Design Update Training 2013

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Agenda

- Design Bulletins
- Index 430
- Permanent Crash Cushions
- PPM, Volume 1 – Chapter 4
- PPM, Volume 1 – Chapter 10
- Key Sheet Revisions
Design Bulletins

2013

- [http://www.dot.state.fl.us/rddesign/](http://www.dot.state.fl.us/rddesign/)
  - 12-05  
    - Crash Cushion Selection, Pay Items and Index 430 Removal.
  - 12-13  
    - Crash Cushion Selection without Extrapolation.
  - 13-01  
    - Index 430 and Exhibit SQ-4.
REQUIREMENTS:

This Design Bulletin suspends the requirements in the Plans Preparation Manual (PPM) Volume 1, Sections 4.5.2 and 10.11.5, and rescinds Design Standard 430. Crash Cushions shall be selected as follows:

1. Crash Cushion performance for both permanent and temporary installations shall be specified as TL-3 for speeds of 60mph or greater. Specifying Crash Cushions based on a specific posted speed or design speed is appropriate for speeds from 30 mph to 60 mph in 5 mph increments. **Extrapolating for speeds above 60 mph will not be allowed.**

2. Only for unusual situations shall a specific Crash Cushion Vendor/Model be specified by plan note. These situations should only be for the geometric uniqueness of the site and the reasons for selecting a specific Crash Cushion brand shall be documented in the project design file.
### Design Bulletins

#### 12-5 cont’ – Pay Item Example

<table>
<thead>
<tr>
<th>544-75- AA Crash Cushion</th>
<th>45 mph or less (TL-2):</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA=40 (Optional)</td>
<td>544-75-50 Crash Cushion TL-2, Optional</td>
</tr>
<tr>
<td>Repairs at cost + 20%</td>
<td>50 mph to 60 mph (TL-3):</td>
</tr>
<tr>
<td></td>
<td>544-75-51 Crash Cushion TL-3, Optional</td>
</tr>
</tbody>
</table>

Supplemental Specification SS54400000 for all projects not meeting the requirements of the Special Provision below.
Recently, the Department has required manufacturers to modify their vendor drawings for both temporary and permanent crash cushions to specify whether the crash cushions are TL-2 or TL-3. TL-2 crash cushions are required on low speed facilities (45 mph or less). TL-3 crash cushions are required on high speed facilities (50 mph or greater). Configurations developed by manufacturers that had FHWA Acceptance Letters for speeds less than 45 mph and for speeds 50 mph to 60 mph were allowed in 5 mph increments. Extrapolating for speeds above 60 mph is no longer allowed. This will be reflected on the revised manufacturers’ vendor drawings.
13-01

- Response to FHWA FAQ
- Released New Index 430
Index 430

Reason for adding the Index

- FHWA - FAQ

2. OUR HIGHWAYS ARE SIGNED FOR 75 MPH. SHOULDN’T WE USE CRASH CUSHIONS THAT HAVE BEEN CRASH TESTED AT SPEEDS HIGHER THAN 100 KM/HR (62.5 MPH)?

A. No. The FHWA Office of Safety considers that a 100 km/hr test is representative of worst case run-off-road crashes.

Early on in the panel discussions related to the NCHRP project for the updating of NCHRP Report 350, there was much discussion involving the need to increase test speeds over the 100 km/h (62.2 mph) maximum speed now used. Based on data available to the research team, it was concluded that regardless of posted speeds, most impacts with fixed objects occurred at somewhat reduced speeds, probably because most drivers are braking hard as they are about to run off the road or into some fixed object. Historically (from FARS data), crash cushions have been directly responsible for very few fatalities and even fewer of these can be attributed directly to inadequate cushion capacity. Granted, a longer cushion will perform better in some head-on full-speed crashes, but the cost-effectiveness of a 70 mph cushion over a 62 mph design is far from clear. FHWA’s position is that highway features tested to Report 350 TL-3 (i.e., 100 km/h) are sufficient, but if any DOT wishes to use longer designs, they may. The best question to ask is whether or not there has been a performance problem with existing installations.
Index 430

History

- Removal of Index 430 from the 2012/2013 Design Standards eBooklet was due to designers/contractors not using it as intended.

- The information in the tables were outdated and limited the contractor to the crash cushions listed in the tables.
Index 430

Reason for adding the Index

- To have a tool for designers and contractors, that provides the minimum design length for a given design speed.

- Provide a plan view and elevation view (typ.) for both guardrail and barrier wall applications with dimension labels.
Index 430

GENERAL NOTES

1. Index 430 is applicable for permanent crash cushion installations that comply with standards of Concrete Barrier Wall of Standard M, 2.
2. Design length is based on the gaps between posts and the standard crash cushion available at the qualified products and input.
3. Per Initial Report/Notice with a Design Status prior to the time, use a Final Crash Cushion.
4. Equipment and facilities Crash Cushion category shall be reviewed. Refer to the FDOT Products Data Sheet Appendix on the qualified products and input.
6. Agency approved, crashworthiness will be reviewed for crushworthiness. Section 2 of the standard specifications for crashworthiness and bridge construction.
7. For additional information, contact the FDOT Products Data Sheet Appendix on the qualified products and input.
8. For additional information, contact the Equivalent Crashworthiness Criteria, reference previous Edition of the Florida DOT crashworthiness Criteria.
9. A qualified crash input should be provided for the crash cushion. Meeting the requirements for the crash cushion will be confirmed with Section 2 of the standard specifications for crashworthiness and bridge construction.

PERMANENT CRASH CUSHION APPLICATIONS

<table>
<thead>
<tr>
<th>Design Length (ft)</th>
<th>Design Speed (mph)</th>
<th>Crash Test Level</th>
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<tbody>
<tr>
<td>5</td>
<td>30</td>
<td>TE-2</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>TE-2</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>TE-2</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td>TE-2</td>
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<tr>
<td>6</td>
<td>70</td>
<td>TE-2</td>
</tr>
<tr>
<td>6</td>
<td>80</td>
<td>TE-2</td>
</tr>
</tbody>
</table>

PERMANENT CRASH CUSHION APPLICATIONS

<table>
<thead>
<tr>
<th>Design Length (ft)</th>
<th>Design Speed (mph)</th>
<th>Crash Test Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>50</td>
<td>TE-2</td>
</tr>
<tr>
<td>10</td>
<td>60</td>
<td>TE-2</td>
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<tr>
<td>10</td>
<td>70</td>
<td>TE-2</td>
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<tr>
<td>10</td>
<td>80</td>
<td>TE-2</td>
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<td>10</td>
<td>90</td>
<td>TE-2</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
<td>TE-2</td>
</tr>
</tbody>
</table>
GENERAL NOTES

1. Index 430 is applicable for permanent crash cushion installations that shield the ends of Concrete Barrier Wall or Guardrail, only.

2. Design Length is based on a given design speed and the shortest Crash Cushion available on the Qualified Products List (QPL).

3. For High Speed Facilities with a Design Speed greater than 60 mph, use a TL-3 Crash Cushion.

4. Assemble and install Crash Cushions according to the limitations noted on the Qualified Products List (QPL) webpage, the manufacturer's specifications, and the applicable crash cushion drawings posted on the QPL.

5. When subjected to reverse direction hits, construct Transition Panels from Concrete Barrier Walls to Crash Cushions; for additional details refer to the applicable crash cushion drawings on the QPL.

6. Galvanize metallic components to meet the requirements for Steel Guardrail, Section 967 of the Standard Specifications for Road and Bridge Construction.

7. For Guardrail Applications, construct the Manufacturer's Transition between the Permanent Crash Cushion and the Standard Guardrail Transition; refer to all Standard Guardrail Transition details of this index.

8. For additional information on the End Measurement for Guardrail Payment, refer to the Standard Specifications for Road and Bridge Construction, Section 536.

9. A yellow Type I Object Marker shall be centered 3' in front of the crash cushion nose. Mounting hardware shall be in conformance with Section 993 of the Standard Specifications for Road and Bridge Construction.

As an option, the contractor may install reflective sheering on the nose of the crash cushion. The sheeting to be used must be solid yellow, Type III or better and must be a product listed on the Department's Qualified Products List (QPL). The sheeting to be applied to the nose of the crash cushion shall be a minimum of 360 square inches with a minimum height of 15 inches.
Index 430
Permanent Crash Cushions

QPL

- Drawings have been updated to match new Index 430.
- Crash Cushion Data Table
- Thrie-beam Transition
- Exhibit SQ-4
# Permanent Crash Cushions

## Crash Cushion Data Table

<table>
<thead>
<tr>
<th>Number of Bays</th>
<th>Model Number</th>
<th>Unit Width</th>
<th>Unit Length</th>
<th>Foundation Length</th>
<th>Design Length</th>
<th>Design Speed</th>
<th>Test Level Designation</th>
<th>Product Specific Data</th>
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</thead>
<tbody>
<tr>
<td>5</td>
<td>ABC - ##</td>
<td>24&quot;</td>
<td>22'-0&quot;</td>
<td>26'-0&quot;</td>
<td>21'-0&quot;</td>
<td>45 mph</td>
<td>TL-2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>XYZ - ##</td>
<td>24&quot;</td>
<td>28'-0&quot;</td>
<td>32'-0&quot;</td>
<td>27'-0&quot;</td>
<td>60 mph</td>
<td>TL-3</td>
<td></td>
</tr>
</tbody>
</table>
PPM Revisions

Chapter 4 – Volume 1 Revision Summary

- Sand barrels are longer an option for Permanent Crash Cushion Applications.

- Section revised to reflect the new requirements for using Index 430.

- Beginning with July 2012 lettings, the designer shall use pay item 544-75-140 (Crash Cushion Optional).
PPM Revisions

Chapter 4 – Volume 1

- The Designer shall no longer specify a particular brand of crash cushion.

Various types of crash cushions and attenuation energy absorbing devices approved eligible for use on Department projects can be found on the Qualified Products List (QPL). Detailed information about these systems is provided in the Design Standards, approved QPL drawings, and in each manufacturer's publications. Each system has its own unique physical and functional characteristics.

For permanent crash cushion applications, the designer shall indicate in the plans either the specific system to be used at each location, or the options that may be used when one or more crash cushion system is suitable at a given location (station and side), barrier system (concrete barrier wall or guardrail), design length, design speed, crash test level, hazard width and all length restriction requirements for each given location (in accordance with Design Standards, Index 430 see PPM, Volume 2, Chapter 7, Exhibit SQ-4).

For site specific conditions, the design engineer of record shall consider the following factors when selecting a system for evaluating each particular site location:

1. Site characteristics.
2. Structural and safety characteristics of candidate systems.
3. Initial and replacement/repair costs.
4. Expected-Anticipated frequency of collisions.
5. Maintenance characteristics.

Site characteristics and economics dictate—dominate the—crash cushion selection consideration. Space constraints and length restrictions shall be identified by the design engineer and shown in the plans. Sand barrels. Some crash cushion systems are relatively low in initial cost, but usually must be completely replaced when struck, so are more...
For permanent crash cushion applications, the designer shall indicate in the plans either the specific system to be used at each location, or the options that may be used when one or more crash cushion system is suitable at the location (station and side), barrier system (concrete barrier wall or guardrail), design length, design speed, crash test level, hazard width and all length restriction requirements for each given location (in accordance with Design Standards, Index 430. see PPM. Volume 2, Chapter 7, Exhibit SQ-4).
## PPM Revisions

Chapter 7, Volume 2 – Exhibit SQ-4

### SUMMARY OF PERMANENT CRASH CUSHIONS

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>BARRIER SYSTEM</th>
<th>DESIGN LENGTH (FT)</th>
<th>DESIGN SPEED (MPH)</th>
<th>CRASH TEST LEVEL (TL-2 / TL-3)</th>
<th>HAZARD WIDTH (IN.)</th>
<th>LENGTH RESTRICTION (FT)</th>
<th>QUANTITY</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>100+64.50</td>
<td>LT/RT</td>
<td>SGL FACE</td>
<td>18.75</td>
<td>60</td>
<td>15.25</td>
<td>N/A</td>
<td>2</td>
<td>Standard Guardrail Transition</td>
</tr>
<tr>
<td>103+77.00</td>
<td>MED</td>
<td>DBL FACE</td>
<td>18.75</td>
<td>60</td>
<td>24.50</td>
<td>N/A</td>
<td>1</td>
<td>Standard Guardrail Transition</td>
</tr>
<tr>
<td>110+45.00</td>
<td>MED</td>
<td>FULL WALL</td>
<td>15.00</td>
<td>60</td>
<td>24.0</td>
<td>23.75</td>
<td>1</td>
<td>Bi-Directional Traffic</td>
</tr>
<tr>
<td>125+25.00</td>
<td>RT</td>
<td>HALF WALL</td>
<td>15.00</td>
<td>70</td>
<td>15.0</td>
<td>N/A</td>
<td>1</td>
<td>Uni-Directional</td>
</tr>
<tr>
<td>775+19.25</td>
<td>RT</td>
<td>BRIDGE WALL</td>
<td>12.50</td>
<td>35</td>
<td>15.0</td>
<td>15.50</td>
<td>1</td>
<td>DRIVE ENTRANCE RESTRICTION</td>
</tr>
<tr>
<td>995+39.25</td>
<td>RT</td>
<td>N/A</td>
<td>9.00</td>
<td>50</td>
<td>69.0</td>
<td>23.50</td>
<td>1</td>
<td>CORE AREA (EXIT RAMP)</td>
</tr>
</tbody>
</table>

**Notes:**
1. The "STATION" is measured to the "LOCATION" of the Downstream End of the Crash Cushion.
2. For Length Restrictions, refer to the Crash Cushion Drawings (Design Length) on the Qualified Product List (QPL).
3. For Additional Information on "Permanent Crash Cushion Applications," see Design Standards, Index 430.
PPM Revisions

Volume 1, Chapter 4, Section 4.5.2 Selection

For future lettings, a pay item has been established for Optional Permanent Crash Cushions, Pay Item No. (2) 544-75-140, beginning with the January 2006 letting. This pay item is applicable ONLY for crash cushions being used to shield the ends of standard concrete barrier wall, standard W-beam guardrail, or three-beam guardrail. Use of this pay item for these locations is not mandatory. The designer may still call for a specific system brand and use the corresponding pay item. However, the reasons for restricting to a specific brand must be documented in the project design file. For crash cushions used to shield hazards other than standard concrete barrier wall, standard W-beam guardrail, or three-beam guardrail, designers must continue to identify the specific constraints to include: design length, hazard width, and system length restrictions. System to be used and use the corresponding pay item, as has been done in the past.

The Optional Crash Cushion pay item is to be used in conjunction with Design Standards, Index 430. Index 430 includes design information for both concrete barrier wall and guardrail applications. In either case, establish the end of the barrier based on the design length of the shortest crash cushion option for a given design speed. Crash cushion length information for each of the crash cushion systems approved for use under this pay item. Designers should note that certain crash cushions may have lengths that exceed the available space and others may have lengths that exceed the available space at a given location. These should be eliminated from the list of options shown in the plans.
The Optional Crash Cushion pay item is to be used in conjunction with Design Standards, Index 430. Index 430 includes design information for both concrete barrier wall and guardrail applications. In either case, establish the end of the barrier based on the design length of the shortest crash cushion option—except for a given design speed—crash cushion length information for each of the crash cushion systems approved for use under this pay item. Designers: For space constraints and length restrictions, designers should note that certain crash cushion options may have lengths that exceed the available space do not provide the proper length of need, and others or may have lengths that exceed the available space at a given do not provide the proper length of need for each location. These should be eliminated from the list of options shown in the plans.
PPM Revisions

Volume 1, Chapter 4, Section 4.5.3

Standard details of systems listed on the QPL for typical installations shielding guardrail ends and concrete barrier wall ends and guardrail ends can be found in on the Design Standards and approved QPL drawings. In addition, some of these systems have standard details for shielding wide hazards. For non-standard applications, crash cushion suppliers normally provide design assistance for their systems. Special designs should be based on providing performance meeting NCHRP 350 crash test criteria for the established design speed of the facility. For special designed inertial systems where the AASHTO Roadside Design Guide charts are used, the maximum average deceleration level should not exceed approximately 7 g's.

All terrain within the likely approach of a vehicle should be relatively flat. An impacting vehicle should strike the unit at normal height, with the vehicle's suspension system neither collapsed nor extended. Curb exceeding 4 inches in height shall not be used in the approach area of a crash cushion.

Care must be taken that the design of a crash cushion system does not create a hazard to opposing traffic.

The nose of all crash cushions shall be delineated with reflective material or standard object markers, as indicated in the Design Standards.

For additional guidance on the design and selection of temporary crash cushions for temporary-use in work zones, see Chapter 10.
Standard details of systems listed on the QPL for typical installations shielding guardrail ends and concrete barrier wall ends and guardrail ends can be found in the Design Standards and approved QPL drawings. In addition, some of these systems have standard details for shielding wide hazards. For non-standard applications, crash cushion suppliers normally provide design assistance for their systems. Special designs should be based on providing performance meeting NCHRP 350 crash test criteria for the established design speed of the facility. For special designed inertial systems where the AASHTO Roadside Design Guide charts are used, the maximum average deceleration level should
PPM Revisions

Volume 1 Chapter 4, Section 4.7

The Qualified Products List (QPL) includes proprietary devices and products that have been evaluated against implemented FDOT Specifications and Standards, and found to meet those Specifications and/or Standards. The majority of proprietary roadside safety devices needed eligible for use on the State Highway System are identified on the QPL. However, just as FDOT Specifications and Standards do not address every potential highway need, the QPL does not cover every type of roadside safety device that may be available on the market. Unique situations will sometimes require unique devices. Examples of available devices that are not covered by FDOT Specifications and Standards include barrier wall gates, aesthetic guard rails, temporary steel barriers, crashworthy stop gates, cable barrier, and others. When the need arises for a unique crashworthy device not covered included on the QPL, the designer must carefully investigate the applicability of the device for the situation, as well as the crash performance characteristics of the device. For some of these devices, the State Roadway Design Office may have information and be of assistance in establishing the appropriateness of the device for a given situation.

The designer must document the following:

1. FHWA Acceptance Federal-Aid Reimbursement Eligibility Letter
2. Crash Test Reports, including review of all test results. All performance characteristics must be reviewed, including post impact vehicle behavior and post impact test article deflection, debris scatter, etc.
3. Compatibility with adjacent and/or connecting standard roadside safety devices.
4. Maintenance requirements and characteristics, including coordination with the District Maintenance Office.
5. For devices such as barrier gates, operational plans and training as appropriate.

The designer will also be responsible for providing special plan details, technical specifications, and method of pay as appropriate.
10.11.5 Temporary Redirective Crash Cushions

Crash cushions are used to protect motorists from the exposed ends of barriers, fixed objects, and other hazards within the clear zone. Approved temporary crash cushions for use on Department contracts are listed on the Qualified Products List (QPL) under Section 102. The designer will determine the need for temporary crash cushions and, if needed, shall complete the following table and include it in the plans:

<table>
<thead>
<tr>
<th>MOT Phase</th>
<th>Station</th>
<th>Offset (feet)</th>
<th>Side (Lt. or Rt.)</th>
<th>Work Zone Regulatory Speed (mph)</th>
<th>Test Level (TL-2 or TL-3)</th>
<th>Width of Hazard (inches)</th>
<th>Restricted Length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* See Design Standard 430 and related IDS.
* The regulatory speed in the work zone shall be established as described in Section 10.13.1.

The designer shall not specify a particular brand of crash cushion. The table above will provide the necessary information for a contractor to choose a suitable crash cushion from those listed on the QPL.

Two types of temporary crash cushions are used: redirective crash cushions and gating crash cushions. Redirective crash cushions will shield hazards by redirecting errant vehicles impacting the side of the crash cushion and decelerate errant vehicles from a direct, in-line impact at the terminus of the crash cushion by absorbing the energy.

Gating crash cushions are non-redirective and are designed only to decelerate errant vehicles from a direct, in-line impact at the terminus of the crash cushion by absorbing the energy. Gating crash cushions are appropriate on low speed facilities and in work zones with higher speeds where only low impact angle hits are expected. An adequate clear runout area shall be provided beyond the gating crash cushion between the departure line and the clear zone. Sand barrel gating systems are no longer allowed.
PPM Revisions

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Key Sheet Revisions
Key Sheet

LIST OF REVISED INDEX DRAWINGS

INDEX NO.    SHEET NO.
11871        1
Key Sheet

GOVERNING STANDARDS AND SPECIFICATIONS:
Florida Department of Transportation, 2013 Design Standards and revised Index Drawings as appended herein, and 2013 Standard Specifications for Road and Bridge Construction, as amended by Contract Documents.

For Design Standards click on the "Design Standards" link at the following web site:
http://www.dot.state.fl.us/rddesign/

For the Standard Specifications for Road and Bridge Construction click on the "Specifications" link at the following web site:
http://www.dot.state.fl.us/specificationsoffice/
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