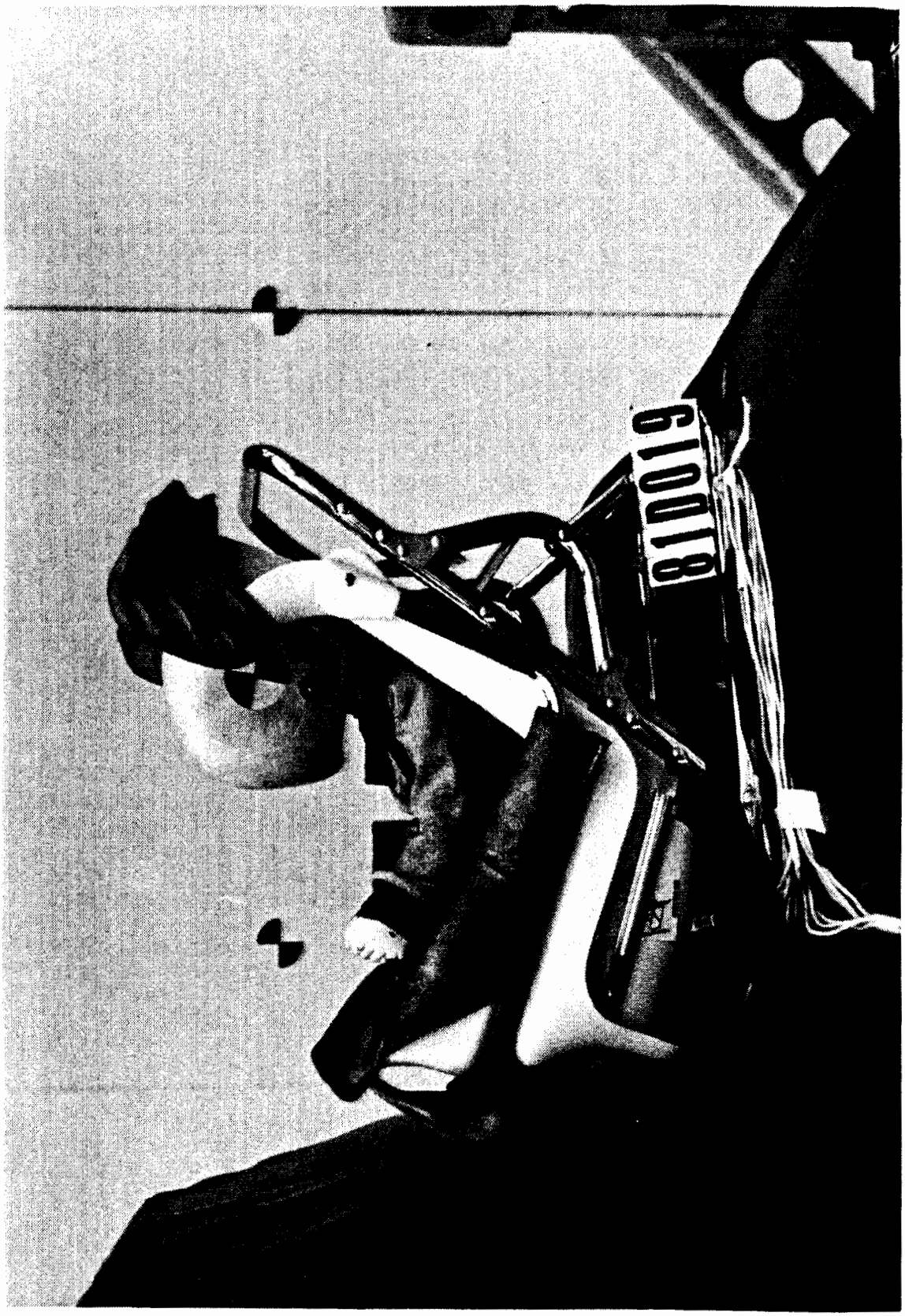
ORIENTATION REAR FACING SEATING POSITION CENTER

ANGLE ADJUSTMENT RECLINE

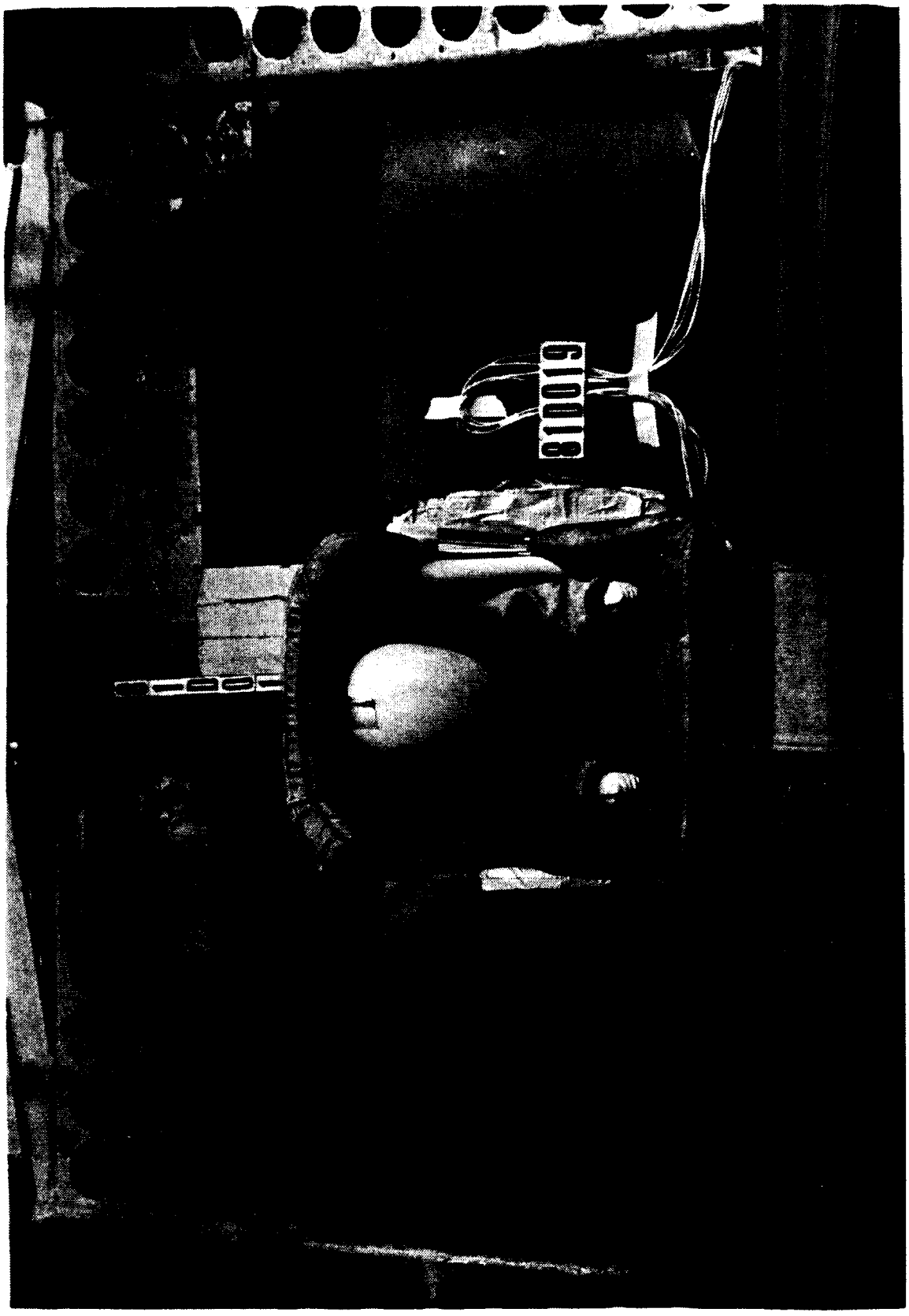
RESULTS

TEST MEASUREMENT	TEST 81D019	PART 572 REQMTS.
SLED VELOCITY, mph	29.0	$^{+0}_{-3}$ 30 mph
SLED ACCELERATION, g	19.8 AVG.	CONFIGURATION I CURVE
HEAD EXCURSION, in	/	$\leq$ 32 in
HEAD INJURY CRITERION	690.	$\leq$ 1000
KNEE EXCURSION, in	/	$\leq$ 36 in
CHEST PEAK RESULTANT, g	47.	$\leq$ 60 g
CHEST ΔT @ 60 g, ms	0.0	$\leq$ 3 ms
PRE-IMPACT BACK ANGLE, deg	42.°	-
MAX. IMPACT BACK ANGLE, deg	70.°	$\leq$ 70°
TORSO RETENTION	YES	YES
HEAD TARGET RETENTION	YES	YES
RESTRAINT SYSTEM INTEGRITY	YES	YES

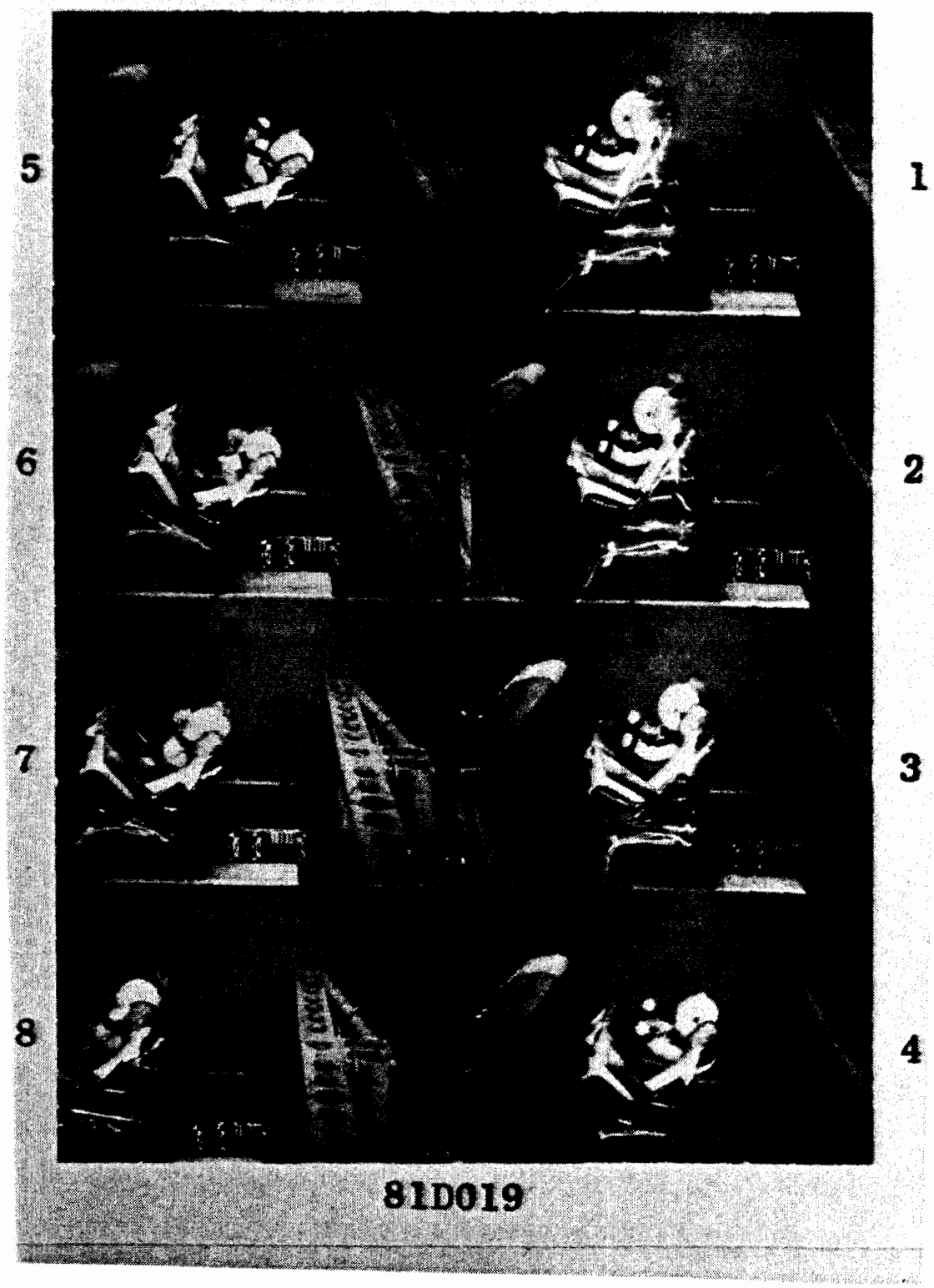
COMMENTS:



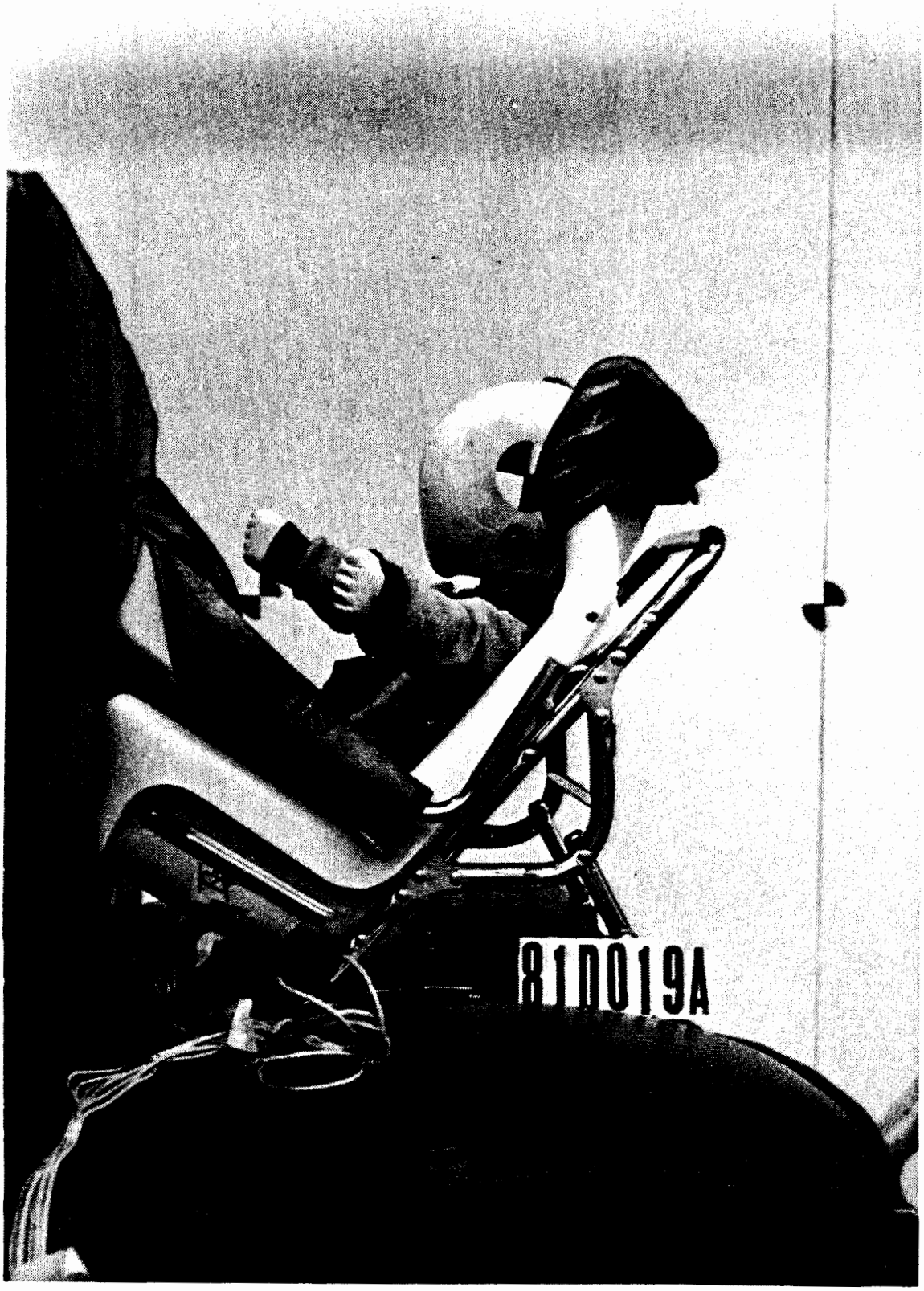
4.9 Test Setup of 810019



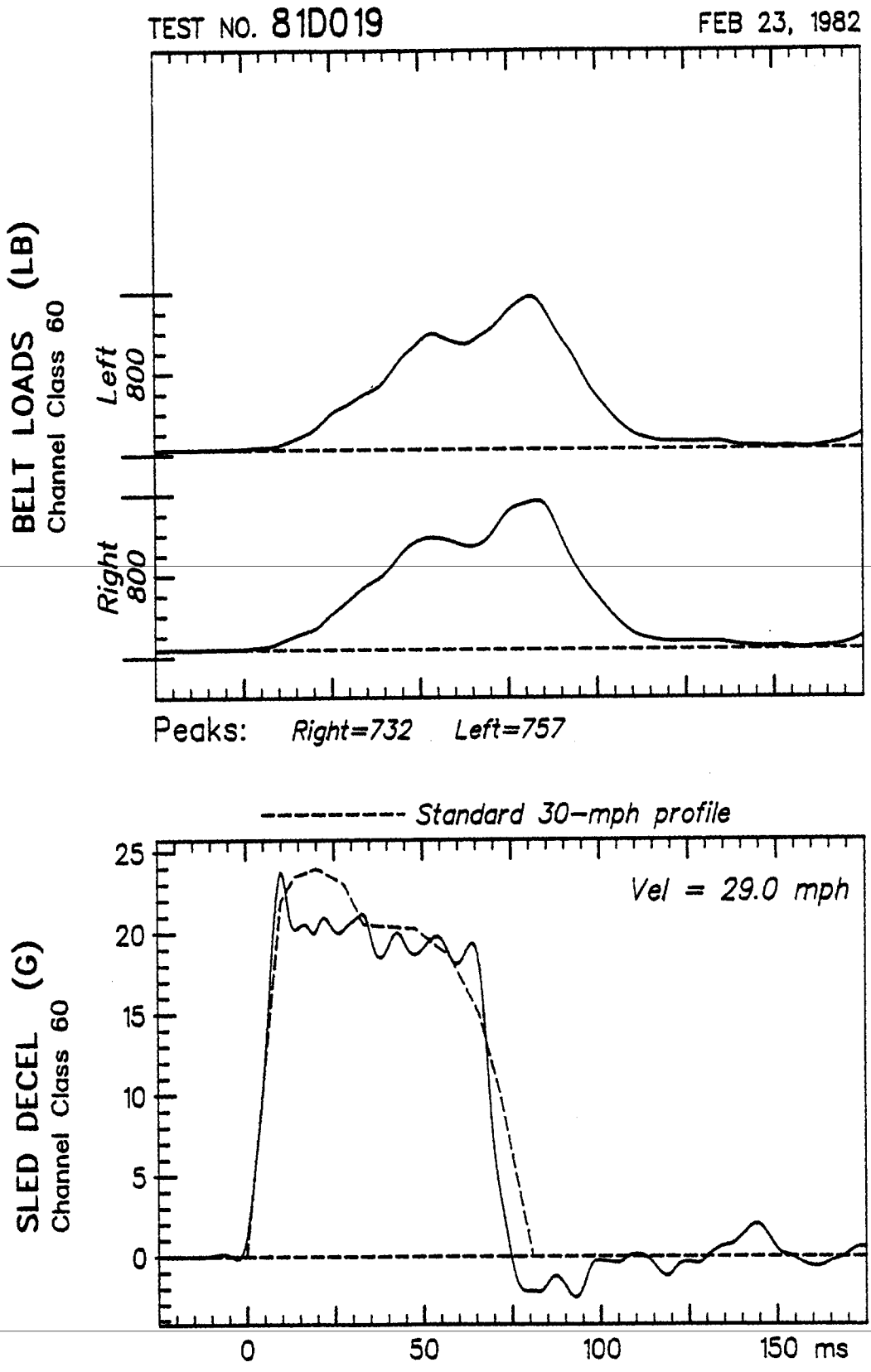
4.10 Test Setup of 81D019



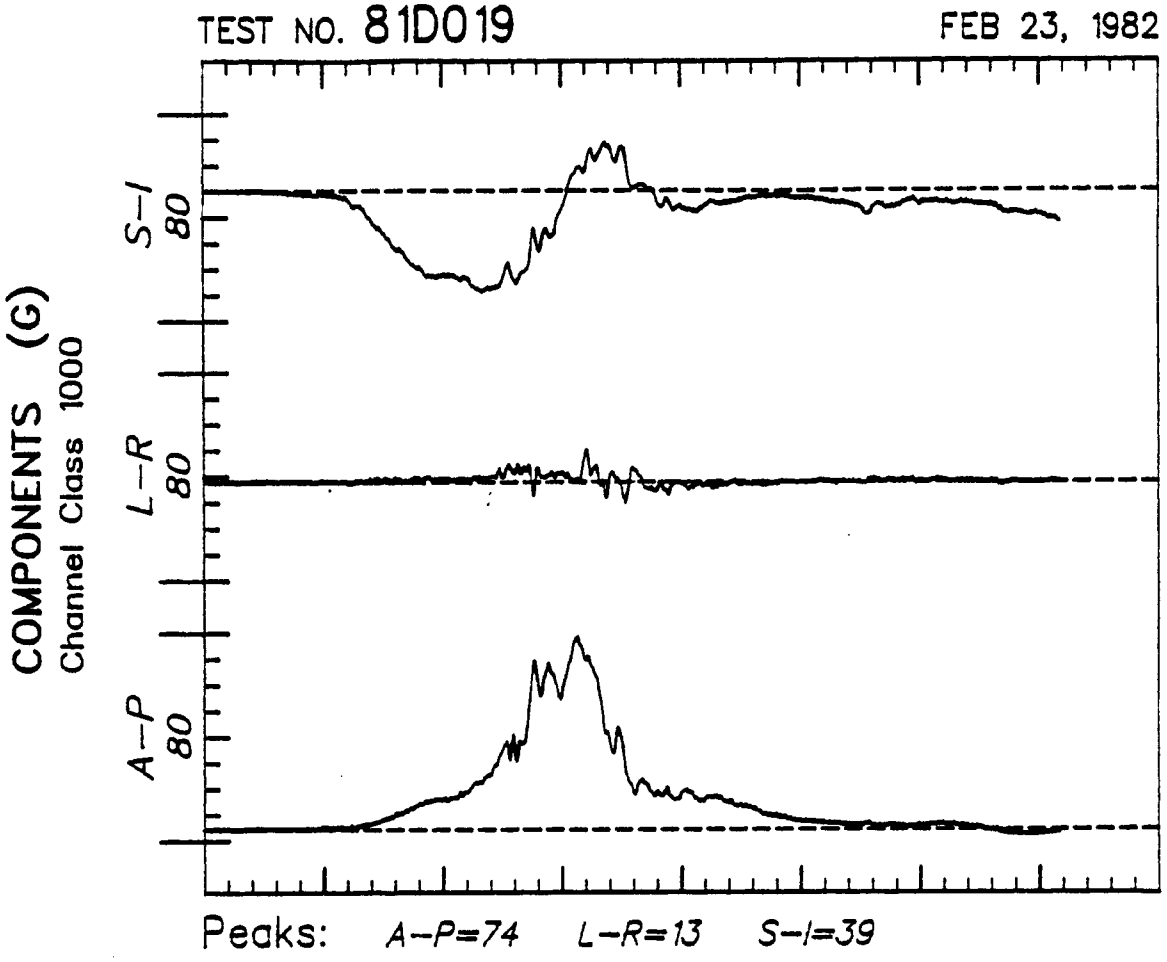
4.11 Graph-Check of 81D019

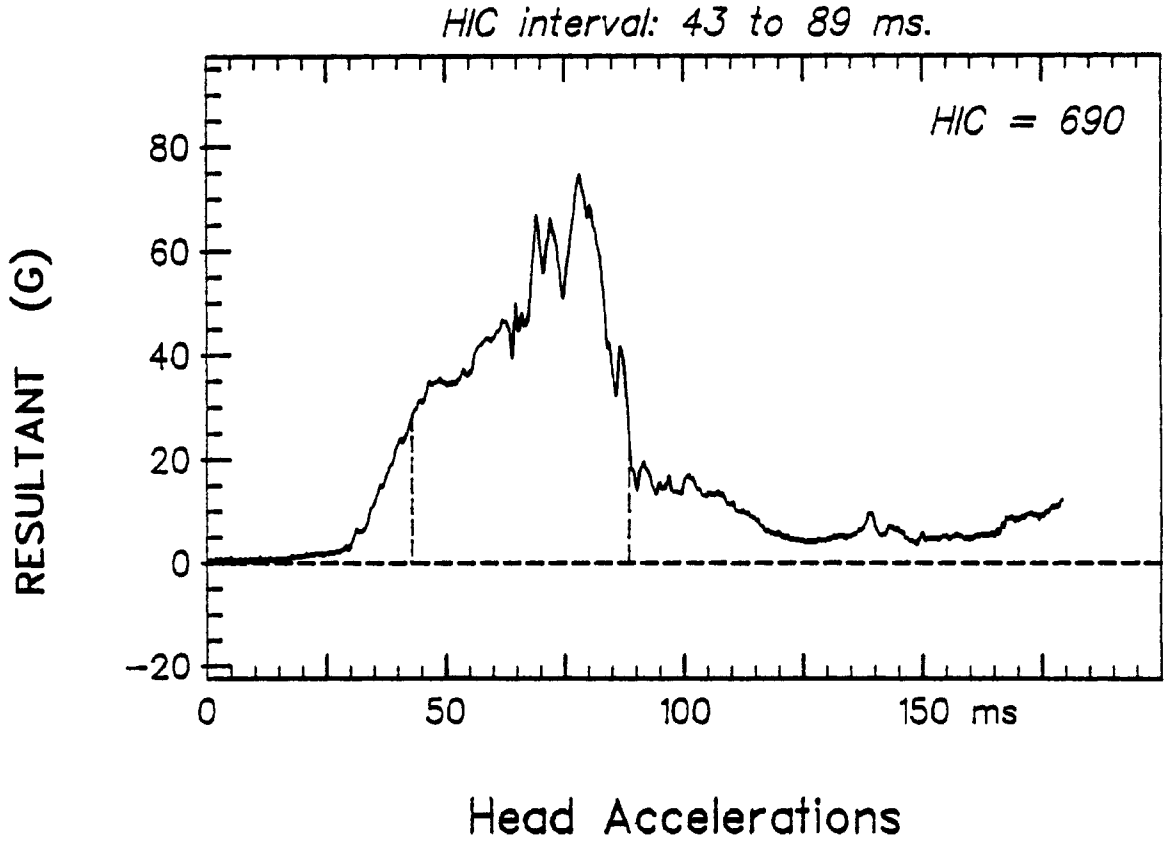


4.12 Post-Test of 81D019

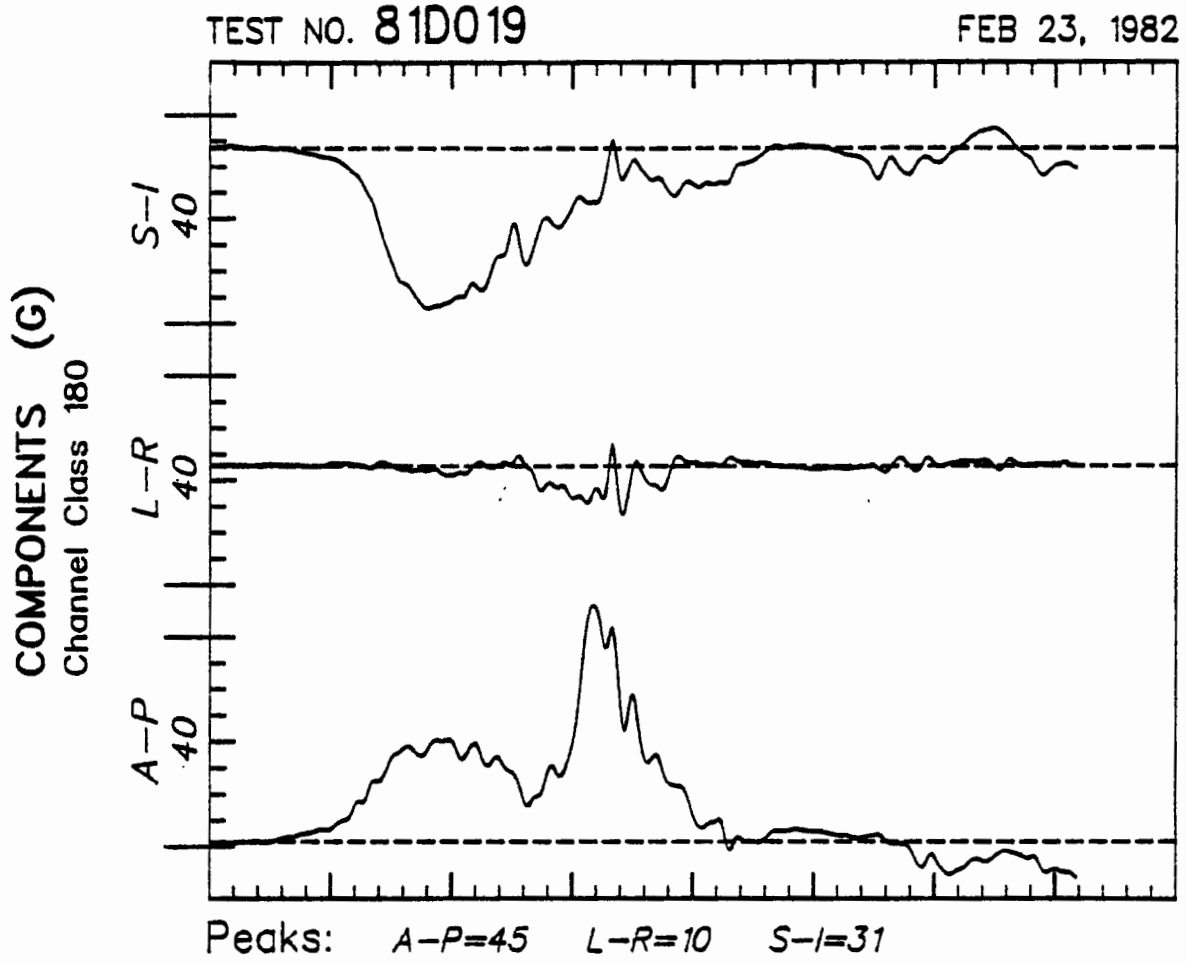


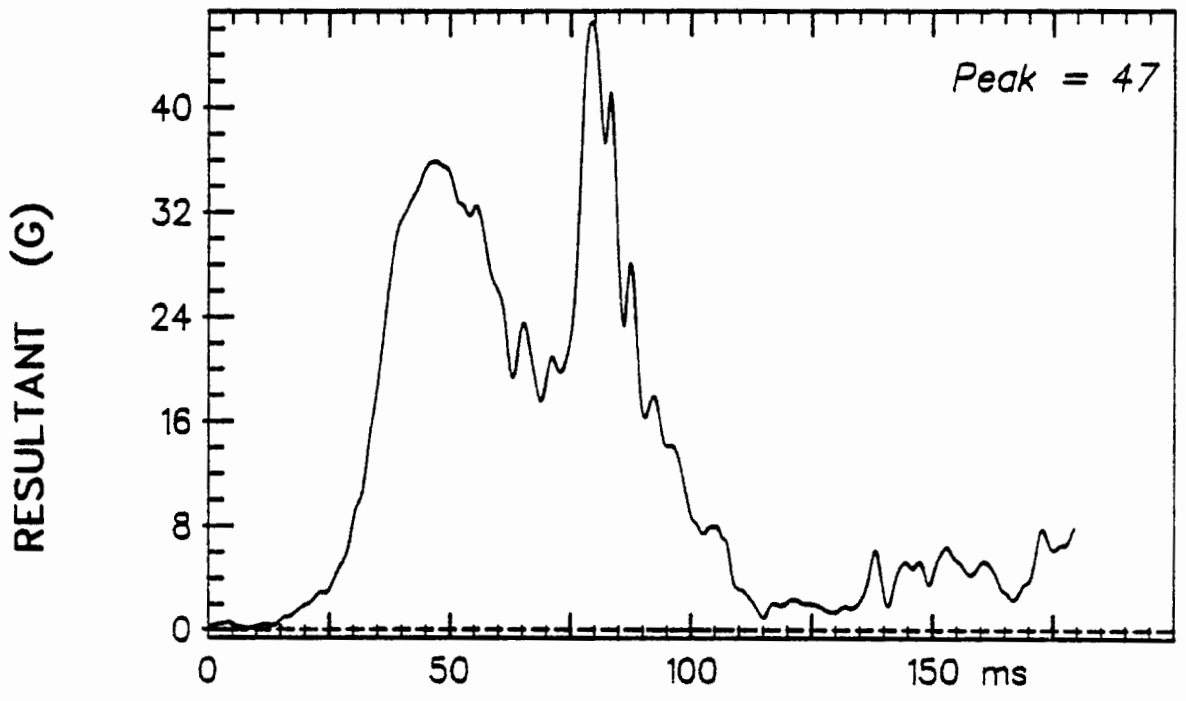
Belt Loads & Sled Profile





Head Accelerations





Chest Accelerations

SUMMARY OF SLED TEST DATA

ECE DUMMY

SETUP

RESTRAINT MODEL STROLEE MODEL 599

PRODUCTION DATE MARCH, 1981 TETHER YES SHIELD YES

ORIENTATION FORWARD FACING SEATING POSITION CENTER

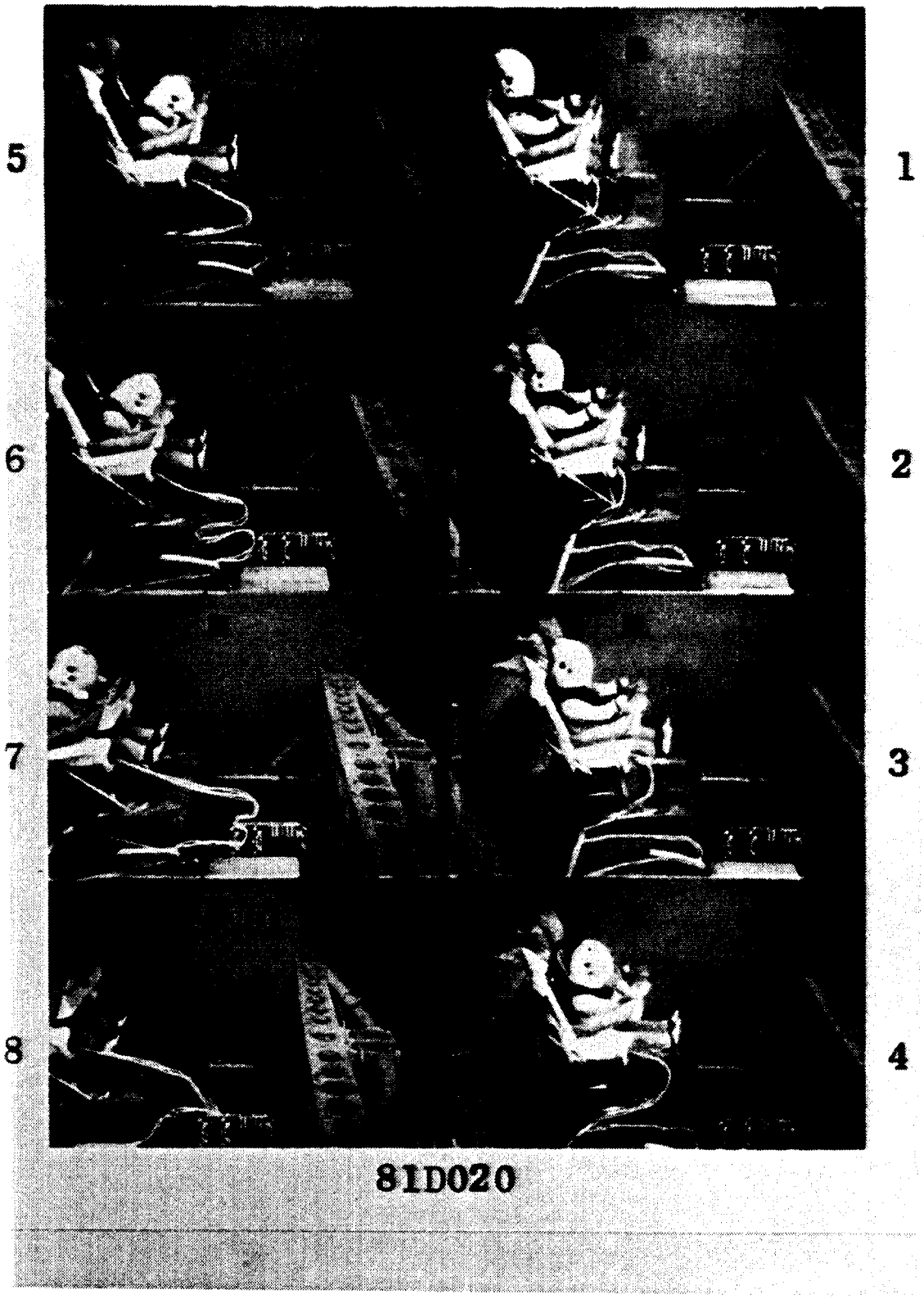
ANGLE ADJUSTMENT UPRIGHT

RESULTS

TEST MEASUREMENT	TEST 81D020	PART 572 REQMTS.
SLED VELOCITY, mph	30.7	30 +0 -3 mph
SLED ACCELERATION, g	20.0 AVG.	CONFIGURATION I CURVE
HEAD EXCURSION, in	18.0	≤ 32 in
HEAD INJURY CRITERION	851.	≤ 1000
KNEE EXCURSION, in	18.4	≤ 36 in
CHEST PEAK RESULTANT, g	41.	≤ 60 g
CHEST ΔT @ 60 g, ms	0.0	≤ 3 ms
PRE-IMPACT BACK ANGLE, deg	/	-
MAX. IMPACT BACK ANGLE, deg	/	≤ 70°
TORSO RETENTION	/	YES
HEAD TARGET RETENTION	/	YES
RESTRAINT SYSTEM INTEGRITY	YES	YES

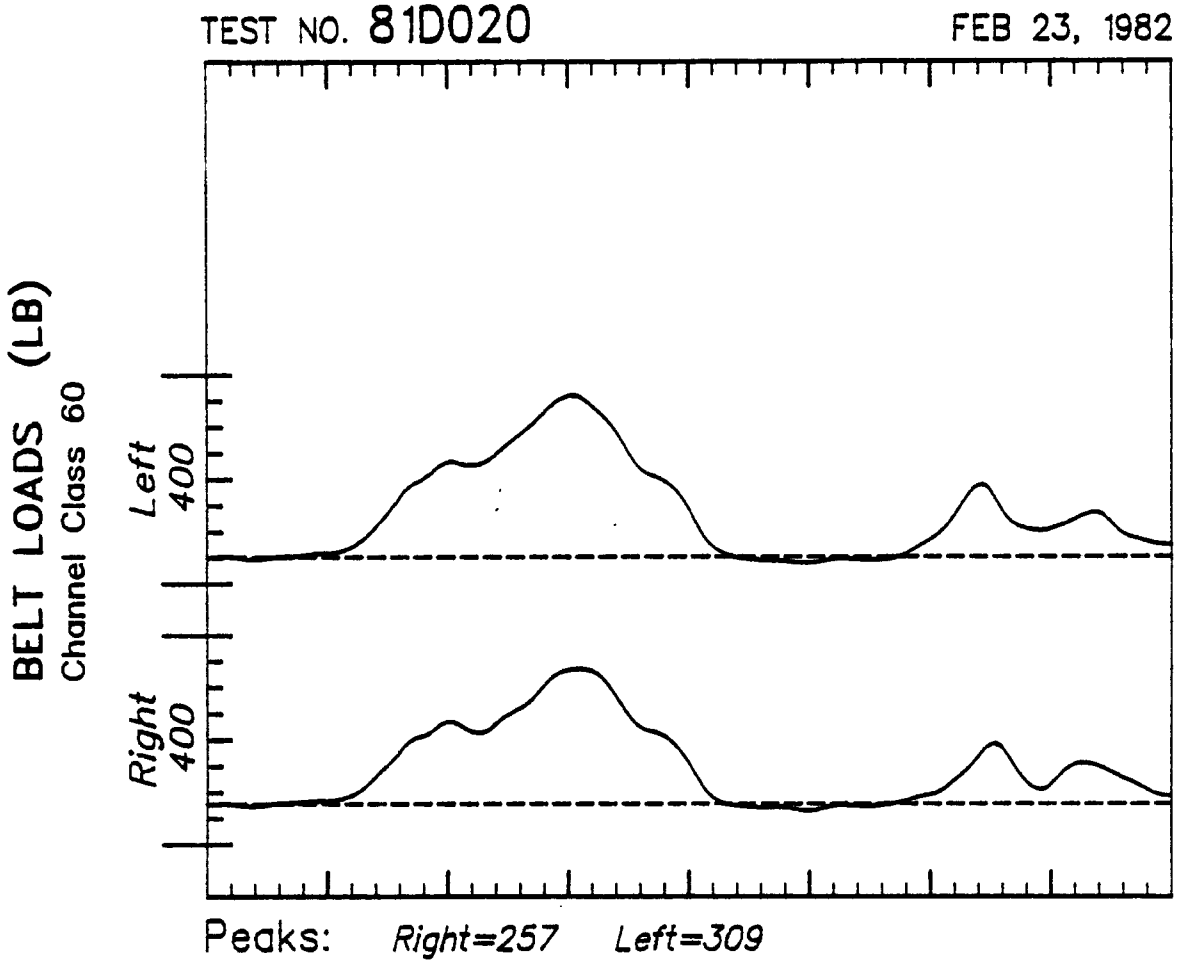
COMMENTS:

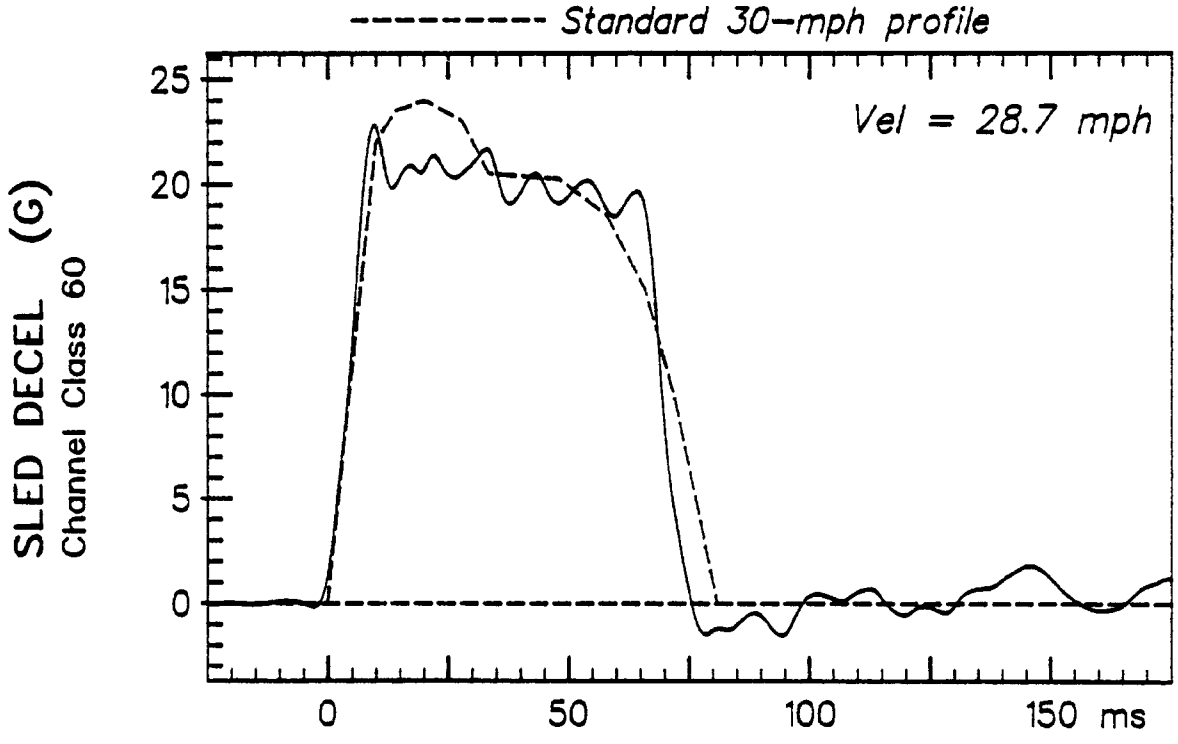
4.13 Test Setup of 81D020



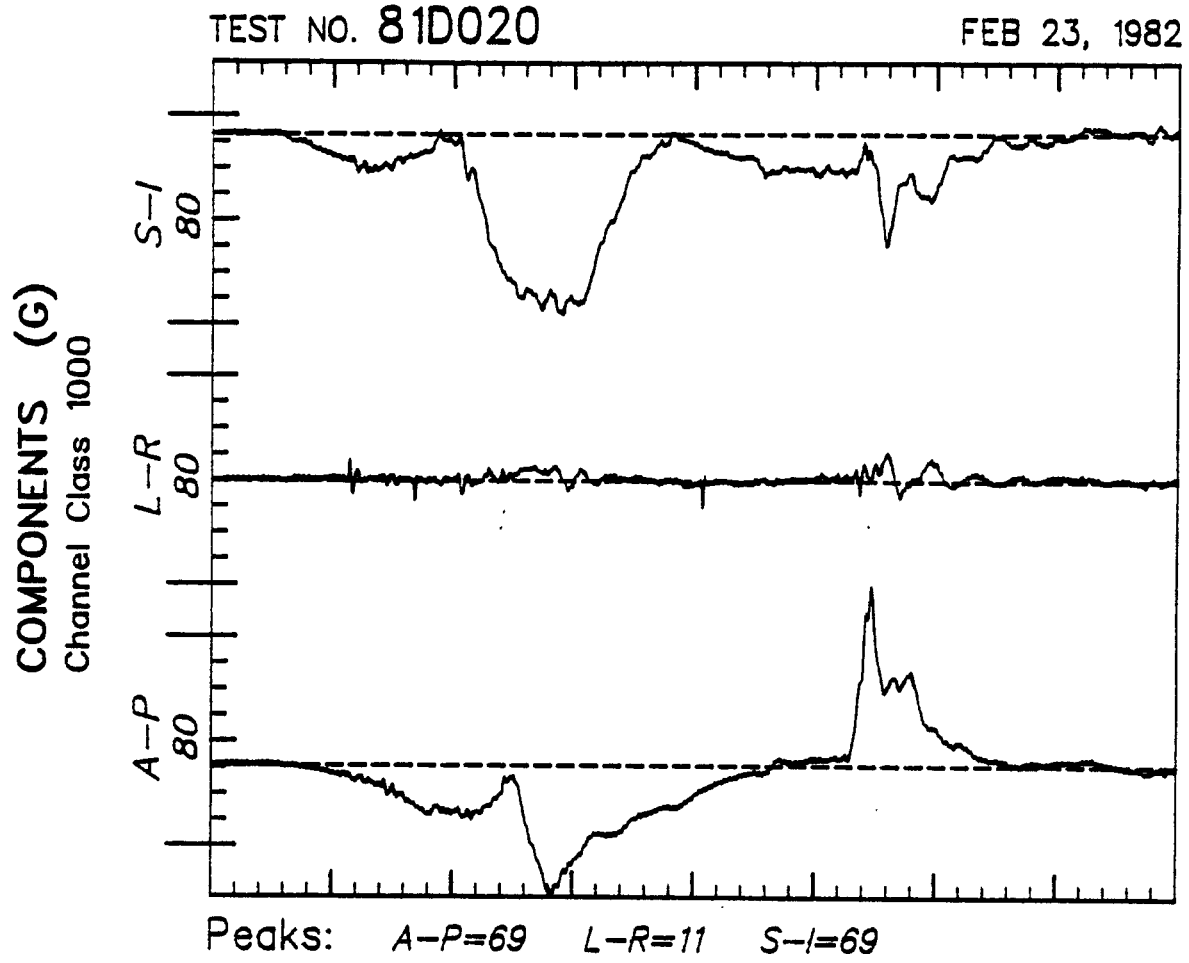
4.14 Graph-Check of 81D020

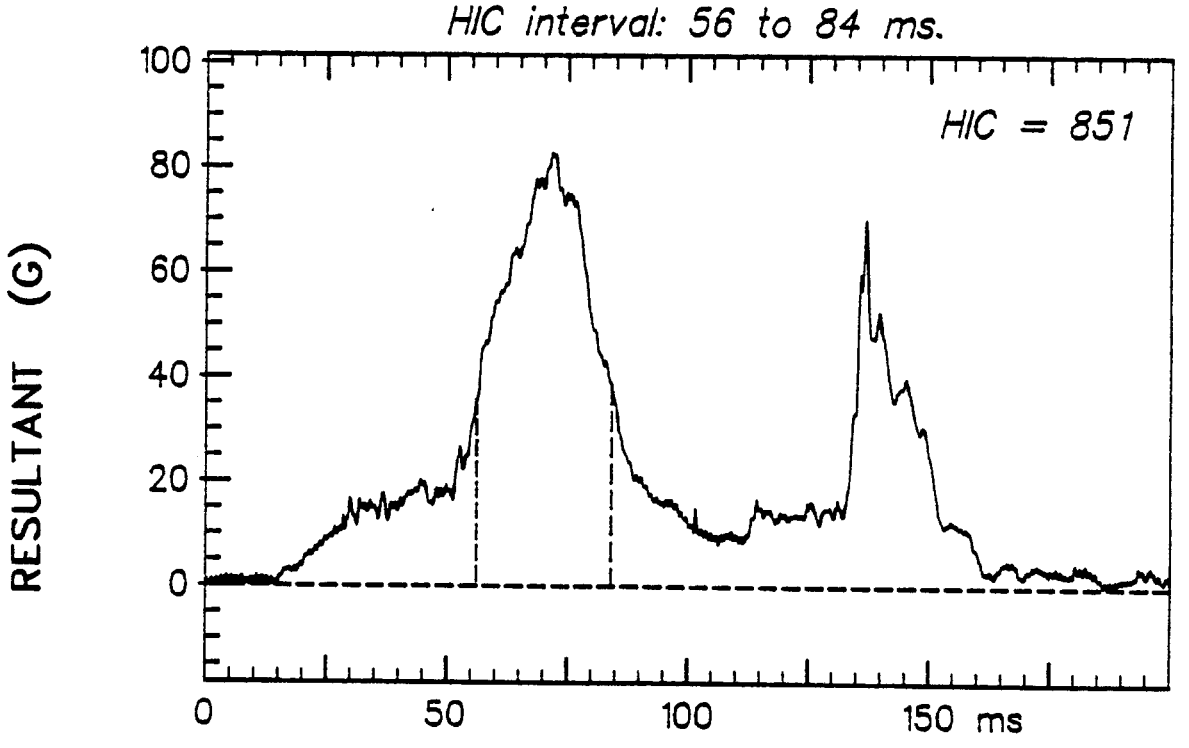
4.15 Post-Test of 81D020



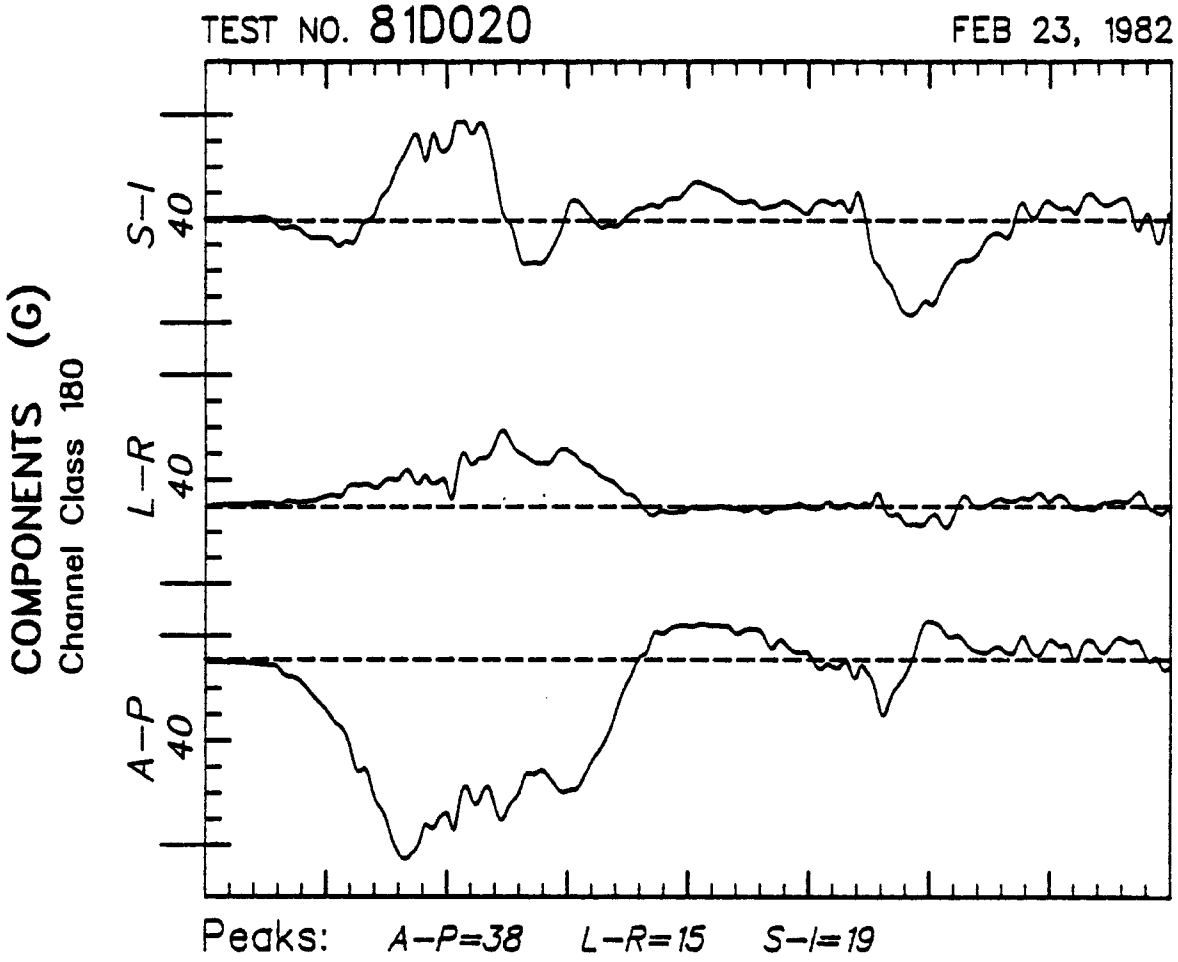


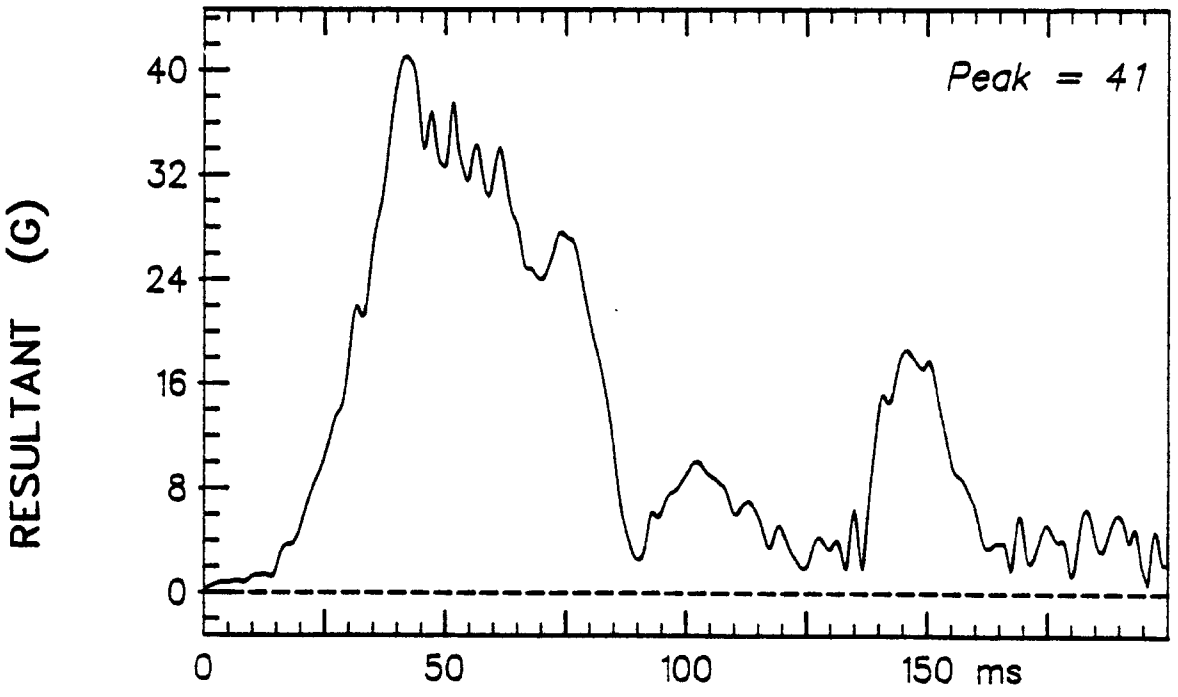
Belt Loads & Sled Profile





Head Accelerations





Chest Accelerations