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Final Report

Study of Differences in Hybrid III Chest Deflections Due to Three-and Two-Point Belt Loadings

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16. Abstract

Parametric studies were performed using the MVMA 2D crash victim simulation program to determine how chest deflection of two point and three point belt-restrained Hybrid III type dummies are affected by belt characteristics, seat cushion geometry and stiffness, floor board and knee cushion locations. Output parameters include hip motion, belt loads, chest deflection (top and bottom), knee loads, belt angles and chest g's. Results of the study indicate that chest deflection for comparable belt geometries are larger for two point belt systems than they are for three point belt systems, and that in all cases the deflection at the bottom of the chest when restrained by a two point belt system is significantly larger than at the top of the chest.

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This letter describes the work that has been done under Order No. DTNH22-87-P-02088, "Study of Differences in Hybrid III Dummy's Chest Deflections Due to Three- and Two-Point Belt Loadings." Under this Order, UMTRI has adapted the Hybrid III dummy's chest deflection characteristics to the MVMA2D crash victim simulation program and performed parametric studies to determine how chest deflection of two-point and three-point belt-restrained dummies are affected by belt properties, seat cushion geometry and stiffness, floor board and knee cushion locations.

DATA RESOURCES

Four information sources were used in developing the data sets for this study. The first of these was used to obtain vehicle interior geometric data. The Volkswagen Rabbit vehicle interior, occupant posture, H-point location, and two-point belt geometry were obtained from previous work conducted at UMTRI reported in "Biomechanical Accident Investigation Methodology." This report, authored by D. H. Robbins, J. W. Melvin, D. F. Huelke, and H. W. Sherman, was the output from a project sponsored by MVMA that was completed in 1983. The vehicle data were obtained from seating package drawings supplied by Volkswagen of America. They were used in the successful reconstruction of an offset head-on crash between a 1979 Blazer and a 1980 VW Rabbit. Both occupants of the Rabbit were wearing automatic shoulder belts.

The second data source was used to replace the human data used in the accident reconstruction with Hybrid III parameters. The source for the Hybrid III parameters in MVMA2D format was a data set provided by General Motors to NHTSA for general use.

The third data source was used to replace the vehicle deceleration estimated for the crash reconstruction mentioned above. The new barrier crash pulse that was used was obtained at TRC.

The fourth, and final, data source provided upgraded advanced three-dimensional belt geometry developed from concepts used in a recent study conducted for industry.

METHOD FOR DETERMINING CHEST DEFORMATION

Figures 1 and 2 show the geometry of the model which is used to estimate chest deflection from MVMA2D simulation output. Two configurations of the torso belt crossing the chest are shown in Figure 1. The first (solid line) is the path over the chest for the MVMA2D simulation. This reflects the fact that the belt is attached to points on the chest which cannot move with respect to the chest center of gravity. The second (dotted line) shows the path the belt would take over the torso if chest deflection is allowed. The displacement at the top of the chest is shown to be different from the displacement at the bottom. In order for dummy kinematics predicted by the MVMA2D model to match test data that includes Hybrid III chest deformation, it is necessary to reduce belt stiffness for the computer simulation to allow more belt stretch for the same applied force.

Figure 2 shows details of belt and chest deformation and the effect of applied forces on both. The upper and lower belts as well as the chest are shown as free bodies. Elongation of all belts includes the effects of the applied forces on the upper and lower sections. An additional elongation is included for the MVMA2D model simulation to take into account the effect of chest deflection. This additional elongation effect depends on both belt angle and the deflection at the top and bottom of the chest. The assumption has been made that the difference in belt angle is small between the MVMA2D and test conditions. Different stiffnesses have been assigned to the top and bottom of the chest to test the hypothesis that Hybrid III dummy chest deflection may have more than one degree of freedom (at a minimum, rotational as well as uniaxial motion).

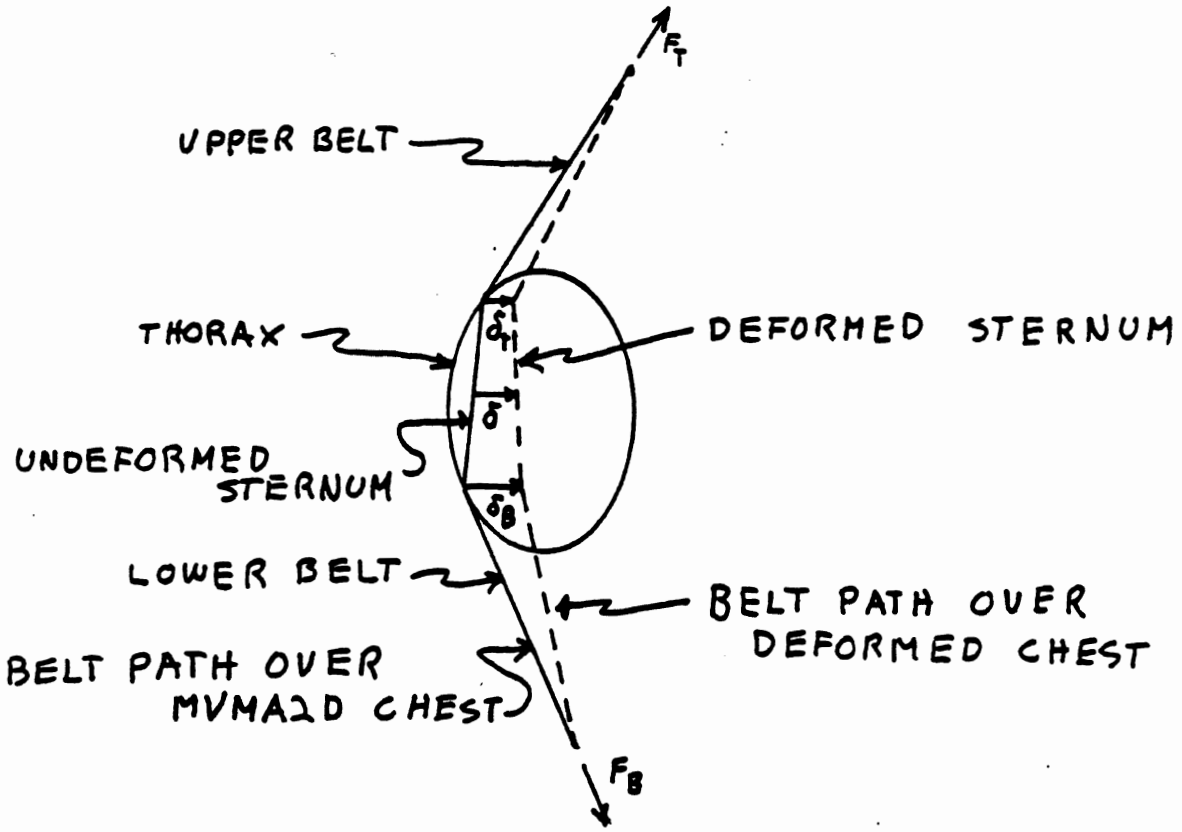
The geometric model that has been presented can now be used to develop a method for using the unmodified MVMA2D model to predict differential chest deflections. The first step is to make a major assumption that both belt and chest stiffnesses can be modeled by linear springs as is done in the following simplistic analysis. The belt force components normal to the chest are related to the displacements at its top, bottom, and center by the equations,

$$F_T \cos\theta_T = k_T \delta_T$$

$$F_B \cos\theta_B = k_B \delta_B$$

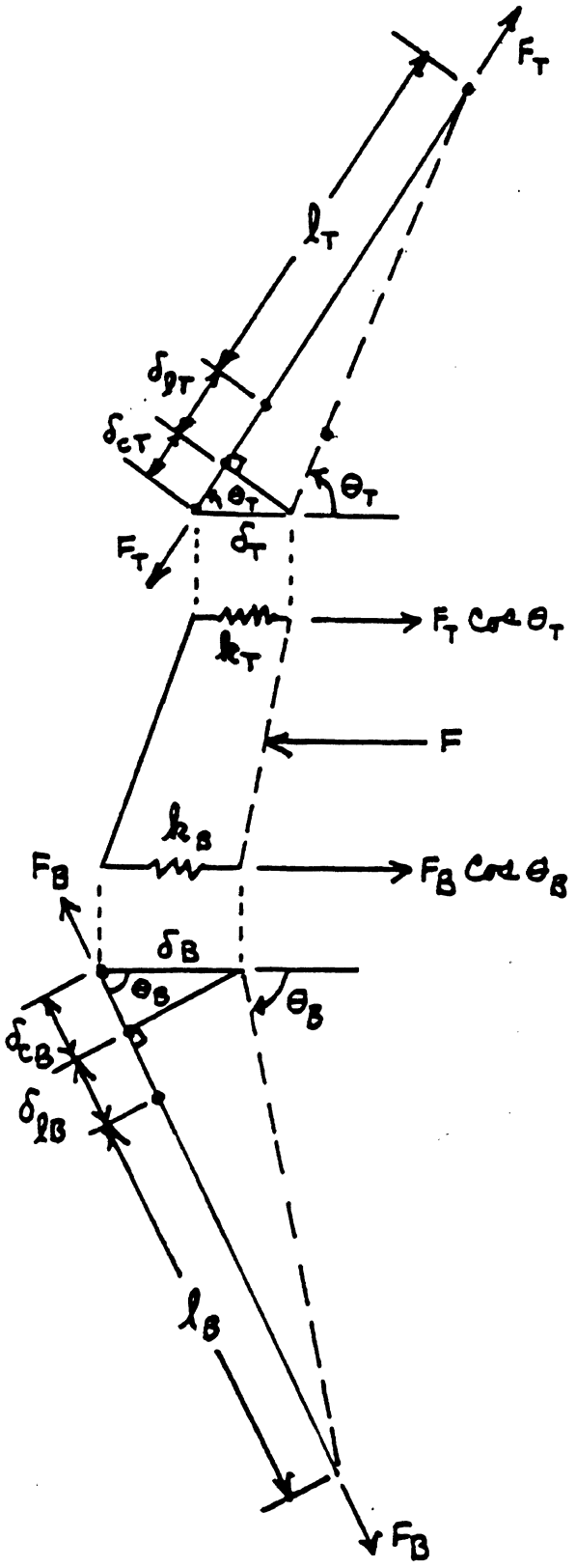
$$F = F_T \cos\theta_T + F_B \cos\theta_B$$

$$F = k_C \delta = k_T \delta_T + k_B \delta_B = k_C \left(\frac{\delta_T + \delta_B}{2} \right)$$



δ_T = deflection at top of sternum
δ = mid-sternum deflection
δ_B = deflection at bottom of sternum
F_T = force in upper belt
F_B = force in lower belt

Figure 1. Schematic of MVMA2D model of belt path over chest with effect of chest deformation superimposed.



- l_T and l_B = unstretched length of upper and lower belts

δ_{lT} and δ_{lB} = elongation of belt due to belt force, F_T and F_B.

δ_{cT} and δ_{cB} = added belt elongation to account for chest compression within limits of MVMA 2D belt model (fixed to torso).

θ_T and θ_B = Belt angles with vertical

k_T and k_B = Stiffnesses at top and bottom of chest

F = overall reaction force of sternum to applied belt forces

δ_T and δ_B = deflections at top and bottom of chest.

F_T and F_B = Forces acting on upper and lower belt segments

Figure 2. Details of belt and chest deformation and the effects of the applied forces.

where k_c is the overall chest stiffness. If the compliances at the top and bottom of the chest are the same,

$$k_T = k_B = k$$

$$k_C \left(\frac{\delta_T + \delta_B}{2}\right) = k \left(\delta_T + \delta_B\right)$$

$$k_c = 2k$$

Note from Figure 2 that the MVMA2D belt elongation effect due to chest deflection can be expressed in terms of chest deflection as,

$$\delta_{CB} = \delta_B \cos\theta_B$$

$$\delta_{CT} = \delta_T \cos\theta_T$$

The force-deflection equations can now be written,

$$F_T \cos\theta_T = \frac{k_c}{2}\delta_T = \frac{k_c}{2}\frac{\delta_{CT}}{\cos\theta_T}$$

$$F_B \cos\theta_B = \frac{k_c}{2}\delta_B = \frac{k_c}{2}\frac{\delta_{CB}}{\cos\theta_B} \qquad (1)$$

In terms of either belt force, or deflection in the belt, they can be rewritten as,

$$\delta_{CT} = \frac{2\cos^2\theta_T}{k_c}F_T \quad ; \quad \delta_{CB} = \frac{2\cos^2\theta_B}{k_c}F_B$$

$$F_T = \frac{k_c}{2\cos^2\theta_T}\delta_{CT} \quad ; \quad F_B = \frac{k_c}{2\cos^2\theta_B}\delta_{CB} \qquad (2)$$

These simplistic equations illustrate the interacting effects of chest stiffness, belt angle, and belt properties for given belt forces. If belt angle is zero, then the entire belt force is applied to chest deformation. As the belt angle increases toward 90 degrees, the effect becomes less. Different belt angles at the top and bottom of the chest can clearly have a major effect on the loads that are applied to the chest and the chest deflections which result.

Equations 2 provide the information needed to compute the amount of strain that must be added to the MVMA2D belt lengths for inclusion of the effect of Hybrid III chest deflection.

$$F_T = \frac{k_c l_T}{2\cos^2\theta_T}\left(\frac{\delta_{CT}}{l_T}\right) = \frac{k_c l_T}{2\cos^2\theta_T}\epsilon_{CT} \qquad (3)$$

$$F_B = \frac{k_c l_B}{2\cos^2\theta_B}\left(\frac{\delta_{CB}}{l_B}\right) = \frac{k_c l_B}{2\cos^2\theta_B}\epsilon_{CB}$$

These equations define belt stiffness adjustments that include effects of chest deflection, belt angle, and belt length. Belt angle and length are known from the test setup geometry. The equations are used to compute the effects of shared deflection between the belt and the chest for inclusion in the input data for the MVMA2D model (Cards 710 and 711, fields 8 and 9 to define the material names, and cards 704-709 to define material properties).

Chest stiffness is based on post-test dummy calibration thorax impact data from the TRC Volkswagen Rabbit barrier impact mentioned earlier. Assuming a linear force-deflection curve, the chest stiffness is about 418 pounds/inch (5413.8 newtons maximum resistive force and 6.39 centimeters maximum deflection from the test) until geometric restrictions to motion are generated. Because of the "clavicle", only a small amount of deflection at the top of the chest beyond about 2.2 inches can take place. At the bottom of the chest, bottoming out begins to occur at about 3.25 inches. Beyond the points at which bottoming out is assumed to occur, a stiffness value of 12750 pounds/inch is chosen on the basis of data obtained from industry sources. So, up to a point, the bottom of the chest is more compliant than the top.

Equations 1 can be rewritten for use in estimating chest deflections from MVMA2D model output.

$$\delta_T = \frac{2\cos\theta_T}{k_c} F_T \quad , \quad \delta_B = \frac{2\cos\theta_B}{k_c} F_B \qquad (4)$$

Belt angle, belt force, and chest stiffness are all known. Maximum values of belt angles and forces are obtained from the MVMA2D output while different chest stiffnesses are used for the top and bottom of the chest. A short program in BASIC was written to compute the deflections from the MVMA2D output.

A final comment should be made about an assumption made in this analysis which is clearly illustrated in Figure 2. The computations are based on forces and deflections normal to the surface of the chest. The drawing correctly shows a surface line of the chest which is not normal to either deflection or force. The results will be most accurate when the torso is essentially upright during the application of crash loads. The predictions using this analysis are intended to show performance trends rather than quantitative results. To determine the accuracy of the procedure, validation against experimental results will be required.

MATRIX OF COMPUTER RUNS

Parameter studies have been conducted to determine how chest deflection of two-point and three-point belt-restrained dummies are affected by belt properties, seat cushion geometry and stiffness, as well as floor board and knee bolster locations. The following variations to the baseline two-point and three-point belt data sets have been made:

- Knee bolster moved 2 inches toward the front of the vehicle. Knee bolster moved 1.85 inches toward the occupant to almost touch the knees.
- Toeboard moved 4 inches toward the front of the vehicle.
- Knee bolster moved 2 inches toward the front of the vehicle and toeboard moved 4 inches toward the front of the vehicle.
- Upper torso belt anchor moved 4 inches toward the rear of the vehicle.
- Lower torso belt anchor (lap belt in the case of the three-point belt) moved 4 inches toward the rear of the vehicle and moved 4 inches toward the front of the vehicle.
- Both upper and lower belt anchors moved 4 inches toward the rear of the vehicle
- Belt stiffness reduced by a factor of 0.5
- Seat cushion stiffness reduced by a factor of 0.5
- Seat cushion friction set to 1.0
- Belt slack increased to 3.5 inches

The baseline data sets are included as Appendices A and B at the end of this letter report.

SUMMARY OF RESULTS

Tables 1 through 4 are a summary of the results obtained from the computer runs. A total of 44 computer runs were made. The earliest and most time consuming were those conducted while assembling data from the various data resources discussed previously. A total of 26 computer runs are included in the tables. A coding for the various runs is given as follows:

- 2 Pt Base. The baseline run for the two-point passive belt system.

- Bols+2. The entire bolster structure is moved forward 2 inches.

- Bols-1.85. The entire bolster structure is moved to nearly touch the occupant's knees.

- UT Anch-4. The anchor in the vehicle for the upper torso belt is moved 4 inches to the rear.

- LT Anch-4. For the two-point belt, the anchor in the vehicle for the lower section of the torso belt is moved 4 inches to the rear. For the three-point belt, the anchor in the vehicle for the stalk is moved 4 inches to the rear.

- LT Anch+4. Same as above except anchor is moved toward the front of the vehicle.

- UT&LT A-4. Both belt anchors are moved 4 inches toward the rear of the vehicle.

- Belt K*.5. The belt stiffness curve is reduced by a factor of 0.5.

- Slack=3.5. Belt slack in the various segments is increased from 1 inch to 3.5 inches.

- Toebo(a)rd+4. The entire toeboard structure is moved 4 inches toward the front of the vehicle.

- SC K*.5. The seat cushion stiffness curve is reduced by a factor of 0.5.

- SC Fric=1. The seat cushion friction coefficient is increased from 0.2 to 1.0.

- Bol+2,TB+4. The bolster and toeboard are moved toward the front of the vehicle by 2 inches and 4 inches respectively.

Table 1. Summary of Hip Motion, Femur Load, Chest Deceleration, and Chest Deflection Output (Two-point belts).

Variation	Hip X (in)	Hip Z (in)	Femur load (lb)	Chest G's	Upper chest defl. (in)	Lower Chest defl. (in)
2 Pt Base	6.43	1.14	4114	55.7	2.53	3.33
Bols+2	8.43	0.50	4850	66.2	2.59	3.37
Bols-1.85	4.24	1.74	3188	50.9	2.48	3.31
UT Anch-4	6.43	1.17	4107	54.0	2.51	3.32
LT Anch-4	6.32	1.02	4074	56.3	2.54	3.37
LT Anch+4	6.56	1.25	4162	54.2	2.51	3.29
UT&LT A-4	6.32	1.05	4068	55.6	2.52	3.35
Belt K*.5	6.59	1.22	4179	50.0	2.44	3.30
Slack=3.5	6.67	1.23	4626	59.2	2.49	3.32
Toebord+4	6.41	1.15	4157	55.6	2.53	3.33
SC K*.5	6.68	1.74	4210	56.2	2.53	3.34
SC Fric=1	5.91	1.24	4120	56.7	2.54	3.34
Bol+2,TB+4	8.34	0.47	4698	65.7	2.59	3.37

Table 2. Summary of Hip Motion, Femur Load, Chest Deceleration, and Chest Deflection Output (Three-point Belts).

Variation	Hip X (in)	Hip Z (in)	Femur load (lb)	Chest G's	Upper chest defl. (in)	Lower chest defl. (in)
3 Pt Base	5.62	2.10	3119	47.6	2.39	2.88
Bols+2	7.19	1.76	2850	59.4	2.46	3.26
Bols-1.85	3.86	2.35	2608	41.8	2.35	2.37
UT Anch-4	5.62	2.11	3108	47.8	2.39	2.76
LT Anch-4	5.20	2.09	2753	49.2	2.40	3.27
LT Anch+4	6.13	2.01	3581	48.0	2.38	1.94
UT&LT A-4	5.20	2.09	2744	49.9	2.40	3.26
Belt K*.5	6.06	1.78	3587	38.1	2.31	2.21
Slack=3.5	6.62	1.40	4215	47.6	2.33	2.71
Toebord+4	5.60	2.11	3193	47.3	2.39	2.84
SC K=.5	5.66	2.75	3195	47.3	2.39	2.91
SC Fric=1	5.37	1.92	3307	51.4	2.40	2.92
Bol+2,TB+4	7.08	1.78	2908	59.1	2.45	3.26

Table 3. Summary of Belt Output (Two-point Belts).

Variation	Up Belt Load (pounds)	Up Belt Angle (degrees)	Lo Belt Load (pounds)	Lo Belt Angle (degrees)
2 Pt Base	2661	14.44	2022	51.71
Bols+2	3079	14.03	2340	50.51
Bols-1.85	2388	15.35	1815	53.19
UT Anch-4	2520	12.18	1915	51.82
LT Anch-4	2714	14.74	2062	44.90
LT Anch+4	2546	13.99	1935	59.92
UT&LT A-4	2569	12.38	1952	44.95
Belt K*.5	2059	13.42	1565	49.57
Slack=3.5	2372	12.78	1803	48.68
Toeboard+4	2658	14.44	2020	51.73
SC K*0.5	2676	15.48	2034	50.24
SC F=1.0	2716	13.95	2064	52.19
Bol+2,TB+4	3073	14.00	2335	50.58

Table 4. Summary of Belt Output (Three-point Belts).

Variation	Up Belt Load (pounds)	Up Belt Angle (degrees)	Lo Belt Load (pounds)	Lo Belt Angle (degrees)
3 Pt Base	1777	15.13	1351	61.79
Bols+2	2192	14.93	1666	61.32
Bols-1.85	1490	15.48	1133	62.30
UT Anch-4	1752	12.67	1331	62.62
LT Anch-4	1844	15.63	1402	54.33
LT Anch+4	1670	14.26	1269	70.20
UT&LT A-4	1815	13.02	1379	54.39
Belt K*0.5	1196	13.89	909	57.35
Slack=3.5	1379	12.38	1048	54.93
Toeboard+4	1771	15.13	1346	62.05
SC K*0.5	1767	16.05	1343	61.28
SC Fric=1.	1818	14.50	1382	61.99
Bol+2,TB+2	2160	14.92	1641	61.33

OBSERVATIONS

The following six output parameters were included in the results given in Tables 1 - 4:

- Hip motion
- Belt loads
- Chest deflection (top and bottom)
- Knee loads
- Belt angles
- Chest G's

Observations of the effects of the various parameter variations on these quantities follow.

1. Hip motion. The X-motion of the hip is the smallest when the bolster is positioned closest to the knees. Likewise, it is the largest when the bolster is located furthest away. Conversely, the Z-motion is greatest when the bolster is closest, and also, when the seat cushion is softest. The hip X-motion is greater for two-point systems than it is for three-point systems. The converse is true for Z-motion.

2. Belt loads. Torso belt loads are largest when the bolster is positioned the furthest from the knees. This is due to the fact that the chest begins to absorb energy before the knees. Torso belt loads are lower when the bolster is closest and when belt slack is greatest. The reason for improved performance with an increase in belt slack in this case is the improved phasing of loads applied to the torso and hip. The smallest loads are applied in the case of the smallest belt stiffness. Loads in the two-point belt systems are larger than those in the three-point belt system.

3. Chest deflections. Chest deflections are larger for the two-point belt systems than they are for the three-point belt systems at both the top and the bottom of the chest. Lower chest deflection values are similar to, or larger than, upper chest deflection values for three-point belt loading. This depends on bolster and lower belt anchor locations. Forward belt anchor locations and bolsters positioned close to the knees result in deflections at the bottom of the chest which are similar in value to those at the top of the chest. In all cases with the two-point belt system, the deflection at the bottom of the chest is significantly larger than that at the top. This effect is accentuated by the blocking effect of the clavicle structure in the Hybrid III against an increase of belt angle as the dummy moves forward.

4. Knee loads. Knee loads are significantly lower for the three-point belt systems because the belts absorb a significant portion of the crash loading on the occupant.

5. Belt angles. The significantly larger angle of the lower torso element in the two-point belt system results in a larger force component normal to the surface of the chest than is the case with the three-point belt systems.

6. Chest G-loading. Chest G's are larger for two-point belts. This reflects the larger loads which are applied. The lowest loads are for the case of belts with reduced stiffness properties. The largest loads occur when there is a time delay before the occupant interacts with the vehicle. In these cases, the bolster is further from the knees or there is slack in the belt system.

APPENDIX A

TWO-POINT BELT SYSTEM
BASELINE DATA SET

```
DOTVW3                                                                  100
1.      0.      32.174  0.      0.      150.    .5      1.      10.     101
3.      0.      0.      0.      0.      0.      10.     .0000015.       102
FOOT            FLOOR                                                   106
CHEST           STEERING WHEEL                                          106
CHEST           SEATBACK                                                106
MID-TORSO       STEERING WHEEL                                          106
HIP             CUSHION                                                 106
ULEG            CUSHION                                                 106
LARM            STEERING WHEEL                                          106
MID-TORSO       SEATBACK                                                106
HEAD            ROOF                                                    106
LARM            INST.PANEL                                              106
HEAD            STEERING WHEEL                                          106
ULEG            BOLSTER                                                 106
S1SHIN          BOLSTER                                                 106
S2SHIN          BOLSTER                                                 106
S3SHIN          BOLSTER                                                 106
HEAD            INST.PANEL                                              106
HEAD            WINDSHIELD                                              106
0.      1.      1.      0.      0.      0.      0.      0.      0.      107
0.      0.      0.      0.      0.      0.      0.      0.      1.      108
1.      1.      0.      0.      0.      0.      0.      0.      0.      109
0.      0.      0.      0.      0.      1.      1.      1.      1.      110
0.      0.      0.      0.      0.      0.      0.      0.      0.      111
  HYBRID 3 DUMMY                                                        200
.477    11.573  5.109   3.722   15.815          10.3    2.993   -.657   201
1.883   6.165   2.55    2.306   9.445   9.45    5.143   5.95    .1434   202
.0258   .098    .0328   .0984   .0691   .0535   .0226   .0259   .0087   203
.253    1.917   .428    1.286   1.202   3.038   .204    .632    .053    204
44.236  123.861 0.      .39812  17.394  10.             -60.    .75     205
44.236  123.861 0.      .39812  17.394  10.             -90.    .75     206
884.72  0.      0.      .69981  884.82  400.    20.     -50.    .75     207
102.4729-7.62075.1943356.69981  884.72  400.    -43.    -83.    .75     208
84.40653-4.80841.10522580.      884.72  400.    0.      -120.   .75     209
0.      29.815  0.      0.      221.18  100.    135.    0.      .75     210
24.391710.      .00645400.      221.18  100.    30.     -180.   .75     211
12.191430.      .00645400.      309.65  100.    3.      -145.   .75     212
4566.32  0.      0.      37.101                                         213
684.95  0.      0.      8.0767                  1.575           1.      214
4.061   13.271  0.      .1106   19.703  8.      46.             .8      215
4.061   17.517  0.      .0531   74.872  30.     21.5            .8      216
-15.1   -11.2   -14.2   -39.    -43.6   74.     -38.3   -63.            217
1.898   6.2     0.                                                      218
HEAD                            1.      1.                              219
CHEST           CHESTMAT        2.      1.                              219
SLDR                            2.      1.                              219
MID-TORSO       CHESTMAT        3.      1.                              219
HIP                             4.      1.                              219
ULEG                            5.      1.                              219
KNEE                            5.      1.                              219
S1SHIN                          6.      1.                              219
S2SHIN                          6.      1.                              219
S3SHIN                          6.      1.                              219
FOOT                            6.      1.                              219
JAW                             1.      1.                              219
UARM                            7.      1.                              219
ELBOW                           7.      1.                              219
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 59  LARM                              8.       1.                                   219
 60  HAND              EC3MAT          8.       1.                                   219
 61  HEAD              .276    -.039   4.4      3.907                                220
 62  CHEST             -1.299  O.      4.872    4.528                                220
 63  SLDR              -5.187  O.      .984     2.559                                220
 64  MID-TORSO         -2.047  -1.063  4.331    4.331                                220
 65  HIP               .866    .63     4.134    4.134                                220
 66  ULEG              -.394   .591    8.346    2.953                                220
 67  KNEE              6.693   .157    2.421    2.421                                220
 68  S1SHIN            -4.646  .287    2.323    2.323                                220
 69  S2SHIN            -.287   .571    2.075    2.075                                220
 70  S3SHIN            3.575   .528    1.61     1.61                                 220
 71  FOOT              6.811   -.055   4.724    4.724                                220
 72  JAW               3.937   -1.772  .787     1.772                                220
 73  UARM              -1.535  O.      4.665    2.028                                220
 74  ELBOW             5.039   .0787   1.929    1.929                                220
 75  LARM              -.0787  O.      4.035    1.821                                220
 76  HAND              6.339   O.      1.821    1.821                                220
 77  CHESTMAT          .1969   .866    O.       39.37    39.76    O.      O.         221
 78  CHESTMAT          33.7    O.      O.       O.       CHESTST I        CHESTGR    222
 79  CHESTGR O.        O.                                                            223
 80  CHESTGR .394      .2                                                            223
 81  CHESTGR .866      .275                                                          223
 82  CHESTGR 1.575     .275                                                          223
 83  CHESTGR 2.756     .357                                                          223
 84  CHESTGR O.        1.                                                            224
 85  CHESTGR .394      .48                                                           224
 86  CHESTGR .866      .356                                                          224
 87  CHESTGR 1.575     .352                                                          224
 88  CHESTGR 2.756     .218                                                          224
 89  CHESTST O.        O.                                                            225
 90  CHESTST .394      1191.                                                         225
 91  CHESTST .866      1965.                                                         225
 92  CHESTST 1.575     2739.                                                         225
 93  CHESTST 2.756     5947.                                                         225
 94  EC3MAT            O.      O.      O.       39.37    39.76    O.      O.         221
 95  EC3MAT            3.37    O.      O.       O.       EC3STAT I        EC3GR      222
 96  EC3GR   -1.       .08                                                           223
 97  EC3GR   -1.       .91                                                           224
 98  EC3STAT O.        .05                                                           225
 99  EC3STAT 1.5       530.                                                          225
100  EC3STAT 3.        1359.                                                         225
101  EC3STAT 3.6       1812.                                                         225
102  EC3STAT 12.       22472.                                                        225
103  I       -1.       O.                                                            226
104  685.    O.        O.      9.047                                                 242
105    HYBRID 3 DUMMY.                                                               300
106  74.9    101.2     115.4   154.4   18.      -56.     -40.5    22.5    90.        301
107  -6.15   O.        -12.15  O.      5.73     O.                                   303
108  O.      O.        O.      O.                                                    304
109  VEHICLE INTERIOR                                                                400
110  FLOOR             MATFL           O.       1.       1.       1.                 401
111  INST.PANEL        MATDASH         O.       1.       1.       1.                 401
112  BOLSTER           MATBOL          O.       1.       1.       1.                 401
113  WINDSHIELD        MATWD           O.       1.       1.       1.                 401
114  CUSHION           MATCH           O.       1.       1.       1.                 401
115  SEATBACK          MATSB           O.       1.       1.       1.                 401
116  ROOF              MATRF           O.       1.       1.       1.                 401
```

117	STEERING WHEEL	MATSTW		0.	1.	1.	1.		401
118	FLOOR	2.	4.	1.	0.	0.			402
119	INST.PANEL	2.	2.	1.	0.	0.			402
120	BOLSTER	1.	2.	1.	0.	0.			402
121	WINDSHIELD	1.	1.	1.	0.	0.			402
122	CUSHION	1.	3.	1.	0.	0.			402
123	SEATBACK	1.	2.	1.	0.	0.			402
124	ROOF	1.	2.	1.	0.	0.			402
125	STEERING WHEEL	1.	5.	1.	0.	0.			402
126	MATFL	0.	0.	0.	1000.	2000.	2400.	8000.	403
127	MATDASH	0.	0.	0.	1000.	2000.	0.	0.	403
128	MATBOL	0.	0.	0.	1000.	2000.	0.	0.	403
129	MATWD	0.	0.	0.	1000.	2000.	0.	0.	403
130	MATCH	0.	0.	0.	1000.	2000.	0.	0.	403
131	MATSB	0.	0.	0.	1000.	2000.	0.	0.	403
132	MATRF	0.	0.	0.	1000.	2000.	0.	0.	403
133	MATSTW	0.	0.	0.	1000.	2000.	0.	0.	403
134	MATFL	2.	0.	0.	0.	FLSTAT	INERZ	FLGR	404
135	MATDASH	2.	0.	0.	0.	DASHSTAT	INERZ	DASHGR	404
136	MATBOL	2.	0.	0.	0.	BOLSTAT	INERZ	BOLGR	404
137	MATWD	2.	0.	0.	0.	WDSTAT	INERZ	WDGR	404
138	MATCH	2.	0.	0.	0.	CHSTAT	INERZ	CHGR	404
139	MATSB	2.	0.	0.	0.	SBSTAT	INERZ	SBGR	404
140	MATRF	2.	0.	0.	0.	RFSTAT	INERZ	RFGR	404
141	MATSTW	2.	0.	0.	0.	STWSTAT	INERZ	STWGR	404
142	FLGR -1.	.2							405
143	FLGR -1.	.2							406
144	DASHGR -1.	.8							405
145	DASHGR -1.	.08							406
146	BOLGR -1.	.8							405
147	BOLGR -1.	.08							406
148	WDGR -1.	.95							405
149	WDGR -1.	.01							406
150	CHGR -1.	.1							405
151	CHGR -1.	.85							406
152	SBGR -1.	.1							405
153	SBGR -1.	.85							406
154	RFGR -1.	.5							405
155	RFGR -1.	.5							406
156	STWGR -1.	.95							405
157	STWGR -1.	.05							406
158	FLSTAT -1.	800.							407
159	DASHSTAT-1.	441.24	-109.64	9.3813	0.17045				407
160	BOLSTAT 0.	0.							407
161	BOLSTAT 6.	5400.							407
162	WDSTAT -1.	2000.							407
163	CHSTAT -1.	122.	37.6	-74.48	22.16				407
164	SBSTAT -1.	14.	-9.	14.	-4.	1.			407
165	STWSTAT 0.	0.							407
166	STWSTAT .1	1562.							407
167	STWSTAT .49	1875.							407
168	STWSTAT .51	2500.							407
169	STWSTAT .75	1875.							407
170	STWSTAT 1.5	1562.							407
171	STWSTAT 2.4	1000.							407
172	STWSTAT 3.9	750.							407
173	STWSTAT 8.	750.							407
174	STWSTAT 10.	10000.							407

```
175     RFSTAT  0.      0.                                                      407
176     RFSTAT  2.      2000.                                                   407
177     RFSTAT  3.      13000.                                                  407
178     INERZ   -1.     0.                                                      408
179     FLOOR           FLOOR           20.     .25     1.      1.              409
180     TOEBOARD        FLOOR           20.     .25     1.      2.              409
181     BOLSTERD        BOLSTER         4.      .25     1.      1.              409
182     MIDDLEDH        INST.PANEL      4.      .25     1.      1.              409
183     UPPERDH         INST.PANEL      4.      .25     -1.     2.              409
184     WINDSHIELD      WINDSHIELD      1.      .25     1.      1.              409
185     CUSHION         CUSHION         20.     .25     1.      1.              409
186     SEATBACK        SEATBACK        20.     .25     1.      1.              409
187     ROOF            ROOF            4.      .25     1.      1.              409
188     STEERING WHEEL  STEERING WHEEL  2.      .25     1.      1.              409
189     FLOOR           1.                                                      410
190     TOEBOARD        1.                                                      410
191     BOLSTERD        1.                                                      410
192     MIDDLEDH        1.                                                      410
193     UPPERDH         1.                                                      410
194     WINDSHIELD      1.                                                      410
195     CUSHION         1.                                                      410
196     SEATBACK        1.                                                      410
197     ROOF            1.                                                      410
198     STEERING WHEEL  1.                                                      410
199     FLOOR           -1.     -15.    12.3    29.7    12.3                    411
200     TOEBOARD        -1.     29.7    12.3    39.2    0.                      411
201     BOLSTERD        -1.     17.5    -10.    24.7    2.5                     411
202     MIDDLEDH        -1.     19.7    -6.3    21.1    -16.8                   411
203     UPPERDH         -1.     21.1    -16.8   32.     -16.2                   411
204     WINDSHIELD      -1.     32.     -16.2   15.3    -30.9                   411
205     CUSHION         -1.     -8.     5.      16.5    -2.5                    411
206     SEATBACK        -1.     -3.4    5.      -14.2   -20.                    411
207     ROOF            -1.     16.     -32.9   -16.    -32.9                   411
208     STEERING WHEEL  -1.     9.7     -6.7    16.6    -20.                    411
209     1.      1.      0.                                                      412
210     1.      2.      .7                                                      412
211     1.      3.      .2      0.                                              412
212     1.      4.      .8      .15                                             412
213     1.      5.      1.                                                      412
214     1.      6.      1.                                                      412
215     CRASH 44.5 FT/SEC                                                       600
216     0.      44.5    0.      0.      0.      0.      0.      0.      0.      601
217     17.     1.      0.                                                      602
218     0.      0.      5.      -1.     7.      -5.     22.     -8.
219     30.     -23.    35.     -23.    38.25   -45.28  47.     -30.
220     55.     -30.    60.     -10.    66.     0.      70.     -6.
221     90.     -12.    95.     -3.     110.    -3.     135.    0.
222     200.    0.
223     PASSIVE TORSO BELT                                                      700
224     BELT            0.      0.      0.      1000.   2000.   0.      0.      704
225     BELT            20.     0.      0.              BLTST   BINERZ  BLTGR   705
226     BLTGR   -1.     .05                                                     706
227     BLTGR   -1.     .95                                                     707
228     BLTST   0.      0.                                                      708
228.1   BLTST   .033    1000.                                                   708
228.2   BLTST   .125    2500.                                                   708
228.3   BLTST   .3      7416.                                                   708
229     BINERZ  -1.     0.                                                      709
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  229.01  H3TOP           0.      0.      0.      1000.   2000.   0.      0.      704
  229.02  H3TOP           20.     0.      0.              TOPST   BINERZ  BLTGR   705
  229.03  TOPST   0.      0.                                                      708
  229.04  TOPST   .06     1000.                                                   708
  229.05  TOPST   .07     6000.                                                   708
  229.06  H3BOT           0.      0.      0.      1000.   2000.   0.      0.      704
  229.07  H3BOT           20.     0.      0.              BOTST   BINERZ  BLTGR   705
  229.08  BOTST   -1.      8534.                                                   708
  230     2.15    2.4     -16.3   -21.3   1.5     BELT            H3TOP           710
  231     12.     3.9     -7.2    10.6    1.5     BELT            H3BOT           711
  232     3.      1.      2.      6.57    0.      1.      1.                      717
  233                             1.              50000.  -.24                    719
  234     3.      3.      0.      0.      1.      1.      0.      0.              720
  235     8.      8.      0.      0.      0.      0.      0.                      725
  236                                                                             800
  237                                                                             1000
 1001     0,1,4-17,21-32,37,40,46-50,45                                          1001
 1002     0.      0.      0.      13.5    0.015                                   1003
 1003     40.     60.     110.3   1.      .085    201.    5.      5.              1004
 1004     0.      0.      -30.    60.     -50.    20.     5.      0.              1500
 1005     21.     0.      6.      0.      0.      0.      1.      0.      10.     1501
 1006                                                                            1600
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APPENDIX B

THREE-POINT BELT SYSTEM
BASELINE DATA SET

```
 1  DOTVW4                                                                  100
 2  1.       0.       32.174   0.       0.       150.     .5       1.      10.  101
 3  3.       0.       0.       0.       0.       0.       10.      .000001 5.   102
 4  FOOT              FLOOR                                                  106
 5  CHEST             STEERING WHEEL                                         106
 6  CHEST             SEATBACK                                               106
 7  MID-TORSO         STEERING WHEEL                                         106
 8  HIP               CUSHION                                                106
 9  ULEG              CUSHION                                                106
10  LARM              STEERING WHEEL                                         106
11  MID-TORSO         SEATBACK                                               106
12  HEAD              ROOF                                                   106
13  LARM              INST.PANEL                                             106
14  HEAD              STEERING WHEEL                                         106
15  ULEG              BOLSTER                                                106
16  S1SHIN            BOLSTER                                                106
17  S2SHIN            BOLSTER                                                106
18  S3SHIN            BOLSTER                                                106
19  HEAD              INST.PANEL                                             106
20  HEAD              WINDSHIELD                                             106
21  0.       1.       1.       0.       0.       0.       0.       0.      0.  107
22  0.       0.       0.       0.       0.       0.       0.       0.      1.  108
23  1.       1.       0.       0.       0.       0.       0.       0.      0.  109
24  0.       0.       0.       0.       0.       1.       1.       1.      1.  110
25  0.       0.       0.       0.       0.       0.       0.       0.      0.  111
26    HYBRID 3 DUMMY                                                          200
27  .477     11.573   5.109    3.722    15.815            10.3     2.993   -.657 201
28  1.883    6.165    2.55     2.306    9.445    9.45     5.143    5.95    .1434 202
29  .0258    .098     .0328    .0984    .0691    .0535    .0226    .0259   .0087 203
30  .253     1.917    .428     1.286    1.202    3.038    .204     .632    .053  204
31  44.236   123.861  0.       .39812   17.394   10.               -60.    .75   205
32  44.236   123.861  0.       .39812   17.394   10.               -90.    .75   206
33  884.72   0.       0.       .69981   884.82   400.     20.      -50.    .75   207
34  102.4729 -7.62075 .1943356 .69981  884.72   400.     -43.     -83.    .75   208
35  84.40653 -4.80841 .10522580.       884.72   400.     0.       -120.   .75   209
36  0.       29.815   0.       0.       221.18   100.     135.     0.      .75   210
37  24.391710.        .00645400.       221.18   100.     30.      -180.   .75   211
38  12.191430.        .00645400.       309.65   100.     3.       -145.   .75   212
39  4566.32  0.       0.       37.101                                         213
40  684.95   0.       0.       8.0767                     1.575             1.  214
41  4.061    13.271   0.       .1106    19.703   8.       46.               .8  215
42  4.061    17.517   0.       .0531    74.872   30.      21.5              .8  216
43  -15.1    -11.2    -14.2    -39.     -43.6    74.      -38.3    -63.       217
44  1.898    6.2      0.                                                     218
45  HEAD                               1.       1.                           219
46  CHEST             CHESTMAT         2.       1.                           219
47  SLDR                               2.       1.                           219
48  MID-TORSO         CHESTMAT         3.       1.                           219
49  HIP                                4.       1.                           219
50  ULEG                               5.       1.                           219
51  KNEE                               5.       1.                           219
52  S1SHIN                             6.       1.                           219
53  S2SHIN                             6.       1.                           219
54  S3SHIN                             6.       1.                           219
55  FOOT                               6.       1.                           219
56  JAW                                1.       1.                           219
57  UARM                               7.       1.                           219
58  ELBOW                              7.       1.                           219
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 59    LARM                          8.      1.                                    219
 60    HAND              EC3MAT      8.      1.                                    219
 61    HEAD              .276   -.039  4.4     3.907                              220
 62    CHEST             -1.299 0.     4.872   4.528                              220
 63    SLDR              -5.187 0.     .984    2.559                              220
 64    MID-TORSO         -2.047 -1.063 4.331   4.331                              220
 65    HIP               .866   .63    4.134   4.134                              220
 66    ULEG              -.394  .591   8.346   2.953                              220
 67    KNEE              6.693  .157   2.421   2.421                              220
 68    S1SHIN            -4.646 .287   2.323   2.323                              220
 69    S2SHIN            -.287  .571   2.075   2.075                              220
 70    S3SHIN            3.575  .528   1.61    1.61                               220
 71    FOOT              6.811  -.055  4.724   4.724                              220
 72    JAW               3.937  -1.772 .787    1.772                              220
 73    UARM              -1.535 0.     4.665   2.028                              220
 74    ELBOW             5.039  .0787  1.929   1.929                              220
 75    LARM              -.0787 0.     4.035   1.821                              220
 76    HAND              6.339  0.     1.821   1.821                              220
 77    CHESTMAT          .1969  .866   0.      39.37   39.76   0.      0.        221
 78    CHESTMAT          33.7   0.     0.      0.      CHESTST I       CHESTGR   222
 79    CHESTGR 0.        0.                                                       223
 80    CHESTGR .394      .2                                                       223
 81    CHESTGR .866      .275                                                     223
 82    CHESTGR 1.575     .275                                                     223
 83    CHESTGR 2.756     .357                                                     223
 84    CHESTGR 0.        1.                                                       224
 85    CHESTGR .394      .48                                                      224
 86    CHESTGR .866      .356                                                     224
 87    CHESTGR 1.575     .352                                                     224
 88    CHESTGR 2.756     .218                                                     224
 89    CHESTST 0.        0.                                                       225
 90    CHESTST .394      1191.                                                    225
 91    CHESTST .866      1965.                                                    225
 92    CHESTST 1.575     2739.                                                    225
 93    CHESTST 2.756     5947.                                                    225
 94    EC3MAT            0.     0.     0.      39.37   39.76   0.      0.        221
 95    EC3MAT            3.37   0.     0.      0.      EC3STAT I       EC3GR     222
 96    EC3GR   -1.       .08                                                      223
 97    EC3GR   -1.       .91                                                      224
 98    EC3STAT 0.        .05                                                      225
 99    EC3STAT 1.5       530.                                                     225
100    EC3STAT 3.        1359.                                                    225
101    EC3STAT 3.6       1812.                                                    225
102    EC3STAT 12.       22472.                                                   225
103    I       -1.       0.                                                       226
104    685.    0.        0.     9.047                                             242
105       HYBRID 3 DUMMY.                                                        300
106    74.9    101.2     115.4  154.4  18.     -56.    -40.5   22.5    90.       301
107    -6.15   0.        -12.15 0.     5.73    0.                                303
108    0.      0.        0.     0.                                               304
109    VEHICLE INTERIOR                                                         400
110    FLOOR             MATFL       0.      1.      1.      1.                 401
111    INST.PANEL        MATDASH     0.      1.      1.      1.                 401
112    BOLSTER           MATBOL      0.      1.      1.      1.                 401
113    WINDSHIELD        MATWD       0.      1.      1.      1.                 401
114    CUSHION           MATCH       0.      1.      1.      1.                 401
115    SEATBACK          MATSB       0.      1.      1.      1.                 401
116    ROOF              MATRF       0.      1.      1.      1.                 401
```

```
117     STEERING WHEEL  MATSTW          0.      1.      1.      1.              401
118     FLOOR           2.      4.      1.      0.      0.                      402
119     INST.PANEL      2.      2.      1.      0.      0.                      402
120     BOLSTER         1.      2.      1.      0.      0.                      402
121     WINDSHIELD      1.      1.      1.      0.      0.                      402
122     CUSHION         1.      3.      1.      0.      0.                      402
123     SEATBACK        1.      2.      1.      0.      0.                      402
124     ROOF            1.      2.      1.      0.      0.                      402
125     STEERING WHEEL  1.      5.      1.      0.      0.                      402
126     MATFL           0.      0.      0.      1000.   2000.   2400.   8000.   403
127     MATDASH         0.      0.      0.      1000.   2000.   0.      0.      403
128     MATBOL          0.      0.      0.      1000.   2000.   0.      0.      403
129     MATWD           0.      0.      0.      1000.   2000.   0.      0.      403
130     MATCH           0.      0.      0.      1000.   2000.   0.      0.      403
131     MATSB           0.      0.      0.      1000.   2000.   0.      0.      403
132     MATRF           0.      0.      0.      1000.   2000.   0.      0.      403
133     MATSTW          0.      0.      0.      1000.   2000.   0.      0.      403
134     MATFL           2.      0.      0.      0.      FLSTAT  INERZ   FLGR    404
135     MATDASH         2.      0.      0.      0.      DASHSTATINERZ   DASHGR  404
136     MATBOL          2.      0.      0.      0.      BOLSTAT INERZ   BOLGR   404
137     MATWD           2.      0.      0.      0.      WDSTAT  INERZ   WDGR    404
138     MATCH           2.      0.      0.      0.      CHSTAT  INERZ   CHGR    404
139     MATSB           2.      0.      0.      0.      SBSTAT  INERZ   SBGR    404
140     MATRF           2.      0.      0.      0.      RFSTAT  INERZ   RFGR    404
141     MATSTW          2.      0.      0.      0.      STWSTAT INERZ   STWGR   404
142     FLGR    -1.     .2                                                      405
143     FLGR    -1.     .2                                                      406
144     DASHGR  -1.     .8                                                      405
145     DASHGR  -1.     .08                                                     406
146     BOLGR   -1.     .8                                                      405
147     BOLGR   -1.     .08                                                     406
148     WDGR    -1.     .95                                                     405
149     WDGR    -1.     .01                                                     406
150     CHGR    -1.     .1                                                      405
151     CHGR    -1.     .85                                                     406
152     SBGR    -1.     .1                                                      405
153     SBGR    -1.     .85                                                     406
154     RFGR    -1.     .5                                                      405
155     RFGR    -1.     .5                                                      406
156     STWGR   -1.     .95                                                     405
157     STWGR   -1.     .05                                                     406
158     FLSTAT  -1.     800.                                                    407
159     DASHSTAT-1.     441.24  -109.64 9.3813  0.17045                         407
160     BOLSTAT 0.      0.                                                      407
161     BOLSTAT 6.      5400.                                                   407
162     WDSTAT  -1.     2000.                                                   407
163     CHSTAT  -1.     122.    37.6    -74.48  22.16                           407
164     SBSTAT  -1.     14.     -9.     14.     -4.     1.                      407
165     STWSTAT 0.      0.                                                      407
166     STWSTAT .1      1562.                                                   407
167     STWSTAT .49     1875.                                                   407
168     STWSTAT .51     2500.                                                   407
169     STWSTAT .75     1875.                                                   407
170     STWSTAT 1.5     1562.                                                   407
171     STWSTAT 2.4     1000.                                                   407
172     STWSTAT 3.9     750.                                                    407
173     STWSTAT 8.      750.                                                    407
174     STWSTAT 10.     10000.                                                  407
```

```
175     RFSTAT  0.      0.                                                      407
176     RFSTAT  2.      2000.                                                   407
177     RFSTAT  3.      13000.                                                  407
178     INERZ   -1.     0.                                                      408
179     FLOOR           FLOOR           20.     .25     1.      1.              409
180     TOEBOARD        FLOOR           20.     .25     1.      2.              409
181     BOLSTERD        BOLSTER         4.      .25     1.      1.              409
182     MIDDLEDH        INST.PANEL      4.      .25     1.      1.              409
183     UPPERDH         INST.PANEL      4.      .25     -1.     2.              409
184     WINDSHIELD      WINDSHIELD      1.      .25     1.      1.              409
185     CUSHION         CUSHION         20.     .25     1.      1.              409
186     SEATBACK        SEATBACK        20.     .25     1.      1.              409
187     ROOF            ROOF            4.      .25     1.      1.              409
188     STEERING WHEEL  STEERING WHEEL  2.      .25     1.      1.              409
189     FLOOR           1.                                                      410
190     TOEBOARD        1.                                                      410
191     BOLSTERD        1.                                                      410
192     MIDDLEDH        1.                                                      410
193     UPPERDH         1.                                                      410
194     WINDSHIELD      1.                                                      410
195     CUSHION         1.                                                      410
196     SEATBACK        1.                                                      410
197     ROOF            1.                                                      410
198     STEERING WHEEL  1.                                                      410
199     FLOOR           -1.     -15.    12.3    29.7    12.3                    411
200     TOEBOARD        -1.     29.7    12.3    39.2    0.                      411
201     BOLSTERD        -1.     17.5    -10.    24.7    2.5                     411
202     MIDDLEDH        -1.     19.7    -6.3    21.1    -18.8                   411
203     UPPERDH         -1.     21.1    -18.8   32.     -16.2                   411
204     WINDSHIELD      -1.     32.     -16.2   15.3    -30.9                   411
205     CUSHION         -1.     -8.     5.      16.5    -2.5                    411
206     SEATBACK        -1.     -3.4    5.      -14.2   -20.                    411
207     ROOF            -1.     16.     -32.9   -16.    -32.9                   411
208     STEERING WHEEL  -1.     9.7     -6.7    16.6    -20.                    411
209     1.      1.      0.                                                      412
210     1.      2.      .7                                                      412
211     1.      3.      .2      0.                                              412
212     1.      4.      .8      .15                                             412
213     1.      5.      1.                                                      412
214     1.      6.      1.                                                      412
215     CRASH 44.5 FT/SEC                                                       600
216     0.      44.5    0.      0.      0.      0.      0.      0.      0.      601
217     17.     1.      0.                                                      602
218     0.      0.      5.      -1.     7.      -5.     22.     -8.
219     30.     -23.    35.     -23.    38.25   -45.28  47.     -30.
220     55.     -30.    60.     -10.    66.     0.      70.     -6.
221     90.     -12.    95.     -3.     110.    -3.     135.    0.
222     200.    0.
223     PASSIVE TORSO BELT                                                      700
224     BELT            0.      0.      0.      1000.   2000.   0.      0.      704
225     BELT            20.     0.      0.              BLTST   BINERZ  BLTGR   705
226     BLTGR   -1.     .05                                                     706
227     BLTGR   -1.     .95                                                     707
228     BLTST   0.      0.                                                      708
228.1   BLTST   .033    1000.                                                   708
228.2   BLTST   .125    2500.                                                   708
228.3   BLTST   .3      7416.                                                   708
229     BINERZ  -1.     0.                                                      709
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 229.01  H3TOP           0.      0.      0.      1000.   2000.   0.      0.      704
 229.02  H3TOP           20.     0.      0.              TOPST   BINERZ  BLTGR   705
 229.03  TOPST   0.      0.                                                      708
 229.04  TOPST   .06     1000.                                                   708
 229.05  TOPST   .07     6000.                                                   708
 229.06  H3BOT           0.      0.      0.      1000.   2000.   0.      0.      704
 229.07  H3BOT           20.     0.      0.              BOTST   BINERZ  BLTGR   705
 229.08  BOTST   -1.     8534.                                                   708
 229.09  STRAPMAT        0.      0.      0.      1000.   2000.   0.      0.      704
 229.1   STRAPMAT        20.     0.      0.              ABELT   BINERZ  HBELT   705
 229.11  HBELT   -1.     .05                                                     706
 229.13  HBELT   -1.     .95                                                     707
 229.15  ABELT   0.      0.                                                      708
 229.16  ABELT   .04     1873.                                                   708
 229.17  ABELT   .062    4275.                                                   708
 229.18  ABELT   .092    6126.                                                   708
 229.19  ABELT   .114    6647.                                                   708
 230     2.15    2.4     -16.3   -21.3   1.0     BELT            H3TOP           710
 231     12.     2.4                     1.0     BELT            H3BOT           711
 231.1   3.722   0.                      1.      BELT                            712
 231.2   3.722   0.      -7.2    10.6    1.      BELT                            713
 231.3                   -7.2    10.6    10.     STRAPMAT                        714
 232     3.      1.      2.      6.57    16.     1.      1.                      717
 232.1   1.      25.     100.                                                    718
 233                             1.              50000.  -.24                    719
 234     3.      1.      0.      3.      1.      3.      0.                      720
 235     8.      4.71    8.      14.     6.                                      725
 236                                                                             800
 237                                                                             1000
1001     0,1,4-17,21-32,37,40,46-50,45                                          1001
1002     0.      0.      0.      13.5    0.015                                   1003
1003     40.     60.     110.3   1.      .085    201.    5.      5.              1004
1004     0.      0.      -30.    60.     -50.    20.     5.      0.              1500
1005     21.     0.      6.      0.      0.      0.      1.      0.      10.     1501
1006                                                                            1600
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