

1.1. SUPPLEMENTAL SPECIFICATION 2.11, HIGH TENSION CABLE BARRIER

2.11 HIGH TENSION CABLE BARRIER

2.11.1 GENERAL

This Work consists of the supply, installation, removal, disposal and reinstallation of High Tension Cable Barrier (HTCB) system.

2.11.2 DEFINITIONS AND INTERPRETATION

2.11.2.1 **Section**

A “section” of HTCB shall mean the length of the HTCB from one anchor end terminal to another anchor end terminal.

2.11.2.2 **Sleeve/Socket**

Where the term “sleeve” or “socket” is used in this Specification, the meaning is the same.

2.11.2.3 **Test Level**

“Test Level” shall mean the designation prescribed to a HTCB system or system component by the Transportation Research Board *National Cooperative Highway Research Program (NCHRP) Report 350* and the American Association of State Highway and Transportation Officials *Manual for Assessing Safety Hardware (MASH) 2009*.

2.11.3 STANDARDS OF REFERENCE

All materials supplied shall refer to the following standards or specifications:

Canadian Standards Association (CSA):

CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

American Society for Testing and Materials (ASTM):

ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM F2329/F2329M – Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

ASTM D4956 – Standard Specification for Retroreflective Sheeting for Traffic Control

2.11.4 MATERIALS

When the Contract specifies “Supply and Install” or “Supply”, all materials shall be new in accordance with the manufacturer’s specifications. All hardware shall be in accordance with the

manufacturer's recommendations. The HTCB system shall be on the Alberta Transportation Product List unless otherwise specified in this Specification and used as per the conditions of the Product List. The HTCB system shall be a four-cable system from a single manufacturer and of a single system type. Intermixing different types of line posts, turnbuckles, line post sockets, cable splices, and other components is prohibited.

When the Contract specifies "Remove and Reinstall" or "Remove and Dispose" all materials shall be inspected and identified for reinstallation or disposal, in writing by the Consultant. Components used for reinstallation shall be unbent, undamaged, galvanized, and rust free in their present condition. Reinstallation shall be in accordance with the manufacturer's specifications.

All steel components of the HTCB system are to be galvanized, in accordance with the manufacturer's specifications. The application of zinc-rich coatings shall be in accordance with ASTM A123/A123M and ASTM F2329/F2329M.

The Contractor shall supply Portland Cement Concrete in accordance with Specification 5.5, Supply of Portland Cement Concrete of the *Standard Specifications for Highway Construction*. All concrete shall be constructed of Type HS sulphate resistant cement and shall meet the requirements for Class C concrete in accordance with Specification 5.5, Supply of Portland Cement Concrete.

2.11.4.1 **Line Posts and Terminal Posts**

The line posts and terminal posts shall be inserted in cast-in-place concrete or in driven steel sleeves.

If the HTCB system has the option of a low-density polyethylene excluder (gasket), profiled to fit tightly around the post to prevent debris from entering the socket, it shall be installed for all line posts and terminal posts.

2.11.4.2 **End Terminal Anchors**

The end terminal anchors shall be cast-in-place, steel reinforced concrete or driven galvanized structural steel in accordance with CSA G40.20/G40.21 Grade 350W. Each of the four cables of the barrier system shall have independent connections to the end terminal anchor or separate anchors.

The end terminal anchor design must meet one of the following conditions:

- a) The end terminal anchor design must be on the Alberta Transportation Product List; or
- b) For driven galvanized structural anchors not on the Alberta Transportation Product List, the size and depth of anchor foundations shall be as recommended and designed by the manufacturer, shall meet or exceed the requirements of the FHWA acceptance letter and shall meet or exceed the following minimum dimensions:
 - i. Where end terminal anchors are placed in an existing or new roadway embankment: Hollow Structural Section (HSS) 200x200x9, 5000 mm depth

- ii. Where end terminal anchors are placed outside of the existing or new roadway embankment: HSS 200x200x9, 6000 mm depth

If bedrock is encountered before the above-noted minimum depths are reached, the Contractor shall provide an alternate anchor design, authenticated by a Professional Engineer registered to practice in the Province of Alberta and approved by the manufacturer; or

- c) Where the Contractor requests the use of anchor foundations not on the Alberta Transportation Products List, the use of a driven galvanized structural steel design with dimensions less than the minimums specified or the use of a cast-in-place, steel-reinforced concrete anchor foundation, the Contractor shall provide an anchor design, authenticated by a Professional Engineer registered to practice in the Province of Alberta and approved by the manufacturer.

2.11.4.3 **Cables**

Cables are to be pre-stretched, post-tensioned, galvanized wire rope in accordance with the manufacturer's recommendations.

2.11.4.4 **Transition to W-Beam Guardrail**

Transition to W-Beam Guardrail shall be as recommended and designed by the manufacturer and shall be consistent with the United States Federal Highway Administration acceptance letters.

2.11.4.5 **Retroreflective Sheeting**

The reflector shall meet the requirements of ASTM D4956 for Type IX or XI sheeting at a minimum size of 102 mm x 76 mm.

2.11.5 **CONSTRUCTION**

2.11.5.1 **Prior to Construction**

Geotechnical testing (soil testing) and site specific engineering design is not required for products (line posts, terminal posts and anchor systems) listed on the AT Products List except in the following cases:

- 1) Where it is a replacement of an existing HTCB where the existing anchors were distressed, heaved or displaced a significant amount (as identified by the Consultant); or
- 2) Unusual foundation conditions are anticipated, such as areas where obvious rock exposures are present (rock cuts) or wet and soft areas (muskeg).

2.11.5.2 **Submittals**

2.11.5.2.1 **Prior to Construction**

At least three weeks prior to installation of the HTCB system, the Contractor shall provide to the Consultant two copies of the following documentation:

- Manufacturers' drawings and construction drawings.

- The manufacturer’s published specifications and requirements, installation manual and maintenance manual.
- Certified calibration certificate for the cable tension testing equipment to be used.
- Copy of the proposed Cable Tension Log. At a minimum, the Cable Tension Log shall include the information on the Alberta Transportation HTCB Tension Log (Sample Form).
- Portland cement concrete details, including the proposed mix design, in accordance with Section 5.5 of the *Standard Specifications for Highway Construction*.
- Certificate of training for trained installation personnel.

2.11.5.2.2 During Construction

During installation of the HTCB system, the Contractor shall provide to the Consultant, on a weekly basis, a copy of all interim and completed Cable Tension Log reports signed by a trained Contractor’s representative.

2.11.5.2.3 Prior to Acceptance

The Contractor shall provide to the Consultant final copies signed by a trained Contractor’s representative of the Cable Tension Log reports prior to acceptance of the HTCB system.

2.11.5.3 **General**

The HTCB system shall be installed as per the manufacturer’s recommendations and specifications. In the case of end terminal anchors in Section 1.1.4.2 b) and c), the system shall be installed as directed by the Consultant. The installation shall be completed by a Contractor trained by the manufacturer to complete the Work.

If using cast-in-place concrete for the line post sockets, terminal post sockets or end terminal anchors, the cast-in-place concrete shall be cast against the excavation walls.

Line post spacing shall be according to the manufacturer’s specifications for the required design dynamic deflection as detailed in the Special Provisions, or as shown on the plans, or as directed by the Consultant. The maximum allowable dynamic deflection shall be 2.45 m. The maximum allowable spacing between line posts shall be 6.1 m.

Line posts shall be installed plumb. Line post plumb shall be measured as the horizontal deviance from the top of the socket to the top of the line post; the tolerance for horizontal deviance shall be 1% of the line post height (as measured from the top of socket to the top of line post).

Cable height tolerances shall be as per the manufacturer’s recommendations.

The cable shall be tensioned immediately after installation. The Contractor shall recheck the cable tension three weeks after the initial tensioning and adjust the tension, if necessary, to meet the manufacturer’s tension requirements. This rechecking shall be documented in the Cable Tension Log.

All surplus excavated material resulting from the installation of the HTCB system will become the property of the Contractor and shall be removed from the highway right-of-way to a disposal site obtained by the Contractor and acceptable to the Consultant. The cost for excavation and disposal of all surplus excavated material will be considered incidental to the Work.

The HTCB system shall be delineated with permanent retroreflective sheeting. Retroreflective sheeting shall be applied near the top of line posts, throughout the barrier system at a maximum spacing of 15.0 m or every fourth post, whichever is less; with the exception that the sheeting shall be applied to each of the last five posts at each end of an installation run, including the crashworthy end terminal.

For both median and shoulder installations, the sheeting shall be applied on both sides of the post (to be visible to both oncoming and opposing traffic). The sheeting shall be white or fluorescent yellow and shall match the colour of the adjacent pavement markings.

2.11.5.4 Remove and Reinstall or Remove and Dispose

Prior to disassembling an existing HTCB system, the Contractor shall confirm with the Consultant the quantities of each HTCB component to be reinstalled or disposed of as specified on the plans, or as directed by the Consultant.

The Contractor shall carefully disassemble the existing HTCB system in a manner which minimizes the potential for damage to the system components. The Contractor shall obtain the Consultant's acceptance for the method of removal and prior to cutting any cables.

The Contractor shall reinstall or dispose of all above-ground HTCB components as identified on the plans or as directed by the Consultant.

Unless otherwise specified, below-ground HTCB components (sockets and foundations) are not to be removed. Following removal of all above-ground HTCB components, the Contractor shall drive all sockets flush with the ground and backfill them with a non-shrinkable material acceptable to the Consultant. The driving and backfilling of sockets will be considered incidental to the Work.

Where the Contract calls for reinstallation of HTCB system, the Contractor shall supply and install new driven post sockets or cast-in-place sockets, new driven end terminal sockets or cast-in-place end terminal sockets and new end terminal anchors and all other related hardware necessary to provide a fully functional barrier system.

Unless otherwise specified, all components identified for disposal shall become the property of the Contractor. The Contractor shall dispose of the components identified for disposal in a manner acceptable to the Consultant.

Where the existing galvanized coating on items for reinstallation is damaged either in-service prior to removal or during installation by the Contractor, those damaged areas shall be prepared and coated with two applications of a zinc-rich coating from the Alberta Transportation Products List and acceptable to the Consultant prior to re-installation. Touch-ups to the cable will be applied post tensioning. Preparation of the steel, supply and application of the zinc-rich coatings shall be considered incidental to the reinstallation.

Line post spacing and end terminal post spacing shall be as designated in the Special Provisions, or as shown on the plans, or as directed by the Consultant. If the HTCB system has

the option of a low-density polyethylene excluder (gasket), all re-installed line post sockets and end terminal post sockets shall be fitted with a gasket, profiled to fit tightly around the post to prevent debris from entering the socket. Supply and installation of this gasket shall be considered incidental to the reinstallation.

2.11.6 WARRANTY

Notwithstanding General Specification 1.2.53, Contractor's Warranty and Final Acceptance, the warranty shall apply in the event that there is a failure of the barrier system to function as intended (for example, an inability to hold the required tension) or in the event that end terminal anchor movement exceeds 50 mm (horizontal or vertical, as measured at the end of the cable anchor base plate).

2.11.7 PROVISION OF BARRIER REPAIR TRAINING

The Contractor shall arrange and pay for the barrier manufacturer to provide training for the maintenance contractor staff for the repair of the barrier system. This training shall be provided in person by a representative of the barrier manufacturer at the maintenance contractor's yard or on the barrier installation site. The training is to be provided no later than one week after the start of the barrier installation. This training is considered incidental to the Work and no additional or separate payment will be made.

2.11.8 SUPPLY OF TENSION MEASURING DEVICE

If specified in the Special Provisions, the Contractor shall supply a calibrated tension measuring device (as specified by the manufacturer) for the HTCB system to the Department's maintenance contractor before the completion of the first section of barrier is installed. The Contractor shall deliver the tension measuring device to the nearest Alberta Transportation maintenance contractor's yard, or to a location as directed by the Consultant.

2.11.9 MEASUREMENT AND PAYMENT

Damage to galvanized components shall be repaired prior to installation unless stated otherwise in Section 1.1.5.4 and to the satisfaction of the Consultant and will be considered incidental to the Work.

The supply and installation or reinstallation of retroreflective sheeting will be considered incidental to the Work.

2.11.9.1 **Supply and Install**

2.11.9.1.1 Line Post Section

Measurement for the supply and installation of the line post section of the HTCB system within the designed "length of need" (as shown on Dwg. No. RDG-B2.5 of the Alberta Transportation Roadside Design Guide, November 2007), will be by the lineal metre of HTCB system installed, excluding end terminals and transition sections to W-Beam guardrail.

Payment for the supply and installation of the line post section of the HTCB system will be made at the unit price bid per lineal metre for "HTCB – Supply and Install" at the specified Test Level and specified design dynamic deflection. The price bid will be considered full compensation for

all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant. Additional posts needed to avoid utilities and obstacles are considered incidental to the Work.

2.11.9.1.2 End Terminals

Measurement for the supply and installation of End Terminals (Crashworthy) will include all HTCB system components, including the end anchor foundation which is outside of the designed “length of need” (as shown on Dwg. No. RDG-B2.5 of the Alberta Transportation Roadside Design Guide, November 2007), and will be by the number of end terminals installed. An end terminal with one or several individual anchors is considered to be one terminal for payment purposes.

Payment for the supply and installation of End Terminals (Crashworthy) will be made at the unit price bid per unit for “HTCB End Terminal (Crashworthy) – Supply and Install”. The price bid will be considered full compensation for all the labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.11.9.1.3 Transition to W-Beam Guardrail

Measurement for the supply and installation of transitions to W-Beam guardrail will be by the number of transitions installed (as shown on Dwg. No. RDG-B2.6 of the Alberta Transportation Roadside Design guide, November 2007).

Payment for the supply and installation of transitions will be made at the unit price bid per unit for “HTCB Transition to W-Beam – Supply and Install” at the specified Test Level, as per the manufacturer’s specifications by the number of transitions installed. The price bid will be considered full compensation for all the labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant. This payment by lump sum for the transitions to W-Beam guardrail shall be the full compensation for all the labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.11.9.2 **Supply**

2.11.9.2.1 Supply of Tension Measuring Device

Measurement and payment for the supply of a tension measuring device will be made at the lump sum price bid for “Supply of HTCB Tension Measuring Device”. The price bid will be considered full compensation for all the labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.11.9.3 **Remove and Dispose**

2.11.9.3.1 Remove and Dispose of HTCB

Measurement for the removal and disposal of barrier will be in lineal metres of barrier system removed and disposed from end of anchor to end of anchor. All removed materials shall become the property of the Contractor.

Payment will be made at the unit price bid per lineal metre for “Remove and Dispose of HTCB” inclusive of line post sections, end terminals and transitions to W-Beam or Thrie Beam

guardrail. The price bid will be considered full compensation for all the labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.11.9.4 **Remove and Reinstall**

2.11.9.4.1 Remove and Reinstall HTCB

Measurement for the removal and reinstallation of barrier will be in lineal metres of barrier system removed and reinstalled from end of anchor to end of anchor.

Payment will be made at the unit price bid per lineal metre for "Remove and Reinstall HTCB" at the specified Test Level and specified design dynamic deflection. This payment will be full compensation for the removal and reinstallation of all the above-ground components of the salvaged barrier and end terminals, the supply and installation of new driven post sockets or cast-in-place sockets and the supply and installation of new driven end terminal sockets or cast-in-place end terminal sockets and new end terminal anchors and all other related hardware necessary to provide a fully functional barrier system. The price bid will be considered full compensation for all the labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

