BRIFEN USA

BRIFEN USA, INC.

WIRE ROPE SAFETY FENCE

Z-Post System and WRGT-FL

NCHRP 350 TL-4

PRODUCT MANUAL

(Installation & Repair Procedures)

Rev: October 2023

12501 N Santa Fe Ave
Oklahoma City, OK 73114

405-751-8062
www.brifenusa.com

IMPORTANT - Confirm which product you are using and that you have the most current product specific manual. This can be determined by the information and date printed on the front cover.

WARNING: *The local highway authority, owners, and contractors are RESPONSIBLE for determining the appropriate design policies for the installation, maintenance, and repair of the Brifen WRSF system. Brifen USA is a material supplier and does not provide highway design services.*

Important: *These instructions are for standard installation specified by the appropriate highway authority. In the event the system installation, maintenance, or repair would require a deviation from standard parameters, contact a Brifen USA representative.*

The Brifen Wire Rope Safey Fence (WRSF) System includes TL-4 Z-Post Length of Need (LON) and Wire Rope Gating Terminal (WRGT-FL). This system has been tested to NCHRP-350 criteria and are eligible for Federal-aid reimbursement for use on the National Highway System (NHS).

This manual must be available onsite to the workers overseeing and/or installing the product. For additional copies, contact Brifen USA, Inc. at 1-866-427-4336. Brifen reserves the right to make changes to this manual at any time.

This document covers the installation, maintenance, and repair of the 4 Rope (Cable) Brifen Wire Rope Safety Fence (WRSF) System with TL-4 Z-Post (LON) and Wire Rope Gating Terminal (WRGT-FL). Installation procedures for the other Brifen Systems are similar, therefore, drawings for the system being installed should be reviewed before the start of work, as post type and size, rope heights, etc. may vary.

CAUTION: *Terminal and line post foundation sizes are determined by soil classification, condition, temperature extremes, etc. If loose, wet, or otherwise questionable soils are encountered at the site, please contact the responsible agency representative or Brifen USA, Inc. for recommended foundation modifications.*

The information herein is proprietary to BRIFEN USA, Inc., and shall not be disclosed, duplicated, or used otherwise without the express written consent of BRIFEN USA, Inc. ©

LIMITATIONS AND WARNINGS

Brifen USA, Inc., in accordance with AASHTO MASH, contracts with ISO 17025 A2LA accredited testing facilities to conduct crash tests, evaluate those tests, and submit the test results to the FHWA for review.

The Brifen TL-4 Z-Post System and MASH Gating Terminal have been evaluated as eligible for FWHA reimbursement according to the requirements and guidelines of MASH. The MASH eligibility requirements include a variety of crash tests to evaluate product performance by testing certain impact conditions.

The system is tested according to the test matrix criteria of MASH as designated by AASHTO and FHWA. These tests are not intended to represent the performance of systems when impacted by every vehicle type or in every impact condition. Each departure from the roadway is unique.

Brifen USA, Inc. expressly disclaims any warranty or liability for injury or damage to persons or property resulting from any impact, collision or harmful contact with its products, other vehicles, or nearby hazards or objects by any vehicle, object, or person, whether the products were assembled in consultation with Brifen USA, Inc. or by third parties.

The system is intended to be assembled, delineated, and maintained in accordance with this manual, associated drawings, and specific state and federal guidelines. **It is the responsibility of the authority specifying the use of a highway product to select the most appropriate product configuration for its site specifications.**

Evaluation of the site layout, vehicle mix, speed, traffic direction, and visibility are some of the elements that should be considered in the selection process.

After an impact occurs, the system must be evaluated and repaired to its original specified condition, as soon as possible. Product selection, approval, proper installation, and maintenance of any Brifen system is the sole responsibility of the specifying highway authority.

Safety Alert Symbols appear throughout this manual and indicate important statements that must be read and followed. Failure to do so could result in severe injury or death.

WARNING: *Do not install, maintain, or repair the system until you have thoroughly and completely read this manual and understand it. Please call Brifen USA, Inc. at (866)427-4336 if you do not understand any portion of these instructions or this manual.*

WARNING: *Safety methods including appropriate traffic control devices and personal protective equipment (PPE) specified by the appropriate highway authority must be used to protect all personnel while at the installation, maintenance, or repair site.*

WARNING: *Ensure that your installation site meets all appropriate Manual on Uniform Traffic Control Devices ("MUTCD") and local standards.*

WARNING: *Use only Brifen USA, Inc. parts that are specified for use with the system for installing, maintaining, or repairing the system. Do not use parts from other systems even if those systems are other Brifen systems unless approved by Brifen USA, Inc. Do not modify the system in any way. These configurations may not have been assessed or been approved for use.*

IMPORTANT: *Brifen USA, Inc. makes no recommendation whether the reuse of any part is appropriate or acceptable following an impact.*

IMPORTANT*: It is the responsibility of the applicable owner/agency/specifier to inspect the System after installation is complete to make certain that the instructions provided in this manual have been properly followed.*

BRIFEN USA

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ABOUT US

CONTACT INFO

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INTRODUCTION

Brifen Wire Rope Safety Fence (WRSF) is a high-tension median or roadside cable (wire rope) barrier system widely used around the world and in many U.S. states. It is available in several designs. This manual discusses the **TL-4 Z-Post System and WRGT-FL.**

The ¾" galvanized wire ropes are pre-stretched during manufacturing to reduce stretching during impact, and thus are more easily maintained. The four ropes are interwoven around the line posts, with all ropes securely connected to the terminal at each end. The ropes are not attached to the posts; nylon pegs hold the ropes up on the sides of the posts, positioning the ropes at the proper heights.

Brifen WRSF is unique among cable barriers due to the patented interweaving of the wire ropes. Each pre-stretched wire rope is highly tensioned, which, together with the weave, creates high post/rope friction. This causes each post to act as a "mini-anchor," which helps limit the extent of damage during impacts, eliminates the need for intermediate anchors, and assures satisfactory performance even around curves.

A major benefit of interweaving the wire ropes is that deflections are more predictable, even when long sections (typical in real-world installations) are impacted. Research has shown that with straight (non-woven) systems, deflections increase with system length.

Brifen Drawings (Included in this Manual) should be carefully reviewed prior to starting the installation.

PARTS LIST

WRGT4-M

WRGT-FL Anchor Assembly
(4 Rope TL-4)
Includes Anchor Plate and Anchor Bolts w/ hardware

F11A

Post A
Z-Post

4F11B1

B1 Post
49 ½" Z-Post
B1 Stamped on post

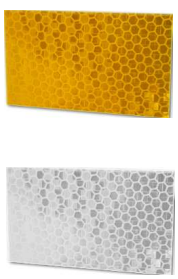
4F11B2

B2 Post
52 ½" Z-Post
B2 Stamped on post

4F11B3

B3 Post
56" Z-Post
w/ weakening cut
B3 Stamped on post

A82
W82



Prismatic Reflector

Z80

Z-Post Post Cap
Required on All Posts

A42

Locating Peg

Z41

Z-Post Plastic Excluder

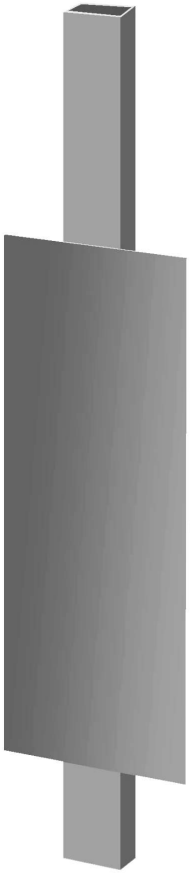
Z40

Z-Post Galvanized Steel Socket

Z40-P

Z Post Plastic Socket

Z44



LON Driven Z-Post Socket with soil plate
(length varies)

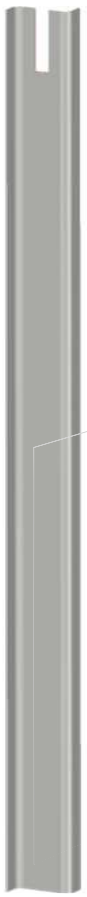
Z21

LON Driven Z-Post with soil plate

Z91

LON Bolt Down Z-Post
Surface Mount requires 4 ea. Anchor Bolts (by others)

Z11



LON Z-Post

A51(x)

Swaged Threaded Terminal
Left (A51L) and Right (A51R)

A52

Turnbuckle (Rigging Screw)

A53

Cable Splice

W86

Retainer Pin

WRGTA1-C

Coupler Fitting Assembly
Includes: Nuts (2), Round Washer, Steel Square Washer, Square Nylon Washer, Tensile Rod, Coupler Fitting

WRGTA1

Combination Fitting Assembly
Includes: Nuts (2), Round Washer, Steel Square Washer, Square Nylon Washer, Tensile Rod, Compression Fitting

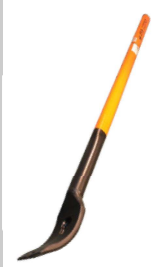
PREPARATION

RECOMMENDED TOOLS

Recommended PPE
It is recommended that the following personal protective equipment (PPE) be provided for the safe installation of Brifen:

- *Safety footwear*
- *Gloves*
- *Hearing protection*
- *High visibility clothing*
- *Hard hat if required*

Items with part numbers available for purchase from Brifen USA, Inc.:

T-05				
				
Klein Pry Bar	Measuring Tape	Hammer	Copper Anti-Seize	Croxby Clamp

	T-23		
			
Post Level	Klein Parallel Jaw Grip	Wrenches Various Sizes (12” Minimum)	Chop Saw or other abrasive cutter

	T-28	T-01	
			
Cable Spreader	Cable Spreader Battery Pump	Tension Meter w/ Infrared Therm.	

	T-20	
		
Cable Spreader	Cable Spreader Manual Pump	Come-Along 1.5-ton Capacity or greater

SITE REVIEW/LAYOUT

Important: *It is the responsibility of the state/specifying agency design engineer to ensure that the Brifen WRSF System placement conforms to the AASHTO Roadside Design Guide.*

Important: *The Beginning of Length of Need for the system starts midway between B3 Post and the first Line Post.*

Important: *Brifen USA, Inc. does not direct grading. Proper site grading must be completed before the installation of the system. Local specifying agency guidelines OR the AASHTO Roadside Design Guide should be followed, whichever is more stringent.*

Prior to beginning installation, the proposed site should be carefully checked. The area should be relatively smooth, with compacted soil and no edge drop-offs, abrupt slope changes, holes, debris, etc. that could prevent a vehicle from impacting the Wire Rope Safety Fence with all wheels on the ground and suspension normal. Some filling and/or grading and compaction may be necessary. The ropes are recommended to be placed at design height above ground, and the maximum deviation is ± 1 inch.

Important: *Sockets should be installed flush with grade in order to maintain proper rope heights.*

Placement in the bottom of a median ditch is generally not recommended due to conflicts with drainage inlets and dikes, which create difficulty in maintaining correct rope heights. Also, these locations are typically wet and offer poor support for post and anchor foundations. Offsets from median ditches should preferably be 10’ or more, but within 1’ of the ditch bottom may be acceptable. Slopes on the traffic approach side should be typically no steeper than 6:1.

For roadside applications, the preference is that the distance to the hinge point behind the fence is sufficient to accommodate the barrier’s design deflection and provide adequate lateral support for the system. Adequate clearance to rigid obstacles such as bridge piers, sign supports, power poles, trees, slopes, etc. is critical. It is important to select the proper post spacing for the minimum design deflection desired. With 7-foot post spacing, minimum clearance should be at least 8 feet, but 10 feet or more is preferable. By reducing the post spacing in the vicinity of an obstacle, clearances can be reduced, if needed, per specifying agency requirements.

When the WRSF must be placed in the vicinity of other barriers, special considerations are required. An example is a barrier at bridge approaches. If the side slopes are relatively flat and the other barrier is parallel to the roadway, the Wire Rope Safety Fence can be tapered over, and the end terminal placed behind the other barrier. A minimum clearance of 10’ from the end treatment of the parallel barrier is recommended. If the other barrier is flared, the WRSF can be terminated on the traffic side using the WRGT.

INSTALLATION

The major steps in the installation of Brifen's TL-4 Z-Post System and WRGT-FL are as follows:

- Constructing the terminal foundations
- Constructing the post socket foundations
- Installing the terminal posts
- Installing the line posts
- Installing the wire ropes
- Tensioning the wire ropes

END ANCHOR FOUNDATIONS

Potential Hazards: *deep excavation, movements from machinery.*
Recommended Control Measures: *Maintain an exclusion zone around moving machinery, do not leave deep excavations unattended.*

Important: *Foundation sizes vary, depending on soil type and condition, water table depth, temperature extremes, etc. If loose, wet, or otherwise questionable soils are encountered at the site, please contact the responsible agency representative or Brifen USA for advice on sizes.*

Important: *All plans and drawings should be reviewed for end terminal locations and system offsets from the edge of the travel lane and from obstacles. End terminal and post foundation concrete should be the strength specified and adequate cure time must be allowed, typically at least one week or until strength test cylinders indicate minimum concrete strength has been attained before tensioning the WRSF.*

Important: *The concrete anchor block must be flush with the existing grade.*

NOTE: *If either the WRGT-RD or WRGT-FL anchor is used, the anchor frame and it's reinforcing cage must be placed into the concrete so that anchor plate will be at the required angle (12° - 14°) from horizontal. Any lesser angle risks having the ropes disengage. This angle can be checked using a small level with an attached angle scale. The area should be shaped to drain.*

A **neat excavation** (vertical sides and flat bottom) for the end terminal foundation is required, with **minimum disturbance of the natural ground**. If surrounding soil is disturbed, loose materials must be removed and the foundation either:

1) over-excavated and forms set, reinforcing steel and concrete placed and, later (after form removal), backfilled using compaction equipment to attain 95% density, or
2) over excavated, with vertical sides and flat bottom, and the loose material removed.

After reinforcing steel placement, the entire over-excavation is then filled to flush with the ground line using extra concrete.

Review shop drawings and/or project specific drawings for proper placement of anchor frame and reinforcing steel (by others) in foundation. The WRGT Anchor Assembly **must** be placed into the wet concrete. The anchor plate **must not** be buried in the concrete; it should sit level on top of the concrete surface so that, if necessary, it can be unbolted, removed, and replaced. The anchor will set at an angle of 12 degrees. All concrete placements should comply with agency requirements.


Push anchor bolts into wet concrete
BRIFEN★USA INC.


Seat Anchor at 12 degree angle


Anchor Plate seated in concrete
BRIFEN★USA INC.

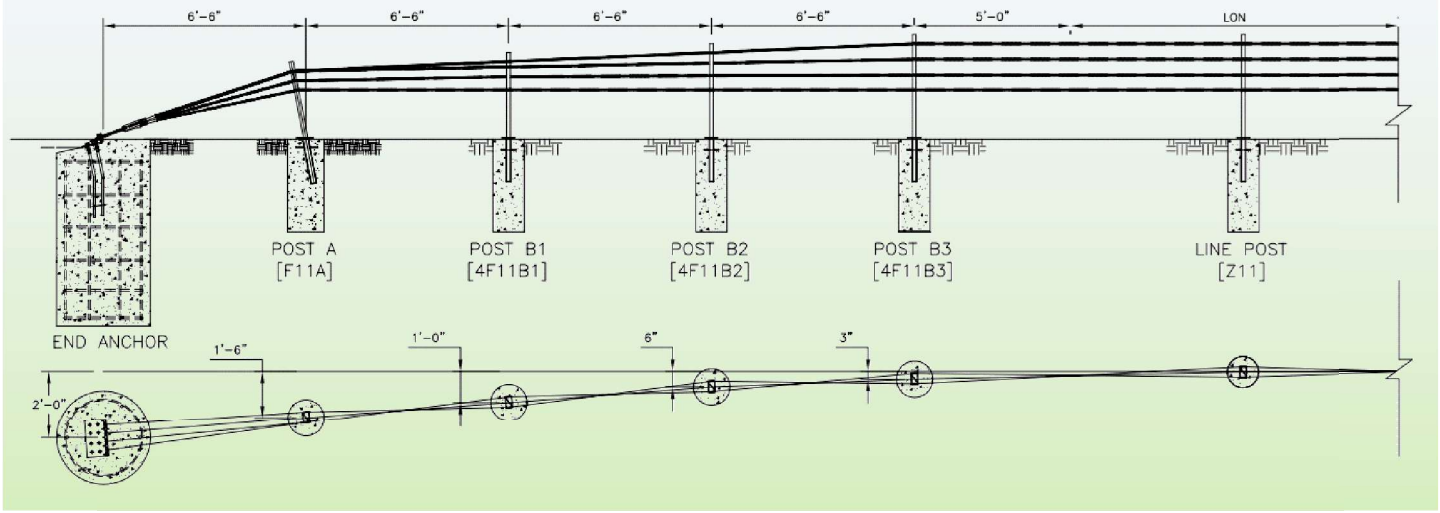

Leveling Anchor in foundation
BRIFEN★USA INC.


Anchor cylinder foundation
BRIFEN★USA INC.

INSTALLATION

WRGT-FL AND LINE POST FOUNDATIONS

WRGT-FL End Terminal



Potential Hazards: *deep excavation, movements from machinery.*
Recommended Control Measures: *Maintain an exclusion zone around moving machinery, do not leave deep excavations unattended.*

The concrete shall have a minimum 28-day strength of 3000 psi or per agency specifications.
NOTE: *The reinforcing ring may be omitted if the socket is placed in a continuous concrete mow strip.*


Jig used to vertically align post socket in concrete


Reinforcing Ring (By Others)

1. The foundations for the terminal post (A, B1, B2, & B3) are all spaced 6'-6" starting from the center of the end anchor.
2. After Post B3 foundation, the first Line Post foundation is spaced at the distance specified by the agency or in the plans. All subsequent foundations placed at the same spacing typically until the ending terminal is reached. Using an auger, drill the post foundations to a depth specified by agency or plans and remove spoils.
3. Pour concrete into the hole to within 1-2 inches of the **finished surface level or grade**.
4. Insert the post socket into the center of the concrete ensuring the top of the socket is aligned with the finish surface level, perpendicular to the roadway and in alignment with other sockets.

NOTE: *The steel socket for the first terminal post (Post A) will be placed at an angle 79° of horizontal toward the end anchor.*

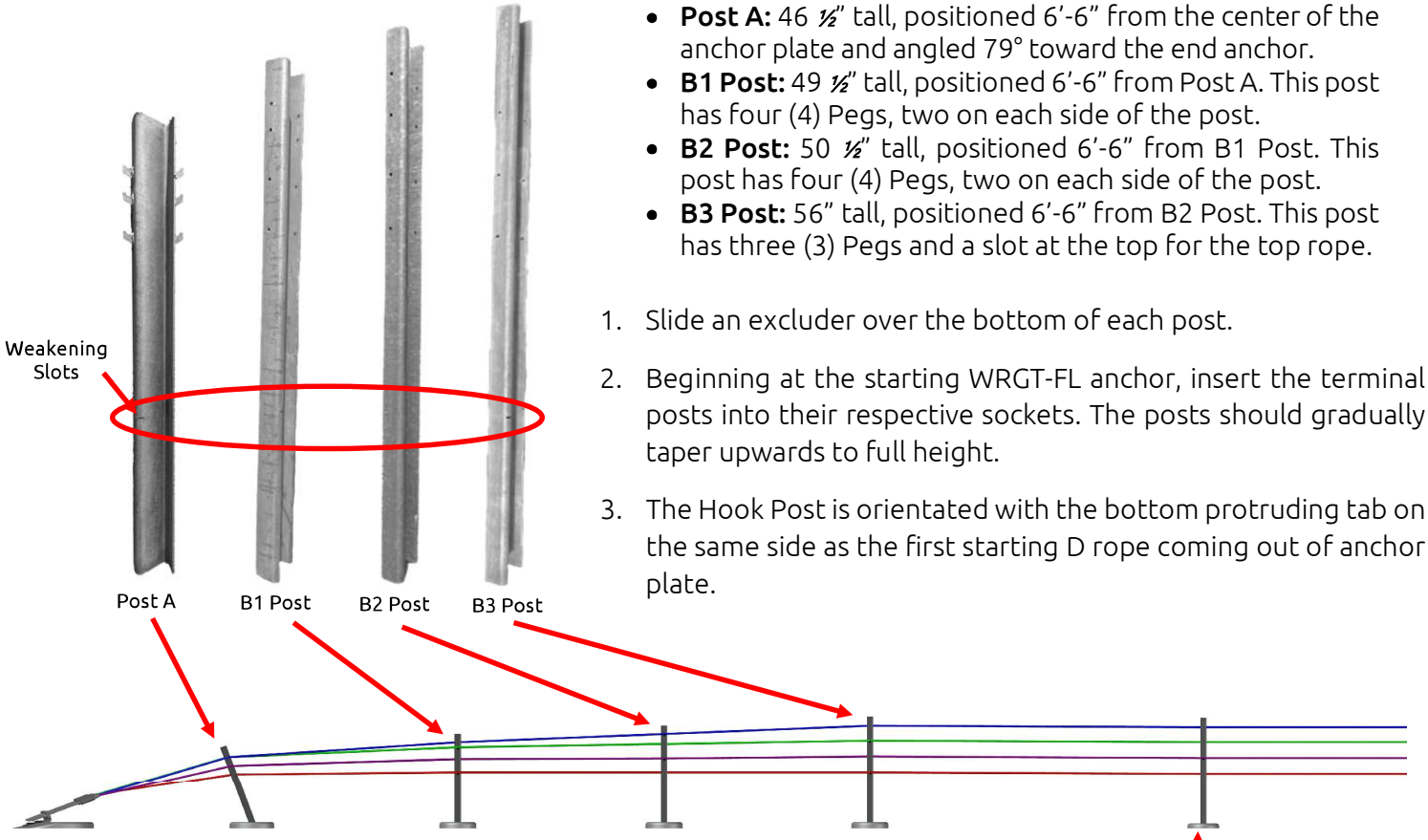
5. Place the reinforcing ring (supplied by others) in the center of the post hole at a depth of 2 inches from the surface. The ring can be omitted, if placed in a continuous concrete mow strip.
6. Insert a post or jig with attached level into the socket to ensure the socket is vertically plumb.

POST INSTALLATION

Potential Hazards: *Injury from movements and posture, hand injury from pinch points.*
Recommended Control Measures: *Observe correct techniques (bend at the knees), wear gloves.*

NOTE: *It is recommended that post caps and reflectors be installed on posts AFTER ropes have tension.*

The Wire Rope Gating Terminal (WRGT-FL) has 4 special steel posts with different heights and a weakening slot toward the bottom of each post.

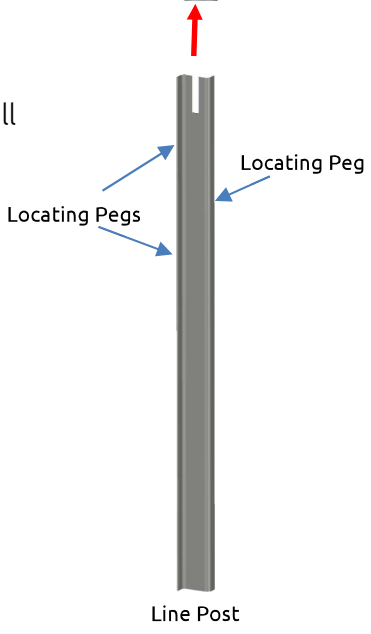


- **Post A:** 46 ½" tall, positioned 6'-6" from the center of the anchor plate and angled 79° toward the end anchor.
- **B1 Post:** 49 ½" tall, positioned 6'-6" from Post A. This post has four (4) Pegs, two on each side of the post.
- **B2 Post:** 50 ½" tall, positioned 6'-6" from B1 Post. This post has four (4) Pegs, two on each side of the post.
- **B3 Post:** 56" tall, positioned 6'-6" from B2 Post. This post has three (3) Pegs and a slot at the top for the top rope.

1. Slide an excluder over the bottom of each post.
2. Beginning at the starting WRGT-FL anchor, insert the terminal posts into their respective sockets. The posts should gradually taper upwards to full height.
3. The Hook Post is orientated with the bottom protruding tab on the same side as the first starting D rope coming out of anchor plate.

Posts located in the Length of Need (LON) are known as Line Posts and are 56" tall and feature holes for three (3) locating pegs, and a slot on top.

1. Insert the Line Posts with excluder in their respective sockets.
2. Tap in a nylon "locating peg" into the pre-drilled hole on the side of the post at each corresponding heights of the 3 cables.
3. Insert next line post but alternate sides when installing pegs.



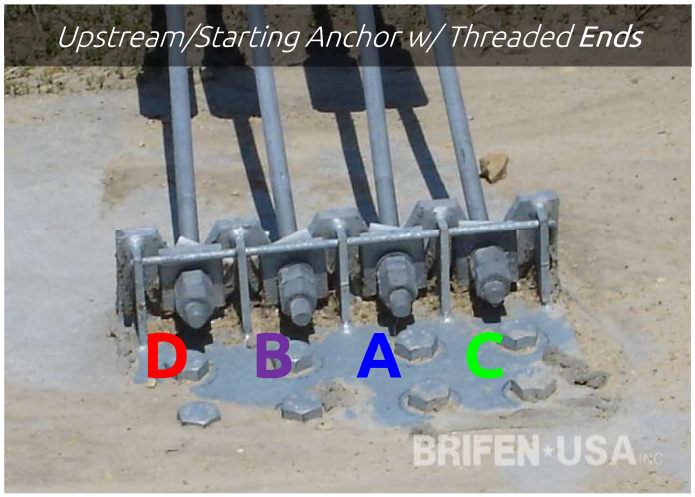
INSTALLATION

The ropes (normally in 1000' lengths) are delivered on large reels, four (4) lengths per reel, with Left and Right hand swaged threaded fittings factory attached. The rope sections will be connected using a "turnbuckle" (rigging screw). Ropes are connected to the starting WRGT-FL anchor frame, left to right, in the order D, B, A, C. Each of the ropes are connected to the trailing/downstream WRGT-FL end terminal using shorter "tail ropes", sized to fit the length of the total wire rope fence (run or section). These tail ropes are delivered on separate reels, marked for a specific fence and not interchangeable. Brifen will supply a fence cabling map/guide based on the project-specific fence lengths **that have been field verified by the contractor prior to fabrication** to assist in assembly

Cable supplied 4 x 1000ft per reel

INSTALLING CABLES

Upstream/Starting Anchor w/ Threaded Ends



Stringing the Cable

Important: *Rigging screws shall not be located within the terminal section.*
Note: *Rope D is positioned on the bottom resting on the lowest hook.*

For clarity, these instructions describe the installation of 1 rope at a time. Installing 2-4 at a time can be done with the proper equipment and manpower. Ropes are installed D, C, B, A; with D being the bottom rope and A the top rope.

1. Using a truck or trailer fitted with a cable reel frame and starting with the D rope, insert the RH threaded swaged fitting directly from the reel into a coupler fitting and secure in the LEFT hole in the anchor frame. Secure the nut on the coupler fitting leaving at least 3 threads exposed. Pull and interweave the rope until you get to the end of the 1000' section where there will be a LH threaded fitting.

2. At each Line Post use a locating peg to rest the rope at the right height.

3. At the location of the rigging screw, ensure the cable slack is pulled tight. Using a parallel jaw cable puller attached to the cable about one post space from the threaded fitting, pull out the rope slack using a winch, vehicle or other equipment and temporarily clamp the rope to a post using a U-bolt or other clamping method (by others). One clamp per rope per post.

4. A turnbuckle will be needed to connect the LH fitting at the end of the first rope to the RH fitting of the next rope section. Coat all threaded ends with a copper anti-seize lubricant before engaging the turnbuckle for easier tightening.

5. Attach the turnbuckle to both threaded end fittings, ensuring at least 1" of thread is secured or until threads are visible in the turnbuckle inspection hole (if present).

> ***Note:*** *Occasionally turnbuckles will land at line posts, and this is normal and has been crash-tested.*
>
> ***Note:*** *The rope position or order on the trailing anchor plate* ***may be opposite*** *to the starting anchor as this is determined by the number of the Line Posts.*

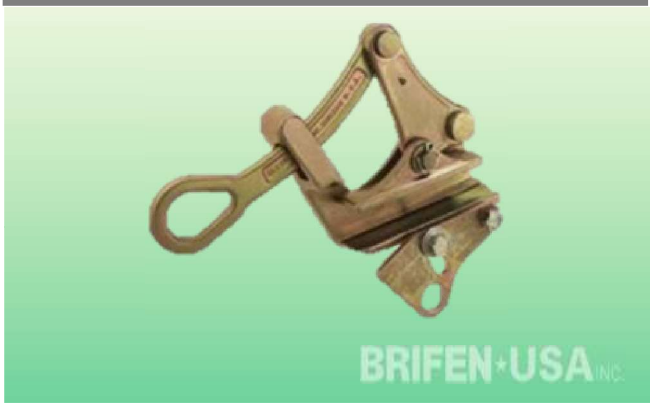
6. Repeat the process of weaving and resting the D rope on the bottom locating peg of the Line Posts until reaching the trailing end anchor.

7. At the trailing anchor, ensure the cable slack is removed from the rope along the system as described above.

8. Repeat steps 1-10 with ropes C and B using the opposite weave pattern to the rope below.

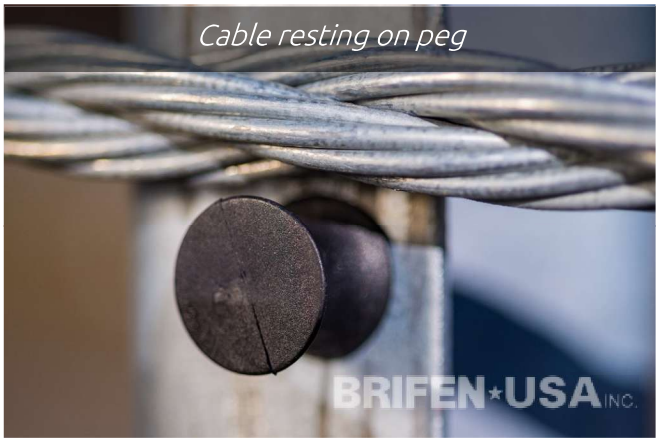
9. For Rope A, follow steps 1-4 until you reach the first line post then the cable will be place in the slot in the top of all the line post until you get to the trailing end terminal. Starting with the hook post at the trailing end terminal begin weaving the cable the opposite of the cable below.

Klein Parallel Jaw Grip



Rigging screws can be located at post

Cable resting on peg



U-bolt used as a temporary clamp

INSTALLATION

Important: *Keep body parts clear of abrasive blade cutting device.*
Ensure proper personal protective equipment (PPE) is worn. Failure to follow this warning could result in serious injury or death.

Note: *Turnbuckles (Rigging Screws) shall not be located in the WRGT-FL.*

At the trailing/downstream end it is important to pull any remaining slack from the rope prior to making the final connection. If a come-along is used to pull rope slack, it can be hooked to the frame by use of a D-Ring. This or other methods can be used to pull any remaining slack prior to making the final rope cut and hardware connection.
On the trailing end, slide each rope through its respective hole in the end anchor plate. Pull the rope tight as described above and cut off any excess rope leaving 2-3 feet extending past the anchor frame. Attach the rope to the trailing anchor frame using a combination fitting (page 14). Do not cut excess rope until the Construction tensioning (page 15) has been completed.

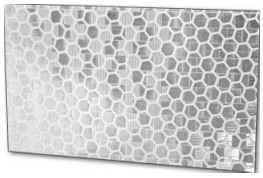
Come-Along Utilizing D-Ring

POST CAPS AND REFLECTORS

POST CAPS ARE TO BE PLACED ACCORDING TO AGENCY REQUIREMENTS
IT IS RECOMMENDED THAT CAPS AND REFLECTOR BE INSTALLED AFTER INITIAL TENSION APPLIED TO ROPES.

Important*: Ensure delineation (reflective sheeting) used on the Brifen WRSF System meets state/specifying agency's MUTCD for proper delineation.*

For all line post install the Rectangle shaped post cap [Z80]. Reflector decals will be placed on the side of the post cap at every 3 to 5 post, or per agency requirements.



TRAILING END ANCHOR

WRGT-FL END TERMINAL ANCHOR ROPE CONNECTION:

All wire ropes are anchored to a single large concrete foundation for the WRGT-FL terminal.

A "Tensile Rod - Combination Mechanical Fitting" is used to connect each of the wire ropes to the anchor frame, which is bolted to the concrete foundation. The steps below illustrate the connection of one rope end at an end terminal.

1. Before starting the connection, as much slack as possible should be pulled out of the rope. A "Come-Along" can be used, hooked to the anchor frame and clamped to the rope approximately 5' from the anchor frame. The rope is then pulled tight.
2. The end is cut off approximately 19" short of the anchor frame.
3. The threaded socket section of the combination mechanical fitting is slid over the rope end, leaving approximately 2" of rope exposed.
4. Gently force a screwdriver between the strands to unlay the rope. When done correctly, the strands will form a symmetrical basket. Do not straighten out the spiral lay of the strands, unlay any wires that make up the strand, or allow the strands to cross each other inside the sleeve.
5. Place the brass plug in the center of the strands, starting with the small, tapered end. Use a metal punch and hammer to drive the plug into the threaded socket while assuring that the strands are spaced somewhat equally around the plug. Drive the plug until firmly seated and no more than 1/3 of the plug is visible outside the threaded socket.
6. Using adjustable pliers or hose clamps, bend the strands toward the center enough that the threaded sleeve can be slipped over all the strands. Coat the threads with a copper anti-seize lubricant for easier tightening.
7. With the threaded sleeve over the strands, engage the threads and tighten until four or fewer threads are visible. If more than four threads are visible, proof load the cable and retighten the threaded socket. (There is no specific requirement for torque)
8. Prior to proof loading, strands visible through the inspection hole are your assurance of a proper assembly.
9. The threaded tensile rod is connected to the anchor frame using a square steel washer, round washer and two nuts (one is a locking nut) with a square HDPE/Nylon washer placed against the steel anchor frame. The nut is then tightened to take up slack in the rope, the lock nut added and the come-along released.
10. After all ropes are fastened to the anchor frame, the retainer pin is inserted and the ends bent to keep it in place. The retainer pin prevents movement due to vibration.

TENSIONING

CONSTRUCTION TENSIONING

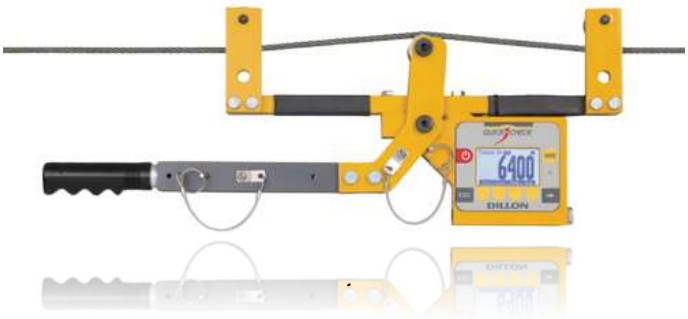
Potential Hazards: *Hand injury from pinch points.* ***Once the tension meter is engaged, make certain to reinstall the lock pin.***

Recommended Control Measures: *Wear gloves.*

Important: *Do not allow bystanders or workers to stand near the system when under tension or in circumstances where the cable may be impacted or cut.*

Important: *Proper cable tension is critical to system performance. A calibrated tension meter and accurate infrared thermometer must be used to obtain the proper tension.*

Tensioning Meter



Infrared Thermometer

The Dillon Tension meter, purchased through Brifen USA, Inc. comes with an infrared thermometer

ROPE TENSION TABLE		
ROPE TEMP.(°F)	**TENSION (LBS)**	**TENSION (kN)**
0	5700	25.4
5	5550	24.7
10	5400	24.0
15	5250	23.4
20	5100	22.7
25	4950	22.0
30	4800	21.4
35	4650	20.7
40	4500	20.0
45	4350	19.3
50	4200	18.7
55	4050	18.0
60	3900	17.3
65	3750	16.7
70	3600	16.0
75	3450	15.3
80	3300	14.7
85	3150	14.0
90	3000	13.3
95	2850	12.7
100	2700	12.0
105	2550	11.3
110	2400	10.7
115	2250	10.0
120	2100	9.3
125	1950	8.7
130	1800	8.0
135	1650	7.3
140	1500	6.7

During the construction phase, it has been found that by applying an initial tensile force of approximately 120% of that required per the Tension Chart or vibrating the ropes by rapping the line posts with a hammer or by use of a mechanical vibrator will aid in Final Tensioning. This accelerates the creep and redistribution of the tensile force by reducing the friction between the posts and the interwoven ropes.

It is not necessary to record tension during the construction phase of tensioning

FINAL TENSIONING

NOTE: *The Final (second) tensioning is recommended after approximately a two or three-week period.*

After Construction Tensioning has been completed, approximately a two-to-three-week period, the rope tension will decrease as a result the rope harmonizing. When measuring for the Final Tensioning the rope tension may be plus or minus of the tension table

Follow the steps outlined below using only the tension values from the chart (page 15). Once the tension meter readings at a given turnbuckle are set, then move to the next turnbuckle and complete checking the entire fence.

1. Ensure that the Turnbuckles have the minimum thread engagement of 1" or are visible in the inspection hole and that the slack has been taken out of the ropes.

2. Check that each rope is securely fastened to the end anchor frames.

3. Start at either end of the fence close to the vicinity of a turnbuckle. Turn on the Dillon Tension Meter (optional). Pull out the pin and open the lever arm and hang on the top A rope. Ensure that all 3 sheaves (rollers) are riding on the rope, then close the lever arm and re-insert the lock pin. The center sheaves will deflect the rope, displaying the current rope tension.

4. Aim the infrared thermometer at the D rope and read the temperature rounding up or down to the nearest 5-degree increment. Refer to the Brifen Rope Tension Table to determine the proper rope tension that coincides with the rope temperature.

5. Connect 3 pipe wrenches to one rope. One on the right-hand fitting, one on the left-hand fitting, and one at the turnbuckle.

6. Adjust the Turnbuckle until the targeted rope tension has been reached. Release the Dillion lever arm and move the tension meter to the next rope below. Repeat the above procedures for the remaining ropes.

Tensioning of the Wire Rope at the Turnbuckle

7. Record the results being sure to log the date, time, rope temperature and rope tension settings on the Tension Log provided (page 32).

Tension Meter Reading

REPAIR

MAINTENANCE

Brifen is a low maintenance barrier. Except for repairs due to impacts, it is recommended that a routine inspection be undertaken to assess the following:

- Tension checked if ropes appear to sag
- No damaged ropes or hardware
- Debris has not accumulated around the barrier which may impede the function of the barrier.
- Vegetation around the barrier is appropriately maintained.
- Post caps and locating pegs have not dislodged
- The system is appropriately delineated.

When checking tension during routine maintenance or after a repair you MUST check the tension at every turnbuckle within the specific fence first, then use an average of all the readings taken for each rope at the turnbuckles for that fence.

NOTE: *Do not adjust rope tension based on one reading as rope migrates with temperature swings and during impacts.*

If the average tension for a given rope is outside the 20% tolerance from the table on page 17, then adjust the tension lower or higher, as needed, starting at the turnbuckle with the lowest or highest reading.

The rope temperature should be checked at each turnbuckle location since rope temperature may vary widely from the ambient temperature and previously tensioned ropes.

The turnbuckles should have been lubricated before assembly to facilitate adjustment and/or removal during maintenance or repair of the safety fence. If lubricant is needed, a copper anti-seize lubricant is recommended.

In the event of an impact, damage to the Brifen system is to be assessed and appropriate repairs made according to agency policy.

If an impact is within 150 ft of the end terminal, then the Hook Post and end anchor should be inspected for damage.

In the unlikely event that, following a vehicle impact it is necessary to remove the Brifen ropes to assist in vehicle recovery see Note on page 20.

DO NOT CUT THE ROPES UNDER TENSION.
Reduce rope tension by removing 5-10 posts first, which introduces slack. Remove more posts, if necessary, to manage ropes.

REPAIRING POSTS

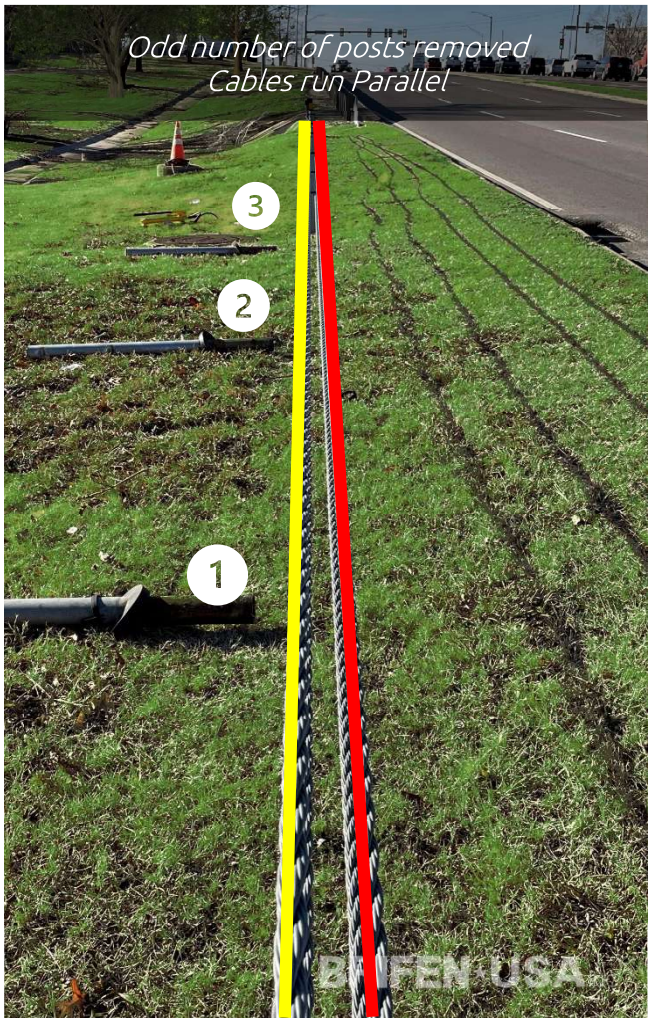
The following are instructions for repairing mid-run hits to Brifen WRSF after the vehicle(s) have been removed from the system. Please see Vehicle Removal (page 22) if vehicles are still present before repairing WRSF.

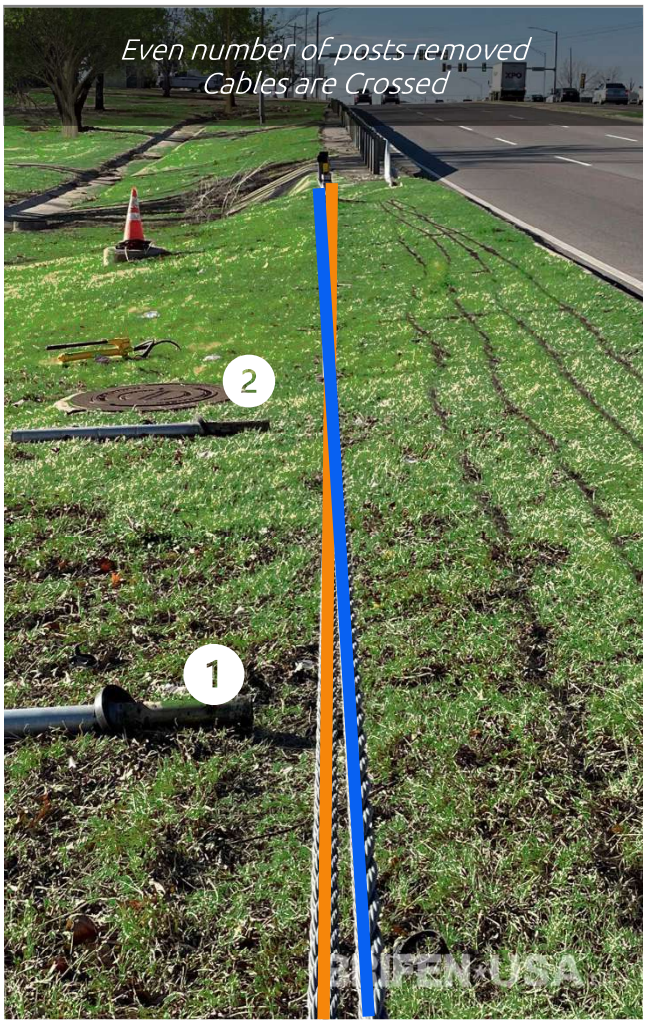
1. Remove bent or damaged post(s). If a post is tight in a socket, use a pry bar to break it loose and then lift post straight up. Posts frozen in sockets may need to be heated (weed burner, torch, steam, etc.)

2. If there are an odd number of posts needing to be replaced, every other post can be inserted through the ropes (now un-woven). Excluders (gaskets) should be in place on the posts before insertion.

3. If there are an even number of posts needing to be replaced, the weave will still be present.

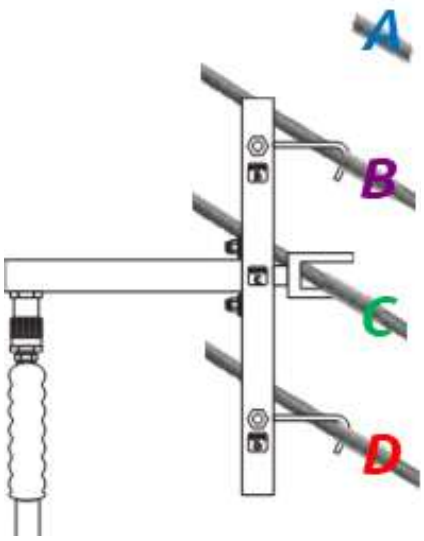
   - Remove one more post; at this point, the weave will not be present, and every other post can be dropped down through the ropes.
   - For the remaining posts, follow the procedures for interweaving the posts through the ropes as described on the following pages.





INSTALLING NEW POST WITH THE ROPE SPREADER TOOL

1. After determining which side of the fence to place the tool, Typically, the Rope Spreader Tool is used on Ropes B, C and D, as shown in the picture.



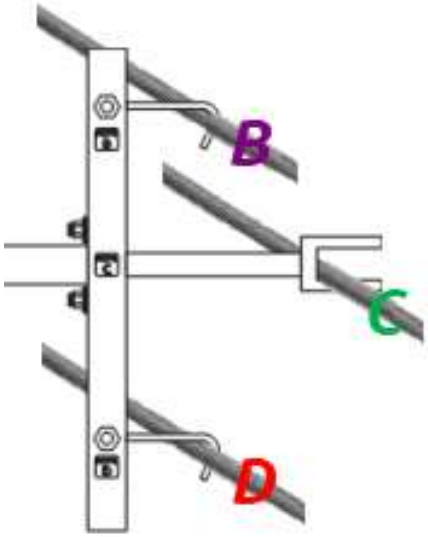
2. Actuate the spreader tool and spread open the 3 ropes (Rope C pushes away from unit).

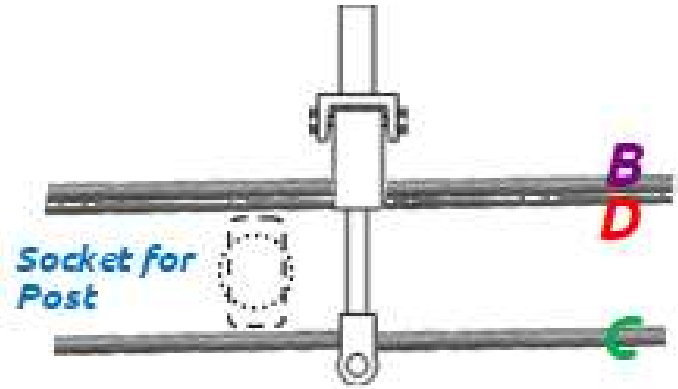
3. After placing the excluder (gasket) on the post, insert the new Z-post into the socket. Pull Rope A up and over the post to slide into the slot.

4. Disengage and remove Spreader Tool. Allow the ropes to rest on the post then tap in locating pegs at the height for each cable on the sides of the post.

5. Repeat this procedure for the remaining posts.

6. Install a new post cap. Install reflector if needed.





PROCEDURES TO REMOVE VEHICLES FROM ROPES

Most vehicles will be able to drive away or are towed from the scene. In the event a vehicle remains caught in the system, the safest and simplest method is to use a tow truck to pull the vehicle out of the system from the direction it entered. No re-tensioning would be required.

Example Scenario:

- **Problem**: Wire rope slid under the hood and then became lodged under the pick-up's bumper. The truck then pulled away from the system causing more tension in the rope than normal. The rope could not be removed at this point.
- **Solution**: Wire rope was too tight to remove with a pry bar. Four bolts were removed from the truck's bumper, which allowed the rope to be removed from the truck. It took one worker approximately 30 minutes to free the truck from the wire ropes and repair the fence. The WRSF was back in service before the wrecker left the area. No re-tensioning was required.

OTHER REMOVAL METHODS

- Wrecker could pull the truck back in line with the fence, allowing ropes to be picked up from behind bumper and removed. No re-tensioning required.
- Remove several nearby posts using the Rope Spreader Tool, which will un-weave ropes creating slack.
- If the tool is not available, posts may be cut between the ground and the bottom rope. Be aware of rope forces on the post when deciding which side of the post to cut. Removal becomes easier with each post removed. No re-tensioning would be required.
- Turnbuckles may be loosened using pipe wrenches to reduce tension. However, this will require re-tensioning.

***In a life-threatening situation only**, and as a last resort, cutting ropes may be necessary. However, if this is required, cut only at the center of nearby turnbuckles so as not to damage the ropes. If a vehicle tangled in the ropes has deflected the ropes, the tension may be greater than normal. Before attempting to disengage the ropes or before cutting any ropes, remove additional posts and/or loosen nearby turnbuckles to relieve tension.*

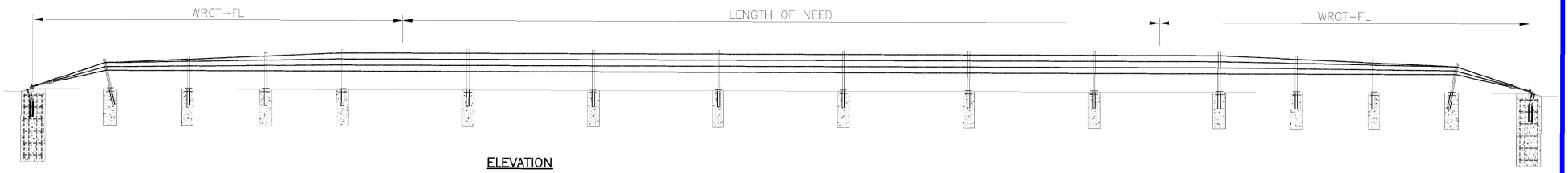
- Re-tensioning will be required if turnbuckles were loosened. If turnbuckles have not been loosened, then re-tensioning should not be necessary. However, if tension is checked immediately after repair, it may be lower than normal since the ropes have migrated during the impact and they need some time to settle out (harmonize) and tension stabilize.

APPENDIX

TOLERANCES

Description	Tolerance
Post Foundations	Flush with ground line
Post Sockets	± 1” to the ground line
Post Vertical Alignment	4” maximum from vertical alignment, measured from grade to top of post
Line Post Spacing	1ft +/-; spacing per agency Specification not to exceed 21-0'
Rope Heights	± 1”
Rope Length between turnbuckles	1000 ft (+10%)
Rope Tension	± 20% from Tension Table
MGT Post Vertical Alignment	3” maximum from vertical alignment, measured from grade to top of post
MGT Post Spacing	± 3”
Horizontal & Vertical Transitions (including centerline)	50:1 Recommended; 25:1 Allowable

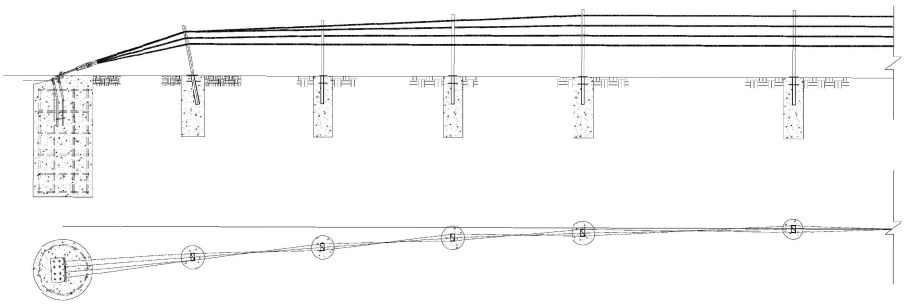
Type of Damage	Description of the Damage	Solution
Damage to posts.	The post is bent or distorted.	The post is to be replaced.
	The protruding tabs of the Hook Post are damaged.	
Damage to wire cable.	The wire rope is bent or distorted.	The wire rope is to be replaced.
	Any strand of the wire cable is broken.	
Damage to end fittings.	The end fitting is deformed.	The end fitting is to be replaced.
	The thread of the end fitting is damaged.	
Damage to rigging screws.	The body of the rigging screw is cracked or distorted.	The rigging screw is to be replaced.
Damage to post fittings.	The ground cover is deformed, split, or cracked.	The item is to be replaced.
	The post cap is deformed, split, or cracked.	
	The locating peg is deformed, split, or cracked.	



ELEVATION

PLAN

WRGT-FL END ANCHOR



* SEE SHEET 3 OF 3 FOR FURTHER INFORMATION

ROPE TENSION TABLE		
ROPE TEMP. (F°)	TENSION (LBS)	TENSION (kN)
0	5700	25.4
5	5550	24.7
10	5400	24.0
15	5250	23.4
20	5100	22.7
25	4950	22.0
30	4800	21.4
35	4650	20.74
40	4500	20.0
45	4350	19.3
50	4200	18.7
55	4050	18.0
60	3900	17.3
65	3750	16.7
70	3600	16.0
75	3450	15.3
80	3300	14.7
85	3150	14.0
90	3000	13.3
95	2850	12.7
100	2700	12.0
105	2550	11.3
110	2400	10.7
115	2250	10.0
120	2100	9.3
125	1950	8.7
130	1800	8.0
135	1650	7.3
140	1500	6.7

* ROPE TENSION: ±20% AFTER 2-WEEK INTERVAL

GENERAL NOTES:

1. BRIFEN DRAWINGS, SPECIFICATIONS, AND PRODUCT MANUAL SHOULD BE REVIEWED PRIOR TO STARTING AN INSTALLATION. FOR ADDITIONAL INFORMATION OR QUESTIONS, CONTACT BRIFEN USA, INC. AT 1-866-427-4336.
2. THE BRIFEN WRSF HAS BEEN SUCCESSFULLY TESTED TO NCHRP 350 TL-4 CONDITIONS ON SLOPES 6:1 OR FLATTER AND NCHRP 350 TL-3 CONDITIONS ON SLOPES 4:1 TO 6:1.
3. THE POST SPACING SHALL BE DETERMINED BY THE SPECIFYING AGENCY. POST SPACING MAY BE DECREASED TO AVOID OBSTRUCTIONS OR UTILITIES. IN NO EVENT SHALL THE POST SPACING EXCEED 21'-0".
4. BRIFEN WRSF SHALL BE PLACED ON A SMOOTH SURFACE, WITHOUT HUMPS, DROP-OFFS, HOLES, ETC THAT WOULD INTERFERE WITH THE STABILITY OF THE ERRANT VEHICLE. GRADING, FILL AND COMPACT MAY BE REQUIRED TO ASSURE THAT ROPES ARE INSTALLED AT THE DESIGN HEIGHT.
5. THE WRGT-FL END ANCHOR HAS BEEN SUCCESSFULLY TESTED TO NCHRP 350 TL-3 CONDITIONS. THE LENGTH OF NEED BEGINS 31'-0" FROM THE END ANCHOR. POSTS 1 THROUGH POST 4, SPACED 6'-6" APART, HAVE WEAKENED CUTS AT THE GROUND THAT SHALL FACE THE ANCHOR.
6. ANCHOR AND LINE POST DIMENSIONS AND STEEL REINFORCEMENT ARE BEST DETERMINED BASED ON PROJECT SPECIFIC SOIL CLASSIFICATION, PROPERTIES AND TEMPERATURE EXTREMES. CONTACT BRIFEN USA, INC. FOR ADDITIONAL INFORMATION.
7. ALL REINFORCEMENT AND CONCRETE FOR THE ANCHORS AND LINE POSTS PROVIDED BY OTHERS.
8. REINFORCEMENT AND CONCRETE PROPERTIES SHALL MEET AGENCY SPECIFICATIONS.
9. FOR PLACEMENT NEAR GUARDRAIL OR OTHER OBSTACLES CONTACT BRIFEN USA, INC. FOR ADDITIONAL DRAWINGS AND SUPPORT.
10. TAPER RATES FOR THE BRIFEN WRSF ARE AS FOLLOWS:
    HORIZONTAL: 50:1 PREFERABLE, 25:1 MAXIMUM
    VERTICAL: 50:1 PREFERABLE, 25:1 MAXIMUM

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BRIFEN ★ USA INC.

Revision		
No.	Date	By
1.	2.8.13	ME
2.	11.20.13	ME
3.		
4.		
5.		

BRIFEN WRSF NCHRP 350 TL-4 INSTALLATION & LAYOUT DETAILS

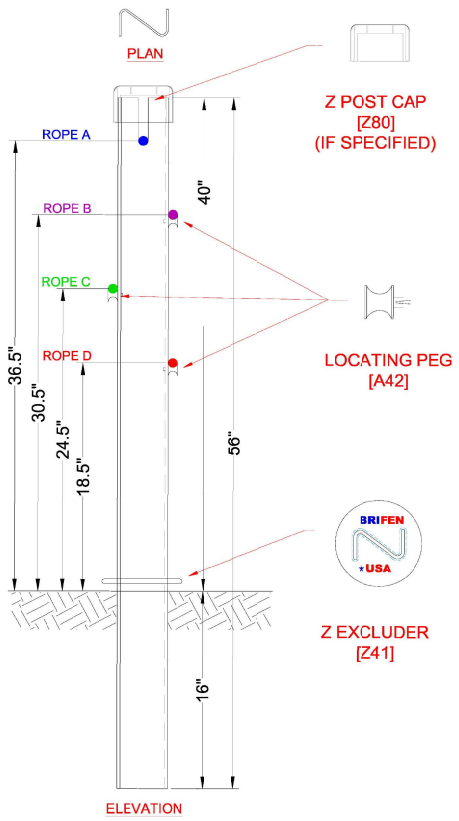
Date	Drawn By	Scale
6.27.12	Manita Elizondo	None

VERSION 12.2

Dwg. No. WRGTFL-11-001b

Sheet No 1 OF 3

LINE POST ASSEMBLY
[Z11]



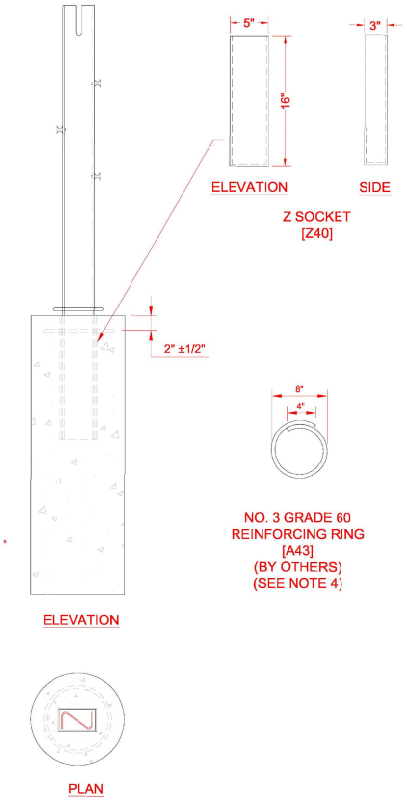
LINE POST
[C11-3]

NOTES SPECIFIC TO LINE POST ASSEMBLY

1. ROPE HEIGHTS SHALL BE ±1" TO GROUND LINE.
2. POST SHALL BE ±4" FROM VERTICAL PLUMB.
3. POST CAPS SHALL BE USED IF SPECIFIED
4. REFLECTORS SHALL BE SPACED ACCORDING TO AGENCY SPECIFICATIONS.
5. REFLECTORS CAN BE PLACED ON THE POST CAP OR POST.

SOCKET ASSEMBLY

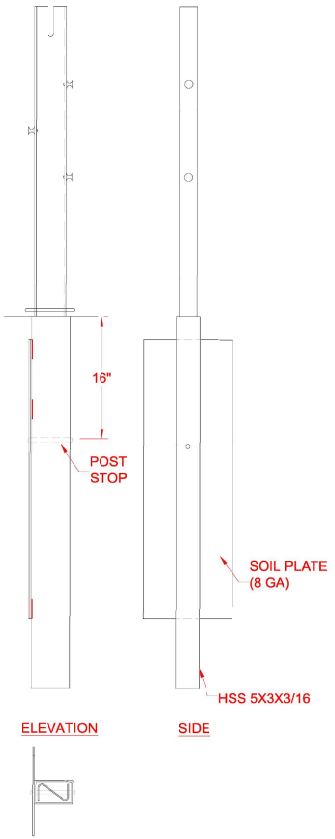
CONCRETE FOOTING



NOTES SPECIFIC TO CONCRETE FOOTING

1. SIZE OF FOOTING WILL BE DETERMINED BY SOIL CONDITIONS, FOUNDATION TYPE AND PROJECT CONDITIONS.
2. CONCRETE BASED ON AGENCY SPECIFICATIONS.
3. CONCRETE BY OTHERS.
4. REINFORCING RING (BY OTHERS) WILL BE USED ACCORDING TO FOUNDATION SIZE AND TYPE. THE REINFORCING RING MAY BE OMITTED IF THE FOOTING IS PLACED IN A CONTINUOUS CONCRETE MOW STRIP.
5. FOOTING SHALL BE FLUSH WITH THE GROUND LINE, TO A MAXIMUM OF 1 INCH BELOW OR ABOVE GROUND LINE.
6. SOCKET SHALL BE ±2° OF VERTICAL PLUMB.

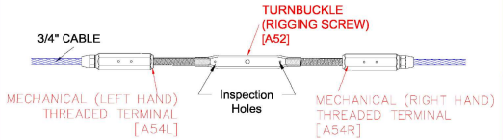
DRIVE SOCKET
[Z44]



NOTES SPECIFIC TO DRIVE SOCKETS

1. SIZE OF SOIL PLATE WILL BE DETERMINED BY SOIL CONDITIONS AND PROJECT CONDITIONS.
2. THE SOIL PLATE SHALL BE PARALLEL TO ROADWAY AND CAN FACE TOWARD OR AWAY FROM THE TRAVEL LANE.
3. SOCKET SHALL BE FLUSH WITH THE GROUND LINE, TO A MAXIMUM OF 1 INCH BELOW OR ABOVE GROUND LINE.
4. SOCKET SHALL BE ±2° OF VERTICAL PLUM.
5. SOCKETS SHALL BE DRIVEN IN A MANNER TO NOT DISTORT OR DESTROY THE TOP OF SOCKET TO A DEGREE THAT PLACES THE SOCKET OR LINE POST OUT OF CONSTRUCTION TOLERANCES.

TURNBUCKLE & MECHANICAL THREADED TERMINALS



TURNBUCKLE & SWAGED THREADED TERMINALS

NOTES SPECIFIC TO ROPE CONNECTION DETAIL

1. THE WIRE ROPE TERMINALS SHALL BE THREADED A MINIMUM OF 1" INTO RIGGING SCREW.

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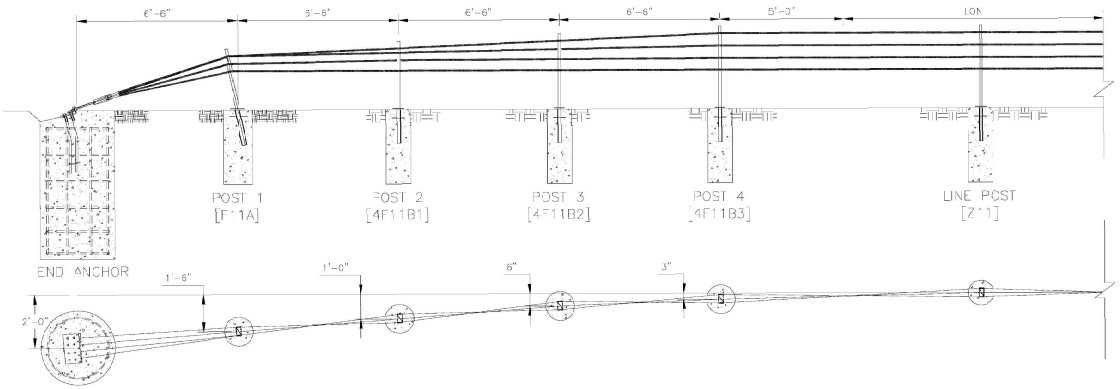
BRIFEN ★ USA INC.

Revision		
No.	Date	By
1.	7/30/2021	JR
2.	8/9/2021	JR
3.		
4.		
5.		

BRIFEN NCHRP 350 TL-4 Z-POST INSTALLATION & LAYOUT DETAILS

Date	Drawn By	Scale
6.21.2021	JAR	None
VERSION 16		Sheet No 2 OF 3
Dwg. No.	MASH350-OP-ZP-01	

WRGT–FL END ANCHOR LAYOUT



GENERAL NOTES:

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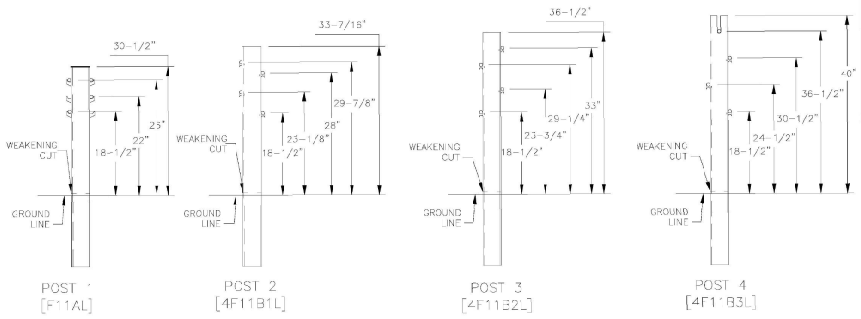
2. THE WRGT-FL END ANCHOR HAS BEEN SUCCESSFULLY TESTED TO NCHRP 350 TL-3 CONDITIONS. THE LENGTH OF NEED BEGINS 31'-0" FROM THE END ANCHOR. POSTS 1 THROUGH POST 4, SPACED 6'-6" APART, HAVE WEAKENED CUTS AT THE GROUND THAT SHALL FACE THE ANCHOR.
3. ANCHOR AND LINE POST DIMENSIONS AND STEEL REINFORCEMENT ARE BEST DETERMINED BASED ON PROJECT SPECIFIC SOIL CLASSIFICATION, PROPERTIES AND TEMPERATURE EXTREMES. CONTACT BRIFEN USA, INC. FOR ADDITIONAL INFORMATION.
4. ALL REINFORCEMENT AND CONCRETE FOR THE ANCHORS AND LINE POSTS PROVIDED BY OTHERS.
5. REINFORCEMENT AND CONCRETE PROPERTIES SHALL MEET AGENCY SPECIFICATIONS.
6. FOR PLACEMENT NEAR GUARDRAIL OR OTHER OBSTACLES CONTACT BRIFEN USA, INC. FOR ADDITIONAL DRAWINGS AND SUPPORT.

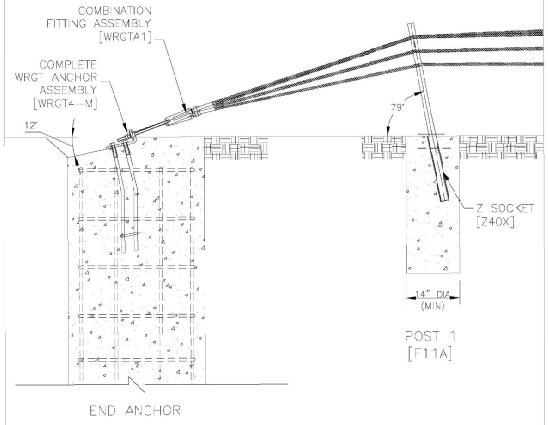
WRGT–FL POST DETAILS



NOTES SPECIFIC TO WRGT–FL POST DETAIL

1. ROPE HEIGHTS SHALL BE ±1" TO GROUND LINE.
2. POST SHALL BE ±4" FROM VERTICAL PLUMB.
3. POST CAPS SHALL BE USED IF SPECIFIED.
4. REFLECTORS SHALL BE SPACED ACCORDING TO AGENCY SPECIFICATIONS.
5. REFLECTORS CAN BE PLACED ON THE POST CAP OR POST.
6. Z EXCLUDER (Z41) SHALL BE USED.
7. POST 1 & SOCKET SHALL BE PLACED 79° (±4°) TOWARD END ANCHOR FROM THE HORIZONTAL PLANE.
8. POST 1 SOCKET SHALL BE PLACED IN 14" (MIN) CONCRETE FOUNDATION. DEPTH TO BE DETERMINED FROM SOIL CONDITIONS AND PROJECT CONDITIONS.
9. FOUNDATIONS FOR POST 2 THRU 4 SHALL BE THE SAME AS THE LINE POST ASSEMBLY'S FOR THE PROJECT.
10. WEAKENED CUTS SHALL FACE END ANCHOR.

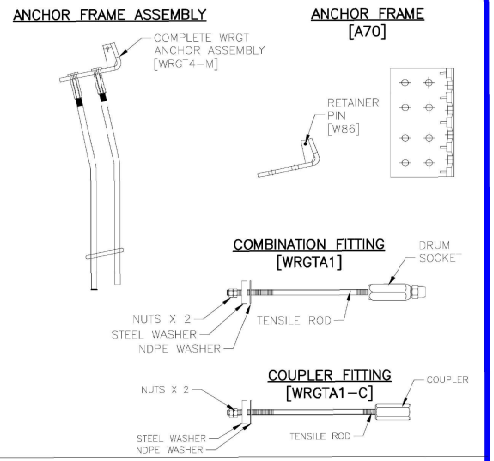
END ANCHOR DETAILS



NOTES SPECIFIC TO END ANCHOR DETAIL

1. THE END ANCHOR ASSEMBLY SHALL BE PLACED 12" (+3", -1") BELOW HORIZONTAL PLANE.
2. POST 1 & SOCKET SHALL BE PLACED 79° (±4°) TOWARD END ANCHOR FROM THE HORIZONTAL PLANE.
3. POST 1 SOCKET SHALL BE PLACED IN 14" (MIN) CONCRETE FOUNDATION. DEPTH TO BE DETERMINED FROM SOIL CONDITIONS AND PROJECT CONDITIONS.

END ANCHOR COMPONENTS



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BRIFEN ★ USA INC.

Revision		
No.	Date	By
1.	2.8.13	ME
2.	11.20.13	ME
3.		
4.		
5.		

BRIFEN WRGT–FL END TERMINAL INSTALLATION & LAYOUT DETAILS

Date	Drawn By	Scale
6.27.12	Manita Elizondo	None
VERSION 12.2		Sheet No 3 OF 3
Dwg. No.	WRGTFL-11-003b	

Tension Log

Customer: _____

Contract: _____

Fence #: _____

Length: _____

Direction: _____

DATE	ROPE TEMP*	TIME	kN/LBS	RIGGING SCREWS			
				A	B	C	D

*Using an infrared thermometer or similar.

Brifen Inspection Form

WIRE ROPE GATING TERMINAL												
Direction: _____ **Fence#**												
Anchor Location	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
1) Is the anchor plate level and free of concrete?												
2) Are ropes in anchor in correct sequence?												
3) Is Post A angled toward the end anchor correctly?												
4) Is the weave correct between End Anchor and WRGT-FL Post-1? Ropes A & D **DO NOT WEAVE** while Ropes B & C do weave												
5) No turnbuckles in WRGT-FL?												
6) Are there two nuts on swaged fitting with minimum 3 threads exposed?												
7) Do all the post in the WRGT-FL have caps and excluders?												
8) Is anchor installed with flare?												
9) WRGT-FL Posts-A, B1, B2 and B3 at proper height and spaced accordingly? Center of Anchor Plate to Post A: 6'-6" Post A to B1: 16'-6" Post B1 to B2: 6'-6" Post B2 to B3: 6'-6"												
10) Is there any damage that would affect the performance of the Brifen WRSF?												

TL-4 Z-Post LENGTH OF NEED						
1) Are the cables woven properly?						
2) Are the turnbuckles properly threaded?						
3) Is the fence at the proper tension? +/- 20%						
4) Are the posts oriented in the proper direction with ropes resting on pegs?						
5) Do all line posts have locating pegs, caps, and excluders?						
6) Is the post spacing per plans?						
7) Is there any damage that would affect the performance of the Brifen WRSF?						

Because
our
families
drive
where
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