

Trinity Guardrail End Cap Survey - Part IV

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Certain guardrail end caps produced by Trinity Highway Products of Dallas Texas are alleged to be defective and dangerous. Recently a federal jury concluded that Trinity had defrauded the U.S. government when it made alterations to its end caps without informing its Federal Highway Administration (FHWA). Those alterations to the ET-Plus end caps allegedly caused them to malfunction.

The ET-Plus is made up of an end cap, terminal or head, and a channel that are attached to the end of a typical "W" rail of a roadside guardrail. When impacted by a wayward vehicle the end cap and channel are designed to ride on the "W" rail while allowing that rail to pass through the channel. The head is designed with a throat that causes the "W" rail to flatten out and deform into a ribbon. The rail is then redirected out the side of the head. This action absorbs the energy needed to bring the impacting vehicle to a controlled ride-down of the impact. It is alleged that the dimensions of the head and channel were altered by Trinity between 2000 and 2005 without informing the U.S. Federal Highway Safety Administration (FHWA). It was these dimensional changes that allegedly caused the rail to fail to pass through the channel and head and thus jam the system. The effect on impacting vehicles included inappropriate rollovers and instances of impaling of the vehicles by the rail.

It has been estimated that there could be as many as 500,000 installations of these units throughout the United States and it is likely that the product is similarly popular in Canada.

Given the large number of these units that are installed throughout North American highways Gorski Consulting has commenced a survey of roads and highways in Southern Ontario to document the locations of those units that resemble the described Trinity products and to provide photographic evidence of their present condition.

Three previous articles discussed the findings from our examinations of 32 end caps. The present article will continue that survey by providing photographic documentations of an additional 8 end caps and 4 different sites.

To maintain some continuity we continue the numbering of the sites from the previous articles.

Survey of Trinity End Caps

19. Highway 119 North of Oxford Road 88, Oxford County

End Cap on North End of West Guardrail



Figure 1: Overall view, looking south, at the two guardrails north of Oxford Road 88 in Oxford County. Our first review will be of the north end cap located on the west guardrail which is visible in the right foreground of the above photo.



Figure 2: Overall view of hazard warning sign, end cap and west guardrail.



Figure 3: Street side view of hazard sign, end cap and guardrail.



Figure 4: Street side view of unusual deformation to the guardrail and rear edge of channel.



Figure 5: View of deformation to the bottom rear of the channel.



Figure 6: View of rotated end plate as part of damage to the system.



Figure 7: Measurement indicating typical 15-inch width of end plate.



Figure 8: Measurement indicating that the base of the end plate is about 12.5 inches above the ground.



Figure 9: Overall ditch side view of hazard sign, end cap and guardrail.



Figure 10: View of deformed status of channel.



Figure 11: View of Trinity Highway Products label indicating this is a ET-Plus unit.



Figure 12: View of deformed top edge of rail at the deformed rear edge of the channel.



Figure 13: View of bottom anchorage to the vertical support beam just behind the end plate which has slipped out of its press fit position.



Figure 14: Measurement indicating the standard 4-inch width of the channel.



Figure 15: View, looking forward toward the end plate from inside the channel showing that the front edge of the rail has buckled.



Figure 16: Close-up view of front edge of rail inside the channel showing the buckling and rupture of the rail.



Figure 17: View of standard measurement being taken to determine the position of the end cap.



Figure 18: Result of standard measurement indicates a distance of 33.25 inches.



Figure 19: Measurement indicating that the hazard warning sign is only approximately 15.5 inches distance from the end plate.



Figure 20: View of yellow label on the hazard warning sign.



Figure 21: Close-up view of label on the hazard warning sign indicating "County of Oxford". The date of May, 2014 often indicates when such a sign was installed. This photo was taken on October 16, 2014.



Figure 22: Measurement indicating that the hazard warning marker is about 66 inches tall.

End Cap on South End of East Guardrail



Figure 23: Overall view, looking north, at the hazard marker, end cap and guardrail.



Figure 24: Street side view of guardrail, end cap hazard marker sign.



Figure 25: View of gravel lying in the crevice between the bottom edge of the rail and channel.



Figure 26: Measurement indicating the typical 15-inch width of the end plate.



Figure 27: Overall, ditch side view of hazard marker, end cap and guardrail.



Figure 28: View of Trinity ET-Plus label.



Figure 29: Measurement indicating that the base of the end plate is approximately 9 inches above the ground.



Figure 30: Measurement confirming the 4-inch-wide channel.



Figure 31: View of Standard measurement to determine the position of the end cap.



Figure 32: Result of measurement indicates a distance of 36 inches.



Figure 33: Measurement indicating the distance between the end plate and hazard sign is only about 7 inches.

20. Valley View Road Just South of Elginfield Road (Highway 7), Middlesex County

End Cap on South End of East Guardrail



Figure 34: View, looking north, toward the hazard marker, end cap and east guardrail on Valleyview Road.



Figure 35: Overall view of guardrail, end cap and hazard marker sign.



Figure 36: View of rail and end cap showing the substantial difference in their horizontal angles.



Figure 37: Measurement indicating the typical 15-inch width of the end plate.



Figure 38: Measurement indicating that the base of the end plate is about 7.5 inches above the ground.



Figure 39: Ditch side view of end cap and rail.



Figure 40: View of Trinity ET-Plus label.



Figure 41: Measurement confirming the 4-inch-wide channel.



Figure 42: View of measurement being taken to document the position of the end cap.



Figure 43: Result of measurement indicates a distance of 36.5 inches.



Figure 44: Measurement of distance between end plate and hazard marker sign.



Figure 45: Result of measurement indicates a distance of 56.5 inches.



Figure 46: Measurement indicating that the hazard marker sign is about 67 inches tall.

21. Catherine Street East of Dorchester Road, Dorchester, Ontario

End Cap on East End of South Guardrail



Figure 47: Overall view of end cap and south guardrail.



Figure 48: Street side view of end cap and guardrail.



Figure 49: Street side view of end cap and rail.



Figure 50: View of sand accumulated in the horizontal plate located just behind the end plate.



Figure 51: View of sand and gravel accumulated in the crevice at the bottom edge of the rail and channel.



Figure 52: Measurement indicating a width of 15.5 inches for the black cover of the end plate.



Figure 53: Measurement indicating that the bottom edge of the black end plate cover is about 9.25 inches above the ground.



Figure 54: Ditch side view of end plate and guardrail.



Figure 55: Measurement confirming 4-inch width of channel.



Figure 56: View of measurement being taken to establish the position of the end cap.



Figure 57: Result of measurement indicating as distance of 35.75 inches.

22. Cobble Hills Road Approximately 500 Metres South of Evelyn Rd (Middlesex) and Oxford Rd 74 (Oxford), Middlesex & Oxford Counties Border

End Cap On South End of East Guardrail



Figure 58: Overall view of hazard warning marker, east guardrail and end cap.



Figure 59: Street side view of hazard marker, end cap and guardrail.



Figure 60: Street side view of end cap showing substantial difference in horizontal angle between end cap and rail.



Figure 61: View of crevice between bottom of rail and channel showing minimal evidence of any stones or sand accumulation.



Figure 62: View of typical plastic tie which has become dislodged and will likely cause end plate cover to become loose.



Figure 63: Measurement confirming that the end plate cover is about 15.5 inches wide.



Figure 64: Measurement indicating that the base of the end plate cover is approximately 6.5 inches above the ground.



Figure 65: Ditch side view of end cap and rail.



Figure 66: Measurement confirming the 4-inch-wide channel.



Figure 67: Result of measurement to determine the position of the end cap indicates a distance of 36 inches.



Figure 68: Measurement indicating that the hazard warning sign is approximately 72 inches from the end plate.



Figure 69: Measurement indicating the height of the hazard marker sign is about 63 inches.

End Cap on the South End of the West Guardrail



Figure 70: Overall view of the hazard marker, end cap and guardrail.



Figure 71: Street side view of end cap and west guardrail.



Figure 72: Measurement confirming 15-inch-wide end plate.



Figure 73: Measurement indicating the base of the end plate is approximately 12 inches above the ground.



Figure 74: View of non-vertical post that is located beneath the rail and directly behind the end plate.



Figure 75: View showing that the vertical post has slipped out of its press fitting near its base.



Figure 76: Close-up view showing how the vertical post has been displaced out of its press fitting at its anchorage bolt.



Figure 77: Ditch side view of end cap and rail.



Figure 78: Measurement indicating that the channel is 4 inches wide.



Figure 79: View of measurement being taken to determine the position of the end cap.



Figure 80: Result of measurement indicates a distance of 37.75 inches.



Figure 81: Measurement indicating the distance from the end plate to the hazard marker is about 78 inches.

End Cap on the North End of the West Guardrail



Figure 82: Street side view of hazard marker, end cap and guardrail. Note there is a newer section of rail while the older portion is visible at the left end of the photo.



Figure 83: View showing portion of guardrail where the newer rail overlaps with the older portion.



Figure 84: Overall view of end cap and rail.



Figure 85: View of the substantial difference in horizontal angle between the rail and channel.



Figure 86: View of deposit of sand and gravel within the crevice at the bottom of the rail and channel.



Figure 87: Measurement indicating that the end plate is 15 inches wide.



Figure 88: Measurement indicating that the base of the end plate is about 9 inches above the ground.



Figure 89: Ditch side view of the end cap and rail.



Figure 90: View of label identifying the Trinity Highway Products unit.



Figure 91: Measurement confirming 4-inch-wide channel.



Figure 92: View of measurement being taken to document the position of the end cap.



Figure 93: Result of measurement indicating a distance of 36.75 inches.



Figure 94: View of measurement indicating the distance between the end plate and hazard marker is about 73.5 inches.

End Cap on the North End of the East Guardrail



Figure 95: Overall view of hazard marker, end cap and guardrail.



Figure 96: View showing the substantial difference in horizontal angle between the channel and rail.



Figure 97: View of black cover on the end plate gravel lying on the horizontal platform just behind the end plate.



Figure 98: Close-up view of gravel lying on the horizontal platform just behind the end plate.



Figure 99: View of substantial quantity of gravel lying in the crevice of the bottom of the rail and channel.



Figure 100: Measurement confirming the 15.5 inch width of the end plate cover.



Figure 101: Measurement noting that the bottom of the end plate cover is approximately 10 inches above the ground.



Figure 102: View of typical plastic tie used to anchor the plate cover to the end plate.



Figure 103: Measurement showing that the channel is 4 inches wide.



Figure 104: Ditch side view of end cap and rail.



Figure 105: View of deposit of gravel on the horizontal platform on the ditch side of the end cap.



Figure 106: View of measurement being taken to document the position of the end cap.



Figure 107: Result of measurement indicating a distance of approximately 36.25 inches.



Figure 108: Measurement indicating that the end hazard marker is approximately 78 inches distance from the end plate cover.

Discussion of Survey Findings

A total of 8 end caps were reviewed in this article.

We continue to be concerned with the number of installations that have gravel trapped within the crevice between the bottom of the rail and channel. If the system is to function properly the end cap must be able to slide freely along the rail without being jammed. When gravel is present in the interface where that sliding is to take place, and if the channel is narrowed as is allegedly the case with the Trinity ET-Plus unit, then there should be a logical concern that the gravel will jam the system.

The findings that were discussed in the earlier articles were repeated in this continuation of the survey. We remain concerned with the anchorage of metal posts that have a hazard marker attached to them and these appear to be too close to the end cap.

There continue to be installations that are missing the black cover over the metal end cap.

We also continue to see minor differences in each installation. There were several installations where the horizontal angle of the rail was significantly different than the angle of the channel. We reason that the end cap may be heavy and it might pivot downward and thus raising the back end of the channel. It needs to be determined how this might affect the proper functioning of the units.

This fourth article now completes a total of 40 end caps that have been examined in our survey. While we knew very little about the units when our survey began, we feel we have educated ourselves in this process.

The latest news we have heard is that Trinity Highway Products has been found liable by a U.S. federal jury with defrauding the U.S. government as a result of the modifications it made to the ET-Plus unit. Trinity was required to inform the U.S. Federal Highway Administration (FHWA) of those modifications and it failed to do so. From our viewpoint, the actions, or inactions of the FHWA must also be questioned as the modified end caps were installed in the neighbourhood of ten years yet the FHWA failed to detect the alterations or the degraded performance of the units as document in the University of Alabama study that was discussed in our earlier articles. We understand now that the FHWA has asked Trinity to retest the ET-Plus unit to confirm that it meets the requirements of the NCHRP 350 guidelines.

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