Ten-Year-Old Child Test Dummy

Hybrid III Type
Problem

- Current 213 covers children up to 6-y-o and 208 starts with small females
- Unaddressed - a large population segment (approx. 10%) between 6-y-o and children approximating the size of small female
- Too big for CRS and borderline for adult restraints
- Laws require use of belts or CRS
- Also exposed to air bags and as pedestrians
- Test tool is needed to evaluate and certify adequacy of available protection systems
### Height and Weight of U.S. Population and Comparable Dummies

<table>
<thead>
<tr>
<th></th>
<th>Standing Height (ft in)</th>
<th>Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H-III</td>
<td>Human</td>
</tr>
<tr>
<td>5th Female 5th Female</td>
<td>4'11&quot;</td>
<td>4’9”/4’11”/5’1”</td>
</tr>
<tr>
<td>10 year-old</td>
<td>?</td>
<td>4’2”/4’6”/4’9”</td>
</tr>
<tr>
<td>6 year-old</td>
<td>3'9&quot;</td>
<td>3’7”/3’11”/4’3”</td>
</tr>
</tbody>
</table>

Female
Concept Definition

- SAE DFTG was asked in early 2000 to develop a 10-year-old
- DFTG accepted the task
- Weight and Height of 10-year-old provided from CDC Data Bank
- DFTG meeting in May 2000 met to define the concept
CDC Children Growth Charts
Concept Design Targets

• Dummy Height – 54 in (4’6”)
• Dummy Weight – 72 lbs
• Postures
  – Erect seated
  – Slouched seated
  – Standing
  – Kneeling
• Basic Construction – Similar to Small Female
Sitting Postures: erect, normal, and slouched
Dummy Development

- DFTG Held first review meeting in June, 2000
- Reviewed impact responses scaled from small female and 6-year-old
- Provisional performance requirements defined
- Anthropometry and mass goals finalized
- Engineering and prototype build:
  - Upper Body: FTSS
  - Lower Body: Denton ATD
- Prototype completion target – Christmas 2000
General Construction

- Head (Small Female)
  - Aluminum Skull Casting
  - Vinyl Skin
- Neck
  - Flexible multiple disc molded rubber
  - Center cable
  - Mounted on adjustable lower bracket to accommodate different postures
Construction

• Upper Torso
  – Steel spine and six damped ribs
  – Combined clavicle and scapula
  – Sloped aluminum shoulder
  – Aluminum/nylon sternum and urethane bib
  – Rib-guides to control vertical rib motion
  – Vinyl torso jacket with improved low friction surface finish
Construction

- Lower Torso
  - Lumbar spine (rubber cylinder) with center cable
  - Adjustable lumbar bracket to accommodate different postures
  - Pelvic bone – aluminum casting
  - Pelvis skin- vinyl over urethane foam
  - Pelvis is formed for semi-slouched seated posture
Construction

- Arms – Upper and Lower
  - Steel skeleton
  - Vinyl skin over urethane foam
  - Hands vinyl skin over steel shank
  - Wrist, elbow - hinge joints

- Legs – Upper and Lower
  - Steel skeleton
  - Vinyl skin over urethane foam
  - Feet – vinyl skin over steel skeleton
  - Ankle – ball joint; knee - hinge joint
Instrumentation

- Head
  - Triax accelerometers
  - Tilt sensors (optional)
- Neck
  - Six axis upper load cell
  - Six axis lower load cell (optional)
- Shoulder
  - Two axis belt load cell (optional)
Instrumentation

- Thorax
  - Triax accelerometer pack
  - Mid sternum rotary potentiometer
  - Two spine accelerometers (optional)
  - Two accelerometers on the sternum (optional)
  - Two IR-TRACCS deflection sensors (optional)
Instrumentation

- Pelvis
  - Lumbar - six channels load cell (optional)
  - Triax accelerometer pack (optional)
  - Biaxial A.S.I.S load cells (optional)
- Femur
  - Uni-axial load cell
- Tibia
  - Five-axis load cell (optional)
## Typical Dimensions

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Design Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing Height</td>
<td>54.1 in</td>
<td>52.6 in</td>
</tr>
<tr>
<td>Erect Sitting Height</td>
<td>28.3 in</td>
<td>29.2 in</td>
</tr>
<tr>
<td>Shoulder Breadth</td>
<td>12.9 in</td>
<td>12.9 in</td>
</tr>
<tr>
<td>Shoulder to Elbow</td>
<td>11.3 in</td>
<td>11.8 in</td>
</tr>
<tr>
<td>Chest Depth</td>
<td>6.1 in</td>
<td>6.5 in</td>
</tr>
<tr>
<td>Hip Width</td>
<td>10.2 in</td>
<td>10.4 in</td>
</tr>
<tr>
<td>Buttock to Knee Pivot</td>
<td>17.9 in</td>
<td>18.0 in</td>
</tr>
</tbody>
</table>
### Body Segment Target Weights

<table>
<thead>
<tr>
<th>Segment</th>
<th>Design Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Weight</td>
<td>72+ lb</td>
<td>76.00 lb</td>
</tr>
<tr>
<td>Head assembly</td>
<td>8.1 lb</td>
<td>8.07 lb</td>
</tr>
<tr>
<td>Neck assembly</td>
<td>1.4 lb</td>
<td>1.66 lb</td>
</tr>
<tr>
<td>Upper Torso</td>
<td>15.6 lb</td>
<td>17.69 lb</td>
</tr>
<tr>
<td>Lower Torso</td>
<td>21.1 lb</td>
<td>18.16 lb</td>
</tr>
<tr>
<td>Arms (both)</td>
<td>6.6 lb</td>
<td>7.02 lb</td>
</tr>
<tr>
<td>Legs (both)</td>
<td>18.7 lb</td>
<td>23.40 lb</td>
</tr>
</tbody>
</table>
The Ten Year Old Hybrid III Dummy
First Prototype
Current and Projected Status

- First prototype assembled in February 2001
- H-III DFTG review – directed design corrections
- Revised prototype assembled in April 2001
- First drawings completed: April, 2001
- Dummy performance verifications: April – May, 2001
- GM check-out and shake down tests: May – June, 2001
- Agency brief shake down tests: June – July, 2001
- Review of sufficiency: July-August, 2001
Future Plans

- Commercial availability of prototypes: July - August
- Extensive Agency evaluation: August – December, 2001
- If no problems are encountered, incorporation into Part 572 may begin around January 2002
- Projected use: evaluations of booster seats and adult restraints, exploratory use in NCAP
- Estimated uninstrumented dummy cost: $32k - $35k
- Estimated instrumentation cost: $12k - $50k