Trinity Guardrail End Caps In & Near London Ontario - Survey of Locations & Condition

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Certain guardrail end caps produced by Trinity Highway Products of Dallas Texas are alleged to be defective and dangerous. The truth of the allegations will be determined in a U.S. court case commencing in November, 2014. Given the large number of these units that are installed throughout North American highways it would seem reasonable to document their locations. Thus Gorski Consulting has commenced a survey of roads and highways in the vicinity of London, Ontario to document the locations of those units that resemble the described Trinity products and to provide photographic evidence of their present condition.

Our photographic survey has captured some of the features that we believe could be important in identifying the installations' characteristics and condition. It would appear that all, except one, of the installations are likely ET-Plus end caps that are produced by Trinity. It is alleged that only the ET-Plus is defective. Following this photographic display we include our comments about our findings at the end of this article.

Survey of Trinity End Cap Location & Condition

1. Southbound Exit Ramp From Highbury Ave onto Bradley Ave., City of London.

West Guardrail

Figure 1: View of end cap of west guardrail. Evidence suggests that the original end cap was damaged and replaced by the current one which has a 4 inch wide channel.

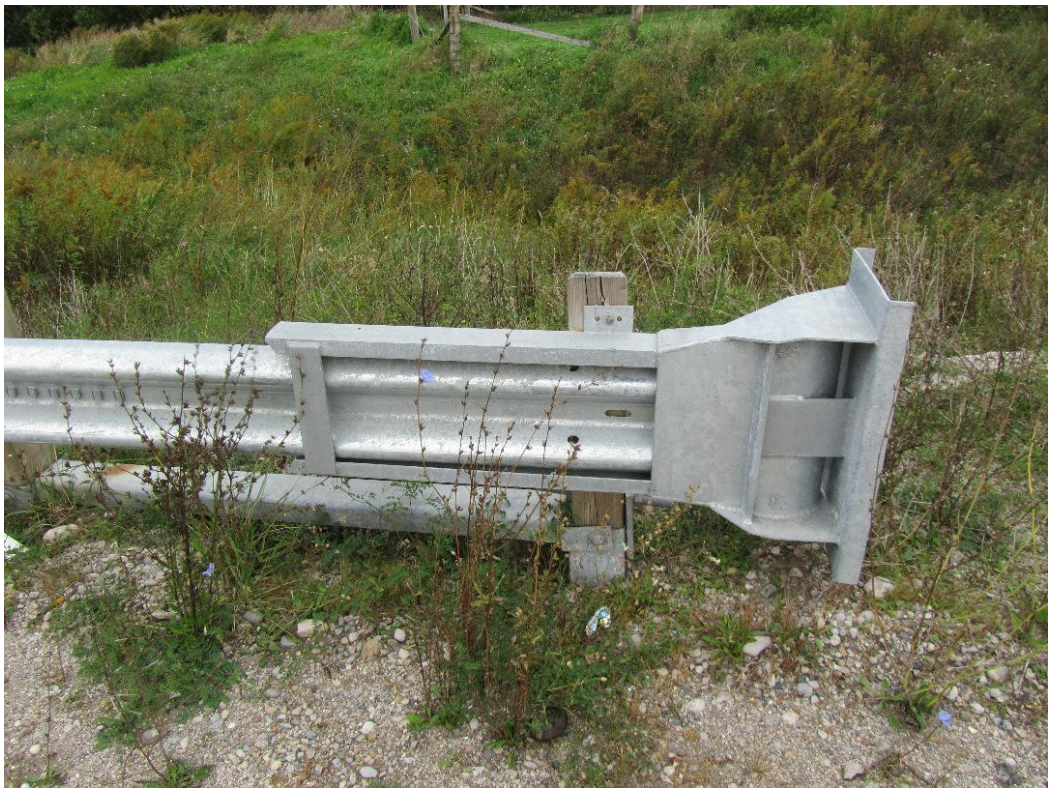

Figure 2: Side view from street.

Figure 3: Measurement of channel indicating a width of 4 inches.

Figure 4: View of standard measurement being taken to identify the position of the end cap with respect to the guardrail.

Figure 5: Result of standard measurement is about 36.25 inches.

East Guardrail

Figure 6: This is likely the original end cap. It is more square.

Figure 7: The end cap appears to be missing its front cover.

Figure 8: Measurement of channel indicating that it is 5 inches wide.

Figure 9: View of standard measurement being taken on the east guardrail.

Figure 10: Result of standard measurement indicating a distance of 35.5 inches.

2. Highbury Ave., North of Ten Mile Road, Middlesex County

East Guardrail

Figure 11: Overall view of east guardrail with end cap that is missing its front cover.

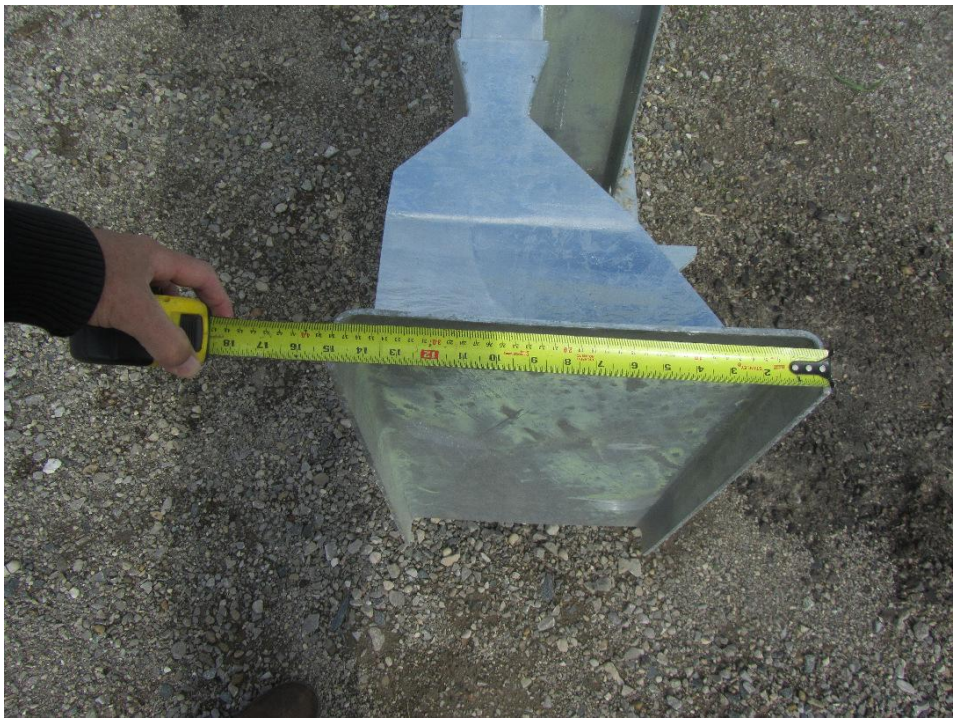

Figure 12: Measurement of front plate indicating a width of 15 inches.

Figure 13: Measurement indicating the end plate height of 28 inches.

Figure 14: Measurement of channel indicating a width of 4 inches.

3. Ilderton Road East of Adelaide Street, Middlesex County

North Guardrail

Figure 15: Overall view of end cap of north guardrail.

Figure 16: Street side view of end cap.

Figure 17: Ditch side view of end cap.

Figure 18: Measurement indicates the width of the channel is 4 inches.

Figure 19: With the black cover attached the end plate is about 16 inches wide.

Figure 20: With the front cover attached the bottom of the end plate is about 9 inches above the ground.

Figure 21: With the black cover attached the end plate is about 37.5 inches above the ground, thus the height of the black cover is about 28.5 inches tall.

Figure 22: Efforts to secure the black cover to the end plate are evident here as a bolt holds the cover to the plate.

Figure 23: A bolt is used to fasten the black cover to the end plate.

4. Richmond Street North of Twelve Mile Road, Middlesex County

East Guardrail

Figure 24: Overall view of east guardrail.

Figure 25: Street side view of the end cap and channel.

Figure 26: Ditch side view of end cap and channel.

Figure 27: Measurement indicates the channel is 5 inches wide.

Figure 28: Without the black cover the end plate is about 15 inches wide.

Figure 29: The base of the end plate is just slightly less than 5 inches above the ground.

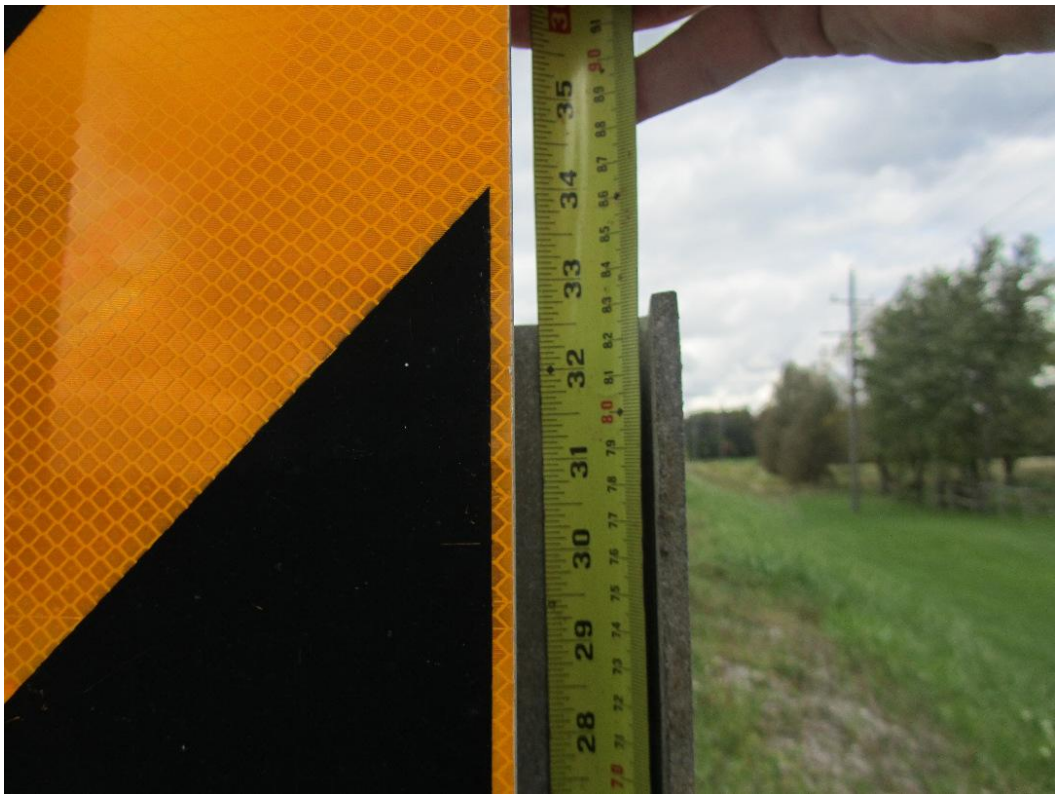

Figure 30: The top edge of the end plate is about 32.5 inches above the ground therefore the plate is about 28 inches tall.

5. Trafalgar Street at East End of Roundabout of Hale Street, City of London

Figure 31: Overall view of guardrail at the eastern end of the roundabout on Trafalgar Street.

Figure 32: Street side view of end cap and channel.

Figure 33: Ditch side view of end cap and channel.

Figure 34: The black cover of the end plate is just over 15 inches wide.

Figure 35: The black cover is slightly taller than 28 inches.

Figure 36: The channel is 4 inches wide.

Figure 37: View of plastic tie used to secure the black plastic cover to the end plate.

6. Westbound Highway 401 Exit Ramp to Wellington Road in London, Ontario Ministry of Transportation

Figure 38: Overall view of hazard marker in front of guardrail end cap.

Figure 39: Street side view of end cap and channel.

Figure 40: Ditch side view of end cap and channel.

Figure 41: View of damage evidence to face of end plate.

Figure 42: Base of end plate positioned about 8.5 inches above the ground.

Figure 43: Top of end plate positioned 36.5 inches above the ground, thus the end plate is 28 inches tall.

Figure 44: Measurement indicating the channel is 4 inches wide.

7. Eastbound Sarnia Road at CP Railway Overpass, City of London

South Guardrail - West End Cap

Figure 45: View of west end cap on south guardrail of Sarnia Road.

Figure 46: Street view of channel and end plate.

Figure 47: Width measurement (15.5 inches) of end plate cover which is consistent with measurements of other covers

Figure 48: Measurement indicating that the base of the end plate cover is about 9.5 inches above the ground.

Figure 49: Closer view of channel and guardrail beam noting that they are not in vertical alignment.

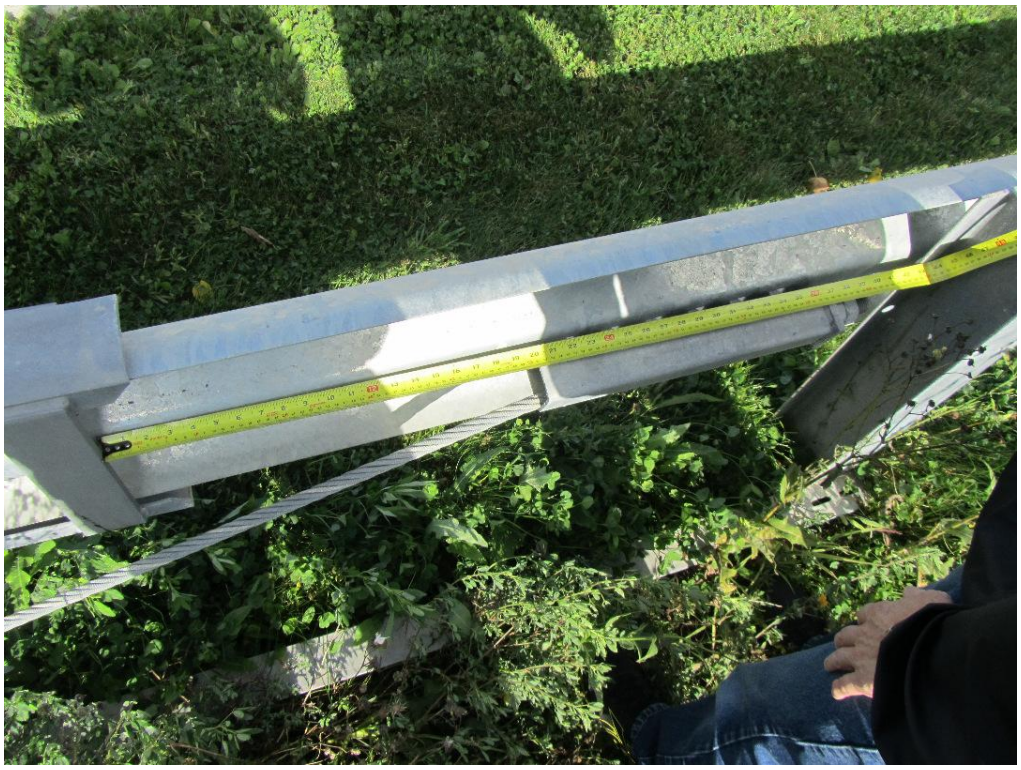

Figure 50: Standard measurement to indicate the position of the end cap with respect to the guardrail.

Figure 51: Close-up view showing standard measurement of just over 37 inches.

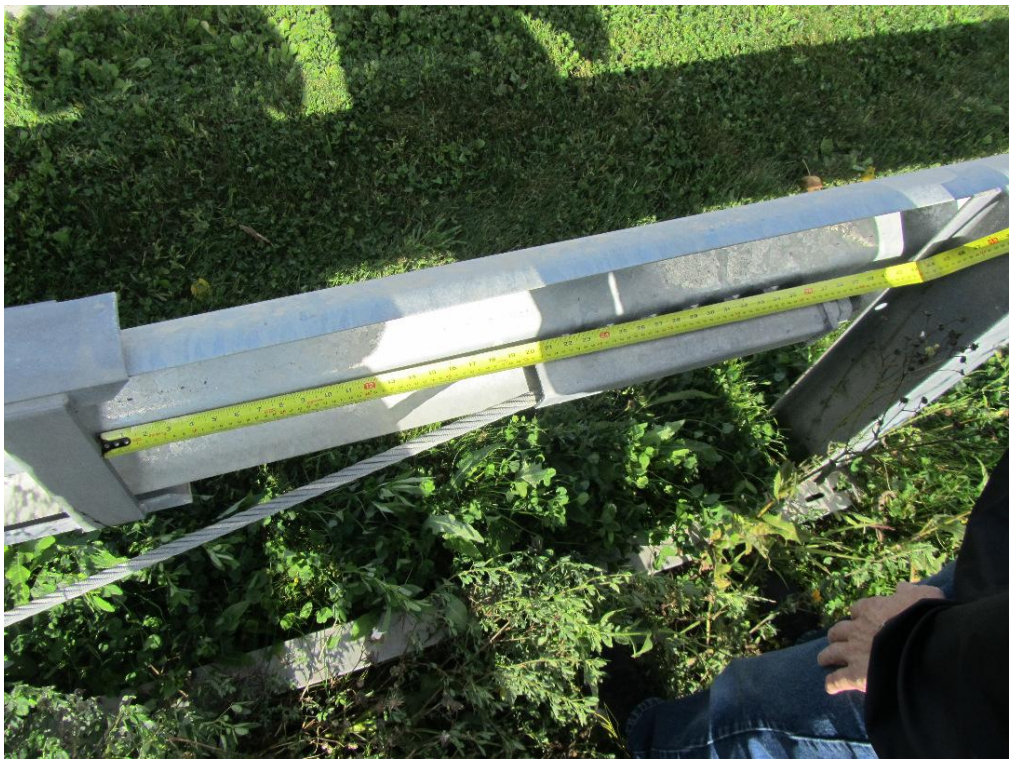

Figure 52: View of standard measurement being taken to document position of the end cap.

Figure 53: Result of standard measurement indicating a distance of 37.25 inches.

Figure 54: Measurement indicating a 4 inch wide channel.

Figure 55: View showing the rail positioned high within the channel.

North Guardrail - East End Cap

Figure 56: Overall view of north guardrail on Sarnia Road CP railway overpass.

Figure 57: Street view of north guardrail.

Figure 58: Ditch view of north guardrail.

Figure 59: Measurement indicating the typical width of 15 inches for the end plate.

Figure 60: View showing the installed height of the end plate with the base positioned 10.5 inches above the ground.

Figure 61: Measurement showing the top edge of the end plate at almost 39 inches above the ground.

Figure 62: View of standard measurement being taken to document the end cap's position with respect to the guardrail.

Figure 63: Result of standard measurement indicating a distance of 36.25 inches.

Figure 64: Measurement indicating the width of the channel is 4 inches.

Figure 65: Evidence of damage to the rail near the channel that could affect how the rail passes through that channel.

Figure 66: Evidence of scrapes to backside of rail at the location where the rail is deformed.

Figure 67: Photo indicating that scrapes also exist to the front face of the rail in the area of the deformation.

8. Northbound Wonderland Road at Medway Creek, City of London

East Guardrail - North End Cap

Figure 68: Overall view of north end cap of east guard rail.

Figure 69: Street side view.

Figure 70: Ditch side view.

Figure 71: Measurement indicating typical width of 15.5 inches to the cover the end plate.

Figure 72: Measurement indicating that the base of the end plate cover is about 7 inches above the ground.

Figure 73: View of typical plastic tie used to secure the cover to the end plate.

Figure 74: Measurement showing that the channel is the typical 4 inch width.

Figure 75: View of standard measurement being taken to document the position of the end cap with respect to the guardrail.

Figure 76: Result of standard measurement indicates a distance of 36.75 inches.

Figure 77: View of peculiar position of the rail anchorage post near the end cap.

Figure 78: View of peculiar position of the rail anchorage post near the end cap.

Figure 79: View of peculiar position of anchorage post.

Figure 80: View of deformed status of the anchorage post.

East Guardrail - South End Cap

Figure 81: Overall view of south end cap of east guardrail.

Figure 82: Street side view.

Figure 83: Ditch side view.

Figure 84: Measurement indicating typical, 15.5 inch wide cover of end plate.

Figure 85: Base of plate cover is 7.25 inches above the ground.

Figure 86: View showing measurement being taken of the width of the channel. Note that the rail is positioned low within the channel.

Figure 87: Measurement indicating typical 4 inch wide channel.

Figure 88: View of standard measurement to locate the end plate with respect to the guard rail.

Figure 89: Result of standard measurement indicates a distance of 36.5 inches.

Figure 90: Because there are no plastic clasps to secure the cover to the end plate the cover can easily become dislodged from its position.

West Guardrail - North End Cap

Figure 91: Overall view of north end cap of west guardrail.

Figure 92: Street side view.

Figure 93: Ditch side view.

Figure 94: Measurement of north end plate (15 inches wide) which is missing its cover.

Figure 95: View of base of end plate which is 5.5 inches above the ground.

Figure 96: View of tag attached to the end plate indicating that this is one of the ET-Plus terminals that is the subject of the defect allegations.

Figure 97: View of standard measurement being taken to determine the end cap's position with respect to the guardrail.

Figure 98: The result of the standard measurement indicates a distance of 35.75 inches.

Figure 99: View of measurement indicating that the channel is 4 inches wide and that the rail is positioned at a low level within the channel.

Figure 100: View showing the bottom edge of the rail resting on the bottom of the channel.

9. Northbound Wonderland Road North of Riverside Drive, City of London

East Guardrail, 1st South End Cap

Figure 101: Overall view of 1st south end cap of the east guardrail. The 2nd south end cap is visible in the distant background.

Figure 102: Street side view.

Figure 103: Ditch side view.

Figure 104: measurement of end plate cover indicating the typical width of 15.5 inches.

Figure 105: Measurement indicating that the base of the cover is 7 inches above the ground.

Figure 106: Vertical view of damage near the end plate indicating that the plate has been pushed along the rail, likely due to a previous impact.

Figure 107: View of the anchorage of the guardrail just behind the end plate showing that the vertical post is deformed and it has sheared away from the anchorage bolts at its base.

Figure 108: Close-up view showing how the base of the vertical post of the guardrail has been broken free from the bottom anchorage and has been displaced likely as a result of a previous impact.

Figure 109: View of buckling and ruptures of the vertical anchorage post just behind the end plate.

Figure 110: Further evidence of separations between the anchorage post and the guardrail.

Figure 111: Top view showing how the back of the end plate has made contact with the vertical anchorage post and deformed it.

Figure 112: Close-up view of damage to the vertical post from contact with the back of the end plate which has been displaced, likely by an impact.

Figure 113: View showing standard measurement being taken to identify the displacement of the end plate along the rail.

Figure 114: The result of the standard measurement of the 26 inches is about 10 inches shorter than the measurements taken at the undamaged guardrails therefore the end plate as been displaced along the rail by about 10 inches.

East Guardrail, 2nd South End Cap

Figure 115: Overall view of 2nd End Cap of east guardrail. Note that the end plate is on an obvious non-vertical angle.

Figure 116: Closer view showing that the end plate hidden by its cover, is at a non-vertical angle.

Figure 117: Street side view.

Figure 118: Ditch side view.

Figure 119: View showing that the end plate cover is the typical width of 15 inches.

Figure 120: Measurement shows that the street side corner of the cover is about 10.5 inches above the ground.

Figure 121: Measurement showing that the ditch side corner of the cover is about 7.25 inches above the ground. This indicates the substantial resting angle of the end plate.

Figure 122: View indicating that there is impact damage to the bottom, street side corner of the end plate.

Figure 123: View of anchor post behind the end plate showing that there is a separation between the it and the bottom anchor bolt.

Figure 124: Close-up view of separation at the bottom anchor bolt suggesting that this was a manufactured "tight fit" only and likely designed to separate whenever the end plate sustained a dislocation.

Figure 125: Measurement indicating that the channel is 4 inches wide. Note that the rail within the channel is resting at a low position.

Figure 126: View showing standard measurement being taken to document the position of the end plate with respect to the guardrail.

Figure 127: Result of the standard measurement indicates a distance of 36.75 inches.

West Guardrail, 1st North End Cap

Figure 128: Overall view of north end of the west guardrail at 1st end cap

Figure 129: Ditch side view of end cap.

Figure 130: Measurement indicating the end plate cover is 15.5 inches wide.

Figure 131: Measurement indicating the base of the end plate cover is 6 inches above the ground.

Figure 132: View showing that some asphalt paving has covered the bottom anchorage plate.

Figure 133: Closer view at the base of the vertical anchor post near the end plate where the higher asphalt pavement might interfere with the separation of the post from its "tight fit" design.

Figure 134: View of measurement indicating that the channel is 4 inches wide. Note that the rail is sitting low within the channel.

Figure 135: View demonstrating the standard measurement taken to establish the end plate position with respect to the guardrail.

Figure 136: Result of standard measurement indicates a distance of 36 inches.

Figure 137: View of typical plastic tie used to hold the plate cover onto the end plate.

Figure 138: Overall view of the position of the north end of guardrail with respect to the road.

West Guardrail, 2nd North End Cap

Figure 139: Overall view of 2nd end cap at the west guardrail.

Figure 140: Street side view.

Figure 141: Measurement indicating that the end plate cover is 15.5 inches wide.

Figure 142: Measurement indicating that the base of the end plate cover is 8.5 inches above the ground.

Figure 143: Ditch side view of base of the vertical anchor post just behind the end plate.

Figure 144: View showing the press fit of the base of the vertical anchor post just behind the end plate.

Figure 145: Measurement indicating that the channel is 4 inches wide.

Figure 146: View demonstration the standard measurement being taken to establish the position of the end plate with respect to the guardrail.

Figure 147: Result of standard measurement indicating a distance of 36.25 inches.

Figure 148: Overall view of guardrail position with respect to the road.

Discussion of Survey Results

A total of 16 end caps are reviewed in this article from 9 different sites in the vicinity of the City of London, Ontario.

Almost all of the documented end caps have the characteristics of the ET-Plus system manufactured by Trinity Highway Products of Dallas, Texas. The only exception would appear to be the end cap located on the southbound exit ramp from Highbury Ave to Bradley Ave in south-east London. This exception bears the characteristics of the ET-2000, also a product of Trinity.

A U.S. court will determine whether the alleged defects in the ET-Plus end cap are genuine. We have no input into that determination. However, our survey of the end caps that appear to be ET-Plus, has created some additional concerns beyond the alleged defect. These concerns are generally in the area of the installation and maintenance of the systems.

With respect to the installations, we have observed, at a number of sites, that posts bearing hazard markers have been placed in front of the end plates. An example is shown below, from the Highbury Ave site north of Ten Mile Road.

Figure 149: View of post and hazard marker placed in front of the guardrail end plate.

Another example below is taken from the site of the exit ramp onto Bradley Ave.

Figure 150: View of post and hazard marker placed in front of the guardrail end plate.

When the end caps were tested for compliance with federal standards the test conditions would have been idealized to isolate the system from any extraneous influences. When the post and hazard marker are struck in real-life conditions there is a good likelihood that they will be bent and possibly pushed against the end plate. The post of the hazard marker may be pulled out of the ground but that is not a guarantee. The result can be that this extraneous object could affect how the striking vehicle interacts with the end plate and how the system collapses to deform energy.

Similarly such posts and hazard markers have been observed anchored within the immediate location where the end cap must ride the rail of the guardrail system. Such an occurrence is shown below from the east guardrail on the Bradley Ave exit ramp. Again, this is an extraneous device placed in a location where it is vital that the end cap ride properly on the rail. That extraneous device could potentially jam the functioning of the system as it collapses and the system may not function properly.

Figure 151: View of post and hazard marker placed in the zone where the end cap's proper collapse along the guardrail must be isolated from any extraneous devices.

A maintenance concern relates to the number of times we have observed that the cover to the end cap was found missing on a number of systems. It needs to be determined in what status the end cap was tested for compliance, with or without that cover. Although we see the potential argument that the plastic cover might have little influence on the system's performance we do not see this as a guarantee. Even if several compliance tests were performed with and without the cover and no difference was noted, that does not guarantee that result will be the same after a hypothetical 1000 tests, or 10,000 tests. Because these large numbers of real life "tests" are what

could be expected in the real world over a number of years throughout the large population of these installations in North America. If the system fails several times in this larger exposure, this failure rate may need to be considered.

Our concern may not be with the collapsing and energy absorption of the end cap, rather, our concern is with the difference that might exist in the damage caused to the striking vehicle. The end plate equipped with the plastic cover could provide a more forgiving contact with the structure of the vehicle and might lessen the possibility of ruptures and failures in areas of contact. The end plate without the plastic cover gives the impression of an aggressive structure, particularly the exposed edges around the perimeter of the plate. These narrow and stiff edges could rip into the structure of a vehicle and cause separations, including potential penetrations into the occupant space. We are unaware of what testing has been done to alleviate our concerns on this issue.

In a number of installations we have observed some minor differences in the installation height of the end plate and the vertical angle of the plate with respect to the length of the rail and how high the rail rests within the channel. All these minor alterations may be of little consequence to the system's performance, however, we simply do not know.

At several sites we have observed that the system was damaged, possibly from previous impacts, and that the system was still left in its condition, without a repair. Again, it cannot be known what level of damage could become important in changing the safe functioning of the systems.

Whatever the potential problem, once a system is installed, it becomes important to confirm that the installation is as close as possible to the conditions under which it was tested for compliance. As with any roadside infrastructure, maintenance must be maintained.

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