8th TEG FlexPLI Meeting
on 19.05.2009
Offices of TÜV Rheinland, Cologne

Summary of ACEA Tests

ACEA Comments
Content:

♦ ACEA previous and latest test series
♦ Problems related to Flex-GTα and Flex-GTR
♦ Observations of ACEA members during Round Robin Tests
♦ ACEA remarks
♦ Conclusions and recommendations
## ACEA previous test series

**When:** 2005, August  
**Who:** Tests at BASt/BGS  
**Test object:** Real world „green“ *) vehicles, modified vehicles  
**Impactor:** Flex-G, 2004 version  

**Main results:** FlexG not suitable for impact speed above 25 kph  
                 further investigation required  

**Reference:**  
TEG-004 presented on TEG kick-off meeting on 04.09.2005  

*) „green“ = pedestrian friendly based on EuroNCAP results
ACEA previous test series

When: 2007, January
Who: Tests at BASt/BGS
Test object: Real world „green“ vehicles, Functional (inverse) tests
Impactor: Flex-GTα

Main results: Repeatability, Reproducibility appears to be acceptable
Problems on robustness observed
Calibration problems
Asymmetric knee behavior

Reference: TEG-043, presented on 5. TEG meeting, 07.12.2007
TEG-046, presented on 5. TEG meeting, 07.12.2007
TEG-037, presented on 4. TEG meeting, 02.04.2007
### ACEA previous test series

**When:** 2008, January  
**Who:** Tests at BASt/BGS  
**Test object:** Real world „green“ vehicles  
**Oblique tests ±30°**  
**Test on modified bumper (exemption zone)**  
**Impactor:** Flex-GTα  

**Main results:**  
- Repeatability & reproducibility in inverse tests  
  - at least acceptable except for ACL and PCL  
- Knee response not symmetrical at ±30°  
  - (Knee tends to torque only in one direction)  
- No obvious damage observed

**Reference:** no TEG paper so far
ACEA latest test series

When: 2009, January
Who: Tests at BASt/BGS
Test object: Real world „green“ vehicles
Round robin tests performed by manufacturers

Impactor: 3 Flex-GTR (prototypes) with/without onboard DAS

Expectation: Scheduled to be finalized by end of April 2009
to be ready by May 2009

Problems: Technical problems on DAS equipments of Flex-GTRs
Discussion on solutions (BGS, JARI, DAS-supplier)
One Flex-GTR returned to Japan by end of January 2009

-> Delay of scheduled test program

No round robin tests possible within scheduled time
Main results:  Tibia A3 signal scatter due to impact on edge of the rubber sheet (neoprene skin)
Knee behavior still asymmetric despite symmetric design
Reproducibility in vehicle tests marginal
Flex-GTR test results 10% to 15% higher than Flex-GTα’s
Acceleration device to be optimized (vibrations before contact)
More details see BGS report ...

Reference:  BGS report presented on 8. TEG meeting, 19.05.2009
(TEG-089)
Problems related to Flex-GTα and Flex-GTR

List of problems of the Flex-GTα and Flex-GTR

References:

- **TEG-037** Flex-GTα handling usage 4.TEG, 02.04.2007
- **TEG-042** ACEA comments Sept.2008 5.TEG, 07.12.2007
- **TEG-046** JARI answer to TEG-042 5.TEG, 07.12.2007
- **TEG-052** FTSS-Flex-GTR-development 5.TEG, 07.12.2007
- **TEG-089** BGS report on 2009 ACEA tests 8.TEG, 19.05.2009

Color code:

- Incomplete, solution in sight
- Solution accepted
- Problem, no solution available
- Not applicable
### Problems related to Flex-\(\text{GT}\alpha\) and Flex-GTR

<table>
<thead>
<tr>
<th>no</th>
<th>observations before, during and after testing</th>
<th>Flex-(\text{GT}\alpha)</th>
<th>Flex-GTR</th>
<th>comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>definition of certification / calibration procedures</td>
<td></td>
<td></td>
<td>component calibration (TEG-056), assembly certification (TEG-075), corridors to be proposed in 8. TEG meeting</td>
</tr>
<tr>
<td>2</td>
<td>function of a &quot;marginal&quot; performing vehicle to be checked</td>
<td></td>
<td></td>
<td>checked in 2008 ACEA test program</td>
</tr>
<tr>
<td>3</td>
<td>asymmetrical knee measurement</td>
<td></td>
<td></td>
<td>improved, but still differences in oblique tests (\pm 30^\circ), open issue, to be discussed in 8.TEG</td>
</tr>
<tr>
<td>4</td>
<td>bending moment measurements - full bridge configuration</td>
<td></td>
<td></td>
<td>improved</td>
</tr>
<tr>
<td>5</td>
<td>DAS calibration problems / no procedures available</td>
<td></td>
<td></td>
<td>DAS calibration procedures along specifications</td>
</tr>
<tr>
<td>6</td>
<td>generally higher measurement of Flex-GTR</td>
<td></td>
<td></td>
<td>no reason found so far, open issue, to be discussed in 8.TEG</td>
</tr>
<tr>
<td>7</td>
<td>availability of a robust, well calibrated FE model</td>
<td></td>
<td></td>
<td>FE activities started in Nov.2008, in progress, in time so far, BUT: mesh to be improved, simulation time appears to be too long</td>
</tr>
<tr>
<td>8</td>
<td>complete disassembling when cable is damaged</td>
<td></td>
<td></td>
<td>easy exchange, no problem with onboard DAS</td>
</tr>
<tr>
<td>9</td>
<td>cable guiding near sharp edges / angles</td>
<td></td>
<td></td>
<td>cable routing improved</td>
</tr>
<tr>
<td>10</td>
<td>potentiometer string crimping poor</td>
<td></td>
<td></td>
<td>damage of crimp connection, solution available, to be discussed in 8.TEG</td>
</tr>
</tbody>
</table>
### Problems related to Flex-GTα and Flex-GTR

<table>
<thead>
<tr>
<th>No</th>
<th>Observations before, during and after testing</th>
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<th>Flex-GTR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Channel order different in three GTR legforms</td>
<td></td>
<td></td>
<td>solution by ISO codes, but to be confirmed in 8. TEG meeting</td>
</tr>
<tr>
<td>12</td>
<td>Support of complete impactor height during acceleration to avoid vibration</td>
<td></td>
<td></td>
<td>Additional support of knee, solution to be discussed in 8.TEG</td>
</tr>
<tr>
<td>13</td>
<td>Roller guidance allows rotation around z-axis during acceleration</td>
<td></td>
<td></td>
<td>Rotation minimized</td>
</tr>
<tr>
<td>14</td>
<td>Cable influence during free flight</td>
<td></td>
<td></td>
<td>No problem with onboard DAS, BUT: for impactor with cables damage is very likely</td>
</tr>
<tr>
<td>15</td>
<td>Impact accuracy detection by paint spots is difficult</td>
<td></td>
<td></td>
<td>Improved due to one piece outer skin, no difference to WG17 impactor</td>
</tr>
<tr>
<td>16</td>
<td>Edged shape of impactor surface causes z-rotation during impact</td>
<td></td>
<td></td>
<td>No further observation, but further investigations recommended</td>
</tr>
<tr>
<td>17</td>
<td>Tibia neoprene length too short (scatter of tibia-A3)</td>
<td></td>
<td></td>
<td>Solution available: neoprene skin which covers the whole length, to be discussed in 8.TEG</td>
</tr>
<tr>
<td>18</td>
<td>Tibia surface plate damage</td>
<td></td>
<td></td>
<td>Not observed in Flex-GTR tests</td>
</tr>
<tr>
<td>19</td>
<td>Separation of lowest segment impact face</td>
<td></td>
<td></td>
<td>Still possible, appears to be no problem during impact, to be discussed in 8.TEG</td>
</tr>
<tr>
<td>20</td>
<td>Skin damage by sharp edges</td>
<td></td>
<td></td>
<td>Not observed in Flex-GTR tests</td>
</tr>
</tbody>
</table>
# Problems related to Flex-GTα and Flex-GTR

<table>
<thead>
<tr>
<th>no</th>
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<th>Flex-GTα</th>
<th>Flex-GTR</th>
<th>comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>neoprene skin zippers very sensitive</td>
<td></td>
<td></td>
<td>zippers improved but still sensitive</td>
</tr>
<tr>
<td>22</td>
<td>robustness of cable, possible damage in rebound</td>
<td></td>
<td></td>
<td>no damage with onboard-DAS, damage still likely on cable impactor</td>
</tr>
<tr>
<td>23</td>
<td>check of 8 knee screws</td>
<td></td>
<td></td>
<td>recommended after three tests</td>
</tr>
<tr>
<td>24</td>
<td>check of 20 knee spring ends</td>
<td></td>
<td></td>
<td>not needed after each test, recommended during certification test</td>
</tr>
<tr>
<td>25</td>
<td>check of 4 upper bending stopper cable ends</td>
<td></td>
<td></td>
<td>not needed after each test, recommended during certification test</td>
</tr>
<tr>
<td>26</td>
<td>check of 4 lower bending stopper cable ends</td>
<td></td>
<td></td>
<td>not needed after each test, recommended during certification test</td>
</tr>
<tr>
<td>27</td>
<td>check of cable clearance (tool)</td>
<td></td>
<td></td>
<td>see item 25 and 26</td>
</tr>
<tr>
<td>28</td>
<td>check of distortion of knee parts</td>
<td></td>
<td></td>
<td>not needed due to improved symmetry</td>
</tr>
<tr>
<td>29</td>
<td>change and re-change of mounting device (roller to joint) for certification test</td>
<td></td>
<td></td>
<td>not needed for inverse certification test, only needed for pendulum test, to be discussed in 8.TEG</td>
</tr>
<tr>
<td>30</td>
<td>cable / wiring</td>
<td></td>
<td></td>
<td>significantly improved</td>
</tr>
</tbody>
</table>
### Problems related to Flex-GTα and Flex-GTR

#### Overview of the color codes for 30 identified items

<table>
<thead>
<tr>
<th>Flex-GTα</th>
<th>Flex-GTR</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>no reason found, open issue</td>
</tr>
<tr>
<td>16</td>
<td>9</td>
<td>to be worked out and checked</td>
</tr>
<tr>
<td>0</td>
<td>20</td>
<td>improvements</td>
</tr>
</tbody>
</table>
Observations of ACEA members during Round Robin Tests

By now: Round Robin tests are performed by only a few ACEA members in 2007 with Flex-GTα, some tests in March 2009 with Flex-GTR

Round Robin tests not yet finished due to impactor unavailability caused by technical problems in the beginning of the ACEA 2009 tests

Further tests are scheduled with Flex-GTR more time for careful assessment and evaluation needed

First experiences and observations with Flex-GTR:
- repeatability poor - results in vehicle tests vary too much
- test results much higher than with the previous legform version
- current vehicle designs don’t necessarily comply with draft criteria
- long time experiences are necessary
- manuals need to be improved
- knee cross section alignment to be checked before test (may reduce scatter)
ACEA remarks

Generally:

Onboard DAS: at first realized in Flex-GTR prototype (FTSS commercial design)

Availability: at first by December 2008 (FTSS Flex-GTR prototype)
(originally expected by September 2008)

In Europe: availability of 3 Flex-GTR prototypes by January 2009

Experience: no experience of Flex-GTR testing for ACEA before December 2008

Intention: faultless 2009 evaluation test program planned by ACEA

BUT: problems delay start of 2009 tests at BASt/BGS

Round Robin tests: are to be finalized and assessed
ACEA remarks

Repeatability and reproducibility acceptable based on inverse tests

Repeatability and reproducibility need to be reviewed for vehicle tests

Durability improved, long time experience is missing

Handling improved

Feasibility depends on criteria which are in question up to now

Open issues:
- criteria issue
- choice of certification test - inverse test vs pendulum test
- higher vehicle test results of Flex-GTR compared to Flex-GTα to be clarified, also linked to feasibility issue
- pink & red colored items of the Flex-GTR (see list of problems)
- review of meeting the TEG terms of reference
ACEA remarks

Conclusions and recommendations:

- Development process of the Flex-GTR is very promising
- Open questions left to be solved
- All outstanding Round Robin tests should be awaited & assessed
- Evaluation of the Flex-GTR as a regulatory tool is very important
- Evaluation should be done very carefully

- Avoid an overhasty introduction of Flex-GTR into a regulatory frame
- By now, an amendment of the Flex-GTR in the GTR-9 is too premature
- Elimination of problems is more difficult and time consuming after acceptance of the Flex-GTR as a legal tool

- ACEA´s recommendation:
  careful review of open issues – fixation of next TEG activities
  clarification Flex-GTR criteria and feasibility on vehicle design
  review of TOR decision on Flex-GTR availability for Round Robin tests