Establishment of the Performance Characteristics of the SA 1031 - 6-Month-Old Infant Dummy

Joseph B. Benson and John W. Melvin

Highway Safety Research Institute
The University of Michigan
Ann Arbor, Michigan 48109

National Highway Traffic Safety Administration
U. S. Department of Transportation
Washington, D.C.

Twenty-one compliance-type sled tests were run utilizing the standard bench seat and six different infant restraint systems to compare the impact performance of a modified six-month-old-infant dummy having upgraded neck structure and joint stops to an unmodified dummy. No significant performance differences were noted except for excessive neck elongation on the unmodified, used dummy.

Some of the tests included alteration of the restraint system initial back angle to investigate occupant ejections. It was concluded that a maximum back angle of 70° or less, during impact, was adequate to prevent ejection in a frontal impact.
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1.0 FOREWORD

Improving the durability of the SA1031 6-month-old-infant dummy and then establishing its response in compliance-type testing was the purpose of this project. Humanoid Systems, 747 E. 223rd. St., Carson, CA. 90745, provided a modified six-months-old-infant dummy with modifications based on approximately five years of field experience and feedback plus the information provided by a teardown and inspection of HSRI'S extensively used infant dummy. Twenty-one sled tests were conducted at HSRI comparing the response of an unmodified dummy to the new modified six-month-old-infant dummy using six different types of infant restraint systems. Special attention was paid to the relationship between the restraint initial seatback angle and occupant ejection.
2.0 SUMMARY

The improved SA1031 dummy was subjected to compliance-type testing on the HSRI impact sled to the requirements of proposed standard FMVSS No. 213 — Child Restraint Systems. No significant performance differences were noted between the modified dummy and a used, unmodified dummy using six different commercial restraint systems. Three of these restraints did not meet the 60° maximum angular excursion requirement of the proposed standard. Occupant ejection did not occur with the rear facing restraints when the maximum seatback angle during impact was 70° or less. The vehicle lap belt angle and attachment point relative to the c.g. of the restraint/dummy system was observed to be a significant factor in limiting restraint angular deflection and dummy head excursion during impact.
3.0 METHODOLOGY

3.1 Sled Facility

The HSRI impact sled is a 975-pound test platform, 6.5 foot square, moving on linear bearings along a 45-foot track. The sled is accelerated by a compressed-air-driven ram acting over a ten-foot stroke, and the impact deceleration is produced by impacting a gas pressure programmer which provides the desired severity of impact. This programmer operates on the rebound principle, providing the intended sled velocity change by reversing the sled direction during the test. The standard bench seat developed for testing of child restraint systems was securely fastened to the sled frame in a frontal impact mode for these tests.

3.2 Instrumentation

3.2.1 Transducers

The following transducers were used to obtain the data during testing:

a. Belt webbing forces: GSE Model 2500 Seat Belt Force Sensor
b. Sled deceleration: Setra Accelerometer Model 111

3.2.2 Signal Conditioning

a. For belt forces: Honeywell Accudata Model 120 Bridge Balance Signal Conditioner
   Honeywell Accudata Model 105 D.C. Amplifier
b. For sled deceleration: Setra Model SCM-1A signal conditioner

c. For signal filtering: Krohn-Hite Model 3750 filter

3.2.3 Data Recording and Playback

Honeywell Model 7600 14-channel FM tape recorder
3.2.4 Data Presentation

Gould Model 260 brush strip chart recorder

3.2.5 Photo - Instrumentation

a. For high-speed movies: Two Photosonics Model 16mm-1B, 16mm high-speed movie cameras operating at 1000 F.P.S., providing overhead and right side views.

b. For Polaroid sequence: Graphcheck sequence camera model 300
3.3 **Test Procedure**

The infant restraint systems were attached to the standard bench seat with Type 1 lap belts, which were pretensioned from twelve to fourteen pounds force before each run. Pre and post-test photos were taken for each test. Special care was taken to symmetrically position the dummies in the restraint systems, and to ensure that any restraint harnesses were snugly and correctly fitted according to the manufacturer's recommendations.

To study occupant ejection, foam pads were placed under the base of the restraints to tip them forward and thereby produce larger angular excursions during impact. The Test Summary, section 5.1, indicated which restraints were evaluated in this manner, the amount of initial tipping, the resulting maximum angle, and the effect on ejection.
3.4 **Restraint Systems**

Three of each of the following infant restraints were obtained through retail outlets and used for this test program:

1. Peterson Safety Shell, Model 75 (with insert for frontal installation)
2. Strolee Wee Care Car Seat 5975
3. Kantwet Care Seat, Model 42988
4. Romer Baby-Swinger Car Bed
5. GM Infant Love Seat
6. Bunny Bear Sweetheart II Car Seat, Model 70R
4.0 DISCUSSION

4.1 Dummy Inspection

The teardown of the used HSRI infant dummy confirmed the previously observed joint deterioration findings of Humanoid Systems. The leather neck structure had lost its initial stiffness resulting in excessive looseness of the dummy head. Similar effects were noted in the limb joints along with deformation of the joint stops.

4.2 Revised Dummy

The modified dummy supplied by Humanoid Systems was primarily intended to solve the joint problem, although a teardown at HSRI to inspect the revisions was not performed.

The first modified dummy received was under the specified minimum weight limits. At the direction of the contract monitor, the stitching on the dummy back was opened and lead sheeting inserted to bring the dummy weight into specification. This additional ballast was added in a symmetrical manner that would not change the c.g. of the thorax. Later in the testing a second modified dummy was received from Humanoid Systems properly ballasted and was used for the last six tests.

4.3 Dummy Response

The only observable response difference between the used and modified dummies was greater head excursions with the used dummy attributable to the weakened neck structure. This neck elongation did not cause the head target to fall outside the specified limits with respect to the restraint in any of the tests, but potentially could prevent certification of a borderline restraint system.
4.4 Restraint Performance

While actual certification was not the intent of this program, it should be noted that two of the restraint systems, the Bunny Bear and Strolee, greatly exceeded the proposed 60° maximum angular excursion of the seatback surface, and the Kantwet restraint marginally exceeded the same 60° angular excursion requirement. Also, the frame tubes of the Strolee would consistently jump out of the locked configuration during impact, and the Bunny Bear seat frame bent somewhat during impact in tests 79K413 and 79K414.

The lowest restraint seatback angular excursion producing occupant ejection was 79.5° for the GM Infant Love Seat in test 79K409 which had an additional 19.5° of induced initial forward tipping. It is felt that limiting the restraint seatback angular excursion to 70° or less will effectively prevent ejection conditions.

It was also noted that restraints which utilized a low attachment point for the vehicle lap belt tended to have larger angular excursions as a result of the tipping moment exerted by the restraint/dummy system center of gravity.
5.0 RESULTS

5.1 Test Summary

Table 1 is a matrix listing the impact tests performed, the test conditions, and the test results.
### 5.1 Test Summary

#### INFANT DUMMY TEST PROGRAM

<table>
<thead>
<tr>
<th>TEST</th>
<th>SEAT</th>
<th>POSITION</th>
<th>DUMMY</th>
<th>SEATTRACK INITIAL ANGLE</th>
<th>MAX. ANGLE</th>
<th>INITIAL TIPPING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>79K400</td>
<td>Peterson (new)</td>
<td>75</td>
<td>Center</td>
<td>New</td>
<td>Front Facing</td>
<td>N.A.</td>
<td>--</td>
</tr>
<tr>
<td>79K401</td>
<td>Peterson (new)</td>
<td>75</td>
<td>Center</td>
<td>Old</td>
<td>Front Facing</td>
<td>N.A.</td>
<td>--</td>
</tr>
<tr>
<td>79K402</td>
<td>Strolee (new)</td>
<td>5975</td>
<td>Center</td>
<td>New</td>
<td>50°</td>
<td>84.5°</td>
<td>None</td>
</tr>
<tr>
<td>79K403</td>
<td>Strolee (new)</td>
<td>5975</td>
<td>Center</td>
<td>Old</td>
<td>50°</td>
<td>77°</td>
<td>None</td>
</tr>
<tr>
<td>79K404</td>
<td>Kantwet (new)</td>
<td>988</td>
<td>Center</td>
<td>New</td>
<td>40°</td>
<td>57°</td>
<td>None</td>
</tr>
<tr>
<td>79K405</td>
<td>Kantwet (new)</td>
<td>988</td>
<td>Center</td>
<td>Old</td>
<td>40°</td>
<td>60°</td>
<td>None</td>
</tr>
<tr>
<td>79K408</td>
<td>GM Infant (new)</td>
<td>Center</td>
<td>New</td>
<td>41.5°</td>
<td>67.5°</td>
<td>6.5°</td>
<td>Dummy ejected.</td>
</tr>
<tr>
<td>79K409</td>
<td>GM Infant (new)</td>
<td>Center</td>
<td>Old</td>
<td>54.5°</td>
<td>79.5°</td>
<td>19.5°</td>
<td>Dummy ejected on rebound.</td>
</tr>
<tr>
<td>79K410</td>
<td>Peterson (used)</td>
<td>75</td>
<td>Driver</td>
<td>Old</td>
<td>Front Facing</td>
<td>N.A.</td>
<td>None</td>
</tr>
<tr>
<td>79K410</td>
<td>Peterson (new)</td>
<td>75</td>
<td>Passenger</td>
<td>New</td>
<td>Front Facing</td>
<td>N.A.</td>
<td>None</td>
</tr>
<tr>
<td>79K411</td>
<td>Strolee (used)</td>
<td>5975</td>
<td>Driver</td>
<td>Old</td>
<td>36°</td>
<td>--</td>
<td>None</td>
</tr>
<tr>
<td>79K411</td>
<td>Strolee (new)</td>
<td>5975</td>
<td>Passenger</td>
<td>New</td>
<td>36°</td>
<td>87°</td>
<td>None</td>
</tr>
<tr>
<td>79K412</td>
<td>Kantwet (used)</td>
<td>988</td>
<td>Driver</td>
<td>Old</td>
<td>40°</td>
<td>--</td>
<td>None</td>
</tr>
<tr>
<td>79K412</td>
<td>Kantwet (new)</td>
<td>988</td>
<td>Passenger</td>
<td>New</td>
<td>40°</td>
<td>64°</td>
<td>None</td>
</tr>
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</table>
**INFANT DUMMY TEST PROGRAM (cont'd.)**

<table>
<thead>
<tr>
<th>TEST</th>
<th>SEAT</th>
<th>POSITION</th>
<th>DUMMY</th>
<th>SEATBACK INITIAL ANGLE</th>
<th>MAX. ANGLE</th>
<th>INITIAL TIPPING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>79K413</td>
<td>Bunny Bear (new)</td>
<td>Center</td>
<td>New</td>
<td>38°</td>
<td>128.5°</td>
<td>None</td>
<td>Seat rotated about lap belt.</td>
</tr>
<tr>
<td>79K414</td>
<td>Bunny Bear (new)</td>
<td>Center</td>
<td>Old</td>
<td>38°</td>
<td>122°</td>
<td>None</td>
<td>Seat rotated about lap belt.</td>
</tr>
<tr>
<td>79K415</td>
<td>Kant wet</td>
<td>Driver</td>
<td>Old</td>
<td>60°</td>
<td>--</td>
<td>20°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(used)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kant wet</td>
<td>Passenger</td>
<td>New</td>
<td>45°</td>
<td>60°</td>
<td>10°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(used)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79K416</td>
<td>Kant wet</td>
<td>Driver</td>
<td>Old</td>
<td>80°</td>
<td>--</td>
<td>40°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(used)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kant wet</td>
<td>Passenger</td>
<td>New</td>
<td>63°</td>
<td>64°</td>
<td>30°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(used)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79K417</td>
<td>Strolee</td>
<td>Driver</td>
<td>Old</td>
<td>70°</td>
<td>--</td>
<td>20°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(used)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strolee</td>
<td>Passenger</td>
<td>New</td>
<td>68.5°</td>
<td>116°</td>
<td>10°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(used)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79K418</td>
<td>Bunny Bear</td>
<td>Driver</td>
<td>Old</td>
<td>58°</td>
<td>--</td>
<td>20°</td>
<td>Dummy partially ejected.</td>
</tr>
<tr>
<td></td>
<td>(used)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79K419</td>
<td>Bunny Bear</td>
<td>Passenger</td>
<td>New</td>
<td>48°</td>
<td>143°</td>
<td>10°</td>
<td>Dummy ejected.</td>
</tr>
<tr>
<td></td>
<td>(new)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79K420</td>
<td>Peterson</td>
<td>Center</td>
<td>New</td>
<td>60°</td>
<td>116°</td>
<td>35°</td>
<td>Dummy ejected.</td>
</tr>
<tr>
<td></td>
<td>(used)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*New dummy, correctly ballasted by Humanoid Systems
5.2 Test Data

The data for each test is arranged in the following sequence:

a. Test Description Page
b. Test Setup Photograph
c. Graphcheck Sequence Photograph
d. Post-Test Photograph(s)
e. Instrumentation Output Signals
f. High-Speed Movie Motion Analysis

The high-speed film analysis traces the kinematics of the most forward, upper portion of the restraint and the seatback angle, and also indicates the dummy head whenever it becomes visible. The side camera view was used to obtain this information. When two restraints and dummies were involved in a single test, the motions of both are depicted on the same motion analysis tracing.
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K400</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>Peterson 75</td>
</tr>
<tr>
<td>DUMMY</td>
<td>New (Ballasted)</td>
</tr>
<tr>
<td>RESTRAINT TEST POSITION</td>
<td>Center</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>Front Facing</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

COMMENTS:
Pre-Test: Peterson 75 Restraint
Peterson 75 Restraint
Post-Test: Peterson 75 Restraint
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K400
SLED VELOCITY: 29.4 MPH

DUMMY: NEW (ballasted)

RESTRAINT: PETERSON (new)

TEST CONDITION: FRONT FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
TEST 79K400

Peterson 75 Restraint Side Profile

Dummy Head

Dummy Head Target

MAXIMUM HEAD EXCURSION 25.3"

'NUMBERS DENOTE TIME IN 'SEC.

1 FOOT
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K401</th>
</tr>
</thead>
<tbody>
<tr>
<td>RERAINT</td>
<td>Peterson 75</td>
</tr>
<tr>
<td>DUMMY</td>
<td>Old</td>
</tr>
<tr>
<td>RERAINT TEST POSITION</td>
<td>Center</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>Front Facing</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

**COMMENTS:** The dummy was ejected during sled braking after impact.
Pre-Test: Peterson 75 Restraint
Peterson 75 Restraint
Post-Test: Peterson 75 Restraint
Post Test: Peterson 75 Restraint
SLED TEST RESULTS

6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K401  SLED VELOCITY: 30.4 MPH

DUMMY: OLD

RERAINT: PETERSON (new)

TEST CONDITION: FRONT FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
TEST 79K401

Peterson 75
Restraint Side Profile

Dummy Head

Dummy Head Target

- NUMBERS DENOTE TIME IN MSEC.

MAXIMUM HEAD EXCURSION 27.8

1 FOOT

25
| COMMENTS: | The seatback elevation support jumped out of adjustment. |

| TEST NUMBER | 79K402 |
| RERAINT     | Strolee 5975 |
| DUMMY       | New (Ballasted) |
| RESTRAINT TEST POSITION | Center |
| INITIAL TIPPING | None |
| MAXIMUM ANGLE | 84.5° |
Pre-Test: Strolee 5975 Restraint
Post-Test: Strolee 5975 Restraint
Strolee 5975 Post-Test Photograph Showing Dislodged Seat Adjustment
SLED TEST RESULTS

6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K402  SLED VELOCITY: 29.4 MPH

DUMMY: NEW (ballasted)

RESTRAINT: STROLEE (new) 5975

TEST CONDITION: REAR FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
"NUMBERS DENOTE TIME IN MSEC."
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K403</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>Strolee 5975</td>
</tr>
<tr>
<td>DUMMY</td>
<td>Old</td>
</tr>
<tr>
<td>RESTRAINT TEST</td>
<td>Center</td>
</tr>
<tr>
<td>POSITION</td>
<td></td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>None</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>77°</td>
</tr>
</tbody>
</table>

**COMMENTS:** The seatback elevation support jumped out of adjustment.
Pre-Test: Strolee 5975 Restraint
Pre-Test: Strolee 5975 Restraint
Strolee 5975 Restraint
Post-Test: Strolee 5975 Restraint a) Support Dislodged
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K403
SLED VELOCITY: 29.5 MPH

DUMMY: OLD

RESTRAINT: STROLEE (new) 5975

TEST CONDITION: REAR FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
TEST 79K403

Strolee 5973
Restraint Side Profile

0°
20
30
40
50
60
70
80
90
100

- 30° REF. LINE

"NUMBERS DENOTE TIME IN MSEC.

1 FOOT

39
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K404</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>Kantwet 988</td>
</tr>
<tr>
<td>DUMMY</td>
<td>New (Ballasted)</td>
</tr>
<tr>
<td>RESTRAINT TEST POSITION</td>
<td>Center</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>None</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>57°</td>
</tr>
</tbody>
</table>

COMMENTS:
Pre-Test: Kantwet 988 Restraint
Pre-Test: Kantwet 988 Restraint
Post-Test: Kantwet 988 Restraint
CLASS 60
FILTERED CHANNEL
10 IN. / DIVISION
CENTER POSITION
LT. BELT LOAD

CLASS 60
FILTERED CHANNEL
20 IN. / DIVISION
CENTER POSITION
RT. BELT LOAD

CLASS 60
FILTERED CHANNEL
1.0 IN. / DIVISION
SLED PULSE

TEST CONDITION: REAR FACINGS

RESTRRAIN: XKREST (new)
DUMMY: NEW (8914346)

SLED VELOCITY: 29.6 MPH

TEST NO.: 794494

6-MONTH OLD INFRARED DUMMY

SLED TEST RESULTS
TEST 79K404

Kantwet 988 Restraint Side Profile

Seat Targets Marking Seat Back Angle

0 20 30 40 50 60 70 80

Maximum Excursion

30" REF. LINE

1 FOOT

*NUMBERS DENOTE TIME IN MSEC.
<table>
<thead>
<tr>
<th><strong>TEST NUMBER</strong></th>
<th>79K405</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESTRAINT</strong></td>
<td>Kantwe 988</td>
</tr>
<tr>
<td><strong>DUMMY</strong></td>
<td>Old</td>
</tr>
<tr>
<td><strong>RESTRAINT TEST POSITION</strong></td>
<td>Center</td>
</tr>
<tr>
<td><strong>INITIAL TIPPING</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>MAXIMUM ANGLE</strong></td>
<td>60°</td>
</tr>
</tbody>
</table>

**COMMENTS:**
Pre-Test: Kantwet 983 Restraint
Post-Test: Kantwet 988 Restraint
SLED TEST RESULTS

6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K405
SLED VELOCITY: 29.8 MPH

DUMMY: OLD

RESTRAINT: KANTWET (new)

TEST CONDITION: REAR FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
TEST 79K405

Kantwet 988
Restraint Side Profile

0°
20°
30°
40°
50°
60°
70°
80°

30° REF. LINE

1 FOOT

MINDERS REPRE. TIME IN USEC.
<table>
<thead>
<tr>
<th><strong>TEST NUMBER</strong></th>
<th>79K406</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESTRAINT</strong></td>
<td>Romer</td>
</tr>
<tr>
<td><strong>DUMMY</strong></td>
<td>New (Ballasted)</td>
</tr>
<tr>
<td><strong>RESTRAINT TEST POSITION</strong></td>
<td>Center</td>
</tr>
<tr>
<td><strong>INITIAL TIPPING</strong></td>
<td>Side Facing</td>
</tr>
<tr>
<td><strong>MAXIMUM ANGLE</strong></td>
<td>Not Available</td>
</tr>
</tbody>
</table>

**COMMENTS:** Restraint zipper tore and shell of restraint cracked.
Pre-Test: Romer Car Bed
Pre-Test: Romer Car Bed
Post-Test: Romer Car Bed
Romer Post-Test Photograph Showing Zipper Tear
Romer Post-Test Photograph Showing Crack in Outer Shell
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K406  SLED VELOCITY: 29.9 MPH

DUMMY: NEW (ballasted)

RESTRRAINT: ROMER

TEST CONDITION: SIDE FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST NUMBER</td>
<td>79K407</td>
</tr>
<tr>
<td>RESTRAINT</td>
<td>Romer</td>
</tr>
<tr>
<td>DUMMY</td>
<td>Old</td>
</tr>
<tr>
<td>RESTRAINT TEST POSITION</td>
<td>Center</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>Side Facing</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

**COMMENTS:** Zipper in restraint tore completely loose and attaching belt broke.
Pre-Test: Romer Car Bed
Pre-Test: Romer Car Bed
Post-Test: Romer Car Bed
Romer Car Bed Belt Failure
Roman Car Bed Held Sideways. Showing the effect of zipper tear.
SLED TEST RESULTS

6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K407
SLED VELOCITY: 30.0 MPH

DUMMY: OLD
RESTRANIT: ROMER
TEST CONDITION: SIDE FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K40R</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>GM Infant</td>
</tr>
<tr>
<td>DUMMY</td>
<td>New (Ballasted)</td>
</tr>
<tr>
<td>RERAINT TEST POSITION</td>
<td>Center</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>6.5°</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>67.5°</td>
</tr>
</tbody>
</table>

COMMENTS: -
Pre-Test: GM Infant Love Seat
Pre-Test: GM Infant Love Seat
Post-Test: GM Infant Love Seat
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K408
SLED VELOCITY: 30.3 MPH

DUMMY: NEW (ballasted)

RESTRAINT: GM INFANT (new)

TEST CONDITION: REAR FACING (6.5° INCR. INITIAL ANGLE)

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
TEST 79K408

0°

20°

30°

40°

50°

60°

70°

80°

30° REF. LINE

0° INFANT RESTRAINT SIDE PROFILE

*NUMBERS DENOTE TIME IN MS.*

1 FOOT
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K409</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>GM Infant</td>
</tr>
<tr>
<td>DUMMY</td>
<td>Old</td>
</tr>
<tr>
<td>RERAINT TEST POSITION</td>
<td>Center</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>19.5°</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>79.5°</td>
</tr>
</tbody>
</table>

**COMMENTS:** Dummy would have been ejected during impact except for snagging of tape on its leg with the restraint harness.
Pre-Test: GM Infant Love Seat

79
Pre-Test: GM Infant Love Seat
GM Infant Love Seat
GM Infant Love Seat: Post-Test Photograph Showing Tape on Leg Catching on Seat Belt
Post Test: GM Infant Love Seat
SLED TEST RESULTS

6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K409
SLED VELOCITY: 29.7 MPH

DUMMY: OLD

RESTRRAINT: GM INFANT (new)

TEST CONDITION: REAR FACING (19.5° INCR. INITIAL ANGLE)

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

84
TEST 79K409

GM Infant Restraint Side Profile

-30" REF. LINE

**NUMBERS DENOTE TIME IN MSEC.**

1 FOOT
TEST NUMBER: 79K410
RESTRAINT: Peterson
DUMMY: D - Old, P - New
RESTRANIT TEST POSITION: Driver, Passenger
INITIAL TIPPING: Front Facing, Front Facing
MAXIMUM ANGLE: Not Available

COMMENTS: The old dummy (driver's side) was ejected as the sled rebounded.
Pre-Test: Peterson 75 Restraints
Post-Test: Peterson 75 Restraints
Post Test: Peterson Restraints
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K 410
SLED VELOCITY: 29.5 MPH

DUddy:
NEW (ballasted)
NEW

RESTRAINT:
PETERSON (used)
PETERSON (used)

TEST CONDITION:
FRONT FACING
FRONT FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
PASSenger SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
PASSenger SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

BRUSH AC

RT. BELT LOAD
DRIVER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
DRIVER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
TEST 79K410

Right Peterson 75 Restraint Side Profile

30L

Right Dummy Head

40L

Left Dummy Head

50L

Right Dummy Head Target

0° 10 20 30 40 50 65

MAXIMUM RIGHT HEAD EXCURSION 25°

MAX. LEFT HEAD EXCURSION 28.2°

*NUMBERS DENOTE TIME IN MSEC.

1 FOOT

92
TEST NUMBER 79K411
RESTRAINT Strolee 5975
DUMMY D - Old, P - New
RESTRAINT TEST POSITION Driver, Passenger
INITIAL TIPPING None, None
MAXIMUM ANGLE N.A., 87°

COMMENTS: Both of the seatback elevation supports jumped out of adjustment.
Pre-Test: Strolee 5975 Restraints
TEST 79K411

"NUMBERS DENOTE TIME IN MSEC."
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K412</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>Kantwet</td>
</tr>
<tr>
<td>DUMMY</td>
<td>D - Old, P - New</td>
</tr>
<tr>
<td>RESTRAINT TEST POSITION</td>
<td>Driver, Passenger</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>None, None</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>N.A., 64°</td>
</tr>
</tbody>
</table>

COMMENTS:
Pre-Test: Kantwet 988 Restraints
Post-Test: Kantwet 988 Restraints
TEST 79K412

*NUMBERS DENOTE TIME IN MSEC.

1 FOOT
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K413</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>Bunny Bear</td>
</tr>
<tr>
<td>DUMMY</td>
<td>New (Ballasted)</td>
</tr>
<tr>
<td>RERAINT TEST POSITION</td>
<td>Center</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>None</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>128.5°</td>
</tr>
</tbody>
</table>

**COMMENTS:** One of restraint tubes bent.
Post-Test: Bunny Bear Model 70R Restraint
Post-Test: Bunny Bear Model 70R Restraint
Bunny Bear Restraint: Post-Test Showing Bent Frame
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K413
SLED VELOCITY: 30.3 MPH

DUMMY: NEW (ballasted)
RESTRAYNT: BUNNY BEAR (new)
TEST CONDITION: REAR FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
TEST NUMBER 79K414
RERAINT Bunny Bear
DUMMY Old
RERAINT TEST POSITION Center
INITIAL TIPPING None
MAXIMUM ANGLE 122°

COMMENTS: One of restraint tubes bent slightly.
Pre-Test: Bunny Bear Model 70R Restraint

114
Pre-Test: Bunny Bear Model 70R Restraint
Bunny Bear Model 70R Restraint

79K414
Post-Test: Bunny Bear Model 79R Restraint
Post-Test: Bunny Bear Model 70R Restraint

118
Bunny Bear Model 70R: Post-Test Showing Bent Support
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K414
SLED VELOCITY: 30.2 MPH

DUMMY: OLD

RESTRAINT: BUNNY BEAR (new)

TEST CONDITION: REAR FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K415</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>Kantwet</td>
</tr>
<tr>
<td>DUMMY</td>
<td>D - Old, P - New</td>
</tr>
<tr>
<td>RERAINT TEST POSITION</td>
<td>Driver, Passenger</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>20°, 10°</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>N.A., 60°</td>
</tr>
</tbody>
</table>

**COMMENTS:**
Pre-Test: Kantwet 988 Restraints
Pre-Test: Kantwet 988 Restraints
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K 415
SLED VELOCITY: 30.3 MPH

DUMMY:

PASSENGER SIDE
NEW

DRIVER SIDE
OLD

RERAINT:
KANTWET (used)
KANTWET (used)

TEST CONDITION:
5° INCR. INITIAL ANGLE
20° INCR. INITIAL ANGLE

REAR FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
PASSENGER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
PASSENGER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
DRIVER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
DRIVER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60
TEST 79K415

Right Kantwet 988 Restraint Side Profile

0° 20 30 40 50 60 70 75

30" REF. LINE

1 FOOT

*NUMBERS DENOTE TIME IN MSEC.

128
<table>
<thead>
<tr>
<th><strong>TEST NUMBER</strong></th>
<th>79K416</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RERAINT</strong></td>
<td>Kantwet</td>
</tr>
<tr>
<td><strong>DUMMY</strong></td>
<td>D - Old, P - New</td>
</tr>
<tr>
<td><strong>RESTRAINT TEST POSITION</strong></td>
<td>Driver, Passenger</td>
</tr>
<tr>
<td><strong>INITIAL TIPPING</strong></td>
<td>40°, 30°</td>
</tr>
<tr>
<td><strong>MAXIMUM ANGLE</strong></td>
<td>N.A., 64°</td>
</tr>
</tbody>
</table>

**COMMENTS:**
Pre-Test: Kantwet 988 Restraints.
Pre-Test: Kantwet 988 Restraints
Kantwet 988 Restraints
Post-Test: Kantwet 988 Restraints
Post-Test: Kantwet 988 Restraints
<table>
<thead>
<tr>
<th></th>
<th>PASSENGER SIDE</th>
<th>DRIVER SIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TEST NO.</strong></td>
<td>79K415</td>
<td></td>
</tr>
<tr>
<td><strong>SLED VELOCITY</strong></td>
<td>30.2 MPH</td>
<td></td>
</tr>
<tr>
<td><strong>DUMMY:</strong></td>
<td>NEW</td>
<td>OLD</td>
</tr>
<tr>
<td><strong>RERAINT:</strong></td>
<td>KANTWET (used)</td>
<td>KANTWET (used)</td>
</tr>
<tr>
<td><strong>TEST CONDITION:</strong></td>
<td>23° INCR. INITIAL ANGLE</td>
<td>40° INCR. INITIAL ANGLE</td>
</tr>
<tr>
<td><strong>SLED PULSE</strong></td>
<td>1.0 G/DIVISION</td>
<td></td>
</tr>
<tr>
<td><strong>FILTERED CHANNEL</strong></td>
<td>CLASS 60</td>
<td></td>
</tr>
<tr>
<td><strong>RT. BELT LOAD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PASSenger SIDE</strong></td>
<td>20 LB./DIVISION</td>
<td></td>
</tr>
<tr>
<td><strong>FILTERED CHANNEL</strong></td>
<td>CLASS 60</td>
<td></td>
</tr>
<tr>
<td><strong>RT. BELT LOAD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Driver SIDE</strong></td>
<td>20 LB./DIVISION</td>
<td></td>
</tr>
<tr>
<td><strong>FILTERED CHANNEL</strong></td>
<td>CLASS 60</td>
<td></td>
</tr>
<tr>
<td><strong>LT. BELT LOAD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Passenger SIDE</strong></td>
<td>20 LB./DIVISION</td>
<td></td>
</tr>
<tr>
<td><strong>FILTERED CHANNEL</strong></td>
<td>CLASS 60</td>
<td></td>
</tr>
<tr>
<td><strong>RT. BELT LOAD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Driver SIDE</strong></td>
<td>20 LB./DIVISION</td>
<td></td>
</tr>
<tr>
<td><strong>FILTERED CHANNEL</strong></td>
<td>CLASS 60</td>
<td></td>
</tr>
<tr>
<td><strong>LT. BELT LOAD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Driver SIDE</strong></td>
<td>20 LB./DIVISION</td>
<td></td>
</tr>
<tr>
<td><strong>FILTERED CHANNEL</strong></td>
<td>CLASS 60</td>
<td></td>
</tr>
</tbody>
</table>
TEST 79K416

Right Kantew 388
Restraint Side Profile

-30" REF. LINE

1 FOOT

*NUMBERS DENOTE TIME IN "SEC.*
TEST NUMBER: 79K417
RESTRAINT: Strolee
DUMMY: D - Old, P - New
RESTRAINT TEST POSITION: Driver, Passenger
INITIAL TIPPING: 20°, 10°
MAXIMUM ANGLE: N.A., 116°

COMMENTS:
Pre-Test: Strolee 5975 Restraints
79K417

Strolee 5975 Restraints
Post-Test: Strolee 5975 Restraints
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K 417  SLED VELOCITY: 29.2 MPH

DUddy:               PASSENGER SIDE        DRIVER SIDE
NEW                 OLD
RESTRAINT:          STROLEE (used)       STROLEE (used)
TEST CONDITION:    19° INCR. INITIAL ANGLE  20° INCR. INITIAL ANGLE
REAR FACING

SLED PULSE: 1.0 G/DIVISION
FILTERED CHANNEL CLASS 60

RT. BELT LOAD
PASSENGER SIDE
20 LB./DIVISION
FILTERED CHANNEL CLASS 60

LT. BELT LOAD
PASSENGER SIDE
20 LB./DIVISION
FILTERED CHANNEL CLASS 60

RT. BELT LOAD
DRIVER SIDE
20 LB./DIVISION
FILTERED CHANNEL CLASS 60

LT. BELT LOAD
DRIVER SIDE
20 LB./DIVISION
FILTERED CHANNEL CLASS 60
TEST 79K417

Right Strolee 5975
Restraint Side Profile

30° REF. LINE

Left Dummy Head

50

60

60

75

75

75

60

50

40

30

20

0°

*NUMBERS DENOTE TIME IN MSEC.*

1 FOOT
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K418</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>Bunny Bear</td>
</tr>
<tr>
<td>DUMMY</td>
<td>D - Old, P - New</td>
</tr>
<tr>
<td>RESTRAINT TEST POSITION</td>
<td>Driver, Passenger</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>20°, 10°</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>N.A., 143°</td>
</tr>
</tbody>
</table>

**COMMENTS:** The new dummy (passenger's side) was ejected and the old dummy (driver's side) was partially ejected.
Pre-Test: Bunny Bear Model 70R Restraints
Pre-Test: Bunny Bear Model 70R Restraints

146
Bunny Bear Model 70R Restraints
Post-Test: Bunny Bear Model 70R Restraints
Post-Test: Bunny Bear Model 70R Restraints
SLED TEST RESULTS

6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K 418
SLED VELOCITY: 29.4 MPH

DUMMY:
NEW

RESTRANST:
BUNNY BEAR (new)

TEST CONDITION:
10° INCR. INITIAL ANGLE

REAR FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
PASSENGER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
PASSENGER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
DRIVER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
DRIVER SIDE
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

150
TEST 79K418

- Right Bunny Bear Restraint Side Profile
- Left Dummy Head
- Right Dummy Head

30° REF. LINE
1 FOOT
120 - 150
100
90
80
70
60
50
40
30
20

NUMBERS DENOTE TIME IN MSEC.
<table>
<thead>
<tr>
<th><strong>TEST NUMBER</strong></th>
<th>79K419</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RERAINT</strong></td>
<td>Peterson</td>
</tr>
<tr>
<td><strong>DUMMY</strong></td>
<td>New</td>
</tr>
<tr>
<td><strong>RESTRAINT TEST POSITION</strong></td>
<td>Center</td>
</tr>
<tr>
<td><strong>INITIAL TIPPING</strong></td>
<td>35°</td>
</tr>
<tr>
<td><strong>MAXIMUM ANGLE</strong></td>
<td>116°</td>
</tr>
</tbody>
</table>

**COMMENTS:**
Pre-Test: Peterson 75 Restraint
Pre-Test: Peterson 75 Restraint
Post-Test: Peterson 75 Restraint
Post-Test: Peterson 75 Restraint
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K419 SLED VELOCITY: 23.5 MPH

DUMMY: NEW

RESTRAINT: PETERTON (used)

TEST CONDITION: REAR FACING (35° INCR. INITIAL ANGLE)
<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>79K420</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRAINT</td>
<td>Bunny Bear</td>
</tr>
<tr>
<td>DUMMY</td>
<td>New</td>
</tr>
<tr>
<td>RERAINT TEST POSITION</td>
<td>Center</td>
</tr>
<tr>
<td>INITIAL TIPPING</td>
<td>Side Facing</td>
</tr>
<tr>
<td>MAXIMUM ANGLE</td>
<td>N.A.</td>
</tr>
</tbody>
</table>

COMMENTS: The dummy was ejected.
Pre-Test: Bunny Bear Model 70R Restraint
Pre-Test: Bunny Bear Restraint
Post-Test: Bunny Bear Model 70R Restraint
SLED TEST RESULTS
6-MONTH-OLD-INFANT DUMMY

TEST NO.: 79K420
SLED VELOCITY: 29.7 MPH

DUMMY: NEW
RESTRAINT: BUNNY BEAR (used)
TEST CONDITION: SIDE FACING

SLED PULSE
1.0 G/DIVISION
FILTERED CHANNEL
CLASS 60

RT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60

LT. BELT LOAD
CENTER POSITION
20 LB./DIVISION
FILTERED CHANNEL
CLASS 60