723.1 GENERAL

Various proprietary permanent and temporary energy attenuators are used to reduce the hazard associated with the ends of permanent and temporary concrete barriers. Tables 1 and 2 in OPSS 723 list the names of systems acceptable for the items Energy Attenuator - Permanent, and Energy Attenuator - Temporary for several applications. The Contractor is given the option of supplying and installing any of the listed systems specified in the contract documents for the appropriate tender item.

The energy attenuators all meet the crash test acceptance requirements of NCHRP Report 350.

Additional background information can be found in Highway Design Bulletin 2009-003.

723.2 REFERENCES

CDED B206-1 - Earth Excavation Grading
Roadside Safety Manual
Highway Design Bulletin 2009-003

723.3 TENDER ITEMS

Energy Attenuator – Permanent, Narrow (Variation)
Energy Attenuator – Permanent, Wide (Variation)
Energy Attenuator – Permanent, Extra Wide (Variation)
Energy Attenuator – Permanent, High Exposure (Variation)
Energy Attenuator – Permanent, Single Sided
Energy Attenuator – Temporary, Narrow (Variation)
Energy Attenuator – Temporary, Wide (Variation)
Energy Attenuator – Temporary, Extra Wide (Variation)
Energy Attenuator – Temporary, Reduced Exposure (Variation)
Energy Attenuator – Temporary, Dual Duty (Variation)
Energy Attenuator – Relocation, Narrow (Variation)
Energy Attenuator – Relocation, Wide (Variation)
Energy Attenuator – Relocation, Extra Wide (Variation)
Energy Attenuator – Relocation, Reduced Exposure (Variation)
Energy Attenuator – Relocation, Dual Duty (Variation)
723.4 **SPECIFICATIONS**

The requirements for the Energy Attenuators are contained in OPSS 723.

723.5 **SPECIAL PROVISIONS**

Refer to Chapter “E” of this Manual to review the applicable standard special provisions.

723.6 **STANDARD DRAWINGS**

Applicable Standard Drawings are contained in the 900 series of the Ontario Provincial Standard Drawings (OPSD).

723.7 **DESIGN**

**Foundations:**

A permanent energy attenuator installation includes a new concrete pad. If an existing concrete surface or pad can be used to support the system, it should be specified in the Contract Documents.

Temporary energy attenuators are typically installed on an existing surface. The designer should confirm that one of the following foundation options is available for each temporary energy attenuator installation:

a. Existing concrete surface:
   -min. 200 mm deep, 28 MPa min. compressive strength

b. Asphalt over compacted granular:
   -min. 150 mm asphalt over 150 mm min. compacted granular
   -the asphalt must extend a minimum of 500 mm beyond the anchor bolts

c. Asphalt over concrete:
   -min. 75 mm asphalt over 75 mm min. concrete, 28 MPa min. compressive strength

If the existing surface is not suitable for the temporary installation, a concrete pad should be specified in the Contract Documents.

The designer should confirm that any existing concrete surface or pad is in good condition and will provide a smooth operating surface for the system.
Single-Sided Installations:

For single-sided installations, the granular base and earth or rock slopes for the roadway shall be widened in accordance with the minimum dimensions detailed in the appropriate OPSD. Where the roadway is being widened for installation of the terminal, ensure that drainage requirements are properly addressed.

Single-sided systems should not be installed in a location where backside hits towards the concrete barrier are possible (e.g. in gore areas), or in a narrow median where backside, opposite direction hits are possible. The area behind and beyond the system should be traversable and free of fixed objects. The minimum recommended rectangular area should be 6 m wide, measured behind and perpendicular to the back of the rail, by 22 m long, measured from the front face of the system and parallel to the system.

Reduced Exposure Systems:

The reduced exposure tender item provides the Contractor with the option of supplying water filled energy attenuator system as an alternative to the conventional narrow energy attenuator systems. When a reduced exposure tender item is selected, the designer should confirm that the following requirements for water filled energy attenuator systems are satisfied:

a. Water filled energy attenuator systems shall be installed at an offset of not less than 2.0 m from the edge of the travelled way.

b. When installed adjacent to an existing guide rail system, the clearance shall be less than or equal to 0.3 m or greater than or equal to 3.0 m. Otherwise, the area behind and beyond the water filled energy attenuator system shall be traversable and free of fixed objects. The minimum recommended rectangular area shall be 6 m wide, measured behind and perpendicular to the back of the system, by 22 m long, measured from the front face of the system and parallel to the system.

c. At a minimum, the first 16 m of temporary concrete barrier shall be placed tangential to the water filled energy attenuator system.

Curb and Gutter:

Wherever possible, the designer should eliminate the use of curb with gutter in advance of and along the length of energy attenuators. See the Roadside Safety Manual for additional information.
These are Plan Quantity Payment items.

The quantity is based on each completed installation.

The unit of measurement for Energy Attenuators is each complete installation.

723.9 DOCUMENTATION

The tender items are variation items (with the exception of single sided energy attenuators). Provide two columns on the quantity sheet to indicate whether each attenuator installation is a TL-2 or TL-3 configuration:

- TL-3 configurations are required for high-speed installations with posted speeds of 70 km/h and greater.
- TL-2 configurations may be used for low-speed installations with posted speeds of less than 70 km/h.

Enter each installation in the “Quantities Miscellaneous” sheets as a separate line entry under the appropriate column heading. Enter the station at the back end of the system (at the interface between the energy attenuator and the concrete barrier or object) and indicate location, left, right, or median. Total each column and sum the TL-2 and TL-3 installations.

For each permanent energy attenuator installation where there is a suitable existing concrete surface or pad, note in the location and position column of the Q-sheet: “Install on Existing Concrete Surface or Pad”, as applicable.

Temporary energy attenuators are typically installed on an existing surface. For those locations where the existing surface is not suitable, a standard concrete pad should be provided. For those locations, note in the location and position column of the Q-sheet: “Install on Concrete Pad”.

For all permanent installations, use the “Energy Attenuator – Permanent” standard item for the appropriate application (i.e. Wide, Extra Wide, etc.).

For all temporary installations, use the “Energy Attenuator – Temporary” and “Energy Attenuator – Relocation” standard items for the appropriate application (i.e. Wide, Extra Wide, etc.).

The “Energy Attenuator – Temporary” standard items pay for the supply, installation, and removal of the units. The total cannot exceed the largest number of units in place at any one time during the contract.
The “Energy Attenuator – Relocation” items are comprised of all relocations during the contract.

Show the location of each Energy Attenuator, Permanent and/or Temporary, and each Energy Attenuator Relocation on the contract drawings with the appropriate notation (from Table 3 in OPSS 723) shown adjacent to the symbol.

**Single-Sided Installations:**

For single-sided installations, show the location of the roadway widening on the contract drawings (see section B206-1, "Earth Excavation (Grading)" for more information) with the appropriate OPSD number shown adjacent to the system. Also, show roadway widening on the cross sections. Payment for all grading shall be made under appropriate grading items.

When a single-sided system is connected to existing concrete barrier, the designer should included payment in the Contract Documents for the removal of the 4.0 m section of existing concrete barrier and placement of a new 4.0 m section adjacent to each system.

**723.9.1 Documentation Accuracy**

Record stations to the nearest whole metre and indicate median, left, or right side of road. The quantity is the number of units required.