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Final Report

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US Department of Transportation
National Highway Traffic Safety Administration

VALIDATION OF THE CRASH VICTIM SIMULATOR
Volume III: User's Manual

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16. Abstract

A combined analytical and experimental research project was carried out to develop and examine the validity of an improved version of the computer program used to simulate the three-dimensional dynamic gross motion responses of motor vehicle crash victims. Among the improvements incorporated in the new (CVS-IV) version of the program are a more efficient integration technique, a routine to automatically position a seated occupant in equilibrium, and modifications of the input and output control routines that make it easier to use the program. Measurements of a Part 572 50th percentile male anthropomorphic dummy were made to define an input data set for a simulation model of the dummy. Dynamic pendulum impact tests of dummy sub-assemblies were performed and modeled with the computer program. Detailed comparisons of predicted system responses with those measured in special impact sled tests of the dummy restrained by a three-point restraint belt and by a pre-inflated air bag are also presented.

Results of the project are documented in four manuals as follows:

Volume 1 - Engineering Manual - Part I: Analytical Formulation
Volume 2 - Engineering Manual - Part II: Validation Effort
Volume 3 - User's Manual
Volume 4 - Programmer's Manual

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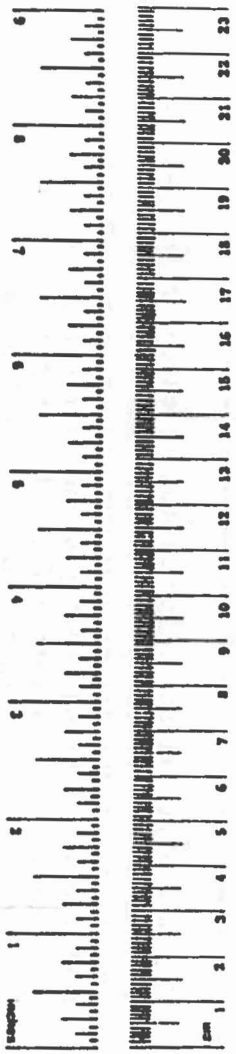
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

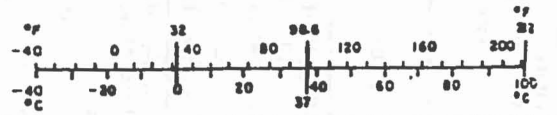
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



FOREWORD

This document is one of four manuals that constitute the final report of the research project conducted under Contract No. DOT-HS-6-01300 for the National Highway Traffic Safety Administration. Dr. John T. Fleck and Mr. Frank E. Butler of J & J Technologies, Inc. served as Principal Investigator and Project Engineer, respectively, during their earlier tenure as members of the Calspan Transportation Research Department. Subsequently, Mr. Norman J. DeLeys coordinated the efforts of Calspan and J & J Technologies, Inc., who was retained as a subcontractor to maintain the continuity necessary in preparation of the report.

The Contract Technical Monitor for this project was Dr. Lee Ovenshire of the National Highway Traffic Safety Administration.

This report has been reviewed and approved by:

Anthony L. Rússo, Head
Transportation Research Department

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

In 1970 Calspan Corporation (formerly Cornell Aeronautical Laboratory, Inc.) began development of a mathematical model for simulating the three-dimensional dynamic responses of a motor vehicle crash victim. Under the joint sponsorship of the Motor Vehicle Manufacturers Association (MVMA) and the National Highway Traffic Safety Administration (NHTSA), the original development and validation of the progrm was accomplished in two phases (Ref. 1 and 2). Except for a special version of the Phase II crash victim simulation (CVS) program created for the MVMA (Ref. 3), the next major developmental effort was accomplished for the NHTSA and resulted in what was designated as the CVS-III computer program (Ref. 4).

Recognizing the CVS-III as a potentially valuable tool for aiding studies of crew member dynamics during ejection from high-speed aircraft, the Air Force Aerospace Medical Research Laboratory (AFAMRL) sponsored the development of a special version of the program that formed the basis of the AFAMRL "Articulated Total Body" model or ATB (Ref. 5). Later, the ATB model was updated and some new features were added under another contract with the AFAMRL (Ref. 6).

This report documents work performed in the research project entitled "Validation of the Crash Victim Simulator" under Contract No. DOT-HS-6-01300 with the NHTSA which states the general objective as "the development of the CVS to a level that it can be used for a variety of rulemaking activities". A significant goal was "to conduct studies that specifically, quantitatively and validly pertain to the Part 572 dummy in several realistic crash safety compliance test situations". The project consisted of two principal areas of effort: (1) further development, improvement and refinement of the computer program, culminating in a version designated as the CVS-IV, and (2) the performance of detailed measurements and tests to define inputs for modeling the 50th percentile male dummy conforming to government specifications (Ref. 7) and executing computer simulations of experiments performed with the dummy to examine the validity of the model results.

The CVS-IV version of the computer program incorporates many modifications and features developed in this project as well as in conjunction with other closely related research studies (e.g., Ref. 5, 6 and 8). Among the improvements implemented in the CVS-IV are the following:

- a new, more efficient integration technique.
- a routine to automatically position a seated occupant in equilibrium.
- an advanced harness belt formulation that treats interaction of belts connected at a common junction point, belt slippage on deformable segments, and allows use of rate-dependent functions for calculation of belt forces.
- simulation of aerodynamic forces acting on body segments that may be partially shielded.
- improved routines for calculating joint torques.
- use of the main program integrator for computing vehicle and air bag motions.
- the ability to specify the motion of as many as six segments.
- a provision to account for segment principal axes that are not coincident with geometric axes, thereby allowing use of any convenient geometric axis system as the reference for segment input data.
- generality in specifying axes about which segments are rotated, and the sequence of rotations, to achieve a desired initial orientation.
- elimination of the need for multiple output units.
- routines for computing injury criteria values (HIC, HSI, and CSI) and for plotting any output variable(s) against any other variable or time.

During the course of the present study, several interim versions of the computer program were distributed to numerous users throughout the world. However, it should be noted that the modifications of each version were incorporated in such a way that, in most instances, input data decks remained upward compatible and useable with successive versions of the program.

The final report of this project is composed of four volumes:

Volume 1 - Engineering Manual - Part I: Analytical Formulation

Volume 2 - Engineering Manual - Part II: Validation Effort

Volume 3 - User's Manual

Volume 4 - Programmer's Manual

Volume 1 describes the analytical formulations, assumptions and the detailed development of the mathematical equations and relations used in the program.* Volume 2 documents the measurement of the dummy geometric, inertial and joint characteristics and experiments performed to validate computer models of the physical systems tested. The experiments simulated include static tests of an ellipsoidal air bag to check the validity of the idealized bag shape and force algorithms, dynamic pendulum impact tests of dummy component sub-assemblies, and impact sled tests in which the dummy was restrained by an air bag and a three-point belt restraint system (Ref. 9). The third volume provides instruction on how to use the program. Besides giving a detailed description of all data furnished on each input card, it explains the special input and output features and provides examples of program applications along with the Job Control Language needed to execute a simulation run. Volume 4 is intended primarily for use by programmers interested in the detailed structure of the program. Included in Volume 4 are descriptions of each subroutine, cross reference charts showing the subroutines called by other subroutines, labeled common blocks used by each subroutine and usage of each variable in the labeled common blocks in every subprogram, and a complete listing of the computer Fortran source deck.

*See also References 5 and 6 which document the analytical formulation of some algorithms and features not described in detail herein.

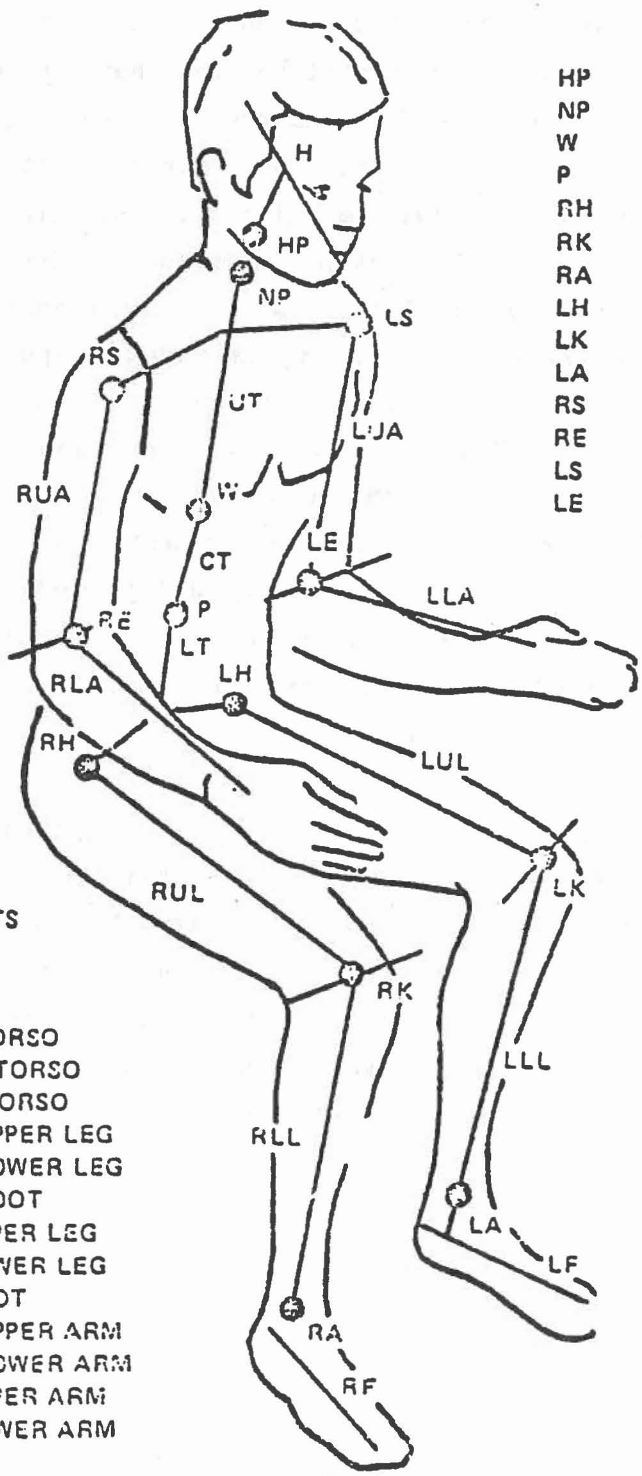
2.0 GENERAL CONSIDERATIONS

The Calspan three-dimensional Crash Victim Simulation (CVS) program is primarily designed to evaluate the interactions of a parametrically described body model with its crash environment. However, due to the generality of many of the program features, it is adaptable to many other physical dynamic situations as well. These same generalities have caused the application of the CVS program to appear to be overly complex to the uninitiated user. The purpose of this discussion is to present some of those program features that should be mastered to utilize the CVS program in body model - crash environment simulations.

2.1 Body Segment Connectivity

The first consideration is a description of the body model. This consists of subdividing the crash victim body into segments that are connected by joints. Both the number of body segments (NSEG) and the number of joints (NJNT) are input parameters to the program (input Card B.1), thereby giving the capability of varying the body model structure dependent upon the nature of the simulation. Figure 2.1 depicts a "standard" 15 segment model with 14 joints that is applicable to most seated occupant simulations, but it is advisable to add two more segments and joints (for the hands and connecting wrists) for pedestrian simulations to accomodate the initial contacts of the hands with the hood of the impacting vehicle.

The body segments and joints are assigned identification numbers, i = 1 to NSEG for the segments and j = 1 to NJNT for the joints. The assignment of the identification numbers is somewhat but not completely arbitrary. They are used along with the one-dimensional array, JNT(j) for j = 1 to NJNT, to define the connectivity of the segments by the joints. First, a base or reference segment is chosen as segment No. 1 which may be any of the segments. During the initial development of the CVS program, it seemed logical to assign the Head as segment No. 1, but, due to the effect



JOINTS

HP	HEAD PIVOT
NP	NECK PIVOT
W	WAIST
P	PELVIS
RH	RIGHT HIP
RK	RIGHT KNEE
RA	RIGHT ANKLE
LH	LEFT HIP
LK	LEFT KNEE
LA	LEFT ANKLE
RS	RIGHT SHOULDER
RE	RIGHT ELBOW
LS	LEFT SHOULDER
LE	LEFT ELBOW

SEGMENTS

H	HEAD
N	NECK
UT	UPPER TORSO
CT	CENTER TORSO
LT	LOWER TORSO
RUL	RIGHT UPPER LEG
RLL	RIGHT LOWER LEG
RF	RIGHT FOOT
LUL	LEFT UPPER LEG
LLL	LEFT LOWER LEG
LF	LEFT FOOT
RUA	RIGHT UPPER ARM
RLA	RIGHT LOWER ARM
LUA	LEFT UPPER ARM
LLA	LEFT LOWER ARM

Figure 2.1 BODY DYNAMICS MODEL

of the erratic accelerations of the Head on the behavior of the program integrator, it proved to be more beneficial to use a heavier nonextremity segment, hence the choice of the Lower Torso as the reference segment No. 1. Now one has the choice of assigning either the Pelvis, Right Hip or Left Hip as joint No. 1. Choosing the Pelvis as joint No. 1 stipulates that the Center Torso must be assigned as segment No. 2 since the Center Torso is connected to the Lower Torso by the Pelvis joint. This connectivity is established within the program by specifying as input (input Cards B.3) JNT(1) = 1. In general, JNT(j) = i specifies that joint No. j connects segment No. j+1 to segment No. i. Successive segment and joint identification numbers are assigned with the proviso that each new segment assigned be connected to a previously assigned segment (the corresponding restriction within the program is that the value of JNT(j) must be less than or equal to j). Continuing this process produces the identification and connectivity assignments of Table 2.1 as one possible arrangement. Obviously, this arrangement is not unique.

The restriction, JNT(j) $\leq$ j, allows for the possibility of specifying JNT(j) = 0. The CVS program utilizes this concept to signify that joint No. j will be a null joint and that segment No. j+1 will be the reference or base segment of another body. This permits the specification of multiple bodies that remain disconnected. However, one must be careful not to exceed the maximum number of segments or joints specified by the dimension statements of the compiled program variables. Currently this maximum is 30.

i	Segment Name	Symbol	j	Joint Name	Symbol	JNT(j)	Connects
1	Lower Torso	LT	1	Pelvis	P	1	LT - CT
2	Center Torso	CT	2	Waist	W	2	CT - UT
3	Upper Torso	UT	3	Neck Pivot	NP	3	UT - N
4	Neck	N	4	Head Pivot	HP	4	N - H
5	Head	H	5	Right Hip	RH	1	LT - RUL
6	Right Upper Leg	RUL	6	Right Knee	RK	6	RUL - RLL
7	Right Lower Leg	RLL	7	Right Ankle	RA	7	RLL - RF
8	Right Foot	RF	8	Left Hip	LH	1	LT - LUL
9	Left Upper Leg	LUL	9	Left Knee	LK	9	LUL - LLL
10	Left Lower Leg	LLL	10	Left Ankle	LA	10	LLL - LF
11	Left Foot	LF	11	Right Shoulder	RS	3	UT - RUA
12	Right Upper Arm	RUA	12	Right Elbow	RE	12	RUA - RLA
13	Right Lower Arm	RLA	13	Left Shoulder	LS	3	UT - LUA
14	Left Upper Arm	LUA	14	Left Elbow	LE	14	LUA - LLA
15	Left Lower Arm	LLA					

TABLE 2.1: Segment and Joint Assignments and Connectivity

2.2 Reference Coordinate Systems

The CVS program utilizes many reference coordinate systems that are used to locate points within the program. Dependent upon the immediate application, it is usually advantageous to operate within a particular coordinate system by which it is easiest to locate the points involved. As a result, the program and the input description (Section 4.0) may specify the inertial, vehicle, local body segment or joint reference coordinate systems. Each reference coordinate system requires an origin, an assumed frame of reference denoted by the directions of an orthogonal set of X, Y and Z axes, and a direction cosine matrix (usually initially specified by three rotation angles, yaw, pitch and roll) which relates one reference coordinate system with respect to another.

2.2.1 Inertial Reference Coordinate System

The CVS program assumes that the coordinates of the origin of the inertial reference coordinate are zero which the user may equate to any convenient point from which his data are referenced. The frame of reference is arbitrary and is partially specified by defining which way is down by the values supplied for the components of the gravity vector on input Card A.3. It has been customary to supply (zero, zero, g) as these components to specify that the positive Z axis is pointing downward. Then by assuming that the positive X axis is pointing forward stipulates (by the right hand rule) that the positive Y axis points to the right. However, the user may specify any frame of reference that suits his application, one with which he is more familiar, or one by which his input data has been measured.

Sometimes it is necessary that contact surfaces (planes or ellipsoids) be located with respect to the inertial reference coordinate system, e.g., the ground for pedestrian simulations. Since the program assumes that contact surfaces are associated with segments, a special segment identification number (NGRND) is used within the program for this purpose.

NGRND is the largest segment number used by the program and is assigned the value NGRND = NSEG + NBAG + 2. The linear position and velocity for this artificial segment are initially set to zero and its direction cosine matrix to the identity matrix, but, since its motion is not computed by the program integrator, these parameters remain constant throughout the duration of the program. This permits the assignment of segment No. NGRND by the contact subroutines identical to the use of other segments.

2.2.2 The Vehicle Reference Coordinate System

This reference coordinate system is very important for much of the input and output of the CVS program. Most of the contact panels are defined with respect to this system and much of the output (printer plots and tabular time histories) is produced with respect to this system to correspond with photographs and drawings of the vehicle. Its origin is arbitrary, and any convenient reference point may be chosen for which input and output data would be most meaningful. The location of the vehicle origin with respect to the inertial reference coordinate system origin is specified by XO on input Card C.2. Again, the frame of reference (the directions of the positive X, Y and Z axes) is arbitrary and should be chosen to accommodate available input data. The initial velocity and direction cosine matrix are determined from the options available to specify the vehicle motion on the input C cards to relate this frame of reference to the inertial frame of reference.

Since the vehicle motion is now computed by the program integrator, the accelerations, computed from the options available on the input C cards, must relate to the chosen vehicle origin in its frame of reference. Again, a special segment identification number (NVEH) is assigned for the vehicle, where NVEH = NSEG + 1, so that the vehicle may be treated like other segments for segment assignments by the contact subroutines. However, any forces and torques computed to act on this segment by the contact subroutines are ignored, since its motion is specified.

2.2.3 Body Segment Local Reference Coordinate Systems

It is advantageous to supply the input for body segment parameters in the local reference coordinate systems of the individual body segments. Also, it is convenient for the computer program itself to operate in these same reference systems for the various contact subroutines. Because of the mathematical formulation of the equations of motion used within the program, it is necessary that the origin of the body segment local reference coordinate systems be the center of gravity for each of the body segments. Here it is convenient to use as a frame of reference, a geometric reference coordinate system to facilitate input data measurements. To date, most body model inputs have been made for a standing body, with the positive Z axis pointing downward along the long bones of applicable segments, the positive X axis pointing forward and the positive Y axis to the right, to correspond with the inertial reference coordinate system. Since the program operates basically in the inertial reference coordinate system, it is necessary that a direction cosine matrix be maintained for each segment to relate the body segment reference coordinate system to it.

One of the underlying assumptions made during the early development of the CVS program was that the geometric reference coordinate system coincided with the principal moment of inertia reference coordinate system, i.e., the nondiagonal elements of the inertia matrix are zero. However, it became obvious from the data collected for the Alderson Part 572 Dummy that this was an incorrect assumption due to the nonsymmetry and nonhomogeneity of many of the body segments. Since it is convenient for input and output to be with respect to the geometric reference coordinate system, the CVS program optionally accepts as input (so as not to invalidate previous input decks) the rotation angles (yaw, pitch and roll) of the principal moment of inertia reference coordinate system with respect to the geometric reference coordinate system (input Cards B.2.i2) and operates internally in the principal moment of inertia reference coordinate system. This requires that the CVS program convert all data points expressed in the local segment reference coordinate system after input and prior to output. This is done in a manner that is transparent to the user. This is analogous to the concept that all angular data is currently expressed in degrees for input and output but is expressed in radians internally in the program. Therefore, when the input description (Section 4.0) refers to local body segment reference, the geometric, and not the principal moment of inertia reference coordinate system is implied.

2.2.4 Joint Reference Coordinate Systems

This is perhaps the most complicated and least understood reference coordinate system used by the CVS program. Because of the mathematical formulations used by the joint force and torque computation subroutines within the program, it is necessary to define a principal axis system for each joint with respect to both body segments that are connected by the joint. As described above, these two body segments are identified as segments Nos. JNT(j) and j+1 for joint No. j. The origin of each joint reference coordinate system (or the location of the joint) is specified by the values for SR on input Cards B.3.j1 in the local body segment reference coordinate systems for both segment Nos. JNT(j) and j+1. The orientation of the principal axis system is specified by rotation angles (yaw, pitch and roll) from the frame of reference for both of these segments as YPR1 and YPR2 on input Cards B.3.j2.

Joint forces and torques are computed by the CVS program as a function of angular rotation deviations from this defined principal axis system that are caused by angular rotations of the adjacent segments for each joint. Thus, data points measured in the joint reference coordinate systems are not linear coordinates in an orthogonal X, Y and Z axes system, but rather one, two or three rotation angles dependent on the type (pinned, ball and socket or Euler) of the joint. The reader is directed to Volume I of this series of reports for a more comprehensive description of the joint types.

2.3 Body Segment Positions

Using the above stated concepts, enough information is available to compute the position of each body segment in the inertial reference coordinate system provided that the location of the first (base or reference) segment and the angular orientation of each segment is known.

2.3.1 The Chain routine

Since the location of each joint has been defined with respect to both of the adjacent segments that it connects, it can be expressed in the inertial reference coordinate system in two different ways using the available information for each of the adjacent segments. The CVS program assumes that the segments are rigidly connected at the joints, i.e., they do not pull apart, hence these two expressions may be equated to give the vector relationship

$$z_i + D_i^T r_{j,i} = z_{j+1} + D_{j+1}^T r_{j,j+1}$$

where z_k is a vector from the origin of the inertial reference coordinate system to the c.g. of segment No. k,

D_k is the direction cosine matrix for segment No. k,

$r_{j,k}$ is a vector from the c.g. of segment No. k to joint No. j whose components are expressed in the local reference coordinate system of segment No. k,

and $i = JNT(j)$

The above formula can thus be used to solve for the location of each succesive segment from that of the previously defined segments. These computations are performed by Subroutine CHAIN of the CVS program.

2.3.2 Initial Segment Position Input

The input for the CVS program requires the initial position of the c.g. of the base or reference segments expressed in the inertial reference coordinate system (input Cards G.2.i) and the initial rotation angles that relate the frame of reference of each local body segment to the inertial reference coordinate system (input Cards G.3.i). This scheme can be rather difficult to use for initial positioning. For example, one may want the body to be seated in a seat with his feet on the floor or toeboard of the vehicle. Lengthy hand computations are required to achieve the desired initial body configuration. It is best to let the CVS program itself do these computations by running the program for time zero only. This can be done by setting NSTEPS (input Card A.4) to zero, and by supplying a nonzero value for NPRT(3) (input Card A.5), a tabular printout of all of the external forces and torques and resulting linear and angular positions and accelerations is produced for time zero. This procedure may require several iterations to insure that the body is in static equilibrium with its environment which is determined by the absence of large accelerations for any of the body segments. If only a few initial positions are to be required by the user, the effort spent is worthwhile to familiarize him with the program and check out his input, but it can be exceedingly frustrating.

For the case of the standing pedestrian, these computations are somewhat simplified. Once the complete input data deck has been established, it may be executed for time zero only as described above. From the tabular time history of the feet-ground contacts, the penetration of the feet into the ground or the distance that it misses contacting the ground (as indicated by a negative penetration) can be determined. From the supplied force deflection function for this contact, the penetration can be determined such that the total contact forces will equal the total body weight. This difference in penetrations can then be added to the vertical component of the initial position of the reference segment. Rerun the program again for time zero and observe the results. True equilibrium probably will not be established due to joint forces and torques produced and the fact that it is impossible to balance the body with a single contact of each foot with the ground. However, any small accelerations that still exist will have little effect once contact with the impacting vehicle is made.

2.3.3 The Equilibrium Routine

However, the initial positioning of a seated occupant is much more difficult. For example, it is difficult to estimate the required change in pitch of the leg segments to produce the proper penetration of the feet with the floor and toeboard. Also, it is difficult to predict the effect of changing the result of more than one contact due to the complicated geometry of the body segments. Ideally, one would like to achieve an initial position such that all body segment accelerations (both linear and angular) are zero (or equal to those of the vehicle). In order to achieve this, it is necessary to not only determine satisfactory geometric positions, but also to impose certain constraints (locked joints, rolling-sliding constraints, etc.) that are available within the CVS program. In addition, the final answers are not unique as demonstrated by the fact that one need not always sit the same way in an automobile.

Subroutine EQUILB has been incorporated into the CVS program to assist the user to achieve equilibrium of the initial body segments. It has been designed in a general manner to solve any equilibrium problem, but is exceedingly complex to use. The input description (Section 4.0) describes under input Cards G.4, G.5 and G.6 a procedure designed at Calspan that produces equilibrium (zero accelerations on all body segments) for a typical seated occupant configuration. It utilizes a multiple iteration procedure that simulates the adjustments a body makes to comfortably seat himself inside an automobile configuration. It is suspected that the resulting configuration is unique, for the set of specified contact forces desired (the values for GX on input Card G.5). To adapt this procedure to other configurations, it is necessary that the body segments are not either over or under constrained as determined by the contacts allowed, locked joints and the imposition of rolling and sliding constraints. Obviously, supplying the proper input for the general case is not a simple matter, but following the instructions described in the input description should greatly assist the initial positioning for the seated occupant in a standard automobile compartment configuration.

2.4 Time and Output Control of CVS Program

One important item that must be established by the input to the CVS program are the time control parameters required. These parameters control (1) the length (simulation time) of the run, (2) amount and format of the output, primarily the tabular time histories, and (3) efficient operation of the program integrator. Although the program places no restrictions on these input parameters, a judicious choice of the parameters can prove beneficial in achieving the above objectives.

The primary control of time is performed by the Main Program of the CVS program. Here, after all input and initialization is performed, time is advanced in steps of DT seconds by calling the program integrator. After each DT time step, control is returned to the main program where the print indicators NPRT(1) thru NPRT(7) are tested to perform the optional outputs (output unit No. 1, printer plots, restart output unit, Subroutine ELTIME and Subroutine PRINT) described in Section 5.0. This is done for time zero and at each integral (one to NSTEPS) multiple of DT seconds of simulation time. The total simulation time is therefore NSTEPS*DT seconds where NSTEPS and DT are input parameters specified on input Card A.4. The values of NSTEPS and DT should therefore be chosen as determined by the desired amount and frequency of these optional output items .

A secondary control of time is performed by the program integrator (Subroutine DINT) for each of the DT time steps. This is controlled by the supplied values for H0, HMIN and HMAX on input Card A.4. The integrator advances time in substeps of H seconds which is allowed to vary between HMIN and HMAX. Optimally, the value of H will be HMAX for most of the CVS run, but H is halved when convergence of the integrator parameters is not achieved and H is not permitted to become less than HMIN. Although not required, it is best that DT be an integer multiple of HMAX so that the DT time step will be executed in equal HMAX substeps during periods of stable activity. Also, since the value of H is permitted to double during these stable periods or be halved during unstable periods, the integrator will execute more efficiently if HMAX is a power of two multiple of HMIN. The supplied value for H0 is the initial integration step size. The integrator has difficulty getting started without past history. Again, it is best for HMAX to be a power of two multiple of H0.

It has been observed that suitable values for HMAX lie between one and five msec for most occupant and pedestrian simulations. The value chosen is mostly determined by the economics of the computer charges and scheduling problems encountered by a large estimated computer run time. Choosing a value for HMAX that is large can cause the integrator to halve the step size many more times than is necessary. The additional effort required by the program can be more expensive than that for a smaller value of HMAX. Calspan has observed that values for DT of 0.004, 0.010 or 0.020; HMAX of 0.001 or 0.002; and HMIN and H0 of 0.000125 or 0.000250 seconds have performed satisfactorily. If one desires a value of 0.005 seconds for DT, HMAX could be specified as 0.001 (with HMIN and H0 equal to 0.000125 or 0.000250) or 0.0025 (with HMIN and H0 equal to 0.0003125 or 0.000625) seconds. It is possible to execute the integrator in a "fixed step mode" by setting HMAX = HMIN = H0, but this is not recommended.

One other input parameter is worth mentioning here, namely NDINT on input Card A.4. The integrator basically performs NDINT iterations of functional evaluations at both the midpoint (TIME + H/2) and endpoint (TIME + H) of the current time substep with convergence being tested after each endpoint evaluation. Although some writers have suggested that only one is necessary for the value of NDINT, Calspan has observed that an even number is desirable (because of the behavior of the integrator) and that extra evaluations in an attempt to achieve convergence is less costly than permitting the integrator to halve the time step. Therefore, Calspan strongly recommends a value of 4 or 6 for NDINT.

The above discussion of CVS program time points was presented to clarify the problems that a user may encounter in trying to specify the line and paging formats of the tabular time history output as described in Section 5.2. These tabular time histories are the most important and useful output of the CVS program. Although two methods are available to generate them, the recommended method is the one that stores the time history data on output unit No. 8 and produces the printed tabular time histories at the end of the program by Subroutine POSTPR. (This method is controlled by the supplied value of NPRT(4) on input Card A.5.)

These tabular time histories are printed 45 lines per page. Each line represents a time point. Three types of time points are possible as determined by the supplied value of NPRT(26) on input Card A.5. They are (1) at DT time steps (default) specified by NPRT(26) = 0 , (2) at the completion of each successful integration step (H) specified by NPRT(26) = 1, or (3) at each midpoint and endpoint evaluation of every integration step (recommended for diagnostic purposes only) specified by NPRT(26) = 2. If one uses the default option (NPRT(26) = 0), he should consider the effect of the total simulation time (NSTEPS*DT) on the format of his printed tabular time histories. For example, a 100 msec run specified by 10*0.010 seconds would produce only eleven lines of output (time zero always produces an extra line) which may not present sufficient information. On the other hand, specifying 100 msec by 50*0.002 seconds would produce 51 lines, six of which would be on a second page for each time history. Calspan has found it convenient to specify a 200 msec run by 40*0.005 seconds. Using the option NPRT(26) = 1 has the disadvantages that the printed lines represent unequal time steps and can produce lengthy time histories.

2.5 Input Units for the CVS Program

One of the unique features of the CVS program is the capability to specify the measurement units to be used for both the input and output of the program. This is accomplished by supplying the alphanumeric names or abbreviations for the units of force (UNITM), distance (UNITL) and time (UNITT) on input Card A.3. These input parameters are used to annotate the output of the program including the listing of the input on the primary output file. At the time of the initial stages of development, it was decided to use pounds, inches and seconds as the "standard" units of measurements for the CVS program because most data available at that time were in these units. As a result, the input description (Section 4.0) uses these as examples of the units required for each of the input parameters. Also, the format (field width and number of digits following the decimal point) for various output items were established assuming these units.

It will be observed that mass units are not required for input and output purposes although they are assumed internally by the program. This is accomplished by supplying the weight of the body segments (W(i) on input Cards B.2.i1) using the force units. The program converts these input values to mass units (comparable to slugs except that the distance unit is inches) by dividing these force units by the value of the acceleration due to gravity. Unfortunately, an inconsistency was introduced during the early development of the program for the input units required for the principal moments of inertia (PHI(j,i) for j = 1 to 3 on input Cards B.2.i1). In retrospect, their units should have been weight (force) times distance squared, and the input values later divided by the acceleration due to gravity as is done for the segment weights. As the input is now established, the required units for these principal moments of inertia are weight (force) times distance times time squared which requires the user to divide these values by g prior to input. This inconsistency has never been removed since it would have invalidated already established input files.

The developers of the CVS program have observed two different applications of metric units for the program. The first consists of using kilograms, centimeters and seconds as the units of force, distance and time. This is somewhat more consistent with the CVS "standard" units and available data, and, since the conversion factors consist primarily of 2.54 and 2.2, most of the input and output data formats are still applicable. For those who prefer the more formal Standard International (SI) units, the use of newtons, meters and seconds as the units of force, distance and time can be used. In fact, Calspan modified several of the output formats suggested by one user to accommodate this unit system in a manner that did not adversely affect the usage of other unit systems. However, one word of warning here; several values of time (e.g., in the tabular time histories) have been converted to milliseconds for output purposes.

3.0 INPUT DATA ORGANIZATION

The input for the CVS program is contained in a single primary input file (FORTRAN unit No. 5). It is a formatted file, structured in a fixed 80 column card format of alphanumeric input. Each record of the file therefore corresponds to the contents of an input card that has a unique identification (e.g. input Card A.1.a). This produces a modular form for the contents of an input file for the CVS program. For example, the A input cards contain the general run parameters, the B input cards contain the geometric parameters that define the segments and joints of the body, the C cards contain the parameters that define the vehicle motion, etc. Since most computer systems permit the concatenation of files, the input file for the CVS program could possibly consist of several previously constructed files that are concatenated in the proper sequence at execution time. For those users that still prefer to work with input cards, this is the same as having multiple sets of A cards, B cards, C cards, etc., and forming a complete CVS input deck by combining the appropriate sets of cards. The modularity of the input makes it possible for complete sets to be replaced by existing sets that have been previously used.

The CVS program has innumerable options available to the user, and each characteristic generally consists of a predefined number of parameters. For example, the crash victim body consists of a variable number of segments and joints specified by NSEG and NJNT supplied on input Card B.1 that, in turn, control the number of B cards to follow. Therefore, the structure of any CVS program input file or deck is variable and is completely specified by previously supplied parameters. Some input cards are always required, others are needed only for previously specified parameters, and, in most cases, the number of cards within any given set is determined by a previously defined parameter.

This variable structure for the input deck made it somewhat impossible to use a fixed format for the program input that is common for most computer programs. In fact, we have seen CVS program input decks as small as 15 or 20 cards and as large as 500 or 600 cards. Unfortunately, a more general fixed format for cards in different sets of input cards was not used, due primarily to the manner in which most of the input routines were originally developed.

During the development of the CVS program, Calspan has strived to insure that, as new features were added to the program, any previously constructed input decks would still be acceptable as proper input for the program. Therefore, for the several versions of the program that were made available to many users, compatibility was maintained for the most part so as not to invalidate any previously constructed input decks.

During the input portion of the CVS program, considerable program initialization is performed that, in some cases, changes the actual supplied input (e.g., degrees are converted to radians) and a completely annotated listing of the program input is produced on the primary output unit (FORTRAN unit No. 6). It is suggested that, as one first attempts to read the input description for the CVS program (Section 4.0), he have one of the listings available to assist in the initial understanding of the many program features that are available and the manner by which they are controlled within the program.

Following is a summary of all of the input cards. A complete description, giving the format for each card, the conditions that specify its existence, the input parameters to be supplied on each card and a definition of each of these parameters, is presented in Section 4.0.

A. Run control parameters

A.1.a-c	Date, restart control, run description
A.2.a-n	Variable changes for restart procedure
A.3	Input variable units, components of g
A.4	Integrator parameters
A.5	NPRT array for output control

B. Physical characteristics of the crash victim body

B.1	Body title, No. of segments and joints
B.2.a-n	Physical characteristics of body segments
B.3.a-j	Physical characteristics of joints
B.4.a-j	Joint spring function coefficients
B.5.a-j	Joint viscous function coefficients
B.6.a-n	Integrator convergence tests for body segments
B.7.a-n	Controls for flexible elements

C. Prescribed segment (vehicle) motion

C.1	Crash vehicle deceleration title
C.2.a-b	Prescribed motion control parameters
C.3.a-n	Unidirectional deceleration tables
C.4.a-n	Six degree of freedom deceleration tables
C.5.a-m	Spline fit position tables

D. Contact surface definitions

D.1	Number of various contact surfaces
D.2.a-d	Plane description and input data
D.3.a-c	Belt description and input data
D.4.a-h	Airbag description and input data
D.5.a-j	Additional ellipsoid contact surface input data
D.6.a-j	Constraint and tension element input data
D.7	Body segment symmetry options
D.8.a-j	Spring damper input data
D.9.a-j	Directed force function input data

E. Function definitions

E.1	Function identification number and title
E.2	Function definition control parameters
E.3	5th degree polynomial coefficients
E.4.a-n	Tabular function definition
E.5	(No longer required by program)
E.6.a-n	Wind force functions input data
E.7.a-n	Joint forces functions input data

F. Allowed contacts and associated functions

F.1.a-n	Menu for plane-segment contact functions
F.2.a-n	Menu for belt-segment contact functions
F.3.a-n	Menu for segment-segment contact functions
F.4.a-j	Specifications for globalgraphic joint functions
F.5.a	Specifications for joint forces option
F.6.a-n	Allowed airbag-segment contact definitions
F.7.a-b	Wind force functions specifications
F.8.a-d	Harness-belt systems input data

G. Initial positioning input

G.1.a-b	Printer plots control parameters
G.2.a-m	Initial position and velocity for reference segments
G.3.a-n	Initial segment angular orientation input data
G.4	Equilibrium control parameters
G.5.a-n	Equilibrium control assignments
G.6.a-m	Equilibrium constraint assignments

H. Tabular time history output control parameters

H.1.a-n	Linear accelerations of selected points on segments
H.2.a-n	Linear velocities of selected points on segments
H.3.a-n	Linear positions of selected points on segments
H.4	Angular accelerations of selected segments
H.5	Angular velocities of selected segments
H.6	Angular orientations of selected segments
H.7	Torque calculations for selected joints
H.8	Parameters for HIC, HSI and CSI computations

I. Specifications for Calcomp plots

I.1	No. of plots and Y variables per plot
I.2.k	X and Y variables to be plotted
I.3.k	Parameters for horizontal (X) axis
I.4.k	Parameters for vertical (Y) axis
I.5.k	X axis label
I.6.k	Y axis label
I.7.k	First line of plot label
I.8.k	Second line of plot label

4.0 INPUT DESCRIPTION FOR THE CVS-IV PROGRAM

This section contains a description of the inputs to the CVS-IV computer program. In addition to defining the format and the input data supplied on each card, explanatory notes and comments regarding many of the input parameters are included to aid the understanding of the use of various optional features and capabilities available in the program. It is suggested the reader refer to the CVS program output presented in Section 7.0 where input data used for a sample run are given that may be helpful by way of illustration.

```
INPUT DESCRIPTION FOR THE CALSPAN 3-D CRASH VICTIM SIMULATION PROGRAM
                                       VERSION 20 - 06/24/80            |

NOTE: THIS REPORT IS SUPPLIED WITH '1' IN COLUMN 1 FOR PAGE SKIP        |
      CONTROL TO ALLOW FOR PRINTING ON VARIOUS COMPUTER SYSTEMS.        |

      THE FOLLOWING SPECIAL SYMBOLS MAY DIFFER ON OTHER SYSTEMS:        |

           "#" IS USED TO INDICATE "NOT EQUAL".                         |
           "<" IS USED TO INDICATE "LESS THAN".                         |
           ">" IS USED TO INDICATE "GREATER THAN".                      |
           "|" IS USED TO INDICATE "ABSOLUTE VALUE".                    |

ANY LINE WITH EITHER OF THE SYMBOLS "|","*" OR "$" AT THE RIGHT         |
INDICATES THAT A CHANGE HAS BEEN MADE TO THIS INPUT DESCRIPTION         |
SINCE THAT INCLUDED IN NHTSA REPORT NOS. DOT-HS-801 507 THROUGH 510,    |
"AN IMPROVED THREE DIMENSIONAL COMPUTER SIMULATION OF MOTOR VEHICLE     |
CRASH VICTIMS", APRIL 1975 (FORMERLY CALSPAN REPORT NO. ZQ-5180-L-1).   |

THE SYMBOL "*" INDICATES THAT AN ITEM OR CARD HAS BEEN ADDED TO THE     |
CVS MODEL INPUT IN SUCH A MANNER THAT PREVIOUS INPUT DECKS ARE STILL    |
ACCEPTABLE AS PROPER INPUT FOR THE CURRENT VERSION OF THE PROGRAM.      |

THE SYMBOL "$" INDICATES THAT CHANGES IN FORMAT OR CONTENT ARE          |
REQUIRED TO PREVIOUS INPUT DECKS TO BE ACCEPTABLE AS PROPER INPUT       |
FOR THE CURRENT VERSION OF THE PROGRAM.                                 |


OUTLINE OF INPUT TO THE PROGRAM :


CARDS A -  DATE AND RUN DESCRIPTION, UNITS OF INPUT AND OUTPUT,
           CONTROL OF RESTART, INTEGRATOR AND OPTIONAL OUTPUT.

CARDS B -  PHYSICAL CHARACTERISTICS OF THE SEGMENTS AND JOINTS.

CARDS C -  DESCRIPTION OF THE VEHICLE MOTION.

CARDS D -  CONTACT PLANES, BELTS, AIR BAGS, CONTACT ELLIPSOIDS,
           CONSTRAINTS, AND SYMMETRY OPTIONS.

CARDS E -  FUNCTIONS DEFINING FORCE-DEFLECTIONS, INERITIAL SPIKE,
           ENERGY ABSORPTION FACTOR, AND FRICTION COEFFICIENTS.

CARDS F -  ALLOWED CONTACTS AMONG SEGMENTS, PLANES, BELTS, AIR BAGS
           AND CONTACT ELLIPSOIDS.

CARDS G -  INITIAL ORIENTATIONS AND VELOCITIES OF THE SEGMENTS.

CARDS H -  CONTROL OF OUTPUT OF TIME HISTORY OF SELECTED SEGMENT
           MOTIONS AND JOINT PARAMETERS.

CARDS I -  CONTROL INFORMATION FOR PLOTTER OUTPUT                       *
```

DESCRIPTION OF FORTRAN FORMAT STATEMENTS USED

AT THE BEGINNING OF THE DESCRIPTION OF EACH CARD APPEARS THE FORTRAN FORMAT STATEMENT THAT SPECIFIES THE STRUCTURE OF THE INPUT IMAGE FOR THAT CARD. THE ONLY FORMAT CODES USED BY THE CVS PROGRAM ARE

NFW.D	(F TO DESCRIBE REAL DATA FIELDS)
NIW	(I TO DESCRIBE INTEGER DATA FIELDS)
NAW	(A TO DESCRIBE ALPHANUMERIC DATA FIELDS)
WX	(X TO INDICATE A FIELD TO BE SKIPPED)

WHERE: N, W AND D ARE UNSIGNED INTEGER CONSTANTS

N IS OPTIONAL AND IS A REPEAT COUNT USED TO DENOTE THE NUMBER OF TIMES THE FORMAT CODE IS TO BE USED. IF N IS OMITTED, A VALUE OF ONE IS ASSUMED AND THE CODE IS USED ONLY ONCE.

W SPECIFIES THE FIELD WIDTH (NUMBER OF COLUMNS ON THE CARD).

D NORMALLY SPECIFIES THE NUMBER OF DECIMAL PLACES TO THE RIGHT OF THE DECIMAL POINT, I.E., THE FRACTIONAL PART OF THE NUMBER. HOWEVER, A DECIMAL POINT SUPPLIED WITHIN THE FIELD WILL OVER-RIDE THE D SPECIFICATION.

/ IS USED TO INDICATE THE END OF A CARD IMAGE AND THAT THE REMAINING FIELDS ARE TO BE SUPPLIED ON A SUCCEEDING CARD.

ALL VARIABLE NAMES USED FOLLOW THE STANDARD FORTRAN NAMING CONVENTION, I.E., THOSE VARIABLES WHERE THE FIRST LETTER OF THEIR NAME IS A-H OR O-Z ARE REAL (ACTUALLY DOUBLE PRECISION ON IBM AND UNIVAC COMPUTERS AND SINGLE PRECISION ON CDC COMPUTERS) AND THOSE WITH I-N AS THEIR FIRST LETTER ARE INTEGER.

ALL REAL DATA HAVE A FW.0 FORMAT CODE WHICH REQUIRES THE USE OF A DECIMAL POINT WITHIN THE SPECIFIED FIELD TO OVERRIDE THE D=0 SPECIFICATION. ON MOST COMPUTERS F, D AND E FORMAT CODES ARE COMPLETELY INTERCHANGEABLE FOR INPUT WHICH PERMITS ONE TO SUPPLY AN EXPONENTIAL (POWER OF TEN) MULTIPLIER; E.G., 0.000001 MAY BE SUPPLIES AS 1.0D-6, PROVIDED THAT THE EXPONENTIAL TERM IS RIGHT ADJUSTED WITHIN THE FIELD WIDTH. IN ALL OTHER CASES, REAL DATA USING THE FW.0 FORMAT CODE MAY APPEAR ANYWHERE WITHIN THE FIELD WIDTH. ALL BLANKS ARE ASSUMED TO BE A ZERO AND THEREFORE IGNORED. A BLANK FIELD WILL THEREFORE INPUT A VALUE OF ZERO.

ALL INTEGER DATA USE A IW FORMAT CODE AND MUST BE RIGHT ADJUSTED, I.E., MUST APPEAR IN THE RIGHTMOST COLUMNS OF THE FIELD.

SEVERAL NAMES, TITLES AND OTHER DESCRIPTIVE ITEMS ARE ALPHANUMERIC DATA AND USE THE AW FORMAT CODE. HERE BLANKS ARE SPACES AND THE ACTUAL CHARACTERS DESIRED MAY APPEAR ANYWHERE WITHIN THE FIELD.

A. MAIN PROGRAM INPUT

CARD A.1.A	FORMAT (3A4, 2I4, F8.0)
DATE(I),I=1,3	DATE OF THE RUN (12 CHARACTERS).
IRSIN	RESTART INPUT UNIT NO. IF BLANK OR ZERO, ALL INPUT TO BE SUPPLIED ON CARDS A.3 TO CARDS H.7. IF NONZERO (SUGGESTED VALUE =4) INPUT WILL BE SUPPLIED FROM A PREVIOUS RESTART TAPE AND CARDS A.1.B,C AND A.2.
IRSOUT	RESTART OUTPUT UNIT NO. IF NONZERO (SUGGESTED VALUE =3) RECORDS WILL BE WRITTEN ON THIS OUTPUT UNIT FOR FUTURE RESTART RUNS. AN INITIAL RECORD CONTAINING ALL INPUT AND INITIALIZATION DATA WILL BE WRITTEN PLUS A TIME POINT RECORD AT EVERY TIME INTERVAL AS SPECIFIED BY DT ON CARD A.4.
RSTIME	RESTART TIME (SEC.) REQUIRED IF IRSIN ≠ 0. SHOULD BE NONZERO AND AN INTEGER MULTIPLE OF DT ON CARD A.4. PROGRAM WILL READ RECORDS FROM THE PREVIOUS RESTART TAPE UP TO AND INCLUDING THIS TIME, MAKE CHANGES PER CARD A.2 AND CONTINUE OPERATION FROM THERE.
CARDS A.1.B - A.1.C	FORMAT (20A4 / 20A4) **
COMENT(I),I=1,40	DESCRIPTION OF THE RUN (160 CHARACTERS ON TWO CARDS).

** ANY FORMAT MARKED IN THIS MANNER INDICATES THAT COLUMNS 73-80 OF THAT CARD ARE USED FOR INPUT AND SHOULD NOT BE USED FOR IDENTIFICATION.

CARDS A.2 ARE REQUIRED ONLY IF IRSIN > 0, IN WHICH CASE ALL OTHER INPUT AS SPECIFIED ON CARDS A.3 TO H.7 ARE BYPASSED. TWO SETS OF A.2 (EACH TERMINATED WITH A BLANK CARD) ARE REQUIRED. THE FIRST SET IS PROCESSED AFTER THE INITIAL INPUT RECORD IS READ FROM INPUT UNIT IRSIN AND, IF IRSOUT # 0, BEFORE THE INPUT RECORD IS WRITTEN ON OUTPUT UNIT IRSOUT. THE SECOND SET IS PROCESSED AFTER THE TIME POINT RECORD FOR TIME = RSTIME HAS BEEN READ AND, IF IRSOUT # 0, AFTER THE SAME RECORD IS WRITTEN ON OUTPUT UNIT IRSOUT, BUT BEFORE THE PROGRAM RESUMES OPERATION.

CARDS A.2.A - A.2.N	FORMAT(A8, 4I4, 2(F8.0, I8, A8))
AVAR	ALPHANUMERIC NAME (LEFT ADJUSTED IN FIELD) OF VARIABLE TO BE REDEFINED FOR RESTART. PROGRAM IS CAPABLE OF CHANGING ANY VARIABLE IN THE LABELED COMMON BLOCKS AS USED AFTER ALL INITIALIZATION HAS BEEN PERFORMED. THE USER SHOULD ASCERTAIN THAT CHANGING THIS VARIABLE IS VALID FOR THE PROGRAM.
INDEX(I),I=1,3	THE ARRAY INDICES, IF ANY, OF THE VARIABLE. MUST AGREE IN NUMBER AND THE VALUES MUST BE LESS THAN OR EQUAL TO THE DIMENSIONS OF THE VARIABLE. BLANK OR ZERO FOR NO DIMENSION.
ITYPE	SUPPLY 1,2 OR 3 TO INDICATE THAT THE NEW VALUE IS TO BE REAL(RR), INTEGER(II) OR ALPHANUMERIC(AA). MUST AGREE WITH THE TYPE OF THE VARIABLE WITHIN THE PROGRAM.
RR,II OR AA	NEW VALUE OF THE VARIABLE AVAR TO BE SUPPLIED IN THE APPROPRIATE FIELD DETERMINED BY THE VALUE OF ITYPE.
RROLD,IIOLD OR AAOLD	THE PREVIOUS VALUE OF THE VARIABLE AVAR IN THE APPROPRIATE FIELD ACCORDING TO THE ITYPE VALUE. INTEGER OR ALPHANUMERIC DATA WILL BE TESTED EXACTLY, REAL DATA TO 5 SIGNIFICANT DIGITS. IF THE CURRENT VALUE IS DIFFERENT, THE PROGRAM WILL TERMINATE WITH AN ERROR MESSAGE. IF ZERO OR BLANK IS SUPPLIED,NO CHECK IS PERFORMED.

THESE A.2 CARDS WILL BE PROCESSED UNTIL A BLANK VALUE FOR AVAR IS ENCOUNTERED. NO FURTHER INPUT IS REQUIRED.

CARD A.3 FORMAT (3A4, 4F12.0) *

UNITL	UNIT OF LENGTH (4 CHARACTERS)
UNITM	UNIT OF FORCE (MASS) (4 CHARACTERS)
UNITT	UNIT OF TIME (4 CHARACTERS).

NOTE : UNITL, UNITM AND UNITT SHOULD CORRESPOND TO THE USER'S INPUTS. THROUGHOUT THIS DESCRIPTION, INCHES, POUNDS AND SECONDS (IN,LBS,SEC) ARE USED AS SAMPLE UNITS.

GRAVTY(I),I=1,3	THE X, Y AND Z COMPONENTS (IN/SEC**2) OF THE GRAVITY VECTOR. NORMALLY THIS IS USED AS THE GRAVITY FORCE VECTOR ACTING ON THE SEGMENTS. THIS VECTOR DEFINES THE INERTIAL OR GROUND REFERENCE COORDINATE SYSTEM TO BE USED BY THE PROGRAM. THE ORIENTATION OF OTHER COORDINATE REFERENCE SYSTEMS (E.G., VEHICLE AND LOCAL SEGMENT) ARE DEFINED LATER WITH RESPECT TO THIS INERTIAL REFERENCE COORDINATE SYSTEM. ONE CAN THEREFORE DEFINE ANY DESIRED COORDINATE SYSTEMS TO MEET INDIVIDUAL REQUIREMENTS.
G	THE VALUE OF G (IN/SEC**2). IF BLANK OR ZERO, THE MAGNITUDE OF THE GRAVITY VECTOR WILL BE USED. SUPPLYING THE VALUE OF G PERMITS ONE TO SPECIFY A DIFFERENT GRAVITY VECTOR ABOVE (E.G., ZERO) FOR SPECIAL APPLICATIONS. *

CARD A.4 FORMAT (2I4, 4F8.0)

NDINT	NUMBER OF ITERATIONS FOR FINAL CONVERGENCE TEST OF THE INTEGRATOR SUBROUTINE DINT (MINIMUM VALUE = 2, SUGGESTED VALUE = 4).
NSTEPS	NUMBER OF INTEGRATION STEPS (OR OUTPUT TIME POINTS) FOR THE INTEGRATOR ROUTINE. MAY BE ZERO TO OBTAIN INITIAL CONDITIONS.
DT	MAIN PROGRAM TIME INTERVAL FOR INTEGRATOR ROUTINE OUTPUT (SEC). TOTAL TIME OF RUN WILL BE NSTEPS*DT SECONDS WITH MAIN PROGRAM TAPE 1, PRINTER PLOT AND OPTIONAL OUTPUT PRODUCED EVERY DT SECONDS.
HO	INITIAL INTEGRATOR STEP SIZE (SEC).
HMAX	MAXIMUM INTEGRATOR STEP SIZE (SEC). FOR BEST EFFICIENCY DT SHOULD BE AN INTEGRAL MULTIPLE OF HMAX AND HMAX A POWER OF TWO MULTIPLE OF HO. (SUGGESTED VALUE = 0.001 SEC.)
HMIN	MINIMUM INTEGRATOR STEP SIZE (SEC). IF A FIXED STEP SIZE IS DESIRED, SET HMIN GREATER THAN HMAX, AND STEP SIZE WILL DOUBLE FROM HO UNTIL HMAX IS ACHIEVED.

CARD A.5 FORMAT (36I2)

NPRT(I),I=1,36 AN ARRAY OF INDICATORS THAT CONTROL VARIOUS OPTIONAL OUTPUT FEATURES OF THE PROGRAM. GENERALLY, A BLANK OR ZERO VALUE INDICATES NO OUTPUT FOR THAT ITEM AND A VALUE OF ONE WILL PRODUCE OUTPUT EACH TIME THE ROUTINE IS EXECUTED. THE PRINTED OUTPUT PRODUCED BY ELEMENTS 8-28 IS INTENTED FOR DIAGNOSTIC OR "CHECK OUT" PURPOSES ONLY, CAN PRODUCE LARGE AMOUNTS OF OUTPUT AND SHOULD NOT BE USED FOR LONG OR PRODUCTION RUNS. IT IS NOT COMPLETELY LABELED AND ONE SHOULD CONSULT THE LISTING OF THE SUBROUTINE FOR A DESCRIPTION OF THE ITEMS THAT ARE PRINTED.

THE NPRT ARRAY (* - SEE NOTES BELOW)

ELEMENT NO.	SUBROUTINE	OUTPUT PRODUCED
1 (1*)	MAIN	OUTPUT UNIT NO. 1
2 (1*)	MAIN	SUBROUTINE ELTIME TABLE
3 (1*)	MAIN	SUBROUTINE PRINT OUTPUT
4 (3*)	OUTPUT,POSTPR	OUTPUT UNIT NO. 8, PLOTS
5 (1*)	PRIPLT	Y-Z VIEW PRINTER PLOTS
6 (1*)	PRIPLT	X-Z VIEW PRINTER PLOTS
7 (1*)	PRIPLT	X-Y VIEW PRINTER PLOTS
8 (2*)	DAUX	IJK, RHS AND C ARRAYS
9	DAUX	SUBROUTINE PRINT OUTPUT
10	IMPULS	DIAGNOSTIC OUTPUT
11	SETUP1	U2,V1 ARRAYS
12	VISPR	DIAGNOSTIC OUTPUT
13	PRIPLT	CJOINT ARRAY
14	WINDY	WIND FORCES
15	BELTG	DIAGNOSTIC OUTPUT
16	HBELT	HARNESS-BELT FORCES
17	EDEPTH	DIAGNOSTIC OUTPUT
18	NOT USED	
19	NOT USED	
20	CHAIN	SEGLP,SEGLV
21	AIRBAG	DIAGNOSTIC OUTPUT
22	AIRBG1	DIAGNOSTIC OUTPUT
23	BINPUT	HA AND HB ARRAYS
24	UPDATE	ROLL-SLIDE TEST OUTPUT
25	DINT	CONVERGENCE TEST DATA
26 (4*)	DINT,POSTPR	TABULAR TIME HISTORY OUTPUT
27	EQUILB	INTERMEDIATE RESULTS
28 (5*)	HPTURB	HARNESS BELT FORCES

NOTES CONCERNING ELEMENTS OF THE NPRT ARRAY

1* FOR ELEMENTS 1,2,3,5 AND 6, THE VALUE INDICATES THE FREQUENCY, ZERO FOR NO OUTPUT (FOR ELEMENT NO. 2, THE ELTIME TABLE WILL BE PRINTED ONCE AT THE END OF THE RUN), AND A NON-ZERO POSITIVE VALUE (N) WILL PRODUCE OUTPUT EVERY N*DT (FROM CARD A.4) SECONDS.

2* A VALUE OF NPRT(8) = 2 WILL PRINT THE DESIGNATED ARRAYS BEFORE AND AFTER THE FIRST CALL TO SUBROUTINE FSMSOL ONLY.

3* THE VALUE OF NPRT(4) IS USED (AFTER VERSION 18A) TO CONTROL

(1) WRITE THE TABULAR TIME HISTORIES (SPECIFIED BY CARDS H AND THE ALLOWED CONTACTS ON CARDS F) ON EITHER
 (A) THE MULTIPLE OUTPUT UNITS (NO. 21 AND UP) BY SUBROUTINE OUTPUT, OR
 (B) THE PRIMARY OUTPUT UNIT (NO. 6) BY SUBROUTINE HEDING.

(2) STORE THE TIME HISTORY DATA ON OUTPUT UNIT NO. 8 BY SUBROUTINE OUTPUT TO BE LATER USED BY SUBROUTINE POSTPR.

(3) GENERATE PLOTS OF THE TIME HISTORY DATA (SPECIFIED ON CARDS I) BY SUBROUTINE POSTPR.

THE PERMISSIBLE VALUES OF NPRT(4) RANGE FROM -3 TO +4 AS FOLLOWS:

	SUPPLIED VALUE FOR NPRT(4)							
	+4	+3	+2	+1	0	-1	-2	-3
1 CONTROL CARDS								
MULTIPLE OUTPUT UNITS	YES	NO	NO	YES	YES	NO	NO	NO
OUTPUT UNIT NO. 8	YES	YES	YES	YES	NO	YES	YES	YES
2 CARD INPUT								
CARDS B.1-H.7	YES	YES	YES	YES	YES	NO	NO	NO
CARD H.8	NO	YES	YES	YES	NO	YES	YES	YES
CARDS I	NO	YES	NO	YES	NO	YES	NO	YES
3 MAIN PROGRAM OPERATION								
INTEGRATE AND/OR RESTART	YES	YES	YES	YES	YES	NO	NO	NO
CALL SUBROUTINE POSTPR	NO	YES	YES	YES	NO	YES	YES	YES
4 PRINT TIME HISTORIES								
MULTIPLE OUTPUT UNITS	YES	NO	NO	YES	YES	NO	NO	NO
PRIMARY OUTPUT UNIT	NO	YES	YES	NO	NO	NO	YES	YES
5 OUTPUT UNIT NO. 8								
WRITE (SUB OUTPUT)	YES	YES	YES	YES	NO	NO	NO	NO
READ (SUB POSTPR)	NO	YES	YES	YES	NO	YES	YES	YES
6 GENERATE PLOTS (CARDS I)	NO	YES	NO	YES	NO	YES	NO	YES

4* NPRT(26) CONTROLS THE FREQUENCY OF THE TABULAR TIME HISTORY OUTPUT. VALUES OF 0,1 OR 2 ARE PERMISSIBLE TO CONTROL

(A) IF THE TABULAR TIME HISTORIES ARE PRINTED ON THE MULTIPLE OUTPUT UNITS 21 AND UP (NPRT(4) = 0,1 OR 4), A VALUE OF NPRT(26) = 0 OR 1 WILL PRINT AT THE END OF EACH SUCCESSFUL INTEGRATION STEP. A VALUE OF NPRT(26) = 2 WILL PRINT AT EACH INTERMEDIATE TIME POINT OF EACH INTEGRATION STEP.

(B) IF OUTPUT UNIT NO. 8 IS GENERATED (NPRT(4) > 0), RECORDS ARE WRITTEN AT THE SAME FREQUENCY SPECIFIED IN (A) ABOVE.

(C) IF THE TABULAR TIME HISTORIES ARE PRINTED FROM OUTPUT UNIT NO. 8 (NPRT(4) = +2,+3,-2 OR -3), A VALUE OF NPRT(26) EQUAL TO
0 WILL PRINT ONE LINE EVERY DT (FROM CARD A.4) SECONDS;
1 WILL PRINT AT THE END OF EACH SUCCESSFUL INTEGRATION STEP;
2 WILL PRINT AT EVERY INTERMEDIATE TIME POINT OF EACH STEP.

5* NPRT(28) CONTROLS THE FREQUENCY AND LEVEL OF DIAGNOSTIC HARNESS BELT FORCES OUTPUT PRODUCED. VALUES OF 0,1,2 AND 3 ARE ALLOWED AS FOLLOWS: (EACH VALUE INCLUDES OUTPUT OF ALL LOWER VALUES)

(0) - PRODUCES A TABLE OF THE FINAL HARNESS BELT FORCES AT EACH POINT IN PLAY AT THE SAME TIME POINTS AS OUTPUT IS PRODUCED BY SUBROUTINE PRINT AS SPECIFIED BY NPRT(3).

(1) - PRINTS A TABLE OF THE FINAL HARNESS BELT FORCES AT EACH POINT IN PLAY AT EACH TIME POINT OF SUBROUTINE HPTURB.

(2) - PRINTS A TABLE OF THE HARNESS BELT FORCES AT EACH POINT IN PLAY FOR EVERY ITERATION STEP OF SUBROUTINE HPTURB.

(3) - PRINTS THE RHS,IJK AND C ARRAYS BEFORE THE CALL TO FSMSOL AT EACH ITERATION STEP AT EACH TIME POINT OF HPTURB

IF NPRT(4) IS NEGATIVE, INPUT CARDS B.1-H.7 SHOULD NOT BE SUPPLIED. *

B. SUBROUTINE BINPUT

CARD B.1 — FORMAT (2I6, 8X, 5A4)

NSEG	THE NUMBER OF SEGMENTS FOR THE CRASH VICTIM. THE MAXIMUM VALUE IS 30, BUT THIS INCLUDES ONE FOR THE GROUND, NBAG AIRBAGS, AND THE NEW SEGMENTS (INCLUDING THE PRIMARY VEHICLE) FOR WHICH PRESCRIBED MOTION IS DEFINED ON CARDS C.
NJNT	THE NUMBER OF JOINTS (MAXIMUM = 29). NOTE: NORMALLY NJNT = NSEG-1, BUT JOINT NUMBERS NVEH-1 AND NGRND-1 MAY BE USED TO CONNECT THE VEHICLE AND THE GROUND TO A LOWER NUMBERED SEGMENTS.
BDYTTL(I),I=1,5	DESCRIPTION OF THE CRASH VICTIM (20 CHARACTERS).

CARDS B.2.A1 - B.2.N1 (NSEG CARDS) — FORMAT (A4, 1X, A1, 10F6.0, I4)

EACH CARD (I) FOR I = 1, NSEG WILL CONTAIN INPUT DATA FOR THE ITH SEGMENT. THE SEGMENT IDENTIFYING NUMBERS (I) WILL BE REFERRED TO ON LATER INPUT CARDS.

SEG(I)	AN ABBREVIATION OF THE NOMENCLATURE OF THE ITH SEGMENT (4 CHARACTERS).
CGS(I)	THE PLOT SYMBOL OF THE SEGMENT C.G. (1 CHARACTER).
W(I)	THE WEIGHT OF THE SEGMENT (LBS).
PHI(J,I),J=1,3	THE PRINCIPAL MOMENTS OF INERTIA OF THE SEGMENT ABOUT THE X, Y, AND Z AXES OF THE SEGMENT (LBS-SEC**2-IN). THERE ARE NO RESTRICTIONS ON THE VALUES OF W(I) OR PHI(J,I), THEY MAY BE NEGATIVE OR ZERO. IF ANY COMPONENT IS ZERO, IT IS ASSUMED THAT THE SYSTEM IS SUITABLY CON-STRAINED SO THAT THE SYSTEM MATRIX IS NON-SINGULAR.
BD(J,I),J=1,3	THE X, Y, AND Z SEMIAXES OF THE SEGMENT CONTACT ELLIPSOID (IN).
BD(J,I),J=4,6	THE LOCATION OF THE CENTER OF THE SEGMENT CONTACT ELLIPSOID, WITH RESPECT TO THE CENTER OF GRAVITY OF THE SEGMENT, IN THE LOCAL BODY SEGMENT REFERENCE(IN). THESE PRIMARY CONTACT ELLIPSOIDS ARE GIVEN THE SAME INDENTIFYING NUMBER AS THE SEGMENT. THEY MAY BE REDEFINED WITH AN ARBITRARY ORIENTATION ON CARDS D.5.

PRIOR TO VERSION 20 (JANUARY 1980), THE CVS PROGRAM ASSUMED THAT THE PRINCIPAL AXES (DEFINED SUCH THAT THE MOMENT OF INERTIA MATRIX IS DIAGONAL) COINCIDED WITH THE LOCAL GEOMETRIC AXES OF EACH SEGMENT. TO HANDLE THOSE SITUATIONS WHERE THIS IS NOT THE CASE, LPMI(I) HAS BEEN ADDED TO CARD B.2.I1 WHICH, IF NON-ZERO, INDICATES THAT THE PRINCIPAL AXES ARE ROTATED FROM THE LOCAL GEOMETRIC AXES FOR SEGMENT NO. I AND THAT AN ADDITIONAL INPUT CARD B.2.I2 MUST IMMEDIATELY FOLLOW TO SPECIFY THE ROTATION. SINCE IT IS DESIRABLE THAT INPUT DEFINING POINTS ON A SEGMENT BE SUPPLIED WITH RESPECT TO THE LOCAL GEOMETRIC AXES AND, ALSO, NOT TO INVALIDATE PREVIOUS INPUT DECKS, THE PROGRAM (SUBROUTINE ROTATE) WILL TRANSFORM ALL DATA THAT HAS BEEN DEFINED WITH RESPECT TO THE LOCAL GEOMETRIC AXES TO THE PRINCIPAL AXES IN A MANNER THAT IS TRANSPARENT TO THE USER. ALSO, ALL STANDARD OUTPUT, WHERE APPLICABLE, WILL BE TRANSFORMED BACK TO THE LOCAL GEOMETRIC AXES.

CARDS B.2.A1 - B.2.N1 (CONTINUED) *

LPMI(I)	AN INTEGER WHICH, IF NON-ZERO, INDICATES THAT THE PRINCIPAL AXES FOR SEGMENT NO. I ARE ROTATED FROM THE LOCAL GEOMETRIC AXES. IF LPMI(I) # 0, CARD B.2.I2 MUST IMMEDIATELY FOLLOW THIS CARD B.2.I1. IF LPMI(I) IS ZERO OR BLANK, CARD B.2.I2 IS NOT REQUIRED.	*
CARD B.2.I2	FORMAT (12X, 3F6.0)	*
YPRPMI(J,I),J=1,3	THE YAW, PITCH AND ROLL (DEGREES) OF THE PRINCIPAL AXES WITH RESPECT TO THE LOCAL GEOMETRIC AXES OF SEGMENT NO. I.	*

IN NJNT IS ZERO ON CARD B.1, CARDS B.3 - B.5 ARE NOT REQUIRED.

CARDS B.3.A1 - B.3.J1   FORMAT (A4, 1X, A1, 2I4, 6F6.0)
(NJNT SETS OF CARDS, 2 CARDS PER SET. THE FIRST CARD OF EACH SET IS DESCRIBED ON THIS PAGE, THE SECOND CARD ON THE NEXT PAGE.)

EACH CARD (J) FOR J = 1, NJNT WILL CONTAIN INPUT DATA FOR THE JTH JOINT. THE JOINT IDENTIFYING NUMBERS (J) WILL BE REFERRED TO ON LATER INPUT CARDS.

JOINT(J) — AN ABBREVIATION OF THE NOMENCLATURE OF THE JTH JOINT (4 CHARACTERS).

JS(J) — PLOT SYMBOL OF THE JOINT LOCATION (1 CHARACTER).

JNT(J) — MAGNITUDE INDICATES THE NUMBER OF THE SEGMENT THAT IS CONNECTED TO SEGMENT J+1 BY JOINT J. IF NEGATIVE, JOINT J IS ASSOCIATED WITH A FLEXIBLE ELEMENT. IF ZERO, SEGMENT J+1 IS THE REFERENCE SEGMENT OF ANOTHER BODY. (|JNT(J)| < J+1).

IPIN(J) —
0 - THERE ARE TO BE NO CONSTRAINTS ON JOINT J.
1 - JOINT J IS PINNED (HINGE).
2 - JOINT J IS NOT PINNED (BALL AND SOCKET).
3 - JOINT J IS GLOBALGRAPHIC (BALL AND SOCKET)
4 - JOINT J IS AN EULER JOINT.

NON-ZERO VALUES FOR IPIN MAY BE SUPPLIED AS POSITIVE OR NEGATIVE TO INDICATE THAT THE INITIAL CONDITION OF THE JOINT IS UNLOCKED (POSITIVE) OR LOCKED (NEGATIVE).
AN EULER JOINT MAY USE THE GLOBALGRAPHIC OPTION. SPECIFY IGLOB = 1 ON CARD F.4.A
THE INITIAL STATE OF AN EULER JOINT IS SET BY USE OF IPIN AS FOLLOWS

IPIN	IEULER	STATE	
4	8	FREE	
- 4	7	ALL AXES LOCKED	
- 5	6	SPIN	FREE, OTHERS LOCKED
- 6	5	NUTATION	FREE, OTHERS LOCKED
- 7	4	PRECESSION	FREE, OTHERS LOCKED
- 8	3	SPIN	LOCKED, OTHERS FREE
- 9	2	NUTATION	LOCKED, OTHERS FREE
-10	1	PRECESSION	LOCKED, OTHERS FREE

WHERE PRECESSION IS ABOUT THE Z AXIS OF THE JOINT REFERENCE (YPR1) IN SEGMENT NO. JNT(J), NOTATION ABOUT THE RESULTANT X AXIS, AND SPIN ABOUT THE RESULTANT Z AXIS OF THE JOINT REFERENCE (YPR2) IN SEGMENT NO. J+1.
IF IPIN IS LESS THAN -3 PROGRAM WILL SET IEULER AS ABOVE AND THEN SET IPIN = -4.

SR(I,2*J-1),I=1,3 — COORDINATES OF LOCATION OF JOINT J (IN.) IN THE LOCAL REFERENCE SYSTEM OF SEGMENT JNT(J).

SR(I,2*J),I=1,3 — COORDINATES OF LOCATION OF JOINT J (IN.) IN THE LOCAL REFERENCE SYSTEM OF SEGMENT J+1.

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CARDS B.3.A2 - B.3.J2   FORMAT (14X, 9F6.0, 6I2) **                          *
(ONE OF THESE CARDS MUST FOLLOW EACH CARD FROM PREVIOUS PAGE.)               |

    YPR1(I,J),I=1,3     THE ROTATION ANGLES (DEGREES) ABOUT THE Z, Y         |
                        AND X AXES, RESPECTIVELY, OF THE LOCAL REF-          |
                        ERENCE OF SEGMENT NO. JNT(J) TO SPECIFY THE          |
                        PRINCIPAL AXES OF JOINT J. THE ORDER OF THESE        *
                        ROTATIONS IS SPECIFIED BY ID1 BELOW.                 *

    YPR2(I,J),I=1,3     THE ROTATION ANGLES (DEGREES) ABOUT THE Z, Y         |
                        AND X AXES, RESPECTIVELY, OF THE LOCAL REF-          |
                        ERENCE OF SEGMENT NO. J+1 TO SPECIFY THE             |
                        PRINCIPAL AXES OF JOINT J. THE ORDER OF THESE        *
                        ROTATIONS IS SPECIFIED BY ID2 BELOW.                 *
                        THE Z AXIS IS THE REFERENCE AXIS TO DEFINE
                        FLEXURE. THE Y AXIS IS USED AS THE PIN AXIS
                        EXCEPT FOR THE SPECIAL EULER JOINTS. THE XY
                        PLANE IS USED FOR GLOBALGRAPHIC JOINTS WITH
                        X AS THE REFERENCE AXIS.

    YPR3(I,J),I=1,3     THE CENTER OF SYMMETRY (DEGREES) FOR EULER           *
                        JOINTS (USED ONLY IF |IPIN(J)| = 4) SUPPLIED IN      |
                        THE ORDER PRECESSION, NOTATION AND SPIN. JOINT       |
                        TORQUES FOR EULER JOINTS ARE A FUNCTION OF           *
                        THE DEVIATION OF THE EULER ANGLES FROM THESE         *
                        ANGLES. PREVIOUS VERSIONS (BEFORE 18A) OF            *
                        PROGRAM ASSUMED VALUES OF ZERO.                      *

    ID1(I,J),I=1,3      VALUES OF 1,2 AND 3, CORRESPONDING TO THE X,         *
                        Y AND Z AXES, SPECIFYING THE ORDER OF THE AXES       *
                        ABOUT WHICH THE ROTATIONS GIVEN IN YPR1 ARE          *
                        TO BE PERFORMED. ZERO OR BLANK VALUES WILL           *
                        DEFAULT TO THE ORDER 3,2 AND 1 TO SPECIFY THE        *
                        NORMAL YAW, PITCH AND ROLL SEQUENCE, I.E.,           *
                                                                             *
                          YAW ABOUT ORIGINAL  Z AXIS USING YPR1(1,J),        *
                        PITCH ABOUT RESULTANT Y AXIS USING YPR1(2,J),        *
                         ROLL ABOUT RESULTANT X AXIS USING YPR1(3,J).        *
                                                                             *
                        THE SAME AXIS CANNOT BE SPECIFIED FOR TWO OR         *
                        MORE CONSECUTIVE ROTATIONS. HOWEVER, THE THIRD       *
                        AXIS MAY BE THE SAME AS THE FIRST, PROVIDED IT       *
                        IS SUPPLIED AS A NEGATIVE NUMBER, IN WHICH CASE      *
                        THE UNUSED VALUE OF YPR1 WILL BE USED ABOUT          *
                        THE INDICATED AXIS. E.G., VALUES OF 3,1 AND -3       *
                        WILL SPECIFY THE NORMAL EULER ROTATIONS WHERE        *
                        YPR1 IS SUPPLIED IN THE ORDER PRECESSION,            *
                        SPIN AND NOTATION TO COMPUTE                         *
                                                                             *
                        PRECESSION (YPR1(1,J)) ABOUT ORIGINAL Z AXIS,        *
                        NUTATION (YPR1(3,J)) ABOUT RESULTANT X AXIS,         *
                        AND SPIN (YPR1(2,J)) ABOUT RESULTANT Z AXIS.         *

    ID2(I,J),I=1,3      SPECIFIES THE ORDER OF THE ROTATIONS GIVEN BY        *
                        YPR2 IDENTICAL TO THE DESCRIPTION OF ID1.            *
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CARDS B.4.A - B.4.J        FORMAT (2 (4F6.0, F12.0))
    (NJNT SETS OF CARDS, ONE FOR EACH JOINT J. IF |IPIN(J)| # 4,
     EACH SET READS VALUES FOR 3*J-2 AND 3*J-1 ON ONE CARD ONLY.
    IF |IPIN(J)| = 4 , JOINT J IS AN EULER JOINT AND A SECOND CARD
    IS NECESSARY TO READ VALUES FOR 3*J)

    SPRING(I,3*J-2),       THE FLEXURAL SPRING CHARACTERISTICS FOR
           I=1,5           JOINT J. IF J IS AN EULER JOINT, THE SPRING
                           CHARACTERISTICS ABOUT THE PRECESSION AXIS.
                           IF JOINTF(J) # 0 (ON CARD F.5.A), THESE          |
                           VALUES ARE NOT USED AND SHOULD BE ZERO.          |

    SPRING(I,3*J-1),       THE TORSIONAL SPRING CHARACTERISTICS FOR
           I=1,5           JOINT J. IF J IS AN EULER JOINT, THE SPRING
                           CHARACTERISTICS ABOUT THE NUTATION AXIS.

    SPRING(I,3*J),         SECOND CARD OF EACH SET IS REQUIRED
           I=1,5           ONLY IF J IS AN EULER JOINT, THE SPRING
                           CHARACTERISTISCS ABOUT THE SPIN AXIS.

               I=1         LINEAR SPRING COEFFICIENT
                           (IN-LBS/DEG).

               I=2         QUADRATIC SPRING COEFFICIENT
                           (IN-LBS/DEG**2).

               I=3         CUBIC SPRING COEFFICIENT
                           (IN-LBS/DEG**3).

               I=4         ENERGY DISSIPATION COEFFICIENT
                           (DIMENSIONLESS).
                           A VALUE OF 1. SPECIFIES NO LOSS
                           A VALUE OF 0. SPECIFIES MAXIMUM LOSS

               I=5         JOINT STOP LOCATION WITH RESPECT TO
                           THE CENTER OF SYMMETRY (DEG).
                           FOR A VALUE OF ZERO THE ROUTINE WILL USE ONLY
                           THE LINEAR SPRING COEFFICIENT AND WILL APPLY
                           THE ENERGY DISSIPATION FACTOR

    ANG(I,J),I=1,3         THE APPROXIMATE INITIAL ROTATION ANGLES,          *
                           IN THE ORDER PRECESSION, NUTATION AND SPIN,       *
                           (DEGREES) FOR JOINT J WHICH IS AN EULER JOINT.    *
                           THESE ARE USED AS THE INITIAL ANGLES FOR THE      *
                           MEMORY MODE USED BY SUBROUTINE EULRAD AND         *
                           NEED NOT BE EXACT. THE VALUES ARE ABSOLUTE        *
                           AND NOT RELATIVE TO THE CENTER OF SYMMETRY.       *
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CARDS B.5.A - B.5.J FORMAT (5F6.0, 18X, 2F6.0)

(NJNT SETS OF CARDS, ONE FOR EACH JOINT J. IF |IPIN(J)| # 4, VALUES FOR 3*J-2 ARE ON ONE CARD ONLY. IF |IPIN(J)| = 4, J IS AN EULER JOINT AND VALUES FOR 3*J-1 AND 3*J ARE REQUIRED ON A SECOND AND THIRD CARD OF EACH SET.)

VISC(I,3*J-2), I=1,7 — THE VISCOUS CHARACTERISTICS FOR JOINT J. IF J IS AN EULER JOINT, THE VISCOUS CHARACTERISTICS ABOUT THE PRECESSION AXIS.

VISC(I,3*J-1), I=1,7 — THE SECOND CARD OF EACH SET IS REQUIRED ONLY IF J IS AN EULER JOINT, THE VISCOUS CHARACTERISTICS ABOUT THE NUTATION AXIS.

VISC(I,3*J) I=1,7 — THE THIRD CARD OF EACH SET IS REQUIRED ONLY IF J IS AN EULER JOINT, THE VISCOUS CHARACTERISTICS ABOUT THE SPIN AXIS.

I=1 VISCOUS COEFFICIENT (IN-LB-SEC/DEG).

I=2 COULOMB FRICTION COEFFICIENT (IN-LB).

I=3 RELATIVE ANGULAR VELOCITY OF JOINT AT WHICH FULL COULOMB FRICTION IS APPLIED (DEG/SEC). MUST BE GREATER THAN 0.

I=4 T1: THE MAXIMUM TORQUE (IN-LBS) ALLOWED FOR A LOCKED JOINT (OR EULER AXIS). IF EXCEEDED,THE JOINT WILL UNLOCK. IF T1 = 0, THE TEST WILL NOT BE PERFORMED. NOTE: IF JOINT J IS LOCKED, IF T1=0, AND IF SUBROUTINE EQUILB IS CALLED, THEN VISC(4,3*J-2) WILL BE SET BY SUBROUTINE EQUILB. (SEE DESCRIPTION UNDER CARDS G.6)

I=5 T2: THE MINIMUM TORQUE (IN-LBS) ALLOWED FOR JOINT J TO REMAIN UNLOCKED. IF T2 = 0, THE TEST WILL NOT BE PERFORMED.

I=6 T3: THE MINIMUM ANGULAR VELOCITY (RAD/SEC) NECESSARY FOR JOINT J TO REMAIN UNLOCKED. IF T3 = 0, THE TEST WILL NOT BE PERFORMED.

I=7 E = (1+U)/2 WHERE U IS THE CLASSICAL COEFFICIENT OF RESTITUTION TO BE USED FOR THE IMPULSE OPTION IF THE JOINT HITS THE JOINT STOP (0<E<1 OR -1<U<+1). A VALUE OF E = 0 MEANS THAT THE IMPULSE OPTION WILL NOT BE EXERCISED FOR THIS JOINT.

CARDS B.6.A - B.6.I (NSEG CARDS) FORMAT (12F6.0)

SGTEST(1,1,I)	MAGNITUDE TEST FOR THE ANGULAR VELOCITY OF SEGMENT NO. I (RAD/SEC).
SGTEST(2,1,I)	ABSOLUTE ERROR TEST FOR THE ANGULAR VELOCITY OF SEGMENT NO. I (RAD/SEC).
SGTEST(3,1,I)	RELATIVE ERROR TEST FOR THE ANGULAR VELOCITY OF SEGMENT NO. I (DIMENSIONLESS).
SGTEST(1,2,I) (2,2,I) (3,2,I)	SAME AS ABOVE, BUT FOR THE LINEAR VELOCITY OF SEGMENT NO. I (IN/SEC).
SGTEST(1,3,I) (2,3,I) (3,3,I)	SAME AS ABOVE, BUT FOR THE ANGULAR ACCELERATION OF SEGMENT NO. I (RAD/SEC**2).
SGTEST(1,4,I) (2,4,I) (3,4,I)	SAME AS ABOVE BUT FOR THE LINEAR ACCELERATION OF SEGMENT NO. I (IN/SEC**2).

THESE CONVERGENCE TESTS ARE PERFORMED IN SUBROUTINE DINT ON THE RESULTANT OF THE DERIVATIVE VECTORS. THE LINEAR VELOCITIES AND ACCELERATIONS ARE COMPUTED ONLY FOR REFERENCE SEGMENTS (I.E. SEGMENT NO. 1 AND THOSE SEGMENTS I WHERE JNT(I-1) = 0), THEREFORE ANY TEST NUMBERS SUPPLIED FOR LINEAR VELOCITIES AND ACCELERATIONS OF OTHER SEGMENTS WILL BE IGNORED. THE TESTS FOR CONVERGENCE ARE PERFORMED IN THE FOLLOWING ORDER :

1) IF THE MAGNITUDE TEST IS ZERO, NO TESTING IS DONE FOR THAT VARIABLE.

2) IF THE MAGNITUDE OF THE RESULTANT VECTOR IS LESS THAN THE MAGNITUDE TEST,THE ROUTINE HAS PASSED THE CONVERGENCE TEST FOR THAT VARIABLE.

3) IF THE ABSOLUTE ERROR TEST IS GREATER THAN ZERO, AND THE MAGNITUDE OF THE ABSOLUTE ERROR (DIFFERENCE BETWEEN THE PREDICTED AND COMPUTED VECTOR) IS LESS THAN THE ABSOLUTE ERROR TEST, THE ROUTINE HAS PASSED THE CONVERGENCE TEST FOR THAT VARIABLE.

4) IF THE RELATIVE ERROR OF THE MAGNITUDE OF THE ABSOLUTE ERROR COMPARED TO THE MAGNITUDE OF THE COMPUTED VECTOR IS GREATER THAN THE RELATIVE ERROR TEST, THE CONVERGENCE TEST HAS FAILED.

IF NFLX # 0, CARDS B.7 ARE REQUIRED. EACH FLEXIBLE ELEMENT AS DEFINED ON CARDS B.3 CONTAINS AT LEAST THREE CONNECTED SEGMENTS CONSISTING OF A REFERENCE SEGMENT, ONE OR MORE INTERIOR SEGMENTS AND A TERMINATING SEGMENT. EACH JOINT IN THE ELEMENT SHOULD HAVE A NEGATIVE VALUE FOR JNT, AND THE NUMBER OF INTERIOR SEGMENTS WILL BE ONE LESS THAN THE NUMBER OF NEGATIVE VALUES OF JNT FOR EACH ELEMENT. NFLX IS THE TOTAL NUMBER OF INTERIOR SEGMENTS OF ALL FLEXIBLE ELEMENTS.

CARD B.7.A FORMAT (18I4)

NFX	THE NUMBER OF INTERIOR SEGMENTS FOR WHICH HF ARRAYS ARE TO BE SUPPLIED.
KNT(K),K=1,NFX	THE INTERIOR SEGMENT IDENTIFICATION NUMBERS IN THE ORDER OF THE HF ARRAYS TO BE SUPPLIED. IF THE VALUES OF NFX AND KNT ARE NOT CONSISTENT WITH THE NEGATIVE VALUES OF JNT ON CARDS B.3 THE PROGRAM WILL TERMINATE WITH AN APPROPRIATE ERROR MESSAGE.

CARDS B.7.B - B.7.N FORMAT (12F6.0)

(4*NFX CARDS, 4 CARDS FOR EACH SEGMENT IN THE ORDER AS THEY ARE DEFINED IN THE KNT VECTOR.)

(HF(I,J,K),J=1,12) ,I=1,4	THE COEFFICIENTS OF THE QUADRATIC FORM FUNCTION USED TO DEFINE THE ORIENTATION OF INTERIOR SEGMENT KNT(K) WITH RESPECT TO REFERENCE SEGMENT OF THE ELEMENT.

FORM THE COLUMN VECTOR V WITH FOUR COMPONENTS Y,P,R AND 1, WHERE Y,P,R ARE THE YAW, PITCH AND ROLL OF THE TERMINATING SEGMENT RELATIVE TO THE REFERENCE SEGMENT. LET H BE A SYMMETRIC 4X4 MATRIX SUCH THAT F(V) = 1/2 V.HV REPRESENTS A QUADRATIC SCALAR FUNCTION OF THE VARIABLES Y,P AND R IN RADIANS. THUS

```
  YAW OF SEGMENT KNT(K) = 1/2 V.HF(I,J  ,K)V
PITCH OF SEGMENT KNT(K) = 1/2 V.HF(I,J+4,K)V
 ROLL OF SEGMENT KNT(K) = 1/2 V.HF(I,J+8,K)V     (I,J=1,4)
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C. SUBROUTINE VINPUT

THESE C CARDS ARE USED TO PRESCRIBE THE MOTION (ACCELERATION TIME HISTORY) OF SPECIFIED SEGMENTS. NORMALLY ONLY ONE SET IS SUPPLIED WITH MSEG (LAST ITEM ON CARD C.2) EQUAL TO ZERO (OR BLANK) TO PRESCRIBE THE MOTION OF THE PRIMARY VEHICLE (SEGMENT NO. NSEG+1). HOWEVER, MULTIPLE SETS MAY BE SUPPLIED (MAXIMUM = 6) WITH MSEG = 0 ON THE LAST SET TO DENOTE THE PRIMARY VEHICLE.

SEVERAL OPTIONS ARE AVAILABLE FOR EACH PRESCRIBED MOTION. THE REQUIRED INPUTS FOR EACH OPTION ARE AS FOLLOWS:

OPTION 1: HALF SINE WAVE DECELERATION IMPULSE (NATAB = 0)

REQUIRED INPUTS - CARD C.1; CARD C.2.A: ANGLE(1), ANGLE(2), VIPS, VTIME, X0, NATAB=0, MSEG.

OPTION 2: TABULAR UNIDIRECTIONAL DECELERATION (NATAB > 0)

REQUIRED INPUTS - CARD C.1; CARD C.2.A: ANGLE(1), ANGLE(2), VIPS, X0, NATAB>0, AT0, ADT, MSEG; CARDS C.3.

OPTION 3: SIX DEGREE OF FREEDOM DECELERATION (NATAB < 0 AND LTYPE = 0)

REQUIRED INPUTS - CARD C.1; CARD C.2.A: ANGLE(1), ANGLE(2), ANGLE(3), VIPS, X0, NATAB<0, AT0, ADT, MSEG; CARD C.2.B: LTYPE=0, VMEG; CARDS C.4.

OPTION 4: SPLINE FIT POSITION, VELOCITY OR ACCELERATION DATA (NATAB <0 AND LTYPE > 0)

REQUIRED INPUTS - CARD C.1; CARD C.2.A: NATAB<0, AT0, ADT, MSEG; CARD C.2.B; LTYPE>0, LFIT, NPTS; CARDS C.5.

THESE OPTIONS AND THEIR REQUIRED INPUTS HAVE BEEN ESTABLISHED IN SUCH A MANNER THAT ANY PREVIOUS INPUT DECKS ARE STILL ACCEPTABLE AS INPUT, EXCEPT THAT CARD C.2.B WAS ADDED FOR OPTION 3 FOR VERSION 18 OF THE CVS PROGRAM. FOR VERSION 19, CARD C.2.B HAS BEEN MODIFIED AND OPTION 4 (CARDS C.5) AND THE MULTIPLE PRESCRIBED MOTION WERE ADDED.

CARD C.1 FORMAT (20A4) **

VPSTTL(I),I=1,20	DESCRIPTION OF THE CRASH VEHICLE DECELERATION (80 CHARACTERS).

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CARD C.2.A          FORMAT (8F6.0, I6, 2F6.0, I6)                    *

    ANGLE(I),I=1,3  OPTIONS 1 AND 2: ANGLE(1) AND ANGLE(2) (DEG)     |
                    ARE THE AZIMUTH AND ELEVATION (OBLIQUE ANGLES)   |
                    OF THE DIRECTION OF THE DECELERATION IMPULSE.    |
                    THE INITIAL YAW, PITCH AND ROLL OF THE VEHICLE   |
                    ARE ASSUMED TO BE ZERO.                          |
                    OPTION 3: THE THREE ANGLES ARE THE INITIAL YAW,  |
                    PITCH AND ROLL (DEG) OF THE VEHICLE.             |

    VIPS            THE INITIAL VELOCITY (IN/SEC) OF THE VEHICLE.    |
                    FOR OPTION 1, A NEGATIVE VALUE MAY BE SUPPLIED   *
                    TO INDICATE THAT THE VEHICLE WILL ACCELERATE     *
                    FROM AN INITIAL VELOCITY OF ZERO TO -VIPS.       *

    VTIME           THE TIME DURATION (SEC) OF THE HALF SINE WAVE    |
                    DECELERATION IMPULSE. CANNOT BE ZERO OR BLANK    |
                    FOR OPTION 1.                                    |

    X0(I),I=1,3     THE X, Y AND Z COORDINATES (IN) OF THE VEHICLE   |
                    REFERENCE ORIGIN IN INERTIAL REFERENCE.          |

    NATAB           NUMBER OF TIME POINTS OF VEHICLE DECELERATION    |
                    DATA TO BE SUPPLIED OR GENERATED BY THE PRO-     |
                    GRAM. THE ALGEBRAIC SIGN OF NATAB DETERMINES     |
                    THE OPTION OF PRESCRIBED MOTION AS FOLLOWS:      |

                    IF NATAB = 0 (OPTION 1), THE IMPULSE IS AN       |
                    ANALYTICAL HALF SINE WAVE FUNCTION THAT          |
                    (VIPS>0) DECELERATES THE VEHICLE FROM AN         |
                    INITIAL VELOCITY OF VIPS TO ZERO, OR             |
                    (VIPS<0) ACCELERATES THE VEHICLE FROM AN         *
                    INITIAL VELOCITY OF ZERO TO -VIPS IN VTIME SEC.  *

                    IF NATAB > 0 (OPTION 2), THE VEHICLE MOTION IS   |
                    UNIDIRECTIONAL AND NATAB VALUES OF LINEAR        |
                    DECELERATION ARE TO BE SUPPLIED ON CARDS C.3.    |
                    NATAB SHOULD BE ODD, MAXIMUM VALUE IS 99.        |

                    IF NATAB < 0 (OPTIONS 3 AND 4), THE PRESCRIBED   *
                    MOTION IS SPECIFIED ON EITHER CARDS C.4 OR C.5.  *
                    HERE MATAB (= -NATAB) IS THE NUMBER OF TIME      |
                    POINTS OF ACCELERATION DATA TO BE SUPPLIED ON    |
                    CARD C.4 OR COMPUTED FROM THE SPLINE FIT DATA    *
                    ON CARDS C.5. MAXIMUM VALUE OF MATAB IS 101.     *

    AT0,ATD         THE FIRST TIME AND FIXED TIME INTERVAL (SEC)     |
                    FOR THE TABLE OF ACCELERATION DATA THAT FOR      |
                    (OPTION 3) IS TO BE SUPPLIED ON CARDS C.4, OR    |
                    (OPTION 4) IS TO BE COMPUTED FROM THE SPLINE     *
                    FIT DATA TO BE SUPPLIED ON CARDS C.5.            *
```

MSEG — THE SEGMENT NUMBER ASSOCIATED WITH THIS PRE- *
SCRIBED DECELERATION TIME HISTORY. IF MSEG IS *
LESS THAN OR EQUAL TO NSEG (CARD B.1), THE *
MOTION OF SEGMENT NO. MSEG AS DEFINED ON CARDS *
B.2 WILL BE PRESCRIBED (NOTE: EXTREME CAUTION *
MUST BE EXERCISED IN USING THIS OPTION.) *
IF MSEG > NSEG, THE SETS MUST BE SUPPLIED IN *
THE ORDER MSEG=NSEG+1, NSEG+2, ETC., TO PRE- *
SCRIBE THE MOTION OF SECONDARY VEHICLE SEGMENTS. *
IF MSEG = 0, THIS IS THE LAST (OR ONLY) SET OF *
C CARDS TO BE SUPPLIED TO PRESCRIBE THE MOTION *
OF THE PRIMARY VEHICLE WHOSE SEGMENT NO. WILL *
BE ONE GREATER THAN NSEG OR THE LAST VALUE OF *
MSEG THAT WAS GREATER THAN NSEG. *

CARD C.2.B — FORMAT (3I6, 22X, 3F10.0) $

THIS CARD IS REQUIRED ONLY IF NATAB < 0 (OPTIONS 3 AND 4) $
NOTE: THIS CARD WAS ADDED FOR VERSION 18 OF THE CVS PROGRAM TO SUPPLY $
THE INITIAL ANGULAR VELOCITY AND REVISED FOR VERSION 19. A BLANK CARD $
SHOULD BE INSERTED HERE FOR ANY PREVIOUS INPUT DATA DECKS THAT UTILIZED $
THE SIX DEGREE OF FREEDOM OPTION ON CARDS C.4. $

LTYPE — OPTION 3: SUPPLY A VALUE OF ZERO OR BLANK FOR $
THE SIX DEGREE OF FREEDOM INPUT ON CARDS C.4. $
OPTION 4: A VALUE OF 1,2 OR 3 SPECIFIES THAT *
THE TABLES TO BE SUPPLIED ON CARDS C.5 ARE *
(1) POSITION, (2) VELOCITY OR (3) ACCELERATION *
DATA FOR EACH TIME POINT. *

LFIT — THE DEGREE OF THE POLYNOMIALS TO BE SPLINE *
FITTED THROUGH THE TIME POINT DATA ON CARDS D.5. *
A VALUE OF 0, 1, 2 OR 3 MAY BE USED BUT THE *
DEGREE SHOULD BE SUFFICIENT TO PRODUCE CONT- *
INUITY FOR THE COMPUTED VELOCITY VALUES. *
FOR LTYPE = 1, SUPPLY LFIT = 2 OR 3. *
FOR LTYPE = 2, SUPPLY LFIT = 1,2 OR 3. *
FOR LTYPE = 3, SUPPLY LFIT = 0,1,2 OR 3. *
NOTE: FOR LFIT = 0, A CONSTANT VALUE IS *
ASSUMED FROM THE CURRENT TIME VALUE TO THE *
NEXT TIME VALUE BUT ROUND OFF ERRORS IN *
TIME COMPUTATIONS MAY NOT PRODUCE THE TIME *
DESIRED. *

NPTS — THE NUMBER OF ACTUAL TIME POINT DATA TO BE *
SUPPLIED ON CARDS C.5. *

VMEG(I),I=1,3 — THE THREE COMPONENTS OF THE INITIAL ANGULAR $
VELOCITY (DEG/SEC) ABOUT THE LOCAL X, Y AND $
Z AXES OF THE VEHICLE. $

CARDS C.3.A - C.3.N FORMAT (12F6.0)

THESE CARDS ARE REQUIRED ONLY IF NATAB > 0 (OPTION 2)

DEC(I),I=1,NATAB — THE VALUES OF DECELERATION (G'S) OF THE VEHICLE FOR THE NATAB EQUALLY SPACED TIME POINTS

T(I) = ATO + (I-1)*ADT FOR I=1,NATAB.

SUPPLY 12 VALUES PER CARD, USE AS MANY CARDS AS NECESSARY. SINCE A SIMPSON'S INTEGRATION IS USED TO COMPUTE VELOCITY AND POSITION, THE VALUE OF NATAB MUST BE ODD. THE LAST VALUE, ATAB(1,NATAB) WILL BE USED TO INTEGRATE FOR ANY TIME GREATER THAN T(NATAB-1).

CARDS C.4.A - C.4.M FORMAT (10X, 6F10.0)

THESE CARDS ARE REQUIRED IF NATAB<0 AND LTYPE=0 (OPTION 3)

MATAB CARDS ARE REQUIRED WHERE MATAB = -NATAB. EACH CARD (I) WILL CONTAIN DATA FOR EQUALLY SPACED TIME POINTS T(I), WHERE

T(I) = ATO + (I-1)*ADT FOR I=1,MATAB.

ATAB(J,I),J=1,3 — THE X,Y AND Z COMPONENTS (G'S) OF THE LINEAR DECELERATION OF THE VEHICLE ORIGIN AT TIME T(I).

ATAB(J,I),J=4,6 — THE ANGULAR ACCELERATIONS (DEG/SEC**2) ABOUT THE LOCAL X,Y AND Z AXES OF THE VEHICLE AT T(I).

NOTE: THE PROGRAM WILL INTEGRATE FOR VELOCITY AND POSITION BEYOND THE LAST TIME POINT USING THE VALUES AT THAT POINT. THE PROGRAM WILL PRINT AT INPUT TIME A COMPLETE TABLE OF THE INTEGRATED VELOCITY AND POSITION FROM THE SUPPLIED ACCELERATION DATA. THE INTEGRATION PROCEDURE IS NOT IDENTICAL TO THE PROGRAM INTEGRATOR.

```
CARDS C.5.A -C.5.M        FORMAT (7F10.0)                                    *

    THESE CARDS ARE REQUIRED IF NATAB<0 AND LTYPE>0 (OPTION 4)               *

    (LTYPE-1) CARDS ARE REQUIRED FIRST TO SET INITIAL CONDITIONS             *
    FOLLOWED BY NPTS CARDS CONTAINING TIME POINT DATA.                       *

IF LTYPE=1, THE INPUT TABLE IS POSITION DATA FOR NPTS TIME POINTS.           *

IF LTYPE=2, THE FIRST CARD IS THE INITIAL POSITION DATA, WHICH IS            *
FOLLOWED BY THE INPUT TABLE OF VELOCITY DATA FOR NPTS TIME POINTS.           *

IF LTYPE=3, THE FIRST CARD IS THE INITIAL POSITION DATA, THE SECOND          *
CARD IS THE INITIAL VELOCITY DATA, WHICH IS FOLLOWED BY THE INPUT            *
TABLE OF ACCELERATION DATA FOR NPTS TIME POINTS.                             *

    T(I)                THE TIME (SEC) FOR THE DATA ON THIS CARD.            *
                        IF THIS CARD IS FOR INITIAL CONDITION DATA,          *
                        T(1) SHOULD BE ZERO OR BLANK, THE TIMES              *
                        SHOULD BE IN ASCENDING ORDER BUT DO NOT              *
                        HAVE TO BE EQUALLY SPACED.                           *

    XYZ(J,I),J=1,3      IF POSITION DATA, THE X,Y AND Z COORDINATES          *
                        (IN) OF THE VEHICLE ORIGIN IN THE INERTIAL           *
                        REFERENCE COORDINATE SYSTEM FOR TIME T(I).           *
                        IF VELOCITY DATA, THE X,Y AND Z COMPONENTS           *
                        (IN/SEC) OF VELOCITY OF THE VEHICLE ORIGIN           *
                        IN INERTIAL REFERENCE FOR TIME T(I).                 *
                        IF ACCELERATION DATA, THE X,Y AND Z COMPONENTS       *
                        (IN/SEC**2) OF THE DECELERATION OF THE VEHICLE       *
                        ORIGIN IN INERTIAL REFERENCE FOR TIME T(I).          *

    XYZ(J,I),J=4,6      IF POSITION DATA, THE YAW, PITCH AND ROLL (DEG)      *
                        OF THE VEHICLE COORDINATE REFERENCE AXES WITH        *
                        RESPECT TO THE INERTIAL REFERENCE.                   *
                        IF VELOCITY DATA, THE COMPONENTS OF ANGULAR          *
                        VELOCITY (DEG/SEC) ABOUT THE LOCAL X,Y,Z AXES.       *
                        IF ACCELERATION DATA, THE COMPONENTS OF ANGULAR      *
                        ACCELERATION (DEG/SEC**2) ABOUT THE LOCAL            *
                        X,Y AND Z AXES.                                      *

NOTE: THE PROGRAM WILL SPLINE FIT THE NPTS DATA POINTS FOR EACH OF THE       *
SIX COMPONENTS INDEPENDENTLY TO PRODUCE A PIECE-WISE SET OF POLYNOMIALS      *
OF DEGREE LFIT. THESE POLYNOMIALS ARE THEN EVALUATED TO PRODUCE A SET        *
OF ACCELERATION TABLES AT MATAB(= -NATAB) EQUALLY SPACED TIME POINTS         *
EQUIVALENT TO THE SIX DEGREE OF FREEDOM (OPTION 3) DATA OF CARDS C.4.        *
THE PROGRAM WILL THEN PRINT AT INPUT TIME A COMPLETE TABLE OF THE            *
INTEGRATED VELOCITY AND POSITION FROM THESE GENERATED ACCELERATION           *
DATA. THE INTEGRATION PROCEDURE USED IS NOT IDENTICAL TO THE PROGRAM         *
INTEGRATOR.                                                                  *
```

D. SUBROUTINE SINPUT

CARD D.1	FORMAT (10I6)
NPL	THE NUMBER OF PLANES DESCRIBING CONTACT PANELS (30 MAXIMUM).
NBLT	THE NUMBER OF BELTS USED TO RESTRAIN THE CRASH VICTIM (8 MAXIMUM).
NBAG	THE NUMBER OF AIRBAGS USED TO RESTRAIN THE CRASH VICTIM (MAX = 5, MAX NSEG+NBAG = 20).
NELP	THE NUMBER OF CONTACT ELLIPSOIDS TO BE SUPPLIED ON CARDS D.5 (40 MAXIMUM).
NQ	THE NUMBER OF CONSTRAINTS TO BE SUPPLIED ON CARDS D.6. EACH CONSTRAINT TYPE 5 WILL BE CONSIDERED AS TWO CONSTRAINTS REQUIRING TWO SETS OF CARDS (NOTE: THE PROGRAM WILL LATER INCREMENT NQ BY 1 FOR EACH NF(1) = 0 ON CARDS F.1.B AND F.3.B AND THE FINAL MAXIMUM ON NQ IS 12).
NSD	THE NUMBER OF SPRING DAMPERS TO BE SUPPLIED ON CARDS D.8 (20 MAXIMUM).
NHRNSS	NUMBER OF HARNESS-BELT SYSTEMS TO BE SUPPLIED ON CARDS F.8.B-F.8.D. MAY BE ZERO OR BLANK. MAXIMUM VALUE = 5. NOTE: IN VERSION 12 (FOR WPAFB) THIS VARIABLE WAS SUPPLIED ON CARD F.8.A.
NWINDF	THE NUMBER OF WIND FORCE FUNCTIONS TO BE SUPPLIED ON CARDS E.6.A-E.6.N. MAY BE ZERO. NOTE: IN VERSION 12, THIS VARIABLE WAS SUPPLIED ON CARD E.5.
NJNTF	THE NUMBER OF JOINT RESTORING FORCE FUNCTIONS TO BE SUPPLIED ON CARDS E.7.A-E.7.N. MAY BE BLANK OR ZERO. NOTE: IN VERSION 12, THIS VARIABLE WAS SUPPLIED ON CARD E.5.
NFORCE	THE NUMBER OF FORCE FUNCTIONS TO BE SUPPLIED ON CARDS D.9.

IF NPL IS NONZERO ON CARD D.1, NPL SETS OF CARDS D.2 ARE REQUIRED.

CARD D.2.A	FORMAT (I4, 4X, 5A4)
J	THE PLANE IDENTIFICATION NUMBER, MUST BE SUPPLIED AS CONSECUTIVE INTEGERS 1 TO NPL.
PLTTL(I,J),I=1,5	A 20 CHARACTER DESCRIPTION OF THE JTH PANEL.
CARDS D.2.B - D.2.D	FORMAT (3F12.0)
P1(I),I=1,3	THE X,Y AND Z COORDINATES OF POINT P1 IN VEHICLE (OR SEGMENT TO WHICH PLANE IS ATTACHED) REFERENCE (IN).
P2(I),I=1,3	THE X,Y AND Z COORDINATES OF POINT P2 IN VEHICLE (OR SEGMENT TO WHICH PLANE IS ATTACHED) REFERENCE (IN).
P3(I),I=1,3	THE X,Y AND Z COORDINATES OF POINT P3 IN VEHICLE (OR SEGMENT TO WHICH PLANE IS ATTACHED) REFERENCE (IN).

WHERE P1, P2 AND P3 ARE THREE OF THE CORNERS OF A PARALLELOGRAM SUCH THAT THE EDGE P1P2 IS LESS THAN 180 DEGREES CLOCKWISE (AS VIEWED FROM THE EXTERNAL SURFACE) FROM THE EDGE P1P3. NOTE: ANY PREVIOUS INPUT DECK IN WHICH THE VECTOR P2-P1 IS NOT PERPENDICULAR TO THE VECTOR P3-P1 WILL NOW PRODUCE DIFFERENT RESULTS.

IF NBLT IS NONZERO ON CARD D.1, NBLT SETS OF CARDS D.3 ARE REQUIRED.

CARD D.3.A		FORMAT (5A4)
	BLTTTL(I,J),I=1,5	A 20 CHARACTER DESCRIPTION OF THE JTH BELT.
CARD D.3.B		FORMAT (6F12.0)
	BELT(I,J),I=1,3	X,Y, AND Z COORDINATES, IN VEHICLE (OR SEGMENT TO WHICH BELT IS ANCHORED) REFERENCE, OF ANCHOR POINT A FOR THE JTH BELT (IN).
	BELT(I,J),I=4,6	X,Y, AND Z COORDINATES, IN VEHICLE (OR SEGMENT TO WHICH BELT IS ANCHORED) REFERENCE, OF ANCHOR POINT B FOR THE JTH BELT (IN).

NOTE: THE PROGRAM MUST PASS A PLANE THROUGH THE THREE POINTS, ANCHOR POINT A, ANCHOR POINT B, AND A FIXED POINT ON THE CONTACTED BODY SEGMENT. IF ANCHOR POINTS A AND B COINCIDE, THEY MUST BE SEPARATED SLIGHTLY FOR INPUT SUCH THAT THE DESIRED BELT PLANE WILL BE DEFINED.

CARD D.3.C		FORMAT (5F12.0)
	BELT(I,J),I=7,9	X, Y, AND Z COORDINATES, IN LOCAL BODY SEGMENT REFERENCE (BUT WITH RESPECT TO ELLIPSOID CENTER, NOT C.G.), OF THE FIXED CONTACT POINT ON THE BODY SEGMENT FOR THE JTH BELT (IN).
	BELT(10,J)	CURRENTLY NOT USED BY THE PROGRAM.
	BELT(11,J)	BELT SLACK (IN). THE SLACK, WHEN ADDED TO THE INITIAL GEOMETRIC LENGTH, RESULTS IN THE INITIAL BELT LENGTH. IF DESIRED, THE INITIAL BELT LENGTH MAY BE INPUTTED AS A NEGATIVE NUMBER AND THE PROGRAM WILL COMPUTE THE SLACK.

IF NBAG IS NONZERO ON CARD D.1, NBAG SETS OF CARDS D.4 ARE REQUIRED BY SUBROUTINE AIRBG1.

CARD D.4.A		FORMAT (5A4, I4)
	BAGTTL(I,J),I=1,5	A 20 CHARACTER DESCRIPTION OF THE JTH AIR BAG.
	NPANEL(J)	NUMBER OF VEHICLE CONTACT PANELS THAT ARE ALLOWED TO INTERACT WITH THE JTH AIR BAG (MAXIMUM = 4).
CARD D.4.B		FORMAT (6F12.0)
	AB(I,J),I=1,3	THE X, Y AND Z SEMIAXES OF THE JTH AIR BAG WHEN FULLY INFLATED AND UNDEFORMED (IN).
	BFA(I,J),I=1,3	THE X,Y AND Z COORDINATES OF THE CENTER OF THE AIR BAG CONTACT ELLIPSOID WITH RESPECT TO THE AIR BAG CENTER OF GRAVITY (IN).
CARD D.4.C		FORMAT (6F12.0)
	YB,PB,RB	THE INITIAL ORIENTATION (YAW, PITCH, AND ROLL) OF THE JTH AIR BAG IN THE VEHICLE REFERENCE (DEG).
	ZDEP(I,J),I=1,3	THE X, Y, AND Z COORDINATES OF THE DEPLOYMENT POINT OF THE JTH AIR BAG IN THE LOCAL REFERENCE OF THE 1ST PANEL ON CARD D.4.G (IN).
CARD D.4.D		FORMAT (6F12.0)
	XBM(J)	WEIGHT OF AIR BAG MEMBRANE AND CONTENTS (LBS).
	CYTD(J)	GAS SUPPLY ACTUATOR FIRING TIME AFTER THE START OF VEHICLE DECELERATION (SEC).
	CYPA(J)	ATMOSPHERIC PRESSURE (PSIA).
	CYSP(J)	INITIAL GAS SUPPLY PRESSURE (PSIG).
	CYT0(J)	INITIAL GAS SUPPLY TEMPERATURE (DEG R).
	CYV0(J)	GAS SUPPLY RESERVOIR VOLUME (IN**3).

CARD D.4.E FORMAT (6F12.0)

CYCD(J)	SONIC THROAT DISCHARGE COEFFICIENT (DIMENSIONLESS).
CYK(J)	RATIO OF SPECIFIC HEATS OF SUPPLY GAS (DIMENSIONLESS).
CYR(J)	SPECIFIC GAS CONSTANT (IN/DEG R).
CYAT(J)	SONIC THROAT AREA (IN**2).
CYPV(J)	VENT PRESSURE OF THE EXHAUST ORIFICE (PSIG).
CYCDO(J)	EXHAUST ORIFICE DISCHARGE COEFFICIENT (DIMENSIONLESS).

CARD D.4.F FORMAT (5F12.0)

CYAO(J)	EXHAUST ORIFICE AREA (IN**2).
SPRK(J)	SPRING CONSTANT OF A LINEAR SPRING USED TO SIMULATE ATTACHMENT OF THE BAG AT THE DEPLOYMENT POINT IN THE VEHICLE (LB/IN).
VSCS(J)	COEFFICIENT OF SLIDING FRICTION OF THE AIR BAG (DIMENSIONLESS)
CK(J)	PARAMETER USED TO STABILIZE AIR BAG NUMERICAL INTEGRATION (SEC**-1). SUGGESTED VALUE = 250.
CMASS(J)	MULTIPLIER TO INCREASE OR DECREASE THE MASS OF THE AIR BAG TO ARTIFICIALLY DAMPEN THE INTEGRATED AIR BAG MOTION.

NPANEL(J) SETS OF THE FOLLOWING TWO CARDS ARE REQUIRED TO DEFINE THE ELLIPSOIDS USED TO APPROXIMATE THE CONTACT PANELS FOR THE JTH AIR BAG. THE FIRST PANEL IS THE REACTION PANEL.

CARD D.4.G		FORMAT (6F12.0)
	B(I,K,J),I=1,3	X, Y, AND Z SEMIAXES FOR THE KTH PANEL FOR THE JTH AIR BAG (IN).
	BFB(I,K,J),I=1,3	THE LOCATION OF THE CENTER OF THE PANEL ELLIPSOID WITH RESPECT TO ITS CENTER OF GRAVITY (IN).
CARD D.4.H		FORMAT (6F12.0)
	ZR(I,K,J),I=1,3	X, Y, AND Z COORDINATES IN VEHICLE REFERENCE OF THE CENTER OF GRAVITY OF THE KTH PANEL OF THE JTH AIR BAG (IN).
	YP,PP,RP	ANGULAR ORIENTATION, YAW,PITCH AND ROLL (DEG.), OF THE KTH PANEL WITH RESPECT TO THE VEHICLE.

IF NELP IS NONZERO ON CARD D.1, NELP D.5 CARDS ARE REQUIRED BY SUBROUTINE BINPUT.

NOTE: NELP IS THE NUMBER OF CONTACT ELLIPSOIDS TO BE SUPPLIED HERE, NOT THE NUMBER OF CONTACT ELLIPSOIDS IN THE PROGRAM. THE FIRST NSEG ELLIPSOIDS WERE SUPPLIED ON CARDS B.2.A - B.2.I WITH NO ANGULAR ROTATIONS. THEY MAY BE REPLACED HERE IF DESIRED.

CARDS D.5.A - D.5.J (NELP CARDS)	FORMAT (I6, 9F6.0)
M	CONTACT ELLIPSOID NUMBER. MAX = 40. IF M < NSEG + 1, DATA WILL REPLACE INPUT SUPPLIED ON CARDS B.2A - B.2.I. OTHERWISE, M MUST BE GREATER THAN NSEG+NBAG+1.
P1(I),I=1,3	THE X, Y, AND Z SEMIAXES OF THE CONTACT ELLIPSOID (IN).
P2(I),I=1,3	THE X, Y, AND Z COORDINATES OF THE ELLIPSOID OFFSET FROM THE SEGMENT CENTER OF GRAVITY.
P3(I),I=1,3	THE YAW, PITCH AND ROLL (DEGREES) OF THE CONTACT ELLIPSOID FROM THE PRINCIPAL AXIS OF THE SEGMENT.

IF NQ IS NONZERO ON CARD D.1, NQ D.6 CARDS ARE REQUIRED.

CARDS D.6.A - D.6.J (NQ CARDS) FORMAT (3I6, 6F6.0)

KQTYPE(J)
: TYPE NO. OF THE JTH CONSTRAINT
  1: POINT SPECIFIED BY RK1 ON SEGMENT KQ1 WILL BE CONSTRAINED TO BE THE SAME AS THE POINT SPECIFIED BY RK2 ON SEGMENT KQ2.
  2: POINT SPECIFIED BY RK1 ON SEGMENT KQ1 WILL BE CONSTRAINED TO REMAIN AT AN EQUAL DISTANCE (D > 0) FROM THE POINT SPECIFIED BY RK2 ON SEGMENT KQ2.
  5: TENSION ELEMENT CONSTRAINT CONNECTING POINT RK1 ON SEGMENT KQ1 TO POINT RK2 ON SEGMENT RK2 (REQUIRES TWO CARDS WITH KQTYPE, KQ1 AND KQ2 THE SAME ON BOTH).

KQ1(J)
: SEGMENT IDENTIFICATION NUMBER OF THE 1ST SPECIFIED POINT.

KQ2(J)
: SEGMENT IDENTIFICATION NUMBER OF THE 2ND SPECIFIED POINT.

RK1(I,J),I=1,3
: COORDINATES OF SPECIFIED POINT ON SEGMENT KQ1 (IN). IF KQTYPE = 5, THE SECOND CARD WILL CONTAIN THE EFFECTIVE MASSES MA, MB AND MAB (LB.SEC**2/IN) IN PLACE OF RK1.

RK2(I,J),I=1,3
: COORDINATES OF SPECIFIED POINT ON SEGMENT KQ2 (IN). IF KQTYPE = 5, THE SECOND CARD WILL CONTAIN THE SPRING CONSTANT K (LB/IN), THE VISCOUS DAMPING CONSTANT D (LB SEC/IN) AND THE REFERENCE LENGTH L (IN) IN PLACE OF RK2. NOTE: IF KQTYPE = 1 AND KQ2 IS THE NUMBER FOR THE VEHICLE, THEN SUBROUTINE EQUILB WILL MODIFY THESE VALUES OF RK2 SUCH THAT THEY WILL BE EQUIVALENT TO RK1 IN INERTIAL REFERENCE FOR TIME ZERO. (SEE DESCRIPTION UNDER CARDS G.6.)

CARD D.7 IS ALWAYS REQUIRED. SUPPLY BLANK CARD FOR NORMAL 3D MOTION.

CARD D.7	FORMAT (18I4)	IF NSEG>18, USE 2 CARDS.

NSYM(J),J=1,NSEG — CONTROLS SYMMETRY OPTION OF BODY SEGMENTS AS FOLLOWS :

NSYM(J) = 0 : NORMAL THREE DIMENSIONAL MOTION FOR BODY SEGMENT J.

NSYM(J) = J : MOTION OF BODY SEGMENT J WILL BE RESTRICTED TO THE X-Z PLANE WITH NO LATERAL MOTION, HENCE IT WILL BE TWO DIMENSIONAL.

NSYM(J) = K : BODY SEGMENTS J AND K ARE TO REMAIN SYMMETRICAL WITH NO LATERAL MOTION. THE MOTION OF EACH WILL BE REPLACED WITH THEIR AVERAGE AND RESTRICTED TO THE LOCAL X-Z PLANE. NSYM(K) MUST EQUAL J.

NSYM(J) = -K : BODY SEGMENTS J AND K ARE TO REMAIN MIRROR SYMMETRICAL WITH RESPECT TO THE X-Z PLANE. EQUAL BUT OPPOSITE LATERAL MOTION IS PERMITTED. NSYM(K) MUST EQUAL -J.

NOTE : IN THE ABOVE SYMMETRY OPTIONS, THE USER MUST TAKE EXTREME CARE THAT ALL INPUT WILL ALLOW THE SYMMETRY TO EXIST.

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IF NSD IS NONZERO ON CARD D.1, NSD D.8 CARDS ARE REQUIRED.                    |

CARDS D.8.A - D.8.J        FORMAT (2I3, 11F6.0)
     (NSD CARDS)

    MSDM(J)                SEGMENT IDENTIFICATION NUMBERS (M AND N)
    MSDN(J)                TO WHICH THE JTH SPRING DAMPER IS ATTACHED.

    APSDM(I,J),I=1,3       COORDINATES OF ATTACHMENT POINTS IN LOCAL
    APSDN(I,J),I=1,3       SEGMENT REFERENCE ON SEGMENTS M AND N FOR
                           THE JTH SPRING DAMPER (IN.)

    ASD(I,J),I=1,5         COEFFICIENTS OF QUADRATIC FUNCTIONS TO
 I=1 : D0 (IN)             COMPUTE THE SPRING FORCE (FS) AND THE
 I=2 : A1 (LB/IN)          VISCOUS FORCE (FD) FOR THE JTH SPRING
 I=3 : A2 (LB/IN**2)       DAMPER USING THE RELATIONSHIPS
 I=4 : B1 (LB SEC/IN)
 I=5 : B2 (LB SEC**2/IN**2)
                                   FS= (D-D0)*(|A1| + A2*|D-D0|)
                                   FD=       DV*( B1  + B2*|DV|)

                           WHERE D AND DV ARE THE DISTANCE AND ITS TIME
                           DERIVATIVE BETWEEN THE POINTS APSDM AND APSDN.

THE FOLLOWING OPTIONS ARE AVAILABLE:                                          |
(1) IF A1<0 AND (D-D0)<0, THE PROGRAM WILL SET FS=0 AND FD=0,                 |
    I.E., THIS WILL ACT AS A TENSION ELEMENT.                                 |
(2) IF D0<0 AND (D-|D0|)<0 OR A2=0                                            *
    A. IF A1=0, PROGRAM WILL SET FS=0.                                        *
       IF A1#0, A1 WILL BE A FUNCTION NUMBER (A POSITIVE REAL INTEGER)        *
       TO INDICATE THAT FD WILL BE EVALUATED AS A FUNCTION OF                 *
       (D-|D0|) USING FUNCTION NO. A1 DEFINED ON CARDS E.                     *
    B. IF B1=0, PROGRAM WILL SET FD=0.                                        *
       IF B1#0, FD WILL BE COMPUTED AS FS ABOVE BY FUNCTION NO. B1.           *

IF NFORCE IS NONZERO ON CARD D.1, NFORCE D.9 CARDS ARE REQUIRED.              *

CARDS D.9.A - D.9.J        FORMAT (2I6, 6F10.0)                               *
     (NFORCE CARDS)                                                           *

    NFVSEG(J)              THE IDENTIFICATION NUMBER OF THE SEGMENT TO        *
                           WHICH THE JTH FORCE FUNCTION IS TO BE APPLIED.     *

    NFVNT(J)               THE IDENTIFICATION NUMBER OF THE FUNCTION          *
                           ON CARDS E THAT DEFINES THE FORCE (LBS) AS         *
                           A FUNCTION OF TIME (SEC).                          *

    X,Y,Z                  THE COORDINATES (IN) OF THE POINT  (LOCAL          *
                           REFERENCE) ON SEGMENT NFVSEG AT WHICH THE          *
                           FORCE IS TO BE APPLIED.                            *

    Y,P,R                  THE YAW, PITCH AND ROLL (DEGREES) OF THE           *
                           DIRECTION OF THE FORCE WITH RESPECT TO THE         *
                           LOCAL REFERENCE OF SEGMENT NFVSEG.                 *
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E. SUBROUTINE CINPUT (FUNCTIONS INPUT)

THESE FUNCTIONS ARE REFERRED TO BY NUMBER IN THE NF ARRAYS REQUIRED ON CARDS F.1.B, F.2.B, F.3.B AND F.4.B. THEY ARE USED TO DEFINE THE FORCE DEFLECTION, INERTIAL SPIKE, R (ENERGY ABSORPTION) FACTOR, G (DEFLECTION) FACTOR AND FRICTION COEFFICENT FUNCTIONS.

EACH FUNCTION MAY BE SUBDIVIDED, IF DESIRED, INTO TWO SEPARATE PARTS, F1 AND F2, WHERE

F1(D) IS DEFINED FOR 0 .LE. D0 .LE. D .LE. |D1|

F2(D) IS DEFINED FOR |D1| .LE. D .LE. |D2|.

IN ADDITION, EACH PART OF A FUNCTION MAY BE DEFINED BY EITHER OF THREE FUNCTIONAL FORMS: CONSTANT VALUE, TABULAR DATA OR A FIFTH DEGREE POLYNOMIAL. THE EXISTENCE AND FORM OF EACH PART IS DETERMINED BY THE SUPPLIED VALUES OF D0, D1 AND D2 AS FOLLOWS:

F1	F2	D0	D1	D2
CONSTANT	-	0	0	F1 = D2
TABULAR	-	D0 .GE. 0	D1 .LT. 0	0
POLYNOMIAL	-	D0 .GE. 0	D1 .GT. 0	0
TABULAR	POLYNOMIAL	D0 .GE. 0	D1 .LT. 0	D2 .GT. 0
POLYNOMIAL	TABULAR	D0 .GE. 0	D1 .GT. 0	D2 .LT. 0
POLYNOMIAL	POLYNOMIAL	D0 .GE. 0	D1 .GT. 0	D2 .GT. 0

THE CONSTANT FORM IS APPLICABLE TO F1 ONLY BECAUSE THE ROUTINES ASSUME

IF D .GT. |D2| THEN F(D) = F(|D2|) FOR D2 .NE. 0 OR

IF D .GT. |D1| THEN F(D) = F(|D1|) FOR D2 = 0.

THE CASE OF BOTH F1 AND F2 BEING TABULAR IS UNNECESSARY.

A MAXIMUM OF 50 FUNCTIONS MAY BE SUPPLIED TO THE PROGRAM. THESE FUNCTIONS MAY BE OF THE TYPES DESCRIBED ON EITHER CARDS E.1-E.4, CARDS E.6 OR CARDS E.7.

CARD E.1	FORMAT (I4, 4X, 5A4)
I	THE FUNCTION IDENTIFYING NUMBER. THESE NUMBERS NEED NOT BE SUPPLIED IN NUMERIC ORDER. IF THE SAME NUMBER IS USED MORE THAN ONCE, A WARNING WILL BE PRINTED AND THE LAST ONE SUPPLIED WILL BE USED. THE END OF THE FUNCTION INPUT IS INDICATED BY SUPPLYING A SINGLE CARD WITH I > 50.
KTITLE	A 20 CHARACTER ALPHANUMERIC TITLE DESCRIBING THE FUNCTION.

CARD E.2 FORMAT (5F12.0)

D0 — THE LOWER ABSCISSA VALUE OF THE FIRST PART (F1) OF THE FUNCTION. UNITS ARE DEPENDENT ON USAGE OF THE FUNCTION, I.E. IN. FOR DEFLECTION, IN./IN. FOR STRESS-STRAIN, IN/SEC FOR RATE DEPENDENT FUNCTIONS. NORMALLY A VALUE OF ZERO IS USED FOR FORCE DEFLECTION FUNCTIONS. A NEGATIVE VALUE MAY BE SUPPLIED FOR RATE DEPENDENT FUNCTIONS.

D1 — THE MAGNITUDE OF D1 IS THE UPPER ABSCISSA VALUE OF F1 AND THE LOWER ABSCISSA VALUE OF F2, IF ANY. D1 < 0 INDICATES F1 IS TABULAR, D1 > 0 INDICATES F1 IS A POLYNOMIAL, AND D1 = 0 INDICATES F1 = D2, A CONSTANT.

D2 — IF D1 = 0, D2 IS THE CONSTANT VALUE OF F1. OTHERWISE, THE MAGNITUDE OF D2 IS THE UPPER ABSCISSA VALUE OF F2. IF D2 = 0, F2 IS NOT DEFINED; IF D2 IS NEGATIVE, F2 IS TABULAR; AND IF D2 IS POSITIVE, F2 IS A POLYNOMIAL.

D3 — IF THE FUNCTION IS TO BE USED FOR AN INERTIAL SPIKE, D3 REPRESENTS THE ABSCISSA VALUE FOR WHICH THE INERTIAL SPIKE IS TO BE IGNORED IF UNLOADING OCCURS AFTER DEFLECTION EXCEEDS D3. IF THE FUNCTION IS TO BE USED FOR A COEFFICIENT OF FRICTION, D3 = (1+U)/2 WHERE U IS THE COEFFICIENT OF RESTITUTION FOR THE IMPULSE OPTION (0<D3<1 OR -1<U<+1). A VALUE OF D3 = 0 MEANS THAT THE IMPULSE OPTION WILL NOT BE USED FOR THOSE CONTACTS USING THIS FUNCTION. WHEN THE GLOBALGRAPHIC OPTION IS USED, A FRICTION FUNCTION IS DEFINED AND THE VALUE OF D3 IS USED TO SPECIFY THE IMPULSE. (SEE CARD B.5.)

D4 — IF THE FUNCTION IS TO BE USED AS A FORCE DEFLECTION FUNCTION BY SUBROUTINE PLELP, D4=RHO, THE SCALAR THAT DETERMINES THE POINT OF FORCE APPLICATION. SUPPLY ZERO FOR POINT OF MAXIMUM PENETRATION, ONE FOR CENTER OF INTERSECTION ELLIPSE. IF USED AS THE FRICTION FUNCTION FOR A ROLL-SLIDE CONSTRAINT. D4 IS THE COEFFICIENT OF STATIC FRICTION TO BE USED FOR THE ROLL CONSTRAINT.

THE DEFINITIONS OF F1 AND F2, IF THEY EXIST, ARE NOW SUPPLIED ON CARD E.3 FOR THE FIFTH DEGREE POLYNOMIAL DEFINITION, OR ON CARDS E.4 FOR THE TABULAR DEFINITION.

CARD E.3	FORMAT (6F12.0)
A0,A1,A2,A3,A4,A5	COEFFICIENTS OF FIFTH-DEGREE POLYNOMIAL F = A0 + A1*X + A2*X**2 + A3*X**3 + A4*X**4 + A5*X**5 (UNITS ARE DEPENDENT ON USE OF FUNCTION.)
CARD E.4.A	FORMAT (I6)
NPI	THE NUMBER OF DATA POINTS TO BE SUPPLIED TO IDENTIFY THE FUNCTION IF IT IS DEFINED IN TABULAR FORM.
CARDS E.4.B - E.4.N	FORMAT (6F12.0)
(X(I),Y(I),I=1,NPI)	THE ABSCISSA AND ORDINATE VALUES OF THE DATA POINTS USED TO DEFINE THE TABULAR FORM OF THE FUNCTION. THE PROGRAM WILL LINEARLY INTERPOLATE TO DETERMINE INTERMEDIATE VALUES. SUPPLY 3 POINTS PER CARD; USE AS MANY CARDS AS REQUIRED. (UNITS ARE DEPENDENT ON USE OF FUNCTION.)

NOTE: ALWAYS SUPPLY A CARD E.1 WITH A FUNCTION NUMBER > 50 AFTER ALL FUNCTIONS ARE DEFINED TO SIGNAL THE END OF FUNCTION INPUTS.

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SUBROUTINE KINPUT (WIND FORCE AND JOINT RESTORING FORCE FUNCTIONS)

NOTE: CARD E.5, PREVIOUSLY REQUIRED FOR VERSION 12 (WPAFB CONTRACT
NO. F33615-75-C-5002 AS DOCUMENTED IN REPORT NO. AMRL-TR-75-14) IS
NO LONGER REQUIRED. THE VARIABLES NWINDF AND NJNTF ARE NOW SUPPLIED
ON CARD D.1.

IF NWINDF=0 ON CARD D.1, CARDS E.6 ARE NOT REQUIRED. OTHERWISE,
NWINDF SETS OF CARDS E.6.A - E.6.N ARE REQUIRED.

CARD E.6.A               FORMAT (I4, 4X, 5A4)

    I,KTITLE             SAME AS CARD E.1 EXCEPT THAT EACH FUNCTION
                         NUMBER (I) MUST BE LESS THAN 51 AND MUST BE
                         DISTINCT FROM THOSE SUPPLIED ON CARDS E.1.

CARD E.6.B               FORMAT (5F12.0)

    D0,D1,D2,D3,D4       CURRENTLY NOT USED BY PROGRAM.

CARD E.6.C               FORMAT (I6)

    NTMPTS               THE NUMBER OF TIME POINTS OR CARDS REQUIRED
                         TO DEFINE THIS FUNCTION ON CARDS E.6.D-E.6.N.

CARDS E.6.D - E.6.N      FORMAT (4F12.0)
   (NTMPTS CARDS)

    T                    TIME (SEC.) SINCE INITIAL PENETRATION OF
                         BOUNDARY PLANE. VALUES SHOULD BE IN ASCENDING
                         ORDER WITH FIRST VALUE EQUAL TO ZERO.

    FX,FY,FZ             THE X,Y AND Z COMPONENTS OF FORCE PER UNIT
                         AREA (LBS./IN.**2) IN INERTIAL REFERENCE
                         DUE TO THE WIND BLAST FORCE AT TIME T. THE
                         PROGRAM WILL USE LINEAR INTERPOLATION ON T.
                         IF LAST VALUE OF T IS EXCEEDED, THE LAST
                         VALUES OF FX,FY AND FZ WILL BE USED.
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                                                                         *
IF NJNTF=0 ON CARD D.1, CARDS E.7 ARE NOT REQUIRED. OTHERWISE,           *
NJNTF (FROM CARD D.1) SETS OF CARDS E.7.A - E.7.N ARE REQUIRED.          *
                                                                         *
CARD E.7.A                   FORMAT (I4, 4X, 5A4)                        *
                                                                         *
    I,KTITLE                 SAME AS CARD E.1 EXCEPT THAT EACH FUNCTION  *
                             NUMBER (I) MUST BE LESS THAN 51 AND MUST BE *
                             DISTINCT FROM THOSE SUPPLIED ON CARDS E.1   *
                             OR CARDS E.6.A.                             *
                                                                         *
CARD E.7.B                   FORMAT (5F12.0)                             *
                                                                         *
    D0,D1,D2,D3,D4           CURRENTLY NOT USED BY PROGRAM.              *
                                                                         *
CARD E.7.C                   FORMAT (2I6)                                *
                                                                         *
    NTHETA                   MAGNITUDE INDICATES THE NUMBER OF COLUMNS   *
                             IN THE TWO DIMENSIONAL INPUT DATA MATRIX    *
                             TO BE SUPPLIED ON CARDS E.7.D-E.7.N. THE    *
                             MINIMUM VALUE IS 2. IF POSITIVE, THE NTHETA *
                             ENTRIES IN EACH ROW WILL BE TABULAR DATA FOR *
                             EQUALLY SPACED VALUES OF THE JOINT FLEXURE  *
                             ANGLE (THETA) BETWEEN 0 AND 180 DEGREES.    *
                             IF NEGATIVE, THE ENTRIES WILL REPRESENT THE *
                             COEFFICIENTS OF A (-NTHETA-1) ORDER         *
                             POLYNOMIAL IN (THETA-THETA0)                *
                                                                         *
    NPHI                     NUMBER OF ROWS OF MATRIX OF DATA TO BE SUPPLIED *
                             ON CARDS E.7.D-E.7.N. EACH ROW REPRESENTS   *
                             EQUALLY SPACED VALUES OF THE JOINT AZIMUTH  *
                             ANGLE (PHI) BETWEEN -180 AND +180 DEGREES,  *
                             BUT DOES NOT INCLUDE THE LAST ROW SINCE THE *
                             PROGRAM ASSUMES DATA FOR PHI(NPHI+1)=180 ARE *
                             THE SAME AS FOR PHI(1)=-180. MINIMUM = 1.   *
                                                                         *
CARDS E.7.D - E.7.N          FORMAT (5F12.0)                             *
(NPHI SETS OF CARDS. USE EXTRA CARDS PER SET IF |NTHETA| > 5.)           *
                                                                         *
    THETA0                   THE VALUE OF THE "DEAD BAND" ZONE FOR THIS  *
                             VALUE OF PHI (DEGREES). IF THE FLEXURE      *
                             ANGLE (THETA) IS LESS THAN THETA0, THE      *
                             JOINT RESTORING FORCE WILL BE ZERO.         *
                                                                         *
    F(J),J=2,NTHETA          FOR NTHETA POSITIVE, TABULAR VALUES OF THE  *
                             JOINT RESTORING FORCE FOR FLEXURE ANGLES    *
                                                                         *
                              THETA(J) = (J-1)*180/(NTHETA-1) DEGREES    *
                                                                         *
                             VALUES OF ZERO SHOULD BE SUPPLIED FOR       *
                             THETA < THETA0.                             *
                             FOR NTHETA NEGATIVE, THE COEFFICIENTS OF A  *
                             POLYNOMIAL IN (THETA-THETA0) OF ORDER ONE   *
                             LESS THAN THE MAGNITUDE OF NTHETA. F(J) IS  *
                             THE COEFFICIENT OF (THETA-THETA0)**(J-1)    *
                             WHERE (THETA-THETA0) IS EXPRESSED IN RADIANS. *
                             F(1) IS ASSUMED TO BE ZERO.                 *
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F. SUBROUTINE FINPUT (ALLOWED CONTACTS)

IF NPL IS NONZERO ON CARD D.1, CARDS F.1 ARE REQUIRED.

CARD F.1.A FORMAT (18I4) IF NPL>18, USE 2 CARDS.

MNPL(J),J=1,NPL — FOR PLANE J, THE NUMBER OF SEGMENTS FOR WHICH SEGMENT-PLANE CONTACT IS ALLOWED. NPL IS THE NUMBER OF PLANES FROM CARD D.1. THE VALUE OF ANY MNPL FOR PLANE J MAY BE ZERO AND THE MAXIMUM VALUE IS 5. HOWEVER IF IT IS REQUIRED TO HAVE MORE THAN 5 SEGMENTS CONTACT THE SAME PLANE, SET UP TWO OR MORE IDENTICAL PLANES AND PERMIT A MAXIMUM OF 5 SEGMENTS TO CONTACT EACH PLANE.

FOR EACH PLANE J, MNPL(J) CARDS OF THE FOLLOWING MUST BE SUPPLIED.

CARDS F.1.B - F.1.N FORMAT (9I4)

NJ — THE PLANE NUMBER FOR WHICH CONTACT IS ALLOWED. NJ MUST CORRESPOND TO J ABOVE. THERE MUST BE MNPL(J) CARDS WITH THIS SAME NJ. IF MNPL(J) = 0, NO NJ = J SHOULD BE PRESENT.

NS(1) — THE SEGMENT NUMBER TO WHICH PLANE J IS ATTACHED. IF VEHICLE, SUPPLY NSEG+1, IF GROUND, SUPPLY NSEG+NBAG+2. $

NS(2) — THE SEGMENT NUMBER (DETERMINED BY THE CARD NUMBER I UNDER CARD B.2.A) FOR WHICH CONTACT WITH THE NJTH PLANE IS ALLOWED.

NS(3) — THE NUMBER OF THE CONTACT ELLIPSOID ASSOCIATED WITH THE SEGMENT NS(2).

NF(1)	THE FUNCTION NO. FROM CARD E.1 TO DEFINE THE FORCE DEFLECTION FUNCTION FOR THIS CONTACT. IF NF(1)=0, A ROLL-SLIDE CONSTRAINT WILL BE EXERCISED BY THE PROGRAM FOR THIS CONTACT WHICH DOES NOT REQUIRE NF(2),NF(3) OR NF(4) BUT DOES REQUIRE A FRICTION COEFFICIENT FUNCTION TO BE DEFINED BY NF(5). ALSO, THE INITIAL POSITIONS ON CARDS G.2 MUST BE SUCH THAT THERE IS NO CONTACT AT TIME = 0.	
NF(2)	THE FUNCTION NO. FROM CARD F.1 TO DEFINE THE INERTIAL SPIKE FUNCTION FOR THIS CONTACT. IF ZERO OR NEGATIVE, NO INERTIAL SPIKE EXISTS. IF NEGATIVE, THE MAGNITUDE SPECIFIES THE FUNCTION NO. FOR F2 OF THE RATE DEPENDENT FUNCTIONS DESCRIBED BELOW.	 * * * *
NF(3)	THE FUNCTION NO. FROM CARD E.1 TO DEFINE THE R (ENERGY ABSORPTION) FACTOR FUNCTION. A VALUE OF R=1 INDICATES THAT ALL ENERGY IS RECOVERED (NO LOSS) AND R=0 THAT NO ENERGY IS RECOVERED. IF ZERO OR NEGATIVE, R=1 IS ASSUMED (DEFAULT). IF NEGATIVE, THE MAGNITUDE SPECIFIES THE FUNCTION NO. FOR F3 OF THE RATE DEPENDENT FUNCTIONS DESCRIBED BELOW.	 * * * *
NF(4)	THE FUNCTION NO. FROM CARD E.1 TO DEFINE THE G (PERMANENT DEFLECTION) FACTOR FUNCTION. IF ZERO OR NEGATIVE, G=0 IS ASSUMED (DEFAULT). IF NEGATIVE, THE MAGNITUDE SPECIFIES THE FUNCTION NO. FOR F4 OF THE RATE DEPENDENT FUNCTIONS DESCRIBED BELOW.	 * * * *
NF(5)	THE FUNCTION NO. FROM CARD E.1 TO DEFINE THE FRICTION COEFFICIENT FUNCTION. IF FOR A ROLL-SLIDE CONSTRAINT (NF(1)=0), THE VALUE OF D3 ON CARD E.2 FOR THIS FUNCTION SHOULD BE 0.5.	

NOTE: RATE DEPENDENT FUNCTIONS CAN BE USED INSTEAD OF THE INERTIAL *
SPIKE, R AND G FACTORS BY DEFINING NF(2), NF(3) AND NF(4) ALL ZERO *
OR NEGATIVE. THE TOTAL FORCE DEFLECTION FUNCTION IS COMPUTED BY *
*
F(D,D') = F1(D) + F2(D)*F3(D') + F4(D') *
*
WHERE D AND D' ARE THE DEFLECTION AND RATE OF DEFLECTION; AND F1,F2, *
F3 AND F4 ARE FUNCTIONS SPECIFIED BY NF(1),NF(2),NF(3) AND NF(4). *
IF NF(2),NF(3) OR NF(4) IS ZERO, THE CORRESPONDING FUNCTION IS ZERO. *
IF D<0, THE RATE DEPENDENT FUNCTIONS ARE NOT COMPUTED AND F(D,D')=0. *
THE FUNCTIONS SHOULD BE DEFINED SUCH THAT F1(D), F2(D), D'*F3(D') *
AND D'*F4(D') ARE ALL GREATER THAN OR EQUAL TO ZERO. HENCE, F(D,D') *
MAY BE NEGATIVE IF D' IS NEGATIVE. *

IF NBLT IS NONZERO ON CARD D.1, CARDS F.2 ARE REQUIRED. |

CARD F.2.A — FORMAT (8I4)

MNBLT(J),J=1,NBLT	FOR BELT J, THE NUMBER OF SEGMENTS FOR WHICH SEGMENT-BELT INTERACTION IS ALLOWED. NBLT IS THE NUMBER OF BELTS FROM CARD D.1. EACH MNBLT MAY HAVE A VALUE OF 0 OR 1 ONLY.

FOR EACH BELT J, MNBLT(J) CARDS OF THE FOLLOWING MUST BE SUPPLIED.

CARDS F.2.B - F.2.N — FORMAT (9I4)

NJ	THE BELT NUMBER TO BE CONTACTED, MUST CORRESPOND TO J ABOVE. THERE MUST BE MNBLT(J) CARDS WITH THE SAME NJ. IF MNBLT(J) = 0, NO NJ = J SHOULD BE PRESENT.
NS(1)	THE SEGMENT NUMBER TO WHICH BELT NJ IS ATTACHED. IF VEHICLE, SUPPLY NSEG+1, IF GROUND, SUPPLY NSEG+NBAG+2. $
NS(2)	THE SEGMENT NUMBER (DETERMINED BY THE CARD NUMBER I UNDER CARD B.2.A) FOR WHICH INTERACTION WITH THE NJTH BELT IS ALLOWED.
NS(3)	THE NUMBER OF THE CONTACT ELLIPSOID ASSOCIATED WITH THE SEGMENT NS(2).
NF(1)	THE FUNCTION NUMBER FROM CARD E.1 TO DEFINE THE FORCE-DEFLECTION FUNCTION FOR THIS CONTACT. THE ABSCISSA FOR THIS FUNCTION SHOULD BE STRAIN (IN/IN).
NF(I),I=2,4	SAME DEFINITION AS ON CARD F.1.B ABOVE.
NF(5)	IF NON-ZERO, FULL BELT FRICTION IS ASSUMED, I.E., FORCES ARE COMPUTED FOR EACH HALF OF THE BELT SEPARATELY. IF ZERO, ZERO BELT FRICTION IS ASSUMED, I.E., BELT TENSION IS IS THE SAME AT BOTH BELT ANCHOR POINTS.

NOTE: THE USE OF RATE DEPENDENT FUNCTIONS AS DEFINED UNDER CARDS |
F.1.B ARE NOT CURRENTLY OPERATIONAL FOR BELT-SEGMENTS CONTACTS. |

CARD F.3.A IS ALWAYS REQUIRED. MAY BE BLANK TO SPECIFY THAT NO SEGMENT-SEGMENTS ARE TO BE COMPUTED BY THE PROGRAM.

CARD F.3.A — FORMAT (18I4) IF NSEG>18, USE TWO CARDS.

MNSEG(J),J=1,NSEG	FOR SEGMENT J, THE NUMBER OF SEGMENTS FOR WHICH SEGMENT-SEGMENT CONTACT IS ALLOWED. NSEG IS THE NUMBER OF SEGMENTS FROM CARD B.1. EACH SEGMENT CONTACT, A VERSUS B, MAY BE INPUTTED EITHER WAY EXCEPT WHERE AN INTERIOR CONTACT IS DESIRED (SEE NS(3)). ANY OR ALL VALUES OF MNSEG MAY BE ZERO. THE MAXIMUM VALUE FOR EACH MNSEG IS 5.

FOR EACH SEGMENT J, MNSEG(J) CARDS OF THE FOLLOWING MUST BE SUPPLIED.

CARDS F.3.B - F.3.N — FORMAT (9I4)

NJ	THE SEGMENT NUMBER TO BE CONTACTED, MUST CORRESPOND TO J ABOVE. THERE MUST BE MNSEG(J) CARDS WITH THIS SAME NJ. IF MNSEG(J) = 0, NO NJ = J SHOULD BE PRESENT.
NS(1)	THE NUMBER OF THE CONTACT ELLIPSOID ASSOCIATED WITH SEGMENT NJ.
NS(2)	THE SEGMENT NUMBER (DETERMINED BY THE CARD NUMBER I UNDER CARD B.2.A) FOR WHICH CONTACT WITH THE NJTH SEGMENT IS ALLOWED.
NS(3)	THE NUMBER OF THE CONTACT ELLIPSOID ASSOCIATED WITH THE SEGMENT NS(2). IF NEGATIVE, AN INTERIOR CONTACT WILL BE ASSUMED WITH ELLIPSOID NS(1) INSIDE NS(3).
NF(I),I=1,5	SAME DEFINITIONS AS ON CARD F.1.B ABOVE.

NOTE: THE USE OF RATE DEPENDENT FUNCTIONS AS DEFINED UNDER CARDS F.1.B ARE PERMISSABLE FOR SEGMENT-SEGMENT CONTACTS.

IF NJNT IS NONZERO ON CARD B.1, CARD F.4.A IS REQUIRED.
SUPPLY IGLOB=1 FOR GLOBALGRAPHIC OPTION, OTHERWISE SUPPLY 0 OR BLANK

CARD F.4.A	FORMAT (18I4) IF NJNT>18, USE TWO CARDS.
IGLOB(J),J=1,NJNT	FOR EACH JOINT J, SUPPLY 1 FOR IGLOB(J) IF IPIN(J) IS +3 OR -3 ON CARDS B.3.A - B.3.J; OTHERWISE SUPPLY ZERO OR BLANK. ONE CARD F.4.J MUST BE SUPPLIED BELOW FOR EACH J FOR WHICH IGLOB(J) =1.
CARDS F.4.B - F.4.J	FORMAT (9I4)
NJ	THE IDENTIFICATION NUMBER FOR A GLOBALGRAPHIC JOINT, MUST CORRESPOND TO J ABOVE AND CARDS MUST BE SUPPLIED IN ASCENDING ORDER ON NJ.
NS(I),I=1,3	CURRENTLY NOT USED BY PROGRAM.
NF(1)	THE FUNCTION NUMBER FROM CARD E.1 TO DEFINE THE TORQUE-DEFLECTION FOR THIS GLOBALGRAPHIC JOINT. THE ORDINATE FOR THIS FUNCTION SHOULD BE TORQUE (IN. LB.) AND THE ABSCISSA IS THE ANGULAR DEFLECTION (RADIANS) INTO THE STOP.

NF(2)

THE FUNCTION NUMBER FROM CARD E.1 TO DEFINE THE HERRON FORMULAS FOR T (JOINT STOP ANGLE IN RADIANS) AND ITS DERIVATIVE TP WITH RESPECT TO PHI BOTH AS FUNCTIONS OF PHI (THE JOINT ANGLE FROM THE REFERENCE AXIS IN RADIANS). NORMALLY THEY WILL BE COMPUTED BY

$$T = P1 + SP*P2$$
$$TP = P1' + CP*P2 + SP*P2'$$

WHERE P1,P2 ARE THE 5TH DEGREE POLYNOMIAL EVALUATIONS OF COS(PHI) USING THE TWO POLYNOMIALS F1 AND F2 OBTAINED BY SETTING BOTH D1,D2 > 0 ON CARD E.2;

P1',P2' ARE THEIR DERIVATIVES WITH RESPECT TO PHI;

AND CP,SP ARE COS(PHI) AND SIN(PHI).

IF D1,D2 ARE NOT BOTH POSITIVE, T AND TP WILL BE EVALUATED AS FUNCTIONS OF PHI IN RADIANS (0 < PHI < 2*PI) AS SPECIFIED ON CARDS E.1 - E.4 FOR FUNCTION NF(2).

NF(I),I=3,5	SAME DEFINITIONS AS ON CARD F.1.B ABOVE EXCEPT THAT THE USE OF RATE DEPENDENT FUNCTIONS IS NOT PERMITTED.

IF NJNT>0 (CARD B.1) AND NJNTF>0 (CARD D.1), CARD F.5.A IS REQUIRED. IF NJNT>0 AND NJNTF=0, THE PROGRAM WILL SET THE JOINTF ARRAY TO ZERO AND CARD F.5.A IS NOT REQUIRED (NOTE: FOR VERSION 12 A BLANK CARD WAS REQUIRED).

CARD F.5.A	FORMAT (18I4) USE TWO CARDS IF NJNT > 18.
JOINTF(J),J=1,NJNT	FOR EACH JOINT (J), THE FUNCTION IDENTIFICATION NUMBER AS SUPPLIED ON CARDS E.7.A TO BE USED BY SUBROUTINE VISPR TO COMPUTE THE JOINT RESTORING FORCE BY FUNCTION FNTERP. IF ZERO, THE VALUES OF SPRING(1,3*J-2) AS SUPPLIED ON CARDS B.4.A WILL BE USED USING FUNCTION EJOINT.

IF NBAG # 0, NBAG CARDS OF THE FOLLOWING MUST BE SUPPLIED. SINCE THE AIR BAG ROUTINES DO NOT USE THE FORCE-DEFLECTION FUNCTIONS, THIS INPUT HAS DIFFERENT FORMATS THAN THE ABOVE ALLOWED CONTACTS.

CARDS F.6.A - F.6.N	FORMAT (2I4, 20I2)
K	THE AIR BAG NUMBER CORRESPONDING TO THE INDEX J UNDER CARDS D.4 ABOVE. K MUST BE IN NUMERIC ORDER K = 1 TO NBAG, WHERE NBAG IS THE NUMBER OF AIR BAGS DEFINED ON CARD D.1.
NK	THE NUMBER OF SEGMENTS ALLOWED TO CONTACT THE KTH AIR BAG. THE MAXIMUM VALUE IS 10. IF NK = 0, THE REMAINDER OF THE CARD IS BLANK.
MBAG(2,I,K), MBAG(3,I,K),I=1,NK	THE SEGMENT NUMBERS (DETERMINED BY THE CARD NUMBER I UNDER CARD B.2.A) EACH FOLLOWED BY THE NUMBER OF THE ASSOCIATED CONTACT ELLIPSOID FOR WHICH CONTACT FORCES WITH THE KTH AIR BAG WILL BE COMPUTED.

IF NWINDF=0 ON CARD D.1, CARDS F.7 ARE NOT REQUIRED AND THE PROGRAM WILL SET THE MWSEG ARRAY TO ZEROS (NOTE: FOR VERSION 12 A BLANK CARD F.7.A WAS PREVIOUSLY REQUIRED). OTHERWISE, CARDS F.7 ARE REQUIRED.

CARD F.7.A — FORMAT (18I4) USE TWO CARDS IF NSEG > 18.

MWSEG(1,J),J=1,NSEG — FOR EACH SEGMENT J, SUPPLY ZERO IF NO WIND FORCE CALCULATIONS ARE TO BE PERFORMED. OTHERWISE, SUPPLY A VALUE OF ONE TO INDICATE WIND FORCES ARE TO BE PERFORMED.

SUPPLY CARD F.7.B FOR EACH SEGMENT (J) WHERE MWSEG(1,J) = 1.

CARD F.7.B — FORMAT (5I4)

JJ — THE SEGMENT IDENTIFICATION NUMBER FROM CARDS B.2.A FOR WHICH WIND FORCE CALCULATIONS ARE TO BE PERFORMED. MUST CORRESPOND TO J FROM CARD F.7.A AND BE SUPPLIED IN ASCENDING ORDER.

MWSEG(2,J) — THE NUMBER OF THE CONTACT ELLIPSOID TO BE ASSOCIATED WITH SEGMENT NUMBER JJ.

MWSEG(3,J) — THE SEGMENT IDENTIFICATION NUMBER (NSEG+1 FOR THE VEHICLE, NSEG+2 FOR THE GROUND) ASSOCIATED WITH PLANE NUMBER MWSEG (4,J).

MWSEG(4,J) — THE PLANE IDENTIFICATION NUMBER FROM CARD D.2.A THROUGH WHICH IF SEGMENT J PASSES, WIND FORCE CALCULATIONS WILL BE PERFORMED.

MWSEG(5,J) — THE FUNCTION NUMBER FROM CARD E.6.A FOR THE WIND FORCE FUNCTION TO BE USED.

```
F.8  SUBROUTINE HINPUT - CARD INPUT FOR HARNESS-BELT SYSTEMS.                  *
                                                                               *
     NOTE: NHRNSS WHICH WAS SUPPLIED ON CARD F.8.A FOR VERSION 12 IS NOW       *
     SUPPLIED ON CARD D.1. IF NHRNSS#0, CARDS F.8 MUST BE SUPPLIED.            *
     PREVIOUSLY FOR VERSION 12, A BLANK CARD F.8.A WAS REQUIRED IF NO          *
     HARNESS BELT SYSTEMS WERE DESIRED.                                        *
                                                                               *
     CARD F.8.A               FORMAT (5I4)                                     *
                                                                               *
         NBLTPH(I),           NUMBER OF INDIVIDUAL BELTS FOR EACH HARNESS      *
          I=1,NHRNSS          NO. I. MAY BE ZERO OR BLANK. MAXIMUM VALUE       *
                              OF SUM OF ALL NBLTPH IS 20.                      *
                                                                               *
     CARD F.8.A IS FOLLOWED BY NHRNSS SETS OF CARDS F.8.B - F.8.D.             *
                                                                               *
     CARD F.8.B               FORMAT (18I4) USE TWO CARDS IF NBLTPH(I)>18.     *
                                                                               *
         NPTSPB(J),           THE NUMBER OF REFERENCE POINTS INCLUDING         *
          J=1,NBLTPH(I)       ANCHOR POINTS FOR BELT NO. J OF HARNESS          *
                              NO. I. MAY BE ZERO OR BLANK. THE MAXIMUM         *
                              VALUE OF THE SUM OF ALL NPTSPB FOR ALL           *
                              HARNESS-BELT SYSTEMS IS 100. THE MAXIMUM         S
                              VALUE OF THE SUM OF ALL NPTSPB FOR ANY ONE       S
                              HARNESS BELT SYSTEM IS 50. THE MAXIMUM VALUE     S
                              OF ANY INDIVIDUAL NPTSPB IS 25.                  S
                                                                               *
     EACH CARD F.8.B IS FOLLOWED BY NBLTPH(I) SETS OF CARDS F.8.C - F.8.D.     *
                                                                               *
     CARD F.8.C               FORMAT (5I4, F12.0)

         NF(L),L=1,5          THE FUNCTION NUMBERS FROM CARDS E.1 TO DEFINE    *
                              THE STRESS-STRAIN OF BELT NO. J. THE DEFINITION  *
                              OF THESE FUNCTIONS ARE IDENTICAL TO THOSE OF     *
                              NF(1) TO NF(5) ON CARDS F.2.B, EXCEPT THAT THE   *
                              USE OF RATE DEPENDENT FUNCTIONS IS PERMITTED.    *

         XLONG(J)             THE INITIAL SLACK (IN) OF BELT NO. J. A NEG-     *
                              ATIVE VALUE CAN BE SPECIFIED TO INDICATE A       S
                              PRE-TIGHTENED BELT. THE PROGRAM WILL ADD THIS    S
                              TO THE INITIAL GEOMETRIC LENGTH TO OBTAIN THE    S
                              INITIAL BELT LENGTH AND DISTRIBUTE THE SLACK     S
                              PROPORTIONATELY BETWEEN THE POINTS.              S
                                                                               S
```

EACH CARD F.8.C IS FOLLOWED BY NPTSPB(J) PAIRS OF F.8.D1 AND D2 CARDS TO SPECIFY THE REFERENCE POINTS (K) FOR BELT (J) OF HARNESS (I). $ $

CARD F.8.D1	FORMAT (9I4, 3F12.0)	$
KS	INTEGER OF THE FORM 100*KTP+KSEG, WHERE KSEG IS THE IDENTIFICATION NUMBER OF THE SEGMENT ASSOCIATED WITH REFERENCE POINT (K), AND KTP IS A TIE-POINT IDENTIFICATION NUMBER WHICH MAY BE BLANK OR ZERO. ALL POINTS (K) OF HARNESS (I) THAT HAVE THE SAME NON-ZERO VALUE FOR KTP (THERE SHOULD BE ONLY ONE FOR EACH BELT (J)) WILL BE CONNECTED AND SHOULD HAVE IDENTICAL VALUES FOR ALL OTHER INPUT.	$ * * $ $ $ $ $ $
KE	THE IDENTIFICATION NUMBER OF THE CONTACT ELLIPSOID ASSOCIATED WITH REFERENCE POINT NO. K. IF NO ELLIPSOID IS SPECIFIED (KE=0), THE PROGRAM WILL ASSUME A UNIT SPHERE.	* * * *
NPD	INDICATOR FOR THE PREFERRED DIRECTION OPTION. IF A NON-ZERO INTEGER IS GIVEN, A NON-ZERO VECTOR MUST BE SPECIFIED FOR BAR(L,K),L=10,12 ON CARD F.8.D2. THE REFERENCE POINT WILL BE ALLOWED TO MOVE ALONG THE SURFACE IN A DIRECTION WHICH IS PERPENDICULAR BOTH TO THIS VECTOR AND TO THE NORMAL OF THE SURFACE SUBJECT TO THE CONSTRAINT IMPOSED BY D2 OF FUNCTION NF(5) BELOW. IF NPD=0, THE NOMINAL BELT LINE IS USED IN PLACE OF THIS VECTOR. NPD MUST BE NONZERO IF POINT NO. K IS A TIE PONT.	$ $ $ $ $ $ $ $ $ $ $
NDR	INDICATOR FOR THE DELTA R OPTION. IF NDR = 0, BELT (J) WILL BE ALLOWED TO SLIP AT REFERENCE POINT (K). IF NDR # 0, BELT (J) WILL NOT SLIP BUT REFERENCE POINT (K) WILL BE MOVED ALONG THE NOMINAL BELT LINE. IN BOTH CASES THE SLIPPAGE OR MOTION IS SUBJECT TO THE CONSTRAINT IMPOSED BY THE COEFFICIENT OF FRICTION GIVEN BY D4 OF FUNCTION NF(5) BELOW. NDR MUST BE NON-ZERO FOR END REFERENCE POINTS OF THE BELT.	$ $ $ $ $ $ $ $ $
NF(L),L=1,4	THE FUNCTION NUMBERS FROM CARDS E.1 TO DEFINE THE FORCE DEFLECTION FUNCTION BETWEEN BELT (J) AND REFERENCE POINT (K). IF NF(1) = 0, THE SURFACE IS TREATED AS RIGID AND NO PERTURBATION OF THE REFERENCE POINT NORMAL TO THE SURFACE IS ALLOWED. THE USE OF RATE DEPENDENT FUNCTIONS AS DEFINED UNDER CARDS F.1.B IS PERMITTED.	$ $ $ $ $ $ $

NF(5) THE FUNCTION NUMBER FROM CARD E.1 TO DEFINE THE FRICTION COEFFICIENTS FOR BELT (J) AT REFERENCE POINT (K). TWO CONSTANT VALUES ARE TO BE DEFINED ON CARD E.2 OF THIS FUNCTION BY SETTING DD = D1 = D3 = 0. D2 IS THE COEFFICIENT OF FRICTION PERPENDICULAR TO THE NOMINAL BELT LINE ALONG THE SURFACE AND D4 IS THE COEFFICIENT OF FRICTION ALONG THE NOMINAL BELT LINE. IF NF(5) = 0, INFINITE FRICTION IS ASSUMED. $

BAR(L,K),L=1,3 THE X,Y AND Z COORDINATES (IN) OF REFERENCE POINT (K) OF BELT (J) IN THE LOCAL COORDINATE SYSTEM OF SEGMENT NO. KS. IF AN ELLIPSOID IS SPECIFIED (KE#0), THE POINT IS REFERRED TO THE CENTER OF THE ELLIPSOID AND THE SUPPLIED VALUES WILL BE ADJUSTED BY THE PROGRAM TO LIE ON THE ELLIPSOID SURFACE. IF KE = 0, A NON-ZERO VECTOR MUST BE SPECIFIED. THIS VECTOR WILL BE USED TO TO COMPUTE THE NORMAL IN THE DEFINITION OF ITS LOCAL COORDINATE SYSTEM AND TO RESOLVE THE BELT FORCES. THE PROGRAM WILL ASSUME THAT BELT (J) WILL RUN THROUGH THE POINTS IN THE SPECIFIED ORDER. HOWEVER, IF THE FORCES ARE SUCH AS TO PULL THE BELT AWAY FROM THE SURFACE, THIS POINT WILL BE IGNORED IF IT IS NOT AN END OR ATTACHMENT POINT. *

CARD F.8.D2 FORMAT (6F12.0) $

BAR(L,K),L=7,9 THE X,Y AND Z COORDINATES (IN) OF THE OFFSET IN THE LOCAL COORDINATE SYSTEM OF SEGMENT KS. THIS VECTOR IS ADDED TO THE REFERENCE VECTOR DEFINED ABOVE (L=1,3) TO DETERMINE THE LOCATION OF THE REFERENCE POINT (K) RELATIVE TO THE C.G. OF SEGMENT KS. $

BAR(L,K),L=10,12 THE X,Y AND Z COORDINATES OF A VECTOR IN THE LOCAL COORDINATE SYSTEM OF SEGMENT KS. THIS VECTOR IS USED FOR THE PREFERRED DIRECTION (SEE NPD ABOVE). THIS VECTOR MUST NOT BE PARALLEL TO THE NORMAL COMPUTED FROM BAR(L,K), FOR L=1,3 ABOVE. $

G. SUBROUTINE INITAL

CARD G.1.A	FORMAT (3F10.0, 5I4)
ZPLT(I),I=1,3	THE X, Y, AND Z PLOT COORDINATES (FOR SUBROUTINE PRIPLT) OF THE ORIGIN OF THE VEHICLE REFERENCE SYSTEM. $0 < X < 61$ $0 < Y < 61$ $0 < Z < 121$
I1	A VALUE OF 15 IS REQUIRED TO CALL SUBROUTINE EQUILB AND PROCESS CARDS G.4, G.5 AND G.6.
J1	IF NON-ZERO, CARD G.1.B IS REQUIRED TO DEFINE SCALING INFORMATION FOR THE PRINTER PLOTS
I2,J2	CURRENTLY NOT USED BY THE PROGRAM.
I3	IF ZERO, SEGMENT AND ANGULAR VELOCITIES ARE NOT SUPPLIED ON THE FOLLOWING CARDS BUT ARE SET EQUAL TO THE INITIAL VEHICLE VELOCITY. IF I3 # 0, SEGLV AND WMGDEG MUST BE SUPPLIED.

IF J1 IS ZERO OR BLANK ON CARD G.1.A, THE FOLLOWING CARD G.1.B SHOULD NOT BE SUPPLIED AND DEFAULT VALUES OF 10.0, 6.0 AND 1.0 WILL BE USED FOR THE SPLT ARRAY.

CARD G.1.B	FORMAT (3F10.0)
SPLT(1)	THE NUMBER OF HORIZONTAL PRINT POSITIONS PER UNIT LENGTH FOR THE OUTPUT UNIT THAT WILL PRINT THE PRINTER PLOTS PRODUCED BY SUBROUTINE PRIPLT (NORMAL VALUE IS 10.0 FOR 10 SPACES OR COLUMNS PER INCH).
SPLT(2)	THE NUMBER OF VERTICAL PRINT LINES PER UNIT LENGTH (NORMAL VALUES ARE 6.0 OR 8.0 FOR 6 OR 8 LINES PER INCH). THE PROGRAM USES ONLY THE RATIO OF SPLT(1) TO SPLT(2).
SPLT(3)	SCALE FACTOR THAT REPRESENTS THE DISTANCE (INCHES OR LENGTH UNIT ON CARD A.3) BETWEEN VERTICAL PRINT LINES FOR THE PRINTER PLOTS. NOTE: THE PRINTER PLOT WAS ORIGINALLY DESIGNED FOR 120X60 UNITS (INCHES) ALONG THE Z AND X OR Y DIRECTIONS WHICH MAY NOT BE SATISFACTORY FOR CERTAIN SITUATIONS (E.G., METRIC UNITS).

ONE G.2 CARD MUST BE SUPPLIED FOR EACH REFERENCE SEGMENT (I.E., SEGMENT NO. 1 AND FOR EACH SEGMENT J+1 WHERE JNT(J) = 0 ON CARDS B.3) IN ASCENDING SEGMENT NUMBER SEQUENCE.

CARDS G.2.A - G.2.M FORMAT (6F10.0)

SEGLP(I,J),I=1,3 THE INITIAL X, Y, AND Z COORDINATES OF THE JTH BODY SEGMENT IN INERTIAL REFERENCE (IN).

SEGLV(I,J),I=1,3 THE INITIAL X, Y, AND Z COMPONENTS OF VELOCITY OF THE JTH BODY SEGMENT IN INERTIAL REFERENCE (IN/SEC). THESE FIELDS MAY BE LEFT BLANK IF I3 = 0 ON CARD G.1 IN WHICH CASE THE INITIAL VELOCITY OF THE VEHICLE WILL BE USED.

CARDS G.3.A1-G.3.N1 FORMAT (6F10.0, 4I3) *
(NSEG CARDS OR SETS OF G.3.J1,G.3.J2 CARDS) *

YPR(I,J),I=1,3 THE INITIAL ROTATION ANGLES (DEGREES) OF THE JTH SEGMENT ABOUT THE LOCAL Z, Y AND X AXES OF THE SEGMENT GIVEN BY ID(4,J) IN THE ORDER SPECIFIED BY ID(I,J),I=1,3 BELOW. *

WMGDEG(I,J),I=1,3 THE INITIAL COMPONENTS OF ANGULAR VELOCITY ABOUT THE LOCAL X,Y AND Z AXES OF THE JTH BODY SEGMENT (DEG/SEC). IF I3 = 0 ON CARD G.1, THE INITIAL ANGULAR VELOCITY OF THE VEHICLE WILL BE CONVERTED TO THE SEGMENT REFERENCE AND WILL BE USED.

ID(I,J),I=1,3 INDICATORS USED TO SPECIFY THE ORDER OF THE AXES OF THE ROTATIONS GIVEN IN YPR ABOVE. (SEE COMPLETE DEFINITION UNDER CARDS B.3.A2.) ZEROS OR BLANKS WILL DEFAULT TO 1,2 AND 3 TO INDICATE THAT THE STANDARD SEQUENCE OF YAW, PITCH AND ROLL IS REVERSED (AS REQUIRED BY VERSIONS PREVIOUS TO 18A OF THE PROGRAM). *

VALUES OF 3,2,1 INDICATES THAT THE STANDARD YAW, PITCH AND ROLL SEQUENCE BE USED. *

VALUES OF 3,1,-3 INDICATES THAT PRECESSION, NOTATION AND SPIN FOR EULER JOINTS BE USED. *

A NEGATIVE VALUE FOR ID(1,J) INDICATES THAT PROJECTIONS OR PROJECTION ANGLES OF THE PRINCIPAL AXES OF SEGMENT J WILL BE USED AND THAT A CARD G.3.J2 WILL FOLLOW THIS CARD. *

ID(4,J) — THE SEGMENT NUMBER TO WHICH THE ROTATIONS GIVEN BY YPR OR BY ANGLES ON CARD G.3.J2 ARE RESPECT TO. A VALUE OF ZERO OR BLANK WILL DEFAULT TO THE GROUND (NSEG+NBAG+2) OR INERTIAL REFERENCE. THE VEHICLE MAY BE SPECIFIED BY SUPPLYING NSEG+1. OTHERWISE THE NO. OF THE SEGMENT MUST BE LESS THAN J. A NEGATIVE NUMBER (-|JNT(J-1)|, AS SPECIFIED ON CARD B.3.A1) MAY BE USED TO DEFINE THE ROTATION ANGLES WITH RESPECT TO THE JOINT PRINCIPAL AXES AS SPECIFIED ON CARD B.3.A2.

NOTE: THE VALUES OF YPR AND ID ARE USED TO COMPUTE A DIRECTION COSINE MATRIX R. THE DIRECTION COSINE MATRIX D(J) OF SEGMENT J IS DETERMINED BY THE VALUE OF K = ID(4,J) AS FOLLOWS:

```
K = 0: D(J) = R(J)                  ( K=0 OR EQUAL TO NGRND )
K > 0: D(J) = R(J)D(K)              ( K<J OR EQUAL TO NVEH )
K < 0: D(J) = H'(J)R(J)H(K)D(K)     ( K = -|JNT(J-1)| )
```

THERE ARE NO RESTRICTIONS ON A BALL OR EULER JOINT. AN EULER JOINT CAN BE SET TO AN INITIAL PRECESSION(P), NUTATION(N) AND SPIN(S) BY SPECIFYING YPR = P,N,S AND ID = 3,1,-3,-|JNT(J-1)|. TO PRESERVE THE AXES OF A PIN JOINT, CARE MUST BE TAKEN THAT THE RELATIVE ORIENTATION OF SEGMENTS J AND JNT(J-1) REPRESENTS A ROTATION ABOUT THE PIN AXIS ONLY. (THE PIN AXIS IS ALWAYS THE Y AXIS OF THE JOINT PRINCIPAL AXES AS SPECIFIED ON CARD B.3.A2.) THIS CAN BE ASSURED BY SUPPLYING YPR = 0,P,0 AND ID = 0,0,0,-|JNT(J-1)| WHERE P IS THE PITCH OF SEGMENT J WITH RESPECT TO THE CENTER OF SYMMETRY (CARD B.3.A2) OF JOINT J-1. FOR THE CASE WHERE THE Y AXES OF SEGMENTS J AND JNT(J-1) ARE PARALLEL TO THE PIN AXIS, THE PIN AXIS CAN BE PRESERVED BY SUPPLYING VALUES OF YPR = 0,P,0 AND ID = 0,0,0,+|JNT(J-1)| WHERE P IS THE PITCH OF SEGMENT J WITH RESPECT TO SEGMENT JNT(J-1).

A CARD G.3.J2 MUST FOLLOW ANY CARD G.3.J1 ON WHICH ID(1,J) IS NEGATIVE. *

CARDS G.3.A2-G.3.N2 FORMAT (6F10.0, 4I3) *

A1,A2,A3	SPECIFIES THE PROJECTION OF THE PRIMARY AXIS GIVEN BY IK BELOW. IF II IS NEGATIVE, VALUES WILL BE THE X,Y AND Z COMPONENTS (IN) IN THE PROJECTION REFERENCE SYSTEM OF A VECTOR ALONG THE POSITIVE IK AXIS OF SEGMENT NO. J. IF II IS POSITIVE, A1,A2 (A3 NOT USED) ARE THE PROJECTION ANGLES (DEG) OF THE POSITIVE IK AXIS OF SEGMENT NUMBER J IN TWO OF THE PROJECTION REFERENCE PLANES SPECIFIED BY THE VALUE OF II.	*
B1,B2,B3	SPECIFIES THE PROJECTION OF A SECONDARY AXIS GIVEN BY JK BELOW. DEFINITION IS IDENTICAL TO A1,A2,A3 ABOVE BUT USES JJ AND JK INSTEAD OF II AND IK.	*
II	IF II IS NEGATIVE, THE COMPONENTS OF A VECTOR ALONG THE POSITIVE IK AXIS WILL BE GIVEN BY A1, A2,A3. IF II IS POSITIVE, A VALUE OF 1,2 OR 3 IS USED TO INDICATE THAT THE X,Y OR Z AXIS IS THE COMMON AXIS OF THE TWO PROJECTION REFERENCE PLANES USED TO SPECIFY THE TWO PROJECTION ANGLES AS FOLLOWS: IF II=1, A1 IN Z-X PLANE, A2 IN X-Y PLANE. IF II=2, A1 IN X-Y PLANE, A2 IN Y-Z PLANE. IF II=3, A1 IN Y-Z PLANE, A2 IN Z-X PLANE. IN THE X-Y PLANE, THE ANGLE IS MEASURED FROM THE X-AXIS, POSITIVE TOWARD THE Y AXIS. IN THE Y-Z PLANE, THE ANGLE IS MEASURED FROM THE Y-AXIS, POSITIVE TOWARD THE Z AXIS. IN THE Z-X PLANE, THE ANGLE IS MEASURED FROM THE Z AXIS, POSITIVE TOWARD THE X AXIS. RESTRICTION: SIN(A1) * COS(A2) CANNOT BE ZERO.	*
IK	A VALUE OF 1,2 OR 3 TO SPECIFY THAT THE X,Y OR Z AXIS OF SEGMENT NUMBER J IS THE PRIMARY AXIS TO BE PROJECTED.	*
JJ,JK	SAME DEFINITION AS FOR II,IK ABOVE BUT FOR A SECONDARY AXIS OF SEGMENT NUMBER J. THE VALUE OF JK MUST BE DIFFERENT THAN THAT OF IK.	*

```
SUBROUTINE EQUILB                                                          *
                                                                           *
CARDS G.4, G.5 AND G.6 ARE REQUIRED IF I1 = 15 ON CARD G.1.                *
                                                                           *
CARD G.4                  FORMAT (2I4)                                     *
                                                                           *
   NVAR                   NO. OF INDEPENDENT VARIABLES SUPPLIED ON CARDS   *
                          G.2 AND G.3 THAT ARE TO BE ADJUSTED SUCH THAT    *
                          CONTACT NORMAL FORCES ARE EQUAL TO EITHER GX     *
                          SUPPLIED ON CARDS G.5 OR CONSTRAINT NORMAL       *
                          FORCES CONTROLLED BY CARDS G.6 (MAX = 10).       *
                                                                           *
   NCON                   NO. OF CONSTRAINTS TO BE IMPOSED TO COMPUTE      *
                          THOSE CONSTRAINT FORCES WHICH WILL BE SATISFIED  *
                          BY INITIAL CONTACT FORCES. IF ZERO, THE SUPPLIED *
                          VALUES OF GX WILL BE USED. (MAX = 5)             *
                                                                           *
                                                                           *
CARDS G.5.A - G.5.N       FORMAT (3I4, 2F8.0, 8I4)                         *
   (NVAR CARDS)                                                            *
                                                                           *
   NTV(J)                 INDICATES TYPE OF JTH INDEPENDENT VARIABLE       *
                            1 - SEGLP FROM CARDS G.2                       *
                            2 -   YPR FROM CARDS G.3                       *
                                                                           *
   NI1(J)                 A VALUE OF 1,2 OR 3 TO INDICATE THE X,Y OR Z     *
                          COORDINATE OF SEGLP IF NTV(J)=1, OR YAW, PITCH   *
                          OR ROLL OF YPR IF NTV(J)=2.                      *
                                                                           *
   NSG(J)                 THE SEGMENT NUMBER (AS SPECIFIED BY INDEX I      *
                          OF CARDS B.2) FOR THE JTH INDEPENDENT VARIABLE.  *
                                                                           *
   GX(J)                  THE MAGNITUDE OF THE CONTACT NORMAL FORCE FOR    *
                          THE JTH INDEPENDENT VARIABLE (LBS.). IF THIS     *
                          CONTACT IS TO BE CONTROLLED BY A CONSTRAINT ON   *
                          CARDS G.6 (I.E., J=INDGX(I)), THE SUPPLIED       *
                          VALUE OF GX WILL BE THE INITIAL VALUE FOR THE    *
                          ITERATION OF THE CONTACT NORMAL FORCE TO EQUAL   *
                          THE CONSTRAINT NORMAL FORCE; OTHERWISE, THE JTH  *
                          INDEPENDENT VARIABLE WILL BE ADJUSTED SUCH THAT  *
                          THE CONTACT NORMAL FORCE WILL BE EQUAL TO GX.    *
                                                                           *
   XDEV(J)                THE MAXIMUM ALLOWABLE DEVIATION FROM THE INITIAL *
                          POSITIONS SPECIFIED ON CARDS G.2 AND G.3 DURING  *
                          THE ITERATION OF THE JTH INDEPENDENT VARIABLE    *
                          FOR THE CONTACT NORMAL FORCE TO EQUAL GX. IF     *
                          EXCEEDED, THE PROGRAM WILL TERMINATE WITH AN     *
                          ERROR MESSAGE.  IF XDEV = 0, THE TESTS WILL      *
                          NOT BE PERFORMED.                                *
                                                                           *
```

JPL(J)	THE PLANE NUMBER CORRESPONDING TO NJ ON CARDS F.1.B - F.1.N FOR THE CONTACT WHOSE NORMAL FORCE IS TO BE CONTROLLED BY THE JTH VARIABLE.
JSG(J)	THE SEGMENT IDENTIFICATION NUMBER (AS SPECIFIED BY INDEX I OF CARDS B.2) INVOLVED IN THE CONTACT WITH PLANE NO. JPL(J). NOTE: A CONTACT FOR THIS PLANE AND SEGMENT MUST HAVE BEEN SET UP ON CARDS F.1.B - F.1.N.
NAV(J)	NO. OF VARIABLES ASSOCIATED WITH THE JTH INDEPENDENT VARIABLE. (MAX= 5, MAY BE ZERO)
KSG(I,J),I=1,NAV	THE SEGMENT NUMBERS (DEFINITION SAME AS FOR NSG(J)) FOR THE NAV(J) VARIABLES ASSOCIATED WITH THE JTH INDEPENT VARIABLE. ANY CHANGE MADE TO THE JTH INDEPENDENT VARIABLE TO ACHIEVE INITIAL EQUILIBRIUM WILL ALSO BE MADE TO THE CORRESPONDING VARIABLES FOR THESE SEGMENTS SUCH THAT THE INITIAL RELATIVE ORIENTATION WILL BE MAINTAINED AS SPECIFIED ON CARDS G.2 AND G.3.

CARDS G.6.A - G.6.M (NCON CARDS)	FORMAT (4I4)
IPL(I),ISG(I)	THE PLANE AND SEGMENT NUMBERS (DEFINITION SAME AS FOR JPL(J) AND JSG(J) ABOVE) FOR THE ITH CONSTRAINT TO BE IMPOSED FOR INITIAL EQUILIBRIUM DURING THE CONTACT NORMAL FORCE TO CONSTRAINT NORMAL FORCE ITERATION.
LTYPE(I)	INDICATES THE TYPE OF THE ITH CONSTRAINT 3 - ROLL CONSTRAINT 4 - SLIDE CONSTRAINT
INDGX(I)	THE INDEX J (FROM 1 TO NVAR) FROM CARD G.5 FOR WHOSE CONTACT NORMAL FORCE WILL BE ITERATED TO BE EQUAL TO THE ITH CONSTRAINT NORMAL FORCE. MAY BE ZERO, BUT IF INDGX(I) = J, THEN IPL(I) AND ISG(I) MUST BE EQUAL TO JPL(J) AND JSG(J).

NOTE: SUBROUTINE EQUILB WILL ADJUST THE INITIAL POSITION PARAMETERS SUPPLIED ON CARDS G.2 AND G.3. IF THE CONSTRAINTS TEMPORARILY IMPOSED BY CARDS G.6 PROPERLY CONSTRAIN ALL OF THE SEGMENTS, ZERO ACCELERATIONS WILL BE OBTAINED WHILE THE CONSTRAINTS ARE ON. THE ITERATION WILL PRODUCE NORMAL AND TANGENTIAL CONTACT FORCES THAT WILL RESULT IN SMALL (< 0.02 G) INITIAL LINEAR ACCELERATIONS FOR ALL OF THE BODY SEGMENTS. FOR THE SEATED "STANDARD" FIFTEEN SEGMENT OCCUPANT, THIS CAN BE ACHIEVED AS FOLLOWS:

A. LOCK JOINT P, W, NP, HP, RA AND LA BY SETTING IPIN = -2 ON CARDS B.3. IF THE MAXIMUM TORQUE FOR A LOCKED JOINT (T1 FOR VISC(4,3*J-2) ON CARDS B.5) IS ZERO, THEN SUBROUTINE EQUILB WILL SET T1 FOR THESE LOCKED JOINTS TO 1.5 TIMES THE MAGNITUDE OF THE JOINT TORQUE FINALLY PRODUCED AT TIME ZERO.

B. CONSTRAIN THE ARMS BY EITHER SETTING UP FIXED POINT CONSTRAINTS (TYPE=1) FOR THE RLA AND LLA WITH THE VEHICLE ON CARDS D.6, OR LOCK THE JOINTS RS, RE, LS AND LE AS IN STEP A ABOVE. IF THE CONSTRAINTS ARE IMPOSED ON CARDS D.6, SUBROUTINE EQUILB WILL ADJUST THE POINT ON THE VEHICLE (RK2 ON CARDS D.6) FOR ANY TYPE 1 CONSTRAINT INVOLVING THE VEHICLE SO THAT IT WILL COINCIDE WITH THE SPECIFIED POINT ON THE BODY SEGMENT (RK1 ON CARDS D.6) AS ADJUSTMENTS ARE MADE TO THE INITIAL POSITION PARAMETERS.

C. SET UP ALLOWED CONTACTS AND ASSOCIATED FORCE DEFLECTION FUNCTIONS ON CARDS F.1 FOR THE SEAT CUSHION PLANE WITH THE LT, RUL AND LUL SEGMENTS, THE SEAT BACK PLANE WITH THE LT, CT AND UT SEGMENTS, AND THE FLOORBOARD PLANE WITH THE RF AND LF SEGMENTS.

D. SET UP INITIAL POSITION PARAMETERS ON CARDS G.2 AND G.3 THAT ARE JUST "SHORT OF" OR CLOSE TO THE FINAL PENETRATION DISTANCES FOR THE SEGMENTS WITH THE CONTACT PLANES.

E. SET NVAR = 5 AND NCON = 4 ON CARD G.4.

F. SUPPLY THE FOLLOWING INPUT PARAMETERS ON CARDS G.5:

J	NTV	NI1	NSG	GX	XDEV	JPL	JSG	NAV	KSG
1	1	3	(LT)	90.0	1.0	(SEAT CUSHION)	(LT)	0	
2	1	1	(LT)	5.0	1.0	(SEAT BACK)	(LT)	0	
3	2	2	(UT)	10.0	5.0	(SEAT BACK)	(UT)	4	(LT),(CT),(N),(H)
4	2	2	(RUL)	25.0	10.0	(SEAT CUSHION)	(RUL)	1	(LUL)
5	2	2	(RLL)	10.0	10.0	(FLOORBOARD)	(RF)	1	(LLL)

( ) INDICATES THAT IDENTIFICATION NUMBER SHOULD BE USED

G. SUPPLY THE FOLLOWING INPUT PARAMETERS ON CARDS G.6:

I	IPL	ISG	LTYPE	INDGX
1	(SEAT CUSHION)	(LT)	3	1
2	(SEAT BACK)	(UT)	4	3
3	(FLOORBOARD)	(RF)	3	5
4	(FLOORBOARD)	(LF)	3	0

USING THE ABOVE INPUT PARAMETERS, SUBROUTINE EQUILB WILL ADJUST THE X AND Z COORDINATES OF THE LT, THE PITCH ANGLES (MAINTAINING THE INITIAL RELATIVE ORIENTATION) OF THE UT, LT, CT, N AND H SEGMENTS, THE RUL AND LUL SEGMENTS, AND THE RLL AND LLL SEGMENTS, AND THE INITIAL NORMAL CONTACT FORCES (GX) OF THE SEAT CUSHION WITH THE LT, THE SEAT BACK WITH THE UT AND THE FLOORBOARD WITH THE RF. IT IS BELIEVED THAT THE RESULTING INITIAL POSITIONS ARE UNIQUE AND ARE FUNCTIONS OF THE VALUES OF THE CONTACT NORMAL FORCES (GX) SUPPLIED FOR THE SEAT BACK WITH THE LT AND THE SEAT CUSHION WITH THE RUL CONTACTS.

H. SUBROUTINE OUTPUT

THIS SUBROUTINE PROVIDES INPUT TO CONTROL THE DESIRED TIME HISTORY OUTPUT OF SELECTED SEGMENT LINEAR AND ANGULAR ACCELERATIONS, VELOCITIES, AND DISPLACEMENTS, AND JOINT PARAMETERS.

H.1 (K=1) SEGMENT LINEAR ACCELERATIONS IN LOCAL REFERENCE

CARD H.1.A — FORMAT (2I6, 3F12.6)

- NSG(K) — THE NUMBER OF SELECTED POINTS ON THE VARIOUS BODY SEGMENTS FOR WHICH TIME HISTORIES ARE DESIRED. THE MAXIMUM VALUE FOR NSG(K) IS 20. IF NSG(K) IS 0, INSERT 2 BLANK CARDS. IF NSG(K) IS 1, A SINGLE BLANK CARD SHOULD FOLLOW CARD H.1.K.
- MSG(1,K) — THE SEGMENT NUMBER OF THE FIRST POINT AS DETERMINED BY THE INDEX I ON CARDS B.2.A - B.2.N. THE VEHICLE MAY BE SPECIFIED BY NSEG+1, OR THE JTH AIRBAG BY NSEG+1+J.
- XSG(I,1,K),I=1,3 — THE X, Y, AND Z COORDINATES IN SEGMENT REFERENCE OF THE FIRST POINT (INCHES).

FOLLOWED BY NSG(K)-1 CARDS OF THE FOLLOWING (J = 2, NSG(K))

CARDS H.1.B - H.1.N — FORMAT (I12, 3F12.6)

- MSG(J,K) — SAME AS ABOVE BUT FOR THE JTH POINT.
- XSG(I,J,K),I=1,3 — SAME AS ABOVE BUT FOR THE JTH POINT.

H.2 (K=2) SEGMENT LINEAR VELOCITIES IN VEHICLE REFERENCE

CARDS H.2.A - H.2.N — FORMAT (2I6, 3F12.6/ (I12, 3F12.6))

DESCRIPTION SAME AS FOR H.1.

H.3 (K=3) SEGMENT LINEAR DISPLACEMENTS IN VEHICLE REFERENCE

CARDS H.3.A - H.3.N — FORMAT (2I6, 3F12.6/ (I12, 3F12.6))

DESCRIPTION SAME AS FOR H.1.

H.4 (K=4) SEGMENT ANGULAR ACCELERATIONS IN LOCAL REFERENCE |

CARD H.4 FORMAT (12I6/ (I12, 10I6)) |

NSG(K)	THE NUMBER OF SELECTED SEGMENTS FOR WHICH TIME HISTORIES ARE DESIRED (MAXIMUM = 20). SUPPLY BLANK CARD IF NONE ARE DESIRED.
MSG(J,K),J=1,KSG WHERE KSG=NSG(K)	THE SEGMENT NUMBERS AS DETERMINED BY INDEX I ON CARDS B.2.A - B.2.N. THE VEHICLE MAY BE SPECIFIED BY NSEG+1, OR THE JTH AIRBAG BY NSEG+1+J. IF NSG(K) > 11, USE THE SECOND CARD, LEAVING THE FIRST FIELD OF 6 COLUMNS BLANK. IF NSG(K) = 11, A SECOND CARD, COMPLETELY BLANK, SHOULD FOLLOW THIS CARD.

H.5 (K=5) SEGMENT ANGULAR VELOCITIES IN VEHICLE REFERENCE |

CARD H.5 FORMAT (12I6/ (I12, 10I6)) |

DESCRIPTION SAME AS FOR H.4.

H.6 (K=6) SEGMENT ANGULAR DISPLACEMENTS IN VEHICLE REFERENCE |

CARD H.6 FORMAT (12I6/ (I12, 10I6)) |

DESCRIPTION SAME AS FOR H.4.

H.7 (K=7) JOINT PARAMETERS |

CARD H.7 FORMAT (12I6/ (I12, 10I6)) |

NSG(K)	THE NUMBER OF SELECTED JOINTS FOR WHICH TIME HISTORIES ARE DESIRED. INSERT BLANK CARD IF NONE ARE DESIRED (NJNT MAXIMUM).
MSG(J,K),J=1,KSG WHERE KSG=NSG(K)	THE JOINT NUMBERS AS DETERMINED BY INDEX J ON CARDS B.3.A - B.3.J. IF NSG(K) > 11, USE A SECOND CARD LEAVING THE FIRST FIELD OF 6 COLUMNS BLANK. IF NSG(K) = 11, A SECOND CARD, COMPLETELY BLANK, SHOULD FOLLOW THIS CARD.

H.8 (SUBROUTINE POSTPR) - HIC, HSI AND CSI CALCULATIONS. *
THIS CARD IS REQUIRED WHENEVER SUBROUTINE POSTPR IS CALLED AS DETER- *
MINED BY THE VALUE OF NPRT(4) ON CARD A.5 (ALL VALUES BUT 0 OR 4). *

CARD H.8 FORMAT (18I4) *

JDTPTS(1)	THE INDEX J ON CARDS H.1 CORRESPONDING TO THE HEAD C.G. WHOSE RESULTANT ACCELERATION TIME HISTORY WILL BE USED TO COMPUTE THE HEAD INJURY CRITERIA (HIC) AND HEAD SEVERITY INDEX (HSI). THE COMPUTATIONS WILL NOT BE DONE IF JDTPTS(1) = 0 OR BLANK.	*
JDTPTS(2)	THE INDEX J ON CARDS H.1 CORRESPONDING TO THE POINT WHOSE RESULTANT ACCELERATION TIME HISTORY WILL BE USED TO COMPUTE THE CHEST SEVERITY INDEX (CSI). THE COMPUTATIONS WILL NOT BE DONE IF JDTPTS(2) = 0 OR BLANK.	*

I. SUBROUTINE POSTPR

CARDS I ARE REQUIRED ONLY IF NPRT(4) IS AN ODD INTEGER ON CARD A.5. (SEE NOTE IN SUBROUTINE SLPLOT REGARDING PROGRAM CHANGES THAT MAY BE NECESSARY ON PLOTTING FACILITIES OTHER THAN THOSE AT CALSPAN.)

THESE CARDS ESSENTIALLY SPECIFY ALL OF THE ARGUMENTS TO SUBROUTINE SLPLOT AND THE INDICEES OF THE DATA IN THE TABULAR TIME HISTORIES TO BE PLOTTED. THE ABILITY EXISTS TO PLOT ANY SET OF VARIABLES IN THE TIME HISTORIES AS A FUNCTION OF ANY OTHER VARIABLE ON A FIXED (SPECIFIED BY THE USER INPUT) X-Y AXIS. BOTH AXES MAY BE EITHER LINEAR OR LOGARITHMIC. ANY DATA FALLING OUTSIDE OF THE SPECIFIED RANGE OF EACH AXIS WILL BE IGNORED. THE INPUT ALSO SPECIFIES THE X AND Y AXIS LABELS AND TWO LINES OF PLOT IDENTIFICATION THAT LIES BELOW THE X AXIS LABEL.

CARD I.1	FORMAT (18I4)
NPLT	THE NUMBER OF PLOTS TO BE GENERATED (MAX=20). (IF NPLT > 17, USE TWO CARDS.)
NYP(K),K=1,NPLT	THE NUMBER OF Y VARIABLES TO BE PLOTTED VS. THE SAME X VARIABLE FOR EACH OF THE NPLT PLOTS. NPLT + SUM OF NYP IS LIMITED TO 25.

A SET OF CARDS I.2-I.8 IS REQUIRED FOR EACH OF THE NPLT PLOTS.

CARD I.2.K	FORMAT (18I4)
MX1(K),MX2(K)	THE PAGE NO. (MX1) AND COLUMN NO. (MX2) FROM THE TABULATED TIME HISTORIES OF THE X (HORIZONTAL) VARIABLE FOR THE KTH PLOT. THESE PAGE NOS. START WITH 21 SO MX1 > 20. MX2 = 0 REFERS TO TIME (MSEC), THE LEFTMOST COLUMN. MX2 CAN BE SUPPLIED AS A NEGATIVE INTEGER TO INDICATE THAT THE VALUE FOR TIME ZERO WILL BE SUBTRACTED FROM ALL VALUES FOR PLOTTING PURPOSES.
MY1(J,K),MY2(J,K) FOR J=1,NYP(K)	THE PAGE NO. (MY1) AND COLUMN NO. (MY2) FOR THE NYP(K) Y (VERTICAL) VARIABLES TO BE PLOTTED VS. THE X VARIABLE SPECIFED BY MX1 AND MX2 FOR THE KTH PLOT. DEFINITION OF EACH MY1,MY2 SAME AS FOR MX1,MX2 ABOVE.

```
CARD I.3.K                FORMAT (I4, 4X, 4F8.0)                          *
                                                                          *
    NX(K)                 THE NUMBER OF INTERVALS OR PLOTTING DECRE-      *
                          MENTS ALONG THE X (HORIZONTAL) AXIS FOR THE     *
                          KTH PLOT. THERE WILL BE NX(K)+1 TIC MARKS       *
                          AND NUMERIC ANNOTATIONS, THE FIRST WILL BE      *
                          FOR XO(K) AND THE LAST FOR XN(K). IF NX(K)      *
                          IS POSITIVE, THE SCALE WILL BE LINEAR, AND      *
                          IF NEGATIVE, THE SCALE WILL BE LOGARITHMIC.     *
                                                                          *
    XO(K)                 THE VALUE OF THE ORIGIN OF THE X AXIS FOR       *
                          THE KTH PLOT.                                   *
                                                                          *
    XN(K)                 THE VALUE OF THE END OF THE X AXIS FOR THE      *
                          KTH PLOT. FOR NX(K) POSITIVE, XN(K) SHOULD      *
                          EQUAL XO(K) + NX(K)*DX, WHERE DX IS A REASON-   *
                          ABLE PLOT DECREMENT. IF NX(K) IS NEGATIVE,      *
                          BOTH XO(K) AND XN(K) SHOULD BE POWERS OF TEN,   *
                          WHERE XN(K) = XO(K)*10**|NX(K)|.                *
                                                                          *
    XL(K)                 THE LENGTH (PLOTTING INCHES) OF THE X AXIS      *
                          FOR THE KTH PLOT. XL(K) SHOULD BE AT LEAST      *
                          ONE INCH LESS THAN XS(K).                       *
                                                                          *
    XS(K)                 THE PAPER SIZE (PLOTTING INCHES) IN THE X       *
                          DIRECTION FOR THE KTH PLOT. THE PLOT WILL BE    *
                          CENTERED WITHIN THIS DIMENSION.                 *
                                                                          *
CARD I.4.K                FORMAT (I4, 4X, 4F8.0)                          *
                                                                          *
    NY(K),YO(K),YN(K),    SAME DEFINITIONS AS FOR THE CORRESPONDING       *
    YL(K) AND YS(K)       ITEMS ON CARD I.3.K BUT FOR THE Y (VERTICAL)    *
                          AXIS FOR THE KTH PLOT. NOTE THAT EACH OF THE    *
                          NYP(K) VARIABLES WILL BE PLOTTED ON THE SAME    *
                          SCALE.                                          *
                                                                          *
NOTE: TO PLOT ON THE VERSATEC PLOTTER AT CALSPAN, THE EXEC CARD SHOULD    *
CONTAIN THE PARAMETERS     ,PLOTTER=VERSATEC,LONG=M                       *
    WHERE M=V INDICATES THAT THE X AXIS WILL BE IN THE LONG (11 INCH)     *
              DIRECTION. FOR THIS CASE, THE RECOMMENDED VALUES FOR        *
              XS(K) AND YS(K) ARE 10.5 AND 8.0.                           *
      AND M=U INDICATES THAT THE Y AXIS WILL BE IN THE LONG DIRECTION,    *
              AND THE RECOMMENDED VALUES FOR XS(K) AND YS(K) ARE REV-     *
              ERSED.                                                      *
                                                                          *
IN ADDITION, THE FOLLOWING CARD IS REQUIRED AT THE END OF THE JOB:        *
    //  EXEC  VPLOT,PCOPY=N                                               *
        WHERE N IS THE NUMBER OF COPIES TO BE PRODUCED.                   *
                                                                          *
```

```
CARD I.5.K                FORMAT (I4, 4X, 15A4)                                 *
                                                                                *
    NXLAB(K)              THE NUMBER OF CHARACTERS IN THE LABEL OF THE          *
                          X AXIS FOR THE KTH PLOT (MAX=60, MAY BE ZERO).        *
                                                                                *
    XLAB(K)               THE ALPHANUMERIC INFORMATION TO BE USED AS            *
                          THE LABEL OF THE X AXIS FOR THE KTH PLOT.             *
                          DATA SHOULD BE LEFT ADJUSTED AS INPUT SINCE           *
                          PROGRAM WILL CENTER THE NXLAB(K) CHARACTERS           *
                          BENEATH THE X AXIS.                                   *
                                                                                *
CARD I.6.K                FORMAT (I4, 4X, 15A4)                                 *
                                                                                *
    NYLAB(K),             SAME DEFINITION AS FOR CARD I.5.K BUT FOR THE         *
    YLAB(K)               LABEL OF THE Y AXIS FOR THE KTH PLOT.                 *
                                                                                *
CARD I.7.K                FORMAT (I4, 4X, 15A4)                                 *
                                                                                *
    NPLB1(K)              THE NUMBER OF CHARACTERS IN THE UPPER OF TWO          *
                          LINES OF PLOT IDENTIFICATION FOR THE KTH PLOT         *
                          (MAX = 60, MAY BE ZERO).                              *
                                                                                *
    PLB1(K)               THE ALPHANUMERIC INFORMATION TO BE USED IN            *
                          THE UPPER LINE OF THE PLOT IDENTIFICATION             *
                          FOR THE KTH PLOT. DATA SHOULD BE LEFT ADJUSTED        *
                          AS INPUT SINCE THE PROGRAM WILL CENTER THE            *
                          NPLB1(K) CHARACTERS BENEATH THE X AXIS LABEL.         *
                                                                                *
CARD I.8.K                FORMAT (I4, 4X, 15A4)                                 *
                                                                                *
    NPLB2(K),             SAME DEFINITION AS FOR CARD I.7.K BUT FOR THE         *
    PLB2(K)               LOWER LINE OF THE PLOT IDENTIFICATION.                *
                                                                                *
NOTE: THE 15A4 TERM IN THE FORMAT FOR CARDS I.5-I.8 IS TO BE USED               *
ON COMPUTERS WHERE A SINGLE PRECISION WORD IS EQUIVALENT TO FOUR                *
ALPHANUMERIC CHARACTERS. THIS TERM IN THE FORMAT FOR SUBROUTINE                 *
POSTPR SHOULD BE TO 10A6 OR 6A10 FOR THOSE COMPUTERS WHOSE SINGLE               *
PRECISION WORD SIZE IS EQUIVALENT TO 6 OR 10 CHARACTERS. THIS IS                *
NECESSARY TO INSURE THAT A CONTIGUOUS STRING OF CHARACTERS IS STORED            *
IN THE COMPUTER MEMORY AS REQUIRED BY SUBROUTINE SYMBOL.                        *
```

5.0 OUTPUT FILES GENERATED BY THE CVS PROGRAM

Execution of the CVS program requires the use of several FORTRAN input/output files. Except for the primary input and output files (FORTRAN unit Nos. 5 and 6), the use of each I/O file is controlled by input parameters contained within the program input file. It is therefore necessary that the input job stream for a CVS computer run contain those control statements required by the host computer's operating system to access those I/O files that the run may use. Table 5.1 summarizes all of the FORTRAN I/O files that may be used by the CVS program.

TABLE 5.1

Summary of CVS Program I/O Files

FILE NO.	TYPE*	DESCRIPTION	GENERATING SUBROUTINE	CONTROLLING PARAMETERS
1	U	Program VIEW input	UNIT1	NPRT(1) on Card A.5
2	F	Printer plots	PRIPLT	NPRT(5,6,7) on Card A.5
3	U	Restart output	RSTART	IRSOUT on Card A.1.a
4	U	Restart input	RSTART	IRSIN on Card A.1.a
5	F	Primary input	several	always required
6	F	Primary output	several	always required
7	-	FORTRAN punch	none	never used
8	U	Time histories	OUTPUT	NPRT(4) on Card A.5
9	U	CALCOMP plots	POSTPR	NPRT(4) on Card A.5
21+	F	Time histories	OUTPUT	NPRT(4) on Card A.5

* Type is F for formatted, U for unformatted file.

5.1 Primary Output File (FORTRAN Unit No. 6)

The primary output file for the CVS program is FORTRAN unit No. 6. It contains the printed output of the following items:

1. A completely annotated printout of the CVS program input, generally in the basic card input format.

2. Subroutine PRINT produces tables of segment linear and angular position information, joint forces and torques, the sum of all external forces and torques acting on each segment, and constraint forces data. They are generated by the main program at fixed time intervals of m*DT seconds, where m is the value of NPRT(3) supplied on input Card A.5 and DT on input Card A.4, and by other subroutines for diagnostic purposes. In general, these tables are not as useful as the tabular time histories (to be discussed later), and their generation may be completely suppressed by setting NPRT(3) equal to zero on input Card A.5.

3. Tables of the computer elapsed CPU time used by selected subroutines and the number of calls to these subroutines are generated by Subroutine ELTIME. They are printed at fixed time intervals as specified by DT on input Card A.4 at a frequency specified by NPRT(2) on input Card A.5. If a value of zero is supplied for NPRT(2), then the table is generated only once at the successful completion of a run of the CVS program.

4. Diagnostic type output is produced at every call to various subroutines as controlled by the values supplied for NPRT(8) to (28) on input Card A.5. This output is intended for diagnostic or checkout purposes only, and, if used indiscriminately, can produce voluminous amounts of output. This output is not always completely annotated and the user should refer to the listing of the subroutine involved for a description of the variables printed

5. Short descriptions of changes in some of the conditions of a CVS run are produced as they occur. They include:

a. Failures of the convergence tests for the program integrator that cause the integration step to decrease in size. The time, step size, segment and test involved, and the final convergence test parameters are printed.

b. Changes in the lock conditions of joints as detected by changes in the values of IPIN or IEULER for the various joints. The time, previous and new value of the indicator, and the identification number and nomenclature of the joint involved are printed.

c. Changes in the set of contact points in play for the harness-belt systems are indicated by listing the time, the set of points and the distance between them at each time a point is added to or deleted from the set of points.

6. A page containing values of the head injury criterion (HIC), head and chest severity indices (HSI and CSI) and related information is produced under the following conditions:

a. the tabular time histories are produced on output file no. 8 (see below) by supplying a nonzero value for NPRT(4) on input Card A.5; and,

b. accelerations for the head and chest are generated on the tabular time histories as specified on input Cards H.1; and,

c. either JDTPTS(1) or (2) is nonzero as specified on input Card H.8.

7. The tabular time histories may be generated on the primary output file as described in the next section.

5.2 Tabular Time Histories

The tabular time histories are perhaps the most useful output of the CVS program. Their generation, contents, frequency of output and the manner by which they are generated are completely controlled by program input parameters.

5.2.1 Control of Types of Tabular Time History Pages

The data printed on the tabular time histories are computed by Subroutine OUTPUT. The type of each page produced is controlled by program input as follows:

1. Optional pages controlled by input Cards H.1 to H.7.

a. The components and resultant of linear accelerations (in local segment reference to simulate accelerometer data) for points on segments as specified by input Cards H.1. These tables contain three points per page.

b. The components and resultant of linear velocities (in vehicle reference to correspond to a camera attached to the vehicle) for points on segments as specified by input Cards H.2. These tables contain three points per page.

c. The components and resultant of linear positions (in vehicle reference) for points on segments as specified by input Cards H.3. These tables contain three points per page.

d. The components and resultant of angular acceleration (in local segment reference) for segments as specified by input Cards H.4. These tables contain three segments per page.

e. The components and resultant of angular velocities (in vehicle reference) for segments as specified by input Cards H.5. These tables contain three segments per page.

f. The components (yaw, pitch and roll) and resultant of angular rotations (in vehicle reference) for segments as specified by input Cards H.6. These tables contain three segments per page.

g. The lock condition, angles and torques for joints as specified by input Cards H.7. These tables contain two joints per page.

2. Results of forces generated for allowed contacts.

a. Contact forces data for the allowed contacts between planes and segments as specified by input Cards F.1. These tables contain two plane - segment contacts per page.

b. Strain and anchor point forces for each allowed contact between belts and segments as specified by input Cards F.2. These tables contain two belt - segment contacts per page.

c. Strain and endpoint forces for all belt sections of the harness belt systems from the points specified as endpoints on input Cards F.8.d. These tables contain two belt sections per page.

d. The results of spring damper forces as specified by input Cards D.8. These tables contain two spring dampers per page.

e. Contact forces data for the allowed contacts between segments and other segments as specified by input Cards F.3. These tables contain one segment - segment contact per page.

f. The airbag parameters and contact forces for the allowed contacts between airbags and segments as specified by input Cards F.6. These tables contain four airbag - segment contacts per page.

5.2.2 Methods of Generating the Tabular Time Histories

The CVS program contains two methods that may be used to generate the tabular time histories. These are controlled by the value supplied for NPRT(4) on input Card A.5.

1. Multiple secondary output files (FORTRAN unit Nos. 21 and up)

The first method (NPRT(4) = 0, 1 or 4) causes Subroutines OUTPUT and HEDING to produce the tabular time histories on multiple secondary output files, commencing with FORTRAN output unit No. 21 and using as many consecutive unit numbers as required by the program input, with each new page (as described in the previous section) assigned to the next higher FORTRAN output unit No. This method requires control statements be included in the CVS program input stream to assign and print these multiple secondary output files as required by the host computer system. The number of these multiple secondary files is virtually unlimited, and, in many cases, has taxed the facilities of the host computer system. Prior to Version 18 of the CVS program, it was the only method available to produce the tabular time histories, and it has been retained (more or less by default) in later versions of the program to maintain compatability with earlier versions.

The first page generated in the sequence described above will be assigned to FORTRAN unit No. 21 and identified as page 21.01. As new page types are required, they will be assigned to FORTRAN unit Nos. 22, 23, etc. with the first printed page on each unit identified as page 22.01, 23.01, etc. The heading on each printed page contains this page identification in the upper right corner, followed by lines containing the date (DATE from input Card A.1.a), run description (COMENT from input Cards A.1.b and c), the vehicle deceleration (VPSTTL from input Card C.1), crash victim identification (BDYTTL from input Card B.1), and a completely annotated description of the tabular columns contained on each page.

The frequency of the printed lines of output on each file or page of the tabular time histories is controlled by the supplied value of NPRT(26) on input Card A.5. A value of NPRT(26) = 0 (default) will cause a line to be produced on each file or page at fixed time intervals of DT (input Card A.4) seconds, whereas a value of 1 or 2 will cause printed lines to be produced at the end of every successful integration interval or at every intermediate integration step, respectively.

The first column of each line on every file contains the value of TIME (msec). Each individual page on each file contains 45 lines of tabular data. Each page is numbered with a unique identification of the form NT.XX, where NT is the FORTRAN unit number and .XX commencing with .01 and is incremented by .01 for subsequent pages of each file. Each page contains the complete heading information described in the previous paragraph. Therefore, the pages from the different NT files with the same .XX identifier contain the tabular time history data for the same time points.

2. Post-processing time history data file (FORTRAN unit No. 8)

The data generated for the tabular time histories by Subroutine OUTPUT can be transmitted to an unformatted output file (FORTRAN unit No. 8) designed to serve as an input file for the post-processing features now available in the CVS program. The generation of this time history output file and its use by the post-processing features are controlled by the value of NPRT(4) supplied on input Card A.5 as follows:

a. NPRT(4) = 0 (default): the time history file (FORTRAN unit No. 8) is not accessed and the tabular time histories are produced on the multiple secondary output files as descibed above.

b. NPRT(4) positive (+1 to +4): the time history file is generated as an unformatted output file by Subroutine OUTPUT during the integration process portion of the CVS program. The frequency of data stored on the time history file is controlled by the supplied value for NPRT(26) on input Card A.5 and is identical to the use of NPRT(26) described above for the multiple secondary output files except that NPRT(26) = 0 here operates the same as NPRT(26) = 1 in order to preserve more data for plotting and for the HIC, HSI and CSI computations. At the end of the run, the main program writes an end-of-file on the time history file, rewinds it, and then calls Subroutine POSTPR, which now uses the time history file as an input file to perform the required post-processing operations. Note that Subroutine POSTPR is not called for NPRT(4) = 4, this value operates essentially the same as for NPRT(4) = 0 except that a time history file is generated for possible use by subsequent CVS runs.

c. NPRT(4) negative (-1, -2 or -3): the time history file that was generated during a previous run is used as an input file for the post-processing operations (Subroutine POSTPR) of the current CVS run. In this case, the main program processes input Cards A.1 to A.5, bypasses the other input routines (input Cards B.1 to H.7) and integration process, and transfers to the end of the main program to call Subroutine POSTPR to perform the post-processing operations, using the time history file from a previous run.

d. NPRT(4) = plus or minus 2 or 3: the tabular time histories will be produced on the primary output file (FORTRAN unit No. 6) by Subroutines POSTPR and HEDING from the time history input file (FORTRAN unit No. 8) during the post-processing operations performed at the end of a CVS run. The tabular time histories produced by this method will be identical to those described for the multiple secondary output files above, except for the following conditions:

(1) The output will be produced from single precision words rather than from double precision words except on those computer (CDC or Cyber) systems that do not require double precision computations for the CVS program. This means that any exponential formats will print with an E rather than with a D format.

(2) The individual pages will be ordered by time and not by file numbers, i.e., the page number sequence here will be 21.01, 22.01, 23.01, ...; 21.02, 22.02, 23.02, ...; 21.03, 22.03, 23.03, ... etc., rather than the sequence 21.01, 21.02, 21.03 ...; 22.01, 22.02, 22.03, ...; 23.01, 23.02, 23.03, ... etc. that is produced from the multiple secondary output files. Some find this new sequence to be objectionable, once they have been familiar with the former page sequence.

(3) The use of NPRT(26) = 2 to control the frequency of the printed lines will not be operational unless it was also used to generate the time history file (FORTRAN unit No. 8).

e. NPRT(4) odd (plus or minus 1 or 3): Calcomp plots of data from the tabular time histories will be generated during the post-processing operations performed by Subroutine POSTPR at the end of a CVS run. These are discussed in more detail in the following section.

5.3 Calcomp Plots of Tabular Time History Data

One of the post-processing operations now available in the CVS program is the capability to generate Calcomp plots from the data contained on the time history file (FORTRAN unit No. 8). The generation of these plots is controlled by supplying an odd value (plus or minus 1 or 3) for NPRT(4) on input card A.5; a positive value indicates the plots will be generated during the same run that computed the time history data, while a negative value indicates the plots will be generated from the time history file of a previous run; a magnitude of one indicates that only the plots will be generated while a magnitude of three indicates that the printed tabular time histories will also be generated on the primary output file (FORTRAN unit No. 6). Although Table 5.1 lists FORTRAN unit No. 9 as the Calcomp plot output file, the actual file assignment, the control statements required in the CVS program input job stream and the procedures for the actual generation of the Calcomp plots from the Calcomp plot output file are a function of the host computer system.

These Calcomp plots are completely general in nature, with the general format, page and plot size, and the variables to be plotted supplied as program input. The capability is available to plot, as a function of any variable, any other variables that are listed in the tabular time histories from the data stored on the time history file (FORTRAN unit No. 8). The complete specifications for each plot is supplied on input Cards I.1 to I.8, following input Card H.8, of the CVS program input file. Seven input cards are required for each plot to specify:

1. The number of plots to be generated.

2. The number of dependent (Y) variables to be plotted against the same independent (X) variable on each plot.

3. The page number and column number (from the printed tabular time

histories) for each of the dependent (Y) variables and the independent (X) variable for each plot.

4. For both the horizontal (X) and vertical (Y) axes on each plot

a. the number of intervals or decrements along the axis,

b. an indicator to specify a linear or logarithmic axis,

c. the values at the origin and end of the axis,

d. the length of the axis and of the paper or page size in the direction of the axis, and

e. the number of characters and the alphanumeric information for the label of each axis.

5. The number of characters and the alphanumeric information for each of two lines of a plot label to appear below the X axis label.

For a complete description of the required input parameters for the Calcomp plots, the user should refer to the input description for input Cards I.1 to I.8 contained in Section 4.0. In addition to plotting any variables from the tabular time histories against time, examples of other types of plots that have been generated include X-Z plots of the head C.G. positions and plots of force vs. deflection (or strain) that depicts the actual loading and unloading characteristics that were experienced. Since it is possible to specify the size and scaling for each axis, plots may be generated for comparison with available experimental data plots.

5.4 Printer Plots (FORTRAN Unit No. 2)

FORTRAN unit No. 2 is a formatted output file to be printed as a secondary program output. It contains printer plots generated by Subroutine PRIPLT depicting Y-Z, X-Z and X-Y views of the body segments, joints, belts, harness-belts and airbags. Their generation is controlled by the values of NPRT(5, 6 and 7) supplied on input Card A.5 for the Y-Z, X-Z and X-Y views, respectively. If any value is zero or blank, the corresponding view will not be generated; if nonzero, the corresponding view will be generated every m*DT seconds, where m is the positive nonzero value of the NPRT indicator and DT is defined on input Card A.4.

These printer plots have also been called "stickman plots". They appear to be confusing at first, but, as one becomes accustomed to the plot symbols used, can give a quick view of the dynamics of the crash victim. Each view gives the location in the vehicle reference coordinate system of the following items:

1. the c.g. of each body segment using the plot symbols defined by CGS(I) for I = 1 to NSEG as supplied on input Cards B.2.i1,

2. each joint using the plot symbols defined by JS(J) for J = 1 to NJNT as supplied on input Cards B.3.j1,

(NOTE: It has been found to be much easier to visualize the printer plots by supplying values for CGS and JS for each of the "standard" 15 segments as depicted in Table 5.2.)

TABLE 5.2

Suggested Printer Plot Symbols

segment or joint	H -HP - N -NP -UT - W -CT - P -LT
CGS or JS	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9
segment or joint	RH -RUL-RK -RLL-RA -RF
CGS or JS	A - B - C - D - E - F
segment or joint	LH -LUL-LK -LLL-LA -LF
CGS or JS	I - J - K - L - M - N
segment or joint	RS -RUA-RE -RLA
CGS or JS	P - Q - R - S
segment or joint	LS -LUA-LE -LLA
CGS or JS	W - X - Y - Z

3. the anchor points, tangent points and fixed point for each belt using the plot symbol ".",

4. each point in play for the harness-belt systems using the plot symbol ".",

5. the center and semiaxes endpoints for each airbag using the plot symbols "@" for the center, "-" for the endpoints of the Z axis and "!" for the endpoints of the X and y axes, and

6. the origin of the vehicle reference coordinate system using the plot symbol "*". This origin (in X,Y and Z plot coordinates) is specified by the values of ZPLT on input Card G.1.a, all plotted points are translated with respect to this origin, and those plot coordinates falling outside of the plotting area (1 to 120 for the plot Z axis, and 1 to 60 for the plot X and Y axes) are ignored.

The printed output pages produced from FORTRAN output unit No. 2 consist of 60 lines of 120 characters each. In general, the first or top line represents the plot Z axis and the first column or the left side edge, running from top to bottom, represents the plot X axis. If the view contains the plot Y axis, it is used in place of the unused X or Z axis. By rotating the printed pages 90 degrees in a counter-clockwise direction, the printed page becomes more familiarly orientated, i.e., negative Z up and positive X to the right from the lower left corner. The first character of each line is filled with the symbol "-" that serves as tick marks along the positive plot X axis. The distance between each of these tick marks is one length unit (UNITL on input Card A.3). Distances or lengths in the plot Z direction are the same and are established by the supplied values of SPLT on input Card G.1.b to accomodate printers that differ from default values of 10 horizontal characters and 6 lines per inch.

5.5 AFAMRL Program VIEW Input File (FORTRAN Unit No. 1)

FORTRAN unit No. 1 is an unformatted (binary) output file designed to be used as input to other programs that plot the contact ellipsoids of the body segments. Formerly, this output was produced near the end of the main program, but as of Version 20 of the CVS program (January 1980), the information contained on output file No. 1 has been modified to conform to the input specifications of the AFAMRL program VIEW that is now being distributed on the CVS program tapes. It is now generated by Subroutine UNIT1 of the CVS program.

The generation of this output file is controlled by the value of NPRT(1) that is supplied on input Card A.5. A blank or zero value for NPRT(1) will suppress the generation of output file No. 1, whereas a non-zero positive value will produce data records on output file No. 1 that are equally spaced at every m*DT seconds of simulation time, where m is the integer value of NPRT(1) and DT is defined on input Card A.4.

The first record on output file No. 1 contains fixed initialization data describing the plane and contact ellipsoids, and succeeding records contain the values of time and the c.g. linear coordinates in inertial reference and the direction cosine matrix for each of the body segments. These data are converted to single precision prior to transmission to output file No. 1 on those computer systems that require double precision computations for the CVS program.

5.6 Description of the Restart Procedure

The Calspan 3-D Crash Victim Simulation Program has a built-in optional restart procedure that is versatile, is easy to use and is independent of the computer and operating system being used.

To use the restart procedure, the following steps must be followed:

1) Any computer simulator run (including a restart run itself) may be a base run by defining the restart output unit IRSOUT $\neq$ 0 on card A.1.A.

2) To restart the base run, define the restart input unit IRSIN $\neq$ 0 and the restart time (RSTIME) on card A.1.A. and redefine the date and run description on cards A.1.A-A.1.C.

3) Program modifications are made on cards A.2 which permit the user to change any variables in the program labeled common blocks. No further input is required for the restart run.

4) For the restart run, the program is loaded into the computer as normal. However, the user should include the necessary Job Control Language (JCL) to define the restart input and output units.

To use the restart procedure, the user should be aware of the following procedures, considerations and restrictions.

1) The procedure consists of two subroutines (RSTART and SEARCH called by the main program) written entirely in FORTRAN IV and is therefore completely independent of the computer and operating system being used.

2) The restart procedure is completely optional. Its use is controlled by three additional input parameters on the first input card in such a manner that blank or zero values deactivate the procedure. This permits its optional use without disturbing the organization of current input decks.

3) Any computer simulation can be made the base run by defining IRSOUT $\neq$ 0 on card A.1.A. This defines the restart output unit (a value of 3 or 4 is suggested since the program uses units 1, 2, 5, 6, 7 and 21 and up) and requires the proper JCL to define this output unit.

4) During execution of the base run, an initial record is written on the restart output unit containing all the information in the program labeled common blocks that were defined by the input and initialization portions of the program.

5) At equally spaced simulation time intervals (DT as specified on card A.4), when the integration returns control to the main program to perform optional output, time point records are written on the restart output unit. These records contain all information in the program labeled common blocks that are time dependent and/or necessary to restart the program. The writing of the restart unit in no way disturbs the normal operation of the computer simulation.

6) To restart, the program is reloaded in the normal manner (program changes since the base run are permissible if the changes did not affect the format and contents of the restart unit.) Input cards A.1.A, A.1.B and A.1.C are required defining a new date, run description, the restart input unit number (IRSIN) and the restart time (RSTIME, an integral multiple of DT). IRSOUT may be defined, if desired, to generate an

additional restart output unit. Again make sure the proper JCL is included for units IRSIN and IRSOUT.

7) The program reads the initial input record from the restart input unit described in step 4. The program then bypasses the remainder of the input and initialization steps. One set of A.2 cards are then processed to modify any of the input or initialization data from the base run that is to apply to the new run. If the new value of IRSOUT is non-zero, step 4 is repeated for the new restart output unit with the input modifications, if any.

8) The program then advances the computer simulation time in DT increments by reading the restart input unit records, instead of calling the integrating routine DINT, up to and including the restart time RSTIME. After each step, the main program performs any optional output that is required including writing the time point record onto the new restart output unit, if required. In addition, the restart procedure calls Subroutine OUTPUT at each DT time increment to write a line of output on all the time history output units, thereby producing abbreviated time histories prior to the resumption of normal operation.

9) Immediately preceeding the resumption of normal operation at the restart time RSTIME, the second set of A.2 input cards is read allowing the user to change any variable in the labeled common blocks to be used by the program during the succeeding normal operation of the program.

10. All program modifications are made through the use of the input cards A.2. Two sets (each terminated by a blank card) are processed, the first after the input record is read from the restart input time, and the second just prior to resumption of normal operation of the program. Through the use of these cards, the user has the capability of changing any variable in the program labeled common blocks. The program merely makes the changes indicated by the user and no attempt is made to check the validity or consistency of the modifications. The program modifications fall into five broad categories as follows:

A. Desirable (and useful) Modifications

1. To control the length of the run (NSTEPS, DT)
2. To control optional output (elements of NPRT array)
3. To control the integrator (HMIN,HMAX,NDINT,SGTEST)

B. Permissible Modifications

1. Any alphanumeric variables used for identification purposes

C. Restrictive Modifications

1. In general, any variable that affects the position and velocity of segments through contacts or constraints can be modified before they become active

D. Useless Modifications

1. Many variables would be recomputed before they are used or supplied for output purposes
2. Variables that would not normally be used by the current options and controls in effect

3. Input parameters that are modified or used to establish initial conditions and hence are no longer active in the program

E. Prohibited Modifications

1. Modifications that would cause abrupt discontinuities in the integration procedure
2. Geometrical dimensions of the body segments and joints used to compute segment positions by the CHAIN procedure
3. Controls of contacts, constraints that are currently active
4. Control of force deflection characteristic functions that are currently loading or reloading.

In general, the user should carefully evaluate the potential effects of restart modifications before prescribing them.

6.0 NUMBERED STOPS WITHIN THE CVS-IV COMPUTER PROGRAM

There are many program stops within the CVS-IV computer program. These are all numbered (in octal to be compatible with most computer systems) and most computer systems will print out the STOP number message (as a condition code on the IBM/360 and IBM/370 systems). Most of the program stops will print out an error message indicating the reason for the program stop. For those produced by the input routines, the actual input error is probably caused by missing or erroneous data on previous input cards. The user is advised to check the output produced by the input routines to ascertain at what point within the input deck the error may have occurred.

Following is a list of all the numbered program stops within the CVS-IV computer program, the subroutine involved, the input card number (where applicable), the reason for the stop and possible remedial action.

1. Main Program; normal program stop, all activity requested by the user has been completed.
2. Subroutine RSTART, input card A.2; improper variable name, index or type has been supplied.
3. Subroutine BINPUT, input card B.3; error in defining flexible elements, there is only one negative JNT in string.
4. Subroutine BINPUT, input card B.7.A; value of NFX does not agree with the value of NFLX that has been computed from the data supplied on input cards B.3.
5. Subroutine BINPUT, input card B.7.J; the segment number defined by KNT(J) is not an interior segment of a flexible element from data supplied on input cards B.3.

6. Subroutine VINPUT, input card C.2; improper value for MSEG. Allowable values are zero or blank (to represent the primary vehicle), $\leq$ NSEG (to indicate prescribed motion for one of the specified segments) or one greater than the value of MSEG supplied on a previous C.2 card.

7. Subroutine VINPUT, input cards C; the number of sets of C cards is greater than 6 or the total number of segments defined by the program is greater than 30.

10. Subroutine SINPUT, input card D.2; the plane identification index (J) is in error, must be supplied as consecutive integers.

11. Subroutine KINPUT, input card E.6; the function number is less than 1 or greater than 50.

12. Subroutine KINPUT, input card E.7; the function number is less than 1 or greater than 50.

13. Subroutine KINPUT, input card E.7.D; inconsistent value for THETAO.

14. Subroutine FINPUT, input cards F.1.B-F.4.B; the supplied value for NJ (first number on line just printed) does not correspond to the index J supplied on input cards F.1.A-F.4.B.

15. Subroutine FDINIT, input cards F.1-F.4 (Subroutine FINPUT), F.8.C or F.8.D1 (Subroutine HINPUT); the printed function number has not been defined on input cards E.

16. Subroutine FDINIT, input cards F.1-F.4 (Subroutine FINPUT). F.8.C or F.8.D1 (Subroutine HINPUT); the size of the generated TAB array exceeds 2000 or the size of the NTAB array exceeds 500. These arrays are generated by input cards E and F.

17. Subroutine FINPUT, input cards F.5; the function number has not been defined on input cards E.7.

20. Subroutine FINPUT, input card F.6; the air bag number K has not been supplied in numeric order.

21. Subroutine FINPUT, input card F.7.B; the value of JJ does not correspond to the index J of the non-zero elements read in on input card F.7.A.

24. Subroutine INITAL, input cards G.3; input error for IYPR(4,J), supplied value is greater than J and less than or equal to NSEG.

25. Subroutine INITAL, input cards G.3; input error for IYPR(4,J), supplied value is negative but not equal to - [JNT(J-1)].

26. Subroutine EQUILB, input card G.4, G.5 or G.6; card number and contents are printed.

27. Subroutine EQUILB, input cards G.5; iteration for listed variable is not converging within the specified range.

30. Subroutine POSTPR, input card I.9 (on Edgewood Univac 1108 only); card is missing or in error, no plots have been generated.

31. Subroutine DINT; negative square root has been detected in Subroutine PDAUX with the time step size H=HMIN. This is usually an indication that there is extreme angular motion occurring. Unless there are other obvious errors, can be remedied by tightening the angular convergance tests on input cards B.6 or decreasing the value for HMIN on input card A.3.

32. Subroutine AIRBG3; logical error in program code has been detected.

33. Subroutine IMPULS; improper arguments to Subroutine IMPULS, program logic error.

34. Subroutine DAUX; value of NJ2 exceeds the array size for RHS and IJK.

35. Subroutine FSMSOL; maximum dimension of 400 on C array has been exceeded.

36. Function FNTERP; improper arguments to function as indicated by error code as follows:

1 - PHI less than $-\pi$

2 - PHI greater than π

3 - THETA less than zero,

4 - THETA greater than π.

37. Subroutine OUTPUT; program logic error, NPRT(4) on input card A.5 is less than or equal to -4 or greater than +4.

40. Subroutine HEDING; program logic error, NPRT(4) on input card A.5 is less than or equal to -4 or greater than +4.

41. Subroutine DSMSOL; matrix supplied to Subroutine DSMSOL (by Subroutine IMPLS2, SEGSEG, EDEPTH or INTERS) is singular.

42. Subroutine HBPLAY; program logic error is determining points that are in play for harness-belt systems.

43. Subroutine ROTATE; the listed plane number has been assigned to the listed segment numbers at least one of which has a rotated principal axes coordinate system. Error can be eliminated by defining multiple identical planes on input Cards D.2 and using different plane assignments on input Cards F.1.

44. Subroutine ROTATE; the listed ellipsoid number has been assigned to more than one segment on input Cards F.1, at least one of which has a rotated principal axes coordinate system. Error can be eliminated by defining multiple identical ellipsoids on input Cards D.5.

45. Subroutine ROTATE; same as STOP 44 except that the duplicate assignment was detected on input Cards F.2.

46. Subroutine ROTATE; same as STOP 44 except that the duplicate assignment was detected for a first segment on input Cards F.3.

47. Subroutine ROTATE; same as STOP 44 except that the duplicate assignment was detected for a second segment on input Cards F.3.

50. Subroutine ROTATE; same as STOP 44 except that the duplicate assignment was detected on input Cards F.6.

51. Subroutine ROTATE; same as STOP 44 except that the duplicate assignment was detected on input Cards F.8.

[Note: for STOP 45 to STOP 51, although the duplicate assignment was detected on the indicated input card, the original assignment would have been made on input Cards F.1, F.2, F.3, F.6 or F.8.]

7.0 SAMPLE OUTPUT

This section contains, for reference purposes, the computer output of CVS Run R2050G (6-12-80) that was a simulation of Calspan sled Runs 2049-2051 employing an Alderson Part 572 Dummy restrained by a three-point belt system. Included herein is the CVS output of the input to the program, the results at time zero followed by the tabular time histories printed for times from zero to 140 msec. at intervals of 5 msec. Also included on pages 111 and 112 are the control commands used to execute the program on the Univac 1108 Computer System at Edgewood, Maryland.

```
CALSPAN*CVS3SYM(1).XQTR2050G
        @DELETE,C  U1R2050G.
        @ASG,UP    U1R2050G.
        @USE     1,U1R2050G.
        @DELETE,C  U2R2050G.
        @ASG,UP    U2R2050G.
        @USE     2,U2R2050G.
        @DELETE,C  U8R2050G.
        @ASG,UP    U8R2050G.
        @USE     8,U8R2050G.
        @PRT       CVS3SYM.R2050INPUT
        @ASG,AX    CALSPAN*CVS3PROG.
        @XQT       CALSPAN*CVS3PROG.VER20A
        @ADD       CVS3SYM.R2050INPUT
        @BRKPT     2
        @FREE      U2R2050G.
        @SYM       U2R2050G.,,RMTS54

@ADD,P      CVS3SYM.XQTR2050G

@DELETE,C  U1R2050G.

@ASG,UP    U1R2050G.

@USE     1,U1R2050G.

@DELETE,C  U2R2050G.
FURPUR 27R3A      E33 SL73R1 06/12/80 22:25:28

U2R2050G      IS NOT CATALOGUED OR ASSIGNED
FAC STATUS: 400010000000

@ASG,UP    U2R2050G.

@USE     2,U2R2050G.

@DELETE,C  U8R2050G.
FURPUR 27R3A      E33 SL73R1 06/12/80 22:25:29

@ASG,UP    U8R2050G.

@USE     8,U8R2050G.

@PRT       CVS3SYM.R2050INPUT
FURPUR 27R3A      E33 SL73R1 06/12/80 22:25:30
```

```
CALSPAN*CVS3SYM(1).R2050INPUT
        @ADD        CVS3SYM.R2050ACARDS
        @ADD        CVS3SYM.P572ECARDS
        @ADD        CVS3SYM.R2049PULSE
        @ADD        CVS3SYM.R2050DCARDS
        @ADD        CVS3SYM.R2049ECARDS
        @ADD        CVS3SYM.R2050FCARDS
        @ADD        CVS3SYM.R2044GCARDS
        @ADD,E      CVS3SYM.R2049HCARDS

@ASG,AX    CALSPAN*CVS3PROG.
FAC WARNING       040200000000

@XQT       CALSPAN*CVS3PROG.VER20A
```

CALSPAN 3-D CRASH VICTIM SIMULATION PROGRAM

DEVELOPED BY CALSPAN CORP., P.O. BOX 400, BUFFALO NY 14225

FOR THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION,
U.S. DEPARTMENT OF TRANSPORTATION, UNDER CONTRACTS
FH-11-7592, HS-053-2-485, HS-6-01300 AND HS-6-01410;

AND FOR THE AEROSPACE MEDICAL RESEARCH LABORATORY,
AEROSPACE MEDICAL DIVISION, WRIGHT-PATTERSON AIR FORCE BASE
UNDER CONTRACTS F33615-75C-5002 AND F33615-78C-0516.

PROGRAM DOCUMENTATION - NHTSA REPORT NOS. DOT-HS-801-507
THROUGH 510 (FORMERLY CALSPAN REPORT NO. ZQ-5180-L-1)
AVAILABLE FROM NTIS (ACCESSION NOS. PB-241692,3,4 AND 5)
AND APPENDIXES A-J TO THE ABOVE, AVAILABLE FROM CALSPAN;
AND REPORT NO. AMRL-TR-75-14, AVAILABLE FROM NTIS.

PROGRAM VERSION 20A, EXECUTED ON THE UNIVAC 1108 COMPUTER
SYSTEM, EDGEWOOD ARSENAL, EDGEWOOD, MARYLAND.

12 JUNE 1980 IRSIN= 0 IRSOUT= 0 RSTIME = .0000 CARDS A

CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM, RUN R20506.

UNITL = IN UNITM = LBS UNITT = SEC GRAVITY VECTOR = (.0000, .0000, 386.0880)

NDINT = 6 NSTEPS = 28 DT = .005000 HO = .000250 HMAX = .001000 HMIN = .000125

NPRT ARRAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
2	1	1	2	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CRASH VICTIM ALDERSON PART 572 15 SEGMENTS 14 JOINTS

CARD B.1

CARDS B.2

SEGMENT			WEIGHT	PRINCIPAL MOMENTS OF INERTIA (LBS- SEC**2- IN)			SEGMENT CONTACT ELLIPSOID SEMIAXES (IN)			CENTER (IN)			PRINCIPAL AXES (DEG)		
I	SYM	PLOT	(LBS)	X	Y	Z	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL
1	LT	9	29.040	1.9859	1.3852	1.4802	4.900	6.940	6.000	.000	.000	-.270	.00	23.85	.00
2	CT	7	3.000	.0213	.0213	.0087	4.100	5.250	4.400	2.150	.000	.300	.00	.00	.00
3	UT	5	37.870	2.0799	1.5915	1.3362	4.660	6.780	9.000	.800	.000	2.200	.00	.00	.00
4	NECK	3	1.820	.0118	.0118	.0050	2.700	2.280	4.000	-.100	.000	1.650	.00	.00	.00
5	HEAD	1	9.670	.2197	.2562	.1638	4.000	3.100	5.000	.500	.000	.400	.00	42.21	.00
6	LUL	J	20.990	.7723	.7721	.1164	3.300	3.500	11.400	.150	.000	-2.200	.00	.00	.00
7	LLL	L	7.000	.5948	.5907	.0322	2.360	2.230	9.450	.000	.000	.000	.00	-3.74	.00
8	LF	N	2.760	.0383	.0434	.0132	1.520	1.600	5.220	.000	.000	.950	.00	.00	.00
9	RUL	B	20.990	.7723	.7721	.1164	3.300	3.500	11.400	.150	.000	-2.200	.00	.00	.00
10	RLL	D	7.000	.5948	.5907	.0322	2.360	2.230	9.450	.000	.000	.000	.00	-3.74	.00
11	RF	F	2.760	.0383	.0434	.0132	1.520	1.600	5.220	.000	.000	.950	.00	.00	.00
12	LUA	X	4.760	.1378	.1426	.0125	2.070	1.640	6.880	.000	.000	.006	.00	.00	11.52
13	LLA	Z	4.610	.2696	.2614	.0125	1.300	1.110	8.380	.000	.000	.000	.00	.00	.00
14	RUA	Q	4.760	.1378	.1426	.0125	2.070	1.640	6.880	.000	.000	.000	.00	.00	-11.52
15	RLA	S	4.610	.2696	.2614	.0125	1.300	1.110	8.380	.000	.000	.000	.00	.00	.00

CARDS B.3

JOINT					LOCATION(IN) - SEG(JNT)			LOCATION(IN) - SEG(J+1)			PRIN. AXIS(DEG) - SEG(JNT)			PRIN. AXIS(DEG) - SEG(J+1)		
J	SYM	PLOT	JNT	PIN	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL	YAW	PITCH	ROLL
1	P	8	1	-2	-1.790	.000	-2.140	.000	.000	2.075	.00	.00	.00	.00	.00	.00
2	W	6	2	-2	.000	.000	-2.325	-1.131	.000	6.559	.00	.00	.00	.00	.00	.00
3	NP	4	3	-2	1.575	.000	-6.576	.000	.000	2.185	.00	-20.00	.00	.00	.00	.00
4	HP	2	4	-2	.000	.000	-2.185	-.370	.000	1.390	.00	.00	.00	.00	.00	.00
5	LH	I	1	-4	-.130	-3.500	1.700	1.300	.000	-9.000	-90.00	90.00	.00	.00	4.76	.00
6	LK	K	6	1	-.043	.100	6.740	-.097	.000	-7.365	.00	.00	.00	.00	43.00	.00
7	LA	M	7	-4	-.097	.000	8.835	1.600	-.130	-2.030	90.00	.00	-.60	90.00	.00	.00
8	RH	A	1	-4	-.130	3.500	1.700	1.300	.000	-9.000	90.00	90.00	.00	.00	4.76	.00
9	RK	C	9	1	-.043	-.100	6.740	-.097	.000	-7.365	.00	.00	.00	.00	43.00	.00
10	RA	E	10	-4	-.097	.000	8.835	1.600	.130	-2.030	90.00	.00	-.60	90.00	.00	.00
11	LS	W	3	-4	-.161	-7.400	-3.580	.047	.030	-4.690	.00	.00	90.00	.00	.00	.00
12	LE	Y	12	-4	.047	.030	5.610	-.120	-.025	-6.340	90.00	.00	.00	90.00	.00	.00
13	RS	P	3	-4	-.161	7.400	-3.580	.047	-.030	-4.690	.00	.00	-90.00	.00	.00	.00
14	RE	R	14	-4	.047	-.030	5.610	-.120	.025	-6.340	90.00	.00	.00	90.00	.00	.00

JOINT TORQUE CHARACTERISTICS

CARDS E.4

JOINT	FLEXURAL SPRING CHARACTERISTICS: SPRING COEF. (IN LBS/DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)	TORSIONAL SPRING CHARACTERISTICS: SPRING COEF. (IN LBS/DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)
1 P	50.000	.000	.000	.000	90.000	34.383	.000	.000	.000	170.000
2 W	50.000	.000	.000	.000	90.000	34.383	.000	.000	.000	170.000
3 NP	31.200	.000	.000	.000	90.000	15.000	.000	.000	.000	170.000
4 HP	31.200	.000	.000	.000	90.000	15.000	.000	.000	.000	170.000
5 LH	7.500	75.000	75.000	.000	77.000	7.500	75.000	75.000	.000	35.000
	16.000	160.000	160.000	.000	60.000					
6 LK	.000	10.000	10.000	.000	53.000	.000	.000	.000	.000	.000
7 LA	1.000	10.000	10.000	.000	26.000	1.000	10.000	10.000	.000	42.000
	.000	.000	.000	.000	.000					
8 RH	7.500	75.000	75.000	.000	77.000	7.500	75.000	75.000	.000	35.000
	16.000	160.000	160.000	.000	60.000					
9 RK	.000	10.000	10.000	.000	53.000	.000	.000	.000	.000	.000
10 RA	1.000	10.000	10.000	.000	26.000	1.000	10.000	10.000	.000	42.000
	.000	.000	.000	.000	.000					
11 LS	.000	100.000	100.000	.000	125.000	.000	100.000	100.000	.000	60.000
	.000	.000	.000	.000	.000					
12 LE	.000	20.000	20.000	.000	52.000	5.000	50.000	50.000	.000	70.000
	.000	.000	.000	.000	.000					
13 RS	.000	100.000	100.000	.000	125.000	.000	100.000	100.000	.000	60.000
	.000	.000	.000	.000	.000					
14 RE	.000	20.000	20.000	.000	52.000	5.000	50.000	50.000	.000	70.000
	.000	.000	.000	.000	.000					

CARDS E.5

JOINT VISCOUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS

JOINT	VISCOUS COEFFICIENT (IN LBS SEC/DEG)	COULOMB FRICTION COEF. (IN LBS)	FULL FRICTION ANGULAR VELOCITY (DEG/ SEC)	MAX TORQUE FOR A LOCKED JOINT (IN LBS)	MIN TORQUE FOR UNLOCKED JOINT (IN LBS)	MIN. ANG. VELOCITY FOR UNLOCKED JOINT (RAD/ SEC)	IMPULSE RESTITUTION COEFFICIENT
1 P	1.200	122.40	30.00	500.00	.00	.00	.000
2 W	1.200	122.40	30.00	300.00	.00	.00	.000
3 NP	.150	100.00	30.00	15.00	.00	.00	.000
4 HP	.150	100.00	30.00	10.00	.00	.00	.000
5 LH	1.000	100.00	30.00	150.00	.00	.00	.000
	1.000	200.00	30.00	300.00	.00	.00	.000
	1.000	100.00	30.00	150.00	.00	.00	.000
6 LK	1.000	20.00	30.00	30.00	.00	.00	.000
7 LA	.500	20.00	30.00	30.00	.00	.00	.000
	.500	20.00	30.00	30.00	.00	.00	.000
	.000	.00	30.00	.00	.00	.00	.000
8 RH	1.000	100.00	30.00	150.00	.00	.00	.000
	1.000	200.00	30.00	300.00	.00	.00	.000
	1.000	100.00	30.00	150.00	.00	.00	.000
9 RK	1.000	20.00	30.00	30.00	.00	.00	.000
10 RA	.500	20.00	30.00	30.00	.00	.00	.000
	.500	20.00	30.00	30.00	.00	.00	.000

	.000	.00	30.00	.00	.00	.00	.000
11 LS	.100	50.00	30.00	100.00	.00	.00	.000
	.100	50.00	30.00	100.00	.00	.00	.000
	.000	.00	30.00	.00	.00	.00	.000
12 LE	.100	20.00	30.00	30.00	.00	.00	.000
	.100	20.00	30.00	30.00	.00	.00	.000
	.000	.00	30.00	.00	.00	.00	.000
13 RS	.100	50.00	30.00	100.00	.00	.00	.000
	.100	50.00	30.00	100.00	.00	.00	.000
	.000	.00	30.00	.00	.00	.00	.000
14 RE	.100	20.00	30.00	30.00	.00	.00	.000
	.100	20.00	30.00	30.00	.00	.00	.000
	.000	.00	30.00	.00	.00	.00	.000

SEGMENT INTEGRATION CONVERGENCE TEST INPUT

SEGMENT		ANGULAR VELOCITIES (RAD/ SEC)			LINEAR VELOCITIES (IN / SEC)			ANGULAR ACCELERATIONS (RAD/ SEC**2)			LINEAR ACCELERATIONS (IN / SEC**2)		
NO.	SYM	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR
1	LT	.000	.000	.0000	.000	.000	.0000	.010	.010	.0100	.001	.001	.0010
2	CT	.000	.000	.0000	.000	.000	.0000	.010	.010	.0400	.000	.000	.0000
3	UT	.000	.000	.0000	.000	.000	.0000	.010	.010	.0100	.000	.000	.0000
4	NECK	.000	.000	.0000	.000	.000	.0000	.010	.010	.4000	.000	.000	.0000
5	HEAD	.000	.000	.0000	.000	.000	.0000	.010	.010	.1000	.000	.000	.0000
6	LUL	.000	.000	.0000	.000	.000	.0000	.010	.010	.0400	.000	.000	.0000
7	LLL	.000	.000	.0000	.000	.000	.0000	.010	.010	.1000	.000	.000	.0000
8	LF	.000	.000	.0000	.000	.000	.0000	.010	.010	.4000	.000	.000	.0000
9	RUL	.000	.000	.0000	.000	.000	.0000	.010	.010	.0400	.000	.000	.0000
10	RLL	.000	.000	.0000	.000	.000	.0000	.010	.010	.1000	.000	.000	.0000
11	RF	.000	.000	.0000	.000	.000	.0000	.010	.010	.4000	.000	.000	.0000
12	LUA	.000	.000	.0000	.000	.000	.0000	.010	.010	.0400	.000	.000	.0000
13	LLA	.000	.000	.0000	.000	.000	.0000	.010	.010	.1000	.000	.000	.0000
14	RUA	.000	.000	.0000	.000	.000	.0000	.010	.010	.0400	.000	.000	.0000
15	RLA	.000	.000	.0000	.000	.000	.0000	.010	.010	.1000	.000	.000	.0000

VEHICLE DECELERATION INPUTS . CARDS C

RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

YAW	PITCH	ROLL	VIPS	VTIME	X0(X)	X0(Y)	X0(Z)	NATAL	ATO	ADT	MSEG
.000	.000	.000	.000	.100	.000	.000	.000	41	.000000	.002500	0

UNIDIRECTIONAL VEHICLE POSITION TABLES

TIME (MSEC)	ACC (G)	VELOCITY (IN / SEC)	POSITION (IN)	TIME (MSEC)	ACC (G)	VELOCITY (IN / SEC)	POSITION (IN)
.00000	.00	.0000	.00000				
2.50000	7.40	-4.0137	-.00408				
5.00000	9.30	-12.5157	-.02381				
7.50000	9.50	-21.5405	-.06628				
10.00000	10.30	-31.0479	-.13191				
12.50000	11.80	-41.7860	-.22274				
15.00000	12.40	-53.5375	-.34169				
17.50000	11.10	-64.7180	-.48957				
20.00000	11.80	-75.6089	-.66504				
22.50000	13.20	-87.7305	-.86990				
25.00000	13.90	-100.6655	-1.10453				
27.50000	14.40	-114.5073	-1.37363				
30.00000	15.10	-128.7282	-1.67755				
32.50000	15.90	-143.6650	-2.01785				
35.00000	17.00	-159.5187	-2.39664				
37.50000	19.30	-177.0213	-2.81683				
40.00000	21.80	-196.8405	-3.28368				
42.50000	24.10	-219.0647	-3.60319				
45.00000	25.50	-243.0746	-4.36049				
47.50000	26.20	-268.1462	-5.01953				
50.00000	25.40	-293.1695	-5.72118				
52.50000	24.70	-317.3482	-6.48447				
55.00000	24.00	-340.6514	-7.30736				
57.50000	23.50	-363.7834	-8.18626				
60.00000	22.90	-386.1845	-9.12583				
62.50000	21.70	-407.7491	-10.11854				
65.00000	20.00	-427.9142	-11.16341				
67.50000	18.50	-446.5269	-12.25681				
70.00000	16.60	-463.4986	-13.39468				
72.50000	15.00	-478.7974	-14.57293				
75.00000	12.80	-492.2622	-15.76714				
77.50000	11.20	-503.8207	-17.03253				
80.00000	9.90	-513.9796	-18.30508				
82.50000	8.00	-522.6425	-19.60127				
85.00000	5.80	-529.3266	-20.91664				
87.50000	1.50	-532.6727	-22.24478				
90.00000	-.60	-532.9301	-23.57743				
92.50000	-1.50	-531.8040	-24.90839				
95.00000	-1.00	-530.4849	-26.23629				
97.50000	-1.00	-529.5197	-27.56129				
100.00000	-1.00	-528.5545	-28.88389				

NPL	NBLT	NBAG	NELP	NQ	NSG	NHRNSS	NWINDF	NJNTF	NFORCE
12	2	0	5	0	0	1	0	0	0

CARD L.1

PLANE INPUTS

CARDS L.2

PLANE NO. 1 TEFLON SEAT

	X	Y	Z
POINT 1	19.6250	8.2500	-6.8750
POINT 2	37.0625	8.2500	-6.8750
POINT 3	19.6250	-8.2500	-6.8750

PLANE NO. 2 SEAT BACK PLATE

	X	Y	Z
POINT 1	19.6250	-5.0000	-4.3750
POINT 2	19.6250	-5.0000	-11.3750
POINT 3	19.6250	5.0000	-4.3750

PLANE NO. 3 SEAT SIDE SKIRT

	X	Y	Z
POINT 1	37.0625	8.2500	-4.3750
POINT 2	37.0625	8.2500	-6.8750
POINT 3	19.6250	8.2500	-4.3750

PLANE NO. 4 SEAT FRONT SKIRT

	X	Y	Z
POINT 1	37.0625	-8.2500	-4.3750
POINT 2	37.0625	-8.2500	-6.8750
POINT 3	37.0625	8.2500	-4.3750

PLANE NO. 5 SEAT BACK LEG

	X	Y	Z
POINT 1	22.1250	8.2500	.0000
POINT 2	22.1250	8.2500	-6.8750
POINT 3	19.6250	8.2500	.0000

PLANE NO. 6 SEAT FRONT LEG

	X	Y	Z
POINT 1	37.0625	8.2500	.0000
POINT 2	37.0625	8.2500	-6.8750
POINT 3	34.5625	8.2500	.0000

PLANE NO. 7 FLOORBOARD

	X	Y	Z
POINT 1	10.0000	24.0000	.0000
POINT 2	60.0000	24.0000	.0000
POINT 3	10.0000	-24.0000	.0000

PLANE INPUTS

PLANE NO. 8 TOEBOARD

	X	Y	Z
POINT 1	54.7500	8.0000	.0000
POINT 2	65.4757	8.0000	-9.0000
POINT 3	54.7500	-6.0000	.0000

PLANE NO. 9 TOEBOARD PLATE

	X	Y	Z
POINT 1	63.0923	8.0000	-7.0000
POINT 2	61.8067	8.0000	-8.5321
POINT 3	63.0923	-8.0000	-7.0000

PLANE NO. 10 LOWER BAG PANEL

	X	Y	Z
POINT 1	50.1253	15.0000	-22.5003
POINT 2	60.5552	15.0000	-32.9302
POINT 3	50.1253	-15.0000	-22.5003

PLANE NO. 11 UPPER BAG PANEL

	X	Y	Z
POINT 1	58.2500	15.0000	-30.6250
POINT 2	39.6652	15.0000	-49.0098
POINT 3	58.2500	-15.0000	-30.6250

PLANE NO. 12 KNEE BAR PLATE

	X	Y	Z
POINT 1	57.5399	10.5000	-12.0899
POINT 2	53.0000	10.5000	-21.0000
POINT 3	57.5399	-10.5000	-12.0899

BELT INPUTS

BELT NO. 1 LAP BELT

	ANCHOR POINT A			ANCHOR POINT B	
X	Y	Z	X	Y	Z
11.500	-8.000	-1.000	11.437	8.500	-1.000

	FIXED POINT ON SEGMENT			SLACK(+)
X	Y	Z	BLANK	LENGTH(-)
4.744	.000	-1.500	.000	.010

BELT NO. 2 SHOULDER BELT

	ANCHOR POINT A			ANCHOR POINT B	
X	Y	Z	X	Y	Z
-2.000	-11.187	-42.375	11.437	8.500	-1.000

	FIXED POINT ON SEGMENT			SLACK(+)
X	Y	Z	BLANK	LENGTH(-)
4.655	.000	.400	.000	2.000

121

ADDITIONAL ELLIPSOID INPUT

CARDS D.5

NO.	SEMIAXES (IN) X	Y	Z	OFFSET (IN) X	Y	Z	ROTATION (DEG) YAW	PITCH	ROLL
21	1.500	1.600	1.750	-.150	.000	-2.520	.000	.000	.000
22	1.500	1.600	1.750	-.150	.000	-2.520	.000	.000	.000
23	1.000	1.600	3.000	-.650	.000	3.170	.000	.000	.000
24	1.000	1.600	3.000	-.650	.000	3.170	.000	.000	.000
25	4.660	20.000	9.000	.800	.000	2.200	.000	.000	.000

BODY SEGMENT SYMMETRY INPUT

CARD D.7

SEC NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NSYM(J)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

FUNCTION NO. 1 SEG-SEAT FDF NTI(1) = 1 CARDS E

D0	D1	D2	D3	D4
.0000	-8.0000	.0000	.0000	1.0000

FIRST PART OF FUNCTION - 6 TABULAR POINTS

D	F(D)
.000000	.0000
.200000	60.0000
1.000000	860.0000
2.000000	1690.0000
3.000000	2380.0000
8.000000	2360.0000

FUNCTION NO. 2 SEG-SEAT R NTI(2) = 19 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.8800	.0000	.0000

FUNCTION IS CONSTANT .880000

FUNCTION NO. 3 SEG-SEAT C NTI(3) = 24 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.1000	.0000	.0000

FUNCTION IS CONSTANT .100000

FUNCTION NO. 4 TEFLON SEAT CF NTI(4) = 29 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.0100	.0000	.0000

FUNCTION IS CONSTANT .010000

FUNCTION NO. 5 SEG-PLATE FDF NTI(5) = 34 CARDS E

D0	D1	D2	D3	D4
.0000	-8.0000	.0000	.0000	1.0000

FIRST PART OF FUNCTION - 7 TABULAR POINTS

D	F(D)
.000000	.0000
.500000	50.0000
1.500000	860.0000
2.250000	1690.0000
3.250000	2380.0000
4.250000	2380.0000
8.000000	2380.0000

125

FUNCTION NO. 6 PLATE R NTI(6) = 54 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.8800	.0000	.0000

FUNCTION IS CONSTANT .880000

FUNCTION NO. 7 PLATE 6 NTI(7) = 59 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.1000	.0000	.0000

FUNCTION IS CONSTANT .100000

FUNCTION NO. 8 SEG-PLATE CF NTI(8) = 64 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.5000	.0000	.0000

FUNCTION IS CONSTANT .500000

FUNCTION NO. 9 FOOT-FLOOR FDF NTI(9) = 69 CARDS E

D0	D1	D2	D3	D4
.0000	-8.0000	.0000	.0000	1.0000

FIRST PART OF FUNCTION - 6 TABULAR POINTS

D	F(D)
.000000	.0000
.075000	5.0000
1.000000	1400.0000
2.000000	2100.0000
3.000000	2800.0000
6.000000	2800.0000

FUNCTION NO. 10 FLOORBOARD R NTI(10) = 87 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.8800	.0000	.0000

FUNCTION IS CONSTANT .880000

FUNCTION NO. 11 FLOOREGARD G NTI(11) = 92 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.1000	.0000	.0000

FUNCTION IS CONSTANT .100000

FUNCTION NO. 12 FOOT-FLOOR CF NTI(12) = 97 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.5000	.0000	.0000

FUNCTION IS CONSTANT .500000

FUNCTION NO. 13 SEG-SEG FDF NTI(13) = 102 CARDS E

D0	D1	D2	D3	D4
.0000	-8.0000	.0000	.0000	1.0000

FIRST PART OF FUNCTION - 8 TABULAR POINTS

D	F(D)
.000000	.0000
1.000000	50.0000
2.000000	470.0000
3.000000	890.0000
4.000000	1220.0000
5.000000	1470.0000
6.000000	1580.0000
8.000000	1580.0000

FUNCTION NO. 14 SEG-SEG R NTI(14) = 124 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	1.0000	.0000	.0000

FUNCTION IS CONSTANT 1.000000

FUNCTION NO. 15   SEG-SEG G   NTI(15) = 129   CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.0000	.0000	.0000

FUNCTION IS CONSTANT .000000

FUNCTION NO. 16   SEG-SEG CF   NTI(16) = 134   CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.5000	.0000	.0000

FUNCTION IS CONSTANT .500000

FUNCTION NO. 21 LEFT LAP BELT FDF NTI(21) = 139 CARDS E

D0	D1	D2	D3	D4
.0000	-.5000	.0000	.0000	.0000

FIRST PART OF FUNCTION - 7 TABULAR POINTS

D	F(D)
.000000	.0000
.050000	150.0000
.075000	400.0000
.100000	800.0000
.125000	1550.0000
.290000	1550.0000
.500000	1550.0000

FUNCTION NO. 22 RIGHT LAP BELT FDF NTI(22) = 159 CARDS E

D0	D1	D2	D3	D4
.0000	-.5000	.0000	.0000	.0000

FIRST PART OF FUNCTION - 7 TABULAR POINTS

D	F(D)
.000000	.0000
.060000	360.0000
.120000	900.0000
.165000	1500.0000
.185000	1850.0000
.350000	1850.0000
.500000	1850.0000

131

FUNCTION NO. 23 SHOULDER BELT FDF NTI(23) = 175 CARDS E

D0	D1	D2	D3	D4
.0000	-.5000	.0000	.0000	.0000

FIRST PART OF FUNCTION - 5 TABULAR POINTS

D	F(D)
.000000	.0000
.010000	100.0000
.095000	1800.0000
.350000	1800.0000
.500000	1800.0000

FUNCTION NO. 24 BELT R NTI(24) = 195 CARDS E

D0	D1	D2	D3	D4
.0000	.0000	.7500	.0000	.0000

FUNCTION IS CONSTANT .750000

```
FUNCTION NO.  25          BELT G                    NTI(25) =  200                    CARDS E

      D0           D1           D2           D3           D4
    .0000        .0000        .1500        .0000        .0000

   FUNCTION IS CONSTANT     .150000


FUNCTION NO.  26          BELT CF                   NTI(26) =  205                    CARDS E

      D0           D1           D2           D3           D4
    .0000        .0000       1.0000        .0000        .0000

   FUNCTION IS CONSTANT    1.000000
```

```
FUNCTION NO. 33      EELT-SFG CF                    NTI(33) =  210                      CARDS E

        D0          D1          D2          D3          D4
        .0000       .0000       1.0000      .0000       .5000

    FUNCTION IS CONSTANT    1.000000


FUNCTION NO. 34      TIE-POINT CF                   NTI(34) =  215                      CARDS E

        D0          D1          D2          D3          D4
        .0000       .0000       .5000       .0000       .5000

    FUNCTION IS CONSTANT    .500000
```

ALLOWED CONTACTS AND ASSOCIATED FUNCTIONS

CARDS F.1

PLANE	SEGMENT	FORCE DEFLECTION	INERTIAL SPIKE	R FACTOR	G FACTOR	FRICTION COEF.
1- 16 TEFLON SEAT	6- 6 LUL	1 SEG-SEAT FDF	0	2 SEG-SEAT R	3 SEG-SEAT G	4 TEFLON SEAT CF
1- 16 TEFLON SEAT	9- 9 RUL	1 SEG-SEAT FDF	0	2 SEG-SEAT R	3 SEG-SEAT G	4 TEFLON SEAT CF
1- 16 TEFLON SEAT	1- 1 LT	1 SEG-SEAT FDF	0	2 SEG-SEAT R	3 SEG-SEAT G	4 TEFLON SEAT CF
2- 16 SEAT BACK PLATE	1- 1 LT	5 SEG-PLATE FDF	0	6 PLATE R	7 PLATE G	8 SEG-PLATE CF
7- 16 FLOORBOARD	8- 21 LF	9 FOOT-FLOOR FDF	0	10 FLOORBOARD R	11 FLOORBOARD G	12 FOOT-FLOOR CF
7- 16 FLOORBOARD	11- 22 RF	9 FOOT-FLOOR FDF	0	10 FLOORBOARD R	11 FLOORBOARD G	12 FOOT-FLOOR CF
8- 16 TOEBOARD	8- 21 LF	9 FOOT-FLOOR FDF	0	10 FLOORBOARD R	11 FLOORBOARD G	12 FOOT-FLOOR CF
8- 16 TOEBOARD	11- 22 RF	9 FOOT-FLOOR FDF	0	10 FLOORBOARD R	11 FLOORBOARD G	12 FOOT-FLOOR CF
8- 16 TOEBOARD	8- 23 LF	9 FOOT-FLOOR FDF	0	10 FLOORBOARD R	11 FLOORBOARD G	12 FOOT-FLOOR CF
8- 16 TOEBOARD	11- 24 RF	9 FOOT-FLOOR FDF	0	10 FLOORBOARD R	11 FLOORBOARD G	12 FOOT-FLOOR CF
9- 16 TOEBOARD PLATE	8- 23 LF	5 SEG-PLATE FDF	0	6 PLATE R	7 PLATE G	8 SEG-PLATE CF
9- 16 TOEBOARD PLATE	11- 24 RF	5 SEG-PLATE FDF	0	6 PLATE R	7 PLATE G	8 SEG-PLATE CF

CARDS F.3

SEGMENT	SEGMENT	FORCE DEFLECTION	INERTIAL SPIKE	R FACTOR	G FACTOR	FRICTION COEF.
6- 6 LUL	13- 13 LLA	13 SEG-SEG FDF	0	14 SEG-SEG R	15 SEG-SEG G	16 SEG-SEG CF
9- 9 RUL	15- 15 RLA	13 SEG-SEG FDF	0	14 SEG-SEG R	15 SEG-SEG G	16 SEG-SEG CF

HARNESS-BELT SYSTEM INPUT CARDS F.6

NO. OF HARNESSES = 1

NO. OF BELTS PER HARNESS = 3

FOR HARNESS NO. 1 NO. OF POINTS PER BELT = 10 5 11

HARNESS NO. 1 BELT NO. 1 FUNCTION NOS. 21 0 24 25 26 REFERENCE SLACK = .010 IN

CARDS F.6.D

K	KS	KE	NT	NPD	NDR	FUNCTION NOS.				
1	101	1	91	1	1	0	0	0	0	34
2	1	1	97	0	0	0	0	0	0	33
3	1	1	103	0	0	0	0	0	0	33
4	1	1	109	0	0	0	0	0	0	33
5	1	1	115	0	0	0	0	0	0	33
6	1	1	121	0	0	0	0	0	0	33
7	1	1	127	0	0	0	0	0	0	33
8	1	1	133	0	0	0	0	0	0	33
9	1	1	139	0	0	0	0	0	0	33
10	16	0	145	0	1	0	0	0	0	0

	BASE REFERENCE (IN)			ADJUSTED REFERENCE (IN)			OFFSET (IN)			PREFERRED DIRECTION (IN)		
K	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
1	3.991	3.824	-1.090	3.991	3.824	-1.050	.000	.000	-.270	.000	-1.000	.000
2	4.711	.847	-1.481	4.711	.847	-1.481	.000	.000	-.270	.000	.000	.000
3	4.733	-.493	-1.494	4.733	-.493	-1.495	.000	.000	-.270	.000	.000	.000
4	4.561	-1.951	-1.404	4.561	-1.951	-1.404	.000	.000	-.270	.000	.000	.000
5	4.179	-3.347	-1.200	4.179	-3.347	-1.200	.000	.000	-.270	.000	.000	.000
6	3.583	-4.623	-.882	3.583	-4.623	-.882	.000	.000	-.270	.000	.000	.000
7	2.772	-5.700	-.447	2.772	-5.700	-.447	.000	.000	-.270	.000	.000	.000
8	1.769	-6.471	.091	1.769	-6.471	.091	.000	.000	-.270	.000	.000	.000
9	.655	-6.831	.690	.655	-6.831	.690	.000	.000	-.270	.000	.000	.000
10	.000	.250	.000	.000	.250	.000	11.500	-8.250	-1.000	.000	.000	.000

HARNESS NO. 1 BELT NO. 2 FUNCTION NOS. 22 0 24 25 26 REFERENCE SLACK = .010 IN

CARDS F.6.D

K	KS	KE	NT	NPD	NDR	FUNCTION NOS.				
11	101	1	157	1	1	0	0	0	0	34
12	1	1	163	0	0	0	0	0	0	33
13	1	1	169	0	0	0	0	0	0	33
14	1	1	175	0	0	0	0	0	0	33
15	16	0	181	0	1	0	0	0	0	0

	BASE REFERENCE (IN)			ADJUSTED REFERENCE (IN)			OFFSET (IN)			PREFERRED DIRECTION (IN)		
K	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
11	3.991	3.824	-1.090	3.991	3.824	-1.050	.000	.000	-.270	.000	-1.000	.000
12	3.065	5.371	-.591	3.065	5.371	-.551	.000	.000	-.270	.000	.000	.000
13	2.072	6.289	-.056	2.072	6.289	-.056	.000	.000	-.270	.000	.000	.000
14	.838	6.802	.608	.838	6.802	.608	.000	.000	-.270	.000	.000	.000
15	.000	-.250	.000	.000	-.250	.000	11.437	8.750	-1.000	.000	.000	.000

HARNESS NO. 1 BELT NO. 3 FUNCTION NOS. 23 0 24 25 26 REFERENCE SLACK = .750 IN

CARDS F.B.D

K	KS	KE	NT	NPD	NDR	FUNCTION NOS.				
16	101	1	193	1	1	0	0	0	0	34
17	3	25	199	0	0	0	0	0	0	33
18	3	25	205	0	0	0	0	0	0	33
19	3	25	211	0	0	0	0	0	0	33
20	3	25	217	0	0	0	0	0	0	33
21	3	25	223	0	0	0	0	0	0	33
22	3	25	229	0	0	0	0	0	0	33
23	3	25	235	0	0	0	0	0	0	33
24	3	25	241	0	0	0	0	0	0	33
25	3	25	247	0	0	0	0	0	0	33
26	16	0	253	0	1	0	0	0	0	0

	BASE REFERENCE (IN)			ADJUSTED REFERENCE (IN)			OFFSET (IN)			PREFERRED DIRECTION (IN)		
K	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
16	3.991	3.824	-1.090	3.991	3.824	-1.090	.000	.000	-.270	.000	-1.000	.000
17	4.513	.859	2.210	4.513	.859	2.210	.800	.000	2.200	.000	.000	.000
18	4.643	.157	.769	4.643	.157	.769	.800	.000	2.200	.000	.000	.000
19	4.644	-.471	-.707	4.644	-.471	-.707	.800	.000	2.200	.000	.000	.000
20	4.514	-1.099	-2.183	4.514	-1.099	-2.183	.800	.000	2.200	.000	.000	.000
21	4.238	-1.727	-3.659	4.238	-1.727	-3.659	.800	.000	2.200	.000	.000	.000
22	3.788	-2.355	-5.135	3.788	-2.355	-5.135	.800	.000	2.200	.000	.000	.000
23	3.085	-2.983	-6.611	3.085	-2.983	-6.611	.800	.000	2.200	.000	.000	.000
24	1.864	-3.611	-8.087	1.864	-3.611	-8.087	.800	.000	2.200	.000	.000	.000
25	.000	-3.925	-8.825	.000	-3.925	-8.825	.800	.000	2.200	.000	.000	.000
26	.000	.250	.000	.000	.250	.000	-2.000	-11.437	-42.375	.000	.000	.000

SUBROUTINE INITAL INPUT CARD G.1

ZPLT(X)	ZPLT(Y)	ZPLT(Z)	I1	J1	I2	J2	I3	SPLT(1)	SPLT(2)	SPLT(3)
-10.	25.	1.	0	0	0	0	0	10.00	6.00	1.00

INITIAL POSITIONS (INERTIAL REFERENCE) CARDS G.2

SEGMENT		LINEAR POSITION (IN)			LINEAR VELOCITY (IN / SEC)		
NO.	SEG	X	Y	Z	X	Y	Z
1	LT	24.12900	.00000	-12.30900	.00000	.00000	.00000
2	CT	21.54688	.00000	-16.06280	.00000	.00000	.00000
3	UT	21.21508	.00000	-25.00343	.00000	.00000	.00000
4	NECK	22.16406	.00000	-33.86916	.00000	.00000	.00000
5	HEAD	23.25468	.00000	-37.30530	.00000	.00000	.00000
6	LUL	33.45274	-3.50000	-10.77709	.00000	.00000	.00000
7	LLL	46.49891	-3.40000	-8.14335	.00000	.00000	.00000
8	LF	56.63452	-3.27000	-3.63639	.00000	.00000	.00000
9	RUL	33.45274	3.50000	-10.77709	.00000	.00000	.00000
10	RLL	46.49891	3.40000	-8.14335	.00000	.00000	.00000
11	RF	56.63452	3.27000	-3.63639	.00000	.00000	.00000
12	LUA	20.78651	-7.43000	-23.83323	.00000	.00000	.00000
13	LLA	27.10839	-7.37500	-15.85194	.00000	.00000	.00000
14	RUA	20.78651	7.43000	-23.83323	.00000	.00000	.00000
15	RLA	27.10839	7.37500	-15.85194	.00000	.00000	.00000

INITIAL ANGULAR ROTATION AND VELOCITY CARDS G.3

138

SEGMENT		ANGULAR ROTATION (DEG)			ANGULAR VELOCITY (DEG/ SEC)						
NO.	SEG	YAW	PITCH	ROLL	X	Y	Z		IYPR		
1	LT	.00000	12.18330	.00000	.00000	.00000	.00000	1	2	3	0
2	CT	.00000	10.57500	.00000	.00000	.00000	.00000	1	2	3	0
3	UT	.00000	8.96670	.00000	.00000	.00000	.00000	1	2	3	0
4	NECK	.00000	-20.00000	.00000	.00000	.00000	.00000	1	2	3	3
5	HEAD	.00000	-12.96670	.00000	.00000	.00000	.00000	1	2	3	0
6	LUL	.00000	99.21000	.00000	.00000	.00000	.00000	1	2	3	0
7	LLL	.00000	59.36000	.00000	.00000	.00000	.00000	1	2	3	0
8	LF	.00000	130.00000	.00000	.00000	.00000	.00000	1	2	3	0
9	RUL	.00000	99.21000	.00000	.00000	.00000	.00000	1	2	3	0
10	RLL	.00000	59.36000	.00000	.00000	.00000	.00000	1	2	3	0
11	RF	.00000	130.00000	.00000	.00000	.00000	.00000	1	2	3	0
12	LUA	.00000	4.10000	.00000	.00000	.00000	.00000	1	2	3	0
13	LLA	.00000	66.78330	.00000	.00000	.00000	.00000	1	2	3	0
14	RUA	.00000	4.10000	.00000	.00000	.00000	.00000	1	2	3	0
15	RLA	.00000	66.78330	.00000	.00000	.00000	.00000	1	2	3	0

LINEAR AND ANGULAR VELOCITIES HAVE BEEN SET EQUAL TO THE INITIAL VEHICLE VELOCITIES.

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HBPLAY TIME =      .000 MSEC. NH,NB,NPTS NT=     1     1    10    85
NL(1)=      1       2       3       4       5       6       7       8       9      10
BB    =        3.089   1.341   1.472   1.461   1.444   1.417   1.375   1.315  17.373

HBPLAY TIME =      .000 MSEC. NH,NB,NPTS NT=     1     2     5   151
NL(1)=     11      12      13      14      15
BB    =        1.871   1.455   1.493  17.866

HBPLAY TIME =      .000 MSEC. NH,NB,NPTS NT=     1     3     9   187
NL(1)=     16      18      19      20      21      22      23      24      26
```

BB = 9.371 1.629 1.635 1.653 1.692 1.779 2.047 28.781

MAIN3D FUNCTIONS IN INERTIAL REFERENCE FOR TIME= .000 MSEC

SEGMENT	ANGULAR ROTATION (DEG) YAW	PITCH	ROLL	ANGULAR VELOCITY (RAD/ SEC) X	Y	Z	ANGULAR ACCELERATION (RAD/ SEC**2) X	Y	Z
1 LT	.0000	12.1633	.0000	.00000	.00000	.00000	.000000	-6.476424	.000000
2 CT	.0000	10.5750	.0000	.00000	.00000	.00000	.000000	-6.476424	.000000
3 UT	.0000	8.9667	.0000	.00000	.00000	.00000	.000000	-6.476424	.000000
4 NECK	.0000	-11.0333	.0000	.00000	.00000	.00000	.000000	-6.476424	.000000
5 HEAD	.0000	-12.9667	.0000	.00000	.00000	.00000	.000000	-6.476424	.000000
6 LUL	.0000	99.2100	.0000	.00000	.00000	.00000	.000000	-6.476424	.000000
7 LLL	.0000	59.3600	.0000	.00000	.00000	.00000	.000000	9.266431	.000000
8 LF	.0000	130.0000	.0000	.00000	.00000	.00000	.000000	9.266431	.000000
9 RUL	.0000	99.2100	.0000	.00000	.00000	.00000	.000000	-6.476424	.000000
10 RLL	.0000	59.3600	.0000	.00000	.00000	.00000	.000000	9.266431	.000000
11 RF	.0000	130.0000	.0000	.00000	.00000	.00000	.000000	9.266431	.000000
12 LUA	.0000	4.1000	.0000	.00000	.00000	.00000	.000000	-6.345957	1.293407
13 LLA	.0000	66.7833	.0000	.00000	.00000	.00000	.000000	-6.476424	.000000
14 RUA	.0000	4.1000	.0000	.00000	.00000	.00000	.000000	-6.345957	-1.293407
15 RLA	.0000	66.7833	.0000	.00000	.00000	.00000	.000000	-6.476424	.000000
16 VEH	.0000	.0000	.0000	.00000	.00000	.00000	.000000	.000000	.000000

SEGMENT	LINEAR POSITION (IN) X	Y	Z	LINEAR VELOCITY (IN / SEC) X	Y	Z	LINEAR ACCELERATIONS (G'S) X	Y	Z
1 LT	24.1290	.0000	-12.3090	.00000	.00000	.00000	-.198623	.000000	-.006312
2 CT	21.5469	.0000	-16.0628	.00000	.00000	.00000	-.135655	.000000	-.049625
3 UT	21.2151	.0000	-25.0034	.00000	.00000	.00000	.014319	.000000	-.055191
4 NECK	22.1641	.0000	-33.8692	.00000	.00000	.00000	.163373	.000000	-.039273
5 HEAD	23.2547	.0000	-37.3053	.00000	.00000	.00000	.220677	.000000	-.020978
6 LUL	33.4527	-3.5000	-10.7771	.00000	.00000	.00000	-.224320	.000000	.150069
7 LLL	46.4989	-3.4000	-8.1434	.00000	.00000	.00000	-.118662	.000000	.108203
8 LF	56.6345	-3.2700	-3.6364	.00000	.00000	.00000	-.010258	.000000	-.135585
9 RUL	33.4527	3.5000	-10.7771	.00000	.00000	.00000	-.224320	.000000	.150069
10 RLL	46.4989	3.4000	-8.1434	.00000	.00000	.00000	-.118662	.000000	.108203
11 RF	56.6345	3.2700	-3.6364	.00000	.00000	.00000	-.010258	.000000	-.135585
12 LUA	20.7865	-7.4300	-23.8332	.00000	.00000	.00000	-.005310	.000000	-.062380
13 LLA	27.1084	-7.3750	-15.6519	.00000	.00000	.00000	-.139192	.000000	.043666
14 RUA	20.7865	7.4300	-23.8332	.00000	.00000	.00000	-.005310	.000000	-.062380
15 RLA	27.1084	7.3750	-15.6519	.00000	.00000	.00000	-.139192	.000000	.043666
16 VEH	.0000	.0000	.0000	.00000	.00000	.00000	.000000	.000000	.000000

SEGMENT		UI ARRAY (IN / SEC**2) EXTERNAL LINEAR ACCELERATIONS X	Y	Z	U2 ARRAY (RAD/ SEC**2) EXTERNAL ANGULAR ACCELERATIONS X	Y	Z
1	LT	.0000	.0000	-1174.9374	.00000	28.85248	.00000
2	CT	.0000	.0000	386.0880	.00000	.00000	.00000
3	UT	.0000	.0000	386.0880	.00000	.00000	.00000
4	NECK	.0000	.0000	386.0880	.00000	.00000	.00000
5	HEAD	.0000	.0000	386.0880	.00000	.00000	.00000
6	LUL	.0000	.0000	189.5333	.00000	-99.45211	.00000
7	LLL	.0000	.0000	386.0880	.00000	.00000	.00000
8	LF	-1096.0284	.0000	-920.0978	.00000	93.40856	.00000
9	RUL	.0000	.0000	189.5333	.00000	-99.45211	.00000
10	RLL	.0000	.0000	386.0880	.00000	.00000	.00000
11	RF	-1096.0284	.0000	-920.0978	.00000	93.40856	.00000
12	LUA	.0000	.0000	386.0880	.00000	.00000	.00000
13	LLA	.0000	.0000	386.0880	.00000	.00000	.00000
14	RUA	.0000	.0000	386.0880	.00000	.00000	.00000
15	RLA	.0000	.0000	386.0880	.00000	.00000	.00000

JOINT		IPIN	JOINT FORCES (LBS) X	Y	Z	JOINT TORQUES (IN LBS) X	Y	Z	RELATIVE ANGULAR VELOCITY (RAD/ SEC)
1	P	-2	1.2327	.0000	-73.8046	.00000	57.20629	.00000	.000000
2	W	-2	1.6396	.0000	-70.6557	.00000	-7.44666	.00000	.000000
3	NP	-2	2.4313	.0000	-11.7643	.00000	-1.44736	.00000	.000000
4	HP	-2	2.1339	.0000	-9.8729	.00000	-2.26646	.00000	.000000
5	LH	7	2.2677	.0000	-7.1931	-.80248	-129.86468	1.71250	.000000
6	LK	1	6.9762	.0000	-.0394	-.80642	.00000	1.01488	.000000
7	LA	7	7.8068	.0000	6.2032	-.80642	20.29532	1.01488	.000000
8	RH	7	2.2677	.0000	-7.1931	.80248	-129.86468	-1.71250	.000000
9	RK	1	6.9762	.0000	-.0394	.80642	.00000	-1.01488	.000000
10	RA	7	7.8068	.0000	6.2032	.80642	20.29532	-1.01488	.000000
11	LS	7	-.6670	.0000	-9.4656	-.02970	-19.77464	.14923	.000000
12	LE	7	-.6417	.0000	-4.4087	.11022	-22.67020	-.01604	.000000
13	RS	7	-.6670	.0000	-9.4656	.02970	-19.77464	-.14923	.000000
14	RE	7	-.6417	.0000	-4.4087	-.11022	-22.67020	.01604	.000000

DATE: 12 JUNE 1980 PAGE: 21.01
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572

SEGMENT LINEAR ACCELERATIONS (G'S) IN LOCAL REFERENCE

TIME	POINT (-.40, -.39, -.00) ON SEGMENT NO. 5 - HEAD				POINT (-.27, .00, -2.86) ON SEGMENT NO. 3 - UT				POINT (-1.79, .00, 2.25) ON SEGMENT NO. 1 - LT			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
.000	.206	.000	-.075	.219	.071	.000	-.057	.091	-.239	.000	-.060	.247
5.000	-.222	.000	-.168	.278	-.623	.000	-.424	.754	-.599	-.003	-.459	.754
10.000	.561	.094	.252	.622	-.176	-.048	.121	.219	-3.300	.183	-.681	3.374
15.000	1.878	.056	.672	1.996	-.714	-.035	.308	.778	-8.647	-.104	-.127	8.649
20.000	1.931	-.056	.900	2.131	-.988	.017	.272	1.024	-10.015	-.037	-.928	10.058
25.000	2.548	.018	1.122	2.784	-2.440	.027	.065	2.441	-6.779	-.122	-1.664	6.981
30.000	2.142	-.143	1.385	2.555	-4.466	.025	-.411	4.485	-4.208	-.149	-2.276	4.766
35.000	-3.199	-.516	2.809	4.288	-3.981	.476	.483	4.038	-3.593	-.138	-2.660	4.473
40.000	-4.582	-.796	4.756	6.652	-11.104	-.182	.236	11.108	-6.829	.134	-2.119	7.151
45.000	-6.923	-1.434	9.454	11.805	-18.273	-.946	1.678	18.374	-12.643	.602	-1.131	12.708
50.000	-10.895	-2.606	15.376	19.024	-23.710	-2.243	3.071	24.013	-17.585	1.314	-2.090	17.758
55.000	-14.860	-4.092	22.017	26.876	-26.763	-3.939	4.895	27.490	-21.920	1.163	-5.095	22.534
60.000	-16.607	-6.112	28.453	33.507	-31.131	-7.070	4.429	32.230	-28.276	-1.104	-10.580	30.210
65.000	-18.923	-8.943	31.104	37.490	-28.234	-10.371	3.932	30.335	-29.519	-3.002	-11.482	31.815
70.000	-18.290	-11.224	30.229	37.072	-24.625	-10.505	4.288	27.114	-29.294	-5.579	-14.521	33.168
75.000	-16.024	-10.969	28.202	34.241	-23.492	-10.196	2.352	25.717	-28.269	-6.134	-19.718	35.006
80.000	-15.100	-7.685	24.631	29.896	-20.439	-8.907	.496	22.301	-26.293	-7.976	-22.113	35.270
85.000	-13.364	-5.467	29.000	32.396	-21.008	-9.764	1.507	23.215	-23.554	-8.422	-19.624	31.793
90.000	-13.372	-6.541	28.333	32.005	-18.001	-8.708	3.374	20.279	-19.583	-6.863	-15.455	26.475
95.000	-13.373	-6.007	24.582	28.621	-16.138	-3.596	4.851	17.231	-14.479	-7.887	-11.341	20.012
100.000	-13.639	-5.694	15.425	21.491	-3.609	-3.267	2.854	5.643	-12.303	-3.085	-5.323	13.756
105.000	-13.497	-4.553	9.209	16.962	-1.582	-.473	1.288	2.095	-7.730	-1.725	-3.174	8.533
110.000	-13.956	-.880	5.542	15.042	2.536	-.438	-2.406	3.523	-5.488	3.860	-.382	6.720
115.000	-13.186	1.685	3.430	13.728	4.643	-1.222	-2.021	5.209	-1.092	5.333	-3.059	6.244
120.000	-10.837	3.071	1.538	11.369	4.181	-2.939	-3.011	5.932	2.779	4.858	-5.241	7.667
125.000	-8.595	3.579	.465	9.322	3.141	-4.445	-2.985	6.208	2.701	3.832	-4.468	6.476
130.000	-6.883	3.738	-.241	7.836	2.089	-5.332	-2.144	6.115	.851	3.256	-1.971	3.933
135.000	-5.739	3.904	-.678	6.974	1.270	-5.687	-.989	5.911	-1.570	2.591	.138	3.033
140.000	-4.853	4.235	-.850	6.497	.611	-5.736	-.147	5.770	-1.785	2.500	1.196	3.256

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF 604 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050C.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.26 MPH.
CRASH VICTIM: ALDERSON PART 572

SEGMENT LINEAR ACCELERATIONS (G'S) IN LOCAL REFERENCE

TIME	POINT (-.97, .00, 5.92) ON SEGMENT NO. 13 - LLA				POINT (-.97, .00, 5.92) ON SEGMENT NO. 15 - RLA				POINT (.00, .00, .00) ON SEGMENT NO. 16 - VEH			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
.000	-.194	.000	-.127	.232	-.194	.000	-.127	.232	.000	.000	.000	.000
5.000	.028	-.001	-.753	.754	.025	-.001	-.754	.754	-9.300	.000	.000	9.300
10.000	-.572	.071	-1.926	2.010	-.374	.071	-1.614	1.658	-10.300	.000	.000	10.300
15.000	-.248	-.064	-2.501	2.514	-.319	-.063	-2.494	2.515	-12.400	.000	.000	12.400
20.000	-.570	-.054	-.783	.970	-.655	-.054	-.752	.999	-11.800	.000	.000	11.800
25.000	-.650	-.375	-.618	.972	-.804	-.376	-.775	1.178	-13.900	.000	.000	13.900
30.000	-.646	-1.365	-.587	1.620	-.874	-1.367	-.852	1.833	-15.100	.000	.000	15.100
35.000	1.613	-1.205	-1.365	2.399	-.625	-1.197	-.816	1.578	-17.000	.000	.000	17.000
40.000	1.971	-1.730	-.750	2.728	.923	1.444	-1.210	2.098	-21.800	.000	.000	21.800
45.000	3.269	-3.627	-1.128	5.012	2.088	3.081	-.851	3.818	-25.500	.000	.000	25.500
50.000	4.250	-4.718	-3.831	7.417	2.585	3.449	-.645	4.358	-25.400	.000	.000	25.400
55.000	5.255	-4.919	-10.247	12.523	3.676	2.899	-.820	4.752	-24.000	.000	.000	24.000
60.000	5.786	-3.353	-23.678	24.604	2.981	1.632	-1.982	3.934	-22.500	.000	.000	22.500
65.000	9.398	1.915	-44.361	45.386	2.067	.073	-3.798	4.325	-20.000	.000	.000	20.000
70.000	17.871	9.545	-60.779	64.067	2.448	-1.563	-5.257	6.006	-16.600	.000	.000	16.600
75.000	26.380	.028	-59.154	64.770	3.479	-.425	-5.314	5.951	-12.800	.000	.000	12.800
80.000	29.276	-9.726	-42.748	52.717	5.588	4.382	-16.147	17.640	-9.500	.000	.000	9.500
85.000	22.313	-6.779	-46.304	51.898	7.643	8.591	-27.935	30.209	-5.600	.000	.000	5.600
90.000	17.265	-4.830	-50.519	53.605	11.567	13.009	-40.852	44.406	.600	.000	.000	.600
95.000	13.423	-14.886	-43.940	48.296	16.284	6.808	-55.247	57.998	1.000	.000	.000	1.000
100.000	7.112	16.135	-46.411	49.647	27.893	-19.174	-51.385	61.532	1.000	.000	.000	1.000
105.000	4.491	12.261	-33.797	36.231	34.922	-15.597	-43.831	58.172	1.000	.000	.000	1.000
110.000	1.563	9.818	-32.470	33.958	24.055	16.171	-47.089	55.294	1.000	.000	.000	1.000
115.000	-1.201	7.523	-30.879	31.902	10.770	19.670	-50.257	55.033	1.000	.000	.000	1.000
120.000	-2.648	7.071	-27.925	28.928	2.825	13.638	-45.724	47.798	1.000	.000	.000	1.000
125.000	-3.477	6.571	-24.765	25.657	-.833	9.295	-37.465	38.610	1.000	.000	.000	1.000
130.000	-3.852	6.203	-21.874	23.061	-2.457	6.895	-29.433	30.330	1.000	.000	.000	1.000
135.000	-3.823	5.861	-19.422	20.644	-3.287	5.434	-22.947	23.810	1.000	.000	.000	1.000
140.000	-3.361	5.463	-17.533	18.669	-3.828	4.454	-18.022	18.955	1.000	.000	.000	1.000

DATE: 12 JUNE 1980 PAGE: 23.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

SEGMENT LINEAR DISPLACEMENTS (IN) IN VEHICLE REFERENCE

-	POINT (-.40, -.39, -.00) ON				POINT (-.27, .00, -2.66) ON				POINT (-1.79, .00, 2.25) ON			
TIME	SEGMENT NO. 5 - HEAD				SEGMENT NO. 3 - UT				SEGMENT NO. 1 - LT			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
.000	22.867	-.394	-37.398	43.836	20.498	.000	-27.786	34.528	22.854	.000	-9.732	24.840
5.000	22.891	-.394	-37.398	43.849	20.521	.000	-27.786	34.543	22.877	-.000	-9.732	24.861
10.000	23.001	-.394	-37.395	43.908	20.624	.000	-27.789	34.606	22.975	-.001	-9.735	24.953
15.000	23.207	-.393	-37.396	44.013	20.816	.000	-27.790	34.721	23.140	-.004	-9.734	25.104
20.000	23.535	-.391	-37.384	44.177	21.114	.001	-27.787	34.898	23.340	-.007	-9.721	25.283
25.000	24.004	-.389	-37.358	44.407	21.520	.001	-27.780	35.140	23.565	-.011	-9.697	25.482
30.000	24.623	-.388	-37.317	44.710	22.035	.002	-27.770	35.450	23.853	-.016	-9.672	25.740
35.000	25.407	-.389	-37.259	45.098	22.659	.003	-27.758	35.832	24.240	-.022	-9.653	26.091
40.000	26.372	-.395	-37.171	45.578	23.390	.005	-27.740	36.285	24.749	-.031	-9.642	26.561
45.000	27.517	-.406	-37.044	46.147	24.218	.007	-27.711	36.802	25.395	-.038	-9.630	27.160
50.000	28.819	-.431	-36.847	46.780	25.117	.002	-27.655	37.358	26.163	-.038	-9.596	27.867
55.000	30.220	-.481	-36.543	47.423	26.032	-.013	-27.558	37.909	27.005	-.028	-9.530	28.637
60.000	31.636	-.567	-36.101	48.004	26.905	-.040	-27.409	38.407	27.855	.001	-9.436	29.410
65.000	32.995	-.712	-35.503	48.473	27.691	-.090	-27.215	38.826	28.643	.033	-9.330	30.124
70.000	34.224	-.942	-34.778	48.803	28.380	-.170	-26.981	39.159	29.322	.049	-9.214	30.736
75.000	35.285	-1.265	-33.982	49.004	28.976	-.262	-26.713	39.411	29.849	.034	-9.102	31.205
80.000	36.155	-1.679	-33.165	49.091	29.453	-.324	-26.438	39.579	30.175	-.015	-9.020	31.494
85.000	36.826	-2.153	-32.372	49.079	29.807	-.350	-26.173	39.669	30.267	-.111	-8.983	31.572
90.000	37.238	-2.659	-31.616	48.922	29.997	-.335	-25.926	39.649	30.107	-.259	-8.981	31.419
95.000	37.339	-3.172	-30.926	48.589	29.995	-.266	-25.680	39.487	29.691	-.464	-8.995	31.027
100.000	37.178	-3.654	-30.337	48.124	29.853	-.107	-25.419	39.208	29.072	-.712	-9.020	30.447
105.000	36.855	-4.061	-29.872	47.614	29.651	.081	-25.157	38.886	28.312	-.968	-9.030	29.733
110.000	36.427	-4.386	-29.526	47.095	29.425	.292	-24.890	38.541	27.464	-1.211	-9.024	28.934
115.000	35.950	-4.624	-29.297	46.605	29.203	.487	-24.635	38.209	26.570	-1.414	-8.999	28.088
120.000	35.467	-4.762	-29.162	46.163	28.992	.644	-24.391	37.893	25.652	-1.567	-8.999	27.230
125.000	35.009	-4.812	-29.096	45.775	28.781	.754	-24.172	37.592	24.728	-1.669	-9.056	26.387
130.000	34.591	-4.792	-29.077	45.442	28.557	.818	-23.990	37.305	23.602	-1.728	-9.163	25.563
135.000	34.221	-4.718	-29.090	45.161	28.308	.839	-23.847	37.023	22.873	-1.752	-9.293	24.751
140.000	33.902	-4.602	-29.121	44.928	28.023	.825	-23.740	36.736	21.933	-1.748	-9.424	23.935

DATE: 12 JUNE 1980 PAGE: 24.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

SEGMENT LINEAR DISPLACEMENTS (IN) IN VEHICLE REFERENCE

TIME	POINT (-.97, .00, 5.52) ON SEGMENT NO. 13 - LLA				POINT (-.97, .00, 5.92) ON SEGMENT NO. 15 - RLA				POINT (-.10, 2.69, -7.36) ON SEGMENT NO. 10 - RLL			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
.000	32.167	-7.375	-12.625	35.334	32.167	7.375	-12.625	35.334	40.113	6.090	-11.813	42.257
5.000	32.190	-7.375	-12.625	35.355	32.190	7.375	-12.625	35.355	40.135	6.090	-11.813	42.278
10.000	32.281	-7.376	-12.619	35.436	32.282	7.374	-12.624	35.438	40.233	6.090	-11.820	42.373
15.000	32.444	-7.376	-12.609	35.581	32.449	7.374	-12.624	35.591	40.389	6.090	-11.890	42.541
20.000	32.702	-7.377	-12.604	35.814	32.712	7.373	-12.628	35.831	40.569	6.091	-12.096	42.770
25.000	33.068	-7.378	-12.597	36.147	33.083	7.372	-12.629	36.171	40.753	6.092	-12.441	43.043
30.000	33.557	-7.383	-12.586	36.593	33.575	7.367	-12.627	36.620	40.977	6.096	-12.670	43.361
35.000	34.188	-7.400	-12.576	37.171	34.206	7.350	-12.620	37.193	41.280	6.102	-13.310	43.800
40.000	34.979	-7.429	-12.581	37.908	34.992	7.324	-12.612	37.910	41.694	6.103	-13.734	44.320
45.000	35.978	-7.476	-12.606	38.848	35.980	7.311	-12.616	38.823	42.231	6.090	-14.180	44.962
50.000	37.221	-7.559	-12.665	40.037	37.213	7.324	-12.641	39.978	42.848	6.052	-14.742	45.715
55.000	38.689	-7.688	-12.778	41.463	38.693	7.369	-12.693	41.383	43.470	5.989	-15.458	46.524
60.000	40.303	-7.861	-12.975	43.064	40.404	7.441	-12.778	43.025	44.068	5.906	-16.230	47.332
65.000	41.938	-8.060	-13.317	44.733	42.324	7.521	-12.897	44.880	44.627	5.798	-16.902	48.072
70.000	43.415	-8.222	-13.919	46.327	44.412	7.596	-13.048	46.908	45.112	5.680	-17.411	48.688
75.000	44.629	-8.284	-14.926	47.763	46.618	7.655	-13.237	49.061	45.488	5.570	-17.760	49.148
80.000	45.572	-8.363	-16.404	49.152	48.880	7.700	-13.485	51.288	45.740	5.478	-17.947	49.435
85.000	46.331	-8.556	-18.319	50.550	51.110	7.768	-13.839	53.517	45.840	5.407	-17.966	49.531
90.000	46.839	-8.815	-20.658	51.945	53.165	7.890	-14.365	55.634	45.748	5.353	-17.836	49.393
95.000	46.917	-9.062	-23.275	53.151	54.879	8.073	-15.149	57.501	45.429	5.315	-17.583	49.002
100.000	46.566	-9.367	-26.077	54.186	56.134	8.200	-16.227	59.005	44.945	5.294	-17.240	48.426
105.000	45.802	-9.550	-28.904	54.996	56.971	8.012	-17.575	60.156	44.345	5.274	-16.845	47.725
110.000	44.724	-9.540	-31.640	55.609	57.438	7.584	-19.238	61.047	43.678	5.245	-16.422	46.957
115.000	43.386	-9.394	-34.221	56.050	57.435	7.215	-21.125	61.621	42.964	5.194	-15.977	46.132
120.000	41.834	-9.156	-36.590	56.328	56.919	6.955	-23.002	61.783	42.245	5.126	-15.512	45.294
125.000	40.131	-8.866	-38.726	56.470	55.962	6.725	-24.727	61.550	41.550	5.042	-15.039	44.475
130.000	38.333	-8.548	-40.629	56.509	54.683	6.470	-26.254	61.003	40.874	4.930	-14.577	43.675
135.000	36.488	-8.223	-42.314	56.475	53.186	6.172	-27.580	60.228	40.197	4.791	-14.133	42.878
140.000	34.629	-7.901	-43.800	56.392	51.551	5.826	-28.720	59.298	39.466	4.626	-13.751	42.069

DATE: 12 JUNE 1980 PAGE: 25.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R20500.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.26 MPH.

CRASH VICTIM: ALDERSON PART 572

SEGMENT LINEAR DISPLACEMENTS (IN) IN VEHICLE REFERENCE

TIME	POINT (.05, .03, -4.69) ON SEGMENT NO. 12 - LUA				POINT (.05, -.03, -4.69) ON SEGMENT NO. 14 - RUA				POINT (-.10, 1.62, 6.83) ON SEGMENT NO. 10 - RLL			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
.000	20.498	-7.400	-28.515	35.889	20.498	7.400	-28.515	35.889	54.051	5.222	-3.557	54.419
5.000	20.522	-7.400	-28.515	35.905	20.522	7.400	-28.515	35.903	54.072	5.222	-3.554	54.440
10.000	20.625	-7.400	-28.518	35.965	20.625	7.400	-28.518	35.964	54.153	5.222	-3.533	54.519
15.000	20.820	-7.399	-28.520	36.077	20.818	7.401	-28.517	36.075	54.243	5.222	-3.492	54.605
20.000	21.123	-7.399	-28.518	36.252	21.120	7.401	-28.513	36.247	54.269	5.222	-3.450	54.629
25.000	21.536	-7.398	-28.512	36.491	21.534	7.402	-28.505	36.484	54.255	5.222	-3.489	54.617
30.000	22.063	-7.398	-28.502	36.795	22.065	7.402	-28.494	36.791	54.247	5.222	-3.578	54.615
35.000	22.685	-7.397	-28.489	37.161	22.719	7.403	-28.482	37.178	54.308	5.222	-3.682	54.682
40.000	23.389	-7.395	-28.468	37.579	23.510	7.405	-28.464	37.654	54.497	5.228	-3.808	54.879
45.000	24.117	-7.393	-28.436	38.013	24.467	7.403	-28.433	38.235	54.793	5.240	-3.949	55.184
50.000	24.802	-7.391	-28.384	38.411	25.600	7.387	-28.373	38.923	55.062	5.248	-4.095	55.462
55.000	25.363	-7.382	-28.290	38.706	26.884	7.339	-28.271	39.697	55.152	5.246	-4.226	55.562
60.000	25.744	-7.348	-28.141	38.842	28.260	7.236	-28.121	40.519	55.119	5.235	-4.371	55.539
65.000	25.923	-7.277	-27.937	38.800	29.668	7.042	-27.934	41.353	55.142	5.234	-4.561	55.578
70.000	25.942	-7.160	-27.683	38.608	31.047	6.732	-27.716	42.160	55.272	5.236	-4.770	55.724
75.000	25.892	-6.993	-27.408	38.347	32.320	6.338	-27.446	42.873	55.317	5.221	-4.858	55.775
80.000	25.802	-6.756	-27.204	38.098	33.406	5.940	-27.088	43.416	55.226	5.175	-4.789	55.674
85.000	25.664	-6.451	-27.123	37.893	34.307	5.553	-26.623	43.779	55.089	5.084	-4.641	55.516
90.000	25.395	-6.043	-27.165	37.674	35.014	5.151	-26.066	43.954	54.963	4.567	-4.490	55.369
95.000	24.975	-5.511	-27.269	37.401	35.488	4.739	-25.429	43.915	54.813	4.831	-4.358	55.197
100.000	24.553	-4.915	-27.440	37.148	35.687	4.452	-24.730	43.646	54.602	4.667	-4.220	54.964
105.000	24.194	-4.334	-27.611	36.966	35.702	4.248	-24.012	43.235	54.317	4.472	-4.074	54.653
110.000	23.955	-3.839	-27.771	36.875	35.551	4.191	-23.290	42.707	53.960	4.249	-3.912	54.268
115.000	23.842	-3.450	-27.958	36.905	35.290	4.220	-22.559	42.097	53.544	4.000	-3.736	53.823
120.000	23.809	-3.143	-28.145	36.999	34.973	4.253	-21.844	41.453	53.085	3.724	-3.523	53.332
125.000	23.817	-2.909	-28.322	37.120	34.615	4.262	-21.180	40.604	52.568	3.431	-3.259	52.800
130.000	23.831	-2.749	-28.488	37.243	34.221	4.240	-20.599	40.167	52.049	3.141	-2.953	52.227
135.000	23.820	-2.658	-28.634	37.341	33.792	4.199	-20.115	39.549	51.507	2.872	-2.662	51.656
140.000	23.760	-2.637	-28.754	37.393	33.332	4.150	-19.733	38.957	51.202	2.736	-2.667	51.346

DATE: 12 JUNE 1980

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R20506.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

SEGMENT ANGULAR ACCELERATIONS (REV/ SEC**2) IN LOCAL REFERENCE

TIME	SEGMENT NO. 5 - HEAD				SEGMENT NO. 13 - LLA				SEGMENT NO. 15 - RLA			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
.000	.000	-1.031	.000	1.031	.000	-1.031	.000	1.031	.000	-1.031	.000	1.031
5.000	-.005	-5.761	.003	5.761	-.003	-.001	.013	.013	-.003	-.001	.013	.013
10.000	1.571	9.160	.946	9.342	-.820	2.887	.681	3.078	-.821	3.397	.681	3.560
15.000	1.892	-4.412	.413	4.818	.021	7.500	.146	7.502	.020	7.273	.146	7.275
20.000	3.006	-12.439	.374	12.803	.302	1.224	-.074	1.263	.301	.782	-.074	.842
25.000	-.190	-6.833	-.626	6.885	2.951	.487	-2.594	3.959	2.960	-1.319	-2.563	4.144
30.000	.118	-25.044	-4.352	25.420	7.466	-2.136	-4.104	8.784	7.493	-3.188	-4.074	9.165
35.000	-3.226	-79.799	-12.377	80.818	10.269	17.391	-7.255	21.461	10.375	1.778	-7.335	12.830
40.000	11.726	-102.180	-14.878	103.921	2.031	9.951	5.959	11.775	-12.753	13.375	10.400	21.206
45.000	21.452	-123.117	-27.911	128.051	21.694	9.630	-18.064	29.827	-17.148	27.673	1.688	32.769
50.000	36.342	-156.655	-41.229	166.016	31.793	-6.361	-34.881	47.623	-5.841	35.013	-30.251	46.638
55.000	43.530	-167.471	-63.374	184.276	35.296	-34.173	-54.721	73.540	6.200	44.330	-62.397	76.792
60.000	49.094	-109.714	-76.311	142.376	30.645	-90.623	-97.978	136.936	20.396	22.423	-104.101	108.425
65.000	61.537	-92.580	-56.188	124.559	6.734	-89.718	-192.869	212.822	30.262	-7.397	-145.197	148.502
70.000	46.433	-41.093	-26.372	67.361	-90.557	45.625	-46.413	111.518	24.763	-24.770	-140.368	144.675
75.000	-31.134	19.385	-13.279	39.006	-88.126	241.313	466.018	532.138	-.088	-49.083	-115.281	125.255
80.000	-158.864	49.391	-17.415	167.274	63.515	347.441	190.409	401.255	-55.705	-57.445	-61.765	101.084
85.000	-215.860	95.137	-11.966	236.199	75.399	270.755	76.323	291.236	-93.417	-73.809	-54.711	131.026
90.000	-179.432	94.031	6.365	202.678	75.844	186.627	119.317	234.133	-152.582	-43.316	65.667	171.667
95.000	-139.756	75.349	26.094	160.905	68.116	115.735	284.650	314.738	-216.150	54.408	779.355	810.602
100.000	-78.845	63.540	-8.376	101.607	99.421	-12.842	-734.245	741.057	-45.725	386.674	1550.883	1599.014
105.000	-80.646	70.636	-6.115	107.381	9.008	-5.173	-163.616	163.945	299.674	445.659	311.549	620.966
110.000	-106.692	62.587	.775	123.697	1.394	-24.670	-69.731	73.979	232.595	220.605	-623.281	700.869
115.000	-80.304	81.153	4.176	114.245	4.409	-59.977	-16.591	62.385	118.070	37.189	-533.550	547.722
120.000	-20.968	123.124	21.094	126.666	8.057	-77.695	-9.897	78.934	80.904	-60.487	-373.204	386.633
125.000	56.684	153.440	46.499	170.056	9.517	-89.387	-17.139	91.511	48.733	-91.000	-211.449	235.301
130.000	129.547	163.366	69.857	219.901	8.844	-97.606	-32.427	103.235	29.414	-92.136	-124.199	157.415
135.000	183.265	150.808	83.876	251.722	6.536	-102.462	-53.639	115.838	18.392	-83.547	-76.484	114.753
140.000	209.042	121.269	85.611	256.386	2.758	-101.570	-75.816	126.776	12.069	-73.272	-48.308	88.590

DATE: 12 JUNE 1980 PAGE: 27.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R20506.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

SEGMENT ANGULAR DISPLACEMENTS (DEG) IN VEHICLE REFERENCE

TIME	SEGMENT NO. 5 - HEAD				SEGMENT NO. 13 - LLA				SEGMENT NO. 15 - RLA			
(MSEC)	YAW	PITCH	ROLL	RES	YAW	PITCH	ROLL	RES	YAW	PITCH	ROLL	RES
.000	.000	-12.967	.000	12.967	.000	66.783	.000	66.783	.000	66.783	.000	66.783
5.000	.000	-12.973	-.000	12.973	.000	66.779	.000	66.779	.000	66.779	.000	66.779
10.000	-.001	-13.007	-.001	13.007	.006	66.734	.006	66.734	.006	66.761	.006	66.761
15.000	.001	-13.009	-.002	13.009	.029	66.684	.026	66.684	.029	66.775	.026	66.775
20.000	.005	-12.998	-.002	12.998	.055	66.680	.048	66.680	.056	66.832	.048	66.832
25.000	.009	-13.049	.007	13.049	.079	66.689	.069	66.689	.080	66.898	.069	66.858
30.000	.005	-13.204	.023	13.204	.061	66.699	.075	66.699	.062	66.954	.076	66.954
35.000	-.038	-13.610	.065	13.610	-.037	66.714	.069	66.714	-.036	66.990	.070	66.990
40.000	-.197	-14.627	.133	14.628	-.183	66.622	.076	66.822	-.174	67.045	.071	67.045
45.000	-.525	-16.519	.327	16.529	-.236	67.011	.200	67.012	-.076	67.223	.179	67.223
50.000	-1.146	-19.523	.820	19.565	-.634	67.283	.179	67.286	.032	67.653	.152	67.653
55.000	-2.266	-23.901	1.861	24.041	-1.856	67.499	-.319	67.517	-.602	68.402	-.613	68.404
60.000	-4.272	-29.671	3.779	30.063	-4.397	67.328	-1.725	67.407	-2.952	69.480	-2.924	69.513
65.000	-7.621	-36.343	7.055	37.294	-9.069	66.259	-4.818	66.582	-8.415	70.598	-7.999	70.841
70.000	-12.726	-43.490	12.320	45.502	-16.332	64.146	-10.266	65.262	-18.194	71.159	-16.923	72.223
75.000	-20.123	-50.437	20.092	54.228	-22.903	62.240	-15.759	64.615	-31.246	70.443	-28.735	73.610
80.000	-30.469	-56.344	30.404	62.850	-22.742	63.232	-15.789	65.477	-43.962	68.131	-40.160	74.978
85.000	-43.964	-60.488	42.516	70.838	-18.613	67.885	-11.693	69.103	-53.989	64.335	-49.341	76.320
90.000	-59.120	-62.449	54.594	77.792	-9.489	75.625	-1.971	75.989	-60.839	59.341	-56.241	77.669
95.000	-73.630	-62.607	64.646	83.765	32.168	82.985	40.795	84.781	-64.307	54.729	-61.393	79.036
100.000	-86.512	-61.656	71.820	89.123	-78.352	103.538	-68.273	95.009	-62.241	56.987	-63.691	79.431
105.000	-97.654	-59.909	76.325	94.201	-60.743	113.949	-48.745	105.794	-51.885	71.913	-58.601	80.987
110.000	-106.790	-57.668	78.177	98.984	-52.736	124.271	-38.829	116.602	70.114	85.644	60.608	88.653
115.000	-114.227	-55.258	77.467	103.525	-48.272	134.456	-32.440	127.219	-59.852	109.793	-70.007	100.065
120.000	-120.087	-52.843	74.602	107.778	-45.972	144.308	-27.969	137.358	-49.955	122.600	-59.901	111.599
125.000	-124.096	-50.511	69.965	111.416	-44.999	153.583	-24.427	146.866	-43.623	132.805	-52.944	122.045
130.000	-126.048	-48.266	64.172	114.048	-44.861	162.068	-21.255	155.645	-39.008	141.345	-47.404	131.300
135.000	-125.942	-46.008	57.969	115.367	-45.227	169.663	-18.146	163.613	-35.551	148.755	-42.755	139.518
140.000	-124.021	-43.596	52.119	115.244	-45.798	176.189	-14.968	170.706	-32.941	155.329	-38.695	146.875

DATE: 12 JUNE 1980

PAGE: 26.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF L04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050C.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

JOINT PARAMETERS

	JOINT NO. 1 - P							JOINT NO. 2 - W								
TIME	STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)			STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)				
(MSEC)	IPIN	FLEXURE	AZIMUTH	TORSION	SPRING	VISCOUS	RES.	IPIN	FLEXURE	AZIMUTH	TORSION	SPRING	VISCOUS	RES.		
.000	-2.	1.608	180.000	.000	.000	.000	.000	-2.	1.606	180.000	.000	.000	.000	.000		
5.000	-2.	1.608	-180.000	.000	.000	.000	.000	-2.	1.608	100.000	-.000	.000	.000	.000		
10.000	2.	1.632	179.986	-.001	81.586	167.867	249.429	2.	1.658	179.906	-.003	82.684	49.466	35.887		
15.000	2.	1.959	-179.922	-.003	97.930	231.015	328.945	2.	1.595	179.638	-.004	79.769	156.974	77.438		
20.000	2.	2.489	179.897	-.007	124.432	269.870	394.292	2.	1.444	179.433	-.005	72.208	149.129	77.108		
25.000	2.	3.251	179.707	-.016	162.539	343.279	505.799	2.	1.365	179.195	-.008	68.243	44.531	28.440		
30.000	2.	4.376	179.570	-.055	218.793	440.285	658.935	2.	1.357	178.483	-.015	67.675	61.122	109.381		
35.000	2.	5.813	179.592	-.176	290.723	481.576	771.538	2.	1.444	176.910	-.051	72.237	200.409	269.727		
40.000	2.	7.484	-178.817	-.362	374.430	576.945	946.633	2.	1.852	172.168	-.191	92.820	230.098	312.073		
45.000	2.	9.438	-176.111	-.873	472.840	655.842	1111.521	2.	2.119	165.594	-.535	107.545	263.356	317.984		
50.000	2.	11.594	-172.660	-1.743	582.781	776.129	1323.822	2.	2.113	155.043	-1.266	114.270	393.749	435.341		
55.000	2.	14.205	-168.358	-3.012	717.766	977.086	1649.574	2.	2.079	135.492	-2.498	134.837	516.370	611.283		
60.000	2.	17.707	-163.731	-4.473	898.609	1213.892	2081.138	2.	2.536	115.079	-3.984	186.680	554.191	722.307		
65.000	2.	21.943	-160.423	-6.058	1116.770	1254.670	2347.591	2.	3.560	106.542	-5.609	262.439	625.652	886.123		
70.000	2.	26.143	-159.258	-7.818	1334.487	1208.566	2529.422	2.	4.947	109.143	-7.363	353.938	716.099	1064.605		
75.000	2.	30.265	-159.301	-9.443	1547.698	1173.904	2716.560	2.	6.879	116.883	-8.987	462.382	798.249	1239.858		
80.000	2.	34.416	-159.543	-10.690	1759.626	1115.951	2874.651	2.	8.921	125.362	-10.275	569.020	828.870	1347.898		
85.000	2.	38.198	-159.199	-11.672	1951.582	1009.359	2951.980	2.	11.300	134.985	-11.520	690.008	968.477	1558.854		
90.000	2.	41.471	-157.916	-12.680	2116.887	975.932	3036.347	2.	14.173	142.509	-13.080	839.292	1084.114	1890.435		
95.000	2.	44.068	-155.123	-13.578	2252.341	1058.585	3063.594	2.	18.121	147.088	-14.974	1042.088	1345.785	2373.810		
100.000	2.	46.119	-150.608	-13.528	2352.408	1027.208	3038.233	2.	22.934	149.499	-16.394	1277.758	1240.420	2459.296		
105.000	2.	47.723	-147.026	-13.242	2429.194	796.779	2877.459	2.	26.569	151.314	-17.267	1455.074	936.838	2365.946		
110.000	2.	48.491	-144.118	-12.465	2462.161	332.114	2555.485	2.	29.203	153.487	-17.420	1578.233	630.349	2025.779		
115.000	2.	48.312	-144.085	-12.259	2452.099	288.045	2282.630	2.	29.688	157.776	-17.267	1598.728	702.768	1792.944		
120.000	2.	47.871	-144.891	-12.193	2429.972	290.928	2250.997	2.	29.604	162.778	-17.113	1592.863	714.458	1800.635		
125.000	2.	47.483	-145.489	-12.005	2409.758	285.328	2235.991	2.	29.690	167.668	-16.852	1593.589	691.808	1802.044		
130.000	2.	47.060	-146.080	-11.787	2387.654	313.267	2177.080	2.	29.815	172.190	-16.535	1595.467	633.835	1765.023		
135.000	2.	46.429	-146.789	-11.617	2355.541	370.925	2070.747	2.	29.825	176.121	-16.240	1592.353	551.601	1678.467		
140.000	2.	45.470	-147.699	-11.570	2308.043	451.892	1935.050	2.	29.576	179.324	-16.014	1577.958	477.537	1546.792		

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572

JOINT PARAMETERS

	JOINT NO. 3 - NP								JOINT NO. 4 - HP					
TIME	STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)			STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)		
(MSEC)	IPIN	FLEXURE	AZIMUTH	TORSION	SPRING	VISCOUS	RES.	IPIN	FLEXURE	AZIMUTH	TORSION	SPRING	VISCOUS	RES.
.000	-2.	.000	.000	.000	.000	.000	.000	-2.	1.933	180.000	.000	.000	.000	.000
5.000	2.	.002	179.974	-.000	.073	18.931	19.004	-2.	1.933	-180.000	.000	.000	.000	.000
10.000	2.	.003	91.435	-.000	.083	8.069	8.148	2.	1.927	179.969	-.000	60.120	46.684	13.979
15.000	2.	.071	6.948	-.001	2.223	103.123	105.335	2.	1.865	179.932	-.001	58.184	86.821	28.755
20.000	2.	.360	2.854	-.002	11.221	112.771	123.961	2.	1.780	179.689	-.001	55.551	99.255	43.767
25.000	2.	.904	1.053	.000	28.218	120.377	148.591	2.	1.659	179.869	-.001	51.751	95.085	43.335
30.000	2.	1.455	-.090	.013	45.395	112.049	157.311	2.	1.381	179.767	.007	43.094	113.017	70.023
35.000	2.	1.586	-1.737	.032	49.483	104.712	62.251	2.	.788	-178.926	.067	24.600	121.741	97.703
40.000	2.	1.205	-7.201	.098	37.631	133.887	100.263	2.	.135	-164.809	.169	4.907	127.964	124.345
45.000	2.	.688	-124.088	.433	22.436	172.715	190.707	2.	.695	1.645	.364	22.359	127.488	149.797
50.000	2.	3.789	-155.489	1.145	119.472	225.332	344.349	2.	1.617	3.933	.710	51.557	125.931	160.527
55.000	2.	8.606	-155.774	2.299	270.710	267.702	537.182	2.	2.334	4.233	1.159	74.853	117.218	185.293
60.000	2.	14.547	-152.305	3.904	457.642	301.072	755.258	2.	2.468	3.192	1.434	79.962	107.625	138.770
65.000	2.	21.332	-147.410	5.329	670.349	320.831	983.778	2.	2.283	-.609	1.813	76.231	121.243	125.870
70.000	2.	28.078	-141.960	6.138	880.864	301.112	1163.174	2.	1.513	-27.161	2.423	59.583	160.427	163.655
75.000	2.	33.436	-137.142	6.290	1047.464	253.952	1274.450	2.	2.533	-104.446	2.873	90.026	196.550	274.041
80.000	2.	37.028	-135.006	5.771	1158.504	185.918	1324.728	2.	6.021	-116.434	2.840	192.616	209.882	396.991
85.000	2.	38.929	-134.321	4.939	1216.848	150.633	1339.691	2.	9.149	-119.465	2.318	287.557	175.212	454.916
90.000	2.	40.206	-134.262	4.026	1255.881	143.449	1365.017	2.	10.573	-120.539	1.816	331.009	118.587	432.610
95.000	2.	40.774	-134.555	3.131	1273.025	128.521	1267.740	2.	10.766	-121.221	1.637	336.802	93.959	380.195
100.000	2.	39.932	-137.316	1.656	1246.136	191.588	1167.840	2.	10.807	-121.390	1.575	338.010	108.015	330.535
105.000	2.	38.346	-141.714	.102	1196.388	219.995	1103.526	2.	10.633	-124.654	1.399	332.415	121.498	348.123
110.000	2.	35.936	-149.276	-2.056	1121.636	286.034	1042.712	2.	10.706	-128.551	1.060	334.406	124.624	350.178
115.000	2.	33.547	-160.024	-4.283	1048.627	302.647	989.037	2.	10.586	-135.270	.480	330.373	157.230	351.097
120.000	2.	31.324	-171.754	-6.073	981.557	295.624	927.667	2.	10.497	-148.505	-.397	327.553	190.349	362.560
125.000	2.	29.376	176.426	-7.473	923.359	280.477	882.396	2.	10.766	-165.872	-1.400	336.540	203.347	419.440
130.000	2.	27.837	164.933	-8.526	877.875	262.500	849.272	2.	11.412	177.095	-2.353	357.809	197.668	448.657
135.000	2.	26.628	154.137	-9.244	842.274	244.091	816.463	2.	12.085	162.963	-3.135	379.971	181.016	455.297
140.000	2.	25.476	144.260	-9.637	807.901	228.654	767.707	2.	12.418	151.969	-3.694	391.390	162.560	432.753

DATE: 12 JUNE 1980 PAGE: 30.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050C.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

JOINT PARAMETERS

	JOINT NO. -5 - LH							JOINT NO. -8 - RH						
TIME	STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)			STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)		
(MSEC)	IEULER	PREC.	NUTATION	SPIN	SPRING	VISCOUS	RES.	IEULER	PREC.	NUTATION	SPIN	SPRING	VISCOUS	RES.
.000	7.	-28.787	-20.000	.000	.000	.000	.000	7.	28.787	20.000	.000	.000	.000	.000
5.000	7.	-28.787	-20.000	.000	.000	.000	.000	7.	28.787	20.000	.000	.000	.000	.000
10.000	4.	-28.769	-20.000	.000	215.767	22.175	343.645	4.	28.772	20.000	.000	215.787	12.697	368.503
15.000	4.	-28.890	-20.000	.000	216.672	178.614	395.286	4.	28.895	20.000	.000	216.713	179.081	395.795
20.000	4.	-29.673	-20.000	.000	222.548	330.089	552.637	4.	29.682	20.000	.000	222.616	330.716	553.331
25.000	4.	-31.063	-20.000	.000	232.975	406.930	639.905	4.	31.075	20.000	.000	233.063	407.648	640.711
30.000	4.	-32.586	-20.002	.003	244.397	388.599	632.997	4.	32.606	19.999	.002	244.542	390.754	635.296
35.000	4.	-33.855	-20.004	.006	253.910	310.307	564.217	4.	33.888	19.997	.005	254.156	311.780	565.936
40.000	4.	-34.637	-20.006	.009	259.777	222.722	482.500	4.	34.645	19.996	.007	259.834	211.430	471.264
45.000	4.	-35.263	-20.008	.011	264.470	252.525	516.995	2.	35.161	19.994	.019	263.866	232.884	516.191
50.000	2.	-36.302	-20.011	.055	272.270	382.736	650.210	2.	36.077	19.993	.097	270.580	353.443	613.605
55.000	8.	-37.757	-20.095	.240	283.207	413.238	796.095	8.	37.325	19.864	.375	280.017	383.236	656.543
60.000	8.	-38.734	-20.764	.511	290.731	218.320	747.134	8.	38.068	19.075	.823	286.026	222.074	551.058
65.000	8.	-38.465	-21.937	.402	288.773	331.418	630.038	8.	37.705	17.720	.939	283.785	302.251	371.151
70.000	8.	-37.077	-23.069	-.350	277.832	592.787	704.426	8.	36.528	16.345	.380	274.413	506.608	464.629
75.000	8.	-34.576	-24.071	-1.678	258.806	839.550	870.940	8.	34.658	15.037	-.786	259.152	688.075	616.004
80.000	8.	-31.145	-25.181	-3.241	234.658	975.068	1012.874	8.	32.059	13.546	-2.121	239.017	799.686	741.292
85.000	8.	-27.390	-26.170	-4.852	211.654	965.353	1010.052	8.	29.021	12.080	-3.235	216.674	809.263	749.263
90.000	8.	-24.021	-26.838	-6.387	196.252	854.060	910.635	8.	26.055	10.880	-4.058	195.504	728.775	663.757
95.000	8.	-21.267	-27.128	-7.811	190.150	726.737	830.041	8.	23.617	10.066	-4.705	180.135	599.657	564.400
100.000	8.	-19.165	-27.633	-9.032	189.806	611.953	813.180	8.	21.848	9.118	-5.199	169.188	456.416	514.435
105.000	8.	-17.839	-28.337	-10.314	196.807	471.627	807.609	8.	21.065	7.999	-5.831	165.931	299.603	511.557
110.000	8.	-17.310	-29.308	-11.583	208.369	432.854	814.391	8.	21.154	6.641	-6.540	168.666	287.113	584.389
115.000	8.	-17.182	-29.933	-12.904	223.729	333.824	749.507	8.	21.688	5.718	-7.396	175.969	291.184	553.299
120.000	8.	-17.297	-30.369	-13.844	235.695	251.403	712.178	8.	22.226	4.587	-7.676	181.079	201.990	459.453
125.000	8.	-17.423	-30.668	-14.378	242.207	197.503	694.668	8.	22.517	4.127	-7.927	181.351	172.333	459.804
130.000	8.	-17.601	-31.400	-14.724	246.231	201.336	656.713	8.	22.721	3.232	-7.876	180.355	164.516	466.643
135.000	8.	-18.059	-31.852	-15.039	250.711	259.725	709.395	8.	23.178	2.457	-7.963	181.935	247.409	527.854
140.000	8.	-19.004	-32.093	-15.452	258.211	368.012	748.071	8.	24.253	2.045	-8.659	191.688	414.943	649.664

DATE: 12 JUNE 1980 PAGE: 31.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

JOINT PARAMETERS

	JOINT NO. 6 - LK								JOINT NO. 9 - RK							
TIME	STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)			STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)		
(MSEC)	IPIN	FLEXURE	AZIMUTH	TORSION	SPRING	VISCOUS	RES.	IPIN	FLEXURE	AZIMUTH	TORSION	SPRING	VISCOUS	RES.
.000	1.	3.150	.000	.000	.000	.000	.000	1.	3.150	.000	.000	.000	.000	.000
5.000	1.	3.146	.000	.000	.000	12.185	12.185	1.	3.146	.000	.000	.000	12.182	12.182
10.000	1.	3.014	.000	.000	.000	82.857	82.857	1.	3.012	.000	.000	.000	83.533	83.533
15.000	1.	2.300	.001	.000	.000	265.900	265.900	1.	2.301	.001	.000	.000	264.811	264.811
20.000	1.	.460	.003	.000	.000	492.676	492.676	1.	.466	.009	.000	.000	491.591	491.591
25.000	1.	2.201	-179.997	.001	.000	604.269	604.269	1.	2.186	179.996	.000	.000	602.489	602.489
30.000	1.	5.325	-179.996	.002	.000	665.804	665.804	1.	5.307	-179.999	.000	.000	666.309	666.309
35.000	1.	8.467	-179.995	.004	.000	622.892	622.892	1.	8.453	-179.997	.000	.000	620.716	620.716
40.000	1.	11.366	-179.994	.005	.000	588.198	588.198	1.	11.304	-179.997	-.000	.000	573.200	573.200
45.000	1.	14.366	-179.994	.006	.000	682.671	682.671	1.	14.224	-179.996	-.000	.000	670.607	670.607
50.000	1.	18.286	-179.993	.008	.000	944.411	944.411	1.	18.122	-179.996	-.000	.000	949.905	949.905
55.000	1.	23.529	-179.993	.010	.000	1152.100	1152.100	1.	23.506	-179.996	-.000	.000	1211.985	1211.985
60.000	1.	28.960	-179.993	.012	.000	996.011	996.011	1.	29.421	-179.997	-.003	.000	1139.307	1139.307
65.000	1.	33.155	-179.993	.014	.000	735.715	735.715	1.	34.353	-180.000	-.010	.000	660.259	660.259
70.000	1.	36.303	-179.977	.041	.000	560.771	560.771	1.	37.905	179.998	-.019	.000	638.619	638.619
75.000	1.	38.388	-179.957	.073	.000	307.745	307.745	1.	40.853	179.994	-.029	.000	573.269	573.269
80.000	1.	39.120	-179.934	.107	.000	14.306	14.306	1.	43.180	179.994	-.038	.000	379.822	379.822
85.000	1.	38.505	-179.910	.141	.000	251.933	251.933	1.	44.281	179.993	-.048	.000	91.734	91.734
90.000	1.	36.927	-179.885	.175	.000	402.399	402.399	1.	43.905	179.993	-.057	.000	232.230	232.230
95.000	1.	34.812	-179.858	.212	.000	480.599	480.599	1.	42.299	179.995	-.066	.000	430.947	430.947
100.000	1.	32.336	-179.825	.249	.000	547.159	547.159	1.	39.996	179.997	-.074	.000	511.091	511.091
105.000	1.	29.616	-179.789	.285	.000	574.893	574.893	1.	37.525	-180.000	-.083	.000	512.256	512.256
110.000	1.	26.864	-179.746	.321	.000	553.159	553.159	1.	35.120	-179.996	-.091	.000	485.469	485.469
115.000	1.	24.347	-179.697	.356	.000	492.536	492.536	1.	32.820	-179.991	-.100	.000	479.993	479.993
120.000	1.	22.086	-179.639	.391	.000	457.043	457.043	1.	30.463	-179.985	-.109	.000	500.912	500.912
125.000	1.	19.959	-179.569	.426	.000	435.066	435.066	1.	28.040	-179.979	-.118	.000	504.617	504.617
130.000	1.	17.944	-179.481	.460	.000	408.801	408.801	1.	25.656	-179.974	-.127	.000	485.311	485.311
135.000	1.	16.094	-179.373	.494	.000	369.895	369.895	1.	23.199	-179.967	-.136	.000	603.409	603.409
140.000	1.	14.367	-179.241	.527	.000	409.538	409.538	1.	19.535	-179.945	-.145	.000	854.697	854.697

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF L04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R20506.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572

JOINT PARAMETERS

JOINT NO. -7 - LA

TIME (MSEC)	STATE IEULER	JOINT ANGLES (DEG) PREC.	NUTATION	SPIN	TOTAL TORQUE (IN LBS) SPRING	VISCOUS	RES.
.000	7.	.000	-7.760	.000	.000	.000	.000
5.000	5.	.000	-7.754	-.000	.000	.000	23.406
10.000	5.	-.000	-7.359	-.000	.000	.000	74.645
15.000	5.	-.000	-6.533	.000	.000	.000	120.215
20.000	3.	-.003	-5.110	.000	.003	2.811	199.343
25.000	3.	-.011	-3.983	.001	.011	3.260	113.212
30.000	3.	-.001	-3.151	.005	.001	13.793	134.279
35.000	3.	.054	-1.953	.009	.054	19.523	143.128
40.000	3.	.117	-.541	.016	.117	20.584	181.621
45.000	3.	.184	1.269	.027	.184	21.262	216.212
50.000	3.	.266	3.349	.041	.266	31.158	248.109
55.000	3.	.483	5.475	.059	.483	50.588	220.931
60.000	3.	.828	6.943	.088	.828	54.143	141.219
65.000	3.	1.107	7.662	.107	1.107	46.039	131.683
70.000	3.	1.451	9.059	.090	1.451	63.221	184.520
75.000	3.	1.963	10.584	.083	1.963	78.519	200.733
80.000	3.	2.571	11.909	.095	2.571	76.829	156.470
85.000	3.	3.015	12.822	.100	3.015	54.240	81.944
90.000	3.	3.282	12.243	.098	3.282	41.021	166.267
95.000	3.	3.462	10.480	.096	3.462	38.344	212.339
100.000	3.	3.587	8.970	.096	3.587	22.329	88.947
105.000	3.	3.654	8.639	.096	3.654	16.664	29.936
110.000	3.	3.731	8.603	.097	3.731	29.875	37.870
115.000	3.	3.846	8.643	.098	3.846	29.917	43.560
120.000	3.	3.929	8.713	.100	3.929	22.497	41.151
125.000	3.	3.995	8.788	.101	3.995	18.930	38.074
130.000	3.	4.052	8.852	.103	4.052	17.006	33.991
135.000	3.	4.102	8.900	.105	4.102	15.310	29.230
140.000	3.	4.032	9.052	.107	4.032	68.545	108.373

JOINT NO.-10 - RA

TIME (MSEC)	STATE IEULER	JOINT ANGLES (DEG) PREC.	NUTATION	SPIN	TOTAL TORQUE (IN LBS) SPRING	VISCOUS	RES.
.000	7.	.000	-7.760	.000	.000	.000	.000
5.000	5.	.000	-7.754	-.000	.000	.000	23.406
10.000	5.	-.000	-7.362	-.000	.000	.000	74.039
15.000	5.	-.000	-6.543	-.000	.000	.000	115.010
20.000	3.	-.012	-5.136	-.000	.012	6.689	185.187
25.000	3.	-.034	-4.022	.001	.034	8.869	67.208
30.000	3.	-.056	-3.208	.004	.056	.184	131.598
35.000	3.	-.042	-2.005	.007	.042	6.338	143.335
40.000	3.	-.026	-.600	.013	.026	6.249	183.548
45.000	3.	-.005	1.262	.021	.005	9.488	224.944
50.000	3.	.061	3.486	.030	.061	37.081	275.836
55.000	3.	.300	6.000	.038	.300	48.671	276.281
60.000	3.	.613	8.240	.050	.613	50.937	231.505
65.000	3.	.839	9.909	.059	.839	37.630	170.508
70.000	3.	1.003	11.046	.053	1.003	38.218	142.739
75.000	3.	1.192	12.292	.041	1.192	40.698	162.285
80.000	3.	1.476	13.775	.033	1.476	55.639	166.829
85.000	3.	1.911	14.971	-.036	1.911	69.501	143.159
90.000	3.	2.383	15.749	-.130	2.383	63.530	123.728
95.000	3.	2.630	15.833	-.224	2.630	17.911	36.114
100.000	3.	2.649	15.587	-.318	2.649	12.254	31.328
105.000	3.	2.676	15.432	-.412	2.676	8.633	11.457
110.000	3.	2.707	15.390	-.506	2.707	21.165	23.594
115.000	3.	2.772	15.375	-.599	2.772	21.722	33.846
120.000	3.	2.812	15.448	-.692	2.812	12.250	46.200
125.000	3.	2.823	15.571	-.785	2.823	.991	46.175
130.000	3.	2.812	15.659	-.878	2.812	.242	34.870
135.000	3.	2.674	16.081	-.970	2.674	65.794	171.328
140.000	3.	1.758	17.793	-1.064	1.758	97.251	189.507

DATE: 12 JUNE 1980 | PAGE: 33.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF L04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

JOINT PARAMETERS

	JOINT NO.-11 - LS							JOINT NO.-13 - RS						
TIME	STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)			STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)		
(MSEC)	IEULER	PREC.	NUTATION	SPIN	SPRING	VISCOUS	RES.	IEULER	PREC.	NUTATION	SPIN	SPRING	VISCOUS	RES.
.000	7.	59.867	-25.000	.000	.000	.000	.000	7.	-59.867	25.000	.000	.000	.000	.000
5.000	7.	59.867	-25.000	.000	.000	.000	.000	7.	-59.867	25.000	.000	.000	.000	.000
10.000	4.	59.870	-25.000	.000	.000	11.655	122.452	4.	-59.878	25.000	.000	.000	17.480	98.684
15.000	4.	59.882	-25.000	.000	.000	3.502	164.967	4.	-59.893	25.000	.000	.000	3.354	167.506
20.000	4.	59.768	-25.000	.000	.000	55.265	55.265	4.	-59.779	25.000	.000	.000	55.290	55.290
25.000	4.	59.330	-25.000	.000	.000	62.096	62.096	4.	-59.340	25.000	.000	.000	61.947	61.947
30.000	4.	58.552	-25.000	.000	.000	69.365	69.365	4.	-58.604	25.000	.000	.000	67.475	67.475
35.000	4.	57.381	-24.999	.000	.000	78.467	78.467	4.	-57.623	25.000	.000	.000	72.586	72.586
40.000	4.	55.671	-24.999	.000	.000	91.252	91.252	4.	-56.391	25.000	-.000	.000	74.864	74.864
45.000	3.	53.129	-25.023	.000	.000	112.004	127.063	3.	-55.182	24.992	.000	.000	73.340	107.586
50.000	3.	49.321	-25.294	-.001	.000	142.032	154.216	3.	-54.036	24.842	.000	.000	72.959	92.038
55.000	3.	43.773	-26.166	-.001	.000	181.247	196.635	3.	-52.805	24.294	.000	.000	78.014	102.659
60.000	3.	36.102	-28.112	-.002	.000	226.391	248.845	3.	-51.149	23.032	-.000	.000	89.588	123.507
65.000	3.	26.166	-31.637	-.003	.000	268.826	302.457	3.	-48.758	20.646	-.001	.000	105.101	153.634
70.000	3.	14.456	-36.789	-.004	.000	296.275	338.425	3.	-45.579	16.741	-.001	.000	123.181	190.032
75.000	3.	1.956	-42.581	-.005	.000	299.820	342.247	3.	-41.327	11.126	-.002	.000	147.305	232.733
80.000	3.	-9.980	-48.145	-.006	.000	277.332	319.486	3.	-35.713	3.686	-.002	.000	178.041	280.567
85.000	3.	-20.565	-53.425	-.008	.000	238.605	282.221	3.	-28.559	-5.493	-.003	.000	207.870	324.652
90.000	3.	-29.396	-58.177	-.010	.000	215.794	256.143	3.	-19.983	-16.072	-.003	.000	238.365	360.851
95.000	3.	-37.348	-61.940	-.012	.000	202.332	1230.350	3.	-8.916	-26.978	-.004	.000	316.146	406.646
100.000	3.	-44.428	-62.895	-.014	.000	180.395	189.783	3.	8.146	-35.364	-.005	.000	451.019	485.013
105.000	3.	-50.400	-61.732	-.015	.000	161.141	184.613	3.	29.407	-39.554	-.000	.000	486.817	496.772
110.000	3.	-55.417	-58.783	-.017	.000	137.103	185.690	3.	49.850	-39.830	.005	.000	408.296	420.127
115.000	3.	-59.419	-54.451	-.018	.000	124.966	192.418	3.	64.290	-35.779	.009	.000	274.841	316.037
120.000	3.	-63.145	-49.268	-.018	.000	124.805	203.045	3.	73.205	-29.783	.008	.000	190.410	261.551
125.000	3.	-66.903	-43.508	-.019	.000	125.729	211.167	3.	78.984	-23.167	.008	.000	144.829	233.487
130.000	3.	-70.723	-37.353	-.020	.000	127.257	217.202	3.	82.964	-16.618	.007	.000	116.068	212.265
135.000	3.	-74.644	-30.960	-.020	.000	129.868	221.261	3.	85.708	-10.474	.007	.000	94.566	192.360
140.000	3.	-78.750	-24.498	-.021	.000	134.792	223.791	3.	87.498	-4.901	.007	.000	77.656	173.554

DATE: 12 JUNE 1980 — PAGE: 34.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R20506.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.26 MPH.

CRASH VICTIM: ALDERSON PART 572

JOINT PARAMETERS

TIME	JOINT NO.-12 - LE STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)			JOINT NO.-14 - RE STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN LBS)		
(MSEC)	IEULER	PREC.	NUTATION	SPIN	SPRING	VISCOUS	RES.	IEULER	PREC.	NUTATION	SPIN	SPRING	VISCOUS	RES.
.000	7.	-8.000	-7.317	.000	.000	.009	.000	7.	8.000	-7.317	.000	.000	.000	.000
5.000	7.	-8.000	-7.317	.000	.000	.000	.000	7.	8.000	-7.317	-.000	.000	.000	.000
10.000	5.	-8.000	-7.316	-.000	.000	.000	8.043	5.	8.000	-7.280	.000	.000	.000	13.085
15.000	5.	-8.000	-7.220	.000	.000	.000	12.451	5.	8.000	-7.117	.000	.000	.000	10.652
20.000	5.	-8.000	-6.975	.000	.000	.000	9.393	5.	8.000	-6.812	.000	.000	.000	7.442
25.000	5.	-8.000	-6.687	-.000	.000	.000	7.848	5.	8.000	-6.468	.000	.000	.000	5.572
30.000	3.	-8.000	-6.471	-.000	.000	.753	32.108	3.	8.000	-6.164	.000	.000	.782	30.974
35.000	3.	-7.966	-6.498	-.000	.000	15.735	59.865	3.	6.034	-5.980	.000	.000	15.638	25.537
40.000	3.	-7.782	-6.815	-.000	.000	26.159	73.197	3.	8.230	-5.872	.000	.000	29.172	30.921
45.000	3.	-7.062	-8.037	-.001	.000	40.770	105.865	3.	9.115	-5.773	.000	.000	47.338	46.036
50.000	3.	-5.725	-10.752	-.001	.000	52.824	156.167	3.	10.980	-5.665	.000	.000	67.344	67.929
55.000	3.	-3.818	-15.558	-.002	.000	62.038	226.617	3.	13.828	-5.621	-.000	.000	85.571	93.186
60.000	3.	-1.701	-23.005	-.002	.000	59.856	320.212	3.	17.436	-5.825	-.000	.000	97.276	113.464
65.000	3.	-.253	-33.582	-.003	.000	32.502	431.439	3.	21.362	-6.762	-.001	.000	97.621	128.447
70.000	3.	-.798	-46.587	-.005	.000	53.548	523.945	3.	24.919	-8.889	-.001	.000	81.579	146.273
75.000	3.	-2.980	-59.249	-.010	.000	58.602	547.440	3.	27.228	-12.618	-.002	.000	48.837	183.627
80.000	3.	-3.620	-68.330	-.100	.000	10.899	491.300	3.	27.592	-18.340	-.002	.000	34.899	247.769
85.000	3.	-2.716	-71.790	-1.050	.000	8.923	334.203	3.	25.632	-25.889	-.003	.000	84.981	327.998
90.000	3.	-4.013	-69.509	.159	.000	6.985	244.456	3.	21.004	-34.889	-.003	.000	141.785	409.688
95.000	3.	-3.113	-63.892	-.708	.000	22.857	162.960	3.	13.481	-44.577	-.004	.000	193.722	477.762
100.000	3.	-1.012	-55.749	-.742	.000	38.628	68.102	3.	5.214	-53.656	-.009	.000	140.163	460.148
105.000	3.	-1.960	-46.531	-.731	.000	61.889	67.309	3.	2.753	-58.166	-.022	.000	25.065	337.997
110.000	3.	-4.871	-37.144	-.723	.000	91.595	94.535	3.	3.350	-56.635	-.025	.000	30.539	184.067
115.000	3.	-8.867	-27.972	-.718	.000	106.708	120.302	3.	3.545	-50.797	-.025	.000	20.485	93.232
120.000	3.	-13.430	-19.834	-.714	.000	114.701	134.292	3.	3.116	-43.060	-.022	.000	37.420	50.906
125.000	3.	-18.264	-13.133	-.711	.000	117.746	138.364	3.	1.767	-35.106	-.019	.000	55.039	55.040
130.000	3.	-23.128	-8.049	-.709	.000	115.905	132.579	3.	-.259	-27.660	-.016	.000	64.649	68.923
135.000	3.	-27.774	-4.692	-.706	.000	109.078	118.438	3.	-2.600	-20.888	-.015	.000	68.134	81.354
140.000	3.	-31.960	-3.071	-.704	.000	97.638	99.724	3.	-5.015	-14.744	-.013	.000	68.026	93.061

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572
CONTACT FORCES - VEHICLE PANELS VS. SEGMENTS

	PANEL 1 (TEFLON SEAT) VS. SEGMENT 6 (LUL)							PANEL 1 (TEFLON SEAT) VS. SEGMENT 9 (RUL)						
TIME (MSEC)	DEFL- ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z	DEFL- ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z
.000	.036	10.69	.00	10.69	26.267	-3.500	-6.875	.036	10.69	.00	10.69	26.267	3.500	-6.875
5.000	.035	10.64	.11	10.64	26.291	-3.500	-6.875	.035	10.64	.11	10.64	26.291	3.500	-6.875
10.000	.031	9.07	.09	9.07	26.378	-3.501	-6.875	.032	9.29	.09	9.30	26.378	3.499	-6.875
15.000	.020	5.44	.05	5.44	26.426	-3.503	-6.875	.023	6.14	.06	6.14	26.425	3.497	-6.875
20.000	.010	1.93	.02	1.93	26.303	-3.506	-6.875	.014	3.39	.03	3.39	26.303	3.494	-6.875
25.000	.004	.04	.00	.04	26.043	-3.509	-6.875	.012	2.52	.03	2.52	26.046	3.491	-6.875
30.000	.002	.00	.00	.00	25.821	-3.514	-6.875	.015	3.77	.04	3.78	25.829	3.487	-6.875
35.000	.000	.00	.00	.00	25.767	-3.520	-6.875	.021	5.79	.06	5.79	25.783	3.480	-6.875
40.000	-.004	.00	.00	.00	.000	.000	.000	.016	3.03	.03	3.03	25.935	3.471	-6.875
45.000	.004	.20	.00	.20	26.258	-3.536	-6.875	.006	.13	.00	.13	26.261	3.464	-6.875
50.000	.062	18.51	.19	18.51	26.779	-3.536	-6.875	.016	2.76	.03	2.76	26.725	3.463	-6.875
55.000	.190	57.08	.57	57.08	27.471	-3.525	-6.875	.054	16.20	.16	16.20	27.305	3.471	-6.875
60.000	.378	238.21	2.38	238.23	28.275	-3.510	-6.875	.090	26.92	.27	26.92	27.977	3.478	-6.875
65.000	.568	428.48	4.28	428.50	29.050	-3.504	-6.875	.113	34.00	.34	34.00	28.678	3.471	-6.875
70.000	.717	576.73	5.77	576.76	29.687	-3.510	-6.875	.162	48.47	.48	48.47	29.366	3.449	-6.875
75.000	.796	655.90	6.56	655.93	30.101	-3.540	-6.875	.232	91.61	.92	91.61	29.963	3.396	-6.875
80.000	.806	664.16	6.64	664.20	30.243	-3.597	-6.875	.270	130.47	1.30	130.48	30.348	3.303	-6.875
85.000	.751	589.72	5.90	589.75	30.111	-3.686	-6.875	.263	122.76	1.23	122.77	30.451	3.163	-6.875
90.000	.656	469.09	4.69	469.12	29.729	-3.814	-6.875	.232	94.45	.94	94.45	30.274	2.981	-6.875
95.000	.528	327.22	3.27	327.24	29.115	-3.992	-6.875	.213	78.59	.79	78.59	29.858	2.755	-6.875
100.000	.392	199.37	1.99	199.36	28.328	-4.222	-6.875	.201	69.35	.69	69.35	29.282	2.478	-6.875
105.000	.268	104.33	1.04	104.34	27.441	-4.465	-6.875	.232	94.83	.95	94.83	28.666	2.187	-6.875
110.000	.171	44.23	.44	44.23	26.515	-4.700	-6.875	.298	157.99	1.58	158.00	28.051	1.901	-6.875
115.000	.085	1.67	.02	1.67	25.589	-4.884	-6.875	.409	268.59	2.69	268.60	27.464	1.674	-6.875
120.000	-.006	.00	.00	.00	.000	.000	.000	.484	344.16	3.44	344.18	26.830	1.502	-6.875
125.000	-.125	.00	.00	.00	.000	.000	.000	.477	332.11	3.32	332.12	26.120	1.368	-6.875
130.000	-.271	.00	.00	.00	.000	.000	.000	.411	247.99	2.48	248.01	25.377	1.272	-6.875
135.000	-.424	.00	.00	.00	.000	.000	.000	.330	161.67	1.62	161.68	24.652	1.211	-6.875
140.000	-.560	.00	.00	.00	.000	.000	.000	.276	113.58	1.14	113.59	23.969	1.187	-6.875

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R20506.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572
CONTACT FORCES - VEHICLE PANELS VS. SEGMENTS

	PANEL 1 (TEFLON SEAT) VS. SEGMENT 1 (LT)							PANEL 2 (SEAT BACK PLATE) VS. SEGMENT 1 (LT)						
TIME (MSEC)	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z
.000	.257	117.41	.00	117.41	24.469	.000	-6.875	.507	.00	.00	.00	.000	.000	.000
5.000	.257	117.18	1.17	117.19	24.492	-.000	-6.875	.485	.00	.00	.00	.000	.000	.000
10.000	.253	113.68	1.14	113.69	24.590	-.001	-6.875	.388	.00	.00	.00	.000	.000	.000
15.000	.251	111.62	1.12	111.62	24.753	-.002	-6.875	.231	.00	.00	.00	.000	.000	.000
20.000	.264	123.92	1.24	123.92	24.952	-.003	-6.875	.031	.00	.00	.00	.000	.000	.000
25.000	.288	148.04	1.48	148.05	25.175	-.004	-6.875	-.195	.00	.00	.00	.000	.000	.000
30.000	.309	169.36	1.69	169.37	25.460	-.005	-6.875	-.476	.00	.00	.00	.000	.000	.000
35.000	.317	177.17	1.77	177.18	25.838	-.006	-6.875	-.840	.00	.00	.00	.000	.000	.000
40.000	.307	164.76	1.65	164.77	26.333	-.013	-6.875	-1.302	.00	.00	.00	.000	.000	.000
45.000	.291	146.93	1.47	146.93	26.960	-.032	-6.875	-1.868	.00	.00	.00	.000	.000	.000
50.000	.294	151.22	1.51	151.22	27.705	-.065	-6.875	-2.589	.00	.00	.00	.000	.000	.000
55.000	.324	184.44	1.84	184.45	28.513	-.118	-6.875	-3.346	.00	.00	.00	.000	.000	.000
60.000	.367	227.22	2.27	227.23	29.309	-.210	-6.875	-4.065	.00	.00	.00	.000	.000	.000
65.000	.411	270.88	2.71	270.90	30.014	-.328	-6.875	-4.669	.00	.00	.00	.000	.000	.000
70.000	.460	319.84	3.20	319.86	30.586	-.426	-6.875	-5.131	.00	.00	.00	.000	.000	.000
75.000	.501	360.52	3.61	360.54	30.987	-.499	-6.875	-5.412	.00	.00	.00	.000	.000	.000
80.000	.512	371.53	3.72	371.55	31.175	-.578	-6.875	-5.476	.00	.00	.00	.000	.000	.000
85.000	.488	338.34	3.38	338.36	31.138	-.676	-6.875	-5.322	.00	.00	.00	.000	.000	.000
90.000	.444	282.23	2.82	282.24	30.878	-.793	-6.875	-4.967	.00	.00	.00	.000	.000	.000
95.000	.397	227.38	2.27	227.39	30.407	-.919	-6.875	-4.428	.00	.00	.00	.000	.000	.000
100.000	.355	183.31	1.83	183.32	29.772	-1.074	-6.875	-3.750	.00	.00	.00	.000	.000	.000
105.000	.341	169.47	1.69	169.48	29.035	-1.218	-6.875	-2.994	.00	.00	.00	.000	.000	.000
110.000	.356	184.67	1.85	184.68	28.237	-1.352	-6.875	-2.198	.00	.00	.00	.000	.000	.000
115.000	.399	234.42	2.34	234.43	27.410	-1.422	-6.875	-1.383	.00	.00	.00	.000	.000	.000
120.000	.424	266.96	2.67	266.97	26.570	-1.464	-6.875	-.562	.00	.00	.00	.000	.000	.000
125.000	.397	229.25	2.29	229.26	25.731	-1.502	-6.875	.260	.00	.00	.00	.000	.000	.000
130.000	.324	143.06	1.43	143.07	24.899	-1.525	-6.875	1.077	.00	.00	.00	.000	.000	.000
135.000	.236	65.27	.65	65.27	24.074	-1.526	-6.875	1.878	.00	.00	.00	.000	.000	.000
140.000	.161	22.91	.23	22.91	23.247	-1.503	-6.875	2.661	.00	.00	.00	.000	.000	.000

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572
CONTACT FORCES - VEHICLE PANELS VS. SEGMENTS

	PANEL 7 (FLOORBOARD) VS. SEGMENT 8 (LF)							PANEL 7 (FLOORBOARD) VS. SEGMENT 11 (RF)						
TIME (MSEC)	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z
.000	-.294	.00	.00	.00	.000	.000	.000	-.294	.00	.00	.00	.000	.000	.000
5.000	-.291	.00	.00	.00	.000	.000	.000	-.291	.00	.00	.00	.000	.000	.000
10.000	-.271	.00	.00	.00	.000	.000	.000	-.272	.00	.00	.00	.000	.000	.000
15.000	-.234	.00	.00	.00	.000	.000	.000	-.235	.00	.00	.00	.000	.000	.000
20.000	-.195	.00	.00	.00	.000	.000	.000	-.197	.00	.00	.00	.000	.000	.000
25.000	-.233	.00	.00	.00	.000	.000	.000	-.235	.00	.00	.00	.000	.000	.000
30.000	-.319	.00	.00	.00	.000	.000	.000	-.320	.00	.00	.00	.000	.000	.000
35.000	-.423	.00	.00	.00	.000	.000	.000	-.424	.00	.00	.00	.000	.000	.000
40.000	-.552	.00	.00	.00	.000	.000	.000	-.551	.00	.00	.00	.000	.000	.000
45.000	-.702	.00	.00	.00	.000	.000	.000	-.692	.00	.00	.00	.000	.000	.000
50.000	-.862	.00	.00	.00	.000	.000	.000	-.830	.00	.00	.00	.000	.000	.000
55.000	-1.019	.00	.00	.00	.000	.000	.000	-.946	.00	.00	.00	.000	.000	.000
60.000	-1.195	.00	.00	.00	.000	.000	.000	-1.070	.00	.00	.00	.000	.000	.000
65.000	-1.369	.00	.00	.00	.000	.000	.000	-1.235	.00	.00	.00	.000	.000	.000
70.000	-1.429	.00	.00	.00	.000	.000	.000	-1.424	.00	.00	.00	.000	.000	.000
75.000	-1.364	.00	.00	.00	.000	.000	.000	-1.499	.00	.00	.00	.000	.000	.000
80.000	-1.238	.00	.00	.00	.000	.000	.000	-1.427	.00	.00	.00	.000	.000	.000
85.000	-1.152	.00	.00	.00	.000	.000	.000	-1.288	.00	.00	.00	.000	.000	.000
90.000	-1.155	.00	.00	.00	.000	.000	.000	-1.155	.00	.00	.00	.000	.000	.000
95.000	-1.164	.00	.00	.00	.000	.000	.000	-1.051	.00	.00	.00	.000	.000	.000
100.000	-1.116	.00	.00	.00	.000	.000	.000	-.952	.00	.00	.00	.000	.000	.000
105.000	-1.045	.00	.00	.00	.000	.000	.000	-.856	.00	.00	.00	.000	.000	.000
110.000	-.962	.00	.00	.00	.000	.000	.000	-.750	.00	.00	.00	.000	.000	.000
115.000	-.854	.00	.00	.00	.000	.000	.000	-.628	.00	.00	.00	.000	.000	.000
120.000	-.710	.00	.00	.00	.000	.000	.000	-.469	.00	.00	.00	.000	.000	.000
125.000	-.526	.00	.00	.00	.000	.000	.000	-.255	.00	.00	.00	.000	.000	.000
130.000	-.303	.00	.00	.00	.000	.000	.000	.014	.94	.47	1.05	52.829	1.047	.000
135.000	-.046	.00	.00	.00	.000	.000	.000	.274	304.48	152.24	340.41	52.348	.773	.000
140.000	.222	227.00	113.50	253.79	50.156	-5.715	.000	.203	161.18	80.59	180.20	52.127	.654	-.000

DATE: 12 JUNE 1980

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R20506.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

CONTACT FORCES - VEHICLE PANELS VS. SEGMENTS

	PANEL 8 (TOEBOARD) VS. SEGMENT 8 (LF)							PANEL 8 (TOEBOARD) VS. SEGMENT 11 (RF)						
TIME (MSEC)	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z
.000	.076	6.08	.00	6.06	55.716	-3.270	-.811	.076	6.08	.00	6.08	55.716	3.270	-.811
5.000	.092	29.97	14.98	33.51	55.727	-3.270	-.820	.092	29.97	14.98	33.51	55.727	3.270	-.820
10.000	.163	137.16	68.58	153.35	55.768	-3.270	-.855	.162	136.51	68.25	152.62	55.766	3.270	-.855
15.000	.255	275.93	137.96	308.50	55.808	-3.271	-.888	.254	274.42	137.21	306.81	55.808	3.269	-.888
20.000	.307	355.24	138.35	381.23	55.810	-3.271	-.889	.306	352.90	136.97	378.55	55.810	3.269	-.890
25.000	.266	269.42	119.91	294.90	55.818	-3.271	-.896	.265	267.06	119.62	292.62	55.818	3.269	-.896
30.000	.187	136.20	68.10	152.28	55.847	-3.273	-.921	.185	133.83	66.91	149.62	55.847	3.269	-.921
35.000	.143	81.15	40.58	90.73	55.932	-3.276	-.992	.142	79.13	39.57	88.47	55.931	3.266	-.991
40.000	.166	110.82	55.41	123.90	56.107	-3.271	-1.139	.168	112.91	56.46	126.24	56.107	3.272	-1.136
45.000	.247	251.13	125.56	280.77	56.359	-3.253	-1.350	.258	271.05	135.53	303.05	56.356	3.287	-1.348
50.000	.308	356.31	178.16	398.37	56.605	-3.228	-1.557	.329	387.54	193.77	433.29	56.586	3.302	-1.540
55.000	.265	266.68	133.34	298.16	56.753	-3.208	-1.681	.292	309.49	154.74	346.02	56.691	3.307	-1.628
60.000	.129	66.26	33.13	74.09	56.839	-3.197	-1.753	.161	101.27	50.64	113.22	56.719	3.303	-1.652
65.000	-.018	.00	.00	.00	56.948	-3.169	-1.844	.035	.54	.27	.61	56.803	3.313	-1.723
70.000	-.012	.00	.00	.00	.000	.000	.000	-.034	.00	.00	.00	.000	.000	.000
75.000	.031	.00	.00	.00	56.952	-3.160	-1.848	-.065	.00	.00	.00	.000	.000	.000
60.000	.117	68.05	34.03	76.09	56.880	-3.190	-1.787	-.067	.00	.00	.00	.000	.000	.000
85.000	.168	165.02	74.37	181.00	56.841	-3.207	-1.755	-.042	.00	.00	.00	.000	.000	.000
90.000	.160	109.90	54.95	122.87	56.818	-3.221	-1.736	-.008	.00	.00	.00	.000	.000	.000
95.000	.036	.20	.10	.23	56.718	-3.258	-1.651	-.006	.00	.00	.00	.000	.000	.000
100.000	-.129	.00	.00	.00	.000	.000	.000	-.042	.00	.00	.00	.000	.000	.000
105.000	-.326	.00	.00	.00	.000	.000	.000	-.124	.00	.00	.00	.000	.000	.000
110.000	-.569	.00	.00	.00	.000	.000	.000	-.244	.00	.00	.00	.000	.000	.000
115.000	-.846	.00	.00	.00	.000	.000	.000	-.393	.00	.00	.00	.000	.000	.000
120.000	-1.140	.00	.00	.00	.000	.000	.000	-.546	.00	.00	.00	.000	.000	.000
125.000	-1.441	.00	.00	.00	.000	.000	.000	-.687	.00	.00	.00	.000	.000	.000
130.000	-1.748	.00	.00	.00	.000	.000	.000	-.819	.00	.00	.00	.000	.000	.000
135.000	-2.063	.00	.00	.00	.000	.000	.000	-.957	.00	.00	.00	.000	.000	.000
140.000	-2.391	.00	.00	.00	.000	.000	.000	-1.157	.00	.00	.00	.000	.000	.000

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572
CONTACT FORCES - VEHICLE PANELS VS. SEGMENTS

	PANEL 8 (TOEBOARD) VS. SEGMENT 8 (LF)							PANEL 8 (TOEBOARD) VS. SEGMENT 11 (RF)						
TIME (MSEC)	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z
.000	.076	6.11	.00	6.11	60.075	-3.270	-4.468	.076	6.11	.00	6.11	60.075	3.270	-4.468
5.000	.092	30.41	15.21	34.00	60.086	-3.270	-4.478	.092	30.41	15.21	34.00	60.086	3.270	-4.478
10.000	.136	96.48	48.24	107.87	60.106	-3.269	-4.494	.135	96.17	46.08	107.52	60.106	3.271	-4.494
15.000	.192	181.36	90.68	202.76	60.120	-3.269	-4.506	.191	180.32	90.16	201.61	60.120	3.271	-4.506
20.000	.207	199.70	78.62	214.62	60.094	-3.267	-4.484	.207	198.94	77.19	213.39	60.095	3.272	-4.485
25.000	.184	152.16	68.36	166.81	60.113	-3.265	-4.500	.183	151.91	68.12	166.48	60.115	3.273	-4.502
30.000	.167	122.12	61.06	136.53	60.190	-3.261	-4.565	.167	122.88	61.44	137.38	60.192	3.275	-4.566
35.000	.151	97.37	48.68	108.86	60.297	-3.252	-4.655	.150	95.59	47.80	106.88	60.296	3.280	-4.654
40.000	.167	125.08	62.54	139.84	60.467	-3.238	-4.797	.167	126.06	63.03	140.94	60.465	3.290	-4.796
45.000	.203	197.01	98.51	220.27	60.686	-3.223	-4.981	.209	206.18	103.09	230.52	60.679	3.298	-4.975
50.000	.235	246.54	123.27	275.64	60.913	-3.214	-5.171	.249	266.93	133.47	298.44	60.889	3.296	-5.151
55.000	.223	218.48	109.24	244.26	61.081	-3.214	-5.313	.238	243.33	121.67	272.05	61.011	3.291	-5.254
60.000	.180	137.45	68.72	153.67	61.236	-3.219	-5.442	.195	156.37	79.18	177.06	61.102	3.282	-5.330
65.000	.149	89.85	44.93	100.46	61.405	-3.223	-5.584	.156	98.00	49.00	109.57	61.253	3.275	-5.456
70.000	.142	81.18	40.59	90.76	61.467	-3.231	-5.636	.138	74.56	37.28	83.36	61.455	3.269	-5.626
75.000	.155	99.00	49.50	110.68	61.403	-3.243	-5.583	.132	67.51	33.75	75.48	61.535	3.260	-5.694
80.000	.177	138.35	69.18	154.69	61.282	-3.257	-5.481	.132	68.10	34.05	76.14	61.450	3.245	-5.622
85.000	.151	95.68	43.08	104.93	61.170	-3.277	-5.387	.138	75.37	37.69	84.27	61.291	3.216	-5.489
90.000	.106	40.20	20.10	44.95	61.138	-3.298	-5.354	.107	39.56	19.78	44.23	61.119	3.175	-5.344
95.000	.055	5.71	2.85	6.38	61.091	-3.325	-5.321	.028	.06	.03	.07	60.932	3.108	-5.187
100.000	-.070	.00	.00	.00	.000	.000	.000	-.098	.00	.00	.00	.000	.000	.000
105.000	-.354	.00	.00	.00	.000	.000	.000	-.295	.00	.00	.00	.000	.000	.000
110.000	-.714	.00	.00	.00	.000	.000	.000	-.535	.00	.00	.00	.000	.000	.000
115.000	-1.096	.00	.00	.00	.000	.000	.000	-.800	.00	.00	.00	.000	.000	.000
120.000	-1.473	.00	.00	.00	.000	.000	.000	-1.059	.00	.00	.00	.000	.000	.000
125.000	-1.836	.00	.00	.00	.000	.000	.000	-1.283	.00	.00	.00	.000	.000	.000
130.000	-2.183	.00	.00	.00	.000	.000	.000	-1.473	.00	.00	.00	.000	.000	.000
135.000	-2.520	.00	.00	.00	.000	.000	.000	-1.698	.00	.00	.00	.000	.000	.000
140.000	-2.872	.00	.00	.00	.000	.000	.000	-2.203	.00	.00	.00	.000	.000	.000

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.26 MPH.
CRASH VICTIM: ALDERSON PART 572
CONTACT FORCES - VEHICLE PANELS VS. SEGMENTS

PANEL 9 (TOEBOARD PLATE) VS. SEGMENT 8 (LF)

TIME (MSEC)	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z
.000	-.939	.00	.00	.00	.000	.000	.000
5.000	-.925	.00	.00	.00	.000	.000	.000
10.000	-.866	.00	.00	.00	.000	.000	.000
15.000	-.809	.00	.00	.00	.000	.000	.000
20.000	-.802	.00	.00	.00	.000	.000	.000
25.000	-.793	.00	.00	.00	.000	.000	.000
30.000	-.764	.00	.00	.00	.000	.000	.000
35.000	-.658	.00	.00	.00	.000	.000	.000
40.000	-.428	.00	.00	.00	.000	.000	.000
45.000	-.093	.00	.00	.00	.000	.000	.000
50.000	.233	23.32	7.08	24.37	62.580	-3.204	-7.611
55.000	.422	42.16	5.77	42.56	62.581	-3.204	-7.609
60.000	.518	64.85	13.24	66.18	62.578	-3.204	-7.614
65.000	.644	166.44	26.86	168.59	62.574	-3.201	-7.618
70.000	.695	208.46	24.90	209.94	62.574	-3.200	-7.618
75.000	.651	179.77	16.56	180.53	62.575	-3.201	-7.616
80.000	.570	133.14	66.45	148.80	62.576	-3.204	-7.615
85.000	.536	115.83	57.91	129.50	62.535	-3.211	-7.664
90.000	.509	102.89	51.44	115.03	62.501	-3.218	-7.704
95.000	.366	46.83	23.42	52.36	62.486	-3.223	-7.722
100.000	.087	.16	.08	.18	62.418	-3.254	-7.803
105.000	-.245	.00	.00	.00	.000	.000	.000
110.000	-.649	.00	.00	.00	.000	.000	.000
115.000	-1.138	.00	.00	.00	.000	.000	.000
120.000	-1.706	.00	.00	.00	.000	.000	.000
125.000	-2.348	.00	.00	.00	.000	.000	.000
130.000	-3.057	.00	.00	.00	.000	.000	.000
135.000	-3.832	.00	.00	.00	.000	.000	.000
140.000	-4.638	.00	.00	.00	.000	.000	.000

PANEL 9 (TOEBOARD PLATE) VS. SEGMENT 11 (RF)

TIME (MSEC)	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) (VEHICLE REFERENCE) X	Y	Z
.000	-.939	.00	.00	.00	.000	.000	.000
5.000	-.925	.00	.00	.00	.000	.000	.000
10.000	-.866	.00	.00	.00	.000	.000	.000
15.000	-.809	.00	.00	.00	.000	.000	.000
20.000	-.801	.00	.00	.00	.000	.000	.000
25.000	-.793	.00	.00	.00	.000	.000	.000
30.000	-.765	.00	.00	.00	.000	.000	.000
35.000	-.660	.00	.00	.00	.000	.000	.000
40.000	-.429	.00	.00	.00	.000	.000	.000
45.000	-.095	.00	.00	.00	.000	.000	.000
50.000	.208	20.84	9.82	23.04	62.586	3.298	-7.603
55.000	.342	34.17	9.67	35.52	62.588	3.296	-7.601
60.000	.364	36.42	13.37	38.80	62.583	3.292	-7.606
65.000	.456	45.64	10.37	46.80	62.579	3.291	-7.612
70.000	.658	177.97	38.52	182.09	62.575	3.292	-7.617
75.000	.733	239.08	50.40	244.34	62.574	3.293	-7.617
80.000	.618	163.09	11.31	163.48	62.577	3.286	-7.614
85.000	.434	71.50	25.20	75.81	62.581	3.279	-7.610
90.000	.280	23.39	11.70	26.16	62.548	3.266	-7.649
95.000	.131	1.77	.89	1.98	62.477	3.234	-7.733
100.000	-.059	.00	.00	.00	.000	.000	.000
105.000	-.302	.00	.00	.00	.000	.000	.000
110.000	-.611	.00	.00	.00	.000	.000	.000
115.000	-.985	.00	.00	.00	.000	.000	.000
120.000	-1.426	.00	.00	.00	.000	.000	.000
125.000	-1.940	.00	.00	.00	.000	.000	.000
130.000	-2.527	.00	.00	.00	.000	.000	.000
135.000	-3.104	.00	.00	.00	.000	.000	.000
140.000	-3.262	.00	.00	.00	.000	.000	.000

DATE: 12 JUNE 1980 PAGE: 41.01

RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.

VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.

CRASH VICTIM: ALDERSON PART 572

HARNESS SYSTEM BELT ENDPOINT FORCES

	BELT NO. 1 OF HARNESS NO. 1				BELT NO. 2 OF HARNESS NO. 1			
	POINT NO. 1		POINT NO. 10		POINT NO. 11		POINT NO. 15	
TIME (MSEC)	STRAIN (IN / IN)	FORCE (LBS)	STRAIN (IN / IN)	FORCE (LBS)	STRAIN (IN / IN)	FORCE (LBS)	STRAIN (IN / IN)	FORCE (LBS)
.000	.000000	.00	.000000	.00	.000000	.00	.000000	.00
5.000	.000000	.00	.000661	1.98	.000000	.00	.000537	3.22
10.000	.002889	6.89	.004391	13.17	.001808	5.06	.002342	10.45
15.000	.007844	22.67	.009571	28.71	.005007	25.11	.007953	47.72
20.000	.013106	36.54	.016583	49.75	.008658	44.22	.013019	78.12
25.000	.018838	51.85	.023846	71.54	.012542	63.45	.018661	111.97
30.000	.026380	69.33	.035800	107.40	.019455	105.91	.025257	151.54
35.000	.042520	122.92	.049111	147.33	.038242	229.45	.038719	232.31
40.000	.048303	152.28	.061992	269.92	.058103	348.62	.060764	366.88
45.000	.056705	205.22	.079783	476.53	.076749	502.72	.085399	588.59
50.000	.066911	312.81	.095493	727.88	.102406	698.62	.119124	892.12
55.000	.081347	519.42	.112939	1168.17	.133894	1048.79	.151789	1323.65
60.000	.094157	770.53	.130374	1550.00	.163465	1439.36	.184182	1835.69
65.000	.102200	758.71	.140557	1550.00	.181302	1400.37	.220597	1850.00
70.000	.107218	755.84	.146595	1550.00	.187560	1289.33	.253716	1850.00
75.000	.102641	663.58	.149361	1550.00	.197556	1244.25	.278281	1850.00
80.000	.098623	604.16	.141354	1376.70	.228405	1362.17	.294701	1850.00
85.000	.100962	638.38	.128434	1110.25	.259061	1315.56	.292744	1762.10
90.000	.098267	599.03	.109900	777.75	.259663	1322.97	.286066	1668.40
95.000	.091576	506.70	.091225	502.06	.267791	1425.04	.265239	1392.59
100.000	.077480	337.19	.072418	284.59	.264391	1451.47	.236837	1056.60
105.000	.060002	174.11	.053909	129.52	.244934	1259.82	.204551	730.91
110.000	.057364	184.23	.037587	41.29	.188364	611.33	.166943	426.59
115.000	.049053	140.52	.027661	4.92	.127803	196.91	.123666	177.73
120.000	.034034	30.52	.022892	.06	.082013	39.37	.076743	28.96
125.000	.024199	.97	.012151	.00	.047900	.72	.037380	.00
130.000	.022421	.00	.000000	.00	.045071	.00	.007786	.00
135.000	.022366	.00	.000000	.00	.044982	.00	.000000	.00
140.000	.022364	.00	.000000	.00	.044979	.00	.000000	.00

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572

HARNESS SYSTEM BELT ENDPOINT FORCES
BELT NO. 3 OF HARNESS NO. 1

	POINT NO. 16		POINT NO. 26	
TIME (MSEC)	STRAIN (IN / IN)	FORCE (LBS)	STRAIN (IN / IN)	FORCE (LBS)
.000	.000000	.00	.000000	.00
5.000	.000000	.00	.000000	.00
10.000	.000000	.00	.000000	.00
15.000	.000000	.00	.000000	.00
20.000	.000000	.00	.002334	23.34
25.000	.001061	8.16	.005399	53.99
30.000	.002862	9.17	.014516	190.32
35.000	.010659	83.72	.019784	295.68
40.000	.013595	108.32	.030747	514.94
45.000	.023112	241.86	.044427	788.54
50.000	.033980	422.64	.057301	1046.03
55.000	.044632	590.45	.072049	1340.97
60.000	.052779	711.87	.084342	1586.84
65.000	.051079	613.53	.095495	1800.00
70.000	.049566	583.74	.103254	1800.00
75.000	.053219	660.40	.108770	1800.00
80.000	.075489	700.03	.103257	1525.63
85.000	.077199	741.56	.104258	1560.86
90.000	.081586	853.93	.101278	1455.93
95.000	.089894	1088.45	.094156	1219.79
100.000	.081999	876.26	.076099	714.63
105.000	.077045	853.02	.057124	328.46
110.000	.049953	273.34	.036376	75.86
115.000	.024353	14.63	.019207	.85
120.000	.018726	1.32	.016624	.00
125.000	.015324	.00	.014468	.00
130.000	.007649	.00	.007978	.00
135.000	.002277	.00	.001623	.00
140.000	.000000	.00	.000000	.00

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R20506.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572

CONTACT FORCES - SEGMENT NO. 6 (LUL) VS. SEGMENT NO. 13 (LLA)

TIME (MSEC)	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) SEG. 6 LOCAL REFERENCE X	Y	Z	SEG. 13 LOCAL REFERENCE X	Y	Z
.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
5.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
10.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
15.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
20.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
25.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
30.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
35.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
40.000	.028	1.38	.69	1.55	1.124	-3.224	.506	-.308	.707	6.102
45.000	.088	4.41	2.21	4.93	1.034	-3.212	.563	-.298	.750	5.705
50.000	.117	5.85	2.93	6.54	.954	-3.206	.684	-.292	.806	5.199
55.000	.116	5.82	2.91	6.50	.889	-3.202	.891	-.294	.872	4.537
60.000	.078	3.89	1.94	4.34	.859	-3.195	1.280	-.317	.935	3.788
65.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
70.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
75.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
80.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
85.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
90.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
95.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
100.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
105.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
110.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
115.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
120.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
125.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
130.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
135.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
140.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000

DATE: 12 JUNE 1980
RUN DESCRIPTION: CVS-III (VERSION 20A) SIMULATION OF E04 RUNS 2049 - 2051.
ALDERSON PART 572 DUMMY WITH THREE POINT BELT SYSTEM. RUN R2050G.
VEHICLE DECELERATION: RUN 2049 SLED PULSE. DELTA V = 30.28 MPH.
CRASH VICTIM: ALDERSON PART 572

CONTACT FORCES - SEGMENT NO. 9 (RUL) VS. SEGMENT NO. 15 (RLA)

TIME (MSEC)	DEFL-ECTION (IN)	NORMAL FORCE (LBS)	FRICTION FORCE (LBS)	RESULTANT FORCE (LBS)	CONTACT LOCATION (IN) SEG. 9 LOCAL REFERENCE X	Y	Z	SEG. 15 LOCAL REFERENCE X	Y	Z
.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
5.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
10.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
15.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
20.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
25.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
30.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
35.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
40.000	.129	6.44	3.22	7.20	1.135	3.153	.638	-.294	-.670	6.197
45.000	.246	12.32	6.16	13.78	1.015	3.120	.666	-.281	-.704	5.793
50.000	.313	15.65	7.82	17.50	.890	3.108	.654	-.272	-.760	5.240
55.000	.333	16.63	8.32	18.59	.760	3.112	.718	-.260	-.835	4.467
60.000	.298	14.91	7.45	16.67	.643	3.138	.776	-.236	-.920	3.499
65.000	.205	10.24	5.12	11.45	.541	3.194	.966	-.192	-1.005	2.411
70.000	.050	2.49	1.25	2.78	.447	3.276	1.366	-.115	-1.083	1.265
75.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
80.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
85.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
90.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
95.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
100.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
105.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
110.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
115.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
120.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
125.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
130.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
135.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000
140.000	.000	.00	.00	.00	.000	.000	.000	.000	.000	.000

HIC, HSI AND CSI RESULTS

HEAD INJURY CRITERION

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HIC =   274.26          TIME DURATION =     49.000  TO    104.000 MSEC
                  WITH HEAD RESULTANTS =     17.686 AND    18.134 G'S

          AVERAGE HEAD RESULTANT FOR TIME DURATION =     30.138 G'S
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HEAD SEVERITY INDEX

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HSI =   313.17

MAX  HEAD RESULTANT =     38.652 G'S AT    66.000 MSEC
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CHEST SEVERITY INDEX

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CSI =   180.48

MAX CHEST RESULTANT =    32.594 G'S AT    77.000 MSEC
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ELAPSED CPU TIME = 901.094 SECONDS

SUB	CALLS	TIME	%
MAIN3D	1	21.351	2.369
INPUT	1	10.771	1.195
CHAIN	1112	8.674	.963
DINT	29	25.420	2.821
PDAUX	1285	29.907	3.319
DAUX	1111	19.359	2.148
SETUP1	1111	17.604	1.954
CONTCT	1111	1.801	.200
PLELP	13332	43.417	4.818
SEGSEG	2222	20.009	2.220
HBELT	1777	166.508	18.700
VISPR	1111	19.133	2.123
EJOINT	1111	66.399	7.369
SETUP2	1111	6.868	.762
DAUX11	1111	31.271	3.470
DAUX12	1111	12.258	1.360
DAUX22	1111	14.742	1.636
FSMSOL	1777	212.759	23.611
OUTPUT	175	32.884	3.649
PRIPLT	8	9.566	1.062
UPDATE	174	8.939	.992
HPTURB	174	67.922	7.538
DZP	1110	14.052	1.559
POSTPR	1	37.484	4.160
TOTAL		901.099	100.000

@BRKPT 2

@FREE U2R2050G.

@SYM U2R2050G.,,RMTS54

@FIN

RUNID: R2050G ACCT: 850A1B PROJECT: CALSPAN

0-R2050G*MSG: LARGE CORE (128K) JOB ABOUT 25 MINUTES.

0 OK

STOP 1

TIME: TOTAL: 00:15:24.711 CBSUPS: 1147478633

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2. Bartz, John A. and Butler, Frank E., "A Three-Dimensional Computer Simulation of a Motor Vehicle Crash Victim, Phase 2 - Validation Study of the Model", Calspan Report No. VJ-2978-V-2, December, 1972.

3. Bartz, John A., Butler, Frank E. and Ryan, Charles T., "A Three-Dimensional Computer Simulation of a Motor Vehicle Crash Victim, Further Development - Mutual Force-Deflection Characteristics and Comprehensive 'Debug' Facility", Calspan Report No. ZQ-5326-V-2, September, 1974.

4. Fleck, J. T., Butler, F. E., and Vogel, S. L., "An Improved Three-Dimensional Computer Simulation of Motor Vehicle Crash Victims", Volumes I-IV, Report Nos. DOT-HS-801507, -508, -509, -510, July, 1974.

5. Fleck, J. T. and Butler, F. E., "Development of an Improved Computer Model of the Human Body and Extremity Dynamics", Report No. AMRL-TR-75-14, July, 1975 (AD A-014816).

6. Butler, F. E. and Fleck, J. T., "Advanced Restraint System Modeling", Report No. AFAMRL-TR-80-14, May, 1980.

7. Federal Motor Vehicle Safety Standard 208, Part 572, "Anthropomorphic Test Dummy".

8. "Development of Approximating Solutions for CVS Program and of Dummy Design Information", Contract No. DOT-HS-6-01418 (in progress).

9. DeLeys, Norman J., "Data For Validation of Crash Victim Simulator", Calspan Report No. 6197-V-1, August, 1981.