TTCI Transportation Technology Center, Inc.

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IMPACT TEST REPORT

Bi-Level Motor Vehicle Securement Systems With Bi-Level Products Only

NOTE: THIS TEST REPORT DOES NOT CONSTITUTE APPROVAL OR DISAPPROVAL OF THE EQUIPMENT, METHOD OR MATERIAL TESTED

TEST REPORT: FI 7- 09

June 9, 2009

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REPORT OF IMPACT TEST – JUNE 9, 2009

SUBJECT: Test of Motor Vehicle Bi-Level Securement Systems With Bi-Level Products Only

SYNOPSIS:

A series of Impact Tests were conducted at TCI, Pueblo, CO June 8 - 11, 2009 to evaluate the performance of 4 new Bi-Level securement systems. Holden America, Holland Company, TrinityRail, and ZefTek (a Division of Standard Car Truck Company/ Wabtec) each provided individual designs of a securement system for evaluation. Each of the systems was designed for application to all four wheels of a vehicle although the TrinityRail representative advised that their system could be used on one side of the vehicle.

The **Holden America** system is an eight chock per vehicle system (2 chocks per wheel) that attaches to the chock grating currently equipped on most of the bi-level fleet. Vehicles are secured by a colored coded chock applied inboard and outboard of each tire. A **L**ime green colored chock is applied to the **L**eft side of the tire as a loader faces the tire, and a **R**ed colored chock is applied to the **R**ight side. The chock is constructed with a platform that attaches to the grating and when the locking handle is engaged the faceplate and upper portion of the chock moves forward to fill any void space between the tire and faceplate. The lateral restraint provision is applied to the outside of the tire. This lateral restraint is angled so that it contacts the outer tread area of the tire and not the sidewall. The chock is adjustable in height.

View of Holden America's system.

View showing lateral restraint paddle.

The **Holland Company's** system is a four chock system (one outboard of each tire) with each chock equipped with a strap that is to be placed over the vehicle tire and secured to the grating with curved locking fingers. The strap operates similar to a shoulder/seat belt in a vehicle as any slack that is created is automatically retracted. The chock has a lateral restraint paddle that is adjustable to either side. The chocks attach to the grating currently equipped on most of the bi-level fleet. The system locking handle is color coded **R**ed and **G**reen to indicate if the chock is locked in position. The strap has moveable rubber cleats that are to be positioned in the tread area of the tire when installing the system. These cleats also must fully retract to allow proper chock storage.

View of the Holland chock system.

View showing the attachment to grating.

The **TrinityRail** system required a special track system to be installed on the deck of the autorack to provide attachment points for the securement system. The system includes a strap, idler, hooks and a remotely placed and operated ratchet winch. The decking is ¾ inch in height with punched holes to accept securement hooks and is coated with an anti-skid material. Two systems were used to secure the decking to the car body. One system was huck bolted to the deck so it cannot be moved. The second system was attached with removable Shaft Locking pins which can be removed on one side of the deck so it can be raised for access under the deck for cleaning purposes.

Strap system and huck bolted decking.

Note Shaft Clips securing decking

ZefTek had two versions of their system, one with a strap for added vertical securement and one system without a strap. Both versions were a four chock system (one chock outboard of each tire) that will attach to the grating currently equipped on most bi-levels. The strap, on the system with a strap, attached to the chock with a hook and the other end attached to the track with curve “fingers” designed to engage the grating. The strap has a buckle to allow tensioning . The chock faceplate is adjustable in height.

View of ZefTek chock system w/o strap.

View of strap attached to ZefTek chock.

The tests included impacts of 6 – 7 – 8 and 9 MPH in the forward direction (direction of headlights) and reverse impacts of 8 and 9 MPH. All impacts were into a anvil string with a minimum weight of 500,000 pounds. An inspection of each system was made following each impact.

BACKGROUND:

This test was conducted at the request of the Vehicle and Equipment Quality Task Force as part of the new securement system development project that was initiated at the April 20, 2006 AAR Town Hall meeting. At that meeting it was noted that vehicle designs are changing, some to the point that securement with the current system is difficult. Vehicle design changes include lower clearance underbodies, more and lower ground effects, air dams, and closing of wheel well openings. All of these changes reduce clearance areas for chock application. In addition, projections indicate that there will be more similar changes in the future to help increase fuel efficiencies and vehicle mileage. Based on these issues, suppliers were advised that the industry was interested in new securement systems.

The VEQ established that any new system must successfully complete the AAR impact test and over-the-road testing with a minimum of 25 shipments. In addition, the committee recommended that additional testing be conducted above the standard 4 – 6 – 6 and reverse 6 MPH impacts to help evaluate and understand the dynamics and effects of higher speed impacts that are above acceptable handling practices.

Suppliers responded and several systems were developed. Testing was conducted and in-service test shipments were made. However, after several shipments, exceptions were noted with each of the systems and the testing was stopped. Suppliers were advised to make required modifications to their systems and another series of test would then be conducted.

EQUIPMENT / LOAD DESCRIPTION:

The test car, bi-level TTGX-982500, was a typical representative of the multi-level fleet. Side panels were removed from one side of the rack for viewing and video purposes. The UP owned rack was built and Certified 08/95 at TCWI and the flat was certified 7/95 at HIIX. The car traveled approximately 568,734 miles since certification. The car has a Load Limit of 80,000 lbs. The car was equipped as follows: National Swing Motion, 5'8" Wheel Base, Special RB Adapters, Spring Group 6 Outer D7 Springs, 2 Special Snubber Outer 49421, FMI F15 MC2FT M921D units installed 7/95, and 60 inch couplers. The rack has Radial style end doors and decks equipped with a Grate Lock Chock system except for the special decking applied in 2 positions for the TrinityRail securement system. Deck Settings are 87 ½ inches on "A" deck setting and 95 5/16 on "B" deck. The rack was condition Scored 9/05 in Roanoke, IN.

The autorack was loaded with 8 vehicles typical of those normally shipped on bi-levels, 4 on each deck. A random system was used to assign the securement system to a vehicle and position. Representatives of each of the supplier companies applied their respective system as recommended and designed. Each system was applied to one vehicle on each deck. The vehicles and securement systems were:

Position	Vehicle	Securement System	Transmission Setting
A-1	Toyota Tacoma Pickup	Holden America	Park
A-2	Chevy Traverse LTZ	TrinityRail	Park
A-3	Dodge Ram 4x4	ZefTek (no strap)	Park
A-4	Aveo	Holland	Park
B-1	Toyota Tundra	TrinityRail	Park
B-2	Ford Edge	Holland	Park
B-3	Toyota Sienna	ZefTek	Park
B-4	Toyota RAV	Holden America	Neutral

All vehicles were loaded centered laterally on the autorack and spaced with well over 3 inches between bumpers and 5 inches between bumpers and end doors. All parking brakes were all fully set. Vehicle in the B-4 position had the automatic transmission place in “Neutral” as is the normal recommendation for this vehicle.   The remaining vehicle transmissions were place in “Park” as recommended.

Note: The B-1Toyota Tundra and the B-2 Ford Edge was instrumented to measure force input when under impact conditions.   This instrumentation was applied at the request of the supplier and was handled separate from the committee sponsored testing. Results of these data are not included in this report.

TEST DESCRIPTION

The impact series was conducted with forward target speeds of 6, 7, 8, and 9 MPH and reverse impacts with target speeds of 8 and 9 MPH.   Each securement system was applied by the respective supplier and judged to be properly applied, intact and ready for testing. The anvil string consisted of cars with their brakes applied and with a total weight of approximately 500,000 lbs.   The anvil cars were:

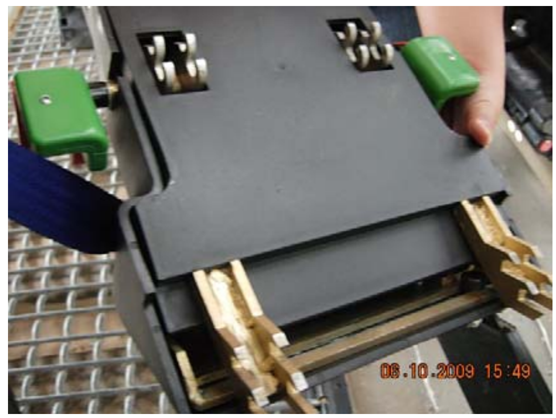
MP- 582911	57,900 lbs
CR - 433432	49,600 lbs
DRGW - 60971	81,100 lbs
DRGW - 60932	80,500 lbs
BN - 5227423	286,000 lbs

View of test car with panels removed for viewing.

IMPACT NO. 1 – TARGET SPEED 6.0 MPH FORWARD DIRECTION – Actual speed was 6.2 MPH; Anvil string wheel slide was 8 inches. There was a general tightening of the load in the direction of the struck end of the car. There was no visible damage to test components, vehicles or railcar.

IMPACT NO. 2 – TARGET SPEED 7.0 MPH FORWARD DIRECTION – Actual speed was 6.7 MPH; Anvil string wheel slide was 11.5 inches. There was visible movement of all vehicles. The load continued to tighten toward the struck end of the autorack which created slight voids between the tires and face plate of the chock type systems. The left rear chock on the B-2 unit secured with the Holland system became disengaged from the locking track. The locking handle was still in the locked position. There was one very small scratch noted on one cross wire of the floor grating but no other signs to indicate reason for disengagement. There were no broken or otherwise defect components of any kind visible. All locking teeth, levers and all components appeared to be intact and undamaged in any manner. There was no visible damage to the railcar or to the vehicle. It appeared likely that the chock may not have been full and correctly applied to the grating but an exact cause for the release is unknown.

View of disengage Holland chock.



Underside of chock with no witness marks.

IMPACT NO. 3 – TARGET SPEED 8.0 MPH FORWARD DIRECTION – Actual speed was 8.0 MPH; Anvil string wheel slide was 23 inches. There was visible movement of all vehicles but all were contained by the securement systems. The grating at the B-2 unit secured by the Holland system was pulled upward approximately 1 inch but did not appear to be bent. The grating appeared to only be under tension and not permanently deformed. (Note – This was observed later during the test after the tension was released and the panel returned to its original shape with no visible permanent deformation). There were no other exceptions of any kind noted with any of the other systems, vehicles or railcar.

View of lifted grating.

IMPACT NO. 4 – TARGET SPEED 9.0 MPH FORWARD DIRECTION – Actual speed was 8.9 MPH; Anvil string wheel slide was 25 inches. There was considerable visible movement of the vehicles and the A-3 (Dodge Ram 4x4 secured by the ZefTek system) vehicle moved over the front chocks. The upper face plate of both front ZefTek chocks was severely permanently deformed. There was no visible damage to the vehicle or railcar nor to any other chock system, vehicles or railcar.

Note: The front chocks on the A-3 unit were replaced prior to the reverse impact.

View of vehicle tire out-of-chocks.

IMPACT NO. 5 – TARGET SPEED 8.0 MPH REVERSE DIRECTION – Actual speed was 8.1 MPH; Anvil string wheel slide was 25 inches. There was considerable visible movement of vehicles and a tightening of vehicles in the direction of the impact resulting in slight voids created between the chocks and the faceplate of the chock type securement systems. The tension on the grading of the B-2 unit secured by the Holland system returned to its original position and did not show any permanent deformation. There was no visible damage to any test components, vehicles or railcar.

IMPACT NO. 6 – TARGET SPEED 9.0 MPH FORWARD DIRECTION - The actual speed was 9.1 MPH; Anvil string wheel slide was 29 inches. There was considerable visible vehicle movement with the vehicles continuing to tighten against chocks in the direction of impact. Slight voids remained at the rear chocks. All system remained intact and secured all vehicles. There was no visible damage to test components, vehicles or railcar.

SECUREMENT REMOVAL

Following this impact the securement systems were attempted to be removed. The vehicles secured by the ZefTek and Holland systems exerted pressure on the chocks and the chocks could not be removed until the parking brakes were released and the vehicles moved. The tires of the vehicles secured with the TrinityRail system prohibited the hooks from being removed from the decking until the vehicles were moved. The Holden America chocks were removed without special handling.

RESULTS AND OBSERVATIONS:

There were no clearance issues between any of the securement systems and any of the vehicles in the test.

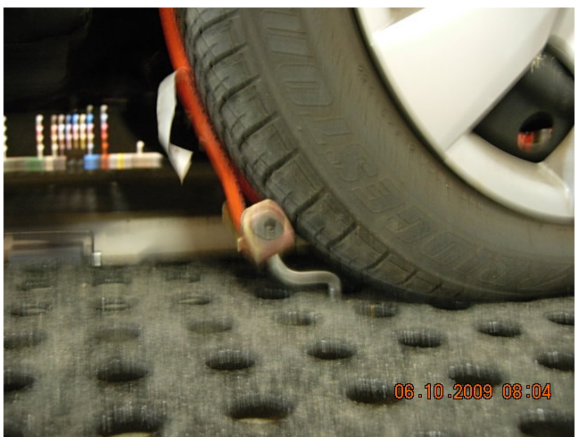
Each of the securement systems supplied by Holden America, Holland, TrinityRail and ZefTek secured the vehicles until higher than normal acceptable coupling speeds were reached. The only damage to any securement system, vehicle or railcars was to the 2 front chocks of the ZefTek system when the B-3 vehicle moved over the chocks at 8.9 MPH. There was no other visible damage to any of the securement systems, components, vehicles or railcar throughout the remaining portion of the test.

HOLLAND CO. - The reason for the Holland chock disengagement remains unknown but was likely due to incorrect installation. Users of this system must be aware of the retracting feature of the strap and be aware that it retracts quite quickly and may potentially contact a vehicle causing damage or cause personnel injury. Care must be exerted to control the hook end during this procedure. The strap also has moveable rubber cleats that are to be positioned in the tread area of the tire when installing the system. These cleats must also fully retract, or be moved by hand, to be against the chock to allow proper chock storage. Both the positioning of the cleats during application and ensuring the strap is fully retracted and the cleats are in proper position when storing will likely be an issue that will require considerable training with loading and unloading crews. The Holland system did not experience the problem of hook removal as the other systems that used a hook. The system is relatively easy and fast to apply and remove. The chock is relatively heavy and feels out of balance when handled by the handle which is at the end of the chock. Most of the weight is forward of the handle making the chock very “nose” heavy and difficult to hold in a level position.

ZEFTEK - At 8.9 MPH the Dodge Ram vehicle in the A-3 position secured by the ZefTek product without a strap, moved over the chocks. This is a large vehicle and both front chocks were severely distorted (permanently) but not fractured during this incident which was far above normal coupling speeds. The chock is relatively heavy and feels out of balance with much of the weight forward of the normal handling position. This makes it difficult to handle. The system performed well in all other impacts. There is concern with the strap application as it pulls directly vertically on the chock body which is a different force than in the original design. There were no problems with this during the test but should continue to be monitored.

TRINITYRAIL - The TrinityRail securement track exhibited some slight distortion through a lifting action during the high speed impacts. Upon release of the applied pressure, the tracks returned to normal shape and did not show any signs of permanent deformation. Two systems for installation of the special tracks were used. The system permanently affixed to the deck will make it very difficult to remove and clean debris, snow, ice, etc. from under the track. There is concern with the use of the Shaft Locking pins on the deck that can be lifted to allow cleaning. The locking mechanism of the Shaft Pin is a wire fastener that can potentially be a hazard to snag clothing or footwear or can be easily be disengaged if stepped on. The ability to clean under the decking is desirable but a different locking feature is recommended.

Upon completion of the test, the securement system could not be removed until the vehicle was moved due to the curvature of the tire being over the securement hook which prevented the hook from being released from the track. There was only slight movement of the vehicle during the test but it was sufficient to prevent hook release. This is a major concern that would affect unloading personnel. The strap system is somewhat difficult to handle because of the winch at the end of the strap and the various hooks used to secured the strap to the deck. Application is more time consuming the other systems.



View showing hook blocked by tire.

Example the idler hook blocked.

HOLDEN AMERICA - The Holden America system uses 8 chocks per vehicle, 2 chocks per wheel. This fact obviously requires more chocks and storage means as well as positioning 8 chocks is more work and time than positioning a lesser number. The actual application of each chock is fast and easy to accomplish. The color coded system works very well. The system is designed so a portion of the chock moves to contact the tire which will reduce any void. Removal of all voids is a great feature; however, moving parts are always a concern from a maintenance perspective. This feature must be observed over time. During the test the system performed as designed. This feature was also instrumental in allowing easy removal of the chocks at the conclusion of the test, even with the vehicles exerting pressure against the chocks. The chock feels out of balance and is relatively heavy to handle with one hand as much of the weight is away from the handle position.

Test Attendees Included :

Kevin Merten, UP
Bruno Pietrobon, Holden America
Jean Iorio, Holden America
Diego Pino, Holden America
Jyll Boudreau, Holland
Jon Butler, Holland
Bob Cencer, TrinityRail
John Peach, ZefTek
Ed Vechiola, Wabtec/ZefTek
Mark Derickson, Toyota
Dwayne Florence, AAR/TTCI
Mike Sandoval, AAR/TTCI
John Blackman, AAR/TTCI
Assorted TTCI Test and Train crew

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