MICHIGAN

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

FOR

**GIBRALTAR TL-4 HIGH-TENSION CABLE BARRIER WITH DRIVEN SOCKETS AND DRIVEN CABLE TERMINALS**

MAC:SNK 1 of 13 APPR:CT:DBP:06-01-21

**a. Description.** This work consists of constructing three-cable, Gibraltar TL-4 high-tension cable barrier (HTCB), with driven sockets and driven cable terminals, manufactured by Gibraltar Global, LLC, as shown on the plans. HTCB systems made by other manufacturers are prohibited when HTCB is measured as specified in this special provision. Complete this work in accordance with manufacturer’s details and specifications, and this special provision. If the requirements of this special provision conflict with the requirements of the manufacturer’s details, comply with the requirements of this special provision.

**b. Materials.** Furnish materials in accordance with the manufacturer’s specifications and this special provision. Provide written certification to the Engineer stating that the materials used to construct the HTCB system and end terminals meet manufacturer’s specifications and this special provision.

Provide manufacturer’s written certification to the Engineer indicating that all components supplied by the manufacturer meet manufacturer’s specifications and this special provision.

Provide all HTCB and end terminals of the same type from Gibraltar Global, LLC; do not intermix or overlap different HTCB types. HTCB systems made by other manufacturers are prohibited. Provide all line posts of the same type; do not intermix different types of line posts. Ensure that the end terminals are compatible with the HTCB system installed.

The HTCB must meet or exceed *NCHRP 350, Test Level 3 (TL-3)* or *MASH, TL-3* when installed on a slope with an inclination of 1:4 (1 Vertical on 4 Horizontal). The HTCB must also meet or exceed *NCHRP 350, TL-4* or *MASH, TL-4* when installed on a slope with an inclination of 1:6 (1 Vertical on 6 Horizontal) or flatter. The end terminals must meet or exceed *NCHRP 350, TL-3* or *MASH, TL-3*. The HTCB and end terminals must have FHWA acceptance. Furnish FHWA acceptance letters, to the Engineer, stating that the HTCB meets or exceeds *NCHRP 350, TL-3* or *MASH, TL-3* when installed on a 1:4 slope, the HTCB meets or exceeds *NCHRP 350, TL-4* or *MASH, TL-4* when installed on a 1:6 slope or flatter, and the end terminals meet or exceed *NCHRP 350, TL-3* or *MASH, TL-3*.

Ensure the HTCB system and all associated components are manufactured in the United States of America and meet Buy America Act requirements.

1. Cables. The HTCB must have three cables. Each cable must be 3/4-inch (minimum) diameter, 3 × 7 construction, zinc-coated (galvanized) wire rope manufactured in accordance with *AASHTO MP30M/MP30, Type I, Class A* coating. Each cable must have a minimum tensile strength of 39,000 pounds. Each cable must be factory pre-stretched after manufacture with a tensile load of 50 percent (minimum) of the cable’s tensile strength to prevent future strain relaxation of the cable. The cable must not be damaged during the pre-stretching process. Each cable must have a minimum modulus of elasticity of 11,805,090 psi after pre-stretching.

With each cable spool, the cable manufacturer must provide documentation, to the Engineer, certifying the breaking strength of the cable, the amount of force used to pre-stretch the cable, the modulus of elasticity of the cable after pre-stretching, and the pre-stretching/testing date(s).

2. Posts and Fittings. All posts must be made of steel meeting *ASTM A36/A36M*. Ensure all posts are zinc coated (galvanized) after fabrication to *ASTM A123/A123M*.

All fittings, including but not limited to turnbuckles and connections, must have a minimum diameter of 3/4 inch. All fittings must develop a minimum tensile load (without yielding) of 36,800 pounds. The manufacturer must conduct one tensile load test on each fitting type used in the HTCB system. The manufacturer must provide documentation, to the Engineer, certifying that all fitting types have been tested and meet the minimum load requirements specified in this special provision. The documentation must also list the tensile yield strength and test date(s) for each fitting type.

Ensure threaded terminals are right hand or left hand threaded M24 × 3 pitch in accordance with *ANSI B1.13M*. A maximum of one open-type wedge lock terminal or two closed-type wedge lock terminals are allowed per cable per run (between end anchor foundations). Closed-type wedge lock terminals must utilize a threaded-end socket to secure the wedge by compression. Only one wedge lock terminal type (open-type or closed-type) is permitted. Ensure all other terminals are of the swaged type. Swaged type terminals may be shop or field swaged.

The body of the threaded terminal must provide a minimum of 5.9 inches wire rope engagement depth. Fully fitted ropes must develop a minimum breaking load of 36,800 pounds. Ensure threaded terminals are galvanized, after threading, in accordance with *ASTM A153/A153M*.

Thread one end of each turnbuckle right handed and the other end left handed in accordance with *ANSI B1.13M*, M24 x 3 to accept threaded rope terminals. Ensure turnbuckles are of the solid or closed body type with two inspection holes to determine threaded rope terminal penetration. Turnbuckles must allow for a minimum of 6 inches of penetration from each end.

All fittings, including but not limited to turnbuckles and connections, must either be zinc coated (galvanized) in accordance with *ASTM A153/A153M* after threading, or be made of stainless steel. Ensure all other components made of ferrous metal, excluding stainless steel components, are zinc coated (galvanized) in accordance with *ASTM A123/A123M* after fabrication.

3. Reflective Sheeting. Attach Type XI reflective sheeting to all reflectors as specified in subsection 919.03.B of the Standard Specifications for Construction. Reflectors must meet manufacturer’s specifications. Reflectors must match color of edge line adjacent to approaching traffic. Each reflector must have a minimum of 13 square inches of reflective sheeting facing approaching traffic.

4. Driven Cable Terminals. Furnish driven cable terminals manufactured by Gibraltar Global, LLC, and meeting all of the design and material requirements of this special provision. Each driven cable terminal must contain a total of three driven beams, with one driven beam at each of the following terminal post locations; anchor post, terminal post 1 (TP1), and terminal post 2 (TP2).

Driven Beam and Soil Plate Assembly. Make driven beams of steel meeting *ASTM A992/A922M*, each consisting of a W8x31 beam, with a minimum length of 96 inches (8 feet). Weld a soil plate, 1/4 inch (minimum) thick, to each driven beam in accordance with the manufacturer’s specifications. Secure the soil plate to the flange furthest from the nose (front) of the terminal. The soil plate must have a minimum width of 36 inches, and a minimum length of 86 inches. The soil plate must protrude a minimum of 14 inches beyond the flange edge on both sides of the driven beam. Locate the top of the soil plate 10 inches below the top of the driven beam. Make soil plates of steel meeting *ASTM A36/A36M*. Ensure driven beam and soil plate assemblies are zinc coated (galvanized) after fabrication in accordance with *ASTM A123/A123M*.

Driven Beam Connectors. Use two C-channel members, each consisting of a C 6x13 channel and fabricated in accordance with manufacturer’s specifications, to interconnect the anchor post, terminal post 1 (TP1), and terminal post 2 (TP2) driven beams. Ensure driven beam connectors are zinc coated (galvanized) after fabrication in accordance with *ASTM A123/A123M*.

Other Driven Terminal Components and Miscellaneous Hardware. Ensure all other driven terminals components and hardware are made of steel meeting manufacturer’s specifications. Ensure all components and hardware are zinc coated (galvanized) in accordance with the manufacturer’s specifications.

5. Miscellaneous Materials.

A. Excluder caps must meet manufacturer’s specifications and be made of low-density polyethylene or polypropylene.

B. Use sound earth meeting the requirements specified in section 205 of the Standard Specifications for Construction for grading and earthwork.

C. Use marine-grade anti-seize lubricant for threaded fittings that is acceptable for use on galvanized steel.

D. Driven sockets for all line posts and cable terminal posts 3 and 4 (i.e., TP3 and TP4, respectively) must meet the requirements contained on the plans, this special provision, and manufacturer’s specifications. The rectangular tube portion of the driven socket must have a minimum thickness of 3/16 inch and a minimum length of 60 inches (5 feet). The inner cross-sectional dimensions of the rectangular tube (i.e., the area for inserting the line post into the driven socket) must meet manufacturer’s specifications. The soil plate attached to the rectangular tube must have a minimum thickness of 8 gauge, and must meet the dimensional requirements specified on the plans. Attach the soil plate to the rectangular tube as specified on the plans. Each driven socket must have a post stop, meeting manufacturer’s specifications, in order to keep the post at its intended height. The post stop must allow water to pass through. The bottom of the driven socket must have an opening for water to drain out of the rectangular tube. Ensure driven sockets, including soil plates and other hardware attached to the driven socket, are made of steel meeting *ASTM A36/A36M*. Ensure the driven socket assembly (rectangular tube, soil plate, post stop, and any other hardware attached to the driven socket) are zinc coated (galvanized) after fabrication to *ASTM A123/A123M*.

**c. Manufacturer’s Representative.** Prior to HTCB installation, the HTCB manufacturing company must provide the Engineer with the name, telephone number, electronic mail (e-mail) address, and a resume of a representative from the HTCB system manufacturing company that has been assigned to this project. The manufacturer’s representative must be employed, either directly or under contract, by the HTCB manufacturer. The manufacturer’s representative cannot be employed, either directly or under contract, by the Contractor. The Contractor is prohibited from acting as the manufacturer’s representative.

The manufacturer’s representative must have thorough knowledge of the HTCB system being installed, and must have prior experience installing the HTCB system used for this project. The representative’s resume must specify the length of time working for the manufacturer, and contain a list detailing the HTCB projects the representative has worked on over the last 3 years. The Engineer reserves the right to reject a manufacturer’s representative if the representative fails to demonstrate thorough knowledge of the HTCB system being installed, fails to submit proof of prior experience installing the HTCB system used for this project, or fails to comply with the requirements of this special provision. If the Engineer rejects a manufacturer’s representative at any time during construction, the HTCB system manufacturing company must provide a different manufacturer’s representative, meeting the requirements of this special provision, within 2 working days and at no additional cost to the contract.

The manufacturer’s representative must respond to any telephone or e-mail inquiries from the Engineer within 2 working days. If requested by the Engineer, the manufacturer’s representative must travel to the project site and meet with the Engineer to inspect the HTCB installation and discuss any issues regarding the HTCB installation. The manufacturer’s representative must travel to the project site and meet with the Engineer no later than 5 working days after the Engineer’s request.

No later than 5 days after initial cable tensioning of all HTCB runs, the manufacturer’s representative must travel to the project site, meet with the Engineer, and inspect the entire HTCB installation. Any deviations from manufacturer’s specifications must be reported directly to the Engineer.

**d. Consultation and Training.** The HTCB manufacturing company must be available to consult with and train personnel from MDOT and/or any of MDOT’s invitees, without additional cost, as requested by MDOT. Consultation and training must encompass the design, installation, operation, and maintenance of the HTCB system.

The manufacturer must provide training with respect to the design, installation, operation, and maintenance of the HTCB system. Hold training and consultation at a location in the State of Michigan deemed acceptable by MDOT. The manufacturer must issue a dated certificate to each individual that has undergone formal training. The manufacturer must comply with all of the training requirements specified in the contract.

Prior to installation of the HTCB system, provide written certification from the manufacturer, to the Engineer, that the entire work force to be used for installing the system has received the training and necessary aids to install the system. This work force training must include installation of driven sockets, driven cable terminals, posts, cables, turnbuckles, reflectors, miscellaneous hardware, and tensioning of the cables. The written certification must contain a list of individuals trained and certified by the manufacturer. Provide an updated list of workers trained and certified by the manufacturer no later than 48 hours after personnel changes occur.

**e. Plans and Shop Drawings.** At least 30 days prior to HTCB installation, submit the shop drawings electronically to the Engineer for review and approval.

The Department will require up to 30 days for reviewing plans and shop drawings. The Contractor and manufacturer must address any questions, comments, or concerns raised by MDOT personnel. Do not commence HTCB construction/installation until the plans and shop drawings have been reviewed and approved by the Department.

Incomplete shop drawings will not be accepted or reviewed by the Department. The Contractor will be held responsible for incomplete and/or late plan set submittals. Extension of the completion dates for the project will not be granted due to incomplete and/or late plan set submittals.

Ensure all drawings and calculations are in English units. Design the HTCB system in accordance with manufacturer’s recommendations and this special provision. Ensure shop drawings detailing the driven cable terminals are signed and sealed by a Professional Engineer licensed in the State of Michigan.

Include all of the following in each set of plans:

1. Detailed shop drawings of the HTCB system, design calculations and notes, and any construction specifications.

2. One drawing for each HTCB run, containing the following items:

A. The height of each cable in the system;

B. The post length and height of each post with respect to ground level;

C. The post spacing along the entire length of each cable run;

D. Detailed drawings of all posts and hardware;

E. Turnbuckle locations;

F. The overall length of the cable run, including the end terminals;

G. The HTCB length, excluding the end terminals;

H. End terminal locations (stations);

I. Detailed driven socket design, including rectangular tube and soil plate dimensions and thicknesses, and details of all welds. Post stop details, and details of all drainage openings, must also be included. Ensure the orientation of the driven socket for proper installation is shown; and

J. Detailed driven cable terminal design(s), including all driven beam details, soil plate dimensions, details of all welds, channel connector details, and details of all other connectors and hardware within the limits of the driven cable terminal. Ensure the layout and orientation for proper installation of all driven cable terminal components is shown.

3. Reflector design.

4. A report detailing the methodology and geotechnical data (including soil boring logs and soil test results) used to design driven cable terminals. Ensure geotechnical data and any assumptions, conclusions, and/or recommendations are included and clearly identified in the report.

5. A table showing the recommended post spacing as a function of roadway curvature.

6. A table or graph, or both, showing impact deflection (under *NCHRP 350, TL-3* or *MASH, TL-3* conditions) as a function of post spacing.

7. A table showing the recommended cable tension as a function of cable temperature.

8. Detailed drawing of a modified cable post and/or hardware that can accommodate turnbuckles and/or fittings.

9. A signed certification letter from the manufacturer indicating the HTCB system conforms to this special provision.

10. FHWA acceptance letter indicating the HTCB meets or exceeds *NCHRP 350, TL-3* or *MASH, TL-3* when installed on a 1:4 slope.

11. FHWA acceptance letter indicating the HTCB meets or exceeds *NCHRP 350, TL-4* or *MASH, TL-4* when installed on a 1:6 slope or flatter.

12. FHWA acceptance letter indicating the end terminals meet *NCHRP 350, TL-3* or *MASH, TL-3*.

**f. Geotechnical Information.** Limited geotechnical information is furnished by the Department on the project plans. Geotechnical information furnished by the Department may be used for design purposes at the manufacturer’s discretion. It is expressly understood that the Department will not be responsible for interpretations or conclusions drawn from geotechnical information furnished by the Department by the Contractor, manufacturer, and/or any of their affiliates. Soil data furnished by the Department represent conditions at specific locations. No inference should be made that subsurface conditions are the same at other locations. Additional soil data will not be furnished by the Department.

Contact the manufacturer prior to bidding and determine if additional geotechnical data is required. Obtain and furnish additional geotechnical data (including soil borings and soil testing data) and laboratory tests required for the manufacturer to complete design of end terminal foundations or other components of the HTCB system. Conduct laboratory tests in accordance with *AASHTO* and *ASTM* Standard Methods of Testing.

**g. General HTCB System Design.** Design the HTCB system in accordance with the manufacturer’s recommendations and specifications, and the following general requirements.

1. The modified cable post and/or hardware for accommodating turnbuckles and/or fittings must meet manufacturer’s specifications and must not undermine the crash worthiness of the HTCB system.

2. Individual cables must terminate at an end terminal foundation. Anchoring individual cables to other cables is prohibited.

3. Driven cable terminal designs must satisfy all of the following requirements.

A. Ensure all of the requirements of subsection b.4 of this special provision are satisfied.

B. Ensure the minimum design load for end terminal foundations and cable connections to the foundation are based on the theoretical cumulative cable tension expected at ­25 ºF.

C. Design driven cable terminals using the P-Y Method (e.g., L­Pile) when checking the theoretical deflection, and use the Broms’ Design Methods when checking overturning. Other design methods may be used if approved by the Engineer.

D. Design each driven cable terminal using the appropriate geotechnical information furnished by the Department and/or appropriate geotechnical information furnished by the Contractor, as determined by the manufacturer.

E. Use a minimum factor of safety of 2.5 against overturning when using the Broms’ Design Methods (Refer to Subsection 13.6.1.1 of the *Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition, 2013*). Other design methods and/or factors of safety may be used if approved by the Engineer.

F. Ensure driven cable terminal deflection does not exceed 1.0 inch when subjected to the minimum end terminal design load described in this special provision. Use a minimum factor of safety of 1.0 in the foundation deflection analysis.

G. Design end terminal foundations to resist uplift and/or downward forces using a minimum factor of safety of 2.0 and the Beta and Alpha Methods as described in *FHWA-IF-99-025 Drilled Shaft: Construction Procedures and Design Methods (O’Neill and Reese, 1999).* Other design methods and/or factors of safety may be used if approved by the Engineer.

4. Ensure steel driven sockets are used to support all line posts, and cable terminal posts 3 and 4, respectively.

**h. Contractor Qualification Requirements.** The Contractor performing the work items described in this special provision must meet the following requirements:

1. Qualifications of Contractor Installing HTCB. The Contractor must have prior experience installing HTCB; installing cables, posts, turnbuckles, driven sockets, reflectors, miscellaneous hardware, cutting cables, splicing cables, and tensioning cables. In addition, the Contractor must have received training by Gibraltar Global, LLC pertaining to the installation and maintenance of the Gibraltar TL-4, 3-cable, HTCB system.

Prior to HTCB installation, provide the Engineer a certification letter from Gibraltar Global, LLC indicating that the Contractor has received the training and necessary aids to install and maintain the Gibraltar TL-4, 3-cable, HTCB system. The certification letter must specify that the entire work force to be used for installing the system has received the training and necessary aids to install the system. This work force training must include installation of driven sockets, driven cable terminals, posts, cables, turnbuckles, reflectors, miscellaneous hardware, and tensioning of the cables.

The manufacturer’s certification letter must contain a list of individuals trained and certified by the manufacturer. Provide an updated list of workers trained and certified by the manufacturer no later than 48 hours after personnel changes occur.

2. Qualifications of Contractor Installing Driven Cable Terminals. Ensure the Contractor installing driven cable terminals has installed driven cable terminals or other similar devices with dimensions and depths similar to those identified in this special provision within a period of 3 years or less prior to the bid date for this project. The Contractor must demonstrate to the Engineer that the Contractor's supervisor and installers performing the work have completed at least three projects of similar scope, dimensions, depths, and subsurface conditions to this project. Ensure the Contractor's supervisor has at least 3 years of acceptable experience installing driven cable terminals or other similar devices.

**i. HTCB Construction/Installation.** Furnish and install the HTCB system in accordance with the following:

1. General. Furnish and install Gibraltar TL-4 HTCB and driven cable terminals at the location(s) specified on the plans. Install all HTCB and driven cable terminals in accordance with the plans, this special provision, and the shop drawings developed by the manufacturer for this project.

2. Protection of Existing Structures, Utilities, Culverts, and Drain Pipes. Control operations to prevent damage to existing structures, utilities, culverts, and drain pipes. Preventative measures include, but are not limited to, selecting construction methods and procedures that will prevent caving of shaft excavations, monitoring and controlling the vibrations from construction activities, and monitoring and controlling the depth of excavations. Repair any damage to existing structures, utilities, culverts, or drain pipes, to the satisfaction of the Engineer at no additional cost to the contract, including engineering analysis and redesign, and without any extension of the completion dates for the project.

3. Construction Tolerances. The manufacturer of the HTCB system selected for this project must prepare a complete list of construction tolerances, including but not limited to cable height, post spacing, and horizontal alignment, for the HTCB system selected for this project. Submit the list of construction tolerances to the Engineer for review and approval. Obtain the Engineer’s approval of all construction tolerances prior to beginning HTCB construction/installation.

Manufacturer’s tolerances must comply with the following minimum construction tolerances:

A. After HTCB installation, ensure the out-of-plumb of all HTCB line posts is no greater than one percent in all directions. The use of plastic shims for leveling line posts is prohibited.

B. The top of driven sockets must not protrude more than 1 inch above the surrounding ground. The top of driven sockets must not be below ground level. Ensure all portions of the soil plate attached to driven sockets are at least 1 inch below ground level.

Driven cable terminal construction tolerances must meet manufacturer’s specifications.

Installations that fall outside the required tolerances will be considered unacceptable. Correct all unacceptable installations to the satisfaction of the Engineer. Furnish labor, equipment, and materials necessary to correct all unacceptable installations, including engineering analysis and redesign, at no additional cost to the contract, and without an extension of the completion dates for the project.

4. Obstructions. Immediately notify the Engineer if surface and subsurface obstructions are encountered at driven beam and driven socket locations. Such obstructions may include materials such as old concrete foundations or abandoned utilities, or natural materials such as boulders. Obtain the Engineer’s approval before attempting to perform any excavations and/or use special procedures or tools to install driven beams and/or driven sockets. Special procedures or tools for removing obstructions include, but are not limited to, conventional augers fitted with soil or rock teeth, drilling buckets, reaming tools, chisels, boulder breakers, core barrels, air tools, and hand excavation. Unless otherwise specified in the contract, removal of such obstructions will be paid for as extra work provided that special procedures or tools are utilized. To be considered for payment for obstruction removal, submit written notification to the Engineer no later than 24 hours after encountering obstructions and allow the Engineer to inspect the site and verify that excavation, special procedures, or tools are required prior to undertaking the removal.

5. Line Posts and Driven Sockets. Base post spacing on manufacturer’s specifications depending on the roadway curvature shown on the plans while satisfying the following condition: Ensure the post spacing does not exceed 10 feet, 6 inches, unless otherwise specified on the plans developed by the Department or directed by the Engineer.

Install a driven socket at each line post location between cable terminals, and at cable terminal posts 3 and 4, respectively. Install driven sockets such that the soil plates are on the side furthest from the closest traveled lane.

Driven sockets must not be driven into the ground, unless the Contractor conducts an on-site field demonstration in the Engineer’s presence demonstrating that the socket can be driven into the ground without soil and debris entering the inner portion of the rectangular tube and without damaging the socket assembly. The Contractor must receive Engineer’s approval in order to drive sockets into the ground. Compact the soil around driven sockets after installation. Loose soil or voids around driven sockets after installation are unacceptable, and must be corrected by the Contractor at the Contractor’s expense.

Unless otherwise specified by the Engineer, ensure driven sockets are set in augered holes. Auger a hole for each driven socket large enough to fully accommodate the driven socket, including the soil plate. Compact the bottom of augered holes to provide a stable foundation. Install driven sockets in augered holes to within the tolerances specified in this special provision and backfill with sound earth compacted in 6-inch maximum layers. Compact the backfill over the entire augered hole cross-section for each 6-inch layer. Ensure the entire length of the inner portion of the rectangular tube is free of soil and debris after installation.

Ensure any driven sockets damaged during installation or as a result of the Contractor’s operations are replaced by the Contractor at the Contractor’s expense.

Install a modified cable post and/or hardware, in accordance with the plans developed by the manufacturer for this project and this special provision, at all locations where a standard cable post cannot be properly installed and attached to the cables due to the presence of a turnbuckle or fitting.

Install excluder caps on all line and cable terminal posts to prevent debris from entering the socket.

6. Driven Cable Terminals. Ensure driven beams are not damaged during the installation process. Ensure any driven beams damaged during installation or as a result of the Contractor’s operations are replaced by the Contractor at the Contractor’s expense.

If driven beams cannot be properly installed, and without damages, by driving the beam into the ground, install driven beams in augered holes. Auger a hole for each driven beam large enough to fully accommodate the driven beam, including the soil plate. Compact the bottom of augered holes to provide a stable foundation. Install driven beam in augered holes to within the tolerances specified in this special provision and backfill with sound earth compacted in 6-inch maximum layers. Compact the backfill over the entire augered hole cross-section for each 6-inch layer.

7. Reflectors. Attach reflectors to line posts in accordance with manufacturer’s specifications and this special provision. Install reflectors on both sides of the line post, unless otherwise specified on the plans developed by the Department. Space reflectors at the following intervals:

A. 48 feet (maximum) on tangent sections and curves with a radius of 1,150 feet or greater.

B. 24 feet (maximum) on curves with a radius less than 1,150 feet.

8. Slope Grading. Grade around all driven beams, C-channel connectors, and driven sockets, as necessary, to remove any ridges, dips, holes, or voids and match the surrounding slopes. Graded areas must have a slope of 1:4 or flatter. Graded areas must meet Class A slope tolerances in accordance with subsection 205.03.N of the Standard Specifications for Construction.

9. Fittings. Ensure that wedge-lock type fittings have a minimum of one wire crimped over the base of the wedge to hold it firmly in place. The crimped section of wire over the base of the wedge must have a minimum length of 3/16 inch. Lubricate all threaded fittings with marine-grade anti-seize lubricant prior to assembly and installation.

10. Cable Tensioning. Upon complete assembly of the HTCB, set each cable to the initial tension specified by the manufacturer. Measure the temperature of each cable prior to tensioning and use this temperature to determine the required tension. Perform final cable tensioning in each cable a minimum of 2 weeks after initial cable tensioning and, if necessary, adjust the tension to the proper setting. Submit written certification to the Engineer indicating the date of initial cable tensioning, date of final cable tensioning, the ambient temperature and cable temperature on each of these dates, and the tension in each cable on each of these dates.

Upon complete assembly of the HTCB, ensure that all threaded terminals, except one terminal per cable per run, penetrate a minimum of 3 inches and a maximum of 4 inches into the turnbuckle measured from the ends of the turnbuckle. Ensure that all threaded terminals, including terminals not required to meet the 3 inch minimum and 4 inch maximum penetration requirements, penetrate the turnbuckle past the inspection holes located on the turnbuckle. Ensure that the terminal threads are visible through the inspection holes located on the turnbuckle.

Upon completion of the construction/installation of the HTCB, both the Contractor and the manufacturer’s representative must provide written certifications to the Engineer indicating that the HTCB system and end terminals were installed in accordance with the plans, manufacturer’s specifications and guidelines, and this special provision.

**j. Measurement and Payment.** The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

**Pay Item Pay Unit**

Cable Barrier, High Tension, 3-Cable, Gibraltar TL-4, Driven Socket Foot

Cable Barrier Terminal, Driven, High Tension, 3-Cable, Gibraltar TL-4 Each

1. **Cable Barrier, High Tension, 3-Cable, Gibraltar TL-4, Driven Socket.** The plan quantity for **Cable Barrier, High Tension, 3-Cable, Gibraltar TL-4, Driven Socket** is based on the overall length of each run of HTCB, including HTCB terminals. Actual final payment will be based on the field measurements deducting the terminal system per the manufacturer's approved shop drawings. For bidding and ordering purposes, it is the Contractor’s responsibility to make necessary adjustments by deducting the length of the terminal endings from the plan length.

**Cable Barrier, High Tension, 3-Cable, Gibraltar TL-4, Driven Socket** includes all materials, labor, and equipment required for the following:

A. Constructing three-cable, HTCB manufactured by Gibraltar Global, LLC that is NCHRP 350, TL-3 or MASH, TL-3 compliant when installed on a 1:4 slope, and NCHRP 350, TL-4 or MASH, TL-4 compliant when installed on a 1:6 slope or flatter;

B. Constructing the HTCB in accordance with the plans, the plan set developed by the manufacturer for this project, and this special provision;

C. Obtaining and furnishing soil properties (including soil borings and laboratory testing), as specified by the manufacturer;

D. Furnishing and installing reflectors, as specified in this special provision;

E. Installing driven sockets, as specified on the plans developed by the manufacturer for this project and this special provision;

F. Providing a trained work force and a manufacturer’s representative on-site during installation and during consultation/training requested by MDOT;

G. Preparing and submitting plans and/or requested information to MDOT;

H. Grading around driven sockets;

I. Removal and disposal of excavated materials;

J. Furnishing, installing, and removing shaft excavation casings;

K. Providing training/consultation by the manufacturer as requested by MDOT; and

L. Providing a manufacturer’s representative on-call throughout the duration of the project, on-site as requested by the Engineer and as specified in this special provision, and during consultation/training requested by MDOT.

2. **Cable Barrier Terminal, Driven, High Tension, 3-Cable, Gibraltar TL-4** includes all materials, labor, and equipment required for the following:

A. Constructing a NCHRP 350, TL-3 or MASH, TL-3 compliant HTCB driven cable terminal manufactured by Gibraltar Global, LLC that is compatible with the HTCB system installed;

B. Installing driven cable terminal in accordance with the plans, the plans developed by the manufacturer for this project, and this special provision;

C. Obtaining and furnishing soil properties (including soil borings and laboratory testing), as specified by the manufacturer;

D. Preparing and submitting plans and requested information to MDOT pertaining to the end terminals;

E. Certification of the manufacturer’s driven cable terminal design(s) by a Professional Engineer licensed in the State of Michigan;

F. Grading around driven beams, driven sockets, and C-channel connectors;

G. Removal and disposal of excavated materials; and

H. Furnishing, installing, and removing shaft excavation casings.

3.Payment Schedule. Payment will be made after final cable tensioning is completed, unless otherwise authorized by the Engineer.

4. Bid Preparation. Bidders are required to consult with Gibraltar Global, LLC and geotechnical consultants prior to bidding, and estimate driven beam dimensions based on the minimum driven beam dimensions specified in this special provision, the foundation design requirements of this special provision, and appropriate soil data furnished on the project plans. Unit prices should be based on conservative designs that meet or exceed the requirements of this special provision. Additional payment will not be provided for furnishing driven cable terminals with dimensions and/or depths different from those used by the bidder for bidding and estimating purposes.

All costs associated with conducting driven socket installation demonstrations, as specified in this special provision, will be considered incidental and will not be paid for separately.