UPDATE TO GTR7 IG ON CERTIFICATION & DRAWINGS

prevented by: Paul Depinet, John Below, John Stephens, Dennis Moeller, John Arthur, Lars Beholz, Gus Serrano, Travis West, Casey Linzmeier, Alexis de Leon, Jason Jordan, Niccole Theisen-Godin 02/05/14
Agenda

• Drawings for UN
• Goal – reminder
• Status of certification test development
• Bumper work update
• Finishing dummies for Injury Criteria Development
  o VRTC dummies
• Test Documentation Discussion
Drawings for UN

• Need to update all drawings to UN standard
• Incorporate comments from GTR7 IG reviewers
• Have samples for discussion
  o Title block ok?
  o BOM and PN handling ok?
  o REV block ok?
  o Weldment handling?
  o Other comments?
Drawings for UN

- Position split bushings at approx. 20-25 degree angle to slot as shown, to prevent cables from riding against split line between bushings.

A. Bond bumpers to structural replacement with bonding adhesive, operating temperature -40°C to +120°C after cleaning with MEK.
B. Glue bumper with rough side down (side with sprues).

Unless otherwise specified:
- All machined surfaces 1.6μ or better.

Draft for Review

E007850 C
ADDED NOTE FOR POSITIONING SPLIT BUSHINGS
11/11/10 3AA

720411 D
RELEASED TO UN
1/29/2014 357

Revision History

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All dimensions ±0.5 unless otherwise specified.

Note: All part numbers begin with ECE/TRANS/WP.25/1101/Add.1.
Drawings for UN - Weldment
Goal - reminder

• Develop certification tests which can control dummy reproducibility
  o Must control setup of neck muscle substitutes and damper
  o Must detect critical differences between dummies found in vehicle seat R&R work
    ▶ Spine bumper stiffness
    ▶ Jacket stiffness
    ▶ Pelvis stiffness
Test to Finalize Documentation

• Spine quasi-static setup *(In Mutual Resolution draft)*
  • Set springs and thorax/lumbar shape adjustment

• Jacket only impact *(in 1/27/14 draft)*
  o Control jacket stiffness

• Pelvis only impact, bottom *(in 1/27/14 draft)*
  o Control pelvis stiffness

• Dummy without head restraint *(in 1/27/14 draft)*
  o Set damper, verify correct spring & shape adjustments
  o Need to discuss and finalize corridors
Test Documentation

• Generic procedure for UN MR
  o Draft 1/27/14 provided for review
    ‣ Tried to make generic for regulation
    ‣ Only necessary information
    ‣ Not limit future improvements
  o Need review and comment on what should be in doc
    ‣ Procedures themselves
    ‣ Appropriate level of information

• We will do update with comments to provide for inclusion into MR
  o Will leave thorough formatting for after put into MR
Tests Under Development

• Dummy with head rest (*corridors TBD*)
  o Check complete system performance
  o Trying to detect differences in Thorax/lumbar bumpers
  o Test & procedures under development
  o *Need to resolve bumper issues first*

• Pelvis shape verification (*corridors TBD*)
  o Make sure shrinkage is not too large
  o Test & procedures under development

• Bumper compression on spine (*corridors TBD*)
  o Check change in bumper stiffness
  o Test & procedures under development
Tests Under Development

• Steps to complete
  o Resolve bumper control issue
  o Finish testing R&R and VRTC dummies
  o Run testing varying thorax/lumber bumper stiffnesses to confirm we can detect differences
  o Pick headrest test version (with or without back)
    ▶ Make sure can detect large variation in bumpers
  o Establish corridors around R&R and VRTC dummies
  o Finalize test procedure documentation
Bumper Update

• Why are we discussing
  o TRL/BAST R&R work indicated thorax/lumbar bumpers might be source of problem
  o Rebuild 2 PDB dummies which were problem for years made them match in TRL/BAST testing
  o Rebuild 4 dummies for BAST R&R series with new dummies provided acceptable R&R

• What was different?
  o Bumpers manufactured at one point in time!
    ▸ Standard production process but only 1 batch material
  o Indicates inadequate control of bumpers
Bumper Update

• How are bumpers controlled?
  o HIS orders urethane from suppliers based on durometer specifications
  o HIS manufactures bumpers
  o **HIS checks every bumpers to print durometer specifications**
  o Durometer targets have not changed
Bumper Update

• Why use durometer?
  o ASTM, ISO, and other national standards available
  o Gives indication of material stiffness property
  o Common tool with elastomers to talk about material stiffness
    ‣ This is always the first property discussed when picking a material
  o Very simple, inexpensive, and quick test to do
Bumper Update

• Why not use durometer?
  o Surface indentation test
    ‣ Affected by surface skin and tension
    ‣ Testing a cube on sides, top, bottom will typically give different readings
    ‣ Surface preparation changes readings
  o Poor R&R relative to a tight corridor
    ‣ ASTM R&R study: repeatability 1.92, reproducibility 5.72
      ‣ Differences greater than these numbers are assumed to come from different population
    ‣ Durometer is highly equipment and operator dependent
  o Gage calibration can vary up to +/- 2 points
    ‣ We have seen this with 2 identical gages giving consistent differences of about 2 durometer points
Bumper Update

• Why not use durometer?
  o Most bumpers don’t meet ASTM material size requirements
    ‣ Minimum 6 mm thick
    ‣ Readings must be taken at least 12 mm from edge of part
  o Bumpers don’t test same as material poured from same mix with correct size requirements
Bumper Update

• Why look at compression test?
  o More closely indicates material modulus
  o Closer to how bumpers are used in a dummy
  o Test stand is more automated => less operator influence

• Do durometer and compression indicate same answer?
  o They are related
Bumper Update

**ARA-521**

Avg Force = -175.1 + 17.36 Durometer - Lab

This was supposed to be a 50 shore A material per the manufacture information
Bumper Update

• Compression testing
  o There is correlation, but wide spread in comparison of data (low $R^2$)

• Status of compression testing
  o Started with R&R dummies
  o Only done on engineering samples
  o Not used at this time for production control
Bumper Update

• Status of compression test usage
  o Set targets based on R&R dummy bumper test data
  o Tried making bumpers to match
  o Ran into material reproducibility issues
    ▶ Still investigating source of this and when it started

• Did R&R dummy bumpers stiffen?
  o Sample of 10 of each bumper part number removed from 2 dummies for retest
Bumper Update – R&R dummy bumper testing

Plot of Avg Force Change
ARA-521
Retest of R&R Bumpers

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Plot of Avg Force Change
ARA-521
Retest of R&R Bumpers

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New
Retest

Plot of Avg Force Change
ARA-521
Retest of R&R Bumpers
Bumper Update – R&R dummy bumper testing

Plot of Avg Force Change
ARA-520
Retest of R&R Bumpers

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- 054: 2
- 054: 3
- 054: 4
- 077: 1
- 077: 11
- 077: 12
- 077: 16
- 077: 9

Plot of Avg Force Change
ARA-520
Retest of R&R Bumpers
Bumper Update – R&R dummy bumper testing

Plot of Avg Force Change
ARA-381-37
Retest of R&R Bumpers

- Dummy SPEC_ID 054
- 054
- 077
- 077

- SPEC_ID
- Avg Force
- 15
- 131.3
- 123.7
- 172
- 120
- 100
- 80

Plot of Avg Force Change
ARA-381-37
Retest of R&R Bumpers
Bumper Update – R&R dummy bumper testing

Plot of Avg Force Change
ARA-381-30
Retest of R&R Bumpers

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Plot of Avg Force Change
ARA-381-30
Retest of R&R Bumpers
Bumper Update – R&R dummy bumper testing

Plot of Avg Force Change
ARA-227
Retest of R&R Bumpers

- SPEC-_ID
- Avg Force
- 52.9
- 40.4
- 46.2
- 58.7

Dummy SPEC-_ID
- 054 11
- 054 17
- 054 22
- 054 4
- 054 8
- 077 10
- 077 12
- 077 2
- 077 24
- 077 7
Bumper Update – R&R dummy bumper testing

Plot of Avg Force Change
ARA-220
Retest of R&R Bumpers

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Plot of Avg Force Change
ARA-220
Retest of R&R Bumpers

Diagram showing the average force change for different SPEC-_ID values with color-coded markers for new and retest conditions.
Bumper Update

• R&R dummy bumpers did stiffen
  o Before or after R&R test series?
  o How long does stiffening take?
Bumper Update

Bumper Stiffness Gain
ARA-520 "standard" @ ~60 days

Avg Force

SPEC-_ID

L-1416  L-1421  L-1422  L-1423  L-1424  L-1425  L-1426  L-1427

827
538

SPEC-_ID

L-1416
L-1421
L-1422
L-1423
L-1424
L-1425
L-1426
L-1427
Bumper Update

Plot of Avg Force Change @ 7 Months
ARA-520 Standard

Index

1500
1250
1000
750
500

Plot of Avg Force Change @ 7 Months
ARA-520 Standard
R&R Dummies Bumper and Testing Timeline

- **February-2012**: Bumpers Tested for R&R Dummies (Huron)
- **April-2012**: Bumpers Installed in R&R Dummies
- **July-2012**: R&R Dummies Shipped to BAST
- **September-2012**: Vehicle Seat R&R Sled Series (BAST)
- **October-2012**: R&R Dummies Tested
- **November-2012**: R&R Dummies Post Tested Dummy 54 (Huron)
- **December-2012**: R&R Dummies Tested (BAST)
- **February-2013**: R&R Dummies Post Tested (BAST)
- **March-2013**: R&R Dummies Post Tested (Heidelberg)
Bumper Update

• Using retest compressions to reset corridors
  o Think from timeline bumpers stiffened between original compression and BAST sled series
  o Using Green corridors as targets for aged bumpers

• VRTC dummies
  o Looking for aged bumpers that meet green corridors
Bumper Update

• Still in progress
  o Comparing durometer to compression
  o Can durometer indicate stiffening
    ‣ Data not ready to present (maybe tomorrow)
  o Investigating material stiffening
  o More conclusive proof of best method for control
    ‣ R&R studies on durometer and compression
  o Process to assure stable parts for installation into dummies
Bumper Update

• Might have more info by tomorrow
  o Durometer vs compression on a variety of batches
  o Aging studies on a variety of batches
  o Plan for R&R studies
  o Detailed plan for finishing test development by April
  o Selection of bumpers for VRTC dummies

• R&R studies durometer & compression
  o Shooting for end next week
Finishing dummies for Injury Criteria Development

• VRTC dummies
• Need to get bumpers right
  o Looking for aged bumpers hitting aged R&R bumper targets right now
• Finish testing to certification tests and proposals
  o Assuming we find enough bumpers hitting new targets
Test

Documentation Discussion

Discuss 1/27/14 Draft?
Questions?