



Dummy Infoday

FTSS Dummy Models Update

April 14th,
2005

Dummy Infoday

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Presentation Outline

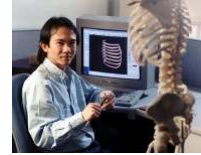
- Overview
 - Introduction to FTSS
 - Model Development Methodology
 - Future dummies and new regulations
- Frontal Impact Dummies
 - Hybrid III Adult: 50th %, 5th % and 95th %
 - Hybrid III Child: 3 yr old and 6 yr old
- Side Impact Dummies
 - SIDIIs and SIDIIsFRG
 - WorldSID50th
- Future Model Developments

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Introduction to FTSS

- Largest Crash Test Dummy Manufacturer and Crash Test Dummy Model Supplier
- Headquarters Located in Plymouth, Michigan
 - Manufacturing Plant
 - Engineering
 - Test Laboratories
- Offices in:
 - USA, Korea, Japan, China, UK, Netherlands, Germany, India, Aust'l
- Test Labs in:
 - USA, Netherlands, Germany, Japan, Korea, China
- Computer Aided Engineering
 - Plymouth, USA
 - Shanghai, China
 - Coventry, UK
 - 10 CAE Engs



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FE Model Library



- **Frontal Dummies**
 - H3-50 Male
 - H3-5 Small Female
 - H3-95 Large Male
 - H3-3 year old
 - H3-6 year old
 - H3-10 year old (Apr '05)
 - Free Motion Headform
- **Side Dummies**
 - SID-IIs
 - SIDIIIs FRG
 - WorldSID 50th
- **Future Dummies**
 - Thor-Lx (July '05)
 - Q3 Child (Jan '06)

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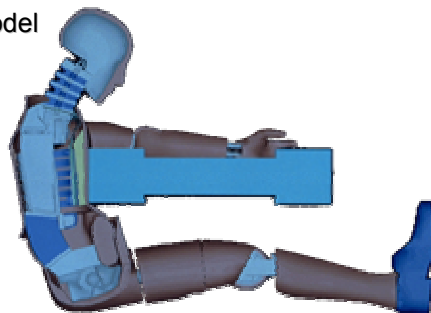
Customer Base

FTSS has over 70 customers worldwide with over 250 users, using the finite element models as a core part of the vehicle design and development process

- GM
- DCX
- Ford
- Toyota
- Mazda
- Daihatsu
- Honda
- Isuzu
- Nissan
- Hyundai
- BMW
- Audi
- VW
- TRW
- Autoliv
- Delphi
- Land Rover/Jaguar
- Lotus
- Gedas
- Karmann
- Mitsubishi
- Takata
- TATA
- Suzuki
- Magna Steyr
- Opel
- EDAG
- Idiada
- SAAB
- Porsche

Development and Validation Methodology

- Accurate Geometry Data
- Testing and correlation for model development
 - Material level
 - Component level
 - Sub-assembly level
- Fully dummy validation
 - Assembly level
 - Sled test level
- Robustness checks
- QA checks and Documentation



Model development

- Typical Dummy Materials

- Metals
 - Steels, Aluminium, Lead, brass
- Viscoelastic materials
 - Rubbers (several grades/durometer readings),
Vinyls (several grades), Hyperlast (several grades)
- Low Density Foam
 - Urethane (varied density), Confor foam (high and low density), Foamed Hyperlast, Brand specific foams
- Elastic behaviour
 - Polyurethane (bib, bones), Ureol (iliac wing)
- Unusual materials
 - Rib damping material (pseudo-plastic & creep), Nitinol (shape memory Nickel-Titanium alloy)

FTSS Manufacture majority of the material on-site

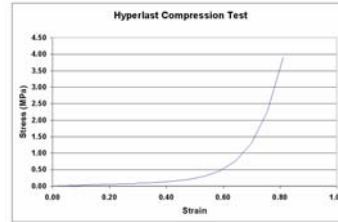
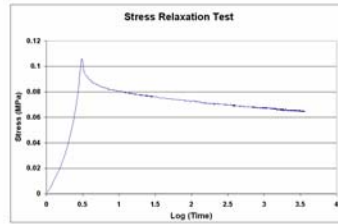
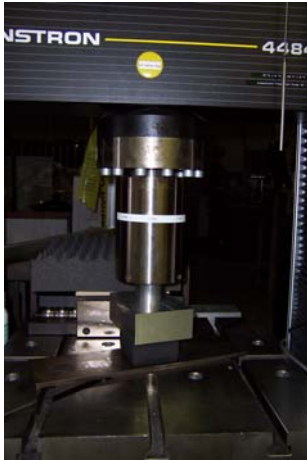


Model Development – material testing

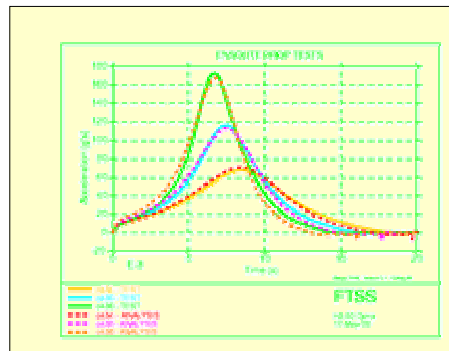
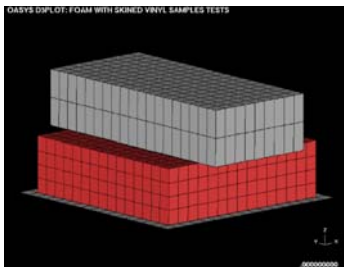
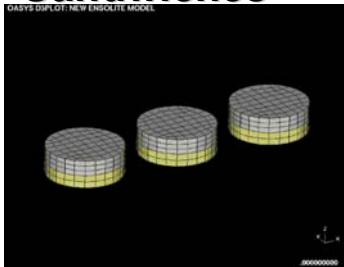
- Over 1000 materials tests have been conducted for model development by FTSS
- **Low Density Foams** – high speed **Drop Tests** at several rates (up to 90% compression) are used to develop material data for rate-dependent foams
- **Elastomers** or Viscoelastic materials – **Stress relaxation** and **compression tests** are used to develop OGDEN_RUBBER material properties and verified on component tests
- **Vinyl-foam-vinyl sandwich** structure **Drop Tests** at various speeds: pelvis, legs, arms, etc.

Elastomer Material Testing

Stress Relaxation & Compression Tests
 Test example: Hyperlast cube (3" each side)

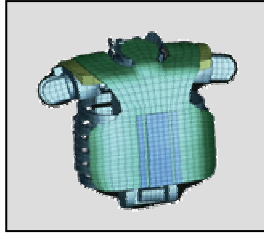


Drop Testing – Foams and Sandwiches



Model Development – geometry data

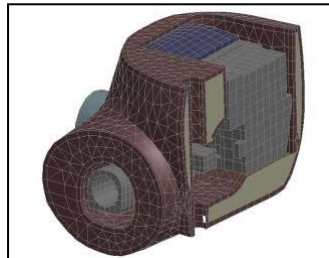
- **Accurate geometry data** – from design CAD data or drawings, or directly digitized from mould surfaces where necessary.
- The assembled model is verified to dimensions of the production crash dummy.



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 **First Technology**
Innovative Solutions

Geometry Data – SID-IIs Pelvis Flesh



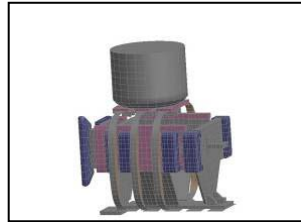
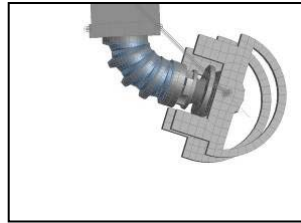
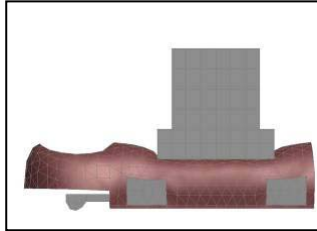
- The pelvis flesh is modeled with separated vinyl and foam to match closely the physical construction.

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 **First Technology**
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Model Development – component

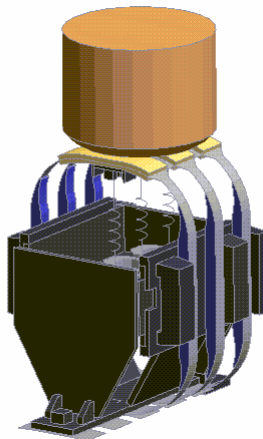
- **Component level validation**
- Each component is tested and validated using representative drop or pendulum tests at a multiple of speeds and realistic crash load cases



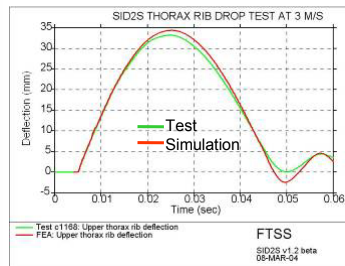
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SID-IIs rib cage validation



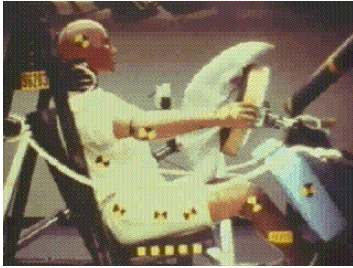
- **Thorax Development**
 - Single rib tests
 - 3-rib tests



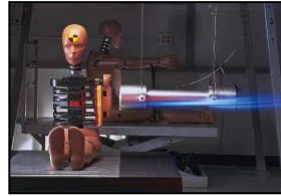
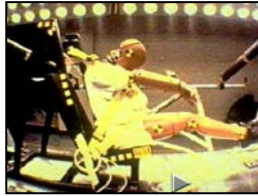
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Pendulum and Sled Testing

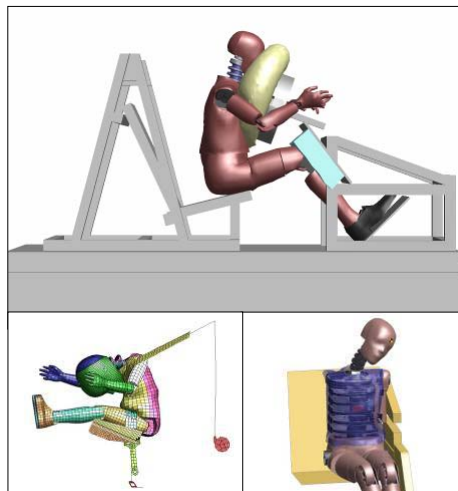


- Pendulum tests offer a controlled environment for full dummy model evaluation
- Sled tests include the complexity of different loading into the dummy
- Fully instrumented dummies used for model correlation



Assembly and sled Validation

- Check for correct assembly and joints
- Test effect on parts of the model that are not directly impacted
- Contact modelling developments
- Robustness checks



QA procedure and documentation

- ISO 9001 QA procedure for all new modeling projects starting from project planning through material testing, component validation, and whole assembly correlation.
- Dummy model release package contains the following
 - LS-Dyna input deck/s in two common unit systems
 - user manual (injury output, filters, positioning, user tips etc)
 - technical report (describing the correlation and improvements)

