MGA & NTEA Present

FMVSS 201U-Upper Interior Head Impact Protection

August 20, 2009
- Independent test services
- Began in New York, 1977
- ISO/IEC 17025:2005 Accredited
- Specializes in: Safety Regulations (FMVSS, ECE, SAE, ASTM, MIL_STD, etc.), Vibration, Noise, Life Cycle, Environmental, Equipment, etc.
- Customer base: Automotive, Military, Aerospace, Other Transportation, etc.
National Truck Equipment Association (NTEA)

- Established in 1964
- Represents over 1,800 companies that manufacture, distribute, install, buy, sell and repair commercial trucks, truck bodies, truck equipment, trailers and accessories
Presenters: D.J. Whiteside

- BSME, MBA, PMP
- MGA Associate since 2003
- Focus on Dynamic Testing
  - FMVSS 201U FMH
  - Pedestrian Protection
  - Mine Blast Simulation
  - Custom Dynamic, etc.
- Previously involved in Life Cycle, Durability, and Environmental testing
Presenters: Helen A. Kaleto

- BSEE
- MGA Associate since 1993
- ISO/IEC 17025:2005 Quality Manager
- Extensive Dynamic testing experience (201U, 202A, ECE, etc.)
- Program Manager and Project Engineer for the FMVSS 201U NHTSA contract
MGA and 201U

- 10th year of NHTSA contract, 15th year of testing
- Tested between 400-500 vehicles
- Wrote and presented many SAE papers
- Developed EZ-Target ™, a computer program used with a CMM to aid in locating targets
- Performed many impactor installations around the world
Webinar Overview

- Introduction to FMVSS 201U FMH Testing
  - Purpose
  - Requirements
- Phase-In Schedule #4
- Definitions of the Targets and Critical Notes
Introduction to FMVSS 201U
Abstract of the Process

- FMH (Free Motion Head Form) fired at various targets within the vehicle interior at a certain velocity
- Data is collected from tri-axial accelerometer inside the head form CG and analyzed for injury criteria
The Purpose of FMVSS 201U

- CFR = Code of Federal Regulations
- "This standard specifies requirements to afford impact protection for occupants", 49 CFR Ch. V §571.201
- Applies to instrument panels, seat backs, interior compartment doors, armrests, sun visors, and upper interior components.
- The addendum “U” in 201 is a common distinction referring to only the “Upper” interior section (§6-10) of this requirement.
FMVSS 201U Procedure Overview

1. Target the vehicle
2. Establish vertical and horizontal angles (defined in CFR) for impact
3. Select targets likely to be worst-case (based on engineering judgment)
4. Evaluate targets for airbag proximity:
   - Standard impacts conducted at $V = 24$ kph
   - Impacts near airbags conducted at $V = 19$ kph
5. Conduct test and analyze data
Requirements of FMVSS 201U

“The HIC(d) shall not exceed 1000”

Two Parts:

- **HIC** = Head Injury Criteria
  - Unit-less value which represents injury severity of the head
- **HIC(d)** = Head Injury Criteria for an Anthropomorphic Test Dummy (ATD)
  - Relates the FMH back to a full ATD
\[ A_R = \sqrt{A_x^2 + A_y^2 + A_z^2} \text{ (Gs)} \]

\[ \text{RESULTANT ACCELERATION } A_R, \text{ G's} \]

\[ \text{HIC} = \begin{bmatrix} 1 & t_2 \end{bmatrix} \begin{bmatrix} 0 & 0 \end{bmatrix}^{2.5} (\text{G's}) \]

\[ \text{HIC(d)} = 0.75446 \text{ (FMH HIC)} + 166.4 < 1,000 \]
FMVSS 201U: Phase-In Schedules

Schedule #1 - 3:
All OEM vehicles compliant after September 1, 2002.

Schedule #4:
“A final stage manufacturer or alterer of vehicles manufactured on or after September 1, 2009 shall comply with the requirements of the Performance Criterion”

* Applies to vehicles with GVWR ≤ 10,000 lbs
Final Stage Manufacturers & Alterers

- Completes an incomplete vehicle or alters a completed vehicle prior to the first retail sale.
Final Stage Manufacturers & Alterers

- Alterers responsible for maintaining compliance with 201U with modification performed during up-fit.

- Final Stage Mfrs. responsible for completing vehicle within conformity statements for 201U contained in incomplete Vehicle Document provided by OEM or developing own rationale for compliance through testing, engineering judgment, or other analysis.
Final Stage Mfr & Alterers: Exemptions

- Any target located rearward of a vertical plane 300 mm behind the seating reference point of the driver’s designated seating position.
Final Stage Mfr & Alterers: Exemptions

- Any free motion headform contact with components rearward of this 300 mm plane within the time period for measuring HIC(d)
Final Stage Mfr & Alterers: Exemptions

- Any target rearward of a vertical partition if one is between the driver’s seating reference point and a vertical plane 300 mm rearward
Overview of the Applicable Targets
## Common Applicable Targets

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A-Pillar

Any pillar entirely forward of a transverse vertical plane passing through the seating reference point (SgRP) of the driver's seat.
A-Pillar (from NHTSA Procedure)
A-Pillar: Critical Notes

- APR (AP1) determines almost every other target in the vehicle. Changes to the upper roof structure may alter the position of APR and change the position (and result) of every other target.
- Exterior changes may reinforce the cab structure raising the likelihood of higher HIC(d) results.
- Interior changes may also reinforce the cab structure raising the likelihood of higher HIC(d) results.
Upper Roof

- The area of the vehicle interior that is determined in accordance with the procedure set forth in S8.15, Upper Roof.
- The entire area of the roof within the boundary lines (planes) and above the belt-line.
- May have an infinite number of targets.
Upper Roof - Distinctions

No-Entry From Cab:
- Boundary includes only the cab of the vehicle

Pass-Through Cab:
- Boundary includes the entire roof of the vehicle (cab and work compartment)
Upper Roof (from NHTSA Procedure)
Upper Roof: Critical Notes

- Targets on doors, pass-throughs, etc. are exempt if they are beyond 300mm or beyond the partition.
- Exterior changes may reinforce the cab structure and raise the likelihood of higher HIC(d) results.
- Interior objects (tools, equipment, etc.) placed within the boundary are applicable targets and may raise the likelihood of higher HIC(d) results.
B-Pillar / Rear Pillar

- The forwardmost pillar on each side of the vehicle that is, in whole or part, rearward of a transverse vertical plane passing through the SgRP of the driver's seat.
- If there is only one pillar rearward of that plane, it is also a rearmost pillar.
B-Pillar (from NHTSA Procedure)
Rear-Pillar (from NHTSA Procedure)
B-Pillar: Critical Notes

- Target BP4 is applicable if there is seating for a rear occupant and in front of the 300mm boundary or partition.
- Exterior changes may reinforce the pillar and raise the likelihood of higher HIC(d) results.
- Interior objects (tools, equipment, etc.) placed within the measured targets are applicable targets and may raise the likelihood of higher HIC(d) results.
Front Header

- Area forward of the Head CG
- On vehicle surface, not on sun visor
Changes to the roof structure will have significant impacts on the location of APR and on the rigidity of the structure, and may raise the likelihood of higher HIC(d) results.

Interior objects (tools, equipment, etc.) placed within the measured targets are applicable targets and may raise the likelihood of higher HIC(d) results.
Side Rails

- Area between pillars measured along the vehicle interior.
- Multiple areas dependent on number of pillars
Side Rail (from NHTSA Procedure)

*ALTERNATELY, SR2 CAN BE LOCATED 300 mm FORWARD OF BPR OR RPR

UPPER ROOF

SR2* TARGET

PT.14

PT.13

SR1 TARGET

PT.12

PT.11

APR

A-PILLAR

PLANE 26 (P26)

UPPER EDGE OF FORWARDMOST DOOR OPENING

PLANE 25 (P25)
Changes to the roof structure will have significant impacts on the location of APR and on the rigidity of the structure, and may raise the likelihood of higher HIC(d) results.

Interior objects (tools, equipment, etc.) placed within the measured targets are applicable targets and may raise the likelihood of higher HIC(d) results.
FMVSS 201U Review

- FMH testing is designed to “afford impact protection for occupants”
- Requirement: HIC(d) < 1,000
- Compliance responsibility depends on vehicle design and/or design changes
- Variety of targets / impact possibilities:
  - A-Pillar, B-Pillar/Rear-Pillar, Upper Roof, Front Header, Side Rails, etc.
Questions & Answers

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