



MASH TL-3 CRASH TESTING AND EVALUATION OF THE TxDOT T631 BRIDGE RAIL



Crash testing performed at:
TTI Proving Ground
3100 SH 47, Building 7091
Bryan, TX 77807

Test Report No. 9-1002-12-12

Cooperative Research Program

**TEXAS A&M TRANSPORTATION INSTITUTE
COLLEGE STATION, TEXAS**

in cooperation with the
Federal Highway Administration and the
Texas Department of Transportation

<http://tti.tamu.edu/documents/9-1002-12-12.pdf>

1. Report No. FHWA/TX-14/9-1002-12-12		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle MASH TL-3 CRASH TESTING AND EVALUATION OF THE TxDOT T631 BRIDGE RAIL				5. Report Date Published: July 2016	
				6. Performing Organization Code	
7. Author(s) William F. Williams, Roger P. Bligh, Wanda L. Menges, and Darrell L. Kuhn				8. Performing Organization Report No. Test Report No. 9-1002-12-12	
9. Performing Organization Name and Address Texas A&M Transportation Institute Proving Ground College Station, Texas 77843-3135				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. Project 9-1002-12	
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Implementation Office P.O. Box 5080 Austin, Texas 78763-5080				13. Type of Report and Period Covered Test Report: September 2013–May 2014	
				14. Sponsoring Agency Code	
15. Supplementary Notes Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project Title: Roadside Safety Device Crash Testing Program URL: http://tti.tamu.edu/documents/9-1002-12-12.pdf					
16. Abstract <p>The Texas Type T631 bridge rail was developed as a low-cost, flexible bridge rail system for TL-2 applications. Many of the features used for the system tested at MwRSF for TL-3 were incorporated into the design developed for this project for <i>MASH</i> TL-2 application. The TxDOT Type T631 bridge rail was designed, developed, and evaluated under <i>MASH</i> TL-2.</p> <p>The objective of this research was to evaluate the impact performance of the new TxDOT Type T631 bridge rail to <i>MASH</i> TL-3. The TxDOT Type T631 bridge rail was intended to serve as a low-cost replacement for the TxDOT Type T6 bridge rail for <i>MASH</i> TL-2 applications. The crash testing was performed in accordance with the requirements of <i>MASH</i> TL-3.</p> <p>The TxDOT T631 Bridge Rail performed acceptably for <i>MASH</i> TL-3.</p>					
17. Key Words Bridge Rail, Guardrail, Longitudinal Barrier, Crash Testing, Roadside Safety			18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Alexandria, Virginia 22312 http://www.ntis.gov		
19. Security Classif.(of this report) Unclassified		20. Security Classif.(of this page) Unclassified		21. No. of Pages 168	22. Price

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BRIDGE RAIL***

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Test Report No. 9-1002-12-12
Project 9-1002-12
Project Title: Roadside Safety Device Crash Testing Program

Performed in cooperation with the
Texas Department of Transportation
and the
Federal Highway Administration

Published: July 2016

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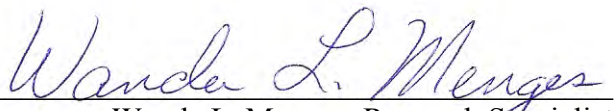
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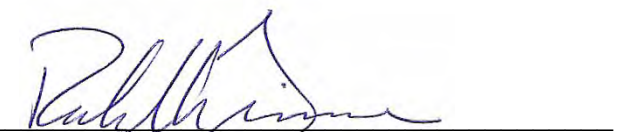
This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation, and its contents are not intended for construction, bidding, or permit purposes. In addition, the above listed agencies assume no liability for its contents or use thereof. The United States Government and the State of Texas do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report. The engineer in charge of the project was William Williams, P.E. (Texas, #71898).

TTI PROVING GROUND DISCLAIMER

The results of the crash testing reported herein apply only to the article being tested.




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ACKNOWLEDGMENTS

This research project was conducted under a cooperative program between the Texas A&M Transportation Institute, the Texas Department of Transportation, and the Federal Highway Administration. The TxDOT project manager for this research was Wade Odell, RTI. Amy Smith, P.E., TxDOT Bridge Division provided support. The authors acknowledge and appreciate their guidance and assistance.

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CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

The project under which the current research was conducted was set up to provide the Texas Department of Transportation (TxDOT) with a mechanism to quickly and effectively evaluate high-priority issues related to roadside safety devices. Roadside safety devices shield motorists from roadside hazards such as non-traversable terrain and fixed objects. To maintain the desired level of safety for the motoring public, these safety devices must be designed to accommodate a variety of site conditions, placement locations, and a changing vehicle fleet. Periodically, there is a need to assess the compliance of existing safety devices with current vehicle testing criteria and develop new devices that address identified needs.

Under this project, roadside safety issues were identified and prioritized for investigation. Each roadside safety issue was addressed with a separate work plan, and the results are summarized in individual test reports.

1.2 BACKGROUND

In August 2010, Midwest Roadside Safety Facility (MwRSF) developed and crash-tested a low-cost, energy-absorbing bridge rail in accordance with the American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware (MASH)* Test Level 3 (TL-3) applications (1, 2). This low-cost bridge rail was designed to be compatible with the Midwest Guardrail System (MGS) such that an approach transition would not be required between the two barriers. It was desired that the system minimize bridge deck and rail costs. As part of this project, several concepts for an energy-absorbing bridge post were developed and tested. These concepts included strong-post systems designed with plastic hinges and weak-post systems designed to bend near the attachment to the bridge deck. The final post concept incorporated $S3 \times 5.7$ steel sections designed to yield at their bases. The posts were spaced on 6 ft 3 inch centers. A W-beam section was used as the rail element and was attached to the posts with a bolt designed to break during an impact event. Two full-scale crash tests were performed according to the TL-2 impact conditions provided in *MASH*. The new bridge rail system successfully met all the safety performance criteria for *MASH*.

The Texas Type T631 bridge rail was developed as a low-cost, flexible bridge rail system for TL-2 applications. Many of the features used for the system tested at MwRSF for TL-3 were incorporated into the design developed for this project for *MASH* TL-2 application. The TxDOT Type T631 bridge rail was designed, developed, and evaluated under *MASH* TL-2.

1.3 OBJECTIVES/SCOPE OF RESEARCH

This research evaluated the impact performance of the new TxDOT Type T631 bridge rail to *MASH* TL-3. The TxDOT Type T631 bridge rail was intended to serve as a low-cost replacement for the TxDOT Type T6 bridge rail for *MASH* TL-2 applications. The crash testing was performed in accordance with the requirements of *MASH* TL-3.

This report describes the TxDOT Type T631 bridge rail, documents the performance of the rail system according to *MASH* TL-3 specifications, and presents recommendations regarding implementation and future work.

CHAPTER 2. SYSTEM DETAILS

2.1 TEST ARTICLE DESIGN AND CONSTRUCTION

Both test installations consisted of a 100 ft 0 inch long W-beam and structural steel post bridge rail constructed on a 101 ft 6 inch long concrete cantilever deck with a standard ET-PLUS end terminal on the upstream end and a standard Downstream Anchor Terminal (DAT) on the opposite end. However, there were differences in the upstream (ET-PLUS end) guardrail installation and length that are described in separate sections below.

Thirty-three posts on the bridge deck were equally spaced at 3 ft 1½ inches, and were installed as S3×5.7 A992 structural steel posts welded to base plates and subsequently bolted through the bridge deck cantilever. The base plates were 8-inch × 8-inch × ⅝-inch thick A529 grade 55 steel and were welded to the bottom of each of the posts with continuous ¼-inch fillet welds. The center lines of the post and base plates coincided. The base plates contained four ¾-inch × 1-inch oblong bolting slots (refer to Appendix A, Sheet 5 of 7).

Each base plate was attached to the bridge deck cantilever with four ⅝-inch diameter × 10-inch long A325 bolts (FBX16a) from below with an 8-inch × 6¾-inch × ¼-inch thick A36 steel washer plate on the bottom and corresponding ⅝-inch flat washers, lock washers, and hex nuts on top of the base plate.

On the cantilevered deck, the bridge deck posts were 32 inches in height (inclusive of the base plate) and had two ⅜-inch diameter holes drilled in the roadside flange of each post, located 25 inches above the base (7 inches from the top of the post) through which to attach the W-beam. The W-beam was attached using one ⅝-inch diameter × 2½-inch long A307 bolt (FBX08a) per post, each assembled with a corresponding standard square guardrail washer, a ⅝-inch flat washer, lock washer, hex nut, and jam nut.

Backup plates were used between the bridge deck posts and the W-beam rail (see Appendix A, Sheet 1 and 6 of 7). The backup plates were 15 inches tall, fabricated from 8-inch wide, ⅝-inch thick A1011 CS Type B sheet steel (substituted for A1011 SS Grade 33) with 2½-inch wide flat and equal legs (of approximately 2½ inches) bent longitudinally away from the guardrail at 30 degrees. Each backup plate contained three ⅝-inch diameter holes for attaching to the posts (one for attaching the guardrail, and one for a shelf bolt).

Additionally, one ⅞-inch diameter hole was drilled in one leg of the roadside flange of each bridge deck post, located 18½ inches above the base, provided to accommodate the installation of a shelf bolt (½-inch diameter × 1¼-inch long A307 hex bolt with one hex nut). The W-beam rested on a flat of the head of the hex bolt. W-beam guardrail sections were joined with standard 1¼-inch guardrail bolts and nuts.

Both test installations utilized a reinforced concrete bridge deck cantilever that was constructed by adding on to the existing concrete runway mat. The cantilever was 30 inches wide × 101 ft 6 inches long × 8-inch thick reinforced concrete with a minimum specified strength of 4000 psi. The centerlines of the bridge deck guardrail posts were located laterally approximately 5½ inches from the field side edge of the cantilevered deck slab.

Transverse reinforcement in the deck cantilever consisted of two layers of $\frac{5}{8}$ -inch nominal diameter reinforcing wire (#5 rebar) at approximately 2 inches and $6\frac{3}{4}$ inches below the upper surface of the deck. The traverse bars were welded to the existing rebar that protrudes from the edge of the runway. The upper transverse bars were spaced on 6-inch centers and longitudinally joined with three runs of $\frac{1}{2}$ -inch nominal diameter reinforcing wire (#4 rebar) placed at 2 inches, 11 inches, and 20 inches from the field side face of the cantilever and located on the bottom side of the upper traverse bars. The lower transverse bars were spaced on 18-inch centers longitudinally joined with three runs of $\frac{5}{8}$ -inch nominal diameter reinforcing wire (#5 rebar) placed at 2 inches, $5\frac{1}{2}$ inches, and $17\frac{1}{2}$ inches from the field side face of the cantilever and located on the top side of the lower traverse bars.

Longitudinal reinforcement within the rebar panels was overlapped a minimum of 15 inches for the #4 rebar in the top panel, and overlapped a minimum of 19 inches for the #5 rebar in the bottom panel (refer to Appendix A1, Sheet 7 of 7). All unions of longitudinal, traverse, and vertical rebar were wire-tied on site.

The bolting was inserted through the deck via four $\frac{3}{4}$ -inch nominal diameter electrical metallic tubing conduit sleeves cast into the deck at the 17 odd numbered post locations at the time of the concrete pour. Holes for the 16 even numbered post location base plates were core drilled (as opposed to pneumatic/hammer drilled) in the deck as required.

On the downstream end of each installation, a standard 31 ft 3 inch long TxDOT DAT with five posts equally spaced at 6 ft 3 inches was constructed. The first three of five posts (adjacent to the bridge deck) were standard W6×8.5 structural steel line posts (SLP) embedded in drilled and tamped soil as found in a typical terminal installation. The final two posts were DAT terminal posts as described in TxDOT Design Standard GF(31)DAT-11 (refer to Appendix A1, Sheet 1 and 4 of 7 and the TxDOT drawing included as the last page of Appendix A1).

2.1.1 Test Article 490024-1-2 Design and Construction

For *MASH* Test 3-11, the test installation included a standard 50-ft ET-PLUS end terminal directly attached to the upstream end of the bridge deck. The ET-PLUS, bridge deck, and standard DAT combined for a total end-post to end-post installation length of 181 ft 3 inches.

The ET-PLUS was comprised of eight posts equally spaced at 6 ft 3 inches. Post 1 was a standard ET-PLUS cable release post (CRP) and embedded in the soil per a typical ET-PLUS terminal installation. A standard ET-PLUS anchor cable and cable anchor bracket were used to anchor the W-beam rail to post 1. A $3\times 3\times\frac{1}{4}$ -inch steel angle ground strut on the field side of the terminals connected posts 1 and 2 (refer to Appendix A1, Sheet 1 and 3 of 6).

Posts 2 through 7 were steel yielding terminal posts (SYTPs) fabricated from W6×8.5 structural steel shapes and embedded in the soil per a typical ET-PLUS terminal installation (refer to Appendix A1, Sheet 3 of 6). Post 8 was a standard W6×8.5 structural steel line post SLP (type PWE01) embedded in drilled and tamped soil. The W-beam guardrail was attached to posts 3 through 18 with standard routed wooden offset spacer blocks (type PDB01b) and 10 inch guardrail bolts and recessed nuts (types FBB03 and FBB).

Post 9 was the first post on the bridge deck, and post 41 was the last post on the bridge deck as described above. Posts 42 through 46 comprised the DAT. Figure 2.1 presents the overall details of the installation, and Figure 2.2 shows photographs of the completed installation. Appendix A1 provides the detailed drawings.

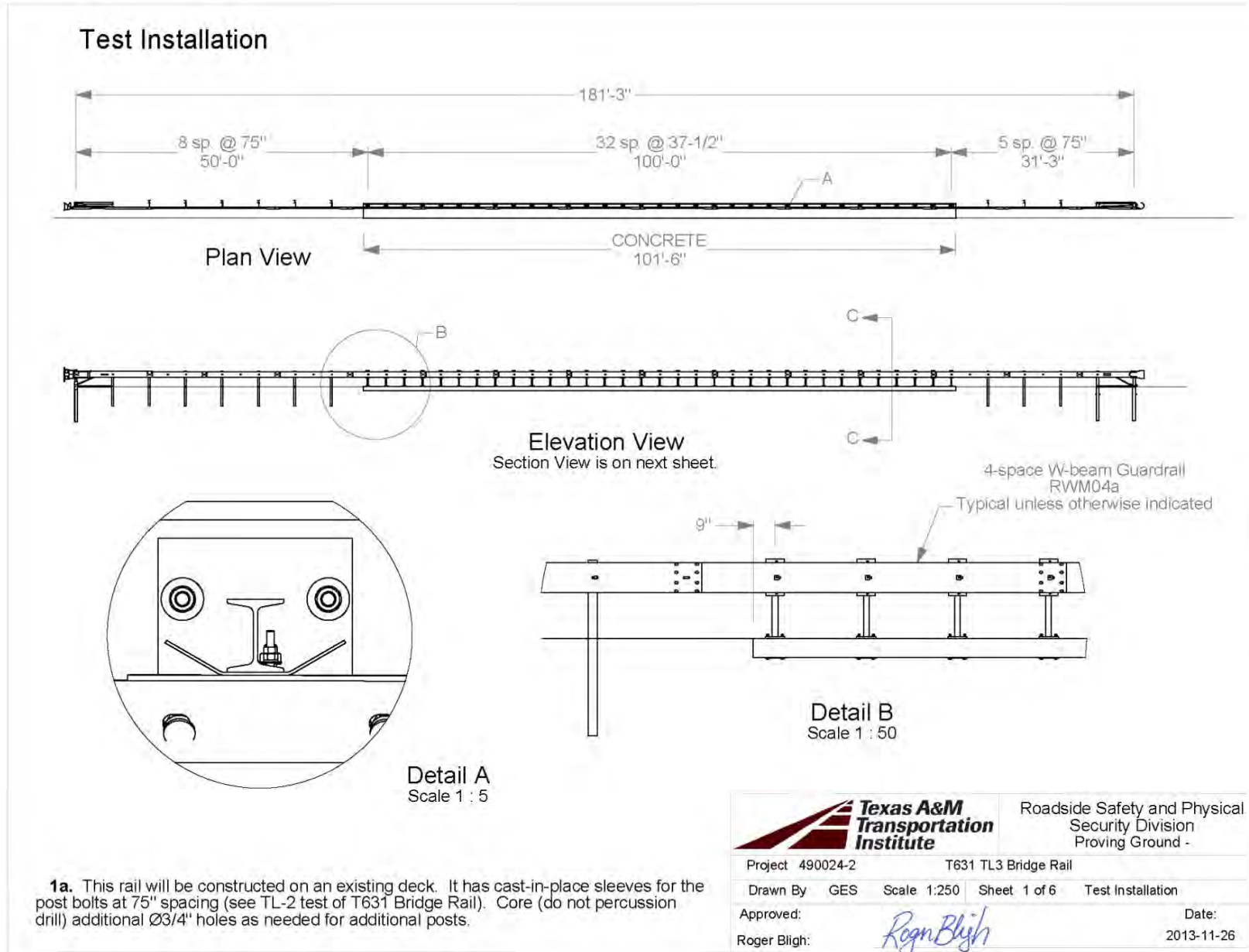
2.1.2 Test Article 490024-1-5 Design and Construction

For *MASH* Test 3-10, the test installation included a standard 50-ft ET-PLUS end terminal on the upstream end of the installation, plus a 62 ft 6 inch long length-of-need section of standard W-Beam guardrail supported on steel line posts between the 50-ft ET-PLUS section and the bridge deck. The ET-PLUS, length-of-need section, bridge deck, and standard DAT combined for a total installation length of 243 ft 9 inches.

The ET-PLUS was comprised of eight posts equally spaced at 6 ft 3 inches. Post 1 was a standard ET-PLUS CRP and embedded in the soil per a typical ET-PLUS terminal installation. A standard ET-PLUS anchor cable and cable anchor bracket were used to anchor the W-beam rail to post 1. A 3×3×¼-inch steel angle ground strut on the field side of the terminals connected posts 1 and 2 (refer to Appendix A2, Sheet 1 and 3 of 6).

Posts 2 through 8 were SYTPs fabricated from W6×8.5 structural steel shapes and embedded in the soil per a typical ET-PLUS terminal installation (refer to Appendix A2, Sheet 3 of 6). Posts 9 through 18 in the length-of-need section were standard W6×8.5 SLPs (type PWE01) embedded in drilled and tamped soil. The W-beam guardrail was attached to posts 3 through 18 with standard routed wooden offset spacer blocks (type PDB01b) and 10 inch guardrail bolts and recessed nuts (types FBB03 and FBB).

Post 19 was the first post on the bridge deck and post 51 was the last post on the bridge deck as described above. Posts 52 through 56 comprised the DAT. Figures 2.3 presents the overall details of the installation, and Figure 2.4 shows photographs of the completed installation. Appendix A2 provides the detailed drawings.

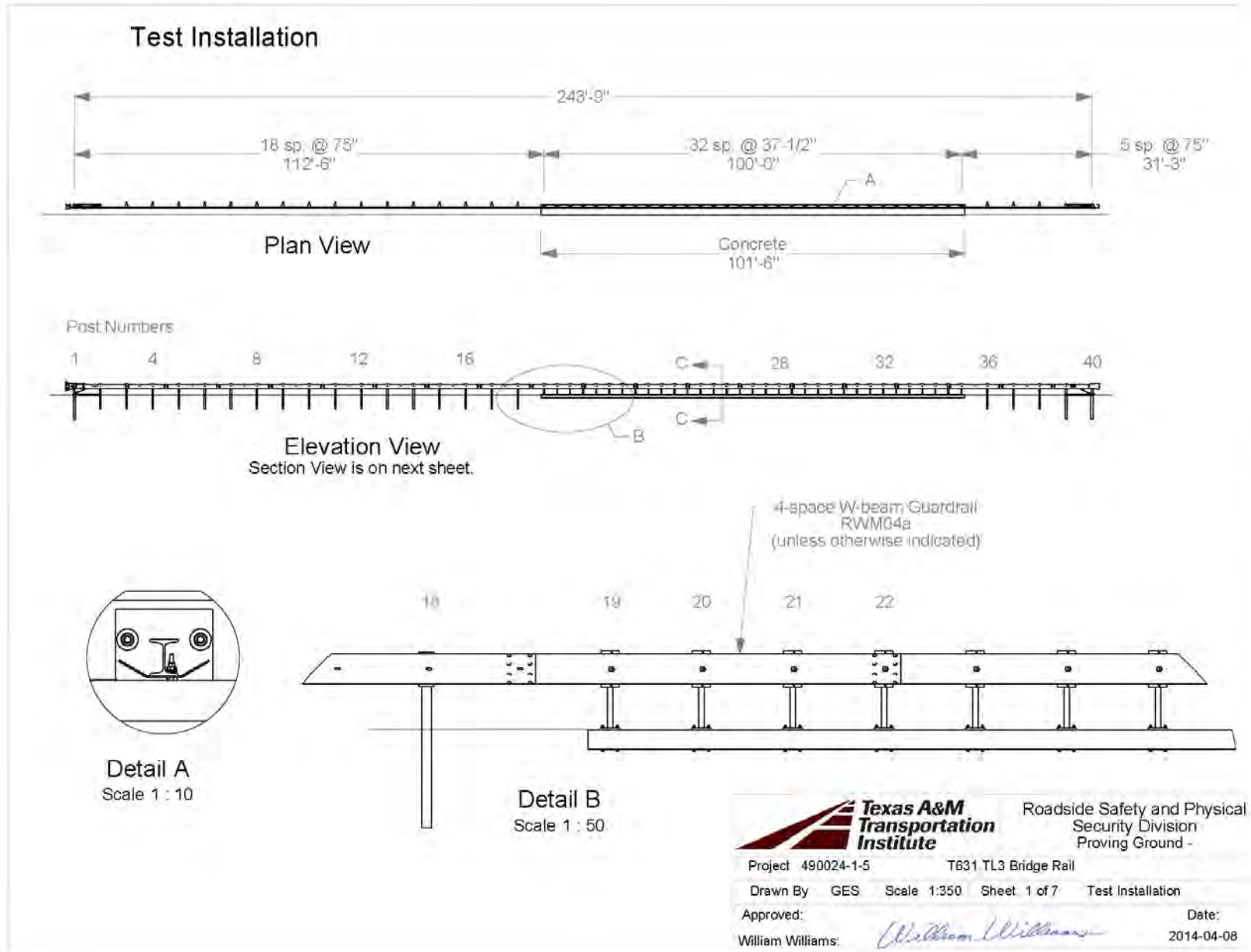


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Figure 2.1. Overall Details of the TxDOT T631 Bridge Rail Used for Test No. 490024-1-2.



Figure 2.2. TxDOT T631 Bridge Rail before Test No. 490024-1-2.



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Figure 2.3. Overall Details of the TxDOT T631 Bridge Rail Used for Test No. 490024-1-5.



Figure 2.4. TxDOT T631 Bridge Rail before Test No. 490024-1-5.

2.2 MATERIAL SPECIFICATIONS

The TxDOT Class S specified minimum compressive strength of the concrete for the bridge deck cantilever was 4000 psi. The compressive strengths of the two batches of concrete used in the deck cantilever measured an average of 6770 psi (at 28 days) and 4610 psi (at 28 days).

Reinforcement of the bridge deck was comprised of Grade 60 rebar wire reinforcement as fabricated on site by TTI, with a specified minimum yield strength of 60 ksi. Appendix B contains mill certification sheets and other certification documents for the materials used in the bridge deck test installation.

2.3 SOIL CONDITIONS

In accordance with Appendix B of *MASH*, soil strength was measured the day of the crash test. During installation of the terminal sections for the TxDOT T631 Bridge Rail for full-scale crash testing, two standard W6×16 posts were installed in the immediate vicinity of the TxDOT T631 Bridge Rail, utilizing the same fill materials and installation procedures used in the standard dynamic test. As determined in the tests shown in Appendix C, Table C1, the minimum post load required for deflections at 5 inches, 10 inches, and 15 inches, measured at a height of 25 inches, is 3940 lb, 5500 lb, and 6540 lb, respectively (90 percent of static load for the initial standard installation).

On the day of Test No. 490024-1-2, December 5, 2013, load on the post at deflections of 5 inches, 10 inches, and 15 inches was 6313 lbf, 6262 lbf, and 6161 lbf, respectively. The strength of the backfill material met minimum requirements for 5 inches and 10 inches, however, was below the minimum for 15 inches (refer to Appendix C, Table C2). The engineers determined that the difference was minimal, and the crash test was performed.

On the day of Test No. 490024-1-5, May 12, 2014, load on the post at deflections of 5 inches, 10 inches, and 15 inches was 6262 lbf, 6161 lbf, and 5909 lbf, respectively. The strength of the backfill material met minimum requirements for 5 inches and 10 inches, however, was below the minimum for 15 inches (refer to Appendix C, Table C3). The engineers determined that the difference was minimal, and the crash test was performed.

CHAPTER 3. TEST REQUIREMENTS AND EVALUATION CRITERIA

3.1 CRASH TEST MATRIX

According to *MASH*, two tests are recommended to evaluate longitudinal barriers to Test Level Three (TL-3).

- ***MASH* Test 3-10:** A 2420-lb vehicle impacting the critical impact point (CIP) of the length of need (LON) of the barrier at a nominal impact speed and angle of 62 mi/h and 25 degrees, respectively. This test investigates a barrier's ability to successfully contain and redirect a small passenger vehicle.
- ***MASH* Test 3-11:** A 5000-lb pickup truck impacting the CIP of the LON of the barrier at a nominal impact speed and angle of 62 mi/h and 25 degrees, respectively. This test investigates a barrier's ability to successfully contain and redirect light trucks and sport utility vehicles.

The tests reported herein correspond to *MASH* Test 3-10 and *MASH* Test 3-11. The CIP for *MASH* Test 3-10 was 9 ft 9 inches upstream of the third splice on the deck located at post 30, placing the target impact point at 4.5 inches upstream of post 27 (no splice). The CIP for *MASH* Test 3-11 was 13 ft 7.25 inches upstream of the fourth splice on the deck located at post 24, placing the target impact point at 13.25 inches upstream of the third splice on the deck located at post 20. These CIPs were calculated in accordance with the *MASH* specifications.

The crash tests and data analysis procedures performed for this research were in accordance with guidelines presented in *MASH*, and a brief description of these are provided in Chapter 4.

3.2 EVALUATION CRITERIA

The crash test was evaluated in accordance with the criteria presented in *MASH*. The performance of the TxDOT T631 Bridge Rail is judged on the basis of three factors: structural adequacy, occupant risk, and post-impact vehicle trajectory. Structural adequacy is judged on the ability of the bridge rail to contain and redirect the vehicle, or bring the vehicle to a controlled stop in a predictable manner. Occupant risk criteria evaluate the potential risk of hazard to occupants in the impacting vehicle, and, to some extent, other traffic, pedestrians, or workers in construction zones, if applicable. Post-impact vehicle trajectory is assessed to determine potential for secondary impact with other vehicles or fixed objects, creating further risk of injury to occupants of the impacting vehicle and/or risk of injury to occupants in other vehicles. The appropriate safety evaluation criteria from Table 5-1 of *MASH* were used to evaluate the crash test reported here and are listed in further detail under the assessment of the crash test.

CHAPTER 4. CRASH TEST PROCEDURES

4.1 TEST FACILITY

The full-scale crash tests reported here were performed at Texas A&M Transportation Institute (TTI) Proving Ground, an International Standards Organization (ISO) 17025 accredited laboratory with American Association for Laboratory Accreditation (A2LA) Mechanical Testing certificate 2821.01. The full-scale crash tests were performed according to TTI Proving Ground quality procedures and the *MASH* guidelines and standards.

The TTI Proving Ground is a 2000-acre complex of research and training facilities located 10 miles northwest of the main campus of Texas A&M University. The site, formerly a United States Army Air Corp base, has large expanses of concrete runways and parking aprons well-suited for experimental research and testing in the areas of vehicle performance and handling, vehicle-roadway interaction, durability and efficacy of highway pavements, and safety evaluation of roadside safety hardware. The site selected for construction and testing of the TxDOT T631 Bridge Rail evaluated under this project was along the edge of an out-of-service apron. The apron consists of an unreinforced jointed-concrete pavement in 12.5-ft × 15-ft blocks nominally 6 inches deep. The apron was built in 1942, and the joints have some displacement, but are otherwise flat and level.

4.2 VEHICLE TOW AND GUIDANCE PROCEDURES

The test vehicles were towed into the test installation using a steel cable guidance and reverse tow system. A steel cable for guiding the test vehicle was tensioned along the path, anchored at each end, and threaded through an attachment to the front wheel of the test vehicle. An additional steel cable was connected to the test vehicle, passed around a pulley near the impact point, through a pulley on the tow vehicle, and then anchored to the ground such that the tow vehicle moved away from the test site. A 2:1 speed ratio between the test and tow vehicle existed with this system. Just prior to impact with the installation, the test vehicle was released to be unrestrained. The vehicle remained freewheeling (i.e., no steering or braking inputs) until it cleared the immediate area of the test site, after which the brakes were activated to bring it to a safe and controlled stop.

4.3 DATA ACQUISITION SYSTEMS

4.3.1 Vehicle Instrumentation and Data Processing

The test vehicle was instrumented with a self-contained, on-board data acquisition system. The signal conditioning and acquisition system is a 16-channel, Tiny Data Acquisition System (TDAS) Pro that Diversified Technical Systems, Inc. produced. The accelerometers, which measure the x, y, and z axis of vehicle acceleration, are strain gauge type with linear millivolt output proportional to acceleration. Angular rate sensors, measuring vehicle roll, pitch, and yaw rates, are ultra-small, solid state units designed for crash test service. The TDAS Pro hardware and software conform to the latest SAE J211, Instrumentation for Impact Test. Each of the 16 channels is capable of providing precision amplification, scaling, and filtering based on transducer specifications and calibrations. During the test, data are recorded from each channel

at a rate of 10,000 values per second with a resolution of one part in 65,536. Once data are recorded, internal batteries back these up inside the unit should the primary battery cable be severed. Initial contact of the pressure switch on the vehicle bumper provides a time zero mark and initiates the recording process. After each test, the data are downloaded from the TDAS Pro unit into a laptop computer at the test site. The Test Risk Assessment Program (TRAP) software then processes the raw data to produce detailed reports of the test results. Each of the TDAS Pro units is returned to the factory annually for complete recalibration. Accelerometers and rate transducers are also calibrated annually with traceability to the National Institute for Standards and Technology. Acceleration data are measured with an expanded uncertainty of ± 1.7 percent at a confidence factor of 95 percent ($k=2$).

TRAP uses the data from the TDAS Pro to compute occupant/compartment impact velocities, time of occupant/compartment impact after vehicle impact, and the highest 10-millisecond (ms) average ridedown acceleration. TRAP calculates change in vehicle velocity at the end of a given impulse period. In addition, maximum average accelerations over 50-ms intervals in each of the three directions are computed. For reporting purposes, the data from the vehicle-mounted accelerometers are filtered with a 60-Hz digital filter, and acceleration versus time curves for the longitudinal, lateral, and vertical directions are plotted using TRAP.

TRAP uses the data from the yaw, pitch, and roll rate transducers to compute angular displacement in degrees at 0.0001-s intervals, then plots yaw, pitch, and roll versus time. These displacements are in reference to the vehicle-fixed coordinate system with the initial position and orientation of the vehicle-fixed coordinate systems being initial impact. Rate of rotation data is measured with an expanded uncertainty of ± 0.7 percent at a confidence factor of 95 percent ($k=2$).

4.3.2 Anthropomorphic Dummy Instrumentation

An Alderson Research Laboratories Hybrid II, 50th percentile male anthropomorphic dummy, restrained with lap and shoulder belts, was placed in the driver's position of the 1100C vehicle. The dummy was uninstrumented. Use of a dummy in the 2270P vehicle is optional according to *MASH*, and no dummy was used in the tests with the 2270P vehicle.

4.3.3 Photographic Instrumentation and Data Processing

Photographic coverage of the test included three high-speed cameras: one overhead with a field of view perpendicular to the ground and directly over the impact point; one placed behind the installation at an angle; and a third placed to have a field of view parallel to and aligned with the installation at the downstream end. A flashbulb activated by pressure-sensitive tape switches was positioned on the impacting vehicle to indicate the instant of contact with the installation and was visible from each camera. The films from these high-speed cameras were analyzed on a computer-linked motion analyzer to observe phenomena occurring during the collision and to obtain time-event, displacement, and angular data. A mini-DV camera and still cameras recorded and documented conditions of the test vehicle and installation before and after the test.

CHAPTER 5. RESULTS FOR TEST 490024-1-2 (MASH TEST 3-11)

5.1 TEST DESIGNATION AND ACTUAL IMPACT CONDITIONS

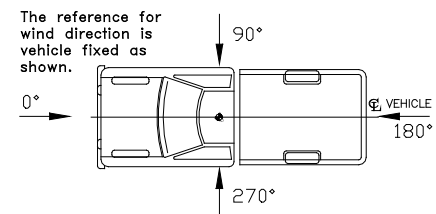
MASH Test 3-11 involves a 2270P vehicle weighing 5000 lb \pm 110 lb and impacting the CIP of the bridge rail at an impact speed of 62.2 mi/h \pm 2.5 mi/h and an angle of 25 degrees \pm 1.5 degrees. The CIP for *MASH* Test 3-11 on the TxDOT T631 Bridge Rail was 13 ft 7.25 inches upstream of the fourth splice on the deck located at post 24, placing the target impact point at 13.25 inches upstream of the third splice on the deck located at post 20. The 2007 Dodge Ram 1500 pickup truck used in the test weighed 5023 lb, and the actual impact speed and angle were 62.6 mi/h and 26.1 degrees, respectively. The actual impact point was 24.0 inches upstream of post 20. Target impact severity was 115.5 kip-ft, and actual IS was 127.4 kip-ft (+11 percent).

5.2 TEST VEHICLE

The 2007 Dodge Ram 1500 pickup truck, shown in Figures 5.1 and 5.2, was used for the crash test. Test inertia weight of the vehicle was 5023 lb, and its gross static weight was 5023 lb. The height to the lower edge of the vehicle bumper was 15.5 inches, and it was 27.0 inches to the upper edge of the bumper. The height to the vehicle's center of gravity was 29.125 inches. Tables D1 and D2 in Appendix D gives additional dimensions and information on the vehicle. The vehicle was directed into the installation using the cable reverse tow and guidance system, and was released to be free-wheeling and unrestrained just prior to impact.

5.3 WEATHER CONDITIONS

The test was performed on the morning of December 5, 2013. Weather conditions at the time of testing were as follows: (a) wind speed: 14 mi/h; (b) wind direction: 334 degrees with respect to the vehicle (vehicle was traveling in a northwesterly direction); (c) temperature: 41°F; (d) relative humidity: 84 percent.



5.4 TEST DESCRIPTION

The 2007 Dodge Ram 1500 pickup truck, traveling at an impact speed of 62.6 mi/h, impacted the T631 Bridge Rail 24 inches downstream of post 20 at an impact angle of 26.1 degrees. At approximately 0.059 s after impact, the rail element and posts in the immediate area of impact began to deflect toward the field side, and at 0.089 s, the left front tire rode off the edge of the bridge deck. The rail element detached from posts 20 through 26 at 0.183 s, and the left rear tire rode off the deck and the right rear tire became airborne at 0.212 s. At 0.230 s, the rail element detached from posts 27 through 29, and at 0.280 s, the vehicle was traveling parallel with the bridge rail. The bridge rail began to redirect the vehicle back onto the bridge deck at 0.918 s, and the left front tire contacted the posts at the end of the system at 1.041 s. The vehicle was out of view of the high-speed cameras when it lost contact with the bridge rail. Figures D1 and D2 in Appendix D show sequential photographs of the test period.



Figure 5.1. Vehicle/Installation Geometrics for Test No. 490024-1-2.



Figure 5.2. Vehicle before Test No. 490024-1-2.

5.5 DAMAGE TO TEST INSTALLATION

Figure 5.3 and 5.4 shows the damage to the T631 Bridge Rail. The soil around post 1 was minimally disturbed. Posts 16 through 18 were leaning downstream 3 degrees, and post 19 was leaning downstream 10 degrees. Posts 20 and 21 fractured through the front flange and web just above the weld and were deformed over the edge of the bridge deck. Posts 22 and 23 were leaning downstream 45 degrees and toward the field side 80 degrees. Posts 24 through 39 were leaning downstream 80 degrees. The backup plates separated from posts 31 and 32, and the rail element separated from posts 19 through 43. The rail element tore halfway through its height at the splice at post 24. The vehicle was in contact with the bridge rail 64.5 ft. Maximum dynamic deflection of the rail element during the test was 55.2 inches, and maximum permanent deformation was 17.0 inches. Working width was 57.7 inches, and vehicle intrusion was 58.3 inches.

5.6 VEHICLE DAMAGE

Figure 5.5 provides photographs of the damage sustained by the pickup truck. The front bumper, left front fender, left front tire and wheel rim, left front and rear doors, left rear tire, left rear exterior bed, and rear bumper were damaged. Maximum exterior crush to the vehicle was 8.0 inches in the front plane at the left front corner at bumper height. No occupant compartment deformation or intrusion occurred. Figure 5.6 shows the interior of the vehicle before and after the test. Tables D3 and D4 in Appendix D provide exterior crush and occupant compartment measurements.

5.7 OCCUPANT RISK FACTORS

Data from the accelerometer, located at the vehicle center of gravity, were digitized for evaluation of occupant risk. In the longitudinal direction, the occupant impact velocity was 15.4 ft/s at 0.143 s, the highest 0.010-s occupant ridedown acceleration was 5.1 Gs from 0.557 to 0.567 s, and the maximum 0.050-s average acceleration was -4.3 Gs between 0.015 and 0.065 s. In the lateral direction, the occupant impact velocity was 16.4 ft/s at 0.143 s, the highest 0.010-s occupant ridedown acceleration was 5.1 Gs from 0.143 to 0.153 s, and the maximum 0.050-s average was 4.7 Gs between 0.103 and 0.153 s. Theoretical Head Impact Velocity (THIV) was 24.0 km/h or 6.7 m/s at 0.138 s; Post-Impact Head Decelerations (PHD) was 5.3 Gs between 0.143 and 0.153 s; and Acceleration Severity Index (ASI) was 0.63 between 0.046 and 0.096 s. Figure 5.7 summarizes these data and other pertinent information from the test. Appendix D, Figures D3 through D9 show the vehicle angular displacements and accelerations versus time traces.



Figure 5.3. After Impact Trajectory Path for Test No. 490024-1-2.



Figure 5.4. TxDOT T631 Bridge Rail after Test No. 490024-1-2.



Figure 5.5. Vehicle after Test No. 490024-1-2.

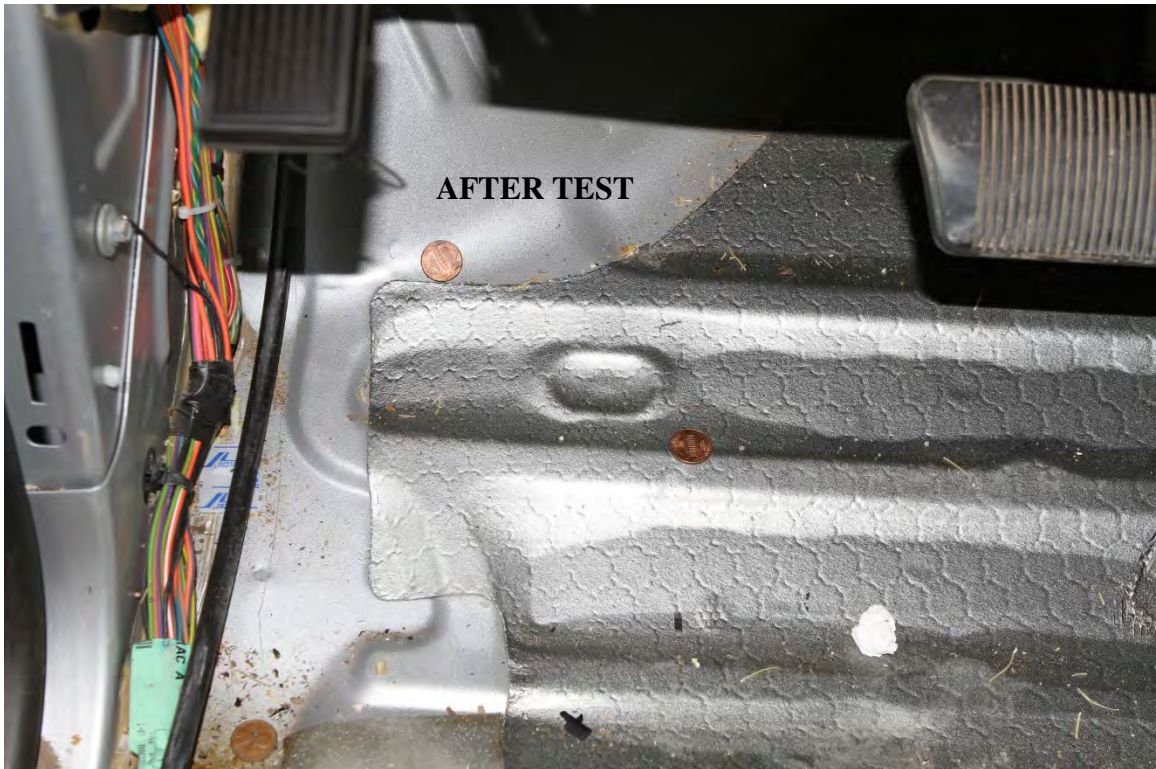
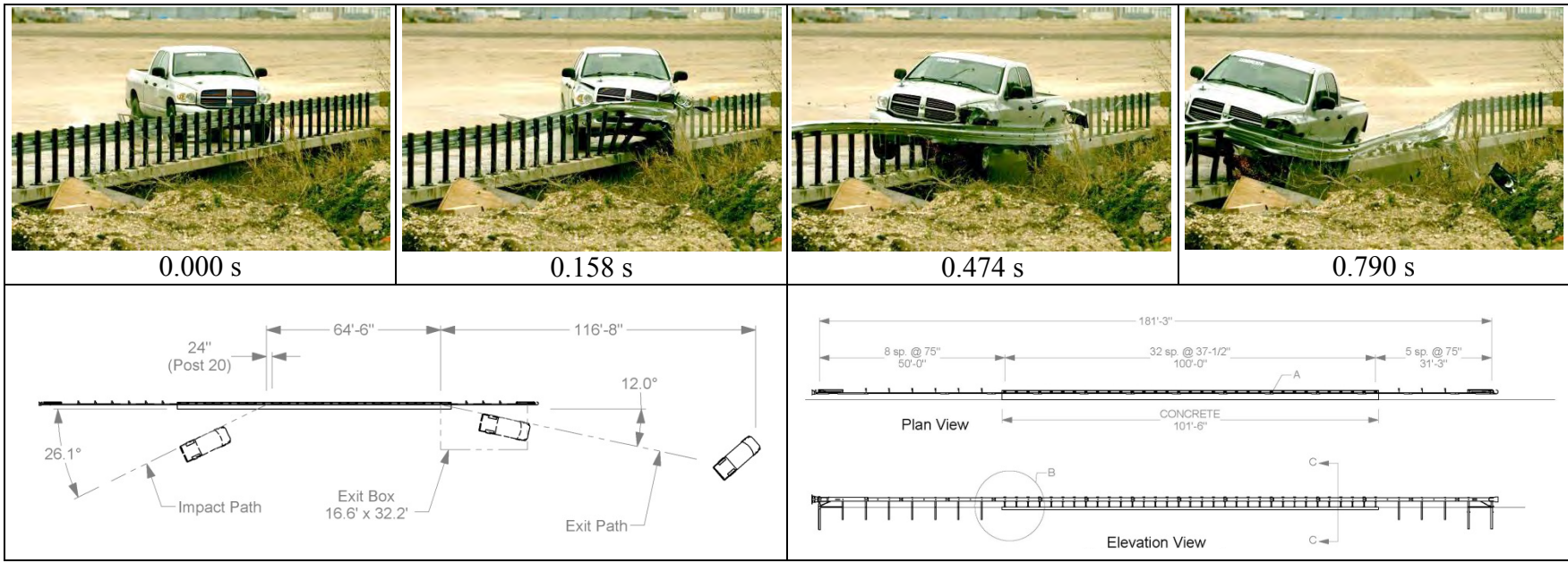


Figure 5.6. Interior of Vehicle for Test No. 490024-1-2.



General Information

Test Agency Texas A&M Transportation Institute (TTI)
 Test Standard Test No. MASH Test 3-11
 TTI Test No. 490024-1-2
 Test Date 2013-12-05

Test Article

Type Bridge Rail
 Name TxDOT T631 Bridge Rail
 Installation Length 181 ft 3 inches
 Material or Key Elements Reinforced concrete bridge deck cantilever with S3x5.7 A992 structural steel posts welded to base plates and bolted through the bridge deck

Soil Type and Condition..... Concrete Deck, Dry

Test Vehicle

Type/Designation 2270P
 Make and Model..... 2007 Dodge Ram 1500 Pickup
 Curb 5110 lb
 Test Inertial 5023 lb
 Dummy..... No dummy
 Gross Static..... 5023 lb

Impact Conditions

Speed62.6 mi/h
 Angle26.1 degrees
 Location/Orientation CIP
 Impact Severity.....127.4 kip-ft (+11%)

Exit Conditions

SpeedNot obtainable
 AngleNot obtainable

Occupant Risk Values

Impact Velocity
 Longitudinal.....15.4 ft/s
 Lateral.....16.4 ft/s
 Ridedown Accelerations
 Longitudinal.....5.1 G
 Lateral5.1 G
 THIV24.0 km/h
 PHD5.3 G
 ASI0.63
 Max. 0.050-s Average
 Longitudinal.....-4.3 G
 Lateral4.7 G
 Vertical1.8 G

Post-Impact Trajectory

Stopping Distance 181 ft dwnstrm
 24 ft twd traffic

Vehicle Stability

Maximum Yaw Angle 47 degrees
 Maximum Pitch Angle..... 5 degrees
 Maximum Roll Angle..... 16 degrees
 Vehicle Snagging..... No
 Vehicle Pocketing No

Test Article Deflections

Dynamic 55.2 inches
 Permanent..... 17.0 inches
 Working Width 57.7 inches
 Vehicle Intrusion..... 58.3 inches

Vehicle Damage

VDS..... 11LFQ4
 CDC 11LFEW3
 Max. Exterior Deformation 8.0 inches
 OCDI LF0000000
 Max. Occupant Compartment Deformation..... None

Figure 5.7. Summary of Results for MASH Test 3-11 on the TxDOT T631 Bridge Rail.

5.8 ASSESSMENT OF TEST RESULTS

An assessment of the test based on the applicable *MASH* safety evaluation criteria is provided below.

5.8.1 Structural Adequacy

- A. *Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underide, or override the installation although controlled lateral deflection of the test article is acceptable.*

Results: The TxDOT T631 Bridge Rail contained and redirected the 2270P vehicle. The vehicle did not penetrate, underide, or override the installation. Maximum dynamic deflection during the test was 55.2 inches. (PASS)

5.8.2 Occupant Risk

- D. *Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians, or personnel in a work zone. Deformation of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.3 and Appendix E of MASH (roof ≤ 4.0 inches; windshield = ≤ 3.0 inches; side windows = no shattering by test article structural member; wheel/foot well/toe pan ≤ 9.0 inches; forward of A-pillar ≤ 12.0 inches; front side door area above seat ≤ 9.0 inches; front side door below seat ≤ 12.0 inches; floor pan/transmission tunnel area ≤ 12.0 inches).*

Results: No detached elements, fragments, or other debris was present to penetrate or show potential for penetrating the occupant compartment or to present hazard to others in the area. (PASS)
No occupant compartment deformation or intrusion occurred. (PASS)

- F. *The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.*

Results: The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 16 degrees and 5 degrees, respectively. (PASS)

H. *Occupant impact velocities should satisfy the following:*
Longitudinal and Lateral Occupant Impact Velocity

<u>Preferred</u>	<u>Maximum</u>
30 ft/s	40 ft/s

Results: Longitudinal occupant impact velocity was 15.4 ft/s, and lateral occupant impact velocity was 16.4 ft/s. (PASS)

I. *Occupant ridedown accelerations should satisfy the following:*
Longitudinal and Lateral Occupant Ridedown Accelerations

<u>Preferred</u>	<u>Maximum</u>
15.0 Gs	20.49 Gs

Results: Longitudinal ridedown acceleration was 5.1 G, and lateral occupant ridedown acceleration was 5.1 G. (PASS)

5.8.3 Vehicle Trajectory

For redirective devices, the vehicle shall exit the barrier within the exit box (not less than 32.8 ft).

Result: The 2270P exited the bridge rail within the exit box requirement. (PASS)

CHAPTER 6. RESULTS FOR TEST 490024-1-5 (MASH TEST 3-10)

6.1 TEST DESIGNATION AND ACTUAL IMPACT CONDITIONS

MASH Test 3-10 involves an 1100C vehicle weighing 2420 lb \pm 55 lb and impacting the CIP of the bridge rail at an impact speed of 62 mi/h \pm 2.5 mi/h and an angle of 25 degrees \pm 1.5 degrees. The CIP of the TxDOT T631 Bridge Rail for *MASH* Test 3-10 was 9 ft 9 inches upstream of the third splice on the deck located at post 30, placing the target impact point at 4.5 inches upstream of post 27 (no splice). The 2010 Kia Rio used in the test weighed 2426 lb, and the actual impact speed and angle were 62.2 mi/h and 25.6 degrees, respectively. The actual impact point was 10.8 inches upstream of the post 27. Target IS was 55.7 kip-ft, and actual IS was 58.6 kip-ft.

6.2 TEST VEHICLE

A 2010 Kia Rio, shown in Figures 6.1 and 6.2, was used for the crash test. Test inertia weight of the vehicle was 2426 lb, and its gross static weight was 2591 lb. The height to the lower edge of the vehicle bumper was 7.50 inches, and it was 21.25 inches to the upper edge of the bumper. Table E1 in Appendix E gives additional dimensions and information on the vehicle. The vehicle was directed into the installation using the cable reverse tow and guidance system, and was released to be free-wheeling and unrestrained just prior to impact.

6.3 WEATHER CONDITIONS

The test was performed on the morning of May 12, 2014. Weather conditions at the time of testing were as follows: (a) wind speed: 11 mi/h; (b) wind direction: 141 degrees with respect to the vehicle (vehicle was traveling in a northwesterly direction); (c) temperature: 79°F; (d) relative humidity: 82 percent.

6.4 TEST DESCRIPTION

The 2010 Kia Rio, traveling at an impact speed of 62.2 mi/h, impacted the TxDOT T631 Bridge Rail 10.8 inches upstream of post 27 at an impact angle of 25.6 degrees. At approximately 0.015 s after impact, post 27 began to rotate counterclockwise and began to deflect toward the field side, and at 0.022 s, the left front tire contacted post 27. The W-beam rail element began to deform at 0.023 s, and post 26 began to deflect toward the field side at 0.025 s. At 0.029 s, post 28 began to deflect toward the field side and the vehicle began to redirect, and at 0.032 s, the rail element separated from post 27. Post 29 began to deflect toward the field side at 0.034 s, and the rail separated from post 28 at 0.043 s. At 0.054 s, the left front tire reached the field side edge of the bridge deck, and at 0.065 s, post 30 began to deflect toward the field side. The rail element separated from post 29 at 0.081 s, and post 31 began to deflect toward the field side at 0.082 s. At 0.110 s, post 32 began to deflect toward the field side, and at 0.113 s, the rail element separated from post 30. Posts 33 and 34 began to deflect toward the field side at 0.121 s, and the rail element separated from posts 31 at 0.127 s. At 0.149 s, the W-beam rail element began to tear at the lower edge of the splice at post 30, and at 0.152 s, the rail separated from post 32. The vehicle began traveling parallel with the bridge rail at 0.338 s. At 0.627 s, the vehicle lost contact with the bridge rail and was traveling at an exit speed and angle of 30.1 mi/h and 14.5 degrees, respectively. Brakes on the vehicle were not applied, and the vehicle came to rest 189 ft downstream of impact and 43 ft toward traffic lanes. Figures E1 and E2 in Appendix E show sequential photographs of the test period.



Figure 6.1. Vehicle/Installation Geometrics for Test No. 490024-1-5.



Figure 6.2. Vehicle before Test No. 490024-1-5.

6.5 DAMAGE TO TEST INSTALLATION

Figures 6.3 and 6.4 show damage to the bridge rail. Post 1 was pulled downstream 0.125 inch, and posts 2 through 24 exhibited no movement or damage. Posts 25 and 26 were leaning toward the field side at 3 degrees and 9 degrees, respectively. The rail element released from posts 27 through 38. At posts 27 through 29, the backup plates released from the posts, the posts were fractured through the front flange and web just above the weld, and the posts were deformed over the edge of the bridge deck. Posts 30 and 31 were leaning toward the field side 15 degrees and leaning 90 degrees downstream, and the flanges on the upstream side of the posts were fractured just above the weld. Posts 32 through 34 were leaning downstream 60 degrees, post 32 fractured on the upstream field side flange and partially torn on the upstream traffic side flange. The rail element was partially torn (approximately 6 inches) at the splice at post 30.

6.6 VEHICLE DAMAGE

Figure 6.5 shows damage sustained by the vehicle. The left front strut, front bumper, hood, radiator and support, left front fender, left front tire and wheel rim, left front door, left rear quarter panel, and rear bumper were deformed. Maximum exterior crush was 9.0 inches in the side plane at the left front corner at bumper height. No occupant compartment deformation or intrusion occurred. Figure 6.6 provides a photograph of the interior of the vehicle after the test. Tables E2 and E3 provide exterior crush and occupant compartment measurements.

6.7 OCCUPANT RISK FACTORS

Data from the accelerometer, located at the vehicle center of gravity, were digitized for evaluation of occupant risk. In the longitudinal direction, the occupant impact velocity was 26.6 ft/s at 0.134 s, the highest 0.010-s occupant ridedown acceleration was 10.0 Gs from 0.146 to 0.156 s, and the maximum 0.050-s average acceleration was -7.5 Gs between 0.086 and 0.136 s. In the lateral direction, the occupant impact velocity was 16.4 ft/s at 0.134 s, the highest 0.010-s occupant ridedown acceleration was 8.4 Gs from 0.148 to 0.158 s, and the maximum 0.050-s average was 5.2 Gs between 0.070 and 0.120 s. THIV was 33.6 km/h or 9.3 m/s at 0.130 s; PHD was 12.3 Gs between 0.146 and 0.156 s; and ASI was 0.79 between 0.152 and 0.202 s. Figure 6.7 summarizes these data and other pertinent information from the test. Appendix E, Figures E3 through E9 show the vehicle angular displacements and accelerations versus time traces.



Figure 6.3. After Impact Trajectory Path for Test No. 490024-1-5.



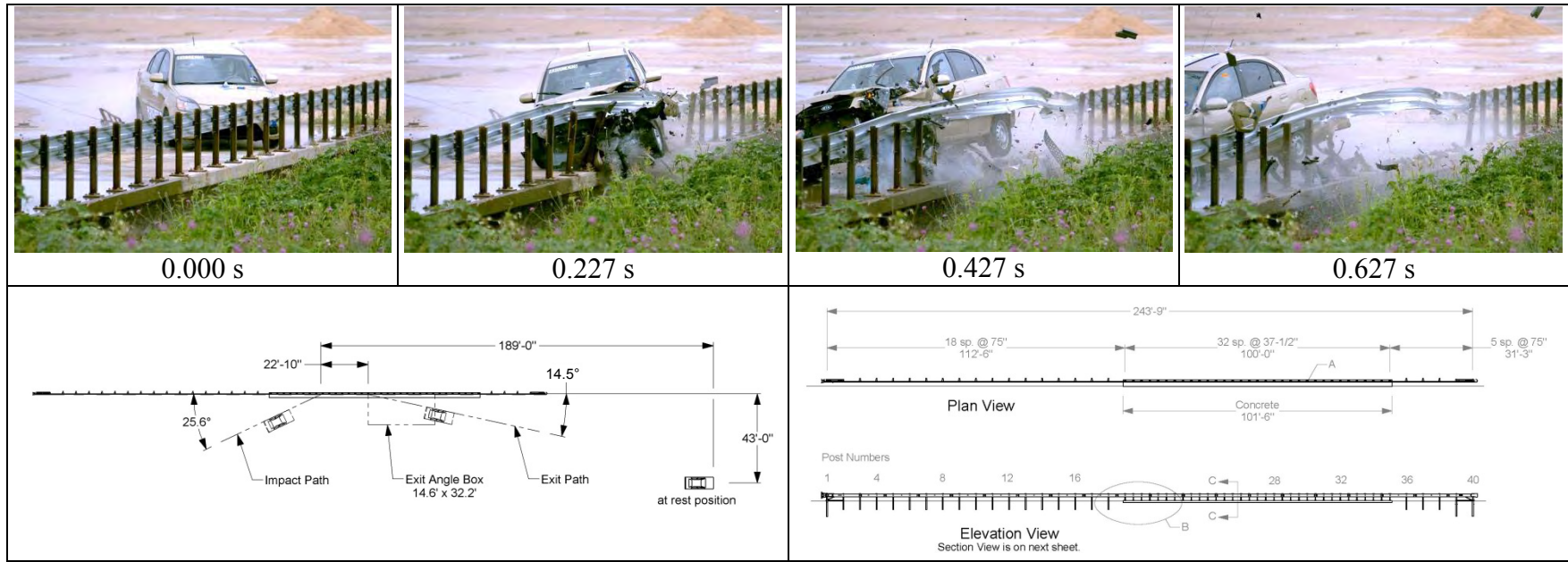
Figure 6.4. Installation after Test No. 490024-1-5.



Figure 6.5. Vehicle after Test No. 490024-1-5.



Figure 6.6. Interior of Vehicle after Test No. 490024-1-5.



General Information

Test Agency Texas A&M Transportation Institute (TTI)
 Test Standard Test No. MASH Test 3-10
 TTI Test No. 490024-1-5
 Test Date 2014-05-12

Test Article

Type Bridge Rail
 Name TxDOT T631 Bridge Rail
 Installation Length 243 ft 9 inches
 Material or Key Elements Reinforced concrete bridge deck cantilever with S3x5.7 A992 structural steel posts welded to base plates and bolted through the bridge deck

Soil Type and Condition

..... Concrete Deck, Dry

Test Vehicle

Type/Designation 1100C
 Make and Model 2010Kia Rio
 Curb 2410 lb
 Test Inertial 2426 lb
 Dummy 165 lb
 Gross Static 2591 lb

Impact Conditions

Speed 62.2 mi/h
 Angle 25.6 degrees
 Location/Orientation CIP
 Impact Severity (IS) 58.6 kip-ft (+5%)

Exit Conditions

Speed 30.1 mi/h
 Angle 14.5 degrees

Occupant Risk Values

Impact Velocity
 Longitudinal 26.6 ft/s
 Lateral 16.4 ft/s
 Ridedown Accelerations
 Longitudinal 10.0 G
 Lateral 8.4 G
 THIV 33.6 km/h
 PHD 12.3 G
 ASI 0.79
 Max. 0.050-s Average
 Longitudinal -7.5 G
 Lateral 5.2 G
 Vertical -2.4 G

Post-Impact Trajectory

Stopping Distance 189 ft dwnstrm
 43 ft twd traffic

Vehicle Stability

Maximum Yaw Angle 41 degrees
 Maximum Pitch Angle 7 degrees
 Maximum Roll Angle 17 degrees
 Vehicle Snagging No
 Vehicle Pocketing No

Test Article Deflections

Dynamic 28.2 inches
 Permanent 19.5 inches
 Working Width 34.8 inches
 Vehicle Intrusion 30.5 inches

Vehicle Damage

VDS 11LFQ5
 CDC 11FLEW4
 Max. Exterior Deformation 9.0 inches
 OCDI LF0000000
 Max. Occupant Compartment Deformation None

Figure 6.7. Summary of Results for MASH Test 3-10 on the TxDOT T631 Bridge Rail.

6.8 ASSESSMENT OF TEST RESULTS

An assessment of the test based on the applicable *MASH* safety evaluation criteria is provided below.

6.8.1 Structural Adequacy

- A. *Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underride, or override the installation although controlled lateral deflection of the test article is acceptable.*

Results: The TxDOT T631 Bridge Rail contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 28.2 inches. (PASS)

6.8.2 Occupant Risk

- D. *Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians, or personnel in a work zone.*
Deformation of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.3 and Appendix E of MASH (roof ≤ 4.0 inches; windshield = ≤ 3.0 inches; side windows = no shattering by test article structural member; wheel/foot well/toe pan ≤ 9.0 inches; forward of A-pillar ≤ 12.0 inches; front side door area above seat ≤ 9.0 inches; front side door below seat ≤ 12.0 inches; floor pan/transmission tunnel area ≤ 12.0 inches).

Results: No detached elements, fragments, or other debris was present to penetrate or show potential for penetrating the occupant compartment or to present hazard to others in the area. (PASS)
No occupant compartment deformation or intrusion occurred. (PASS)

- F. *The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.*

Results: The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 17 degrees and 7 degrees, respectively. (PASS)

H. *Occupant impact velocities should satisfy the following:*
Longitudinal and Lateral Occupant Impact Velocity

<u>Preferred</u>	<u>Maximum</u>
30 ft/s	40 ft/s

Results: Longitudinal occupant impact velocity was 26.6 ft/s, and lateral occupant impact velocity was 16.4 ft/s. (PASS)

I. *Occupant ridedown accelerations should satisfy the following:*
Longitudinal and Lateral Occupant Ridedown Accelerations

<u>Preferred</u>	<u>Maximum</u>
15.0 Gs	20.49 Gs

Results: Longitudinal ridedown acceleration was 10.0 G, and lateral ridedown acceleration was 8.4 G. (PASS)

6.8.3 Vehicle Trajectory

For redirective devices, the vehicle shall exit the barrier within the exit box (not less than 32.8 ft).

Result: The 1100C vehicle exited the installation within the exit box criteria. (PASS)

CHAPTER 7. SUMMARY AND CONCLUSIONS

7.1 ASSESSMENT OF TEST RESULTS

7.1.1 MASH Test 3-11 (Crash Test 490024-1-2)

MASH Test 3-11 involves a 2270P vehicle weighing 5000 lb \pm 110 lb and impacting the CIP of the bridge rail at an impact speed of 62.2 mi/h \pm 2.5 mi/h and an angle of 25 degrees \pm 1.5 degrees. The CIP for *MASH* Test 3-11 on the TxDOT T631 Bridge Rail was 13 ft 7.25 inches upstream of the fourth splice on the deck located at post 24, placing the target impact point at 13.25 inches upstream of the third splice on the deck located at post 20. The 2007 Dodge Ram 1500 pickup truck used in the test weighed 5023 lb, and the actual impact speed and angle were 62.6 mi/h and 26.1 degrees, respectively. The actual impact point was 24.0 inches upstream of post 20. Target impact severity was 115.5 kip-ft, and actual IS was 127.4 kip-ft (+11 percent).

The TxDOT T631 Bridge Rail contained and redirected the 2270P vehicle. The vehicle did not penetrate, underide, or override the installation. Maximum dynamic deflection during the test was 55.2 inches. No detached elements, fragments, or other debris was present to penetrate or show potential for penetrating the occupant compartment or to present hazard to others in the area. No occupant compartment deformation or intrusion occurred. The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 16 degrees and 5 degrees, respectively. Occupant risk factors were with the preferred limits specified in *MASH*. The 2270P exited the bridge rail within the exit box requirement.

7.1.2 MASH Test 3-10 (Crash Test 490024-1-5)

MASH Test 3-10 involves an 1100C vehicle weighing 2420 lb \pm 55 lb and impacting the CIP of the bridge rail at an impact speed of 62 mi/h \pm 2.5 mi/h and an angle of 25 degrees \pm 1.5 degrees. The CIP for *MASH* Test 3-10 of the TxDOT T631 Bridge Rail was 9 ft 9 inches upstream of the third splice on the deck located at post 30, placing the target impact point at 4.5 inches upstream of post 27 (no splice). The 2010 Kia Rio used in the test weighed 2426 lb, and the actual impact speed and angle were 62.2 mi/h and 25.6 degrees, respectively. The actual impact point was 10.8 inches upstream of the post 27. Target IS was 55.7 kip-ft, and actual IS was 58.6 kip-ft.

The TxDOT T631 Bridge Rail contained and redirected the 1100C vehicle. The vehicle did not penetrate, underide, or override the installation. Maximum dynamic deflection during the test was 28.2 inches. No detached elements, fragments, or other debris was present to penetrate or show potential for penetrating the occupant compartment or to present hazard to others in the area. No occupant compartment deformation or intrusion occurred. The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 17 degrees and 7 degrees, respectively. Occupant risk factors were with the preferred limits specified in *MASH*. The 1100C vehicle exited the installation within the exit box criteria.

7.2 CONCLUSIONS

The TxDOT T631 Bridge Rail performed acceptably for *MASH* TL-3, as shown in Tables 7.1 and 7.2.

Table 7.1. Performance Evaluation Summary for MASH Test 3-11 on the TxDOT T631 Bridge Rail.

Test Agency: Texas A&M Transportation Institute

Test No.: 490024-1-2

Test Date: 2013-12-05

MASH Test 3-11 Evaluation Criteria	Test Results	Assessment
Structural Adequacy <i>A. Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underride, or override the installation although controlled lateral deflection of the test article is acceptable.</i>	The TxDOT T631 Bridge Rail contained and redirected the 2270P vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 55.2 inches.	Pass
Occupant Risk <i>D. Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians, or personnel in a work zone.</i>	No detached elements, fragments, or other debris was present to penetrate or show potential for penetrating the occupant compartment or to present hazard to others in the area.	Pass
<i>Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.3 and Appendix E of MASH.</i>	No occupant compartment deformation or intrusion occurred.	Pass
<i>F. The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.</i>	The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 16 degrees and 5 degrees, respectively.	Pass
<i>H. Longitudinal and lateral occupant impact velocities should fall below the preferred value of 30 ft/s, or at least below the maximum allowable value of 40 ft/s.</i>	Longitudinal occupant impact velocity was 15.4 ft/s, and lateral occupant impact velocity was 16.4 ft/s.	Pass
<i>I. Longitudinal and lateral occupant ridedown accelerations should fall below the preferred value of 15.0 Gs, or at least below the maximum allowable value of 20.49 Gs.</i>	Longitudinal ridedown acceleration was 5.1 G, and lateral occupant ridedown acceleration was 5.1 G.	Pass
Vehicle Trajectory <i>For redirective devices, the vehicle shall exit the barrier within the exit box.</i>	The 2270P exited the bridge rail within the exit box requirement.	Pass

Table 7.2. Performance Evaluation Summary for MASH Test 3-10 on the TxDOT T631 Bridge Rail.

Test Agency: Texas A&M Transportation Institute

Test No.: 490024-1-5

Test Date: 2014-05-12

MASH Test 3-10 Evaluation Criteria	Test Results	Assessment
Structural Adequacy <i>A. Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underride, or override the installation although controlled lateral deflection of the test article is acceptable.</i>	The TxDOT T631 Bridge Rail contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 28.2 inches.	Pass
Occupant Risk <i>D. Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians, or personnel in a work zone.</i>	No detached elements, fragments, or other debris was present to penetrate or show potential for penetrating the occupant compartment or to present hazard to others in the area.	Pass
<i>Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.3 and Appendix E of MASH.</i>	No occupant compartment deformation or intrusion occurred.	Pass
<i>F. The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.</i>	The 1100C vehicle remained upright during and after the collision event. Maximum roll was 17 degrees and maximum pitch was 7 degrees.	Pass
<i>H. Longitudinal and lateral occupant impact velocities should fall below the preferred value of 30 ft/s, or at least below the maximum allowable value of 40 ft/s.</i>	Longitudinal occupant impact velocity was 26.6 ft/s, and lateral occupant impact velocity was 16.4 ft/s.	Pass
<i>I. Longitudinal and lateral occupant ridedown accelerations should fall below the preferred value of 15.0 Gs, or at least below the maximum allowable value of 20.49 Gs.</i>	Longitudinal ridedown acceleration was 10.0 G, and lateral ridedown acceleration was 8.4 G.	Pass
Vehicle Trajectory <i>For redirective devices, the vehicle shall exit the barrier within the exit box.</i>	The 1100C vehicle exited the installation within the exit box criteria.	Pass

CHAPTER 8. IMPLEMENTATION STATEMENT

Based on the results from this crash testing, the TxDOT T631 Bridge Rail is recommended for use on TxDOT Projects for *MASH* TL-3 applications.

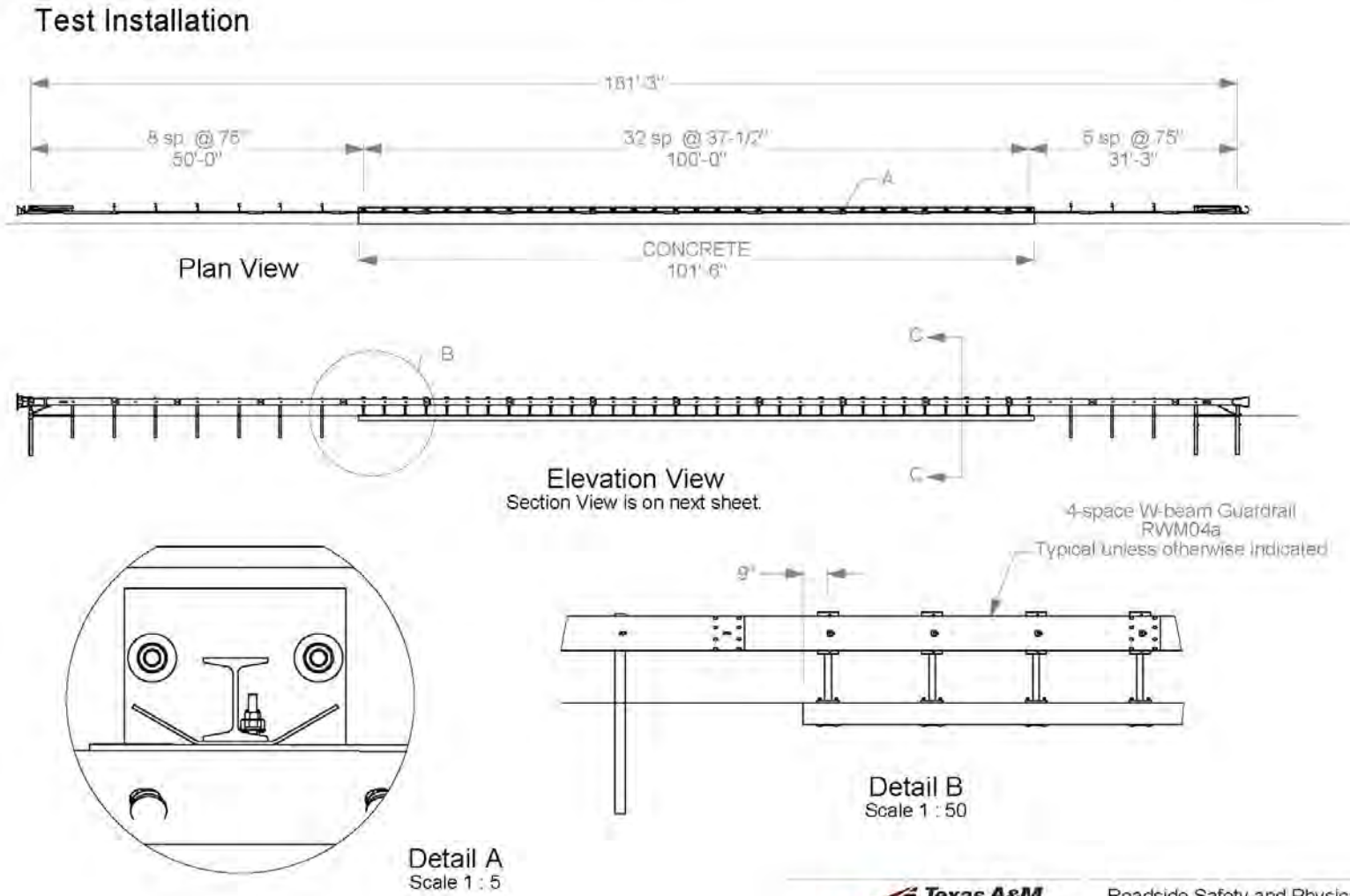
REFERENCES

1. AASHTO, *Manual for Assessing Safety Hardware*, American Association of State Highway and Transportation Officials, Washington, D.C., 2009.
2. Jeffrey Thiele, Dean Sicking, Ronald Faller, Robert Bielenberg, Karla (Polivka) Lechtenberg, John Reid, and Scott Rosenbaugh. [*Development of a Low-Cost, Energy-Absorbing Bridge Rail*](#), MwRSF Research Report No. TRP-03-226-10, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, 2010.

APPENDIX A. DETAILS OF THE TEST ARTICLE

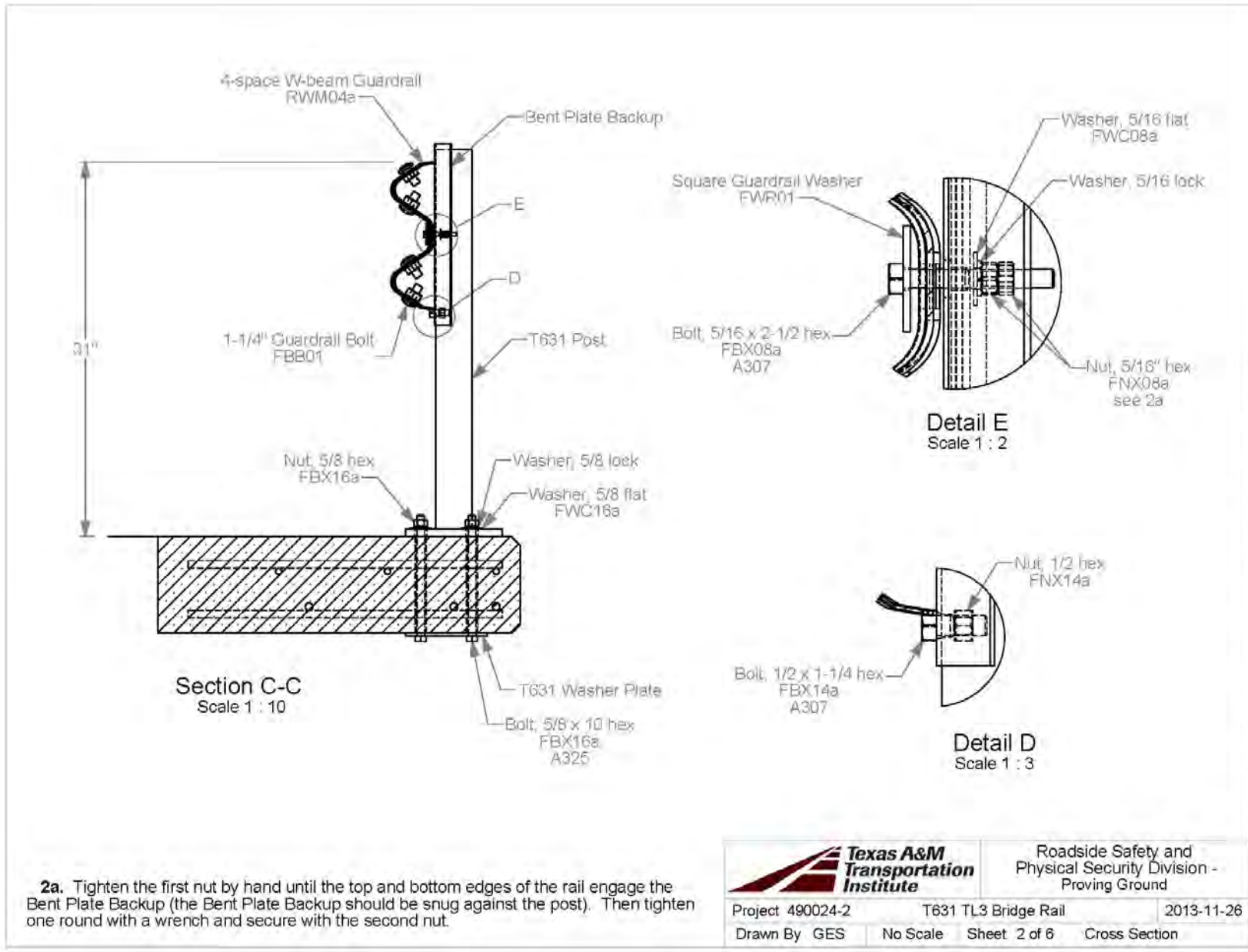
A1 TEST ARTICLE FOR TEST NO. 490024-1-2

D:\mwork\c-720057\mwork\490024-1-2\c-720057\TLOD-A1 - 720057\102-3100-01.dwg



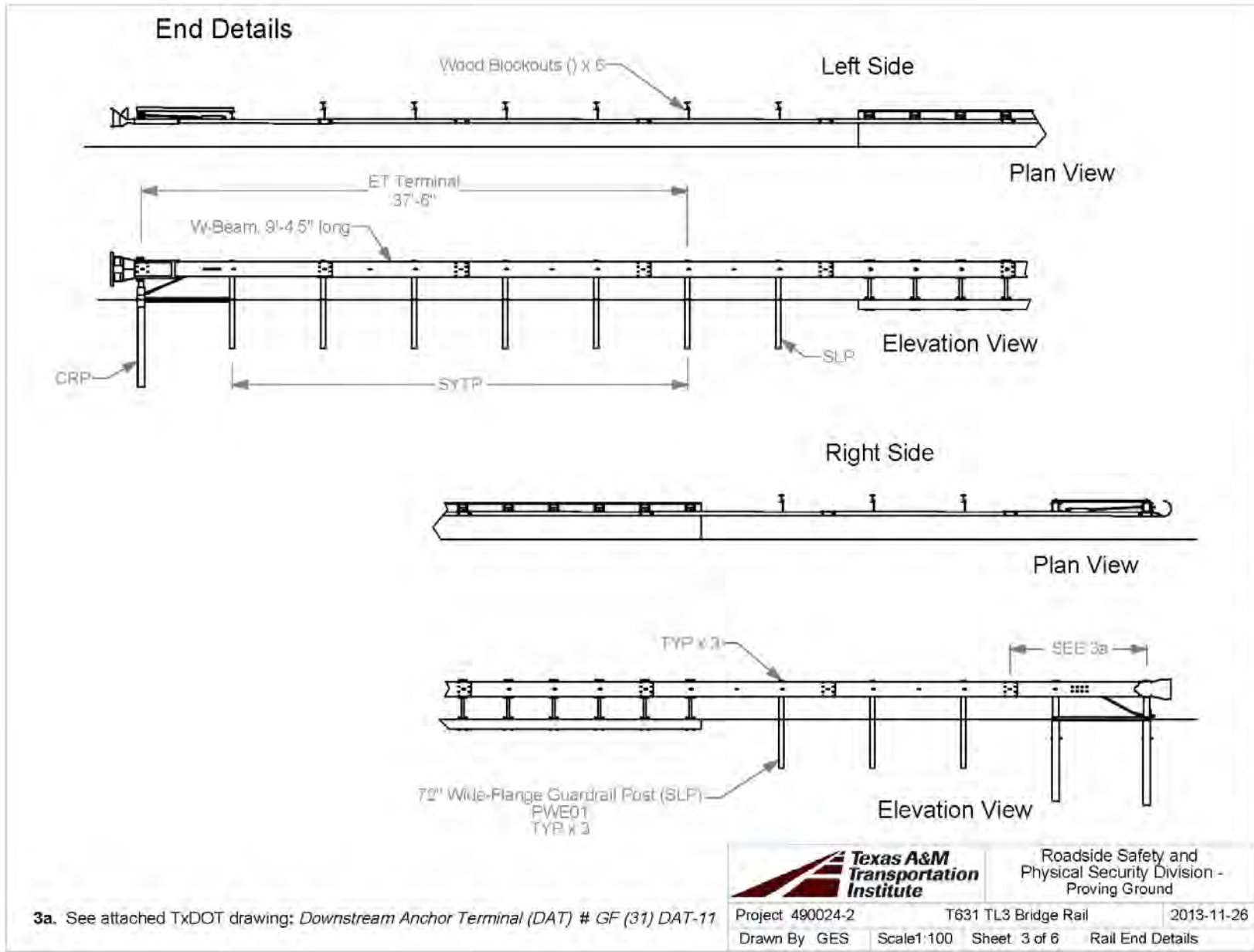
1a. This rail will be constructed on an existing deck. It has cast-in-place sleeves for the post bolts at 75" spacing (see TL-2 test of T631 Bridge Rail). Core (do not percussion drill) additional Ø3/4" holes as needed for additional posts.

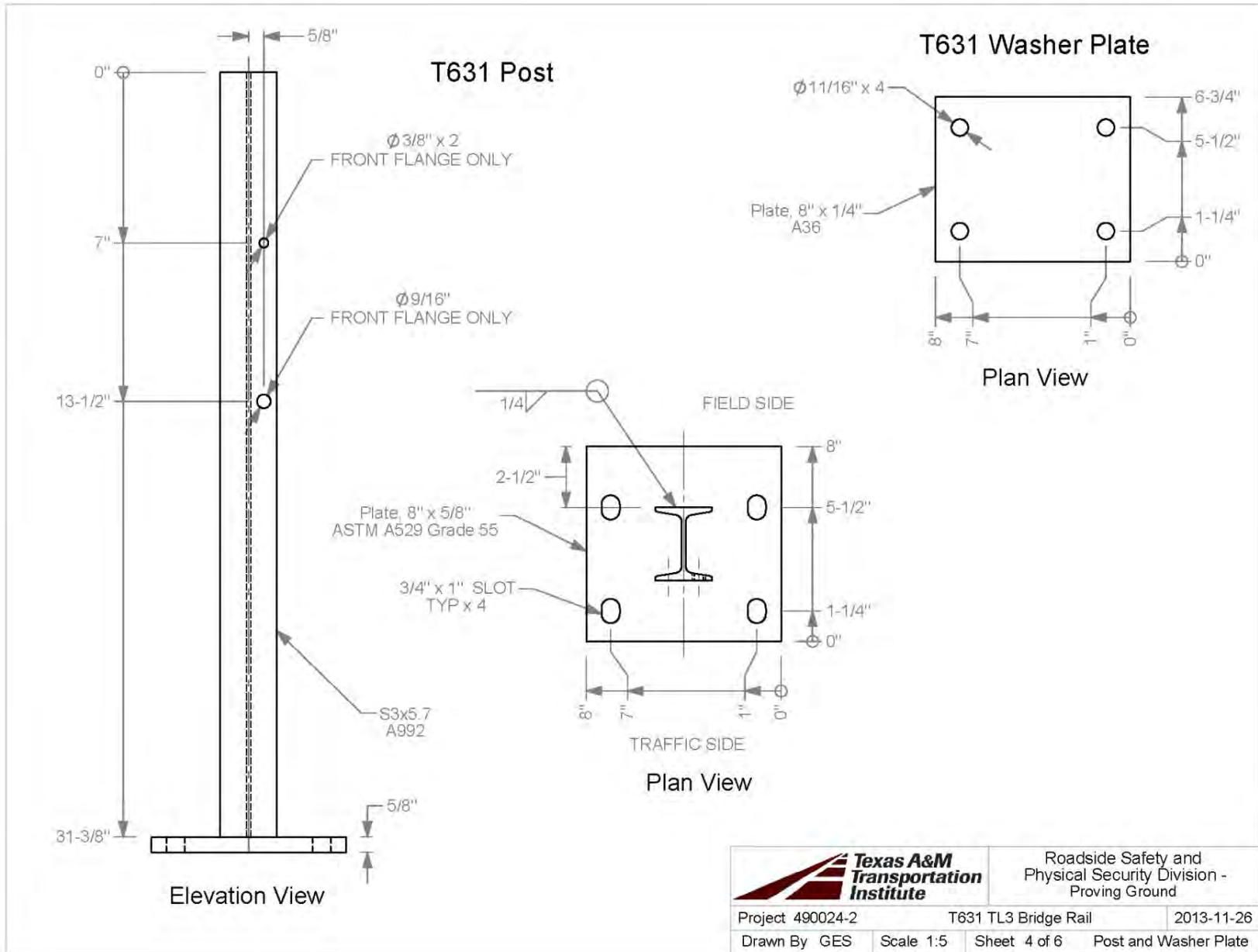
		Roadside Safety and Physical Security Division Proving Ground -				
				Project	490024-2	T631 TL3 Bridge Rail
Drawn By	GES	Scale	1:250	Sheet	1 of 6	Test Installation
Approved:						Date:
Roger Bligh:						2013-11-26



		Roadside Safety and Physical Security Division - Proving Ground	
Project 490024-2	T631 TL3 Bridge Rail	2013-11-26	
Drawn By GES	No Scale	Sheet 2 of 6	Cross Section

T:\2013-2014\490024 - TxDOT\490024 1-3 T631-2 TL3 T631\Drafting\490024-2 Drawing

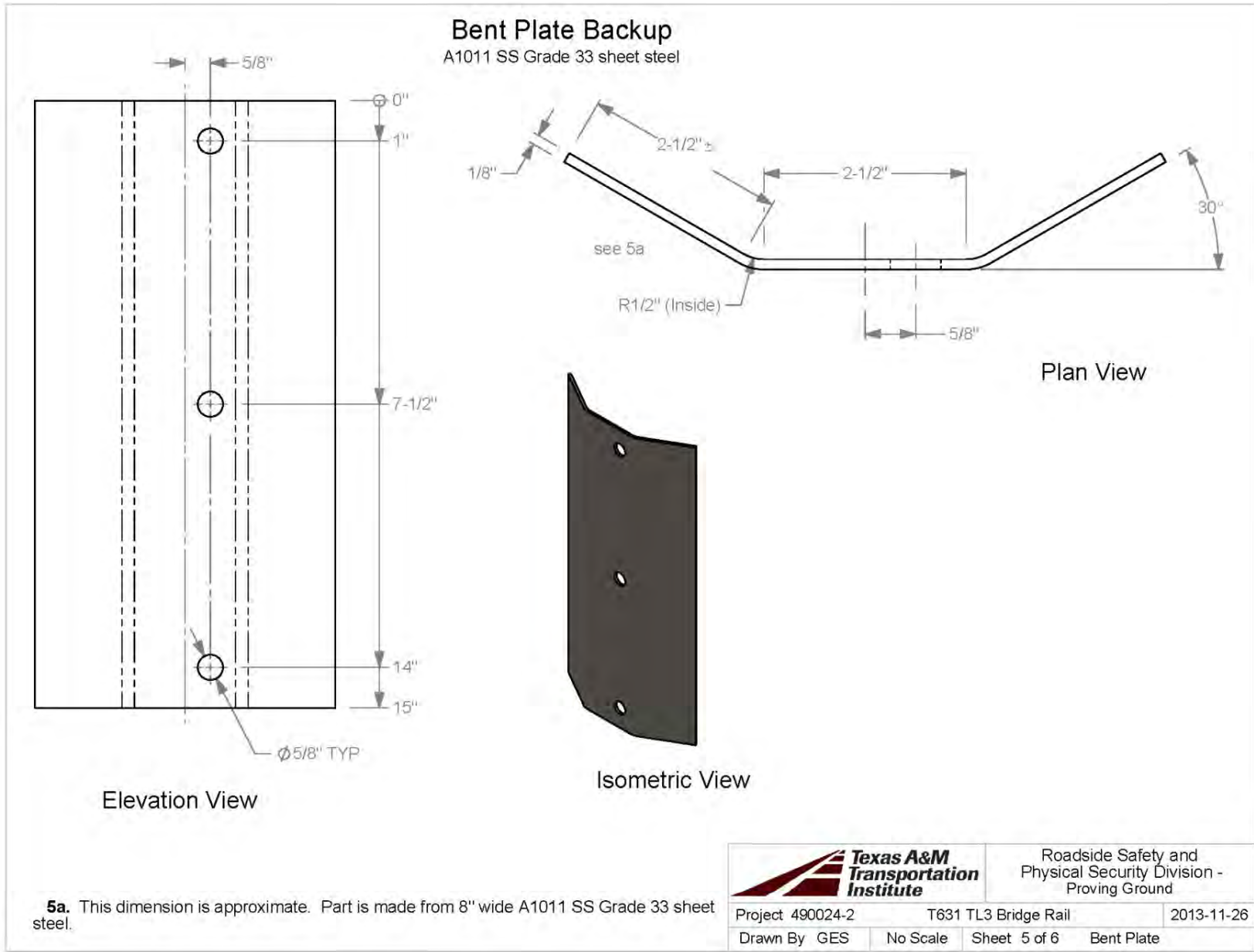




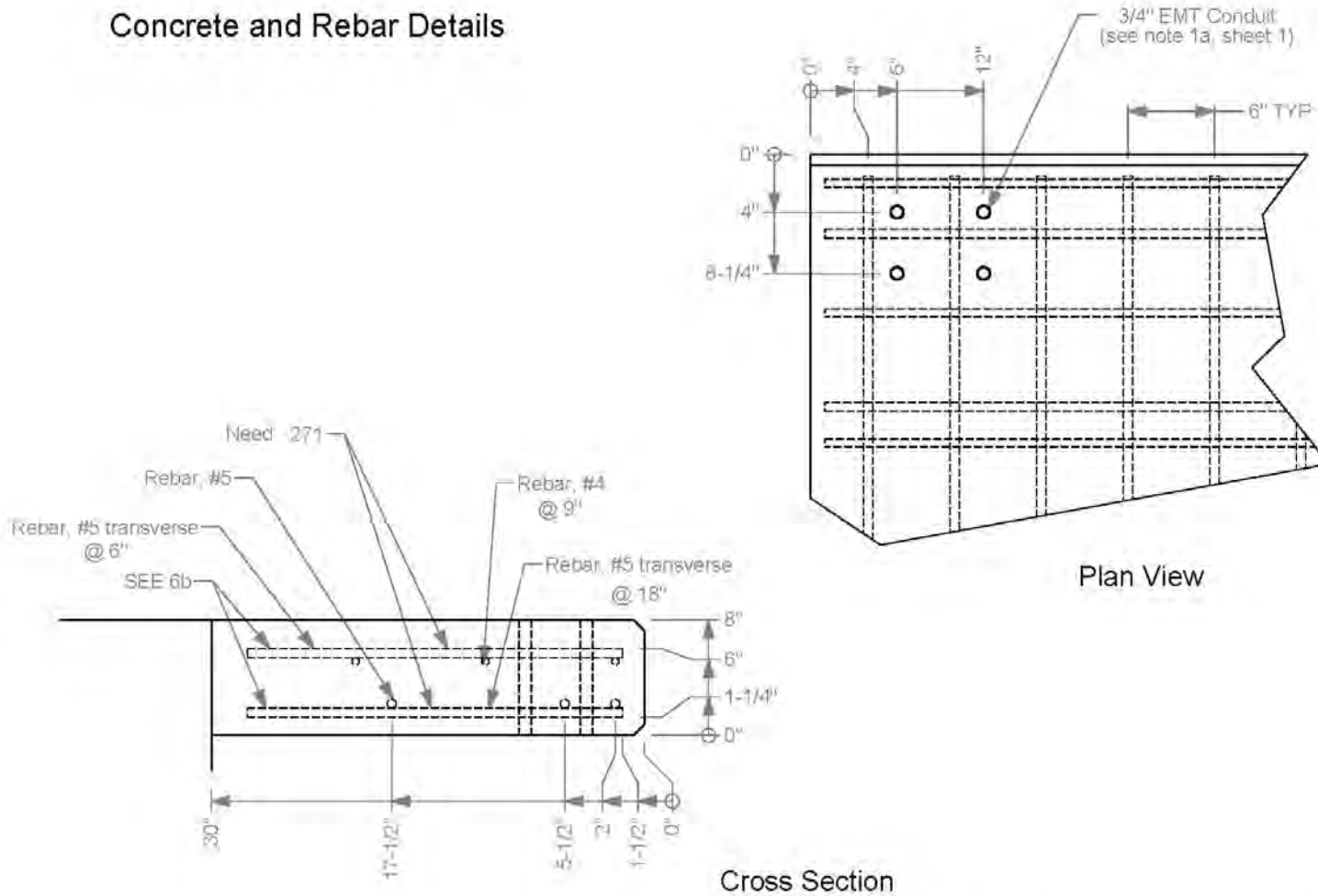
Roadside Safety and Physical Security Division - Proving Ground

Project 490024-2	T631 TL3 Bridge Rail	2013-11-26
Drawn By GES	Scale 1:5	Sheet 4 of 6
Post and Washer Plate		

T:\2013-2014\490024 - TxDOT\490024 1-3 T631-2 TL3 T631\Drafting\490024-2 Drawing



Concrete and Rebar Details



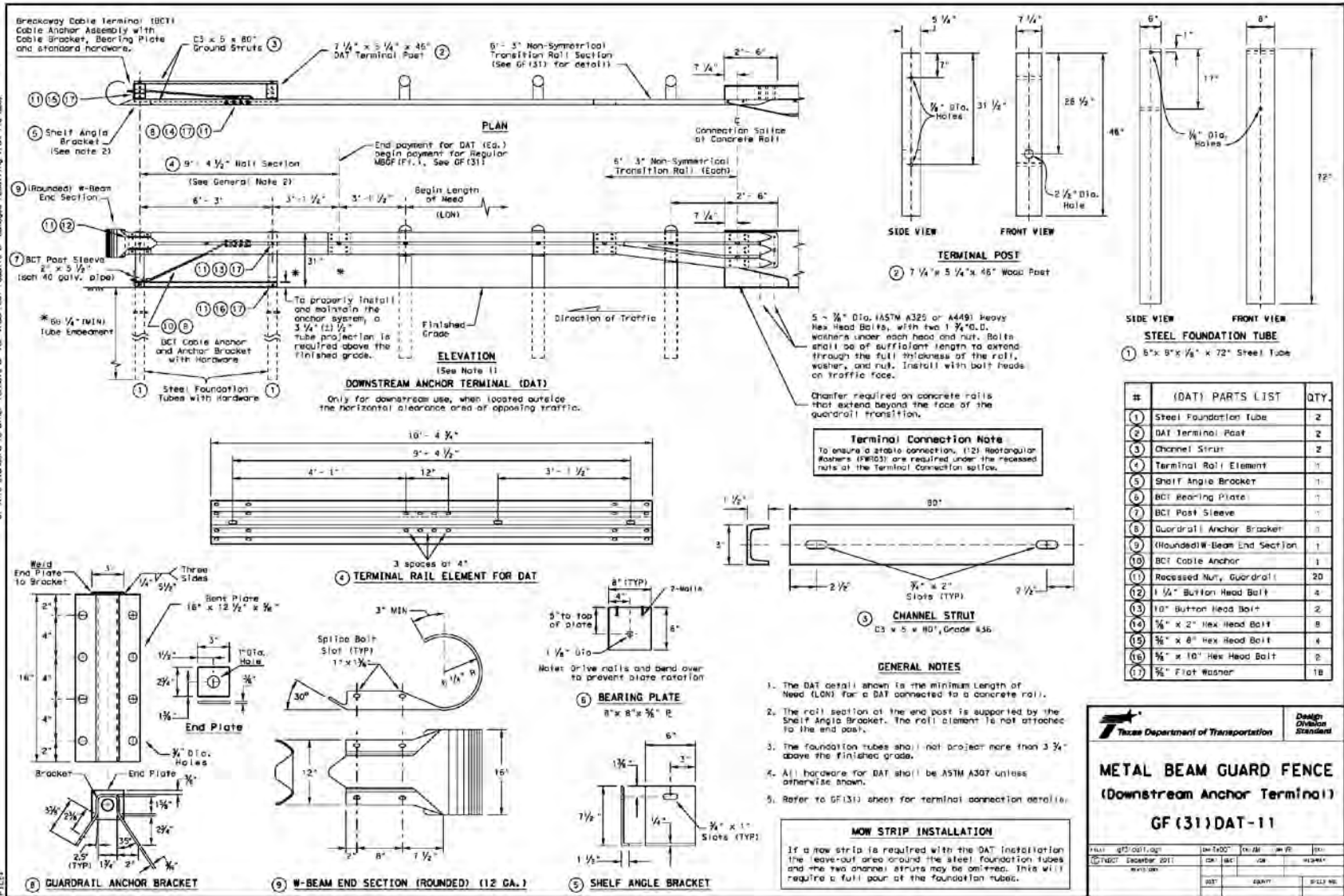
- 6a.** Concrete is Class S (4000 psi). Rebar is grade 60. Minimum rebar laps are 15" for #4 bars (top mat) and 19" for #5 bars (bottom mat).
- 6b.** Transverse Bars weld to existing rebar protruding from the runway (not shown).
- 6c.** Chamfer exposed edges of the deck 3/4".

		Roadside Safety and Physical Security Division - Proving Ground				
		Project 490024-2	T631 TL3 Bridge Rail	2013-11-26		
Drawn By	GES	Scale	1:10	Sheet	6 of 6	Concrete and Rebar

T:\2013-2014\490024 - TxDOT\490024 1-3 T631-2 TL3 T631\Drafting\490024-2 Drawing

DISCLAIMER: This document is intended for use as a guide only. It is not intended to be used as a substitute for professional engineering or architectural services. The user assumes all liability for any and all consequences resulting from the use of this document.

DATE FILED



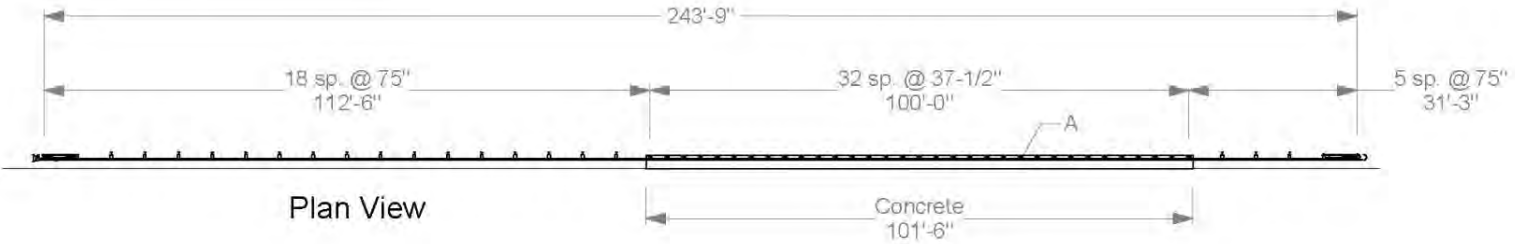
Texas Department of Transportation

Design Division Standard

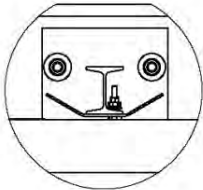
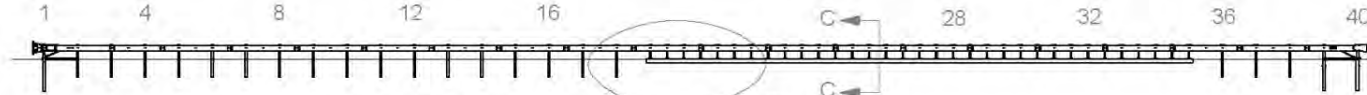
METAL BEAM GUARD FENCE
(Downstream Anchor Terminal)
GF(31) DAT-11

FILED	GF(31) DAT-11	DATE	BY	CHKD	DATE	BY
	December 2011					
		DATE	BY	DATE	BY	

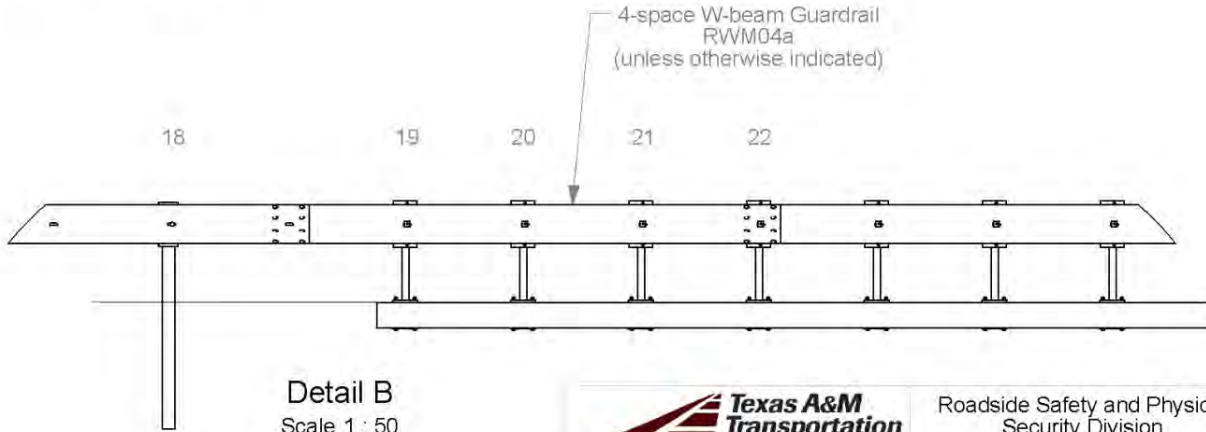
Test Installation



Post Numbers



Detail A
Scale 1 : 10

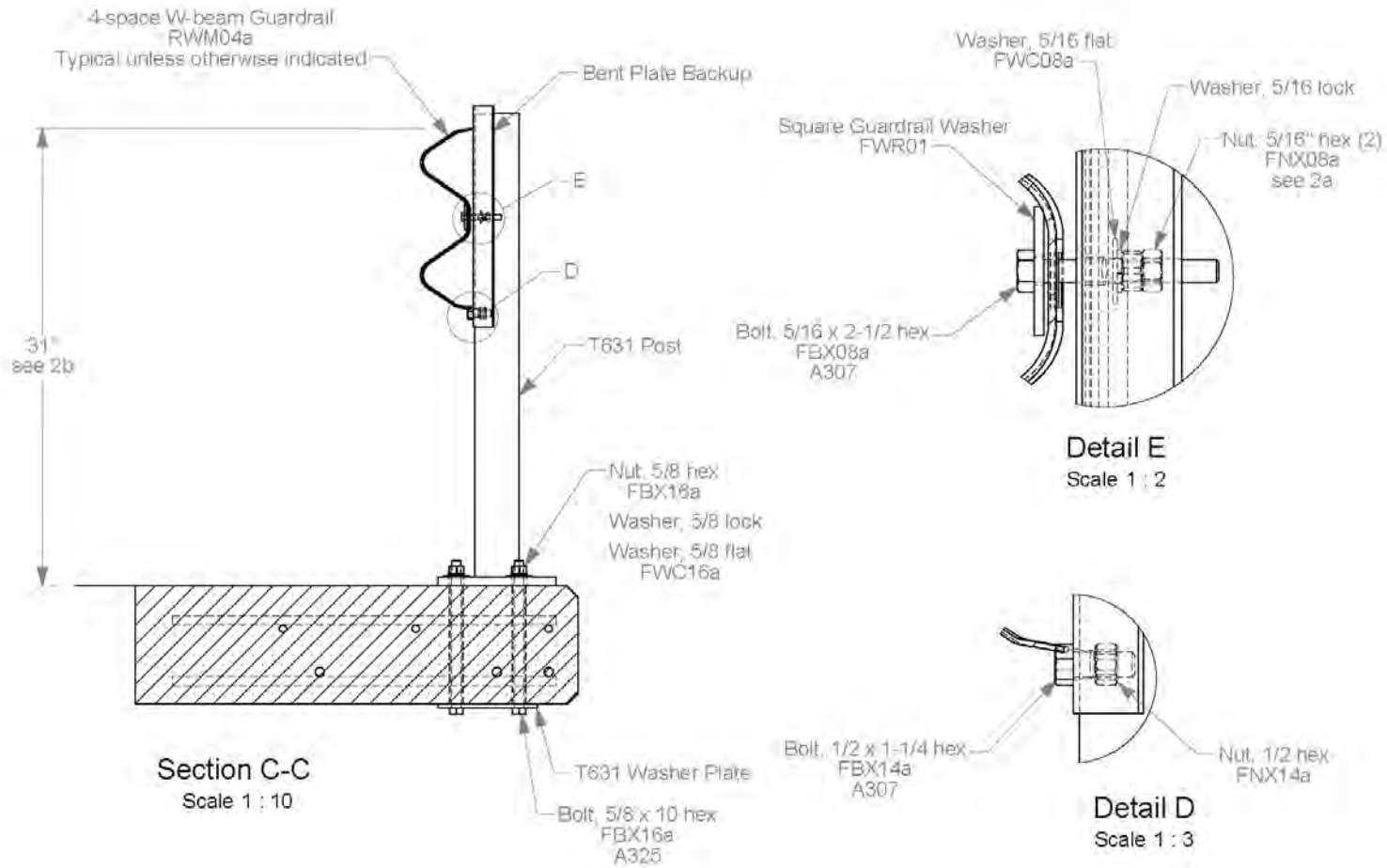


Detail B
Scale 1 : 50



Roadside Safety and Physical Security Division Proving Ground -

Project	490024-1-5	T631 TL3 Bridge Rail
Drawn By	GES	Scale 1:350 Sheet 1 of 7 Test Installation
Approved:	<i>William Williams</i>	Date: 2014-04-08
William Williams:		

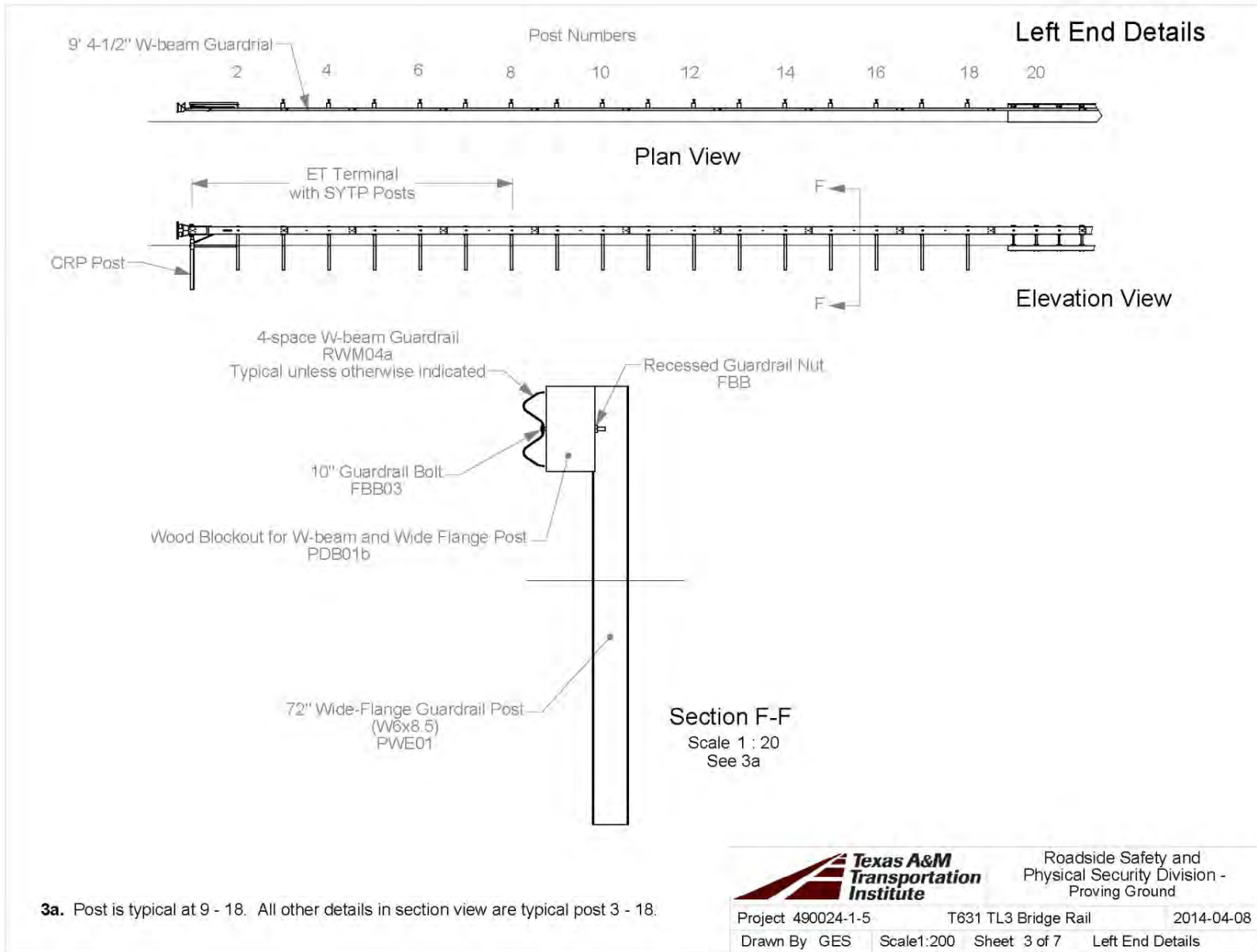


- 2a.** Tighten the first nut by hand until the top and bottom edges of the rail engage the Bent Plate Backup (the Bent Plate Backup should be snug against the post). Then tighten one round with a wrench and secure with the second nut.
- 2b.** Rail height typical full length of installation.



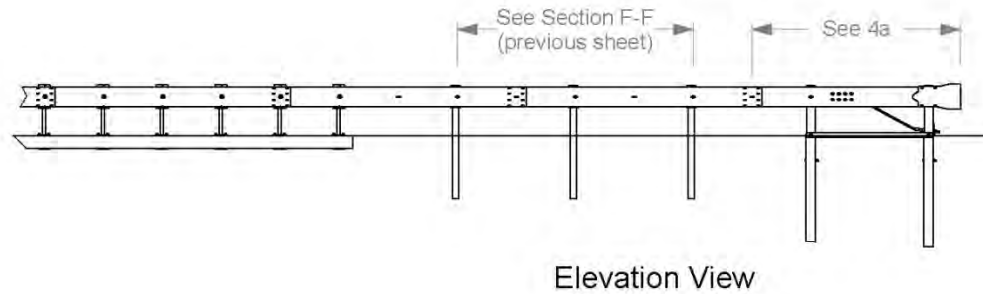
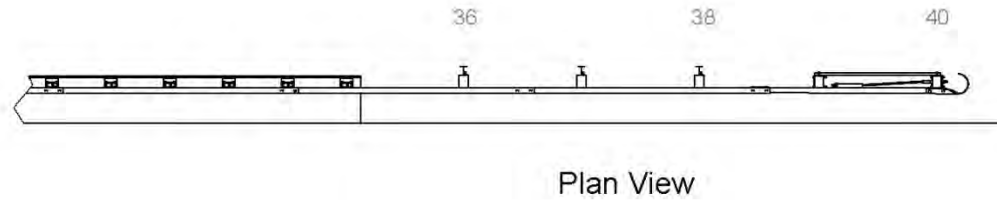
Roadside Safety and
Physical Security Division -
Proving Ground

Project 490024-1-5 T631 TL3 Bridge Rail 2014-04-08
 Drawn By GES No Scale Sheet 2 of 7 Cross Section



T:\2013-2014\490024-1 T631\1-5 TL3 T631\Drafting\490024-1-5 Drawing

Right End Details



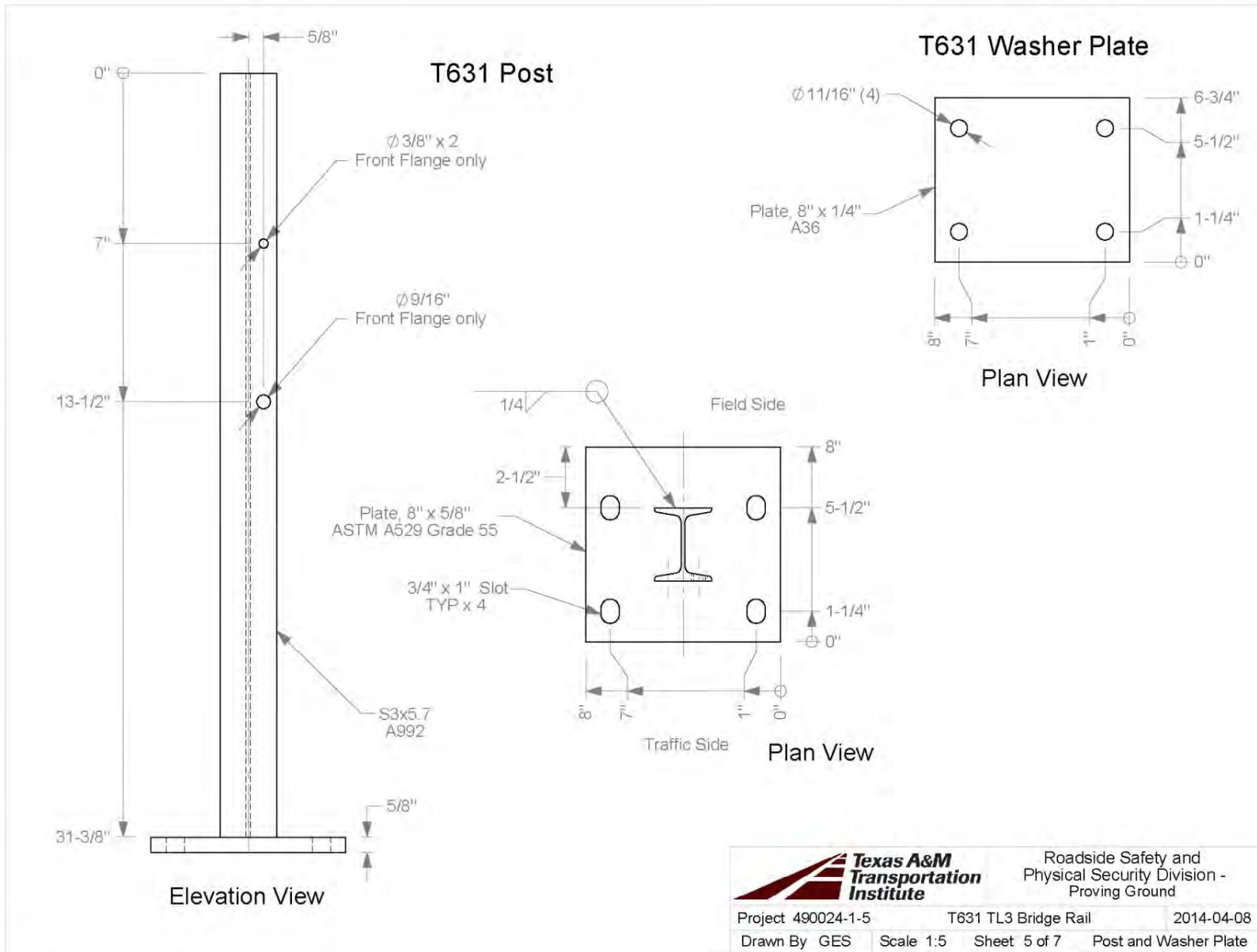
4a. See attached TxDOT drawing: *Downstream Anchor Terminal (DAT) # GF (31) DAT-11.*



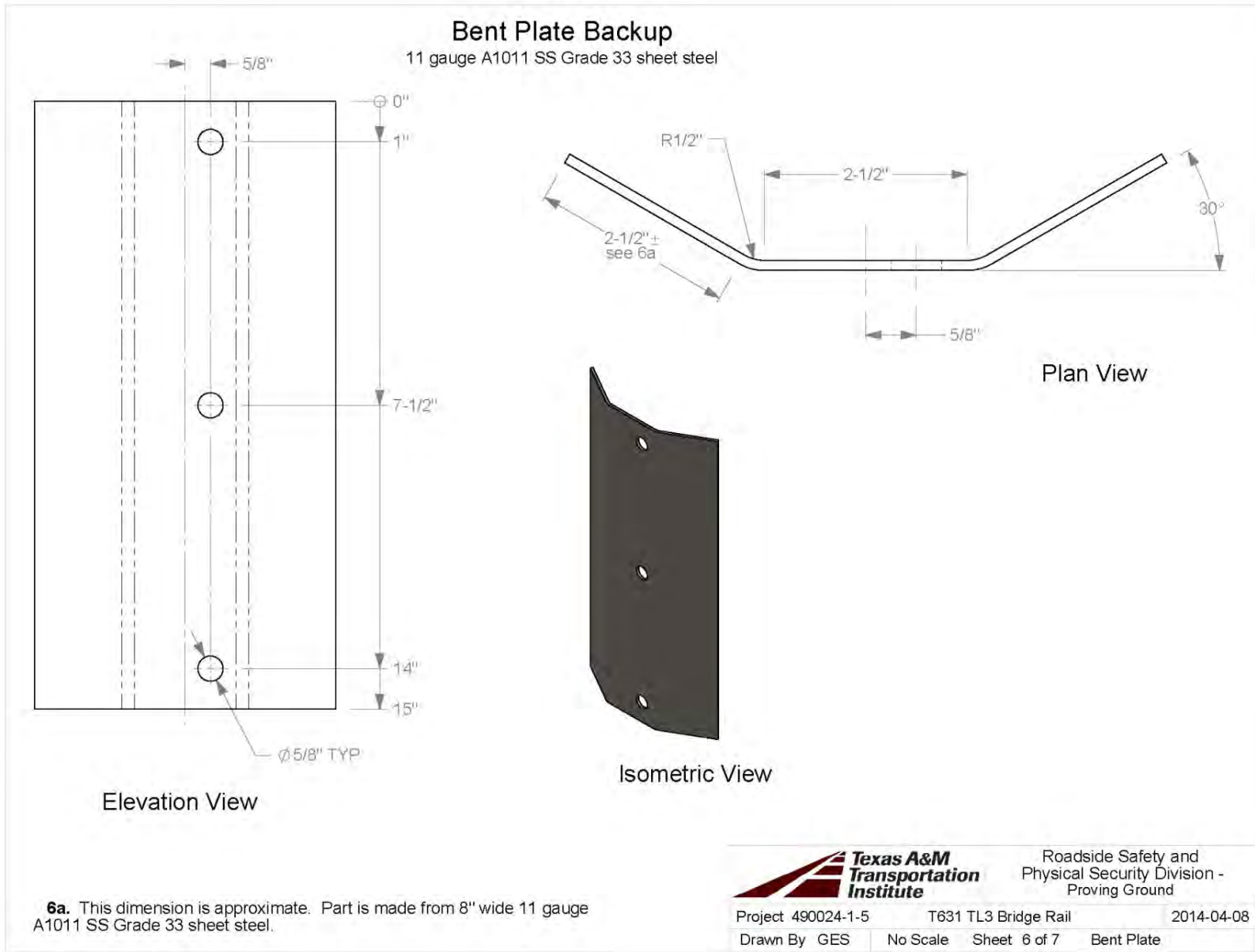
Roadside Safety and Physical Security Division - Proving Ground

Project 490024-1-5	T631 TL3 Bridge Rail	2014-04-08
Drawn By GES	Scale: 1:100	Sheet 4 of 7
Right End Details, etc.		

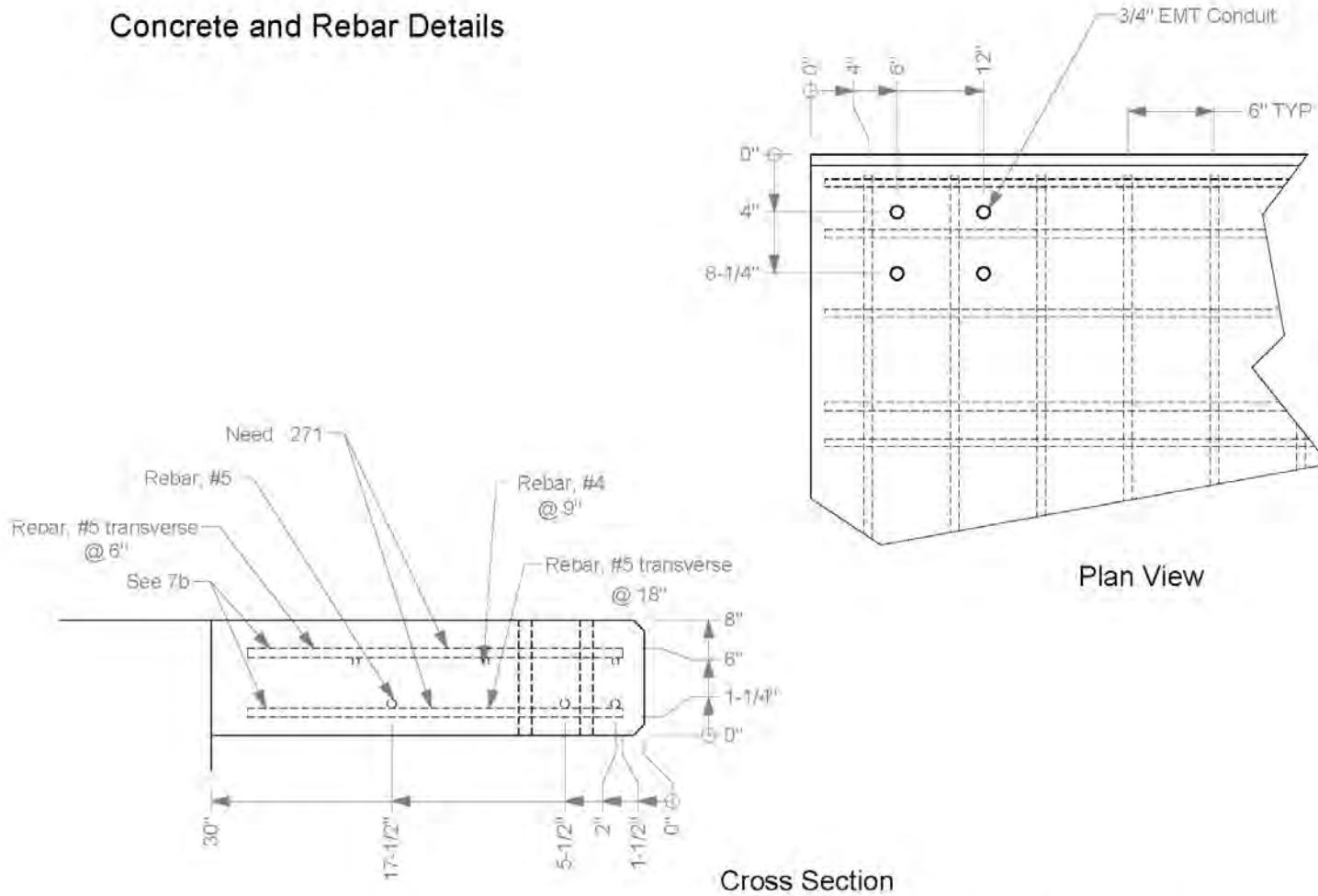
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Concrete and Rebar Details

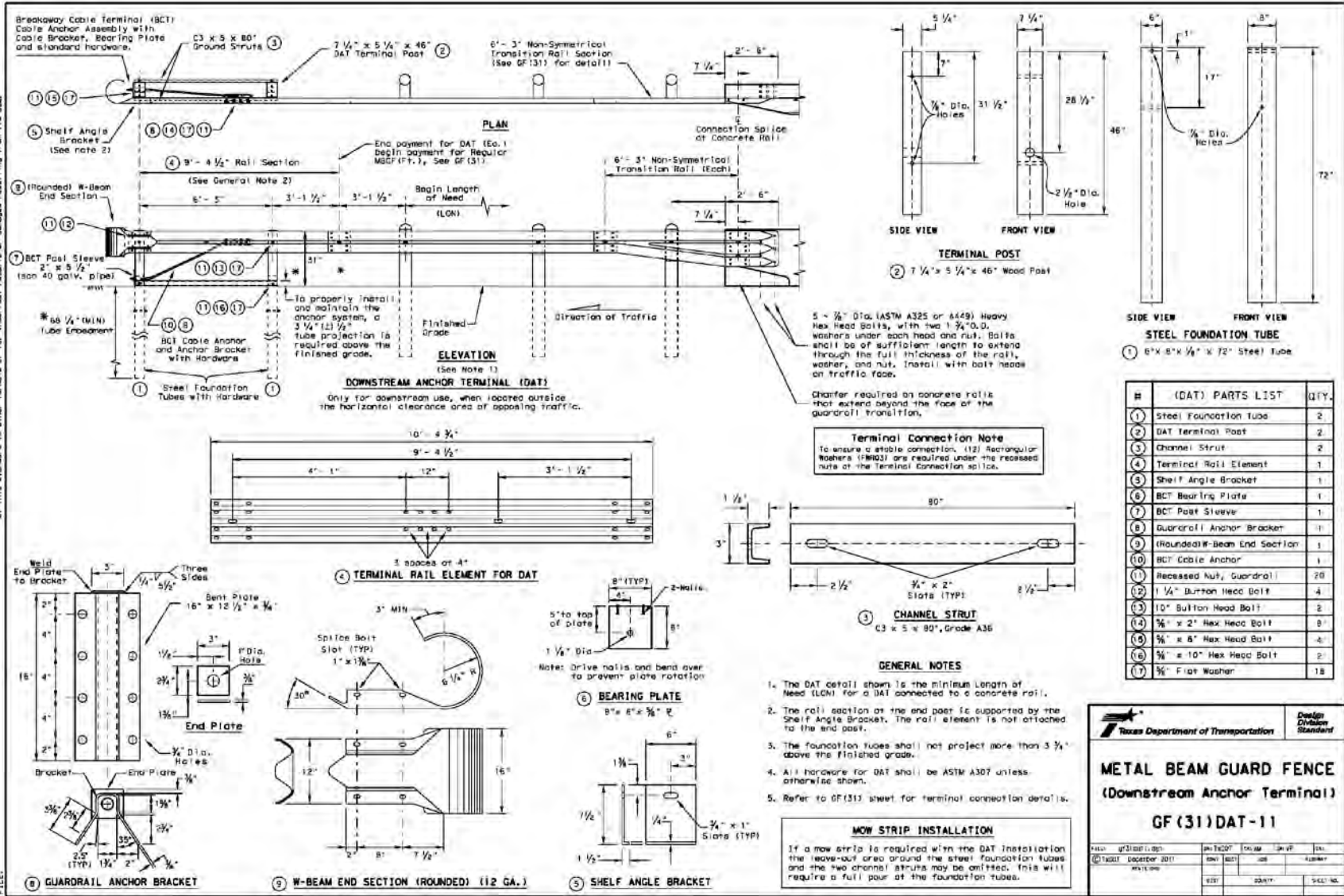


- 7a.** Concrete is Class S (4000 psi). Rebar is grade 60. Minimum rebar laps are 15" for #4 bars (top mat) and 19" for #5 bars (bottom mat).
- 7b.** Transverse Bars weld to existing rebar protruding from the runway (not shown).
- 7c.** Chamfer exposed edges of the deck 3/4".



Roadside Safety and Physical Security Division - Proving Ground

Project 490024-1-5 T631 TL3 Bridge Rail 2014-04-08
 Drawn By GES Scale 1:10 Sheet 7 of 7 Concrete and Rebar



#	(DAT) PARTS LIST	QTY.
1	Steel Foundation Tube	2
2	DAT Terminal Post	2
3	Channel Strut	2
4	Terminal Rail Element	1
5	Shelf Angle Bracket	1
6	BCT Bearing Plate	1
7	BCT Post Sleeve	1
8	Guardrail Anchor Bracket	1
9	(Rounded) W-Beam End Section	1
10	BCT Cable Anchor	1
11	Recessed Nut, Guardrail	20
12	1 1/2" Bolted Head Bolt	4
13	10" Bolted Head Bolt	2
14	3/4" x 2" Hex Head Bolt	8
15	3/4" x 8" Hex Head Bolt	4
16	3/4" x 10" Hex Head Bolt	2
17	3/4" Flat Washer	18

Texas Department of Transportation Design Division Standard

METAL BEAM GUARD FENCE (Downstream Anchor Terminal)
GF(31)DAT-11

FILED	GF(31)DAT-11 (01)	REVISED	DATE	BY	CHK'D	DATE
FILED	DECEMBER 2011	REV	REV	JOB	REVISION	
		REV	DATE	BY	DATE	

APPENDIX B. CERTIFICATION DOCUMENTATION

B1. CRASH TEST NO. 490024-1-2

MATERIAL USED

TEST NUMBER 490024-1-2
 TEST NAME TL3 T631
 DATE 2013-12-05

#	DATE RECEIVED	DESCRIPTION	GRADE	YIELD	TENSILE	SUPPLIER
13-043	2013-10-28	S3x5.7	A992	53.0 / 52.9	73.2 / 72.3	Mack Bolt & Steel
13-044	2013-10-28	Plate, 8 x 5/8	A529 Gr55	68.5	85.7	Mack Bolt & Steel
13-045	2013-10-28	Plate, 8 x 1/4	A529 Gr55	64.1	80.4	Mack Bolt & Steel
13-062	2013-11-15	Nut, 5/16 hex	A563	-	-	Trinity Industries
13-063	2013-11-15	Bolt, 1/2 x 1-1/2 hex	A307	see paperwork	see paperwork	Trinity Industries
13-064	2013-11-15	Bolt, 5/16 x 2-3/8 hex	A307	see paperwork	see paperwork	Trinity Industries
13-068	2013-12-05	Backup Plates	A 1011 SS Gr 33	44.9 - 55.4	63.0 - 69.7	Brazos Industries

TR No. 9-1002-12-12

64

2014-08-13



CERTIFIED MILL TEST REPORT

Ship from:
 Nucor Steel - Texas
 8812 Hwy 79 W
 JEWETT, TX 75846
 800-527-6445

Page: 2
 Date: 10-Oct-2013
 B.L. Number: 650621
 Load Number: 256031

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 Mack Bolt & Steel
 Cust. PO - 25853
 Nucor Steel

Load - 1815837

BL - 3731019
 Heat - JW13107522
 Order-Line - 10097499 / 3

10/10/2013 3:11:25 PM PAGE 2/003 Fax Server
 BLR466

Material Safety Data Sheets are available at www.nucorbar.com or by contacting your inside sales representative.

NBMG.08 January 1, 2012

LOT # HEAT #	DESCRIPTION	PHYSICAL TESTS					CHEMICAL TESTS												
		YIELD P.S.I.	TENSILE P.S.I.	ELONG % IN 8"	BEND	WT% DEF	C	Ni	Mn	Cr	P	Mo	S	V	Si	Cb	Cu	Sn	C.E.
PO# --> JW1310752251	6725864 Nucor Steel - Texas	65,600	81,800	18.0%			.13		1.05		.012		.044		.21		.32		.43
JW13107522	1/4x8" Flat	452MPa	564MPa				.20		.16		.057		.053		.001				
	20' A529 Gr55	64,100	80,400	18.0%			CBV		MN/C										
	ASTM A529/A529M-05 GR 55	442MPa	554MPa				0.050		08.08										
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1																		
PO# --> JW1310836151	6725864 Nucor Steel - Texas	64,200	83,100	20.0%			.14		.99		.011		.031		.19		.30		.43
JW13108361	1/4x6" Flat	443MPa	573MPa				.19		.15		.090		.052		.001				
	20' A529 Gr55	64,000	83,600	19.0%			CBV		MN/C										
	ASTM A529/A529M-05 GR 55	441MPa	576MPa				0.050		07.07										
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1																		
PO# --> JW1310843451	6725044 Nucor Steel - Texas	54,400	71,100	21.0%			.13		.85		.010		.020		.20		.27		.35
JW13108434	3/8x4" Flat	375MPa	490MPa				.13		.16		.048		.033		.002				
	20' A36	54,900	70,900	24.0%															
	ASTM A36/A36M-12, A709/709M-13 G	379MPa	489MPa																
	R36, ASME SA36-10 Ed '11 Ad.																		
	MEETS ASTM A529/A529M-05 GR 50																		
PO# --> JW1310843751	6725864 Nucor Steel - Texas	51,400	69,200	20.0%			.12		.82		.010		.020		.19		.27		.33
JW13108437	3/4x4" Flat	354MPa	477MPa				.15		.15		.047		.045		.002				
	20' A36	52,600	69,500	20.0%															
	ASTM A36/A36M-12, A709/709M-13 G	363MPa	479MPa																
	R36, ASME SA36-10 Ed '11 Ad.																		

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed above and that it satisfies those requirements.
 1) Weld repair was not performed on this material.
 2) Melted and Manufactured in the United States.
 3) Mercury, Radium, or Alpha source materials in any form have not been used in the production of this material.

QUALITY ASSURANCE: _____

Jim Patchland

TR No. 9-1002-12-12

65

2014-08-13

SOLD TO:



CERTIFIED MILL TEST REPORT

Page: 2

SHIP TO:

Ship from:
Nucor Steel - Texas
8812 Hwy 79 W
JEWETT, TX 75846
800-527-6445

Date: 20-Jun-2013
B.L. Number: 640965
Load Number: 247025

Material Safety Data Sheets are available at www.nucorbar.com or by contacting your inside sales representative.

NPMG-08 January 1, 2012

LOT # HEAT #	DESCRIPTION	PHYSICAL TESTS				CHEMICAL TESTS												
		YIELD P.S.I.	TENSILE P.S.I.	ELONG % IN 8"	BEND	WT% DEF	C	Ni	Mn	Cr	P	Mo	S	V	Si	Cb	Cu	Sn
PO# => JW1310468501	6681291 Nucor Steel - Texas	58,500	73,000	20.0%			.14		.92		.012		.021		.21		.35	
JW13104685	6x4x3/8 Angle	403MPa	503MPa				.17		.21		.058		.044		.001			
	20' A36/A529GR50	58,600	76,700	20.0%			CE4020		CEA529									
	ASTM A36-08, A529-05, A709-09a G R36, ASME SA36-07 Ed 11 Ad	404MPa	529MPa				0.39		0.43									
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1																	
PO# => JW1310472451	6680943 Nucor Steel - Texas	68,100	85,300	20.0%			.14		1.08		.013		.033		.21		.44	
JW13104724	1/2x12" Flat	470MPa	588MPa				.19		.17		.051		.079		.001			
	20' A529 Gr55	69,700	87,100	20.0%			CBV		CE4020		CEA529		MN/C					
	ASTM A529/A529M-05 GR 55	481MPa	601MPa				0.080		PB = *		0.46		0.71					
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1																	
PO# => JW1310515252	6681426 Nucor Steel - Texas	68,500	85,700	20.0%			.16		1.11		.013		.029		.23		.33	.48
JW13105152	5/8x8" Flat	472MPa	591MPa				.22		.18		.056		.075		***			
	20' A529 Gr55	68,800	86,900	21.0%			CBV		MN/C									
	ASTM A529/A529M-05 GR 55	474MPa	599MPa				0.080		06.94									
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1																	

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed above and that it satisfies those requirements.
1.) Weld repair was not performed on this material.
2.) Melted and Manufactured in the United States.
3.) Mercury, Radium, or Alpha source materials in any form have not been used in the production of the material.

QUALITY ASSURANCE:

Jim Butchard

Nucor Steel

6/20/2013 3:58:46 PM PAGE 2/002 Fax Server

BLR466

10-25-2013 02:00
 Mack Bolt & Steel
 Cust. PO - 25853

Load - 1815837
 BL - 3731019
 Heat - G124204
 Order-Line - 10097499 / 1

ID: R272431 Page 4 of 9

Name: Gerdau - Tampa Office Ph: 1-800-537-9200

09/27/2012 Thu 14:28



CARTERSVILLE STEEL MILL
 384 OLD GRASSDALE RD NE
 CARTERSVILLE GA 30121 USA
 (770) 387-3300

Chemical and Physical Test Report
 Made and Melted In USA

G-208749

SHIP TO	INVOICE TO	SHIP DATE 09/27/12
		CUST. ACCOUNT NO 33119363

PRODUCED IN: CARTERSVILLE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER															
W3 X 5.79 S-BEAM	A57250/992	ASTM A572 GR50-07, ASTM A992-06A, ASTM A709 GR50-10	2731726-01	8547158-01															
HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	B	N	Sn	Al	Ti	Ca	Zn	C Eqv
G124204	.15	.94	.007	.021	.21	.26	.10	.06	.031	.016	.001	.0000	.0090	.010	.001	.00100	.00100	.00400	.35

Mechanical Test: Yield 53000 PSI, 365.42 MPA Tensile: 73200 PSI, 504.7 MPA %EL: 20.2/8in, 20.2/200MM
 Customer Requirements: CASTING: STRAND CAST
 Comment: NO WELD REPAIRMENT PERFORMED. STEEL NOT EXPOSED TO MERCURY.

Mechanical Test: Yield 52900 PSI, 364.73 MPA Tensile: 72500 PSI, 498.49 MPA %EL: 19.8/8in, 19.8/200MM
 Customer Requirements: CASTING: STRAND CAST
 Comment: NO WELD REPAIRMENT PERFORMED. STEEL NOT EXPOSED TO MERCURY.

CUST ITEM NUMBER: 835705401400

Customer Notes

NO WELD REPAIRMENT PERFORMED. STEEL NOT EXPOSED TO MERCURY.
 All manufacturing processes including melt and cast, occurred in USA. MTR
 complies with EN10204 3.1B

THE ABOVE FIGURES ARE CERTIFIED CHEMICAL AND PHYSICAL TEST RECORDS AS CONTAINED IN THE
 PERMANENT RECORDS OF COMPANY.

Maskary
 Bhaskar Yalamanchili
 Quality Director
 Gerdau

Zankhary
 Metallurgical Services Manager
 CARTERSVILLE STEEL MILL

Seller warrants that all material furnished shall comply with specifications subject to standard published manufacturing variations. NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, ARE MADE BY THE
 SELLER, AND SPECIFICALLY EXCLUDED ARE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
 In no event shall seller be liable for indirect, consequential or punitive damages arising out of or related to the materials furnished by seller.
 Any claim for damages for materials that do not conform to specifications must be made from buyer to seller immediately after delivery of same in order to allow the seller the opportunity to inspect the material in
 question.



MARTIN SUPPLY COMPANY
 FASTENER DIVISION
 111-B Gordon Street
 Jackson, Tennessee 38301

Phone: (731) 935- 8505
 Fax: (731) 935- 8520

6267
 TE
 7-22-13

CERTIFICATE of COMPLIANCE

Trinity Industries

Date:

P.O. #:

Part #:

Description:

Quantity:


Heat : Lot #:

THIS IS TO CERTIFY THAT THE ITEMS SHIPPED AGAINST THE PURCHASE ORDER LISTED ABOVE CONFORM TO THE APPLICABLE PRINTS AND SPECIFICATIONS REQUIRED, MELTED AND MANUFACTURED IN THE USA.

Order Filled By: EVELYN TURNER

Order Checked By: TIM STEELE

Quality Technician: BLAKE MURCHISON

SINCERELY,

 CHARLES BLANKENSHIP
 QUALITY MANAGER

Form # COC 001 Date Rev. 11/15/02



CSM Fastener Products Company

Certificate of Conformance

2451 Estes Avenue
Elk Grove Village, IL 60007

Phone: 630.350.8282
Fax: 630.350.8499

TE
7-17-13

Certificate of Conformance		Date:	
		7/17/13	
Customer Name:	MARTIN INDUSTRIAL	Customer P/N:	ENY-006267G
Address:	111-B GORDON ST JACKSON TN. 38301	CSM Internal Number: LOT#	65362 42162
Part Description: 5/16-18 X 2-3/8 HEX HEAD CAP SCREW MECHANICAL GALVANIZE ↘ HEAT# 20168810 (MILL:CHARTER STEEL) ↘ PLATE P.O.# 91196 (DYNA BURR)			
<hr/> <p>We do hereby certify that the fasteners covered by this shipment meet all of your requirements listed on your purchase order 301001620. The listed p.o. was manufactured in the United States of America.</p> <hr/>			

CSM Fastener Products
JOE NYTKO



DynaBurr Chicago Inc.
Certification

Order No.: 29072
Date: 07/17/2013
Entry Date: 07/08/2013
Page: 1 of 1

To:
CSM FASTENERS
2451 Estes Ave.

Purchase Order No.: 91196
Packing List No.:

Elk Grove IL 60007 1

We are pleased to provide you with the following Certification. If you have any questions regarding this Certification, please contact Bob Bea at 708-345-0762. (10 Pieces Certified)

Quantity	Part Number / Part Name / Part Description	Pounds
11,160	55362 5/16-18 x 2 3/8 Hex Head Cap Screw Full Thread .002 Mechanical Galvanize	572

Insp. Type	Scale	Minimum	Maximum	Number	Other
<u>Customer Requirements:</u>					
Inches		.002	.0035		. ASTM B695-04 Class 50 Type I
Process Inspection Overlayed by Part					
<u>Results:</u>					
Thick	Inches	.00218	.00267	.00254	Mean
Processed In the USA					

Thickness of plating deposit: The thickness of plating was measured by the CMI EDDY-MAG 700 Thickness Tester.

DynaBurr Chicago Inc.


7-17-13
Inspector
Quality Control Department
DynaBurr Chicago Inc.

This certifies that the plating thickness meets the specified requirements.

66 East Lake Street Northlake IL 60164

Phone: 708-345-0762

Fax: 708-345-0778

DynaBurr Chicago, Inc.
EMX 29072 ..
Fri Jul 12, 2013 07:05:01
Customer: CSM FASTENER
Part No:
Batch No:
Inspector:
Accept/Reject:

Fri Jul 12, 2013 07:05:02
4: WASHERS (THIN)
NMAG/MAG SMP-1

=== Session Stats ===
Total Readings 10 Mean 0.002544 in
SDev 0.000157 in %Dev 6.159372%
Accuracy 0.000099 in
CPK 0.005412
High 0.00267 in Low 0.00218 in
Range 0.00049 in

- 1: 0.00262 in
- 2: 0.00264 in
- 3: 0.00266 in
- 4: 0.00252 in
- 5: 0.00251 in
- 6: 0.00264 in
- 7: 0.00261 in
- 8: 0.00267 in
- 9: 0.00218 in
- 10: 0.00238 in

BLR466

BL - 3733657

Load - 1846261

12-04-2013 03:00

Brazos Industries Inc

Heat - 231117

Cust. PO -

Order-Line - 10257562 / 3



ALTOS HORNOS DE MEXICO

MILL TEST CERTIFICATE

AHMSA:QUALITY WITH THE STRENGTH OF STEEL

B434464

CUSTOMER		DATE OF ISSUE		PAGE		WE HEREBY THAT CHEMICAL AND / OR TEST SHOW IN THIS REPORT ARE CORRECT AS CONTAINED THE RECORDS OF THE COMPANY.									
COUTINHO & FERROSIAL INC.		31.01.2013		1											
ADDRESS		ING. RAMIRO CORTES BENCHACA													
16510 Northchase Drive, HOUSTON, TX.		MECHANICAL TESTS AND CERTIFICATION													
PRODUCT		HOT ROLLED STEEL IN COILS.													
CHEMICAL COMPOSITION															
HEAT	SPECIFICATION	C	Mn	P	S	SI	CU	CR	NI	MO	ALt	V	Nb(Cb)	Ti	N2
230945	ASIM A 1018 SS 36 TYPE 2.	0.163	0.823	0.019	0.007	0.1279	0.025	0.020	0.017	0.009	0.039	0.004	0.002	0.004	0.0054
231113	ASIM A 1011 SS GR. 33	0.142	0.544	0.015	0.010	0.0090	0.021	0.019	0.017	0.011	0.034	0.002	0.001	0.001	0.0046
231117	ASIM A 1011 SS GR. 33	0.120	0.551	0.017	0.010	0.0109	0.030	0.022	0.018	0.011	0.045	0.002	0.002	0.001	0.0057
TEST OF THE PRODUCT															
HEAT	COIL NO.	SLAB	THICKNESS (Inch)	Y. STRENGTH	T. STRENGTH	ELONG.	T. ELONG.	D. MAX. X TH.							
230945	4768074	5040	0.2380	48.928 (KSI)	65.622 (KSI)	41(%)	2								
230945	4768073	6040	0.2380	47.462 (KSI)	69.684 (KSI)	42(%)	2	1.0 (Inch)							
231113	4767089	5030	0.1260	50.853 (KSI)	62.587 (KSI)	40(%)	2	1.0 (Inch)							
231117	4768098	6040	0.1100	55.420 (KSI)	66.743 (KSI)	41(%)	2								
HEAT	COIL NO.	SLAB	FL-BEND												
231113	4767089	5030	A												
231117	4768098	6040	A												
SHIPPED PRODUCT															
HEAT	COIL NO.	THICKNESS (Inch)	WIDTH (Inch)	ORDER	ITEM	DELIVERY	CUSTOMER ORD								
230945	4768074	0.2380	48.0000	0000137558	000070	1001731300	1050156800/FEB13								
230945	4768073	0.2380	48.0000	0000137558	000070	1001731300	1050156800/FEB13								
231113	4767089	0.1260	48.0000	0000137558	000040	1001731300	1050156800/FEB13								
231117	4768098	0.1100	48.0000	0000137558	000030	1001731300	1050156800/FEB13								
HEAT	COIL NO.	STANDARD													
230945	4768074	A568/A635													
230945	4768073	A568/A635													
231113	4767089	A568/A635													
231117	4768098	A568/A635													
COUNTRY OF ORIGIN: MEXICO															
END OF DATA															

Heat# 231117
 wt# 22031
 H# 119ax48"

ISSUED : S0550133

AHMSA'S COMPROMISE IS ONLY WITH THE CUSTOMER MENTIONED IN THIS CERTIFICATE, AHMSA WILL ONLY ACCEPT THE ORIGINAL DOCUMENT.

CC-65-F-01-A



**CHARTER
STEEL**

A Division of
Charter Manufacturing Company, Inc.

FILE

1658 Cold Springs Road
Saukville, Wisconsin 53060

(262) 268-2400

1-800-437-8769

FAX (262) 268-2570

CHARTER STEEL TEST REPORT
Reverse Has Text And Codes

Beta Steel
44225 Utica Rd.
Utica, MI- 48318

Cust P.O.	266779
Customer Part#	328010220100SC(SW1022M- E)
Charter Sales Order	30034177
Heat #	20168810
Ship Lot #	2020726
Grade	1022 M SK CG SQ 21/64
Process	HR
Finish Size	21/64

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed below and on the reverse side, and that it satisfies these requirements.

Lab Code: 125544

Test Results of Heat Lot# 20168810

CHEM	C	MN	P	S	SI	NI	CR	MO	CU	SN	V
%Wt	.21	.95	.011	.003	.190	.04	.07	.02	.09	.006	.002
	AL	N	B	TI	CA	NB					
	.004	.0060	.0001	.001	.0001	.001					

JOMINY(HRC) JOM01 JOM02 JOM03
45 33 25

JOMINY SAMPLE TYPE ENGLISH = C
GRAIN SIZE LAB = 0358-04
McQuaid- Ehrn Grain Size Comparison = 3 - 5
CHEM. DEVIATION EXT.- GREEN =

Test Results of Rolling Lot# 2020726

	# of Tests	Min Value	Max Value	Mean Value	
TENSILE (KSI)	1	79.5	79.5	79.5	TENSILE LAB = 0358-04
REDUCTION OF AREA (%)	1	72	72	72	RA LAB = 0358-04

NUM DECARB = 1 AVE DECARB (Inch) = .001
REDUCTION RATIO = 580:1

Specifications: Manufactured per Charter Steel Quality Manual Rev 9,08-01-09
Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents:
Customer Document = PS-1 Revision = Dated = 11-MAR-08

Additional Comments:

Charter Steel
Cuyahoga Heights, OH, USA

Rem: Load, Fax, Mail



Page 1 of 1

This MTR supersedes all previously dated MTRs for this order

Janice Barnard
Janice Barnard
Manager of Quality Assurance
07/17/2013

CERTIFICATE OF COMPLIANCE

ROCKFORD BOLT & STEEL CO.
126 MILL STREET
ROCKFORD, IL 61101
815-968-0514 FAX# 815-968-3111

CUSTOMER NAME: TRINITY INDUSTRIES

CUSTOMER PO: 156635

INVOICE #: 951315

DATE SHIPPED: 6/18/13

ROCKFORD BOLT PO#: P34308

NUCOR LOT#: 317729A, 314191A

SPECIFICATION: ASTM A307 , GRADE A MILD CARBON STEEL BOLTS

COATING: ASTM SPECIFICATION F2329 HOT DIP GALVANIZE

ROGERS BROTHERS GALVANIZE JOB#: R51744-05

CHEMICAL COMPOSITION

MILL	GRADE	HEAT#	C	Mn	P	S	Si
NUCOR	1017ML	NF12204133	.18	.44	.007	.023	.15
NUCOR	1017ML	NF12202977	.18	.46	.011	.017	.18

QUANTITY AND DESCRIPTION:

1,817 PCS 1/2" X 1-1/2 " HEX HEAD CAP BOLT
P/N 4308G

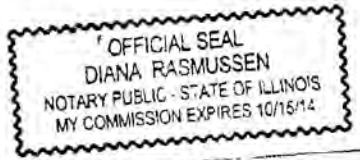
WE HEREBY CERTIFY THE ABOVE PARTS HAVE BEEN MANUFACTURED IN THE U.S.A WITH DOMESTIC STEEL. WE FURTHER CERTIFY THAT THIS DATA IS A TRUE REPRESENTATION OF INFORMATION PROVIDED BY THE MATERIALS SUPPLIER, AND THAT OUR PROCEDURES FOR THE CONTROL OF PRODUCT QUALITY ASSURE THAT ALL ITEMS FURNISHED ON THIS ORDER MEET OR EXCEED ALL APPLICABLE TESTS, PROCESS, AND INSPECTION REQUIREMENTS PER ABOVE SPECIFICATION.

STATE OF ILLINOIS
COUNTY OF WINNEBAGO

SIGNED BEFORE ME ON THIS
19 DAY OF June 2013
Diana Rasmussen

Diana Melomas
APPROVED SIGNATORY

6/19/13
DATE



NUCOR
FASTENER DIVISION

LOT NO.
 317729A

Post Office Box 8100
 Saint Joe, Indiana 46785
 Telephone 219/337-1800

CUSTOMER NO/NAME
 730 ROCKFORD BOLT & STEEL CO. NUCOR ORDER # 805376
 TEST REPORT SERIAL# FB399231 CUST PART #
 TEST REPORT ISSUE DATE 11/26/12
 DATE SHIPPED 11/29/12 CUSTOMER P.O. # P34308
 NAME OF LAB SAMPLER: DAWN LEAVITT, LAB TECHNICIAN
 *****CERTIFIED MATERIAL TEST REPORT*****
 NUCOR PART NO QUANTITY LOT NO. DESCRIPTION
 4190080 2700 317729A 1/2-13 X 1 1/2 A307 RX CAP
 MANUFACTURE DATE 11/14/12 SCREW PLAIN



---CHEMISTRY MATERIAL GRADE -1017ML

MATERIAL NUMBER	HEAT NUMBER	**CHEMISTRY COMPOSITION (WT% HEAT ANALYSIS) BY MATERIAL SUPPLIER					NUCOR STEEL - NEBRASKA
		C	MN	P	S	SI	
RMD27817	NF12204133	.18	.44	.007	.023	.15	
		MIN					
		MAX	.040	.150			

---MECHANICAL PROPERTIES IN ACCORDANCE WITH ASTM A307-10 & SAE J429 GR2-11

SURFACE HARDNESS (R30N)	CORE HARDNESS (RB)	PROOF LOAD N/A	TENSILE STRENGTH 10 DEG-WEDGE	
			(LBS)	STRESS (PSI)
N/A	92.4	N/A	14050	99013
N/A	93.9	N/A	14080	99225
N/A	93.8	N/A	13900	97956
N/A	93.8	N/A	14040	98943
N/A	92.8	N/A	13990	98591
AVERAGE VALUES FROM TESTS		PRODUCTION LOT SIZE	120000 PCS	
	93.3	14012	98746	

---DIMENSIONS PER ASME B18.2.1-2010

CHARACTERISTIC	#SAMPLES TESTED	MINIMUM	MAXIMUM
Width Across Corners	8	0.8440	0.8480
Screw Length	8	1.4670	1.4680
Threads	8	PASS	PASS

ALL TESTS ARE IN ACCORDANCE WITH THE LATEST REVISIONS OF THE METHODS PRESCRIBED IN THE APPLICABLE SAE AND ASTM SPECIFICATIONS. THE SAMPLES TESTED CONFORM TO THE SPECIFICATIONS AS DESCRIBED/LISTED ABOVE AND WERE MANUFACTURED FREE OF MERCURY CONTAMINATION.
 THE STEEL WAS MELTED AND MANUFACTURED IN THE U.S.A. AND THE PRODUCT WAS MANUFACTURED AND TESTED IN THE U.S.A. PRODUCT COMPLIES WITH DEARS 252.225-7014. WE CERTIFY THAT THIS DATA IS A TRUE REPRESENTATION OF INFORMATION PROVIDED BY THE MATERIAL SUPPLIER AND OUR TESTING LABORATORY. THIS CERTIFIED MATERIAL TEST REPORT RELATES ONLY TO THE ITEMS LISTED ON THIS DOCUMENT AND MAY NOT BE REPRODUCED EXCEPT IN FULL.



MECHANICAL FASTENER
 CERTIFICATE NO. AZ1A 0139.01
 EXPIRATION DATE 12/31/13

NUCOR FASTENER
 A DIVISION OF NUCOR CORPORATION

John W. Ferguson
 JOHN W. FERGUSON
 QUALITY ASSURANCE SUPERVISOR

NUCOR
NUCOR CORPORATION
NUCOR STEEL NEBRASKA

Mill Certification
9/28/2012

27817
 2911 East Nueces Road
 NORFOLK, NE 68701
 (402) 844-6200
 Fax: (402) 844-6229

Bill To: NUCOR FASTENER INDIANA
 PO BOX 6100
 9730 COUNTY RD 60
 ST JOE, IN 46785-0000
 (260) 357-1600
 Fax: (438) 734-4591

Ship To: NUCOR FASTENER INDIANA
 COUNTY RD 60
 ST JOE, IN 46785-0000

Customer P.O.	130691	Sales Order	124154.1
Product Group	Red	Part Number	32800812000U300
Grade	1017HL	Lot #	NF1230413311
Size	.5125-33/64 Wire Rod	Heat #	NF12304133
Product	.5125-33/64 Wire Rod Coil 1017HL	Q.L. Number	N1-257470
Description	1017HL	Lead Number	N1-183665
Customer Spec		Customer Part #	002008

Kindly verify that the material described herein has been manufactured in accordance with the specifications and standards listed above and that it satisfies those requirements.

C	Mn	V	Si	S	P	Cu	Cr	NI	Mo	Al	Cb
0.18%	0.44%	0.000%	0.18%	0.002%	0.007%	0.17%	0.07%	0.00%	0.02%	0.002%	0.000%
Pb	Sn	Co	B	Ti							
0.000%	0.006%	0.000%	0.000%	0.001%							

Reduction Ratio 210 :1

Specification Comments: Coarse Grain Practice

Selenium, Tellurium, Lead, Bismuth or Boron were not intentionally added to this heat.

- All manufacturing processes of the steel materials in this product including melting, have been performed in the United States.
- All products produced are weld free.
- Mercury, in any form, has not been used in the production or testing of this material.
- Test methods are ASTM A228-11a, ASTM E213 and ASTM E1019-recommended grades or applicable customer requirements.
- All material melted at Nucor Steel Nebraska is produced in an Electric Arc Furnace.
- Standard Cast
- L-A-B accreditation certificate is available upon request.

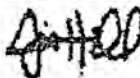
Chemistry Verification Checks

Part# 2008 of 27817

Checked By _____ Date _____

Receiving Of: 297 10-8-12

Certifications Of: 375 10-8-12



Jim Hill
 Division Metallurgist

Form 11, Revision 1, 2010

Page 1 of 1

NUCOR

FASTENER DIVISION

LOT NO.
314191A

Post Office Box 8100
Baird, Iowa 48786
Telephone 888-333-1000

CUSTOMER NO/NAME
730 ROCKFORD BOLT & STEEL CO.
TEST REPORT SERIAL# FB395116
TEST REPORT ISSUE DATE 9/18/12
DATE SHIPPED 11/29/12
NAME OF LAB SAMPLER: FRANKLIN A. NEAL, LAB TECHNICIAN
*****CERTIFIED MATERIAL TEST REPORT*****
NUCOR PART NO QUANTITY LOT NO. DESCRIPTION
4190080 4500 314191A 1/2-13 X 1 1/2 A307 HX CAP
MANUFACTURE DATE 9/14/12 SCREW PLAIN

NUCOR ORDER # 805376
CUST PART #

CUSTOMER P.O. # P34308



---CHEMISTRY MATERIAL GRADE -1017ML
MATERIAL HEAT **CHEMISTRY COMPOSITION (WT% HEAT ANALYSIS) BY MATERIAL SUPPLIER
NUMBER NUMBER C MN P S SI NUCOR STEEL - NEBRASKA
RM027654 NF12202977 .18 .46 .011 .017 .18
MIN
MAX .040 .150

---MECHANICAL PROPERTIES IN ACCORDANCE WITH ASTM A307-10 & SAE J429 GR2-11
SURFACE CORE PROOF LOAD TENSILE STRENGTH
HARDNESS HARDNESS N/A 10 DEG-WEDGE
(R30N) (RB) (LBS) STRESS (PSI)
N/A 94.6 N/A 14180 99930
N/A 95.2 N/A 14040 98943
N/A 94.3 N/A 14280 100634
N/A 94.9 N/A 14270 100564
N/A 94.8 N/A 14340 101057
AVERAGE VALUES FROM TESTS PRODUCTION LOT SIZE 83300 PCS
94.8 14222 100226

---DIMENSIONS PER ASME B18.2.1-2010
CHARACTERISTIC #SAMPLES TESTED MINIMUM MAXIMUM
Width Across Corners 8 0.8430 0.8470
Screw Length 8 1.4780 1.4810
Threads 8 PASS PASS

ALL TESTS ARE IN ACCORDANCE WITH THE LATEST REVISIONS OF THE METHODS PRESCRIBED IN THE APPLICABLE SAE AND ASTM SPECIFICATIONS. THE SAMPLES TESTED CONFORM TO THE SPECIFICATIONS AS DESCRIBED/LISTED ABOVE AND WERE MANUFACTURED FREE OF MERCURY CONTAMINATION.
THE STEEL WAS MELTED AND MANUFACTURED IN THE U.S.A. AND THE PRODUCT WAS MANUFACTURED AND TESTED IN THE U.S.A. PRODUCT COMPLIES WITH DEARS 252.225-7014. WE CERTIFY THAT THIS DATA IS A TRUE REPRESENTATION OF INFORMATION PROVIDED BY THE MATERIAL SUPPLIER AND OUR TESTING LABORATORY. THIS CERTIFIED MATERIAL TEST REPORT RELATES ONLY TO THE ITEMS LISTED ON THIS DOCUMENT AND MAY NOT BE REPRODUCED EXCEPT IN FULL.



MECHANICAL FASTENER
CERTIFICATE NO. A2LA 0139.01
EXPIRATION DATE 12/31/13

NUCOR FASTENER
A DIVISION OF NUCOR CORPORATION

James O. Neuman
JAMES GALAMAS
TECHNICAL SERVICES MANAGER

NUCOR

NUCOR CORPORATION
NUCOR STEEL SERVICES

API Certification
7/12/2012

27654
2711 East Wiley Road
NORFOLK, NE 68701
(402) 844-0220
Fax: (402) 844-0222

Sold To: **NUCOR FASTENER INDIANA**
PO BOX 8123
8930 COUNTY RD 80
ST JOE, IN 46785-0000
(260) 237-1800
Fax: (490) 734-4281

Ship To: **NUCOR FASTENER INDIANA**
COUNTY RD 80
ST JOE, IN 46785-0000

Customer P.O.	131623	Sales Order	132753.7
Product Group	Prod	Part Number	5230058125001300
Grade	10175L	Lot #	NP1230297711
Size	.5125-20.94 Wire Prod	Heat #	NP12302977
Product	.5125-20.94 Wire Prod Coil 10175L	S.L. Number	N1-281341
Description	10175L	Lead Number	N1-179114
Customer Spec		Customer Part #	002008

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards cited above and that it conforms thereto.

C	Mn	V	Si	S	P	Cu	Cr	Ni	Mo	Al	Cb
0.18%	0.45%	0.000%	0.13%	0.017%	0.011%	0.13%	0.07%	0.06%	0.02%	0.000%	0.000%
Pb	In	Ca	B	Ti							
0.000%	0.000%	0.000%	0.000%	0.001%							

Reduction Ratio 210 :1

Specification Comments: Control Grain Practice

Selenium, Tellurium, Lead, Bismuth or Arsen were not intentionally added to this steel.

- All manufacturing processes of the steel materials in this product, including melting, have been performed in the United States.
- All products produced are acid free.
- Laboratory, in dry form, has not been used in the production or testing of this material.
- Test methods to ASTM A29-11a, ASTM E443 and ASTM E1019-referenced grades or applicable customer requirements.
- All material melted at Nucor Steel Materials is produced in an Electric Arc Furnace.
- Standard Cast
- L-4-B certification certificate is available upon request.

Chemistry Certification Check

Part: 2008 # 27654

Checked By Date

Receiving CR: 297 7-16-12

Certification CR: 375 7-16-12

[Handwritten Signature]

**ROCHS
BROTHERS
GALVANIZING**



HOT DIP GALVANIZING
1825 KISHWAUKEE STREET
ROCKFORD, IL 61104-8197
PHONE: 815/985-5132
FAX: 815/985-3785

ORDER NO. 85816
12/04/12
Page 1

SOLD TO	<input type="checkbox"/> RKB ROCKFORD BOLT & STEEL COMPANY 126 MILL STREET ROCKFORD, IL 61181	<input type="checkbox"/> SHIP TO ROCKFORD BOLT & STEEL COMPANY 126 MILL STREET ROCKFORD, IL 61181

TREASURER	SHIPPER VIA	COLLECT	PREPAID	CUSTOMER ORD. NO.	INVOICE DATE	INVOICE NO.
1/24 10-N38	CUR TRUCK		X	972431		

QUANTITY	DESCRIPTION	UNIT	PRICE	TOTAL
7305	1/2 X 1-1/3 HEX CAP SCREW A307	1 TUB	798	
7306	398824-D JOB#R51735-95 BLK WT 8163 44 P34308		798	
7305	1 AVG. COATING WEIGHT: <u>3.2</u> MILS. 1 WE CERTIFY THE ABOVE SIZES & LOTS'S COMPLY W/ THE COATING, WORKMANSHIP, FINISH & APPEARANCE OF ASTM F2329. 1 THE GALVANIZING PROCESS WAS CONDUCTED IN A TEMPERATURE RANGE OF 839F TO 859F 1 THIS PRODUCT WAS GALVANIZED IN ROCKFORD, IL USA WE CERTIFY THAT THE ABOVE SIZES AND LOT NUMBERS THAT WERE GALVANIZED IN OUR PLANT MEET SPECS ASTM A153 CLASS C or ASTM A123. ROHS COMPLIANT AS IT PERTAINS TO HDG. DATE: <u>12-05-12</u> O. C. DEPT. <u>Tracy Glat</u> Request Date: 12/17/12 1 Tub Galv OK 12/15/12 <u>SR</u>			

Seller represents that with respect to the production of the articles and/or the performance of the services covered by this invoice, it has fully complied with Section 12 (a) of the Fair Labor Standards Act of 1938 as amended.
 ALL AGREEMENTS CONTINGENT UPON STRIKES, ACCIDENTS OR OTHER CAUSES BEYOND OUR CONTROL.
 NOTICE—CLAIMS FOR LOSS OR DAMAGE MUST BE MADE WITHIN FIVE DAYS. ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE.
 DUPLICATE DELIVERY RECEIPT

CERTIFICATE OF COMPLIANCE

43036

ROCKFORD BOLT & STEEL CO.
126 MILL STREET
ROCKFORD, IL 61101
815-968-0514 FAX# 815-968-3111

CUSTOMER NAME: TRINITY INDUSTRIES

CUSTOMER PO: 157307

INVOICE #: 951785

DATE SHIPPED: 8/12/13

LOT#: P34858 R54163

DECKER LOT#13-31-022

SPECIFICATION: ASTM A563, GRADE A MILD CARBON STEEL NUTS

COATING: ASTM SPECIFICATION F-2329 HOT DIP GALVANIZE

ROGERS BROS. GALVANIZING: 13-31-022

Hardness: HRB
Spec: 69 min

CHEMICAL COMPOSITION

MILL	GRADE	HEAT#	C	Mn	P	S	Si	Actual:
CHARTER STEEL	1010	20255180	.09	.37	.008	.001	.07	82 82.5 81.5 84 81 83.5 80 84

QUANTITY AND DESCRIPTION:

19,573 PCS 1/2" HEXAGONAL NUT.
P/N 4303G

WE HEREBY CERTIFY THE ABOVE PARTS HAVE BEEN MANUFACTURED IN THE U.S.A. WITH DOMESTIC STEEL. WE FURTHER CERTIFY THAT THIS DATA IS A TRUE REPRESENTATION OF INFORMATION PROVIDED BY THE MATERIALS SUPPLIER, AND THAT OUR PROCEDURES FOR THE CONTROL OF PRODUCT QUALITY ASSURE THAT ALL ITEMS FURNISHED ON THIS ORDER MEET OR EXCEED ALL APPLICABLE TESTS, PROCESS, AND INSPECTION REQUIREMENTS PER ABOVE SPECIFICATION.

STATE OF ILLINOIS
COUNTY OF WINNEBAGO

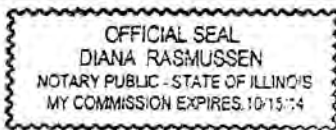
SIGNED BEFORE ME ON THIS

14 DAY OF August 20 13

Diana Rasmussen

Grada McLomas
APPROVED SIGNATORY

8/14/13
DATE



43036

DECKER
MANUFACTURING CORPORATION



MANUFACTURERS OF INDUSTRIAL FASTENERS & PIPE PLUGS
703 North Clark Street Albion, Michigan 49224

Phone 517-629-3955
Fax 517-629-3535
Sales Fax 517-629-8424
www.deckermul.com

Printed: 8/13/2013 4:12:02 PM
August 13, 2013

ROCKFORD BOLT & STEEL CO
126 MILL STREET
ROCKFORD, IL 61101

PRODUCT MATERIAL CERTIFICATION

CUSTOMER PART NUMBER : 903608-D INVOICE: 64880
CUSTOMER P.O. NUMBER : P34858

LOT NUMBER: 13-31-022 DESCRIPTION: 1/2-13 HX NUT DC .013
DATE: Apr 22, 2013 QUANTITY: 35,000
HEAT NUMBER: 20255180 MATERIAL SUPPLIER: CHARTER STEEL
MATERIAL: STEEL - C1010

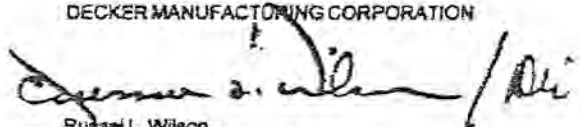
We certify the product above was manufactured at DECKER MANUFACTURING CORPORATION from the specified raw material and that said product is certified to be manufactured, randomly sampled, tested and/or inspected and conforms to applicable specifications. We additionally certify that said raw material was domestically manufactured in the United States of America and that said raw material was manufactured free of mercury contamination.

The items were processed under the Decker Quality Manual. The current revision is dated January 12, 2005
No welding was performed.

This document accurately represents values and statements provided by our suppliers accredited testing facility. The original metallurgical test report shall be retained on file by DECKER MANUFACTURING CORPORATION for a period of not less than (10) years.

CHEMICAL ANALYSIS BY MATERIAL SUPPLIER

CARBON : 0.090 PHOSPHOROUS: 0.008
MANGANESE: 0.370 SULFUR : 0.001

DECKER MANUFACTURING CORPORATION

Russell L. Wilson
Quality Assurance Manager

The above results pertain only to the items tested. This report shall not be reproduced except in full without the approval of the testing facility.

43036



CHARTER STEEL

EMAIL

1858 Cold Springs Road
Saukville, Wisconsin 53080
(262) 268-2400
1-800-437-8789
FAX (262) 268-2570

A Division of
Charter Manufacturing Company, Inc.

CHARTER STEEL TEST REPORT Reverse Has Text And Codes

Decker Manufacturing Corp.
703 N. Clark St.
Albion, MI - 49224

Cust P.O.	47696-1304
Customer Part #	734 1010
Charter Sales Order	30055791
Heat #	20255180
Shp Lot #	4159722
Grade	1010 A AK FG RHQ 47/64
Process	HRCC
Finish Size	47/64

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed below and on the reverse side, and that it satisfies these requirements.

Test Results of Heat Lot# 20255180												
Lab Code: 125544	C	MN	P	S	SI	NI	CR	MO	CU	SN	V	
CHEM %WT	.08	.37	.008	.001	.075	.04	.05	.01	.08	.004	.001	
	AL	N	B	TI	MB							
	.034	.0020	.0001	.001	.001							

CHEM. DEVIATION EXT. - GREEN *

Test Results of Rolling Lot# 2043777					
	# of Tests	Min Value	Max Value	Mean Value	
ROCKWELL B	3	92	93	92	RB LAB = 0353-04
ROD SIZE	18	.728	.740	.733	
ROD OUT OF ROUND	4	.005	.011	.009	
REDUCTION RATIO = 11&:1					

Specifications: Manufactured per Charter Steel Quality Manual Rev 9.08-01-09
Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents:
Customer Document = ASTM A299A299-12 Revision = Dated = 01-MAY-12

Additional Comments:

Charter Steel
Cuyahoga Heights, OH, USA



This MTR supersedes all previously dated MTRs for this order

Jepice Bernard
Jepice Bernard
Manager of Quality Assurance
04/04/2013

Rem: Load, Fax, Mail

43036

The following statements are applicable to the material described on the front of this Test Report:

1. Except as noted, the steel supplied for this order was melted, rolled, and processed in the United States meeting DFAR's compliance.
2. Mercury was not used during the manufacture of this product, nor was the steel contaminated with mercury during processing.
3. Unless directed by the customer, there are no welds in any of the coils produced for this order.
4. The laboratory that generated the analytical or test results can be identified by the following key:

Certificate Number	Lab Code	Laboratory		Address
0358-01	7388	CSSM	Charter Steel Melting Division	1653 Cold Springs Road, Saukville, WI 53080
0358-02	8171	CSSR/ CSSP	Charter Steel Rolling/ Processing Division	1658 Cold Springs Road, Saukville, WI 53080
0358-03	123633	CSFP	Charter Steel Ohio Processing Division	6255 US Highway 23, Risingsun, OH 43457
0358-04	125544	CSCM/ CSCR	Charter Steel Cleveland	4300 E. 49th St., Cuyahoga Heights, OH 44125-1004
*	*	--	Subcontracted test performed by laboratory not in Charter Steel system	

5. When run by a Charter Steel laboratory, the following tests were performed according to the latest revisions of the specifications listed below, as noted in the Charter Steel Laboratory Quality Manual:

Test	Specification	CSSM	CSSR/CSSP	CSFP	CSCM/CSCR
Chemistry Analysis	ASTM E415; ASTM E1019	X			X
Macroetch	ASTM E381	X			X
Hardenability (Jominy)	ASTM A255; SAE J406; JIS G056	X			X
Grain Size	ASTM E112	X	X	X	X
Tensile Test	ASTM E8; ASTM A370		X	X	X
Rockwell Hardness	ASTM E18; ASTM A370	X	X	X	X
Microstructure (spheroidization)	ASTM A892		X	X	
Inclusion Content (Methods A, E)	ASTM E45		X		X
Decarburization	ASTM E1077		X	X	X

Charter Steel has been accredited to perform all of the above tests by the American Association for Laboratory Accreditation (A2LA). These accreditations expire 01/31/15.

All other test results associated with a Charter Steel laboratory that appear on the front of this report, if any, were performed according to documented procedures developed by Charter Steel and are not accredited by A2LA.

6. The test results on the front of this report are the true values measured on the samples taken from the production lot. They do not apply to any other sample.
7. This test report cannot be reproduced or distributed except in full without the written permission of Charter Steel. The primary customer whose name and address appear on the front of this form may reproduce this test report subject to the following restrictions:
 - It may be distributed only to their customers
 - Both sides of all pages must be reproduced in full
8. This certification is given subject to the terms and conditions of sale provided in Charter Steel's acknowledgement (designated by our Sales Order number) to the customer's purchase order. Both order numbers appear on the front page of this Report.
9. Where the customer has provided a specification, the results on the front of this test report conform to that specification unless otherwise noted on this test report.



43036

ROGERS BROTHERS INC.



July 23, 2013

Decker Manufacturing Corporation
 703 N. Clark Street
 Albion, MI 49224

To Whom It May Concern:

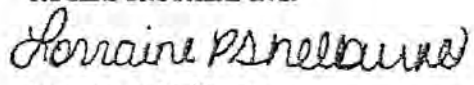
This is to certify that the hot dip galvanizing of the following material on your Purchase Order number 48176 conforms to specification ASTM A-153. The following sizes and lot numbers comply with the coating, workmanship, finish, and appearance requirements of ASTM F2329 specifications. The hot dip galvanizing is ROHS compliant. The galvanizing process was conducted in a temperature range of 830F to 850F.

137,762 pieces	#026-0813-26	Lot#13-31-022	3.09 Avg. Mils
9,635 pieces	#035-1031-26	Lot#13-52-023	2.72 Avg. Mils
21,101 pieces	#035-1031-26	Lot#13-52-024	2.37 Avg. Mils
21,125 pieces	#035-1031-26	Lot#13-52-025	3.17 Avg. Mils
20,852 pieces	#035-1031-26	Lot#13-52-026	3.26 Avg. Mils
19,384 pieces	#035-1031-26	Lot#13-52-030	3.62 Avg. Mils
41,650 pieces	#035-1031-26	Lot#13-52-033	2.38 Avg. Mils
64,813 pieces	#035-1031-26	Lot#13-52-034	2.37 Avg. Mils

This certification in no way implies anything other than the quality of our hot dip galvanizing as it pertains to your order.

This product was galvanized in Rockford, IL USA

Yours very truly,

ROGERS BROTHERS INC.

 Lorraine P. Shelburne
 Vice President

MATERIAL USED

TEST NUMBER 490024-1-5
 TEST NAME T631
 DATE 2014-05-12

#	DATE RECEIVED	DESCRIPTION	GRADE	YIELD	TENSILE	SUPPLIER
13-070	2013-12-06	S3x5.7	A36	58.6 / 59.0	74.2 / 74.4	Mack Bolt & Steel
13-072	2013-12-11	Plate, 8 x 5/8	A529 grade 55	68.5 / 68.8	85.7 / 86.9	Mack Bolt & Steel
13-074	2013-12-17	Backup Plates	A 1011 SS Gr. 33	44.9 - 55.4	63.0 - 69.7	Brazos Industries
13-075	2013-12-17	Nut, 5/16 hex	A563	see paperwork	see paperwork	Trinity Industries
13-076	2013-12-17	Nut, 1/2 hex	A563	see paperwork	see paperwork	Trinity Industries
13-077	2013-12-17	Bolt, 1/2 x 1-1/2 hex	A307	see paperwork	see paperwork	Trinity Industries
13-078	2013-12-17	Bolt, 5/16 x 2-3/8 hex	A307	see paperwork	see paperwork	Trinity Industries
13-113	2014-03-11	Guardrail Parts	-	see paperwork	-	Trinity Industries
	2013-05-22	W-beam-10		see attached		Trinity
	2013-05-22	W-beam-11		see attached		Trinity
	2013-05-22	Parts-36		see attached		Trinity
13-122	2014-04-10	S3x5.7	several, see paper	59.3/59.2	77.9/76.8	Mack Bolt & Steel
13-123	2014-04-10	Plate, 8 x 5/8	A529 gr. 55	65.2	82.4	Mack Bolt & Steel
13-145	2014-04-28	Bent Plate Backups	ASTM A 1011	see file	see file	Brazos Industries

TR No. 9-1002-12-12

86

2014-08-13



US-ML-MIDLOTHIAN
300 WARD ROAD
MIDLOTHIAN, TX 76065
USA

CERTIFIED MATERIAL TEST REPORT

CUSTOMER SHIP TO TRIPLE S STEEL SUPPLY 6000 JENSEN DR HOUSTON, TX 77026-1113 USA		CUSTOMER BILL TO TRIPLE S STEEL 6000 JENSEN DR HOUSTON, TX 77226-1119 USA		GRADE A36/A57250	SHAPE / SIZE Standard I-Beam / 3 X 5.7# / 75 X 8.5	
SALES ORDER 508314/000030		CUSTOMER MATERIAL N°		LENGTH 40' 00"	WEIGHT 16.416 LB	HEAT / BATCH 59053535/02
CUSTOMER PURCHASE ORDER NUMBER HOU-154620			BILL OF LADING 1327-0000067633	DATE 08/07/2013	SPECIFICATION / DATE of REVISION A36/A36M-08 A572/A572M-07 ASTM A6/A6M-11	

CHEMICAL COMPOSITION													
C %	Mn %	P %	S %	Si %	Cu %	Ni %	Cr %	Mo %	Sb %	V %	Nb %	Al %	
0.06	0.86	0.017	0.026	0.21	0.27	0.10	0.15	0.024	0.009	0.002	0.015	0.003	

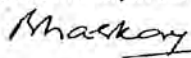
CHEMICAL COMPOSITION	
C _{Eqv} A6 %	
0.3	

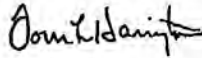
MECHANICAL PROPERTIES						
YS KSI	UTS KSI	YS MPa	UTS MPa	G/L Inch	G/L mm	
58.6	74.2	407	513	8.000	200.0	
59.0	74.4	404	512	8.000	200.0	

MECHANICAL PROPERTIES		
Elong. %	Y/T ratio %	
22.50	0.788	
22.10	0.795	

COMMENTS / NOTES

The above figures are certified chemical and physical test records as contained in the permanent records of company. This material, including the billets, was melted and manufactured in the USA. CMTR complies with EN 10204 3.1.


 BHASKAR YALAMANCHILI
 QUALITY DIRECTOR


 TOM HARRINGTON
 QUALITY ASSURANCE MGR.

TR No. 9-1002-12-12

87

2014-08-13

SOLD KLOECKNER METALS CORP
500 COLONIAL CENTER PKWY
TO: STE 500
ROSWELL, GA 30076-

SHIP KLOECKNER METALS
2560 SOUTH LOOP 4
TO: BUDA, TX 78610-



CERTIFIED MILL TEST REPORT

Ship from:
Nucor Steel - Texas
8812 Hwy 79 W
JEWETT, TX 75846
800-527-6445

Page: 2
Date: 20-Jun-2013
B.L. Number: 640965
Load Number: 247025

Material Safety Data Sheets are available at www.nucorbar.com or by contacting your inside sales representative.

FORM 00 January 1, 2012

LOT # HEAT #	DESCRIPTION	PHYSICAL TESTS				CHEMICAL TESTS												
		YIELD P.S.I.	TENSILE P.S.I.	ELONG % IN 8"	BEND	WT% DEF	C	Ni	Mn	Cr	P	Mo	S	V	Si	Cb	Cu	Sn
PO# -- JW1310469501	6681291 Nucor Steel - Texas	58,500	73,000	20.0%			.14	.92	.012	.021	.21	.35						
JW131046885	5x4x3/8 Anglo 20' A36/A529GR50	403MPa	503MPa				.17	.21	.058	.044	.001							
	ASTM A36-08, A529-05, A709-09a G R36, ASME SA36-07 Ed 11 Ad	58,800	76,700	20.0%			CE4020	CEA529										
		404MPa	529MPa				0.39	0.43										
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1																	
PO# -- JW1310472451	6680943 Nucor Steel - Texas	68,100	85,300	20.0%			.14	1.08	.013	.033	.21	.44						
JW13104724	1/2x12" Flat 20' A529 Gr55	470MPa	586MPa				.18	.17	.051	.079	.001							
	ASTM A529/A529M-05 GR 55	69,700	87,100	20.0%			CBV	CE4020	CEA529	MN/C								
		481MPa	601MPa				0.080	PB = *	0.46	0.7,1								
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1																	
PO# -- JW1310515252	6681426 Nucor Steel - Texas	68,500	85,700	20.0%			.16	1.11	.013	.029	.29	.33	.48					
JW13105152	5/8x8" Flat 20' A529 Gr55	472MPa	591MPa				.22	.18	.056	.075	***							
	ASTM A529/A529M-05 GR 55	68,800	86,900	21.0%			CBV	MN/C										
		474MPa	599MPa				0.080	05.94										
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1																	

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed above and that it satisfies those requirements.
1) Work order was not performed on this material.
2) Melts and Manufactured in the United States.
3) Mercury, Cadmium, or Alpha source materials (very low) have not been used in the production of this material.

QUALITY ASSURANCE _____

Jim Cutchend

12-10-2013 06:00
Mack Bolt & Steel
Cust. PO - 26090
Nucor Steel
Load - 1850893
BL - 3734120
Heat - JW13105152
Order-Line - 10281480 / 7
6/20/2013 3:58:48 PM PAGE 2/002 Fax Server
BLR466



MARTIN SUPPLY COMPANY
FASTENER DIVISION
 111-B Gordon Street
 Jackson, Tennessee 38301

Phone: (731) 935- 8505
 Fax: (731) 935- 8520

6267
 TE
 7-22-13

CERTIFICATE of COMPLIANCE
 Trinity Industries

Date: 7/22/13
 P.O. #: 156699
 Part #: 006267G
 Description: 5/16-18X2.375 HXBLT A307 FT MG
 Quantity: 10,000
 Heat : 20168810 Lot #: 42162

THIS IS TO CERTIFY THAT THE ITEMS SHIPPED AGAINST THE PURCHASE ORDER LISTED ABOVE CONFORM TO THE APPLICABLE PRINTS AND SPECIFICATIONS REQUIRED. MELTED AND MANUFACTURED IN THE USA.

Order Filled By: EVELYN TURNER
 Order Checked By: TIM STEELE
 Quality Technician: BLAKE MURCHISON

SINCERELY,

 CHARLES BLANKENSHIP
 QUALITY MANAGER

Form # COC 001 Date Rev. 11/15/02



CSM Fastener Products Company

Certificate of Conformance

TE
7-17-13

2451 Estes Avenue
Elk Grove Village, IL 60007

Phone: 630.350.8282
Fax: 630.350.8499

Certificate of Conformance			Date:
			7/17/13
Customer Name:	MARTIN INDUSTRIAL	Customer P/N:	ENY-006267G
Address:	111-B GORDON ST JACKSON TN. 38301	CSM Internal Number: LOT#	65362 42162
Part Description:	5/16-18 X 2-3/8 HEX HEAD CAP SCREW MECHANICAL GALVANIZE ↘ HEAT# 20168810 (MILL:CHARTER STEEL) ↘ PLATE P.O.# 91196 (DYNA BURR)		
<p>We do hereby certify that the fasteners covered by this shipment meet all of your requirements listed on your purchase order 301001620. The listed p.o. was manufactured in the United States of America.</p>			

CSM Fastener Products
JOE NYTKO



DynaBurr Chicago Inc. Certification

Order No.: 29072
Date: 07/17/2013
Entry Date: 07/08/2013
Page: 1 of 1

To:
CSM FASTENERS
2451 Estes Ave.

Purchase Order No.: 91196
Packing List No.:

Elk Grove IL 60007

We are pleased to provide you with the following Certification. If you have any questions regarding this Certification, please contact Bob Bea at 708-345-0762. (10 Pieces Certified)

Quantity	Part Number / Part Name / Part Description	Pounds
11,160	65362 5/16-18 x 2 3/8 Hex Head Cap Screw Full Thread .002 Mechanical Galvanize	572

Insp. Type	Scale	Minimum	Maximum	Number	Other
<u>Customer Requirements:</u>					
Inches		.002	.0035		ASTM B695-04 Class 50 Type I
Process Inspection Overlayed by Part					
<u>Results:</u>					
Thick	Inches	.00218	.00267	.00254	Mean
Processed In the USA					

Thickness of plating deposit: The thickness of plating was measured by the CMI EDDY-MAG 700 Thickness Tester.

DynaBurr Chicago Inc.


7-17-13
Inspector
Quality Control Department
DynaBurr Chicago Inc.

This certifies that the plating thickness meets the specified requirements.

65 East Lake Street Northlake IL 60164

Phone: 708-345-0762

Fax: 708-345-0778

DynaBurr Chicago, Inc.
EMX 29072
Fri Jul 12, 2013 07:05:01
Customer: CSM FASTENER
Part No:
Batch No:
Inspector:
Accept/Reject:

Fri Jul 12, 2013 07:05:02
 4: WASHERS (THIN)
 NMAG/MAG SMP-1

=== Session Stats ===
 Total Readings 10 Mean 0.002544 in
 SDev 0.000157 in %Dev 6.159372%
 Accuracy 0.000099 in
 CPK 0.005412
 High 0.00267 in Low 0.00218 in
 Range 0.00049 in

- 1: 0.00262 in
- 2: 0.00264 in
- 3: 0.00266 in
- 4: 0.00252 in
- 5: 0.00251 in
- 6: 0.00264 in
- 7: 0.00261 in
- 8: 0.00267 in
- 9: 0.00218 in
- 10: 0.00238 in



CHARTER STEEL

FILE

1658 Cold Springs Road
Saukville, Wisconsin 53080

(262) 268-2400

1-800-437-8789

FAX (262) 268-2570

A Division of
Charter Manufacturing Company, Inc.

CHARTER STEEL TEST REPORT Reverse Has Text And Codes

Beta Steel
44225 Utica Rd.
Utica, MI- 48318

Cust P.O.	268779
Customer Part #	328010220100SC(SW1022M-B)
Charter Sales Order	30034177
Heat #	20168810
Ship Lot #	2020726
Grade	1022 M SK CG SQ 21/64
Process	HR
Finish Size	21/64

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed below and on the reverse side, and that it satisfies these requirements.

Test Results of Heat Lot# 20168810												
Lab Code: 125544	C	MN	P	S	SI	NI	CR	MO	CU	SN	V	
CHEM %Wt	.21	.95	.011	.003	.190	.04	.07	.02	.09	.006	.002	
	AL	N	B	TI	CA	NB						
	.004	.0060	.0001	.001	.0001	.001						
JOMINY(HRC)	JOM01	JOM02	JOM03									
	45	33	25									
JOMINY SAMPLE TYPE ENGLISH = C GRAIN SIZE LAB = 0358-04 McQuaid- Ehn Grain Size Comparison = 3 - 5 CHEM. DEVIATION EXT.- GREEN =												

Test Results of Rolling Lot# 2020726					
	# of Tests	Min Value	Max Value	Mean Value	
TENSILE (KSI)	1	79.5	79.5	79.5	TENSILE LAB = 0358-04
REDUCTION OF AREA (%)	1	72	72	72	RA LAB = 0358-04
NUM DECARB = 1 AVE DECARB (Inch) = .001 REDUCTION RATIO = 580:1					

Specifications: Manufactured per Charter Steel Quality Manual Rev 9,08-01-09
Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents:
Customer Document = PS-1 Revision = Dated = 11-MAR-08

Additional Comments:

Charter Steel
Cuyehoga Heights, OH, USA

Rem: Load1,Fax0,Mail0



This MTR supersedes all previously dated MTRs for this order
Janice Barnard
Janice Barnard
Manager of Quality Assurance
07/17/2013

The following statements are applicable to the material described on the front of this Test Report:

1. Except as noted, the steel supplied for this order was melted, rolled, and processed in the United States meeting DFAR's compliance.
2. Mercury was not used during the manufacture of this product, nor was the steel contaminated with mercury during processing.
3. Unless directed by the customer, there are no welds in any of the coils produced for this order.
4. The laboratory that generated the analytical or test results can be identified by the following key:

Certificate Number	Lab Code	Laboratory		Address
0358-01	7388	CSSM	Charter Steel Melting Division	1653 Cold Springs Road, Saukville, WI 53080
0358-02	8171	CSSR/CSSP	Charter Steel Rolling/Processing Division	1658 Cold Springs Road, Saukville, WI 53080
0358-03	123633	CSFP	Charter Steel Ohio Processing Division	6255 US Highway 23, Risingsun, OH 43457
0358-04	125544	CSCM/CSCR	Charter Steel Cleveland	4300 E. 49th St., Cuyahoga Heights, OH 44125-1004
.	.	--	Subcontracted test performed by laboratory not in Charter Steel system	

5. When run by a Charter Steel laboratory, the following tests were performed according to the latest revisions of the specifications listed below, as noted in the Charter Steel Laboratory Quality Manual:

Test	Specification	CSSM	CSSR/CSSP	CSFP	CSCM/CSCR
Chemistry Analysis	ASTM E415; ASTM E1019	X			X
Macroetch	ASTM E381	X			X
Hardenability (Jominy)	ASTM A255; SAE J406; JIS G0551	X			X
Grain Size	ASTM E112	X	X	X	X
Tensile Test	ASTM E8; ASTM A370		X	X	X
Rockwell Hardness	ASTM E18; ASTM A370	X	X	X	X
Microstructure (spheroidization)	ASTM A892		X	X	
Inclusion Content (Methods A, E)	ASTM E45		X		X
Decarburization	ASTM E1077		X	X	X

Charter Steel has been accredited to perform all of the above tests by the American Association for Laboratory Accreditation (A2LA). These accreditations expire 01/31/13.

All other test results associated with a Charter Steel laboratory that appear on the front of this report, if any, were performed according to documented procedures developed by Charter Steel and are not accredited by A2LA.

6. The test results on the front of this report are the true values measured on the samples taken from the production lot. They do not apply to any other sample.
7. This test report cannot be reproduced or distributed except in full without the written permission of Charter Steel. The primary customer whose name and address appear on the front of this form may reproduce this test report subject to the following restrictions:
 - It may be distributed only to their customers
 - Both sides of all pages must be reproduced in full
8. This certification is given subject to the terms and conditions of sale provided in Charter Steel's acknowledgement (designated by our Sales Order number) to the customer's purchase order. Both order numbers appear on the front page of this Report.
9. Where the customer has provided a specification, the results on the front of this test report conform to that specification unless otherwise noted on this test report.



43086

CERTIFICATE OF COMPLIANCE

ROCKFORD BOLT & STEEL CO.
126 MILL STREET
ROCKFORD, IL 61101
815-968-0514 FAX# 815-968-3111

CUSTOMER NAME: TRINITY INDUSTRIES

CUSTOMER PO: 241147

SHIPPER #: 050687
DATE SHIPPED: 12/4/2013

INVOICE #:

ROCKFORD BOLT PO#: P34735
NUCOR LOT#: 320299A

SPECIFICATION: ASTM A307 , GRADE A MILD CARBON STEEL BOLTS

COATING: ASTM SPECIFICATION F2329 HOT DIP GALVANIZE
ROGERS BROTHERS GALVANIZE JOB#: R53477-02

CHEMICAL COMPOSITION

MILL	GRADE	HEAT#	C	Mn	P	S	SI
NUCOR	1017M	NF12204133	.18	.44	.007	.023	.15

QUANTITY AND DESCRIPTION:

816 PCS 1/2" X 1-1/2 " HEX HEAD CAP SCREW
P/N 4308G

WE HEREBY CERTIFY THE ABOVE PARTS HAVE BEEN MANUFACTURED IN THE U S A WITH DOMESTIC STEEL. WE FURTHER CERTIFY THAT THIS DATA IS A TRUE REPRESENTATION OF INFORMATION PROVIDED BY THE MATERIALS SUPPLIER, AND THAT OUR PROCEDURES FOR THE CONTROL OF PRODUCT QUALITY ASSURE THAT ALL ITEMS FURNISHED ON THIS ORDER MEET OR EXCEED ALL APPLICABLE TESTS, PROCESS, AND INSPECTION REQUIREMENTS PER ABOVE SPECIFICATION

STATE OF ILLINOIS
COUNTY OF WINNEBAGO

SIGNED BEFORE ME ON THIS
5 DAY OF December 13
Diana Rasmussen

Don Kemp
APPROVED SIGNATORY

12-5-13
DATE





ROCKFORD BOLT AND STEEL CO.

PHONE: 815-968-0514 • FAX# 815-968-3111
E-MAIL: rockfordbolt@voyager.net
126 MILL STREET • ROCKFORD, ILLINOIS 61101

43086

If charges are to be prepaid
write or stamp here; To be Prepaid.

STRAIGHT BILL OF LADING - SHORT FORM

Original - Not Negotiable

RECEIVED, subject to the classifications and tariffs in effect on the date of issue of this Original Bill of Lading.

PRODUCT SHIPPED
IRON BOLTS
CLASS OR RATE 50
NMFC 093-486-02

***** Packing List *****

SHIP TO: 003144

TRINITY INDUSTRIES
1170 N. STATE STREET
ATTN: FOREST ROEDER
PLANT # 31
GIRARD, OH 44420

Shipper#: 050687
Ship Date: 12/04/13
Page#: 1
Sales Order#: 241147
Purchase Order: 159783
Ordered by:

SOLD TO:

TRINITY INDUSTRIES
MAIL STOP: 7115
P O BOX 568887
DALLAS, TX 75356-8887

Trinity Highway Products, LLC
Dallas, Texas Plant # 99
DEC - 5 2013
PASSED & CERTIFIED
DEC 4 2013

Attention:

Bill of Lading	Weight	Packages
	573.0	3

Payment Terms	Freight Terms	Carrier
*	COLLECT CPU	305544385-6 FEDEX FRT PRIORITY

Ship Qty	Line	Part Number	Description	Weight
816	0002	000824-D	1/2 X 1-1/2 HCS A307 HDG	P 34735
			CUST PART#: 4308G/113457G	
4183	0002	000824-D	1/2 X 1-1/2 HCS A307 HDG	P 34890
			CUST PART#: 4308G/113457G	

The property described in appears paid order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and delivered as indicated below which said company (the carrier) being understood throughout this contract as involving any person or corporation in possession of the property under the contract agrees to carry to its usual place of delivery or said destination, if on its road or its own water line, otherwise to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Freight Bill of Lading and Form (1) in Office, Standard, Western and Motor Freight Classifications in effect on the date hereof, if this is a rail or rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment.

Shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

Subject to Section 7 of Conditions of applicable bill of lading, if the shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement.

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

ROCKFORD BOLT & STEEL CO., Shipper, Per _____ Agent, Per _____

DOCK _____

BILLING COPY

ROCKFORD BOLT & STEEL
(Signature of Consignor)

NUCOR
FASTENER DIVISION

LOT NO.
 320299A

413086
 Post Office Box 6100
 Saint Joe, Indiana 46785
 Telephone 260/337-1000

CUSTOMER NO/NAME
 750 ROCKFORD BOLT & STEEL CO.
 TEST REPORT SERIAL# FB402327
 TEST REPORT ISSUE DATE 1/16/13
 DATE SHIPPED 6/07/13
 NAME OF LAB SAMPLER: FRANKLIN A. NEAL, LAB TECHNICIAN
 NUCOR PART NO QUANTITY LOT NO. DESCRIPTION
 419000 15000 320299A 1/2-13 X 1 1/2 A307 HX CAP
 MANUFACTURE DATE 1/11/13
 NUCOR ORDER # 826851
 CUST PART #
 CUSTOMER P.O. # P34735



--CHEMISTRY MATERIAL GRADE -1017ML

MATERIAL NUMBER	HEAT NUMBER	ANALYSIS					MATERIAL SUPPLIER
		C	MN	P	S	SI	
RM027817	MF12204133	.18	.44	.007	.023	.15	NUCOR STEEL - NEBRASKA
		MIN					
		MAX	.040	.150			

--MECHANICAL PROPERTIES IN ACCORDANCE WITH ASTM A307-10 & SAE J429 GR2-11

SURFACE HARDNESS (R50N)	CORE HARDNESS (R8)	PROOF LOAD (N/A)	TENSILE STRENGTH 10 DEG-WEDGE	
			(LBS)	STRESS (PSI)
N/A	95.4	N/A	14000	98945
N/A	95.3	N/A	14050	99013
N/A	94.7	N/A	14060	99084
AVERAGE VALUES FROM TESTS		PRODUCTION LOT SIZE	20000 PCS	
	95.1	14050		99013

--DIMENSIONS PER ASME B10.2.1-2010

CHARACTERISTIC	#SAMPLES TESTED	MINIMUM	MAXIMUM
Width Across Corners	8	0.3440	0.5490
Screw Length	8	1.4670	1.4840
Threads	8	PASS	PASS

ALL TESTS ARE IN ACCORDANCE WITH THE LATEST REVISIONS OF THE METHODS PRESCRIBED IN THE APPLICABLE SAE AND ASTM SPECIFICATIONS. THE SAMPLES TESTED CONFORM TO THE SPECIFICATIONS AS DESCRIBED/LISTED ABOVE AND WERE MANUFACTURE FREE OF MERCURY CONTAMINATION. THE STEEL WAS MELTED AND MANUFACTURED IN THE U.S.A. AND THE PRODUCT WAS MANUFACTURED AND TESTED IN THE U.S.A. PRODUCT COMPLIES WITH DFARS 252.225-7014. WE CERTIFY THAT THIS DATA IS A TRUE REPRESENTATION OF INFORMATION PROVIDED BY THE MATERIAL SUPPLIER AND OUR TESTING LABORATORY. THIS CERTIFIED MATERIAL TEST REPORT RELATES ONLY TO THE ITEMS LISTED ON THIS DOCUMENT AND MAY NOT BE REPRODUCED EXCEPT IN FULL.



MECHANICAL FASTENER
 CERTIFICATE NO. AZLA 0139.01
 EXPIRATION DATE 12/31/13

NUCOR FASTENER
 A DIVISION OF NUCOR CORPORATION

John W. Ferguson
 JOHN W. FERGUSON
 QUALITY ASSURANCE SUPERVISOR

NUCOR
NUCOR CORPORATION
NUCOR STEEL NEBRASKA

MHI Certification
 9/28/2012

43086 27817
 2811 East Nucor Road
 NORFOLK, NE 68701
 (402) 644-0200
 Fax: (402) 644-0329

Sold To: NUCOR FASTENER INDIANA
 PO BOX 8100
 6730 COUNTY RD 60
 ST JOE, IN 46785-0000
 (200) 337-1800
 Fax: (435) 734-4581

Ship To: NUCOR FASTENER INDIANA
 COUNTY RD 60
 ST JOE, IN 46785-0000

Customer P.O.	193001	Sales Order	124154.1
Product Group	Rod	Part Number	32800616000U360
Grade	1017ML	Lot #	NF1220413311
Size	.5156-33/64 Wire Rod	Heat #	NF12204133
Product	.5156-33/64 Wire Rod Call 1017ML	B.L. Number	N1-237470
Description	1017ML	Load Number	N1-183665
Customer Spec		Customer Part #	002008

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed above and that it satisfies these requirements.

C	Mn	V	Si	S	P	Cu	Cr	Ni	Mo	Al	Cb
0.16%	0.44%	0.000%	0.15%	0.023%	0.007%	0.11%	0.07%	0.05%	0.02%	0.002%	0.000%
Pb	Sn	Ca	B	Ti							
0.000%	0.006%	0.0000%	0.0000%	0.001%							

Reduction Ratio 210 :1

Specification Comments: Coarse Grain Practice

Selenium, Tellurium, Lead, Bismuth or Boron were not intentionally added to this heat.

- All manufacturing processes of the steel materials in this product, including melting, have been performed in the United States.
- All products produced are weld free.
- Mercury, in any form, has not been used in the production or testing of this material.
- Test conform to ASTM A29-11a, ASTM E415 and ASTM E1019-re-sulfurized grades or applicable customer requirements.
- All material melted at Nucor Steel Nebraska is produced in an Electric Arc Furnace
- Strand Cast
- L-A-B accreditation certificate is available upon request

Chemistry Verification Checks

Part# 2008 lot 27817

Checked By Date
 Receiving OK: 297 10-8-12
 Certification OK: 325 10-8-12

Jim Hill

Jim Hill
 Division Metallurgist

**ROGERS
BROTHERS
CALVANIZING**



HOT DIP GALVANIZING
1925 KISHWAUKEE STREET
ROCKFORD, IL 61104-5197
PHONE: 815/965-5132
FAX: 815/965-3765

43086

ORDER NO. 89825
06/12/13
Page 1

SOLD TO <input type="checkbox"/> RKB ROCKFORD BOLT & STEEL COMPANY 126 MILL STREET ROCKFORD, IL 61101		SHIP TO ROCKFORD BOLT & STEEL COMPANY 126 MILL STREET ROCKFORD, IL 61101				
TERMS: 1/2% 10-N30	SHIPPED VIA OUR TRUCK	COLLECT	PREPAID X	CUSTOMER ORD. NO. 873599	INVOICE DATE	INVOICE NO.
QUANTITY	DESCRIPTION	WEIGHT	PRICE	AMOUNT		
15880 15049	1/2 X 1-1/2 HEX CAP SCREW A307 #888824-D JOB#R53477-02 BLK WT 1788# PS4735 1 AVG. COATING WEIGHT: 3.85 MILS. 1 WE CERTIFY THE ABOVE SIZES & LOT# S COMPLY W/ THE COATING, WORKMANSHIP, FINISH & APPEARANCE OF ASTM F2329. 1 THE GALVANIZING PROCESS WAS CONDUCTED IN A TEMPERATURE RANGE OF 838F TO 858F 1 THIS PRODUCT WAS GALVANIZED IN ROCKFORD, IL USA WE CERTIFY THAT THE ABOVE SIZES AND LOT NUMBERS THAT WERE GALVANIZED IN OUR PLANT MEET SPECS ASTM A153 CLASS OR ASTM A123. ROHS COMPLIANT AS IT PERTAINS TO HDG. DATE: 06-16-2013 Q. C. DEPT. <i>Tacey</i> Request Date: 06/25/13	1 TUB	1644 1640			
(D) GAL OK TO 6/17/13 <i>Mind</i>						

Seller represents that with respect to the production of the articles and/or the performance of the services covered by this invoice, it has fully complied with Section 12 (a) of the Fair Labor Standards Act of 1938 as amended.
 ALL AGREEMENTS CONTINGENT UPON STRIKES, ACCIDENTS OR OTHER CAUSES BEYOND OUR CONTROL.
 NOTICE—CLAIMS FOR LOSS OR DAMAGE MUST BE MADE WITHIN FIVE DAYS. ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE

DUPLICATE DELIVERY RECEIPT

CERTIFICATE OF COMPLIANCE

4303G

ROCKFORD BOLT & STEEL CO.
126 MILL STREET
ROCKFORD, IL 61101
815-968-0514 FAX# 815-968-3111

CUSTOMER NAME: TRINITY INDUSTRIES

CUSTOMER PO: 157307

INVOICE #: 951785

DATE SHIPPED: 8/12/13

LOT#: P34858 R54163

DECKER LOT#13-31-022

SPECIFICATION: ASTM A563, GRADE A MILD CARBON STEEL NUTS

COATING: ASTM SPECIFICATION F-2329 HOT DIP GALVANIZE
ROGERS BROS. GALVANIZING: 13-31-022

Hardness: HRB
Spec: 69 min

CHEMICAL COMPOSITION

MILL	GRADE	HEAT#	C	Mn	P	S	Si	Actual:
CHARTER STEEL	1010	20255180	.09	.37	.008	.001	.07	82 82.5 81.5 84 81 83.5 80 84

QUANTITY AND DESCRIPTION:

19,573 PCS 1/2" HEXAGONAL NUT.
P/N 4303G

WE HEREBY CERTIFY THE ABOVE PARTS HAVE BEEN MANUFACTURED IN THE U.S.A WITH DOMESTIC STEEL. WE FURTHER CERTIFY THAT THIS DATA IS A TRUE REPRESENTATION OF INFORMATION PROVIDED BY THE MATERIALS SUPPLIER, AND THAT OUR PROCEDURES FOR THE CONTROL OF PRODUCT QUALITY ASSURE THAT ALL ITEMS FURNISHED ON THIS ORDER MEET OR EXCEED ALL APPLICABLE TESTS, PROCESS, AND INSPECTION REQUIREMENTS PER ABOVE SPECIFICATION.

STATE OF ILLINOIS

COUNTY OF WINNEBAGO

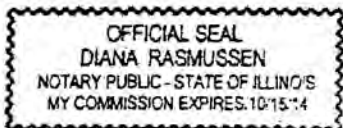
SIGNED BEFORE ME ON THIS

14 DAY OF August 20 13

Diana Rasmussen

Linda Melomas
APPROVED SIGNATORY

8/14/13
DATE



43036

DECKER

MANUFACTURING CORPORATION

MANUFACTURERS OF INDUSTRIAL FASTENERS & PIPE PLUGS
703 North Clark Street Albion, Michigan 49224



Phone 517-629-3855
Fax 517-629-3535
Sales Fax 517-629-8424
www.deckermuf.com

Printed: 8/13/2013 4:12:02 PM
August 13, 2013

ROCKFORD BOLT & STEEL CO
126 MILL STREET
ROCKFORD, IL 61101

PRODUCT MATERIAL CERTIFICATION

CUSTOMER PART NUMBER: 903608-D INVOICE: 64880
CUSTOMER P.O. NUMBER: P34858

LOT NUMBER: 13-31-022 DESCRIPTION: 1/2-13 HX NUT DC .018
DATE: Apr 22, 2013 QUANTITY: 35,000
HEAT NUMBER: 20255180 MATERIAL SUPPLIER: CHARTER STEEL
MATERIAL: STEEL - C1010

We certify the product above was manufactured at DECKER MANUFACTURING CORPORATION from the specified raw material and that said product is certified to be manufactured, randomly sampled, tested and/or inspected and conforms to applicable specifications. We additionally certify that said raw material was domestically manufactured in the United States of America and that said raw material was manufactured free of mercury contamination.

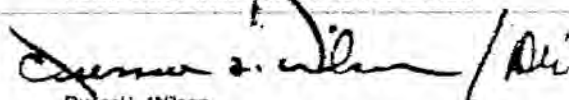
The items were processed under the Decker Quality Manual. The current revision is dated January 12, 2005. No welding was performed.

This document accurately represents values and statements provided by our suppliers accredited testing facility. The original metallurgical test report shall be retained on file by DECKER MANUFACTURING CORPORATION for a period of not less than (10) years.

CHEMICAL ANALYSIS BY MATERIAL SUPPLIER

CARBON: 0.090 PHOSPHOROUS: 0.008
MANGANESE: 0.370 SULFUR: 0.001

DECKER MANUFACTURING CORPORATION


Russel L. Wilson
Quality Assurance Manager

The above results pertain only to the items tested. This report shall not be reproduced except in full without the approval of this testing facility.

4303



**CHARTER
STEEL**

A Division of
Charter Manufacturing Company, Inc.

EMAIL

1658 Cold Springs Road
Saukville, Wisconsin 53080
(262) 268-2400
1-800-437-8788
FAX (262) 268-2570

CHARTER STEEL TEST REPORT
Reverse Has Text And Codes

Decker Manufacturing Corp.
703 N. Clark St.
Albion, MI-49224

Cust P.O.	47696-1304
Customer Part #	.734 1010
Charter Sales Order	30055791
Heat #	20255180
Ship Lot #	4199722
Grade	1010 A AK FG RHQ 47/64
Process	HRCC
Finish Size	47/64

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed below and on the reverse side, and that it satisfies these requirements.

Lab Code: 128544

Test Results of Heat Lot# 20255180

CHEM	C	MN	P	S	SI	NI	CR	MO	CU	SN	V
%Wt	.08	.17	.008	.004	.070	.04	.06	.01	.00	.004	.001
	AL	N	B	TI	MB						
	.034	.0080	.0007	.001	.001						

CHEM. DEVIATION EXT. -GREEN =

Test Results of Rolling Lot# 2043777

	# of Tests	Min Value	Max Value	Mean Value	RS LAB = 0328-04
ROCKWELL B	3	62	63	62	
ROD SIZE	18	.728	.740	.735	
ROD OUT OF ROUND	4	.006	.011	.009	
REDUCTION RATIO = 118:1					

Specifications: Manufactured per Charter Steel Quality Manual Rev 9.06-01-08
Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents:
Customer Document = ASTM A299A299M-12 Revision = Dated = 01-MAY-12

Additional Comments:

Charter Steel
Cuyahoga Heights, OH, USA

Rem: Load, Fax, Mail



Page 1 of 1

This MTR supersedes all previously dated MTRs for this order

Janice Barnard
Janice Barnard
Manager of Quality Assurance
04/04/2013

43036

The following statements are applicable to the material described on the front of this Test Report:

1. Except as noted, the steel supplied for this order was melted, rolled, and processed in the United States meeting DFAR's compliance.
2. Mercury was not used during the manufacture of this product, nor was the steel contaminated with mercury during processing.
3. Unless directed by the customer, there are no welds in any of the coils produced for this order.
4. The laboratory that generated the analytical or test results can be identified by the following key:

Certificate Number	Lab Code	Laboratory		Address
0358-01	7388	CSSM	Charter Steel Melting Division	1653 Cold Springs Road, Saukville, WI 53080
0358-02	8171	CSSR/CSSP	Charter Steel Rolling/Processing Division	1658 Cold Springs Road, Saukville, WI 53080
0358-03	123633	CSFP	Charter Steel Ohio Processing Division	6255 US Highway 23, Risingsun, OH 43457
0358-04	125544	CSCM/CSCR	Charter Steel Cleveland	4300 E. 49th St., Cuyahoga Heights, OH 44125-1004
.	.	--	Subcontracted test performed by laboratory not in Charter Steel system	

5. When run by a Charter Steel laboratory, the following tests were performed according to the latest revisions of the specifications listed below, as noted in the Charter Steel Laboratory Quality Manual:

Test	Specification	CSSM	CSSR/CSSP	CSFP	CSCM/CSCR
Chemistry Analysis	ASTM E415; ASTM E1019	X			X
Macroetch	ASTM E381	X			X
Hardenability (Jominy)	ASTM A255; SAE J406; JIS G056	X			X
Grain Size	ASTM E112	X	X	X	X
Tensile Test	ASTM E8; ASTM A370		X	X	X
Rockwell Hardness	ASTM E18; ASTM A370	X	X	X	X
Microstructure (spheroidization)	ASTM A892		X	X	
Inclusion Content (Methods A, E)	ASTM E45		X		X
Decarburization	ASTM E1077		X	X	X

Charter Steel has been accredited to perform all of the above tests by the American Association for Laboratory Accreditation (A2LA). These accreditations expire 01/31/15.

All other test results associated with a Charter Steel laboratory that appear on the front of this report, if any, were performed according to documented procedures developed by Charter Steel and are not accredited by A2LA.

6. The test results on the front of this report are the true values measured on the samples taken from the production lot. They do not apply to any other sample.
7. This test report cannot be reproduced or distributed except in full without the written permission of Charter Steel. The primary customer whose name and address appear on the front of this form may reproduce this test report subject to the following restrictions:
 - It may be distributed only to their customers
 - Both sides of all pages must be reproduced in full
8. This certification is given subject to the terms and conditions of sale provided in Charter Steel's acknowledgement (designated by our Sales Order number) to the customer's purchase order. Both order numbers appear on the front page of this Report.
9. Where the customer has provided a specification, the results on the front of this test report conform to that specification unless otherwise noted on this test report.



43036

ROGERS BROTHERS INC.



July 23, 2013

Decker Manufacturing Corporation
 703 N. Clark Street
 Albion, MI 49224

To Whom It May Concern:

This is to certify that the hot dip galvanizing of the following material on your Purchase Order number 48176 conforms to specification ASTM A-153. The following sizes and lot numbers comply with the coating, workmanship, finish, and appearance requirements of ASTM F2329 specifications. The hot dip galvanizing is ROHS compliant. The galvanizing process was conducted in a temperature range of 830F to 850F.

137,762 pieces	#026-0813-26	Lot#13-31-022	3.09 Avg. Mils
9,635 pieces	#035-1031-26	Lot#13-52-023	2.72 Avg. Mils
21,101 pieces	#035-1031-26	Lot#13-52-024	2.37 Avg. Mils
21,125 pieces	#035-1031-26	Lot#13-52-025	3.17 Avg. Mils
20,852 pieces	#035-1031-26	Lot#13-52-026	3.26 Avg. Mils
19,384 pieces	#035-1031-26	Lot#13-52-030	3.62 Avg. Mils
41,650 pieces	#035-1031-26	Lot#13-52-033	2.38 Avg. Mils
64,813 pieces	#035-1031-26	Lot#13-52-034	2.37 Avg. Mils

This certification in no way implies anything other than the quality of our hot dip galvanizing as it pertains to your order.

This product was galvanized in Rockford, IL USA

Yours very truly,

ROGERS BROTHERS INC.

Lorraine P. Shelburne
 Vice President

ROGERS BROTHERS, INC. 1925 KISHWAUKEE STREET, ROCKFORD, ILLINOIS 61104-5197 PHONE: 815/985-5132 FAX: 815/985-3785
 E-MAIL: rogersbro@rbs.net

DECKER

MANUFACTURING CORPORATION

MANUFACTURERS OF INDUSTRIAL FASTENERS & PIPE PLUGS
703 North Clark Street Albion, Michigan 49224

Phone 517-629-3955
Fax 517-629-3535
Sales Fax 517-629-8424
www.deckernut.com



Printed: 1/10/2013 7:34:19 AM
January 10, 2013

TRINITY INDUSTRIES INC 31
1170 NORTH STATE STREET
GIRARD, OH 44420

PRODUCT MATERIAL CERTIFICATION

CUSTOMER PART NUMBER: 003245G INVOICE: 55194
CUSTOMER P.O. NUMBER: 153628

LOT NUMBER: 12-02-031 DESCRIPTION: 5/16-18 HX NUT DC 017
DATE: Aug 03, 2012 QUANTITY: 80,500
HEAT NUMBER: 20218770 MATERIAL SUPPLIER: Charter Steel
MATERIAL: STEEL - C1010

We certify the product above was manufactured at DECKER MANUFACTURING CORPORATION from the specified raw material and that said product is certified to be manufactured, randomly sampled, tested and/or inspected and conforms to applicable specifications. We additionally certify that said raw material was domestically manufactured in the United States of America and that said raw material was manufactured free of mercury contamination.

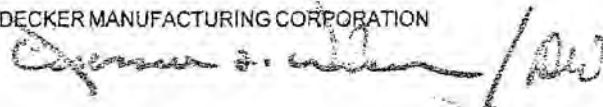
The items were processed under the Decker Quality Manual. The current revision is dated January 12, 2005
No welding was performed.

This document accurately represents values and statements provided by our suppliers accredited testing facility. The original metallurgical test report shall be retained on file by DECKER MANUFACTURING CORPORATION for a period of not less than (10) years.

CHEMICAL ANALYSIS BY MATERIAL SUPPLIER

CARBON: 0.090 PHOSPHOROUS: 0.007
MANGANESE: 0.500 SULFUR: 0.002

DECKER MANUFACTURING CORPORATION


Russel L. Wilson
Quality Assurance Manager

The above results pertain only to the items tested. This report shall not be reproduced except in full without the approval of this testing facility.

32456

DECKER MANUFACTURING CORPORATION

LABORATORY AND TESTING FACILITY
Reaffirmed to be in compliance to current Rev Level Form 8.0
ORIGINAL LABORATORY AND/OR INSPECTION REPORT
THIS IS A LEGAL DOCUMENT

NAME AND ADDRESS OF CLIENT:

PAGE 1 OF 2 DATE OF MANUFACTURE: 10-11-12

LAB FILE ID NUMBER/LOT NUMBER: 12-02-031

DMC PART NUMBER #: 026-0518-26

ITEM DESCRIPTION: 5/16 x 18 2B HEX NUT HEAVY HEX +0.17

GRADE ID MARK AND INSIGNIA: DMC

NAME (S) OF PERSON (S) SAMPLING: M. Crider K. Timmerman

PROCEDURES ARE UNDER THE SUPERVISION OF DECKER MANUFACTURING CORPORATION'S QUALITY DEPARTMENT

PRODUCTION LOT SIZE: <200M SUITABILITY/CONDITION OF TEST SPECIMENS: ACCEPTABLE

TOTAL NO. OF SAMPLES INSPECTED AND/OR TESTED: (8) EIGHT

INSPECTIONS AND/OR TESTS:

INSPECTION/TEST DATE (S): 11-9-12 11-9-12

DESCRIPTION (S): ROCKWELL HRB | PROOFLOAD

SPECIFICATION (S): ASTM E18 (08) | ASTM F606 (11)

REQUIREMENTS: ASTM A563 GRADE B @ HRB 69 MIN & HRC 32 MAX. | ASTM A563 GRADE B-2A @ 5240 LBF

EQUIPMENT ID #: 80178407 # 184280

UNIT OF MEASUREMENT: HRB W		UNIT OF MEASUREMENT: LBF	
(1) 87.5	(5) 85.5	(1) 5678	(5) 5680
(2) 87.0	(6) 83.0	(2) 5797	(6) 5680
(3) 86.5	(7) 82.5	(3) 5729	(7) 5664
(4) 85.5	(8) 84.0	(4) 5769	(8) 5761

RESULTS OBTAINED FROM:

SPECIFICATION OR MATERIAL GRADE AS EVIDENCED: C-1010

REMARKS OR DEVIATIONS: MEET AND EXCEED ASTM A563 (09) GRADE A REQUIREMENTS

PER ASTM F606 SECTION 4 THE HARDNESS OF EACH SAMPLE IS THE AVERAGE OF TWO READINGS

HEAT TREAT, SURFACE TREATMENT, COATING, ETC.: PROOFLOAD SAMPLES WERE GALVANNEED

All parts reported on this document were manufactured at this location in the United States from domestic materials

TO THE SPECIFICATIONS ABOVE, THE SAMPLES INSPECTED AND/OR TESTED

CONFORM: ARE RESULTS ONLY: DO NOT CONFORM:

APPROVED SIGNATORY
QUALITY MANAGER

Russell L. Wilson HLM

Russell L. Wilson

INSPECTED AND/OR TESTED BY:

Daniel R. ...

Authorized Lab Technician

I CERTIFY THAT THE ABOVE TEST (S) WAS CONDUCTED IN ACCORDANCE WITH THE ABOVE STATED SPECIFICATION (S) AND THAT THE RESULTS ARE CORRECT AS ENTERED. THE ABOVE RESULTS ONLY PERTAIN TO THE SAMPLE (S) TESTED. SEE THE QUALITY MANUAL FOR MANDATORY REPORT CONTENT. THIS DOCUMENT SHALL NOT BE REPRODUCED IN FULL WITHOUT THE APPROVAL OF DECKER MANUFACTURING CORPORATION. DO NOT ERASE OR ALTER ANY ERRORS - DRAW A STRAIGHT LINE THROUGH AND INITIAL. SEE REVERSE OF THIS DOCUMENT FOR THE TERMS AND CONDITIONS OF THIS TEST REPORT.



TESTING CERT # 0499-01

32456

DECKER MANUFACTURING CORPORATION

LABORATORY AND TESTING FACILITY
Addendum to FORM 8.x Form 8.4
ROCKWELL DATA COLLECTION WORKSHEET

PAGE 2 OF 2 DATE OF MANUFACTURE 10-11-12
LAB FILE ID NUMBER/LOT NUMBER: 12-02-031
DMC PART NUMBER #: 026-0518-26
ITEM DESCRIPTION: 5/16 x 1 3/8 + 017 HEX NUTS
NAME (S) OF PERSON (S) SAMPLING: R. TIMMYEL, D.M. SAMPLING PROCEDURES ARE UNDER THE SUPERVISION OF DECKER MANUFACTURING CORPORATION'S QUALITY DEPARTMENT
INSPECTION/TEST DATE (S): 11-9-12
DESCRIPTION (S): ROCKWELL HRB
SPECIFICATION (S): ASTM E-18
REQUIREMENTS: ASTM A-563 B @ HRB 69 MIN & HRC 32 MAX
EQUIPMENT ID: # 30178407

INSPECTION / TEST RESULTS:

UNIT OF MEASUREMENT: HRB

Individual readings	Total	Mean Average
(1) <u>87.0, 88.0:</u>	<u>175.0:</u>	<u>87.5:</u>
(2) <u>87.0, 87.0:</u>	<u>174.0:</u>	<u>87.0:</u>
(3) <u>87.6, 86.0:</u>	<u>173.0:</u>	<u>86.5:</u>
(4) <u>87.0, 84.0:</u>	<u>171.0:</u>	<u>85.5:</u>
(5) <u>86.0, 85.0:</u>	<u>171.5:</u>	<u>85.5:</u>
(6) <u>84.0, 82.0:</u>	<u>166.0:</u>	<u>83.0:</u>
(7) <u>87.0, 88.0:</u>	<u>175.0:</u>	<u>87.5:</u>
(8) <u>84.0, 84.0:</u>	<u>168.0:</u>	<u>84.0:</u>

READINGS OBTAINED FROM WRENCH FLATS BEARING SURFACE CORE
PER ASTM F606 PARAGRAPH 4.12 THE REPORTED HARDNESS IS THE AVERAGE OF 2 READINGS OF EACH TEST SAMPLE.
IN ADDITION ALL READINGS SHALL BE WITHIN HARDNESS VALUES LISTED IN THE PRODUCT SPECIFICATION.

INSPECTED AND/OR TESTED BY:

Warren R. Underhill Sr.
Authorized Lab Technician

I CERTIFY THAT THE ABOVE TEST (S) WAS CONDUCTED IN ACCORDANCE WITH THE ABOVE STATED SPECIFICATION (S) AND THAT THE RESULTS ARE CORRECT AS ENTERED. THE ABOVE RESULTS ONLY PERTAIN TO THE SAMPLE ITEMS TESTED. SEE THE QUALITY MANUAL FOR MANDATORY REPORT CONTENT. THIS DOCUMENT SHALL NOT BE REPRODUCED IN FULL WITHOUT THE APPROVAL OF DECKER MANUFACTURING CORPORATION. DO NOT ERASE OR ALTER ANY ERRORS - DRAW A STRAIGHT LINE THROUGH AND INITIAL. SEE REVERSE OF THIS DOCUMENT FOR THE TERMS AND CONDITIONS OF THIS TEST REPORT.





**CHARTER
STEEL**

A Division of
Charter Manufacturing Company, Inc.

EMAIL

**CHARTER STEEL TEST REPORT
Reverse Has Text And Codes**

32456

1658 Cold Springs Road

Saukville, Wisconsin 53080

(262) 268-2400

1-800-437-8789

FAX (262) 268-2570

Decker Manufacturing Corp.
703 N. Clark St.
Albion, MI - 49224

Cust P.O.	45908-1208
Customer Part #	.515 1010
Charter Sales Order	30046188
Heat #	20218770
Ship Lot #	3086961
Grade	1010 A AK FG RHQ 33/64
Process	HRCC
Finish Size	33/64

I hereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed below and on the reverse side, and that it satisfies these requirements.

Test Results of Heat Lot# 20218770

Lab Code: 125544												
CHEM	C	MN	P	S	SI	NI	CR	MO	CU	SN	V	
%WT	.09	.50	.007	.002	.07	.04	.06	.01	.09	.009	.001	
	AL	N	B	TI	NB							
	.044	.0060	.0003	.000	.001							

CHEM. DEVIATION EXT. - GREEN =

	# of Tests	Test Results of Rolling Lot# 2034142			RB LAB = 0358-04
		Min Value	Max Value	Mean Value	
ROCKWELL B	3	59	61	60	
ROD SIZE	6	.512	.522	.517	
ROD OUT OF ROUND	2	.008	.009	.008	
REDUCTION RATIO = 234:1					

Specifications: Manufactured per Charter Steel Quality Manual Rev 9,08-01-09
Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents:
Customer Document = ASTM A29/A29M-11a Revision = Dated = 01-OCT-11

Additional Comments:

Charter Steel
Cuyahoga Heights, OH, USA

Rem: Load, Fax, Mail



Page 1 of 1

This MTR supersedes all previously dated MTRs for this order

Janice Barnard
Janice Barnard
Manager of Quality Assurance
08/16/2012

32456

The following statements are applicable to the material described on the front of this Test Report:

1. Except as noted, the steel supplied for this order was melted, rolled, and processed in the United States meeting DFAR's compliance.
2. Mercury was not used during the manufacture of this product, nor was the steel contaminated with mercury during processing.
3. Unless directed by the customer, there are no welds in any of the coils produced for this order.
4. The laboratory that generated the analytical or test results can be identified by the following key:

Certificate Number	Lab Code	Laboratory		Address
0358-01	7388	CSSM	Charter Steel Melting Division	1653 Cold Springs Road, Saukville, WI 53080
0358-02	8171	CSSR/CSSP	Charter Steel Rolling/Processing Division	1658 Cold Springs Road, Saukville, WI 53080
0358-03	123633	CSFP	Charter Steel Ohio Processing Division	6255 US Highway 23, Risingsun, OH 43457
0358-04	125544	CSCM/CSCR	Charter Steel Cleveland	4300 E. 49th St., Cuyahoga Heights, OH 44125-1004
.	.	--	Subcontracted test performed by laboratory not in Charter Steel system	

5. When run by a Charter Steel laboratory, the following tests were performed according to the latest revisions of the specifications listed below, as noted in the Charter Steel Laboratory Quality Manual:

Test	Specification	CSSM	CSSR/CSSP	CSFP	CSCM/CSCR
Chemistry Analysis	ASTM E415; ASTM E1019	X			X
Macroetch	ASTM E381	X			X
Hardenability (Jominy)	ASTM A255; SAE J406; JIS G056	X			X
Grain Size	ASTM E112	X	X	X	X
Tensile Test	ASTM E8; ASTM A370		X	X	X
Rockwell Hardness	ASTM E18; ASTM A370	X	X	X	X
Microstructure (spheroidization)	ASTM A892		X	X	
Inclusion Content (Methods A, E)	ASTM E45		X		X
Decarburization	ASTM E1077		X	X	X

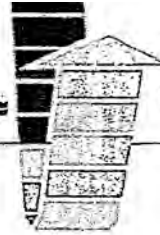
Charter Steel has been accredited to perform all of the above tests by the American Association for Laboratory Accreditation (A2LA). These accreditations expire 01/31/13.

All other test results associated with a Charter Steel laboratory that appear on the front of this report, if any, were performed according to documented procedures developed by Charter Steel and are not accredited by A2LA.

6. The test results on the front of this report are the true values measured on the samples taken from the production lot. They do not apply to any other sample.
7. This test report cannot be reproduced or distributed except in full without the written permission of Charter Steel. The primary customer whose name and address appear on the front of this form may reproduce this test report subject to the following restrictions:
 - It may be distributed only to their customers
 - Both sides of all pages must be reproduced in full
8. This certification is given subject to the terms and conditions of sale provided in Charter Steel's acknowledgement (designated by our Sales Order number) to the customer's purchase order. Both order numbers appear on the front page of this Report.
9. Where the customer has provided a specification, the results on the front of this test report conform to that specification unless otherwise noted on this test report.



ROGERS BROTHERS INC.



HOT DIP
GALVANIZING

32456

October 31, 2012

Decker Manufacturing Corporation
703 N. Clark Street
Albion, MI 49224

To Whom It May Concern:

This is to certify that the hot dip galvanizing of the following material on your Purchase Order number 47645 conforms to specification ASTM A-153. The following sizes and lot numbers comply with the coating, workmanship, finish, and appearance requirements of ASTM F2329 specifications. The hot dip galvanizing is ROHS compliant. The galvanizing process was conducted in a temperature range of 830F to 850F.

88,317 pieces	#035-1011-92	Lot#12-35-046	3.08 Avg. Mils
114,502 pieces	#040-12DH-26	Lot#12-52-023	6.34 Avg. Mils
273,712 pieces	#026-0518-26	Lot#12-02-031	3.79 Avg. Mils
6,865 pieces	#044-16DH-26	Lot#12-41-026	4.87 Avg. Mils
9,746 pieces	#026-1210-26	Lot#12-52-024	4.36 Avg. Mils
12,059 pieces	#026-0616-26	Lot#12-21-031	3.37 Avg. Mils

This certification in no way implies anything other than the quality of our hot dip galvanizing as it pertains to your order.

This product was galvanized in Rockford, IL USA

Yours very truly,

ROGERS BROTHERS INC.

Lorraine P. Shelburne
Vice President

TR No. 9-1002-12-12

111

2014-08-13

BLR466

BL - 3733657
Heat - 231117
Order-Line - 10257562 / 3

Load - 1846261
12-04-2013 03:00
Brazos Industries Inc
Cust. PO -



ALTOS HORNOS DE MEXICO

MILL TEST CERTIFICATE

AHMSA: QUALITY WITH THE STRENGTH OF STEEL B434464

CUSTOMER		DATE OF ISSUE	PAGE	WE HEREBY THAT CHEMICAL AND / OR TEST SHOW IN THIS REPORT ARE CORRECT AS CONTAINED THE RECORDS OF THE COMPANY.											
COUTINHO & FERROSTAL, INC.		31.01.2013	1												
ADDRESS		PRODUCT		ING. RAMIRO GONZALEZ BENCHACA MECHANICAL TESTS AND CERTIFICATION											
16510 Northchase Drivs. HOUSTON, TX.		HOT ROLLED STEEL IN COILS.													
CHEMICAL COMPOSITION															
HEAT	SPECIFICATION	C	Mn	P	S	SI	CU	Cr	NI	Mo	Al _T	V	Nb (Cb)	Ti	N ₂
230945	ASTM A 1018 SS 36 TYPE 2.	0.163	0.823	0.019	0.007	0.1279	0.025	0.020	0.017	0.009	0.039	0.004	0.002	0.004	0.0054
231113	ASTM A 1011 SS GR. 33	0.142	0.844	0.015	0.010	0.0090	0.021	0.019	0.017	0.011	0.034	0.002	0.001	0.001	0.0046
231117	ASTM A 1011 SS GR. 33	0.120	0.551	0.017	0.010	0.0108	0.030	0.022	0.018	0.011	0.045	0.002	0.002	0.001	0.0057
TEST OF THE PRODUCT															
HEAT	COIL NO.	SLAB	THICKNESS (Inch)	Y. STRENGTH	T. STRENGTH	YELON.	T. ELONG.	D. MAX. X TH.							
230945	4768074	5040	0.2380	44.928 (KSI)	65.622 (KSI)	41 (%)	2								
230945	4768073	6040	0.2380	47.462 (KSI)	69.684 (KSI)	42 (%)	2								
231113	4767089	5030	0.1260	50.853 (KSI)	62.987 (KSI)	40 (%)	2	1.0 (Inch)							
231117	4768098	6040	0.1100	55.420 (KSI)	66.743 (KSI)	41 (%)	2	1.0 (Inch)							
HEAT	COIL NO.	SLAB	R-BEND												
231113	4767089	5030	A												
231117	4768098	6040	A												
SHIPPED PRODUCT					DELIVERY		CUSTOMER ORD								
HEAT	COIL NO.	THICKNESS (Inch)	WIDTH (Inch)	ORDER	ITEM	DELIVERY	CUSTOMER ORD								
230945	4768074	0.2380	48.0000	0000137558	000070	1001731300	1050156800/FEB13								
230945	4768073	0.2380	48.0000	0000137558	000070	1001731300	1050156800/FEB13								
231113	4767089	0.1260	48.0000	0000137558	000040	1001731300	1050156800/FEB13								
231117	4768098	0.1100	48.0000	0000137558	000030	1001731300	1050156800/FEB13								
HEAT	COIL NO.	STANDARD													
230945	4768074	A568/A635													
230945	4768073	A568/A635													
231113	4767089	A568/A635													
231117	4768098	A568/A635													
COUNTRY OF ORIGIN: MEXICO					END OF DATA										
<i>Heat# 231117 with 22031 the 119ax4e"</i>					ISSUED : S0550133										

AHMSA'S COMPROMISE IS ONLY WITH THE CUSTOMER MENTIONED IN THIS CERTIFICATE, AHMSA WILL ONLY ACCEPT THE ORIGINAL DOCUMENT.

CC-03-001-A

NIFORM STRAIGHT BILL OF LADING **Original—Not Negotiable—Domestic**

Shipper's No. **16-51464**

Carrier **Trinity Highway Products, LLC**
 Date of Issue **3/7/14** from **Trinity Highway Products, LLC** to **TEXAS TRANSPORTATION INSTITUTE**
 No. of Pieces **3**

S/O No. **1215074**

Property described below, in apparent good order, except as noted (contents and condition of packages unknown) marked, cartoned and dunnaged as shown below, which said commodity (the word commodity being understood to include this contract as meaning any person or corporation in possession of the property under this contract) agrees to carry to the usual place of delivery at said destination, if so to be so indicated, within the territory of its lawful operation, or transfer to another carrier on the route to said destination, if a railway receipt, as to each carrier of all or any of said property over all or any portion of said route as to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the conditions not prohibited by law, whether printed or written, herein contained, including the conditions on back hereof, which are hereby agreed to by the shipper and accepted for himself and his assigns.

Subject to Section 7 of Conditions of applicable Bill of Lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:
 The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.
TRINITY HIGHWAY PRODUCTS, LLC
 Trinity Highway Products, LLC
 (Signature of Consignor)

Consignment to: **SAMPLES, TESTING, TRAINING MTRLS** Cust. P.O. _____ Load No. **42-1**
 Destination: **TEXAS TRANSPORTATION INSTITUTE BLDG 7090** Total Weight: **2,544.37**
3100 STATE HWY 47

If charges are to be prepaid, write or stamp here: **TO BE PREPAID**

Origin: **BRYAN TX 77807** Ship: **3/7/14**
 Date: **3/5/14 8:00:00AM** Arrive: **405015**

Received \$ _____
 to apply in prepayment of the charges on the property described herein.
 Agent or Cashier _____
 Per _____
 (The signature here acknowledges only the amount prepaid.)
 Charges advanced: _____

Contact: **GARY GERKE** Phone: **936-825-4661**
 Delivering Carrier: **YRC** Vehicle or Car Initial: _____ No. _____

Collect On Delivery: _____ C.O.D. charge Shipper
 and remit to: _____ to be paid by Consignee
 Street _____ City _____ State _____

No. Pkgs.	Piece Count	Description of Articles	*Wt.	Class or Rate	✓ Col.	No. Pkgs.	Piece Count	Description of Articles	*Wt.	Class or Rate	✓ Col.
Upon delivery, all materials subject to Trinity Highway Products, LLC Storage Stain Policy No. LG-002 . Project Info: MATERIAL LD Comments:											
	4	62G 12/25/6 3/8 ET-2000 ANC									
	4	3000G CBL 3/4X6 6/DBL SWG/NOHW									
	10	3300G 5/8" WASHER F344 A/W									
	10	3340G 5/8" GR. HEX NUT									
	10	3580G 5/8" X 18" GR. BOLT A307									
	8	3900G 1" ROUND WASHER F344									
	8	3910G 1" HEX NUT A563									
	10	4071B WD 6" POST 6X8 CRT ET-31									
	10	4075B WD BLK 6X8X14									
	20	34045G CASS-SIX5, 7# PST 5/0/CONC									

YRC FREIGHT SHIPMENT STATUS CALL 1-800-610-6600
196-627728-9

1 - BUNDLE
2 - Pallets
GUARDRAIL HWY STEEL
NMFC ITEM 105460
CLASS 50

SPECIAL INSTRUCTIONS: **SHIPPER LOAD - CONSIGNEE UNLOAD** **16-51464** **Total Weight** **2,544**

If the shipment moves between two ports by a carrier by water, the law requires that the bill of lading shall state whether it is "carrier's or shipper's weight."
 NOTE - Where the rate is dependant on value, shippers are required to state specifically in writing the agreed or declared value of the property.
 The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding _____ per _____
 SHIPPER OR AGENT: **Gary Gerke** DATE: **3/7/14**
 CONSIGNEE OR AGENT: _____ DATE: **3/7/14**
 SIGN HERE: _____ DATE: _____ TIME: _____
 DRIVER OR DRIVER: **M. Brown** DATE: _____ TIME: _____
 (SIGN HERE) DATE: _____ DRIVER: **YRC 430523**

Permanent post-office address of shipper: _____ (This Bill of Lading is to be signed by the shipper) ORIGINAL

TR No. 9-1002-12-12

113

2014-08-13

Certified Analysis



Trinity Highway Products , LLC
 2548 N.E. 28th St.
 Ft Worth, TX 76111

Customer: SAMPLES,TESTING,TRAINING MTRLS
 2525 STEMMONS FRWY

DALLAS, TX 75207

Project: MATERIAL

Order Number: 1215074 Prod Ln Grp: 3-Guardrail (Dom)
 Customer PO:
 BOL Number: 51464 Ship Date: 3/7/2014
 Document #: 1
 Shipped To: TX
 Use State: TX

As of: 3/24/14

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn	ACW
4	62G	12/25/6/3/S ET-2000 ANC				F10514													
			M-180	A		A311129	61,700	83,500	24.0	0.220	0.720	0.007	0.002	0.020	0.080	0.001	0.060	0.002	4
			M-180	A		A311131	60,800	82,000	24.0	0.200	0.710	0.009	0.003	0.030	0.090	0.001	0.060	0.002	4
4	3000G	CBL 3/4X6/6/DBL	HW			99343													
10	3300G	5/8" WASHER F844 A/W	HW			P35095													
10	3340G	5/8" GR HEX NUT	HW			131122N													
10	3580G	5/8"X18" GR BOLT A307	HW			24634													
8	3900G	1" ROUND WASHER F844	HW			P35176													
8	3910G	1" HEX NUT A563	HW			P35185													
10	4071B	WD 6" POST 6X8 CRT	HW			14-74													
10	4075B	WD BLK 6X8X14	HW			14-79													
20	34045G	CASS-S3X5.7# PST	A-36			1212193	60,000	70,500	26.8	0.060	0.840	0.012	0.025	0.170	0.170	0.015	0.030	0.004	4

TL -3 or TL-4 COMPLIANT when installed according to manufactures specifications

Upon delivery, all materials subject to Trinity Highway Products , LLC Storage Stain Policy No. LG-002.
 ALL STEEL USED WAS MELTED AND MANUFACTURED IN USA AND COMPLIES WITH THE BUY AMERICA ACT.
 ALL GUARDRAIL MEETS AASHTO M-180, ALL STRUCTURAL STEEL MEETS ASTM A36

TR No. 9-1002-12-12

114

2014-08-13

Certified Analysis



Trinity Highway Products , LLC

2548 N.E. 28th St.

Ft Worth, TX 76111

Customer: SAMPLES,TESTING,TRAINING MTRLS
2525 STEMMONS FRWY

DALLAS, TX 75207

Project: MATERIAL

Order Number: 1215074

Prod Ln Grp: 3-Guardrail (Dom)

Customer PO:

BOL Number: 51464

Ship Date: 3/7/2014

Document #: 1

Shipped To: TX

Use State: TX

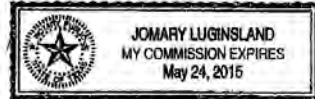
As of: 3/24/14

ALL COATINGS PROCESSES OF THE STEEL OR IRON ARE PERFORMED IN USA AND COMPLIES WITH THE "BUY AMERICA ACT"
ALL GALVANIZED MATERIAL CONFORMS WITH ASTM-123 (US DOMESTIC SHIPMENTS)
ALL GALVANIZED MATERIAL CONFORMS WITH ASTM A123 & ISO 1461 (INTERNATIONAL SHIPMENTS)

FINISHED GOOD PART NUMBERS ENDING IN SUFFIX B,P, OR S, ARE UNCOATED
BOLTS COMPLY WITH ASTM A-307 SPECIFICATIONS AND ARE GALVANIZED IN ACCORDANCE WITH ASTM A-153, UNLESS OTHERWISE STATED.
NUTS COMPLY WITH ASTM A-563 SPECIFICATIONS AND ARE GALVANIZED IN ACCORDANCE WITH ASTM A-153, UNLESS OTHERWISE STATED.
WASHERS COMPLY WITH ASTM F-436 SPECIFICATION AND/OR F-844 AND ARE GALVANIZED IN ACCORDANCE WITH ASTM F-2329.
3/4" DIA CABLE 6X19 ZINC COATED SWAGED END AISI C-1035 STEEL ANNEALED STUD 1" DIA ASTM 449 AASHTO M30, TYPE II BREAKING
STRENGTH - 46000 LB

State of Texas, County of Tarrant. Sworn and subscribed before me this 24th day of March, 2014

Notary Public:
Commission Expires:



Jomary Luginland

Trinity Highway Products, LLC

Certified By:

Luis Ortiz
Quality Assurance

Certified Analysis



Trinity Highway Products, LLC
 550 East Robb Ave.
 Lima, OH 45801

Customer: SAMPLES, TESTING, TRAINING MTRLS
 2525 STEMMONS FRWY
 DALLAS, TX 75207

Order Number: 1197356 Prod Ln Grp: 9-End Terminals (Dom)
 Customer PO:
 BOL Number: 75527 Ship Date:
 Document #: 1
 Shipped To: TX
 Use State: TX

As of: 5/17/13

Project: TTI TEST 400923-3 31" MEDIAN RAIL (NOT TRINITY)

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn	ACW
48	11G	12/12'6/3'1.5/S			2	L10613													
			M-180	A	2	4144812	58,600	79,500	22.0	0.230	0.760	0.009	0.007	0.020	0.030	0.000	0.020	0.002	4
			M-180	A	2	4144813	57,100	79,000	27.0	0.210	0.770	0.009	0.006	0.020	0.020	0.000	0.030	0.001	4
			M-180	A	2	4144815	56,400	78,000	31.0	0.220	0.750	0.010	0.006	0.010	0.030	0.000	0.020	0.002	4
			M-180	A	2	4144816	55,600	75,200	22.0	0.220	0.750	0.011	0.006	0.010	0.020	0.000	0.020	0.002	4
			M-180	A	2	4144819	57,900	79,000	27.0	0.220	0.750	0.010	0.007	0.010	0.020	0.000	0.020	0.002	4
			M-180	A	2	9407528	54,700	75,500	30.0	0.200	0.720	0.010	0.006	0.010	0.020	0.002	0.030	0.003	4
			M-180	A	2	9407531	56,400	78,100	28.0	0.210	0.730	0.008	0.005	0.010	0.020	0.002	0.030	0.002	4
			M-180	A	2	9407555	56,400	76,700	29.0	0.220	0.740	0.009	0.008	0.010	0.030	0.002	0.030	0.002	4
			M-180	A	2	C63862	61,900	81,600	26.6	0.210	0.840	0.015	0.004	0.040	0.110	0.002	0.060	0.001	4
8	10545G	12/9'4.5/1'6.75/S			2	L12013													
			M-180	A	2	166224	58,340	74,860	32.3	0.190	0.730	0.011	0.004	0.010	0.130	0.000	0.090	0.001	4
			M-180	A	2	166282	58,270	74,990	26.7	0.190	0.720	0.011	0.002	0.020	0.120	0.000	0.070	0.001	4
			M-180	A	2	166768	59,620	75,820	26.8	0.200	0.740	0.009	0.004	0.020	0.080	0.001	0.050	0.000	4
			M-180	A	2	166769	55,220	71,140	28.5	0.180	0.710	0.010	0.002	0.020	0.070	0.000	0.050	0.001	4
			M-180	A	2	41315760	67,000	87,600	27.0	0.200	0.870	0.007	0.002	0.030	0.080	0.000	0.030	0.001	4

TL -3 or TL-4 COMPLIANT when installed according to manufactures specifications

Upon delivery, all materials subject to Trinity Highway Products, LLC Storage Stain Policy No. LG-002.

ALL STEEL USED WAS MELTED AND MANUFACTURED IN USA AND COMPLIES WITH THE BUY AMERICA ACT.

ALL GUARDRAIL MEETS AASHTO M-180, ALL STRUCTURAL STEEL MEETS ASTM A36

ALL COATINGS PROCESSES OF THE STEEL OR IRON ARE PERFORMED IN USA AND COMPLIES WITH THE "BUY AMERICA ACT"

ALL GALVANIZED MATERIAL CONFORMS WITH ASTM-123 (US DOMESTIC SHIPMENTS)

ALL GALVANIZED MATERIAL CONFORMS WITH ASTM A123 & ISO 1461 (INTERNATIONAL SHIPMENTS)

TR No. 9-1002-12-12

116

2014-08-13

Certified Analysis



Trinity Highway Products, LLC

550 East Robb Ave.

Lima, OH 45801

Customer: SAMPLES, TESTING, TRAINING MTRLS
2525 STEMMONS FRWY

DALLAS, TX 75207

Project: TTI TEST 400923-3 31" MEDIAN RAIL (NOT TRINITY)

Order Number: 1197356

Prod Ln Grp: 9-End Terminals (Dom)

Customer PO:

As of: 5/17/13

BOL Number: 75527

Ship Date:

Document #: 1

Shipped To: TX

Use State: TX

BOLTS COMPLY WITH ASTM A-307 SPECIFICATIONS AND ARE GALVANIZED IN ACCORDANCE WITH ASTM A-153, UNLESS OTHERWISE STATED.

NUTS COMPLY WITH ASTM A-563 SPECIFICATIONS AND ARE GALVANIZED IN ACCORDANCE WITH ASTM A-153, UNLESS OTHERWISE STATED.

WASHERS COMPLY WITH ASTM F-436 SPECIFICATION AND/OR F-844 AND ARE GALVANIZED IN ACCORDANCE WITH ASTM F-2329.

3/4" DIA CABLE 6X19 ZINC COATED SWAGED END AISI C-1035 STEEL ANNEALED STUD 1" DIA ASTM 449 AASHTO M30, TYPE II BREAKING STRENGTH - 46000 LB

State of Ohio, County of Allen, Sworn and subscribed before me this 17th day of May, 2013

Notary Public:

Commission Expires:

Angela Counts
1/23/2016



Trinity Highway Products, LLC
Certified By: *B. Orshkey*
Quality Assurance

Certified Analysis



Trinity Highway Products, LLC

550 East Robb Ave.

Lima, OH 45801

Customer: SAMPLES, TESTING, TRAINING MTRLS
2525 STEMMONS FRWY

DALLAS, TX 75207

Project: PENNDOT WEAK POST

Order Number: 1197242

Prod Ln Grp: 3-Guardrail (Dom)

Customer PO:

As of: 5/16/13

BOL Number: 75489

Ship Date:

Document #: 1

Shipped To: TX

Use State: TX

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn	ACW
34	3G	12/12"/BACKUP	M-180	A	2	166282	58,270	74,990	26.7	0.190	0.720	0.011	0.002	0.020	0.120	0.000	0.070	0.001	4
20	11G	12/12"/3"1.5/S			2	L10613													
			M-180	A	2	4144812	58,600	79,500	22.0	0.230	0.760	0.009	0.007	0.020	0.030	0.000	0.020	0.002	4
			M-180	A	2	4144813	57,100	79,000	27.0	0.210	0.770	0.009	0.006	0.020	0.020	0.000	0.030	0.001	4
			M-180	A	2	4144815	56,400	78,000	31.0	0.220	0.750	0.010	0.006	0.010	0.030	0.000	0.020	0.002	4
			M-180	A	2	4144816	55,600	75,200	22.0	0.220	0.750	0.011	0.006	0.010	0.020	0.000	0.020	0.002	4
			M-180	A	2	4144819	57,900	79,000	27.0	0.220	0.750	0.010	0.007	0.010	0.020	0.000	0.020	0.002	4
			M-180	A	2	9407528	54,700	75,500	30.0	0.200	0.720	0.010	0.006	0.010	0.020	0.002	0.030	0.003	4
			M-180	A	2	9407531	56,400	78,100	28.0	0.210	0.730	0.008	0.005	0.010	0.020	0.002	0.030	0.002	4
			M-180	A	2	9407555	56,400	76,700	29.0	0.220	0.740	0.009	0.008	0.010	0.030	0.002	0.030	0.002	4
			M-180	A	2	C63862	61,900	81,600	26.6	0.210	0.840	0.015	0.004	0.040	0.110	0.002	0.060	0.001	4
4	62G	12/25/6"3/S ET-2000 ANC			2	L11713													
			M-180	A	2	165617	57,070	75,470	30.4	0.190	0.720	0.010	0.004	0.010	0.120	0.000	0.060	0.001	4
			M-180	A	2	165620	59,230	75,960	26.1	0.190	0.730	0.012	0.004	0.020	0.120	0.001	0.060	0.000	4
			M-180	A	2	165860	57,710	75,180	28.0	0.190	0.720	0.011	0.004	0.020	0.120	0.000	0.060	0.001	4
			M-180	A	2	166223	58,970	76,290	28.1	0.190	0.720	0.010	0.005	0.010	0.120	0.000	0.070	0.001	4
			M-180	A	2	166224	58,340	74,860	32.3	0.190	0.730	0.011	0.004	0.010	0.130	0.000	0.090	0.001	4
			M-180	A	2	166225	61,810	77,130	28.6	0.190	0.730	0.011	0.002	0.020	0.120	0.000	0.080	0.001	4
			M-180	A	2	166226	54,560	73,550	30.6	0.190	0.720	0.011	0.005	0.020	0.130	0.000	0.080	0.001	4
			M-180	A	2	166404	61,640	77,570	24.9	0.180	0.720	0.014	0.003	0.030	0.100	0.000	0.060	0.001	4
			M-180	A	2	166405	56,380	72,870	29.4	0.190	0.730	0.010	0.003	0.010	0.100	0.000	0.060	0.001	4
6	533G	6"0 POST/8.5/DDR	A-36			25161	47,000	69,000	24.1	0.130	0.670	0.019	0.030	0.230	0.260	0.000	0.160	0.003	4
4	704A	CABLE ANCHOR BRKT	A-36			JJ1621	50,000	72,500	28.1	0.150	0.970	0.027	0.009	0.220	0.090	0.000	0.260	0.021	4

Certified Analysis



Trinity Highway Products , LLC

550 East Robb Ave.

Lima, OH 45801

Customer: SAMPLES, TESTING, TRAINING MTRLS
2525 STEMMONS FRWY

DALLAS, TX 75207

Project: PENNDOT WEAK POST

Order Number: 1197242

Prod Ln Grp: 3-Guardrail (Dom)

Customer PO:

BOL Number: 75489

Document #: 1

Shipped To: TX

Use State: TX

Ship Date:

As of: 5/16/13

Qty	Part #	Description	Spec	CL	TY	Heat Code/ Heat	Yield	TS	Elg	C	Mn	P	S	Si	Cu	Cb	Cr	Vn	ACW	
	704A		A-500			D43983	66,767	75,769	23.0	0.190	0.820	0.015	0.007	0.014	0.030	0.007	0.040	0.001	4	
4	10545G	12/94.5/1'6.75/S			2	L12013														
			M-180	A	2	166224	58,340	74,860	32.3	0.190	0.730	0.011	0.004	0.010	0.130	0.000	0.090	0.001	4	
			M-180	A	2	166282	58,270	74,990	26.7	0.190	0.720	0.011	0.002	0.020	0.120	0.000	0.070	0.001	4	
			M-180	A	2	166768	59,620	75,820	26.8	0.200	0.740	0.009	0.004	0.020	0.080	0.001	0.050	0.000	4	
			M-180	A	2	41315760	67,000	87,600	27.0	0.200	0.870	0.007	0.002	0.030	0.080	0.000	0.030	0.001	4	
12	15000G	6'0 SYT PST/8.5/31" GR HT	A-36			11333	47,000	68,000	19.5	0.110	0.630	0.021	0.026	0.240	0.250	0.002	0.280	0.004	4	
4	33795G	SYT-3"AN STRT 3-HL 6/6	A-36			DL13101192	55,000	74,000	25.0	0.140	0.690	0.020	0.025	0.200	0.440	0.003	0.140	0.028	4	

TL -3 or TL-4 COMPLIANT when installed according to manufactures specifications

Upon delivery, all materials subject to Trinity Highway Products , LLC Storage Stain Policy No. LG-002.

ALL STEEL USED WAS MELTED AND MANUFACTURED IN USA AND COMPLIES WITH THE BUY AMERICA ACT.

ALL GUARDRAIL MEETS AASHTO M-180, ALL STRUCTURAL STEEL MEETS ASTM A36

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WASHERS COMPLY WITH ASTM F-436 SPECIFICATION AND/OR F-844 AND ARE GALVANIZED IN ACCORDANCE WITH ASTM F-2329.

3/4" DIA CABLE 6X19 ZINC COATED SWAGED END AISI C-1035 STEEL ANNEALED STUD 1" DIA ASTM 449 AASHTO M30, TYPE II BREAKING STRENGTH - 46000 LB

TR No. 9-1002-12-12

119

2014-08-13

Certified Analysis



Trinity Highway Products , LLC

550 East Robb Ave.

Lima, OH 45801

Customer: SAMPLES, TESTING, TRAINING MTRLS
2525 STEMMONS FRWY

DALLAS, TX 75207

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Ship Date:

Document #: 1

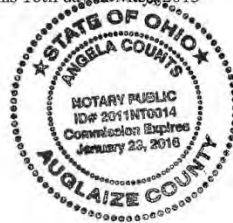
Shipped To: TX

Use State: TX

State of Ohio, County of Allen. Sworn and subscribed before me this 16th day of May, 2013

Notary Public:
Commission Expires:

Angela Counts
12/23/2016



Trinity Highway Products , LLC
Certified By: *B. B. B. B.*
Quality Assurance

TR No. 9-1002-12-12

120

2014-08-13

SOLD TO: KLOECKNER METALS CORP
900 COLONIAL CENTER PKWY
STE 500
ROSWELL, GA 30076-



CERTIFIED MILL TEST REPORT

Page: 1

SHIP TO: KLOECKNER METALS
2560 SOUTH LOOP 4
BUDA, TX 78610-

Ship from:
Nucor Steel - Texas
8812 Hwy 79 W
JEWETT, TX 75546
800-527-6445

Date: 13-Dec-2013
B.L. Number: 656195
Load Number: 261447

Material Safety Data Sheets are available at www.nucorbar.com or by contacting your inside sales representative.

NSMCO January 1, 2012

LOT # HEAT #	DESCRIPTION	PHYSICAL TESTS					CHEMICAL TESTS									
		YIELD P.S.I.	TENSILE P.S.I.	ELONG % IN 8"	BEND	WT% DEF	C	Mn	P	S	Si	Cu	Sn	C.E.		
PO# -> JW131009951	6746835 Nucor Steel - Texas	66,000	64,700	20.0%			15	1.14	0.12	0.28	21	35	.47			
JW13100999	3/4x12" Flat	455MPa	584MPa				19	1.8	.059	0.72	.001					
	20' A529 Gr55	66,300	83,700	20.0%			CBV	MN/C								
	ASTM A529/A529M-05 GR 55	457MPa	577MPa				0.070	0.760								
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1															
PO# -> JW13100914252	6749405 Nucor Steel - Texas	65,200	82,400	20.0%			13	1.05	0.13	0.07	18	50	.48			
JW13109142	5/8x8" Flat	490MPa	588MPa				16	.23	.050	0.010	.00					
	20' A529 Gr55	65,900	82,800	20.0%			CBV	MN/C								
	ASTM A529/A529M-05 GR 55	454MPa	571MPa				0.060	0.808								
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1															
PO# -> JW1310915051	6746836 Nucor Steel - Texas	62,700	79,900	20.0%			13	1.03	0.12	0.24	19	35	.42			
JW13109150	1/2x10" Flat	432MPa	551MPa				17	.17	.052	.005	.045					
	20' A529 Gr55	60,900	83,000	18.0%			CBV	MN/C								
	ASTM A529/A529M-05 GR 55	420MPa	572MPa				0.050	0.792								
	COMPLIES WITH DIN 50049 PARA 3.1B & EN 10204-3.1															
PO# -> JW1310954501	6748877 Nucor Steel - Texas	52,600	71,900	25.0%			12	.83	0.10	0.20	21	30	.33			
JW13109545	1/4x1" Flat	363MPa	496MPa				17	.11	.059	.013	.001					
	20' A36	52,600	71,300	26.0%												
	ASTM A36/A36M-12 A709/709M 12 G	363MPa	492MPa													
	R36, ASME SA36-10 Ed 11 Ad															
	MEETS ASTM A529/A529M-05 GR 50															

1) Kindly verify that the recipient of this report has been instructed in the use of this report.
 2) This report was prepared on the basis of the test results and the test results of the test specimens.
 3) Material was manufactured in the United States.
 4) Missing, Partial, or Aligned to the material may vary from the actual condition of the product or the process.

QUALITY ASSURANCE: Kim Pritchard

04-09-2014 08:00
 Mack Bolt & Steel
 Cust. PO - 26735
 Nucor Steel
 12/13/2013 1:01:38 PM
 Order-Line - 10767958 / 12
 Heat - JW13109142
 BL - 374277
 BLR466
 Load - 1944244
 Page 1/002
 FAX Server

TR No. 9-1002-12-12

121

2014-08-13



GERDAU

US-ML-MIDLOTHIAN
300 WARD ROAD
MIDLOTHIAN, TX 76065
USA

CERTIFIED MATERIAL TEST REPORT

CUSTOMER SHIP TO KLOECKNER METALS US SOUTH LOOP 4 BUDA, TX 78610 USA		CUSTOMER BILL TO KLOECKNER METALS CORPORATION 500 COLONIAL CENTER PKWY ROSWELL, GA 30076-8856 USA		GRADE A36/A57250	SHAPE / SIZE Standard I-Beam / 3 X 5.7# / 75 X 8.5		
SALES ORDER 809419/000010			CUSTOMER MATERIAL N° B3570S401400		LENGTH 40'00"	WEIGHT 8,208 LB	HEAT / BATCH 59058159/02
CUSTOMER PURCHASE ORDER NUMBER 6778605		BILL OF LADING 1327-0000097375		DATE 03/14/2014		SPECIFICATION / DATE of REVISION A36/A36M-08 A572/A572M-07 ASTM A6/A6M-11	

CHEMICAL COMPOSITION													
C %	Mn %	P %	S %	Si %	Cu %	Ni %	Cr %	Mo %	Sn %	V %	Nb %	Al %	
0.14	0.81	0.014	0.027	0.18	0.32	0.10	0.09	0.022	0.009	0.002	0.012	0.003	

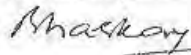
CHEMICAL COMPOSITION													
CEqvA6													
%													
0.3													

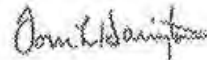
MECHANICAL PROPERTIES											
YS		UTS		YS		UTS		G/L		G/L	
KSI		KSI		MPa		MPa		Inch		mm	
59.3		77.9		408		529		8.000		200.0	
59.2		76.8		409		537		8.000		200.0	

MECHANICAL PROPERTIES	
Elong %	Y/T ratio %
21.20	0.772
22.20	0.760

COMMENTS / NOTES

The above figures are certified chemical and physical test records as contained in the permanent records of company. This material, including the billers, was melted and manufactured in the USA. CMTR complies with EN 10204 3.1.


 BHASKAR YALAMANCHILI
QUALITY DIRECTOR


 TOM HARRINGTON
QUALITY ASSURANCE MGR.


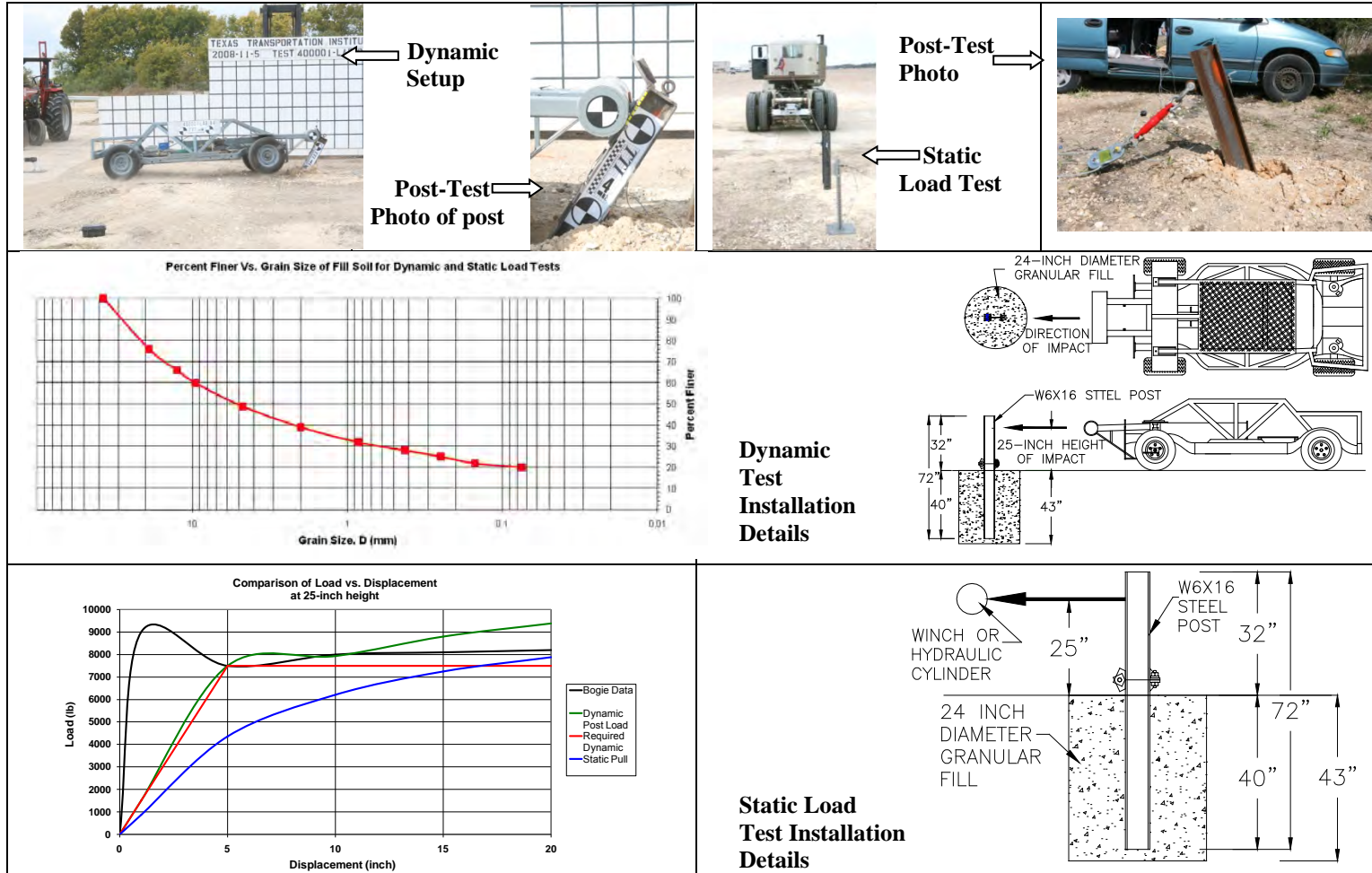
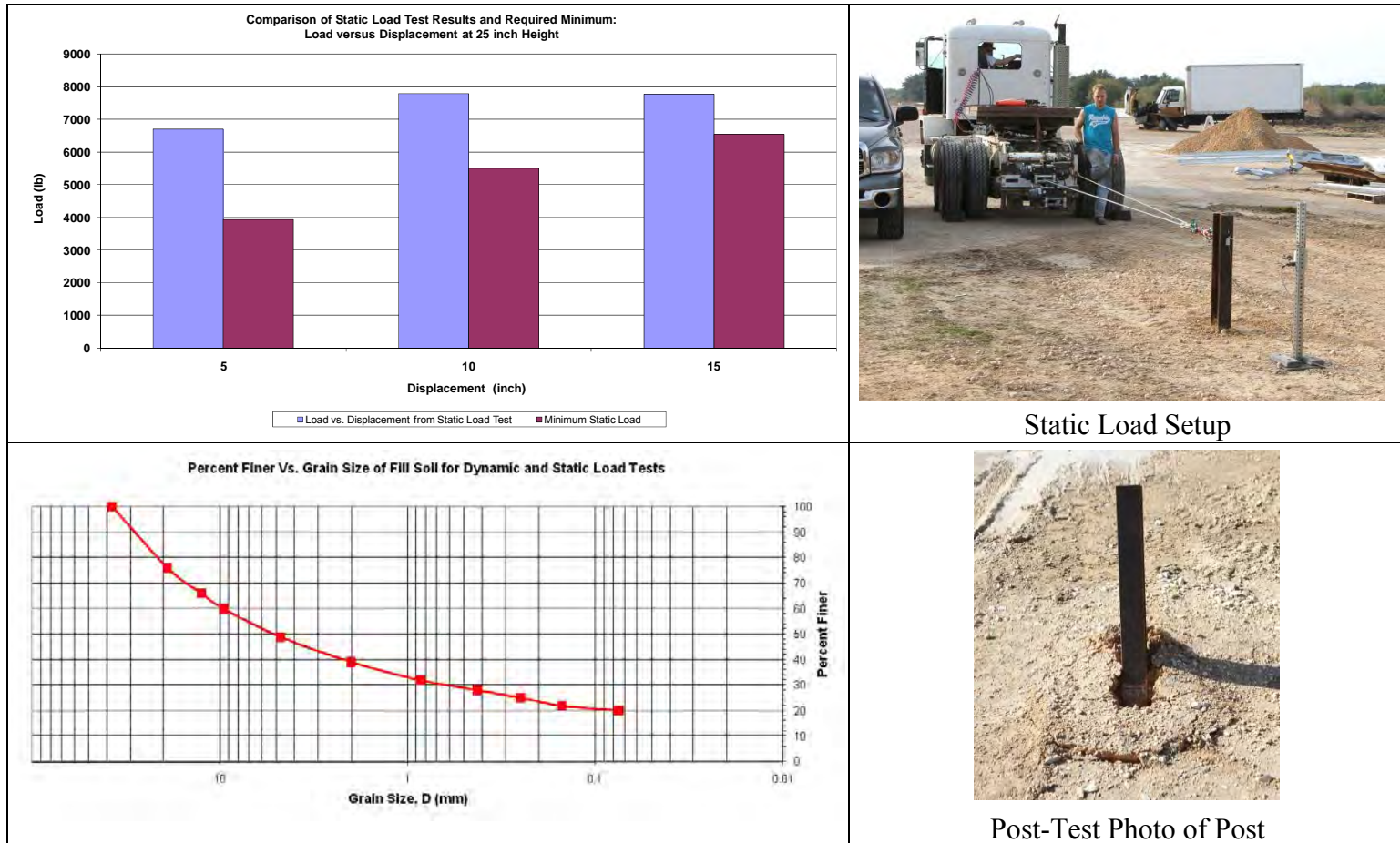
A01 Tata Steel IJmuiden BV Meskeboechstraat 1 1951 JZ Velsen Noord Postbus 10000 1970 GA IJmuiden The Netherlands Telephone: 0251-492110 Quality Department Telefax : 0251-479414 Quality Department Company Trade Register 34040551 E-mail : info.testing@tatasteel.com		A07.A09 Reference 6741966 6741966-5 GC-02-06		A02 Test report 2.2, EN 10204. 001.002.005.004.015		TATA STEEL																						
A05 Doc. nr 10469 00		Hot rolled dry, Coil, SS GRADE 33, ASTM A 1011. Mill edges. Temper passed. Tolerance ASTM A 568 HR (Width tolerance +1.125/-0 inch) Dev.Tol. (Thickness tolerance +0.016/-0 inch).																										
A06 Customer/Consignee KLOECKNER METALS CORP - HTX 7400 MESA ROAD 77228 HOUSTON (TEXAS) U.S.A.				A08 Order nr. 57846 E				A10 Transport STAR ISTIND																				
A09.B10.B11 Dimensions 48.000 ** X 0.1116 **		A11 Dispatch note 14146		TENSILE TEST UYP LYP VS TS E E YP/TS		HARDNESS C40.C40.C45		IMPACT TEST AND OTHER TESTS																				
B07	B15	B08	B07	C01	C10	C05	C11	C12	C15	C15	C16	C17	C10	C32	C01	C10	B05	C41	C40.C40.C45	C05	C44	C42	C42	C42	C45	C95		
PROD.-IDENT	MASS lbs	NR	CAST NR.			Temp °C	R _{0.2} psi	R _m psi	A %	A %	R _p /R _m %	r-value	n-value					mm		Temp °C		ind.	ind.	ind.	mean	ASTM E-112		
3759002	42329	1	L5476	32	1L P	+ 20			43645	62060	33.2			70														
TOTAL		42329	1																									
C71-C92 CHEMICAL COMPOSITION in %																		C44 1: J/cm ² 2: J 3: Later. exp. (mm)		4: Contraction (%) 5: Shear area (Z)								
B07	B07	C71	C72	C75	C74	C75	C76	C77	C78	C79	C80	C81	C82	C83	C84	C85	C86	C87	C88	C89	C61 1:Top 2:Edge 3:Bottom		C01 1:Surface 2:Centre 3:Surface		C02 1:transverse 2:in thick dir 3: Surface 4:in diagonal dir		C10 P=prismatic C=cylindrical	
CAST NR.	PROD.-IDENT	C	Mn	P	S	Si	Al	Cu	Cr	Ni	Mo	Nb	V	N	B	C-eq	Al-ZO	Sn	Ti									
L5476		.105	0.509	.017	.009	0.003	0.040	.010	0.017	0.016	.002	.000	.002	.0049	.0000	.196	0.038	.001	.000									
C70 STEELMAKING PROCESS: B0																		Page 1 of 1										
C85 Stamp of the expert :												C92 Tata Steel IJmuiden BV Test House, IJmuiden J.M. VAN DER WAL MANAGER TESTING 																
C01 We certify that the delivery complies with the order prescriptions.												IJMUIDEN, 22 JANUARI 2014																

Table C1. Summary of Strong Soil Test Results for Establishing Installation Procedure.



Date	2008-11-05
Test Facility and Site Location	TTI Proving Ground, 3100 SH 47, Bryan, TX 77807
In Situ Soil Description (ASTM D2487)	Sandy gravel with silty fines
Fill Material Description (ASTM D2487) and sieve analysis	AASHTO Grade B Soil-Aggregate (see sieve analysis)
Description of Fill Placement Procedure	6-inch lifts tamped with a pneumatic compactor
Bogie Weight	5009 lb
Impact Velocity	20.5 mph

Table C2. Test Day Static Soil Strength Documentation for Test No. 490024-1-2.



Date 2013-12-05

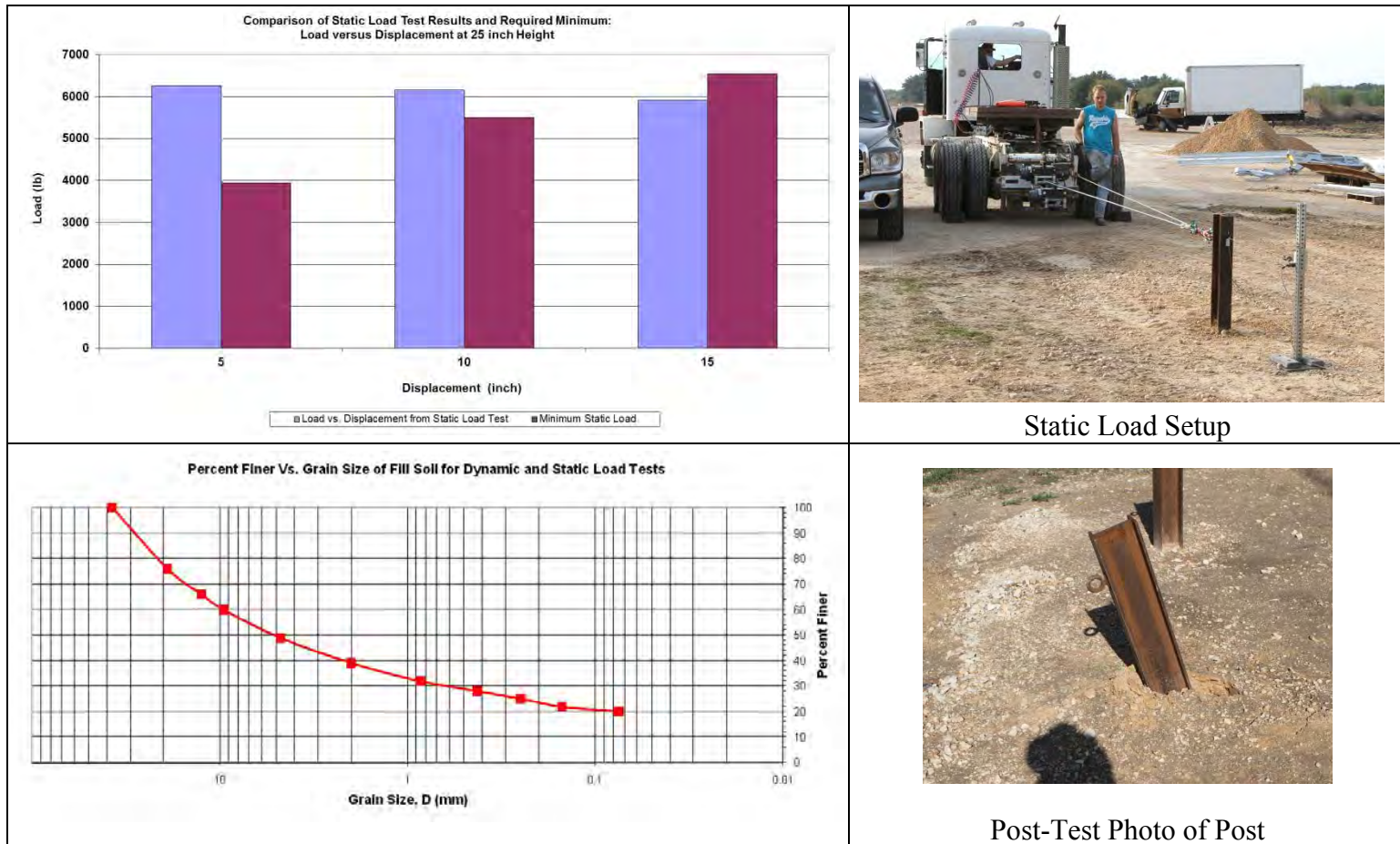
Test Facility and Site Location..... TTI Proving Ground – 3100 SH 47, Bryan, Tx

In Situ Soil Description (ASTM D2487) Sandy gravel with silty fines

Fill Material Description (ASTM D2487) and sieve analysis..... AASHTO Grade B Soil-Aggregate (see sieve analysis)

Description of Fill Placement Procedure 6-inch lifts tamped with a pneumatic compactor

Table C3. Test Day Static Soil Strength Documentation for Test No. 490024-1-5.



Date 2014-05-12

Test Facility and Site Location..... TTI Proving Ground – 3100 SH 47, Bryan, Tx

In Situ Soil Description (ASTM D2487) Sandy gravel with silty fines

Fill Material Description (ASTM D2487) and sieve analysis..... AASHTO Grade B Soil-Aggregate (see sieve analysis)

Description of Fill Placement Procedure 6-inch lifts tamped with a pneumatic compactor

APPENDIX D. INFORMATION AND DATA FOR TEST NO. 490024-1-2

D1. VEHICLE PROPERTIES AND INFORMATION

Table D1. Vehicle Properties for Test No. 490024-1-2.

Date: 2013-12-05 Test No.: 490024-1-2 VIN No.: 1D7HA18PX7S154260

Year: 2007 Make: Dodge Model: Ram 1500

Tire Size: 265/70R17 Tire Inflation Pressure: 35 psi

Tread Type: Highway Odometer: 156836

Note any damage to the vehicle prior to test: _____

- Denotes accelerometer location.

NOTES: NA

Engine Type: V-8
Engine CID: 4.7 Liter

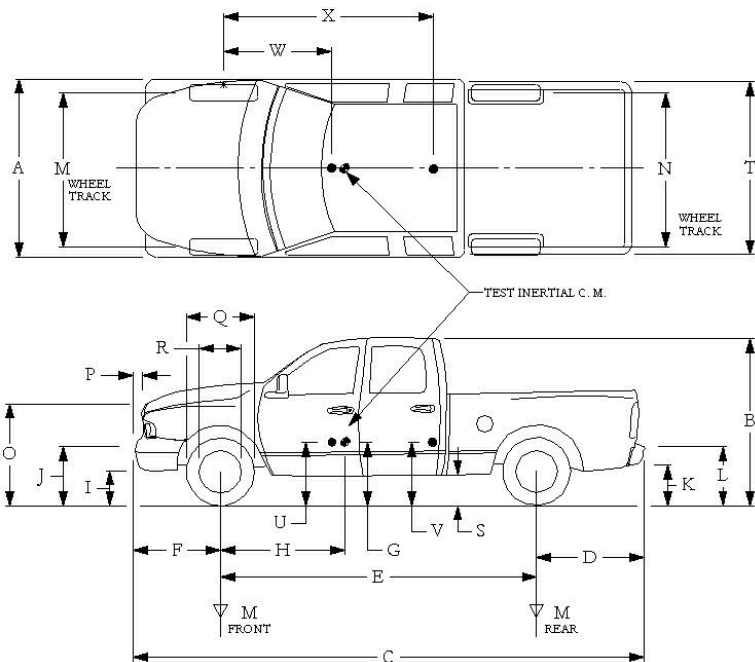
Transmission Type:
 Auto or Manual
 FWD RWD 4WD

Optional Equipment:
NA

Dummy Data:
Type: No dummy used
Mass: NA
Seat Position: NA

Geometry: inches

A	<u>78.25</u>	F	<u>36.00</u>	K	<u>21.50</u>	P	<u>2.88</u>	U	<u>27.50</u>
B	<u>75.50</u>	G	<u>29.12</u>	L	<u>30.00</u>	Q	<u>30.50</u>	V	<u>30.50</u>
C	<u>223.75</u>	H	<u>62.38</u>	M	<u>68.50</u>	R	<u>18.38</u>	W	<u>62.30</u>
D	<u>47.25</u>	I	<u>15.50</u>	N	<u>68.00</u>	S	<u>16.00</u>	X	<u>80.50</u>
E	<u>140.50</u>	J	<u>27.00</u>	O	<u>46.00</u>	T	<u>77.50</u>		
	Wheel Center Height Front	<u>14.75</u>		Wheel Well Clearance (Front)	<u>5.50</u>		Bottom Frame Height - Front	<u>18.25</u>	
	Wheel Center Height Rear	<u>14.75</u>		Wheel Well Clearance (Rear)	<u>10.50</u>		Bottom Frame Height - Rear	<u>24.50</u>	



GVWR Ratings:	Mass: lb	Curb	Test Inertial	Gross Static
Front <u>3700</u>	M_{front}	<u>2898</u>	<u>2793</u>	
Back <u>3900</u>	M_{rear}	<u>2212</u>	<u>2230</u>	
Total <u>6700</u>	M_{Total}	<u>5110</u>	<u>5023</u>	

(Allowable Range for TIM and GSM = 5000 lb ±110 lb)

Mass Distribution:

lb	LF: <u>1415</u>	RF: <u>1378</u>	LR: <u>1094</u>	RR: <u>1136</u>
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Table D2. Vehicle Parametric Measurements for Vertical CG for Test No. 490024-1-2.

Date: 2013-12-05 Test No.: 490024-1-2 VIN: 1D7HA18PX7S154260

Year: 2007 Make: Dodge Model: Ram 1500

Body Style: Quad Cab Mileage: 156836

Engine: 4.7 liter V-8 Transmission: Automatic

Fuel Level: Empty Ballast: 176 lb (440 lb max)

Tire Pressure: Front: 35 psi Rear: 35 psi Size: 265/70R17

Measured Vehicle Weights: (lb)

LF: 1415 RF: 1378 Front Axle: 2793

LR: 1094 RR: 1136 Rear Axle: 2230

Left: 2509 Right: 2514 Total: 5023

5000 ±110 lb allowed

Wheel Base: 140.5 inches Track: F: 68.5 inches R: 68 inches

148 ±12 inches allowed

Track = (F+R)/2 = 67 ±1.5 inches allowed

Center of Gravity, SAE J874 Suspension Method

X: 62.38 inches Rear of Front Axle (63 ±4 inches allowed)

Y: 0.03 inches Left - Right + of Vehicle Centerline

Z: 29.125 inches Above Ground (mininum 28.0 inches allowed)

Hood Height: 46.0 inches Front Bumper Height: 27.0 inches

43 ±4 inches allowed

Front Overhang: 36.0 inches Rear Bumper Height: 30.0 inches

39 ±3 inches allowed

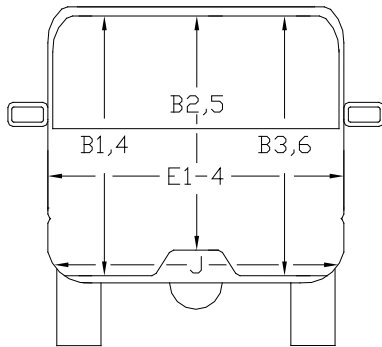
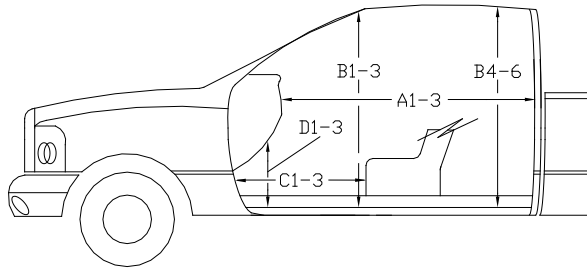
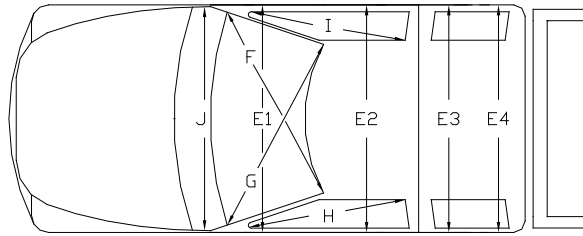
Overall Length: 223.75 inches

237 ±13 inches allowed

Table D4. Occupant Compartment Measurements for Test No. 490024-1-2.

Date: 2013-12-05 Test No.: 490024-1-2 VIN No.: 1D7HA18PX7S154260
 Year: 2007 Make: Dodge Model: Ram 1500

OCCUPANT COMPARTMENT DEFORMATION MEASUREMENT



	Before (inches)	After (inches)
A1	64.75	64.75
A2	64.50	64.50
A3	65.00	65.00
B1	45.25	45.25
B2	39.75	39.75
B3	45.25	45.25
B4	42.00	42.00
B5	44.75	44.75
B6	42.00	42.00
C1	30.00	30.00
C2	-----	-----
C3	27.50	27.50
D1	12.75	12.75
D2	-----	-----
D3	11.50	11.50
E1	62.75	62.75
E2	64.50	64.50
E3	64.00	64.00
E4	64.50	64.50
F	60.00	60.00
G	60.00	60.00
H	39.00	39.00
I	39.00	39.00
J*	62.25	62.25

*Lateral area across the cab from driver's side kickpanel to passenger's side kickpanel.

D2. SEQUENTIAL PHOTOGRAPHS



0.000 s



0.158 s



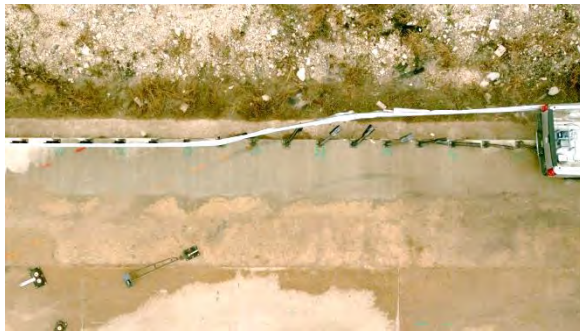
0.316 s



0.474 s



Figure D1. Sequential Photographs for Test No. 490024-1-2 (Overhead and Frontal Views).



0.632s



0.790 s



Vehicle out of view

0.948 s



Vehicle out of view

1.106 s



Figure D1. Sequential Photographs for Test No. 490024-1-2 (Overhead and Frontal Views) (continued).



0.000 s



0.632 s



0.158 s



0.790 s



0.316 s



0.948 s



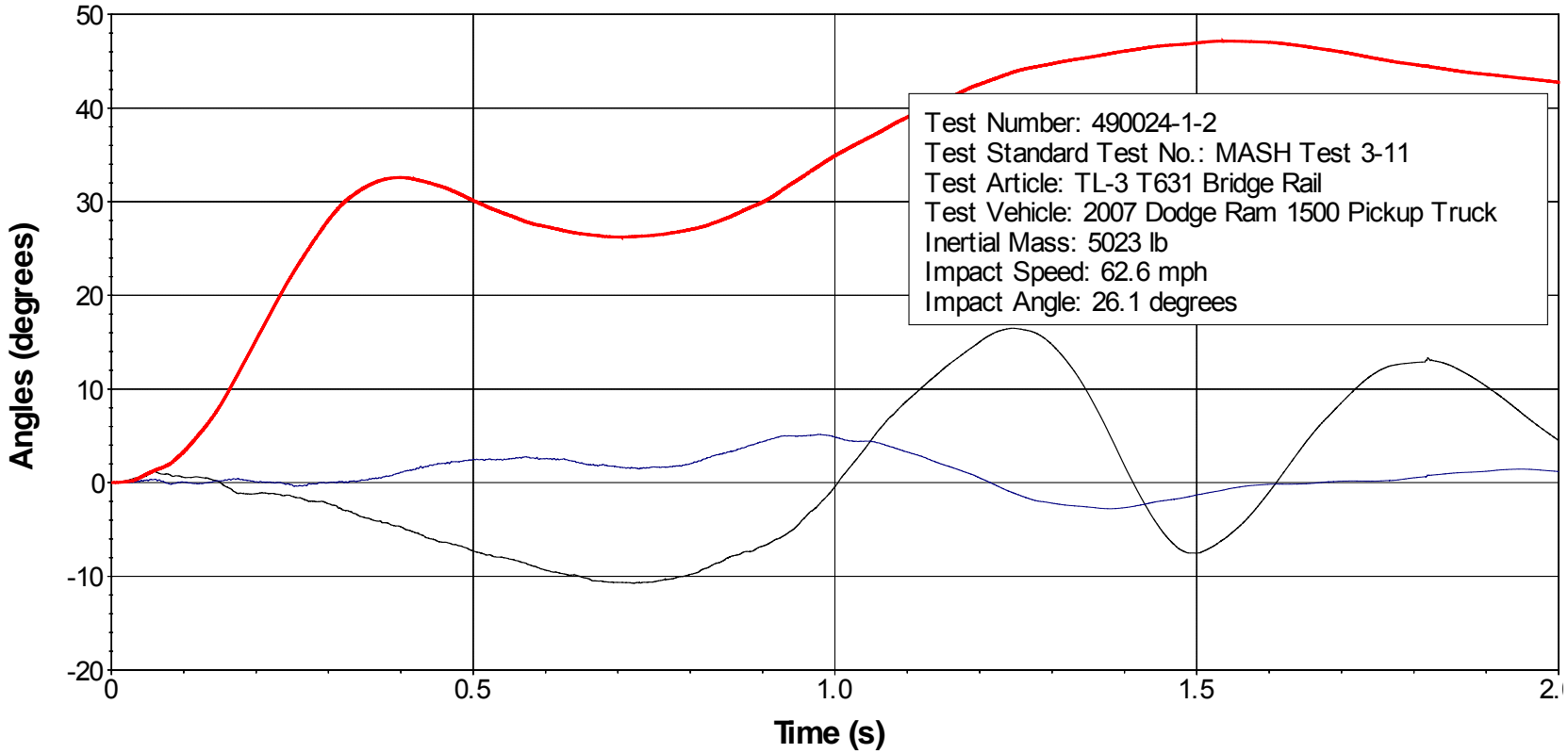
0.474 s



1.106 s

Figure D2. Sequential Photographs for Test No. 490024-1-2 (Rear View).

Roll, Pitch, and Yaw Angles



Test Number: 490024-1-2
 Test Standard Test No.: MASH Test 3-11
 Test Article: TL-3 T631 Bridge Rail
 Test Vehicle: 2007 Dodge Ram 1500 Pickup Truck
 Inertial Mass: 5023 lb
 Impact Speed: 62.6 mph
 Impact Angle: 26.1 degrees

— Roll — Pitch — Yaw

Axes are vehicle-fixed.
 Sequence for determining orientation:

1. Yaw.
2. Pitch.
3. Roll.

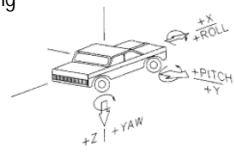


Figure D3. Vehicle Angular Displacements for Test No. 490024-1-2.

X Acceleration at CG

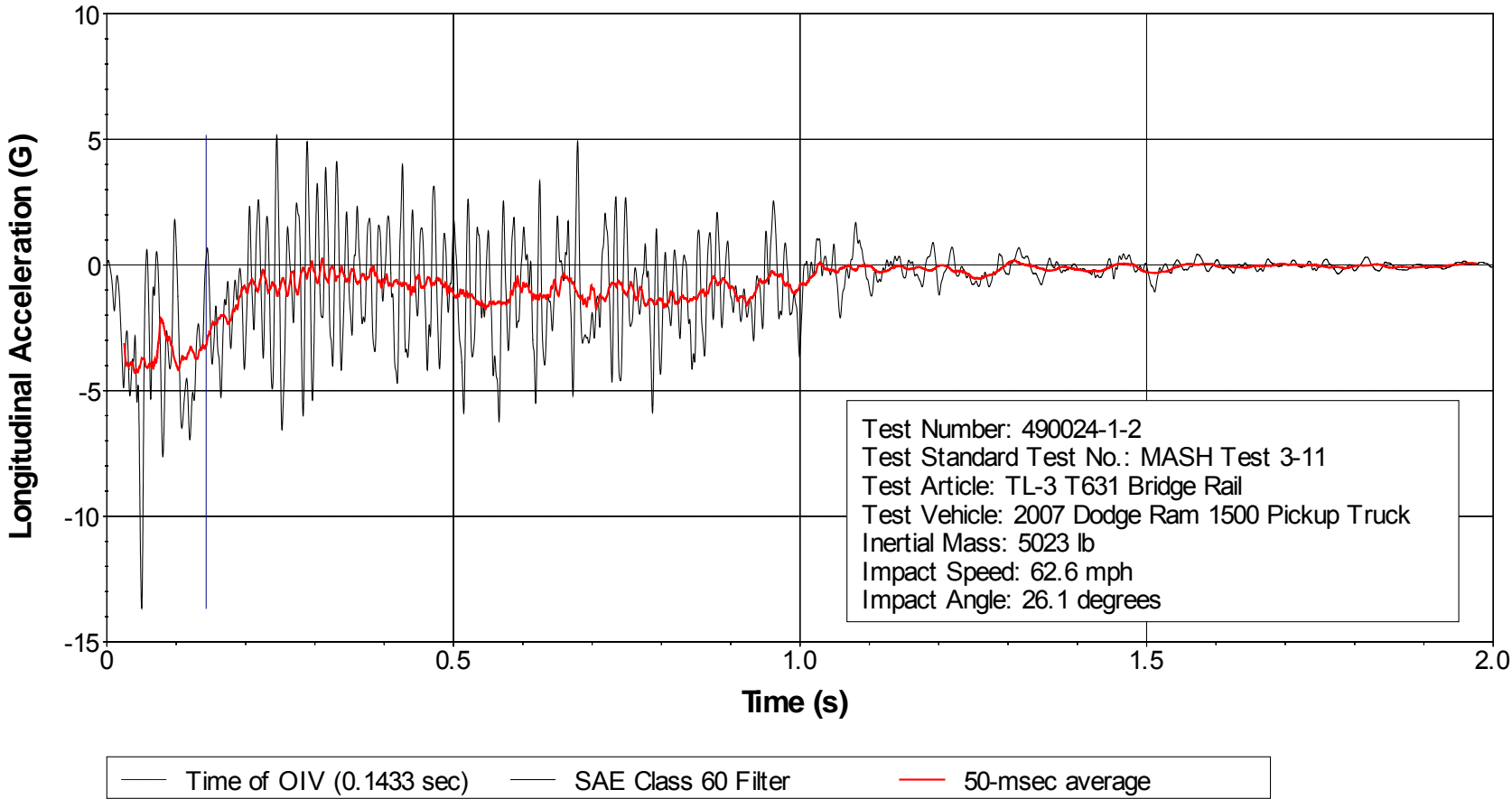


Figure D4. Vehicle Longitudinal Accelerometer Trace for Test No. 490024-1-2 (Accelerometer Located at Center of Gravity).

Y Acceleration at CG

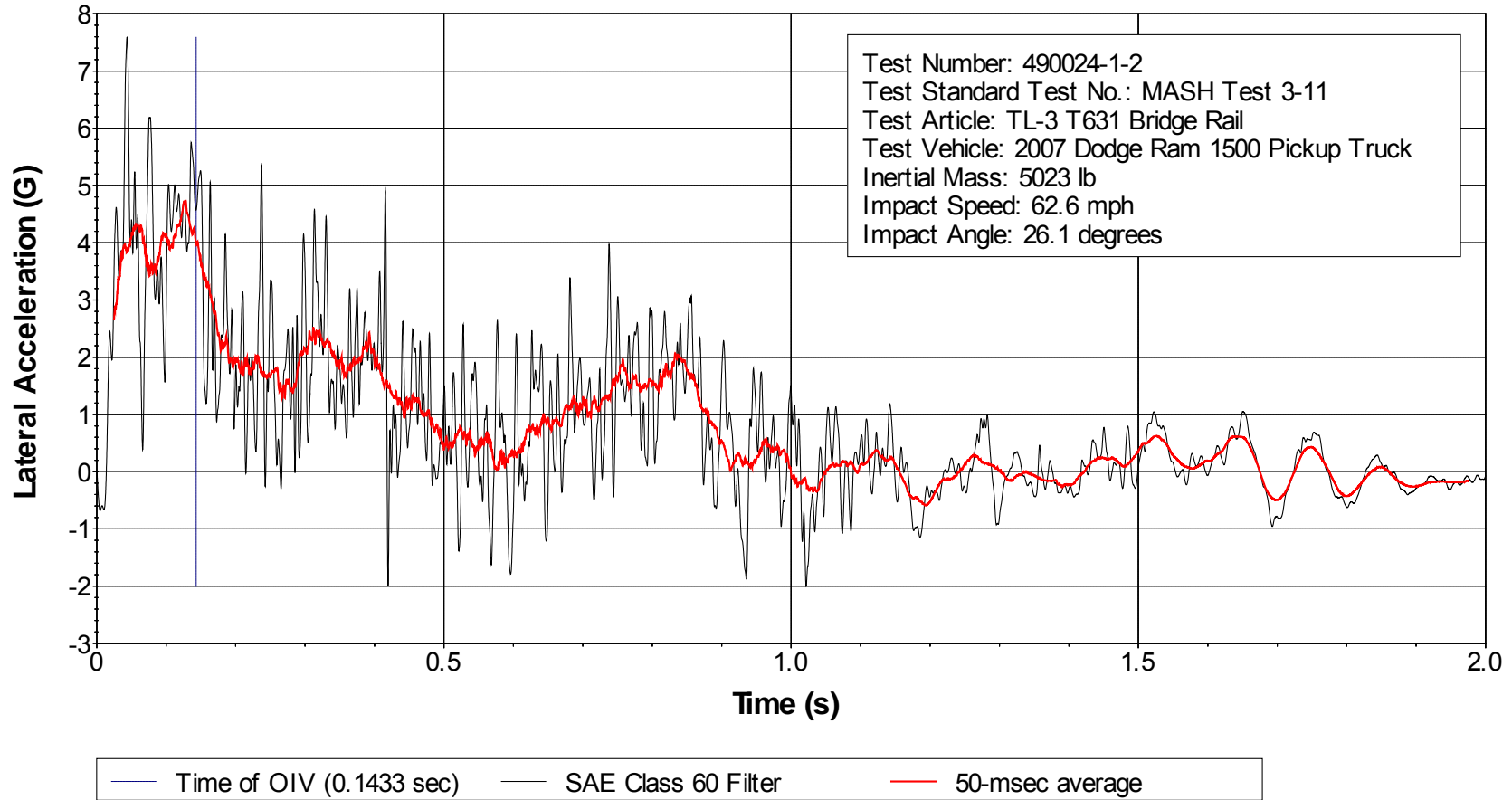


Figure D5. Vehicle Lateral Accelerometer Trace for Test No. 490024-1-2 (Accelerometer Located at Center of Gravity).

Z Acceleration at CG

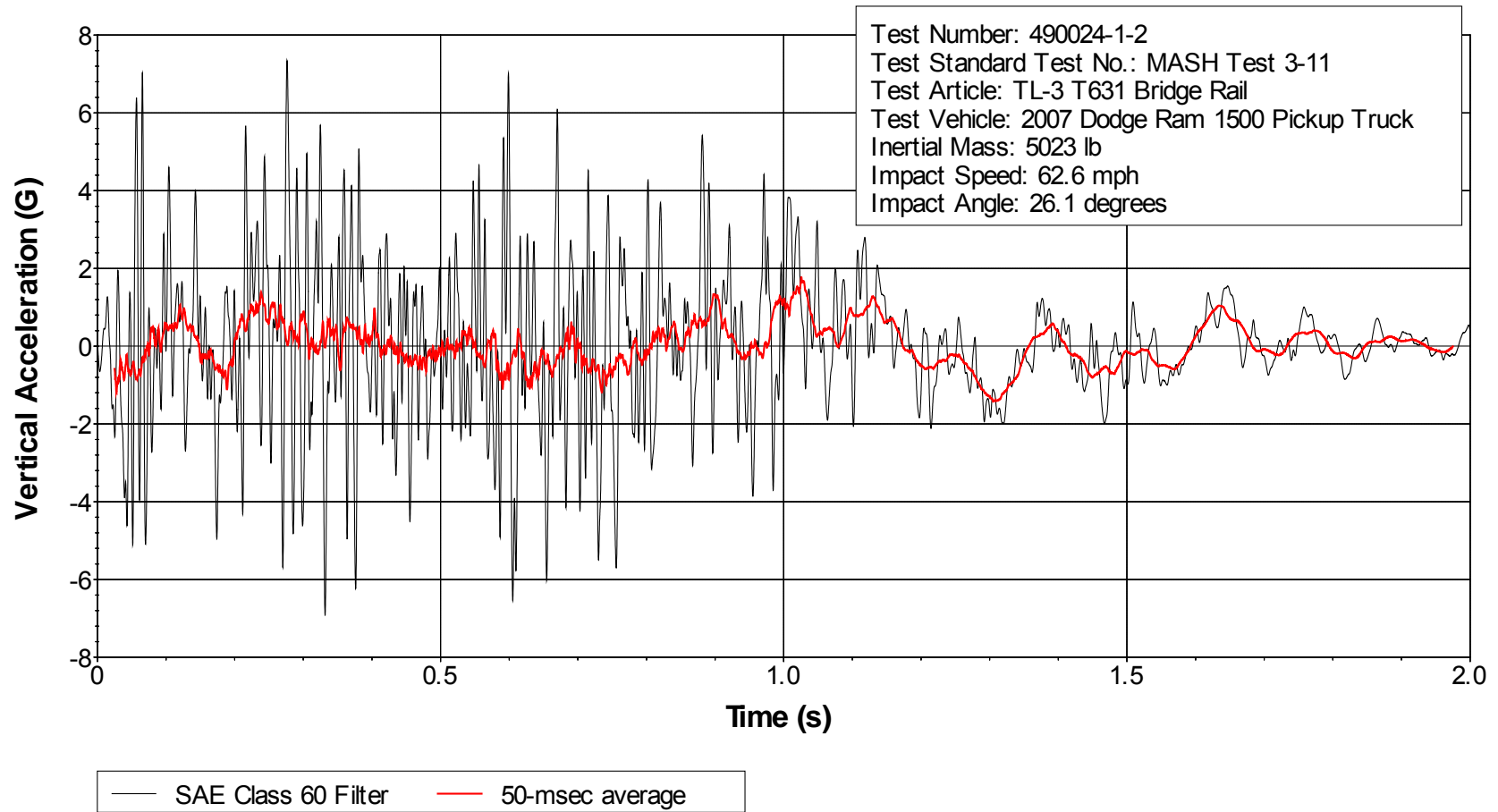


Figure D6. Vehicle Vertical Accelerometer Trace for Test No. 490024-1-2 (Accelerometer Located at Center of Gravity).

X Acceleration Rear of CG

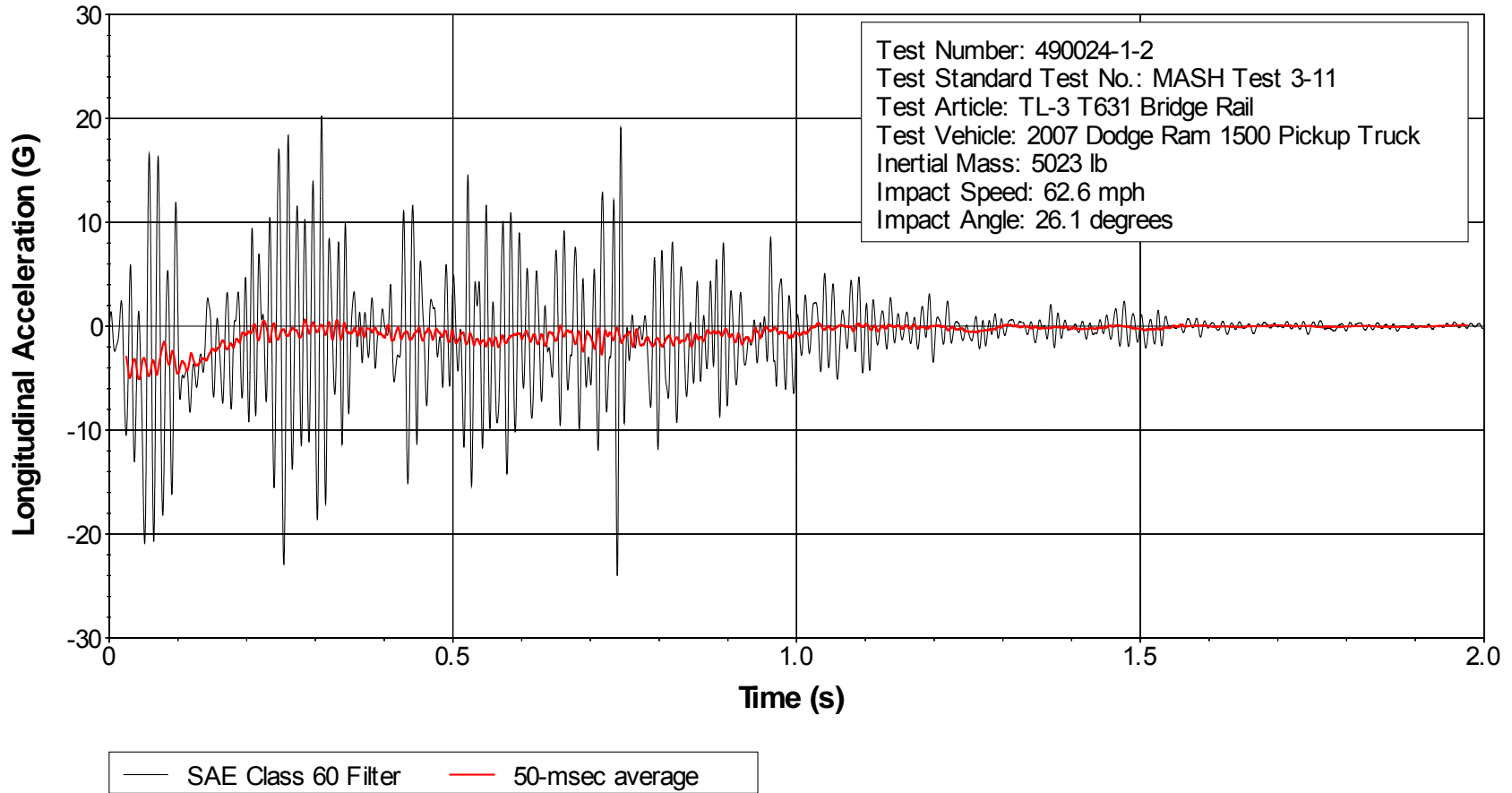


Figure D7. Vehicle Longitudinal Accelerometer Trace for Test No. 490024-1-2 (Accelerometer Located Rear of Center of Gravity).

Y Acceleration Rear of CG

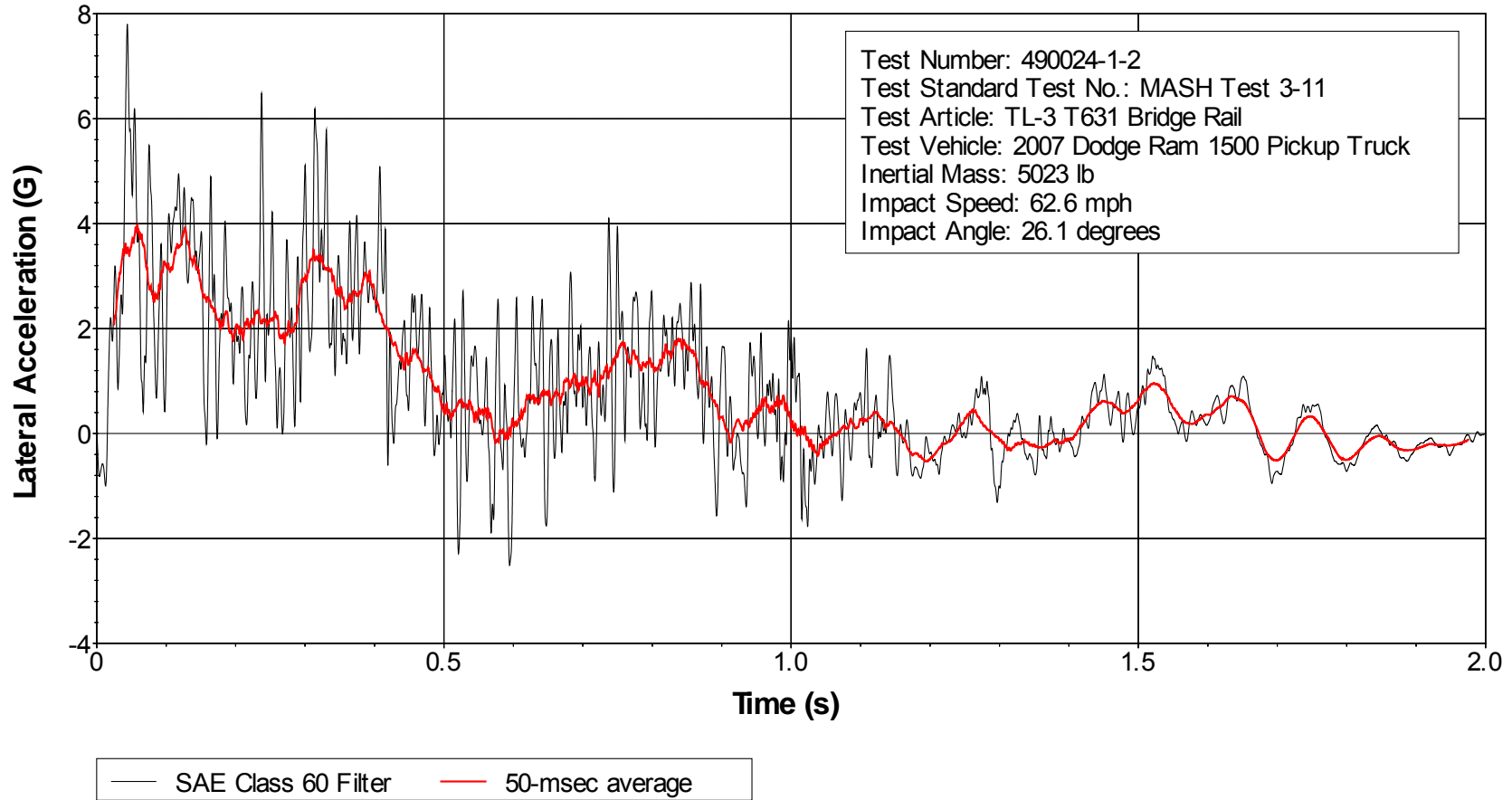


Figure D8. Vehicle Lateral Accelerometer Trace for Test No. 490024-1-2 (Accelerometer Located Rear of Center of Gravity).

Z Acceleration Rear of CG

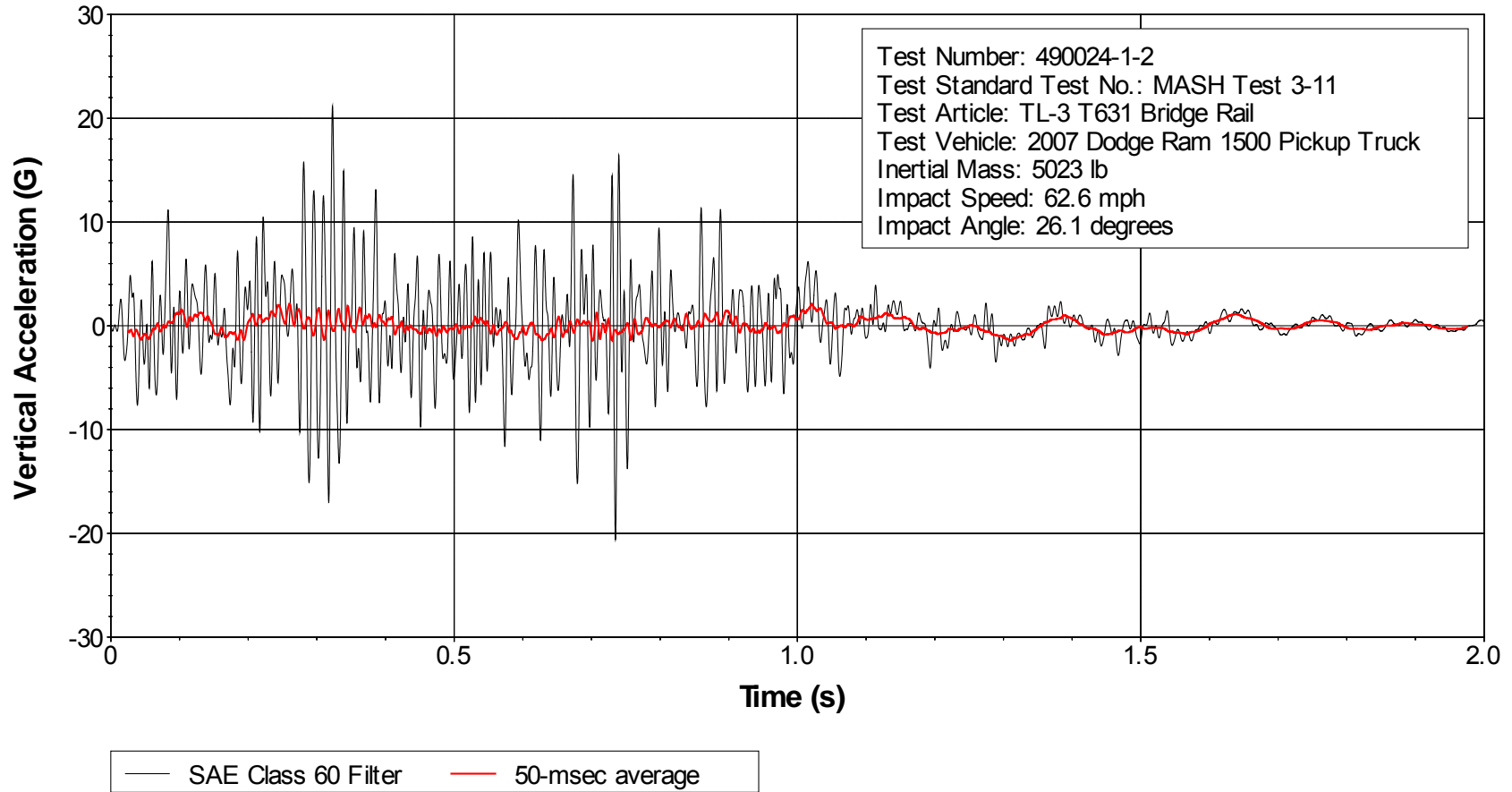


Figure D9. Vehicle Vertical Accelerometer Trace for Test No. 490024-1-2 (Accelerometer Located Rear of Center of Gravity).

APPENDIX E. INFORMATION AND DATA FOR TEST NO. 490024-1-5

E1. VEHICLE PROPERTIES AND INFORMATION

Table E1. Vehicle Properties for Test No. 490024-1-5.

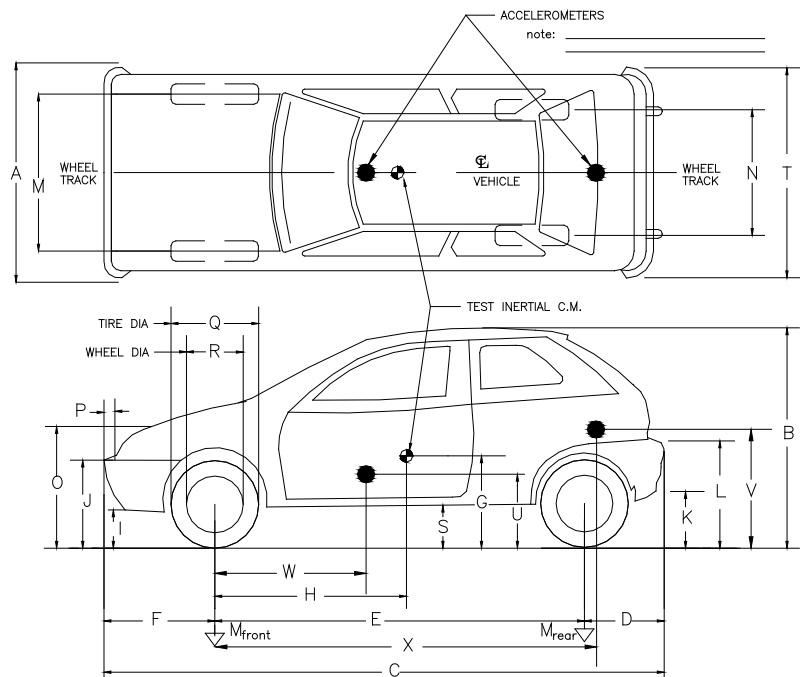
Date: 2014-05-12 Test No.: 490024-1-5 VIN No.: KNADH4A30A6629926
 Year: 2010 Make: Kia Model: Rio
 Tire Inflation Pressure: 32 psi Odometer: 96192 Tire Size: P185/65R14
 Describe any damage to the vehicle prior to test: None noted

● Denotes accelerometer location.

NOTES: None

Engine Type: 4 cylinder
 Engine CID: 1.6 liter
 Transmission Type:
Auto or x Manual
x FWD RWD 4WD
 Optional Equipment:
None

Dummy Data:
 Type: 50th percentile male
 Mass: 165 lb
 Seat Position: Driver Side



Geometry: inches

A	<u>66.38</u>	F	<u>33.00</u>	K	<u>12.75</u>	P	<u>4.50</u>	U	<u>15.00</u>
B	<u>59.00</u>	G	<u>-----</u>	L	<u>26.75</u>	Q	<u>22.18</u>	V	<u>20.50</u>
C	<u>165.75</u>	H	<u>35.98</u>	M	<u>57.75</u>	R	<u>15.38</u>	W	<u>42.00</u>
D	<u>34.00</u>	I	<u>7.50</u>	N	<u>57.12</u>	S	<u>9.00</u>	X	<u>101.50</u>
E	<u>98.75</u>	J	<u>21.25</u>	O	<u>31.50</u>	T	<u>66.12</u>		
Wheel Center Ht Front	<u>11.00</u>	Wheel Center Ht Rear	<u>11.00</u>						

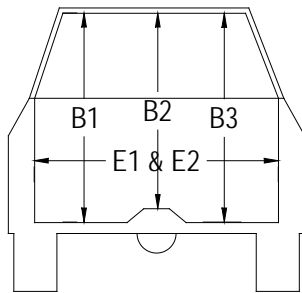
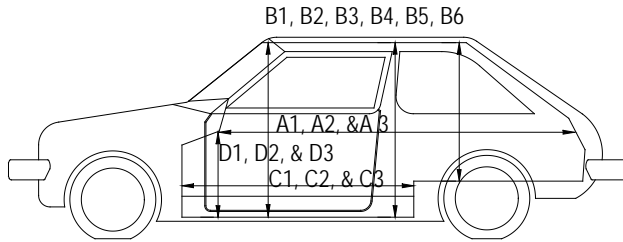
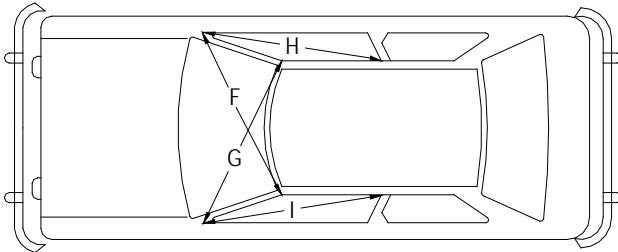
GVWR Ratings:	Mass: lb	Curb	Test Inertial	Gross Static
Front	<u>1918</u>	M_{front}	<u>1542</u>	<u>1626</u>
Back	<u>1874</u>	M_{rear}	<u>884</u>	<u>965</u>
Total	<u>3638</u>	M_{Total}	<u>2426</u>	<u>2591</u>

Mass Distribution:

lb LF: 753 RF: 789 LR: 454 RR: 430

Table E3. Occupant Compartment Measurements for Test No. 490024-1-5.

Date: 2014-05-12 Test No.: 490024-1-5 VIN No.: KNADH4A30A6629926
 Year: 2010 Make: Kia Model: Rio



OCCUPANT COMPARTMENT DEFORMATION MEASUREMENT

	Before (inches)	After (inches)
A1	67.75	
A2	67.50	
A3	67.75	
B1	40.50	
B2	35.75	
B3	40.50	
B4	36.25	
B5	35.75	
B6	36.25	
C1	27.50	
C2	-----	
C3	27.75	
D1	9.75	
D2	----	
D3	9.50	
E1	51.50	
E2	51.00	
F	50.50	
G	50.50	
H	37.50	
I	37.50	
J*	51.00	

*Lateral area across the cab from driver's side kickpanel to passenger's side kickpanel.

E2. SEQUENTIAL PHOTOGRAPHS



0.000 s



0.127 s



0.227 s



0.327 s



Figure E1. Sequential Photographs for Test No. 490024-1-5 (Overhead and Vehicle Frontal Views).



0.427s



0.527 s



0.627 s



0.727 s



**Figure E1. Sequential Photographs for Test No. 490024-1-5
(Overhead and Vehicle Frontal Views) (Continued).**



0.000 s



0.327 s



0.127 s



0.427 s



0.227 s

Camera stopped

**Figure E2. Sequential Photographs for Test No. 490024-1-5
(Rear View).**

Roll, Pitch, and Yaw Angles

E3. VEHICLE ANGULAR DISPLACEMENTS

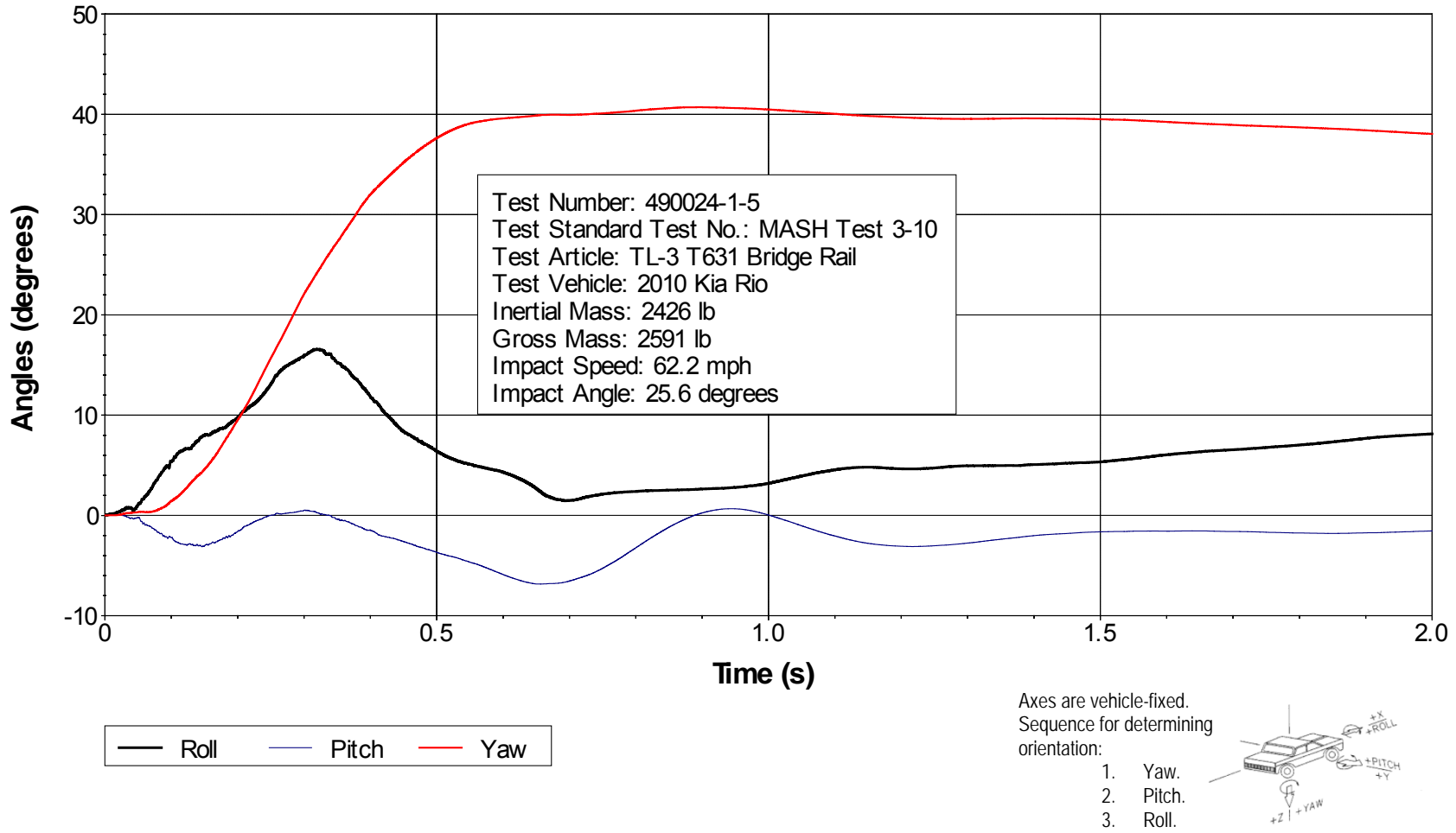


Figure E3. Vehicle Angular Displacements for Test No. 490024-1-5.

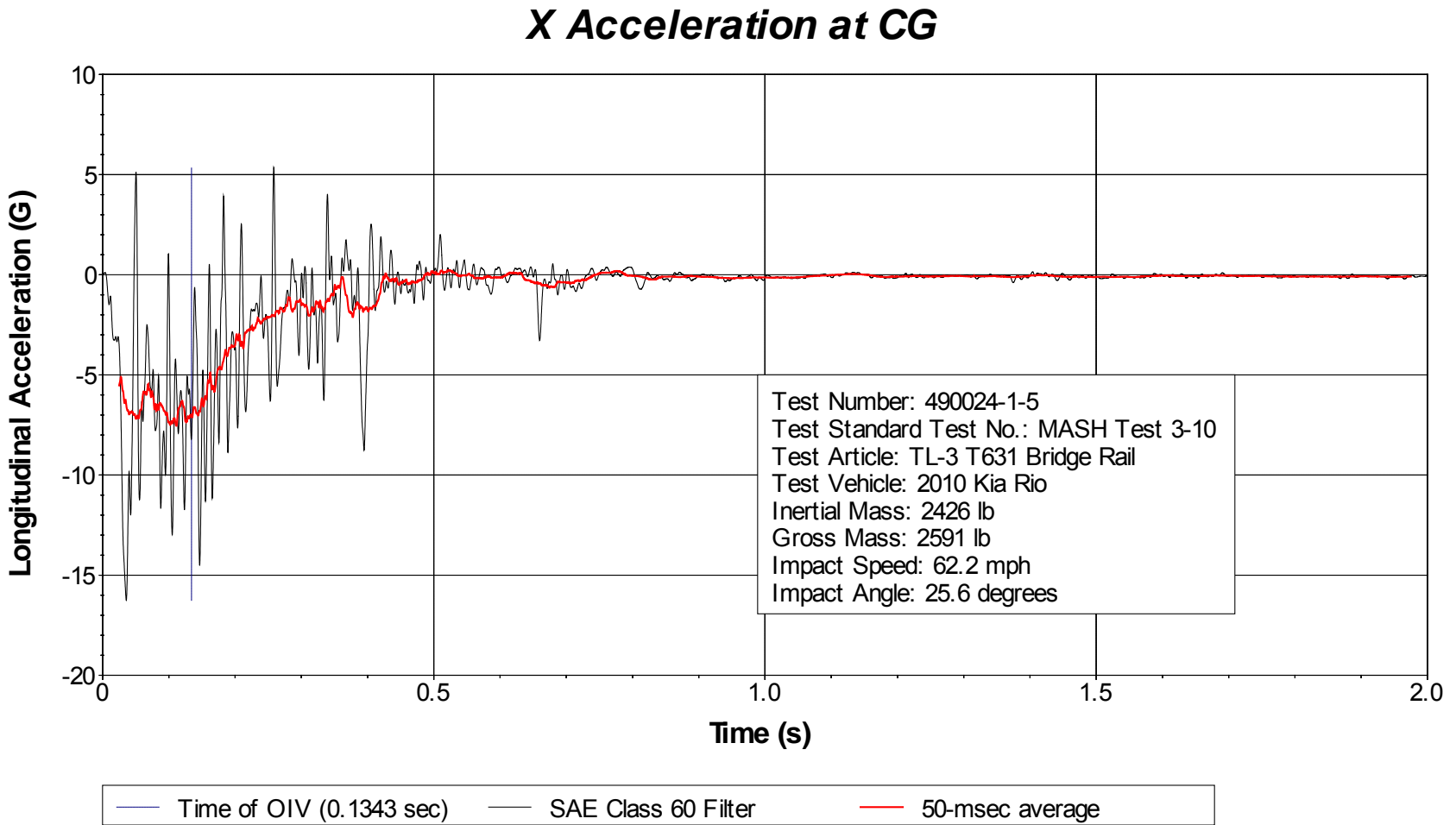


Figure E4. Vehicle Longitudinal Accelerometer Trace for Test No. 490024-1-5 (Accelerometer Located at Center of Gravity).

Y Acceleration at CG

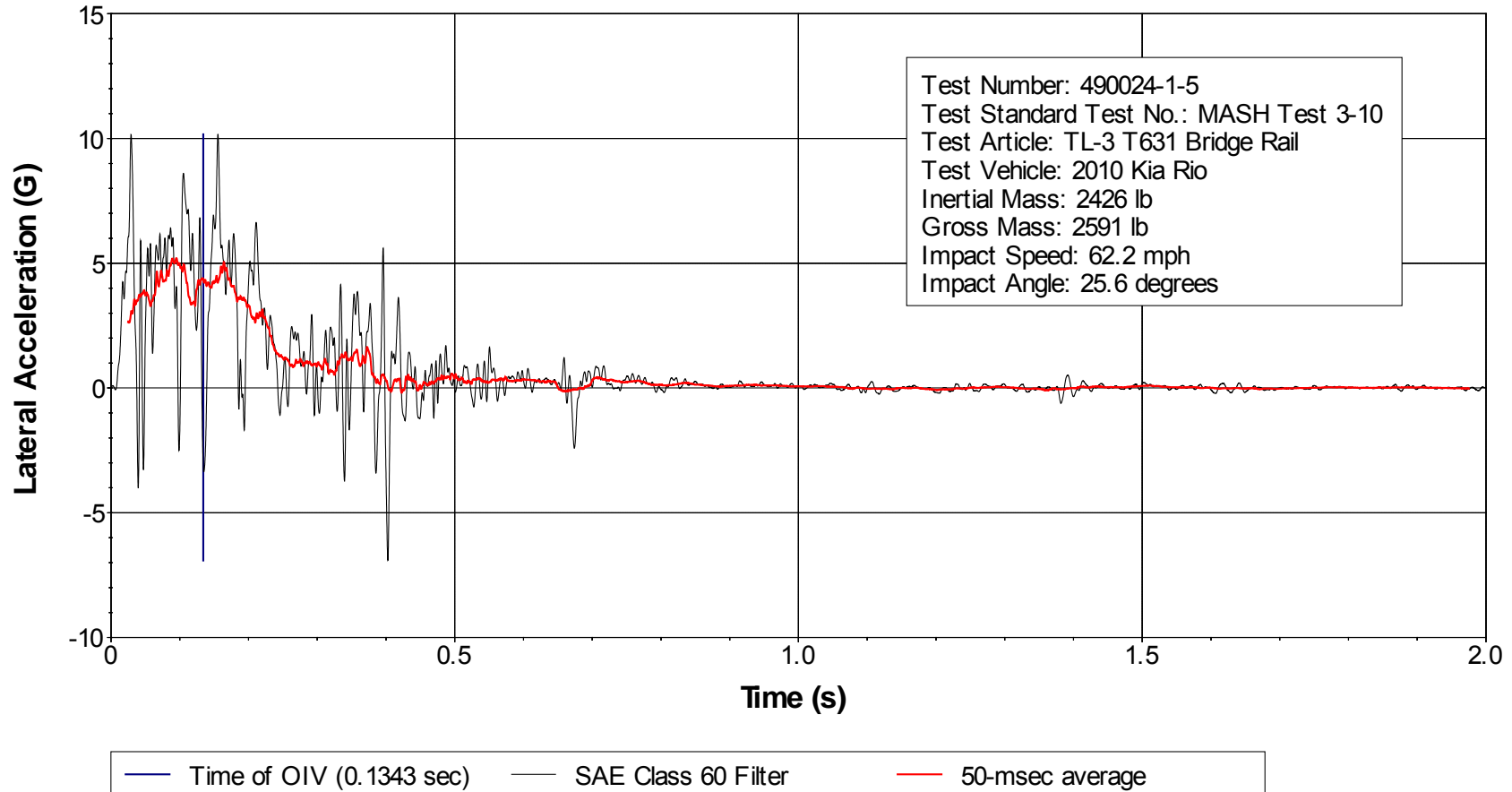


Figure E5. Vehicle Lateral Accelerometer Trace for Test No. 490024-1-5 (Accelerometer Located at Center of Gravity).

Z Acceleration at CG

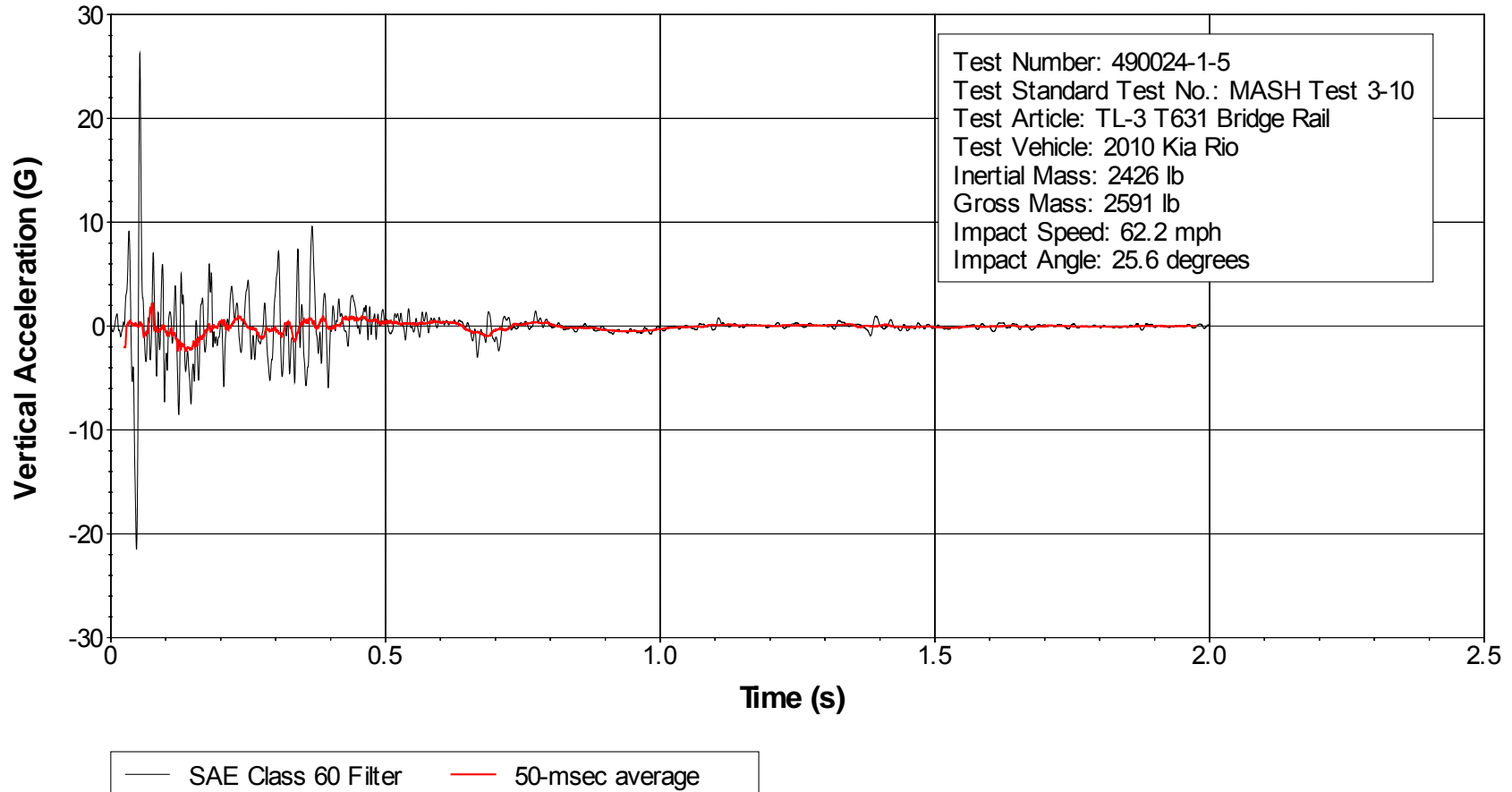


Figure E6. Vehicle Vertical Accelerometer Trace for Test No. 490024-1-5 (Accelerometer Located at Center of Gravity).

X Acceleration Rear of CG

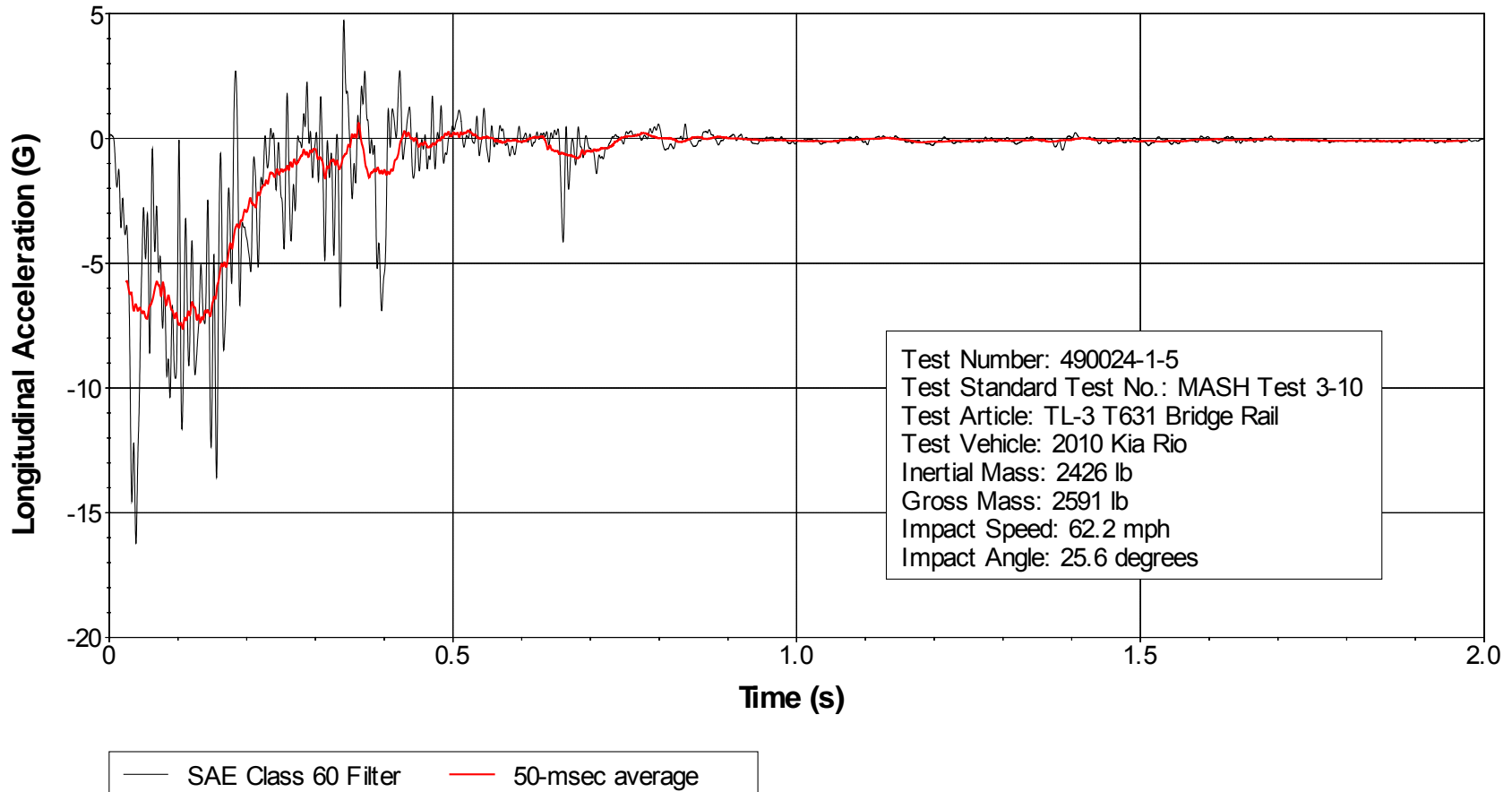


Figure E7. Vehicle Longitudinal Accelerometer Trace for Test No. 490024-1-5 (Accelerometer Located Rear of Center of Gravity).

Y Acceleration Rear of CG

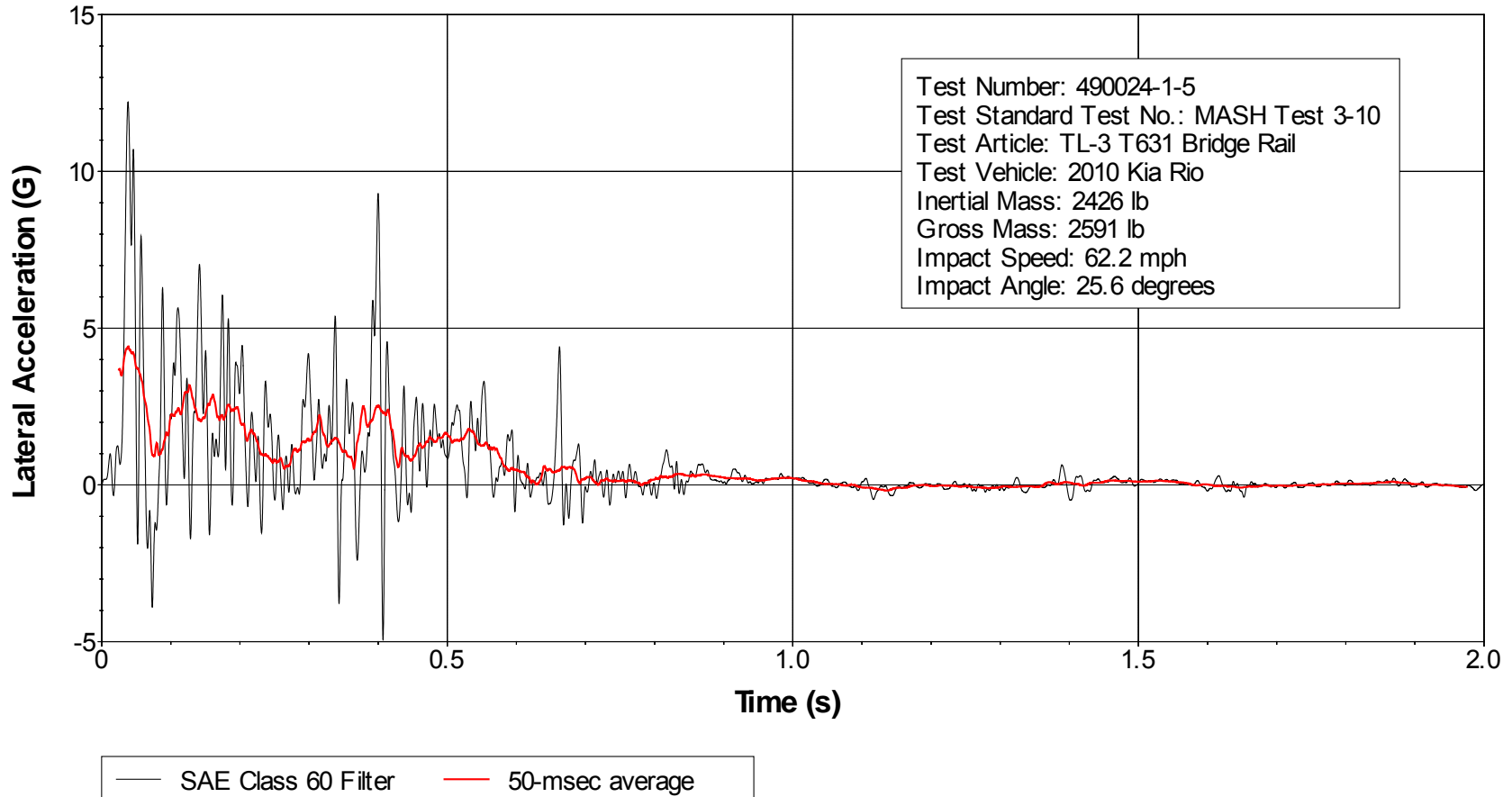


Figure E8. Vehicle Lateral Accelerometer Trace for Test No. 490024-1-5 (Accelerometer Located Rear of Center of Gravity).

Z Acceleration Rear of CG

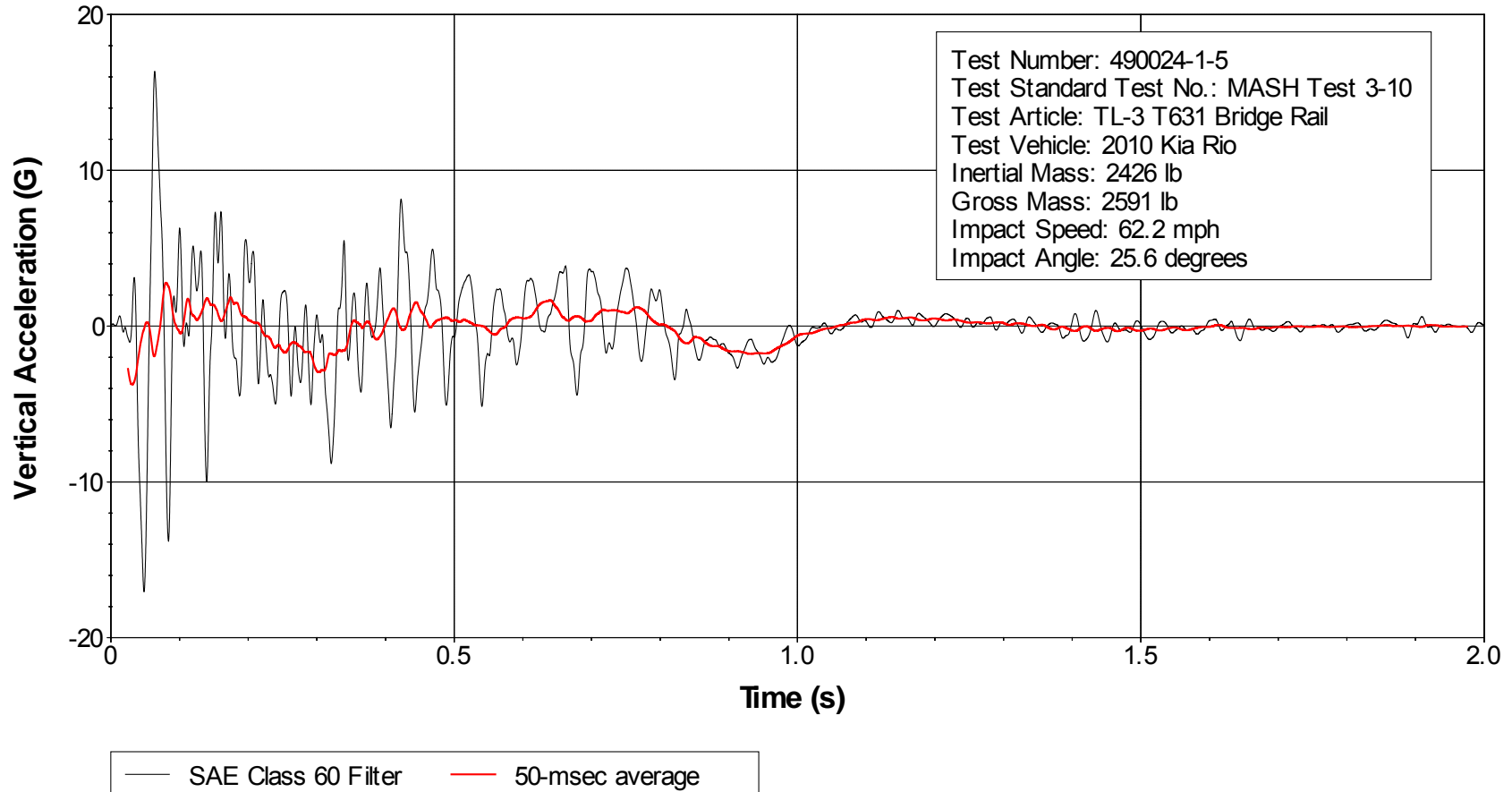


Figure E9. Vehicle Vertical Accelerometer Trace for Test No. 490024-1-5 (Accelerometer Located Rear of Center of Gravity).

