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USAAVSCOM TECHNICAL REPORT 70-9

UH-1B/D ARMORED HELICOPTER SEAT TEST PROGRAM

BY

W. H. REED
D. F. CARROLL
V. E. ROTHE

FEBRUARY 1966

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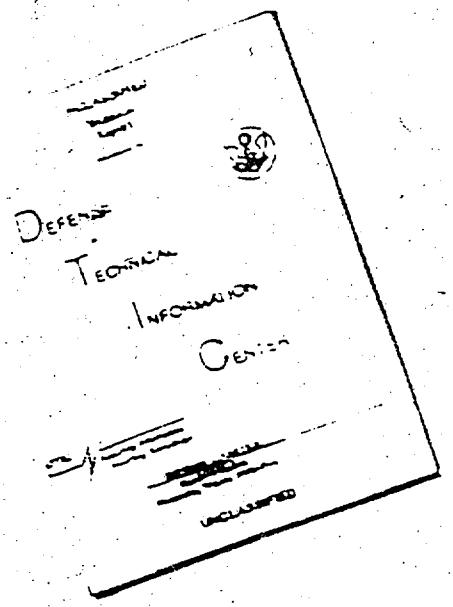

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SEAT TEST PROGRAM

CONDUCTED FOR AEROJET-GENERAL CORPORATION

UNDER U. S. ARMY

CONTRACT DA 23-204-AMC-03025(T)

ASER REPORT NO. M66-7

2 February 1966

Poor copy throughout. Refer questions to source.

Prepared: William H. Reed Reviewed: Donald F. Carroll

Approved: [illegible]

UH-1B/D ARMORED SEAT TEST PROGRAM

VERTICAL DROP TEST SERIES NUMBER THREE

INTRODUCTION

The Aerojet-General Corporation is engaged in the development of an armored crew seat for the Bell UH-1B/D series helicopters It is required that the armored seat developed in this program protect the seat occupant against impact at least as well as the standard UH-1D crew seat. To show compliance with this requirement, a test program was initiated in May 1965 during which the armored seat and a standard UH-1D crew seat were subjected to controlled vertical impacts. Measurements of the vertical accelerations applied to the seats and their occupants were recorded. Study of the recorded data and high-speed motion pictures provided a basis for comparison of the dynamic response of the seat-occupant systems and the forces transmitted to the seat occupants.

This report presents the results of two tests of a redesigned armored crew seat conducted 27 January 1966 by Aviation Safety Engineering and Research (AvSER), a Division of Flight Safety Foundation, Incorporated. The results of this series of tests are compared with the results of the first series of tests completed 21 May 1965

The results of the first series of tests conducted under this program are presented in AvSER Report M65-24, 4 June 1965. The second test series is reported in AvSER Report M66-1, 18 January 1966.

TEST OBJECTIVES

The objectives of this test series were:

1. To determine the response of a redesigned armored crew seat under 15G and 5G vertical impact conditions.
2. To compare the response of the redesigned armored seat with the response of a standard UH-1D crew seat tested in May 1965 under the same conditions.

TEST PROCEDURES

The following procedures were followed to conduct this test series.

1. The AvSER vertical drop tower facility was modified to accept the single test article. This modification included the addition of ballast weight to bring the total weight of the drop cage and test articles to 1,680 pounds. This ballast compensated for the weight of the UH-1D seat and dummy installed in the first test series. Of this weight, the armored seat accounted for approximately 137 pounds, the dummy occupant 186 pounds, and the drop cage and ballast weighed 1,357 pounds.
2. Instrumentation transducers were installed on the drop cage, on the seat frame, and in the dummy occupant.

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3. Two high-speed movie cameras (500 frames per second) were installed, providing a front view and a 45° side view of the seat and dummy during the tests.

4. The armored seat and dummy occupant were installed in the drop cage and two drop tests were conducted.

TEST CONDITIONS

The test conditions specified by Aerojet-General called for vertical impacts at the following acceleration levels:

Test No. 1 - 15G peak deceleration, half sine wave pulse, 0.05 second duration

Test No 2 - 5G peak deceleration, half sine wave pulse, 0.05 second duration.

TEST INSTRUMENTATION

Transducers

The transducers used in this test series were Statham Instruments Model A5 accelerometers. These are strain gage type instruments which provide a frequency response in excess of 300 cycles per second. Transducers were installed at the following locations to measure vertical acceleration:

1. Drop Cage Frame
2. Armored Seat Frame - Right
3. Armored Seat Frame - Left

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4. Armored Seat Occupant - Pelvic

5. Armored Seat Occupant - Head

Electronic Data Recording System

The measurements listed above were recorded on a magnetic tape recording system. This system utilizes a constant bandwidth FM/FM multiplex modulation technique in which the analog signal from the transducer is converted by a subcarrier oscillator into a frequency deviation proportional to the input signal amplitude. Seven of these subcarrier oscillator outputs are combined in a mixer amplifier and the resulting composite signal is then recorded on one track of a 14-track tape recorder. In this test series the data obtained from each test was recorded on one track of the tape recorder.

Electronic Data Processing System

The data recorded on the data recording system was recovered by utilizing a compatible data processing system. In this system a tape playback machine removes the composite signal from each track of the test tape and processes it through a series of FM discriminators. These discriminators separate the composite signal into various subcarrier frequency deviations. These frequency deviations are then converted to an analog signal which is recorded on an oscillograph plotter. The resulting oscillograph record is then available as an analog time history plot of the recorded parameter.

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Photo Instrumentation

Photographic instrumentation was provided by two Photosonics 1B 16 mm motion picture cameras operating at approximately 500 frames per second. Timing and correlation was provided to aid in analyzing the motions of the seat and occupant and correlating this motion with the accelerations measured during each test.

TEST RESULTS

General

Examination of the results of these two drop tests indicates that the data from these tests are comparable with the data obtained from the earlier test series. Measurable permanent deformation of the seat structure occurred during the 15G test. This deformation was slight, however, and did not detract from the protection afforded the occupant in this test series. In both tests of this series the occupant remained upright and well restrained.

A summary of the data obtained from these tests, along with a summary of the data from the earlier tests is presented in Table I.

Pre- and post-test photographs of Test No. 1 are presented in Figures 1 through 6. These photographs are considered typical of the complete series. The acceleration-time histories of the data recorded during this test program is presented in Figures 9 through 11.

The acceleration-time histories of the data recorded during the January 1966 test program is presented in Appendix A. Appendix B contains the accelerometer data recorded during the May 1965 test series.

Data Analysis - Test No. 1 (15G Acceleration)

The input acceleration pulse (drop cage acceleration) achieved in this test is similar to the input acceleration in the May 1955 15G test, so that a comparison may be made between the results of this test and the earlier one.

Figure 7 presents superimposed curves showing data obtained from the 15G tests of each test series. Measurements of drop cage acceleration, seat acceleration, and occupant pelvic acceleration are included, to provide direct comparison of the results obtained from the three tests.

The armored seat occupant experienced a single acceleration pulse with a peak acceleration of 49G and a mean acceleration of 31G. Because of the increased rate of onset and the high maximum acceleration, this acceleration environment would likely produce a more severe effect upon a human occupant than the occupant accelerations experienced in either of the 15G tests in the first two test series. (Reference acceleration-time curves in Figure 7 and the Appendices.)

This test produced more deformation of the armored seat support structure than was experienced in earlier tests, also, indicating that loads developed in this test approached the structural limits for this seat. The most obvious deformation which indicated impending structural failure was forward bending of the right aft vertical support tube. The seat was raised to the highest position

for this test, and the support tube bent at the location of the highest exposed vertical positioning hole. This bending can be seen in Figure 4. Two cracks appeared in the right (sliding) side armor plate lower support bracket as shown in Figures 5 and 6, and this armor panel came out of the upper slide, but remained in place.

The right forward corner of the seat pan was permanently deflected downward 1-1/16 inches and the left corner was permanently deflected downward 13/16 inch. The dummy occupant settled downward in the seat enough (approximately 3/4 inch) to allow approximately 1-1/2 inches of slack in the lap belt. This permanent downward deflection is beneficial as an energy absorption mechanism for vertical impacts. The downward settling of the dummy must be controlled, however, so that slack does not develop in the occupant restraint harness which can add to amplification of occupant accelerations in combined vertical and longitudinal acceleration environments.

The severity of the acceleration experienced by the occupant in this test serves to point up the need for high capacity energy absorption to provide adequate occupant protection under even moderately severe impact conditions.

Data Analysis - Test No. 2 (5G Acceleration)

The 5G acceleration level test was performed after the 15G test in this series. [illegible] very similar

to the input for earlier tests. Occupant pelvic acceleration was less severe in this test than acceleration of the standard UH-1D seat occupant in the earlier test and approximately equivalent to the armored seat occupant accelerations in the earlier tests. The vertical acceleration environment was definitely within tolerable limits.

The seat was damaged in the 15G drop test which preceded this test, as mentioned earlier, but maintained enough load carrying capacity to prevent further deformation in this drop.

DISCUSSION OF TEST RESULTS

The armored crew seat tested in these two drop tests is similar to the seat tested on 11 January 1966 (second test series). The seat pan was changed to provide increased energy absorption.

Analysis of the test results indicates that the protection offered by this seat at low acceleration levels is adequate. At the higher acceleration level, however, this seat did not protect the occupant as well as the seat tested on 11 January 1966 (second test series). The protection offered by the revised seat was however comparable to that offered by the standard UH-1D crew seat.

Test Condition	Accelerometer Location	First Test Series (May 1965)		Second Test Series (January 11, 1966)		Third Test Series (January 27, 1966)	
		Mean "G"	Peak "G"	Mean "G"	Peak "G"	Mean "G"	Peak "G"
5G Acceleration Drop Height 1 Ft. Vertical Velocity 8 Ft/Sec.	Drop Cage	5	11	4	15	5	10
	Standard UH-1D Seat (Left)	6	11				
	Standard UH-1D Seat (Right)	5	12				
	Standard Seat Dummy Pelvic	8	14				
	Standard Seat Dummy Head	7	11				
	Armored Seat (Left)	7	15	5	18	4	11
	Armored Seat (Right)	5	11	5	14	4	11
	Armored Seat Dummy Pelvic	10	21	6	11	6	10
	Armored Seat Dummy Head	11	28	6	10	6	10
10G Acceleration Drop Height 4 Ft. Vertical Velocity 16 Ft/Sec.	Drop Cage	10	18	11	17		
	Standard UH-1D Seat (Left)	11	23				
	Standard UH-1D Seat (Right)	10	24				
	Standard Seat Dummy Pelvic	15	27				
	Standard Seat Dummy Head	12	23				
	Armored Seat (Left)	11	24	10	26		
	Armored Seat (Right)	10	18	8	23		
	Armored Seat Dummy Pelvic	13	27	15	28		
	Armored Seat Dummy Head	13	38	16	29		
15G Acceleration Drop Height 9 Ft. Vertical Velocity 24 Ft/Sec.	Drop Cage	15	22	15	27	14	27
	Standard UH-1D Seat (Left)	14	30				
	Standard UH-1D Seat (Right)	14	32				
	Standard Seat Dummy Pelvic	22	51				
	Standard Seat Dummy Head	18	30				
	Armored Seat (Left)	14	35	13	35	14	36
	Armored Seat (Right)	12	25	16	31	14	30
	Armored Seat Dummy Pelvic	15	50	23	43	31	49
	Armored Seat Dummy Head	15	30	30	50	30	47

TABLE I. SUMMARY OF ACCELEROMETER DATA

NOT REPRODUCIBLE

Figure 1. Left Side View of Armored Seat and Occupant, Pre-Test.

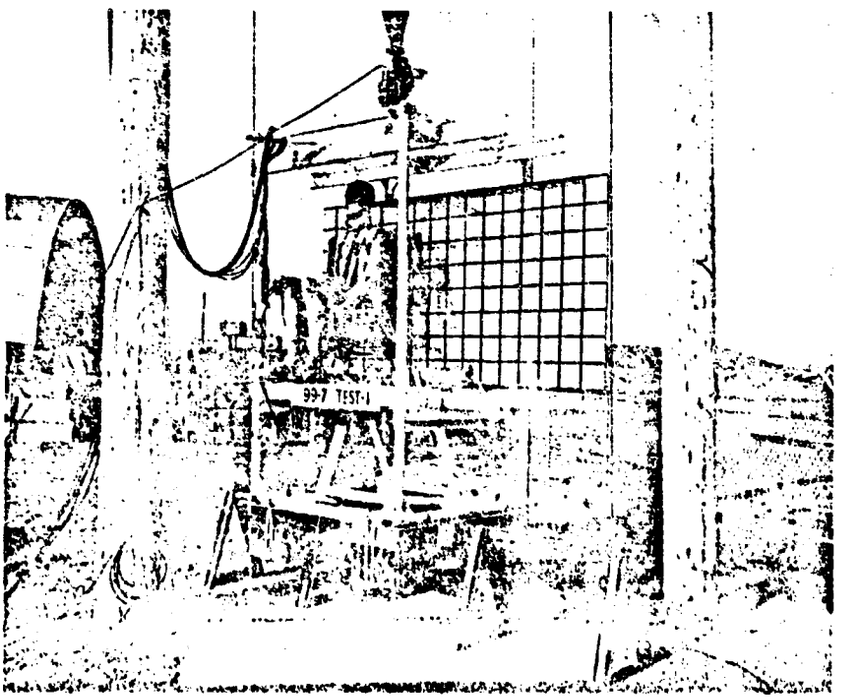

Figure 2. Overhead Left Front View of Armored Seat and Occupant, Pre-Test.

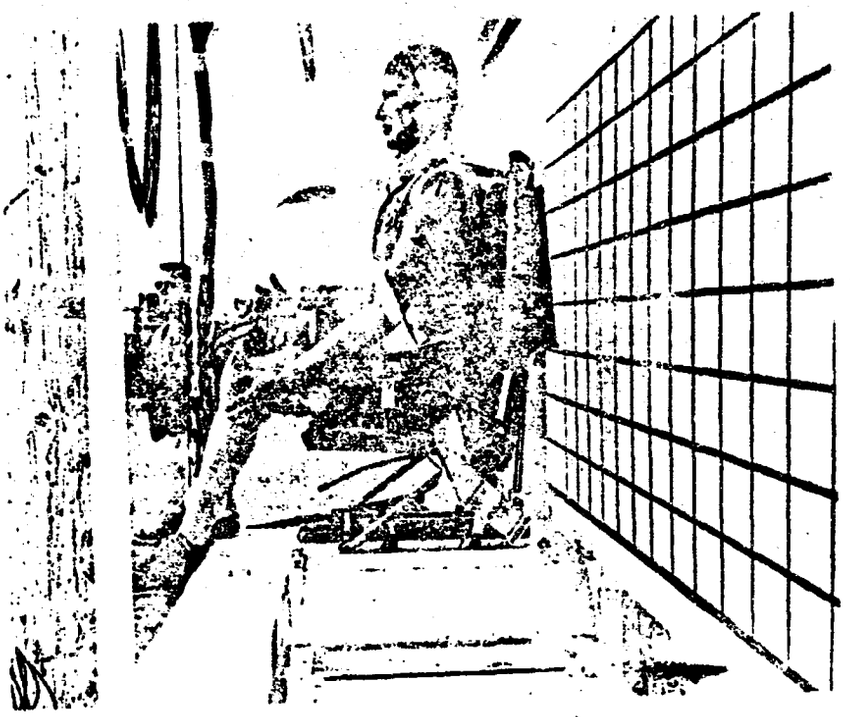

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Figure 3. Left Side View of Armored Seat and Occupant After Test 1.

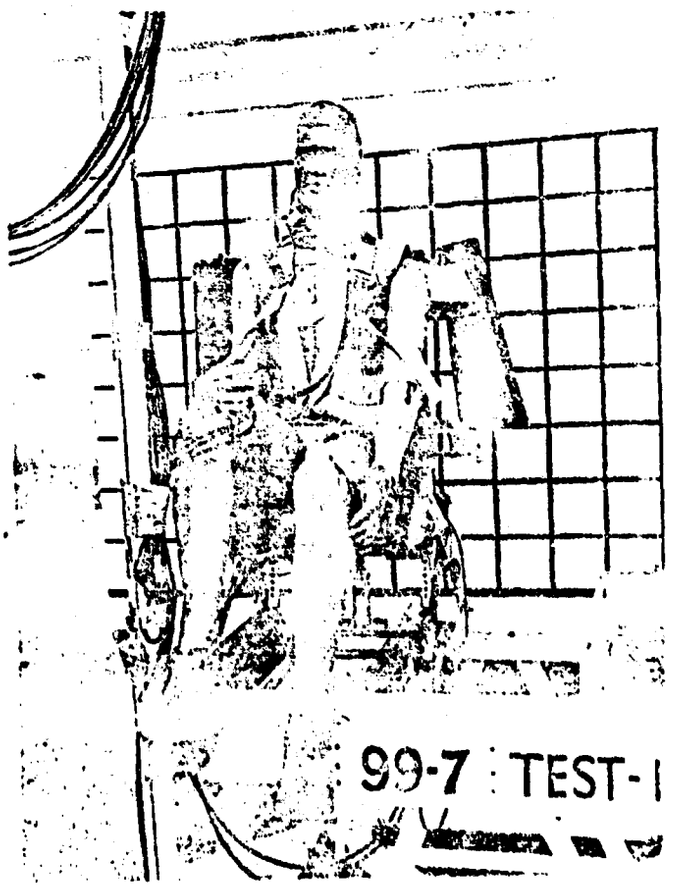

Figure 4. Front View of Armored Seat and Occupant After Test 1. (Bent right aft vertical support tube shown just below seat pan between legs of dummy.)

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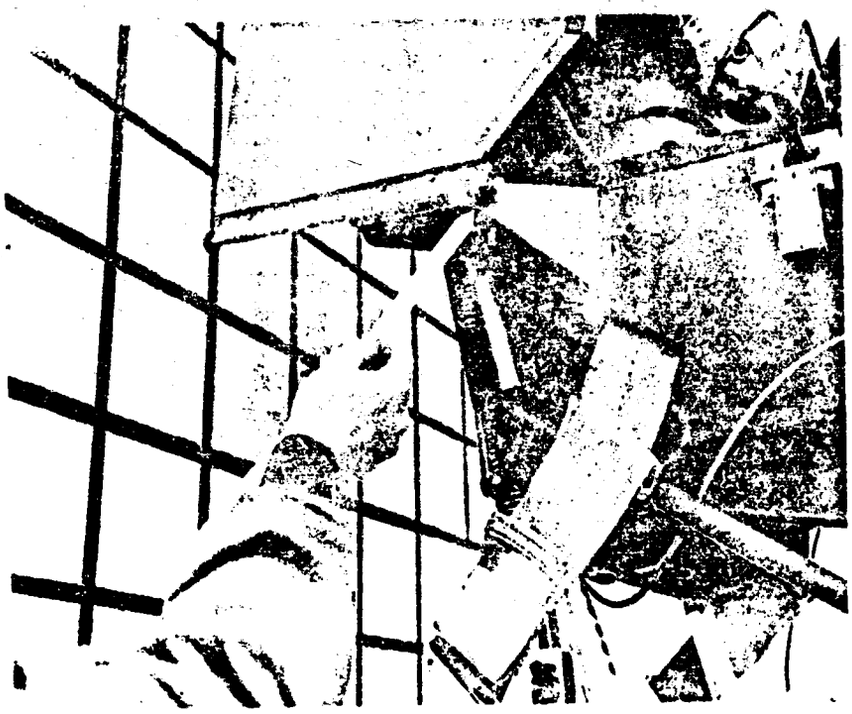


Figure 5. Cracked Sliding Armor Lower Support Bracket, Following Test 1. (Notice black lap belt.)

Figure 6. Second Crack in Sliding Armor Lower Support [illegible], Following Test 1.

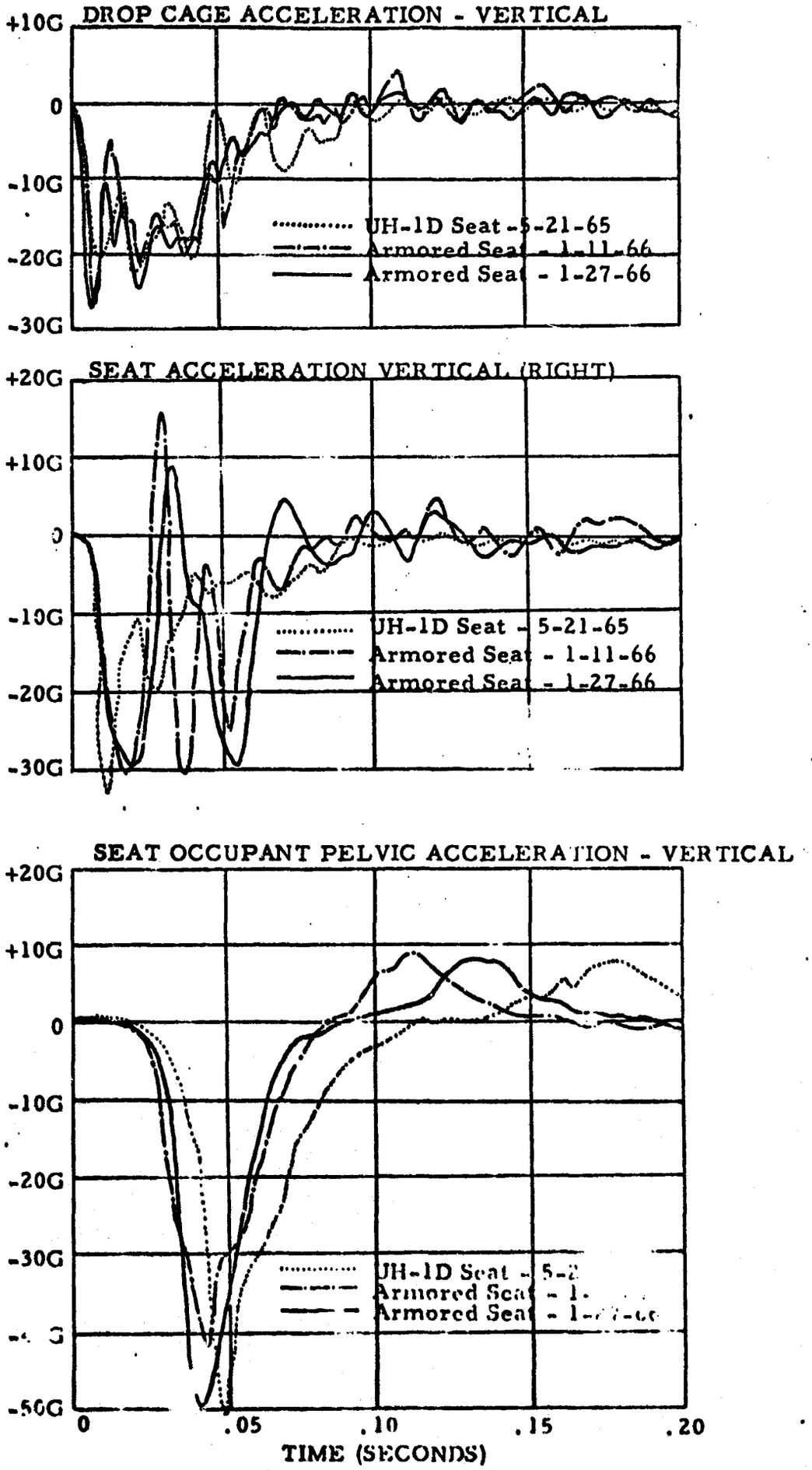


Figure 7. UH-1B/D Armored Seat Test No. 1 With Results of May 1965 and January 11, 1966 Tests Superimposed.

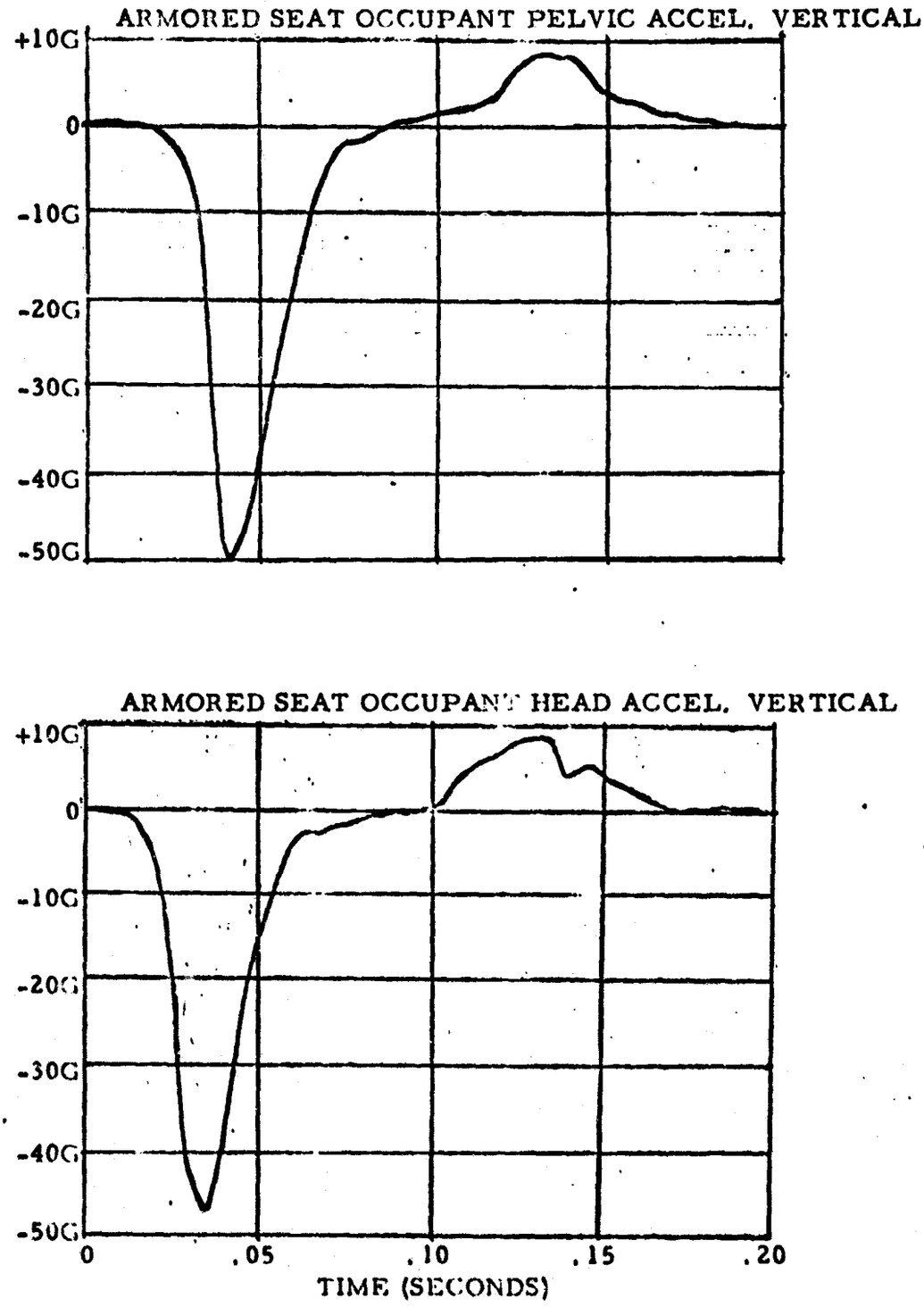


Figure 9. UH-1B/D ARMORED SEAT TEST NO. 1 THIRD TEST SERIES.

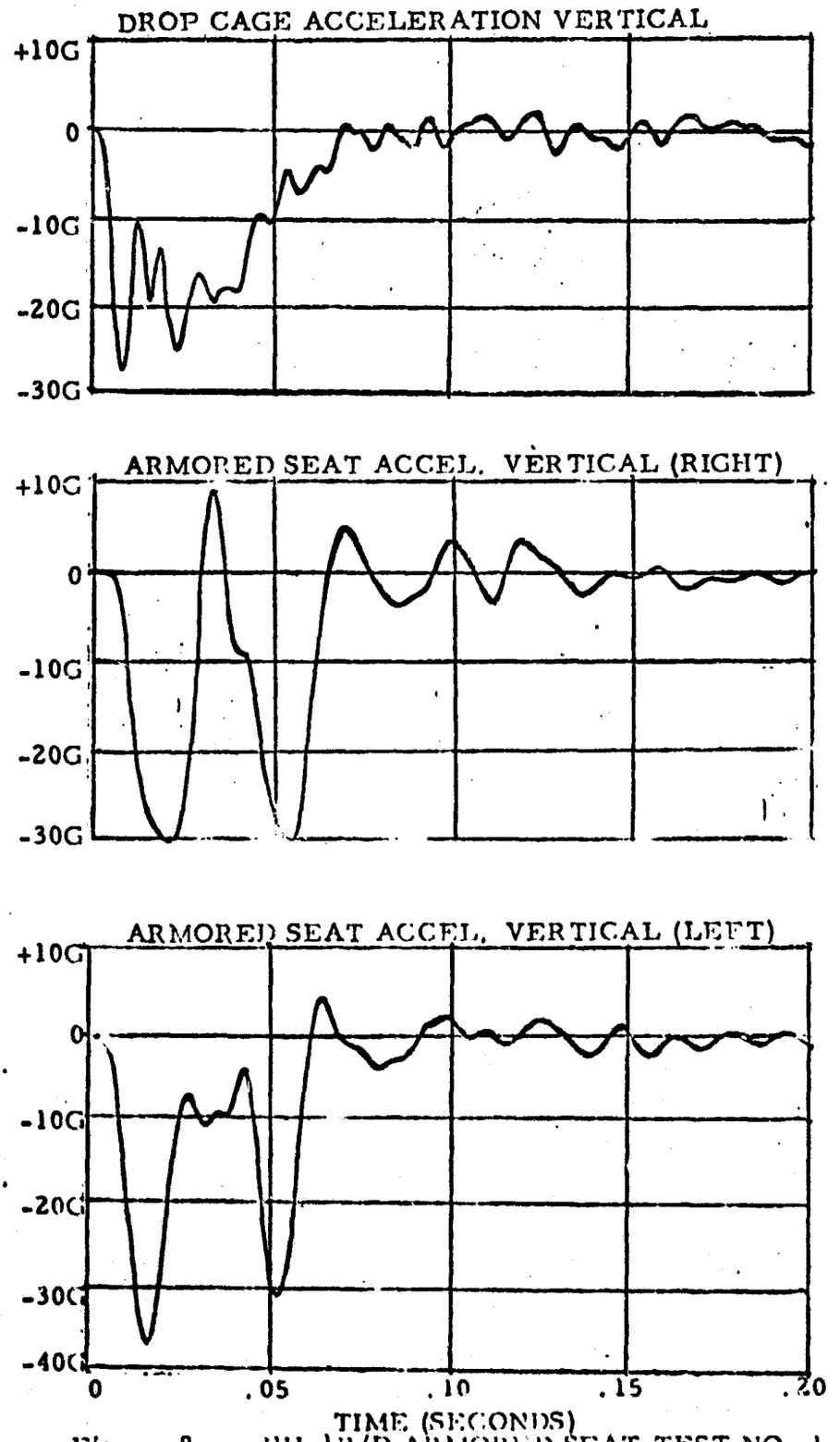


Figure 8. UH-1B/D ARMORED SEAT TEST NO. 1 THIRD TEST SERIES.

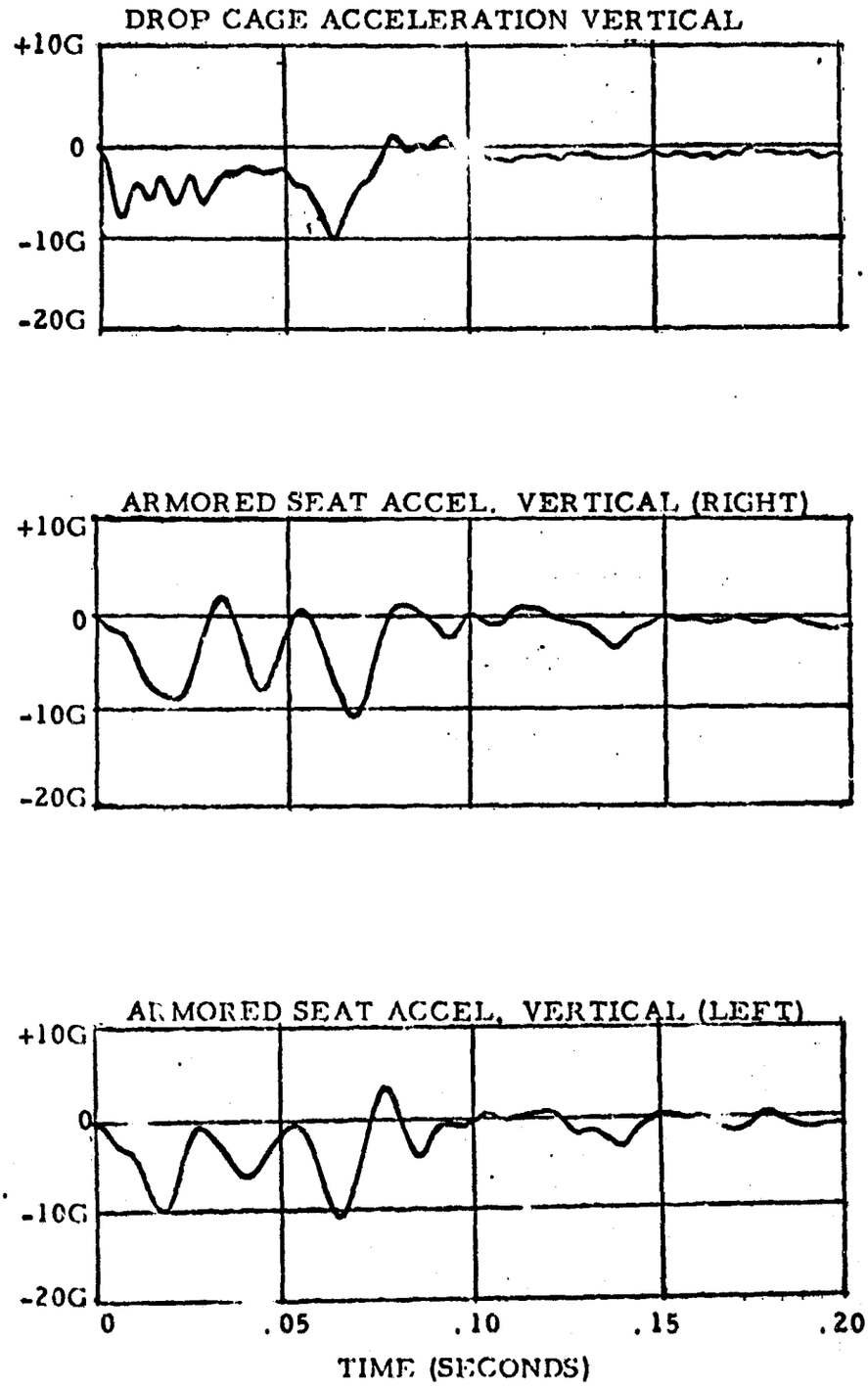


Figure 10. UH-1B/D ARMORED SEAT TEST NO. 2 THIRD TEST SERIES.

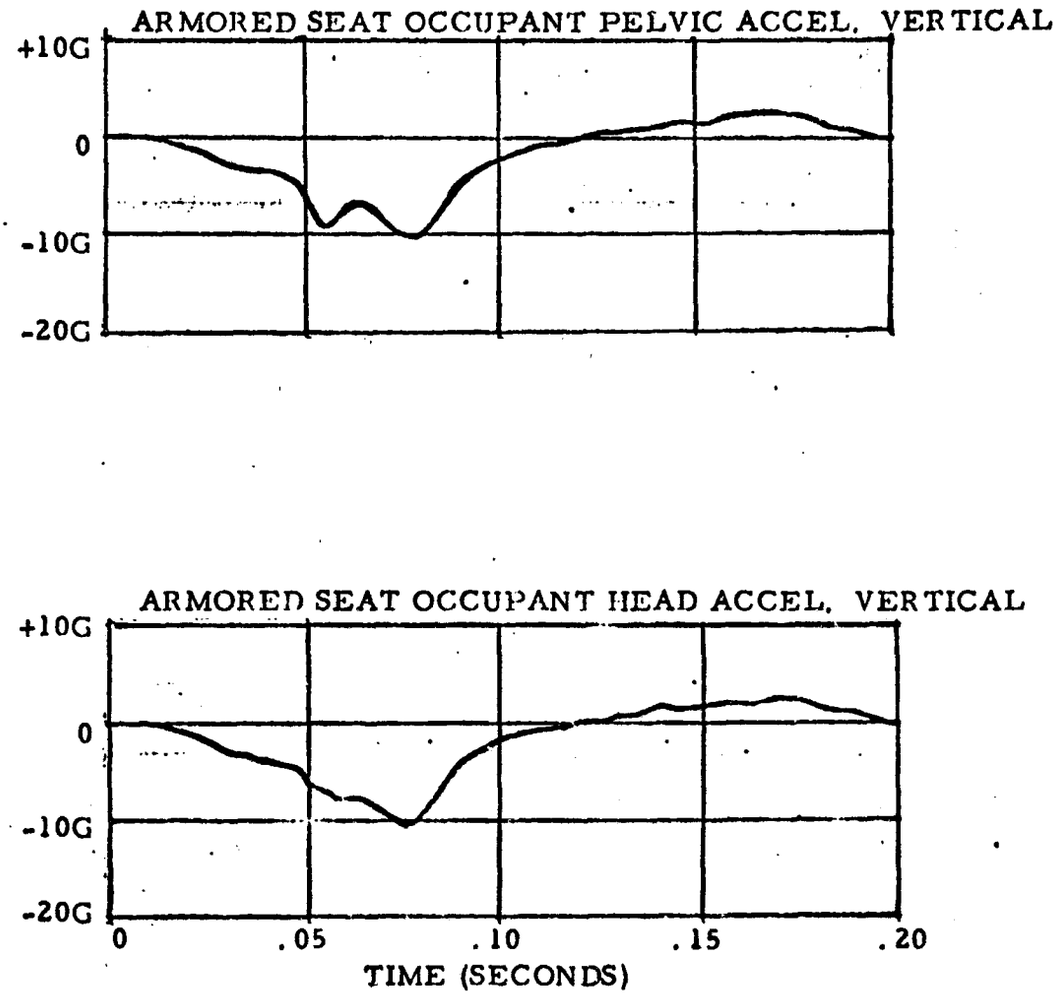


Figure 11. UH-1B/D ARMORED SEAT TEST NO. 2 THIRD TEST SERIES.

APPENDIX A

OSCILLOGRAPH DATA RECORDED DURING

SECOND TEST SERIES - JANUARY 1966

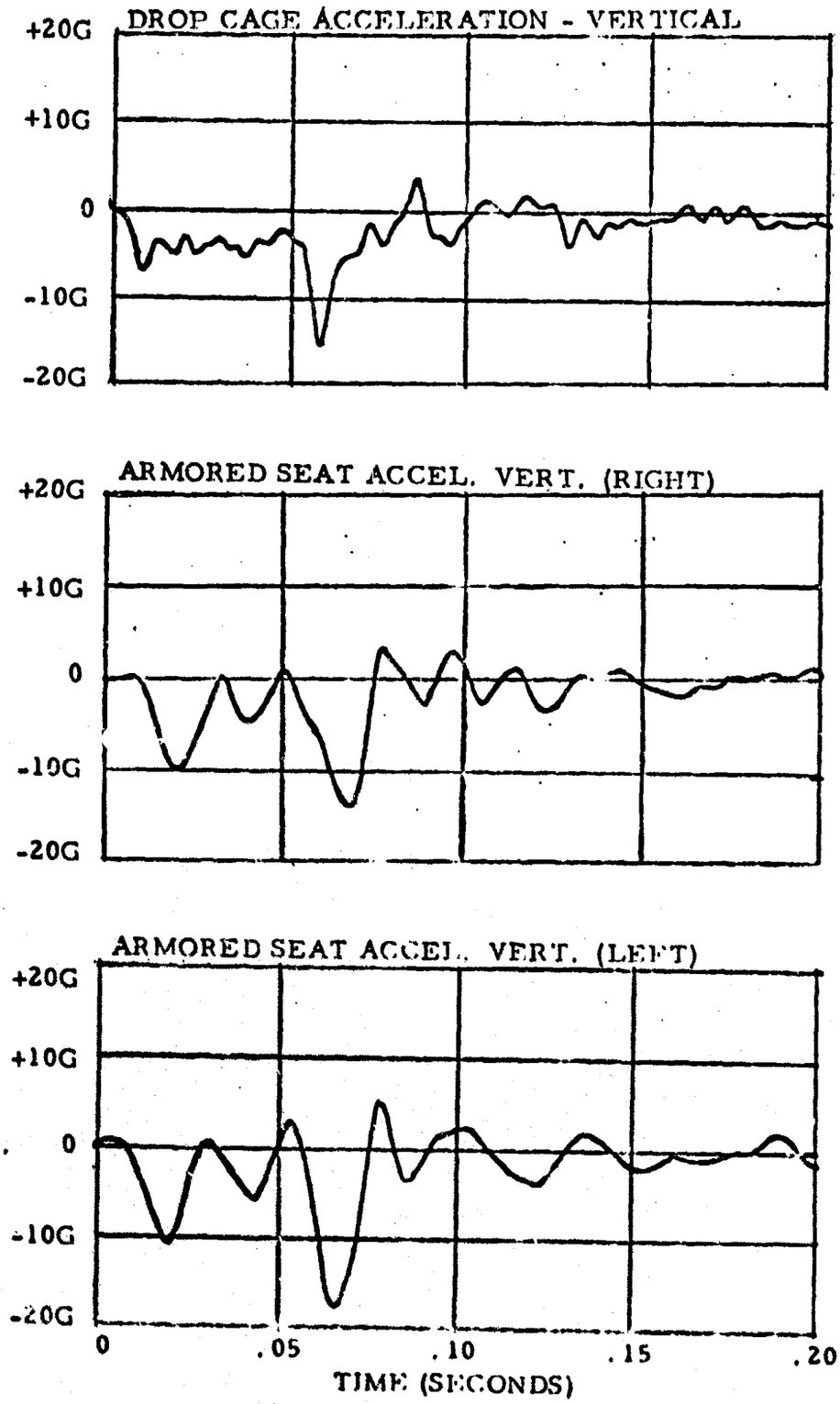


Figure A1. UH-1B/D ARMORED SEAT TEST NO. 1

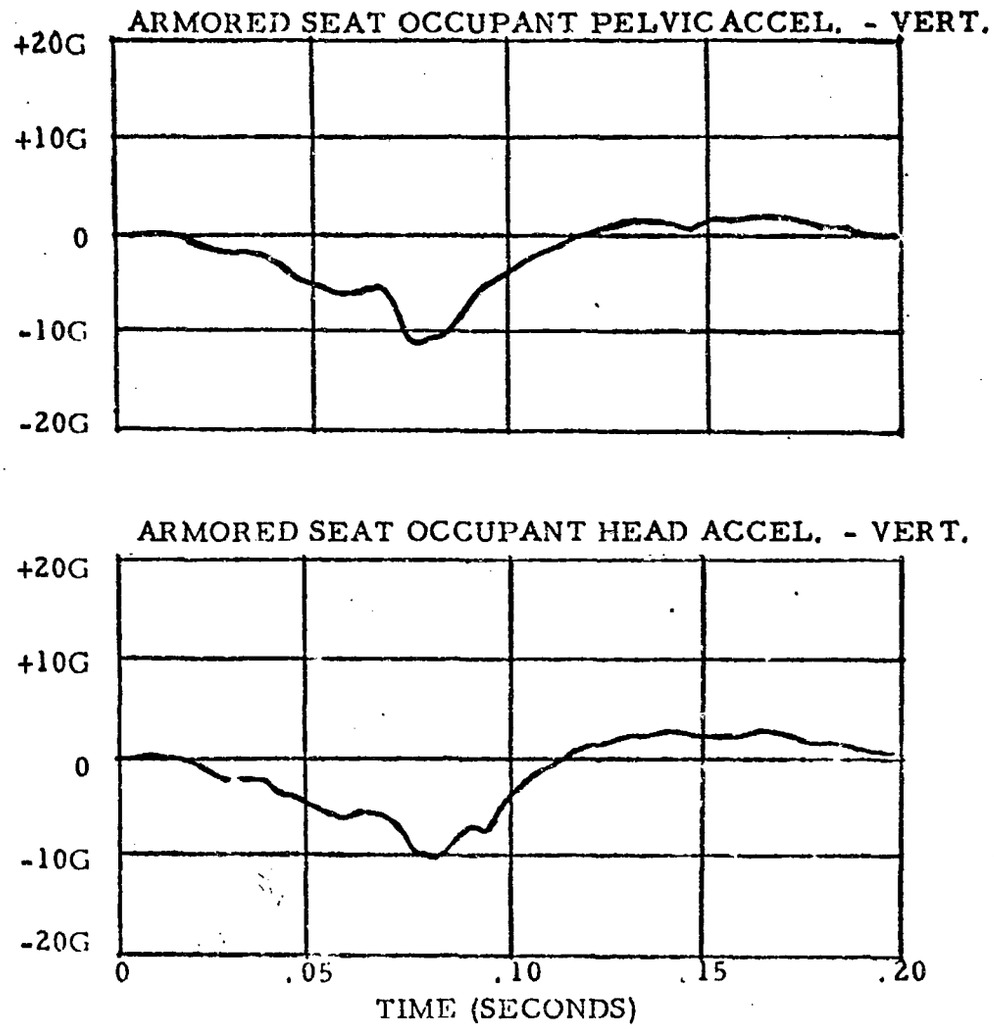


Figure A2. UH-1B/D ARMORED SEAT TEST NO. 1

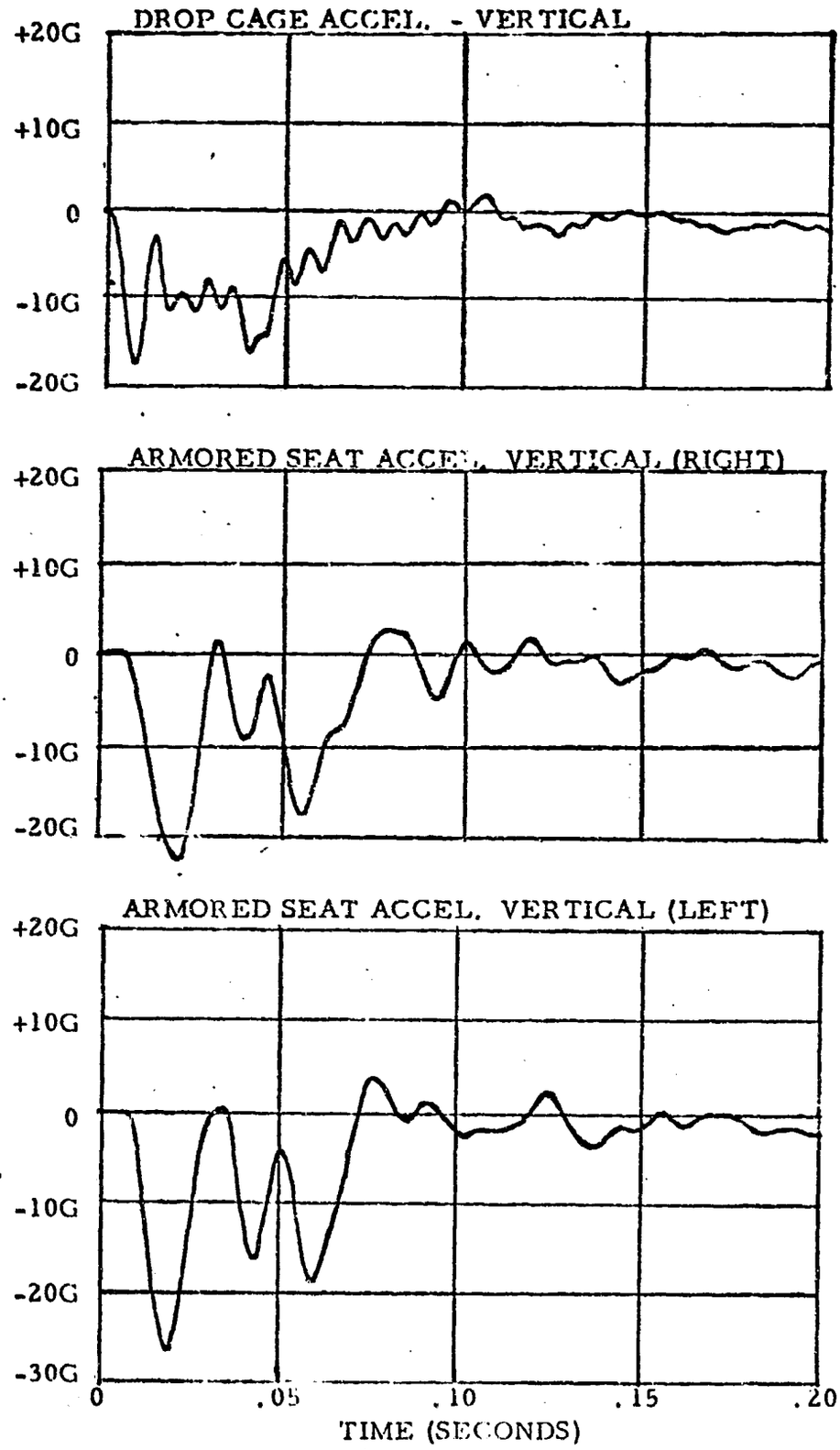


Figure A3. UH-1B/D ARMORED SEAT TEST NO. 2.

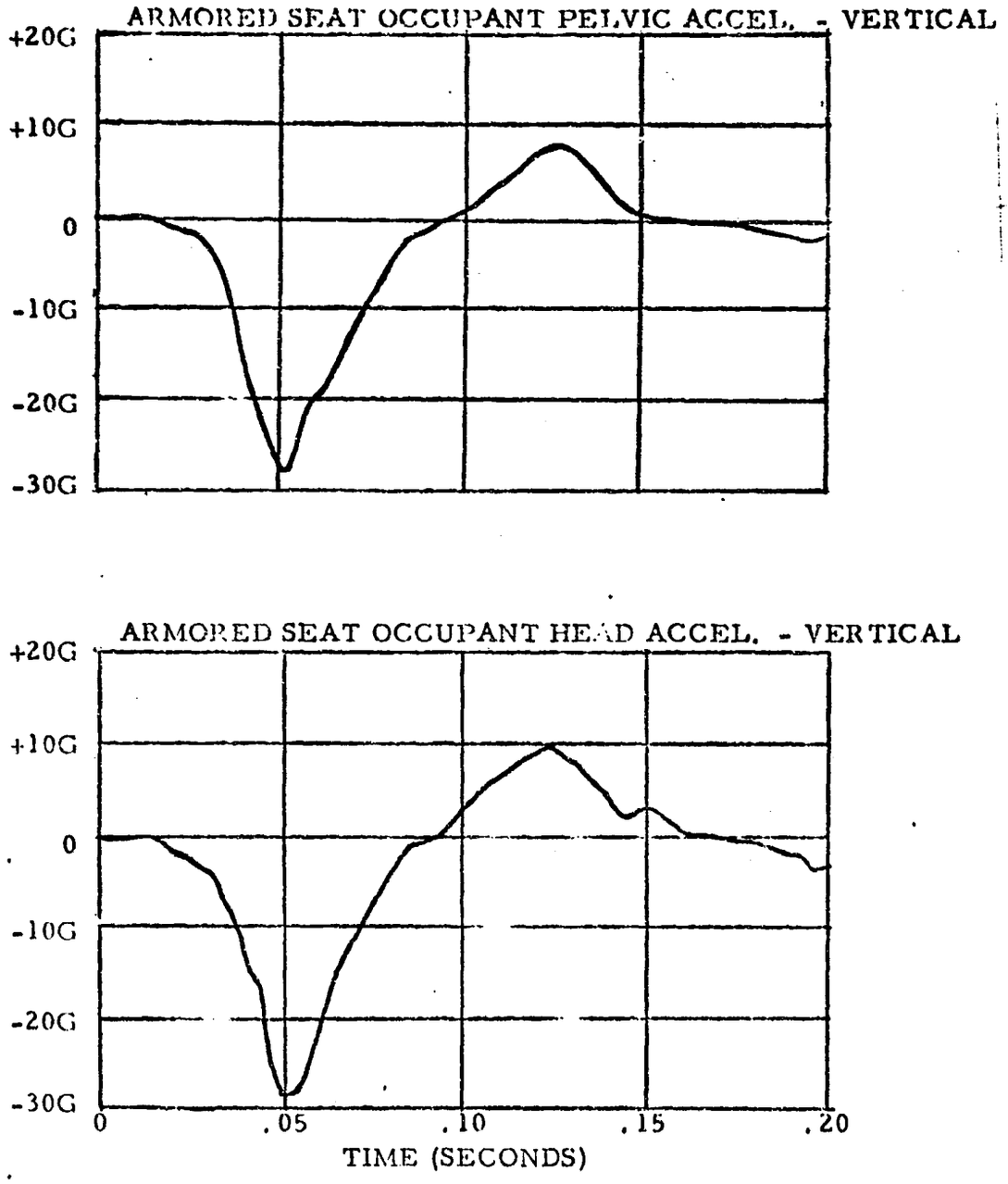


Figure A4. UH-1B/D ARMORED SEAT TEST NO. 2.

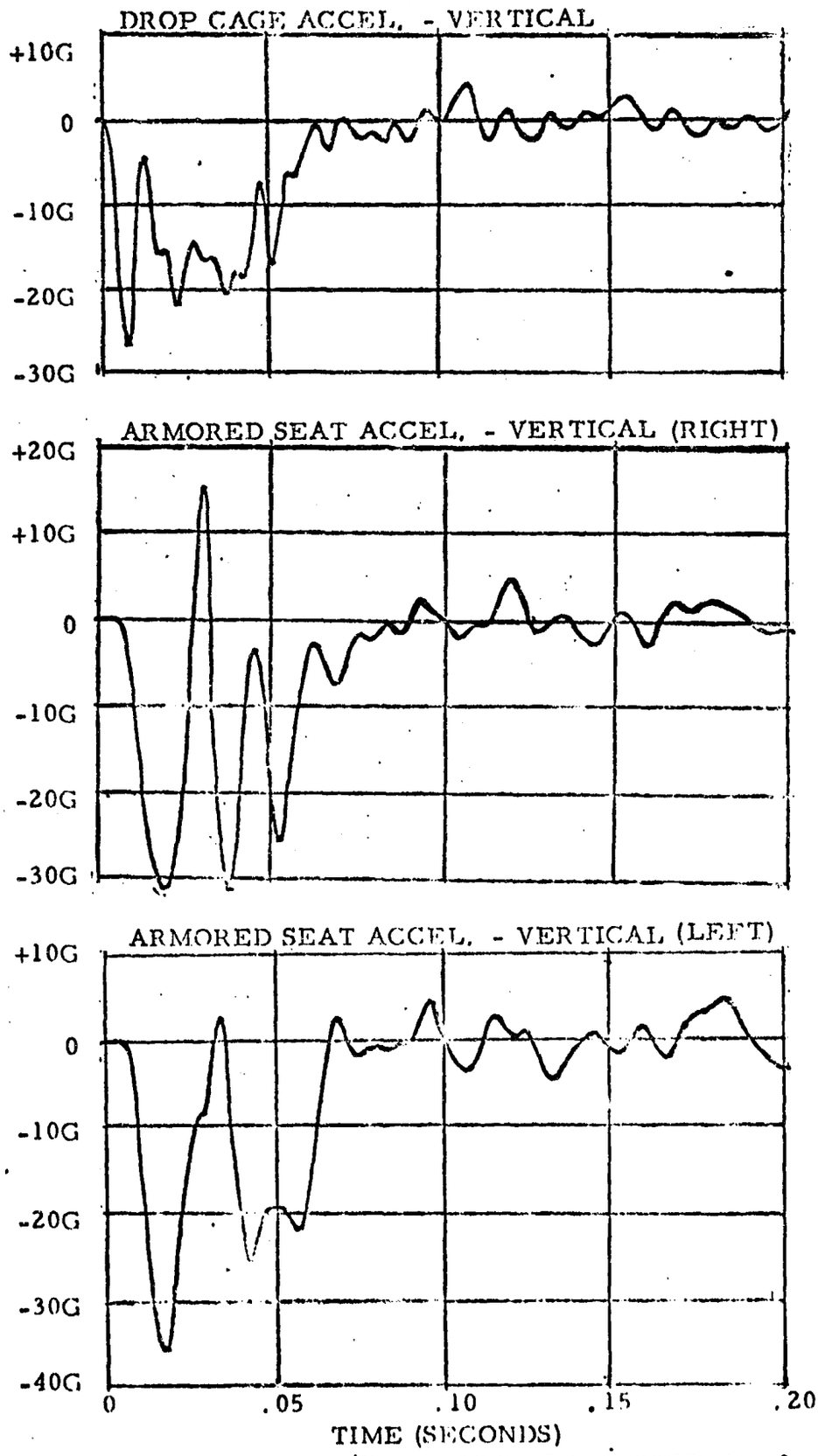


Figure A5. UH-1B/D ARMORED SEAT TEST NO. 3.

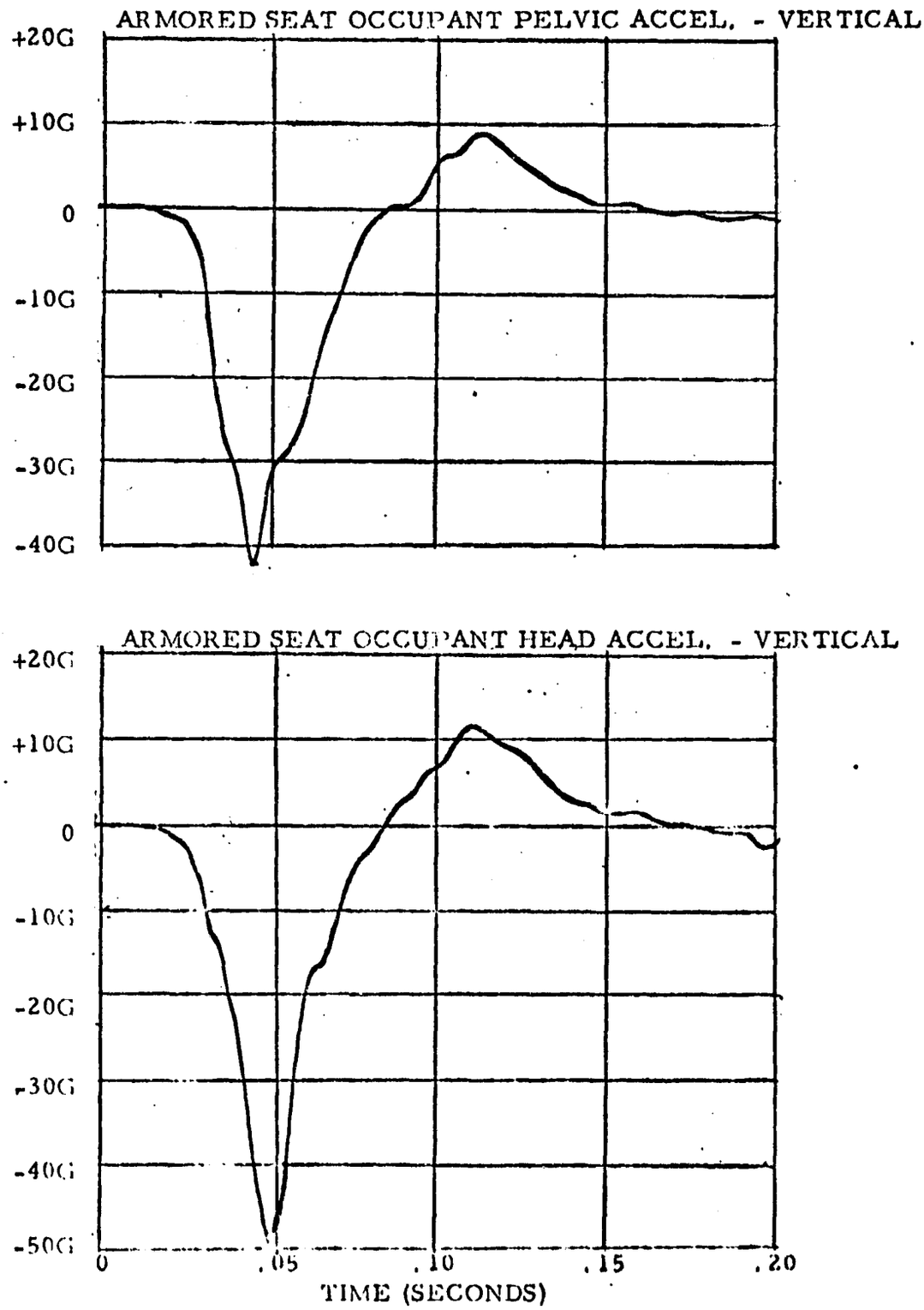


Figure A6. UH-1B/D ARMORED SEAT TEST NO. 3.

APPENDIX B

OSCILLOGRAPH DATA RECORDED DURING

FIRST TEST SERIES - MAY 1965

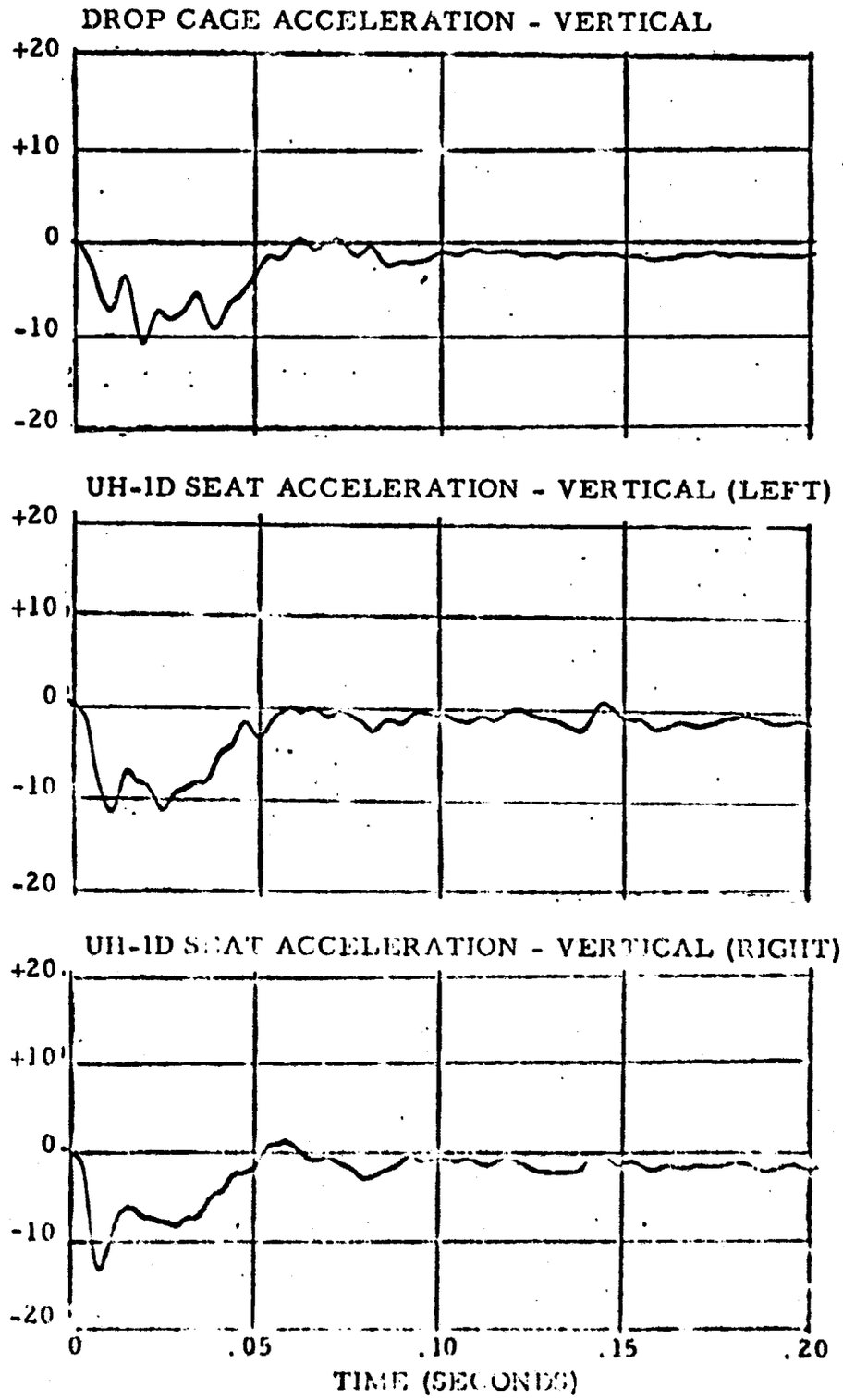


Figure B1. UH-1B/D SEAT TEST NO. 1.

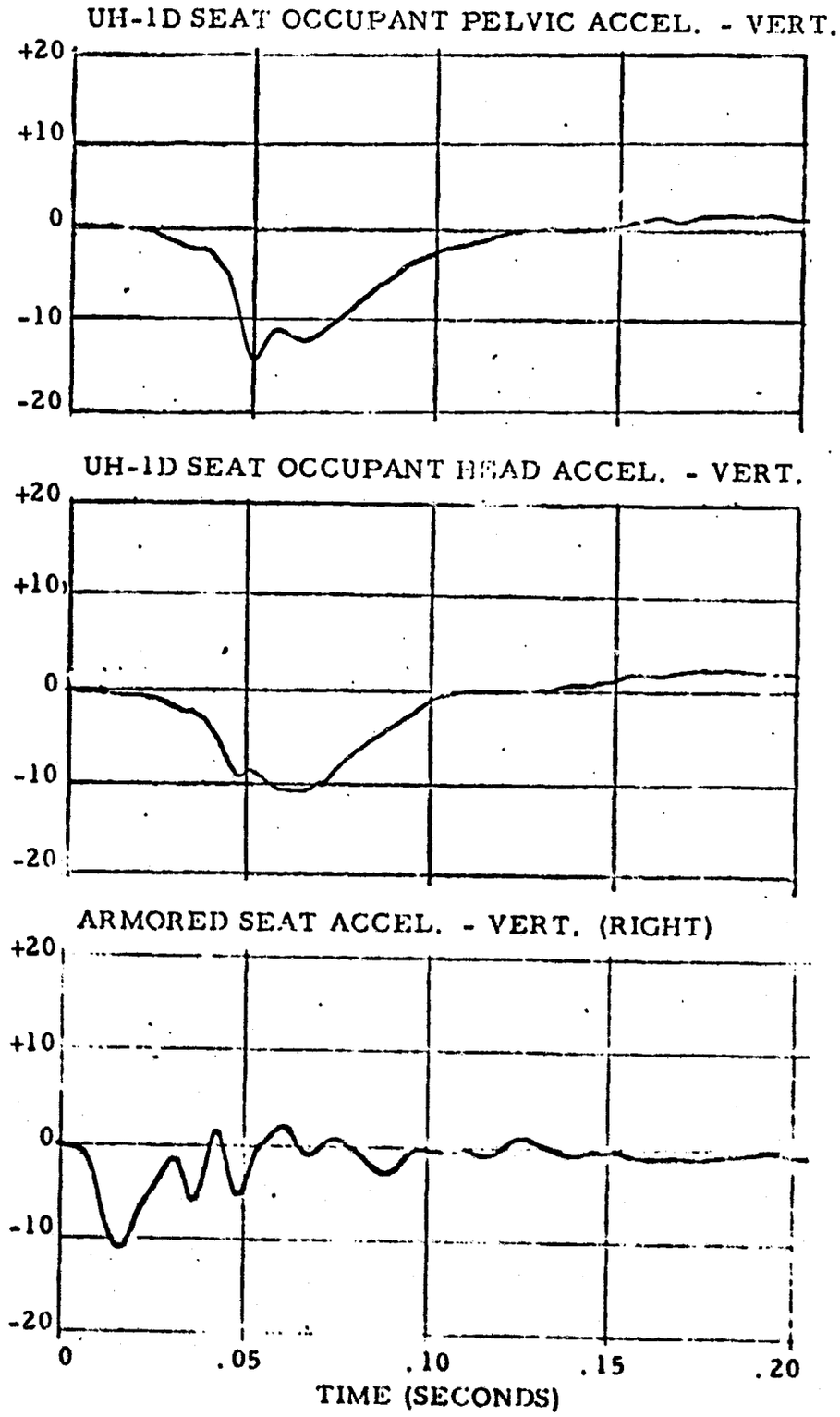


Figure B2. UH-1B/D SEAT TEST NO. 1.

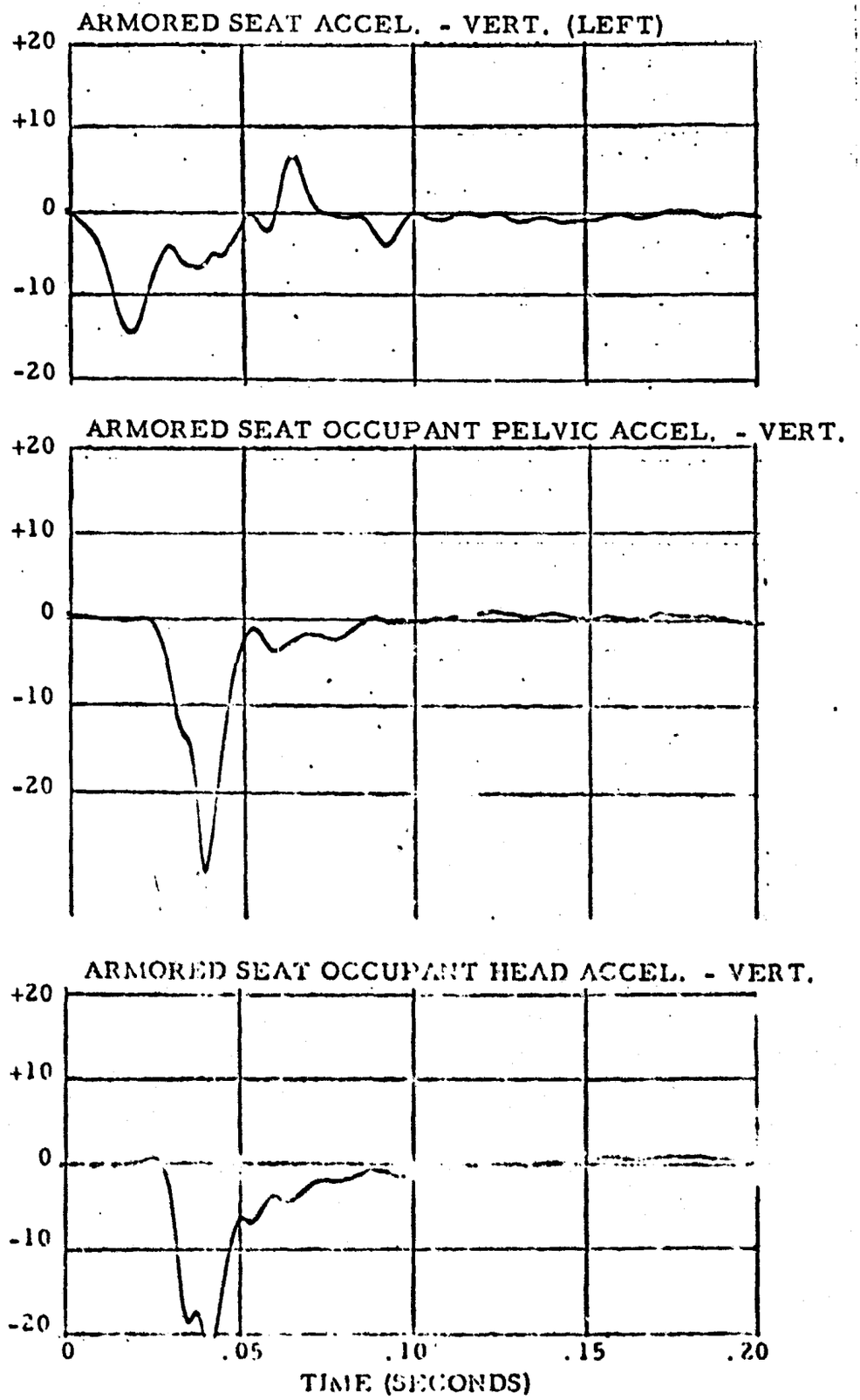


Figure B3. UH-1B/D SEAT TEST NO. 1.

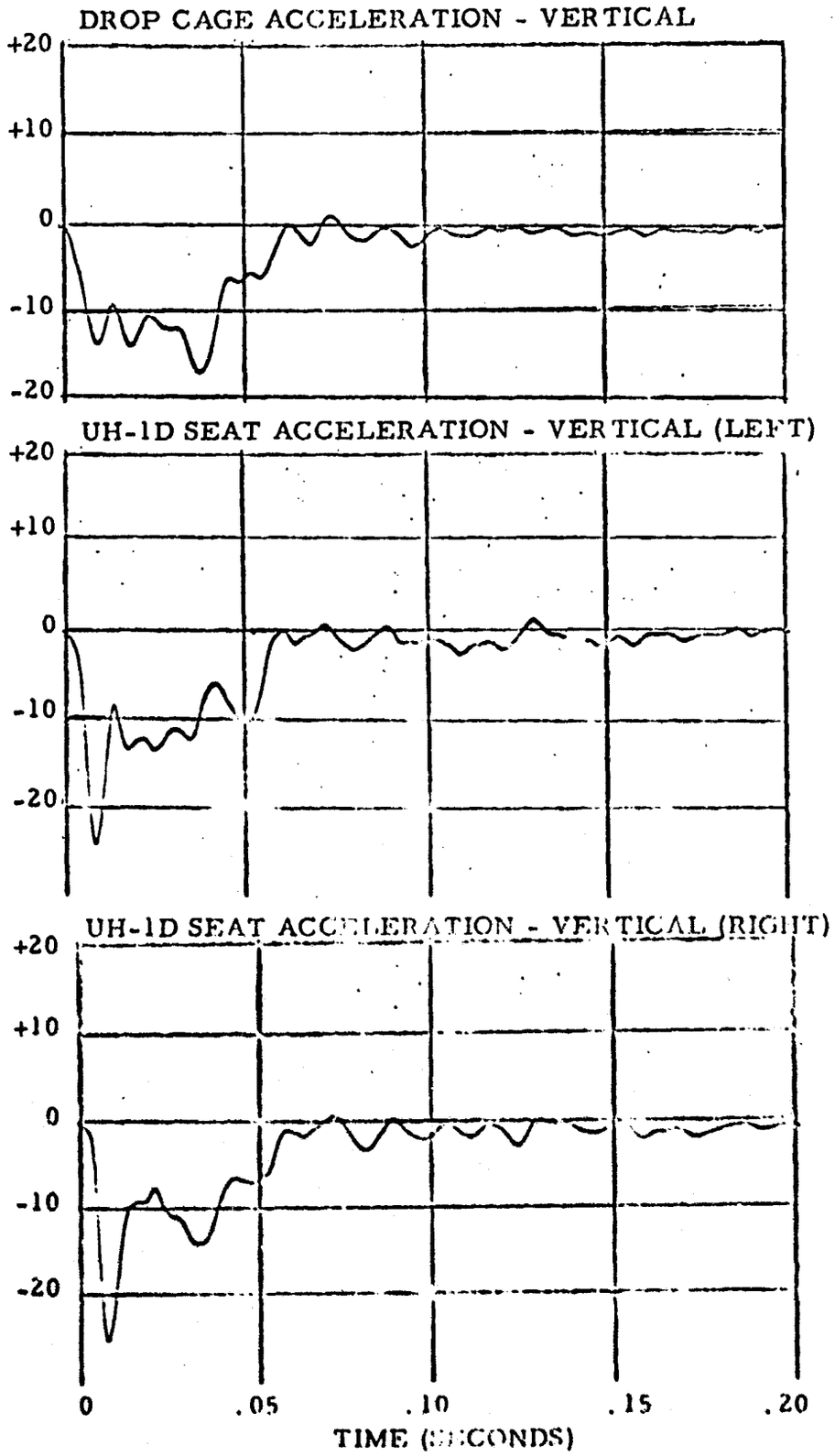


Figure B'. UH-1B/D SEAT TEST NO. 2.

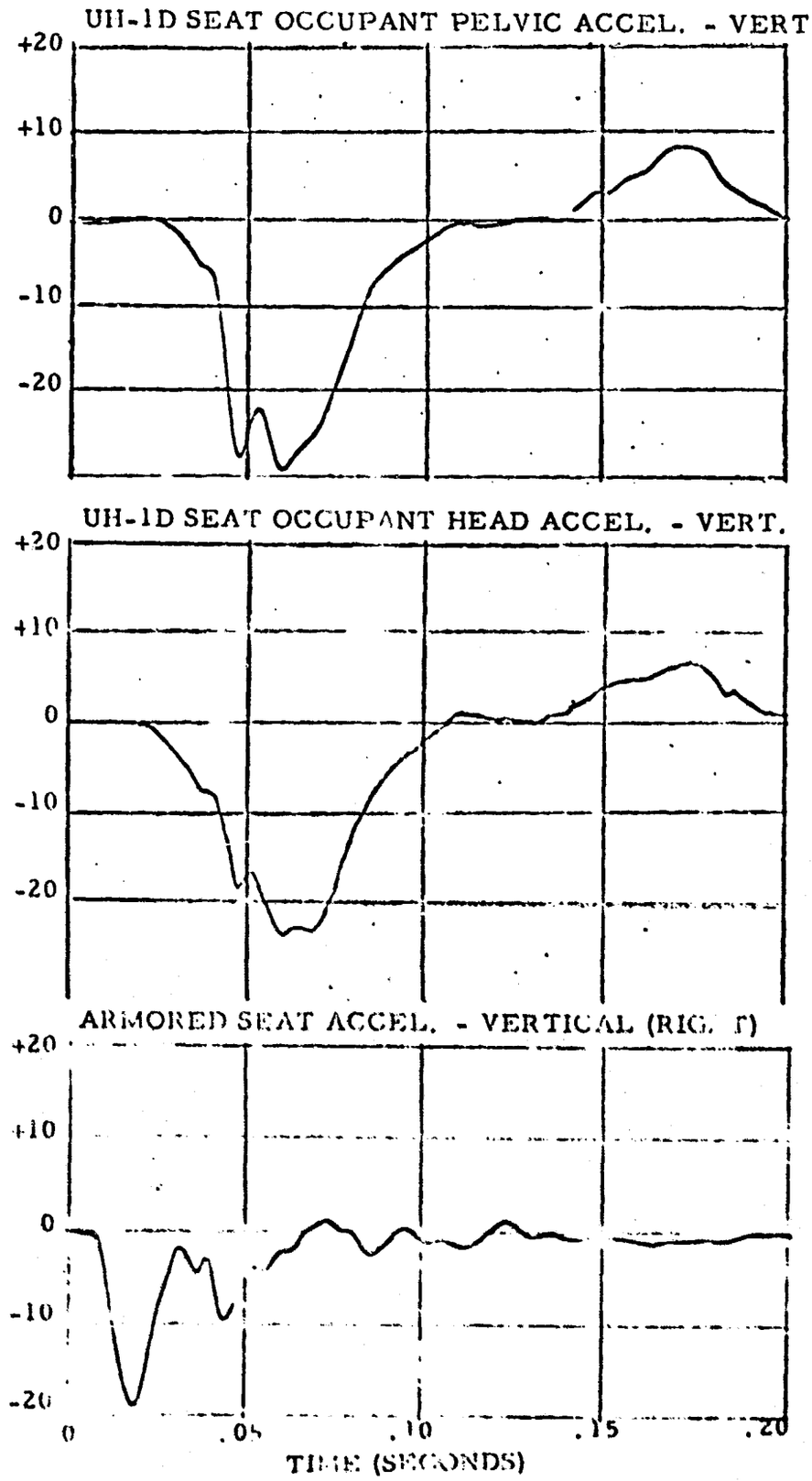


Figure B5. UH-1B/D SEAT TEST NO. 2.

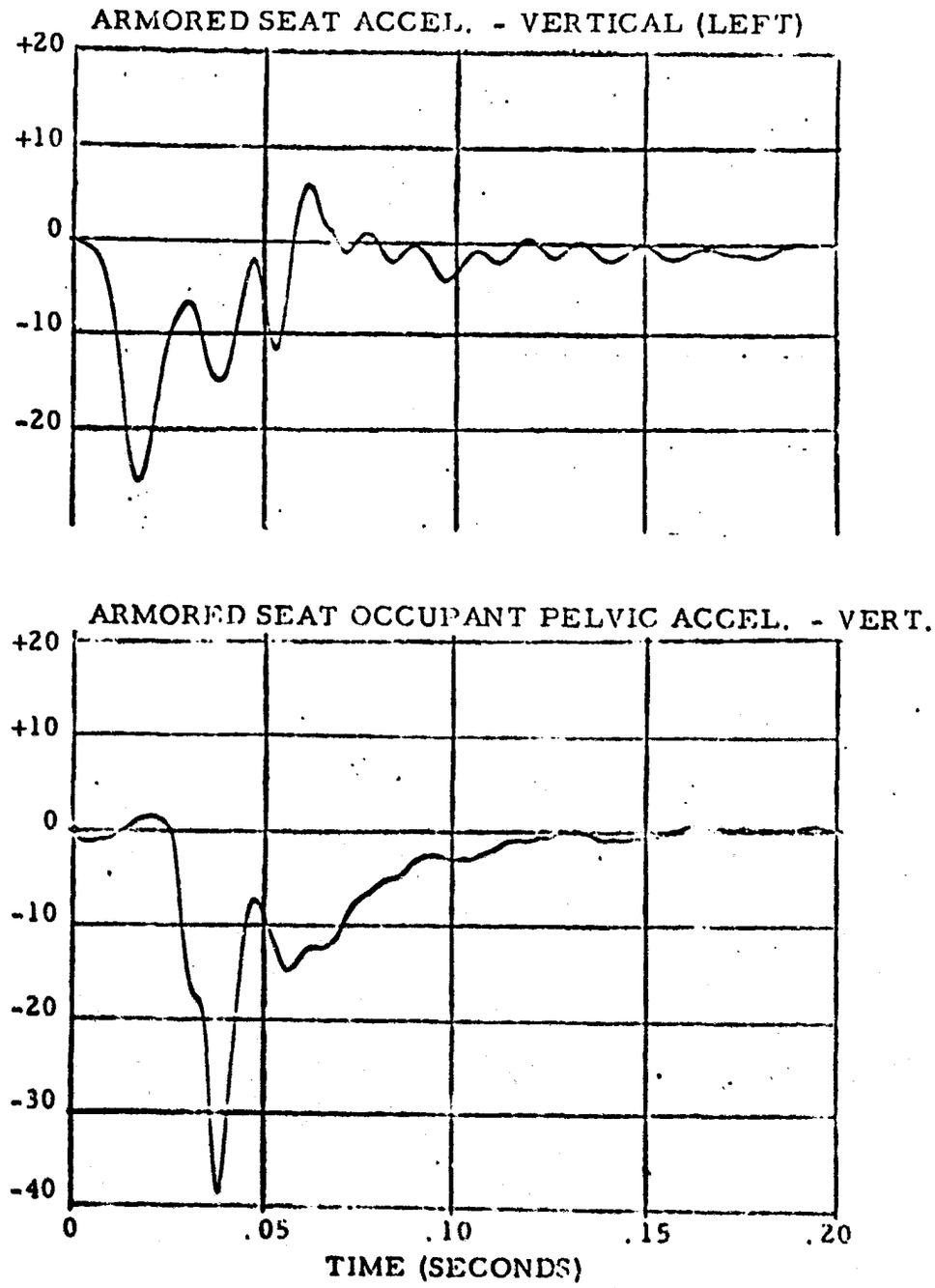


Figure B6. UH-1B/D SEAT TEST NO. 2.

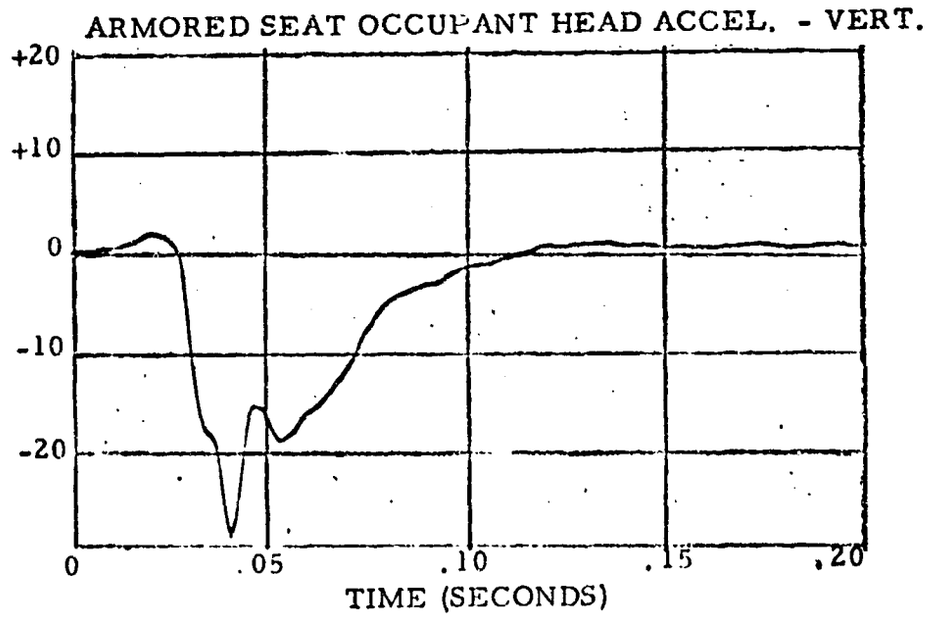


Figure B7. UH-1B/D SEAT TEST NO. 2.

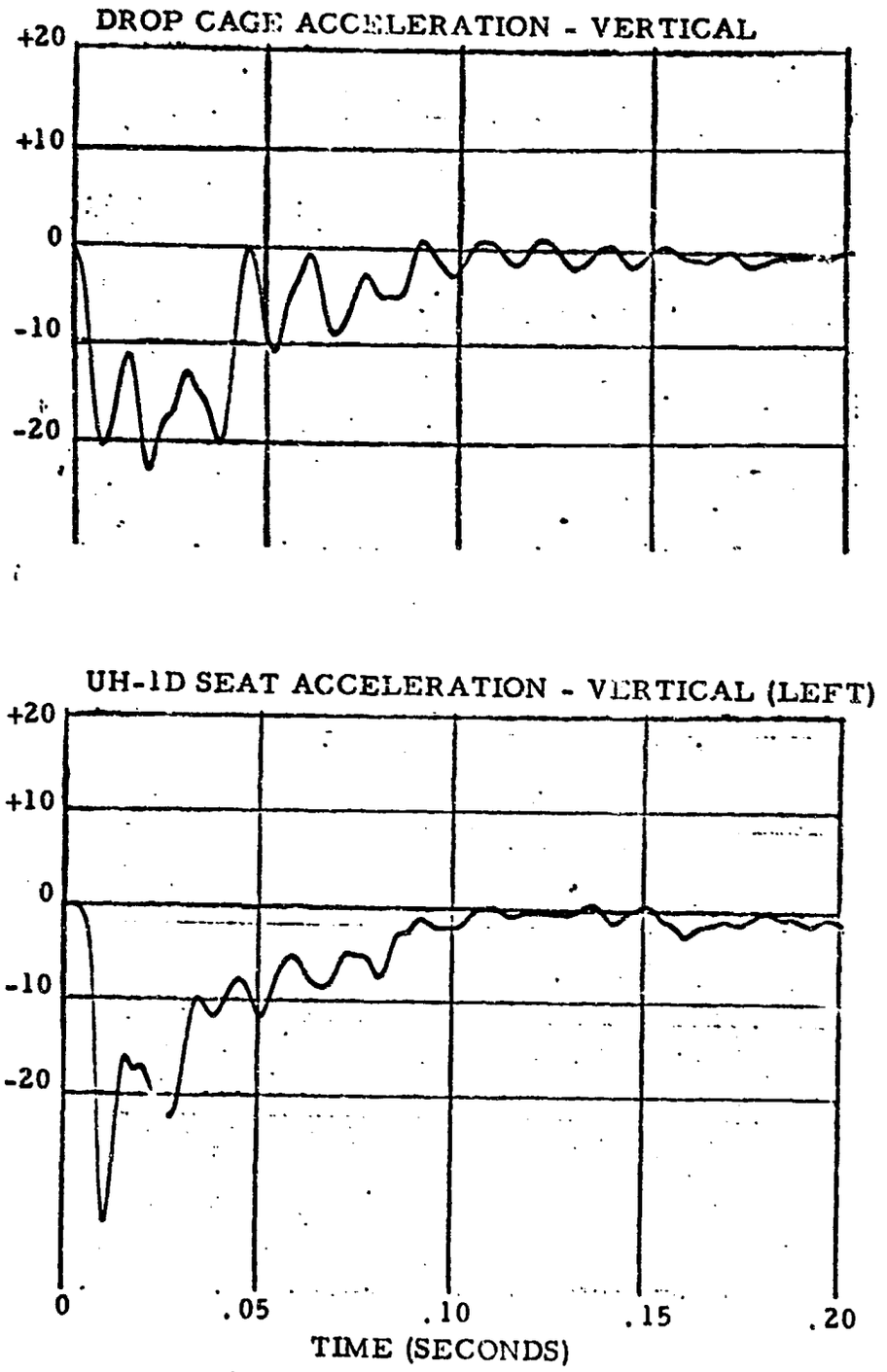


Figure B8. UH-1B/D SEAT TEST NO. 3.

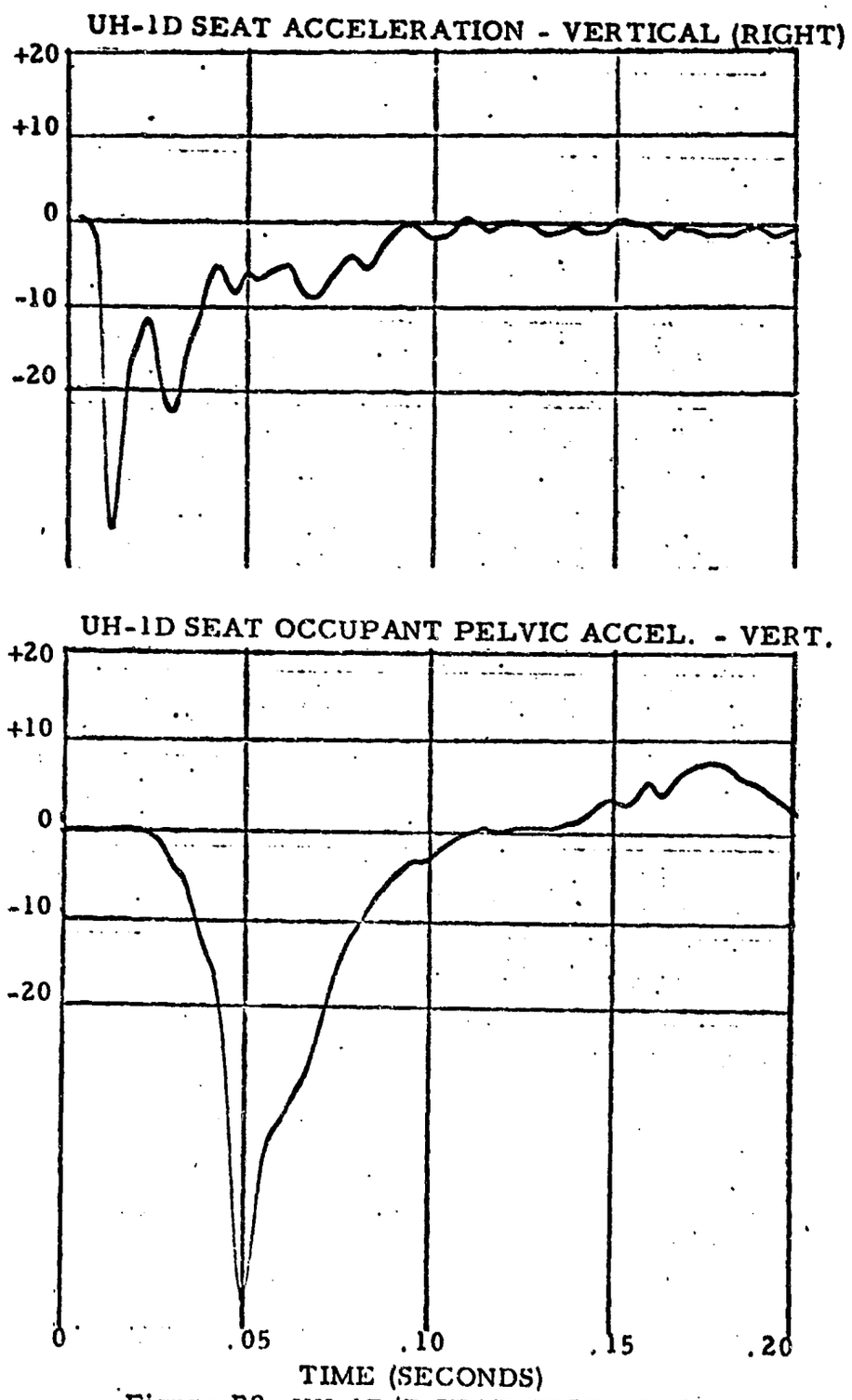


Figure B9. UH-1B/D SEAT TEST NO. 3.

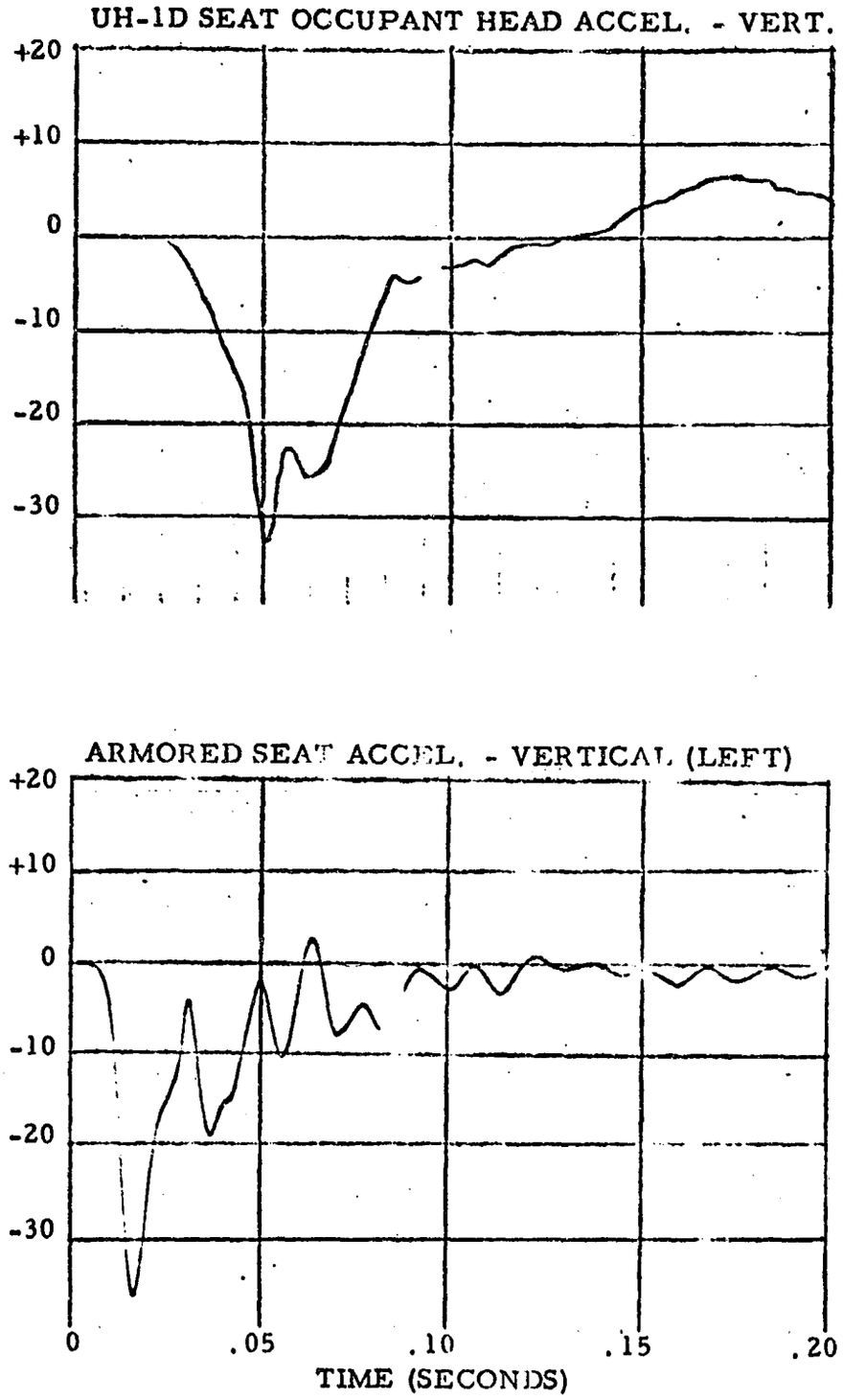
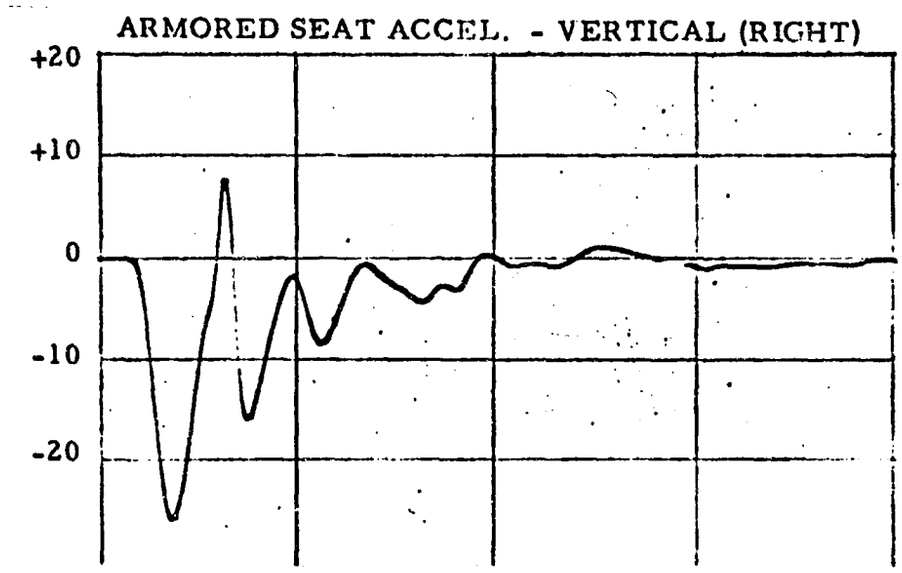


Figure B10. UH-1B/D SEAT TEST NO. 3.



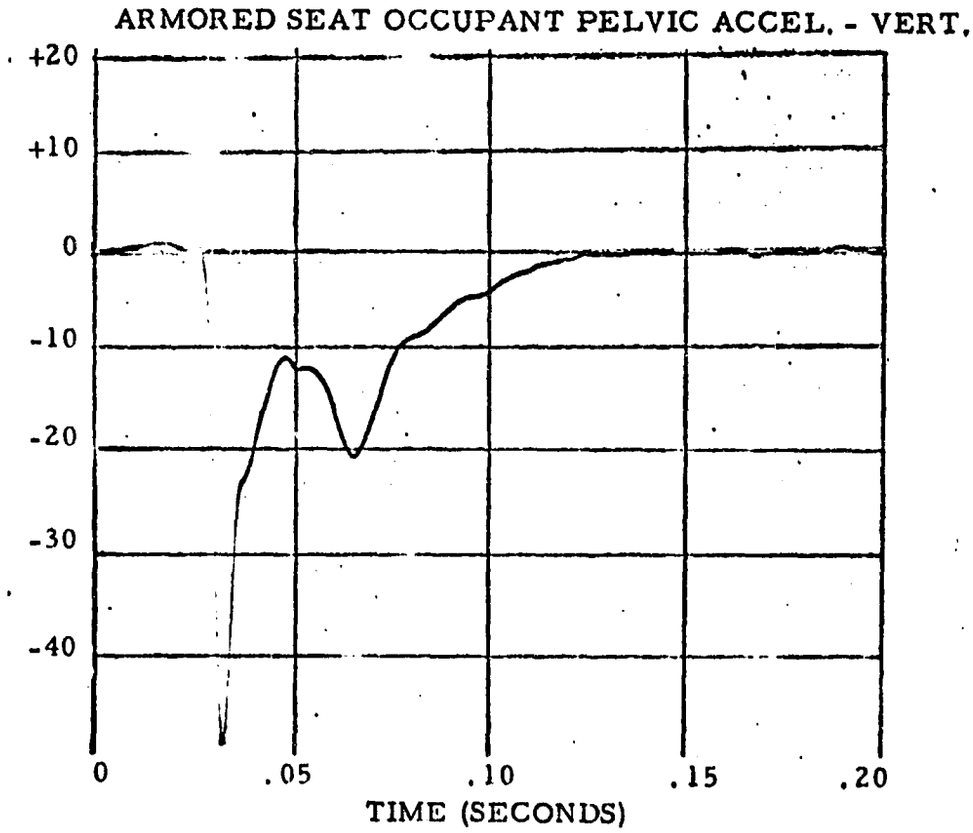


Figure B11. UH-1B/D SEAT TEST NO. 3.

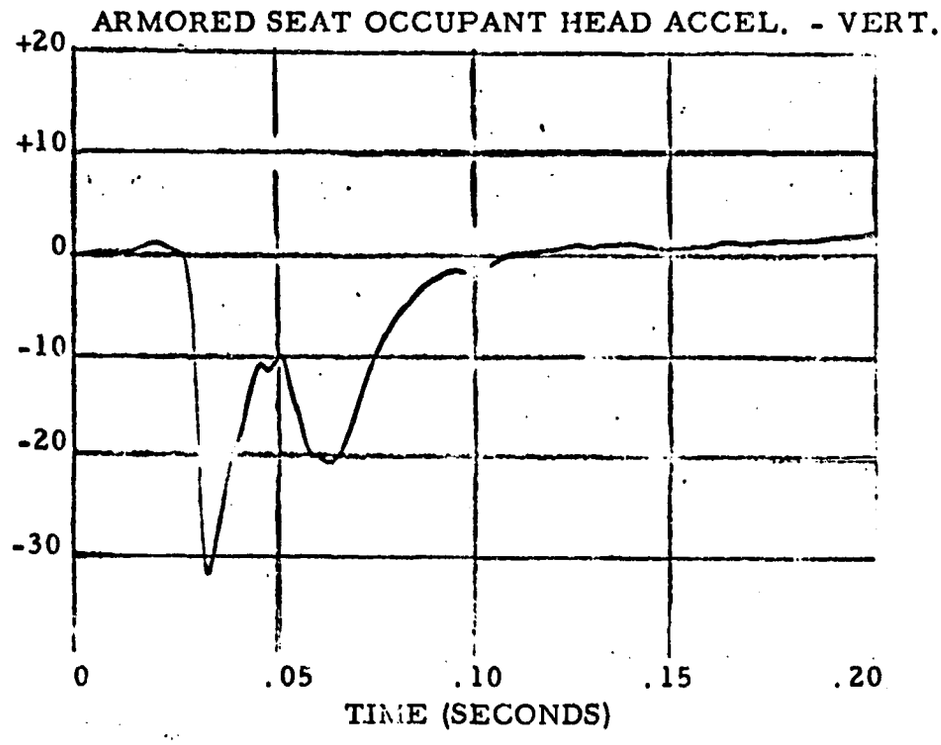


Figure B12. UH-1B/D SEAT TEST NO. 3.

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13. ABSTRACT

The dynamic response of the redesigned armored seat is compared to the dynamic response of the unarmored seat tested under the same conditions.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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