TESTING CERT # 2937.01

DYNAMIC EVALUATION OF A PINNED ANCHORING SYSTEM FOR NEW YORK STATE'S TEMPORARY CONCRETE BARRIERS – PHASE II

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NEW YORK STATE DEPARTMENT OF TRANSPORATION
50 Wolf Road, 6th Floor
Albany, New York 12232

MwRSF Research Report No. TRP-03-224-10

January 27, 2010

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.	2.	3. Recipient's Accession No.	
TRP-03-224-10			
4. Title and Subtitle Dynamic Evaluation of a Pinned Anchoring System for New York State's Temporary Concrete Barriers – Phase II		5. Report Date January 27, 2010 6.	
7. Author(s) Lechtenberg, K.A., Faller, R.K., Reid, J.D., and Sicking, D.L.		8. Performing Organization Report No. TRP-03-224-10	
9. Performing Organization Name and Address Midwest Roadside Safety Facility (MwRSF) University of Nebraska-Lincoln 527 Nebraska Hall Lincoln, Nebraska 68588-0529		10. Project/Task/Work Unit No. 11. Contract © or Grant (G) No.	
12. Sponsoring Organization Name and Address New York State Department of Transportation 50 Wolf Road, 6th Floor Albany, New York 68502		13. Type of Report and Period Covered Final Report: 2009-2010 14. Sponsoring Agency Code Project No. TPF-5(193) Supplement #11	
15. Supplementary Notes Prepared in cooperation with U.S. Department of Transportation, Federal Highway Administration.			

16. Abstract (Limit: 200 words)

Temporary concrete barrier (TCB) systems are utilized in many situations, including placement adjacent to vertical drop-offs. Free-standing TCB systems are known to have relatively large deflections when impacted, which may be undesirable when dealing with limited space behind the barrier, such as on a bridge deck or with limited lane width in front of the barrier system. In order to allow TCB systems to be used in space-restricted locations, a variety of TCB stiffening options have been tested, including beam stiffening and pinning the barriers to the pavement. These pavement-pinning procedures have been considered time-consuming and may pose undue risk to work-zone personnel who are anchoring the barrier on the traffic-side face. Thus, a means of reducing TCB deflections while reducing risk to workers was deemed necessary.

The primary research objectives were to evaluate the potential for reducing barrier deflections through the use of pinning every barrier section on the back-side toe of the New York State's New Jersey-shape TCBs and evaluate the barrier system according to the Test Level 3 (TL-3) criteria set forth in the *Manual for Assessing Safety Hardware* (MASH). The research study included one full-scale vehicle crash test with a Dodge Quad Cab pickup truck. Four 15½-in. (394-mm) long, vertical steel pins were placed through holes on the back-side toe of each barrier section and inserted into drilled holes within the rigid concrete surface. Following the successful redirection of the pickup truck, the safety performance of the pinned anchoring system was determined to be acceptable according to the TL-3 evaluation criteria specified in MASH using the 2270P vehicle.

17. Document Analysis/Descriptors	18. Availability Statement		
Highway Safety, Crash Test, Roadside Appurtenances, Compliance Test, MASH, Longitudinal Barrier, Temporary Concrete Barrier, Anchored, Pinned	No restrictions. Document available from: National Technical Information Services, Springfield, Virginia 22161		
19. Security Class (this report) Unclassified	20. Security Class (this page) Unclassified	21. No. of Pages 125	22. Price

DISCLAIMER STATEMENT

This report was funded in part through funding from the New York State Department of Transportation and the Federal Highway Administration, U.S. Department of Transportation. The contents of this report reflect the views and opinions 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 views or policies of the New York State Department of Transportation nor the Federal Highway Administration, U.S. Department of Transportation. This report does not constitute a standard, specification, regulation, product endorsement, or an endorsement of manufacturers.

UNCERTAINTY OF MEASUREMENT STATEMENT

The Midwest Roadside Safety Facility (MwRSF) has determined the uncertainty of measurements for several parameters involved in standard full-scale crash testing and non-standard testing of roadside safety features. Information regarding the uncertainty of measurements for critical parameters is available upon request by the sponsor and the Federal Highway Administration.

The Independent Approving Authority (IAA) for the data contained herein was Dr. Ronald K. Faller, Research Assistant Professor.

ACKNOWLEDGEMENTS

The authors wish to acknowledge several sources that made a contribution to this project: (1) the New York State Department of Transportation for sponsoring this project; and (2) MwRSF personnel for constructing the barrier and conducting the crash test.

Acknowledgement is also given to the following individuals who made a contribution to the completion of this research project.

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1 INTRODUCTION

1.1 Problem Statement

Over the years, temporary concrete barrier (TCB) systems have been utilized to serve several functions. These include preventing motorists from encroaching into the work space within work zones; providing positive protection for construction and maintenance workers as well as the associated operations; separating two-way or opposing traffic; shielding vehicles from roadside and median hazards; and separating pedestrians and bicyclists from vehicle traffic.

In general, these temporary concrete barrier (TCB) systems are used in free-standing configurations where the base of each barrier segment is placed on a paved surface and without physical attachment to that surface. Under high-energy impact scenarios, these free-standing, linked concrete barrier segments can be displaced laterally for several feet, thus allowing the barrier system to encroach into the work space. For narrow work areas, this barrier displacement could potentially result in workers being crushed between the barrier system and objects located within the workspace. Free-standing barrier systems are also often used to shield vertical drop-offs, such as excavations adjacent to the roadway or at the exposed edge of a bridge deck. If TCBs are placed too close to a vertical drop-off and are displaced laterally, there exists a potential for the barrier system to fall onto workers in an excavation or below a bridge, or even onto traffic under the bridge.

Various anchorage and stiffening systems have been incorporated into selected TCB systems in order to reduce barrier deflections and allow their use in restricted work zones with confined space behind the barrier system and/or limited lane width in front of the barrier system. Some of these systems have included the use of stiffening beams placed on the back side of the barriers and across the joints, the placement of vertical pins or rods through either the front toe or

both toes of the barrier and into the pavement or bridge deck surface, as well as the use of an anchorage system that connects the joint hardware to the deck surface. Although various vertical pinning methods have been successfully developed for anchoring TCBs to paved surfaces, including concrete bridge decks, the installation process is often considered to be time-consuming, costly, and ultimately may result in damage to the bridge deck.

Over the last decade, the New York State Department of Transportation (NYSDOT) sponsored considerable research for the crash testing and evaluation of a New Jersey-shape temporary concrete barrier system used in both free-standing and stiffened configurations and with the barrier ends both pinned and unpinned to the pavement surface [1-4]. These crash testing programs were conducted according to the Test Level 3 (TL-3) safety performance criteria found in either the National Cooperative Highway Research Program (NCHRP) Report No. 350 [5] or the Manual for Assessing Safety Hardware (MASH) [6].

For TCBs located adjacent to vertical drop-offs, the NYSDOT has deemed it desirable to utilize vertical pins through the back-side toe in order to reduce barrier deflections as well as to reduce the need for workers to be positioned on the traffic-side face of the TCBs while anchoring the barrier segments. One of the aforementioned research programs explored the idea of the pinned, temporary concrete barrier system with alternating segments anchored to the rigid concrete surface with vertical steel pins placed through the back-side toe of New York State's New Jersey-shape TCB and set into drilled holes in the concrete surface [4]. However, significant barrier deflections were observed during the crash test and may be greater than desired for work areas with restricted space.

As a result, there still remained a need for determining whether the NYSDOT's New Jersey-shape, temporary concrete barrier system could be pinned throughout its length and only

on the back-side face of the barrier. In order to reduce construction costs and damage to bridge decks, an investigation was undertaken to evaluate whether barrier deflections would be maintained to reasonable levels with vertical pins placed in every barrier segment.

1.2 Research Objective

The objectives of this research project were to evaluate the deflection performance and safety performance of a pinned option of NYSDOT's New Jersey-shape, temporary concrete barrier system. The NYSDOT officials were confident that the barrier system would meet all of the impact safety standards. However, the NYSDOT wanted to evaluate the TCB system using the TL-3 safety performance criteria set forth in MASH, which results in a 13.5 percent increase in impact severity over that provided in NCHRP Report No. 350.

1.3 Scope

The research objective was achieved through the completion of several tasks. First, a full-scale vehicle crash test was performed on the pinned temporary concrete barrier system with every segment anchored to the pavement surface. The crash test utilized a pickup truck, weighing approximately 5,000 lb (2,268 kg), as recommended in MASH guidelines [6]. The target impact conditions for the test were an impact speed of 62 mph (100 km/h) and an impact angle of 25 degrees. Next, the test results were analyzed, evaluated, and documented. Finally, conclusions and recommendations were made that pertain to the safety performance of the pinned temporary concrete barrier system.

2 LITERATURE REVIEW

Previous testing on the NYSDOT TCB system was conducted by the Texas Transportation Institute (TTI) and the Midwest Roadside Safety Facility (MwRSF) [1-4]. At TTI, the TCB system was evaluated according to the criteria provided in NCHRP Report No. 350 [5], while at MwRSF the TCB system was evaluated according to the criteria presented in MASH [6].

In 1999, TTI tested a free-standing version of the NYSDOT TCB with unpinned ends [1]. In test no. 473220-7, a 4,575-lb (2,075-kg) pickup truck impacted the ten barrier system 3 ft - 11 in. (1.2 m) upstream of the joint between barrier segment nos. 3 and 4 at a speed of 60.9 mph (98.0 km/h) and at an angle of 26.3 degrees. During the impact, three of the barrier joints failed, causing the barrier at the point of impact to overturn. Subsequently, the vehicle overrode the barrier and rolled over. Thus, the test was determined to be unacceptable according to the NCHRP Report No. 350 requirements, since the vehicle did not remain upright after collision with the system. The joint failure was subsequently attributed to substandard welding in the connection joints.

In 2001, TTI retested the properly fabricated unpinned NYSDOT TCB system [2]. It should be noted that the end barrier sections were unpinned as well. In test no. 473220-14, a 4,577-lb (2,076-kg) pickup truck impacted the ten barrier system 4 ft - 6 in. (1.4 m) upstream of the joint between barrier segment nos. 3 and 4 at a speed of 62.6 mph (100.8 km/h) and at an angle of 25.6 degrees. During the impact, the vehicle was redirected smoothly, and the test was determined to be acceptable according to the NCHRP Report No. 350 requirements. The barrier system experienced 50 in. (1,270 mm) of dynamic deflection and 50 in. (1,270 mm) of permanent set deflection. During the test, the upstream end was pulled 5 13/16 in. (148 mm)

longitudinally downstream, while the downstream end was displaced 3/16 in. (5 mm) longitudinally upstream, or toward the impact point. The noted lateral barrier deflections would be correlated to the unpinned section ends. It was NYSDOT's concern over this large barrier deflection that caused the state agency to contract with MwRSF to conduct the barrier stiffening research noted below.

In 2008, MwRSF crash tested three different versions of NYSDOT's TCB system [3]. The research study included three full-scale vehicle crash tests with 2270P pickup trucks conducted in accordance to the TL-3 evaluation criteria published in MASH. In all three tests, the first and last barrier sections were anchored to the concrete surface.

The first test, test no. NYTCB-1, consisted of stiffening three joints between barrier nos. 4 and 7 with 6-in. x 6-in. x 3/16-in. (152-mm x 152-mm x 4.8-mm) box beam sections. In this test, a 5,016-lb (2,275-kg) pickup truck impacted the ten barrier system essentially at the target location, which was 4 ft - 3 3/16 in. (1.3 m) upstream from the downstream end of barrier no. 4 at a speed of 61.8 mph (99.5 km/h) and at an angle of 24.6 degrees. During the impact, the vehicle was redirected smoothly, and the test was determined to be acceptable according to MASH requirements. The barrier system with anchored ends experienced 27 5/8 in. (700 mm) of dynamic deflection and 26 in. (660 mm) of permanent set deflection.

The second test, test no. NYTCB-2, consisted of an unstiffened version of the NYSDOT TCB system with anchored ends. In this test, a 5,024-lb (2,279-kg) pickup truck impacted the ten barrier system essentially at the target location, which was 4 ft - 3 3/16 in. (1.3 m) upstream from the downstream end of barrier no. 4 at a speed of 61.2 mph (98.5 km/h) and at an angle of 25.8 degrees. During the impact, the vehicle was redirected smoothly, and the test was determined to be acceptable according to MASH requirements. The barrier system with anchored ends

experienced 40 5/16 in. (1,023 mm) of dynamic deflection and 39½ in. (1,003 mm) of permanent set deflection.

The third test, test no. NYTCB-3, consisted of stiffening six joints between barrier nos. 2 and 8 with 6-in. x 8-in. x ¼-in. (152-mm x 203-mm x 6.4-mm) box beam sections. In addition, this system was installed with the back side of the barrier sections placed 12 in. (305 mm) away from a simulated bridge deck edge. In this test, a 5,001-lb (2,268-kg) pickup truck impacted the ten barrier system essentially at the target location, which was 4 ft - 3 3/16 in. (1.3 m) upstream from the downstream end of barrier no. 4, at a speed of 63.5 mph (102.2 km/h) and at an angle of 24.4 degrees. During the test, the vehicle was redirected smoothly, and the test was determined to be acceptable according to MASH requirements. The barrier system with anchored ends experienced 30⅞ in. (784 mm) of dynamic deflection and 26 in. (660 mm) of permanent set deflection.

In 2009, MwRSF crash tested a pinned anchoring system for NYSDOT's TCB system [4]. The barrier system consisted of NYSDOT's TCB system with every other barrier pinned to the concrete surface with steel vertical rods placed through the back-side toe of the barrier section and set into drilled holes in the rigid concrete surface. In test no. NYTCB-4, a 5,172-lb (2,346-kg) pickup truck impacted the ten barrier system essentially at the target location, which was 4 ft - 3 3/16 in. (1.3 m) upstream from the joint between barrier nos. 4 and 5, at a speed of 62.3 mph (100.3 km/h) and at an angle of 24.3 degrees. During the impact and due to the vehicle's tail slap against the barrier, the joint between barrier nos. 4 and 5 completely separated at approximately the same time that the vehicle exited the barrier system. The barrier system experienced 64.8 in. (1,646 mm) of dynamic deflection and 53½ in. (1,359 mm) of permanent set deflection. The additional dynamic deflection was the result of the joint separation. However, the

vehicle was contained and smoothly redirected. Although complete joint separation occurred and is generally undesirable, the test was determined to be acceptable according to MASH requirements.

3 DESIGN DETAILS

The test installation was 200 ft (61.0 m) long and comprised of ten temporary concrete barrier sections in an anchored configuration, as shown in Figures 1 through 9. The 20-ft (6.1-m) long, temporary concrete barrier sections were placed on the rigid concrete surface with all sections attached to the concrete surface. Photographs of the test installation are shown in Figures 10 through 12. Material specifications, mill certifications, and/or certificates of conformity for the system materials are shown in Appendix A.

The concrete used for the barrier sections consisted of a concrete mix with a minimum 28-day compressive strength of 3,000 psi (21.0 MPa). A minimum concrete cover of 1½ in. (38 mm) was used along all rebar in the barrier. All of the steel reinforcement in the barrier was ASTM A615 Grade 60 rebar and consisted of four No. 6 longitudinal bars, eight No. 4 bars for the vertical stirrups, four No. 6 lateral bars, and nine No. 4 bars for the anchor hole reinforcement loops. The section reinforcement details are shown in Figures 3 and 8.

The barrier sections used a connection key, as shown in Figures 4 through 7, 10, and 11. The connection key assembly consisted of ½-in. (13-mm) thick, ASTM A36 steel plates welded together to form the key shape. Two stiffeners were welded to the top plate with their interior faces in contact with the I-beam shape and located 5/16 in. (8 mm) up from the ends of the top plate, as shown in Figures 4 and 5.

A connector key was configured at each end of the barrier section, as shown in Figure 3, 10, and 11. The connector key consisted of one ASTM A500 steel tube and three ASTM A36 steel plates. Three U-shaped plates were welded on the sides of the tube, as shown in Figure 6. A connection key was inserted into the steel tubes of two adjoining sections to form the connection, as shown in Figure 7. The connector key provides a stout connection that is particularly effective

at distributing the system's torsional twist about the longitudinal axis to the adjoining sections of TCB. This combined resistance is essential in order to minimize the barrier rotation sustained by the impacted section.

All barrier sections were pinned to the rigid concrete pavement with four 1-in. (25-mm) diameter by 15½-in. (394-mm) long, ASTM A36 (hot rolled) steel rods. The steel rods or pins were passed through the precast holes on the back-side toe of the barrier sections, as shown in Figures 1, 2, and 12. Each anchor rod was then inserted into a 1⅛-in. (29-mm) diameter, drilled hole in the rigid concrete surface using an embedment depth of 5 in. (127 mm), as shown in Figure 1. In addition, the system was installed with the back side of the sections placed 12 in. (305 mm) away from the edge of a simulated bridge deck, as shown in Figure 1.

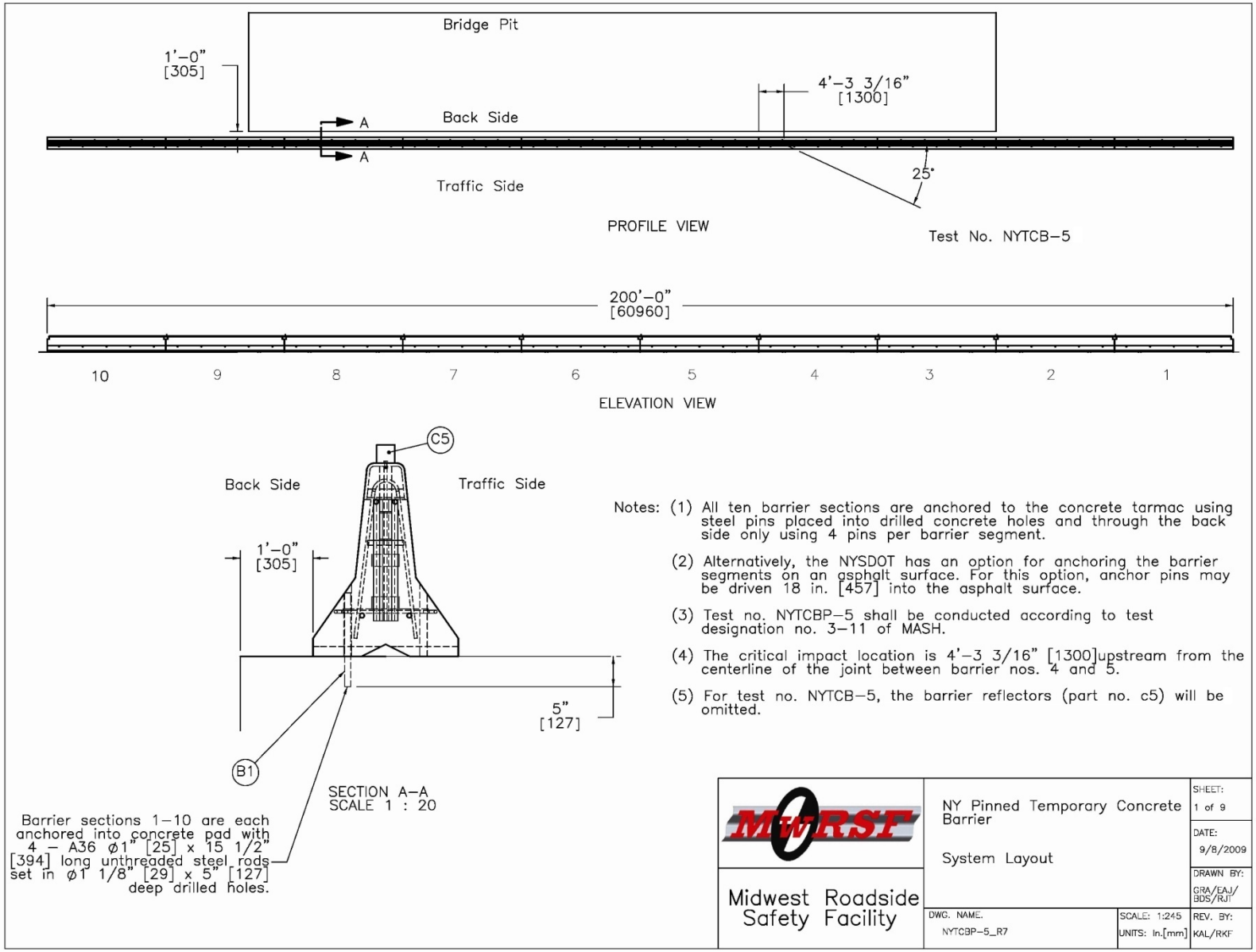


Figure 1. Test Installation Layout, Test No. NYTCB-5

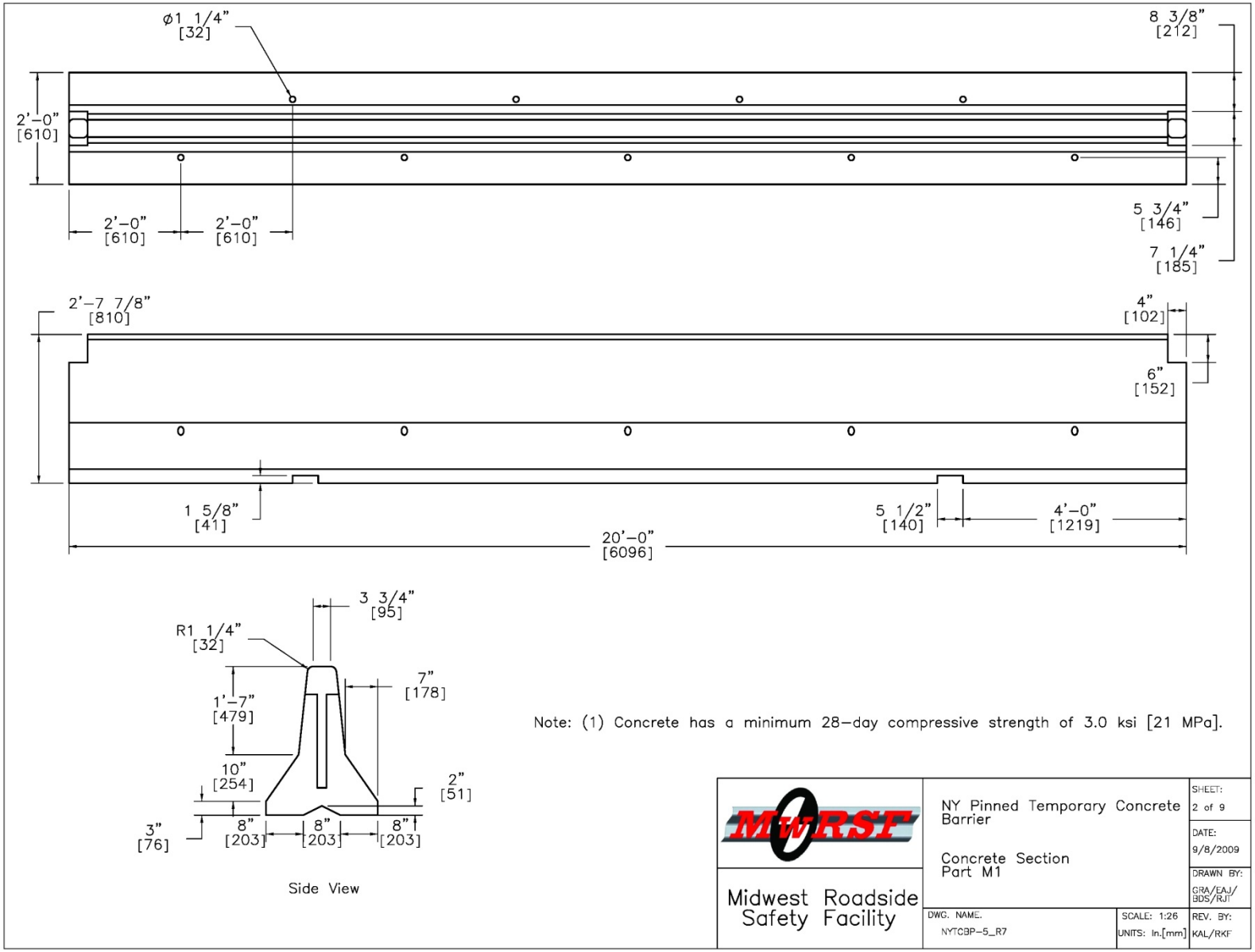


Figure 2. Temporary Concrete Barrier Details, Test No. NYTCB-5

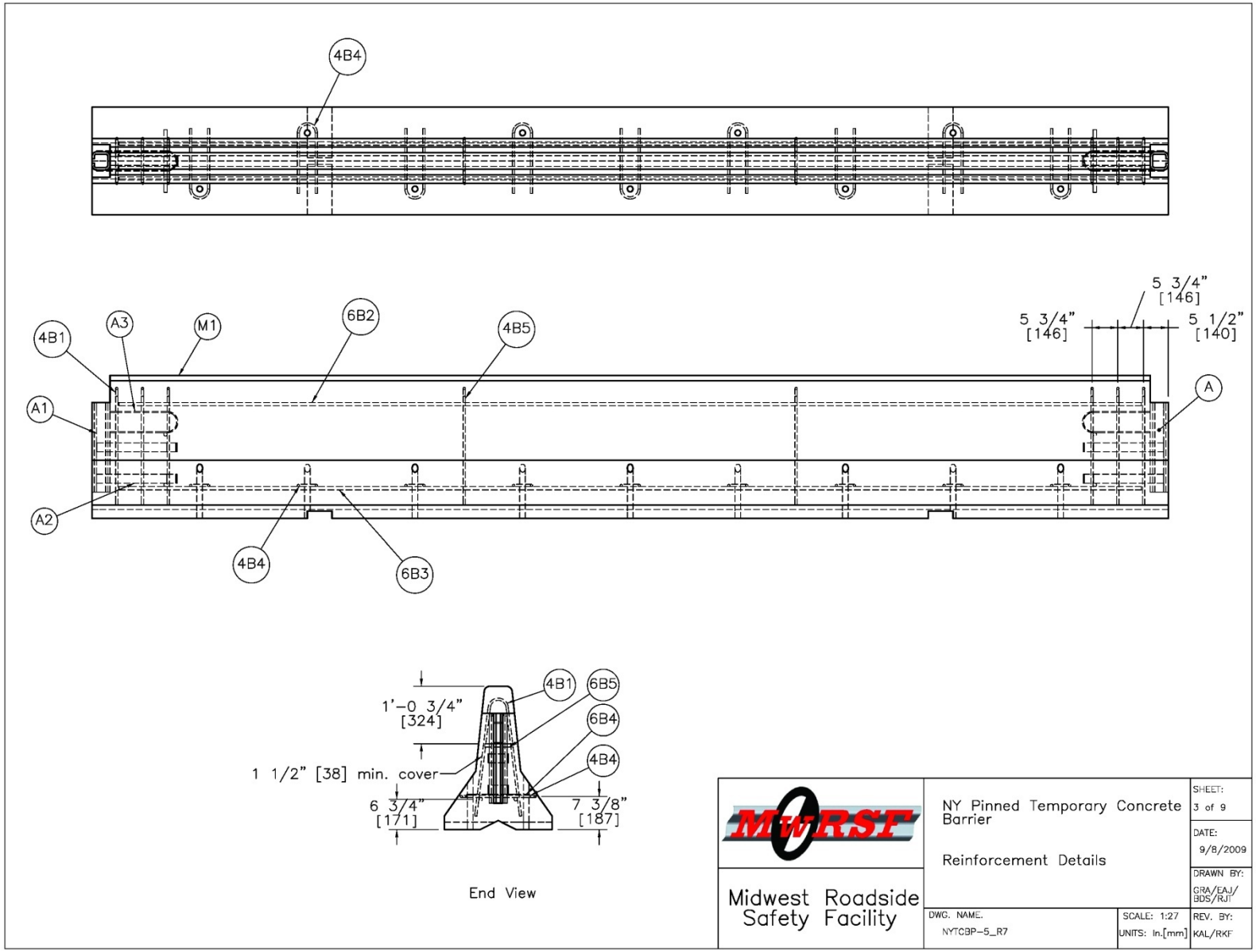


Figure 3. Temporary Concrete Barrier Reinforcement Details, Test No. NYTCB-5

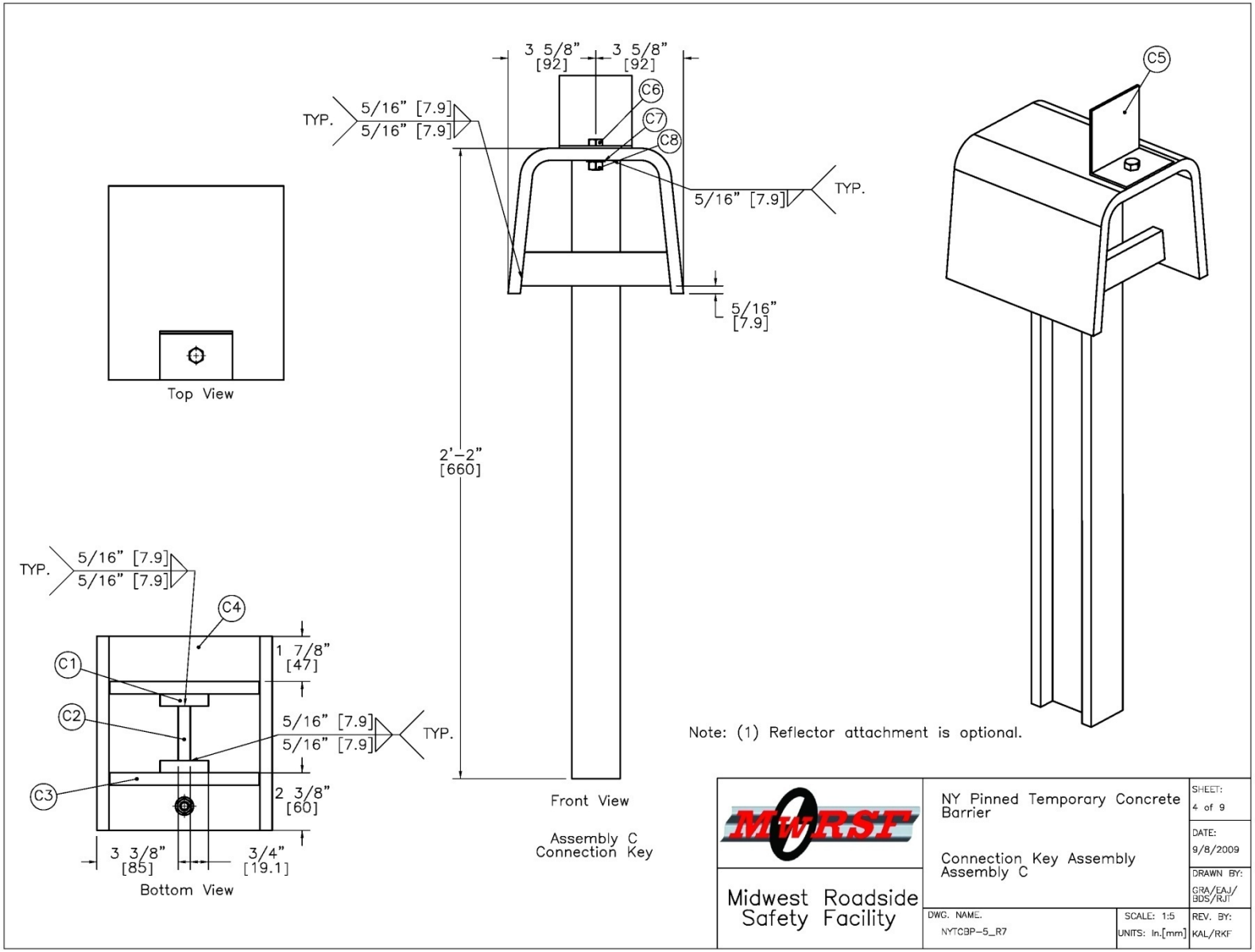


Figure 4. Connection Key Assembly Details, Test No. NYTCB-5

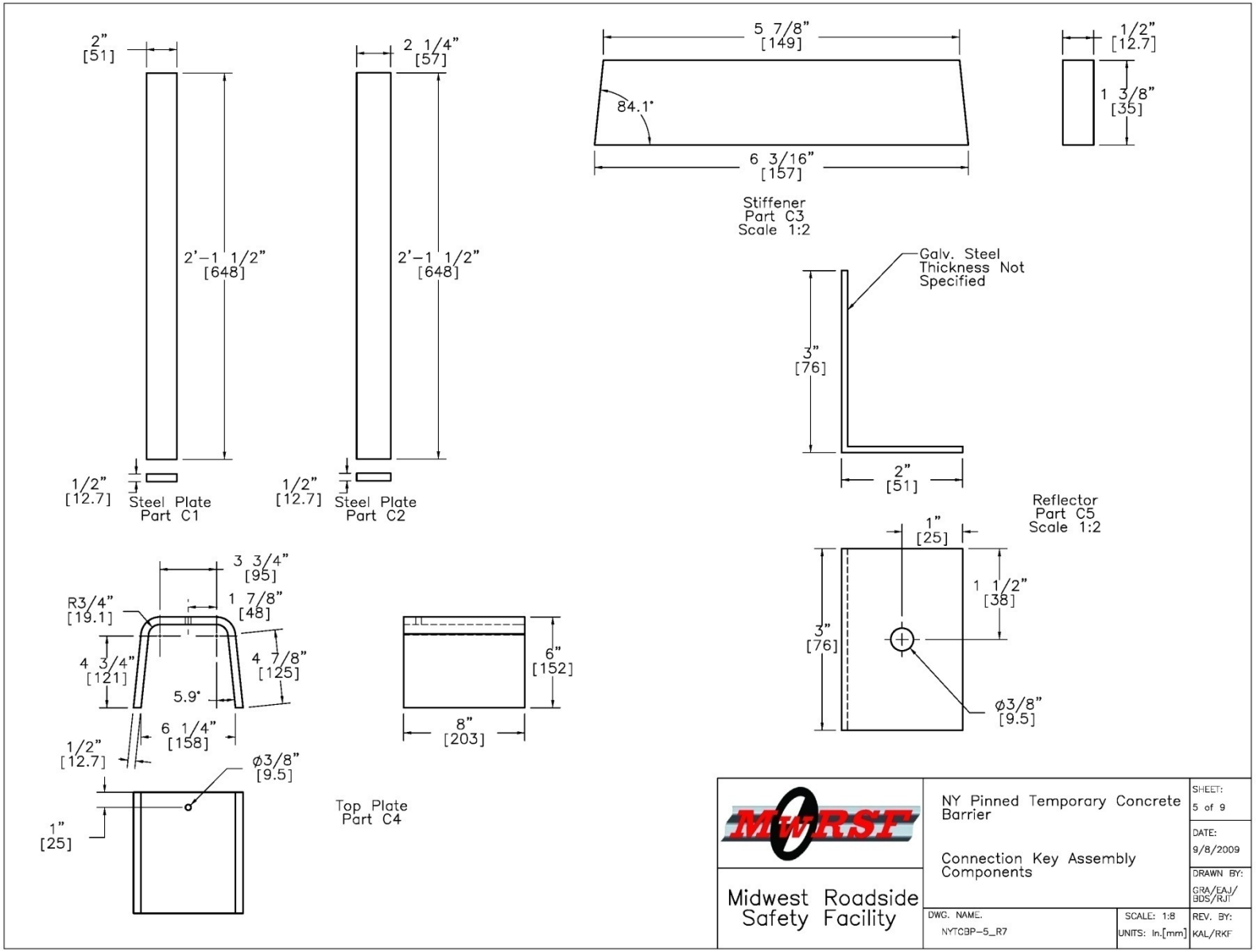


Figure 5. Connection Key Assembly Details, Test No. NYTCB-5

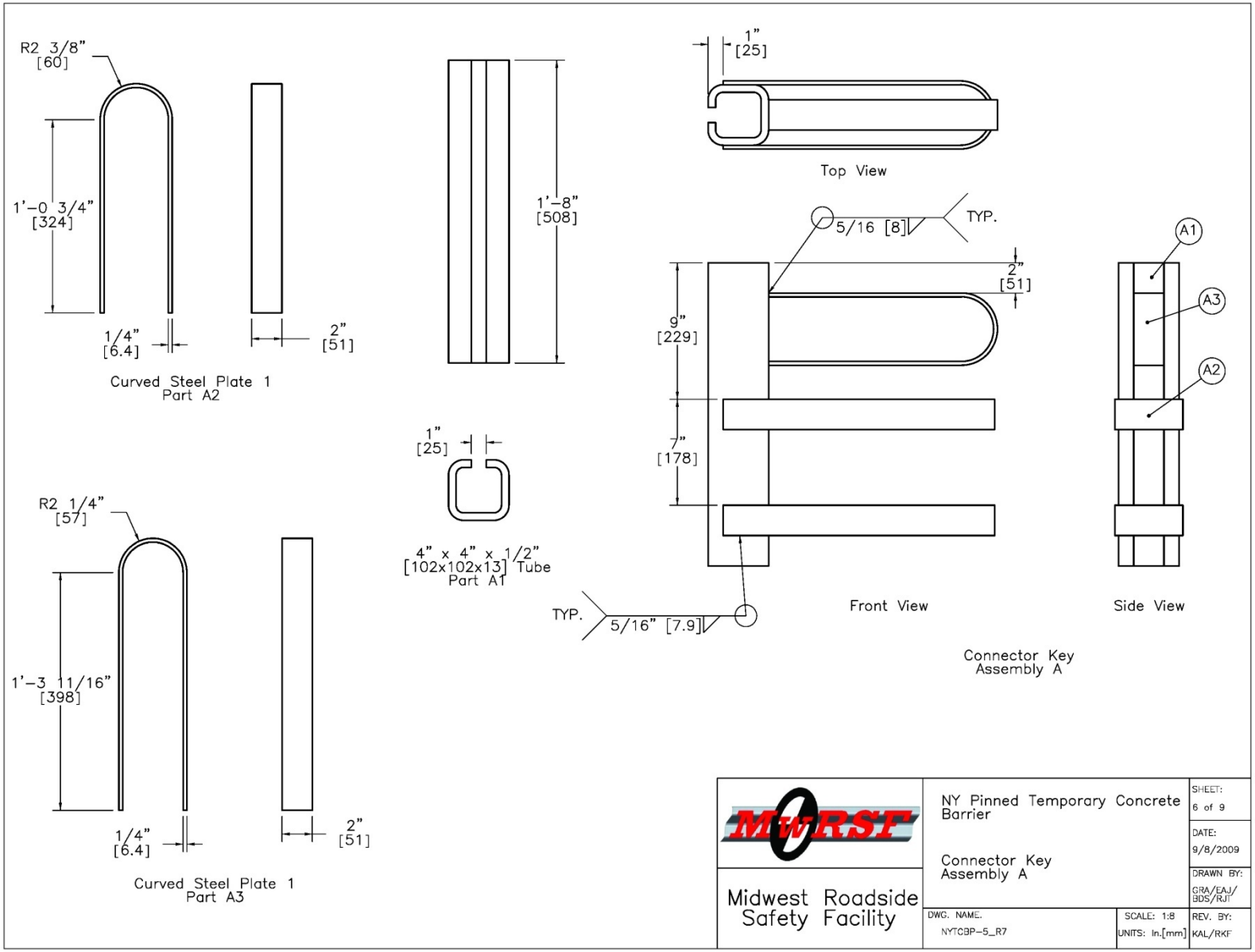


Figure 6. Temporary Concrete Barrier Connector Assembly Detatils, Test No. NYTCB-5

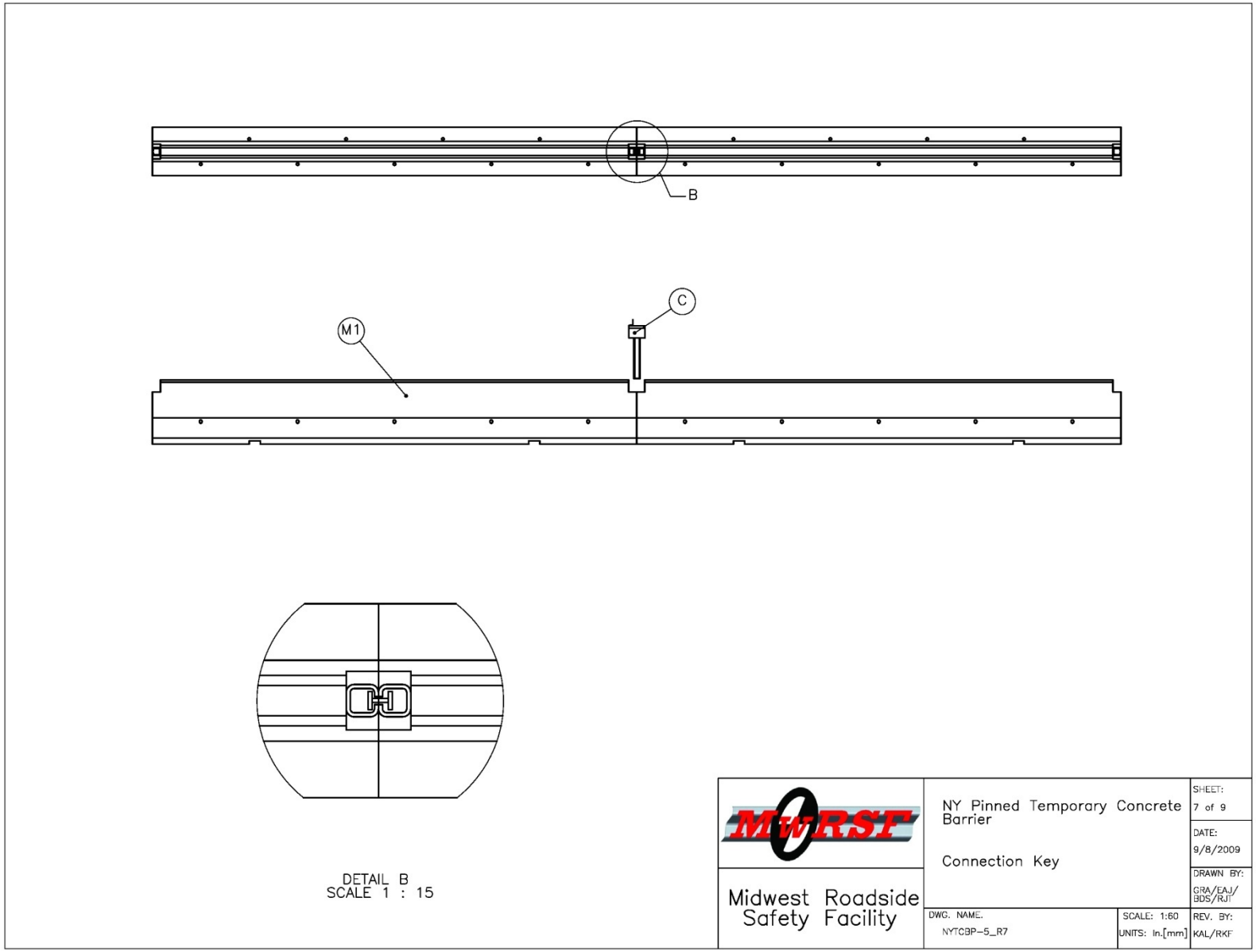


Figure 7. Temporary Concrete Barrier Connection Details, Test No. NYTCB-5

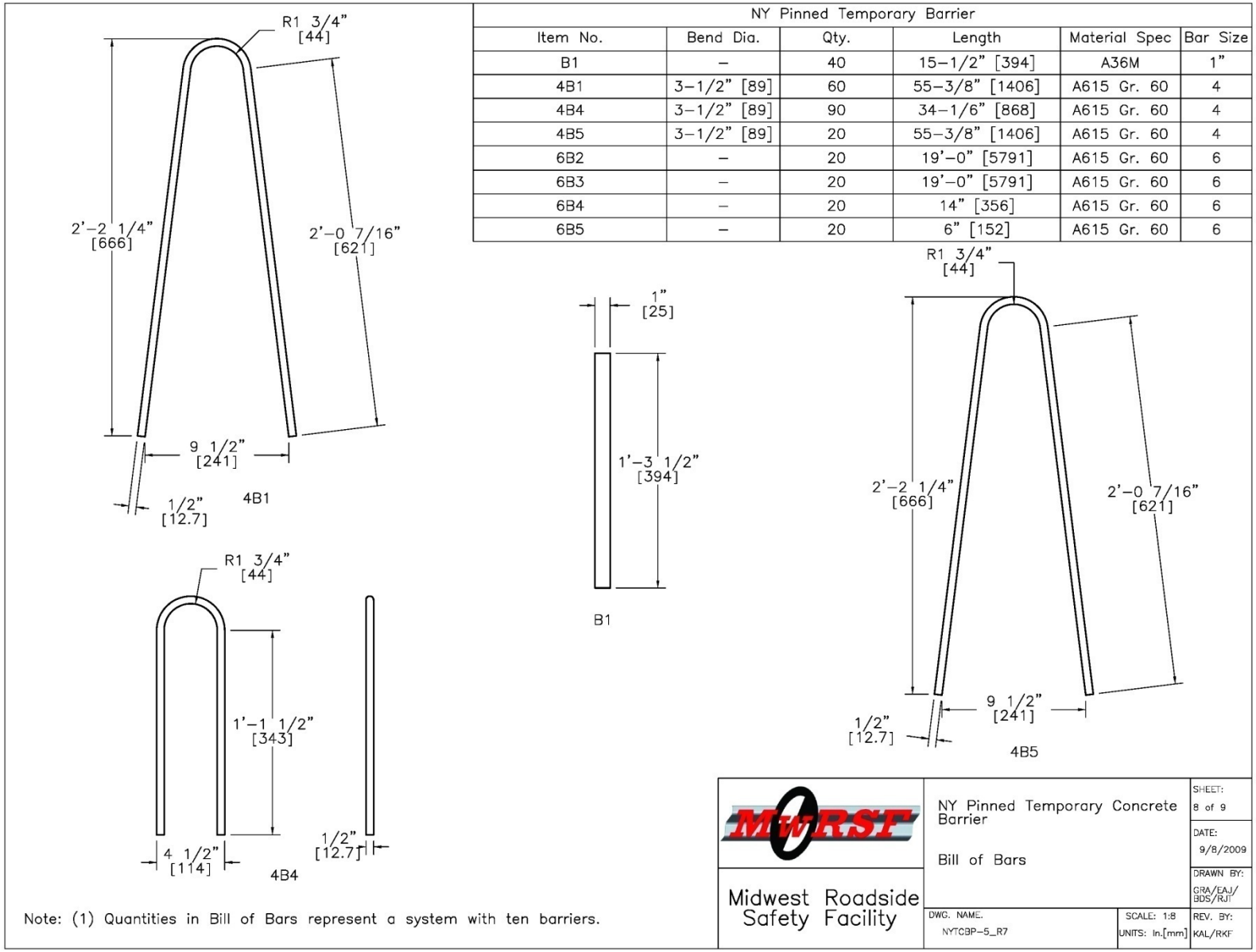


Figure 8. Bill of Bars, Test No. NYTCB-5

Item No.	QTY.	Description	Material Specification
M1	10	Concrete Section	f'c = 3,000 psi [21 MPa]
4B1	60	Rebar 4B1	ASTM A615 Gr. 60
4B4	90	Rebar 4B4	ASTM A615 Gr. 60
4B5	20	Rebar 4B5	ASTM A615 Gr. 60
6B2	20	Rebar 6B2	ASTM A615 Gr. 60
6B3	20	Rebar 6B3	ASTM A615 Gr. 60
6B4	20	Rebar 6B4	ASTM A615 Gr. 60
6B5	20	Rebar 6B5	ASTM A615 Gr. 60
A1	20	Steel Tube – 4"x4"x1/2" [102x102x12.7] thick x 20" [508] long	ASTM A500 Gr. B or C
A2	40	Steel Plate	ASTM A36
A3	20	Steel Plate	ASTM A36
B1	40	Anchor Rod	ASTM A36M
C1	18	Steel Plate	ASTM A36
C2	9	Steel Plate	ASTM A36
C3	18	Steel Plate–1/2" [12.7]	ASTM A36
C4	9	Steel Plate– 1/2" [12.7]	ASTM A36
C5	9	Steel Plate	ASTM A36
C6	9	ø7/16"–17 x 1" [M10 x 25] long bolt	ASTM A325
C7	9	7/16" [11.1] Dia. Lock Washer	ASTM F436 Gr. 1
C8	9	7/16" [11.1] Dia. Hex Nut	ASTM A563

Midwest Roadside Safety Facility

NY Pinned Temporary Concrete Barrier

Bill of Materials

SHEET: 9 of 9

DATE: 9/8/2009

DRAWN BY: GRA/EAJ/BDS/RJT

REV. BY: KAL/RKF

DWG. NAME. NYTCBP-5_R7

SCALE: None

UNITS: In.[mm]

Figure 9. Bill of Materials, Test No. NYTCB-5

Figure 10. Pinned Temporary Concrete Barrier Test Installation, Test No. NYTCB-5

Figure 11. Temporary Concrete Barrier Sections and Connection Key, Test No. NYTCB-5

Figure 12. Temporary Concrete Barrier Section Anchor, Test No. NYTCB-5

4 TEST REQUIREMENTS AND EVALUATION CRITERIA

4.1 Test Requirements

Longitudinal barriers, such as temporary concrete barriers, must satisfy impact safety standards in order to be accepted by the Federal Highway Administration (FHWA) for use on National Highway System (NHS) new construction projects or as a replacement for existing designs not meeting current safety standards. In recent years, these safety standards have consisted of the guidelines and procedures published in NCHRP Report No. 350 [1]. However, NCHRP Project 22-14(2) generated revised testing procedures and guidelines for use in the evaluation of roadside safety appurtenances and are provided in MASH [6]. According to TL-3 of MASH, longitudinal barrier systems must be subjected to two full-scale vehicle crash tests. The two full-scale crash tests are as follows:

1. Test Designation 3-10 consisting of a 2,425-lb (1,100-kg) passenger car impacting the system at a nominal speed and angle of 62 mph (100 km/h) and 25 degrees, respectively.

2. Test Designation 3-11 consisting of a 5,000-lb (2,268-kg) pickup truck impacting the system at a nominal speed and angle of 62 mph (100 km/h) and 25 degrees, respectively.

A rigid, F-shape bridge rail was successfully impacted by a small car weighing 1,800 lb (893 kg) at 60.1 mph (96.7 km/h) and 21.4 degrees according to the American Association of State Highway and Transportation Officials (AASHTO) *Guide Specifications for Bridge Railings* [7-8]. In the same manner, rigid New Jersey safety shape barriers struck by small cars have also been shown to meet safety performance standards [9-10]. In addition, a New Jersey safety shape barrier was impacted by a passenger car weighing 2,579 lb (1,170 kg) at 60.8 mph (97.9 km/h) and 26.1 degrees according to the TL-3 standards set forth in MASH [11]. Furthermore, temporary New Jersey safety shape concrete median barriers have experienced only slight barrier

deflections when impacted by small cars and behave similar to rigid barriers [12]. Thus, if the NYSDOT's pinned TCB system does not exhibit significant roll when subjected to the pickup truck impact condition, then it may not be necessary to conduct the 2,425-lb (1,100-kg) passenger car test due to expectations for only minor barrier rotations. However, if the pickup truck impact into the barrier system induces significant barrier rotations, then it also may be necessary to conduct the passenger car test in order to evaluate the propensity for vehicular instabilities upon redirection. The test conditions of TL-3 longitudinal barriers are summarized in Table 1.

For this crash testing program, the NYSDOT's primary objective was to evaluate the deflection performance of a pinned version of the NYSDOT's TCB system when subjected to high-speed, high-energy, pickup truck impacts.

Table 1. MASH TL-3 Crash Test Conditions

Test Article	Test Designation	Test Vehicle	Impact Conditions			Evaluation Criteria [1]
			Speed		Angle (deg)	
			mph	km/h		
Longitudinal Barrier	3-10	1100C	62	100	25	A,D,F,H,I
	3-11	2270P	62	100	25	A,D,F,H,I

[1] Evaluation criteria explained in Table 2.

4.2 Evaluation Criteria

Evaluation criteria for full-scale vehicle crash testing are based on three appraisal areas: (1) structural adequacy; (2) occupant risk; and (3) vehicle trajectory after collision. Criteria for structural adequacy are intended to evaluate the ability of the barrier to contain and redirect impacting vehicles. Occupant risk evaluates the degree of hazard to occupants in the impacting

vehicle. Vehicle trajectory after collision is a measure of the potential for the post-impact trajectory of the vehicle to result in secondary collisions with other vehicles and/or fixed objects, thereby increasing the risk of injury to the occupants of the impacting vehicle and other vehicles. These evaluation criteria are summarized in Table 2 and defined in greater detail in MASH. The full-scale vehicle crash test was conducted and reported in accordance with the procedures provided in MASH.

In addition to the standard occupant risk measures, the Post-Impact Head Deceleration (PHD), the Theoretical Head Impact Velocity (THIV), and the Acceleration Severity Index (ASI) were determined and reported on the test summary sheet. Additional discussion on PHD, THIV and ASI is provided in Reference 6.

Table 2. MASH Evaluation Criteria for Longitudinal Barrier

<table>
<tr><td>Structural Adequacy</td><td>A.</td><td colspan="3">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.</td></tr>
<tr><td rowspan="5">Occupant Risk</td><td>D.</td><td colspan="3">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. Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.3 and Appendix E of MASH.</td></tr>
<tr><td>F.</td><td colspan="3">The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.</td></tr>
<tr><td>H.</td><td colspan="3">Occupant Impact Velocities (OIV) (see Appendix A, Section A5.3 of MASH for calculation procedure) should satisfy the following limits:</td></tr>
<tr><td></td><td colspan="3"><table><tr><td colspan="3">Occupant Impact Velocity Limits</td></tr><tr><td>Component</td><td>Preferred</td><td>Maximum</td></tr><tr><td>Longitudinal and Lateral</td><td>30 ft/s
(9.1 m/s)</td><td>40 ft/s
(12.2 m/s)</td></tr></table></td></tr>
<tr><td>I.</td><td colspan="3">The Occupant Ridedown Accelerations (ORA) (see Appendix A, Section A5.3 of MASH for calculation procedure) should satisfy the following limits:</td></tr>
<tr><td></td><td colspan="3"><table><tr><td colspan="3">Occupant Ridedown Acceleration Limits</td></tr><tr><td>Component</td><td>Preferred</td><td>Maximum</td></tr><tr><td>Longitudinal and Lateral</td><td>15.0 g’s</td><td>20.49 g’s</td></tr></table></td></tr>
</table>

5 TEST CONDITIONS

5.1 Test Facility

The testing facility is located at the Lincoln Air Park on the northwest side of the Lincoln Municipal Airport and is approximately 5 miles (8.0 km) northwest of the University of Nebraska-Lincoln.

5.2 Vehicle Tow and Guidance System

A reverse cable tow system with a 1:2 mechanical advantage was used to propel the test vehicle. The distance traveled and the speed of the tow vehicle were one-half that of the test vehicle. The test vehicle was released from the tow cable before impact with the barrier system. A digital speedometer on the tow vehicle increased the accuracy of the test vehicle impact speed.

A vehicle guidance system developed by Hinch [13] was used to steer the test vehicle. A guide-flag, attached to the right-front wheel and the guide cable, was sheared off before impact with the barrier system. The 3/8-in. (9.5-mm) diameter guide cable was tensioned to approximately 3,500 lb (15.6 kN) and supported both laterally and vertically every 100 ft (30.48 m) by hinged stanchions. The hinged stanchions stood upright while holding up the guide cable, but as the vehicle was towed down the line, the guide-flag struck and knocked each stanchion to the ground.

5.3 Test Vehicles

For test no. NYTCB-5, a 2003 Dodge Ram 1500 Quad Cab pickup truck was used as the test vehicle. The curb, test inertial, and gross static vehicle weights were 5,109 lb (2,317 kg), 4,953 lb (2,247 kg), and 5,124 lb (2,324 kg), respectively. The test vehicle is shown in Figure 13, and vehicle dimensions are shown in Figure 14.

Figure 13. Test Vehicle, Test No. NYTCB-5

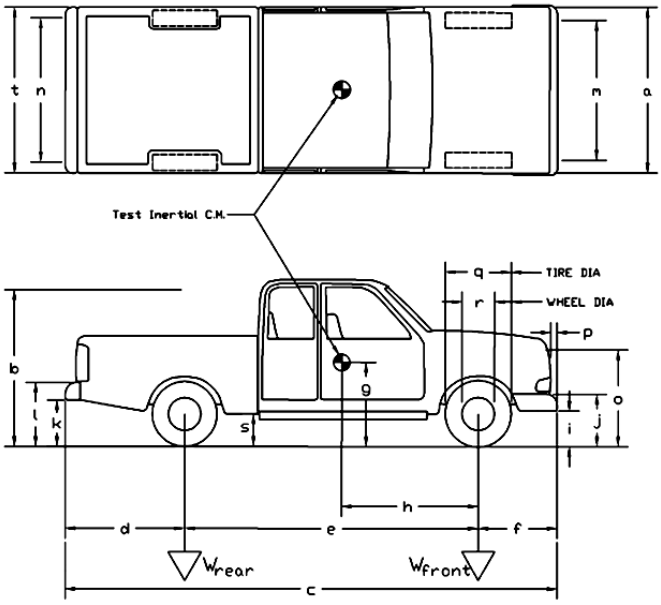
Date: 9/4/2009 **Test Number:** NYTCB-5 **Model:** Ram (2270P)

Make: Dodge **Vehicle I.D.#:** 1D7HA18N03J541754

Tire Size: 265/70R17 **Year:** 2003 **Odometer:** 238247

Tire Inflation Pressure: 35Psi

***(All Measurements Refer to Impacting Side)**



Vehicle Geometry -- in. (mm)

a	77.25	(1962)	b	74.75	(1899)
c	227.5	(5779)	d	47.25	(1200)
e	140.25	(3562)	f	40	(1016)
g	28.13	(714)	h	61.67	(1567)
i	16	(406)	j	24	(610)
k	21.5	(546)	l	29	(737)
m	67.75	(1721)	n	57.25	(1454)
o	43.75	(1111)	p	3	(76)
q	18.5	(470)	r	31	(787)
s	16	(406)	t	75	(1905)

Wheel Center Height Front 14.75 (375)

Wheel Well Clearance (F) 35.5 (902)

Wheel Well Clearance (R) 38 (965)

Frame Height (F) 17.75 (451)

Frame Height (R) 25 (635)

Engine Type 8 Cyl. Gas

Engine Size 4.7L

Transmition Type: (Automatic) Manual

FWD (RWD) 4WD

Mass Distribution

Gross Static	LF	1414	RF	1451
	LR	1115	RR	1144

Weights lbs (kg)	Curb	Test Inertial	Gross Static
W-front	2869 (1301)	2758 (1251)	2865 (1300)
W-rear	2240 (1016)	2195 (996)	2259 (1025)
W-total	5109 (2317)	4953 (2247)	5124 (2324)

GVWR Ratings

Front	3650
Rear	3900
Total	6550

Dummy Data

Type: Hybrid II

Mass: 170 lbs

Seat Position: Passenger

Note any damage prior to test: none

Figure 14. Vehicle Dimensions, Test No. NYTCB-5

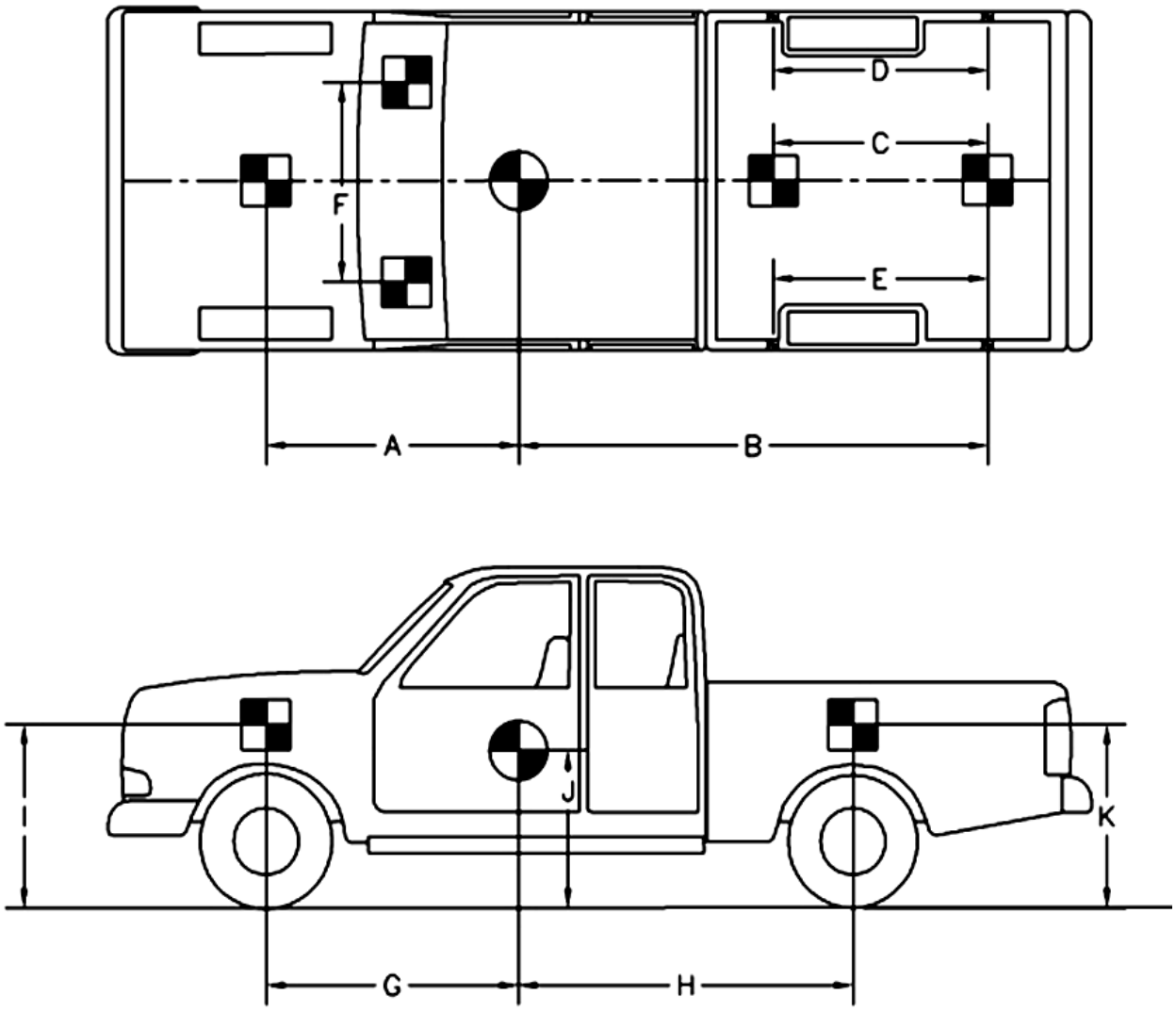
The Suspension Method [14] was used to determine the vertical component of the center of gravity (c.g.) for the pickup truck. This method is based on the principle that the c.g. of any freely suspended body is in the vertical plane through the point of suspension. The vehicle was suspended successively in three positions, and the respective planes containing the c.g. were established. The intersection of these planes pinpointed the c.g. location. The longitudinal component of the c.g. was determined using the measured axle weights. The location of the final c.g. is shown in Figures 14 and 15. The data used for the c.g. calculations and ballast information is shown in Appendix B.

Square, black- and white-checkered targets were placed on the vehicle to aid in the analysis of the high-speed videos, as shown in Figure 15. Round, checkered targets were placed on the center of gravity on the left-side door, the right-side door, and the roof of the vehicle. The remaining targets were located for reference so that they could be viewed from the high-speed cameras for video analysis.

The front wheels of the test vehicle were aligned for camber, caster, and toe-in values of zero so that the vehicles would track properly along the guide cable. A 5B flash bulb was mounted on the left side of the vehicle's dash to pinpoint the time of impact with the barrier system on the high-speed videos. The flash bulb was fired by a pressure tape switch mounted at the impact corner of the bumper. A remote controlled brake system was installed in the test vehicle so the vehicle could be brought safely to a stop after the test.

5.4 Simulated Occupant

For test no. NYTCB-5, A Hybrid II 50th Percentile Adult Male Dummy, was placed in the right-front seat of the test vehicle with the seat belt fastened. The dummy was equipped with clothing and footwear and had a final weight of 170 lb (77 kg). The dummy was manufactured



TEST #: NYTCB-5

TARGET GEOMETRY-- in. (mm)

A	**73.75**	**(1873)**	**E**	**70.25**	**(1784)**	**I**	**40.25**	**(1022)**
B	**103**	**(2616)**	**F**	**46.25**	**(1175)**	**J**	**28.13**	**(715)**
C	**44.25**	**(1124)**	**G**	**61.67**	**(1566)**	**K**	**42.25**	**(1073)**
D	**70.75**	**(1797)**	**H**	**79.5**	**(2019)**			

Figure 15. Target Geometry, Test No. NYTCB-5

by Android Systems of Carson, California under model no. 572 and serial no. 451. As recommended by MASH, the dummy was not included in calculating the c.g location.

5.5 Data Acquisition Systems

5.5.1 Accelerometers

Three environmental shock and vibration sensor/recorder systems were used to measure the accelerations in the longitudinal, lateral, and vertical directions. All of the accelerometers were mounted near the center of gravity of the test vehicle.

One triaxial piezoresistive accelerometer system, Model EDR-4-6DOF-500/1200, was developed and manufactured by Instrumented Sensor Technology (IST) of Okemos, Michigan and includes three differential channels as well as three single-ended channels. The EDR-4-6DOF-500/1200 was configured with 24 MB of RAM memory, a range of ±500 g's, a sample rate of 10,000 Hz, and a 1,677 Hz anti-aliasing filter. "EDR4COM" and "DynaMax Suite" computer software programs and a customized Microsoft Excel worksheet were used to analyze and plot the accelerometer data.

The second system was a two-arm piezoresistive accelerometer system developed by Endevco of San Juan Capistrano, California. Three accelerometers were used to measure each of the longitudinal, lateral, and vertical accelerations independently at a sample rate of 10,000 Hz. The accelerometers were configured and controlled using a system developed and manufactured by Diversified Technical Systems, Inc. (DTS) of Seal Beach, California. More specifically, data was collected using a DTS Sensor Input Module (SIM), Model TDAS3-SIM-16M. The SIM was configured with 16 MB SRAM memory and 8 sensor input channels with 250 kB SRAM/channel. The SIM was mounted on a TDAS3-R4 module rack. The module rack was configured with isolated power/event/communications, 10BaseT Ethernet and RS232

communication, and an internal backup battery. Both the SIM and module rack were crashworthy. The computer software program "DTS TDAS Control" and a customized Microsoft Excel worksheet were used to analyze and plot the accelerometer data.

The third system, Model EDR-3, was a triaxial piezoresistive accelerometer system developed and manufactured by IST of Okemos, Michigan. The EDR-3 was configured with 256 kB of RAM memory, a range of ±200 g's, a sample rate of 3,200 Hz, and a 1,120 Hz low-pass filter. The computer software program "DynaMax 1 (DM-1)" and a customized Microsoft Excel worksheet were used to analyzed and plot the accelerometer data.

5.5.2 Rate Transducers

An Analog Systems 3-axis rate transducer with a range of 1,200 degrees/sec in each of the three directions (roll, pitch, and yaw) was used to measure the rates of motion of the test vehicle. The rate transducer was mounted inside the body of the EDR-4 6DOF-500/1200. Data was recorded at 10,000 Hz to a second data acquisition board inside the EDR-4 6DOF-500/1200 housing. The raw data measurements were then downloaded, converted to the appropriate Euler angles for analysis, and plotted. "EDR4COM" and "DynaMax Suite" computer software programs and a customized Microsoft Excel worksheet were used to analyze and plot the angular rate sensor data.

An additional angle rate sensor, the ARS-1500, with a range of 1,500 degrees/sec in each of the three directions (roll, pitch, and yaw) was used to measure the rates of rotation of the test vehicle. The angular rate sensor was mounted on an aluminum block inside the test vehicle near the center of gravity. Data was recorded at 10,000 Hz to the SIM unit. The raw data measurements were then downloaded, converted to the proper Euler angles for analysis, and

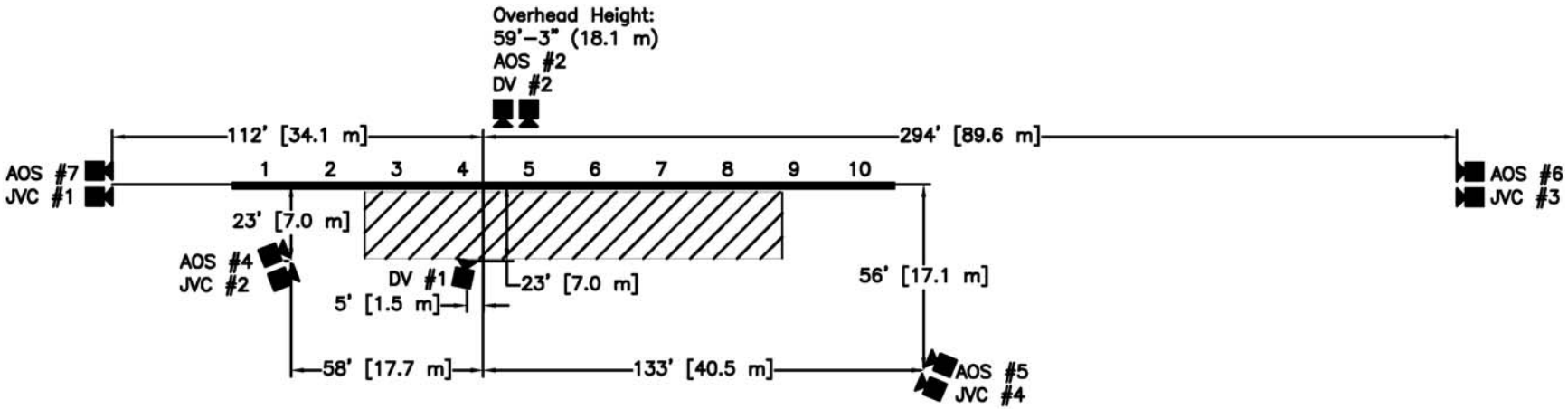
plotted. The computer software program "DTS TDAS Control" and a customized Microsoft Excel worksheet were used to analyze and plot the angular rate sensor data.

5.5.3 Pressure Tape Switches

For test no. NYTCB-5, five pressure-activated tape switches, spaced at approximately 6.6 ft (2 m) intervals, were used to determine the speed of the vehicle before impact. Each tape switch fired a strobe light which sent an electronic timing signal to the data acquisition system as the right-front tire of the test vehicle passed over it. Test vehicle speeds were determined from electronic timing mark data recorded using TestPoint and LabVIEW computer software programs. Strobe lights and high-speed video analysis provided a backup method of determining the vehicle speed in the event that it could not be determined from the electronic data.

5.5.4 High-Speed Photography

Two AOS VITcam high-speed digital video cameras, three AOS X-PRI high-speed digital video cameras four JVC digital video cameras, and two Canon digital video cameras were utilized to film test no. NYTCB-5. Camera details, camera operating speeds, lens information, and a schematic of the camera locations relative to the system are shown in Figure 16. The high-speed videos were analyzed using ImageExpress MotionPlus software. Actual camera speed and camera divergence factors were considered in the analysis of the high-speed videos.



	No.	Type	Operating Speed (frames/sec)	Lens	Lens Setting
High-Speed Video	2	AOS Vitcam CTM	500	Kowa 8mm fixed	---
	4	AOS Vitcam CTM	500	Sigma 24-135	28
	5	AOS X-PRI Gigabit	500	Sigma 24-70	50
	6	AOS X-PRI Gigabit	500	Tamron 100-300	135
	7	AOS X-PRI Gigabit	500	Fujinon 50 mm fixed	---
Digital Video	1	JVC – GZ-MC500 (Everio)	29.97		
	2	JVC – GZ-MG27u (Everio)	29.97		
	3	JVC – GZ-MG27u (Everio)	29.97		
	4	JVC – GZ-MG27u (Everio)	29.97		
	1	Canon ZR90	29.97		
	2	Canon ZR10	29.97		

Figure 16. Camera Locations, Speeds, and Lens Settings, Test No. NYTCB-5

6 FULL-SCALE CRASH TEST NO. NYTCB-5

6.1 Test No. NYTCB-5

The 5,124-lb (2,324-kg) pickup truck impacted the pinned temporary concrete barrier system at a speed of 64.3 mph (103.4 km/h) and at an angle of 26.2 degrees. A summary of the test results and sequential photographs are shown in Figure 17. Additional sequential photographs are shown in Figures 18 through 20. Documentary photographs of the crash test are shown in Figures 21 and 22.

6.2 Weather Conditions

Test No. NYTCB-5 was conducted on September 4, 2009 at approximately 2:15 pm. The weather conditions as per the National Oceanic and Atmospheric Administration (station 14939/LNK) were reported as shown in Table 3.

Table 3. Weather Conditions, Test No. NYTCB-5

Temperature	75° F
Humidity	54 %
Wind Speed	10 mph
Wind Direction	70° from True North
Sky Conditions	Overcast
Visibility	10.00 Statute Miles
Pavement Surface	Dry
Previous 3-Day Precipitation	0.43 in.
Previous 7-Day Precipitation	0.43 in.

6.3 Test Description

Initial vehicle impact was to occur 4 ft - 3 3/16 in. (1.3 m) upstream from the centerline of the joint between barrier nos. 4 and 5, as shown in Figure 23. Actual vehicle impact occurred at the targeted impact location. A sequential description of the impact events is shown in Table 4. The vehicle came to rest 205 ft (62.5 m) downstream from impact and 18 ft - 8 in. (5.7 m)

laterally away from the traffic-side face of the barrier. The vehicle trajectory and final position are shown in Figures 17 and 24.

Table 4. Sequential Description of Impact Events, Test No. NYTCB-5

TIME (sec)	EVENT
0.000	Right-front corner of the vehicle impacted barrier no. 4 at the targeted impact location.
0.006	Right headlight contacted the top of barrier no. 4, and the right-front tire became airborne.
0.016	Top of barrier no. 4 deflected backward at the downstream end, the joint between barrier nos. 4 and 5 twisted upstream, and the right-front tire deflated.
0.024	Right side of grill contacted the front face of barrier no. 4.
0.036	Top of barrier no. 5 deflected backward at the upstream end, the front of the engine hood deformed inward, and the vehicle pitched upward and began to redirect.
0.040	Top of barrier no. 4 deflected backward at the upstream end, the joint between barrier nos. 3 and 4 twisted downstream, and the top of the right-front door became ajar.
0.052	Downstream end of barrier no. 3 experienced cracking on the back side.
0.058	Toe on the back side of barrier no. 5 experienced cracking near the barrier's middle.
0.066	Tops of barrier nos. 3 and 5 deflected backward at their downstream ends.
0.076	Toe on the back side of barrier no. 3 experienced cracking, a large piece of concrete separated from the back side of barrier no. 5 near the barrier's middle, and the vehicle continued to redirect.
0.086	Surrogate occupant's head contacted the right-side door window and caused the window to disengage from the top frame and deflect outward.
0.098	Top of barrier no. 3 deflected backward at the upstream end, and the left-front tire became airborne.
0.116	A large piece of concrete separated from the back side of barrier no. 3 at the downstream end.
0.146	Tops of barrier nos. 2 and 6 deflected backward at the downstream end and both ends, respectively.
0.160	Crack that originated in the back-side toe of barrier no. 5 extended to the top of the barrier, and the right-rear tire contacted the downstream end of the front toe of barrier no. 4.
0.166	Right-rear tire deflated.
0.174	Right-rear tire became airborne.
0.182	Top of barrier no. 7 deflected backward at the upstream end.
0.210	Right corner of the rear bumper contacted the front face of barrier no. 4 near the downstream end, and the vehicle was parallel to the system with a velocity of approximately 54 mph (87 km/h).

0.240	Toe on the back side of barrier no. 5 experienced cracking near the downstream end, and the right-rear tire disengaged from the axle and was crushed between the barrier and the vehicle.
0.252	Left-rear tire became airborne.
0.280	Vehicle experienced roll toward the left, and a large piece of concrete separated from the back-side toe of barrier no. 5 near the downstream end.
0.296	Left-front tire lost contact with the front face of barrier no. 5, and the top of barrier no. 4 deflected forward along its entire length.
0.312	Top of barrier no. 2 deflected forward along its entire length.
0.322	A large piece of concrete separated from the toe on the back side of barrier no. 3 near the upstream quarter point, and the top of barrier no. 3 deflected forward.
0.336	Right-rear tire became detached from the axle and lost contact with the top of barrier no. 5, and the vehicle exited the system at an angle of 7.7 degrees with a velocity of approximately 51 mph (82 km/h).
0.488	Front toe of barrier no. 2 contacted the ground.
0.518	Front toe of barrier no. 3 contacted the ground.
0.576	Front toe of barrier no. 5 and the left-front tire contacted the ground.
0.594	Front toe of barrier no. 4 contacted the ground.
0.610	Detached right-rear tire contacted the upper-back edge of barrier no. 4.
0.638	Vehicle experienced roll toward the right.
0.752	Vehicle pitched upward.
0.790	Right-front tire contacted the ground.
1.044	Right-rear quarter panel contacted the top of barrier no. 7.
1.134	Vehicle rolled toward its left side.
1.260	Right-rear quarter panel lost contact with the barrier system.
1.530	Right-rear quarter panel contacted the top of barrier no. 8.
1.828	Left-rear tire contacted the ground.
1.898	Right corner of the rear bumper lost contact with the top of barrier no. 10.
2.038	Tailpipe contacted the ground as the vehicle continued downstream.

6.4 Barrier Damage

Damage to the barrier was moderate, as shown in Figures 25 through 32. Barrier damage consisted of contact and gouge marks, spalling of concrete, and concrete cracking and failure. The length of vehicle contact along the barrier was approximately 22 ft – 8 in. (6.9 m) which spanned from 6 ft – 4 in. (1.9 m) upstream from the center of the joint between barrier nos. 4 and 5 to 16 ft – 4 in. (5.0 m) downstream from the center of the joint between barrier nos. 4 and 5.

The vehicle contacted the system again for approximately 60 ft (18.3 m) which spanned from the joint between barrier nos. 7 and 8 through the downstream end of barrier no. 10.

Tire marks were visible on the front fact of barrier nos. 4 and 5 and started 76 in. (1,930 mm) upstream from the downstream end of barrier no. 4 and continued through 44 in. (1,118 mm) upstream from the downstream end of barrier no. 5. Contact marks were also found on the top faces of barrier nos. 8 through 10 as well as the connection keys between barrier nos. 4 and 7.

A 28-in. (711-mm) long gouge was found on the front face of barrier no. 4 and began 51 in. (1,295 mm) upstream from the downstream end. A 19-in. (483-mm) long gouge was found on the front face of barrier no. 4 and began 39 in. (991 mm) upstream from the downstream end. A 7-in. (178-mm) and a 32-in. (813-mm) long gouge was found on the front face of barrier no. 5 near the upstream end. Gouges, 7 in. (178 mm) and 6 in. (152 mm) long, were found on the front- and back-top edges, respectively, beginning 65 in. (1,651 mm) upstream from the downstream end of barrier no. 5. Gouges, 4 in. (102 mm) and 3 in. (76 mm) long, were found on the front- and back-top edges, respectively, near the upstream quarter point of barrier no. 5. A 4-in. (102-mm) gouge was found on the front and back-top edges near the upstream quarter-point of barrier no. 8.

Minor cracking was found on barrier nos. 2 and 6. A 7½-in. (191-mm) long vertical crack was found at the corner of the upstream connection key socket in barrier no. 3. Barrier no. 4 experienced a vertical crack that extended the height of the barrier near the center anchor hole on the front side as well as cracking around the downstream-most anchor hole on the back side. Vertical cracks were found in the front and back face of barrier no. 5 at 19 in., 50 in., and 79 in. (483 mm, 1,270 mm, and 2,007 mm) downstream from the upstream end and at the middle of the

barrier. A 15-in. (381-mm) long, vertical crack was found at the downstream anchor hole on the front face of barrier no. 5.

Concrete spalling occurred on barrier nos. 3 through 7. The back side of barrier no. 3 experienced concrete spalling at the lower-upstream corner, the upper-downstream corner, and near the middle of the barrier. Concrete spalling also occurred at the lower-downstream corner at the front of barrier no. 3. An 8-in. x 14-in. x 3-in. (203-mm x 356-mm x 76-mm) piece of concrete was removed from the bottom-upstream corner on the back side of barrier no. 4. A 5-in x 12-in. (127-mm x 305-mm) piece of concrete was fractured near the connection key, but it remained attached to the barrier. A 4-in. x 15-in. (102-mm x 381-mm) piece of concrete was removed from the upstream toe on the front side of barrier no. 5. A 28-in. (711-mm) long piece of concrete was removed from the back side of barrier no. 5, slightly upstream of the middle of the barrier. Concrete spalling, measuring 15 in. x 11 in. (381 mm x 279 mm), was found at the bottom-downstream corner on the back side of barrier no. 5. Concrete spalling occurred on barrier no. 6 at the front upstream-most anchor hole. Concrete spalling, measuring 33 in. x 7 in. (838 mm x 178 mm), occurred near the upstream quarter-point of the toe on the back side of barrier no. 7.

The maximum permanent set of the barrier system was 9 in. (229 mm) at the downstream end of barrier no. 4, as measured in the field. The maximum lateral dynamic barrier deflection, including tipping of the barrier along the top surface, was 20.5 in. (521 mm) at the upstream end of barrier no. 5, as determined from high-speed video analysis. The working width of the system was found to be 32.5 in. (826 mm).

6.5 Vehicle Damage

The damage to the vehicle was moderate, as shown in Figures 33 through 35. The maximum occupant compartment deformations are listed in Table 5 with the deformation limits established in MASH for various areas of the occupant compartment. It should be noted that none of the MASH established deformation limits were violated. Complete occupant compartment and vehicle deformations and the corresponding locations are provided in Appendix C.

Table 5. Maximum Occupant Compartment Deformations by Location

LOCATION	MAXIMUM DEFORMATION in. (mm)	MASH ALLOWABLE DEFORMATION in. (mm)
Wheel Well & Toe Pan	7¼ (184)	≤ 9 (229)
Floor Pan & Transmission Tunnel	1¼ (32)	≤ 12 (305)
Side Front Panel (in Front of A-Pillar)	¾ (19)	≤ 12 (305)
Side Door (Above Seat)	2½ (64)	≤ 9 (229)
Side Door (Below Seat)	1 (25)	≤ 12 (305)
Roof	NA	≤ 4 (102)
Windshield	NA	≤ 3 (76)

The majority of the damage was concentrated on the right-front corner and right side of the vehicle where the impact occurred. The right side of the bumper was crushed inward and back and the plastic portion was fractured. The left side of the front bumper was deformed downward 2 in. (51 mm). Denting and scraping were observed on the entire right side. The right-front and right-rear quarter-panels were deformed inward toward the engine compartment and truck box, respectively. The top of the right-front door, the left side of the hood, and the tailgate were ajar. The grill was fractured around the bottom of the right-side headlight assembly. The

right-side headlight and left-side foglight were fractured, and the right-side foglight was removed from the vehicle. The right-front wheel and tire disengaged from the vehicle and were located under the rest of the wheel assembly. The right upper control arm and tie rod disengaged, while the right upper control arm fractured. The right-rear axle sheared, and the brake assembly disengaged from the vehicle. The right taillight was removed. The right side of the rear bumper was deformed outward, while a kink was found in the left side. The left-rear wheel assembly was deformed outward. The right side of the floorpan encountered significant deformation. The roof and all window glass remained undamaged.

6.6 Occupant Risk

The calculated occupant impact velocities (OIVs) and maximum 0.010-sec occupant ridedown accelerations (ORAs) in both the longitudinal and lateral directions are shown in Table 6. It is noted that the OIVs and ORAs were within the suggested limits provided in MASH. The calculated THIV, PHD, and ASI values are also shown in Table 6. The results of the occupant risk analysis, as determined from the accelerometer data, are summarized in Figure 17. The recorded data from the accelerometers and the rate transducers are shown graphically in Appendix D. Due to technical difficulties, the DTS did not collect acceleration data in the longitudinal direction, but it did collect acceleration data in the lateral direction and angular data from the rate sensors.

6.7 Discussion

The analysis of the test results for test no. NYTCB-5 showed that the pinned temporary concrete barrier system adequately contained and redirected the 2270P vehicle with controlled lateral displacements of the barrier. There were no detached elements nor fragments which showed the potential for penetrating the occupant compartment nor presented undue hazard to

Table 6. Summary of OIV, ORA, THIV, and PHD Values, Test No. NYTCB-5

Evaluation Criteria		Transducer		
		EDR-3	**EDR-4**	**DTS**
OIV ft/s (m/s)	Longitudinal	-16.41 (-5.00)	-12.40 (-3.78)	NA
	Lateral	-20.14 (-6.14)	-18.51 (-3.78)	-19.93 (-6.07)
ORA g's	Longitudinal	-4.79	-5.31	NA
	Lateral	-6.92	-6.65	-6.92
THIV ft/s (m/s)		NA	21.21 (6.46)	20.94 (6.38)
PHD g's		NA	7.11	7.59
ASI		1.50	1.36	1.40

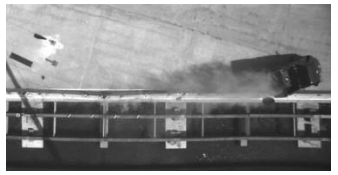
other traffic. Deformations of, or intrusions into, the occupant compartment that could have caused serious injury did not occur. The test vehicle did not penetrate nor ride over the barrier and remained upright during and after the collision. Vehicle roll, pitch, and yaw angular displacements were noted, as shown in Appendix D, and were deemed acceptable because they did not adversely influence occupant risk safety criteria nor cause rollover. After impact, the vehicle exited the barrier at an angle of 7.7 degrees and its trajectory did not violate the bounds of the exit box. Therefore, test no. NYTCB-5 conducted on the pinned temporary concrete barrier system was determined to be acceptable according to the MASH safety performance criteria for test designation no. 3-11.

0.000 sec

0.098 sec

0.182 sec

0.488 sec



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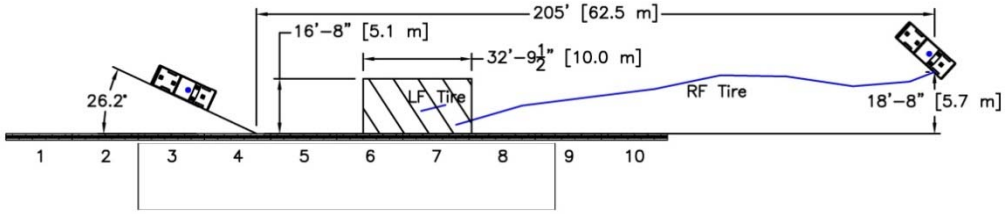
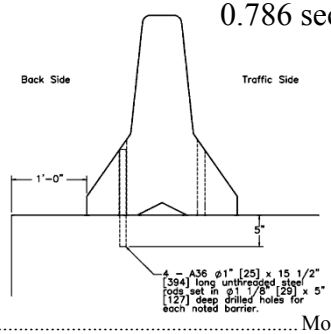
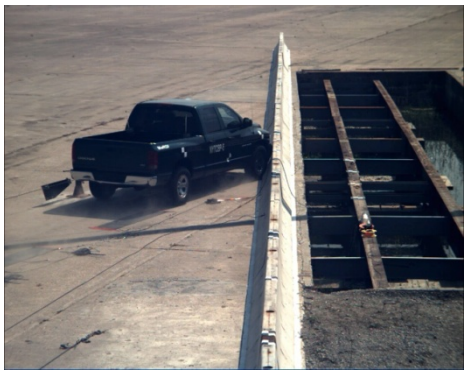




- Test Agency ..... MwRSF
- Test Number NYTCB-5
- Date 9/4/09
- MASH Test Designation 3-11
- Test Article ..... Pinned Temporary Concrete Barrier
- Total Length ..... 200 ft (61.0 m)
- Key Component – NYSDOT TCB with Connection Keys
  - Length ..... 20 ft (6.1 m)
  - Width ..... 24 in. (610 mm)
  - Depth ..... 32 in. (813 mm)
- Key Component – Anchored Barrier Sections
  - Pin Size ..... 1-in. (25-mm) diameter unthreaded rod
  - Pin Length ..... 15½ in. (394 mm)
  - Pin Material ..... ASTM A36 steel
  - Number of Pins per Barrier ..... 4 on back side
  - Embedment Depth ..... 5 in. (127 mm)
- Type of Support Surface ..... Rigid Concrete Pavement
- Vehicle Make and Model ..... 2003 Dodge Ram 1500 Quad Cab
  - Curb ..... 5,109 lb (2,317 kg)
  - Test Inertial ..... 4,953 lb (2,247 kg)
  - Gross Static ..... 5,124 lb (2,324 kg)
- Impact Conditions
  - Speed ..... 64.3 mph (103.4 km/h)
  - Angle ..... 26.2 deg
  - Impact Location ..... 4 ft - 3 3/6 in. (1.3 m) upstream joint 4-5
- Exit Conditions
  - Speed ..... 51 mph (82 km/h)
  - Angle ..... 7.7 deg
  - Exit Box Criterion ..... Pass
- Vehicle Stability ..... Satisfactory
- Vehicle Stopping Distance ..... 205 ft (62.5 m) downstream
  18 ft – 8 in. (5.7 m) laterally away
- Vehicle Damage ..... Moderate
  - VDS[15] 11-RFQ-4
  - CDC[16] 11-RYEW4
  - Maximum Interior Deformation ..... 7¼ in. (184 mm)
- Test Article Damage ..... Moderate
- Test Article Deflections
  - Permanent Set ..... 9 in. (229 mm)
  - Dynamic ..... 20.5 in. (521 mm)
  - Working Width ..... 32.5 in. (826 mm)
- Maximum Angular Displacements
  - Roll ..... 41.8 deg < 75 deg
  - Pitch ..... -21.2 deg < 75 deg
  - Yaw ..... -331.4 deg
- Transducer Data

Evaluation Criteria		Transducer			MASH Limit
		EDR-3	EDR-4	DTS	
OIV ft/s (m/s)	Longitudinal	-16.41 (-5.00)	-12.40 (-3.78)	NA	≤ 40 (12.2)
	Lateral	-20.14 (-6.14)	-18.51 (-3.78)	-19.93 (-6.07)	≤ 40 (12.2)
ORA g's	Longitudinal	-4.79	-5.31	NA	≤ 20.49
	Lateral	-6.92	-6.65	-6.92	≤ 20.49
THIV – ft/s (m/s)		NA	21.21 (6.46)	20.94 (6.38)	not required
PHD – g's		NA	7.11	7.59	not required
ASI		1.50	1.36	1.40	not required

Figure 17. Summary of Test Results and Sequential Photographs, Test No. NYTCB-5


0.000 sec


0.916 sec


0.158 sec


1.102 sec


0.240 sec


1.672 sec

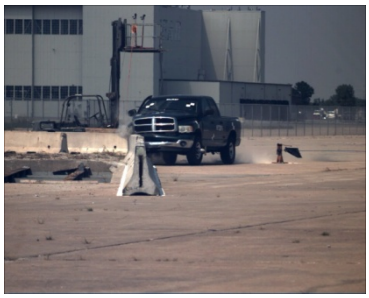

0.536 sec


2.410 sec

Figure 18. Additional Sequential Photographs, Test No. NYTCB-5

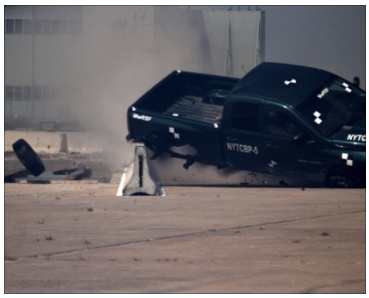

0.000 sec


0.752 sec


0.098 sec


1.044 sec


0.252 sec


1.530 sec


0.434 sec

1.828 sec


0.576 sec

2.038 sec

Figure 19. Additional Sequential Photographs, Test No. NYTCB-5

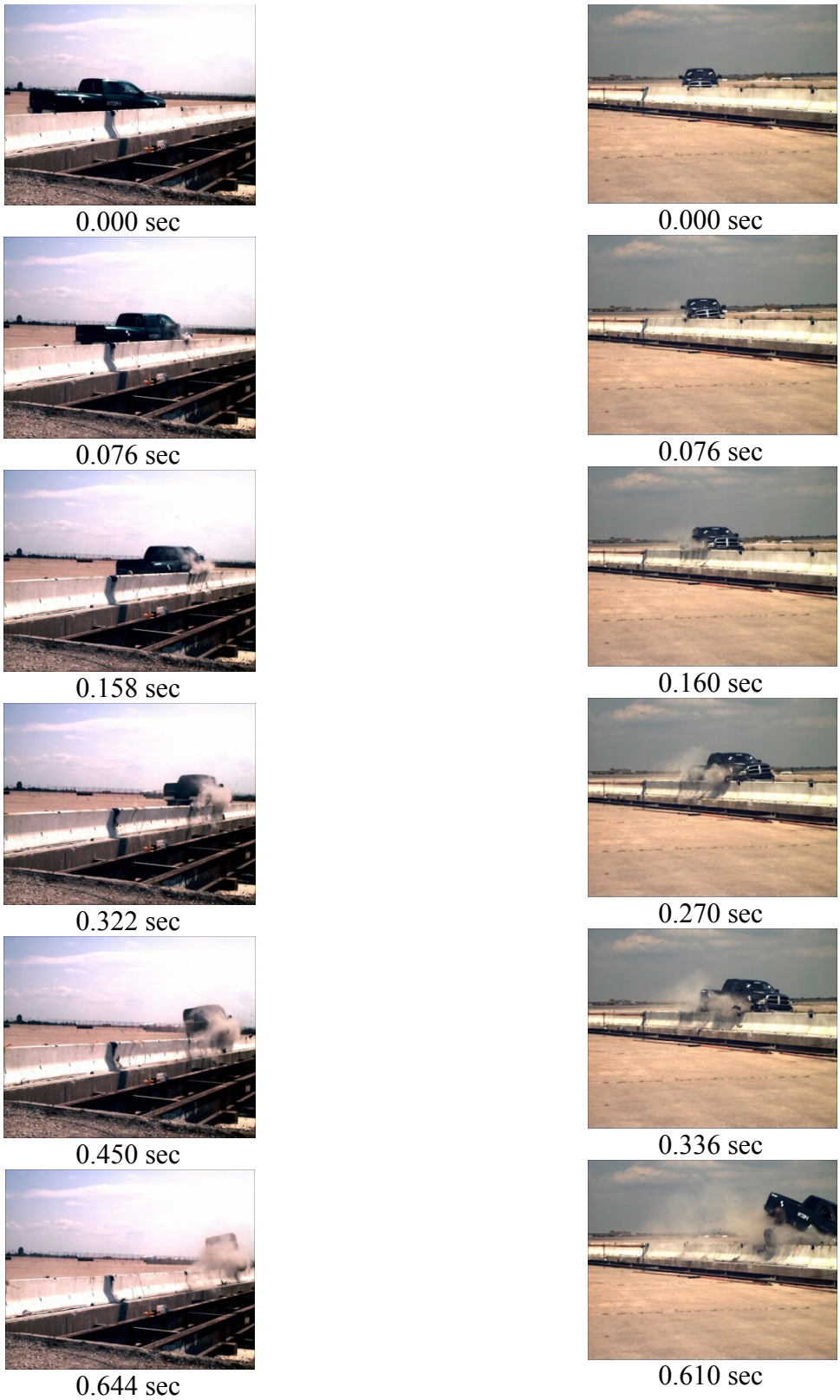


Figure 20. Additional Sequential Photographs, Test No. NYTCB-5

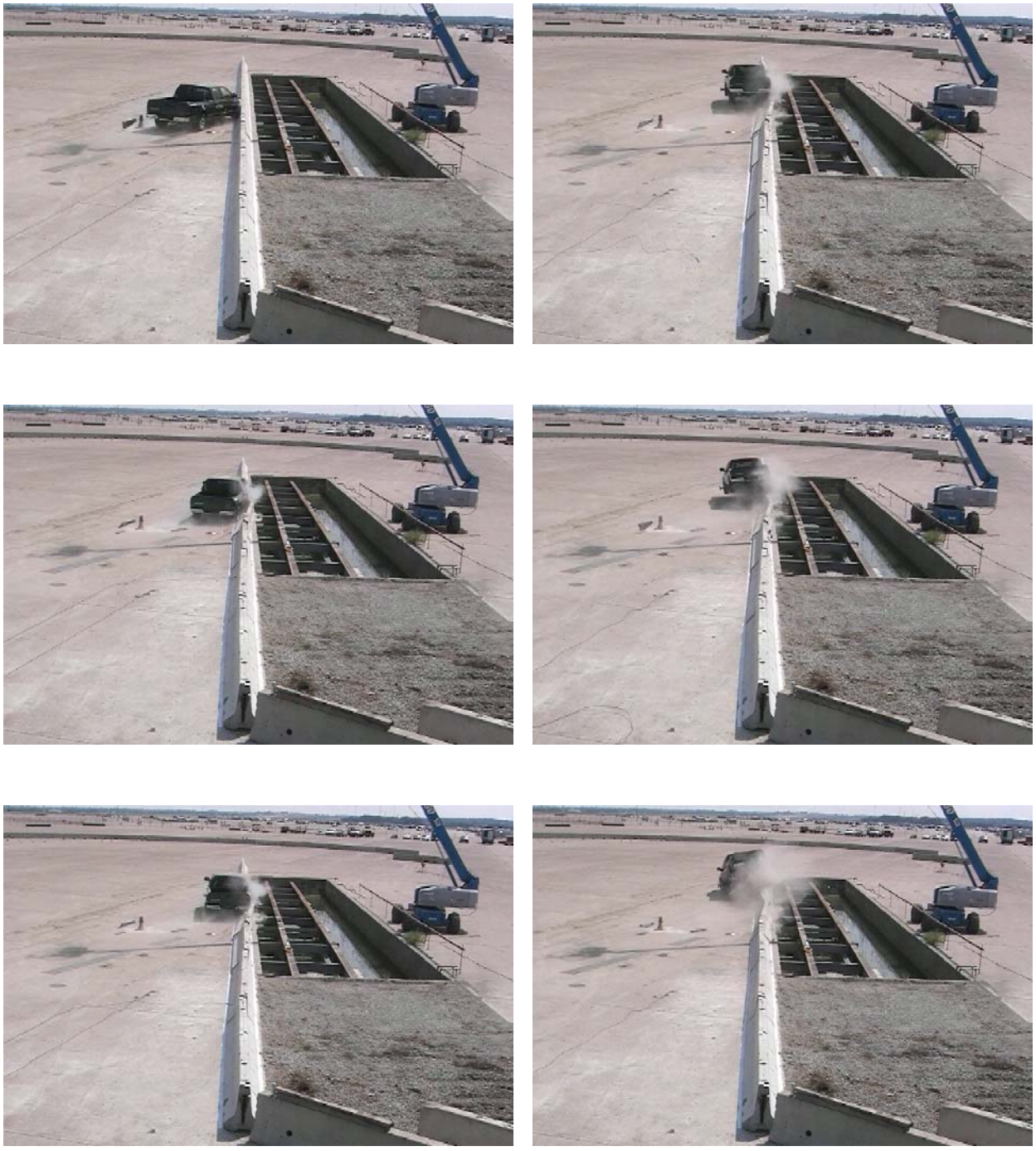


Figure 21. Documentary Photographs, Test No. NYTCB-5

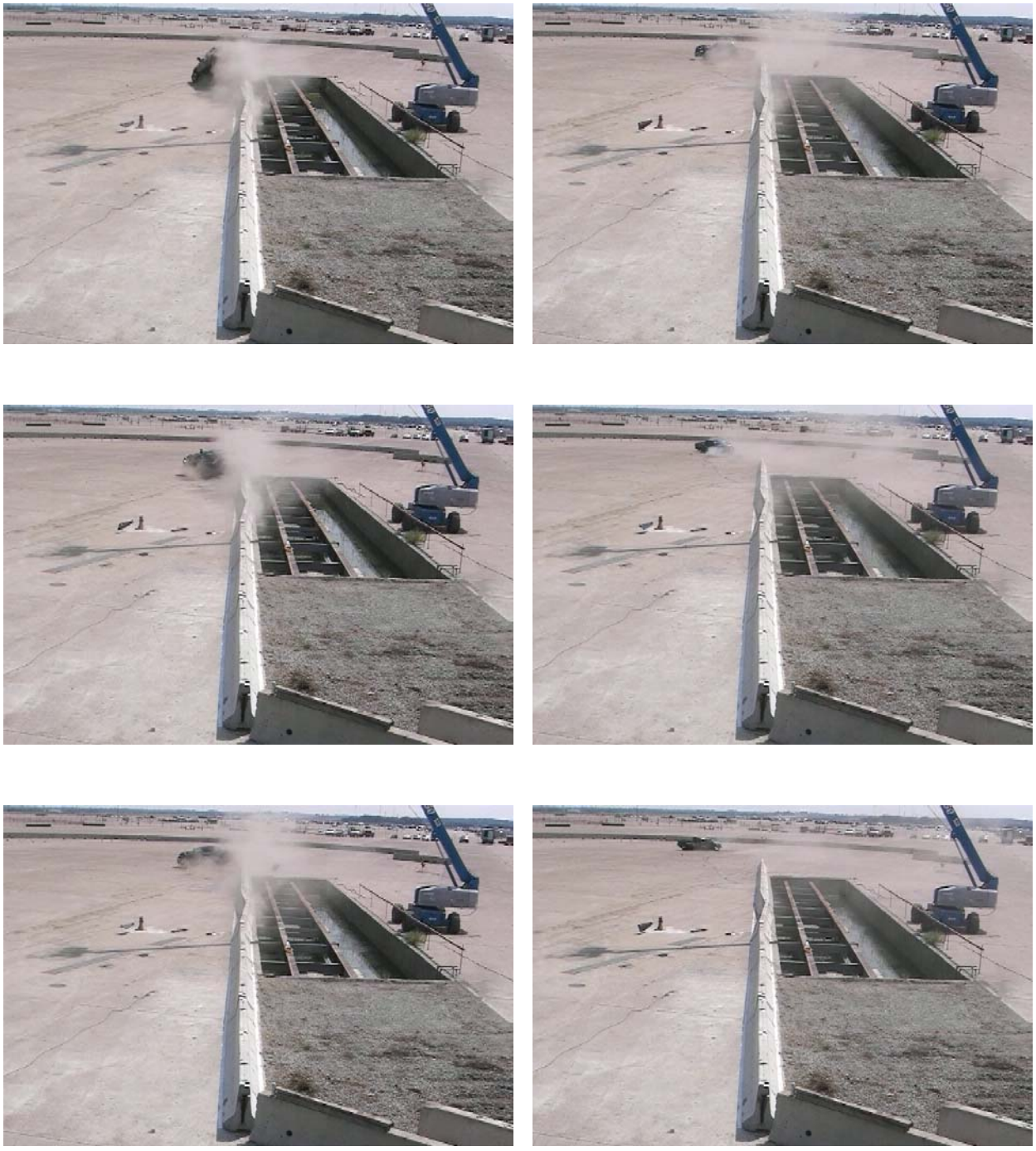


Figure 22. Documentary Photographs, Test No. NYTCB-5

Figure 23. Impact Location, Test No. NYTCB-5

Figure 24. Vehicle Final Position and Trajectory Marks, Test No. NYTCB-5

Figure 25. System Damage, Test No. NYTCB-5

Figure 26. System Damage, Test No. NYTCB-5

Barrier No. 3

Barrier No. 3

Barrier No. 2

Barrier No. 3

Figure 27. Barrier Nos. 2 and 3 Damage, Test No. NYTCB-5

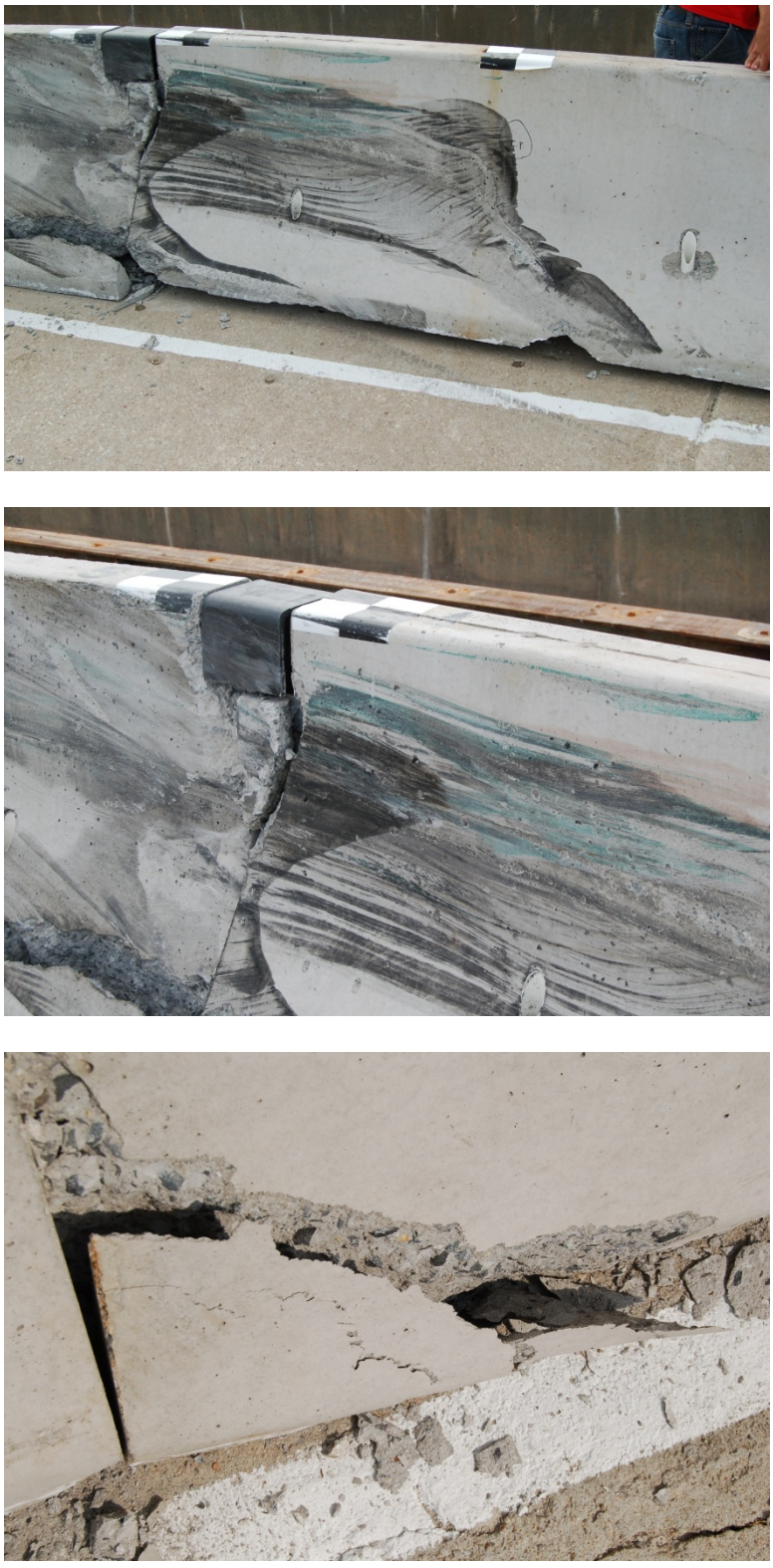


Figure 28. Barrier No. 4 Damage, Test No. NYTCB-5

Figure 29. Barrier No. 5 Damage, Test No. NYTCB-5

Joint between Barrier Nos. 6 and 7

Barrier No. 7

Barrier No. 7

Figure 30. Barrier Nos. 6 and 7 Damage, Test No. NYTCB-5

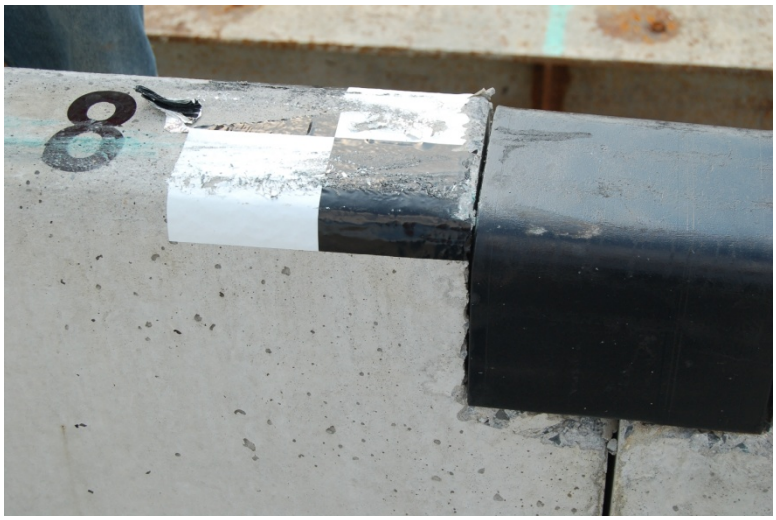


Figure 31. Barrier No. 8 Damage, Test No. NYTCB-5

Barrier No. 9

Joint between Barrier Nos. 9 and 10

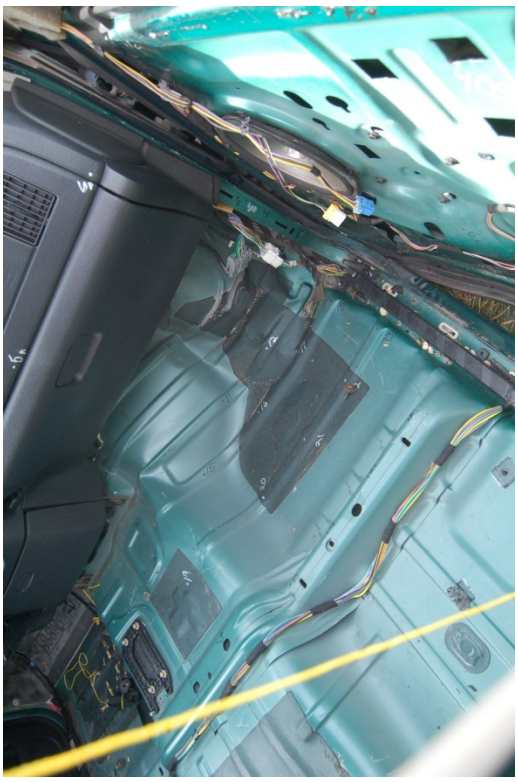
Barrier No. 10

Barrier No. 10

Figure 32. Barrier Nos. 9 and 10 Damage, Test No. NYTCB-5

Figure 33. Vehicle Damage, Test No. NYTCB-5

Figure 34. Vehicle Damage, Test No. NYTCB-5



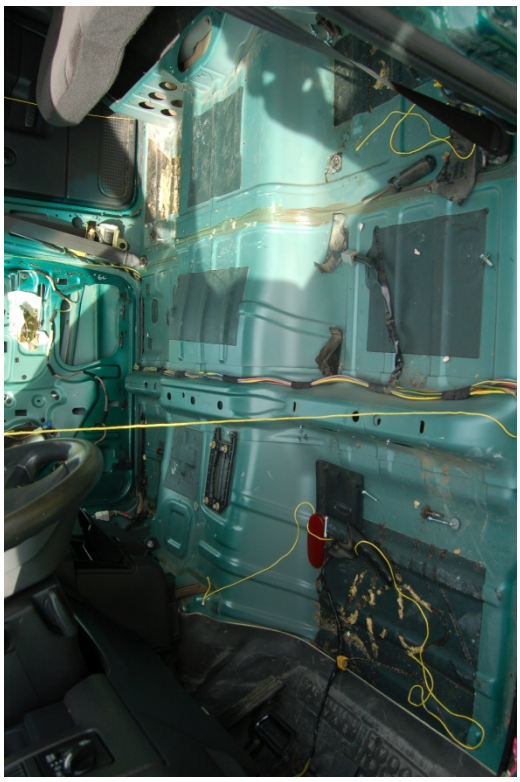


Figure 35. Occupant Compartment Deformation, Test No. NYTCB-5

7 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The goal of this study was to investigate the potential for reducing barrier deflections through the use of vertical steel pins placed through the back-side toe of the NYSDOT's New Jersey-shape TCB sections. A longitudinal barrier system was constructed with ten, 20-ft (6.1-m) long, temporary concrete barrier sections attached end-to-end utilizing a connection at the joints. All sections were pinned to the concrete surface with four 1-in. (25-mm) diameter by 15½-in. (394-mm) long steel rods placed through the back-side toe of the barrier sections and inserted into drilled holes within the rigid concrete surface.

One full-scale vehicle crash test was conducted, evaluated, and reported according to the TL-3 safety performance criteria found in MASH. A summary of the safety performance evaluation for the test is provided in Table 7. Test no. NYTCB-5 (test designation 3-11) consisted of a 5,124-lb (2,324-kg) pickup truck impacting the pinned temporary concrete barrier system at a speed of 64.3 mph (103.4 km/h) and at an angle of 26.2 degrees, thus resulting in an impact severity of 138.0 kip-ft (187.2 kJ). The target impact location was 4 ft - 3 3/16 in. (1.3 m) upstream from the centerline of the joint between barrier nos. 4 and 5. The maximum permanent set and dynamic deflections were 9 in. (229 mm) and 20.5 in. (521 mm), respectively. Following an evaluation of the test results, the pinned, New Jersey-shape, temporary concrete barrier system was found to meet the MASH TL-3 safety requirements for the 2270P pickup truck.

Two full-scale crash tests were performed on the NYSDOT's New Jersey TCB sections when pinned to a rigid concrete surface. Test no. NYTCB-4 utilized four pins placed on the back-side toe of every other barrier segment, while test no. NYTCB-5 used four pins placed on the back-side toe of each section. For test no. NYTCB-5 and as a result of the continuous pinning, the maximum permanent set deflection, maximum dynamic deflection, and working

width were reduced by 83.2, 68.4, and 66.0 percent, respectively, from that observed during test no. NYTCB-4. This result was significant when considering the impact severity for test no. NYTCB-5 was approximately 21 percent greater than that observed in test no. NYTCB-4.

Table 7. Summary of Safety Performance Evaluation Results

<table>
<tr><th>Evaluation Factors</th><th colspan="4">Evaluation Criteria</th><th>Test No. NYTCB-5</th></tr>
<tr><td>Structural Adequacy</td><td>A.</td><td colspan="3">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.</td><td>S</td></tr>
<tr><td rowspan="4">Occupant Risk</td><td>D.</td><td colspan="3">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. Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.3 and Appendix E of MASH.</td><td>S</td></tr>
<tr><td>F.</td><td colspan="3">The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.</td><td>S</td></tr>
<tr><td>H.</td><td colspan="3">Occupant Impact Velocities (OIV) (see Appendix A, Section A5.3 of MASH for calculation procedure) should satisfy the following limits:
<table>
<tr><th colspan="3">Occupant Impact Velocity Limits</th></tr>
<tr><th>Component</th><th>Preferred</th><th>Maximum</th></tr>
<tr><td>Longitudinal and Lateral</td><td>30 ft/s
(9.1 m/s)</td><td>40 ft/s
(12.2 m/s)</td></tr>
</table></td><td>S</td></tr>
<tr><td>I.</td><td colspan="3">The Occupant Ridedown Accelerations (ORA) (see Appendix A, Section A5.3 of MASH for calculation procedure) should satisfy the following limits:
<table>
<tr><th colspan="3">Occupant Ridedown Acceleration Limits</th></tr>
<tr><th>Component</th><th>Preferred</th><th>Maximum</th></tr>
<tr><td>Longitudinal and Lateral</td><td>15.0 g’s</td><td>20.49 g’s</td></tr>
</table></td><td>S</td></tr>
</table>

S – Satisfactory
U – Unsatisfactory
NA - Not Applicable

For 1100C passenger car impacts into the NYSDOT's New Jersey TCB sections that are pinned to a rigid concrete surface, the impact severity would be reduced by at least 50 percent, thus resulting in reduced barrier deflections from those observed in test no. NYTCB-5. Further, the 1100C passenger car of MASH has been shown to be more stable than the NCHRP Report No. 350 820C passenger car. Thus, it is the researchers' opinion that the New Jersey-shape TCB sections that are pinned to a rigid concrete surface would also meet the TL-3 safety performance criteria specified in MASH for the 1100C passenger car impacts. However, this opinion can only be verified through the use of full-scale vehicle crash testing.

The pinned, TCB system described herein was designed for use with the NYSDOT New Jersey-shape temporary concrete barrier segments. These sections utilize a connection key which provides sufficient torsional resistance and load distribution about the longitudinal axis to the adjoining TCB sections. Therefore, the vertical pinning of the NYDOT's TCB sections to rigid surfaces should not be used with other TCB sections or joint connections without further study. Although it is very likely that this pinned system can be adapted to other accepted TCB systems, it is necessary to utilize some criteria to aid in that determination. They are as follows:

1. Joints between barrier segments must have comparable or greater torsional rigidity about the longitudinal barrier axis when compared to that of the as-tested configuration.
2. Alternative barrier segment lengths would be acceptable as long as they are at least 20 ft (6.1 m) long and utilize an equivalent or greater number of anchors per foot of barrier length. With shorter barrier lengths, it is believed that additional barrier rotation will occur due to the greater number of joints, thus resulting in the propensity for increased vehicle climb and rollover.

3. Alternative barrier segments should have comparable mass per unit length.
4. Alternative barrier segments should have equal or greater reinforcement than that provided in the NYSDOT's New Jersey-shape barrier described herein. This reinforcement recommendation is to include the longitudinal steel, shear stirrups, and containment steel bars surrounding the holes used for placing the vertical pins.
5. The shape of alternative barrier segments may require further study. Past research has shown that the F-shape provides slightly improved results over those observed during tests performed on the New Jersey-shape barrier. However, further study may be necessary to assure safe performance when applying the design to other barrier shapes.

8 REFERENCES

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9 APPENDICES

Appendix A. Material Specifications

JERSEY PRECAST CORP.
853 Nottingham Way, Hamilton Township, NJ 08638
Phone: 609-689-3700 • Main Fax: 609-689-3797 • Accts. Fax: 609-689-9222
E-Mail: mail@jerseyprecast.com
www.jerseyprecast.com

ENGINEERING
DESIGN
MANUFACTURE

pci
CERTIFIED
PLANT

August 20, 2009
Job #09-082

CERTIFICATION OF COMPLIANCE NYS DEPARTMENT OF TRANSPORTATION

1.	Project:	University of Nebraska Lincoln
2.	Contractor:	Midwest Roadside Safety 4800 NW 35th Street Lincoln, NE. 68524
3.	Material Supplied:	Precast Concrete Barrier 24" x 32" in 20' Lengths
4.	Quantity of Material Supplied:	160 Lft. Typical Barrier (8 Pcs.)
5.	Means of Identification:	Barrier Elements are dated per date of fabrication.
6.	Date & Method of Shipment:	8/19/09 on Flat Bed Trailers.
7.	Material Found to Conform:	The 160 Lft. of Precast Concrete Temporary Barrier as supplied to the job site has been manufactured using tested and approved materials and meets or exceeds applicable ASTM standards and NYSDOT. Specifications and requirements.
8.	Signature of Authorization For Jersey Precast Corp:	Khwaja Abbas. General Manager
9.	Notary Public Attestment:	State of New Jersey County of Middlesex Sworn and Subscribed Before Me The 20th Day of August, 2009

ILSE C. SOSA
NOTARY PUBLIC OF NEW JERSEY
Commission Expires 2/3/2011

Over 25 Years of Experience

Figure A-1. Temporary Concrete Barrier Certificate of Conformity, Test No. NYTCB-5

Page 1 of 4

GERDAU AMERISTEEL

Straight Bill Of Lading

Shippers No. S-113492

(732) 721-6600

SAYREVILLE STEEL MILL,NORTH CROSSMAN ROAD , SAYREVILLE NJ 08872 USA (732) 721-6600

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

The property described below, in apparent good order, except as noted (contents and condition of contents of package unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery as said description, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over 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 Straight Bill of Lading set forth (1) in Uniform Freight Classification, 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 or this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

CONSIGNED TO	INVOICE TO	SHIP DATE	APPROVAL CODE	M/R ORDER NO.
RE-STEEL SUPPLY COMPANY INC ROUTE 291 - INDUSTRIAL HWY 2000 EDDYSTONE INDUSTRIAL PK EDDYSTONE, PA 19013	RE-STEEL SUPPLY CO INC/ MILL P 2000 EDDYSTONE INDUSTRIAL PARK EDDYSTONE, PA 19022-1588	02-JUL-09 **CUST. ACCOUNT NO** 40131575	SAYLOAD2 *MTC REQUIRED*	

CARRIER:	PU	CLT	**CAR / VEHICLE INITIALS:**	TRAILER	123
DESTINATION:	SEE CONSIGNED TO:		**DELIVERY ADDRESS:**	SEE CONSIGNED TO:	
ROUTE:	N/A		**DELIVERY CARRIER:**	CPU	

SPECIAL INSTRUCTIONS:

DESCRIPTION OF ARTICLES: 10 BUNDLES, IRON OR STEEL RODS OR BARS, DESCRIBED BELOW **COMMODITY CODE NO.** : NMFC 33-124 **FOB ORIGIN** Freight Charges are to be PREPAID, unless marked Collect. Check Box if Collect. [X]

SHAPE & SIZE PART #	DRAWING#	GRADE BUNDLE ID	MILL	LENGTH	CUST PO # HEAT NO	ALTPO# MILL	SALES ORDER # WEIGHT	ITEM # PCS	PROCESS
X 13M (#4)		42		40-00	BB-8807-01		9165620-01		
		S3267583	S		S902892	S	4810 LB	180	
		S3267672	S		S902898	S	4810 LB	180	
		S3267680	S		S902898	S	4810 LB	180	
		S3267681	S		S902898	S	4810 LB	180	
		S3267692	S		S902899	S	4810 LB	180	
		S3268550	S		S902929	S	4810 LB	180	
		S3268551	S		S902929	S	4810 LB	180	
		S3268552	S		S902929	S	4810 LB	180	
		S3268557	S		S902929	S	4810 LB	180	
		S3268565	S		S902929	S	4810 LB	180	

Note -- Where the rate is dependent 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 _______________

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consigner, 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.

Gerdau Ameristeel
(SIGNATURE OF CONSIGNER)

Shippers Total Net Weight 48,100

AGENT

DATE

Gerdau AmeriSteel Corporation Shipper, per ....

Permanent post office address of shipper NORTH CROSSMAN ROAD, SAYREVILLE, NJ 08871 Per ....

Load Style: EYES / SIDE ** Shipping Instructions: 800-876-8216/MUST BE NY DOT MAT'L Load # 23880 Time of Day 7:17:41 EST S-113492

Jeff 07/2/09

Figure A-2. No. 4 Rebar Material Specifications, Test No. NYTCB-5

Page 2 of 4

GERDAU AMERISTEEL

Straight Bill Of Lading

Shippers No. S-113492

(732) 721-6600

SAYREVILLE STEEL MILL,NORTH CROSSMAN ROAD , SAYREVILLE NJ 08872 USA (732) 721-6600

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

The property described below, in apparent good order, except as noted (contents and condition of contents of package unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery as said description, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over 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 Straight Bill of Lading set forth (1) in Uniform Freight Classification, 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 or this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

CONSIGNED TO
RE-STEEL SUPPLY COMPANY INC
ROUTE 291 - INDUSTRIAL HWY
2000 EDDYSTONE INDUSTRIAL PK
EDDYSTONE, PA 19013

INVOICE TO
RE-STEEL SUPPLY CO INC/ MILL P
2000 EDDYSTONE INDUSTRIAL PARK
EDDYSTONE, PA 19022-1588

SHIP DATE
02-JUL-09

CUST. ACCOUNT NO
40131575

APPROVAL CODE
SAYLOAD2
MTC REQUIRED

M/R ORDER NO.

CARRIER: PU CLT
DESTINATION: SEE CONSIGNED TO:
ROUTE: N/A

CAR / VEHICLE INITIALS: TRAILER 123
DELIVERY ADDRESS: SEE CONSIGNED TO:
DELIVERY CARRIER: CPU

SPECIAL INSTRUCTIONS:

DESCRIPTION OF ARTICLES: 10 BUNDLES, IRON OR STEEL RODS OR BARS, DESCRIBED BELOW

COMMODITY CODE NO. : NMFC 33-124

FOB ORIGIN Freight Charges are to be PREPAID, unless marked Collect. Check Box if Collect. [X]

SHAPE & SIZE PART #	DRAWING#	GRADE BUNDLE ID MILL	LENGTH	CUST PO # HEAT NO	ALTPO# MILL	SALES ORDER # WEIGHT	ITEM # PCS	PROCESS
X 13M (#4)		42	40-00	BB-8807-01		9165620-01		
			10 BUNDLES			48100 LB		

Note – Where the rate is dependent 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 ________

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consigner, 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.

Gerdau Ameristeel
(SIGNATURE OF CONSIGNER)

Shippers Total Net Weight 48,100

AGENT

DATE

Gerdau AmeriSteel Corporation Shipper, per ....

Permanent post office address of shipper NORTH CROSSMAN ROAD, SAYREVILLE, NJ 08871

Per ....

Load Style: EYES / SIDE ** Shipping Instructions: 800-876-8216/MUST BE NY DOT MAT'L

Load # 23880 Time of Day 7:17:41 EST S-113492

Figure A-3. No. 4 Rebar Material Specifications, Test No. NYTCB-5

Page 3 of 4

GERDAU AMERISTEEL

SAYREVILLE STEEL MILL
NORTH CROSSMAN ROAD
SAYREVILLE NJ 08872 USA
(732) 721-6600

Chemical and Physical Test Report

MADE IN UNITED STATES

S-113492

SHIP TO	INVOICE TO	SHIP DATE
RE-STEEL SUPPLY COMPANY INC ROUTE 291 - INDUSTRIAL HWY 2000 EDDYSTONE INDUSTRIAL PK EDDYSTONE, PA 19013	RE-STEEL SUPPLY CO INC/ MILL P 2000 EDDYSTONE INDUSTRIAL PARK EDDYSTONE, PA 19022-1588	07/02/09 **CUST. ACCOUNT NO** 40131575

PRODUCED IN: SAYREVILLE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
X13MM REBAR (# 4)	420 (60)	ASTM A615M GR420 [GR60]	9165620-01	BB-8807-01

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	B	N	Sn	Al	Ti	Zr	Ca	C Eqv
S902892	.46	.68	.019	.053	.17	.33	.09	.06	.023	.010	.000	.0000	.0000	.023	.000	.00000	.000	.00000	.587

Mechanical Test: Yield 67315 PSI, 464.12 MPA Tensile: 102990 PSI, 710.09 MPA %El: 13.5/8in, 13.5/200MM Bend: OK Def HT: 0, 0MM %l/h -4.7L
Mechanical Test: Yield 66970 PSI, 461.74 MPA Tensile: 102990 PSI, 710.09 MPA %El: 13.0/8in, 13.0/200MM Bend: OK Def HT: 0, 0MM %l/h -4.1L

PRODUCED IN: SAYREVILLE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
X13MM REBAR (# 4)	420 (60)	ASTM A615M GR420 [GR60]	9165620-01	BB-8807-01

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	B	N	Sn	Al	Ti	Zr	Ca	C Eqv
S902898	.46	.63	.028	.067	.16	.32	.09	.10	.026	.013	.001	.0000	.0000	.047	.000	.00000	.000	.00000	.591

Mechanical Test: Yield 66815 PSI, 460.67 MPA Tensile: 100650 PSI, 693.96 MPA %El: 12.0/8in, 12.0/200MM Bend: OK Def HT: 0, 0MM %l/h -4.7L
Mechanical Test: Yield 67570 PSI, 465.88 MPA Tensile: 102800 PSI, 708.78 MPA %El: 12.5/8in, 12.5/200MM Bend: OK Def HT: 0, 0MM %l/h -4.9L

PRODUCED IN: SAYREVILLE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
X13MM REBAR (# 4)	420 (60)	ASTM A615M GR420 [GR60]	9165620-01	BB-8807-01

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	B	N	Sn	Al	Ti	Zr	Ca	C Eqv
S902899	.47	.71	.018	.055	.18	.28	.09	.08	.026	.014	.002	.0000	.0000	.032	.000	.00000	.000	.00000	.608

Mechanical Test: Yield 63500 PSI, 439.69 MPA Tensile: 97460 PSI, 672.1 MPA %El: 15.0/8in, 15.0/200MM Bend: OK Def HT: 0, 0MM %l/h -4.2L
Mechanical Test: Yield 62895 PSI, 433.65 MPA Tensile: 98635 PSI, 680.06 MPA %El: 14.0/8in, 14.0/200MM Bend: OK Def HT: 0, 0MM %l/h -4.3L

This material, including the billets, was produced and manufactured in the United States of America

Bhaskar Yalamanchili
Quality Director
Gerdau Ameristeel

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

Mgr. Metallurg. Svcs.
SAYREVILLE 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

Figure A-4. No. 4 Rebar Material Specifications, Test No. NYTCB-5

Page 4 of 4

GERDAU AMERISTEEL

SAYREVILLE STEEL MILL
NORTH CROSSMAN ROAD
SAYREVILLE NJ 08872 USA
(732) 721-6600

Chemical and Physical Test Report

MADE IN UNITED STATES

S-113492

SHIP TO	INVOICE TO	SHIP DATE
RE-STEEL SUPPLY COMPANY INC ROUTE 291 - INDUSTRIAL HWY 2000 EDDYSTONE INDUSTRIAL PK EDDYSTONE, PA 19013	RE-STEEL SUPPLY CO INC/ MILL P 2000 EDDYSTONE INDUSTRIAL PARK EDDYSTONE, PA 19022-1588	07/02/09 **CUST. ACCOUNT NO** 40131575

PRODUCED IN: SAYREVILLE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
X13MM REBAR (# 4)	420 (60)	ASTM A615M GR420 [GR60]	9165620-01	BB-8807-01

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	B	N	Sn	Al	Ti	Zr	Ca	C Eqv
S902929	.47	.64	.014	.056	.19	.26	.10	.06	.027	.010	.001	.0000	.0000	.027	.000	.00000	.000	.00000	.596

Mechanical Test: Yield 63805 PSI, 439.92 MPA Tensile: 97505 PSI, 672.27 MPA %El: 14.0/8in, 14.0/200MM Bend: OK Def HT: 0, 0MM %l/h 4.1L
Mechanical Test: Yield 64995 PSI, 448.12 MPA Tensile: 100185 PSI, 690.75 MPA %El: 13.5/8in, 13.5/200MM Bend: OK Def HT: 0, 0MM %l/h 0L

This material, including the billets, was produced and manufactured in the United States of America

Bhaskar Yalamanchili
Quality Director
Gerdau Ameristeel

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

Mgr. Metallurg. Svcs.
SAYREVILLE 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.

Figure A-5. No. 4 Rebar Material Specifications, Test No. NYTCB-5

Page 1 of 3

GERDAU AMERISTEEL

Straight Bill Of Lading

Shippers No. S-113630

(732) 721-6600

SAYREVILLE STEEL MILL,NORTH CROSSMAN ROAD , SAYREVILLE NJ 08872 USA (732) 721-6600

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

The property described below, in apparent good order, except as noted (contents and condition of contents of package unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery as said description, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over 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 Straight Bill of Lading set forth (1) in Uniform Freight Classification, 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 or this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

CONSIGNED TO
RE-STEEL SUPPLY COMPANY INC
ROUTE 291 - INDUSTRIAL HWY
2000 EDDYSTONE INDUSTRIAL PK
EDDYSTONE, PA 19013

INVOICE TO
RE-STEEL SUPPLY CO INC/ MILL P
2000 EDDYSTONE INDUSTRIAL PARK
EDDYSTONE, PA 19022-1588

SHIP DATE 07-JUL-09

CUST. ACCOUNT NO 40131575

APPROVAL CODE SAYLOAD2

MTC REQUIRED

M/R ORDER NO.

CARRIER: PU CPU
DESTINATION: SEE CONSIGNED TO:
ROUTE: N/A
SPECIAL INSTRUCTIONS:

CAR / VEHICLE INITIALS: TRAILER 8341
DELIVERY ADDRESS: SEE CONSIGNED TO:
DELIVERY CARRIER: CPU

DESCRIPTION OF ARTICLES: 8 BUNDLES, IRON OR STEEL RODS OR BARS, DESCRIBED BELOW

COMMODITY CODE NO. : NMFC 33-124

FOB ORIGIN Freight Charges are to be PREPAID, unless marked Collect. Check Box if Collect. [X]

SHAPE & SIZE PART #	DRAWING#	GRADE BUNDLE ID	MILL	LENGTH	CUST PO # HEAT NO	ALTPO# MILL	SALES ORDER # WEIGHT	ITEM # PCS	PROCESS
X 19M (#6)		42		40-00	BB-8808-01		9165622-01		
		K1528127	K		K092233	K	7991 LB	133	
		K1528133	K		K092233	K	7991 LB	133	
		S3274535	S		S903181	S	5047 LB	84	
		S3274536	S		S903181	S	5047 LB	84	
		S3274537	S		S903181	S	5047 LB	84	
		S3274539	S		S903181	S	4927 LB	82	
		S3274541	S		S903181	S	5047 LB	84	
		S3274552	S		S903182	S	5047 LB	84	
				8 BUNDLES			46144 LB		

Note – Where the rate is dependent 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 ________

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consigner, 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.

Gerdau Ameristeel
(SIGNATURE OF CONSIGNER)

Shippers Total Net Weight 46,144

AGENT

DATE

Gerdau AmeriSteel Corporation Shipper, per ....

Permanent post office address of shipper NORTH CROSSMAN ROAD, SAYREVILLE, NJ 08871

Load Style: EYES / SIDE ** Shipping Instructions: 800-876-8216/MUST BE NY DOT MAT'L

Per ....

Load # 23881 Time of Day 19:55:16 EST S-113630

Carlos Perez

Rec 7/9/09 10-30 am

Figure A-6. No. 6 Rebar Material Specifications, Test No. NYTCB-5

Page 2 of 3

GERDAU AMERISTEEL

SAYREVILLE STEEL MILL
NORTH CROSSMAN ROAD
SAYREVILLE NJ 08872 USA
(732) 721-6600

Chemical and Physical Test Report

MADE IN UNITED STATES

S-113630

SHIP TO	INVOICE TO	SHIP DATE
RE-STEEL SUPPLY COMPANY INC ROUTE 291 - INDUSTRIAL HWY 2000 EDDYSTONE INDUSTRIAL PK EDDYSTONE, PA 19013	RE-STEEL SUPPLY CO INC/ MILL P 2000 EDDYSTONE INDUSTRIAL PARK EDDYSTONE, PA 19022-1588	07/07/09 **CUST. ACCOUNT NO** 40131575

PRODUCED IN: KNOXVILLE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
X19MM REBAR (# 6)	420 (60)	ASTM A615/A615M-08B	9165622-01	BB-8808-01

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Sn	C Eqv
K092233	.42	1.12	.011	.069	.22	.44	.12	.08	.018	.031	.004	.632

Mechanical Test: Yield 79100 PSI, 545.38 MPA Tensile: 109800 PSI, 757.04 MPA %El: 11.0/8in, 11.0/200MM Bend: OK Def HT: .05, 1.27MM Def Gap: .136, 3.45MM Def SP: .477, 12.12MM %l/h
2.9L

Customer Requirements Not suitable for hot forging applications

This material, including the billets, was produced and manufactured in the United States of America

Bhaskar Yalamanchili
Quality Director
Gerdau Ameristeel

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

Mgr. Metallurg. Svcs.
KNOXVILLE 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.

Figure A-7. No. 6 Rebar Material Specifications, Test No. NYTCB-5

Page 3 of 3

GERDAU AMERISTEEL

SAYREVILLE STEEL MILL
NORTH CROSSMAN ROAD
SAYREVILLE NJ 08872 USA
(732) 721-6600

Chemical and Physical Test Report

MADE IN UNITED STATES

S-113630

SHIP TO	INVOICE TO	SHIP DATE
RE-STEEL SUPPLY COMPANY INC ROUTE 291 - INDUSTRIAL HWY 2000 EDDYSTONE INDUSTRIAL PK EDDYSTONE, PA 19013	RE-STEEL SUPPLY CO INC/ MILL P 2000 EDDYSTONE INDUSTRIAL PARK EDDYSTONE, PA 19022-1588	07/07/09 **CUST. ACCOUNT NO** 40131575

PRODUCED IN: SAYREVILLE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
X19MM REBAR (# 6)	420 (60)	ASTM A615M GR420 [GR60]	9165622-01	BB-8808-01

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	B	N	Sn	Al	Ti	Zr	Ca	C Eqv
S903181	.44	.67	.007	.055	.19	.43	.11	.06	.038	.024	.001	.0000	.0000	.026	.000	.00000	.000	.00000	.569

Mechanical Test: Yield 69766 PSI, 481.02 MPA Tensile: 104445 PSI, 720.12 MPA %El: 11.0/8in, 11.0/200MM Bend: OK Def HT: 0, 0MM %l/h -3.4L
Mechanical Test: Yield 70368 PSI, 485.17 MPA Tensile: 104114 PSI, 717.84 MPA %El: 10.0/8in, 10.0/200MM Bend: OK Def HT: 0, 0MM %l/h -3.8L

PRODUCED IN: SAYREVILLE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
X19MM REBAR (# 6)	420 (60)	ASTM A615M GR420 [GR60]	9165622-01	BB-8808-01

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	B	N	Sn	Al	Ti	Zr	Ca	C Eqv
S903182	.45	.61	.007	.050	.21	.40	.11	.06	.038	.023	.001	.0000	.0000	.022	.000	.00000	.000	.00000	.568

Mechanical Test: Yield 69752 PSI, 480.92 MPA Tensile: 103130 PSI, 711.06 MPA %El: 11.0/8in, 11.0/200MM Bend: OK Def HT: 0, 0MM %l/h -4.6L
Mechanical Test: Yield 70886 PSI, 488.74 MPA Tensile: 103466 PSI, 713.37 MPA %El: 10.0/8in, 10.0/200MM Bend: OK Def HT: 0, 0MM %l/h -4.7L

This material, including the billets, was produced and manufactured in the United States of America

Bhaskar Yalamanchili
Quality Director
Gerdau Ameristeel

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

Mgr. Metallurg. Svcs.
SAYREVILLE 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.

Figure A-8. No. 6 Rebar Material Specifications, Test No. NYTCB-5

Atlas ABC Corp (Atlas Tube Chicago)
1855 East 122nd Street
Chicago, Illinois, USA
60633
Tel: 773-646-4500
Fax: 773-646-6128

Ref.B/L: 80338055
Date: 04.13.2009
Customer: 98

TUBE

MATERIAL TEST REPORT

Sold to

Metals USA-Northeast L.P. (Sto
50 Cabot Blvd East
LANGHORNE PA 19047
USA

Shipped to

Jersey Precast Corp.
853 Nottingham Way
HAMILTON TOWNSHIP NJ 08
USA

Material: 4.0x4.0x500x40'0"0(4x2). **Material No:** 400405004000 **Made in:** USA
Melted & Manufactured in USA
Sales order: 464827 **Purchase Order:** PHI 14472 **Cust Material #:** 4500-40

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V	Tl
T64898	0.220	0.770	0.010	0.009	0.011	0.048	0.030	0.001	0.004	0.010	0.030	0.001	0.001

Bundle No	Yield	Tensile	Eln.2in	Certification	CE: 0.36
M800102326	073670 Psi	080780 Psi	33 %	ASTM A500-07 GRADE B&C	

Material Note:
Sales Or.Note:

Material: 4.0x4.0x500x40'0"0(4x2). **Material No:** 400405004000 **Made in:** USA
Melted & Manufactured in USA
Sales order: 464827 **Purchase Order:** PHI 14472 **Cust Material #:** 4500-40

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V	Tl
T64900	0.230	0.780	0.010	0.011	0.011	0.034	0.040	0.001	0.005	0.010	0.030	0.001	0.001

Bundle No	Yield	Tensile	Eln.2in	Certification	CE: 0.37
M800102320	063960 Psi	077680 Psi	35 %	ASTM A500-07 GRADE B&C	

Material Note:
Sales Or.Note:

Material: 4.0x4.0x500x40'0"0(4x2). **Material No:** 400405004000 **Made in:** USA
Melted & Manufactured in USA
Sales order: 464827 **Purchase Order:** PHI 14472 **Cust Material #:** 4500-40

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V	Tl
T64898	0.220	0.770	0.010	0.009	0.011	0.048	0.030	0.001	0.004	0.010	0.030	0.001	0.001

Bundle No	Yield	Tensile	Eln.2in	Certification	CE: 0.36
M800102323	073670 Psi	080780 Psi	33 %	ASTM A500-07 GRADE B&C	

Material Note:
Sales Or.Note:

OFFICIAL SEAL
SHIRLEY L AUGUSTINIUS
NOTARY PUBLIC - STATE OF ILLINOIS
MY COMMISSION EXPIRES:07/11/09

Shirley L Augustinius 4/14/09

Authorized by Quality Assurance:
The results reported on this report represent the actual attributes of the material furnished and indicate full compliance with all applicable specification and contract requirements.
CE calculated using the AWS D1.1 method.

Steel Tube Institute OF NORTH AMERICA

Page : 1 Of 3

Metals Service Center Institute

Figure A-9. Flat Plate Material Specifications, Test No. NYTCB-5

Atlas ABC Corp (Atlas Tube Chicago)
1855 East 122nd Street
Chicago, Illinois, USA
60633
Tel: 773-646-4500
Fax: 773-646-6128

Ref.B/L: 80338055
Date: 04.13.2009
Customer: 98

MATERIAL TEST REPORT

Sold to

Metals USA-Northeast L.P. (Sto
50 Cabot Blvd East
LANGHORNE PA 19047
USA

Shipped to

Jersey Precast Corp.
853 Nottingham Way
HAMILTON TOWNSHIP NJ 08
USA

Material: 4.0x4.0x500x40'0"0(4x2). **Material No:** 400405004000 **Made in:** USA
Melted & Manufactured in USA
Sales order: 464827 **Purchase Order:** PHI 14472 **Cust Material #:** 4500-40

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V	Ti
T64899	0.220	0.800	0.009	0.008	0.012	0.051	0.030	0.001	0.004	0.010	0.020	0.001	0.001

Bundle No	Yield	Tensile	Eln.2in	Certification	CE: 0.36
M800102331	071140 Psi	078750 Psi	35 %	ASTM A500-07 GRADE B&C	

Material Note:
Sales Or.Note:

Material: 4.0x4.0x500x40'0"0(4x2). **Material No:** 400405004000 **Made in:** USA
Melted & Manufactured in USA
Sales order: 464827 **Purchase Order:** PHI 14472 **Cust Material #:** 4500-40

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V	Ti
T64898	0.220	0.770	0.010	0.009	0.011	0.048	0.030	0.001	0.004	0.010	0.030	0.001	0.001

Bundle No	Yield	Tensile	Eln.2in	Certification	CE: 0.36
M800102324	073670 Psi	080780 Psi	33 %	ASTM A500-07 GRADE B&C	

Material Note:
Sales Or.Note:

Material: 4.0x4.0x500x48'0"0(3x2). **Material No:** 400405004800 **Made in:** USA
Melted & Manufactured in USA
Sales order: 464827 **Purchase Order:** PHI 14472 **Cust Material #:** 4500-48

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V	Ti
D62523	0.210	0.750	0.009	0.009	0.010	0.040	0.030	0.002	0.004	0.010	0.040	0.001	0.001

Bundle No	Yield	Tensile	Eln.2in	Certification	CE: 0.35
M800091360	066840 Psi	079220 Psi	33 %	ASTM A500-07 GRADE B&C	

Material Note:
Sales Or.Note:

OFFICIAL SEAL
SHIRLEY L AUGUSTINIUS
NOTARY PUBLIC - STATE OF ILLINOIS
MY COMMISSION EXPIRES:07/11/09

Shirley L Augustinius 4/14/09

Authorized by Quality Assurance:
The results reported on this report represent the actual attributes of the material furnished and indicate full compliance with all applicable specification and contract requirements.
CE calculated using the AWS D1.1 method.

Steel Tube Institute OF NORTH AMERICA

Page : 2 Of 3

Metals Service Center Institute

Figure A-10. Flat Plate Material Specifications, Test No. NYTCB-5

Atlas ABC Corp (Atlas Tube Chicago)
1855 East 122nd Street
Chicago, Illinois, USA
60633
Tel: 773-646-4500
Fax: 773-646-6128

Ref.B/L: 80338055
Date: 04.13.2009
Customer: 98

Atlas TUBE

MATERIAL TEST REPORT

Sold to

Metals USA-Northeast L.P. (Sto
50 Cabot Blvd East
LANGHORNE PA 19047
USA

Shipped to

Jersey Precast Corp.
853 Nottingham Way
HAMILTON TOWNSHIP NJ 08
USA

Material: 4.0x4.0x500x48'0"0(3x2). **Material No:** 400405004800 **Made in:** USA
Melted & Manufactured in USA
Sales order: 464827 **Purchase Order:** PHI 14472 **Cust Material #:** 4500-48

Heat No	C	Mn	P	S	Si	Al	Cu	Cb	Mo	Ni	Cr	V	Ti
D62523	0.210	0.750	0.009	0.009	0.010	0.040	0.030	0.002	0.004	0.010	0.040	0.001	0.001

Bundle No	Yield	Tensile	Eln.2in	Certification	CE: 0.35
M800091359	066840 Psi	079220 Psi	33 %	ASTM A500-07 GRADE B&C	

Material Note:
Sales Or.Note:

OFFICIAL SEAL
SHIRLEY L AUGUSTINIUS
NOTARY PUBLIC - STATE OF ILLINOIS
MY COMMISSION EXPIRES:07/11/09

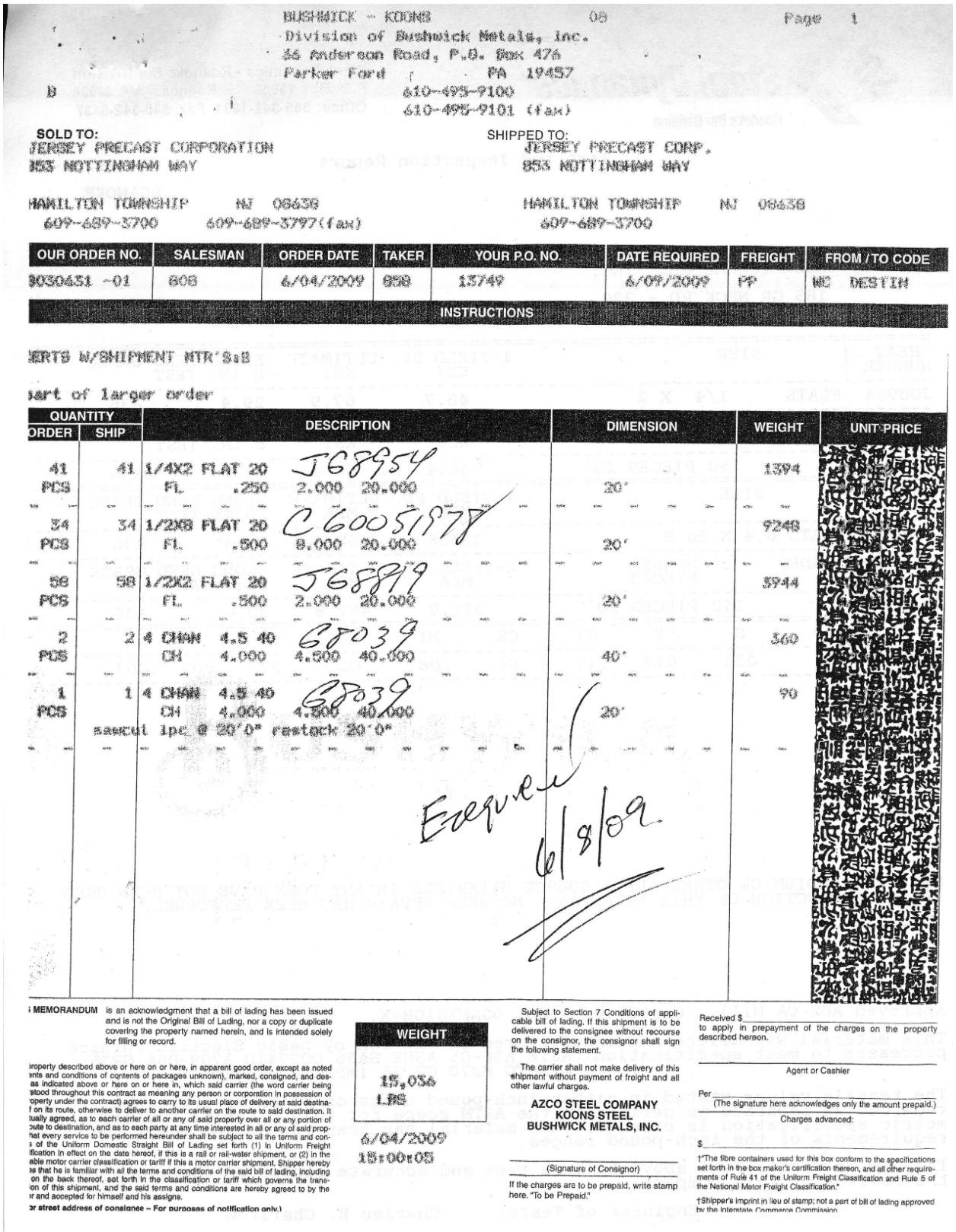
Authorized by Quality Assurance: 4/14/05
The results reported on this report represent the actual attributes of the material furnished and indicate full compliance with all applicable specification and contract requirements.
CE calculated using the AWS D1.1 method.

Steel Tube Institute OF NORTH AMERICA

Page : 3 Of 3

Metals Service Center Institute

Figure A-11. Flat Plate Material Specifications, Test No. NYTCB-5



BUSHWICK - KOONS 05 Page 1
Division of Bushwick Metals, Inc.
55 Anderson Road, P.O. Box 476
Parker Ford (PA 19457
610-495-9100
610-495-9101 (fax)

SOLD TO:
JERSEY PRECAST CORPORATION
853 NOTTINGHAM WAY
HAMILTON TOWNSHIP NJ 08638
609-689-3700 609-689-3797(fax)

SHIPPED TO:
JERSEY PRECAST CORP.
853 NOTTINGHAM WAY
HAMILTON TOWNSHIP NJ 08638
609-689-3700

OUR ORDER NO.	SALESMAN	ORDER DATE	TAKER	YOUR P.O. NO.	DATE REQUIRED	FREIGHT	FROM / TO CODE
3030451 -01	808	6/04/2009	858	13749	6/09/2009	PP	WC DESTIN

INSTRUCTIONS

CERTS W/SHIPMENT NTR'S:S

part of larger order

QUANTITY ORDER	QUANTITY SHIP	DESCRIPTION	DIMENSION	WEIGHT	UNIT PRICE
41 PCS	41	1/4X2 FLAT 20 FL .250 2.000 20.000 J68954	20'	1394	
34 PCS	34	1/2X8 FLAT 20 FL .500 8.000 20.000 C6005178	20'	9248	
58 PCS	58	1/2X2 FLAT 20 FL .500 2.000 20.000 J68919	20'	3944	
2 PCS	2	4 CHAN 4.5 40 CH 4.000 4.500 40.000 68039	40'	360	
1 PCS	1	4 CHAN 4.5 40 CH 4.000 4.500 40.000 68039 sawcut 1pc @ 20'0" restack 20'0"	20'	90	

Received 6/8/09

MEMORANDUM is an acknowledgment that a bill of lading has been issued and is not the Original Bill of Lading, nor a copy or duplicate covering the property named herein, and is intended solely for filing or record.

roperty described above or here on or here, in apparent good order, except as noted nts and conditions of contents of packages unknown), marked, consigned, and des- as indicated above or here on or here in, which said carrier (the word carrier being stood throughout this contract as meaning any person or corporation in possession of operty under the contract) agrees to carry to its usual place of delivery at said destina- f on its route, otherwise to deliver to another carrier on the route to said destination. It tually agreed, as to each carrier of all or any of said property over all or any portion of ute to destination, and as to each party at any time interested in all or any of said prop- hat every service to be performed hereunder shall be subject to all the terms and con- s of the Uniform Domestic Straight Bill of Lading set forth (1) in Uniform Freight fication in effect on the date hereof, if this is a rail or rail-water shipment, or (2) in the able motor carrier classification or tariff if this a motor carrier shipment. Shipper hereby e that he is familiar with all the terms and conditions of the said bill of lading, including on the back thereof, set forth in the classification or tariff which governs the trans- on of this shipment, and the said terms and conditions are hereby agreed to by the r and accepted for himself and his assigns.

or street address of consignee -- For purposes of notification only.)

WEIGHT
15,056 LBS

6/04/2009
18:00:05

Subject to Section 7 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.

AZCO STEEL COMPANY
KOONS STEEL
BUSHWICK METALS, INC.

(Signature of Consignor)

If the charges are to be prepaid, write stamp here. "To be Prepaid."

Received $_____ to apply in prepayment of the charges on the property described hereon.

Agent or Cashier

Per _____
(The signature here acknowledges only the amount prepaid.)

Charges advanced:

$_____

†"The fibre containers used for this box conform to the specifications set forth in the box maker's certification thereon, and all other requirements of Rule 41 of the Uniform Freight Classification and Rule 5 of the National Motor Freight Classification."

†Shipper's imprint in lieu of stamp; not a part of bill of lading approved by the Interstate Commerce Commission.

Figure A-12. Flat Plate Material Specifications, Test No. NYTCB-5

Steel Dynamics®
Roanoke Bar Division

Steel Dynamics - Roanoke Bar Division
P.O. Box 13948 Roanoke, VA 24038
Office: 540-342-1831 Fax: 540-342-9437

Test and Inspection Report NO. 79781-1

ROANOKE

BUSHWICK METALS, INC.

185 GR NECK RD - 320
GREAT NECK NY 11021-0000 Date 6/04/0

HEAT NUMBER	SIZE	1-YIELD Pt. KSI	ULTIMATE KSI	ELONG 8 IN.	BEND TEST	GRADE
JG8954	FLATS 1/4 X 2	48.7	67.9	29.4		A36

PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. KSI	ULTIMATE KSI	ELONG 8 IN.	BEND TEST	GRADE
MO600R	150 PIECES 20'	46.4	66.4	30.0		A36

HEAT NUMBER	SIZE	1-YIELD Pt. MPA	ULTIMATE MPA	ELONG 203mm	BEND TEST	GRADE
JG8954	FLATS 6.4 X 50.8	335.8	468.2	29.4		A36

PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. MPA	ULTIMATE MPA	ELONG 203mm	BEND TEST	GRADE
MO600R	150 PIECES 20'	319.9	457.8	30.0		A36

C	MN	S	P	SI	CR	NI	MO	CU	V	NB
.14	.72	.036	.017	.19	.06	.08	.02	.27	.002	.001

MERCURY, RADIUM OR OTHER ALPHA SOURCE MATERIALS IN ANY FORM HAVE NOT BEEN USED IN THE PRODUCTION OF THIS MATERIAL. NO WELD REPAIR HAS BEEN PERFORMED.

Approved ABS QA Mill. Certificate No. 00NN10108-X.

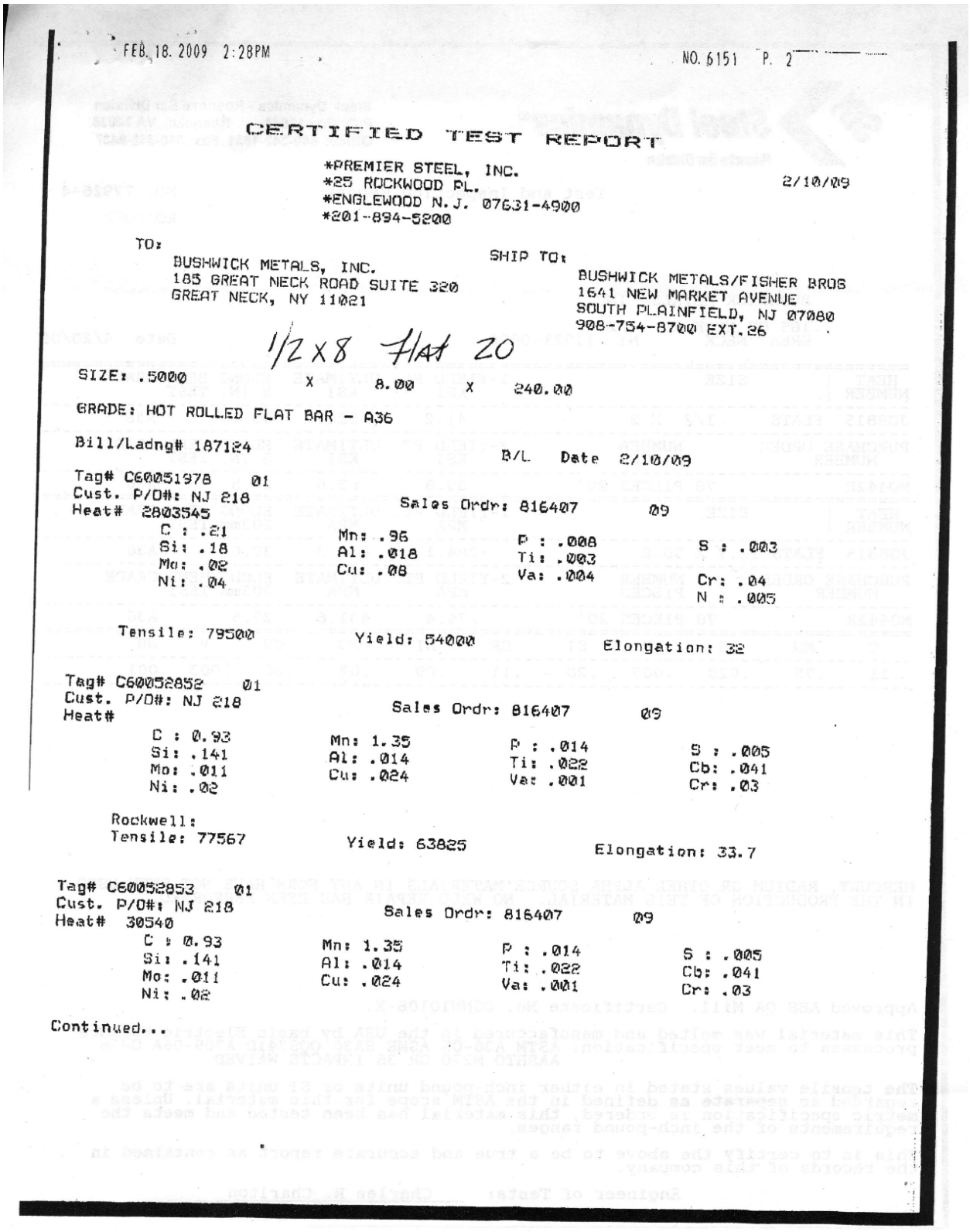
This material was melted and manufactured in the USA by basic Electric Furnace processes to meet specification: ASTM A36-05 ASME SA36 QQS741D A709-06A GR36
AASHTO M270 GR 36 IMPACTS WAIVED

The tensile values stated in either inch-pound units or SI units are to be regarded as separate as defined in the ASTM scope for this material. Unless a metric specification is ordered, this material has been tested and meets the requirements of the inch-pound ranges.

This is to certify the above to be a true and accurate report as contained in the records of this company.

Engineer of Tests: Charles R. Charlton

Figure A-13. Flat Plate Material Specifications, Test No. NYTCB-5



FEB. 18. 2009 2:28PM NO. 6151 P. 2

CERTIFIED TEST REPORT

*PREMIER STEEL, INC.
*25 ROCKWOOD PL.
*ENGLEWOOD N.J. 07631-4900
*201-894-5200

2/10/09

TO:
BUSHWICK METALS, INC.
185 GREAT NECK ROAD SUITE 320
GREAT NECK, NY 11021

SHIP TO:
BUSHWICK METALS/FISHER BROS
1641 NEW MARKET AVENUE
SOUTH PLAINFIELD, NJ 07080
908-754-8700 EXT.26

1/2 X 8 Flat 20

SIZE: .5000 X 8.00 X 240.00

GRADE: HOT ROLLED FLAT BAR - A36

Bill/Ladng# 187124 B/L Date 2/10/09

Tag# C60051978 01
Cust. P/O#: NJ 218
Heat# 2803545 Sales Ordr: 816407 09

C : .21 Mn: .96 P : .008 S : .003
Si: .18 Al: .018 Ti: .003
Mo: .02 Cu: .08 Va: .004 Cr: .04
Ni: .04 N : .005

Tensile: 79500 Yield: 54000 Elongation: 32

Tag# C60052852 01
Cust. P/O#: NJ 218
Heat# Sales Ordr: 816407 09

C : 0.93 Mn: 1.35 P : .014 S : .005
Si: .141 Al: .014 Ti: .022 Cb: .041
Mo: .011 Cu: .024 Va: .001 Cr: .03
Ni: .02

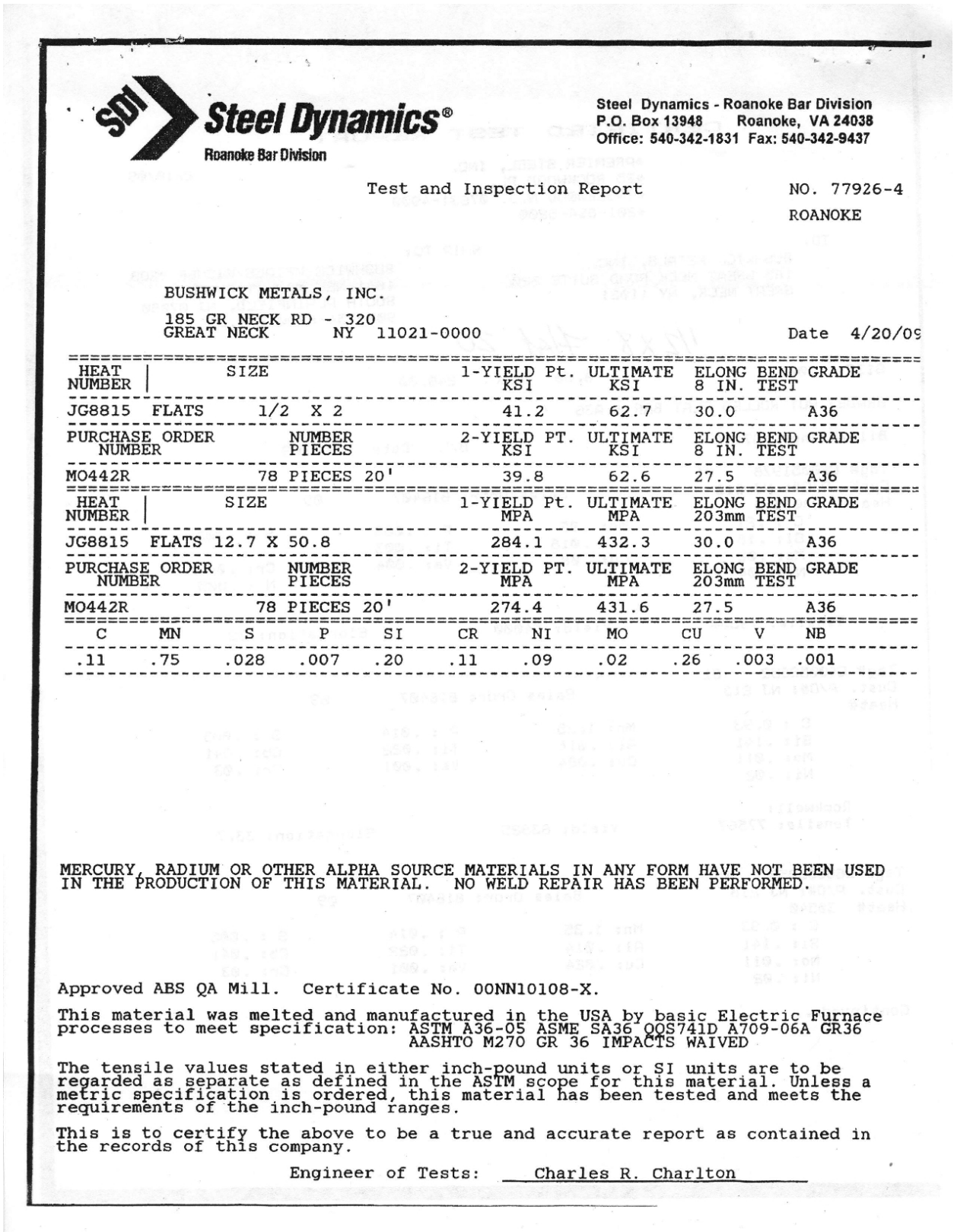
Rockwell:
Tensile: 77567 Yield: 63825 Elongation: 33.7

Tag# C60052853 01
Cust. P/O#: NJ 218
Heat# 30540 Sales Ordr: 816407 09

C : 0.93 Mn: 1.35 P : .014 S : .005
Si: .141 Al: .014 Ti: .022 Cb: .041
Mo: .011 Cu: .024 Va: .001 Cr: .03
Ni: .02

Continued...

Figure A-14. Flat Plate Material Specifications, Test No. NYTCB-5



Steel Dynamics®
Roanoke Bar Division

Steel Dynamics - Roanoke Bar Division
P.O. Box 13948 Roanoke, VA 24038
Office: 540-342-1831 Fax: 540-342-9437

Test and Inspection Report NO. 77926-4
ROANOKE

BUSHWICK METALS, INC.

185 GR NECK RD - 320
GREAT NECK NY 11021-0000

Date 4/20/09

HEAT NUMBER	SIZE	1-YIELD Pt. KSI	ULTIMATE KSI	ELONG 8 IN.	BEND TEST	GRADE
JG8815	FLATS 1/2 X 2	41.2	62.7	30.0		A36
PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. KSI	ULTIMATE KSI	ELONG 8 IN.	BEND TEST	GRADE
MO442R	78 PIECES 20'	39.8	62.6	27.5		A36

HEAT NUMBER	SIZE	1-YIELD Pt. MPA	ULTIMATE MPA	ELONG 203mm	BEND TEST	GRADE
JG8815	FLATS 12.7 X 50.8	284.1	432.3	30.0		A36
PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. MPA	ULTIMATE MPA	ELONG 203mm	BEND TEST	GRADE
MO442R	78 PIECES 20'	274.4	431.6	27.5		A36

C	MN	S	P	SI	CR	NI	MO	CU	V	NB
.11	.75	.028	.007	.20	.11	.09	.02	.26	.003	.001

MERCURY, RADIUM OR OTHER ALPHA SOURCE MATERIALS IN ANY FORM HAVE NOT BEEN USED IN THE PRODUCTION OF THIS MATERIAL. NO WELD REPAIR HAS BEEN PERFORMED.

Approved ABS QA Mill. Certificate No. 00NN10108-X.

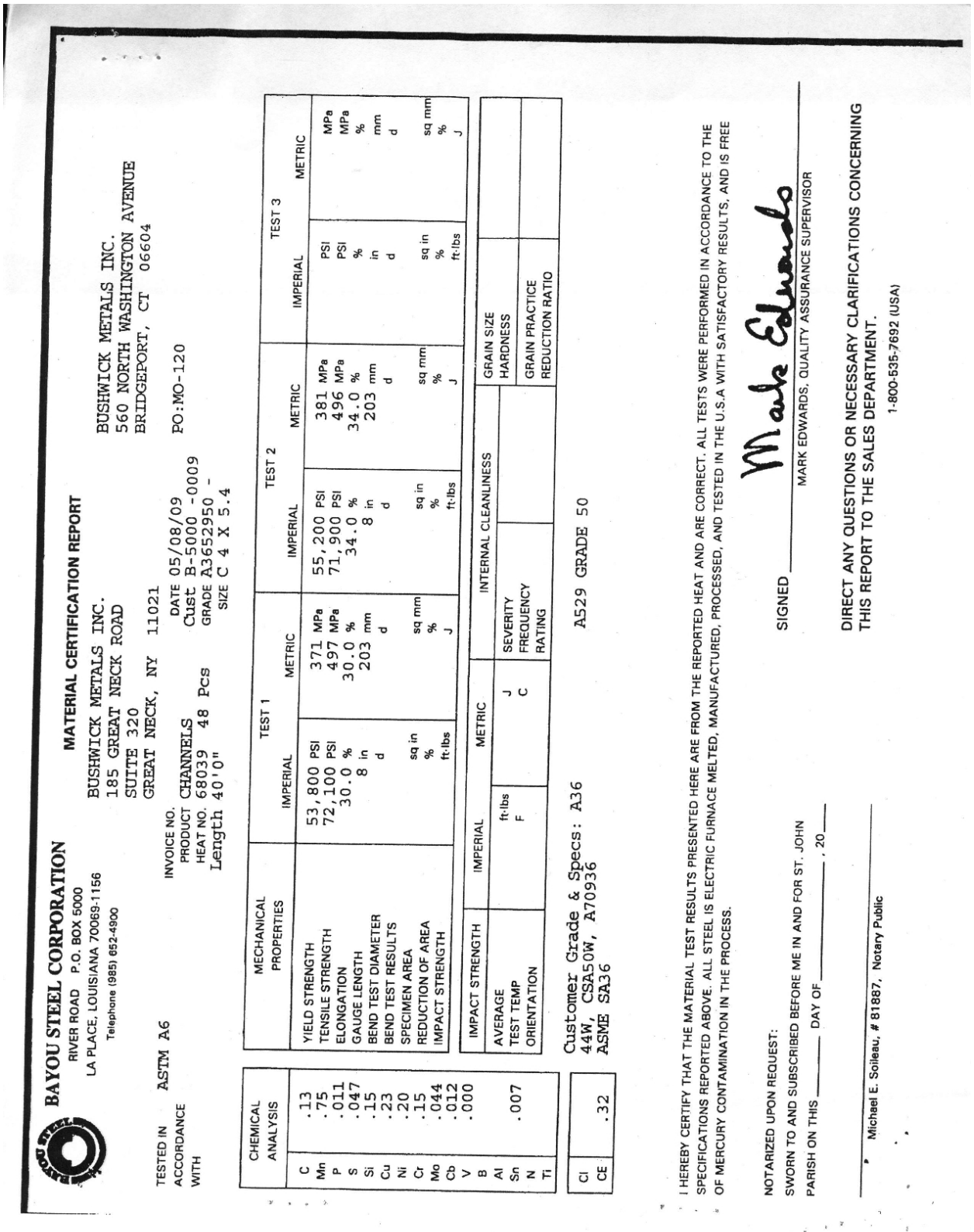
This material was melted and manufactured in the USA by basic Electric Furnace processes to meet specification: ASTM A36-05 ASME SA36 QOS741D A709-06A GR36 AASHTO M270 GR 36 IMPACTS WAIVED

The tensile values stated in either inch-pound units or SI units are to be regarded as separate as defined in the ASTM scope for this material. Unless a metric specification is ordered, this material has been tested and meets the requirements of the inch-pound ranges.

This is to certify the above to be a true and accurate report as contained in the records of this company.

Engineer of Tests: Charles R. Charlton

Figure A-15. Flat Plate Material Specifications, Test No. NYTCB-5



BAYOU STEEL CORPORATION
RIVER ROAD P.O. BOX 5000
LA PLACE, LOUISIANA 70069-1156
Telephone (985) 652-4900

MATERIAL CERTIFICATION REPORT

BUSHWICK METALS INC.
185 GREAT NECK ROAD
SUITE 320
GREAT NECK, NY 11021

BUSHWICK METALS INC.
560 NORTH WASHINGTON AVENUE
BRIDGEPORT, CT 06604

TESTED IN ACCORDANCE WITH ASTM A6

INVOICE NO.
PRODUCT CHANNELS
HEAT NO. 68039 48 Pcs
Length 40'0"

DATE 05/08/09
Cust B-5000 -0009
GRADE A3652950 -
SIZE C 4 X 5.4

PO:MO-120

CHEMICAL ANALYSIS	
C	.13
Mn	.75
P	.011
S	.047
Si	.15
Cu	.23
Ni	.20
Cr	.15
Mo	.044
Cb	.012
V	.000
B	
Al	
Sn	.007
N	
Ti	

MECHANICAL PROPERTIES	TEST 1 IMPERIAL	TEST 1 METRIC	TEST 2 IMPERIAL	TEST 2 METRIC	TEST 3 IMPERIAL	TEST 3 METRIC
YIELD STRENGTH	53,800 PSI	371 MPa	55,200 PSI	381 MPa	PSI	MPa
TENSILE STRENGTH	72,100 PSI	497 MPa	71,900 PSI	496 MPa	PSI	MPa
ELONGATION	30.0 %	30.0 %	34.0 %	34.0 %	%	%
GAUGE LENGTH	8 in	203 mm	8 in	203 mm	in	mm
BEND TEST DIAMETER	d	d	d	d	d	d
BEND TEST RESULTS						
SPECIMEN AREA	sq in	sq mm	sq in	sq mm	sq in	sq mm
REDUCTION OF AREA	%	%	%	%	%	%
IMPACT STRENGTH	ft-lbs	J	ft-lbs	J	ft-lbs	J

IMPACT STRENGTH	IMPERIAL	METRIC
AVERAGE	ft-lbs	J
TEST TEMP	F	C
ORIENTATION		

INTERNAL CLEANLINESS	
SEVERITY	
FREQUENCY	
RATING	

GRAIN SIZE	
HARDNESS	
GRAIN PRACTICE	
REDUCTION RATIO	

CI	
CE	.32

Customer Grade & Specs: A36
44W, CSA50W, A70936
ASME SA36

A529 GRADE 50

I HEREBY CERTIFY THAT THE MATERIAL TEST RESULTS PRESENTED HERE ARE FROM THE REPORTED HEAT AND ARE CORRECT. ALL TESTS WERE PERFORMED IN ACCORDANCE TO THE SPECIFICATIONS REPORTED ABOVE. ALL STEEL IS ELECTRIC FURNACE MELTED, MANUFACTURED, PROCESSED, AND TESTED IN THE U.S.A WITH SATISFACTORY RESULTS, AND IS FREE OF MERCURY CONTAMINATION IN THE PROCESS.

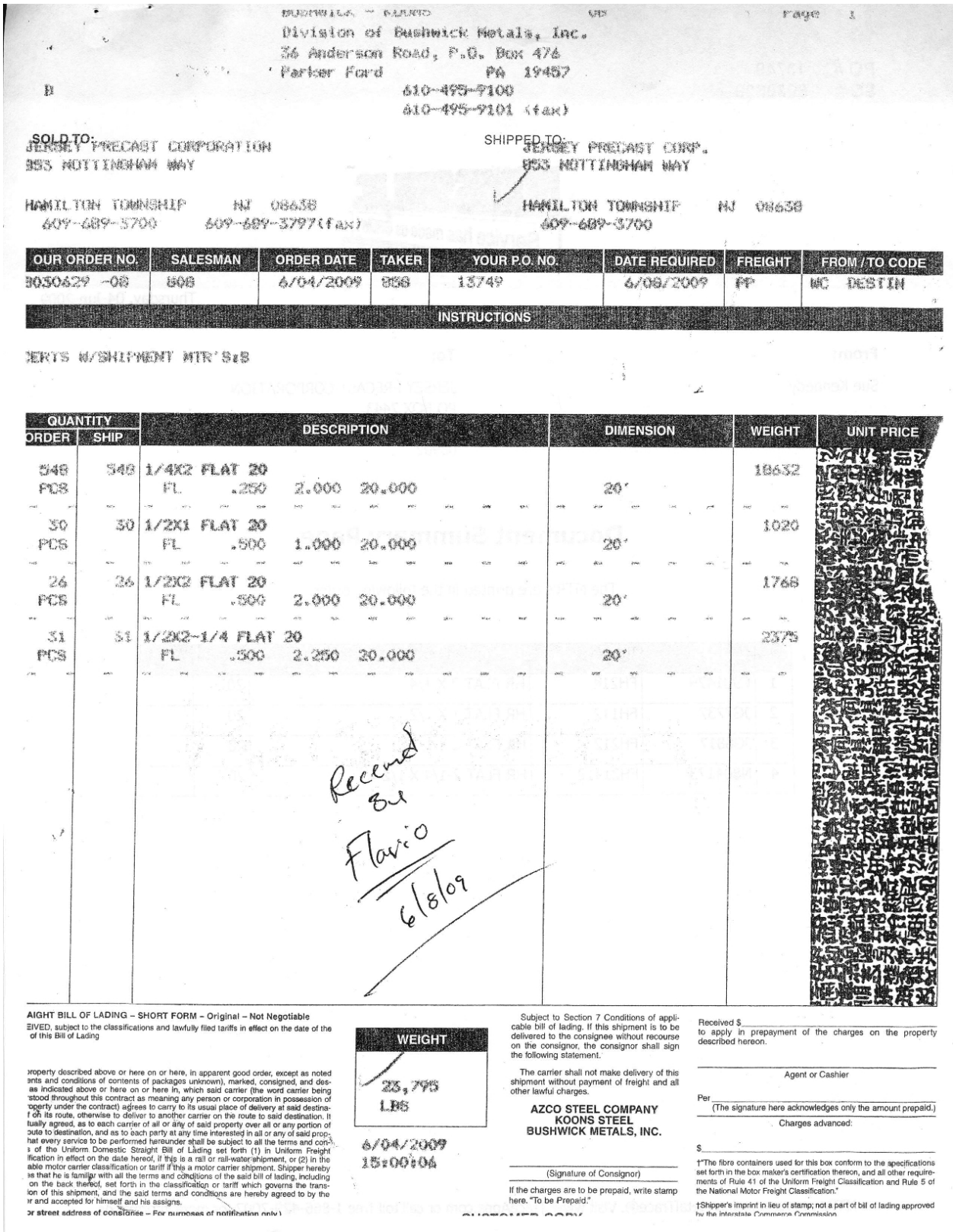
NOTARIZED UPON REQUEST:
SWORN TO AND SUBSCRIBED BEFORE ME IN AND FOR ST. JOHN
PARISH ON THIS _____ DAY OF _____, 20___

Michael E. Soileau, # 81887, Notary Public

SIGNED Mark Edwards
MARK EDWARDS, QUALITY ASSURANCE SUPERVISOR

DIRECT ANY QUESTIONS OR NECESSARY CLARIFICATIONS CONCERNING THIS REPORT TO THE SALES DEPARTMENT.
1-800-535-7692 (USA)

Figure A-16. Flat Plate Material Specifications, Test No. NYTCB-5



Division of Bushwick Metals, Inc.
36 Anderson Road, P.O. Box 476
Parker Ford PA 19457
610-495-7100
610-495-9101 (fax)

SOLD TO:
JERSEY PRECAST CORPORATION
953 NOTTINGHAM WAY
HAMILTON TOWNSHIP NJ 08638
609-689-3700 609-689-3797(fax)

SHIPPED TO:
JERSEY PRECAST CORP.
953 NOTTINGHAM WAY
HAMILTON TOWNSHIP NJ 08638
609-689-3700

OUR ORDER NO.	SALESMAN	ORDER DATE	TAKER	YOUR P.O. NO.	DATE REQUIRED	FREIGHT	FROM /TO CODE
3050629 -08	606	6/04/2009	858	13749	6/08/2009	PP	WC DESTIN

INSTRUCTIONS

CERTS W/SHIPMENT MTR'S:S

QUANTITY ORDER	QUANTITY SHIP	DESCRIPTION	DIMENSION	WEIGHT	UNIT PRICE
548 PCS	548	1/4X2 FLAT 20 FL .250 2.000 20.000	20'	18632	
30 PCS	30	1/2X1 FLAT 20 FL .500 1.000 20.000	20'	1020	
26 PCS	26	1/2X2 FLAT 20 FL .500 2.000 20.000	20'	1768	
31 PCS	31	1/2X2-1/4 FLAT 20 FL .500 2.250 20.000	20'	2375	

Received 8u
Flavio
6/8/09

STRAIGHT BILL OF LADING – SHORT FORM – Original – Not Negotiable

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the of this Bill of Lading

property described above or here on or here, in apparent good order, except as noted rents and conditions of contents of packages unknown), marked, consigned, and des- as indicated above or here on or here in, which said carrier (the word carrier being stood throughout this contract as meaning any person or corporation in possession of operty under the contract) agrees to carry to its usual place of delivery at said destina- f on its route, otherwise to deliver to another carrier on the route to said destination. It tually agreed, as to each carrier of all or any of said property over all or any portion of oute to destination, and as to each party at any time interested in all or any of said prop- hat every service to be performed hereunder shall be subject to all the terms and con- s of the Uniform Domestic Straight Bill of Lading set forth (1) in Uniform Freight ification in effect on the date hereof, if this is a rail or rail-water shipment, or (2) in the able motor carrier classification or tariff if this a motor carrier shipment. Shipper hereby as that he is familiar with all the terms and conditions of the said bill of lading, including on the back thereof, set forth in the classification or tariff which governs the trans- ion of this shipment, and the said terms and conditions are hereby agreed to by the r and accepted for himself and his assigns.

or street address of consignee – For purposes of notification only.)

WEIGHT
23,795
LBS

6/04/2009
15:00:06

Subject to Section 7 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.

AZCO STEEL COMPANY
KOONS STEEL
BUSHWICK METALS, INC.

(Signature of Consignor)

If the charges are to be prepaid, write stamp here, "To be Prepaid."

Received $_____ to apply in prepayment of the charges on the property described hereon.

Agent or Cashier

Per _____
(The signature here acknowledges only the amount prepaid.)

Charges advanced:

$_____

†"The fibre containers used for this box conform to the specifications set forth in the box maker's certification thereon, and all other requirements of Rule 41 of the Uniform Freight Classification and Rule 5 of the National Motor Freight Classification."

†Shipper's imprint in lieu of stamp; not a part of bill of lading approved by the Interstate Commerce Commission.

Figure A-17. Flat Plate Material Specifications, Test No. NYTCB-5

PO # 13749
SO# 8030629

KOONS STEEL, INC.
Service has made us GROW

Thursday, 04-Jun-2009

From:

Sue Kennedy

To:

JERSEY PRECAST CORPORATION
PO BOX 7443
NORTH BRUNSWICK, NJ, USA
08902

Document Summary Page

The MTR's are printed in the following order:

#	Heat#	Item#	Description	Length	Width
1	C901479	FH214	HR FLAT 2 X 1/4	20	
2	JG7737	FH112	HR FLAT 1 X 1/2	20	
3	JG8817	FH212	HR FLAT 2 X 1/2	20	
4	N804173	FH21412	HR FLAT 2-1/4 X 1/2	20	

MTRs produced using MetalTrace®. Visit www.TraceApps.com or call toll-free 1-866-429-7007 for more information.

Figure A-18. Flat Plate Material Specifications, Test No. NYTCB-5

GERDAU AMERISTEEL
:HARLOTTE STEEL MILL
:601 LAKEVIEW ROAD
:HARLOTTE NC 28269 USA
704) 596-0361

Chemical and Physical Test Report
MADE IN UNITED STATES

Page 1 of 2
C-531065

HIP TO	INVOICE TO	SHIP DATE
USHWICK KOONS STEEL 6 ANDERSON RD (OFF RT 724) 10-495-9162 (DAN) ARKER FORD, PA 19457	BUSHWICK KOONS STEEL PO BOX 476 PARKER FORD, PA 19457 0476	05/29/09 CUST. ACCOUNT NO 40200735

RODUCED IN: CHARLOTTE

HAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
1 1/4 X 1 1/4 X 1/4	A36	ASTM A36-05 & ASME SA36-08A	9156383-03	GRK246-03

EAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	Sn	C Eqv
300629	.17	.64	.011	.033	.17	.34	.11	.11	.030	.002	<.008	.012	.34

echanical Test: Yield 44899 PSI, 309.57 MPA Tensile: 67299 PSI, 464.01 MPA %El: 24.0/8in, 24.0/200MM
stomer Requirements CASTING: STRAND CAST

ODUCED IN: CHARLOTTE

IAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
/8 X 2 1/2	A36	ASTM A36-05 & ASME SA36-08A	9156383-06	GRK246-06

EAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	Sn	C Eqv
01474	.16	.70	.010	.025	.20	.32	.12	.12	.020	.001	<.008	.011	.34

chanical Test: Yield 47408 PSI, 326.87 MPA Tensile: 69317 PSI, 477.92 MPA %El: 29.0/8in, 29.0/200MM
stomer Requirements CASTING: STRAND CAST

ODUCED IN: CHARLOTTE

APE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
4 X 2	44W	CSA-G40.21-44W-98	9156383-04	GRK246-04

AT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Sn	C Eqv
01479	.17	.71	.014	.031	.21	.34	.15	.18	.030	.001	.012	.37

hanical Test: Yield 51136 PSI, 352.57 MPA Tensile: 72546 PSI, 500.19 MPA %El: 29.0/8in, 29.0/200MM
tomer Requirements CASTING: STRAND CAST

: material, including the billets, was produced and manufactured in the United
es of America

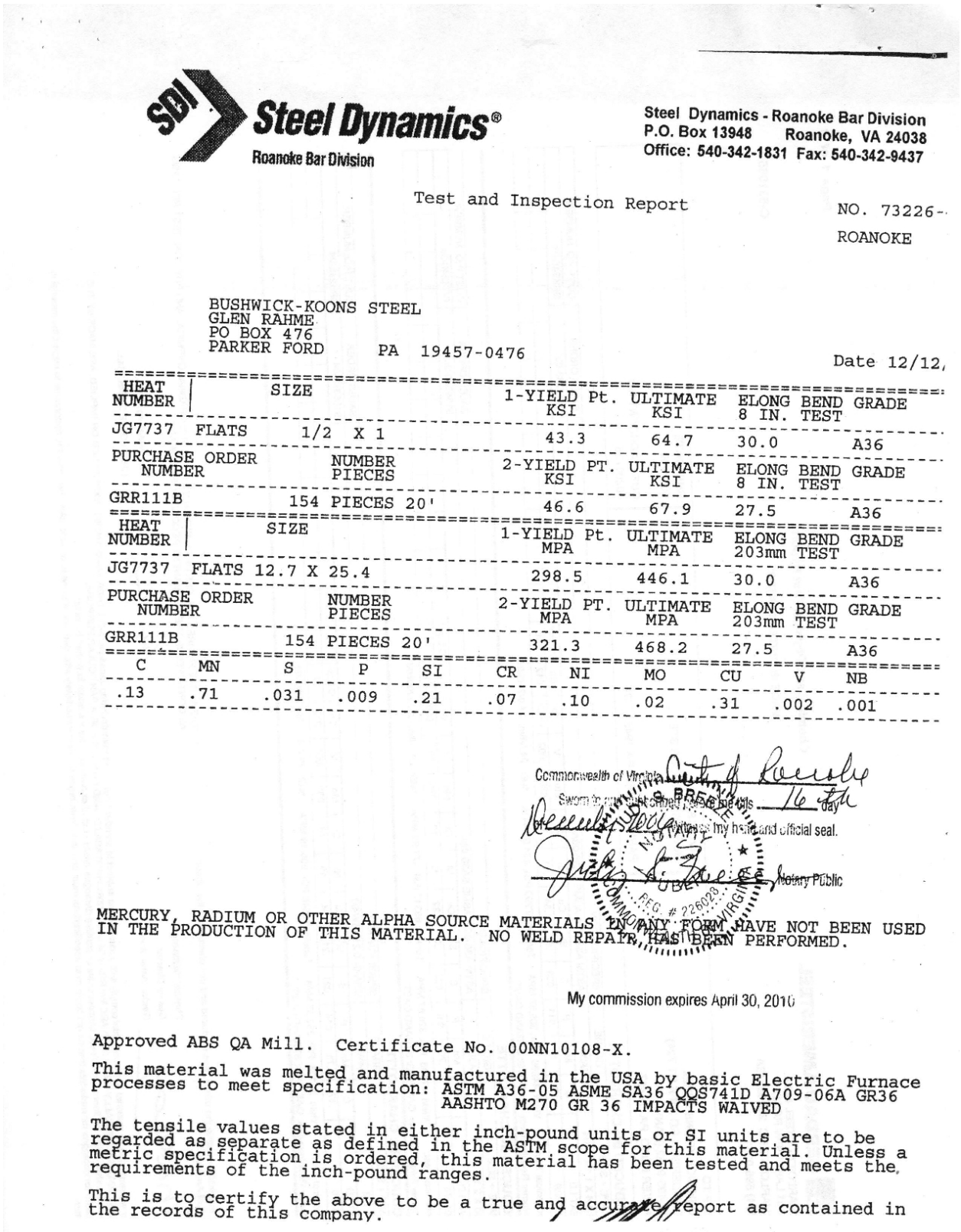
Bhaskar Yalamanchili
Quality Director
Gerdau Ameristeel

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

Mgr. Metallurg. Svcs.
CHARLOTTE STEEL MILL

r 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 LER, AND SPECIFICALLY EXCLUDED ARE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. event shall seller be liable for indirect, consequential or punitive damages arising out of or related to the materials furnished by seller. 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 tion.

Figure A-19. Flat Plate Material Specifications, Test No. NYTCB-5



Steel Dynamics®
Roanoke Bar Division

Steel Dynamics - Roanoke Bar Division
P.O. Box 13948 Roanoke, VA 24038
Office: 540-342-1831 Fax: 540-342-9437

Test and Inspection Report

NO. 73226-
ROANOKE

BUSHWICK-KOONS STEEL
GLEN RAHME
PO BOX 476
PARKER FORD PA 19457-0476

Date 12/12,

HEAT NUMBER	SIZE	1-YIELD Pt. KSI	ULTIMATE KSI	ELONG 8 IN.	BEND TEST	GRADE
JG7737	FLATS 1/2 X 1	43.3	64.7	30.0		A36
PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. KSI	ULTIMATE KSI	ELONG 8 IN.	BEND TEST	GRADE
GRR111B	154 PIECES 20'	46.6	67.9	27.5		A36

HEAT NUMBER	SIZE	1-YIELD Pt. MPA	ULTIMATE MPA	ELONG 203mm	BEND TEST	GRADE
JG7737	FLATS 12.7 X 25.4	298.5	446.1	30.0		A36
PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. MPA	ULTIMATE MPA	ELONG 203mm	BEND TEST	GRADE
GRR111B	154 PIECES 20'	321.3	468.2	27.5		A36

C	MN	S	P	SI	CR	NI	MO	CU	V	NB
.13	.71	.031	.009	.21	.07	.10	.02	.31	.002	.001

Commonwealth of Virginia
Sworn to and subscribed before me this 16th day
Witness my hand and official seal.
Notary Public
REG. # 226028
COMMONWEALTH OF VIRGINIA

MERCURY, RADIUM OR OTHER ALPHA SOURCE MATERIALS IN ANY FORM HAVE NOT BEEN USED IN THE PRODUCTION OF THIS MATERIAL. NO WELD REPAIR HAS BEEN PERFORMED.

My commission expires April 30, 2010

Approved ABS QA Mill. Certificate No. 00NN10108-X.

This material was melted and manufactured in the USA by basic Electric Furnace processes to meet specification: ASTM A36-05 ASME SA36 QOS741D A709-06A GR36 AASHTO M270 GR 36 IMPACTS WAIVED

The tensile values stated in either inch-pound units or SI units are to be regarded as separate as defined in the ASTM scope for this material. Unless a metric specification is ordered, this material has been tested and meets the requirements of the inch-pound ranges.

This is to certify the above to be a true and accurate report as contained in the records of this company.

Figure A-20. Flat Plate Material Specifications, Test No. NYTCB-5

Steel Dynamics®
Roanoke Bar Division

Steel Dynamics - Roanoke Bar Division
P.O. Box 13948 Roanoke, VA 24038
Office: 540-342-1831 Fax: 540-342-9437

Test and Inspection Report NO. 79312-4

ROANOKE

BUSHWICK-KOONS STEEL
GLEN RAHME
PO BOX 476
PARKER FORD PA 19457-0476

Date 5/22/

HEAT NUMBER	SIZE	1-YIELD Pt. KSI	ULTIMATE KSI	ELONG 8 IN.	BEND TEST	GRADE
JG8817	FLATS 1/2 X 2	41.2	64.5	31.3		A36
PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. KSI	ULTIMATE KSI	ELONG 8 IN.	BEND TEST	GRADE
GRR216B	78 PIECES 20'	43.2	64.4	28.8		A36

HEAT NUMBER	SIZE	1-YIELD Pt. MPA	ULTIMATE MPA	ELONG 203mm	BEND TEST	GRADE
JG8817	FLATS 12.7 X 50.8	284.1	444.7	31.3		A36
PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. MPA	ULTIMATE MPA	ELONG 203mm	BEND TEST	GRADE
GRR216B	78 PIECES 20'	297.9	444.0	28.8		A36

C	MN	S	P	SI	CR	NI	MO	CU	V	NB
.13	.75	.030	.006	.21	.07	.08	.02	.27	.002	.002

Commonwealth of Virginia City of Roanoke
Sworn to and subscribed before me this 27th day
of May 2009. Witness my hand and official seal.
Notary Public

MERCURY, RADIUM OR OTHER ALPHA SOURCE MATERIALS IN ANY FORM HAVE NOT BEEN USED IN THE PRODUCTION OF THIS MATERIAL. NO WELD REPAIR HAS BEEN PERFORMED.

My commission expires April 30, 2010

Approved ABS QA Mill. Certificate No. 00NN10108-X.

This material was melted and manufactured in the USA by basic Electric Furnace processes to meet specification: ASTM A36-05 ASME SA36 QQS741D A709-06A GR36 AASHTO M270 GR 36 IMPACTS WAIVED

The tensile values stated in either inch-pound units or SI units are to be regarded as separate as defined in the ASTM scope for this material. Unless a metric specification is ordered, this material has been tested and meets the requirements of the inch-pound ranges.

This is to certify the above to be a true and accurate report as contained in the records of this company

Figure A-21. Flat Plate Material Specifications, Test No. NYTCB-5

Page 4 of 6

GERDAU AMERISTEEL

CAMBRIDGE STEEL MILL
160 ORION PLACE
CAMBRIDGE ON N1T 1R9 CAN
(519) 740-2488

Chemical and Physical Test Report

MADE IN CANADA

N-070597

SHIP TO	INVOICE TO	SHIP DATE
BUSHWICK FISHER BROS. 1641 NEW MARKET AVE. SOUTH PLAINFIELD, NJ 07080	BUSHWICK METALS INC ACCTS PAYABLE 185 GREAT NECK ROAD ST-320 GREATNECK, NY 11021	04/16/09 **CUST. ACCOUNT NO** 40206708

PRODUCED IN: CAMBRIDGE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
F1/2 X 2 1/4 20	A36	ASTM A36/A36M-08; CSA-G40.21-300W-04(44W)	8019549-03	NJ-412R-03

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	B	N	Sn	Al	Ti	Zr	Ca	Zn	C Eqv
N804173	.19	.76	.022	.037	.25	.35	.09	.12	.020	.003	.003	.0003	.0114	.011	.002	.00100	.001	.00000	.00600	.38

Mechanical Test: Yield 52646 PSI, 362.98 MPA Tensile: 77056 PSI, 531.28 MPA %El: 24.0/8in, 24.0/200MM Red R 22.2 : 1
Customer Requirements CASTING: STRAND CAST
Mechanical Test: Yield 53333 PSI, 367.72 MPA Tensile: 77717 PSI, 535.84 MPA %El: 24.0/8in, 24.0/200MM Red R 22.2 : 1
Customer Requirements CASTING: STRAND CAST

PRODUCED IN: CAMBRIDGE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
F5/8 X 1 3/4 20	A36	ASTM A36/A36M-08; CSA-G40.21-300W-04(44W)	9144147-03	NJ-412R-03

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	B	N	Sn	Al	Ti	Zr	Ca	Zn	C Eqv
N804254	.18	.72	.016	.039	.19	.36	.12	.16	.030	.003	.002	.0002	.0066	.012	.001	.00100	.001	.00000	.00000	.37

Mechanical Test: Yield 49063 PSI, 338.28 MPA Tensile: 73645 PSI, 507.76 MPA %El: 23.0/8in, 23.0/200MM Red R 22.9 : 1
Customer Requirements CASTING: STRAND CAST
Mechanical Test: Yield 48521 PSI, 334.54 MPA Tensile: 73634 PSI, 507.69 MPA %El: 22.0/8in, 22.0/200MM Red R 22.9 : 1
Customer Requirements CASTING: STRAND CAST

This material, including the billets, was produced and manufactured in Canada

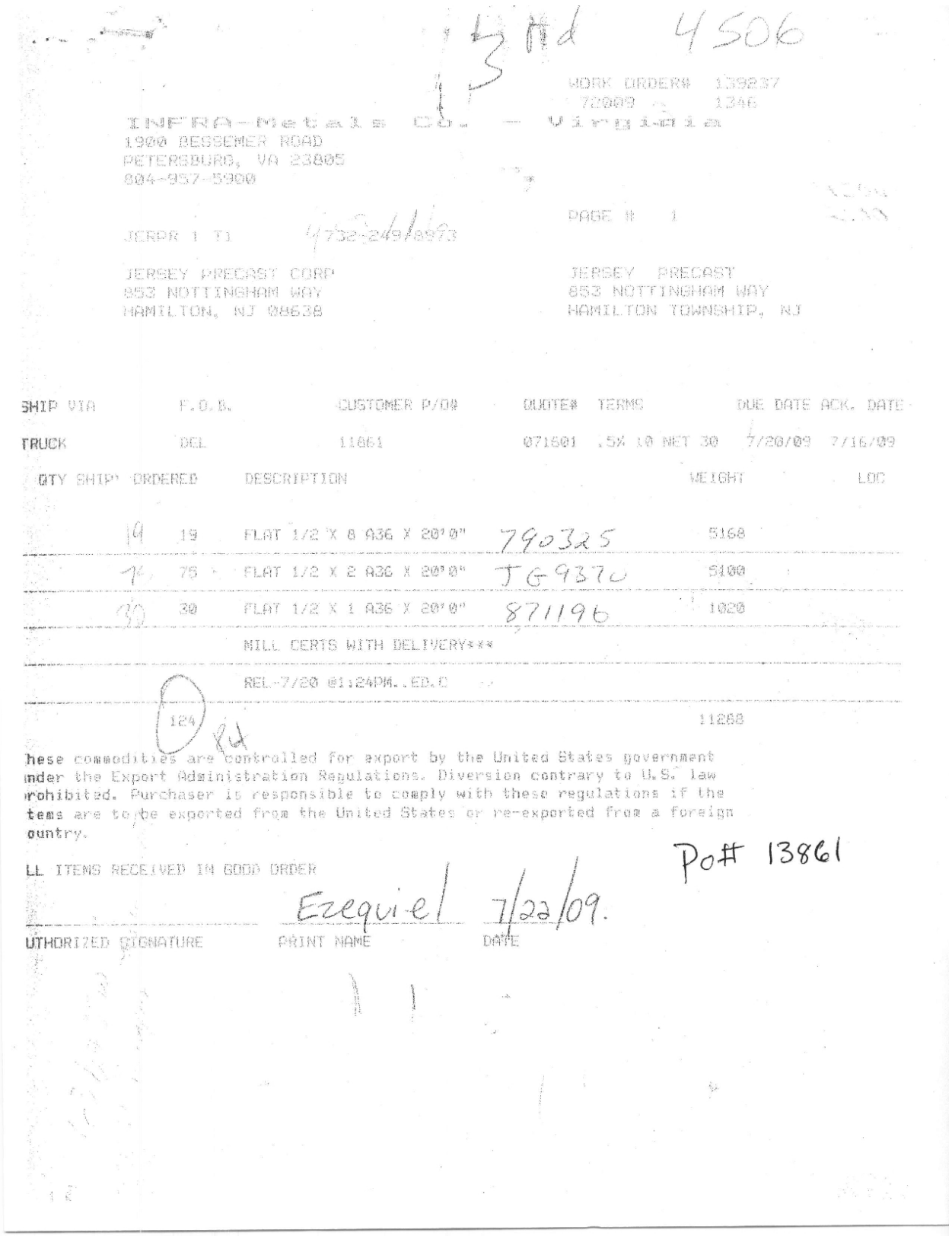
Bhaskar Yalamanchili
Quality Director
Gerdau Ameristeel

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

Mgr. Metallurg. Svcs.
CAMBRIDGE 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.

Figure A-22. Flat Plate Material Specifications, Test No. NYTCB-5



4506

WORK ORDER# 139237
72009 1346

INFRA-Metals Co. — Virginia
1900 BESSEMER ROAD
PETERSBURG, VA 23805
804-957-5900

PAGE # 1

JCRPR 1 TI 732-249-8973

JERSEY PRECAST CORP
853 NOTTINGHAM WAY
HAMILTON, NJ 08638

JERSEY PRECAST
853 NOTTINGHAM WAY
HAMILTON TOWNSHIP, NJ

SHIP VIA	F.O.B.	CUSTOMER P/O#	QUOTE#	TERMS	DUE DATE	ACK. DATE
TRUCK	DEL	11661	071501	.5% 10 NET 30	7/20/09	7/16/09

QTY SHIP	ORDERED	DESCRIPTION		WEIGHT	LOC
19	19	FLAT 1/2 X 8 A36 X 20'0"	790325	5168	
75	75	FLAT 1/2 X 2 A36 X 20'0"	JG937U	5100	
30	30	FLAT 1/2 X 1 A36 X 20'0"	871196	1020	
		MILL CERTS WITH DELIVERY***			
		REL-7/20 @1:24PM..ED.C			
				11288	

124

These commodities are controlled for export by the United States government
under the Export Administration Regulations. Diversion contrary to U.S. law
prohibited. Purchaser is responsible to comply with these regulations if the
items are to be exported from the United States or re-exported from a foreign
country.

ALL ITEMS RECEIVED IN GOOD ORDER

Po# 13861

Ezequiel 7/22/09.

AUTHORIZED SIGNATURE PRINT NAME DATE

Figure A-23. Flat Plate Material Specifications, Test No. NYTCB-5

Steel Dynamics®
Roanoke Bar Division

Steel Dynamics - Roanoke Bar Division
P.O. Box 13948 Roanoke, VA 24038
Office: 540-342-1831 Fax: 540-342-9437

Test and Inspection Report NO. 80149-0
ROANOKE

INFRA METALS -VA

1900 BESSEMER ROAD
PETERSBURG VA 23805-0000

Date 6/12/09

HEAT NUMBER	SIZE	1-YIELD Pt. KSI	ULTIMATE KSI	ELONG 8 IN. TEST	BEND TEST	GRADE
JG9370	FLATS 1/2 X 2	44.8	66.4	28.8		A36
PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. KSI	ULTIMATE KSI	ELONG 8 IN. TEST	BEND TEST	GRADE
V2161	78 PIECES 20'	45.1	67.2	27.5		A36

HEAT NUMBER	SIZE	1-YIELD Pt. MPA	ULTIMATE MPA	ELONG 203mm TEST	BEND TEST	GRADE
JG9370	FLATS 12.7 X 50.8	308.9	457.8	28.8		A36
PURCHASE ORDER NUMBER	NUMBER PIECES	2-YIELD PT. MPA	ULTIMATE MPA	ELONG 203mm TEST	BEND TEST	GRADE
V2161	78 PIECES 20'	311.0	463.3	27.5		A36

C	MN	S	P	SI	CR	NI	MO	CU	V	NB
.14	.71	.021	.011	.19	.15	.11	.03	.29	.002	.002

MERCURY, RADIUM OR OTHER ALPHA SOURCE MATERIALS IN ANY FORM HAVE NOT BEEN USED IN THE PRODUCTION OF THIS MATERIAL. NO WELD REPAIR HAS BEEN PERFORMED.

Approved ABS QA Mill. Certificate No. 00NN10108-X.

This material was melted and manufactured in the USA by basic Electric Furnace processes to meet specification: ASTM A36-05 ASME SA36 QQS741D A709-06A GR36 AASHTO M270 GR 36 IMPACTS WAIVED

The tensile values stated in either inch-pound units or SI units are to be regarded as separate as defined in the ASTM scope for this material. Unless a metric specification is ordered, this material has been tested and meets the requirements of the inch-pound ranges.

This is to certify the above to be a true and accurate report as contained in the records of this company.

Engineer of Tests: Charles R. Charlton

Figure A-24. Flat Plate Material Specifications, Test No. NYTCB-5

FROM **NUCOR**
AT Darlington, South Carolina
Phone: (843) 393-5841 Fax: (843) 395-8701

MILL TEST REPORT

BILL OF LADING
No. 471964 Page 1

Freight Prepaid

SOLD TO: INFRA-METALS
580 MIDDLETOWN BLVD
SUITE D-100
LANGHORNE, PA 19047
CUST# 4942
PHONE 215-741-1000

SHIP TO: INFRA-METALS
1900 BESSEMER ROAD
PETERSBURG, VA 23805

Carrier Name or Initials & No.: MITCHELL G
Carrier Code: 4470
Load No.: 31712
Point No.: 1706
Check In No.: 117
Route: SCRF-FLORE-CSXT
BL Printed: 12/17/07 21:22:34

Tag No.	P.O.	Size		Spec	Length	Pcs	Weight	Heat #	Tensil	Yield	EL	C	Mn	Si	S	P	V	Nb	Cu	Cr	Ni	Mo	CE
407070574	V9867	31/2X	31/2X	1/2 A36	40' 00"	23	10,212	776260	72000	48000	28	.18	.77	.17	.030	.010	.003	.00	.40	.15	.11	.03	.37
									72000	49000	27												
107193427	V9599	2X	2X	1/4 A36/36M	40' 00"	81	10,335	777592	73000	51000	27	.19	.67	.16	.050	.010	.004	.00	.45	.14	.11	.03	.37
									74000	52000	25												
107193428	V9599	2X	2X	1/4 A36/36M	40' 00"	81	10,335	777592	73000	51000	27	.19	.67	.16	.050	.010	.004	.00	.45	.14	.11	.03	.37
									74000	52000	25												
307001909	V9867	1/2X	1	A36	20' 00"	140	4,760	871196	68000	48000	29	.15	.67	.20	.040	.020	.004	.00	.30	.18	.10	.03	.33
									68000	49000	30												
307002374	V9867	6X	6X	3/8 A36	40' 00"	17	10,132	871251	75000	57000	21	.14	.79	.18	.040	.001	.003	.00	.37	.16	.24	.05	.35
									75000	57000	21												

Total 342 45,774 Tons 22.887

Grade A36 meets all requirements for grades ASTM A36-05, A709-06a GR36(250), ASME SA36-04(250), and AASHTO M270-05 GR36(250)
Grade A36/A36M meets all requirements for grades ASTM A36-05, A529-05 GR50(345), A709-06a GR36,(250) ASME SA36-04(250)and AASHTO M270-05 GR36(250)

TARP!! INFRA TRK NO TARP. CALL CUST PRIOR TO LOADING FOR APPT. VERT/HOR BLK
SHIP 20' TOGETHER. 40' TOGETHER FILL LOAD W/ 20'PP/RAIL$1.19CWT THRU9/30/08

GRADE A36/36M MEETS ASTM A36-05 AND ASTM A529-50 - A36 MEETS ASTM A36-05

WELDING OR WELD REPAIR WAS NOT PERFORMED ON THIS MATERIAL.
MELTED AND MANUFACTURED IN THE U.S.A.
MERCURY, RADIUM OR ALPHA SOURCE MATERIALS IN ANY FORM HAVE NOT BEEN USED IN THE PRODUCTION OF THIS MATERIAL.

WE HEREBY CERTIFY THAT THE ABOVE FIGURES ARE CORRECT AS CONTAINED IN THE RECORDS OF NUCOR STEEL
JAMES H. BLEW
CHIEF METALLURGIST

NUCOR
300 STEEL MILL ROAD
DARLINGTON, SC 29540
Permanent post office address of shipper
SLS-FRM-08 REV DATE: 07/16/07 REV:4 APPROVAL:RLJ

Figure A-25. Flat Plate Material Specifications, Test No. NYTCB-5

MILL TEST REPORT

FROM **NUCOR** BAR MILL DARLINGTON
AT Darlington, South Carolina BL Printed: 6/08/09 14:38:46 Load # 71717 BOL # 508479

NUCOR
BAR MILL GROUP
DARLINGTON DIVISION
TELEPHONE 843/393-5841

508479
PAGE 1

BILL OF LADING NO.

Prepaid

R J

SOLD TO:
Cust# 4942 WESTERN EX
INFRA METALS
580 MIDDLETOWN BLVD
STE D 100
LANGHORNE, PA
215-741-1000 19047

SHIP TO:
INFRA-METALS
1900 BESSEMER RD
PETERSBURG, VA
804-957-5900 23805

P - 1706 C - 1499
WESTERN EX 33

Tag No.	P.O.	Size	Spec	Length	Pcs	Weight	Heat #	Tensil	Yield	EL	C	Mn	Si	S	P	V	Nb	Cu	Cr	Ni	Mo	CE
409004758	V2160	1/2X 8	A36	20' 00'	18	4,896	790325	70000	50000	26	.15	.65	.18	.040	.010	.003	.00	.51	.09	.13	.03	.32
								69000	49000	28												
409014881	V2160	3X 3X 1/2	A36	40' 00'	28	10,472	791625	70000	50000	25	.23	.72	.14	.040	.010	.003	.00	.32	.09	.10	.02	.40
409017879	V2160	6CX 8.2	A36	40' 00'	30	9,840	791974	77000	51000	28	.20	.72	.15	.040	.020	.005	.00	.61	.17	.13	.03	.40
								77000	51000	27												
409017880	V2160	6CX 8.2	A36	40' 00'	30	9,840	791974	77000	51000	28	.20	.72	.15	.040	.020	.005	.00	.61	.17	.13	.03	.40
								77000	51000	27												
409017559	V2160	4X 3X 3/8	A36/36M	40' 00'	30	10,200	791977	78000	52000	30	.24	.78	.16	.040	.010	.005	.00	.31	.12	.09	.02	.42
								78000	52000	29												

Total 136 45,248 Tons 22.624

Grade A36 meets all requirements for grades ASTM A36 05, A709-06a GR36(250), ASME SA36-04(250), and AASHTO M270-05 GR36(250)
Grade A36/A36M meets all requirements for grades ASTM A36-05, A529-05 GR50(345), A709-06a GR36(250), ASME SA36-04(250) and AASHTO M270-05 GR36(250

TARP!! INFRA TRK NO TARP.CALL CUST PRIOR TO LOAD APPT.VERT/HOR BLK/W/WOOD
SHIP 20' TOGETHER. 40' TOGETHER FILL LOAD W/ 20'PP/RAIL$1.28CWT THRU9/30/09
SCRF-FLURE-CSXT CUSTOMER RELEASE - PREPAID TRUCK
GRADE A36/36M MEETS ASTM A36-05 AND ASTM A529-50 - A36 MEETS ASTM A36-05

CC JANICE

SLS-FRM-08 REVISION:1 REVISION DATE: 8/10/97

Permanent address of shipper:
NUCOR
300 STEEL MILL ROAD
DARLINGTON, S.C. 29540

WELDING OR WELD REPAIR WAS NOT PERFORMED ON THIS MATERIAL
MELTED AND MANUFACTURED IN THE USA
MERCURY, RADIUM OR ALPHA SOURCE MATERIALS IN ANY FORM HAVE NOT BEEN USED IN THE PRODUCTION OF THIS MATERIAL

WE HEREBY CERTIFY THAT THE ABOVE FIGURES ARE CORRECT AS CONTAINED IN THE RECORDS OF NUCOR STEEL.

James H. Blew
Chief Metallurgist

Figure A-26. Flat Plate Material Specifications, Test No. NYTCB-5

Page 5 of 5 1v8284

GERDAU AMERISTEEL

CHARLOTTE STEEL MILL
6601 LAKEVIEW ROAD
CHARLOTTE NC 28269 USA
(704) 596-0361

Chemical and Physical Test Report

MADE IN UNITED STATES

C-524824

SHIP TO	INVOICE TO	SHIP DATE
STEEL AND PIPE SUPPY CO INC 401 NEW CENTURY PARKWAY 785-587-5185 NEW CENTURY, KS 66031	STEEL AND PIPE SUPPLY CO. INC. PO BOX 1688 MANHATTAN, KS 66505-1688	09/29/08 **CUST. ACCOUNT NO** 40130833

PRODUCED IN: CHARLOTTE

SHAPE + SIZE	GRADE	SPECIFICATION	SALES ORDER	CUST P.O. NUMBER
R1	A36	ASTM A36-03A	8075224-01	4500108284-01

HEAT I.D.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Nb	Sn	C Eqv
C806750	.16	.65	.012	.035	.22	.36	.10	.11	.020	.002	<.008	.013	.33

Mechanical Test: Yield 51353 PSI, 354.07 MPA Tensile: 71723 PSI, 494.51 MPA %El: 26.5/8in, 26.5/200MM

Customer Requirements CASTING: STRAND CAST

Customer Notes

A36: ASTM A36-00A & ASTM A709 GR36

This material, including the billets, was produced and manufactured in the United States of America

Bhaskar Yalamanchili
Quality Director
Gerdau Ameristeel

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

Mgr. Metallurg. Svcs.
CHARLOTTE 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.

Figure A-27. Steel Anchor Rod Material Specifications, Test No. NYTCB-5

Appendix B. Vehicle Center of Gravity Determination

NYTCB-5 Vehicle: Ram (2270P)

Vehicle CG Determination

VEHICLE	Equipment	Weight	Long CG	Vert CG	HOR M	Vert M
+	Unbalasted Truck(Curb)	5109	61.56149	28.08136	314517.7	143467.7
+	Brake receivers/wires	5	110	52	550	260
+	Brake Frame	5	38	26	190	130
+	Brake Cylinder (Nitrogen)	28	74	27	2072	756
+	Strobe/Brake Battery	5	79	32	395	160
+	Hub	22	0	14.8125	0	325.875
+	CG Plate (EDRs)	6	55	32	330	192
-	Battery	-41	-7	40	287	-1640
-	Oil	-6	10	17	-60	-102
-	Interior	-73	66	23	-4818	-1679
-	Fuel	-167	114.5	18	-19121.5	-3006
-	Coolant	-13	-20	36	260	-468
-	Washer fluid	-5	-16	35	80	-175
BALLAST	Water	110	114.5	18	12595	1980
	Misc. DTS	20	70	29	1400	580
	Misc.				0	0
					308677.2	140781.6
	TOTAL WEIGHT	5005			61.67376	28.12818

wheel base 140.25

Calculated Test Inertial Weight

MASH Targets	Targets	CURRENT	Difference
Test Inertial Weight	5000	5005	5.0
Long CG	62	61.67	-0.32624
Vert CG	28	28.13	0.12818

Note, Long. CG is measured from front axle of test vehicle

Curb Weight

	Left	Right
Front	1523	1346
Rear	1090	1150
FRONT	2869	
REAR	2240	
TOTAL	5109	

Actual test inertial weight (from scales)

	Left	Right
Front	1394	1364
Rear	1100	1095
FRONT	2758	
REAR	2195	
TOTAL	4953	

Figure B-1. Vehicle Mass Distribution, Test No. NYTCB-5

Appendix C. Vehicle Deformation Records

VEHICLE PRE/POST CRUSH
FLOORPAN - SET 1

TEST: NYTCB-5
VEHICLE: Ram (2270P)

Note: If impact is on driver side need to enter negative number for Y

POINT	X	Y	Z	X'	Y'	Z'	DEL X	DEL Y	DEL Z
1	26.25	11.75	0	26	11.5	1.5	-0.25	-0.25	1.5
2	26.5	16.75	-1.25	26.5	17.75	1.25	0	1	2.5
3	31.75	22.5	-1.5	25.25	22.25	4.25	-6.5	-0.25	5.75
4	30.5	28	0	26.75	28.75	2.75	-3.75	0.75	2.75
5	22.5	10.5	-1.25	22.5	10.25	-0.5	0	-0.25	0.75
6	25.25	17	-4	24.25	17	-2.25	-1	0	1.75
7	26.25	22.75	-6	21	22.75	-3.75	-5.25	0	2.25
8	27	30.25	-4	25	29.25	-2.5	-2	-1	1.5
9	15.5	3.5	-3	15.25	3.5	-2.75	-0.25	0	0.25
10	17.5	10.75	-4	17.5	10.75	-3.25	0	0	0.75
11	19.5	16	-8	19	15.75	-7.25	-0.5	-0.25	0.75
12	20.25	22.25	-9	19	22.25	-8.25	-1.25	0	0.75
13	20.5	28.75	-8.75	20	29	-8.75	-0.5	0.25	0
14	11	3	-3.5	10.75	3	-3	-0.25	0	0.5
15	14.75	10.75	-6.5	15	10	-6.25	0.25	-0.75	0.25
16	16.5	16.75	-9.25	16.5	16.5	-9	0	-0.25	0.25
17	16.75	24	-9	16.75	24	-9.25	0	0	-0.25
18	16.5	29.25	-8.75	16.5	29.25	-9	0	0	-0.25
19	7.5	4.5	-3.75	7.25	4.5	-3.75	-0.25	0	0
20	10	11.75	-9.25	10	11.5	-9.25	0	-0.25	0
21	10	18.5	-9	10.25	18	-9.25	0.25	-0.5	-0.25
22	10.5	24.5	-8.5	10	24.5	-9.25	-0.5	0	-0.75
23	10.25	29.5	-8.5	10.5	29	-8.75	0.25	-0.5	-0.25
24	1.25	4.75	-3.25	1.25	4.75	-3	0	0	0.25
25	0.75	11.75	-5.25	0.75	11.5	-5.25	0	-0.25	0
26	0.75	17.25	-5	0.75	17	-5	0	-0.25	0
27	0.75	22.25	-4.75	0.75	22	-4.75	0	-0.25	0
28	0.75	28.25	-4.5	0.75	28	-4.5	0	-0.25	0
29							0	0	0
30							0	0	0
31							0	0	0

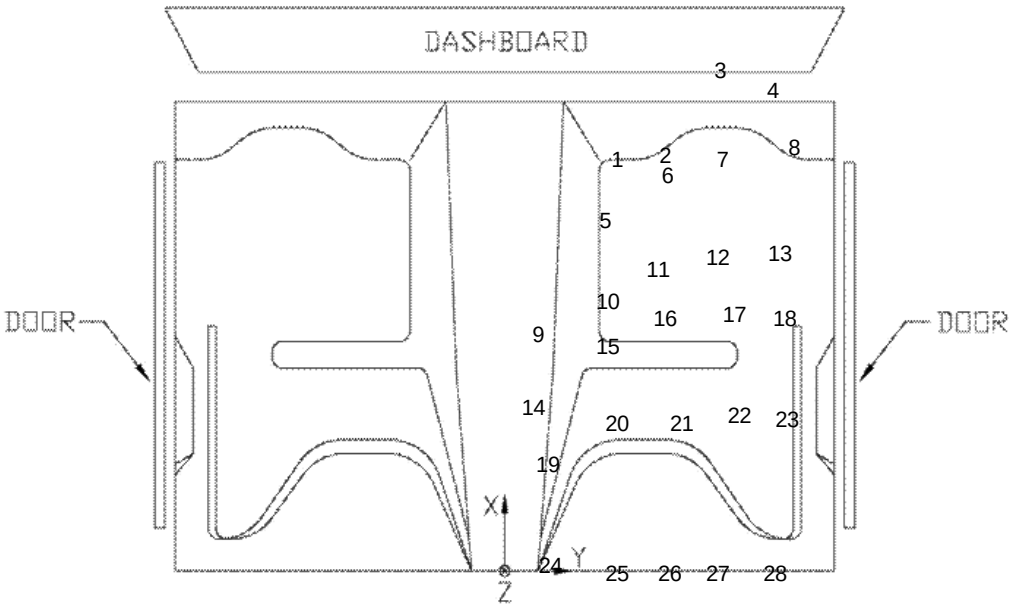


Figure C-1. Floor Pan Deformation Data – Set 1, Test No. NYTCB-5

VEHICLE PRE/POST CRUSH
FLOORPAN - SET 2

TEST: NYTCB-5
VEHICLE: Ram (2270P)

Note: If impact is on driver side need to enter negative number for Y

POINT	X	Y	Z	X'	Y'	Z'	DEL X	DEL Y	DEL Z
1	49	17.5	0	48.25	17.5	1.25	-0.75	0	1.25
2	52	22.5	-1.5	49	23.25	0.75	-3	0.75	2.25
3	54.5	29	-2.25	47.25	28.25	3.25	-7.25	-0.75	5.5
4	53	34.5	-1.5	49.25	35	1.5	-3.75	0.5	3
5	45.25	16.25	-1.25	45	16.5	-0.25	-0.25	0.25	1
6	48	23.5	-4.25	47	23	-2.75	-1	-0.5	1.5
7	49.25	28.75	-6.75	44	28.5	-4	-5.25	-0.25	2.75
8	50	36.5	-5.25	47.75	35.25	-4	-2.25	-1.25	1.25
9	38.25	9.75	-2.25	38.25	9.75	-2	0	0	0.25
10	40.75	17	-3.75	40.25	16.75	-3	-0.5	-0.25	0.75
11	42.5	22	-8	42	21.75	-7.5	-0.5	-0.25	0.5
12	43.25	28.75	-9.75	42	28.5	-9	-1.25	-0.25	0.75
13	43.5	35	-10	43.25	34.25	-10.25	-0.25	-0.75	-0.25
14	34	9.25	-2.75	33.75	9.25	-2.25	-0.25	0	0.5
15	38	17	-6.5	38	15.75	-6	0	-1.25	0.5
16	39.75	23	-9.75	39.5	22.75	-9.5	-0.25	-0.25	0.25
17	39.75	29.75	-9.75	39.75	29	-10	0	-0.75	-0.25
18	39.75	35	-10	39.75	35	-10.25	0	0	-0.25
19	30.5	11	-3	30.25	10.75	-3	-0.25	-0.25	0
20	33.5	18.25	-9.25	33.25	17.5	-9.25	-0.25	-0.75	0
21	33.75	24.25	-9.5	33.5	24.25	-9.75	-0.25	0	-0.25
22	33.75	30.75	-9.5	33.5	30.5	-10	-0.25	-0.25	-0.5
23	33.75	36	-9.75	33.75	35.5	-10	0	-0.5	-0.25
24	24.25	11	-2.5	24.25	11	-2.25	0	0	0.25
25	23.25	18.25	-5.25	23.75	17.75	-5	0.5	-0.5	0.25
26	24	23.5	-5.5	24	23	-5.25	0	-0.5	0.25
27	24	28.75	-5.5	24	28.5	-5.5	0	-0.25	0
28	24	34.5	-5.75	24	34.5	-6	0	0	-0.25
29							0	0	0
30							0	0	0
31							0	0	0

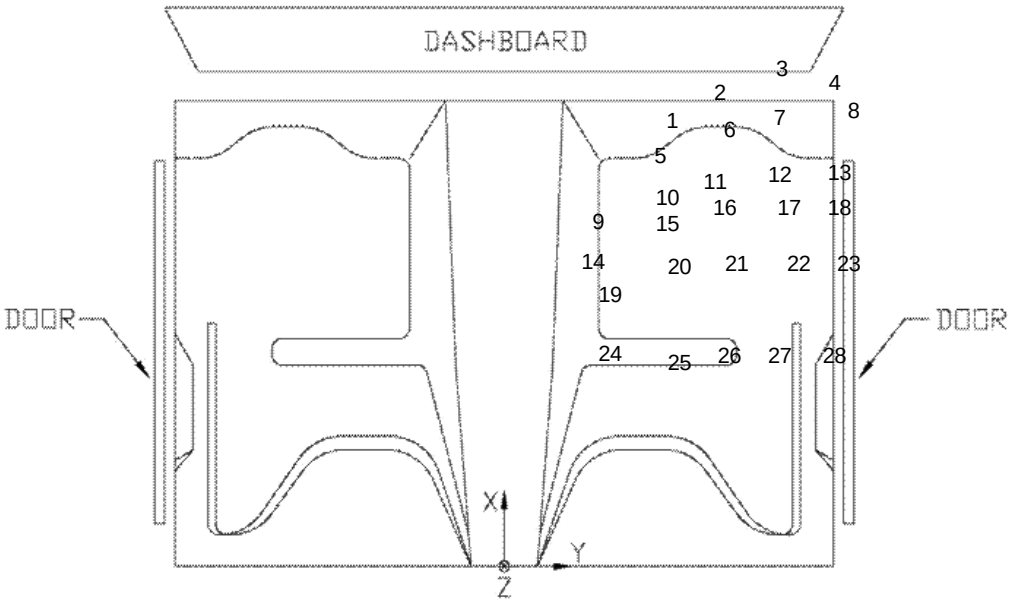


Figure C-2. Floor Pan Deformation Data – Set 2, Test No. NYTCB-5

VEHICLE PRE/POST CRUSH
INTERIOR CRUSH - SET 1

TEST: NYTCB-5
VEHICLE: Ram (2270P)

Note: If impact is on driver side need to enter negative number for Y

	POINT	X	Y	Z	X'	Y'	Z'	DEL X	DEL Y	DEL Z
DASH	A1	28.5	11	23.5	29.5	11.25	23.75	1	0.25	0.25
	A2	30.5	23.25	22.25	30	23.25	22.5	-0.5	0	0.25
	A3	30.5	37	22	30.25	37	22.5	-0.25	0	0.5
	A4	26	14	11.5	25.75	14	11.75	-0.25	0	0.25
	A5	27.5	27.75	15.5	27.5	27.25	15.75	0	-0.5	0.25
	A6	28	40	16.25	28	39.75	16.75	0	-0.25	0.5
SIDE PANEL	B1	40.5	43	-1.5	40.5	42.5	-1.25	0	-0.5	0.25
	B2	38	43	-5	38	42.5	-4.5	0	-0.5	0.5
	B3	35.5	43	-1	35.75	42.25	-0.5	0.25	-0.75	0.5
IMPACT SIDE DOOR	C1	28	44	17.75	28.5	43	17.75	0.5	-1	0
	C2	14.25	44	19.25	13.75	45.5	19.25	-0.5	1.5	0
	C3	2.25	44	20	1.5	46.5	19.5	-0.75	2.5	-0.5
	C4	31.5	45.5	-0.25	30.75	44.5	-0.25	-0.75	-1	0
	C5	18	45	0.25	17.5	45	0.75	-0.5	0	0.5
	C6	0.5	45.25	-1.75	0.25	45.75	-1	-0.25	0.5	0.75
ROOF	D1							0	0	0
	D2							0	0	0
	D3	This section is not applicable						#VALUE!	0	0
	D4							0	0	0
	D5							0	0	0
	D6							0	0	0
	D7							0	0	0
	D8							0	0	0
	D9							0	0	0
	D10							0	0	0
	D11							0	0	0
	D12							0	0	0
	D13							0	0	0
	D14							0	0	0
	D15							0	0	0

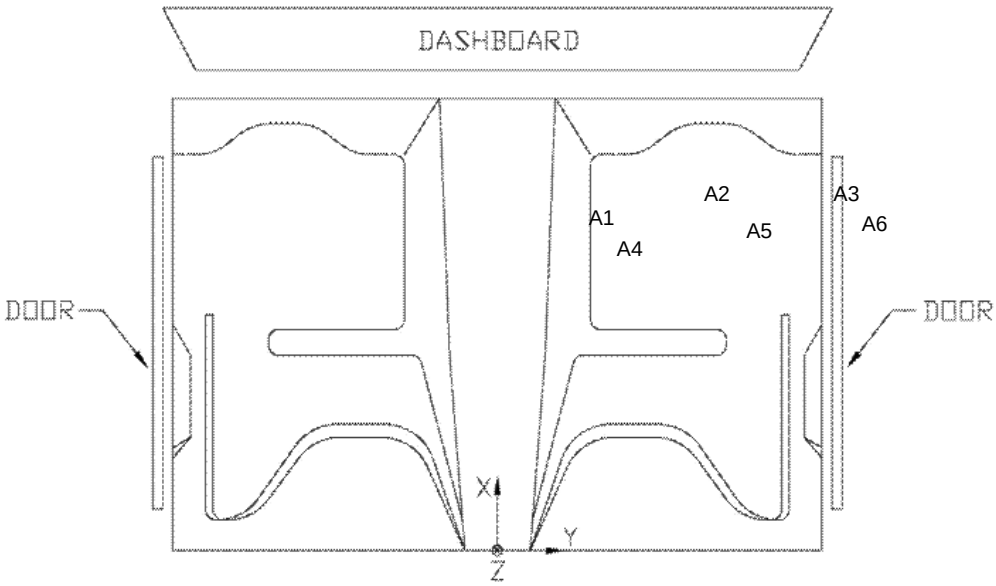


Figure C-3. Occupant Compartment Deformation Data – Set 1, Test No. NYTCB-5

VEHICLE PRE/POST CRUSH
INTERIOR CRUSH - SET 2

TEST: NYTCB-5
VEHICLE: Ram (2270P)

Note: If impact is on driver side need to enter negative number for Y

	POINT	X	Y	Z	X'	Y'	Z'	DEL X	DEL Y	DEL Z
DASH	A1	49.75	24	24	49.75	24.25	24.25	0	0.25	0.25
	A2	50.25	36.5	22	50.5	36.5	22.25	0.25	0	0.25
	A3	50.25	49.75	20.75	50.5	49.5	21.5	0.25	-0.25	0.75
	A4	46.75	27	12.25	47	27	12.5	0.25	0	0.25
	A5	47.25	40.5	14.75	47.5	41	15.25	0.25	0.5	0.5
	A6	48.25	52.75	14.75	48.5	52.75	15.5	0.25	0	0.75
SIDE PANEL	B1	61.5	54.75	-3	62	54.25	-2.75	0.5	-0.5	0.25
	B2	59.25	54.75	-6	60	54	-6	0.75	-0.75	0
	B3	56.75	54.75	-2.25	57	54.5	-2.25	0.25	-0.25	0
IMPACT SIDE DOOR	C1	49.25	57	16	49.75	57.25	16.25	0.5	0.25	0.25
	C2	34.5	57	17.5	35.25	58	17.5	0.75	1	0
	C3	21.75	57	17.75	22.75	58.75	18	1	1.75	0.25
	C4	52.5	56.25	-2	53	56	-2	0.5	-0.25	0
	C5	39	56.75	-1	39.5	57	-1	0.5	0.25	0
	C6	21.25	56.25	-3.5	22.25	56.5	-3.25	1	0.25	0.25
ROOF	D1							0	0	0
	D2							0	0	0
	D3	This section is not applicable						#VALUE!	0	0
	D4							0	0	0
	D5							0	0	0
	D6							0	0	0
	D7							0	0	0
	D8							0	0	0
	D9							0	0	0
	D10							0	0	0
	D11							0	0	0
	D12							0	0	0
	D13							0	0	0
	D14							0	0	0
	D15							0	0	0

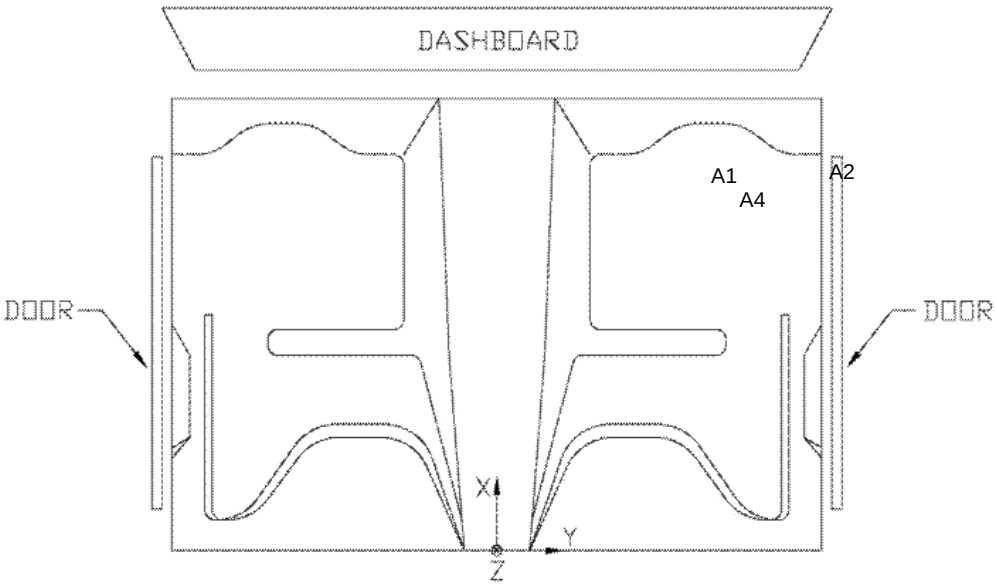
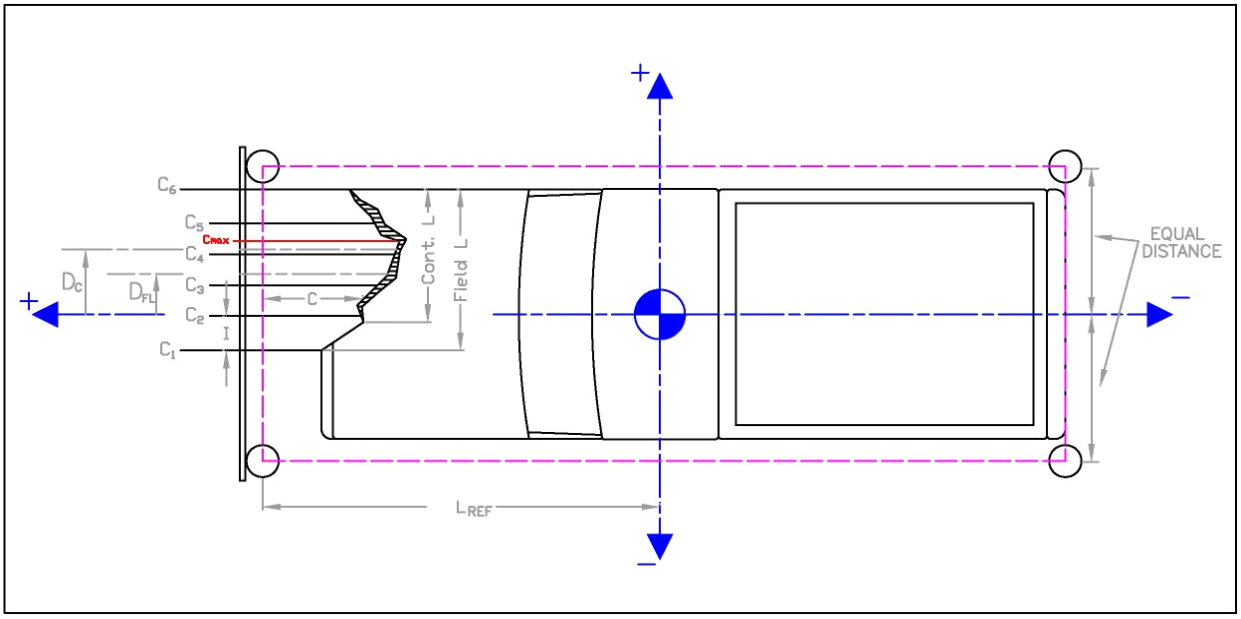


Figure C-4. Occupant Compartment Deformation Data – Set 2, Test No. NYTCB-5

Date: 9/10/2009 **Test Number:** NYTCB-5

Make: Dodge **Model:** Ram (2270P) **Year:** 2003



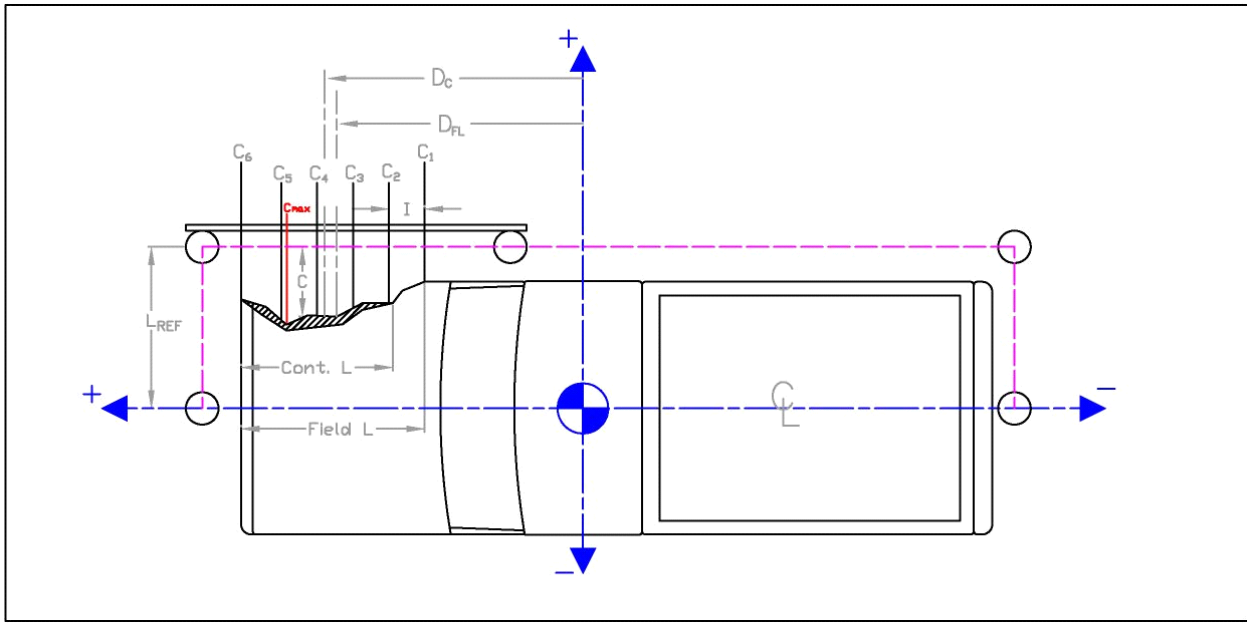
	in.	(mm)
Distance from C.G. to reference line - L_{REF}:	119.5	(3035)
Width of contact and induced crush - Field L:	22.37	(568)
Crush measurement spacing interval (L/5) - I:	4.474	(114)
Distance from center of vehicle to center of Field L - D_{FL}:	27.435	(697)
Width of Contact Damage:	22.37	(568)
Distance from center of vehicle to center of contect damage - D_C:	27.43	(697)

	Crush Measurement		Lateral Location		Original Profile Measurement		Dist. Between Ref. Lines		Actual Crush	
	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
C_1	21	(533)	16.25	(413)	11.797	(300)	8.0762	(205)	1.1269	(29)
C_2	25.5	(648)	20.724	(526)	12.625	(321)			4.7988	(122)
C_3	33	(838)	25.198	(640)	14.063	(357)			10.861	(276)
C_4	NA	NA	29.672	(754)	15.906	(404)			NA	NA
C_5	NA	NA	34.146	(867)	19.25	(489)			NA	NA
C_6	NA	NA	38.62	(981)	29	(737)			NA	NA
C_{MAX}	44	(1118)	29	(737)	15.688	(398)			20.236	(514)

Figure C-5. Exterior Vehicle Crush (NASS) - Front, Test No. NYTCB-5

Date: 9/10/2009 **Test Number:** NYTCB-5

Make: Dodge **Model:** Ram (2270P) **Year:** 2003



	in.	(mm)
Distance from centerline to reference line - L_{REF}:	46	(1168)
Width of contact and induced crush - Field L:	227.5	(5779)
Crush measurement spacing interval (L/5) - I:	45.5	(1156)
Distance from vehicle c.g. to center of Field L - D_{FL}:	-12.08	-(307)
Width of Contact Damage:	227.5	(5779)
Distance from vehicle c.g. to center of contect damage - D_C:	12.1	(307)

	Crush Measurement		Longitudinal Location		Original Profile Measurement		Dist. Between Ref. Lines		Actual Crush	
	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
C_1	8	(203)	-125.8	-(3196)	15.688	(398)	-4	-(102)	-3.688	-(94)
C_2	NA	NA	-80.33	-(2040)	10.5	(267)			NA	NA
C_3	6.5	(165)	-34.83	-(885)	11.604	(295)			-1.104	-(28)
C_4	7.75	(197)	10.67	(271)	11.25	(286)			0.5	(13)
C_5	NA	NA	56.17	(1427)	10.5	(267)			NA	NA
C_6	NA	NA	101.67	(2582)	36.125	(918)			NA	NA
C_{MAX}	18.5	(470)	79	(2007)	11.25	(286)			11.25	(286)

Figure C-6. Exterior Vehicle Crush (NASS) - Side, Test No. NYTCB-5

Appendix D. Accelerometer and Rate Transducer Data Plots, Test No. NYTCB-5

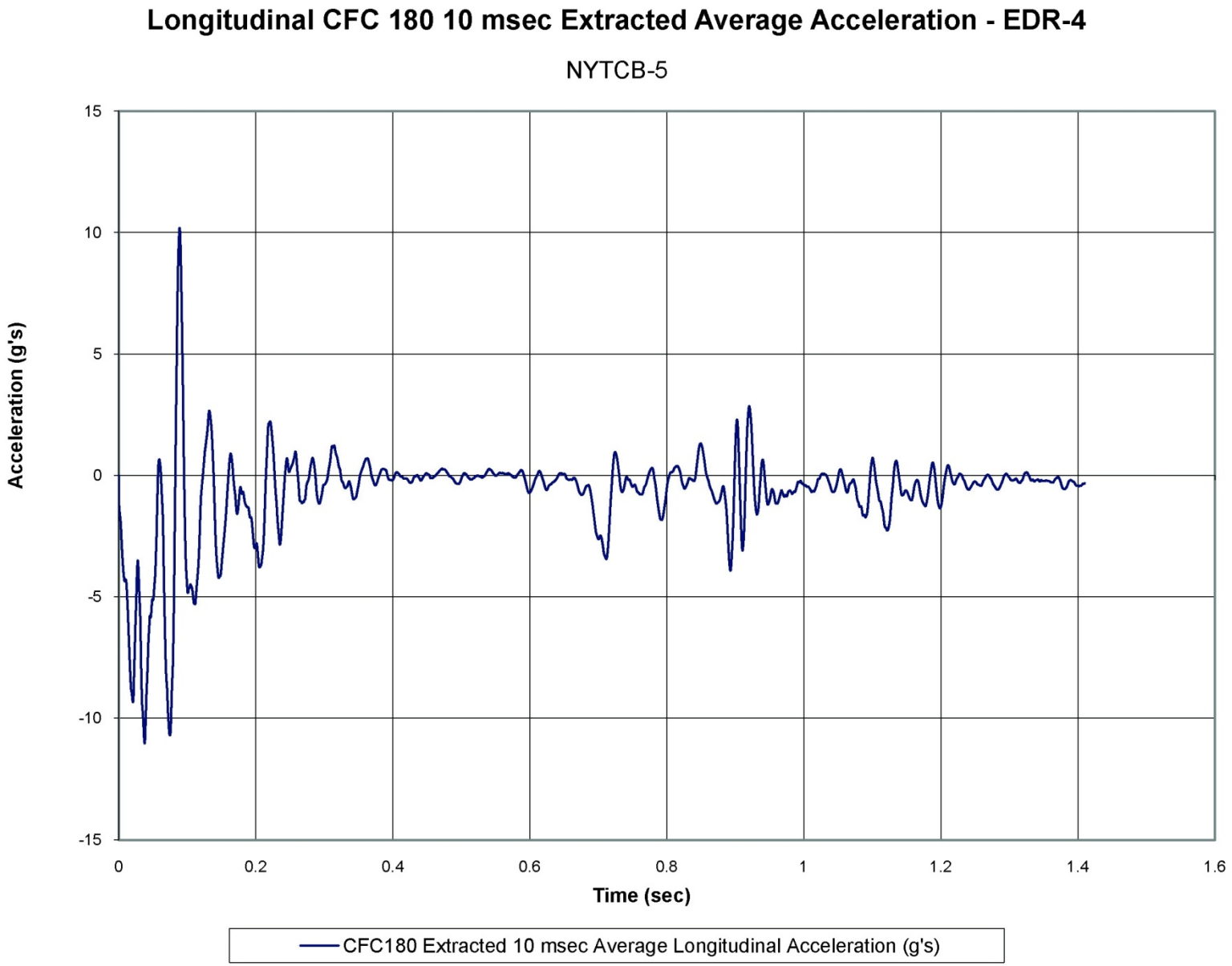


Figure D-1. 10-ms Average Longitudinal Deceleration (EDR-4), Test No. NYTCB-5

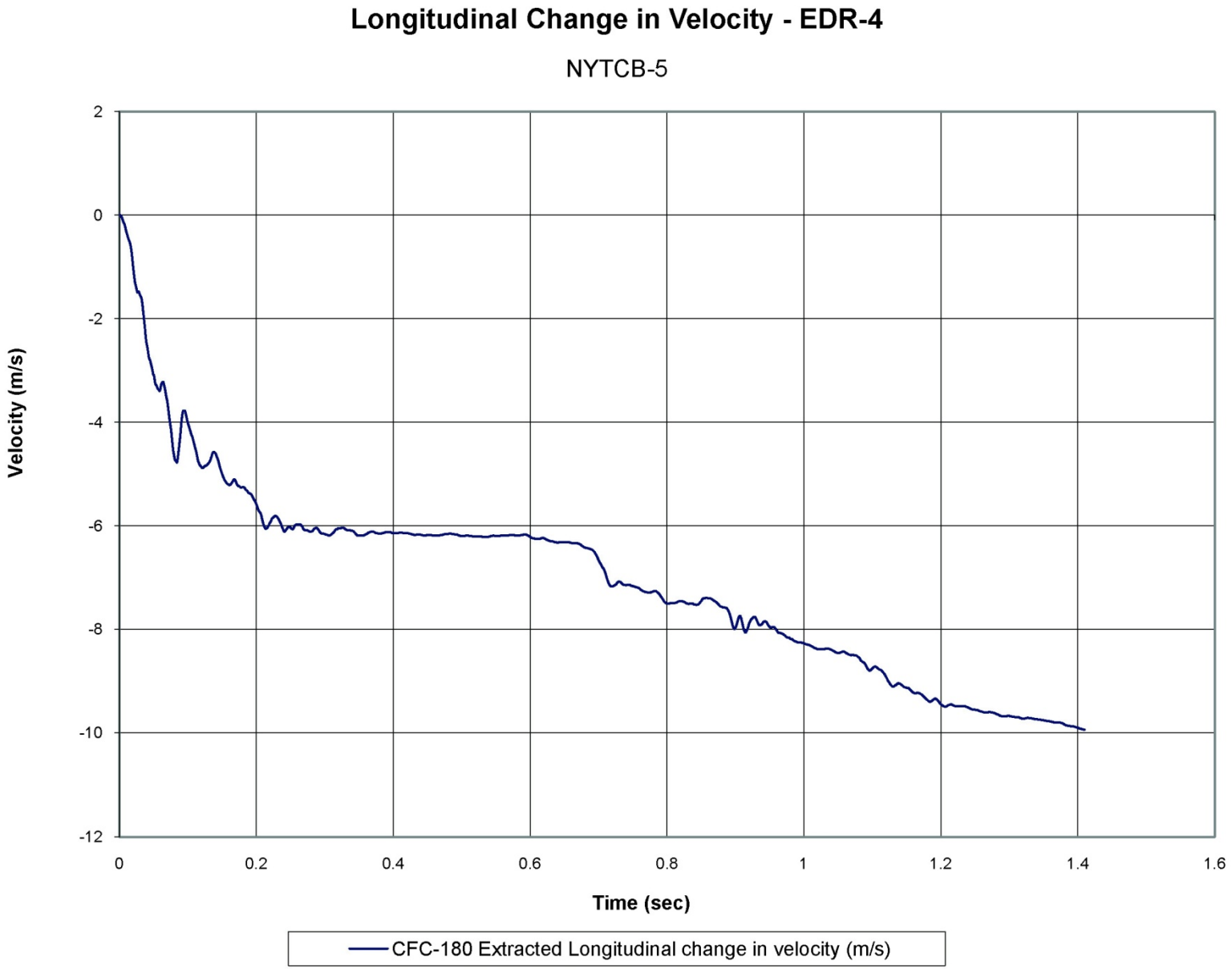


Figure D-2. Longitudinal Occupant Impact Velocity (EDR-4), Test No. NYTCB-5

Figure D-3. Longitudinal Occupant Displacement (EDR-4), Test No. NYTCB-5

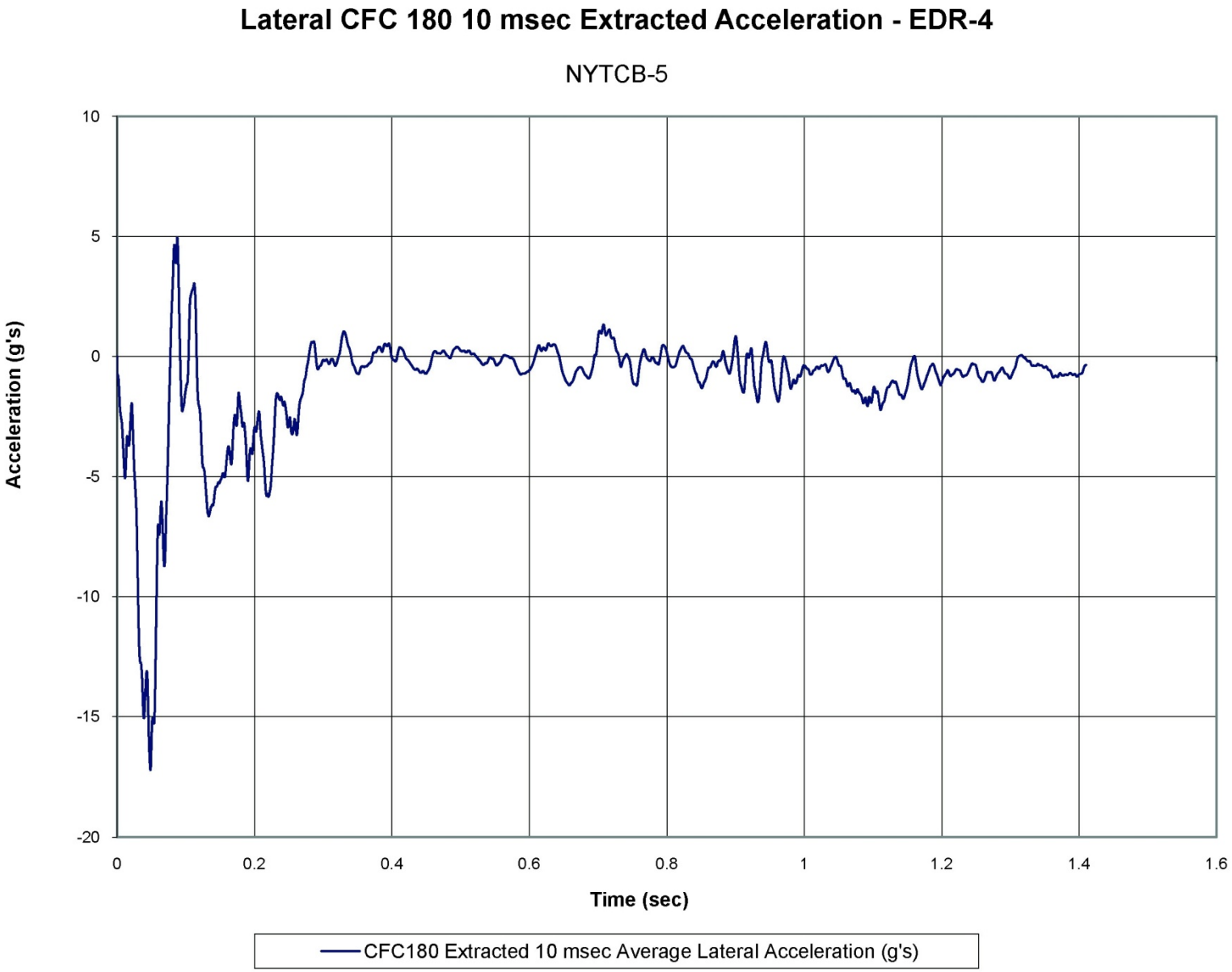


Figure D-4. 10-ms Average Lateral Deceleration (EDR-4), Test No. NYTCB-5

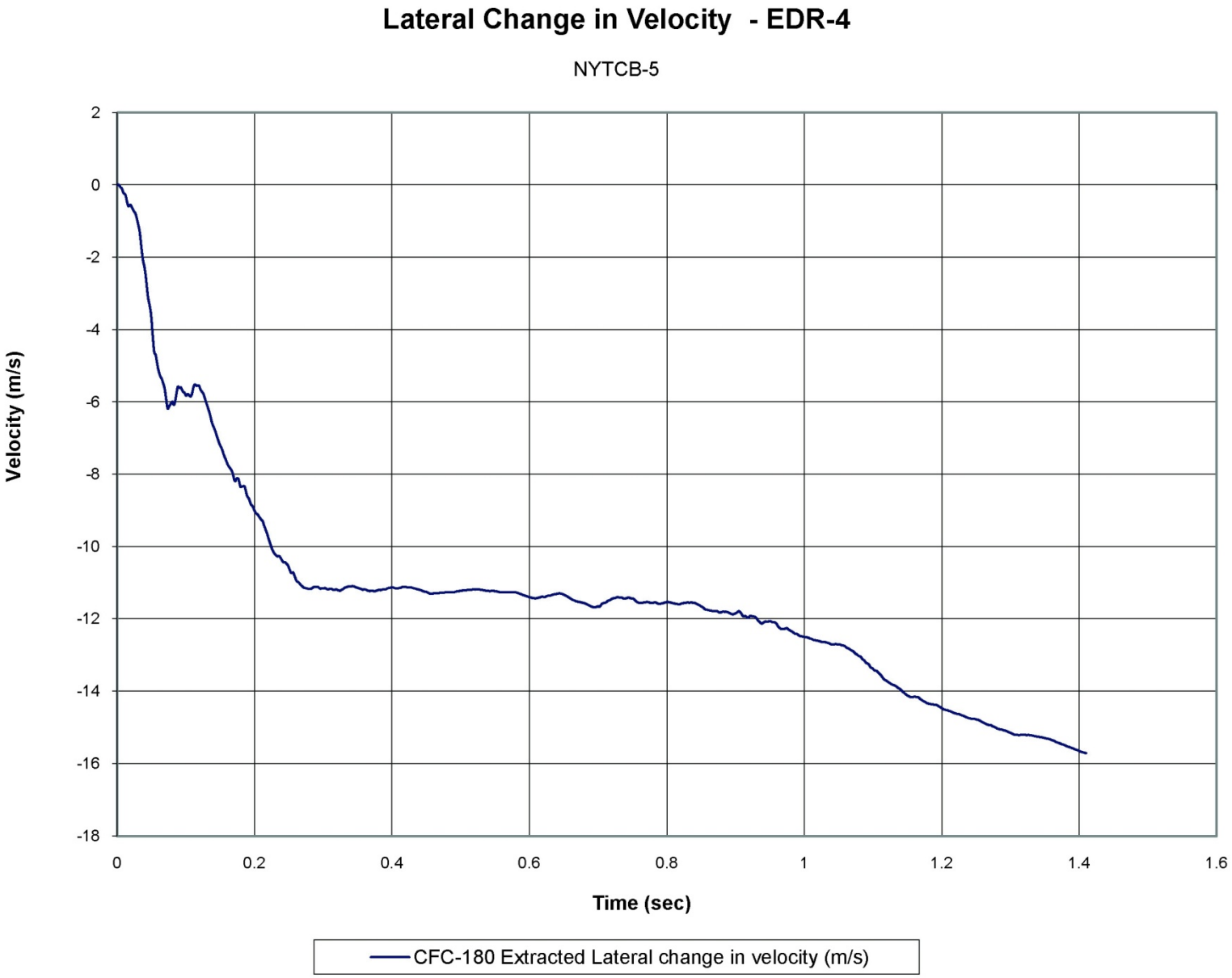


Figure D-5. Lateral Occupant Impact Velocity (EDR-4), Test No. NYTCB-5

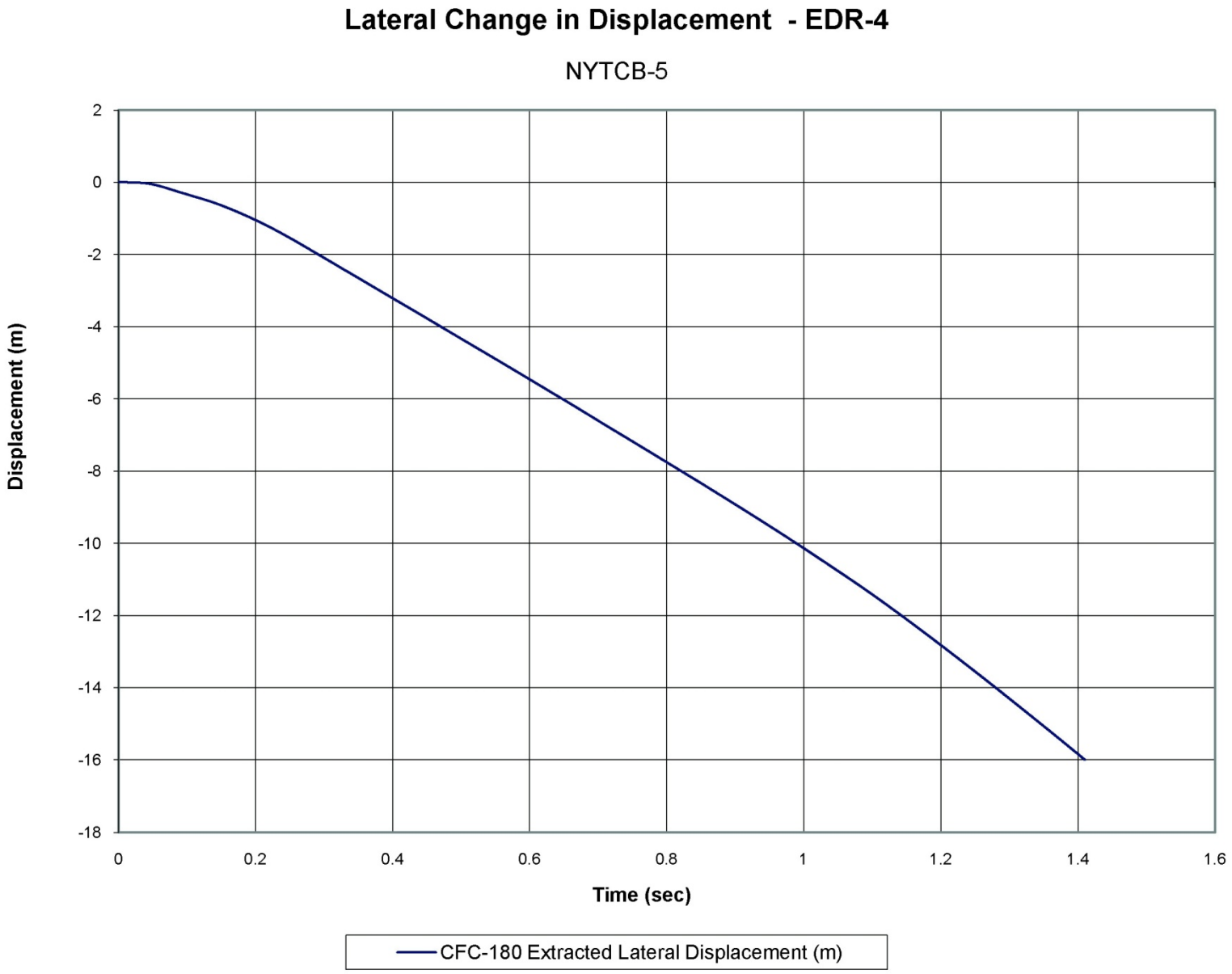


Figure D-6. Lateral Occupant Displacement (EDR-4), Test No. NYTCB-5

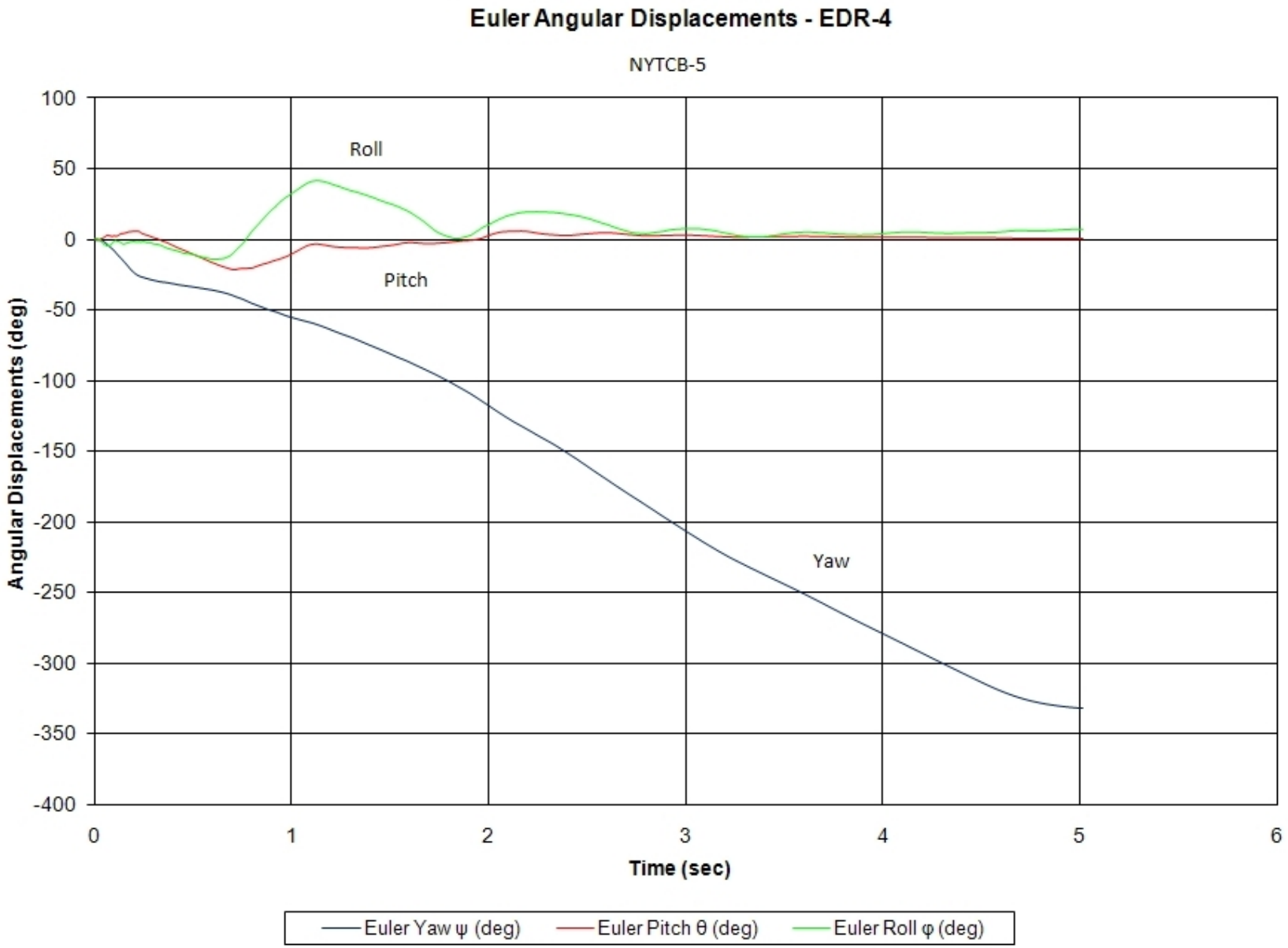


Figure D-7. Vehicle Angular Displacements (EDR-4), Test No. NYTCB-5

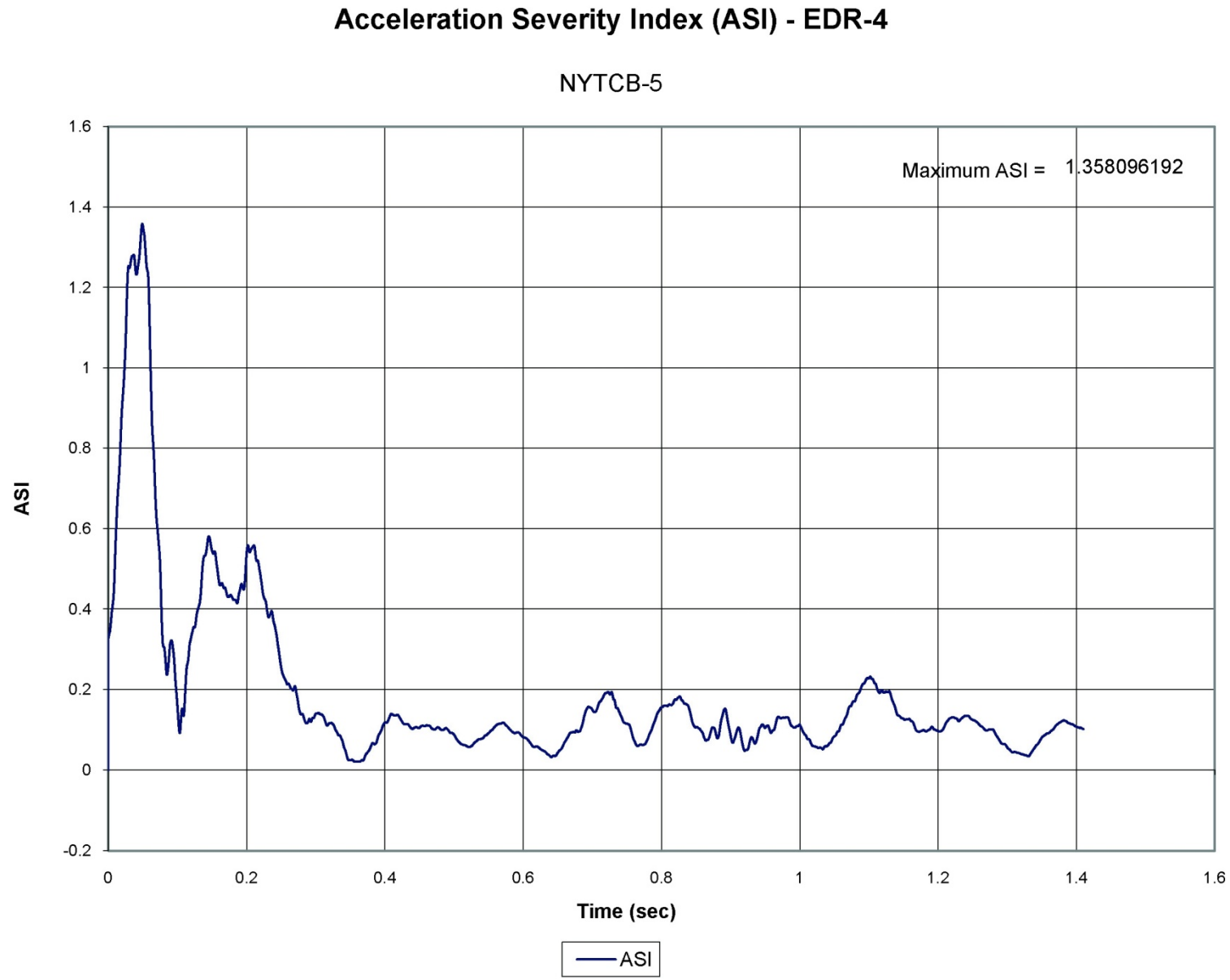


Figure D-8. Acceleration Severity Index (EDR-4), Test No. NYTCB-5

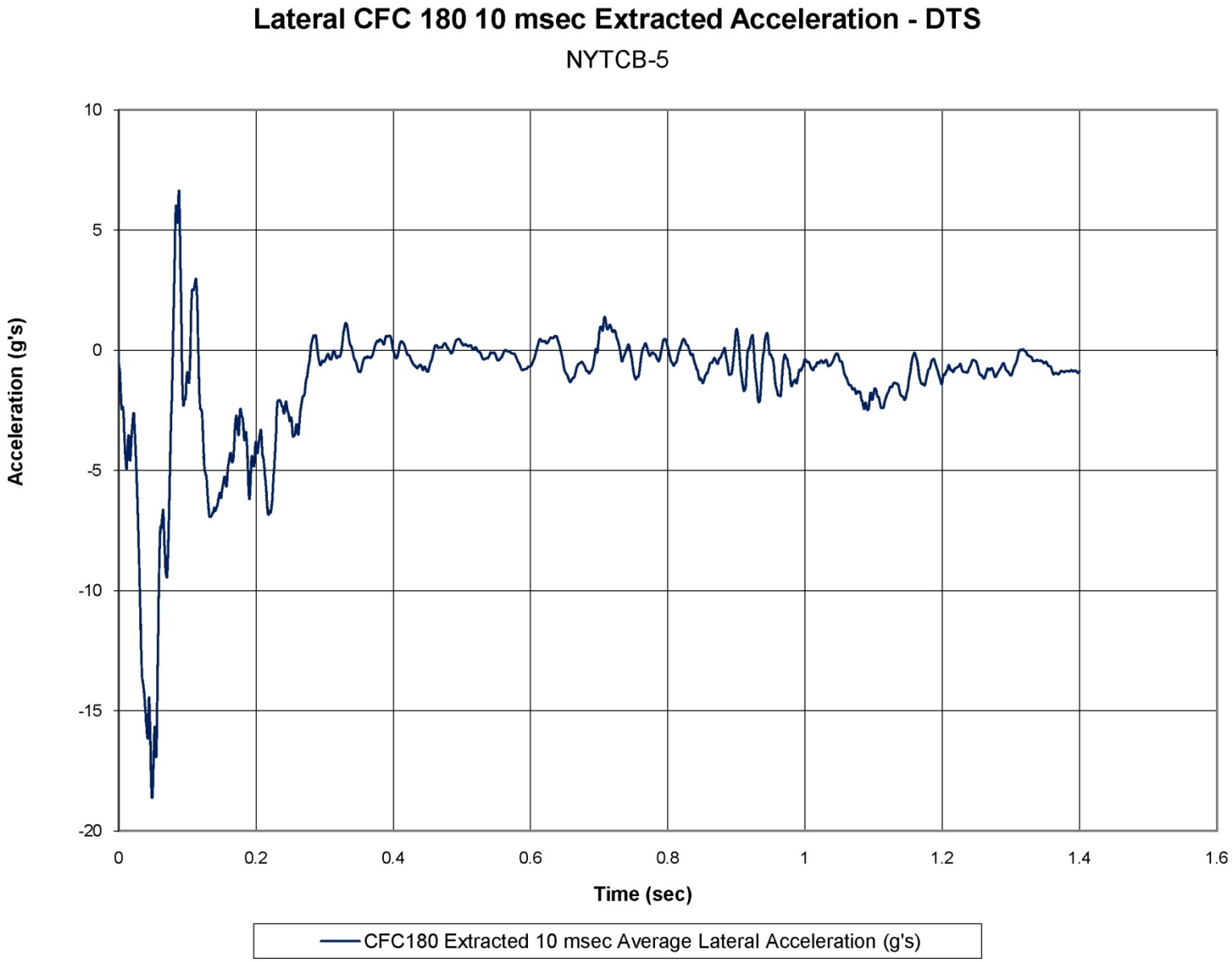


Figure D-9. 10-ms Average Lateral Deceleration (DTS), Test No. NYTCB-5

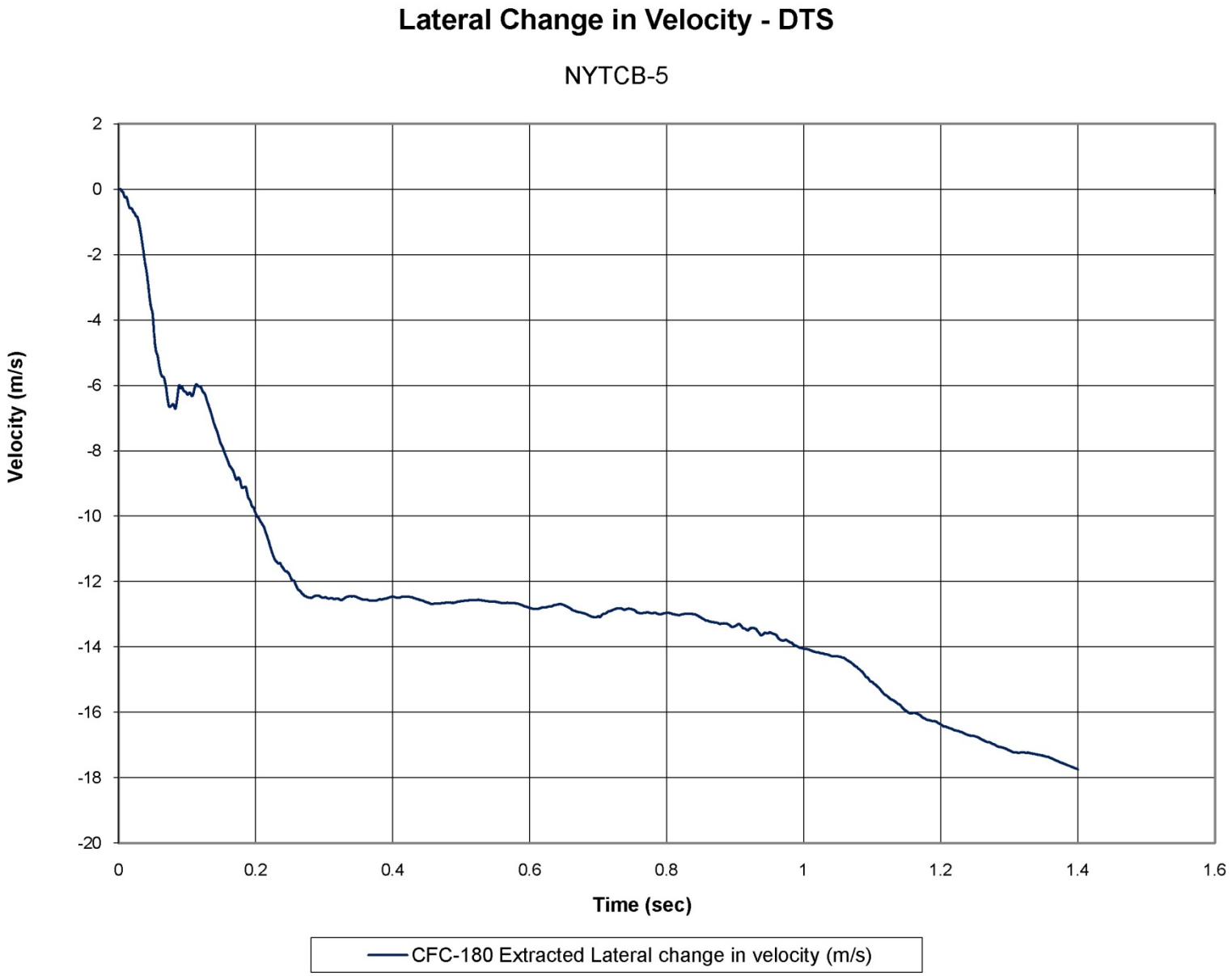


Figure D-10. Lateral Occupant Impact Velocity (DTS), Test No. NYTCB-5

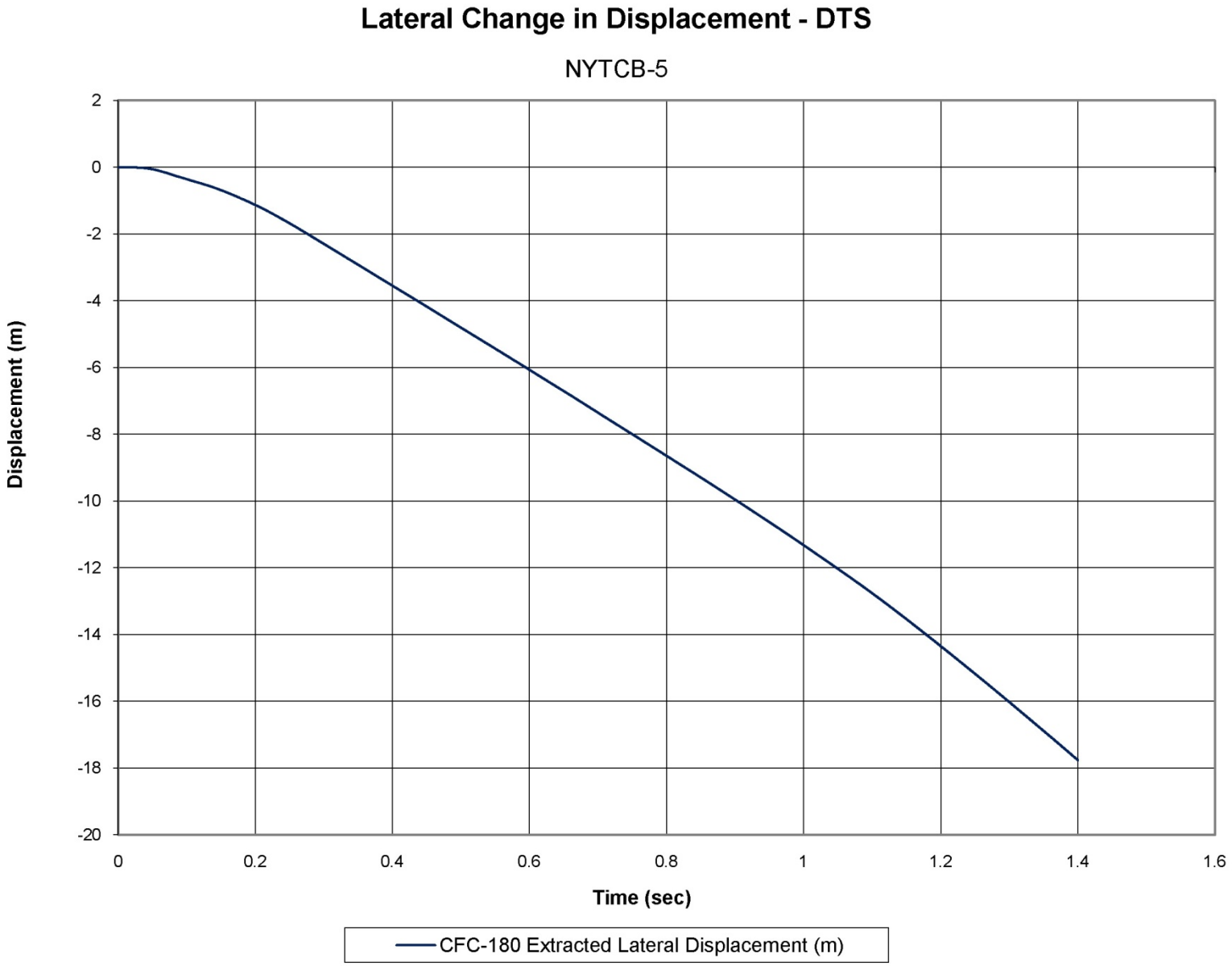


Figure D-11. Lateral Occupant Displacement (DTS), Test No. NYTCB-5

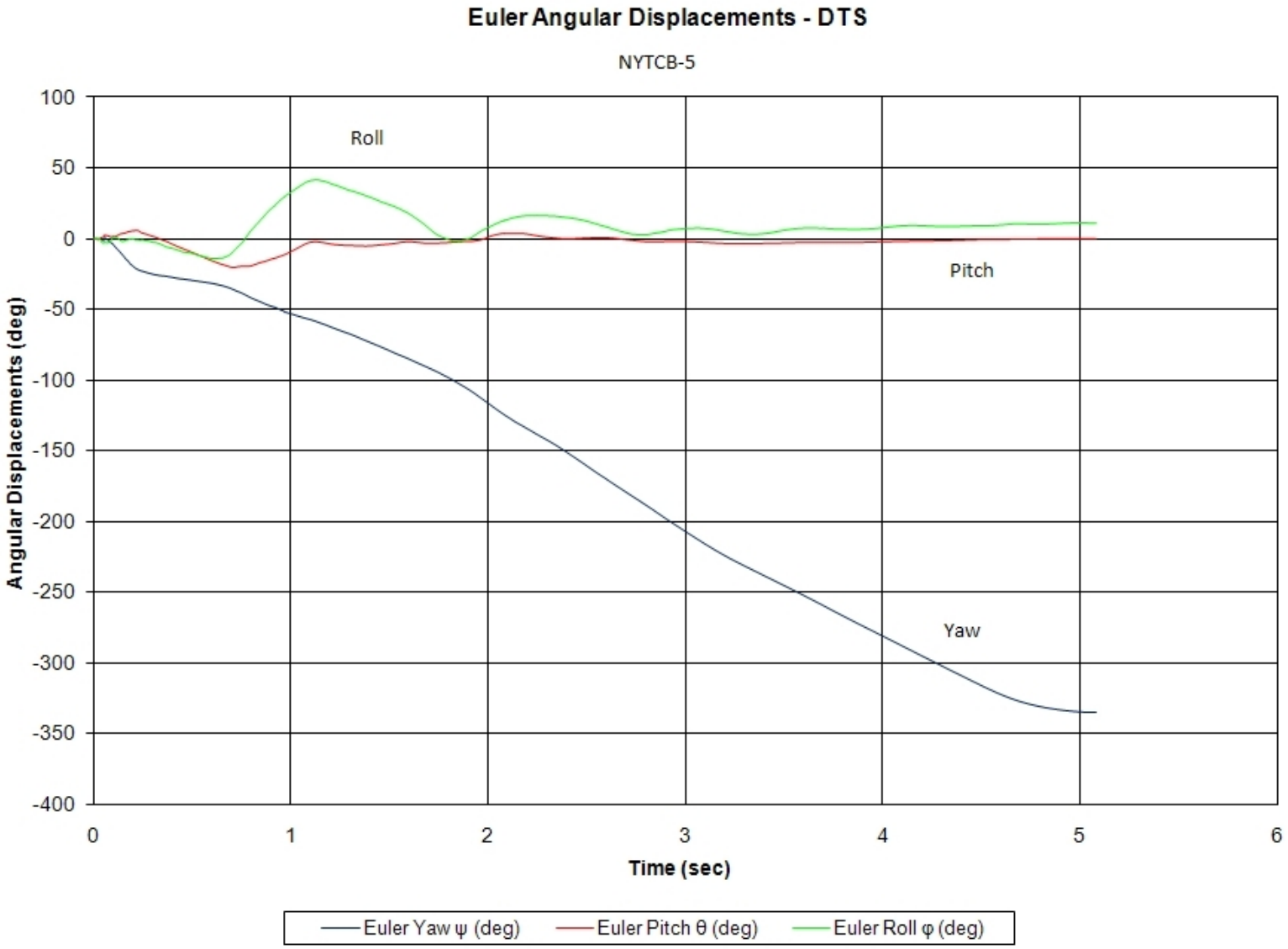


Figure D-12. Vehicle Angular Displacements (DTS), Test No. NYTCB-5

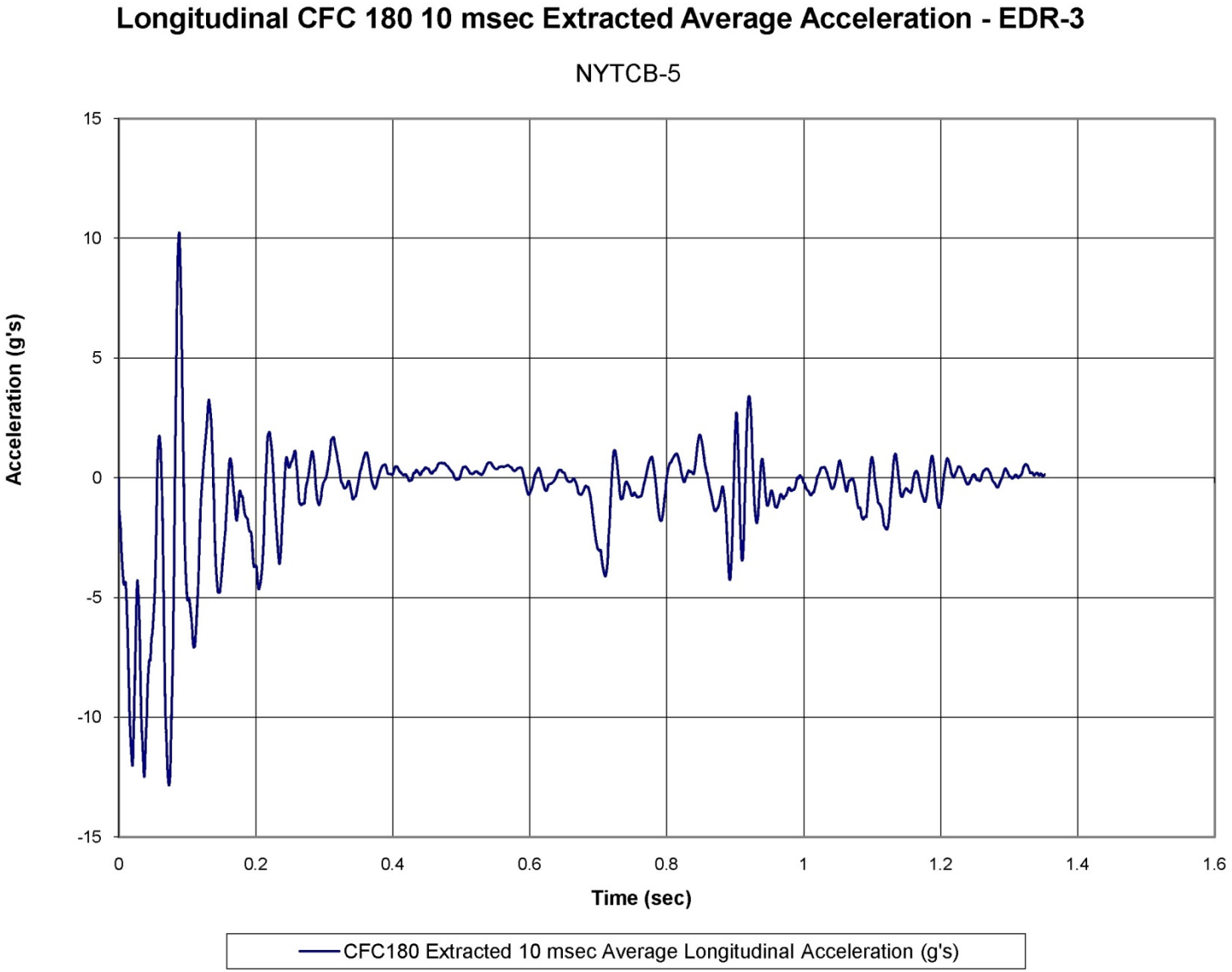


Figure D-13. 10-ms Average Longitudinal Deceleration (EDR-3), Test No. NYTCB-5

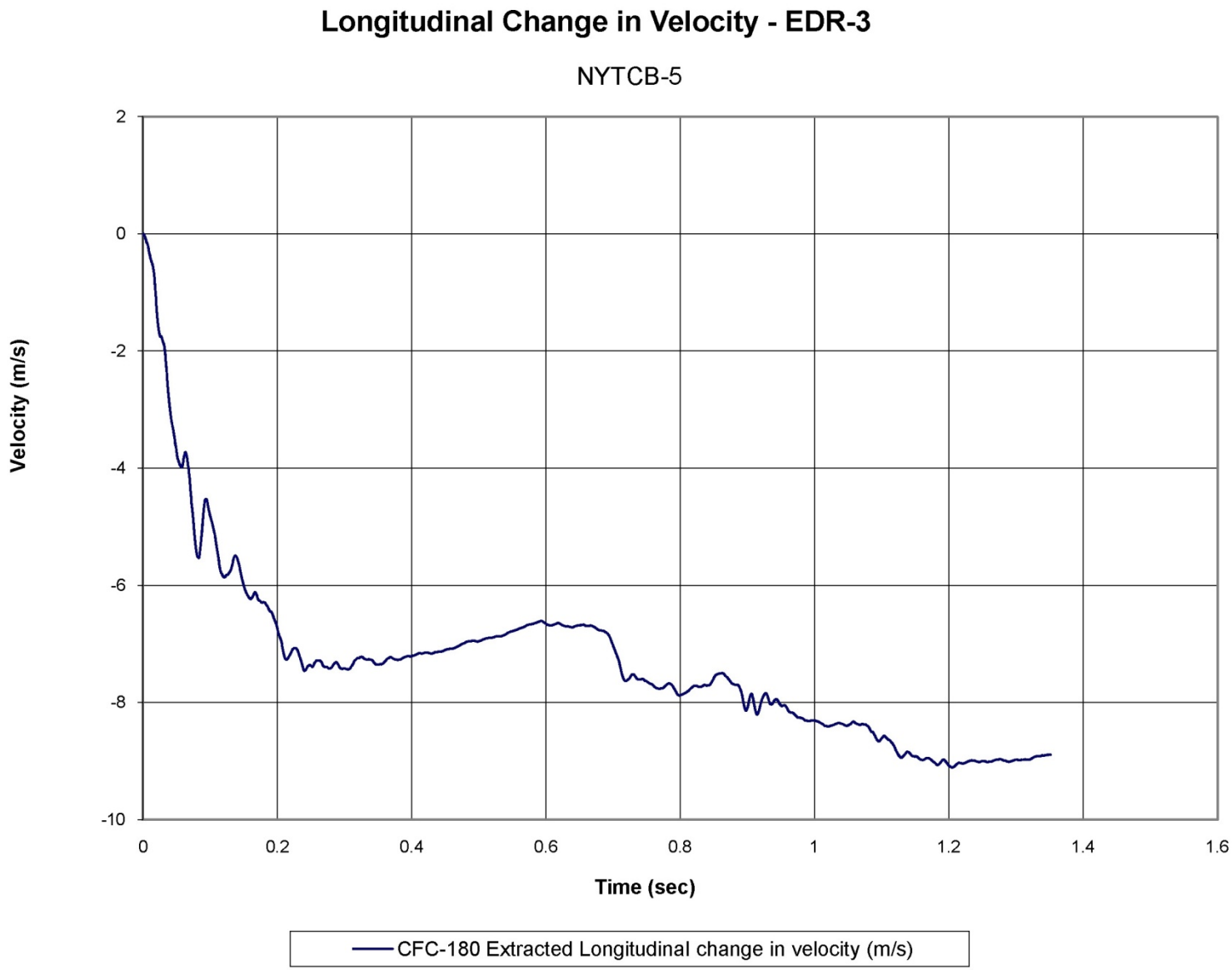


Figure D-14. Longitudinal Occupant Impact Velocity (EDR-3), Test No. NYTCB-5

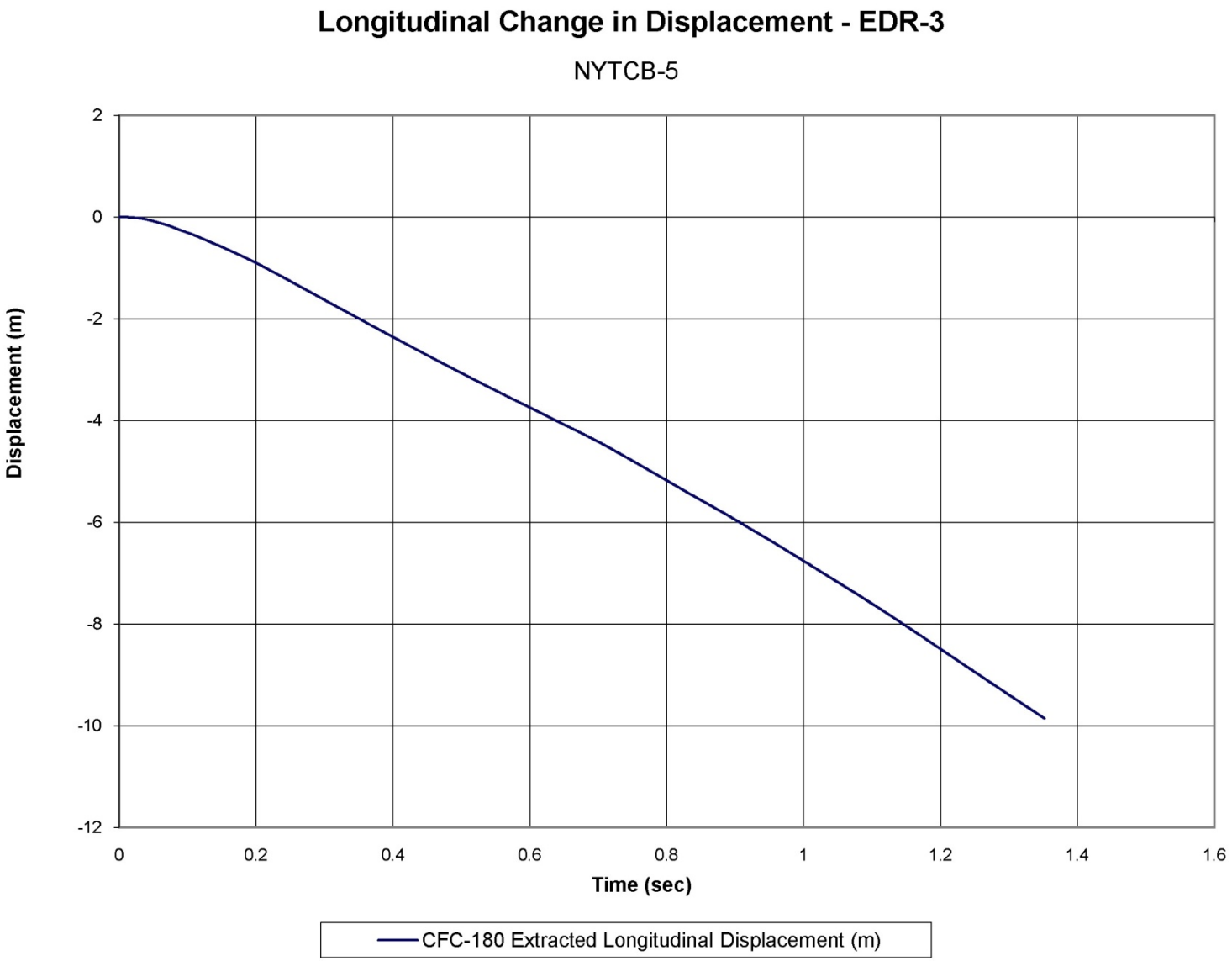


Figure D-15. Longitudinal Occupant Displacement (EDR-3), Test No. NYTCB-5

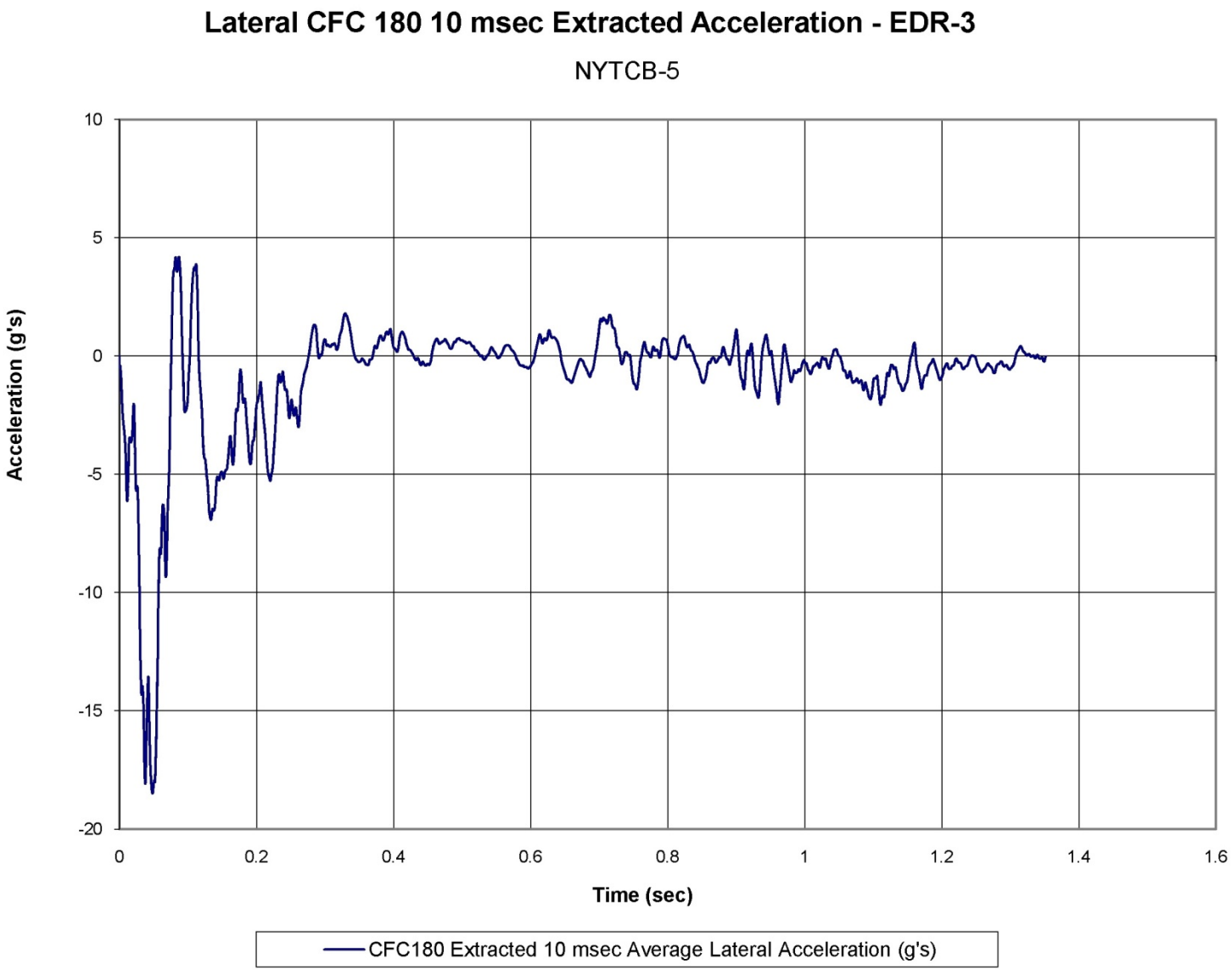


Figure D-16. 10-ms Average Lateral Deceleration (EDR-3), Test No. NYTCB-5

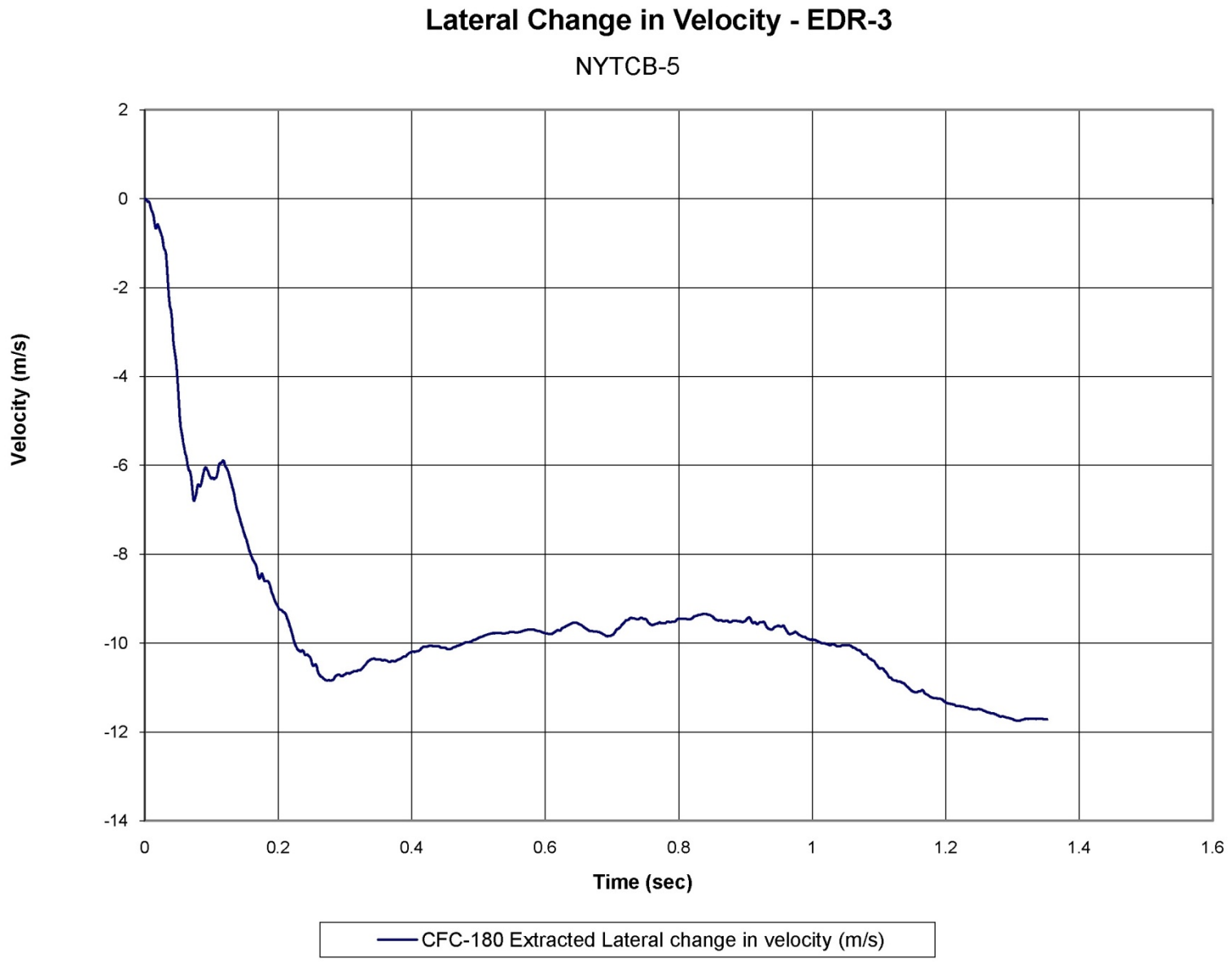


Figure D-17. Lateral Occupant Impact Velocity (EDR-3), Test No. NYTCB-5

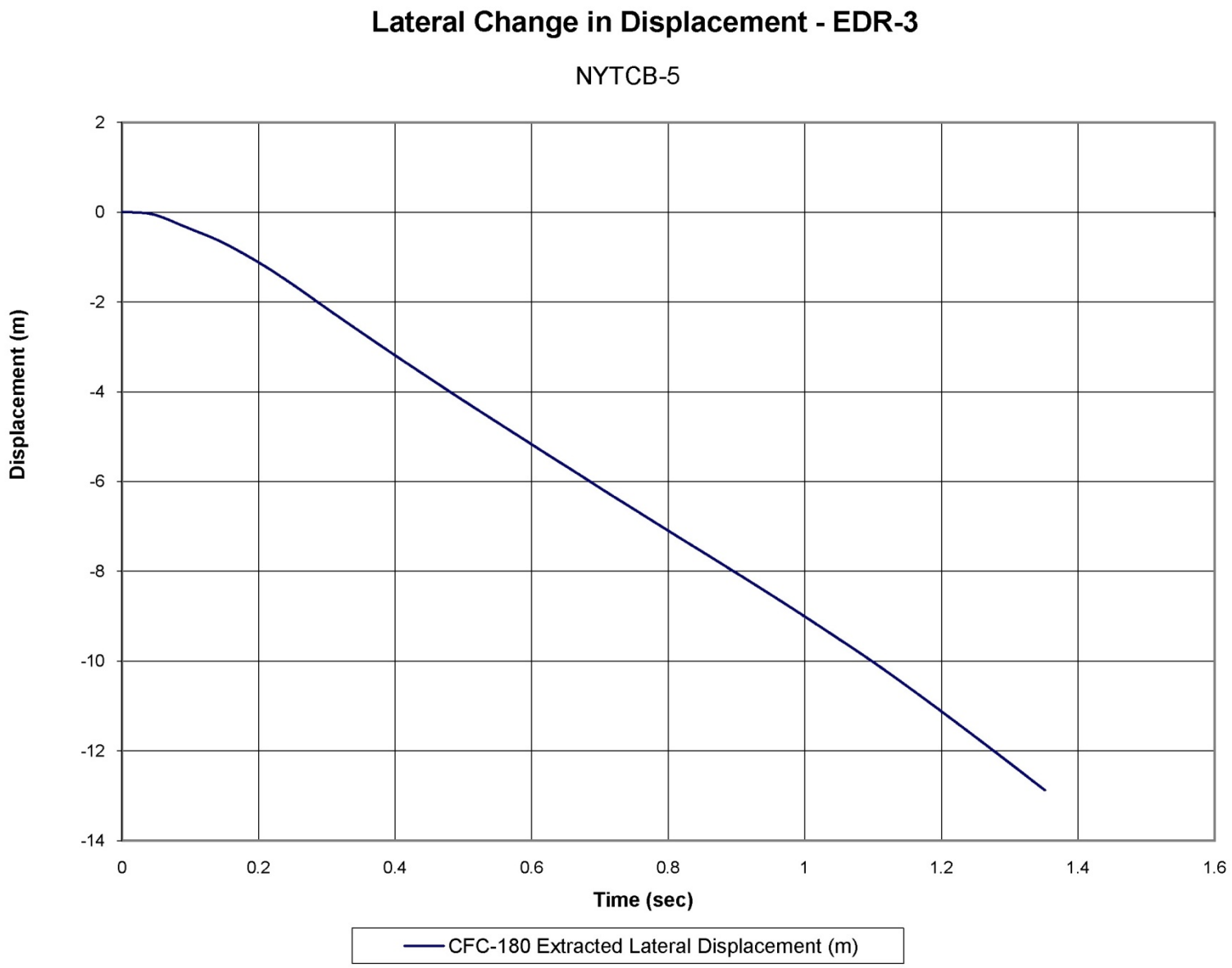


Figure D-18. Lateral Occupant Displacement (EDR-3), Test No. NYTCB-5

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