

## **Section 2505. Guardrail Construction and Removal**

### **2505.01 DESCRIPTION.**

Construct guardrail. Remove existing guardrail.

### **2505.02 MATERIAL.**

Provide guardrail materials meeting the requirements for the type of guardrail specified. Provide guardrail posts of wood or steel as specified in the contract documents.

#### **A. Formed Steel Beam Guardrail and Low Tension Three Strand Cable Guardrail.**

Apply Section 4155.

#### **B. High Tension Cable Guardrail.**

1. Meet the manufacturer's materials requirements. For concrete foundations for posts and end anchors, use Class C mix according to Section 2403.
2. Supply spare parts kits for high tension cable guardrail consisting of:
  - An extra supply of line posts (socketed-type), including post hardware and accessories (caps, reflective sheeting, straps, spacers, and socket covers). This supply is to include enough materials to complete a 300 foot (90 m) installation.
  - An extra supply of anchor posts (socketed-type), including post hardware and accessories (caps, reflective sheeting, straps, fittings, spacers, and socket covers). This supply is to include enough materials to complete one end anchor installation.
  - Specialized tools necessary to maintain the guardrail, such as a spreader tool.
3. Spare parts kits do not include a tension meter. Deliver spare parts kit to Contracting Authority's nearest maintenance office.

### **2505.03 CONSTRUCTION AND REMOVAL OF GUARDRAIL.**

Furnish and install posts, beams or cables, end anchors, and special connections and fittings required in the contract documents. Install to the specified line and mounting height. Changes in the installed length require the Engineer's approval.

#### **A. Steel Beam Guardrail and Low Tension Cable Guardrail.**

##### **1. Steel Beam Guardrail.**

- a. Install w-beam or thrie-beam as designated in the contract documents. When not designated, install w-beam.
- b. Use steel beam guardrail ready for assembly when delivered to the project. Do not punch, drill, cut, or weld beam in the field.
- c. Steel beam guardrail elements may be furnished in either 25 foot (7.62 m) or 12.5 foot (3.81 m) nominal length sections.
- d. Straight rail sections may be used to construct radii of 150 feet (45 m) or greater. Shop curve rail sections for radii less than 150 feet (45 m).
- e. Install posts for steel beam guardrail at spacing identified in the contract documents. If not defined, use 6.25 foot (1.91 m) spacing.
- f. Where necessary, adjust horizontal and vertical alignment of the guardrail to account for road curvature. Use minor adjustments with no abrupt changes.
- g. Fully connect beam to all posts as shown in the contract documents. For W-beam guardrail installations with wood blockouts, nail the blockout to the post to prevent blockout rotation. Other methods of preventing rotation may be approved by the Engineer.

##### **2. Low Tension Cable Guardrail.**

- a. Attach the cables to the posts and end anchors according to the contract documents. Attach compensation devices and turnbuckles so as not to interfere with the function of any part of the installation.
- b. Individual cables may be spliced by use of an approved device installed where no interference with any other function will occur. One splice per cable is allowed. Cable may not be spliced within 250 feet (75 m) of another splice in one of the other cables.

- c. Tighten individual cables using mechanical means. Stretch cables tight so that no sags occur between posts and so that, in the opinion of the Engineer, the finished installation presents a satisfactory appearance.

### **3. Posts.**

- a. Drive posts in a manner that does not damage the post. Place backfill material (consisting of material removed or other suitable soil) around posts required to be set in prebored holes. Place the backfill material in lifts not exceeding 4 inches (100 mm). Thoroughly compact each lift before the next lift is placed.
- b. Install the posts to be firm, plumb, and at the location, spacing, and elevation designated.

### **4. End Anchors and Terminals.**

- a. Install end anchors and terminals of the type shown in the contract documents. Cast end anchors in place using Class C concrete according to Section 2403, except air content may vary from 4% to 7%. Finish exposed concrete as directed by the Engineer.
- b. When bolt holes in concrete bridge end posts or concrete barrier do not align correctly for the steel beam guardrail terminal connection, drill new bolt holes in the locations required for the terminal connection. Use a core bit to ensure correct bolt hole location and alignment.

### **5. Guardrail Markers.**

When indicated in the contract documents, install guardrail markers of the required type meeting the requirements of Article 4186.12.

### **6. Delineators and Object Markers.**

When indicated in the contract documents, install delineators and object markers of the required type meeting the requirements of Articles 4186.11 and 4186.12.

## **B. High Tension Cable Guardrail.**

Furnish high tension cable guardrail from the approved products listed in Materials I.M. 455.01.

### **1. Installation of High Tension Cable Guardrail.**

- a. Install high tension cable guardrail according to the manufacturer's recommendations. Prior to construction, provide the Engineer with three copies of the manufacturer's most current product manuals covering installation and maintenance of the installation. Include signed certification statements that all materials to be incorporated into the installation comply with Materials I.M. 455.01.
- b. Tension the cables according to the manufacturer's recommendations at the time of installation, then check and adjust the tension approximately three weeks after installation.

### **2. Posts.**

- a. Ensure posts are plumb and at the manufacturer's recommended location, spacing, and elevation. Spacing is not to exceed 20 feet (6 m).
- b. Furnish "socketed" type posts and install in reinforced concrete foundations. Cast the foundations in place according to Article 2505.03, A, 4. Use the dimensions and reinforcement recommended by the manufacturer, except with a foundation depth of at least 42 inches (1.1 m).

### **3. End Anchors.**

- a. Incorporate one of the approved end anchors listed in Materials I.M. 455.01. Furnish end anchors produced by the same manufacturer of the high tension cable guardrail.
- b. Construct end anchors according to the manufacturer's recommendations for the site specific soil conditions. Soils testing required is incidental to the cable installation.

### **4. Delineating High Tension Cable Guardrail.**

- a. Delineate high tension cable guardrail installations using retroreflective sheeting. Apply the sheeting to the last five posts at each end of an installation and throughout the remainder of the installation at a maximum spacing of 50 feet (15 m). Apply Type III or IV retroreflective sheeting that:
  - Meets the requirements of Article 4186.03,
  - Provides at least 7 square inches (4500 mm<sup>2</sup>) of surface area when viewed from a line parallel to the roadway centerline, and

- Is yellow or white and of the same color as the adjacent edge line.
- b. Attach sheeting near the top of the post: 1) in a manner recommended by the manufacturer; and 2) to that side of the post from which vehicle impacts are most likely. For installations where impacts are likely to occur from either side, apply the sheeting to both sides of the post.

### **C. Guardrail Removal.**

1. Remove guardrail, delineators, and object markers as shown in the contract documents. Guardrail materials become the property of the Contactor unless stated otherwise in the contract documents. Deliver salvaged materials to the location stated in the contract documents. Salvaged materials become the property of the Contracting Authority. Remove non-salvaged materials from project site.
2. Carefully remove, disassemble, and clean the salvaged guardrail without damaging the parts. Replace material damaged during removal, disassembly, or cleaning with new material of the same kind (at no cost to the Contracting Authority). Stockpile salvaged materials as indicated in the contract documents. Restore areas disturbed by the removal operation to an acceptable condition.
3. Place backfill material consisting of suitable soil in post holes. Sand or other granular materials are not acceptable for use as backfill material. Place backfill material in lifts not exceeding 4 inches (100 mm). Thoroughly compact each lift before the next lift is placed. Fill and tamp holes within the same working day.

### **D. Limitations.**

1. **General.**
  - a. Do not stress attachments to new concrete or to bolts set in epoxy resin until the new concrete or epoxy resin has attained an age of 3 calendar days. Concrete foundations for posts and end anchors may be subjected to cable tensioning after 3 calendar days. These time requirements may be lengthened by the Engineer during cool weather.
  - b. Complete grading work, if required, prior to removal of existing guardrail or installation of new guardrail.
  - c. When a roadway is open to traffic during construction, complete guardrail installations within 5 working days from the day the structure, barrier rail, pavement, or shoulder (whichever is the controlling item of work) is sufficiently completed to allow guardrail installation. Each installation exceeding the 5 working day completion requirement will be subject to a contract price adjustment of \$100 per working day. For high tension cable guardrail, this price adjustment will be waived when the installation serves as crossover protection only and no guardrail or concrete barrier has been removed.
  - d. When a roadway is closed to public traffic for construction, complete all guardrail installations before opening the road to traffic.
2. **Steel Beam Guardrail and Low Tension Cable Guardrail.**
  - a. In areas where guardrail construction is not restricted by other construction, remove existing guardrail (if any) and construct new guardrail, except for end anchors requiring concrete, on the same working day. Place concrete for the final end anchor no later than the next working day.
  - b. For steel beam guardrail installations requiring end anchors, use a Type E Terminal Section, a Type II Barricade, and a Type A Warning Light to end the installations until the final anchor is finished.
3. **High Tension Cable Guardrail.**
  - a. In case of a discrepancy between these Specifications and the manufacturer's recommendations, these Specifications will govern.
  - b. At locations where the proposed guardrail installation does not interfere with the functioning of the existing guardrail, do not remove the existing guardrail until the high tension cable guardrail system is fully functional. Once the installation is fully functional, remove existing guardrail within 5 working days.

#### **2505.04 METHOD OF MEASUREMENT.**

Measurement will be as follows:

##### **A. Steel Beam Guardrail Installation.**

- 1. Steel Beam Guardrail.**  
Linear feet (meters) shown in the contract documents.
- 2. Steel Beam Guardrail Barrier Transition Section.**  
By count.
- 3. Steel Beam Guardrail End Anchors.**  
By count for each type of end anchor constructed. Installations continued across a bridge will not be counted as end anchors.
- 4. End Terminals.**  
By count for each type of end terminal constructed.

##### **B. Low Tension Cable Guardrail Installation.**

- 1. Low Tension Cable Guardrail.**
  - a. Linear feet (meters) shown in the contract documents.
  - b. Length will be calculated using one of the cables of cable guardrail, with no deductions for turnbuckles or compensating devices.
- 2. Low Tension Cable Guardrail, End Anchors.**  
By count.

##### **C. High Tension Cable Guardrail Installation.**

- 1. High Tension Cable Guardrail.**
  - a. Linear feet (meters) shown in the contract documents.
  - b. Length will be calculated as the protection length, not including lengths of end anchors.
- 2. High Tension Cable Guardrail, End Anchor.**  
By count.
- 3. High Tension Cable Guardrail, Spare Parts Kit.**  
By count for the number of spare parts kits delivered.

##### **D. Removal of Guardrail.**

- 1. Steel beam guardrail:** linear feet (meters) to the nearest 0.5 foot (0.1 m) by measuring along the front of the rail from bolt hole to bolt hole.
- 2. Cable guardrail:** in linear feet (meters) to the nearest 1 foot (0.1 m) by measuring along the front of one of the cables with no deductions for turnbuckles or compensating devices.

#### **2505.05 BASIS OF PAYMENT.**

Payment for guardrail items will be the contract unit price as described below. Payment includes furnishing all materials, equipment, tools, and labor necessary to complete the removal and installation of the guardrail, including excavation and placing backfill. However, excavation in unexpected rock will be paid for as extra work according to Article 1109.03. Unexpected rock will be considered as rock encountered during excavation that was not visible from the roadway and was not indicated in the contract documents.

##### **A. Steel Beam Guardrail Installation.**

- 1. Steel Beam Guardrail.**
  - a. Per linear foot (meter).
  - b. Payment for nested steel beam guardrail will be included in the contract unit price.
  - c. Posts, spacer blocks, object markers, delineators, guardrail markers, barrier markers, offset brackets, and remaining hardware are incidental.

**2. Steel Beam Guardrail Barrier Transition Section.**

- a. Each.
- b. Payment for nested steel beam guardrail will be included in the contract unit price.
- c. Posts, spacer blocks, object markers, delineators, guardrail markers, barrier markers, offset brackets, and remaining hardware are incidental.

**3. Steel Beam Guardrail End Anchors.**

- a. Each for the type of end anchor constructed.
- b. Payment for nested steel beam guardrail will be included in the contract unit price.
- c. Drilling new bolt holes for guardrail connection is incidental.

**4. End Terminals.**

- a. Each for the type of end terminal constructed.
- b. Payment for nested steel beam guardrail will be included in the contract unit price.
- c. Posts, spacer blocks, object markers, delineators, guardrail markers, offset brackets, and remaining hardware are incidental.

**B. Low Tension Cable Guardrail Installation.**

**1. Low Tension Cable Guardrail.**

- a. Per linear foot (meter).
- b. Posts, spacer blocks, object markers, delineators, guardrail markers, barrier markers, offset brackets, hook bolts, turnbuckles, compensating devices, concrete, and remaining hardware are incidental.

**2. Low Tension Cable Guardrail, End Anchor.**

Each.

**C. High Tension Cable Guardrail Installation.**

**1. High Tension Cable Guardrail.**

- a. Per linear foot (meter).
- b. Posts and accessories required by the manufacturer, additional hardware and concrete, and grading required to meet cable height tolerance are incidental.

**2. High Tension Cable Guardrail, End Anchor.**

Each. Grading required to meet the manufacturer's recommendations is incidental.

**3. High Tension Cable Guardrail, Spare Parts Kit.**

Each. Payment is full compensation for delivering spare parts kit to the location identified in the contract documents.

**D. Removal of Guardrail.**

- 1. Per linear foot (meter) for removal of guardrail, including steel beam guardrail, cable guardrail, end anchors, and terminal devices.
- 2. Payment includes hauling salvaged material to the stockpile site. Placing backfill material around posts and in end anchor footing holes is incidental.
- 3. Payment for nested steel beam guardrail will be included in the contract unit price.
- 4. Posts, spacer blocks, object markers, delineators, guardrail markers, offset brackets, end anchors, terminal devices, and remaining hardware are incidental.
- 5. For low tension cable guardrail, the following additional items are incidental: hook bolts, turnbuckles, compensating devices, and remaining hardware.