



VERTICAL ACCELERATION COMPARISONS FOR PRIMUS AND WIAMAN

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GROUND VEHICLE SURVIVABILITY AND PROTECTION (GVSP) MISSION & VISION

Mission

Bring our Soldiers home injury free with **superior** ground vehicle **survivability and protection** systems

Vision

To be the renowned leaders in **decisive** survivability and protection products and services throughout the ground domain lifecycle

INTRODUCTION



- Comparison Study of PRIMUS Dummy and WIAMan responses
- Motivation
 - Awareness of PRIMUS
 - Use by German partners (WTD-91, WTD-71)
 - Answer question: does PRIMUS respond like WIAMan
- Method
 - Established CRADA with Kistler
 - Test PRIMUS in OPL environments: Live-fire, in laboratory
 - Vertical acceleration tests
 - Generic Hull (GH)
 - Crew Compartment Under-body Blast Simulator (CCUBS)
 - Test PRIMUS and WIAMan side-by-side

METHOD

- Phase I
- Generic Hull (GH)/December 2021
 (PRIMUS, Hybrid III)
- Phase II
- Crew Compartment Underbody Blast Simulator (CCUBS)/April 2022
 - Reported here last year (PRIMUS, Hybrid III)
- Phase III
- Crew Compartment Underbody Blast Simulator (CCUBS)/December 2022 ~ January 2023
 - Two (2) occupants (PRIMUS, WIAMan)
 - COTS blast mitigating seats (stroking)
 - Seat rigid mount accelerations (x, y, z)
 - Seat stroking acceleration
 - Seat acceleration sampled at 20kHz
 - Dummy responses sampled at 20kHz
 - Fifteen (15) tests (12 actual)

METHOD (PREVIOUS TEST MATRICES)



Phase I

GVSP-GH-20211208-01

GVSP-GH-20211208-02

Phase II

Crew Compartment Underbody Blast Simulator (CCUBS)				
150g	250g	350g		
GVSP-CCUBS-20220330-01	GVSP-CCUBS-20220330-06	GVSP-CCUBS-20220404-01		
GVSP-CCUBS-20220330-02	GVSP-CCUBS-20220331-01	GVSP-CCUBS-20220404-02		
GVSP-CCUBS-20220330-03	GVSP-CCUBS-20220331-02	GVSP-CCUBS-20220404-03		
GVSP-CCUBS-20220330-04	GVSP-CCUBS-20220331-03	GVSP-CCUBS-20220405-01		
GVSP-CCUBS-20220330-05	GVSP-CCUBS-20220331-04	GVSP-CCUBS-20220405-02		

METHOD (TEST MATRIX)



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Phase III

CREW COMPARTMENT UNDERBODY BLAST SIMULATOR (CCUBS)				
150g	250g	350g		
GVSP-CCUBS 2022121301	GVSP-CCUBS-2023010401	GVSP-CCUBS-2023011001		
GVSP-CCUBS-2022121401	GVSP-CCUBS-2023010501	GVSP-CCUBS-2023011002		
GVSP-CCUBS-2022121402	GVSP-CCUBS-2023010502	-		
GVSP-CCUBS-2022121501	GVSP-CCUBS-2023010503	-		

GVSP-CCUBS-2022121502	GVSP-CCUBS-2023010901	









METHOD (CCUBS)





SEVERITY COMPARISON





CCUBS RESULTS – INPUT ACCELERATIONS





PRIMUS WIAMAN CCUBS 250G





CCUBS RESULTS – PELVIS AND SEAT SPEEDS PRIMUS (BLACK) vs WIAMan (GRAY)





CCUBS RESULTS – SEAT DISPLACEMENT (150G TESTS)



PRIMUS (GRAY) vs WIAMan (BLACK)



CCUBS RESULTS - CORRIDORS FROM WIAMAN RESPONSES AVG PRIMUS (GRAY) vs WIAMan CORRIDORS (RED)





CCUBS PULSE COMPARISONS PRIMUS (GRAY) vs WIAMan (BLACK)





CCUBS RESULTS - CORRIDORS FROM WIAMAN RESPONSES AVG PRIMUS (GRAY) vs WIAMan CORRIDORS (RED)





DISCUSSION



- Comparisons of PRIMUS responses to Hybrid III 50th and WIAMan
- Visually and qualitatively, PRIMUS looks very comparable to the other ATDs
- The similarity should be quantified
- Comparison to PMHS data is one way
- Danelson KA, Kemper AR, Mason MJ, Tegtmeyer M, Swiatkowski SA, Bolte JH 4th, Hardy WN. Comparison of ATD to PMHS Response in the Under-Body Blast Environment. Stapp Car Crash J. 2015 Nov;59:445-520. doi: 10.4271/2015-22-0017. PMID: 26660754.

DISCUSSION – SPEED CORRIDORS FROM WIAMAN RESPONSES AVG PRIMUS (GRAY) vs WIAMan CORRIDORS (RED)





CCUBS SEAT ACCELERATIONS VERSUS WIAMAN PMHS SEATS





FUTURE EFFORTS



- Current test series

 - Repeated CCUBS testing
 Replaced HIII with WIAMan

CREATING REPRESENTATIVE CURVES FROM MULTIPLE TIME HISTORIES OF VEHICLE, ATD AND BIOMECHANICS TESTS

Guy S. Nusholtz **Timothy P. Hsu** Yibing Shi Sadegh Babaii Kochekseraii Manuel Alejandro Gracián Luna Chrvsler LLC USA Paper Number 09-0249

OBJECTIVE RATING OF SIGNALS USING TEST AND SIMULATION RESPONSES

Should be done

- Combine data from current study with previous
- Compare to STAPP data
- Create Representative Curves using select STAPP PMHS data
- Apply CORA analysis to data
- Develop Biofidelity rating

PRIMUS ٠

- Load measuring capability
- Strain Gage array on bones

Christian Gehre PDB - Partnership for Dummy Technology and Biomechanics

Germany

- Heinrich Gades VOLKSWAGEN AG
- Germany

Philipp Wernicke

BMW Group Germany Paper Number 09-0407

A PROPOSED SIDE IMPACT ATD BIO-FIDELITY EVALUATION SCHEME USING CROSS-CORRELATION APPROACH

Guy S. Nusholtz Timothy P. Hsu Lynn C. Byers DaimlerChrysler Corporation United States Paper Number 07-0399

A METHODOLOGY FOR GENERATING OBJECTIVE TARGETS FOR QUANTITATIVELY ASSESSING THE BIOFIDELITY OF CRASH TEST DUMMIES

Heather Rhule

Bruce Donnelly Kevin Moorhouse National Highway Traffic Safety Administration Yun Seok Kang The Ohio State University United States Paper Number 13-0138



