6-26.1 Energy Absorbing Terminals

To function appropriately Energy Absorbing Terminals (EATs) must be designed, installed, and maintained properly. This section will concentrate on the proper installation of EATs. Guidance provided in this section will apply to EATs for non-MGS beam guard and for MGS beam guard. Both Non-MGS EATs and MGS EATs have the same manufacturers. Additional information about the design and operation of an EAT can be found at:

FDM 11-45-1

FDM 11-45-2

Designer notes for SDD 14b24

Designer notes for SDD 14b44

AASHTO Roadside Design Guide Chapter 8

FHWA has produced a short video about end terminals. This video discusses the history and design of many different types of end terminals. Although portions of the video cover hardware that WisDOT does not use, the video does discuss the operation of EATs. This video can be found at:

Video link-FHWA's Guidelines for the Selection of W-Beam Barrier Terminals:

http://www.efl.fhwa.dot.gov/files/technology/w-beam-barrier-terminals/Start_Here.htm

Note: This link leads to a webpage that will scan your computer to see if you have the correct software (i.e. FLASH 7 or higher) to run presentation. If you do not have it the web page will direct you to load the software. If you have the correct software, the web page will have a hyperlink titled “Launch the Presentation”. Click on hyperlink. You will hear some music and see the FHWA symbol appear.A pop up box will ask you to close a tab. Click yes. On the bottom left corner (below the FHWA symbol) there is a play button. Press the button and the presentation should play.

6-26.1.1 Hardware

See the Approved Products List for approved manufactures of non-MGS and MGS EATs. Below are drawings and photos from the manufacturers of MGS EATs. These drawings and photos provide useful installation information:

Trinity Highway Products

Drawings (Exhibit 1)

Project lettings during November 2014 and later cannot install ET-Plus by Trinity

Photos (Exhibit 2)

Roadway Systems

Drawings (Exhibit 3)

Photos (Exhibit 4)

6-26.1.1.1 Installation Issues

This section will discuss typical hardware installation issues.

Figure 1 Breakaway Post

The breakaway holes in Figure 1 are too high. During a head-on impact the undercarriage of a vehicle could snag on a post[1]. Objects taller than 4 inches on a 5 foot chord are considered to be potential snag hazards. The second post from the left also appears to be out of plumb and may not absorb enough impact energy or an errant vehicle may vault over the EAT. In either case, the errant vehicle may engage a roadside hazard that the EAT was installed to protect.

Figure 2 Close Up of EAT Post 1

The steel foundation tube in Figure 2 is too high and may snag a vehicle during an impact with an EAT. Also, the cable has slack in it which can cause excessive deflection or rail failure for the whole installation of semi-rigid barrier. Finally, the bearing plate is not installed correctly.

[1]Object taller than 4 inches on a 5 foot chord are considered to be potential snag hazards.

Figure 3 Poor Compaction/Visible Gaps

Visual gaps, seen in Figure 3, between foundation tubes and soils or improper compaction around the foundation tube can reduce the amount of force the whole semi-rigid barrier system can absorb.

Figure 4 Ground Strut and Bearing Plate Problems

In Figure 4, the ground strut is too high and can spear into a vehicle cab or cause a vehicle to roll over during an impact. Also, the bearing plate is not installed correctly.

Other hardware issues such as missing or damaged components are discussed in CMM 6-25. and FDM 11-45.2.

6-26.1.2 Grading Issues

Grading is critical to the function of the EAT and the entire semi-rigid barrier system. Grading around an EAT is broken down into three primary areas:

Approach grading- Is grading leading to the EAT. This grading allows a vehicle to avoid impacting an EAT.

Adjacent grading- Is grading next to the EAT. This grading allows for vehicle stability during impact and provides structural strength to the entire barrier installation.

Runout grading- Is grading behind the EAT. This grading allows for a vehicle to traverse a slope and stop after impacting an EAT.

Desirable grading has:

Compacted material

Traversable slopes that blend into the surrounding

A flat area between head of EAT and hinge slope

Room for errant vehicle to traverse (see runout grading SDDs: SDD 14b24 and SDD 14b44).

Marginal grading has:

Poorly compacted materials

Slopes that do not blend into surroundings

No flat area between EAT and hinge point

Restricted room for an errant vehicle

Grading adjacent to the EAT is consider marginal if a vehicle can slowly drive around the terminal and park directly behind or adjacent to EAT end section. Runout grading is considered marginal If a vehicle can drive at slow speeds behind the terminal for a distance of 75 feet without running into fixed object or losing control.

Figures 5 to 10 show examples of desirable grading, marginal grading and EAT with little to no grading.

Figure 5 Desirable Grading

Side slopes match into other slopes - side slopes are relatively flat and well compacted.

Figure 6 Desirable Grading

Good distance from hinge point to EAT, good compaction of materials, slopes are relatively flat.

Figure 7 Marginal Grading

Side slopes don't match into existing slopes, side slopes are too steep, materials are not compacted.

Figure 8 Marginal Grading

Side slopes are not compacted; side slopes do not blend with surrounding slopes.

Figure 9 Little to No Grading

Minimum to no grading; no flat area behind the EAT; material not compacted near the foundation tube.

Figure 10 Little to No Grading

Minimum to no grading; ditch check is in the runout area.

6-26.1.3 Curb and Gutter Issues

Curb and gutter can degrade the performance of an EAT. Curbs can make it difficult for an errant vehicle to engage an EAT properly. Curbs could trip a vehicle into an EAT. Installations similar to Figure 11 are problematic because of the use of curb.

Typically curb and gutter is installed prior to installation of an EAT. Review FDM 11-45-1 for guidance on installing curb and gutter near an EAT.

Figure 11 Use of Curb Near EAT

6-26.1.4 Fixed Object Issues

Collisions into multiple fixed objects are more likely to have negative consequences. This is especially true with EATs. A fixed object in front of and EAT may channel drivers into an EAT (see Figures 12 and 13). On the other hand, fixed objects installed within the adjacent or runout areas can be struck by an errant vehicle after it has

impacted an EAT (see Figures N and O).

Figure 12 Sign Could Funnel Vehicles into EAT

Figure 13 Pole and EAT Will Likely be Hit

Figure 14 Rock Wall Can Still be Hit

Figure 15 ITS Pole Can Still be Hit

After post 3 an EAT reacts like other semi-rigid barriers. The working width is similar to the semi-rigid barrier system it is connected to. Placing fixed objects too close to an EAT may allow a vehicle to hit those objects. FDM 11-45-2.5.2.8 discusses working width and what can happen when working width is not provided.

List of Exhibits

Exhibit 1	Trinity Highway Products - Drawings
Exhibit 2	Trinity Highway Products - Photos
Exhibit 3	Roadway Systems - Drawings
Exhibit 4	Roadway Systems - Photos