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Preventing Seat Belt Interlock Misuse Final Report

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16. Abstract

In 1972 NHTSA adopted an occupant protection option for passenger cars manufactured from 1973, to 1975 that required an interlock to prevent a vehicle from starting if front seat belts were not fastened; this was not well received by the public. In 2012 BMW of North America petitioned to amend FMVSS No. 208, "Occupant Crash Protection," to permit an OEM optional certification using seat belt interlocks for front occupants as an alternative to unbelted crash testing. FMVSS No. 208 currently requires OEMs have their vehicles comply in frontal crash protection with both buckled and unbuckled occupants. In their petition, BMW cited arguments in support of their request, including the potential benefits associated with the increased use of seat belts and the opportunity to design solely for the optimization of belted occupants. BMW claimed vehicles would be lighter, more spacious, and fuel efficient with lower emissions. NHTSA denied this petition because of insufficient information. Following the Moving Ahead for Progress in the 21st Century Act (MAP-21), NHTSA initiated research to gather data to inform a decision as to whether implementation of seat belt interlock systems would be feasible. One effort focused on the seat belt interlock system sensors determining if an occupant was properly buckled. The National Center for Manufacturing Sciences was contracted to determine if an effective sensor solution could be devised to detect properly buckled occupants. A project team consisted of four technology providers, Takata Corporation, Fiat Chrysler Automotive, Survivability Solutions, and BGM Engineering. NCMS, a nonprofit collaborative research consortium of 83 cross-industry members, was the prime contractor. The outcome was a solution that varies greatly from the original and uses multiple sensors to discern if occupants are properly restrained, rather than relying on a single sensor.

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Acronyms and Abbreviations

BIW	body-in-white
BMW	Bayerische Motoren Werke AG
BTS	belt tension sensor
COTS	commercial off-the-shelf
DAQ	data acquisition
(D)FMEA	(design) failure mode effects and analysis
DS/PS	driver's side/passenger side
DVP&R	design verification plan and report
ESOH	Environmental, Safety and Occupational Health
FCA	Fiat Chrysler Automotive
FD	full down
FF	full forward
FMVSS	Federal Motor Vehicle Safety Standard
FR	full rearward
Ft.	foot
FU	full upright
HMI	human machine interface
In.	inch
IOT&E	initial operational test and evaluation
IP	instrument panel
IR	infrared
KPP	key performance parameters
KSA	key system attributes
Lb.	pound
LDF	LIN description file
LEDs	light-emitting diodes
LIN	local interconnect network
MAP-21	Moving Ahead for Progress in the 21st Century Act
MT	mid track
NA	not applicable
NCMS	National Center for Manufacturing Sciences
OCS	Occupant Classification System
OEM	original equipment manufacturer
PCB	printed circuit board
RFID	radio frequency identification
RFP	request for purchase
SDLC	system development life cycle
SOR	statement of requirements
TRL	Technology Readiness Level
VIN	Vehicle Identification Number
WBS	work breakdown structure

Acknowledgments

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Details on skills and previous experiences for each of the personnel can be found in the technical proposal submitted prior to contract award.

1. Executive Summary

In 1972 the National Highway Traffic Safety Administration adopted an occupant protection option for passenger cars manufactured from August 15, 1973, to August 15, 1975, which required an interlock system to prevent a vehicle from starting if any of the front seat (occupied) belts were not fastened. The initial introduction of the system was not well received by the public, prompting drivers to disable or circumvent the system.

On October 23, 2012, Bayerische Motoren Werke AG (BMW Group), BMW of North America, LLC, petitioned to amend the FMVSS No. 208, “Occupant Crash Protection,” to permit an OEM optional certification using a seat belt interlock for front occupants as an alternative to unbelted crash testing. FMVSS No. 208 currently stipulates that OEMs are required to have their vehicles comply in frontal crash protection with both buckled and unbuckled occupants. In their petition, BMW cited several arguments in support of their request, including the potential benefits associated with the increased use of seat belts and the opportunity to design solely for the optimization of belted occupants. By allowing vehicles to be optimized for belted occupants, BMW claimed vehicles would be lighter, more spacious, and fuel efficient with lower emissions. NHTSA denied this petition because the petitioner failed to provide sufficient information that would allow proceeding with a rulemaking.

Following the Moving Ahead for Progress in the 21st Century Act (MAP-21) was signed into law (P.L. 112-141) Sec. 31202 (Permits Reminder System for Non-Use of Safety Belts), NHTSA initiated research to gather data to inform a decision as to whether implementation of seat belt interlock systems would be feasible. One of the initiated efforts focused on the sensing portion of a seat belt interlock system, which would determine if an occupant is properly buckled. NHTSA awarded the National Center for Manufacturing Sciences (NCMS) a contract to determine whether or not an effective sensor solution could be devised that could effectively detect properly buckled occupants. As part of detecting a properly buckled occupant, the research needed to further define, analyze, and evaluate seat belt misuse cases and the work-arounds that users traditionally attempt. It should be noted that software hacking was not part of the effort.

A project team led by NCMS was formed consisting of four technology providers. The project team included Takata Corporation, Fiat Chrysler Automotive, Survivability Solutions, and BGM Engineering. NCMS, a nonprofit collaborative research consortium of 83 cross-industry members based in Ann Arbor, Michigan, was the prime contractor and handled all project management functions. Takata, a manufacturer and seller of seat belts, air bags, steering wheels, interior trims, and child restraint systems, provided expertise relative to seat belt systems, misuse analysis, and overall system level architecture development within the scope of this project. FCA, the world’s seventh-largest automaker, designs, engineers, manufactures, distributes, and sells vehicles under the brand names Abarth, Alfa Romeo, Chrysler, Dodge, Fiat, Fiat Professional, Jeep, Lancia, Ram, and Maserati. Within the scope of this project, FCA provided the instrument panel, vehicle buck, and expertise relative to system level interlock development. Survivability Solutions, a provider of occupant safety technology and advanced seating systems, provided expertise in seat technology integration. BGM Engineering, a provider of personal navigation, firefighting technology, medical innovation, and automotive electronics including motor control and lighting systems, led the overall data acquisition development and execution, integrated the component technology into the buck and vehicle, and provided expertise on safety electronics.

The outcome of this study was a vehicle solution that varies greatly from the original seat belt interlock systems developed in the 1970s. This system uses multiple sensors to discern whether or not the occupants are properly restrained, rather than relying on a single sensor. Focusing on the work-arounds that occupants developed to defeat the initial interlock systems, the team has also investigated misuses that may arise from the proposed solution.

Additionally, it was suggested there be multiple levels of interlock, depending on the misuse detected and the duration of the misuse. Details of the final interlock solution, as well as the data and methodology behind the solution, are detailed in Section 4.5 of this report.

The goals of this project were met by the study, concluding that for the misuse cases identified within the study, a vehicle can be designed and developed, with commercial off-the-shelf technologies, to reliably determine if the occupants within the vehicle are properly restrained.

2. Introduction

2.1 Background

In 1972 NHTSA adopted as an occupant protection option (for passenger cars that did not provide automatic protection) an interlock system that would prevent a vehicle from starting if any of the front seat belts were not fastened. The systems were not well received by the public and prompted drivers to disable or circumvent the system. As a result of negative public reaction, Congress adopted a provision (as part of the Motor Vehicle and School Bus Safety Amendments of 1974) prohibiting NHTSA from prescribing a motor vehicle safety standard that required, or permitted as a compliance option, either ignition interlocks designed to prevent starting or operating a motor vehicle if an occupant was not using a seat belt, or a buzzer designed to indicate a seat belt was not in use for a period of more than 8 seconds after the vehicle ignition was turned to the “start” or “on” position. However, on July 6, 2012, the Moving Ahead for Progress in the 21st Century Act (MAP-21) was signed into law. Sec. 31202 (Permits Reminder System for Non-use of Safety Belts) allows NHTSA to remove the limit on the duration of the audible component of a seat belt reminder system and allows NHTSA to permit compliance with a Federal Motor Vehicle Safety Standard (FMVSS) through a compliance option that includes seat belt interlocks.

2.2 Recent Original Equipment Manufacturer Petition

On October 23, 2012, BMW Group, BMW of North America, petitioned to amend the FMVSS No. 208, “Occupant Crash Protection,” to permit an OEM optional certification using a seat belt interlock for front occupants as an alternative to unbelted crash testing. FMVSS No. 208 currently stipulates that OEMs are required to have their vehicles comply in frontal crash protection with both buckled and unbuckled occupants. In their petition, BMW cited several arguments in support of their request, including the potential benefits associated with the increased use of seat belts and the opportunity to design solely for the optimization of belted occupants. In addition, by allowing vehicles to be optimized for belted occupants, BMW claimed vehicles would be lighter, more spacious and fuel efficient with lower emissions. BMW additionally claimed that, in certain cases, vehicles designed to protect unbelted occupants in the event of a crash require additional safety structures and features that increase vehicle weight. NHTSA denied this petition because the petitioner failed to provide sufficient information that would allow proceeding with a rulemaking.

2.3 Project Scope

NHTSA recently initiated research programs to evaluate the effectiveness and acceptance of prototype seat belt interlock systems. Within the scope of NHTSA’s evaluation of these systems, it was clear that the initial interlock systems were not developed to minimize misuse or work-arounds.

This study through NCMS was conducted to determine whether or not an effective sensor solution could be devised that could effectively detect properly buckled occupants. The project scope included a detailed technical plan that evaluated potential seat belt interlock strategies, that assure proper seat belt use, their susceptibility to potential misuse or mechanical work-around, and technical means to discuss all identified misuse situations regardless of whether a practical countermeasure exists or not. The technical plan included the strengths and weaknesses of multiple seat belt interlock systems relative to each misuse case. There were assumptions made relative to technologies that once worked on a prototype vehicle, but did not have the applicability, based on data, to add value to an interlock system. The team's technical plan also included the strengths and weaknesses of the selected seat belt interlock strategies. The technical plan discussed the potential occupant misuse cases and plans to reduce or eliminate seat belt misuse. Upon completion of the analysis and technical plan, the team began to implement the approved plan to develop, design, evaluate and demonstrate the prototype seat belt interlock system with improved resilience to occupant misuse or work-arounds. It should be noted that several items were determined to be outside the scope of this task:

1. Rear seat consideration (only the front row of seats in the vehicle was considered).
2. Bench seat consideration (only bucket seats were considered).
3. Aftermarket modification to the vehicle (i.e., the seat had not been replaced by an aftermarket product or removed to accommodate a wheelchair).
4. Malicious hacking of vehicle electronic and computer systems.
5. Autonomous or semi-autonomous control of the vehicle.

The prototype seat belt interlock system was implemented on a 2016 Jeep Grand Cherokee (Figures 2-1, 2-2, 2-3, and 2-4) and has been evaluated against the misuse cases as described in the technical plan. The Jeep Grand Cherokee was selected because Takata is the current supplier of the vehicle's seat belt systems. This was critical when developing the hardware, and changes to the seat belt system for engineering development needed to be easily achieved and hardware needed to be readily available.

While outside the scope of this contract, it would be possible to use this vehicle to demonstrate the implementation of "interlocks," based on the lack of proper seat belt use. This could include any combination of visual and audible feedback, interrupting the infotainment system, interrupting or limiting vehicle speed, and not allowing the transmission into gear.

Figure 2-1: 2016 Jeep Grand Cherokee Front Three-Quarter View

Figure 2-2: 2016 Jeep Grand Cherokee Rear Three-Quarter View

Figure 2-3: 2016 Jeep Grand Cherokee Rear View

Figure 2-4: 2016 Jeep Grand Cherokee Front View

The Technical Plan has been provided as Appendix C to this report.

3. Risk and Mitigation Plans

The risk identification and proposed mitigation plans ensured the seat belt interlock plan was low risk and compliant to the Statement of Requirements.

3.1 Requirement Risks

To ensure there was a lack of scope creep for the task order, the team established a list of risks associated with the requirements (Table 3-1). Plans to avoid these risks were documented and were continually assessed through the life cycle of the design and test phase of the project.

Table 3-1. Risk Mitigation

Requirements Risks	Plan to Mitigate	Implemented Mitigation
Incomplete review and understanding of the requirements.	Assemble a team of subject matter experts, review lessons learned of similar projects, and cross reference to the requirements in the Request for Purchase.	NCMS assembled a team of industry experts from OEMs, suppliers, and occupant classification specialists. Requirements were analyzed and were well understood.
Too many key requirements resulting in excessive constraint on design trade space.	Ensure the design of the interlock system is guided by a small set of key requirements (e.g., minimize the number of key performance parameters and key system attributes.	Technical team used sound design and analysis principles including a thorough misuse case study and Pugh Analysis to ensure key requirements were considered and analyzed.
Requirement does not include a specification providing for future technology insertion that can improve system performance.	Conduct systems engineering trade-off analysis to assess the requirements' affordability and technical feasibility. Also identify system (hardware and software) assurance risks early to ensure system requirements, design, and architecture will produce a secure system in operations.	System trade-offs were analyzed through a Pugh analysis and misuse studies. System hardware was identified and an attempt to use COTS technology was used to ensure system requirements and technical risks were minimized.

3.2 Technology Risks

Managing technology risks was critical to the successful development on the interlock technical plan. When dealing with a complex system that could contain components from many locations in the vehicle, it was critical to place emphasis on mitigating these risks. Table 3-2 identifies the technology risks along with the plans to mitigate those risks.

3.3 Engineering Risks

Engineering risks included those associated with engineering technical processes, engineering technical management processes, and engineering products. Software engineering risks included those associated with software design requirements, design of architecture, and development of software. These risks, and their mitigation plans, are detailed in Table 3-3.

Table 3-2. Technological Risk Mitigation

Technology Risks	Plan to Mitigate	Implemented Mitigation
Too many critical technologies with a Technology Readiness Level lower than 6. Too many critical technologies, overall.	Ensure critical technologies (with TRL lower than 6) are achievable and risks are manageable within schedule and resource constrains. Limit the number of critical technologies, as appropriate. Use COTS hardware wherever possible.	The team detailed out hardware, from existing OEM and Tier 1 automotive suppliers, currently in production. Although some combinations of sensors and hardware are not currently used in production, the team felt that these technologies, in combination, were not high risk.
Technologies selected not thoroughly vetted.	Include an assessment of the maturity of proposed technologies.	The team used mostly COTS hardware and technologies for the prototype system.
Design of system architecture for vehicle integration.	Design an open system architecture which enables both a cost effective and rapid development of systems that are interoperable with the interlock system. Use no proprietary devices and allow for future add-ons.	System architecture from a controls and software standpoint used industry standard code along with existing sensor technology. No current OEM or supplier-specific proprietary devices were used.

Table 3-3. Engineering Risk Mitigation

Engineering Risks	Plan to Mitigate	Implemented Mitigation
Risks not identified early enough in the project that can cause schedule delays, cost increases, etc.	Use a full set of event-driven developmental test activities across the program's life cycle (e.g., hardware in the loop testing in system integration laboratories) to support risk reduction, design validation, and requirements verification. Use the Design Review Board to ensure technical requirements are balanced with the allocated schedule and funding.	Test plans were developed and are attached part of the Design Verification Plan and Report. They are based on up-front technical work using a Pugh analysis and lessons learned from industry best practices. Team experts conducted up-front design reviews on included documentation to ensure completeness of research conducted.
Full system physical prototyping not performed soon enough in the project resulting in higher risk of technical problems during integration.	Use early prototypes as part of the normal integration process for complex systems to facilitate the integration of major subsystems and infrastructural components, as well as the discovery/resolution of potential subsystem-level interaction risks. Create competing systems in parallel and compare compliance to performance requirements.	The NCMS team procured a full level of prototype vehicle mules along with seats, instrument panels, and other required hardware. This allowed for the ability to create competing systems and make modifications based on the adaptive life cycle approach.

4. Project Methodology

4.1 Stakeholders Requirements Definition

The objective of this process was to help ensure that stakeholder requirements were feasible, balanced, and fully integrated as more information was learned through requirements analysis. This process ensured that NHTSA's requirements, expectations, and perceived constraints were fully understood. By performing an exhaustive stakeholder requirements definition process, requirements creep due to misunderstanding of end-user needs, unexpected contract modifications, cost growth, and schedule slip was reduced. The specific activities conducted during this process included

- Eliciting stakeholder capability objectives,
- Defining stakeholder requirements, and
- Analyzing and maintaining stakeholder requirements.

4.2 Requirements Analysis Process

The requirements analysis process involved the breakdown of NHTSA's needs into clear, achievable, and verifiable high-level requirements. As the system design evolved, requirements analysis activities supported allocation and derivation of requirements down to the system elements representing the lowest level of the design. The resultant system requirements were addressed at technical reviews and audits throughout the seat belt interlock technical planning phase. The specific activities conducted during this process included

- Analysis of NHTSA requirements,
- Translated NHTSA needs into basic functions,
- Developed a quantifiable set of performance requirements by defining the functional boundaries of the system in terms of the behavior and properties to be provided,
- Defined each function that the system was required to perform,
- Defined implementation constraints (NHTSA requirements or solution limitations), and
- Translated performance requirements into specific system technical design requirements and functions.

4.3 Architectural Design

After the requirements analysis process was completed, the team began the trade and synthesis process known as architectural design. In this phase, the outputs of the stakeholder requirements definition and requirements analysis processes were translated into alternative design solutions and the architectural design of candidate solutions was established. These solutions included hardware, software, and human elements, their enabling system elements, and related internal and external interfaces. These solutions considered key system aspects and attributes such as reliability, maintainability, survivability, sustainability, performance, and total ownership cost. Architecture design was integral to ensuring that multiple well-supported solutions were considered.

Architecture design ultimately synthesized multiple potential solutions from system performance requirements, evaluated those solutions, and eventually described the system down to the individual system element for implementation. The process was iterative and strove to seek a balance among cost, schedule, performance, and risk that still met stakeholder needs.

The output of this process was the system allocated baseline, which included the documentation that describes the physical architecture of the system and the specifications that describe the functional and performance requirements for each configuration item along with the interfaces that compose the system. In addition, work breakdown structures and other technical planning documentation were updated.

The system architecture and the resulting design documentation were sufficiently detailed to allow the following:

- Confirmation of upward and downward traceability of requirements,
- Confirmation of interoperability and open system performance requirements,
- Sufficient product and process definition to support implementation, verification, and validation of the system, and
- Establishment of achievable alternatives to allow key stakeholders to make informed decisions.

The result of the architecture design process was the architectural design of the seat belt interlock system that met both the end-user capability and the technical requirements stated in the SOR. It also contained the derived requirements needed for the component needs of the seat belt system, seating system, wiring, electronics, and other possible areas that make up the interlock system.

The major output of this process was the technical plan deliverable of the interlock system for NHTSA review and approval.

Upon receiving customer approval, the implementation process phase began, which launched the realization, testing, and evaluation phases of the project. Another output of this phase was the initial generation of a lessons learned document deliverable.

4.4 Implementation Process

The implementation process was the first step in the development and evaluation of the prototype interlock system phase. This process involved two primary efforts: design and realization.

The outputs of the implementation process included the detailed design down to the lowest level system elements (retractors, buckles, wiring, software, etc.) in the system architecture, and the fabrication/production procedures of forming, joining, and finishing, and coding for software. Implementation was integral to systematically increasing maturity, reducing risk, and ensuring the system was ready for integration, verification, and validation.

4.5 Iterative Design Process

4.5.1 Adaptive System Development Life Cycle Approach to System Optimization

The design approach for this project followed an adaptive System Development Life Cycle that allowed project activities to be adjusted as the project progressed. During the design and development phase, the traditional adaptive SDLC was cycled repeatedly throughout development activities and adjustments were made until the project was complete. Figure 4-1 is a graphical representation of this design model. After each cycle, or iteration, a system, consisting of a combination of sensors, was ready to be tested and evaluated. An iteration was one cycle in the spiral model during which work activities (analysis, design, and implementation) were used to demonstrate a version of the working prototype.

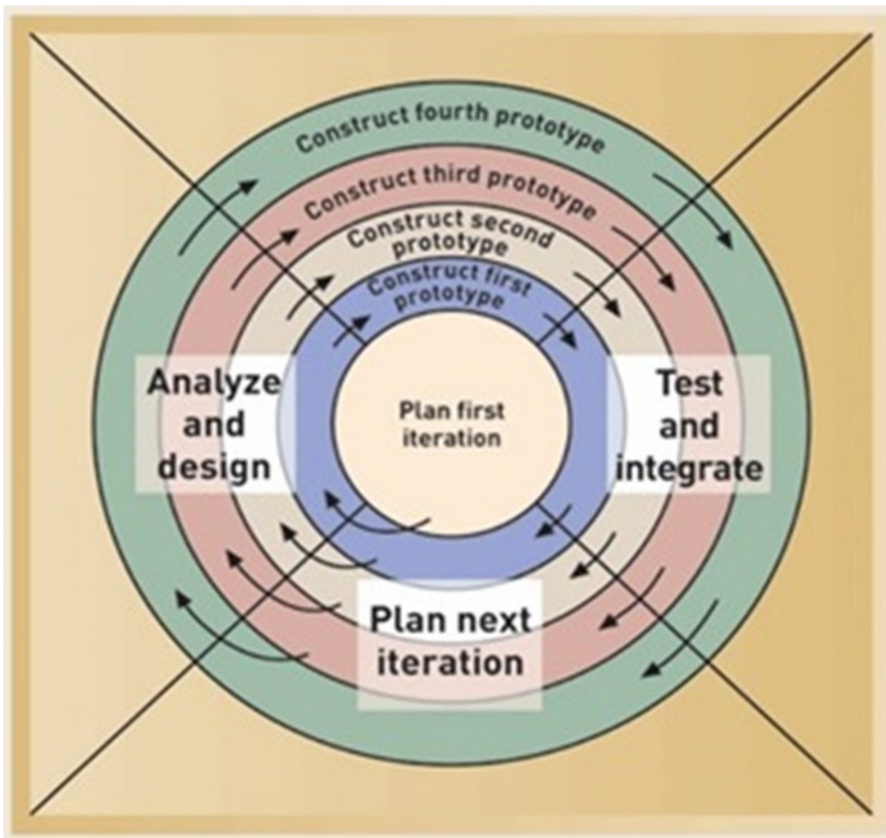


Figure 4-1: Development Model

4.5.2 Design and Development

The design effort for the interlock system included modeling and simulation, experiments, and prototypes through which competing systems were assessed. Careful decisions regarding the design of the interlock system elements enabled the use of open (non-proprietary) standards and an open systems or modular approach that allowed for resiliency and reduced costs.

Design activities included:

- Identifying and analyzing the constraints of the technology, design, and realization techniques imposed on the design solution;

- Developing, designing, and implementing prototypes and solutions for the system elements;
- Analyzing candidate system element design and implementation solutions and conducting variability studies to identify conflicts and resolution alternatives to ensure system integrity; and
- Identifying fabrication and quality procedures, and documenting design assumptions and decisions in the final system elements.

4.5.2.1 Seat Belt Interlock Study

The team documented a series of misuse cases for seat belt interlock systems. The team worked with known industry leaders to help conduct a study to document and prioritize a set of misuse cases. The team also developed and prioritized possible countermeasures for the misuses. These documents provided the team guidance to develop a system.

The Seat Belt Interlock Misuse Study evaluated and rated all known misuses as well as possible countermeasures to those misuses. The team rated the identified sensors as to their possible effectiveness as a countermeasure to a given misuse.

The study is in Appendix A.

Seat Belt Misuses

The first step in developing the seat belt interlock system was to identify all known seat belt misuses. In collaboration with NHTSA, the team identified the misuses described in Table 4-2 and are referred to by their designator/IDs, M1, M2, etc. The terms used in the description of the identified misuses are listed in Table 4-1.

Although not a misuse, M0 refers to a properly buckled occupant. During the testing phase, it was determined that M4 and M5 could each be implemented in two ways, so each of these misuses was split (M4-1, M4-2, M5-1 and M5-2). In a similar fashion, M14 (occupant out of position), was split into three defined out of position scenarios (M14-1, M14-2 and M14-3).

Table 4-1: Seat Belt Terminology

Technology Item	Definition
Lap belt	A strap that goes over an occupant's waist to secure the occupant against harmful movement that may result during a collision or a sudden stop.
Shoulder belt	A strap that goes diagonally over the vehicle occupant's shoulder, closest to the vehicle exterior, and is buckled, towards the vehicle's interior, and secures the occupant against harmful movement that may result during a collision or a sudden stop.
D-ring	A metal ring used to retain the seat belt. Usually located in the B-pillar.
B-pillar	The support post that connects a vehicle's roof to its body at the rear of the front passenger door. The B-pillar is typically the center pillar of the vehicle.
Latch plate	A metal apparatus through which the seat belt passes through; secures inside the buckle.
Buckle	A device that receives the seat belt latch plate.
Dashboard	A panel extending across the interior of a vehicle (as an automobile) below the windshield that contains the instrument panel.

Table 4-2: Seat Belt Misuses

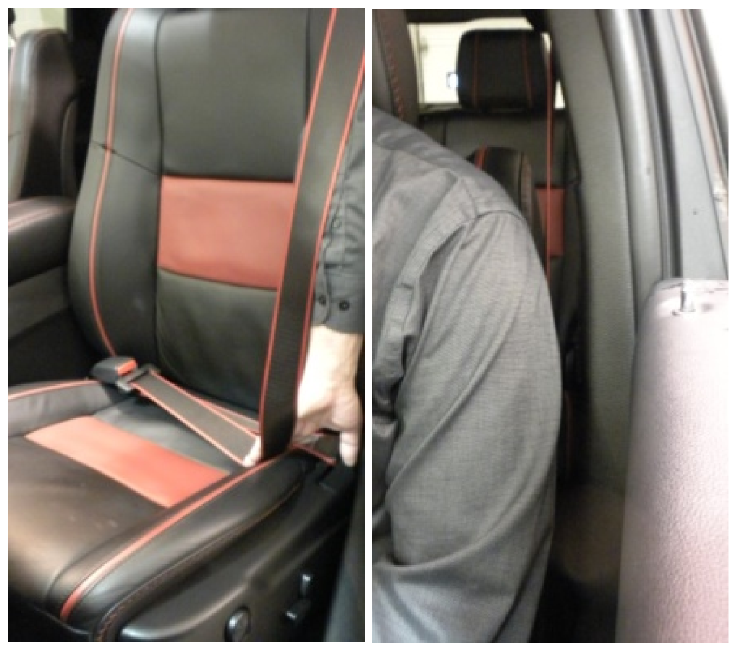
Designator	Description	Photo
M0	Properly buckled occupant	
M1	Sitting on buckled seat belt (lap belt and shoulder belt behind occupant).	
M2	Leaving seat belt unbuckled.	

Table 4-2. Seat Belt Misuses (continued)

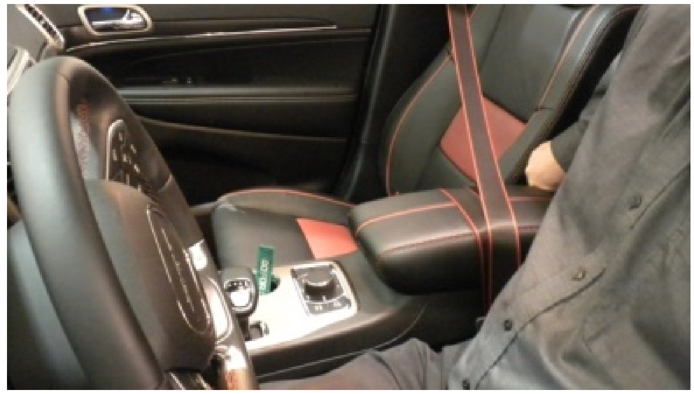
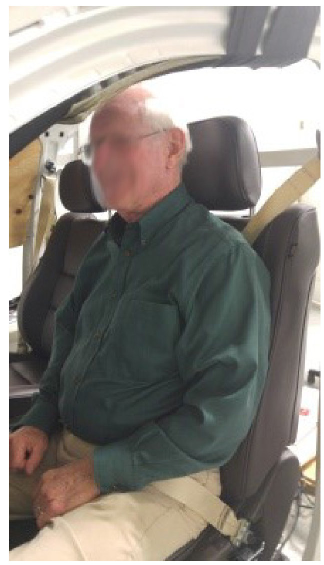
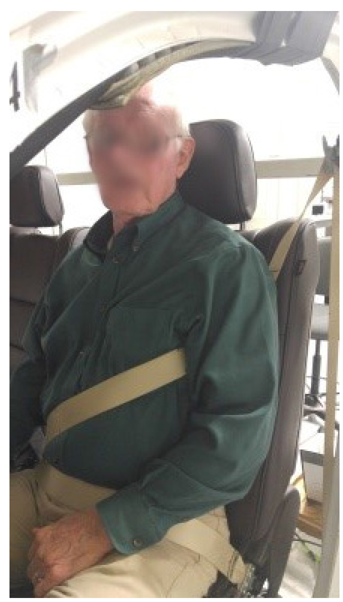
M3	Passenger seat belt latch plate engaged with driver's seat buckle.	
M4-1	Shoulder belt behind user; lap belt in correct position. Shoulder belt behind the occupant's back.	
M4-2	Shoulder belt behind user; lap belt in correct position. Shoulder belt under occupant's arm.	

Table 4-2. Seat Belt Misuses (continued)

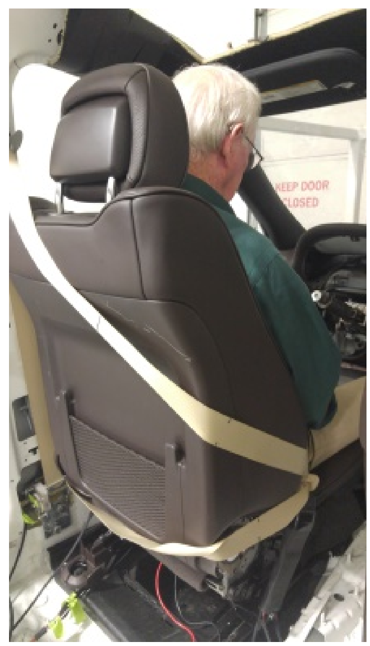
M5-1	Wrap belt around seat. Lap belt bucked but shoulder belt behind the seat (occupant restrained by lap belt).	
M5-2	Wrap belt around seat. Belt buckled behind the seat (no occupant restraint).	

Table 4-2. Seat Belt Misuses (continued)

M6	Remove head restraint, bring latch plate behind seat through head restraint opening and buckle from behind.	 
M7	Clipping the “expected” belt payout (for example, with a binder clip) to emulate a properly buckled occupant.	 

Table 4-2. Seat Belt Misuses (continued)

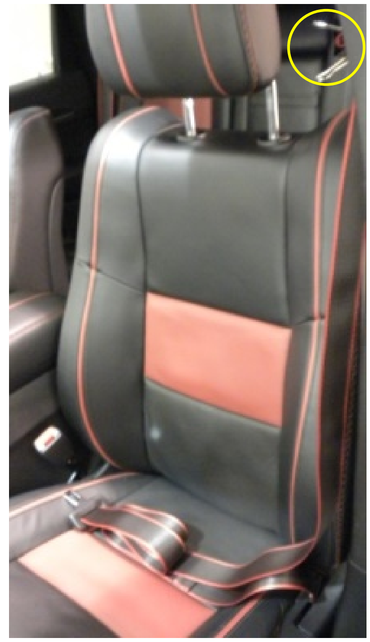
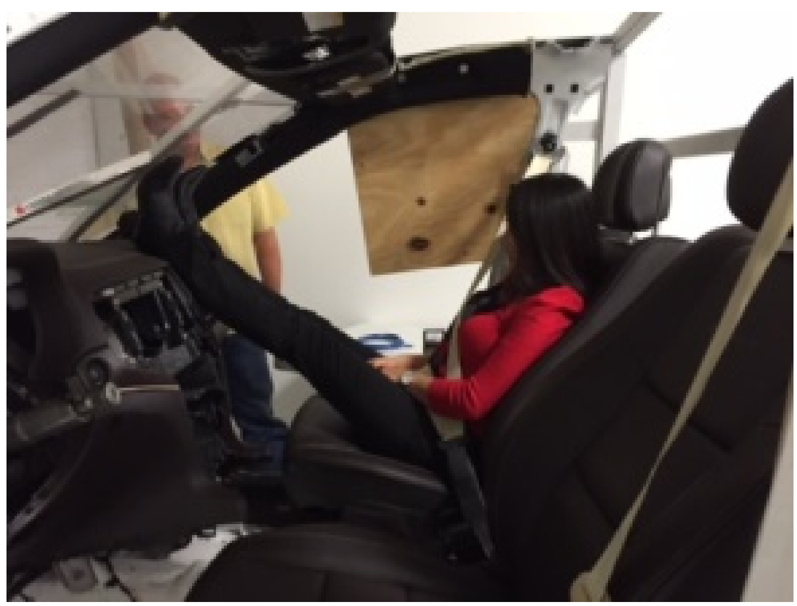
M8	Clipping extracted belt and latch plate not in buckle.	
M9	Surrogate Latch plates. Latch plates can be purchased to be inserted into a buckle to emulate a properly buckled occupant.	
M14-1	Out of position – Feet on Dashboard (straight out); occupant is buckled.	

Table 4-2. Seat Belt Misuses (continued)

M14-2	Out of position – Head resting on pillow against B-pillar/window; occupant is bucked.	
M14-3	Out of position – Twisted to face the rear seats; occupant is buckled.	

The team then rated the misuses as to the ease and likelihood of the misuse being implemented and whether or not the action was temporary or permanent. Temporary misuses are misuses that would return to their original state if removed or undone. Permanent misuses would be those that could not easily be undone such as a modification to the wire harness or re-flashing the microcontroller. The potential for misuse is, if the misuse has been implemented, how likely would it be used. These findings are described in Table 4-3. Also, certain misuses were being considered, but were not required as part of the scope of this project. Please refer to the key in Table 4-3 to discern which misuses were part of the study and which were not required.

The final rating (ExP) is the "Ease" value multiplied by the "Potential" value. This allows a misuse that is easy to accomplish and very likely to occur to have the lowest value; "1." A more difficult misuse will have a higher value and, likewise, a higher ExP rating, showing it is less likely to happen.

Table 4-3: Seat Belt Misuse Ratings

KEY:
Misuse
Normal Use Consideration
Misuse taken into consideration but not required.

ID	Misuse Action	Ease of Implementing (1=low, 5=high)	Potential for Misuse (1=high, 5=low)	Rating (ExP)
M0	Properly buckled occupant.	NA	NA	NA
M1	Sitting on buckled seat belt (lap and shoulder belt behind user).	1	1	1
M2	Leaving belt unbuckled.	1	1	1
M3	Passenger seat belt latch plate engaged with driver's seat buckle.	1	2	2
M4-1	Shoulder belt behind user; lap belt in correct position. Shoulder belt behind the occupant's back.	2	1	2
M4-2	Shoulder belt behind user; lap belt in correct position. Shoulder belt under occupant's arm.	1	1	1
M5-1	Wrap belt around seat. Lap belt bucked but shoulder belt behind the seat (occupant restrained by lap belt).	2	1	2
M5-2	Wrap belt around seat. Belt buckled behind the seat (no occupant restraint).	3	1	3
M6	Remove head restraint, bring latch plate behind seat through head restraint opening and buckle from behind. Occupant buckled.	2	1	2
M7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.	2	1	2
M8	Clipping extracted belt and latch plate not in buckle.	2	1	2
M9	Surrogate latch plates.	3	1	3
M10	Wire harness modification to "close" the buckle.	4	1	4
M11	Unbuckle after the vehicle is moving.	1	1	1
M12	Vehicle started, all occupants buckled initially, passenger gets out and returns and does not re-buckle.	1	1	1
M13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).	1	1	1
M14-1	Out of position – Feet on dashboard (straight out).	1	2	2
M14-2	Out of position – Head resting on pillow against B-pillar/window.	1	1	1
M14-3	Out of position – Twisted to face the rear seats.	1	1	1
M15	Reflash code on main controller.	5	1	5
M16	Reflash SBI module.	5	1	5

4.5.2.2 Countermeasure Analysis

A countermeasure is a device or sensor that may detect a misuse. This analysis was part of the Seat Belt Interlock Misuse Study. It is important to note that, for the purposes of this evaluation, each sensor was considered based on its own merits as a countermeasure. The comprehensive system approach was not being considered for this part of the study. The effectiveness of each countermeasure was ranked based on the criteria described in Table 4-4.

Table 4-4: Countermeasure Effectiveness Ranking

Ranking	Criteria
1	No use as a countermeasure.
2	Good countermeasure for about 25% of misuse.
3	Good countermeasure for about 50% of misuse.
4	Good countermeasure for about 75% of misuse.
5	Very good countermeasure for a high percentage of the misuse.

4.5.2.3 Pugh Analysis

The Pugh analysis (Appendix B) was used as part of the development approach to evaluate conceptual interlock sensors for the detection of misuses. It is a tool that can be used to evaluate several concepts simultaneously. The Misuse Study captured the thoughts on misuses as well as evaluated single sensors against one another to detect misuses based upon the team’s knowledge on the subject matter. Upon the completion of the matrix, this analysis highlighted a camera system would likely be the best option to adequately detect if a misuse has occurred. However, after further review, it was determined that the use of a camera could create other misuses and further refinement was required.

A second matrix was developed (sensor fusion) that defined the base system as a camera system and then evaluated various combinations of sensors that could provide equal, worse, or better protection to that of the base system. The results of the second matrix highlighted various combinations of sensors, which could be used and improve the detection of misuses vs. just a camera system. The final matrix, took additional factors into consideration, such as cost, weight, resistance to laptop interference, and camera specific misuses. These results then fed the test plans and focused the development efforts on vehicle implementation and functional testing of the 4 sensor systems that would provide optimal detection of misuses.

4.5.2.4 DFMEA Boundary Diagram

The FMEA block diagram is the foundation for the development of the full system design FMEA for the concept. It illustrates how the system may interface at a vehicle level and identifies the systems and sub-systems within the scope of this project (inside the boundary). Additionally, it identifies systems and sub-systems outside the scope of this project (outside the boundary), which may be potential causes and effects of a failures.

Figure 4-2 shows the internal and external interfaces of the system.

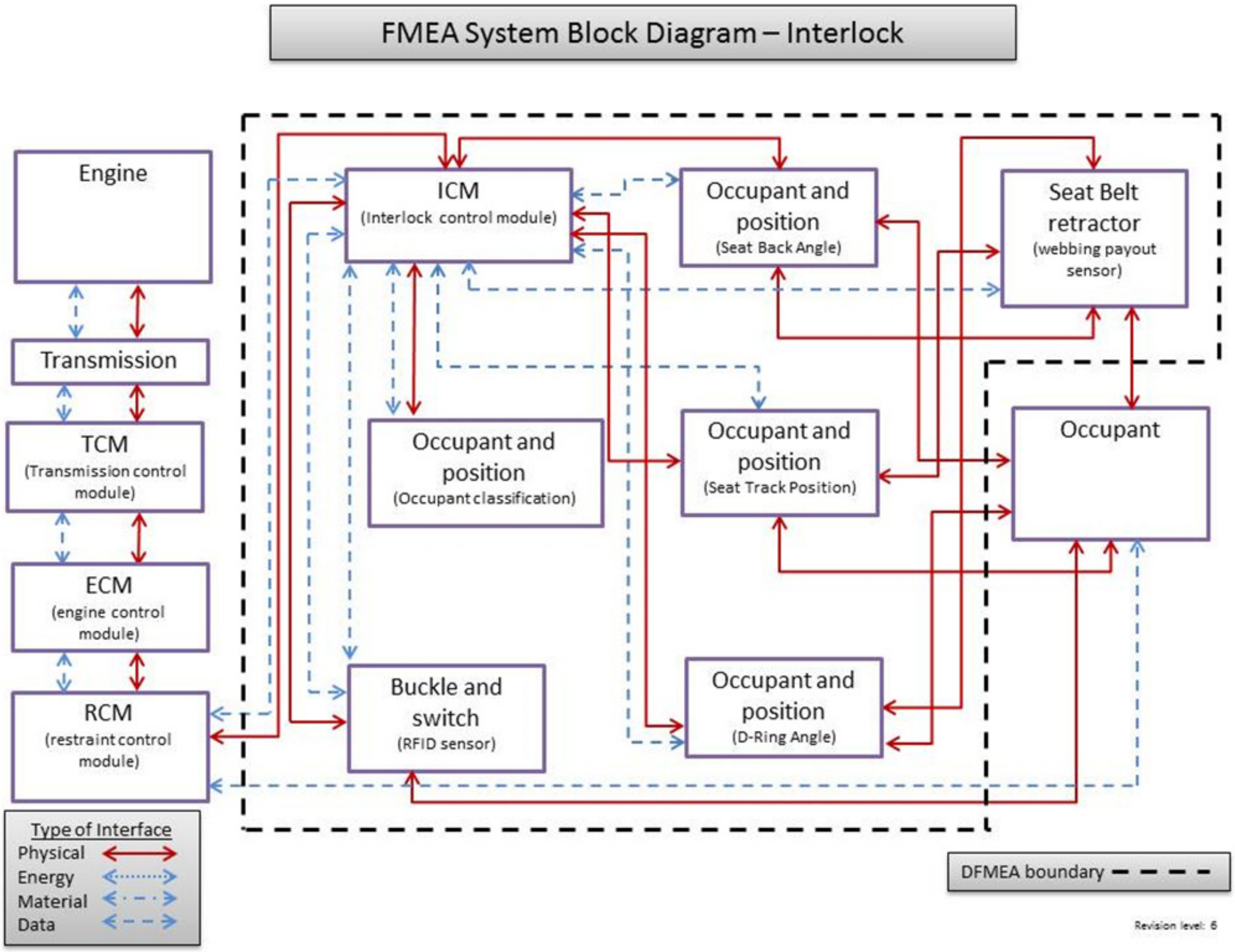


Figure 4-2: System Boundary Diagram

4.5.3 Realization

After completing the design effort (the realization process) of building the interlock system, the team began using specified materials and fabrication and production tools/procedures identified during the design phase. Early fabrication and production planning was critical for successful realization and delivery of the needed capability. System elements were built to the product baseline and should meet quality standards. Realization activities included:

- Obtaining or acquiring access to materials and tools required to build system elements;
- Obtaining external system elements as applicable;
- Building system elements in accordance with implementation procedures, tolerances, and applicable environmental, safety, and occupational health, security, and privacy;
- Determining system elements functionality against specified product quality characteristics;
- Documenting fabrication and production issues and associated corrective actions; and
- Delivering implemented system elements for integration and subsequent verification.

The next phase of the task was to design the seat belt interlock system. With the misuse and countermeasure evaluations completed, the team focused on a system that could be developed to optimize the goals of the task. The team assessed many technology options, including current components such as pressure sensors as well as new sensors for occupant detection, such as camera and wireless communication technologies.

This phase of the project was performed using a buck. A buck is a mockup of an actual vehicle or portion of a vehicle for testing purposes. A buck, typically, contains body-in-white as well as interior components. It does not contain a chassis or powertrain. For this project, a 2016 Jeep Grand Cherokee buck was used, as seen in Figures 4-3, 4-4 and 4-5.

Figure 4-3: Vehicle Buck Front Three-Quarter View

Figure 4-4: Vehicle Buck Rear View

Figure 4-5: Vehicle Buck Side View

Use of the buck allowed the team to evaluate sensors and make changes without the concern of jeopardizing the integrity of the vehicle and the final vehicle solution. For certain sensors, a bench level evaluation was sufficient and was also documented.

4.5.3.1 Countermeasures Evaluated

The countermeasures evaluated are shown in Table 4-5.

Table 4-5: Evaluation of Countermeasures

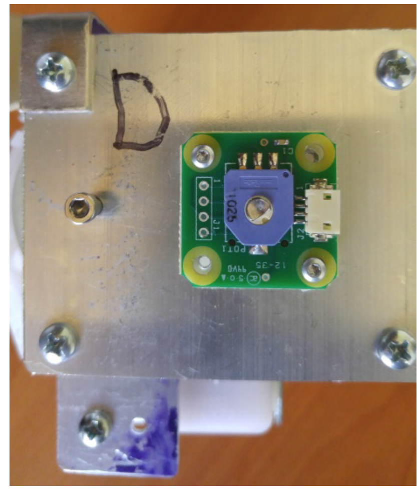
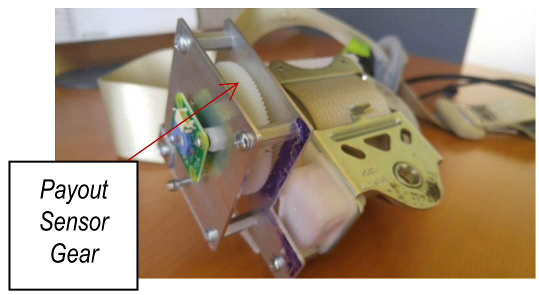
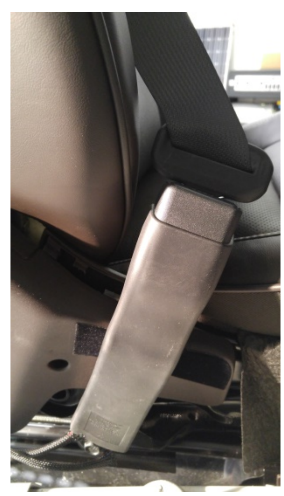
Countermeasure and Description	Photo of Countermeasure
C1 Seat Belt Webbing Payout Sensor – Webbing Dispensing **Location:** Driver and passenger seats. **Comments:** • Belt payout sensors were installed in both the driver and passenger sides of the buck. • The gear ratio for payout was 8:1.	 
C2 Belt Tension Sensor; Location: Buckle (B) **Location:** Driver and passenger seats **Comments:** • The belt tension sensor was located below the buckle in the buckle extender housing. • Testing revealed that the BTS could also demonstrate whether or not there was an occupant and if that occupant was buckled or sitting on the belt. (Significant for BTS at buckle and D-ring.)	

Table 4-5. Evaluation of Countermeasures (continued)

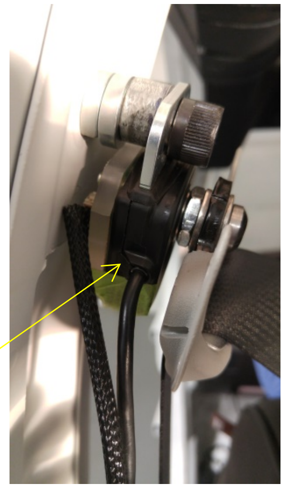
C2 Belt Tension Sensor; Location: D-Ring (D)

Location: Driver and passenger seats

Comments:

- The belt tension sensor, at the D-ring, was integrated with the position sensor at the same location.
- Testing revealed that the BTS could also demonstrate whether or not there was an occupant and if that occupant was buckled or sitting on the belt. (Significant for BTS at buckle and D-ring.)

Belt Tension Sensor



C2 Belt Tension Sensor; Locations: Anchor (A)

Location: Driver and passenger seats

Comments:

- The belt tension sensor at the buckle was affected by the anchor and chest. Therefore, the sensor at the buckle may be sufficient.
- The sensors were installed in the buck and data was collected for this sensor.

C3 Buckle & Latch Recognition (mechanical – keying)

Location: Passenger seat

Comment:

- The key was added to the passenger side latch plate. It is physically impossible to insert the passenger side latch plate into the driver's side buckle.

Table 4-5. Evaluation of Countermeasures (continued)

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C4 Buckle & Latch Recognition (latch plate sensing)

Location: Bench Level Demo

Comments:

- Radio-frequency identification was implemented in a buckle/latch system that was demonstrated at the bench level. The transponder begins communication approximately ½ in. from being fully engaged and will continue to transmit while buckled.
- Due to the complexity of the installation, this was not installed on the buck but was tested on the bench.
- The final vehicle solution included the RFID sensing.

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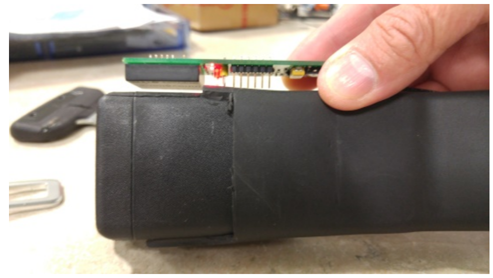

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C7 D-Ring Position Recognition

Location: Driver and passenger seats

Comment:

- The D-ring position sensor provides the angle of the D-ring. The position sensor is secured at a 35-degree angle to align with a 50% male occupant.

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Table 4-5. Evaluation of Countermeasures (continued)

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C8 Seat Track Position Sensor

Location: Driver and passenger seats

Comments:

- The seat track sensors were installed. Sensors were in three positions per side: full forward, mid track and full rearward.
- It was observed that the allowable travel differed between the driver's and passenger sides:
  - Driver seat: 11.25 in.
  - Passenger seat: 9.00 in.

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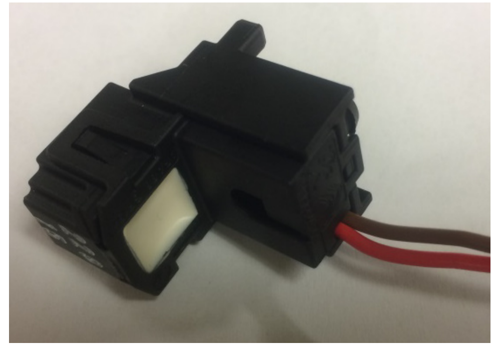

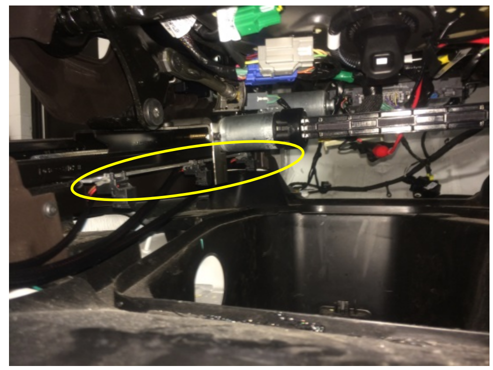

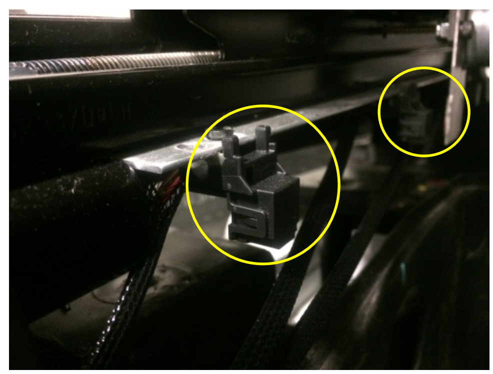

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C9 Capacitive Seat Mat Sensing

Location: Driver and passenger seats

Comments:

- For installation in the buck, the mats will be secured in place (i.e. taped down). If the final system (vehicle delivery) requires these sensors, they will be installed in the seat appropriately (under the first layer of fabric).
- For the passenger side, the cap sense will be used over the top of the bladder in the seat.
- Switched to local interconnect network (LIN) communications for the sense mat. Have the LIN communication protocol from the LIN description file. Communications are coded and are being tested and validated.

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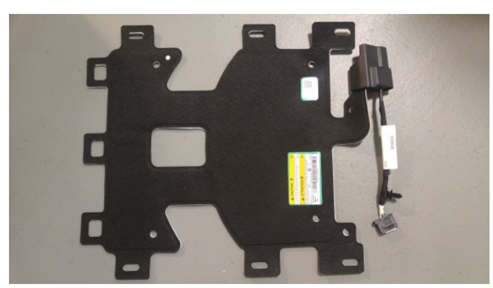

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Table 4-5. Evaluation of Countermeasures (continued)

C10 Occupant Classification (Bladder) Sensor **Location:** Passenger Seat **Comments:** • The bladder sensor is part of the original equipment with the seat/vehicle. The sensor output has been evaluated. ○ ≈ 600Ω = Unoccupied ○ ≈ 1400Ω = Occupied ○ Threshold force was between 35 lb. and 40 lb.	
C11 Force Sensor (for belt angle detection) **Location:** Driver's Seat ***Comments:*** • The force sensor detects a positive force when the buckle is used with an occupant. If buckled with no occupant, very low force detected. • The force sensor addition and the modification to the buckle for mechanical keying (C3) are not able to, physically, both be located in the buckle. For testing purposes, the force sensor was only implanted on the driver's side and the mechanical keying was implanted on the passenger side.	 Buckled, no occupant. Low Force ("negative" angle)  Buckled, occupant, Force Detected ("positive" angle)

4.5.4 Testing

An iterative process was also applied to the data collection and testing phase of the project. During the testing phase, multiple sets of data were collected until the data collection process had been optimized. Three steps were taken to develop the optimum method for collecting data:

1. Raw signal data was recorded under each condition (voltages);
2. The collected data was converted to the useful units (degrees, lb., etc.) and recorded by the data acquisition (DAQ) system along with the raw data; and

3. The test flow was optimized to create as much consistency as possible with a fluid test plan. This meant the seat track, seat incline, and misuse cases were put in an order such that there was minimal change between events tested.

4.5.4.1 Test Plan

The test plan evaluated three occupant types and six positions of each seat as detailed in the following sections.

Occupant Types

The occupant types described in Table 4-6 are representative of the Hybrid III crash test dummies. The Hybrid III crash test dummies are the standard representative occupants used for automotive crash testing. The 5th percentile female is a female in which 5 percent of the entire population, is below her in stature, size, and weight. Likewise, the 50th percentile male is a male in which 50 percent of the entire population are below him and 50 percent of the entire population are above him in stature, size, and weight. The 95th percentile male is a male in which 95 percent of the entire population are below him in stature, size and weight. The testing was done using human occupants who were close to the Hybrid III standards for the occupants listed.

Table 4-6: Occupant Types

Occupant	Height	Weight
5th Percentile Female	5 ft. 0 in.	110 lb.
50th Percentile Male	5 ft. 9 in.	170 lb.
95th Percentile Male	6 ft. 2 in.	223 lb.

Test Trials

The seat positions of each trial are noted in Table 4-7.

Table 4-7: Test Trials Seat Positions

1	5th Female		Full Up	Full Forward
2				Mid Position
3				Full Rearward
4	5th Female		Full Down	Full Forward
5				Mid Position
6				Full Rearward
7	50th Male		Full Up	Full Forward
8				Mid Position
9				Full Rearward
10	50th Male		Full Down	Full Forward
11				Mid Position
12				Full Rearward
13	95th Male		Full Up	Mid Position
14				Full Rearward
15	95th Male		Full Down	Mid Position
16				Full Rearward
17		5th Female	Full Up	Full Forward
18				Mid Position
19				Full Rearward
20		5th Female	Full Down	Full Forward
21				Mid Position
22				Full Rearward
23		50th Male	Full Up	Full Forward
24				Mid Position
25				Full Rearward
26		50th Male	Full Down	Full Forward
27				Mid Position
28				Full Rearward
29		95th Male	Full Up	Full Forward
30				Mid Position
31				Full Rearward
32		95th Male	Full Down	Full Forward
33				Mid Position
34				Full Rearward

Test Procedure

Step 1. Set seat incline/seat track
Step 2. Go through misuses
   Step 2A. Log file
   Step 2B. Take picture
Step 3. Repeat Step 2 until all misuses recorded
Step 4. Repeat Step 1 until all seat incline/track positions recorded

The abbreviations for seat incline and seat track positions are described in Table 4-8. Descriptions of each misuse case are described in Table 4-9. The seat incline test positions are described in Tables 4-10 and 4-11. The driver's seat track positions are described in Table 4-12 and the passenger's seat track positions are described in Table 4-13.

Table 4-8: Abbreviations for Seat Incline/Seat

Abbreviation	Seat Incline	Seat Track
FU FF	Full Upright	Full Forward
FD FF	Full Down	Full Forward
FD MT	Full Down	Mid Track
FU MT	Full Upright	Mid Track
FU FR	Full Upright	Full Rearward
FD FR	Full Down	Full Rearward

Table 4-9: Misuse Case Test Order

Misuse Case	Description
2	Unbuckled
1	Buckled belt, sit on the belt
0	Properly buckled
4-2	Put shoulder belt under arm (lap buckled)
4-1	Put shoulder belt behind back (lap buckled)
5-1	Put shoulder belt behind seat (lap buckled)
5-2	Unbuckle belt, buckle from behind the seat

Driver and passenger seat Inclines are referenced with horizontal being 0 degrees. Fully upright is 90 degrees.

Table 4-10: Driver's Side Seat Incline Test Positions

	Upright (FU)	Reclined (FD)
5th Percentile Female	90-degrees	75-degrees
50th Percentile Male	90-degrees	65-degrees
95th Percentile Male	90-degrees	60-degrees

Table 4-11: Passenger Side Seat Incline Test Positions

	Upright (FU)	Reclined (FD)
5th Percentile Female	80-degrees	42.5-degrees
50th Percentile Male	78.5-degrees	57-degrees
95th Percentile Male	77-degrees	60-degrees

Driver and passenger seat track positions are referenced with the full forward position being 0 in. and increasing as you move rearward in the vehicle.

Table 4-12: Driver's Side Seat Track Positions

	Forward (FF)	Mid Track (MT)	Rearward (FR)
5th Percentile Female	2 ⅛ in.	5 ⅜ in.	6 1/16 in.
50th Percentile Male	4 ⅛ in.	5 ⅜ in.	7 ⅛ in.
95th Percentile Male	N/A	5 ⅜ in.	10 ¾ in.

Table 4-13: Passenger Side Seat Track Positions

	Forward (FF)	Mid Track (MT)	Rearward (FR)
5th Percentile Female	0 in.	4 ⅝ in.	9 ¼ in.
50th Percentile Male	0 in.	4 ⅝ in.	9 ¼ in.
95th Percentile Male	3 in.	4 ⅝ in.	9 ¼ in.

4.5.4.2 Data Acquisition

Data acquisition was performed using a system from National Instruments capable of simultaneously recording data from multiple sensors and cameras, and displaying the data in real-time. The DAQ system was also used for the software algorithm development.

4.5.4.3 Data Analysis

For each test trial, all sensor data was recorded simultaneously using the DAQ. The data collected was reviewed and analyzed. The report for the data analysis can be found in Appendix D.

4.5.4.4 Data Analysis Summary

Tables 4-14 and 4-15 summarize the misuses the sensors were able to detect, over the occupant range, with known seat track and seat incline positions. The belt tension at the Buckle was not able to detect any misuses, therefore that row is blank. Also note, the status of the D-ring angle, when unbuckled, is not reliable because the belt can be left in any position.

Table 4-14: Driver's Side Seat Belt Misuse Detection

	Sitting on Buckled Belt	Unbuckled	Lap belt buckled; shoulder belt behind back	Lap belt buckled; shoulder belt under arm	Lap belt buckled; shoulder belt behind seat	Belt buckled behind seat; occupant not restrained.
MISUSE:	1	2	4-1	4-2	5-1	5-2
D-ring angle (with seat track and seat incline)	X	NA	X	X	X	X
Short Range Wireless Communication Buckle/Latch Recognition System (RFID) – Bench tested		X				
Belt Payout		X				
Pressure Switch at Buckle		X				
Belt Tension at D-ring				X		
Belt Tension at Anchor						X
Belt Tension at Buckle						

Table 4-15: Passenger Side Seat Belt Misuse Detection

	Sitting on buckled belt	Unbuckled	Lap belt buckled; shoulder belt behind back	Lap belt buckled; shoulder belt under arm	Lap belt buckled; shoulder belt behind seat	Belt buckled behind seat; occupant not restrained.
MISUSE:	1	2	4-1	4-2	5-1	5-2
D-ring Angle (with seat track and seat incline)	X	NA	X	X	X	X
Short Range Wireless Communication Buckle/Latch Recognition System (RFID) – Bench tested		X				
Belt Payout		X		X	X	X
Pressure Switch at Buckle		X				
Belt Tension at D-ring				X		
Belt Tension at Anchor						X
Belt Tension at Buckle						

4.5.5 Integration

The integration process was used to systematically assemble lower-level system elements into successively higher-level system elements, iterative with verification until the system itself emerged. Integration was essential to increasing system maturity, reducing risk, and preparing the system for transition to the vehicle and end user. This plan defined the stages of integration during which system elements were successively integrated to form higher level elements and eventually the finished product. The integration plan included a description of the required Systems Integration Laboratories or other facilities, personnel, test stands, harnesses, testing software, and integration schedule.

4.5.5.1 Vehicle Integration – Hardware

Prototype Vehicle

The prototype vehicle used was a 2016 Jeep Grand Cherokee. The passenger side seat had an occupant classification system that detects the presence of a passenger seat occupant through a pressure sensor in a bladder that senses weight.

Modifications Made to Vehicle

In addition to the inclusion of the sensors required for the interlock system, other modifications that were made to the vehicle.

- D-ring Height Adjustment: The original equipment allowed for adjustment to the height of the D-ring. In order to package and use the D-ring angle sensor, the D-ring was fixed at its highest allowable location.
- D-ring Support Hub: The D-ring support hub was modified by boring out the center section to accept a low friction roller bearing which allows the D-ring to move more freely and provide an accurate D-ring angle.

Baseline Interlock System

The baseline interlock system was comprised of multiple sensors. Their arrangement is depicted in Figure 4-6 and details are provided in Tables 4-16 to 4-22.

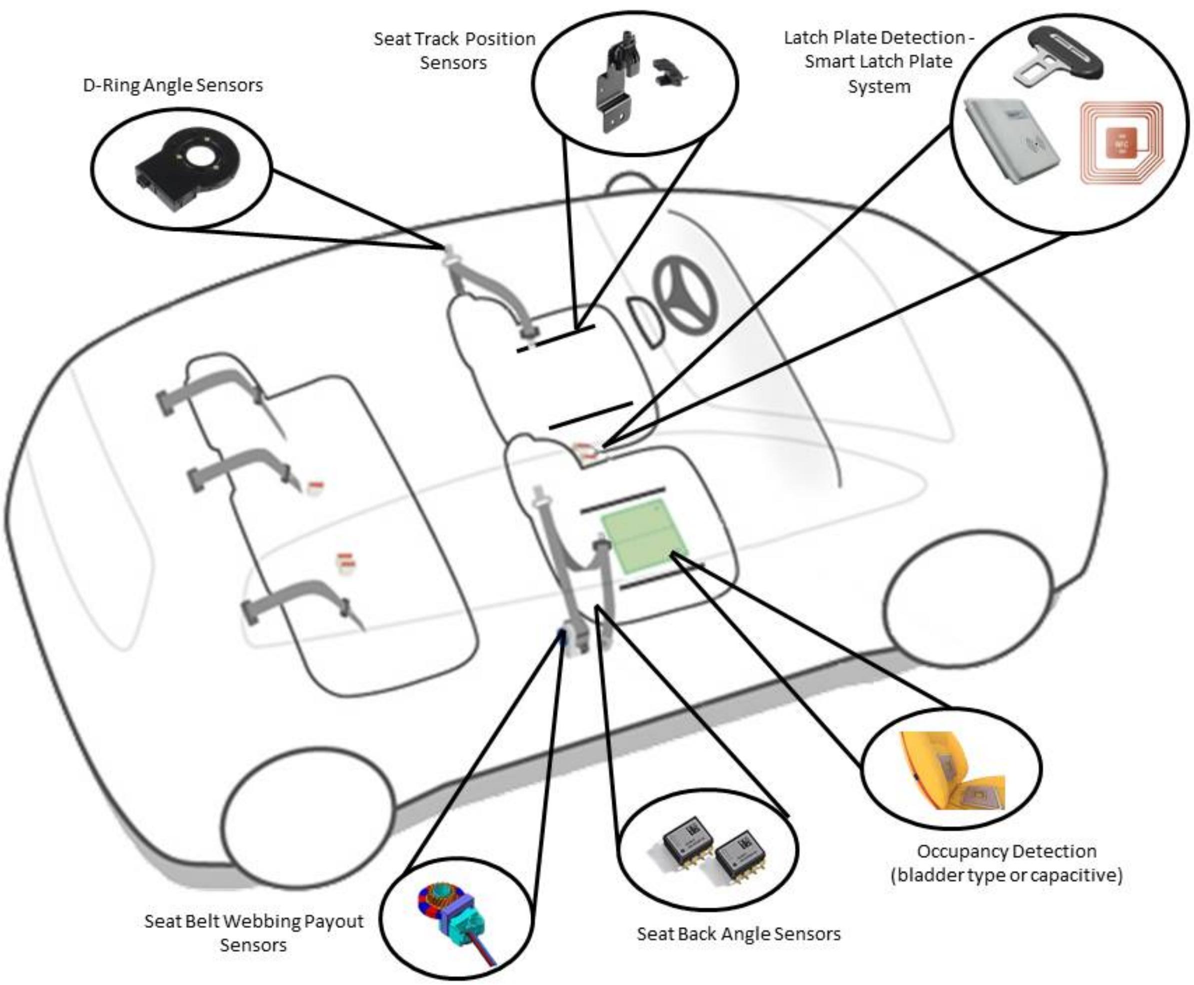


Figure 4-6: Baseline Interlock System Sensors

Table 4-16: Occupant Classification System (OCS) Sensor Description

Vehicle location:	Integrated in passenger seat.
DS/PS or both?	Passenger side only.
Description of sensor:	The OCS is standard equipment on the 2016 Jeep Grand Cherokee. The sensor acts as a switch and is triggered based on occupant weight.
Primary function in interlock system:	The OCS will determine if there is an occupant located in the passenger side of the vehicle. If there is not, the system will not interlock based on a passenger.
Manufacturer and part number:	FCA: 6054211AC (part of front seat assembly)
Modifications made to the purchased part:	None
Photo:	
Advantages of this sensor:	This sensor is already in production on many Chrysler products; the only modification needed would be an output to the interlock module.
Disadvantages of this sensor:	Not all OEMs may have this system in their vehicles.

Table 4-17: Buckle Switch Sensor Description

Vehicle location:	Integrated with the seat buckle.
DS/PS or both?	Located in both driver and passenger sides.
Description of sensor:	This sensor is standard equipment on all vehicles.
Primary function in interlock system:	This sensor is used, as intended, in its function as an indication that the buckle is inserted into the latch.
Manufacturer and part number:	Chrysler: 1VL10TRMAD, 1VL12TRMAD
Modifications made to the purchased part:	None
Photo:	
Advantages of this sensor:	This sensor is already standard equipment on many vehicles as it is used for the belt minder function.
Disadvantages of this sensor:	On its own, the sensor cannot determine if the proper buckle and latch are engaged. For example, if the passenger latch plate is inserted in the driver's side buckle.

Table 4-18: Short Range Wireless Communication Buckle/Latch Recognition System Sensor Description

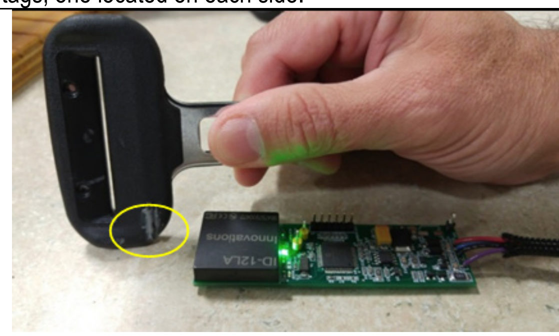
Vehicle location:	Integrated with the buckle and latch.
DS/PS or both?	Located in both driver and passenger sides.
Description of sensor:	This sensor uses the basis of short-range wireless communication proximity to establish communication between a buckle and latch.
Primary function in interlock system:	The latch contains an identifier which is transmitted to the buckle when they are in proximity, such that the latch has been inserted into the buckle.
Manufacturer and part number:	ID Innovation: Reader ID-12LA; Tag JSGT313-RO
Modifications made to the purchased part:	Custom electronics were developed for the short range wireless communication system in this application. The buckles were then modified to include a custom printed circuit board (PCB) with a short-range wireless communication reader. The latch plates have two tags, one located on each side.
Photos:	 Short-range wireless communication tag in yellow circle; PCB and short-range wireless communication reader with green LED. PCB to be packaged with the buckle.  Receiver packaged in white housing.
Advantages of this sensor:	1. The identifier for the latch can also include the VIN that will further enhance the safety system. 2. The transmitter can only be located on one side of the latch. This will assure it is inserted in the proper orientation.
Disadvantages of this sensor:	The electronics for the receiver need to be packaged in the buckle.

Table 4-19: Seat Track Position Sensor Description

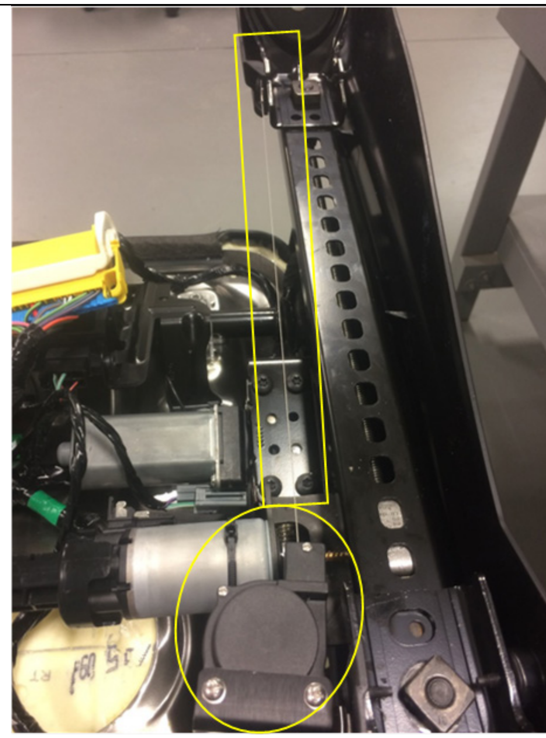
Vehicle location:	The underside of the seat.
DS/PS or both?	Located in both driver and passenger sides.
Description of sensor:	The sensor is a simple string potentiometer. A potentiometer is a rotational sensor that uses a resistor with a moving contact that creates an adjustable voltage divider. This allows movement to be detected with a change in voltage.
Primary function in interlock system:	D-ring angle varies based on seat track location and seat incline. Thus the seat track needs to be known.
Manufacturer and part number:	UniMeasure, Inc. LX-PA
Modifications made to the purchased part:	None
Photo:	 Underside of seat shown.
Advantages of this sensor:	Readily available COTS part.
Disadvantages of this sensor:	Use of a string potentiometer would not be ideal for a production vehicle unless it was packaged in such a way that it was covered. The entire seat track length is not needed so three to five located along the seat track would be sufficient.

Table 4-20: Seat Incline Sensor Description

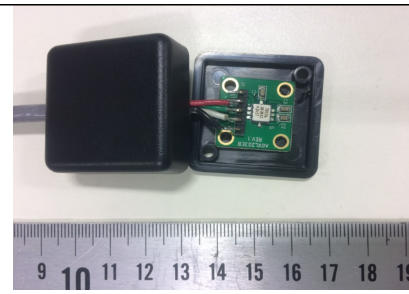
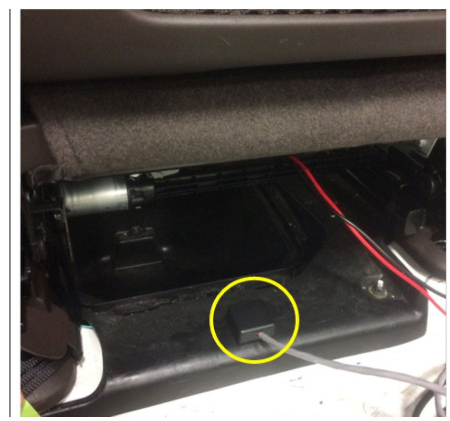
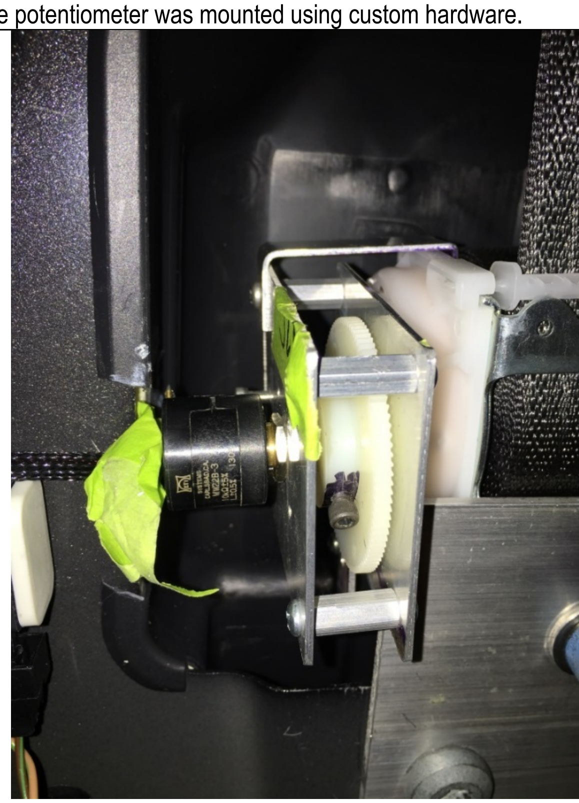
Vehicle location:	Seat incline is determined using accelerometers. One accelerometer is packaged in the seat back parallel to the floor. The other accelerometer is packaged on the seat floor.
DS/PS or both?	Located in both driver and passenger sides.
Description of sensor:	The accelerometers are used to determine true position of the seat back. This is done by subtracting the reading on the floor (so that if the vehicle is on an incline, an accurate seat incline can be calculated).
Primary function in interlock system:	D-ring angle varies based on seat track location and seat incline; thus the seat incline needs to be known.
Manufacturer and part number:	Analog devices; ADXL203
Modifications made to the purchased part:	None
Photos:	  Baseline sensor, located on seat floor.  Sensor packaged in seat back.
Advantages of this sensor:	The sensor comes packaged and is readily available.
Disadvantages of this sensor:	In addition to needing one sensor per seat, a baseline sensor is also needed to calculate true position.

Table 4-21: D-Ring Angle Sensor Description

Vehicle location:	Packaged with the seat belt D-ring in the B-pillar.
DS/PS or both?	Located in both driver and passenger sides.
Description of sensor:	This sensor had an output voltage that correlates to the angle of the D-ring.
Primary function in interlock system:	D-ring angle has proven to be a good indication of proper seat belt use versus the identified misuses.
Manufacturer and part number:	Not applicable.
Modifications made to the purchased part:	Not applicable.
Photos:	 D-ring at fixed height.  D-ring angle sensor; custom encoder PCB.
Advantages of this sensor:	This sensor is able to detect proper belt use from misuses. It is small, low cost, and relatively easy to package.
Disadvantages of this sensor:	The sensor is useful when the seat track and seat incline are known, so it requires the addition of those sensors. It also assumes a fixed D-ring height. If the OEM desires an adjustable D-ring height then another sensor, to detect the height, may be required.

Table 4-22: Belt Payout Sensor Description

Vehicle location:	Located in B-pillar with belt retractor.
DS/PS or both?	Located in both driver and passenger sides.
Description of sensor:	The sensor is a 3-turn potentiometer that uses the entire length of the belt. It uses a custom encoder PCB. A potentiometer is a rotational sensor that uses a resistor with a moving contact that creates an adjustable voltage divider. This allows movement to be detected with a change in voltage.
Primary function in interlock system:	The belt payout is a redundant sensor. It will be used if there is conflict in the data from other sensors to determine if there is a properly buckled occupant.
Manufacturer and part number:	ETI Systems, MW22B
Modifications made to the purchased part:	The potentiometer was mounted using custom hardware.
Photo:	 3-turn potentiometer with custom encoder PCB.
Advantages of this sensor:	This sensor may help prevent false misuses detection, which would improve consumer acceptance.
Disadvantages of this sensor:	Belt payout reading can be falsified by clipping extracted belt to a length that represents a properly buckled occupant.

The following data presented is for the hardware calibrations for required sensors.

The calibration of the seat track position sensors is detailed in Tables 4-23 and 4-24. The calibration of the D-ring sensors is detailed in Tables 4-26 and 4-27. The calibration of the belt payout sensor is detailed in Table 4-28.

Table 4-23: Driver's Side Seat Track Position Sensor Calibration

Input Voltage [V]:	5
String Pot [Ohm]:	1000

Seat Position [in.]	Output Voltage	Delta
0.0	0.529	-
0.5	0.683	0.154
1.0	0.843	0.160
1.5	1.003	0.160
2.0	1.170	0.167
2.5	1.329	0.159
3.0	1.486	0.157
3.5	1.647	0.161
4.0	1.807	0.160
4.5	1.946	0.139
5.0	2.121	0.175
5.5	2.276	0.155
6.0	2.435	0.159
6.5	2.582	0.147
7.0	2.760	0.178
7.5	2.911	0.151
8.0	3.073	0.162
8.5	3.235	0.162
9.0	3.379	0.144
9.5	3.537	0.158
10.0	3.704	0.167
10.5	3.864	0.160
11.0	4.001	0.137
10.5	3.856	-0.145
10.0	3.698	-0.158
9.5	3.541	-0.157
9.0	3.399	-0.142
8.5	3.235	-0.164
8.0	3.068	-0.167
7.5	2.905	-0.163
7.0	2.749	-0.156
6.5	2.592	-0.157
6.0	2.434	-0.158
5.5	2.275	-0.159
5.0	2.118	-0.157
4.5	1.954	-0.164
4.0	1.802	-0.152
3.5	1.642	-0.160
3.0	1.490	-0.152
2.5	1.326	-0.164
2.0	1.165	-0.161
1.5	0.992	-0.173
1.0	0.835	-0.157
0.5	0.690	-0.145
0.0	0.530	-0.160

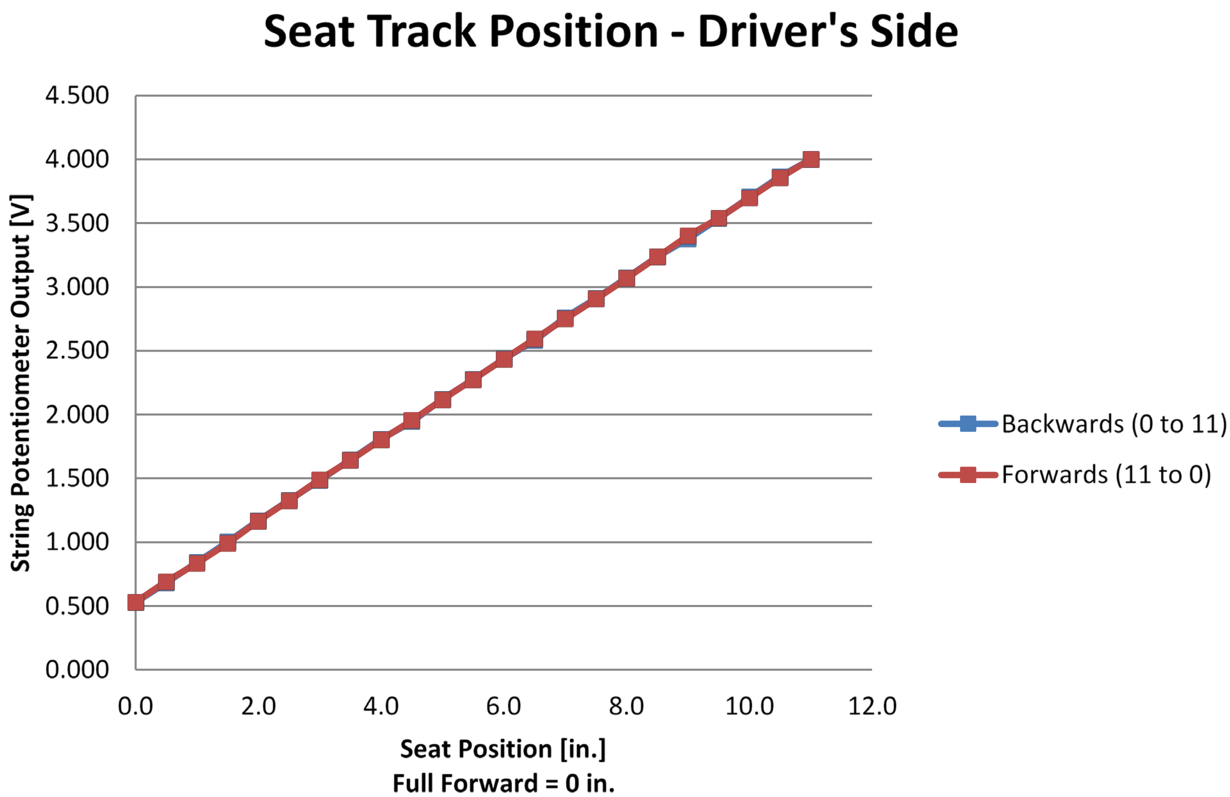


Figure 4-7: Driver's Side Seat Track Position Sensor Calibration Graph

Table 4-24: Passenger Side Seat Track Position Sensor Calibration

Input Voltage [V]:	5	
String Pot [Ohm]:	1000	
Seat Position [in.]	**Output Voltage**	**Delta**
0.0	1.191	-
0.5	1.336	0.145
1.0	1.485	0.149
1.5	1.654	0.169
2.0	1.799	0.145
2.5	1.944	0.145
3.0	2.095	0.151
3.5	2.264	0.169
4.0	2.420	0.156
4.5	2.570	0.150
5.0	2.721	0.151
5.5	2.889	0.168
6.0	3.038	0.149
6.5	3.210	0.172
7.0	3.367	0.157
7.5	3.512	0.145
8.0	3.692	0.180
8.5	3.837	0.145
9.0	3.976	0.139
8.5	3.835	-0.141
8.0	3.691	-0.144
7.5	3.535	-0.156
7.0	3.359	-0.176
6.5	3.205	-0.154
6.0	3.049	-0.156
5.5	2.892	-0.157
5.0	2.732	-0.160
4.5	2.580	-0.152
4.0	2.416	-0.164
3.5	2.263	-0.153
3.0	2.103	-0.160
2.5	1.940	-0.163
2.0	1.779	-0.161
1.5	1.638	-0.141
1.0	1.485	-0.153
0.5	1.336	-0.149
0.0	1.190	-0.146

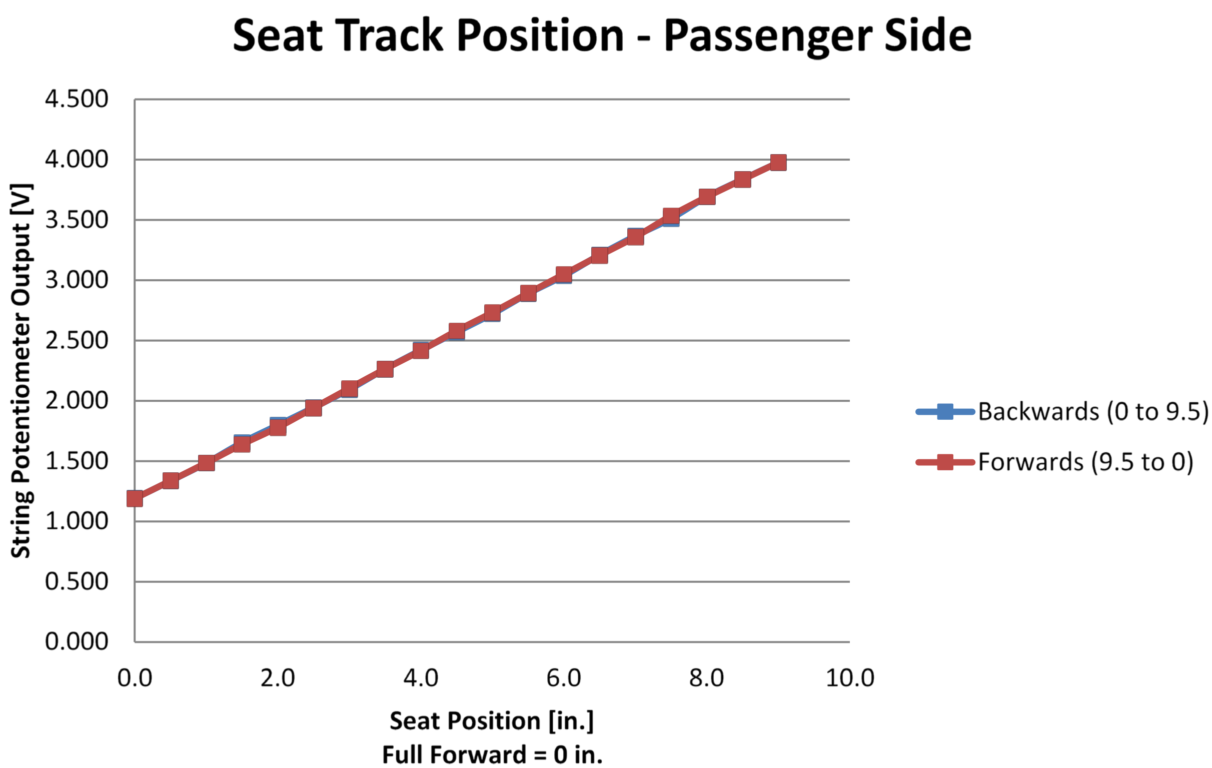


Figure 4-8: Passenger Side Seat Track Position Sensor Calibration Graph

Table 4-25: Seat Incline Sensor Calibration

Sensor Model No:	ADXL203EB
Angle Sensor Input Voltage:	5
Floor Sensor Output (flat):	2.431

Seat Angle		
Actual [degrees]	**Measured [degrees]**	**Sensor Output Voltage [V]**
90	78.5	2.400
95	83.5	2.485
100	88.5	2.569
105	86.5	2.655
110	81.5	2.737
115	76.5	2.818
120	71.5	2.894
125	66.5	2.971
130	61.5	3.039
135	56.5	3.108
140	51.5	3.166
145	46.5	3.225
150	41.5	3.276
155	36.5	3.320
160	31.5	3.357
165	26.5	3.388
170	21.5	3.411
175	16.5	3.431
180	11.5	3.440
175	16.5	3.430
170	21.5	3.411
165	26.5	3.386
160	31.5	3.354
155	36.5	3.315
150	41.5	3.268
145	46.5	3.217
140	51.5	3.160
135	56.5	3.094
130	61.5	3.031
125	66.5	2.961
120	71.5	2.884
115	76.5	2.808
110	81.5	2.722
105	86.5	2.641
100	88.5	2.559
95	83.5	2.473
90	78.5	2.398

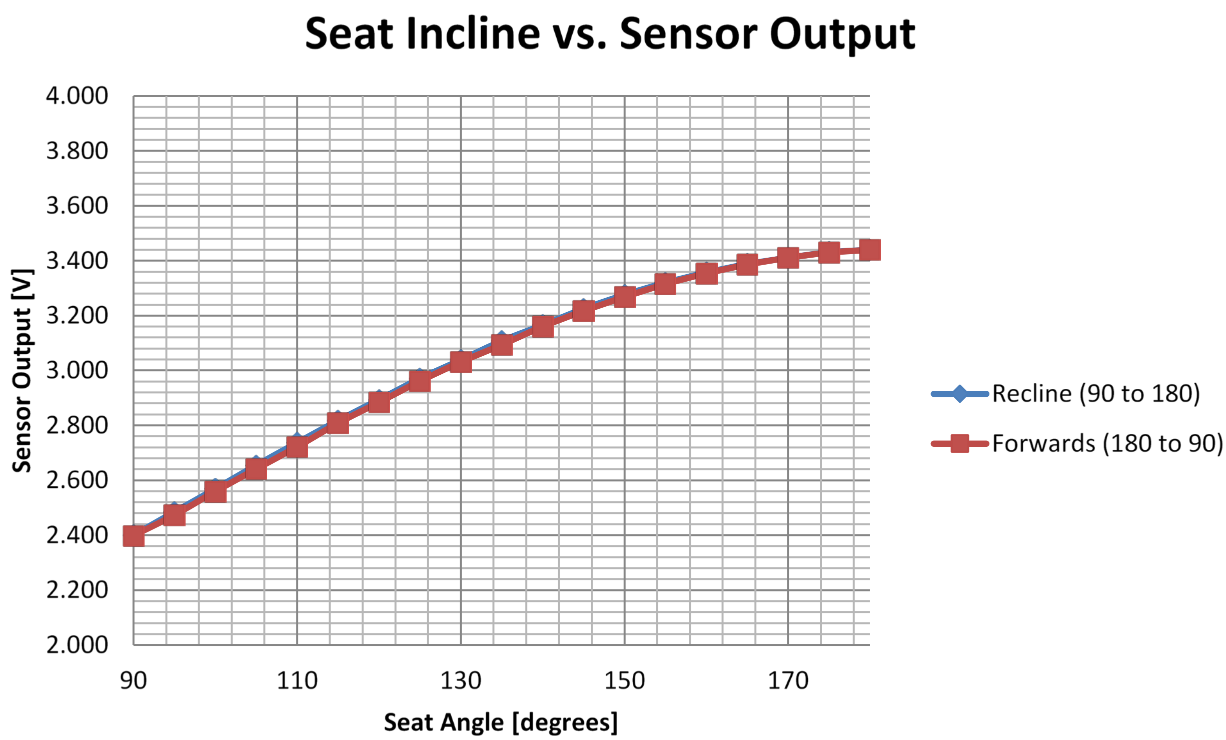


Figure 4-9: Seat Incline Sensor Calibration Graph

Table 4-26: Driver's Side D-Ring Sensor Calibration

ANGLE (degrees)	VOLTS (Clockwise Rotation)	VOLTS (Counterclockwise Rotation)
0	2.71	2.71
10	2.57	2.87
20	2.41	3.03
30	2.26	3.16
40	2.08	3.32
50	1.94	3.47
60	1.79	3.62
70	1.65	3.77
80	1.51	3.91
90	1.36	4.04

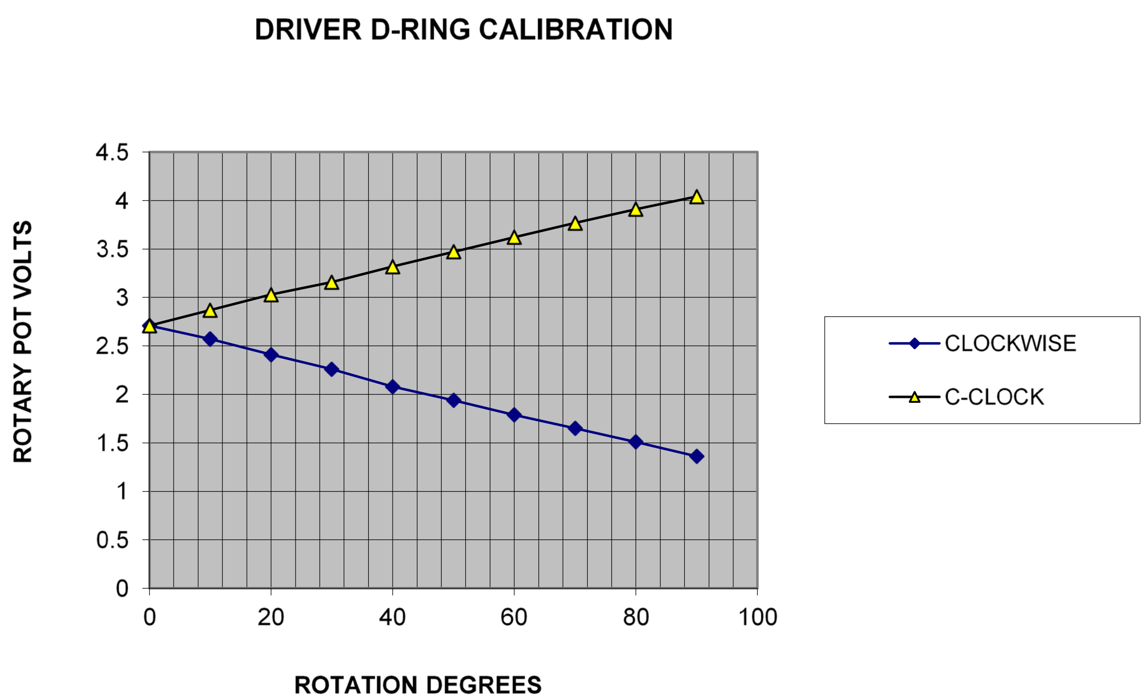


Figure 4-10: Driver's Side D-Ring Sensor Calibration Graph

Table 4-27: Passenger Side D-Ring Sensor Calibration

ANGLE (degrees)	VOLTS (Clockwise Rotation)	VOLTS (Counterclockwise Rotation)
0	2.28	2.28
10	2.17	2.44
20	2.03	2.6
30	1.87	2.73
40	1.72	2.89
50	1.57	3.06
60	1.42	3.19
70	1.24	3.35
80	1.08	3.49
90	0.93	3.69

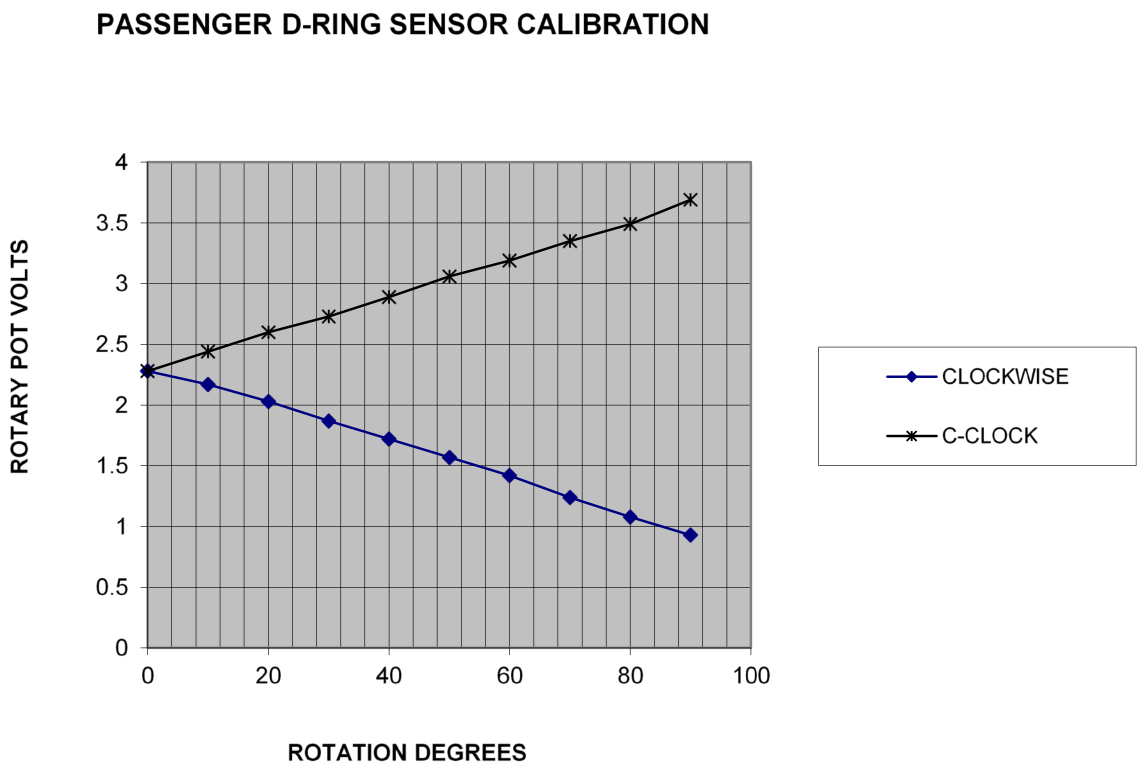


Figure 4-11: Passenger Side D-Ring Sensor Calibration Graph

Table 4-28: Belt Payout Sensor Calibration

Belt Extraction (in.)	Driver's Side Sensor (volts)	Passenger Side Sensor (volts)
0	1.185	2.376
10	1.443	2.64
20	1.737	2.927
30	2.042	3.226
40	2.37	3.554
50	2.72	3.898
60	3.114	4.301
70	3.573	4.747

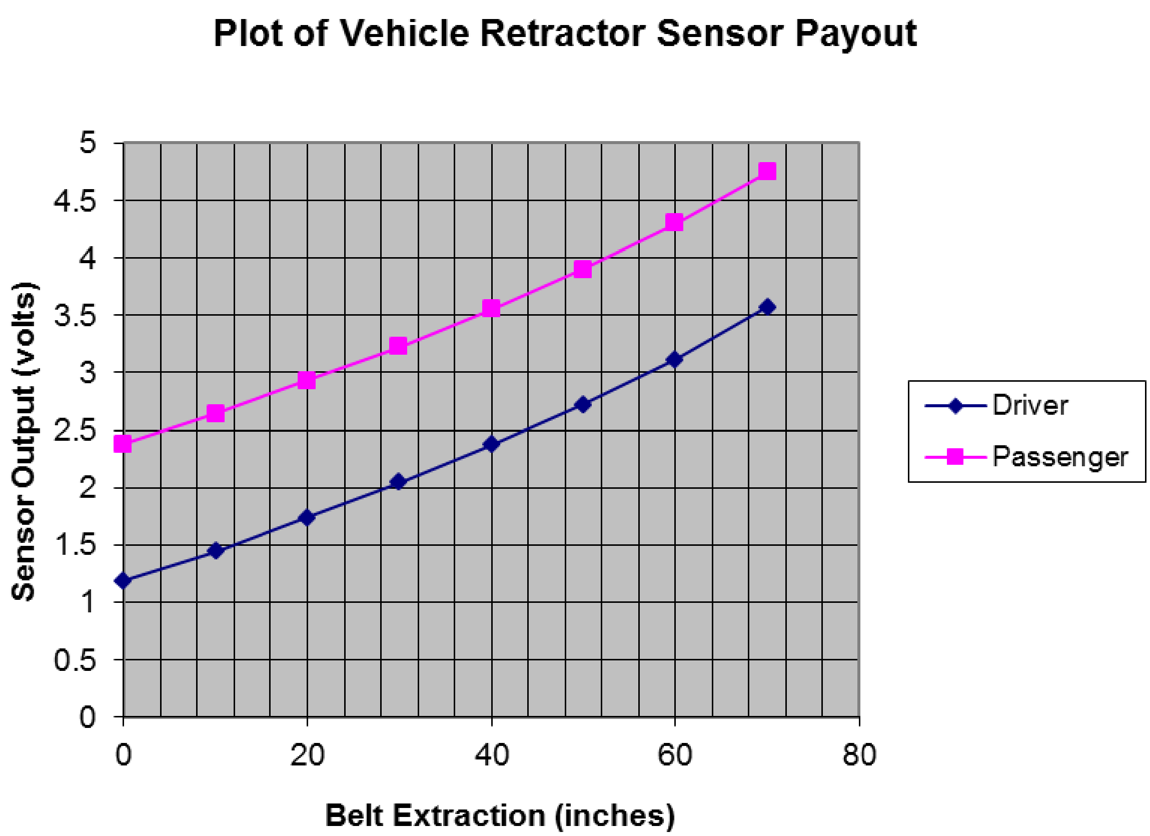


Figure 4-12: Belt Payout Sensor Calibration Graph

4.5.5.2 Vehicle Integration – Software/Algorithm

Figure 4-13 is a possible implementation of an interlock system. The interlocks shown in this section are to demonstrate the potential for vehicle integration to interrupt and limit vehicle functionality based on lack of proper belt use.

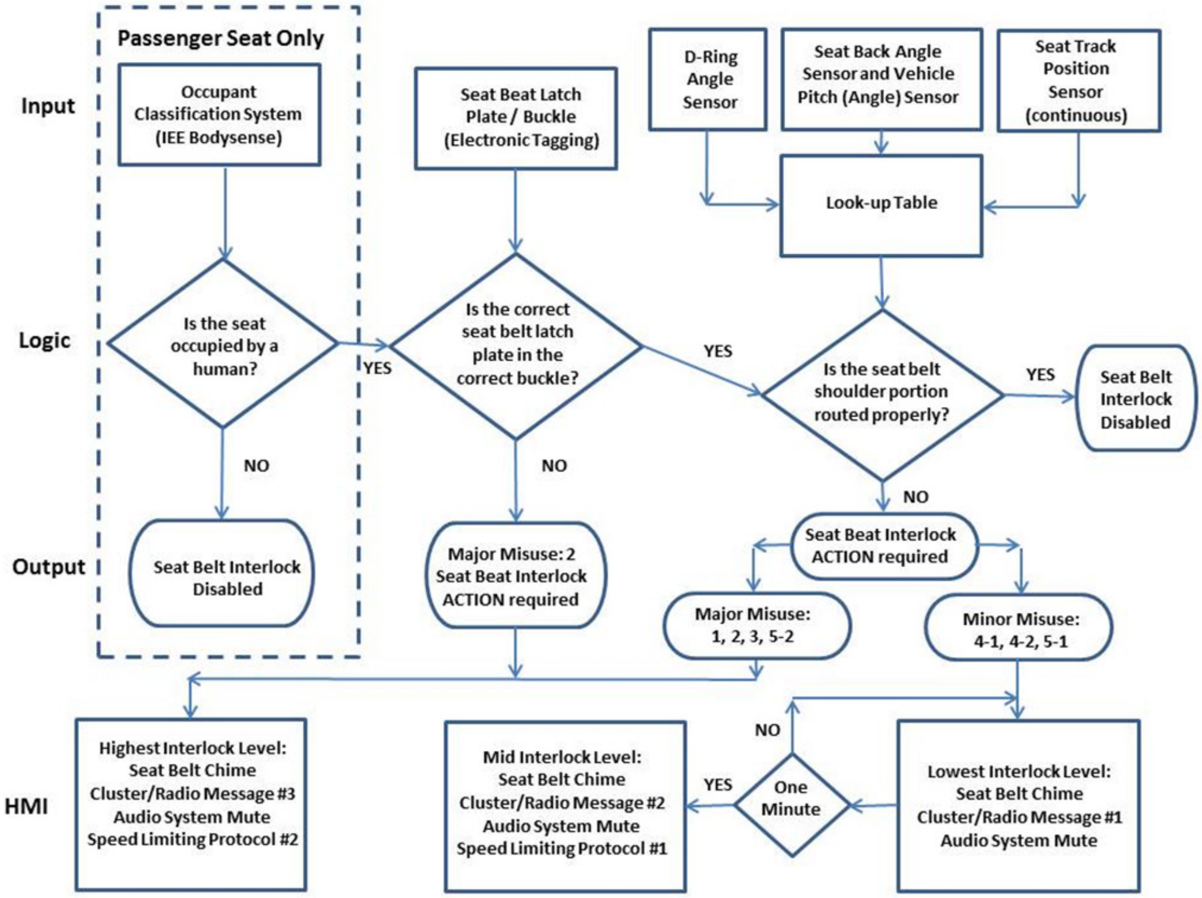


Figure 4-13: Vehicle Integration Implementation

There are two levels of misuse, as shown in Table 4-29.

Table 4-29: Level of Misuse

Misuse Level	Description	Misuses in Study
Major Misuse	Lap and shoulder belts not in use; not buckled.	1, 2, 3, 5-2
Minor Misuse	Lap belt in use but shoulder not used or used improperly.	4-1, 4-2, 5-1

The durations shown in Table 4-30 are arbitrary but show that the duration of misuse could be considered before implementing an interlock. This could also be based on vehicle speed with a similar implementation.

Table 4-30: Duration of Misuse

Duration	Duration Description
Start	Ignition to 1 minute
Post Start	1+ to 5 minutes
Long Term	5+ minutes

In the recommended interlock strategy (detailed in Table 4-31) if the driver is not properly buckled prior to starting the vehicle, the interlock system would be at the highest level of interlock (possibly not allowing the vehicle into gear). There would be more flexibility with the passenger. However, after one minute, the interlock strategy is the same for both driver and passenger.

Table 4-31: Interlock Strategy

	MISUSE TYPE	
DURATION	**Minor Misuse** (4-1, 4-2, 5-1)	**Major Misuse** (1, 2, 3, 5-2)
Start	Low Level	Highest Level (DS) Low Level (PS)
Post Start	Mid-Level	Highest Level
Long Term	Mid-Level	Highest Level of Interlock

Figures 4-14 and 4-15 detail possible interlock strategies involving the human machine interface.

HMI MESSAGES:

Lowest Interlock Level:	Mid Interlock Level:	Highest Interlock Level:
Seat Belt Chime	Seat Belt Chime	Seat Belt Chime
Cluster/Radio Message #1	Cluster/Radio Message #2	Cluster/Radio Message #3
Audio System Mute	Audio System Mute	Audio System Mute
	Speed Limiting Protocol #1	Speed Limiting Protocol #2

Cluster/Radio Message #1: 'Driver, please fasten your seat belt' or 'Passenger, please fasten your seat belt' or 'Occupants, please fasten your seat belts'.

Cluster/Radio Message #2: 'Vehicle will be speed restricted to 40 mph until all occupants have fastened their seat belts'.

Cluster/Radio Message #3: 'Vehicle will be speed restricted to 20 mph until all occupants have fastened their seat belts'.

Figure 4-14: Use of HMI Messages in Interlock Strategies

SPEED LIMITING PROTOCOL:

Lowest Interlock Level:	Mid Interlock Level:	Highest Interlock Level:
Seat Belt Chime	Seat Belt Chime	Seat Belt Chime
Cluster/Radio Message #1	Cluster/Radio Message #3	Cluster/Radio Message #3
Audio System Mute	Audio System Mute	Audio System Mute
	Speed Limiting Protocol #1	Speed Limiting Protocol #2

Speed Limiting Protocol #1: Maximum vehicle speed restricted to 40 mph.

Speed Limiting Protocol #2: Maximum vehicle speed restricted to 20 mph.

Figure 4-15: Use of a Speed Limiting Protocol in Interlock Strategies

4.5.6 Verification Process

The verification process provided evidence that the interlock system or system elements performed its intended functions and met all performance requirements listed in the system performance specification. Verification simply answers the question, "Was the system built correctly?" Verification is a key risk-reduction activity in the implementation and integration of a system and enabled the team to catch defects in system elements before integration at the next level, thereby preventing costly troubleshooting and rework.

The team's experience in using this methodology allowed use of one or more of the following methods to verify the interlock seat belt system:

- **Demonstration** – Operations were performed at the system or vehicle level where visual observations were the primary means of verification. Demonstration was used when quantitative assurance was not required for verification of the requirements.
- **Examination** – Visual inspection of equipment was performed and evaluation of drawings and other pertinent design data and processes verified conformance with characteristics such as physical, material, part, and product marking and workmanship.
- **Analysis** – Several analytic techniques were used (including computer models) to interpret or explain the behavior/performance of the system element. Test data was analyzed and compared to design data, as appropriate, to verify requirements.
- **Test** – The interlock system was tested against misuse and work-arounds so data could be provided on functional features and equipment operation under fully controlled and traceable conditions. The data would, subsequently, be used to evaluate quantitative characteristics.

The individual system elements were verified by the implementation process through developmental test and evaluation. For the interlock system, this included acceptance testing. During the integration process, successively higher-level system elements were verified before moving on to the next level of integration. Verification of the system as a whole occurred when integration was complete.

As design changes occurred, assessments were made for each change relative to potential impact to the qualified baseline. Often, this prompted a need to repeat portions of verification in order to mitigate risk of performance degradation.

The output of the verification process was a seat belt interlock system with documentation to support NHTSA's Initial Operational Test and Evaluation. NHTSA will provide a determination of the extent to which the system meets the system performance specification.

4.5.7 Validation Process

The last step in the design methodology was the validation process. Validation provided objective evidence that the capability provided by the system complies with NHTSA's performance requirements, achieving its use in its intended goals and objectives. Validation answered the question, "Is it the right solution to the problem?" Validation consisted of evaluating the operational effectiveness, misuse and work-around robustness, sustainability, and the ability to integrate into the vehicle architecture. The product of the validation process was a validated system and enabling system elements, leading to approval. The other major output of this process was the lessons learned document.

4.5.7.1 Design Validation Plan and Report

Vehicle performance will be evaluated via the DVP&R (Appendix F).

4.5.7.2 VRTC Independent Evaluation

The final validation will conclude with the results of the independent evaluation of the prototype vehicle by NHTSA, which took place from February 1 to August 2, 2017.

5. Conclusions

This study concludes that a vehicle sensor solution can be achieved, that is able to determine if the occupants are properly restrained, for the identified occupant range (5th percentile female to 95th percentile male). The study was conducted by Survivability Solutions, in partnership with NHTSA, NCMS, BGM Engineering, FCA, and Takata. The scope of the effort included defining, analyzing, and evaluating seat belt misuse cases and known work-arounds to preventative measures. The outcome of this study was a vehicle solution that meets the project goals, outlined by NHTSA, and also varies greatly from the original seat belt interlock systems developed in the 1970s. This system uses multiple sensors to discern whether or not the occupants are properly restrained, rather than relying on a single sensor. This system and its capabilities are described below in Table 5-1. Focusing on the work-arounds that occupants developed to defeat the initial interlock systems, the team has also investigated misuses that may arise from the proposed solution. Key achievements from this project are summarized as follows.

- Sensor combination identified to detect all known seat belt misuses
- Vehicle integration of the interlock system

The goals of this project were met by the study concluding that, for the misuse cases identified within the study, a vehicle can be designed and developed, with COTS technologies, to reliably determine if the occupants within the vehicle are properly restrained.

Table 5-1: Interlock Capabilities

Key
(No interlock)
Successful Interlock
Success of interlock will be determined with final NHTSA testing (see Section 4.5.7.2 *VRTC Independent Evaluation*). The outcome of these cases will not have an impact to overall system or robustness if they are not successful; if these cases are successful it will be an added bonus.

	Misuse	Buckle Switch	Short Range Wireless Communication Buckle/Latch Recognition System (RFID)	D-ring angle (with seat track and seat incline)	Belt Payout
1	Sitting on Buckled Belt.			**X**	
2	Unbuckled.	**X**	**X**		**X**
3	Passenger seat belt latch plate engaged with driver's buckle.		**X**		
4-1	Lap belt buckled; shoulder belt behind back.			**X**	
4-2	Lap belt buckled; shoulder belt under arm.			**X**	

Table 5-1. Interlock Capabilities (continued)

	Misuse	Buckle Switch	Short Range Wireless Communication Buckle/Latch Recognition System (RFID)	D-ring angle (with seat track and seat incline)	Belt Payout
5-1	Lap belt buckled; shoulder belt behind seat.			X	
5-2	Belt buckled behind seat; occupant not restrained.			X	
6	Remove head restraint, bring latch plate behind seat through head restraint opening and buckle from behind. Occupant buckled.			X	X
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.			X	X
8	Clipping extracted belt and latch plate not in buckle.	X	X		
9	Surrogate latch plates.		X		
10	Wire harness modification to “close” the buckle.		X		X

6. Lessons Learned

There were several lessons learned from the sensors that were evaluated on the buck and from bench level testing.

6.1 Cameras

Originally, the use of a camera system was considered to be optimal for detecting proper belt routing and/or the proper angle of the D-ring. However, the team encountered several factors that needed to be considered. The first was low light conditions. In low light conditions, the camera was unable to detect the location and path of the belt, resulting in false negatives and poor interlock performance. Low light conditions can be overcome with the use of infrared LEDs, but their use can be damaging to the human eye and must be used carefully and on a limited basis. The second concern was packaging, especially if more than one camera, per occupant, is needed. Incorporating these cameras into interior designs could pose a significant spatial challenge. However, as modern passenger vehicles continue to integrate more cameras into their design, an existing camera (included for another use) could serve a dual purpose and also be used for belt routing detection. Another concern was cost; while camera use is becoming more widespread in modern passenger vehicles, the number of cameras required for an interlock system may be cost prohibitive. Lastly, the time investment necessary to develop the algorithms to assess the camera images could also be prohibitive as this type of development can take anywhere from several months to several years.

The full report for the camera evaluation can be found in Appendix E.

6.2 Belt Tension Sensors

Belt tension sensors were evaluated in three locations on the vehicle buck: D-ring, anchor, and at the buckle. None of the belt tensions sensors were able to discern a properly buckled occupant from the misuses, over the occupant and position range tested.

6.3 Pressure Switch – Buckle

The pressure switch, located on the buckle, was only able to detect if the latch was engaged with the buckle. However, the wireless communication sensors system was able to detect this and also assure the proper buckle and latch were connected.

Appendix A – Seat Belt Interlock Misuse Study

Preventing Seat Belt Interlock Misuse

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List of Figures

Figure **Page**

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Acronyms and Abbreviations

SBI	Seat Belt Interlock Module

2. Project Assumptions and Normal Use Considerations

Table 2-1. Project Assumptions

ITEM	Project Assumptions
A1	Only the front row of seats in the vehicle is being considered.
A2	Only bucket seats are being considered (not a bench seat).
A3	The vehicle contains original equipment (the seat has not been replaced by an aftermarket product or removed to accommodate a wheelchair).
A4	Malicious hacking of vehicle electronic and computer systems is not considered.
A5	Driver is in complete control of the vehicle; not an autonomous or semi-autonomous vehicle.

Table 2-2. Normal Use Considerations

ID	Normal Use Considerations
N1	Weight in passenger seat that is not an occupant (laptop, dog, etc.)
N2	Car seat that uses the seat belt to hold the car seat in place; 5-point harness on car seat holds infant/child.

Table 2-3. Completion Assumptions

The following assumptions were made regarding completing the study:	
SA1	Each countermeasure is ranked based on its independent potential against a given misuse.
SA2	Combinations of countermeasures are evaluated in the follow up Pugh Analysis.

3. Seat Belt Misuse Study

Table 3-1. Seat Belt Misuse Study

COUNTERMEASURES

ID	Misuse Action	Ease of Implementing Misuse Action (1=low, 5=high)	Potential for Misuse (1=high, 5=low)	Rating (E x P)	C1a. Spool payout sensor (STATIC) - webbing dispensing.	Lou Brown	Joe Boyle	Paul Smith	C1b. Spool payout sensor (DYNAMIC) - webbing dispensing.	Lou Brown	Joe Boyle	Paul Smith	C2. Belt Tension Sensor; Locations: Anchor (A), Buckle (B), D-Ring (D)	Lou Brown	Joe Boyle	Paul Smith	C3. Buckle & latchplate Recognition (mechanical - keying)	Lou Brown	Joe Boyle	Paul Smith
1	Sitting on buckled seat belt (lap and shoulder belt behind user).	1	1	1	X	3	2	3		3	3	3		2	3	1		1	1	1
2	Leaving belt unbuckled.	1	1	1	X	5	5	5		5	5	5	X (B)	5	5	5	X	5	5	5
3	Passenger seat belt latchplate engaged with driver's buckle.	1	2	2	X	5	1	5		5	4	5		3	3	3	X	5	5	4
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.	1	1	1	X	3	1	3		3	3	3		2	3	2		1	1	1
5	Wrap belt around seat. Occupant buckled.	2	1	2	X	1	1	2		2	2	2		3	3	2		1	1	1
6	Remove headrest, bring latchplate behind seat through headrest opening and buckle from behind. Occupant buckled.	2	1	2	X	2	1	2		2	3	2		3	3	2		1	1	1
7	Clipping extracted belt. Latchplate in buckle. (Variation of #1) Clipping will be a more permanent action.	2	1	2	X	1	1	3		4	4	3	X (D)	2	3	2		1	1	1
8	Clipping extracted belt and latchplate not in buckle.	2	1	2		3	1	1		3	4	3	X	5	5	3	X	5	5	5
9	Surrogate latchplates.	3	1	3	X	5	5	5		5	5	5	X	3	4	4		3	3	3
10	Wire harness modification to "close" the buckle.	4	1	4	X	5	5	5		5	5	5	X (B)	5	5	4	X	1	1	1
11	Unbuckle after the vehicle is moving.	1	1	1	X	5	5	5		5	5	5	X	5	5	3	X	5	5	5
12	Vehicle started, all occupants buckled initially, passenger gets out and returns and does not re-buckle.	1	1	1	X	5	5	4		5	5	4	X	5	5	3	X	5	5	5
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).	1	1	1	X	5	5	5		5	5	5	X	5	5	3	X	5	5	5
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).	2	1	2	X	2	1	2		2	2	2		2	1	1		2	1	1
15	Reflash code on main controller.	5	1	5		1	1	1		1	1	1		1	1	1		2	1	1
16	Reflash seatbelt interlock (SBI) Module	5	1	5		1	1	1		1	1	1		1	1	1		2	1	1
						52	41	52		56	57	54		52	55	40		45	42	41

ID	C4. Buckle & latchplate Recognition (mechanical keying with latchplate plate sensing)	Lou Brown	Joe Boyle	Paul Smith	C5. Vision system for non seat belt routing items.	Lou Brown	Joe Boyle	Paul Smith	C6. Vision System focused on belt routing.	Lou Brown	Joe Boyle	Paul Smith	C7. D-ring position	Lou Brown	Joe Boyle	Paul Smith
1		1	1	1		3	4	4	X	5	5	5	X	3	3	3
2	X	5	5	5		5	5	5	X	5	5	5		4	5	5
3	X	5	5	5		5	5	5	X	5	5	5		5	5	5
4		1	1	1		3	3	4	X	5	5	5	X	2	3	3
5		1	1	1		3	4	4	X	5	5	5	X	3	4	4
6		1	1	1		3	4	4	X	5	5	5	X	4	4	4
7		1	1	1	X	4	5	5	X	5	5	5	X	5	4	4
8	X	5	5	5		5	5	5	X	5	5	5	X	5	4	4
9	X	5	5	5	X	5	5	5	X	5	5	5	X	5	5	4
10	X	3	3	3		5	5	5	X	5	5	5	X	4	5	4
11	X	5	5	5		5	5	5	X	5	5	5	X	5	5	5
12	X	5	5	5		5	5	5	X	5	5	5	X	5	4	4
13	X	5	5	5	X	5	5	5	X	5	5	5	X	5	4	4
14		2	1	1	X	2	3	3	X	4	4	4	X	1	1	2
15		2	1	1		1	1	1		1	1	1		1	1	1
16		2	1	1		1	1	1		1	1	1		1	1	1
		49	46	46		60	65	66		71	71	71		58	58	57

ID	C8. Seat Track Position Sensor	Lou Brown	Joe Boyle	Paul Smith	C9. Capacitive Seat Mat Sensing	Lou Brown	Joe Boyle	Paul Smith	C10. Occupant Classification (Bladder) Sensor	Lou Brown	Joe Boyle	Paul Smith	C11. Potentiometer (belt angle/position); Location: Buckle (B), D-ring (D)	Lou Brown	Joe Boyle	Paul Smith	Notes (Also see general notes at the bottom of the page.)
1		1	1	1		1	1	1		1	1	1	X	4	3	4	
2		1	1	1		2	1	1		2	1	1		4	3	4	
3		1	1	1		2	1	1		2	1	1		4	3	4	(PS) C1. Assuming no payout is detected from driver side, reset during every vehicle entry
4		1	1	1		2	1	1		2	1	1	X	3	3	4	(PS) C9. Depends on webbing type. Metal strands in the webbing may change the capacitance and allow you to pick up a signal - fidelity needs to be checked
5		1	1	1		2	1	1		2	1	1	X	4	3	4	(PS) C1. depends on fidelity of the sensor to differentiate a 5th female and the amount of webbing payout. Could be very vehicle dependent C9. Depends on webbing type. Metal strands in the webbing may change the capacitance and allow you to pick up a signal - fidelity needs to be checked
6		1	1	1		2	1	1		2	1	1	X	4	3	4	(PS) C1. depends on fidelity of the sensor to differentiate a 5th female and the amount of webbing payout. Could be very vehicle dependent
7		1	1	1		2	1	1		2	1	1	X	4	3	4	
8		1	1	1		2	1	1		2	1	1	X	5	5	4	(PS) C1B. Assume no change in payout over x period of time, may need to look at the fidelity, C2 - occupant interaction could cause change in status
9		1	1	1		2	1	1		2	1	1	X	5	5	5	(PS) C1a. assuming no payout is detected, C2. fidelity needs to be verified (IE: load vs. unload cases)
10		1	1	1		2	1	1		2	1	1		5	5	5	(PS) C1a. assuming no payout is detected, C2. fidelity needs to be verified (IE: load vs. unload cases)
11		1	1	1		2	1	1		2	1	1		5	5	5	(PS) C2. Act of unbuckling may overlap with occupant movement - fidelity needs to be reviewed
12		1	1	1		2	1	1		2	1	1		5	5	5	(PS) C2. Act of unbuckling may overlap with occupant movement - fidelity needs to be reviewed
13		1	1	1	X	2	1	1	X	2	1	1		5	5	5	(PS) C1. would require input from another sensor to determine if there is an occupant in the passenger seat (PS) C2. Act of unbuckling may overlap with occupant movement - fidelity needs to be reviewed (PS) C9~C11 can't be detected by seat related items only - other sensors required (IE buckle switch)
14		2	1	1	X	2	1	2	X	2	1	2	X	2	1	2	(PS) C7~C11. Fidelity issue may exist (OOP vs. occupant)
15		1	1	1		1	1	1		1	1	1		1	1	1	
16		1	1	1		1	1	1		1	1	1		1	1	1	
		17	16	16		29	16	17		29	16	17		61	54	61	

GENERAL NOTES:

1 No single countermeasure may resolve all potential misuses; in most cases, several countermeasures need to be considered.

2 While items #15 and #16 are not required there are being considered in evaluating countermeasures.

RANKING:

1 No use as a countermeasure.

2

3 Good countermeasure for about 50% of misuse.

4

5 Very good countermeasure for a high percentage of the misuse.

4. Countermeasure Details

Table 4-1. Countermeasure Details

ID	Countermeasure	Detailed Description / Assumptions about Countermeasures
C1a.	C1a. Spool payout sensor (static) - webbing dispensing.	This countermeasure will not be useful when payout is used in a misuse (sitting on buckled belt, belt wrapped around seat). This countermeasure assumes data taken at the point of a decision about correct use.
C1b.	C1b. Spool payout sensor (dynamic) - webbing dispensing.	This countermeasure will not be useful when payout is used in a misuse (sitting on buckled belt, belt wrapped around seat). This countermeasure assumes data taken on a periodic basis to detect movement, indicating an occupant that is restrained.
C2	Belt Tension Sensor; Locations: Anchor (A), Buckle (B), D-Ring (D)	The belt tensions sensors will be used statically.
C3	Buckle & Latch Recognition (mechanical - keying)	
C4	Buckle & Latch Recognition (mechanical keying with latch plate sensing)	
C5	Vision	The vision system may be trained on an anchor, D-ring or buckle.
C6	Vision with florescent material in belt	Florescent material must be a unique pattern and visible to a day/night camera.
C7	D-ring position recognition	
C8	Seat Track Position Sensor	
C9	Capacitive Seat Mat Sensing	Current capacitive systems that exist today. Primarily used to determine whether human/non-human occupants/objects are located in seat.
C10	Occupant Classification (Bladder) Sensor	Primarily used to determine whether human/non-human occupants/objects are located in seat.
C11	Potentiometer (belt angle/position); Location: Buckle (B), D-ring (D)	Assume all locations are being used.

5. Misuse ID Images

Figure 5-1. Misuse ID 1

Sitting on buckled seat belt (lap and shoulder behind occupant).

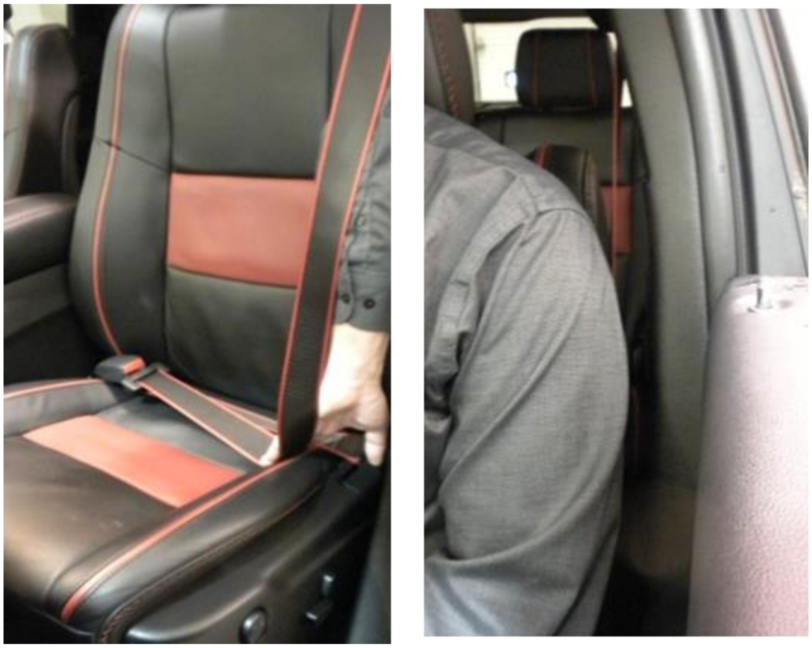


Figure 5-2. Misuse ID 3

Passenger seat belt latch plate engaged with driver's buckle.

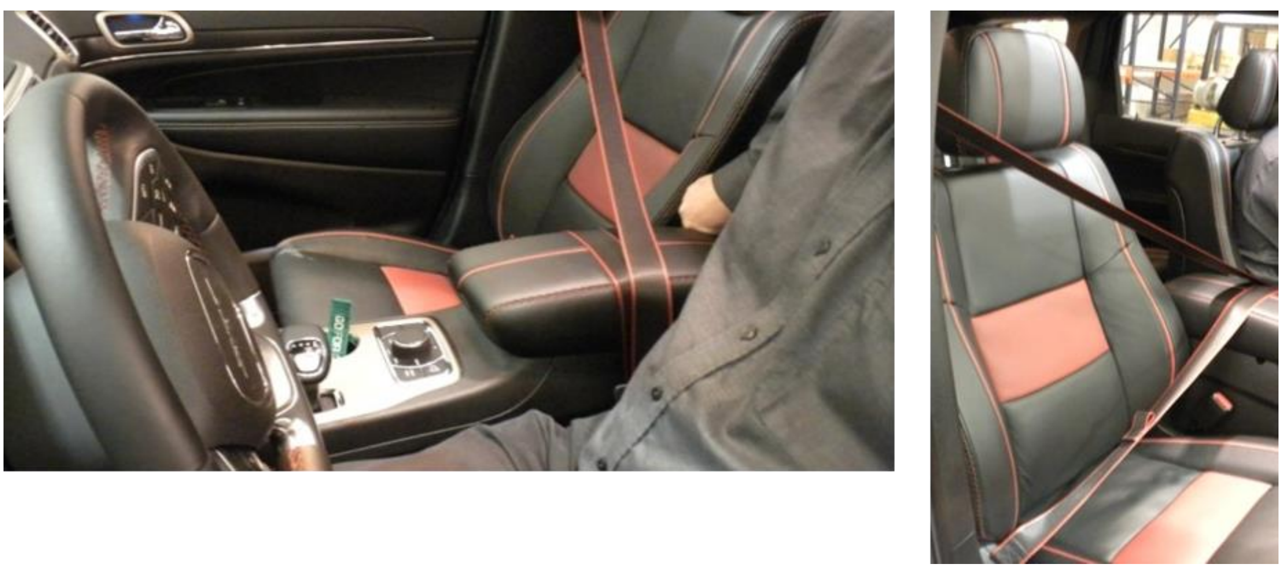


Figure 5-3. Misuse ID 4

Shoulder belt behind user (lap belt in correct position). Occupant buckled.

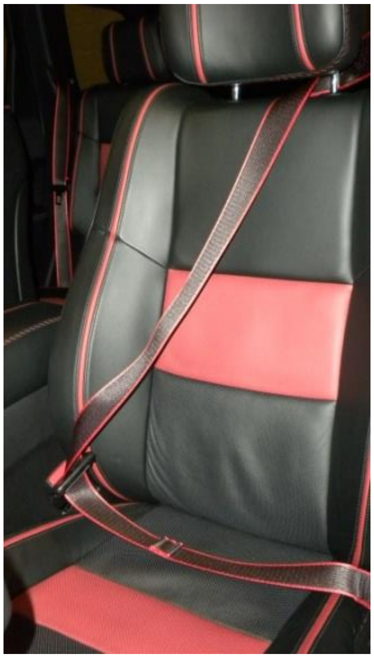


Figure 5-4. Misuse ID 5

Wrap belt around seat. Occupant buckled.

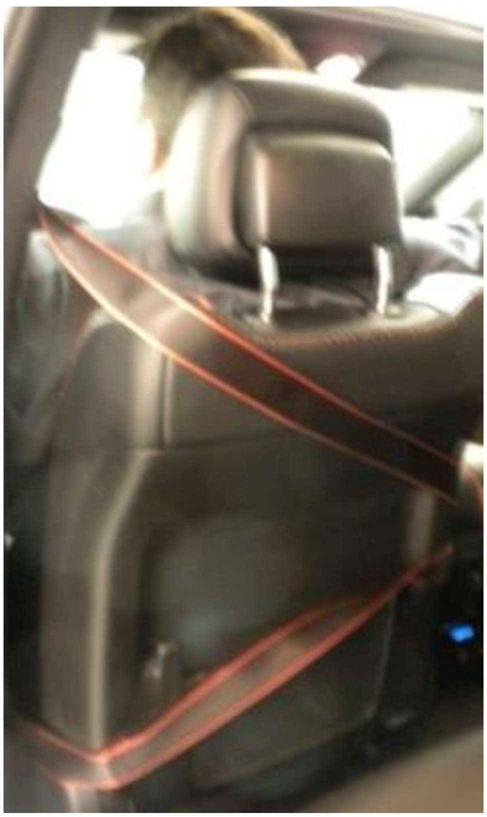


Figure 5-5. Misuse ID 6

Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.

Figure 5-6. Misuse ID 7

Clipping extracted belt. Latch plate in buckle (variation of Misuse 1). Clipping will be a more permanent action.

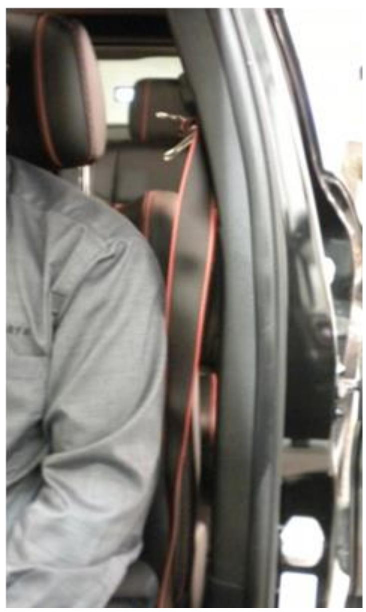


Figure 5-7. Misuse ID 8

Clipping extracted belt and latch plate not in buckle.

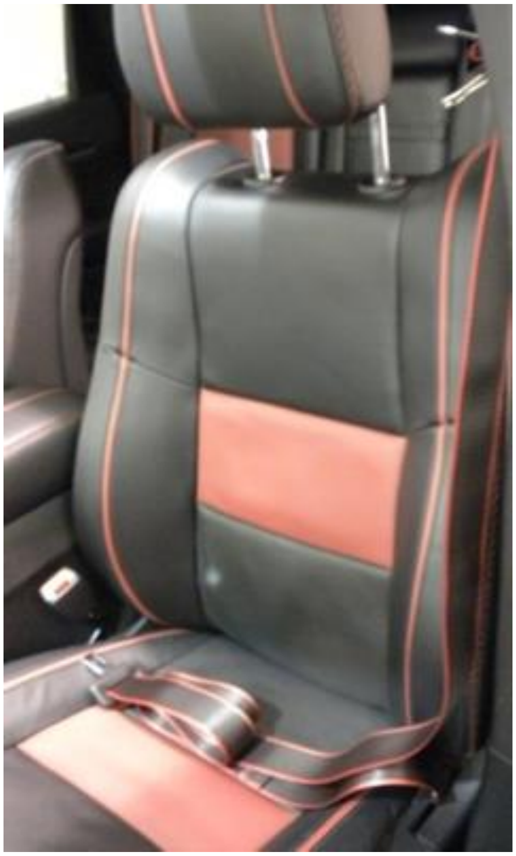


Figure 5-8. Misuse ID 9

Surrogate latch plates.

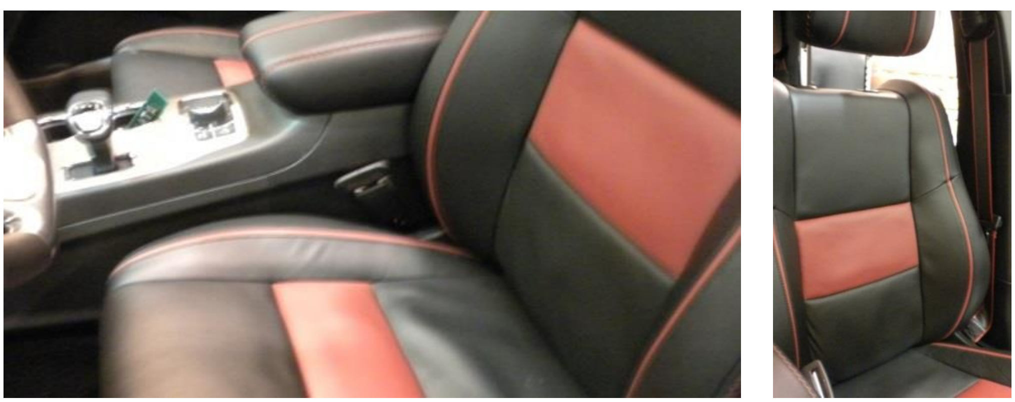
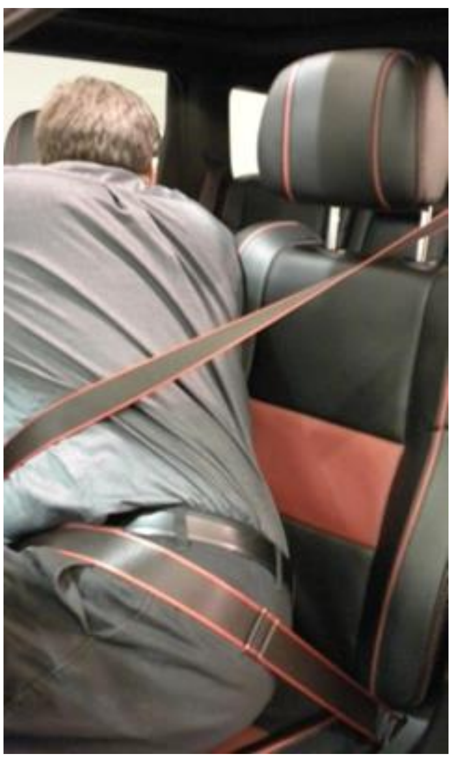


Figure 5-9. Misuse ID 19

Webbing path covered by clothing (or coat, blanket, etc.).

Figure 5-10. Misuse ID 20

Person buckled but not in correct position (feet not on floor, belts not positioned correctly).



Appendix B – Pugh Analysis

Preventing Seat Belt Interlock Misuse

Sensor Fusion Pugh Analysis Chart

Work this way ---->

ID	Criteria / Concept	C 0	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C 10
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		s	s	s	s	s	s	s	s	s	s
2	Leaving belt unbuckled.	D	+	s	s	s	s	+	+	+	+	+
3	Passenger seat belt latch plate engaged with driver's buckle.	A	s	s	s	s	s	s	s	s	s	s
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.	T	s	s	s	s	s	s	s	s	s	s
5	Wrap belt around seat. Occupant buckled.	U	s	s	s	s	s	s	s	s	s	s
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.	M	s	s	s	s	s	s	s	s	s	s
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		s	s	s	s	s	s	s	s	s	s
8	Clipping extracted belt and latch plate not in buckle.		s	s	s	s	s	s	s	s	s	s
9	Surrogate latch plates.		s	s	s	s	s	s	s	s	s	s
10	Wire harness modification to "close" the buckle.		s	s	s	s	s	s	s	s	s	s
11	Unbuckle after the vehicle is moving.		s	s	s	s	s	s	s	s	s	s
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		s	s	s	s	s	s	s	s	s	s
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		s	s	s	s	s	s	s	s	s	s
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		s	s	s	s	s	s	s	s	s	s
15	Reflash code on main controller.		s	s	s	s	s	s	s	s	s	s
16	Reflash SBI Module		s	s	s	s	s	s	s	s	s	s
17	New: Covering up the camera - intentional		s	s	s	+	s	+	+	+	+	+
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		s	s	s	+	+	+	+	+	+	+
19	New: Articles blocking camera (IE...Blanket, Coat) unintentional		s	s	s	+	+	+	+	+	+	+
20	New: Occupant out of position (IE; turned to block web path)		s	+	s	+	s	+	+	+	+	+
21	New: shoulder belt routed, but not buckled		+	s	s	s	s	+	+	+	+	+
22	New: System Weight		-	-	-	-	-	-	s	-	-	-
23	New: System Cost		-	-	-	-	-	-	s	-	-	+
24	New: Child Seat Web Routing		s	s	s	s	s	s	-	s	s	s
25	New: laptop interference		s	s	s	s	s	s	-	s	s	s
26	New: Artificial limb/organ interference (pace maker, etc.)		s	s	s	s	s	s	-	s	s	s
27	New: Works with buckle extender		s	s	s	s	s	s	s	s	s	+

		C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C 10
S+		2	1	0	4	2	6	6	6	6	8
S-		2	2	2	2	2	2	3	2	2	1
SS		23	24	25	21	23	19	18	19	19	18

Best Cases	Major Strengths	Major Weaknesses
Case 10 - Capacitve seat mat with, D-ring Angle, Seat Track position, Seat Back angle and RFID buckle switch	covers a broad spectrum of misuse	weight
Case 6 - Vision system w/ capacitive in webbing, seat back and cushion, buckle switch	covers a broad spectrum of misuse	cost and weight
Case 7 - 3 capacitive system - webbing, seat back and seat cushion	Cost, weight	Interferences (laptop, pacemaker)
Case 8 - Vision system with potentiometers at the D-Ring and the buckle, with buckle switch	Provides backup when camera is covered or blocked	cost and weight, potential fidelity
Case 9 - Vision System with retractor spool payout sensor and buckle switch	Provides backup when camera is covered or blocked	cost and weight, potential fidelity

C	Concept Summary
0	***DATUM*** - Vision System focused on seat belt web routing and occupant
1	Vision System focused on seat belt web routing and occupant, with smrt buckle switch
2	Vision system focused on web routing coupled with capacitive sensor on seat cushion and seat back
3	Vision System focus on web routing with D-Ring sensor
4	Vision System focused on web routing coupled with capacitive sensor on seat back, cushion and seat belt webbing
5	Vision System focused on web routing coupled with sensor on seat belt webbing
6	Vision System focused on web routing coupled with capacitive sensor on seat back, cushion, seat belt webbing and smrt buckle switch
7	Capacitive sensor on seat back, cushion, seat belt webbing and smrt buckle switch
8	Vision system with Potentiometers at the D-Ring, Seat Belt Buckle and with a smrt buckle switch
9	Vision system with retractor spool payout sensors and with a smrt buckle switch
10	Capacitive seat mat with D-ring Angle, Seat Track position, Seat Back angle and RFID buckle switch

Revision level: 6

Process:

1) Rate each concept with respect to datum case
2) Select best cases (least -'s and most +'s)
3) Identify major strengths and weaknesses of best
4) Identify other hybrid concepts to maximize strengths
5) Choose new datum and iterate process

Enter a +, - or S in each cell to represent whether the concept is SIGNIFICANTLY better, worse, or the same as the datum concept.

Appendix C – Technical Plan

Preventing Seat Belt Interlock Misuse

Preventing Seat Belt Interlock Misuse
TECHNICAL PLAN

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DTNH2214D00321L/0002
Preventing Seat Belt Interlock Misuse
Survivability Solutions

TECHNICAL PLAN

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Tom Messner, Tricia Mayer

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TECHNICAL PLAN

1 Introduction

This document contains the Technical Plan for developing and evaluating a prototype system for Preventing Seat Belt Interlock Misuse. Survivability Solutions was contracted, through NCMS, to develop a system which will prevent or limit occupant misuse or workarounds.

The enclosed information provides a clear technical plan that evaluates potential seat belt interlock strategies, their susceptibility to potential misuse or mechanical workaround, and technical means to discuss all identified misuse of situations regardless of whether a practical countermeasure exists or not. This document contains all of the detailed background research conducted, lists the potential misuse cases, as well as addressing the major steps and timeframe for implementing and demonstrating the technical solution(s).

The baseline or datum system detailed in section 6 of this document is the prototype system that, based on our expert analysis and research, will be iterated and optimized during the prototype system development.

2 General Information

Contractor Name:	Survivability Solutions
NHTSA Contract Number:	DTNH2214D00321L/0002
Item Number:	3 (Draft Technical Plan)
Task Order Number:	C.4.2
Project Title:	Preventing Seat Belt Interlock Misuse
Period of Performance:	January 2016 thru August 2017

NHTSA COR (TO):	Sanjay Patel (sanjay.patel@dot.gov)
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Phone Number:	

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Rev 007 4/14/2016
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TECHNICAL PLAN

3 Seatbelt Interlock Technical Plan

This document provides a technical plan that evaluates potential seat belt interlock strategies, their susceptibility to potential misuse or mechanical workaround, and technical means to discuss all identified misuse of situations regardless of whether a practical countermeasure exists or not. This technical plan shall not consider malicious hacking of vehicle electronic and computer systems as a focus of this task.

This document is the CLIN 002 deliverable. Below is the executive summary of what has been accomplished, and also addresses upcoming efforts specific to the remaining contract CLIN's.

Work Conducted through CLIN 002:

1. Identified all seatbelt misuses that are being considered.
2. Identified and rank potential countermeasures to the misuses.
3. Identified the initial baseline interlock system based on our expert analysis of the misuses, countermeasures, and technologies.

Work Yet to Be Conducted:

4. Evaluate baseline interlock system and iterate as required to optimize system in development buck.
5. Finalize prototype interlock system.
6. Implement prototype interlock system in vehicle.
7. Conduct thorough misuse case evaluation.
8. Deliver vehicle to NHTSA for test and evaluation.
9. Write and deliver final report.

4 Risk and Mitigation Plans

We are confident that the risk identification and proposed mitigation plans will ensure our seatbelt interlock plan will be low risk and compliant to the SOR.

4.1 Requirement Risks

To ensure that there is a lack of scope creep for the task order, the team has put together a list of risks associated with requirements. Plans to minimize these risks are documented in the table below and will be monitored throughout the program lifecycle to ensure requirements risks are minimized.

Requirements Risks	Plan to Mitigate	Implemented Mitigation
Non Complete Review and Understanding of the Requirements.	We have assembled a team of subject matter experts, reviewed lessons learned of similar projects, and cross referenced to the	NCMS has assembled a team of industry experts from OEM, suppliers, and occupant classification specialists. Requirements have been analyzed and are well understood.

Requirements Risks	Plan to Mitigate	Implemented Mitigation
	requirements in the RFP.	
Too many key requirements resulting in excessive constraint on design trade space.	Ensure the design of the interlock system is guided by a small set of key requirements (e.g., minimize the number of Key Performance Parameters [KPP] and Key System Attributes [KSA].	Technical team has utilized sound design and analysis principles including a thorough misuse case study and Pugh Analysis to ensure key requirements are considered and analyzed.
Requirement does not include a specification providing for future technology insertion that can improve system performance.	Conduct systems engineering trade-off analysis to assess the requirements' affordability and technical feasibility. Identify system (hardware and software) assurance risks early to ensure system requirements, design, and architecture will produce a secure system in operations.	System trade-offs have been analyzed through our Pugh analysis and misuse studies. System hardware has been identified and an attempt to use off the shelf technology has been utilized to ensure system requirements and technical risks are minimized.

4.2 Technology Risks

The team believes that managing technology risks are critical to the successful development on the interlock technical plan. When dealing with a complex system that may contain components that include a variety of technologies, it is critical to place emphasis on mitigating these risks. The table below identifies the technology risks along with our plans to mitigate. We will continuously monitor and select as much off the shelf technology as appropriate to ensure these risks are minimized.

Technology Risks	Plan to Mitigate	Implemented Mitigation
Too many critical technologies with a Technology Readiness Level <6 Too many critical technologies, overall.	Ensure critical technologies (with Technology Readiness Level [TRL] < 6) are achievable and risks are manageable within schedule and resource constrains. Limit the number of critical technologies, as appropriate. Utilize COTS hardware wherever possible	The team has detailed out hardware from existing OEM and Tier 1 Automotive suppliers that are currently in production. Although some combinations of sensors and hardware are not currently utilized in production, team feels these technologies in combination are not high risk.
Technologies selected are not thoroughly vetted.	Include an assessment of the maturity of proposed technologies.	Team has utilized mostly off the shelf hardware and technologies for the

Technology Risks	Plan to Mitigate	Implemented Mitigation
		prototype system.
Design of System Architecture for vehicle integration.	Design an open system architecture which enables both a cost effective and rapid development of systems that are interoperable with the interlock system. Utilize no proprietary devices and allow for future add-on's.	System architecture from a controls and software standpoint is using industry standard code along with existing sensor technology. No current OEM or supplier specific proprietary devices are being utilized.

4.3 Engineering Risks

Engineering risks include those associated with engineering technical processes; engineering technical management processes; and engineering products. Software engineering risks include those associated with software design requirements, design of architecture, and development of software. Our team has captured the engineering risks and the chart below details our mitigation plans.

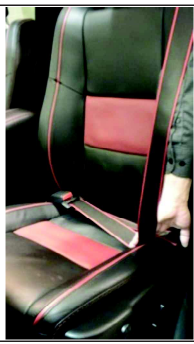
Engineering Risks	Plan to Mitigate	Implemented Mitigation
Risks not identified early enough in the project that can cause schedule delays, cost increases, etc.	Utilize a full set of event-driven developmental test activities across the program's life cycle (e.g., hardware in the loop testing in system integration laboratories) to support risk reduction, design validation, and requirements verification. Utilize our design review board to ensure technical requirements are balanced with the allocated schedule and funding.	Test plans have been developed and attached in Appendix A. They are based on up front technical work using Pugh analysis and lessons learned from industry best practices. Team experts have conducted up from design reviews on included documentation to ensure completeness of research conducted.
Full system physical prototyping not performed soon enough in the project resulting in higher risk of technical problems during integration.	Use early prototypes as part of the normal integration process for complex systems to Facilitate the integration of major subsystems and infrastructural components; as well as the discovery/resolution of potential subsystem-level interaction risks. Create competing systems in parallel and compare compliance to performance requirements.	The NCMS team has procured a full level of prototype vehicle mules along with seats, IP's, and other required hardware. This will allow for the ability to create competing systems and make modification based on out adaptive life cycle approach.

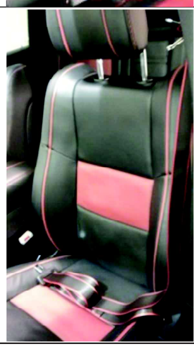
5 Seatbelt Misuses

5.1 Misuse actions being considered.

- Refer to the following table for a list of seatbelt misuses that are being considered.

KEY:
Misuse
Normal Use Consideration
Misuse taken into consideration but not required.

ID	Misuse Action	
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).	 
2	Leaving belt unbuckled.	
3	Passenger seat belt latchplate engaged with driver's buckle.	
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.	

ID	Misuse Action	
5	Wrap belt around seat. Occupant buckled.	
6	Remove headrest, bring latchplate behind seat through headrest opening and buckle from behind. Occupant buckled.	 
7	Clipping extracted belt. Latchplate in buckle. (Variation of #1) Clipping will be a more permanent action.	 
8	Clipping extracted belt and latchplate not in buckle.	

ID	Misuse Action	
9	Surrogate latchplates.	
10	Wire harness modification to "close" the buckle.	
11	Unbuckle after the vehicle is moving.	
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.	
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).	
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).	
15	Reflash code on main controller.	
16	Reflash SBI Module	

6 Countermeasure Analysis

6.1 Countermeasures Evaluated

ID	Countermeasure	Detailed Description / Assumptions about Countermeasures
C1a.	C1a. Spool payout sensor (STATIC) - webbing dispensing.	This countermeasure WILL NOT be useful when payout is used in a misuse (sitting on buckled belt, belt wrapped around seat). This countermeasure assumes data taken at the point of a decision about correct use.
C1b.	C1b. Spool payout sensor (DYNAMIC) - webbing dispensing.	This countermeasure WILL NOT be useful when payout is used in a misuse (sitting on buckled belt, belt wrapped around seat). This countermeasure assumes data taken on a periodic basis to detect movement, indicating an occupant that is restrained.
C2	Belt Tension Sensor; Locations: Anchor (A), Buckle (B), D-Ring (D)	The belt tensions sensors will be used statically.
C3	Buckle & Latch Recognition (mechanical - keying)	Simple mechanical keying may assure correct buckle and latch pairing.
C4	Buckle & Latch Recognition (mechanical keying with latch plate sensing)	Possibly use RFID to verify buckle is paired with correct latch.
C5	Vision	The vision system may be trained on an anchor, D-ring or buckle.
C6	Vision with capacitive/reflected material in belt	Capacitive/reflected material must be a unique pattern and visible to a day/night camera.
C7	D-ring position recognition	D-ring position will provide angle of belt routing to know if belt is routed for correct use.
C8	Seat Track Position Sensor	Track position may help with occupant classification.
C9	Capacitive Seat Mat Sensing	Current capacitive systems that exist today. Primarily used to determine whether human/non-human occupants/objects are located in seat.
C10	Occupant Classification	Primarily used to determine whether human/non-human

ID	Countermeasure	Detailed Description / Assumptions about Countermeasures
	(Bladder) Sensor	occupants/objects are located in seat.
C11	Potentiometer (belt angle/position); Location: Buckle (B), D-ring (D)	Assume all locations are being used.

6.2 Seatbelt Interlock Misuse Study

The Seatbelt Interlock Study is an analysis of possible countermeasures for the identified misuses. Each countermeasure was evaluated and ranked based on its individual ability to prevent the misuse. Sensor combinations were evaluated in the Pugh Analysis (section 6.3 Pugh Analysis) as the misuse study wanted to evaluate each technology individually.

- Appendix A: Seat Belt Interlock Use_Misuse Study 014 160414.pdf

6.2.1 Countermeasure Ranking

The effectiveness of each countermeasure was ranked based on the following criteria:

Ranking	Criteria
1	No use as a countermeasure.
2	Good countermeasure for about 25% of misuse.
3	Good countermeasure for about 50% of misuse.
4	Good countermeasure for about 75% of misuse.
5	Very good countermeasure for a high percentage of the misuse.

6.3 Pugh Analysis

The Pugh Analysis is our primary decision making tool used to determine the best combination of sensors relative to the potential misuses. Any potential misuses that were introduced, based on sensor choice, were added to this analysis.

- Appendix B: pughanalysissensorfusionrev_006.xlsx

6.3.1 Sensor Combinations

The following lists the combinations of sensors that were evaluated and ranked in the Pugh Analysis. The datum system is a vision system focused on seat belt web routing and the occupant.

C	Concept Summary
0	DATUM - Vision System focused on seat belt web routing and occupant
1	Vision System focused on seat belt web routing and occupant, with buckle switch
2	Vision system focused on web routing coupled with capacitive sensor on seat cushion and seat back
3	Vision System focus on web routing with D-Ring sensor
4	Vision System focused on web routing coupled with capacitive sensor on seat back, cushion and seat belt webbing
5	Vision System focused on web routing coupled with sensor on seat belt webbing
6	Vision System focused on web routing coupled with capacitive sensor on seat back, cushion, seat belt webbing and buckle switch
7	Capacitive sensor on seat back, cushion, seat belt webbing and buckle switch
8	Vision system with Potentiometers at the D-Ring, Seat Belt Buckle and with a buckle switch
9	Vision system with retractor spool payout sensors and with a buckle switch

6.3.2 Optimal Sensor Combinations

The results of the Pugh Analysis showed the following as the optimal sensor combinations to evaluate for prototype evaluation:

Case 6 - Vision system w/ capacitive in webbing, seat back and cushion.
Case 7 - 3 Capacitive system - webbing, seat back and seat cushion.
Case 8 - Vision system with potentiometers at the D-Ring and the buckle, with buckle switch.
Case 9 - Vision System with retractor spool payout sensor and buckle switch.

6.4 Baseline Interlock System

From the initial misuse/use study, it was determined that the most effective countermeasure is a vision system focused on seat belt web routing and occupant. It is highly probable, based upon the Pugh analysis, that the baseline or datum vision system will not adequately cover all the misuse/use cases. The datum system will be iterated in conjunction with multiple sensor combinations in an attempt to improve the interlock system robustness. The image below shows the datum or baseline system that the team will begin their prototype development with. In addition, pictures of the additional optimal sensor combinations from Section 6.3.2 are also pictured below. These systems will be evaluated as part of our adaptive life cycle approach.

Baseline System
Vision System Focused On Seat Belt Web Routing and Occupant

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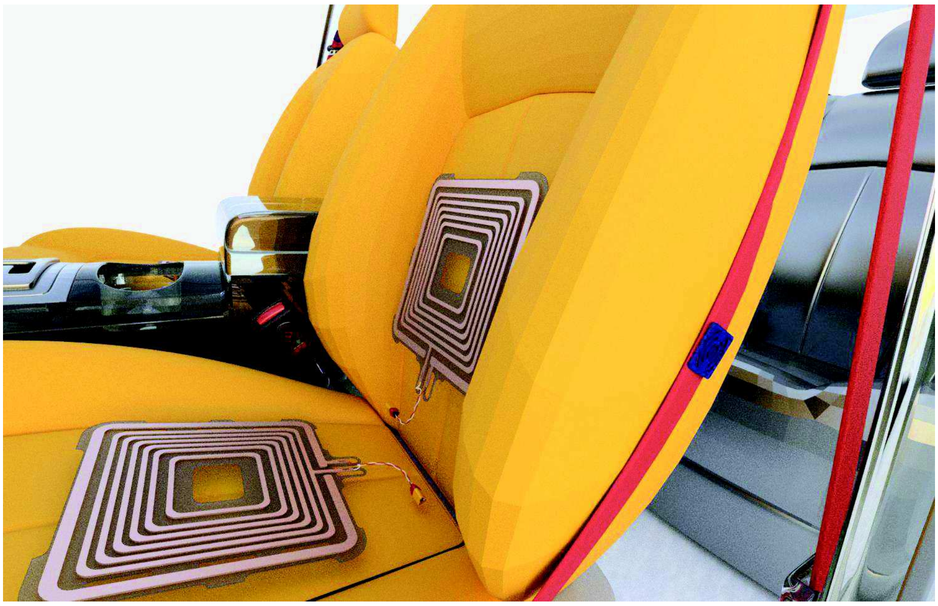
Concept System 6
Vision System focused on web routing coupled with capacitive sensor, cushion, seat belt webbing and smart buckle switch



Concept System 7
Capacitive sensor on seat back, cushion, seat belt webbing and smart buckle switch

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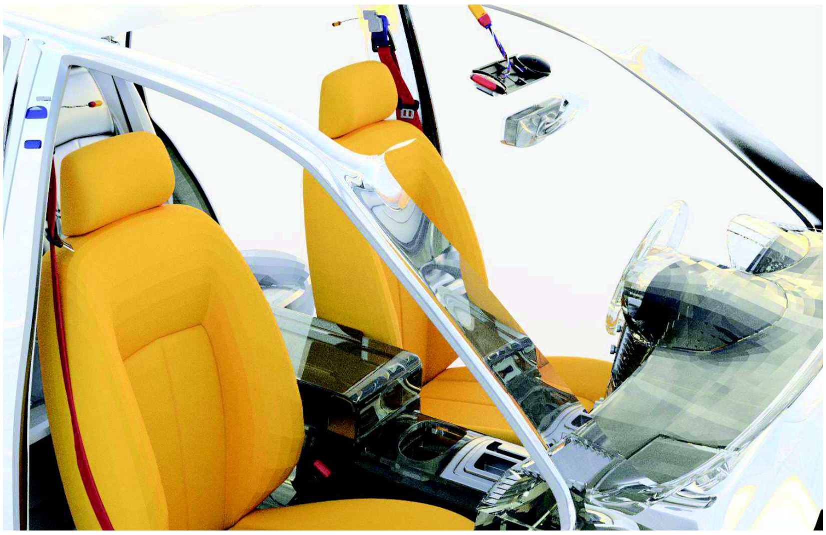

Concept System 8
Vision system with Potentiometers at the D-Ring, Seat Belt Buckle and with a smart buckle switch

Concept System 9
Vision system with retractor spool payout sensors and with a smart buckle switch

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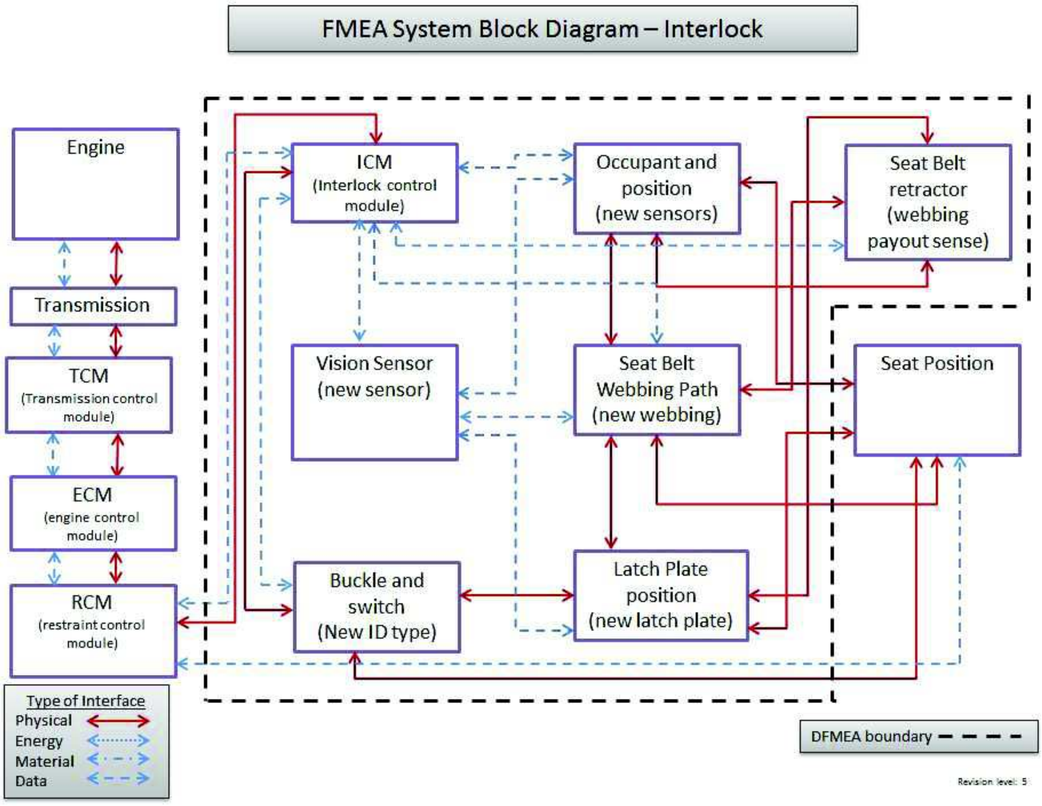
DFMEA Boundary Diagram

The system boundary diagram shows the internal and external interfaces of the system.



6.4.1 Strengths of chosen system.

System Choice	Major Strengths
Case 6 - Vision system w/ capacitive in webbing, seat back and cushion.	Improved performance system for misuse/use ID's 2, 17, 18, 19, 20 and 21 compared to datum system.
Case 7 - 3 Capacitive system - webbing, seat back and seat cushion.	Improved performance system for misuse/use ID's 2, 17, 18, 19, 20 and 21 with similar weight and cost compared to the datum system.
Case 8 - Vision system with potentiometers at the D-Ring and the buckle, with buckle switch.	Improved performance system for misuse/use ID's 2, 17, 18, 19, 20 and 21 compared to datum system.
Case 9 - Vision System with retractor spool payout sensor and buckle switch.	Better than datum system against misuse/use ID's 2, 17, 18, 19, 20 and 21 compared to datum system.

6.4.2 Weaknesses of chosen system.

System Choice	Major Weaknesses
Case 6 - Vision system w/ capacitive in webbing, seat back and cushion.	Added cost and weight compared to the datum system.
Case 7 - 3 Capacitive system - webbing, seat back and seat cushion.	Reduced performance against misuse/use ID's 24, 25 and 26 compared to datum system.
Case 8 - Vision system with potentiometers at the D-Ring and the buckle, with buckle switch.	Increased cost and weight compared to the datum. Data fidelity across multiple occupants may overlap.
Case 9 - Vision System with retractor spool payout sensor and buckle switch.	Increased cost and weight, Data fidelity across multiple occupants may overlap.

6.4.2.1 Misuses introduced with proposed system.

Misuses (and "normal use" considerations) need to be addressed for any proposed countermeasures. With a Vision System, the potential for the camera to be blocked needs to be considered. The new considerations, relative to the countermeasures, were added to the Pugh Analysis and are listed below.

Pugh Analysis ID	Misuse/Consideration
17.	Covering up the camera - intentional
18.	Articles of clothing to trick camera (IE printed shirt, coat etc.)
19.	Articles blocking camera (IE…Blanket, Coat) unintentional
20.	Occupant out of position (IE; turned to block web path)
21.	Shoulder belt routed, but not buckled
22.	System Weight (Not applicable as a misuse.)
23.	System Cost (Not applicable as a misuse.)
24.	Child Seat Web Routing
25.	Laptop interference
26.	Artificial limb/organ interference (pace maker, etc.)
27.	Buckle extender

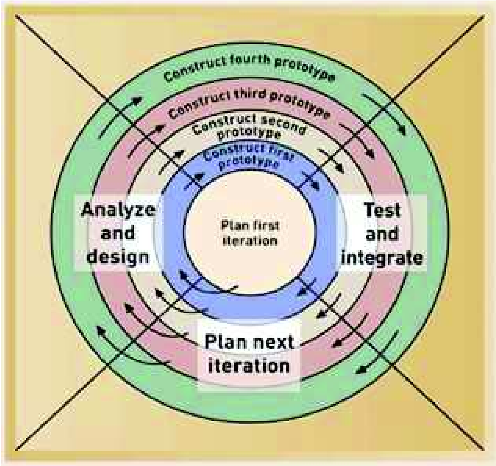
6.4.2.2 Countermeasures for induced misuses.

The Pugh Analysis includes the above listed misuses that were introduced with the proposed vision system. The induced misuses are part of the study so that that all new considerations are addressed in the study.

7 Seatbelt Interlock System Approach

7.1 Adaptive System Development Life Cycle Approach to System Optimization

The design approach for this project resembles an Adaptive System Development Life Cycle (SDLC) which allows project activities to be adjusted as the project progresses. The traditional adaptive SDLC is called a spiral model, which during our design and development phase, will cycle over and over again throughout development activities and make adjustments until the project is complete. The figure below is a graphical representation of the spiral model. After each cycle, or iteration, a system, consisting of a combination of sensors, will be ready to be tested and evaluated. An iteration is one cycle in the spiral model during which work activities—analysis, design, implementation—are used to demonstrate a version of the working prototype.



7.2 Buck Development

The iterative design process will be done using a vehicle mock up, or buck. The buck will be retrofitted with the same seats and instrument panel as in the final vehicle prototype. This will allow flexibility in adding and removing sensors, as they are evaluated, minimizing the impact to the final vehicle prototype system.

7.2.1 Hardware Procurement

Hardware has been obtained from existing OEM and Tier 1 Automotive suppliers. We have attempted to utilized production hardware where possible, and then utilized technologies that are currently available in the marketplace, but may not currently be used for this specific application.

Part Name / Description	Supplier
Vehicle – Jeep Grand Cherokee	ncms
Frontal Vehicle buck	TAKATA
Smart Webbing	TAKATA
Capacitive mat	TAKATA

Part Name / Description	Supplier
WK IP	FCA FIAT CHRYSLER AUTOMOBILES
Interlock Controller	BGM Electronic Design & Assembly
Encoder	BGM Electronic Design & Assembly
Camera	SHARP

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Part Name / Description	Supplier
Motorized Seat Belts	TAKATA
Buckle Switches	TAKATA
Belt Tension Sensors	TAKATA
D-ring	TAKATA

Part Name / Description	Supplier
Capacitive Sensors	a sense for innovation IEE
Weight Sensors	a sense for innovation IEE
RFID	TBD
Controller Software	NATIONAL INSTRUMENTS

7.2.2 Data Acquisition

Data Acquisition (DAQ) will be achieved using a National Instruments™ system. The system will be capable of simultaneously recording data from multiple sensors and cameras. The DAQ system will also display the data real time. The DAQ system will carry over for the software algorithm development as well.

7.2.3 Test Plan

- Appendix C: Interlock Module testing__DVP&R_rev003.xlsx

Data, from all of the sensors, will be recorded, using the DAQ system, for each misuse, under 18 conditions (6 seat positions, 3 occupant types). Three tests will be run for those items which require more fidelity in the results. Refer to Section 6.3 Pugh Analysis. The test plan will be executed on both the developmental buck, and then also on the final prototype system in the Jeep Grand Cherokee.

Seat Positions	1. Full Forward, Full Up 2. Full Forward, Full Down 3. Full Rear, Full Up 4. Full Rear, Full Down 5. Mid track, Full Up 6. Mid track Full Down
Occupant Types (3 ranging from 5th to 95th)	1. 5th female 2. 50th male 3. 95th male

7.2.3.1 Occupant Types

The occupant types are representative of the Hybrid III crash test dummies.

Occupant	Height	Weight
5th female	5'0"	110 lbs.
50th male	5'9"	170 lbs.
95th male	6'2"	223 lbs.

7.2.4 <u>Data Analysis</u>

Once collected, all of the data will be analyzed to:

- Verify that the abilities identified for the sensors match the assumptions in the studies.
- Verify "normal use" ranges of sensors don't overlap "misuse" ranges over seat positions and occupant types.
- Determine the best combination of sensors to detect all misuses.

7.3 Modification and Optimization

As outlined, in section 7.1 Adaptive System Development Life Cycle Approach to System Optimization, the steps above will be repeated until a sensor combination has been realized that can accurately detect the identified misuses.

7.4 Prototype Vehicle Execution

Once the adaptive design process is complete with the buck, the chosen prototype system will be implemented on a production 2015 Jeep Grand Cherokee vehicle.

7.4.1 <u>Production Vehicle</u>

- 2015 Jeep Grand Cherokee (WK)
- Vehicle has "Advanced Technology Group" package. This includes:
    - Adaptive Cruise Control with Stop
    - Advanced Brake Assist (*Uses camera, Forward Collision Warning and Adaptive Cruise Control systems.)*
    - Automatic-Dimming Exterior Passenger Mirror
    - Blind Spot and Cross Path Detection
    - Full Speed Fwd. Collision Warning Plus
- No seat track position sensors on either side on the front seats.
- The passenger side seat has an Occupant Detection System (ODS) supplied by IEE.

7.4.2 <u>Data Acquisition (DAQ)</u>

The same National Instruments data acquisition system used in the prototype system development in the vehicle buck will also be utilized for the system installed in the Jeep Grand Cherokee.

7.4.3 Test Plan

The same test plan in Section 7.32.3 will be used to qualify the system installed in the Jeep Grand Cherokee.

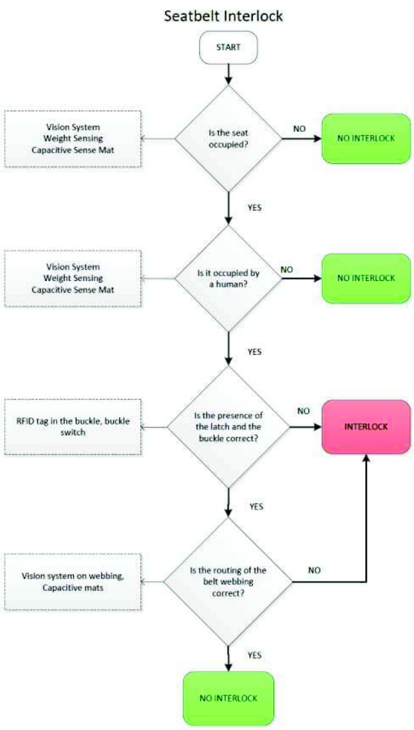
8 Interlock Strategy

8.1 Algorithm Development

The software algorithm(s) for detecting and reacting to misuses will be developed once the final countermeasure strategy has been designed. The DAQ system, used for the sensor development, will also be used to implement the software algorithm(s).

8.1.1 Software Flowchart

The software flowchart, shown below, attempts to demonstrate the interlock system logic.



8.2 Proposed Interlocks

Determining how the seatbelt interlock system interfaces and inhibits certain vehicle operations is outside the scope of the project, but should be strongly considered as a Phase II Project. It is possible that several levels of "interlock" would be appropriate in this type of system. From a demonstration standpoint, the multiple levels of system response will be indicated by either LEDs or a simple display.

While implementation of the system will allow the details to be further defined, the following gives an idea of what is proposed:

SITUATION	ACTION
Normal Operation, No Misuses Identified	Green LED, "Normal Operation" Display
Misuse(s) detected, may be unintentional.	Yellow LED, "Level 1 Interlock" Display
Misuse(s) detected after vehicle has been started.	Blue LED, "Level 2 Interlock" Display
Blatant misuse detected.	Red LED, "Level 3 Interlock" Display

9 Timeline

The table below matches the schedule outlined in the SOW. A, more detailed, timeline is shown in Appendix D.

Item No.	Task Number	Deliverable / Milestone	Due Date
1	C.4.1	Kick Off Meeting in Washington DC (No later than 2/3/16.)	01/26/16
2	C.4.2	DRAFT Final Technical Plan	04/21/16
3	C.4.2	Technical Plan Briefing	04/21/16
4	C.4.2	COR (TO) Plan Approval of Technical Plan	04/28/16
5	C.4.3	Delivery of Vehicle with Prototype Seat Belt interlock System	02/01/17
6	C.4.3	VRTC Independent Evaluation (Conclusion)	08/02/17
7	C.4.4	DRAFT Final Report	01/18/17
8	C.4.4	Final Presentation NHTSA Headquarters Washington DC	02/01/17
9	C.4.4	COR (TO) Comments on DRAFT Final Report Due	03/01/17
10	C.4.5	FINAL REPORT	03/22/17

- Appendix D: NHTSA SBI Project Timing Rev 003 160406.mpp"

10 Appendices

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Appendix A

Seatbelt Interlock Use/Misuse Study

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CHANGE LOG

CHANGES TO FILE - Rev 013		
CHANGE #	**ID REF.**	**DESCRIPTION**
1	All	Removed all "Draft" references.

CHANGES TO FILE - Rev 012		
CHANGE #	**ID REF.**	**DESCRIPTION**
1	All	Added Lou's rankings for C1b.

CHANGES TO FILE - Rev 011		
CHANGE #	**ID REF.**	**DESCRIPTION**
1	All	Updated based on final review of all for consensus on rankings.

CHANGES TO FILE - Rev 010		
CHANGE #	**ID REF.**	**DESCRIPTION**
1	All	Re-evaluation of all rankings based on common understanding of countermeasure.

CHANGES TO FILE - Rev 009		
CHANGE #	**ID REF.**	**DESCRIPTION**
1	C1b.	Split Spool Payout Sensor into two categories; static and dynamic sensing.
2	Countermeasure Detail Tab	Added assumptions and more detail to the countermeasures being studied.
3	ID REF. #11-#13	Highlighted those misuses as "Normal Use" considerations (as opposed to "Misuses").

PROJECT ASSUMPTIONS

ITEM	ASSUMPTION
A1	Only the front row of seats in the vehicle is being considered.
A2	Only bucket seats are being considered (not a bench seat).
A3	The vehicle contains original equipment (the seat has not been replaced by an aftermarket product or removed to accommodate a wheelchair).
A4	Malicious hacking of vehicle electronic and computer systems are not considered.
A5	Driver is in complete control of the vehicle; not an autonomous or semi-autonomous vehicle.

ID	Normal Use Considerations
N1	Weight in passenger seat that is not a passenger (laptop, dog, etc)
N2	Car seat that uses the seat belt to hold the car seat in place; 5 point harness on car seat holds infant / child.

ID	Study Assumptions
SA1	Each countermeasure is ranked based on it's independent potential against a given misuse.
SA2	Combinations of countermeasures are evaluated in the follow up Pugh Analysis.

SEAT BELT INTERLOCK USE/MISUSE STUDY

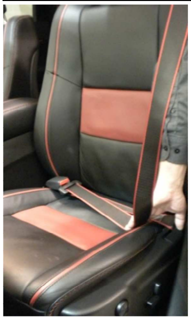
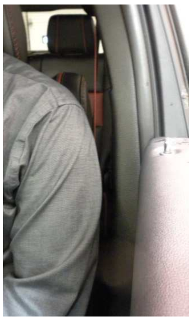
					COUNTERMEASURES																															
ID	Misuse Action	Ease of Implementing Misuse Action (1=low, 5=high)	Potential for Misuse (1=low, 5=high)	Rating (E x P)	C1a. Spool payout sensor (STATIC) - webbing dispensing.	Lou Brown	Joe Boyle	Paul Smith	C1b. Spool payout sensor (DYNAMIC) - webbing dispensing.	Lou Brown	Joe Boyle	Paul Smith	C2. Belt Tension Sensor; Locations: Anchor (A), Buckle (B), D-Ring (D)	Lou Brown	Joe Boyle	Paul Smith	C3. Buckle & latchplate Recognition (mechanical - keying)	Lou Brown	Joe Boyle	Paul Smith	C4. Buckle & latchplate Recognition (mechanical keying with latchplate plate sensing)	Lou Brown	Joe Boyle	Paul Smith	C5. Vision system for non seat belt routing items.	Lou Brown	Joe Boyle	Paul Smith	C6. Vision System focused on belt routing.	Lou Brown	Joe Boyle	Paul Smith	C7. D-ring position recognition	Lou Brown	Joe Boyle	Paul Smith
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).	1	1	1	X	3	2	3		3	3	3		2	3	1		1	1	1		1	1	1		3	4	4	X	5	5	5	X	3	3	3
2	Leaving belt unbuckled.	1	1	1	X	5	5	5		5	5	5	X (B)	5	5	5	X	5	5	5	X	5	5	5		5	5	5	X	5	5	5		4	5	5
3	Passenger seat belt latchplate engaged with driver's buckle.	1	2	2	X	5	1	5		5	4	5		3	3	3	X	5	5	4	X	5	5	5		5	5	5	X	5	5	5		5	5	5
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.	1	1	1	X	3	1	3		3	3	3		2	3	2		1	1	1		1	1	1		3	3	4	X	5	5	5	X	2	3	3
5	Wrap belt around seat. Occupant buckled.	2	1	2	X	1	1	2		2	2	2		3	3	2		1	1	1		1	1	1		3	4	4	X	5	5	5	X	3	4	4
6	Remove headrest, bring latchplate behind seat through headrest opening and buckle from behind. Occupant buckled.	2	1	2	X	2	1	2		2	3	2		3	3	2		1	1	1		1	1	1		3	4	4	X	5	5	5	X	4	4	4
7	Clipping extracted belt. Latchplate in buckle. (Variation of #1) Clipping will be a more permanent action.	2	1	2	X	1	1	3		4	4	3	X (D)	2	3	2		1	1	1		1	1	1	X	4	5	5	X	5	5	5	X	5	4	4
8	Clipping extracted belt and latchplate not in buckle.	2	1	2		3	1	1		3	4	3	X	5	5	3	X	5	5	5	X	5	5	5		5	5	5	X	5	5	5	X	5	4	4
9	Surrogate latchplates.	3	1	3	X	5	5	5		5	5	5	X	3	4	4		3	3	3	X	5	5	5	X	5	5	5	X	5	5	5	X	5	5	4
10	Wire harness modification to "close" the buckle.	4	1	4	X	5	5	5		5	5	5	X (B)	5	5	4	X	1	1	1	X	3	3	3		5	5	5	X	5	5	5	X	4	5	4
11	Unbuckle after the vehicle is moving.	1	1	1	X	5	5	5		5	5	5	X	5	5	3	X	5	5	5	X	5	5	5		5	5	5	X	5	5	5	X	5	5	5
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.	1	1	1	X	5	5	4		5	5	4	X	5	5	3	X	5	5	5	X	5	5	5		5	5	5	X	5	5	5	X	5	4	4
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).	1	1	1	X	5	5	5		5	5	5	X	5	5	3	X	5	5	5	X	5	5	5	X	5	5	5	X	5	5	5	X	5	4	4
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).	2	1	2	X	2	1	2		2	2	2		2	1	1		2	1	1		2	1	1	X	2	3	3	X	4	4	4	X	1	1	2
15	Reflash code on main controller.	5	1	5		1	1	1		1	1	1		1	1	1		2	1	1		2	1	1		1	1	1		1	1	1		1	1	1
16	Reflash SBI Module	5	1	5		1	1	1		1	1	1		1	1	1		2	1	1		2	1	1		1	1	1		1	1	1		1	1	1
						52	41	52		56	57	54		52	55	40		45	42	41		49	46	46		60	65	66		71	71	71		58	58	57

SEAT BELT INTERLOCK USE/MISUSE STUDY

ID	Misuse Action	Ease of Implementing Misuse Action (1=low, 5=high)	Potential for Misuse (1=low, 5=high)	Rating (E x P)	C8. Seat Track Position Sensor	Lou Brown	Joe Boyle	Paul Smith	C9. Capacitive Seat Mat Sensing	Lou Brown	Joe Boyle	Paul Smith	C10. Occupant Classification (Bladder) Sensor	Lou Brown	Joe Boyle	Paul Smith	C11. Potentiometer (belt angle/position); Location: Buckle (B), D-ring (D)	Lou Brown	Joe Boyle	Paul Smith	Notes (Also see general notes at the bottom of the page.)
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).	1	1	1		1	1	1		1	1	1		1	1	1	X	4	3	4	
2	Leaving belt unbuckled.	1	1	1		1	1	1		2	1	1		2	1	1		4	3	4	
3	Passenger seat belt latchplate engaged with driver's buckle.	1	2	2		1	1	1		2	1	1		2	1	1		4	3	4	(PS) C1. Assuming no payout is detected from driver side, reset during every vehicle entry
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.	1	1	1		1	1	1		2	1	1		2	1	1	X	3	3	4	(PS) C9. Depends on webbing type. Metal strands in the webbing may change the capacitance and allow you to pick up a signal - fidelity needs to be checked
5	Wrap belt around seat. Occupant buckled.	2	1	2		1	1	1		2	1	1		2	1	1	X	4	3	4	(PS) C1. depends on fidelity of the sensor to differentiate a 5th female and the amount of webbing payout. Could be very vehicle dependent C9. Depends on webbing type. Metal strands in the webbing may change the capacitance and allow you to pick up a signal - fidelity needs to be checked
6	Remove headrest, bring latchplate behind seat through headrest opening and buckle from behind. Occupant buckled.	2	1	2		1	1	1		2	1	1		2	1	1	X	4	3	4	(PS) C1. depends on fidelity of the sensor to differentiate a 5th female and the amount of webbing payout. Could be very vehicle dependent
7	Clipping extracted belt. Latchplate in buckle. (Variation of #1) Clipping will be a more permanent action.	2	1	2		1	1	1		2	1	1		2	1	1	X	4	3	4	
8	Clipping extracted belt and latchplate not in buckle.	2	1	2		1	1	1		2	1	1		2	1	1	X	5	5	4	(PS) C1B. Assume no change in payout over x period of time, may need to look at the fidelity, C2 - occupant interaction could cause change in status
9	Surrogate latchplates.	3	1	3		1	1	1		2	1	1		2	1	1	X	5	5	5	(PS) C1a. assuming no payout is detected, C2. fidelity needs to be verified (IE: load vs. unload cases)
10	Wire harness modification to "close" the buckle.	4	1	4		1	1	1		2	1	1		2	1	1		5	5	5	(PS) C1a. assuming no payout is detected, C2. fidelity needs to be verified (IE: load vs. unload cases)
11	Unbuckle after the vehicle is moving.	1	1	1		1	1	1		2	1	1		2	1	1		5	5	5	(PS) C2. Act of unbuckling may overlap with occupant movement - fidelity needs to be reviewed
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.	1	1	1		1	1	1		2	1	1		2	1	1		5	5	5	(PS) C2. Act of unbuckling may overlap with occupant movement - fidelity needs to be reviewed
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).	1	1	1		1	1	1	X	2	1	1	X	2	1	1		5	5	5	(PS) C1. would require input from another sensor to determine if there is an occupant in the passenger seat. (PS) C2. Act of unbuckling may overlap with occupant movement - fidelity needs to be reviewed (PS) C9~C11 can't be detected by seat related items only - other sensors required (IE buckle switch)
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).	2	1	2		2	1	1	X	2	1	2	X	2	1	2	X	2	1	2	(PS) C7~C11. Fidelity issue may exist (OOP vs. occupant)
15	Reflash code on main controller.	5	1	5		1	1	1		1	1	1		1	1	1		1	1	1	
16	Reflash SBI Module	5	1	5		1	1	1		1	1	1		1	1	1		1	1	1	
						17	16	16		29	16	17		29	16	17		61	54	61	

ID	Countermeasure	Detailed Description / Assumptions about Countermeasures
C1a.	C1a. Spool payout sensor (STATIC) - webbing dispensing.	This countermeasure WILL NOT be useful when payout is used in a misuse (sitting on buckled belt, belt wrapped around seat). This countermeasure assumes data taken at the point of a decision about correct use.
C1b.	C1b. Spool payout sensor (DYNAMIC) - webbing dispensing.	This countermeasure WILL NOT be useful when payout is used in a misuse (sitting on buckled belt, belt wrapped around seat). This countermeasure assumes data taken on a periodic basis to detect movement, indicating an occupant that is restrained.
C2	Belt Tension Sensor; Locations: Anchor (A), Buckle (B), D-Ring (D)	The belt tensions sensors will be used statically.
C3	Buckle & Latch Recognition (mechanical - keying)	
C4	Buckle & Latch Recognition (mechanical keying with latch plate sensing)	
C5	Vision	The vision system may be trained on an anchor, D-ring or buckle.
C6	Vision with florescent material in belt	Florescent material must be a unique pattern and visible to a day/night camera.
C7	D-ring position recognition	
C8	Seat Track Position Sensor	
C9	Capacitive Seat Mat Sensing	Current capacitive systems that exist today. Primarily used to determine whether human/non-human occupants/objects are located in seat.
C10	Occupant Classification (Bladder) Sensor	Primarily used to determine whether human/non-human occupants/objects are located in seat.
C11	Potentiometer (belt angle/position); Location: Buckle (B), D-ring (D)	Assume all locations are being used.

MISUSE ID IMAGES

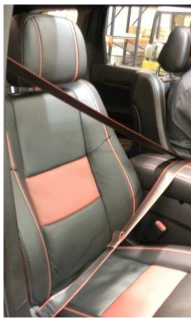



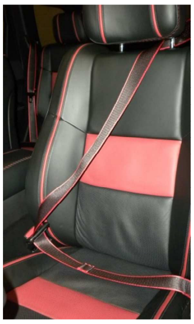
Sitting on buckled seat belt (lap and shoulder behind occupant

ID 1

Passenger seat belt latch plate engaged with driver's buckle.

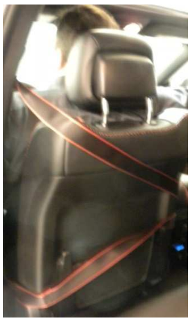
ID 3






Shoulder belt behind user (lap belt in correct position). Occupant buckled.

ID 4



Wrap belt around seat. Occupant buckled.

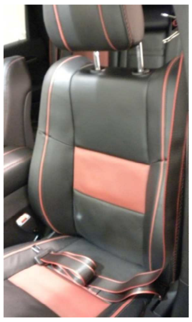
ID 5

Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.

ID 6

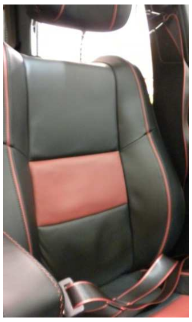
Clipping extracted belt and latch plate not in buckle.

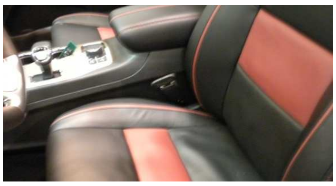
ID 8



Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.

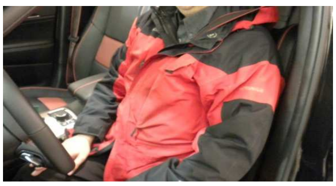
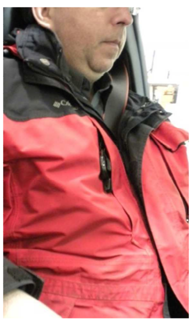
ID 7



Surrogate latch plates.

ID 9

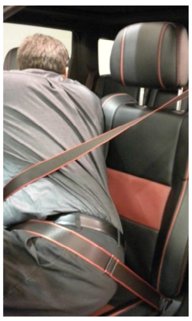



ID 19

Webbing path covered by clothing (Coat, blanket).

Person buckled but not in correct position (feet not on floor, belts not positioned correctly).

ID 20



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Preventing Seat Belt Interlock Misuse
Survivability Solutions

TECHNICAL PLAN

Appendix B

Pugh Analysis

Rev 007 4/14/2016
Tom Messner, Tricia Mayer

Sensor Fusion Pugh Analysis Chart

Work this way ---->

ID	Criteria / Concept	C 0	C 1	C 2	C 3	C 4	C 5	C 6	C 7	8	9
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		S	S	S	S	S	S	S	S	S
2	Leaving belt unbuckled.	D	+	S	S	S	S	+	+	+	+
3	Passenger seat belt latch plate engaged with driver's buckle.	A	S	S	S	S	S	S	S	S	S
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.	T	S	S	S	S	S	S	S	S	S
5	Wrap belt around seat. Occupant buckled.	U	S	S	S	S	S	S	S	S	S
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.	M	S	S	S	S	S	S	S	S	S
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		S	S	S	S	S	S	S	S	S
8	Clipping extracted belt and latch plate not in buckle.		S	S	S	S	S	S	S	S	S
9	Surrogate latch plates.		S	S	S	S	S	S	S	S	S
10	Wire harness modification to "close" the buckle.		S	S	S	S	S	S	S	S	S
11	Unbuckle after the vehicle is moving.		S	S	S	S	S	S	S	S	S
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		S	S	S	S	S	S	S	S	S
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		S	S	S	S	S	S	S	S	S
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		S	S	S	S	S	S	S	S	S
15	Reflash code on main controller.		S	S	S	S	S	S	S	S	S
16	Reflash SBI Module		S	S	S	S	S	S	S	S	S
17	New: Covering up the camera - intentional		S	S	S	+	S	+	+	+	+
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		S	S	S	+	+	+	+	+	+
19	New: Articles blocking camera (IE...Blanket, Coat) unintentional		S	S	S	+	+	+	+	+	+
20	New: Occupant out of position (IE; turned to block web path)		S	+	S	+	S	+	+	+	+
21	New: shoulder belt routed, but not buckled		+	S	S	S	S	+	+	+	+
22	New: System Weight		-	-	-	-	-	-	S	-	-
23	New: System Cost		-	-	-	-	-	-	S	-	-
24	New: Child Seat Web Routing		S	S	S	S	S	S	-	S	S
25	New: laptop interference		S	S	S	S	S	S	-	S	S
26	New: Artificial limb/organ interference (pace maker, etc.)		S	S	S	S	S	S	-	S	S
27	New: Works with buckle extender		S	S	S	S	S	S	S	S	S
	S+		2	1	0	4	2	6	6	6	6
	S-		2	2	2	2	2	2	3	2	2
	SS		23	24	25	21	23	19	18	19	19

Best Cases	Major Strengths	Major Weaknesses
Case 6 - Vision system w/ capacitive in webbing, seat back and cushion, buckle switch	covers a broad spectrum of misuse	cost and weight
Case 7 - 3 capacitive system - webbing, seat back and seat cushion	Cost, weight	Interferences (laptop, pacemaker)
Case 8 - Vision system with potentiometers at the D-Ring and the buckle, with buckle switch	Provides backup when camera is covered or blocked	cost and weight, potential fidelity
Case 9 - Vision System with retractor spool payout sensor and buckle switch	Provides backup when camera is covered or blocked	cost and weight, potential fidelity

C	Concept Summary
0	***DATUM*** - Vision System focused on seat belt web routing and occupant
1	Vision System focused on seat belt web routing and occupant, with smrt buckle switch
2	Vision system focused on web routing coupled with capacitive sensor on seat cushion and seat back
3	Vision System focus on web routing with D-Ring sensor
4	Vision System focused on web routing coupled with capacitive sensor on seat back, cushion and seat belt webbing
5	Vision System focused on web routing coupled with sensor on seat belt webbing
6	Vision System focused on web routing coupled with capacitive sensor on seat back, cushion, seat belt webbing and smrt buckle switch
7	Capacitive sensor on seat back, cushion, seat belt webbing and smrt buckle switch
8	Vision system with Potentiometers at the D-Ring, Seat Belt Buckle and with a smrt buckle switch
9	Vision system with retractor spool payout sensors and with a smrt buckle switch

Revision level: 5

Process:

1) Rate each concept with respect to datum case
2) Select best cases (least -'s and most +'s)
3) Identify major strengths and weaknesses of best
4) Identify other hybrid concepts to maximize strengths
5) Choose new datum and iterate process

Enter a +, - or S in each cell to represent whether the concept is SIGNIFICANTLY better, worse, or the same as the datum concept.

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Survivability Solutions

TECHNICAL PLAN

Appendix C

DV P & R

Rev 007 4/14/2016
Tom Messner, Tricia Mayer

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DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #

PLAN DATE: **4/12/2016** rev. **3** ORIGINATOR: **P. Smith**

PART NAME: **Interlock Module - Baseline system** CUSTOMER: **NHTSA**

REPORT DATE: TBD QUALITY ENGR: J. Boyle

MY **2018** PART # TBD REVISION: 3

LOCATION: **Shelby Township, MI** APPROVAL: T. Messner

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Group I Baseline System - Camera Only - pugh matrix confirmation**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	36	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Added light and dark conditions. Data will be collected with all sensors and we will only report on system
2	Leaving belt unbuckled.		Static	36	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	36	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	36	A							
5	Wrap belt around seat. Occupant buckled.		Static	36	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	36	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	36	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	36	A							
9	Surrogate latch plates.		Static	36	A							
10	Wire harness modification to "close" the buckle.		Static	36	A							
11	Unbuckle after the vehicle is moving.		Static	36	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	36	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	36	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	36	A							
17	New: Covering up the camera - intentional		Static	36	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	108	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	108	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	108	A							
21	New: shoulder belt routed, but not buckled		Static	108	A							
24	New: Child Seat Web Routing		Static	108	A							
25	New: laptop interference		Static	108	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	108	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	108	A							

BGM **DESIGN VERIFICATION / VALIDATION PLAN & REPORT**		PROGRAM #	PAGE **1** of **1**
		PLAN DATE: **4/12/2016** rev. **3**	ORIGINATOR: **P. Smith**
PART NAME: **Interlock Module - Concept System 6**	CUSTOMER: **NHTSA**	REPORT DATE: TBD	QUALITY ENGR: J. Boyle
MY **2018** PART # TBD	REVISION: 3	LOCATION: **Shelby Township, MI**	APPROVAL: T. Messner

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Concept System 6 - Camera system, capacitive systems in webbing, seat back, cushion with smrt buck**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	n/a	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Data will be collected in "Baseline" testing, no duplicate testing is expected Results reported will focus on sensors used for concept 6
2	Leaving belt unbuckled.		Static	n/a	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	n/a	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	n/a	A							
5	Wrap belt around seat. Occupant buckled.		Static	n/a	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	n/a	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	n/a	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	n/a	A							
9	Surrogate latch plates.		Static	n/a	A							
10	Wire harness modification to "close" the buckle.		Static	n/a	A							
11	Unbuckle after the vehicle is moving.		Static	n/a	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	n/a	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	n/a	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	n/a	A							
17	New: Covering up the camera - intentional		Static	n/a	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	n/a	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	n/a	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	n/a	A							
21	New: shoulder belt routed, but not buckled		Static	n/a	A							
24	New: Child Seat Web Routing		Static	n/a	A							
25	New: laptop interference		Static	n/a	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	n/a	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	n/a	A							

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DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #		PAGE **1** of **1**	
PLAN DATE: **4/12/2016** rev. **3**		ORIGINATOR: **P. Smith**	
PART NAME: **Interlock Module - Concept System 7**	CUSTOMER: **NHTSA**	REPORT DATE: TBD	QUALITY ENGR: J. Boyle
MY **2018**	PART # TBD	REVISION: 3	LOCATION: **Shelby Township, MI**
APPROVAL: T. Messner			

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Concept System 7 - Capacitive systems in webbing, seat back, cushion with smrt buckle switch**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	n/a	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Data will be collected in "Baseline" testing, no duplicate testing is expected Results reported will focus on sensors used for concept 7
2	Leaving belt unbuckled.		Static	n/a	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	n/a	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	n/a	A							
5	Wrap belt around seat. Occupant buckled.		Static	n/a	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	n/a	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	n/a	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	n/a	A							
9	Surrogate latch plates.		Static	n/a	A							
10	Wire harness modification to "close" the buckle.		Static	n/a	A							
11	Unbuckle after the vehicle is moving.		Static	n/a	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	n/a	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	n/a	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	n/a	A							
17	New: Covering up the camera - intentional		Static	n/a	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	n/a	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	n/a	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	n/a	A							
21	New: shoulder belt routed, but not buckled		Static	n/a	A							
24	New: Child Seat Web Routing		Static	n/a	A							
25	New: laptop interference		Static	n/a	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	n/a	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	n/a	A							

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DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #		PAGE **1** of **1**	
PLAN DATE: **4/12/2016** rev. **3**		ORIGINATOR: **P. Smith**	
PART NAME: **Interlock Module - Concept System 8**	CUSTOMER: **NHTSA**	REPORT DATE: TBD	QUALITY ENGR: J. Boyle
MY **2018**	PART # TBD	REVISION: 3	LOCATION: **Shelby Township, MI**	APPROVAL: T. Messner

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Concept System 8 - Vision systems with potentiameters at the D-Ring and the buckle with smrt buckle**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	n/a	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Data will be collected in "Baseline" testing, no duplicate testing is expected Results reported will focus on sensors used for concept 8
2	Leaving belt unbuckled.		Static	n/a	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	n/a	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	n/a	A							
5	Wrap belt around seat. Occupant buckled.		Static	n/a	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	n/a	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	n/a	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	n/a	A							
9	Surrogate latch plates.		Static	n/a	A							
10	Wire harness modification to "close" the buckle.		Static	n/a	A							
11	Unbuckle after the vehicle is moving.		Static	n/a	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	n/a	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	n/a	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	n/a	A							
17	New: Covering up the camera - intentional		Static	n/a	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	n/a	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	n/a	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	n/a	A							
21	New: shoulder belt routed, but not buckled		Static	n/a	A							
24	New: Child Seat Web Routing		Static	n/a	A							
25	New: laptop interference		Static	n/a	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	n/a	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	n/a	A							

BGM

DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #		PAGE **1** of **1**	
PLAN DATE: **4/12/2016** rev. **3**		ORIGINATOR: **P. Smith**	
PART NAME: **Interlock Module - Concept System 9**	CUSTOMER: **NHTSA**	REPORT DATE: TBD	QUALITY ENGR: J. Boyle
MY **2018**	PART # TBD	REVISION: 3	LOCATION: **Shelby Township, MI**	APPROVAL: T. Messner

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Concept System 9 - Vision systems with retractor spool payout sensor and smrt buckle switch**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	n/a	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Data will be collected in "Baseline" testing, no duplicate testing is expected Results reported will focus on sensors used for concept 9
2	Leaving belt unbuckled.		Static	n/a	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	n/a	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	n/a	A							
5	Wrap belt around seat. Occupant buckled.		Static	n/a	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	n/a	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	n/a	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	n/a	A							
9	Surrogate latch plates.		Static	n/a	A							
10	Wire harness modification to "close" the buckle.		Static	n/a	A							
11	Unbuckle after the vehicle is moving.		Static	n/a	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	n/a	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	n/a	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	n/a	A							
17	New: Covering up the camera - intentional		Static	n/a	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	n/a	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	n/a	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	n/a	A							
21	New: shoulder belt routed, but not buckled		Static	n/a	A							
24	New: Child Seat Web Routing		Static	n/a	A							
25	New: laptop interference		Static	n/a	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	n/a	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	n/a	A							

Form Revision History:

Revision Level	Revision Date	Description of Change	Reviewed by:
001	3/21/2016	Draft Version of Test Plan	Paul Smith
002	4/5/2016	Further defined seating characterstics and occupants, clarified	Paul Smith
003	4/11/2016	Added lighting characterstics, added buckle extender	Paul Smith
004			

DTNH2214D00321L/0002
Preventing Seat Belt Interlock Misuse
Survivability Solutions

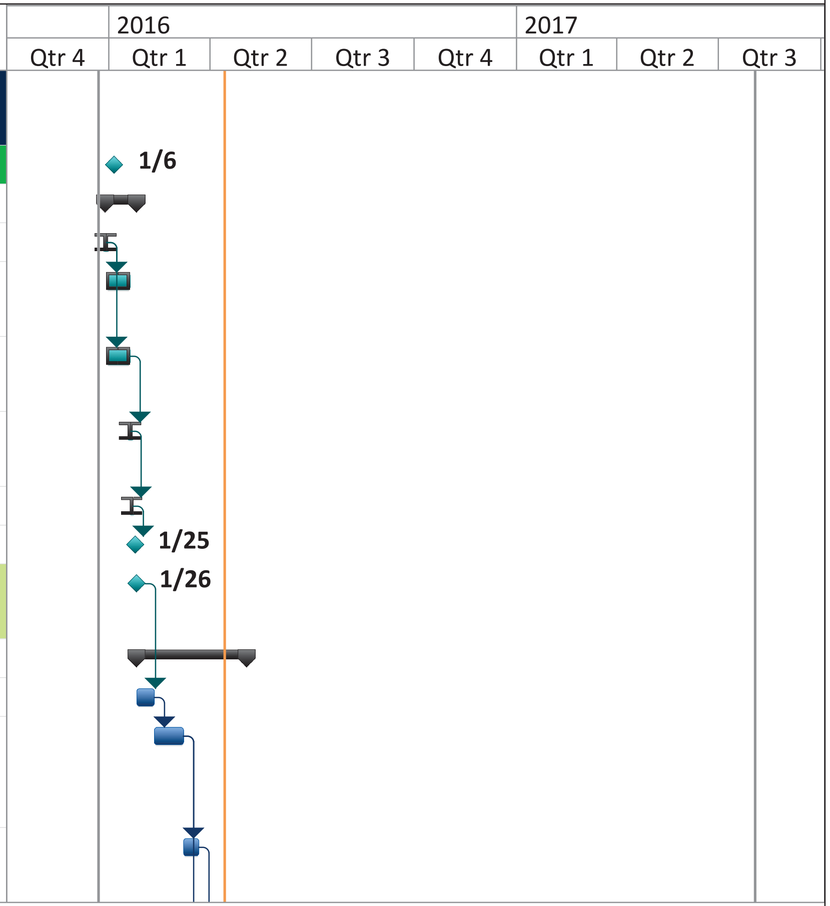
TECHNICAL PLAN

Appendix D

Project Timing

Rev 007 4/14/2016
Tom Messner, Tricia Mayer

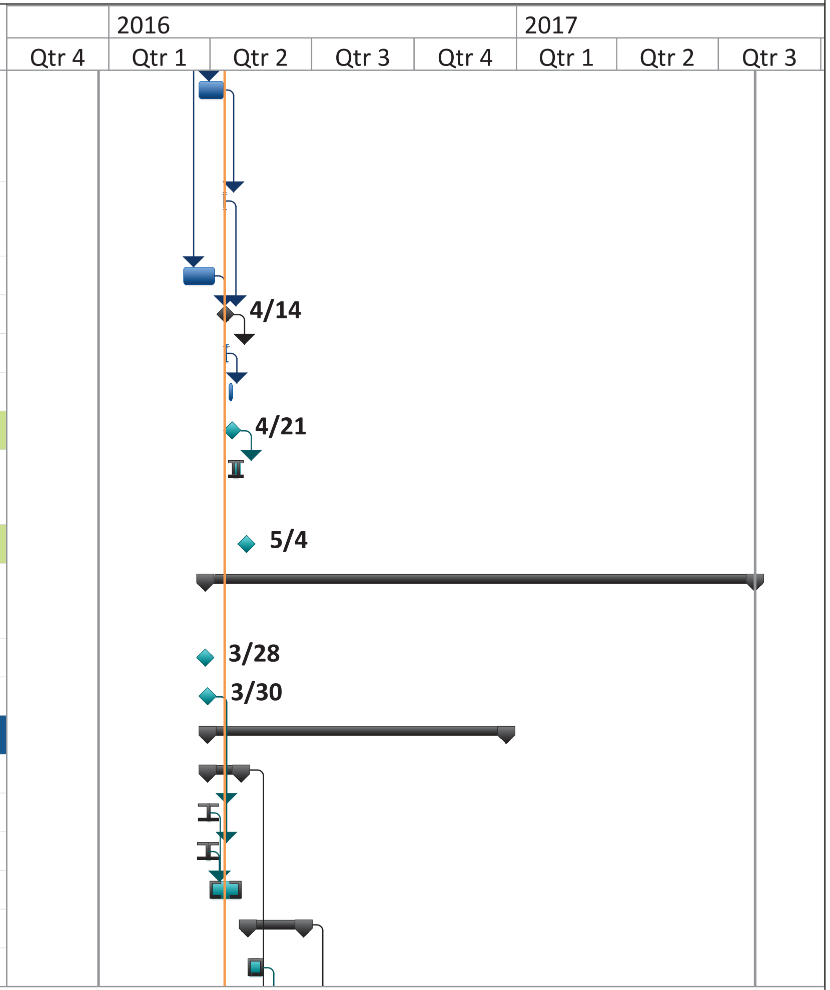
ID	Task Name	Duration	Start	Finish
1	**NHTSA Preventing Seat Belt Interlock Misuse DTNH2214D00321L/0002**			
2	**TASK ORDER AWARD**	**0 days**	**1/6/16**	**1/6/16**
3	**Project Kick Off**	**18 days**	**12/29/15**	**1/26/16**
4	Discuss Overall Project Objectives	1 day	12/29/15	12/29/15
5	Identification of Seatbelt Interlock Strategies	13 days	12/30/15	1/19/16
6	Preparation of Seatbelt Use/Misuse Study	13 days	12/30/15	1/19/16
7	Team Review of Seatbelt Use/Misuse Study	1 day	1/20/16	1/20/16
8	Seatbelt Use/Misuse Study Final Edits	2 days	1/21/16	1/22/16
9	DRAFT Seatbelt Use/Misuse Study	0 days	1/25/16	1/25/16
10	C.4.1 Kick Off Meeting in Washington DC (no later than 2/3/16)	0 days	1/26/16	1/26/16
11	**Seatbelt Interlock Technical Plan**	**69 days**	**1/26/16**	**5/4/16**
12	Finalize Seatbelt Use/Misuse Study	12 days	1/26/16	2/10/16
13	Review and analyze misuse countermeasures required to eliminate misuses.	18 days	2/11/16	3/7/16
14	Finalize intended countermeasures to be implemented.	2 wks	3/8/16	3/21/16



Project: NHTSA SBI Project Timing
Date: 4/14/16

Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Deadline
External Tasks	Duration-only	Progress

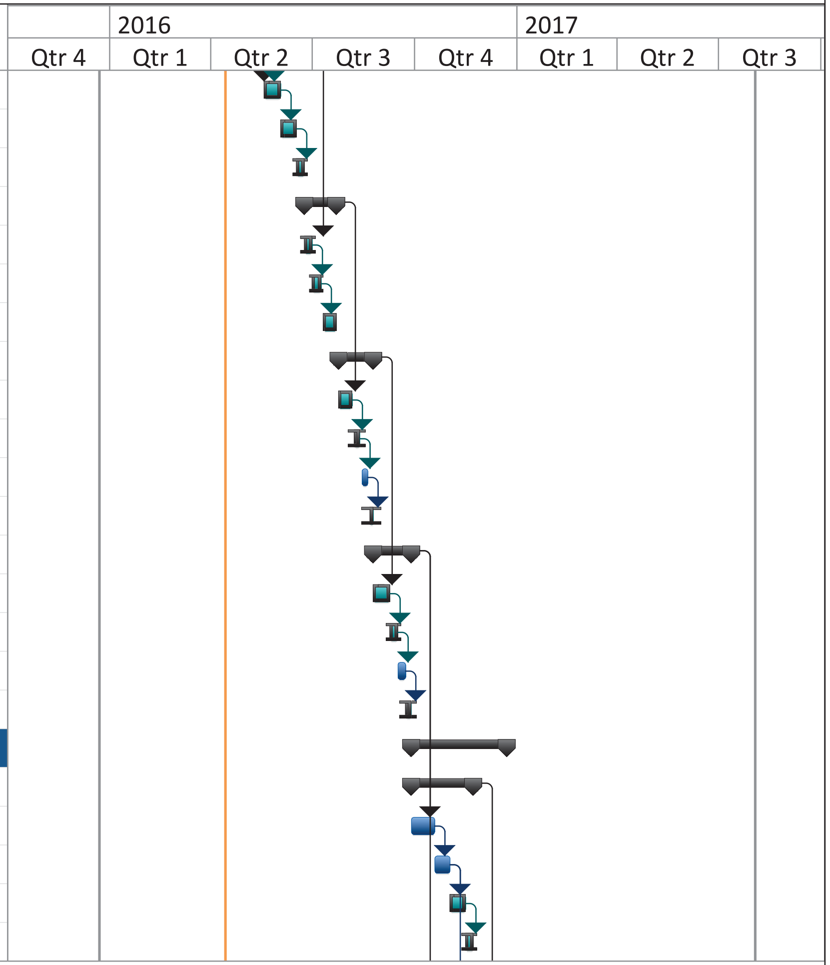
ID	Task Name	Duration	Start	Finish
15	Research development needed to implement Seat Belt Interlock System with Countermeasures	14 days	3/22/16	4/12/16
16	Update Timeline for counter measure implementation	2 days	4/13/16	4/14/16
17	Create the DRAFT Final Technical Plan	18 days	3/8/16	4/4/16
18	Technical Plan Ready	0 days	4/14/16	4/14/16
19	Team Review of Technical Plan	1 day	4/15/16	4/15/16
20	Technical Plan Final Edits	3 days	4/18/16	4/20/16
21	C.4.2 DRAFT Final Technical Plan	0 days	4/21/16	4/21/16
22	NTHSA Plan Modifications and/or Approval	5 days	4/21/16	4/27/16
23	C.4.2 COR (TO) Plan Approval	0 days	5/4/16	5/4/16
24	**Development and Evaluation of Prototype System**	**346 days**	**3/28/16**	**8/2/17**
25	Vehicle Delivery	0 days	3/28/16	3/28/16
26	Sensor & Buck Delivery	0 days	3/30/16	3/30/16
27	**Buck Development Work**	**187 days**	**3/30/16**	**12/22/16**
28	**Buck Hardware Installation**	**22 days**	**3/30/16**	**4/28/16**
29	Install IP	2 days	3/30/16	3/31/16
30	Install Seats	1 day	3/30/16	3/30/16
31	Install Sensors	4 wks	4/1/16	4/28/16
32	**Data Acquisition**	**35 days**	**5/5/16**	**6/23/16**
33	Procure DAQ Hardware	2 wks	5/5/16	5/18/16



Project: NHTSA SBI Project Timing
Date: 4/14/16

Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Deadline
External Tasks	Duration-only	Progress

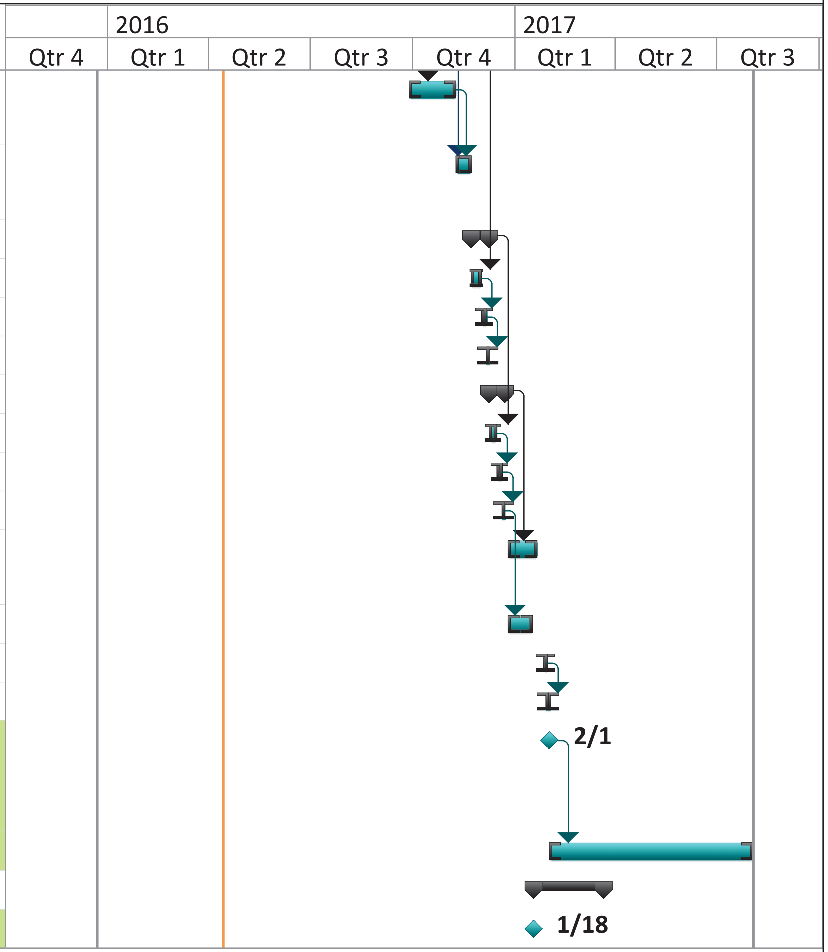
ID	Task Name	Duration	Start	Finish
34	Install DAQ System	2 wks	5/19/16	6/2/16
35	Software development on DAQ	2 wks	6/3/16	6/16/16
36	Test / Prove-out system	1 wk	6/17/16	6/23/16
37	**Execute DV P & R with Vehicle Buck**	**20 days**	**6/24/16**	**7/22/16**
38	Baseline System Evaluation	1 wk	6/24/16	6/30/16
39	Concepts 6, 7, 8 & 9 Evaluation	1 wk	7/1/16	7/8/16
40	Analyze & Review Data	2 wks	7/11/16	7/22/16
41	**Iterate Baseline System Design (1)**	**23 days**	**7/25/16**	**8/24/16**
42	Update Hardware	2 wks	7/25/16	8/5/16
43	DAQ based on new system	1 wk	8/8/16	8/12/16
44	Repeat DV P&R	1 wk	8/15/16	8/19/16
45	Analyze & Review Data	3 days	8/22/16	8/24/16
46	**Iterate Baseline System Design (2)**	**23 days**	**8/25/16**	**9/27/16**
47	Update Hardware	2 wks	8/25/16	9/8/16
48	DAQ based on new system	1 wk	9/9/16	9/15/16
49	Repeat DV P&R	1 wk	9/16/16	9/22/16
50	Analyze & Review Data	3 days	9/23/16	9/27/16
51	**Vehcile Development Work**	**60 days**	**9/28/16**	**12/22/16**
52	**Sensor Installation on Vehicle**	**40 days**	**9/28/16**	**11/22/16**
53	Sensor Installation on Vehicle	3 wks	9/28/16	10/18/16
54	Install DAQ in Vehicle	2 wks	10/19/16	11/1/16
55	Perform DV P & R	2 wks	11/2/16	11/15/16
56	Analyze & Review Data	1 wk	11/16/16	11/22/16



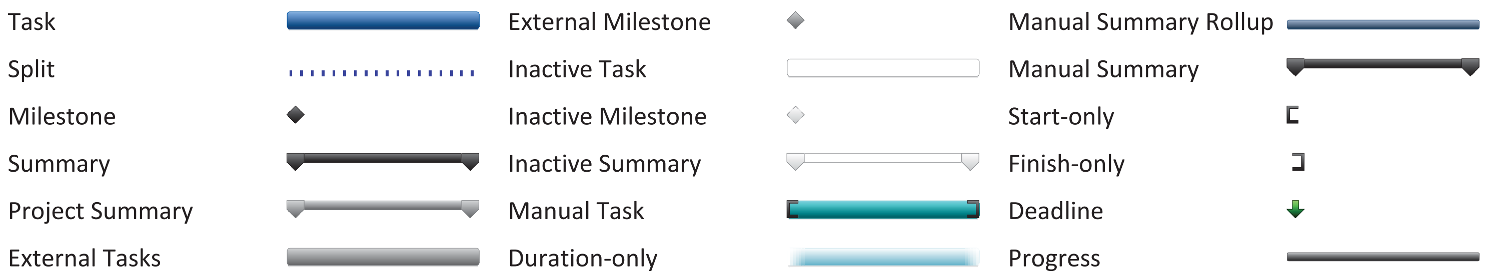
Project: NHTSA SBI Project Timing
Date: 4/14/16

Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress

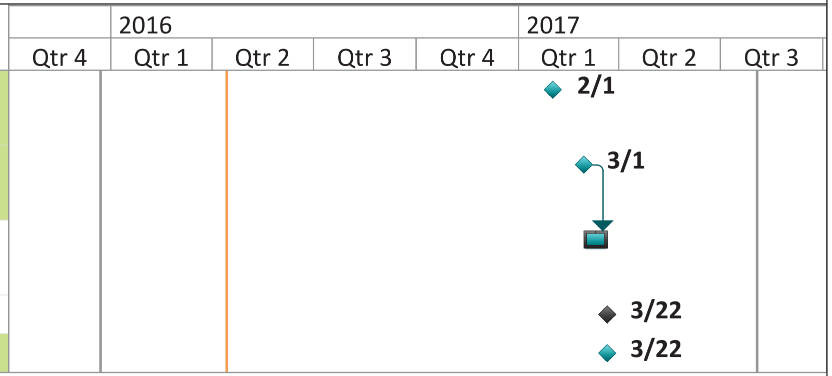
ID	Task Name	Duration	Start	Finish
57	Algorithm Develpoment for Interlock	6 wks	9/28/16	11/8/16
58	Repeat DV P & R for Interlock Status	2 wks	11/9/16	11/22/16
59	**Iterate Interlock Algorithm (1)**	**10 days**	**11/23/16**	**12/8/16**
60	Update algorithm	1 wk	11/23/16	12/1/16
61	Repeat DV P&R	3 days	12/2/16	12/6/16
62	Analyze & Review Data	2 days	12/7/16	12/8/16
63	**Iterate Interlock Algorithm (2)**	**10 days**	**12/9/16**	**12/22/16**
64	Update algorithm	1 wk	12/9/16	12/15/16
65	Repeat DV P&R	3 days	12/16/16	12/20/16
66	Analyze & Review Data	2 days	12/21/16	12/22/16
67	Final Hardware & Software Updates & Testing	1 mon	12/26/16	1/20/17
68	Prepare Final Report and Presentation	16 days	12/26/16	1/16/17
69	Prepare Vehicle for Delivery	2 days	1/26/17	1/30/17
70	Drive vehicle to Ohio	1 day	1/30/17	1/31/17
71	C.4.3 Delivery of Vehicle with Prototype Seat Belt interlock System (East Liberty, Ohio)	0 days	2/1/17	2/1/17
72	C.4.3 VRTC Independent Evaluation	131 days	2/1/17	8/2/17
73	**Draft Final Report and Presentation**	**45 days**	**1/18/17**	**3/21/17**
74	C.4.4 DRAFT Final Report	0 days	1/18/17	1/18/17



Project: NHTSA SBI Project Timing
Date: 4/14/16



ID	Task Name	Duration	Start	Finish
75	C.4.4 Final Presentation NHTSA Headquarters Washington DC	0 days	2/1/17	2/1/17
76	C.4.4 COR (TO) Comments on DRAFT Final Report	0 days	3/1/17	3/1/17
77	Update Final Report base on COR (TO) Comments	15 days	3/1/17	3/21/17
78	**Final Report**	**0 days**	**3/22/17**	**3/22/17**
79	C.4.5 FINAL REPORT	0 days	3/22/17	3/22/17



Project: NHTSA SBI Project Timing
Date: 4/14/16

Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Deadline
External Tasks	Duration-only	Progress

Appendix D – Data Analysis Report

Preventing Seat Belt Interlock Misuse

Preventing Seat Belt Interlock Misuse

DATA ANALYSIS REPORT

www.nhtsa.gov

DTNH2214D0032L/0002

Contents

Authors: Tricia Mayer, BGM Engineering Inc.
Data Analysis Report

Introduction and Summary

This document contains a summary of the data collection method and results for the Driver's Side Data. These results show that D-ring angle along with Seat Track Position and Seat Incline Angle can detect all misuse scenarios with the occupants tested.

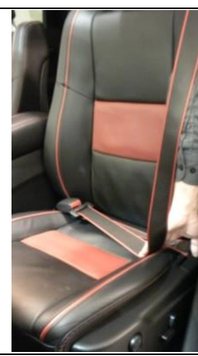
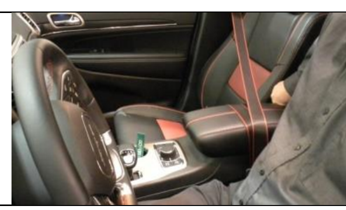
1 Testing and Data Collection

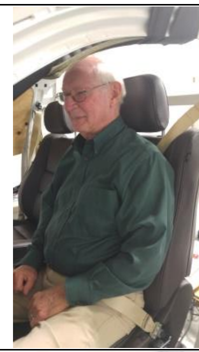
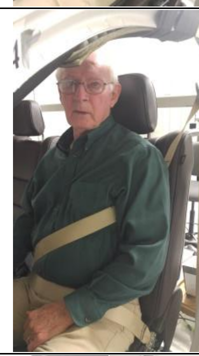
1.1 Occupant Types

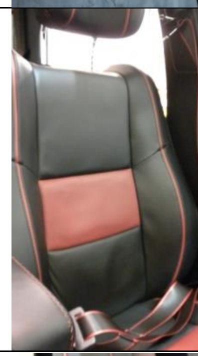
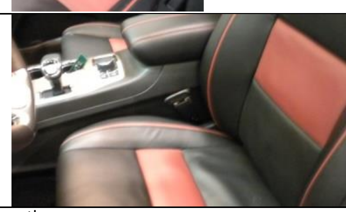
The occupant types are representative of the Hybrid III crash test dummies.

Occupant	Height	Weight
5th female	5'0"	110 lbs.
50th male	5'9"	170 lbs.
95th male	6'2"	223 lbs.

1.2 Misuse Cases

ID	Use / Misuse Action	
0	Properly Buckled Occupant	
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).	 
2	Leaving belt unbuckled.	
3	Passenger seat belt latchplate engaged with driver's buckle.	

ID	Use / Misuse Action
4-1	Shoulder belt behind user; lap belt in correct position. Shoulder belt behind the occupant's back. 
4-2	Shoulder belt behind user; lap belt in correct position. Shoulder belt under occupant's arm. 
5-1	Wrap belt around seat. Lap belt bucked but shoulder belt behind the seat (occupant restrained by lap belt).  
5-2	Wrap belt around seat. Belt buckled behind the seat (no occupant restraint). 
6	Remove headrest, bring latchplate behind seat through headrest opening and buckle from behind. Occupant buckled. 

ID	Use / Misuse Action	
		
7	Clipping extracted belt. Latchplate in buckle. (Variation of #1) Clipping will be a more permanent action.	 
8	Clipping extracted belt and latchplate not in buckle.	
9	Surrogate latchplates.	
14-1	Out of Position – Feet on dash (straight out)	5th female  50th male 

1.3 Test Trials

Occupants

Trial Number	Driver's Seat	Passenger Seat	Seat Tilt	Seat Track
1	5th Female		Full Up	Full Forward
2				Mid Position
3				Full Rearward
4	5th Female		Full Down	Full Forward
5				Mid Position
6				Full Rearward
7	50th Male		Full Up	Full Forward
8				Mid Position
9				Full Rearward
10	50th Male		Full Down	Full Forward
11				Mid Position
12				Full Rearward
13	95th Male		Full Up	Mid Position
14				Full Rearward
15	95th Male		Full Down	Mid Position
16				Full Rearward
17		5th Female	Full Up	Full Forward
18				Mid Position
19				Full Rearward
20		5th Female	Full Down	Full Forward
21				Mid Position
22				Full Rearward
23		50th Male	Full Up	Full Forward
24				Mid Position
25				Full Rearward
26		50th Male	Full Down	Full Forward
27				Mid Position
28				Full Rearward
29		95th Male	Full Up	Full Forward
30				Mid Position
31				Full Rearward
32		95th Male	Full Down	Full Forward
33				Mid Position
34				Full Rearward

1.4 Test Procedure

1. Set Seat Incline/Seat Track
2. Go through misuses
    a. Log file
    b. Take Picture
3. Repeat Step 2 until all misuses recorded.
4. Repeat Step 1 until all seat incline/track positions recorded.

1.4.1 Seat Incline/Seat Track

Abbreviation	Seat Incline	Seat Track
FU FF	Full Upright	Full Forward
FD FF	Full Down	Full Forward
FD MT	Full Down	Mid Track
FU MT	Full Upright	Mid Track
FU FR	Full Upright	Full Rearward
FD FR	Full Down	Full Rearward

1.4.2 Misuse Case Test Order

Misuse Case	Description
2	Unbuckled
1	Buckled belt, sit on it
0	PROPERLY BUCKLED
4-2	Put shoulder belt under arm (Lap buckled)
4-1	Put shoulder belt behind back (Lap buckled)
5-1	Put shoulder belt behind seat (Lap buckled)
5-2	Unbuckle belt, buckle from behind the seat.

1.4.3 Seat Track Positions

1.4.3.1 Driver's Side

Full Forward (FF) 0"

Mid Track (MT) 5 3/8"

Full Rearward (FR) 10 ¾"

	Forward (FF)	Mid Track (MT)	Rearward (FR)
5th Female	2 1/8"	5 3/8"	6 1/16"
50th Male	4 1/8"	5 3/8"	7 1/8"
95th Male	N/A	5 3/8"	10 ¾"

1.4.3.2 Passenger Side

Full Forward (FF) 0"

Mid Track (MT) 4 5/8""

Full Rearward (FR) 9 ¼"

	Forward (FF)	Mid Track (MT)	Rearward (FR)
5th Female	0”	4 5/8”	9 ¼”
50th Male	0”	4 5/8”	9 ¼”
95th Male	3”	4 5/8”	9 ¼”

2 Test Results

2.1 All Data Collected (by occupant type)

2.1.1 Example of Raw Data Collected off DAQ

5th_Driver FD FF_M0_2016-11-03_

BeltTension_DRing_Driv	D-Ring_Angle_Driv	Payout_Driv	BeltTension_Anchor_Driv	Anchor_Angle_Driv	SeatTrackPos_Forward_Driv	SeatTrackPos_Mid_Driv	SeatTrackPos_Rear_Driv	Accelerometer_X_Driv
3.176194388	34.00179103	24.95073768	2.716252883	1.247971157	0.721667266	0.700641413	0.685857611	0.020587205
3.238615027	33.95382533	24.96183227	2.73596466	1.252242042	0.721338737	0.699327297	0.685857611	0.019930148
3.278038589	33.90585963	24.95073768	2.785244103	1.258155574	0.721667266	0.700312884	0.685529082	0.020587205
3.317462152	33.71399685	24.96183227	2.758961733	1.258155574	0.722324324	0.699984355	0.68618614	0.020258676
3.294465074	33.76196255	24.96183227	2.785244103	1.259798222	0.721667266	0.699984355	0.685857611	0.019930148
3.297750371	33.78594539	24.95073768	2.758961733	1.258812634	0.721995795	0.699984355	0.68618614	0.020258676
3.314176855	33.85789394	24.95073768	2.722823475	1.256184397	0.722652853	0.699984355	0.68618614	0.020258676
3.343744528	33.690014	24.9285485	2.614408703	1.249613805	0.721995795	0.699327297	0.685857611	0.020258676
3.379882795	33.690014	24.95073768	2.617693999	1.24534292	0.721338737	0.700312884	0.684543495	0.020915733
3.409450468	33.66603115	24.95073768	2.666973441	1.246657039	0.722324324	0.700312884	0.68618614	0.020258676
3.33060334	33.690014	24.93964309	2.594696927	1.244028802	0.721667266	0.700969942	0.685200553	0.020258676
3.366741607	33.80992824	24.96183227	2.588126335	1.241400565	0.721667266	0.699984355	0.685857611	0.019930148
3.307606261	33.71399685	24.96183227	2.617693999	1.243371743	0.721995795	0.700312884	0.685857611	0.01960162
3.343744528	33.66603115	24.95073768	2.712967586	1.249285275	0.722324324	0.699984355	0.685857611	0.020258676
3.373312201	33.7379797	24.93964309	2.660402848	1.249613805	0.722652853	0.699327297	0.684214966	0.020258676
3.297750371	33.78594539	24.95073768	2.614408703	1.245014391	0.721667266	0.700312884	0.68618614	0.019930148
3.255041511	33.76196255	24.95073768	2.492852753	1.236801151	0.722652853	0.699984355	0.685857611	0.020587205
3.248470917	33.71399685	24.9285485	2.450143906	1.230887619	0.721667266	0.700969942	0.685200553	0.019930148
3.212332652	33.690014	24.97292686	2.410720357	1.226945264	0.721010208	0.699327297	0.685857611	0.01960162
3.209047356	33.71399685	24.93964309	2.407435061	1.224317028	0.721338737	0.699655826	0.68618614	0.019930148
3.14334142	33.80992824	24.95073768	2.391008582	1.222017321	0.721338737	0.700312884	0.685529082	0.020258676
3.140056124	33.76196255	24.93964309	2.322017372	1.217746437	0.722981382	0.699327297	0.68618614	0.020258676
3.07435019	33.83391109	24.96183227	2.331873259	1.216432318	0.722652853	0.701298471	0.68618614	0.020587205
3.021785445	33.88187679	24.95073768	2.315446781	1.2151182	0.721667266	0.700641413	0.68618614	0.019930148
3.044782521	33.95382533	24.96183227	2.318732076	1.214132612	0.721667266	0.699984355	0.68618614	0.01960162
3.021785445	34.02577388	24.95073768	2.315446781	1.214132612	0.722324324	0.699984355	0.68618614	0.020258676
3.044782521	33.95382533	24.93964309	2.315446781	1.212818493	0.721667266	0.699655826	0.685857611	0.019930148
3.025070741	33.95382533	24.95073768	2.315446781	1.213475553	0.722981382	0.699655826	0.685529082	0.020587205
3.021785445	33.92984248	24.96183227	2.282593824	1.212489964	0.721995795	0.699655826	0.685857611	0.01960162
3.015214852	33.97780818	24.9285485	2.315446781	1.213147023	0.721010208	0.700969942	0.685529082	0.020258676
3.051353114	34.07373957	24.9285485	2.36144092	1.216103789	0.721995795	0.699984355	0.685857611	0.020258676
3.117059047	34.00179103	24.95073768	2.450143906	1.22234585	0.722324324	0.699327297	0.685857611	0.020258676
3.10391786	33.92984248	24.93964309	2.473140977	1.226288205	0.721338737	0.699984355	0.685529082	0.019930148
3.159767904	33.95382533	24.93964309	2.522420416	1.231216149	0.721667266	0.699984355	0.68618614	0.01960162
3.179479684	33.97780818	24.95073768	2.555273375	1.234501444	0.721667266	0.700641413	0.685857611	0.01960162
3.182764981	34.00179103	24.96183227	2.620979295	1.240414977	0.721010208	0.699655826	0.685200553	0.019930148
3.192620872	33.97780818	24.96183227	2.660402848	1.24534292	0.721995795	0.700312884	0.685529082	0.020915733
3.228759136	33.95382533	24.96183227	2.696541106	1.249285275	0.721010208	0.700312884	0.685857611	0.020258676
3.238615027	34.00179103	24.97292686	2.670258737	1.248299687	0.721010208	0.699327297	0.684872024	0.019930148
3.294465074	33.92984248	24.96183227	2.611123407	1.24567145	0.721995795	0.699327297	0.685857611	0.020258676
3.310891558	33.90585963	24.96183227	2.834523548	1.258155574	0.722324324	0.699655826	0.685529082	0.01960162
3.324032746	33.76196255	24.93964309	2.857520622	1.264069107	0.722324324	0.699984355	0.685200553	0.019930148
3.258326808	33.85789394	24.93964309	2.8772324	1.268011463	0.721995795	0.699655826	0.685857611	0.019930148
3.268182699	33.97780818	24.95073768	2.785244103	1.262754989	0.721667266	0.699984355	0.685857611	0.020587205
3.278038589	33.83391109	24.95073768	2.762247029	1.260126752	0.721338737	0.700312884	0.68618614	0.020258676
3.258326808	33.76196255	24.95073768	2.732679364	1.257827045	0.721995795	0.699655826	0.684872024	0.020915733
3.271467996	33.85789394	24.93964309	2.785244103	1.259469693	0.721667266	0.700312884	0.685529082	0.01960162
3.228759136	33.97780818	24.96183227	2.739249956	1.256841456	0.721667266	0.700312884	0.68618614	0.019930148
3.192620872	33.85789394	24.95073768	2.617693999	1.249613805	0.721995795	0.700641413	0.685529082	0.019930148
3.159767904	33.78594539	24.97292686	2.499423344	1.238772329	0.721338737	0.700312884	0.685200553	0.01960162
3.130200234	33.83391109	24.97292686	2.410720357	1.22990203	0.721667266	0.699327297	0.68618614	0.019930148
3.117059047	33.88187679	24.95073768	2.364726216	1.223002909	0.721338737	0.700312884	0.685529082	0.01960162
3.10391786	34.00179103	24.95073768	2.368011512	1.220046143	0.721338737	0.700641413	0.685200553	0.020258676
3.21	**33.86**	**24.95**	**2.57**	**1.24**	**0.72**	**0.70**	**0.69**	**0.02**

5th_Driver FD FF_M0_2016-11-03_

Accelerometer_Y_Driv	BeltTension_Buckle_Driv	BuckleSw_Driv	PressureSw_Driv	RFID_Driv	BeltTension_DRing_Pass	D-Ring_Angle_Pass	BladderSw_Pass	BeltTension_Buckle_Pass	BuckleSw_Pass
-0.007337699	2.474826766	0.690785545	0.056396789	-0.007994755	6.996997469	9.653456671	0.001204036	0.73896801	0.307721038
-0.007666227	2.467474271	0.690457016	0.056725318	-0.007666227	6.980570959	9.653456671	0.001532564	0.734375169	0.30739251
-0.006680642	2.496884249	0.691114074	0.056068261	-0.008651812	7.00028277	9.674811241	0.001532564	0.736671589	0.30739251
-0.007337699	2.499335081	0.690457016	0.056396789	-0.008323284	6.954288544	9.653456671	0.001532564	0.73896801	0.30739251
-0.006352114	2.499335081	0.691114074	0.056068261	-0.008651812	6.977285657	9.610747533	0.001532564	0.748153692	0.307721038
-0.007009171	2.501785912	0.690785545	0.057053846	-0.007666227	6.974000355	9.610747533	0.001861093	0.736671589	0.30739251
-0.006680642	2.472375934	0.690785545	0.056725318	-0.007337699	6.983856261	9.589392964	0.001204036	0.74126443	0.307721038
-0.006352114	2.487080923	0.690785545	0.056396789	-0.008323284	6.974000355	9.610747533	0.001861093	0.732078748	0.30739251
-0.006680642	2.496884249	0.691114074	0.056068261	-0.00898034	6.987141563	9.653456671	0.001861093	0.73896801	0.307721038
-0.006680642	2.477277597	0.690457016	0.056396789	-0.008651812	6.970715053	9.610747533	0.001861093	0.745857271	0.307721038
-0.007009171	2.472375934	0.690457016	0.056725318	-0.008323284	6.970715053	9.632102102	0.001532564	0.73896801	0.307721038
-0.007337699	2.48217926	0.691114074	0.057053846	-0.007994755	6.990426865	9.653456671	0.001532564	0.736671589	0.30739251
-0.007337699	2.491982586	0.691442603	0.056396789	-0.007666227	6.990426865	9.632102102	0.001861093	0.73896801	0.307721038
-0.006023586	2.469925103	0.691114074	0.056396789	-0.008323284	6.987141563	9.653456671	0.001532564	0.736671589	0.30739251
-0.007337699	2.462572608	0.690785545	0.056068261	-0.007994755	6.987141563	9.632102102	0.001532564	0.727485907	0.307721038
-0.007009171	2.462572608	0.690457016	0.056725318	-0.007994755	7.00028277	9.632102102	0.001532564	0.727485907	0.307721038
-0.007337699	2.469925103	0.690785545	0.056396789	-0.007666227	6.987141563	9.589392964	0.001861093	0.727485907	0.307721038
-0.006352114	2.479728429	0.690457016	0.056396789	-0.008323284	6.967429751	9.653456671	0.001532564	0.736671589	0.307721038
-0.007337699	2.440515125	0.690457016	0.056396789	-0.008323284	6.977285657	9.632102102	0.001204036	0.734375169	0.307721038
-0.007337699	2.474826766	0.690785545	0.056725318	-0.008323284	6.977285657	9.653456671	0.000875508	0.734375169	0.307063981
-0.006352114	2.467474271	0.691442603	0.056396789	-0.007337699	6.970715053	9.653456671	0.001861093	0.736671589	0.30739251
-0.006680642	2.460121777	0.690457016	0.056725318	-0.008323284	6.980570959	9.653456671	0.001861093	0.736671589	0.30739251
-0.007009171	2.411105147	0.690457016	0.055739733	-0.009308868	6.967429751	9.610747533	0.001532564	0.734375169	0.307721038
-0.006680642	2.408654316	0.690785545	0.056725318	-0.008323284	6.967429751	9.610747533	0.001861093	0.73896801	0.307721038
-0.007337699	2.39885099	0.690785545	0.057053846	-0.007994755	6.990426865	9.610747533	0.001532564	0.73896801	0.308049567
-0.007666227	2.401301821	0.690785545	0.056396789	-0.008323284	6.967429751	9.610747533	0.001532564	0.734375169	0.30739251
-0.007009171	2.389047664	0.690785545	0.055739733	-0.008323284	6.996997469	9.610747533	0.001204036	0.734375169	0.30739251
-0.006680642	2.376793507	0.690785545	0.056725318	-0.007994755	6.983856261	9.632102102	0.001861093	0.73896801	0.30739251
-0.007994755	2.369441013	0.691114074	0.056396789	-0.008323284	6.980570959	9.653456671	0.001532564	0.736671589	0.307721038
-0.006680642	2.384146002	0.690785545	0.056396789	-0.007666227	6.974000355	9.610747533	0.001861093	0.736671589	0.30739251
-0.007666227	2.389047664	0.690785545	0.056725318	-0.007994755	6.967429751	9.632102102	0.001204036	0.736671589	0.30739251
-0.007009171	2.376793507	0.690457016	0.056725318	-0.008323284	6.974000355	9.632102102	0.001861093	0.73896801	0.307721038
-0.006680642	2.401301821	0.691114074	0.056396789	-0.008323284	6.970715053	9.632102102	0.001532564	0.736671589	0.307721038
-0.007337699	2.401301821	0.691114074	0.056725318	-0.007994755	6.970715053	9.653456671	0.001532564	0.73896801	0.30739251
-0.007337699	2.389047664	0.690785545	0.056725318	-0.007337699	6.970715053	9.632102102	0.002189621	0.734375169	0.307721038
-0.007009171	2.41600681	0.691114074	0.056068261	-0.007994755	6.990426865	9.632102102	0.001532564	0.734375169	0.30739251
-0.006352114	2.391498496	0.690457016	0.056396789	-0.008323284	6.957573846	9.632102102	0.001532564	0.73896801	0.30739251
-0.007009171	2.403752653	0.690457016	0.056068261	-0.008651812	6.970715053	9.589392964	0.001204036	0.748153692	0.30739251
-0.007009171	2.403752653	0.690785545	0.056725318	-0.007666227	6.983856261	9.610747533	0.001532564	0.734375169	0.307721038
-0.007009171	2.413555979	0.690457016	0.056068261	-0.007994755	6.977285657	9.632102102	0.001532564	0.736671589	0.30739251
-0.007337699	2.406203484	0.690785545	0.056725318	-0.007994755	6.987141563	9.653456671	0.001861093	0.734375169	0.30739251
-0.006680642	2.401301821	0.690785545	0.056725318	-0.008323284	6.970715053	9.653456671	0.001861093	0.736671589	0.307721038
-0.007009171	2.41600681	0.690785545	0.057053846	-0.007666227	6.970715053	9.653456671	0.001861093	0.727485907	0.308049567
-0.007666227	2.413555979	0.691114074	0.056725318	-0.007994755	6.996997469	9.610747533	0.001532564	0.736671589	0.307721038
-0.007337699	2.41600681	0.690457016	0.056068261	-0.008651812	6.990426865	9.653456671	0.001204036	0.73896801	0.307721038
-0.006680642	2.406203484	0.690785545	0.056068261	-0.008651812	6.980570959	9.653456671	0.001861093	0.736671589	0.30739251
-0.007337699	2.418457642	0.690785545	0.056725318	-0.007666227	6.987141563	9.653456671	0.001532564	0.743560851	0.30739251
-0.007009171	2.411105147	0.691114074	0.056396789	-0.007994755	7.00028277	9.632102102	0.001861093	0.73896801	0.307063981
-0.007009171	2.389047664	0.690785545	0.055739733	-0.008323284	6.990426865	9.632102102	0.001532564	0.734375169	0.30739251
-0.007337699	2.379244339	0.690457016	0.056725318	-0.007994755	6.957573846	9.653456671	0.001532564	0.743560851	0.30739251
-0.006680642	2.389047664	0.690785545	0.056396789	-0.008323284	6.96414445	9.653456671	0.001532564	0.727485907	0.308049567
-0.007009171	2.389047664	0.690457016	0.056396789	-0.007666227	6.957573846	9.610747533	0.001532564	0.734375169	0.307721038
-0.006680642	2.391498496	0.690785545	0.056396789	-0.007666227	6.977285657	9.674811241	0.001204036	0.736671589	0.30739251
-0.01	**2.43**	**0.69**	**0.06**	**-0.01**	**6.98**	**9.63**	**0.00**	**0.74**	**0.31**

5th_Driver FD FF_M0_2016-11-03_

PressureSw_Pass	RFID_Pass	BeltTension_DRing_Driv_Volts	D-Ring_Angle_Driv_Volts	Payout_Driv_Volts	BeltTension_Anchor_Driv_Volts	Anchor_Angle_Driv_Volts	SeatTrackPos_Forward_Driv_Volts
0.021244261	-0.012594151	1.317619439	2.925777959	3.833843283	1.271625288	1.247971157	0.721667266
0.021572789	-0.012594151	1.323861503	2.925120895	3.834171817	1.273596466	1.252242042	0.721338737
0.020258676	-0.013579736	1.327803859	2.924463831	3.833843283	1.27852441	1.258155574	0.721667266
0.020258676	-0.013579736	1.331746215	2.921835573	3.834171817	1.275896173	1.258155574	0.722324324
0.021901318	-0.012594151	1.329446507	2.922492638	3.834171817	1.27852441	1.259798222	0.721667266
0.020258676	-0.012922679	1.329775037	2.92282117	3.833843283	1.275896173	1.258812634	0.721995795
0.020258676	-0.012594151	1.331417686	2.923806766	3.833843283	1.272282348	1.256184397	0.722652853
0.020915733	-0.013251207	1.334374453	2.921507041	3.833186215	1.26144087	1.249613805	0.721995795
0.020915733	-0.012922679	1.337988279	2.921507041	3.833843283	1.2617694	1.24534292	0.721338737
0.020915733	-0.013579736	1.340945047	2.921178509	3.833843283	1.266697344	1.246657039	0.722324324
0.021244261	-0.012594151	1.333060334	2.921507041	3.833514749	1.259469693	1.244028802	0.721667266
0.020258676	-0.012594151	1.336674161	2.923149702	3.834171817	1.258812634	1.241400565	0.721667266
0.020587205	-0.013251207	1.330760626	2.921835573	3.834171817	1.2617694	1.243371743	0.721995795
0.019930148	-0.013579736	1.334374453	2.921178509	3.833843283	1.271296759	1.249285275	0.722324324
0.021572789	-0.012922679	1.33733122	2.922164105	3.833514749	1.266040285	1.249613805	0.722652853
0.01960162	-0.013579736	1.329775037	2.92282117	3.833843283	1.26144087	1.245014391	0.721667266
0.020258676	-0.012594151	1.325504151	2.922492638	3.833843283	1.249285275	1.236801151	0.722652853
0.020258676	-0.013251207	1.324847092	2.921835573	3.833186215	1.245014391	1.230887619	0.721667266
0.020258676	-0.013251207	1.321233265	2.921507041	3.834500351	1.241072036	1.226945264	0.721010208
0.021244261	-0.012922679	1.320904736	2.921835573	3.833514749	1.240743506	1.224317028	0.721338737
0.020258676	-0.013579736	1.314334142	2.923149702	3.833843283	1.239100858	1.222017321	0.721338737
0.020587205	-0.012922679	1.314005612	2.922492638	3.833514749	1.232201737	1.217746437	0.722981382
0.020915733	-0.013251207	1.307435019	2.923478234	3.834171817	1.233187326	1.216432318	0.722652853
0.020915733	-0.012922679	1.302178544	2.924135298	3.833843283	1.231544678	1.2151182	0.721667266
0.021572789	-0.013251207	1.304478252	2.925120895	3.834171817	1.231873208	1.214132612	0.721667266
0.019930148	-0.013251207	1.302178544	2.926106491	3.833843283	1.231544678	1.214132612	0.722324324
0.021244261	-0.012594151	1.304478252	2.925120895	3.833514749	1.231544678	1.212818493	0.721667266
0.01960162	-0.013908264	1.302507074	2.925120895	3.833843283	1.231544678	1.213475553	0.722981382
0.021244261	-0.012922679	1.302178544	2.924792363	3.834171817	1.228259382	1.212489964	0.721995795
0.019930148	-0.012922679	1.301521485	2.925449427	3.833186215	1.231544678	1.213147023	0.721010208
0.020258676	-0.012922679	1.305135311	2.926763556	3.833186215	1.236144092	1.216103789	0.721995795
0.020587205	-0.012922679	1.311705905	2.925777959	3.833843283	1.245014391	1.22234585	0.722324324
0.020915733	-0.012922679	1.310391786	2.924792363	3.833514749	1.247314098	1.226288205	0.721338737
0.019930148	-0.013579736	1.31597679	2.925120895	3.833514749	1.252242042	1.231216149	0.721667266
0.019930148	-0.013251207	1.317947968	2.925449427	3.833843283	1.255527338	1.234501444	0.721667266
0.020587205	-0.012922679	1.318276498	2.925777959	3.834171817	1.26209793	1.240414977	0.721010208
0.01960162	-0.014236792	1.319262087	2.925449427	3.834171817	1.266040285	1.24534292	0.721995795
0.021244261	-0.012922679	1.322875914	2.925120895	3.834171817	1.269654111	1.249285275	0.721010208
0.020587205	-0.012594151	1.323861503	2.925777959	3.834500351	1.267025874	1.248299687	0.721010208
0.01960162	-0.013251207	1.329446507	2.924792363	3.834171817	1.261112341	1.24567145	0.721995795
0.01960162	-0.013908264	1.331089156	2.924463831	3.834171817	1.283452355	1.258155574	0.722324324
0.021244261	-0.012922679	1.332403275	2.922492638	3.833514749	1.285752062	1.264069107	0.722324324
0.020915733	-0.012922679	1.325832681	2.923806766	3.833514749	1.28772324	1.268011463	0.721995795
0.021244261	-0.012265623	1.32681827	2.925449427	3.833843283	1.27852441	1.262754989	0.721667266
0.021244261	-0.012922679	1.327803859	2.923478234	3.833843283	1.276224703	1.260126752	0.721338737
0.020915733	-0.012922679	1.325832681	2.922492638	3.833843283	1.273267936	1.257827045	0.721995795
0.021244261	-0.012594151	1.3271468	2.923806766	3.833514749	1.27852441	1.259469693	0.721667266
0.019930148	-0.013251207	1.322875914	2.925449427	3.834171817	1.273924996	1.256841456	0.721667266
0.020587205	-0.013251207	1.319262087	2.923806766	3.833843283	1.2617694	1.249613805	0.721995795
0.019273091	-0.014236792	1.31597679	2.92282117	3.834500351	1.249942334	1.238772329	0.721338737
0.020587205	-0.013579736	1.313020023	2.923478234	3.834500351	1.241072036	1.22990203	0.721667266
0.020258676	-0.013579736	1.311705905	2.924135298	3.833843283	1.236472622	1.223002909	0.721338737
0.020258676	-0.013251207	1.310391786	2.925777959	3.833843283	1.236801151	1.220046143	0.721338737
0.02	**-0.01**	**1.32**	**2.92**	**3.83**	**1.26**	**1.24**	**0.72**

5th_Driver FD FF_M0_2016-11-03_

SeatTrackPos_Mid_Driv_Volts	SeatTrackPos_Rear_Driv_Volts	Payout_Pass_Volts	BeltTension_Anchor_Pass_Volts	Anchor_Angle_Pass_Volts	SeatTrackPos_Forward_Pass_Volts	SeatTrackPos_Mid_Pass_Volts
0.700641413	0.685857611	1.421434838	1.005516432	0.988761439	0.686843198	0.674030569
0.699327297	0.685857611	1.422091897	1.005516432	0.989747027	0.687171726	0.673373512
0.700312884	0.685529082	1.421434838	1.005844961	0.987775851	0.687171726	0.672716454
0.699984355	0.68618614	1.421434838	1.005516432	0.98810438	0.686514669	0.674030569
0.699984355	0.685857611	1.421434838	1.005844961	0.98810438	0.687500255	0.673373512
0.699984355	0.68618614	1.421763367	1.005844961	0.987447322	0.686514669	0.674030569
0.699984355	0.68618614	1.421763367	1.006173491	0.988761439	0.687500255	0.673373512
0.699327297	0.685857611	1.421434838	1.006173491	0.987775851	0.687171726	0.673702041
0.700312884	0.684543495	1.421763367	1.005187903	0.989089968	0.687828784	0.673373512
0.700312884	0.68618614	1.421763367	1.005516432	0.990404085	0.687500255	0.674359098
0.700969942	0.685200553	1.421763367	1.005844961	0.98810438	0.686514669	0.674030569
0.699984355	0.685857611	1.421763367	1.005516432	0.989747027	0.687171726	0.674030569
0.700312884	0.685857611	1.422091897	1.005516432	0.98843291	0.687171726	0.673044983
0.699984355	0.685857611	1.421106308	1.005187903	0.989418497	0.687828784	0.674030569
0.699327297	0.684214966	1.422091897	1.005516432	0.988761439	0.687500255	0.674359098
0.700312884	0.68618614	1.421106308	1.005516432	0.988761439	0.686843198	0.674030569
0.699984355	0.685857611	1.421763367	1.006173491	0.98843291	0.686514669	0.673373512
0.700969942	0.685200553	1.421434838	1.005844961	0.98843291	0.686843198	0.674030569
0.699327297	0.685857611	1.421434838	1.005844961	0.98810438	0.686843198	0.674030569
0.699655826	0.68618614	1.421106308	1.005516432	0.988761439	0.687171726	0.674359098
0.700312884	0.685529082	1.421106308	1.005844961	0.988761439	0.686843198	0.673702041
0.699327297	0.68618614	1.421763367	1.005187903	0.988761439	0.687500255	0.673373512
0.701298471	0.68618614	1.421106308	1.005187903	0.989089968	0.687500255	0.673702041
0.700641413	0.68618614	1.422091897	1.005844961	0.989747027	0.686514669	0.673702041
0.699984355	0.68618614	1.421763367	1.005844961	0.988761439	0.686514669	0.673044983
0.699984355	0.68618614	1.420777778	1.005516432	0.98843291	0.687171726	0.673044983
0.699655826	0.685857611	1.421763367	1.005844961	0.989418497	0.687500255	0.674030569
0.699655826	0.685529082	1.421106308	1.005516432	0.98810438	0.686843198	0.673373512
0.699655826	0.685857611	1.421763367	1.005516432	0.98843291	0.687500255	0.673702041
0.700969942	0.685529082	1.420777778	1.003873786	0.98810438	0.686843198	0.673373512
0.699984355	0.685857611	1.421434838	1.005516432	0.988761439	0.687171726	0.673044983
0.699327297	0.685857611	1.421434838	1.006173491	0.988761439	0.686843198	0.673044983
0.699984355	0.685529082	1.421763367	1.005516432	0.988761439	0.687500255	0.673373512
0.699984355	0.68618614	1.421763367	1.005844961	0.989089968	0.686843198	0.673044983
0.700641413	0.685857611	1.421763367	1.005516432	0.987775851	0.686843198	0.673044983
0.699655826	0.685200553	1.421434838	1.005844961	0.989418497	0.68618614	0.673044983
0.700312884	0.685529082	1.421106308	1.005516432	0.988761439	0.687828784	0.673044983
0.700312884	0.685857611	1.421763367	1.005187903	0.987775851	0.686514669	0.673373512
0.699327297	0.684872024	1.421434838	1.005844961	0.987775851	0.687500255	0.673373512
0.699327297	0.685857611	1.421763367	1.005516432	0.988761439	0.686843198	0.673373512
0.699655826	0.685529082	1.421763367	1.005516432	0.989089968	0.686514669	0.673702041
0.699984355	0.685200553	1.421434838	1.005516432	0.990075556	0.686514669	0.673702041
0.699655826	0.685857611	1.421763367	1.005844961	0.98843291	0.687171726	0.674687627
0.699984355	0.685857611	1.422091897	1.005844961	0.989089968	0.687171726	0.673373512
0.700312884	0.68618614	1.421763367	1.005844961	0.989418497	0.687828784	0.674359098
0.699655826	0.684872024	1.421434838	1.006173491	0.988761439	0.686514669	0.673702041
0.700312884	0.685529082	1.421106308	1.005516432	0.98843291	0.687171726	0.673702041
0.700312884	0.68618614	1.421434838	1.005844961	0.98810438	0.687500255	0.672716454
0.700641413	0.685529082	1.421434838	1.005516432	0.988761439	0.687828784	0.674030569
0.700312884	0.685200553	1.421763367	1.005187903	0.989418497	0.687171726	0.672716454
0.699327297	0.68618614	1.421763367	1.00650202	0.988761439	0.687171726	0.673702041
0.700312884	0.685529082	1.421763367	1.005516432	0.988761439	0.687171726	0.673373512
0.700641413	0.685200553	1.421763367	1.005187903	0.987775851	0.686843198	0.673373512
0.70	**0.69**	**1.42**	**1.01**	**0.99**	**0.69**	**0.67**

5th_Driver FD FF_M0_2016-11-03_

SeatTrackPos_Rear_Pass_Volts	Accelerometer_X_Pass_Volts	Accelerometer_Y_Pass_Volts	Accelerometer_X_Driv_Volts	Accelerometer_Y_Driv_Volts	BeltTension_Buckle_Driv_Volts	BuckleSw_Driv_Volts
0.292280197	0.017958978	-0.007337699	0.020587205	-0.007337699	1.331746215	0.690785545
0.291951668	0.01763045	-0.007994755	0.019930148	-0.007666227	1.330760626	0.690457016
0.292608725	0.017958978	-0.007009171	0.020587205	-0.006680642	1.334702982	0.691114074
0.292280197	0.018287507	-0.007666227	0.020258676	-0.007337699	1.335031512	0.690457016
0.291294611	0.017301922	-0.007666227	0.019930148	-0.006352114	1.335031512	0.691114074
0.29162314	0.017958978	-0.007994755	0.020258676	-0.007009171	1.335360042	0.690785545
0.292280197	0.01763045	-0.007666227	0.020258676	-0.006680642	1.331417686	0.690785545
0.292280197	0.017958978	-0.007337699	0.020258676	-0.006352114	1.333388864	0.690785545
0.292608725	0.017301922	-0.007009171	0.020915733	-0.006680642	1.334702982	0.691114074
0.29162314	0.01763045	-0.008323284	0.020258676	-0.006680642	1.332074745	0.690457016
0.291951668	0.017958978	-0.007666227	0.020258676	-0.007009171	1.331417686	0.690457016
0.291294611	0.018287507	-0.007666227	0.019930148	-0.007337699	1.332731804	0.691114074
0.291951668	0.01763045	-0.008323284	0.01960162	-0.007337699	1.334045923	0.691442603
0.292937254	0.017301922	-0.008323284	0.020258676	-0.006023586	1.331089156	0.691114074
0.292608725	0.017958978	-0.007994755	0.020258676	-0.007337699	1.330103567	0.690785545
0.292280197	0.01763045	-0.007666227	0.019930148	-0.007009171	1.330103567	0.690457016
0.291951668	0.018287507	-0.007337699	0.020587205	-0.007337699	1.331089156	0.690785545
0.292937254	0.017301922	-0.008323284	0.019930148	-0.006352114	1.332403275	0.690457016
0.292608725	0.018287507	-0.008651812	0.01960162	-0.007337699	1.3271468	0.690457016
0.290966083	0.01763045	-0.007994755	0.019930148	-0.007337699	1.331746215	0.690785545
0.291294611	0.01763045	-0.007337699	0.020258676	-0.006352114	1.330760626	0.691442603
0.292608725	0.017958978	-0.007337699	0.020258676	-0.006680642	1.329775037	0.690457016
0.290966083	0.017958978	-0.007009171	0.020587205	-0.007009171	1.323204443	0.690457016
0.292280197	0.017301922	-0.008323284	0.019930148	-0.006680642	1.322875914	0.690785545
0.291951668	0.01763045	-0.008651812	0.01960162	-0.007337699	1.321561795	0.690785545
0.29162314	0.017958978	-0.007666227	0.020258676	-0.007666227	1.321890325	0.690785545
0.292280197	0.018287507	-0.007994755	0.019930148	-0.007009171	1.320247676	0.690785545
0.291951668	0.017958978	-0.007666227	0.020587205	-0.006680642	1.318605028	0.690785545
0.292280197	0.017301922	-0.00898034	0.01960162	-0.007994755	1.317619439	0.691114074
0.292608725	0.017958978	-0.007666227	0.020258676	-0.006680642	1.319590617	0.690785545
0.292280197	0.017958978	-0.007994755	0.020258676	-0.007666227	1.320247676	0.690785545
0.29162314	0.01763045	-0.007994755	0.020258676	-0.007009171	1.318605028	0.690457016
0.291951668	0.017301922	-0.008323284	0.019930148	-0.006680642	1.321890325	0.691114074
0.29162314	0.01763045	-0.007994755	0.01960162	-0.007337699	1.321890325	0.691114074
0.292608725	0.017301922	-0.008323284	0.01960162	-0.007337699	1.320247676	0.690785545
0.29162314	0.017958978	-0.007666227	0.019930148	-0.007009171	1.323861503	0.691114074
0.291294611	0.01763045	-0.007666227	0.020915733	-0.006352114	1.320576206	0.690457016
0.292280197	0.018287507	-0.007666227	0.020258676	-0.007009171	1.322218854	0.690457016
0.292608725	0.017301922	-0.007994755	0.019930148	-0.007009171	1.322218854	0.690785545
0.292608725	0.018287507	-0.007994755	0.020258676	-0.007009171	1.323532973	0.690457016
0.291951668	0.01763045	-0.007994755	0.01960162	-0.007337699	1.322547384	0.690785545
0.292280197	0.01763045	-0.007666227	0.019930148	-0.006680642	1.321890325	0.690785545
0.291951668	0.01763045	-0.007994755	0.019930148	-0.007009171	1.323861503	0.690785545
0.29162314	0.017958978	-0.006680642	0.020587205	-0.007666227	1.323532973	0.691114074
0.293265782	0.017958978	-0.007666227	0.020258676	-0.007337699	1.323861503	0.690457016
0.29162314	0.018287507	-0.007337699	0.020915733	-0.006680642	1.322547384	0.690785545
0.292280197	0.017301922	-0.008651812	0.01960162	-0.007337699	1.324190032	0.690785545
0.291951668	0.018287507	-0.007337699	0.019930148	-0.007009171	1.323204443	0.691114074
0.291951668	0.018287507	-0.007337699	0.019930148	-0.007009171	1.320247676	0.690785545
0.291951668	0.01763045	-0.007994755	0.01960162	-0.007337699	1.318933557	0.690457016
0.292608725	0.017958978	-0.007994755	0.019930148	-0.006680642	1.320247676	0.690785545
0.291951668	0.017301922	-0.008323284	0.01960162	-0.007009171	1.320247676	0.690457016
0.292280197	0.01763045	-0.007994755	0.020258676	-0.006680642	1.320576206	0.690785545
0.29	**0.02**	**-0.01**	**0.02**	**-0.01**	**1.33**	**0.69**

5th_Driver FD FF_M0_2016-11-03_

PressureSw_Driv_Volts	RFID_Driv_Volts	BeltTension_DRing_Pass_Volts	D-Ring_Angle_Pass_Volts	BladderSw_Pass_Volts	BeltTension_Buckle_Pass_Volts	BuckleSw_Pass_Volts	PressureSw_Pass_Volts
0.056396789	-0.007994755	1.699699747	2.738514718	0.001204036	1.105717884	0.307721038	0.021244261
0.056725318	-0.007666227	1.698057096	2.738514718	0.001532564	1.105060825	0.30739251	0.021572789
0.056068261	-0.008651812	1.700028277	2.73884325	0.001532564	1.105389355	0.30739251	0.020258676
0.056396789	-0.008323284	1.695428854	2.738514718	0.001532564	1.105717884	0.30739251	0.020258676
0.056068261	-0.008651812	1.697728566	2.737857654	0.001532564	1.107032002	0.307721038	0.021901318
0.057053846	-0.007666227	1.697400036	2.737857654	0.001861093	1.105389355	0.30739251	0.020258676
0.056725318	-0.007337699	1.698385626	2.737529123	0.001204036	1.106046413	0.307721038	0.020258676
0.056396789	-0.008323284	1.697400036	2.737857654	0.001861093	1.104732296	0.30739251	0.020915733
0.056068261	-0.00898034	1.698714156	2.738514718	0.001861093	1.105717884	0.307721038	0.020915733
0.056396789	-0.008651812	1.697071505	2.737857654	0.001861093	1.106703472	0.307721038	0.020915733
0.056725318	-0.008323284	1.697071505	2.738186186	0.001532564	1.105717884	0.307721038	0.021244261
0.057053846	-0.007994755	1.699042686	2.738514718	0.001532564	1.105389355	0.30739251	0.020258676
0.056396789	-0.007666227	1.699042686	2.738186186	0.001861093	1.105717884	0.307721038	0.020587205
0.056396789	-0.008323284	1.698714156	2.738514718	0.001532564	1.105389355	0.30739251	0.019930148
0.056068261	-0.007994755	1.698714156	2.738186186	0.001532564	1.104075237	0.307721038	0.021572789
0.056725318	-0.007994755	1.700028277	2.738186186	0.001532564	1.104075237	0.307721038	0.01960162
0.056396789	-0.007666227	1.698714156	2.737529123	0.001861093	1.104075237	0.307721038	0.020258676
0.056396789	-0.008323284	1.696742975	2.738514718	0.001532564	1.105389355	0.307721038	0.020258676
0.056396789	-0.008323284	1.697728566	2.738186186	0.001204036	1.105060825	0.307721038	0.020258676
0.056725318	-0.008323284	1.697728566	2.738514718	0.000875508	1.105060825	0.307063981	0.021244261
0.056396789	-0.007337699	1.697071505	2.738514718	0.001861093	1.105389355	0.30739251	0.020258676
0.056725318	-0.008323284	1.698057096	2.738514718	0.001861093	1.105389355	0.30739251	0.020587205
0.055739733	-0.009308868	1.696742975	2.737857654	0.001532564	1.105060825	0.307721038	0.020915733
0.056725318	-0.008323284	1.696742975	2.737857654	0.001861093	1.105717884	0.307721038	0.020915733
0.057053846	-0.007994755	1.699042686	2.737857654	0.001532564	1.105717884	0.308049567	0.021572789
0.056396789	-0.008323284	1.696742975	2.737857654	0.001532564	1.105060825	0.30739251	0.019930148
0.055739733	-0.008323284	1.699699747	2.737857654	0.001204036	1.105060825	0.30739251	0.021244261
0.056725318	-0.007994755	1.698385626	2.738186186	0.001861093	1.105717884	0.30739251	0.01960162
0.056396789	-0.008323284	1.698057096	2.738514718	0.001532564	1.105389355	0.307721038	0.021244261
0.056396789	-0.007666227	1.697400036	2.737857654	0.001861093	1.105389355	0.30739251	0.019930148
0.056725318	-0.007994755	1.696742975	2.738186186	0.001204036	1.105389355	0.30739251	0.020258676
0.056725318	-0.008323284	1.697400036	2.738186186	0.001861093	1.105717884	0.307721038	0.020587205
0.056396789	-0.008323284	1.697071505	2.738186186	0.001532564	1.105389355	0.307721038	0.020915733
0.056725318	-0.007994755	1.697071505	2.738514718	0.001532564	1.105717884	0.30739251	0.019930148
0.056725318	-0.007337699	1.697071505	2.738186186	0.002189621	1.105060825	0.307721038	0.019930148
0.056068261	-0.007994755	1.699042686	2.738186186	0.001532564	1.105060825	0.30739251	0.020587205
0.056396789	-0.008323284	1.695757385	2.738186186	0.001532564	1.105717884	0.30739251	0.01960162
0.056068261	-0.008651812	1.697071505	2.737529123	0.001204036	1.107032002	0.30739251	0.021244261
0.056725318	-0.007666227	1.698385626	2.737857654	0.001532564	1.105060825	0.307721038	0.020587205
0.056068261	-0.007994755	1.697728566	2.738186186	0.001532564	1.105389355	0.30739251	0.01960162
0.056725318	-0.007994755	1.698714156	2.738514718	0.001861093	1.105060825	0.30739251	0.01960162
0.056725318	-0.008323284	1.697071505	2.738514718	0.001861093	1.105389355	0.307721038	0.021244261
0.057053846	-0.007666227	1.697071505	2.738514718	0.001861093	1.104075237	0.308049567	0.020915733
0.056725318	-0.007994755	1.699699747	2.737857654	0.001532564	1.105389355	0.307721038	0.021244261
0.056068261	-0.008651812	1.699042686	2.738514718	0.001204036	1.105717884	0.307721038	0.021244261
0.056068261	-0.008651812	1.698057096	2.738514718	0.001861093	1.105389355	0.30739251	0.020915733
0.056725318	-0.007666227	1.698714156	2.738514718	0.001532564	1.106374943	0.30739251	0.021244261
0.056396789	-0.007994755	1.700028277	2.738186186	0.001861093	1.105717884	0.307063981	0.019930148
0.055739733	-0.008323284	1.699042686	2.738186186	0.001532564	1.105060825	0.30739251	0.020587205
0.056725318	-0.007994755	1.695757385	2.738514718	0.001532564	1.106374943	0.30739251	0.019273091
0.056396789	-0.008323284	1.696414445	2.738514718	0.001532564	1.104075237	0.308049567	0.020587205
0.056396789	-0.007666227	1.695757385	2.737857654	0.001532564	1.105060825	0.307721038	0.020258676
0.056396789	-0.007666227	1.697728566	2.73884325	0.001204036	1.105389355	0.30739251	0.020258676
0.06	**-0.01**	**1.70**	**2.74**	**0.00**	**1.11**	**0.31**	**0.02**

5th_Driver FD FF_M0_2016-11-03_

RFID_Pass_Volts
-0.012594151
-0.012594151
-0.013579736
-0.013579736
-0.012594151
-0.012922679
-0.012594151
-0.013251207
-0.012922679
-0.013579736
-0.012594151
-0.012594151
-0.013251207
-0.013579736
-0.012922679
-0.013579736
-0.012594151
-0.013251207
-0.013251207
-0.012922679
-0.013579736
-0.012922679
-0.013251207
-0.012922679
-0.013251207
-0.013251207
-0.012594151
-0.013908264
-0.012922679
-0.012922679
-0.012922679
-0.012922679
-0.012922679
-0.013579736
-0.013251207
-0.012922679
-0.014236792
-0.012922679
-0.012594151
-0.013251207
-0.013908264
-0.012922679
-0.012922679
-0.012265623
-0.012922679
-0.012922679
-0.012594151
-0.013251207
-0.013251207
-0.014236792
-0.013579736
-0.013579736
-0.013251207
-0.01

2.1.2 Driver's Side Collected Data

MISUSE CASE 0 - PROPERLY BUCKLED	Units	5th_Driver FD FF_M0	5th_Driver FD MT_M0	5th_Driver FD FR_M0	5th_Driver FU FF_M0	5th_Driver FU MT_M0	5th_Driver FU FR_M0
BeltTension_DRing_Driv	lbs.	3.21	3.03	3.28	2.83	2.84	2.91
D-Ring_Angle_Driv	degrees	33.86	35.25	32.37	41.91	40.32	37.20
Payout_Driv	inches	24.95	23.48	21.96	31.50	28.45	26.74
BeltTension_Anchor_Driv	lbs.	2.57	2.57	2.63	1.71	1.89	2.44
Anchor_Angle_Driv	degrees	1.24	1.24	1.25	1.16	1.17	1.22
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.99	0.99	0.98	0.99	1.00	0.99
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	2.43	2.23	2.41	1.38	1.80	2.05
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.98	6.99	6.96	6.98	6.99	6.96
D-Ring_Angle_Pass	degrees	9.63	9.64	9.64	9.63	9.64	9.65
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.32	1.30	1.33	1.28	1.28	1.29
D-Ring_Angle_Driv_Volts	volts	2.92	2.94	2.90	3.03	3.01	2.97
Payout_Driv_Volts	volts	3.83	3.79	3.75	4.03	3.94	3.89
BeltTension_Anchor_Driv_Volts	volts	1.26	1.26	1.26	1.17	1.19	1.24
Anchor_Angle_Driv_Volts	volts	1.24	1.24	1.25	1.16	1.17	1.22
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.99	0.99	0.98	0.99	1.00	0.99
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.33	1.30	1.32	1.19	1.24	1.28
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.70	1.70	1.70	1.70	1.70	1.70
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 1 - SITTING ON BUCKLED BELT	Units	5th_Driver FD FF_M1	5th_Driver FD MT_M1	5th_Driver FD FR_M1	5th_Driver FU FF_M1	5th_Driver FU MT_M1	5th_Driver FU FR_M1
BeltTension_DRing_Driv	lbs.	3.65	3.05	3.24	3.09	3.17	3.42
D-Ring_Angle_Driv	degrees	26.46	18.48	14.06	38.53	34.52	27.39
Payout_Driv	inches	16.03	15.19	14.66	19.15	16.73	15.54
BeltTension_Anchor_Driv	lbs.	3.78	3.20	4.09	3.69	4.57	4.54
Anchor_Angle_Driv	degrees	1.36	1.30	1.39	1.35	1.44	1.44
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.99	0.99	0.99	0.99	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.67	2.31	2.73	2.35	2.38	2.36
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.98	6.99	6.96	6.97	6.98	6.96
D-Ring_Angle_Pass	degrees	9.63	9.64	9.65	9.64	9.63	9.64
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.37	1.30	1.32	1.31	1.32	1.34
D-Ring_Angle_Driv_Volts	volts	2.82	2.71	2.65	2.99	2.93	2.84
Payout_Driv_Volts	volts	3.57	3.54	3.53	3.66	3.59	3.56
BeltTension_Anchor_Driv_Volts	volts	1.38	1.32	1.41	1.37	1.46	1.45
Anchor_Angle_Driv_Volts	volts	1.36	1.30	1.39	1.35	1.44	1.44
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.99	0.99	0.99	0.99	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.22	1.31	1.37	1.32	1.32	1.32
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.70	1.70	1.70	1.70	1.70	1.70
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 2 - LEAVING BELT UNBUCKLED	Units	5th_Driver FD FF_M2	5th_Driver FD MT_M2	5th_Driver FD FR_M2	5th_Driver FU FF_M2	5th_Driver FU MT_M2	5th_Driver FU FR_M2
BeltTension_DRing_Driv	lbs.	3.43	3.01	3.07	3.10	2.79	2.56
D-Ring_Angle_Driv	degrees	14.05	17.88	11.15	16.29	11.42	18.36
Payout_Driv	inches	-7.20	-8.22	-8.76	-7.23	-8.22	-9.10
BeltTension_Anchor_Driv	lbs.	1.21	1.17	1.34	1.07	0.97	2.15
Anchor_Angle_Driv	degrees	1.10	1.10	1.11	1.09	1.08	1.20
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.98	0.98	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.02	1.04	1.16	0.77	0.77	1.32
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.98	6.99	6.96	6.99	6.98	6.96
D-Ring_Angle_Pass	degrees	9.65	9.64	9.66	9.64	9.64	9.65
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.30	1.31	1.31	1.28	1.26
D-Ring_Angle_Driv_Volts	volts	2.65	2.70	2.61	2.68	2.62	2.71
Payout_Driv_Volts	volts	2.88	2.85	2.84	2.88	2.85	2.83
BeltTension_Anchor_Driv_Volts	volts	1.12	1.12	1.13	1.11	1.10	1.21
Anchor_Angle_Driv_Volts	volts	1.10	1.10	1.11	1.09	1.08	1.20
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.14	1.14	1.15	1.10	1.10	1.18
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.70	1.70	1.70	1.70	1.70	1.70
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-1 - LAP BUCKLED, SHOULDER BEHIND BACK	Units	5th_Driver FD FF_M4-1	5th_Driver FD MT_M4-1	5th_Driver FD FR_M4-1	5th_Driver FU FF_M4-1	5th_Driver FU MT_M4-1	5th_Driver FU FR_M4-1
BeltTension_DRing_Driv	lbs.	3.76	4.06	3.38	2.92	3.14	2.81
D-Ring_Angle_Driv	degrees	27.85	16.99	13.07	39.93	34.00	31.89
Payout_Driv	inches	23.16	21.49	21.19	27.85	25.02	24.44
BeltTension_Anchor_Driv	lbs.	1.23	2.58	1.98	1.10	1.73	1.32
Anchor_Angle_Driv	degrees	1.11	1.24	1.18	1.09	1.15	1.11
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.98	0.99	0.99	1.00	0.99	0.99
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.52	2.52	2.35	1.54	2.23	1.74
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.98	7.00	6.97	6.97	6.96	6.96
D-Ring_Angle_Pass	degrees	9.63	9.64	9.65	9.64	9.64	9.65
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.38	1.41	1.34	1.29	1.31	1.28
D-Ring_Angle_Driv_Volts	volts	2.84	2.69	2.64	3.01	2.93	2.90
Payout_Driv_Volts	volts	3.78	3.73	3.72	3.92	3.84	3.82
BeltTension_Anchor_Driv_Volts	volts	1.12	1.26	1.20	1.11	1.17	1.13
Anchor_Angle_Driv_Volts	volts	1.11	1.24	1.18	1.09	1.15	1.11
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.99	0.99	1.00	0.99	0.99
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.20	1.34	1.32	1.21	1.30	1.23
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.70	1.70	1.70	1.70	1.70	1.70
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-2 - LAP BUCKLED, SHOULDER BELT UNDER ARM	Units	5th_Driver FD FF_M4-2	5th_Driver FD MT_M4-2	5th_Driver FD FR_M4-2	5th_Driver FU FF_M4-2	5th_Driver FU MT_M4-2	5th_Driver FU FR_M4-2
BeltTension_DRing_Driv	lbs.	3.78	5.11	4.22	4.06	3.60	3.70
D-Ring_Angle_Driv	degrees	29.77	23.47	19.18	35.17	33.35	31.84
Payout_Driv	inches	28.65	28.14	27.12	34.26	30.74	29.54
BeltTension_Anchor_Driv	lbs.	2.37	2.22	2.30	2.03	2.54	2.06
Anchor_Angle_Driv	degrees	1.22	1.20	1.22	1.18	1.23	1.19
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.98	0.99	0.99	0.99	0.98	1.00
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	3.33	2.64	2.76	2.21	2.82	2.59
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.98	6.99	6.96	6.97	6.99	6.96
D-Ring_Angle_Pass	degrees	9.63	9.64	9.65	9.64	9.64	9.65
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.38	1.51	1.42	1.41	1.36	1.37
D-Ring_Angle_Driv_Volts	volts	2.87	2.78	2.72	2.94	2.92	2.90
Payout_Driv_Volts	volts	3.94	3.93	3.90	4.11	4.01	3.97
BeltTension_Anchor_Driv_Volts	volts	1.24	1.22	1.23	1.20	1.25	1.21
Anchor_Angle_Driv_Volts	volts	1.22	1.20	1.22	1.18	1.23	1.19
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.99	0.99	0.99	0.98	1.00
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.45	1.35	1.37	1.30	1.38	1.35
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.70	1.70	1.70	1.70	1.70	1.70
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-1 - LAP BUCKLED, SHOULDER BELT BEHIND SEAT	Units	5th_Driver FD FF_M5-1	5th_Driver FD MT_M5-1	5th_Driver FD FR_M5-1	5th_Driver FU FF_M5-1	5th_Driver FU MT_M5-1	5th_Driver FU FR_M5-1
BeltTension_DRing_Driv	lbs.	3.64	3.24	2.98	3.37	2.87	3.33
D-Ring_Angle_Driv	degrees	-5.08	-13.91	-19.24	17.72	5.95	-0.75
Payout_Driv	inches	30.80	32.72	34.89	30.80	29.85	29.97
BeltTension_Anchor_Driv	lbs.	2.97	2.87	1.62	1.52	2.49	2.19
Anchor_Angle_Driv	degrees	1.28	1.27	1.14	1.13	1.24	1.20
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	1.00	0.99	1.01	0.98	0.99	1.00
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.79	1.67	1.43	1.31	1.77	2.07
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.98	6.99	6.96	6.97	6.99	6.96
D-Ring_Angle_Pass	degrees	9.63	9.63	9.65	9.63	9.63	9.65
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.36	1.32	1.30	1.34	1.29	1.33
D-Ring_Angle_Driv_Volts	volts	2.39	2.27	2.20	2.70	2.54	2.45
Payout_Driv_Volts	volts	4.01	4.06	4.13	4.01	3.98	3.98
BeltTension_Anchor_Driv_Volts	volts	1.30	1.29	1.16	1.15	1.25	1.22
Anchor_Angle_Driv_Volts	volts	1.28	1.27	1.14	1.13	1.24	1.20
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.00	0.99	1.01	0.98	0.99	1.00
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.24	1.22	1.19	1.18	1.24	1.28
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.70	1.70	1.70	1.70	1.70	1.70
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-2 - BELT BUCKLED BEHIND THE SEAT	Units	5th_Driver FD FF_M5-2	5th_Driver FD MT_M5-2	5th_Driver FD FR_M5-2	5th_Driver FU FF_M5-2	5th_Driver FU MT_M5-2	5th_Driver FU FR_M5-2
BeltTension_DRing_Driv	lbs.	3.77	3.61	4.04	3.83	3.69	4.30
D-Ring_Angle_Driv	degrees	1.06	-13.38	-18.12	18.56	10.21	1.39
Payout_Driv	inches	48.04	47.01	51.62	47.47	43.76	48.75
BeltTension_Anchor_Driv	lbs.	1.19	0.95	0.56	0.74	1.43	1.16
Anchor_Angle_Driv	degrees	1.10	1.08	1.04	1.06	1.12	1.10
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	1.00	1.00	1.01	1.00	1.00	1.01
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.10	0.83	1.08	1.35	0.44	1.25
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.98	6.99	6.96	6.97	6.95	6.96
D-Ring_Angle_Pass	degrees	9.63	9.64	9.65	9.63	9.64	9.65
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.38	1.36	1.40	1.38	1.37	1.43
D-Ring_Angle_Driv_Volts	volts	2.47	2.28	2.21	2.71	2.60	2.48
Payout_Driv_Volts	volts	4.52	4.49	4.62	4.50	4.39	4.54
BeltTension_Anchor_Driv_Volts	volts	1.12	1.09	1.06	1.07	1.14	1.12
Anchor_Angle_Driv_Volts	volts	1.10	1.08	1.04	1.06	1.12	1.10
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.00	1.00	1.01	1.00	1.00	1.01
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.15	1.11	1.14	1.18	1.06	1.17
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.70	1.70	1.70	1.70	1.70	1.70
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 0 - PROPERLY BUCKLED	Units	50th_Driver FD FF_M0	50th_Driver FD MT_M0	50th_Driver FD FR_M0	50th_Driver FU FF_M0	50th_Driver FU MT_M0	50th_Driver FU FR_M0
BeltTension_DRing_Driv	lbs.	2.88	2.92	3.03	3.06	3.13	3.07
D-Ring_Angle_Driv	degrees	35.71	35.18	29.53	43.30	42.81	39.73
Payout_Driv	inches	31.24	31.00	29.65	42.76	40.21	37.82
BeltTension_Anchor_Driv	lbs.	1.08	1.29	1.17	1.46	2.36	1.88
Anchor_Angle_Driv	degrees	1.09	1.11	1.10	1.13	1.22	1.17
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.99	0.99	0.99	0.99	0.99	0.99
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.28	1.14	1.20	1.00	1.00	1.30
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.73	6.82	6.98	6.52	6.89	6.92
D-Ring_Angle_Pass	degrees	9.64	9.63	9.64	9.65	9.63	9.63
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.75	0.75	0.74	0.75	0.75
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.29	1.29	1.30	1.31	1.31	1.31
D-Ring_Angle_Driv_Volts	volts	2.95	2.94	2.86	3.05	3.05	3.00
Payout_Driv_Volts	volts	4.02	4.01	3.97	4.36	4.29	4.22
BeltTension_Anchor_Driv_Volts	volts	1.11	1.13	1.12	1.15	1.24	1.19
Anchor_Angle_Driv_Volts	volts	1.09	1.11	1.10	1.13	1.22	1.17
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.99	0.99	0.99	0.99	0.99	0.99
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.17	1.15	1.16	1.13	1.13	1.17
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.67	1.68	1.70	1.65	1.69	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 1 - SITTING ON BUCKLED BELT	Units	50th_Driver FD FF_M1	50th_Driver FD MT_M1	50th_Driver FD FR_M1	50th_Driver FU FF_M1	50th_Driver FU MT_M1	50th_Driver FU FR_M1
BeltTension_DRing_Driv	lbs.	3.29	3.13	3.11	3.07	3.05	3.19
D-Ring_Angle_Driv	degrees	15.65	10.26	1.62	35.23	34.53	28.24
Payout_Driv	inches	16.92	19.02	18.92	24.13	20.80	20.93
BeltTension_Anchor_Driv	lbs.	2.41	1.12	1.44	1.66	1.73	1.60
Anchor_Angle_Driv	degrees	1.22	1.09	1.12	1.15	1.15	1.14
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.98	1.00	1.00	0.99	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.47	0.63	0.34	1.07	0.99	1.02
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.70	6.81	6.97	6.47	6.88	6.92
D-Ring_Angle_Pass	degrees	9.64	9.64	9.64	9.64	9.63	9.63
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.75	0.74	0.75	0.75
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.33	1.31	1.31	1.31	1.30	1.32
D-Ring_Angle_Driv_Volts	volts	2.67	2.60	2.48	2.94	2.93	2.85
Payout_Driv_Volts	volts	3.60	3.66	3.66	3.81	3.71	3.71
BeltTension_Anchor_Driv_Volts	volts	1.24	1.11	1.14	1.17	1.17	1.16
Anchor_Angle_Driv_Volts	volts	1.22	1.09	1.12	1.15	1.15	1.14
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	1.00	1.00	0.99	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.20	1.08	1.05	1.14	1.13	1.14
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.67	1.68	1.70	1.65	1.69	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 2 - SITTING ON A BUCKLED BELT	Units	50th_Driver FD FF_M2	50th_Driver FD MT_M2	50th_Driver FD FR_M2	50th_Driver FU FF_M2	50th_Driver FU MT_M2	50th_Driver FU FR_M2
BeltTension_DRing_Driv	lbs.	2.94	2.93	3.88	3.10	2.99	2.80
D-Ring_Angle_Driv	degrees	13.10	13.52	5.64	23.09	13.89	14.01
Payout_Driv	inches	-7.76	-8.22	-8.15	-6.67	-8.28	-8.70
BeltTension_Anchor_Driv	lbs.	0.97	1.08	1.09	0.95	1.21	1.02
Anchor_Angle_Driv	degrees	1.08	1.09	1.09	1.09	1.10	1.08
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.98	0.98	0.98	0.97	0.97	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.89	1.14	0.72	0.61	0.17	0.69
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.69	6.80	6.96	6.47	6.87	6.92
D-Ring_Angle_Pass	degrees	9.64	9.65	9.64	9.63	9.64	9.64
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.75	0.75	0.74	0.75	0.75
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.29	1.29	1.39	1.31	1.30	1.28
D-Ring_Angle_Driv_Volts	volts	2.64	2.65	2.54	2.78	2.65	2.65
Payout_Driv_Volts	volts	2.87	2.85	2.85	2.90	2.85	2.84
BeltTension_Anchor_Driv_Volts	volts	1.10	1.11	1.11	1.09	1.12	1.10
Anchor_Angle_Driv_Volts	volts	1.08	1.09	1.09	1.09	1.10	1.08
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.98	0.97	0.97	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.12	1.15	1.10	1.08	1.02	1.09
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.67	1.68	1.70	1.65	1.69	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-1 - LAP BUCKLED, SHOULDER BEHIND BACK	Units	50th_Driver FD FF_M4-1	50th_Driver FD MT_M4-1	50th_Driver FD FR_M4-1	50th_Driver FU FF_M4-1	50th_Driver FU MT_M4-1	50th_Driver FU FR_M4-1
BeltTension_DRing_Driv	lbs.	3.38	3.34	3.53	3.32	3.30	3.69
D-Ring_Angle_Driv	degrees	14.53	11.87	1.61	35.16	34.08	27.13
Payout_Driv	inches	28.44	29.78	30.37	35.21	32.71	32.14
BeltTension_Anchor_Driv	lbs.	1.89	1.45	1.23	1.19	2.05	1.60
Anchor_Angle_Driv	degrees	1.17	1.13	1.10	1.10	1.18	1.14
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.05	0.06	0.06
Anchor_Angle_Pass	degrees	1.00	1.00	1.00	1.00	0.99	0.99
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	2.56	1.53	1.34	2.35	2.00	1.71
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.74	6.84	6.99	6.56	6.89	6.93
D-Ring_Angle_Pass	degrees	9.63	9.64	9.63	9.64	9.63	9.63
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.75	0.75	0.74	0.75	0.75
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.33	1.35	1.33	1.33	1.37
D-Ring_Angle_Driv_Volts	volts	2.66	2.62	2.48	2.94	2.93	2.83
Payout_Driv_Volts	volts	3.94	3.98	3.99	4.14	4.06	4.05
BeltTension_Anchor_Driv_Volts	volts	1.19	1.15	1.12	1.12	1.20	1.16
Anchor_Angle_Driv_Volts	volts	1.17	1.13	1.10	1.10	1.18	1.14
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.00	1.00	1.00	1.00	0.99	0.99
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.34	1.21	1.18	1.31	1.27	1.23
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.67	1.68	1.70	1.66	1.69	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-2 - LAP BUCKLED, SHOULDER BELT UNDER ARM	Units	50th_Driver FD FF_M4-2	50th_Driver FD MT_M4-2	50th_Driver FD FR_M4-2	50th_Driver FU FF_M4-2	50th_Driver FU MT_M4-2	50th_Driver FU FR_M4-2
BeltTension_DRing_Driv	lbs.	5.82	6.27	6.54	5.28	4.92	4.61
D-Ring_Angle_Driv	degrees	21.55	18.17	11.85	31.87	34.68	28.74
Payout_Driv	inches	38.65	37.50	37.31	46.96	44.53	42.23
BeltTension_Anchor_Driv	lbs.	1.94	2.17	2.04	1.95	1.96	2.04
Anchor_Angle_Driv	degrees	1.17	1.21	1.18	1.18	1.18	1.19
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.98	0.99	1.00	0.99	1.00	1.00
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	2.97	3.51	3.74	1.94	1.94	2.43
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.74	6.83	6.98	6.54	6.89	6.93
D-Ring_Angle_Pass	degrees	9.63	9.63	9.64	9.63	9.63	9.63
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.75	0.75	0.74	0.75	0.75
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.58	1.63	1.65	1.53	1.49	1.46
D-Ring_Angle_Driv_Volts	volts	2.76	2.71	2.62	2.90	2.94	2.85
Payout_Driv_Volts	volts	4.24	4.21	4.20	4.49	4.41	4.35
BeltTension_Anchor_Driv_Volts	volts	1.19	1.22	1.20	1.19	1.20	1.20
Anchor_Angle_Driv_Volts	volts	1.17	1.21	1.18	1.18	1.18	1.19
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.99	1.00	0.99	1.00	1.00
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.40	1.47	1.50	1.26	1.26	1.33
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.67	1.68	1.70	1.65	1.69	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-1 - LAP BUCKLED, SHOULDER BELT BEHIND SEAT	Units	50th_Driver FD FF_M5-1	50th_Driver FD MT_M5-1	50th_Driver FD FR_M5-1	50th_Driver FU FF_M5-1	50th_Driver FU MT_M5-1	50th_Driver FU FR_M5-1
BeltTension_DRing_Driv	lbs.	3.29	3.12	4.38	3.64	3.46	3.45
D-Ring_Angle_Driv	degrees	-20.71	-19.57	-14.36	11.23	7.79	-1.96
Payout_Driv	inches	44.15	43.69	47.00	37.32	38.33	37.95
BeltTension_Anchor_Driv	lbs.	1.74	1.89	1.66	2.31	1.46	1.77
Anchor_Angle_Driv	degrees	1.16	1.17	1.16	1.22	1.13	1.16
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	1.00	1.01	1.01	0.99	1.00	1.00
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.47	1.56	1.24	2.69	0.87	1.72
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.75	6.84	6.99	6.58	6.90	6.93
D-Ring_Angle_Pass	degrees	9.63	9.63	9.62	9.63	9.63	9.63
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.75	0.74	0.75	0.75
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.33	1.31	1.44	1.36	1.35	1.35
D-Ring_Angle_Driv_Volts	volts	2.18	2.19	2.26	2.61	2.57	2.43
Payout_Driv_Volts	volts	4.40	4.39	4.49	4.20	4.23	4.22
BeltTension_Anchor_Driv_Volts	volts	1.17	1.19	1.17	1.23	1.15	1.18
Anchor_Angle_Driv_Volts	volts	1.16	1.17	1.16	1.22	1.13	1.16
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.00	1.01	1.01	0.99	1.00	1.00
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.20	1.21	1.17	1.36	1.12	1.23
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.68	1.68	1.70	1.66	1.69	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-2 - BELT BUCKLED BEHIND THE SEAT	Units	50th_Driver FD FF_M5-2	50th_Driver FD MT_M5-2	50th_Driver FD FR_M5-2	50th_Driver FU FF_M5-2	50th_Driver FU MT_M5-2	50th_Driver FU FR_M5-2
BeltTension_DRing_Driv	lbs.	3.51	3.57	4.11	3.53	3.66	3.54
D-Ring_Angle_Driv	degrees	-16.14	-15.90	-21.99	15.06	11.40	0.72
Payout_Driv	inches	46.13	45.30	50.15	36.16	38.41	39.23
BeltTension_Anchor_Driv	lbs.	0.55	0.51	0.51	0.51	0.51	0.74
Anchor_Angle_Driv	degrees	1.04	1.03	1.03	1.03	1.03	1.05
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	1.01	1.01	1.01	1.00	1.01	1.01
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.92	1.24	1.33	1.32	2.25	0.94
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.75	6.85	6.99	6.62	6.90	6.94
D-Ring_Angle_Pass	degrees	9.63	9.63	9.64	9.63	9.64	9.64
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.75	0.75	0.75	0.74	0.75	0.75
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.35	1.36	1.41	1.35	1.37	1.35
D-Ring_Angle_Driv_Volts	volts	2.24	2.24	2.16	2.67	2.62	2.47
Payout_Driv_Volts	volts	4.46	4.44	4.58	4.17	4.23	4.26
BeltTension_Anchor_Driv_Volts	volts	1.06	1.05	1.05	1.05	1.05	1.07
Anchor_Angle_Driv_Volts	volts	1.04	1.03	1.03	1.03	1.03	1.05
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.01	1.01	1.01	1.00	1.01	1.01
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.26	1.17	1.18	1.18	1.30	1.13
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.68	1.68	1.70	1.66	1.69	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 0 - PROPERLY BUCKLED	Units	95th_Driver FD MT_M0	95th_Driver FD FR_M0	95th_Driver FU MT_M0	95th_Driver FU FR_M0
BeltTension_DRing_Driv	lbs.	3.45	3.56	3.28	3.25
D-Ring_Angle_Driv	degrees	32.69	26.99	45.17	39.31
Payout_Driv	inches	32.51	28.83	45.81	41.27
BeltTension_Anchor_Driv	lbs.	1.45	2.31	3.68	2.65
Anchor_Angle_Driv	degrees	1.12	1.21	1.35	1.24
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.28	0.69	0.28
Payout_Pass	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	1.00	0.99	1.00	1.00
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.88	2.29	3.77	2.20
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.94	6.93	6.98	6.95
D-Ring_Angle_Pass	degrees	9.64	9.65	9.65	9.66
BladderSw_Pass	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.36	1.33	1.33
D-Ring_Angle_Driv_Volts	volts	2.91	2.83	3.08	3.00
Payout_Driv_Volts	volts	4.06	3.95	4.45	4.32
BeltTension_Anchor_Driv_Volts	volts	1.15	1.23	1.37	1.26
Anchor_Angle_Driv_Volts	volts	1.12	1.21	1.35	1.24
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.28	0.69	0.28
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.00	0.99	1.00	1.00
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.25	1.31	1.51	1.30
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.69	1.69	1.70	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 1 - SITTING ON BUCKLED BELT	Units	95th_Driver FD MT_M1	95th_Driver FD FR_M1	95th_Driver FU MT_M1	95th_Driver FU FR_M1
BeltTension_DRing_Driv	lbs.	3.15	3.22	3.22	3.76
D-Ring_Angle_Driv	degrees	6.05	-8.74	35.53	16.55
Payout_Driv	inches	19.07	20.30	19.08	17.69
BeltTension_Anchor_Driv	lbs.	2.15	2.52	1.66	1.97
Anchor_Angle_Driv	degrees	1.20	1.23	1.14	1.18
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.28	0.69	0.28
Payout_Pass	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.99	1.00	0.99	0.99
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.33	1.70	1.09	0.93
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.94	6.93	6.98	6.95
D-Ring_Angle_Pass	degrees	9.64	9.66	9.65	9.66
BladderSw_Pass	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.32	1.32	1.32	1.38
D-Ring_Angle_Driv_Volts	volts	2.54	2.34	2.95	2.69
Payout_Driv_Volts	volts	3.66	3.70	3.66	3.62
BeltTension_Anchor_Driv_Volts	volts	1.21	1.25	1.17	1.20
Anchor_Angle_Driv_Volts	volts	1.20	1.23	1.14	1.18
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.28	0.69	0.28
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.99	1.00	0.99	0.99
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.18	1.23	1.15	1.12
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.69	1.69	1.70	1.70
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 2 - SITTING ON A BUCKLED BELT	Units	95th_Driver FD MT_M2	95th_Driver FD FR_M2	95th_Driver FU MT_M2	95th_Driver FU FR_M2
BeltTension_DRing_Driv	lbs.	3.34	3.34	3.12	2.88
D-Ring_Angle_Driv	degrees	13.12	8.92	11.18	11.16
Payout_Driv	inches	-7.94	-8.93	-8.58	-8.98
BeltTension_Anchor_Driv	lbs.	1.03	1.17	1.22	1.01
Anchor_Angle_Driv	degrees	1.09	1.10	1.10	1.08
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.28	0.69	0.28
Payout_Pass	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.42	0.33	0.99	0.50
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.93	6.94	6.98	6.94
D-Ring_Angle_Pass	degrees	9.65	9.66	9.66	9.66
BladderSw_Pass	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.33	1.33	1.31	1.29
D-Ring_Angle_Driv_Volts	volts	2.64	2.58	2.61	2.61
Payout_Driv_Volts	volts	2.86	2.83	2.84	2.83
BeltTension_Anchor_Driv_Volts	volts	1.10	1.12	1.12	1.10
Anchor_Angle_Driv_Volts	volts	1.09	1.10	1.10	1.08
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.28	0.69	0.28
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.06	1.04	1.13	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.69	1.69	1.70	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-1 - LAP BUCKLED, SHOULDER BEHIND BACK	Units	95th_Driver FD MT_M4-1	95th_Driver FD FR_M4-1	95th_Driver FU MT_M4-1	95th_Driver FU FR_M4-1
BeltTension_DRing_Driv	lbs.	3.36	3.67	3.49	3.56
D-Ring_Angle_Driv	degrees	4.29	-5.78	32.88	18.59
Payout_Driv	inches	32.72	34.12	37.53	35.97
BeltTension_Anchor_Driv	lbs.	1.09	2.69	1.64	1.22
Anchor_Angle_Driv	degrees	1.09	1.25	1.14	1.10
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.28	0.69	0.28
Payout_Pass	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	1.00	1.00	1.00	1.00
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	2.20	1.57	2.41	1.92
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.94	6.94	6.98	6.94
D-Ring_Angle_Pass	degrees	9.64	9.66	9.65	9.65
BladderSw_Pass	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.37	1.35	1.36
D-Ring_Angle_Driv_Volts	volts	2.52	2.38	2.91	2.71
Payout_Driv_Volts	volts	4.06	4.11	4.21	4.16
BeltTension_Anchor_Driv_Volts	volts	1.11	1.27	1.16	1.12
Anchor_Angle_Driv_Volts	volts	1.09	1.25	1.14	1.10
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.28	0.69	0.28
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.00	1.00	1.00	1.00
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.30	1.21	1.32	1.26
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.69	1.69	1.70	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-2 - LAP BUCKLED, SHOULDER BELT UNDER ARM	Units	95th_Driver FD MT_M4-2	95th_Driver FD FR_M4-2	95th_Driver FU MT_M4-2	95th_Driver FU FR_M4-2
BeltTension_DRing_Driv	lbs.	6.44	8.26	4.82	4.87
D-Ring_Angle_Driv	degrees	14.00	1.19	35.51	23.87
Payout_Driv	inches	44.27	40.90	50.78	48.61
BeltTension_Anchor_Driv	lbs.	1.96	4.00	4.02	2.59
Anchor_Angle_Driv	degrees	1.19	1.38	1.37	1.24
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.28	0.69	0.28
Payout_Pass	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	1.00	1.01	1.00	1.00
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	2.98	4.63	3.84	2.13
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.94	6.93	6.98	6.94
D-Ring_Angle_Pass	degrees	9.64	9.66	9.65	9.65
BladderSw_Pass	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.64	1.83	1.48	1.49
D-Ring_Angle_Driv_Volts	volts	2.65	2.48	2.95	2.79
Payout_Driv_Volts	volts	4.41	4.31	4.60	4.53
BeltTension_Anchor_Driv_Volts	volts	1.20	1.40	1.40	1.26
Anchor_Angle_Driv_Volts	volts	1.19	1.38	1.37	1.24
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.28	0.69	0.28
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.00	1.01	1.00	1.00
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.40	1.62	1.51	1.28
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.69	1.69	1.70	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-1 - LAP BUCKLED, SHOULDER BELT BEHIND SEAT	Units	95th_Driver FD MT_M5-1	95th_Driver FD FR_M5-1	95th_Driver FU MT_M5-1	95th_Driver FU FR_M5-1
BeltTension_DRing_Driv	lbs.	3.58	3.77	4.25	3.64
D-Ring_Angle_Driv	degrees	-20.39	-21.87	12.57	-7.49
Payout_Driv	inches	49.50	50.88	41.71	42.87
BeltTension_Anchor_Driv	lbs.	1.51	4.35	1.19	2.21
Anchor_Angle_Driv	degrees	1.14	1.42	1.10	1.21
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.28	0.69	0.28
Payout_Pass	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	1.01	1.01	1.00	1.01
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.30	1.82	1.42	1.74
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.94	6.93	6.97	6.94
D-Ring_Angle_Pass	degrees	9.65	9.65	9.65	9.65
BladderSw_Pass	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.75	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.36	1.38	1.42	1.36
D-Ring_Angle_Driv_Volts	volts	2.18	2.16	2.63	2.36
Payout_Driv_Volts	volts	4.56	4.60	4.33	4.36
BeltTension_Anchor_Driv_Volts	volts	1.15	1.43	1.12	1.22
Anchor_Angle_Driv_Volts	volts	1.14	1.42	1.10	1.21
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.28	0.69	0.28
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.01	1.01	1.00	1.01
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.17	1.24	1.19	1.23
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.69	1.69	1.70	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-2 - BELT BUCKLED BEHIND THE SEAT	Units	95th_Driver FD MT_M5-2	95th_Driver FD FR_M5-2	95th_Driver FU MT_M5-2	95th_Driver FU FR_M5-2
BeltTension_DRing_Driv	lbs.	3.87	5.92	3.90	3.50
D-Ring_Angle_Driv	degrees	-19.49	-12.93	8.10	-3.41
Payout_Driv	inches	56.52	57.42	45.67	45.36
BeltTension_Anchor_Driv	lbs.	0.57	0.65	0.65	0.51
Anchor_Angle_Driv	degrees	1.03	1.05	1.05	1.03
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.28	0.69	0.28
Payout_Pass	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass	lbs.	0.06	0.06	0.06	0.06
Anchor_Angle_Pass	degrees	1.02	1.01	1.01	1.01
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass	Gs	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass	Gs	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	Gs	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv	Gs	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	1.05	0.81	0.36	0.39
BuckleSw_Driv	volts	0.69	0.69	0.69	0.69
PressureSw_Driv	lbs.	0.06	0.06	0.06	0.06
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.95	6.99	6.92	6.93
D-Ring_Angle_Pass	degrees	9.65	9.64	9.65	9.66
BladderSw_Pass	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	volts	0.74	0.74	0.74	0.74
BuckleSw_Pass	lbs.	0.31	0.31	0.31	0.31
PressureSw_Pass	volts	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.39	1.59	1.39	1.35
D-Ring_Angle_Driv_Volts	volts	2.19	2.28	2.57	2.41
Payout_Driv_Volts	volts	4.77	4.80	4.45	4.44
BeltTension_Anchor_Driv_Volts	volts	1.06	1.06	1.06	1.05
Anchor_Angle_Driv_Volts	volts	1.03	1.05	1.05	1.03
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.28	0.69	0.28
Payout_Pass_Volts	volts	1.42	1.42	1.42	1.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	1.02	1.01	1.01	1.01
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.29	0.29	0.29	0.29
Accelerometer_X_Pass_Volts	volts	0.02	0.02	0.02	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.00	0.02	0.00
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.14	1.11	1.05	1.05
BuckleSw_Driv_Volts	volts	0.69	0.69	0.69	0.69
PressureSw_Driv_Volts	volts	0.06	0.06	0.06	0.06
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.69	1.70	1.69	1.69
D-Ring_Angle_Pass_Volts	volts	2.74	2.74	2.74	2.74
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.11	1.11	1.11
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01

2.1.3 Passenger Side Collected Data

MISUSE CASE 0 - PROPERLY BUCKLED	Units	5th_Passenger FD FF_M0	5th_Passenger FD MT_M0	5th_Passenger FD FR_M0	5th_Passenger FU FF_M0	5th_Passenger FU MT_M0	5th_Passenger FU FR_M0
BeltTension_DRing_Driv	lbs.	3.48	3.44	3.44	3.47	3.44	3.43
D-Ring_Angle_Driv	degrees	19.11	19.11	19.12	19.11	19.12	19.11
Payout_Driv	inches	-8.03	-8.02	-8.02	-8.03	-8.03	-8.02
BeltTension_Anchor_Driv	lbs.	1.14	1.11	1.13	1.13	1.11	1.13
Anchor_Angle_Driv	degrees	1.10	1.09	1.09	1.10	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.69	0.68	0.68	0.69	0.68
Payout_Pass		2.15	2.12	2.13	2.29	2.23	2.16
Payout_Pass	inches	19.73	18.93	19.17	23.73	21.93	20.04
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.08
Anchor_Angle_Pass	degrees	0.98	0.98	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.54	0.54	0.53	0.54	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.63	5.94	5.78	6.97	6.90	6.62
D-Ring_Angle_Pass	degrees	18.90	13.19	8.13	25.84	21.32	14.57
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.55	1.02	0.09	1.39	1.50	1.30
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.35	1.34	1.34	1.35	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.10	1.09	1.09	1.10	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.69	0.68	0.68	0.69	0.68
Payout_Pass_Volts	volts	2.15	2.12	2.13	2.29	2.23	2.16
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.66	1.59	1.58	1.70	1.69	1.66
D-Ring_Angle_Pass_Volts	volts	2.88	2.79	2.72	2.99	2.92	2.81
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.08	1.15	1.01	1.20	1.22	1.19
BeltTension_Buckle_Pass	lbs.	0.75	1.38	0.13	1.87	2.03	1.75
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 1 - SITTING ON BUCKLED BELT	Units	5th_Passenger FD FF_M1	5th_Passenger FD MT_M1	5th_Passenger FD FR_M1	5th_Passenger FU FF_M1	5th_Passenger FU MT_M1	5th_Passenger FU FR_M1
BeltTension_DRing_Driv	lbs.	3.47	3.44	3.43	3.47	3.44	3.44
D-Ring_Angle_Driv	degrees	19.11	19.12	19.12	19.11	19.12	19.12
Payout_Driv	inches	-8.03	-8.02	-8.02	-8.03	-8.03	-8.02
BeltTension_Anchor_Driv	lbs.	1.14	1.11	1.13	1.12	1.11	1.13
Anchor_Angle_Driv	degrees	1.10	1.10	1.10	1.09	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.69	0.69	0.68	0.69	0.68
Payout_Pass		2.18	2.25	2.37	2.27	2.11	2.13
Payout_Pass	inches	20.68	22.68	25.94	23.22	18.66	19.02
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.05
Anchor_Angle_Pass	degrees	0.98	0.98	0.97	0.98	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.54	0.53	0.53	0.53	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.36	6.50	8.19	6.94	7.72	7.34
D-Ring_Angle_Pass	degrees	0.48	-3.79	-11.46	14.72	7.69	-4.28
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.76	1.30	0.34	1.06	0.43	0.97
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.35	1.34	1.34	1.35	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.10	1.10	1.10	1.09	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.69	0.69	0.68	0.69	0.68
Payout_Pass_Volts	volts	2.18	2.25	2.37	2.27	2.11	2.13
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.97	0.98	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.64	1.65	1.82	1.69	1.77	1.73
D-Ring_Angle_Pass_Volts	volts	2.60	2.53	2.41	2.82	2.71	2.52
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.19	1.05	1.15	1.06	1.14
BeltTension_Buckle_Pass	lbs.	1.02	1.75	0.46	1.43	0.59	1.30
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 2 - LEAVING BELT UNBUCKLED	Units	5th_Passenger FD FF_M2	5th_Passenger FD MT_M2	5th_Passenger FD FR_M2	5th_Passenger FU FF_M2	5th_Passenger FU MT_M2	5th_Passenger FU FR_M2
BeltTension_DRing_Driv	lbs.	3.48	3.45	3.43	3.47	3.44	3.44
D-Ring_Angle_Driv	degrees	19.13	19.13	19.12	19.11	19.12	19.13
Payout_Driv	inches	-8.02	-8.02	-8.02	-8.02	-8.02	-8.02
BeltTension_Anchor_Driv	lbs.	1.14	1.12	1.14	1.12	1.12	1.14
Anchor_Angle_Driv	degrees	1.09	1.09	1.10	1.10	1.09	1.10
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.69	0.68	0.68	0.68	0.68
Payout_Pass		1.47	1.45	1.42	1.48	1.46	1.43
Payout_Pass	inches	0.36	-0.38	-1.16	0.53	0.10	-0.97
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.06
Anchor_Angle_Pass	degrees	0.98	0.98	0.98	0.98	0.99	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.54	0.54	0.53	0.54	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.06	6.57	6.45	6.79	7.21	7.18
D-Ring_Angle_Pass	degrees	16.07	12.66	7.36	15.19	14.92	8.37
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	-0.12	1.03	0.00	0.33	0.79	0.04
BuckleSw_Pass	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.35	1.34	1.34	1.35	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.10	1.10	1.09	1.10
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.69	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	1.47	1.45	1.42	1.48	1.46	1.43
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.98	0.98	0.99	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.61	1.66	1.65	1.68	1.72	1.72
D-Ring_Angle_Pass_Volts	volts	2.84	2.78	2.70	2.82	2.82	2.72
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	0.98	1.15	1.00	1.05	1.11	1.01
BeltTension_Buckle_Pass	lbs.	-0.16	1.39	0.00	0.45	1.06	0.05
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-1 - LAP BUCKLED, SHOULDER BEHIND BACK	Units	5th_Passenger FD FF_M4-1	5th_Passenger FD MT_M4-1	5th_Passenger FD FR_M4-1	5th_Passenger FU FF_M4-1	5th_Passenger FU MT_M4-1	5th_Passenger FU FR_M4-1
BeltTension_DRing_Driv	lbs.	3.46	3.44	3.44	3.47	3.43	3.44
D-Ring_Angle_Driv	degrees	19.12	19.11	19.12	19.11	19.11	19.12
Payout_Driv	inches	-8.02	-8.03	-8.02	-8.03	-8.03	-8.02
BeltTension_Anchor_Driv	lbs.	1.13	1.11	1.12	1.14	1.12	1.13
Anchor_Angle_Driv	degrees	1.09	1.10	1.09	1.10	1.09	1.10
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass		2.31	2.37	2.47	2.24	2.22	2.24
Payout_Pass	inches	24.36	26.02	28.74	22.39	21.82	22.37
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.06	0.05	0.05
Anchor_Angle_Pass	degrees	0.98	0.98	0.99	0.98	0.98	0.97
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	-0.01	-0.01	0.00	-0.01	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.54	0.54	0.53	0.54	0.54
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.69	6.72	6.77	6.15	7.73	7.72
D-Ring_Angle_Pass	degrees	0.55	-5.02	-11.46	14.60	9.52	-2.10
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.76	0.49	0.44	1.00	1.12	0.90
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.35	1.34	1.34	1.35	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.10	1.09	1.10	1.09	1.10
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	2.31	2.37	2.47	2.24	2.22	2.24
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.99	0.98	0.98	0.97
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	-0.01	-0.01	0.00	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.67	1.67	1.68	1.62	1.77	1.77
D-Ring_Angle_Pass_Volts	volts	2.60	2.51	2.41	2.81	2.74	2.56
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	1.07	1.06	1.14	1.16	1.13
BeltTension_Buckle_Pass	lbs.	1.02	0.66	0.60	1.35	1.52	1.22
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-2 - LAP BUCKLED, SHOULDER BELT UNDER ARM	Units	5th_Passenger FD FF_M4-2	5th_Passenger FD MT_M4-2	5th_Passenger FD FR_M4-2	5th_Passenger FU FF_M4-2	5th_Passenger FU MT_M4-2	5th_Passenger FU FR_M4-2
BeltTension_DRing_Driv	lbs.	3.47	3.44	3.43	3.47	3.44	3.43
D-Ring_Angle_Driv	degrees	19.11	19.11	19.12	19.10	19.12	19.12
Payout_Driv	inches	-8.03	-8.03	-8.02	-8.03	-8.03	-8.02
BeltTension_Anchor_Driv	lbs.	1.14	1.12	1.12	1.12	1.11	1.13
Anchor_Angle_Driv	degrees	1.10	1.09	1.09	1.10	1.10	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.68	0.68	0.68	0.68	0.69
Payout_Pass		2.39	2.40	2.46	2.36	2.34	2.36
Payout_Pass	inches	26.56	26.95	28.51	25.58	25.20	25.64
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.22
Anchor_Angle_Pass	degrees	0.98	0.98	0.98	0.97	0.97	1.00
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	0.00	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.54	0.54	0.53	0.54	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	8.63	8.40	7.95	8.51	8.53	7.63
D-Ring_Angle_Pass	degrees	12.99	7.21	-0.83	18.72	12.49	4.11
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	1.12	1.11	0.83	1.75	1.61	1.54
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.35	1.34	1.34	1.35	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.10	1.09	1.09	1.10	1.10	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.68	0.68	0.68	0.68	0.69
Payout_Pass_Volts	volts	2.39	2.40	2.46	2.36	2.34	2.36
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.02
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.98	0.97	0.97	1.00
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	0.00	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.86	1.84	1.79	1.85	1.85	1.76
D-Ring_Angle_Pass_Volts	volts	2.79	2.70	2.58	2.88	2.78	2.65
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.16	1.16	1.12	1.25	1.23	1.22
BeltTension_Buckle_Pass	lbs.	1.51	1.50	1.12	2.36	2.17	2.08
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-1 - LAP BUCKLED, SHOULDER BELT BEHIND SEAT	Units	5th_Passenger FD FF_M5-1	5th_Passenger FD MT_M5-1	5th_Passenger FD FR_M5-1	5th_Passenger FU FF_M5-1	5th_Passenger FU MT_M5-1	5th_Passenger FU FR_M5-1
BeltTension_DRing_Driv	lbs.	3.47	3.44	3.44	3.47	3.45	3.44
D-Ring_Angle_Driv	degrees	19.10	19.12	19.12	19.11	19.11	19.13
Payout_Driv	inches	-8.03	-8.02	-8.02	-8.03	-8.03	-8.02
BeltTension_Anchor_Driv	lbs.	1.14	1.11	1.12	1.14	1.11	1.12
Anchor_Angle_Driv	degrees	1.10	1.09	1.09	1.10	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.69	0.68	0.68	0.69	0.68
Payout_Pass		3.16	3.29	3.34	2.55	2.58	2.72
Payout_Pass	inches	48.44	52.22	53.58	31.15	32.07	35.96
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	1.26
Anchor_Angle_Pass	degrees	0.98	0.98	0.98	0.98	0.97	1.10
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	0.00	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.54	0.53	0.53	0.54	0.54
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	8.28	7.27	6.96	5.86	6.42	6.21
D-Ring_Angle_Pass	degrees	-14.69	-19.81	-23.08	-3.44	-9.55	-17.28
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.49	0.46	0.77	0.87	0.88	1.45
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.35	1.34	1.34	1.35	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.10	1.09	1.09	1.10	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.69	0.68	0.68	0.69	0.68
Payout_Pass_Volts	volts	3.16	3.29	3.34	2.55	2.58	2.72
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.13
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.98	0.98	0.97	1.10
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	0.00	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.83	1.73	1.70	1.59	1.64	1.62
D-Ring_Angle_Pass_Volts	volts	2.36	2.29	2.23	2.54	2.44	2.32
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.07	1.07	1.11	1.13	1.13	1.21
BeltTension_Buckle_Pass	lbs.	0.66	0.62	1.04	1.18	1.19	1.96
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-2 - BELT BUCKLED BEHIND THE SEAT	Units	5th_Passenger FD FF_M5-2	5th_Passenger FD MT_M5-2	5th_Passenger FD FR_M5-2	5th_Passenger FU FF_M5-2	5th_Passenger FU MT_M5-2	5th_Passenger FU FR_M5-2
BeltTension_DRing_Driv	lbs.	3.47	3.45	3.44	3.48	3.44	3.44
D-Ring_Angle_Driv	degrees	19.10	19.11	19.11	19.11	19.11	19.12
Payout_Driv	inches	-8.03	-8.03	-8.02	-8.03	-8.02	-8.02
BeltTension_Anchor_Driv	lbs.	1.14	1.11	1.12	1.14	1.11	1.12
Anchor_Angle_Driv	degrees	1.09	1.10	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.69	0.68	0.68	0.68	0.68
Payout_Pass		3.35	3.46	3.41	2.92	2.81	3.06
Payout_Pass	inches	54.00	57.16	55.58	41.85	38.52	45.63
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.05
Anchor_Angle_Pass	degrees	0.98	0.97	0.98	0.99	0.99	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.54	0.54	0.53	0.54	0.55
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	7.77	7.34	7.21	5.97	5.88	6.46
D-Ring_Angle_Pass	degrees	-16.24	-18.06	-21.95	-2.83	-11.25	-20.83
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.29	0.15	0.64	0.70	1.50	0.61
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.35	1.34	1.34	1.35	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.10	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.69	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	3.35	3.46	3.41	2.92	2.81	3.06
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.97	0.98	0.99	0.99	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.78	1.73	1.72	1.60	1.59	1.65
D-Ring_Angle_Pass_Volts	volts	2.34	2.31	2.25	2.55	2.42	2.27
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.04	1.02	1.09	1.10	1.21	1.09
BeltTension_Buckle_Pass	lbs.	0.39	0.20	0.86	0.94	2.02	0.82
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 0 - PROPERLY BUCKLED	Units	50th_Passenger FD FF_M0	50th_Passenger FD MT_M0	50th_Passenger FD FR_M0	50th_Passenger FU FF_M0	50th_Passenger FU MT_M0	50th_Passenger FU FR_M0
BeltTension_DRing_Driv	lbs.	3.42	3.45	3.44	3.37	3.41	3.43
D-Ring_Angle_Driv	degrees	19.10	19.10	19.10	19.10	19.10	19.12
Payout_Driv	inches	-8.03	-8.03	-8.03	-8.03	-8.03	-8.02
BeltTension_Anchor_Driv	lbs.	1.11	1.11	1.11	1.11	1.11	1.12
Anchor_Angle_Driv	degrees	1.09	1.09	1.09	1.09	1.09	1.08
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass		2.35	2.32	2.26	2.54	2.44	2.34
Payout_Pass	inches	25.50	24.55	22.99	30.77	27.91	25.19
BeltTension_Anchor_Pass	lbs.	2.31	0.05	0.05	0.05	0.05	0.24
Anchor_Angle_Pass	degrees	1.20	0.97	0.98	0.98	0.98	1.00
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.53	0.53	0.52	0.53	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.80	7.03	6.57	6.61	6.98	7.20
D-Ring_Angle_Pass	degrees	22.56	17.62	12.03	28.17	22.70	16.60
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	1.39	0.61	0.89	2.63	2.20	1.83
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.35	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.09	1.09	1.09	1.08
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	2.35	2.32	2.26	2.54	2.44	2.34
BeltTension_Anchor_Pass_Volts	volts	1.23	1.01	1.01	1.01	1.01	1.02
Anchor_Angle_Pass_Volts	volts	1.20	0.97	0.98	0.98	0.98	1.00
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.68	1.70	1.66	1.66	1.70	1.72
D-Ring_Angle_Pass_Volts	volts	2.94	2.86	2.78	3.02	2.94	2.85
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.20	1.09	1.13	1.38	1.32	1.26
BeltTension_Buckle_Pass	lbs.	1.88	0.82	1.20	3.55	2.97	2.46
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 1 - SITTING ON BUCKLED BELT	Units	50th_Passenger FD FF_M1	50th_Passenger FD MT_M1	50th_Passenger FD FR_M1	50th_Passenger FU FF_M1	50th_Passenger FU MT_M1	50th_Passenger FU FR_M1
BeltTension_DRing_Driv	lbs.	3.42	3.45	3.43	3.37	3.40	3.42
D-Ring_Angle_Driv	degrees	19.09	19.10	19.11	19.10	19.10	19.11
Payout_Driv	inches	-8.03	-8.03	-8.02	-8.03	-8.03	-8.03
BeltTension_Anchor_Driv	lbs.	1.11	1.11	1.11	1.11	1.12	1.11
Anchor_Angle_Driv	degrees	1.10	1.09	1.08	1.10	1.09	1.10
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass		2.26	2.28	2.34	2.12	2.29	2.25
Payout_Pass	inches	22.87	23.34	25.15	18.77	23.79	22.50
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.05
Anchor_Angle_Pass	degrees	0.97	0.98	0.98	0.98	0.98	0.97
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	0.00	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.53	0.53	0.52	0.53	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.83	6.78	7.29	7.27	6.94	7.25
D-Ring_Angle_Pass	degrees	2.57	-6.97	-14.69	12.54	1.85	-7.17
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	1.38	-0.09	0.18	1.16	0.18	0.81
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.35	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.10	1.09	1.08	1.10	1.09	1.10
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	2.26	2.28	2.34	2.12	2.29	2.25
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.97	0.98	0.98	0.98	0.98	0.97
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	0.00	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.68	1.68	1.73	1.73	1.69	1.73
D-Ring_Angle_Pass_Volts	volts	2.63	2.48	2.36	2.78	2.62	2.48
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.20	0.99	1.03	1.17	1.03	1.12
BeltTension_Buckle_Pass	lbs.	1.87	-0.12	0.24	1.56	0.24	1.10
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 2 - LEAVING BELT UNBUCKLED	Units	50th_Passenger FD FF_M2	50th_Passenger FD MT_M2	50th_Passenger FD FR_M2	50th_Passenger FU FF_M2	50th_Passenger FU MT_M2	50th_Passenger FU FR_M2
BeltTension_DRing_Driv	lbs.	3.41	3.45	3.44	3.35	3.42	3.43
D-Ring_Angle_Driv	degrees	19.10	19.11	19.12	19.10	19.10	19.12
Payout_Driv	inches	-8.03	-8.03	-8.02	-8.03	-8.03	-8.02
BeltTension_Anchor_Driv	lbs.	1.11	1.11	1.11	1.11	1.11	1.12
Anchor_Angle_Driv	degrees	1.09	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass		1.49	1.45	1.45	1.49	1.50	1.44
Payout_Pass	inches	0.78	-0.24	-0.30	0.85	1.11	-0.67
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.05
Anchor_Angle_Pass	degrees	0.98	0.98	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	-0.01	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.53	0.53	0.52	0.53	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.52	7.46	6.28	6.14	7.28	5.80
D-Ring_Angle_Pass	degrees	15.47	12.65	6.97	14.15	16.60	7.00
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.30	-0.12	0.42	0.79	0.22	-0.11
BuckleSw_Pass	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.35	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	1.49	1.45	1.45	1.49	1.50	1.44
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	-0.01	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.65	1.75	1.63	1.61	1.73	1.58
D-Ring_Angle_Pass_Volts	volts	2.83	2.78	2.70	2.81	2.85	2.70
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.04	0.98	1.06	1.11	1.03	0.98
BeltTension_Buckle_Pass	lbs.	0.41	-0.16	0.56	1.06	0.30	-0.16
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-1 - LAP BUCKLED, SHOULDER BEHIND BACK	Units	50th_Passenger FD FF_M4-1	50th_Passenger FD MT_M4-1	50th_Passenger FD FR_M4-1	50th_Passenger FU FF_M4-1	50th_Passenger FU MT_M4-1	50th_Passenger FU FR_M4-1
BeltTension_DRing_Driv	lbs.	3.43	3.46	3.43	3.38	3.41	3.43
D-Ring_Angle_Driv	degrees	19.10	19.10	19.12	19.12	19.11	19.11
Payout_Driv	inches	-8.03	-8.03	-8.02	-8.04	-8.03	-8.03
BeltTension_Anchor_Driv	lbs.	1.11	1.11	1.11	1.11	1.11	1.12
Anchor_Angle_Driv	degrees	1.11	1.09	1.08	1.09	1.09	1.10
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass		2.47	2.50	2.60	2.45	2.43	2.44
Payout_Pass	inches	28.96	29.60	32.49	28.15	27.58	27.92
BeltTension_Anchor_Pass	lbs.	0.05	1.15	0.05	0.05	0.05	0.05
Anchor_Angle_Pass	degrees	0.97	1.09	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.53	0.53	0.53	0.53	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	7.58	7.18	7.04	7.21	7.32	7.01
D-Ring_Angle_Pass	degrees	1.60	-4.85	-13.01	13.61	4.45	-8.67
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.69	0.53	0.32	0.71	0.85	0.94
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.35	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.11	1.09	1.08	1.09	1.09	1.10
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	2.47	2.50	2.60	2.45	2.43	2.44
BeltTension_Anchor_Pass_Volts	volts	1.01	1.11	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.97	1.09	0.98	0.98	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.76	1.72	1.70	1.72	1.73	1.70
D-Ring_Angle_Pass_Volts	volts	2.61	2.52	2.39	2.80	2.66	2.46
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.10	1.08	1.05	1.10	1.12	1.13
BeltTension_Buckle_Pass	lbs.	0.94	0.72	0.43	0.96	1.14	1.27
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-2 - LAP BUCKLED, SHOULDER BELT UNDER ARM	Units	50th_Passenger FD FF_M4-2	50th_Passenger FD MT_M4-2	50th_Passenger FD FR_M4-2	50th_Passenger FU FF_M4-2	50th_Passenger FU MT_M4-2	50th_Passenger FU FR_M4-2
BeltTension_DRing_Driv	lbs.	3.42	3.46	3.43	3.38	3.41	3.42
D-Ring_Angle_Driv	degrees	19.10	19.11	19.11	19.09	19.10	19.11
Payout_Driv	inches	-8.03	-8.03	-8.03	-8.03	-8.03	-8.02
BeltTension_Anchor_Driv	lbs.	1.12	1.11	1.11	1.11	1.12	1.12
Anchor_Angle_Driv	degrees	1.09	1.09	1.10	1.09	1.10	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass		2.63	2.62	2.63	2.71	2.63	2.58
Payout_Pass	inches	33.46	33.16	33.46	35.84	33.32	31.95
BeltTension_Anchor_Pass	lbs.	2.26	1.15	2.25	0.05	1.66	0.87
Anchor_Angle_Pass	degrees	1.20	1.09	1.20	0.98	1.13	1.06
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	0.00	-0.01	0.00	-0.01	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.53	0.53	0.53	0.53	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	8.54	9.65	9.39	8.95	9.03	9.90
D-Ring_Angle_Pass	degrees	10.51	4.03	-4.88	19.29	13.60	2.62
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	2.96	1.58	2.20	4.52	2.81	2.16
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.35	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.10	1.09	1.10	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	2.63	2.62	2.63	2.71	2.63	2.58
BeltTension_Anchor_Pass_Volts	volts	1.23	1.12	1.23	1.00	1.17	1.09
Anchor_Angle_Pass_Volts	volts	1.20	1.09	1.20	0.98	1.13	1.06
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	0.00	-0.01	0.00	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.85	1.97	1.94	1.89	1.90	1.99
D-Ring_Angle_Pass_Volts	volts	2.75	2.65	2.51	2.89	2.80	2.63
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.42	1.23	1.31	1.65	1.40	1.31
BeltTension_Buckle_Pass	lbs.	4.00	2.14	2.97	6.11	3.79	2.92
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-1 - LAP BUCKLED, SHOULDER BELT BEHIND SEAT	Units	50th_Passenger FD FF_M5-1	50th_Passenger FD MT_M5-1	50th_Passenger FD FR_M5-1	50th_Passenger FU FF_M5-1	50th_Passenger FU MT_M5-1	50th_Passenger FU FR_M5-1
BeltTension_DRing_Driv	lbs.	3.43	3.46	3.44	3.39	3.41	3.43
D-Ring_Angle_Driv	degrees	19.09	19.09	19.11	19.10	19.10	19.11
Payout_Driv	inches	-8.03	-8.03	-8.03	-8.03	-8.03	-8.03
BeltTension_Anchor_Driv	lbs.	1.11	1.12	1.12	1.11	1.11	1.11
Anchor_Angle_Driv	degrees	1.09	1.09	1.09	1.10	1.09	1.10
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass		2.93	3.15	3.22	2.74	2.75	2.86
Payout_Pass	inches	41.87	48.31	50.39	36.54	36.78	39.91
BeltTension_Anchor_Pass	lbs.	1.12	2.18	1.07	0.05	0.05	1.40
Anchor_Angle_Pass	degrees	1.09	1.19	1.08	0.97	0.99	1.11
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.53	0.53	0.53	0.53	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.41	7.47	6.79	6.24	5.92	5.78
D-Ring_Angle_Pass	degrees	-11.48	-18.45	-20.87	-2.11	-11.45	-19.75
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.70	0.73	0.54	0.53	1.08	0.86
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.35	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.09	1.10	1.09	1.10
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	2.93	3.15	3.22	2.74	2.75	2.86
BeltTension_Anchor_Pass_Volts	volts	1.11	1.22	1.11	1.01	1.01	1.14
Anchor_Angle_Pass_Volts	volts	1.09	1.19	1.08	0.97	0.99	1.11
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.64	1.75	1.68	1.62	1.59	1.58
D-Ring_Angle_Pass_Volts	volts	2.41	2.31	2.27	2.56	2.41	2.29
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.10	1.10	1.08	1.08	1.16	1.12
BeltTension_Buckle_Pass	lbs.	0.95	0.99	0.73	0.72	1.46	1.16
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-2 - BELT BUCKLED BEHIND THE SEAT	Units	50th_Passenger FD FF_M5-2	50th_Passenger FD MT_M5-2	50th_Passenger FD FR_M5-2	50th_Passenger FU FF_M5-2	50th_Passenger FU MT_M5-2	50th_Passenger FU FR_M5-2
BeltTension_DRing_Driv	lbs.	3.44	3.45	3.45	3.40	3.41	3.44
D-Ring_Angle_Driv	degrees	19.11	19.10	19.09	19.09	19.10	19.12
Payout_Driv	inches	-8.03	-8.03	-8.02	-8.03	-8.03	-8.02
BeltTension_Anchor_Driv	lbs.	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv	degrees	1.09	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass		3.27	3.41	3.49	2.97	2.86	3.03
Payout_Pass	inches	51.70	55.62	58.08	43.18	39.92	44.81
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.05
Anchor_Angle_Pass	degrees	0.98	0.98	0.98	0.97	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	0.00	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.53	0.53	0.53	0.53	0.53	0.53
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.61	6.96	7.19	6.26	5.68	6.34
D-Ring_Angle_Pass	degrees	-15.20	-19.42	-26.09	-1.98	-12.79	-20.83
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	-0.02	-0.02	0.64	0.91	-0.12	0.81
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.34	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.68	0.68	0.68	0.68	0.68	0.68
Payout_Pass_Volts	volts	3.27	3.41	3.49	2.97	2.86	3.03
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.98	0.98	0.98	0.97	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.67	0.67	0.67	0.67	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	0.00	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.07	1.07	1.07	1.07	1.07
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.66	1.70	1.72	1.63	1.57	1.63
D-Ring_Angle_Pass_Volts	volts	2.36	2.29	2.19	2.56	2.39	2.27
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.00	1.00	1.09	1.13	0.98	1.12
BeltTension_Buckle_Pass	lbs.	-0.03	-0.02	0.86	1.23	-0.16	1.09
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 0 - PROPERLY BUCKLED	Units	95th_Passenger FD FF_M0	95th_Passenger FD MT_M0	95th_Passenger FD FR_M0	95th_Passenger FU FF_M0	95th_Passenger FU MT_M0	95th_Passenger FU FR_M0
BeltTension_DRing_Driv	lbs.	3.44	3.43	3.44	3.42	3.44	3.44
D-Ring_Angle_Driv	degrees	19.11	19.13	19.12	19.12	19.13	19.13
Payout_Driv	inches	-8.03	-8.03	-8.03	-8.03	-8.03	-8.03
BeltTension_Anchor_Driv	lbs.	1.11	1.12	1.11	1.11	1.12	1.11
Anchor_Angle_Driv	degrees	1.09	1.08	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass		2.41	2.38	2.31	2.56	2.56	2.47
Payout_Pass	inches	27.14	26.40	24.29	31.32	31.55	28.97
BeltTension_Anchor_Pass	lbs.	0.05	0.05	2.70	2.59	2.31	1.97
Anchor_Angle_Pass	degrees	0.97	0.98	1.24	1.23	1.21	1.17
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	0.00	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.55	0.56	0.56	0.55	0.56	0.57
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	7.08	7.08	7.30	7.01	7.19	6.95
D-Ring_Angle_Pass	degrees	21.80	18.28	13.63	28.40	26.38	18.80
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	1.95	1.59	2.91	1.81	2.61	3.37
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.34	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.08	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	2.41	2.38	2.31	2.56	2.56	2.47
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.27	1.26	1.23	1.20
Anchor_Angle_Pass_Volts	volts	0.97	0.98	1.24	1.23	1.21	1.17
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	0.00	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.08	1.08	1.07	1.08	1.08
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.71	1.71	1.73	1.70	1.72	1.69
D-Ring_Angle_Pass_Volts	volts	2.93	2.87	2.80	3.03	3.00	2.88
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.28	1.23	1.42	1.26	1.37	1.48
BeltTension_Buckle_Pass	lbs.	2.64	2.14	3.93	2.44	3.52	4.55
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 1 - SITTING ON BUCKLED BELT	Units	95th_Passenger FD FF_M1	95th_Passenger FD MT_M1	95th_Passenger FD FR_M1	95th_Passenger FU FF_M1	95th_Passenger FU MT_M1	95th_Passenger FU FR_M1
BeltTension_DRing_Driv	lbs.	3.44	3.44	3.45	3.41	3.44	3.44
D-Ring_Angle_Driv	degrees	19.11	19.12	19.12	19.12	19.13	19.12
Payout_Driv	inches	-8.03	-8.03	-8.03	-8.03	-8.03	-8.03
BeltTension_Anchor_Driv	lbs.	1.11	1.12	1.11	1.11	1.12	1.11
Anchor_Angle_Driv	degrees	1.09	1.09	1.09	1.09	1.08	1.10
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass		2.31	2.33	2.41	2.27	2.31	2.52
Payout_Pass	inches	24.15	24.98	27.24	23.23	24.32	30.28
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.05
Anchor_Angle_Pass	degrees	0.99	0.98	0.98	0.98	0.99	0.97
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.55	0.56	0.56	0.55	0.56	0.56
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.80	6.84	6.48	6.52	6.86	7.01
D-Ring_Angle_Pass	degrees	-6.05	-9.46	-18.36	5.55	2.87	-10.42
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.75	-0.04	0.39	0.31	0.85	0.55
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.34	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.09	1.09	1.08	1.10
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	2.31	2.33	2.41	2.27	2.31	2.52
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.99	0.98	0.98	0.98	0.99	0.97
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.08	1.08	1.07	1.08	1.08
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.68	1.68	1.65	1.65	1.69	1.70
D-Ring_Angle_Pass_Volts	volts	2.50	2.44	2.31	2.68	2.63	2.43
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.11	0.99	1.06	1.05	1.12	1.08
BeltTension_Buckle_Pass	lbs.	1.02	-0.05	0.52	0.42	1.14	0.74
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 2 - LEAVING BELT UNBUCKLED	Units	95th_Passenger FD FF_M2	95th_Passenger FD MT_M2	95th_Passenger FD FR_M2	95th_Passenger FU FF_M2	95th_Passenger FU MT_M2	95th_Passenger FU FR_M2
BeltTension_DRing_Driv	lbs.	3.44	3.44	3.44	3.41	3.44	3.44
D-Ring_Angle_Driv	degrees	19.12	19.13	19.13	19.13	19.13	19.14
Payout_Driv	inches	-8.03	-8.03	-8.02	-8.02	-8.02	-8.02
BeltTension_Anchor_Driv	lbs.	1.12	1.12	1.11	1.12	1.12	1.12
Anchor_Angle_Driv	degrees	1.09	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass		1.47	1.46	1.44	1.46	1.45	1.44
Payout_Pass	inches	0.35	0.03	-0.47	0.04	-0.18	-0.54
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.06	0.05	0.05	0.05
Anchor_Angle_Pass	degrees	0.97	0.97	0.98	0.97	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.54	0.56	0.57	0.55	0.57	0.56
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	8.75	8.90	9.00	8.14	8.02	8.32
D-Ring_Angle_Pass	degrees	10.39	10.66	7.18	12.99	10.76	3.77
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.64	-0.11	0.84	0.13	0.20	0.25
BuckleSw_Pass	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.34	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	1.47	1.46	1.44	1.46	1.45	1.44
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.97	0.97	0.98	0.97	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.08	1.08	1.07	1.08	1.08
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.88	1.89	1.90	1.81	1.80	1.83
D-Ring_Angle_Pass_Volts	volts	2.75	2.75	2.70	2.79	2.76	2.65
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.09	0.98	1.12	1.02	1.03	1.04
BeltTension_Buckle_Pass	lbs.	0.86	-0.15	1.14	0.18	0.26	0.34
BuckleSw_Pass_Volts	volts	0.31	0.31	0.31	0.31	0.31	0.31
PressureSw_Pass_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-1 - LAP BUCKLED, SHOULDER BEHIND BACK	Units	95th_Passenger FD FF_M4-1	95th_Passenger FD MT_M4-1	95th_Passenger FD FR_M4-1	95th_Passenger FU FF_M4-1	95th_Passenger FU MT_M4-1	95th_Passenger FU FR_M4-1
BeltTension_DRing_Driv	lbs.	3.44	3.44	3.44	3.42	3.44	3.44
D-Ring_Angle_Driv	degrees	19.11	19.12	19.12	19.12	19.13	19.12
Payout_Driv	inches	-8.04	-8.03	-8.03	-8.03	-8.03	-8.03
BeltTension_Anchor_Driv	lbs.	1.11	1.11	1.12	1.11	1.11	1.10
Anchor_Angle_Driv	degrees	1.10	1.09	1.09	1.10	1.08	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass		2.60	2.62	2.70	2.58	2.52	2.61
Payout_Pass	inches	32.46	33.28	35.54	31.99	30.33	32.84
BeltTension_Anchor_Pass	lbs.	0.05	0.31	0.05	0.05	2.19	0.05
Anchor_Angle_Pass	degrees	0.97	1.00	0.98	0.99	1.20	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.55	0.56	0.57	0.54	0.56	0.56
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	7.21	8.02	6.95	8.58	7.50	8.45
D-Ring_Angle_Pass	degrees	-3.40	-8.31	-17.48	12.16	5.55	-3.69
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.61	0.08	0.12	0.57	1.11	0.98
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.34	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.10	1.09	1.09	1.10	1.08	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	2.60	2.62	2.70	2.58	2.52	2.61
BeltTension_Anchor_Pass_Volts	volts	1.01	1.03	1.01	1.01	1.22	1.01
Anchor_Angle_Pass_Volts	volts	0.97	1.00	0.98	0.99	1.20	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	-0.01	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.08	1.08	1.07	1.08	1.08
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.72	1.80	1.70	1.86	1.75	1.84
D-Ring_Angle_Pass_Volts	volts	2.54	2.46	2.32	2.78	2.68	2.53
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.09	1.01	1.02	1.08	1.16	1.14
BeltTension_Buckle_Pass	lbs.	0.82	0.11	0.16	0.77	1.50	1.32
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 4-2 - LAP BUCKLED, SHOULDER BELT UNDER ARM	Units	95th_Passenger FD FF_M4-2	95th_Passenger FD MT_M4-2	95th_Passenger FD FR_M4-2	95th_Passenger FU FF_M4-2	95th_Passenger FU MT_M4-2	95th_Passenger FU FR_M4-2
BeltTension_DRing_Driv	lbs.	3.44	3.44	3.44	3.42	3.44	3.44
D-Ring_Angle_Driv	degrees	19.12	19.12	19.13	19.11	19.12	19.12
Payout_Driv	inches	-8.03	-8.03	-8.03	-8.03	-8.03	-8.03
BeltTension_Anchor_Driv	lbs.	1.11	1.12	1.11	1.11	1.12	1.12
Anchor_Angle_Driv	degrees	1.09	1.09	1.10	1.09	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass		2.77	2.93	2.84	2.80	2.80	2.88
Payout_Pass	inches	37.36	42.05	39.56	38.40	38.38	40.48
BeltTension_Anchor_Pass	lbs.	0.05	0.05	2.66	2.38	2.37	2.30
Anchor_Angle_Pass	degrees	0.98	0.98	1.24	1.21	1.21	1.20
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.55	0.56	0.57	0.55	0.57	0.56
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	11.51	9.42	8.02	10.73	10.59	10.56
D-Ring_Angle_Pass	degrees	2.73	1.83	-8.27	14.00	10.48	0.00
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	2.52	1.03	2.91	2.66	2.63	2.39
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.34	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.10	1.09	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	2.77	2.93	2.84	2.80	2.80	2.88
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.27	1.24	1.24	1.23
Anchor_Angle_Pass_Volts	volts	0.98	0.98	1.24	1.21	1.21	1.20
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.08	1.08	1.07	1.08	1.08
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	2.15	1.94	1.80	2.07	2.06	2.06
D-Ring_Angle_Pass_Volts	volts	2.63	2.62	2.46	2.81	2.75	2.59
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.36	1.15	1.42	1.38	1.38	1.34
BeltTension_Buckle_Pass	lbs.	3.41	1.39	3.92	3.59	3.55	3.23
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-1 - LAP BUCKLED, SHOULDER BELT BEHIND SEAT	Units	95th_Passenger FD FF_M5-1	95th_Passenger FD MT_M5-1	95th_Passenger FD FR_M5-1	95th_Passenger FU FF_M5-1	95th_Passenger FU MT_M5-1	95th_Passenger FU FR_M5-1
BeltTension_DRing_Driv	lbs.	3.44	3.44	3.44	3.43	3.44	3.44
D-Ring_Angle_Driv	degrees	19.11	19.12	19.12	19.11	19.12	19.12
Payout_Driv	inches	-8.04	-8.03	-8.03	-8.03	-8.03	-8.03
BeltTension_Anchor_Driv	lbs.	1.11	1.11	1.11	1.11	1.12	1.11
Anchor_Angle_Driv	degrees	1.09	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass		3.00	3.09	3.21	2.81	2.83	2.97
Payout_Pass	inches	44.10	46.69	49.99	38.66	39.18	43.16
BeltTension_Anchor_Pass	lbs.	2.37	0.05	2.42	0.05	2.37	0.05
Anchor_Angle_Pass	degrees	1.21	0.98	1.22	0.98	1.21	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	0.00	0.00	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.55	0.56	0.56	0.55	0.56	0.57
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.75	6.77	6.78	6.22	5.89	6.58
D-Ring_Angle_Pass	degrees	-14.81	-17.49	-26.16	-8.08	-11.43	-19.69
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	0.41	0.44	0.60	0.97	1.05	1.55
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.34	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.09	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	3.00	3.09	3.21	2.81	2.83	2.97
BeltTension_Anchor_Pass_Volts	volts	1.24	1.01	1.24	1.01	1.24	1.01
Anchor_Angle_Pass_Volts	volts	1.21	0.98	1.22	0.98	1.21	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	0.00	0.00	-0.01	0.00	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.08	1.08	1.07	1.08	1.08
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.68	1.68	1.68	1.62	1.59	1.66
D-Ring_Angle_Pass_Volts	volts	2.36	2.32	2.19	2.47	2.41	2.29
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.06	1.06	1.09	1.14	1.15	1.22
BeltTension_Buckle_Pass	lbs.	0.56	0.59	0.82	1.31	1.42	2.10
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

MISUSE CASE 5-2 - BELT BUCKLED BEHIND THE SEAT	Units	95th_Passenger FD FF_M5-2	95th_Passenger FD MT_M5-2	95th_Passenger FD FR_M5-2	95th_Passenger FU FF_M5-2	95th_Passenger FU MT_M5-2	95th_Passenger FU FR_M5-2
BeltTension_DRing_Driv	lbs.	3.43	3.44	3.44	3.43	3.44	3.44
D-Ring_Angle_Driv	degrees	19.12	19.12	19.12	19.11	19.12	19.12
Payout_Driv	inches	-8.03	-8.03	-8.03	-8.03	-8.03	-8.03
BeltTension_Anchor_Driv	lbs.	1.11	1.11	1.11	1.12	1.12	1.11
Anchor_Angle_Driv	degrees	1.10	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass		3.36	3.44	3.55	3.29	3.02	3.42
Payout_Pass	inches	54.32	56.69	59.64	52.38	44.61	56.03
BeltTension_Anchor_Pass	lbs.	0.05	0.05	0.05	0.05	0.05	0.05
Anchor_Angle_Pass	degrees	0.97	0.98	0.98	0.97	0.98	0.98
SeatTrackPos_Forward_Pass	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass	m/s	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass	m/s	-0.01	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv	m/s	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv	m/s	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv	lbs.	0.55	0.56	0.56	0.55	0.56	0.56
BuckleSw_Driv	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv	lbs.	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass	lbs.	6.77	6.87	7.93	5.91	6.31	6.79
D-Ring_Angle_Pass	degrees	-17.49	-18.35	-24.55	-9.14	-12.04	-21.36
BladderSw_Pass	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass	lbs.	-0.03	0.16	0.00	0.97	-0.11	0.88
BuckleSw_Pass	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass	lbs.	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Driv_Volts	volts	1.34	1.34	1.34	1.34	1.34	1.34
D-Ring_Angle_Driv_Volts	volts	2.72	2.72	2.72	2.72	2.72	2.72
Payout_Driv_Volts	volts	2.86	2.86	2.86	2.86	2.86	2.86
BeltTension_Anchor_Driv_Volts	volts	1.11	1.11	1.11	1.11	1.11	1.11
Anchor_Angle_Driv_Volts	volts	1.10	1.09	1.09	1.09	1.09	1.09
SeatTrackPos_Forward_Driv_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
SeatTrackPos_Mid_Driv_Volts	volts	0.70	0.70	0.70	0.70	0.70	0.70
SeatTrackPos_Rear_Driv_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
Payout_Pass_Volts	volts	3.36	3.44	3.55	3.29	3.02	3.42
BeltTension_Anchor_Pass_Volts	volts	1.01	1.01	1.01	1.01	1.01	1.01
Anchor_Angle_Pass_Volts	volts	0.97	0.98	0.98	0.97	0.98	0.98
SeatTrackPos_Forward_Pass_Volts	volts	0.69	0.69	0.69	0.69	0.69	0.69
SeatTrackPos_Mid_Pass_Volts	volts	0.67	0.27	0.67	0.67	0.27	0.67
SeatTrackPos_Rear_Pass_Volts	volts	0.72	0.72	0.29	0.72	0.72	0.29
Accelerometer_X_Pass_Volts	volts	0.06	0.06	0.02	0.06	0.06	0.02
Accelerometer_Y_Pass_Volts	volts	-0.01	0.00	-0.01	-0.01	0.00	-0.01
Accelerometer_X_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
Accelerometer_Y_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_Buckle_Driv_Volts	volts	1.07	1.08	1.08	1.07	1.08	1.08
BuckleSw_Driv_Volts	volts	0.30	0.30	0.30	0.30	0.30	0.30
PressureSw_Driv_Volts	volts	0.02	0.02	0.02	0.02	0.02	0.02
RFID_Driv_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BeltTension_DRing_Pass_Volts	volts	1.68	1.69	1.79	1.59	1.63	1.68
D-Ring_Angle_Pass_Volts	volts	2.32	2.31	2.21	2.45	2.40	2.26
BladderSw_Pass_Volts	volts	0.00	0.00	0.00	0.00	0.00	0.00
BeltTension_Buckle_Pass_Volts	volts	1.00	1.02	1.00	1.14	0.98	1.13
BeltTension_Buckle_Pass	lbs.	-0.03	0.21	0.00	1.31	-0.15	1.19
BuckleSw_Pass_Volts	volts	0.72	0.72	0.72	0.72	0.72	0.72
PressureSw_Pass_Volts	volts	0.06	0.06	0.06	0.06	0.06	0.06
RFID_Pass_Volts	volts	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

2.2 Sensor Analysis

The charts below indicate what misuses the sensors are able to detect, over all occupants, independently. These misuses are shaded green.

2.2.1 Driver's Side

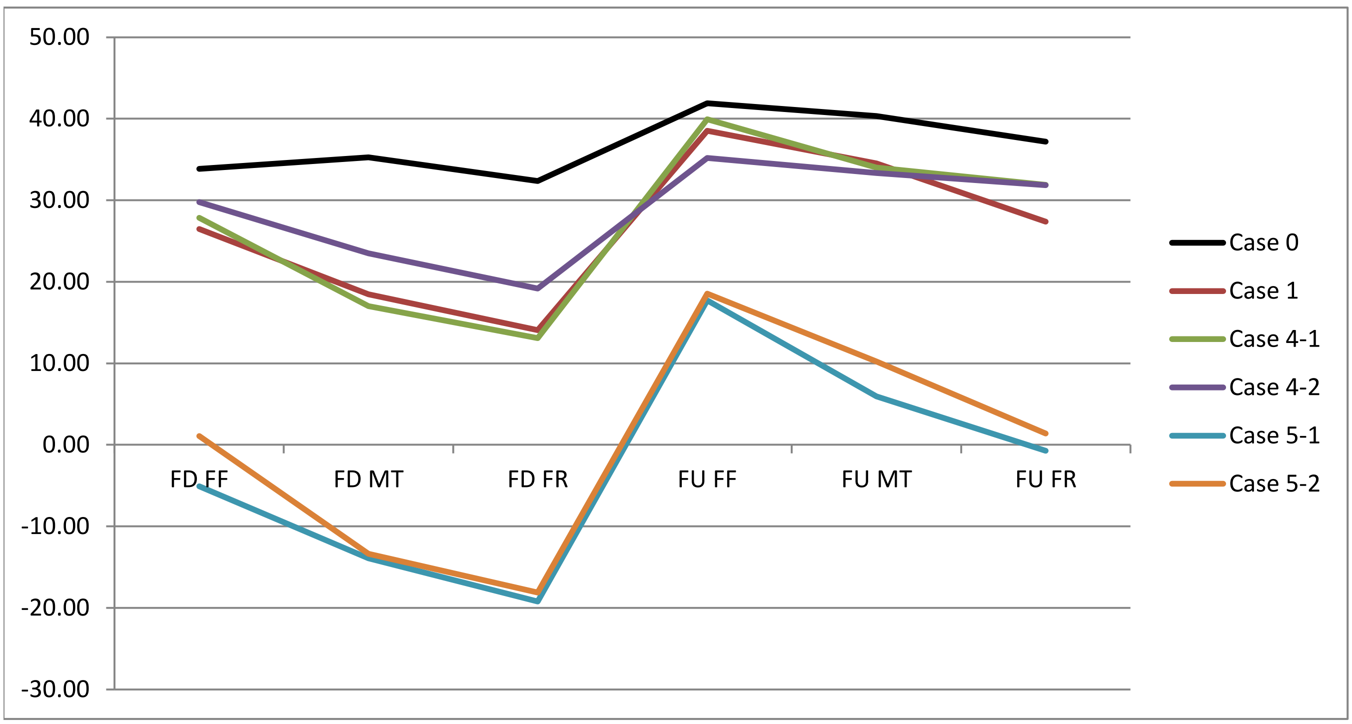
2.2.1.1 D-ring Angle

D-ring angle can detect misuse cases, independent of seat track position and incline, for misuses 2 (unbuckled), 5-1 (lap belt bucked but shoulder belt behind the seat-occupant restrained by lap belt), and 5-2 (belt buckled behind the seat-no occupant restraint).

D-ring Angle		
5th Female	**50th Male**	**95th Male**
2	2	2
5-1	5-1	5-1
5-2	5-2	5-2

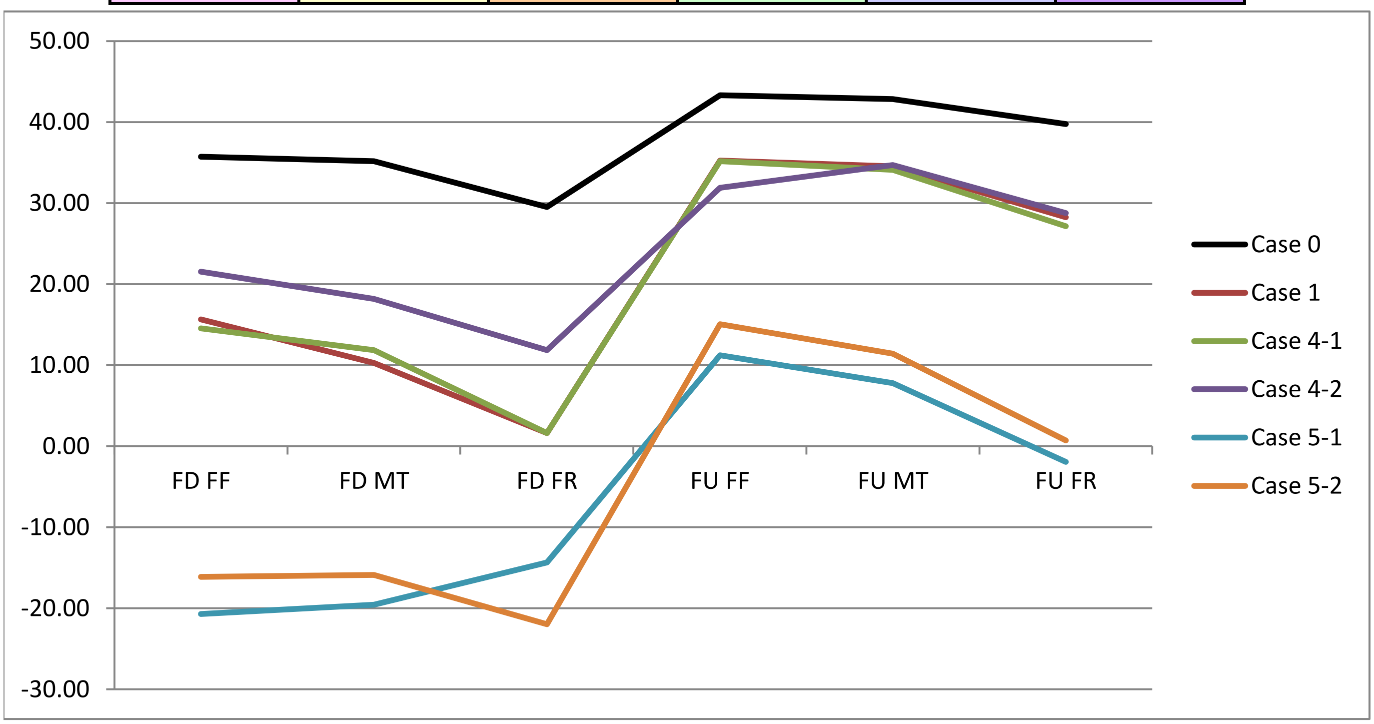
5th Female Driver's Side D-ring Angle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	33.86	26.46	27.85	29.77	-5.08	1.06
FD MT	35.25	18.48	16.99	23.47	-13.91	-13.38
FD FR	32.37	14.06	13.07	19.18	-19.24	-18.12
FU FF	41.91	38.53	39.93	35.17	17.72	18.56
FU MT	40.32	34.52	34.00	33.35	5.95	10.21
FU FR	37.20	27.39	31.89	31.84	-0.75	1.39



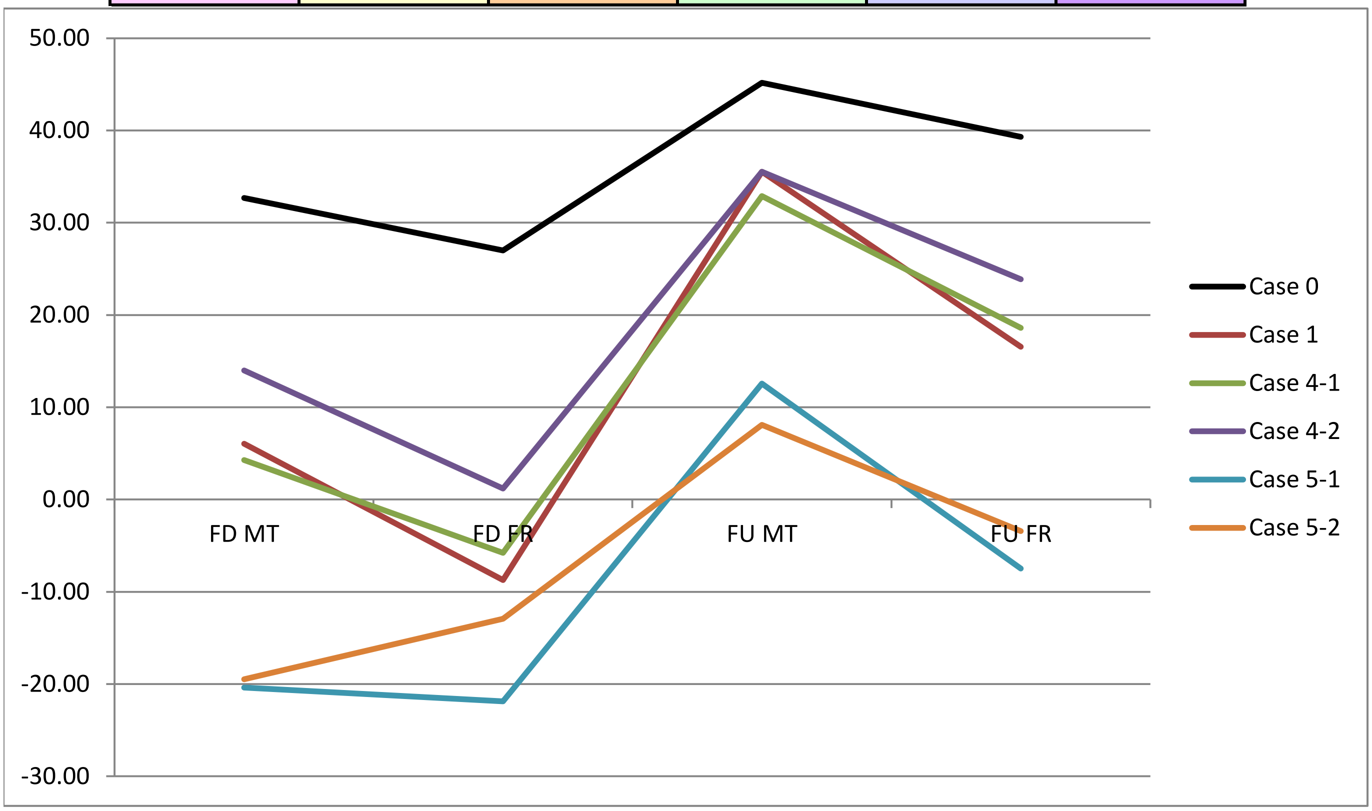
50th Male Driver's Side D-ring Angle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	35.71	15.65	14.53	21.55	-20.71	-16.14
FD MT	35.18	10.26	11.87	18.17	-19.57	-15.90
FD FR	29.53	1.62	1.61	11.85	-14.36	-21.99
FU FF	43.30	35.23	35.16	31.87	11.23	15.06
FU MT	42.81	34.53	34.08	34.68	7.79	11.40
FU FR	39.73	28.24	27.13	28.74	-1.96	0.72



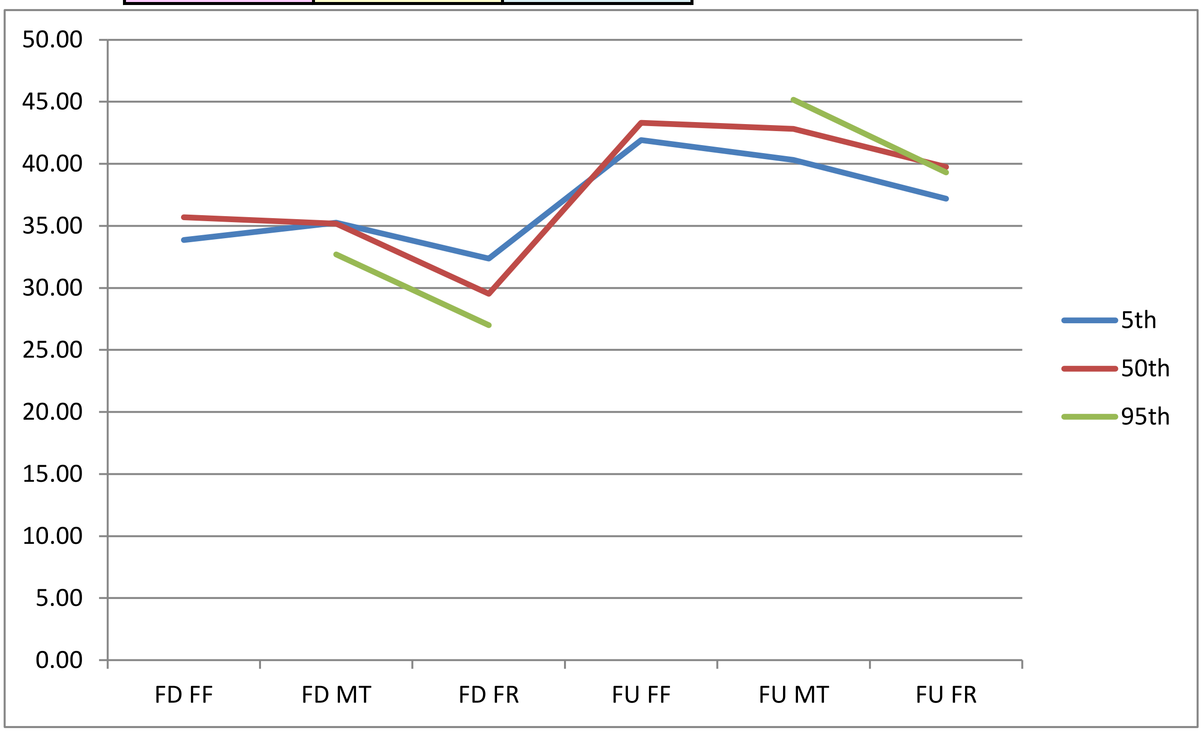
95th Male Driver's Side D-ring Angle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD MT	32.69	6.05	4.29	14.00	-20.39	-19.49
FD FR	26.99	-8.74	-5.78	1.19	-21.87	-12.93
FU MT	45.17	35.53	32.88	35.51	12.57	8.10
FU FR	39.31	16.55	18.59	23.87	-7.49	-3.41



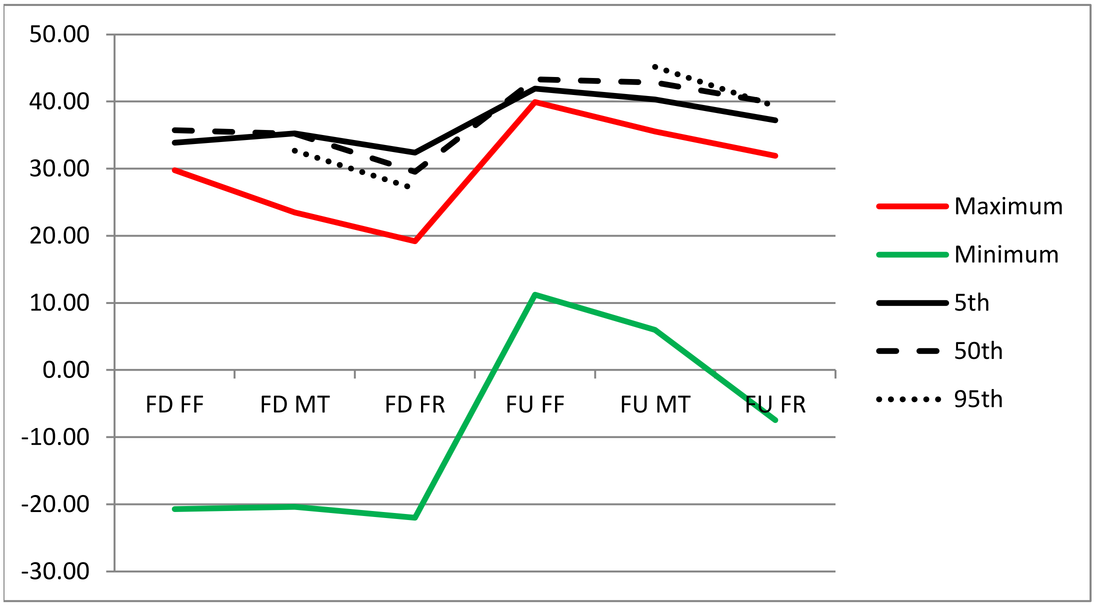
All Properly Buckled (Case 0) D-ring Angle

	PROPERLY BUCKLED 5th	PROPERLY BUCKLED 50th	PROPERLY BUCKLED 95th
FD FF	33.86	35.71	
FD MT	35.25	35.18	32.69
FD FR	32.37	29.53	26.99
FU FF	41.91	43.30	
FU MT	40.32	42.81	45.17
FU FR	37.20	39.73	39.31



All Properly Buckled D-ring Angle

	Maximum	Minimum	5th	50th	95th
FD FF	29.77	-20.71	33.86	35.71	
FD MT	23.47	-20.39	35.25	35.18	32.69
FD FR	19.18	-21.99	32.37	29.53	26.99
FU FF	39.93	11.23	41.91	43.30	
FU MT	35.53	5.95	40.32	42.81	45.17
FU FR	31.89	-7.49	37.20	39.73	39.31



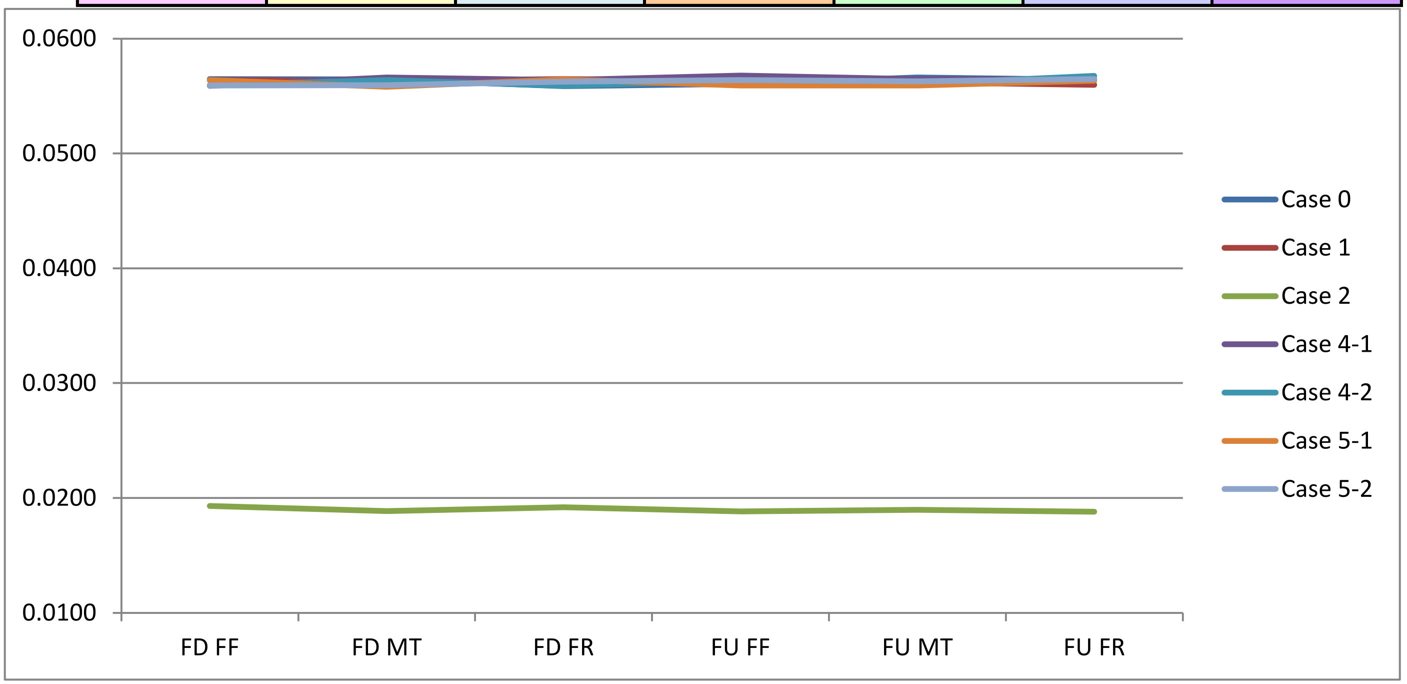
2.2.1.2 Pressure Switch

The pressure switch, located in the buckle, can only detect misuse case 2 (unbuckled), independent of seat track position and incline. However, this misuse can be detected by D-ring angle as well as the RFID sensor.

Pressure Switch in Buckle		
5th Female	**50th Male**	**95th Male**
2	2	2

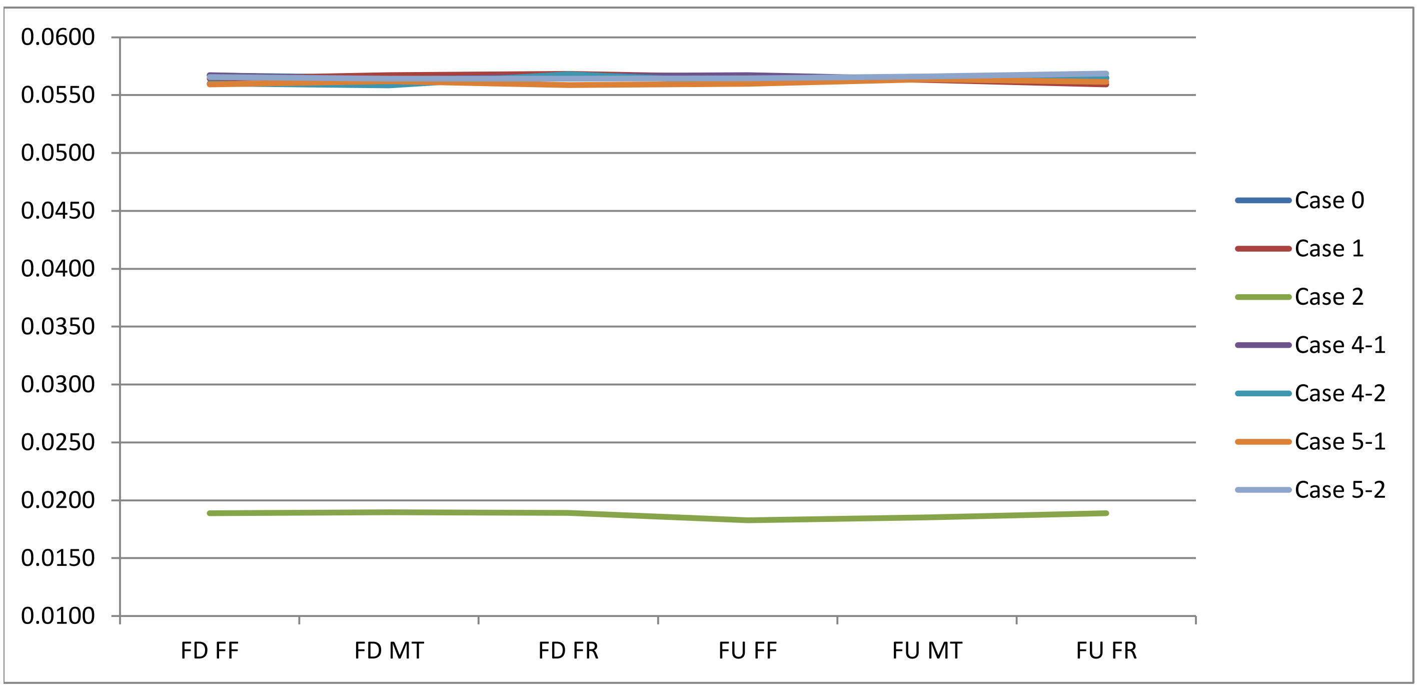
5th Female Driver's Side Pressure Switch

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	0.0565	0.0564	0.0193	0.0559	0.0559	0.0564	0.0559
FD MT	0.0565	0.0563	0.0189	0.0566	0.0564	0.0558	0.0560
FD FR	0.0558	0.0565	0.0192	0.0564	0.0559	0.0564	0.0563
FU FF	0.0560	0.0564	0.0188	0.0568	0.0563	0.0559	0.0564
FU MT	0.0566	0.0562	0.0190	0.0565	0.0560	0.0559	0.0563
FU FR	0.0564	0.0560	0.0188	0.0565	0.0568	0.0563	0.0565



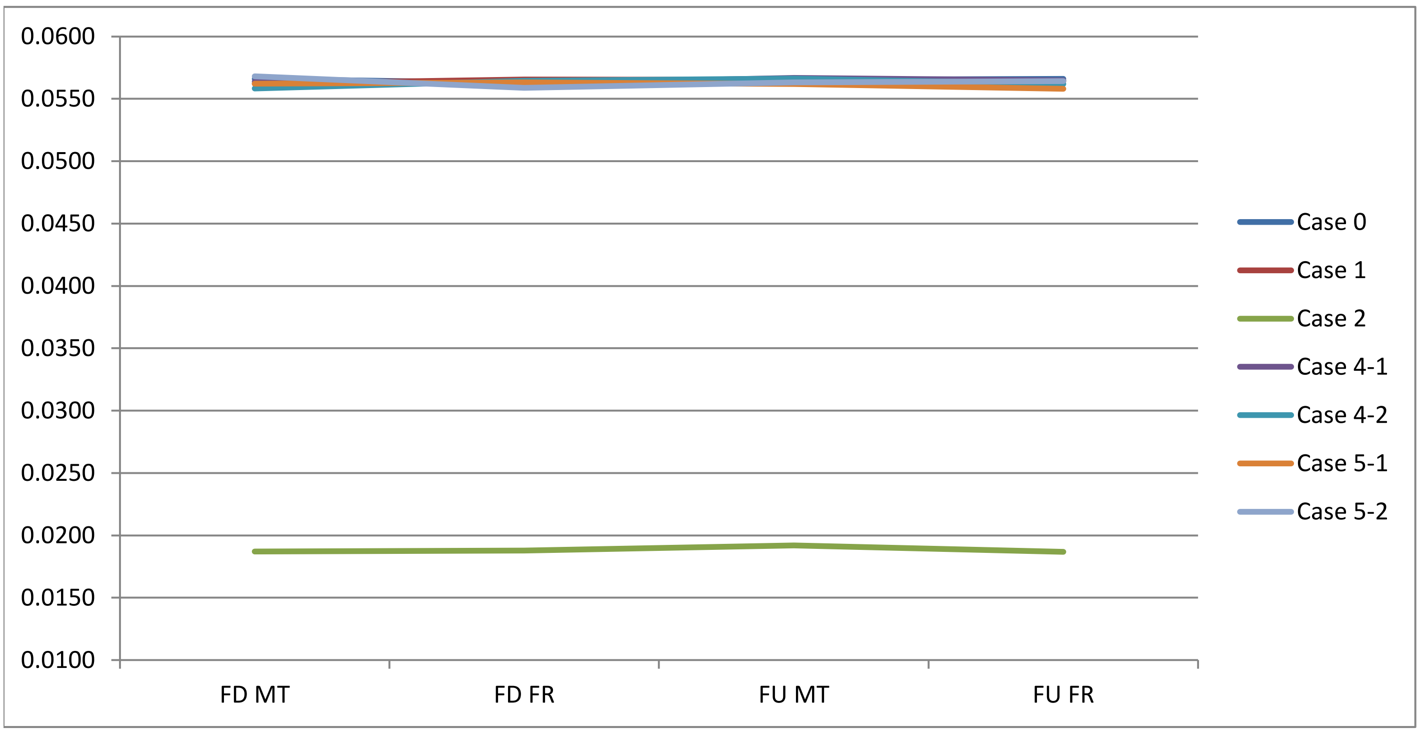
50th Male Driver's Side Pressure Switch

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	0.0567	0.0564	0.0189	0.0567	0.0560	0.0559	0.0565
FD MT	0.0565	0.0567	0.0190	0.0563	0.0558	0.0562	0.0564
FD FR	0.0564	0.0568	0.0189	0.0566	0.0568	0.0559	0.0564
FU FF	0.0565	0.0566	0.0183	0.0567	0.0561	0.0560	0.0564
FU MT	0.0565	0.0563	0.0185	0.0564	0.0565	0.0564	0.0566
FU FR	0.0565	0.0559	0.0189	0.0565	0.0564	0.0561	0.0569



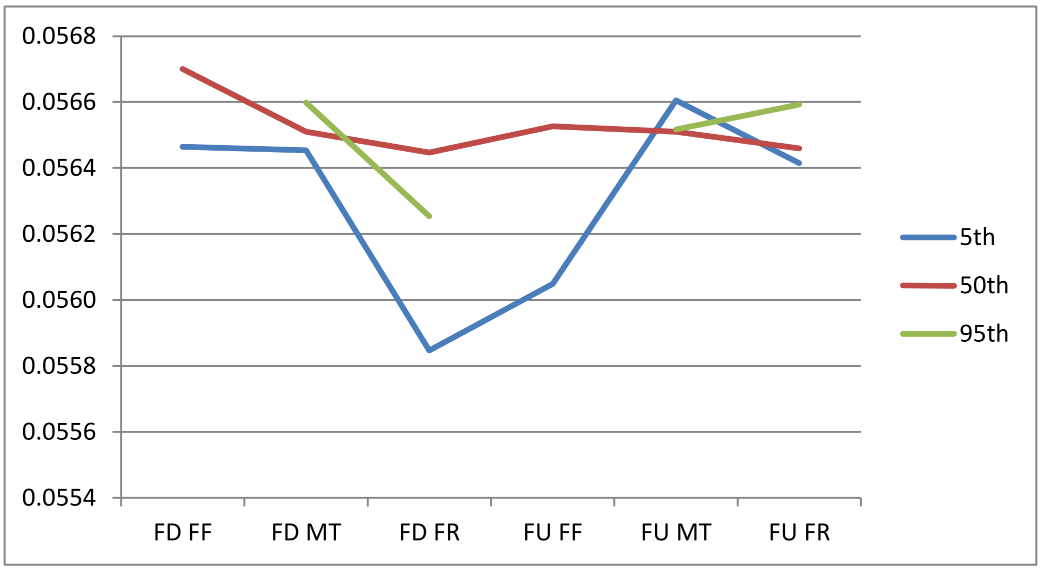
95th Male Driver's Side Pressure Switch

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD MT	0.0566	0.0562	0.0187	0.0564	0.0558	0.0562	0.0568
FD FR	0.0563	0.0565	0.0188	0.0562	0.0564	0.0563	0.0559
FU MT	0.0565	0.0565	0.0192	0.0567	0.0566	0.0562	0.0563
FU FR	0.0566	0.0564	0.0187	0.0565	0.0562	0.0558	0.0564



All Properly Buckled (Case 0) Pressure Switch

	PROPERLY BUCKLED 5th	PROPERLY BUCKLED 50th	PROPERLY BUCKLED 95th
FD FF	0.0565	0.0567	
FD MT	0.0565	0.0565	0.0566
FD FR	0.0558	0.0564	0.0563
FU FF	0.0560	0.0565	
FU MT	0.0566	0.0565	0.0565
FU FR	0.0564	0.0565	0.0566



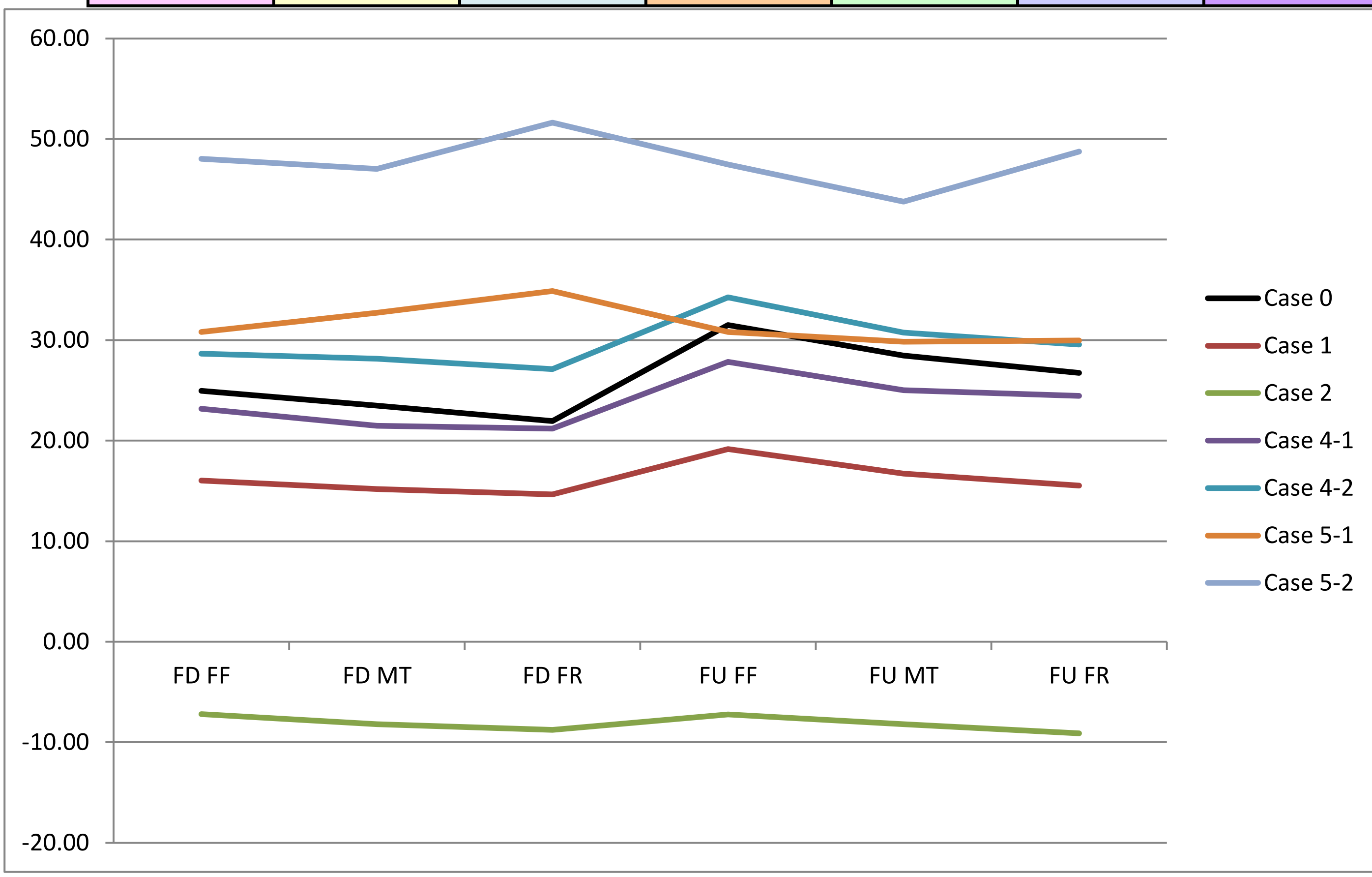
2.2.1.3 Belt Payout

Belt payout can detect misuse case 1 (sitting on a buckled lap and shoulder belt), independent of seat track position and incline.

Belt Payout		
5th Female	**50th Male**	**95th Male**
1	1	1
2	2	2
5-2		

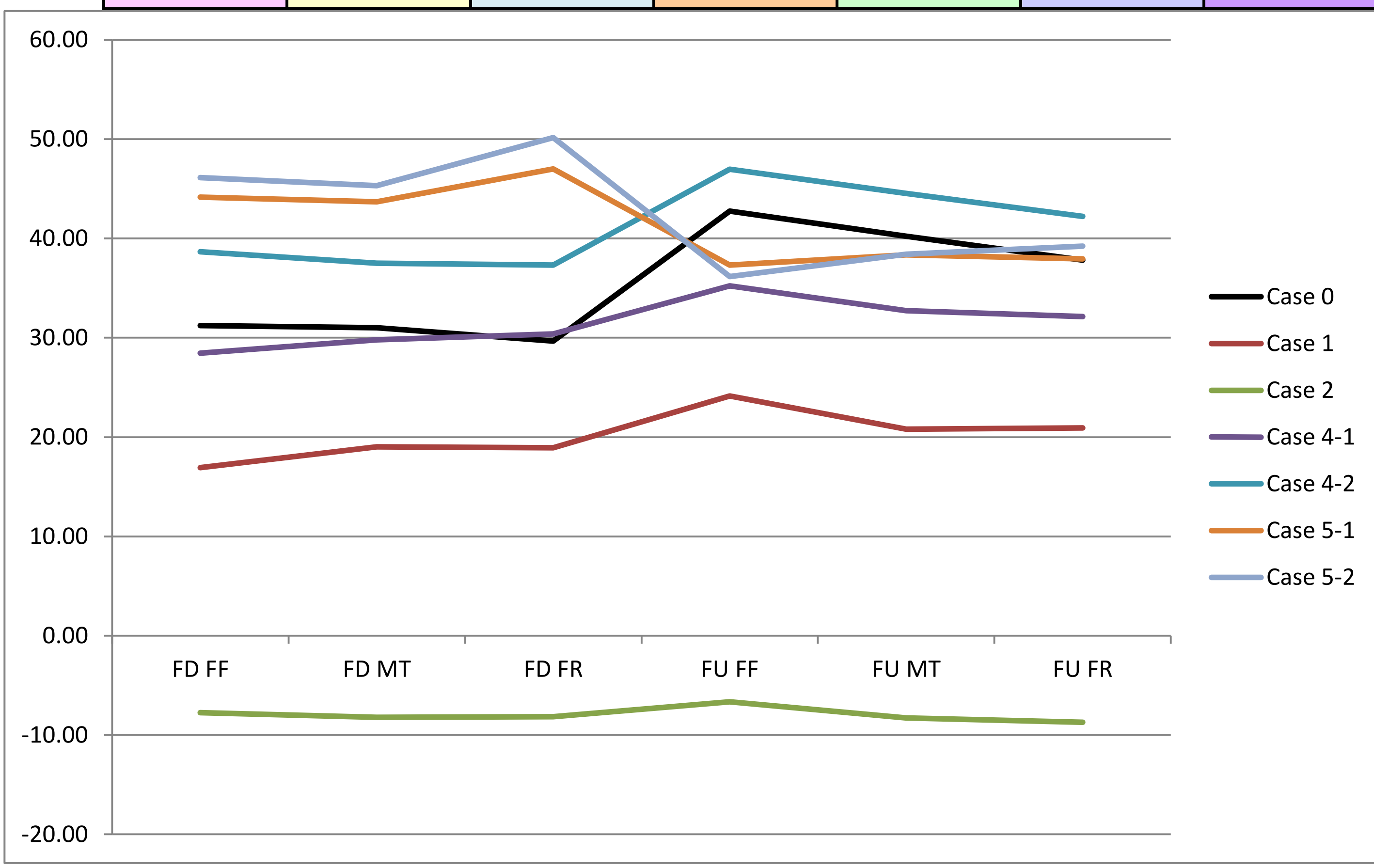
5th Female Driver's Side Belt Payout

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	24.95	16.03	-7.20	23.16	28.65	30.80	48.04
FD MT	23.48	15.19	-8.22	21.49	28.14	32.72	47.01
FD FR	21.96	14.66	-8.76	21.19	27.12	34.89	51.62
FU FF	31.50	19.15	-7.23	27.85	34.26	30.80	47.47
FU MT	28.45	16.73	-8.22	25.02	30.74	29.85	43.76
FU FR	26.74	15.54	-9.10	24.44	29.54	29.97	48.75



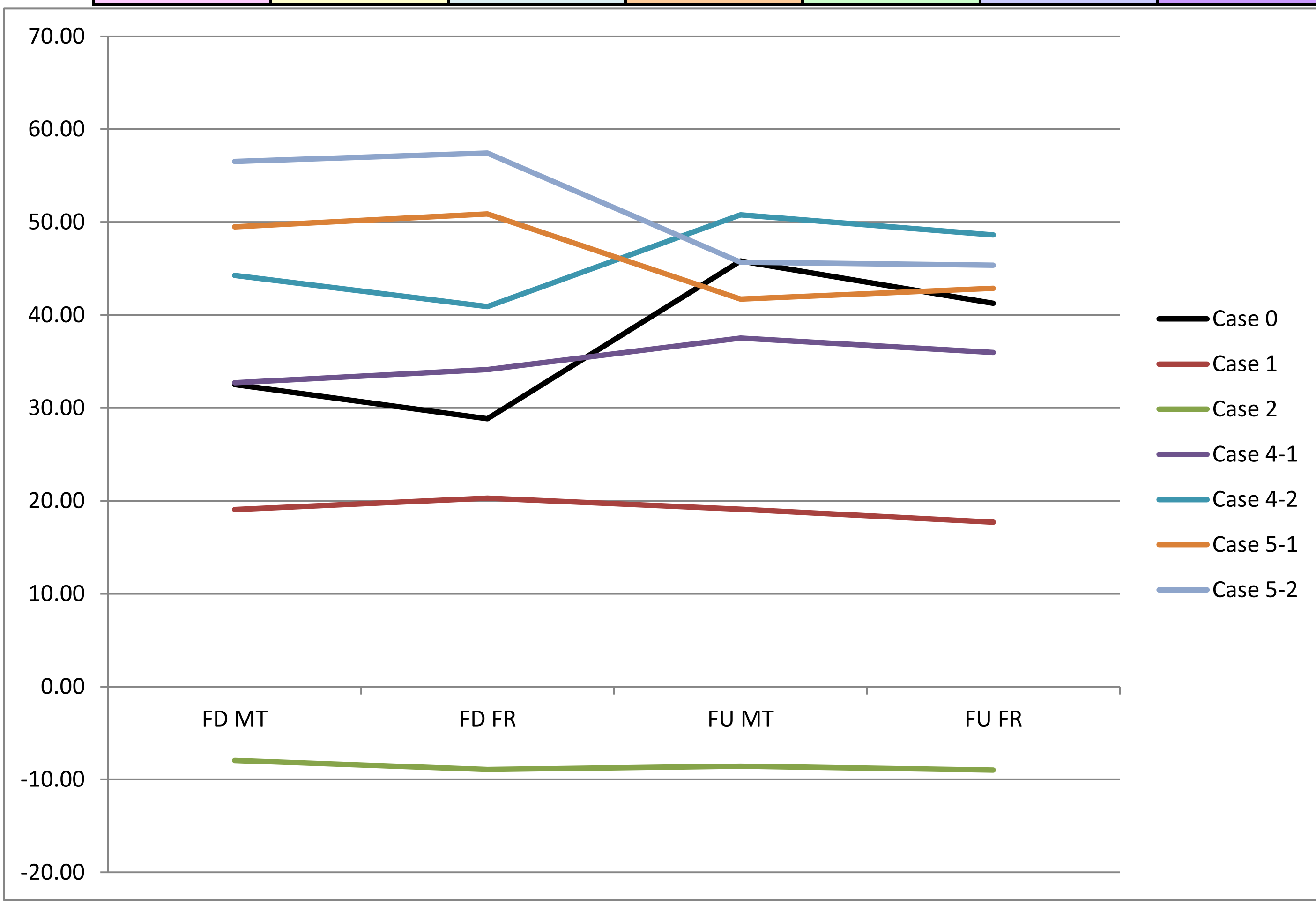
50th Male Driver's Side Belt Payout

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	31.24	16.92	-7.76	28.44	38.65	44.15	46.13
FD MT	31.00	19.02	-8.22	29.78	37.50	43.69	45.30
FD FR	29.65	18.92	-8.15	30.37	37.31	47.00	50.15
FU FF	42.76	24.13	-6.67	35.21	46.96	37.32	36.16
FU MT	40.21	20.80	-8.28	32.71	44.53	38.33	38.41
FU FR	37.82	20.93	-8.70	32.14	42.23	37.95	39.23



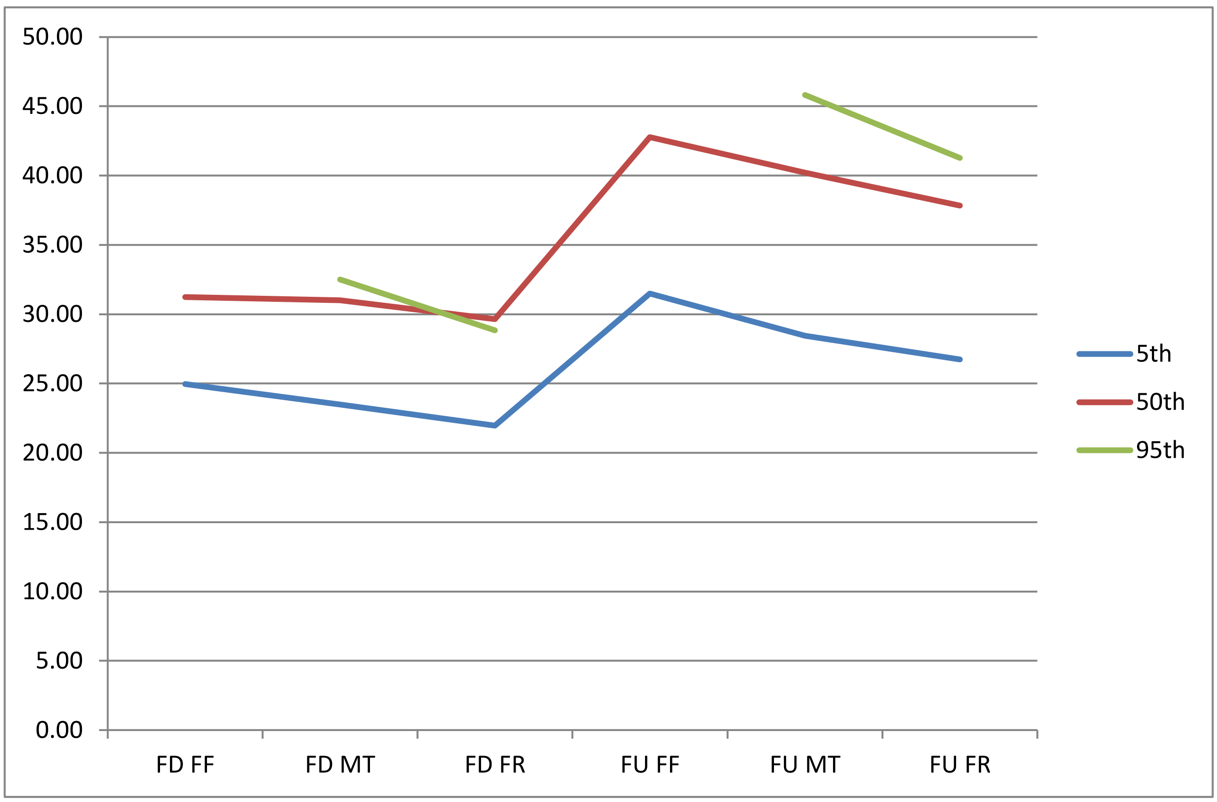
95th Male Driver's Side Belt Payout

	PROPERLY BUCKLED	Sitting on Buckled Belt	Unbuckled	Lap belt buckled; shoulder belt behind back	Lap belt buckled; shoulder belt under arm	Lap belt buckled; shoulder belt behind seat	Belt buckeld behind seat; occupant not restrained.
	Case 0	Case 1	Case 2	Case 4-1	Case 4-2	Case 5-1	Case 5-2
FD MT	32.51	19.07	-7.94	32.72	44.27	49.50	56.52
FD FR	28.83	20.30	-8.93	34.12	40.90	50.88	57.42
FU MT	45.81	19.08	-8.58	37.53	50.78	41.71	45.67
FU FR	41.27	17.69	-8.98	35.97	48.61	42.87	45.36



All Properly Buckled (Case 0) Belt Payout

	PROPERLY BUCKLED 5th	PROPERLY BUCKLED 50th	PROPERLY BUCKLED 95th
FD FF	24.95	31.24	
FD MT	23.48	31.00	32.51
FD FR	21.96	29.65	28.83
FU FF	31.50	42.76	
FU MT	28.45	40.21	45.81
FU FR	26.74	37.82	41.27



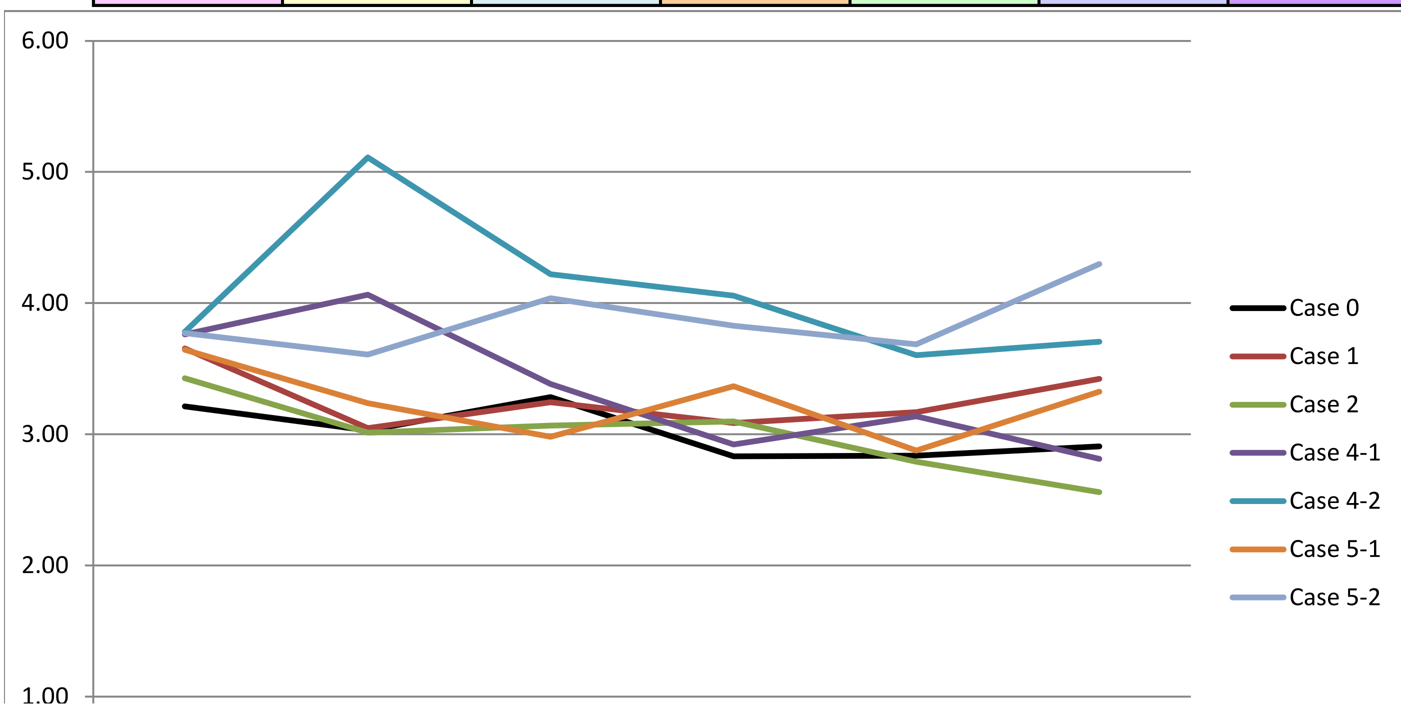
2.2.1.4 Belt Tension D-ring

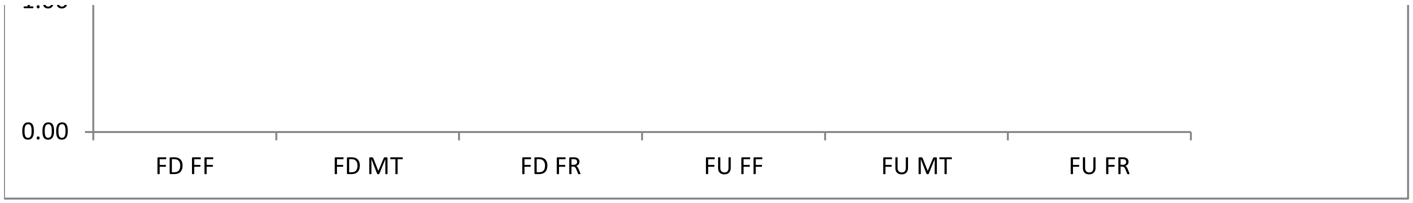
Belt tension at the D-ring can detect misuse 4-2 (lap belt buckled, shoulder belt under occupant's arm), independent of seat track position and incline.

Belt Tension at D-ring		
5th Female	**50th Male**	**95th Male**
	4-1	
4-2	4-2	4-2
5-2	5-2	

5th Female Driver's Side Belt Tension at D-ring

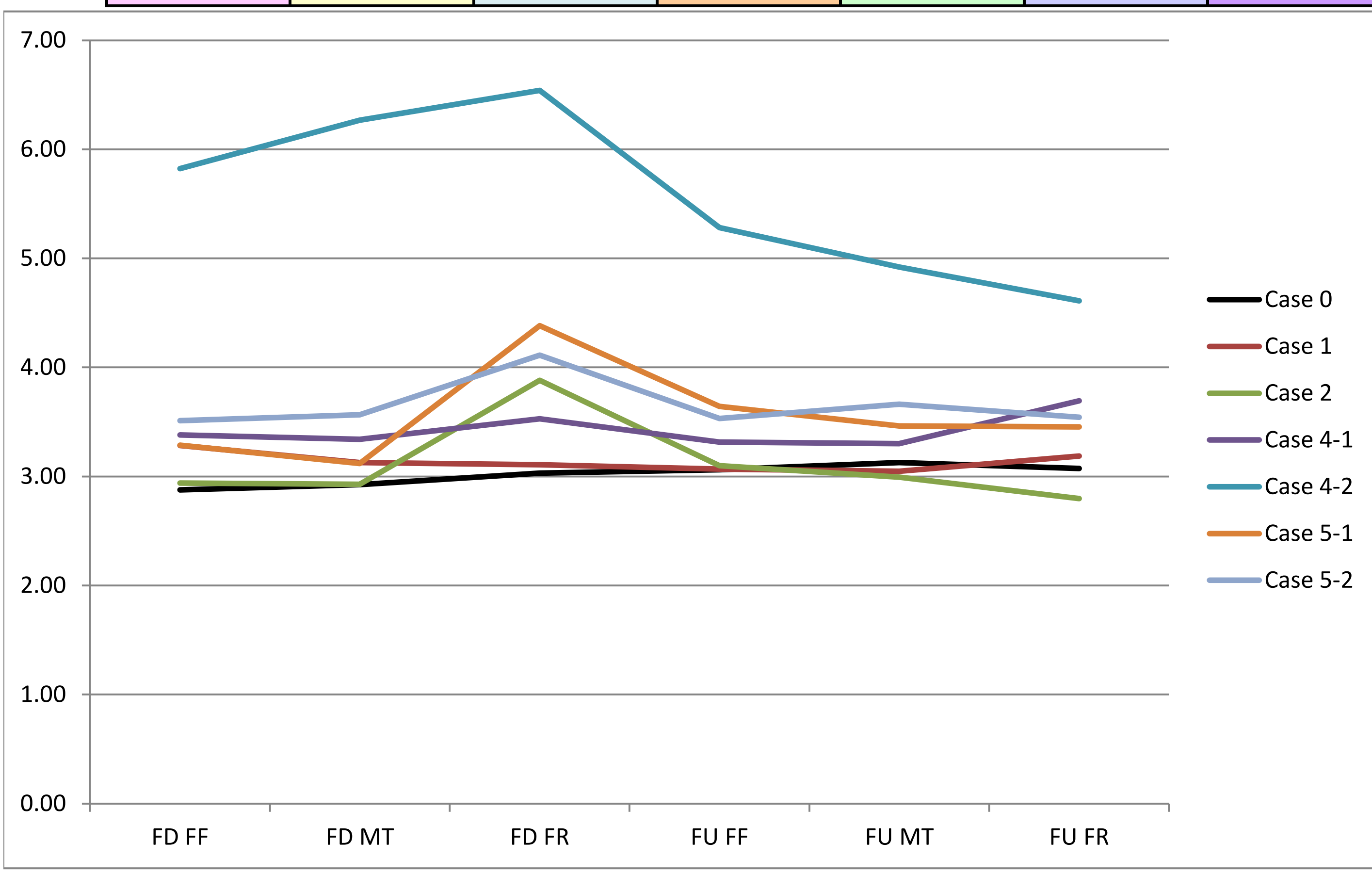
	PROPERLY BUCKLED	Sitting on Buckled Belt	Unbuckled	Lap belt buckled; shoulder belt behind back	Lap belt buckled; shoulder belt under arm	Lap belt buckled; shoulder belt behind seat	Belt buckeld behind seat; occupant not restrained.
	Case 0	Case 1	Case 2	Case 4-1	Case 4-2	Case 5-1	Case 5-2
FD FF	3.21	3.65	3.43	3.76	3.78	3.64	3.77
FD MT	3.03	3.05	3.01	4.06	5.11	3.24	3.61
FD FR	3.28	3.24	3.07	3.38	4.22	2.98	4.04
FU FF	2.83	3.09	3.10	2.92	4.06	3.37	3.83
FU MT	2.84	3.17	2.79	3.14	3.60	2.87	3.69
FU FR	2.91	3.42	2.56	2.81	3.70	3.33	4.30




0.00
FD FF
FD MT
FD FR
FU FF
FU MT
FU FR

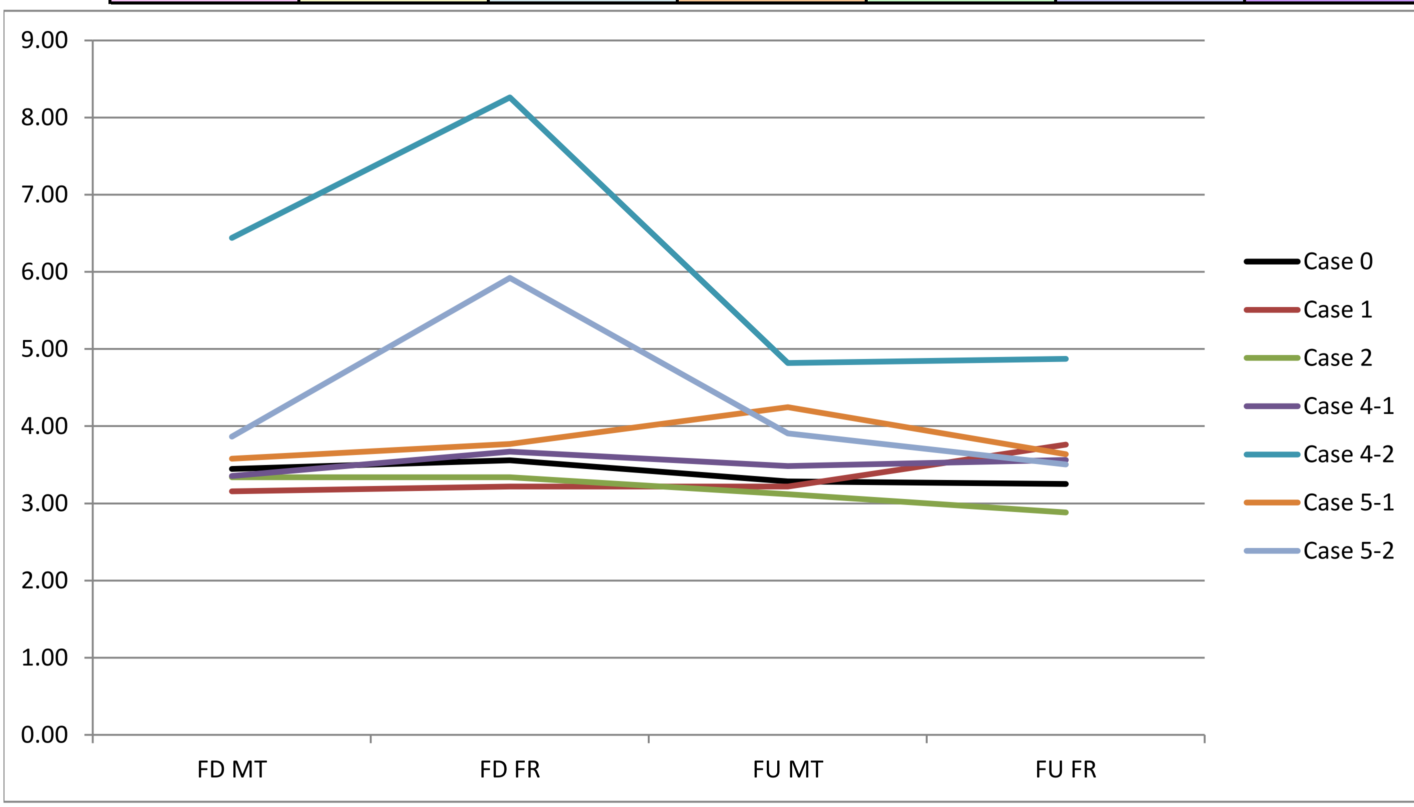
50th Male Driver's Side Belt Tension at D-ring

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	2.88	3.29	2.94	3.38	5.82	3.29	3.51
FD MT	2.92	3.13	2.93	3.34	6.27	3.12	3.57
FD FR	3.03	3.11	3.88	3.53	6.54	4.38	4.11
FU FF	3.06	3.07	3.10	3.32	5.28	3.64	3.53
FU MT	3.13	3.05	2.99	3.30	4.92	3.46	3.66
FU FR	3.07	3.19	2.80	3.69	4.61	3.45	3.54



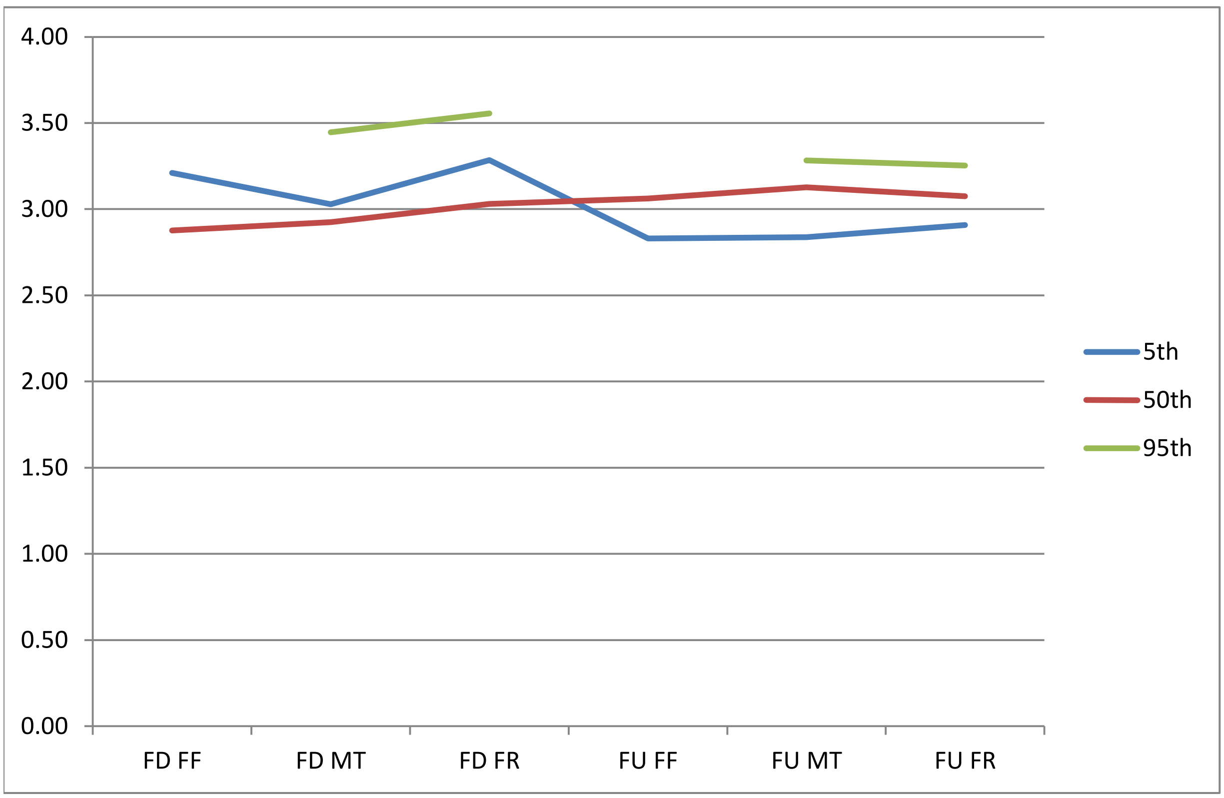
95th Male Driver's Side Belt Tension at D-ring

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD MT	3.45	3.15	3.34	3.36	6.44	3.58	3.87
FD FR	3.56	3.22	3.34	3.67	8.26	3.77	5.92
FU MT	3.28	3.22	3.12	3.49	4.82	4.25	3.90
FU FR	3.25	3.76	2.88	3.56	4.87	3.64	3.50



All Properly Buckled (Case 0) Belt Tension at D-ring

	PROPERLY BUCKLED 5th	PROPERLY BUCKLED 50th	PROPERLY BUCKLED 95th
FD FF	3.21	2.88	
FD MT	3.03	2.92	3.45
FD FR	3.28	3.03	3.56
FU FF	2.83	3.06	
FU MT	2.84	3.13	3.28
FU FR	2.91	3.07	3.25



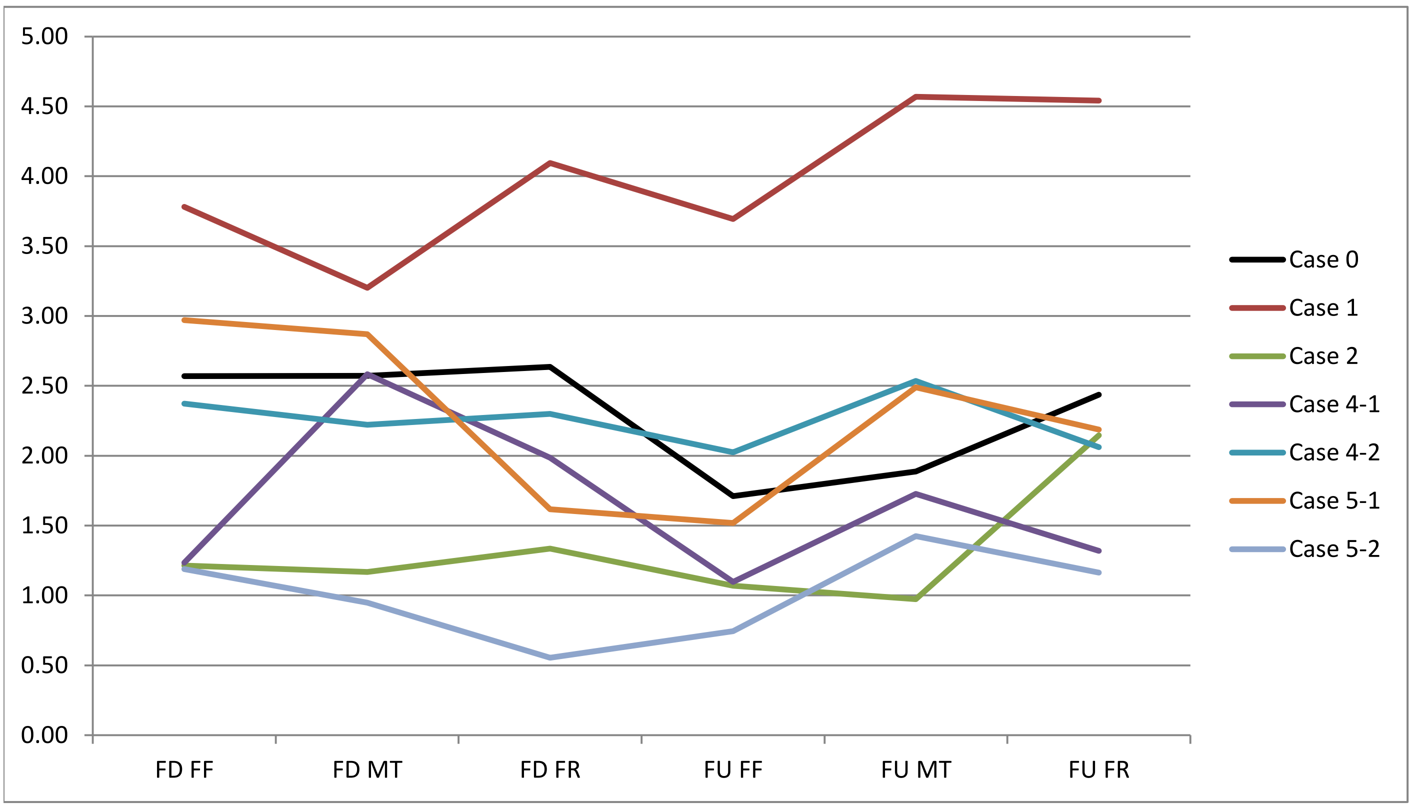
2.2.1.5 Belt Tension Anchor

Belt tension at the anchor can detect misuse case 5-2 (belt buckled behind the seat-no occupant restraint), independent of seat track position and incline.

Belt Tension at Anchor		
5th Female	**50th Male**	**95th Male**
1		
5-2	5-2	5-2

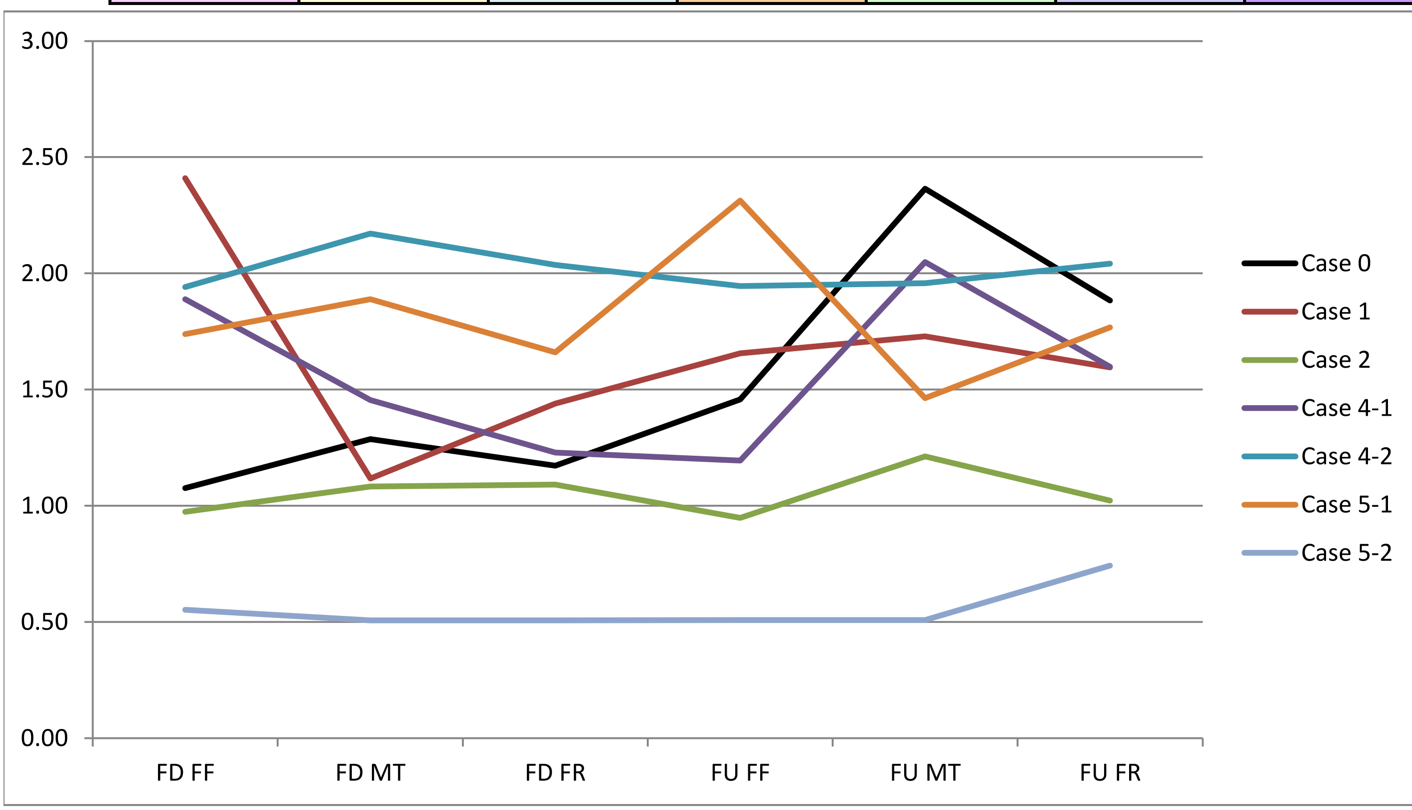
5th Female Driver's Side Belt Tension at Anchor

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	2.57	3.78	1.21	1.23	2.37	2.97	1.19
FD MT	2.57	3.20	1.17	2.58	2.22	2.87	0.95
FD FR	2.63	4.09	1.34	1.98	2.30	1.62	0.56
FU FF	1.71	3.69	1.07	1.10	2.03	1.52	0.74
FU MT	1.89	4.57	0.97	1.73	2.54	2.49	1.43
FU FR	2.44	4.54	2.15	1.32	2.06	2.19	1.16



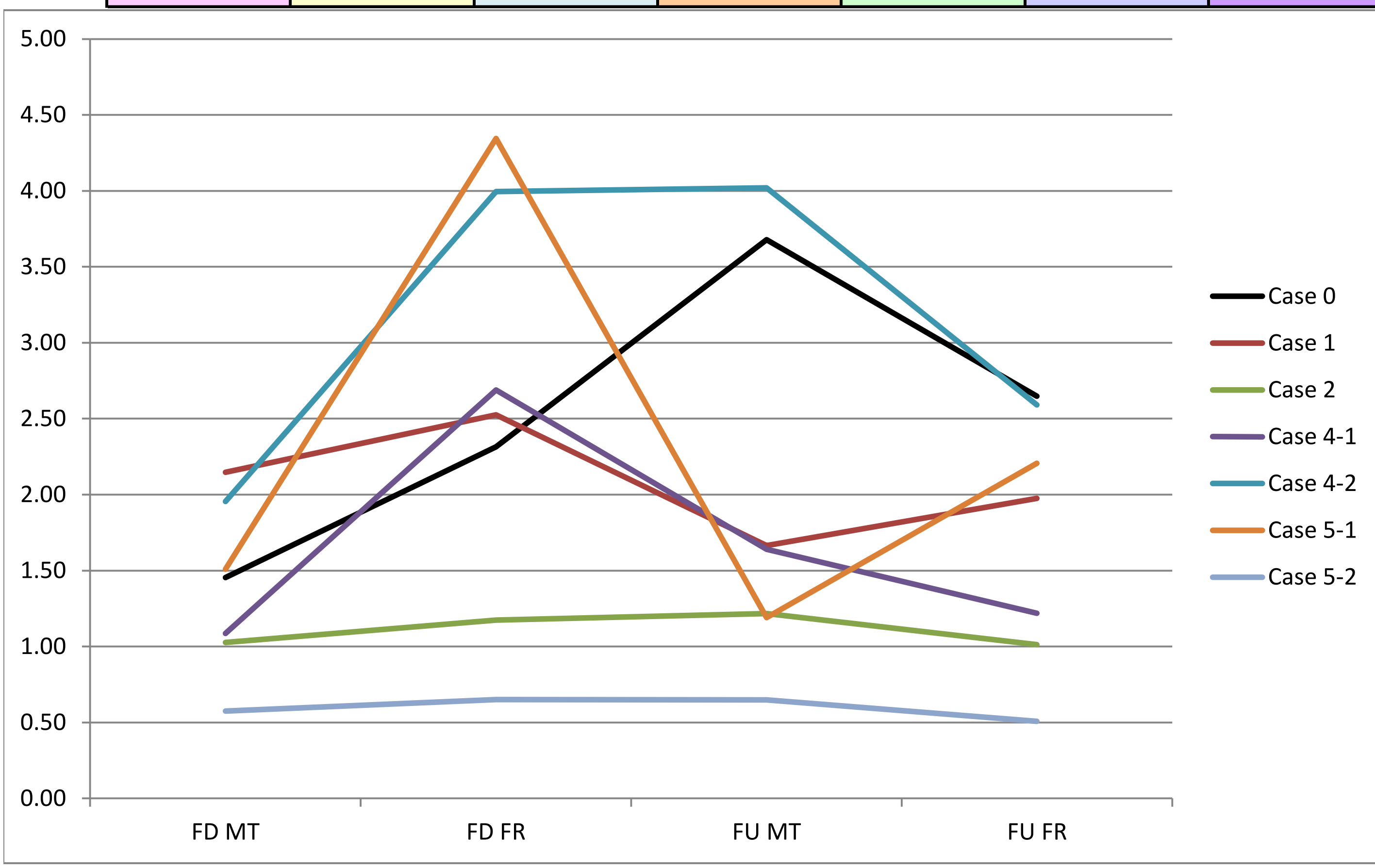
50th Male Driver's Side Belt Tension at Anchor

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	1.08	2.41	0.97	1.89	1.94	1.74	0.55
FD MT	1.29	1.12	1.08	1.45	2.17	1.89	0.51
FD FR	1.17	1.44	1.09	1.23	2.04	1.66	0.51
FU FF	1.46	1.66	0.95	1.19	1.95	2.31	0.51
FU MT	2.36	1.73	1.21	2.05	1.96	1.46	0.51
FU FR	1.88	1.60	1.02	1.60	2.04	1.77	0.74



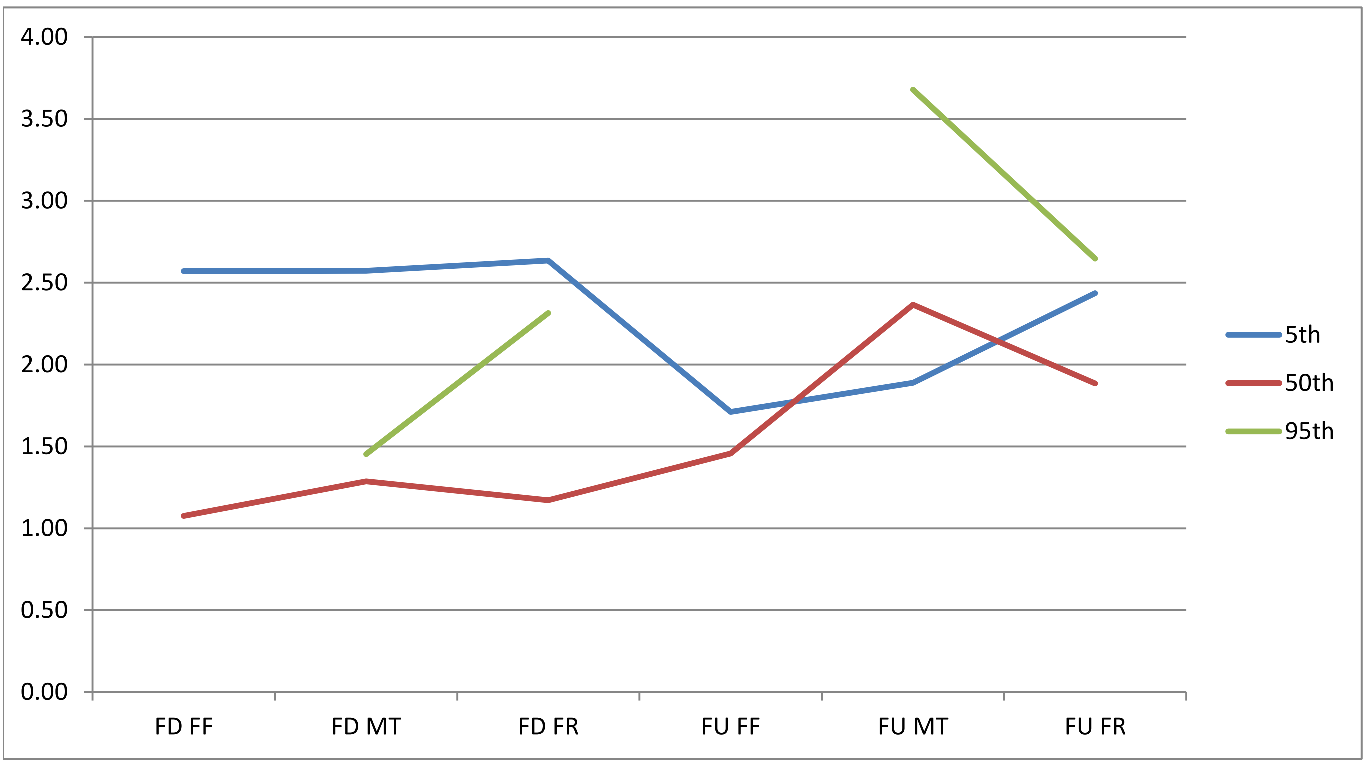
95th Male Driver's Side Belt Tension at Anchor

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD MT	1.45	2.15	1.03	1.09	1.96	1.51	0.57
FD FR	2.31	2.52	1.17	2.69	4.00	4.35	0.65
FU MT	3.68	1.66	1.22	1.64	4.02	1.19	0.65
FU FR	2.65	1.97	1.01	1.22	2.59	2.21	0.51



All Properly Buckled (Case 0) Belt Tension at Anchor

	PROPERLY BUCKLED 5th	PROPERLY BUCKLED 50th	PROPERLY BUCKLED 95th
FD FF	2.57	1.08	
FD MT	2.57	1.29	1.45
FD FR	2.63	1.17	2.31
FU FF	1.71	1.46	
FU MT	1.89	2.36	3.68
FU FR	2.44	1.88	2.65



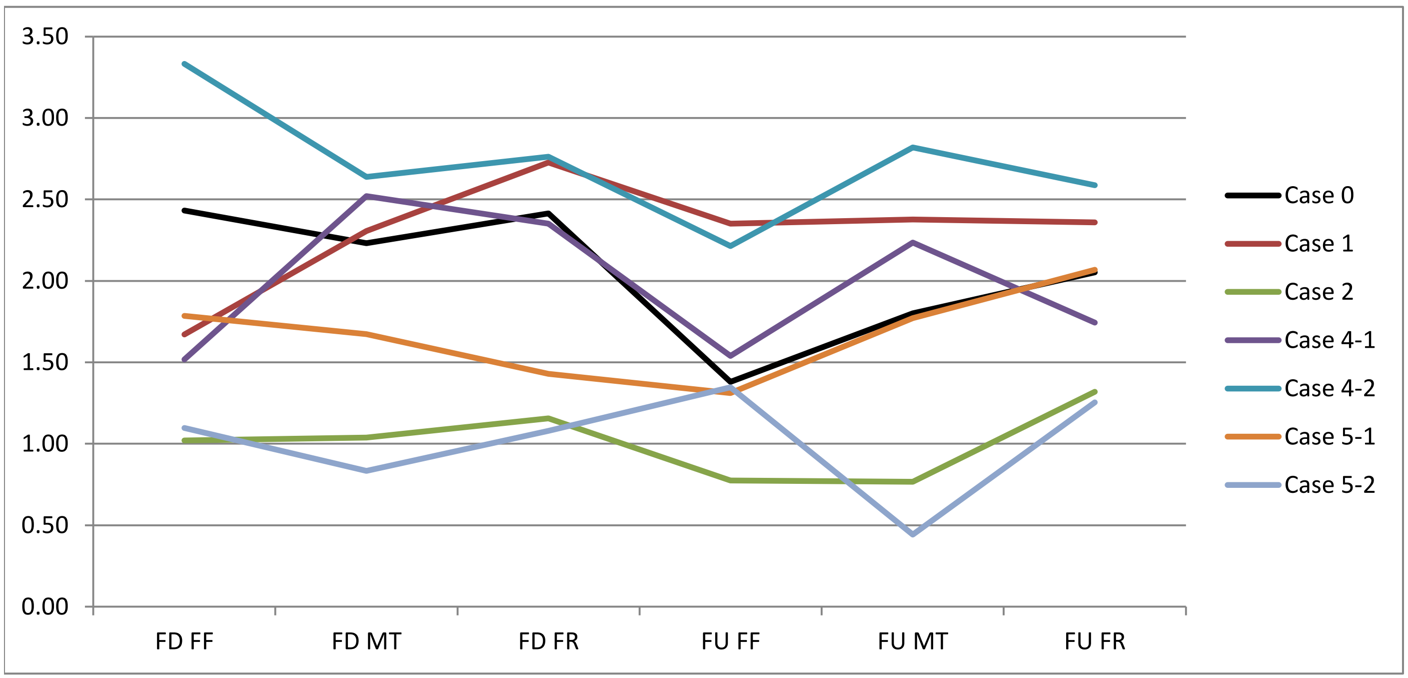
2.2.1.6 Belt Tension Buckle

The belt tension sensor at the buckle is not able to detect any misuses, consistently, over the occupant types.

Belt Tension at Buckle		
5th Female	**50th Male**	**95th Male**
		1
2 (Marginal)		2
		5-1
		5-2

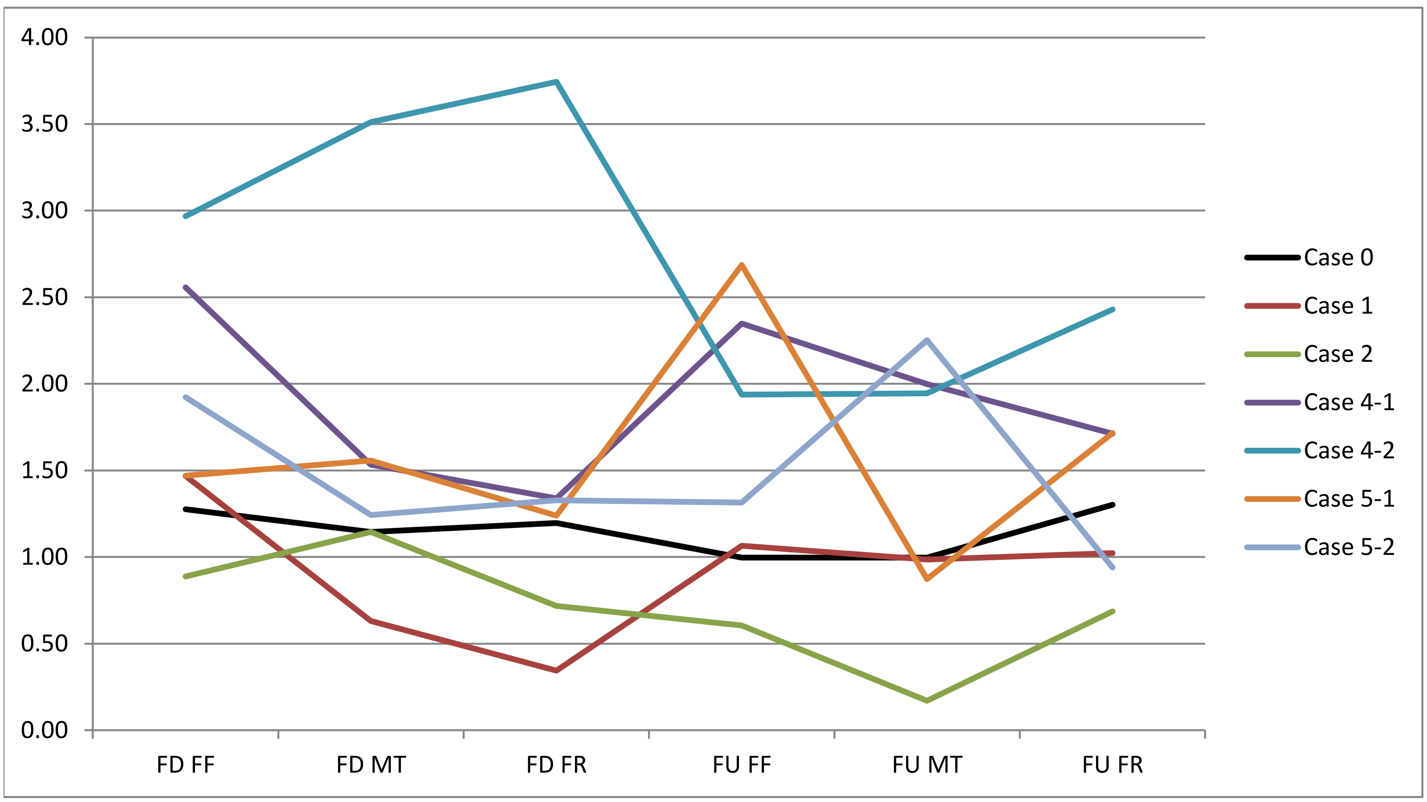
5th Female Driver's Side Belt Tension at Buckle

	PROPERLY BUCKLED	Sitting on Buckled Belt	Unbuckled	Lap belt buckled; shoulder belt behind back	Lap belt buckled; shoulder belt under arm	Lap belt buckled; shoulder belt behind seat	Belt buckeld behind seat; occupant not restrained.
	Case 0	**Case 1**	**Case 2**	**Case 4-1**	**Case 4-2**	**Case 5-1**	**Case 5-2**
FD FF	2.43	1.67	1.02	1.52	3.33	1.79	1.10
FD MT	2.23	2.31	1.04	2.52	2.64	1.67	0.83
FD FR	2.41	2.73	1.16	2.35	2.76	1.43	1.08
FU FF	1.38	2.35	0.77	1.54	2.21	1.31	1.35
FU MT	1.80	2.38	0.77	2.23	2.82	1.77	0.44
FU FR	2.05	2.36	1.32	1.74	2.59	2.07	1.25



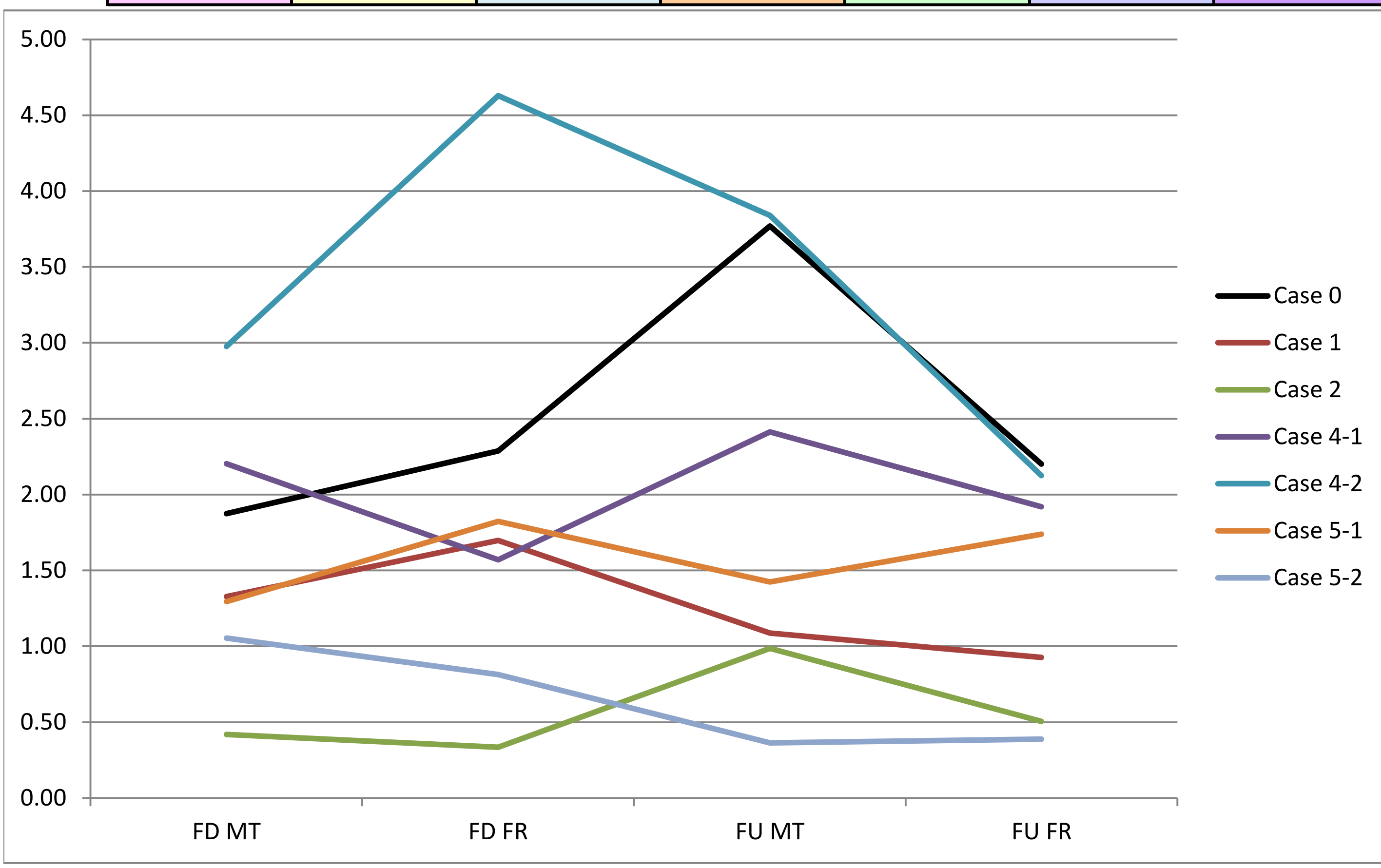
50th Male Driver's Side Belt Tension at Buckle

	PROPERLY BUCKLED	Sitting on Buckled Belt	Unbuckled	Lap belt buckled; shoulder belt behind back	Lap belt buckled; shoulder belt under arm	Lap belt buckled; shoulder belt behind seat	Belt buckeld behind seat; occupant not restrained.
	Case 0	Case 1	Case 2	Case 4-1	Case 4-2	Case 5-1	Case 5-2
FD FF	1.28	1.47	0.89	2.56	2.97	1.47	1.92
FD MT	1.14	0.63	1.14	1.53	3.51	1.56	1.24
FD FR	1.20	0.34	0.72	1.34	3.74	1.24	1.33
FU FF	1.00	1.07	0.61	2.35	1.94	2.69	1.32
FU MT	1.00	0.99	0.17	2.00	1.94	0.87	2.25
FU FR	1.30	1.02	0.69	1.71	2.43	1.72	0.94



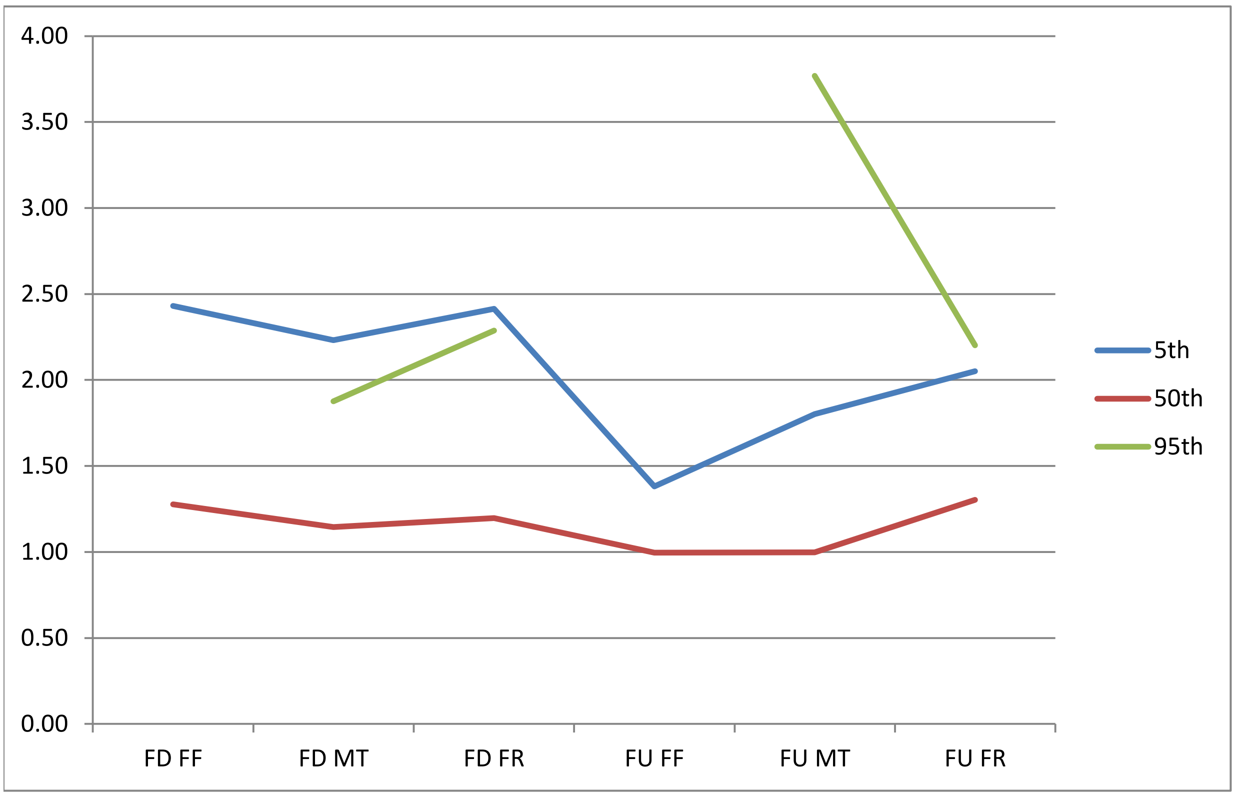
95th Male Driver's Side Belt Tension at Buckle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD MT	1.88	1.33	0.42	2.20	2.98	1.30	1.05
FD FR	2.29	1.70	0.33	1.57	4.63	1.82	0.81
FU MT	3.77	1.09	0.99	2.41	3.84	1.42	0.36
FU FR	2.20	0.93	0.50	1.92	2.13	1.74	0.39



All Properly Buckled (Case 0) Belt Tension at Buckle

	PROPERLY BUCKLED 5th	PROPERLY BUCKLED 50th	PROPERLY BUCKLED 95th
FD FF	2.43	1.28	
FD MT	2.23	1.14	1.88
FD FR	2.41	1.20	2.29
FU FF	1.38	1.00	
FU MT	1.80	1.00	3.77
FU FR	2.05	1.30	2.20



2.2.2 Passenger Side

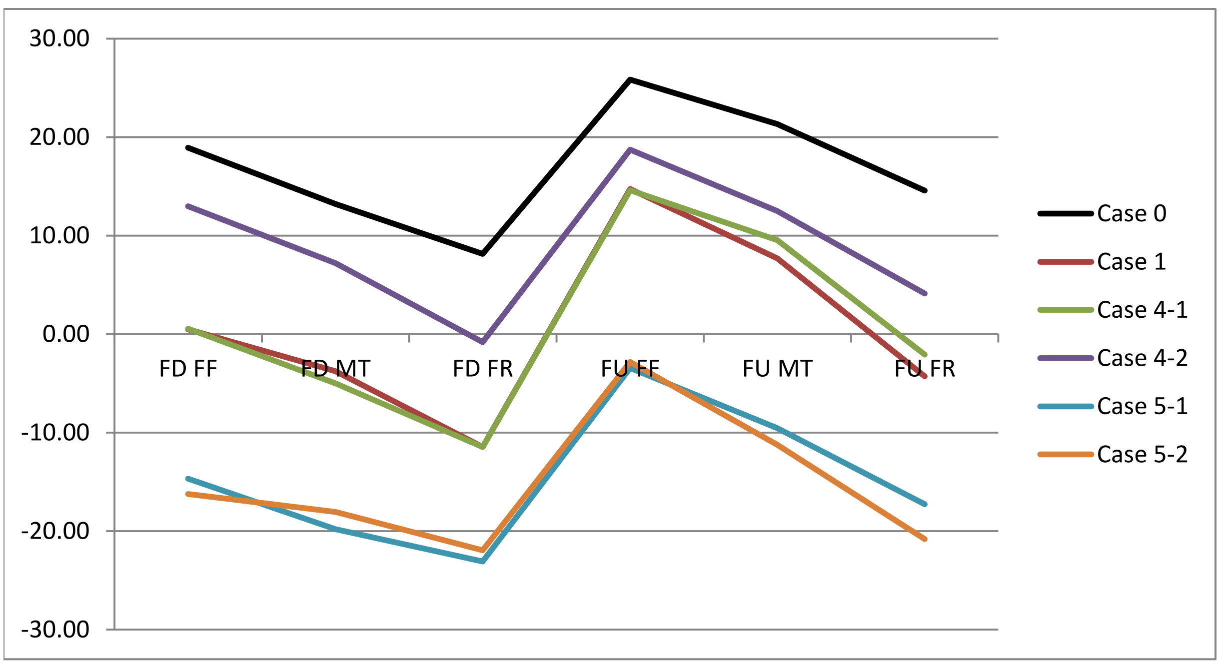
2.2.2.1 D-ring Angle

D-ring angle can detect misuse cases, independent of seat track position and incline 5-1 (lap belt bucked but shoulder belt behind the seat-occupant restrained by lap belt), and 5-2 (belt buckled behind the seat-no occupant restraint).

D-ring Angle		
5th Female	**50th Male**	**95th Male**
		1
5-1	5-1	5-1
5-2	5-2	5-2

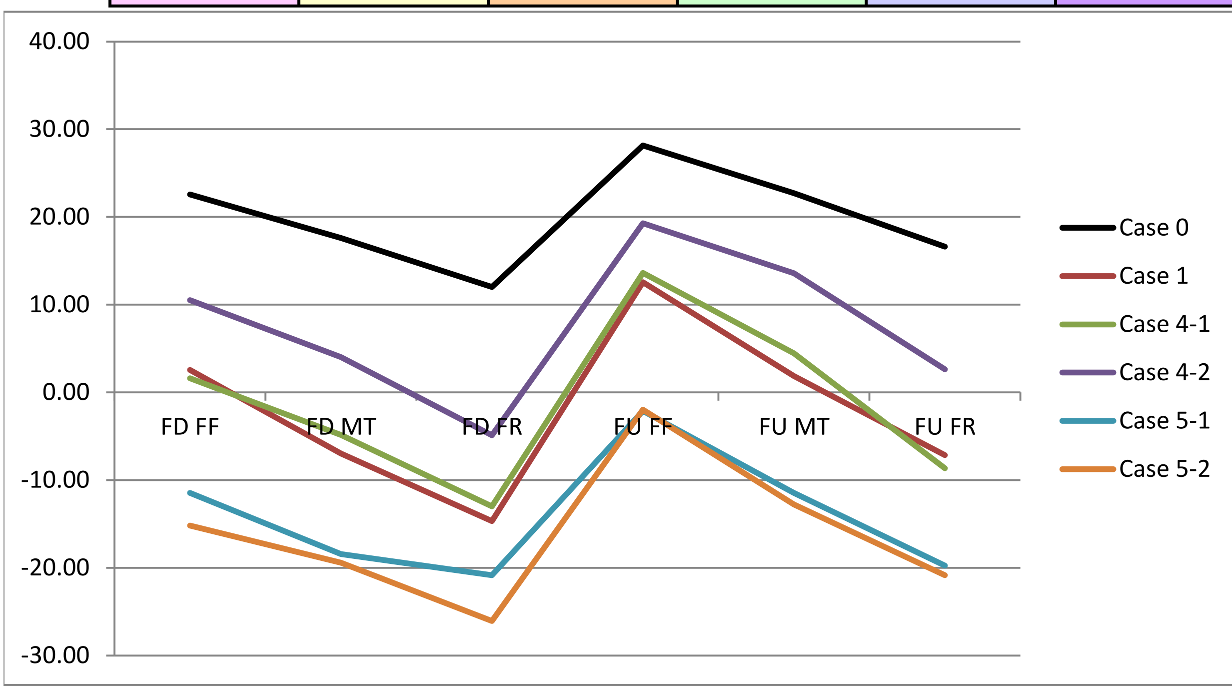
5th Female Driver's Side D-ring Angle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	18.90	0.48	0.55	12.99	-14.69	-16.24
FD MT	13.19	-3.79	-5.02	7.21	-19.81	-18.06
FD FR	8.13	-11.46	-11.46	-0.83	-23.08	-21.95
FU FF	25.84	14.72	14.60	18.72	-3.44	-2.83
FU MT	21.32	7.69	9.52	12.49	-9.55	-11.25
FU FR	14.57	-4.28	-2.10	4.11	-17.28	-20.83



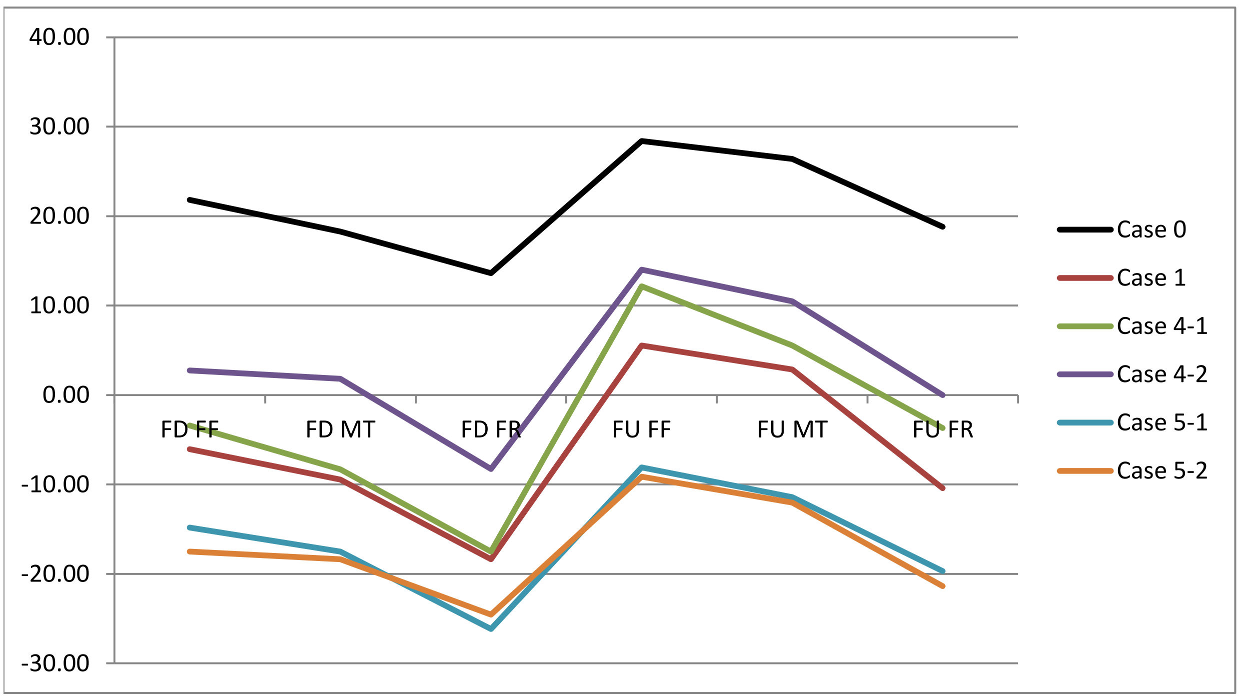
50th Male Driver's Side D-ring Angle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	22.56	2.57	1.60	10.51	-11.48	-15.20
FD MT	17.62	-6.97	-4.85	4.03	-18.45	-19.42
FD FR	12.03	-14.69	-13.01	-4.88	-20.87	-26.09
FU FF	28.17	12.54	13.61	19.29	-2.11	-1.98
FU MT	22.70	1.85	4.45	13.60	-11.45	-12.79
FU FR	16.60	-7.17	-8.67	2.62	-19.75	-20.83



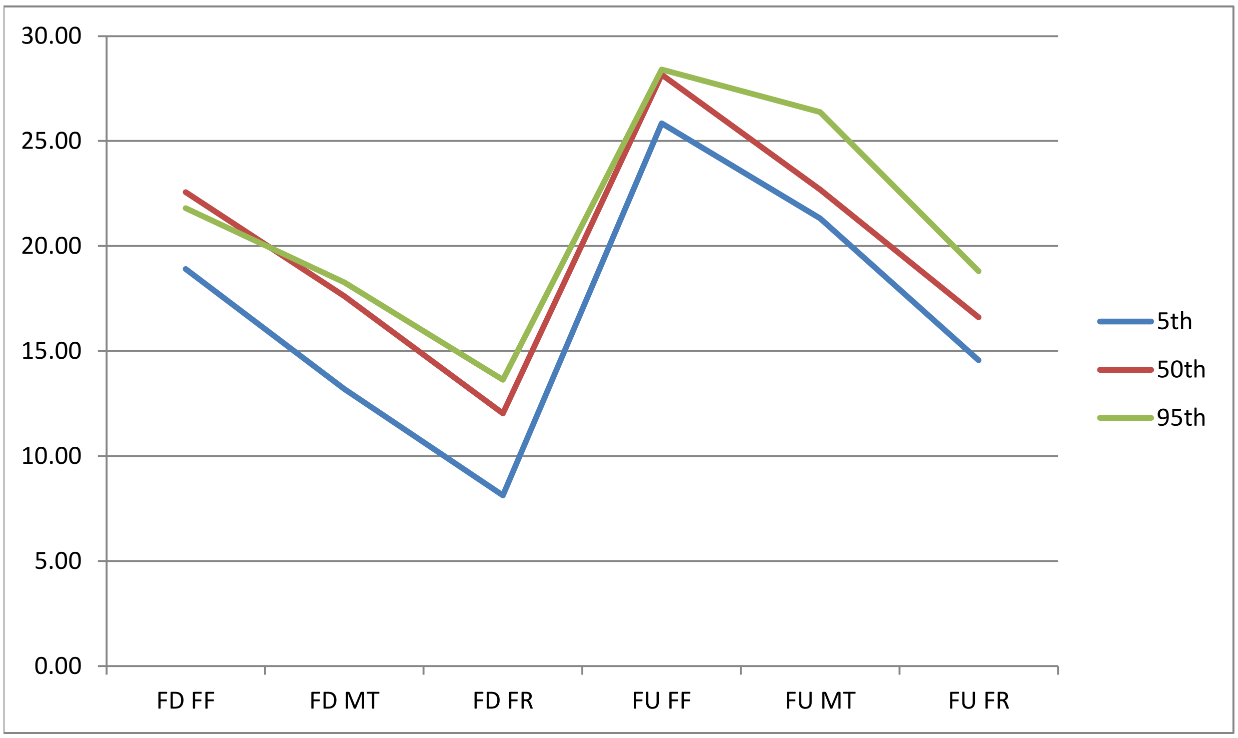
95th Male Driver's Side D-ring Angle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	21.80	-6.05	-3.40	2.73	-14.81	-17.49
FD MT	18.28	-9.46	-8.31	1.83	-17.49	-18.35
FD FR	13.63	-18.36	-17.48	-8.27	-26.16	-24.55
FU FF	28.40	5.55	12.16	14.00	-8.08	-9.14
FU MT	26.38	2.87	5.55	10.48	-11.43	-12.04
FU FR	18.80	-10.42	-3.69	0.00	-19.69	-21.36



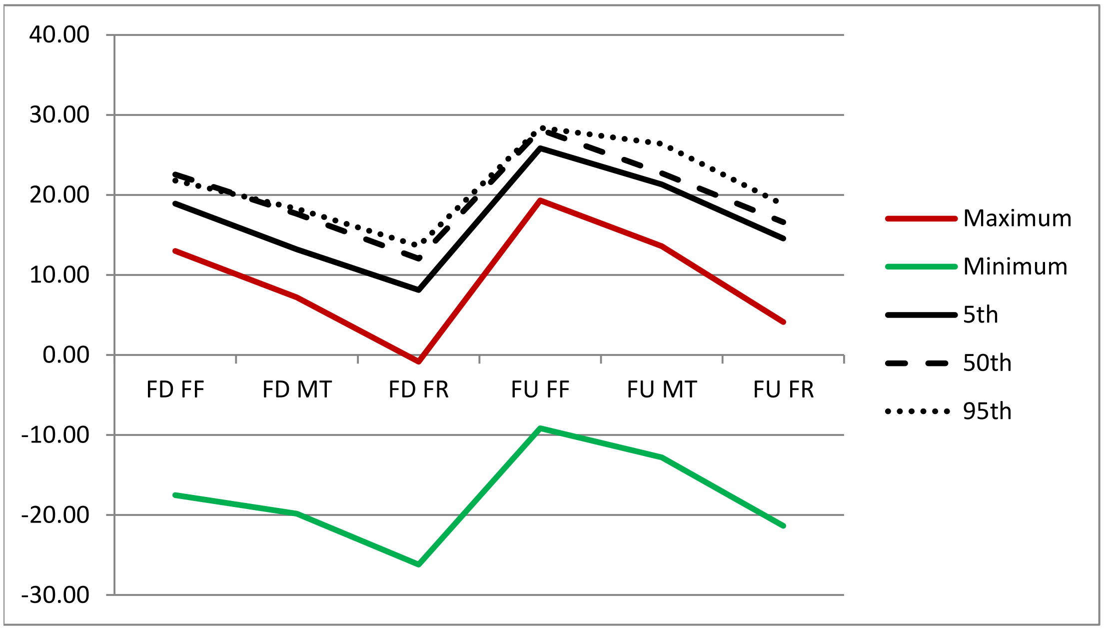
All Properly Buckled (Case 0) D-ring Angle

	PROPERLY BUCKLED 5th	PROPERLY BUCKLED 50th	PROPERLY BUCKLED 95th
FD FF	18.90	22.56	21.80
FD MT	13.19	17.62	18.28
FD FR	8.13	12.03	13.63
FU FF	25.84	28.17	28.40
FU MT	21.32	22.70	26.38
FU FR	14.57	16.60	18.80



All Properly Buckled D-ring Angle

	Maximum	Minimum	5th	50th	95th
FD FF	12.99	-17.49	18.90	22.56	21.80
FD MT	7.21	-19.81	13.19	17.62	18.28
FD FR	-0.83	-26.16	8.13	12.03	13.63
FU FF	19.29	-9.14	25.84	28.17	28.40
FU MT	13.60	-12.79	21.32	22.70	26.38
FU FR	4.11	-21.36	14.57	16.60	18.80



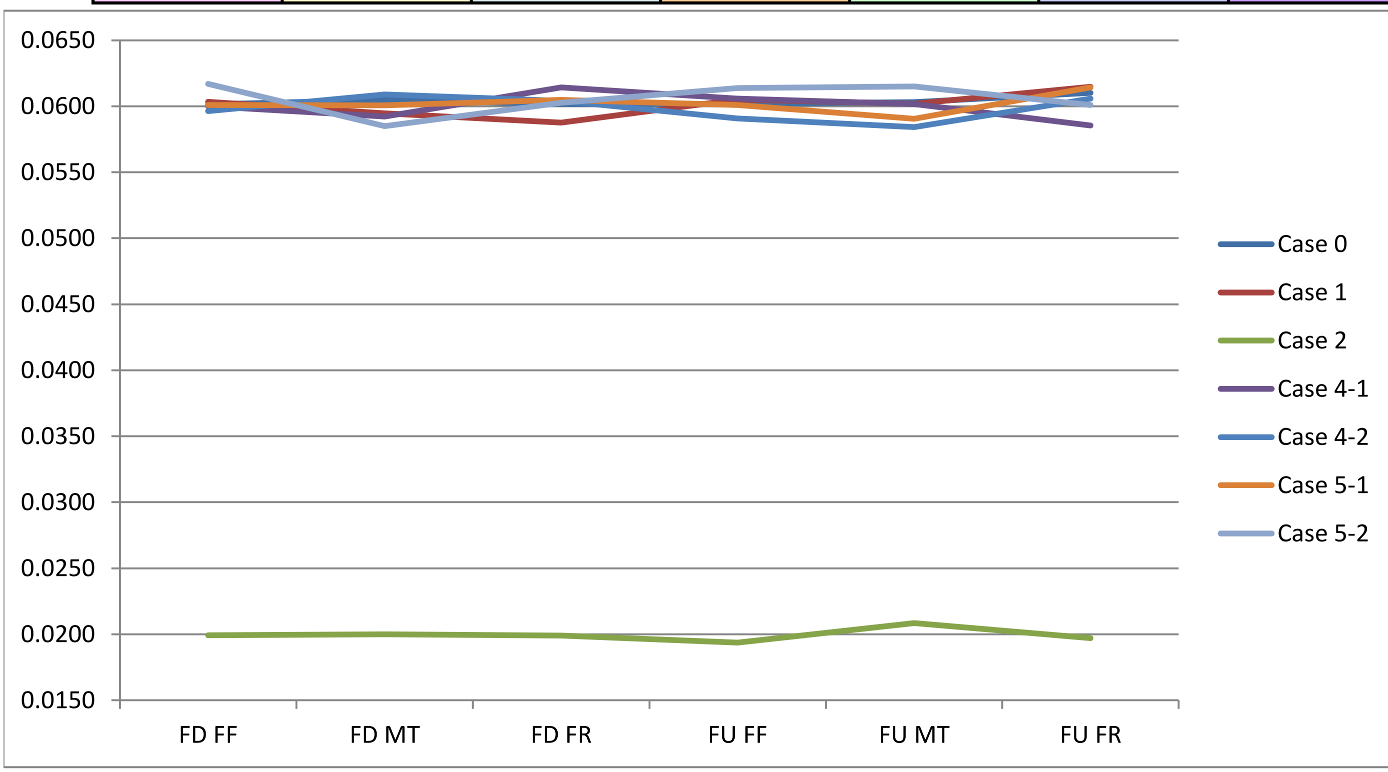
2.2.2.2 Pressure Switch

The pressure switch, located in the buckle, can only detect misuse case 2 (unbuckled), independent of seat track position and incline. However, this misuse can be detected by D-ring angle as well as the RFID sensor.

Pressure Switch in Buckle		
5th Female	50th Male	95th Male
2	2	2

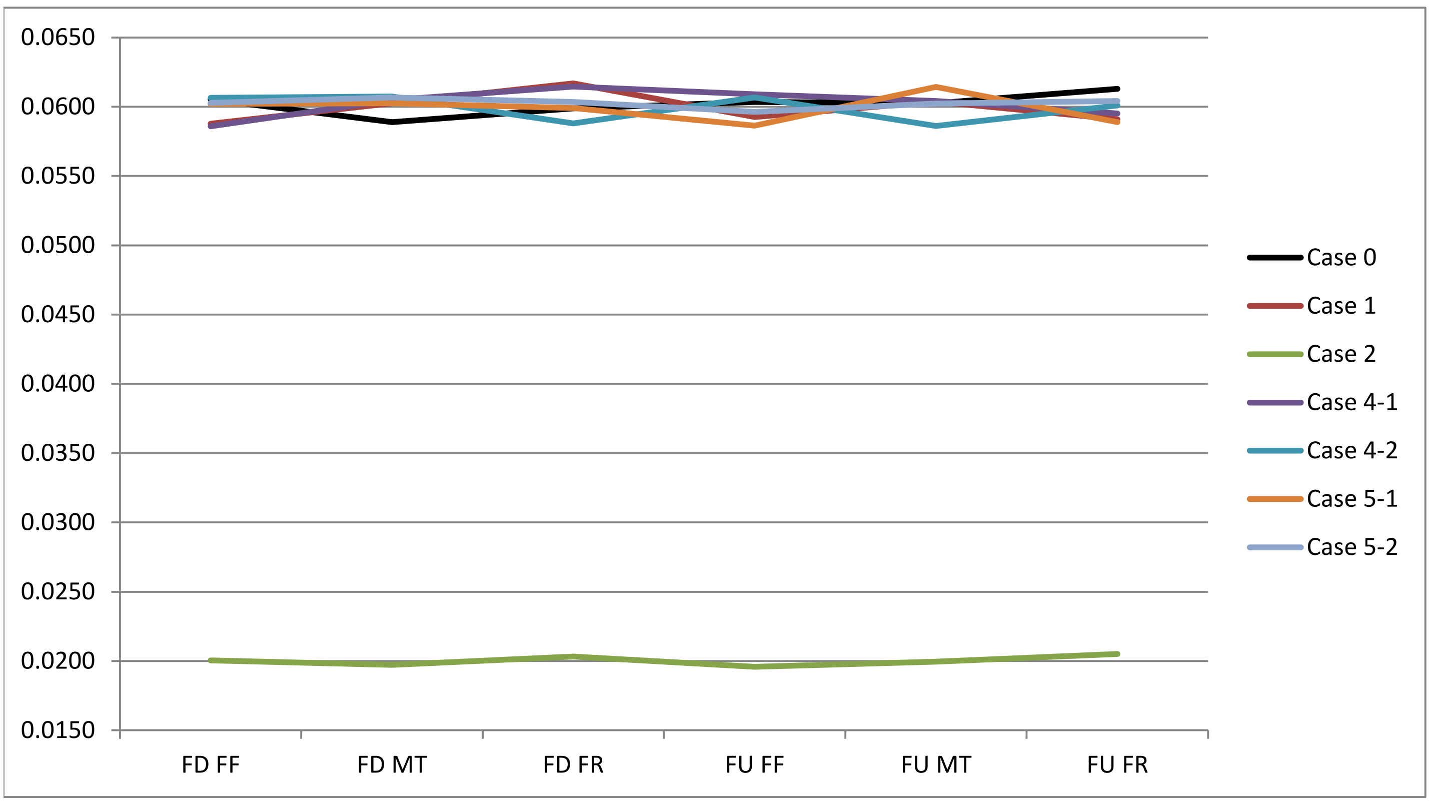
5th Female Passenger Side Pressure Switch

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	0.0601	0.0603	0.0199	0.0600	0.0596	0.0601	0.0617
FD MT	0.0605	0.0595	0.0200	0.0592	0.0609	0.0601	0.0585
FD FR	0.0602	0.0588	0.0199	0.0614	0.0604	0.0605	0.0603
FU FF	0.0602	0.0605	0.0194	0.0606	0.0591	0.0601	0.0614
FU MT	0.0603	0.0602	0.0209	0.0602	0.0584	0.0590	0.0615
FU FR	0.0610	0.0615	0.0197	0.0585	0.0606	0.0614	0.0601



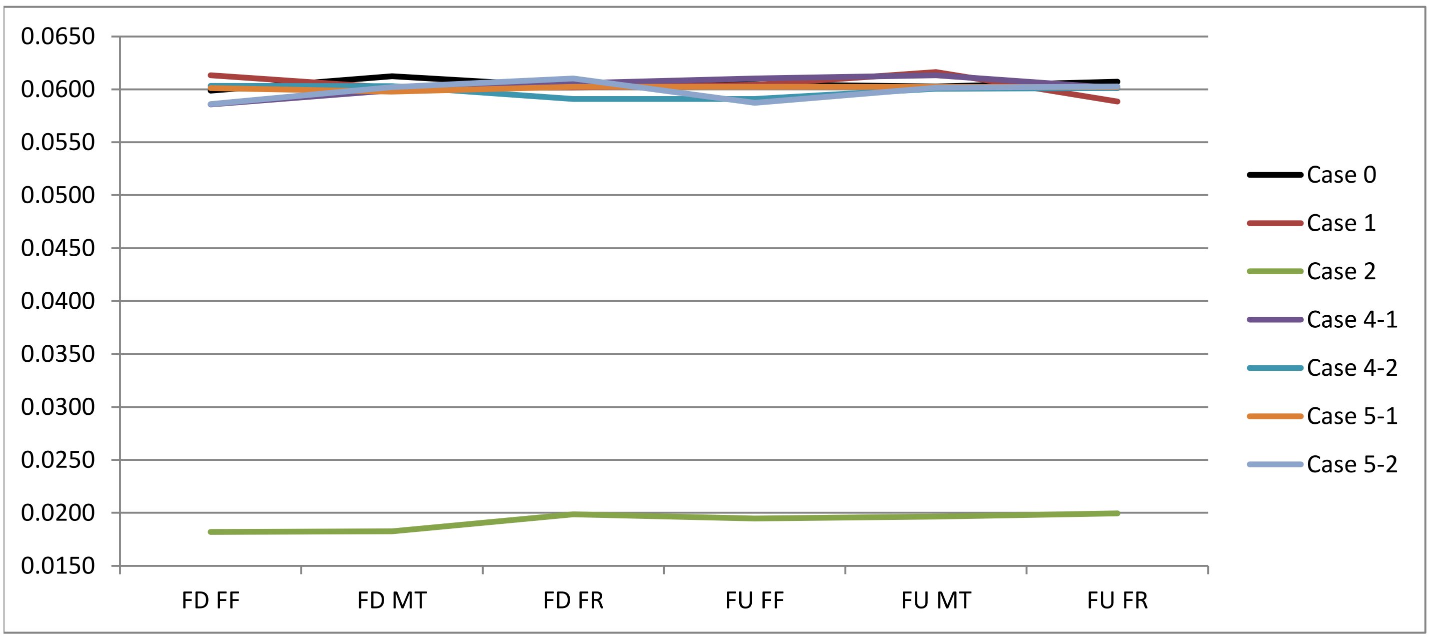
50th Male Passenger Side Pressure Switch

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	0.0605	0.0588	0.0200	0.0586	0.0607	0.0602	0.0603
FD MT	0.0589	0.0603	0.0197	0.0605	0.0607	0.0603	0.0607
FD FR	0.0599	0.0617	0.0203	0.0614	0.0588	0.0599	0.0604
FU FF	0.0604	0.0593	0.0196	0.0609	0.0607	0.0586	0.0596
FU MT	0.0603	0.0604	0.0200	0.0604	0.0586	0.0614	0.0602
FU FR	0.0613	0.0591	0.0205	0.0595	0.0601	0.0589	0.0604



95th Male Passenger Side Pressure Switch

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	0.0599	0.0613	0.0182	0.0586	0.0603	0.0601	0.0586
FD MT	0.0612	0.0601	0.0183	0.0599	0.0603	0.0598	0.0602
FD FR	0.0602	0.0602	0.0198	0.0606	0.0591	0.0602	0.0610
FU FF	0.0605	0.0604	0.0195	0.0610	0.0591	0.0602	0.0587
FU MT	0.0603	0.0616	0.0196	0.0613	0.0601	0.0602	0.0601
FU FR	0.0607	0.0588	0.0200	0.0601	0.0601	0.0602	0.0603



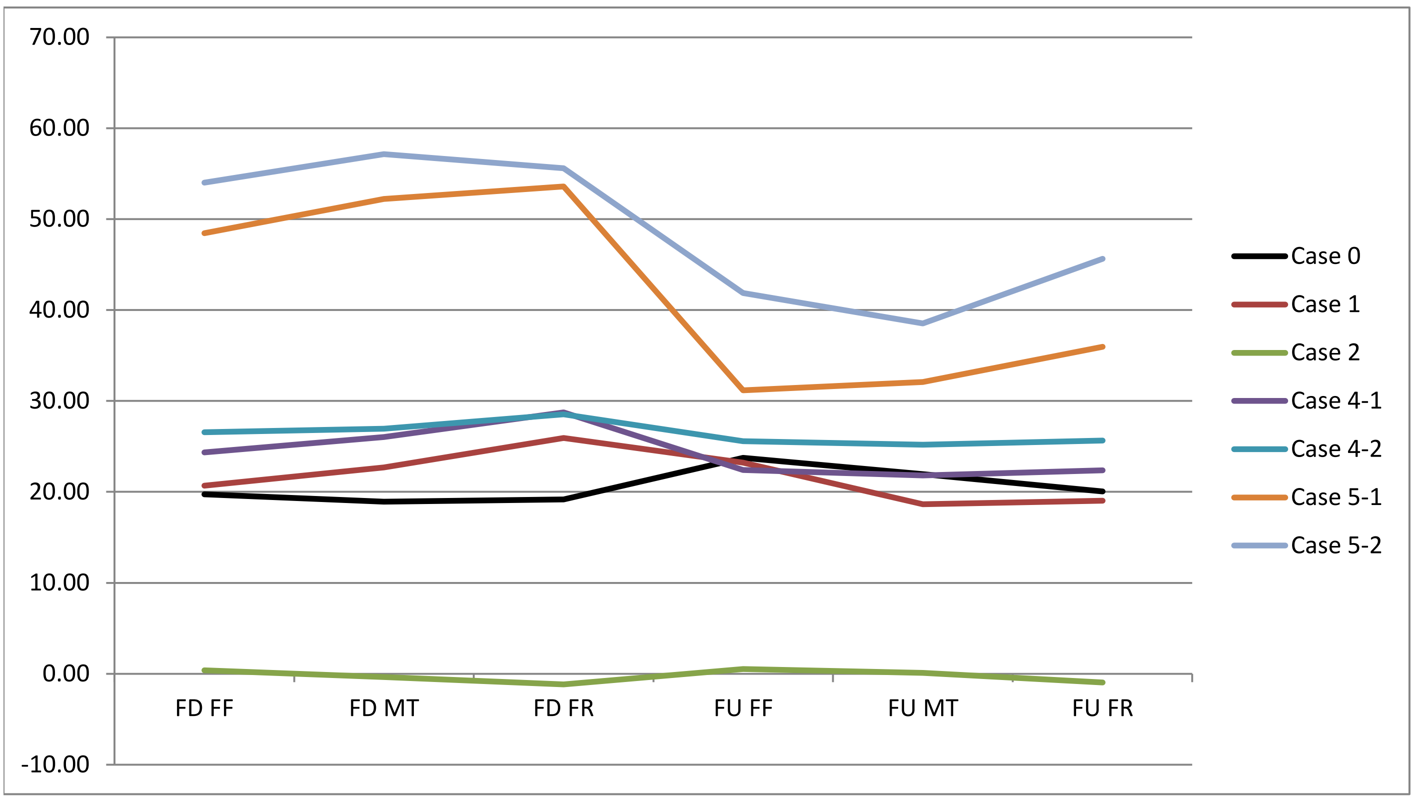
2.2.2.3 Belt Payout

Belt payout can detect misuse case 2 (unbuckled), 4-2 (lap belt buckled, shoulder belt under occupant's arm), 5-1 (lap belt bucked but shoulder belt behind the seat-occupant restrained by lap belt), and 5-2 (belt buckled behind the seat-no occupant restraint).

Belt Payout		
5th Female	**50th Male**	**95th Male**
2	2	2
4-2	4-2	4-2
5-1	5-1	5-1
5-2	5-2	5-2

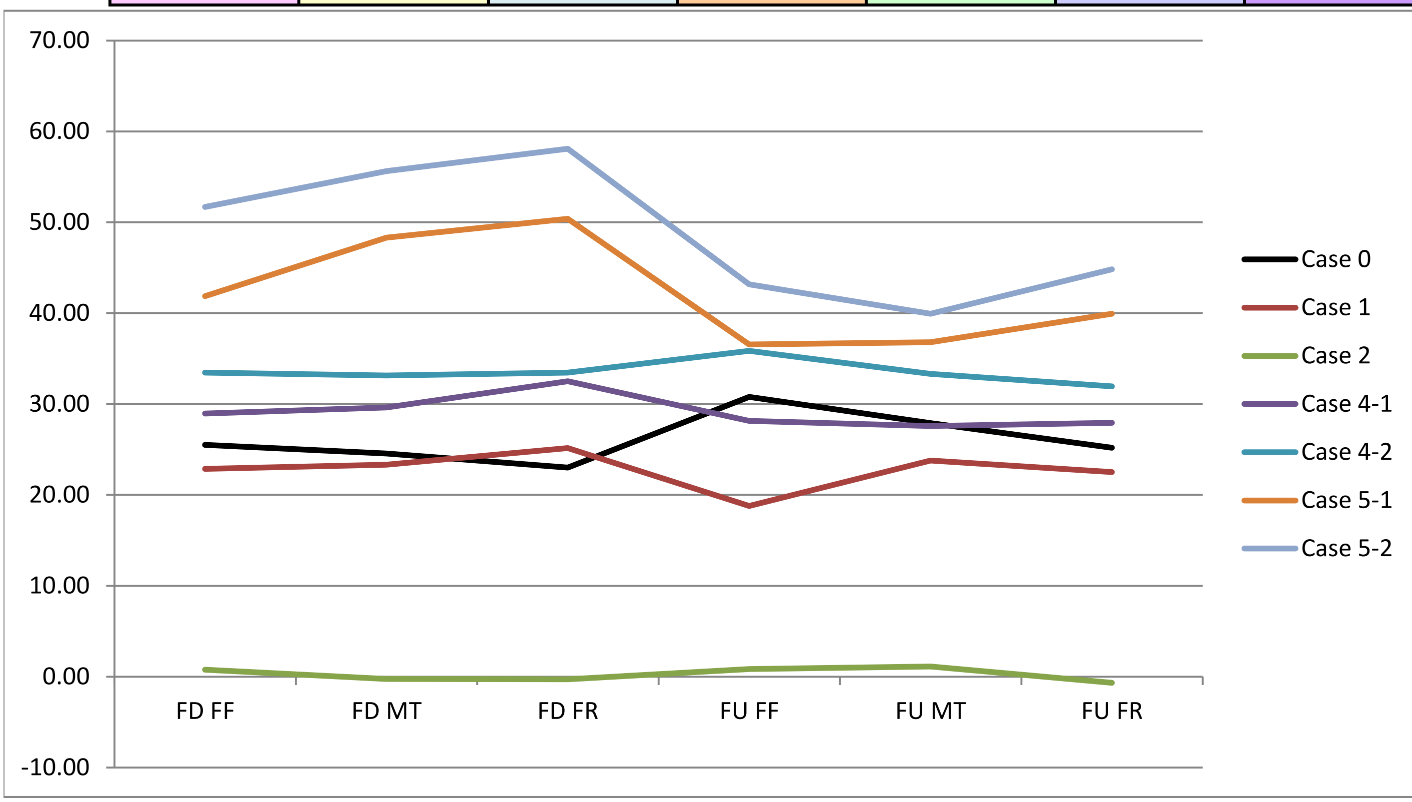
5th Female Passenger Side Belt Payout

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	19.73	20.68	0.36	24.36	26.56	48.44	54.00
FD MT	18.93	22.68	-0.38	26.02	26.95	52.22	57.16
FD FR	19.17	25.94	-1.16	28.74	28.51	53.58	55.58
FU FF	23.73	23.22	0.53	22.39	25.58	31.15	41.85
FU MT	21.93	18.66	0.10	21.82	25.20	32.07	38.52
FU FR	20.04	19.02	-0.97	22.37	25.64	35.96	45.63



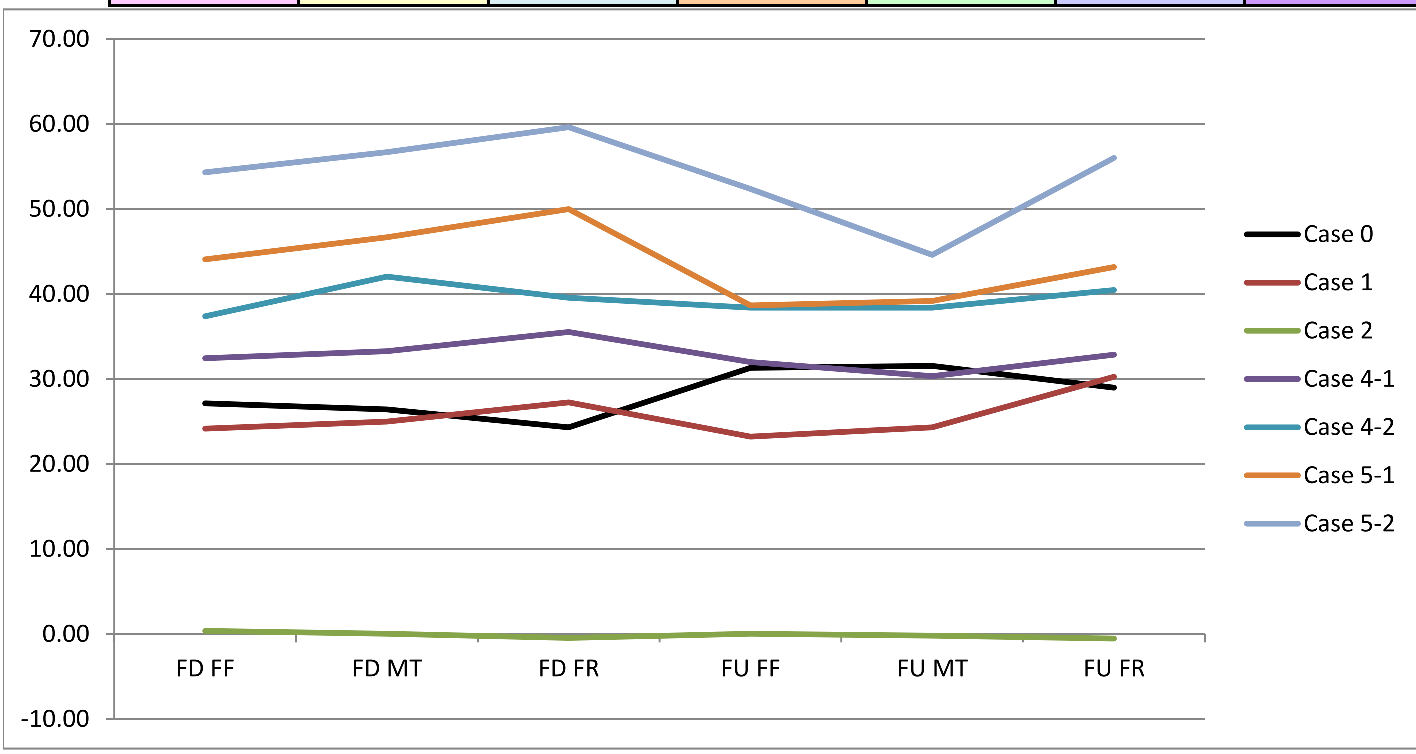
50th Male Passenger Side Belt Payout

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	25.50	22.87	0.78	28.96	33.46	41.87	51.70
FD MT	24.55	23.34	-0.24	29.60	33.16	48.31	55.62
FD FR	22.99	25.15	-0.30	32.49	33.46	50.39	58.08
FU FF	30.77	18.77	0.85	28.15	35.84	36.54	43.18
FU MT	27.91	23.79	1.11	27.58	33.32	36.78	39.92
FU FR	25.19	22.50	-0.67	27.92	31.95	39.91	44.81



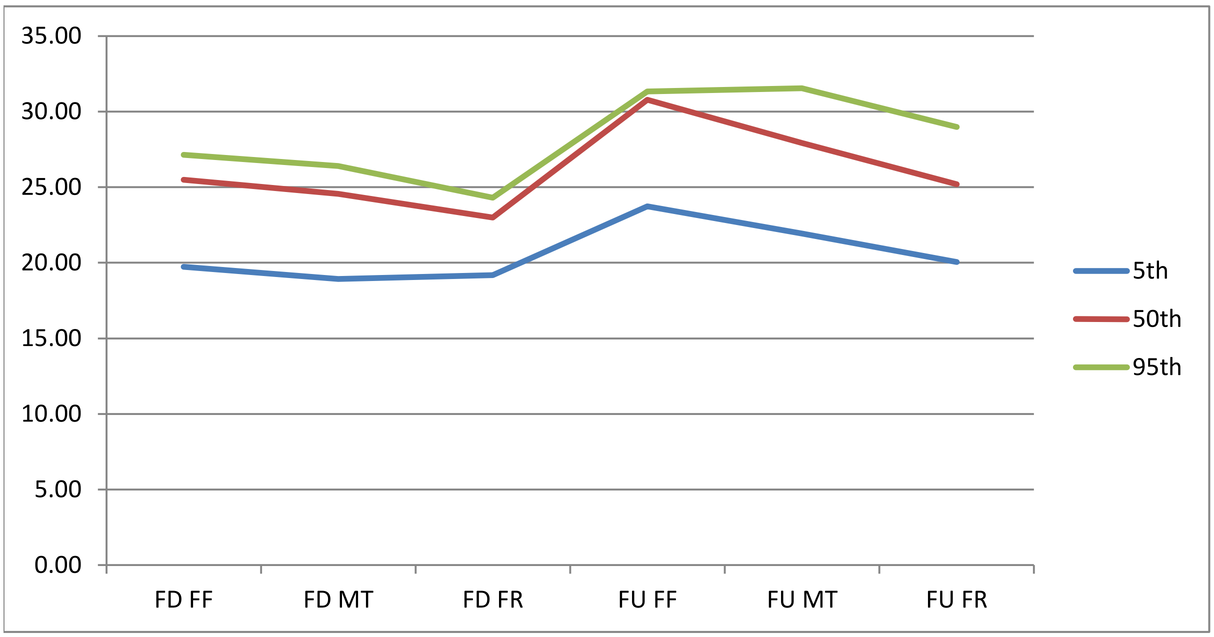
95th Male Passenger Side Belt Payout

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	27.14	24.15	0.35	32.46	37.36	44.10	54.32
FD MT	26.40	24.98	0.03	33.28	42.05	46.69	56.69
FD FR	24.29	27.24	-0.47	35.54	39.56	49.99	59.64
FU FF	31.32	23.23	0.04	31.99	38.40	38.66	52.38
FU MT	31.55	24.32	-0.18	30.33	38.38	39.18	44.61
FU FR	28.97	30.28	-0.54	32.84	40.48	43.16	56.03



All Properly Buckled (Case 0) Belt Payout Passenger Side

	PROPERLY BUCKLED 5th	PROPERLY BUCKLED 50th	PROPERLY BUCKLED 95th
FD FF	19.73	25.50	27.14
FD MT	18.93	24.55	26.40
FD FR	19.17	22.99	24.29
FU FF	23.73	30.77	31.32
FU MT	21.93	27.91	31.55
FU FR	20.04	25.19	28.97



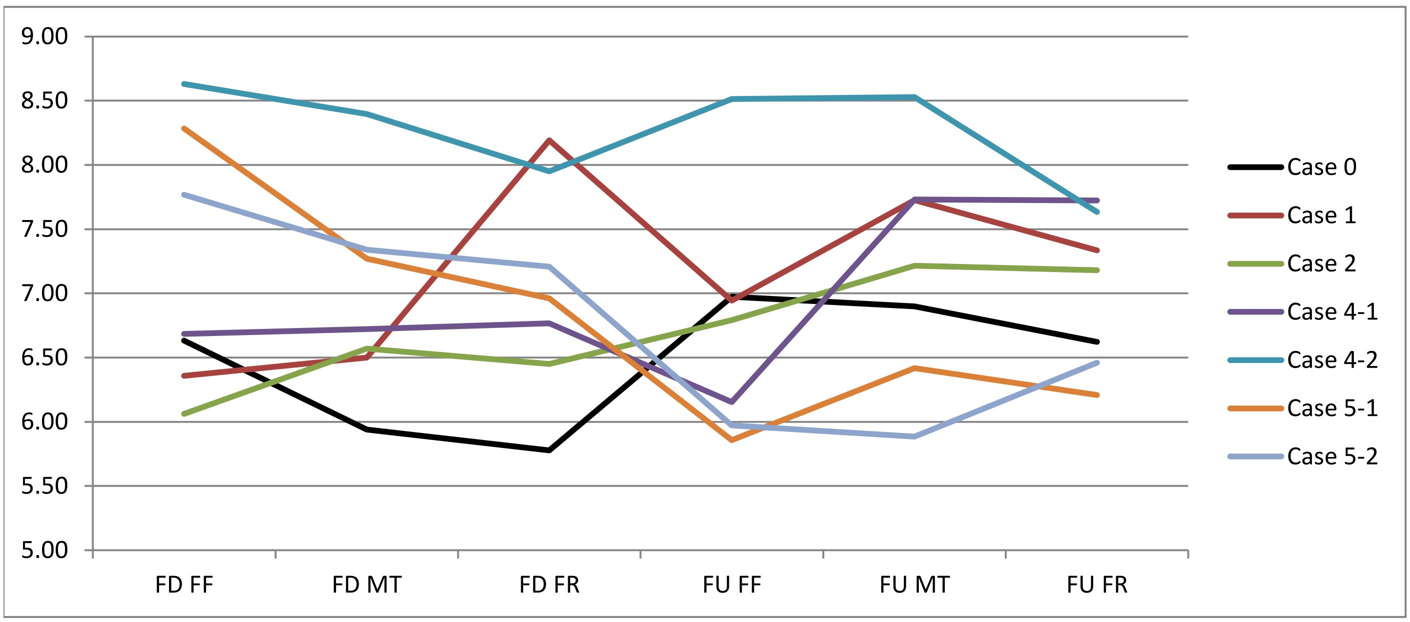
2.2.2.4 Belt Tension D-ring

Belt tension at the D-ring can detect misuse 4-2 (lap belt buckled, shoulder belt under occupant's arm), independent of seat track position and incline.

Belt Tension at D-ring		
5th Female	**50th Male**	**95th Male**
		2
4-2	4-2	4-2
		5-1

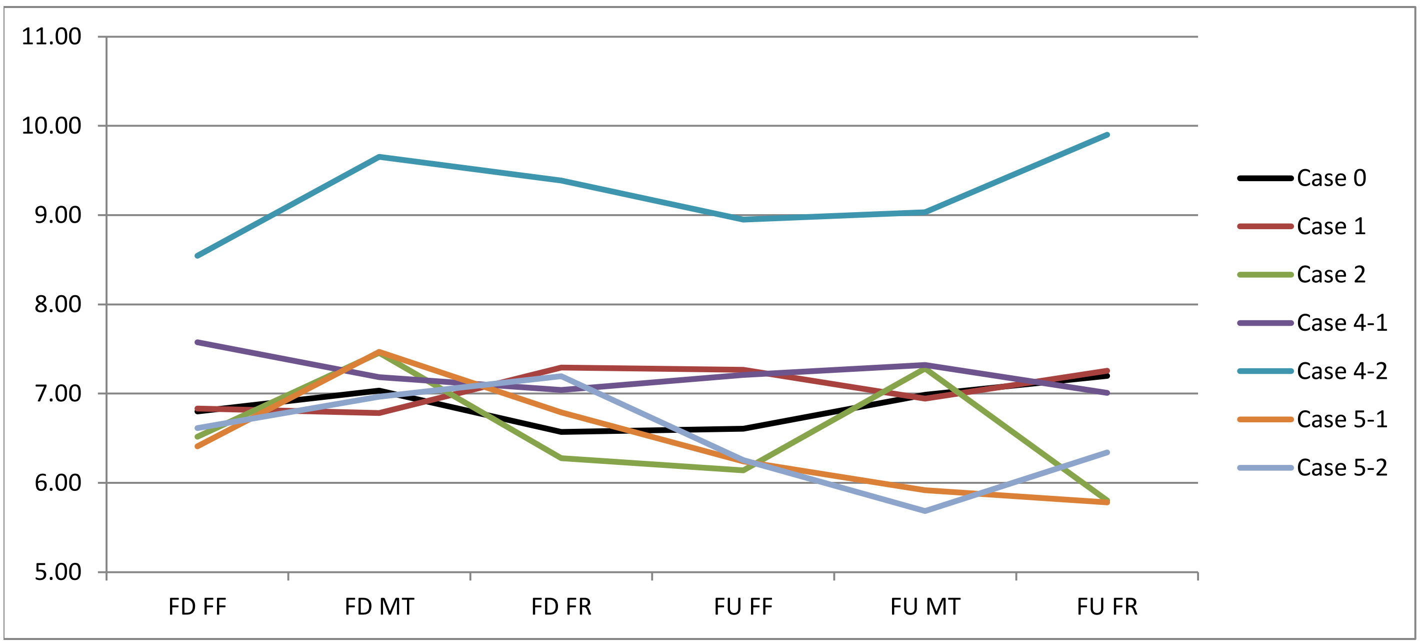
5th Female Passenger Side Belt Tension at D-ring

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	6.63	6.36	6.06	6.69	8.63	8.28	7.77
FD MT	5.94	6.50	6.57	6.72	8.40	7.27	7.34
FD FR	5.78	8.19	6.45	6.77	7.95	6.96	7.21
FU FF	6.97	6.94	6.79	6.15	8.51	5.86	5.97
FU MT	6.90	7.72	7.21	7.73	8.53	6.42	5.88
FU FR	6.62	7.34	7.18	7.72	7.63	6.21	6.46



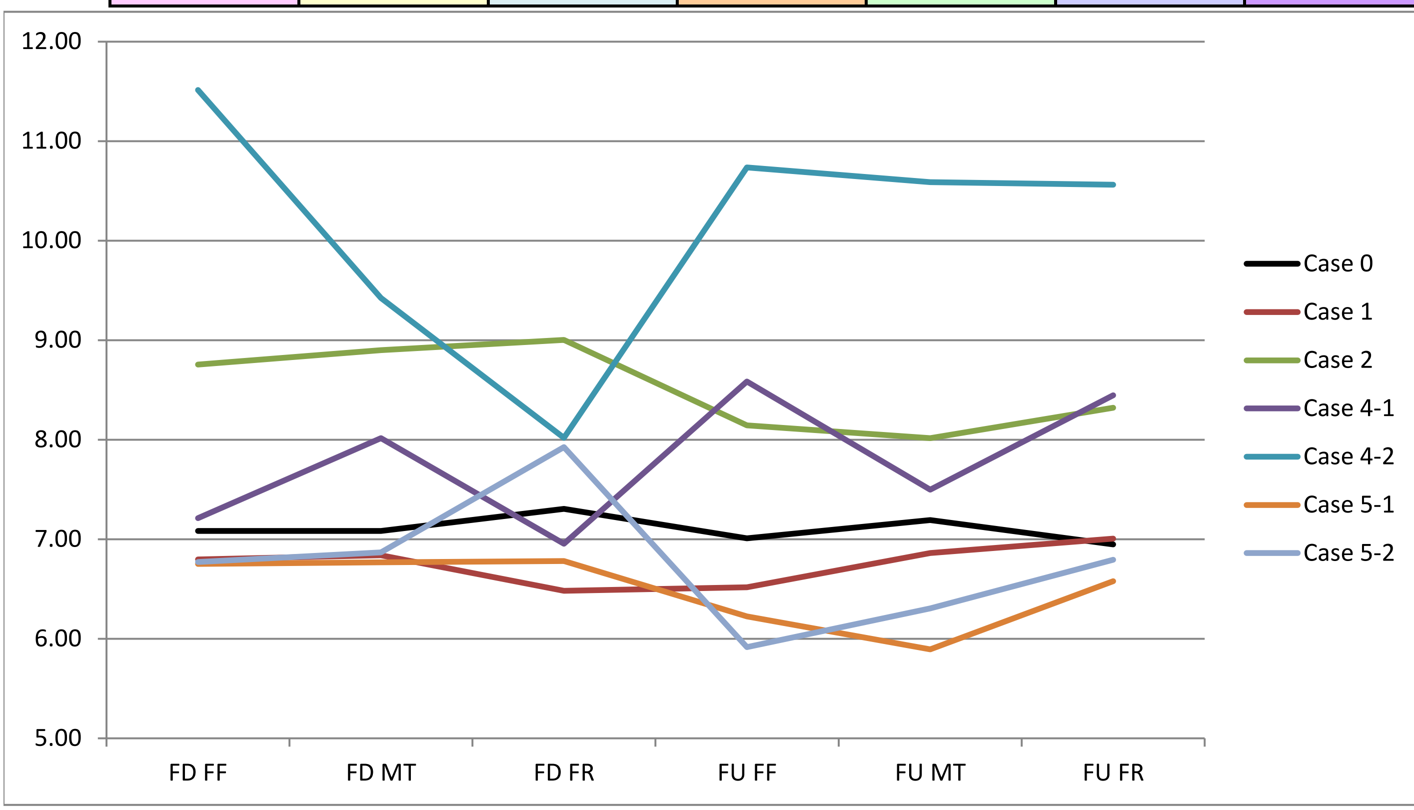
50th Male Passenger Side Belt Tension at D-ring

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	6.80	6.83	6.52	7.58	8.54	6.41	6.61
FD MT	7.03	6.78	7.46	7.18	9.65	7.47	6.96
FD FR	6.57	7.29	6.28	7.04	9.39	6.79	7.19
FU FF	6.61	7.27	6.14	7.21	8.95	6.24	6.26
FU MT	6.98	6.94	7.28	7.32	9.03	5.92	5.68
FU FR	7.20	7.25	5.80	7.01	9.90	5.78	6.34



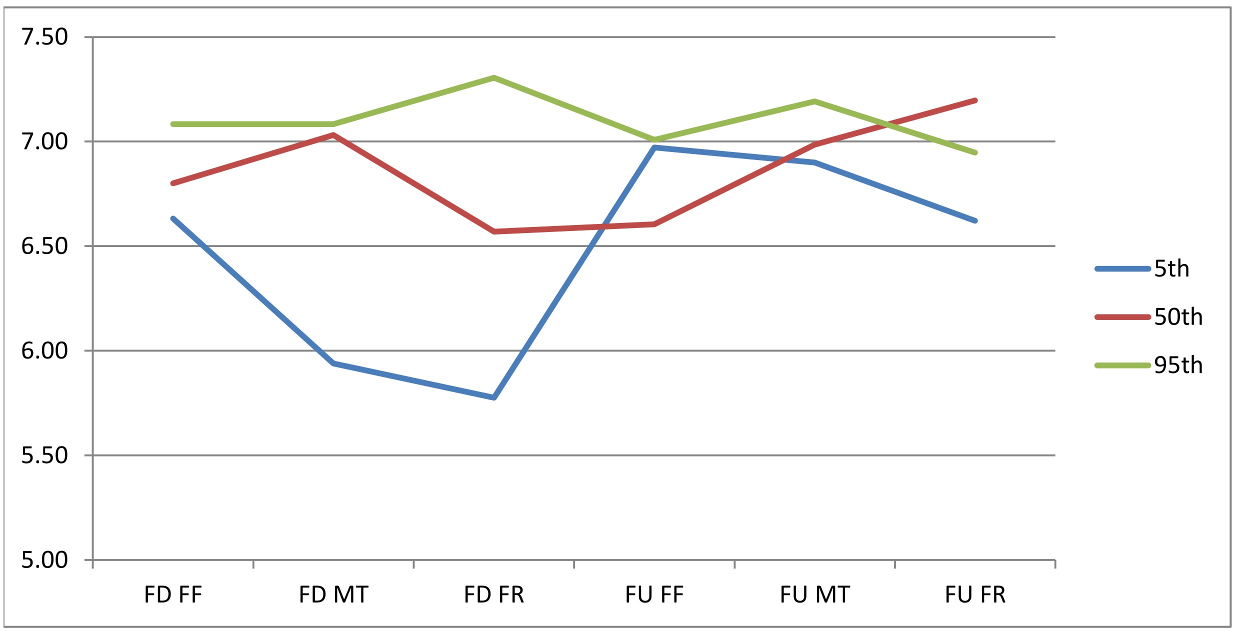
95th Male Passenger Side Belt Tension at D-ring

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	7.08	6.80	8.75	7.21	11.51	6.75	6.77
FD MT	7.08	6.84	8.90	8.02	9.42	6.77	6.87
FD FR	7.30	6.48	9.00	6.95	8.02	6.78	7.93
FU FF	7.01	6.52	8.14	8.58	10.73	6.22	5.91
FU MT	7.19	6.86	8.02	7.50	10.59	5.89	6.31
FU FR	6.95	7.01	8.32	8.45	10.56	6.58	6.79



All Properly Buckled Passenger Side (Case 0) Belt Tension at D-ring

	PROPERLY BUCKLED 5th	PROPERLY BUCKLED 50th	PROPERLY BUCKLED 95th
FD FF	6.63	6.80	7.08
FD MT	5.94	7.03	7.08
FD FR	5.78	6.57	7.30
FU FF	6.97	6.61	7.01
FU MT	6.90	6.98	7.19
FU FR	6.62	7.20	6.95



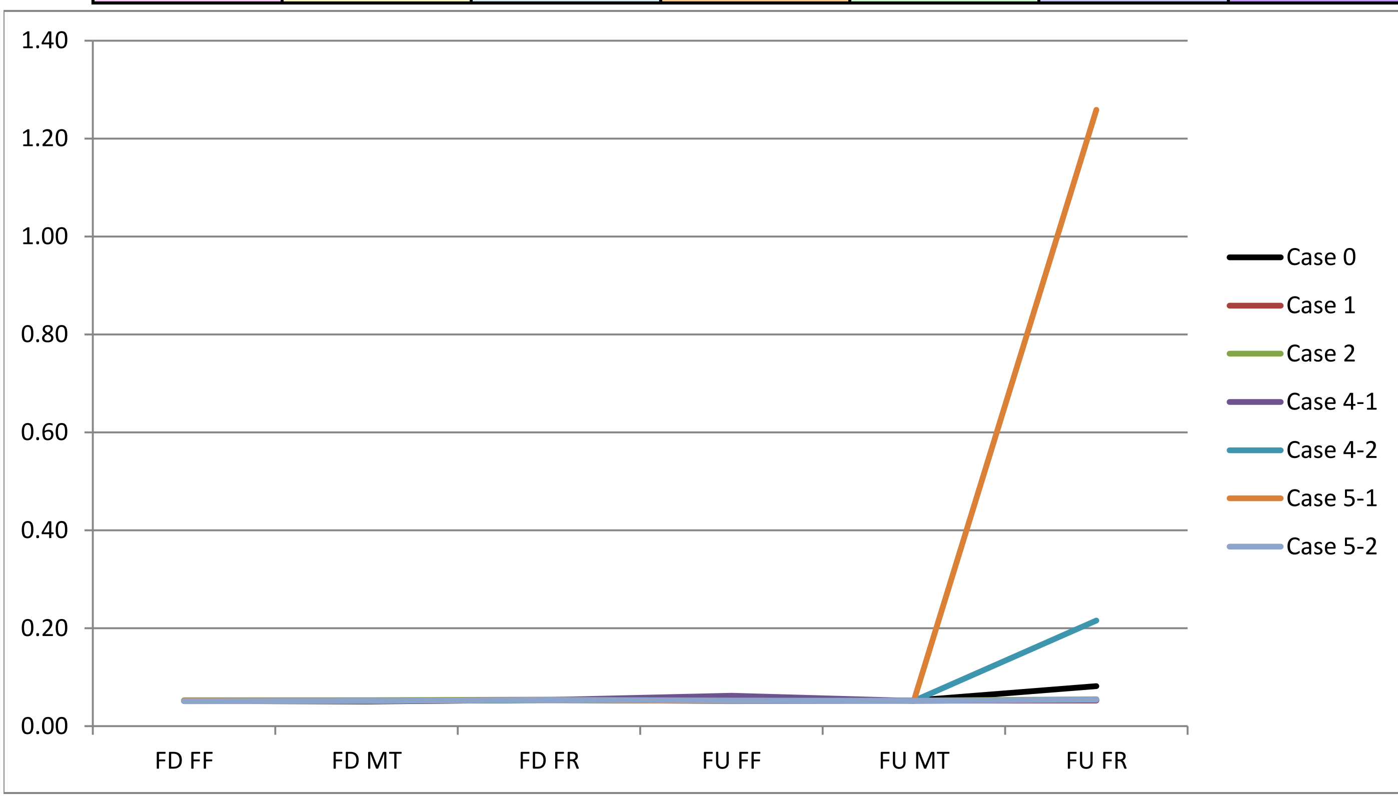
2.2.2.5 Belt Tension Anchor

Belt tension at the anchor was not able to accurately detect any of the misuses.

Belt Tension at Anchor		
5th Female	**50th Male**	**95th Male**
None	None	None

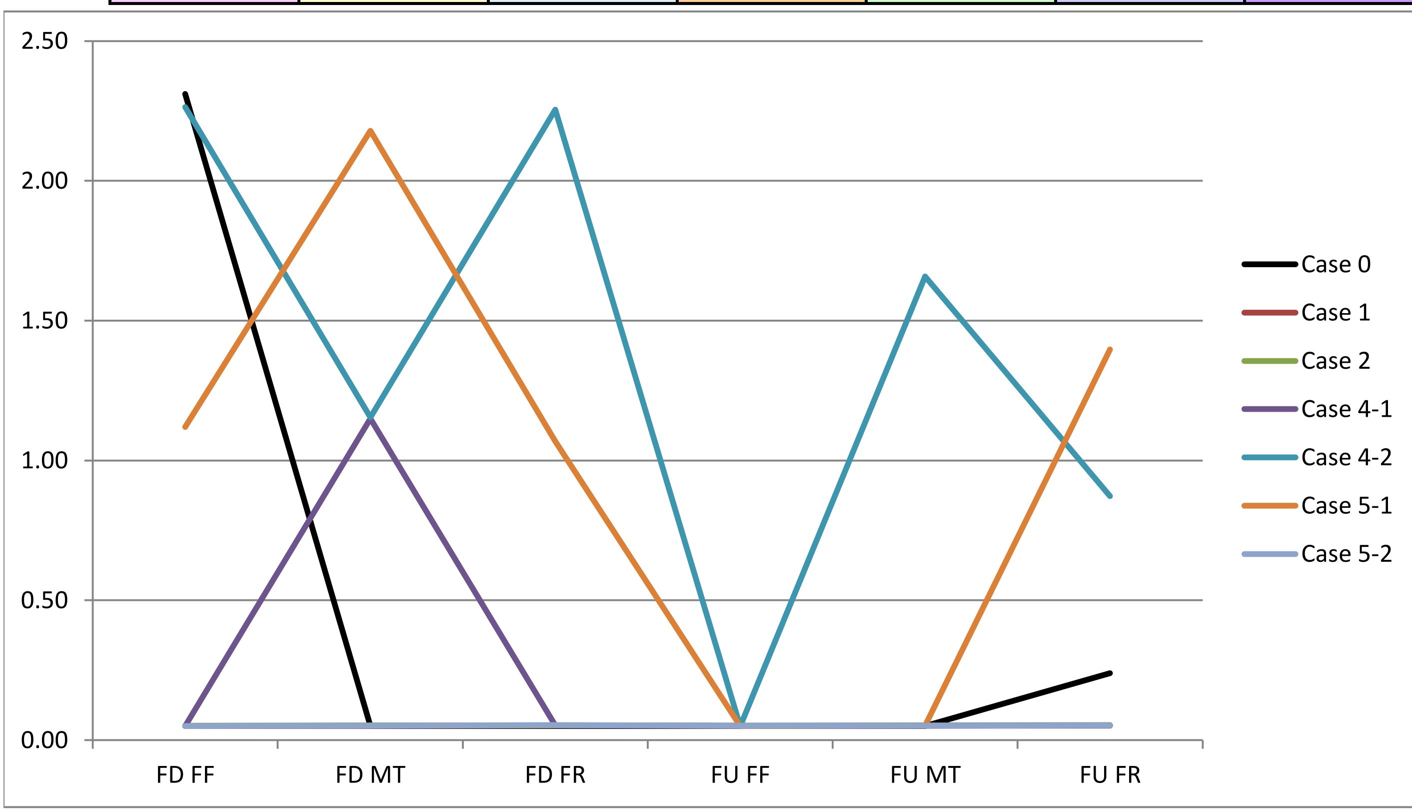
5th Female Passenger Side Belt Tension at Anchor

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	0.05	0.05	0.05	0.05	0.05	0.05	0.05
FD MT	0.05	0.05	0.05	0.05	0.05	0.05	0.05
FD FR	0.05	0.05	0.05	0.05	0.05	0.05	0.05
FU FF	0.05	0.05	0.05	0.06	0.05	0.05	0.05
FU MT	0.05	0.05	0.05	0.05	0.05	0.05	0.05
FU FR	0.08	0.05	0.06	0.05	0.22	1.26	0.05



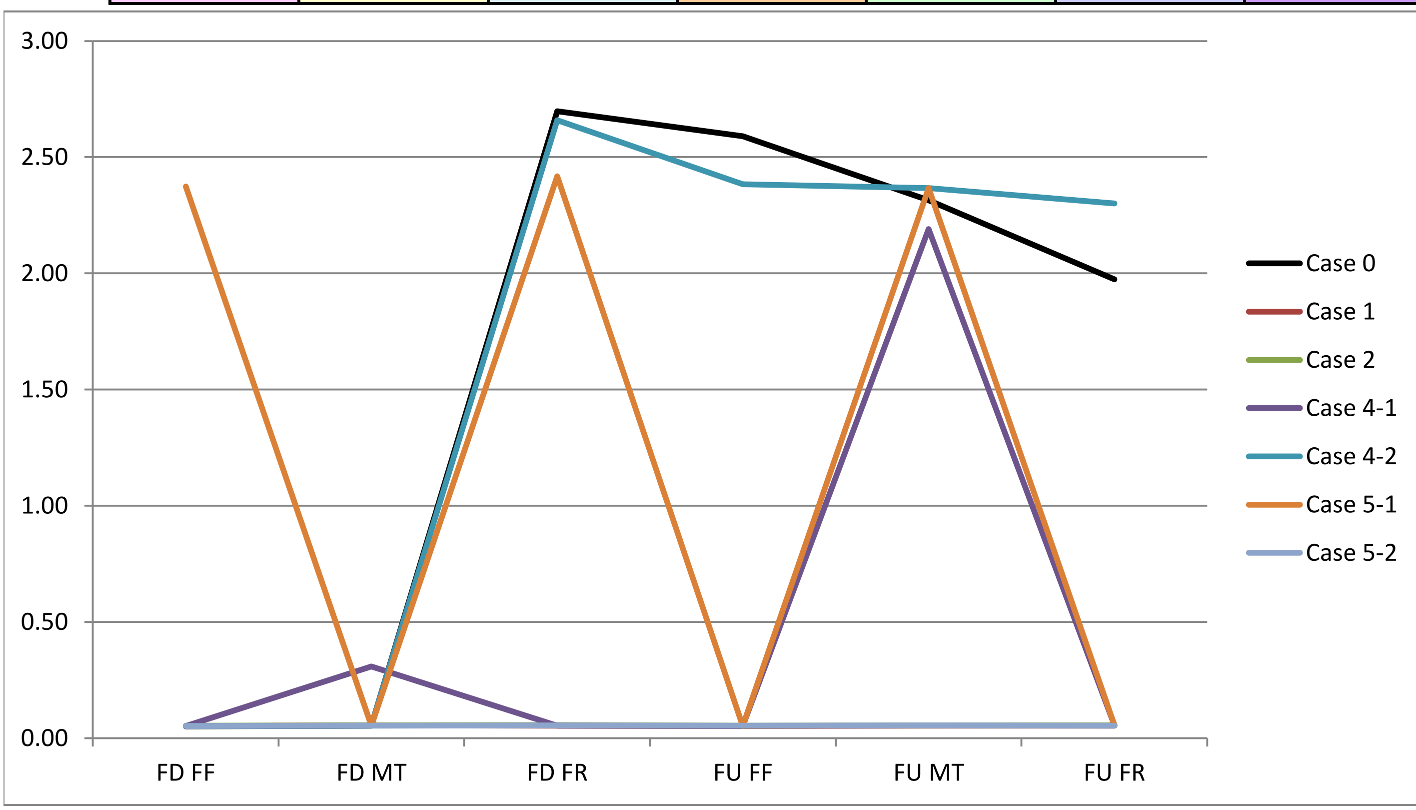
50th Male Passenger Side Belt Tension at Anchor

	PROPERLY BUCKLED	Sitting on Buckled Belt	Unbuckled	Lap belt buckled; shoulder belt behind back	Lap belt buckled; shoulder belt under arm	Lap belt buckled; shoulder belt behind seat	Belt buckeld behind seat; occupant not restrained.
	Case 0	Case 1	Case 2	Case 4-1	Case 4-2	Case 5-1	Case 5-2
FD FF	2.31	0.05	0.05	0.05	2.26	1.12	0.05
FD MT	0.05	0.05	0.05	1.15	1.15	2.18	0.05
FD FR	0.05	0.05	0.05	0.05	2.25	1.07	0.05
FU FF	0.05	0.05	0.05	0.05	0.05	0.05	0.05
FU MT	0.05	0.05	0.05	0.05	1.66	0.05	0.05
FU FR	0.24	0.05	0.05	0.05	0.87	1.40	0.05



95th Male Passenger Side Belt Tension at Anchor

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	0.05	0.05	0.05	0.05	0.05	2.37	0.05
FD MT	0.05	0.05	0.05	0.31	0.05	0.05	0.05
FD FR	2.70	0.05	0.06	0.05	2.66	2.42	0.05
FU FF	2.59	0.05	0.05	0.05	2.38	0.05	0.05
FU MT	2.31	0.05	0.05	2.19	2.37	2.37	0.05
FU FR	1.97	0.05	0.05	0.05	2.30	0.05	0.05



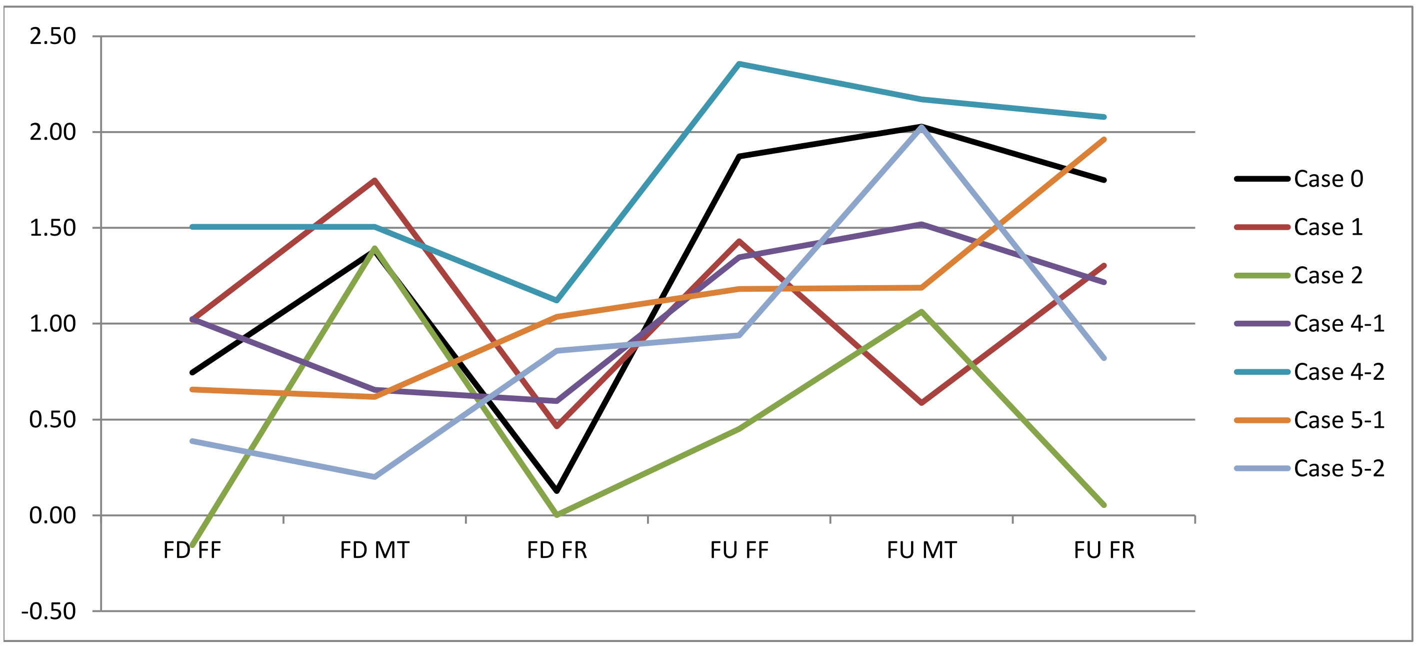
2.2.2.6 Belt Tension Buckle

The belt tension sensor at the buckle is not able to detect any misuses, consistently, over the occupant types.

Belt Tension at Buckle		
5th Female	**50th Male**	**95th Male**
None	None	1
		2
		4-2
		5-1
		5-2

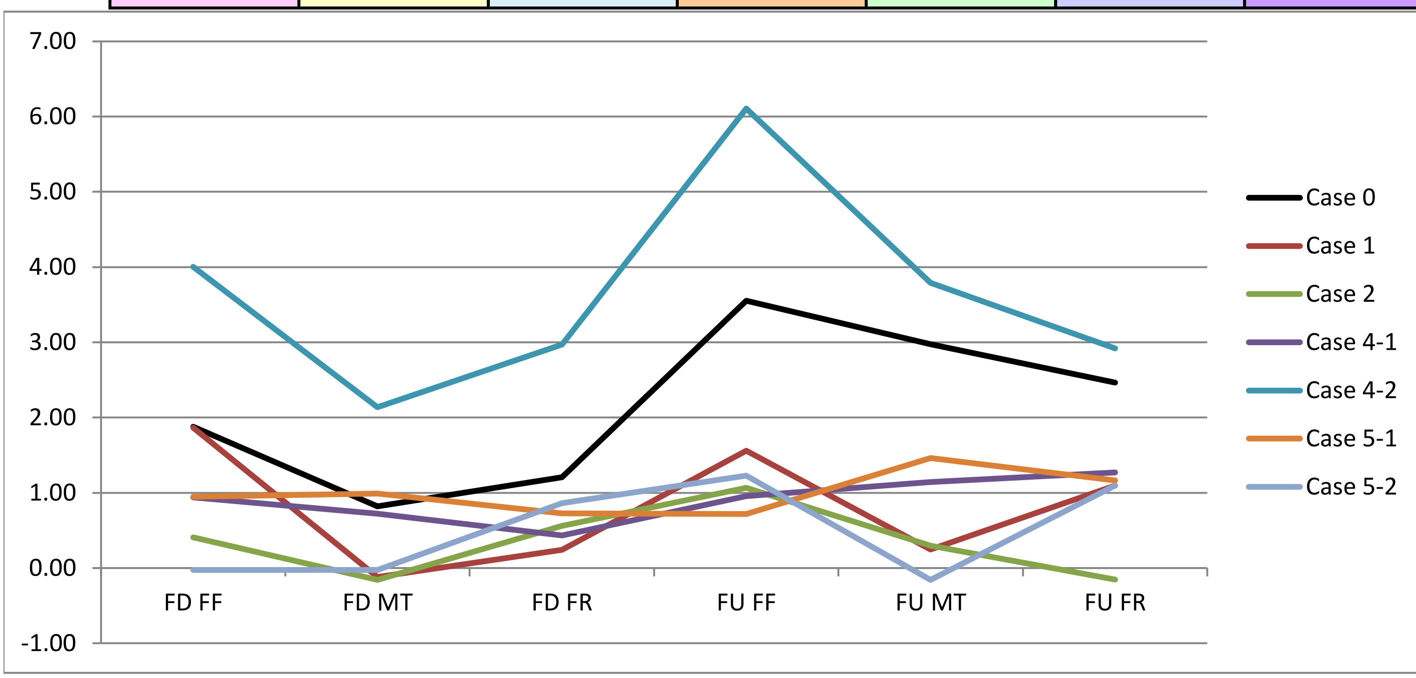
5th Female Passenger Side Belt Tension at Buckle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	0.75	1.02	-0.16	1.02	1.51	0.66	0.39
FD MT	1.38	1.75	1.39	0.66	1.50	0.62	0.20
FD FR	0.13	0.46	0.00	0.60	1.12	1.04	0.86
FU FF	1.87	1.43	0.45	1.35	2.36	1.18	0.94
FU MT	2.03	0.59	1.06	1.52	2.17	1.19	2.02
FU FR	1.75	1.30	0.05	1.22	2.08	1.96	0.82



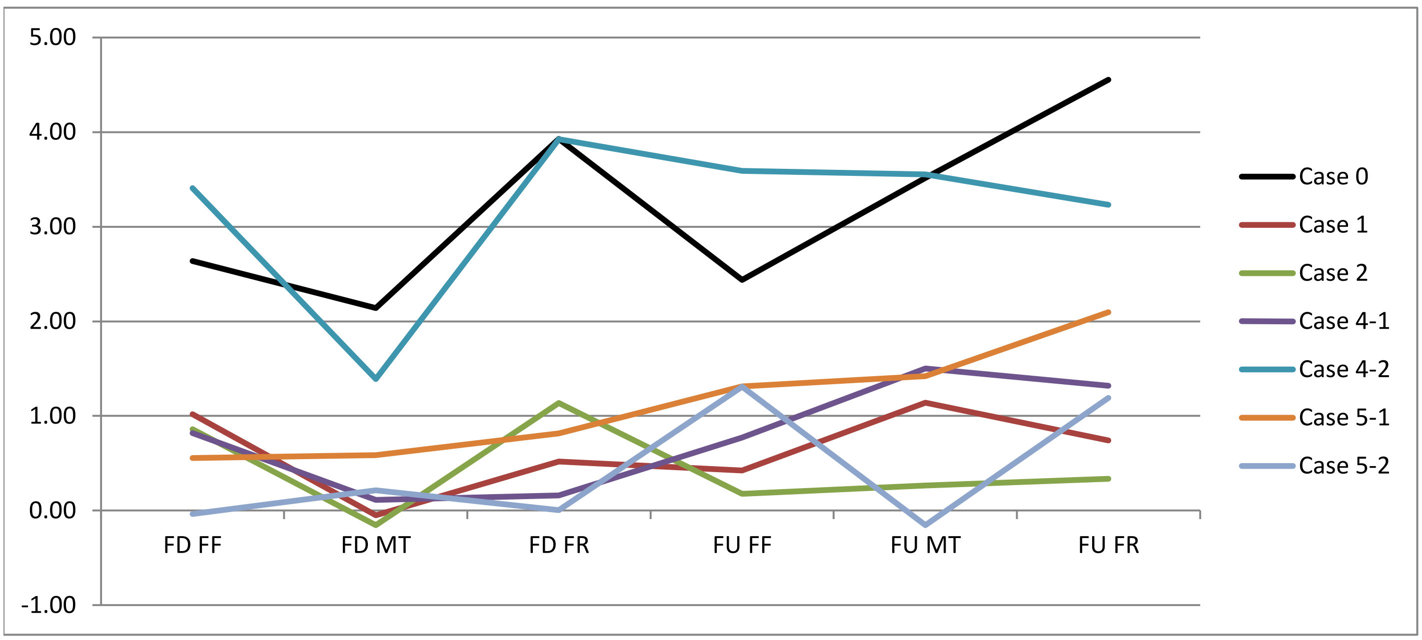
50th Male Passenger Side Belt Tension at Buckle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	1.88	1.87	0.41	0.94	4.00	0.95	-0.03
FD MT	0.82	-0.12	-0.16	0.72	2.14	0.99	-0.02
FD FR	1.20	0.24	0.56	0.43	2.97	0.73	0.86
FU FF	3.55	1.56	1.06	0.96	6.11	0.72	1.23
FU MT	2.97	0.24	0.30	1.14	3.79	1.46	-0.16
FU FR	2.46	1.10	-0.16	1.27	2.92	1.16	1.09



95th Male Passenger Side Belt Tension at Buckle

	PROPERLY BUCKLED Case 0	Sitting on Buckled Belt Case 1	Unbuckled Case 2	Lap belt buckled; shoulder belt behind back Case 4-1	Lap belt buckled; shoulder belt under arm Case 4-2	Lap belt buckled; shoulder belt behind seat Case 5-1	Belt buckeld behind seat; occupant not restrained. Case 5-2
FD FF	2.64	1.02	0.86	0.82	3.41	0.56	-0.03
FD MT	2.14	-0.05	-0.15	0.11	1.39	0.59	0.21
FD FR	3.93	0.52	1.14	0.16	3.92	0.82	0.00
FU FF	2.44	0.42	0.18	0.77	3.59	1.31	1.31
FU MT	3.52	1.14	0.26	1.50	3.55	1.42	-0.15
FU FR	4.55	0.74	0.34	1.32	3.23	2.10	1.19



2.3 Conclusions (Both Driver and Passenger Sides)

2.3.1 SENSORS TO INCLUDE

2.3.1.1 D-ring Angle

This is a vital sensor and is able to detect all misuse conditions, knowing the seat track position and seat incline angle.

2.3.2 SENSORS TO REMOVE

2.3.2.1 Pressure Switch

This sensor is only able to detect an unbuckled situation which we are already able to detect "smartly" with the RFID tag in the buckle.

2.3.2.2 Belt Tension at the Buckle

This sensor is not able to detect any misuses over the occupant range.

2.3.3 SENSORS THAT MAY BE USEFUL FOR REDUNDANCY

2.3.3.1 Belt Payout

This sensor is useful in detecting misuse case 1 (sitting on a buckled belt) on the driver's side any multiple misuses on the passenger side. On the passenger side, belt payout can detect misuse 2 (unbuckled), 4-2 (lap belt buckled, shoulder belt under occupant's arm), 5-1 (lap buckled and shoulder behind the seat) and 5-2 (belt buckled behind the seat-no occupant restraint).

2.3.3.2 Belt Tension at the D-ring

Belt tension at the D-ring can detect misuse 4-2 (lap belt buckled, shoulder belt under occupant's arm).

2.3.3.3 Belt Tension at the Anchor

Belt tension at the anchor can detect misuse case 5-2 (belt buckled behind the seat-no occupant restraint),

Appendix E – Camera Report

Preventing Seat Belt Interlock Misuse

Preventing Seat Belt Interlock Misuse

Camera Investigation Report: December 1, 2016

DTNH2214D0032L/0002

Contents

1 Introduction and Summary

The NCMS/ Survivability Solutions team has been working on a Seat Belt Interlock (SBI) project that is being sponsored by NHTSA. The objective of the project is to prove out the viability of a system that determines whether a vehicle's driver and front seat passenger are wearing their seat belt properly. Based on this information, the Interlock system is enabled as required.

The Interlock will use a series of sensors that measure the vehicle front seat occupant's use of the seat belt and determine if it is being worn and being worn properly. If the belts are used properly, the system will allow for the vehicle to be driven. If the belts are not worn properly, there will be a series of indicators which will prevent the regular use of the vehicle. These interlocks will range from transmission interlocks to visual and audible warnings.

The successful implementation of an interlock system will allow for eliminating the unbelted test from the vehicle certification test matrix, which can reduce the power that the airbag needs to restrain the occupant. This reduction in power can reduce the injury potential of the airbag as well as the cost of the airbag.

1.1 General Camera Information

One of the sensors that had been proposed for the measurement of the vehicle front seat occupant's use of the seat belt is a camera. Cameras offer advantages in sensing situations like seat belt usage, because an image can show a number of different details about the usage situation. Once the image is acquired, image analysis software must algorithmically determine the situation and determine the correct or incorrect belt usage scenario. However, there are also many drawbacks that could make this sensing situation difficult. This includes low light conditions as well as similar belt/clothing situations.

It should be noted, that in selecting a camera as a viable detection method, the drawbacks of camera use, in low light conditions, had not been considered.

1.2 Report Objective

The objective of this report is to review some of the challenges of utilizing cameras in a vehicle, for the seat belt interlock system objective, and determine whether it would be viable to integrate this sensor into the interlock system.

2 Identified uses for cameras relative to seatbelt interlock.

There are several attributes of proper belt usage that can be potentially determined with a camera.

2.1 Lap and shoulder belt routing.

- Sensing the lap belt in the proper position.
- Sensing the shoulder belt in the proper position.

2.2 Belt routing through the D-ring.

- Sensing the belt routing through the D-ring.

3 Camera Challenges

3.1 Image Capture / View

3.1.1 Low ambient light conditions for any vehicle camera application.

- Cameras and processing algorithms will have general issue in this application with the differentiation of colors between clothes and seat belt material colors.
- Cameras have issues with low light performance. The differentiation of the belt from colors of clothes becomes even more difficult.
- The night vision systems are larger and more expensive.

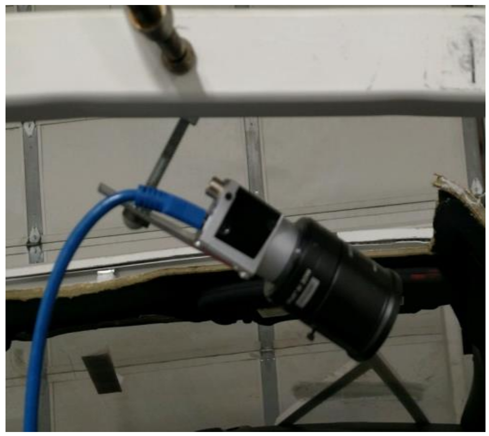
3.1.2 Belt Routing Concerns

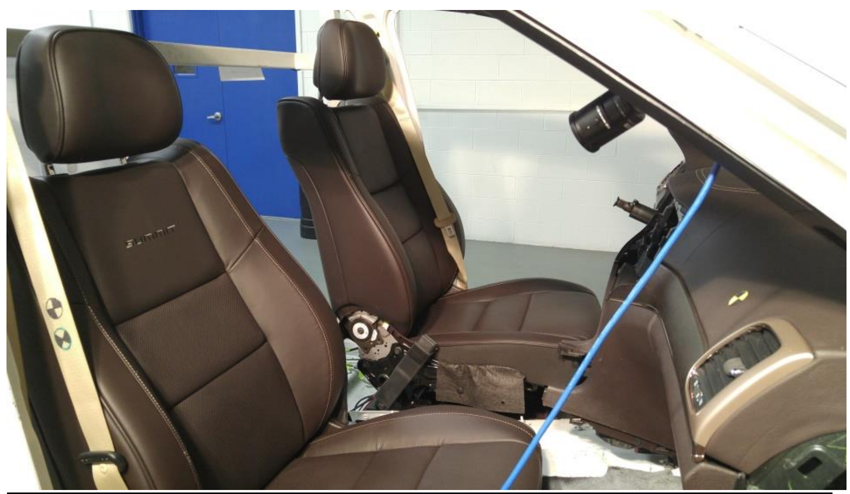
3.1.2.1 Camera View can easily be blocked.

- Many everyday items used in the car like pillows, blankets, etc., can block the camera.
- This requires the system designer and the vehicle designer to package the cameras in a location to minimize the potential for blocking
- Due to the fact that the lap belt may be flat when being worn, detecting proper usage would be very difficult if not impossible.
- Additionally clothing that is worn can cover the belt and block the view of the camera

3.1.2.2 Implementation Concerns

- Cameras are large and difficult to package – the picture below is a picture of the camera that was used to take the data shown in this report. This is an industrial camera is larger than most cameras but there is still space required for the camera and the associated wiring that needs to be packaged. There is limited space in the passenger compartment of a vehicle, especially in the headliner or A pillars.
- Camera wiring must avoid high power connectors to minimize noise on the power cables.





3.1.3 <u>D-ring Concerns</u>

- The camera data is one dimensional. The belt routing from the D-ring moves in two dimensions.
- It would be ideal to have a camera image from the front and from the top for algorithm analysis however, two camera views would be expensive and the top camera would be difficult to package.
- Hidden D-rings make this impossible to measure. These are becoming very popular in most vehicles.

3.2 Sensing Capability / Potential Use

3.2.1 <u>Overcoming Low Light</u>

- Infrared LED illuminators can be used with the cameras to provide night vision but these LEDs can cause potential eye damage, so they have to be on for a very short time.

3.2.2 <u>Belt Routing</u>

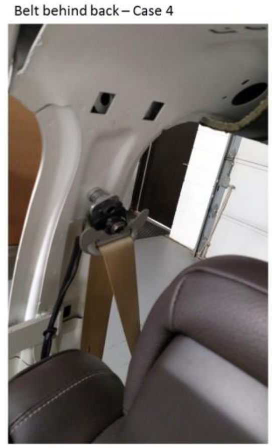
- As shown in the images collected, the addition of targets, permanently located on the belt webbing, may help in detecting proper use.

3.2.3 <u>D-ring</u>

- The camera can be aimed at the D-ring to determine this usage.
- The front view and the top view both provide valuable information.
- It has been determined that measuring the D-ring angle is also very good indicator of belt routing and can be used to determine proper belt usage as opposed to multiple cameras aimed at the D-ring.

Belt worn properly – Case 0

Belt behind back – Case 4

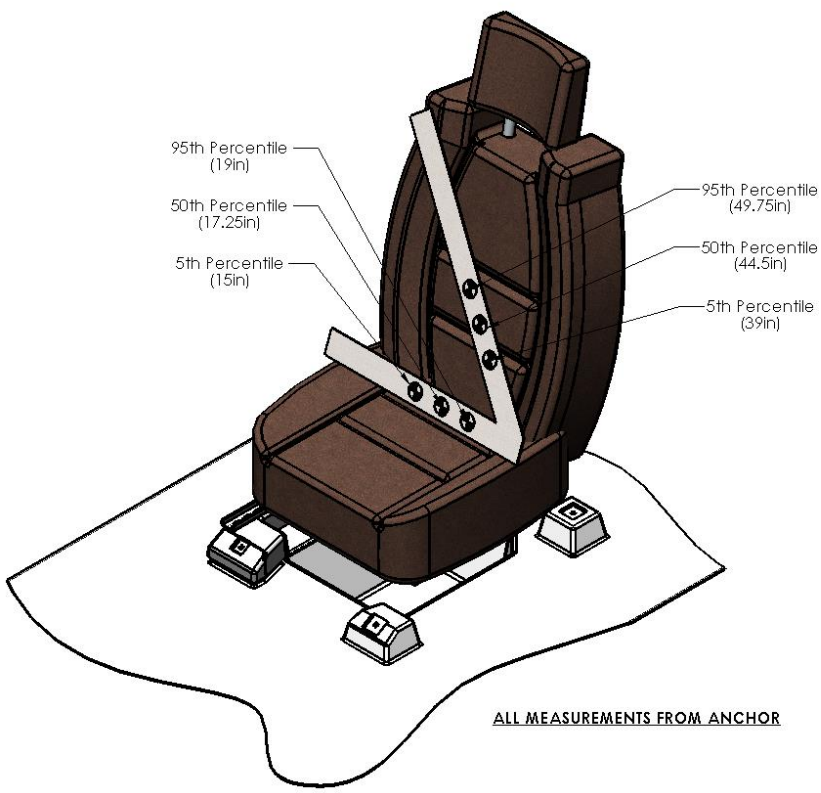


4 Data Collection

4.1 Belt Routing

The images that follow represent the data collected, on the passenger side of the vehicle, for belt routing, of the three identified occupant types (5th female, 50th male and 95th male) over varying seat track and seat incline positions for proper use as well as multiple misuses.

To add a visual aid, to the data collection, two targets were placed on the belt for each passenger type. The locations of the targets were determined by locating them at the center of the occupant, on both the shoulder and lap belts, when the occupant was in a, subjectively, comfortable positon. The target locations, for each occupant type is shown on the drawing below. The measurements of the target locations were taken from the anchor.

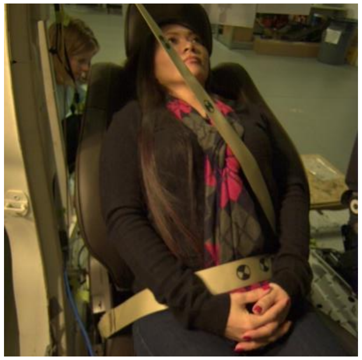


Camera Images – Belt Routing View

Passenger Side
5th Female

FD FF
Seat Incline: 42.5^{o}
Seat Track: 0”

M0 Properly buckled.



M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

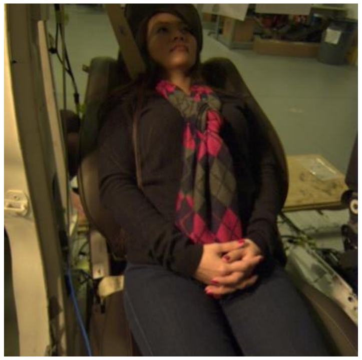
Camera Images – Belt Routing View

Passenger Side
5th Female

FD MT
Seat Incline: 42.5^o
Seat Track: 4 5/8"

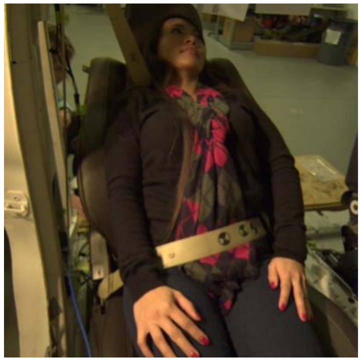
M0 Properly buckled.

M1 Sitting on buckled belt.



M2 Leaving belt unbuckled.

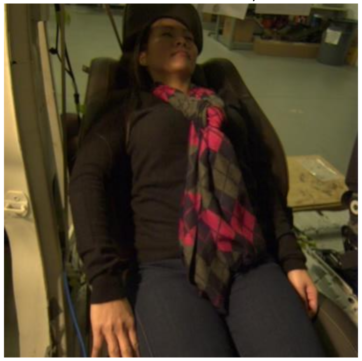
M4-1 Lap buckled, shoulder belt behind back.



M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.



Camera Images – Belt Routing View

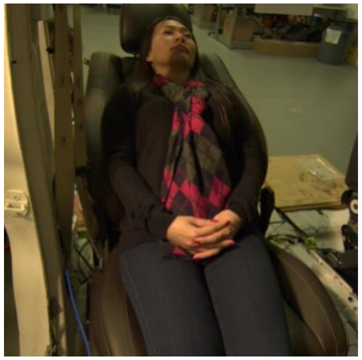
Passenger Side
5th Female

FD FR
Seat Incline: 42.5^{o}
Seat Track: 9 ¼"

M0 Properly buckled.

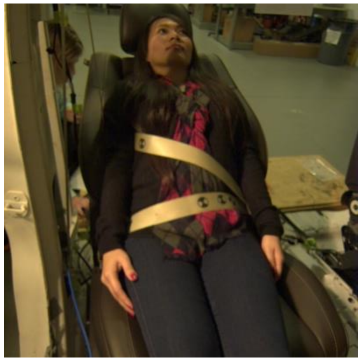
M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.



M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

Camera Images – Belt Routing View

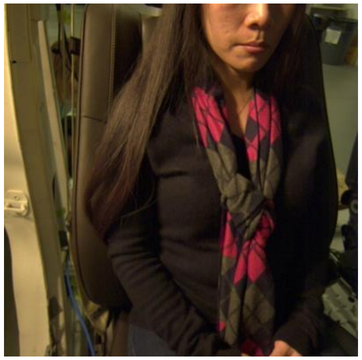
Passenger Side
5th Female

FU FF
Seat Incline: 80^o
Seat Track: 0"

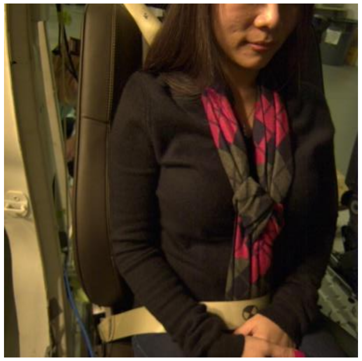
M0 Properly buckled.

M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.



M4-1 Lap buckled, shoulder belt behind back.



M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

Camera Images – Belt Routing View

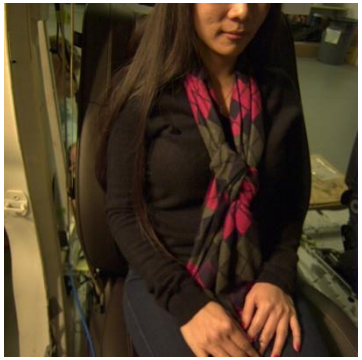
Passenger Side
5th Female

FU MT
Seat Incline: 80°
Seat Track: 4 5/8”

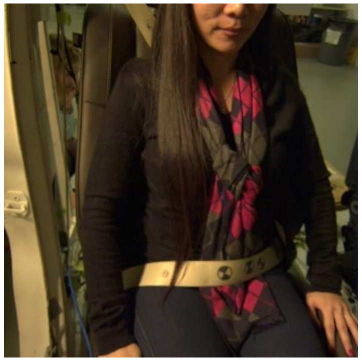
M0 Properly buckled.

M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.



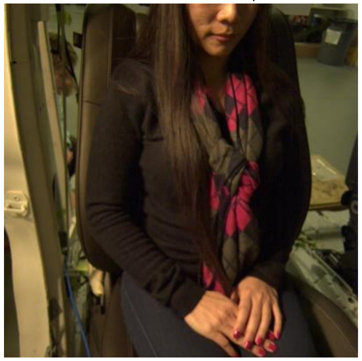
M4-1 Lap buckled, shoulder belt behind back.



M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

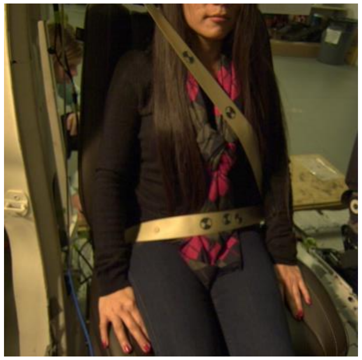


Camera Images – Belt Routing View

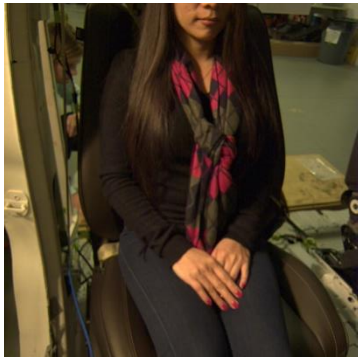
Passenger Side
5th Female

FU FR
Seat Incline: 80^{o}
Seat Track: 9 ¼"

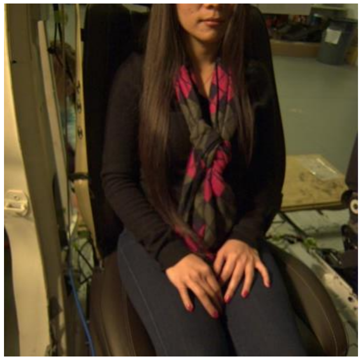
M0 Properly buckled.



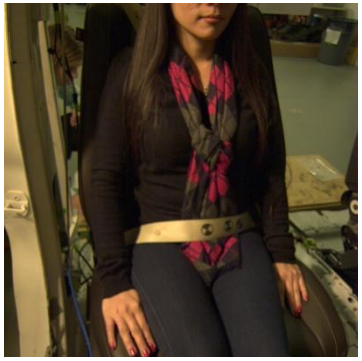
M1 Sitting on buckled belt.



M2 Leaving belt unbuckled.

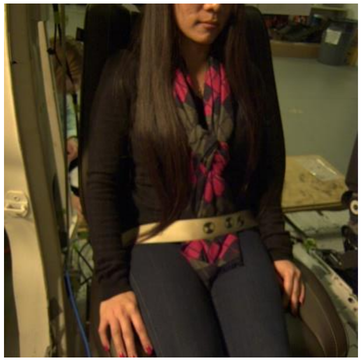


M4-1 Lap buckled, shoulder belt behind back.

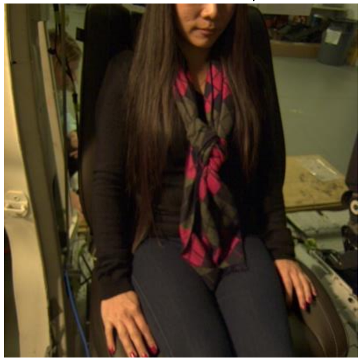


M4-2 Lap buckled shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.



Camera Images – Belt Routing View

Passenger Side
50th Male

FD FF
Seat Incline: 57°
Seat Track: 0"

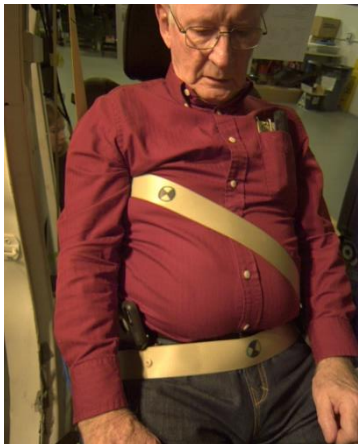
M0 Properly buckled.

M1 Sitting on buckled belt.

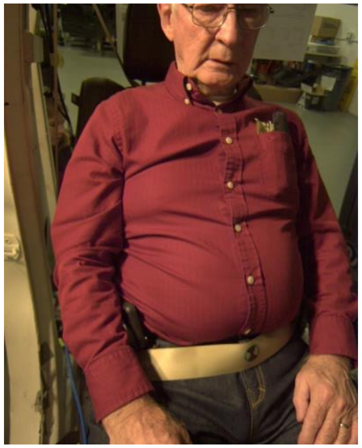
M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



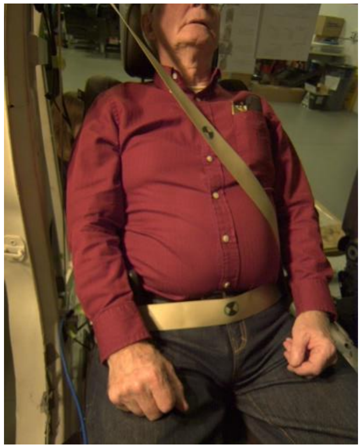
M5-2 Belt buckled behind seat, no restraint.

Camera Images – Belt Routing View

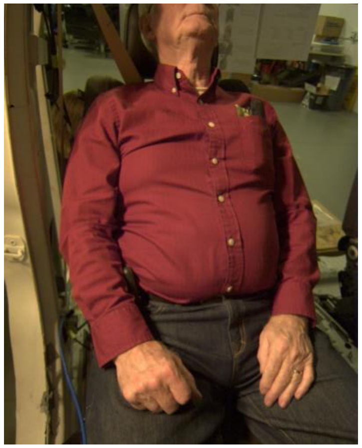
Passenger Side
50th Male

FD MT
Seat Incline: 57°
Seat Track: 4 5/8"

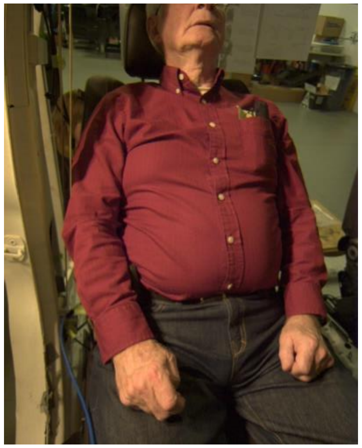
M0 Properly buckled.



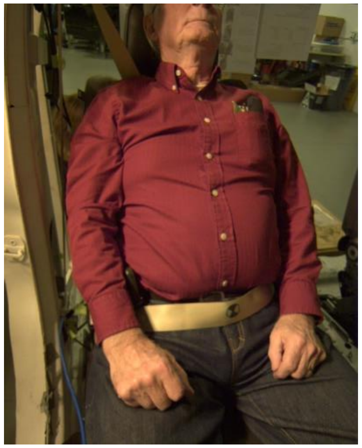
M1 Sitting on buckled belt.



M2 Leaving belt unbuckled.

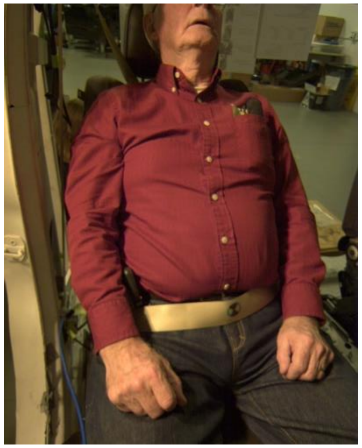


M4-1 Lap buckled, shoulder belt behind back.

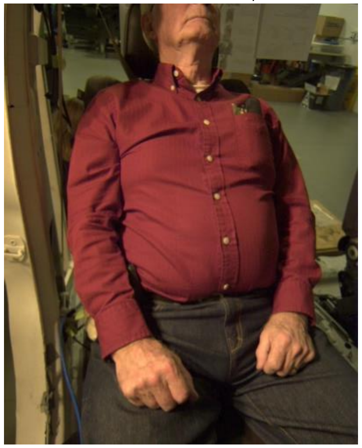


M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.

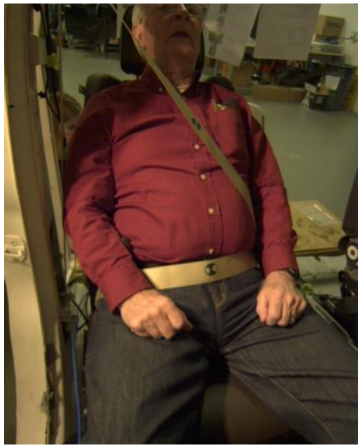


Camera Images – Belt Routing View

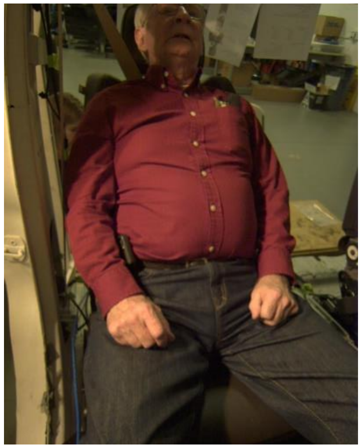
Passenger Side
50th Male

FD FR
Seat Incline: 57°
Seat Track: 9 ¼”

M0 Properly buckled.

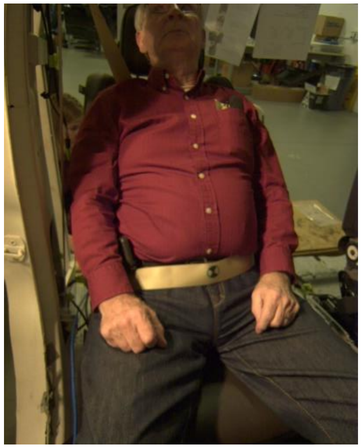


M1 Sitting on buckled belt.

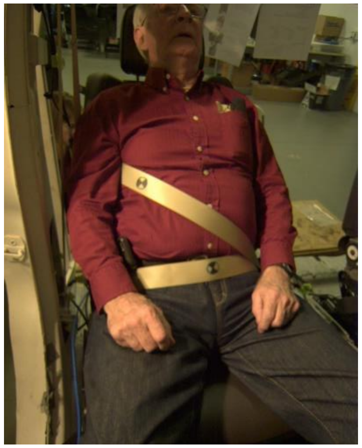


M2 Leaving belt unbuckled.

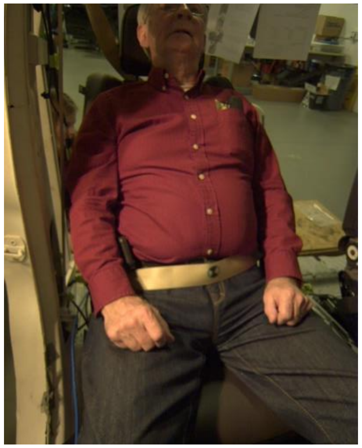
M4-1 Lap buckled, shoulder belt behind back.



M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



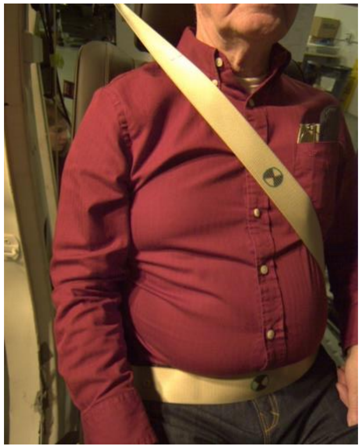
M5-2 Belt buckled behind seat, no restraint.

Camera Images – Belt Routing View

Passenger Side
50th Male

FU FF
Seat Incline: 78.5°
Seat Track: 0”

M0 Properly buckled.

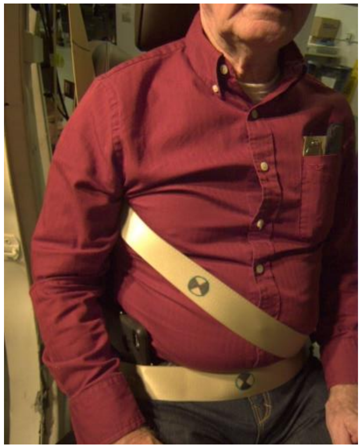


M1 Sitting on buckled belt.

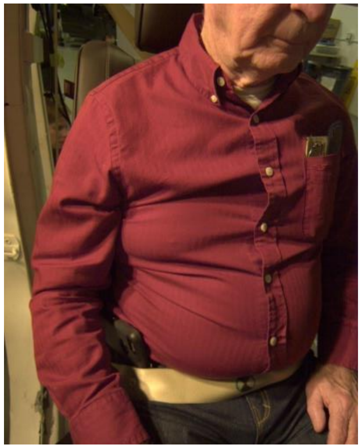
M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



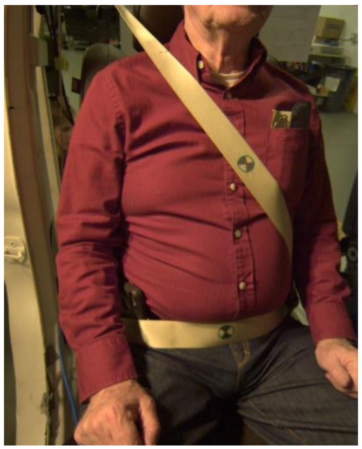
M5-2 Belt buckled behind seat, no restraint.

Camera Images – Belt Routing View

Passenger Side
50th Male

FU MT
Seat Incline: 78.5°
Seat Track: 4 5/8"

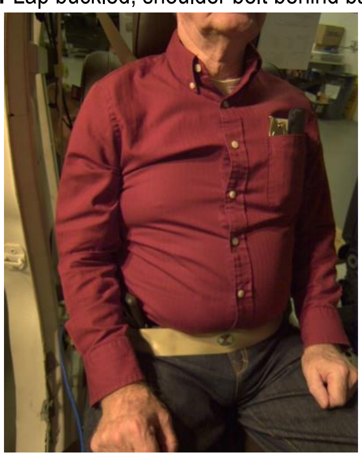
M0 Properly buckled.



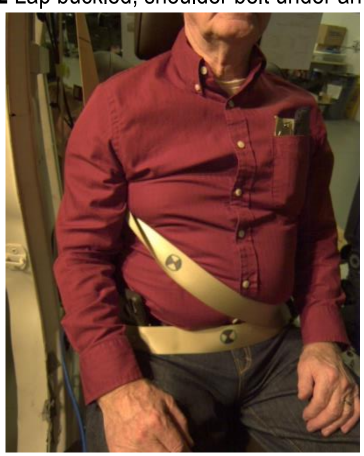
M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

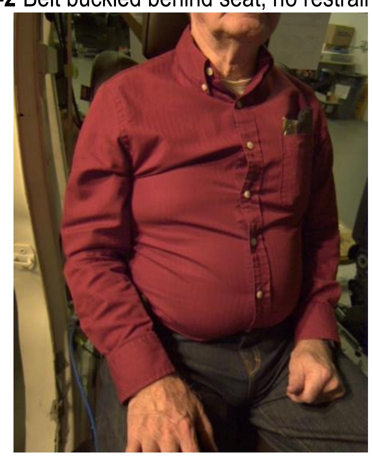


M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

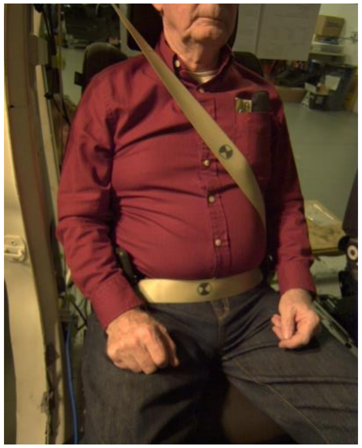


Camera Images – Belt Routing View

Passenger Side
50th Male

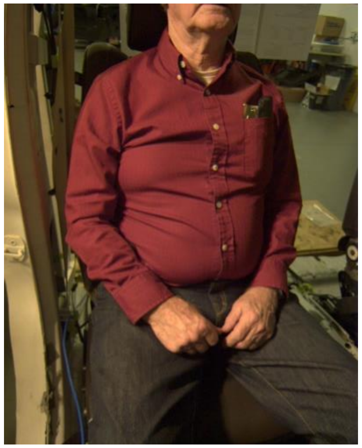
FU FR
Seat Incline: 78.5°
Seat Track: 9 ¼"

M0 Properly buckled.

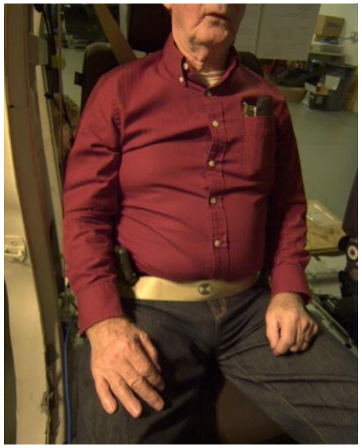


M1 Sitting on buckled belt.

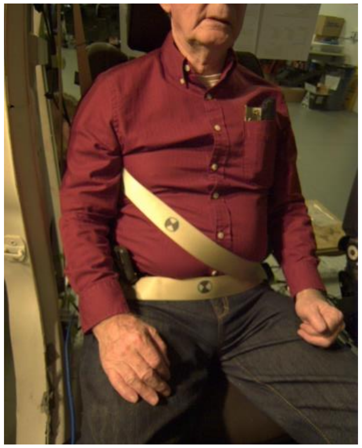
M2 Leaving belt unbuckled.



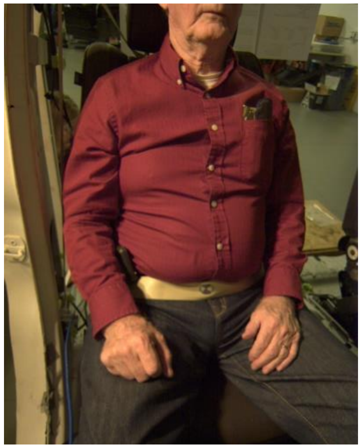
M4-1 Lap buckled, shoulder belt behind back.



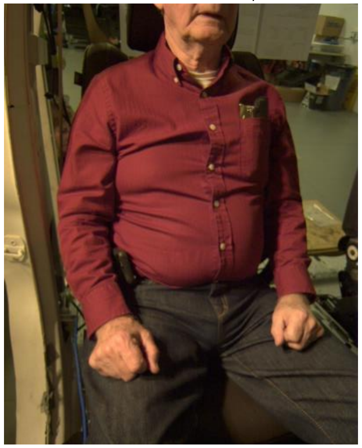
M4-2 Lap buckled shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.



Camera Images – Belt Routing View

Passenger Side
95th Male

FD FF
Seat Incline: 60°
Seat Track: 3”

M0 Properly buckled.

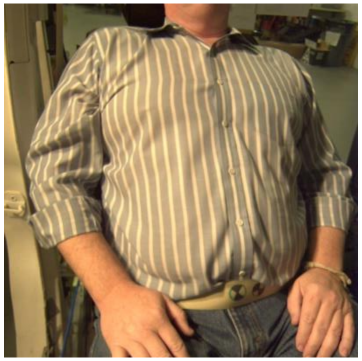
M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.

Camera Images – Belt Routing View

Passenger Side
95th Male

FD MT
Seat Incline: 60°
Seat Track: 4 5/8”

M0 Properly buckled.

M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

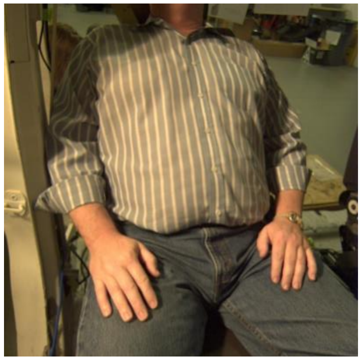
Camera Images – Belt Routing View

Passenger Side
95th Male

FD FR
Seat Incline: 60^{o}
Seat Track: 9 ¼"

M0 Properly buckled.

M1 Sitting on buckled belt.



M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

Camera Images – Belt Routing View

Passenger Side
95th Male

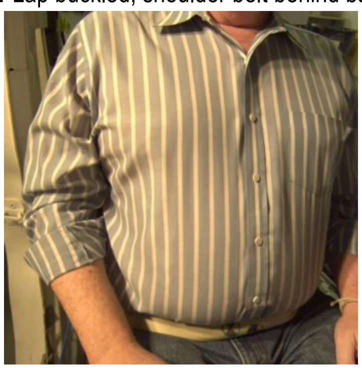
FU FF
Seat Incline: 77°
Seat Track: 3”

M0 Properly buckled.

M1 Sitting on buckled belt.

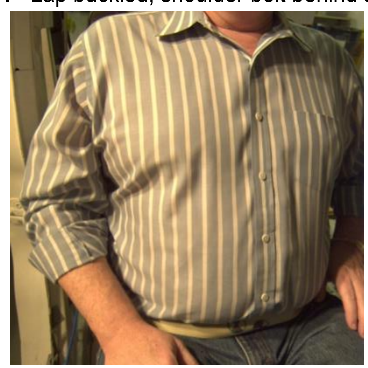
M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

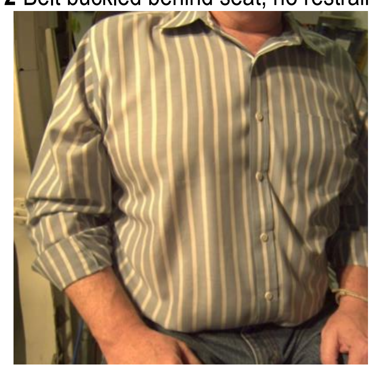


M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.



Camera Images – Belt Routing View

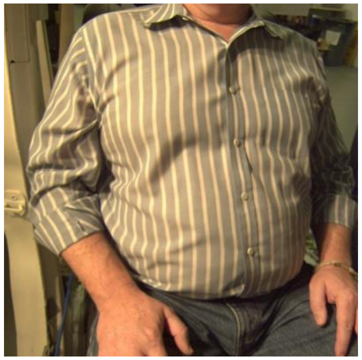
Passenger Side
95th Male

FU MT
Seat Incline: 77°
Seat Track: 4 5/8”

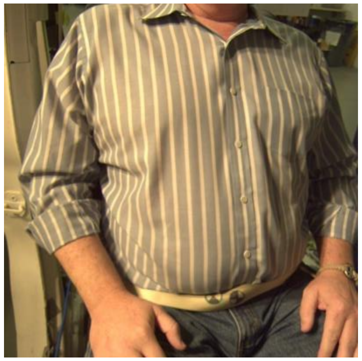
M0 Properly buckled.

M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.



M4-1 Lap buckled, shoulder belt behind back.



M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

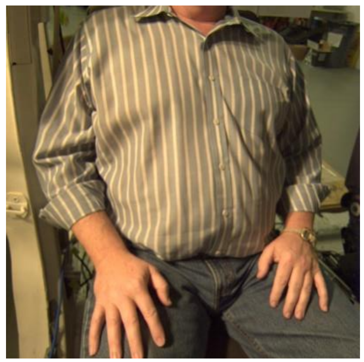
Camera Images – Belt Routing View

Passenger Side
95th Male

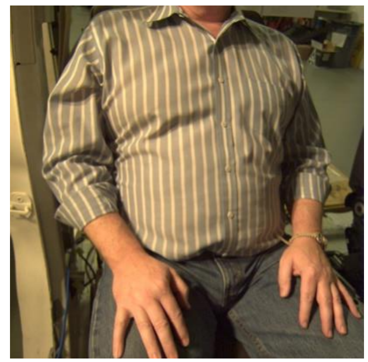
FU FR
Seat Incline: 77^{o}
Seat Track: 9 ¼”

M0 Properly buckled.

M1 Sitting on buckled belt.



M2 Leaving belt unbuckled.



M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

4.2 D-ring

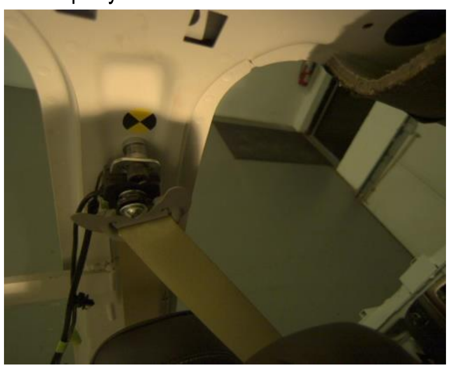
The images below represent the data collected, on the driver's side of the vehicle, for the D-ring angle, in one dimension, of the three identified occupant types (5th female, 50th male and 95th male) over varying seat track and seat incline positions for multiple misuses.

Camera Images – D-ring View

Driver's Side
5th Female

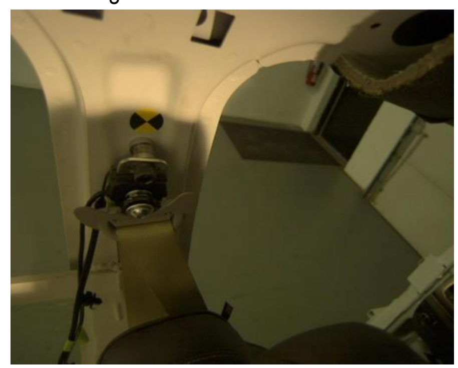
FD FF
Seat Incline: 75°
Seat Track: 2 1/8"

M0 Properly buckled.



M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.



M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

Camera Images – D-ring View

Driver's Side
5th Female

FD MT
Seat Incline: 75°
Seat Track: 5 3/8"

M0 Properly buckled.

M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

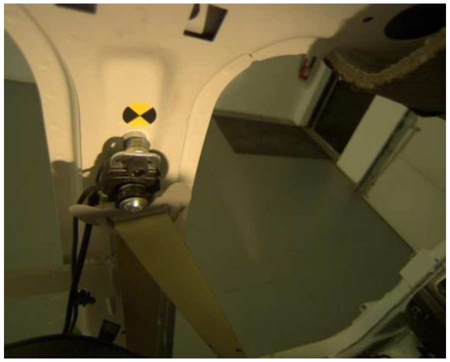
M5-2 Belt buckled behind seat, no restraint.

Camera Images – D-ring View

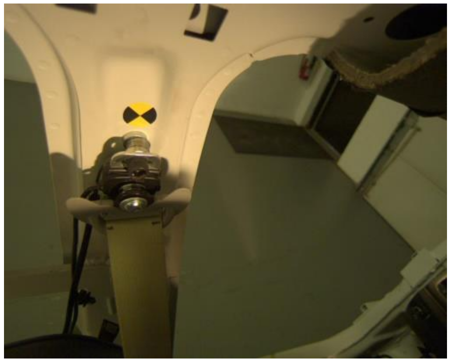
Driver's Side
5th Female

FD FR
Seat Incline: 75°
Seat Track: 6 1/16"

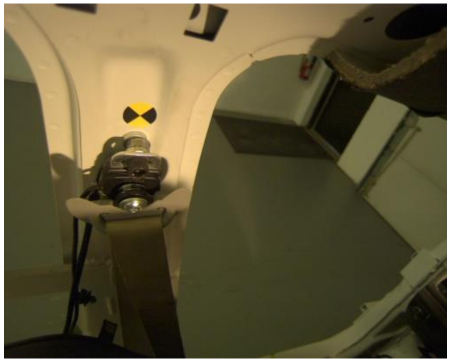
M0 Properly buckled.



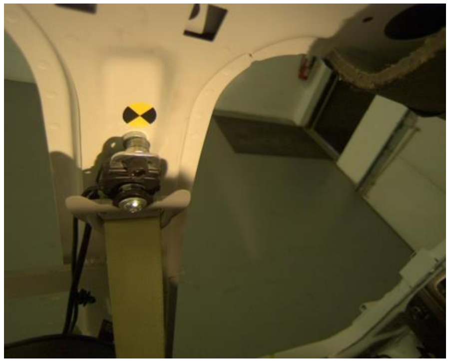
M1 Sitting on buckled belt.



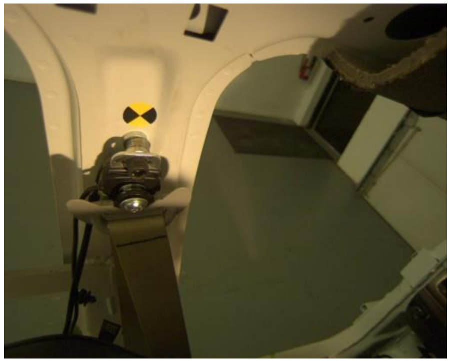
M2 Leaving belt unbuckled.



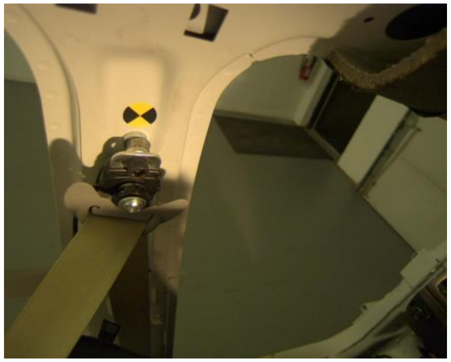
M4-1 Lap buckled, shoulder belt behind back.



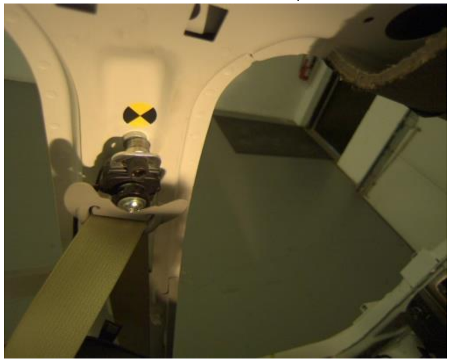
M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.

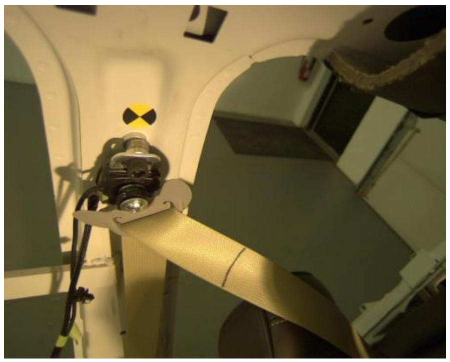


Camera Images – D-ring View

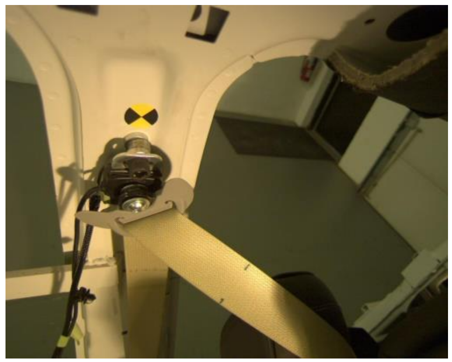
Driver's Side
5th Female

FU FF
Seat Incline: 90^{o}
Seat Track: 2 1/8"

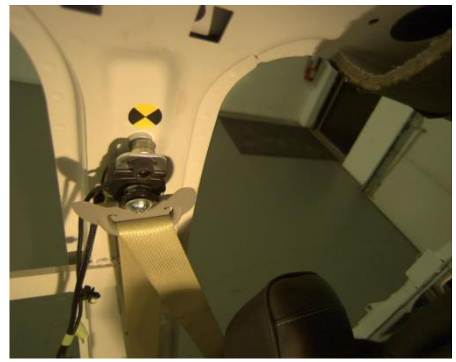
M0 Properly buckled.



M1 Sitting on buckled belt.



M2 Leaving belt unbuckled.



M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

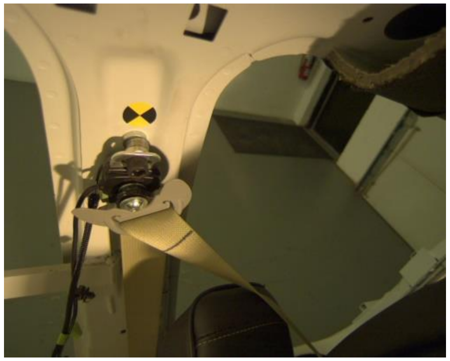
M5-2 Belt buckled behind seat, no restraint.

Camera Images – D-ring View

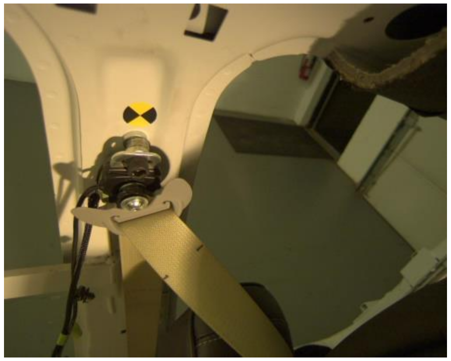
Driver's Side
5th Female

FU MT
Seat Incline: 90°
Seat Track: 5 3/8"

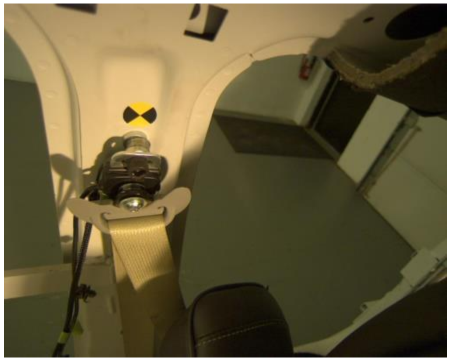
M0 Properly buckled.



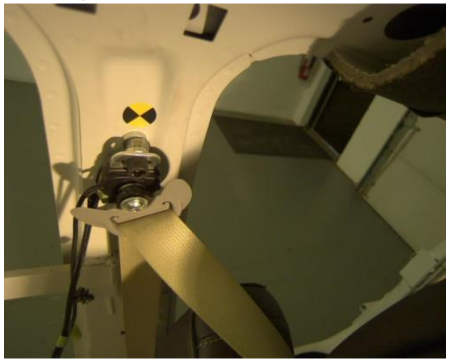
M1 Sitting on buckled belt.



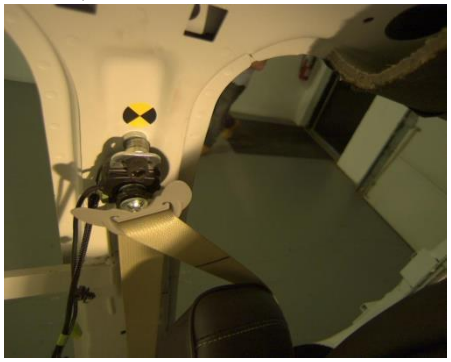
M2 Leaving belt unbuckled.



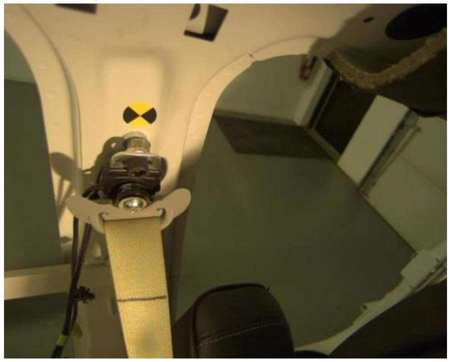
M4-1 Lap buckled, shoulder belt behind back.



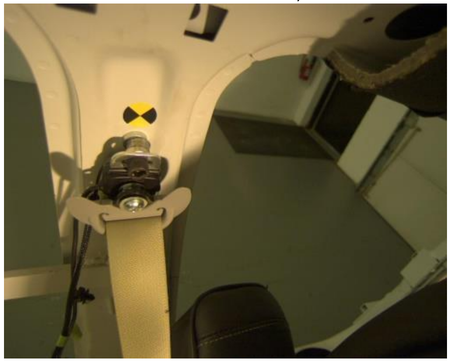
M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.

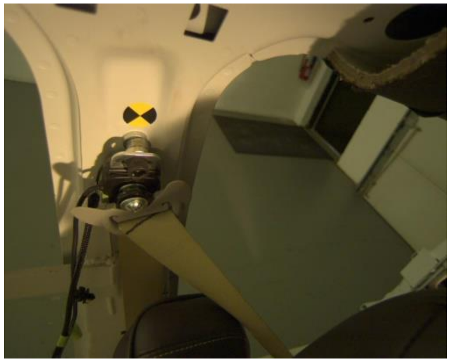


Camera Images – D-ring View

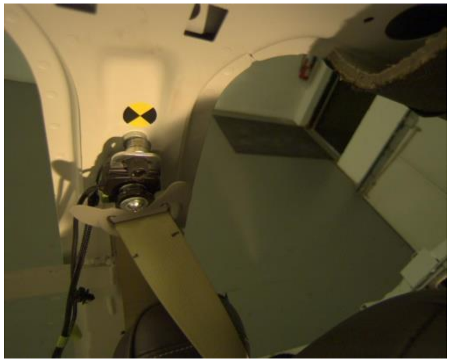
Driver's Side
5th Female

FU FR
Seat Incline: 90°
Seat Track: 6 1/16"

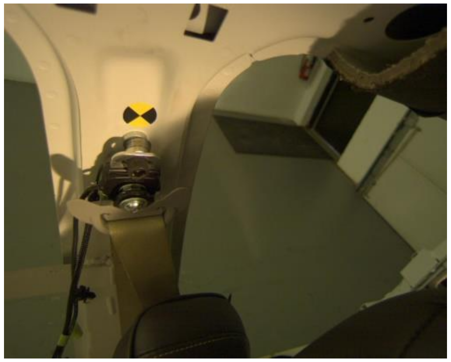
M0 Properly buckled.



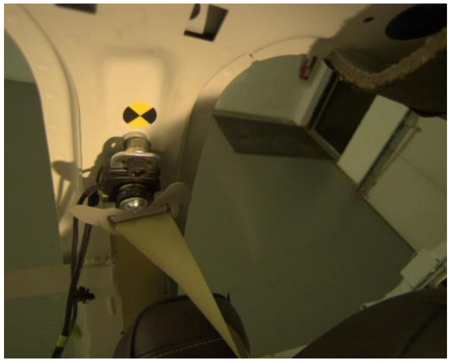
M1 Sitting on buckled belt.



M2 Leaving belt unbuckled.

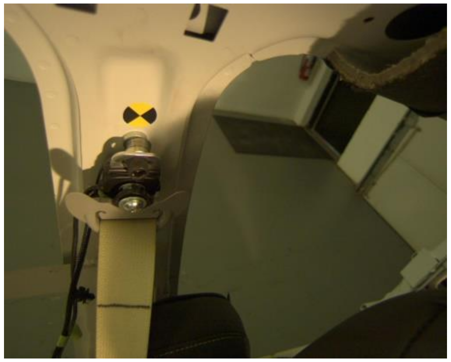


M4-1 Lap buckled shoulder belt behind back.

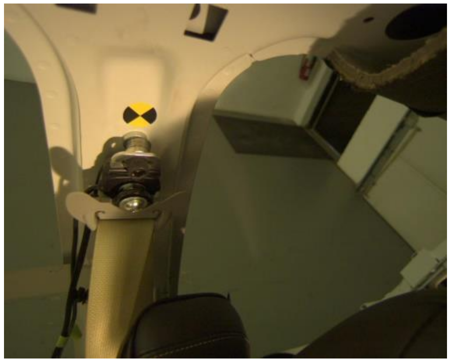


M4-2 Lap buckled shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.

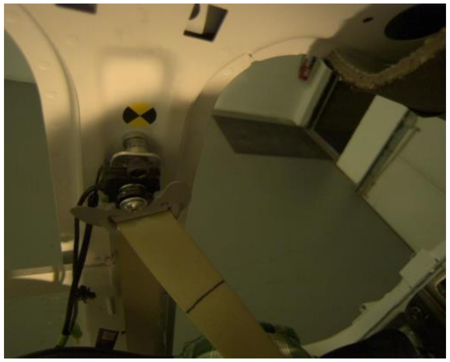


Camera Images – D-ring View

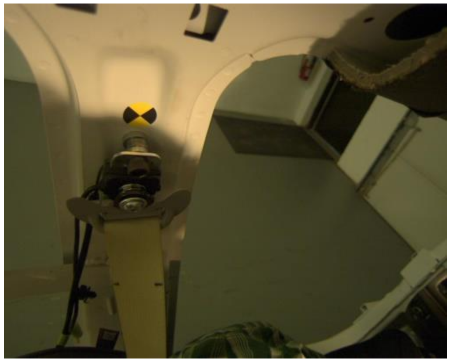
Driver's Side
50th Male

FD FF
Seat Incline: 65°
Seat Track: 4 1/8"

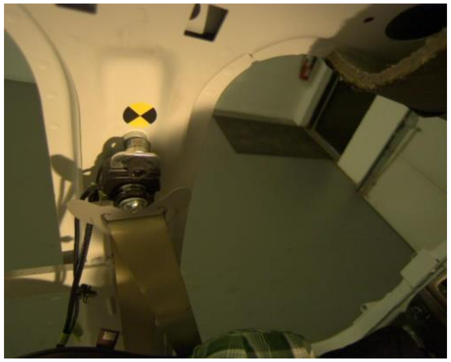
M0 Properly buckled.



M1 Sitting on buckled belt.

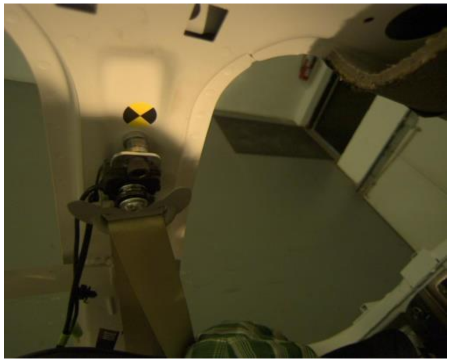


M2 Leaving belt unbuckled.

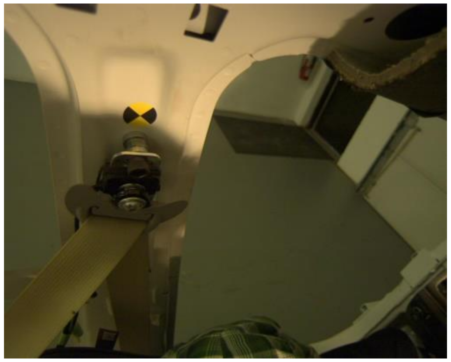


M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



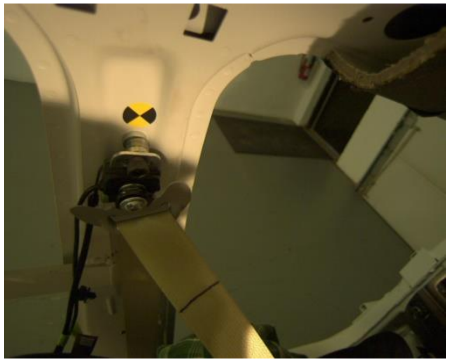
M5-2 Belt buckled behind seat, no restraint.

Camera Images – D-ring View

Driver's Side
50th Male

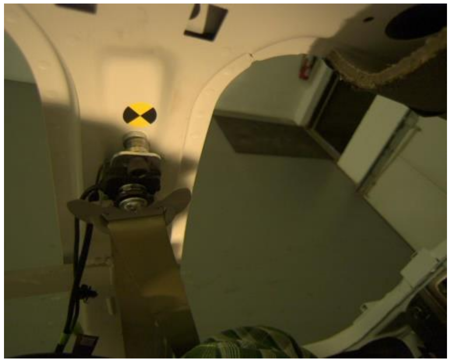
FD MT
Seat Incline: 65^o
Seat Track: 5 3/8"

M0 Properly buckled.



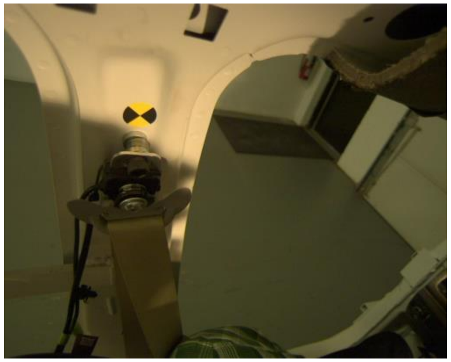
M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

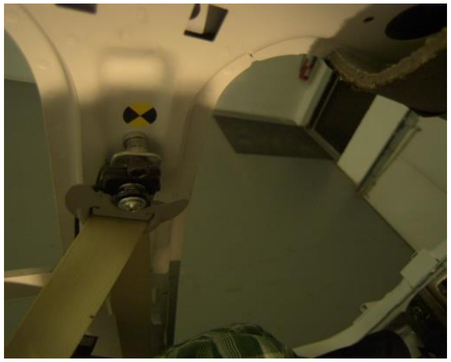


M4-1 Lap buckled, shoulder belt behind back.

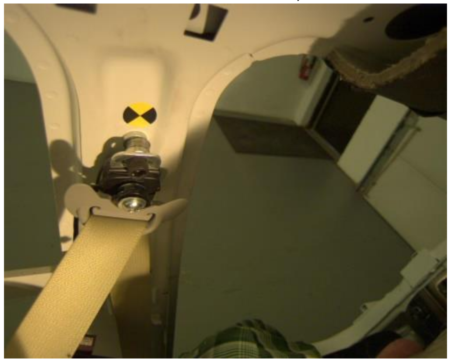
M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.

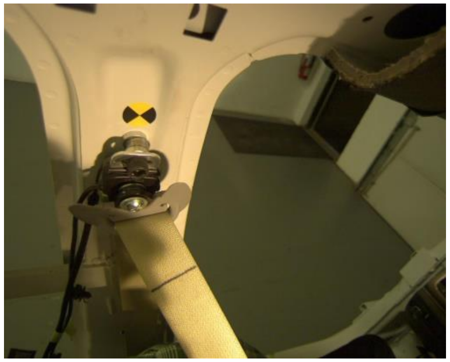


Camera Images – D-ring View

Driver's Side
50th Male

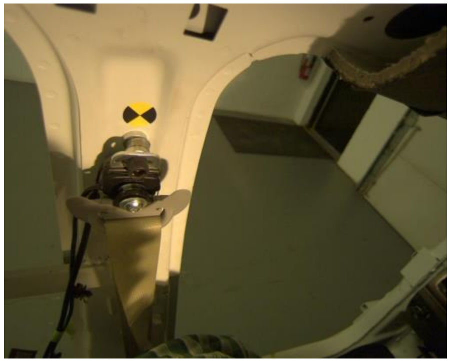
FD FR
Seat Incline: 65^o
Seat Track: 7 1/8"

M0 Properly buckled.



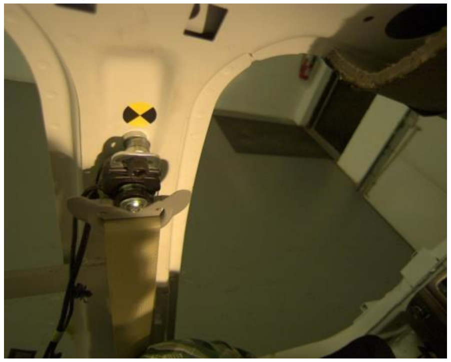
M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

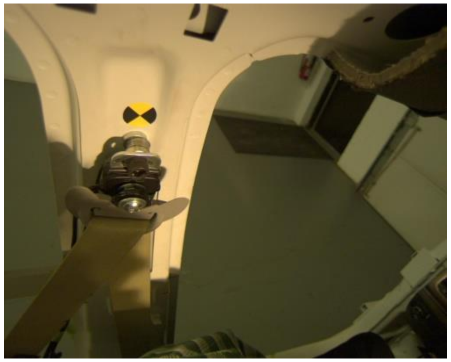


M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.

Camera Images – D-ring View

Driver's Side
50th Male

FU FF
Seat Incline: 90^{o}
Seat Track: 4 1/8"

M0 Properly buckled.

M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

Camera Images – D-ring View

Driver's Side
50th Male

FU MT
Seat Incline: 90°
Seat Track: 5 3/8"

M0 Properly buckled.

M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

Camera Images – D-ring View

Driver's Side

50th Male

FU FR

Seat Incline: 90°

Seat Track: 7 1/8"

M0 Properly buckled.

M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.

Camera Images – D-ring View

Driver's Side
95th Male

FD MT
Seat Incline: 60^o
Seat Track: 5 3/8"

M0 Properly buckled.

M1 Sitting on buckled belt.

M2 Leaving belt unbuckled.

M4-1 Lap buckled, shoulder belt behind back.

M4-2 Lap buckled, shoulder belt under arm.

M5-1 Lap buckled, shoulder belt behind seat.

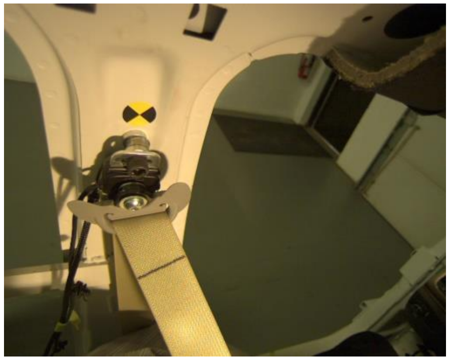
M5-2 Belt buckled behind seat, no restraint.

Camera Images – D-ring View

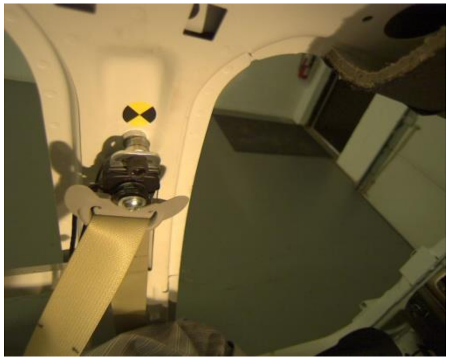
Driver's Side
95th Male

FD FR
Seat Incline: 60°
Seat Track: 10 ¾"

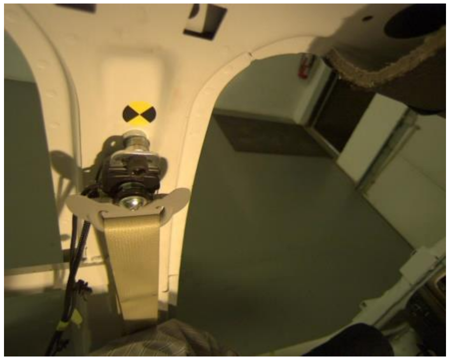
M0 Properly buckled.



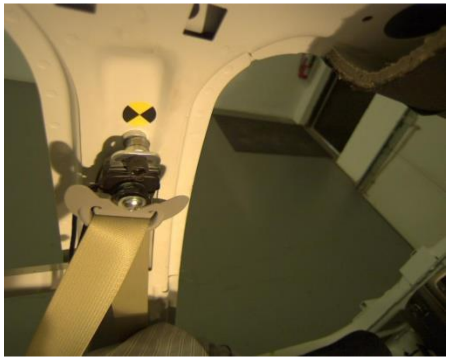
M1 Sitting on buckled belt.



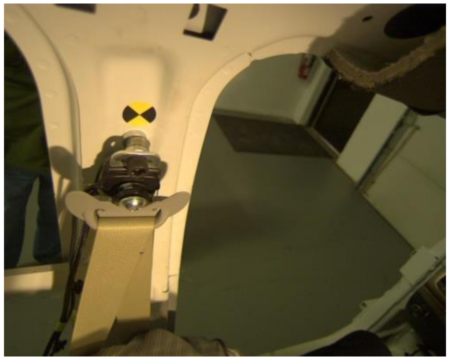
M2 Leaving belt unbuckled.



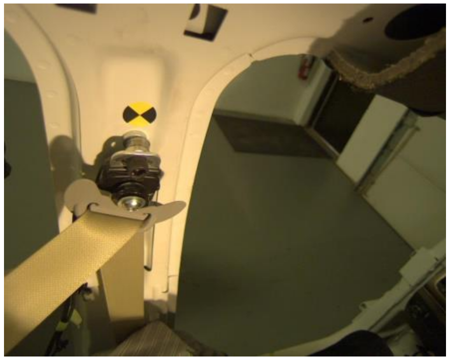
M4-1 Lap buckled, shoulder belt behind back.



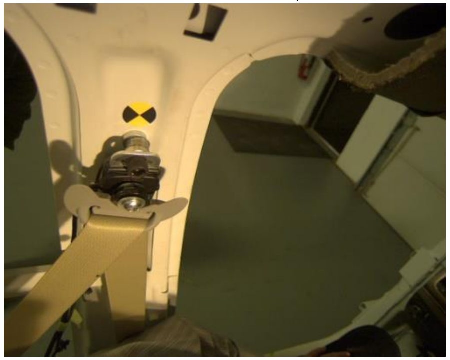
M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.

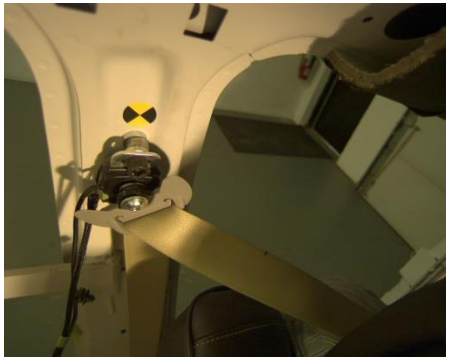


Camera Images – D-ring View

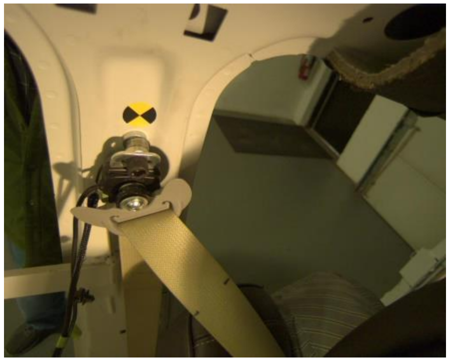
Driver's Side
95th Male

FU MT
Seat Incline: 90^{o}
Seat Track: 5 3/8"

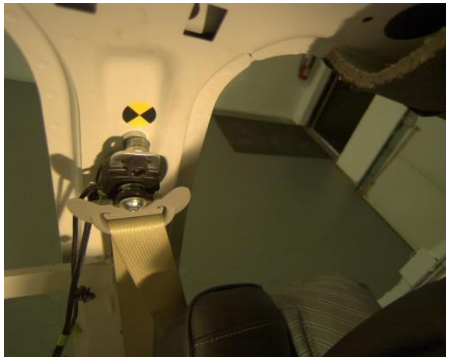
M0 Properly buckled.



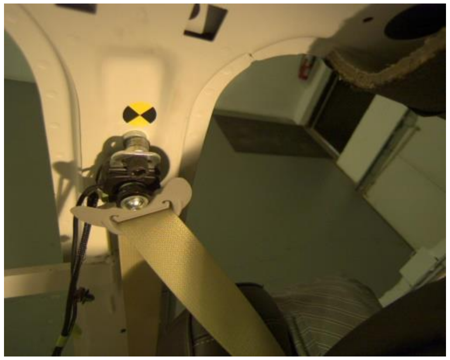
M1 Sitting on buckled belt.



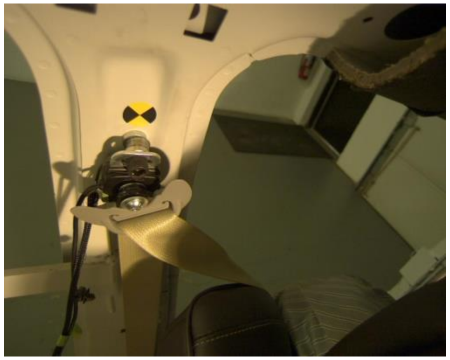
M2 Leaving belt unbuckled.



M4-1 Lap buckled, shoulder belt behind back.

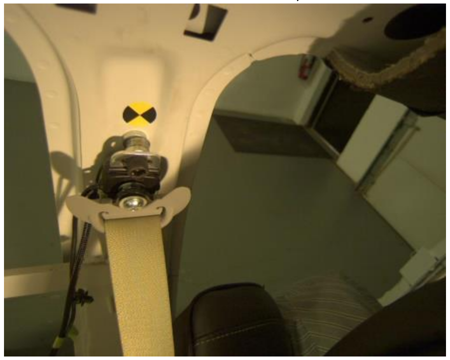


M4-2 Lap buckled, shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.

M5-2 Belt buckled behind seat, no restraint.



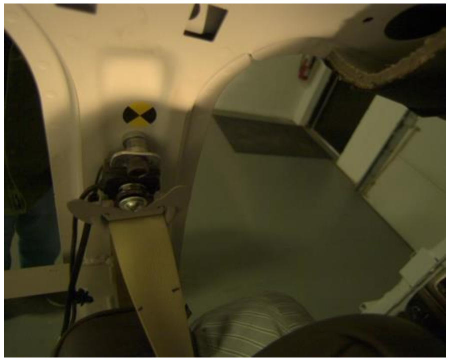
Camera Images – D-ring View

Driver's Side
95th Male

FU FR
Seat Incline: 90^o
Seat Track: 10 ¾"

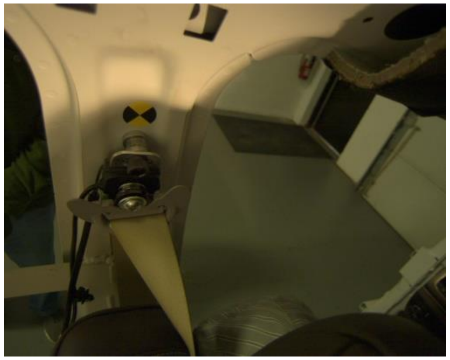
M0 Properly buckled.

M1 Sitting on buckled belt.

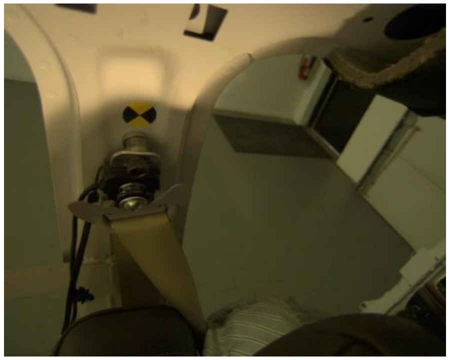


M2 Leaving belt unbuckled.

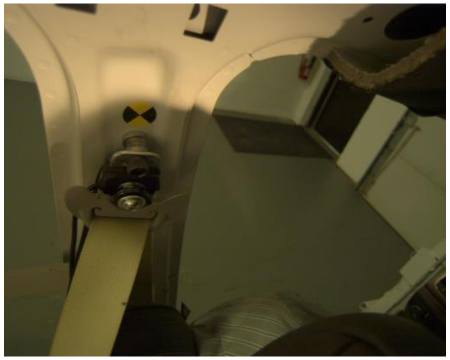
M4-1 Lap buckled, shoulder belt behind back.



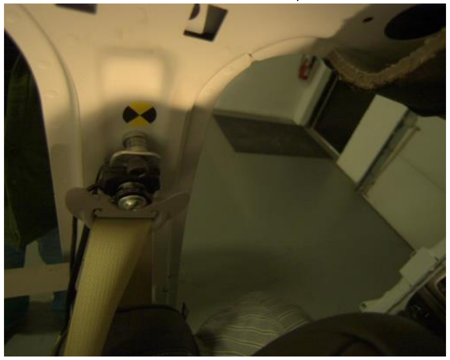
M4-2 Lap buckled shoulder belt under arm.



M5-1 Lap buckled, shoulder belt behind seat.



M5-2 Belt buckled behind seat, no restraint.



5 Conclusion

Cameras may provide a viable solution to detecting belt routing, to determine proper use, relative to a seatbelt interlock system. However, several factors need to be considered. The first is low light conditions which can be overcome with the use of IR LEDs but their use can be harmful and must be used carefully and as limited as possible. The second concern is packaging especially if more than one camera, per occupant, is needed. As vehicles integrate more cameras, an existing camera (included for another use) may be able to have a dual purpose and be used for belt routing detection. Another concern is cost; while cameras use is becoming more widespread in the vehicle, the number of cameras required may be cost prohibitive. Lastly, the time to sufficiently develop the algorithm(s) to assess the camera images may also be a factor.

As an alternative, there are other sensor solutions (less costly, simpler to integrate, and with easier data to assimilate) that are able to give a similar result in detecting misuse. The D-ring measurement angle itself has also been shown to detect misuses where an image solution would require, potentially, two cameras per D-ring. A D-ring angle sensor gets a resultant of the two angles in one measurement rather than processing two camera images.

If, for some reason, there was a misuse that could not be detected, with other sensors, a camera may become useful for that specific situation. In other words, a camera may be beneficial as a secondary sensor rather than a primary solution.

Appendix F – Design Validation Plan and Report

Preventing Seat Belt Interlock Misuse

BGM

DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #				PAGE 1 of 1	
PLAN DATE:	**4/12/2016** rev. 4	ORIGINATOR:	**P. Smith**		
PART NAME:	**Interlock Module - Baseline system**	CUSTOMER:	**NHTSA**	REPORT DATE:	TBD
QUALITY ENGR:	J. Boyle				
MY	**2018**	PART #	TBD	REVISION:	3
LOCATION:	**Shelby Township, MI**	APPROVAL:	T. Messner		

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Group I Baseline System - Camera Only - pugh matrix confirmation**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	36	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Added light and dark conditions. Data will be collected with all sensors and we will only report on system
2	Leaving belt unbuckled.		Static	36	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	36	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	36	A							
5	Wrap belt around seat. Occupant buckled.		Static	36	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	36	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	36	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	36	A							
9	Surrogate latch plates.		Static	36	A							
10	Wire harness modification to "close" the buckle.		Static	36	A							
11	Unbuckle after the vehicle is moving.		Static	36	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	36	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	36	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	36	A							
17	New: Covering up the camera - intentional		Static	36	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	108	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	108	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	108	A							
21	New: shoulder belt routed, but not buckled		Static	108	A							
24	New: Child Seat Web Routing		Static	108	A							
25	New: laptop interference		Static	108	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	108	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	108	A							

BGM

DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #		PAGE **1** of **1**	
PLAN DATE:	**4/12/2016** rev. **3**	ORIGINATOR:	**P. Smith**
PART NAME: **Interlock Module - Concept System 6**	CUSTOMER: **NHTSA**	REPORT DATE: TBD	QUALITY ENGR: J. Boyle
MY **2018**	PART # TBD	REVISION: 3	LOCATION: **Shelby Township, MI**
APPROVAL:	T. Messner		

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Concept System 6 - Camera system, capacitive systems in webbing, seat back, cushion with smrt buck**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	n/a	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Data will be collected in "Baseline" testing, no duplicate testing is expected Results reported will focus on sensors used for concept 6
2	Leaving belt unbuckled.		Static	n/a	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	n/a	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	n/a	A							
5	Wrap belt around seat. Occupant buckled.		Static	n/a	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	n/a	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	n/a	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	n/a	A							
9	Surrogate latch plates.		Static	n/a	A							
10	Wire harness modification to "close" the buckle.		Static	n/a	A							
11	Unbuckle after the vehicle is moving.		Static	n/a	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	n/a	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	n/a	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	n/a	A							
17	New: Covering up the camera - intentional		Static	n/a	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	n/a	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	n/a	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	n/a	A							
21	New: shoulder belt routed, but not buckled		Static	n/a	A							
24	New: Child Seat Web Routing		Static	n/a	A							
25	New: laptop interference		Static	n/a	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	n/a	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	n/a	A							

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DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #					PAGE 1 of 1		
PLAN DATE:	4/12/2016	rev.	3	ORIGINATOR:	P. Smith		
PART NAME:	Interlock Module - Concept System 7	CUSTOMER:	NHTSA	REPORT DATE:	TBD	QUALITY ENGR:	J. Boyle
MY	2018	PART # TBD	REVISION: 3	LOCATION:	Shelby Township, MI	APPROVAL:	T. Messner

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Concept System 7 - Capacitive systems in webbing, seat back, cushion with smrt buckle switch**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	n/a	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Data will be collected in "Baseline" testing, no duplicate testing is expected Results reported will focus on sensors used for concept 7
2	Leaving belt unbuckled.		Static	n/a	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	n/a	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	n/a	A							
5	Wrap belt around seat. Occupant buckled.		Static	n/a	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	n/a	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	n/a	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	n/a	A							
9	Surrogate latch plates.		Static	n/a	A							
10	Wire harness modification to "close" the buckle.		Static	n/a	A							
11	Unbuckle after the vehicle is moving.		Static	n/a	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	n/a	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	n/a	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	n/a	A							
17	New: Covering up the camera - intentional		Static	n/a	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	n/a	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	n/a	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	n/a	A							
21	New: shoulder belt routed, but not buckled		Static	n/a	A							
24	New: Child Seat Web Routing		Static	n/a	A							
25	New: laptop interference		Static	n/a	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	n/a	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	n/a	A							

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DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #				PAGE **1** of **1**	
PLAN DATE:	**4/12/2016** rev. **3**	ORIGINATOR:	**P. Smith**		
PART NAME:	**Interlock Module - Concept System 8**	CUSTOMER:	**NHTSA**	REPORT DATE: TBD	QUALITY ENGR: J. Boyle
MY **2018**	PART # TBD	REVISION:	3	LOCATION: **Shelby Township, MI**	APPROVAL: T. Messner

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Concept System 8 - Vision systems with potentiameters at the D-Ring and the buckle with smrt buckle**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	n/a	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Data will be collected in "Baseline" testing, no duplicate testing is expected Results reported will focus on sensors used for concept 8
2	Leaving belt unbuckled.		Static	n/a	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	n/a	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	n/a	A							
5	Wrap belt around seat. Occupant buckled.		Static	n/a	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	n/a	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	n/a	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	n/a	A							
9	Surrogate latch plates.		Static	n/a	A							
10	Wire harness modification to "close" the buckle.		Static	n/a	A							
11	Unbuckle after the vehicle is moving.		Static	n/a	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	n/a	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	n/a	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	n/a	A							
17	New: Covering up the camera - intentional		Static	n/a	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	n/a	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	n/a	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	n/a	A							
21	New: shoulder belt routed, but not buckled		Static	n/a	A							
24	New: Child Seat Web Routing		Static	n/a	A							
25	New: laptop interference		Static	n/a	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	n/a	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	n/a	A							

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DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #		PAGE 1 of 1	
PLAN DATE:	4/12/2016 rev. 3	ORIGINATOR:	P. Smith
REPORT DATE:	TBD	QUALITY ENGR:	J. Boyle
LOCATION:	Shelby Township, MI	APPROVAL:	T. Messner

PART NAME: **Interlock Module - Concept System 9** CUSTOMER: **NHTSA**

MY **2018** PART # TBD REVISION: 3

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Concept System 9 - Vision systems with retractor spool payout sensor and smrt buckle switch**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	n/a	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Data will be collected in "Baseline" testing, no duplicate testing is expected Results reported will focus on sensors used for concept 9
2	Leaving belt unbuckled.		Static	n/a	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	n/a	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	n/a	A							
5	Wrap belt around seat. Occupant buckled.		Static	n/a	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	n/a	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	n/a	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	n/a	A							
9	Surrogate latch plates.		Static	n/a	A							
10	Wire harness modification to "close" the buckle.		Static	n/a	A							
11	Unbuckle after the vehicle is moving.		Static	n/a	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	n/a	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	n/a	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	n/a	A							
17	New: Covering up the camera - intentional		Static	n/a	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	n/a	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	n/a	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	n/a	A							
21	New: shoulder belt routed, but not buckled		Static	n/a	A							
24	New: Child Seat Web Routing		Static	n/a	A							
25	New: laptop interference		Static	n/a	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	n/a	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	n/a	A							

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DESIGN VERIFICATION / VALIDATION PLAN & REPORT

PROGRAM #				PAGE 1 of 1	
PLAN DATE:	**4/12/2016** rev. **3**			ORIGINATOR:	**P. Smith**
PART NAME:	**Interlock Module - Concept System 9**	CUSTOMER:	**NHTSA**	REPORT DATE: TBD	QUALITY ENGR: J. Boyle
MY **2018**	PART # TBD	REVISION:	3	LOCATION: **Shelby Township, MI**	APPROVAL: T. Messner

TEST PLAN									TEST REPORT			
ITEM #	TEST DESCRIPTION / PROCEDURE OR STANDARD	ACCEPTANCE CRITERIA	TEST TYPE	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	LOC	SAMPLE QTY	SAMPLE TYPE	TEST NUMBER	REMARKS
A	**Concept System 10 - Capacitive seat mat with D-Ring Angle, Seat Track position, seat back angle sensor and smrt buckle switch**											
1	Sitting on buckled seatbelt (lap and shoulder belt behind user).		Static	n/a	A							1 sample for testing we agree on confidence level of camera to pick up - ref. pugh matrix Runs - 6 seat positions (Full Forward, Full up; Full Forward, Full Down; Full Rear, Full up; Full Rear, Full Down; Mid track, full up, mid track full down) 3 occupant types Range of Occupants - 5th to 95th Data will be collected in "Baseline" testing, no duplicate testing is expected Results reported will focus on sensors used for concept 9
2	Leaving belt unbuckled.		Static	n/a	A							
3	Passenger seat belt latch plate engaged with driver's buckle.		Static	n/a	A							
4	Shoulder belt behind user (lap belt in correct position). Occupant buckled.		Static	n/a	A							
5	Wrap belt around seat. Occupant buckled.		Static	n/a	A							
6	Remove headrest, bring latch plate behind seat through headrest opening and buckle from behind. Occupant buckled.		Static	n/a	A							
7	Clipping extracted belt. Latch plate in buckle. (Variation of #1) Clipping will be a more permanent action.		Static	n/a	A							
8	Clipping extracted belt and latch plate not in buckle.		Static	n/a	A							
9	Surrogate latch plates.		Static	n/a	A							
10	Wire harness modification to "close" the buckle.		Static	n/a	A							
11	Unbuckle after the vehicle is moving.		Static	n/a	A							Simulate in lab environment
12	Vehicle started, all passengers buckled initially, passenger gets out and returns and does not re-buckle.		Static	n/a	A							Simulate in lab environment
13	Vehicle started, initially only driver in vehicle. Passenger picked up and does not buckle (vehicle already running; may or not be in park).		Static	n/a	A							Simulate in lab environment
14	Person buckled but not in correct position (feet not on floor, belts not positioned correctly).		Static	n/a	A							
17	New: Covering up the camera - intentional		Static	n/a	A							
18	New: Articles of clothing to trick camera (IE printed shirt, coat etc.)		Static	n/a	A							3 test runs for those items which require more fidelity in the results - ref. pugh matrix
19	New: Articles blocking camera (IE…Blanket, Coat) unintentional		Static	n/a	A							
20	New: Occupant out of position (IE; turned to block web path)		Static	n/a	A							
21	New: shoulder belt routed, but not buckled		Static	n/a	A							
24	New: Child Seat Web Routing		Static	n/a	A							
25	New: laptop interference		Static	n/a	A							
26	New: Artificial limb/organ interference (pace maker, etc.)		Static	n/a	A							
27	New: Works with buckle extender (change to webbing layout pattern)		Static	n/a	A							

Form Revision History:

Revision Level	Revision Date	Description of Change	Reviewed by:
001	3/21/2016	Draft Version of Test Plan	Paul Smith
002	4/5/2016	Further defined seating characterstics and occupants, clarified	Paul Smith
003	4/11/2016	Added lighting characterstics, added buckle extender	Paul Smith
004	11/5/2016	Added concept system 10	Paul Smith

DOT HS 812 496
February 2018

U.S. Department
of Transportation

National Highway
Traffic Safety
Administration

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