Final Report

DYNAMIC PERFORMANCE OF CHILD RESTRAINT SYSTEMS

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by

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PART I. INTRODUCTION

Approximately 1,000 children per year under the age of four are killed in automotive accidents (1)* with an even greater number injured. Last year in the City of Detroit alone (2) over 70% of all children injured in traffic accidents of all forms including pedestrians, bicycles and mini-bike operators were passengers in motor vehicles at the time of their injury. Many of these deaths and injuries could have been prevented had the children been wearing a proper restraint system.

The research regarding effective child protection has been underway since the 1950's. Moore et al (3) reported the accident experience of child passengers in auto accidents studied in the ACIR program in 1959. In 1962, Dye (4) reported his experiences in the evaluation of a large series of then available child restraint devices and documented a number of criteria which should be applied in the evaluation of potential child seats or restraints systems. Subsequent to the Dye paper, Aldman (5) reported in 1966 on the development of a rearward facing child seat for use in Swedish automotibles, and Appoldt (6) discussed dynamic tests of child restraint devices manufactured by Rose Manufacturing Company. In addition, Siegel (7) and his coworkers in 1968 related the design of several types of child seats to the types and frequency of injury patterns as found in accident investigations. Based upon accident cases, Siegel recommended the use of lap belts for children over four years of age but recommended special devices for younger children.

Burdie (8) and his coworkers have discussed the [illegible] of children with

They suggested that the child's braincase is relatively weaker than that of adults and therefore recommended that head impact tolerances for children be reduced accordingly. This paper by Burdie, as well as other works on the same subject, points out the danger of a lap belt only restraint used in conjunction with the child due to the lack of development of the iliac crest on the child's pelvis. Because the child's pelvis is incompletely developed relative to the adult pelvis, the iliac crest does not provide the foundation for total body support as is generally given by the larger, more developed bone structure found in the adult. Burdie also suggested that restraint loads be distributed widely over the chest because of the extreme flexibility of the child's thorax and hence the vulnerability of the internal thoracic organs to nonpenetrating compression injuries.

King (9) in 1969 developed a reasonably thorough presentation of child anthropometry which included a set of design criteria. King suggested that for children under 50 pounds a stable support platform be provided for any child restraint device. He noted that extreme motion is undesirable due to the danger of contact with interior vehicle structures, and developed requirements for the distribution of load over wide areas of the body. He pointed out the importance of the location of the child's center of gravity as it would affect the dynamic design of a restraint system. For children weighing more than 50 pounds, it was suggested that a stiff booster cushion coupled with a stable mounting platform and an adult lap belt should provide an acceptable restraint system.

Two papers have resulted from the automotive industry's attempts to [illegible]. Tolas (10) in 1970 discussed [illegible]

other restraint system developed with the automotive industry, the Ford Tot Guard, was discussed and the basis for its design given in the paper by Head (11) in 1970. Both the General Motors Infant Carrier and the Ford Tot Guard reflect improvements which are possible in child restraints if a carefully conceived program is used to develop and dynamically test the child seating device.

The child seating standard which currently exists had the effect of removing the "hook over" and "hook under" seats from the marketplace and, in some instances, raising the performance of the seating systems to a 15 to 20 mph frontal barrier equivalent crash. Unfortunately in almost every instance, the intent of the standard, injury reduction at 30 mph was not achieved.

PART II. TEST PROGRAM

The basic objective of the test program is to obtain an experimentally determined estimate of the protection potential offered to the child by the 9 devices to be tested in the study.

In order to achieve this, it was necessary to:

1. Develop a performance criterion for evaluating the various devices.
2. Select an occupant for use in the test program.
3. Construct a test environment, including an adult seat capable of being oriented so that impacts from various directions could be studied.
4. Select instrumentation and data-handling procedures to determine forces and motions experienced by the occupant in the test in order to provide data for performance evaluations.
5. Select a test matrix.
6. Conduct the test program and gather data.

PERFORMANCE CRITERION

The purpose of this research is to provide an objective measure of the protection from serious injury afforded a child occupant by these restraint systems. Injury to the vehicle occupants in a crash can arise from three basic causes.

First, and probably most critical, is the possibility of the child being thrown on impact against the dash board, windshield, door pillars, or windows, etc.

The second factor which can cause injury to occupants of a restraint

vital organs during impact due to improper load distribution. The location of the restraining (load bearing) surfaces is especially critical in children because some skeletal regions are not fully developed and ossification is not complete. In particular, the iliac crest has not developed and therefore doesn't provide as good a load bearing structure for a child as for an adult. Therefore, in an accident there is a strong tendency for the lap belt to ride up off the pelvis and into the abdominal region, which can be very dangerous.

SELECTION OF OCCUPANT

The 3-year size Sierra Engineering anthropometric dummy was used for all tests. The Sierra 3 year is 37.5 inches high and weighs 31 pounds. The weights of the various body components are distributed nearly correctly, thus giving a fair duplication of body kinematics (See Figure 1).

SELECTION OF TEST ENVIRONMENT

The test configurations consisted of a 1973 General Motors bench seat mounted on a test rig which exactly duplicated the seat mounting, lap belt attachment points, simulated dash and floor and toe board locations in a 1973 Chevrolet Impala. The entire assembly was capable of being rotated as a unit and thus the geometry of the simulated vehicle remains constant for front, side, and rear impacts.

SELECTION OF INSTRUMENTATION AND DATA-HANDLING PROCEDURES

The 3-year dummy was instrumented with triaxial accelerometer packs in the [illegible] were Setra Model [illegible] to sense sled deceleration signals [illegible] were made [illegible]

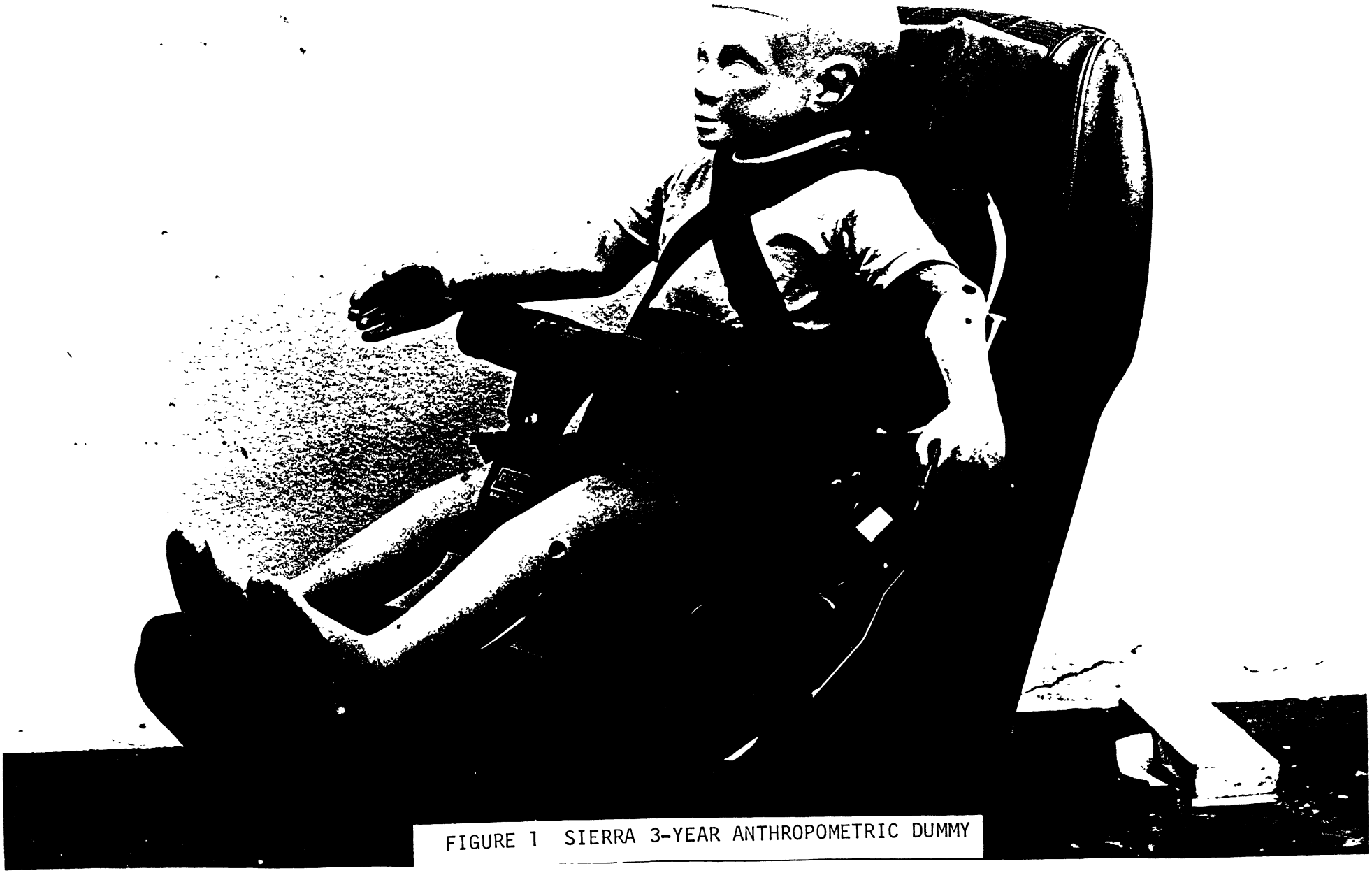

FIGURE 1 SIERRA 3-YEAR ANTHROPOMETRIC DUMMY

High speed motion pictures were taken for each test. A Photosonics 16-mm camera was located directly to the side of the impact area, and another directly overhead. The filming rate used was 1000 frames per second. These motion pictures were supplemented by slides taken before and after each test. Also, a Graph-Chek sequence camera was used in the test program to provide an instantaneous evaluation of the test as a sequence of eight frames on a 3 x 5 in. Polaroid sheet.

TEST MATRIX

A retail market survey was conducted to determine which restraint devices for children would offer the most protection in a crash environment. The devices tested and studied were available between August 6, 1973 and August 29, 1973, and all met government Standard No. 517.213.

With this information, nine test devices were selected on the basis of their potential effectiveness. Descriptions and comments on the test devices are shown in Table I.

All seat restraint systems were installed according to the manufacturer's instructions. In addition, the General Motors Love Seat and the Sears Harness were tested in modes of installation not recommended by the manufacturer. This was done in anticipation of possible incorrect installation by the user.

The test matrix for this program was designed to include forward impact, side impact, and rear impact. Each of the restraint devices was mounted on the bench seat in accordance with the manufacturer's instructions (Table II), securing the dummy in the device with the appropriate restraints. All of the restraint devices were tested in the frontal impact direction at 30 mph [illegible] G's. Those devices which [illegible] were then retested,

TABLE I DEVICES SELECTED FOR CONSUMER UNION STUDY

MANUFACTURER	SEAT NAME	DESCRIPTION	COMMENTS
Peterson Baby Products 6904 Tujunga N. Hollywood, Ca. 91605	Imperial Safe-T-Seat Model 67B	Tubular fold-up pedestal. Padded seat and face shield. Child lap and crotch belts. Child seat restrained by adult lap belt.	Reclinable. Metal frame unpadded at hip sides.
Ford Motor Co. c/o American Road Dearborn, Michigan	Tot-Guard	Molded Plastic shell encapsulating child. Child sits on molded plastic riser within shell. Adult lap belt restrains shell. Padded face guard.	Easy to use Child's visibility limited.
Chrysler Corporation Parts Division Detroit, Michigan	Mopar Seat Part No. 3744976	One piece molded plastic seat-shell combination restrained by adult lap belt. Padded face guard. Child slips into shell from top.	Same as model CS-200 of Doulon Plastics, Toronto, Canada. Easy to use. Child's visibility limited. No straps to unbuckle.
General Motors Corp. P.O. Box 7096 North End Station Detroit, Michigan 48202	Love Seat	Molded plastic seat with padding. Side support along entire upper torso. Belly, crotch, and suspender straps with one universal buckle. Retained by adult lap belt and top belt over carseat attaches to rear seat belt.	Top anchor belt over car seat requires adjustment with change in position of front seat.
Miller-Keyworth Co. Worcester, Mass. 01440	Bobby-Mac 3 in 1 Baby Chair	Molded plastic seat with padding. Molded and padded plastic shield encapsulating trunk region. Double diagonal chest harness with belly strap. Seat and shield restrained by adult lap belt. Tubular fold up pedestal.	Has three uses: car seat, high chair, and infant carrier. Car seat position in upright, reclining, and rear facing positions.
Main Industries, Inc. 1115 Versailles Rd. Lexington, Ky. 40501	Child Car Seat and Safety Cushion Model I-165	U-shaped vinyl and cloth "bean bag" (styrofoam beans) for face protection. Plastic seat riser with pad. Bag and seat riser restrained by adult lap belt.	Adult lap belt must be quite tight to retain bag in place.
Kiddy-Go Baby Products 511 Young Street Piqua, Ohio	Fitz-All Deluxe Recliner Model 784	Tubular fold-up pedestal. Padded seat and chest guard bar. Suspender type child shoulder harness and crotch belt. Child seat restrained by adult lap belt and top strap over car seat anchor to floor.	Top anchor belt over car seat requires adjustment with change in position of front seat.

TABLE I DEVICES SELECTED FOR CONSUMER UNION STUDY

(continued)

MANUFACTURER	SEAT NAME	DESCRIPTION	COMMENTS
Kantwet Baby Products 501 Young Street Piqua, Ohio	Infanseat Harness Model 275	Suspender, waist, and crotch straps. One universal buckle. Anchor strap around car seat back and anchored to floor.	Same as above. (Kantwet Fitz-All Deluxe Recliner)
Sears, Roebuck, and Co. Chicago, Ill. 60607	Harness #6401 Part No. 504082	Small Harness size with vest, crotch, and shoulder straps. Anchor strap encircles car seat back.	Very hard to adjust properly with heavy clothing on child. Available in two sizes: (small) #6401 and (large) #6402.

TABLE II SUMMARY OF MANUFACTURER SPECIFICATIONS

MANUFACTURER'S NAME AND MODEL NUMBER	TEST NUMBER	AGE OF CHILD (years)	STANDING HEIGHT OF CHILD (inches)	WEIGHT OF CHILD (pounds)	FOR USE IN FORWARD FACING SEAT ONLY	USED WITH ADULT LAP BELT ACROSS CHILD'S LAP	DOES NOT USE ADULT SEAT BELT	USED ONLY WITH NON-FOLDING SEATS OR SEATS WITH LATCH	NOT FOR USE IN TRUCKS OR BUSSES	USE ON BOTH FRONT AND REAR FACING SEATS	ONLY FOR CHILDREN CAPABLE OF SITTING UPRIGHT	RESTRICTIONS ON USE
PETERSON MODEL 67B	690		26-40.5	17-37	✓	✓		✓	✓			
FORD TOT GUARD	691 703 705	1-5	< 46[a]	20-50		✓				✓		(1) Use in forward-rearward positions only in 1968 and later US cars with seat belts. (2) Use in front seat only in 1964 and later cars with seat belts. (3) Top of child's head must not exceed 3" above carseat back/ head rest when in child seat.
CHRYSLER MOPAR SEAT	692 706		30-45	21-50		b		✓				(1) Center seating position preferred. (2) Recommended for 1966 and later Chrysler cars and perhaps others. (3) When in child seat, child's head must not be higher than 3" above car seat back/headrest.
GENERAL MOTORS LOVE SEAT	693 694 696 707 712		40	20-40	✓	c		✓	✓		✓	(1) Use in only 1968 and later US cars with rear seats. (2) For cars with unseparable shoulder strap must fit behind child seat.

TABLE II SUMMARY OF MANUFACTURER SPECIFICATIONS
(continued)

MANUFACTURER'S NAME AND MODEL NUMBER	TEST NUMBER	AGE OF CHILD (years)	STANDING HEIGHT OF CHILD (inches)	WEIGHT OF CHILD (pounds)	FOR USE IN FORWARD FACING SEAT ONLY	USED WITH ADULT LAP BELT ACROSS CHILD'S LAP	DOES NOT USE ADULT SEAT BELT	USED ONLY WITH NON-FOLDING SEATS OR SEATS WITH LATCH	NOT FOR USE IN TRUCKS OR BUSSES	USE ON BOTH FRONT AND REAR FACING SEATS	ONLY FOR CHILDREN CAPABLE OF SITTING UPRIGHT	RESTRICTIONS ON USE
COLLIER-KEYWORTH BOOBY MAC	697 708 714		40	7-35	✓	d		✓				(1) For Children ≥ 30" high, car seat back /headrest must be at least 22" above cushion. (2) Infants ≤ 15 lbs. must use rear facing position only.
IRVIN MODEL I-165	698		39	15-35	✓	✓		✓				(1) Car seat back/headrest must be no more than 19" from the front of the child's riser and at least 4" above the top of the child's sitting on the seat riser.
KAWTWET MODEL 784 SEAT	709 709 715		25-43	< 40		c						
KAWTWET MODEL 775 INFANTSEAT HARNESS	701 711			< 53			✓					
SEARS HARNESS	702 710			< 50 or 40-70			✓					

a Seating Height should be 19-25 inches
b Shoulder and lap belts must be separable
c Adult lap belt holds only seat in place
d Adult belt loop length above cushion must be at least 43" so it can loop around

using another child seat where necessary, in the side direction at 20 mph and 16 G's. Those devices which performed satisfactorily in the side impact were then tested for rear impact performance, at 20 mph and 16 G's.

DATA GATHERED IN TEST PROGRAM

The data from all tests are summarized in Table III. All acceleration and force data are given as peak values. The head and chest accelerations are given as "A-P" referring to the anterior-posterior direction, "S-I" to the superior-inferior direction, and "L-R" to the left-right direction.

The complete set of data gathered in this study is included as Appendix A to this report.

TABLE III

CHILD SEAT TEST SUMMARY

Manufacturer and Model	Test No.	Direction	SLED		HEAD ACCELERATION					CHEST ACCELERATION				Maximum Head Excursion (inches)	Comments
			VEL. MPH	ACCL G's	AP G's	LR G's	SI G's	RES G's	Severity Index	AP G's	SI G's	LR G's	RES G's		
PETERSON, 67B	690	FRONT	27.2	21	220	34	78	230	> 2000	78	38	15	86	29.8	
FORD, TOT GUARD	691	FRONT	26.1	21	67	10	38	70	760	35	18	12	37	25.1	
	705	SIDE	20.0	16	50	215	30	219	1400	16	14	45	50	19.0	
CHRYSLER, MOPAR	692	FRONT	30.0	21	102	15	35	104	1440	41	31	22	41	22.0	
	706	SIDE	20.6	16	90	209	40	221	1400	25	27	140	148	23.9	
GENERAL MOTORS, LOVE SEAT	693	FRONT	30.0	21	65	11	66	88	1680	35	21	5	36	18.7	With Rear Strap
	707	SIDE	20.2	16	21	40	9	41	125	9	13	33	34	10.2	
	712	BACK	19.3	16	28	3	13	30	100	16	12	5	18	11.4	
	694	FRONT	30.0	21	50	10	70	74	880	32	16	11	32	26.0	Without Rear Strap*
	696	FRONT	30.0	21	55	35	63	79	1040	37	22	6	41	19.3	Strap Around Lower Portion*
COLLIER-KEYWORTH BOBBY-MAC	697	FRONT	29.5	21	83	10	56	89	1400	37	19	10	38	19.5	
	708	SIDE	19.9	16	50	205	52	207	850	10	9	44	44	17.7	
	714	BACK	20.2	16	40	3	17	42	180	21	36	5	38	10.6	
IRVIN, I-165	698	FRONT	29.8	21	230	50	40	250	> 2000	40	33	8	44	28.1	
KANTWET, 784	699	FRONT	29.8	21	48	8	46	59	580	29	18	9	32	21.75	
	709	SIDE	20.5	16	66	120	35	126	280	18	10	43	45	18.8	
	715	BACK	20.2	16	38	4	18	40	164	22	11	5	24	15.5	
KANTWET INFAN-SEAT HARNESS	701	FRONT	30.2	21	35	8	50	52	650	30	15	6	30	18.8	Harness
	711	SIDE	20.0	16	75	29	85	122	450	25	13	32	37	17.8	
SEARS HARNESS	702	FRONT	30.2	21	52	6	77	82	1000	34	15	8	35	25.7	Harness
	710	SIDE	19.9	16	180	225	60	280	> 2000	24	13	48	50	19.3	
	703	FRONT	30.2	21	225	30	70	235	> 2000	45	15	10	46	20.7	With Car Seat Belt*

* Restraint device installation not in accordance with manufacturer's recommendations.

PART III RESULTS

HEAD EXCURSION

Most serious injuries and fatalities in automobile accidents are due to head injuries resulting from impact of the occupant's head with the interior of the vehicle. Therefore, head excursion is the most important indicator of the protection afforded by the restraint device.

The devices tested for this study were ranked largely according to the amount of head excursion allowed. The Canadian Government is considering a proposed standard which requires that maximum head excursion be limited to less than 24 inches in a front impact at 30 mph.

The GM Love Seat, Kantwet Infanseat Harness, Kantwet Model 784, and Bobby-Mac all met this standard. The Ford Tot-Guard and the Sears Harness failed the proposed standard, but prevented the dummy's head from coming into contact with the simulated dash. The Irvin I-165 and Peterson Model 67B failed the standard and allowed the dummy's head to impact the simulated dash.

In the side impact tests, only the GM Love Seat prevented the dummy's head from impacting the door. Acceleration records and high speed movies indicated that the Kantwet Infanseat and Model 784 restrained the dummy partially so that its head impacted the door with minimal force. The Ford Tot-Guard, Mopar Seat, Bobby-Mac Seat and Sears Harness all allowed the dummy's head to impact the door with considerable velocity. The Peterson Model 67B and the Irvin I-165 were not tested in a side impact because they [illegible] so clearly failed the front impact.

[illegible] all e[illegible]oy similar, vell

is too high. Each seat uses a pair of shoulder harnesses to limit excursion of the head and torso.

The Ford Tot Guard and Mopar seat employ the same type of load bearing surface. Both have semi-rigid encasing shells that bear upon the child's chest and abdomen in a front impact. The loads are very well distributed in front impacts. Neither provides protection for the head and torso in a side impact.

The Sears Harness distributed loads fairly well. The Irvin seat and the Peterson Model 61 used the adult lap belt around the child. As a result, these two seats offer little or no protection over that supplied by the adult lap belt alone.

ACCELERATION

Accident investigations show that little if any head injury occurs if there is no head-to-vehicle contact. Therefore, performance criteria based on head acceleration are inadequate and inappropriate for evaluating the life-saving potential of a restraint system in frontal impacts without head-to-vehicle contact. In the frontal test the G.M. Love Seat, Kantwet Seat and Harness, and the Sears Harness all fit into this category of injury assessment. That is, no head contact, therefore no life threatening injury potential.

The Bobby-Mac, Ford Tot Guard, and Chrysler Mopar seat all have front body shields which were contacted by the dummy's head in the front impact. Head accelerations for the Bobby-Mac and the Tot-Guard are high but not so high as to make the seat unsafe. Head accelerations for the Mopar are [illegible] ess of the shield

The Peterson and the Irvin seats both allowed the dummy's head to contact the simulated dash. The resulting head accelerations were high enough in these tests to be considered life threatening.

The G.M. Love Seat gave total side protection with the dummy's head contacting only the side of the child seat. Head accelerations were very low. The Kantwet seat and harness allowed the dummy's head to impact the side door, but the force of impact was very light and no serious injury would be expected.

The Bobby-Mac, Ford Tot Guard, Chrysler Mopar, and the Sears Harness all allowed the dummy's head to impact the door in the side impact test. The head accelerations were all high enough to be considered dangerous to life.

In all tests, chest accelerations were low enough to be considered no threat to life except for the Peterson front impact and the Mopar side impact.

PART IV CONCLUSIONS

All seats evaluated in this study must be installed and used according to their directions. In addition, it is recommended that they be installed in the middle section of the rear seat, wherever possible.

The GM Love Seat, both the Kantwet seat and harness, and the Sears harness require a back strap. When any of these seats are installed in the front seat the strap passes through the rear passenger compartment where it can be a nuisance. Without these straps, the protection afforded by these seats is greatly reduced.

The test configuration employed in the side impacts for this study represents the most severe conditions which may result from a real automobile side collision. The child restraint system was installed on a bench seat nearest the point of impact. If the restraint system had been installed in the middle of the seat, or on the side opposite the impact site, the test results would have indicated less severe consequences.

The restraint systems for all 1974 American made autos incorporate a single buckle which is hard fastened to both the lap belt and the shoulder strap. This configuration may seriously reduce the safety effectiveness of those seats which require that the seat belt be passed through an enclosure (i.e. the Chrysler Mopar, Kantwet Model 784 seats). Preliminary examination revealed that the above described seat belt configuration may cause the seats to rotate out of position in an impact. This would be particularly dangerous for the Mopar seat, as it has no belts to restrain the child, and the child may be ejected from the seat.

One additional important limitation upon the performance of all the restraint devices tested was the adult car seat. These seats deformed

considerably in all tests. Head excursion in the rear impacts, and to a lesser extent in the front impacts was due in part to deflection of the adult car seat back. This deflection allowed the child restraint system to travel further than it would have, had the seat back been rigid.

PART V QUALITATIVE EVALUATION

A qualitative evaluation of the restraint systems was made on the basis of all available (quantitative data, film record, lab notes, etc.)

EXCELLENT

General Motors Love Seat - Provided good protection in all impact directions Proper installation of this seat is critical (See Text). Head and chest accelerations were low. Can be used in all '74 cars.

GOOD

Kantwet Harness - Provided good protection in front and rear impacts, only fair in side impact. This harness system is excellent. Accelerations were very low for both head and chest. Can be used in all '74 cars.

Kantwet Child Seat - The harness system employed by this seat is identical to the Kantwet harness, and its performance is similar. Head and chest acceleration were very low. Can be used in all '74 cars.

Bobby-Mac - Good general performance. Head and chest accelerations were low. Stiff face shield on this seat may cause facial injuries. Can be used in all '74 cars.

POOR

Tot-Guard - The Tot Guard's performance was excellent in front and rear collisions, but poor in side collisions. This seat was by far the easiest to use, with no straps to tighten and no buckles to fasten. Can be used in all '74 cars.

Mopar - Fair protection in front and rear impacts, poor protection in side impacts. G loads high. This seat is easy to use, and can be used in all '74 cars.

Sears Harness - Its dynamic performance is fair, but this device may take up to one hour and could require five minutes to put the harness on every time it's used. Can be used in all '74 cars.

NOT ACCEPTABLE

Irvin I-165 - This seat provides little or no real protection. Dummy's head impacted dash at high velocity, resulting in extremely high accelerations. Can be used in all '74 cars.

Peterson - Head and chest accelerations were very high. The structure of the seat collapsed allowing the dummy to move forward and impact the dash. Can be used in all '74 cars.

Table IV is a recommended ordering of the child restraint systems according to their overall safety.

TABLE IV. THE QUANTITATIVE RESULTS OF THE CHILD RESTRAINT SYSTEMS TESTED

EXCELLENT	General Motors Love Seat
GOOD	Kantwet Harness Model 275
	Kantwet Seat Model 784
	Bobby-Mac
POOR	Ford Tot-Guard
	Chrysler Monar Seat
	Sears Harness
* NOT ACCEPTABLE	Peterson Model 67B
	Irvin Child Seat Model I-165

* The rating Not Acceptable implies that the child restraint system being tested did not successfully meet the performance criterion I used to evaluate the effectiveness of the restraint system. That doesn't mean these restraint systems have no protective ability at all. They all did meet the requirements of Federal Motor Vehicle Safety Standard 213.

PART VI REFERENCES

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11. S. A. Head and E. P. Grenier, "The Design and Development of a More Effective Child Restraint Concept." SAE Paper No. 680002, 1968.

12. D. H. Robbins, A. W. Henke and V. L. Roberts, "A Study of Concepts in Child Seating and Restraint Systems." Paper No. 700041 presented at the SAE Automotive Engineering Congress, January 1970.

13. V. L. Roberts, "Child Restraint Development." Final Report on DOT Contract DOT-HS-081-1-113, 1972.

APPENDIX A

HSRI SUMMARY DATA SHEET

Test Number:	A-690
Test Date:	August 23, 1973
Restraint Descriptions:	Peterson Model 67B
Dummy:	3-Year
Sled Velocity:	27.2 mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

The structure of the child seat collapsed, allowing the dummy to move forward and contact the simulated dash. The dummy then carried through the dash. Head and chest accelerations were very high.

FIGURE A-1 SET UP FOR PETERSON 67B, FRONT IMPACT

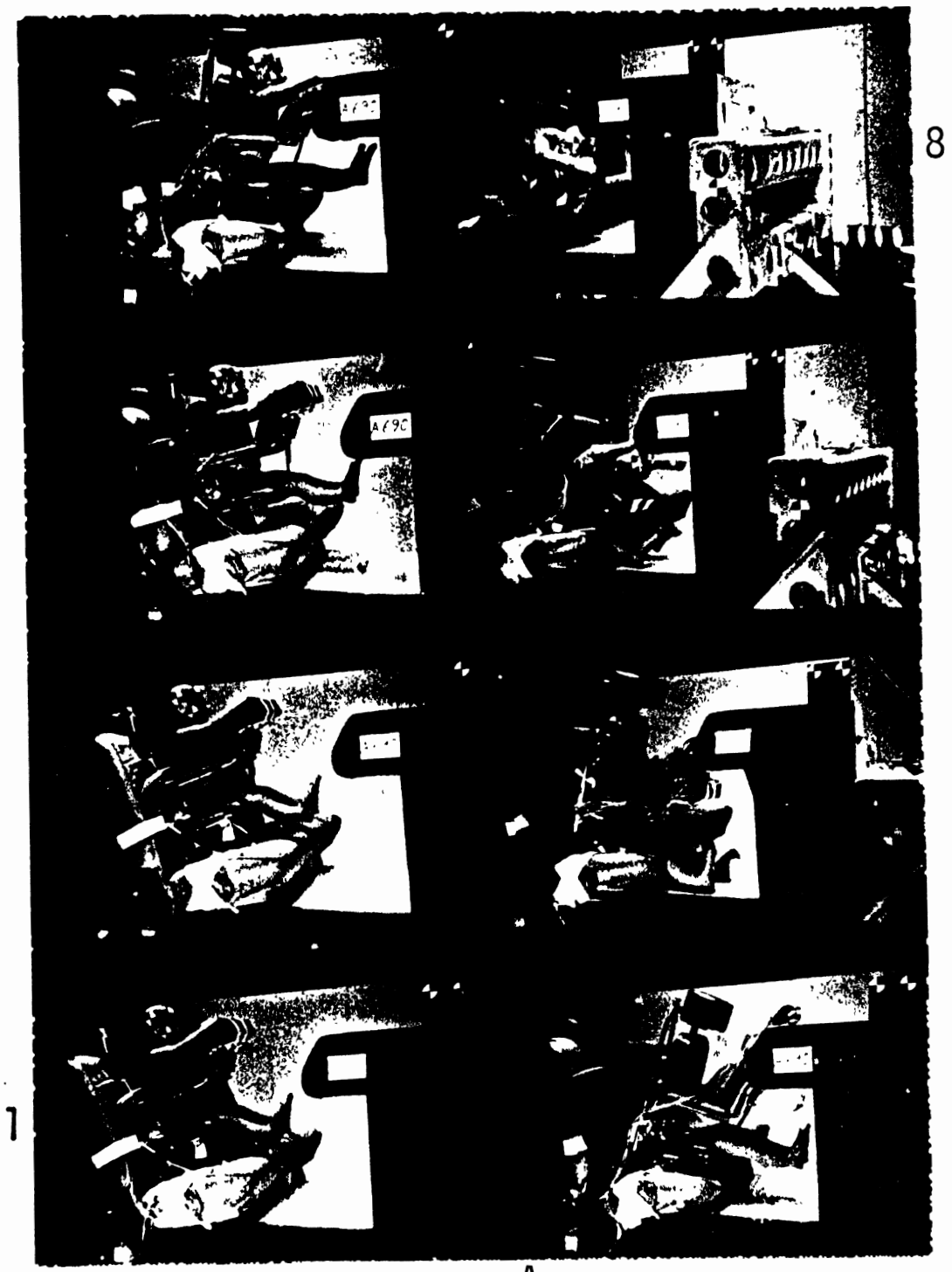


FIGURE A-2 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

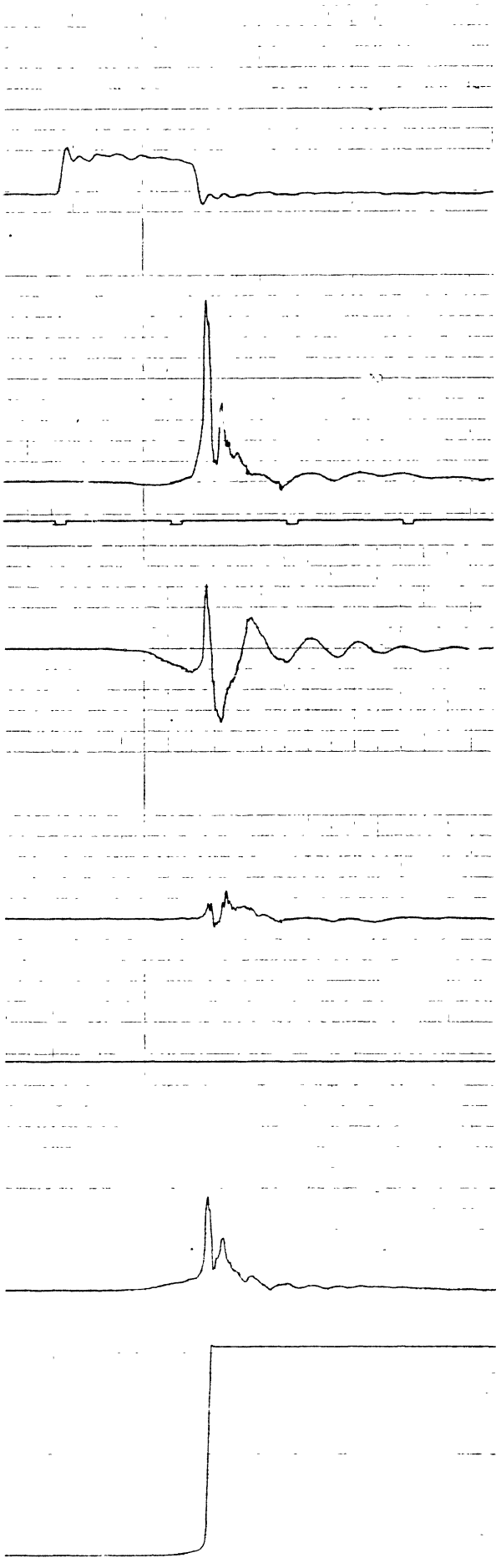
TEST NO. A-630

SEAT TYPE Peterson Model 67B

DUMMY 3-Year

IMPACT TYPE Front

SLED VELOCITY 39.9 ft/sec



SLED PULSE
2 g's/division
Filtered
Class 60

Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000

Superior-Inferior
Head Acceleration
5 g's/division
Filgered
Class 1000

Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000

Resultant Head
Acceleration
10 g's/division
Filtered
Class 1000

Severity Index
40 sec/div

CHEST ACCELERATION DATA

TEST NO. A-690

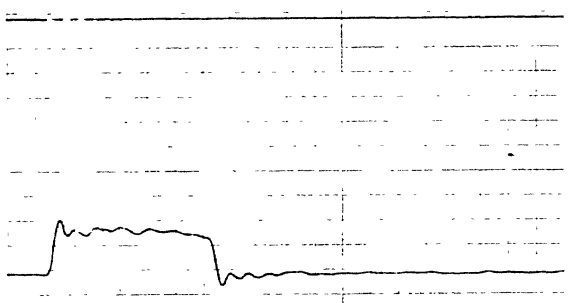
SEAT TYPE Peterson Model 67B

DUMMY 3-Year

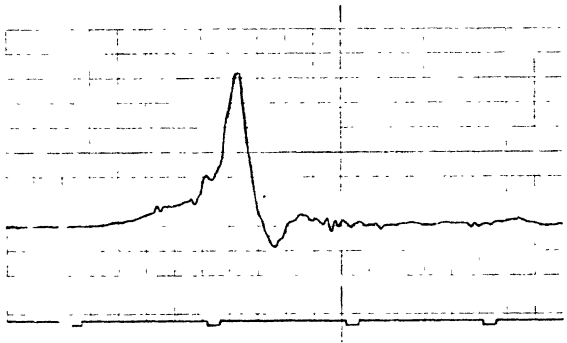
IMPACT TYPE Front

SLED VELOCITY 39.9 ft/sec

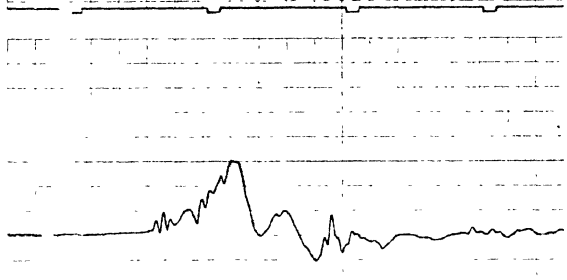
SLED PULSE
2.0 g's/division
Filtered
Class 60



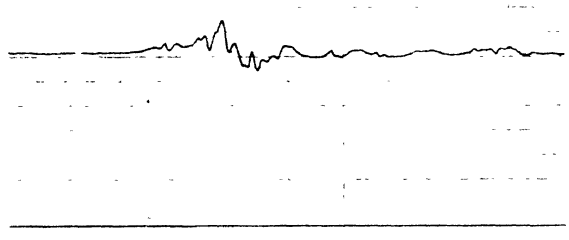
Anterior-Posterior
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



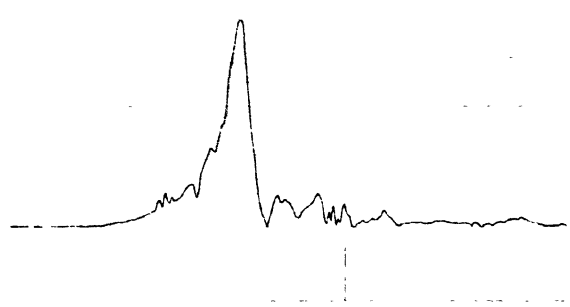
Superior-Inferior
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
2.0 gs/division
Filtered
Class 1000



HSRI SUMMARY DATA SHEET

Test Number:	A-691
Test Date:	August 23, 1973
Restraint Descriptions:	Ford Tot Guard
Dummy:	3-Year
Sled Velocity:	26.1 mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Good load distribution over chest and head. Head and chest g loads were moderate. Dummy rebounded into adult seat back and headrest, resulting in flexion of the neck. No damage to seat.

FIGURE A-3 SET UP FOR FORD TOT GUARD, FRONT IMPACT

Test No.: A-691

FIGURE A-4 GRAPHCHEK SEQUENCE CAMERA

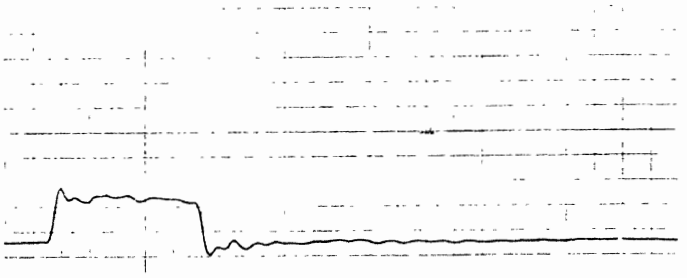
HEAD ACCELERATION DATA

TEST NO. A-691 SEAT TYPE Ford Tot Guard

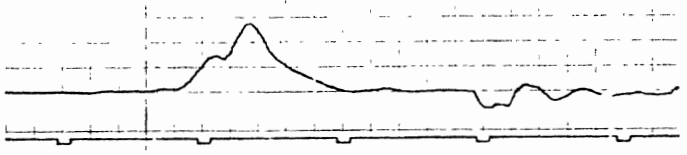
DUMMY 3-Year IMPACT TYPE Front

SLED VELOCITY 38.3 ft/sec

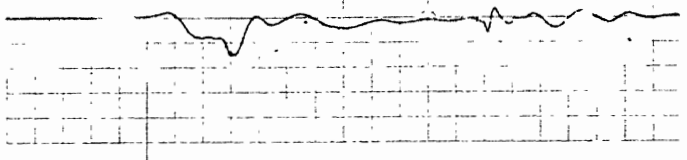
SLED PULSE
2 g's/division
Filtered
Class 60



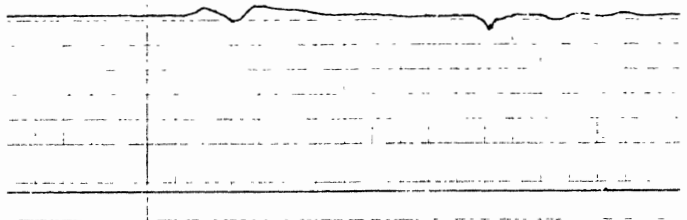
Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000



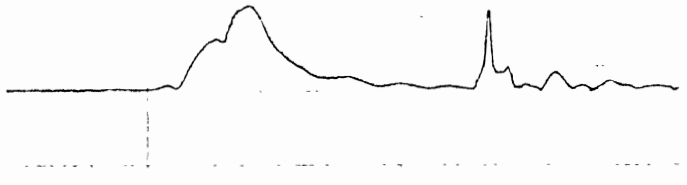
Superior-Inferior
Head Acceleration
5 g's/division
Filgered
Class 1000



Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
4 g's/division
Filtered
Class 1000



Severity Index
40 sec/div

CHEST ACCELERATION DATA

TEST NO. A-691

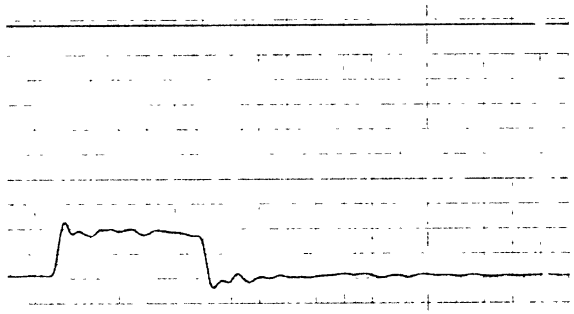
SEAT TYPE Ford Tot Guard

DUMMY 3-Year

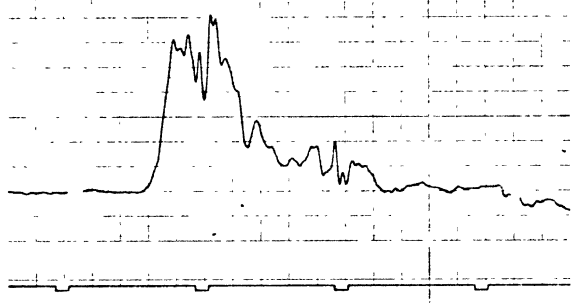
IMPACT TYPE Front

SLED VELOCITY 38.3 ft/sec

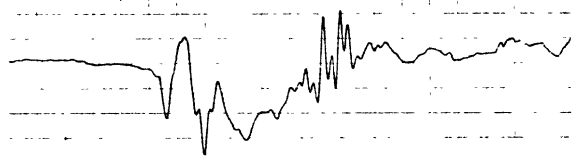
SLED PULSE
2.0 g's/division
Filtered
Class 60



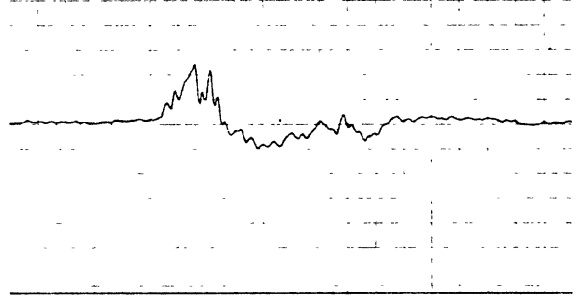
Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000

HSRI SUMMARY DATA SHEET

Test Number:	A-705
Test Date:	August 28, 1973
Restraint Descriptions:	Ford Tot Guard
Dummy:	3-Year
Sled Velocity:	20.0 mph
Sled G-Level:	16
Impact Direction:	Side
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Seat provides little or no protection in side impacts. Head and chest g-s were very high. Head impacted door.

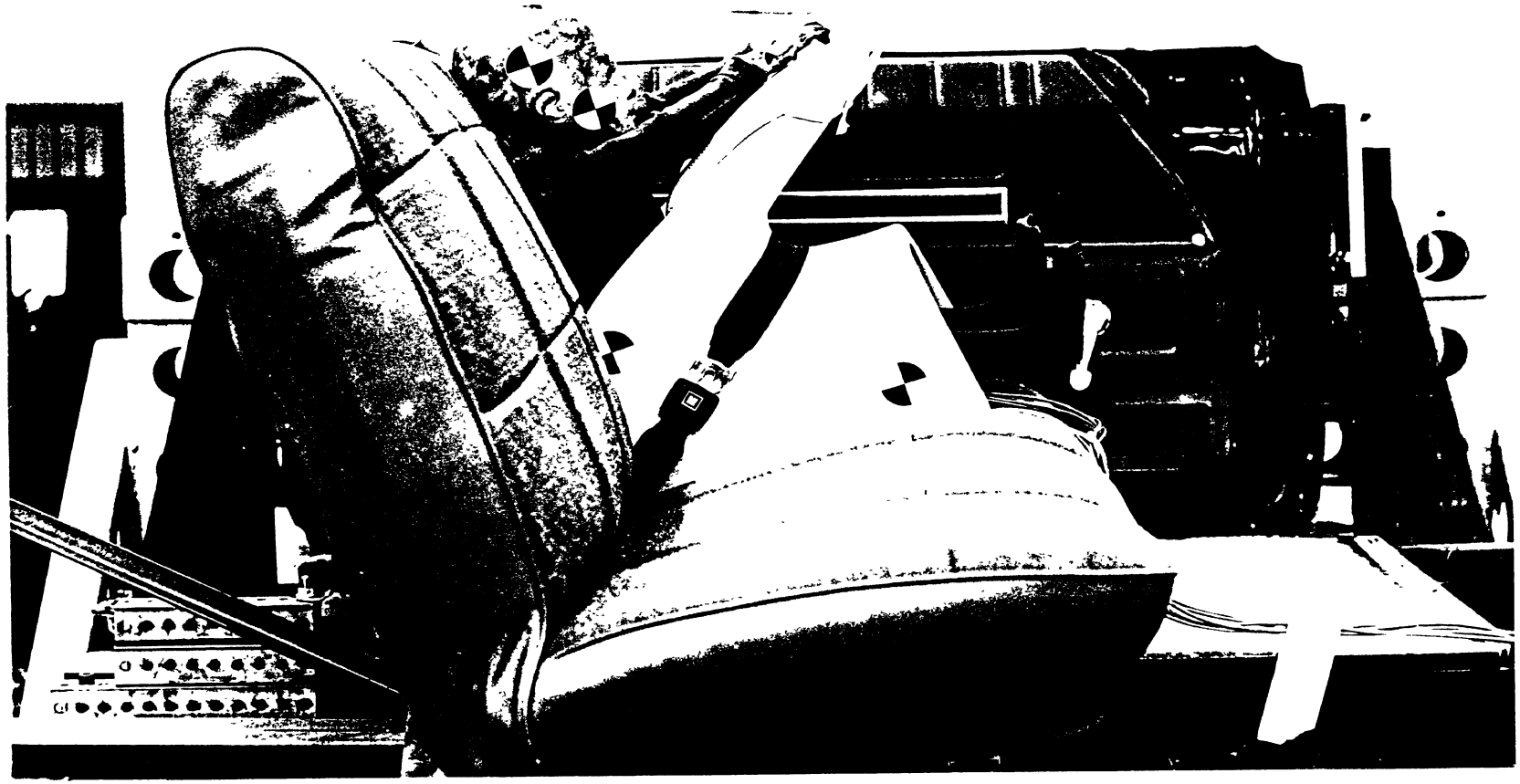


FIGURE A-5 SET UP FOR FORD TOT GUARD, SIDE IMPACT

FIGURE A-6 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-705

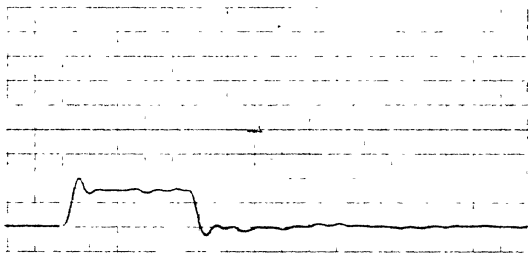
SEAT TYPE Ford Tot Guard

DUMMY 3-year

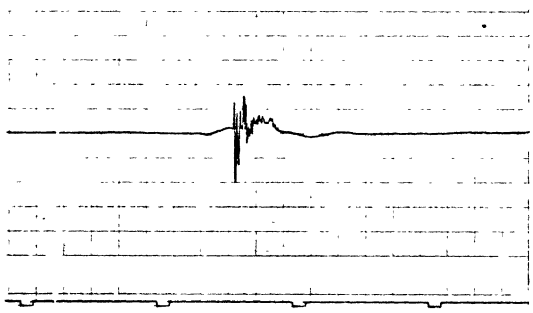
IMPACT TYPE Side

SLED VELOCITY 29.3 ft/sec

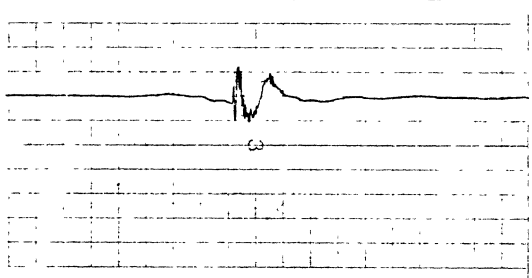
SLED PULSE
2 g's/division
Filtered
Class 60



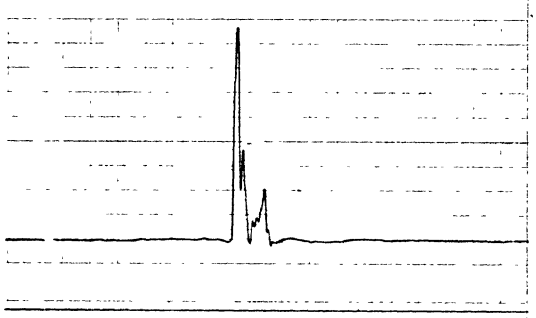
Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000



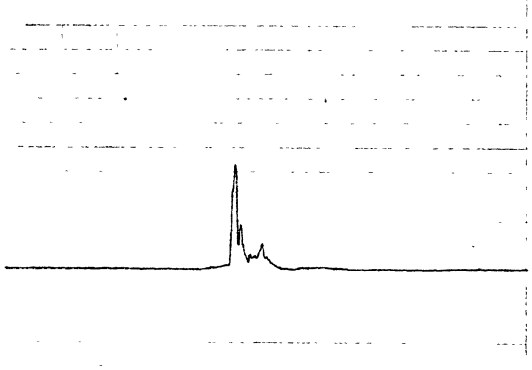
Superior-Inferior
Head Acceleration
5 g's/division
Filgered
Class 1000



Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
10 g's/division
Filtered
Class 1000



Severity Index
40 sec/div

CHEST ACCELERATION DATA

TEST NO. A-705

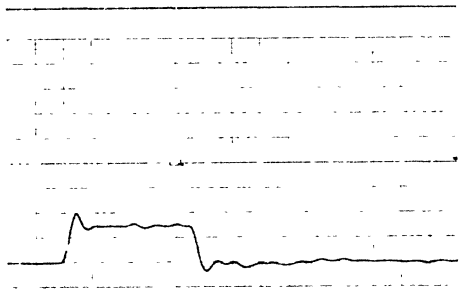
SEAT TYPE Ford Tot Guard

DUMMY 3-Year

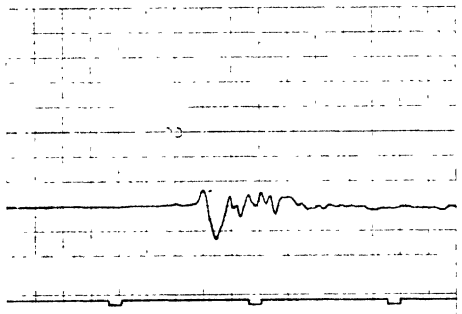
IMPACT TYPE Side

SLED VELOCITY 29.3 ft/sec

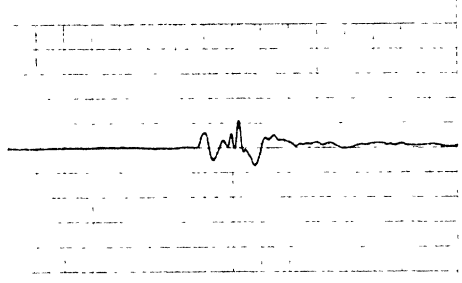
SLED PULSE
2.0 g's/division
Filtered
Class 60



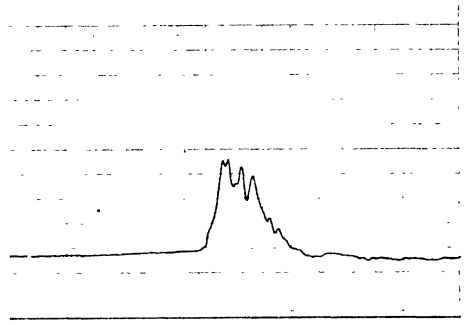
Anterior-Posterior
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



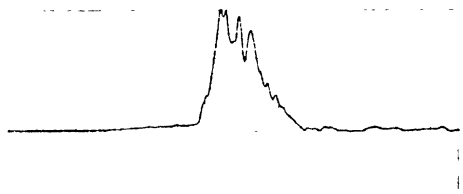
Superior-Inferior
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
2.0 g's/division
Filtered
Class 1000



HSRI SUMMARY DATA SHEET

Test Number:	A-692
Test Date:	August 23, 1973
Restraint Descriptions:	Chrysler Mopar
Dummy:	3-year
Sled Velocity:	30.0 mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

G's in head and chest were high due to rigidity of face shield. Dummy tends to submarine.

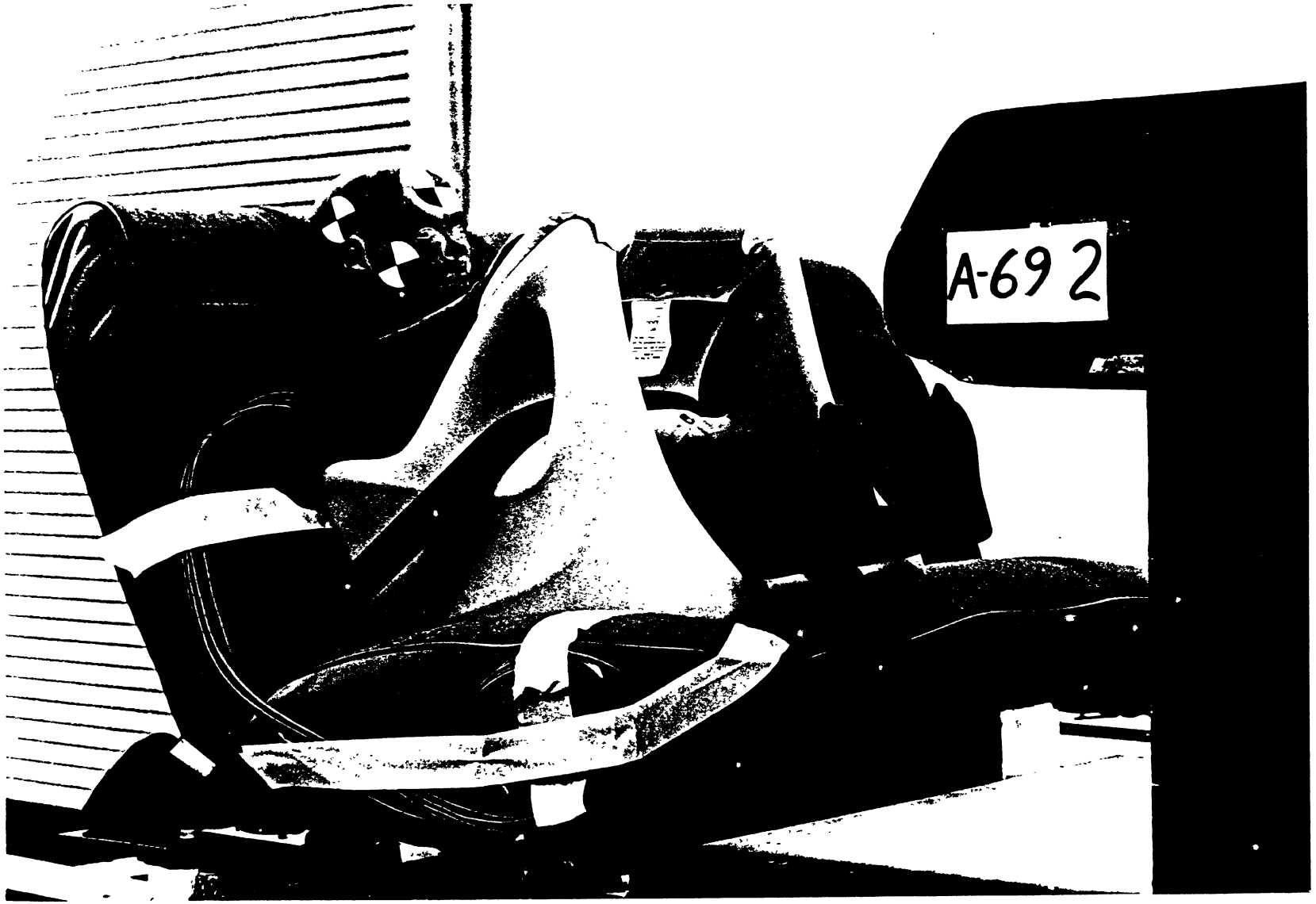
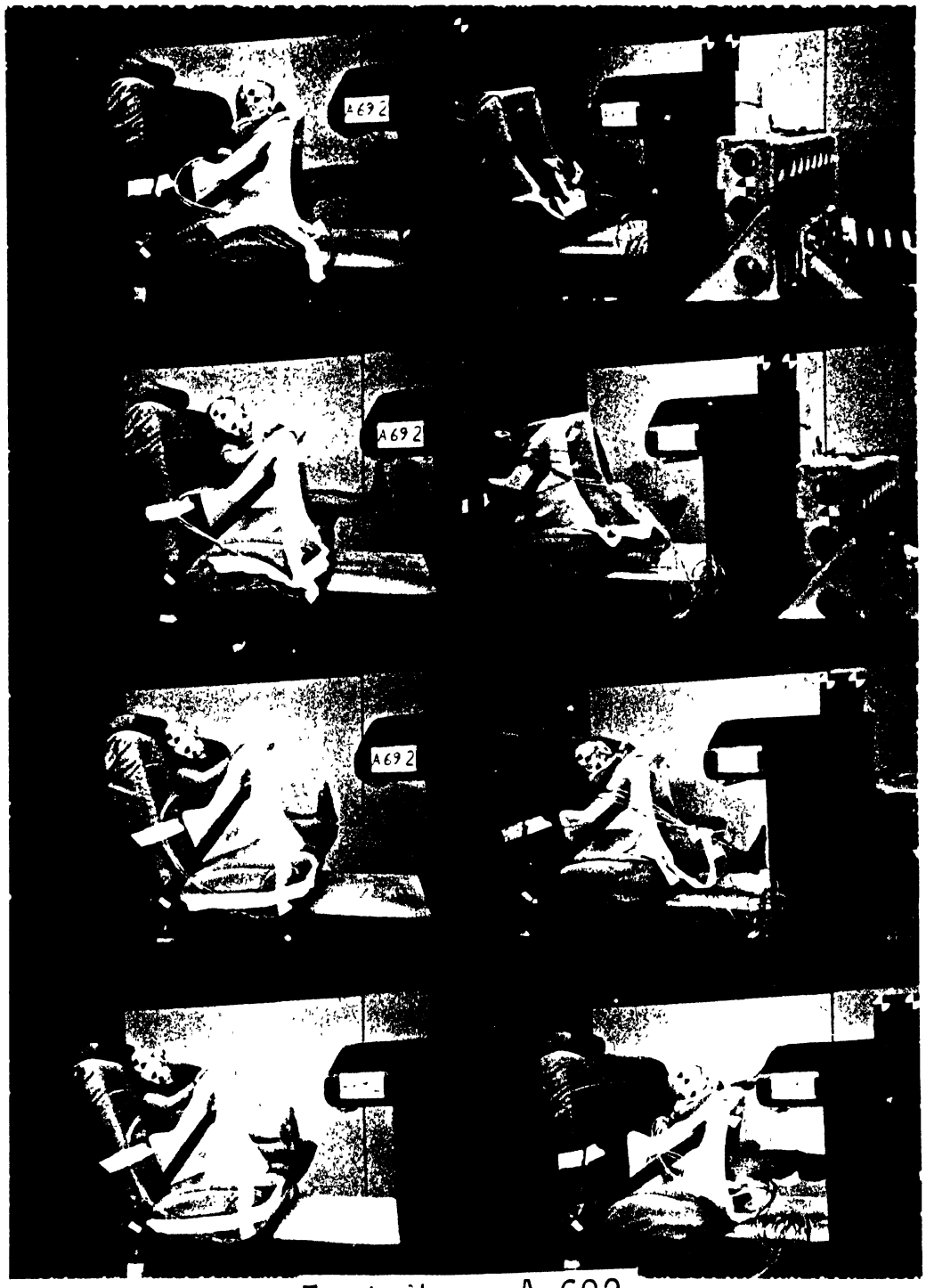


FIGURE A-7 SET UP FOR CHRYSLER MOPAR, FRONT IMPACT



Test No.; A-692

FIGURE A-8 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-692

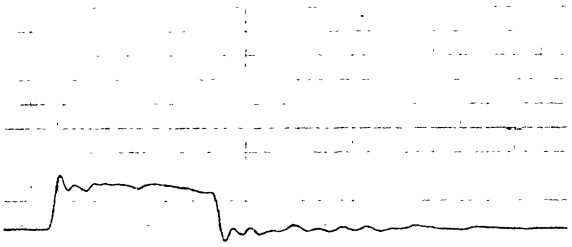
SEAT TYPE Chrysler Mopar

DUMMY 3-Year

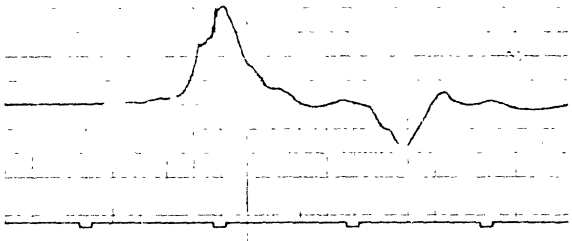
IMPACT TYPE Front

SLED VELOCITY 44.0 ft/sec

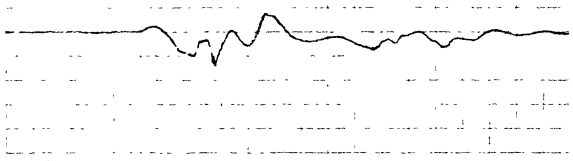
SLED PULSE
2 g's/division
Filtered
Class 60



Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000



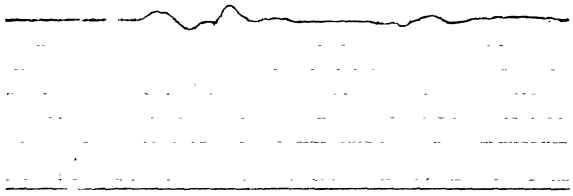
Superior-Inferior
Head Acceleration
5 g's/division
Filgered
Class 1000



VISION, GOULD INC

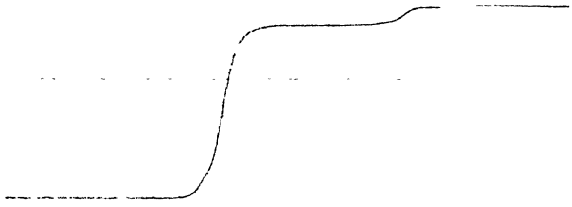
PRINTED

Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
4 g's/division
Filtered
Class 1000

Severity Index
40 sec/div



CHEST ACCELERATION DATA

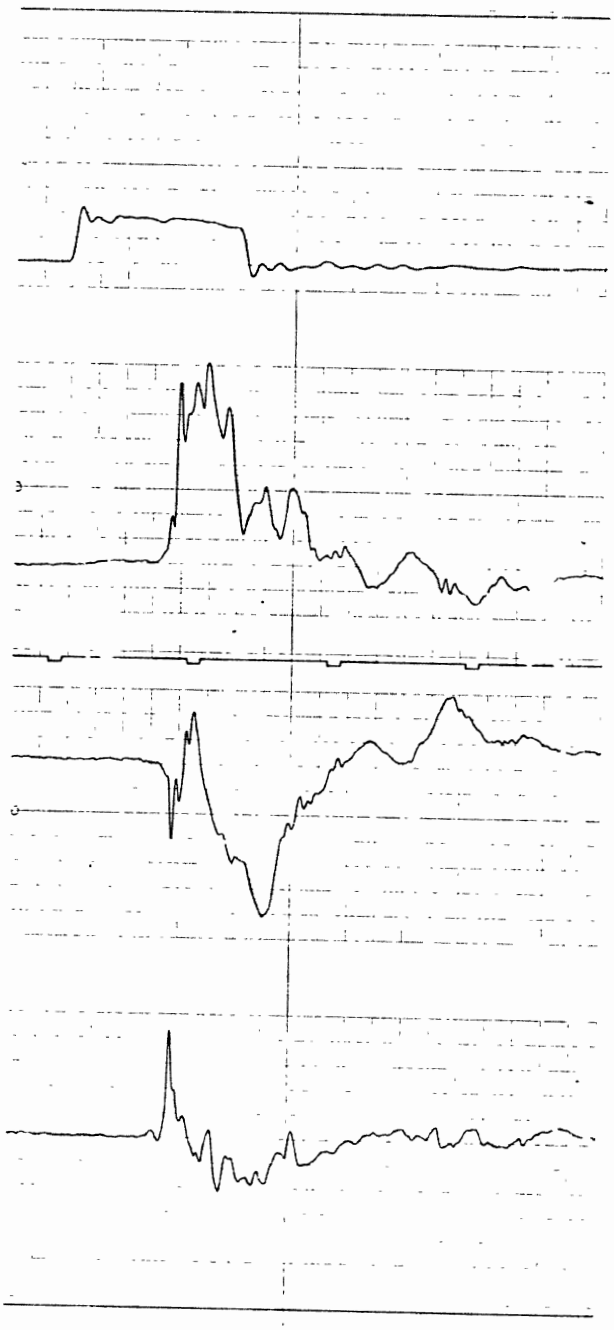
TEST NO. A-692

SEAT TYPE Chrysler Mopar

DUMMY 3-Year

IMPACT TYPE Front

SLED VELOCITY 44 ft/sec



SLED PULSE
2.0 g's/division
Filtered
Class 60

Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000

HSRI SUMMARY DATA SHEET

Test Number:	A-706
Test Date:	August 28, 1973
Restraint Descriptions:	Chrysler Mopar
Dummy:	3-Year
Sled Velocity:	20.0 mph
Sled G-Level:	16
Impact Direction:	Si e
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Seat provides little or no protection in side impacts. Head and chest g's were very high. Head impacted door.

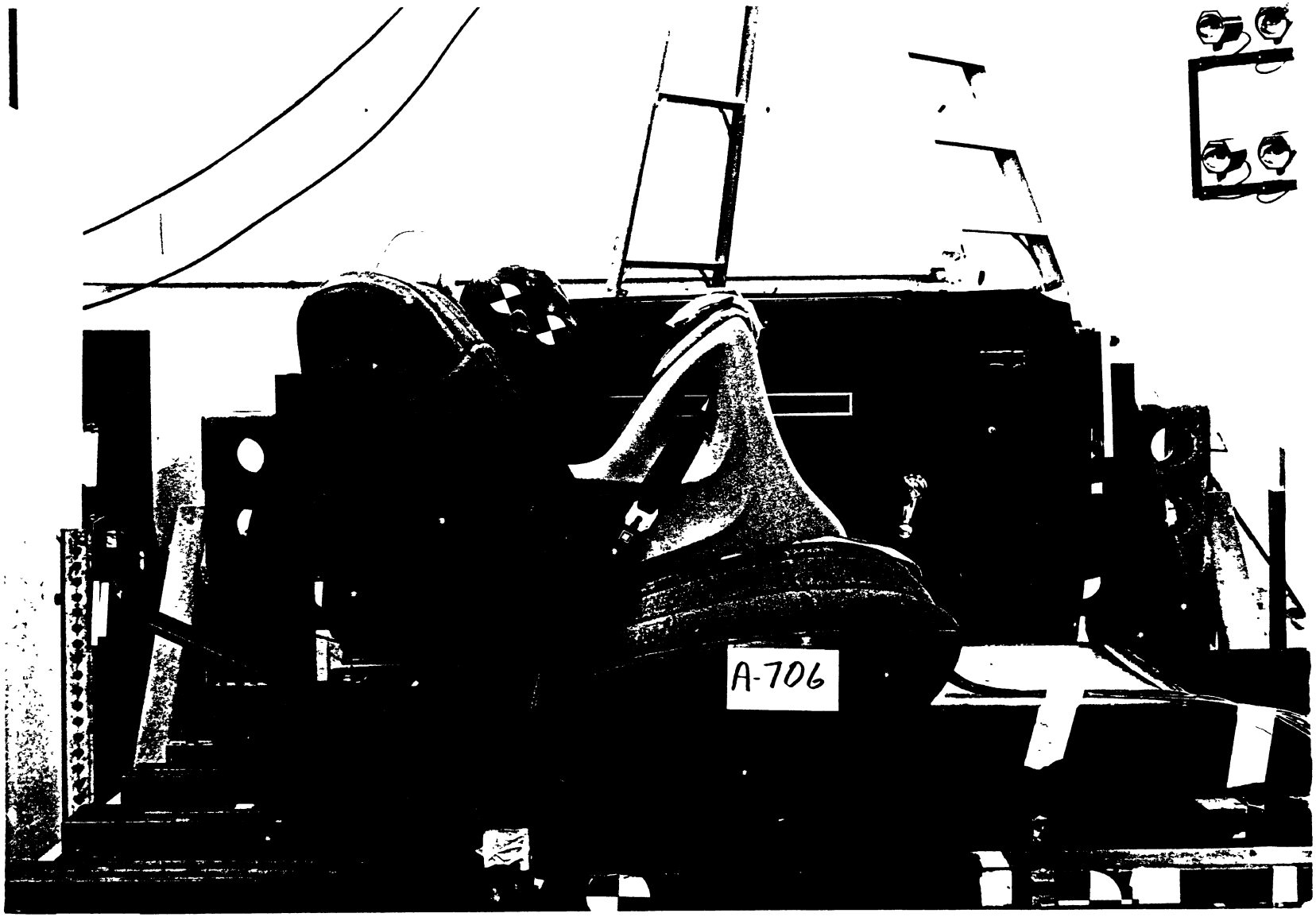


FIGURE A-9 SET UP FOR CHRYSLER MOPAR, SIDE IMPACT

Test No.: A-706

FIGURE A-10 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-706

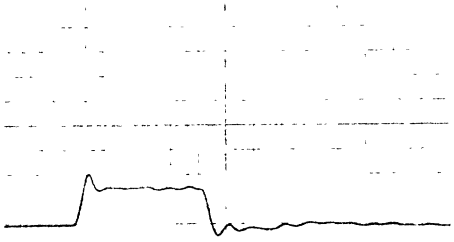
SEAT TYPE Chrysler Mopar

DUMMY 3-Year

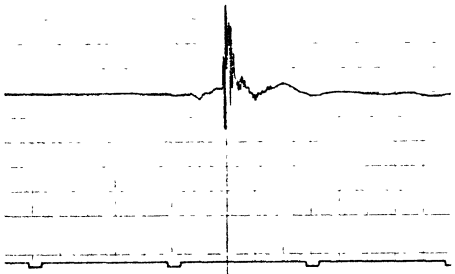
IMPACT TYPE Side

SLED VELOCITY 29.3 ft/sec

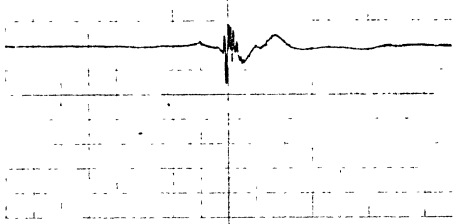
SLED PULSE
2 g's/division
Filtered
Class 60



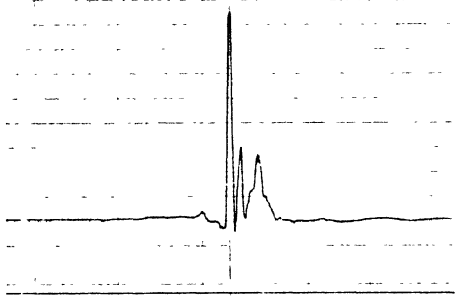
Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000



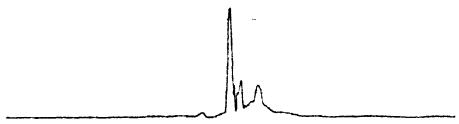
Superior-Inferior
Head Acceleration
5 g's/division
Filgered
Class 1000



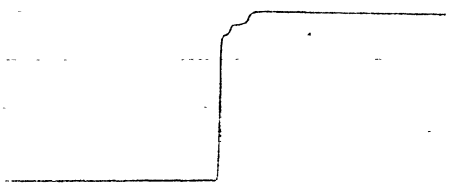
Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
10 g's/division
Filtered
Class 1000



Severity Index
40 sec/div



[illegible] ACCELERATION DATA

TEST NO. A-706

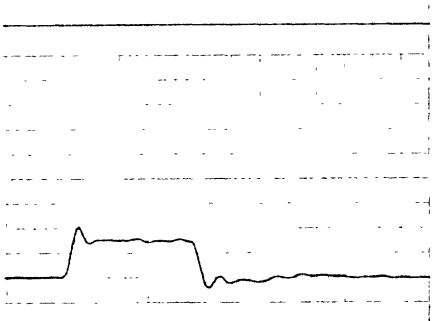
SEAT TYPE Chrysler Mopar

DUMMY 3-Year

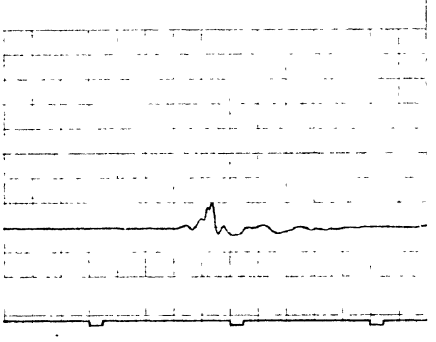
IMPACT TYPE Side

SLED VELOCITY 29.3 ft/sec

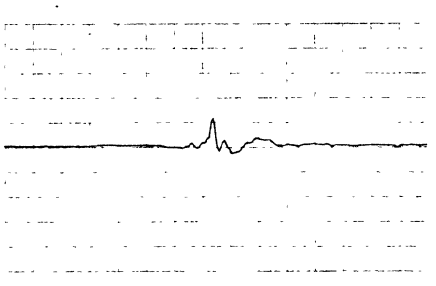
SLED PULSE
2.0 g's/division
Filtered
Class 60



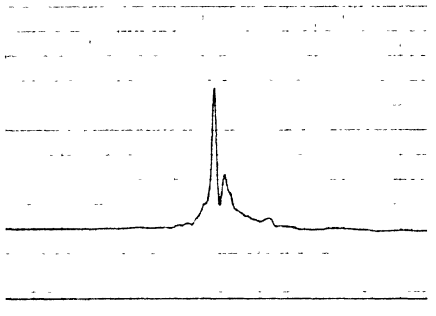
Anterior-Posterior
Chest Acceleration
5.0 g's/division
Filtered
Class 1000



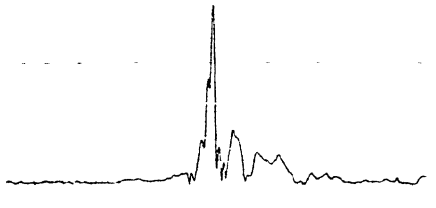
Superior-Inferior
Chest Acceleration
5.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
5.0 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
4.0 g's/division
Filtered
Class 1000



HSRI SUMMARY DATA SHEET

Test Number:	A-693
Test Date:	August 23, 1973
Restraint Descriptions:	G.M. Love Seat
Dummy:	3-Year
Sled Velocity:	30.0 mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Good load distribution, minimum head excursion. Possible overflexion of the neck, also possible abdominal contact with adult lap belt if harness is loose.

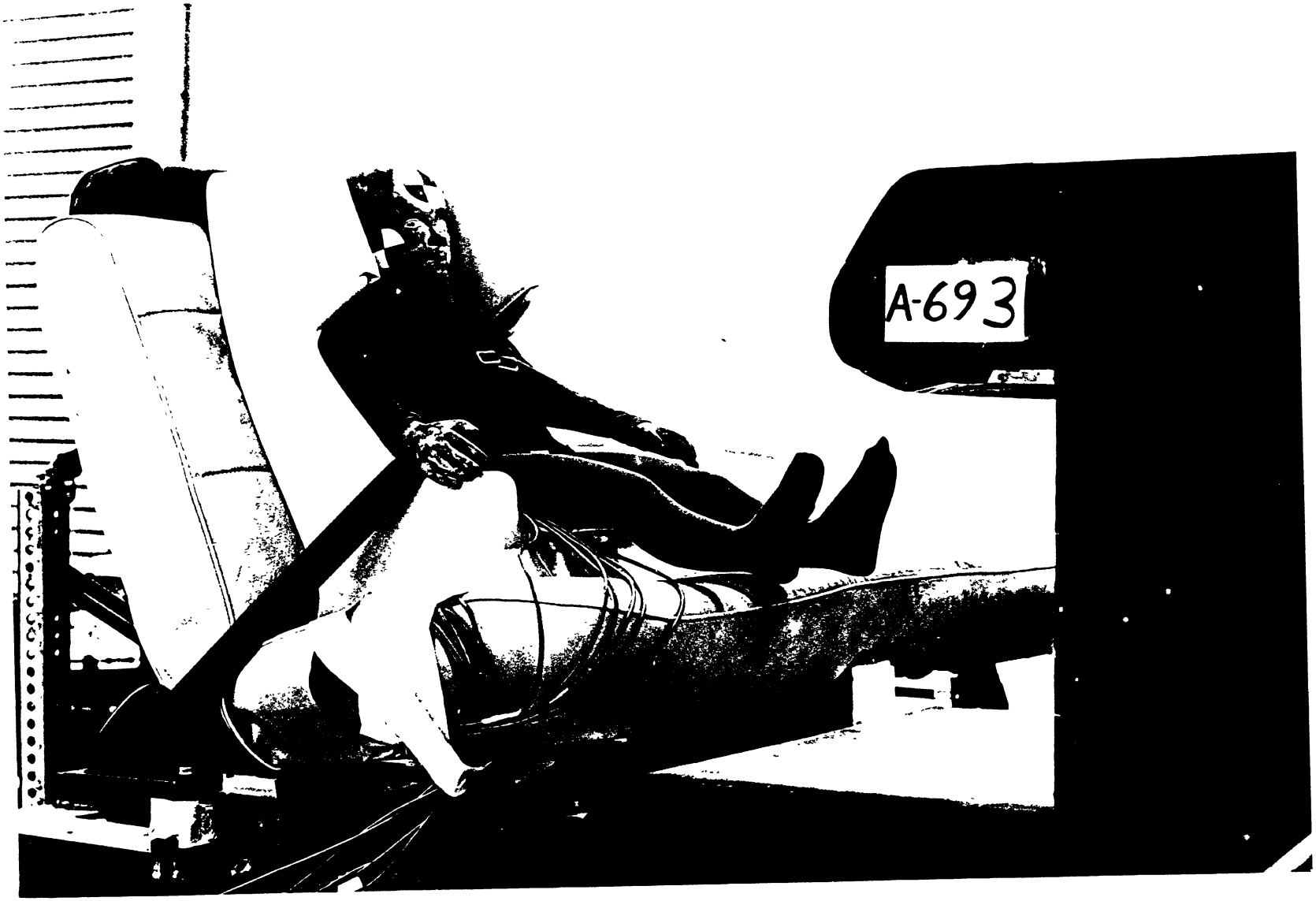


FIGURE A-11 SET UP FOR GENERAL MOTORS LOVE SEAT, FRONT IMPACT

Test No.; A-693

FIGURE A-12 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

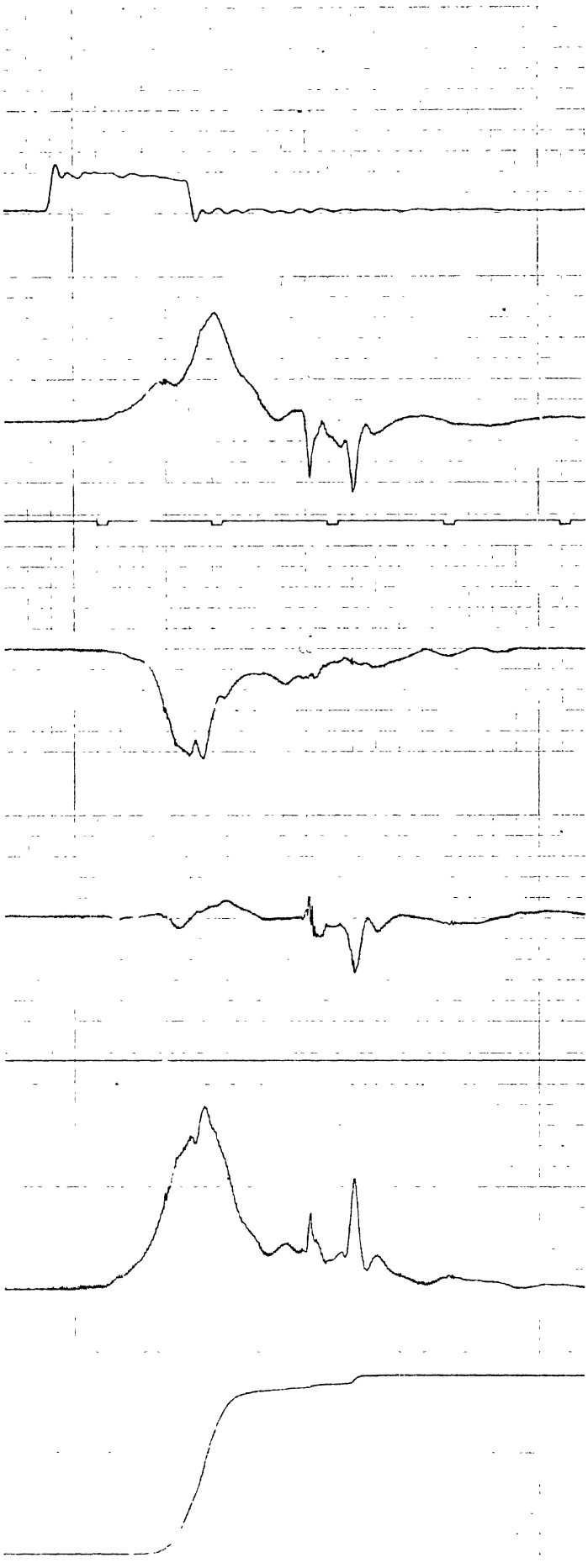
TEST NO. A-693

SEAT TYPE G.M. Love Seat

DUMMY 3-Year

IMPACT TYPE Front

SLED VELOCITY 44 ft/sec



SLED PULSE
2 g's/division
Filtered
Class 60

Anterior-Posterior
Head Acceleration
2.5 g's/division
Filtered
Class 1000

Superior-Inferior
Head Acceleration
2.5 g's/division
Filtered
Class 1000

Left-Right
Head Acceleration
2.5 g's/division
Filtered
Class 1000

Resultant Head
Acceleration
2 g's/division
Filtered
Class 1000

Severity Index
40 sec/div

CHEST ACCELERATION DATA

TEST NO. A-693

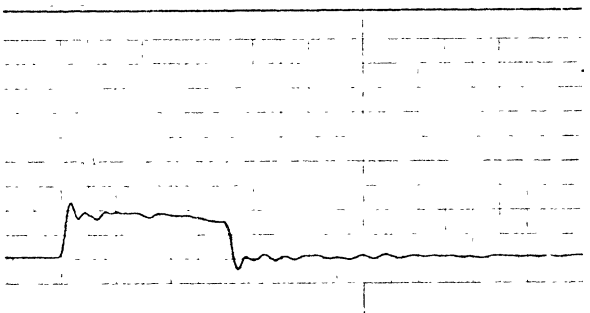
SEAT TYPE G.M. Love Seat

DUMMY 3-Year

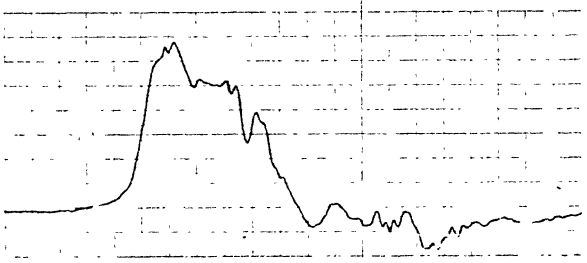
IMPACT TYPE Front

SLED VELOCITY 44 ft/sec

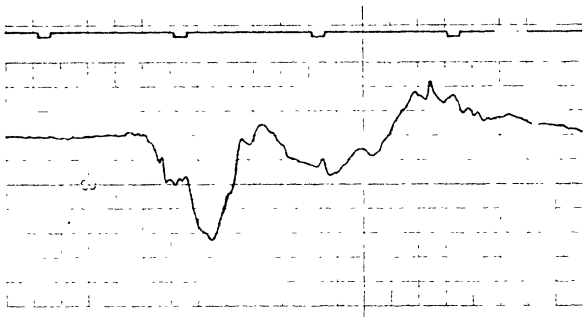
SLED PULSE
2.0 g's/division
Filtered
Class 60



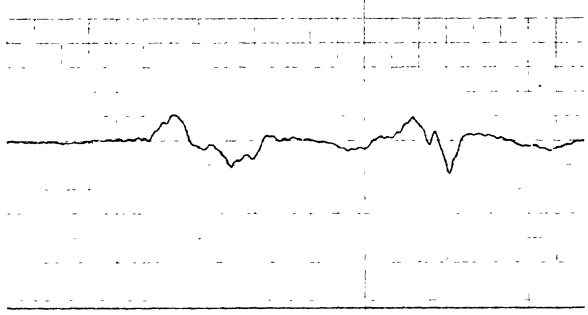
Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000

HSRI SUMMARY DATA SHEET

Test Number:	A-707
Test Date:	August 28, 1973
Restraint Descriptions:	G.M. Love Seat
Dummy:	3-year
Sled Velocity:	20.2 mph
Sled G-Level:	16
Impact Direction:	Side
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

G loads very low. No contact of head and torso with vehicle interior. Lower extremeties contacted door.

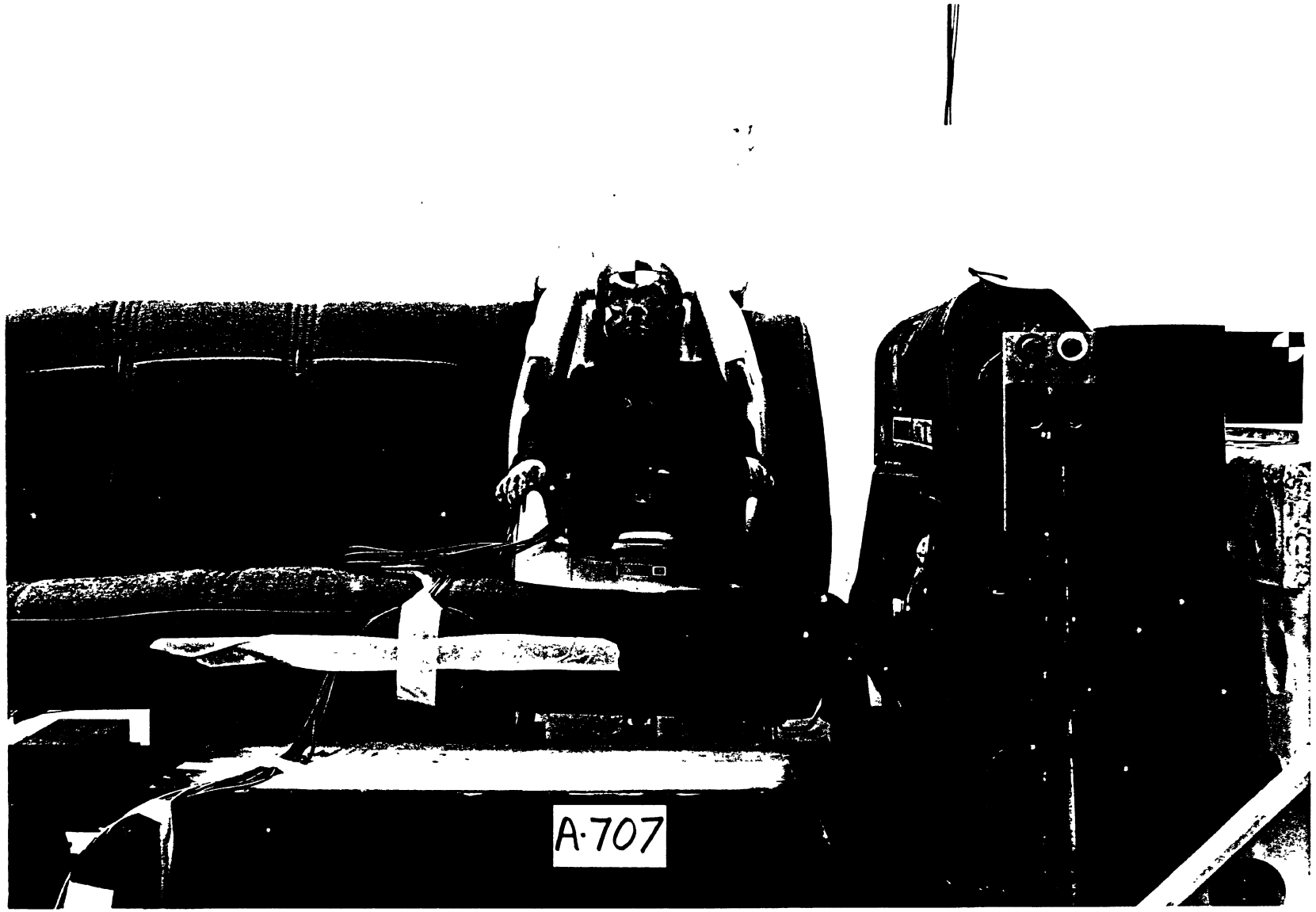


FIGURE A-13 SET UP FOR GENERAL MOTORS LOVE SEAT, SIDE IMPACT

Test No.: A-707

FIGURE A-14 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-707

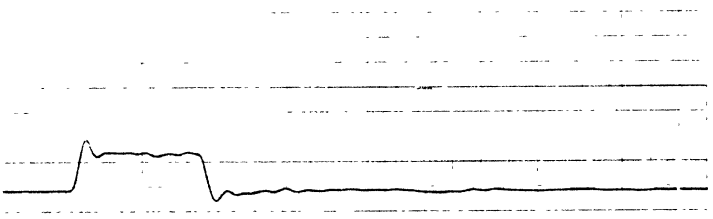
SEAT TYPE G.M. Love Seat

DUMMY 3-Year

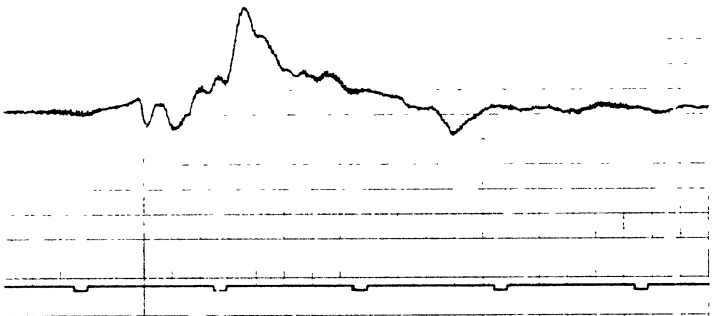
IMPACT TYPE Side

SLED VELOCITY 29.6 ft/sec

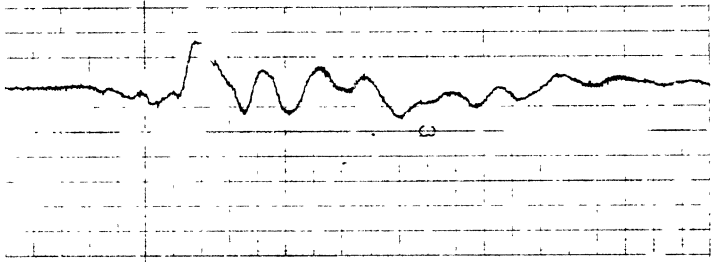
SLED PULSE
2 g's/division
Filtered
Class 60



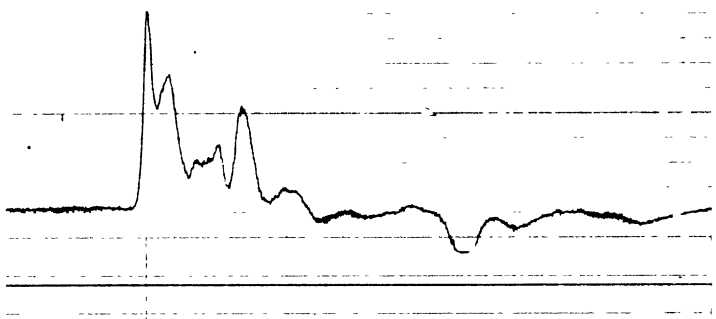
Anterior-Posterior
Head Acceleration
1 g's/division
Filtered
Class 1000



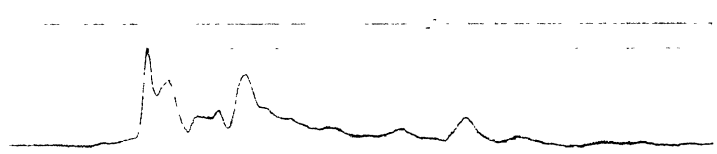
Superior-Inferior
Head Acceleration
1 g's/division
Filtered
Class 1000



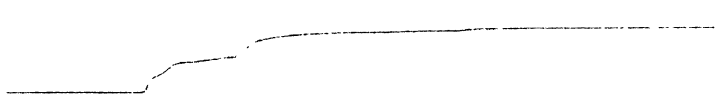
Left-Right
Head Acceleration
1 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
2 g's/division
Filtered
Class 1000



Severity Index
10 sec/div



CHEST ACCELERATION DATA

TEST NO. A-707

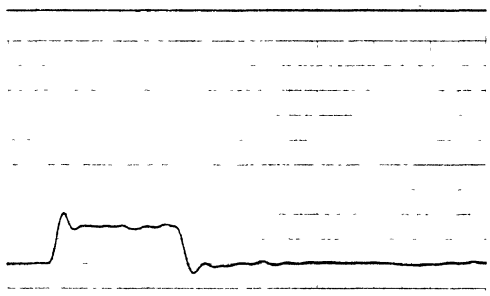
SEAT TYPE G.M. Love Seat

DUMMY 3-Year

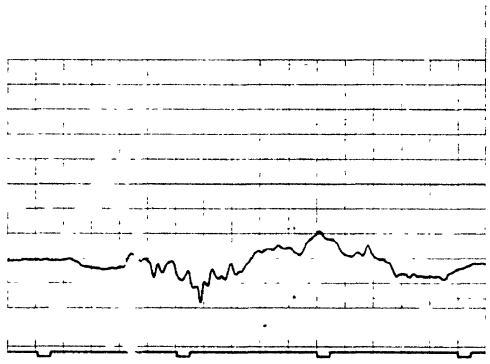
IMPACT TYPE Side

SLED VELOCITY 29.6 ft/sec

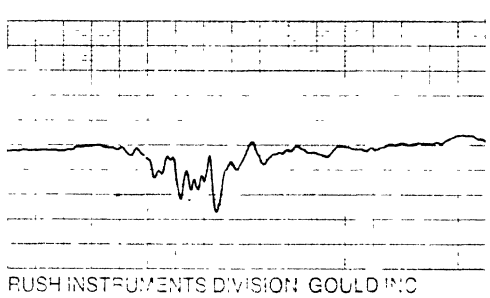
SLED PULSE
2.0 g's/division
Filtered
Class 60



Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

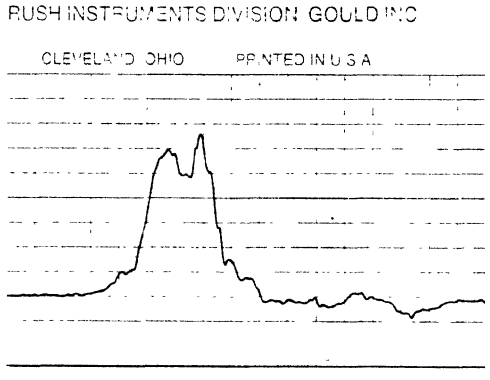


Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

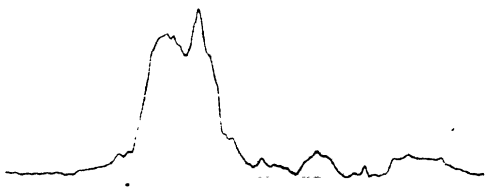


RUSH INSTRUMENTS DIVISION GOULD INC
CLEVELAND OHIO PRINTED IN U.S.A.

Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
1.0 g/division
Filtered
Class 1000



HSRI SUMMARY DATA SHEET

Test Number:	A-712
Test Date:	August 30, 1973
Restraint Descriptions:	G.M. Love Seat
Dummy:	3-Year
Sled Velocity:	19.3 mph
Sled G-Level:	16
Impact Direction:	Rear
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Gentle ride, g loads very low, head well supported.

FIGURE A-15 SET UP FOR GENERAL MOTORS LOVE SEAT, BACK IMPACT

FIGURE A-16 GRAPHCHEK SEQUENCE CAMERA

Test No. A-210

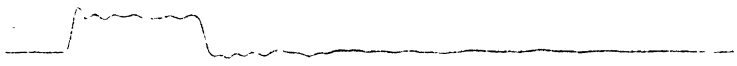
SEAT TYPE G.M. Love Seat

DUMMY 3-Year

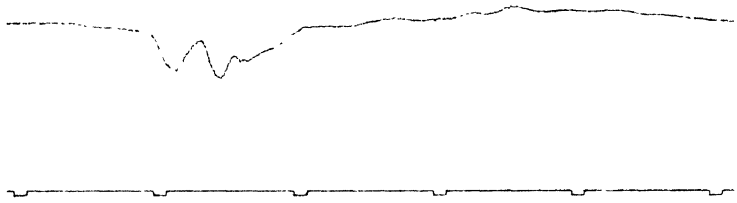
IMPACT TYPE Rear

SLED VELOCITY 28.3 ft/sec

SLED PULSE
2 g's/division
Filtered
Class 60

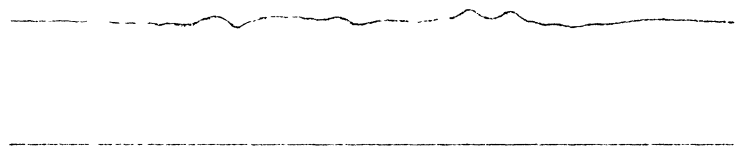


Anterior-Posterior
Head Acceleration
2.5 g's/division
Filtered
Class 1000

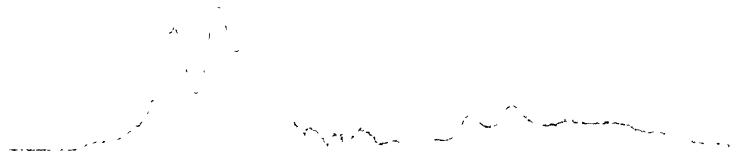


Superior-Inferior
Head Acceleration
2.5 g's/division
Filgered
Class 1000

Left-Right
Head Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
1 g's/division
Filtered
Class 1000



Severity Index
[illegible]

TEST NO. A-712 SEAT TYPE G.M. Love Seat

3-Year IMPACT TYPE Rear

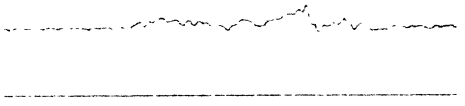
SLED VELOCITY 28.3 ft/sec

SLED PULSE
2.0 g's/division
Filtered
Class 60

Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Left-right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Head Acceleration
1.0 g's/division
Filtered

USRT SURROGATE DATA SHEET

Test Number:	A-694
Test Date:	August 24, 1973
Restraint Description:	G.M. Love Seat without back strap
[illegible]	[illegible]
Sled Velocity:	30.0 mph
Sled Deceleration:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observations:

Seat pivoted forward, resulting in large head excursions. Distinct possibility of suit and occupant retaining out of adult lap belt and becoming a free body.

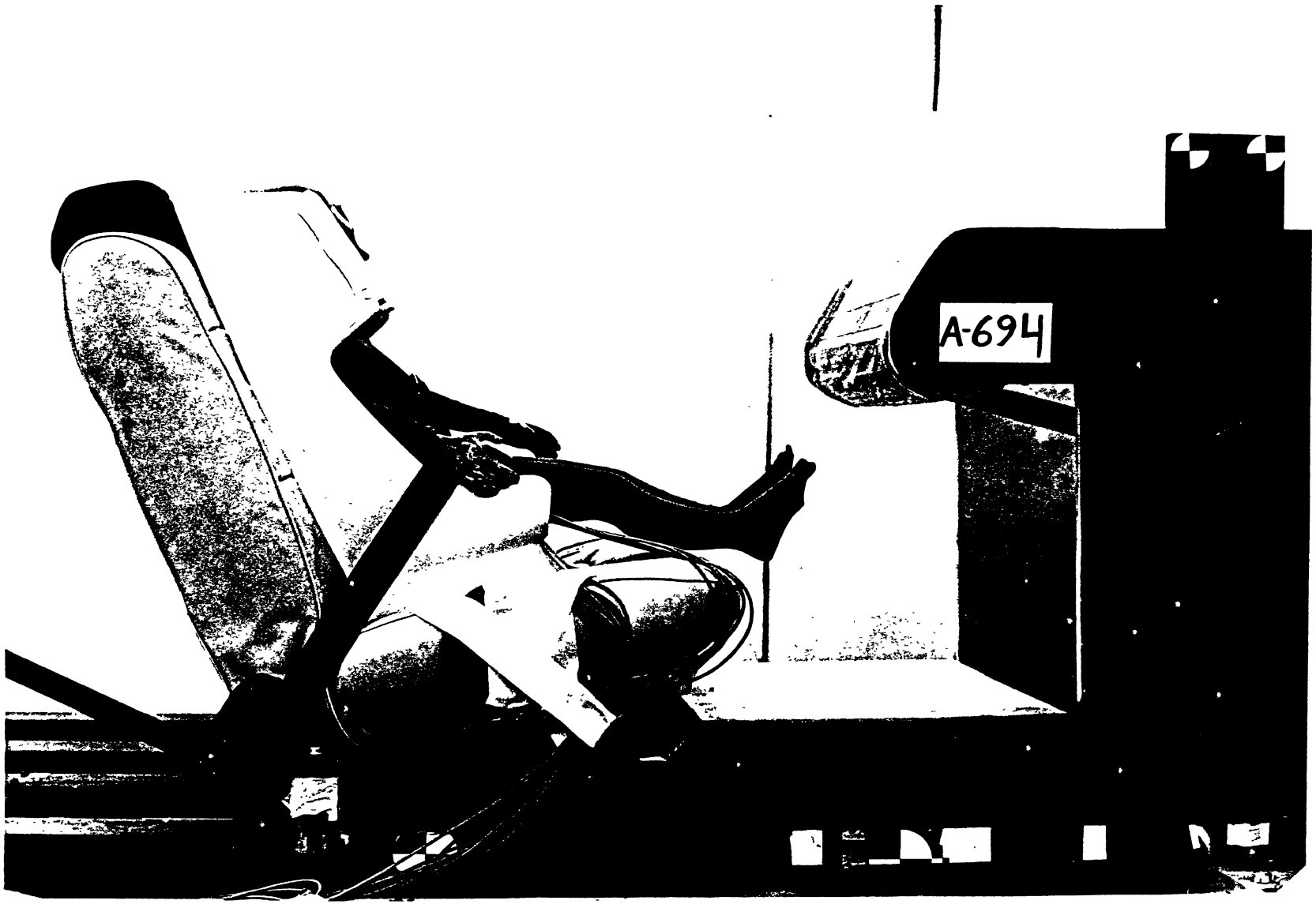


FIGURE A-17 SET UP FOR GENERAL MOTORS LOVE SEAT WITHOUT REAR STRAP, FRONT IMPACT

FIGURE A-18 GRAPHCHEK SEQUENCE CAMERA

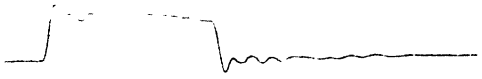
TEST NO. [illegible]

DUMMY 3-Year

SLED VELOCITY 44.0 ft/sec

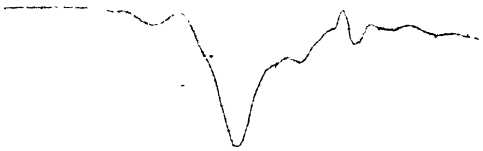
SEAT TYPE G.M. Love Seat
Run without back strap
IMPACT TYPE Front

SLED PULSE
2 g's/division
Filtered
Class [illegible]

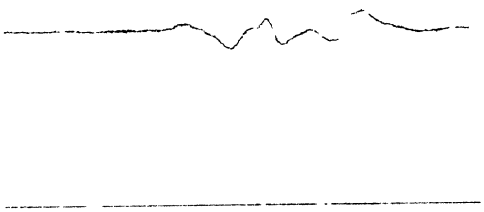


Anterior-Posterior
Head Acceleration
2.5 g's/division
Filtered
Class 1000

Superior-Inferior
Head Acceleration
2.5 g's/division
Filgered
Class 1000



Left-Right
Head Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
2 g's/division
Filtered
Class 1000

Severity Index
[illegible] g's/div

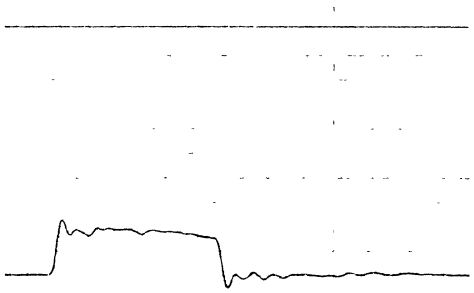
TEST NO. A-694

DUMMY 3-Year

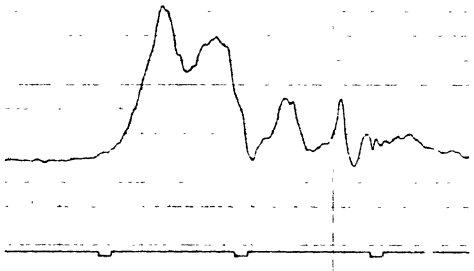
SLED VELOCITY 44 ft/sec

SEAT TYPE G.M. Love Seat
Run without back strap
IMPACT TYPE Front

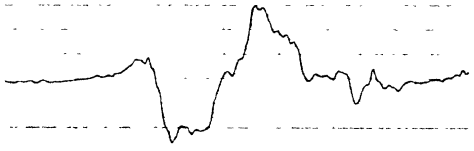
SLED PULSE
2.0 g's/division
Filtered
Class 60



Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

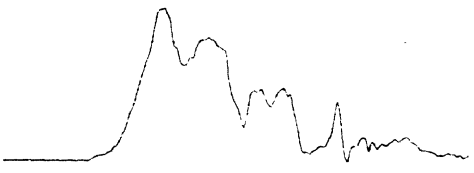


Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000



HSRI SUMMARY DATA SHEET

Test Number:	A-696
Test Date:	August 24, 1973
Restraint Descriptions:	G.M. Love Seat with Adult Lap Belt in lowest position
Dummy:	3-Year
Sled Velocity:	30.0 mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Distinct possibility of seat back failure at the point of connection with the top strap. The seat would then pivot out of the adult lap belt and become a free body.

Otherwise, the seat performance in this configuration is good.

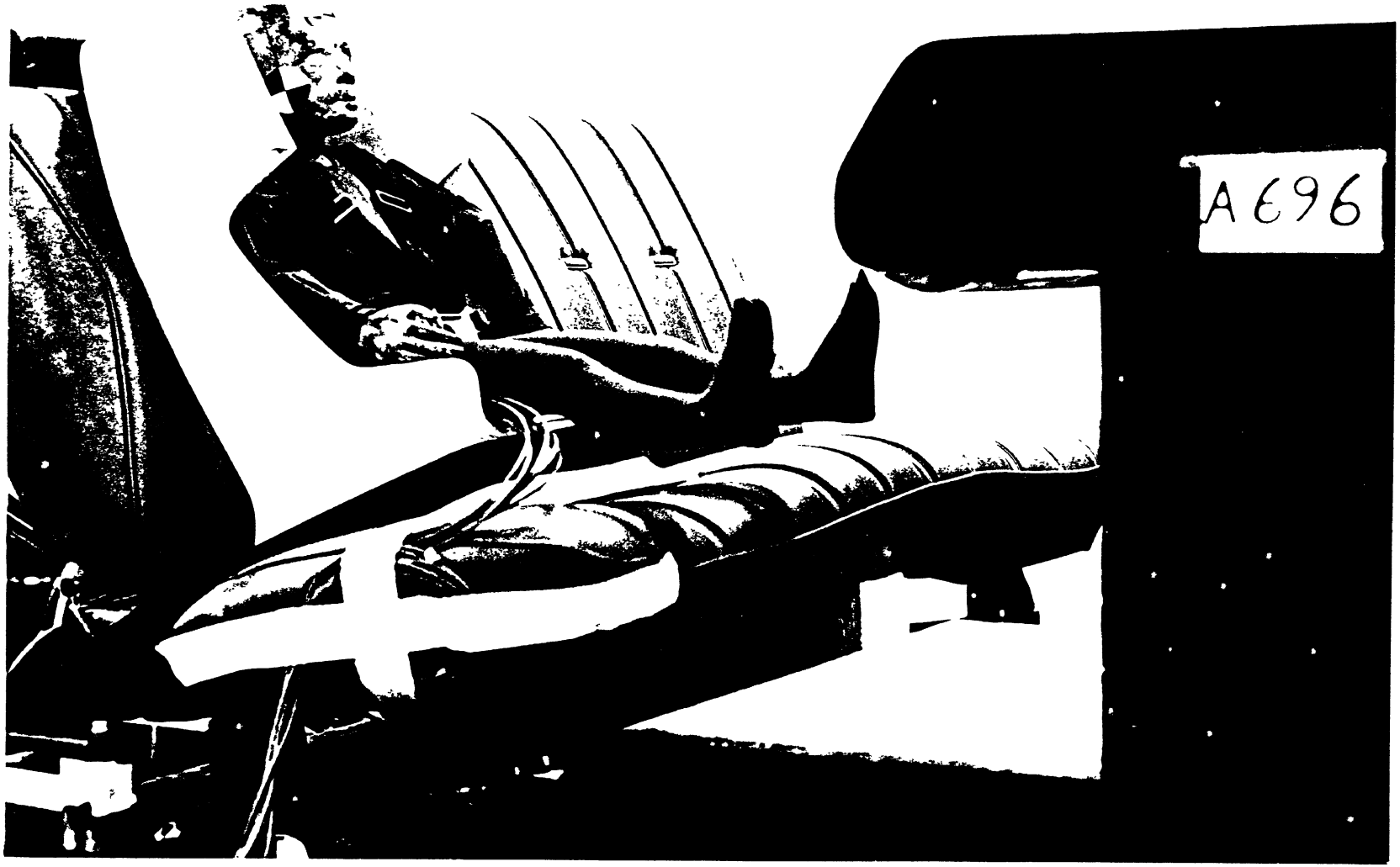


FIGURE A-19 SET UP FOR GENERAL MOTORS LOVE SEAT WITH STRAP AROUND LOWER PORTION, FRONT IMPACT

Test No.; A-696

FIGURE A-20 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-696

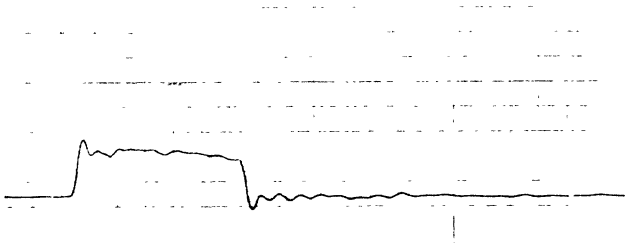
DUMMY 3-Year

SLED VELOCITY 44.0 ft /sec

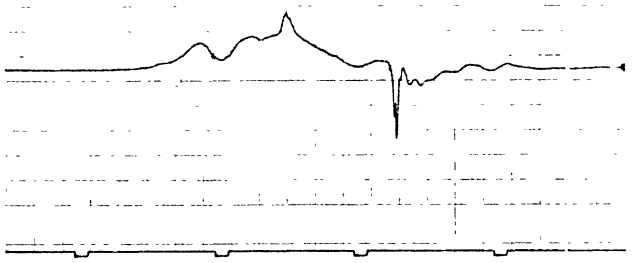
SEAT TYPE G.M. Love Seat

IMPACT TYPE Run with adult lap belt in lowest position - Front

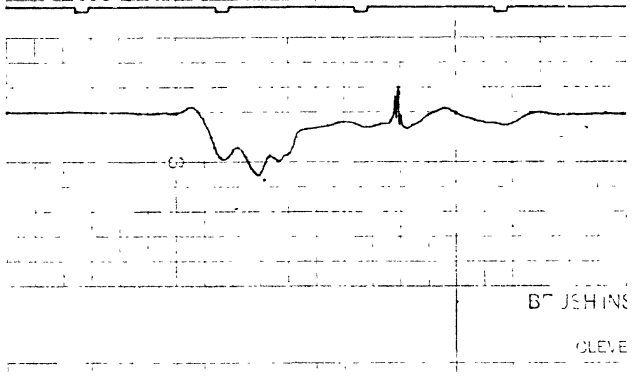
SLED PULSE
2 g's/division
Filtered
Class 60



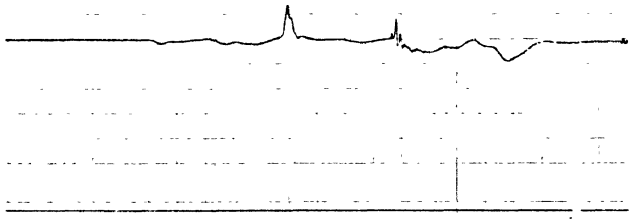
Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000



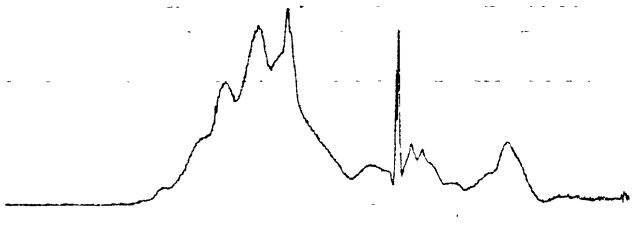
Superior-Inferior
Head Acceleration
5 g's/division
Filgered
Class 1000



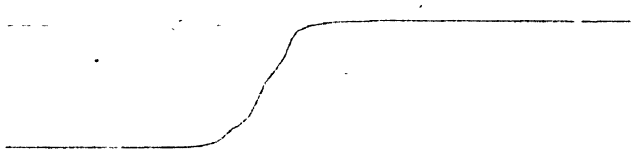
Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
2 g's/division
Filtered
Class 1000



Severity Index
40 sec/div



CHEST ACCELERATION DATA

TEST NO. A-696

DUMMY 3-Year

SLED VELOCITY 44 ft/sec

SEAT TYPE G.M. Love Seat

IMPACT TYPE Front - Run with adult lap belt in lowest position

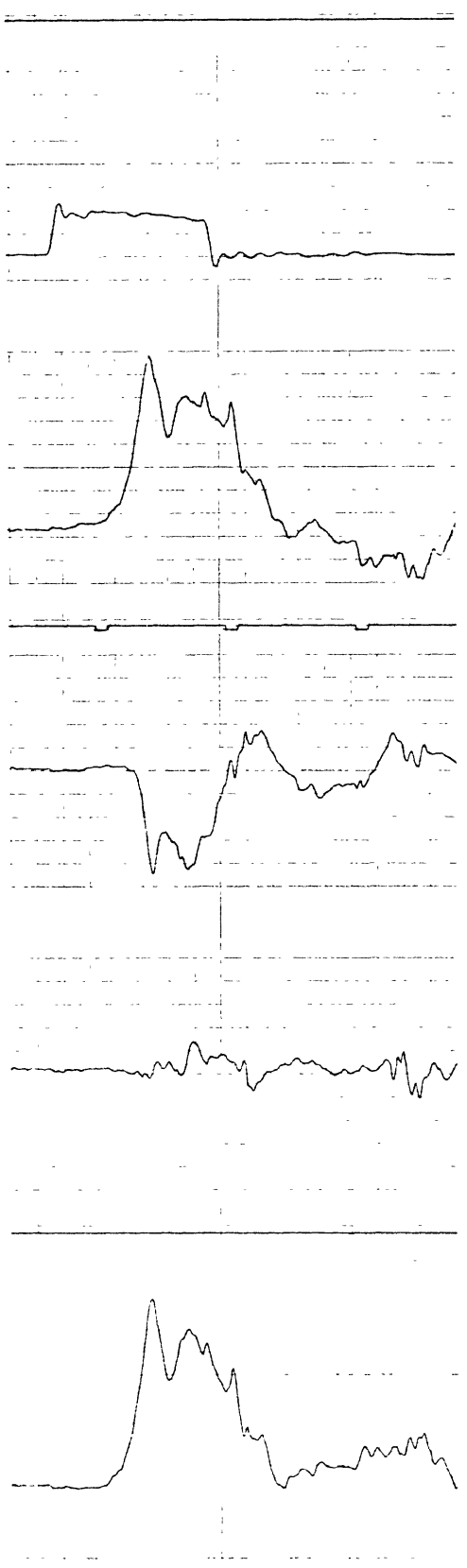
SLED PULSE
2.0 g's/division
Filtered
Class 60

Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000



HSRI SUMMARY DATA SHEET

Test Number:	A-697
Test Date:	August 24, 1973
Restraint Descriptions:	Collier-Keyworth Bobby Mac
Dummy:	3-Year
Sled Velocity:	29.5 mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Head excursion minimal, chest g loads moderate, good load distribution. Facial injuries possible due to impact with stiff face shield.

FIGURE A-21 SET UP FOR COLLIER-KENTWORTH BOBBY-MAC, FRONT IMPACT

FIGURE A-22 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-697

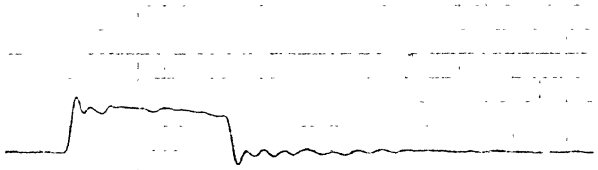
DUMMY 3-Year

SLED VELOCITY 43.3 ft

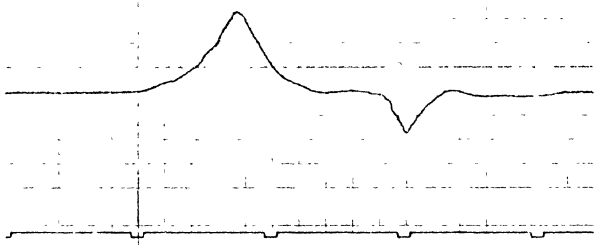
SEAT TYPE Collier-Keyworth Bobby-Mac

IMPACT TYPE Front

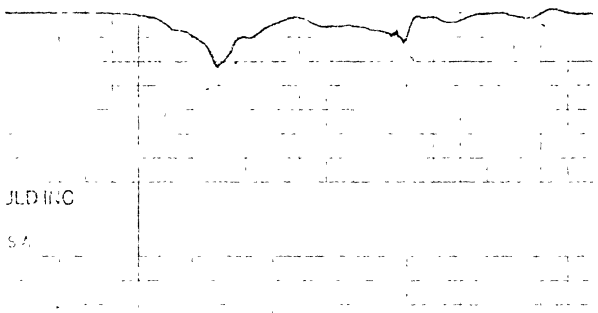
SLED PULSE
2 g's/division
Filtered
Class 60



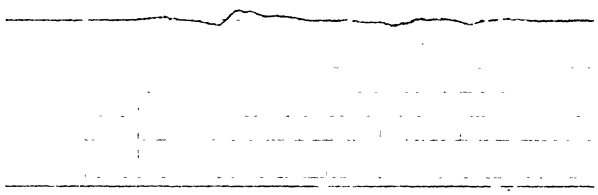
Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000



Superior-Inferior
Head Acceleration
5 g's/division
Filgered
Class 1000

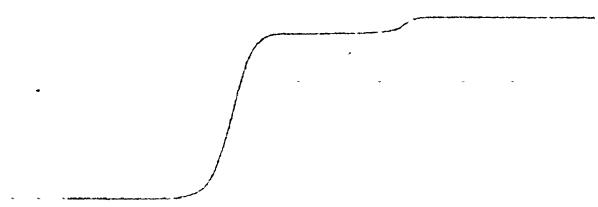


Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
2 g's/division
Filtered
Class 1000

Severity Index
40 sec/div



TEST NO. A-697

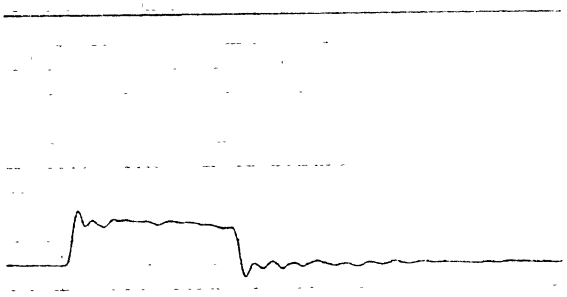
SEAT TYPE Collier-Keywworth Bobby-Mac

DUMMY 3-Year

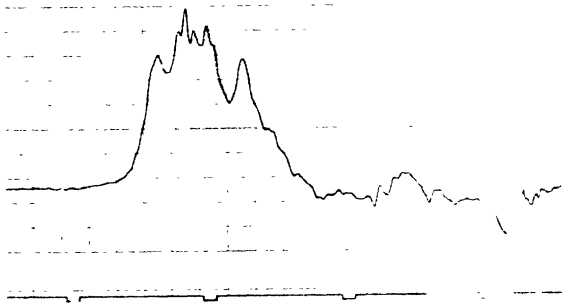
IMPACT TYPE Front

SLED VELOCITY 43.3 ft/sec

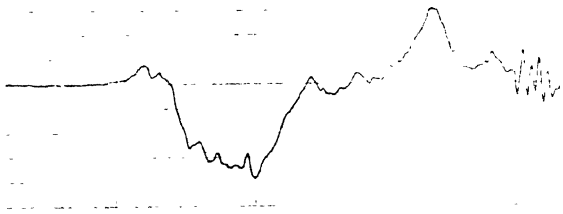
SLED PULSE
2.0 g's/division
Filtered
Class 60



Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000

HSRI SUMMARY DATA SHEET

Test Number:	A-708
Test Date:	August 28, 1973
Restraint Descriptions:	Collier-Keyworth Bobby-Mac
Dummy:	3-year
Sled Velocity:	19.9 mph
Sled G-Level:	16
Impact Direction:	Side
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Some (limited) protection in side impact. Head impacted door.

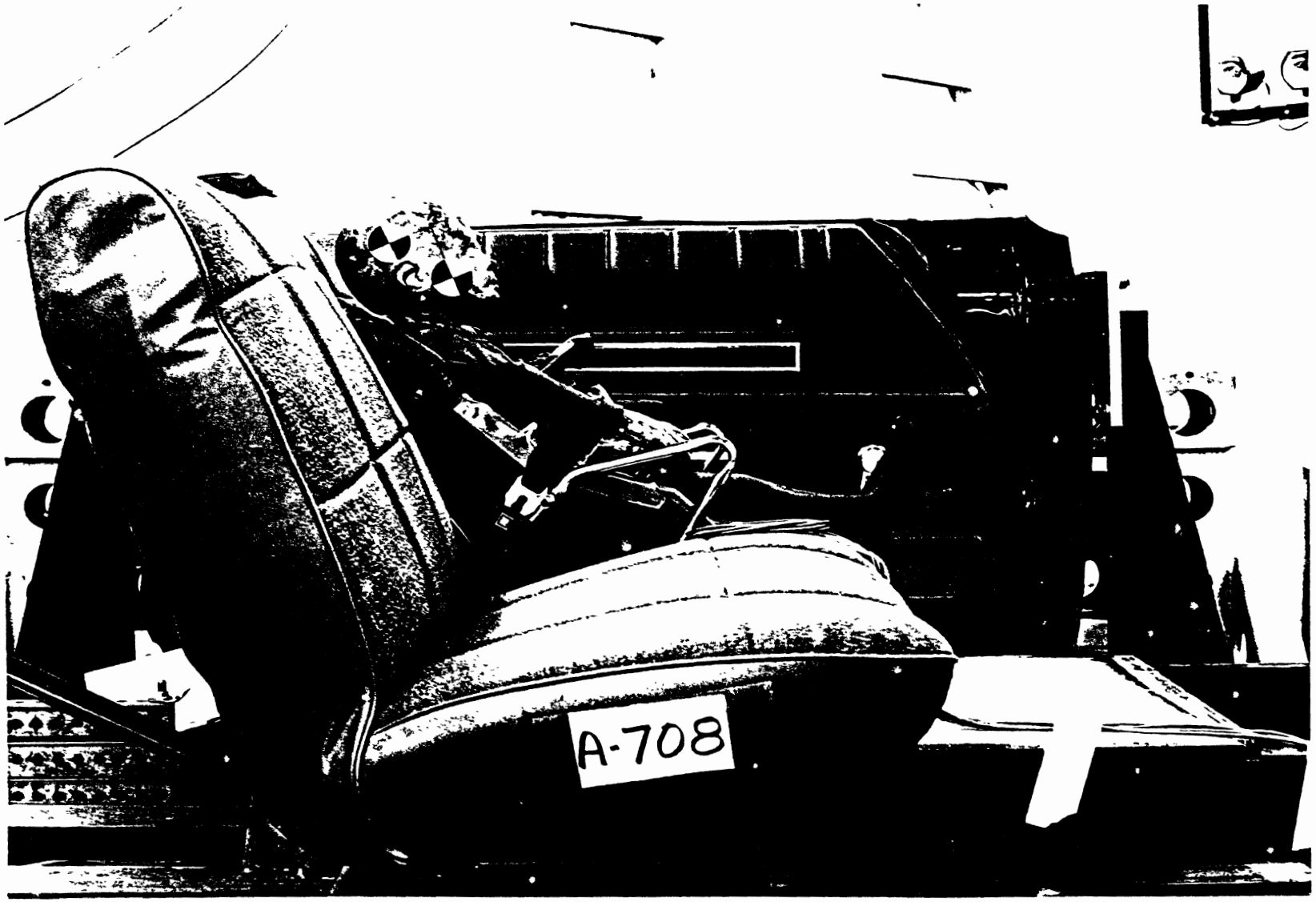
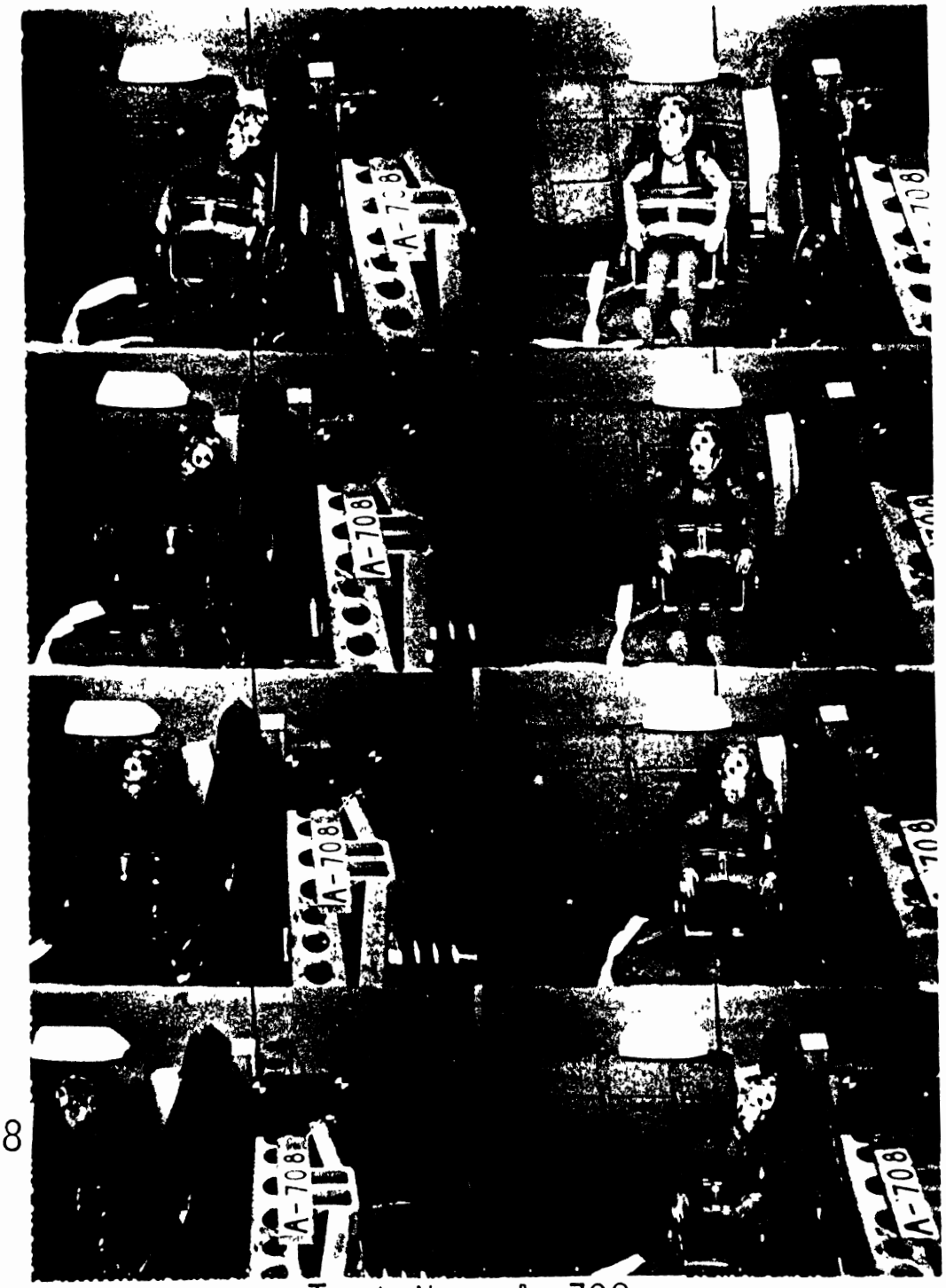


FIGURE A-23 SET UP FOR COLLIER-KENTWORTH BOBBY-MAC, SIDE IMPACT



Test No.: A-708

FIGURE A-24 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-708

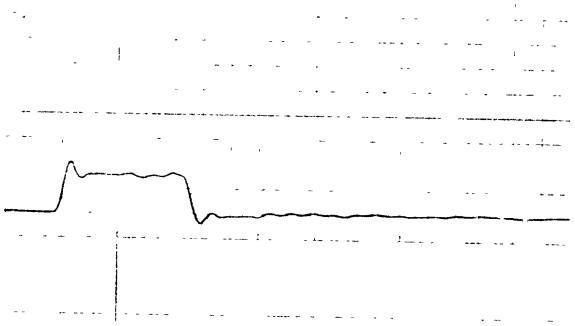
DUMMY 3-Year

SLED VELOCITY 29.2 ft

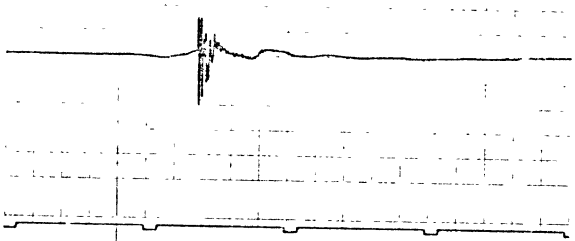
SEAT TYPE Collier-Keyworth Bobby-Mac

IMPACT TYPE Side

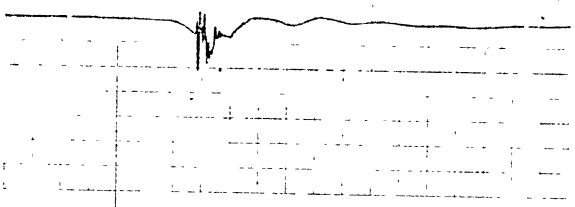
SLED PULSE
2 g's/division
Filtered
Class 60



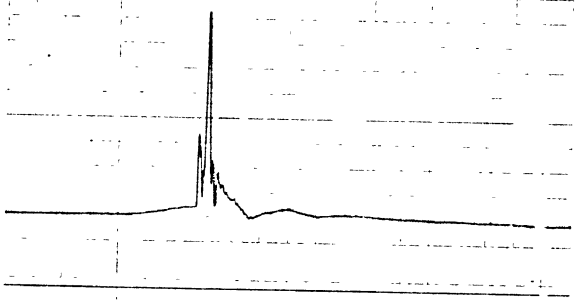
Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000



Superior-Inferior
Head Acceleration
5 g's/division
Filgered
Class 1000

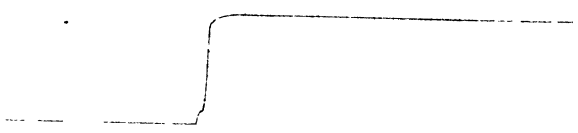


Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
10 g's/division
Filtered
Class 1000

Severity Index
40 sec/div



TEST NO. A-730

SEAT TYPE Collier-Keyworth Bobby-Mac

DUMMY 3-Year

IMPACT TYPE Side

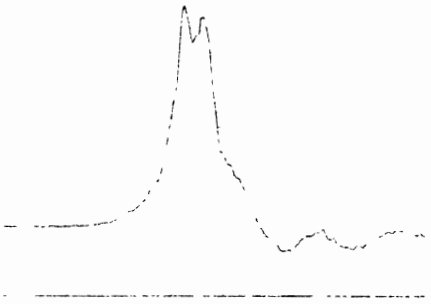
SLED VELOCITY 29.2 ft/sec

SLED (CLSF)
2.0 g's/division
Filtered
Class 60

Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Resultant
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



HSRI SUMMARY DATA SHEET

Test Number:	A-714
Test Date:	August 30, 1973
Dummy:	3-Year
Sled velocity:	20.2 mph
Sled G-Level:	16
Impact direction:	Rear
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observations:

Gentle ride

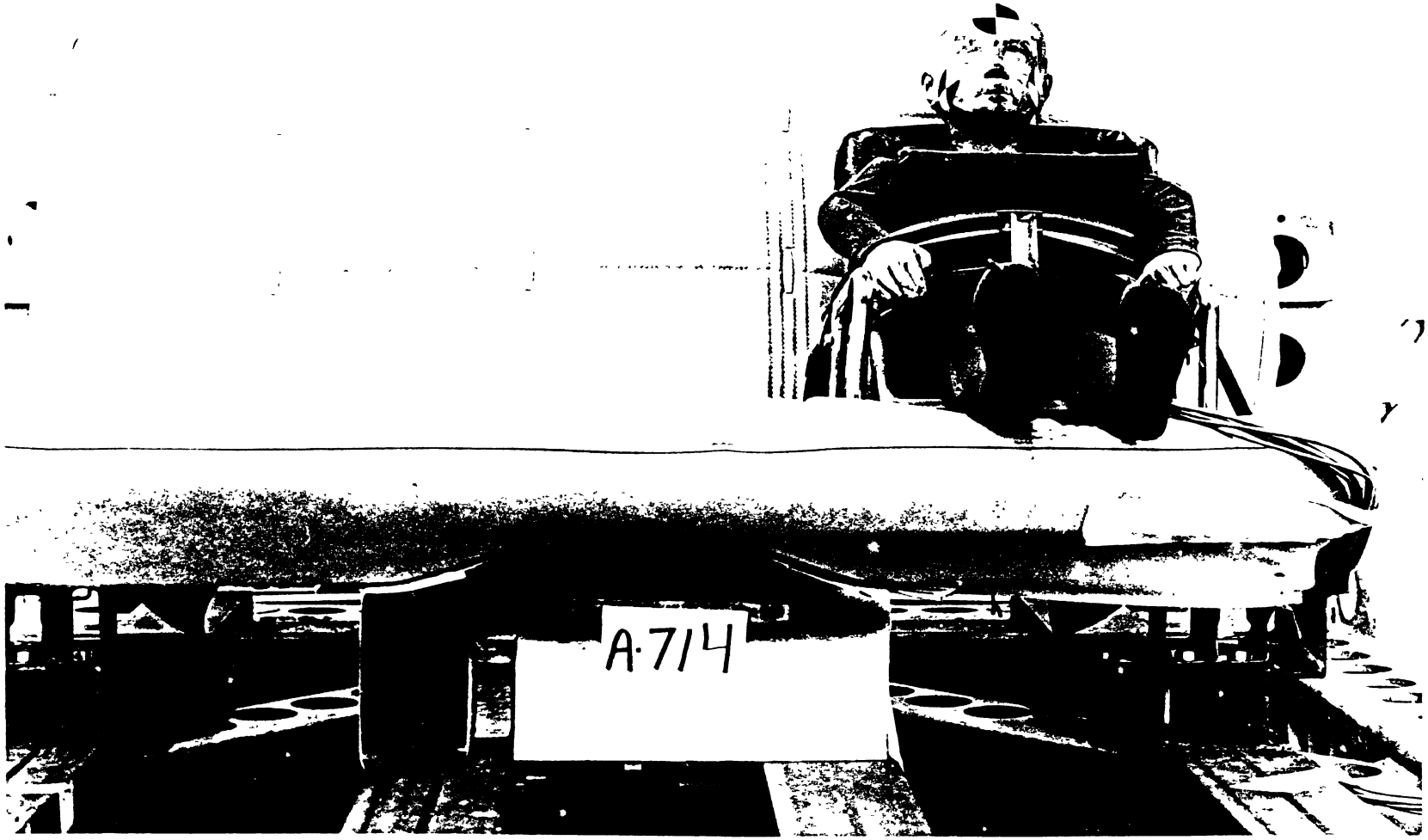


FIGURE A-25 SET UP FOR COLLIER-KENTWORTH BOBBY-MAC, BACK IMPACT

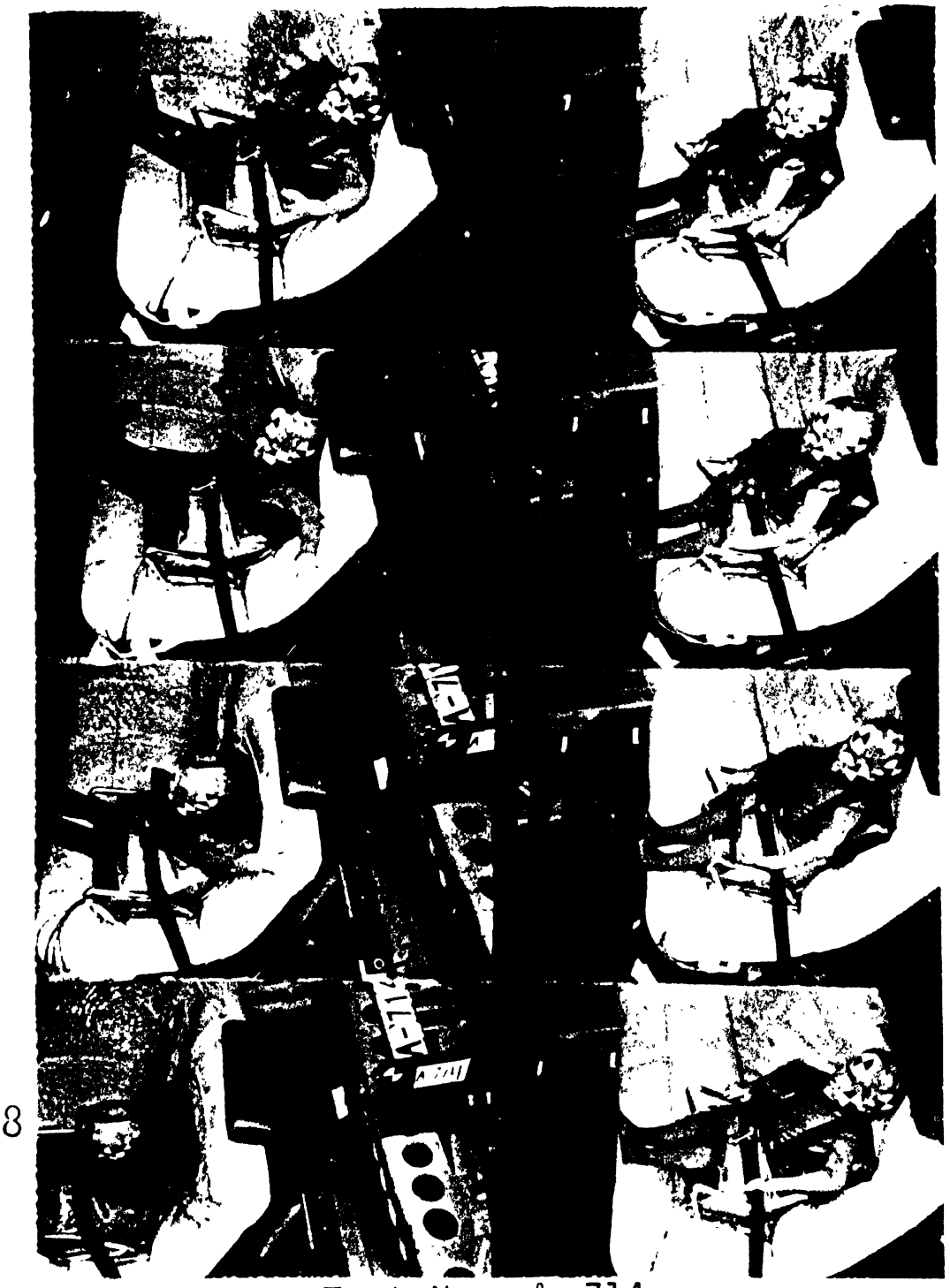


FIGURE A-26 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-714

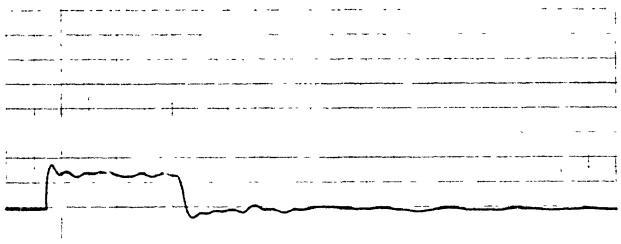
SEAT TYPE Collier-Keyworth Bobby-Mac

DUMMY 3-Year

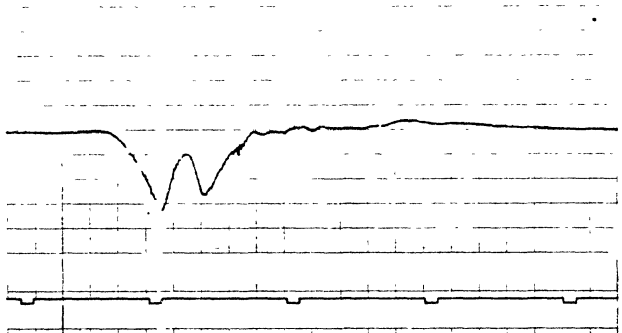
IMPACT TYPE Rear

SLED VELOCITY 29.6 ft/sec

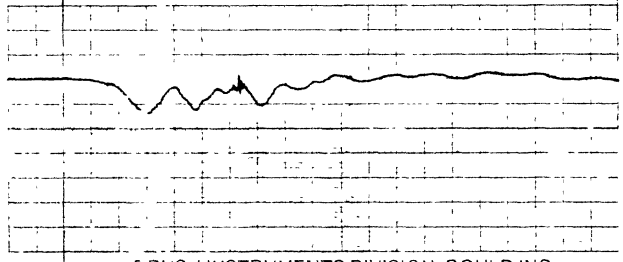
SLED PULSE
2 g's/division
Filtered
Class 60



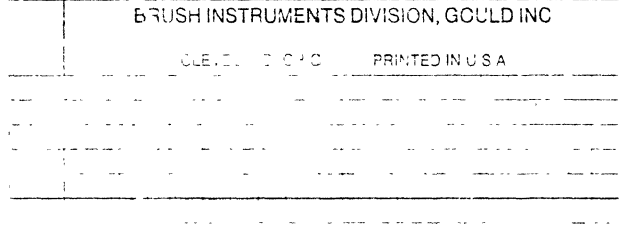
Anterior-Posterior
Head Acceleration
2.5 g's/division
Filtered
Class 1000



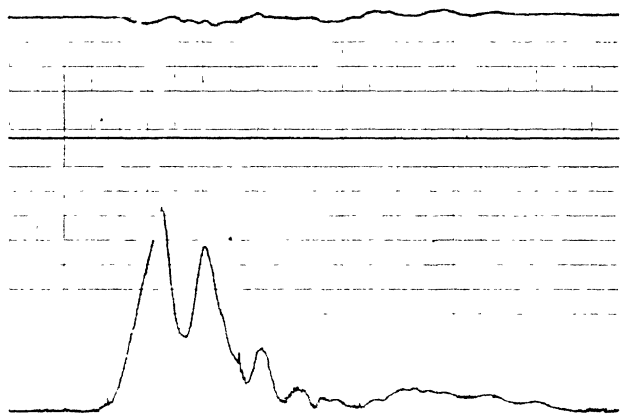
Superior-Inferior
Head Acceleration
2.5 g's/division
Filtered
Class 1000



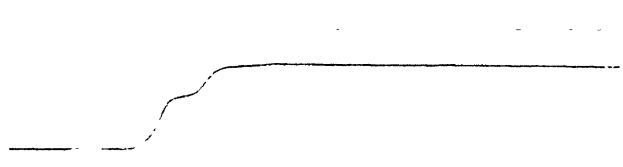
Left-Right
Head Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
1 g's/division
Filtered
Class 1000



Severity Index
10 sec/div



TEST NO. A-714

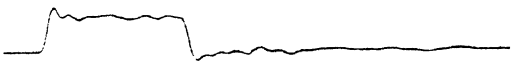
SEAT TYPE Collier-Keyworth Bobby-Mac

DUMMY 3-Year

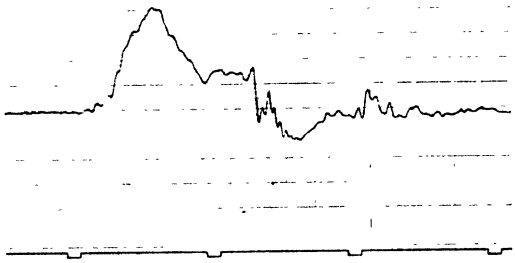
IMPACT TYPE Rear

SLED VELOCITY 29.6 ft/sec

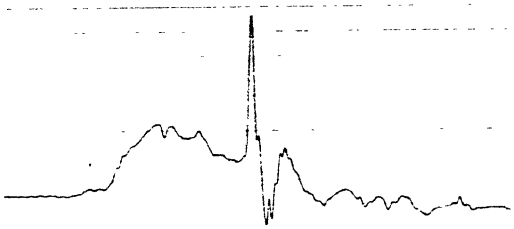
SLED PULSE
2.0 g's/division
Filtered
Class 60



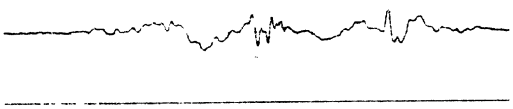
Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



HSRI SUMMARY DATA SHEET

Test Number:	A-6[illegible]
Test Date:	August 24, 1973
[illegible]	[illegible]
Dummy:	3-Year
Sled Velocity:	2[illegible] mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Large head [illegible]cursion (head impacted [illegible] at high velocity). Extension of neck was severe. Abdominal loading resulted from direct contact with the adult lap belt. G levels extremely high.

FIGURE A-27 SET UP FOR IRVIN I-65, FRONT IMPACT

Test No.: A-698

FIGURE A-28 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-698

SEAT TYPE Irvin Model I-165

DUMMY 3-Year

IMPACT TYPE Front

SLED VELOCITY 43.8 ft/sec

SLED PULSE
2.0 g's/division
Filtered
Class 60

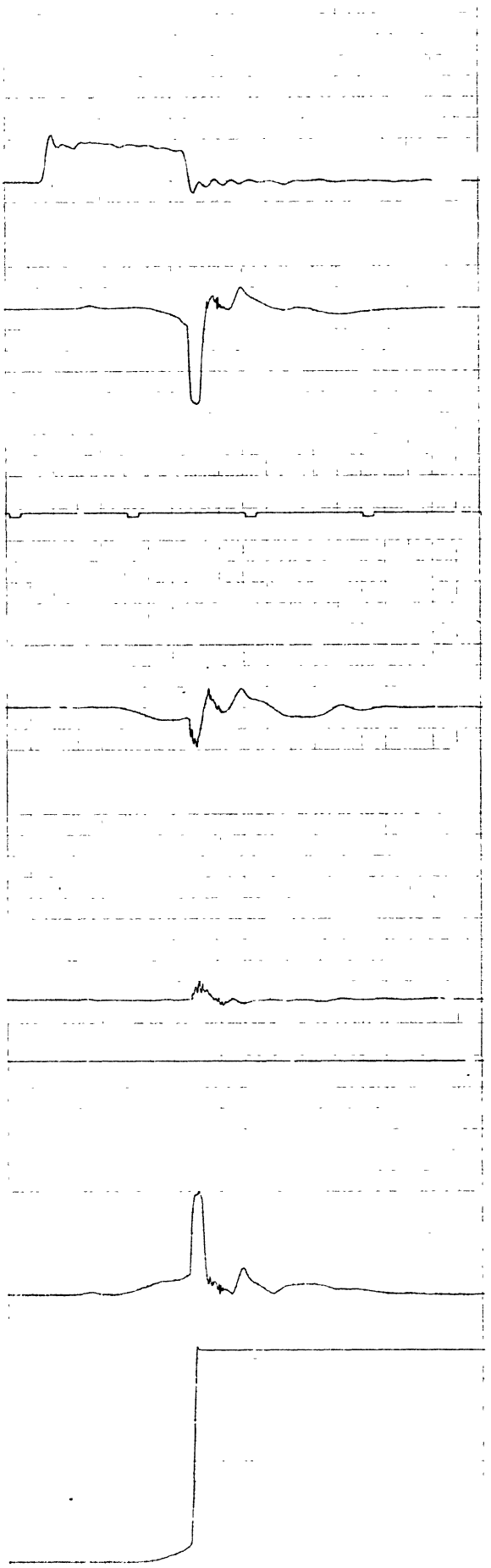
Anterior-Posterior
Head Acceleration
10.0 g's/division
Filtered
Class 1000

Superior-Inferior
Head Acceleration
10.0 g's/division
Filgered
Class 1000

Left-Right
Head Acceleration
10.0 g's/division
Filtered
Class 1000

Resultant Head
Acceleration
10.0g's/division
Filtered
Class 1000

Severity Index
40.0 sec/div



CHEST ACCELERATION DATA

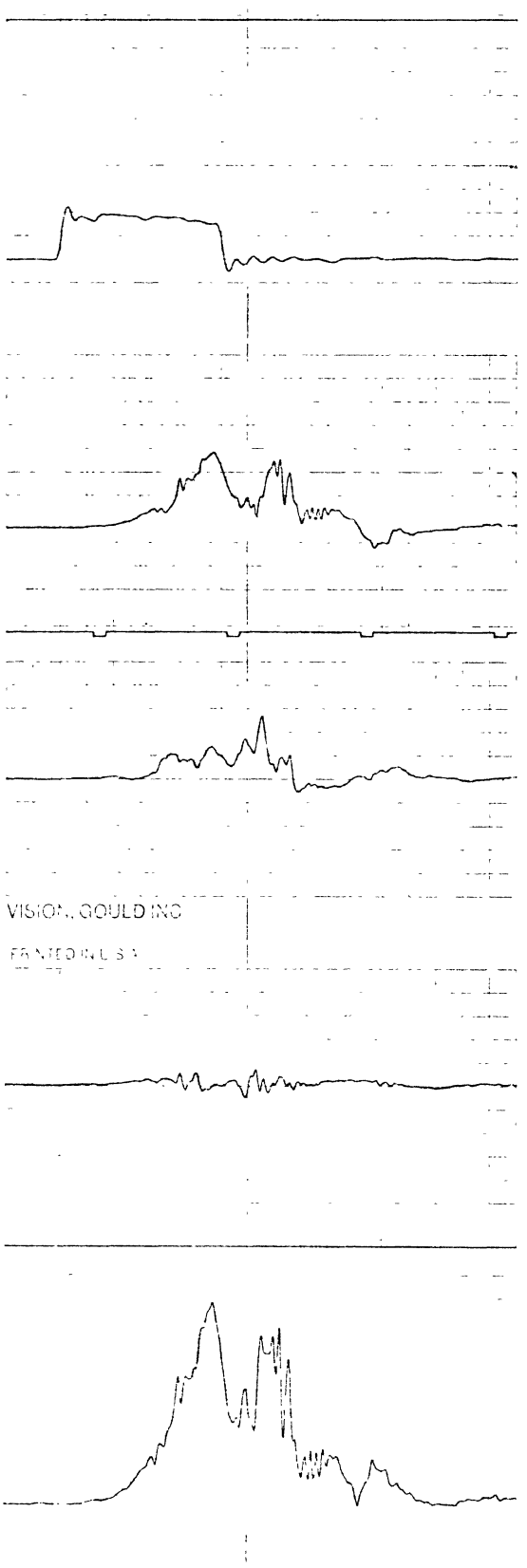
TEST NO. A-698

SEAT TYPE Irvin Model I-165

DUMMY 3-Year

IMPACT TYPE Front

SLED VELOCITY 43.7 ft/sec



HSRI SUMMARY DATA SHEET

Test Number:	A-699
Test Date:	August 27, 1973
Restraint Descriptions:	Kantwet 784
Dummy:	3-Year
Sled Velocity:	29.8 mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Body motions moderate. G levels very low. Overall body restraint good.

FIGURE A-29 SET UP FOR KANTWET 784, FRONT IMPACT

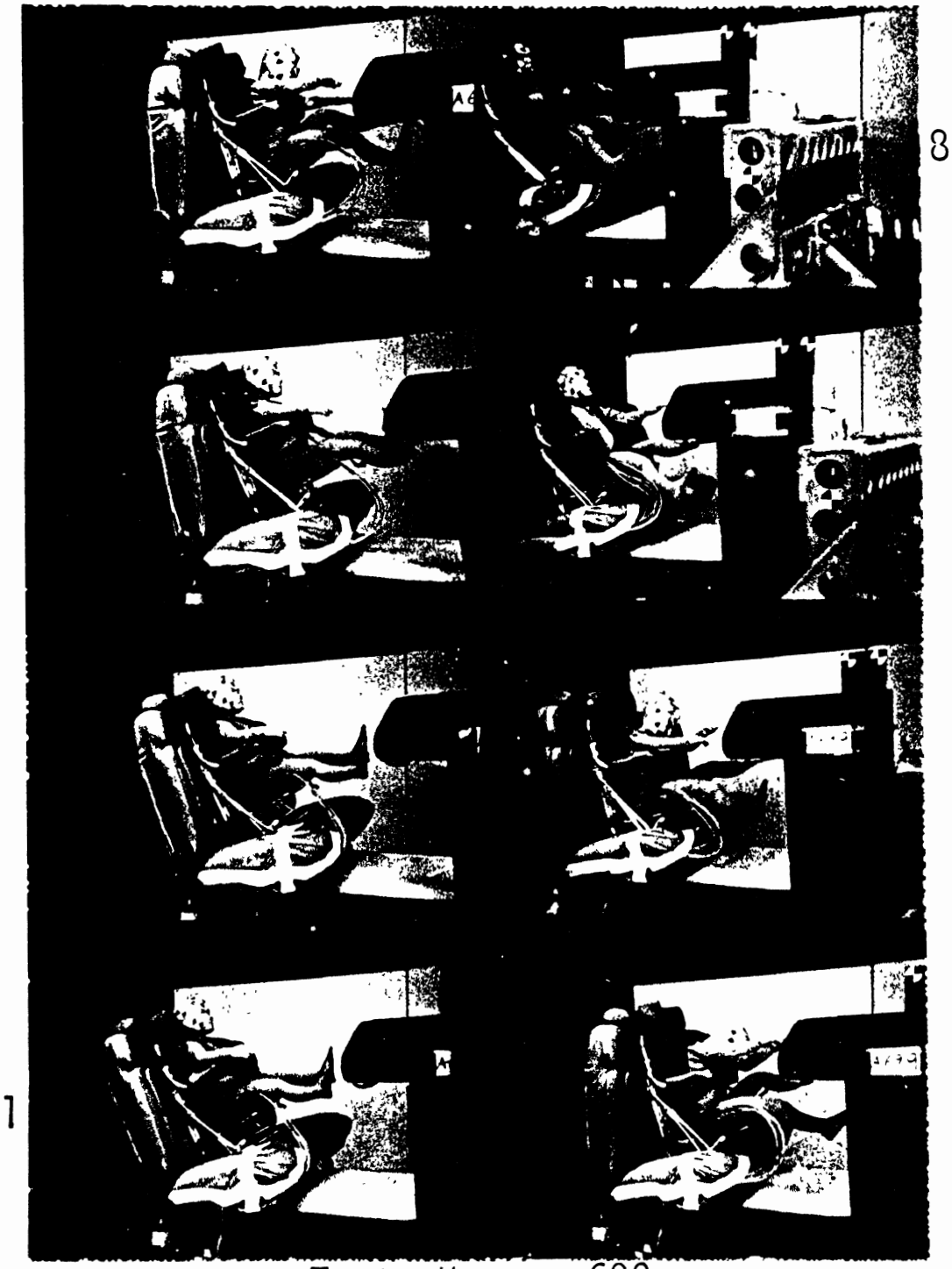


FIGURE A-30 GRAPHCHEK SEQUENCE CAMERA

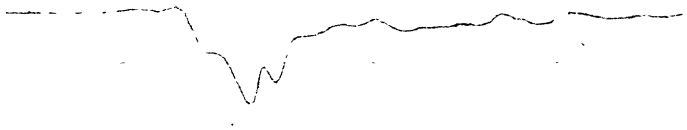
SLED VELOCITY 43.7 ft

IMPACT TYPE Front

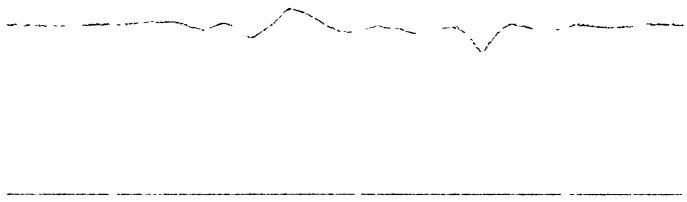
SLED PULSE
2 g's/division
Filtered
Class 60

Anterior-Posterior
Head Acceleration
2.5 g's/division
Filtered
Class 1000

Superior-Inferior
Head Acceleration
2.5 g's/division
Filtered
Class 1000



Left-Right
Head Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
2 g's/division
Filtered
Class 1000

Severity Index

TEST SIMULATION DATA

TEST NO. A-699

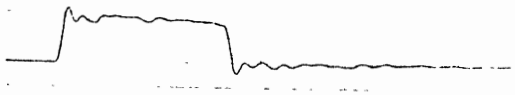
DUMMY 3-Year

SLED VELOCITY 43.7 ft/sec

SEAT TYPE Kantwet 784

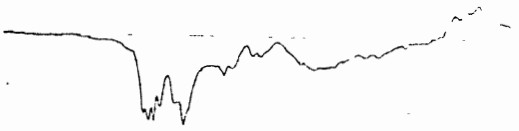
IMPACT TYPE Front

SLED PULSE
2.0 g's/division
Filtered
Class 60



Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000

HSRI SUMMARY DATA SHEET

Test Vehicle:	A-70d
Test Date:	August 20, 1973
[illegible]	[illegible]
[illegible]	3-Year
Seat Track:	Double
Seat Adjustments:	15
Upper Torso:	Bare
Body Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Description:

Pads [illegible] to simulate driver's [illegible] before head and shoulders contacted door. 5 levels were achieved.

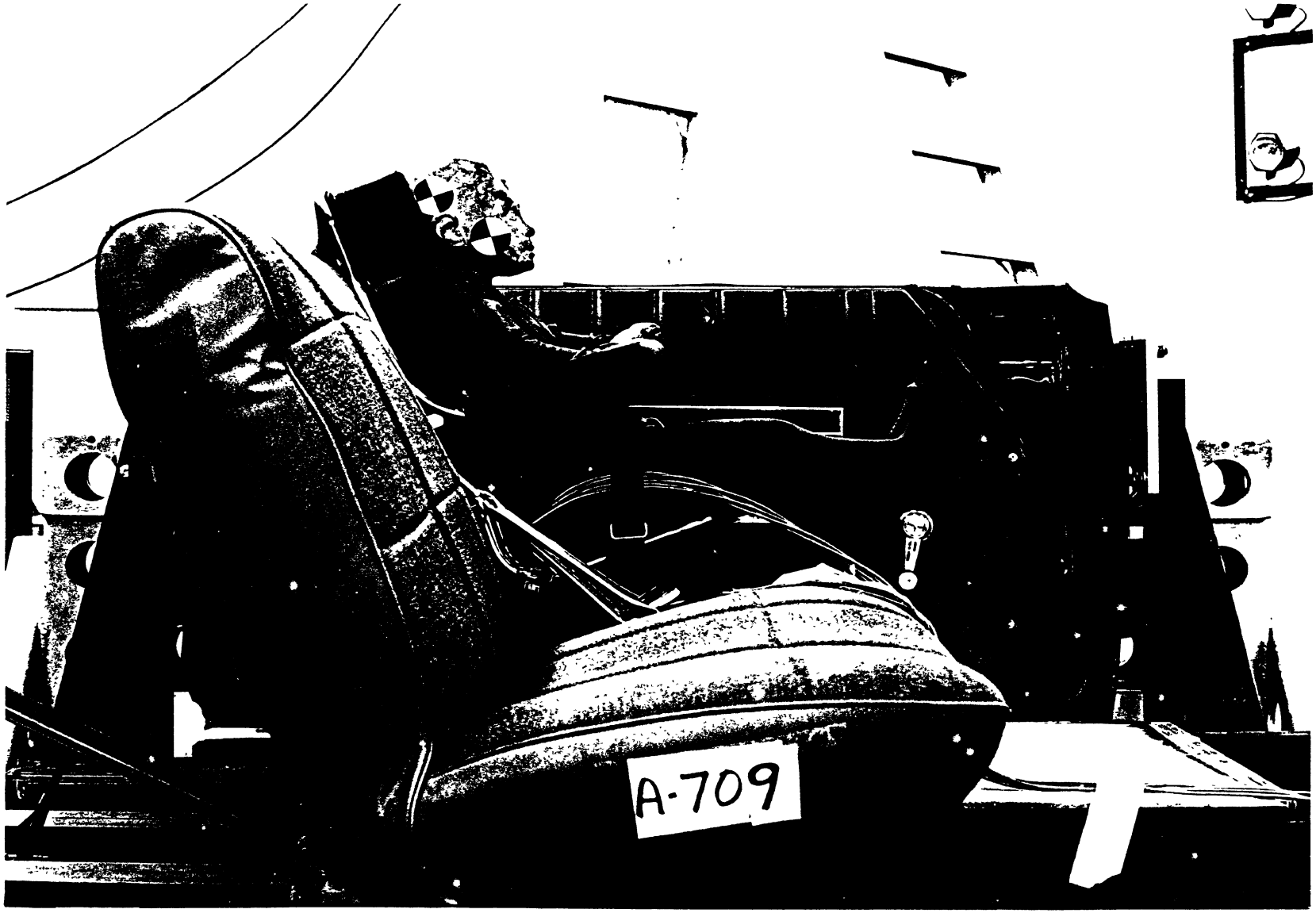


FIGURE A-31 SET UP FOR KANTWET 784, SIDE IMPACT

FIGURE A-32 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-709

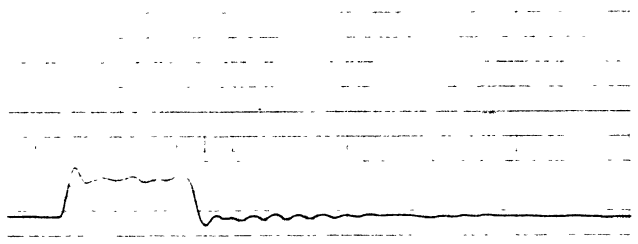
SEAT TYPE Kantwet Model 784

DUMMY 3-year

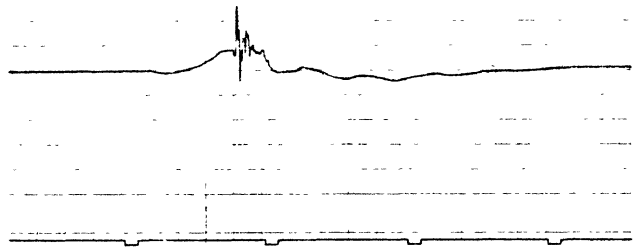
IMPACT TYPE Side

SLED VELOCITY 30.1 ft/sec

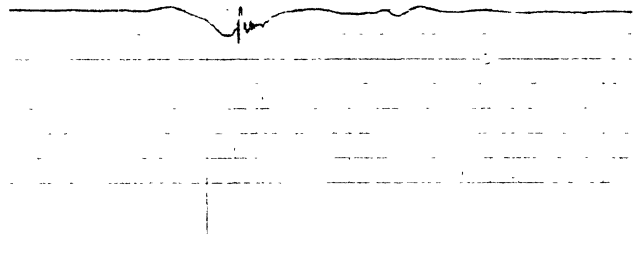
SLED PULSE
2 g's/division
Filtered
Class 60



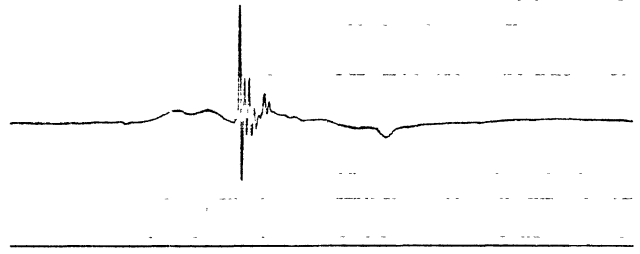
Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000



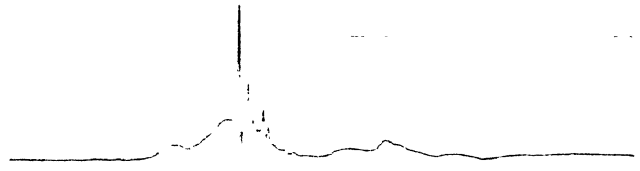
Superior-Inferior
Head Acceleration
5 g's/division
Filtered
Class 1000



Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
4 g's/division
Filtered
Class 1000



Severity Index
50 sec/div

CHEST ACCELERATION DATA

TEST NO. A-709

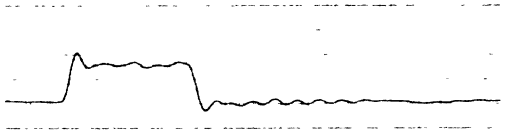
SEAT TYPE Kantwet Model 784

DUMMY 3-Year

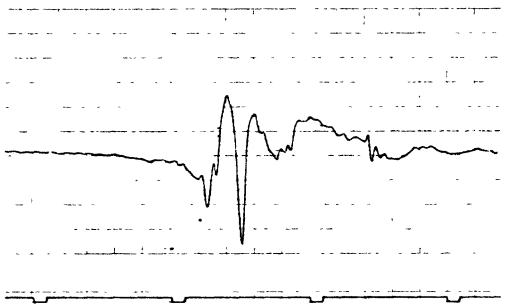
IMPACT TYPE Side

SLED VELOCITY 30.1 ft/sec

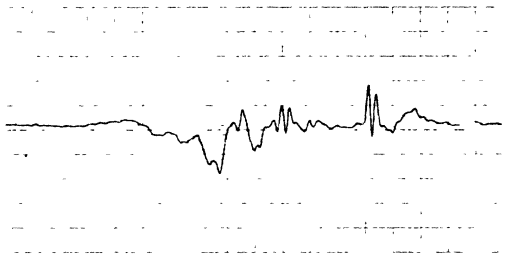
SLED PULSE
2.0 g's/division
Filtered
Class 60



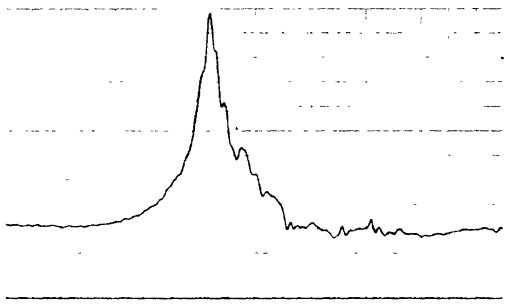
Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000

HSRI SUMMARY DATA SHEET

Test Number:	A-715
Test Date:	August 30, 1973
Restraint Descriptions:	Kantwet Model 784
Dummy:	3-Year
Sled Velocity:	20.2 mph
Sled G-Level:	16
Impact Direction:	Rear
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

- Gentle ride.

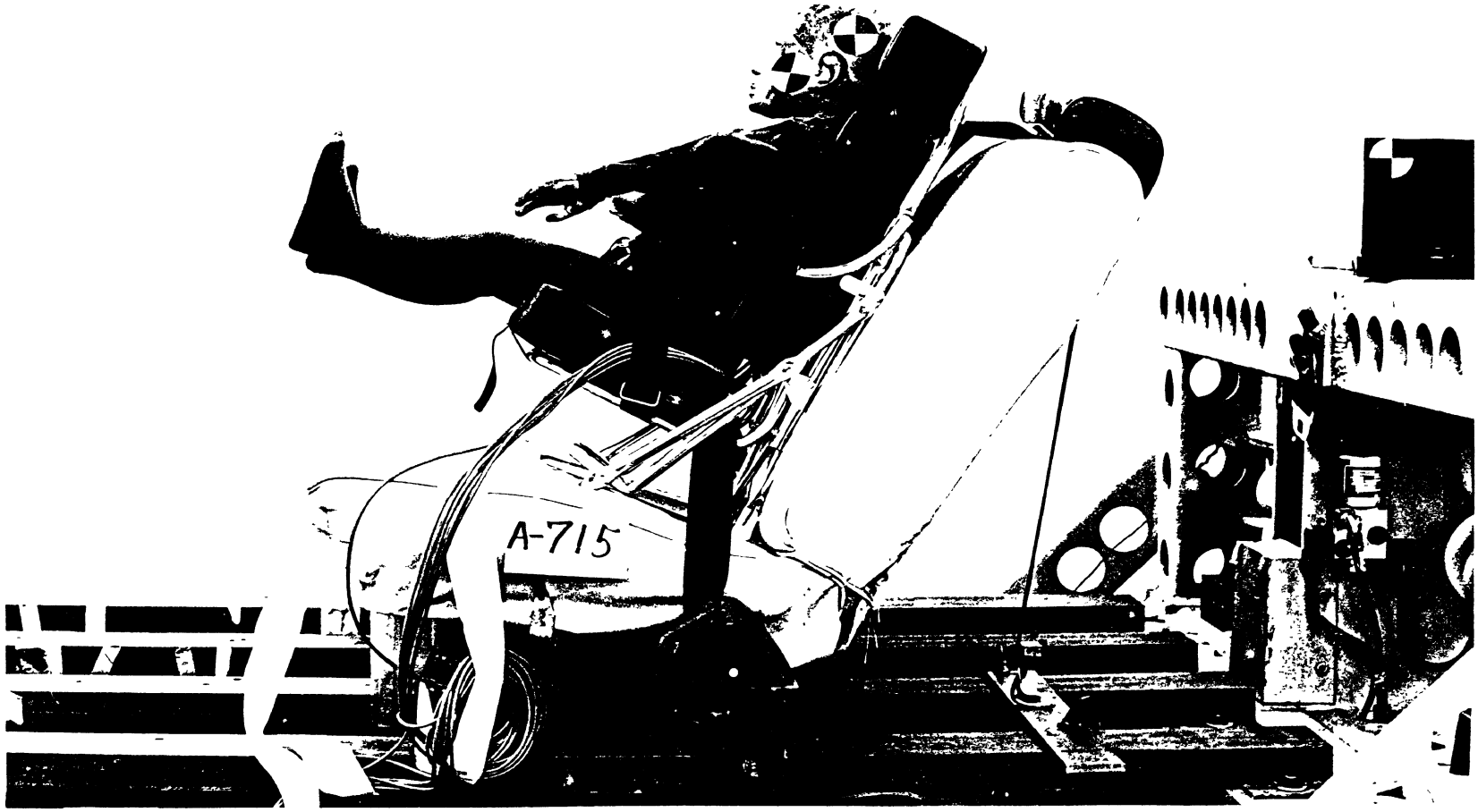


FIGURE A-33 SET UP FOR KANTWET 784, BACK IMPACT

FIGURE A-34 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-715

DUMMY 3-Year

SLED VELOCITY 29.6 ft

SEAT TYPE Kantwet Model 784

IMPACT TYPE Rear

SLED PULSE
2 g's/division
Filtered
Class 60

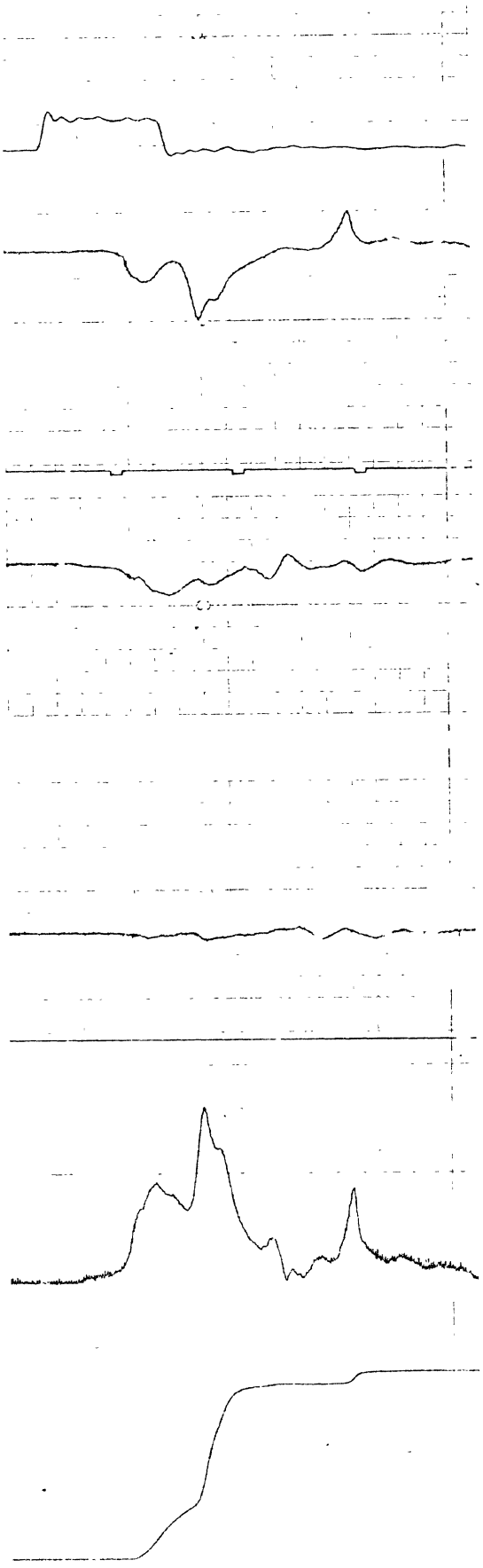
Anterior-Posterior
Head Acceleration
2.5g's/division
Filtered
Class 1000

Superior-Inferior
Head Acceleration
2.5g's/division
Filgered
Class 1000

Left-Right
Head Acceleration
2.5g's/division
Filtered
Class 1000

Resultant Head
Acceleration
1 g's/division
Filtered
Class 1000

Severity Index
4 sec/div

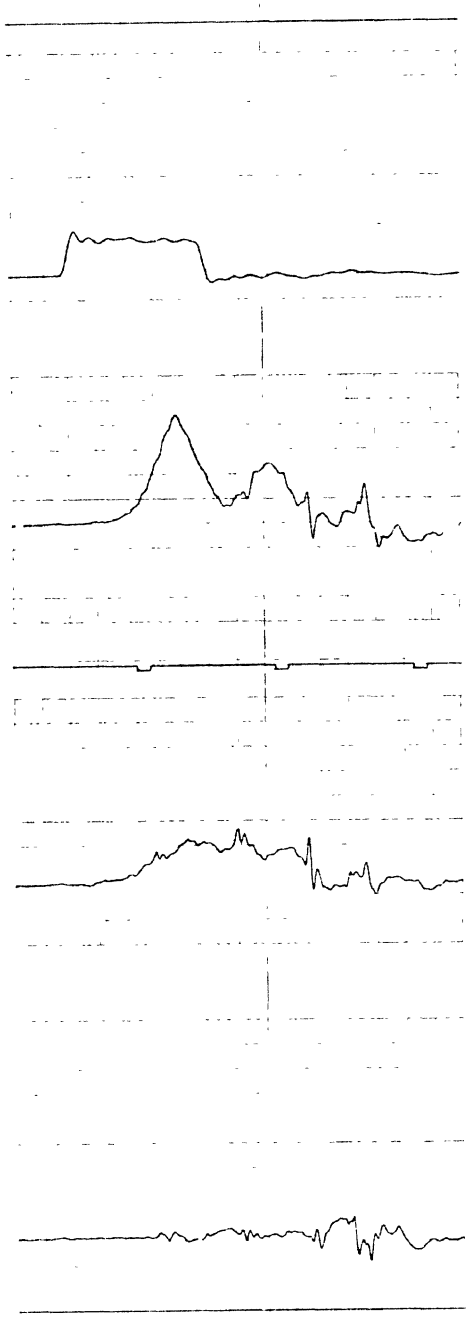


CHEST ACCELERATION DATA

TEST NO. A-715 SEAT TYPE Kantwet Model 784

DUMMY 3-Year IMPACT TYPE Rear

SLED VELOCITY 29.6 ft/sec



SLED PULSE
2.0 g's/division
Filtered
Class 60

Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000

HSRI SUMMARY DATA SHEET

Test Number:	A-701
Test Date:	August 27, 1973
Restraint Descriptions:	Kantwet Model 275 Intranseat Harness
Dummy:	3-Year
Sled Velocity:	30.2 mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observation:

Head excursion very low. G levels very low. Belts distribute load well. Possible overflexion of the neck.

FIGURE A-35 SET UP FOR KANTWET INFANSEAT HARNESS, FRONT IMPACT

FIGURE A-36 GRAPHCHEK SEQUENCE CAMERA

TEST NO. A-701

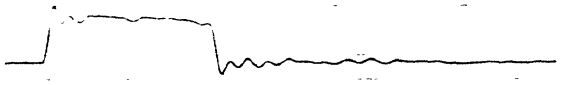
SEAT TYPE Kantseat Model 275 Infanseat Harness

DUMMY 3-Year

IMPACT TYPE Front

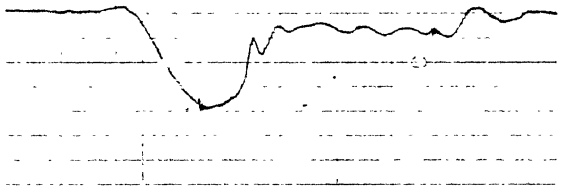
SLED VELOCITY 44.3 ft/sec

SLED PULSE
2 g's/division
Filtered
Class 60

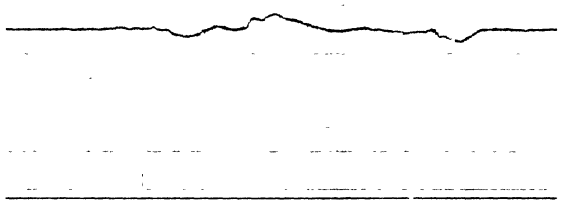


Anterior-Posterior
Head Acceleration
2.5 g's/division
Filtered
Class 1000

Superior-Inferior
Head Acceleration
2.5 g's/division
Filgered
Class 1000



Left-Right
Head Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
2 g's/division
Filtered
Class 1000

Severity Index

TEST NO. A-701

SEAT TYPE Kartwet Model 275
Infanseat Harness

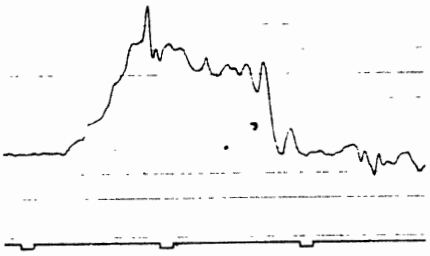
~~3-Year~~

IMPACT TYPE Front

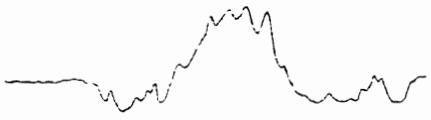
SLED VELOCITY 44.3 ft/sec

SLED PULSE
2.0 g's/division
Filtered
Class 60

Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

HSRI SUMMARY DATA SHEET

Test Number:	A-711
Test Date:	August 30, 1973
Restraint Descriptions:	Kantwet Model 275 Infanseat Harness
Dummy:	3-Year
Sled Velocity:	20.0 mph
Sled G-Level:	16
Impact Direction:	Side
Dummy Attitude:	Sitting, facing toward front of simulated vehicle.

Test Observation:

Restraint system slowed dummy considerably before head and shoulders contacted door. G levels moderate. Graph-check failed; no still photos.

FIGURE A-37 SET UP OF KANTWET INFANSEAT HARNESS, SIDE IMPACT

HEAD ACCELERATION DATA

TEST NO. X-211

SEAT TYPE Ramsey Model 275 Infanseat Harness

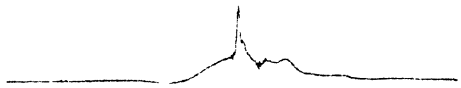
DUMMY 3-Year

IMPACT TYPE Side

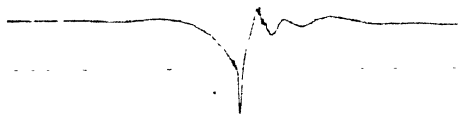
SLED VELOCITY 29.3 ft

SLED PULSE
2 g's/division
Filtered
Class 60

Anterior-Posterior
Head Acceleration
5 g's/division
Filtered
Class 1000

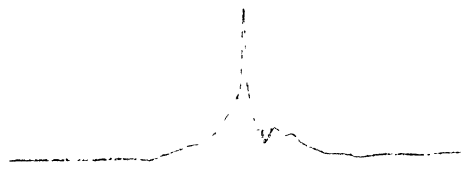


Superior-Inferior
Head Acceleration
5 g's/division
Filgered
Class 1000

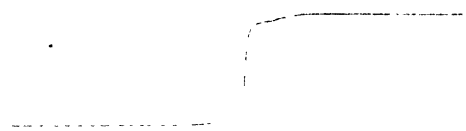


Left-Right
Head Acceleration
5 g's/division
Filtered
Class 1000

Resultant Head
Acceleration
4 g's/division
Filtered
Class 1000



Severity Index
20 sec/div



TEST NO. A-711

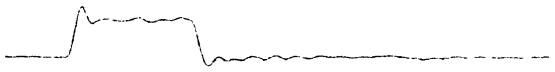
DUMMY 3-Year

SLED VELOCITY 29.3 ft/sec

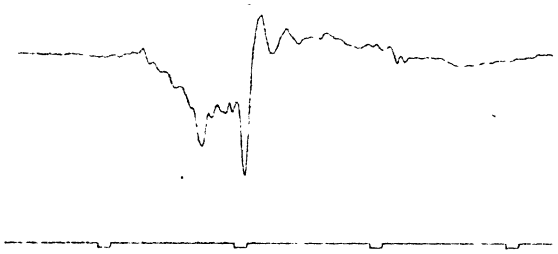
SEAT TYPE Kantwet Model 275 Infanseat Harness

IMPACT TYPE Side

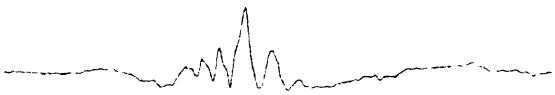
SLED PULSE
2.0 g's/division
Filtered
Class 60



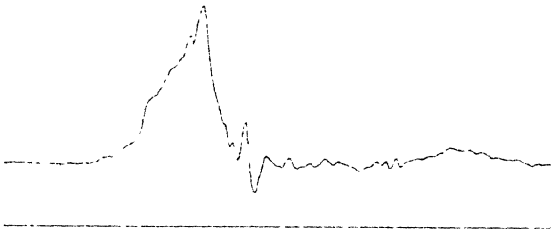
Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



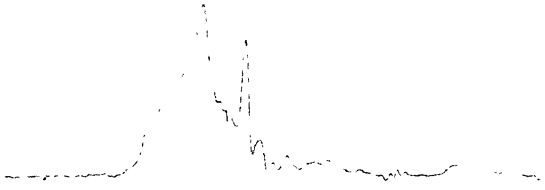
Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000



[illegible] DATA SHEET

Test Number:	A-702
Test Date:	August 27, 1973
Restraint Description:	Sears Weather Tamer (401
[illegible]:	[illegible]
Sled Velocity:	[illegible]
Sled Deceleration:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the stationary vehicle.

Test Observations:

Head [illegible] very high. [illegible] Chest and abdominal loads are not well distributed with this harness.

FIGURE A-38 SET UP OF SEARS HARNESS, FRONT IMPACT

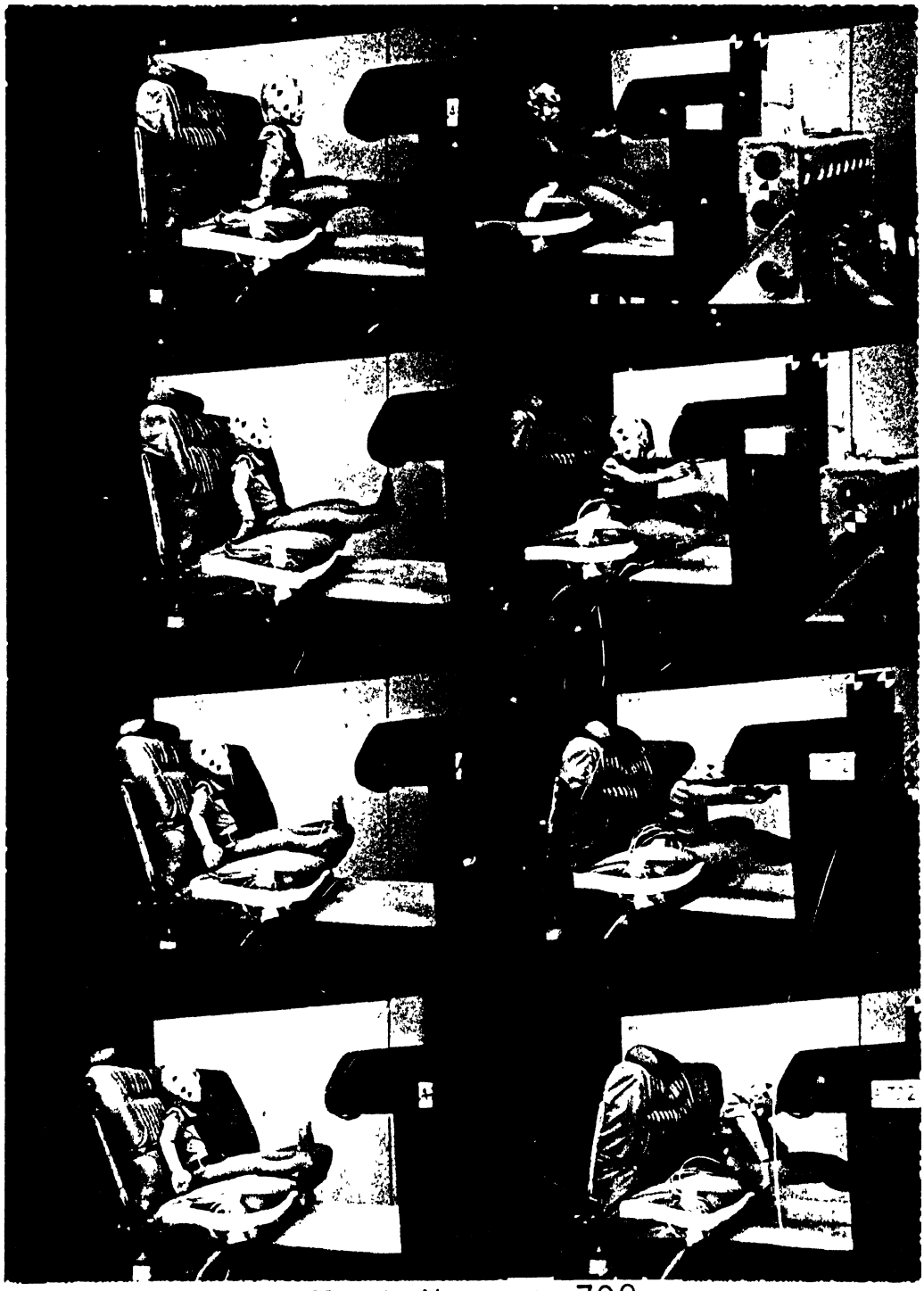


FIGURE A-39 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. [illegible]

SEAT TYPE Sears Harness Model 6401

DUMMY 6-Year

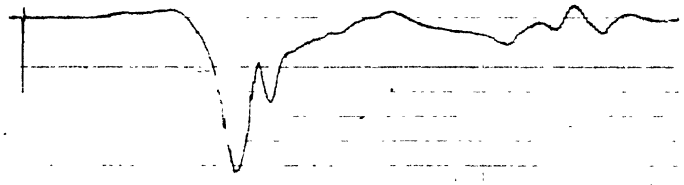
IMPACT TYPE Front

SLED VELOCITY 44.3 ft/sec

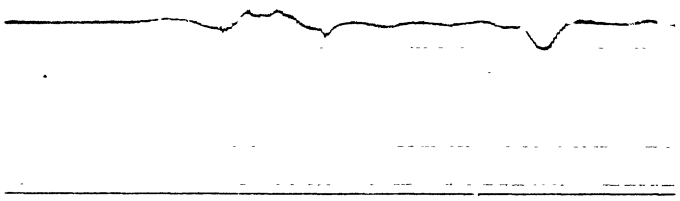
SLED PULSE
2 g's/division
Filtered
Class 60

Anterior-Posterior
Head Acceleration
2.5 g's/division
Filtered
Class 1000

Superior-Inferior
Head Acceleration
2.5 g's/division
Filtered
Class 1000



Left-Right
Head Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
[illegible] g's/division
Filtered
Class [illegible]

Severity Index
[illegible]

TEST NO. A-702

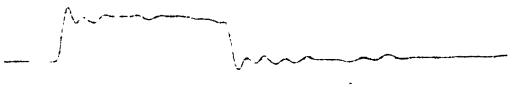
SEAT TYPE Sears Harness Model 6401

CURVE 3-Year

IMPACT TYPE Front

SLED VELOCITY 44.3 ft/sec

SLED PULSE
2.0 g's/division
Filtered
Class 60



Anterior-Posterior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Superior-Inferior
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

Left-Right
Chest Acceleration
1.0 g's/division
Filtered
Class 1000

HSRI SUMMARY DATA SHEET

Test Number:	A-710
Test Dat.:	August 29, 1973
Restraint Descriptions:	Sears Harness Model 6401
Dummy:	3-Year
Sled Velocity:	19.9 mph
Sled G Level:	16
Impact Direction:	Side
Dummy Attitude:	Sitting, facing towards the front of the simulated vehicle.

Test Observation:

Little protection in side impact.

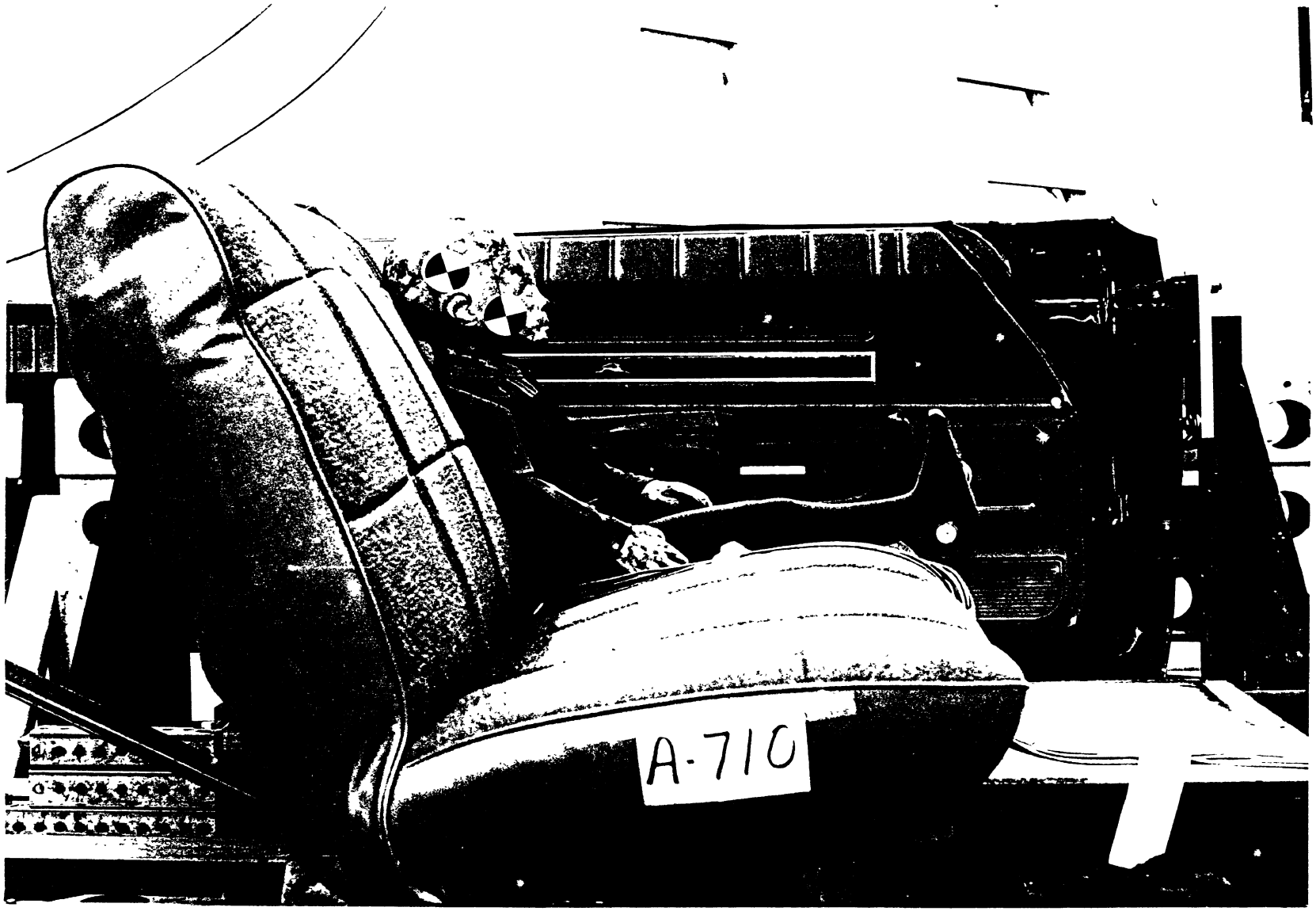


FIGURE A-40 SET UP FOR SEARS HARNESS, SIDE IMPACT

FIGURE A-41 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-710

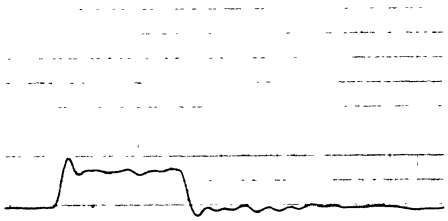
DUMMY 3-Year

SLED VELOCITY 29.2 ft

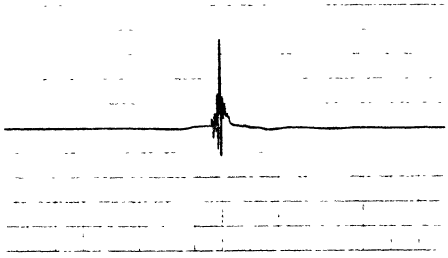
SEAT TYPE Sears Harness Model 6401

IMPACT TYPE Side

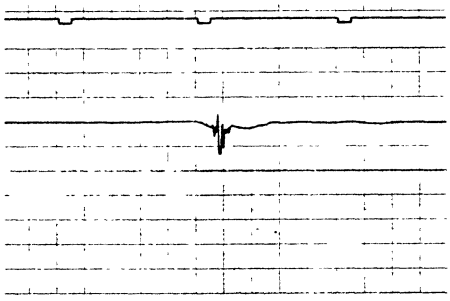
SLED PULSE
2 g's/division
Filtered
Class 60



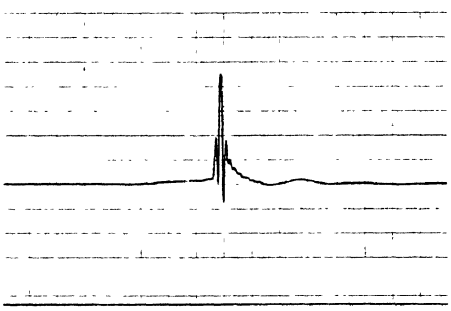
Anterior-Posterior
Head Acceleration
10 g's/division
Filtered
Class 1000



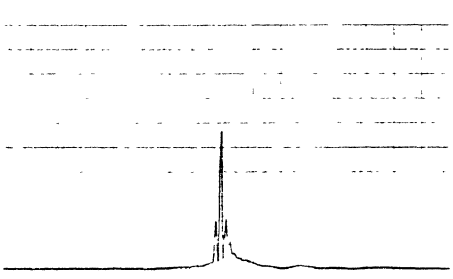
Superior-Inferior
Head Acceleration
10 g's/division
Filtered
Class 1000



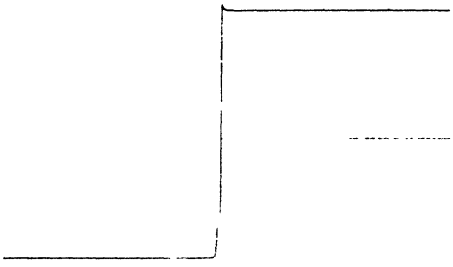
Left-Right
Head Acceleration
10 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
10 g's/division
Filtered
Class 1000



Severity Index
10 sec/div



OUTPUT ACCELERATION DATA

TEST NO. A-710

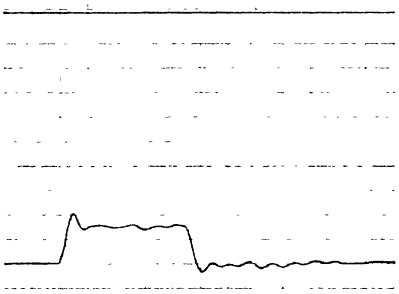
SEAT TYPE Sears Harness Model 6401

DUMMY 3-Year

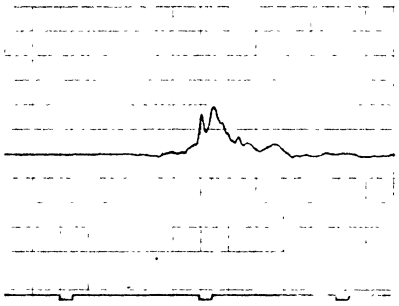
IMPACT TYPE Side

SLED VELOCITY 29.2 ft/sec

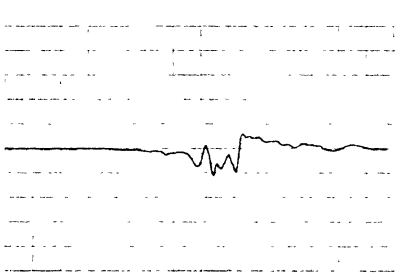
SLED PULSE
2.0 g's/division
Filtered
Class 60



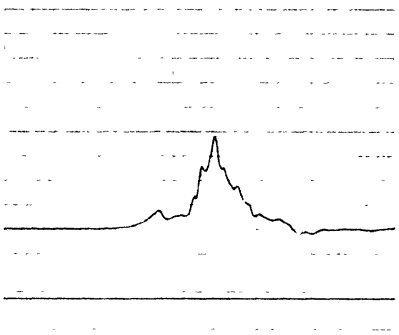
Anterior-Posterior
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



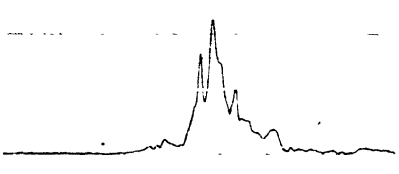
Superior-Inferior
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



Left-Right
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
2.0 g's/division
Filtered
Class 1000



HSRI SUMMARY DATA SHEET

Test Number:	A-703
Test Date:	August 27, 1973
Restraint Descriptions:	Sears Harness Model 6401 with car seat belt
Dummy:	3-Year
Sled Velocity:	30.2 mph
Sled G-Level:	21
Impact Direction:	Front
Dummy Attitude:	Sitting, facing toward the front of the simulated vehicle.

Test Observations:

Large head and whole body excursions. Dummy slid off adult seat, impacted dash and floor pan. Head and chest accelerations extremely high.

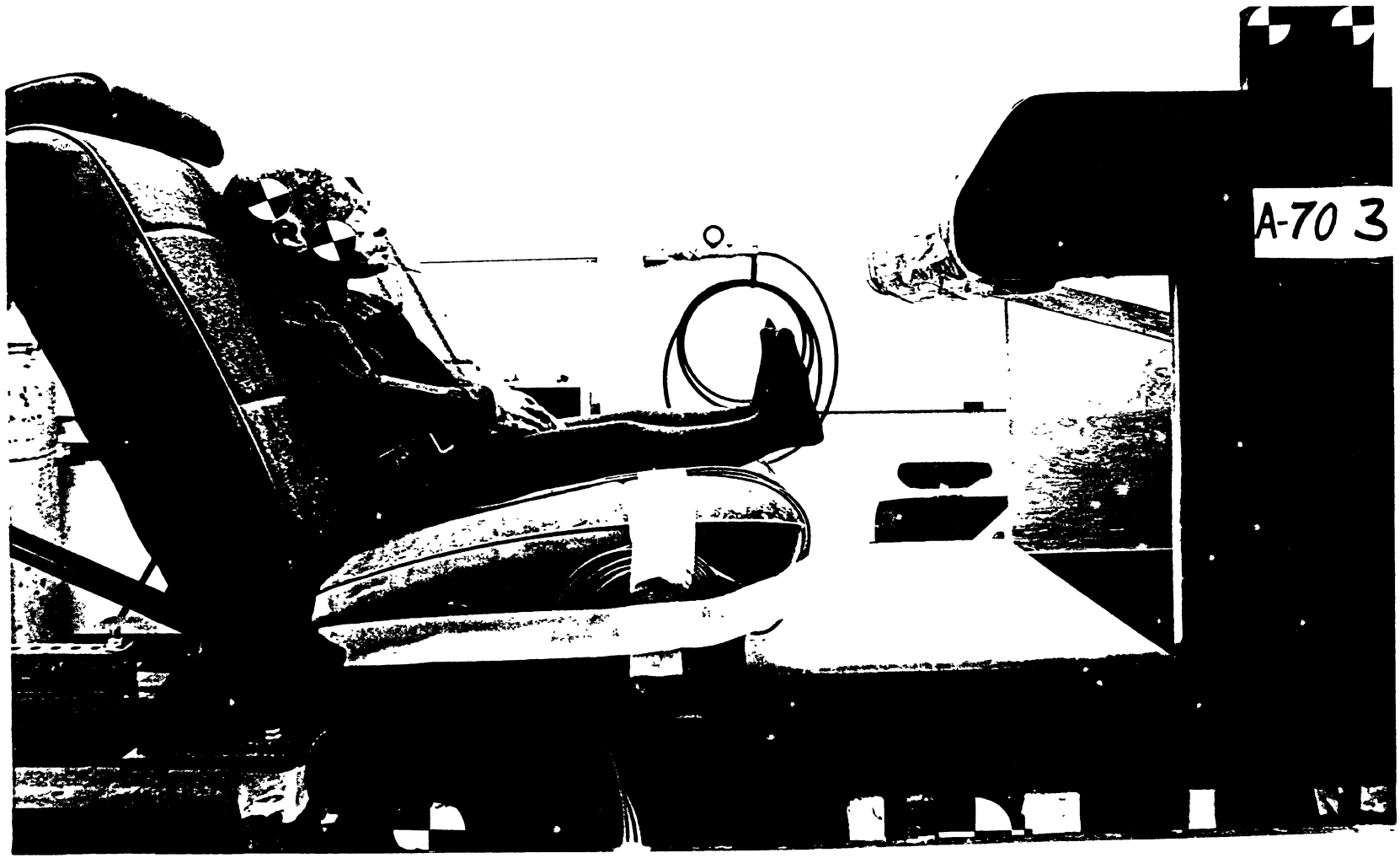


FIGURE A-42 SET UP OF SEARS HARNESS WITH CAR SEAT BELT, FRONT IMPACT

Test No.: A-703

FIGURE A-43 GRAPHCHEK SEQUENCE CAMERA

HEAD ACCELERATION DATA

TEST NO. A-703

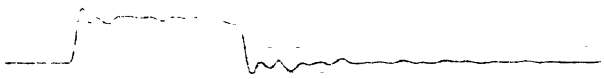
SEAT TYPE Sears Harness Model 5[illegible] with car seat belt

DUMMY 3-Year

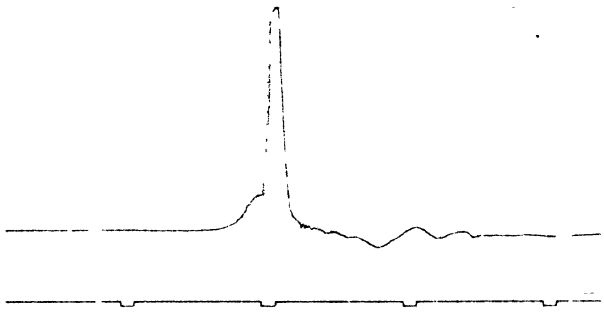
IMPACT TYPE Front

SLED VELOCITY 44.3 ft/sec

SLED PULSE
2 g's/division
Filtered
Class 60

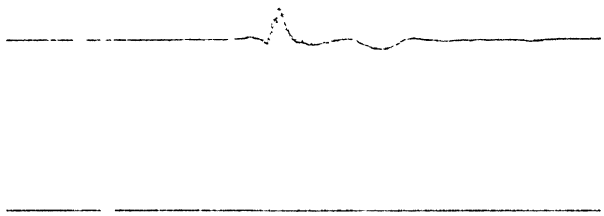


Anterior-Posterior
Head Acceleration
2.5 g's/division
Filtered
Class 1000

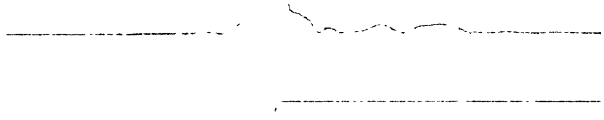


Superior-Inferior
Head Acceleration
2.5 g's/division
Filgered
Class 1000

Left-Right
Head Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Head
Acceleration
10 g's/division
Filtered
Class 1000



Severity Index
40 sec/div

CHEST ACCELERATION DATA

TEST NO. A-703

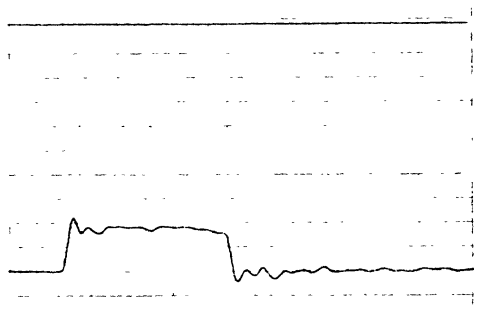
DUMMY 3-Year

SLED VELOCITY 44.3 ft/sec

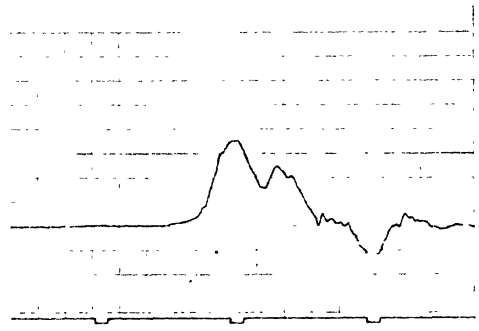
SEAT TYPE Sears Harness Model 6401 with car seat belt

IMPACT TYPE Front

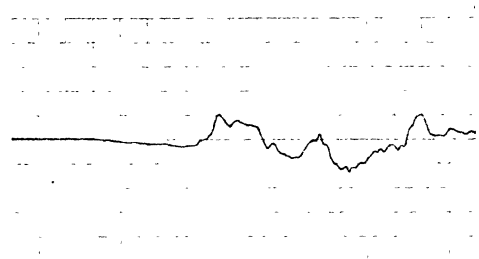
SLED PULSE
2.0 g's/division
Filtered
Class 60



Anterior-Posterior
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



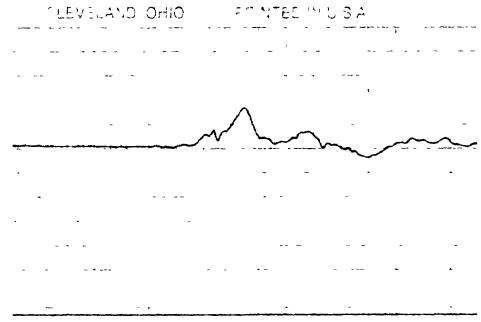
Superior-Inferior
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



RUSH INSTRUMENTS DIVISION GOULD INC

CLEVELAND OHIO PRINTED IN U.S.A.

Left-Right
Chest Acceleration
2.5 g's/division
Filtered
Class 1000



Resultant Chest
Acceleration
1.0 g's/division
Filtered
Class 1000