

Test Report No. 609591-03 Test Report Date: September 2018

MASH TL-5 Evaluation of PennDOT PA Bridge Barrier

by

D. Lance Bullard, Jr., P.E. Senior Research Engineer

Bill Griffith Research Specialist

and

Darrell L. Kuhn, P.E. Research Specialist

Contract No.: PDT-E03657 Test No.: 609591-03-1, -2, -3 Test Date: July 2018

Sponsored by **Pennsylvania Department of Transportation**

TEXAS A&M TRANSPORTATION INSTITUTE PROVING GROUND

Mailing Address: Roadside Safety & Physical Security Texas A&M University System 3135 TAMU College Station, TX 77843-3135 Located at: Texas A&M University RELLIS Campus Building 7091 3100 State Highway 47 Bryan, TX 77807





DISCLAIMER

The contents of this report reflect the views of the authors, who are solely responsible for the facts and accuracy of the data, and the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Pennsylvania Department of Transportation, The Texas A&M University System, or Texas A&M Transportation Institute. This report does not constitute a standard, specification, or regulation. In addition, the above listed agencies/ companies assume no liability for its contents or use thereof. The names of specific products or manufacturers listed herein do not imply endorsement of those products or manufacturers.

The results reported herein apply only to the article being tested. The full-scale crash tests were performed according to TTI Proving Ground quality procedures and according to the *MASH* guidelines and standards.

The Proving Ground Laboratory within the Texas A&M Transportation Institute's Roadside Safety and Physical Security Division ("TTI Lab" or "TTI LAB") strives for accuracy and completeness in its crash test reports. On rare occasions, unintentional or inadvertent clerical errors, technical errors, omissions, oversights, or misunderstandings (collectively referred to as "errors") may occur and may not be identified for corrective action prior to the final report being published and issued. When the TTI Lab discovers an error in a published and issued final report, the TTI Lab shall promptly disclose such error to Gannet Fleming, Inc and the Pennsylvania Department of Transportation, and both parties shall endeavor in good faith to resolve this situation. The TTI Lab will be responsible for correcting the error that occurred in the report, which may be in form of errata, amendment, replacement sections, or up to and including full reissuance of the report. The cost of correcting an error in the report shall be borne by TTI Lab. Any such errors or inadvertent delays that occur in connection with the performance of the related testing contract shall not constitute a breach of the testing contract.

THE TTI LAB SHALL NOT BE LIABLE FOR ANY INDIRECT, CONSEQUENTIAL, PUNITIVE, OR OTHER DAMAGES SUFFERED BY GANNET FLEMING, INC. AND THE PENNSYLVANIA DEPARTMENT OF TRANSPORTATION OR ANY OTHER PERSON OR ENTITY, WHETHER SUCH LIABILITY IS BASED, OR CLAIMED TO BE BASED, UPON ANY NEGLIGENT ACT, OMISSION, ERROR, CORRECTION OF ERROR, DELAY, OR BREACH OF AN OBLIGATION BY THE TTI LAB.

Technical Report Documentation Pag

1. Report No. 2. Government Accession No. 4. Title and Subtitle MASH TL-5 Evaluation of PennDOT PA Bridge Barrier 7. Author(s) D. Lance Bullard, Jr., Bill Griffith, and Darrell L. Kuhn 9. Performing Organization Name and Address Texas A&M Transportation Institute Proving Ground 3135 TAMU College Station, Texas 77843-3135 12. Sponsoring Agency Name and Address Gannett Fleming, Inc	3. Recipient's Catalog No. 5. Report Date September 2018 6. Performing Organization Code 8. Performing Organization Report No. Test Report No. 609591-03 10. Work Unit No. (TRAIS) 11. Contract or Grant No. PDT-E03657 13. Type of Report and Period Covered
 MASH TL-5 Evaluation of PennDOT PA Bridge Barrier ^{7. Author(s)} D. Lance Bullard, Jr., Bill Griffith, and Darrell L. Kuhn ^{9. Performing Organization Name and Address} Texas A&M Transportation Institute Proving Ground 3135 TAMU College Station, Texas 77843-3135 12. Sponsoring Agency Name and Address Gannett Fleming, Inc 	September 2018 6. Performing Organization Code 8. Performing Organization Report No. Test Report No. 609591-03 10. Work Unit No. (TRAIS) 11. Contract or Grant No. PDT-E03657 13. Type of Report and Period Covered
 ^{7.} Author(s) D. Lance Bullard, Jr., Bill Griffith, and Darrell L. Kuhn ^{9.} Performing Organization Name and Address Texas A&M Transportation Institute Proving Ground 3135 TAMU College Station, Texas 77843-3135 ^{12.} Sponsoring Agency Name and Address Gannett Fleming, Inc 	6. Performing Organization Code 8. Performing Organization Report No. Test Report No. 609591-03 10. Work Unit No. (TRAIS) 11. Contract or Grant No. PDT-E03657 13. Type of Report and Period Covered
D. Lance Bullard, Jr., Bill Griffith, and Darrell L. Kuhn 9. Performing Organization Name and Address Texas A&M Transportation Institute Proving Ground 3135 TAMU College Station, Texas 77843-3135 12. Sponsoring Agency Name and Address Gannett Fleming, Inc	8. Performing Organization Report No. Test Report No. 609591-03 10. Work Unit No. (TRAIS) 11. Contract or Grant No. PDT-E03657 13. Type of Report and Period Covered
D. Lance Bullard, Jr., Bill Griffith, and Darrell L. Kuhn 9. Performing Organization Name and Address Texas A&M Transportation Institute Proving Ground 3135 TAMU College Station, Texas 77843-3135 12. Sponsoring Agency Name and Address Gannett Fleming, Inc	Test Report No. 609591-03 10. Work Unit No. (TRAIS) 11. Contract or Grant No. PDT-E03657 13. Type of Report and Period Covered
 9. Performing Organization Name and Address Texas A&M Transportation Institute Proving Ground 3135 TAMU College Station, Texas 77843-3135 12. Sponsoring Agency Name and Address Gannett Fleming, Inc 	10. Work Unit No. (TRAIS) 11. Contract or Grant No. PDT-E03657 13. Type of Report and Period Covered
Texas A&M Transportation Institute Proving Ground 3135 TAMU College Station, Texas 77843-3135 12. Sponsoring Agency Name and Address Gannett Fleming, Inc	11. Contract or Grant No. PDT-E03657 13. Type of Report and Period Covered
College Station, Texas 77843-3135 12. Sponsoring Agency Name and Address Gannett Fleming, Inc	PDT-E03657 13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address Gannett Fleming, Inc	13. Type of Report and Period Covered
Gannett Fleming, Inc	
	Technical Report:
PO Box 67100	October 2017 – September 2018
Harrisburg, PA 17106-7100	14. Sponsoring Agency Code
Pennsylvania Department of Transportation	
Bureau of Project Delivery	
Bridge Design and Technology Division	
400 North Street, 7th Floor	
Harrisburg,PA 17120	
15. Supplementary Notes	
Project Title: <i>MASH</i> test 5-10, 5-11, 5-12	
Name of Contacting Representative: Travis C. Arentz, P.E.	(Gannett Fleming, Inc.) and Tom Macioce, P.E.
(PennDOT)	
16. Abstract	
TTI evaluated the performance of the PennDOT PA specified in the American Association of State Highway and <i>for Assessing Safety Hardware (MASH, Second Edition, 201</i> performed on the bridge rail. The tests involved an 1100C a PennDOT PA Bridge Barrier at a target impact speed and in a 36000V vehicle impacting the PennDOT PA Bridge Barrier mi/h and 15°, respectively. Assessment of the tests based on the applicable safet showed that the PennDOT PA Bridge Barrier performed acc	d Transportation Officials (AASHTO), <i>Manual</i> (6). <i>MASH</i> Tests 5-10, 5-11, and 5-12 were and a 2270P vehicle, each impacting the npact angle of 62 mi/h and 25°, respectively, and er at a target impact speed and impact angle of 50 by evaluation criteria for longitudinal barriers

^{17. Key Words} Longitudinal Barrier, Concrete Barrier, Bridge Barrier, Crash Testing, Roadside Safety		 18. Distribution Statement Copyrighted. Not to be copied or reprinted without consent from Pennsylvania Department of Transportation 		
19. Security Classif.(of this report) Unclassified	20. Security Classif.(of th Unclassified	is page)	21. No. of Pages 166	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized.

This page intentionally left blank.

REPORT AUTHORIZATION

REPORT REVIEWED BY:

DocuSigned by:

Glenn Schroeder

Glenn Schroeder, Research Specialist Drafting & Reporting

— DocuSigned by:

Gary Gerke

Gary Gerke, Research Specialist Construction

DocuSigned by: Scott Dobrowolny

Scott Dobrovolny, Research Specialist Mechanical Instrumentation -DocuSigned by:

Ken Reeves

Ken Reeves, Research Specialist Electronics Instrumentation

DocuSigned by:

Pichard Badillo

Richard Badillo, Research Specialist Photographic Instrumentation

DocuSigned by:

Wander L. Menger

Wanda L. Menges, Research Specialist Reporting & Deputy QM

DocuSigned by:

Danel Kuhr

Darrell L. Kuhn, P.E., Research Specialist Quality Manager

DocuSigned by:

Matthew Robinson

Matthew N. Robinson, Research Specialist Test Facility Manager & Technical Manager

DocuSigned by: D. Lance Bullard, Jr., P.E.

D. Lance Bullard, Jr., P.E. Senior Research Engineer



TR No. 609591-03

This page intentionally left blank.

TABLE OF CONTENTS

		age
	er	
	Contents	
	igures	
	ables	
Chapter		
Chapter		
2.1.	Test Article and Installation Details	
2.2.	Material Specifications	
Chapter		
3.1.	Crash Test Performed / Matrix	7
3.2.	Evaluation Criteria	7
Chapter	4. Test Conditions	9
4.1.	Test Facility	9
4.2	Vehicle Tow and Guidance System	9
4.3	Data Acquisition Systems	. 10
4.	3.1 Vehicle Instrumentation and Data Processing	. 10
4.	3.2 Anthropomorphic Dummy Instrumentation	. 11
4.	3.3 Photographic Instrumentation Data Processing	. 11
Chapter	5. MASH Test 5-11 (Crash Test No. 609591-03-1)	. 13
5.1	Test Designation and Actual Impact Conditions	. 13
5.2	Weather Conditions	
5.3	Test Vehicle	. 13
5.4	Test Description	. 14
5.5	Damage to Test Installation	. 14
5.6	Vehicle Damage	. 15
5.7	Occupant Risk Factors	. 16
Chapter	6. MASH Test 5-10 (Crash Test No. 609591-03-2)	. 19
6.1	Test Designation and Actual Impact Conditions	
6.2	Weather Conditions	. 19
6.3	Test Vehicle	. 19
6.4	Test Description	. 20
6.5	Damage to Test Installation	. 21
6.6	Vehicle Damage	. 22
6.7	Occupant Risk Factors	. 23
Chapter	7. MASH Test 5-12 (Crash Test No. 609591-03-3)	. 27
7.1	Test Designation and Actual Impact Conditions	. 27
7.2	Weather Conditions	
7.3	Test Vehicle	. 27
7.4	Test Description	. 28
7.5	Damage to Test Installation	
7.6	Vehicle Damage	. 30
7.7	Occupant Risk Factors	
Chapter	-	

8.1	Assessment of Test Results	33
8.2	Conclusions	
Reference	Ces	38
	x A. Details of the Bridge Rail	
	x B. Supporting Certification Documents	
	x C. MASH Test 5-11 (Crash Test No. 609591-03-1)	
C1	Vehicle Properties and Information	107
C2	Sequential Photographs	111
C3	Vehicle Angular Displacements	
C4	Vehicle Accelerations	115
Appenid	x D. MASH Test 5-10 (Crash Test No. 609591-03-2)	121
D1	Vehicle Properties and Information	121
D2	Sequential Photographs	
D3	Vehicle Angular Displacements	127
D4	Vehicle Accelerations	128
Appenid	x E. MASH Test 5-12 (Crash Test No. 609591-03-3)	135
E1	Vehicle Properties and Information	135
E2	Sequential Photographs	137
E3		
LJ	Vehicle Angular Displacements	140

LIST OF FIGURES

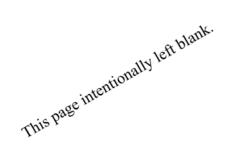
		Page
	Details of the PennDOT PA Bridge Barrier.	
	PennDOT PA Bridge Barrier prior to Testing	
	Concrete Map Overview of the of the PennDOT PA Bridge Barrier	6
Figure 5.1.	PennDOT PA Bridge Barrier/Test Vehicle Geometrics for Test No. 609591-	
	03-1	
	Test Vehicle before Test No. 609591-03-1.	
Figure 5.3.	PennDOT PA Bridge Barrier after Test No. 609591-03-1	15
Figure 5.4.	Test Vehicle after Test No. 609591-03-1.	16
Figure 5.5.	Interior of Test Vehicle for Test No. 609591-03-1.	16
Figure 5.6.	Summary of Results for MASH Test 5-11 on PennDOT PA Bridge Barrier	
Figure 6.1.	PennDOT PA Bridge Barrier/Test Vehicle Geometrics for Test No. 609591-	
	03-2	
Figure 6.2.	Test Vehicle before Test No. 609591-03-2.	20
Figure 6.3.	PennDOT PA Bridge Barrier after Test No. 609591-03-2	22
Figure 6.4.	Test Vehicle after Test No. 609591-03-2.	23
	Interior of Test Vehicle for Test No. 609591-03-2.	
	Summary of Results for MASH Test 5-10 on PennDOT PA Bridge Barrier	
	PennDOT PA Bridge Barrier/Test Vehicle Geometrics for Test No. 609591-	
-	03-3	27
Figure 7.2.	Test Vehicle before Test No. 609591-03-3.	
	PennDOT PA Bridge Barrier after Test No. 609591-03-3	
	Test Vehicle after Test No. 609591-03-3.	
	Interior of Test Vehicle for Test No. 609591-03-3.	
	Summary of Results for MASH Test 5-12 on PennDOT PA Bridge Barrier	
	Sequential Photographs for Test No. 609591-03-1 (Overhead and Gut	
U	Views).	111
Figure C.2.	Sequential Photographs for Test No. 609591-03-1 (Rear View)	
	Vehicle Angular Displacements for Test No. 609591-03-1.	
	Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-1	
0	(Accelerometer Located at Center of Gravity)	115
Figure C.5.	Vehicle Lateral Accelerometer Trace for Test No. 609591-03-1	
8	(Accelerometer Located at Center of Gravity)	116
Figure C.6.	Vehicle Vertical Accelerometer Trace for Test No. 609591-03-1	-
	(Accelerometer Located at Center of Gravity)	117
Figure C.7.	Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-1	
1 19410 0171	(Accelerometer Located Rear of Center of Gravity)	118
Figure C.8.	Vehicle Lateral Accelerometer Trace for Test No. 609591-03-1	
115410 0101	(Accelerometer Located Rear of Center of Gravity)	120
Figure C 9	Vehicle Vertical Accelerometer Trace for Test No. 609591-03-1	120
1 15010 0.7.	(Accelerometer Located Rear of Center of Gravity)	120
Figure D 1	Sequential Photographs for Test No. 609591-03-2 (Overhead and Gut	120
1 15010 D.1	Views).	124
Figure D 2	Sequential Photographs for Test No. 609591-03-2 (Rear View).	

Figure D.3. Vehicle Angular Displacements for Test No. 609591-03-2.	
Figure D.4. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-2	
(Accelerometer Located at Center of Gravity)	
Figure D.5. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-2	
(Accelerometer Located at Center of Gravity)	
Figure D.6. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-2	
(Accelerometer Located at Center of Gravity)	
Figure D.7. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-2	
(Accelerometer Located Rear of Center of Gravity)	
Figure D.8. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-2	
(Accelerometer Located Rear of Center of Gravity)	
Figure D.9. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-2	
(Accelerometer Located Rear of Center of Gravity)	
Figure E.1. Location of Accelerometers and Rate Transducers.	
Figure E.2. Sequential Photographs for Test No. 609591-03-3 (Overhead and Gut	
Views).	
Figure E.3. Sequential Photographs for Test No. 609591-03-3 (Rear View)	
Figure E.4. Vehicle Angular Displacements for Test No. 609591-03-3.	
(Accelerometer Located at Fifth Wheel)	
Figure E.5. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-3	
(Accelerometer Located at Fifth Wheel)	
Figure E.6. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-3	
(Accelerometer Located at Fifth Wheel)	
Figure E.7. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-3	
(Accelerometer Located at Fifth Wheel)	
Figure E.8. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-3	
(Accelerometer Located Rear of Trailer).	
Figure E.9. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-3	
(Accelerometer Located Rear of Trailer).	
Figure E.10. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-3	
Figure E.11. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-3	
(Accelerometer Located at Tractor).	
Figure E.12. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-3	
(Accelerometer Located at Tractor).	
Figure E.13. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-3	
(Accelerometer Located at Tractor)	

LIST OF TABLES

Page

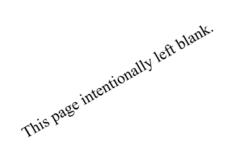
7
8
14
17
20
24
28
31
34
35
36
37
107
108
109
110
121
122
123
135



Chapter 1. INTRODUCTION

The purpose of the tests reported herein was to assess the performance of the PennDOT PA Bridge Barrier according to the safety-performance evaluation guidelines included in the American Association of State Highway and Transportation Officials (AASHTO), *Manual for Assessing Safety Hardware (MASH) (1)*. The crash testing was performed in accordance with *MASH* Tests 5-10, 5-11, and 5-12, which involve an 1100C and a 2270P vehicle impacting the PennDOT PA Bridge Barrier at a target impact speed and impact angle of 62 mi/h and 25°, respectively, and a 36000V vehicle impacting the PennDOT PA Bridge Barrier at a target impact speed and impact angle of 50 mi/h and 15°, respectively.

This report provides details of the PennDOT PA Bridge Barrier, detailed documentation of the crash test results, and an assessment of the performance of the PennDOT PA Bridge Barrier for *MASH* Tests 5-10, 5-11, and 5-12 evaluation criteria.



Chapter 2. SYSTEM DETAILS

2.1. TEST ARTICLE AND INSTALLATION DETAILS

The test installation was comprised of a steel reinforced cantilevered concrete bridge deck, 11 inches thick, supporting a 24-inch tall \times 18-inch thick steel reinforced concrete barrier. The test installation was constructed with three $\frac{1}{2}$ -inch wide joints, two extended through the parapet wall only, and the third through the wall and deck.

There were 20 posts attached to the top of the parapet using cast in place anchor bolts. The posts were spaced on 90–inch centers, beginning 44-inches from each end of the concrete deck and parapet, for a total installation length of 149 ft-10 inches. Two rectangular HSS $5 \times 4 \times 3/8$ rails were attached to each post, with the tops of the rails located 37 inches and 50 inches above grade, respectively.

Figure 2. presents overall information on the PennDOT PA Bridge Barrier, and Figure 2.2 provides photographs of the installation. Appendix A provides further details of the PennDOT PA Bridge Barrier.

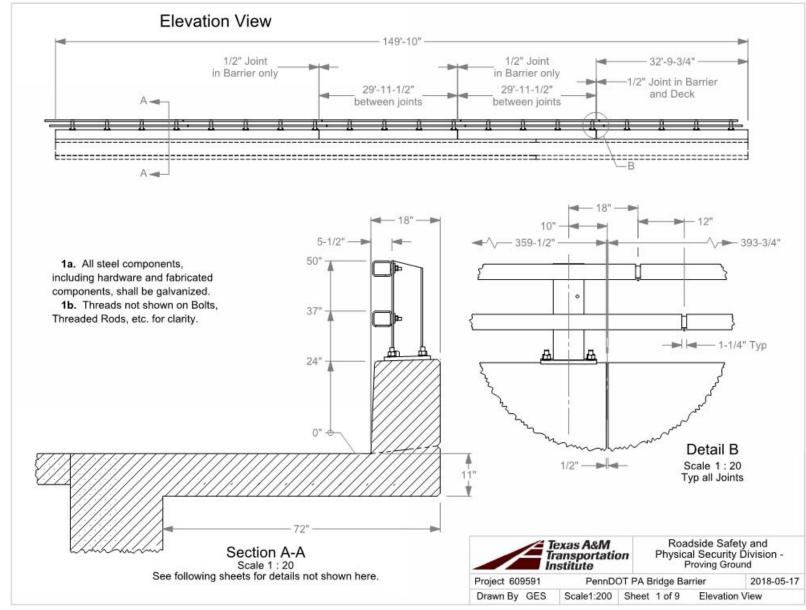


Figure 2.1. Details of the PennDOT PA Bridge Barrier.

TR No. 609591-03

4

2018-09-27



Figure 2.2. PennDOT PA Bridge Barrier prior to Testing.

2.2. MATERIAL SPECIFICATIONS

Appendix B provides material certification documents for the materials used to install/construct the PennDOT PA Bridge Barrier.

The specified minimum unconfined compressive strength of the concrete for the support wall, bridge deck and moment slab (moment slab was poured along with bridge deck batches) was 4,000 psi, the working slab was 3,000 psi, and the barrier was 3,500 psi. The average unconfined compressive strengths of the batches of concrete used in the construction of the test installation were as follows with locations of the different batches shown in the following illustration Figure 2.3

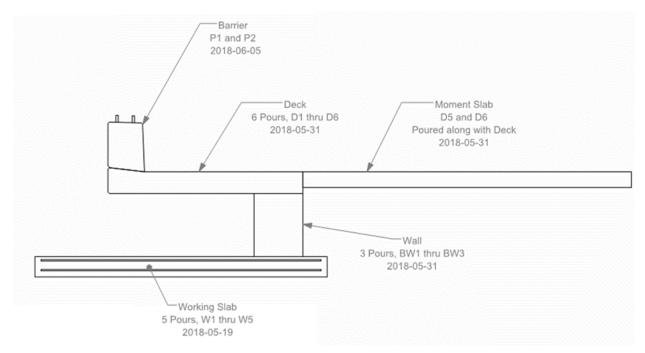


Figure 2.3. Concrete Map Overview of the of the PennDOT PA Bridge Barrier

Working Slab: 3,895 psi (over 5 batches) on 2018-05-19, 37 days from pour date.
Wall: 6,225 psi (over 3 batches) on 2018-05-31, 26 days from pour date.
Deck (moment slab): 5,815 psi (over 6 batches) on 2018-05-31, 26 days from pour date.
Barrier: 4,981 psi (over 2 batches) on 2018-06-05, 20 days from pour date.

Steel reinforcement of the bridge deck and wall was comprised of epoxy coated ASTM A615 Grade 60 rebar with specified minimum yield strength of 60 ksi.

Chapter 3. TEST REQUIREMENTS AND EVALUATION CRITERIA

3.1. CRASH TEST PERFORMED / MATRIX

Table 3.1 shows the test conditions and evaluation criteria for *MASH* TL-5 for longitudinal barriers. *MASH* Test 5-10 involves an 1100C vehicle, weighing 2420 lb ±55 lb, impacting the critical impact point (CIP) of the barrier at an impact speed of 62 mi/h ±2.5 mi/h and an angle of $25^{\circ} \pm 1.5^{\circ}$. *MASH* Test 5-11 involves a 2270P vehicle, weighing 5000 lb ±110 lb, impacting the CIP of the barrier at an impact speed of 62 mi/h ±2.5 mi/h and an angle of $25^{\circ} \pm 1.5^{\circ}$. *MASH* Test 5-12 involves a 36000V vehicle weighing 79,300 lb ±1100 lb, impacting the CIP of the barrier at an impact speed of 50 mi/h ±2.5 mi/h and an angle of $15^{\circ} \pm 1.5^{\circ}$.

The target CIPs were determined using the information provided in *MASH* Section 2.2.1 and Section 2.3.2, and Tables 2-7 and 2-8. The target CIP for *MASH* Test 5-11 on the PennDOT PA Bridge Barrier was 4.3 ft ± 1 ft upstream of post 9 edge with lower rail splice. The target CIP for *MASH* Test 5-10 was 3.6 ft ± 1 ft upstream of post 13 edge with lower rail splice. The target CIP for *MASH* Test 5-12 was 1 ft ± 1 ft, downstream of post 5 edge with lower rail splice.

Test Article	Test	Test Vehicle	Impact Conditions		Evaluation Criteria
	Designation	venicie	Speed	Angle	Criteria
	5-10	1100C	62 mi/h	25°	A, D, F, H, I
Longitudinal Barrier	5-11	2270P	62 mi/h	25°	A, D, F, H, I
	5-12	36000V	50 mi/h	15°	A, D,G

Table 3.1. Test Conditions and Evaluation Criteria Specified for MASH TL-5Longitudinal Barriers.

The crash tests and data analysis procedures were in accordance with guidelines presented in *MASH*. Chapter 4 presents brief descriptions of these procedures.

3.2. EVALUATION CRITERIA

The appropriate safety evaluation criteria from Tables 2-2A and 5-1 of *MASH* were used to evaluate the crash tests reported herein. The test conditions and evaluation criteria required for *MASH* Tests 5-10, 5-11, and 5-12 are listed in Table 3.1, and the substance of the evaluation criteria in Table 3.2. An evaluation of the crash test results is presented in detail under the section Assessment of Test Results.

Evaluation Factors	Evaluation Criteria				
Structural Adequacy	A. Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underride, or override the installation although controlled lateral deflection of the test article is acceptable.	5-10, 5-11, 5-12			
Occupant Risk	 D. Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present 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 5.2.2 and Appendix E of MASH. 	5-10, 5-11, 5-12			
	<i>F.</i> The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.	5-10, 5-11			
	<i>G.</i> It is preferable, although not essential, that the vehicle remain upright during and after the collision.	5-12			
	H. Occupant impact velocities (OIV) should satisfy the following limits: Preferred value of 30 ft/s, or maximum allowable value of 40 ft/s.	5-10, 5-11			
	<i>I.</i> The occupant ridedown accelerations should satisfy the following: Preferred value of 15.0 g, or maximum allowable value of 20.49 g.	5-10, 5-11			

 Table 3.2. Evaluation Criteria Required for MASH TL-5 Longitudinal Barriers.

Chapter 4. TEST CONDITIONS

4.1. TEST FACILITY

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

The test facilities of the TTI Proving Ground are located on the Texas A&M University RELLIS Campus, which consists of a 2000-acre complex of research and training facilities situated 10 miles northwest of the flagship campus of Texas A&M University. The site, formerly a United States Army Air Corps base, has large expanses of concrete runways and parking aprons well suited for experimental research and testing in the areas of vehicle performance and handling, vehicle-roadway interaction, durability and efficacy of highway pavements, and evaluation of roadside safety hardware and perimeter protective devices. The site selected for construction and testing of the PennDOT PA Bridge Barrier was at the end of an out-of-service runway. The runway consists of an unreinforced jointed-concrete pavement in 12.5-ft \times 15-ft blocks nominally 6 inches deep. The runway was built in 1942, and the joints have some displacement, but are otherwise flat and level.

4.2 VEHICLE TOW AND GUIDANCE SYSTEM

For the 5-10 and 5-11 tests, the vehicle was towed into the test installation using a steel cable guidance and reverse tow system. A steel cable for guiding the test vehicle was tensioned along the path, anchored at each end, and threaded through an attachment to the front wheel of the test vehicle. An additional steel cable was connected to the test vehicle, passed around a pulley near the impact point, through a pulley on the tow vehicle, and then anchored to the ground such that the tow vehicle moved away from the test site. A 2:1 speed ratio between the test and tow vehicle existed with this system. Just prior to impact with the installation, the test vehicle was released and ran unrestrained. The vehicle remained freewheeling (i.e., no steering or braking inputs) until it cleared the immediate area of the test site (no sooner than 2 s after impact), after which the brakes were activated, if needed, to bring the test vehicle to a safe and controlled stop.

For the 5-12 test the vehicle was placed in 9th gear for the 5-12 test. With the vehicle idling the clutch was remotely engaged, to allow the truck to be pushed to speed. Once at speed, within the power band of the gear, the clutch was remotely released.. The accelerator was then remotely depressed and the vehicle accelerated under its own power to the required speed. A steel cable for guiding the test vehicle was tensioned along the path, anchored at each end, and threaded through an attachment to the front wheel of the test vehicle. The vehicle was released and ran unrestrained just prior to impact with the installation. The vehicle remained freewheeling (i.e., no steering or braking inputs) until it cleared the immediate area of the test site (no sooner than 2 s after impact), after which the brakes were activated, if needed, to bring the test vehicle to a safe and controlled stop.

4.3 DATA ACQUISITION SYSTEMS

4.3.1 Vehicle Instrumentation and Data Processing

Each test vehicle was instrumented with a self-contained, on-board data acquisition system. The signal conditioning and acquisition system is a 16-channel, Tiny Data Acquisition System (TDAS) Pro produced by Diversified Technical Systems, Inc. The accelerometers, which measure the x, y, and z axis of vehicle acceleration, are strain gauge type with linear millivolt output proportional to acceleration. Angular rate sensors, measuring vehicle roll, pitch, and yaw rates, are ultra-small, solid state units designed for crash test service. The TDAS Pro hardware and software conform to the latest SAE J211, Instrumentation for Impact Test. Each of the 16 channels is capable of providing precision amplification, scaling, and filtering based on transducer specifications and calibrations. During the test, data are recorded from each channel at a rate of 10,000 values per second with a resolution of one part in 65,536. Once data are recorded, internal batteries back these up inside the unit should the primary battery cable be severed. Initial contact of the pressure switch on the vehicle bumper provides a time zero mark as well as initiates the recording process. After each test, the data are downloaded from the TDAS Pro unit into a laptop computer at the test site. The Test Risk Assessment Program (TRAP) software then processes the raw data to produce detailed reports of the test results.

Each of the TDAS Pro units is returned to the factory annually for complete recalibration and all instrumentation used in the vehicle conforms to all specifications outlined by SAE J211. All accelerometers are calibrated annually by means of an ENDEVCO[®] 2901, precision primary vibration standard. This standard and its support instruments are checked annually and receive a National Institute of Standards Technology (NIST) traceable calibration. The rate transducers used in the data acquisition system receive a calibration via a Genisco Rate-of-Turn table. The subsystems of each data channel are also evaluated annually, using instruments with current NIST traceability, and the results are factored into the accuracy of the total data channel, per SAE J211. Calibrations and evaluations are also made any time data are suspect. Acceleration data is measured with an expanded uncertainty of ± 1.7 percent at a confidence factor of 95 percent (k=2).

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

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

Placement of the electronic instrumentation in the *MASH* Test 5-12 is shown in Appendix E1, Figure E.1 and described below.

- (A) The front accelerometers were placed on the tractor frame rail 14.0 inches forward of the front axle, 20.0 inches left of the longitudinal centerline, and at height of 33.0 inches above ground surface.
- (B) Accelerometers and rate transducers were placed on the tractor frame just ahead of the fifth wheel, 105 inches rearward of the front axle, at the longitudinal centerline, and at a height of 32 inches above ground surface.
- (C) The rear accelerometers were placed on the trailer frame, between the two rear trailer axles, 677 inches rearward of the front axle, at the longitudinal centerline, and 49.5 inches above ground surface.

4.3.2 Anthropomorphic Dummy Instrumentation

An Alderson Research Laboratories Hybrid II, 50th percentile male anthropomorphic dummy, restrained with lap and shoulder belts, was placed in the front seat on the impact side of the 1100C vehicle. The dummy was not instrumented.

According to *MASH*, use of a dummy in the 2270P vehicle is optional, however, it is recommended a dummy be used when testing "any longitudinal barrier with a height greater than or equal to 33 inches." Use of the dummy in the 2270P vehicle is recommended for tall rails to evaluate the "potential for an occupant to extend out of the vehicle and come into direct contact with the test article." Although this information is reported, it is not part of the impact performance evaluation. Since the rail height of the PennDOT PA Bridge Barrier was 50 inches above grade, a dummy was placed in the front seat of the 2270P vehicle on the impact side and restrained with lap and shoulder belts.

MASH does not recommend or require use of a dummy in the 36000V vehicle.

4.3.3 Photographic Instrumentation Data Processing

Photographic coverage of each test included three digital high-speed cameras:

- One overhead with a field of view perpendicular to the ground and directly over the impact point;
- One placed upstream of the impact point on the traffic side of the barrier; and
- A third placed to have a field of view parallel to and aligned with the installation at the downstream end.

A flashbulb on the impacting vehicle was activated by a pressure-sensitive tape switch to indicate the instant of contact with the PennDOT PA Bridge Barrier. The flashbulb was visible from each camera. The video files from these digital high-speed cameras were analyzed to observe phenomena occurring during the collision and to obtain time-event, displacement, and angular data. A digital camera recorded and documented conditions of each test vehicle and the installation before and after the test.

This page intentionally left blank.

Chapter 5. MASH TEST 5-11 (CRASH TEST NO. 609591-03-1)

5.1 TEST DESIGNATION AND ACTUAL IMPACT CONDITIONS

MASH Test 5-11 involves a 2270P vehicle, weighing 5000 lb \pm 110 lb, impacting the CIP of the bridge rail at an impact speed of 62 mi/h \pm 2.5 mi/h and an angle of 25° \pm 1.5°. The target CIP for *MASH* Test 5-11 on the PennDOT PA Bridge Barrier was 4.3 ft \pm 1 ft upstream of post 9 edge with lower rail splice. The 2013 RAM 1500 pickup used in the test weighed 5004 lb, and the actual impact speed and angle were 63.2 mi/h and 24.8°, respectively. The actual impact point was 4.3 ft upstream of the upstream edge of post 9. Minimum target impact severity (IS) was 106 kip-ft, and actual IS was 121 kip-ft.

5.2 WEATHER CONDITIONS

The test was performed on the morning of June 28, 2018. Weather conditions at the time of testing were as follows: wind speed: 8 mi/h; wind direction: 228° (vehicle was traveling in a southerly direction); temperature: 86°F; relative humidity: 73 percent.

5.3 TEST VEHICLE

Figures 5.1 and 5.2 show the 2013 RAM 1500 pickup used for the crash test. The vehicle's test inertia weight was 5004 lb, and its gross static weight was 5169 lb. The height to the lower edge of the vehicle bumper was 11.8 inches, and height to the upper edge of the bumper was 27.0 inches. The height to the vehicle's center of gravity was 29.0 inches. Tables C.1 and C.2 in Appendix C1 give additional dimensions and information on the vehicle. The vehicle was directed into the installation using the cable reverse tow and guidance system, and was released to be freewheeling and unrestrained just prior to impact.



Figure 5.1. PennDOT PA Bridge Barrier/Test Vehicle Geometrics for Test No. 609591-03-1.



Figure 5.2. Test Vehicle before Test No. 609591-03-1.

5.4 TEST DESCRIPTION

The 2013 RAM 1500 was traveling at an impact speed of 61.7 mi/h when it contacted the PennDOT PA Bridge Barrier 4.3 ft upstream of post 9 at an impact angle of 24.825.3°. Table 5.1 lists events that occurred during Test No. 609591-03-1. Figures C.1 and C.2 in Appendix C2 present sequential photographs during the test.

TIME (s)	EVENTS
0.000	Vehicle makes contact with bridge rail
0.023	Vehicle begins to redirect
0.051	Right front bumper shears off of vehicle when contacting post 9
0.082	Dummy head begins to break through passenger side window
0.182	Vehicle becomes parallel with bridge rail
0.188	Rear right side of truck contacts bridge rail
0.192	Left front tire lifts off of pavement
0.214	Left rear tire lands back on pavement
0.255	Left front tire lands back on pavement
0.299	Vehicle loses contact with bridge rail while traveling at 50.8 mi/h

Table 5.1. Events during Test No. 609591-03-1.

For longitudinal barriers, it is desirable that the vehicle redirects and exits the barrier within the exit box criteria (not less than 32.8 ft downstream from loss of contact for cars and pickups). The test vehicle exited within the exit box criteria defined in *MASH*. After loss of contact with the barrier, the vehicle came to rest 212 ft downstream of the impact and 12 ft toward traffic lanes.

5.5 DAMAGE TO TEST INSTALLATION

Figure 5.3 shows the damage to the PennDOT PA Bridge Barrier. There was slight concrete damage to the concrete barrier edges near impact and at joint, along with some surface

scuffing of the traffic face of the rail and concrete wall. Working width was 18.0 inches at a height of 24.0 inches. Maximum dynamic deflection during the test was 0.7 inches, and there was no measureable permanent deformation.



Figure 5.3. PennDOT PA Bridge Barrier after Test No. 609591-03-1.

5.6 VEHICLE DAMAGE

Figure 5.4 shows the damage sustained by the vehicle. The front bumper, hood, grill, radiator and support, right front fender, right head light, right A-post, right front tire and rim,

right front corner of roof, right front and rear doors and glass, right rear fender, right rear tail light, rear bumper and tailgate were damaged. The windshield sustained a crack starting at the bottom and radiating upward. Maximum exterior crush to the vehicle was 11.0 inches in the side plane at the right corner at bumper height. Maximum occupant compartment deformation was 3.0 inches on the right side from the firewall to the passenger seat, and vertically on the passenger side from the floorboard to the roof at the passenger seat location. Figure 5.5 shows the interior of the vehicle. Tables C.3 and C.4 in Appendix C1 provide exterior crush and occupant compartment measurements.



Figure 5.4. Test Vehicle after Test No. 609591-03-1.



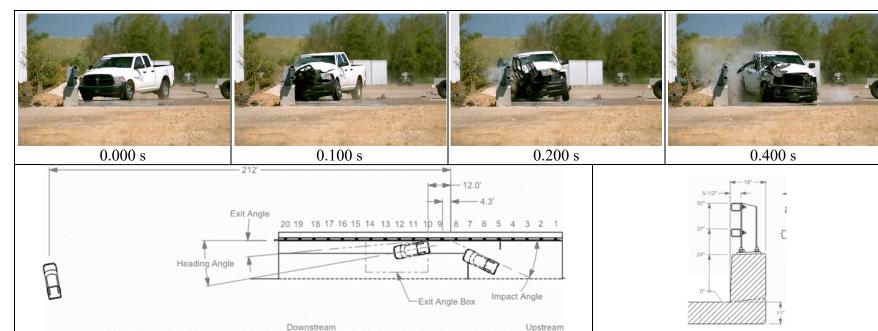
Figure 5.5. Interior of Test Vehicle for Test No. 609591-03-1.

5.7 OCCUPANT RISK FACTORS

Data from the accelerometer, located at the vehicle center of gravity, were digitized for evaluation of occupant risk and are shown in Table 5.2. Figure 5.6 summarizes these data and other pertinent information from the test. Figure C.3 in Appendix C3 shows the vehicle angular displacements, and Figures C.4 through C.9 in Appendix C4 show accelerations versus time traces.

Occupant Risk Factor	Value	Time	
Occupant Impact Velocity (OIV)	ft/s		
Longitudinal	19.4	 at 0.0918 seconds on right side of interior 	
Lateral	28.2		
Occupant Ridedown Accelerations (G's)			
Longitudinal	-3.2	(0.1038 - 0.1138 seconds)	
Lateral	-6.7	(0.2152 - 0.2252 seconds)	
	km/h		
	38.1	at 0.0895 seconds on right	
Theoretical Head Impact Velocity (THIV)	m/s	side of interior	
	10.6		
Post Head Deceleration (PHD) (G's)	7.1	(0.2152 - 0.2252 seconds)	
Acceleration Severity Index (ASI)	2.06	(0.0574 - 0.1074 seconds)	
Maximum 50-ms Moving Average (G's)			
Longitudinal	-9.4	(0.0318 - 0.0818 seconds)	
Lateral	-15.9	(0.0328 - 0.0828 seconds)	
Vertical	-2.3	(0.0013 - 0.0513 seconds)	
Maximum Roll, Pitch, and Yaw Angles	Degrees		
Roll	4	(0.4838 seconds)	
Pitch	4	(0.0623 seconds)	
Yaw	34	(0.5737 seconds)	

Table 5.2. Occupant Risk Factors for Test No. 609591-03-1.



General Information		Impact Conditions	Post-Impact Trajectory
Test Agency	Texas A&M Transportation Institute (TTI)	Speed63.2 mi/h	Stopping Distance
Test Standard Test No		Angle	12 ft toward tra
TTI Test No.	609591-03-1	Location/Orientation	f Vehicle Stability
Test Date	2018-06-28	post 9	Maximum Yaw Angle 34°
Test Article		Impact Severity	Maximum Pitch Angle 4°
Туре	Longitudinal Barrier - Bridge Rail	Exit Conditions	Maximum Roll Angle 4°
Name		Speed50.7 mi/h	Vehicle Snagging No
Installation Length		Exit Traj./Heading Angle4.4°/5.7°	Vehicle Pocketing No
Material or Key Elements	24-inch tall × 18-inch thick reinforced	Occupant Risk Values	Test Article Deflections
-	concrete parapet with two HSS 5×4×3/8	Longitudinal OIV19.4 ft/s	Dynamic 0.7 inches
	rails at 37 inches and 50 inches	Lateral OIV28.2 ft/s	Permanent None
Soil Type and Condition	Concrete bridge deck, damp	Longitudinal Ridedown3.2 g	Working Width 18.0 inches
		Lateral Ridedown6.7 g	Working Width Height 24.0 inches
Test Vehicle		THIV	Vehicle Damage
Type/Designation	2270P	PHD7.1 g	VDS 10-RFQ-5
Make and Model	2013 RAM 1500 Pickup	ASI2.06	CDC 10FREW3
Curb	4952 lb	Max. 0.050-s Average	Max. Exterior Deformation 11.0 inches
Test Inertial	5004 lb	Longitudinal9.4 g	OCDI RF0122110
Dummy	165 lb	Lateral15.9 g	Max. Occupant Compartment
Gross Static	5169 lb	Vertical2.3 g	Deformation 3.0 inches

Figure 5.6. Summary of Results for MASH Test 5-11 on PennDOT PA Bridge Barrier.

Chapter 6. MASH TEST 5-10 (CRASH TEST NO. 609591-03-2)

6.1 TEST DESIGNATION AND ACTUAL IMPACT CONDITIONS

MASH Test 5-10 involves an 1100C vehicle, weighing 2420 lb \pm 55 lb, impacting the CIP of the bridge rail at an impact speed of 62 mi/h \pm 2.5 mi/h and an angle of 25° \pm 1.5°. The target CIP for *MASH* Test 5-10 on the PennDOT PA Bridge Barrier was 3.6 ft \pm 1 ft upstream of post 13 edge with lower rail splice.

The 2011 Kia Rio^{*} used in the test weighed 2427 lb, and the actual impact speed and angle were 61.7 mi/h and 25.3°, respectively. The actual impact point was 4.1 ft upstream of the upstream edge of post 13. Minimum target IS was 51 kip-ft, and actual IS was 60 kip-ft.

6.2 WEATHER CONDITIONS

The test was performed on the morning of June 26, 2018. Weather conditions at the time of testing were as follows: wind speed: 9 mi/h; wind direction: 182° (vehicle was traveling in a southerly direction); temperature: 88°F; relative humidity: 69 percent.

6.3 TEST VEHICLE

Figures 6.1 and 6.2 show the 2011 Kia Rio used for the crash test. The vehicle's test inertia weight was 2427 lb, and its gross static weight was 2592 lb. The height to the lower edge of the vehicle bumper was 7.8 inches, and height to the upper edge of the bumper was 21.5 inches. Table D.1 in Appendix D1 gives additional dimensions and information on the vehicle. The vehicle was directed into the installation using a cable reverse tow and guidance system, and was released to be freewheeling and unrestrained just prior to impact.

^{*} An older model vehicle was used, based upon availability. An older model vehicle is permitted by AASHTO as long as it is otherwise *MASH* compliant. This vehicle meets the *MASH* dimensional specifications.



Figure 6.1. PennDOT PA Bridge Barrier/Test Vehicle Geometrics for Test No. 609591-03-2.



Figure 6.2. Test Vehicle before Test No. 609591-03-2.

6.4 **TEST DESCRIPTION**

The 2011 Kia Rio was traveling at an impact speed of 61.7 mi/h when it contacted the PennDOT PA Bridge Barrier was 4.1 ft upstream of the upstream edge of post 13 at an impact angle of 25.3°. Table 6.1 lists events that occurred during Test No. 609591-03-2. Figures D.1 and D.2 in Appendix D2 present sequential photographs during the test.

TIME (s)	EVENTS	
0.000	Vehicle makes contact with bridge rail	
0.034	Vehicle begins to redirect	
0.059	Right front panel and hood of vehicle contact post # 13	
0.084	Left front and rear tire lift off of pavement	
0.129	Dummy head at maximum extension outside of window but did not contact bridge rail.	
0.162	Vehicle becomes parallel with bridge rail	
0.184	Right rear of vehicle contacts bridge rail	

Table 6.1.	Events	during	Test No.	609591-03-2.
------------	--------	--------	----------	--------------

0.293	Vehicle loses contact with bridge rail while traveling at 46.2 mi/h
0.326	Front left tire lands back on pavement
0.398	Rear left tire lands back on pavement

For longitudinal barriers, it is desirable that the vehicle redirects and exits the barrier within the exit box criteria (not less than 32.8 ft downstream from loss of contact for cars and pickups). The test vehicle exited within the exit box criteria defined in *MASH*. After loss of contact with the barrier, the vehicle came to rest 169 ft downstream of the impact and 2 ft toward traffic lanes.

6.5 DAMAGE TO TEST INSTALLATION

Figure 6.3 shows the damage to the PennDOT PA Bridge Barrier. There was only superficial damage to the traffic face of the concrete and some light scrapping on the railing. Working width was 18.0 inches at a height of 24 inches from the ground. There was no dynamic deflection and no permanent deformation in the PennDOT PA Bridge Barrier.



Figure 6.3. PennDOT PA Bridge Barrier after Test No. 609591-03-2.

6.6 VEHICLE DAMAGE

Figure 6.4 shows the damage sustained by the vehicle. The front bumper, hood, radiator and support, right strut, right front fender, right head light, right front door and glass, right rear door, right rear quarter panel, right rear tail light, and rear bumper were damaged. The windshield sustained stress cracks starting at the bottom right side and radiating upward. Maximum exterior crush to the vehicle was 6.0 inches in the horizontal plane at the front bumper at bumper height. Maximum occupant compartment deformation was 3.0 inches at the floor panel to lower instrument panel on the passenger side. Figure 6.5 shows the interior of the vehicle. Tables D.2 and D.3 in Appendix D1 provide exterior crush and occupant compartment measurements.



Figure 6.4. Test Vehicle after Test No. 609591-03-2.



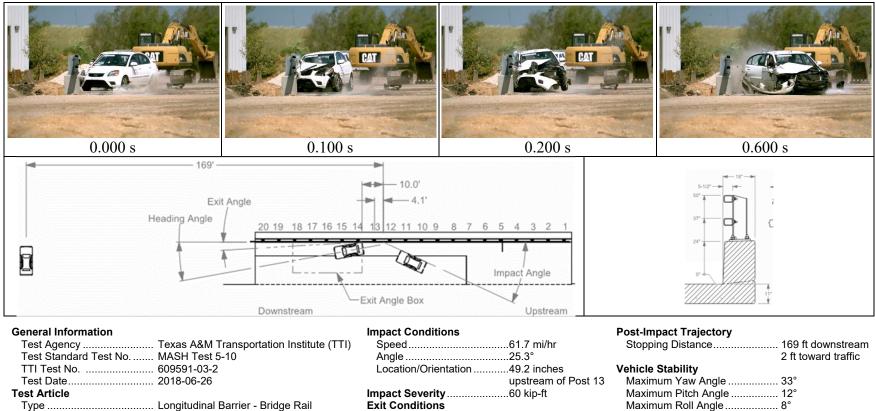
Figure 6.5. Interior of Test Vehicle for Test No. 609591-03-2.

6.7 OCCUPANT RISK FACTORS

Data from the accelerometer, located at the vehicle center of gravity, were digitized for evaluation of occupant risk and are shown in Table 6.2. Figure 6.6 summarizes these data and other pertinent information from the test. Figure C.3 in Appendix C3 shows the vehicle angular displacements, and Figures C.4 through C.9 in Appendix C4 show accelerations versus time traces.

Occupant Risk Factor	Value	Time	
Occupant Impact Velocity (OIV)	ft/s		
Longitudinal	22.3	at 0.0702 seconds on right side of interior	
Lateral	34.1	side of interior	
Occupant Ridedown Accelerations (G's)			
Longitudinal	-7.9	(0.2732 - 0.2832 seconds)	
Lateral	-9.7	(0.1938 - 0.2038 seconds)	
	km/h		
	44.5	at 0.0696 seconds on right	
Theoretical Head Impact Velocity (THIV)	m/s	side of interior	
	12.4		
Post Head Deceleration (PHD) (G's)	10.2	(0.2780 - 0.2880 seconds)	
Acceleration Severity Index (ASI)	2.93	(0.0439 - 0.0939 seconds)	
Maximum 50-ms Moving Average (G's)			
Longitudinal	-12.6	(0.0229 - 0.0729 seconds)	
Lateral	-20.9	(0.0117 - 0.0617 seconds)	
Vertical	6.7	(0.0158 - 0.0658 seconds)	
Maximum Roll, Pitch, and Yaw Angles	Degrees		
Roll	8	(0.1345 seconds)	
Pitch	12	(0.8042 seconds)	
Yaw	33	(0.6349 seconds)	

Table 6.2. Occupant Risk Factors for Test No. 609591-03-2.



	Туре	Longitudinal Barrier - Bridge Rail	Exit
	Name	PennDOT Bridge Deck	Sp
	Installation Length	149 ft-10 inches	Ex
	Material or Key Elements	24-inch tall × 18-inch thick reinforced	Осси
	-	concrete wall with two HSS 5×4×3% rails at	Lo
		37 inches and 50 inches	La
S	oil Type and Condition	Concrete bridge deck, damp	Lo
		- ·	La

Test Vehicle

Type/Designation	1100C
Make and Model	2011 KIA RIO
Curb	2457 lb
Test Inertial	2427 lb
Dummy	165 lb
Gross Static	2592 lb

EXILCONDITIONS	
Speed	46.3 mi/h
Exit Traj./Heading Angle	3.4°/10.3°
Occupant Risk Values	
Longitudinal OIV	22.3 ft/s
Lateral OIV	34.1 ft/s
Longitudinal Ridedown	7.9 g
Lateral Ridedown	9.7 g
THIV	40.7 ft/s
PHD	10.2g
ASI	2.9
Max. 0.050-s Average	
Longitudinal	12.6 g
Lateral	20.9 g
Vertical	6.7 g
	0

Stopping Distance 169 ft downst 2 ft toward tra 2 ft toward tra Vehicle Stability 33° Maximum Yaw Angle 33° Maximum Pitch Angle 12° Maximum Roll Angle 8° Vehicle Snagging No Vehicle Pocketing No Test Article Deflections None Permanent None Working Width 18 inches Working Width 18 inches VDS 10-RFQ-5 CDC 10FREW3 Max. Exterior Deformation 6.0 inches OCDI RF0114100 Max. Occupant Compartment 3.0 inches

Figure 6.6. Summary of Results for MASH Test 5-10 on PennDOT PA Bridge Barrier.

This page intentionally left blank.

Chapter 7. MASH TEST 5-12 (CRASH TEST NO. 609591-03-3)

7.1 TEST DESIGNATION AND ACTUAL IMPACT CONDITIONS

MASH Test 5-12 involves a 36000V vehicle, weighing 79,300 lb \pm 1100 lb, impacting the CIP of the bridge rail at an impact speed of 50 mi/h \pm 2.5 mi/h and an angle of 15° \pm 1.5°. The target CIP for *MASH* Test 5-12 on the PennDOT PA Bridge Barrier was 1 ft \pm 1 ft downstream of the edge of post 5.

The 2008 Freightliner CL120 Tractor & 53ft 2002 Utility Trailer used in the test weighed 79,280 lb, and the actual impact speed and angle were 49.9 mi/h and 14.8°, respectively. The actual impact point was 1.9 ft downstream of the edge of post 15 with the lower rail splice. Minimum target IS was 404 kip-ft, and actual IS was 430.6 kip-ft.

7.2 WEATHER CONDITIONS

The test was performed on the morning of July 3, 2018. Weather conditions at the time of testing were as follows: wind speed: 7 mi/h; wind direction: 195° (vehicle was traveling in a southerly direction); temperature: 86°F; relative humidity: 71 percent.

7.3 TEST VEHICLE

Figures 7.1 and 7.2 show the 2008 Freightliner CL120 Tractor & 2002 Utility 53ft Trailer used for the crash test. The vehicle's test inertia weight was 79,280 lb. The height to the lower edge of the vehicle bumper was 15 inches, and height to the upper edge of the bumper was 34.5 inches. The height to the ballast's center of gravity was 72.5 inches. Tables E.1 and Figure E.1 in Appendix E1 give additional dimensions and information on the vehicle. The vehicle was directed into the installation using a cable guidance system under self-power, and was released to be freewheeling and unrestrained just prior to impact.



Figure 7.1. PennDOT PA Bridge Barrier/Test Vehicle Geometrics for Test No. 609591-03-3.



Figure 7.2. Test Vehicle before Test No. 609591-03-3.

7.4 TEST DESCRIPTION

The 2008 Freightliner CL120 Tractor & 2002 Utility 53ft Trailer was traveling at an impact speed of 61.7 mi/h when it contacted the PennDOT PA Bridge Barrier 1.9 ft downstream of the edge of Post 15 with the lower rail splice at an impact angle of 25.3°. Table 7.1 lists events that occurred during Test No. 609591-03-3. Figures E.2 and E.3 in Appendix E2 present sequential photographs during the test.

TIME (s)	EVENTS
0.000	Tractor contacts bridge rail
0.101	Tractor begins to redirect
0.148	Front left tire of tractor lifts off of pavement
0.165	Trailer front right corner contacts rail
0.283	Tractor becomes parallel with bridge rail
0.347	Left front tire lands back on pavement
0.735	Trailer right rear corner contacts rail
0.766	Trailer becomes parallel with bridge rail
0.970	Trailer right rear corner makes furthest penetration to field side
0.973	Left turn indicator comes on and begins blinking
1.258	Tractor Trailer loses contact with bridge rail while traveling at 44.0 mi/h

Table 7.1. Events during Test No. 609591-03-3.

For longitudinal barriers, it is desirable that the vehicle redirects and exits the barrier within the exit box criteria (not less than 65.6 ft downstream from loss of contact for vehicles other than cars and pickups). The test vehicle exited within the exit box criteria defined in *MASH*. After loss of contact with the barrier, the vehicle came to rest 270 ft downstream of the impact and 8 ft toward traffic lanes.

7.5 DAMAGE TO TEST INSTALLATION

Figure 7.3 shows the damage to the PennDOT PA Bridge Barrier. Both top and bottom rails were deformed upstream of post 5 to post 7. The concrete at posts 4 through 7 was broken completely through. Working width was 51.9 inches at a height of 130.8 inches. Maximum dynamic deflection during the test was estimated (all views partially or fully obscured) to be 20 inches, and maximum permanent deformation was 6.5 inches, 43 inches downstream of center of post 5.



Figure 7.3. PennDOT PA Bridge Barrier after Test No. 609591-03-3.

7.6 VEHICLE DAMAGE

Figure 7.4 shows the damage sustained by the vehicle. The vehicle sustained damage to the front bumper, hood, front axle, right front U-bolts and springs, right head light, front right tire and rim, right door, right fuel tank, right front outer tire and rim on tractor, and right side of trailer. Maximum exterior crush to the vehicle was 18 inches in the horizontal plane at bumper height. Maximum occupant compartment deformation was 2.5 inches. Figure 7.5 shows the interior of the vehicle. Table C.3 and Figure C.41 in Appendix C11 provide exterior crush and occupant compartments.



Figure 7.4. Test Vehicle after Test No. 609591-03-3.



Figure 7.5. Interior of Test Vehicle for Test No. 609591-03-3.

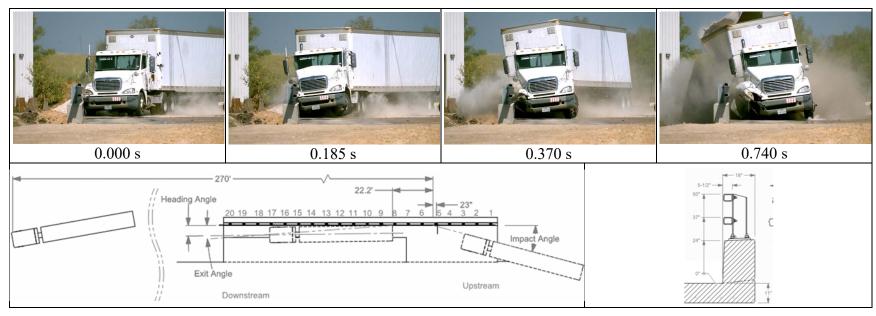
7.7 OCCUPANT RISK FACTORS

Data from the accelerometer, located near the 5th wheel of the Tractor, were digitized for informational purposes only. The results are shown in Table 7.2. Figure 7.6 summarizes these data and other pertinent information from the test. Figure E.4 in Appendix E3 shows the vehicle angular displacements, and Figures E.5 through E.13 in Appendix E4 show accelerations versus time traces.

Occupant Risk Factor	Value	Time
Occupant Impact Velocity (OIV)	ft/s	
Longitudinal	3.0	at 0.1980 seconds on right side of interior
Lateral	13.5	side of interior
Occupant Ridedown Accelerations (G's)		
Longitudinal	-8.9	(0.2158 - 0.2258 seconds)
Lateral	20.5	(0.2394 - 0.2494 seconds)
	km/h	
	15.1	at 0.1978 seconds on right
Theoretical Head Impact Velocity (THIV)	m/s	side of interior
	4.2	
Post Head Deceleration (PHD) (G's)	21.2	(0.2393 - 0.2493 seconds)
Acceleration Severity Index (ASI)	1.35	(0.2214 - 0.2714 seconds)
Maximum 50-ms Moving Average (G's)		
Longitudinal	-2.4	(0.1760 - 0.2260 seconds)
Lateral	-6.9	(0.2569 - 0.3069 seconds)
Vertical	12.8	(0.2009 - 0.2509 seconds)
Maximum Roll, Pitch, and Yaw Angles	Degrees	
Roll	22	(1.3763 seconds)
Pitch	35	(1.9979 seconds)
Yaw	25	(1.9666 seconds)

 Table 7.2. Occupant Risk Factors for Test No. 609591-03-3. Measure from 5th wheel

 Accelerometers



General Information Impact Conditions Test Agency Texas A&M Transportation Institute (TTI) Speed......49.9 mi/h Test Standard Test No. MASH Test 5-12 Angle14.8° TTI Test No. 609591-03-3 Test Date..... 2018-07-03 of post 5 Test Article Impact Severity Type Longitudinal Barrier - Bridge Rail Exit Conditions Name...... PennDOT PA Bridge Barrier Installation Length 149 ft-10 inches Exit Traj./Heading Angle4.2°/0.8° Material or Key Elements 24-inch tall × 18-inch thick reinforced **Occupant Risk Values** concrete wall with two HSS 5×4×3% rails at Longitudinal OIV......3.0 ft/s 37 inches and 50 inches Lateral OIV13.5 ft/s Soil Type and Condition Concrete bridge deck, damp Longitudinal Ridedown......8.9 g **Test Vehicle** THIV13.8 ft/s PHD......21.2 g Make and Model...... 2008 Freightliner CL120 & 2002 Utility 53ft ASI1.4 Curb 28,750 lb Max. 0.050-s Average Test Inertial 79.280 lb Longitudinal.....-2.4 g Dummy......None Lateral-6.9 g

Dent lange of Taste down	
Post-Impact Trajectory	
Stopping Distance	. 270 ft downstream
	8 ft toward traffic
Vehicle Stability	
Maximum Yaw Angle	25°
Maximum Pitch Angle	35°
Maximum Roll Angle	
Vehicle Snagging	
Vehicle Pocketing	
Test Article Deflections	
Dynamic (View Partially	
Obscured)	
Permanent	. 7.0 inches
Working Width	. 51.9 inches
Working Width Height	. 130.8 inches
Vehicle Damage	
VDS	NA
CDC	
Max. Exterior Deformation	
OCDI	
Max. Occupant Compartment	0.5 1
Deformation	2.5 inches

Figure 7.6. Summary of Results for MASH Test 5-12 on PennDOT PA Bridge Barrier.

Vertical12.8 g

Gross Static...... 79,280 lb

32

Chapter 8. SUMMARY AND CONCLUSIONS

8.1 ASSESSMENT OF TEST RESULTS

The crash testing reported herein was performed in accordance with *MASH* Tests 5-10, 5-11, and 5-12, which involves an 1100C and 2270P vehicle impacting the PennDOT PA Bridge Barrier at a target impact speed and impact angle of 62 mi/h and 25°, respectively, and a 36000V vehicle impacting the PennDOT PA Bridge Barrier at target impact speed and impact angle of 50 mi/h and 15°, respectively. An assessment of the tests based on the applicable safety evaluation criteria for *MASH* Tests 5-10, 5-11, and 5-12 for longitudinal barriers are provided in Table 8.1, 8.2, and 8.3.

8.2 CONCLUSIONS

The PennDOT PA Bridge Barrier performed acceptably for *MASH* Tests 5-10, 5-11, and 5-12 for longitudinal barriers.

Table 8.1. Performance Evaluation Summary for MASH Test 5-11 on PennDOT PA Bridge Barrier.

	MASH Test 5-10 Evaluation Criteria	Test Results	Assessment
<u>Str</u> A.	uctural Adequacy 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.	The PennDOT PA Bridge Barrier contained and redirected the 2270P vehicle. The vehicle did not penetrate, underride, or override the installation. The dynamic deflection of the bridge rail during the test was 0.7 inches.	Pass
<u>Ос</u> D.	cupant Risk 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.	No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or to present hazard to others in the area.	Pass
	Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.2.2 and Appendix E of MASH.	Maximum occupant compartment deformation was 3.0 inches on the passenger side at the floor pan to roof, and wheel/foot well and toe pan area measurements.	Pass
F.	The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.	The 2270P vehicle remained upright during and after the collision event. Roll and pitch angles were 4° and 4° , respectively.	Pass
Η.	Occupant impact velocities (OIV) should satisfy the following limits: Preferred value of 30 ft/s, or maximum allowable value of 40 ft/s.	Longitudinal OIV was 19.4 ft/s, and lateral OIV was 28.2 ft/s.	Pass
Ι.	The occupant ridedown accelerations should satisfy the following limits: Preferred value of 15.0 g, or maximum allowable value of 20.49 g.	Longitudinal occupant ridedown acceleration was 3.2 g, and lateral occupant ridedown acceleration was 6.7 g.	Pass

TR No. 609591-03

Table 8.2. Performance Evaluation Summary for MASH Test 5-10 on PennDOT PA Bridge Barrier.

105	t Agency: Texas A&M Transportation Institute MASH Test 5-10 Evaluation Criteria	Test No.: 609591-03-2 Te Test Results Test Results Test Results	st Date: 2018-06-2 Assessment
Str	uctural Adequacy		Assessment
<u>3ti</u> A.	Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underride, or override the installation although controlled lateral deflection of the test article is acceptable.	The PennDOT PA Bridge Barrier contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. There was no observable dynamic deflection or residual permanent deformation of the bridge rail.	Pass
Oce	cupant Risk		
D.	Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians, or personnel in a work zone.	No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or to present hazard to others in the area.	Pass
	Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.2.2 and Appendix E of MASH.	Maximum occupant compartment deformation was 3.0 inches in the passenger side foot well area.	Pass
F.	The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.	The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 8° and 12°, respectively.	Pass
Η.	Occupant impact velocities (OIV) should satisfy the following limits: Preferred value of 30 ft/s, or maximum allowable value of 40 ft/s.	Longitudinal OIV was 22.3 ft/s, and lateral OIV was 34.1 ft/s.	Pass
Ι.	The occupant ridedown accelerations should satisfy the following limits: Preferred value of 15.0 g, or maximum allowable value of 20.49 g.	Longitudinal occupant ridedown acceleration was 7.9 g, and lateral occupant ridedown acceleration was 9.7 g.	Pass

Table 8.3. Performance Evaluation Summary for MASH Test 5-12 on PennDOT PA Bridge Barrier.

Tes	t Agency: Texas A&M Transportation Institute	Test No.: 609591-03-3	Test Date: year-mo-da
	MASH Test 5-12 Evaluation Criteria	Test Results	Assessment
<u>Str</u> A.	uctural Adequacy 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.	The PennDOT PA Bridge Barrier contained and redirected the 36000V vehicle. The vehicle did not penetrate, underride, or override the installation. The dynamic deflection of the bridge rail during the test was 7.0 inches.	Pass
<u>Oc</u> D.	<u>cupant Risk</u> 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.	No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or to present hazard to others in the area.	Pass
	Deformations of, or intrusions into, the occupant compartment should not exceed limits set forth in Section 5.2.2 and Appendix E of MASH.	Maximum occupant compartment deformation was 2.5 inches.	Pass
<i>G</i> .	It is preferable, although not essential, that the vehicle remain upright during and after collision.	The 36000V vehicle remained upright during and after the collision.	l Pass

Evaluation Factors	Evaluation Criteria	Test No. 609591-03-2	Test No. 609591-03-1	Test No. 609591-03-3
Structural Adequacy	А	S	S	S
	D	S	S	S
	F	S	S	N/A
Occupant Risk	G	N/A	N/A	S
	Н	S	S	N/A
	Ι	S	S	N/A
	Test No.	<i>MASH</i> Test 5-10	MASH Test 5-11	MASH Test 5-12
	Pass/Fail	Pass	Pass	Pass

Table 8.4. Assessment Summary for MASH TL-5 Testson PennDOT PA Bridge Barrier.

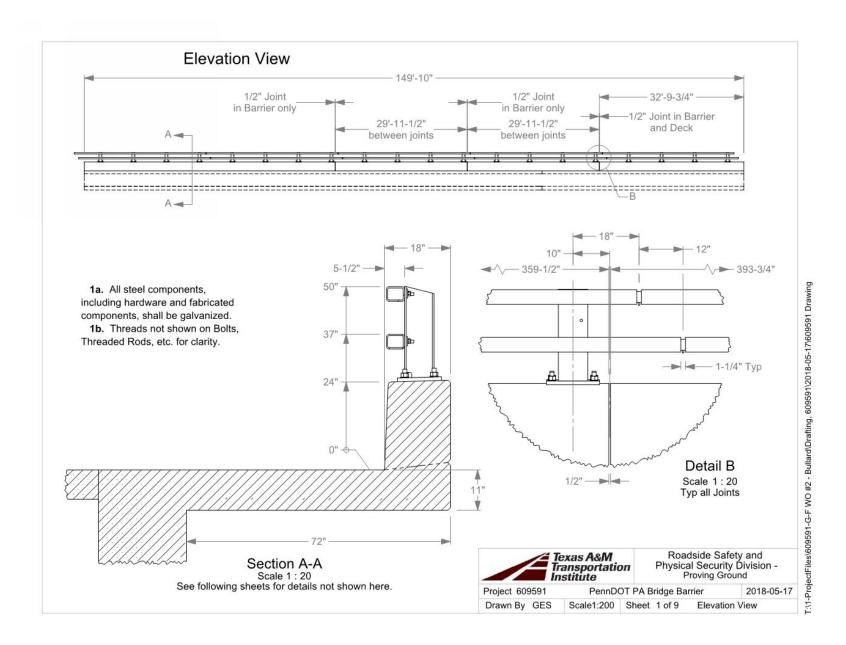
S = Satisfactory U = Unsatisfactory N/A = Not Applicable

This page intentionally left blank.

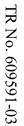
REFERENCES

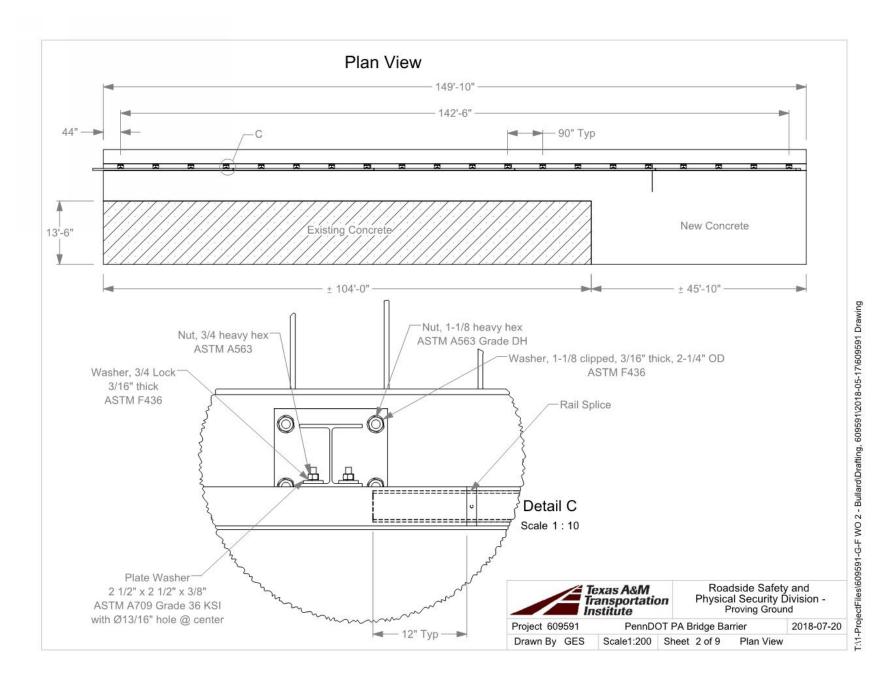
1. AASHTO. *Manual for Assessing Roadside Safety Hardware, Second Edition.* 2016, American Association of State Highway and Transportation Officials: Washington, D.C.

This page intentionally left blank.

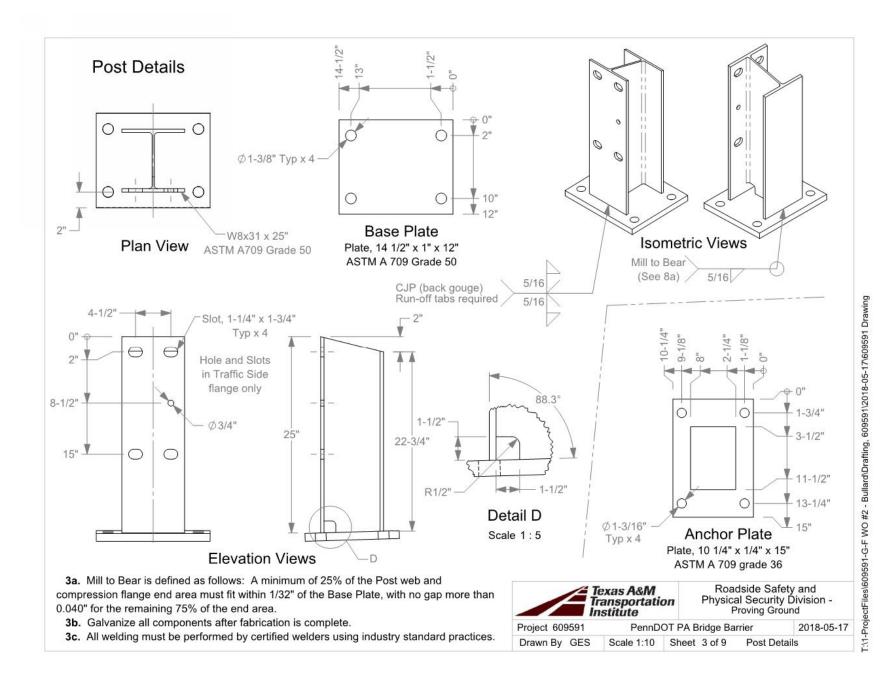


41



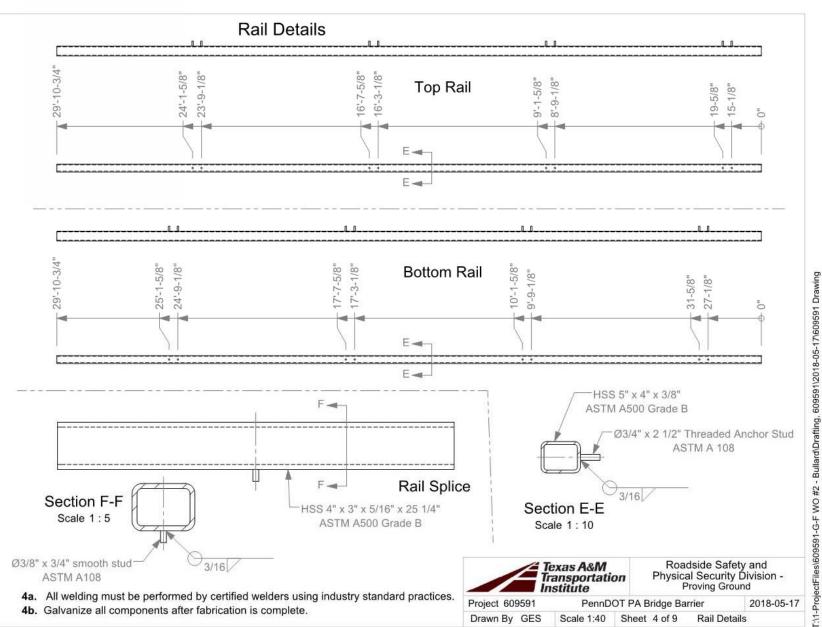


42



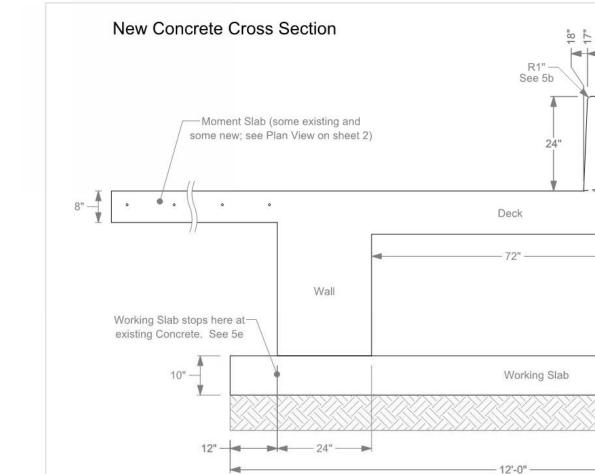
43





44





5a. Note 1/2" slope at top of Barrier and 1" slope on traffic face.5b. R1" Fillet at front edge of Barrier. Chamfer 3/4" each way at back of

Deck and Barrier, four places total.

 $\ensuremath{\textbf{5c.}}$ Rake finish construction joint between Barrier and Deck.

5d. The concrete strength shall be as follows: Working Slab and Moment Slab: minimum 3000 psi. Wall and Deck: 4000 psi. Barrier 3500 psi.
5e. Working Slab 12" overhang on the traffic side of the Wall is only at the new Moment Slab sections.

	Texas A&M Transportatio Institute	n Physica	dside Safe al Security Proving Grou	Division -
Project 609591	PennDO	T PA Bridge Ba	rrier	2018-05-17
Drawn By GES	Scale 1:20	Sheet 5 of 9	New Con Section	crete Cross

Soil-

12-1/2"

Barrier

4-1/2"

0

3-1/4"

See 5b

24-1/2"

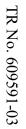
2"

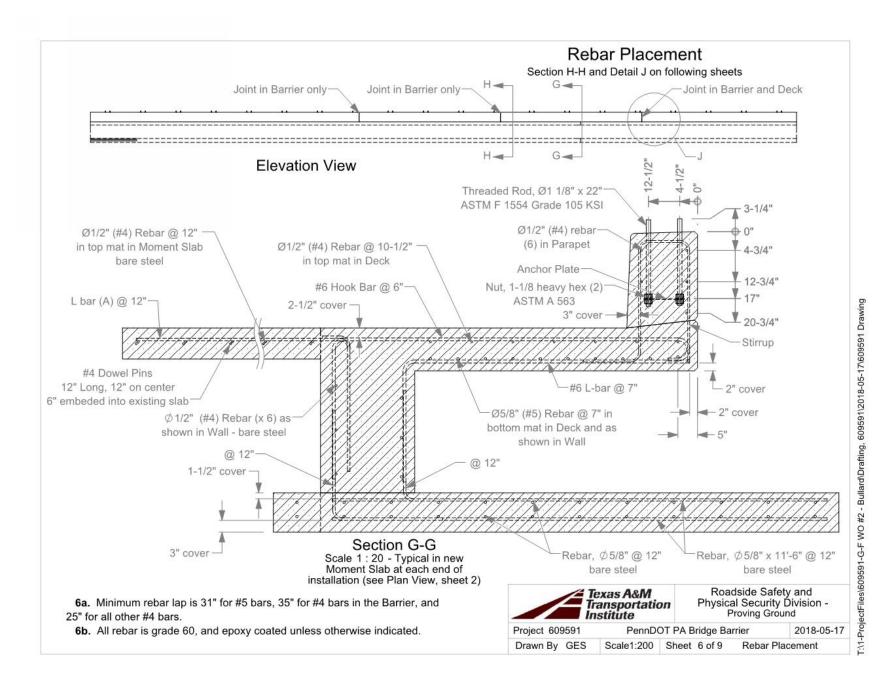
0"

11"

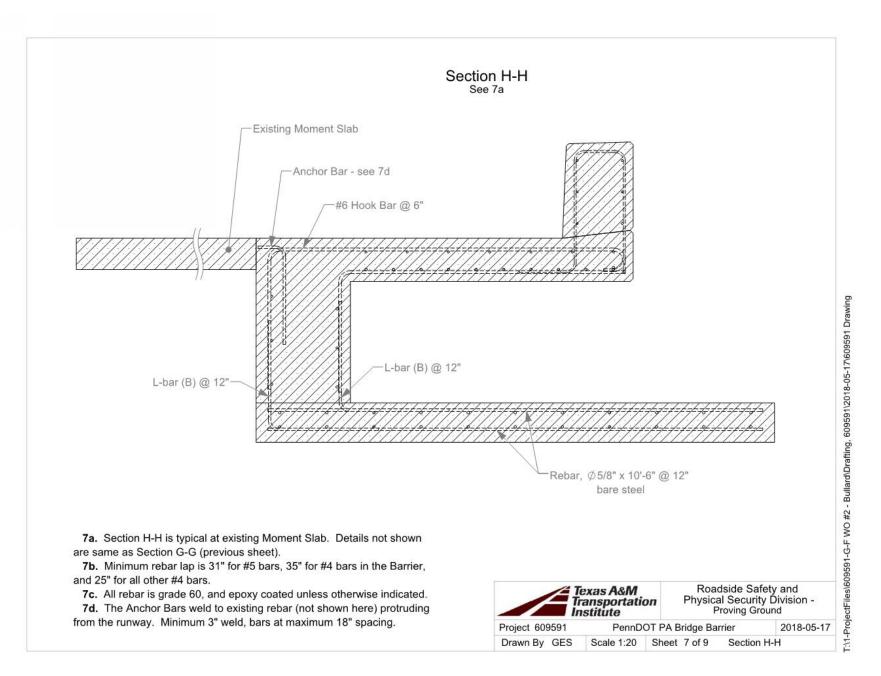
31'

45

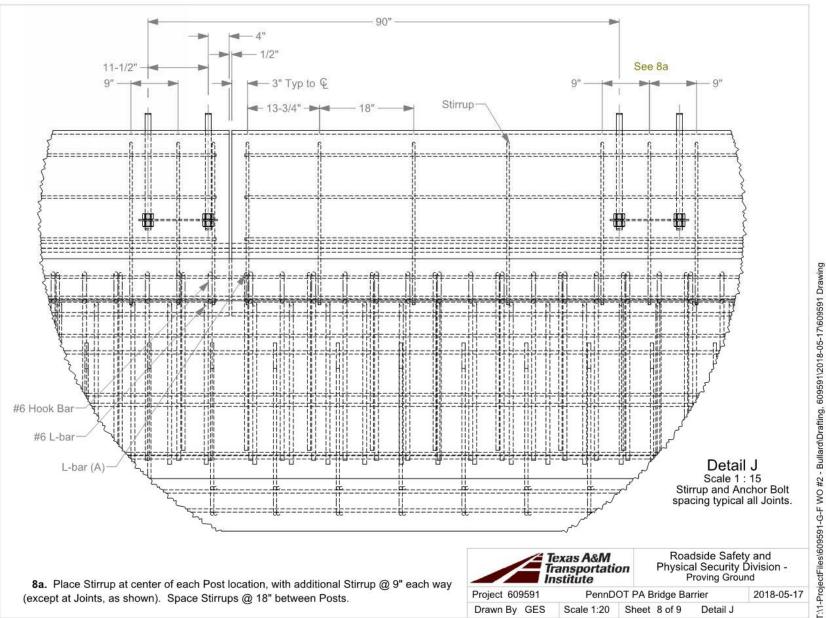


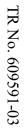


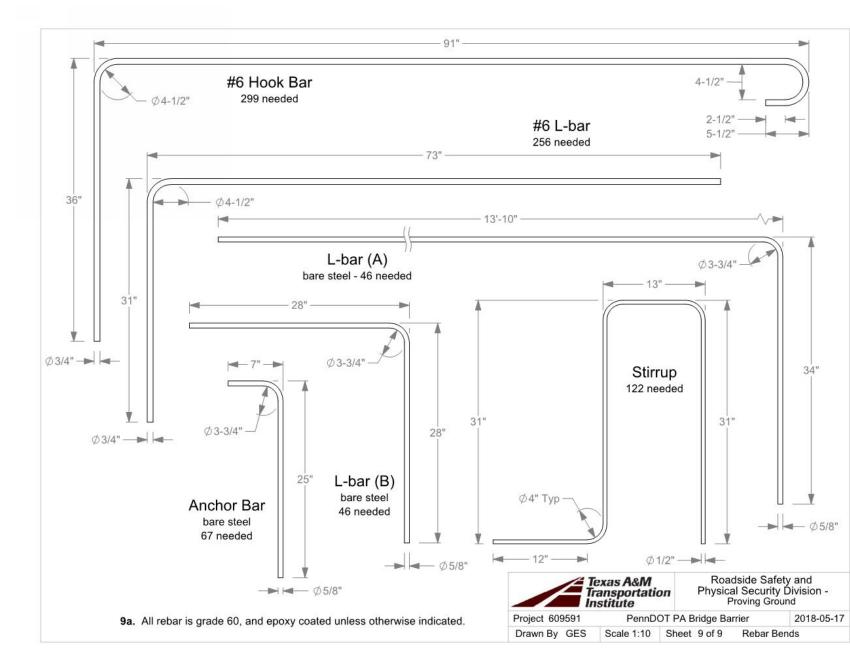
46









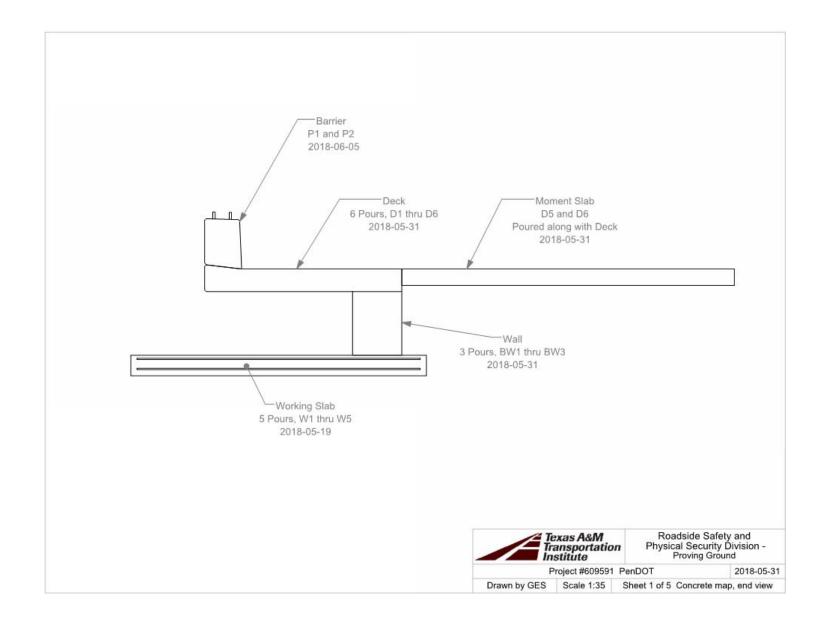


T:\1-ProjectFiles\609591-G-F WO #2 - Bullard\Drafting, 609591\2018-05-17\609591 Drawing

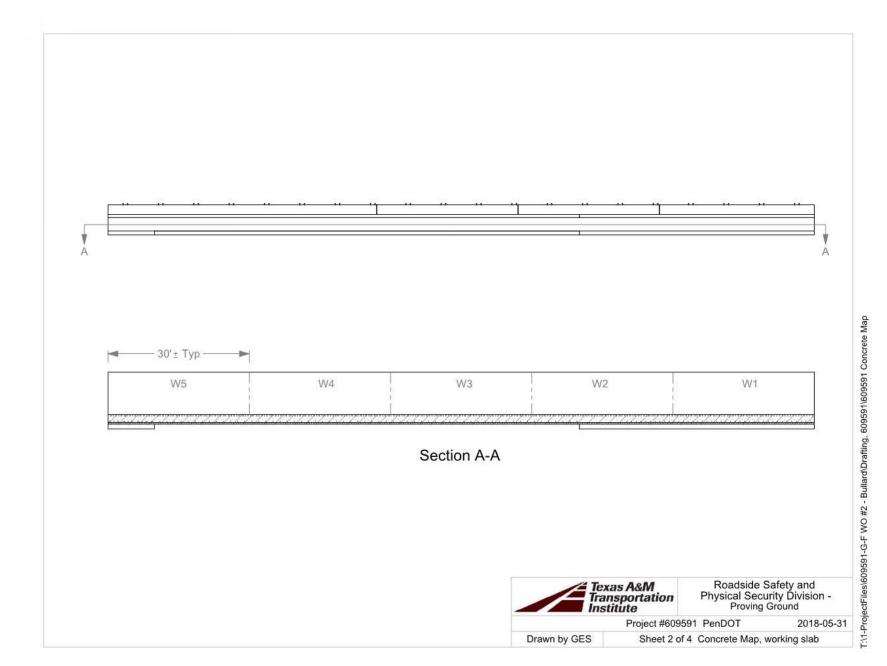
49

This page intentionally left blank.

50

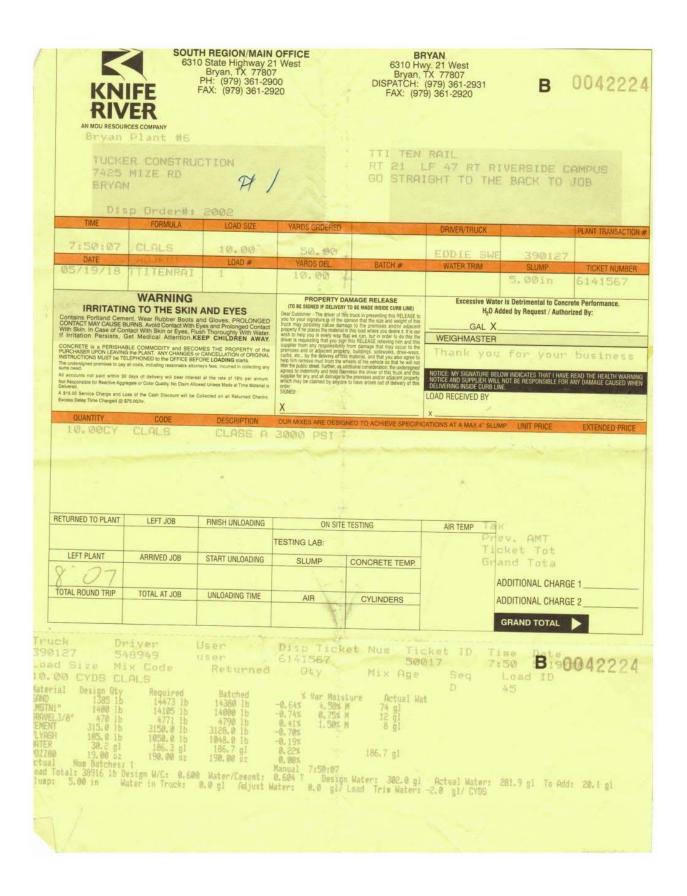


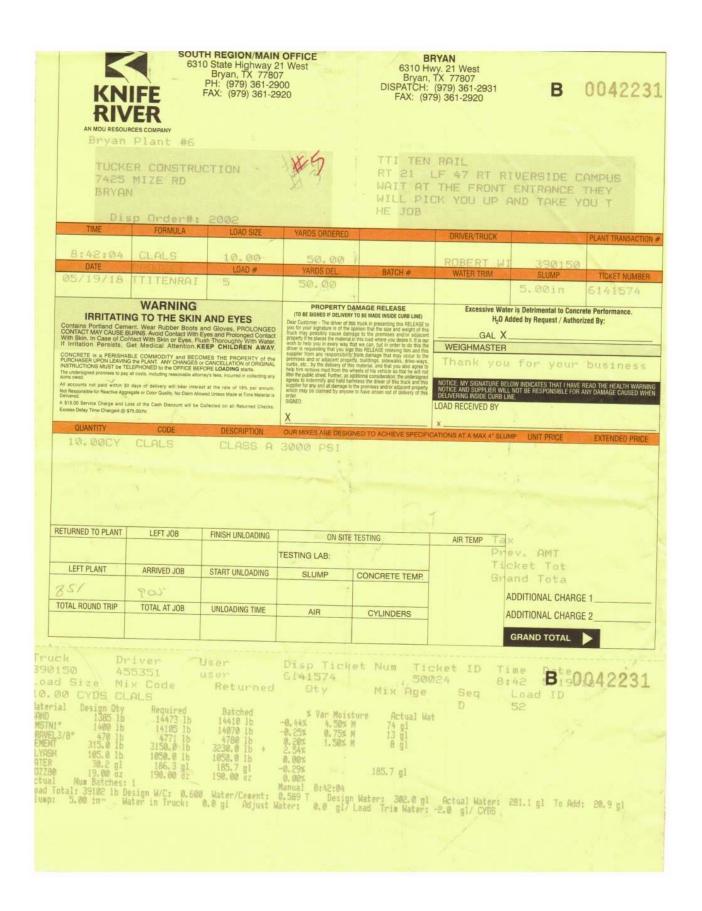




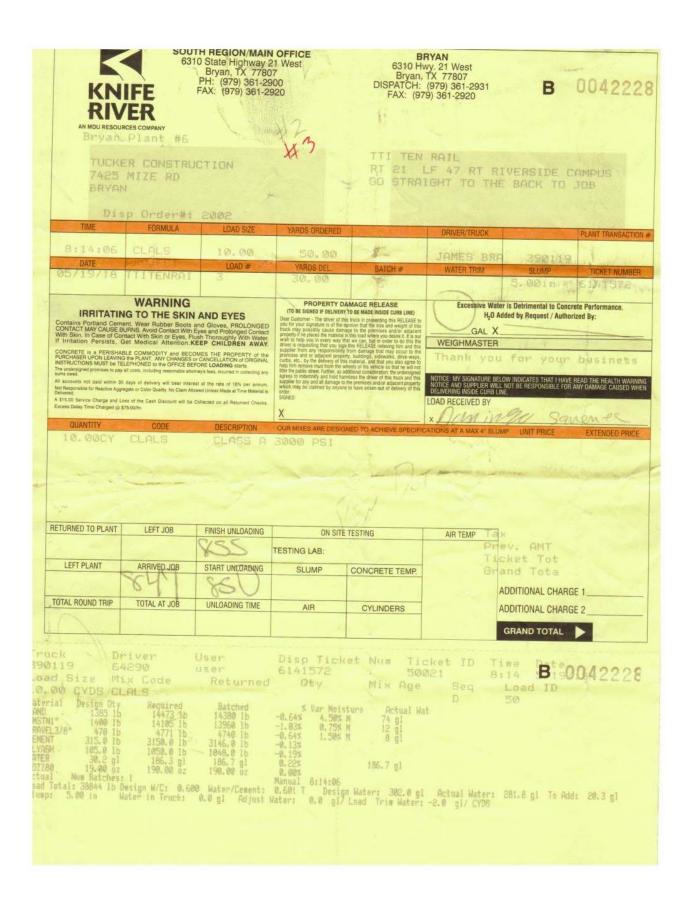
Proving Grou 3100 SH 47, Sivian: TX 77	Texas A&A Transporta Institute Texas A&M Universit Golege Staten, TX Phone 979-845-6375	ation	Concrete Sampli	Doc. No. QPF 5.7.2	Revision Date: 2018-04-17
	Quality Policy Form		Revised by: B. L. Griffith Approved by: D. Kuhn		Page: 1 of 1
Project No: Printed Name o Technician taking Sample	609581 Matt	Casting Date	Printed Name of Technician breaking	Mix Design (psi	1: <u>3000</u> 1 t Kobil
Signed Name or Technician taking Sample	n	n	Signed Name of Technician breaking Sample	1/1/	11-
Load No.	Truck No.	Ticket No.	Locat	tion (from concre	te map)
WZ/172	390127	0042224	Right Sida	Warking Sta	6 = 30'
W2/12	390144	0042225	Next to I:	sr Pour #:	30'
W3/0	390/19	0042228	Nexto 200	Par = 30	0.
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average
WITTI	2012-06-25	37 days	3295	56000	Reality
WITI		1	3891	110000	3548
WITI	A large		3360	15000	
1					
W2/T2	2081-06-25	37 days	3714	105000	
WR/12			3926	111000	3255
W2/T2		1	7526	111000	
V/3/TZ	2018-06.25	37 days	4204	119000	
12/3/73	1	1	4669	132000	4220
W3/T3		1	3784		1.40
		Car Ling			
				and the second	
					BACK SALA

Project No:	ality Policy Form	7843	Concrete Sampli	C. D. Marshall	Date: 2018-04-17
Printed Name of		m Revised by: Approved by		Revision: 6	Page: 1 of 1
Technician taking Sample	2	Casting Date	: <u>2012-05-19</u> Printed Name of Technician breaking Sample		<u>3000</u> t Kob
Signed Name of Technician taking Sample	Mai	1 2	Signed Name of Technician breaking Sample	1-	hL
Load No.	Truck No.	Ticket No.	Locat	ion (from concrete	e map)
W4/14	390107	0042230	Next to Po	ur #3, 23	30'
W5/T5	390150	0042231	Finel Pour	on left, a	: 30'
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average
WY/TY	2019-06-25	37 days	3745	106000	N.
1/4/14	I	1	4067	115000	396
6/4/74			4067	115000	
WS/TS	2013-06-25	37 daysi	3961	112000	
W6/75	1	1	3997	117000	3898
W5/15			3714	105000	
					123

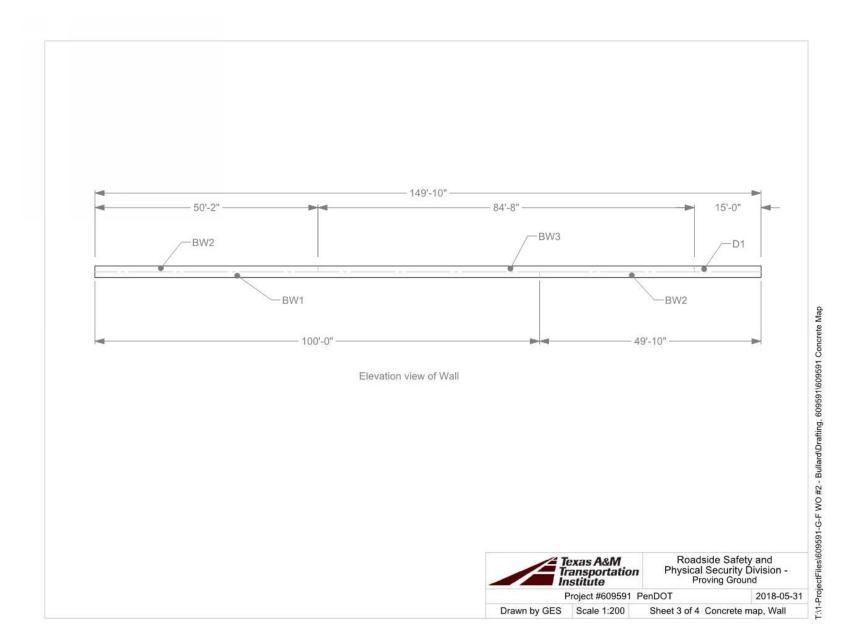




		631	TH REGION/MAIN 0 State Highway 2 Bryan, TX 7780 PH: (979) 361-29 FAX: (979) 361-29	1 West 7 00	6310 H Bryan, DISPATCH:	RYAN wy. 21 West TX 77807 (979) 361-2931 79) 361-2920	В	0042230
	TUCK 7425 BRYA	ER CONSTRU MIZE RD N		#FY	TTI TEN RT 21 GD STRA	RAIL LF 47 RT R IGHT TO TH	IVERSIDE (E BACK TO	CAMPUS JOB
	TIME	Sp Onder#: FORMULA	LOAD SIZE	YARDS ORDERED		DDB/CD CDUOX		Stand and
	8:22:39	and a		in the other inco		DRIVER/TRUCK		PLANT TRANSACTION #
	DATE	CLALS	1.01. 010 LOAD #	YARDS DEL.	BATCH #	WATER TRIM	390107	
	05/19/18	TTITENRAL	4	40.00		TRISC LOUR	SLUMP 5.00in	G141573
	19 C. S. M.	WARNING	and the second	PROPERTY D	AMAGE RELEASE	Excessive Wat	er is Detrimental to Conc	
	IRRITATI Contains Portland Cer	NG TO THE SKIN	AND EYES			H ₂ O A	dded by Request / Autho	rized By:
	CONTACT MAY CAUSE With Skin, in Case of C If Irritation Persists,	nent. Wear Rubber Boots a BURNS. Avoid Contact With B ontact With Skin or Eyes, Flu Get Medical Attention. K	eyes and Prolonged Contact ish Thoroughly With Water.	fruck may possibly cause dam property if he places the material wish to help you in every way to	age to the premises and/or adjacent in this load where you desire it. It is our tak we can, but in order to do this the	GAL X		
	CONCRETE is a PERISH. PURCHASER UPON LEAVIN	ABLE COMMODITY and BECO NG the PLANT. ANY CHANGES of TELEPHONED to the OFFICE BEP	MES THE PROPERTY of the CANCELLATION of ORIGINAL	supplier from any responsibility premises and or adjacent prope curbs, etc., by the delivery of th	from damage that may occur to the from damage that may occur to the fry, buildings, sidewalks, drive-ways, s material, and that you also agree to	Thank you	for your	business
	All accounts not paid within :	an costs, including reasonable after	ney's tees, incurred in collecting any	help him remarks mud from the v litter the public stheet. Further, as a agrees to indemnify and hold ha supplier for any and all damage to	(TO BE MADE INSIDE CURS LINE) is truck in present this RELEASE is optimion that the size and weight of this age to the premise and/or adjacent if this load where you desire. If is our line and where you desire. If is our line size and a weight of the size and the time set. EASE indexing in man desire it this RELEASE indexing in man desire this set. The size and the size and the time set and the size of the size of the time set and the size of the size of the time set and the size of the size of the size size of the size of the size of the difficult or adjacent processive with premises and/or adjacent processive in the variation of the size of adjacent processive in the size of the	NOTICE: MY SIGNATURE BE		
	A \$15.00 Service Charge and	gregate or Color Duality. No Claim Allo	wed Unless Made at Time Material is	which may be claimed by anyon order. SIGNED	e to have arisen out of delivery of this	LOAD RECEIVED BY	l not be responsible for Ne.	READ THE HEALTH WARNING ANY DAMAGE CAUSED WHEN
	Excess Dealy Time Crisiged G	-875.00/hr	The second contract	X		x		and the second
	10.00CY	CLALS	CLASS A		NED TO ACHIEVE SPECIFI	CATIONS AT A MAX 4" SLU	MP UNIT PRICE	EXTENDED PRICE
			WEHOD H	3000 PS1	X			1 1 1 1
1	5.1.4							
			1. 1.		170	T +	3	12- 3- 4
								and the second
F	RETURNED TO PLANT	LEFT JOB	FINISH UNLOADING	ON SITE	TESTING	AIR TEMP		
		the second s		TESTING LAB:		Pr	ev. AMT	
F	LEFT PLANT	ARRIVED JOB	START UNLOADING	SLUMP	CONCRETE TEMP.	and the second	cket Tota	
		905	9118	1 March			ADDITIONAL CHAR	SE 1
	TOTAL ROUND TRIP	TOTAL AT JOB	UNLOADING TIME	AIR	CYLINDERS		ADDITIONAL CHARC	
						1962.	GRAND TOTAL	
-				i in the		cket ID T 023 8 Seq	CHARDTOTAL	
390	107 D	20723	User user	Disp Tick	et Num Ti	cket ID T	me Date,	040000
0.00	d Size M 80 CYDS C	ix Code	Returned	Qty_	Mix Age	Seq 8	Load ID	1042230
ateri	al Design Oty	Required	Batched	C. Haw Male	han the second	0	51	w *
AND MSTN1	· 1498 16	14473 1b 14105 1b	14380 1b 13960 1b	-8.64% 4.58%	ture Actual Na M 74 gl	10		
RAVEL EMENT	215 0 11	4771_15 3158.0 1b	4730 1b 3234.0 1b +	-0.85% 1.50% 2.57%	M B gi			
TER 17740	105.0 1b 105.0 1b 30.2 gl 19.00 oz Nus Batches	1856.3 g1	Batched 14380 lb 13960 lb 4730 lb 234.0 lb 165.7 gl 169.00 cz	0,19% -0,29%	185.7 ml			
tual ad T	Num Batches otal: 38918 Th	: 1 Design W/P+ 0 con	190, 00 02	0.00% Manual 8:22:39		Actual Water: -2.0 gl/ CYDS		
usb:	5.00 in	Water in Truck:	0.0 gl Adjust W	0.588 Desig ater: 0.0 gl/	n Water: 302.0 gl Load Trim Water:	Actual Mater: -2.0 gl/ CVDS	280.8 g1 To Add	d: 21.2 gl
						and a stranger of the stand of		
						1		



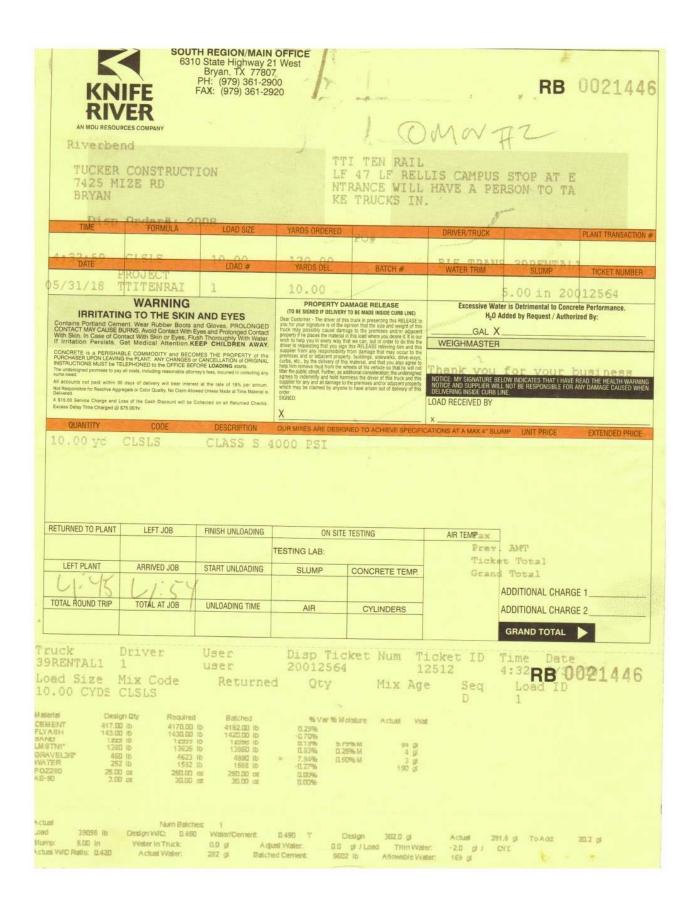
KN	IFE /ER	TH REGION/MAIN 10 State Highway 2 Bryan, TX 7780 PH: (979) 361-29 FAX: (979) 361-29	21 West 07 900	6310 H Bryan, DISPATCH:	RYAN wy. 21 West TX 77807 (979) 361-2931 79) 361-2920	В	0042225
- 444	Plant #6		42				
TUCH			pr	TTI TEN	RAIL		
	ER CONSTRU MIZE RD N	ICTION .		RT 21 GO STRA	LF 47 RT RI IGHT TO THE	VERSIDE CI BACK TO	AMPUS JOB
	sp Order#:	2002					
TIME	FORMULA	LOAD SIZE	YARDS ORDERED		DRIVER/TRUCK		PLANT TRANSACTION
8:01:35 DATE	CLALS	10.00	50.00		RAY ALWEL	390144	
05/19/18	TTITENRAL	LOAD #	YARDS DEL.	BATCH #	WATER TRIM	SLUMP	TICKET NUMBER
-	WADNING					5.00in	6141568
	WARNING NG TO THE SKIN			AMAGE RELEASE TO BE MADE INSIDE CURB LINE) Is truck in presenting this RELEASE to	Excessive Water H ₂ O Add	is Detrimental to Concre ded by Request / Authorit	ete Performance. zed By:
CONTACT MAY CAUSE With Skin. In Case of Co	BURNS Avoid Contact With antact With Skin or Eyes, Fi	and Gloves, PROLONGED Eyes and Prolonged Contact ush Thoroughly With Water. (EEP CHILDREN AWAY.	you for your signature is of the o fruck may possibly cause dam property if he places the material wish to their you in process area of	TO BE MADE INSIDE CLIBE (LIKE) Is truck in presentation in RELEASE of ophroin that the size and weight of this ophroin that may also and an adjuster in the size and an adjuster and the intervention of the size of the size of the size size of the size of the size of the size of the size of the size of the theory of the size of the size of the theory of the size of	GAL X		
CONCRETE is a PERISH	ABLE COMMODITY and BECO	OMES THE PROPERTY of the	driver is requesting that you sign supplier from any responsibility premises and or adjacent proper	at we can, but in order to do this the this RELEASE relieving him and this from damage that may occur to the ty, buildings, sidewalks, drive-ways,	WEIGHMASTER Thank you	for your	hund here
The undersigned promises to pa sums owed.	y all costs, including reasonable atto	mey's fees, incurred in collecting any	Curbs, etc by the delivery of the help him remove mud from the w litter the public street. Further, as a agrees to indemnify and hold har	s material, and that you also agree to heets of his vehicle so that he will not didicinal consideration; the undersigned missis the driver of this functions and the release the driver of this function.	Notice All		
Delivered.	pregate or Color Quality. No Claim Alk	est at the rate of 16% per annum, owed Unless Made at Time Material is	supplier for any and all damage to which may be claimed by anyons order. SIGNED:	the premises and/or adjacent property to have arisen out of delivery of this	NOTICE: MY SIGNATURE BELO NOTICE AND SUPPLIER WILL M DELIVERING INSIDE CURB LINE	W INDICATES THAT I HAVE R NOT BE RESPONSIBLE FOR A	READ THE HEALTH WARNING NY DAMAGE CAUSED WHEN
A \$15.00 Service Charge and Excess Delay Time Charged @	Loss of the Cash Discount will be \$75.00/hr.	Collected on all Returned Checks.	X		LOAD RECEIVED BY	and the second second	Y d
QUANTITY 10.00CY	CODE	DESCRIPTION	A MARKET AND A	NED TO ACHIEVE SPECIFI	CATIONS AT A MAX 4" SLUM	P UNIT PRICE	EXTENDED PRICE
and the second				0.			
				R, Pot	rV-		
RETURNED TO PLANT	LEFT JOB	FINISH UNLOADING	ON SITE	Pot TESTING	AIR TEMP TO X		
RETURNED TO PLANT	LEFT JOB	FINISH UNLOADING	ON SITE TESTING LAB:	TESTING	Pre	v. AMT	
RETURNED TO PLANT	LEFT JOB ARRIVED JOB	FINISH UNLOADING	The second secon	TESTING CONCRETE TEMP	Pre Tic	v. AMT ket Tot nd Tota	
LEFT PLANT B11			TESTING LAB:		Pre Tic Gra	ket Tot	1
			TESTING LAB:		Pre Tic Gra Al	ket Tot nd Tota	
LEFT PLANT B11	ARRIVED JOB	START UNLOADING	TESTING LAB:	CONCRETE TEMP.	Pre Tic Gra Al	ket Tot nd Tota DDITIONAL CHARGE	
LEFT PLANT B11 TOTAL ROUND TRIP	ARRIVED JOB 8 30 TOTAL AT JOB river 54014 ix Code	START UNLOADING UNLOADING TIME	TESTING LAB: SLUMP AIR Disp Tick	CONCRETE TEMP. CYLINDERS	Pre Tic Gra Al Al Cket ID 318 8: Seq 1	ket Tot nd Tota DDITIONAL CHARGE DDITIONAL CHARGE GRAND TOTAL BI 01 BI 00 Load ID	2
LEFT PLANT B1 TOTAL ROUND TRIP UCK 001 44 ad Size will Design 0ty b1 45 15 min 1400 15 1257 15 min 1400 15 1257 15 min 1400 15	ARRIVED JOB 8 30 TOTAL AT JOB TOTAL AT JOB	START UNLOADING UNLOADING TIME User User Returned Batched 14370 lb 14910 lb	TESTING LAB: SLUMP AIR Disp Tick 6141568 Qty X Var Mois -0.71X 4.50X -0.57X 0.77X A 57	CYLINDERS CYLINDERS et Num Tit SQI Mix Age ture Actual Ha 74 gi 12 gi	Pre Tic Gra Al Al Cket ID Ti 318 8: Seq 1 D 14	ket Tot nd Tota DDITIONAL CHARGE DDITIONAL CHARGE SRAND TOTAL SRAND TOTAL 01 B 190 Load ID 46	²
LEFT PLANT B1 TOTAL ROUND TRIP UCK 001 44 ad Size will Design 0ty b1 45 15 min 1400 15 1257 15 min 1400 15 1257 15 min 1400 15	ARRIVED JOB 8 30 TOTAL AT JOB TOTAL AT JOB	START UNLOADING UNLOADING TIME User User Returned Batched 14370 lb 14910 lb	TESTING LAB: SLUMP AIR Disp Tick 6141568 Qty X Var Mois -0.71X 4.50X -0.57X 0.77X A 57	CYLINDERS CYLINDERS et Num Tit SQI Mix Age ture Actual Ha 74 gi 12 gi	Pre Tic Gra Al Al Cket ID Ti 018 8: Seq 1 D	ket Tot nd Tota DDITIONAL CHARGE DDITIONAL CHARGE SRAND TOTAL SRAND TOTAL 01 B 190 Load ID 46	²

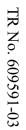


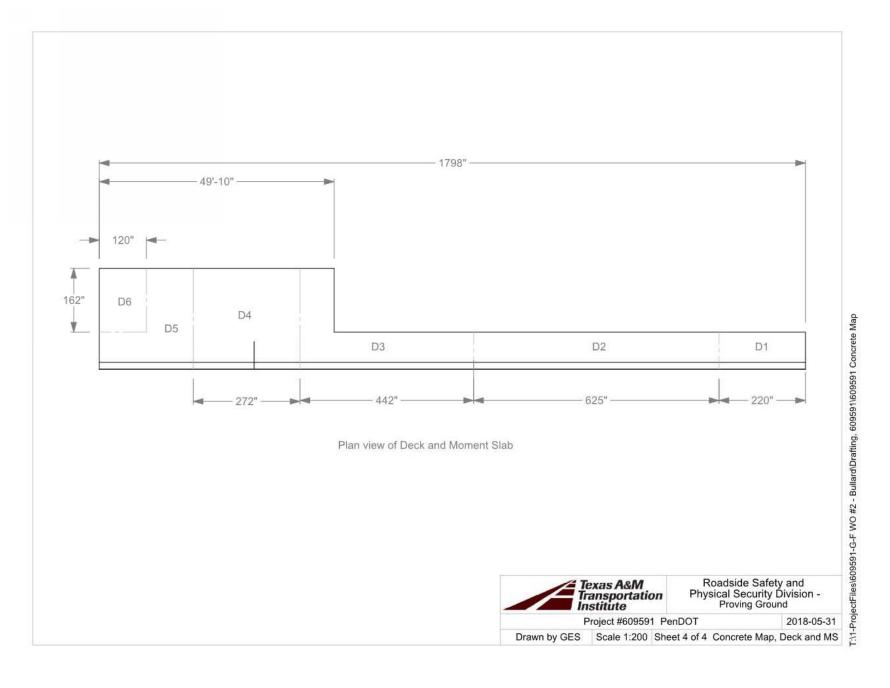
Proving On 3100 SH 47 Brivan, TX 7	und Bidg 7091 7807 Hone 979-845-637	ation	Concrete Sampli	Doc. No. QPF 5.7.2	Revision Date: 2018-04-17
Q	ality Policy For		B. L. Griffith 7: D. Kuhn	Revision: 6	Page:
Project No Printed Name o Technician takin Samp Signed Name o Technician takin		_	Printed Name of Technician breaking Sample Signed Name of Technician breaking	mat	* 4000 * Robins
Sampl	e ho	-00	Sample	cm	110
Load No.	Truck No.	Ticket No.		tion (from concre	
412/22	JARENTAL1 39Renta/2	0021446	Pottom HA	LE VALL	- 110
BU3/73	3Frental1	0021447	TOD HALF VAL	7+L Rost to 15	= 110' Tom Hay = = 45 ' from and
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average
BWITTI	2018-06-25	26 days	5659	160000	*,
BUITT		1	5659	160000	5059
BUITT			5657	160000	
BUZITZ	2013-06-25	Zbdays	6720	190000	
BUZITZ	1	1,	6685	189000	6685
OUSTR			6650	188000	
56343	2018-01-25	262-4	6508	184000	
PW3/TD		1	6013	120000	6331
BW3/T2			6423	187000	
1.					

TUCKER					
BRYAN	CONSTRUCT	'ION	LF	I TEN RAIL 47 LF REL RANCE WILL TRUCKS IN	LIS CAMPUS STOP AT E HAVE A PERSON TO TA
Disp	Order#: 2	008			
TIME	FORMULA	LOAD SIZE	YARDS ORDERED	PO# UNRES	DRIVER/TRUCK PLANT TRANSACTIO
5:04:17	CLSLS	10.00	120.00		B'S TRANS 39RENTAL
DATE 5/31/18	TTITENRAI	LOAD #	YARDS DEL.	BATCH #	WATER TRIM SLUMP TICKET NUMBER
-,,	WARNING	9	30.00		5.00 in 20012566
IRRITATI	NG TO THE SKIN	AND EYES	(TO BE SIGNED IF DELIVERY T	MAGE RELEASE 0 BE MADE INSIDE CURB LINE) truck in presenting this RELEASE to	Excessive Water is Detrimental to Concrete Performance. H ₂ O Added by Request / Authorized By:
CONTACT MAY CAUSE With Skin. In Case of Co	nent, Wear Rubber Boots BURNS, Avoid Contact With ontact With Skin or Eyes, FI	and Gloves, PROLONGED Eyes and Prolonged Contact ush Thoroughly With Water. EEP CHILDREN AWAY.	you for your signature is of the op truck may possibly cause damag property if he places the material in which to believe	mon that the size and weight of this to the premises and/or adjacent this load where you desire it. It is our	GAL X
CONCRETE is a PERISH/ PURCHASER UPON LEAVIN	ABLE COMMODITY and BECO	OMES THE PROPERTY of the	driver is requesting that you sign t supplier from any responsibility fr premises and or adjacent property	truck in presenting this RELEASE to intern that the size and weight of this is to the premises and ion adjacent this load withmy work desire (1, 15 our here RELASET in order to do this this here RELASET in order to do this this here RELASET in order to do this this of adjacent that may occur to the . Duildings sidewales, drive-ways, the understand that you also agree to eated of here of this through and the sess the other of this through and the o taken assess of the divery of this	WEIGHMASTER
The undersigned promises to pe sums owed.	y all costs. Including reasonable atto	rney's fees, incurred in collecting any	curbs, etc., by the delivery of this i help him remove mud from the whe litter the public street. Further, as add	material, and that you also agree to eets of his vehicle so that he will not Itional consideration the undersioned	Thank you for your business
All accounts not paid within 3			agrees to indemnify and hold harm	inss the driver of this bruck and this	
Delivered.	gregate or Color Guality. No Claim All	est at the rate of 18% per annum. owed Unless Made at Time Material is	order.	less the driver of this truck and this repremises and/or adjacent property to have arisen out of delivery of this	NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNIN NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WH DELIVERING INSIDE CURB LINE.
Dehremad. A \$15.00 Service Charge and Excess Delay Time Charged @ QUANTITY	pregate or Color Quality. No Claim All	Collected on all Returned Checks.	order SIGNED:		
A \$15.00 Service Charge and Excess Delay Time Charged @	pregate or Color Guality, No Chaim Alls Loss of the Cash Discount will be \$75.00th: CODE	Collected on all Returned Checks.	OUR MIXES ARE DESIGN		NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNIN NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUGED WH DELIVERING INSIDE CURB LINE. LOAD RECEIVED BY X
Delivered. A \$15.00 Service Charge and Excess Delay Time Charged @ QUANTITY	pregate or Color Guality, No Chaim Alls Loss of the Cash Discount will be \$75.00th: CODE	Collected on all Returned Checks.	OUR MIXES ARE DESIGN	IED TO ACHIEVE SPECIFIC	NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNIN NOTICE AND SUPPLIES WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUGED WH DELEVENING INSIDE CURB LINE. LOAD RECEIVED BY X
Deliveral. A 51:50 Service Charge and Excess Delay Time Charged (# QUANTITY 10.00 yC	Insert of Cator Guards, No Olam Ab (ass of the Cash Discount will be (\$75.00m; CODE CLSLS	Collected on all Returned Checks.	OUR MIXES ARE DESIGN	IED TO ACHIEVE SPECIFIC	NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNIN NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WH DELIVERING INSIDE CURS UNRE LOAD RECEIVED BY X
Deliveral. A 51:50 Service Charge and Excess Delay Time Charged (# QUANTITY 10.00 yC	Insert of Cator Guards, No Olam Ab (ass of the Cash Discount will be (\$75.00m; CODE CLSLS	Collected on all Returned Checks.	OUR MIXES ARE DESIGN	IED TO ACHIEVE SPECIFIC	NOTICE MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNIN NOTICE AND SUPPLIES WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUGED WH DELIVERING INSIDE CURB LINE. LOAD RECEIVED BY X
Deleveral. A 51:50 Service Arrow of Charge and Excesse Delay Time Charged @ QUANTITY 10.00 YC	LEFT JOB ARRIVED JOB	Collected on all Returned Checks.	OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN OUR STEE ON SITE T TESTING LAB:	IED TO ACHIEVE SPECIFIC	NOTICE MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNIN NOTICE AND SUPPLIES WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUGED WH DELIVERING INSIDE CURB LINE LOAD RECEIVED BY x
Deleveral. S Fisca Service Charge and Excess Delay Time Charged (b) QUANTITY 10.00 yc	LEFT JOB	Collected on all Returned Checks.	OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN OUR STEE ON SITE T TESTING LAB:	IED TO ACHIEVE SPECIFIC	NOTICE MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNI NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WH DELIVERING INSIDE CURB LINE LOAD RECEIVED BY x
Deleveral. A 51:00 Service Charge and Excess Delay Time Charged @ QUANTITY I O . OO YC ETURNED TO PLANT LEFT PLANT TOTAL ROUND TRIP	LEFT JOB ARRIVED JOB TOTAL AT JOB	Class Made al Time Material is Collected on all Returned Checks.	OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN OUR STREE ON SITE T TESTING LAB: SLUMP	TESTING CONCRETE TEMP.	NOTICE MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNING DOTIE AND SUPPLIES WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUGED WH DELIVERING INSIDE CURB LINE LOAD RECEIVED BY x
Deleveral. A 51:00 Service Charge and Excess Delay Time Charged @ QUANTITY I O . OO YC EETURNED TO PLANT LEFT PLANT TOTAL ROUND TRIP UCK	LEFT JOB ARRIVED JOB	Class Start UNLOADING START UNLOADING UNLOADING TIME	OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN OUR SITE OUR SITE OUR SITE TESTING LAB: SLUMP AIR DI 3D TIC	TESTING CONCRETE TEMP. CYLINDERS	NOTICE MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARRIN DOTICE AND SUPPLIES WILL NOT BE READONDRILE FOR ANY DAMAGE CAUGED WH DELMERING INSIDE CURB LINE LOAD RECEIVED BY x
ETURNED TO PLANT	LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB	Class Made al Time Material is Collected on all Returned Checks.	OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN OUD PSI ON SITE TESTING LAB: SLUMP AIR DISP Tic 20012566	TESTING CONCRETE TEMP. CYLINDERS	AIR TEMP ^{2X} AIR T
ETURNED TO PLANT ETURNED TO PLANT LEFT PLANT IOTAL ROUND TRIP UCK RENTAL1 ad Size .00 CYDS tal Desi	LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB	Class S 4	OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN OUD PSI OUN SITE TESTING LAB: SLUMP AIR DI 3D-Ti c) 20012566 d Qty	TESTING CONCRETE TEMP. CYLINDERS Ket Num - T. 1 Mix Ago	AIR TEMPERATURE BELOW NOTCHIES THAT I HAVE READ THE HEALTH WARNIN DELEVARING INSIDE CURB LINE: LOAD RECEIVED BY * AIR TEMPERATURE ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL CKEET ID TIME Date 2514 Seq Lo RB 0021448
Deleveral Control of the second seco	CLS LS CODE CLS LS	Class S 4	OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN 1000 PS1 ON SITE T TESTING LAB: SLUMP AIR Disp-Tic 20012566	ED TO ACHIEVE SPECIFIC TESTING CONCRETE TEMP. CYLINDERS Ket Num - T. 1 Mix Ago	AIR TEMPERATURE BELOW NOTCHIES THAT I HAVE READ THE HEALTH WARNIN DELEVARING INSIDE CURB LINE: LOAD RECEIVED BY * AIR TEMPERATURE ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL CKEET ID TIME Date 2514 Seq Lo RB 0021448
ETURNED TO PLANT COUNTY COUN	CODE CLSLS	Class S 4	OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN OUR SITE OUR SITE ON SITE TESTING LAB: SLUMP AIR Disp-Tic 20012566 d Qty % Var % Mol -014% -01	ED TO ACHIEVE SPECIFIC TESTING CONCRETE TEMP. CYLINDERS Ket Num - 7: 1 Mix Ago store Actual Wa	AIR TEMPERATURE BELOW NOTCHIES THAT I HAVE READ THE HEALTH WARNIN DELEVARING INSIDE CURB LINE: LOAD RECEIVED BY * AIR TEMPERATURE ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL CKEET ID TIME Date 2514 Seq Lo RB 0021448
ETURNED TO PLANT ETURNED TO PLANT ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP ICK RENTAL1 ad Size .00 CYDS Hal Dess ENT 47.0 SH 1932 CR 25.0 CR	LEFT JOB LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 1 Mix Code CLSLS	Class S 4	OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN OUR SITE OUN SITE TESTING LAB: SLUMP AIR Disp-Tic 20012566 d Qty % Var % Mol -0.14%	ED TO ACHIEVE SPECIFIC TESTING CONCRETE TEMP. CYLINDERS Ket Num - 7: 1 Mix Ago store Actual Wa	AIR TEMPERATURE BELOW NOTCHIES THAT I HAVE READ THE HEALTH WARNIN DELEVARING INSIDE CURB LINE: LOAD RECEIVED BY * AIR TEMPERATURE ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL CKEET ID TIME Date 2514 Seq Lo RB 0021448

AN MDU RESOU Riverbe					
	CONSTRUCT	ION	TT LF NT KE		LIS CAMPUS STOP AT E HAVE A PERSON TO TA
Disp	Order#: 2	008		**************************************	
TIME	FORMULA	LOAD SIZE	YARDS ORDERED	EDE	DRIVER/TRUCK PLANT TRANSACTION
4:47:44	CLSLS	10.00	120.00		B'S TRANS 39RENTAL2
DATE	TTITENRAL	LOAD #	YARDS DEL 20.00	BATCH #	WATER TRIM SLUMP TICKET NUMBER 5.00 in 20012565
	WARNING			AMAGE RELEASE	Excessive Water is Detrimental to Concrete Performance.
Contains Bodland Co-	NG TO THE SKIN		Dear Customer - The driver of the	TO BE MADE INSIDE CURB LINE) is truck in presenting this RELEASE to pinion that the size and weight of this	H ₂ O Added by Request / Authorized By:
With Skin. In Case of Co	BURNS. Avoid Contact With E antact With Skin or Eyes, Flu Get Medical Attention K	Eyes and Prolonged Contact	truck may possibly cause damp property if he places the material i wish to help you in every way the driver is requesting that you simple	prinon that the size and weight of this age to the premises and/or adjacent in this load where you desire it. It is our all we can, but in order to do this the this BEF EASE relievent him and this and this BEF.	GAL X WEIGHMASTER
CONCRETE IS & PERISH	ABLE COMMODITY and BECO IG the PLANT ANY CHANGES O ELEPHONED to the OFFICE BEF	MES THE PROPERTY of the	supplier from any responsibility premises and or adjacent proper surbs, etc., by the delivery of the	In this load where you desire it. It is our all we can, built in order to do this the this RELEASE relieving him and this from damage that may occur to the from damage that may occur to the virty, buildings, sidewaka, dhrew-ways, is material, and that you also agree to the will be will be all the will be difficult consideration the undersigned	Thank you for your business
The undersigned promises to pa sums owed.	y all costs, including reasonable attor	TRUE LOADING Starts	litter the public street. Further, as a	totional consideration the undersinged	A second the second the second the second
All accounts not paid within 2	30 days of delivery will bear intere	st at the rate of 18% per annum	agrees to indemnify and hold har supplier for any and all damage to	miess the driver of this truck and this the premises and/or adjacent property	NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNIN NOTICE AND SUPPLIES WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CALLERD WILL
Not Responsible for Reactive Age Delivered.	30 days of delivery will bear intere gregate or Color Quality. No Claim Alio Loss of the Cash Discount will be	at at the rate of 18% per annum wed Unies Made at Time Material is Collected an all Returned Checks.	suppler for any and all damage to which may be claimed by anyon order SIGNED:	the previses of the study and the study and the the previses and/or adjacent property. To have arisen out of delivery of this.	NOTICE AND SIGNATURE BELIW INDICATES THAT THAVE READ THE HEATTY WARNING CAUSED WH NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WH DELIVERING INSIDE CURB LINE: LOAD RECEIVED BY X
Not Responsible for Reactive Ag Delivered. A \$15.00 Service Charge and Excess Detay Time Charged @ QUANTITY	30 days of delivery will bear intere gregate or Color Quality. No Claim Alia Loss of the Cash Discount will be 1 \$76.00.hr. CODE	st at the rate of 18% per annum, wed Unless Made at Time Material is Collected on all Returned Checks. DESCRIPTION	sopple for any and all damage to which may be claimed by anyon order. SIGNED: X OUR MIXES ARE DESIG	the previses of the study and the study and the the previses and/or adjacent property. To have arisen out of delivery of this.	NOTICE, WI SIGNATURE BELIW INDICATES THAT I HAVE READ THE HEATTY WARNING TO A DEVENTION OF DE RESPONSIBLE FOR ANY DAMAGE CAUSED WHI DELIVENING INSIDE CURB LINE: LOAD RECEIVED BY
Not Responsible for Reactive Ag Delivered. A \$15.00 Service Charge and Excess Detay Time Charged @ QUANTITY	30 days of delivery will bear intere gregate or Color Quality. No Claim Alia Loss of the Cash Discount will be 1 \$76.00.hr. CODE	st at the rate of 18% per annum, wed Unless Made at Time Material is Collected on all Returned Checks. DESCRIPTION	sopple for any and all damage to which may be claimed by anyon order. SIGNED: X OUR MIXES ARE DESIG	the previses of the study and the study and the the previses and/or adjacent property. To have arisen out of delivery of this.	NOTICE, WI SIGNATURE BELIW INDICATES THAT I HAVE READ THE HEATTY WARNING CAUSED WH DOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WH DELIVENING INSIDE CURB LINE: LOAD RECEIVED BY
Not Responsible for Reactive Ag Delivered. A \$15.00 Service Charge and Excess Detay Time Charged @ QUANTITY	30 days of delivery will bear intere gregate or Color Quality. No Claim Alia Loss of the Cash Discount will be 1 \$76.00.hr. CODE	st at the rate of 18% per annum, wed Unless Made at Time Material is Collected on all Returned Checks. DESCRIPTION	sopple for any and all damage to which may be claimed by anyon order. SIGNED: X OUR MIXES ARE DESIG	The permises and/or adjacent property.	NOTICE, WI SIGNATURE BELIW INDICATES THAT I HAVE READ THE HEATTY WARNING CAUSED WH DOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WH DELIVENING INSIDE CURB LINE: LOAD RECEIVED BY
Mor Responsible for Reactive Ag Deliverad. A 515.00 Servicer Charge and Exceed Delay Time Charged ⊜ QUANTITY	IO days of delivery will bear intere greate or Color Quality. No Claim Alo Loss of the Cash Discount will be i 양7500/hr. CODE CODE	at at the rate of 18% per annum, weed Unless Mode at Time Material is Collected on all Returned Checks.	supporter for any and all damage to which may be claimed by anyon order SIGNED X OUR MIXES ARE DESIG	The permose and/or an added encourses to have ansen out of delivery of this	NOTICE AND SOLANDARE BELIW INVICATES THAT THAVE READ THE HEATTY WARNIN NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WH DELIVERING INSIDE CURB LINE: LOAD RECEIVED BY x
Not Responsible for Reactive Ag Delivered. A \$15.00 Service Charge and Excess Detay Time Charged @ QUANTITY	30 days of delivery will bear intere gregate or Color Quality. No Claim Alia Loss of the Cash Discount will be 1 \$76.00.hr. CODE	st at the rate of 18% per annum, wed Unless Made at Time Material is Collected on all Returned Checks. DESCRIPTION	supporter for any and all damage to which may be claimed by anyon order. StokeD: X OUR MIXES ARE DESIG	The permises and/or adjacent property.	AIR TEMP
Mor Responsible for Reactive Ag Deliverad. A 515.00 Servicer Charge and Exceed Delay Time Charged ⊜ QUANTITY	IO days of delivery will bear intere greate or Color Quality. No Claim Alo Loss of the Cash Discount will be i 양7500/hr. CODE CODE	at al the rate of 18% per annum, wed Unless Mode at Time Material In Collected on all Returned Checks.	Support for any and all damage to which may be claimed by anyon order. X OUR MIXES ARE DESIG	The permises and/or adjusted property- to have answer out of delivery of this	NOTICE AND SOLANDARE BELLWI MOUCHES THAT ITAY READ THE HEALTH WARNIN NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WH DELIVERING INSIDE CURB LINE. LOAD RECEIVED BY X X CATIONS AT A MAX 4" SLUMP UNIT PRICE EXTENDED PRICE
More Reportable for Reactive Ag Determine. A Bis 30 Service: Charge and Exceede Belly Time Charged @ QUANTITY 10 - 00 YC	ID days of delivery will bear intere greate or Color Duelly, No Cleam Ale Loss of the Cash Discount will be 1975/00/hr CODE	at at the rate of 18% per annum, weed Unless Mode at Time Material is Collected on all Returned Checks.	supporter for any and all damage to which may be claimed by anyon order. StokeD: X OUR MIXES ARE DESIG	The permose and/or an added encourses to have ansen out of delivery of this	AIR TEMPERAT AIR TEMPERAT AIR TEMPERAT AIR TEMPERAT AIR TEMPERAT AIR TEMPERAT AIR TEMPERAT AIR TEMPERAT AIRT TO ALL AIRT TO AL
More Reportable for Reactive Ag Determine. A Bis 30 Service: Charge and Exceede Belly Time Charged @ QUANTITY 10 - 00 YC	ID days of delivery will bear intere greate or Color Duelly, No Cleam Ale Loss of the Cash Discount will be 1975/00/hr CODE	at al the rate of 18% per annum, wed Unless Mode at Time Material In Collected on all Returned Checks.	Support for any and all damage to which may be claimed by anyon order. X OUR MIXES ARE DESIG OUD PSI OUR SITE TESTING LAB:	The permises and/or adjusted property- to have answer out of delivery of this	AIR TEMP AIR TEMP AIR TEMP AIR TEMP AIR TEMP AIR TEMP AIRT TEMP AIRT TEMP AIRT TEMP AIRT TEMP Ticket Total
An Bragonable for Rescree Ag Deliveration Rescrete Delay Time Changed and Exceede Delay Time Changed and OUANTITY TO TO TO PLANT RETURNED TO PLANT LEFT PLANT	ID days of delivery will bear intere greate or Color Quelty, No Clean Ale Loss of the Cash Discount will be \$75,001+r CODE CLEATED LEFT JOB	at at the rate of 18% per annum weed Unless Mode at Time Material in Cohected on all Returned Checks.	Support for any and all damage to which may be claimed by anyon order. X OUR MIXES ARE DESIGN OUR MIXES ARE DESIGN OUR SITE TESTING LAB: SLUMP	The permanent and/or adjusted property- to have answer out of delivery of this NED TO ACHIEVE SPECIFI TESTING	AIR TEMP AIR TE
And Reportable for Reactive Ag Determined A BIS 00 Service Charge and Exceede Belly Time Charged and Exceede Belly Time Charged and QUANTITY IO. OUT COMPARING RETURNED TO PLANT LEFT PLANT LEFT PLANT TOTAL ROUND TRIP	D days of delivery will bear intere greate of Color Duelly, No Clean Ale Loss of the Cash Discount will be i \$75:001br CODE CLEAN LING LEFT JOB ARRIVED JOB TOTAL AT JOB DRIVER	at at the rate of 18% per annum weed Unless Mode at Time Material in Collected on all Returned Checks.	DISP Tic	TESTING CONCRETE TEMP CYLINDERS KEC NUM T	AIR TEMPERATURAL AND THE RESPONSIBLE FOR ANY DAMAGE CAUSED WHOLE AND THE RESPONSIBLE FOR ANY DAMAGE CAUSED WHOLE ANY DAMAGE CAUSED ANY DAMAGE ANY DAMA
ACREADCOME TO PRESENCE AND DEVENTION OF CHARGE AND EXCREME DEVINE CHARGE AND EXCREME DEVINE CHARGE AND ADDRESS AND ADDRESS AND ADDRESS AND	D days of delivery will bear intere propose of Color Duelly, No Clean Ale Loss of the Cash Discount will be STROOM: LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 2	at al the rate of 18% per annum weed Unless Mode at Time Material in Collected on all Returned Checks.	OUR MIXES ARE DESIG	NED TO ACHIEVE SPECIFI TESTING CONCRETE TEMP CYLINDERS KEC NUM T	AIR TEMP Press AIR TEMP AIR TEMP
ACREADCOME TO PRESENCE AND DEVENTION OF CHARGE AND EXCREME DEVINE CHARGE AND EXCREME DEVINE CHARGE AND ADDRESS AND ADDRESS AND ADDRESS AND	D days of delivery will bear intere greate of Color Duelly, No Clean Ale Loss of the Cash Discount will be i \$75:001br CLE3 LIS LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 2 Mix Code	at at the rate of 18% per annum weed Unless Mode at Time Material in Collected on all Returned Checks.	OVER MIXES ARE DESIGNED OUR STEE TESTING LAB: SLUMP AIR DISP TIC 20012565	Interest and a related strongly to be the base around of delivery of the base around the base of the base around the base of the base	AIR TEMP AIR TOTAL Grand 'Potal ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL CKEEL ID Time Date 2513 4:47
An Bragonable for Rescrive Ag Determine: A Brago Service Charge and Exceed Belly Time Charged and Exceed Belly Time Charged and A Brago Service Charged and A Brago Servic	D days of delivery will bear intere propose of Color Duality. No Cleam Ale Less of the Cash Discount will be 1 S75:0017: CODE CLES LIS LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 2 Mix Code CLS LIS Registry Registry	at at the rate of 18% per annum weed Unless Mode at Time Matanal is Collected on all Returned Checks.	ON SITE OUT MIXES ARE DESIGNED OUT MIXES ARE DESIGNED OUT MIXES ARE DESIGNED OUT MIXES ARE DESIGNED OUT FILL ON SITE TESTING LAB: SLUMP AIR DISP TIC 20012565 DISP TIC 20012565	NED TO ACHIEVE SPECIFI TESTING CONCRETE TEMP. CYLINDERS KEET Num T Mix Ag	AIR TEMP AIR TE
ACREPCONDENT OF RESCRICT AND A BISO Service Charge and Exceed belay time Charged and Exceed belay time Charged and Exceed belay time Charged and Exceed belay time Charged and A BISO Service Charge and A BISO SERVICE AND A BISO SERVIC	Di days of delivery will bear intere propose of Color Davids, No Clem Ale Loss of the Cash Discount will be i 's75:0010' LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 2 Mix Code CLSLS Str QV Receiver 3 123202 5 Ib 123202	at al the rate of 18% per annum weed Unless Made at Time Material in Collected on all Returned Checks.	ON SITE OUR MIXES ARE DESIGNED OUR MIXES ARE DESIGNED OUR MIXES ARE DESIGNED OUR MIXES ARE DESIGNED OUR SITE TESTING LAB: SLUMP AIR DISP TIC 20012565 d Qty % Var % M -0.88%	Internets and a algorithm depropring to have aroun out of delivery of this NED TO ACHIEVE SPECIFI CONCRETE TEMP. CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS	AIR TEMP AIR TEMP AIR TEMP AIR TEMP AIR TEMP AIR TEMP DELV AIR TEMP AIR TEMP DELV AIR TEMP AIR TEMP DELV AIR TEMP AIR TEMP DELV AIR TEMP AIR TEMP DELV AIR TEMP AIR TEMP
ACREPCONDENT AND	Di days of delivery will bear intere propose of Color Davids, No Clem Ale Loss of the Cash Discount will be i 's75:0010' LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 2 Mix Code CLSLS Star 4171100 5 Ib 1133100 5 Ib 1133100 5 Ib 1133100 5 Ib 1133100 5 Ib 1133100	at al the rate of 18% per annum weed Uniess Made at Time Material in Collected on all Returned Checks.	OUR MIXES ARE DESIGNED OUR SITE TESTING LAB: SLUMP AIR DI 3D TIC 20012565 C Q Cy 9 Var 9 MI -0.85% -0.27% 5.7 -0.37% C 2056 C	NED TO ACHIEVE SPECIFI TESTING CONCRETE TEMP. CYLINDERS XKEC NUM T MIX Ag OSLIVE Actual W	AIR TEMP AIR TE
A 33300 Service Charge Ag A 33300 Service Charge and Exceed Delay Time Charge of COURTINE TO TO YC A 33300 Service Charge and Exceed Delay Time Charge of COURT A 2010 YC A 2010	Di days of delivery will bear intere greate of Color Duelly, No Clem Ale Loss of the Cash Discount will be i STROOM: CLES LIS LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 2 Mix Code CLS LS Mix Code CLS LS	at al the rate of 18% per annum weed Uniess Made at Time Material in Collected on all Returned Checks.	ON SITE OUR MIXES ARE DESIG SIGNED: X OUR MIXES ARE DESIG OUR MIXES ARE DESIG OUR SITE TESTING LAB: SLUMP AIR DISP TIC 20012565 d Qty 96 Var 96 M -0.8576 d Qty 96 Var 96 M	TESTING CONCRETE TEMP CYLINDERS XKET Num T Mix Ag Olstore Actual W Stand as a galaxy and a	AIR TEMP AIR TE







65

	Proving Groun 3100 SH 47, B Brvan, TX 778	Idg 7091 College Station, 1X 7	tion 572	Concrete Sampli		Revision Date: 2018-04-17
	Qu	ality Policy For	n Revised by: I Approved by		Revision: 6	Page:
F	roject No:	609851	Casting Date	: 2018-05-31	Mix Design (psi)	1000
	ted Name of nician taking Sample	/	FRITE	Printed Name of Technician breaking	142	t Kobins
	ned Name of nician taking Sample	9	- B	Signed Name of Technician breaking	//-	hL
Lo	ad No.	Truck No.	Ticket No.	Locat	tion (from concret	e map)
" DH	TY	390143	0021449	Final 15 of Top	Wall, SouthEn	D DECK to Por
21/2	175	390120	6042469		3 on South Pe	
200	176	390123	0021450	Stort @ Posi		L Deck to Po
Loa	ad No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average
VI/	79	2012-06-25	26 days	6225	126000	
DY	TY TY			5518	156000	6060
N	14			6,4,37	182000	
P2/-	Ţ	2018-06-25	26 days	5942	168000	
22/1	9	1	1	6190	175000	6115
172/7	5		(6225	176000	
D)/1	6	2018-06-25	26 days	5236	165000	
73/	T6	1	1		161000	5694
P3/1	16			5553	157000	5011
-						
			10 10 10 10 10 10 10 10 10 10 10 10 10 1		1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	
1						
						St. 6.2

Proving Gro 3100 SH 47 Brivan: TX 7	And Bidg 701 7807 Abdg 701 Abdg 701 Abd	ation 572	Concrete Sampli	Doc. No. QPF 5.7.2	Revision Date: 2018-04-17
	uality Policy For		B. L. Griffith :: D. Kuhn	Revision: 6	Page: 1 of 1
Project No Printed Name Technician takir Samp Signed Name	le Grad i		Printed Name o Technician breaking Sample	mat	: <u>4000</u> 7 R.Lin
Technician takin Samp	19 2	-15	Signed Name o Technician breaking Sample	in	-nc
Load No.	Truck No.	Ticket No.	Loca	tion (from concret	e map)
DY/T7	390108	0021452	Post # 15 from S	att side to 1	Post # 12 W/MS
25/18	390126	0021454	Post# 18 W/M	s to Endof	Deck
06/19	39Renta/2	0042475	10'x15' sect	ion of Mona	at Slab NE con
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average
4/17	2012-06-23	26 days	5164	146000	
24/17			5164	146000	5140
24/77			5093	144000	
5/78	2012-06-25	26 days	5552	15 7000	
15/18	1	1	5129	145000	5423
5/178		1	5588	158000	
06/19	2012-06-25	26 days	1.473	183000	
26/19	1	(rays	1614	187000	6445
06/79			6261	177000	0///
			0~0/	177000	
		-			
		1.1.1.1.1		1.12	
				31120 202	

KN RIV AN MOU RESOUT	IFE FR	TH REGION/MAIN 0 State Highway 2 Bryan, TX 77807 PH: (979) 361-290 FAX: (979) 361-290	1 West 7 00	6310 Hw Bryan, DISPATCH:	YAN y. 21 West IX 77807 (979) 361-2931 9) 361-2920	В	004246
7425 BRYAN	ER CONSTRU MIZE RD V			TTI TEN LF 47 LF NTRANCE KE TRUCH	RELLIS CA	MPUS STOP A PERSON	AT E TO TA
TIME	FORMULA	LOAD SIZE	YARDS ORDERED	HEALTH AND	DRIVER/TRUCK	Salar Statistics	PLANT TRANSACTION
5:50:01	CLSLS	10.00	120.00		DON KING	390128	
DATE	PROJECT TTITENRHI	LOAD #	YARDS DEL.	BATCH #	WATER TRIM	SLUMP	TICKET NUMBER
			00.00			5.001h	6141807
Contains Portland Cem CONTACT MAY CAUSE E With Skin. In Case of Co If Irritation Persists, of	ntact With Skin or Eyes, Flu Get Medical Attention.K	AND EYES and Gloves, PROLONGED Eyes and Prolonged Contact ush Thoroughly With Water. EEP CHILDREN AWAY OMES THE PROPERTY of the CANCELLATION of ORGINAL	(TO BE SIGNED IF DELIVERY T Dear Customer - The driver of this you for your signature is of the op truck may possibly cause damage	MAGE RELEASE 0 8 MADE NISCE CURB LINE) forsk in presenting this RELEASE to inscrib the second and weight of this te to the premises and/or adjacent this load where you desire. It is our this RELEASE returning that and this instellation of the second and the material, and that you also agree to exist on the second this thus and they have and when of this thus, and they have and the second the second these the second the second the second these these these the desire of the second these these these the desire of the second these these these the desire of the second these these the second these these these these these these these the desire of the second these these the second these t		r is Detrimental to Conc ded by Request / Author for your	orized By:
INSTRUCTIONS MUST be TE The undersigned promises to pay sums owed.	LEPHONED to the OFFICE HER	FORE LOADING starts	curbs, etc., by the delivery of this help him remove mud from the who litter the nubic streat. Forther as who	material, and that you also agree to sels of his vehicle so that he will not			
All accounts not paid within 3/ Not Responsible for Reactive Agg Delivered.	days of delivery will bear intere regate or Color Quality. No Claim Allo cas of the Cash Discount will be	ist at the rate of 15% per annum, owed Unless Made all Time Material is Collected on all Returned Checks.	signed:	4	NOTICE MY SIGNATURE BEL NOTICE AND SUPPLER WILL DELIVERING INSIDE CUBB LU LOAD RECEIVED BY XXATIONS AT A MAX 4" SLUN	NOT BE RESPONSIBLE FOR E. MP UNIT PRICE	R ANY DAMAGE CAUSED WH
All accounts not paid within 3 and accounts not paid within 3 between the second second second second between the second	0 days of delivery will bear inter- water or Color Duality, No Gum Also cost of the Cash Discount will be i \$72.00hr. CODE	ist at the rate of 19% per annum, wed Unless Made at Time Material is Collected on all Returned Checks. DESCRIPTION DESCRIPTION	OUR MIXES ARE DESIGN	IED TO ACHIEVE SPECIFIC	NOTICE AND SUPPLIER WILL DELIVERING INSIDE CURB LIN LOAD RECEIVED BY	NOT BE RESPONSIBLE FOR E. MP UNIT PRICE	RANY DAMAGE CAUSED WH
All accounts not paid within 3 Not Responsible for Reactive Agg Delivend A 315.00 Service Charge and L Excess Delay Time Charged (a)	o days of delivery will bear inter- regate or Color Quality. No Claim Allo cas of the Cash Discount will be o \$75.00mr.	In at the rate of 19% per annum, werd Unless Made at Time Material is Collected on all Returned Checks.	OUR MIXES ARE DESIGN 2008 MIXES ARE DESIGN 2008 PS1	IED TO ACHIEVE SPECIFIC	AIR TEMP	AP UNIT PRICE	R ANY DAMAGE CAUSED WHI
All accounts not paid within 3 and accounts not paid within 3 between the second second second second between the second	0 days of delivery will bear inter- water or Color Duality, No Gum Also cost of the Cash Discount will be i \$72.00hr. CODE	In at the rate of 19% per annum, well Unless Made at Time Material is Collected on all Refumed Checks.	OUR MIXES ARE DESIGN 40000 FST	IED TO ACHIEVE SPECIFIC		NOT DE RESPONSIBLE FOR	R ANY DAMAGE CAUSED WHI
All accounts not paid within 3 the accounts not paid within 3 beiness the accounts for Heatthe Agg All 500 Benties for Heatthe Agg All 500 Benties Time Charged (B) OUANTITY 100 0100 CM RETURNED TO PLANT) days of delivery will bear inter- regate or Color Quality, No Guan Alto cost of the Cash Discount will be i \$73.00hr. CODE CLSLS LEFT JOB	In at the rate of 19% per annum, werd Unless Made at Time Material is Collected on all Returned Checks.	OUR MIXES ARE DESIGN 2008 MIXES ARE DESIGN 2008 PS1	IED TO ACHIEVE SPECIFIC	AIR TEMP	AP UNIT PRICE	EXTENDED PRICE
All accounts not paid within 3 the accounts not paid within 3 beiness the accounts for Heatthe Agg All 500 Benties for Heatthe Agg All 500 Benties Time Charged (B) OUANTITY 100 0100 CM RETURNED TO PLANT) days of delivery will bear inter- regate or Color Quality, No Guan Alto cost of the Cash Discount will be i \$73.00hr. CODE CLSLS LEFT JOB	In at the rate of 19% per annum, well Unless Made at Time Material is Collected on all Refumed Checks.	OUR MIXES ARE DESIGN 40000 FST	TESTING	AIR TEMP	AP UNIT PRICE	EXTENDED PRICE
All accounts not paid within 3 Not Responsible for Residue Age A 15 00 Bention Charge and 1 Excess Delay Time Charged (B) OUANTITY 10.0103.07 RETURNED TO PLANT LEFT PLANT LEFT PLANT	o days of delivery will bear inter- regate or Color Quality, No Claim Alto cost of the Cash Discount will be in stration	In at the rate of 19% per annum, werd Unless Made at Time Material is Collected on all Refumed Checks.	OUR MIXES ARE DESIGN 4000 PS1 OUR SITE TESTING LAB: SLUMP	IED TO ACHIEVE SPECIFIC	AIR TEMP TI C	AP UNIT PRICE	EXTENDED PRICE

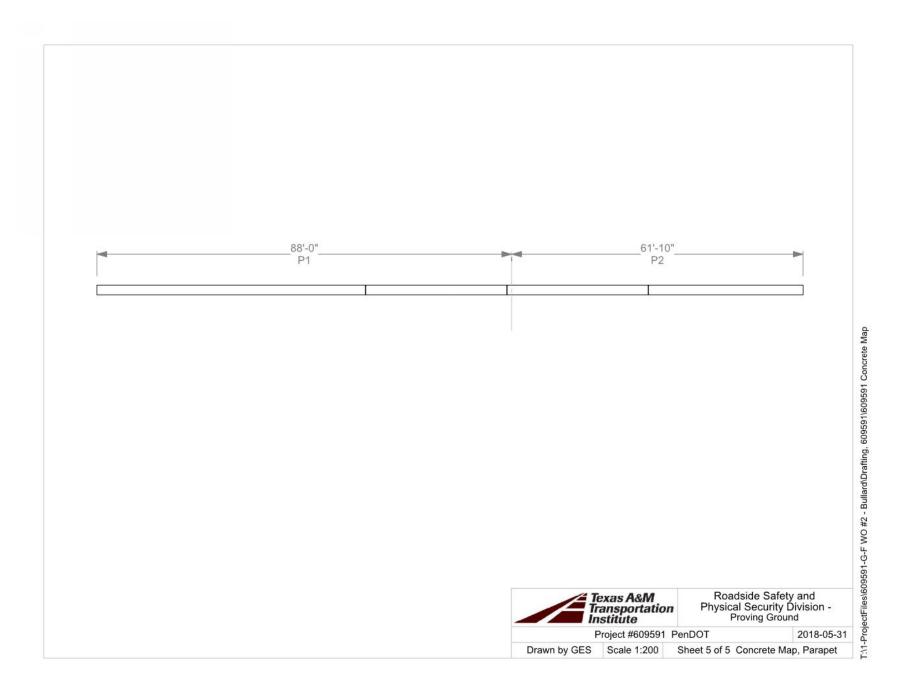
K	6310	H REGION/MAIN State Highway 21 Bryan, TX 77807 PH: (979) 361-290	1 West	2		DR	0021449
KN RIV AN MDU RESOUR	IFE & F 'ER CES COMPANY	AX: (979) 361-29	20			nD	UVELING
Riverbei			TT	I TEN RAIL			
7425 MI BRYAN	1	put	J KE	47 LF REL RANCE WILL TRUCKS IN	HAVE A PE	S STOP AT E RSON TO TA	
TIME	Order#: 21	LOAD SIZE	YARDS ORDERED	ROA MINING	DRIVER/TRUCK	P DURMOUTHERS	PLANT TRANSACTION #
5:19:05	CLSLS	10.00	120.00		ROY DAVI	3 390143	
DATE	ROJECT	LOAD #	YARDS DEL	BATCH #	WATER TRIM	SLUMP	TICKET NUMBER
05/31/18 7	TITENRAI	4	40.00			5.00 in 20	
Contains Partland Com	WARNING IG TO THE SKIN ent. Wear Rubber Boots a UURNS. Aveid Contact With Skin or Eyes, Flu Bet Medical Attention. KE	- I OL	(TO BE SIGNED IF DELIVERY Dear Customer - The driver of th you for your signature is of the truck may possibly cause dark	AMAGE RELEASE "TO BE MADE INSIDE CURB LINE) is truck in presenting this RELEASE to ppinion that the size and weight of this age to the premises and/or adjacent in this load where you desire it. It is our	H ₂ 0 GAL >		
	BLE COMMODITY and BECO G the PLANT, ANY CHANGES or		wish to help you in every way t driver is requesting that you sig supplier from any responsibility premises and or adjacent prope	In this load where you beside it. It is our nat we can, but in order to do this the n this RELEASE relieving him and this from damage that may occur to the rty, buildings, sidewalks, drive-ways, is material, and that you also agree to wheels of his vehicle so that he will not	WEIGHMASTE		
The undersigned promises to pay sums owed.	ELEPHONED to the OFFICE BEF all costs, including reasonable attorn a days of delivery will bear interes	ORE LOADING starts. rey's fees, incurred in collecting any		whells of his vehicle so that he will not ddflonal consideration; the undersigned mises the driver of this truck and this the premises and/or adjacent property e to have arison out of delivery of this		for your l	READ THE HEALTH WARNING ANY DAMAGE CAUSED WHEN
Not Responsible for Reactive Agg Delivered.	regate or Color Quality. No Claim Allor oss of the Cash Discount will be C	wed Unless Made at Time Material is	which may be claimed by anyor order. SIGNED.	e to have arisen out of delivery of this	DELIVERING INSIDE CURB	LINE.	ANT DAMAGE GAUSED WHEN
	675.04(m)		X				
QUANTITY 10.00 YC	CP2P2	DESCRIPTION CLASS S 4	UR MIXES ARE DESIG	INED TO ACHIEVE SPECIFI	x	LUMP UNIT PRICE	EXTENDED PRICE
and the second	CODE	and the second se	OUR MIXES ARE DESIG	INED TO ACHIEVE SPECIFI	x	LUMP UNIT PRICE	EXTENDED PRICE
and the second	CODE	and the second se	OUR MIXES ARE DESIG	INED TO ACHIEVE SPECIFI	x	LUMP UNIT PRICE	EXTENDED PRICE
RETURNED TO PLANT	CODE CLOLS	FINISH UNLOADING	OUR MIXES ARE DESIGN 4000 PS1	ETESTING	AIR TEMP		EXTENDED PRICE
10.00 ¥S	CLSLS	CLASS 5 4	OUR MIXES ARE DESIG		AIR TEMP	AMT et Total id Total	
RETURNED TO PLANT	CODE CLOLS	FINISH UNLOADING	OUR MIXES ARE DESIGN 4000 PS1	ETESTING	AIR TEMP	AMT et Total	GE 1
RETURNED TO PLANT	LEFT JOB	FINISH UNLOADING	OUR MIXES ARE DESIGN 1000 PS1	CONCRETE TEMP.	AIR TEMP	- AMT et Total d Total ADDITIONAL CHAR	GE 1
RETURNED TO PLANT	LEFT JOB ARRIVED JOB 5749 TOTAL AT JOB	FINISH UNLOADING START UNLOADING (G. 22 UNLOADING TIME User	OUR MIXES ARE DESIGN	CONCRETE TEMP.	AIR TEMP	AMT Total ADDITIONAL CHAR ADDITIONAL CHAR GRAND TOTAL Time Date	GE 1 GE 2
RETURNED TO PLANT LEFT PLANT 3:35 TOTAL ROUND TRIP PUCK 90143	LEFT JOB ARRIVED JOB 5749 TOTAL AT JOB Driver 554626 Mix Code	FINISH UNLOADING START UNLOADING G. 27 UNLOADING TIME	OUR MIXES ARE DESIGN 1000 PS1 ON SITI TESTING LAB: SLUMP AIR Disp Tic 2001256	CONCRETE TEMP.	AIR TEMP AIR TEMP Tick Gran	AMT Total ADDITIONAL CHAR ADDITIONAL CHAR GRAND TOTAL Time Date 5:19 Log Bir	GE 1 GE 2
RETURNED TO PLANT LEFT PLANT 5:35 TOTAL ROUND TRIP PUCK 90143 ORD SIZE 0.00 CYDS MENT 1432 Dest	LEFT JOB LEFT JOB ARRIVED JOB 57/49 TOTAL AT JOB Driver 554626 Mix Code CLSLS	FINISH UNLOADING START UNLOADING G. 22 UNLOADING TIME USER USER RETURNE Batched b 415000 ip	OUR MIXES ARE DESK 1000 PS1 ON SITI TESTING LAB: SLUMP AIR Disp Tic 2001256 cd Qty %Var% k	CONCRETE TEMP. CYLINDERS CKet Num T 7 1 Mix Ag	AIR TEMP AIR TEMP Tick Gran Cicket ID 2515 Te Seq D	AMT Total ADDITIONAL CHAR ADDITIONAL CHAR GRAND TOTAL	GE 1 GE 2
RETURNED TO PLANT LEFT PLANT 5:35 TOTAL ROUND TRIP PUCK 90143 ORD SIZE 0.00 CYDS MENT NDD CYDS MENT NDD 122 MENT NDD 122 MENT NDD 122 MENT NDD 222280 250	LEFT JOB LEFT JOB ARRIVED JOB 57/49 TOTAL AT JOB Driver 554626 Mix Code CLSLS	FINISH UNLOADING FINISH UNLOADING START UNLOADING (G. 27 UNLOADING TIME USER USER Returne B 415020 ib b 12500 ib b 1500 ib b 1500 ib b 1500 ib b 1500 ib b 1500 ib b 1500 ib	OUR MIXES ARE DESK 1000 PS1 ON SITI TESTING LAB: SLUMP AIR DISP TIC 2001256 C Qty % Var % k 149% S. 149% S. 149% S.	CONCRETE TEMP CYLINDERS CYLINDERS	AIR TEMP AIR TEMP Tick Gran Cicket ID 2515 Te Seq D	AMT Total ADDITIONAL CHAR ADDITIONAL CHAR GRAND TOTAL Time Date 5:19 Log Bir	GE 1 GE 2
RETURNED TO PLANT LEFT PLANT 5:35 TOTAL ROUND TRIP PUCK 90143 ORD SIZE 0.00 CYDS MENT NDD CYDS MENT NDD 122 MENT NDD 122 MENT NDD 122 MENT NDD 222280 250	LEFT JOB LEFT JOB ARRIVED JOB 5/49 TOTAL AT JOB Driver 554626 Mix Code CLSLS of A 12842 of A 12842	FINISH UNLOADING START UNLOADING G. 27 UNLOADING TIME USET USET Returne B H 12501 ID ID 15310 ID ID 15310 ID ID 15310 ID	OUR MIXES ARE DESK 1000 PS1 ON SIT TESTING LAB: SLUMP AIR Disp Tic 2001256 d Qty % Var % M -1.4% Disp Tic 2001256	CONCRETE TEMP. CYLINDERS CYLINDERS CKEC - Num - T 7 1 Mix Ag Notsure Actual W 2755M 74 g 2755M 74 g 2755M 74 g	AIR TEMP AIR TEMP Tick Gran Cicket ID 2515 Te Seq D	AMT Total ADDITIONAL CHAR ADDITIONAL CHAR GRAND TOTAL Time Date 5:19 Log Bir	GE 1 GE 2
RETURNED TO PLANT LEFT PLANT 5:35 TOTAL ROUND TRIP PUCK 90143 ORD SIZE 0.00 CYDS MENT NDD CYDS MENT NDD 122 MENT NDD 122 MENT NDD 122 MENT NDD 222280 250	LEFT JOB LEFT JOB ARRIVED JOB 5/49 TOTAL AT JOB Driver 554626 Mix Code CLSLS of A 12842 of A 12842	FINISH UNLOADING START UNLOADING G. 22 UNLOADING TIME USER Returne Batched B 4150,00 b 1432,00 b 1432,00 b 1432,00 b 1432,00 c 1432,00 c 16 159,00 c 17,00 c 15,00 c 17,00	OUR MIXES ARE DESK 4000 PS1 ON SIT TESTING LAB: SLUMP AIR Disp Tic 2001256 cd Qty %Var% M 10% E 10% E	CONCRETE TEMP. CYLINDERS CYLINDERS CKEC - Num - T 7 1 Mix Ag Notsure Actual W 2755M 74 g 2755M 74 g 2755M 74 g	AIR TEMP AIR TEMP Tick Gran Cicket-ID- 2515 (e Seq D) (m)	AMT Total ADDITIONAL CHAR ADDITIONAL CHAR GRAND TOTAL Time Date 5:19 Log Bir	GE 1 GE 2

KN	631	TH REGION/MAIN 0 State Highway 2 Bryan, TX 77807 PH: (979) 361-29 FAX: (979) 361-29	1 West 7 00		RB 0021450
AN MDU RESOL	nd		~		
	CONSTRUCT IZE RD	ION	LE NT	I TEN RAIL 47 LF REL RANCE WILL TRUCKS IN	LIS CAMPUS STOP AT E HAVE A PERSON TO TA
Disp	FORMULA	LOAD SIZE	YARDS ORDERED	In Statistics	
6:03:46	CLSLS	10.00	120.00		DRIVER/TRUCK PLANT TRANSACTION #
DATE	RODECT	LOAD #	YARDS DEL.	BATCH #	LLOYD JON 390133 WATER TRIM SLUMP TICKET NUMBER
05/31/18	TTITENRAI	6	60.00		5.00 in 20012569
Contains: Portland Cerr CONTACT May CAUSE With Skin, In Case of C If Irritation Persists, CONCRETE to a PERSIST PURCHASER UPON LEAV INSTRUCTIONS MUST for 1 The undersigned promises to put tums owed. All accounts not paid within Net Responsible for Reactive Ap Delivered.	WARNING NG TO THE SKIN Near Rubber Boots, BURNS, Avid Contact With Durbar, Avid Contact With BURNS, Avid Contact With BURNS, Avid Attention, K attention, And Attention, K attention, And Contact State Plant and Contact attention of the Contact attention of the Contact Disc of the Contact Discout with the 755 polyn:	and Gloves, PROLONGED Eves and Prolonged Contact ush Thoroughly With Water. EEP CHILDREN AWAY. DMES THE PROPERTY of the cONDELLATION of ORIGINAL FORE LOADING starts. They's best, incurred is collecting any still at the rate of 185 per annum- sed Unites Made at Time Material is		MAGE FELEASE To BE MADE INSIDE CUIRB LINE) To Vick in presenting this RELEASE to onion that the suite and weight of this go to they preimises and/or abjacent of the preimises and/or abjacent the RELEASE releving him and this from damage that may occur to the ty, buildings, adversion, and was a space to international and that you also apres to them a constraint of the theory of the theory material, and that you also apres to distance constraints, there-anyone them are anyone to the theory of the theory of the premises and/or adjuncet property to have arisen out of ballvery of this	Excessive Water is Detrimental to Concrete Performance. H ₂ 0 Added by Request / Authorized By: GAL X WEIGHMASTER Thank you for your business NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNING NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNING DOTLOVERING INSIDE OURS LINE: LOAD RECEIVED BY
RETURNED TO PLANT	LEFT JOB	FINISH UNLOADING		TESTING	AIR TEMP
LEFT PLANT	ARRIVED JOB	START UNLOADING	SLUMP	CONCRETE TEMP	Ticket Total Grand Total
10.19	10:36		CLOWN C	CONCRETE TEMP.	ADDITIONAL CHARGE 1
TOTAL ROUND TRIP	TOTAL AT JOB	UNLOADING TIME	AIR	CYLINDERS	ADDITIONAL CHARGE 2
					GRAND TOTAL
Truck ====================================	Driver 490896	User user	Disp Tic 20012569	ket Num T	
Load Size 10.00 CYDS	Mix Code CLSLS	Returne	d Qty	Mix Ag	
Material Desi	gri Qiy Required		% \/ 雪 % 林	stature Actual Wa	
CEMENT 417.0 FLYAGH 143.0 SAND 122 LMOTH* 130 GRAVEL36 46 WATER 25.0 P0.2280 25.0		Ib 1449.00 Ib ID 12360 Ib Ib 13660 Ib Ib 5010 Ib Ib 163 Ib or 250.00 or	0.10% 0.2	776 M 74 g 776 M 4 g 786 M 3 g 2012 g	

		10 State Highway 2 Bryan, TX 7780 PH: (979) 361-29)7 900	6310 Hy Bryan, DISPATCH:	RYAN wy. 21 West TX 77807 (979) 361-2931	B 004247
		FAX: (979) 361-29	920	FAX: (97	79) 361-2920	D symmetry
AN MDU RESOUR		and a second sec				
Bryan					- Mar	
TUCKE	ER CONSTRU	ICTION		TTI TEN		
7425	MIZE RD			NTRANCE	F RELLIS CA WILL HAVE	A PERSON TO TA
BRYAN		*		KE TRUC	KS IN.	The second real real
The second se	p Order#:	2008				
TIME	FORMULA	LOAD SIZE	YARDS ORDERED)	DRIVER/TRUCK	PLANT TRANSACTIO
周期:57:52	CLSLS	8.00	98.00	4	B'S TRANS	39RENTAL 2
DATE 05/31/18	TTITENRAL	LOAD #	YARDS DEL 98.00	BATCH #	WATER TRIM	SLUMP TICKET NUMBER
		100		ġ		5.00in 6141818
IBRITATIN	WARNING IG TO THE SKIN	AND EVES	(TO BE SIGNED IF DELIVE	DAMAGE RELEASE RY TO BE MADE INSIDE CURB LINE)	HOAd	r is Detrimental to Concrete Performance. Ided by Request / Authorized By:
Contains Portland Cemi CONTACT MAY CAUSE B	ant. Wear Rubber Boots URNS. Avoid Contact With	and Gloves, PROLONGED Eyes and Prolonged Contact ush Thoroughly With Water	Dear Customer - The driver of you for your signature is of the truck may possibly cause do	I this truck in presenting this RELEASE to be opinion that the size and weight of this smage to the premises and/or adjacent	GAL X	need by nequest / Autionzed by.
			wish to help you in every way driver is requesting that you is supplier from any resonnable	tai in this load where you desire it, it is our y that we can, but in order to do this the sign this RELEASE releving him and this life from demons that make order to the	WEIGHMASTER	
PURCHASER UPON LEAVING	The PLANT ANY CHANGES LEPHONED to the OFFICE BE	OMES THE PROPERTY of the or CANCELLATION of ORIGINAL FORE LOADING starts.	premises and or adjacent pro curbs, etc., by the delivery of help him remove mud from the	I this truck is presenting the RELEASE to doption that the size part weight of this arrays to the promises and/or palacent is in this load where you desire it. It is our with the size car, buil in order to do this there with the size car, buil in order to do this there out the size car. Built in order to do this there with the size car. Built in order to do the part the size carses releavable that may occur to there where an its vision also agree to where an its visities so that he with not additional consolutation the undersigned additional consolutation the time desire additional consolutation to this buck and this.	Thank you	for your business
sums owed. All accounts not paid within 30	date of delivery will have been	mey's neek, incurred in collecting any	Suppler for any and all denses	s additional consideration: the undersigned hatmless the driver of this truck and this to the premises and/or adjacent property one to have arisen out of delivery of this	NOTICE: MY SIGNATURE BELO NOTICE AND SUPPLIER WILL	OW INDICATES THAT I HAVE READ THE HEALTH WARNIN NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WH IE.
Not Responsible for Reactive Appr Delivered.	egate or Color Quality. No Claim All		order	Alle in used supply ont or norshift or 032.	DELIVERING INSIDE CURR LIN	IE.
s \$15.00 Service Charge and Lo	as of the Cash Discourt will be	Collected on all Returned Checks	SIGNED:	+	LOAD RECEIVED BY	
A the do Service Charge and Lo Excess Delay Time Charged (a) § QUANTITY 8 : (2) (2) (2) Y	as of the Cash Discourt will be	Collected on all Returned Croccia DESCRIPTION	SIGNED:	IGNED TO ACHIEVE SPECIFI	LOAD RECEIVED BY	
QUANTITY	ess of the Cash Discount will be 75.00/hr.	Collected on all Returned Checks	OUR MIXES ARE DESI	IGNED TO ACHIEVE SPECIFI	LOAD RECEIVED BY	\$)
QUANTITY B. QQCY	ess of the Cash Discount will be 75.00/hr.	Collected on all Returned Checks	SGRED: X OUR MIXES ARE DESI 4080 PSI		LOAD RECEIVED BY	\$)
QUANTITY B. QQCY	es of the Cash Decount will be 75:00 Pr CODE CLISES	Collected on all Returned Onecks.	SGRED: X OUR MIXES ARE DESI 4080 PSI	IGNED TO ACHIEVE SPECIFU	LOAD RECEIVED BY x CATIONS AT A MAX 4" SLUK	E UNIT PRICE EXTENDED PRICE
QUANTITY B. QQCY	es of the Cash Decount will be 75:00 Pr CODE CLISES	Collected on all Returned Checks	SIGNER: X OUR MIXES ARE DESI 4/2/2/0 PSI	TETESTING	LOAD RECEIVED BY x CATIONS AT A MAX 4" SLUB AIR TEMP	E UNIT PRICE EXTENDED PRICE
QUANTITY 8. @@CY	As of the Cash Decount will be 7500/r: CODE CLISES	Collected on all Returned Checks	OUR MIXES ARE DESI OUR MIXES ARE DESI 4080 PS I ON SI TESTING LAB:		AIR TEMP	e UNIT PRICE EXTENDED PRICE
QUANTITY B. OOCY ETURNED TO PLANT LEFT PLANT	As of the Cash Decount will be 7500/r: CODE CLISES	Collected on all Returned Checks	OUR MIXES ARE DESI OUR MIXES ARE DESI 4080 PS I ON SI TESTING LAB:	TETESTING	LOAD RECEIVED BY x CATIONS AT A MAX 4" SLUK AIR TEMP T Gr A	e UNIT PRICE EXTENDED PRICE
QUANTITY B. OOCY ETURNED TO PLANT LEFT PLANT	ARRIVED JOB	Cellected on all Returned Checks	OUR MIXES ARE DESI	TE TESTING CONCRETE TEMP:	AIR TEMP	AP UNIT PRICE EXTENDED PRICE
QUANTITY B. QQCY ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP	As of the Cash Decount will be 7500hr. CODE CLISES LEFT JOB ARRIVED JOB TOTAL AT JOB	Cellected on all Returned Checks	OUR MIXES ARE DESI	CONCRETE TEMP.	AIR TEMP	e UNIT PRICE EXTENDED PRICE
QUANTITY B. QQCY ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP	As of the Cash Decount will be 7500hr. CODE CLISES LEFT JOB ARRIVED JOB TOTAL AT JOB	Cellected on all Returned Checks	OUR MIXES ARE DESI	CONCRETE TEMP.	AIR TEMP	AP UNIT PRICE EXTENDED PRICE
QUANTITY 8. 00CY ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP OTAL ROUND TRIP	ARRIVED JOB	Cellected on all Returned Checks	OUR MIXES ARE DESI OUR MIXES ARE DESI 4/0/2/0 PSI 4/0/2/0 PSI 0N SR TESTING LAB: SLUMP AIR DISE Tio	CONCRETE TEMP. CYLINDERS	AIR TEMP TO AIR TEMP TO CATIONS AT A MAX 4" SLUA Pro- Check ID TO 267 8:	AP UNIT PRICE EXTENDED PRICE
QUANTITY 8.00CY ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP OTAL ROUND TRIP	ARRIVED JOB	Cellected on all Returned Coecks	OUR MIXES ARE DESI OUR MIXES ARE DESI 4/0/2/0 PSI 4/0/2/0 PSI 0/0 SI 0/0 SI TESTING LAB: SLUMP AIR Disp Tic 61/41/81/8 Ot y	CONCRETE TEMP. CYLINDERS CYLINDERS Ket Num Ti. 50 Mix Age	AIR TEMP TA CATIONS AT A MAX 4" SLUK CATIONS AT A MAX 4" SLUK	AP UNIT PRICE EXTENDED PRICE
QUANTITY B. @@CY B. @@CY ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP OTAL ROUND TRIP OTAL ROUND TRIP CAL ROUND	ARRIVED JOB	Cellected on all Returned Coecks	OUR MIXES ARE DESI 4/0/2/0 PSI 4/0/2/0 PSI 4/0/2/0 PSI 0/0/5/1 TESTING LAB: SLUMP AIR Disp Tic 6141818 Qty -0.19: 428	CONCRETE TEMP CONCRETE TEMP CYLINDERS CYLINDERS CYLINDERS Mix Age sture Actual Ma	AIR TEMP TA CATIONS AT A MAX 4" SLUK CATIONS AT A MAX 4" SLUK	AP UNIT PRICE EXTENDED PRICE
QUANTITY B. @@CY B. @@CY ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP OTAL ROUND TRIP OTAL ROUND TRIP CAL ROUND	ARRIVED JOB	Cellected on all Returned Checks	OUR MIXES ARE DES 4/0/2/0 PSI 4/0/2/0 PSI 4/0/2/0 PSI 0/0 SI TESTING LAB: SLUMP AIR Disp Tic 6141818 Qty -8.193 4.259	CONCRETE TEMP. CYLINDERS CYLINDERS Ket Num Til SØ Mix Age sture Actual W 50 gl	AIR TEMP TA CATIONS AT A MAX 4" SLUK CATIONS AT A MAX 4" SLUK	AP UNIT PRICE EXTENDED PRICE
QUANTITY B. @@CY B. @@CY ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP TOTAL ROUND TRIP CYDS CL al Design Qty 1223 1b 123 1b	CODE CLISES CLISES LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB TOTAL AT JOB	Cellected on all Returned Checks	OUR MIXES ARE DES 4/0/2/0 PSI 4/0/2/0 PSI 4/0/2/0 PSI 0/0 SI TESTING LAB: SLUMP AIR Disp Tic 6141818 Qty -8.193 4.259	CONCRETE TEMP. CYLINDERS CYLINDERS CYLINDERS Mix Age sture Actual Mix S0 g1 M 7 g1	AIR TEMP TA CATIONS AT A MAX 4" SLUK CATIONS AT A MAX 4" SLUK	AP UNIT PRICE EXTENDED PRICE
QUANTITY 8. 00CY 8. 00CY ETURNED TO PLANT LEFT PLANT UTAL ROUND TRIP TOTAL ROUND TRIP TOTAL ROUND TRIP CYDS CL al Design Qty 1523 1b 143.0 lb 143.0 lb 38.3 gi 3.00 cy 25.0 co	LEFT JOB LEFT JOB LEFT JOB TOTAL AT JOB TOTAL AT JOB I V & Y X Code SLS Required 1940 1b 1940 1b 1940 1b 1940 1b 1940 1c 1940 1c 194	Cellected on all Returned Coecks	SQUED: X OUR MIXES ARE DESI 4/0/2/0 4/0/2/0 PSI 10/2/0 PSI 10/2/0 PSI 10/2/0 PSI 10/2/0 PSI 11/2/0 11/2/0 11/2/0 11/2/0 11/2 11/	TE TESTING CONCRETE TEMP CYLINDERS CYLINDERS CYLINDERS Mix Age Mix Age Sture Actual H S0 g1 M 7 g1 169.7 g1	AIR TEMP To CATIONS AT A MAX 4" SLUK CATIONS AT A MAX 4" SLUK Price Grad A A Cket ID Ti 267 B: Seq D	AP UNIT PRICE EXTENDED PRICE
QUANTITY 8. 00CY 8. 00CY ETURNED TO PLANT LEFT PLANT UTAL ROUND TRIP TOTAL ROUND TRIP TOTAL ROUND TRIP CYDS CL al Design Qty 1523 1b 143.0 lb 143.0 lb 38.3 gi 3.00 cy 25.0 co	LEFT JOB LEFT JOB LEFT JOB TOTAL AT JOB TOTAL AT JOB I V & Y X Code SLS Required 1940 1b 1940 1b 1940 1b 1940 1b 1940 1c 1940 1c 194	Cellected on all Returned Coecks	SQUED: X OUR MIXES ARE DESI 4/0/2/0 4/0/2/0 PSI 10/2/0 PSI 10/2/0 PSI 10/2/0 PSI 10/2/0 PSI 11/2/0 11/2/0 11/2/0 11/2/0 11/2 11/	TE TESTING CONCRETE TEMP CYLINDERS CYLINDERS CYLINDERS Mix Age Mix Age Sture Actual H S0 g1 M 7 g1 169.7 g1	AIR TEMP To CATIONS AT A MAX 4" SLUA CATIONS AT A MAX 4" SLUA Price Grad A A Cket ID Ti 267 B: Seq D	AP UNIT PRICE EXTENDED PRICE
QUANTITY 8. 00CY 8. 00CY ETURNED TO PLANT LEFT PLANT UTAL ROUND TRIP TOTAL ROUND TRIP TOTAL ROUND TRIP CYDS CL al Design Qty 1523 1b 143.0 lb 143.0 lb 38.3 gi 3.00 cy 25.0 co	LEFT JOB LEFT JOB LEFT JOB TOTAL AT JOB TOTAL AT JOB I V & Y X Code SLS Required 1940 1b 1940 1b 1940 1b 1940 1b 1940 1c 1940 1c 194	Cellected on all Returned Coecks	SQUED: X OUR MIXES ARE DESI 4/0/2/0 4/0/2/0 PSI 10/2/0 PSI 10/2/0 PSI 10/2/0 PSI 10/2/0 PSI 11/2/0 11/2/0 11/2/0 11/2/0 11/2 11/	TE TESTING CONCRETE TEMP CYLINDERS CYLINDERS CYLINDERS Mix Age Mix Age Sture Actual H S0 g1 M 7 g1 169.7 g1	AIR TEMP To CATIONS AT A MAX 4" SLUA CATIONS AT A MAX 4" SLUA Price Grad A A Cket ID Ti 267 B: Seq D	AP UNIT PRICE EXTENDED PRICE
QUANTITY 8. 00CY 8. 00CY ETURNED TO PLANT LEFT PLANT UTAL ROUND TRIP TOTAL ROUND TRIP TOTAL ROUND TRIP CYDS CL al Design Qty 1523 1b 143.0 lb 143.0 lb 38.3 gi 3.00 cy 25.0 co	LEFT JOB LEFT JOB LEFT JOB TOTAL AT JOB TOTAL AT JOB I V & Y X Code SLS Required 1940 1b 1940 1b 1940 1b 1940 1b 1940 1c 1940 1c 194	Cellected on all Returned Coecks	SQUED: X OUR MIXES ARE DESI 4/0/2/0 4/0/2/0 PSI 10/2/0 PSI 10/2/0 PSI 10/2/0 PSI 10/2/0 PSI 11/2/0 11/2/0 11/2/0 11/2/0 11/2 11/	TE TESTING CONCRETE TEMP CYLINDERS CYLINDERS CYLINDERS Mix Age Mix Age Sture Actual H S0 g1 M 7 g1 169.7 g1	AIR TEMP To CATIONS AT A MAX 4" SLUA CATIONS AT A MAX 4" SLUA Price Grad A A Cket ID Ti 267 B: Seq D	AP UNIT PRICE EXTENDED PRICE

KN	6310	H REGION/MAIN) State Highway 21 Bryan, TX 77807 PH: (979) 361-290 FAX: (979) 361-290	1 West		RB 0021454
AN MOU RESOUR Riverbe					
TUCKER 7425 M. BRYAN	CONSTRUCT	ION	LF NT	I TEN RAIL 47 LF REL RANCE WILL TRUCKS IN	LIS CAMPUS STOP AT E HAVE A PERSON TO TA
Disp	Order#: 20	108			
TIME	FORMULA	LOAD SIZE	YARDS ORDERED	and the second	DRIVER/TRUCK PLANT TRANSACTION #
7:03:09 DATE	CLSLS	10.00	120.00		FREDDIE F 390126
05/31/18	TITENRAL	LOAD #	YARDS DEL	BATCH #	WATER TRIM SLUMP TICKET NUMBER
	WARNING	9	90.00 PROPERTY D	AMAGE RELEASE	5.00 in 20012574 Excessive Water is Detrimental to Concrete Performance.
Contains Rodland Com	IG TO THE SKIN		TO BE RIGHTS IF BEINDER		
With Skin, In Case of Co	BURNS, Avoid Contact With E React With Skin or Eyes, Flu Get Medical Attention K	yes and Prolonged Contact	truck may possibly cause dam property if he places the material wish to help you in every way to	approved that the size and weight of this age to the premises and/or adjacent in this load where you desire it. It is our hat we can, but in order to do this the	GAL X WEIGHMASTER
CONCRETE IS & PERISHA PURCHASER UPON LEAVIN	BLE COMMODITY and BECO G the PLANT ANY CHANGES or ELEPHONED to the OFFICE BEF	MES THE PROPERTY of the CANCELLATION of ORIGINAL	supplier from any responsibility premises and or adjacent prope curbs, etc., by the delivery of the	TO be MADE INSIDE CURR LINE; IT to be MADE INSIDE CURR LINE; polition that the size and weight of this polition that the size and weight of this and to the permission and adjustent in this load where you desire. It is our that we can, but an order to do from the- mits RELEASE releving this and this thront damage that may becaut to the rth; balletings, sidewaks, do agree to the half which all had you also agree to the weight of the vehicles as that agree and thereal of the vehicles as that we all not defined a cost wherean the main order.	mbools and the
Bums owed	all costs, including reasonable attorn 0 days of delivery will bear interes	ey's fees, incurred in collecting any	Theip nim remove mud from the w littler the public street. Further, as a agrees to indemnify and hold has supplier for any and all damage to	thele of his vehicle so that he will not didional consideration; the undersigned mises the driver of this truck and this the promises and/or adjacent property e to have arisen out of delivery of this	Thank you for your business
Delivered	regate or Color Quality. No Claim Aldo	ed Unless Made at Time Material is	which may be claimed by anyon order. SIGNED:	e to have arisen out of delivery of this	NOTICE: MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WARNING NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED WHEN DELIVERING RINGE CURB LINE. LOAD RECEIVED BY
10.00 Yd		CLASS S 4	000 PSI		
RETURNED TO PLANT	LEFT JOB	FINISH UNLOADING	ÓN SITE	TESTING	AIR TEMP ^{100.00}
			TESTING LAB:		Previ AMT Ticket Total
LEFT PLANT	ARRIVED JOB	START UNLOADING	SLUMP	CONCRETE TEMP	Grand Total
7.20	7.35		1		ADDITIONAL CHARGE 1
TOTAL ROUND TRIP	TOTAL AT JOB	UNLOADING TIME	AIR	CYLINDERS	ADDITIONAL CHARGE 2
					GRAND TOTAL
Truck 390126	Driver 559579	User user	Disp Tic 20012574	ket Num T	icket ID Time Date
Load Size 10.00 CYDS	Mix Code	Returned		Mix Ag	$ \sum_{p=10}^{2520} \sum_{p=10}^{7:03} RB_{1p}^{30021454} $
CEMENT 617.0 FLYASH 143.0 SAND 1222 JMRTHEIM 134 GRAVELING 400 YATER 255.0 P02230 25.0	0 ID 1430.00 5 ID 13542 7 W 12638 3 ID 4623 2 ID 1684	Ib 4180.00 Ib 1b 1422.00 ib 10 12350 ib 10 1555 ib 01 1555 ib 02 250.00 oz	EL-4 0725 EL-2	olsture Actual Wa Bream 73 gi Bream 3 gi 2026 M 3 gi	22
votual Load 25036 lb Hump: 5.00 in Loctual W/C Ratio: 0.421	Num Balch Design W/C: 0.450 Water in Truck: A clusi Water:	Water/Cement: 0.0 gl Adju	est Water: 0.0	Destign 302.0 gl gi / Load Trim Wes Z 15 Altowable Wa	

	IFFE PRCES COMPANY	0 State Highway 2 Bryan, TX 7780 PH: (979) 361-29 FAX: (979) 361-29	7			RE	3 0021452
	nd CONSTRUCT IZE RD	ION	LF NT	I TEN RAIL 47 LF REL RANCE WILL TRUCKS IN	HAVE A PI	5 STOP AT SRSON TO	' E TA
Disp	FORMULA						
		LOAD SIZE	YARDS ORDERED	100	DRIVER/TRUCK		PLANT TRANSACTION #
6:37:49 DATE	CISIS	10_00 LOAD #	120.00 YARDS DEL	BATCH #	MELVIN M	17 390108 SLUMP	
05/31/18	TTITENRAI	8	80.00		TO ATAS UTABLE		TICKET NUMBER
IPPITAT	WARNING		(TO BE SIGNED IF DELIVERY	AMAGE RELEASE TO BE MADE INSIDE CURB LINE)		ater is Detrimental to	Concrete Performance.
CONTACT MAY CAUSE With Skip In Case of C	NG TO THE SKIN nent. Wear Rubber Boots of BURNS. Avoid Contact With B ontact With Skin or Eyes, Flu	and Gloves, PROLONGED Eyes and Prolonged Contact	Dear Customer - The driver of the you for your signature is of the o truck may possibly cause dam procetty if he places the material	is truck in presenting this RELEASE to pinion that the size and weight of this age to the premises and/or adjacent this load others.	GAL)	Added by Request / A	Authorized By:
CONCRETE is a PERISH	ABLE COMMODITY and BECC	MES THE PROPERTY of the	wish to help you in every way th driver is requesting that you sign supplier from any responsibility premises and or adjacent proper	Is truck in presenting this RELEASE to phonon that the size and wight of this ique to the size and wight of this ique to the size and size and all we can, but in order to do this the this RELEASE relevang is man and this from damage that may occur to the heads of the size and the this RELEASE relevang is man and this makes of the viewalks, drive-ways, material, and that you also agree to heads of the viewalks of the will not difficus consideration; the undersigned difficus consideration; the undersigned makes the driver of this truck and this	WEIGHMASTE	R	
The undersigned promises to pa sums owed.	y all costs, including reasonable attor	ney's fees, incurred in collecting any	curbs, etc., by the delivery of the help him remove mud from the w litter the public street. Further, as a agrees to indemnify and hold har	s material, and that you also agree to heets of his vehicle so that he will not dottonal consideration, the undersigned mless the driver of this truck and his	Thank you	for you	r business
Delivered.	to days of delivery will bear intere pregate or Color Quality. No Claim Alio	wed Unless Made at Time Material is	supplier for any and all damage to which may be claimed by anyone order. SIGNED.	autorial consideration, the undersigned miless the driver of this truck and this the premises and/or adjacent property r to have arisen out of delivery of this	NOTICE AND SUPPLIER W DELIVERING INSIDE CURB	ILL NOT BE RESPONSIBLE	HAVE READ THE HEALTH WARNING E FOR ANY DAMAGE CAUSED WHEN
Excess Delay Time Charged @	Loss of the Cash Discount will be (\$75.00/W.	Collected on all Returned Checks.	v		LOAD RECEIVED BY		
QUANTITY 10.00 YC	CODE CLSLS	DESCRIPTION CLASS 5 4	OUR MIXES ARE DESIG	NED TO ACHIEVE SPECIFIC	XCATIONS AT A MAX 4" SL	UMP UNIT PRICE	EXTENDED PRICE
	the second se	211 T 12 21 21 21 21	OUR MIXES ARE DESIG	NED TO ACHIEVE SPECIFI	XCATIONS AT A MAX 4" SL	LIMP UNIT PRICE	EXTENDED PRICE
	the second se	211 T 12 21 21 21 21	OUR MIXES ARE DESIG	NED TO ACHIEVE SPECIFIC	CATIONS AT A MAX 4" SE		EXTENDED PRICE
10.00 YC	CLSLS LEFT JOB	CLASS 5 4	OUR MIXES ARE DESIG		AIR TEMPER Prev	UNT PRICE	EXTENDED PRICE
10.00 YC RETURNED TO PLANT	LEFT JOB ARRIVED JOB	CLASS 5 4	OUR MIXES ARE DESIG		AIR TEMPEX Tick	amt	EXTENDED PRICE
10.00 YC	CLSLS LEFT JOB	CLASS 5 4	OUR MIXES ARE DESIGNOUT ON SITE ON SITE TESTING LAB: SLUMP	TESTING CONCRETE TEMP:	AIR TEMPEX Tick	AMT et Total d Total ADDITIONAL CH	IARGE 1
RETURNED TO PLANT	LEFT JOB ARRIVED JOB	FINISH UNLOADING	OUR MIXES ARE DESIGNOUT ON SITE ON SITE TESTING LAB:	TESTING	AIR TEMPEX Tick	AMT et Total d Total ADDITIONAL CH	IARGE 1
RETURNED TO PLANT LEFT PLANT 6:50 TOTAL ROUND TRIP	LEFT JOB ARRIVED JOB TOTAL AT JOB	FINISH UNLOADING	OUR MIXES ARE DESIGNOUT ON SITE OOO PSI TESTING LAB: SLUMP AIR	TESTING CONCRETE TEMP CYLINDERS	AIR TEMPER Tick Gran	AMT et Total d Total ADDITIONAL CH ADDITIONAL CH GRAND TOTA	
RETURNED TO PLANT LEFT PLANT 6:50 TOTAL ROUND TRIP • Truck 390108	LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 569696	FINISH UNLOADING START UNLOADING UNLOADING TIME USER	OUR MIXES ARE DESIGNOUP SITESTING LAB: SLUMP AIR DISP TIC 20012572	TESTING CONCRETE TEMP CYLINDERS KET Num T	AIR TEMPEX Prev Tick Gran icket ID 2518	AMT et Total d Total ADDITIONAL CH ADDITIONAL CH GRAND TOTA Time Da	IARGE 1 IARGE 2
RETURNED TO PLANT LEFT PLANT 6:50 TOTAL ROUND TRIP • Truck 390108	LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 569696 Mix Code	FINISH UNLOADING START UNLOADING UNLOADING TIME	OUR MIXES ARE DESIGNOUP SITE TOOD PSI ON SITE TESTING LAB: SLUMP AIR DISP TIC 20012572	CONCRETE TEMP CYLINDERS	AIR TEMPEX Prev Tick Gran icket ID 2518	AMT et Total d Total ADDITIONAL CH ADDITIONAL CH GRAND TOTA Time Da	
IO.00 yc RETURNED TO PLANT LEFT PLANT LEFT PLANT GISO TOTAL ROUND TRIP TOTAL ROUND TRIP ROUND TRIP TOTAL ROUND T	LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 569696 Mix Code CLSLS grick Required	FINISH UNLOADING START UNLOADING UNLOADING TIME USE r Returned Batched B 416600 b 142500 b 142500 b 142500 b 142500 b 142500 b	OUR MIXES ARE DESIGNOUP MIXES ARE DESIGNOUP PSI OOO PSI TESTING LAB: SLUMP AIR DISP Tic 20012572 d Qty %95% % Ho -0.2% 1,8%% 5.55 3,5%% 5.55	CONCRETE TEMP. CYLINDERS Ket Num T. 1 Mix Ag	AIR TEMPEX Prev Tick Gran icket ID 2518 e Seq D	AMT et Total d Total ADDITIONAL CH ADDITIONAL CH GRAND TOTA Time Da 6:37 Local	



Proving Groun 3100 5H 47, I Srvan, TX 778	3idg 7091 College Station 1X 7	ation	Concrete Sampli	Doc. No. QPF 5.7.2	Revision Date: 2018-04-17			
	ality Policy For			Revision: 6	Page:			
Project No: 60951 Casting Date: 2013-06-05 Mix Design (psi): 3600								
Printed Name of Technician taking Sample Signed Name of Technician taking	GREG	Printed Name o Technician breaking Sample Signed Name o Technician breaking	max.	t Robin				
Sample	Truck No.	Ticket No.	Sample	tion (from concre	te man)			
PITTI	390149	0021554	21	rds of Pa	rape T			
P2/T2	350141	0021556		2 of Peray				
Load No.	Break Date	Cylinder Age	Total Load (lbs)	Break (psi)	Average			
PITT	2010-06-25	20 days	4,421	125,000				
PI/TI	1		47,40	124.000	4.680			
PITTI	1		4,881	138,000				
172/72	2012-06-25	20days	5705	150000				
P2/72	1	(5195	147000	5281			
PRITZ			5341	151000	5 (0)			
. /			1011					
			1. 19.65-15-1					
a succession								
		Hard Barris						

7425 N BRYAN		TON	T	TI TEN RAIL	L THE REAL PROPERTY OF THE
Diam	R CONSTRUC		. H	F 47 LF REL E ENTRANCE	AN WAIT THEY WILL HA
TIME	FORMULA	LOAD SIZE	YARDS ORDERED		DRIVER/TRUCK PLANT TRANSAC
R+5d+32 DATE	CLCLS	10,00 LOAD #	ZO DO VARDS DEL		DON KING 390149
6/05/18	TTITENRAI	1	10.00	BATCH #	WATER TRIM SLUMP TICKET NUM
IDDITAT	WARNING		PROPERTY	DAMAGE RELEASE	5.00 in 20012674 Excessive Water is Detrimental to Concrete Performance.
Contains Portland Cer CONTACT MAY CAUSE	NG TO THE SKI	N AND EYES	(TO BE SIGNED IF DELIVE Deat Customer - The driver of you for your signature is of the	BY TO BE MADE INSURE CARE LINE: This took in Arsenetting the RELASE to this took in Arsenetting the RELASE to the relation of the RELASE to the relation of the RELASE to the relation of the relation of the RELASE of the relation of the relation of the phose RELASE relativity the relation of the the relation of the relation of the relation of the the relation of the relation of the relation of the the relation of the relation of the relation of the the relation of the relation of the relation of the the relation of the relation of the relation of the relation of the the relation of the relation of the the relation of the relation of the relation of the relation of the the relation of the relation o	H ₂ O Added by Request / Authorized By:
With Skin. In Case of Co If Irritation Persists,	ontact With Skin or Eyes, Get Medical Attention	N AND EYES s and Gloves, PROLONGED h Eyes and Prolonged Contact Flush Thoroughly With Water, KEEP CHILDREN AWAY,	truck may possibly cause da property if he places the materi wish to help you in every way driver is requesting that you as	amage to the premises and/or adjacent al in this load where you desire it. It is our (that we can, but in order to do this the	GAL X
PURCHASER UPON LEAVIN	ABLE COMMODITY and BE NG the PLANT. ANY CHANGE	COMES THE PROPERTY of the S or CANCELLATION of ORIGINAL	Supplier from any responsibility premises and or adjacent proj curbs, etc., by the delivery of	by this release fellewing him and this iny from damage that may occur to the perty, buildings, sidewalks, drive-ways, this material, and that you also across to	HEIGHWAGTER
All accounts not paid within a	an along a state of the state o		itter the public street. Further, as agrees to indemnify and hold h suppler for any and all damans	wheels of his vehicle so that he will not additional consideration, the undersigned harmless the driver of this truck and this	Thank you for your business
Desvered	gregate or Color Quality, No Claim,	the set the tate of tote per annum.			NUTICE MY SIGNATURE RELOW INDICATES THAT STRATES
A \$15.00 Service Charge and I	Loss of the Cash Discourse in a	e Collected on all Benursed Charles	which may be claimed by anyc order. SIGNED.	to the premises and/or adjacent property one to have arisen out of delivery of this	NOTICE. MY SIGNATURE BELOW INDICATES THAT I HAVE READ THE HEALTH WA NOTICE AND SUPPLIER WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED DELIVERING INSIDE CURB LINE.
A \$15.00 Service Charge and i Excess Delay Time Charged @	Loss of the Cash Discount will b \$75.00/hr	e Collected on all Returned Checks.	which may be claimed by anyo order. SIGNED: X	to the premises and/or adjacent property one to have arisen out of delivery of this	LOAD RECEIVED BY
A \$15.00 Service Charge and I	Loss of the Cash Discourse in a	e Collected on at Returned Checks.	X	£	NOTICE ANY SIGNATURE BELOW INDICATES THAT I HAVE BEAD THE HEALTH WA NOTICE AND SUPPLIER WILL ON THE RESPONSIBLE FOR ANY DAMAGE CAUSED DELIVERING INSIDE CUBBLINE LOAD RECEIVED BY X CATIONS AT A MAX 41 SLUMP UNIT PRICE EXTENDED PR
A 11:00 Service Orange and Exceed Data Time Charges (b QUANTITY 10.00 YC	Loss of the Cash Discourt wit b (\$5.50hr. CODE CLCLS	e Collected on at Returned Checks.	X OUR MIXES ARE DESI	£	
A 11:00 Service Orange and Exceed Data Time Charges (b QUANTITY 10.00 YC	Loss of the Cash Discourt will b \$75.00/hr CODE	e Collected on at Returned Checks.	UIR MIXES ARE DESH 3600 PSI	£	
A 11:00 Server Orange and Decembrany Time Charges (p QUANTITY 10.00 YC	Lors of the Cash Discourt wit b CODE CLCLS LEFT JOB	e Goliected on all Returned Checks.	UIR MIXES ARE DESH 3600 PSI	GNED TO ACHIEVE SPECIFIC	AIR TEMP 2 X Drev AMT
A 11:00 Service Orange and Exceed Data Time Charges (b QUANTITY 10.00 YC	Loss of the Cash Discourt wit b (\$5.50hr. CODE CLCLS	e Goliected on all Returned Checks.	X OUR MIXES ARE DESK 3600 PSI	GNED TO ACHIEVE SPECIFIC	CATIONS AT A MAX 4" SLUMP UNIT PRICE EXTENDED PR
A 11:00 Server Orange and Decembran The Charges (p QUANTITY 10,00 YC ETURNED TO PLANT LEFT PLANT	LOSS of the Cash Discourt wit is CODE CLCLS LEFT JOB ARRIVED JOB	E Collected on all Returned Checks.	X OUR MIXES ARE DESH 3600 PS1 ON SITE TESTING LAB:	GNED TO ACHIEVE SPECIFIC	AIR TEMP ax Prev AMT Ticket Total Grand Total
A 11:00 Server Orange and Decembrany Time Charges (p QUANTITY 10.00 YC	Lors of the Cash Discourt wit b CODE CLCLS LEFT JOB	E Collected on all Returned Checks.	X OUR MIXES ARE DESH 3600 PS1 ON SITE TESTING LAB:	GNED TO ACHIEVE SPECIFIC	AIR TEMPSA Drev ANT Ticket Total Grand Total ADDITIONAL CHARGE 1
A 11:00 Server Orange and Decembran The Charges (p QUANTITY 10,00 YC	LOSS of the Cash Discourt wit is CODE CLCLS LEFT JOB ARRIVED JOB	ECONTECTED ON All Returned Checks.	X OUR MIXES ARE DESH 3600 PSI ON SITH TESTING LAB: SLUMP	ETESTING	AIR TEMP ** AIR TEMP ** Drev AMT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2
A 11:00 Serves Charge as December Time Charges (p QUANTITY 10.00 YC ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP	LEFT JOB ARRIVED JOB TOTAL AT JOB	Electric on all Returned Checks. DESCRIPTION CLASS C FINISH UNLOADING FINISH UNLOADING START UNLOADING UNLOADING TIME USEE n	X OUR MIXES ARE DESH 3600 PSI 0N SITH TESTING LAB: SLUMP AIR	E TESTING CONCRETE TEMP. CYLINDERS	AIR TEMPAX AIR TEMPAX Drev AIR TEMPAX Drev AIRT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL
A 11:00 Serves Charge are Desee Delay Time Charges () OUANTITY IO. OO YO ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP ICK 14:9	LEFT JOB ARRIVED JOB TOTAL AT JOB	Class Class Class Class Class C Class C Class C Class C Class C C C Class C C C C C C C C C C C C C C C C C C	X OUR MIXES ARE DESM 3600 PSI ON SITU TESTING LAB: SLUMP AIR DISP TIC	E TESTING CONCRETE TEMP. CYLINDERS	AIR TEMPSA AIR TEMPSA Prev ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL
A 19 20 Sevee Outpared of Deceed Data Time Charged of OUANTITY 10,00 YC ETURNED TO PLANT LEFT PLANT OTAL ROUND TRIP ICK I 149	LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 54534 his Code	Class Class Class Class Class C Class C Class C Class C Class C C C Class C C C C C C C C C C C C C C C C C C	X OUR MIXES ARE DESM 3600 PSI ON SITU TESTING LAB: SLUMP AIR DISP TIC	E TESTING CONCRETE TEMP. CYLINDERS	AIR TEMPSA AIR TEMPSA Prev ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL
A 19 50 Serves Charge and December Time Charges (p QUANTITY 10,00 YC ETURNED TO PLANT LEFT PLANT UTAL ROUND TRIP TICK 0149 CASIZE 00 CYDS	LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB Driver 54534 his Code	Class Class Class Class Class C Class C Class C Class C Class C C C Class C C C C C C C C C C C C C C C C C C	X OUR MIXES ARE DESM 3600 PSI ON SITU TESTING LAB: SLUMP AIR DISP TIC	E TESTING CONCRETE TEMP, CYLINDERS	AIR TEMPSAN AIR TEMPSAN Drev ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL
A 19 20 Server Orange and December Time Charges () OUANTITY IO.OO YC ETURNED TO PLANT LEFT PLANT UEFT PLANT OTAL ROUND TRIP IGCK I	LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB	Class C Class C Finish Unicoading Finish Unicoading Unicoading Time User User Returned Batched	X OUR MIXES ARE DESM 3600 PSI ON SITU TESTING LAB: SLUMP AIR DISP TIC 20012674 1 Qty	E TESTING CONCRETE TEMP. CYLINDERS	AIR TEMPSAN AIR TEMPSAN DIEV ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL CKET ID TIME Date 8:54 B 0021554 D 7
A 19:00 Server Orange and December Time Charges () OUANTITY 10.00 YC ETURNED TO PLANT LEFT PLANT UTAL ROUND TRIP OTAL ROUND TRIP ICK 14:9 ICK 00 CYDS ICK 15:40 ICK 15	LEFT JOB LEFT JOB ARRIVED JOB TOTAL AT JOB DOTIVE P 54534 fit Code LICLS		X OUR MIXES ARE DESM 3600 PSI ON SITH TESTING LAB: SLUMP AIR DI 3D TIC 20012674 d Qty	E TESTING CONCRETE TEMP. CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS CYLINDERS	AIR TEMPSAN AIR TEMPSAN DIEV ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL CKET ID TIME Date 8:54 B 0021554 D 7
A 19 50 Serves Charge and December Time Charges (s) OUANTITY IO. OO YC ETURNED TO PLANT LEFT PLANT UTAL ROUND TRIP ICK ICK ICK ICK ICK ICK ICK ICK	LEFT JOB LEFT JOB ARRIVED JOB ARRIVED JOB ARRIVED JOB CLCLS ARRIVED JOB CLCLS ARRIVED JOB CLCLS ARRIVED JOB CLCLS ARRIVED JOB CLCLS ARRIVED JOB ARRIVED AR		X OUR MIXES ARE DESM 3600 PSI ON SITH TESTING LAB: SLUMP AIR DISP TIC 20012674 1 Qty	ETESTING CONCRETE TEMP, CYLINDERS KET NUM TI 12 Mix Age	AIR TEMPSAN AIR TEMPSAN DIEV ANT Ticket Total Grand Total ADDITIONAL CHARGE 1 ADDITIONAL CHARGE 2 GRAND TOTAL CKET ID TIME Date 8:54 B 0021554 D 7

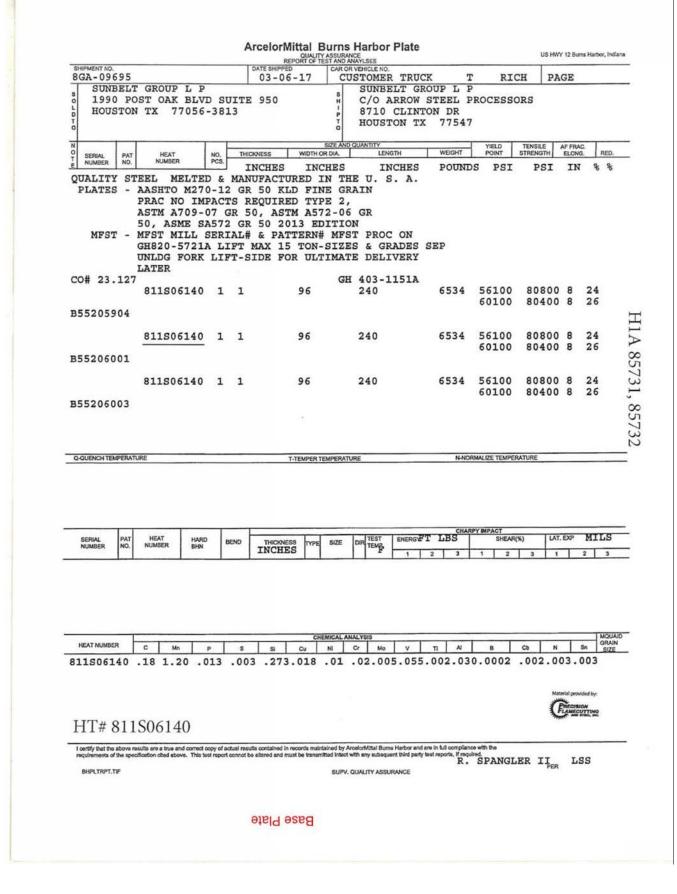
KNV RIV AN MOU RESOURCE	FE FE	HEGION/MAIN (State Highway 21 Bryan, TX 77807 9H: (979) 361-290 AX: (979) 361-292	West		ł	RB 0021556
BRYAN	ovstructj Ze RD		LF HE VE		AN WAIT TH PICK UP TH	STOP AT T TEY WILL HA TE TRUCKS A
TIME	FORMULA	LOAD SIZE	YARDS ORDERED			PLANT TRANSACTION #
DATE 06/05/18 T	TITENRAI	LOAD #	YARDS DEL.	BATCH #	WATER TRIM	SLUMP TICKET NUMBER 5.00 in 20012676
Contains Portland Ceme CONTACT MAY CAUSE B With Skin. In Case of Con If Irritation Persists. G CONCRETE is a PERISMA PURCHASER UPON LEAVING INSTRUCTIONS MUST be TE The Torones to pay Management of the State of the National State of the State of the Research of the State of the Delvice. A \$15.00 Service Charge and L Excess Delay Time Charge (B 5		nd Gloves, PROLONGED year and Prolonged Contact an Thoroughly With Weter EPC PHIDREN AWAY . WES THE PROPERTY of the CANCELATION of ORGINAL ONE LOADING starts. W/s free, neurored in calacteding any 1 at the rate of 19% per annum, and Univers Made at Three Material a otlected on all Returned Checks.	TO BE SIGNED IF DELIVERY Dear Coutomer - The driver of dig you for your algorithm is of the's properly if the process the material with the mission in every way filt with the mission in every way filt and the mission of the delivery of the supplier from any enably nooling premises and or adjacent proper curbs, etc. by the delivery of the appress to indemnify and hold aim supplier from and all damped to in data data data data data data data data	MAGE RELEASE On EMADE MISCHE CURE LINE; strick in presenting this RELEASE to initial the strict and weight of this the load weight of this and weight of this the load weight of this and weight of this this Relative expression was the strict and the strict and the strict this RELEASE relieving him and this min ARELASE relieving him and this min ARELASE relieving him and this this RELEASE relieving him and this strict and the strict and the placet and the strict and the strict and the strict and the strict and the strict and the strict and the strict and the to there arisen out of delivery of this to there arisen out of delivery of this	GAL 2 GAL 2 WEIGHMASTE	121
OUANTITY 10.00 yc	CODE CLCLS	DESCRIPTION CLASS C 3	8600 PSI	TESTING		LUMP UNIT PRICE EXTENDED PRICE
LEFT PLANT	ARRIVED JOB		TESTING LAB:		Pret Tick	et Total
9-38 TOTAL ROUND TRIP			SLUMP	CONCRETE TEMP.	GEAT	ADDITIONAL CHARGE 1
-	TOTAL AT JOB	UNLOADING TIME	AIR	CYLINDERS		ADDITIONAL CHARGE 2
		User user Returne	20012676	ket Num T 1 Mix Ag	2622	9:28 RB 0021556
CEMENT 396.00 FLYASH 159.00 SARES 1257 UMSTNY 1380 GRAVELSS* 430	0 ID 1540.00 7 ID 13976 1 ID 13976 1 ID 13969 1 ID 4836 7 ID 1494	Ib 3960.00 Ib 10 1540.00 Ib 10 13980 Ib 10 13980 Ib 10 5250 Ib 1b 1493 Ib	0.87% 0.5	otstune Actual W orean arg.gr Ofe-M 8 gr S% M 5 gr 173 gr	4	
A chuai Load 29831 Ib Bilong: 5.00 In A chuai W//C Ratio: 0.420	Num Batch Design Vi/C: 0.45 Viater in Truck Actual Water	0 Water/Cement: D.D. gl Ad	lust Water: 0.0	lesign 256.5 gi gi / Load Trim Via 0 lb Alfowable Vi	ter: -Z0 gl /	276,5 gl ToAdd: 19,7 gl CYT

3/4x12 Bolt

	Job No: 545	930	Job Infor	mation	Certified Date:	8/29/17	
C	ontainers: S12		N				
C	Sintainers. 012	650520	ANS			18060 AI Hwy	21
	Customer: Ame	riBolt, Inc	N.		Ship To:	Sycamore, Al	
Vulc	an Part No: ATR	F1554-55 3/4x12	2 HDG				
		R F1554-55 3/4x12					
	ner PO No: 007		100		Shipped Qty:	60 Ft	
Custor		1011-0201			Line No:		
	Order No: 338	482	The	SAME VIDAN	Line No:	2	
	Note:	and the second second	1122	51-015 × 1800		-	
			Applicable Sp	pecifications			
Туре		Specifica	tion	Rev	Amend	C	ption
	ASTM F1554 G	id 55		2015			
Test Results							
	1554-55 3/4x12 -	· 2A					
Test No: 44335	Test: F1554-55 F	hysical Results1					
Description	Tensile (ksi)	Yield (ksi)	Elongation (%)	Elongation GL (in)	Reduction of	Area (%)	Note
	81	71	27	4D	63	I	
	and the second second		Certified Chen	nical Analysis			
	Heat No: DL	17104915 Lot: ,718	- 12014 I.		Origin: USA		
	1	Mn	P	5	Si		Cu
C		0.64	0.006	0.024	0.20		0.24
C 0.160		Cr	Mo	v	Cb		RR
		0.10	0.02	0.004	0.004		120.6:1
0.160		Name and Address of the Owner o		4			
0.160 Ni			No	tea		the second second second second	

Plex 8/29/17 7:35 AM vulc.mgri Pege 1

Customer:						Cus	tomer	P.O.No.	HOU-85	14		11	Aill Or	der	No. 4	1-522	2620-0	5	Shipp	ing M	anifest:	AR255328
CHAPEL ST PO BOX 10						Proc	duct Des	cription	TYPE 2,	72-50/M345 010% MAX = FT.LBS @ -	5			5(17)					11 Dec 11 Dec		ert No: Page 1 o	0816374∛9 of 1)
SPRING HO PA 19477	DUSE					Size	a: 1.00) X 120	0 X 480							-	_					
		Pieces:					Tensil											t Tests				
Heat Id	Piece Id	Piece Dimens	ions	Tst Loc	YS (KSI)	UTS (KSI)		Elong 2in 8		Hardnes			nergy 3				3 Shea		Tst Tmp	Tst Dir	Tst Siz (mm)	BDWTT Tmp %Sh
E7L024	A14	1.001 (DIS	SCRT)	L	56	74		25	Т		61	96	72	76					-22F	L	10.	
Heat								CI	emical A	nalysis												
Id	С	Mn	Р	S		ot AI	Sol AI		Ni Cr		Cb	v										
									1.4.4					TI .	IIW	-						
MERCUR OF THI KILLED CEV (I MTR EN 100% M	.16 STEEL Y IS NOT S PRODUC STEEL, IW) = C 10204:2 ELTED AN TS SHIPP 24	A META T. PRODUCE + MN/6 004 INS D MANUF	LLURGJ D TO F + (CF PECTIC ACTURE	ICAL CO A FINE (+MO+V) ON CER ED IN T	GRAIN J/5 + FIFICA	NT OF PRAC' (NI+CU TE 3.1 A.	THE S THE S FICE J)/15 1 COMP	4 .08		.03 .0	002	.042	.00	2	.39)ED D	DURIN	G THE	MANUF	ACTUF	E	0
KILLED MERCUR OF THI KILLED CEV (I MTR EN 100% M PRODUC	STEEL Y IS NOT S PRODUC STEEL, IW) = C 10204:2 ELTED AN TS SHIPP	A META T. PRODUCE + MN/6 004 INS D MANUF ED:	LLURGJ D TO F + (CF PECTIC ACTURE	(CAL CO A FINE (+MO+V) ON CER 2D IN 7	GRAIN J5 + PIFICA THE US	NT OF PRAC' (NI+CU TE 3.1 A.	THE S THE S FICE J)/15 1 COMP	4 .08 TEEL A LIANT		.03 .0	002	.042	.00	2	.39	ED D	DURIN	G THE	MANUF	ACTUF	E	





AOH 85647 MILL TEST CERTIFICATE 1700 HOLT RD N.E. Tuscaloosa, AL 35404-1000 800 800-8204

NUCOR STEEL TUSCALOOSA, INC.

customerservice@nucortusk.com

Load Number	Tally	Mill Order	Number	PO NO L-	ine NO	Part M	Number	Certificate Number	Prepared
R152486	0000000724815	N-154733-001		V10881Q217	01			S72481501-1	04/30/2017 16:58
Grade			The Provincian		Cu	stomer:	anning		
Quality Plan			E SA36-13 MOD M	MN	LE SI LE	ip TO:	LLC Lisle IL LLC Hudson TX		

Shipped	Certified	Heat	Yield	Tensile	Y/T	ELONGA	FION %	Bend	Hard	C	harpy]	Impacts	(ft-11	os)		Shea	ar %		Test
Item	By	Number	ksi	ksi	%	2"	8"	OK?	HB	Size m	m 1	2	3	Avg	1	2	3	Avg	Temp
7D3213F	S7D3213MTT	B7Q4224 ***	49.4	65.5	75.4	31.1													

Items: 10 PCS: 50 Weight: 163353 LBS

Mercury has not come in contact with this product during the manufacturing process nor has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Material conforms to NACE MR0175 Annex 2.1.2 Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil ISO 9001:2015 Registered, PED Certified

We hereby certify that the product described above passed all of the tests required

by the specifications. U Tu n Dr. Quilin Yu - Metallurgist

Page:3 of 3

**** indicates Heats melted and Manufactured in the U.S.A.

Concession No.	6 B	STREET, STREET	No. of Concession, name	the states
	None of Concession, Name	No. of Concession, Name		of the local division in which the
10 00	And in case of the local division of the loc	PARTY CONTRACTOR	ALC: NOT THE OWNER OF THE OWNER	101 101

MILL TEST CERTIFICATE A0H 85647

NUCOR STEEL TUSCALOOSA, INC.

1700 HOLT RD N.E. Tuscaloosa, AL 35404-1000 800 800-8204 customerservice@nucortusk.com

Load Numbe	r Tall	y Mill C	rder M	Number	•	PO N	10 L	ine NO		Pa	art Nur	mber			Certit	ficate	Number	• F	repar	ed	
R152486	0000000724	815 N-1547	33-001			V108	81Q217	01							\$72481	501-1		0	4/30/2	017 16	:58
Grade					114.17			9.0'EB	Cu	stome	r:	1			12.11	10.1111					
A36, 0.250 Quality Pl	cription: Plate From Coil 00 IN x 96.000 IN lan Description TRIPLE: ASTM A36-	:		E SA36	-13 MO	D MN			Shi LE	ip TO	TEEL LI										
Shipped Item	Heat/Slab Number	Certified By	с	Mn	Р	S	Si	Cu	Ni	Cr	Мо	Cb	v	Al	Ti	N2	В	Ca	Sn	CEV	ACI
					р 0.013	11.1			Ni 0.06				V 0.003				B 0.0001				ACI
Item	Number	Ву	0.18	0.84		0.006	0.06	0.18	0.06	0.08	0.019	0.001		0.031	0.001	0.007		0.0018	0.006	0.36	ACI
Item 7D3212B	Number B7Q4224-02 ***	By B7Q4224	0.18	0.84	0.013	0.006	0.06	0.18	0.06	0.08	0.019	0.001	0.003	0.031	0.001	0.007	0.0001	0.0018	0.006	0.36	ACI
Item 7D3212B 7D3212C	Number B7Q4224-02 *** B7Q4224-02 ***	By B7Q4224 B7Q4224	0.18 0.18 0.18	0.84 0.84 0.84	0.013	0.006	0.06	0.18 0.18 0.18	0.06 0.06 0.06	0.08	0.019 0.019 0.019	0.001 0.001 0.001	0.003	0.031 0.031 0.031	0.001 0.001 0.001	0.007 0.007 0.007	0.0001 0.0001 0.0001	0.0018	0.006	0.36 0.36 0.36	ACI
Item 7D3212B 7D3212C 7D3212D	Number B7Q4224-02 *** B7Q4224-02 *** B7Q4224-02 ***	By B7Q4224 B7Q4224 B7Q4224	0.18 0.18 0.18 0.18	0.84 0.84 0.84 0.84	0.013 0.013 0.013	0.006 0.006 0.006 0.006	0.06 0.06 0.06 0.06	0.18 0.18 0.18 0.18	0.06 0.06 0.06 0.06	0.08 0.08 0.08 0.08	0.019 0.019 0.019 0.019	0.001 0.001 0.001 0.001	0.003 0.003 0.003	0.031 0.031 0.031 0.031	0.001 0.001 0.001 0.001	0.007 0.007 0.007 0.007	0.0001 0.0001 0.0001 0.0001	0.0018 0.0018 0.0018	0.006 0.006 0.006 0.006	0.36 0.36 0.36 0.36	ACI
Item 7D3212B 7D3212C 7D3212D 7D3212E	Number B7Q4224-02 *** B7Q4224-02 *** B7Q4224-02 *** B7Q4224-02 *** B7Q4224-02 ***	By B7Q4224 B7Q4224 B7Q4224 B7Q4224	0.18 0.18 0.18 0.18 0.18	0.84 0.84 0.84 0.84 0.84	0.013 0.013 0.013 0.013	0.006 0.006 0.006 0.006 0.006	0.06 0.06 0.06 0.06 0.06	0.18 0.18 0.18 0.18 0.18	0.06 0.06 0.06 0.06 0.06	0.08 0.08 0.08 0.08 0.08	0.019 0.019 0.019 0.019 0.019 0.019	0.001 0.001 0.001 0.001 0.001	0.003 0.003 0.003 0.003	0.031 0.031 0.031 0.031 0.031	0.001 0.001 0.001 0.001 0.001	0.007 0.007 0.007 0.007 0.007	0.0001 0.0001 0.0001 0.0001 0.0001	0.0018 0.0018 0.0018 0.0018	0.006 0.006 0.006 0.006 0.006	0.36 0.36 0.36 0.36 0.36	ACI
Item 7D3212B 7D3212C 7D3212D 7D3212E 7D3212F	Number B7Q4224-02 *** B7Q4224-02 *** B7Q4224-02 *** B7Q4224-02 *** B7Q4224-02 *** B7Q4224-02 ***	By B7Q4224 B7Q4224 B7Q4224 B7Q4224 B7Q4224 B7Q4224	0.18 0.18 0.18 0.18 0.18 0.18	0.84 0.84 0.84 0.84 0.84 0.84	0.013 0.013 0.013 0.013 0.013	0.006 0.006 0.006 0.006 0.006 0.006	0.06 0.06 0.06 0.06 0.06 0.06	0.18 0.18 0.18 0.18 0.18 0.18	0.06 0.06 0.06 0.06 0.06 0.06	0.08 0.08 0.08 0.08 0.08 0.08	0.019 0.019 0.019 0.019 0.019 0.019	0.001 0.001 0.001 0.001 0.001 0.001	0.003 0.003 0.003 0.003 0.003	0.031 0.031 0.031 0.031 0.031 0.031	0.001 0.001 0.001 0.001 0.001 0.001	0.007 0.007 0.007 0.007 0.007 0.007	0.0001 0.0001 0.0001 0.0001 0.0001 0.0001	0.0018 0.0018 0.0018 0.0018 0.0018	0.006 0.006 0.006 0.006 0.006 0.006	0.36 0.36 0.36 0.36 0.36 0.36	ACJ

Material provided by:

Page:1 of 3

PRECISION FLAMECUTTING

HT# B7Q4224

Mercury has not come in contact with this product during the manufacturing process nor has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Material conforms to NACE MR0175 Annex 2.1.2 Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coll ISO 9001:2015 Registered, PED Certified

0.18 0.84 0.013 0.006 0.06

0.06

0.18 0.84 0.013 0.006

We hereby certify that the product described above passed all of the tests required

0.18 0.06 0.08 0.019 0.001 0.003 0.031 0.001 0.007 0.0001 0.0018 0.006 0.36

0.18 0.06 0.08 0.019 0.001 0.003 0.031 0.001 0.007 0.0001 0.0018 0.006 0.36

by the specifications. U Dr. Quilin Yu - Metallurgist

""" indicates Heats melted and Manufactured in the U.S.A.

B7Q4224-01 ***

B7Q4224-01 ***

B7Q4224

B7Q4224

Anchor Plate

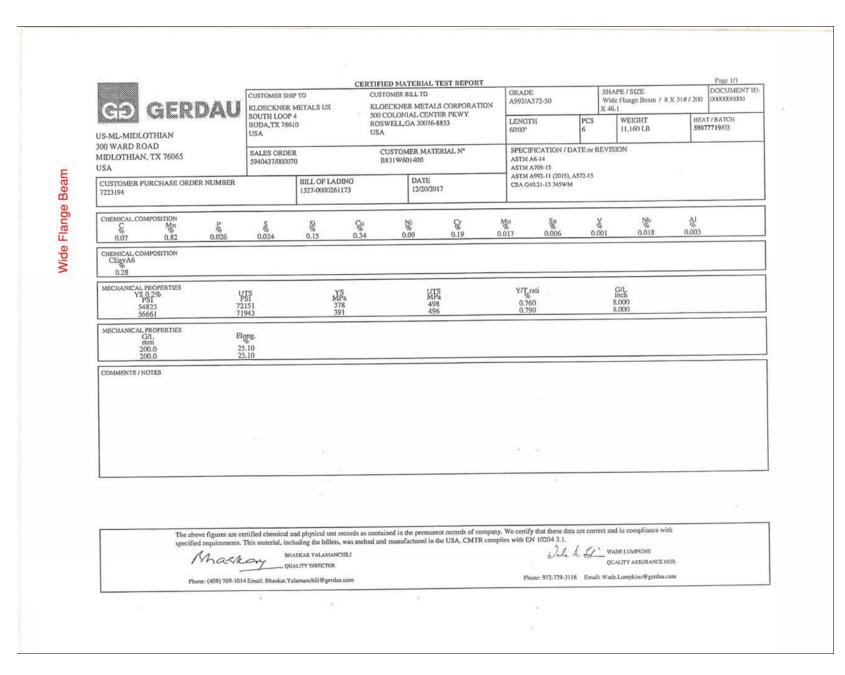
7D3213E

7D3213F

	SS	A	B					01/04/1		85022										
	12	400 High	way 43 I	North, Ax	is, Alab	ama 36	6505, US					8		ŀ	orm T	C1: Re	wision	2: Date	e 23 Ap	r 2014
Customer								P.O.No.:HC				Will Order	the second s	-522	186-03	3	Ship	ping M	anifest	: AR25640
CHAPEL S PO BOX 1		5				Pn	oduct Des			6(14)/A709(17) M270(15)36)36/ASME	E SA36(17)	6			Date: 2			Cert No Page 1	:0816400 of 1)
SPRING H PA 19477	OUSE	2					0.075	100.01		A (1) ()										
	Tes	ed Piece	8!		1	St	Tensile	X 120.0)	(480.	0 (IN)	r		Cha			Tanta				
Heat	Piec			Tst	YS	UTS		Elong %	Tst	Hardness	Abs. E	nergy(FT			Shear	t Tests	Tst	Tst	Tst	BDW
Ict	ld		nsions	Loc	(KSI) (KS))	2in 8in	Dir			3 Av			3		Tmp	Dir	Siz	Tmp %
E7L229 M7L230	A16 A28		DISCRT)	L	50	69		25	Т											
M7L714	D11		DISCRT)		53 48	68 66		27	T											
W7L740	A17		DISCRT)		49	68		27 25	Т											
W7L741	A31		DISCRT)		57	70		24	Ť											
W7L741	A34		DISCRT)	L	53	67		23	T											
Heat Id E7L229 M7L230-A28 M7L714-D11	.18	.54	.011 .007 .010	.002	SI .14 .13 .18	.028	33 .16 26 .11 30 .12	NI Cr .13 .10 .11	04 .04 .03	Cb V 000 003 001 002 001 002	3 .014 2 .012	B .0001 .0001 .0001	N .0079 .0071 .0082							
Id E7L229 M7L230-A28 M7L714-D11 W7L740 W7L740 W7L741 KILLEI MERCUF OF THI MTR EN 100% FRODUC	A STEEL O STEEL O STEEL O STEEL O STEEL O STEEL O STEEL O STEEL TS SHI	0 .52 .54 .29 .52 .52 .28 .52 .28 .52 .28 .52 .28 .52 .28 .52 .28 .52 .52 .52 .52 .52 .52 .52 .52 .52 .52	.011 .007 .010 .010 .008 TALLURG	.002 .002 .005 .001 .001 GICAL C	14 13 18 13 15 0MPON TIFIC	.026 .028 .028 .025 .025 .025 .025 .025 .025 .025 .025	33 .16 26 .11 30 .12 30 .15 26 .14 THE ST 1 COMPL	NI Cr 1.13 .10 .11 .11 .08 EEL AND IANT	Mo .04 .04 .03 .05 .04	Cb V 000 003 001 002 001 002 001 002 000 003 001 002 RCURY WAS	3 .014 2 .012 2 .020 3 .015 2 .012 1NTEN	.0001 .0001 .0001 .0001 .0001 .0001	.0079 .0071 .0082 .0078 .0068 Y ADDE					ACTUR	E	
Id E7L229 M7L230-A28 M7L714-D11 W7L740 W7L741 KILLEE MERCUF OF THI MTR EN 100% M	.11 .11 .11 .11 .11 .11 .11 .11 .11 .11	0 .52 .54 .29 .52 .28 .52 .28 .52 .28 .52 .28 .52 .52 .52 .52 .52 .52 .52 .52 .52 .52	.011 .007 .010 .010 .008 TALLURO ISPECTION DFACTURE 33 .7	.002 .002 .005 .001 .001 .001 .001 .001 .001 .001	.14 .13 .18 .13 .15 OMPON	.026 .028 .028 .025 .025 .025 .025	33 .16 26 .11 30 .12 30 .15 26 .14 THE ST 1 COMPL BS: 4 BS: 1	NI Cr .13 .10 .11 .11 .08 EEL AND	Mo .04 .03 .05 .04 NO ME	Cb V .000 .003 .001 .002 .001 .002 .000 .003 .001 .002	3 .014 2 .012 2 .020 3 .015 2 .012 INTEN	.0001 .0001 .0001 .0001 .0001	.0079 .0071 .0082 .0078 .0068 Y ADDE	D DU PCES PCES		THE 1 1, LB: 6, LB:	s:	ACTUR 6126 36756		
Id E7L229 M7L230-A28 M7L714-D11 W7L740 W7L741 KILLEI MERCUP OF THI MTR EN 100% M FRODUC W7L7 W7L7	.11 .11 .11 .11 .11 .11 .11 .11 .11 .11	0 .52 .54 .29 .52 .28 DT A MET JCT. 2004 IN AND MANU PPED: A3 A1	.011 .007 .010 .010 .008 TALLURO ISPECTION DFACTURE 33 .7	.002 .002 .005 .001 .001 .001 .001 .001 .001 .001	14 13 18 13 15 0MPON TIFIC THE U: CES: CES:	.026 .028 .028 .025 .025 .025 .025 .025 .025 .025 .025	33 .16 26 .11 30 .12 30 .15 26 .14 THE ST 1 COMPL BS: 4 BS: 1	NI Cr 13 10 10 11 11 11 08 EEL AND IANT 2882 2252	Mo .04 .03 .05 .04 NO ME	Cb V .000 .003 .001 .002 .001 .002 .000 .003 .001 .002 .000 .003 .001 .002 .RCURY WAS	3 .014 2 .012 2 .020 3 .015 2 .012 INTEN	.0001 .0001 .0001 .0001 .0001 TIONALL	.0079 .0071 .0082 .0078 .0068 Y ADDE	PCES		1, LB	s:	6126		
1d E7L229 M7L230-A28 M7L714-D11 W7L740 W7L740 W7L741 KILLEI MERCUR OF THI MTR EN 100% M PRODUC W7L7 W7L7	.11 .11 .11 .11 .11 .11 .11 .11 .11 .11	0 .52 .54 .29 .52 .28 DT A MET JCT. 2004 IN AND MANU PPED: A3 A1	.011 .007 .010 .010 .008 TALLURO ISPECTION DFACTURE 33 .7	.002 .002 .005 .001 .001 .001 .001 .001 .001 .001	14 13 18 13 15 0MPON TIFIC THE U: CES: CES:	.026 .028 .028 .025 .025 .025 .025 .025 .025 .025 .025	33 .16 26 .11 30 .12 30 .15 26 .14 THE ST 1 COMPL BS: 4 BS: 1	NI Cr 13 10 10 11 11 11 08 EEL AND IANT 2882 2252	Mo .04 .03 .05 .04 NO ME	Cb V .000 .003 .001 .002 .001 .002 .000 .003 .001 .002 .000 .003 .001 .002 .RCURY WAS	3 .014 2 .012 2 .020 3 .015 2 .012 INTEN	.0001 .0001 .0001 .0001 .0001 TIONALL	.0079 .0071 .0082 .0078 .0068 Y ADDE	PCES		1, LB	s:	6126		
1d E7L229 M7L230-A28 M7L714-D11 W7L740 W7L740 W7L741 KILLEI MERCUR OF THI MTR EN 100% M PRODUC W7L7 W7L7	.11 .11 .11 .11 .11 .11 .11 .11 .11 .11	0 .52 .54 .29 .52 .28 DT A MET JCT. 2004 IN AND MANU PPED: A3 A1	.011 .007 .010 .010 .008 TALLURO ISPECTION DFACTURE 33 .7	.002 .002 .005 .001 .001 .001 .001 .001 .001 .001	14 13 18 13 15 0MPON TIFIC THE U: CES: CES:	.026 .028 .028 .025 .025 .025 .025 .025 .025 .025 .025	33 .16 26 .11 30 .12 30 .15 26 .14 THE ST 1 COMPL BS: 4 BS: 1	NI Cr 13 10 10 11 11 11 08 EEL AND IANT 2882 2252	Mo .04 .03 .05 .04 NO ME	Cb V .000 .003 .001 .002 .001 .002 .000 .003 .001 .002 .000 .003 .001 .002 .RCURY WAS	3 .014 2 .012 2 .020 3 .015 2 .012 INTEN	.0001 .0001 .0001 .0001 .0001 TIONALL	.0079 .0071 .0082 .0078 .0068 Y ADDE	PCES		1, LB	s:	6126		

83

2018-09-27



84

2018-09-27

1 51	STEEL TEXA EEL MILL DRI UIN TX 78155-	٧E		CERTIFIED MILL TES For additional co 830-372-877	pie	REPORT are ac	curate and co	rtify that the test results presented here inform to the reported grade specification <i>Tommy Here</i> TOMMY HEWITT arance Manager
HEAT NO.:3067587 SECTION: CHANNEL 3"x6.0# A36/52950 GRADE: ASTM A36-14/A529-1 ROLL DATE: MELT DATE: 12/03/2016 Cert. No.: 82115476 / 067587A	4 Gr50	O L D T	Delta Steel In 7355 Roundha Houston TX US 77078-452 7136238080 7136350048	ouse Ln	S H I P T O	7355 Roundhouse Ln Houston TX US 77078-4528 7136351200	Div	Delivery#: 82115476 BOL#: 72095406 CUST PO#: DHO-151547 CUST P/N: DLVRY LBS / HEAT: 9360.000 LB DLVRY PCS / HEAT: 39 EA
Characteris	tic Value			Characteristic		Value		Characteristic Value
	t 1 51.9ksi t 1 73.1ksi t 1 33% t 1 8IN			Yield Strength to Tensile Strength to Elongation to Yield to tensile ratio t	st:	2 75.3ksi 2 27% 2 8IN	"Materia "100% n "EN1020 "Contain "Contain "Manufa	is true of the material represented by this MTR: If is fully killed mated and rolled in the USA 04:2004 3.1 complemt is no weld repair is no Mercury contamination clured in accordance with the latest version vlant quality manual

REMARKS : ALSO MEETS ASTM GRADE A36, A529-50, A572-50, A709-36, A709-50, A992, AASHTO M270-36, M270-50, CSA G40.21-04 44W, 50W

06/22/2017 00:28:33 Page 1 OF 1

Page 1 of 1

Gର ଓ	ERD	AU	CUSTOMER SH KLOECKNER SOUTH LOOP	METALS US	KL 500	COLONIAL CEN	ALS CORPORATION NTER PKWY	A	RADE 992/A572-50					DOCUMENT II 0000000000
US-ML-CARTERS 384 OLD GRASSD		F	BUDA,TX 786 USA	-10	RO US	SWELL, GA 3007	6-8853		ENGTH 0'00"	PCS 10		WEIGHT 9,600 LB		T/BATCH 3188/02
CARTERSVILLE, USA			SALES ORDE 6155134/0000			CUSTOMER MA B824W401400	TERIAL N®	A	SPECIFICATION / I STM A6-17 STM A709-17	DATE or R	EVISIO	N		
CUSTOMER PURC 7243904	HASE ORDER N	UMBER		BILL OF LAD 1323-0000106		DATE 02/21/2			STM A992-11 (2015) SA G40.21-13 345W					
CHEMICAL COMPOS	ITION Mn % 1.14	足 0.015	\$ 0.025	Şi 0.28	Си 0.27	Ni 0.12	Çr 1 0.08 0.	Mo	ន្ត្រ 0.008	0.0	(000	Nb %		
MECHANICAL PROP YS 0.2% PSI 54200 55200	ERTIES	UT PS 766 768	S 10 10	MF 37 38	3a 4	U M 5: 5	TS IPa 28 30		Y/T_rati 0.710 0.720		G In 8.0	/L ch 000		
MECHANICAL PROP Elong. 20.80 21.20	ERTIES													
							ŝ							
	The above fi	gures are certi airements. Th	fied chemical at is material, inclu	id physical test re iding the billets, v	cords as contai vas melted and	ined in the perman I manufactured in	eat records of company. the USA. CMTR complic	We c	ertify that these data th EN 10204 3.1.	a are correc	t and in	n compliance with	2 ⁻⁰ - 2-207	
	specified req	uirements. Th	is material, inclue BRA QUA	od physical test re uding the billets, v SKAR YALAMANCH ALITY DIRECTOR amanchili @gerdau.o	was melted and	ined in the perman 1 munufactured in i	eat records of company. the USA. CMTR compile	We c es wi	ertify that these data th EN 10204 3.1.	\$5. 	YAN W QUALI	'ANG TY ASSURANCE MGR		

98

2018-09-27

1

CMC

CMC STEEL TEXAS **1 STEEL MILL DRIVE** SEGUIN TX 78155-7510 CERTIFIED MILL TEST REPORT For additional copies call 830-372-8771

We hereby certify that the test results presented here are accurate and conform to the reported grade specification

Tommy HEWITT

						Quality Assu	rance Manager	
HEAT NO.;3079581 SECTION: REBAR 16MM (#5) 60'0 GRADE: ASTM A615-16 Gr 420/60 ROLL DATE: 04/22/2018 MELT DATE: 04/22/2018 Cert. No.: 82366893 / 079581A002		0 L 901 CAN		S H I P T O	CMC Coatings Waxah 901 Cantrell St Waxahachie TX US 75165-3120 972 937 9841	achie	Delivery#: 82366 BOL#: 72448918 CUST PO#: CUST P/N: DLVRY LBS / HE DLVRY PCS / HE	AT: 15020.000 LE
Characteristic	Value		Characterist	c	Value		Characteristic	Value
C Mn P S Si Cu Cr Ni Mo V Cb Sn Al Yield Strength test 1 Tensile Strength test 1 Elongation test 1 Elongation Gage Lgth test 1 Bend Test Diameter Bend Test 1	0.41% 0.89% 0.013% 0.046% 0.17% 0.28% 0.13% 0.16% 0.063% 0.000% 0.002% 0.002% 0.012% 0.001% 66.4ksi 104.1ksi 14% 8IN 2.188IN Passed					*Matenal *100% m *EN1020 *Contain *Contain *Manufac of the p	s true of the material repr is fully killed solicd and rollod in the USJ 4:2004 3.1 compliant 5 no weld repair 5 no Morcury contamination ctured in accordance with t lant quality manual 9: "Buy America" requirem	n he latest version

REMARKS :

05/15/2018 10:19:57 Page 1 OF 1

78



CMC

CMC STEEL TEXAS 1 STEEL MILL DRIVE SEGUIN TX 78155-7510 CERTIFIED MILL TEST REPORT For additional copies call 830-372-8771

We hereby certify that the test results presented hcre are accurate and conform to the reported grade specification

Tony last

TOMMY HEWITT

				Quality	Assurance Manager
HEAT NO.:3079583 SECTION: REBAR 16MM (#5) 60'0" 420/60 GRADE: ASTM A615-16 Gr 420/60 ROLL DATE: 04/22/2018 MELT DATE: 04/22/2018 Cert. No.: 82366893 / 079583A002	D	CMC COATING WAXAHACHIE 901 CANTRELL STREET WAXAHACHIE TX US 75165-3120 972-937-9841	P	CMC Coatings Waxahachie 901 Cantroll St Waxahachie TX US 75165-3120 972 937 9841	Delivery#: 82366893 BOL#: 72448918 CUST PO#: CUST P/N: DLVRY LBS / HEAT: 30040.000 LB DLVRY PCS / HEAT: 480 EA

Characteristic	Value	Characteristic Value	Characteristic Value
c	0.42%		
Mn	0.83%		
P	0.013%	5	
S	0.047%		
Si	0.18%		
Cu	0.29%	5	
Cr	0.15%		
Ni	0.20%		
Mo	0.077%		
v	0.000%		
Cb	0.003%		
Sn	0.013%		The Following is true of the material represented by this MTR:
AI	0.001%		"Material is fully killed
Yield Strength test 1	67.4ksi		*100% melled and rolled in the USA
Tensile Strength test 1	101.7ksl		*EN10204:2004 3.1 compliant
Elongation test 1	14%		*Contains no weld repair
Elongation Gage Lgth test 1	81N		*Contains no Mercury contamination
Bend Test Diameter	2.188IN		"Manufactured in accordance with the latest version
Bend Test 1	Passed		of the plant quality manual

REMARKS :

05/15/2018 10:19:25 Page 1 OF 1

	CMC STEEL TEXAS 1 STEEL MILL DRIV SEGUIN TX 78155-7	E	CEF	TIFIED MILL TES For additional co 830-372-877	oles		occurate and con	ify that the test resul form to the reported Tomy Kenty TOMMY HEWITT ance Manager	its presented hεre grade specification
HEAT NO.:3078975 SECTION: REBAR 13MM (GRADE: ASTM A615-16 G ROLL DATE: 04/05/2018 MELT DATE: 03/30/2018 Cert. No.: 82365532 / 0789	r 420/60	1	CMC COATING WAX 901 CANTRELL STR WAXAHACHIE TX US 75165-3120 972-937-9841		S H I P T O	CMC Coatings Waxaha 901 Cantrell St Waxahachie TX US 75165-3120 972 937 9841	ichle	Delivery#: 8236553 BOL#: 72446899 CUST PO#: CUST P/N: DLVRY LBS / HEAT DLVRY PCS / HEAT	T: 40404.000 LB
Charac	teristic Value			Characteristic		Value		Characteristic	Value
C Mn P S Si Cu Cr Ni V Cb	0.42% 0.79% 0.009% 0.042% 0.17% 0.31% 0.10% 0.10% 0.08% 0.064% 0.000%								
Cb Sn Al Yield Strength tes Tensile Strength te Elongation test 1 Elongation Gage Lgth Bend Test Diamete Bend Test 1	0.010% 0.002% et 1 65.8ksi est 1 104.0ksi 1 15% test 1 8IN						*Matenal i *100% me *EN10204 *Contains *Contains *Manufact of the pla	true of the material repres s fully killed illed and rolled in the USA 2004 3.1 compliant no weld repair no Mercury contamination ured in accordance with the int quality manual a "Buy America" requirement	latest version

EMARKS :

2018-09-27

05/15/2018 10:18:16 Page 1 OF 1

TR No. 609591-03

1

68

Valspar Corporation

CERTIFICATION of COMPLIANCE

Date: 4/18/2018

Specification: ASTM A775, ASTM A1078, AASHTO M284, AASHTO M254

Valspar Product Code: 720A009 (Epoxy Powder for Coating) Batch Number: 8496026992 Production Date: 4/17/2018 (Expiration is 6 months post production date) Batch Size: 18,000 lbs.

I hereby certify that the above lot of material was manufactured to formulation, meeting all the requirements of the above specifications and that this material is chemically the same material that was tested by Valley Forge Laboratories of Devon, PA. or Wiss, Janney, Elstner Associates of Northbrook, Il.

The individual signing below has the legal authority to bind Valspar to the material

10300 Claude Freeman Drive Charlotte, NC 28262 Phone: (704) 548-2820 Fax: (704) 547-0634 Cabarnis State/Commonwealth N (19.12 2019 April hefore On this the Tie (SV ca Depensionally known to me The undersigned Notary Public, personally appeared Name(s) of Signer(s) To be the person(s) whose name(s) is/are subscribed to the within instrument, and acknowledged to me that he/she/they executed the same for the purposes therein stated. EE L MO WINSSIDN ess my hand nut/official NOV 10211:11 2020 11-29-2020 Other Required Information (Printed Name of Notary, Residence, etc.) The articles adoutified above aware produced in the materials" and "domestic manufactured goods" United States and qualify us "U.S.-made and products", "domestic construction

The data on this streat represent measured values. Since application variables are a major factor in pitiduct performance, this information should terre only as a general guide. Velopar assumes no obligation or liability for use of this information. UNLESS VALSPAR AGREES OTHERWISE IN WRITING, VALSPAR MAKES NO WARRANTIES, EXFRESS OR IMPLIED, AND DISCLARMS ALL IMPLIED WARRANTIES INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR FREEDOM FROM PATENT INFORMET. VALSPAR WILL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES. Your only remedy for any defect in this product is the replacement of the defective product, or a refund of its patrices price, et our option. PEIVISOR

and/Fivie

7/09/18	Certificate of Co	ompliance A	Nelson Fastener Systems Company 69
CUSTOM FABRICATORS 1379 N HARVEY MITCHELL PKW BRYAN	TX 77803		
Material Description/Par	t Numbers Quantity	Heat Numb	er Lab Number
CPT. 3/4-10 X 2 1/2 MS	90	10530700	

CPL 3/4-10 X 2 1/2 MS 90 10530700 24071

Nelson Order Number: 1015428

Customer P.O.: 21486

The product supplied under the contract or purchase order number shown is certified to comply with the latest revision of one or more of the applicable product specifications therein; AWS D1.1, AWS D1.5, AWS D1.6, ISO 13918, BS 5950, ASTM A108, ASTM A29, ASTM A276, ASTM A493, ASTM A1064, ASTM A496, ASTM A479, ASTM A1022.

The chemical analysis reported below was extracted from the certified mill test report. This report will be supplied when specified in the customer order or upon request. The physical properties reported were determined to be in conformance using ASTM A370 testing procedure.

Nelson Stud Welding is an ISO/TS 16949:2009 certified supplier. Our IATF certificate # is 0222148. This material is free from mercury contamination and is RoHS compliant. This product is melted and manufactured in the USA. No weld repair was performed on the raw material or the studs. Parts are manufactured from cold drawn bar.

Grade	C-1015
Heat Number	10530700
Ultimate PSI	82,300
Yield PSI	77,400
% Reduction of Area	60.0
% Elong. (in 2"or4D)	22.0
% Elong. (in 5D)	19.000
Carbon	.160
Manganese	.550
Phosphorous	.005
Sulphur	.008

I hereby certify that the data listed in this Certificate of Compliance is true and correct as as contained in the company test records and that it complies with the specifications shown.

Authorized by:

CHERYL A, MONEAL

COMMISSION EXPIRES February 26, 2019

Nelson® Stud Welding · 2211 Century Center Blvd. #105 · Irving, TX 75062 PH: (972) 721-9055 · FAX: (972) 438-7883 · www.NelsonStud.com

<form> Description of the second second</form>		HARTER		FILE		1658 Cold Springs Ro Saukville, Wisconsin 530
<image/> Proceeding of the material discribes here has been manufactured in accordance with the specifications and standards state below of the specification in the specification is and specification in the specificatio	STEEL	IEEL				(262) 268-240
Methed in USA Manufactured in USA Methed in USA Manufactured in USA Methed in USA Manufactured in USA Method in USA <td></td> <td></td> <td></td> <td></td> <td></td> <td>1-800-437-878</td>						1-800-437-878
Metted in USA Manufactured in USA Meta Manufactured in USA Nelson Stud Welding - A Nelson Fasterer Systems Company 7900 West Ridge Road QC Department Systems Company Comparison of the Company Comparison of the Company Co	Char	ter Manufacturing Company. Inc.				Fax (262) 268-257
Nelson Stud Welding - A Nelson Fasterer Systems Company T800 West Ridge Road QC Department Elyrad, OL44035 1 Interestive Ridge Road QC Department 1 Grade Finish Size 1 Size Society 1 Size Society 1 Size Society 1 Size Society 1 Grade 1 Size Society 1 <	Melted in USA	Manufactured in USA	CHARTER STE	EL TEST RE	PORT	
Nelson Stud Welding - A Nelson Fastener Systems Company 7000 West Ridge Road QC Department Elyria.014-4035 Image: Company 1015 M SK FG RH0 45664 RN0COI Process Image: Company 1015 M SK FG RH0 45664 RN0COI 1015 M SK FG RH0 45664 RN0COI 1015 M SK FG RH0 4566 HN0COI 1015 M SK FG RH0COI 1015 M SK FG RH0 4566 HN0COI 1015 M SK FG RH0COI 1015 M SK FG RH0COI 1			0	ust P.O.		42534
Nelson Stud Welding - A Nelson Fasterrar Systems Company 7000 West Ridge Road CC Department Elyria, 01-44035 Crede 1015 M SK FG RH0 45064 RN0001 Friends Stee 1015 M SK FG RH0 4506 Friends Stee 1015 M SK FG RH0 4506 Friends Stee 1015 M SK FG RH0 45064 RN0001 Friends Stee 1015 M SK FG RH0 4506 Friends Stee 1000 M Friends Stee 1000 M Friend						The second s
Nelson Stud Welding - A Nelson Fastener Systems Company 7800 West Ridge Road QC Department Elyria, OH-44035 Stud Welding - A Nelson Fastener Process Stud West Ridge Road QC Department Elyria, OH-44035 1 Pereby certify that the maining described herein has been manufactured in accordance with the specifications and standards listed below and that it astelles there requirements or entries on this on the counter may be punchable as a fillion under foderal statute Lab Code: 7288 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, Edition and the code of 1035/000 C M N P B State, C M N P D State, C M N P P State, C M N P D State, C M N P State, C			Charter Sale			5004936
Systems Company 7800 West Ridge Road QC Department Elyria,0H-4035 Image: Create State	Nelson S	Stud Welding - A Nelson Fas	tener			the second se
7900 West Ridge Road CC Department Elyria, OH-44035 Encodes Hereby certify that the material described herein has been manufactured in accordance with the specifications and standards tisted below and half it satisfies there requirements. The recording of table, fictious and transfer of table, for this order of the specifications and standards tisted below and half it satisfies there requirements or entires on this document must be purshable as a felony under fideal statute the docur; 7389 Context, 755, 755, 755, 755, 755, 755, 755, 75	Systems	Company		and the second se	1015 M SK	
QC Department Elyria, OH-44035 Firsh Size 4466 11 Pereby certify that the material described herein has been manufactured in accordance with the specifications and standards listed below and that it standards these requirements. The recording of take, fictious and trauduent statements or entries on this document may be purishable as a felony under federal statute these requirements. The recording of take, fictious and trauduent statements or entries on this document may be purishable as a felony under federal statute these requirements. The recording of take, fictious and trauduent statements or entries on this document may be purishable as a felony under federal statute the cordination of takes, fictious and trauduent statements or entries on this document may be purishable as a felony under federal statute the cordination of takes, fictious and trauduent statements or entries on this document may be purishable as a felony under federal statute the cordination of takes, fictious and trauduent statements or entries on this document may be purishable as a felony under federal statute that the cordination of takes, fictious and trauduent statements or entries on this document may be purishable for the cordination of the following customer documents:	7900 We	st Ridge Road			1010 W 5K	
Interply certify that the material described herein has been manufactured in accordance with the specifications and standards listed below and that it satisfies these requirements. The recording of falls, fictuous and fraudulent statements or entries on this document may be pursibable as a felory under federal statute that core is a felory under federal statute that the core is a felory under federal statute that core is a felory under federal statute that core is a felory under federal statute that the core is a felory under federal statute that the core is a felory under federal statute that the core is a felory under federal statute that the core is a felory under federal statute that the core is a felory of the core i			Fin	ish Size		
Test results of Rolling Lot # 1002 and included and included is distributed or think of an included in the content of the start of	Elyria,OF	1-44035	S	hip date		17-JAN-18
Test control Test results of Rolling Left # 123161 Lab Code:::0308 Cf MM P 58 51 MA CR MO CU SN V CHEM 16 A N B Test results of Rolling Left # 123161 Mot Cit S0 0.00 0.001	I hereby certify that the	e material described herein has been	manufactured in accorda	nce with the specific	ations and standards liste	d below and that it satisfies
CHEM C MM P S SI NI CR MO C0 SN V AL N B TO CA NI CR MO C0 SN V AL N B TO CA NI CR MO C0 SN V AL N B TO CA NI CR MO C0 SN V AL N B TO CA NI CR MO C0 SN V V ACX4 NOB B TO NI CA NI SN A SN A <	and be requirementa. In	he recording of false, fictitious and fra	udulent statements or ent	ries on this documer	nt may be punishable as	a felony under federal statute
%With 16 .55 .005 .008 .001 .001 .001 .001 .002 .003 .002 .004 .003 .003 .002 .004 <		C MN PV	s / sı /	NI / 00 /		
A24 NB T1 CA NB SB A3 A24 NB DOMINY (NEC) NB NB </td <td>%Wt</td> <td>.16 .55 .005</td> <td></td> <td></td> <td></td> <td></td>	%Wt	.16 .55 .005				
PB .001 .002 .004 JOMINY(HRC) J J3 J3 JOMINY SAMPLE TYPE ENGLISH-C			II CA	NB SB	AS	
11 33 12 32 JOMINY (HRC) 1 12 32 JOMINY SAMPLE TYPE ENGLISH-C Image: Comparison of the state of the s			.001 .0001	.001 .002	.004	0
42 20 JOMINY SAMPLE TYPE ENGLISH-C Image: Sample of the second of the seco					NIR	CONT
42 20 JOMINY SAMPLE TYPE ENGLISH-C SAMPLE TYPE ENGLISH-C Sample Colspan="2">Sample Colspan="2" Sample Colspan="2" Sample Colspan="2" Sample Colspan= Sample Colspan= Colspan="2" Control Tocspan= Sample Colspan= Sample Colspan= Sample Colspan= Sample Colspan= Sample Colspan="2">Sample Colspan= Sample Colspan= Sample Colspan= Sample Colspan= Sample Colspan= Sample Colspan= Sample Colspan="2">Sample Colspan="2" Sample Colspan= Sample Colspam= Sample Colspan= Sample Colspan= Sample Colspan= Sample Colspam					al-	Co
Mource: If of Tests Test results of Rolling Lot # 1231181 Min Value Max Value Mean Value 72 72 72 REDUCTION RATIO=78:1 To Test results of Rolling Lot # 1231181 Peedfications: Manufactured per Charter Steel Quality Manual Rev Date 05/12/17 Charter Steel certifies this product is indistinguishable from background radiation levels by having process radiation Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235-236 Mource: arter Steel arter					× 1	80 5
Mource: If of Tests Test results of Rolling Lot # 1231181 Min Value Max Value Mean Value 72 72 72 REDUCTION RATIO=78:1 To Test results of Rolling Lot # 1231181 Peedfications: Manufactured per Charter Steel Quality Manual Rev Date 05/12/17 Charter Steel certifies this product is indistinguishable from background radiation levels by having process radiation Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235-236 Mource: arter Steel arter					ELS 7	27.182
Min Value Max Value Mean Value Mean Value Mean Value REDUCTION RATIO-78:1 72 72 RB LAB = 0358-02 pecifications: Manufactured per Charter Steel Quality Manual Rev Date 05/12/17 Charter Steel certifies this product is Indistinguishable from background radiation levels by having process radiation detectors in place to measure for the presence of radiation within our process & products. Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Document = MPS-102C dditional Comments: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- J2G3 It Source: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- J2G3 It Source: This MTR supersedes all previously dated MTRs for this order wireline, U, USA Vision Form p: 1213927 Testing Laborstory	1000				No.	
Min Value Max Value Mean Value Mean Value Mean Value REDUCTION RATIO-78:1 72 72 RB LAB = 0358-02 pecifications: Manufactured per Charter Steel Quality Manual Rev Date 05/12/17 Charter Steel certifies this product is Indistinguishable from background radiation levels by having process radiation detectors in place to measure for the presence of radiation within our process & products. Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Document = MPS-102C dditional Comments: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- J2G3 It Source: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- J2G3 It Source: This MTR supersedes all previously dated MTRs for this order wireline, U, USA Vision Form p: 1213927 Testing Laborstory					s no	WELD
Min Value Max Value Mean Value Mean Value Mean Value REDUCTION RATIO-78:1 72 72 RB LAB = 0358-02 Pecifications: Manufactured per Charter Steel Quality Manual Rev Date 05/12/17 Charter Steel certifies this product is Indistinguishable from background radiation levels by having process radiation detectors in place to measure for the presence of radiation within our process & products. Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Document = MPS-102C dditional Comments: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 5-235- J2G3 It Source: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 5-235- J2G3 It Source: This MTR supersedes all previously dated MTRs for this order factor Steel activitie, WI, USA 2: 1213927 Texting Laboratory						
MOCKWELL B (HRBW) 1 72 72 72 RB LAB = 0358-02 REDUCTION RATIO=78:1 pecifications: Manufactured per Charter Steel Quality Manual Rev Date 05/12/17 Charter Steel certifies this product is indistinguishable from background radiation levels by having process radiation detectors in place to measure for the presence of radiation within our process & products. Meets customer bocuments: Costomer Document = MPS-102C Revision = 6 Date = 17-OCT-16 dditional Comments: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 5-235- J263 At Source: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 5-235- J263 At Source: This Material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 5-235- J263 At Source: This Material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 5-235- J263 At Source: This MTR supersedes all previously dated MTRs for this order At Source: This MTR supersedes all previously dated MTRs for this order The ILT Steel Latorstory This MTR supersedes all previously dated MTRs for this order Partice Dates and Division Mgr. of Quality Assurance Datas and Qichartersteel. Com Datas and Division Mgr. of Quality Assurance Datas and dischartersteel. Com					Maan Value	
pecifications: Manufactured per Charter Steel Quality Manual Rev Date 05/12/17 Charter Steel certifies this product is indistinguishable from background radiation levels by having process radiation detectors in place to measure for the presence of radiation within our process & products. Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Document = MPS-102C Revision = G Dated = 17-0CT-16 This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- JG3 attractions with any applicable Charter Steel exceptions for the following customer documents: Customer Document = MPS-102C Revision = G Dated = 17-0CT-16 This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- JG3 attractions with any applicable Charter Steel exceptions for the following customer Documents: Discource: Interest Steel Customer Document = MPS-102C Revision = G Dated = 17-0CT-16 This MTR supersedes all previously dated MTRs for this order Wivile, WI, USA pr. 1213927 This MTR supersedes all previously dated MTRs for this order Data Document Division Mgr. of Quality Assurance Data Data Division Mgr. of Quality Assurance Data Data Data Data Data Data Data Data	CCKWELL B (HPBW)					RB LAB = 0358-02
Charter Steel cortifies this product is indistinguishable from background radiation levels by having process radiation detectors in place to measure for the presence of radiation within our process & products. Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Document = MPS-102C Revision = G Dated = 17-OCT-16 This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A28 (latest version), and EN 10025-2 S-235- J2G3	(incom)				14	
Charter Steel cortifies this product is indistinguishable from background radiation levels by having process radiation detectors in place to measure for the presence of radiation within our process & products. Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Document = MPS-102C Revision = G Dated = 17-OCT-16 This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- J2G3		O=78:1				
elt Source: ukville, WI, USA p: 1213927 bete Customer Specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Specifications with any applicable Charter Steel exceptions for the following customer documents: Distribution of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- JCG3	REDUCTION RATE					
Meets customer specifications with any applicable Charter Steel exceptions for the following customer documents: Customer Document = MPS-102C dditional Comments: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- J2G3 It Source: arter Steel ukville, WI, USA p: 1213927 This MTR supersedes all previously dated MTRs for this order Dated = 107-0CT-16 (Division Mgr. of Quality Assurance barnard/Bichartersteel.com Printed Date: 01/117/2018	REDUCTION RATE	Manufactured per Charter Steel Charter Steel certifies this produ	uct is indistinguishable t	rom background r	rdiation levels by basis	
dditional Comments: This material meets the chemistry requirements of ASTM-A108 (latest version), ASTM A29 (latest version), and EN 10025-2 S-235- J2G3 It Source: arter Steel ukville, WI, USA p: 1213927 Testing Laborstory Testing Laborstory	REDUCTION RATE	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo	or the presence of radiat	rom background ra	adiation levels by havin	g process radiation
HI Source: arter Steel ukville, WI, USA p: 1213927 Testing Laboratory Testing Laboratory Date Barnard Division Mgr. of Quality Assurance barnard J@chartersteel.com Printed Date : 01/17/2018	REDUCTION RATE	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w	uct is indistinguishable to the presence of radiat with any applicable Char	from background ra ion within our proc ter Steel exception	adiation levels by havin	g process radiation
It Source: arter Steel ukville, WI, USA p: 1213927 Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for the supersed all previously dated MTRs for the	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA D: 1213927 Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order Date: Date: 01/17/2018	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA D: 1213927 Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order Date: Date: 01/17/2018	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA D: 1213927 Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order Date: Date: 01/17/2018	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA D: 1213927 Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order Date: Date: 01/17/2018	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA : 1213927 Testing Laboratory Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA : 1213927 Testing Laboratory It Source: AccretiteD Testing Laboratory Testing Laboratory Testing Laboratory Testing Laboratory Testing Laboratory Testing Laboratory Transition desting Laboratory Transition desting Laboratory Transition desting Laboratory Transition desting Laboratory Transition desting Laboratory Transition desting Laboratory	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA D: 1213927 Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order Date: Date: 01/17/2018	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel Jkville, WI, USA Testing Laboratory Testing Laboratory Testing Laboratory Testing Laboratory Tresting Laboratory Tresting Laboratory Tresting Laboratory Tresting Laboratory Tresting Laboratory Tresting Laboratory Tresting Laboratory Tresting Laboratory	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA : 1213927 Testing Laboratory It Source: AccretiteD Testing Laboratory Testing Laboratory Testing Laboratory Testing Laboratory Testing Laboratory Testing Laboratory Transition desting Laboratory Transition desting Laboratory Transition desting Laboratory Transition desting Laboratory Transition desting Laboratory Transition desting Laboratory	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA D: 1213927 Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order Date: Date: 01/17/2018	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable to the presence of radiat with any applicable Char Revision = G D	from background ration within our proci ter Steel exception	adiation levels by havin ess & products. s for the following cust	g process radiation omer documents:
It Source: arter Steel ukville, WI, USA p: 1213927 Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for the supersed all previously dated MTRs for the	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable (r the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A	from background ra on within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), /	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version	g process radiation omer documents:), and EN 10025-2 S-235-
It Source: arter Steel ukville, WI, USA p: 1213927 Testing Laboratory Testing Laboratory Testing Laboratory This MTR supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for this order procedure of the supersedes all previously dated MTRs for the supersed all previously dated MTRs for the	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable (r the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A	from background ra on within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), /	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version	g process radiation omer documents:), and EN 10025-2 S-235-
arter Steel ukville, WI, USA p: 1213927 Testing Laboratory arter Steel Laboratory Testing Laboratory Testing Laboratory	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable (r the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A	from background ra on within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), /	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version	g process radiation omer documents:), and EN 10025-2 S-235-
Accredition Control Control p: 1213927 Testing Laboratory Printed Date : 01/17/2018	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable (r the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A	from background ra on within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), /	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version	g process radiation omer documents:), and EN 10025-2 S-235-
p: 1213927 Testing Laboratory Printed Date : 01/17/2018	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable (r the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A	from background ra ion within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), <i>i</i>	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version	g process radiation omer documents:), and EN 10025-2 S-235-
p: 1213927 Testing Laboratory Printed Date : 01/17/2018	REDUCTION RATI	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable (r the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A	from background ra ion within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), <i>i</i>	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version	g process radiation omer documents:), and EN 10025-2 S-235-
p: 1213927 Testing Laboratory Printed Date : 01/17/2018	REDUCTION RATH	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	uct is indistinguishable (r the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A	from background ra ion within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), <i>i</i> (latest version), <i>i</i> This MTR su	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version ASTM A29 (latest version generations) generations of the second second second generation second seco	g process radiation omer documents:), and EN 10025-2 S-235-
	REDUCTION RATH	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	inc is indistinguishable in r the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A C	from background ra ion within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), <i>i</i> (latest version), <i>i</i> This MTR su	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version ASTM A29 (latest version generation generation of the second generation of the s	g process radiation omer documents:), and EN 10025-2 S-235- ated MTRs for this order Quality Assurance
		Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	inc is indistinguishable in r the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A C	from background ra ion within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), <i>i</i> (latest version), <i>i</i> This MTR su	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version approximation of the second presedes all previously of <i>General Samma</i> Barnard Division Mgr. of barnardJ@charterstd	g process radiation omer documents:), and EN 10025-2 S-235- ated MTRS for this order Quality Assurance etc.com
	REDUCTION RATH	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	Indistinguishable in ref the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A CASTM-A CASTM-A Tequirements of ASTM-A CASTM-A CASTM-A Tequirements of ASTM-A CASTMA CASTMA CASTMA Testing Laboratory	from background ra ion within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), <i>i</i> (latest version), <i>i</i> This MTR su	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version approximation of the second presedes all previously of <i>General Samma</i> Barnard Division Mgr. of barnardJ@charterstd	g process radiation omer documents:), and EN 10025-2 S-235- ated MTRS for this order Quality Assurance etc.com
	REDUCTION RATH	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	Indistinguishable in ref the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A CASTM-A CASTM-A Tequirements of ASTM-A CASTM-A CASTM-A Tequirements of ASTM-A CASTMA CASTMA CASTMA Testing Laboratory	from background ra ion within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), <i>i</i> (latest version), <i>i</i> This MTR su	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version approximation of the second presedes all previously of <i>General Samma</i> Barnard Division Mgr. of barnardJ@charterstd	g process radiation omer documents:), and EN 10025-2 S-235- ated MTRS for this order Quality Assurance etc.com
	REDUCTION RATH	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	Indistinguishable in ref the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A CASTM-A CASTM-A Tequirements of ASTM-A CASTM-A CASTM-A Tequirements of ASTM-A CASTMA CASTMA CASTMA Testing Laboratory	from background ra ion within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), <i>i</i> (latest version), <i>i</i> This MTR su	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version approximation of the second presedes all previously of <i>General Samma</i> Barnard Division Mgr. of barnardJ@charterstd	g process radiation omer documents:), and EN 10025-2 S-235- ated MTRS for this order Quality Assurance etc.com
	REDUCTION RATH	Manufactured per Charter Steel Charter Steel certifies this produ detectors in place to measure fo Meets customer specifications w Customer Document = MPS-102C This material meets the chemistry	Indistinguishable in ref the presence of radiat vith any applicable Char Revision = G D requirements of ASTM-A CASTM-A CASTM-A Tequirements of ASTM-A CASTM-A CASTM-A Tequirements of ASTM-A CASTMA CASTMA CASTMA Testing Laboratory	from background ra ion within our proc ter Steel exception ated = 17-OCT-16 108 (latest version), <i>i</i> (latest version), <i>i</i> This MTR su	adiation levels by havin ess & products. s for the following cust ASTM A29 (latest version approximation of the second presedes all previously of <i>General Second</i> Barnard Division Mgr. of barnard J@charterste	g process radiation omer documents:), and EN 10025-2 S-235- ated MTRS for this order Quality Assurance etc.com

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

1. Except as noted, the steel supplied for this order was melted, rolled, and processed in the United States meeting DFARS

compliance, LEEDS compliance, REACH compliance, ROHS-WEEE compliance, and Conflict Materials Restrictions.

2. Mercury was not used during the manufacture of this product, nor was the steel contaminated with mercury during

processing.

3. Unless directed by the customer, there are no welds in any of the coils produced for this order.

4. The laboratory that generated the analytical or test results can be identified by the following key:

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

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

Test	Specifications	CSSM	CSSR/ CSSP	CSFP	CSCM/ CSCR
Chemistry Analysis	ASTM E415; ASTM E1019	X			X
Macroetch	ASTM E381	X			X
Hardenability (Jominy)	ASTM A255; SAE J406; JIS G0561	X			X
Grain Size	ASTM E112	X	X	Х	X
Tensile Test	ASTM E8; ASTM A370		X	X	X
Rockwelll Hardness	ASTM E18; ASTM A370	X	X	X	X
Microstructure (spheroidization)	ASTM A892		X	X	
Inclusion Content (Methods A, E)	ASTM E45		X		X
Decarburization	ASTM E1077		X	X	X

Charter Steel has been accredited to perform all of the above tests by the American Association for Laboratory Accreditation (A2LA). These accreditations expire 01/31/19. All other test results associated with a Charter Steel laboratory that appear on the front of this report, if any, were performed according to documented procedures developed by Charter Steel and are not accredited by A2LA.

The test results on the front of this report are the true values measured on the samples taken from the production lot. They do not apply to any other sample.

7. This test report cannot be reproduced or distributed except in full without the written permission of Charter Steel. The primary customer whose name and address appear on the front of this form may reproduce this test report subject to the following restrictions:

It may be distributed only to their customers

· Both sides of all pages must be reproduced in full

 This certification is given subject to the terms and conditions of sale provided in Charter Steel's acknowledgement (designated by our Sales Order number) to the customer's purchase order. Both order numbers appear on the front page of this Report.

Where the customer has provided a specification, the results on the front of this test report conform to that specification unless otherwise noted on this test report.



Page 2 of 2

MILL TEST REPORT Lot#: 1412295 Part#: 350006

BRIGHTON-BEST INTERNATIONAL INC. www.BrightonBest.com

This MTR contains 1 pages (Page: 1)

HANGZHOU SPRING WASHER CO.,LTD QUALITY TEST CERTIFICATE OF SPRING LOCK WASHER

Standard:A			9	Contr	act No. :	14	HZW115	85/12650	
rder No.:	PO	U23775		Invo	ice No.:		15SHI	0052	
Chemical Composition		С	Si	Mn	Р	S	Cr	Ni	Cu
(%)	1	0.65	0.2	0.55	0.01	0.004	0. 02	0.02	0.03
Material Typ	e.		65#		He	eat No.		T49000	9102
Specification	1		RE	GULAR HE	LICAL LO	OCK WASHE	R 3/4"	HDG	
Quantity			162	M					
Lot No.			1412	295		COL	INTRY OF	ORIGIN:C	HINA
Part No.	S		3500	006					
Testing Item	Ac/n	Norm	I	Result	Reject	Norm		Result	Reject
Inside Diameter	2/100	19. 33-19. 8	6 19.	6-19.86	0		-		
Outside Diameter	1/32	Max32, 93	Ма	x32. 27	0				
Width	1/32	Min6.04	Mi	in6. 04	0	1000	-		
Thickness	1/32	4.88-5.33	5.1	18-5.31	0				
Height									
Section									
Surface Defects	2/100	None	1	None	0				· ·
Hardness	0/8	HRC38-46	HR	C44-45	0				
Springing									
Toughness	0/8	Qualified	Qua	lified	0				
Zinc Coating	0/8	Min53um	Min	161. 6um	0				
Zinc Coating Stand									
Customer	Name:	BRI	GHTO	N BEST I	NTERNA	TIONAL	(TAIWA	N) INC.	
G	eneral:	The		lock wash ASME B 1		nformed w		andard	

Inspector: Shiweiqing

Quality Inspection Chief:

Date 2015.02.28

 $^{\prime}$

MILL TEST REPORT Lot#: 5106740003 Part#: 313200 BRIGHTON-BEST INTERNATIONAL INC.

This MTR contains 1 pages (Page: 1)

0

Certified Material Test Report to BS EN 10204-2004 3.1 FOR ASME SA194/ ASTM A194-14 GRADE 2H HVY HEX NUTS

FACTORY: ADDRESS: CUSTOMER QNTY SHIPI SAMPLE SIZ SIZE & DESC	XIJING CHINA : BRIGHT PED: ZE :	CON-BEST 153.000M ACC. TO	OTUO NIN TINTERNA APCS DASME I	ATIONAL 318.18.1	EJIANG 31		MFG LC F	DATE OF ORIGIN: OT NUMBER O NUMBER PART NO ACTURER D	: 510674000 : <u>MILL</u> : 313200	03
FINISH: H. T.			ASTM A153	-09/ASTM	F2329-13					
STEEL PROI STEEL GRA CHEMISTRY	DE:	SWRCH	<u>45K</u>	SIZE:	<u>30mm</u>			HEAT NO	: <u>331</u>	508880
CHEMIST	C%	Mn %	P %	S %	Si %	Cr %	Ni %	Cu %	Mo %	OTHERS
SPE:	MIN 0.40	MAX 1.00	MAX 0.04	MAX 0.05	MAX 0.40					
TEST:	0.44	0.7	0.012	0.003	0.18					
DIMENSION CHARACTE	RISTICS		TEST ME	THOD	SPECIFIC SPECI	FIED	ACTUAI	NSI B18.2 . RESULT	. 2 - 2010 ACC.	REJ.
PPEARAN	CE		ASTM	F812-12				SSED	100	0
VIDTH A/F			1.212"	-1.250"			-	"-1.249"	32	0
WIDTH A/C			1.382"	-1.443"			1.392	."-1.434"	32	õ
THREAD			ASME	B1.1-03			PA	SSED	8	0
IEIGHT			0.710"	-0.758"			0 735	"-0 752"	32	0

madini	0.710 -0.758		0.735"-0.752"	32	0
MARK	2HZN LM		PASSED	100	0
HDG THICKNISS AS	STM A153-09/ASTM]	F2329-13 min:43um	70UM-82UM	20	0
MECHANICAL PROPERTIES:	TO 1-1/2" in	SPECIFI	CATION: ASME SAIS	4/ ASTM A	194-14
CHARACTERISTICS	TEST METHOD	SPECIFIED	ACTUAL RESULT	ACC.	REJ.
******	****	******	****	*****	******
HARDNESS	ASTM E18-12	24-35HRC	HRC29-30	5	0
PROOF LOAD	ASTM F606-11	MIN58450LBF	58450LBF	5	0
HARDNESS AFTER 24H AT 54	10 ⁰ C ASTM A194 MIN	N 89 HRB	HRB 96-98	5	0
TEMPERING TEMPERATURE	Min455°C		PASSED(520°C)		

MACROETCHASTM E381-12S1/R1/C1~S4/R4/C4S2/R2/C25PARTS ARE MANUFACTURED AND TESTED IN ACCORDANCE WITH ASME SA194/ ASTM A194-14ALL TESTS IN ACCORDANCE WITH THE METHODSPRESCRIBED SPECIFICATION. WE CERTIFYTHAT THIS DATA IS A TRUE REPRESENTATION OF INFORMATION PROVIDED BY THE MATERIALSUPPLIER AND OUR TESTING LABORATORY.

All parts meet the requirements of FQA and records of compliance are on file. Maker's ISO#00109Q211593R0M/3302

(SIGN URE OF STAN MANURAD (1

C madden

<u>Certificate of Compliance</u>

	CUSTOM FAB	-
CUSTOMER PO #: MADDEN BOLT SO#:	QUADTEX 2148 103681	6
INDDEN DOLT 30#.	103081	
		F1554 GR 105
	HEX NUTS:	A194
	FLAT WASHER:	F436
	LOCK	
	WASHER:	
	COATING:	A153
	TEMPLATE:	
	OTHER:	
NOTES:		
NOTES:		
	·	
Madden Bolt certifies t	hat the above mater	tial is in compliance with the chemical and
Madden Bolt certifies t physical requirements of	hat the above mater of the ASTM or AIS	tial is in compliance with the chemical and
physical requirements of	hat the above mater of the ASTM or AIS	tial is in compliance with the chemical and
Madden Bolt certifies t physical requirements o Thank you,	hat the above mater of the ASTM or AIS	tial is in compliance with the chemical and
Thank you,	hat the above mater	tial is in compliance with the chemical and
physical requirements of	of the ASTM or AIS	rial is in compliance with the chemical and SI specifications.
Thank you, Authorized Signature:	hat the above mater of the ASTM or AIS Fames Dager	rial is in compliance with the chemical and SI specifications.
Thank you,	of the ASTM or AIS	rial is in compliance with the chemical and SI specifications.
Thank you, Authorized Signature:	of the ASTM or AIS	rial is in compliance with the chemical and SI specifications.
Thank you, Authorized Signature:	of the ASTM or AIS	rial is in compliance with the chemical and SI specifications.
Thank you, Authorized Signature:	of the ASTM or AIS	rial is in compliance with the chemical and SI specifications.
Thank you, Authorized Signature:	of the ASTM or AIS	rial is in compliance with the chemical and SI specifications.
Thank you, Authorized Signature:	of the ASTM or AIS	rial is in compliance with the chemical and SI specifications.

13420 Hempstead HWY I Houston, TX 77040 PH (713) 939-9999 FAX (713) 9397200

WWW.MADDENBOLT.COM

8	8	Cmadden
April 11, 2018		
Madden Bolt Co	orporation	
13420 Hempste		
Houston, TX 77		
RE: Galvanizatio	on Certificate of Compliance	ce
To Whom It May	y Concern:	
We certify that o	our Hot Dip process meets t	the requirements of ASTM A153 Specification on the
following order.		δi se
CUSTOMER: CU	JSTOM FAB.	
SALES ORDER:	103681	PURCHASE ORDER: QUADTEX 21486
	Ryl 1.g.	7
Approved By:	11111	
4	Roger Trejo	
13420 He	mpstead HWY ● Houston TX 7	77040 ● PH (713) 939-9999 ● FAX (713) 9397200

THREADE	PRODUCTS, IN	10 Cro Pelhar Tel (20	Threaded Pross Creek Trail n, AL 35124 05) 620-5100 05) 620-5150	JOB	IATERI	AL CE	RTIFIC	ATIO		
	Job No	: 567407		Jc	b Informa	tion	Certifi	ed Date:	3/22/18	
	Containers	S13658	914							
	Customer	Madden	Bolt Corp						13420 Hemps	tead Hwy
V	ulcan Part No:		-	D405		ex de la		Ship to:	13420 Hemps Houston, TX 7	7040
	omer Part No:									
	stomer PO No:			R 105			21.75			
	Order No:						Ship	oped Qty: 4		
	Note:							Line No: 3	3	
				Applic	able Specif	ications				
T	ype	a	ere of a some	Specificatio			Rev	Ame	od	Onti
	Traat			M F1554 Gd	105 S4		2015	Ame		Option
неа	t Treat	nin	where the second s	SA-193/SA- ASTM A193			2013			e actes dans
Qi	ality			.1		2016		· · · · · · · · · · · · · · · · · · ·		
Test Result	s			an a				* ************************************	e one - seconda esta anna	
See followin	g pages for tes	ts				1				
				Certifie	d Chemical	Analysis				
С	Heat I Mn	No: A181012 P	Lot: 1.152 S			Į		igin: USA		
0.400	0.77	0.012	0.022	Si 0.28	Cr 0.90	0.16	0.13	V 0.003	Cu 0.21	AI 0.025
Sn 0.009	Ti 0.001	N 0.0072	В	Ca	As	Sb	H, ppm	DI	RR	G.S.
Macro S	Macro R	Macro C	0.0002 J1	0.0007 J2	0.005 J3	0.003 J4	1.4 J5	4.50 J6	139.3:1 J7	8 J8
1 J9	1	2	56	56	56	56	56	53	52	50
49	J10 47	J12 44	J14 42	J16 40	J18 38	J20 37	J24 36	J28 33	J32 32	
	- disalatio transference alguna				Notes				32	
naterial. Melt	manufactured, te essed material is ed and Manufact n accordance wit	Quenched a ured in the L	and Tempered	- Stress Free.	No weld repa	ir performed of	n the material. N	No Mercury us	2:13 PM vulc.m	ction of thi
			<u>р</u> 1 <u>1</u> 51: 55:		loiz ulean	3 87		EVI	EW E //b/18	and the second se

b Materia	l Certific	cation					1			Pa	ige 12 o
Uä		Pelt Tel	can Threaded F Cross Creek Tr ham, AL 35124 (205) 620-510((205) 620-515	ail D			ЮВ	MATER	RIAL CE	RTIFICA	TION
	Job	No: 56740)7	Job	Inform	natio	n	Cer	tified Date:	3/22/18	
	Contain	ners: S136	58914								
Test Result	ts										
Part No: HF	RB B7 1.1	52x290 GR10)5				1	1999 - 1997 - 19			
Test No: 474	88 Test: 0	Quench & Tem	per Information	n (Lbs)			a de san 200 anno 10-3	a marina and			and the second sec
Description	n Aus	tenitizing Terr	np (F) 1	Cempering Temp	ng Temp (F) Run			(Ft/min)	Quench Water	Temp (F)	Note
		1,712		1,326				5	89		
Test No: 474	91 Test: F	F1554-105 FB	Requirements				62.0e0000046.000				
Description	Tensile	(ksi) (ksi)	Yield 0.2% Of	ffset (ksi) (ksi)	Elongat	ion	(%)	Elongation Gag	e Length (8in)	ROA (%)	Note
ni entre de la composición de la composic		131		118	1	7		8i	n	61	
Test No: 474	89 Test: /	A193 B7, F155	4-105 Require	ments		-					
Description	Tensile (ksi)	Yield 0.2% Offset (ksi)	Elongation (%)	Elongation Gage Length	ROA (%)		lradius dness	Surface Hardness	Center Hardness	Hardness Test Type	Note
	134	119	22	4D	64		29	28		HRC	
	135	119	21	4D	66		28	27		HRC	
	134 135	119	21	4D 4D	65		28 29	27		HRC	an a
Toot Net 474	a - tota manual	a sente contactore sono.	data and the states with	ale even construction to an discrimination of	des <u>a la pres</u> e de	inth	25	t dama 20	des ser an and	- Into	
Descriptio			t Temp (F)	t/lbs Requirements Test1 (ft/lbs)	Test) (ft)	lbs)	Test3 (ft/lbs)	Results A	vg (ft/lbs)	Note
Decomptio			-20	95		95		93		94	
	n — 3. Advanta					-		Mitchell - Ce	hill h		3/22/18 Date

https://www.plexonline.com/072e42ca-71e0-4cae-824c-4281b4d93dde/Sales/Report_Job_Cert.asp?Mode=... 4/6/2018

Purchaser:	BRIGHTON-BEST INTERNATIONAL (TAIWAN), INC.	Date:	2017-5-10	5				
P.O.NO: `	PO B17020241/U42733	ISO NO:	15/17Q5611R30					
INV NO:	217ZL046L	Expire:	14-Sep-18	14-Sep-18				
Manufacturer:	ZHEJIANG GUORUI CO., LTD.							
Address:	No.283 Chengxi North Road, Wuyuan Town, Haiyan Zhejia	ng,P.R.China						
Commodity:	F436 HARD ROUND STRUCTURAL FLAT WASHER WITH MFG'S I.D.&F436 ON FACE	CUSTOMER P	ART NO.:	355120				
Size:	1-1/8 X 2-1/4	MANUFACTU	RING DATE:	2017.3.15				
Lot NO .:	217L0321-19	HEAT NO .:	H1700015	0				
Ship quantity:	43.200 MPCS	MATERIAL:	45# CARE	BON STEEL				
Finish:	PLN		and the second second second second					

DIMENSIONAL INSPECTION ACCORDING TO: ASTM F436-11

INSPEC	CTION IT:	EM	SAMP	LE SIZE	SPEC	TIFIED	ACTUAL	RESULT	ACC	EPT	REJE
Apj	earance		1	00	ASTM	F436-11	O	C	1	00	0
М	arking		1	00	F436 A	ND JLX	OI	ζ	1	00	0
Ou	tside Dia		8		2.313	-2.187	2.200-2	2.199		8	0
In	ide Dia			8	1.251-1.188		1.238-1	1.236		8	0
Th	ickness			8	0.177	-0.136	0.142-0	0.140	1	8	0
CHEMICAL COM	POSITIO	NACCORI	MNG 10 :	ASTM I	430-11						
CHEMICAL ELEMENT (%)	C	Mn	P	S	Si	Cr	Мо	Ni	Al	Ti	v
SPECIFIED			0.040 MAX	0.050 MAX							

0.044

0.003

0.015

TITLE: QC MANAGER

0.59 MECHANICAL PROPERTIES ACCORDING TO: ASTM F436-11

0.46

TEST ITEM	SAMPLE SIZE	SPECIFIED	ACTUAL RESULT	ACCEPT	REJECT
HARDNESS(HR C)	8	38-45	40-42	8	0
			-		
				-1	

0.22

0.004

0.019

WE CERTIFY THAT THIS DATA IS A TRUE REPRESENTATION OF INFORMATION PROVIDED BY THE MATERIAL SUPPLIER AND OUR TESTING LABORATORY

Madd PO #: PES7	en Bolt Receiving	SIGNATURE:
Heat #: HI	7000150	1000 82
Lot #: 217	10321-19	1 1 m 1 m
Supplier: BR	IGHTON BEST	1
Size: 118	Grade: F434	1 11

17 2/14/18

HEMING

TEST RESULT

MILL TEST REPORT

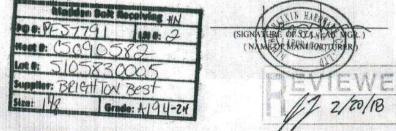
Part#: 313370

BRIGHTON-BEST INTERNATIONAL INC.

This MTR contains 1 pages (Page: 1)

Certified Material Test Report to BS EN 10204-2004 3.1 FOR ASME SA194/ ASTM A194-14 GRADE 2H HVY HEX NUTS

CUSTOME BRI		-BEST IN 2.160MPC	2011 21 10 10 10 10 10 10 10 10 10 10 10 10 10	NAL (TAI	WAN) IN	Ç	PC	NUMBER		
SAMPLE SIZE			ASME B18	. 18 . 1 - 1	1		MANUFA	CTURER D		6/2/25
SIZE & DESCR				-hell & hell and			Wir H VOI / I	er ontar b	2111. 20	(O) Li Led
FINISH:H.T.HO			1	-09/ASTM	F2329-13					
STEEL PROPER										
STEEL GRADE	4	15#		SIZE:	32mm			HEAT NO	: C5	090582
CHEMISTRY C	OMPOS	ITION:								And and a second
CHEMIST	%	Ma %	P %	S %	Si %	Cr %	Ni %	Cu %	Mo %	OTHER
SPE: N	IIN	MAX	MAX	MAX	MAX			1		
0	.40	1.00	0.04	0.05	0.40		Sec. 19	S. M. B.	1.1.1	1
TEST: 0	.45	0.58	0.017	0.007	0.24	-		Percent and	12.000	
THREAD HEIGHT MARK HDG THICKNIS MECHANICAL CHARACTERIS	PROPE TICS		ASM 1.079"- 2HZN 53-09/ASTM TO 1-1/2" TEST MET	I LM 1 F2329-13 in THOD	min:43un SPEC	SPECI IFIED	1.089" PAS	RESULT	8 32 100 20 ME A 194/ ACC.	REJ.
HARDNESS			ASTM	E18-12	24-35	IRC	HRC	29-30	5	0
PROOF LOAD	•		ASTM F	606-11	MIN133	525LBF	13352	25LBF	5	0
HARDNESS AF	TER 24	HAT 540	CASTMA	194 MIN 8	9 HRB		HRE	3 92-93	5	0
TEMPERING TH					al ships not the share.	()=		D(520°C)	and the second second	
MACROETCH			ASTM E38	1-12	S1/R1/CI	-S4/R4/C			5	0
PARTS ARE MA	NUFAC	TURED		and the second second second						
ALL TESTS IN	ACCOR	DANCE		METHODS	PRESCR	IBED SI	PECIFICATI	ION. WE C	ERTIFY	



	STEEL I	EL TEXAS MILL DRIVE X 78155-7		CERTIFIED MILL T For additional 830-372	copies o		are accurate and co	ertify that the test results presented here onform to the reported grade specification Tommy Territy TOMMY HEWITT
HEAT NO.:3077684			-				the state of the s	surance Manager
SECTION: ROUND 1.150 x 20'0" A36/5298 GRADE: ASTM A36-14/A529-14 Gr 50 ROLL DATE: 02/15/2018 MELT DATE: 02/08/2018 Cert. No.: 82330672 / 077684A738			S O L D T O	Madden Bolt Corp 13420 Hempstead Rd Houston TX US 77040-5813 7139399999 7139397200	S H I P T O	Madden Bolt Corp 13420 Hempstea Houston TX US 77040-5813 7139399999 7139397200		Delivery#: 82330672 BOL#: 72394800 CUST PO#: PE57851 CUST P/N: DLVRY LBS / HEAT: 4450.000 LB DLVRY PCS / HEAT: 63 EA
Characte	ristic	Value	_	Characteristi	e Valu	e	Cha	vacteristic Value
	С	0.18%		Reduction of Are	a test 1			
	Mn	0.82%		Yield to tensile rat				
	P	0.009%		Yield Strengt				
	S	0.024%		Tensile Strengt				
	Cu	0.18%		Elongatio				
	Cr	0.28%		Elongation Gage Lgt Reduction of Are				
	Ni	0.08%		Yield to tensile rat				
	Mo	0.024%		Tield to tensile rat	lo test2	0.09		
	v	0.015%						
	Cb	0.002%				0		
	Sn	0.009%		0	-1	5	The Following	is true of the material represented by this MTR:
	AI	0.002%		9E572 307	51	2	*Mate	erial is fully killed
Carbon Eq F	1554	0.33%		307	1684		*100	% melted and rolled in the USA
Carbon Eq A		0.40%				1		0204:2004 3.1 compliant tains no weld repair
Yield Strength to		53.9ksi		Cml			*Cont	tains no Mercury contamination
Tensile Strength t		77.9ksi				AN	*Man	ufactured in accordance with the latest version
Elongation t		25%		1.156120	-	: A34		ne plant quality manual
Elongation Gage Lgth to	est i	81N					"Mee	ts the "Buy America" requirements of 23 CFR635.41

.

1/1/3/9/18

REMARKS :

ALSO MEETS ASTM GRADE A36, A529-50, A572-50, A709-36, A709-50, A992, AASHTO M270-36, M270-50, CSA G40.21-04 44W, 50W

03/07/2018 22:59:36 Page 1 OF 1

2018-09-27

102

2010

		()				-	
MA	Q	ŬI	LA	С	E	R	O

MAQUILACERO, S.A. DE C.V.

Av. Adolfo López Mateos 1220, Col. Margarita Rdz Salazar, San Nicolas de Los Garza, N.L. Codigo Postal / Postal Code: 66479 Telefono / Phone number: +52(81)8158-0300 www.maquilacero.com CERTIFICADO DE CALIDAD - MILL TEST CERTIFICATE Fecta de emisión / Date of invoice) (DAN) 26-08 2017 14:47

Firma / (Signature)

Calidad / (Quality)

No. / (Document number)

Codigo de cliente / (Custamer ID) Cliente / (Custamer)	Factura / (Invoice Num.)
CME0025 TRIPLE-S STEEL SUPPLY	FAC/ 65261
Direction / (Address)	Pedido / (Sales Order)
6000 JENSEN DRIVE HOUSTON TX 77026 95-713-697-7105 Estados	700004977
Destinatario / (Consignated to) TRIPLE-5 STEEL SUPPLY 8411 IRVINGTON HOUSTON TX 77022 Estados Unidos	Orden de compra / (Purchase Order) HOU-177126

Datos generales / (General Data)

Part (Item)	Descripcion / (Description)	Cantidad Quantity		No. Lote (Lot Number)	Colada (Heat)	ASTM		posici mical (-	1	Prueba de ten (Tensile te			
							с	Min	Р	S		Resistencia a la Tension (Tensile Strength) ksi	%Elong.	Dureza (Rockwell Hardness
PRE1501500740N	PTR1.50x1.50, C-3/16, 40' HELEN SQURE TIBINS NON ALLOY" STEEL 1.5"" X 1.5"" 3/16 GA 4	14.4000	CFT		1730631	A-500 GRADE B & C	0.083	0.390	0.007	0.002	60.0000	64.0000	24.0000	75.0000
PRE40030031240N	STEEL 1.3" X 1.3" S/16 GA 4 PTR4x3C-5/16 ,40' WEIGED SQUARE TUBING NON ALLOYT STEEL 4" X 3" 5/16 GA, 40'	6.4000	CFT	PT1222	1711482	A-500 GRADE B & C	0.082	0.420	0.018	0.002	70.0000	79.0000	25.0000	74.0000

Proveedor de acero.

We certify that the above described material satisfies the required specifications. The chemical composition is transcription from the mill test certificate. of the steel supplier.

NOTE: NINGUN PRODUCTO HA SIDO PROBADO HIDROSTATICAMENTE. NONE OF THIS PRODUCTS HAVE BEEN HYDROSTATICALLY TESTED, NO WELD REPAIR WAS MADE IN ALL THIS ITEMS.

MAQUILACERO, S. A. DE C. V. AV. ADOLFO LOPEZ MÁTEOS No. 1220 R.F.C. MAQ-860203-MX5

Sold By: INDEPENDENCE TUBE CORPORATION 6226 W. 74th St. Chicago, IL 60638 Tel: 708-496-0380 Fax: 708-563-1950			Ch	226 W. 74th licago, IL 60 708-496-038 x: 708-563-	638 30		www.independencetube.com itctube.com Certificate Number: CHI 74324				
			S E I	Purchase Order No: 7253396 Sales Order No: CHI 280303 - Bill of Lading No: CHI 167448 Invoice No:				- 13			
Sold To: 1430 - KLOECKNI 500 COLONIAL P/ SUITE 500 ROSWELL, GA 30	ARKWAY	ORPORATION	i t	Ship To: 4 - KLOECKNER METALS-N 14806 W RIDGE LANE 563-583-7329 DUBUQUE, IA 52003							
CERTIFICATI		SIS and TE	STS				Cer	Test Da	lo: CHI 74 te: 3/19/2	018	
TUBING A500 GR 5" X 4" X 3/8" X 3/								Total Pi	eces 7 4	otal Weight 2,378	
Bundle Tag Mill 4680 4N	Heat 281552	Specs YLD=67405/T	EN=733	66/ELG=2	7.66		T Ratio 9187	Pieces		eight ,378	
Mill #: 4N Heat #:	281552 Carbor	1 Eq: 0.3098 F	eat Src	Origin: ME	LTED AN	ID MANUF	ACTURE	D IN THE	USA		
C Mn 0.2000 0.5300	P S 0.0090 0.00	050 0.0200	AI 0.0370	Cu 0.0940	Cr 0.0460	Mo 0.0150	V 0.0020	Ni 0.0390	Nb 0.0020	Cb 0.0020	
Sn N 0.0040 0.0070 LEED Information	B T 0.0000 0.00	030 0.0010	0 0.0000	H 0.0000	the produ	icina mill)					
Method		ation		cycled Cor			Consumer	3.2%	Post Ind	ustrial 52.9%	
Corporation. Swort WE PROUDLY MA INDEPENDENCE AND INSPECTED MATERIAL IDENT ASTM A500 GRAE CURRENT STANE A252-10	NUFACTURE A TUBE PRODUC IN ACCORDAN IFIED AS A500 DE B AND A500	ALL OUR PROE T IS MANUFAG ICE WITH ASTI GRADE B(C) M	CTURED A STANI IEETS B), TESTED DARDS. OTH		- 1474	C			Q CMQ/OE Supervisor	
A500/A500M-13 A513-13 ASTM A53/A53M- A847/A847M-14 A1085/A1085M-15		3/SA-53M-13		<u> </u>							
				Page - 1	1						



Vulcan Threaded Products 10 Cross Creek Trail Pelham, AL 35124 Tel (205) 620-5100 Fax (205) 620-5150

Material Certification

.....

	Triple-S Steel	
	Houston	
Customer PO No:	HOU-178081	
Vulcan Order No:	332140	
Order Line:	•	
Shipped Qty:		_
	CDR 1018 .375x240 DOM	-
	CDR 1018 .375x240 DOM	
Customer Part Description:	r	
Reference No:		
Country of Origin:	USA	
Rolled Mill:	Gerdau Ameristeel - Beaumont, TX	
Melted Mill:	Gerdau Ameristeel - Beaumont, TX	
Grade:	1018	-
Heat:	53147048/03	
Note:	7/16	
Spec No:	AISI 1018	
Spec Note:		·
Spec No:	ASTM A108-13	
Spec Note:		
Material Specification Type	Material Specification	Actual
Chemistry	Carbon (C)	0.1640 %
	Manganese (Mn)	0.62 %
	Phosphorus (P)	0.011 %
	Sulfur (S)	0.014 %
	Silicon (Si)	0.22 %
	Copper (Cu)	0.20 %
	Nickel (Ni)	0.08 %
	Chromium (Cr)	0.10 %
	Molybdenum (Mo)	0.019 %
	Tin (Sn)	0.008 %
	Nitrogen (N)	0.0095 %
This document certifies that t No mercury, lead, radium, of alpha con were performed on this material.	he foregoing data is furnished by the pro ntaining material or equipment is used or deliberately	oducing mill and test lab.

Plex 11/10/17 9:36 AM vulc.roal Page 1

I.

This page intentionally left blank.

APPENIDX C. MASH TEST 5-11 (CRASH TEST NO. 609591-03-1)

C1 VEHICLE PROPERTIES AND INFORMATION

Table C.1. Vehicle Properties for Test No. 609591-03-1.

Date:	20	18-06-28	Test No.:	609591	1-03-1	VIN No.:	1C6RR6	FT1DS71	2245				
Year:		2013	Make:	RA	М	Model:		1500					
Tire Siz	e:	265/70 R	17		Tire In	flation Pre	ssure: 35 P	SI					
Tread T	ype:	HIGHWAY	(Odor	meter: 2363	392					
Note an	Note any damage to the vehicle prior to test: NONE												
Depe	Denotes accelerometer location.												
	_	celefonietei	ocation.			17)					
NOTES				- I Î		711 T			t I				
Engine	Type:	V-8		A M	ei	+- ((••<	_+		- N T				
Engine		4.7 L				ALL		_	WHEEL TRACK				
Transm		Туре:				1.20	-TES	T INERTIAL C. M.					
	Auto FWD	or 🔽	_ Manual ☐ 4WD		R PQ								
Optiona	l Equi			Ρ		11	$ \mathcal{D} _{-}$		1				
NON		oniona.		1 -	_5				B				
Dummy	Data:			ĬJ−I1	FLG)^++	¶ , † ₩• -4	P	TK L				
Type: Mass:		165 LB			- F	н	L _g L _v L _s						
Seat P	Position					-	- E	•	1				
Geome	try:	inches			Ť	M FRONT	6	T M REAR					
Α	78	.50 F	40.00	к	20.00	Р	3.00	U	27.50				
в		.00 G	29.00	L	30.00	Q	30.50	V	30.50				
с	227		60.98	M	68.50	R	18.00	w	60.98				
D		.00	11.75	N	68.00	s	13.00	х	77.00				
E	140 eel Cent		27.00	0 Wheel Well	46.00	т	77.00 Bottom Fram						
	eer Cen		14.75 Cle	Wheel Well arance (Front)		6.00	Height - From		12.00				
	eel Cent eight Re		14.75 Cle	Wheel Well arance (Rear)		9.25	Bottom Fram Height - Rea		25.50				
	-		±13 inches; E=148 ±1	, ,	inches; G = > 28 i	nches; H = 63 ±4			5 inches				
GVWR	Ratir	\$	Mass: Ib	Cu		Test	Inertial	Gross	Static				
Front		3700	M _{front}		2908		2832		2917				
Back		3900	M _{rear}		2044		2172		2252				
Total		6700	M _{Total}		4952	Range for TIM on	5004 d GSM = 5000 lb ±110	0.16)	5169				
Mass D	istrib		1.000										
lb		LF	1400	RF:	1432	LR:	1085	RR: 1	087				

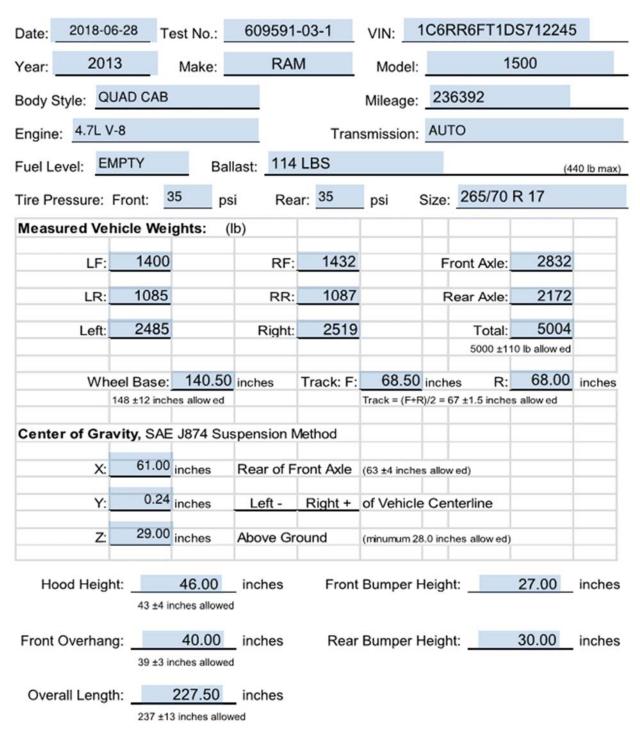


Table C.2. Measurements of Vehicle Vertical CG for Test No. 609591-03-1.

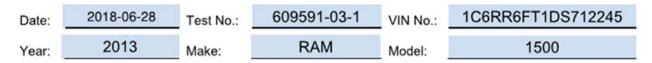
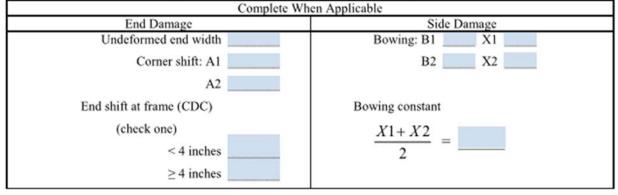


Table C.3. Exterior Crush Measurements for Test No. 609591-03-1.

VEHICLE CRUSH MEASUREMENT SHEET



Note: Measure C1 to C6 from Driver to Passenger Side in Front or Rear impacts - Rear to Front in Side Impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage									
		Width** (CDC)	Max*** Crush	Field L**	C ₁	C2	C3	C4	C ₅	C ₆	±D
1	AT FT BUMPER	24	10	36	1	3	5	6	8	10	+18
2	ABOVE FT BUMPER	24	11	48	1	3	5	7	8	11	+76
	inches										

¹Table taken from National Accident Sampling System (NASS).

*Identify the plane at which the C-measurements are taken (e.g., at bumper, above bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

**Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle).

***Measure and document on the vehicle diagram the location of the maximum crush.

Note: Use as many lines/columns as necessary to describe each damage profile.

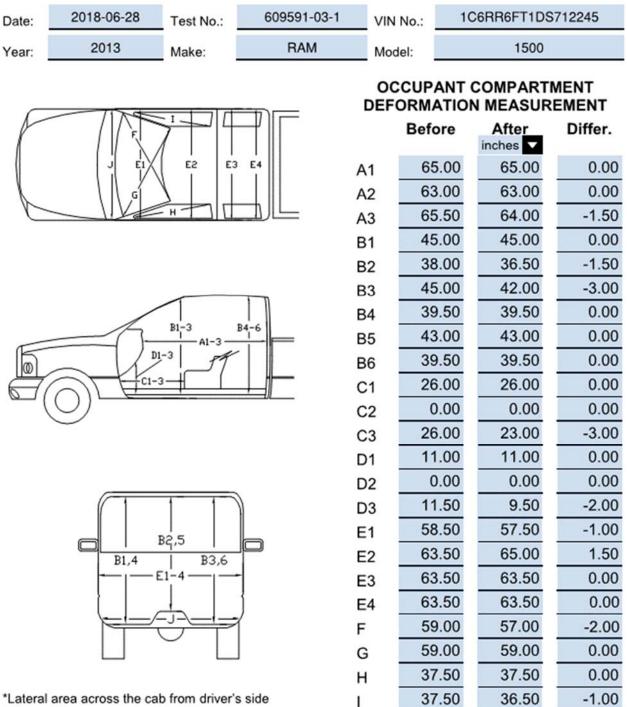


Table C.4. Occupant Compartment Measurements for Test No. 609591-03-1.

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

-3.00

J*

25.00

22.00

C2 SEQUENTIAL PHOTOGRAPHS















Figure C.1. Sequential Photographs for Test No. 609591-03-1 (Overhead and Gut Views).

0.100 s

0.200 s



















Figure C.1. Sequential Photographs for Test No. 609591-03-1 (Overhead and Gut Views) (Continued).

0.600 s





0.000 s



0.200 s



0.100 s



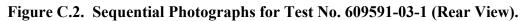
0.300 s



0.500 s



0.700 s







0.600 s

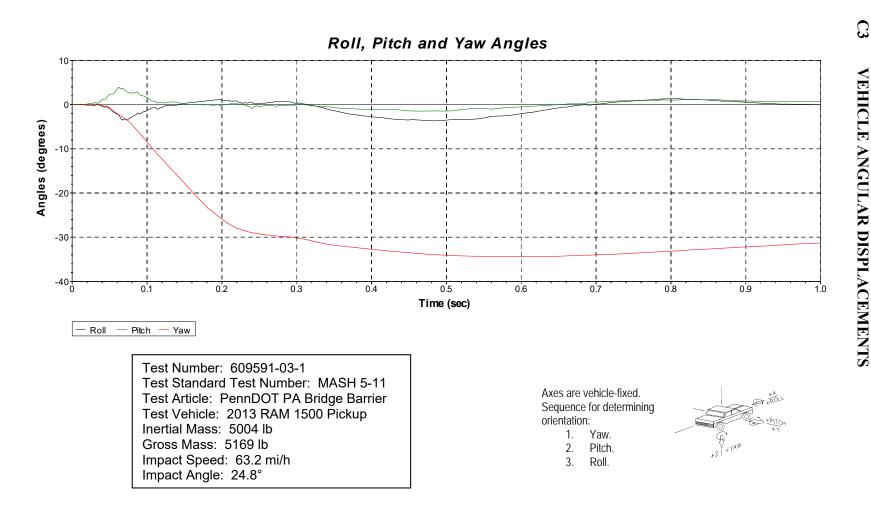


Figure C.3. Vehicle Angular Displacements for Test No. 609591-03-1.

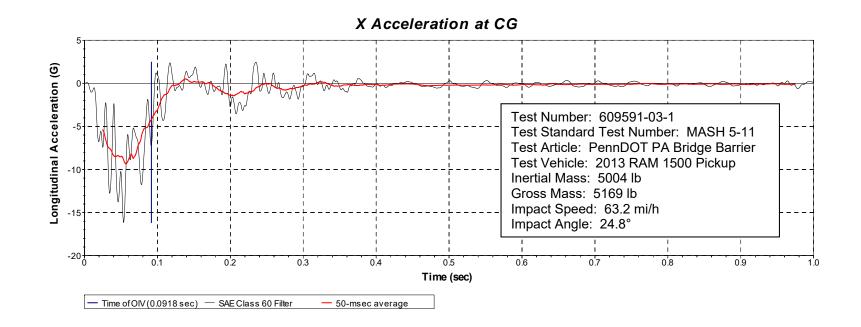
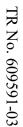


Figure C.4. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-1 (Accelerometer Located at Center of Gravity).



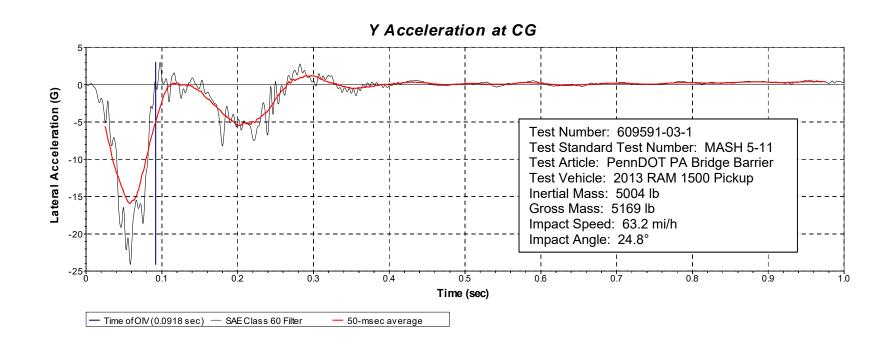
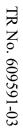


Figure C.5. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-1 (Accelerometer Located at Center of Gravity).



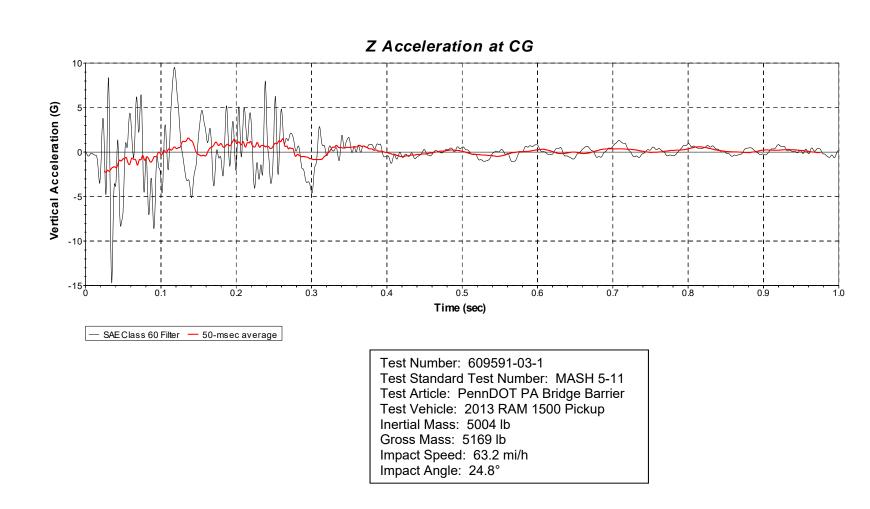


Figure C.6. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-1 (Accelerometer Located at Center of Gravity).

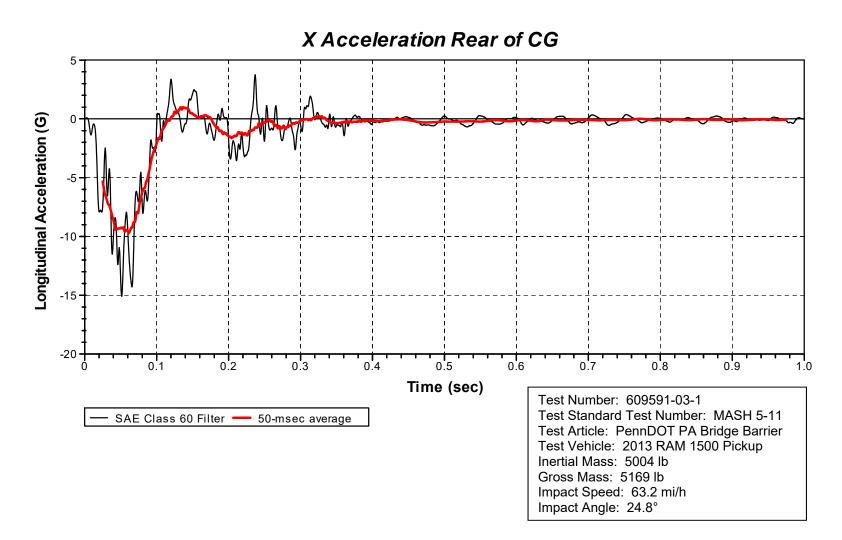
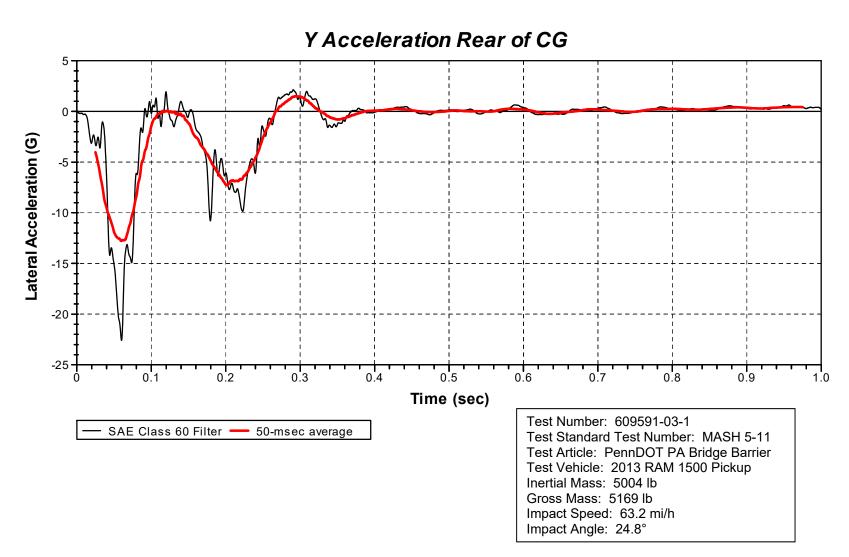


Figure C.7. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-1 (Accelerometer Located Rear of Center of Gravity).



119

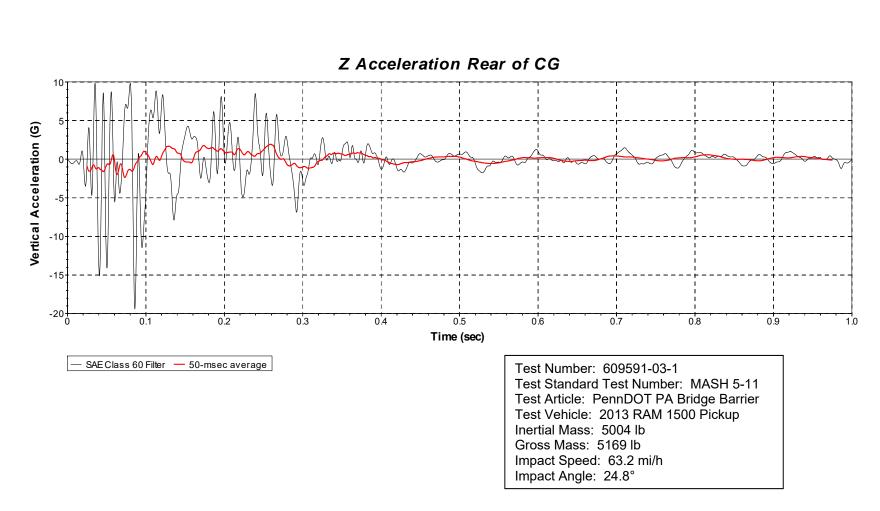


Figure C.8. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-1 (Accelerometer Located Rear of Center of Gravity).

Figure C.9. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-1 (Accelerometer Located Rear of Center of Gravity).

APPENIDX D. MASH TEST 5-10 (CRASH TEST NO. 609591-03-2)

D1 VEHICLE PROPERTIES AND INFORMATION

1331 Vehicle Inventory Number: 609591-03-02 2018-06-26 Test No.: KNADH4A3XB6926848 Date: VIN No.: 2011 KIA RIO Year: Make: Model: Odometer: 154005 Tire Inflation Pressure: 32 PSI Tire Size: 185/65R14 None Describe any damage to the vehicle prior to test: Denotes accelerometer location. NOTES: None 4 cylinder Engine Type: Engine CID: 1.6 L Transmission Type: -0-Auto or Manual FWD RWD 4WD Optional Equipment: None Dummy Data: - G ĸ 50th percentile male Type: u 165 LBS Mass: IMPACT SIDE Seat Position: Geometry: inches 66.38 33.00 12.25 14.50 A F κ Ρ 4.12 U 51.50 25.25 22.50 19.75 В G Q V L 165.75 35.90 57.75 15.50 35.90 С н М R w 100.65 34.00 7.75 57.70 8.25 D L Ν s Х Е 98.75 21.50 28.25 т 66.20 0 J 11.00 11.00 0.00 Wheel Center Ht Front Wheel Center Ht Rear W-H RANGE LIMIT: A = 65 ±3 inches; C = 168 ±8 inches; E = 98 ±5 inches; F = 35 ±4 inches; G = 39 ±4 inches; O = TOP OF RADIATOR M+N/2 = 56 ±2 inches; W-H < 2 inches or use MASH Paragraph A4.3.2 /24 ±4 inchec) GVWR Ratings: Mass: lb Curb Test Inertial Gross Static 1544 1629 Front 1718 M_{front} 1572 1874 885 883 963 Back M_{rear} 3638 2457 2427 2592 Total M_{Total} Allowable TIM = 2420 lb ±55 lb | Allowable GSM = 2585 lb ± 55 lb Mass Distribution: 773 449 434 LF: RF: 771 LR: RR: lb

Table D.1. Vehicle Properties for Test No. 609591-03-2.

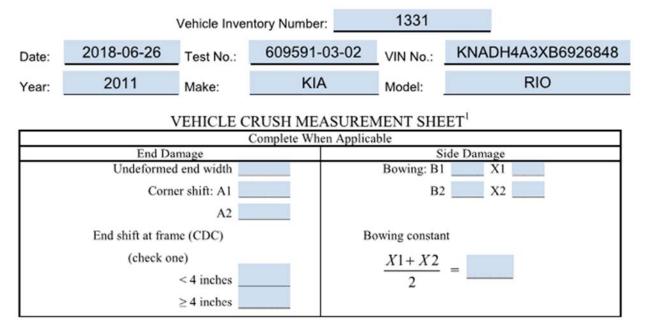


Table D.2. Exterior Crush Measurements for Test No. 609591-03-2.

Note: Measure C1 to C6 from Driver to Passenger Side in Front or Rear impacts - Rear to Front in Side Impacts.

Specific Impact Number	Plane* of C-Measurements	Direct I	amage	Field L**	C1	C2	C3	C4	Cs	C.	±D
		Width** (CDC)	Max*** Crush								
1	AT FT BUMPER	14	6	16	6	4	1				+16
2	ABOVE FT BUMPER	14	6	30	1	3			5	6	+59
	Units in inches										

¹Table taken from National Accident Sampling System (NASS).

*Identify the plane at which the C-measurements are taken (e.g., at bumper, above bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

**Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle).

***Measure and document on the vehicle diagram the location of the maximum crush.

Note: Use as many lines/columns as necessary to describe each damage profile.

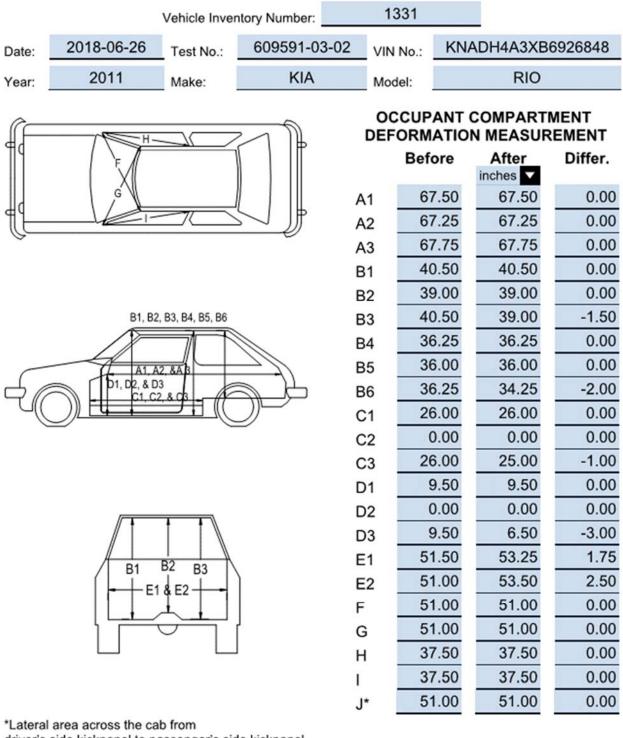


Table D.3. Occ	upant Compartment	Measurements for	Test No. 6095	91-03-2.
----------------	-------------------	------------------	---------------	----------

D2 SEQUENTIAL PHOTOGRAPHS















Figure D.1. Sequential Photographs for Test No. 609591-03-2 (Overhead and Gut Views).

0.100 s

0.200 s

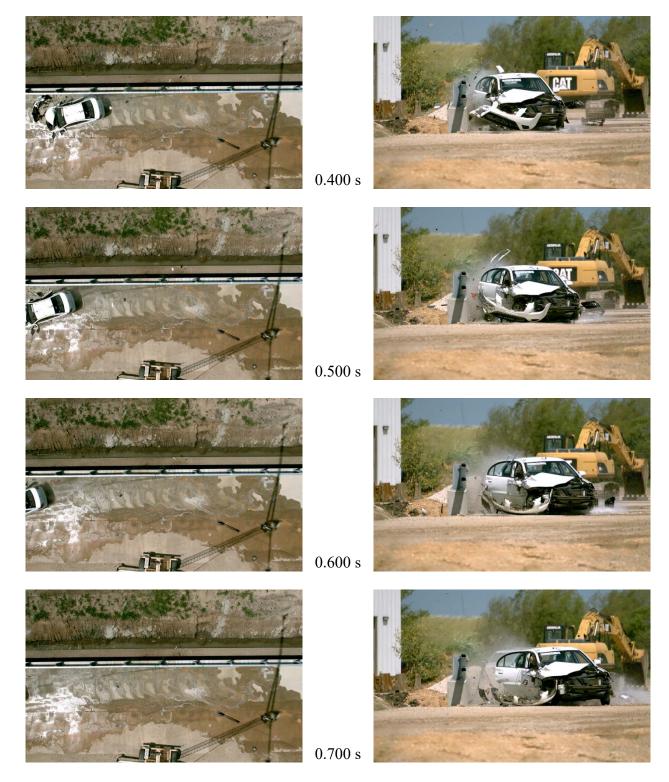


Figure C.1. Sequential Photographs for Test No. 609591-03-2 (Overhead and Gut Views) (Continued).





0.200 s



0.100 s



0.300 s



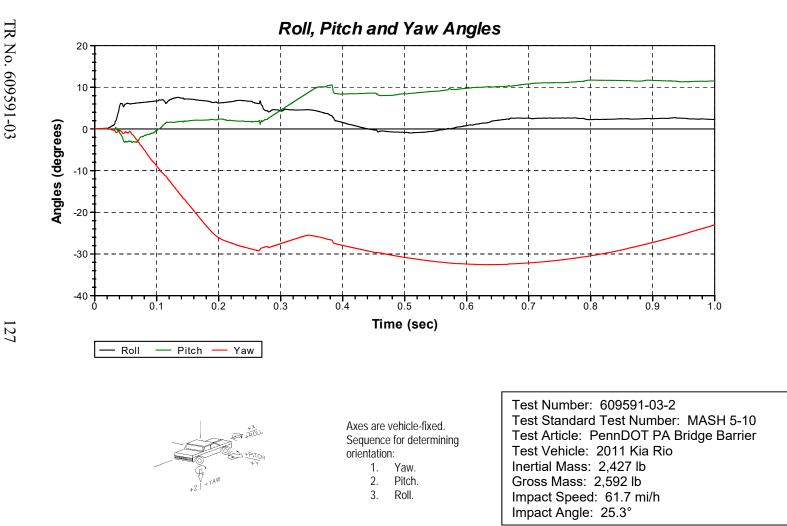
0.500 s



0.600 s

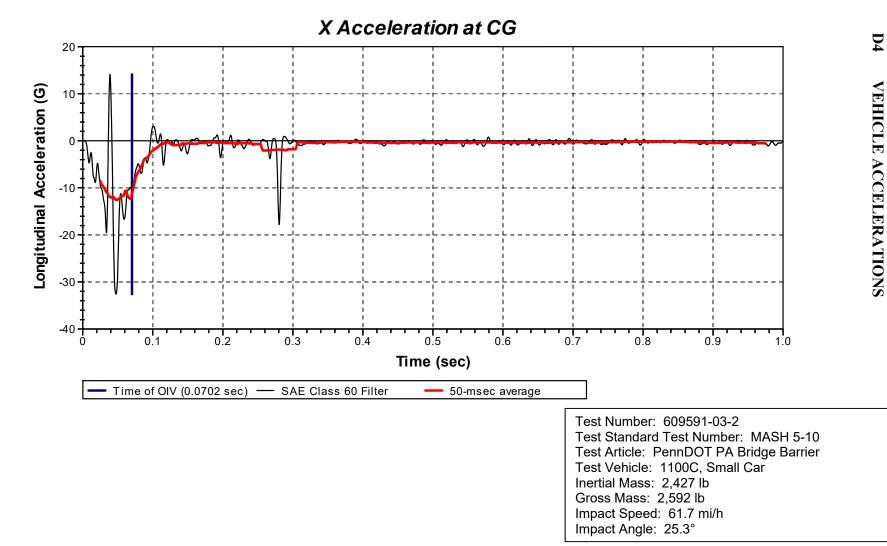
0.700 s

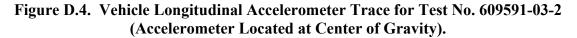
Figure D.2. Sequential Photographs for Test No. 609591-03-2 (Rear View).



2018-09-27

Figure D.3. Vehicle Angular Displacements for Test No. 609591-03-2.





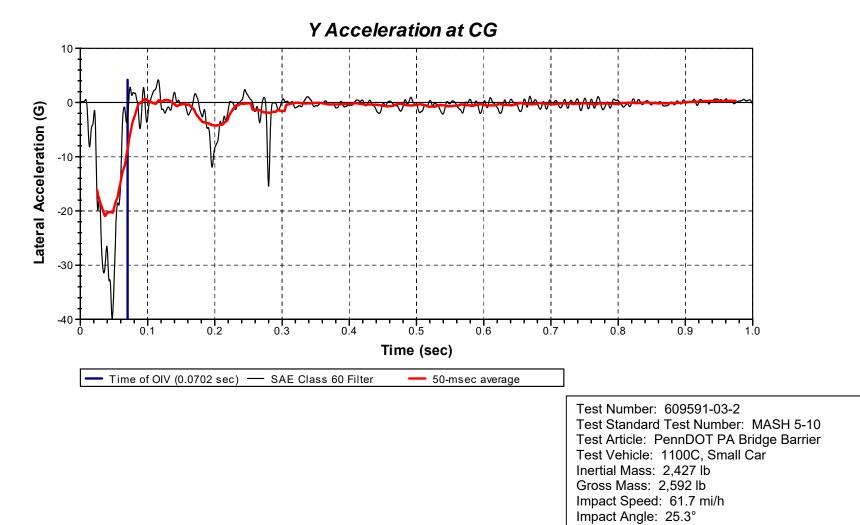


Figure D.5. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-2 (Accelerometer Located at Center of Gravity).

129

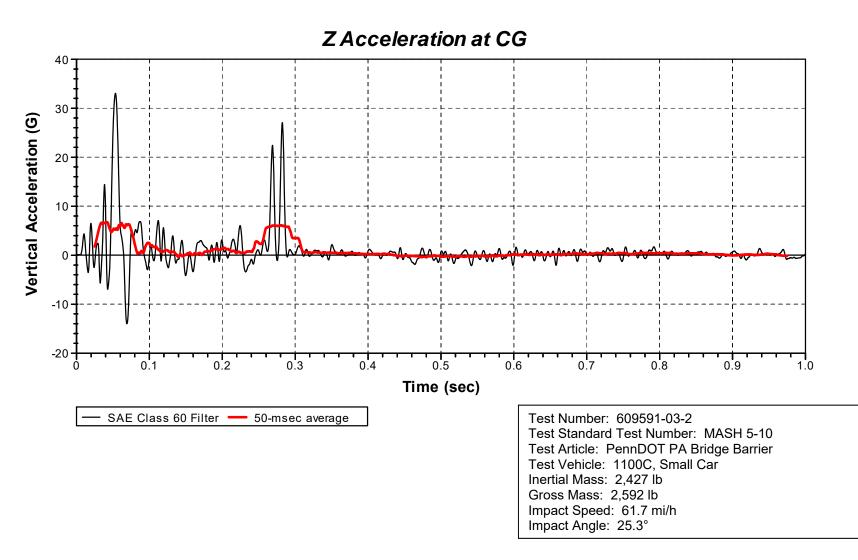


Figure D.6. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-2 (Accelerometer Located at Center of Gravity).

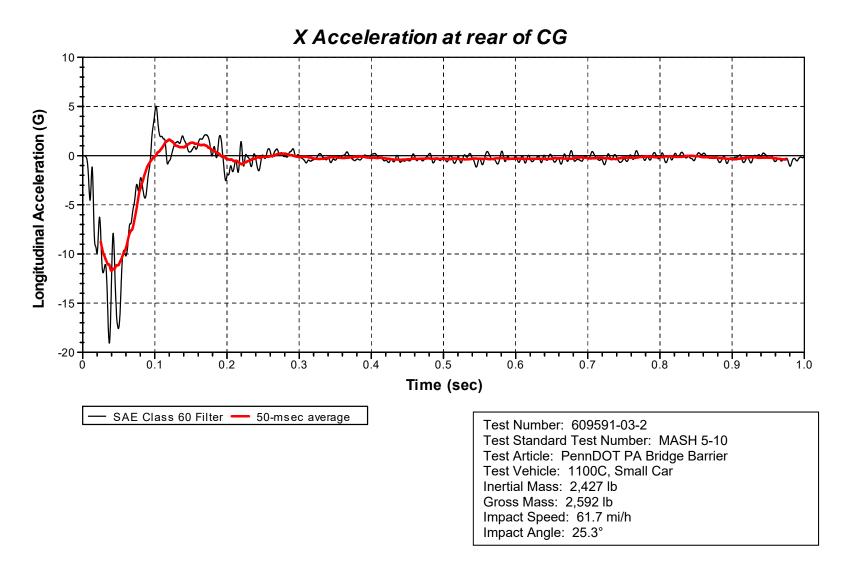


Figure D.7. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-2 (Accelerometer Located Rear of Center of Gravity).

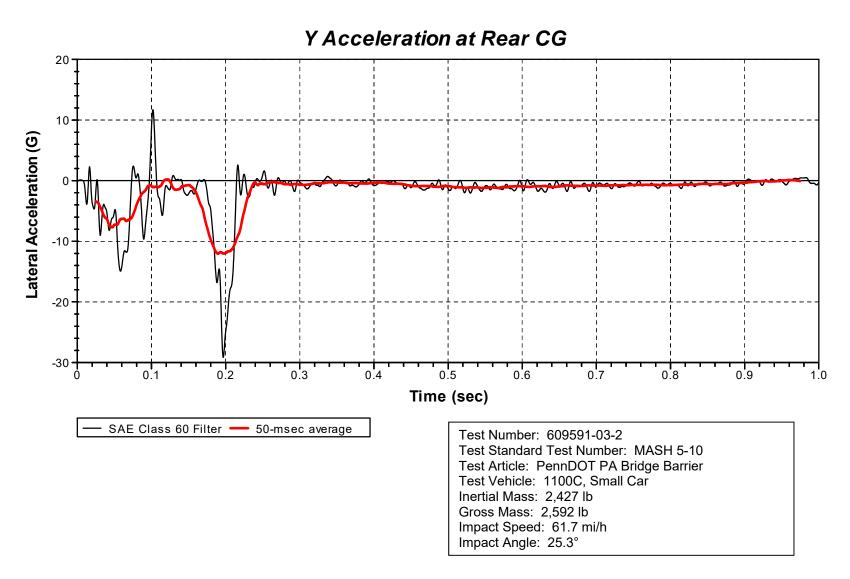
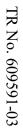


Figure D.8. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-2 (Accelerometer Located Rear of Center of Gravity).



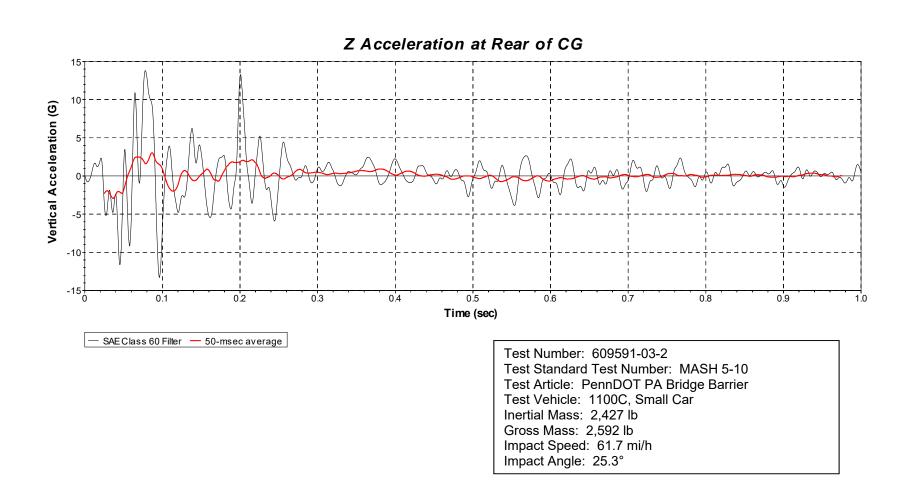


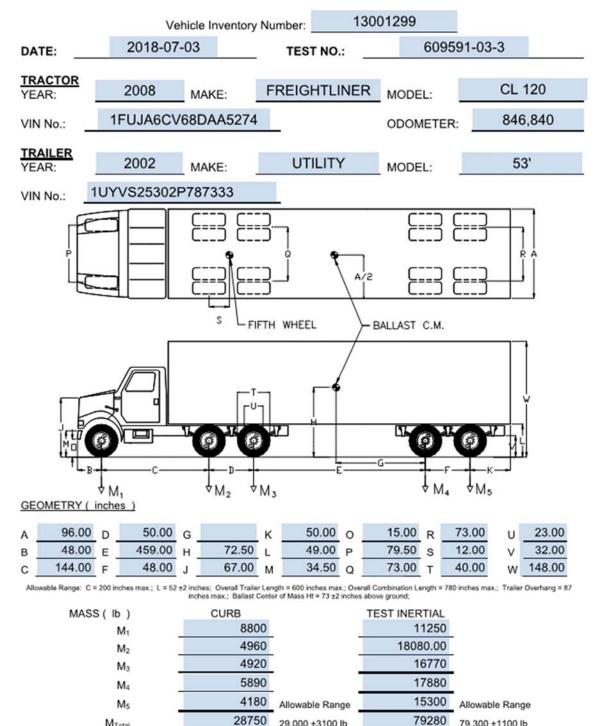
Figure D.9. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-2 (Accelerometer Located Rear of Center of Gravity).

This page intentionally left blank.

APPENIDX E. MASH TEST 5-12 (CRASH TEST NO. 609591-03-3)

E1 VEHICLE PROPERTIES AND INFORMATION

Table E.1. Vehicle Properties for Test No. 609591-03-3.



MTotal

79,300 ±1100 lb

29,000 ±3100 lb

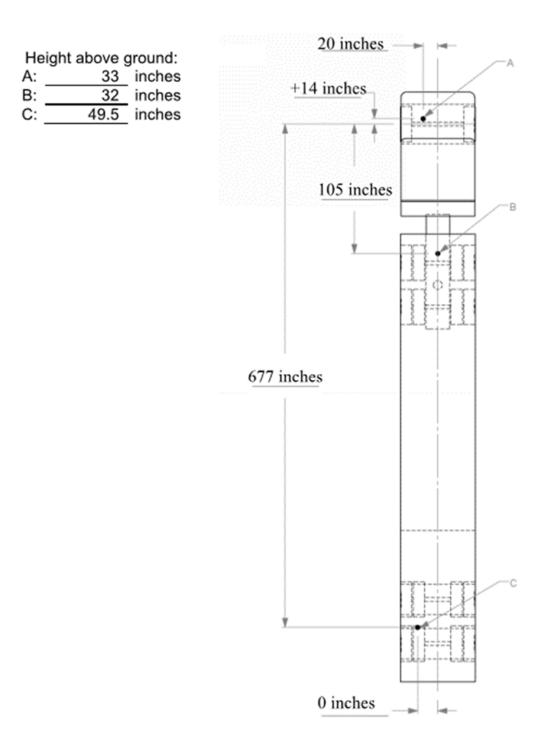


Figure E.1. Location of Accelerometers and Rate Transducers.

E2 **SEQUENTIAL PHOTOGRAPHS**















Figure E.2. Sequential Photographs for Test No. 609591-03-3 (Overhead and Gut Views).



















Figure E.2. Sequential Photographs for Test No. 609591-03-3 (Overhead and Gut Views) (Continued).

0.925 s



0.000 s



0.370 s



0.740 s



1.110 s

Figure E.3. Sequential Photographs for Test No. 609591-03-3 (Rear View).



0.185 s



0.555 s



0.925 s



1.295 s

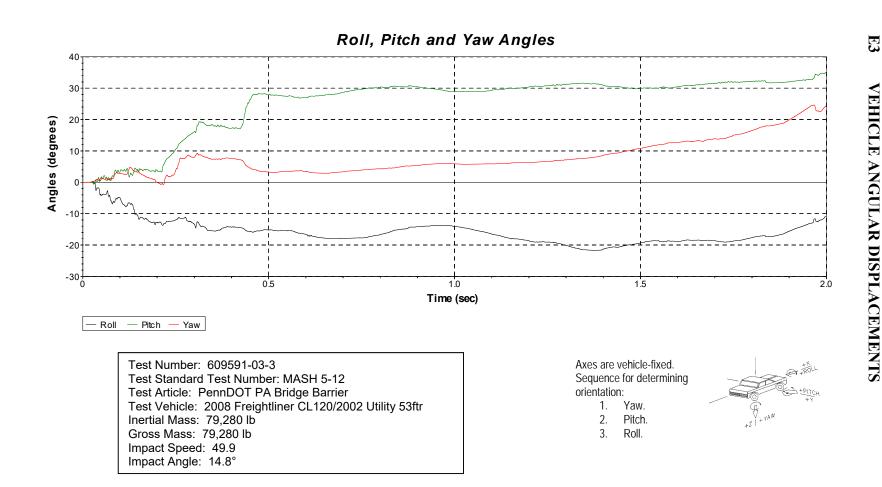


Figure E.4. Vehicle Angular Displacements for Test No. 609591-03-3. (Accelerometer Located at Fifth Wheel)



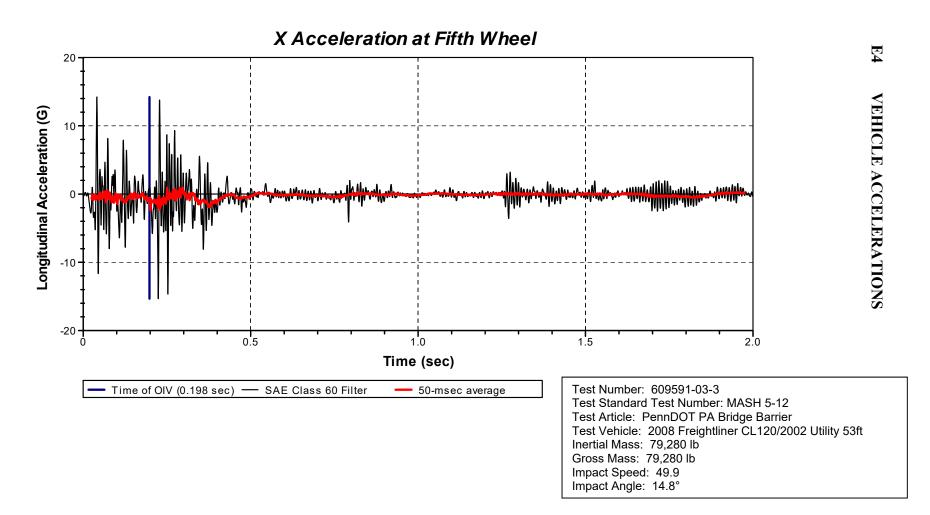


Figure E.5. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-3 (Accelerometer Located at Fifth Wheel).

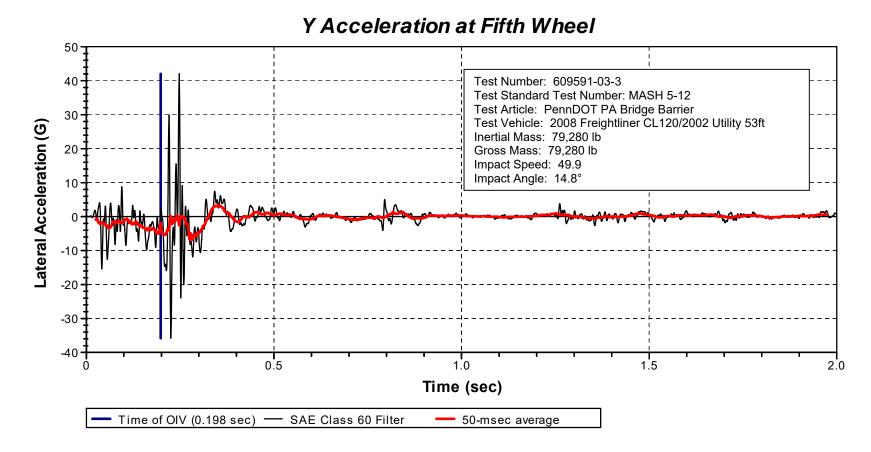


Figure E.6. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-3 (Accelerometer Located at Fifth Wheel).

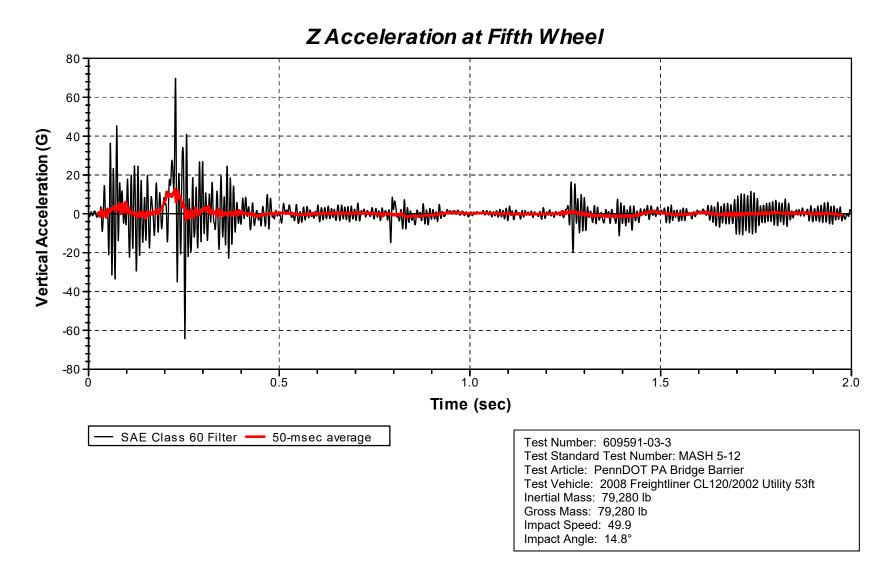


Figure E.7. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-3 (Accelerometer Located at Fifth Wheel).

143

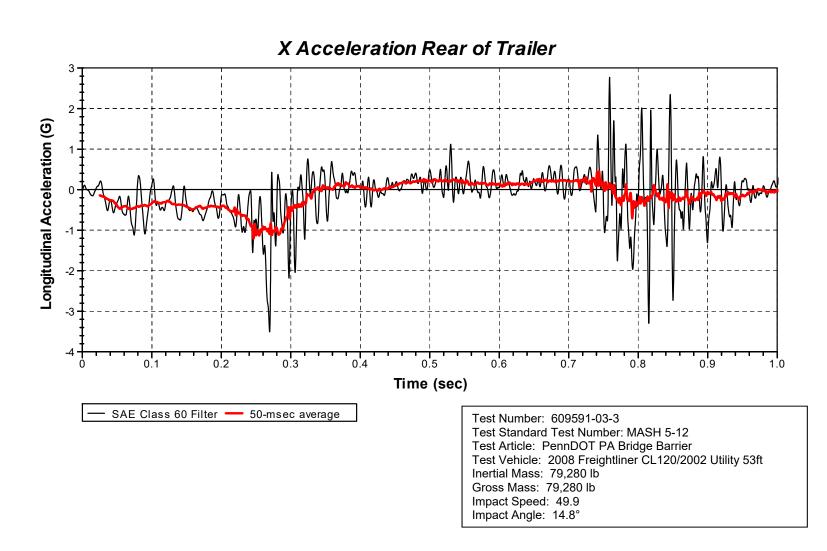


Figure E.8. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-3 (Accelerometer Located Rear of Trailer).

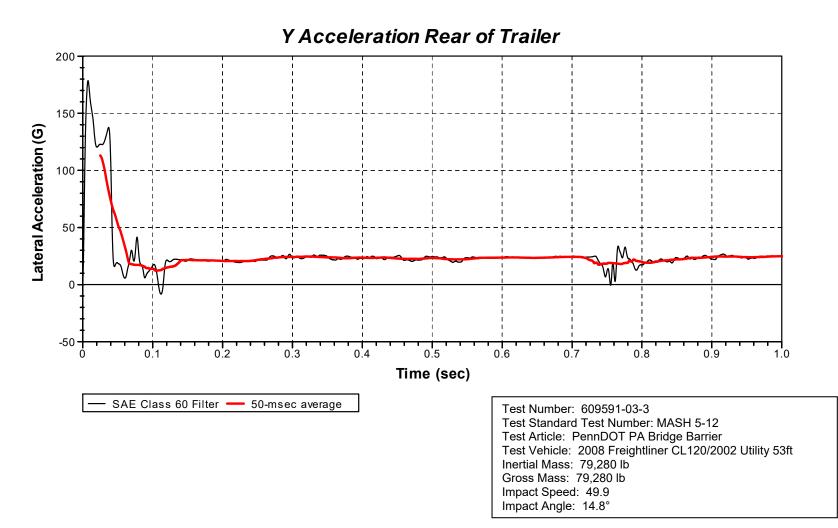


Figure E.9. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-3 (Accelerometer Located Rear of Trailer).

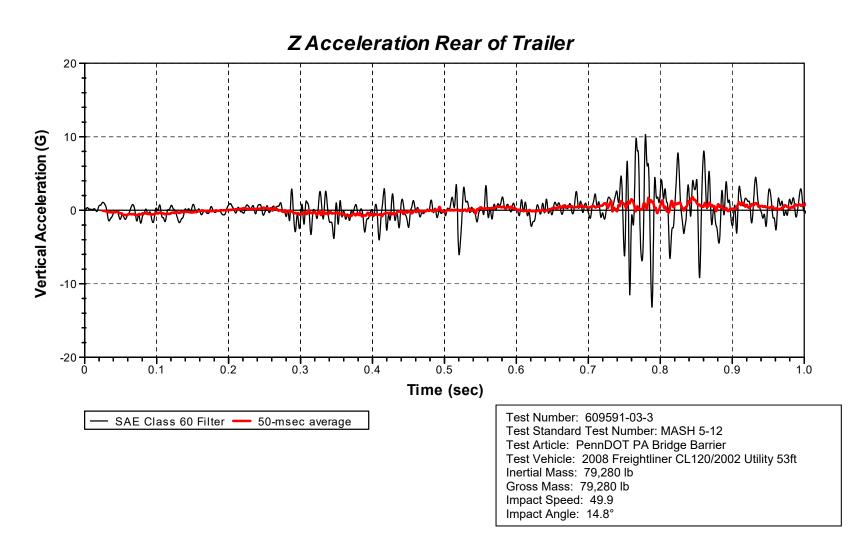


Figure E.10. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-3 (Accelerometer Located Rear of Trailer)

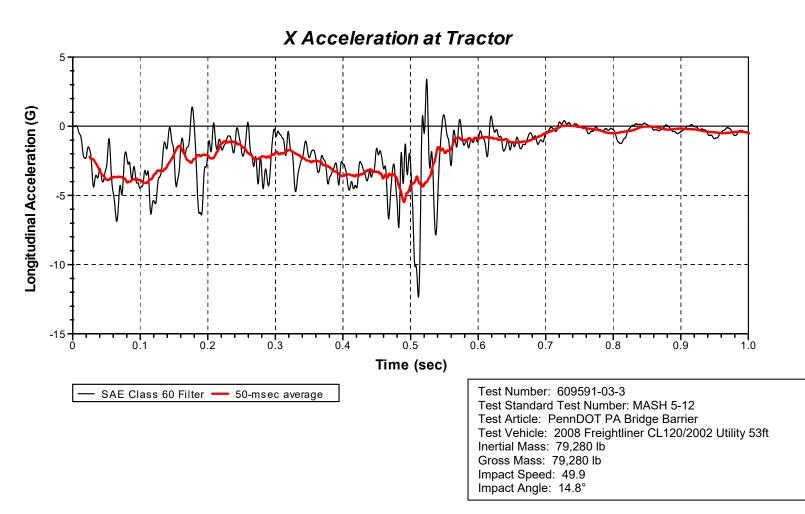


Figure E.11. Vehicle Longitudinal Accelerometer Trace for Test No. 609591-03-3 (Accelerometer Located at Tractor).

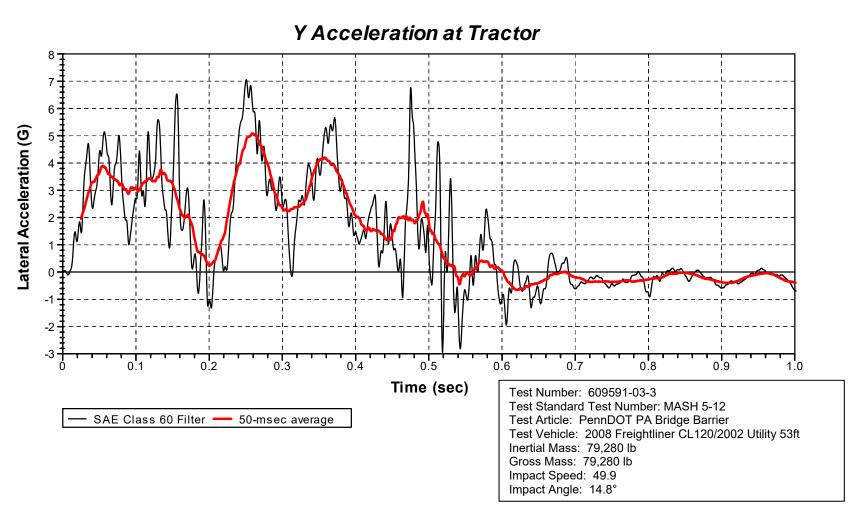


Figure E.12. Vehicle Lateral Accelerometer Trace for Test No. 609591-03-3 (Accelerometer Located at Tractor).

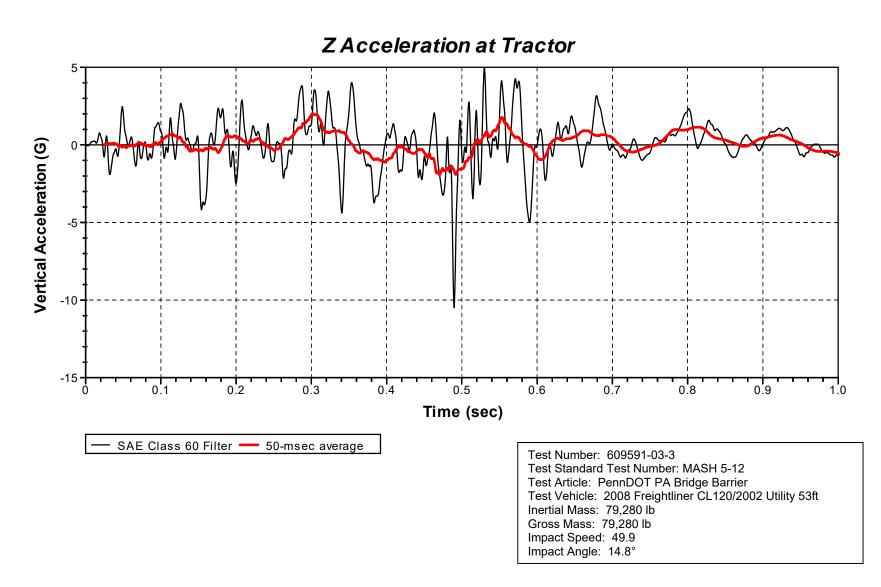


Figure E.13. Vehicle Vertical Accelerometer Trace for Test No. 609591-03-3 (Accelerometer Located at Tractor)

	SI* (MODER	N METRIC) CON	VERSION FACTORS	
	APPRO	XIMATE CONVERSTI	ONS TO SI UNITS	
Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in ²	square inches	645.2	square millimeters	mm ²
ft ²	square feet	0.093	square meters	m²
yd²	square yards	0.836	square meters	m²
ac	acres	0.405	hectares	ha
mi ²	square miles	2.59	square kilometers	km ²
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft ³	cubic feet	0.028	cubic meters	m ³
yd ³	cubic yards	0.765	cubic meters	m ³
	NOTE: vol	umes greater than 1000l	_ shall be shown in m ³	
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
Т	short tons (2000 lb)	0.907	megagrams (or metric ton")	Mg (or "t")
		EMPERATURE (exac		5()
°F	Fahrenheit	5(F-32)/9	Celsius	°C
	1 dimoniton	or (F-32)/1.8	Colorad	U
		ILLUMINATIO)N	
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²
11		RCE and PRESSURE		Cu/III
lbf	poundforce	4.45	newtons	Ν
lbf/in ²	poundforce per square in		kilopascals	kPa
		MATE CONVERSTIO		Kra
0 milest				O mate at
Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters			
km		1.09	yards	yd
	kilometers	0.621	yards miles	yd mi
	kilometers	0.621 AREA	miles	mi
	kilometers square millimeters	0.621 AREA 0.0016		mi in ²
mm² m²	kilometers	0.621 AREA	miles	mi in ² ft ²
	kilometers square millimeters	0.621 AREA 0.0016 10.764 1.195	miles square inches	mi in ²
m² m² ha	kilometers square millimeters square meters square meters hectares	0.621 AREA 0.0016 10.764 1.195 2.47	miles square inches square feet	mi in ² ft ² yd ² ac
m² m² ha	kilometers square millimeters square meters square meters hectares	0.621 AREA 0.0016 10.764 1.195	miles square inches square feet square yards	mi in ² ft ² yd ²
m² m² ha	kilometers square millimeters square meters square meters	0.621 AREA 0.0016 10.764 1.195 2.47	miles square inches square feet square yards acres	mi in ² ft ² yd ² ac
m² m² ha	kilometers square millimeters square meters square meters hectares	0.621 AREA 0.0016 10.764 1.195 2.47 0.386	miles square inches square feet square yards acres	mi in ² ft ² yd ² ac
m ² m ² ha km ²	kilometers square millimeters square meters square meters hectares Square kilometers	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME	miles square inches square feet square yards acres square miles	mi in ² ft ² yd ² ac mi ²
m ² m ² ha km ² mL	kilometers square millimeters square meters square meters hectares Square kilometers milliliters	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034	miles square inches square feet square yards acres square miles fluid ounces	mi in ² ft ² yd ² ac mi ² oz
m ² m ² ha km ² mL L m ³	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet	mi in ² ft ² yd ² ac mi ² oz gal
m ² m ² ha km ² mL	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314	miles square inches square feet square yards acres square miles fluid ounces gallons	mi in ² ft ² yd ² ac mi ² oz gal ft ³
m ² m ² ha km ² mL L m ³ m ³	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters cubic meters	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³
m ² m ² ha km ² mL L m ³ m ³ g	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters cubic meters grams	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz
m ² m ² ha km ² mL L m ³ m ³ g kg	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters grams kilograms	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035 2.202	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces pounds	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz lb
m ² m ² ha km ² mL L m ³ m ³ g kg	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters cubic meters grams kilograms megagrams (or "metric to	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035 2.202 n") 1.103	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces pounds short tons (2000lb)	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz
m ² m ² ha km ² mL L m ³ m ³ g kg Mg (or "t")	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters cubic meters grams kilograms megagrams (or "metric to	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035 2.202 n") 1.103 EMPERATURE (exact	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces pounds short tons (2000lb) ct degrees)	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz lb T
m ² m ² ha km ² mL L m ³ m ³ g kg Mg (or "t")	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters cubic meters grams kilograms megagrams (or "metric to	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035 2.202 n") 1.103 EMPERATURE (exac 1.8C+32	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces pounds short tons (2000lb) ct degrees) Fahrenheit	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz lb
m ² m ² ha km ² mL L m ³ m ³ g kg Mg (or "t") °C	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters cubic meters grams kilograms megagrams (or "metric to T Celsius	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035 2.202 n") 1.103 EMPERATURE (exact 1.8C+32 ILLUMINATIC	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces pounds short tons (2000lb) ct degrees) Fahrenheit DN	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz lb T °F
m ² m ² ha km ² mL L m ³ m ³ g kg Mg (or "t") °C	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters grams kilograms megagrams (or "metric to T Celsius lux	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035 2.202 n") 1.103 EMPERATURE (exact 1.8C+32 ILLUMINATIC 0.0929	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces pounds short tons (2000lb) ct degrees) Fahrenheit N foot-candles	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz lb T °F fc
m ² m ² ha km ² mL L m ³ m ³ g kg Mg (or "t") °C	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters grams kilograms megagrams (or "metric to Celsius lux candela/m ²	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035 2.202 n") 1.103 EMPERATURE (exact 1.8C+32 ILLUMINATIC 0.0929 0.2919	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces pounds short tons (2000lb) ct degrees) Fahrenheit N foot-candles foot-Lamberts	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz lb T °F
m ² m ² ha km ² mL L m ³ m ³ g kg Mg (or "t") °C lx cd/m ²	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters grams kilograms megagrams (or "metric to Celsius lux candela/m ²	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035 2.202 n") 1.103 EMPERATURE (exact 1.8C+32 ILLUMINATIC 0.0929 0.2919 RCE and PRESSURE	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces pounds short tons (2000lb) ct degrees) Fahrenheit DN foot-candles foot-Lamberts E or STRESS	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz lb T °F fc fl
m ² m ² ha km ² mL L m ³ m ³ g kg Mg (or "t") °C	kilometers square millimeters square meters square meters hectares Square kilometers milliliters liters cubic meters grams kilograms megagrams (or "metric to Celsius lux candela/m ²	0.621 AREA 0.0016 10.764 1.195 2.47 0.386 VOLUME 0.034 0.264 35.314 1.307 MASS 0.035 2.202 n") 1.103 EMPERATURE (exact 1.8C+32 ILLUMINATIC 0.0929 0.2919	miles square inches square feet square yards acres square miles fluid ounces gallons cubic feet cubic yards ounces pounds short tons (2000lb) ct degrees) Fahrenheit N foot-candles foot-Lamberts	mi in ² ft ² yd ² ac mi ² oz gal ft ³ yd ³ oz lb T T °F

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)