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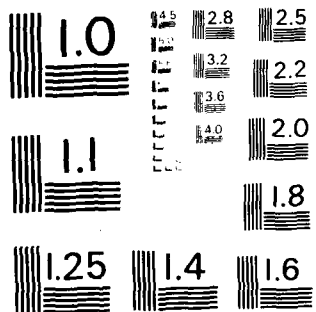
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A Survey of Biodynamic Test Devices and Methods

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ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT
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AGARDograph No.276
A SURVEY OF BIODYNAMIC TEST DEVICES AND METHODS

by

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PREFACE

The growth spurt characterizing biomedical research in the early sixties, associated with the rapid development of the field of aerospace medicine, resulted in the appearance of a mass of experimental data and theory, requiring organization. In an attempt to give structure and direction to this newly expanding field of investigation, the Biodynamics Committee of the Aerospace Medical Panel of AGARD/NATO began to issue a series of monographs "covering the generally accepted basic information in the fields of prolonged radial and linear acceleration", (Gell, C.F. & Jones, W.L., 1971).

The first "Comparative Table of Acceleration Terminology" was compiled and promulgated by the Biodynamics Committee in 1962 and endorsed by the Aerospace Medical Panel of AGARD, the Aerospace Medical Association and the National Aeronautics and Space Administration. A revision appeared in 1965 and was widely distributed as part of "Principles of Biodynamics", AGARDograph No.150, 1971, a publication covering the physics, physiology and tolerance limits of acceleration forces.

Subsequently a working group was established in 1972, under the auspices of the AGARD Aerospace Medical Panel, to consider standardization of impact testing. A publication titled "A Catalogue of Current Impact Devices" (D.H.Glaister, editor, AGARD Report No.658, 1977) was prepared. It was a comparative presentation of the 42 then-operational or proposed impact test facilities, and summarized the features of each device based on data submitted via questionnaires sent to all known research laboratories.

The Biodynamics Sub-Committee has considered it advantageous to update the "Catalogue" regularly. During the tenure of a University Resident Research Fellowship sponsored by the Air Force Office of Scientific Research, on assignment in the Division of Biodynamics and Bioengineering, Air Force Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, the author prepared this survey and catalog. He would like to gratefully acknowledge the support and co-operation of Dr Henning von Gierke, Division Director, and Dr Leon Kazarian, Chief of the Biodynamic Effects Branch, and their associates, for technical support and advice. He is particularly appreciative of the efforts of TSgt. W.R.Johnson and Ms. Suzanne D.Smith-Lagnese in the development of the computer storage and retrieval programs for the impact device data base. The timely and professional preparation of this catalog was accomplished through the very skilful secretarial and editorial services of Ms. Lila Dorn, Ms. Phyllis Reames and Mrs Katherine Bohannon.



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IMPACT TEST FACILITIES

INTRODUCTION

The effort to update the catalog of current impact devices was initiated by corresponding with all facilities listed in the first edition and attempting to verify the name of the current manager or director and their mailing address. A data form was generated, and, as verified names and addresses were received, was sent with an explanatory letter to each. In most cases, data sheets were returned in short order, but second and third mail requests, and in some instances telephone follow-ups, were necessary to achieve returns. Additional facilities were located through personal contact with those responsible for some test devices.

Several new devices were identified that have been built since the last compilation, but in some cases the organization managers indicated that they did not wish to be included. In an effort to increase the data base, announcements were placed in "Aviation Space and Environmental Medicine" inviting participation. No additional laboratories were identified by this mechanism. Several facilities included in the first edition have become non-operational, or were not included in this compilation because of the failure to receive a reply from their supervisory personnel. This resulted in a total of 45 test facilities which form the data base for this revised catalog, representing a slight increase over the originally described 42.

Although all original descriptive and performance data are reported, summary tables have been generated for the benefit and use of technical managers interested in comparing the features and capabilities of the various facilities. These tables are introduced by a master list of all facilities (Table 2) within which the various research centers are listed alphabetically by country and then within countries by appropriate smaller geographic units. Each test instrument is assigned its own identification number (ID#) within this format. Further descriptive summary tables use only this identification number as the instrument entry. It is, therefore, necessary to refer to Table 2 for specific ID numbers before referring to the data base presented in the following tables. The data given represents all input received as of April, 1983. The various facility directors were also asked to report their research goals for the next five years. Their replies can be considered to represent three general areas of effort: human tolerance testing, the development of human analogs, and vehicle hardware and component evaluation. These topics are discussed in a later section.

THE IMPACT FACILITIES DATA BASE

Survey responses are summarized in seven tables arranged to compare design characteristics and performance capabilities. The specific data sheets from which these summaries were generated are presented in a following section. When necessary, units have been converted to SI for comparison purposes in all tables. Individual data sheets reproduce the units as originally reported. Table 2 is an index list of all the facilities and can be used to cross reference the specific data sheet to the facility, as listed in any of the summary tables, using the identification number (ID#) assigned.

Table 3 summarizes the principles of operation and pulse shaping employed, the orientation of the test instrument (horizontal or vertical), man-rating status, physical dimensions and maximum payload. Some managers emphasize the similarity between the deceleration curve produced on impact and the acceleration curve produced by a Hyge apparatus. The operational details of this type of instrument were originally described in the first edition of this catalog, and the number of facilities using, or planning construction of such a test device attests to its popularity. In some cases an organization would identify this form of accelerator as an "impact decelerator" or "reverse impact decelerator" (e.g. MIRA ID# 23). For purposes of this report all instruments of the Hyge type have been considered as impact accelerators.

The most popular instruments are horizontal impact decelerators. Twenty-three of the described 45 facilities utilize this mode of testing. Since this orientation directly simulates the condition of a barrier crash for most civilian vehicle situations, this is not unexpected. Acceleration is accomplished by a variety of methods but 30% (7 of 23) utilize a stretched elastic cord (bungee) to achieve initial velocity. The reliability and reproducibility of this acceleration mode is considered in separate facility descriptions (Giles, 1971) and appears popular because of low construction cost and ease of repetitive testing. A variety of other acceleration mechanisms including solid rocket propulsion, electric and gasoline powered winches, falling weights and pneumatic systems are also in use. The propulsion method seems less critical than the assurance that a period of sustained, controlled velocity precedes impact. This usually involves a "coast" period following the initial acceleration, with and without velocity controlled "trimming," by on-board brakes.

Deceleration impact pulse shaping is accomplished by a variety of methods. Simple barrier crashes into a large mass, simulating the most direct effects of horizontal impact, represent 22% of the reported methods (5 of 23). The use of a flat metal strip of specified physical characteristics adds a degree of control to the pulse shaping process. Deformation of the metal between rollers by a spike fitted to the front of the sled is a function of the impacting mass initial velocity and material properties of the strip employed in a given test. Storage of the deformed strip provides a permanent record of the impact conditions for each test. A variation of the deformable metal strip involves plastic tubes engaging pins on the sled. A greater degree of control is accomplished by utilizing direct impact into pneumatic or hydraulic pistons, or into stretched steel cables attached to hydraulic pistons. The versatility of the fully programmable impact target allows for a greater variety of controlled pulses to be developed (see Table 5), though in practice only a few may actually be used in accord with testing standards.

Vertical impact decelerators are less common than the horizontal orientation, but have the advantage of more directly producing G_z forces without the necessity of reorientation of the test subject. Many

of these devices are used in ejection studies on the premise that the $+G_z$ pulse produced can be made identical to the $+G_z$ pulse experienced during an ejection. However, the force contributed by the weight of the test vehicle and subject, acting in a $-G_z$ direction at the moment of impact, introduces rebound phenomena that have anatomical and physiological effects differing from those of a pure $+G_z$ pulse. The vertical impact decelerator configuration most closely simulates a ground landing impact and can profitably be used for research on human tolerance and crashworthiness of system components in such environments.

The ability to generate a large acceleration pulse over a short stroke distance has made the Hyge type of hydraulic activator a popular research instrument. Reasonably short stroke and "coasting" distances also allow the test area to be completely enclosed for optimum environmental control and data collection. These instruments are thus the most popular horizontal impact accelerators in current use. Since the acceleration pulse can be delivered at a controlled time with such instruments, it is possible to position precisely the test subject and recording instrumentation for accurate simulation of any impact configuration, prior to delivering the pulse. The problems associated with test subject movement during the "coast" period involved in deceleration testing are thus eliminated. These advantages, however, can be expensive to acquire. The simpler bungee cord actuated horizontal decelerators have thus remained popular even though the positioning problem exists. With only two exceptions (ID# 1,35), the impact accelerators of the Hyge type are dedicated instruments and not readily available for commercial contract work.

The final test configuration in use involve vertical impact accelerators. These instruments represent the least common test mode, even though they are capable of reproducing the $+G_z$ forces associated with aircrewmember ejection directly, with the added advantage of precise pre-positioning. The safety problems associated with braking vertical motion within a reasonable distance, limits these instruments to relatively small acceleration forces. Small units are used for component testing, experimental validation studies prior to larger instrument testing, and studies with small to medium size, nonhuman primates. Large ejection towers are used for human testing.

REPRODUCIBILITY OF IMPACT TEST DATA

A. Repeatability

Many investigators have expressed concern that, as human testing proceeds, the input pulse used may approach or accidentally exceed an injury threshold. Accordingly, some attention was drawn to the importance of the reproducibility of specific acceleration or deceleration profiles (von Gierke, 1971). An estimate has been presented, subject to other variables, such as duration, onset times, total velocity change, etc., that these instruments operate with 3 to 5% variability (Kleinhanss, 1971). In an effort to define further the reproducibility of the data generated at the included facilities, each respondent was asked to report the repeatability of peak acceleration (G) and peak velocity for their test instruments. This data is presented in Table 6. Repeatability is defined as deviation from a programmed test value under idealized test conditions for multiple tests. Although not clearly defined in the questionnaire replies, the values presented are assumed to be one standard deviation of a normal distribution of test output data for repeated tests. Some of the replies listed repeatability as relative percentage of the programmed value, assuming the latter to be 100% (i.e. 95% reported was assumed to be 5% of the adopted definition). An estimate of average repeatability was then made and the values for accelerators were compared with those for decelerators. Peak acceleration repeatability averaged $\pm 2.12\%$ for accelerators (N=11) and $\pm 4.21\%$ for decelerators (N=22). Peak velocity repeatability averages were $\pm 2.01\%$ and $\pm 2.70\%$ respectively.

This data indicates a better repeatability is operationally possible, with respect to peak acceleration, when using an accelerator mode, even though the average peak velocity repeatability for the two test configurations, as reported, are essentially the same. When only accelerators of the Hyge type (N=10) are considered, peak acceleration repeatability is further improved to ± 1.38 . It is thus prudent to perform human testing, close to known tolerance limits, with instruments capable of this degree of repeatability.

B. The Mass Ratio Problem

The inertial reaction of a test object influences the acceleration of the test carriage. This is evident as an effect on the input waveform of the accelerating device. This reaction adversely affects control and repeatability. Designing a test apparatus with very high force producing capability, and a much heavier test carriage will improve the operational acceleration repeatability. The inertial reaction of the test object is then a lower proportion of the total force, and control is improved. Chandler (1971) recommended a mass ratio of carriage to test object of 10 to 1 or more, in order to achieve reasonable impact acceleration control.

In practice it is apparently difficult to meet or even approach this proposed condition. Of the 46 test configurations presented in Table 4, only four exceed a mass ratio of 3 and of these only two exceed a value of 7. It is likely that the payload values reported have seat restraint systems or other fixed components used to position a test subject included in the "payload" mass value. Under more specific and limiting definitions, this mass might more properly be considered part of the "sled" mass, thus improving significantly the mass ratio factor for a given operational condition. Since in most test situations the subject is the relevant payload, these other ancillary masses, if properly attached to the transporting mechanism, should be added to the sled weight and deducted from the payload so as greatly to improve the mass ratio value. A standard human male weight of 70kg was therefore used to recalculate the mass ratios of all devices that could be identified as "man-rated." The recalculated values are presented in Table 4. The corrected data indicate that eight devices can be operated with mass ratio values of 10 or more and that another six can achieve values between 5 and 10.

A significant improvement in the reliability and accuracy of test data was originally accomplished by enclosing test facilities, and thereby reducing the effects of temperature on components. It may be difficult to achieve further improvements in reliability, except by careful procedure.

INSTRUMENTATION, DATA ACQUISITION AND REDUCTION

Tables 7 and 8 present details of the instrumentation capability at each test site. The number of data channels and methods of on-line recording are indicated together with the frequency response of the highest class reported, in Table 7. Reference to "Instrumentation for Impact Tests," (Society of Automotive Engineers, J211a) allows evaluation of typical test capability from this data. Recommended applications for the various frequency classes of data channel have been proposed (Table 1) and data filtering techniques to implement these recommendations are in common use (Reichert & Landolt, 1981).

Table 1. EXAMPLES OF CHANNEL CLASSES (Frequency)
{SAE J211a}

Typical Test Measurement	Channel Class Hz
Vehicle structural accelerations for use in:	
Collision simulation	60
Component analysis	600
Integration for velocity or displacement	180
Belt restraint loads	60
Occupant:	
Head acceleration	1000
Chest acceleration	180
Sled acceleration	60

Table 8 presents the accelerometer inventory at each facility, the dynamic and frequency range of these instruments, and the maximum number available for test purposes. Recent refinements of J211a as incorporated in "Road vehicles - Techniques of measurement in impact tests - Instrumentation" (ISO 6487-1980[E]), specify that the amplitude class (the upper limit of the measurement range) as well as the frequency class must be given to define a data channel. Further recommendations refer to recording and data processing standards, and transducer mounting specifications as a guide to meeting the requirements of this International Standard.

Subcommittee 4 on Human Exposure to Mechanical Vibration and Shock of the International Standards Organization (ISO), Technical Committee 108 on Shock and Vibration (ISO/TC108/SC4) is working on a draft standard* to provide guidance on human impact testing, the characterization of input and output data, test subject selection and data interpretation. Additional documents aimed at partial standardization of human impact testing methods and instrumentation are planned.

Direct transcription of data channels by magnetic or paper recording allows for later processing by dedicated computers. Data processing capability generally includes real-time evaluation as well as statistically validated review. Most facilities include high speed film capability. A film digitizing program greatly increases the usefulness of such data, and routinely fiducial indicators are included in all tests for this purpose.

The physical arrangement of a test site should also accommodate medical monitoring and physiological recording if human subjects are involved. All weather enclosures for the various elements of an integrated test site may establish a building expense that represents the major cost of the total facility. Such environmental protection is however, vital to the repeatability criteria stated above.

Several representative test installations have been described in "Open Forum on Facilities for Impact Studies" (AGARD Conference Proceedings No. 88 on Linear Acceleration of Impact Type, pp. B1-1 to B5-7, 1971). Other site details are presented in:

Anon 1980, Crashtanlage, Bayerische Motoren Werke, A.G., Munich.

Huber, G. 1974. Eine Anlage für Fahrzeug - Unfallversuche mit Linearmotor als Antrieb. Automobiltechnische Z. 76:48-52.

Kallieris, D. 1974. Eine Fallgewichtsbeschleunigungsanlage zur Simulation von Aufprallunfällen - Prinzip und Arbeitsweise. Z. Rechtsmedizin 74:25-30.

Prevost, T. G. 1976. An Automotive Crash Test Facility 1976. Environmental Activities Publication A-3398. General Motors Corp. Warren, Michigan 48090.

Reichert, J. K. & Landolt, J. P. 1980. Impact Studies Facility. DCIEM Tech. Con. 80-C-03. Defence and Civil Institute of Environmental Medicine, Downsview, Ontario, Canada.

*ISO/TC108/SC4, Working Group 4, Secretariat: Acoustical Society of America, Standards Secretariat, 335 East 45th St., New York, NY 10017

Shaffer, J. T. 1976. The Impulse Accelerator. An Impact Sled Facility for Human Research and Safety Systems Testing. AFAMRL-TR-76-8. Aerospace Medical Research Lab., WPAFB, OH 45433.

Sievert, W. 1980. Die Aufprall - Versuchsanlage der Bundesanstalt für Strassenwesen. Automobiltechnische Z. 82:507-511.

RESEARCH GOALS AND METHODS

The ultimate goal of biodynamic impact testing is to establish human tolerance levels in terms of injury/fatality probabilities. A complete description of all factors that contribute to such an evaluation is still beyond the state-of-the-art in biomechanics (SAE J885 APR 80). Several complications prevent the direct correlation of injury to impact force. Individual tolerance levels are not precise, quantitative values, and various individuals show large differences in their response to injury. Research to date also indicates that different mechanisms of injury and resultant symptoms occur for each impact direction. (von Gierke and Brinkley, 1975).

Semi-quantitative injury scales have been generated by different workers examining either the whole body or segments (SAE J885 APR 80 for bibliography). However, extensive data collection is required to begin to assess the influence of age, size, sex and weight on statistically valid populations. Each research facility tends to identify a particular subset of this matrix for study in accord with its operational mission and capabilities (Kazarian and Graves, 1977).

Human tolerance levels are investigated by indirect methods such as exposing volunteers to impact forces below their injury levels, and through the use of cadavers or anesthetized animals. Though each test subject offers some distinct advantage, there are inherent problems in the direct applicability of the data. Volunteers are useful in determining the effects of muscle tone and pre-bracing on the biodynamic response to impact. Since they cannot be tested into the injury range, volunteers can only provide information about the upper boundary of the tolerance level. Furthermore, volunteers are usually young, healthy, males who tend to have a higher pain threshold than the general population. Cadavers can be employed when potentially injurious testing is performed. It is assumed that geometric and structural characteristics will be the same as those of volunteers. However the age and the preparation of the cadaver, and the time since death can affect the material properties of tissues and thus the failure mechanisms of various organ systems. Animal testing is usually performed to study the injury mode resulting from severe impact. However, the results of animal tests cannot always be adequately scaled to quantitatively predict human tolerance limits due to differences in size, shape and other structural and physiological parameters.

Data from testing strategies using volunteers, cadavers, or animals have been used to develop human surrogates. These may take the form of instrumented dummies or computer manipulated mathematical models. These analogs must be sufficiently human-like so that their responses will be close to those of the individuals they model. Continued refinement of instrumented dummies to achieve an anthropodynamic surrogate is recognized as an immediate objective by most research teams. The kinematic response of the dummy is determined by its body dimensions, mass distributions and joint characteristics (articulation and motion resistance). Deformability, or the response of body regions under dynamic loading, will determine the accelerations and deflections of each body segment during impact. Deformability properties can be major factors effecting the overall realism of the test and thus the value of the data generated. In some cases, specific research groups, depending upon whether their interests are primarily concerned with land or air/space environments, will specially fabricate a segment, or modify a "standard" dummy. Comparison of test data then becomes more difficult.

Mathematical models describing the dynamic response of the body, allow analysis of the complex waveforms that more closely approximate real impact situations than can be simulated with uni-directional impact testing. Several models have been developed that range in complexity from descriptions of single tissues through subsystems such as the head and neck or the spine, to total body analogs. Refinement and validation of these models and improvement of instrumented anthropodynamic dummies can lead to a more complete analysis of impact protection requirements (AGARD-CP-253).

Seat restraint systems, force attenuation systems and impact surface evaluation are of concern in determining the crashworthiness of vehicles. Animals, particularly non-human primates, as well as dummy surrogates are of value in testing these components to failure. Animal tests are especially valuable in suggesting injury mechanisms that can occur under specified occupant-vehicle configurations. Comparison of test results with clinical information from field accidents often allows valid interpretation and reconstruction of the injury mode, even though direct scaling from animal data is not possible. (Kazarian and von Gierke, 1978).

TABLE 2
IMPACT TEST FACILITIES

ID#	NAME	ADDRESS
---	---	-----
1	DCIEM IMPACT STUDIES FACILITY	DOWNSVIEW, ONT., M3M 3B9, CAN.
2	CENTRE D'ESSAIS EN VOL	91220 BRETIGNY, AIR, FR.
3	ONSER	69500 BRON, FR.
4	CENTRE D'ESSAIS EN VOL	33630 CAZAUX, FR.
5	CENTRE TECHNIQUE RENAULT	F-91 LARDY, FR.
6	LAB. DE L'U.T.A.C.	91310 MONTLHERY, FR.
7	LAB. DE L'U.T.A.C.	91310 MONTLHERY, FR.
8	LAB. DE L'U.T.A.C.	91310 MONTLHERY, FR.
9	LAB. DE L'U.T.A.C.	91310 MONTLHERY, FR.
10	INST. FAHRZEUGTECHNIK	D-1000 BERLIN, W. GER.
11	BATTELLE-INSTITUTE. V.	D-6000 FRANKFURT, W. GER.
12	KLINIKUM DER UNIV. HEIDELBERG	1.6900 HEIDELBERG, W. GER.
13	DAIMLER-BENZ AG	SINDELFINGEN, W. GER.
14	DAIMLER-BENZ AG	SINDELFINGEN, W. GER.
15	DAIMLER-BENZ AG	SINDELFINGEN, W. GER.
16	DAIMLER-BENZ AG	SINDELFINGEN, W. GER.
17	FIAT-CENTRO SICUREZZA	ORBASSANO (TORINO)-ITALIA
18	RAF, INST. AVIATION MED.	FARNBOROUGH, HANTS, UK.
19	ROYAL AIRCRAFT ESTABLISHMENT	FARNBOROUGH, HANTS, UK.
20	ROAD SAFETY ENGINEER LAB, MIDDLESEX POLY.	HENDON, NW4 4BT., UK.
21	DEPT. OF HUMAN SCI., UNIV. TECH.	LOUGHBOROUGH, LE11 3TU, UK.
22	MOTOR INDUSTRY RES. ASSOC.	NUNEATON, WARMS, CV10 OTU, UK.
23	MOTOR INDUSTRY RES. ASSOC.	NUNEATON, WARMS, CV10 OTU, UK.
24	SIMULA INC.	TEMPE, ARIZONA 85282
25	SIMULA INC.	TEMPE, ARIZONA 85282
26	S.R.I. INTERNATIONAL	MENLO PARK, CA. 94025
27	NAVAL BIODYN. LAB	NEW ORLEANS, LA. 70189
28	NAVAL BIODYN. LAB	NEW ORLEANS, LA. 70189
29	BIOENGIN. CENTER, WAYNE STATE U.	DETROIT, MI. 48202
30	BIOENGIN. CENTER, WAYNE STATE U.	DETROIT, MI. 48202
31	BIOENGIN. CENTER, WAYNE STATE U.	DETROIT, MI. 48202
32	DYNAMIC TEST FACILITY, FAA	ATLANTIC CITY, NJ 08405
33	CALSPAN CORPORATION	BUFFALO, NY. 14225
34	INLAND DIV. GENERAL MOTORS	DAYTON, OH. 45401
35	TRANSPORT. RES. CTR. OF OH.	EAST LIBERTY, OH.
36	AF AEROSPACE MEDICAL RESEARCH LAB	WRIGHT-PATTERSON AFB, OH 45433
37	AF AEROSPACE MEDICAL RESEARCH LAB	WRIGHT-PATTERSON AFB, OH 45433
38	AF AEROSPACE MEDICAL RESEARCH LAB	WRIGHT-PATTERSON AFB, OH 45433
39	AF AEROSPACE MEDICAL RESEARCH LAB	WRIGHT-PATTERSON AFB, OH 45433
40	AF AEROSPACE MEDICAL RESEARCH LAB	WRIGHT-PATTERSON AFB, OH 45433
41	PROTECT. SURVIVAL LAB., FAA	OKLAHOMA CITY, OK. 73125
42	NAVAL AIR DEVELOPMENT CENTER	WARMINSTER, PA. 18974
43	NAVAL AIR DEVELOPMENT CENTER	WARMINSTER, PA. 18974
44	NAVAL AIR DEVELOPMENT CENTER	WARMINSTER, PA. 18974
45	SOUTHWEST RES. INST.	SAN ANTONIO, TX. 78284

TABLE 3
FACILITY DESCRIPTION

ID#	PRINCIPLE OF OPERATION AND/OR PULSE SHAPING	MAN* RATED	TRACK LENGTH/ TOWER HEIGHT(m)	PAYLOAD WT (Kg)		
				SLED 1	SLED 2	SLED 3
I. HORIZONTAL IMPACT DECELERATORS						
3	Deformable Plastic Tube	(1)	20.0	300.0		
4	Solid Fuel Rocket	N	600.0	1000.0		
5	Barrier Crash	(1)	(1)	10000.0	10000.0	
6	Elastic Cord/Polyurethane Tube N		6.0	200.0	700.0	
7	Elastic Cord/Polyurethane Tube N		20.0	200.0	700.0	
8	Winch	N	400.0	200.0	700.0	
10	Drop Weight/Metal Strip	(1)	30.0	500.0		
11	Bungee/Metal Strip	Y	11.0	300.0		
12	Drop Weight/Metal Strip	(1)	24.0	611.4		
13	Linear Induction Motor	(1)	65.0	10000.0		
15	Bungee/Barrier Crash	(1)	(1)	670.0		
16	Bungee/Barrier Crash	(1)	(1)	250.0		
17	Electric Drive/Barrier Crash	(1)	420.0	20000.0		
18	Bungee/Steel Cable	Y	46.0	250.0		
22	Linear Induction Motor	(1)	51.8	4536.0		
26	Pneumatic Piston	(2)	3.0	36.3		
29	Pneumatic	Y	40.0	1121.0		
30	Pneumatic	Y	20.0	122.3		
32	Pneumatic	N	91.0	2860.0		
34	Pneumatic	N	11.0	861.8		
39	Hydraulic Piston	Y	76.2	636.0	909.0	
41	Deformable Metal Wire	N	46.0	1000.0		
45	Bungee/Pneumatic Rebound	Y	11.9	1814.4		
II. VERTICAL IMPACT DECELERATORS						
9	Gravity	N	33.0	200.0	700.0	
21	Honeycomb/Tear Webbing	(3)	6.0	120.0		
25	Gravity	N	20.0	(1)		
31	Pneumatic	N	36.5	91.7		
36	Gravity/Hydraulic Piston	Y	15.2	909.0		
38	Gravity/Honeycomb	N	14.9	45.5		
44	Metal Brakes	Y	36.6	317.5		
III. HORIZONTAL IMPACT ACCELERATORS						
1	Hygee 12	(3)	37.0	2268.0		
14	Hygee 12	(1)	65.0	2500.0		
20	Rubber Cord	N	33.0	800.0		
23	Hygee 12	N	28.0	1818.0		
24	Gravity	N	45.0	(1)		
27	Hygee 12	Y	213.0	2268.0	181.4	341.4
33	Hygee 12	Y	27.0	1587.6		
35	Hygee 24	N	29.0	4536.0		
40	Hygee 24	Y	76.0	4550.0	1450.0	
42	Hygee 12	Y	30.5	1361.0		
IV. VERTICAL IMPACT ACCELERATORS						
2	Solid Fuel Rocket	N	33.0	100.0		
19	Ejection Catapult	(3)	47.2	(1)		
28	Hygee 6	N	12.2	227.2		
37	Hygee 6	N	6.1	57.0		
43	Ballistic	Y	45.7	362.9		

NOTES

- (1) Information Not Supplied
 (2) Model Structures Tested Only
 (3) Not U.S. "Man Rated", but safe for use
 in human studies

*"Man-rated" means use of facility with human test subjects after satisfying formal or informal local or national safety requirements.

Y=Yes
 N=No

TABLE 4
SLED CHARACTERISTICS

ID#	SLED WT. Kg	PAYLOAD WT. Kg	MASS RATIO (1)
1	725.76	2268.00*	0.32 (10.37)
2	75.00	100.00	0.75
3	500.00	300.00	1.67
4	1500.00	1000.00	1.50
5	15000.00	10000.00	1.50
5	15000.00	10000.00	1.50
6	400.00	200.00	2.00
6	800.00	700.00	1.14
7	400.00	200.00	2.00
7	800.00	700.00	1.14
8	400.00	200.00	2.00
8	800.00	700.00	1.14
9	400.00	200.00	2.00
9	800.00	700.00	1.14
10	1000.00	500.00	2.00
11	140.00	300.00*	0.47 (2.00)
12	387.22	611.40	0.63
13	(2)	10000.00	-
14	1000.00	2500.00	0.40
15	460.00	670.00	0.69
16	180.00	250.00	0.72
17	(2)	20000.00	-
18	386.00	250.00*	1.54 (5.51)
19	(2)	(2)	-
20	485.00	800.00	0.61
21	200.00	120.00*	1.67 (2.86)
22	(2)	4536.00	-
23	1090.00	1818.00	0.60
24	(2)	(2)	-
25	(2)	(2)	-
26	9.07	36.29	0.25
27	907.00	2268.00*	0.40 (12.96)
27	265.00	181.40*	1.46 (3.79)
27	165.00	341.37*	0.48 (2.36)
28	112.00	227.24	0.49
29	599.00	1121.00*	0.53 (8.56)
30	591.00	122.30*	4.83 (8.44)
31	102.00	91.70	1.11
32	(2)	2860.00	-
33	920.80	1587.60*	0.58 (13.15)
34	272.20	861.80	0.32
35	1633.00	4536.00	0.36
36	909.00	909.00*	1.00 (13.00)
37	40.00	57.00	0.70
38	277.00	45.50	6.09
39	1182.00	636.00*	1.86 (16.89)
39	909.00	909.00*	1.00 (13.00)
40	818.00	4550.00*	0.18 (11.69)
40	364.00	1450.00*	0.25 (5.20)
41	408.00	1000.00	0.41
42	907.00	1361.00*	0.67 (12.96)
43	68.00	362.90*	0.19 (0.97)
44	589.70	317.50*	1.86 (8.42)
45	385.60	1814.40*	0.21 (5.51)

(1) Sled Wt/Payload Wt, (Chandler, R.F. 1971. Discussion on Facilities for Impact studies. AGARD Conference Proceedings No. 88, p. xxxv.)

(2) Information not supplied.

*Man-rated, 70kg used as payload to recalculate mass ratio values, (in parentheses).

TABLE 5
AVAILABLE WAVEFORMS

ID#	WAVEFORM	RANGE ACCEL G	DURATION ms(1)
1	1/2 SINE	0.00 - 50.00	97.00
1	OTHER	PIN DESIGN CAPABILITY FOR VARIOUS WAVEFORMS	
2	SAWTOOTH	1.00 - 40.00	(2)
3	RECTANGLE	-	-
4	TRAPEZOIDAL	-	-
5	SINE	NEARLY ANY SHAPE IS POSSIBLE	
6	SINE	-	-
7	SINE	-	-
8	SINE	-	-
9	SINE	-	-
10	TRAPEZOIDAL	5.00 - 40.00	-
10	RECTANGLE	5.00 - 40.00	-
11	TRAPEZOIDAL	- 30.00	80.00
12	TRAPEZOIDAL	DEPENDENT ON SLED VELOCITY AND DECELERATION	
13	-	DEPENDS ON IMPACT SURFACE AND VEHICLE DYNAMICS	
14	1/2 SINE	-	-
14	TRIANGLE	-	-
14	TRAPEZOIDAL	-	-
14	RECTANGLE	-	-
14	OTHER	(2)	-
15	1/2 SINE	-	-
15	TRIANGLE	-	-
15	TRAPEZOIDAL	-	-
15	RECTANGLE	-	-
15	OTHER	-	-
16	1/2 SINE	-	-
16	TRIANGLE	-	-
16	TRAPEZOIDAL	-	-
16	RECTANGLE	-	-
16	OTHER	-	-
17	-	-	-
18	1/2 SINE	2.00 - 50.00	200.00
19	TRAPEZOIDAL	-	-
20	1/2 SINE	20.00 - 32.00	100.00
20	TRAPEZOIDAL	12.00 - 14.00	FUNCTION OF SLED VELOCITY
21	TRAPEZOIDAL	- 10.20	200.00
22	-	DEPENDS ON VEHICLE TYPE AND BARRIER	
23	1/2 SINE	- 50.00	130.00
23	RECTANGLE	- 50.00	130.00
23	SAWTOOTH	- 50.00	130.00
24	1/2 SINE	-	-
24	TRIANGLE	-	-
24	TRAPEZOIDAL	-	-
25	1/2 SINE	-	-
25	TRIANGLE	-	-
25	TRAPEZOIDAL	-	-
26	RECTANGLE	10.00 - 300.00	-
27	SINE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
27	1/2 SINE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
27	TRAPEZOIDAL	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
27	SAWTOOTH	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
27	OTHER	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	SINE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	1/2 SINE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	TRIANGLE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	TRAPEZOIDAL	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	SAWTOOTH	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	OTHER	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
29	1/2 SINE	5.00 - 50.00	300.00
29	TRIANGLE	5.00 - 50.00	300.00
29	TRAPEZOIDAL	5.00 - 50.00	300.00
29	RECTANGLE	5.00 - 50.00	300.00
29	SAWTOOTH	5.00 - 50.00	300.00
30	1/2 SINE	5.00 - 50.00	300.00
30	TRIANGLE	5.00 - 50.00	300.00
30	TRAPEZOIDAL	5.00 - 50.00	300.00
30	RECTANGLE	5.00 - 50.00	300.00
30	SAWTOOTH	5.00 - 50.00	300.00

TABLE 5 CONTINUED
AVAILABLE WAVEFORMS

ID#	WAVEFORM	RANGE ACCEL G	DURATION ms(1)
31	1/2 SINE	5.00 - 50.00	300.00
31	TRIANGLE	5.00 - 50.00	300.00
31	TRAPEZOIDAL	5.00 - 50.00	300.00
31	RECTANGLE	5.00 - 50.00	300.00
31	SAWTOOTH	5.00 - 50.00	300.00
32	1/2 SINE	3.00 - 50.00	120.00
33	TRIANGLE	55.00 MIN. (2)	50.00
33	TRAPEZOIDAL	5.00 - 40.00	150.00
33	SAWTOOTH	55.00 MIN. (2)	50.00
33	OTHER	70.00 MIN. (2)	150.00
34	OTHER	PROGRAMMABLE TO SIMULATE GIVEN VEHICLE	
35	1/2 SINE	2.00 - 100.00	100.00
35	TRAPEZOIDAL	5.00 - 50.00	130.00
35	OTHER	0.00 - 24.00	100.00
36	1/2 SINE	-	-
36	TRIANGLE	-	-
37	1/2 SINE	-	-
37	TRAPEZOIDAL	-	-
37	RECTANGLE	-	-
37	SAWTOOTH	-	-
38	RECTANGLE	10.00 - 600.00	24.00
39	1/2 SINE	- 100.00	67.00
39	TRIANGLE	- 100.00	76.00
39	TRAPEZOIDAL	- 100.00	49.00
39	SAWTOOTH	- 100.00	93.00
39	OTHER	- 100.00	-
40	1/2 SINE	1.00 - 150.00	55.00
40	TRIANGLE	1.00 - 150.00	70.00
40	TRAPEZOIDAL	1.00 - 150.00	50.00
40	RECTANGLE	1.00 - 150.00	35.00
40	SAWTOOTH	1.00 - 150.00	70.00
40	OTHER	1.00 - 150.00	-
41	1/2 SINE	DEPENDENT UPON VELOCITY AND DECELERATION	
41	TRIANGLE	DEPENDENT UPON VELOCITY AND DECELERATION	
41	TRAPEZOIDAL	DEPENDENT UPON VELOCITY AND DECELERATION	
41	SAWTOOTH	DEPENDENT UPON VELOCITY AND DECELERATION	
42	1/2 SINE	- 40.00	100.00
42	TRIANGLE	- 40.00	100.00
42	TRAPEZOIDAL	- 30.00	100.00
42	OTHER	(2)	-
43	TRAPEZOIDAL	4.00 - 30.00	300.00
44	TRIANGLE	-	-
44	TRAPEZOIDAL	-	-
45	SINE	.50 - 60.00	375.00
45	1/2 SINE	.50 - 60.00	375.00
45	TRIANGLE	.50 - 60.00	375.00
45	TRAPEZOIDAL	.50 - 60.00	375.00
45	RECTANGLE	.50 - 60.00	400.00
45	OTHER	-	-

NOTES

- (1) IF RANGE REPORTED, MAXIMUM GIVEN
(2) SEE DATA SHEET

TABLE 6

I. PERFORMANCE PARAMETERS (HORIZONTAL)

ID#	ACCELERATION	JOLT	VELOCITY	STROKE	REPEATABILITY (PEAK)*	
	G	Gs ⁻¹	ms ⁻¹	m	G%	VELOCITY %
1	50.00	4000.00	29.50	2.44	2.00	2.00
3	30.00		27.78			2.00
4	60.00	75.00	900.00	150.00	95.00	90.00
5					5.00	1.00
6	100.00		35.56		5.00	1.00
7	100.00		35.56		5.00	1.00
8	100.00		35.56		5.00	1.00
10	1.50		22.35	0.80	5.00	5.00
11	40.00	2500.00	19.50	0.80	5.00	1.00
12	40.00		27.78		97.00	100.00
13			13.90			1.00
14	80.00		36.11		1.00	0.50
15	80.00		36.11		1.00	0.50
16	80.00		36.11		1.00	0.50
17			38.88			
18	50.00	1000.00	15.00	0.90	1.00	0.25
20	50.00		22.22	1.00	5.00	4.00
22	INDETERMINATE	INDETERMINATE	22.35	INDETERMINATE		1.00
23	50.00		27.78	3.00	2.50	2.50
24	50.00		20.00			
26	300.00		30.46	0.91		5.00
27	200.00	50.00	40.00	1.70	1.00	1.00
29	50.00	2500.00	30.00	2.00	5.00	5.00
30	50.00	2500.00	30.00	2.00	5.00	5.00
32	15.00		27.30	91.00		
33	72.00		24.59	2.44	2.50	2.50
34	50.00		17.88	1.37		2.00
35	100.00		44.70	1.83	1.00	1.00
39	100.00	10000.00	38.10	1.42	5.00	3.00
40	150.00	4000.00	51.51	2.56	1.00	1.00
41	50.00	2000.00	20.00	5.50	4.60	0.32
42	50.00		30.50	1.50	2.50	2.50
45	60.00	6000.00	31.29	0.50	2.00	4.00

II. PERFORMANCE PARAMETERS (VERTICAL)

ID#	ACCELERATION	JOLT	VELOCITY	STROKE	REPEATABILITY (PEAK)*	
	G	Gs ⁻¹	ms ⁻¹	m	G%	VELOCITY %
2	30.00	100.00	120.00	25.00		
9	100.00		35.56		5.00	1.00
19	20.00	300.00	20.90			
21	100.00		6.00	1.50	20.00	
25	50.00		20.00			
28	15.00	500.00	14.70	0.68	1.00	1.00
31	25.00	2500.00	20.00	2.00	5.00	5.00
36	80.00	500.00	17.07	1.22	7.50	7.50
37	150.00	3200.00	17.98	0.48	2.00	2.00
38	600.00		14.02		95.00	99.00
43	30.00	3000.00	22.90	1.90	5.00	5.00
44	55.00	1000.00	25.90	1.50	5.00	3.00

*Deviation from a programmed test value under idealized test conditions for multiple tests. See p. 7 for further discussion.

TABLE 7
INSTRUMENTATION DESCRIPTION

ID#	NO. CHANNELS	FREQ CLASS (KHZ)	RECORD. METHOD	TRANS. METHOD
1	69	40.0	FM TAPE CHART, A/D	FLYING LEAD
2	14	1.0	TAPE CHART	FLYING LEAD FM TRANSMISS
3	50	1.0	TAPE CHART	FLYING LEAD FM TRANSMISS
4	IN COMPLIANCE WITH IRIG STANDARDS		TAPE CHART	FLYING LEAD FM TRANSMISS
5	80	1.0	TAPE	FLYING LEAD
6	50	1.0	TAPE, CHART PAPER REC.	FLYING LEAD FM TRANSMISS
7	50	1.0	TAPE, CHART PAPER REC.	FLYING LEAD FM TRANSMISS
8	50	1.0	TAPE, CHART PAPER REC.	FLYING LEAD FM TRANSMISS
9	50	1.0	TAPE, CHART PAPER REC.	FLYING LEAD FM TRANSMISS
10	48	1.0	TAPE, PCM	FLYING LEAD
11	10	1.0	TAPE	FLYING LEAD
12	30		TAPE	FM TRANSMISS
13	75	0.6	CHART	FLYING LEAD
14	75	0.6	TAPE	FLYING LEAD
15	75	0.6	TAPE	FLYING LEAD
16	75	0.6	TAPE	FLYING LEAD
17	96	1.65	TAPE, CHART	FM TRANSMISS
18	14	0.2	TAPE, C.R.O.	FLYING LEAD
	12	0.1	CHART	
19	11	1.0	TAPE	FM TRANSMISS
20	16	1.0	CHART	FLYING LEAD
21	6	0.5	TAPE	FLYING LEAD
22	65	10.0	TAPE PAPER	FLYING LEAD FLYING LEAD
23	28	1.0	TAPE GALVANOMETER	FLYING LEAD
24	26		TAPE, CHART	FLYING LEAD
25	26		TAPE, CHART	FLYING LEAD
26	28		TAPE	FLYING LEAD
27	88	12.0	TAPE, CHART	FLYING LEAD
28	88	12.0	TAPE, CHART	FLYING LEAD
29	73	1.0	TAPE, A/D CHART	FLYING LEAD
30	73	1.0	TAPE, A/D CHART	FLYING LEAD
31	40	1.0	TAPE, A/D CHART	FLYING LEAD
32	IN THE PROCESS OF UPDATING			
33	54	1.0	FM TAPE, DDAS	FLYING LEAD
34	50	1.0	FM TAPE, CHART	FLYING LEAD
35	64	1.0	TAPE, CHART	FLYING LEAD
36	50	10.0	TAPE	FLYING LEAD
37	9	2.0	TAPE	FLYING LEAD
38	30	2.0	TAPE, CHART	FLYING LEAD
39	50	10.0	TAPE, A/D CHART	FLYING LEAD FM TRANSMISS
40	50	10.0	TAPE, CHART DIGITAL	FLYING LEAD FM TRANSMISS
41	42	1.0	TAPE, ANALOG CHART	FLYING LEAD
42	28	1.0	TAPE, CHART	FLYING LEAD
43	25	1.0	TAPE, OSCILL. CHART	FLYING LEAD
44	25	1.0	TAPE CHART	FLYING LEAD
45	28	5.0	ANAL/DIG. REC OSCILLOGRAPH	FLYING LEAD

TABLE 8
ACCELEROMETER DESCRIPTION

ID#	TYPE	DYNAMIC RANGE (G)	FREQ. RANGE (KHZ)	MAX. NUMBER USED SLED SUBJECT
1	PIEZO RES.	0.00 - 5000.00	0.00 - 2.00	(1) (1)
2	INDUCTANCE	0.00 - 50.00	-	(2) 9
2	PIEZO RES.	-	-	(2) 9
3	PIEZO RES.	10.00 - 1000.00	-	5 12
4	INDUCTANCE	10.00 - 200.00	-	1 (2)
4	PIEZO ELECT.	-	-	1 (2)
5	(1)	-	-	8 8
6	PIEZO ELECT.	1.00 - 1000.00	-	40 9
6	PIEZO RES.	1.00 - 1000.00	-	40 9
7	PIEZO ELECT.	1.00 - 1000.00	-	40 9
7	PIEZO RES.	1.00 - 1000.00	-	40 9
8	PIEZO ELECT.	1.00 - 1000.00	-	40 9
8	PIEZO RES.	1.00 - 1000.00	-	40 9
9	PIEZO ELECT.	1.00 - 1000.00	-	40 9
9	PIEZO RES.	1.00 - 1000.00	-	40 9
10	ENDEVCO	- 750.00	- 2.00	1 9
10	ENDEVCO	- 2500.00	- 9.00	1 9
11	HOLTINGER	0.00 - 600.00	- 5.00	1 9
12	ENDEVCO 2264	-2000.00 - +2000.00	- 27.00	1 29
13	(1)	-	-	(1) (1)
14	CEC	- 250.00	- 1.00	2 6
14	ENDEVCO	- 750.00	- 2.00	2 3
15	CEC	- 250.00	- 1.00	2 6
15	ENDEVCO	- 750.00	- 2.00	2 3
16	CEC	- 250.00	- 1.00	2 6
16	ENDEVCO	- 750.00	- 2.00	2 3
17	PIEZO RES.	- 200.00	0.00 - 1.10	50 16
17	PIEZO RES.	- 250.00	0.00 - 2.00	50 16
17	PIEZO RES.	- 750.00	0.00 - 2.00	50 16
18	KYOWA	-50.00 - +50.00	DC - 0.75	1 (2)
19	SMITH ALV 692	-	DC - 1.00	(1) (1)
20	PIEZO RES.	0.00 - 1800.00	-	2 1
21	PIEZO ELECT	0.00 - 5098.40	0.00 - 20.00	(1) (1)
22	STRAIN GAUGE	- 750.00	-	(1) (1)
23	STRAIN GAUGE	0.00 - 750.00	0.00 - 2.00	1 9
24	STRAIN GAUGE	-100.00 - +100.00	- 0.50	3 8
24	PIEZO RES.	-100.00 - +100.00	- 2.00	3 8
25	STRAIN GAUGE	-100.00 - +100.00	- 0.50	3 8
25	PIEZO RES.	-100.00 - +100.00	- 2.00	3 8
26	SEE DATA SHEET	-	-	(1) (1)
27	PIEZO RES.	0.00 - 500.00	0.00 - 20.00	3 18
28	PIEZO RES.	0.00 - 500.00	0.00 - 20.00	3 18
29	PIEZO RES.	0.00 - 2000.00	0.00 - 1.00	4 36
29	STRAIN GAUGE	0.00 - 200.00	0.00 - 0.50	4 36
29	PIEZO ELECT.	0.00 - 1000.00	0.01 - 40.00	4 36
30	PIEZO RES.	0.00 - 2000.00	0.00 - 1.00	4 36
30	STRAIN GAUGE	0.00 - 200.00	0.00 - 0.50	4 36
30	PIEZO ELECT.	0.00 - 1000.00	0.01 - 40.00	4 36
31	PIEZO RES.	0.00 - 2000.00	0.00 - 1.00	4 36
31	STRAIN GAUGE	0.00 - 200.00	0.00 - 0.50	4 36
31	PIEZO ELECT.	0.00 - 1000.00	0.01 - 40.00	4 36
32	SEE DATA SHEET	-	-	(1) (1)
32	CEC	-250.00 - +250.00	- 2.00	100 40
33	ENDEVCO	-750.00 - +750.00	-	100 40
33	KISTLER	-100.00 - +100.00	- 1.00	100 40
34	PIEZO RES.	- 750.00	0.00 - 2.00	1 6
35	ENDEV. 7232C	-750.00 - +750.00	0.00 - 2.00	3 61
35	ENDEV. 2260C	-250.00 - +250.00	0.00 - 2.00	3 61
35	ENDEV. 7267C	-750.00 - +750.00	0.00 - 2.00	3 61
35	CEC 4-202	-250.00 - 250.00	0.00 - 2.00	3 61
36	PIEZO RES.	-	-	1 (2)
37	PIEZO RES.	0.00 - 250.00	DC - 2.00	1 (2)
38	PIEZO RES.	0.00 - 250.00	-	21 9
39	PIEZO RES.	- 500.00	0.00 - 3.00	5 12
39	PIEZO ELECT.	- 250.00	0.00 - 3.00	5 12
39	STRAIN GAUGE	- 250.00	0.00 - 0.25	5 12
40	PIEZO RES.	- 250.00	-	6 9
41	STRAIN GAUGE	10.00 - 250.00	0.00 - 1.00	(2) (2)
42	STRAIN GAUGE	-100.00 - +100.00	- 0.75	2 9
43	STRAIN GAUGE	-100.00 - +100.00	0.00 - 0.75	2 9
44	STRAIN GAUGE	-100.00 - +100.00	0.00 - 0.75	2 9
45	ENDEV 2264	-2000.00 - +2000.00	0.00 - 5.00	2 24
45	ENDEV 7264	-2000.00 - +2000.00	0.00 - 5.00	2 24
45	ENDEV 2260	-250.00 - +250.00	0.00 - 2.00	2 24

(1) INFORMATION NOT SUPPLIED; (2) SEE DATA SHEET

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- von Gierke, H. E. and Brinkley, J. W. 1975. "Impact Accelerations," Chapt 6. in: Ecological and Physiological Bases of Space Biology and Medicine. Vol II, Book 1 of Foundations of Space Biology and Medicine (ed. by: Calvin, M. and Gzenko, O.B.) NASA, Washington, DC.

NATO/AGARD

Impact Test Facility Survey

ID: #1

1. Name and Address of Facility DCIEM IMPACT STUDIES FACILITY
P.O. BOX 2000
1133 SHEPPARD AVE. W.
DOWNSVIEW, ON. M3M 3B9, CANADA

2. Name of Director/Manager DR. JACK P. LANDOLT

3. Date Facility became operational OCTOBER 1979

4. Principle of Operation HYDRAULIC/PNEUMATIC 12-INCH ACTUATOR
(BENDIX HYGE)

5. Main Use/Test Type VEHICLE AND AIRCRAFT SEAT AND BELT
TESTS

a. Man Rated: yes no PENDING

6. Descriptive Details

a. Horizontal	<u>X</u>	c. Vertical	<u>N/A</u>
b. Track Length	<u>37m</u>	d. Tower Height	<u>N/A</u>

e. Sled Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max)	<u>1600 LB</u>	<u>11</u>	<u>11</u>
e.2. Width (max)	<u>4 FT</u>	<u>11</u>	<u>11</u>
e.3. Length (max)	<u>15 FT</u>	<u>11</u>	<u>11</u>

f. Payload Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max)	<u>5000 LB</u>	<u>11</u>	<u>11</u>
f.2. Width (max)	<u>18 FT</u>	<u>11</u>	<u>11</u>
f.3. Length (max)	<u>12 FT</u>	<u>11</u>	<u>11</u>
f.4. Range of Orientation	<u>360°</u>	<u>11</u>	<u>11</u>

7. Performance Parameters

a. Acceleration	<u>50 G</u> (max)	(min usable)
b. Jolt	<u>4000 G/SEC</u> (max)	(min usable)
c. Velocity	<u>66 MPH</u> (max)	(min usable)
d. Stroke	<u>8 FT</u> (max)	(min usable)

e. Waveform: (Check all that Apply) Range of Acceleration Duration

e.1. Sine	<u>X</u>	<u>UP TO 50 G</u>	<u>97 MILLISEC</u>
e.2. 1/2 Sine	<u>11</u>	<u>11</u>	<u>11</u>
e.3. Triangle	<u>11</u>	<u>11</u>	<u>11</u>
e.4. Trapezoidal	<u>11</u>	<u>11</u>	<u>11</u>
e.5. Rectangle	<u>11</u>	<u>11</u>	<u>11</u>
e.6. Sawtooth	<u>11</u>	<u>11</u>	<u>11</u>
e.7. Other (indicate)	<u>PIN DESIGN CAPABILITY FOR VARIOUS WAVEFORMS</u>		

f. Repeatability

f.1. Peak G	<u>±2</u>	<u>5</u>
f.2. Peak Velocity	<u>±2</u>	<u>5</u>

8. Instrumentation

a. Number of Channels 69 (49 PRIMARY, 20 SECONDARY)

b. Frequency Response/Class ALL CLASSES (VARIABLE UP TO 40,000 Hz)

c. Method of recording

c.1. Tape	<u>14 CHANNELS FM</u>
c.2. Chart	<u>6 CHANNELS</u>
c.3. Other (specify)	<u>49 CHANNEL ANALOGUE TO DIGITAL CONVERTER SYSTEM (DATALAB)</u>

d. Method of Transmission

d.1. Flying lead	<u>X</u>
d.2. FM Transmission	<u>11</u>

e. Accelerometers

e.1. Types	<u>PIEZORESISTIVE</u>
e.2. Dynamic Range	<u>UP TO 5000 G</u>
e.3. Frequency Range	<u>UP TO 2000 G</u> <u>±5%</u>
e.4. Number	<u>VARIABLE TO MEET REQUIREMENTS</u>
e.4.a. on sled	<u>11</u>
e.4.b. on subject/dummy	<u>11</u>

f. Other Parameters Monitored: LOADS (BELT, AND INTERNAL DUMMY LOCATIONS); BELT PULL-OUT, ANGULAR ACC; 9 COMPONENT ACCEL. OF BITE-PLATE; HEART RATES, EKG, EMG

NATO/AGARD

Impact Test Facility Survey

15 #2

1. Name and Address of Facility CENTRE D'ESSAIS EN VOL
LA PORATOIRE DE REDECINE AEROSPATIALE
91220 BRETIQNY-AN

2. Name of Director/Manager MEDECIN EN CHEF ROBERT ANFRET

3. Date Facility Became Operational 1955

4. Principle of Operation RAMPE D'ESSAI DES DIRIGES EJECTABLES
SOLID ROCKET

5. Main Use/Test Type ESSAIS AU CROC DES EQUIPEMENTS DU
PILOTE. ESSAIS DES PROFUSIONS DE
SIEGE

6. Man Rated: yes 2 no 2

6. Descriptive Details

a. Horizontal	<u> </u>	c. Vertical	<u>X</u>
b. Track Length	<u> </u>	d. Tower Height	<u>33m (31m utilis)</u>

e. Sled Characteristics

	<u>Sled #1</u>	<u>Sled #2</u>	<u>Sled #3</u>
e.1. Weight (max)	<u>75kg</u>	<u> </u>	<u> </u>
e.2. Width (max)	<u>0.60m</u>	<u> </u>	<u> </u>
e.3. Length (max)	<u>1m</u>	<u> </u>	<u> </u>

f. Payload Characteristics

	<u>Sled #1</u>	<u>Sled #2</u>	<u>Sled #3</u>
f.1. Weight (max)	<u>100kg</u>	<u> </u>	<u> </u>
f.2. Width (max)	<u> </u>	<u> </u>	<u> </u>
f.3. Length (max)	<u> </u>	<u> </u>	<u> </u>
f.4. Range of Orientation	<u>1</u>	<u> </u>	<u> </u>

7. Performance Parameters

a. Acceleration	<u>30g</u> (max)	<u>3g</u> (min usable)
b. Jolt	<u>100g/s</u> (max)	<u>10g/s</u> (min usable)
c. Velocity	<u>120m/s</u> (max)	<u> </u> (min usable)
d. Stroke	<u>25m</u> (max)	<u> </u> (min usable)

e. Waveform: (Check all that Apply)

	Range of Acceleration	Duration
e.1. Sine	<u> </u>	<u> </u>
e.2. 1/2 Sine	<u> </u>	<u> </u>
e.3. Triangle	<u> </u>	<u> </u>
e.4. Trapezoidal	<u> </u>	<u> </u>
e.5. Rectangle	<u> </u>	<u> </u>
e.6. Sawtooth	<u>X</u>	<u>1 A 40s</u>
e.7. Other (indicate)	<u> </u>	<u>COUP PAR COUP</u>

f. Repeatability

f.1. Peak G	<u> </u> %
f.2. Peak Velocity	<u> </u> %

8. Instrumentation

a. Number of Channels

b. Frequency Response/Class INSTRUMENTS AU STANDARD IRIG

c. Method of recording

c.1. Tape	<u>X</u>
c.2. Chart	<u>X</u>
c.3. Other (specify)	<u> </u>

d. Method of Transmission

d.1. Flying lead	<u>X</u>
d.2. FM Transmission	<u>X</u>

e. Accelerometers

e.1. Types	<u>A INDUCTANCE</u>	<u>PIEZORESISTIF</u>
e.2. Dynamic Range	<u>0 A 50g</u>	<u> </u>
e.3. Frequency Range	<u> </u>	<u> </u>
e.4. Number	<u> </u>	<u> </u>
e.4.a. on sled	<u>VARIABLE</u>	<u> </u>
e.4.b. on subject/dummy	<u>9</u>	<u> </u>

f. Other Parameters Monitored: COURSE DU CHARIOT RESTITUEE PAR CELLULE
PHOTOELECTRIQUE ET DEUX RAMPES DE LAMPES.

NATO/AGARD

Impact Test Facility Survey

ID #3

1. Name and Address of Facility	ORGANISME NATIONAL DE SECURITE ROUTIERE (ONSR) 109 AVE SALVADOR ALLENDE 69500 BRON FRANCE																										
2. Name of Director/Manager	J. LEROY																										
3. Date Facility Became Operational	1975																										
4. Principle of Operation																											
5. Main Use/Test Type	CAR CRASH TEST																										
a. Man Rated:	yes ☐ no ☐																										
6. Descriptive Details																											
a. Horizontal	☒	c. Vertical	☐																								
b. Track Length	20	d. Tower Height																									
e. Sled Characteristics	<table border="1"> <thead> <tr> <th></th> <th>Sled #1</th> <th>Sled #2</th> <th>Sled #3</th> </tr> </thead> <tbody> <tr> <td>e.1. Weight (max)</td> <td>500kg</td> <td></td> <td></td> </tr> <tr> <td>e.2. Width (max)</td> <td>0.95m</td> <td></td> <td></td> </tr> <tr> <td>e.3. Length (max)</td> <td>1.70m</td> <td></td> <td></td> </tr> </tbody> </table>				Sled #1	Sled #2	Sled #3	e.1. Weight (max)	500kg			e.2. Width (max)	0.95m			e.3. Length (max)	1.70m										
	Sled #1	Sled #2	Sled #3																								
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	Sled #1	Sled #2	Sled #3																								
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f.2. Width (max)																											
f.3. Length (max)																											
f.4. Range of Orientation																											
7. Performance Parameters																											
a. Acceleration	30g (max)		(min usable)																								
b. Jolt	100km/h (max)		(min usable)																								
c. Velocity			(min usable)																								
d. Stroke	1.0m (max)		(min usable)																								
e. Waveform: (Check all that Apply)	<table border="0"> <thead> <tr> <th></th> <th>Range of Acceleration</th> <th>Duration</th> </tr> </thead> <tbody> <tr> <td>e.1. Sine</td> <td></td> <td></td> </tr> <tr> <td>e.2. 1/2 Sine</td> <td></td> <td></td> </tr> <tr> <td>e.3. Triangle</td> <td>X</td> <td></td> </tr> <tr> <td>e.4. Trapezoidal</td> <td></td> <td></td> </tr> <tr> <td>e.5. Rectangle</td> <td></td> <td></td> </tr> <tr> <td>e.6. Sawtooth</td> <td></td> <td></td> </tr> <tr> <td>e.7. Other (indicate)</td> <td></td> <td></td> </tr> </tbody> </table>				Range of Acceleration	Duration	e.1. Sine			e.2. 1/2 Sine			e.3. Triangle	X		e.4. Trapezoidal			e.5. Rectangle			e.6. Sawtooth			e.7. Other (indicate)		
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e.6. Sawtooth																											
e.7. Other (indicate)																											
f. Repeatability																											
f.1. Peak G		%																									
f.2. Peak Velocity	2	%																									
8. Instrumentation																											
a. Number of Channels	50																										
b. Frequency Response/Class	1000Hz																										
c. Method of recording																											
c.1. Tape	X																										
c.2. Chart	X																										
c.3. Other (specify)																											
d. Method of Transmission																											
d.1. Flying lead	X																										
d.2. FM Transmission	X																										
e. Accelerometers																											
e.1. Types	PIEZORESISTIVES																										
e.2. Dynamic Range	10 - 1000g																										
e.3. Frequency Range																											
e.4. Number																											
e.4.a. on sled	5																										
e.4.b. on subject/dummy	12																										
f. Other Parameters Monitored:	FORCE, PRESSURE																										

NATO/AGARD

Impact Test Facility Survey

ID #4

1. Name and Address of Facility CENTRE D'ESSAIS EN VOL
BASE D'ESSAI DE CAZAUX
33630 CAZAUX, FR.

2. Name of Director/Manager INGENIEUR EN CHEF SIX

3. Date Facility became operational 1967

4. Principle of Operation RAIL D'ESSAIS (ROCKET-SOLID FUEL, EJECTION SEAT)

5. Main Use/Test Type IMPACTS
TRAJECTOIRES ACCELEREES
TRAJECTOIRES A VITESSE CONSTANTE

a. Man Rated: yes no X

6. Descriptive Details

a. Horizontal	<u>X</u>	c. Vertical	
b. Track Length	<u>600m</u>	d. Tower Height	

e. Sled Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max) [CHARIOTS]	<u>1500kg</u>		
e.2. Width (max) SPECIFIQUES	<u>1m</u>		
e.3. Length (max) A L'ESSAI	<u>5m</u>		

f. Payload Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max)	<u>1000kg</u>		
f.2. Width (max)	<u>0.8m</u>		
f.3. Length (max)	<u>4m</u>		
f.4. Range of Orientation			

7. Performance Parameters*

a. Acceleration	<u>60g</u> (max)	<u>10g</u> (min usable)
b. Jolt	<u>75g/s</u> (max)	<u>25</u> (min usable)
c. Velocity	<u>900m/s</u> (max)	<u>20</u> (min usable)
d. Stroke	<u>150g</u> (max)	<u>10g</u> (min usable)

e. Waveform: (Check all that Apply)

	Range of Acceleration	Duration
e.1. Sine		
e.2. 1/2 Sine		
e.3. Triangle		
e.4. Trapezoidal	<u>X</u>	
e.5. Rectangle		
e.6. Sawtooth		
e.7. Other (indicate)		

f. Repeatability

f.1. Peak G	<u>95</u> %	*PROPULSION PAR 1 A 86
f.2. Peak Velocity	<u>90</u> %	ROQUETTES DE 68 mm -
		FREINAGE HYDRODYNAMIQUE OU
		RETROPROPULSION

8. Instrumentation

a. Number of Channels SUIVANT LE NOMBRE DE TELEMESURES AU STANDARD IRIG

b. Frequency Response/Class

c. Method of recording

c.1. Tape	<u>X</u>
c.2. Chart	<u>X</u>
c.3. Other (specify)	

d. Method of Transmission

d.1. Flying lead	<u>X</u>
d.2. FM Transmission	<u>X</u>

e. Accelerometers

e.1. Types	<u>A INDUCTANCE</u>	<u>PIEZOELECTRIQUES</u>
e.2. Dynamic Range	<u>10 A 200g</u>	
e.3. Frequency Range		
e.4. Number		
e.4.a. on sled	<u>1</u>	
e.4.b. on subject/dummy	<u>SUIVANT SON INSTRUMENTATION</u>	

f. Other Parameters Monitored: CAPTEUR DE DEPLACEMENT, POSSIBILITE DE TRAJECTOGRAPHIE PAR CINETHODOLITES,

NATO/AGARD

Impact Test Facility Survey

ID #5

1. Name and Address of Facility CENTRE TECHNIQUE RENAULT DE LARDY
E-91 LARDY (FRANCE)

2. Name of Director/Manager M. PHILIPPE

3. Date Facility became operational 1975

4. Principle of Operation _____

5. Main Use/Test Type ALL TYPES OF ACCIDENT SIMULATIONS OR RECONSTRUCTIONS

a. Man Rated: _____
yes _____ no _____

6. Descriptive Details

a. Horizontal _____	c. Vertical _____
b. Track Length _____	d. Tower Height _____

e. Sled Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max)	[15000kg]	[15000kg]	[]
e.2. Width (max)	[2m]	[2m]	[]
e.3. Length (max)	[5m]	[5m]	[]

f. Payload Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max)	[10000kg]	[10000kg]	[]
f.2. Width (max)	[2m]	[2m]	[]
f.3. Length (max)	[5m]	[5m]	[]
f.4. Range of Orientation	[]	[]	[]

7. Performance Parameters

a. Acceleration	_____ (max)	_____ (min usable)
b. Jolt	_____ (max)	_____ (min usable)
c. Velocity	_____ (max)	_____ (min usable)
d. Stroke	_____ (max)	_____ (min usable)

e. Waveform: (Check all that Apply)

	Range of Acceleration	Duration
e.1. Sine	<u>NEARLY ANY</u>	_____
e.2. 1/2 Sine	<u>SHAPE IS</u>	_____
e.3. Triangle	<u>POSSIBLE</u>	_____
e.4. Trapezoidal	_____	_____
e.5. Rectangle	_____	_____
e.6. Sawtooth	_____	_____
e.7. Other (indicate)	_____	_____

f. Repeatability

f.1. Peak G	<u><5</u> %
f.2. Peak Velocity	<u>1</u> %

8. Instrumentation

a. Number of Channels	<u>80</u>
b. Frequency Response/Class	<u>1000</u>
c. Method of recording	_____
c.1. Tape	<u>X</u>
c.2. Chart	<u>X</u>
c.3. Other (specify)	_____
d. Method of Transmission	_____
d.1. Flying lead	_____
d.2. FM Transmission	<u>X</u>
e. Accelerometers	_____
e.1. Types	_____
e.2. Dynamic Range	_____
e.3. Frequency Range	_____
e.4. Number	_____
e.4.a. on sled	<u><80</u>
e.4.b. on subject/dummy	<u><80</u>

f. Other Parameters Monitored: FORCE, DEFLEXION OF DUMMY, SPEEDS, ETC.

NATO/AGARD

Impact Test Facility Survey

ID #6, 7, 8, 9

1. Name and Address of Facility	<u>LABORATOIRE DE L'U.T.A.C.</u>																						
	<u>AUTODROME DE LINAS-MONTLIERY</u>																						
	<u>91150 MONTLIERY</u>																						
	<u>FRANCE</u>																						
2. Name of Director/Manager	<u>GENERAL MANAGER - MR. L.C. MICHELET</u>																						
	<u>TECHNICAL MANAGER - MR. E. CHAPOUX</u>																						
3. Date Facility became operational	<u>1966</u>																						
4. Principle of Operation	<u>SANDWICH, POWERED WINCH, GRAVITY</u>																						
5. Main Use/Test Type	<u>CRASH TESTS ON VEHICLES</u>																						
a. Man Rated:																							
yes	no <u>X</u>																						
6. Descriptive Details																							
a. Horizontal	<u>3</u>	c. Vertical	<u>1</u>																				
b. Track Length	<u>on 20m/400m</u>	d. Tower Height	<u>3m</u>																				
e. Sled Characteristics	<table border="1"> <thead> <tr> <th></th> <th>Sled #1</th> <th>Sled #2</th> <th>Sled #3</th> </tr> </thead> <tbody> <tr> <td>e.1. Weight (max)</td> <td><u>400kg</u></td> <td><u>600kg</u></td> <td></td> </tr> <tr> <td>e.2. Width (max)</td> <td><u>1.2m</u></td> <td><u>1.2m</u></td> <td></td> </tr> <tr> <td>e.3. Length (max)</td> <td><u>1.5m</u></td> <td><u>4m</u></td> <td></td> </tr> </tbody> </table>				Sled #1	Sled #2	Sled #3	e.1. Weight (max)	<u>400kg</u>	<u>600kg</u>		e.2. Width (max)	<u>1.2m</u>	<u>1.2m</u>		e.3. Length (max)	<u>1.5m</u>	<u>4m</u>					
	Sled #1	Sled #2	Sled #3																				
e.1. Weight (max)	<u>400kg</u>	<u>600kg</u>																					
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e.3. Length (max)	<u>1.5m</u>	<u>4m</u>																					
f. Payload Characteristics	<table border="1"> <thead> <tr> <th></th> <th>Sled #1</th> <th>Sled #2</th> <th>Sled #3</th> </tr> </thead> <tbody> <tr> <td>f.1. Weight (max)</td> <td><u>200kg</u></td> <td><u>700kg</u></td> <td></td> </tr> <tr> <td>f.2. Width (max)</td> <td><u>1m</u></td> <td><u>2m</u></td> <td></td> </tr> <tr> <td>f.3. Length (max)</td> <td><u>1.50m</u></td> <td><u>5m</u></td> <td></td> </tr> <tr> <td>f.4. Range of Orientation</td> <td><u>0 to 180</u></td> <td><u>0 to 180</u></td> <td></td> </tr> </tbody> </table>				Sled #1	Sled #2	Sled #3	f.1. Weight (max)	<u>200kg</u>	<u>700kg</u>		f.2. Width (max)	<u>1m</u>	<u>2m</u>		f.3. Length (max)	<u>1.50m</u>	<u>5m</u>		f.4. Range of Orientation	<u>0 to 180</u>	<u>0 to 180</u>	
	Sled #1	Sled #2	Sled #3																				
f.1. Weight (max)	<u>200kg</u>	<u>700kg</u>																					
f.2. Width (max)	<u>1m</u>	<u>2m</u>																					
f.3. Length (max)	<u>1.50m</u>	<u>5m</u>																					
f.4. Range of Orientation	<u>0 to 180</u>	<u>0 to 180</u>																					
7. Performance Parameters																							
a. Acceleration	<u>100g</u> (max)		(min usable)																				
b. Jolt		(max)	(min usable)																				
c. Velocity	<u>120km/h</u> (max)		(min usable)																				
d. Stroke		(max)	(min usable)																				
e. Waveform: (Check all that Apply)	Range of Acceleration Duration																						
e.1. Sine	<u>WE USE SHOCK IN POLYURETHANE. IT IS</u>																						
e.2. Triangular	<u>POSSIBLE TO OBTAIN DIFFERENT SHAPES OF</u>																						
e.3. Impulsive	<u>DECELERATION CURVES VERSUS TIME AND</u>																						
e.4. Rectangular	<u>EQUIVALENT PULSES</u>																						
e.5. Sinusoidal																							
e.6. Other (indicated)																							
8. Reliability																							
a. Mean Time Between Failures	<u>5</u>																						
b. Mean Time to Repair	<u>1</u>																						
9. Instrumentation																							
a. Number of Channels	<u>50</u>																						
b. Frequency Response/Channel	<u>50-100-300-600-1000</u>																						
c. Method of Recording																							
e.1. Tape	<u>YES</u>																						
e.2. Chart	<u>YES</u>																						
e.3. Other (specify)	<u>PAPER RECORDER (U.V.)</u>																						
d. Method of Transmission																							
e.1. Flying lead	<u>YES</u>																						
e.2. FM Transmission	<u>YES</u>																						
e. Accelerometers																							
e.1. Type	<u>PIEZO-ELECTRIC</u>	<u>PIEZO-RESISTIVE</u>																					
e.2. Dynamic range	<u>1 A 1000g</u>																						
e.3. Frequency range	<u>40</u>																						
e.4. Number																							
e.4.a. on sled	<u>ACCORDING TO TEST</u>																						
e.4.b. on subject/dummy	<u>1 HEAD - 3 THORAX - 3 ABDOMEN</u>																						
10. Other Parameters Monitored:	<u>FORCE, TIME, DISPLACEMENT.</u>																						

NATO/AGARD
Impact Test Facility Survey

1. S.I.

1. Name and Address of Facility	<u>INSTITUT FÜR FEMEROTECHNIK</u> <u>TECHNISCHE UNIVERSITÄT BERLIN</u> <u>STRASSE 135 17 JAHN STR.</u> <u>-1000 BERLIN 12, G.F.R.</u>																																									
2. Name of Director/Manager	<u>PROF. DR. ING. HERMANN ARIEL</u>																																									
3. Date facility became operational	<u>1961</u>																																									
4. Principle of operation	<u>Electromagnetic</u>																																									
5. Main test parameters	<u>200000 G - 1000 Hz / CYCLES/CM</u>																																									
a. Test Subject	<u>Pre-Tested</u>																																									
6. Descriptive Details	<table border="0"> <tr> <td>a. Horizontal</td> <td>c. Vertical</td> </tr> <tr> <td>b. Max. Length <u>75cm</u></td> <td>d. Tower Height <u>5m</u></td> </tr> </table>			a. Horizontal	c. Vertical	b. Max. Length <u>75cm</u>	d. Tower Height <u>5m</u>																																			
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e.4.a. on sled	<u>1</u>																																									
e.4.b. on subject/dummy	<u>9</u>																																									
f. Other Parameters Monitored:	<u>FORCES, FILM</u>																																									

NATO/AGARD

Impact Test Facility Survey

ID #11

1. Name and Address of Facility IMPACT CATAPULT (KATAPULTANLAGE)
BATTELLE - INSTITUTE V.
AM ROMERHOF 35
D-6000 FRANKFURT AM MAIN 90/W. GERMANY
2. Name of Director/Manager DIPL.-ING. G. RUTER
3. Date Facility became operational 1965
4. Principle of Operation STRETCHED BUNGEE CABLE TO IMPACT
STEEL STRIP
5. Main Use/Test Type PASSENGER SAFETY. ALL TYPES OF
VEHICLES
- a. Man Rated:
yes X no
6. Descriptive Details
- | | | | |
|-----------------|------------|-----------------|-------------|
| a. Horizontal | <u>X</u> | c. Vertical | <u> </u> |
| b. Track Length | <u>11m</u> | d. Tower Height | <u> </u> |
- e. Sled Characteristics
- | | | | |
|-------------------|-------------|-------------|-------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| e.1. Weight (max) | [140kg] | [] | [] |
| e.2. Width (max) | [.85m] | [] | [] |
| e.3. Length (max) | [2.9m] | [] | [] |
- f. Payload Characteristics
- | | | | |
|---------------------------|-------------|-------------|-------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| f.1. Weight (max) | [300kg] | [] | [] |
| f.2. Width (max) | [1.7m] | [] | [] |
| f.3. Length (max) | [3.0m] | [] | [] |
| f.4. Range of Orientation | [] | [] | [] |
7. Performance Parameters
- | | | |
|-----------------|----------------------|----------------------------|
| a. Acceleration | <u>40g</u> (max) | <u> </u> (min usable) |
| b. Jolt | <u>2500g/s</u> (max) | <u> </u> (min usable) |
| c. Velocity | <u>70km/h</u> (max) | <u>50km/h</u> (min usable) |
| d. Stroke | <u>800mm</u> (max) | <u> </u> (min usable) |
- e. Waveform: (Check all that Apply)
- | | | |
|-----------------------|-----------------------|-------------|
| | Range of Acceleration | Duration |
| e.1. Sine | <u> </u> | <u> </u> |
| e.2. 1/2 Sine | <u> </u> | <u> </u> |
| e.3. Triangle | <u> </u> | <u> </u> |
| e.4. Trapezoidal | <u>X</u> | <u>30g</u> |
| e.5. Rectangle | <u> </u> | <u>80ms</u> |
| e.6. Sawtooth | <u> </u> | <u> </u> |
| e.7. Other (indicate) | <u> </u> | <u> </u> |
- f. Repeatability
- | | |
|--------------------|------------|
| f.1. Peak G | <u>5</u> % |
| f.2. Peak Velocity | <u>1</u> % |
8. Instrumentation
- | | |
|-----------------------------|------------------------|
| a. Number of Channels | <u>10</u> |
| b. Frequency Response/Class | <u>SAE J 211, 211a</u> |
| c. Method of recording | <u> </u> |
| c.1. Tape | <u> </u> |
| c.2. Chart | <u>X</u> |
| c.3. Other (specify) | <u> </u> |
| d. Method of Transmission | <u> </u> |
| d.1. Flying lead | <u>X</u> |
| d.2. FM Transmission | <u> </u> |
| e. Accelerometers | <u> </u> |
| e.1. Types | <u>Holtinger</u> |
| e.2. Dynamic Range | <u>up to 600g</u> |
| e.3. Frequency Range | <u>6000Hz</u> |
| e.4. Number | <u>1</u> |
| e.4.a. on sled | <u>1</u> |
| e.4.b. on subject/dummy | <u>9 (max)</u> |
- f. Other Parameters Monitored: FORCES, DISPLACEMENTS

NATO/AGARD

Impact Test Facility Survey

ID #12

1. Name and Address of Facility KLINIKUM DER UNIVERSITÄT HEIDELBERG
INSTITUT FÜR RECHTSMEDIZIN
POSTFACH 103069, 6900 HEIDELBERG, FED.
REPUBLIC OF GERMANY

2. Name of Director/Manager PROF. DR. SCHMIDT/DR. KALLIERIS

3. Date Facility became operational END OF 1972

4. Principle of Operation DECELERATION SLED

5. Main Use/Test Type CADAVER TESTS, DUMMY TESTS, FRONTAL,
LATERAL, HEAD-ON

a. Man Rated: yes ☐ no ☐

6. Descriptive Details

a. Horizontal	☒	c. Vertical	☐
b. Track Length	<u>24m</u>	d. Tower Height	☐

e. Sled Characteristics

	☐ Sled #1	☐ Sled #2	☐ Sled #3
e.1. Weight (max)	<u>3787N</u>	☐	☐
e.2. Width (max)	<u>140cm</u>	☐	☐
e.3. Length (max)	<u>300cm</u>	☐	☐

f. Payload Characteristics

	☐ Sled #1	☐ Sled #2	☐ Sled #3
f.1. Weight (max)	<u>6000N</u>	☐	☐
f.2. Width (max)	<u>150cm</u>	☐	☐
f.3. Length (max)	<u>400cm</u>	☐	☐
f.4. Range of Orientation	☐	☐	☐

7. Performance Parameters

a. Acceleration 40g (max) ☐ (min usable)

b. Jolt ☐ (max) ☐ (min usable)

c. Velocity 100km/h (max) ☐ (min usable)

d. Stroke ☐ (max) ☐ (min usable)

e. Waveform: (Check all that Apply)

	Range of Acceleration	Duration
e.1. Sine	☐	☐
e.2. 1/2 Sine	☐	☐
e.3. Triangle	☐	☐
e.4. Trapezoidal	☒	☒
e.5. Rectangle	☐	☐
e.6. Sawtooth	☐	☐
e.7. Other (indicate)	☐	☐

*DEPENDENT UPON THE SLED VELOCITY AND DECELERATION LEVEL.

f. Repeatability

f.1. Peak G	<u>97</u> %
f.2. Peak Velocity	<u>100</u> %

8. Instrumentation

a. Number of Channels 30 (POSSIBLE)

b. Frequency Response/Class ☐

c. Method of recording

c.1. Tape	☐
c.2. Chart	☒
c.3. Other (specify)	☐

d. Method of Transmission

d.1. Flying lead	☐
d.2. FM Transmission	☒

e. Accelerometers

e.1. Types	<u>ENDEVCO 2264</u>
e.2. Dynamic Range	<u>-2K TO +2K g</u>
e.3. Frequency Range	<u>27000Hz</u>
e.4. Number	<u>1</u>
e.4.a. on sled	<u>21/29</u>
e.4.b. on subject/dummy	☐

f. Other Parameters Monitored: LUNG PRESSURE, BELT FORCES

NATO/AGARD

Impact Test Facility Survey

ID #13

1. Name and Address of Facility	<u>DAIMLER-BENZ AG</u>		
	<u>7032 SINDELFINGEN 1</u>		
	<u>POSTFACH 2 26</u>		
	<u>ENTWICKLUNG PKW AUFBAUTEN EA1, W. GER.</u>		
2. Name of Director/Manager	<u>DIPL.-ING. GUNTRAM HUBER</u>		
3. Date Facility became operational	<u>JANUARY 1973</u>		
4. Principle of Operation	<u>LINEAR MOTOR ACCELERATION TO BARRIER CRASH</u>		
5. Main Use/Test Type	<u>CRASH TESTS ON PASSENGER AND COMMERCIAL VEHICLES</u>		
a. Man Rated:			
yes	no		
6. Descriptive Details			
a. Horizontal	<u>X</u>	c. Vertical	
b. Track Length	<u>65</u>	d. Tower Height	
e. Sled Characteristics	[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max)			
e.2. Width (max)			
e.3. Length (max)			
f. Payload Characteristics	[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max)	<u>10,000 kg</u>		
f.2. Width (max)	<u>unlimited</u>		
f.3. Length (max)	<u>unlimited</u>		
f.4. Range of Orientation			
7. Performance Parameters			
a. Acceleration		(max)	(min usable)
b. Jolt		(max)	(min usable)
c. Velocity	<u>13.9 ms⁻¹</u>	(max)	(min usable)
d. Stroke		(max)	(min usable)
e. Waveform: (Check all that Apply)	Range of Acceleration Duration		
e.1. Sine	<u>DEPENDS ON IMPACT SURFACE & VEHICLE DYNAMICS</u>		
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			
f. Repeatability			
f.1. Peak G	<u>1</u>		
f.2. Peak Velocity	<u>1</u>		
8. Instrumentation			
a. Number of Channels	<u>75</u>		
b. Frequency Response/Class	<u>FK 60, 180, 600</u>		
c. Method of recording			
c.1. Tape			
c.2. Chart	<u>X</u>		
c.3. Other (specify)			
d. Method of Transmission			
d.1. Flying lead	<u>X</u>		
d.2. FM Transmission			
e. Accelerometers			
e.1. Types			
e.2. Dynamic Range			
e.3. Frequency Range			
e.4. Number			
e.4.a. on sled			
e.4.b. on subject/dummy			
f. Other Parameters Monitored:	<u>HIGH SPEED FILMING</u>		

NATO/AGARD

Impact Test Facility Survey

ID #14, 15, 16

1. Name and Address of Facility DAIMLER-BENZ AG
7032 SINDELFINGEN 1
POSTFACH 2 26
ENTWICKLUNG PKW AUFBAUTEN EA1, W. GER.
2. Name of Director/Manager DIPL.-ING. GUNTRAM HUBER
3. Date Facility became operational 1971/1973/1979
4. Principle of Operation BESCHLEUNIGEN AUS DEM STILLSTAND
(BENDIX) - SLED 1
AUFFAHREN UND RUCKPRALL (MTS) - SLED 2
AUFFAHREN (EIGENBAU) - SLED 3
5. Main Use/Test Type FRONTALAUFPRALL/HALTESYSTEME
- a. Man Rated: _____
yes _____ no _____
6. Descriptive Details
- | | | | |
|-----------------|------------------|-----------------|-------|
| a. Horizontal | <u>X</u> | c. Vertical | _____ |
| b. Track Length | <u>65m (max)</u> | d. Tower Height | _____ |
- e. Sled Characteristics
- | | | | |
|-------------------|-------------------|-------------------|-------------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| e.1. Weight (max) | [<u>1000kg</u>] | [<u>460kg</u>] | [<u>180kg</u>] |
| e.2. Width (max) | [<u>1220mm</u>] | [<u>1220mm</u>] | [<u>960mm</u>] |
| e.3. Length (max) | [<u>3675mm</u>] | [<u>3370mm</u>] | [<u>1460mm</u>] |
- f. Payload Characteristics
- | | | | |
|---------------------------|-------------------|-------------------|-------------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| f.1. Weight (max) | [<u>2500kg</u>] | [<u>670kg</u>] | [<u>250kg</u>] |
| f.2. Width (max) | [<u>4000mm</u>] | [<u>4000mm</u>] | [<u>2000mm</u>] |
| f.3. Length (max) | [<u>4300mm</u>] | [<u>4300mm</u>] | [<u>2000mm</u>] |
| f.4. Range of Orientation | [_____] | [_____] | [_____] |
7. Performance Parameters
- a. Acceleration 80g (max) _____ (min usable)
- b. Jolt 130 km/h (max) _____ (min usable)
- c. Velocity 9 · 10² N (max) _____ (min usable)
- d. Stroke _____ (max) _____ (min usable)
- e. Waveform: (Check all that Apply) Range of Acceleration Duration
- | | | |
|-----------------------|----------------------------|-------|
| e.1. Sine | _____ | _____ |
| e.2. 1/2 Sine | <u>X</u> | _____ |
| e.3. Triangle | <u>X</u> | _____ |
| e.4. Trapezoidal | <u>X</u> | _____ |
| e.5. Rectangle | <u>X</u> | _____ |
| e.6. Sawtooth | _____ | _____ |
| e.7. Other (indicate) | <u>FAHRZEUG-SPEZIFISCH</u> | _____ |
- f. Repeatability
- f.1. Peak G ± 1g
- f.2. Peak Velocity ± 0.5 km/h
8. Instrumentation
- a. Number of Channels 75
- b. Frequency Response/Class EK 60, 180, 600
- c. Method of recording
- c.1. Tape _____
- c.2. Chart X
- c.3. Other (specify) _____
- d. Method of Transmission
- d.1. Flying lead _____
- d.2. FM Transmission X
- e. Accelerometers
- e.1. Types CEC Endevco
- e.2. Dynamic Range 250g 750g
- e.3. Frequency Range 1000Hz 2000Hz
- e.4. Number
- e.4.a. on sled 2
- e.4.b. on subject/dummy 6
- f. Other Parameters Monitored: OBERSCHENKELKRAFT, UNTERSCHENKELKRAFT

NATO/AGARD

Impact Test Facility Survey

ID #17

1. Name and Address of Facility	<u>FIAT - CENTRO SICUREZZA</u> <u>ORBASSANO (TORINO - ITALIA)</u> <u>VIA G. GOZZANO, 2</u>																						
2. Name of Director/Manager	<u>ELZO FRANCHINI</u>																						
3. Date Facility became operational	<u>PRESENTED TO THE PRESS MARCH 1977</u>																						
4. Principle of Operation	<u>HORIZONTAL, CABLEWAY SYSTEM DRIVEN BY</u> <u>A 2300 HP ELECTRIC MOTOR</u>																						
5. Main Use/Test Type	<u>CAR AND TRACK DEVELOPMENT AND LEGIS-</u> <u>LATIVE REQUIREMENTS/BARRIER, CAR-TO-</u> <u>CAR, DUMMY AND COMPONENTS TESTS</u>																						
a. Man Rated:	yes ☐ no ☐																						
6. Descriptive Details																							
a. Horizontal	<u>8 tracks</u>	c. Vertical																					
b. Track Length	<u>30 - 420m</u>	d. Tower Height																					
e. Sled Characteristics	<table border="1"><thead><tr><th></th><th>Sled #1</th><th>Sled #2</th><th>Sled #3</th></tr></thead><tbody><tr><td>e.1. Weight (max)</td><td></td><td></td><td></td></tr><tr><td>e.2. Width (max)</td><td></td><td></td><td></td></tr><tr><td>e.3. Length (max)</td><td></td><td></td><td></td></tr></tbody></table>				Sled #1	Sled #2	Sled #3	e.1. Weight (max)				e.2. Width (max)				e.3. Length (max)							
	Sled #1	Sled #2	Sled #3																				
e.1. Weight (max)																							
e.2. Width (max)																							
e.3. Length (max)																							
f. Payload Characteristics	<table border="1"><thead><tr><th></th><th>Sled #1</th><th>Sled #2</th><th>Sled #3</th></tr></thead><tbody><tr><td>f.1. Weight (max)</td><td><u>20MT</u></td><td></td><td></td></tr><tr><td>f.2. Width (max)</td><td></td><td></td><td></td></tr><tr><td>f.3. Length (max)</td><td></td><td></td><td></td></tr><tr><td>f.4. Range of Orientation</td><td><u>0-180</u></td><td></td><td></td></tr></tbody></table>				Sled #1	Sled #2	Sled #3	f.1. Weight (max)	<u>20MT</u>			f.2. Width (max)				f.3. Length (max)				f.4. Range of Orientation	<u>0-180</u>		
	Sled #1	Sled #2	Sled #3																				
f.1. Weight (max)	<u>20MT</u>																						
f.2. Width (max)																							
f.3. Length (max)																							
f.4. Range of Orientation	<u>0-180</u>																						
7. Performance Parameters																							
a. Acceleration	(max) _____	(min usable) _____																					
b. Jolt	(max) _____	(min usable) _____																					
c. Velocity	<u>140 km/h</u> (max)	<u>50 km/h</u> (min usable)																					
d. Stroke	(max) _____	(min usable) _____																					
e. Waveform: (Check all that Apply)	Range of Acceleration Duration																						
e.1. Sine	_____	_____	_____																				
e.2. 1/2 Sine	_____	_____	_____																				
e.3. Triangle	_____	_____	_____																				
e.4. Trapezoidal	_____	_____	_____																				
e.5. Rectangle	_____	_____	_____																				
e.6. Sawtooth	_____	_____	_____																				
e.7. Other (indicate)	_____	_____	_____																				
f. Repeatability																							
f.1. Peak G	_____ %																						
f.2. Peak Velocity	_____ %																						
8. Instrumentation																							
a. Number of Channels	<u>96</u>																						
b. Frequency Response/Class	<u>100, 300, 1000, 1650</u>																						
c. Method of recording																							
c.1. Tape	<u>X</u>																						
c.2. Chart	<u>X</u>																						
c.3. Other (specify)	_____																						
d. Method of Transmission																							
d.1. Flying lead	_____																						
d.2. FM Transmission	<u>X</u>																						
e. Accelerometers																							
e.1. Types	<u>PIEZORESISTIVE</u>	<u>PIEZORESISTIVE</u>	<u>PIEZORESISTIVE</u>																				
e.2. Dynamic Range	<u>200</u>	<u>250</u>	<u>750</u>																				
e.3. Frequency Range	<u>0 - 1100Hz</u>	<u>0 - 2000Hz</u>	<u>0 - 2000Hz</u>																				
e.4. Number																							
e.4.a. on sled	<u>50</u>																						
e.4.b. on subject/dummy	<u>16 Triax</u>																						
f. Other Parameters Monitored:	<u>SPEED, TIME ZERO, STRAIN, LOAD,</u> <u>DISPLACEMENT</u>																						

NATO/AGARD

Impact Test Facility Survey

ID #16

1. Name and Address of Facility DECELERATION TRACK
ROYAL AIR FORCE
INSTITUTE OF AVIATION MEDICINE
FARNBOROUGH, HANTS U.K.
2. Name of Director/Manager AIR CDRE P. HOWARD O.B.E.
3. Date Facility became operational JANUARY 11, 1972
4. Principle of Operation STRETCHED BUNGEE CORDS ACCELERATE
SLED, ARRESTED BY HYDRAULIC CONTROLLED
STEEL CABLES
5. Main Use/Test Type SEAT & HARNESS TESTING WITH DUMMIES &
HUMAN SUBJECTS, PHYSIOLOGICAL RESEARCH
WITH HUMAN SUBJECTS
- a. Man Rated: yes X no
6. Descriptive Details
- | | | | |
|-----------------|-------------|-----------------|-------------|
| a. Horizontal | <u> </u> | c. Vertical | <u> </u> |
| b. Track Length | <u>46m</u> | d. Tower Height | <u> </u> |
- e. Sled Characteristics
- | | | | |
|-------------------|--------------|-------------|-------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| e.1. Weight (max) | <u>386kg</u> | <u> </u> | <u> </u> |
| e.2. Width (max) | <u>0.9m</u> | <u> </u> | <u> </u> |
| e.3. Length (max) | <u>4m</u> | <u> </u> | <u> </u> |
- f. Payload Characteristics
- | | | | |
|---------------------------|---------------------------------|-------------|-------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| f.1. Weight (max) | <u>250kg</u> | <u> </u> | <u> </u> |
| f.2. Width (max) | <u>3m (overhang acceptable)</u> | <u> </u> | <u> </u> |
| f.3. Length (max) | <u>3m (overhang acceptable)</u> | <u> </u> | <u> </u> |
| f.4. Range of Orientation | <u> </u> | <u> </u> | <u> </u> |
7. Performance Parameters
- a. Acceleration 50g (max) 2g (min usable)
- b. Jolt 1000g/sec⁻¹ (max) (min usable)
- c. Velocity 15m/sec (max) 5.5m/sec (min usable)
- d. Stroke .9m (max) (min usable)
- e. Waveform: (Check all that Apply)
- | | | | |
|-----------------------|-------------|-----------------------|----------------------|
| | | Range of Acceleration | Duration |
| e.1. Sine | <u> </u> | <u> </u> | <u> </u> |
| e.2. 1/2 Sine | <u>X</u> | <u>2 to 50g</u> | <u>200 to 50msec</u> |
| e.3. Triangle | <u> </u> | <u> </u> | <u> </u> |
| e.4. Trapezoidal | <u> </u> | <u> </u> | <u> </u> |
| e.5. Rectangle | <u> </u> | <u> </u> | <u> </u> |
| e.6. Sawtooth | <u> </u> | <u> </u> | <u> </u> |
| e.7. Other (indicate) | <u> </u> | <u> </u> | <u> </u> |
- f. Repeatability
- f.1. Peak G ±1 %
- f.2. Peak Velocity ±.25 %
8. Instrumentation
- a. Number of Channels 12 CHANNEL CONTROL CONSOLE
- b. Frequency Response/Class
- c. Method of recording
- c.1. Tape 14 CHANNEL DC TO 200Hz
- c.2. Chart U.V. RECORDER 12 CHANNEL DC TO 100Hz
- c.3. Other (specify) C.R.O.
- d. Method of Transmission
- d.1. Flying lead X
- d.2. FM Transmission
- e. Accelerometers
- e.1. Types Kyowa ±50g
- e.2. Dynamic Range ±50g
- e.3. Frequency Range D.C. to 750Hz
- e.4. Number
- e.4.a. on sled 1 Gx on Sled Centre of gravity
- e.4.b. on subject/dummy As Required, Triaxial on Bite Plate
- f. Other Parameters Monitored: HIGH SPEED FILMING, IMPACT VELOCITY,
HARNESS LOADS, SEAT STRUCTURE TENSION LOADS, E.C.G.

NATO/AGARD
Impact Test Facility Survey

ID #19

1. Name and Address of Facility EJECTION RIG
ROYAL AIRCRAFT ESTABLISHMENT
FARNBOROUGH
HANTS, UK
2. Name of Director/Manager MR. T. H. KERR
3. Date Facility became operational CURRENTLY DISMANTLED-TO BE REINSTATED
4. Principle of Operation EJECTION CATAPULT, GRAVITY BRAKING
5. Main Use/Test Type EJECTION SYSTEMS, SEAT PACKS, CUSHIONS
 - a. Man Rated: yes X no
6. Descriptive Details

a. Horizontal _____	c. Vertical <u>INCLINED 20°</u>
b. Track Length _____	d. Tower Height <u>47.2m</u>

e. Sled Characteristics	[Sled #1]	[Sled #2]	[Sled #3]	[]
e.1. Weight (max)	[]	[]	[]	[]
e.2. Width (max)	[]	[]	[]	[]
e.3. Length (max)	[]	[]	[]	[]

f. Payload Characteristics	[Sled #1]	[Sled #2]	[Sled #3]	[]
f.1. Weight (max)	[]	[]	[]	[]
f.2. Width (max)	[]	[]	[]	[]
f.3. Length (max)	[]	[]	[]	[]
f.4. Range of Orientation	[]	[]	[]	[]
7. Performance Parameters

a. Acceleration	ca. 20G (max)	_____ (min usable)	_____
b. Jolt	ca. 300Gs ⁻¹ (max)	_____ (min usable)	_____
c. Velocity	20.9ms ⁻¹ (95fts ⁻¹) (max)	_____ (min usable)	_____
d. Stroke	_____ (max)	_____ (min usable)	_____

e. Waveform: (Check all that Apply)	Range of Acceleration	Duration	
e.1. Sine	_____	_____	_____
e.2. 1/2 Sine	_____	_____	_____
e.3. Triangle	_____	_____	_____
e.4. Trapezoidal	<u>X</u>	_____	_____
e.5. Rectangle	_____	_____	_____
e.6. Sawtooth	_____	_____	_____
e.7. Other (indicate)	_____	_____	_____

f. Repeatability	f.1. Peak G	_____ %	f.2. Peak Velocity	_____ %
------------------	-------------	---------	--------------------	---------
8. Instrumentation

a. Number of Channels	11
b. Frequency Response/Class	DC-100Hz, DC-1kHz
c. Method of recording	X
c.1. Tape	_____
c.2. Chart	_____
c.3. Other (specify)	ANALOGUE OUTPUT TO UV RECORDER
d. Method of Transmission	_____
d.1. Flying lead	_____
d.2. FM Transmission	X
e. Accelerometers	SMITH INDUSTRIES ALV692
e.1. Types	_____
e.2. Dynamic Range	_____
e.3. Frequency Range	_____
e.4. Number	_____
e.4.a. on sled	_____
e.4.b. on subject/dummy	_____

f. Other Parameters Monitored: GUN PRESSURE BY PIEZOELECTRIC TRANSDUCER.
HARNESSE LOADS BY BUCKLE STRAIN GAUGES. RECORDING FACILITIES DUPLICATED IN
MOBILE VAN FOR AIR TO GROUND TELEMETRY OF EJECTION DATA.

NATO/AGARD

Impact Test Facility Survey

ID #20

1. Name and Address of Facility ROAD SAFETY ENGINEERING LABORATORY
MIDDLESEX POLYTECHNIC
THE BURROUGHS
HENDONS, NW4 4BT, ENGLAND
2. Name of Director/Manager PETER ROY
3. Date Facility became operational 30 JANUARY 1981
4. Principle of Operation ACCELERATED USING RUBBER CORDS
5. Main Use/Test Type TESTING TO ADULT AND CHILD SEAT BELT STANDARDS
- a. Man Rated:
yes ☐ no ☒
6. Descriptive Details
- | | | | |
|-----------------|------------|-----------------|------------|
| a. Horizontal | <u>YES</u> | c. Vertical | <u>N/A</u> |
| b. Track Length | <u>33m</u> | d. Tower Height | <u>N/A</u> |
- e. Sled Characteristics
- | | | | |
|-------------------|-------------------|-------------|-------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| e.1. Weight (max) | [<u>485kgf</u>] | [] | [] |
| e.2. Width (max) | [<u>114cm</u>] | [] | [] |
| e.3. Length (max) | [<u>280cm</u>] | [] | [] |
- f. Payload Characteristics
- | | | | |
|---------------------------|-------------------|-------------|-------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| f.1. Weight (max) | [<u>800kgf</u>] | [] | [] |
| f.2. Width (max) | [<u>5.8m</u>] | [] | [] |
| f.3. Length (max) | [<u>6m</u>] | [] | [] |
| f.4. Range of Orientation | [<u>360°</u>] | [] | [] |
7. Performance Parameters
- | | | | | |
|-----------------|---------------|-------|--------------|--------------|
| a. Acceleration | <u>50*</u> | (max) | <u>2</u> | (min usable) |
| b. Jolt | | (max) | | (min usable) |
| c. Velocity | <u>80km/h</u> | (max) | <u>5km/h</u> | (min usable) |
| d. Stroke | <u>1m</u> | (max) | <u>50mm</u> | (min usable) |
- e. Waveform: (Check all that Apply)
- | | | | |
|-----------------------|------------|-----------------------|-----------------|
| | | Range of Acceleration | Duration |
| e.1. Sine | | | |
| e.2. 1/2 Sine | <u>YES</u> | <u>20g - 32g</u> | <u>80-100ms</u> |
| e.3. Triangle | | | |
| e.4. Trapezoidal | <u>YES</u> | <u>12g - 14g</u> | <u>**</u> |
| e.5. Rectangle | | | |
| e.6. Sawtooth | | | |
| e.7. Other (indicate) | | | |
- *THIS IS THE MAXIMUM SO FAR ACHIEVED
**THIS IS A FUNCTION OF SLED VELOCITY
- f. Repeatability
- | | | |
|--------------------|----------|---|
| f.1. Peak G | <u>5</u> | % |
| f.2. Peak Velocity | <u>4</u> | % |
8. Instrumentation
- | | |
|-----------------------------|----------------------------------|
| a. Number of Channels | <u>16</u> |
| b. Frequency Response/Class | <u>CLASS 60</u> |
| c. Method of recording | |
| c.1. Tape | <u>NO</u> |
| c.2. Chart | <u>YES</u> |
| c.3. Other (specify) | <u>"ON BOARD" MICROPROCESSOR</u> |
| d. Method of Transmission | |
| d.1. Flying lead | <u>YES</u> |
| d.2. FM Transmission | <u>NO</u> |
| e. Accelerometers | |
| e.1. Types | <u>PIEZORESISTIVE</u> |
| e.2. Dynamic Range | <u>0-1800g</u> |
| e.3. Frequency Range | |
| e.4. Number | |
| e.4.a. on sled | <u>2-Uniaxial</u> |
| e.4.b. on subject/dummy | <u>Head-chest triaxial</u> |

f. Other Parameters Monitored: SLED - VELOCITY, DECELERATION; DUMMY - FORWARD MOVEMENT, HEAD & CHEST ACCELERATIONS ON X,Y, & Z AXES; TRAJECTORY USING 8 SHOT POLAROID AND HIGH SPEED CAMERAS.

NATO/AGARD

Impact Test Facility Survey

ID #21

1. Name and Address of Facility	<u>DEPARTMENT OF HUMAN SCIENCES</u> <u>UNIVERSITY OF TECHNOLOGY</u> <u>LOUGHBOROUGH</u> <u>LEICESTERSHIRE, LE11 3TU. U.K.</u>		
2. Name of Director/Manager	<u>J. SANDOVER</u>		
3. Date Facility became operational	<u>1970</u>		
4. Principle of Operation	<u>HONEYCOMB & TEAR WEBBING RETARDATION</u>		
5. Main Use/Test Type	<u>MAN MODELLING</u> <u>NOT U.S. "MAN RATED" BUT SAFE USE FOR</u> <u>HUMAN STUDIES</u>		
a. Man Rated:	yes _____ no _____		
6. Descriptive Details			
a. Horizontal	_____		
b. Track Length	_____		
c. Vertical	<u>(CAN BE ANGLED TO 30°)</u>		
d. Tower Height	<u>6m (2m SLED MOVEMENT)</u>		
e. Sled Characteristics	[Sled #1] [Sled #2] [Sled #3]		
e.1. Weight (max)	[<u>200kg</u>] [] []		
e.2. Width (max)	[<u>750mm</u>] [] []		
e.3. Length (max)	[<u>500mm</u>] [] []		
f. Payload Characteristics	[Sled #1] [Sled #2] [Sled #3]		
f.1. Weight (max)	[<u>120kg</u>] [] []		
f.2. Width (max)	[<u>500mm</u>] [] []		
f.3. Length (max)	[<u>500mm</u>] [] []		
f.4. Range of Orientation	[] [] []		
7. Performance Parameters			
a. Acceleration	<u>100m/s²</u> (max)	<u>10m/s²</u> (min usable)	
b. Jolt	(max)	(min usable)	
c. Velocity	<u>6m/s²</u> (max)	(min usable)	
d. Stroke	<u>500mm</u> (max)	(min usable)	
e. Waveform: (Check all that Apply)	Range of Acceleration Duration		
e.1. Sine	_____	_____	_____
e.2. 1/2 Sine	_____	_____	_____
e.3. Triangle	_____	_____	_____
e.4. Trapezoidal	<u>(Approx.)</u>	<u>to 100m/s²</u>	<u>0.01s to 0.2s</u>
e.5. Rectangle	_____	_____	_____
e.6. Sawtooth	_____	_____	_____
e.7. Other (indicate)	_____	_____	_____
f. Repeatability			
f.1. Peak G	<u>~20</u>	%	
f.2. Peak Velocity	_____	%	
8. Instrumentation			
a. Number of Channels	<u>6</u>		
b. Frequency Response/Class	<u>0-500Hz (lowest res. frequency of load measuring table)</u>		
c. Method of recording			
c.1. Tape	_____ X _____		
c.2. Chart	_____		
c.3. Other (specify)	_____		
d. Method of Transmission			
d.1. Flying lead	_____ X _____		
d.2. FM Transmission	_____		
e. Accelerometers			
e.1. Types	<u>PIEZO ELECTRIC</u>		
e.2. Dynamic Range	<u>50k m/s²</u>		
e.3. Frequency Range	<u>0-20kHz</u>		
e.4. Number	_____		
e.4.a. on sled	_____		
e.4.b. on subject/dummy	<u>1</u>		
f. Other Parameters Monitored:	<u>LOAD - 300 X 200mm CELL, TO 100kN.</u> <u>0-500Hz</u>		

DATO/AGAR

Impact Test Facility Survey

ID #22

1. Name and Address of Facility MOTOR INDUSTRY RESEARCH ASSOCIATION
WATLING STREET
MILBURN, WARKS
ENGLAND CV10 0TU

2. Name of Director/Manager MR. C. ASHLEY

3. Date Facility became operational LARGE 1969

4. Principle of Operation LINEAR INDUCTION MOTOR

5. Main Use/Test Type VEHICLE IMPACTS AGAINST BARRIERS

a. Man Rated: yes no

6. Descriptive Details

a. Horizontal	<u>X</u>	c. Vertical	
b. Track Length	<u>51.2</u>	d. Tower Height	

e. Sled Characteristics

	<u>I</u>	<u>Sled #1</u>	<u>II</u>	<u>Sled #2</u>	<u>III</u>	<u>Sled #3</u>
e.1. Weight (max)						
e.2. Width (max)						
e.3. Length (max)						

f. Payload Characteristics

	<u>I</u>	<u>Sled #1</u>	<u>II</u>	<u>Sled #2</u>	<u>III</u>	<u>Sled #3</u>
f.1. Weight (max)		<u>4536kg</u>				
f.2. Width (max)		<u>5.2 m</u>				
f.3. Length (max)		<u>unlimited</u>				
f.4. Range of Orientation						

7. Performance Parameters

a. Acceleration INDETERMINATE(max) (min usable)

b. Jolt INDETERMINATE(max) (min usable)

c. Velocity UP TO 50 MPH(max) (min usable)

d. Stroke INDETERMINATE(max) (min usable)

e. Waveform: (Check all that Apply)

	Range of	Duration
	Acceleration	
e.1. Sine		
e.2. 1/2 Sine		
e.3. Triangle		
e.4. Trapezoidal		
e.5. Rectangle		
e.6. Sawtooth		
e.7. Other (indicate)	<u>DEPENDENT UPON VEHICLE TYPE AND BARRIER</u>	

f. Repeatability

f.1. Peak G	<u>3</u>
f.2. Peak Velocity	<u>1</u>

8. Instrumentation

a. Number of Channels 65 DC TO 10 KHz ON MAGNETIC TAPE

b. Frequency Response/Class 65 DC TO 2 KHz ON PAPER

c. Method of recording

c.1. Tape	
c.2. Chart	
c.3. Other (specify)	

d. Method of Transmission

d.1. Flying lead	<u>X</u>
d.2. FM Transmission	

e. Accelerometers

e.1. Types	<u>STRAIN GAUGE</u>
e.2. Dynamic Range	<u>VARIOUS UP TO 750 g</u>
e.3. Frequency Range	
e.4. Number	
e.4.a. on sled	<u>ANY CHOSEN POSITION</u>
e.4.b. on subject/dummy	

f. Other Parameters Monitored: HIGH SPEED FILMING, HARNESS AND SKELETAL LOADS, DISPLACEMENTS, CONTACT TIMING, PRESSURES, IMPACT VELOCITY, BARRIER FACE LOADS.

NATO/AGARD

Impact Test Facility Survey

ID #23

1. Name and Address of Facility MOTOR INDUSTRY RESEARCH ASSOCIATION
WATLING STREET, NUNEATON
WARMS, ENGLAND CV10 0TU, U.K.

2. Name of Director/Manager DR. C. ASHLEY

3. Date Facility became operational 10 NOVEMBER 1980

4. Principle of Operation PNEUMATIC REVERSE IMPACT SLED

5. Main Use/Test Type STUDY OF VEHICLE OCCUPANT PROTECTION,
SEAT BELT SYSTEMS, INERTIA EFFECT ON
VEHICLES AND VEHICLE COMPONENTS

a. Man Rated: yes ☐ no ☒

6. Descriptive Details

a. Horizontal	<u>X</u>	c. Vertical	<u> </u>
b. Track Length	<u>28m</u>	d. Tower Height	<u> </u>

e. Sled Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max)	<u>1090kg</u>	<u> </u>	<u> </u>
e.2. Width (max)	<u>1.2m</u>	<u> </u>	<u> </u>
e.3. Length (max)	<u>3.65m</u>	<u> </u>	<u> </u>

f. Payload Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max)	<u>1610kg</u>	<u> </u>	<u> </u>
f.2. Width (max)	<u>4.5m</u>	<u> </u>	<u> </u>
f.3. Length (max)	<u>4.5m</u>	<u> </u>	<u> </u>
f.4. Range of Orientation	<u> </u>	<u> </u>	<u> </u>

7. Performance Parameters

a. Acceleration	<u>50g</u>	(max)	<u> </u>	(min usable)
b. Jolt	<u> </u>	(max)	<u> </u>	(min usable)
c. Velocity	<u>100kph</u>	(max)	<u> </u>	(min usable)
d. Stroke	<u>3m</u>	(max)	<u> </u>	(min usable)

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine	<u> </u>	<u> </u>	<u> </u>
e.2. 1/2 Sine	<u>X</u>	<u>50g</u>	<u>130 msec</u>
e.3. Triangle	<u> </u>	<u> </u>	<u> </u>
e.4. Trapezoidal	<u> </u>	<u> </u>	<u> </u>
e.5. Rectangle	<u>X</u>	<u>50g</u>	<u>130 msec</u>
e.6. Sawtooth	<u>X</u>	<u>50g</u>	<u>130 msec</u>
e.7. Other (indicate)	<u> </u>	<u> </u>	<u> </u>

f. Repeatability

f.1. Peak G	<u>2.5</u>	<u>%</u>
f.2. Peak Velocity	<u>2.5</u>	<u>%</u>

8. Instrumentation

a. Number of Channels	<u>28 (FURTHER 26 AVAILABLE)</u>
b. Frequency Response/Class	<u>1000/600/130/60</u>
c. Method of recording	<u>X</u>
c.1. Tape	<u> </u>
c.2. Chart	<u> </u>
c.3. Other (specify)	<u>GALVANOMETER</u>
d. Method of Transmission	<u>X</u>
d.1. Flying lead	<u> </u>
d.2. FM Transmission	<u> </u>
e. Accelerometers	<u> </u>
e.1. Types	<u>STRAIN GAUGE</u>
e.2. Dynamic Range	<u>VARIOUS UP TO 750g</u>
e.3. Frequency Range	<u>VARIOUS UP TO 2000Hz</u>
e.4. Number	<u> </u>
e.4.a. on sled	<u>1 NORMALLY (MORE AVAILABLE)</u>
e.4.b. on subject/dummy	<u>9 NORMALLY</u>

f. Other Parameters Monitored: VEHICLE AND COMPONENTS ACCELEROMETERS,
FEMUR LOADS, SEAT BELT LOADS, OTHER FORCES AND DISPLACEMENTS AND VELOCITIES
H.S. FILM

NATO/AGARD

Impact Test Facility Survey

ID #24, 25

1. Name and Address of Facility SIMULA INC.
2223 S. 48TH STREET
TEMPE, ARIZONA 85282

2. Name of Director/Manager S.P. DESJARDINS

3. Date Facility became operational PLANNED FOR OCTOBER 1961

4. Principle of Operation DROP TOWER FOR VERTICAL TESTING, ALSO USED TO PROPEL SLED.

5. Main Use/Test Type AIRCRAFT SEAT EVALUATION

a. Man Rated: yes ☐ no ☒

6. Descriptive Details

a. Horizontal	<u>X</u>	c. Vertical	<u>X</u>
b. Track Length	<u>45m</u>	d. Tower Height	<u>20m</u>

e. Sled Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max)	<u> </u>	<u> </u>	<u> </u>
e.2. Width (max)	<u> </u>	<u> </u>	<u> </u>
e.3. Length (max)	<u> </u>	<u> </u>	<u> </u>

f. Payload Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max)	<u> </u>	<u> </u>	<u> </u>
f.2. Width (max)	<u> </u>	<u> </u>	<u> </u>
f.3. Length (max)	<u> </u>	<u> </u>	<u> </u>
f.4. Range of Orientation	<u> </u>	<u> </u>	<u> </u>

7. Performance Parameters

a. Acceleration	<u>50</u> (max)	<u> </u> (min usable)
b. Jolt	<u> </u> (max)	<u> </u> (min usable)
c. Velocity	<u>20 m/sec</u> (max)	<u> </u> (min usable)
d. Stroke	<u> </u> (max)	<u> </u> (min usable)

e. Waveform: (Check all that Apply)

	Range of Acceleration	Duration
e.1. Sine	<u> </u>	<u> </u>
e.2. 1/2 Sine	<u>X</u>	<u> </u>
e.3. Triangle	<u>X</u>	<u> </u>
e.4. Trapezoidal	<u>X</u>	<u> </u>
e.5. Rectangle	<u> </u>	<u> </u>
e.6. Sawtooth	<u> </u>	<u> </u>
e.7. Other (indicate)	<u> </u>	<u> </u>

f. Repeatability

f.1. Peak G	<u> </u>
f.2. Peak Velocity	<u> </u>

8. Instrumentation

a. Number of Channels 26

b. Frequency Response/Class REP. ON MEASUREMENT & SPECIFIC REQUIREMENTS

c. Method of recording

c.1. Tape	<u>X</u>
c.2. Chart	<u>X</u>
c.3. Other (specify)	<u> </u>

d. Method of Transmission

d.1. Flying lead	<u>X</u>
d.2. FM Transmission	<u> </u>

e. Accelerometers

e.1. Types	<u>STRAIN GAGE</u>	<u>PIEZORESISTIVE</u>
e.2. Dynamic Range	<u>±100 & ±50g</u>	<u>±100g</u>
e.3. Frequency Range	<u>500Hz</u>	<u>2000Hz</u>
e.4. Number	<u> </u>	<u> </u>
e.4.a. on sled	<u>3</u>	<u> </u>
e.4.b. on subject/carry	<u>3</u>	<u> </u>

f. Other Parameters Monitored: RESTRAINT SYSTEM LOADS, FOOTREST LOADS, SEAT ACCELERATIONS, STRUCTURAL DISPLACEMENT

NATO/AGARD

Impact Test Facility Survey

ID #26

1. Name and Address of Facility CRASHWORTHINESS LABORATORY
SRI INTERNATIONAL
333 RAVENSWOOD AVENUE
MENLO PARK, CA 94025
2. Name of Director/Manager J. D. COLTON
3. Date Facility became operational 1972
4. Principle of Operation PNEUMATIC PISTON
5. Main Use/Test Type ACCELERATION OF MODEL STRUCTURES
- a. Man Rated:
yes____ no____
6. Descriptive Details
- | | | | |
|-----------------|-----------|-----------------|-------|
| a. Horizontal | <u>X</u> | c. Vertical | _____ |
| b. Track Length | <u>3m</u> | d. Tower Height | _____ |
- e. Sled Characteristics
- | | | | |
|-------------------|------------------|-------------|-------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| e.1. Weight (max) | [<u>20 lb</u>] | [] | [] |
| e.2. Width (max) | [<u>18 in</u>] | [] | [] |
| e.3. Length (max) | [<u>36 in</u>] | [] | [] |
- f. Payload Characteristics
- | | | | |
|---------------------------|------------------|-------------|-------------|
| | [Sled #1] | [Sled #2] | [Sled #3] |
| f.1. Weight (max) | [<u>80 lb</u>] | [] | [] |
| f.2. Width (max) | [] | [] | [] |
| f.3. Length (max) | [] | [] | [] |
| f.4. Range of Orientation | [<u>360°</u>] | [] | [] |
7. Performance Parameters
- | | | |
|-----------------|-------------------------|-------------------------------|
| a. Acceleration | <u>300 g</u> (max) | <u>10 g</u> (min usable) |
| b. Jolt | _____ (max) | _____ (min usable) |
| c. Velocity | <u>100 ft/sec</u> (max) | <u>10 ft/sec</u> (min usable) |
| d. Stroke | <u>3 ft</u> (max) | <u>3 ft</u> (min usable) |
- e. Waveform: (Check all that Apply)
- | | | |
|-----------------------|--------------|-----------------|
| | Range of | |
| | Acceleration | Duration |
| e.1. Sine | _____ | _____ |
| e.2. 1/2 Sine | _____ | _____ |
| e.3. Triangle | _____ | _____ |
| e.4. Trapezoidal | _____ | _____ |
| e.5. Rectangle | _____ | _____ |
| e.6. Sawtooth | <u>X</u> | <u>10-300 μ</u> |
| e.7. Other (indicate) | _____ | _____ |
- f. Repeatability
- | | |
|--------------------|----------------|
| f.1. Peak G | _____ % |
| f.2. Peak Velocity | <u><5</u> % |
8. Instrumentation
- a. Number of Channels 28
- b. Frequency Response/Class _____
- c. Method of recording
- | | |
|----------------------|----------|
| c.1. Tape | <u>X</u> |
| c.2. Chart | _____ |
| c.3. Other (specify) | _____ |
- d. Method of Transmission
- | | |
|----------------------|----------|
| d.1. Flying lead | <u>X</u> |
| d.2. FM Transmission | _____ |
- e. Accelerometers
- | | |
|-------------------------|-------|
| e.1. Types | _____ |
| e.2. Dynamic Range | _____ |
| e.3. Frequency Range | _____ |
| e.4. Number | _____ |
| e.4.a. on sled | _____ |
| e.4.b. on subject/dummy | _____ |
- f. Other Parameters Monitored: _____

NATO/ASAP

Impact Test Facility Survey

10-407

1. Name and Address of Facility	NAVAL BIOYDYNAMICS LABORATORY P.O. BOX 19407 NEW ORLEANS, LA 70160																						
2. Name of Director/Manager	CHANNING L. EWING, M.D.																						
3. Date Facility became operational	OCTOBER 1972, MAR-RAISED JULY 1973																						
4. Principle of Operation	PENDULUM IN HYDRO																						
5. Main Use/Test Type	TESTING OF HUMANS & LARGE PRIMATES TO DETERMINE DYNAMIC RESPONSE & RELATION TO INJURIES OF HEAD, NECK, & TORSO. PRIMARILY BIOLOGICAL RESEARCH.																						
a. Man Rated:	yes ☐ no ☐																						
6. Descriptive Details																							
a. Horizontal	☒	c. Vertical	☐																				
b. Track Length	213m	d. Tower Height																					
e. Sled Characteristics	<table border="1"> <thead> <tr> <th></th> <th>Sled #1</th> <th>Sled #2</th> <th>Sled #3</th> </tr> </thead> <tbody> <tr> <td>e.1. Weight (max)</td> <td>8500k</td> <td>2000k</td> <td>1020k</td> </tr> <tr> <td>e.2. Width (max)</td> <td>1.2m</td> <td>1.2m</td> <td>1.2m</td> </tr> <tr> <td>e.3. Length (max)</td> <td>3.05m</td> <td>2.31m</td> <td>2.44m</td> </tr> </tbody> </table>				Sled #1	Sled #2	Sled #3	e.1. Weight (max)	8500k	2000k	1020k	e.2. Width (max)	1.2m	1.2m	1.2m	e.3. Length (max)	3.05m	2.31m	2.44m				
	Sled #1	Sled #2	Sled #3																				
e.1. Weight (max)	8500k	2000k	1020k																				
e.2. Width (max)	1.2m	1.2m	1.2m																				
e.3. Length (max)	3.05m	2.31m	2.44m																				
f. Payload Characteristics	<table border="1"> <thead> <tr> <th></th> <th>Sled #1</th> <th>Sled #2</th> <th>Sled #3</th> </tr> </thead> <tbody> <tr> <td>f.1. Weight (max)</td> <td>22200k</td> <td>1780k</td> <td>3350k</td> </tr> <tr> <td>f.2. Width (max)</td> <td>2.4m</td> <td>1.2m</td> <td>1.2m</td> </tr> <tr> <td>f.3. Length (max)</td> <td>2.05m</td> <td>1.3m</td> <td>1.3m</td> </tr> <tr> <td>f.4. Range of Orientation</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				Sled #1	Sled #2	Sled #3	f.1. Weight (max)	22200k	1780k	3350k	f.2. Width (max)	2.4m	1.2m	1.2m	f.3. Length (max)	2.05m	1.3m	1.3m	f.4. Range of Orientation			
	Sled #1	Sled #2	Sled #3																				
f.1. Weight (max)	22200k	1780k	3350k																				
f.2. Width (max)	2.4m	1.2m	1.2m																				
f.3. Length (max)	2.05m	1.3m	1.3m																				
f.4. Range of Orientation																							
7. Performance Parameters																							
a. Acceleration	200 g (max)	1 g (min usable)																					
b. Jolt	10000 g/sec (max)	50 g/sec (min usable)																					
c. Velocity	40 m/s (max)	1 m/s (min usable)																					
d. Stroke	1.7 m (max)	.05 m (min usable)																					
e. Waveform: (Check all that Apply)	Range of Acceleration Duration																						
e.1. Sine	☒																						
e.2. 1/2 Sine	☒	RANGE AND DURATION ARE DEPENDENT UPON SLED WEIGHT AND ACCELERATION CONFIGURATION.																					
e.3. Triangle	☐																						
e.4. Trapezoidal	☒																						
e.5. Rectangle	☐																						
e.6. Sawtooth	☒																						
e.7. Other (Indicate)	IRREGULAR																						
8. Repeatability																							
8.1. Peak g	±1																						
8.2. Peak Velocity	±1																						
9. Instrumentation	INERTIAL 1/2 CAPABILITY PHYSIOLOGICAL																						
a. Number of Channels	40 (BUFFERED) 24 CH-16 BIT	24 CH																					
b. Frequency response/Class	UP TO 5K HZ 04 CH-12 BIT	UP TO 12CH-16																					
c. Method of recording	10K HZ																						
c.1. Tape	☒																						
c.2. Chart	☐																						
c.3. Other (Specify)	RAG DISK W. POST REG. D/T TRANSFER																						
d. Method of Transmission																							
d.1. Flying Lead	☒																						
d.2. FM Transmission	☒																						
e. Accelerometers																							
e.1. Type	PIEZORESISTIVE																						
e.2. Dynamic Range	UP TO 200 g																						
e.3. Frequency Range	UP TO 20K HZ																						
e.4. Number																							
e.4.a. on sled	1																						
e.4.b. on test cell/survey	UP TO 10																						
10. Other Parameters Monitored	SLED MOUNTED CINE AT UP TO 1000 FRAMES/SEC. OPTICALLY SURVEILLED FOR 3-DIMENSIONAL ANALYSIS OF MOTORS.																						

Test Facility

Input Test Facility Survey

Name

1. Name and Address of Facility	<u>LABORATORY MOUNTED CAMERAS</u>		
	<u>100 E. 10th St.</u>		
	<u>ANN ARBOR, MI 48106</u>		
2. Name of Director/Manager	<u>THOMAS L. LIVING, JR.</u>		
3. Date Facility Became Operational	<u>1973/04</u>		
4. Principle of Operation	<u>LABORATORY MOUNTED CAMERAS</u>		
5. Main Use/Test Type	<u>LABORATORY MOUNTED CAMERAS TESTING IN THE PHYSICAL AND MEDICAL</u>		
6. Non-rated:	<u>yes</u> <u>no</u>		
7. Descriptive Details			
a. Horizontal	<u>yes</u>	b. Vertical	<u>yes</u>
c. Track Length	<u>100 ft</u>	d. Tower Height	<u>10 ft</u>
8. Size Characteristics			
a.1. Weight (max)	<u>100 lb</u>	a.2. Weight (min)	<u>10 lb</u>
a.3. Width (max)	<u>10 in</u>	a.4. Width (min)	<u>1 in</u>
a.5. Length (max)	<u>10 in</u>	a.6. Length (min)	<u>1 in</u>
9. Payload Characteristics			
a.1. Weight (max)	<u>100 lb</u>	a.2. Weight (min)	<u>10 lb</u>
a.3. Width (max)	<u>10 in</u>	a.4. Width (min)	<u>1 in</u>
a.5. Length (max)	<u>10 in</u>	a.6. Length (min)	<u>1 in</u>
a.7. Range of Orientation	<u>180°</u>		
10. Performance Parameters			
a. Acceleration	<u>100 g max</u>	<u>100 g</u>	<u>(min usable)</u>
b. Cost	<u>1000000</u>	<u>1000000</u>	<u>(min usable)</u>
c. Velocity	<u>1000000</u>	<u>1000000</u>	<u>(min usable)</u>
d. Stroke	<u>1000000</u>	<u>1000000</u>	<u>(min usable)</u>
e. Waveform: (Check all that Apply)			
a.1. Sine	<u>X</u>	Acceleration	Duration
a.2. 1/f Sine	<u>X</u>	<u>None and Duration are dependent upon Carriage Height & Acceleration Configuration</u>	
a.3. Triangular	<u>X</u>		
a.4. Trapezoidal	<u>X</u>		
a.5. Rectangle	<u>X</u>		
a.6. Sawtooth	<u>X</u>		
a.7. Other (Indicate)	<u>IRREGULAR</u>		
11. Repeatability			
a.1. Peak G	<u>±1</u>		
a.2. Peak Velocity	<u>±1</u>		
12. Instrumentation	<u>INERTIAL A/D CAPABILITY PHYSIOLOGICAL</u>		
a. Number of Channels	<u>40 (BUFFERED) 24 CH-16 BIT</u>	<u>24 CH</u>	
b. Frequency Response/Class	<u>UP TO 5K Hz 64 CH-12 BIT</u>	<u>UP TO 12CH, 1CH</u>	
c. Method of recording	<u>10K Hz</u>		
a.1. Tape	<u>X</u>	<u>X</u>	
a.2. Chart	<u>X</u>	<u>X</u>	
a.3. Other (specify)	<u>AND DISK W/ POST RUN D/T TRANSFER</u>		
13. Method of Transmission			
a.1. Flyin Lead	<u>X</u>		
a.2. FM Transmission	<u>X</u>		
14. Accelerometers			
a.1. Types	<u>PIEZORESISTIVE</u>		
a.2. Dynamic Range	<u>UP TO 500 g</u>		
a.3. Frequency Range	<u>UP TO 20K Hz</u>		
a.4. Number	<u>3</u>		
a.4.a. on sled	<u>3</u>		
a.4.b. on subject/dummy	<u>UP TO 10</u>		

15. Other Parameters Monitored: LABORATORY-MOUNTED CAMERAS AT UP TO 1000 FRAMES/SEC. X-RAY CINEMATOGRAPHY AT UP TO 300 FRAMES PER SEC.

NATO/AGARD

Impact Test Facility Survey

ID #29

1. Name and Address of Facility BIOENGINEERING CENTER
WAYNE STATE UNIVERSITY
DETROIT, MI 48202

2. Name of Director/Manager A. J. KING

3. Date Facility became operational 1970

4. Principle of Operation PNEUMATIC

5. Main Use/Test Type IMPACT ACCELERATION
BARRIER TEST

a. Man Rated: yes X no

6. Descriptive Details

a. Horizontal	<u>X</u>	c. Vertical	<u> </u>
b. Track Length	<u>40m</u>	d. Tower Height	<u> </u>

e. Sled Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max)	<u>5880N</u>	<u> </u>	<u> </u>
e.2. Width (max)	<u>2M</u>	<u> </u>	<u> </u>
e.3. Length (max)	<u>3.7M</u>	<u> </u>	<u> </u>

f. Payload Characteristics

	[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max)	<u>11000N</u>	<u> </u>	<u> </u>
f.2. Width (max)	<u>2M</u>	<u> </u>	<u> </u>
f.3. Length (max)	<u>3.7M</u>	<u> </u>	<u> </u>
f.4. Range of Orientation	<u>360°</u>	<u> </u>	<u> </u>

7. Performance Parameters

a. Acceleration	<u>50 G</u> (max)	<u>.5 G</u> (min usable)
b. Jolt	<u>2500 G/S</u> (max)	<u>50 G/S</u> (min usable)
c. Velocity	<u>30 M/S</u> (max)	<u>1 M/S</u> (min usable)
d. Stroke	<u>2 M</u> (max)	<u>1 M</u> (min usable)

e. Waveform: (Check all that Apply)

	Range of	
	Acceleration	Duration
e.1. Sine	<u> </u>	<u> </u>
e.2. 1/2 Sine	<u>X</u>	<u>5-50 G</u>
e.3. Triangle	<u>X</u>	<u>5-50 G</u>
e.4. Trapezoidal	<u>X</u>	<u>5-50 G</u>
e.5. Rectangle	<u>X</u>	<u>5-50 G</u>
e.6. Sawtooth	<u>X</u>	<u>5-50 G</u>
e.7. Other (indicate)	<u>?</u>	<u>5-50 G</u>

f. Repeatability

f.1. Peak G	<u>5</u> %
f.2. Peak Velocity	<u>5</u> %

8. Instrumentation

a. Number of Channels	<u>73</u>
b. Frequency Response/Class	<u>1000</u>
c. Method of recording	<u> </u>
c.1. Tape	<u>X</u>
c.2. Chart	<u>X</u>
c.3. Other (specify)	<u>AID</u>
d. Method of Transmission	<u> </u>
d.1. Flying lead	<u>X</u>
d.2. FM Transmission	<u> </u>
e. Accelerometers	<u> </u>
e.1. Types	<u>PIEZO RES</u> <u>STRAIN GAGE</u> <u>PIEZO ELEC</u>
e.2. Dynamic Range	<u>0-2000 G</u> <u>0-200 G</u> <u>0-1000 G</u>
e.3. Frequency Range	<u>0-1000 Hz</u> <u>0-500 Hz</u> <u>10000-40000 Hz</u>
e.4. Number	<u> </u>
e.4.a. on sled	<u>4</u>
e.4.b. on subject/dummy	<u>36</u>

f. Other Parameters Monitored: EMG, ECG, LOADS, MOMENTS, PRESSURE,
VELOCITY, DISTANCE, ANGLE, GAUSS

WATOWAGARD

Impact Test Facility Survey

ID #80

1. Name and Address of Facility	<u>BIOENGINEERING CENTER</u>		
	<u>MAYHE STATE UNIVERSITY</u>		
	<u>DETROIT, MI 48202</u>		
2. Name of Director/Manager	<u>A. I. KING</u>		
3. Date Facility became operational	<u>1967</u>		
4. Principle of Operation	<u>PNEUMATIC</u>		
5. Main Use/Test Type	<u>IMPACT ACCELERATION</u>		
a. Man Rated:			
yes <u>X</u> no <u> </u>			
6. Descriptive Details			
a. Horizontal <u>X</u>	c. Vertical		
b. Track Length <u>20m</u>	d. Tower Height		
e. Sled Characteristics	[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max)	[]	[5800N]	[]
e.2. Width (max)	[]	[2M]	[]
e.3. Length (max)	[]	[3.7M]	[]
f. Payload Characteristics	[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max)	[]	[1200N]	[]
f.2. Width (max)	[]	[2M]	[]
f.3. Length (max)	[]	[3.7M]	[]
f.4. Range of Orientation	[]	[360]	[]
7. Performance Parameters			
a. Acceleration	<u>50 G</u> (max)	<u>.5 G</u> (min usable)	
a. Jolt	<u>2500 G/S</u> (max)	<u>50 G/S</u> (min usable)	
c. Velocity	<u>30 M/S</u> (max)	<u>1 M/S</u> (min usable)	
d. Stroke	<u>2 M</u> (max)	<u>.1 M</u> (min usable)	
e. Waveform: (Check all that Apply)	Range of Acceleration Duration		
e.1. Sine	<u> </u>	<u>5-50 G</u>	<u>50-300 MS</u>
e.2. 1/2 Sine	<u>X</u>	<u>5-50 G</u>	<u>50-300 MS</u>
e.3. Triangle	<u>X</u>	<u>5-50 G</u>	<u>50-300 MS</u>
e.4. Trapezoidal	<u>X</u>	<u>5-50 G</u>	<u>50-300 MS</u>
e.5. Rectangle	<u>X</u>	<u>5-50 G</u>	<u>50-300 MS</u>
e.6. Sawtooth	<u>X</u>	<u>5-50 G</u>	<u>50-300 MS</u>
e.7. Other (indicate)	<u>?</u>	<u>5-50 G</u>	<u>50-300 MS</u>
f. Repeatability			
f.1. Peak G	<u>5</u> %		
f.2. Peak Velocity	<u>5</u> %		
8. Instrumentation			
a. Number of Channels	<u>73</u>		
b. Frequency Response/Class	<u>1000</u>		
c. Method of recording			
c.1. Tape	<u>X</u>		
c.2. Chart	<u>X</u>		
c.3. Other (specify)	<u>AMP</u>		
d. Method of Transmission			
d.1. Flying lead	<u>X</u>		
d.2. EM Transmission			
e. Accelerometers			
e.1. Types	<u>PIEZO RES</u>	<u>STRAIN GAGE</u>	<u>PIEZO ELEC</u>
e.2. Dynamic Range	<u>0-2000 G</u>	<u>0-200 G</u>	<u>0-1000 G</u>
e.3. Frequency Range	<u>0-1000 Hz</u>	<u>0-500 Hz</u>	<u>10000-40000 Hz</u>
e.4. Number			
e.4.a. on sled	<u>4</u>		
e.4.b. on subject/dummy	<u>30</u>		
f. Other Parameters Monitored:	<u>ENG, ECG, LOADS, MOMENTS, PRESSURE,</u>		
	<u>VELOCITY, DISTANCE, ANGLE, GAUSS</u>		

SHOCK/VAIBAD

Impact Test Facility Survey

II #41

1. Name and Address of Facility BIOENGINEERING CENTER
WAYNE STATE UNIVERSITY
DETROIT, MI 48202

2. Name of Facility Manager A. J. KING

3. Date facility became operational 1966

4. Principle of operation PNEUMATIC

5. Main Test Type EJECTION

6. Main Test Cell

7. Descriptive Details

a. Horizontal	☐	c. Vertical	☒
b. Track Length	☐	d. Tower Height	<u>30.5m</u>

8. Sled Characteristics

	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>
e.1. Weight (max)	<u>1000 N</u>			
e.2. Width (max)	<u>6 M</u>			
e.3. Length (max)	<u>3 M</u>			

9. Payload Characteristics

	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>
f.1. Weight (max)	<u>900 N</u>			
f.2. Width (max)	<u>5 M</u>			
f.3. Length (max)	<u>5 M</u>			
f.4. Range of Orientation	<u>30</u>			

10. Performance Parameters

a. Acceleration	<u>25 G</u> (max)	<u>1 G</u> (min usable)
b. Jolt	<u>2500 G/S</u> (max)	<u>50 G/S</u> (min usable)
c. Velocity	<u>20 M/S</u> (max)	<u>1 M/S</u> (min usable)
d. Stroke	<u>2 M</u> (max)	<u>2 M</u> (min usable)

e. Waveform: (Check all that Apply)

	Range of Acceleration	Duration
e.1. Sine	☐	☐
e.2. 1/2 Sine	☐	☐
e.3. Triangle	☐	☐
e.4. Trapezoidal	☒	<u>0-25 G</u>
e.5. Rectangle	☒	<u>1</u>
e.6. Sawtooth	☐	<u>50-250 MS</u>
e.7. Other (indicate)	☐	☐

11. Repeatability

f.1. Peak G	<u>5</u> %
f.2. Peak Velocity	<u>5</u> %

12. Instrumentation

a. Number of Channels	<u>40</u>
b. Frequency Response/Class	<u>1000</u>
c. Method of recording	☒
c.1. Tape	☒
c.2. Chart	☒
c.3. Other (specify)	<u>AID</u>
d. Method of Transmission	☒
d.1. Flying lead	☒
d.2. FM Transmission	☐
e. Accelerometers	
e.1. Types	<u>PIEZO RES</u> <u>STRAIN GAGE</u> <u>PIEZO ELEC</u>
e.2. Dynamic Range	<u>0-2000 G</u> <u>0-200 G</u> <u>0-1000 G</u>
e.3. Frequency Range	<u>0-1000 Hz</u> <u>0-500 Hz</u> <u>10000-40000 Hz</u>
e.4. Number	<u>4</u>
e.4.a. on sled	<u>4</u>
e.4.b. on subject/dummy	<u>36</u>

13. Other Parameters Monitored: ENG, ECG, LOADS, MOMENTS, PRESSURE,
VELOCITY, DISTANCE, ANGLE, GAUSS

NATO/AGARD

Impact Test Facility Survey

ID #32

1. Name and Address of Facility	<u>DYNAMIC TEST FACILITY</u>		
	<u>FEDERAL AVIATION ADMINISTRATION</u>		
	<u>TECHNICAL CENTER</u>		
	<u>ATLANTIC CITY AIRPORT, NJ 08405</u>		
2. Name of Director/Manager	<u>CAESER A. CAIAFA</u>		
3. Date Facility became operational	<u>PNEUMATIC</u>		
4. Principle of Operation	<u>CRASHWORTHINESS TESTING OF A/C</u>		
	<u>STRUCTURES AND SEATS</u>		
5. Main Use/Test Type	_____		
a. Man Rated:	_____		
yes_____ no <u>X</u>	_____		
6. Descriptive Details	_____		
a. Horizontal <u>X</u>	c. Vertical	_____	
b. Track Length <u>91 m</u>	d. Tower Height	_____	
e. Sled Characteristics	[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max)	_____	_____	_____
e.2. Width (max)	_____	_____	_____
e.3. Length (max)	_____	_____	_____
f. Payload Characteristics	[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max)	<u>2860Kg</u>	_____	_____
f.2. Width (max)	<u>N/A</u>	_____	_____
f.3. Length (max)	<u>91 m</u>	_____	_____
f.4. Range of Orientation	<u>N/A</u>	_____	_____
7. Performance Parameters	_____		
a. Acceleration	<u>15g at 2860Kg</u>	(max) _____	(min usable) _____
b. Jolt	_____	(max) _____	(min usable) _____
c. Velocity	<u>27.3 m/s at 2860Kg</u>	(max) _____	(min usable) _____
d. Stroke	<u>91 m</u>	(max) _____	(min usable) _____
e. Waveform: (Check all that Apply)	Range of Acceleration Duration		
e.1. Sine	_____	_____	_____
e.2. 1/2 Sine	_____	_____	_____
e.3. Triangle	_____	_____	_____
e.4. Trapezoidal	_____	_____	_____
e.5. Rectangle	_____	_____	_____
e.6. Sawtooth	_____	_____	_____
e.7. Other (indicate)	_____	_____	_____
f. Repeatability	_____		
f.1. Peak G	_____	%	
f.2. Peak Velocity	_____	%	
8. Instrumentation	_____		
a. Number of Channels	<u>IN THE PROCESS OF UPDATING</u>		
b. Frequency Response/Class	_____		
c. Method of recording	_____		
c.1. Tape	_____		
c.2. Chart	_____		
c.3. Other (specify)	_____		
d. Method of Transmission	_____		
d.1. Flying lead	_____		
d.2. FM Transmission	_____		
e. Accelerometers	_____		
e.1. Types	_____	_____	_____
e.2. Dynamic Range	_____	_____	_____
e.3. Frequency Range	_____	_____	_____
e.4. Number	_____	_____	_____
e.4.a. on sled	_____	_____	_____
e.4.b. on subject/dummy	_____	_____	_____
f. Other Parameters Monitored:	_____		

NATO/AGARD

Impact Test Facility Survey

ID #33

1. Name and Address of Facility	<u>CALSPAN CORPORATION</u>																	
	<u>ADVANCED TECHNOLOGY CENTER</u>																	
	<u>4455 GENESSEE STREET</u>																	
	<u>BUFFALO, NEW YORK 14225</u>																	
2. Name of Director/Manager	<u>ANTHONY L. RUSSO</u>																	
3. Date Facility became operational	<u>OCTOBER 1968</u>																	
4. Principle of Operation	<u>HYGEE 12"</u>																	
5. Main Use/Test Type	<u>RESTRAINT SYSTEM RESEARCH</u>																	
	<u>BIOMECHANICS RESEARCH</u>																	
a. Man Rated:																		
yes <u>X</u> no																		
6. Descriptive Details																		
a. Horizontal	<u>X</u>	c. Vertical																
b. Track Length	<u>27 m</u>	d. Tower Height																
e. Sled Characteristics	<table border="0"> <tr> <td>[Sled #1]</td> <td>[Sled #2]</td> <td>[Sled #3]</td> </tr> <tr> <td>e.1. Weight (max)</td> <td><u>2030 lb</u></td> <td></td> </tr> <tr> <td>e.2. Width (max)</td> <td><u>4 ft</u></td> <td></td> </tr> <tr> <td>e.3. Length (max)</td> <td><u>12 ft</u></td> <td></td> </tr> </table>			[Sled #1]	[Sled #2]	[Sled #3]	e.1. Weight (max)	<u>2030 lb</u>		e.2. Width (max)	<u>4 ft</u>		e.3. Length (max)	<u>12 ft</u>				
[Sled #1]	[Sled #2]	[Sled #3]																
e.1. Weight (max)	<u>2030 lb</u>																	
e.2. Width (max)	<u>4 ft</u>																	
e.3. Length (max)	<u>12 ft</u>																	
f. Payload Characteristics	<table border="0"> <tr> <td>[Sled #1]</td> <td>[Sled #2]</td> <td>[Sled #3]</td> </tr> <tr> <td>f.1. Weight (max)</td> <td><u>3500 lb</u></td> <td></td> </tr> <tr> <td>f.2. Width (max)</td> <td><u>12 ft</u></td> <td></td> </tr> <tr> <td>f.3. Length (max)</td> <td><u>20 ft</u></td> <td></td> </tr> <tr> <td>f.4. Range of Orientation</td> <td></td> <td></td> </tr> </table>			[Sled #1]	[Sled #2]	[Sled #3]	f.1. Weight (max)	<u>3500 lb</u>		f.2. Width (max)	<u>12 ft</u>		f.3. Length (max)	<u>20 ft</u>		f.4. Range of Orientation		
[Sled #1]	[Sled #2]	[Sled #3]																
f.1. Weight (max)	<u>3500 lb</u>																	
f.2. Width (max)	<u>12 ft</u>																	
f.3. Length (max)	<u>20 ft</u>																	
f.4. Range of Orientation																		
7. Performance Parameters																		
a. Acceleration	<u>72 G_x</u> (max)	<u>2 G_x</u> (min usable)																
b. Jolt		(max)	(min usable)															
c. Velocity	<u>55 mph</u> (max)	<u>5 mph</u> (min usable)																
d. Stroke	<u>8 ft</u> (max)	<u>1 ft</u> (min usable)																
e. Waveform: (Check all that Apply)	Range of Acceleration		Duration															
e.1. Sine																		
e.2. 1/2 Sine	<u>X</u>	<u>3-50 G_x</u>	<u>50-120 ms</u>															
e.3. Triangle	<u>X</u>	<u>> 55 G_x</u>	<u>20-50 ms</u>															
e.4. Trapezoidal	<u>X</u>	<u>5-40 G_x</u>	<u>60-150 ms</u>															
e.5. Rectangle																		
e.6. Sawtooth		<u>> 55 G_x</u>	<u>20-50 ms</u>															
e.7. Other (indicate)	<u>SPECIAL CRASH PULSES</u>	<u>> 70 G_x</u>	<u>50-150 ms</u>															
f. Repeatability																		
f.1. Peak G	<u>2.5</u>	%																
f.2. Peak Velocity	<u>2.5</u>	%																
8. Instrumentation																		
a. Number of Channels	<u>54</u>																	
b. Frequency Response/Class	<u>1000, 600, 180, 60</u>																	
c. Method of recording																		
c.1. Tape	<u>X (FM)</u>																	
c.2. Chart																		
c.3. Other (specify)	<u>DIRECT DIGITAL DATA ACQUISITION (DDAS)</u>																	
d. Method of Transmission																		
d.1. Flying lead	<u>X</u>																	
d.2. FM Transmission																		
e. Accelerometers																		
e.1. Types	<u>CEC</u>	<u>ENDEVCO</u>	<u>KISTLER</u>															
e.2. Dynamic Range	<u>±250 g</u>	<u>±750 g</u>	<u>±100 g</u>															
e.3. Frequency Range	<u>2000 Hz</u>		<u>1000 Hz</u>															
e.4. Number	<u>1500</u>																	
e.4.a. on sled	<u>> 100</u>																	
e.4.b. on subject/dummy	<u>> 40</u>																	
f. Other Parameters Monitored:	<u>FEMUR LOADS, PRESSURE, VELOCITY, DISTANCE AND DYNAMIC LOADS.</u>																	

NATO/AGARD

Impact Test Facility Survey

ID #34

1. Name and Address of Facility	<u>INLAND DIVISION, GENERAL MOTORS</u>																						
	<u>DEPARTMENT 85 F3-1</u>																						
	<u>P.O. BOX 1224</u>																						
	<u>DAYTON, OHIO 45401</u>																						
2. Name of Director/Manager	<u>J. J. O'CONNELL</u>																						
3. Date Facility became operational	<u>AUGUST, 1971</u>																						
4. Principle of Operation	<u>IMPACTS SHOCK ABSORBER</u>																						
5. Main Use/Test Type	<u>AUTO SAFETY DEVELOPMENT</u>																						
a. Man Rated:																							
yes	<u>no</u>	<u>X</u>																					
6. Descriptive Details																							
a. Horizontal	<u>X</u>	c. Vertical																					
b. Track Length	<u>11m</u>	d. Tower Height																					
e. Sled Characteristics	<table border="1"> <thead> <tr> <th></th> <th>Sled #1</th> <th>Sled #2</th> <th>Sled #3</th> </tr> </thead> <tbody> <tr> <td>e.1. Weight (max)</td> <td>600 lbs</td> <td></td> <td></td> </tr> <tr> <td>e.2. Width (max)</td> <td>6 ft</td> <td></td> <td></td> </tr> <tr> <td>e.3. Length (max)</td> <td>7 ft</td> <td></td> <td></td> </tr> </tbody> </table>				Sled #1	Sled #2	Sled #3	e.1. Weight (max)	600 lbs			e.2. Width (max)	6 ft			e.3. Length (max)	7 ft						
	Sled #1	Sled #2	Sled #3																				
e.1. Weight (max)	600 lbs																						
e.2. Width (max)	6 ft																						
e.3. Length (max)	7 ft																						
f. Payload Characteristics	<table border="1"> <thead> <tr> <th></th> <th>Sled #1</th> <th>Sled #2</th> <th>Sled #3</th> </tr> </thead> <tbody> <tr> <td>f.1. Weight (max)</td> <td>1900 lbs</td> <td></td> <td></td> </tr> <tr> <td>f.2. Width (max)</td> <td>12 ft</td> <td></td> <td></td> </tr> <tr> <td>f.3. Length (max)</td> <td>7 ft</td> <td></td> <td></td> </tr> <tr> <td>f.4. Range of Orientation</td> <td>90°</td> <td></td> <td></td> </tr> </tbody> </table>				Sled #1	Sled #2	Sled #3	f.1. Weight (max)	1900 lbs			f.2. Width (max)	12 ft			f.3. Length (max)	7 ft			f.4. Range of Orientation	90°		
	Sled #1	Sled #2	Sled #3																				
f.1. Weight (max)	1900 lbs																						
f.2. Width (max)	12 ft																						
f.3. Length (max)	7 ft																						
f.4. Range of Orientation	90°																						
7. Performance Parameters																							
a. Acceleration	<u>50 G</u> (max)		(min usable)																				
b. Jolt			(min usable)																				
c. Velocity	<u>40 mph</u> (max)		(min usable)																				
d. Stroke	<u>54 in</u> (max)		(min usable)																				
e. Waveform: (Check all that Apply)	Range of Acceleration Duration																						
e.1. Sine																							
e.2. 1/2 Sine																							
e.3. Triangle																							
e.4. Trapezoidal																							
e.5. Rectangle																							
e.6. Sawtooth																							
e.7. Other (indicate)	<u>PROGRAMMABLE-TO SIMULATE GIVEN VEHICLE</u>																						
f. Repeatability																							
f.1. Peak G			%																				
f.2. Peak Velocity	<u>2</u>		%																				
8. Instrumentation																							
a. Number of Channels	<u>60</u>																						
b. Frequency Response/Class	<u>60, 180, 600, 1000</u>																						
c. Method of recording																							
c.1. Tape	<u>X (FM)</u>																						
c.2. Chart	<u>X</u>																						
c.3. Other (specify)																							
d. Method of Transmission																							
d.1. Flying lead	<u>X</u>																						
d.2. FM Transmission																							
e. Accelerometers																							
e.1. Types	<u>PIEZORESTIVE</u>	<u>ENDEVCO</u>	<u>7231-75</u>																				
e.2. Dynamic Range	<u>750 g</u>																						
e.3. Frequency Range	<u>0-2000 Hz</u>																						
e.4. Number	<u>50</u>																						
e.4.a. on sled	<u>1</u>																						
e.4.b. on subject/dummy	<u>6</u>																						
f. Other Parameters Monitored:	<u>TIBIA LOADS, FEMUR LOADS, NECK LOADS</u>																						

NATO/AGARD

Impact Test Facility Survey

ID #35

1. Name and Address of Facility TRANSPORTATION RESEARCH CENTER OF
OHIO
EAST LIBERTY, OHIO 43319

2. Name of Director/Manager SIDNEY JEFFE

3. Date Facility became operational 1973

4. Principle of Operation HYGE ACCELERATOR (BENDIX 24")

5. Main Use/Test Type IMPACT SIMULATION FOR AUTOMOTIVE AND
AIRCRAFT OCCUPANT PROTECTION SYSTEMS.

a. Man Rated: yes no X

6. Descriptive Details

a. Horizontal X c. Vertical

b. Track Length d. Tower Height

e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	3600 lb		
e.2. Width (max)	1.5 m		
e.3. Length (max)	3.6 m		

f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	10000 lb		
f.2. Width (max)	9 m		
f.3. Length (max)	6 m		
f.4. Range of Orientation	360°		

7. Performance Parameters

a. Acceleration 100 g (max) 2 g (min usable)

b. Jolt (max) (min usable)

c. Velocity 100 mph (max) 5 mph (min usable)

d. Stroke 6 ft (max) 0.1 ft (min usable)

e. Waveform: (Check all that Apply) Range of Acceleration Duration

e.1. Sine	<u> </u>	<u>2 - 100 g</u>	<u>50, 65, 80, 100 ms</u>
e.2. 1/2 Sine	<u>X</u>	<u> </u>	<u> </u>
e.3. Triangle	<u> </u>	<u>5 - 50 g</u>	<u>100 & 130 ms</u>
e.4. Trapezoidal	<u>X</u>	<u> </u>	<u> </u>
e.5. Rectangle	<u> </u>	<u> </u>	<u> </u>
e.6. Sawtooth	<u> </u>	<u> </u>	<u> </u>
e.7. Other (indicate)	<u>DOUBLE HUMP</u>	<u>24 g</u>	<u>100 ms</u>

f. Repeatability

f.1. Peak G 1 %

f.2. Peak Velocity 1 %

8. Instrumentation

a. Number of Channels 64

b. Frequency Response/Class SAE J211A

c. Method of recording

c.1. Tape

c.2. Chart

c.3. Other (specify)

d. Method of Transmission

d.1. Flying lead

d.2. FM Transmission X

e. Accelerometers

	ENDEVCO	ENDEVCO	ENDEVCO	CEC
e.1. Types	7232C	2260C	7267C-TRIAX	4-202
e.2. Dynamic Range	±750g	±250g	±750g	±25-±250g
e.3. Frequency Range	0-2000Hz	0-2000Hz	0-2000 Hz	0-2000Hz
e.4. Number				
e.4.a. on sled	3			
e.4.b. on subject/dummy	61 MAX			

f. Other Parameters Monitored: PRESSURE, FORCE, DISPLACEMENT, STRAIN,
TEMPERATURE.

NATO/AGARD

Impact Test Facility Survey

ID #36

1. Name and Address of Facility	<u>VERTICAL DECELERATION TOWER</u> <u>BIOMECHANICAL PROTECTION BRANCH</u> <u>BIODYNAMICS & BIOENGINEERING DIVISION</u> <u>AFAMRL, WPAFB, OHIO 45433</u>																										
2. Name of Director/Manager	<u>JAMES W. BRINKLEY</u>																										
3. Date Facility became operational	<u>1962</u>																										
4. Principle of Operation	<u>FREEFALL OF CARRIAGE AND PLUNGER ONTO</u> <u>A WATER FILLED CYLINDER</u>																										
5. Main Use/Test Type	<u>TEST SEATS, RESTRAINT SYSTEMS &</u> <u>VEHICLES. PHYSIOLOGICAL & BIODYNAMIC</u> <u>RESEARCH</u>																										
a. Man Rated:	yes <u>X</u> no <u> </u>																										
6. Descriptive Details																											
a. Horizontal	<u> </u>	c. Vertical	<u>X</u>																								
b. Track Length	<u> </u>	d. Tower Height	<u>15.2 m</u>																								
e. Sled Characteristics	<table border="0"> <tr> <td></td> <td>[Sled #1]</td> <td>[Sled #2]</td> <td>[Sled #3]</td> </tr> <tr> <td>e.1. Weight (max)</td> <td><u>909 kg (2000 lb)</u></td> <td><u> </u></td> <td><u> </u></td> </tr> <tr> <td>e.2. Width (max)</td> <td><u>91 cm (36 in)</u></td> <td><u> </u></td> <td><u> </u></td> </tr> <tr> <td>e.3. Length (max)</td> <td><u>183 cm (83 in)</u></td> <td><u> </u></td> <td><u> </u></td> </tr> </table>				[Sled #1]	[Sled #2]	[Sled #3]	e.1. Weight (max)	<u>909 kg (2000 lb)</u>	<u> </u>	<u> </u>	e.2. Width (max)	<u>91 cm (36 in)</u>	<u> </u>	<u> </u>	e.3. Length (max)	<u>183 cm (83 in)</u>	<u> </u>	<u> </u>								
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	[Sled #1]	[Sled #2]	[Sled #3]																								
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f.4. Range of Orientation	<u> </u>	<u> </u>	<u> </u>																								
7. Performance Parameters																											
a. Acceleration	<u>80 g at 227 kg payload(max)</u>	<u> </u>	(min usable)																								
b. Jolt	<u>10g/20msec</u>	<u> </u>	(min usable)																								
c. Velocity	<u>17 m/s (56 ft/sec)</u>	<u> </u>	(min usable)																								
d. Stroke	<u>1.2 m (4 ft)</u>	<u> </u>	(min usable)																								
e. Waveform: (Check all that Apply)	<table border="0"> <tr> <td></td> <td>Range of Acceleration</td> <td>Duration</td> </tr> <tr> <td>e.1. Sine</td> <td><u> </u></td> <td><u> </u></td> </tr> <tr> <td>e.2. 1/2 Sine</td> <td><u>X</u></td> <td><u> </u></td> </tr> <tr> <td>e.3. Triangle</td> <td><u>X</u></td> <td><u> </u></td> </tr> <tr> <td>e.4. Trapezoidal</td> <td><u> </u></td> <td><u> </u></td> </tr> <tr> <td>e.5. Rectangle</td> <td><u> </u></td> <td><u> </u></td> </tr> <tr> <td>e.6. Sawtooth</td> <td><u> </u></td> <td><u> </u></td> </tr> <tr> <td>e.7. Other (indicate)</td> <td><u> </u></td> <td><u> </u></td> </tr> </table>				Range of Acceleration	Duration	e.1. Sine	<u> </u>	<u> </u>	e.2. 1/2 Sine	<u>X</u>	<u> </u>	e.3. Triangle	<u>X</u>	<u> </u>	e.4. Trapezoidal	<u> </u>	<u> </u>	e.5. Rectangle	<u> </u>	<u> </u>	e.6. Sawtooth	<u> </u>	<u> </u>	e.7. Other (indicate)	<u> </u>	<u> </u>
	Range of Acceleration	Duration																									
e.1. Sine	<u> </u>	<u> </u>																									
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e.6. Sawtooth	<u> </u>	<u> </u>																									
e.7. Other (indicate)	<u> </u>	<u> </u>																									
f. Repeatability																											
f.1. Peak G	<u>7.5</u>	<u> </u>	<u> </u>																								
f.2. Peak Velocity	<u>7.5</u>	<u> </u>	<u> </u>																								
8. Instrumentation																											
a. Number of Channels	<u>50</u>																										
b. Frequency Response/Class	<u>0-200Hz @ 1K sample rate; sample rate</u> <u>variable to 10K with on board A/D</u>																										
c. Method of recording	<u>0-2K ANALOG</u>																										
c.1. Tape	<u>X</u>																										
c.2. Chart	<u> </u>																										
c.3. Other (specify)	<u>ON-BOARD A/D, TRANSMITTED TO DISK STORAGE</u>																										
d. Method of Transmission	<u>X</u>																										
d.1. Flying lead	<u> </u>																										
d.2. FM Transmission	<u>X</u>																										
e. Accelerometers	<u>PIEZORESISTIVE</u>																										
e.1. Types	<u>500 g</u>																										
e.2. Dynamic Range	<u>0-3K</u>																										
e.3. Frequency Range	<u>25</u>																										
e.4. Number	<u>1</u>																										
e.4.a. on sled	<u>AS REQUIRED</u>																										
e.4.b. on subject/dummy	<u>AS REQUIRED</u>																										
f. Other Parameters Monitored:	<u>FORCE, VELOCITY, DISPLACEMENT, AND</u> <u>PHYSIOLOGICAL PARAMETERS</u>																										

NATO/AGARD

Impact Test Facility Survey

ID #37

1. Name and Address of Facility	<u>VERTICAL ACCELERATOR</u> <u>BIOMECHANICAL PROTECTION BRANCH</u> <u>BIODYNAMICS & BIOENGINEERING DIVISION</u> <u>AFAMRL, WPAFB, OH 45433</u>		
2. Name of Director/Manager	<u>JAMES W. BRINKLEY</u>		
3. Date Facility became operational	<u>MARCH 1977</u>		
4. Principle of Operation	<u>6" HYGGE DEVICE AIR PRESSURE ACTION ON PISTON TO APPLY THRUST TO A CARRIAGE.</u>		
5. Main Use/Test Type	<u>TEST INSTRUMENTATION, RESTRAINT SYSTEM COMPONENTS, & MODEL METERING PINS FOR 24" IMPULSE ACCELERATOR. UTILIZE SMALL & MEDIUM SIZE PRIMATES. BIODYNAMIC RESEARCH</u>		
a. Man Rated:	yes ☐ no ☒		
6. Descriptive Details			
a. Horizontal	☐	c. Vertical	☒
b. Track Length	☐	d. Tower Height	<u>6.1m</u>
e. Sled Characteristics	[<u>Sled #1</u>] [<u>Sled #2</u>] [<u>Sled #3</u>]		
e.1. Weight (max)	<u>40 kg (88.0 lb)</u> [<u> </u>] [<u> </u>]		
e.2. Width (max)	<u>77 cm (30.5 in)</u> [<u> </u>] [<u> </u>]		
e.3. Length (max)	<u>46 cm (18.0 in)</u> [<u> </u>] [<u> </u>]		
f. Payload Characteristics	[<u>Sled #1</u>] [<u>Sled #2</u>] [<u>Sled #3</u>]		
f.1. Weight (max)	<u>57 kg (125.0 lb)</u> [<u> </u>] [<u> </u>]		
f.2. Width (max)	<u>77 cm (30.5 in)</u> [<u> </u>] [<u> </u>]		
f.3. Length (max)	<u>91 cm (36.0 in)</u> [<u> </u>] [<u> </u>]		
f.4. Range of Orientation	[<u> </u>] [<u> </u>] [<u> </u>]		
7. Performance Parameters	<u>178 KN MAXIMUM THRUST</u>		
a. Acceleration	<u>150 g</u> (max)	<u>8.0</u>	(min usable)
b. Jolt, Acceleration*	<u>32000 g/sec</u> (max)		(min usable)
c. Velocity	<u>18m/s (59 ft/sec)</u> (max)		(min usable)
d. Stroke	<u>48 cm (19 in)</u> (max)		(min usable)
*THRUST COLUMN IS CAPABLE OF RAPID DECELERATION WHEN USED WITH DECELERATION METERING PIN AND HYDRAULIC FLUID. JOLT, DECELERATION 100,000 g/sec.			
e. Waveform: (Check all that Apply)	Range of Acceleration Duration		
e.1. Sine	☐	☐	☐
e.2. 1/2 Sine	☒	☐	☐
e.3. Triangle	☐	☐	☐
e.4. Trapezoidal	☒	☐	☐
e.5. Rectangle	☒	☐	☐
e.6. Sawtooth	☒	☐	☐
e.7. Other (indicate)	☐	☐	☐
f. Repeatability			
f.1. Peak G	<u>2</u>	<u>3</u>	
f.2. Peak Velocity	<u>2</u>	<u>3</u>	
8. Instrumentation			
a. Number of Channels	<u>9</u>		
b. Frequency Response/Class	<u>2K</u>		
c. Method of recording			
c.1. Tape	☒		
c.2. Chart	☐		
c.3. Other (specify)	☐		
d. Method of Transmission			
d.1. Flying lead	☒		
d.2. FM Transmission	☐		
e. Accelerometers			
e.1. Types	<u>PIEZORESISTIVE</u>		
e.2. Dynamic Range	<u>250 g</u>		
e.3. Frequency Range	<u>DC - 2KHz</u>		
e.4. Number	<u>1</u>		
e.4.a. on sled	<u>1</u>		
e.4.b. on subject/dummy	<u>AS REQUIRED</u>		
f. Other Parameters Monitored:	<u>VELOCITY, FORCE, AND DISPLACEMENT.</u>		

NATO/AGARD

Impact Test Facility Survey

ID #30

1. Name and Address of Facility SQUARE WAVE IMPACT SYSTEM (SWISHODE)
BIOMECHANICAL PROTECTION BRANCH
AFAMRL/BBP, AREA 2, BLDG 824
W-PAFB, OH 45433

2. Name of Director/Manager JAMES W. BRINKLEY

3. Date Facility became operational _____

4. Principle of Operation FREE/FALL CARRIAGE ON METAL HONEYCOMB

5. Main Use/Test Type STUDIES OF IMPACTED ANIMALS

a. Man Rated: yes _____ no X

6. Descriptive Details

a. Horizontal _____	c. Vertical <u>X</u>
d. Track Length _____	e. Tower Height <u>14.9m</u>

e. Sled Characteristics

[Sled #1]	[Sled #2]	[Sled #3]
e.1. Weight (max) <u>[277kg/610lb]</u>	<u>[316kg/695lb]</u>	<u>[]</u>
e.2. Width (max) <u>[71 cm/28 in]</u>	<u>[71 cm/28 in]</u>	<u>[]</u>
e.3. Length (max) <u>[121cm/47.5in]</u>	<u>[137cm/54 in]</u>	<u>[]</u>

f. Payload Characteristics

[Sled #1]	[Sled #2]	[Sled #3]
f.1. Weight (max) <u>[45.5kg/100lb]</u>	<u>[45.5kg/100lb]</u>	<u>[]</u>
f.2. Width (max) <u>[]</u>	<u>[]</u>	<u>[]</u>
f.3. Length (max) <u>[]</u>	<u>[]</u>	<u>[]</u>
f.4. Range of Orientation <u>[+Gz]</u>	<u>[+5° to 30°+Gz]</u>	<u>[]</u>

7. Performance Parameters

a. Acceleration	<u>600 g</u> (max)	<u>10 g</u> (min usable)
b. Jolt	(max)	(min usable)
c. Velocity	<u>14 m/s (46 ft/sec)</u> (max)	<u>4.3 m/s (14 ft/sec)</u> (min usable)
d. Stroke	(max)	(min usable)

e. Waveform: (Check all that Apply)

	Range of Acceleration	Duration
e.1. Sine	_____	_____
e.2. 1/2 Sine	_____	_____
e.3. Triangle	_____	_____
e.4. Trapezoidal	_____	_____
e.5. Rectangle	<u>X</u>	<u>10-200 g</u>
e.6. Sawtooth	_____	<u>2-24 ms</u>
e.7. Other (indicate)	_____	_____

f. Repeatability

f.1. Peak G	<u>10</u> %
f.2. Peak Velocity	<u>3</u> %

8. Instrumentation

a. Number of Channels	<u>30</u>
b. Frequency Response/Class	<u>2KHz</u>
c. Method of recording	_____
c.1. Tape	<u>X</u>
c.2. Chart	<u>X</u>
c.3. Other (specify)	_____
d. Method of Transmission	_____
d.1. Flying lead	<u>X</u>
d.2. FM Transmission	_____
e. Accelerometers	_____
e.1. Types	<u>PIEZORESISTIVE STRAIN GAUGE</u> <u>PIEZOELECTRIC</u>
e.2. Dynamic Range	<u>0-250</u> <u>0-250</u> <u>0-250</u>
e.3. Frequency Range	<u>DC-2KHz</u> <u>DC-2KHz</u> <u>2-2KHz</u>
e.4. Number	_____
e.4.a. on sled	<u>21</u>
e.4.b. on subject/dummy	<u>9</u>

f. Other Parameters Monitored: HARNES LOADS, SEAT LOADS, AND VELOCITY

1. Name of Project: STUDY OF THE EFFECTS OF VIBRATION ON THE HUMAN BODY

2. Name of Investigator/Manager: DR. H. H. HARRIS

3. Date of Study or Test Operation: MARCH, 1970

4. Principle of Operation: STORED ENERGY FLYWHEEL ACCELERATOR
SLED FOR 25 G (15-10) PULSE OPERATION
A CONTROLLABLE PULSE SIGNAL, 1000
CYCLES PER SEC. (100 Hz) & 10 PULSES
RATED BY 5 FOOT PISTON AND STROKE
OBTAINABLE WITH PISTON CYLINDER

5. Main Test Type: SEAT/RESTRAINT SYSTEM TESTING, VIBRO-
MATIC & PHYSIOLOGICAL RESEARCH, VIBRO-
MATIC, DYNAMIC & STATIC, PULSED
SYSTEM CONTROL, TESTING

6. Descriptive Details:

a. Horizontal: Yes b. Vertical: No

c. Track Length: 10 cm d. Lower Extremity: No

7. Sled Characteristics:

a. Weight (max): 1100 lb / 500 kg / 2200 lb

b. Width (max): 11.2 1/4 in / 28.5 cm / 11.2 in

c. Length (max): 11.3 1/2 in / 28.9 cm / 11.3 in

8. Payload Characteristics:

a. Weight (max): 1000 lb / 450 kg / 1000 lb

b. Width (max): 11.2 1/4 in / 28.5 cm / 11.2 in

c. Length (max): 11.3 1/2 in / 28.9 cm / 11.3 in

d. Range of Orientation: X, Y, Z

9. Performance Parameters:

a. Acceleration: 100 g (max) 2.5 g (min. steady)

b. Jolt: 1000 g/s (max) 200 g/s (min. steady)

c. Velocity: 32 ft/s (10 m/s) (max) 12 ft/s (3.7 m/s) (min. steady)

d. Stroke: 18 cm (7 in) (max) 12 cm (5 in) (min. steady)

e. Waveform: (Check all that Apply)

	Range of Acceleration	Function
a.1. Sine		
a.2. 1/2 Sine	X	0-100 g
a.3. Triangle	X	0-100 g
a.4. Trapezoidal	X	0-100 g
a.5. Rectangle		
a.6. Sawtooth	X	0-100 g
a.7. Other (Indicate)	IRREGULAR	

f. Repeatability:

f.1. Peak G: 5

f.2. Peak Velocity: 5

10. Instrumentation:

a. Number of Channels: 20

b. Frequency Response/Class: 0-500 Hz & 1K Hz (100 Hz) (100 Hz) (100 Hz)
variable to 10K with sh. 100 Hz

c. Method of Recording:

c.1. Tape: 0-PMU ANALOG

c.2. Chart: X

c.3. Other (Specify): ON-BOARD A/D, TRANSMITTED TO TELESCOPE

d. Method of Transmission:

d.1. Flying Lead: X

d.2. FM Transmission: X

e. Accelerometers:

e.1. Types: PIEZORESISTIVE, PIEZOELECTRIC, DYNAMIC, STATIC

e.2. Dynamic Range: 500 g 25 g 5 g

e.3. Frequency Range: 0-500 Hz 0-100 Hz 0-100 Hz

e.4. Number:

e.4.a. on sled: 5

e.4.b. on subject/dummy: 0-12

f. Other Parameters Monitored: SLED VELOCITY, FUEL LEVELS, SEAL LEAKS,
OIL LEAKS, TELEMETRY ECG, AND BODY SEGMENT DISPLACEMENTS

NATO/AGARD

Impact Test Facility Survey

ID #40

1. Name and Address of Facility	<u>IMPULSE ACCELERATOR</u> <u>BIOMECHANICAL PROTECTION BRANCH</u> <u>BIODYNAMICS & BIOENGINEERING DIVISION</u> <u>AFAMRL, W-PAFB, OH 45433</u>		
2. Name of Director/Manager	<u>JAMES W. BRINKLEY</u>		
3. Date Facility became operational	<u>26 JUNE 1972</u>		
4. Principle of Operation	<u>DIFFERENTIAL GAS PRESSURES CONTROLLED</u> <u>BY METERING PINS IN ORIFICE</u>		
5. Main Use/Test Type	<u>IMPACT TESTS ON SEATS, RESTRAINTS</u> <u>AND VEHICLES USING DUMMIES, HUMANS,</u> <u>AND ANIMAL SUBJECTS</u>		
a. Man Rated:	yes <u>X</u> no <u> </u>		
6. Descriptive Details			
a. Horizontal	<u>X</u>	c. Vertical	<u> </u>
b. Track Length	<u>76m</u>	d. Tower Height	<u> </u>
e. Sled Characteristics	[Sled #1][Sled #2][Sled #3]		
e.1. Weight (max)	<u>1500kg/1800lb</u> [<u>564kg/800lb</u>]		
e.2. Width (max)	<u>5.2 m/4 ft</u> [<u>5.2 m/4 ft</u>]		
e.3. Length (max)	<u>1.8 m/6 ft</u> [<u>1.8 m/6 ft</u>]		
f. Payload Characteristics	[Sled #1][Sled #2][Sled #3]		
f.1. Weight (max)	<u>1450kg/10K lb</u> [<u>1450kg/3200 lb</u>]		
f.2. Width (max)	<u>3.7 m/12 ft</u> [<u>3.7 m/12 ft</u>]		
f.3. Length (max)	<u>UNDEFINED</u> [<u>UNDEFINED</u>]		
f.4. Range of Orientation	<u>NO LIMIT</u> [<u> </u>]		
7. Performance Parameters			
a. Acceleration	<u>150g's @ 227kg payload(max)</u> <u>1 g</u> (min usable)		
b. Jolt	<u>4000 g/sec</u> (max) <u>50 g/sec</u> (min usable)		
c. Velocity	<u>51.5 m/s (169 fps)</u> (max) <u>.3 m (1fps)</u> (min usable)		
d. Stroke	<u>2.6 m (8.4 ft)</u> (max) <u>.3 m (1 ft)</u> (min usable)		
e. Waveform: (Check all that Apply)	Range of Acceleration Duration		
e.1. Sine	<u> </u>	<u>1-150 g</u>	<u>25 ms</u>
e.2. 1/2 Sine	<u>X</u>	<u>1-150 g</u>	<u>75 ms</u>
e.3. Triangle	<u>X</u>	<u>1-150 g</u>	<u>50 ms</u>
e.4. Trapezoidal	<u>X</u>	<u>1-150 g</u>	<u>35 ms</u>
e.5. Rectangle	<u>X</u>	<u>1-150 g</u>	<u>70 ms</u>
e.6. Sawtooth	<u>X</u>	<u>1-150 g</u>	<u> </u>
e.7. Other (indicate)	<u>COMPOUND</u>	<u>1-150 g</u>	<u> </u>
f. Repeatability			
f.1. Peak G	<u><1</u> %		
f.2. Peak Velocity	<u><1</u> %		
8. Instrumentation			
a. Number of Channels	<u>50</u>		
b. Frequency Response/Class	<u>10KHz</u>		
c. Method of recording			
c.1. Tape	<u>X</u>		
c.2. Chart	<u>X</u>		
c.3. Other (specify)	<u>DIGITAL</u>		
d. Method of Transmission			
d.1. Flying lead	<u>X</u>		
d.2. FM Transmission	<u>X</u>		
e. Accelerometers			
e.1. Types	<u>PIEZORESISTIVE</u>	<u>PIEZOELECTRIC</u>	<u>STRAIN GAUGE</u>
e.2. Dynamic Range	<u>250 g</u>	<u>250 g</u>	<u>250 g</u>
e.3. Frequency Range	<u>0-3KHz</u>	<u>0-3KHz</u>	<u>0-250 Hz</u>
e.4. Number			
e.4.a. on sled	<u>6</u>		
e.4.b. on subject/dummy	<u>9</u>		
f. Other Parameters Monitored:	<u>BELT LOADS, SLED VELOCITY, SEAT LOADS,</u> <u>BACKREST LOADS, SLED DISPLACEMENT, HIGH-SPEED PHOTOGRAPHY OF BODY SEGMENT</u> <u>MOTION</u>		

[illegible]

NOTE: TABLE 1.1 LIMITS OF LIABILITY. DATA GIVEN IS TYPICAL MAX. LIMITS. THE FOLLOWING CHARACTERISTICS ARE LIMITED BY THE FOLLOWING: (A) MAXIMUM AC VOLTAGE LIMITED BY MAXIMUM KINETIC ENERGY OF 250 KJ. (B) MAXIMUM AC CURRENT LIMITED BY MAXIMUM BREAKING FORCE OF 200 KN.

14-00000

Impact Test Facility Survey

11-74

1. Name and Address of Facility	<u>HORIZONTAL ACCELERATOR</u>																											
	<u>NAVAL AIR DEVELOPMENT CENTER</u>																											
	<u>WARRINGTON, VA 22094</u>																											
2. Name of Director/Manager	<u>WILLIAM TAYLOR/MARTIN SCHULMAN</u>																											
3. Date Facility became operational	<u>JANUARY 1974 (PLANNED)</u>																											
4. Principle of operation	<u>HYDRAULIC PRESSURE</u>																											
5. Main Use/Test Type	<u>TEST AIRCRAFT WING OF SEATING AIR</u>																											
	<u>RESEARCH STUDIES, IMPACT ATTACHMENTS</u>																											
	<u>DEVICES, CIRCUMFERENCE STUDIES,</u>																											
	<u>TRAILING AIRCRAFT SYSTEMS.</u>																											
6. Test Dates:																												
<u>yes</u> <u>no</u> Planned																												
7. Descriptive Details																												
a. Horizontal	<u>X</u>	c. Vertical																										
b. Track Length	<u>30.9 ft</u>	d. Tower Height																										
e. Load Characteristic	<table border="0"> <tr> <td>1. Load #1</td> <td>11</td> <td>Load #2</td> <td>11</td> <td>Load #3</td> </tr> <tr> <td>1.1. Weight (max)</td> <td><u>100,000 (2000 lb)</u></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1.2. Width (max)</td> <td><u>11.2 ft (41 in)</u></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1.3. Length (max)</td> <td><u>15.2 ft (12 ft)</u></td> <td></td> <td></td> <td></td> </tr> </table>			1. Load #1	11	Load #2	11	Load #3	1.1. Weight (max)	<u>100,000 (2000 lb)</u>				1.2. Width (max)	<u>11.2 ft (41 in)</u>				1.3. Length (max)	<u>15.2 ft (12 ft)</u>								
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1.3. Length (max)	<u>ALLOWANCE</u>																											
1.4. Range of orientation	<u>RANGE</u>																											
8. Performance Parameters																												
a. Acceleration	<u>240 G (5000 Lb/100 ft 1200 Lb(max))</u>	(min usable)																										
b. G-Force		(max)	(min usable)																									
c. Velocity	<u>30 ft/sec (100 ft/sec)</u>	(max)	(min usable)																									
d. Stroke	<u>1.5 ft (5 ft)</u>	(max)	(min usable)																									
e. Waveform: (Check all that Apply)	Range of Acceleration Duration																											
a.1. Sine																												
a.2. 1/2 Sine	<u>X</u>	<u>40 G</u>	<u>100 msec</u>																									
a.3. Triangle	<u>X</u>	<u>40 G</u>	<u>100 msec</u>																									
a.4. Trapezoidal	<u>X</u>	<u>40 G</u>	<u>100 msec</u>																									
a.5. Rectangular																												
a.6. Sawtooth																												
a.7. Other (indicate)	<u>DOUBLE HUMP</u>																											
f. Repeatability																												
1.1. Peak G	<u>± 0.5</u>																											
1.2. Peak Velocity	<u>± 0.5</u>																											
9. Instrumentation																												
a. Number of Channel	<u>2 (PLANNED)</u>																											
b. Frequency response/Channel	<u>1 KHz/1000</u>																											
c. Method of Recursion																												
c.1. Tape	<u>X</u>																											
c.2. Chart	<u>X</u>																											
c.3. Other (specify)																												
d. Method of Transduction																												
d.1. Piezo-electric	<u>X</u>																											
d.2. Strain Gage																												
d.3. Other (specify)																												
e. Acceleration																												
e.1. Type	<u>STRAIN GAGE</u>																											
e.2. Dynamic Range	<u>± 100 G</u>																											
e.3. Frequency Range	<u>0 TO 1000 Hz</u>																											
e.4. Sensor																												
e.5. Amplifier																												
e.6. Other (specify)																												
f. Other Parameters Monitored:	<u>PRESSURE, FORCE, DISPLACEMENT, HIGH SPEED PHOTOGRAPHY, ELECTRICAL MEASUREMENT</u>																											

DATASHEET

Input Test Facility Survey

ID #45

1. Name and Address of Facility		<u>RESEARCH SEAT TOWER</u>	
		<u>NAVY AIR DEVELOPMENT CENTER</u>	
		<u>WARRINGTON, PA 15074</u>	
2. Name of Director/Manager		<u>WILLIAM LAYMAN/CHIEF ENGINEER</u>	
3. Into Facility Include Operations		<u>Yes</u>	
4. Principle of operation		<u>FAULTING PRESSURE FOR PROPOSED</u>	
		<u>TESTING AND EVALUATION</u>	
5. Main Test/Type		<u>EJECTION SEAT, EJECTION SEAT</u>	
a. Man rated:		<u>YES</u>	
yes <u> </u> no <u> </u>		<u>ACCEPTANCE</u>	
6. Descriptive Details			
a. Horizontal	<u> </u>	c. Vertical	<u> X </u>
b. Track Length	<u> </u>	d. Tower Height	<u>40 ft</u>
e. Size Characteristics		1. Size #1 11 Size #2 11 Size #3 11	
e.1. Weight (max)		<u>1800 (150 lb)</u>	
e.2. Width (max)		<u>10.0 (8 ft)</u>	
e.3. Length (max)		<u>12.4 (10 ft)</u>	
f. Payload Characteristics		1. Size #1 11 Size #2 11 Size #3 11	
f.1. Weight (max)		<u>102.0 (800 lb)</u>	
f.2. Width (max)		<u>12.1 (10 ft)</u>	
f.3. Length (max)		<u>13.1 (10 ft)</u>	
f.4. Range of Orientation		<u>210 FIXED</u>	
7. Performance Parameters			
a. Acceleration	<u>30G</u> (max)	<u>4 G</u>	(min. desired)
b. Jerk	<u>3000 G/SEC</u> (max)	<u>30 G/SEC</u>	(min. desired)
c. Velocity	<u>22.9 ft/sec (75 ft/sec)</u> (max)	<u>7.0 ft/sec (25 ft/sec)</u>	(min. desired)
d. Stroke	<u>1.9 ft (6.2 ft)</u> (max)	<u>18 (5.5 ft)</u>	(min. desired)
e. Waveform: (Check all that Apply)		Range of Acceleration Duration	
e.1. Sine	<u> </u>	<u> </u>	<u> </u>
e.2. 1/2 Sine	<u> </u>	<u> </u>	<u> </u>
e.3. Triangle	<u> </u>	<u> </u>	<u> </u>
e.4. Trapezoidal	<u> X </u>	<u>40-50 G</u>	<u>10-500 msec</u>
e.5. Rectangle	<u> </u>	<u> </u>	<u> </u>
e.6. Sawtooth	<u> </u>	<u> </u>	<u> </u>
e.7. Other (indicate)	<u> </u>	<u> </u>	<u> </u>
f. Repeatability			
f.1. Load <u> </u>		<u> </u>	
f.2. Peak Velocity <u> </u>		<u> </u>	
8. Instrumentation			
a. Number of Channels	<u>25 (UP TO 14 ON MAGNETIC TAPE)</u>		
b. Frequency Response/Class	<u>1 Hz/1000</u>		
c. Method of Recording	<u> </u>		
c.1. Tape	<u> </u>		
c.2. Chart	<u> </u>		
c.3. Other (specify)	<u>OSCILLOGRAPH</u>		
d. Method of Transduction	<u> </u>		
d.1. Piezo Load	<u> </u>		
d.2. EM Transduction	<u> </u>		
e. Accelerometers	<u> </u>		
e.1. Type	<u>STRAIN GAGE</u>		
e.2. Dynamic Range	<u>±100 G</u>		
e.3. Frequency Range	<u>0 TO 750 Hz</u>		
e.4. Number	<u>2</u>		
e.5. on sled	<u> </u>		
e.6. on subject/dummy	<u> </u>		
9. Other Parameters Monitored: <u>PRESSURES, DISPLACEMENT, FORCE, MOTION</u>			
<u>HIGH SPEED PHOTOGRAPHY, BIOMEDICAL MONITORING, ANGULAR ROTATION</u>			

10-10-61

10-10-61 (10-10-61)

10-10-61

1. Name and Address of Facility	<u>ARMED & DANGEROUS</u>																																																						
2. Name of Director/Manager	<u>WILLIAM J. WATKINS, JR.</u>																																																						
3. Date of last major operation	<u>1960</u>																																																						
4. Principle of operation	<u>ABLE TO TEST OF CART BY TITAN, FRANK, STAIN</u>																																																						
5. Test Type	<u>TEST & EVALUATE CLASS PROTECTION</u>																																																						
6. Test Type	<u>TEST, EVALUATE CLASS PROTECTION</u>																																																						
7. Descriptive Detail	<table border="0"> <tr> <td>a. Horizontal</td> <td>b. Vertical</td> <td><u>X</u></td> </tr> <tr> <td>c. Shock Test</td> <td>d. Power Test</td> <td><u>NO</u></td> </tr> </table>			a. Horizontal	b. Vertical	<u>X</u>	c. Shock Test	d. Power Test	<u>NO</u>																																														
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10. Performance Parameters	<table border="0"> <tr> <td>a. Acceleration</td> <td><u>20</u></td> <td>(max)</td> <td><u>2 G</u></td> </tr> <tr> <td>b. Jolt</td> <td><u>1000 G/Sec</u></td> <td>(max)</td> <td><u>100 G/Sec</u></td> </tr> <tr> <td>c. Velocity</td> <td><u>25.9 in/Sec (25.9 ft/Sec)</u></td> <td>(max)</td> <td><u>1.5 in/Sec (1.5 ft/Sec)</u></td> </tr> <tr> <td>d. Stroke</td> <td><u>1.5 in (1.5 ft)</u></td> <td>(max)</td> <td><u>0.5 in (0.5 ft)</u></td> </tr> <tr> <td>e. Waveform: (Check all that Apply)</td> <td colspan="2">Range of</td> <td>Duration</td> </tr> <tr> <td></td> <td colspan="2">Acceleration</td> <td>Duration</td> </tr> <tr> <td>e.1. Sine</td> <td><u>---</u></td> <td><u>---</u></td> <td><u>---</u></td> </tr> <tr> <td>e.2. 1/2 Sine</td> <td><u>---</u></td> <td><u>---</u></td> <td><u>---</u></td> </tr> <tr> <td>e.3. Triangle</td> <td><u>---</u></td> <td><u>---</u></td> <td><u>---</u></td> </tr> <tr> <td>e.4. Trapezoidal</td> <td><u>---</u></td> <td><u>---</u></td> <td><u>---</u></td> </tr> <tr> <td>e.5. Rectangle</td> <td><u>---</u></td> <td><u>---</u></td> <td><u>---</u></td> </tr> <tr> <td>e.6. Sawtooth</td> <td><u>---</u></td> <td><u>---</u></td> <td><u>---</u></td> </tr> <tr> <td>e.7. Other (indicate)</td> <td><u>---</u></td> <td><u>---</u></td> <td><u>---</u></td> </tr> </table>			a. Acceleration	<u>20</u>	(max)	<u>2 G</u>	b. Jolt	<u>1000 G/Sec</u>	(max)	<u>100 G/Sec</u>	c. Velocity	<u>25.9 in/Sec (25.9 ft/Sec)</u>	(max)	<u>1.5 in/Sec (1.5 ft/Sec)</u>	d. Stroke	<u>1.5 in (1.5 ft)</u>	(max)	<u>0.5 in (0.5 ft)</u>	e. Waveform: (Check all that Apply)	Range of		Duration		Acceleration		Duration	e.1. Sine	<u>---</u>	<u>---</u>	<u>---</u>	e.2. 1/2 Sine	<u>---</u>	<u>---</u>	<u>---</u>	e.3. Triangle	<u>---</u>	<u>---</u>	<u>---</u>	e.4. Trapezoidal	<u>---</u>	<u>---</u>	<u>---</u>	e.5. Rectangle	<u>---</u>	<u>---</u>	<u>---</u>	e.6. Sawtooth	<u>---</u>	<u>---</u>	<u>---</u>	e.7. Other (indicate)	<u>---</u>	<u>---</u>	<u>---</u>
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HATO/AGARD

Impact Test Facility Survey

ID #45

1. Name and Address of Facility SOUTHWEST RESEARCH INSTITUTE
6220 CULEBRA ROAD
P.O. DRAWER 28510
SAN ANTONIO, TX 78284
2. Name of Director/Manager GERALD D. DRISCOLL
3. Date Facility became operational JANUARY 1972
4. Principle of Operation REBOUND, BUNGEE CORDS
5. Main Use/Test Type EVALUATION OF AUTOMOTIVE AIRBAG AND
BELT TYPE RESTRAINT SYSTEMS
- a. Man Rated:
yes X no
6. Descriptive Details
- | | | | |
|-----------------|--------------|-----------------|-------------|
| a. Horizontal | <u>X</u> | c. Vertical | <u> </u> |
| b. Track Length | <u>11.9m</u> | d. Tower Height | <u> </u> |
- e. Sled Characteristics
- | | | | |
|-------------------|--------------------|--------------------|--------------------|
| | <u>[Sled #1]</u> | <u>[Sled #2]</u> | <u>[Sled #3]</u> |
| e.1. Weight (max) | <u>850 lbs</u> | <u> </u> | <u> </u> |
| e.2. Width (max) | <u>4 ft</u> | <u> </u> | <u> </u> |
| e.3. Length (max) | <u>6 ft</u> | <u> </u> | <u> </u> |
- f. Payload Characteristics
- | | | | |
|---------------------------|---------------------|--------------------|--------------------|
| | <u>[Sled #1]</u> | <u>[Sled #2]</u> | <u>[Sled #3]</u> |
| f.1. Weight (max) | <u>4000 lbs</u> | <u> </u> | <u> </u> |
| f.2. Width (max) | <u>~10 ft</u> | <u> </u> | <u> </u> |
| f.3. Length (max) | <u>~12 ft</u> | <u> </u> | <u> </u> |
| f.4. Range of Orientation | <u>[0-360° yaw]</u> | <u> </u> | <u> </u> |
- with an adjustable turntable
7. Performance Parameters
- | | | |
|--------------------------------|------------------------|-----------------------------|
| a. Acceleration | <u>60 g</u> (max) | <u>~.5 g</u> (min usable) |
| b. Jolt | <u>~6000 g/s</u> (max) | <u>~50 g/s</u> (min usable) |
| c. Velocity | <u>70 mph</u> (max) | <u>~1 mph</u> (min usable) |
| d. Stroke (Rebound Programmer) | <u>19.75 in</u> (max) | <u>~.5 in</u> (min usable) |
- e. Waveform: (Check all that Apply)
- | | Range of Acceleration | Duration |
|-----------------------|--|------------------|
| e.1. Sine | <u>X</u> <u>.5-60 g</u> | <u>34-375 ms</u> |
| e.2. 1/2 Sine | <u>X</u> <u>.5-60 g</u> | <u>34-375 ms</u> |
| e.3. Triangle | <u>X</u> <u>.5-60 g</u> | <u>34-375 ms</u> |
| e.4. Trapezoidal | <u>X</u> <u>.5-60 g</u> | <u>34-375 ms</u> |
| e.5. Rectangle | <u>X</u> <u>.5-60 g</u> | <u>34-375 ms</u> |
| e.6. Sawtooth | <u> </u> <u>.5-60 g</u> | <u>37-400 ms</u> |
| e.7. Other (indicate) | <u>A VARIETY OF SYMMETRICAL BASICALLY GEOMETRICAL WAVEFORMS ARE POSSIBLE</u> | |
- f. Repeatability
- | | |
|--------------------|------------|
| f.1. Peak G | <u>2</u> % |
| f.2. Peak Velocity | <u>4</u> % |
8. Instrumentation
- a. Number of Channels 28
- b. Frequency Response/Class UP TO 5 KHz-SELECTIVE ANALOG FILTERING IS ACCOMPLISHED AS DATA IS TAKEN OFF ANALOG TAPE RECORDERS
- c. Method of recording
- | | |
|----------------------|-------------------------------------|
| c.1. Tape | <u>ANALOG AND DIGITAL RECORDERS</u> |
| c.2. Chart | <u>LIGHT BEAM OSCILLOGRAPH</u> |
| c.3. Other (specify) | <u> </u> |
- d. Method of Transmission
- | | |
|----------------------|-------------------------------------|
| d.1. Flying lead | <u>X</u> <u>(UNBELICAL TO SLED)</u> |
| d.2. FM Transmission | <u> </u> |
- e. Accelerometers - ENDEVCO PIEZORESISTIVE
- | | | | |
|-------------------------|--------------------|--------------------|-------------------|
| e.1. Types | <u>2264-2000</u> | <u>7264-2000</u> | <u>2260-250</u> |
| e.2. Dynamic Range | <u>-2000-2000G</u> | <u>-2000-2000G</u> | <u>-2500-250G</u> |
| e.3. Frequency Range | <u>0-5 KHz</u> | <u>0-5 KHz</u> | <u>0-2 KHz</u> |
| e.4. Number | <u> </u> | <u> </u> | <u> </u> |
| e.4.a. on sled | <u>2</u> | <u> </u> | <u> </u> |
| e.4.b. on subject/dummy | <u>UP TO 24</u> | <u> </u> | <u> </u> |

f. Other Parameters Monitored: TYPICALLY: SLED VELOCITY; RESTRAINT SYSTEM LOADS, PRESSURES, STRAIN; DUMMY FEMUR LOADS, LIVE SUBJECT ECG AND BLOOD PRESSURE; AND TIMES OF SPECIFIED EVENTS.

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The author has up-dated AGARD Report No.658 "A Catalogue of Current Impact Devices" to include new/revised facilities, has presented research procedures in use at each facility and described the personnel capabilities available. The information about each facility has been obtained largely from inputs completed by the establishments concerned, technical reports, previous listings and personal visits. This AGARDograph will be useful to programme managers and scientists of the aerospace medical and biodynamic community who wish to be aware of test facilities currently in use at NATO research establishments. This document is published by the AGARD Aerospace Medical Panel.			

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