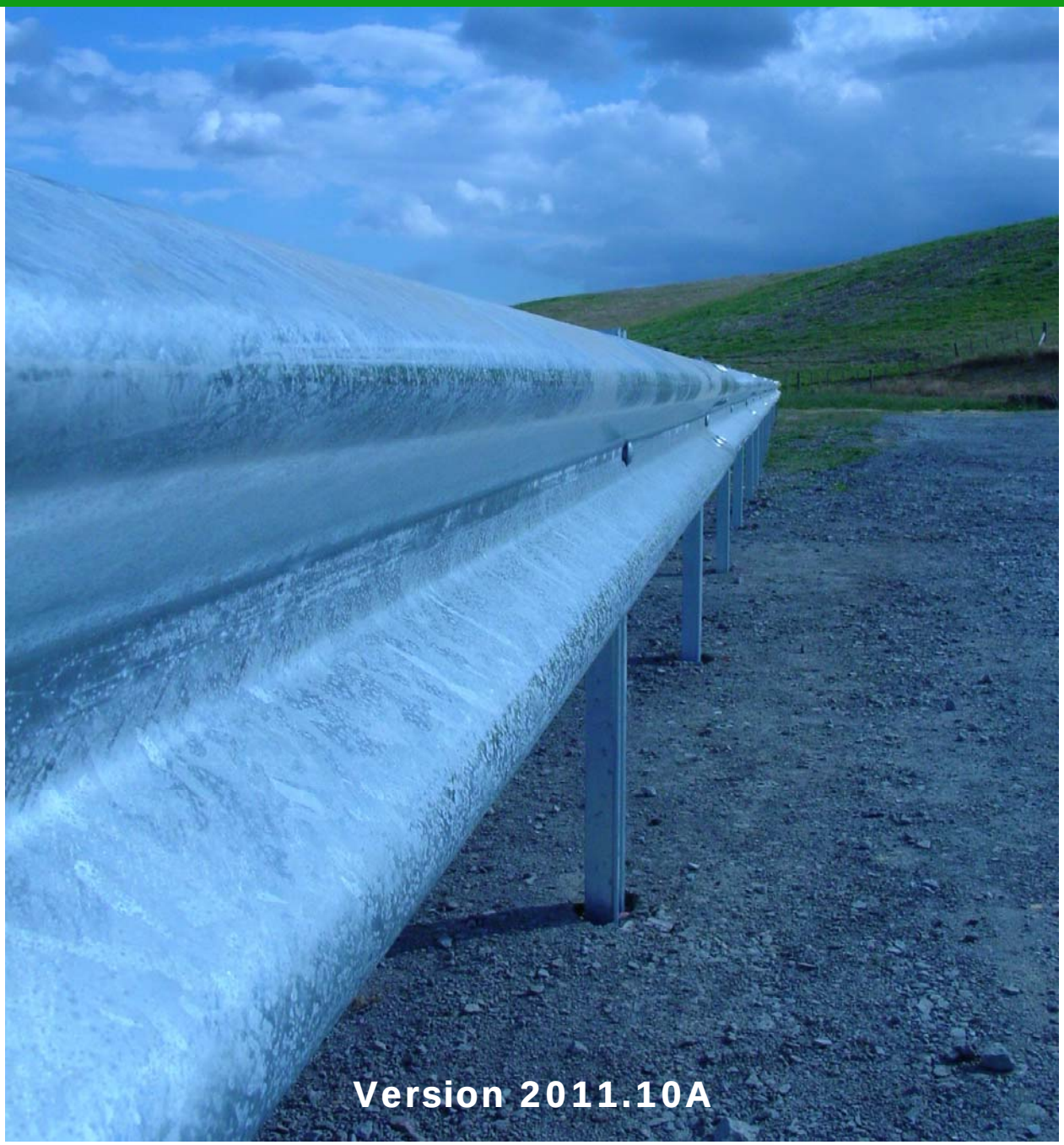
Nu-Guard-27™ & Nu-Guard-31™
Roadway Barrier System
Installation Manual



Version 2011.10A

NUCOR

NUCOR STEEL MARION, INC.

It's Our Nature.

CONTENTS

INSTALLATION CONSIDERATIONS

The Nu-Guard-27™ & Nu-Guard-31™ Roadway Barrier System is installed per Federal, State & Local guidelines for highway guardrail barriers and is supplemented by the manufacturers' installation manual for detailed connection information.

This manual should be carefully reviewed prior to construction to ensure proper installation of the system.

If there is ever any doubt about any part of the installation contact Nucor Steel Marion Inc at (800) 333-4011 or your Nucor Distributor immediately.

Distributor contact information is listed on the last page of this manual.

SYSTEM OVERVIEW

Current Configuration Summary

There are currently **(2)** main categories of the Nu-Guard™ System.

A) Nu-Guard-27™
   a. Conforms to Federal Highway Administration NCHRP-350 Test Level 3 crashworthiness standards for use on the National Highway System.
   b. This system height has been installed since 1965 on nearly every roadway corridor in the United States and elsewhere.
   c. It is intended for use in new installations, retrofits and repair operations wherever a 27" rail height system is called for.

B) Nu-Guard-31™
   a. Conforms to hardware testing criteria NCHRP-350 Test Level 3 & 4.
   b. This design is intended for use in new installations and retrofits wherever a 31" rail height system is called for.

Within each category, are various styles and configurations depending upon the placement of the barrier relative to the roadway and hazards.

Post spacing throughout all systems is standardized to **6' 3" (1905mm).**

The 27" system has a deflection during impact of **3' 9" (1143mm)**.

In contrast, the 31" system has a deflection during impact of **3' 5" (1041mm)**.

Thus, there should be no hard obstacles within a standardized **4' 0" (1219mm)** area behind the barrier.

For the appropriate overall length of barrier installation, consult your local roadway manual.

Site Preparation

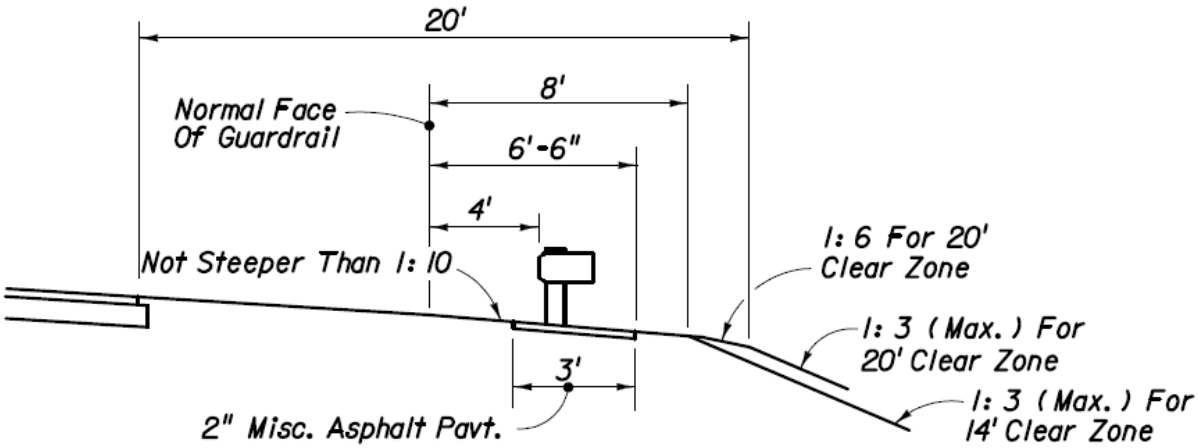
The initial layout for the Nu-Guard™ system should be free of hazards, obstacles, and debris.

The cross-slope should be **10:1** or flatter. Grading may be necessary. No slope changes should occur within **2' (610mm)** of the backside of post.

It is important to note that the w-beam barrier cannot be installed within a range of **1' (305mm) to 8' (2438mm)** from the bottom of a median ditch according to FHWA standards. The system can be installed in the bottom of the median ditch or within a **1' (305mm)** range either side of the median ditch. However, this is not recommended because of potential water drainage issues.

Line Post Placement

The **line post spacing** is standardized at **6'-3" (1905mm)**, to yield a deflection under **4' 0" (1219mm)**. Alternate post spacing can also be used when necessary due to conflicts with utilities or culverts, however, the post spacing **must not exceed 12' 6" (3810mm) unless** rail is double nested (layered) and/or approved by project engineer.



Example of roadside barrier placement. Source FLDOT 2008 Standards.

Take into consideration any local guidelines for flare rates required from approach (upstream) anchor traveling towards the hazard (downstream). Flare rates towards the roadway edge-of-pavement are important as they can influence both the driver reaction to perceived roadside obstacles (aka, the "shy line") and also the barrier deflection if flare is in excess of what is typical for a roadside barrier. (15:1 is nominal standard) See local standards flare rate and approach rail layout considerations.

Anchor Systems

The Nu-Guard™ system has been successfully crash-tested using a standard (2) foundation tube anchor system. This system represents a standard anchorage type currently utilized throughout the National Highway System. Many alternates and system options exist and are approved under national and local Qualified Products Listings or in Standard plans.

For **approach (upstream)** terminal systems, the Nu-Guard™ system must be installed with any contractor provided anchorage device that meets NCHRP-350 Test Level 3 criteria.

For **trailing (downstream)** anchor systems, the Nu-Guard™ system may be installed as above with a Test Level 3 system, if necessary per applicable standards due to proximity of oncoming traffic, **-OR-** with any locally approved terminal device for “downstream and/or shielded” ends.

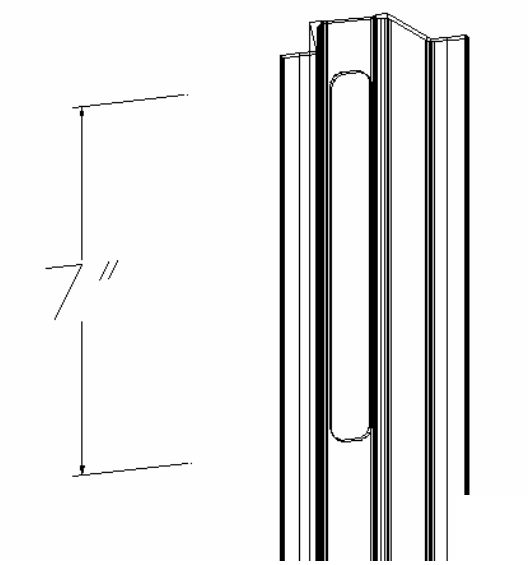
Alternatively, the system may be connected directly to a barrier transition on either the upstream or downstream end, and therefore allowing the usage of an approved terminal of another barrier type.

Nu-Guard-31™ Transition To A Thrie-Beam Bridge Connection

Please review the ‘Details’ section located at the back of this manual for more information on the terminal options for the Nu-Guard™ system.

COMPONENTS

Line Posts

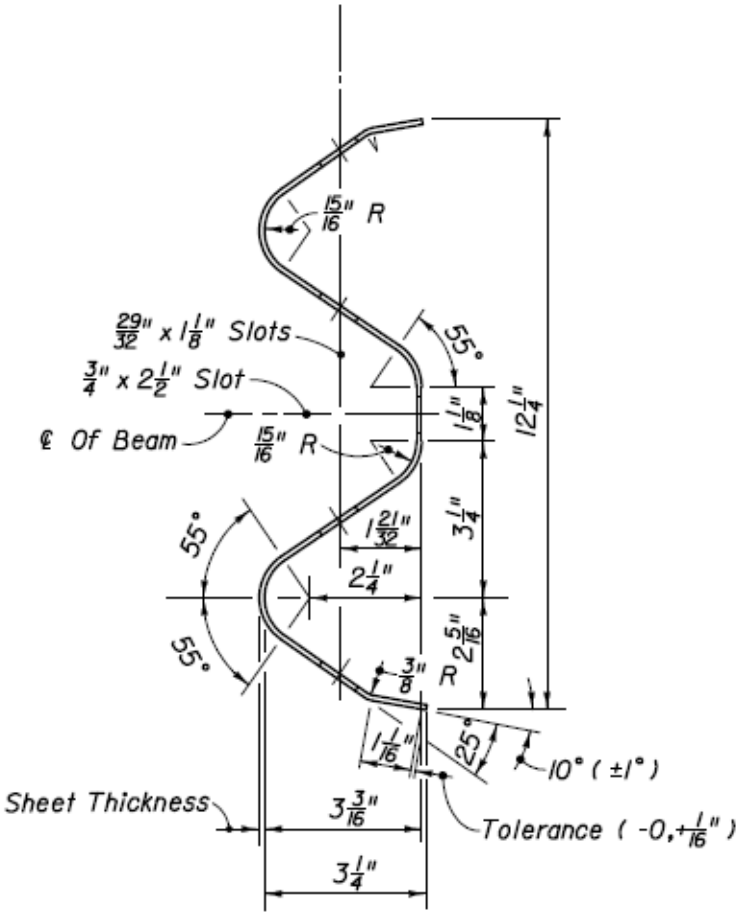


The system utilizes a **5# per foot (7.4 kg/m)** Rib-Bak® Line Post that is **6' 6" (1980mm)** long. No soil plate is required.

The Nu-Guard™ post is identifiable as it contains only a single hole (slot) in the channel. This hole is **7" (178mm)** vertical and **3/4" (19mm)** wide beginning **1" (25.4mm)** down from the top of post.

Rail Sections

The system utilizes a double corrugated metal guardrail beam corresponding to the requirements of **AASHTO M-180 Class A, Type II**.



Hardware

The system utilizes hardware bolts, nuts and washers meeting **ASTM A307** criteria and galvanized. Bolts are of lengths required to provide full engagement with nut depending on system placement. For roadside applications, the bolt may extend at least ¼" (6mm) beyond the nut face to provide for a double nut, where required. For median applications, there shall only be one nut used with the threaded surface

flush with face of nut and/or extending no more than 3/4” (19mm) beyond the nut face. To ensure proper performance, the post bolt torque must be within the following range: 120 N–m to 140 N–m. (89 lbs–ft to 103 lbs–ft)

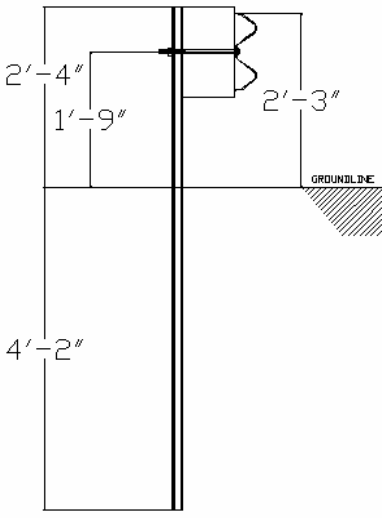
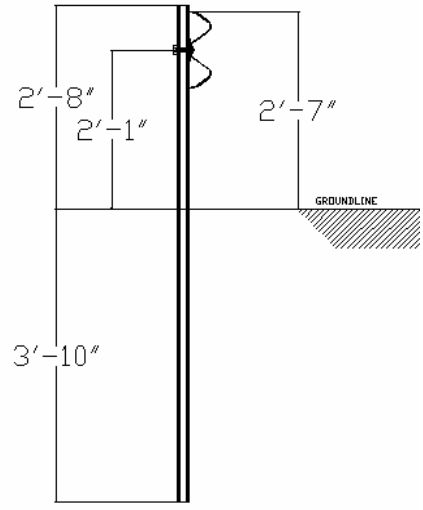
INSTALLING POSTS

Line Posts

It is helpful to mark at least every **75’ (22.9m)** when laying out the system to aid in placement as you install posts.

A string line should be set to aid in properly placing the posts and rail sections. It is best to mark the string at the centerline of rail, as the hole on the post can be aligned against the string during embedment.

The preferred method for line posts is with a post-pounding device so as not to disturb the natural soil. However, boring a hole/backfilling/tamping is also an allowable means of installation. For extremely rocky soils, we recommend using a 4" auger, which allows the post to be positioned while leaving enough space to be filled with a suitable backfill material.

	Nu-Guard-27™	**Nu-Guard-31™**
Center-line of W-Beam (string-line)	**21” (533mm)**	**25” (635mm)**
Embedment Depth of Post	**50” (1270mm)**	**46” (1168mm)**
Top of Post from Groundline	**28” (711mm)**	**32” (813mm)**
Side Views		

Mark each run starting with the location of end treatments.

Then mark the position for each line post to be installed according to project plans for distance from roadway and distance to backside slopes or hazards.

FOR ROADSIDE: Install the post with the open face of the channel facing towards the nearest roadway.

FOR MEDIAN: Install the post with the open face of the channel alternating at each post.

Nu-Guard-31™ Double-Faced Median, Galvanized & Powder Coated, New Hampshire

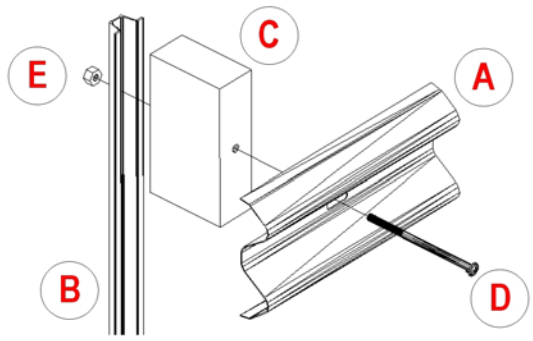
Nu-Guard-31™ Single-Faced Median, Galvanized, Michigan

INSTALLING RAIL

Being that there are different configurations based upon the system used, this chapter is broken down into two sections, one for each barrier type.

Nu-Guard-27™

For the 27" configuration, the system utilizes the following components:



A: RAIL:
W-BEAM, AASHTO M-180, CLASS A or B, TYPE II

B: POST:
5 lb./ft. (7.45 kg/m) X 6' 6" U-CHANNEL Nu-Guard™ SYSTEM POST,
NUCOR GRADE SP-80

C: BLOCK:
4" X 8" X 14" RECYCLED PLASTIC COMPOSITE, 50/50 HDPE PRIMARY/POST-RECYCLED CONTENT

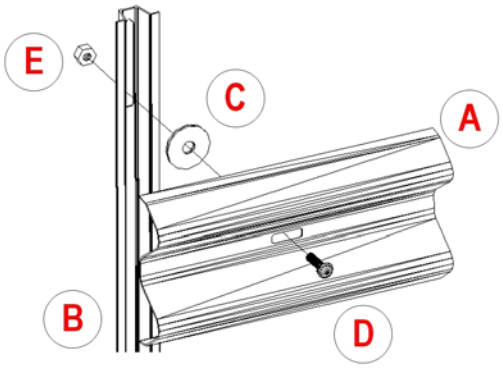
D: BOLT:
FOR ROADSIDE: 5/8" X 12" BUTTON HEAD POST BOLT, GALVANIZED, ASTM A307
FOR MEDIAN: 5/8" X 20" BUTTON HEAD POST BOLT, GALVANIZED, ASTM A307

E: NUT:
5/8" DOUBLE RECESSED NUT, ASTM A307

This system may also be installed in **double-faced (median)** configuration. In which case, **a longer post bolt (20") and a second offset block per post are required.** When installing in median configuration, be sure to alternate the direction of the post bolts at each post connection point.

Nu-Guard-31™

For the 31" configuration, the system utilizes the following components:



SHOWN IN ROADSIDE CONFIGURATION

A: RAIL:
W-BEAM, AASHTO M-180, CLASS A or B, GALVANIZED TYPE II OR POWDER COATED TYPE IV

B: POST:
5 lb./ft. (7.45 kg/m) X 6' 6" U-CHANNEL Nu-Guard™ SYSTEM POST, GALVANIZED OR POWDER-COATED,
NUCOR GRADE SP-80

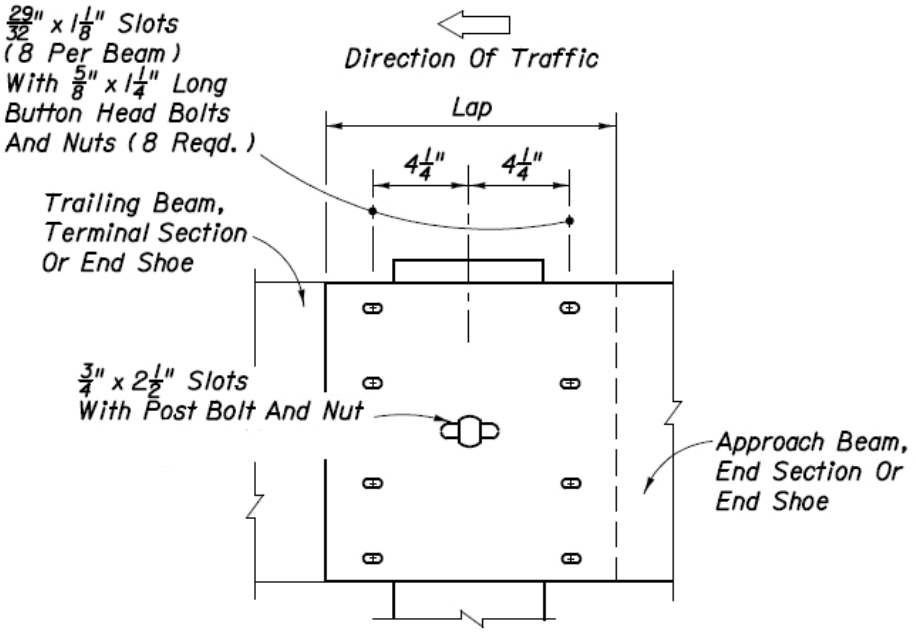
C: SPACER WASHER:
1/4" X 3 1/2" ROUND WASHER, GALVANIZED, ASTM A307

D: BOLT:
FOR ROADSIDE: 5/8" X 3 1/2" BUTTON HEAD POST BOLT, GALVANIZED, ASTM A307
FOR MEDIAN: 5/8" X 4" BUTTON HEAD POST BOLT, GALVANIZED, ASTM A307

E: NUT:
5/8" DOUBLE RECESSED NUT, GALVANIZED, ASTM A307

This system may also be installed in **double-faced (median)** configuration, as represented in the image below. In which case, **a second spacer washer per post is required**. When installing in median configuration, be sure to alternate the direction of the post bolts at each post connection point.

Connection At Rail Splice



Typical Rail Splice connection detail. Source FLDOT 2008.

Shown is the standard overlap and splicing connection detail for w-beam guardrail systems. In some cases, some roadway authorities require the use **(1) additional washer under** on the post bolt at the backside of post. Be sure to check your local standards to meet compliance with hardware requirements.

Outlined below are the key steps that have been used by the manufacturer to easily install Nu-Guard-31™ median barriers once the posts have been driven:

- Splice the next guardrail panel to the existing guardrail end with 8 splice bolts and tighten.
- Insert a 24" steel rod half way through the post bolt slot of the guardrail panel and the vertical slot of the Nu-Guard-31™ post. (This will hold the panel at the correct height while the secondary panel is attached)
- Lever the existing secondary guardrail panel out laterally from the post to gain access. (This is easily achieved because this existing guardrail panel also has a 24" steel rod through the center post bolt slot at this stage and is only connected to the post and guardrail panel at the far end)
- Connect the next secondary guardrail panel to the exposed end with 8 splice bolts and tighten.
- Release the levered secondary guardrail panel so that it returns to the required position against the posts and the 24" rod fits into the center post bolt slot.
- At the newly created double sided splice join now connect the 4 guardrail panels to the post using a post bolt. Make sure that before this is done that a 3 ½" washer is positioned between the post and the guardrail panel on either side.
- Lastly remove the 24" steel rod from the completed section and set aside for use with the next guardrail panels. At this center post bolt slot, connect the panels together to the post with the same bolt and washer assembly as outlined in the previous step.

DELINEATION

System delineation should be as directed by the engineer or local standards. Alternately, at a minimum, a reflector should be located every **75' (25m)** along the length of the barrier.

Reflective washers may be used in the valley of the rail and connected under the head of the post bolt.

Post mounted delineators are also acceptable, so far as at least **8 sq. in.** of reflective surface is visible above the top edge of rail.

Adhesive delineators shall be 3M High Intensity Prismatic **#3931** Reflective Sheeting

REPAIR & MAINTENANCE

The Nu-Guard™ system is designed to contain a pickup truck impacting at 62.5 mph (100km/h) and 25 degrees. (NCHRP-350 Test Level 3)

It may also perform adequately in redirecting larger vehicles if site specific speed and angle are considered against tested values.

For instance, the Nu-Guard™ is an acceptable barrier for tractor trailers in loading facilities to prevent accidental contact with building or drainage structures.

In testing, a length of **50' (15m)** was damaged in an impact event representative of a full-scale crash. Actual damage may be more or less depending on size of vehicle, speed and angle of impact.

The damaged sections of a system should be replaced and repaired promptly after initial impact to assure overall integrity of the guardrail barrier. Follow local guidelines for repair & replacement timeframes. Some areas require repair within 48 hours, while others allow for up to 2 weeks, so be sure to know what your local requirements are if you are in charge of barrier repair.

Posts:

- Damaged or bent posts will need to be replaced.
- Posts may be removed via a vertical winch or post-puller tripod device.
- In cases where the ground has been significantly disturbed from removal, be sure to backfill and tamp prior installation of the repair post.

Rail:

- The rail should be replaced if deformation has exceeded roughly 1" of lateral shape or if significant scratching of the galvanic coating layer has occurred.
- The rail must be replaced if any tearing or visible holes are located along the beam length.

Hardware:

- Bolts within the area of impact should be replaced.
- Nuts and washers may be reused so long as the galvanic coating layer has not been damaged.

Overlays

The barrier height is critical to performance of the system. If the roadway has experienced an overlay, ensure w-beam barrier heights are correct, and that the slope to the barrier does not exceed the maximum allowed. The vertical slot in the post allows for vertical realignment up to **7" (178mm)** of the initial installation.

Materials for Maintenance

Your NUCOR distributor carries an inventory of replacement parts for the Nu-Guard™ System to facilitate quick repair of an impacted system. In addition, we recommend that DOTs or maintenance authorities keep a minimum quantity of repair parts on hand.

A general rule of thumb is to stock 2% to 4% of the total project, rounded up to the minimum order quantities (below).

Line Posts	=	50 piece bundles
Post Bolts & Nut	=	100 pieces
Splice Bolts & Nut	=	1000 pieces
Rail Sections	=	200 ft.

Please contact your distributor for up to date pricing on products.

INSTALLATION CHECKLISTS

Rail Checklist

- ☐ Is there anything in front of the barrier that might cause a vehicle to vault the barrier or make the barrier ineffective? Items to look for include vegetation, rough ground, debris, or hard packed snow. These items should be removed if present.
- ☐ Has the roadside grading been completed correctly?
- ☐ Is there enough clearance between the barrier and the hazard for the expected barrier deflection?
- ☐ Is the barrier the correct height?
- ☐ Are the guardrail panels properly overlapped/spliced?
- ☐ Are there irregular curves or joints where an errant vehicle might snag? Is there evidence of corrosion or damage to the rail? The rail should be scheduled for repair if either of these circumstances exists.
- ☐ Check to see that nuts are installed and tightened on all bolts.

Post Checklist

- ☐ Is there sufficient soil behind the posts to prevent them from being pushed out when the barrier is hit? Eroded or disturbed soil should be replaced and compacted.
- ☐ Is the post spacing correct?
- ☐ Is there evidence of corrosion or damage to the posts? The posts should be replaced if either of these circumstances exists.

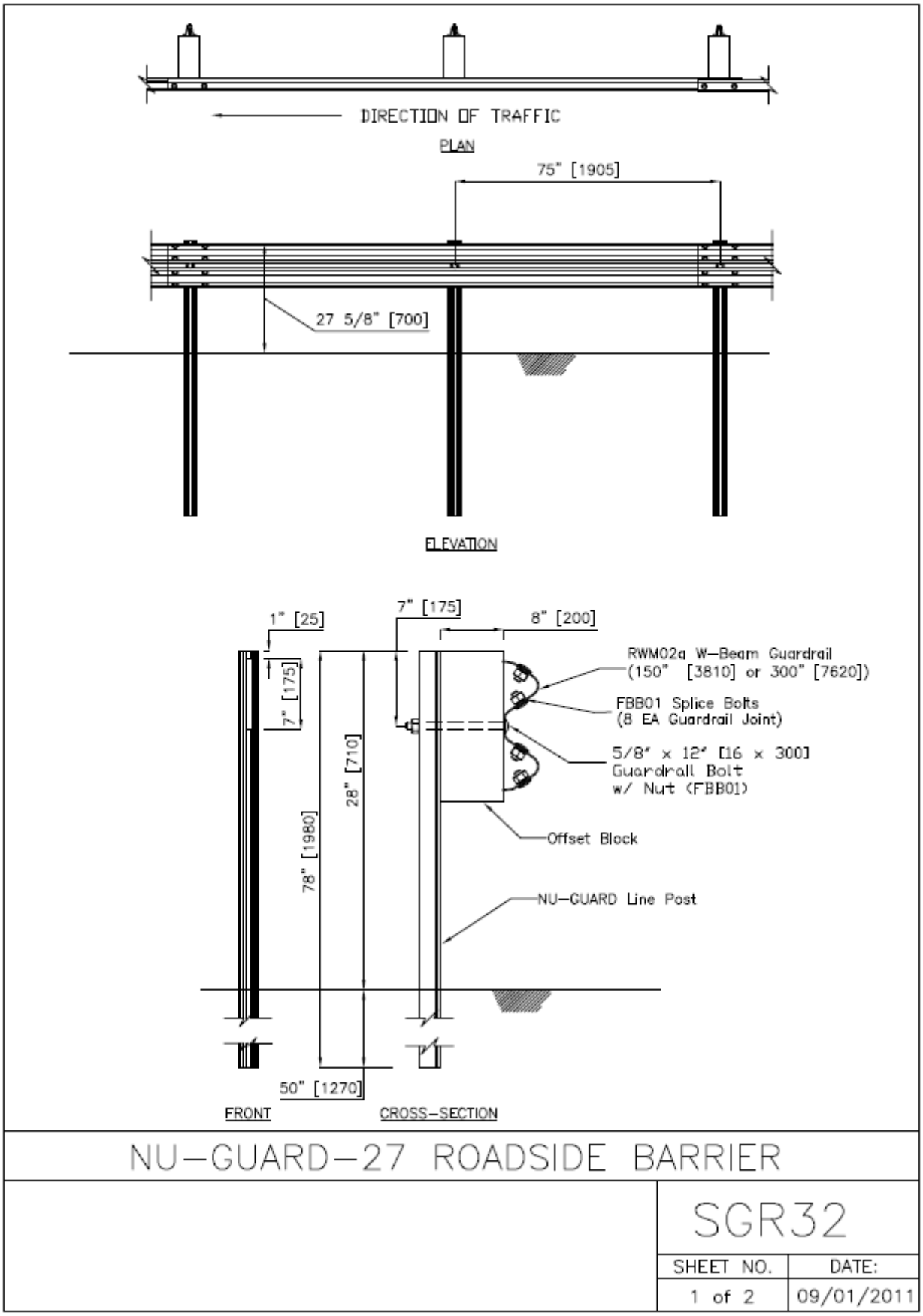
DETAILS

Barrier Systems

The following section includes details for the:

- Nu-Guard-27™ Roadside Option
- Nu-Guard-27™ Median Option
- Nu-Guard-31™ Roadside Option
- Nu-Guard-31™ Median Option

Nu-Guard-27™ Roadside Option



INTENDED USE

The NU-GUARD-27 system is a corrugated metal w-beam barrier for use on national, state and local roadways to prevent collisions with hazards as required by safety design standards. The system is designed for roadside applications as an alternate to SGR04, for strong or weak post applications. The system may be connected to any crashworthy 27 5/8" [702] mounting height guardrail terminal or transition system. The system is to be installed on approach slopes no greater than 10H:1V, wherever a maximum working deflection of 45" [1150] is required. The system posts may be used interchangeably, in lieu of timber and steel posts, when maintaining strong-post W-Beam guardrails (SGR04).

COMPONENTS

The posts are Rib-Bak U-Channel sign posts 5 lb/ft [7.4 kg/m] fabricated from hot rolled carbon steel bars conforming to the requirements of NUCOR/Marion Steel Company Grade SP-80 with a minimum yield point of 80,000 psi [552 MPa].

Unit length = 150" [3810]

Designator	Component	Number
RWM02a	W-beam rail	1
	NU-GUARD Line Post	2
	Offset Block	2
	12" [300] Guardrail-post bolt and nut	2
FBB01	Splice bolt and nut	8

The system meets NCHRP-350 TL-3 requirements as a longitudinal barrier.

AGENCY ACCEPTANCE

FHWA Acceptance Letter B-162, 09/11/2007
FHWA Acceptance Letter B-186, 08/03/2009

CONTACT INFORMATION

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912 Cheney Avenue
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www.nucorhighway.com

NU-GUARD-27 ROADSIDE BARRIER

SGR32

SHEET NO.	DATE
2 of 2	09/01/2011

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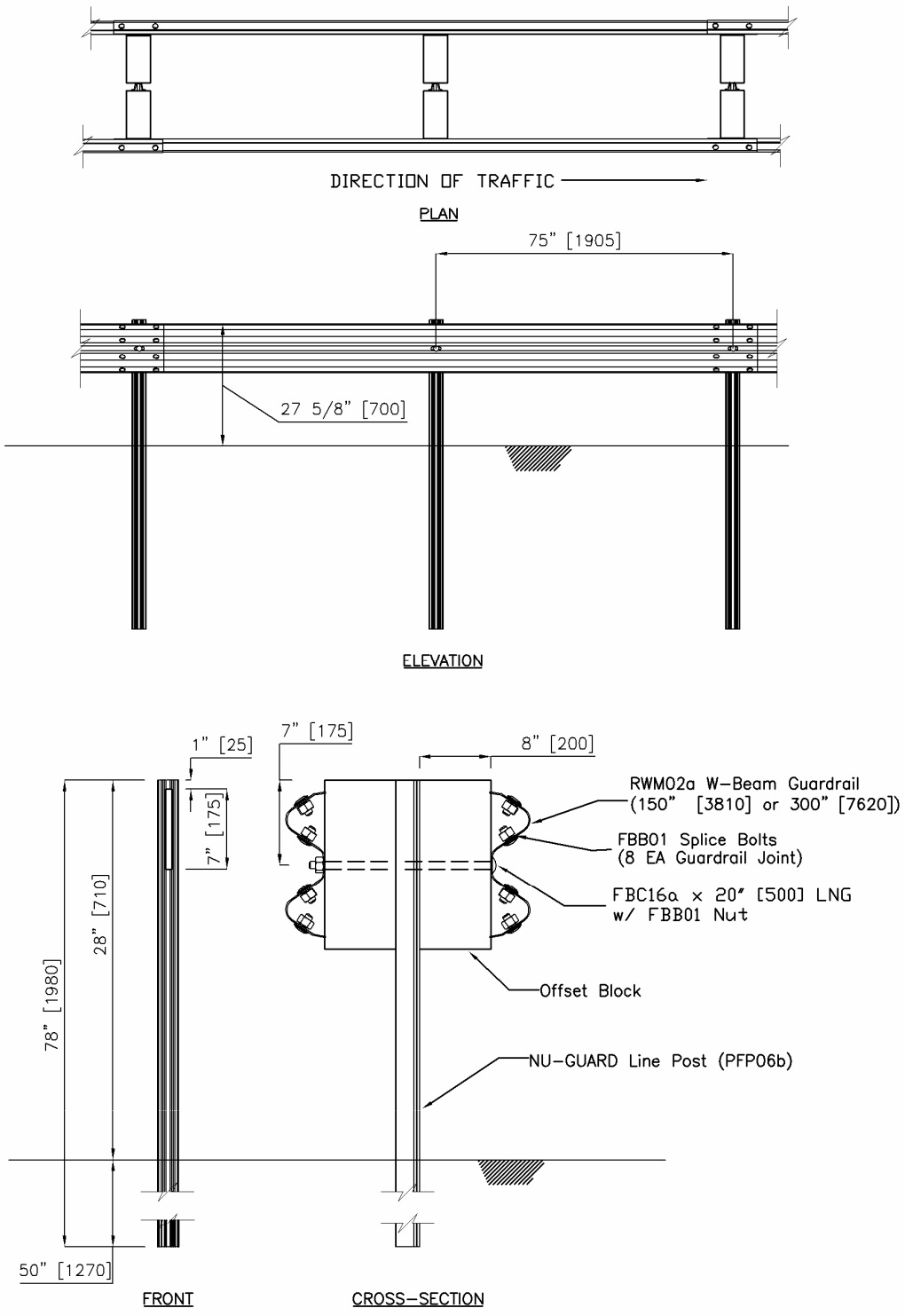
All Nucor Steel Marion Inc. products are produced from 100% recycled steel.

Nu-Guard-27™ Median Option



NU-GUARD-27 MEDIAN BARRIER		
	SGM24	
	SHEET NO.	DATE:
	1 of 2	10/01/09

INTENDED USE

The NU-GUARD-27 median system is a corrugated metal w-beam barrier for use on national, state and local roadways to prevent collisions with hazards as required by safety design standards. The system is designed for median applications as an alternate to SGR04, for strong or weak post applications. The system may be connected to any crashworthy 27 5/8" [702] mounting height guardrail terminal or transition system. The system is to be installed on approach slopes no greater than 10H:1V, wherever a maximum working deflection of 45" [1150] is required. The system posts may be used interchangeably, in lieu of timber and steel posts, when maintaining strong-post W-Beam guardrails (SGR04).

COMPONENTS

The posts are Rib-Bak U-Channel sign posts 5 lb/ft [7.4 kg/m] fabricated from hot rolled carbon steel bars conforming to the requirements of NUCOR/Marion Steel Company Grade SP-80 with a minimum yield point of 80,000 psi [552 MPa].

Unit length = 150" [3810]

Designator	Component	Number
RWM02a	W-beam rail	2
PFP06b	NU-GUARD Line Post	2
	Offset Block	4
FBC16a	20" [500] Guardrail-post bolt and nut	2
FBB01	Splice bolt and nut	16

The system meets NCHRP-350 TL-3 requirements as a longitudinal barrier.

AGENCY ACCEPTANCE

FHWA Acceptance Letter B-162, 09/11/2007
FHWA Acceptance Letter B-186, 08/03/2009

CONTACT INFORMATION

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NU-GUARD-27 MEDIAN BARRIER

SGM24	
SHEET NO.	DATE
2 of 2	10/01/2009

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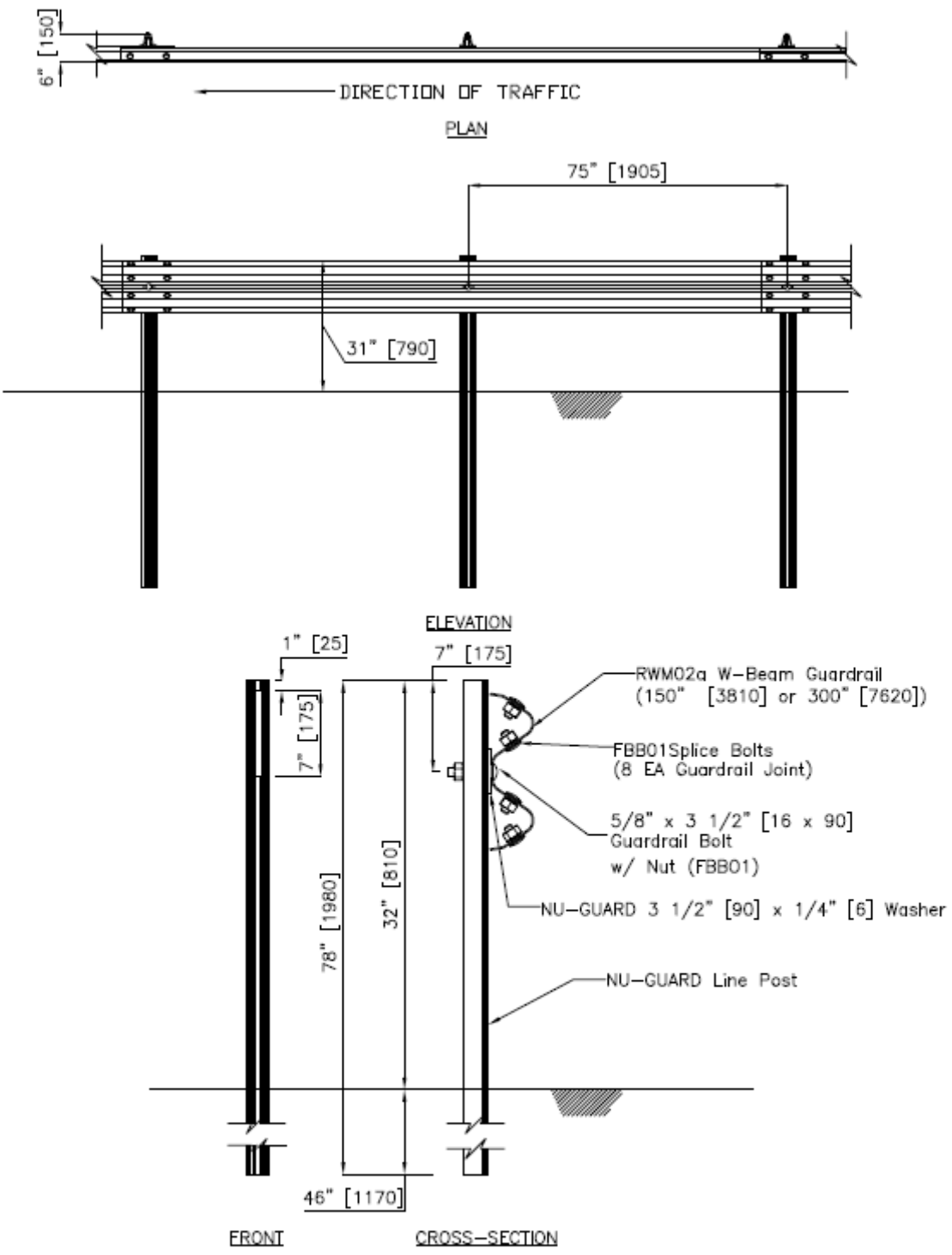
Nu-Guard-31™ Roadside Option



NU-GUARD-31 ROADSIDE BARRIER		
	SGR33	
	SHEET NO.	DATE:
	1 of 2	09/01/2011

INTENDED USE

The NU-GUARD-31 system is a corrugated metal w-beam barrier for use on national, state and local roadways to prevent collisions with hazards as required by safety design standards. The system is designed for roadside applications as an alternate to SGR04, and equivalent to other 31" [790] mounting height w-beam barriers (such as SGR20), for strong or weak post applications. The system may be connected to any crashworthy 31" [790] mounting height guardrail terminal or transition system. The system is to be installed on approach slopes no greater than 10H:1V, wherever a maximum working deflection of 41" [1050] is required for TL-3 applications, and 48" [1220] for TL-4 applications.

COMPONENTS

The posts are Rib-Bak U-Channel sign posts 5 lb/ft [7.4 kg/m] fabricated from hot rolled carbon steel bars conforming to the requirements of NUCOR/Marion Steel Company Grade SP-80 with a minimum yield point of 80,000 psi [552 Mpa]

Unit length = 150" [3810]

Designator	Component	Number
RWM02a	W-beam rail	1
	NU-GUARD Line Post	2
	NU-GUARD 3 1/2" [90] x 1/4" [6] Washer	2
	3 1/2" [90] Guardrail-post bolt and nut	2
FBB01	Splice bolt and nut	8

The system meets NCHRP-350 TL-4 and MASH-08 TL-3 requirements as a longitudinal barrier.

AGENCY ACCEPTANCE

FHWA Acceptance Letter B-162, 09/11/2007

CONTACT INFORMATION

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NU-GUARD-31 ROADSIDE BARRIER

SGR33

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2 of 2	09/01/2011

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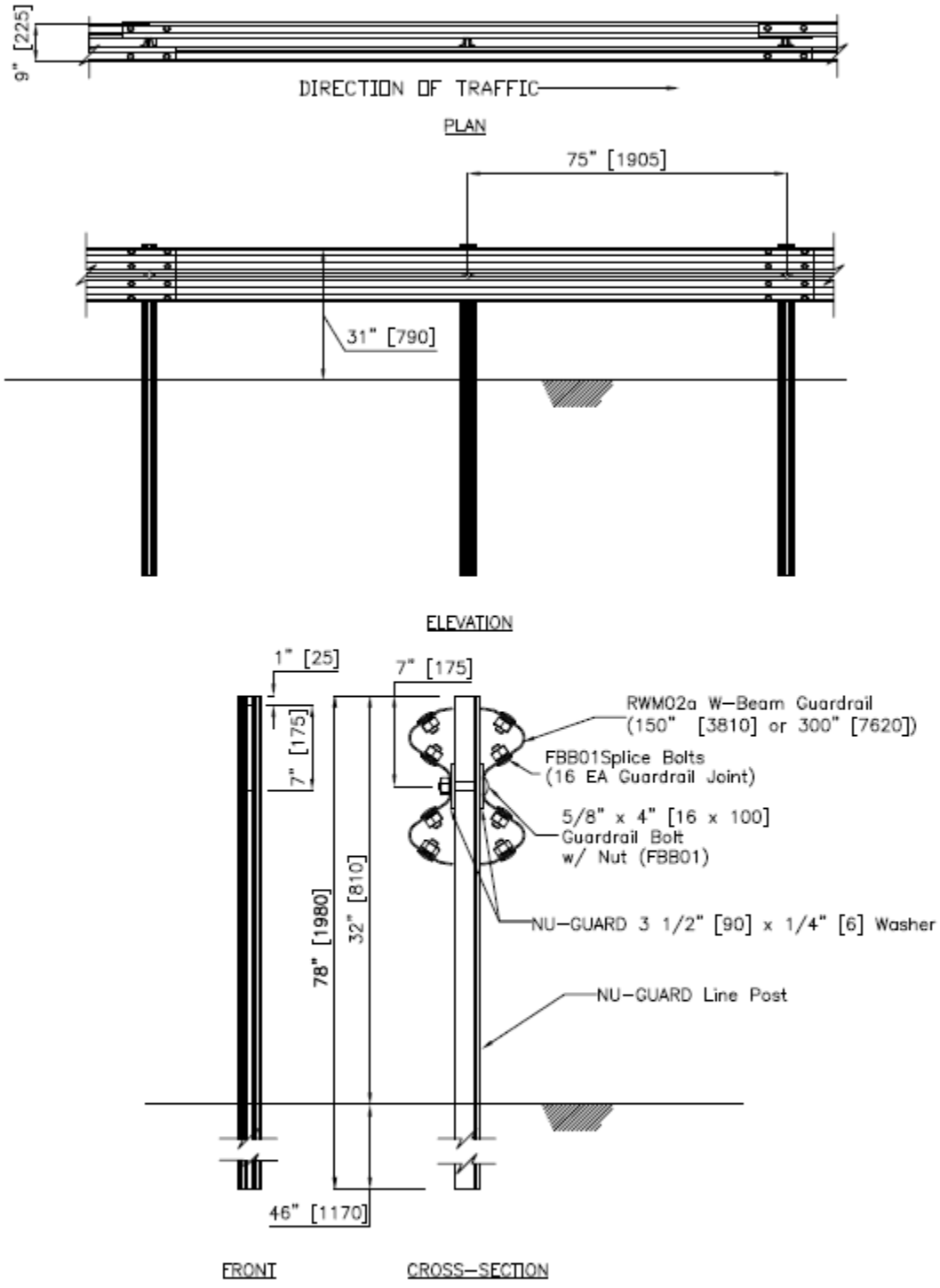
Nu-Guard-31™ Median Option



NU-GUARD-31 MEDIAN BARRIER

SGM25

SHEET NO.	DATE:
1 of 2	09/01/2011

INTENDED USE

The NU-GUARD-31 median system is a corrugated metal w-beam barrier for use on national, state and local roadways to prevent collisions with hazards as required by safety design standards. The system is designed for median installations as an alternate to SGR04, and equivalent to other 31" [790] mounting height w-beam barriers (such as SGR20) for strong or weak post applications. The system may be connected to any crashworthy 31" [790] mounting height guardrail terminal or transition system. The system is to be installed on approach slopes no greater than 10H:1V, wherever a maximum working deflection of 41" [1050] is required for TL-3 applications, and 48" [1220] for TL-4 applications.

COMPONENTS

The posts are Rib-Bak U-Channel sign posts 5 lb/ft [7.4 kg/m] fabricated from hot rolled carbon steel bars conforming to the requirements of NUCOR/Marion Steel Company Grade SP-80 with a minimum yield point of 80,000 psi [552 Mpa].

Unit length = 150" [3810]

Designator	Component	Number
RWM02a	W-beam rail	2
	NU-GUARD Line Post	2
	NU-GUARD 3 1/2" [90] x 1/4"[6] Washer	4
	4" [100] Guardrail-post bolt and nut	2
FBB01	Splice bolt and nut	16

The system meets NCHRP-350 TL-4 and MASH-08 TL-3 requirements as a longitudinal barrier.

AGENCY ACCEPTANCES

FHWA Acceptance Letter B-162, 09/11/2007

CONTACT INFORMATION

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NU-GUARD-31 MEDIAN BARRIER

SGM25

SHEET NO.	DATE
2 of 2	09/01/2011

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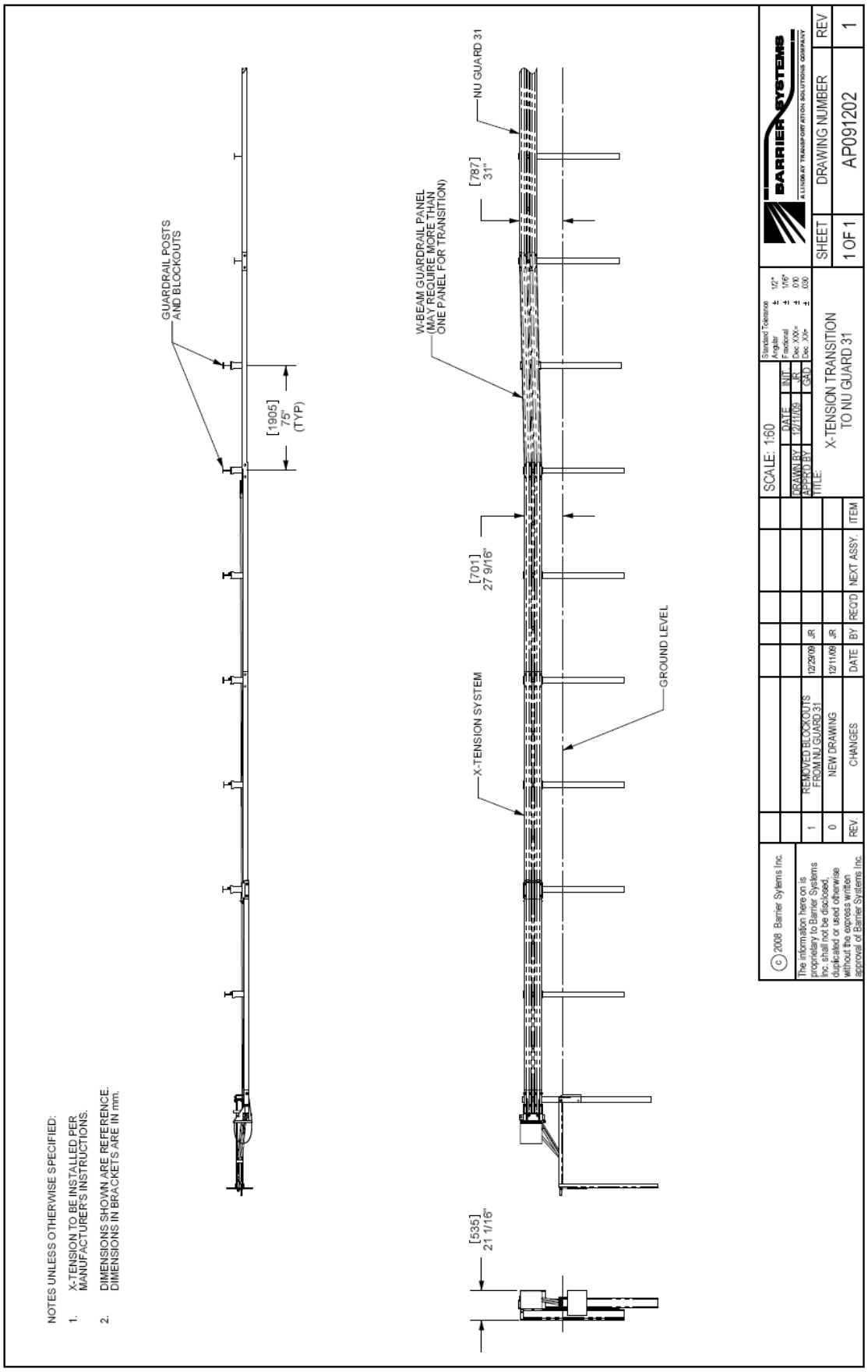
Terminal Systems

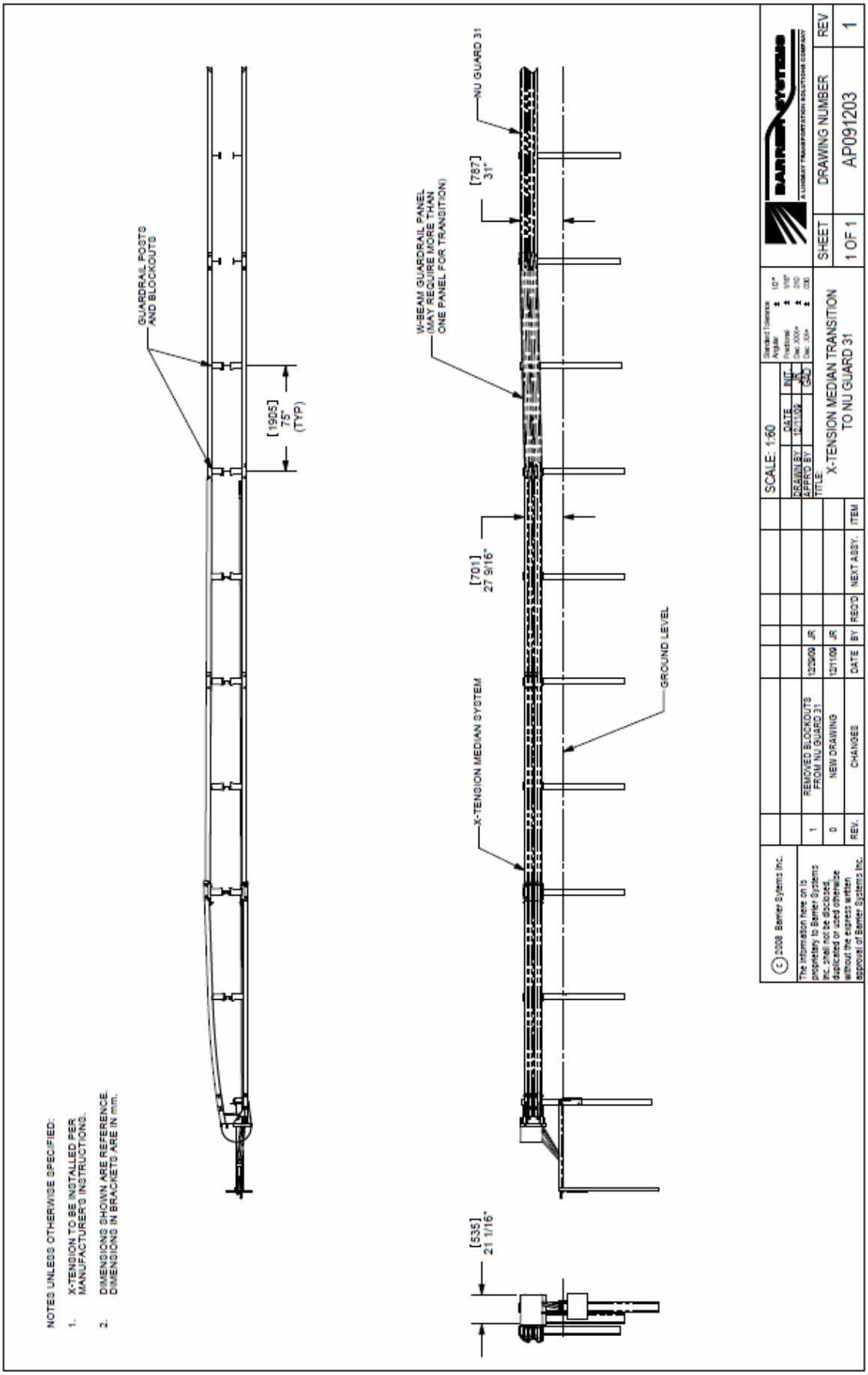
The following section includes details for the:

- Nu-Guard™ Roadside Terminal
- Nu-Guard™ Median Terminal
- Nu-Guard™ Impact Attenuator Transition
- Nu-Guard™ Trailing & Low-Speed Anchor System

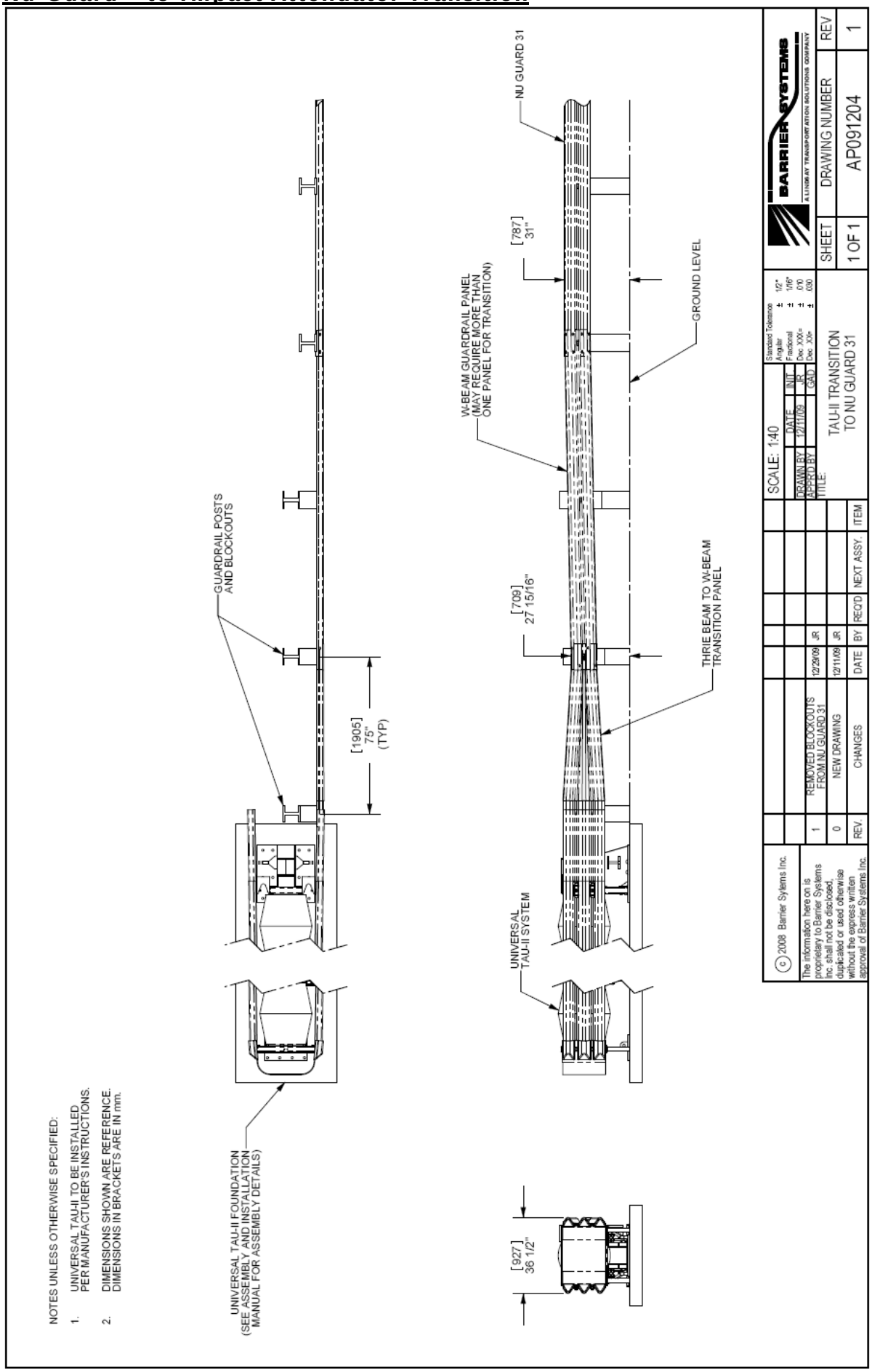
Nu-Guard™ Roadside Terminal



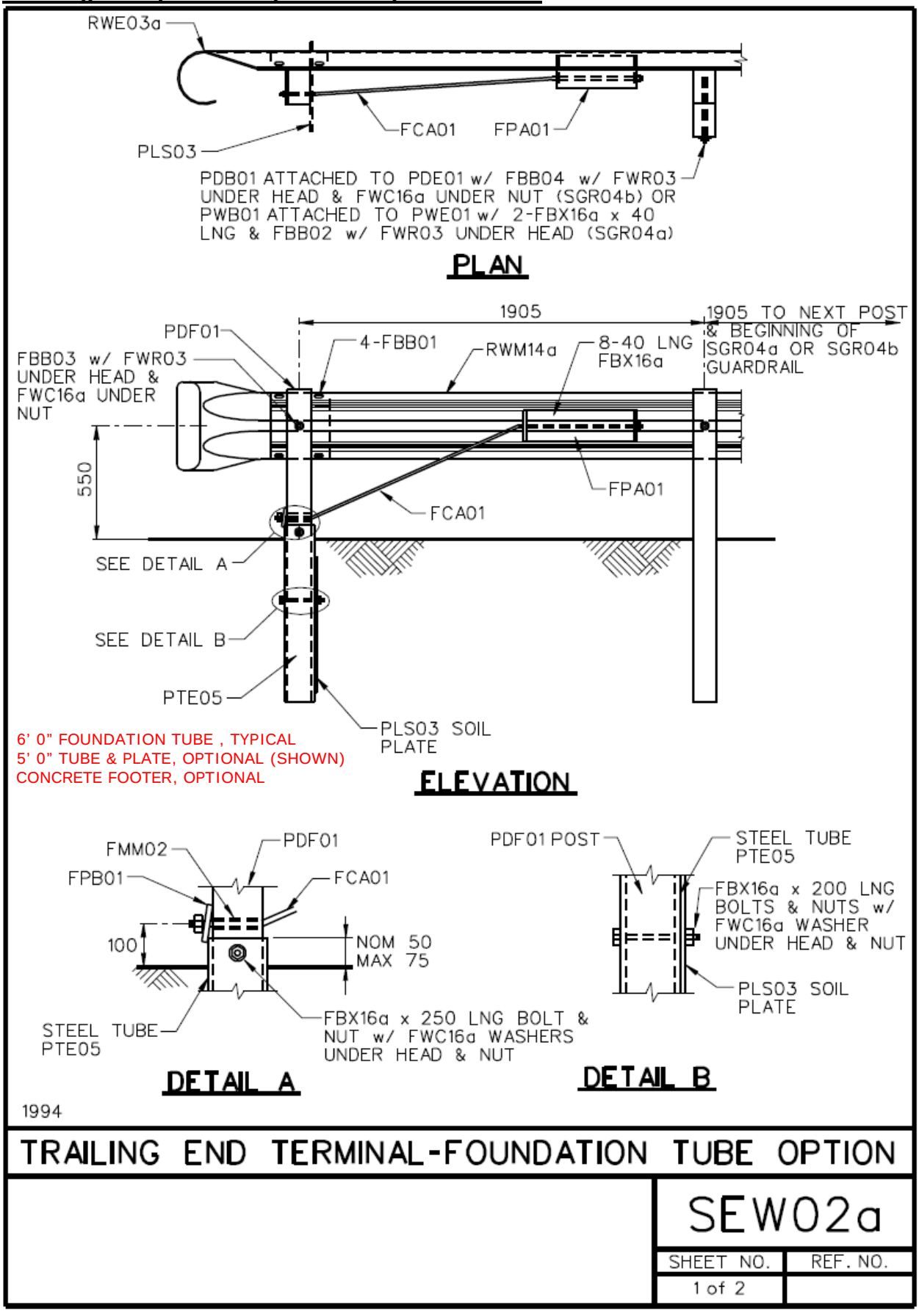
Nu-Guard™ Median Terminal



Nu-Guard™ to Impact Attenuator Transition

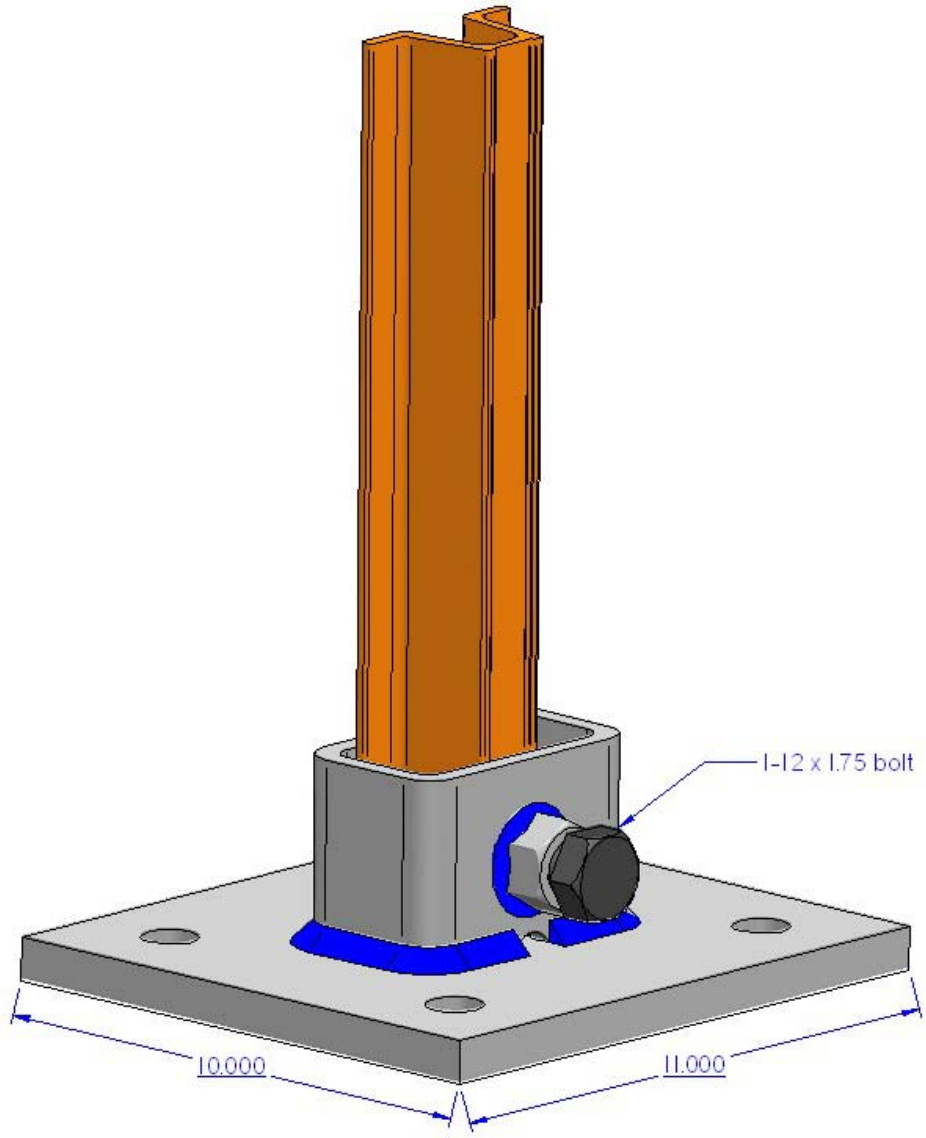


Trailing End (Shielded) & Low-Speed Anchor



Source AASHTO Hardware Barrier Guide

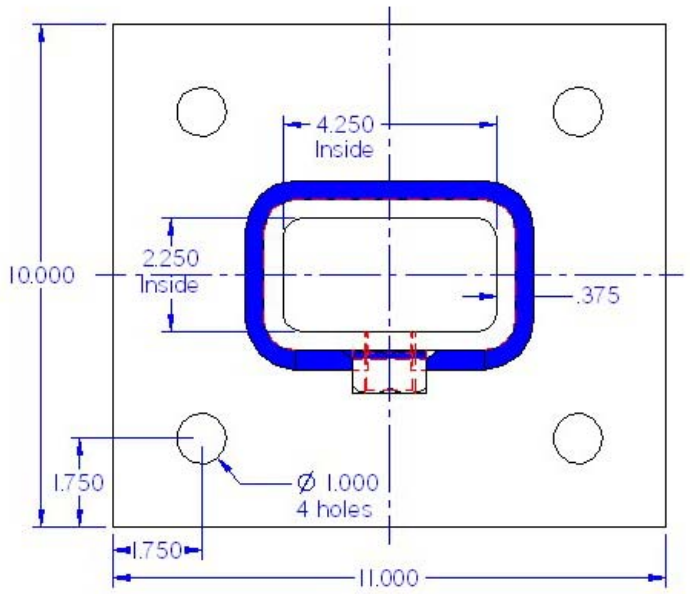
Deck & Culvert Mounted Post Attachment



28 lbs each before galvanize
Surface Area: 385.35in^2

Table of Revisions					
No.	Date	Description	Rev.	CK	AP

Tolerance: XX.XXX = ±.03 Angles ± 1° Unless Specified	CENMAC
	Bridge Socket
Material: Low Carbon Steel	Drawn By: mattc
	Rev: ---
12/15/2009	Pt #CMI-
Pg 1 of 5	File: Bridge Socket with postasm



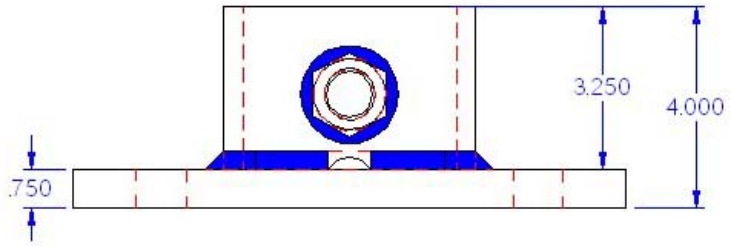


Table of Revisions					
No.	Date	Description	Rev.	CK	AP

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	Bridge Socket
Material: Steel Low Carbon Steel	Drawn By: mattc
	Rev: ---
12/15/2009	Pt #CMI-
Pg 2 of 5	File: Bridge Socket.pwd

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