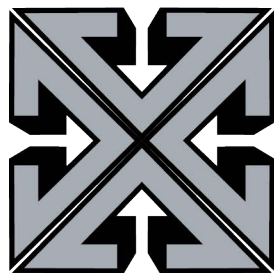


# TREND<sup>®</sup> 350 Tangent

## End Terminal Product Description Assembly Manual



# INGAL

CIVIL PRODUCTS

A valmont  COMPANY

# TREND<sup>®</sup> 350

## Tangent End Terminal

### Product Description Assembly Manual



**INGAL**  
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A valmont  COMPANY

57-65 Airs Rd, Minto  
NSW 2566



**Important:** These instructions are to be used only in conjunction with the assembly, maintenance, and repair of the TREND<sup>®</sup> 350 End Terminal. These instructions are for standard assemblies specified by the appropriate highway authority only. In the event the specified system assembly, maintenance, or repair would require a deviation from standard assembly parameters, contact the appropriate highway authority engineer.

**This Manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Ingal Civil Products at (02) 9827 3333 or download copies from the website listed below.**

The instructions contained in this Manual supersede all previous information and Manuals. All information, illustrations, and specifications in this Manual are based on the latest TREND<sup>®</sup> 350 End Terminal system information available to Ingal Civil Products at the time of printing. We reserve the right to make changes at any time. Please contact Ingal Civil Products to confirm that you are referring to the most current instructions.

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## **Customer Service Contacts**

Ingal Civil Products is committed to the highest level of customer service. Feedback regarding the TREND 350 End Terminal, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

### **Ingal Civil Products**

Telephone:	(02) 9827 3333
Fax:	(02) 9827 3300
E-mail:	sales@ingalcivil.com.au
Website:	www.ingalcivil.com.au

### **Regional Telephone Contacts:**

Queensland	07 3387 3000
Victoria & Tasmania	03 9358 4110
South Australia	08 8169 2300
Western Australia	08 9452 9111
New Zealand	0212 464 997

## **Important Introductory Notes**

Proper assembly of the TREND® 350 End Terminal is critical to achieve performance that has been evaluated under per NCHRP Report 350 criteria. These instructions should be read in their entirety and understood before assembling the TREND® 350 End Terminal. These instructions are to be used only in conjunction with the assembly of the TREND® 350 End Terminal and are for standard assemblies only as specified by the applicable highway authority. If you need additional information, or have questions about the TREND® 350 End Terminal, please contact the highway authority that has planned and specified this assembly and, if needed, contact Ingal Civil Products' Customer Service Department (see p. 3). This product must be assembled in the location specified by the appropriate highway authority. If there are deviations, alterations, or departures from the assembly protocol specified in this Manual, the device may not perform as it was tested and accepted.

This system, like other Ingal Civil Products systems, has been crash tested pursuant to NCHRP Report 350 mandated criteria.



**Important: DO NOT** use any component part that has not been specifically crash tested and/or approved for this system during assembly, repair, or maintenance of this system.

This product has been specified for use by the appropriate highway authority and has been provided to that user who has unique knowledge of how this system is to be assembled. No person should be permitted to assist in the assembly, maintenance, or repair of this system that does not possess the unique knowledge described above. These instructions are intended for an individual who is qualified to both read and accurately interpret them as written. These instructions are intended only for an individual experienced and skilled in the assembly of highway products that are specified and selected by the highway authority.

A manufacturer's drawing package will be supplied by Ingal Civil Products upon request. Each system will be supplied with a specific drawing package unique to that system. Such drawings take precedence over information in this Manual and shall be studied thoroughly by a qualified individual who is skilled in interpreting them before the start of any product assembly.



**Important:** Read safety instructions thoroughly and follow the suggested safe practices before assembling, maintaining, or repairing the TREND® 350 End Terminal. Failure to follow this warning can result in serious injury or death to the worker and/or bystanders. Please keep these instructions for later use.



**Warning:** Ensure that all of the TREND® 350 End Terminal Danger, Warning, Caution, and Important statements within the TREND® 350 End Terminal Manual are completely followed. Failure to follow this warning could result in serious injury or death in the event of a collision.

## **Safety Rules for Assembly**

### **\* Important Safety Instructions \***

This Manual must be kept in a location where it is readily available to persons who assemble, maintain, or repair the TREND 350 End Terminal. Additional copies of this Manual are immediately available from Ingal Civil Products by calling (02) 9827 3333 or by email at: [sales@ingalcivil.com.au](mailto:sales@ingalcivil.com.au). Please contact Ingal Civil Products if you have any questions concerning the information in this Manual or about the TREND 350 End Terminal. This Manual may also be downloaded directly from the websites listed in the Customer Service Contact section (see p. 3).

Always use appropriate safety precautions when operating power equipment and when moving heavy equipment or the TREND® 350 End Terminal components. Work gloves, safety goggles, safety-toe shoes, and back protection should be used.

Safety measures incorporating traffic control devices specified by the highway authority must be used to provide safety for personnel while at the assembly, maintenance, or repair site.



## Safety Symbols

This section describes safety symbols that may appear in the TREND® 350 End Terminal Manual. Read the Manual for complete safety and assembly information.

### Symbol

### Meaning



**Safety Alert Symbol:** Indicates Danger, Warning, Caution, or Important. Failure to read and follow the Danger, Warning, Caution, or Important indicators could result in serious injury or death to the workers and/or bystanders.

## Warnings and Cautions

Read all instructions before assembling, maintaining, or repairing the TREND® 350 End Terminal.



**Warning:** Failure to comply with these warnings could result in increased risk of serious injury or death in the event of a vehicle impact with a system that has not been accepted by the road controlling authority.



**Warning:** Do not assemble, maintain, or repair TREND® 350 End Terminals until you have read this Manual thoroughly and completely understand it. Ensure that all Danger, Warning, Caution, and Important statements within the Manual are completely followed. Please call Ingal Civil Products at (02) 9827 3333 if you do not understand these instructions.



**Warning:** Safety measures incorporating appropriate traffic control devices specified by the highway authority must be used to protect all personnel while at the assembly, maintenance, or repair site.



**Warning:** Be sure adequate time is available for complete assembly, maintenance, or repair before beginning the assembly, maintenance, or repair process.



**Warning:** Use only Ingal Civil Products parts that are specified herein for the TREND® 350 End Terminal for assembling, maintaining, or repairing the TREND® 350 End Terminal. **Do not utilise or otherwise comingle parts from other systems even if those systems are other Ingal Civil Products systems.** Such configurations have not been tested, nor have they been accepted for use. Assembly, maintenance, or repairs using unspecified parts or accessories is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with an UNACCEPTED system.



**Warning:** DO NOT modify the TREND® 350 End Terminal in any way.



**Warning:** Ensure that the TREND® 350 End Terminal system and delineation used meet all federal, state, specifying agency, and local specifications.



**Warning:** Ensure that your assembly meets all appropriate local standards.



**Warning:** Ensure that there is proper site grading for TREND<sup>®</sup> 350 End Terminal as dictated by the state or specifying agency.



**Warning:** Use only Ingal Civil Products parts on the TREND<sup>®</sup> 350 End Terminal for assembly, maintenance, or repair. **The assembly or comingling of unauthorised parts is strictly PROHIBITED.** The TREND<sup>®</sup> 350 End Terminal and its component parts have been accepted for use, however, a comingled system has not been accepted within the applicable criteria.



**Important:** Ingal Civil Products makes no recommendation whether use or reuse of any part of the system is appropriate or acceptable following an impact. It is the sole responsibility of the local highway authority and its engineers to make that determination. It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.



**Warning:** Ensure that this assembly conforms with the guidance provided by the Austroads Part 6 and relevant state supplements, including, but not limited to, those regarding placement on or adjacent to curbs.

## **Limitations and Warnings**

Ingal Civil Products, in compliance with the National Cooperative Research Highway Program 350 (NCHRP Report 350) “Recommended Procedures for the Safety Performance of Highway Safety Features,” contracts with approved testing facilities to perform crash tests, evaluation of tests, and submittal of results to the Austroads Safety Barrier Assessment Panel for review.

The TREND<sup>®</sup> 350 End Terminal has been approved as meeting the requirements and guidelines of NCHRP Report 350, Test Level 3 (TL-3). These tests evaluate product performance by closely simulating actual impacts involving a range of vehicles from lightweight cars (approx. 820 kg) to full size pickup trucks (approx. 2000 kg).

These tests are not intended to represent the performance of products when impacted by every vehicle type, nor every impact condition existing on the roadway. The tests are performed to measure impacts involving vehicles specified by NCHRP Report 350, under those specific impact conditions.

Ingal Civil Products neither represents nor warrants that the impact results of these established test criteria prevent or reduce the severity of any injury to person(s) or damage to property. These tests only demonstrate the occurrence of certain results following an impact within NCHRP Report 350 criteria. Every departure from the roadway is a unique event.

The TREND<sup>®</sup> 350 End Terminal is intended to be assembled, delineated, and maintained in accordance with specific state guidelines. It is important for the road controlling authority to select the most appropriate product configuration for its site specifications. Careful evaluation of the site lay out, vehicle population type; speed, traffic direction, and visibility are some of the elements that require evaluation in the proper selection of a highway product. For example, curbs could cause an untested effect on an impacting vehicle.

After an impact occurs, the debris from the impact should be removed from the area immediately and the specified highway product should be evaluated and restored to its original specified condition or replaced as the highway authority determines as soon as possible.



## **System Overview**

The TREND® 350 End Terminal is a cost-effective, energy absorbing end treatment used to shield the ends of W-beam barriers.

The TREND® 350 End Terminal has a nominal length of 11.43m and a nominal rail height of 720mm.

The TREND® 350 End Terminal is supported by a Hinged Break-Away (HBA®) post in the first post position, a Steel Yielding Terminal Post (SYTP™) in the second post position, and I-Beam guardrail line posts in the remaining post positions.

### **Impact Performance**

The TREND® 350 End Terminal has been approved as meeting the requirements and guidelines of NCHRP Report 350, Test Level 3 (TL-3) as a re-directive, gating end treatment.

During head-on impacts, NCHRP Report 350 crash testing has shown that longitudinal forces separate the HBA® Post, releasing the Upper HBA® Post from the Lower HBA® post. The energy of an impacting vehicle is absorbed by friction between the panels and deformation of the rail sections as they slide rearward over the shaper fins on the adjoining panels.

During side impacts within the length of need, the HBA® post, SYTP™, and the I-Beam guardrail line posts have been shown to remain intact, laterally supporting the rail sections, having the potential to be re-directive if impacted within NCHRP Report 350 criteria.

## **Know Your TREND® 350 End Terminal**

For specific assembly drawings, refer to Ingal Civil Products standard layout drawings (see p. 32 and 33).

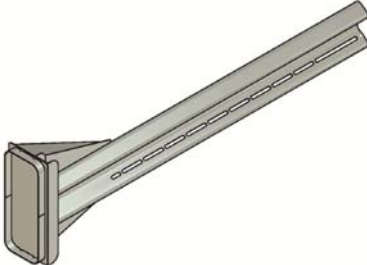

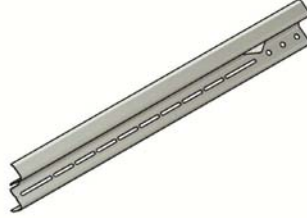





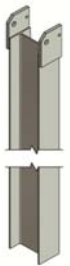
### **Inspect Shipment**

Carefully un-crate all components. Before assembling the TREND® 350 End Terminal, check the received parts against the shipping list supplied with the system. Refer to the System Components section on the next page of this Manual for help in identifying each component. Verify that all parts were received. If parts are missing from the shipment do not attempt to assemble the system; contact Ingal Civil Products immediately (see p. 3). If parts not specified herein were part of the shipment, do not attempt to assemble the system with a non-specified part; contact Ingal Civil Products immediately (see p. 3).

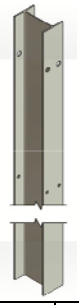
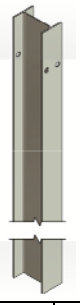
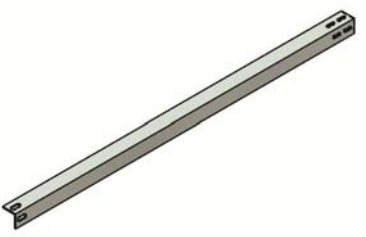
## System Components


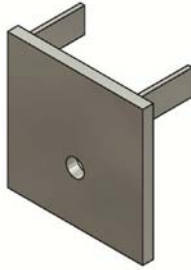
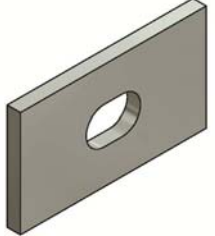
Below is the list of required system components and quantities.




**Note:** Components are not shown to scale.




<p>Head Rail</p> 	<p>Intermediate Rail</p> 	<p>Intermediate Rail with Fin</p> 			
618194B	x1	618192G	x1	618193G	x4
<p>End Rail with Fin</p> 	<p>Backing Plate</p> 	<p>Spacer</p> 			
613554G	x1	604465G	x6	614529G	x5
<p>Spacer with Cable Anchor</p> 	<p>HBA<sup>®</sup> Top Post</p> 	<p>HBA<sup>®</sup> Bottom Post</p> 			
614512G	x1	034074A	x1	033873A	x1










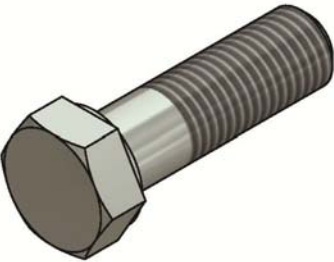


**\*Note:** The Head Rail Assembly is symmetrical and can be used on the upstream and downstream ends of highway guardrail and on either side of the roadway.

SYTP™		W6x8.5# Line Post		Angle Strut	
					
014578G	x1	000533G	x5	033795G	x1

Cable		Bearing Plate		Washer Bar	
					
003012G	x1	019258A	x1	617000G	x6

5/8" x 2" Rail Bolt [Grade 5]		5/8" Hex Nut [Grade 5]		5/8" Flat Washer [Thick]	
					
118614G	x34	003361G	x34	118615G	x34

1" Hex Nut		1" Flat Washer		5/8" x 2" Hex Bolt	
					
003910G	x2	003900G	x2	003403G	x7

5/8" Rail Nut			7/16" x 1 1/2" Hex Bolt [High Strength]			7/16" Hex Nut		
								
003340G	x7		004390G	x2		004396G	x2	
7/16" Flat Washer			7/16" Lock Washer			3/8" x 2" Hex Bolt [High Strength]		
								
004389G	x2		004393G	x2		006321G	x2	
3/8" Hex Nut			3/8" Flat Washer			3/8" Lock Washer		
								
006405G	x2		004254G	x2		004258G	x2	
3/4" x 2 1/2" Hex Bolt [High Strength]			3/4" Hex Nut			3/4" Flat Washer		
								
003717G	x2		003704G	x2		003701G	x2	

3/4" Lock Washer



004699G

x2

## **Assembly**

### **Recommended Tools**

#### **Documentation**

- TREND 350 Assembly Manual

#### **Wrenches**

- 1 1/2" Wrench
- 1 1/4" Wrench
- 11/16" Wrench
- 9/16" Wrench
- Socket Wrench Set Including Sizes Referenced Above
- 154 N.m Torque Wrench

#### **Personal Protective Equipment**

- Safety Glasses
- Work Gloves
- Steel Toe Boots
- Back Protection
- Reflective Vest

#### **Miscellaneous**

- Traffic Control Equipment
- Chalk Line
- Tape Measure
- Marking Paint
- Straight Edge
- Level
- Plumb Line
- Augers
- Soil Tamper
- Post Pounder (commonly used for driving posts)
- Vise Grip Pliers
- 

**Note: The above list of tools is a general recommendation. Depending on specific site conditions and the complexity of the assembly specified by the appropriate highway authority, additional or fewer tools may be required. Decisions as to what tools are needed to perform the job are entirely within the discretion of the specifying highway authority and the authority's selected contractor performing the assembly of the system at the authority's specified site.**





**Important:** The drawing provided with the TREND® 350 End Terminal Product Manual must be used with these instructions for proper assembly and should take precedence over these general instructions.

## Deploy Traffic Control

A traffic control plan appropriate to the complexity of the project should be prepared and understood by all parties before assembling the TREND® 350 End Terminal.

Deploy the appropriate work zone safety devices prior to beginning the assembly and keep them present through all phases on the assembly.



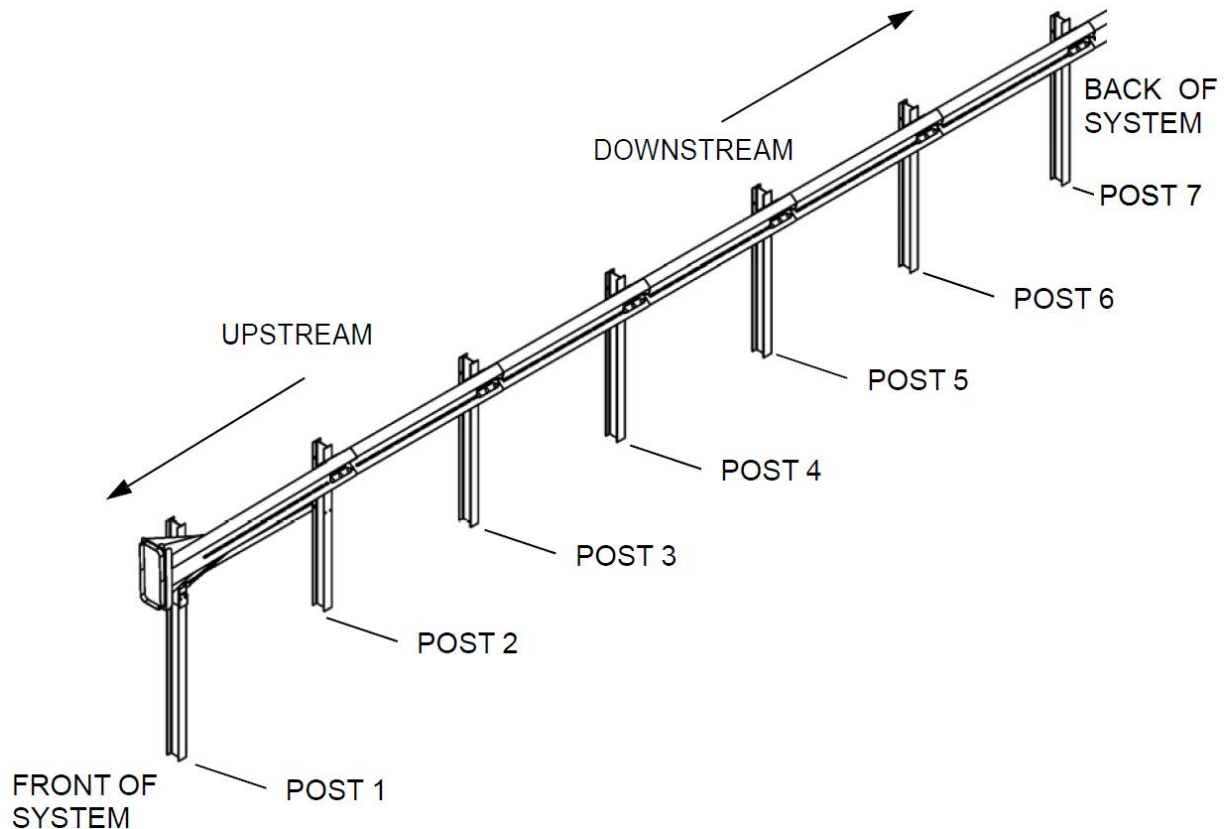
**Warning:** The correct safety equipment and approved traffic management must be used as required for any particular installation site using the TREND® 350 End Terminal.



**Important:** Positioning of the posts is critical. Carefully measure each post centre to other post centres in the line and from the road. Double check all measurements before placing the posts into the ground.



**Important:** See Table A on page 19 for specific post heights dependent on downstream rail height.



**Figure 1 - Post Positioning**

## 1.0 Determine Post Locations

- 1.1 Using a straight edge or plumb line down the existing guardrail face (i.e., traffic side) to the ground, create a datum line (DT1) on the ground. Ensure that this line is parallel with the existing guardrail face. Extend this line ~12m upstream from the end of the existing guardrail. Verify that the datum (DT1) remains parallel to the existing guardrail (see Figure 2).

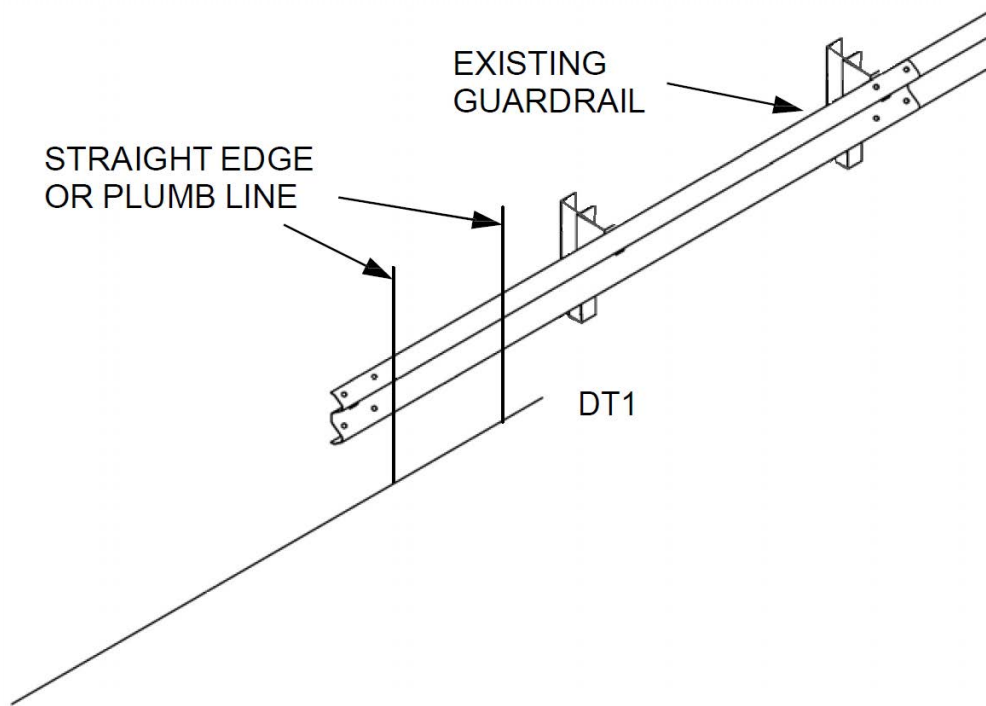
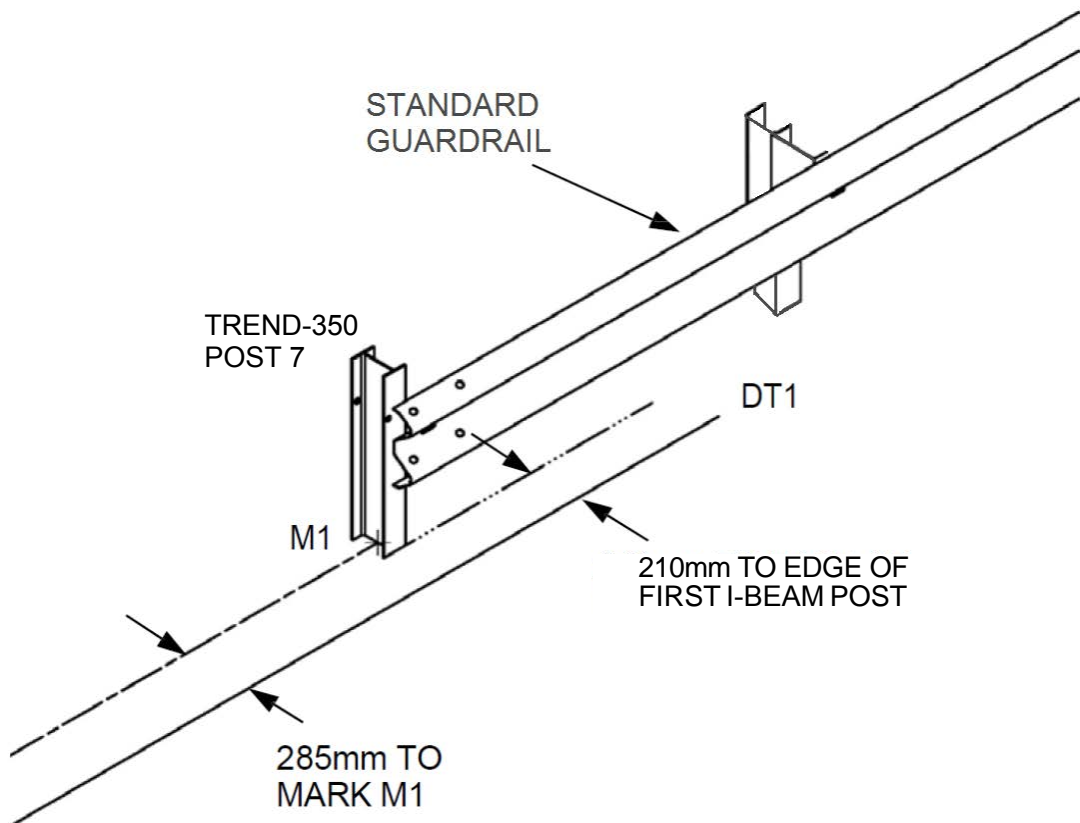


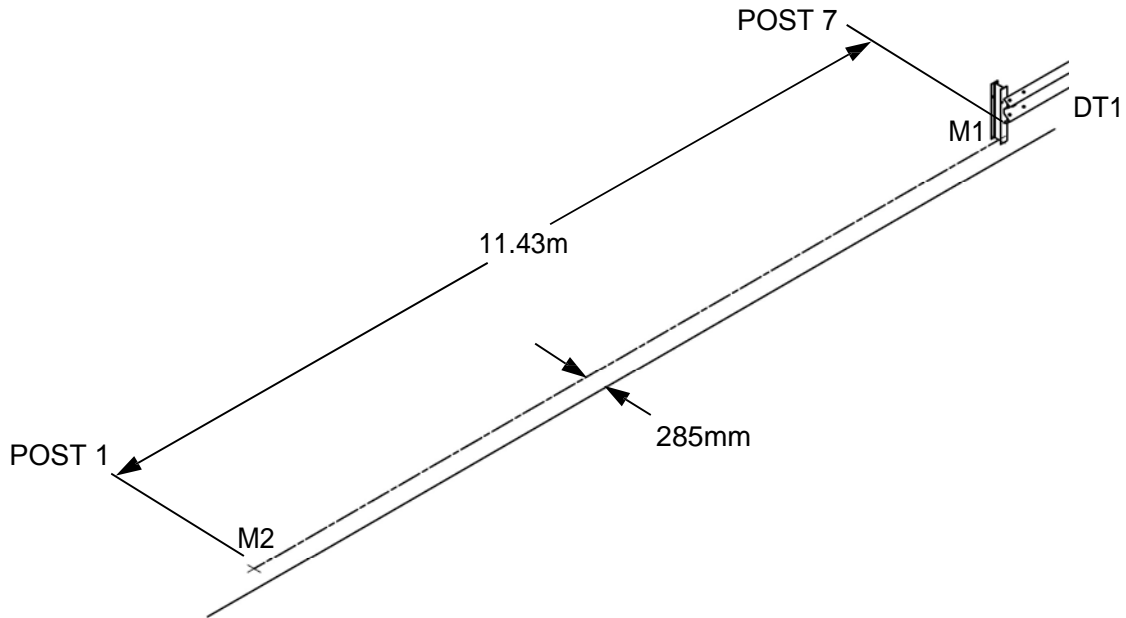
Figure 2 - Determining Post Location

- 1.2 A new I-Beam post must be driven into the ground at the end of the guardrail panel. The edge of this new I-Beam post must be offset from the datum line DT1 towards the existing guardrail by a distance of 210mm (this offset is needed in order to attach a system spacer between the I-Beam post and the guardrail panel). It should be noted that the centreline of this new I-Beam post will not align with the existing guardrail posts (see Figure 3).
- 1.3 Measure perpendicular from the datum line (DT1) towards the existing guardrail 285mm and make a mark (M1) near the first I-Beam post (see Figure 3).



**Figure 3 - Determining Post Location**

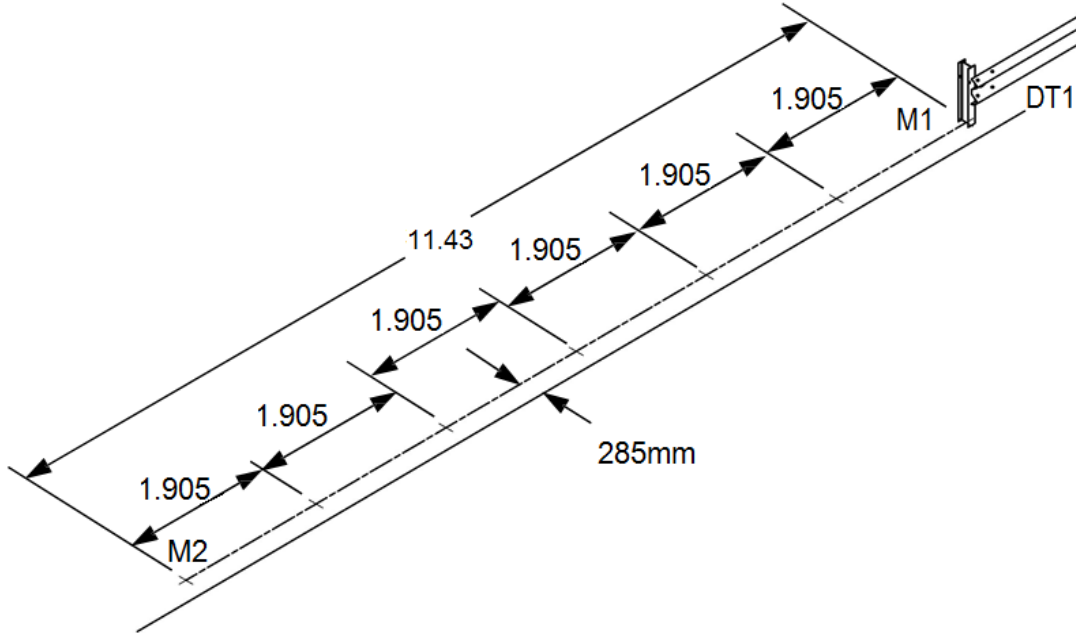
- 1.4 Locate the first post of the TREND<sup>®</sup> 350 End Terminal (i.e., Post 1, refer to Figure 1). First measure from mark (M1) a distance of 11.43m upstream and make a second mark (M2) which is perpendicular to datum line (DT1). Verify the perpendicular distance of 285mm from mark (M2) to the datum line (DT1). Adjust mark (M2) if necessary (see Figure 4).



**Figure 4 - Locating Post 1**

- 1.5 For a TANGENT assembly, chalk or stake a line from mark (M1) to mark (M2). This will be the centreline for the system posts.

- 1.6 From location (M2), measure off the rest of the system post locations (i.e., Posts 2 to 7, Refer to Figure 1), towards the first I-Beam post, at 1.905m  $\pm$ 20mm intervals, 7 total post locations (see Figure 5 and drawings TR-STD-001 and TR-STD-002).



**Figure 5 - Post Spacing for Tangent Assembly**

## 2.0 Post Assembly

- 2.1 Starting with the post location closest to the existing guardrail (i.e., Post 7), place (1) W6x8.5# Line Post. Refer to Table A and Figure 6 for the proper post placement height for the allowable downstream guardrail heights.

**Note: Post spacing is 1.905m ±20mm (see Figure 5 on p. 18).**

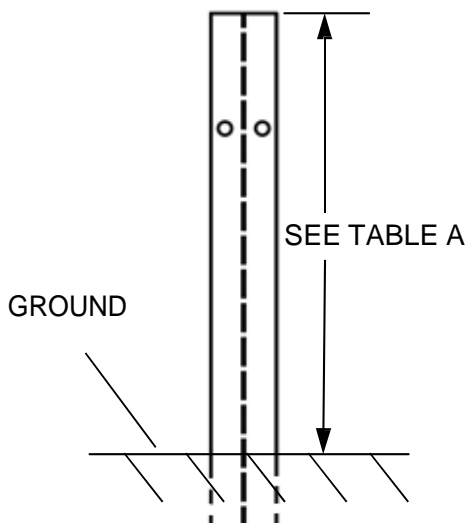
- 2.2 Repeat step 2.1 for the remaining three W6x8.5# System Line Posts (i.e., Posts 6, 5, 4, and 3) (see Table A and Figure 6).

- 2.3 Next, place the SYTP™ (i.e., Post 2). The top of the post should be approximately 730mm above the ground and the 12mm diameter holes should be approximately centered on ground line (see Figure 7).

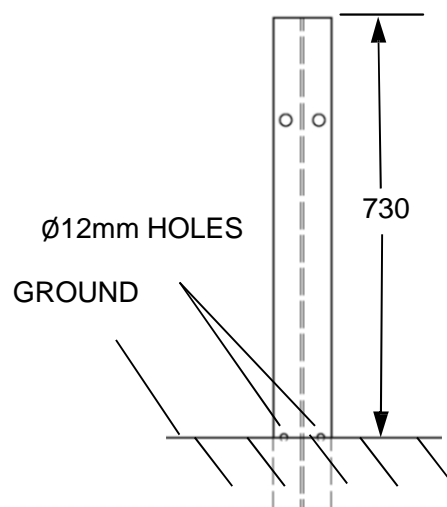
**Note: Post spacing is 1.905m ±20mm (see Figure 5 on p. 18).**

**Table A - Post Height(s)**

Downstream Rail Height (in)	Post Heights Above Ground ±10 (mm)				
	Post 7	Post 6	Post 5	Post 4	Post 3
730	750	750	750	750	750
740	760	760	760	760	760



**Figure 6 - W6x8.5# Line Posts (Post 3 - 7) Placement**

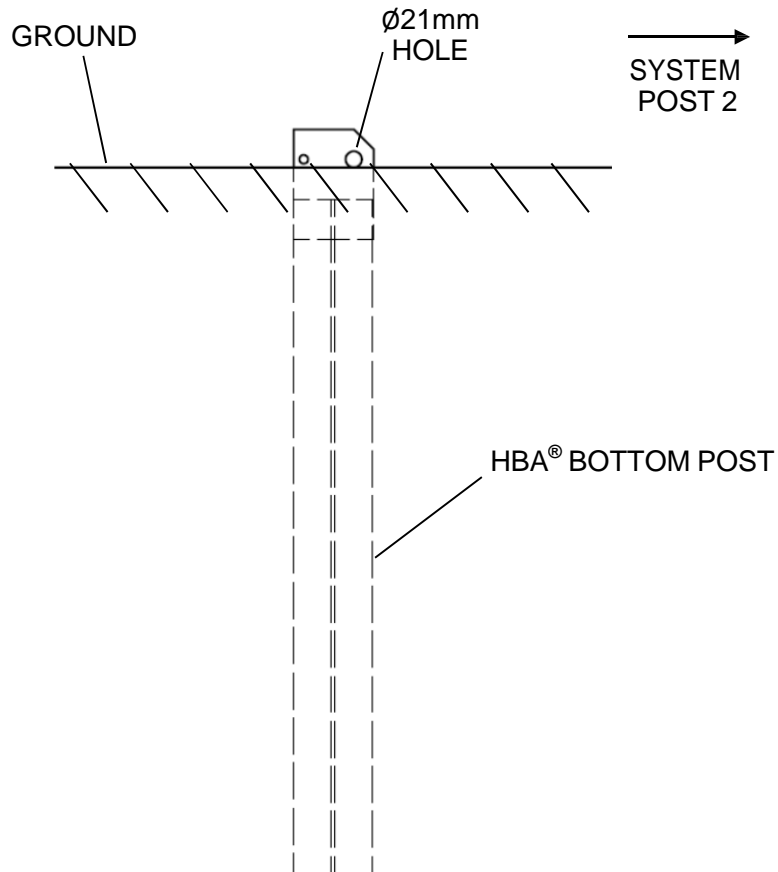


**Figure 7 – SYTP™ (Post 2) Placement**



- 2.4 Place the HBA<sup>®</sup> Bottom Post (i.e., Post 1) at the end post location (i.e., farthest from the existing guardrail). The bottom of the 21mm diameter hole in the ears should be even with the ground (see Figure 8).

**Note: Post spacing is 1.905 (see Figure 5 on p. 18).**

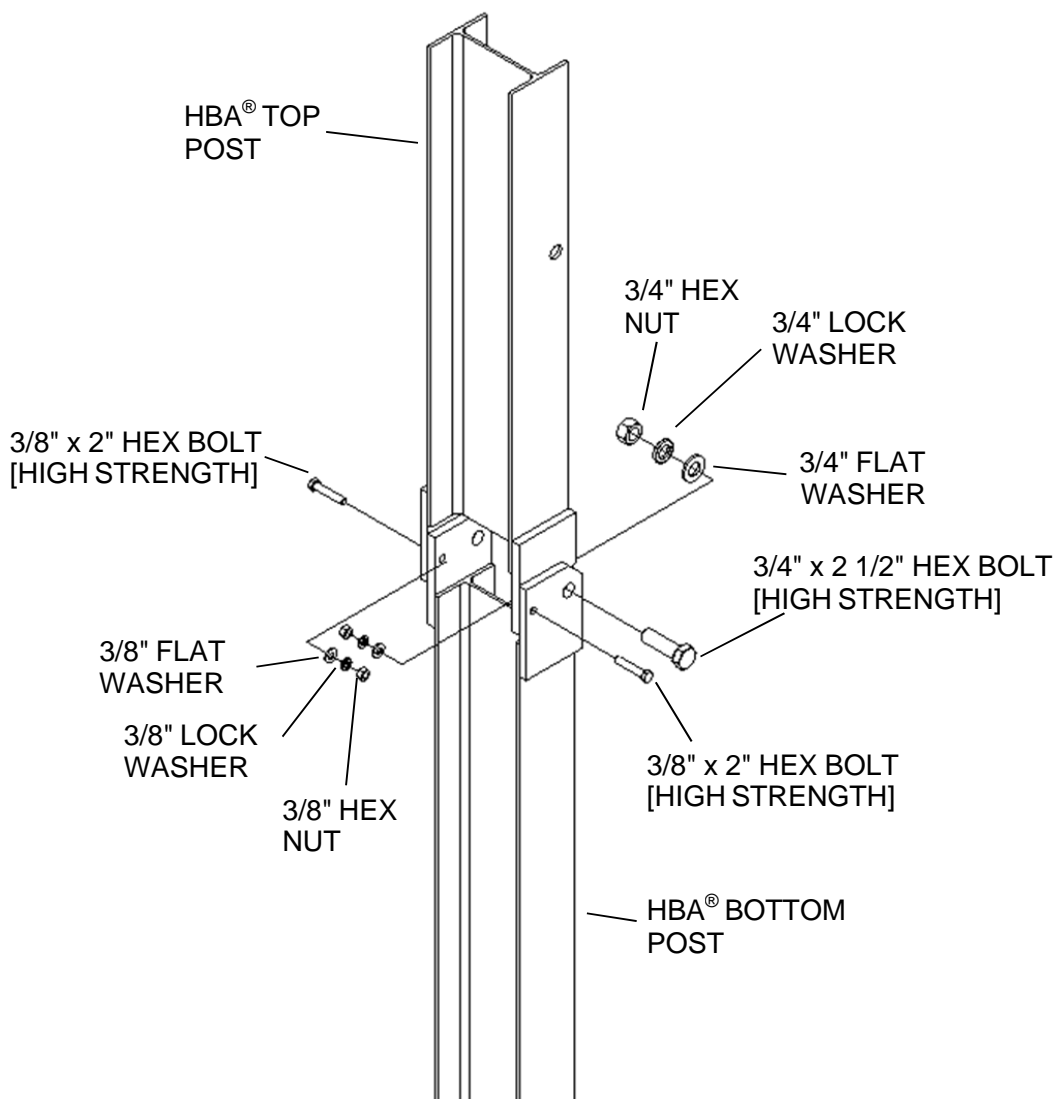


**Figure 8 - HBA<sup>®</sup> Post (Post 1) Placement**

- 2.5 Insert the HBA<sup>®</sup> Top Post into the HBA<sup>®</sup> Bottom Post. Bolt these Posts together first using (1) 3/4" x 2 1/2" hex bolt, (1) 3/4" flat washer, (1) 3/4" lock washer and (1) 3/4" hex nut, then using (2) 3/8" x 2" hex bolts [High Strength], (2) 3/8" flat washers, (2) 3/8" lock washers and (2) 3/8" hex nuts as shown in Figure 9. The 3/4" x 2 1/2" hex bolt [High Strength] must be fastened through the HBA<sup>®</sup> Top Post and HBA<sup>®</sup> Bottom Post on the side opposite the Angle Strut (refer to Section 3.0 Angle Strut Assembly).

**Note: The HBA<sup>®</sup> Top Post Plates (Ears) can be placed on either side of the HBA<sup>®</sup> Bottom Post Plates (Ears).**

There is no torque requirement for these bolts. They should be tightened to a snug position (do not over tighten).

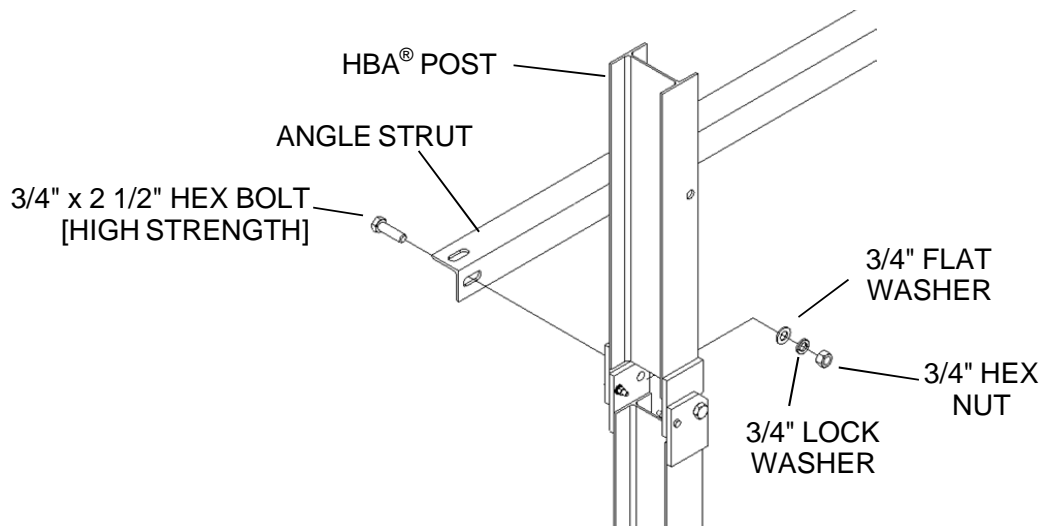


**Figure 9 - Post 1 Assembly**

### 3.0 Angle Strut Assembly

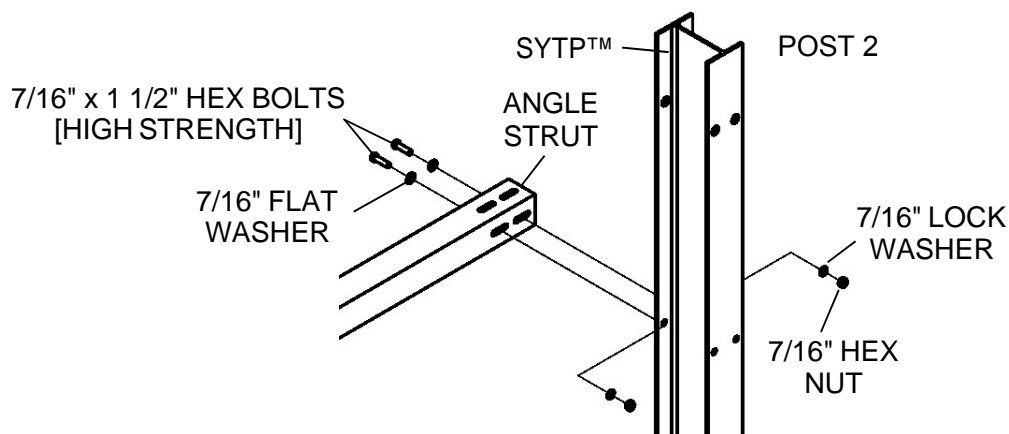
- 3.1 Attach the Angle Strut to the HBA<sup>®</sup> Post using (1) 3/4" x 2 1/2" hex bolt [High Strength], (1) 3/4" flat washer, (1) 3/4" lock washer and (1) 3/4" hex nut. The flat washer and lock washers are placed under the hex nut as shown in Figure 10.

**Note:** Attach Angle Strut only on embankment side of system.



**Figure 10 - Angle Strut Assembly**

- 3.2 Attach the other end of the Angle Strut to the SYTP<sup>™</sup> using (2) 7/16" x 1 1/2" hex bolts [High Strength], (2) 7/16" flat washers, (2) 7/16" lock washers and (2) 7/16" hex nuts. Place the flat washers between the bolt heads and the Angle Strut and the lock washers under the hex nuts as shown in Figure 11.



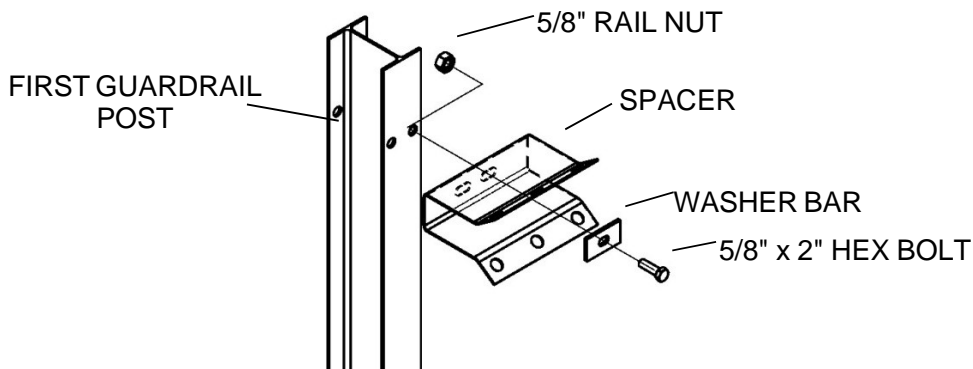
**Figure 11 - Angle Strut Assembly**

**Note:** There is no torque requirement for these bolts. They should be tightened to a snug position (do not over tighten).

## 4.0 Spacer Assembly

- 4.1 Refer to system drawings on page(s) 32 and 33 of this Manual for assistance in locating parts.
- 4.2 Use (1) 5/8" x 2" hex bolt, (1) Washer Bar and (1) 5/8" rail nut to attach the Spacer to the first I-Beam Post. All of the Spacers have two slots on the inside for mounting. Orient as shown in Figure 12 (Guardrail Panel not shown for clarity).

**Note:** The Spacer may be attached to the Post by either slot in the Spacer. The 5/8" x 2" Hex Bolt may be attached to either hole on the front of the first I-beam post.



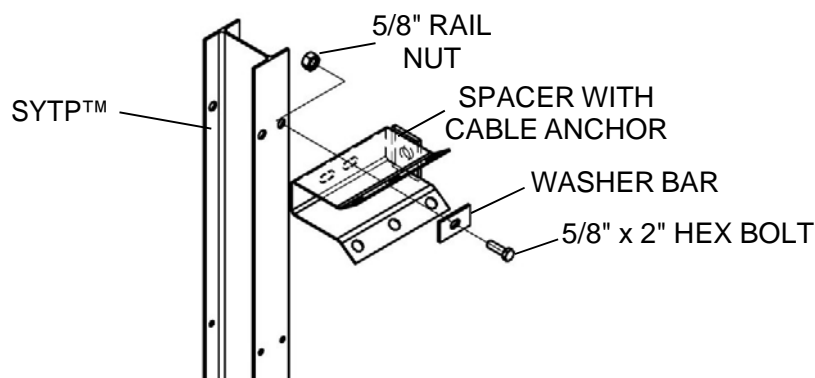
**Figure 12 - Spacer Attachment**

- 4.3 Working from the guardrail to the front of the TREND® 350 End Terminal, use (1) 5/8" x 2" hex bolt, (1) Washer Bar and (1) 5/8" rail nut to attach the Spacer to the W6x8.5# Line Post – Posts 7, 6, 5, 4 and 3. All of the Spacers have two slots on the inside for mounting, orient as shown (see Figure 12).

**Note:** The Washer Bar needs to lie between the 5/8" x 2" hex bolt head and the Spacer.

- 4.4 Next use (1) 5/8" x 2" hex bolt, (1) Washer Bar and (1) 5/8" rail nut to attach the Spacer with Cable Anchor to the SYTP™ (i.e., Post 2). All of the Spacers have two slots on the inside for mounting, orient as shown in Figure 13.

**Note:** Post 1 does NOT receive a Spacer (see Figure 16 on p. 26).

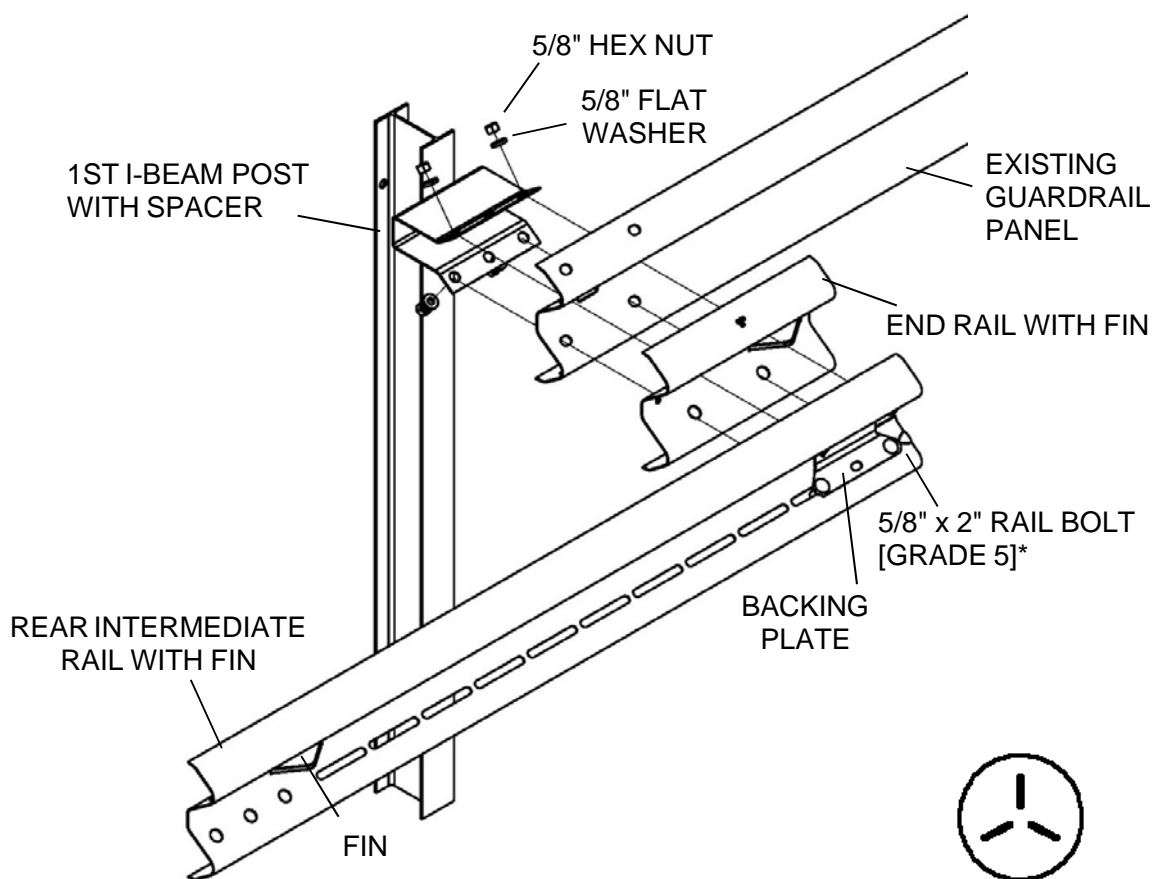


**Figure 13 - Spacer with Cable Anchor Attachment**

## 5.0 Rail Assembly

- 5.1 Begin with the End Rail with Fin and the rear Intermediate Rail with Fin. Attach the End Rail with Fin over the existing guardrail panel and the rear Intermediate Rail with Fin over the End Rail with Fin (i.e., the End Rail with Fin is located in between the existing guardrail panel and the rear Intermediate Rail with Fin). You may have to use alignment tools to aid in aligning the holes. Attach using (4) 5/8" x 2" rail bolts [Grade 5], (4) 5/8" flat washers [thick], (4) 5/8" hex nuts [Grade 5] and (1) Backing Plate as shown in Figure 14.

**Note:** The Backing Plate needs to lie between the rail bolt heads and the Intermediate Rail with Fin (see Figure 14).

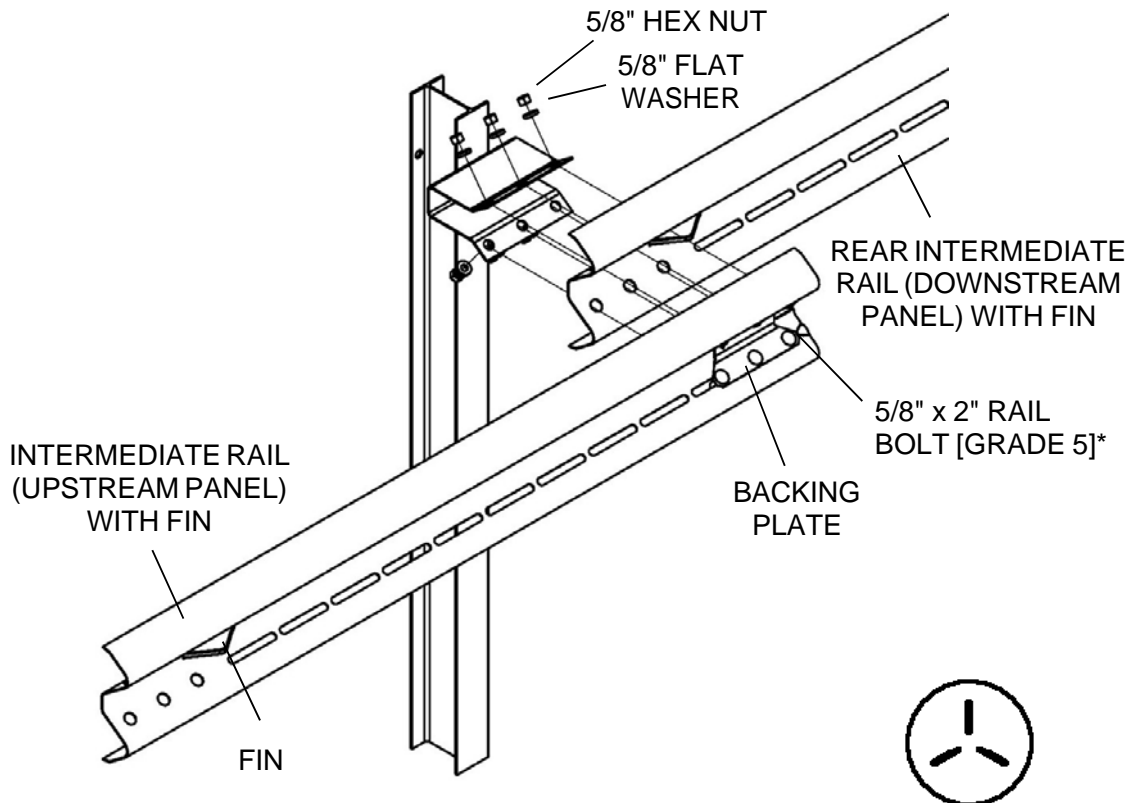


\*Grade 5 head markings

Figure 14 - Rail Attachment

- 5.2 Working from the rear Intermediate Rail, attach the next Intermediate Rail to the system using (6) 5/8" x 2" rail bolts [Grade 5], (6) 5/8" flat washers [thick], (6) 5/8" hex nuts [Grade 5] and (1) Backing Plate as shown. Be sure to overlap the panels as shown in Figure 15; the upstream panel is on top of the downstream panel.

**Note:** The Backing Plate needs to lie between the rail bolt heads and the Intermediate Rail (see Figure 15).



\*Grade 5 head markings

**Figure 15 - Rail Attachment**

- 5.3 Tighten all 5/8" rail bolts [Grade 5] to a torque of 163 N.m using a calibrated torque wrench.



**Important:** The 5/8" rail bolts [Grade 5] must be tightened to the correct torque for proper system operation. Failure to follow this warning could result in serious injury or death in the event of a collision.

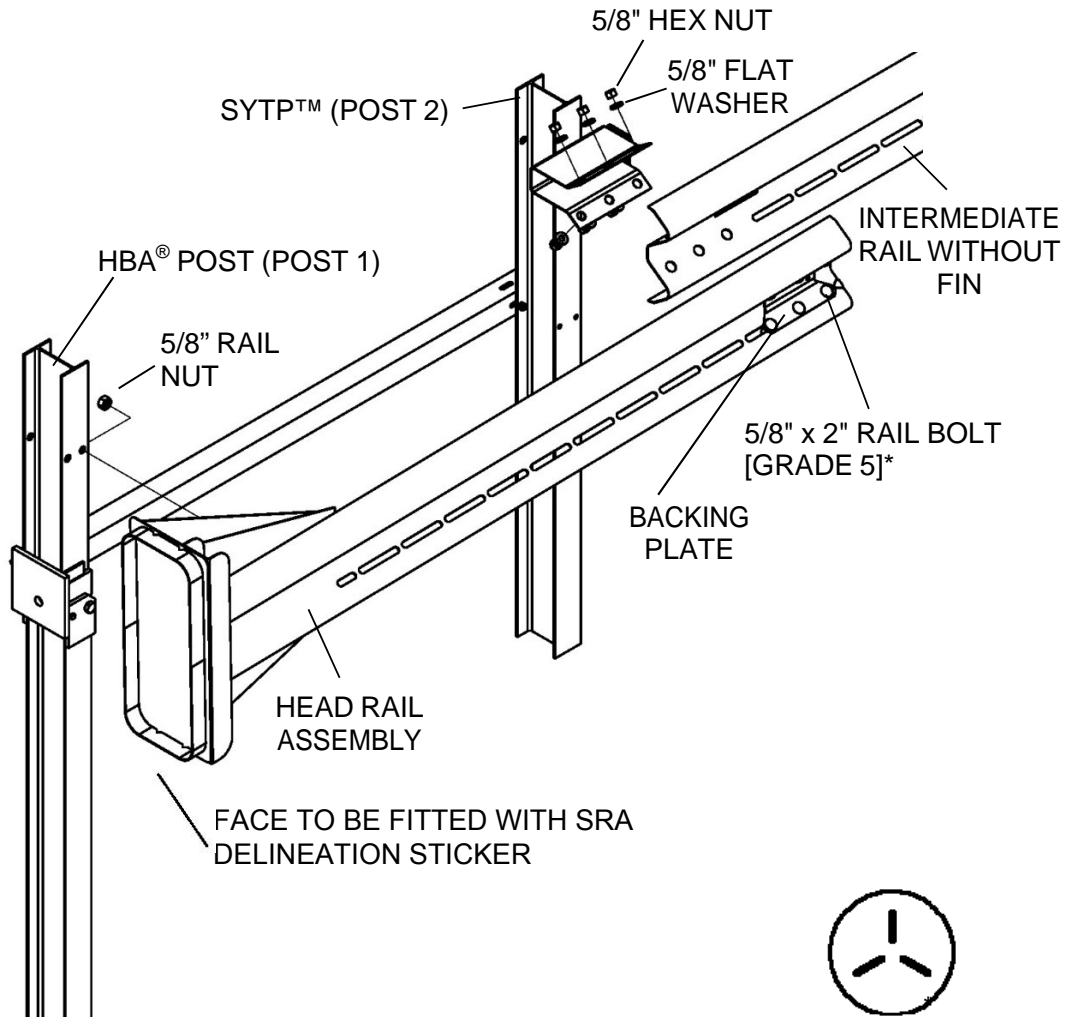
- 5.4 Repeat steps 5.2 and 5.3 until all of the Intermediate Rails are attached.

**Note:** The final Intermediate Rail to be assembled (at the front of the system) does NOT have a fin.



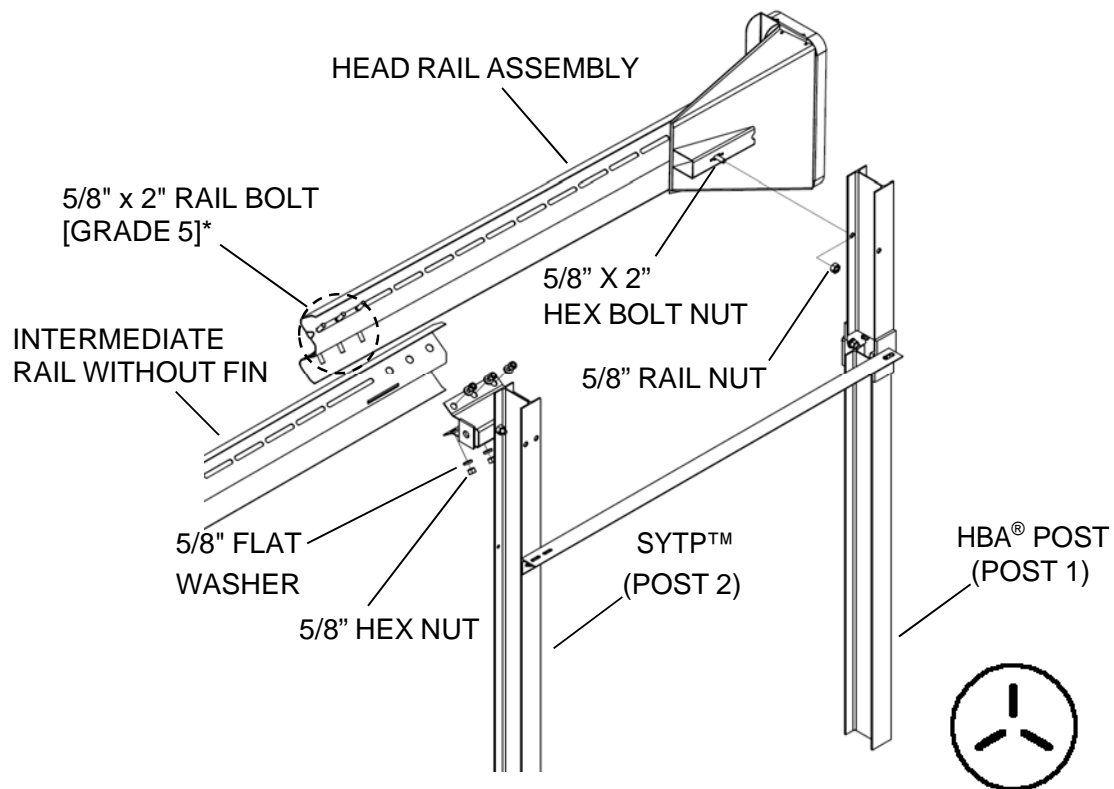
## 6.0 Head Rail Assembly

- 6.1 Position the Head Rail Assembly onto the posts; attach using (6) 5/8" x 2" rail bolts [Grade 5], (6) 5/8" flat washers [thick], (6) 5/8" hex nuts [Grade 5] and (1) Backing Plate. Attach the Head Rail Assembly to Post 1 using (1) 5/8" x 2" hex bolt and (1) 5/8" rail nut (see Figures 16 & 17).



\*Grade 5 head markings

Figure 16 - Head Rail Attachment



\*Grade 5 head markings

**Figure 17 – Head Rail Attachment (Backside)**



**Important:** Verify the head height is 840mm above grade. Ensure that Head Rail is fully extended toward front to system before tightening fasteners.

6.2 Tighten all 5/8" rail bolts [Grade 5] to a torque of 163 N.m using a calibrated torque wrench.



**Important:** The 5/8" rail bolts [Grade 5] must be tightened to the correct torque for proper system operation. Failure to follow this warning could result in serious injury or death in the event of a collision.

## 7.1 Cable Routing

- 7.1 Feed one end of the Cable between the HBA<sup>®</sup> Top Post and HBA<sup>®</sup> Bottom Post and through the Bearing Plate. **Note: The tabs on the Bearing Plate rest on top of the HBA<sup>®</sup> Top Post plates (ears).** Secure the Cable using (1) 1" flat washer and (1) 1" hex nut. Thread the nut approximately 75-100mm onto the Cable end (see Figure 18).

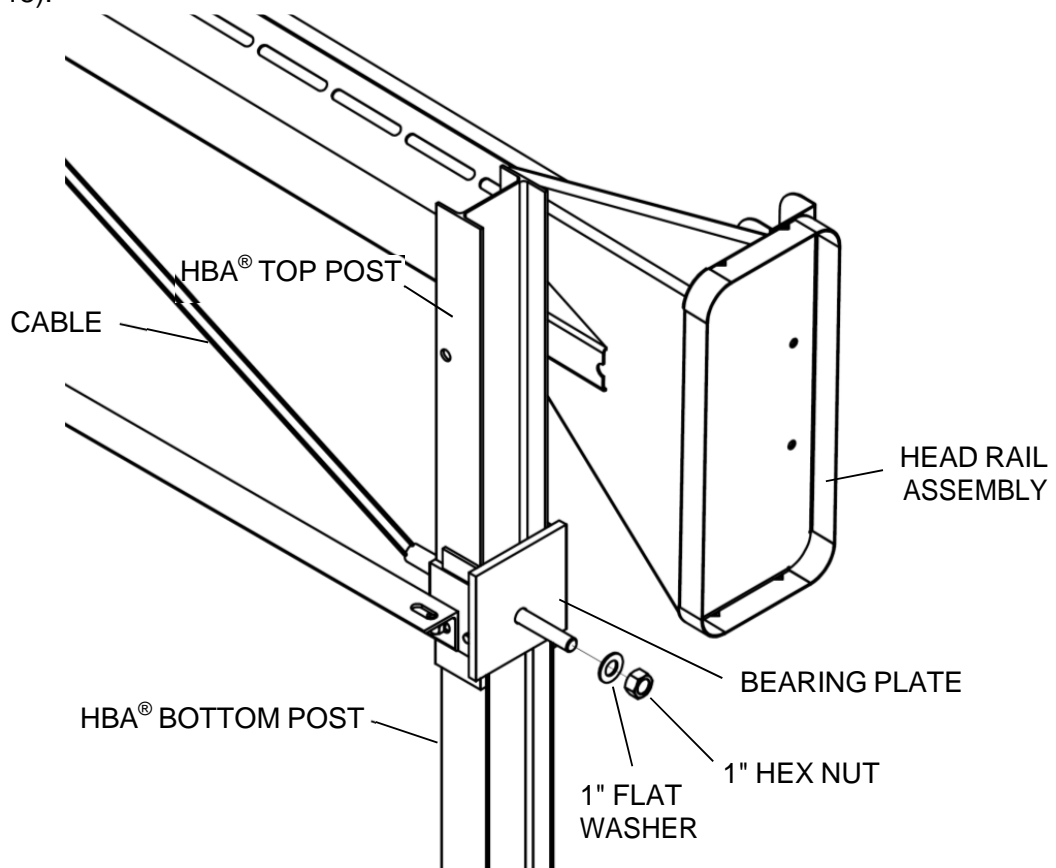
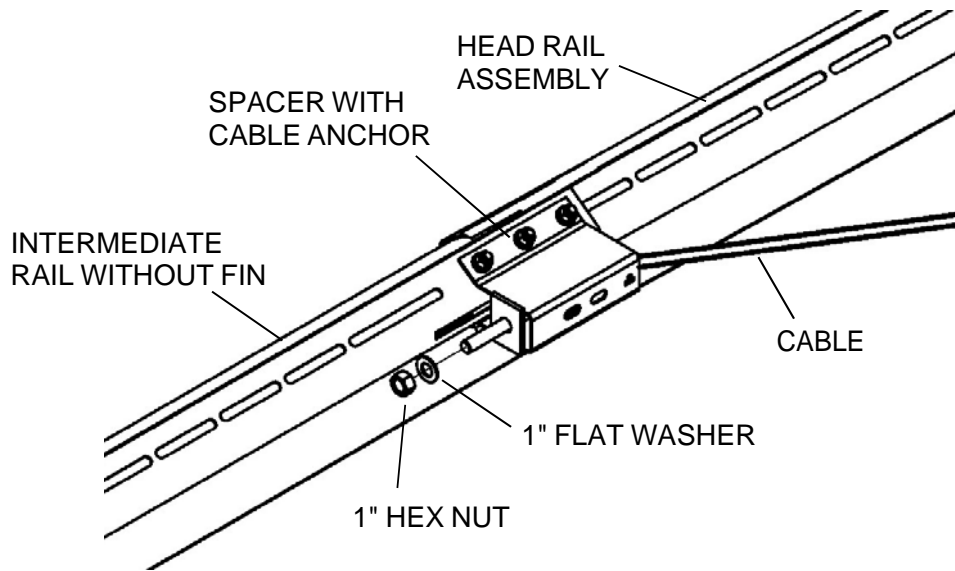


Figure 18 - Cable Attachment

- 7.2 Insert the other end of the Cable through the Spacer with Cable Anchor. Secure the Cable using (1) 1" flat washer and (1) 1" hex nut. Restrain the Cable with Vise Grip Pliers at the end being tightened to avoid twisting the Cable. Make sure the nuts are tight and the Cable is taut (see Figure 19; Post 2 not shown for clarity).

**Note:** The Cable is considered taut when it does not deflect more than 1" when pressure is applied by hand in an up or down direction.



**Figure 19 - Cable to Spacer Attachment**

## **Maintenance**



**Warning:** The system must be periodically inspected to ensure proper operation.

Inspections by the appropriate highway authority are recommended as needed based upon volume of traffic and impact history. Visual drive-by inspections are recommended at least once every month. Walk-up inspections are recommended at least twice a year.

### **Visual Drive-By Inspection**

The purpose of the visual inspection is to spot any conditions that would prevent the system from functioning as intended.

1. Check for an unrecorded impact, misalignment, missing fasteners, corrosion, vandalism, etc.
2. Clear any build-up of waste or dirt around the system that could interfere with intended performance.

### **Walk-Up Inspection**

1. Clear and dispose of any debris on the site.
2. Be sure all fasteners are tight.
3. Verify that all the 5/8" rail bolts [Grade 5] are torqued to 163 N.m.
4. Check to see that slack is removed from the Cable (tighten nut on threaded Cable end if necessary).

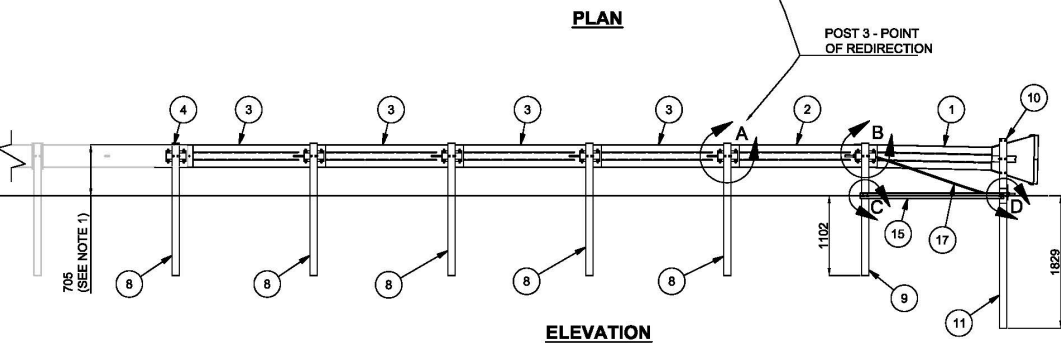
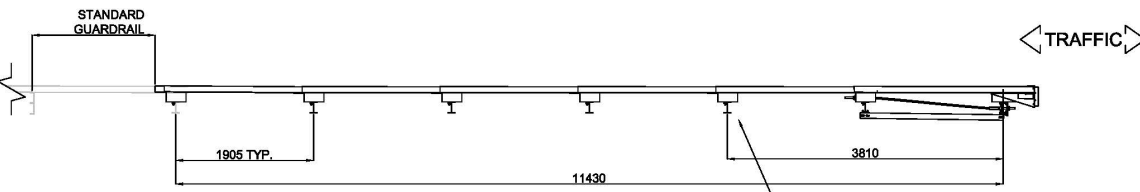
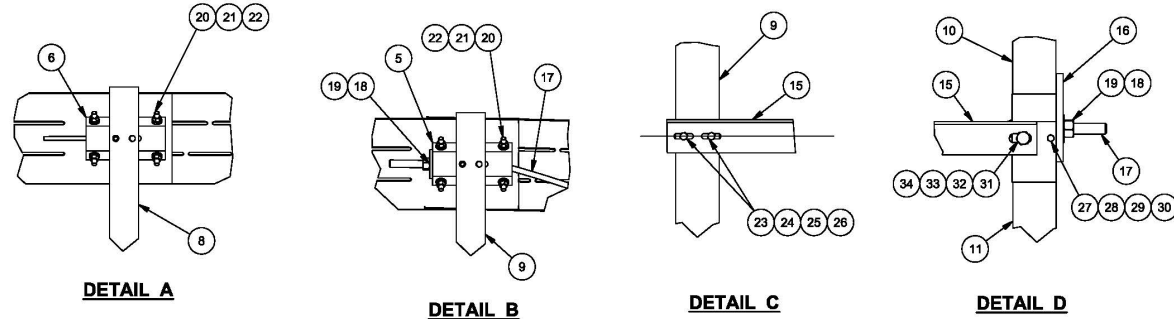
## **Assembly Checklist**

Assembly performed by: \_\_\_\_\_

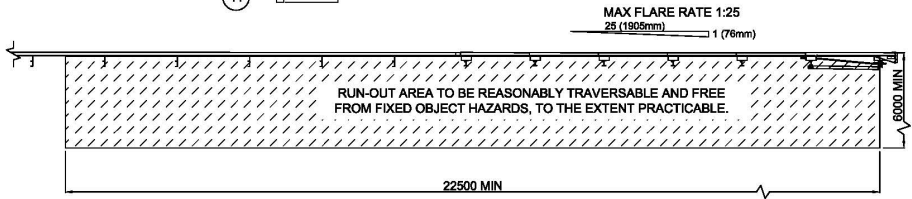
Assembly date: \_\_\_\_\_

Assembly location: \_\_\_\_\_

- Verify the Head height is 840mm above grade (refer to Section 6.0).
- Verify that all 5/8" rail bolts [Grade 5] are torqued to 163 N.m. Also verify that all 5/8" rail bolt heads are seated flat against each Backing Plate (refer to Sections 5.0 and 6.0).
- Verify that the slack has been removed from the Cable; tighten nuts on Cable ends as necessary (refer to Section 7.0).
- Verify that each Spacer has a Washer Bar seated between the inside of the Spacer and the bolt head that attaches the Spacer to the Post (refer to Section 4.0).
- Verify that all rails are lapped correctly along the length of the system (refer to Sections 5.0 and 6.0).
- Verify that the Head Rail Assembly is oriented with a downward slope towards the front of the system (refer to Section 6.0).
- Verify high strength bolts used on HBA<sup>®</sup> Post, SYTP<sup>™</sup>, and system rail connections (refer to Sections 2.0, 3.0, 5.0, and 6.0).



- NOTES:
1. SYSTEM CAN BE ATTACHED TO DOWNSTREAM GUARDRAIL WITH HEIGHTS UP TO 790mm.
  2. THE APPROACH TERRAIN SHOULD BE LEVEL, OTHERWISE MAXIMUM GRADING TO 1V:10H.
  3. MAX DEFLECTION FOR REDIRECTIVE STAGE: 1.2m.

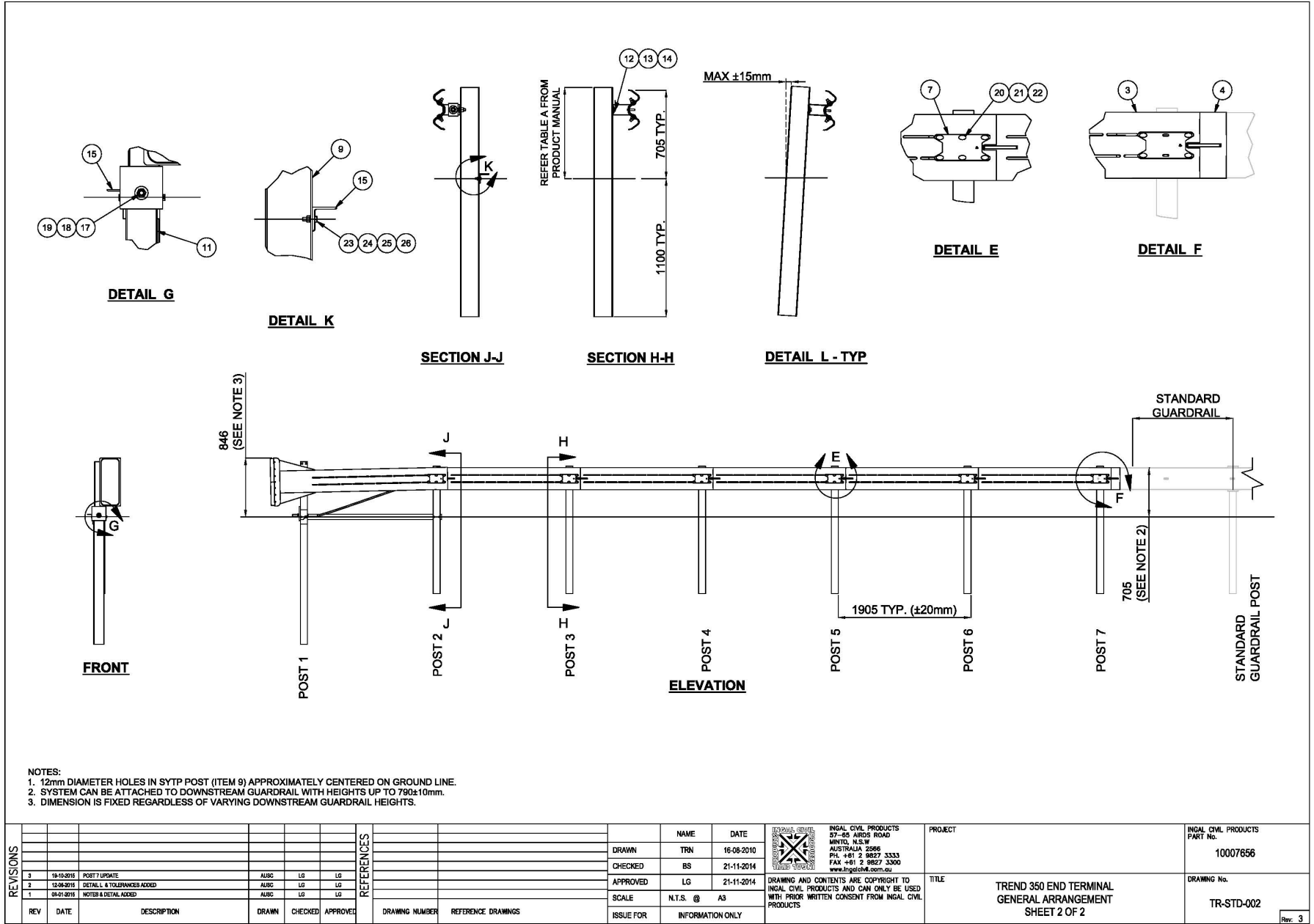


PARTS LIST				
ITEM	STOCK NO.	DESCRIPTION	QTY.	
1	820708	HEAD/RAIL 350 TREND,G,W/DECAL	1	
2	618192	RAIL,W-SHAPE,2228	1	
3	618193	RAIL,W-SHAPE,2228,W/FIN	4	
4	613554	RAIL,W/FIN,W-SHAPE,525	1	
5	820727	SPACER,CABLE ANCHOR,350 TE	1	
6	820726	SPACER,POST/RAIL,350 TE	5	
7	604465	BACKING PLATE,POST,TE	6	
8	000533	1830mm POST/8.5/DDR	5	
9	014578	1830mm PST/8.5W/SYTP	1	
10	034074	TRND350 HBA BKY PST/28.75W/6 HOLES	1	
11	033873	ET HBA P1-2 BTM X 6-1 1/2	1	
12	003403	5/8"X2" HEX BOLT A307	7	
13	617000	WASHER,BAR,1/4X2X89M,W/SLOT	6	
14	003340	5/8" GR HEX NUT	7	
15	033795	SYT-3"AN STRT 3-HL 6"6	1	
16	000782	5/8" X 8" X 8" BEARING PLATE	1	
17	118439	2m CABLE,95 1/2,350TE	1	
18	003900	1" ROUND WASHER F844	2	
19	003910	1" HEX NUT A563	2	
20	118814	BOLT,RAIL,5/8X2,G5,G	34	
21	118815	WASHER,FLAT,5/8,THICK,G	34	
22	003361	5/8" HVY HEX NUT A563 DH	34	
23	004390	7/16"X1.5" HEX BOLT GRD 5	2	
24	004389	7/16" WASHER F844	2	
25	004393	7/16" LOCK WASHER	2	
26	004396	7/16" HEX NUT A563 DH	2	
27	006321	3/8"X2" HEX BOLT GR-5 HDG	2	
28	004254	3/8" ROUND WASHER F436	2	
29	004258	3/8" LOCK WASHER	2	
30	006405	3/8" HVY HEX NUT A563GRDH	2	
31	003717	3/4"X2.5" HEX BOLT A325	2	
32	003701	3/4" ROUND WASHER F436	2	
33	004699	3/4" LOCK WASHER	2	
34	003704	3/4" HVY HEX NUT A563 DH	2	
35	617939	MANUAL,PRODUCT,TREND 350 TANGENT	1	

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	INGAL CIVIL PRODUCTS PART No.
3	18-10-2015	PORT # ADDED	AJSC	LG	LG			TRN	18-08-2010		TREND 350 END TERMINAL GENERAL ARRANGEMENT SHEET 1 OF 2	TR-STD-001
2	08-10-2015	NOTES & DETAIL ADDED	AJSC	LG	LG			BS	21-11-2014			
1	08-12-2014	FLARE DETAIL ADDED	AJSC	LG	LG			LG	21-11-2014			
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	INGAL CIVIL PRODUCTS PART No.
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	INGAL CIVIL PRODUCTS PART No.

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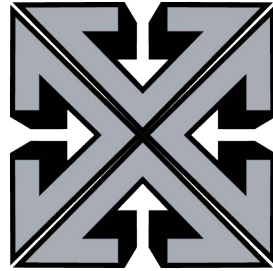
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REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	INGAL CIVIL PRODUCTS PART No.
3	18-10-2015	POST 7 UPDATE	AJSC	LG	LG			TRN	16-08-2010	TRENDS 350 END TERMINAL GUARDRAIL	10007656
2	12-08-2015	DETAILS & TOLERANCES ADDED	AJSC	LG	LG			BS	21-11-2014		
1	05-01-2015	NOTES & DETAIL ADDED	AJSC	LG	LG			LG	21-11-2014		
								SCALE	N.T.S. @ A3	TITLE	TRENDS 350 END TERMINAL GENERAL ARRANGEMENT SHEET 2 OF 2
								ISSUE FOR	INFORMATION ONLY		TR-STD-002



**Notes:**



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