

## SECTION 536 GUARDRAIL

### **536-1 Description.**

Construct guardrail, including end treatments, transition connections to rigid barrier, and other associated hardware, as specified in the Plans and in accordance with the Design Standards, Index No. 400 series.

Remove existing guardrail as specified in the Plans.

### **536-2 Materials.**

Use components for guardrail, including posts, offset blocks, steel panels, bolts, foundations, barrier delineators, end delineators, rub rail, pipe rail, and approach terminals, in accordance with Section 967.

### **536-3 Construction.**

**536-3.1 Height Tolerance:** Install guardrail panels at the height shown in the Design Standards with a tolerance of 1 inch above and 1/2 inch below the nominal height specified. Where unavoidable surface irregularities, including but not limited to across shoulder gutters, inlets, and roadway surface break lines, are encountered, a tolerance of 3 inches above and 1 inch below the nominal height is permissible.

**536-3.2 Station Location Tolerance:** Where guardrail feature stationing is called out in the Plans, the longitudinal stationing tolerance is plus or minus 3 feet and 1-1/2 inch, unless otherwise restricted by field conditions as determined by the Engineer.

For transition connections to rigid barrier, install the three-beam terminal connector at a 1/4 inch tolerance relative to the end of the rigid barrier as defined in the Plans and Design Standards.

**536-3.3 Setting Posts:** Set posts plumb and to the soil depth shown in the Design Standards. Use the deep post option only where specified in the Plans. Place posts in excavations, backfill the space around the posts, and thoroughly tamp the backfilled soil. As an alternate method, use a post-driving machine meeting the approval of the Engineer.

For guardrail post replacement, backfill and tamp the existing soil hole prior to setting the replacement post.

If driving timber posts, either block out holes in the asphalt pavement during the asphalt paving operation or cut holes through the asphalt mat prior to the post installation. Blocked out or cut holes in the asphalt pavement must be at least 50% larger than the cross-sectional area of the timber post. After driving the posts, patch the area of asphalt around each post with hot bituminous mixture in accordance with Section 339.

If driving steel posts, drive the post directly through the asphalt mat. Fill asphalt depressions or cracks with hot bituminous mixture in a manner meeting the approval of the Engineer.

For post locations where subsurface miscellaneous rock or other solid material is obstructing the post placement, remove such material as follows:

1. If any part of an obstruction is located within 0 and 18 inches in depth, excavate a minimum 24 inch diameter hole around the post location for the full depth of the post, with the back edge of the excavated hole placed a minimum of 15 inches behind the back face of the post.

2. If an obstruction is only located below 18 inches in depth, excavate a minimum 12 inch diameter hole around the post location, for the full depth of the post, with the back edge of the excavated hole placed a minimum of 3 inches behind the back face of the post.

3. Backfill the holes with soil and thoroughly tamp.

**536-3.4 Post Location Conflicts:** When the construction of guardrail at the required post spacing results in post(s) conflicting with sidewalks, gutter, underground utilities, or other permanent obstacles which cannot be removed as determined by the Engineer, the following options are permitted with the approval of the Engineer:

1. Additional Offset Blocks – Up to two additional offset blocks (3 total) may be used where the resulting post placement, moved farther behind the face of guardrail, will avoid a post conflict.

Use button-head bolts of added length as needed to secure the panel system with the rear nut and washer. Where bolts greater than 25 inches are required, a 5/8 inch threaded rod meeting the same material requirements may be substituted and secured with steel hex nuts of over 1-1/8 inches in diameter. Use a steel washer against the post and not the panel. The rod is not permitted to extend beyond 3/4 inch from the face of the tightened nut on the panel side; trim the rod as needed and galvanize in accordance with Section 562.

Over a distance of one post spacing, linearly widen the miscellaneous asphalt pavement where required to maintain a minimum of 10 inches of material behind the post.

2. Special Steel Posts – Where post placement atop a concrete structure cannot be avoided, use special steel posts as defined in the Design Standards and 536-3.6.

3. Encased Posts – Where post placement results in a conflict with an underground utility or obstacle, use the shallower encased post option as defined in the Design Standards where the concrete encasement will not damage a utility.

4. Frangible Leave-Out – Where post placement results in a conflict with a concrete slab, use the frangible leave-out as defined in the Design Standards. Do not use posts through concrete slabs deeper than 8 inches.

**536-3.5 Deep Post:** Mark deep posts on the back face, centered 4 inches below the top edge, with a legible black letter ‘D’ approximately 2 inches vertical by 1 inch horizontal in size. Use a permanent black ink stamp or paint stencil.

**536-3.6 Special Steel Post:** Mount to concrete structures using the following systems.

**536-3.6.1 Adhesive Bonded Anchors:** For concrete structures 9 inches deep and greater, mount the base plate to the concrete using steel adhesive-bonded anchor bolts with a minimum tensile strength of 60 ksi and galvanized in accordance with ASTM A153. Stainless steel components may be substituted, but components plated in accordance with ASTM B-633 are not acceptable. Use adhesive-bonded anchors in accordance with Section 937 and 416 (Type HSHV) and in accordance with the manufacturer’s specification.

Drill holes in concrete, through reinforcing steel if encountered.

Thoroughly clean and dry the holes immediately prior to setting anchors.

At a minimum, meet the following strength capacities:

	Approach Slabs	Other Structures
Min. Tensile Load (Each Anchor)	14,000 lbs	8,000 lbs
Min. Shear Load (Each Anchor)	15,000 lbs	7,800 lbs

**536-3.6.2 Hex-Head Bolt:** For concrete structures less than 9 inches deep, use a 3/4 inch Hex-Head bolt passing through a 7/8 inch drilled hole in the concrete structure and secured from underneath with a washer and nut. The threaded bolt must not protrude more than 3/4 inches beyond the tightened nut; trim the threaded portion as needed and galvanize in accordance with Section 562.

**536-3.7 Steel Panels:** Use straight panels to construct radii of 125 feet or greater. Use fabricated shop-bent panels to accommodate radii of less than 125 feet.

**536-3.8 Panel Slots and Holes:** Use the panel's unaltered, prefabricated slots and holes as shown in the Design Standards. Do not drill, punch, ream, or otherwise alter the prefabricated slots and holes, except when creating new post bolt slots for reduced post spacing (quarter spacing) and adjusting post spacing to avoid structure edge conflicts as shown in the Design Standards. Where required, punch new post bolt slots to the dimensions given in the Design Standards, spaced no closer than 4 inches measured edge to edge from an existing slot. Galvanize new punched slots per Section 562.

**536-3.9 Barrier Delineators:** Mount barrier delineators on top of the guardrail post by adhesive or mechanical means per the manufacturer's recommendations.

**536-3.10 End Delineators:** Install the retroreflective sheeting on the approach face (nose) of approach terminals, trailing anchorages, and controlled release terminal (CRT) end treatments where indicated in the Design Standards. Mount the retroreflective sheeting vertically centered on the approach face by adhesive or mechanical means per the manufacturer's recommendations. Retroreflective sheeting must be a minimum 8 inches in height with a minimum area of 160 square inches for approach terminals and trailing anchorages and 240 square inches for CRT end treatments.

**536-3.11 Rub Rail:** Treat field drilled holes in accordance with Section 562.

Rub rail must terminate at the nearest post outside of the rub rail stationing range indicated in the Plans.

**536-3.12 Pipe Rail:** Treat field drilled holes in accordance with Section 562.

Pipe rail must terminate at the nearest post outside of the pipe rail stationing range indicated in the Plans.

**536-3.13 Existing Guardrail:** Stockpile guardrail, if specified, within the right-of-way at a location approved by the Engineer. Dispose of all remaining guardrail not specified for stockpiling.

**536-3.14 Approach Terminal Assemblies:** Install approach terminal assemblies as specified in the Plans and APL drawings and in accordance with the geometry and adjacent grading of the Design Standards. The APL number must be permanently marked on each assembly at a readily visible location using legible lettering at least 3/4 inch in height.

If the Plans call for a "flared" approach terminal assembly and do not identify the specific system to be used, the contractor has the option to construct any Department-approved "flared" terminal assembly identified on the APL, subject to the conditions identified in the Plans or the APL drawings.

Likewise, if the Plans call for a "parallel" approach terminal assembly and do not identify the specific system to be used, the contractor has the option to construct any Department-approved "parallel" terminal assembly identified on the APL, subject to the conditions identified in the Plans or the APL drawings.

#### **536-4 Certification and Acceptance.**

Submit to the Engineer a certification letter from the manufacturer confirming that all materials used meet the requirements of this Section along with Section 6 and the Design Standards. This letter must list all of the APL items used on the project along with the device-specific APL numbers. Provide this certification at least ten days prior to guardrail construction.

For steel panels and panel components, submit to the Engineer a certified mill analysis meeting the material requirements of Section 967.

For steel posts and steel offset blocks, submit to the Engineer a certified mill analysis from the manufacturer showing the physical and chemical properties of each heat meeting the requirements of ASTM A36, the amount of spelter coating, and galvanization meeting the requirements of ASTM A123.

Submit to the Engineer a certificate of compliance verifying that the guardrail system, materials, and construction practices comply with applicable Design Standards and Specifications.

Acceptance of submitted material will be based on the material certifications, certificate of compliance, and visual inspection by the Engineer.

#### **536-5 Method of Measurement.**

**536-5.1 Guardrail:** The quantity paid for will be the plan quantity, in linear feet, constructed, in place and accepted.

The length of guardrail is measured end-to-end following the centerline of the panels, between the begin/end guardrail stations as defined in the Design Standards and the Plans, including the full lengths of the adjoining end treatments and transition connections to rigid barrier.

**536-5.2 Rub Rail:** The quantity paid for will be the plan length, in linear feet, constructed, in place and accepted.

**536-5.3 Pipe Rail:** The quantity paid for will be the plan length, in linear feet, constructed, in place and accepted.

**536-5.4 Special Guardrail Post:** The quantity paid for will be the number of each, constructed, in place and accepted. Special guardrail posts include deep posts, special steel posts, encased posts, and frangible leave-outs as defined in the Design Standards and indicated in the Plans.

**536-5.5 Bridge Anchorage Assembly/Approach Transition Connection to Rigid Barrier:** The quantity paid for will be the number of each, constructed, in place and accepted.

**536-5.6 Guardrail Post Replacement:** The quantity paid for will be the number of each, replaced.

**536-5.7 Guardrail End Treatment:** The quantity paid for will be the number of each type as designated, constructed, in place, and accepted. Guardrail end treatment types may include parallel or flared approach terminals, Type II trailing anchorages, CRT end treatments, and double faced approach terminals as defined in the Design Standards.

#### **536-6 Basis of Payment.**

**536-6.1 Guardrail:** Price and payment will be full compensation for all work specified under this Section, except those items specified in 536-6.2 through 536-6.7. Price and payment includes furnishing and installing posts, panels, barrier delineators, offset blocks, and all other materials as defined in the Plans and the Design Standards. The price and payment will include

any reduced post spacing, nested panels, shop-bent panels, trailing end transition connections to rigid barrier, and CRT posts as required in the Plans.

The type of guardrail specified will be that which comprises the guardrail run between end treatments and transition connections to rigid barrier (including, but not limited to, w-beam general, w-beam double face, w-beam low-speed, modified thrie-beam). For guardrail systems with direct connections between end treatments and transition connections to rigid barrier, the type of guardrail specified will be w-beam for single face guardrail applications or double faced for double face guardrail applications.

**536-6.2 Rub Rail:** Price and payment will include all components specified in the Plans and Design Standards.

**536-6.3 Pipe Rail:** Price and payment will include all components specified in the Plans and Design Standards. Pipe rail will be shown and tabulated in the Plans for the condition that steel posts are installed at the indicated pipe rail location, however the pipe rail is not required if the timber post option is selected and installed at the indicated pipe rail location.

**536-6.4 Special Guardrail Post:** Price and payment will include all costs for furnishing and installing special guardrail posts that are in addition to the cost of items included in 536-6.1, where special guardrail posts are installed instead of standard posts.

**536-6.5 Bridge Anchorage Assembly/Approach Transition Connection to Rigid Barrier:** Price and payment will include all costs for furnishing and installing all hardware for approach transition connections to rigid barrier per the Design Standards that are in addition to the cost of items included in 536-6.1. This includes costs for the concrete alignment curb and its transition where shown in the Design Standards and barrier delineators for existing post and beam bridge railings.

**536-6.6 Removal of Existing Guardrail:** Price and payment will include all labor and equipment required for removal and disposition of the existing guardrail as specified in the Plans. No additional payment will be made for the removal of transition connections, double faced guardrail, thrie-beam guardrail, nested panels, pipe rail, rub rail, or end terminals.

**536-6.7 Guardrail End Treatment:** Price and payment will include all costs for furnishing and installing all guardrail end treatment assemblies specified in the Plans that are in addition to the cost of items included in 536-6.1.

**536-6.8 Payment Items:** Payment will be made under:

Item No. 536- 1-	Guardrail - per foot.
Item No. 536- 5-	Rub Rail - per foot.
Item No. 536- 6-	Pipe Rail - per foot.
Item No. 536- 7-	Special Guardrail Post - each.
Item No. 536- 8-	Bridge Anchorage Assembly/Approach Transition Connection to Rigid Barrier - each.
Item No. 536- 73-	Removal of Existing Guardrail - per foot.
Item No. 536- 85-	Guardrail End Treatment - each.