Nu-Cable™

Cable Barrier Systems

INSTALLATION MANUAL

TEST LEVEL-3 LOW-TENSION

Version 2014.09A

NUCOR

NUCOR STEEL MARION, INC.

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INSTALLATION CONSIDERATIONS

The entire manual should be carefully reviewed prior to construction to ensure proper installation of the Nu-Cable™ Cable Barrier System.

The Nu-Cable™ Cable Barrier System is a straight-forward barrier, which is easy to install and can be safely maintained with the information contained within this installation manual.

The initial installation run for any new crew will need to be trained by a qualified Nucor Distributor or Nucor Steel Marion, Inc. representative. It is also strongly recommended that the first run for any new installation crew be completely installed and tensioned before attempting to start other runs.

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

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

Nucor is not responsible for any certifications, licensing, or permits, such as environmental impact, that may be required in order to complete installation of this or any roadside safety device.

SITE CONSIDERATIONS

The initial layout for the Nu-Cable™ High-Tension System should be free of hazards, obstacles, and debris. The cross-slope should be **4:1, 6:1** or flatter Grading may be necessary.

It is important to note that the high-tension cable barrier cannot be installed within a range of **1’ (305mm) to 8’ (2.44m)** from the bottom of a median ditch according to FHWA memorandum. The high-tension cable barrier 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 and poor soil conditions.

HISTORY AND DEVELOPMENT OF THE NU-CABLE SYSTEM

The Nu-Cable™ system was originally developed by SafeRoads, LLC in 2002. It was designed around the usage of a Marion Steel 4#/ft Rib-Bak® post in a 3-cable configuration. There were three versions of the system: two low-tension and one high tension. The product names were Rib-Bak® Cable System, Modified Rib-Bak® Cable System & the US High-Tension Cable System, respectively. All of the systems were tested using standard cable (non-"pre-stretched"). The US High-Tension Cable system could also be used with factory "pre-stretched" cable. Due to tensioning and temperature cycles, standard cable exhibits the same performance characteristics as "pre-stretched" cables over time. The ability to use standard cable allows for realization of certain economic benefits during installation & maintenance.

Nucor Steel Corporation purchased Marion Steel and Saferoads in July of 2005. Shortly thereafter, Nucor Steel Marion, Inc. renamed the products '*Nu-Cable™*'. The Nu-Cable™ product line utilizes the same Rib-Bak® posts, locking hook bolts and/or hanger, to support the ¾" cable. The cable heights and method of support vary depending the local terrain and desired NCHRP testing level.

The Nu-Cable™ system has amassed an impressive track record of successfully re-directing errant vehicle since its first installations in Ontario, Canada & Winger, Minnesota in 2003. Nucor Steel Marion, Inc. has continued to develop the Nu-Cable™ system to meet the needs of its users. The Nu-Cable™ system can now be used in following applications:

- Low-Tension Applications meeting NCHRP 350 TL-3
  - On 6 to 1 slopes
    - With standard J-Bolts
    - With locking hook-bolts
- High-Tension Applications meeting NCHRP 350 TL-3
  - On 6 to 1 slopes or shallower
    - 4# Rib-Bak® Line posts
    - 3 or 4 cables
    - Direct driven, Driven Steel Sockets, or concrete socketed
  - On 4 to 1 slopes or shallower
    - Utilizing a combination of locking hook bolts & hanger
- High-Tension Application meeting NCHRP 350 TL-4
  - On 6 to 1 slopes
    - Utilizing a combination of locking hook bolts & hanger

The Nu-Cable™ system is eligible for reimbursement according to the Federal Highway Administration for use on the National Highway System under the following letters:

BARRIER	**TERMINAL**
B-96, B-96A, B-167 B-183, B-184, B-184A, B-193	CC-76, CC-105, CC-105A

The NUCOR 4# Rib-Bak® U-Channel posts are an acceptable post alternate in the non-proprietary USDOT 3-Strand Low-Tension Cable Barrier system.

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LINE POST OVERVIEW

A string line should be set to aid in properly placing the posts and cables. Mark each run starting with the location of end treatments. Then mark the position for each cable line post to be installed according to project plans to meet required deflections. Please refer to project plans for job specific post spacing.

Please refer to the project plans and specifications to determine which post spacing is required for the installation. FHWA Memorandum dated July 20, 2007 recommends a maximum post spacing of 15' 0" (4.6m) for all manufactures of cable barriers. Varying post spacing can also be used when necessary due to conflicts with utilities or culverts.

It is helpful to mark every **1000' (305m)*** when laying out the system to aid in turnbuckle placement as the cable is unspooled.

Mark every **750' (229m) if using standard cable.*

LAYING OUT CABLE

The cable used in the Nu-Cable™ system is **3/4" diameter (19mm), 3x7** construction, galvanized cable. It weighs **0.857 lbs/ft**, and is packaged in **2000' or 3000'** (915m) per wooden reel. The empty reel weighs 260 lbs (118kg). Shipping weight per reel is **2831 lbs (1284kg) for 3000'** reel. Illustrated below are different methods contractors have used to transport and pull cable.

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TEST-LEVEL 3 LOW-TENSION

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SYSTEM INSTALLATION

The details included in this section are from the North Carolina Department of Transportation Standards. The State of North Carolina has pioneered the usage of cable barriers with installing over 750 miles in the past 25 years. These details are for reference only, and should not supersede any local regulations or specifications. Check with the project engineer for site-specific details & construction manuals.

The Nucor Nu-Cable™ line post can be used in lieu of S3x5.7 I-Beam wherever shown in these details, when used within the barrier itself or terminal section. (Ref. FHWA Letter B-96) The breakaway anchor post & stub connection to the foundation block shall be as shown in the original drawings. Soil conditions at the intended site may require a larger foundation, or other modifications. Check project documents before installation.

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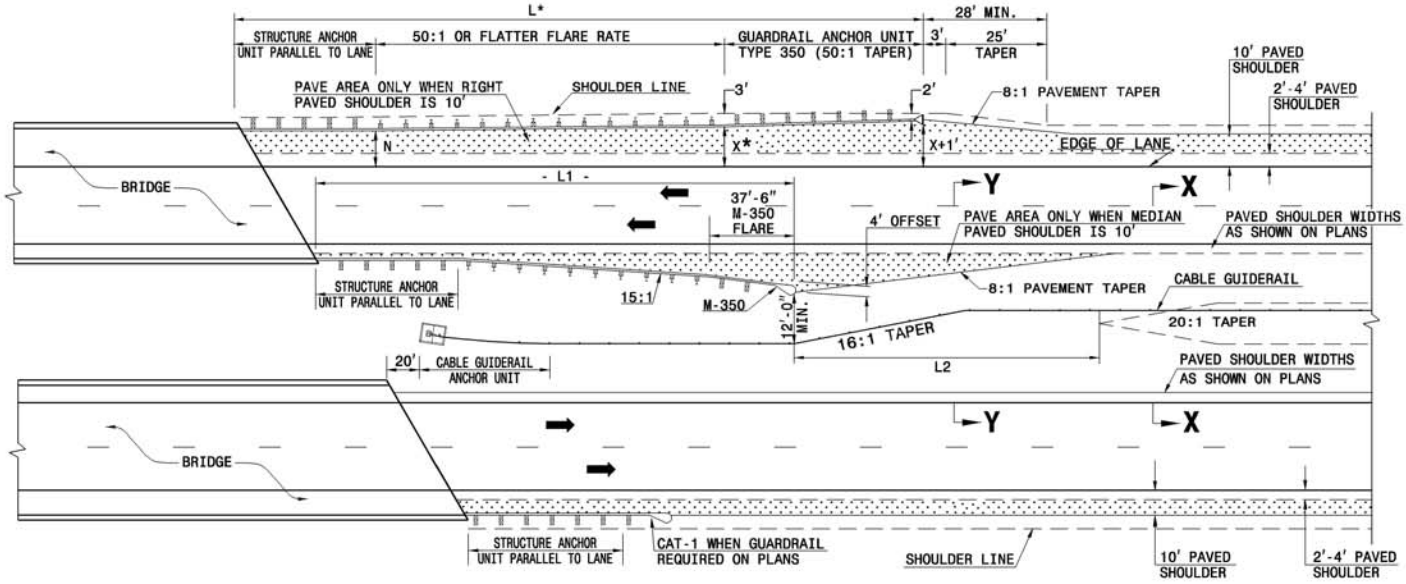
ENGLISH STANDARD DRAWING FOR

CABLE GUIDERAIL

DUAL LANE BRIDGES GUIDERAIL LAYOUT



DIMENSIONS FOR LENGTH OF GUARDRAIL APPROACHING DUAL LANE BRIDGES							
MEDIAN WIDTH	-L-*			-L1-			-L2-
	70 MPH	60 MPH	50 MPH	70 MPH	60 MPH	50 MPH	DIM.
46' & ABOVE	300.0'	250.0'	150.0'	212.5'	187.5'	137.5'	40.0'

NOTES: * BASED ON "X" OF 12'
USE FLARE RATE AS THE CONTROL IF THE "X" DISTANCE IS NOT OBTAINED. ("X" IS BASED ON SHOULDER WIDTHS IN THE HIGHWAY DESIGN BRANCH MANUAL, PART 1, 1-4B, F1A).

"N"= DISTANCE FROM EDGE OF LANE TO FACE OF GUARDRAIL WHERE GUARDRAIL IS PARALLEL TO LANE.

THE DESIGN LAYOUT FOR LENGTHS SHOWN ON THIS STANDARD ARE MINIMUM DESIGN LENGTHS.

SEE STANDARD 862.01 SHEET 1 FOR SECTIONS XX, YY

SEE STD. 862.03 FOR STRUCTURE ANCHOR UNITS

DETAIL OF CABLE GUIDERAIL AT DUAL LANE BRIDGES

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DUAL LANE BRIDGES GUIDERAIL LAYOUT

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***NUCOR Nu-Cable™ POSTS ACCEPTABLE SUBSTITUTION PER FHWA LETTER B-96.**

CHECK LOCAL STANDARDS FOR ANY PROJECT SPECIFIC REQUIREMENTS.

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ENGLISH STANDARD DRAWING FOR

CABLE GUIDERAIL

46′ MEDIAN GUIDERAIL TRANSITIONS WITH SUPERELEVATION AND/OR FALSE SUMPS

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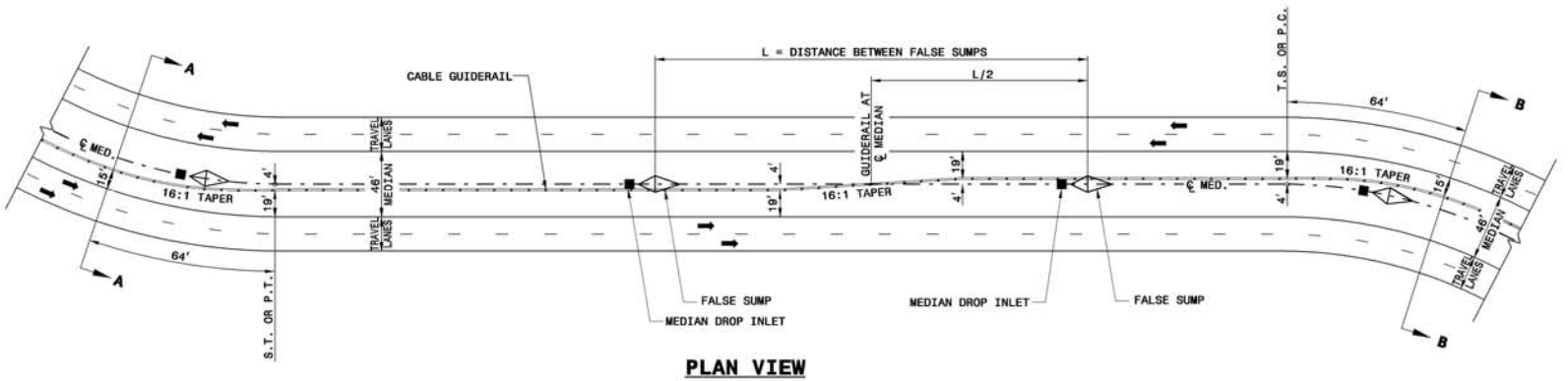
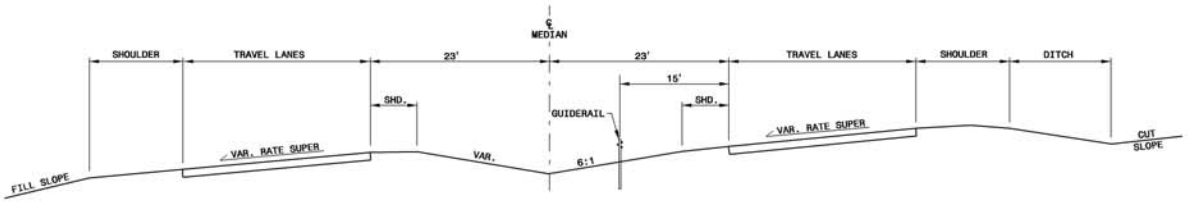
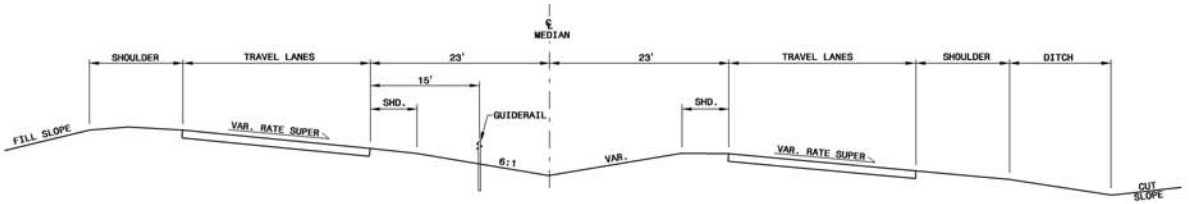


PLAN VIEW

GENERAL NOTES: 1. FALSE SUMP DETAIL IS APPLICABLE TO ALL MEDIAN WIDTHS.
2. DO NOT TRANSITION GUIDERAIL FOR SUPERELEVATION WHEN THE RATE IS 2 PERCENT OR LESS.
3. DO NOT INSTALL GUIDERAIL ON SLOPES STEEPER THAN 6:1.



SECTION A-A



SECTION B-B

46′ MEDIAN GUIDERAIL TRANSITIONS WITH SUPERELEVATION AND/OR FALSE SUMPS

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ENGLISH STANDARD DRAWING FOR

CABLE GUIDERAIL

46′ MEDIAN GUIDERAIL TRANSITIONS WITH SUPERELEVATION AND/OR FALSE SUMPS

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*NUCOR Nu-Cable™ POSTS ACCEPTABLE SUBSTITUTION PER FHWA LETTER B-96.	CHECK LOCAL STANDARDS FOR ANY PROJECT SPECIFIC REQUIREMENTS.

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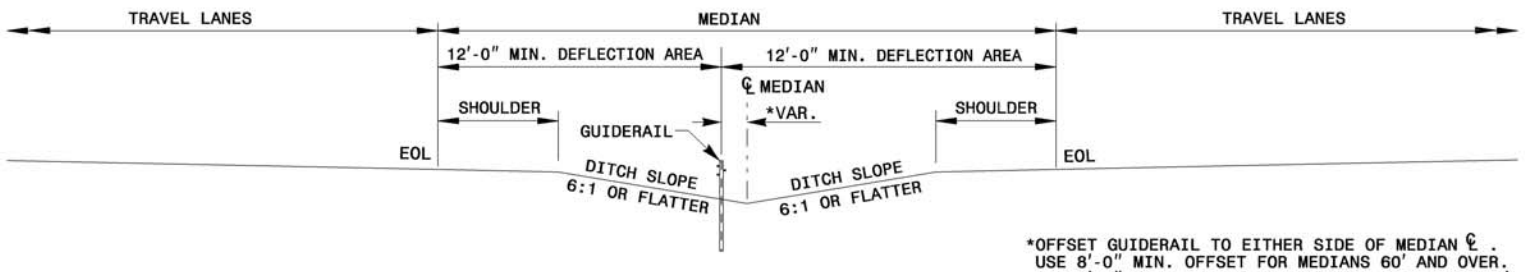
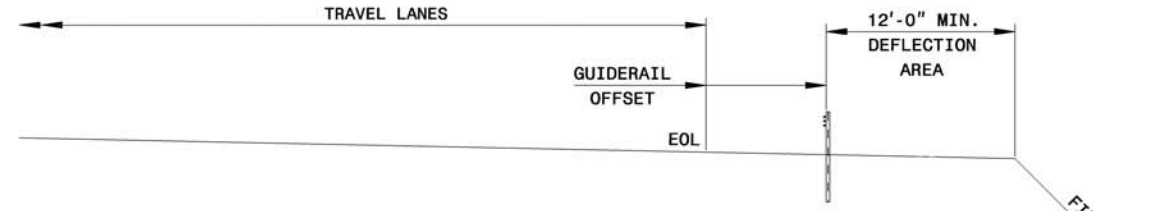
ENGLISH STANDARD DRAWING FOR
CABLE GUIDERAIL
DESIGN AND PLACEMENT

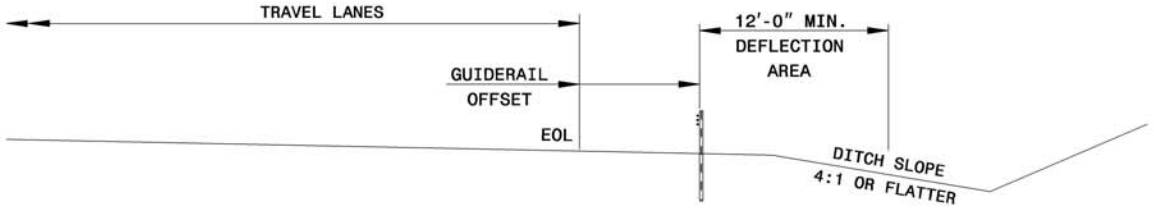


*OFFSET GUIDERAIL TO EITHER SIDE OF MEDIAN ℄ .
USE 8'-0" MIN. OFFSET FOR MEDIANS 60' AND OVER.
USE 4'-0" MIN. OFFSET FOR MEDIANS LESS THAN 60'.

TYPICAL SECTION
(DEFLECTION AREA ON MEDIAN SLOPES)
DOUBLE FACE GUIDERAIL APPLICATION



TYPICAL SECTION
(DEFLECTION AREA ON SHOULDER ONLY)



TYPICAL SECTION
(DEFLECTION AREA ON SHOULDER AND DITCH SLOPE)
SINGLE FACE GUIDERAIL APPLICATION

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ENGLISH STANDARD DRAWING FOR
CABLE GUIDERAIL
DESIGN AND PLACEMENT

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***NUCOR Nu-Cable™ POSTS ACCEPTABLE SUBSTITUTION PER FHWA LETTER B-96.**	**CHECK LOCAL STANDARDS FOR ANY PROJECT SPECIFIC REQUIREMENTS.**

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ENGLISH STANDARD DRAWING FOR
CABLE GUIDERAIL
GUIDERAIL LAYOUT

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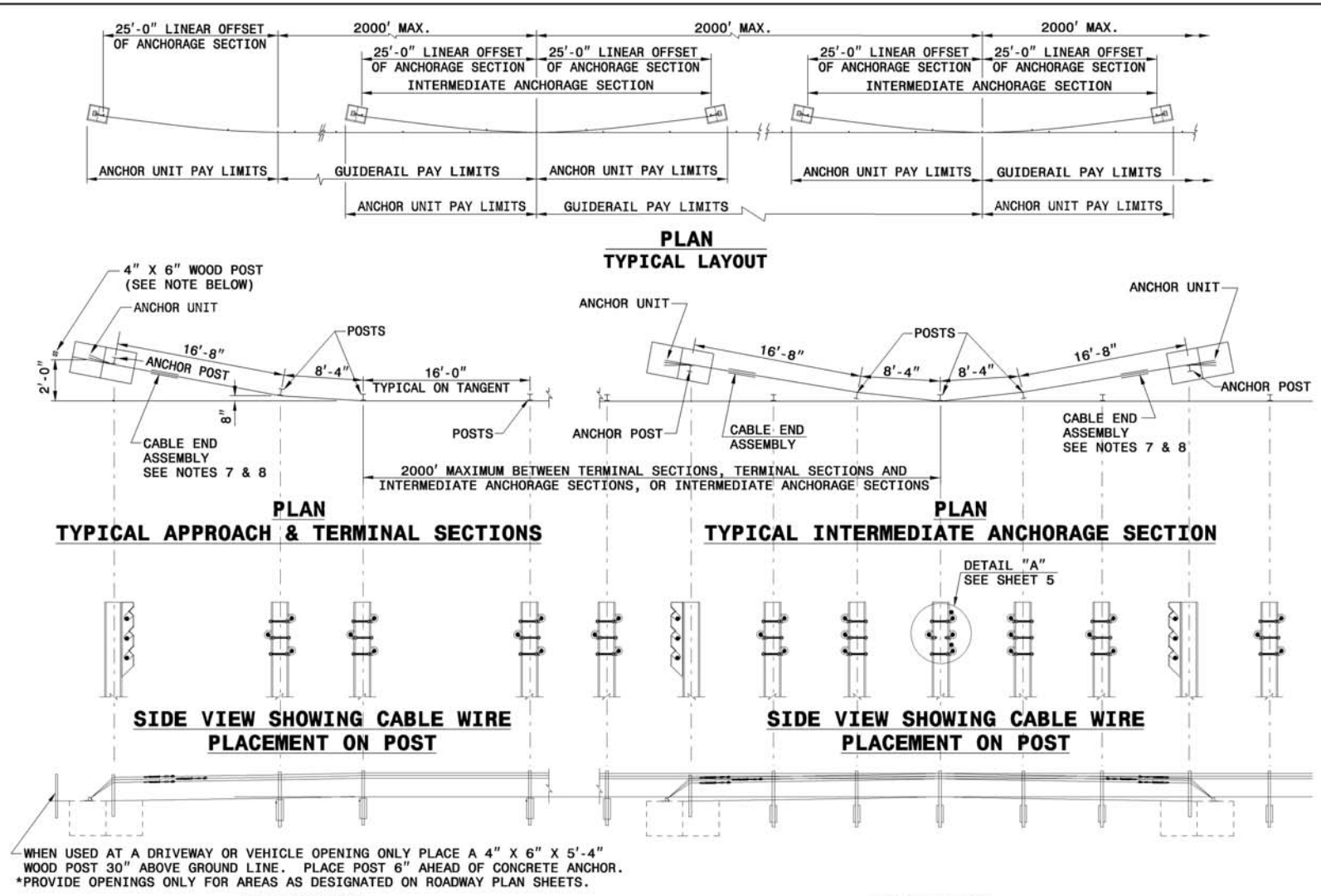

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ENGLISH STANDARD DRAWING FOR
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GUIDERAIL LAYOUT

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ENGLISH STANDARD DRAWING FOR

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DOUBLE FACE GUIDERAIL - POST DETAILS

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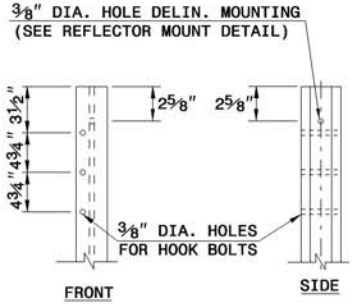
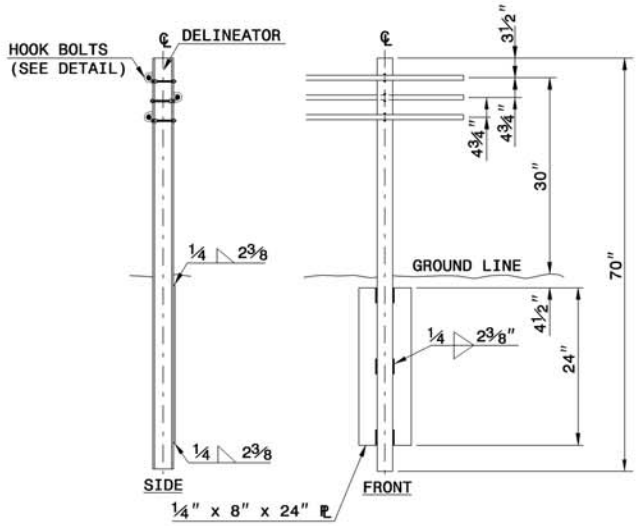
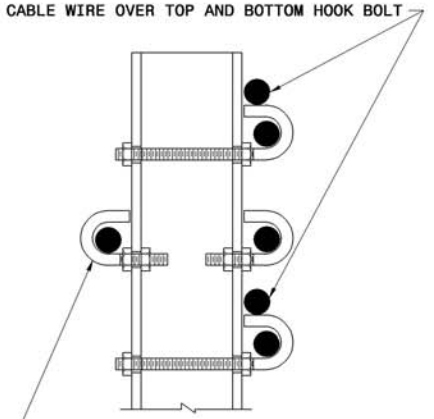


DOUBLE FACE GUIDERAIL POST
HOLE PLACEMENT DETAIL
INTERMEDIATE POST

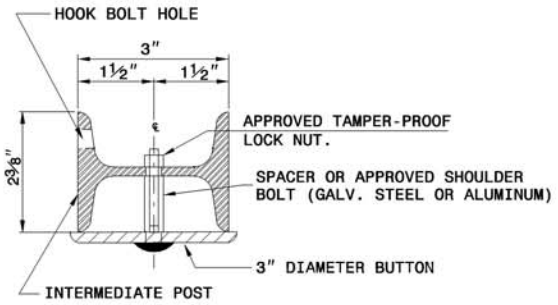


DOUBLE FACE GUIDERAIL
INTERMEDIATE POST

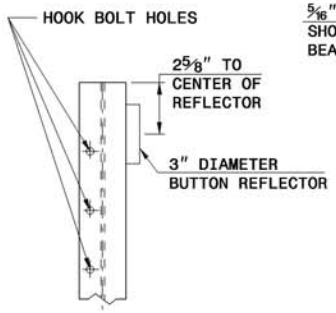


THE CENTER POST IN THE INTERMEDIATE ANCHORAGE SECTION WILL HAVE CABLE WIRE ON BOTH SIDES OF THE MIDDLE STRAND REQUIRING THE USE OF TWO 1 3/4" HOOK BOLTS FOR THIS APPLICATION.

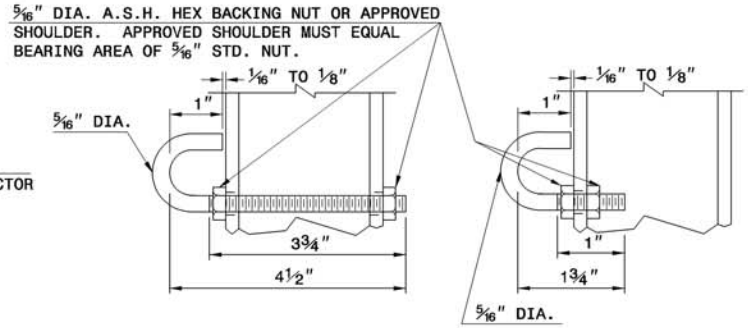
DETAIL "A" CENTER POST
INTERMEDIATE ANCHORAGE SECTION



REFLECTOR MOUNT DETAIL
PLAN VIEW



REFLECTOR MOUNT DETAIL
ELEVATION VIEW



HOOK BOLT (ALTERNATES)

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ENGLISH STANDARD DRAWING FOR

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DOUBLE FACE GUIDERAIL - POST DETAILS

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ENGLISH STANDARD DRAWING FOR

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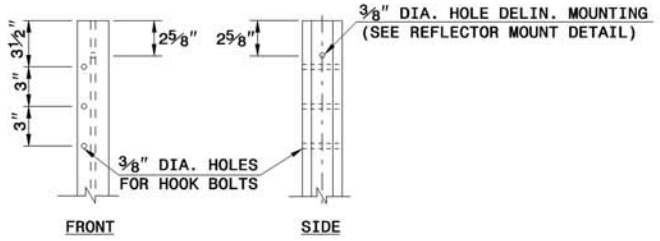
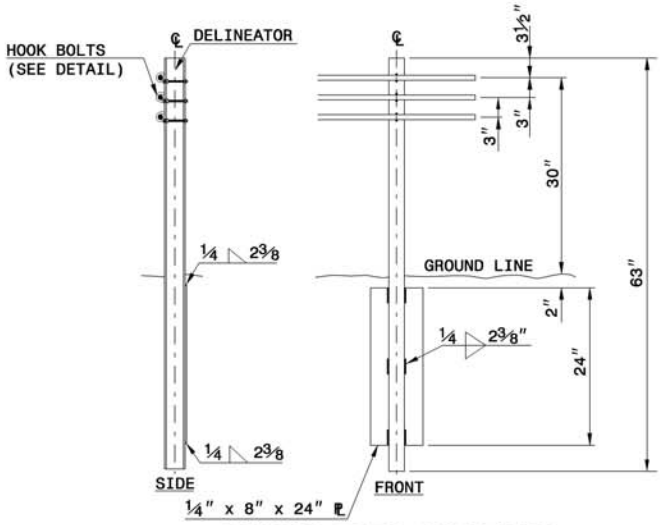
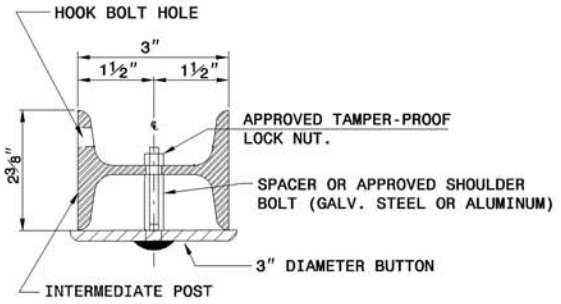
SINGLE FACE GUIDERAIL - POST DETAILS



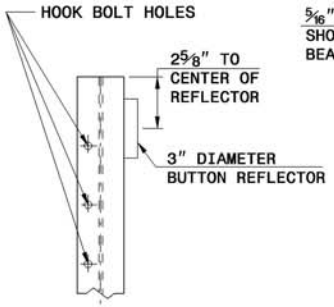
SINGLE FACE GUIDERAIL POST
HOLE PLACEMENT DETAIL



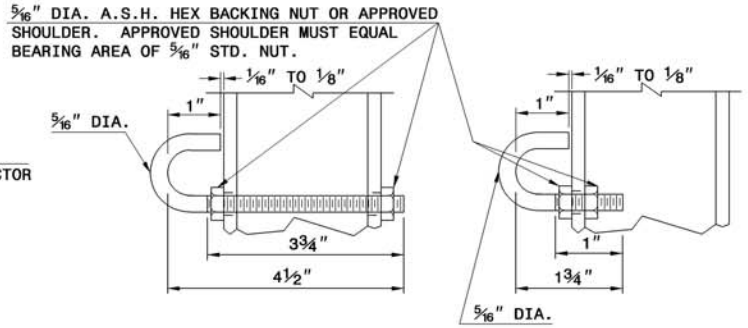
SINGLE FACE GUIDERAIL
INTERMEDIATE POST



REFLECTOR MOUNT DETAIL
PLAN VIEW



REFLECTOR MOUNT DETAIL
ELEVATION VIEW



HOOK BOLT (ALTERNATES)

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ENGLISH STANDARD DRAWING FOR

CABLE GUIDERAIL

SINGLE FACE GUIDERAIL - POST DETAILS

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ENGLISH STANDARD DRAWING FOR
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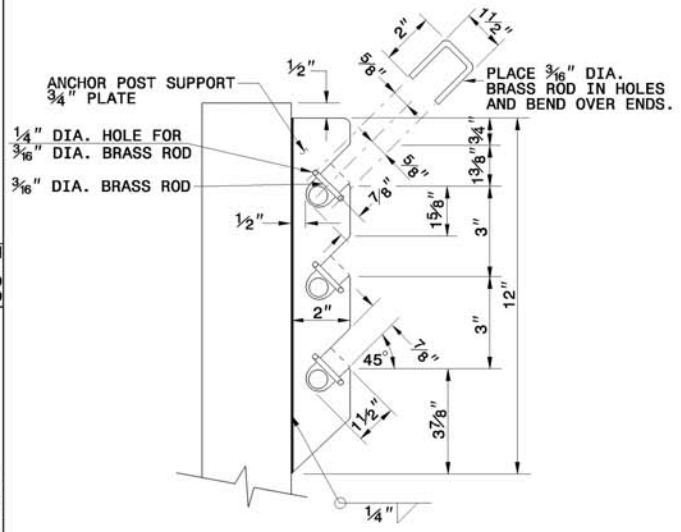
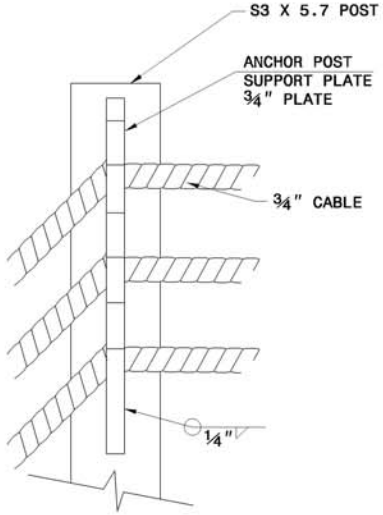
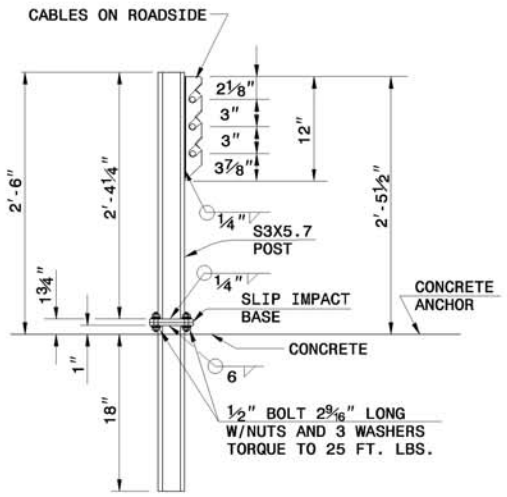
ANCHOR POST DETAILS



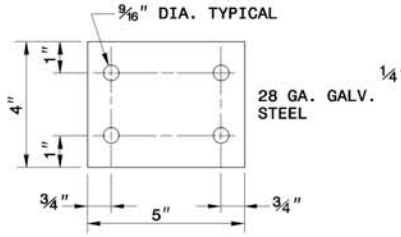
SIDE VIEW OF POST TOP



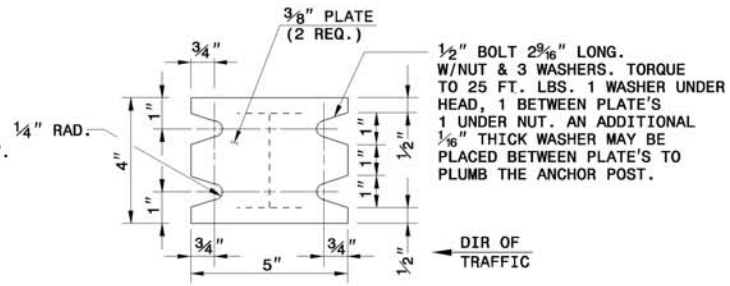
FRONT VIEW OF POST TOP
(ROAD SIDE)



ANCHOR POST DETAIL



KEEPER PLATE



SLIP IMPACT BASE
(KEEPER PLATE NOT SHOWN)

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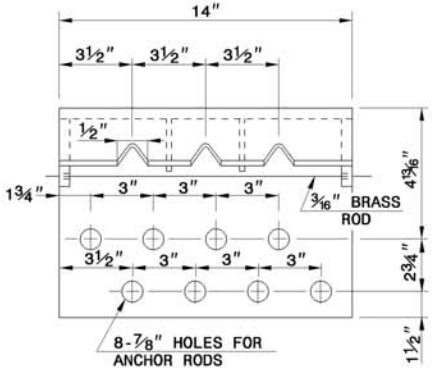
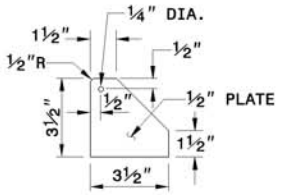
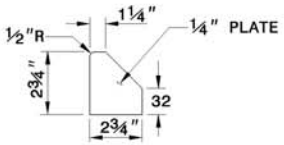
ANCHOR DETAILS

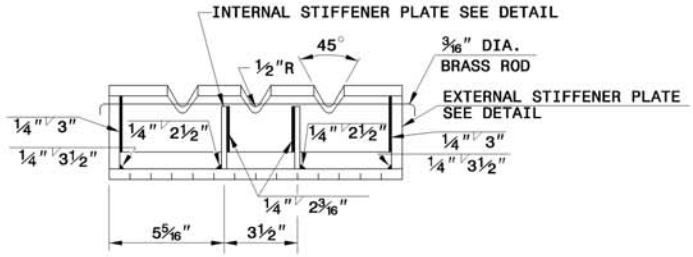




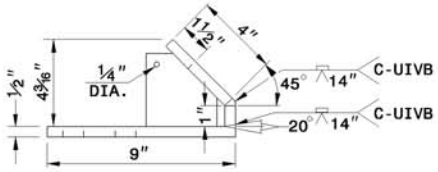
EXTERNAL STIFFENER PLATE



INTERNAL STIFFENER PLATE



ANCHOR ANGLE DETAILS



NOTE: SUBMIT ALTERNATE METHODS OF FABRICATING ANCHOR ANGLES FOR APPROVAL.

BREAKAWAY ANCHOR ANGLE

SHEET 9 OF 12

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***NUCOR Nu-Cable™ POSTS ACCEPTABLE SUBSTITUTION PER FHWA LETTER B-96.**	**CHECK LOCAL STANDARDS FOR ANY PROJECT SPECIFIC REQUIREMENTS.**

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STATE OF
NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.

ENGLISH STANDARD DRAWING FOR

CABLE GUIDERAIL

ANCHOR DETAILS

SHEET 9 OF 12

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STATE OF NORTH CAROLINA
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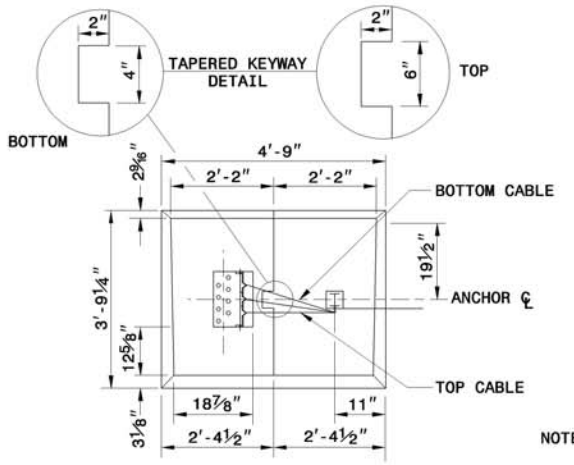
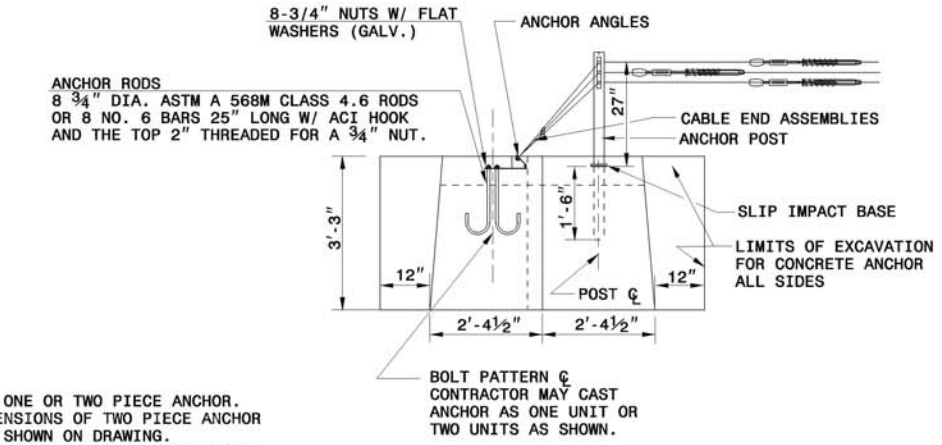
RALEIGH, N.C.
7-06

ENGLISH STANDARD DRAWING FOR
CABLE GUIDERAIL
ANCHOR DETAILS



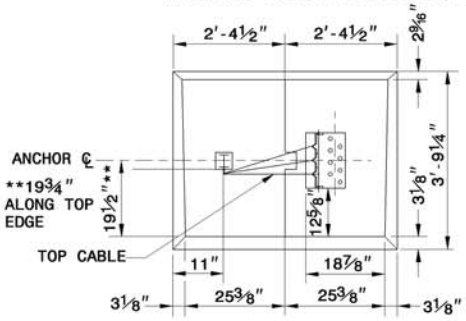
ANCHOR UNIT DETAIL
TOP VIEW LEFT HAND
(REINFORCEMENT NOT SHOWN)
TWO PIECE

NOTE: USE ONE OR TWO PIECE ANCHOR. DIMENSIONS OF TWO PIECE ANCHOR ARE SHOWN ON DRAWING. DIMENSIONS OF ONE PIECE ANCHOR ARE 5'-0" LONG BY 3'-0" WIDE BY 3'-4" HIGH.

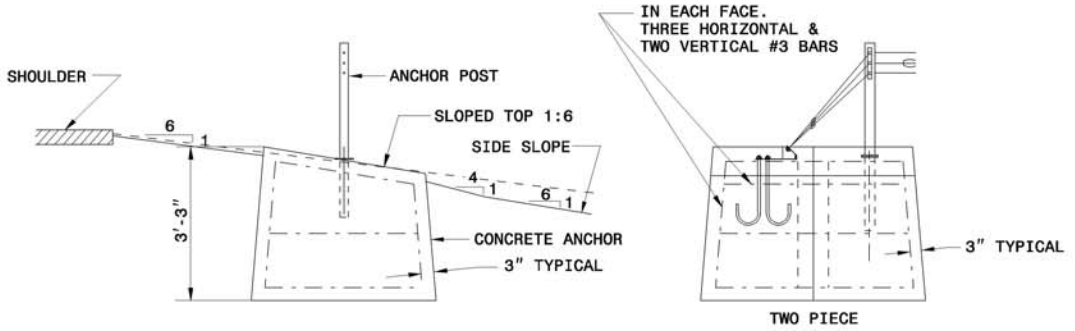


ANCHOR UNIT DETAIL
LEFT HAND
(REINFORCEMENT NOT SHOWN)

NOTE: SET THE CONCRETE ANCHOR INTO THE EXCAVATION AS DETAILED. THE BOTTOM OF THE ANCHOR MUST HAVE A FULL AND EVEN BEARING ON THE SURFACE UNDER IT SO THAT IF THE CONTRACTOR ELECTS TO PLACE THE ANCHOR IN TWO SECTIONS, THERE WILL BE LITTLE OR NO DIFFERENTIAL SETTLEMENT. IF THE CONTRACTOR ELECTS TO PLACE THE ANCHOR IN TWO SECTIONS, PLACE THE TOPS OF BOTH SECTIONS ON THE SAME PLANE. AFTER THE ANCHOR IS IN PLACE, BACKFILL THE EXCAVATION.



ANCHOR UNIT DETAIL
TOP VIEW RIGHT HAND
(REINFORCEMENT NOT SHOWN)
TWO PIECE



ANCHOR UNIT & RE-BAR INSTALLATION DETAIL

SHEET 10 OF 12
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STATE OF NORTH CAROLINA
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ENGLISH STANDARD DRAWING FOR
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ANCHOR DETAILS

SHEET 10 OF 12
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***NUCOR Nu-Cable™ POSTS ACCEPTABLE SUBSTITUTION PER FHWA LETTER B-96.**	**CHECK LOCAL STANDARDS FOR ANY PROJECT SPECIFIC REQUIREMENTS.**

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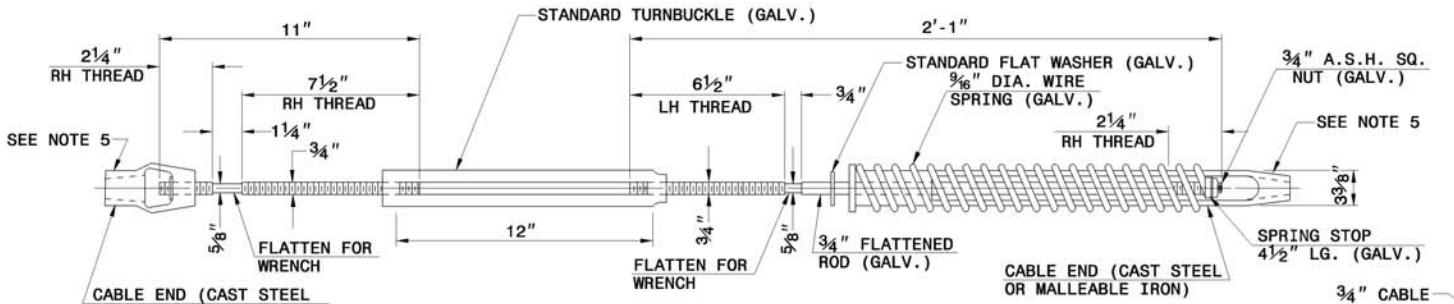
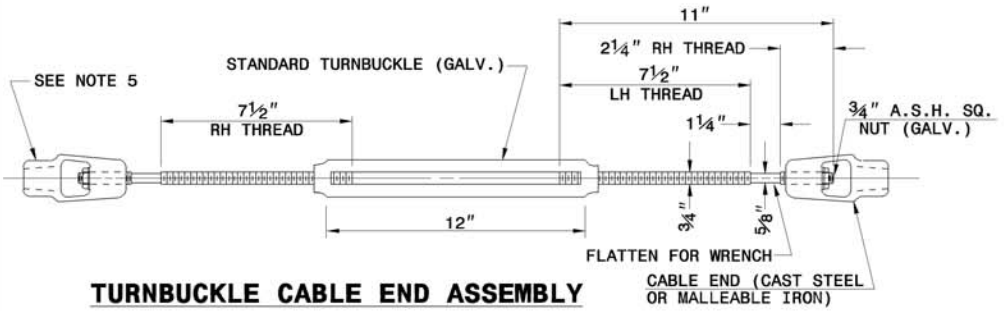
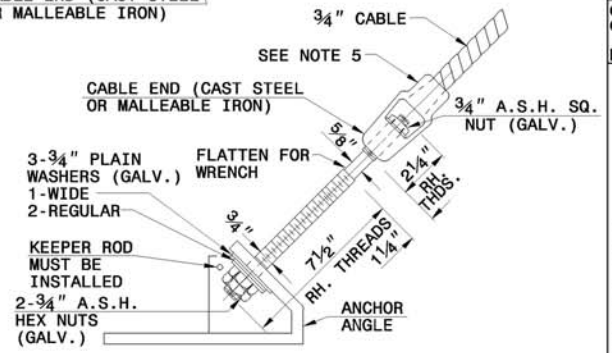
ENGLISH STANDARD DRAWING FOR
CABLE GUIDERAIL
ANCHOR DETAILS



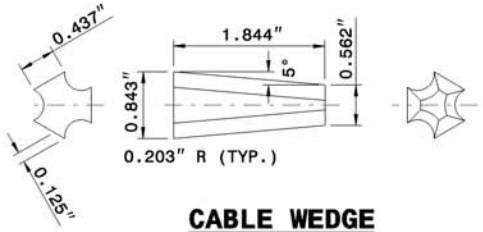
SPRING CABLE END ASSEMBLY
(COMPENSATING DEVICE)



TURNBUCKLE CABLE END ASSEMBLY

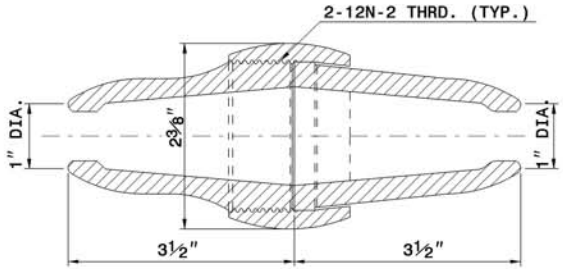


CABLE END ASSEMBLY TO ANCHOR ANGLE DETAIL



CABLE WEDGE

TYPICAL WEDGE FOR ALL SPLICES AND CABLE FITTINGS



CABLE SPLICE

NOTE: USE WITH WEDGE

WASHER

WASHER	WASHER SERIES	A INSIDE DIA.	B OUTSIDE DIA.	C THICKNESS
¾"	REGULAR	⅞"	2"	5/32"
	WIDE	⅞"	2 9/16"	3/16"
½"	NARROW	17/32"	1"	3/32"

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ENGLISH STANDARD DRAWING FOR
CABLE GUIDERAIL
ANCHOR DETAILS

SHEET 11 OF 12
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***NUCOR Nu-Cable™ POSTS ACCEPTABLE SUBSTITUTION PER FHWA LETTER B-96.**	**CHECK LOCAL STANDARDS FOR ANY PROJECT SPECIFIC REQUIREMENTS.**

STATE OF NORTH CAROLINA
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ENGLISH STANDARD DRAWING FOR
CABLE GUIDERAIL
NOTES

GENERAL NOTES:

1. PROVIDE ALL S3x5.7 ROLLED STEEL SECTIONS IN ACCORDANCE WITH ASTM A-6. USE POSTS, PLATES AND ANCHOR ANGLES CONFORMING TO THE REQUIREMENTS OF SECTION 862 OF THE STANDARD SPECIFICATIONS. WHERE THE RAIL IS PARALLEL TO THE EDGE OF THE TRAVEL LANE, REFLECTORIZE EVERY 6th POST (96') (SEE STANDARD 1261.02 FOR DELINEATORS). FOR DOUBLE FACE GUIDERAIL, PLACE DELINEATOR VISIBLE ON EVERY 6th POST TO TRAFFIC IN EITHER DIRECTION. DO NOT REFLECTORIZE POSTS IN THE TYPICAL INTERMEDIATE ANCHORAGE SECTION, TYPICAL APPROACH OR TERMINAL SECTIONS.

2. PROVIDE ROUND ¾" DIAMETER ZINC COATED CABLE WIRE CONSTRUCTED OF THREE STRANDS (7 WIRES PER STRAND) HAVING A MINIMUM TENSILE STRENGTH OF 25000 LBS. IN ACCORDANCE WITH AASHTO M-30 TYPE I CABLE, CLASS 'A' COATING.

3. PROVIDE MATERIALS INDICATED AS 'CAST STEEL' WHICH CONFORM TO AASHTO M103.

4. PROVIDE INSTALLED HOOK BOLTS WHICH DEVELOP AN ULTIMATE PULL OPEN STRENGTH OF 500 LBS TO 1000 LBS. APPLIED IN A DIRECTION NORMAL TO THE LONGITUDINAL AXIS OF THE POST.

5. DESIGN ALL FITTINGS, INCLUDING SPLICES, TO USE THE CABLE WEDGE AND DEVELOP THE FULL STRENGTH OF THE ¾" CABLE. HOT DIP GALVANIZE ALL FITTINGS, EXCEPT THE CABLE WEDGE, ACCORDANCE WITH AASHTO M-30.

6. CRIMP ONE WIRE OF THE WIRE ROPE OVER THE BASE OF THE WEDGE TO HOLD IT FIRMLY IN PLACE AT ALL LOCATIONS WHERE THE CABLE IS CONNECTED TO A CABLE SPLICE CONNECTION.

7. DESIGNS FOR A COMBINATION OR SINGLE UNIT COMPENSATING DEVICE AND TURNBUCKLE ASSEMBLY MAY BE SUMBITTED FOR APPROVAL. COMPENSATING DEVICES MUST HAVE A SPRING RATE OF 450 LBS. PLUS OR MINUS 50 LBS. PER INCH WITH A MINIMUM TOTAL 'THROW' OF 6".

8. APPLY THE FOLLOWING CRITERIA FOR ARRANGEMENT OF SPRING CABLE END ASSEMBLIES (COMPENSATING DEVICES) AND TURNBUCKLE CABLE END ASSEMBLIES:

   LENGTH OF CABLE RUNS:

   TO 1000' - USE COMPENSATING DEVICE ON ONE END AND TURNBUCKLE ON THE OTHER END OF EACH INDIVIDUAL CABLE.

   1000' TO 2000' - USE COMPENSATING DEVICE ON EACH END OF EACH CABLE.

   OVER 2000' - START NEW STRETCH BY INTERLACING AT LAST PARALLEL POST (TYPICAL LAYOUT).

   PRIOR TO FINAL ACCEPTANCE BY THE STATE, USE THE FOLLOWING VALUES TO TIGHTEN THE TURNBUCKLES BASED ON THE TEMPERATURE AT THE TIME OF ADJUSTMENT.

TABLE "A"

PAVEMENT ℄ CURVATURE	POST SPACING
8° OR LESS	16'
MORE THAN 8° TO 13° (440 FT. RAD.)	12'

TEMPERATURE (FAHRENHEIT)	SPRING COMPRESSION FROM UNLOADED POSITION IN EACH SPRING
110° - 120°	1"
100° - 109°	1¼"
90° - 99°	1½"
80° - 89°	1¾"
70° - 79°	2"
60° - 69°	2¼"
50° - 59°	2½"
40° - 49°	2¾"
30° - 39°	3"
20° - 29°	3¼"
10° - 19°	3½"
0° - 9°	3¾"
-10° - -1°	4"
-20° - -11°	4¼"

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ENGLISH STANDARD DRAWING FOR
CABLE GUIDERAIL
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***NUCOR Nu-Cable™ POSTS ACCEPTABLE SUBSTITUTION PER FHWA LETTER B-96.**

CHECK LOCAL STANDARDS FOR ANY PROJECT SPECIFIC REQUIREMENTS.

Nu-Cable™

Cable Barrier Systems

INSTALLATION MANUAL

SECTION D
LINE POST FOUNDATIONS

CONTENTS

NUCOR
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FOUNDATION OPTIONS

CAUTION: The options shown below are examples of typical foundations for use in strong or weak soil conditions. They should not be assumed to be the only options available. If soil conditions at each installation location are unknown or do not meet the minimum requirements for strong or weak soil as outlined in Section M, a geotechnical review by a professional engineer shall be conducted prior to starting installation. The results of this evaluation shall determine foundation design at each installation location.

Some states may require deeper foundations based on site conditions and performance needs. Check with your project specifications and details to be sure you are utilizing the appropriate foundation design and depth.

Option 1: Direct-Driven Line Post

Only TL-3 systems use the direct embedment method. The post used is a 72" (1829mm) Rib-Bak® Line Post with no soil plate required. Direct driven line posts are driven into natural soil (NCHRP strong soil) using a preset string line to depth of 39" (991mm). The top of the line post should be 33" (838mm) above ground after installation.

When solid rock is encountered consult the state DOT's recommended procedures for resolution. If the state DOT does not have a procedure for installing line posts installed in rock, drill a 4" diameter hole to accommodate at least 15" of the line post.

For example if first encountering rock at a depth of 12", excavate out the enough material to drill an additional 15" into the rock. Total embedment in this case would be 27".

Option 2A: Socketed Foundation, Concrete Footing

The socketed method utilizes a steel or plastic socket set into a 12” diameter x 30” deep [305mm x 762mm] concrete footing. The socket depth is assumed to be in NCHRP 350 strong soil.

If rock is encountered which would prevent minimum embedment, please consult the state DOT’s recommended procedures for resolution or contact Nucor for further information.

TEST LEVEL 3 & 4
13 GA 4” OD x 15” (2.41mm x 102mm x 381mm)

All concrete should be 3000 psi (25MPa) minimum and should cure for at least 7 days before tension is added to system.

The concrete foundation is strengthened with one #3 steel reinforcing ring and two #4 x 28” steel dowels (dowel length may vary upon foundation depth). The ring is inserted to a depth of 4”; the dowels are inserted to a depth of 2”. The dowels should be installed at approximately 25 degrees off center so that they are in line against oncoming traffic. The steel reinforcement does not need to be tied.

Use a socket insertion tool (see photo) to install socket after steel reinforcement has been placed. The top of the socket should normally be flush with the top of the foundation concrete. To prevent runoff debris from entering the socket, the foundation should be finished with up to 3/4" (19mm) taper to the outer edge. This may not be required when the system is installed in a mow strip.

Option 2B: Precast Socketed Foundation, Concrete Footing

The precast line post socket follows the same detail as the standard socketed concrete footing.

Use a **12" diameter x 30" deep** [305mm x 768mm] form. Some contractors have found that modifying a standard section of **12"** steel culvert pipe works well as a reusable form. Place steel reinforcement as detailed on plan standard. Plumb posts and pour concrete.

Be sure to not leave more than **1"** (25mm) of the line post socket exposed above the ground line. It is easier to plumb the line post socket with a post temporarily inserted in the socket. The back fill material needs to be strong soil compacted in **6"** (153mm) lifts with a hydraulic tamper.

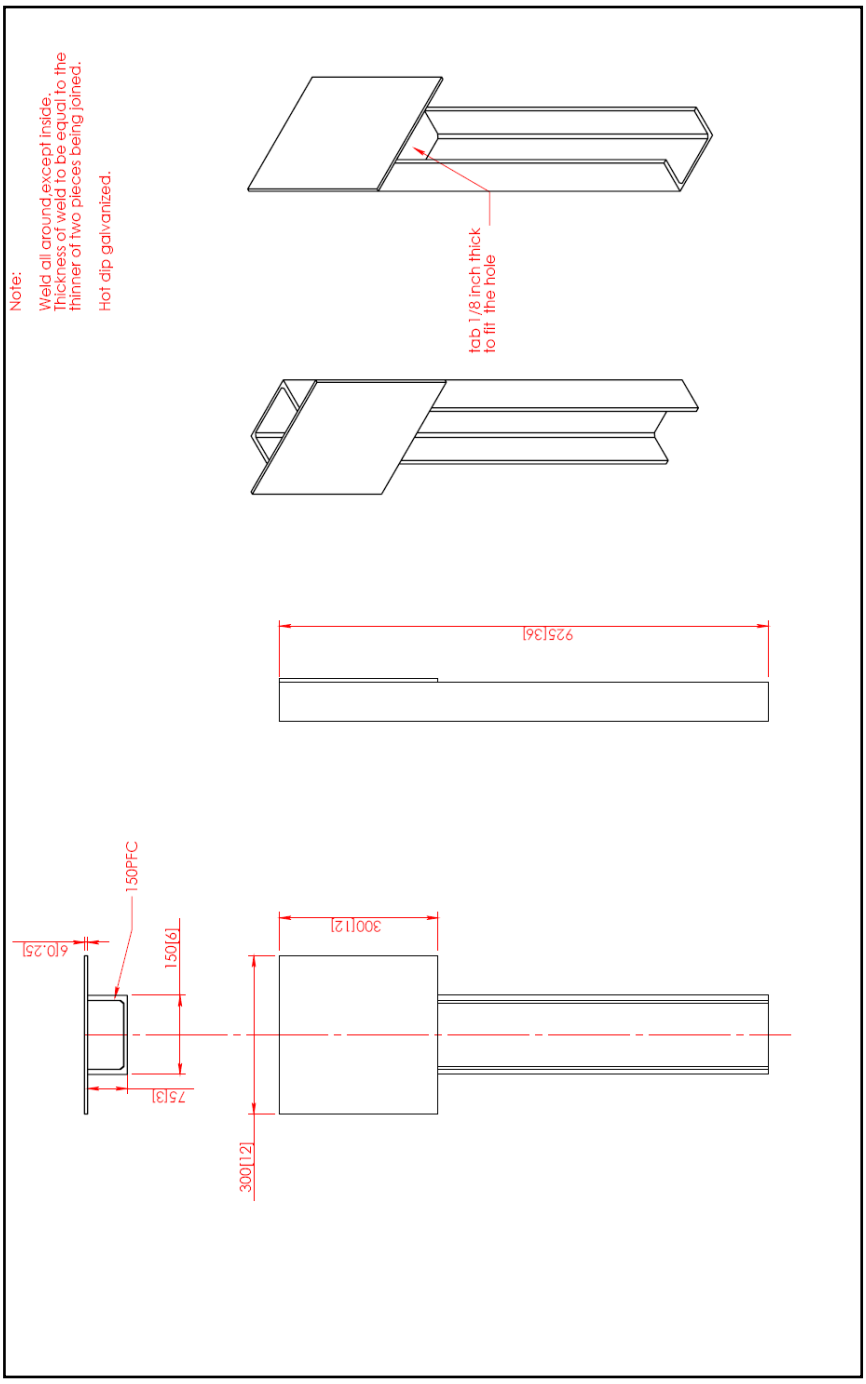
When solid rock is encountered consult the state DOT's recommended procedures for resolution. If the state DOT does not have a procedure for installing concrete piles in rock, drill a 12" [304 mm] diameter hole to accommodate the full depth and width of the precast foundation.

Option 3: Direct-Driven Steel Socket

Much like the direct driven post option, there is a direct driven-steel socket option that can be fitted for post-driving machines and does not require the use of any concrete. This socket allows for the use of a shortened post.

When solid rock is encountered consult the state DOT's recommended procedures for resolution. If the state DOT does not have a procedure for installing line posts installed in rock, drill a 4" [102mm] diameter hole to accommodate at least 15" [381mm] of the line post.

For example if first encountering rock at a depth of 15" [381mm], excavate out the enough material to drill an additional 15" [381mm]into the rock. Total embedment in this case would be 30" [762mm].



For uneven terrain where the potential exists for line posts to be pulled out of their sockets by the tensioning of the cable, remove a shovel full of material around socket, drill a 3/8” (10mm) hole as close to the base of the footing as workable to install a 5/16” x 1 ¼” (8mm) Grade 5 or better bolt to hold the post in place.

UNEVEN TERRAIN

For uneven terrain (see picture below), where the potential exists for line posts to be pulled out of their sockets by the tensioning of the cable, set the socket in the concrete with no more than 1" (25mm) above ground level. After concrete has set, drill a 3/8" (10mm) hole as close to the base of the footing as workable. Install a 5/16" x 1 ¼" (8mm) Grade 5 or better bolt through the post to hold the post in place.

SOFT SOIL FOUNDATIONS

Refer to local guidelines for foundation requirements in soft soil conditions.

In many cases with line post foundations in weak soil, or where the frost line is below **30"** (762mm), the footing should be increased in the depth to accommodate local soil conditions. Some states have successfully utilized 18" diam. (457mm) x 36-48" (914-1219mm) concrete foundations.

Direct-driven steel sockets can be increased in depth to 48" (1219mm) in order to accommodate local soft soil conditions.

Direct drive posts can be increased in depth, in 6" (150) increments, in order to accommodate local soil conditions.

DEBRIS EXCLUDER

Optionally required based on project specifications to help prevent collection of dirt and debris within the foundation socket.

Nu-Cable™

Cable Barrier Systems

INSTALLATION MANUAL

SECTION E
CABLE FITTINGS & TURNBUCKLES

CONTENTS

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TURNBUCKLES

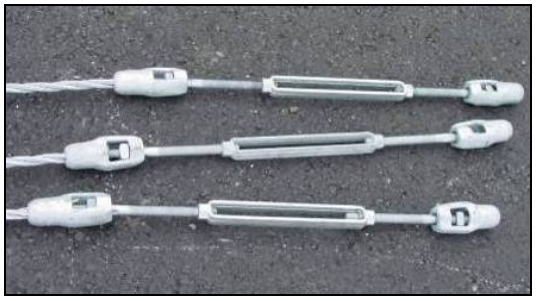
Turnbuckles are used to achieve the appropriate tension in the system. By using pre-stretched cable, turnbuckles are required to be installed every 1000' (305m). If pre-stretched cable is used, the hardware must be 1"D (25mm) to approach the breaking strength of the cable. Note: More turnbuckles than the minimum amount may be used if conditions require this option. Some maintenance crews have successfully used turnbuckles in place of cable splices.

In a TL-3 system, if using standard cable, install one turnbuckle per cable every 750' (229m). When using standard cable, the attachment hardware may be ¾" (19mm) or 1" (25mm) diameter. If the length of the run is 750' long (229m), install the turnbuckle near the middle.

There are two options for the turnbuckle style used. The Nu-Cable™ system can either be installed with:

TEST LEVEL 3 or TEST LEVEL 4:

Standard Turnbuckles and "Wedge-Style" Cable Fittings



It is not recommend putting turnbuckles directly above each other in the same section between two line posts (bay). They will be easier to tighten if they are staggered. If a turnbuckle becomes positioned at a post, do not install a special hook bolt at this post. This should be allowed for only one cable per post. If a maintenance crew strongly desires to place all of the turnbuckle in the same bay, the result will have no adverse effect on the crash worthiness of the system.

FIELD APPLIED CABLE ATTACHMENT AND WEDGE ENCASEMENT

Cable attachment hardware requires the wedge to be properly encased in the cable strands and seated into the casting to insure that the cable will not slip out of the hardware.

- The wedge must be seated into the cables such that the flutes in the wedge nest with the three x strands of the cable. If not properly aligned cable slippage is possible.

- The optimum seating for the wedge is such that there is 1" of cable is beyond the wedge. At a minimum, the wedge must be seated inside the cable strands such that the top of the wedge is flush with all three 7 x strands. If one strand of the three 7 x strands is not at a minimum flush, then the wedge needs to be reset.

- If slippage between the wedge and strands occurs reset the wedge deeper into the strands.

- It is acceptable for the wedge to protrude up to 1/4" from the bottom of the casting as long as the wedge has been seated properly. If the wedge protrudes more it must be reset.

During the initial installation process the three 7x strands should be set in the body of the casting such that the nut has just enough room to be inserted. This will help ensure that the wedge is seated below the three 7 x strands.

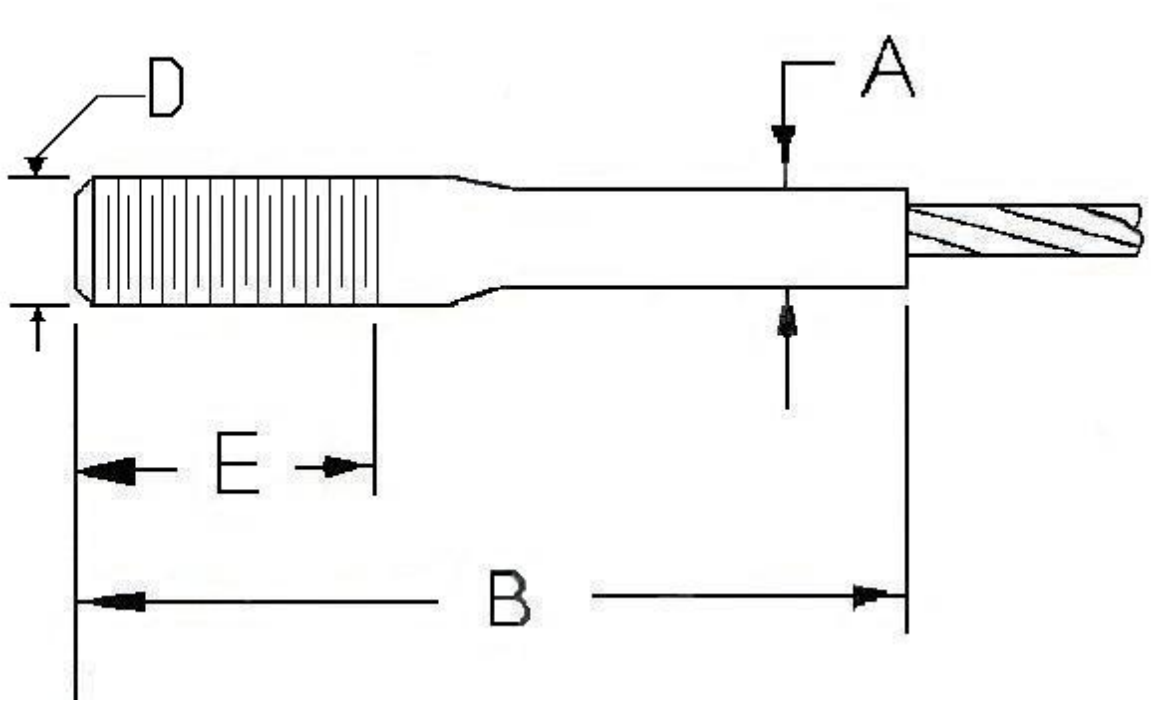
WEDGE INSTALLATION

1. Some contractors choose to use a screw driver to open up the cable and separate the three 7 x strands in preparation for wedge insertion. Once the wedge is inserted into the cable it should be driven approximately 1 inch below the end of the cable.

2. Other contractors have chosen to insert the cable into the casting and twist the casting until the strands “pop open” inside the casting opening up the cable lay. The wedge is inserted into cable strands approximately 1 inch below the end of the cable. The casting is then twisted back so that the cable lay is returned to the initial position.

3. Other installation methods are acceptable as long as the wedge placement & cable engagement is correct.

FACTORY OR FIELD-APPLIED SWADGED FITTING



*NUCOR does supply the field swadging equipment, which may be available through various rental companies. Use of factory applied swadged fittings will require exact measurements of run lengths prior to fabrication. Be sure to compensate for variations in curvatures, and anchor post spacings, when measuring distances within a run. Cables will be delivered with tagged and numbered spools for installation at a specific location.

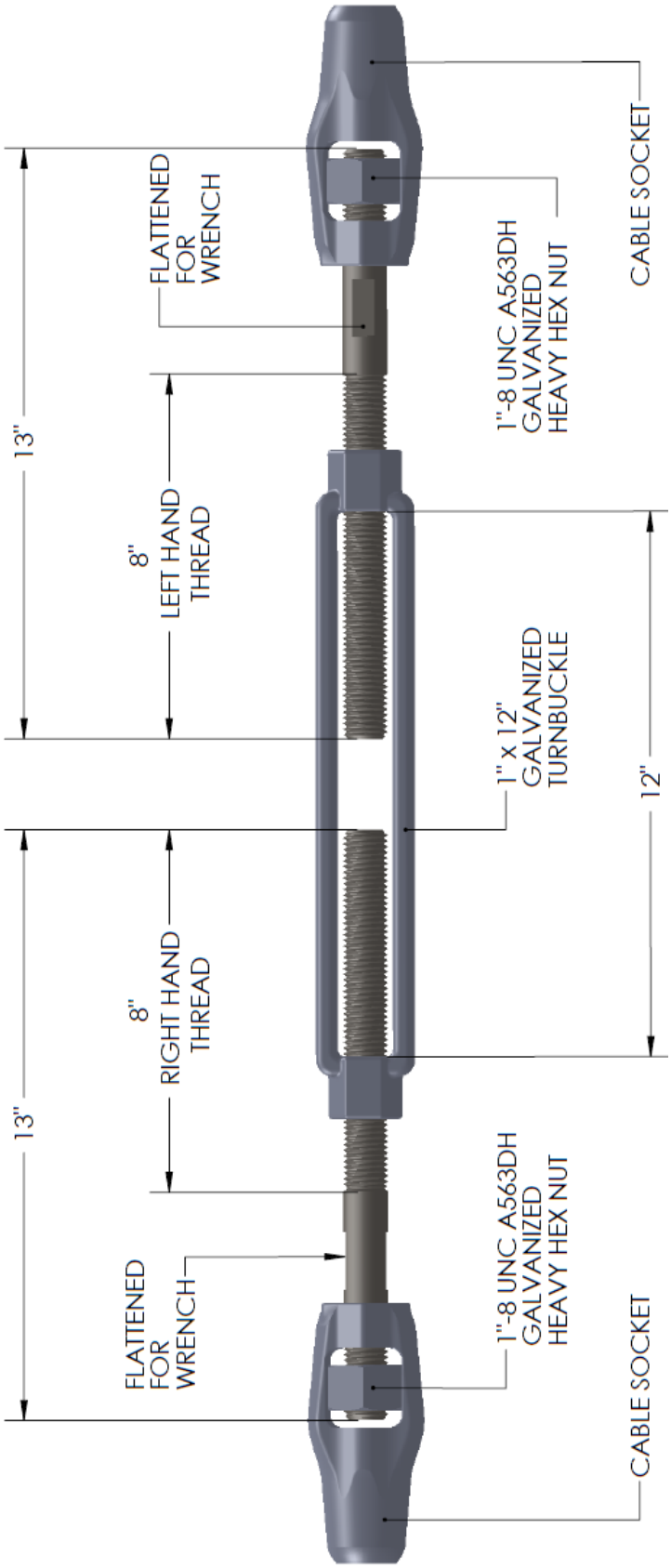
SYSTEM SPLICING

The use of a cable splice is not recommended in the Nu-Cable system. A turnbuckle should be used wherever cable sections are connected. As inspection of a cable coupling is hindered by the closed body design of a standard splice, use of a turnbuckle is strongly encouraged.

However, if needed due to odd cable lengths or for other unforeseen repair or maintenance situations, a standard splice may be used in lieu of a turnbuckle.

STANDARD TURNBUCKLE

SHOWN WITH 1” THREADED ROD



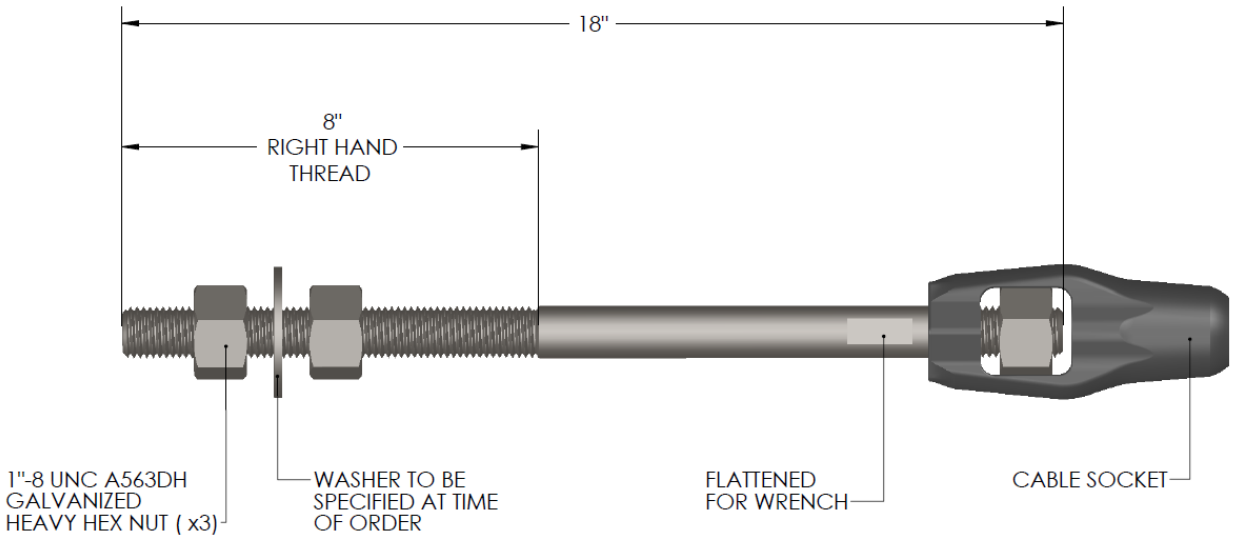
Hardware Strength (Min):

3/4" =
25,000 psi

1" =
36,800 psi

Factory Swadged =
38,000 psi

CABLE END – 18” VERSION



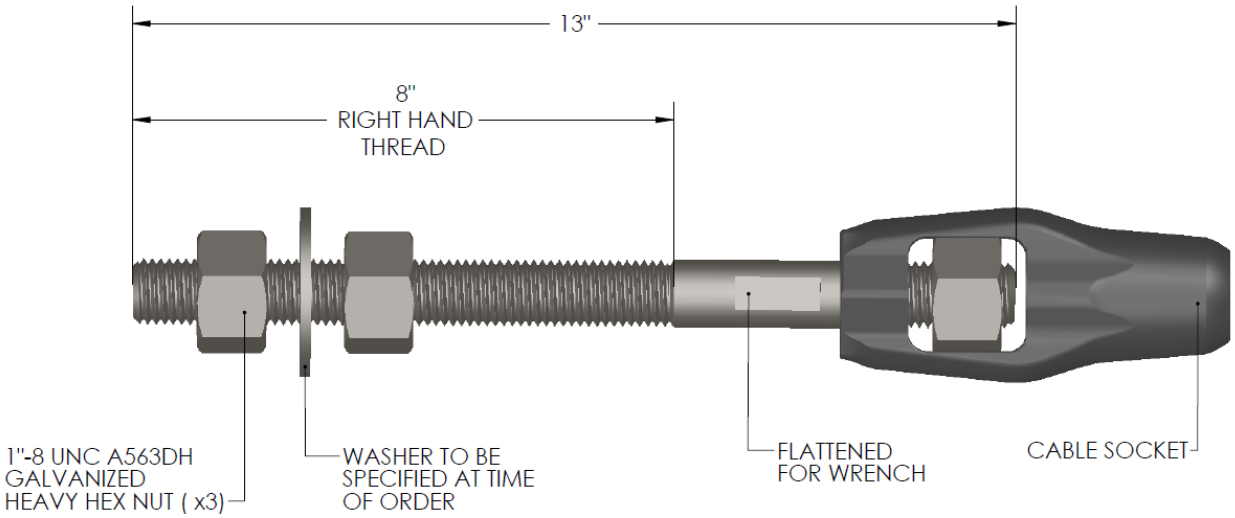
Hardware Strength (Min):

3/4" =
25,000 psi

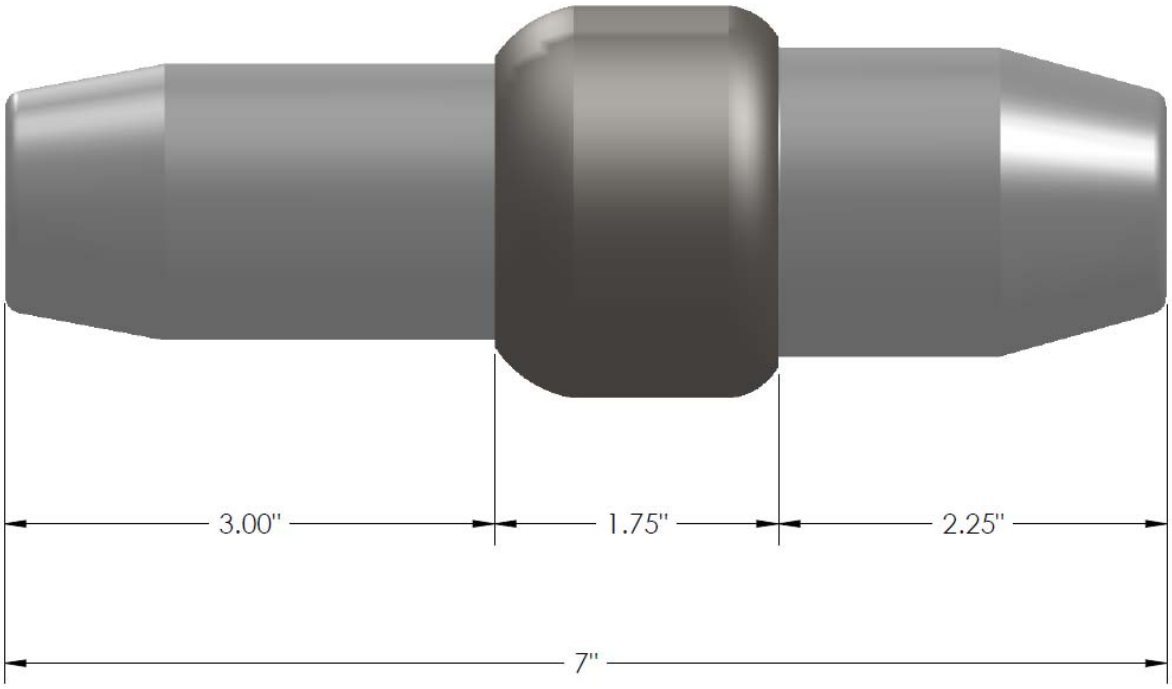
1" =
36,800 psi

Factory Swadged =
38,000 psi

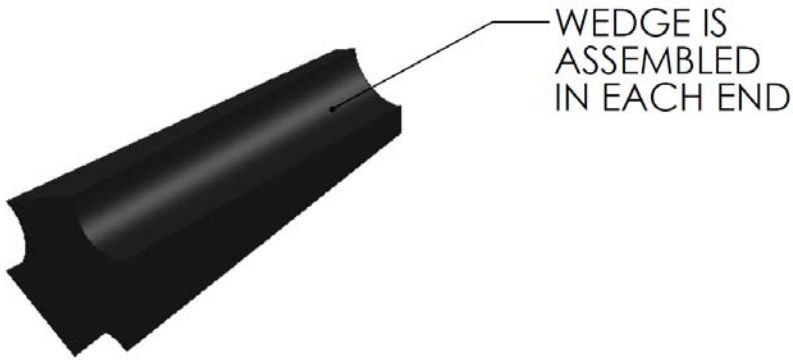
CABLE END – 13” VERSION



CABLE SPLICE



CABLE WEDGE FITTING



Nu-Cable™

Cable Barrier Systems

INSTALLATION MANUAL

SECTION G
BARRIER INSTALLATION CHECKLISTS

CONTENTS

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INSTALLATION CHECKLIST

- ☐ Are all the cables positioned at the correct height?
- ☐ Are there irregular curves or joints where an errant vehicle might snag? Is there evidence of corrosion or damage to the cable? The cable should be scheduled for repair if either of these circumstances exists.
- ☐ Check to see that nuts are installed on the hook bolts.
- ☐ Check that there is enough thread at the cable connections to allow for future tensioning or repairs.
- ☐ 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.
- ☐ Is the grading and slope appropriate for the system to be installed?
- ☐ Is the grading consistent and has been completed correctly?
- ☐ Are there any storm drains, culverts or other obstructions that could interfere with the barrier?
- ☐ Is there anything in front of the cable 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.
- ☐ Is there enough clearance between the barrier and the hazard for the expected barrier deflection? Minimum clearance is dependent upon post spacing.

Nu-Cable®

Cable Barrier Systems

INSTALLATION MANUAL

SECTION J
SYSTEM DELINEATION

CONTENTS

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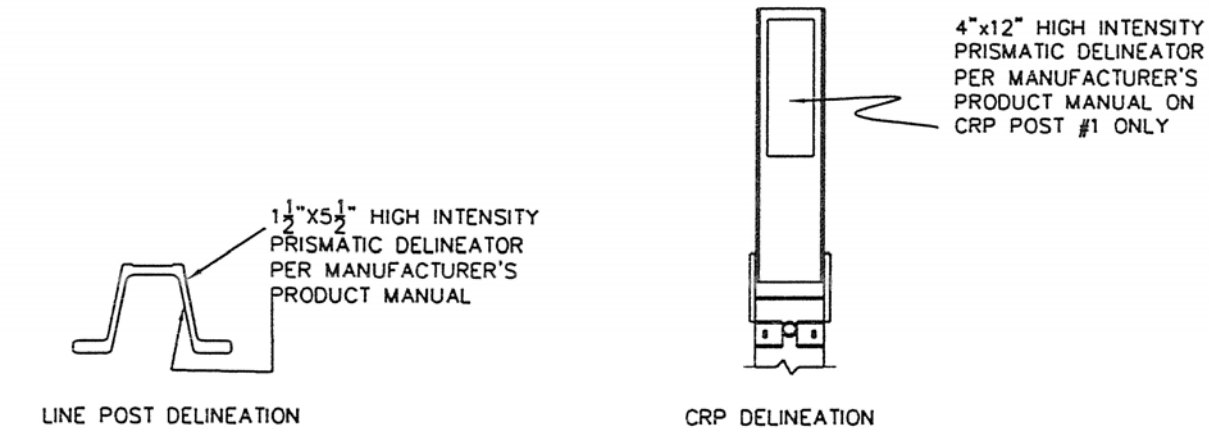
DELINEATION

System delineation is not typically supplied with the Nu-Cable® barrier system due to the wide variety of delineation specifications between states. Delineation should be installed as directed by the engineer.

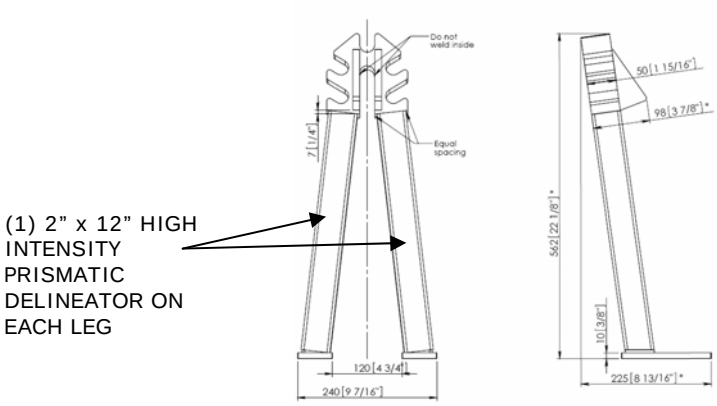
The bonding surface must be relatively clean and dry. Contaminated surfaces should be cleaned with a 50-50 Isopropyl Alcohol and water mixture. Use a lint-free cloth. Substrate temperature must be above 50 degrees F for proper adhesion.

Primer should be shaken well before using. Apply a thin, uniform coating to the bonding surface using the minimum amount that will fully coat the surface. Allow to dry completely before applying tape.

Remove backing from pressure-sensitive reflective sheeting and apply pressure by rolling or rubbing to ensure good contact.



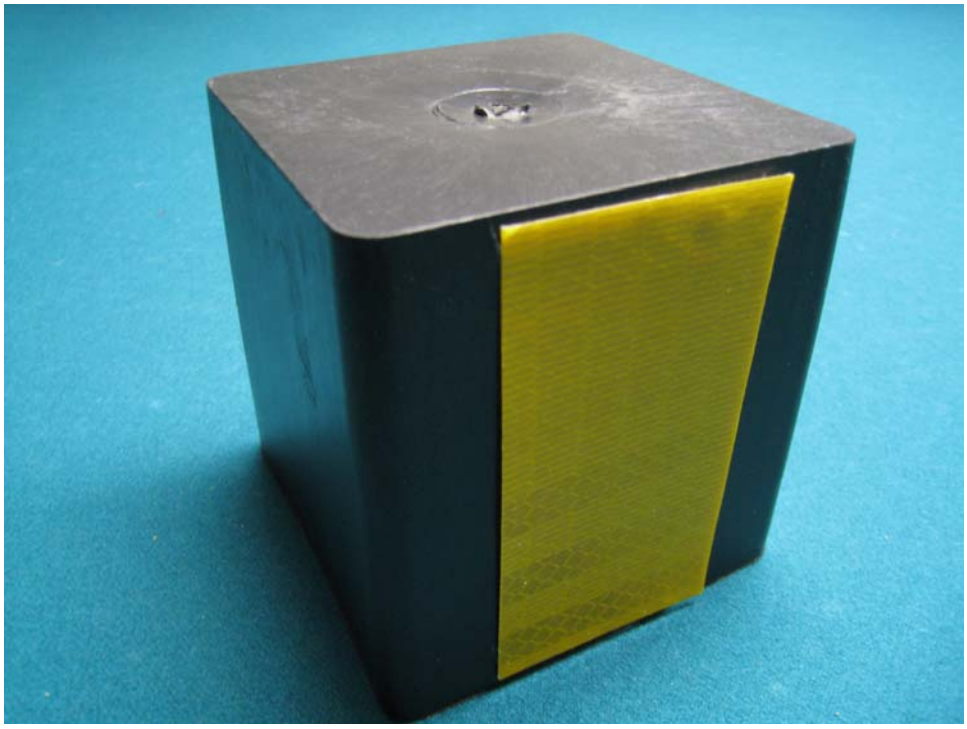
DELINEATION DETAILS



NU-TEN TRIGGER POST

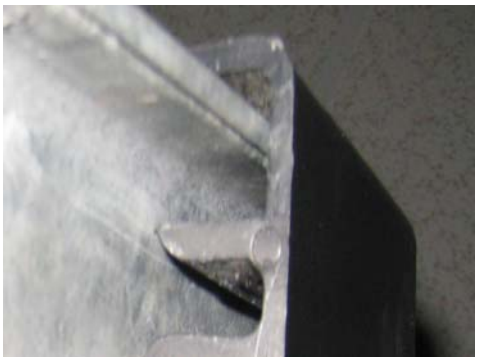
POST CAPS

Optionally required based on project specifications.



The Nu-Cable systems that only use hook bolts (TL3 – 3 or 4 cable for 6:1 slopes) have the line post firmly inside the center grooves of the cap.

The Nu-Cable systems that use hangers and straps (TL3 for 4:1 slopes or TL4 for 6:1 slopes) have the line post inserted all the way to the top of the cover utilizing the top grooves.



Adhesive is optional for securing the caps to the line posts.

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Cable Barrier Systems

INSTALLATION MANUAL

SECTION M

APPENDIX: TESTING SOIL CONDITIONS

CONTENTS

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SOIL TESTING

This section includes information relevant to determining the soil density & conditions at a specific location. The processes and steps listed here are referenced throughout the manual to determine installation modifications to the system foundations required in order to maintain performance in weak, or soft, soils.

CAUTION: The options shown below are examples of typical foundations for use in strong or weak soil conditions. They should not be assumed to be the only options available. If soil conditions at each location are unknown or do not meet the minimum requirements for strong or weak soil as outlined in Section M, a geotechnical review by a professional engineer shall be conducted prior to starting installation. The results of this evaluation shall determine foundation design at each location.

In order to verify site soil as a particular soil using a DCP (Dynamic Cone Penetrometer) or SV (Shear Vane), please reference the following table and instructions:

Cohesive Soils	
Description Su (kpa)	**Foundation Pile Depth NU-CABLE LINE POST**
50 - 75	450mm ø x 900-1200mm (18”ø x 36-48”) *(As Specified Per Project Engineer)
76 - 125	300mm ø x 750mm (12”ø x 30”)
Cohesionless Soils	
Description Phi (0)	**Foundation Pile Depth**
30 – 41	450mm ø x 900-1200mm (18”ø x 36-48”) *(As Specified Per Project Engineer)
>41	300mm ø x 750mm (12”ø x 30”)

Table 1

- **Purchase the DCP equipment.**
- **Purchase the ASTM publication ASTM STP 399 (available at the ASTM website) that describes the test procedure**
- **Submit that to the state or project engineer to make sure the tool is acceptable to them.**
- **The manual shows a curve that correlates the blow count from the DCP to a Standard Penetration Test (SPT) blow count. For native soil, a blow count of 15 (DCP) is equivalent to a Standard Penetration Testing (SPT) blow counts of 10 blows per foot.**
- **Once the SPT blow counts are known, we can use them to calculate the undrained shear strength (Su) of the cohesive soil as follows:**
  - **Su (kPa) = Converted SPT blow count x 5 this is the units included in the NU-TEN manual**
  - **Or**
  - **Su (ksf) = Converted SPT blow count /10**
- **If the blow count in the field is less than 15, then the foundations will have to be increased because the soil will not qualify as stiff.**
- **Need to make sure whoever runs the test out in the field is familiar with the procedure. It is very easy to make a mistake about procedure of using this particular tool. Whoever performs the test in the field will have to assume responsibility for the results.**
- **The test should be performed in one-foot intervals down to the design bottom elevation. We are interested in the strength of the soil above (at depths of 0, 6 inches, and 2 feet) the bottom elevation because this is the soil that will provide lateral resistance to the system. You cannot just drill the holes and check the bottom.**

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INSTALLATION MANUAL

SECTION N

APPENDIX: REPAIR & MAINTENANCE

CONTENTS

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REPAIR & MAINTENANCE

The Nu-Cable™ System, regardless of installation method, is very easy to repair after an impact. The longitudinal elements (the cables) of the barrier will rarely need to be replaced. Visually inspect the cables, and if necessary, use cable splices to replace damaged cable.

Damaged posts and hook bolts should be replaced.

In the case of driven posts, the damaged posts must be removed and ground repaired before driving a new post.

After all impacts, the system requires inspection and replacement or repair of damaged parts.

Cutting Cables

Although it can be done, cutting cables under tension should be done with caution. It is best to first release tension in the cables by using the turnbuckles if at all possible. A vehicle becoming entrapped in the system can create a higher-than-normal tension. In an emergency, the cables CAN be cut, by using great care, with an abrasive wheel saw. Make sure no one is near the cutting point upstream or downstream. Use gloves and safety goggles and cut very carefully. Pay particular attention when there are only a few strands left, at the final stage of cutting. In worst case, use a bolt cutter with long handles.

Pavement Overlays or Resurfacing

Cable heights are critical to performance of the system. If the roadway has experienced an overlay, ensure cable heights are correct, and that the slope to the barrier does not exceed the maximum allowed. For significant overlays, it may be necessary to install extra-height posts.

Where it is anticipated that future roadway construction will require increases in the roadway surface elevation, a pro-active solution is to install extra-height posts in the original installation to allow for vertical adjustment of the cables. This option is only available in Test Level 3 systems.

Emergency Access

A temporary crossover for emergency vehicles or temporary traffic control can be made at any location of the installed cable barrier by removal of the special locking hook bolts and/or cable hanger straps, thus allowing the cables to slacken. The number of posts necessary for removal depends on the tension and temperature, but normally 15-40 posts will be enough. The weight of the cable will provide enough slack for passing over with vehicles.

Materials for Maintenance

Your NUCOR distributor carries an inventory of replacement parts for the Nu-Cable™ 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
Small Hook Bolts	=	100 pieces
Large Hook Bolts	=	50 pieces
Cable Hanger & Retainer Strap	=	50 Bundles
CRP/Trigger posts	=	3 or 4 pairs
Turnbuckles	=	3 or 4 pairs
Cable Anchor Ends	=	3 or 4 pieces
Cable Spool	=	2000 ft.

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

Nu-Cable®

Cable Barrier Systems

INSTALLATION MANUAL

SECTION P
APPENDIX: CONTACT INFORMATION

CONTENTS

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