

Nu-Flex™ Roadway Barrier System Installation Manual v2017.10A



It's Our Nature. 

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INTRODUCTION

LIMITATIONS AND WARNINGS

Nu-Flex™ barriers have been rigorously tested and evaluated per the evaluation criteria in the MASH TL 3 guidelines for longitudinal barriers. The impact conditions recommended in MASH TL 3 are intended to address typical in-service collisions.

Nu-Flex™ barriers allow an impacting vehicle to be re-directed in a safe and predictable manner under the MASH TL 3 impact conditions. It is imperative that the system is installed as per manufacturers' specification.

Vehicle impacts that vary from the MASH TL 3 impact conditions described for longitudinal barriers may result in significantly different results than those experienced in testing. Vehicle impact characteristics different than, or in excess of, those encountered in MASH TL 3 testing (weight, speed and angle) may result in system performance that may not meet these evaluation criteria's.

INSTALLATION CONSIDERATIONS

The Nu-Flex™ 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.

SAFETY STATEMENT

All required traffic safety precautions should be complied with. All workers should wear required safety clothing (Examples, and not limited to, include: high visibility vests, steel capped footwear, gloves etc.)

Only authorized trained personnel should operate any machinery. Where overhead machinery is used, care must be taken to avoid any overhead hazards.

Before installing the posts, always ensure that the area is clear of underground services. (The appropriate service providers may need to be contacted)

All installers must be well clear of machinery when posts are being driven.

The posts and connection hardware are easily lifted and positioned by hand. While a w-beam guardrail panel should be moved and positioned by 2 personnel and care should be taken not to have fingers near the bolt holes while being maneuvered.

SYSTEM OVERVIEW

INTENDED USE

Nu-Flex™ is a MASH Test Level 3 barrier and is used where dynamic deflections of at least 88 inches [2235mm] are acceptable. This system must be anchored with a suitable terminal system. Crashworthy terminals can be transitioned to and used with this guardrail system.

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

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

APPROVALS & TESTING

B-288 Nu-Flex™ with no block, for MASH Test Level 3 roadside application

DEFLECTION SUMMARY

System Type	Dynamic Deflection	Working Width
Nu-Flex™ (MASH TL-3-11)	88" (2235mm)	97" (2464mm)
Nu-Flex™ (MASH TL-3-10)	48" (1220mm)	55" (1397mm)

Table 1

Outside of tested performance limitations, the systems may also perform adequately in redirecting larger vehicles if site specific speed and angle are considered against tested values. For instance, the Nu-Flex™ is an acceptable barrier for tractor trailers in loading facilities to prevent accidental contact with building or drainage structures. Contact Nucor Steel Marion Inc. for guidance regarding non-roadway applications.

ANCHOR SYSTEMS

The Nu-Flex™ 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-Flex™ system must be installed with any contractor provided anchorage device which meets the appropriate test level of MASH TL3 criteria.

For **trailing (downstream)** anchor systems, the Nu-Flex™ system may be installed as above with an appropriate test level of MASH TL3 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.

SITE CONSIDERATIONS

SITE PREPARATION



Figure 1

The initial layout for the Nu-Flex™ 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.

CURBS

As with all road side safety hardware, Nu-Flex™ has been designed and tested so that the center of gravity of the impacting vehicle is at a constant height in relation to the barrier. For this reason, it is preferred that curbs or channels are not installed in front of the barrier as they will result in altering the height of the vehicle at impact. If there is no option but to install a curb or if it is already present consult local guidelines regarding curb height and design, and barrier offset distance.

UNDULATING GROUND CONDITIONS

Site specific grading may be necessary to ensure that there are no 'humps' or 'hollows' that may significantly alter the impacting vehicles stability or substantially alter the barrier height in relation to the ground.

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.

SOIL CONDITIONS

Nu-Flex™ posts require sufficient strength from the supporting soil to function as required and remain at the correct height. The ground conditions need to withstand a push test of 2700lbs (12kN) at 25" (635mm) above ground level. Follow the testing method shown below to determine soil conditions on site. **If it is determined that soil conditions on site do not meet or exceed these requirements, or if the soil is not compliant with local strong soil specifications, alternative post embedment options will need to be considered.**

POST SPACING

The **line post spacing** is standardized at **6'-3" (1905mm)**. Alternate post spacing may be used when necessary due to conflicts with utilities, culverts, or other low-fill sites where maximum post embedment cannot be achieved. The distance between posts may be adjusted **WITHIN** a 12'-6" span, however the post spacing must **NOT** exceed 12'-6" unless a crashworthy long-span design is approved by the project engineer.

FLARE RATES

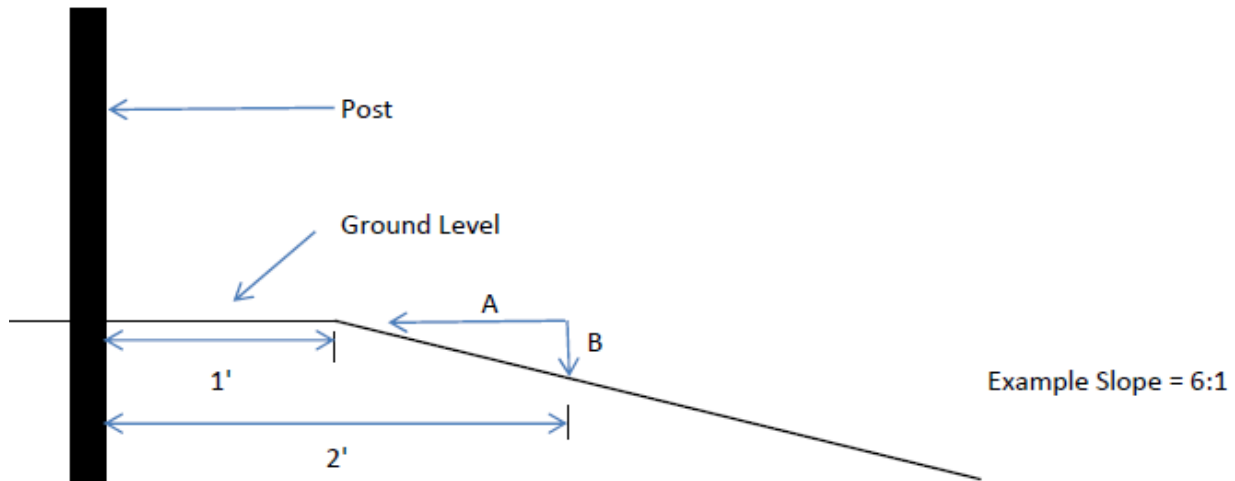
Take into consideration any local guidelines for flare rates required from approach (upstream) anchor traveling towards the hazard (downstream). Flare rates towards the roadway edge-of-pavement are important as they can influence both the driver reaction to perceived roadside obstacles (aka, the "shy 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.

POST LENGTH NEAR SLOPE BREAK POINT

There should be at least 2' 0" (0.6m) behind the post to the slope breakpoint.

For situations where less than 2' 0" (0.6m) of soil is available, or if the soil is not compliant with strong soil specifications, the post length should be increased to provide adequate soil resistance. Use the following guidance to determine appropriate post length. **Be sure to refer to any local standards or specifications which may supersede these recommendations.**

Post Length Calculator



- 1 Measure out from the break-point to the 2.00' point from where the post was driven.
- 2 Measure down to the point where stable soil is reached.

Ex If A = 1' and the slope is 6':1', B will = 2".

- 3 If B = 1"-3", add 6" to the overall post length.
If B = 3+"-6", add 12" to the overall post length.
If B = 6+"-8", add 18" to the overall post length.
If B = 8+"-12", add 24" to the overall post length.
- 4 The slope can be as steep as 1:1 and as shallow as 10:1.
Calculations will need to be adjusted accordingly.

The normal embedment depth of typical 6' 6" post with 2 feet to the break is 3' 10", presumably all in stable soil. Using the original premise that soil stability is reached at 2 feet behind the post, and that you need the embedment depth below that level, increase the post length accordingly to provide adequate soil resistance. It is recommended to use multiples of 6" lengths rather than odd lengths.

Slope	A	=	B	Additional Post Length
4:1	1'	=	3"	6"
2:1	1'	=	6"	1'
1.5:1	1'	=	8"	1.5'
1:1	1'	=	12"	2'

Figure 2

LATERAL OFFSET

To determine the barrier offset from the travel lane, follow these guidelines from the FHWA. **Be sure to refer to any local standards or specifications which may supersede these requirements.**

The designer determines the barrier offset, L2, taking into consideration a number of issues. Table 4.1 lists these considerations, in order of importance.

Figure 4.2: Considerations for Selecting L2 In Order of Importance

- a. Available hazard offset
- b. Slopes in front of the barrier
- c. Presence of curbs
- d. Soil Support Behind the Barrier
- e. Available Shoulder
- f. Shy Line Offset
- g. Location

Each of these considerations is discussed below:

Available Hazard Offset. Tables 3.2, 3.3 and 3.4 match appropriate barrier types with the available hazard offset. The hazard offset includes both the deflection distance and the depth of the barrier system. This criterion is not as important for hazards that go down, such as steep downward slopes, as for hazards that protrude upwards.

Slopes in Front of the Barrier. Maintain a slope of 1V:10H or flatter in front of the barrier. This should include any flare in the barrier and the approach to the end treatment. Conventional cable and some of the high-tension cable systems have been successfully tested on 1V:6H slopes. Although the flatter slopes are preferable, it may be a reasonable trade-off to accept slopes as steep as 1V:6H in front of barriers if the speeds are 40 km/h (25 mph) or lower.

Presence of Curbs. Avoid placing barriers if curbs are present. Specific criteria include:

1. It is preferable to not use barriers with curbs at speeds 80 km/h (50 mph) and higher. If necessary, the best location for the barrier is in front of the curb. If the curb is sloped and no higher than 100 mm (4 in) the barrier may be placed flush with the face of the curb. Do not place a wall-type (CSS, PCG, or SMG) barrier on top of a curb. Remove the curb if necessary. A shoulder gutter design may be good option to a curb.
 2. Avoid placing barriers with curb present at speeds 50 km/h (30 mph) to 70 km/h (45 mph). If necessary, the best location for the barrier is in front of the curb. If the curb is sloped and no higher than 150 mm (6 in) the barrier may be placed flush with the face of the curb. Do not place a walltype (CSS, PCG, or SMG) barrier on top of a curb. Remove the curb if possible. A shoulder gutter design may be good option to a curb.
 3. It is acceptable to place curbs in line with the face of a barrier at speeds 40 km/h (25 mph) and lower.
- o **Soil Support Behind the Barrier Post.** For strong post systems, ensure that at least 0.6 m (2 ft) are present from behind the posts to a slope hinge. At speeds 50 km/h (30 mph) and lower this criterion can be reduced to 0.3 m (1 ft). This criterion ensures the soil support necessary for the posts to resist deflection. This is not an important issue for either rigid or flexible systems. If

this criterion cannot be achieved, 2.1 m (7 ft)-long posts or halved post spacing can be used to mitigate the loss of soil support. If this criterion cannot be achieved, then the strong post system will deflect more than indicated in Chapter 3 and Appendix B.

- Available Shoulder. If possible, the full shoulder should be provided plus at least 0.6 m (2 ft). This allows the shoulder to function as designed and allows a vehicle to park on the shoulder and occupants to exit out the passenger door.
- Shy Line Offset. The shy line offset, as discussed earlier, should be provided if possible. This is not usually an important issue on low volume roads.
- Location. Locate the barrier as far from the road as possible, taking into consideration all the above criteria. The further away from the edge of the traveled way, the more recovery area is available for errant vehicles and there is less barrier to build and maintain.

*(*Source: FHWA, Overview of the AASHTO Roadside Design Guide Design Process, CHAPTER 4 BARRIER DESIGN AND PLACEMENT)*

INSTALLATION IN ROCK AND MOW STRIPS

As rock, concrete or thick asphalt surrounding the **Nu-Flex™** post has no flexibility, unlike soil, it can create a pinch point. In a vehicle impact this may cause the post installed in the hard surface to snap very quickly and as a result not give enough support to the highway rail to perform as designed.

The recommended treatments typically involve creating a hole in the hard surface around the post to remove the possibility of any pinch point and fill with a low strength concrete/grout or flexible asphalt.

Various configurations for posts installed in rock and mow strips may be available. Please refer to local specifications. Various examples are provided below:

US DOT FHWA, "W-Beam Guardrail Installations in Rock and Mowing Strips", HSA-10/B64-B, March 2004
https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/barriers/pdf/b64b.pdf

NZ TRANSPORT AGENCY, "Using low strength concrete around guardrail posts", TM-2005, December 2011
<https://www.nzta.govt.nz/assets/resources/using-low-strength-concrete/docs/tm2005.pdf>

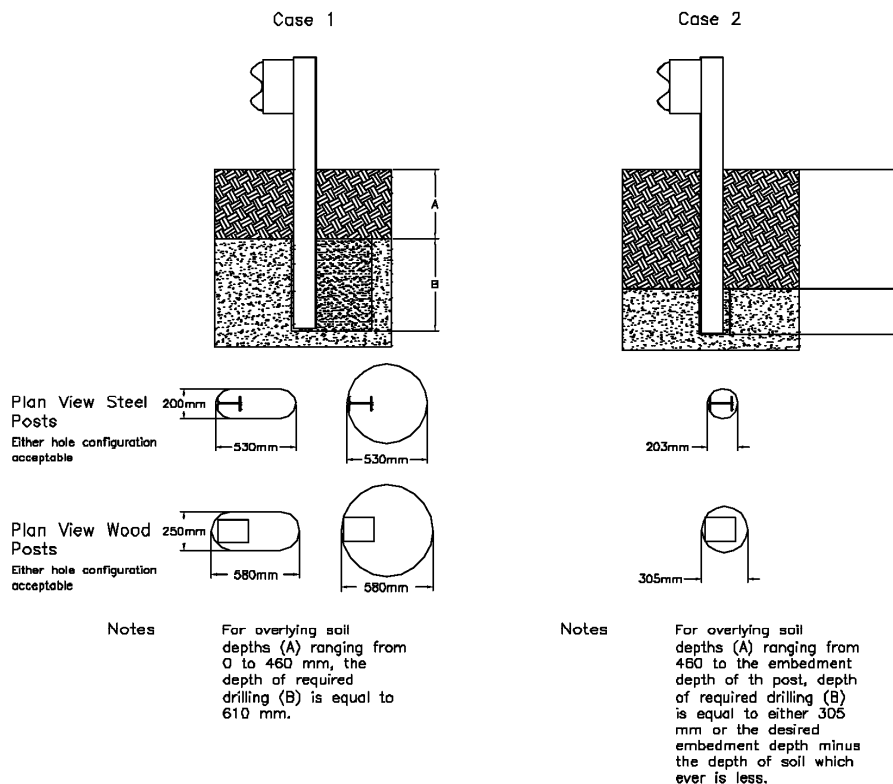


Figure 3

(*Source: FHWA, W-Beam Guardrail Installations in Rock and in Mowing Strips, HSA-10/B64-B, March 10, 2004)

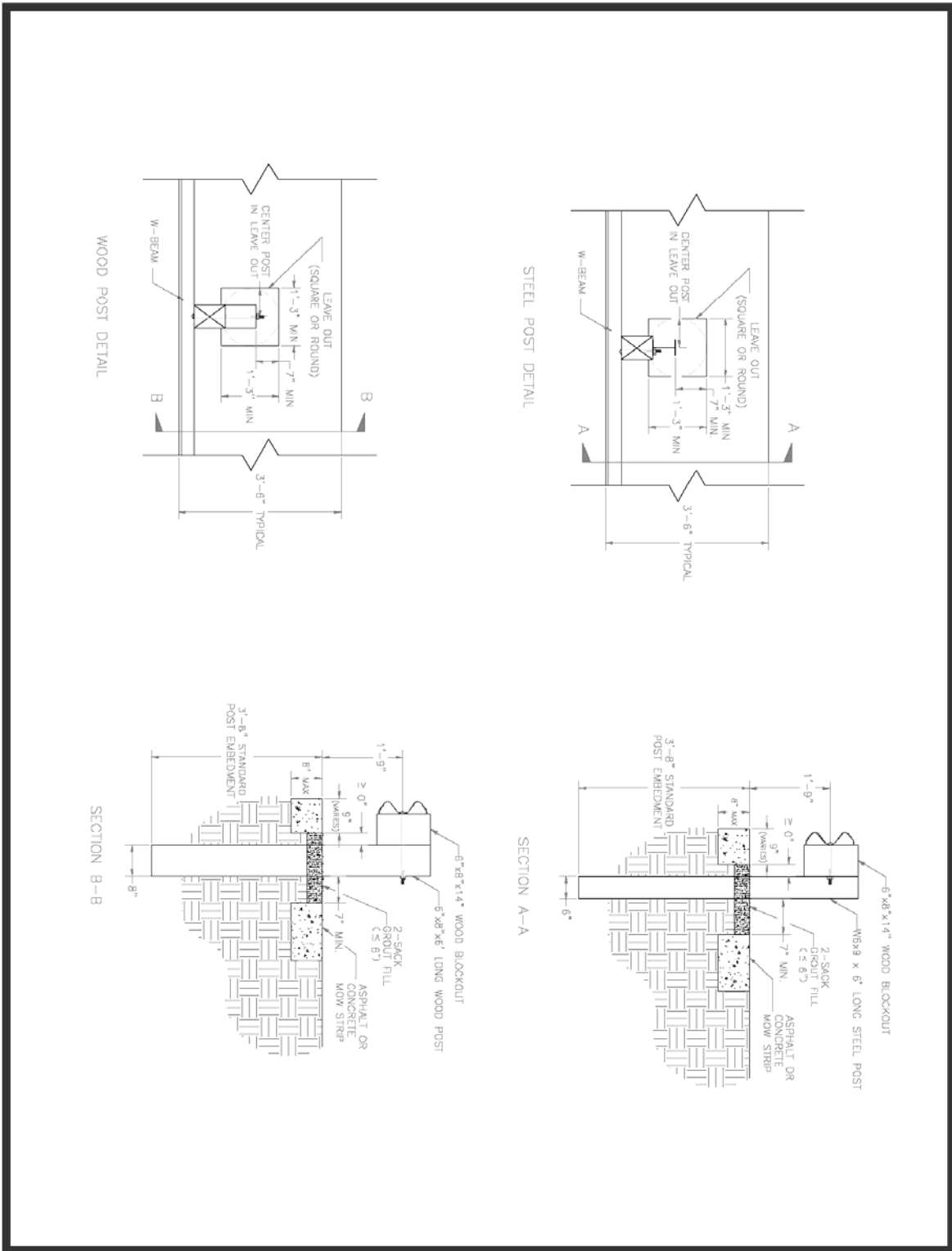
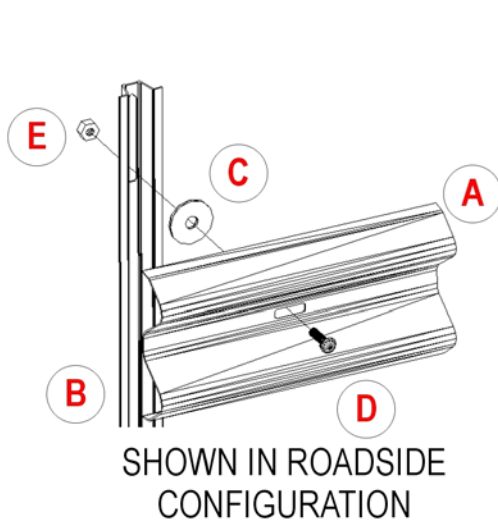


Figure 4

(*Source: FHWA, *W-Beam Guardrail Installations in Rock and in Mowing Strips*, HSA-10/B64-B, March 10, 2004)

COMPONENTS



A: RAIL:

W-BEAM, AASHTO M-180

B: POST:

4 lb./ft. (5.95 kg/m) X 6'-6" Rib-Bak[®] U-CHANNEL POST, GALVANIZED OR POWDER-COATED, NUCOR GRADE SP-80

C: SPACER WASHER:

FOR ROADSIDE: (1) 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

E: NUT:

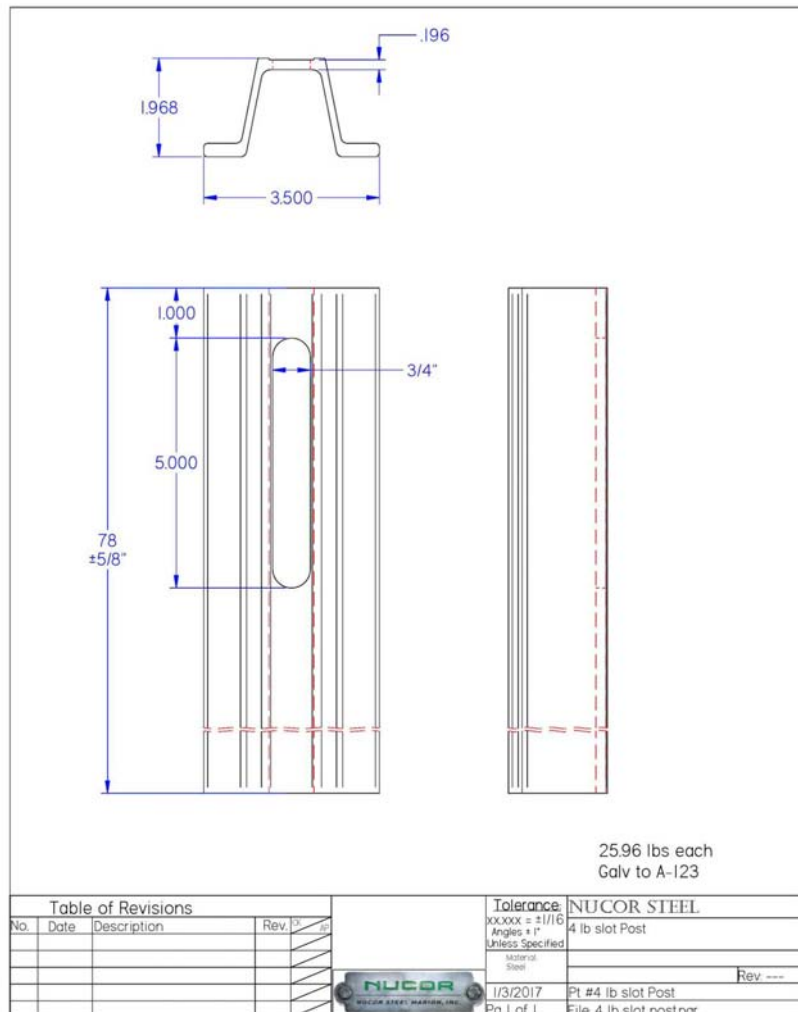
5/8" DOUBLE RECESSED NUT, GALVANIZED, ASTM A307

Figure 5

LINE POSTS

The system utilizes a **4# per foot (5.95 kg/m)** Rib-Bak[®] Line Post that is **6'-6" (1980mm)** long. No soil plate is required.

The Nu-Flex[™] post is identifiable as it contains only a single hole (slot) in the channel. This hole is **5" (125mm)** vertical and **3/4" (19mm)** wide beginning **1" (25.4mm)** down from the top of post. (Figure 6)



BEAM SECTIONS

The system utilizes a double corrugated metal guardrail beam corresponding to the requirements of **AASHTO M-180**. (Figure 7)

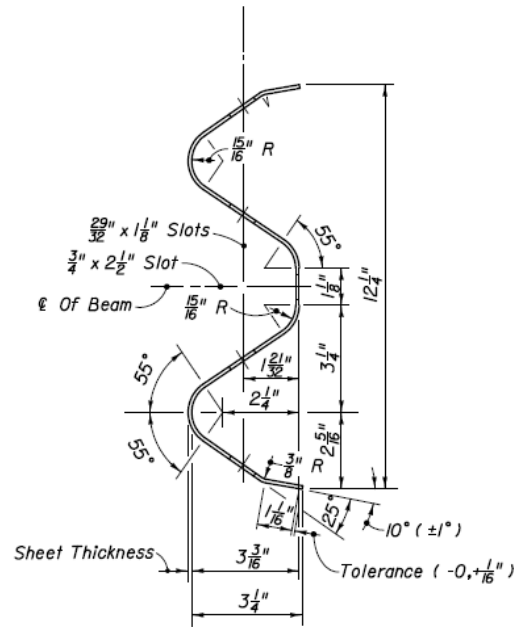


Figure 7

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 1/4" (6mm) beyond the nut face to provide for a double nut, where required. 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)

PARTS IDENTIFICATION



Standard highway rail



NU-FLEX™ Post



Splice (Guardrail) Bolts



Post Bolt, washer & Nut



**Protective Driving Insert
(Nylon)**

All Nu-Flex™ steel components are hot dipped galvanized

Figure 8

INSTALLATION

PREPARATION

Before installing Nu-Flex™, ensure that all components required for the system are on site and have been identified. Nu-Flex™ is a highly engineered safety device made up of small number of parts. Before starting installation ensure that one is familiar with the components of the system. Refer to the Parts Identification and Bill of Materials section in this manual for more information.

POST SPACING

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.

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.

POST ORIENTATION

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



Figure 9

POST ELEVATION

The preferred method for line posts is with a post-pounding device so as not to disturb the natural soil. (Figure 10) However, boring a hole/backfilling/tamping is also an allowable means of installation.

For extremely rocky soils, use of a 4" auger, which allows the post to be positioned while leaving enough space to be filled with a suitable backfill material.



Figure 10

Nu-Flex™

Center-line of W-Beam (string-line)	25" (635mm)*
Embedment Depth of Post	47" (1194mm)
Top of Post from Groundline	31" (787mm) +1"/-0" (+25/-0mm)

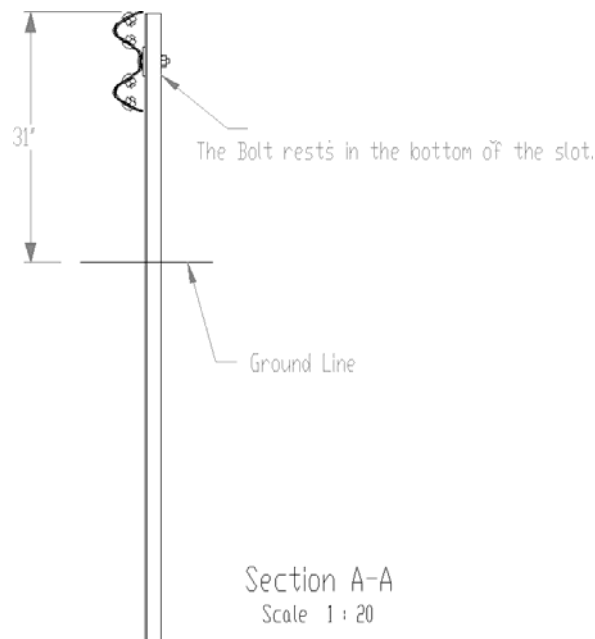


Figure 11

* For construction tolerances, please refer to FHWA Roadside Hardware Policy and Guidance for W-beam Guardrail.

DRIVING THE POSTS

Drive posts at predetermined position to the required depth using suitable machinery. (Figure 12, Figure 13, Figure 14)

For the roadside installation make sure that the post 'flanges' face the back of the rail.

Traditional installation methods used when installing 'other' w-beam guardrail utilising a string line, measuring tape and marker paint are also useful when applied to Nu-Flex™.

Protect the galvanising on top of the posts by using a protective insert



Figure 12



Figure 13



Figure 14

Note: If the conditions on site don't allow for the posts to be driven, contact Nucor Steel Marion Inc. for alternative installation methods.

JOINING GUARDRAIL PANELS

Lap the w-beam guardrail panels on the side of the posts with the direction of the laps the same as the direction of the traffic flow. (Figure 15, Figure 16, Figure 17)

Each 'splice joint' requires the w-beam guardrail panels to be joined using 8 splice bolts and tightened with a wrench or socket. (An impact wrench is optional)



Figure 15



Figure 16

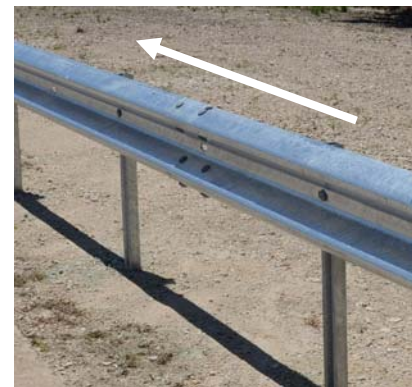


Figure 17

CONNECTING GUARDRAIL PANELS TO THE POSTS

Once the w-beam guardrail panels have been joined together on the traffic side of the posts they can be attached to the post.

Insert the post bolt through from the face of the guardrail with the spacer washer positioned between the back of the rail and the 'flanges' on the post. (Figure 18)

The bolt can then be secured at the back of the post with the splice bolt nut and tightened with a wrench ONLY. (Figure 19)

The post bolt typically rests at the bottom of the slot, but may vary based on changes in elevation. Ensure the top of the post and rail is at **31" (787mm)** and the centre of the w-beam guardrail panel is at **25" (635mm)** relative to the ground. (Figure 20)



Figure 18



Figure 19



Figure 20

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.

REPAIR & MAINTENANCE

In testing, a length of **30-60' (9-18m)** 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.



Figure 21

Refer to FHWA W-Beam Guardrail Repair Guide (Report No. FHWA-SA-08-002) for determining severity of damage and repair guidelines.

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.

MATERIALS FOR MAINTENANCE

Your Nu-Flex™ distributor carries an inventory of replacement parts to facilitate quick repair of an impacted system. In addition, it is recommended 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.

ADDITIONAL INFORMATION

FREQUENTLY ASKED QUESTIONS

Nu-Flex™

Is the Nu-Flex™ system MASH TL-3 only ?

Yes, the Nu-Guard-31-4# system can be in MASH TL-3 roadside applications, with a designed working width of 8'-1" (2460mm).

Can Nu-Flex™ be used with a block ?

No, it was only tested without an offset block. In cases where a block-out is required, utilize the Nu-Guard-27 system, which can be used in rail heights ranging from 27" to 31".

Can Nu-Flex™ be used at a 29" rail height ?

The Nu-Guard-31-4# is intended to be installed with a rail height of 31", with an installation tolerance of +1"/-0" (+25/-0 mm).

General Questions

What type of equipment is required to install Nu-Flex™ ?

Standard tools required include 1 ¼" (32mm) sockets and wrenches, measuring tape and a string line. Machinery includes post driver commonly used in driving posts.

On average, how long does it take to install a Nu-Flex™ Barrier?

Depending on the application and circumstances at the site, installation and assembly of the system should take a three person crew less than 2 hours to install a 150' (50m) section.

When driving the posts what can be used to prevent damage to the galvanizing on the top of the posts?

It is recommended that a timber, plastic or brass insert is fitted to the device being used to drive the posts. (Experience has shown that a brass insert will last the longest)

How easily can Nu-Flex™ be restored after impact?

The system is made up of very few different components and is easily repaired. Machinery will be required to lift out the damaged posts and drive the new ones. The remainder of the barrier requires only a wrench and 1 ¼" (32mm) socket to take apart and reinstate.

Does your company provide spare parts?

Yes, it is important to fix a damaged barrier as soon as possible because it most probably won't perform as required when damaged. For this reason it is recommended that spare Nu-Flex™ key components are held by Maintenance Contractors along with the standard w-beam guardrail hardware. Replacement hardware is available from your Nu-Flex™ Distributor, and recommendations for quantities to keep on hand are shown in the Repair & Maintenance section of the Nu-Guard Installation Manual.

What can Nu-Flex™ be connected to?

Nu-Flex™ systems must be anchored at either end by either an approved terminal end, transition section or w-beam guardrail. For further information consult local standards and qualified products.

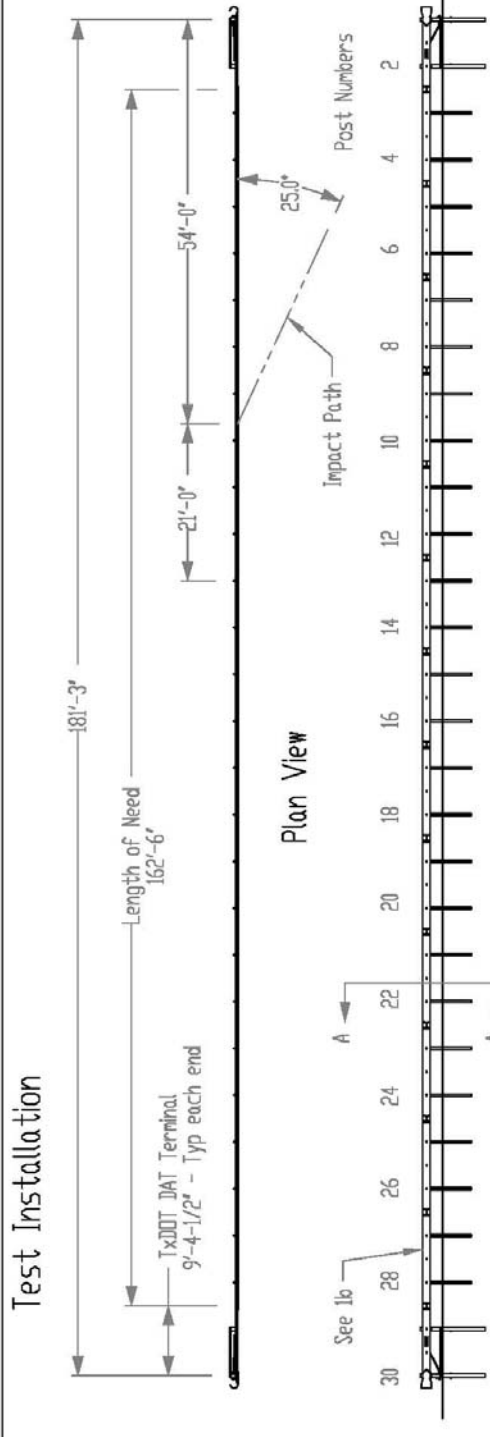
INSTALLATION CHECKLIST

This is a minimum recommended list of installation factors to consider towards evaluating construction of the Nu-Flex™ System. There may be additional requirements as directed by local guidelines or project specifications.

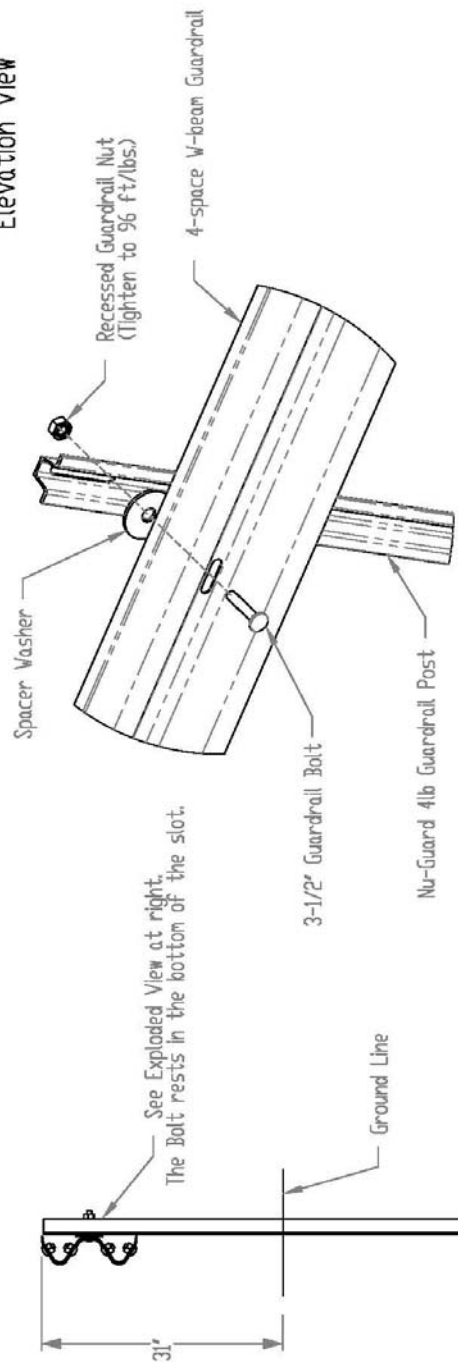
Checklist	Y	N
<u>Site Conditions</u>		
Are there any roadway features in front of the barrier that might cause a vehicle to become unstable prior to impact with the barrier?		
Has the roadside grading been completed correctly?		
Have the soil conditions been properly evaluated for adequate density?		
Is there sufficient soil of required strength behind the posts, or has the post embedment been altered to provide adequate support?		
Is there enough clearance between the barrier and the hazard for the expected barrier deflection?		
<u>Construction</u>		
Is the barrier the correct height?		
Is the post spacing correct?		
Are the posts aligned with flanges toward the rail for road side applications?		
Are the guardrail panels properly spliced and lapped in the direction of traffic?		
Are there irregular curves or joints where an errant vehicle might snag?		
<u>Components</u>		
Is there evidence of corrosion or damage to the rail?		
Is there evidence of corrosion or damage to the posts?		
Check to see that nuts are installed and tightened on all bolts in accordance with torque requirements.		
Has the spacer washer been installed between the rail and the post?		
Has the system been properly delineated per applicable standards?		

Project/Location:			
Installed By:		Date:	
Inspected By:		Date:	

DETAILS



Elevation View



1a. Backfill Post holes with AASHTO M147-65(2004), grade B crushed limestone road base, compacted to MASH standard.

Section A-A
Scale 1 : 20



Roadside Safety, and
Physical Security Division -
Proving Ground

Project 690900-MSN-17	Nucor W-beam Rail / MASH 3-11	2017-03-24
Drawn By GES	Scale 1:250	Sheet 1 of 1
Test Installation		

LIMITED WARRANTY

Nucor Steel Marion Inc. (NUCOR) has tested the impact performance of its barriers and crash cushion systems, and other highway safety hardware under controlled conditions, however, NUCOR does not represent nor warrant that the results of those controlled conditions would necessarily avoid injury to persons or property.

NUCOR EXPRESSLY DISCLAIMS ANY WARRANTY OR LIABILITY FOR CLAIMS ARISING BY REASONS OF DEATH OR PERSONAL INJURY OR DAMAGE TO PROPERTY RESULTING FROM ANY IMPACT, COLLISION OR HARMFUL CONTACT WITH THE PRODUCTS OR NEARBY HAZARDS OR OBJECTS BY ANY VEHICLE, OBJECTS OR PERSONS.

NUCOR warrants that any product or component part manufactured by NUCOR will be free from defects in material or workmanship. NUCOR will replace free of cost any Product or component part manufactured by NUCOR that contains such a defect.

THE FOREGOING WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES NOT EXPRESSLY SET FORTH HEREIN, WHETHER EXPRESS OR IMPLIED BY OPERATION OF LAW OR OTHERWISE, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

NUCOR'S LIABILITY UNDER THIS WARRANTY ONLY APPLY TO PARTS NUCOR MANUFACTURE AND IS EXPRESSLY LIMITED TO REPLACEMENT FREE OF COST (IN THE FORM AND UNDER THE TERMS ORIGINALLY SHIPPED), OR TO REPAIR OR TO MANUFACTURE BY NUCOR, PRODUCTS OR PARTS NOT COMPLYING WITH NUCOR SPECIFICATIONS, OR, AT NUCOR'S ELECTION, TO THE REPAYMENT OF AN AMOUNT EQUAL TO THE PURCHASE PRICE OF SUCH PRODUCTS OR PARTS, WHETHER SUCH CLAIMS ARE FOR BREACH OF WARRANTY OR NEGLIGENCE. NUCOR SHALL NOT BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL LOSSES, DAMAGES OR EXPENSES OF ANY KIND, INCLUDING, WITHOUT LIMITATION, ANY SUCH LOSSES, DAMAGES OR EXPENSES ARISING DIRECTLY OR INDIRECTLY FROM THE SALE, HANDLING OR USE OF THE PRODUCTS FROM ANY OTHER CAUSE RELATING THERETO, OR FROM PERSONAL INJURY OR LOSS OF PROFIT.

Any claim by the Buyer with reference to Products sold hereunder for any cause shall be deemed waived by the Buyer unless NUCOR is notified in writing, in the case of defects apparent on visual inspection, within ninety (90) days from the delivery date, or, in the case of defects not apparent on visual inspection, within twelve (12) months from the said delivery date. Products claimed to be defective may be returned prepaid to NUCOR's plant for inspection in accordance with return shipping instructions that NUCOR shall furnish to the Buyer forthwith upon receipt of the Buyer's notice of claim. If the claim is established, NUCOR will reimburse that Buyer for all carriage costs incurred hereunder.

The forgoing warranty benefits shall not apply to (i) any Products that have been subject to improper storage, accident, misuse or unauthorized alterations, or that have not been installed, operated and maintained in accordance with approved procedures and (ii) any components manufactured by the Buyer.

TECHNICAL SUPPORT AND SALES

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