The CAE Driven Safety Development Process of the new Ford Fiesta

A. Hänschke  
M. Spurling  
R. Santos

Ford Werke GmbH, Köln, Germany  
Ford Motor Company Limited, Dunton, United Kingdom  
TECOSIM Technical Simulation Ltd

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Ford Fiesta – CAE Driven Safety Process

Agenda

- The New Ford Fiesta
- Safety Requirements and Achievements
- Structural and Safety Strategy
- CAE Development Process
- Questions & Answers
Safety Requirements

European Crash Sign-off Modes – High and Low Speed

- Full Frontal Rigid Vehicle = 48.3 kph & 56 kph
- Thatcham / GDV 10deg Rigid Vehicle = 29 kph
- Side Pole Rigid Vehicle = 15 kph
- Thatcham / GDV 10deg Rigid Barrier = 15 kph
- Full Rear Rigid Barrier = 38 kph & 50 kph
- Various Adult & child head, leg-form and thigh pedestrian impacts
- 40% Offset Deformable (L&R) Vehicle = 56 kph & 64 kph
- Side Deformable Barrier = 50 kph
- Fuel Filler Rear Deformable Barrier = 80 kph
- 70% Offset Deformable (L&R) Barrier = 80 kph

Various Adult & child head, leg-form and thigh pedestrian impacts
# Safety Achievements

## Final ratings

### 5-star EuroNCAP rating

<table>
<thead>
<tr>
<th>Rating</th>
<th>Score</th>
<th>Frontal impulse</th>
<th>Seatbelt reminder</th>
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<tbody>
<tr>
<td><strong>Adult occupant</strong></td>
<td>34</td>
<td>14.9</td>
<td>2</td>
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<tr>
<td><strong>Child occupant</strong></td>
<td>38</td>
<td>13.6</td>
<td></td>
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<tr>
<td><strong>Pedestrian</strong></td>
<td>20</td>
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**Adult occupant protection**
- Frontal impact driver
- Frontal impact passenger
- Side impact driver

**Child restraints**
- 10 month old child: Britax Reemer BabySafe ISOFIX, rearward facing
- 3 year old child: Britax Reemer Duo Plus, forward facing

**Pedestrian protection**

### 1E Thatcham Insurance rating

<table>
<thead>
<tr>
<th>ADI Cars Search Results</th>
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<tbody>
<tr>
<td>All Code</td>
</tr>
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<tr>
<td>L74 DEGI</td>
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</tbody>
</table>

**Key**
- Petrol, Diesel, Electric
- Gear Box: Manual, Automatic
- Body Type: Hatchback, Estate
Safety Achievements
EuroNCAP High Speed Crash CAE Simulation Results

EuroNCAP Front Offset Impact

EuroNCAP Side Impact

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Safety Achievements
EuroNCAP High Speed Crash Films

EuroNCAP Front Offset Impact

EuroNCAP Side Impact

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Structural and Safety Strategy
High Speed Impact

- DP600 rear side rails optimised for energy absorption in 80km/h crash mode
- Safety cell for fueltank survival space and door openability post test

- Low velocity “vertical” B-Pillar intrusion profile
- Limit intrusion into the occupant cabin
- Prevent rocker panel rotation
- Transfer load through the underbody

- DP600 front rails with TWB front section to achieve an efficient crush followed by bend and counter-bend collapse strategy
- A/B Pillars hot-stamped from UHS Boron Steel

Legend:
- UHSS (≥800 MPa)
- EHSS (380-800 MPa)
- VHSS (280-380 MPa)
- HSS (180-280 MPa)
- MS (≤180 MPa)
Structural and Safety Strategy
Low Speed Impact

- Hood controlled folding to avoid damage to other parts
- Strong shotgun closing plate
- Fender bracket with integrated headlamp catcher
- Headlamp housing controlled failure
- Lower leg stiffener optimisation to avoid cooling pack damage
- Rear/Front bumper beam and crash cans fitted and optimised
Structural and Safety Strategy
Low Speed Impact

• Low Speed Impact (GDV/AZT)
CAE Development Process
“up front” CAE Support

Parametric Concept Geometry to Support early Attribute Assessments

Master Sections

Top Hat FEA-Model merged with Platform FEA-Model

5dr B-Pillar proposal and Design scan

5dr upper structure (template)
CAE Development Process
The Modular Safety CAE Approach
Fully Automated Data Mapping Tool

**MAPIT***

Projects forming CAE material properties data onto full vehicle models using mesh independent algorithms

Component thickness distribution is extracted

Component residual plastic strain distribution is extracted

The work hardening affects of Dual Phase steel are significant and must be included!

Pre-Strain and thickness distribution included into the full vehicle simulation

* MAPIT is a Ford Motor Company in-house developed software tool
Extensively engineered using CAE methodologies

- Crash simulation models have over 1,000,000 elements.
- Super computers are used to run the models, which can take 24 multi-processors over 20hrs to complete!
Questions & Answers

Thanks for listening