MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
REMOVING, SALVAGING, AND RECONSTRUCTING HIGH TENSION CABLE BARRIER

GCB:CT 1 of 20 APPR:WKP:RWS:04-08-25
FHWA:APPR:04-11-25

a. Description. This work consists of removing and/or salvaging existing high tension cable barrier (HTCB) and cable barrier terminals and installing new and/or salvaged cable barrier and cable barrier terminals. If the requirements of this special provision conflict with the requirements of the manufacturer's details, the requirements of this special provision will take precedence.

b. Materials. Salvage and reuse existing cable barrier and cable barrier terminal components for reconstructing cable barrier and cable barrier terminals, provided that these materials are reusable in their present condition (unbent, undamaged, galvanized, rust free). Do not import used cable barrier and cable barrier terminal components from outside the project for incorporation into this work.

If the quantities of salvaged cable barrier and cable barrier terminal components are insufficient to complete the cable barrier reconstruction, furnish and install additional new cable barrier and cable barrier terminals. New materials will be paid for at the contract unit price for the applicable cable barrier and cable barrier terminal pay items.

Furnish materials in accordance with the manufacturer's specifications and this special provision. Furnish written certification to the Engineer stating that the materials used to construct the high tension cable system and end terminals meet manufacturer's specifications and this special provision. Furnish manufacturer's written certification to the Engineer certifying that all components supplied by the manufacturer meet manufacturer's specifications and this special provision.

Furnish new cable barrier components procured from the manufacturer of the HTCB system being serviced. Ensure all new cable barrier components meet the manufacturer's specifications of the cable barrier system being serviced and this special provision. Ensure new cable barrier components are similar to and compatible with the existing components in the cable barrier system being serviced. For each respective cable barrier system, intermixing different types of line posts, turnbuckles, line post sockets, cable splices, and other components is prohibited.

1. Cable Barriers and End Terminals. Ensure that the end terminals are compatible with the cable barrier system installed.

   Ensure new cable barrier end terminals meet or exceed *NCHRP Report 350, Test Level 3 (TL-3)* or *MASH, Test Level 3 (TL-3)* and have FHWA acceptance. Ensure the cable barrier and end terminals have FHWA acceptance. Furnish FHWA acceptance letters, to the Engineer, stating that the end terminals meet or exceed *NCHRP 350, TL-3* or *MASH, TL-3*.

2. Cables. Ensure cable is 3/4-inch (minimum) diameter, 3 x 7 construction, zinc-coated

(galvanized) wire rope manufactured in accordance with *AASHTO MP30M/MP30, Type I, Class A* coating. Ensure each cable has a minimum tensile strength of 39,000 pounds. Ensure each cable is 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. Ensure the cable is not damaged during the pre-stretching process. Ensure each cable has a minimum modulus of elasticity of 11,805,090 psi after pre-stretching.

Ensure with each spool of new cable, the cable manufacturer furnishes 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).

Ensure each wooden cable spool used for storing salvaged cable can store 1,000 feet of 3/4 inch diameter, 3 x 7 construction steel cable.

3. Posts and Fittings. Ensure all materials used for HTCB and end terminals conform to the manufacturer's specifications. Ensure all posts are made of steel meeting *ASTM A36/A36M*, and zinc coated (galvanized) after fabrication in accordance with *ASTM A123/A123M*. Modified cable posts and hardware for accommodating turnbuckles and fittings must meet the manufacturer's specifications for the cable barrier system being maintained or repaired and must not undermine the crash worthiness of the cable barrier system.

Ensure all fittings, including but not limited to turnbuckles and connections, have a minimum diameter of 3/4 inch. Ensure all fittings develop a minimum tensile load (without yielding) of 36,800 pounds. Ensure when furnishing new fittings, the manufacturer conducts one tensile load test on each fitting type furnished. Ensure the manufacturer provides documentation to the Engineer, certifying that all types of new fittings have been tested and meet the specified minimum load requirements. Ensure the documentation also lists the tensile yield strength and test date(s) for each fitting type.

Ensure threaded terminals are right hand or left hand threaded M24 x 3 pitch in accordance with *ANSI B1.13M*. Swaged type terminals may be shop or field swaged.

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

Ensure one end of each turnbuckle is threaded right hand and the other end left hand 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. Ensure turnbuckles allow for a minimum of 6 inches of penetration from each end.

Ensure all fittings, including but not limited to turnbuckles and connections, either are zinc coated (galvanized) in accordance with *ASTM A153/A153M* after threading, or 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.

4. Reflective Sheeting. Ensure Type XI reflective sheeting is attached to all reflectors as

specified in subsection 919.03.B of the Standard Specifications for Construction. Ensure reflectors meet the manufacturer's specifications. Ensure reflectors match the color of the edge line adjacent to approaching traffic. Each reflector must have a minimum of 13 square inches of reflective sheeting facing approaching traffic.

5. Concrete/Foundation Materials. Furnish Grade 4000 or 4000HP concrete in accordance with section 1004 of the Standard Specifications for Construction for all foundations, except that concrete slump must be modified in accordance with note k or l of Table 1004-1 of the Standard Specifications for Construction.

Furnish concrete curing materials in accordance with subsection 903.07 of the Standard Specifications for Construction.

Furnish temporary casing material in accordance with subsection 919.10 of the Standard Specifications for Construction unless otherwise shown on the plans.

Furnish slurry in accordance with subsection 718.03.E of the Standard Specifications for Construction. Use only polymer type slurries.

6. Steel Reinforcement. Furnish epoxy coated steel reinforcement for concrete foundations in accordance with section 905 of the Standard Specifications for Construction.

7. Cable Barrier Driven Terminal Foundations. Furnish cable barrier driven terminal foundations (i.e., terminal foundations made of steel and requiring no concrete) in accordance with the following:

A. Unless otherwise specified by the manufacturer, ensure driven terminal foundations are manufactured with steel beams meeting *ASTM A992/A992M*. Unless otherwise specified by the manufacturer, ensure soil plates and other components attached to the steel beams are made of steel meeting *ASTM A36/A36M*. Ensure steel beam connectors are made of steel meeting manufacturer's specifications.

B. Ensure steel beams, soil plates, other components attached to steel beams, and steel beam connectors are zinc coated (galvanized) in accordance with *ASTM A123/A123M* after fabrication.

C. Ensure all other driven terminal foundation components and hardware are made of steel meeting manufacturer's specifications, and zinc coated (galvanized) in accordance with manufacturer's specifications.

D. Ensure the driven terminal foundation assembly meets the design requirements specified on the plans, or as specified by the Engineer, and meets manufacturer's specifications.

8. Miscellaneous Materials.

A. Furnish low-density polyethylene or polypropylene excluder caps meeting manufacturer's specifications.

B. Furnish marine-grade anti-seize lubricant acceptable for use on galvanized steel for threaded fittings.

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

D. Furnish concrete post foundation sockets fabricated from 11 gauge (minimum), hot rolled mild steel galvanized in accordance with *ASTM A123/A123M*, after fabrication. Sockets for concrete post foundations must meet manufacturer's specifications.

E. Furnish driven sockets (i.e., steel sockets not encased in concrete) for line posts and/or cable terminal posts in accordance with the plans, the manufacturer's specifications and the following:

(1) Ensure the rectangular tube portion of the driven socket has a minimum thickness of 3/16 inch and a minimum length of 60 inches (5 feet).

(2) Ensure the inner cross-sectional dimensions of the rectangular tube (i.e., the area for inserting the line post into the driven socket) meets the manufacturer's specifications.

(3) Ensure the soil plate attached to the rectangular tube has a minimum thickness of 8 gauge, and meets the dimensional requirements shown on the plans, or as directed by the Engineer.

(4) Ensure the soil plate is attached to the rectangular tube as shown on the plans, or as directed by the Engineer.

(5) Ensure each driven socket has a post stop, meeting manufacturer's specifications, in order to keep the post at its intended height. Ensure the post stop allows water to pass through.

(6) Ensure the bottom of the driven socket has an opening for water to drain out of the rectangular tube.

(7) Ensure driven sockets, including soil plates and other hardware attached to the driven socket, are made of steel meeting *ASTM A36/A36M*.

(8) Ensure the driven socket assembly (rectangular tube, soil plate, post stop, and any other hardware attached to the driven socket) is zinc coated (galvanized) in accordance with *ASTM A123/A123M*, after fabrication.

F. Select zinc-rich paint for repair of damaged galvanized surfaces from the MDOT Qualified Products List (915). Use a zinc-rich paint closely matching the color of the surface to be repaired.

c. Manufacturer's Representative. Ensure prior to removing, salvaging, or reconstructing cable barrier, the cable barrier manufacturing company furnishes the Engineer with the name, telephone number, electronic mail (e-mail) address, and a resume of a representative from the cable system manufacturing company that has been assigned to this project. Ensure the manufacturer's representative is employed, either directly or under contract, by the cable barrier 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.

Ensure the manufacturer's representative has thorough knowledge of the cable barrier system being serviced and has prior experience installing the cable system used for this project. Ensure the representative's resume specifies the length of time working for the manufacturer and contains a list detailing the cable barrier 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 cable barrier system being serviced, fails to submit proof of prior experience installing the cable 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 cable 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 Department.

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 no later than 5 working days after the request is made, to discuss any issues regarding the cable barrier installation and to inspect the cable barrier installation. Ensure any deviations from manufacturer's specifications are reported directly to the Engineer.

Prior to installation of the cable barrier system, furnish written certification from the manufacturer to the Engineer, that the entire work force to be used for removing and installing the system has received the training and necessary aids to install the system. Ensure this work force training includes removal and installation of the foundations, end terminals (including driven terminal foundations, when applicable), posts, cables, turnbuckles, reflectors, miscellaneous hardware, and tensioning of the cables. Ensure the written certification contains a list of individuals trained and certified by the manufacturer. Furnish an updated list of workers trained and certified by the manufacturer no later than 48 hours after personnel changes occur.

d. Construction.

1. Removal. Prior to disassembling any existing cable barrier and/or cable barrier terminals, submit a list of cable components to the Engineer detailing the quantities of each cable barrier component to be salvaged. If requested by the Engineer, conduct a field inspection in the presence of the Engineer to verify the quantities of cable barrier components to be salvaged.

Disassemble the existing cable barrier and/or cable barrier terminals identified for removal or salvaging. Whenever possible, disassemble the existing cable barrier at existing turnbuckle locations in lieu of cutting cables. Obtain the Engineer's approval prior to cutting cables. If approved by the Engineer, cut the cables as necessary in order to remove or salvage the existing cable barrier and/or cable barrier terminals. Prior to cutting cable, wrap the cable with duct tape or other similar tape on both sides of the proposed cut in order to keep the cable from unraveling.

Unless otherwise specified on the plans, or directed by the Engineer, remove/salvage any driven sockets, driven terminal foundations, and backfill the resulting excavations with sound earth thoroughly rammed in 12-inch maximum layers.

Remove and dispose of any cable barrier components identified for removal, unless otherwise

specified by the Engineer. The Department reserves the right to salvage any cable barrier components slated for removal. Cable barrier components that are selected for salvaging by the Engineer become the property of the Department. Dismantle, separate, and stockpile salvaged cable barrier components, not designated for reconstruction, at an approved location(s) on the project site for eventual pick up by the Department or local agency forces. Remove and dispose of any unusable cable barrier components.

Remove and dispose of materials in accordance with subsection 204.03.B of the Standard Specifications for Construction.

After disassembly, neatly wind salvaged cables on wooden cable spools and store for either reuse on the project or pick up by the Department or local agency. Measure the length of cable wound on each spool and clearly denote the length on each spool. Do not cut cables unless otherwise directed by the Engineer.

Replace missing or damaged salvaged components at no additional cost to the Department.

Repair zinc coating, as needed or as directed by the Engineer, on all salvaged posts, hardware, and fittings to be reused on the project. Repair zinc coating using the materials specified in section b of this special provision and in accordance with subsection 716.03.E of the Standard Specifications for Construction.

Completely remove and dispose of all concrete line post and end terminal foundations identified for removal, unless otherwise stated on the plans or directed by the Engineer. After removing each foundation, backfill the resulting excavation with sound earth thoroughly rammed in 12-inch maximum layers.

2. Concrete Line Post and End Terminal Foundations. Construct concrete line post foundations with minimum diameter of 15 inches and minimum depth of 48 inches. Place steel reinforcement in concrete line post foundations as specified in the contract. Embed a steel socket in the concrete of each line post foundation to hold a line post. Install the socket in accordance with the contract and in accordance with the manufacturer's specifications. Ensure that the socket is approved for use with the cable barrier system being serviced. Space concrete line post foundations in accordance with this special provision, unless otherwise directed by the Engineer.

Construct new concrete end terminal foundations in accordance with the minimum dimensions and steel reinforcement requirements specified in the contract; the cable barrier manufacturer's specifications; and this special provision. Embed required sockets and components in the new concrete end terminal foundation. Ensure that the socket and components embedded in the concrete foundation are approved for use with the cable barrier system being serviced.

e. Concrete Foundation Construction. Unless directed otherwise by the Engineer, construct concrete foundations in accordance with the details on the plans, the plan set developed for this project by the barrier system manufacturer, section 718 of the Standard Specification for Construction, and this special provision.

1. Qualifications of Drilled Shaft Contractor Removing and Constructing Concrete Cable Terminal Foundations. Ensure the Contractor removing and constructing concrete cable terminal foundations has installed drilled shafts with diameters and depths similar to those

identified in the contract 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 drillers performing the work have completed at least three projects of similar scope, drilled shaft diameters and depths, and subsurface conditions to this project. Ensure the Contractor's supervisor has at least 3 years of acceptable experience in installing similar types of drilled shafts.

2. Preconstruction Meeting Requirements. The Contractor must furnish the following items to the Engineer at the preconstruction meeting:

A. A resume detailing the Contractor’s experiences demonstrating that the Contractor meets all of the qualification requirements identified in this special provision.

B. If certain work items are going to be subcontracted, the Contractor must furnish a detailed resume of the subcontractor’s experiences, identifying the subcontractor and demonstrating that the subcontractor meets the qualification requirements of this special provision for items of work being subcontracted.

C. A drilled shaft foundation installation plan, in accordance with subsection 718.03.A of the Standard Specifications for Construction. In addition to the requirements of subsection 718.03.A of the Standard Specifications for Construction, the drilled shaft installation plan must include proposed methods to prevent drilled shaft excavation spoils from entering the waters of the state or stormwater drainage systems, when the work is within the influence of same.

3. Casing. Determine the need for casing the shaft excavation and if casing is required, use shaft excavation casing temporarily, and remove casing in accordance with this special provision. The use of permanent shaft excavation casing is prohibited.

4. 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 the shaft excavation, monitoring and controlling the vibrations from construction activities (such as installation of casing and drilling of the shaft), and monitoring and controlling the depth of excavation. Repair any damage to existing structures, utilities, culverts, or drain pipes, to the satisfaction of the Engineer at no additional cost to the Department, including engineering analysis and redesign, and without any extension of the completion dates for the project.

5. Construction Tolerances. Comply with the following minimum construction tolerances:

A. Ensure at the drilled shaft actual bottom elevation, the out-of-plumb is no greater than one percent of the drilled shaft length as measured from the actual center of the shaft at the shaft design top elevation.

B. Ensure after cable barrier installation, the out-of-plumb of all cable barrier line posts is no greater than one percent in all directions. The use of plastic shims for leveling line posts is prohibited.

C. Ensure after all the shaft concrete is placed, the top of the reinforcing steel cage for line post and end terminal foundations is no more than 1 inch above or below plan

position.

D. Ensure the top elevation of all concrete foundations has a tolerance of 0 to 1 inch above top of shaft elevation. Ensure the top of all concrete foundations is not below ground level.

The Department will consider drilled shaft excavations and completed foundations that are not constructed and installed within the required tolerances to be unacceptable. Correct all unacceptable shaft excavations and completed foundations to the satisfaction of the Engineer. Furnish labor, equipment, and materials necessary to complete corrections for out of tolerance drilled shafts and posts, including engineering analysis and redesign, at no additional cost to the Department, and without an extension of the completion dates for the project.

6. Excavation. Maintain the stability of the excavation sidewalls and extend the shaft excavation to a stratum accepted by the Engineer. Extend drilled shaft tip elevations when the Engineer determines the bearing stratum encountered during excavation is unsuitable or differs from that anticipated in the design of the drilled shaft. Furnish the Engineer access to auger cuttings of the bearing material for additional analysis. Fill over-excavation of shafts, and unauthorized shaft excavations extended below required depths or elevations, with concrete when constructing concrete foundations, at no additional cost to the Department.

Do not leave an uncased drilled shaft excavation open overnight. If, when constructing concrete foundations, an uncased drilled shaft cannot be completed in one day, backfill the excavation with flowable fill.

Dispose of excavated materials removed from shaft excavations, and not used for slope grading, in accordance with subsection 205.03.P of the Standard Specifications for Construction. Keep excavated materials away from each open shaft excavation. Remove excavated materials immediately after completing the shaft excavation, or as directed by the Engineer. Direct surface water away from shaft excavations. Ensure that excavated material does not enter the waters of the state or stormwater drainage systems.

7. Obstructions. Remove surface and subsurface obstructions encountered in the length of excavation at concrete foundation locations. Such obstructions may include materials such as old concrete foundations or abandoned utilities, or natural materials such as boulders. In the event that the excavation cannot be advanced using conventional augers fitted with soil or rock teeth, drilling buckets and/or under reaming tools, use special procedures or tools including, but not limited to, chisels, boulder breakers, core barrels, air tools, hand excavation, and enlarging the hole diameter. 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 excavation and verify that special procedures or tools are required prior to undertaking the removal.

8. Excavation Inspections. Ensure excavation inspection is in accordance with subsection 718.03.F.1 of the Standard Specifications for Construction, with the following addition: after shaft excavation, and provided that a tremie pour is not required, provide access and allow time for the Engineer to inspect the shaft. Furnish suitable lighting if needed.

9. Steel Reinforcement. Place steel reinforcement in concrete post foundations as

recommended by the manufacturer, however, ensure the reinforcement is equal to or greater than that shown on the plans. Construct and place the reinforcing steel cage in accordance with subsection 706.03.E of the Standard Specifications for Construction and the following:

A. Completely assemble a reinforcing cage, consisting of longitudinal bars, stiffener bars, centralizers and tie reinforcement or spiral reinforcement prior to placement in the shaft excavation. Tie together steel reinforcement cages for all cable barrier foundations. Do not use welded steel reinforcement cages.

B. Place the steel reinforcement as a unit immediately after the shaft excavation is inspected and accepted, and prior to concrete placement.

C. Use non-corrosive spacers on the exterior of the reinforcing cage, near the bottom of the cage and at sufficient intervals to ensure concentric spacing of the cage for its entire length within the shaft excavation. Ensure the spacers are of adequate dimensions to provide a minimum 3 inches annular space between the outside of the reinforcing cage and the perimeter of the excavated shaft.

D Maintain the bottom of the cage the proper distance above the shaft base using approved concrete bottom supports, or by other methods approved by the Engineer.

E. Tie and support the reinforcing steel in the shaft during concrete placement and temporary casing removal such that the reinforcing steel will remain within the allowable tolerances.

F. Check the elevation of the top of the steel cage before and after the concrete is placed. If the reinforcing steel cage is not maintained within the specified tolerances, make corrections to the satisfaction of the Engineer. Modify the steel cage support in a manner satisfactory to the Engineer prior to constructing additional shafts.

G. Use epoxy coated steel reinforcement for all cable barrier foundations, including line post foundations.

10. Concrete Placement. Complete concrete placement for concrete foundations in accordance with the applicable portions of section 706 and subsection 718.03.H of the Standard Specifications for Construction, and as modified herein.

Ensure that concrete is delivered to the site from the batch plant in a continuous manner to help avoid interruption of placement. Place concrete, either by free-fall or through a tremie or concrete pump, the same day the shaft is excavated.

Place concrete by free-fall methods only in dry excavations where free water accumulation of 3 inches or less can be maintained immediately prior to concrete placement. Direct concrete placed by free-fall methods in the center of the shaft to avoid contact with the reinforcing steel cage, shaft sidewalls and temporary casing. Drop chutes may be used to direct concrete in a vertical stream down the shaft.

Consolidate the concrete in all cable barrier foundations, including line post foundations, with vibrators in accordance with the requirements of subsection 706.03.H.1 of the Standard Specifications for Construction.

11. Temporary Casing. Coordinate temporary casing withdrawal carefully with concrete placement. When temporary casing is being withdrawn, maintain a sufficient head of concrete above the bottom of the casing to prevent reduction in the shaft diameter due to earth and/or hydrostatic pressure on the fresh concrete, and to prevent extraneous material from mixing with fresh concrete. Check the concrete level in the temporary casing prior to, and after casing withdrawal to confirm that separation of the shaft concrete has not occurred.

12. Protection of Concrete. Protect fresh concrete from flowing water and damage from mechanical equipment and nearby construction vibrations. Do not generate vibrations from pounding of sheet piling, pile driving, or casing installation within a radius of 25 feet until the concrete has attained 75 percent of its specified minimum strength. Protect concrete from strength reduction caused by frost or freezing actions.

Comply with the curing requirements of subsection 810.03.J.8 of the Standard Specifications for Construction for all cable barrier foundations, including line post foundations.

13. Conduct concrete quality control in accordance with the contract, or as directed by the Engineer.

f. HTCB Construction/Installation. Protect all cable barrier foundations, driven sockets, and driven terminal foundations, designated to be salvaged, from damage due to the Contractor's operations. Use methods and materials approved by the Engineer for protecting cable barrier foundations, driven sockets, and driven terminal foundations. Repair or replace, at the Engineer's discretion, cable barrier foundations, driven sockets, and driven terminal foundations damaged by the Contractor's operations at no additional cost to the Department.

Ensure that individual cables terminate at an end terminal foundation. Anchoring individual cables to other cables is prohibited.

Furnish and install new or salvaged, or both, HTCB system in accordance with the following:

1. General. Furnish and install new or salvaged HTCB and end terminals, of the type specified and at the location(s) specified on the plans. Install all cable barriers and end terminals in accordance with the plans, and this special provision.

2. Posts. Base post spacing on manufacturer's specifications depending on the roadway curvature shown on the plans while satisfying the following condition: the post spacing must not exceed 10 feet, 6 inches, unless otherwise specified on the plans developed by the Department or directed by the Engineer.

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.

Install excluder caps on all posts placed in sockets.

3. Driven Sockets. Install driven sockets such that the soil plates are on the side furthest from the closest traveled lane. Use driven sockets that meet manufacturer's specifications for the respective cable system being serviced.

Unless otherwise specified by the Engineer, driven sockets are prohibited for use with cable terminal posts at locations with concrete end terminal foundations.

Ensure driven sockets are not 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. Obtain the Engineer's approval to drive sockets into the ground. Ensure that the soil around driven sockets is thoroughly compacted around the socket after installation. Loose soil or voids around driven sockets after installation is unacceptable and must be corrected by the Contractor at no additional cost to the Department.

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. Thoroughly compact the bottom of augered holes to furnish 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. Ensure the backfill is compacted 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 the out-of-plumb tolerance for driven sockets does not exceed one percent. Ensure the top of driven sockets does not protrude more than 1 inch above the surrounding ground. Ensure the top of driven sockets is not below ground level. Ensure all portions of the soil plate attached to driven sockets are at least 1 inch below ground level.

Replace any driven sockets damaged during installation, or as a result of the Contractor's operations, at no additional cost to the Department.

4. Cable Barrier Driven Terminal Foundations. 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.

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.

Immediately notify the Engineer if surface and subsurface obstructions are encountered at driven terminal 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 terminals. 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.

If driven beams cannot be properly installed, and without damage, 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 or approved equal compacted in 6-inch maximum layers. Compact the backfill over the entire augered hole cross-section for each 6-inch layer. Submit a work plan to the Engineer for approval prior to start of work that details the equipment, materials, and methods that will be used.

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

5. 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.

6. Slope Grading. Grade around concrete foundations, driven sockets, and driven terminal foundations, as necessary, to remove any ridges, dips, holes, or voids around the foundations/driven sockets and match the surrounding slopes. Ensure thresholds on slope grading are as specified on the plans or directed by the Engineer.

7. Fittings. Ensure new cable barrier and end terminals are furnished with swaged fittings. A turnbuckle and two wedge lock type fittings (one fitting with a left-hand threaded rod and the other fitting with a right-hand threaded rod) may be used to connect new/salvaged cable to existing cable.

Ensure torpedo cable splices and other similar devices are not used to connect new/salvaged cable barrier to existing cable barrier.

Ensure when installing wedge lock fittings on the Brifen cable system, manufactured by Brifen USA, Inc., only closed-type wedge lock fittings are used. Closed-type wedge lock fittings utilize a threaded-end socket to secure the wedge by compression. Open-type wedge lock fittings do not have a threaded-end socket to secure the wedge by compression. Either type (open-type or closed-type) of wedge lock fitting may be utilized with cable barrier systems made by manufacturers other than Brifen USA, Inc.

Apply anti-seize lubricant to all threaded fittings prior to installation.

Ensure all wedge-lock type fittings, including Torpedo cable splices and other similar cable splice kits, have a minimum of one wire crimped over the base of each wedge to hold it firmly in place. Ensure the crimped section of wire over the base of the wedge has a minimum length of 3/16 inch.

Regarding swaged fittings and wedge lock fittings, the Contractor is responsible for determining and furnishing the correct thread type(s) and connection type(s) required for completing the installation.

Ensure upon complete assembly of the cable barrier run, all threaded terminals in the cable run penetrate a minimum of 3 inches and a maximum of 4 inches into the turnbuckle measured from the ends of the turnbuckle.

8. Cable Tensioning. Do not tension cables until the concrete in all newly constructed concrete cable barrier foundations has reached a minimum compressive strength of 3,000 psi.

Upon complete assembly of the cable barrier, 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.

The Contractor is responsible for removing snow and ice, including the removal of ice located inside post sockets, as required for removal, salvaging, and/or installation.

The Department is not responsible for damages or repairs due to Contractor negligence. Ensure damages due to Contractor negligence are repaired by the Contractor at no additional cost to the Department.

Ensure after installing new/salvaged cable barrier and cable barrier terminals, the Contractor provides written certifications to the Engineer indicating that the high tension cable system and end terminals were installed in accordance with the plans, manufacturer's specifications and guidelines, and this special provision.

g. 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, Rem	Foot
Cable Barrier, High Tension, Salv	Foot
Cable Barrier, High Tension, Reconst	Foot
Cable Barrier, Furn and Install (CASS, 4:1 Slope)	Foot
Cable Barrier, Furn and Install (CASS, TL-4)	Foot
Cable Barrier Terminal, Furn and Install (CASS)	Each
Cable Barrier, Reflector, Furn and Install (CASS)	Each
Cable Barrier, Furn and Install (Gibraltar, TL-4)	Foot
Cable Barrier Terminal, Furn and Install (Gibraltar, TL-4)	Each
Cable Barrier, Reflector, Furn and Install (Gibraltar)	Each
Cable Barrier, Furn and Install (Brifen, TL-4)	Foot
Cable Barrier Terminal, Furn and Install (Brifen, TL-4)	Each
Cable Barrier, Reflector, Furn and Install (Brifen)	Each
Cable Barrier, High Tension, Line Post Fdn, Rem	Each

Cable Barrier, High Tension, Line Post Fdn.....Each
Cable Barrier, High Tension, End Terminal Fdn, Rem.....Each
Cable Barrier, High Tension, End Terminal Fdn .....Each
Cable Barrier, High Tension, Driven Socket, Furn and Install .....Each
Cable Barrier, High Tension, Driven Terminal Fdn, Furn and Install .....Each

The Engineer will not measure an installation for payment if the Contractor fails to crimp one wire over the base of each wedge, as specified in this special provision.

Snow and ice removal is included in associated pay items and will not be paid for separately.

The Department will not pay for damages due to Contractor negligence.

Protecting salvaged concrete cable barrier foundations, driven sockets, and driven terminal foundations will not be paid for separately.

1. **Cable Barrier, High Tension, Rem** will be measured and paid for per foot of barrier removed and disposed, regardless of the number of individual cables removed and disposed. **Cable Barrier, High Tension, Rem** will apply to all cable barrier systems, regardless of manufacturer. **Cable Barrier, High Tension, Rem** includes:

A. Removing and disposing of all cable barrier and cable barrier terminal components, except concrete cable barrier foundations and components embedded in concrete foundations;

B. Removing and disposing of driven sockets (sockets that are not embedded in concrete foundations), and backfilling the resulting excavations with sound earth;

C. Removing and disposing of driven terminal foundations (terminal foundations that are not constructed with concrete), and backfilling the resulting excavations with sound earth;

D. If directed by the Engineer, salvaging cable barrier, cable barrier terminals, driven sockets, and/or driven terminal foundations for use by the Department; and

E. If directed by the Engineer to salvage cable for use by the Department, furnishing, delivering, and handling wooden spools for storing cable. Wooden spools used for storing salvaged cable will become property of the Department.

Removal and disposal of concrete cable barrier foundations and components embedded in concrete foundations will be measured and paid for separately.

2. **Cable Barrier, High Tension, Salv** will be measured and paid for per foot of barrier removed and salvaged and will not be measured per foot of individual cable removed and salvaged. **Cable Barrier, High Tension, Salv** will be applicable to all cable barrier systems, regardless of manufacturer. **Cable Barrier, High Tension, Salv** includes:

A. Removing and salvaging all cable barrier and cable barrier terminal components, except concrete cable barrier foundations and components embedded in concrete foundations;

B. Removing and salvaging driven sockets (sockets that are not embedded in concrete foundations), and backfilling the resulting excavations with sound earth;

C. Removing and salvaging driven terminal foundations (terminal foundations that are not constructed with concrete foundations), and backfilling the resulting excavations with sound earth, and

D. Furnishing, delivering, and handling wooden spools for storing cable.

Removal and disposal of concrete cable barrier foundations and components embedded in concrete foundations will be measured and paid for separately.

3. **Cable Barrier, High Tension, Reconst** will be measured and paid for per foot of barrier installed when constructed with salvaged cable barrier and cable barrier terminal components. The pay item **Cable Barrier, High Tension, Reconst** will be applicable to all cable barrier systems, regardless of manufacturer. **Cable Barrier, High Tension, Reconst** includes:

A. Installing cable barrier and cable barrier terminals using salvaged cable barrier components;

B. Furnishing and installing new cable barrier components required to connect salvaged cable barrier to existing cable barrier;

C. Installing salvaged driven sockets (sockets that are not embedded in concrete foundations);

D. Installing salvaged driven terminal foundations (terminal foundations that are not constructed with concrete foundations);

E. Grading and slope restoration, as necessary, around driven sockets and driven terminal foundations, and

F. Repairing zinc coating on cable barrier components, as specified in this special provision.

Constructing new concrete cable barrier foundations and installing components embedded in concrete foundations will be measured and paid for separately.

4. **Cable Barrier, Furn and Install** of the type specified does not include furnishing and installing new cable barrier terminals; furnishing and installing new reflectors; furnishing and installing new driven sockets; constructing new concrete cable barrier foundations; or installing components embedded in concrete foundations. This work will be measured and paid for separately.

A. **Cable Barrier, Furn and Install (CASS, 4:1 Slope)** will be measured and paid for per foot of new barrier installed, excluding cable barrier terminals. CASS 4:1 Slope cable barrier must meet or exceed *NCHRP 350, TL-3* when placed on 1-on-4 slopes or flatter. Cable barrier furnished and installed with this pay item must contain the same number of cables as the existing cable barrier.

Cable Barrier, Furn and Install (CASS, 4:1 Slope) includes furnishing and installing new CASS 4:1 Slope cable barrier, manufactured by Valtir, LLC.

B. **Cable Barrier, Furn and Install (CASS, TL-4)** will be measured and paid for per foot of new barrier installed, excluding cable barrier terminals. CASS TL-4 cable barrier must meet or exceed *NCHRP 350, TL-4* when placed on 1-on-6 slopes or flatter. Cable barrier furnished and installed with this pay item must contain the same number of cables as the existing cable barrier.

Cable Barrier, Furn and Install (CASS, TL-4) includes furnishing and installing new CASS TL-4 cable barrier, manufactured by Valtir, LLC.

C. **Cable Barrier, Furn and Install (Gibraltar, TL-4)** will be measured and paid for per foot of new barrier installed, excluding cable barrier terminals. Gibraltar TL-4 cable barrier must meet or exceed *NCHRP 350, TL-3* when placed on slopes between 1-on-4 and 1-on-6, and must meet or exceed *NCHRP 350, TL-4* when placed on 1-on-6 slopes or flatter. Cable barrier furnished and installed with this pay item must contain the same number of cables as the existing cable barrier.

Cable Barrier, Furn and Install (Gibraltar, TL-4) includes furnishing and installing new Gibraltar TL-4 cable barrier, manufactured by Gibraltar Global, LLC.

D. **Cable Barrier, Furn and Install (Brifen, TL-4)** will be measured and paid for per foot of new barrier installed, excluding cable barrier terminals. Brifen TL-4 cable barrier must meet or exceed *NCHRP 350, TL-3* when placed on slopes between 1-on-4 and 1-on-6, and must meet or exceed *NCHRP 350, TL-4* when placed on 1-on-6 slopes or flatter. Cable barrier furnished and installed with this pay item must contain the same number of cables as the existing cable barrier.

Cable Barrier, Furn and Install (Brifen, TL-4) includes furnishing and installing new Brifen TL-4 cable barrier, manufactured by Brifen USA, Inc.

5. **Cable Barrier Terminal, Furn and Install** of the type specified does not include furnishing and installing new reflectors; furnishing and installing new driven sockets and/or new driven terminal foundations, including all driven terminal foundation components and hardware, within the cable terminal limits; constructing new concrete cable barrier foundations; and installing components embedded in concrete foundations. This work will be measured and paid for separately.

A. **Cable Barrier Terminal, Furn and Install (CASS)** will be measured and paid for per individual cable barrier terminal installed using all new components. **Cable Barrier Terminal, Furn and Install (CASS)** includes furnishing and installing a CASS cable barrier terminal, manufactured by Valtir, LLC. The CASS cable barrier terminal must meet or exceed *NCHRP 350, TL-3*, and be compatible with the CASS 4:1 Slope and CASS TL-4 cable systems. Cable barrier terminals furnished and installed with this pay item must contain the same number of cables as the existing cable barrier.

B. **Cable Barrier Terminal, Furn and Install (Gibraltar TL-4)** will be measured and paid for per individual cable barrier terminal installed using all new components. **Cable Barrier Terminal, Furn and Install (Gibraltar TL-4)** includes furnishing and installing a Gibraltar cable barrier terminal, manufactured by Gibraltar Global, LLC. The Gibraltar

cable barrier terminal must meet or exceed *NCHRP 350, TL-3*, and be compatible with the Gibraltar TL-4 cable system. Cable barrier terminals furnished and installed with this pay item must contain the same number of cables as the existing cable barrier.

C. **Cable Barrier Terminal, Furn and Install (Brifen TL-4)** will be measured and paid for per individual cable barrier terminal installed using all new components. **Cable Barrier Terminal, Furn and Install (Brifen TL-4)** includes furnishing and installing a Brifen cable barrier terminal, manufactured by Brifen USA, Inc. The Brifen cable barrier terminal must meet or exceed *NCHRP 350, TL-3*, and be compatible with the Brifen TL-4 cable system. Cable barrier terminals furnished and installed with this pay item must contain the same number of cables as the existing cable barrier.

6. **Cable Barrier, Reflector, Furn and Install** of the type specified will be measured and paid for per individual unit, regardless of whether the unit consists of a uni-directional reflector or bi-directional reflector. Salvaged reflectors will not be paid for as **Cable Barrier, Reflector, Furn and Install** of the type specified.

A. **Cable Barrier, Reflector, Furn and Install (CASS)** includes furnishing and installing a new reflector meeting the requirements of this special provision and approved by the manufacturer for use with the CASS 4:1 Slope or CASS TL-4 cable barrier systems, manufactured by Valtir, LLC.

B. **Cable Barrier, Reflector, Furn and Install (Gibraltar)** includes furnishing and installing a new reflector meeting the requirements of this special provision and approved by the manufacturer for use with the Gibraltar TL-4 cable barrier systems, manufactured by Gibraltar Global, LLC.

C. **Cable Barrier, Reflector, Furn and Install (Brifen)** includes furnishing and installing a new reflector meeting the requirements of this special provision and approved by the manufacturer for use with the Brifen TL-4 cable barrier systems, manufactured by Brifen USA, Inc.

7. **Cable Barrier, High Tension, Line Post Fdn, Rem** will be measured and paid for per individual line post foundation removed, regardless of the dimensions of the foundation. **Cable Barrier, High Tension, Line Post Fdn, Rem** will be applicable to all cable barrier systems, regardless of manufacturer. A line post foundation is any concrete cable barrier foundation that does not have cables anchored to the foundation. Line post foundations have embedded steel sockets for installing intermediate line posts, modified line posts, and terminal posts.

Cable Barrier, High Tension, Line Post Fdn, Rem includes removing and disposing of a line post foundation; removing and disposing of any steel components embedded in the foundation; and backfilling the excavation with sound earth.

Cable Barrier, High Tension, Line Post Fdn, Rem is not applicable to the removal of steel driven sockets (sockets not encased in concrete foundations).

8. **Cable Barrier, High Tension, Line Post Fdn** will be measured and paid for per individual line post foundation constructed, regardless of foundation dimensions. **Cable Barrier, High Tension, Line Post Fdn** will be applicable to all cable barrier systems, regardless of manufacturer. A line post foundation is any concrete cable barrier foundation

that does not have cables anchored to the foundation. Line post foundations have embedded steel sockets for installing intermediate line posts, modified line posts, and terminal posts.

Cable Barrier, High Tension, Line Post Fdn includes:

A. Constructing a new line post foundation in accordance with the contract;

B. Filling any voids, dips, or holes around the foundation with sound earth;

C. Removing and disposing of excavated material from foundation excavations;

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

E. Conducting concrete quality control; and

F. Steel socket, any steel components embedded in the foundation, and steel reinforcement required to construct the foundation.

9. **Cable Barrier, High Tension, End Terminal Fdn, Rem** will be measured and paid for per individual concrete end terminal foundation removed, regardless of the number of cables connected to the foundation, foundation dimensions, overall depth of the foundation, or depth of foundation removal. An end terminal foundation will be considered any concrete cable barrier foundation that has cables anchored to the foundation. End terminal foundations have steel components embedded in the foundation for attaching cables and posts to the foundation. An end terminal foundation consisting of one reinforced concrete pile cap connecting two or more drilled shafts will be measured and paid for as one individual end terminal foundation, regardless of foundation dimensions or number of drilled shafts. **Cable Barrier, High Tension, End Terminal Fdn, Rem** will be applicable to all cable barrier systems, regardless of manufacturer.

The end terminal foundation must, as a minimum, be removed to the depth specified on the plans. When the plans specify the depth to which cable barrier end terminal foundation(s) must be removed, the specified depth will be treated as a minimum, and additional compensation will not be provided for removing the foundation beyond the specified depth. When the plans do not specify the depth to which cable barrier end terminal foundation(s) must be removed, the entire foundation, regardless of depth, must be removed.

Cable Barrier, High Tension, End Terminal Fdn, Rem includes:

A. Removing and disposing of an end terminal foundation in accordance with this special provision;

B. Removal and disposal of any steel components embedded in the foundation; and

C. Backfilling the excavation with sound earth.

Cable Barrier, High Tension, End Terminal Fdn, Rem is not applicable to the removal of driven terminal foundations (terminal foundations that are not constructed with concrete foundations).

10. **Cable Barrier, High Tension, End Terminal Fdn** will be measured and paid for per

individual end terminal foundation installed, regardless of the number of cables connected to the foundation or the dimensions of the foundation. An end terminal foundation will be considered any concrete cable barrier foundation that has cables anchored to the foundation. End terminal foundations have steel components embedded in the foundation for attaching cables and posts to the foundation. An end terminal foundation consisting of one reinforced concrete pile cap connecting two or more drilled shafts will be measured and paid for as one individual end terminal foundation, regardless of foundation dimensions or number of drilled shafts. **Cable Barrier, High Tension, End Terminal Fdn** will be applicable to all cable barrier systems, regardless of manufacturer.

Cable Barrier, High Tension, End Terminal Fdn includes:

A. Constructing a new end terminal foundation in accordance with the contract;

B. Filling any voids, dips, or holes around the foundation with sound earth;

C. Furnishing and installing all required steel components embedded in the foundation, including sockets, lower cable release posts, anchor posts, anchor frame assemblies, and reinforcing cage assemblies;

D. Removing and disposing of excavated material from foundation excavations;

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

F. Conducting concrete quality control.

11. **Cable Barrier, High Tension, Driven Socket, Furn and Install** will be measured and paid for per new individual driven socket furnished and installed. **Cable Barrier, High Tension, Driven Socket, Furn and Install** will be applicable to all cable barrier systems, regardless of manufacturer. **Cable Barrier, High Tension, Driven Socket, Furn and Install** will not be applicable for installation of salvaged driven sockets.

Cable Barrier, High Tension, Driven Socket, Furn and Install includes:

A. Furnishing and installing a new driven socket in accordance with the contract;

B. Filling any voids, dips, or holes around the driven socket with sound earth;

C. Removing and disposing of any excavated material; and

D. Furnishing and compacting sound earth around the driven socket as needed for proper installation.

12. **Cable Barrier, High Tension, Driven Terminal Fdn, Furn and Install** will be measured and paid for per new driven terminal foundation installed, and includes all driven beams, plates, connectors, driven sockets, and all other accessories and hardware within the limits of a cable barrier terminal. **Cable Barrier, High Tension, Driven Terminal Fdn, Furn and Install** excludes components measured and paid for as part of the **Cable Barrier Terminal, Furn and Install** pay items. **Cable Barrier, High Tension, Driven Terminal Fdn, Furn and Install** will be applicable to all cable barrier systems, regardless of manufacturer. **Cable Barrier, High Tension, Driven Terminal Fdn, Furn and Install** will not be applicable

for installation of salvaged driven terminal foundations.

Cable Barrier, High Tension, Driven Terminal Fdn, Furn and Install includes:

A. Furnishing and installing a new driven terminal foundation in accordance with the contract;

B. Filling any voids, dips, or holes within the cable terminal limits with sound earth;

C. Removing and disposing of any excavated material; and

D. Furnishing and compacting sound earth or approved equal around driven sockets and driven terminal foundations as needed for proper installation.