U.S. Department of Transportation
Federal Highway Administration

1200 New Jersey Ave., SE
Washington, D.C. 20590

November 24, 2010

In Reply Refer To:
HSSI/SS-126A

Mr. Raymond Kisiel
Northwest Pipe Company
6307 Toledo Street
P.O. Box 2002
Houston, TX 77252-2002

Dear Mr. Kisiel:

This letter is in response to your request for the Federal Highway Administration (FHWA) acceptance of a roadside safety system for use on the National Highway System (NHS).

Name of system:	Northwest Pipe's Performance Post
Type of system:	Breakaway Sign Support Structure
Test Level:	NCHRP Report 350 TL-3
Testing conducted by:	Texas Transportation Institute (TTI)
Task Force 13 Designator:	SSF01, SSF02
Date of request:	February 25, 2010
Date of completed package:	February 25, 2010
Request initially acknowledged:	March 16, 2010

You requested that we find this system acceptable for use on the NHS under the provisions of the (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

Decision
The following breakaway sign supports are found acceptable, with details below:

- Certain Northwest Pipe perforated square steel tube sign supports using ASTM A653 HSLAS Grade 50 steel.

Requirements
Roadside safety devices should meet the guidelines contained in the NCHRP Report 350 or the American Association of State Highway and Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (MASH). Requirements for breakaway supports are those in the AASHTOs' Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals.

Description
The Northwest Pipe Company has previously developed and manufactured perforated square steel tubing of various sizes, gauges, and anchorage systems for use in the NCHRP Report 350 weak and standard soil for use as sign support structures. An FHWA acceptance letter has been completed for these earlier submissions, namely SS-126 dated, September 5, 2008. That letter details a table of accepted products made of ASTM A 653 SS Grade 50 steel, which used both anchor base and direct burial installation methods in NCHRP 350 weak and standard soil.

For this submission Northwest Pipe has proposed a modification to the four perforated square steel tube sign supports using ASTM A653 HSLAS Grade 50 steel:

1. Sign support made of 2.5 inch x 2.5 inch x 13 ft 12 gauge perforated tubing. The sign support was inserted into a 3 inch x 3 inch x 36 inch long 7 gauge footing embedded 34.5 inches in NCHRP 350 standard soil (Enclosure 1).

2. Sign support made of 2.25 inch x 2.25 inch x 14 ft 12 gauge perforated tubing. The post was directly embedded 48 inch in NCHRP 350 standard soil (Enclosure 2).

3. Sign support made of 2.5 inch x 2.5 inch x 13 ft 12 gauge perforated tubing. The post was inserted into a 3 inch x 3 inch x 56 inch long 7 gauge footing embedded 54.5 inches in NCHRP 350 weak soil (Enclosure 3).

4. Sign support made of 2.25 inch x 2.25 inch x 14 ft 12 gauge perforated tubing. The post was directly embedded 48 inch in NCHRP 350 weak soil (Enclosure 4).

Crash Testing
Bogie pendulum testing was conducted on the test articles described above by TTI. The bogie pendulum test was conducted according to NCHRP 350 test designation 3-60.

Findings
According to NCHRP 350, test designation 3-60 and test designation 3-61 are to be conducted for support structures for Test Level 3 evaluation. In both tests full scale automobile testing with 820C small car is required.

For this submission, test 3-60 was conducted using a bogie pendulum. The mass of the pendulum bogie was 838 kg. Although pendulum tests are not routinely accepted for use with base-bending/yielding supports, the crash behavior and post-impact vehicle trajectory is fairly well known for perforated square steel posts. Therefore, we accept that the bogie pendulum can be used as a surrogate test vehicle in this submission.

According to the test results, as reported by TTI, all four test articles passed test 3-60 conducted using the bogie pendulum. In all of these tests Occupant Impact Velocity and Occupant Ridedown Acceleration were below the maximum allowable limits (Enclosure 5 through Enclosure 8). In all four tests the posts either partially or completely pulled out of ground.

Test 3-61, which involves 820C small car hitting the test article at 100 km/h speed, was not conducted on these test articles. However, a combination of full-scale automobile and bogie pendulum testing was conducted in the previous submission, where perforated square steel tube posts were manufactured with ASTM A653 SS Grade 50 steel. These devices were accepted in the letter SS-126, dated on September 5, 2008.

For this submission, the results of bogie pendulum tests were found to be similar to those conducted under the testing done for the previous submission. The results were consistent with previous findings. The following table shows maximum change in velocity for the two types of post materials in different soil type and with different anchor systems:

Test Article	Soil Type	Anchor Type	Anchor Length (inch)	ΔV for SS Steel (m/s)*	ΔV for HSLAS Steel**
2.5 in x2.5 in x12 gauge	Standard	3 in x 3in x 7 gauge	36	3.3	3.56
2.5 in x2.5 in x12 gauge	Standard	Direct Burial	48 ***	2.5	3.84
2.25 in x 2.25 in x 12 gauge	Weak	3 in x 3in x 7 gauge	56	2.4	3.1
2.25 in x 2.25 in x 12 gauge	Weak	Direct Burial	48	2.5	1.62

**Maximum speed change of the bogie pendulum for test articles made of ASTM A653 SS Grade 50 steel
**Maximum speed change of the bogie pendulum for test articles made of ASTM A653 HSLAS Grade 50 steel
*** Post pulled partially out of the ground

In addition, the videos associated with the tests (ASTM A653 HSLAS Grade 50 steel posts) and the tests conducted under the previous acceptance letter SS-126 (ASTM A653 SS Grade 50 steel posts) show the similar behavior. As a result, we agree that Test 3-61 can be waived for the sign support posts made of ASTM A653 HSLAS Grade 50 steel.

Therefore, the system described and detailed in the enclosed drawings, to be manufactured with either ASTM A 653 SS Grade 50 steel or ASTM A653 HSLAS Grade 50 steel is acceptable for use on the NHS when embedded in soil under the range of conditions tested, when such use is acceptable to a highway agency. Posts embedded in concrete should use a square tube slip base system as concrete footings were not tested.

Please note the following standard provisions that apply to FHWA letters of acceptance:

- This acceptance is limited to the crashworthiness characteristics of the systems and does not

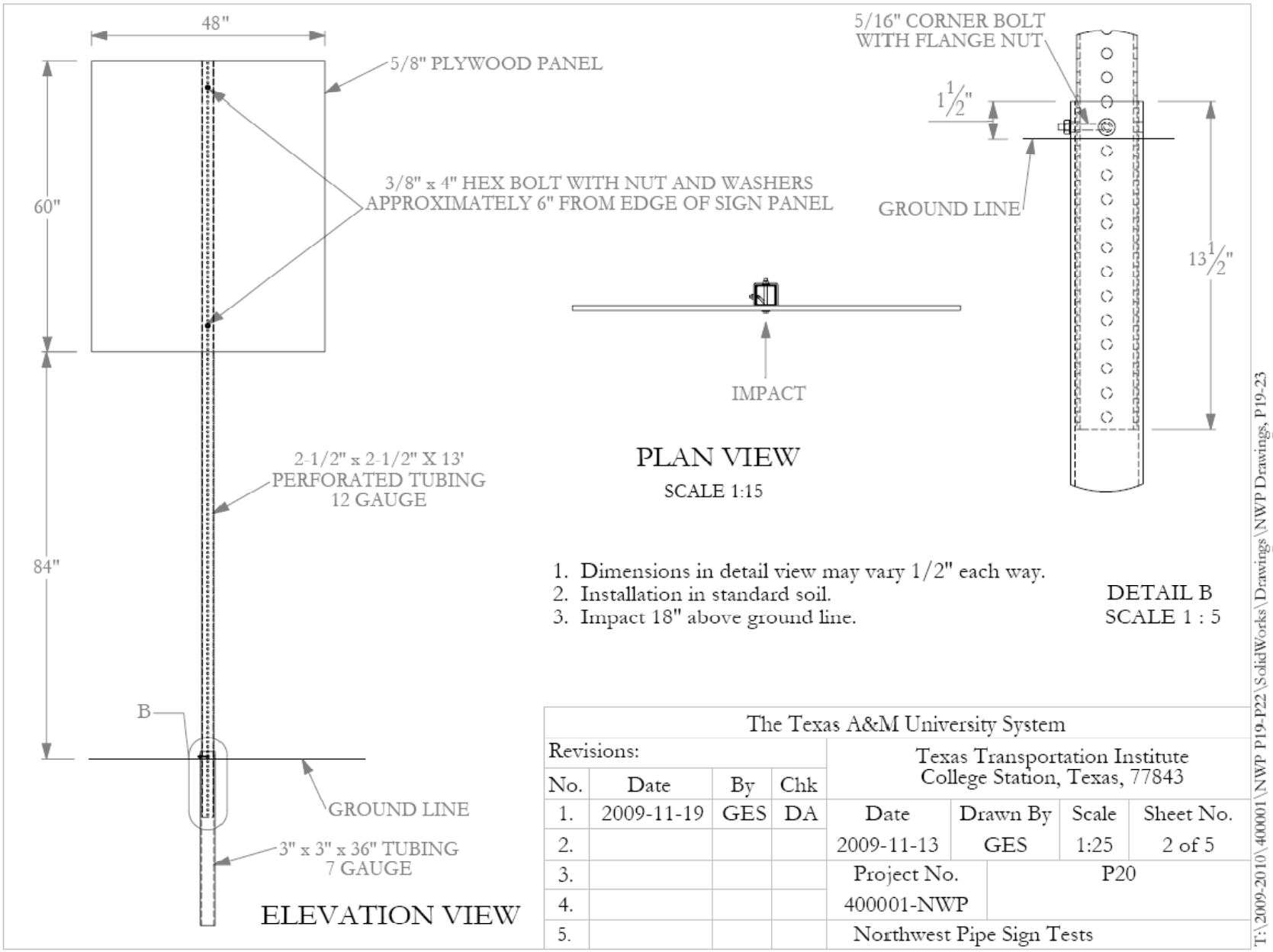
cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

- Any changes that may adversely influence the crashworthiness of the system will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number SS-126A and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate system, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

8 Enclosures



The Texas A&M University System							
Revisions:				Texas Transportation Institute College Station, Texas, 77843			
No.	Date	By	Chk	Date	Drawn By	Scale	Sheet No.
1.	2009-11-19	GES	DA	2009-11-13	GES	1:25	2 of 5
2.				Project No.	P20		
3.				400001-NWP			
4.				Northwest Pipe Sign Tests			
5.							

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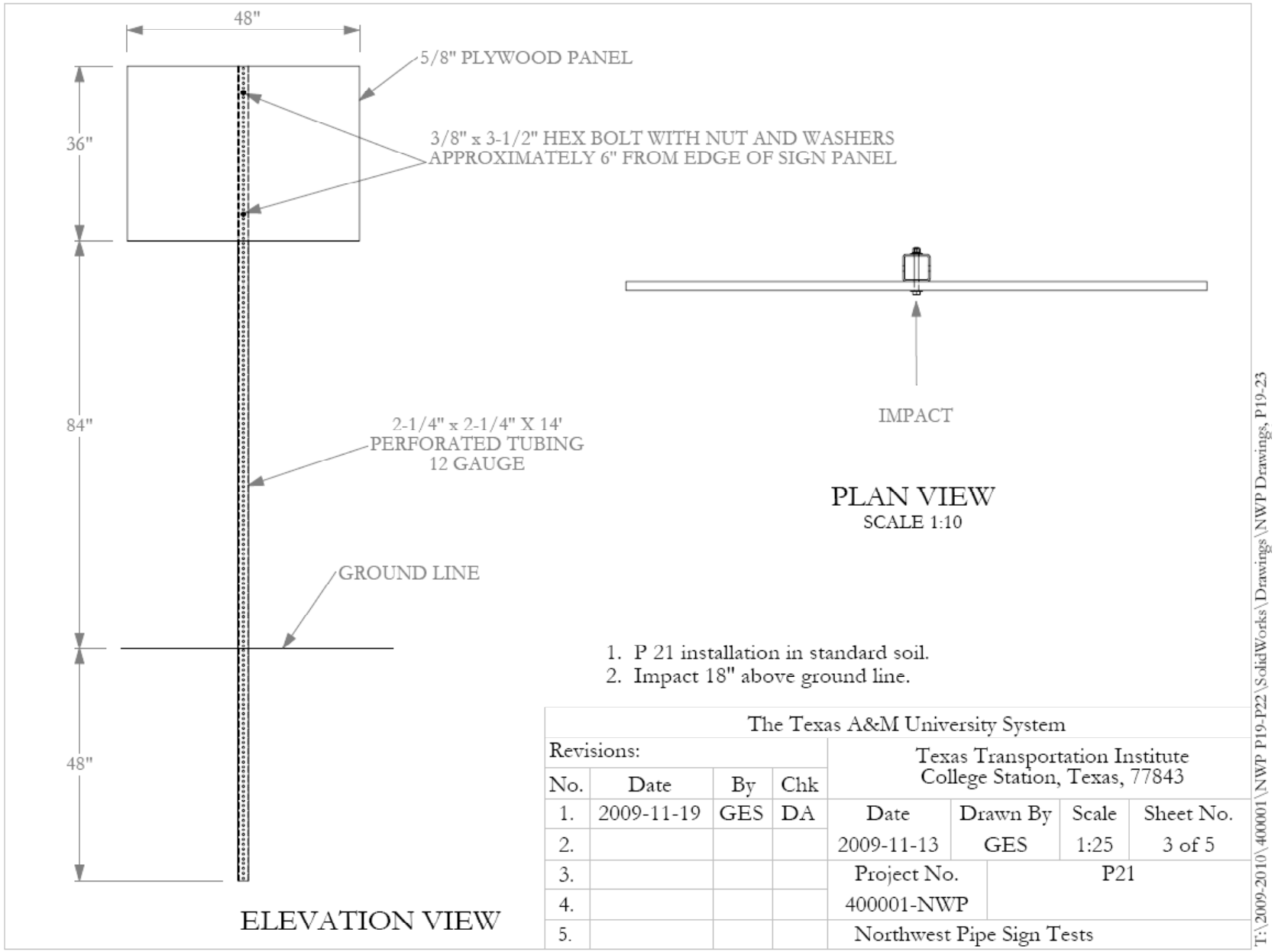
Enclosure 1


48"
5/8" PLYWOOD PANEL
36"
3/8" x 3-1/2" HEX BOLT WITH NUT AND WASHERS
APPROXIMATELY 6" FROM EDGE OF SIGN PANEL
84"
2-1/4" x 2-1/4" X 14'
PERFORATED TUBING
12 GAUGE
GROUND LINE
48"
ELEVATION VIEW
IMPACT
PLAN VIEW
SCALE 1:10
1. P 21 installation in standard soil.
2. Impact 18" above ground line.
The Texas A&M University System
Revisions:
No. Date By Chk
1. 2009-11-19 GES DA
2.
3.
4.
5.
Texas Transportation Institute
College Station, Texas, 77843
Date 2009-11-13
Drawn By GES
Scale 1:25
Sheet No. 3 of 5
Project No. 400001-NWP
P21
Northwest Pipe Sign Tests
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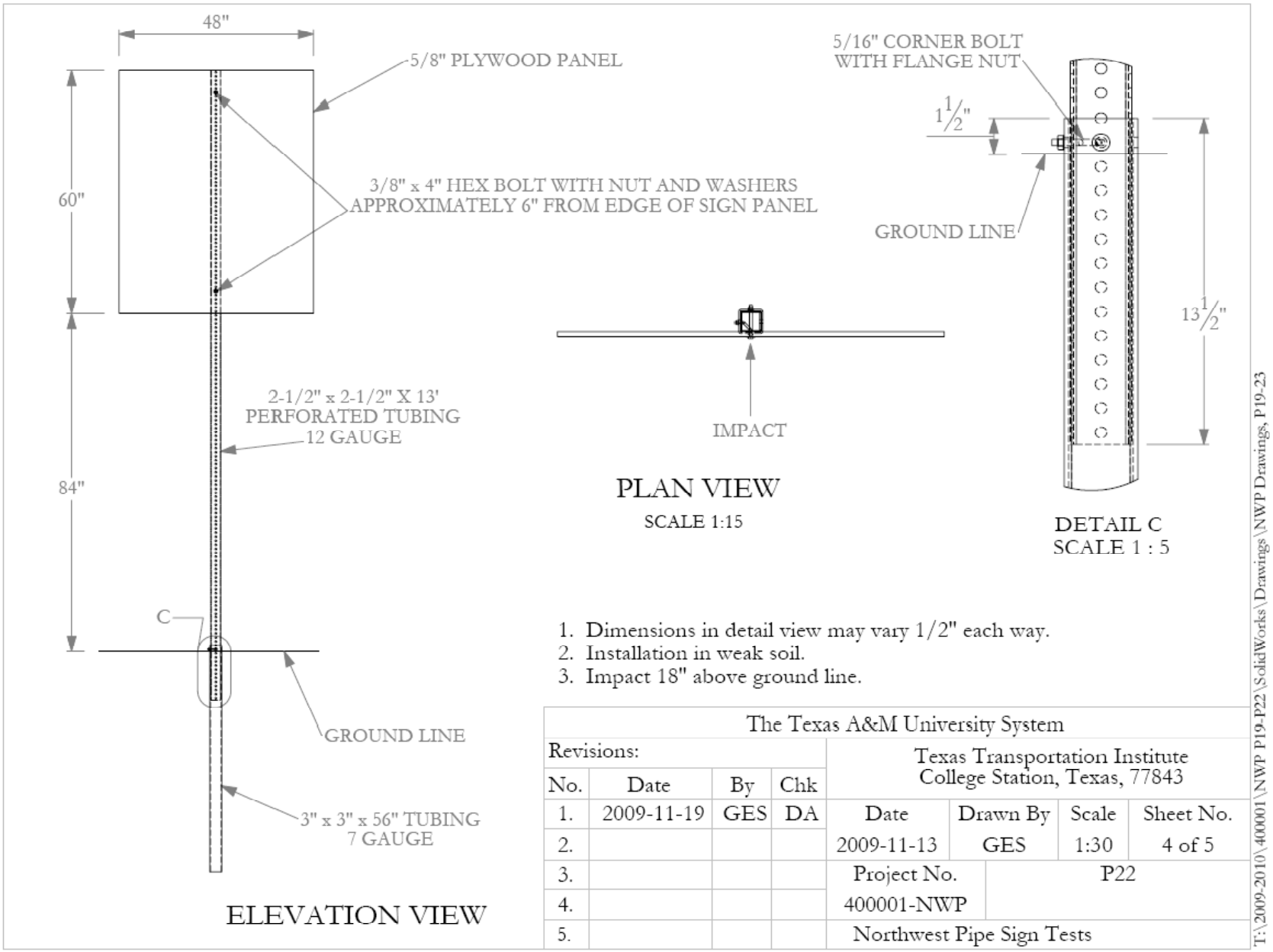
Enclosure 2



1. Dimensions in detail view may vary 1/2" each way.
2. Installation in weak soil.
3. Impact 18" above ground line.

The Texas A&M University System							
Revisions:				Texas Transportation Institute College Station, Texas, 77843			
No.	Date	By	Chk	Date	Drawn By	Scale	Sheet No.
1.	2009-11-19	GES	DA	2009-11-13	GES	1:30	4 of 5
2.				Project No.	P22		
3.				400001-NWP			
4.				Northwest Pipe Sign Tests			
5.							

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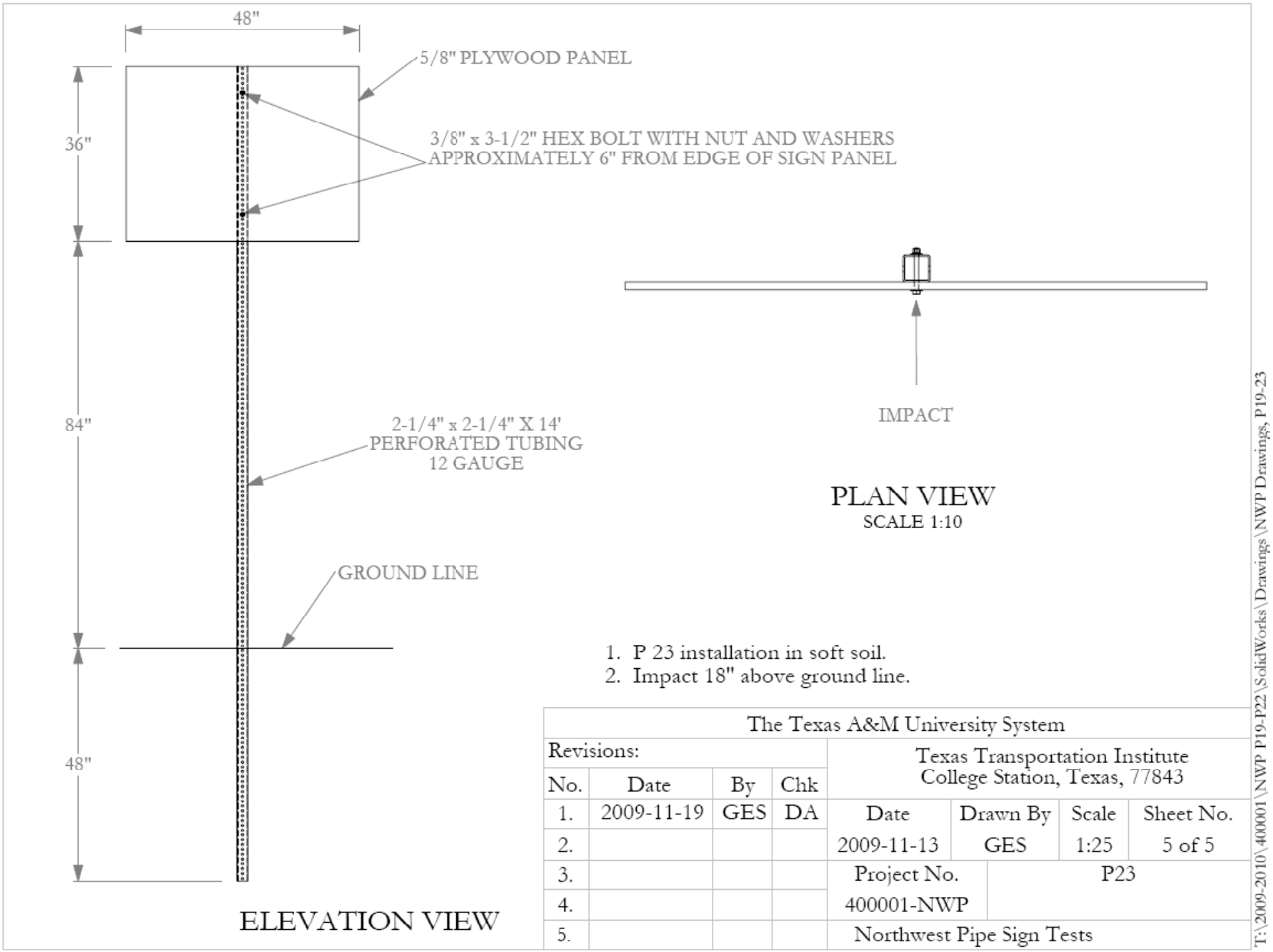
Enclosure 3



1. P 23 installation in soft soil.
2. Impact 18" above ground line.

The Texas A&M University System							
Revisions:				Texas Transportation Institute College Station, Texas, 77843			
No.	Date	By	Chk				
1.	2009-11-19	GES	DA	Date	Drawn By	Scale	Sheet No.
2.				2009-11-13	GES	1:25	5 of 5
3.				Project No.	P23		
4.				400001-NWP			
5.				Northwest Pipe Sign Tests			

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Enclosure 4

Table D1. Summary of results for pendulum test 400001-NWP P20.

0.000 s

0.051 s

0.101 s

0.203 s

0.323

General Information

Test Agency ..... Texas Transportation Institute
Test No. 400001-NWP P20
Date 2009-11-19

Test Article

Type ..... Single Sign Support
Name ..... Northwest Pipe Sign Support
Installation Height ..... 84 inches
Material of Key Element ..... 2.5 inch x 2.5 inch x 13 ft 12 gauge perforated tubing sign support with 3 inch x 3 inch x 36 inch long 7 gauge footing
Soil Type ..... Standard Soil

Test Vehicle

Type ..... Bogie
Designation ..... Pendulum
Test Inertia Mass ..... 1848 lb

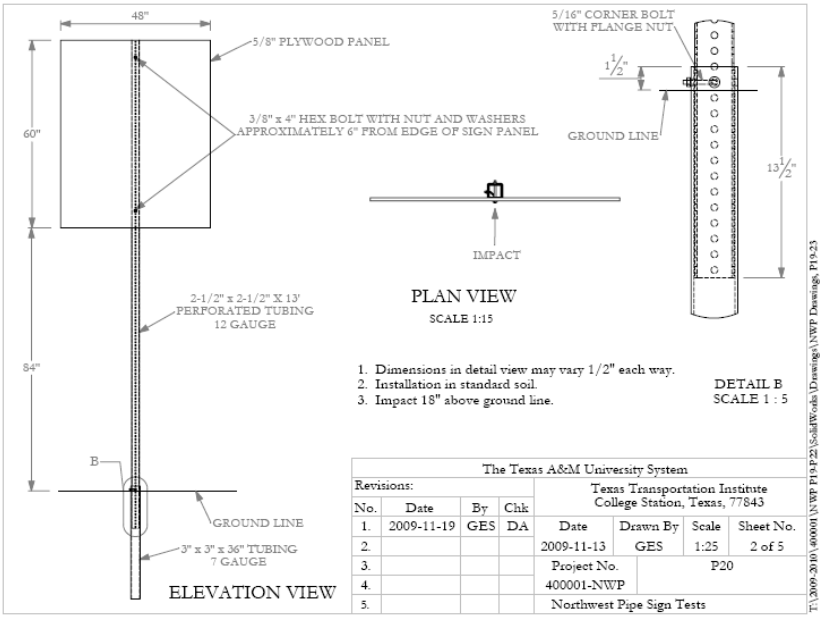
Impact Conditions

Speed ..... 22.0 mi/h
Angle ..... 90 deg

Occupant Risk Values

Impact Velocity
Longitudinal direction ..... 12.1 ft/s (3.7 m/s)
Ridedown Accelerations
Longitudinal direction ..... -0.8 g's

Maximum Change in Velocity ..... 11.7 ft/s
Predicted High-Speed Change in Velocity ..... N/A



Enclosure 5

Table D2. Summary of results for pendulum test 400001-NWP P21.

0.000 s

0.037 s

0.073 s

0.147 s

0.221 s

General Information
Test Agency ..... Texas Transportation Institute
Test No. 400001-NWP P21
Date 2009-11-19

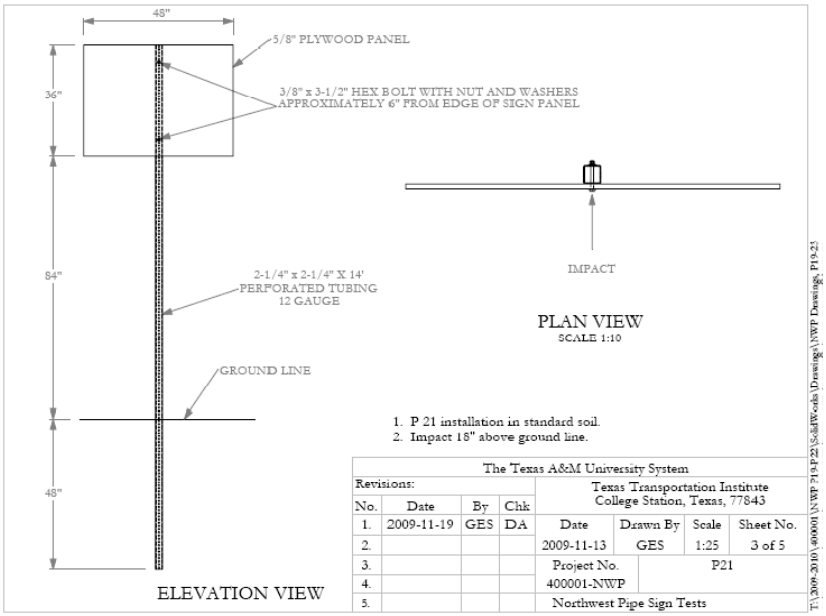
Test Article
Type ..... Single Sign Support
Name ..... Northwest Pipe Sign Support
Installation Height ..... 84 inches
Material of Key Element ..... 2.25 inch x 2.25 inch x 14 ft 12 gauge perforated tubing sign support direct embedded 48 inches
Soil Type ..... Standard Soil

Test Vehicle
Type ..... Bogie
Designation ..... Pendulum
Test Inertia Mass ..... 1848 lb

Impact Conditions
Speed ..... 21.9 mi/h
Angle ..... 90 deg

Occupant Risk Values
Impact Velocity
Longitudinal direction ..... 13.4 ft/s (4.1 m/s)
Ridedown Accelerations
Longitudinal direction ..... -0.8 g's

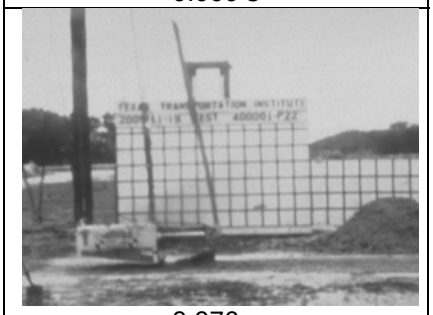
Maximum Change in Velocity ..... 12.6 ft/s
Predicted High-Speed Change in Velocity ..... N/A



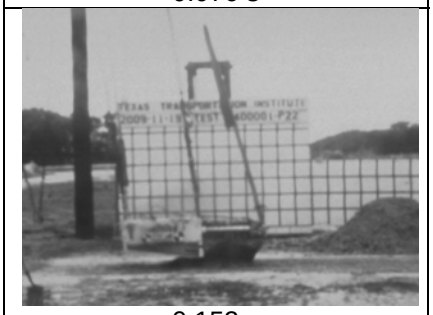
Enclosure 6

Table D3. Summary of results for pendulum test 400001-NWP P22.

0.000 s



0.076 s



0.152 s

0.305 s

0.457 s

General Information
Test Agency ..... Texas Transportation Institute
Test No. 400001-NWP P22
Date 2009-11-19

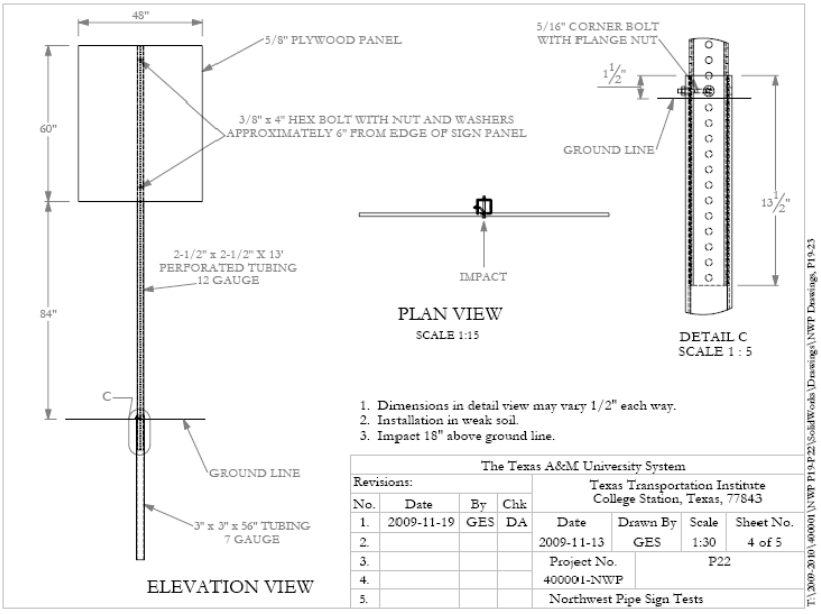
Test Article
Type ..... Single Sign Support
Name ..... Northwest Pipe Sign Support
Installation Height ..... 84 inches
Material of Key Element ..... 2.5 inch x 2.5 inch x 13 ft 12 gauge perforated tubing sign support with 3 inch x 3 inch x 56 inch long 7 gauge footing
Soil Type ..... Weak Soil

Test Vehicle
Type ..... Bogie
Designation ..... Pendulum
Test Inertia Mass ..... 1848 lb

Impact Conditions
Speed ..... 21.9 mi/h
Angle ..... 90 deg

Occupant Risk Values
Impact Velocity
Longitudinal direction ..... 9.8 ft/s (3.0 m/s)
Ridedown Accelerations
Longitudinal direction ..... -0.7 g's

Maximum Change in Velocity ..... 10.1 ft/s
Predicted High-Speed Change in Velocity ..... N/A



Enclosure 7

Table D4. Summary of results for pendulum test 400001-NWP P23.

0.000 s

0.058 s

0.116 s

0.231 s

0.354 s

General Information

Test Agency ..... Texas Transportation Institute
Test No. 400001-NWP P23
Date 2009-11-19

Test Article

Type ..... Single Sign Support
Name ..... Northwest Pipe Sign Support
Installation Height ..... 84 inches
Material of Key Element ..... 2.25 inch x 2.25 inch x 14 ft 12 gauge perforated tubing sign support direct embedded 48 inches
Soil Type ..... Weak Soil

Test Vehicle

Type ..... Bogie
Designation ..... Pendulum
Test Inertia Mass ..... 1848 lb

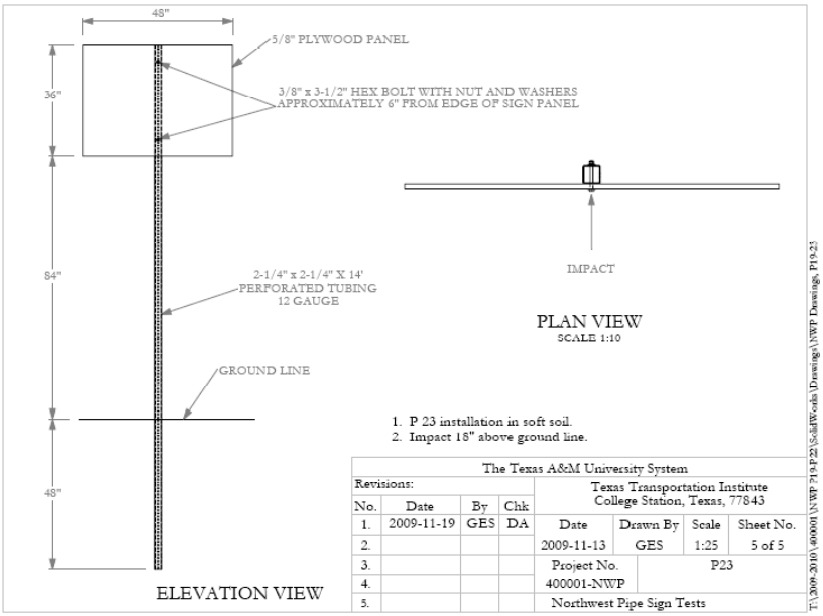
Impact Conditions

Speed ..... 21.7 mi/h
Angle ..... 90 deg

Occupant Risk Values

Impact Velocity
Longitudinal direction ..... 9.8 ft/s (3.0 m/s)
Ridedown Accelerations
Longitudinal direction ..... -0.7 g's

Maximum Change in Velocity ..... 5.3 ft/s
Predicted High-Speed Change in Velocity ..... N/A



Enclosure 8