Index 544-001 Crash Cushion Details

Design Criteria

AASHTO Roadside Design Guide 4th Edition 2011**; FDOT Design Manual *(FDM)***, *FDM 215*; ***AASHTO Manual for Assessing Safety Hardware, MASH 2016***

Design Assumptions and Limitations

Index 544-001 is only applicable for permanent crash cushion installations which shield the ends of Concrete Barrier and Guardrail.

For general usage information for crash cushions, see ***FDM 215***. For a listing of crash cushion types and the corresponding usage limitations, see the Approved Products List (APL) webpage.

A. Location:

A crash cushion is located by the Crash Cushion Station, which corresponds to the end station of the connecting barrier. See the drawings in ***Index 544-001*** for a depiction of the Crash Cushion Station for guardrail and concrete barrier connections.

Crash cushions are typically placed to shield the ends of barrier systems that are either providing median crossover protection or shielding against a hazard per Part B below.

B. Length of Need:

For positioning crash cushions to shield against hazards, follow the Length of Need (LON) method described in the ***SPI for Index 521-001*** (Concrete Barrier) and the ***SPI for Index 536-001*** (Guardrail). It is assumed that the LON departure line is located at the Crash Cushion Station unless there are constrained conditions per Part F below. For more information, see the drawings in the Excel-based ***Design Tool for Index 521-001*** (Concrete Barrier) and the ***Design Tool for Index 536-001*** (Guardrail).

C. Test Level:

Select the crash cushion's crash-test level based on the following:

- For design speeds ≤ 45 mph, use **TL-2 or TL-3**
- For all other design speeds, use **TL-3**

D. System Width:

Select the crash cushion's system width based on the following:

- For connections to barriers with widths ≤ 2'-0" (i.e. standard concrete barrier and single or double-faced guardrail), use a **Narrow System**
- For connections to barriers with widths > 2'-0", use a **Wide System**

Note: Wide systems should only be used when no other option is available (i.e., wherever possible, reduce the connecting barrier width to ≤ 2'-0").

E. Length of End Treatment – Default Values:

For crash cushions, the Length of End Treatment segment includes all proprietary elements of the design as shown in the APL drawing, including the manufacturer's transition to guardrail if applicable. The downstream end of the Length of End Treatment is located at the Crash Cushion Station per Part A. See the drawings in ***Index 544-001*** for a depiction of the Length of End Treatment.

The as-built Length of End Treatment will vary depending on the contractor's choice of products from the APL. Because of this variability, the default lengths below should be used in the Plans to provide space for any crash cushion chosen by the contractor.

Where there is sufficient space available, select the following default Length of End Treatment:

- For TL-2 Crash Cushions, assume the Length of End Treatment = 27'-6"
- For TL-3 Crash Cushions, assume the Length of End Treatment = 27'-6"

F. Constrained Conditions:

Where conditions of a project do not provide adequate space for the barrier and crash cushion, the overall system length may be reduced with the following methods:

1. Upstream End Restriction – Modify LON Calculation:

   For reducing the required length from the upstream end, adjust the LON calculation so that the "Begin LON" point (i.e. the point where the departure line intersects the barrier system) is located 18 feet upstream of the Crash Cushion Station location per Part A. See Part B for LON calculation details.

2. Downstream End Restriction – Crash Cushion *Length Restriction*:

   For reducing the required length from the downstream end, place a Length Restriction on the location-specific Length of End Treatment. The Length Restriction is used to limit the assumed Length of End Treatment to shorter values which restrict the contractor's choice of end treatments on the APL. In general, the Length Restriction value should still be large enough to accommodate two or more crash cushions on the APL. For additional information, see the Plan Content Requirements below.

G. Short Guardrail Extension:

Where bridge traffic railings require a crash cushion end treatment, it's sometimes necessary to extend the overall barrier system using guardrail. If the required lengths of the standard guardrail transitions to w-beam will not fit or are not practical given project constraints, a simpler Short Guardrail Extension may be used per the details of ***Index 544-001***.

H. Grading:

Meet the requirements of ***FDM 215***. Provide flat (1:10 or flatter) terrain for vehicles approaching a crash cushion, assuming a maximum 15-degree roadway departure angle for errant vehicles. Maintain flat terrain at least 2 feet from the face of the crash cushion on all sides.

I. Bicycle/Pedestrian Design:

Avoid placing crash cushions within 4 feet of bicycle/pedestrian facilities or shared use paths. If this clearance cannot be met due to project constraints, then call for crash cushion models on the APL that do not have exposed, protruding guardrail panel ends/edges on sides closest to these facilities (typically occurs nearest a concrete barrier connection). Additionally, some crash cushions on the APL have pedestrian treatment options which extend and connect the guardrail panels to the concrete barriers, thereby avoiding the protruding metal edge near pedestrians. Where needed, such options may be described in the Plans and called for by make and model. Place the needed instructions in the *Design Notes* column of the *Summary of Permanent Crash Cushions Table*.

J. Temporary Crash Cushions:

For information on Temporary Crash Cushions, see ***FDM 215***, ***Index 102-100***, ***Index 102-110***, and the APL website.

K. Alternative Crash Cushion Usage:

For use of crash cushions not connecting to guardrail or concrete barrier, provide project-specific details showing the crash cushion and hazard being shielded. Provide space for the crash cushion per the APL drawings. Per Part D, select a narrow system or wide system as required to adequately shield the approach face of the hazard.

Plan Content Requirements

Follow the general detailing guidance shown in the ***Standard Plans Instructions for Index 536-001 & 521-001***.

Summary Boxes:

Summarize the following information in the *Summary of Permanent Crash Cushions* table per the ***BOE***, Chapter 8 (include "N/A" for categories that are not applicable):

1. *Location (Station and Side), See the Crash Cushion Station in ***Index 544-001***
2. *Crash Cushion System Width (Narrow or Wide)
3. *Crash Test Level (TL-2 or TL-3, included with Pay Item name)
4. *Barrier Width (Inches)
5. **Length Restriction (Based on site specific space constraints)

Notes:

* Required for all locations.

** Length Restrictions that limit the selection of proprietary products from the APL to only one device (i.e. sole sourcing) is not permitted without approval from the District Design Engineer. Submissions for approval must be completed using the Proprietary Product Certification form (Form: 630-020-07), which can be obtained on the ***FDOT Forms & Procedures*** website.

Place applicable project-specific information in the *Design Notes* column. For example, provide instructions for bicycle/pedestrian needs as described in Part I., above.

Payment

Item number	Item Description	Unit Measure
544-2-1	Crash Cushion, Optional, TL-2 Narrow	EA
544-2-2	Crash Cushion, Optional, TL-2 Wide	EA
544-3-1	Crash Cushion, Optional, TL-3 Narrow	EA
544-3-2	Crash Cushion, Optional, TL-3 Wide	EA

See the ***BOE*** and ***Specification 544*** for additional information on payment, pay item use, and compensation.