Make the following section a part of the Standard Specifications:

"SECTION 658 – ENHANCED VEHICLE CLASSIFICATION SYSTEM

658.01 Description. This work includes furnishing labor, materials, tools, machinery, and equipment necessary to install a new Enhanced Vehicle Classification (EVC) System, complete in place according to the Contract. The Contractor shall make improvements as shown in the Contract, including the following:

(A) Provide for traffic counting and classification operations by installing classification sensors (piezoelectric sensors), vehicle detector inductance loops (loop sensors), conduits, cable wiring, EVC controller cabinet, and electrical and communications service.

(B) Provide the solar power system which will operate the electronic devices inside the EVC cabinet.

(C) Provide underground conduit systems including trenching and structural excavation. Furnish and install pull boxes. Provide backfilling and restoration work required to install the new EVC System and restore other improvements at the site.

(D) Coordinate work with and arrange for inspection of work by the Engineer. Arrange for a representative from the piezoelectric sensor's manufacturer to supervise installation of piezoelectric sensors.

(E) Conduct required testing of the loop sensors and piezoelectric sensors. Submit acceptance test procedures and criteria for acceptance test results to the Engineer. Notify the Engineer a minimum of 1 week before the date scheduled for testing.

(F) Turn over to the Engineer a complete and operating EVC System according to the Contract.

Furnish and install incidental parts necessary to complete the EVC System as though such parts were in the Contract.

658.02 Materials. Electrical equipment shall conform to NEMA Standards and this Contract. Materials and workmanship shall conform to the NEC, General Order Nos. 6 and 10 of the Hawaii Public Utilities Commission, ASTM standards, the ANSI, and applicable revisions for all the above codes, standards, and local ordinances that may apply.

(A) Piezoelectric Sensors (Piezo Sensors).

(1) Piezo sensors shall meet the following conditions:

(a) Be Class 1 BL Weigh-in-Motion unencapsulated piezoelectric sensors.

(b) Have a minimum operating life of 1 year from the date of acceptance.

(c) Meet the requirements as outlined in the FHWA document *A Summary of Vehicle Detection and Surveillance Technologies Used in Intelligent Transportation Systems*.

(d) Be of the length shown in the Contract Plans (or as determined by the Engineer).

(e) Be manufactured complete with the piezo sensor lead cable and the sensor itself as one integral unit.

(f) Have a 16 gauge, flat, braided, silver plated copper wire center core that is spiral-wrapped by PVDF piezoelectric film.

(g) Have an outer sheath of 0.16-inch thick brass meeting CDA 260, as required by ASTM B587-19, *Standard Specification for Welded Brass Tube*.

(h) Be approximately 0.26 inches wide, with a maximum thickness of 0.063 inch (plus/minus 0.005 inch).

(i) Have insulation resistance between core and shield greater than 500 megaohms.

(j) Have a nominal piezoelectric coefficient greater than or equal to 20 pC/N.

(k) Have designs and installation techniques proven reliable in soil and environmental conditions similar to those in Hawaii.

(l) Be able to withstand at least 1 million cycles.

(m) Have a compatible interface with the electronics housed in the EVC cabinet to perform the applications required for the EVC System.

(n) Include all mounting hardware and PU200 piezo installation resin (or equivalent) used for installation.

(2) The piezo sensor lead cable to the EVC cabinet shall meet the following conditions:

(a) Be manufactured complete with the piezo sensor lead cable and the sensor itself as one integral unit.

(b) Be RG58 type, rated for underground direct burial.

(c) Have an outer jacket of 0.187-inch outside diameter.

(d) Have a nominal capacitance of at least 27 pF/ft.

(e) Be field measured so that the length of piezo sensor lead cable ordered suits the installation conditions.

(f) Be sufficiently long to reach the EVC cabinet with at least an additional 12 inches extra slack within the cabinet. Excess piezo lead cable, beyond the 12 inches of slack, shall be trimmed in the field during installation.

(g) The maximum length of piezo lead cable shall be 300 feet.

(h) Splicing of the piezo sensor lead cable will not be allowed under any condition.

(3) The supplied PU200 piezo installation resin (or equivalent) shall meet the following conditions:

(a) Be suitable for installation in both Asphalt Concrete (AC) and Portland Cement Concrete (PCC) pavements.

(b) Have a short curing time (less than 75 minutes) to minimize lane closure time.

(c) Be of sufficiently thick consistency to prevent ‘running’ when being applied in saw cuts.

(d) Be uniform in consistency such that particulate matter within the sealant does not separate or settle.

(e) Be approved by the piezo sensor manufacturer and the Engineer.

(4) An appropriate in-road temperature sensor shall be supplied to provide temperature correction data for the piezo sensors. The temperature sensor shall be an in-road sensor, as approved by the Engineer.

(B) Loop sensors.

(1) Loop sensor wire shall meet the following conditions:

(a) Be polyethylene insulated.

(b) Be 14 AWG stranded THHN.

(c) Be 600 Volts rated.

(d) Be IMSA Spec. 51-3 certified.

(e) Be tested at the factory prior to shipment.

(f) Include installation materials and loop sealant for installation.

(2) Loop sensor home-run cables shall meet the following conditions:

(a) Be polyethylene insulated.

(b) Be stranded-tinned-copper 14 AWG.

(c) Be a 2-conductor cable.

(d) Have a stranded-tinned-copper drain wire.

(e) Be aluminum–polyester shielded.

(f) Be polyethylene jacketed.

(g) Be 600 Volts rated.

(h) Be IMSA Spec. 50-2 certified.

(i) Be tested at the factory prior to shipment.

(j) Be sufficiently long that the loop sensor home-run cable is one piece that reaches all the way from the pull box (where it is spliced to the twisted pair of loop wires) to the EVC cabinet. The cable length shall allow for a service loop of 5 feet of extra slack in

pull boxes for each loop sensor home-run cable, and an extra 12 inches of slack inside the cabinet.

(k) Be spliced to the twisted pair of loop wires only at the closest pull box to the loop, using a splice kit approved by the Engineer.

(3) The supplied loop sealant shall meet the following conditions:

(a) Be compatible with IMSA Spec. 51-3 loop detector wire.

(b) Be suitable for installation in both AC and PCC pavements.

(c) Shall have a curing time less than 75 minutes to minimize lane closure time.

(d) Shall be uniform in consistency such that particulate matter within the sealant does not separate or settle.

(e) Shall be approved by the Engineer.

(C) Backer Rod. The Contractor shall use 1-inch-long pieces of 3/8-inch to 1/2-inch diameter foam backer rod to secure loop sensor wires at the bottom of saw cuts, as shown on Contract Plans.

(D) Conduits. The Contractor shall use PVC-coated galvanized steel electrical conduits for all above-ground exposed construction, or as directed by the Engineer. PVC conduits shall be used for all underground construction. All direct-burial PVC conduits shall be Schedule 80. PVC conduits under pavement and at utility crossings shall be concrete encased. Concrete-encased PVC conduits can be Schedule 40. Trenched conduits shall conform to Standard Plan TE-35 or TE-36 as indicated on Contract Plans, or as directed by the Engineer. Installation of new conduits must comply with Chapter 6-73, Hawaii Administrative Rules, 'Installation, Operation, and Maintenance of Overhead and Underground Electrical Supply and Communication Lines,' and be installed in areas under pavement before the new pavement is placed.

(1) Steel Conduits. New steel conduits shall meet the conditions of Section 712.27 (D), 'Rigid Steel Conduit PVC Coated' of the Standard Specifications.

(2) Plastic Conduits. New plastic (PVC) conduits shall meet the conditions of Section 712.27 (B), 'Plastic Conduits' of the Standard Specifications.

(3) Duct Sealing Compound. New duct (conduit) sealing compound shall meet the conditions of Section 712.27 (E), 'Duct Sealing Compound' of the Standard Specifications.

(E) EVC Cabinet. The Contractor shall furnish a new EVC cabinet which shall be a ground-mounted cabinet on reinforced Class A concrete foundation with double reinforced Class A concrete work platforms. The EVC cabinet shall be a 332A-Type controller cabinet or equivalent, as specified on Contract Plans, capable of housing all required communications and control equipment necessary for the EVC System. The cabinet shall be equipped with a 19-inch Electronic Industries Alliance (EIA) standard rack, two shelves, and washable metallic filters on both door vents. The cabinet shall be attached to the foundation using 1/2-inch by 4-1/2-inch stainless steel wedge anchors. The cabinet shall be powder coated in anti-graffiti forest green color on the exterior.

(F) Pre-cast Foundations. A pre-cast concrete foundation for the EVC cabinet and its work pads shall only be used if accepted by the Engineer. Manufacturer's brochures, catalog cuts, and shop drawings of any pre-cast foundations to be used shall be submitted to the Engineer for acceptance as specified in Section 658.03 (A) below.

(G) Power. Solar power system components shall be furnished by the Contractor.

(1) Power to the cabinet electronics shall be provided with two (2) batteries: gel type, deep cycle, 97AH minimum, 12Volts, housed in the cabinet and charged by a 200Watt solar panel mounted on top of the cabinet.

(2) The Contractor shall provide surge protection devices, grounding according to NEC requirements, and a suitable charge controller with minimum of 25Amps capacity, Maximum Power Point Tracking (MPPT) type, with a meter display. The surge protection, grounding, and charge controller shall be housed in the cabinet.

(3) The Contractor shall submit shop drawings of the solar power system components to the Engineer for acceptance prior to ordering materials, as specified in section 658.03 (A) – Equipment List and Drawings below. Manufacturer's brochures, catalog cuts, and shop drawings submitted shall include information on the solar panel, wiring, surge protection, charge controller, batteries, and grounding.

(H) Excavation Warning Signs. The Contractor shall furnish and install two new warning signs and appropriate mounting post adjacent to the sensor lead cable runs or as close as possible to the cables as indicated in the Contract Plans. Signs shall be mounted back-to-back on the post and oriented parallel to the traffic flow direction. Signs and mountings shall conform to the requirements of Section 750.02, 'Sign Posts' of the Standard Specifications and Standard Plan TE-01, and Contract Documents. Sign posts shall be no more than 20 feet from the cabinet. Signs shall be 12 inches wide by 18 inches high. Bottom of signs shall be at 8 feet above finished grade. Signs shall leave a blank space of length 'XXXXXX' so that once the station short name has been determined, it can be added to the sign later:

WARNING
BURIED TRAFFIC MONITORING LINES
NOTIFY HWY-PLANNING BRANCH AT
(808) 587-6352 BEFORE DIGGING OR EXCAVATION
STATION XXXXXX

The first line shall be a minimum of 2 inches in height. Subsequent lines of text shall be 1 inch in height. No border is necessary, but a minimum margin of 1/4 inch shall be maintained. For the letters and background, use black and yellow (non-retro-reflective) paints, respectively. The first line of text shall be centered. Subsequent lines shall also be centered; however, the Contractor shall have the option to move the wording within these lines to allow for best fit. Details of the furnished warning signs, mounting, and sign post shall be submitted to the Engineer for acceptance prior to purchase. Furnishing warning signs, mounting, and installation shall be incidental to the Contract.

(I) Pull Boxes and Covers. A new pull box shall be furnished and installed as indicated in the Contract Documents. The new pull box cover shall be labeled TRAFFIC MONITORING. This label shall be cast or molded into the cover material and not just marked on the cover surface. Pull boxes and covers shall be rated for the largest potential vertical vehicle loads they might encounter, according to their position in shoulders, medians, and traffic lanes, or by direction of the Engineer and as shown in the Contract Documents.

(J) Other Materials. Other materials shall meet the requirements specified in the following sections of the Standard Specifications:

Structural Concrete	Section 601
Reinforcing Steel	Section 602

Trench Backfill Material	Subsection 703.21
Concrete Pull Box	Subsection 712.06 (B)

658.03 Construction Requirements.

(A) Equipment List and Drawings. Within 7 days following Contract award, two copies of materials and equipment purchase requisition, including copies of the equipment list, manufacturer's brochures, catalog cuts, and shop drawings shall be submitted to the Engineer for acceptance.

Materials and equipment shall be ordered immediately upon acceptance by the Engineer. If the Contract award is rescinded by the Department after ordering of materials and equipment, the Department will purchase ordered materials and equipment at cost based on invoices. Purchase price will include transportation cost and applicable State excise taxes. Purchase price will not include profit.

Upon completion and acceptance of work, an 'As Built' or corrected plan shall be submitted, showing in detail any construction changes per Section 648, 'Field Posted Drawings' of the Standard Specifications.

(B) Excavation and Backfill. Excavation and backfill shall be made in accordance with Section 204, 'Excavation and Backfill for Miscellaneous Facilities' of the Standard Specifications. Material from excavation shall be placed to prevent damage and obstruction to vehicular and pedestrian traffic and interference with surface drainage.

(C) Installation. The Contractor shall notify the State and schedule a meeting at least 14 days prior to any construction activity. The State shall install new traffic monitoring equipment and electronics in the cabinet after the installation of the cabinet and sensors. Installation of sensors shall occur after any and all grinding and or milling of the finished pavement surface and after application of pavement markings or striping.

(1) Piezo Sensors.

(a) Installation shall be supervised by the piezo sensor manufacturer's representative.

(b) Construction shall reflect the number and configuration for the piezo sensors as shown in the Contract Plans.

(c) Piezo sensors and leads shall be installed at least 18 inches away from cracks, potholes or joints within the pavement. If the finished pavement at the installation site has cracks, potholes or joints, the number and configuration of piezo sensors shall be modified.

(d) Piezo sensors shall be installed within the roadway, two each per lane, in both traffic directions. Refer to the configuration shown in the Contract Plans.

(e) If the sensor configuration needs to be modified, the Contractor shall inform the State 14 days before the start of construction and submit Shop Drawings of the revised configuration for approval.

(f) A 3/4-inch thick saw blade shall be used to make 3/4-inch wide by 2-inch deep saw cuts for piezo sensors in a single pass of the saw. The slots shall be made as shown in the Contract Plans, or as approved by the Engineer.

(g) A 3/8-inch thick saw blade shall be used to make 3/8-inch wide by 4-inch deep saw cuts (unless shown otherwise on the Contract Plans or by direction of the Engineer) for the piezo sensor lead cables. The transition from the 2-inch deep sensor saw cut to the 4-inch deep lead cable saw cut shall be smooth and gradual to prevent a sharp edge under where the lead cable and sensor connect.

(h) Saw cuts shall be made by wet cutting. Dry cutting shall not be allowed.

(i) Dust, dirt, and refuse shall be collected and cleaned away promptly after saw cutting is done. The saw cuts shall be cleaned by water applied by pressure washer. Residual water within the slots shall be vacuumed by use of a wet/dry vacuum. The saw cuts shall then be dried by air compressor. Flame torches shall not be used to dry saw cuts. After they are dried, any remaining debris stuck within the saw cuts must be removed. The saw cuts must be completely clean and dry before inserting the piezo sensors and lead-in cables.

(j) The saw cuts shall be inspected before inserting piezo sensors. If any additional debris or moisture is observed, compressed air shall be used to dry the saw cuts and remove any additional debris before proceeding with installation.

(k) Piezo sensors shall be tested and cleaned prior to installation according to manufacturer's installation instructions.

(l) Piezo sensors shall be laid in saw cuts at 1-1/4 inch below the surface of the roadway or as recommended by the manufacturer. Piezo sensors shall be installed straight and flat in saw cuts. Piezo sensors shall be secured in place along the entire length of sensors by seating them in the saw cuts with the clips provided in the sensor kit from the manufacturer. The clips shall be spaced 6 inches apart.

(m) Voids of the piezo sensor saw cuts shall be filled with PU200 piezo installation resin (or equivalent) so that the piezo sensors are fully encapsulated. The PU200 piezo installation resin (or equivalent) shall be prepared in accordance with the manufacturer's instructions and shall result in a finish approximately 1/16 inch above the surface of pavement. Once the resin has sufficiently hardened, the sealant shall be ground flush with the road surface along the saw cut.

(n) Hot tar shall not be used.

(o) A service loop of 5 feet of extra slack shall be provided in pull boxes for each piezo lead cable.

(p) Piezo lead cables shall be trimmed after allowing for an extra 12 inches of slack inside the EVC cabinet. Splicing to lengthen the piezo lead cable shall not be allowed under any condition. Spliced piezo lead cables will be rejected.

(q) The in-road temperature sensor shall be installed according to the manufacturer's instructions, as approved by the Engineer. The temperature sensor shall be placed in a 3/8-inch wide by 2-inch deep saw cut at 1-1/4 inch below the road surface. The saw cut for the temperature sensor and its lead shall be cut by wet cutting, then cleaned and prepared in the same way as the saw cuts for the piezo sensors.

(r) Adequate power shall be provided for all test equipment to meet the detailed and specific requirements of the manufacturer for all tests required for certification and acceptance. All necessary equipment to perform the required tests shall be provided.

(s) Traffic shall not be allowed on the completed system until the manufacturer's representative approves all conditions of the installation with the acceptance by the Engineer. Thereafter, testing in accordance with the manufacturer's requirements shall be completed before public traffic is allowed.

(t) HDOT or its representative will make the final connection inside the EVC cabinet; however, the Contractor shall label the wires clearly to identify traffic direction, lane number, and sequence of piezo sensors in each lane per direction. All labeling at the pull box and cabinet must be consistent to prevent confusion.

(2) Loop Sensors.

(a) Construction shall reflect the number, size, and configuration of loop sensors as shown in the Contract Plans.

(b) Loop sensors and their leads shall be installed at least 18 inches away from cracks, potholes or joints within the pavement. If the finished pavement at the installation site has cracks, potholes or joints, the number and configuration of the loop sensors shall be modified.

(c) If the configuration of the loop sensors needs to be modified, the Contractor shall inform the State 14 days before construction and submit Shop Drawings of the revised configuration for approval.

(d) Loops shall be installed two per lane to measure speed and length of the vehicles and to classify vehicles in conjunction with the axle detectors (piezo sensors). Loops shall be installed such that they are centered in lanes relative to the permanent lane striping. Loop sensors not installed centered in each lane relative to the permanent lane striping shall be replaced correctly at no additional cost to the State. If lanes are less than 12 feet in width, the loop configuration may be specified as a non-centered configuration or otherwise modified. Refer to the configuration specified in the Contract Plans.

(e) A 3/8-inch thick blade shall be used to make 4-inch deep (or as shown on Contract Plans) saw cuts for the loop sensors and their leads.

(f) Saw cuts shall be made by wet cutting. Dry cutting shall not be allowed.

(g) Dust, dirt, and refuse shall be cleaned away promptly after saw cutting is done. The saw cuts shall be cleaned by water applied by pressure washer. Residual water within the saw cuts shall then be vacuumed using a wet/dry vacuum. The saw cuts shall then be dried by air compressor. After they are dried, any debris stuck within the saw cut must be removed.

(h) The loop sensor and lead wire shall be one continuous piece of wire, from the pull box, to the loop, around it four turns, and back to the pull box. The size of loops is specified in the Contract Plans.

(i) After laying the four turns of loop sensor wire in the bottom of the 4-inch deep slot, 1-inch long pieces of foam backer rod shall be pressed down on top of the wires in each foot around the loop, to anchor the wires in the bottom of the saw cut before applying the loop sealant. Backer rod pieces shall also be placed on top of the loop leads as was done around the loops, to anchor the leads in the bottom of the collector saw cuts that run from the loops to the conduit entry point (stubout) at the edge of the pavement. Backer rod shall be embedded at least 2 inches below the top of pavement. The backer rod shall be placed into the saw cut with a blunt object, such as a wooden stir stick. No sharp object, such as a screwdriver, shall be used to press backer rod into saw cuts.

(j) Loop sealant shall be applied to saw cuts so that there are no voids, completely filling the saw cut, and such that the sealant will cure flush with the road surface.

(k) Twisted-pair loop leads shall be twisted five twists per foot from the conduit entry point at the roadside to the pull box, where they will be spliced to the home-run cable. The twisting shall be completed prior to inserting the resulting twisted-pair loop lead into the conduit leading to the pull box.

(l) A twisted pair of loop leads from one loop sensor shall not be twisted with the twisted pair from another loop sensor.

(m) The twisted-pair lead-in wires from the loop sensors shall be spliced (as directed by the Engineer) to new home-run cables at the closest pull box to the loop, using a splice kit. The splice kits shall be used in accordance with the manufacturer’s specifications. The splices shall be inspected by the Engineer before acceptance.

Splice points of cables must be suspended near the top of the pull box with a j-hook or equivalent.

(n) A service loop of 5 feet of extra slack shall be provided in the pull box for each loop sensor home-run cable.

(o) Loop sensor home-run cables shall be trimmed after allowing for an extra 12 inches of slack inside the EVC cabinet.

(p) HDOT or its representative will make the final connection inside the EVC cabinet; however, the Contractor shall label the wires clearly to identify traffic direction, lane number, and sequence of loops sensors in each lane per direction. All labeling at the pull box and cabinet must be consistent.

(3) Pull Box.

(a) A new pull box shall be furnished and installed as indicated in the Contract Plans. The location for the new pull box shall be excavated carefully. The location for the pull box shown in the Contract Plans is approximate. The final location shall be determined in the field.

(b) The new pull box shall be installed so that its covers are 1 inch above surrounding ground or level with finished grade if installed in paved areas or sidewalks.

(4) Cabinet Foundation.

(a) New foundations shall be constructed as indicated in the Contract documents.

(b) For cast-in-place foundations, forms shall be set true to correct line and grade. Rigid forms shall be securely braced in place. Conduit ends shall be placed in proper position and height and held in place by rigid top template during concrete placement and until concrete sets. Concrete shall be cured not less than 72 hours.

(c) Mixing, placement and curing of concrete for cast-in-place foundations shall be in accordance with Section 601, ‘Structural Concrete’ and Section 503, ‘Concrete Structures’ of the Standard Specifications.

(5) EVC Cabinet.

The new EVC cabinet shall be mounted on the foundation and set at the required location as shown in the Contract Plans or as ordered by the Engineer. The location shown in the Contract Plans is approximate. The final location shall be determined in the field, and shall not subject the cabinet to spray from irrigation systems. The cabinet shall be secured to the foundation with 1/2-inch by 4-1/2-inch stainless steel wedge anchors.

(6) Conduits.

(a) Lay polyvinyl chloride (PVC) conduits carefully in trenches prepared to receive conduits. Concrete encase PVC Schedule 40 conduits under paved areas and at utility crossings, per Standard Plan TE-36. Metallic Excavation Warning Tape shall be placed above conduits. Use PVC Schedule 80 conduits, direct buried, per Standard Plan TE-35 in unpaved areas not exposed to traffic. Conduits in some unpaved parts of the Right of Way, such as unpaved shoulders and medians may require concrete encasement, as indicated on Contract Plans.

(b) Set conduits to be encased in concrete structure or encased in concrete to required lines and grades. Support conduit rigidly in place by masonry material, manufactured conduit spacers, or other accepted means, so that conduit will not dislodge during concrete placing and tamping. Place concrete encasement using hand shovels only. Cure concrete for at least 12 hours before backfilling and compacting.

(c) Whether shop or field cut, ream end of conduits to remove burrs and rough edges. Make cuts square and true. Slip joints or running threads will not be allowed for coupling conduit. When standard coupling cannot be used for coupling metal-type conduit, use of UL or ETL listed threaded union will be allowed.

(d) Install rigid steel conduit in accordance with NEC requirements for rigid metal conduit. Use white and tinted ready-mixed paint on threads of joints. Repair zinc-coated surfaces in accordance with Subsection 501.03(G)(2) – Repairing Damaged Zinc-Coated Surfaces.

(e) Apply two coats of asphaltic base paint to direct burial steel conduits not encased in concrete immediately after installation.

(f) Install and repair surfaces of PVC-coated rigid steel conduit in accordance with manufacturer's recommendations.

(g) Install PVC conduit in accordance with NEC requirements. Use solvent weld connections. Make solvent weld joints in accordance with conduit manufacturer's recommendations.

(h) Make directional changes in non-metallic conduits with curved segments using accepted deflection couplings, or with short lengths of straight conduits and couplings. Deflection angle between two adjacent lengths of conduit shall not exceed 6 degrees. Do not use radius of less than 12 times nominal size of conduit, unless using factory-made ells.

(i) Use steel or Schedule 80 PVC conduits for exposed construction except for communications cable risers. Use Schedule 80 PVC conduits for communications cable risers.

(j) Thread connection for PVC conduit to rigid metal conduit on metal conduit side.

(k) Provide each conduit run with 1/8-inch polyester or polyolefin pull line extending through entire length. Double additional 2 feet of polyester or polyolefin line back into conduit at each end of run. End conduits entering pull boxes with end bells. Cap or plug ends temporarily.

(l) Cap or plug and mark ends of conduit stubouts. Ends of conduit runs shall extend at least 24 inches past face of curb or edge of pavement unless entering pull boxes. Install markers or markings on curb for ends of conduit runs. Show locations on as-built, as specified under Subsection 658.03(A) – Equipment List and Drawings.

(m) Pass bullet-shaped test mandrel, 14 inches long with diameter 1/2 inch less than inside diameter of each conduit run. Scores found on mandrel deeper than 1/32 inch shall be indication of burrs or obstruction in conduit run. Remove burrs and obstructions. Redo mandrel test until no scoring on mandrel deeper than 1/32 inch is evident.

(n) Keep interior of conduits clean during construction by temporarily plugging ends of conduits. Plug conduit ends at end of each workday, whenever work is stopped, and whenever conduits

are subject to submergence in water. Install conduits to drain toward pull boxes or handholes.

Conduits under pavement and at utility crossings shall be trenched and concrete encased, per Standard Plan TE-36. Metallic Excavation Warning Tape shall be placed above the conduit per Standard Plan TE-36. Conduits in some unpaved parts of the Right of Way may be installed per Standard Plan TE-35, as indicated on Contract Plans.

(7) Wiring.

(a) Wiring shall conform to the appropriate articles of the NEC and shall be arranged within assemblies and pull boxes neatly. Wiring installed underground must be in conduits—no direct burial. Before the final installation of cables in conduits a wire brush shall be pulled through each conduit, to ensure that extraneous matter has been removed, and to verify that the conduit system is clean and free from obstructions.

(b) Cables shall be handled with great care to avoid damage to the conductors or the jacket. Cables shall not be pulled off and laid on the ground before installation. Pulls shall be made in one direction only. Lubricants used shall be as recommended by the cable manufacturer or accepted by the Engineer. Wires or cables shall not be left under tension nor tight against bushings or fittings.

(c) Damaged ends resulting from the use of pulling grips shall be removed soon after pulling conductor and cable. Cable ends shall be temporarily taped or capped to exclude moisture and shall remain protected until HDOT or its representative makes the final connections inside the EVC cabinet. The Contractor shall label the wires clearly to identify traffic direction, lane number, and sequence of loops and piezo sensors in each lane per direction. All labeling at the pull box and cabinet must be consistent.

(D) Bonding and Grounding. The station shall have bonding and grounding constructed as follows:

(1) Metallic conductor and cable sheaths and conduits shall be secured mechanically and electrically to form a continuous system.

(2) The system shall be grounded in accordance with the NEC and as specified herein. No. 8 AWG copper wire or equivalent copper strap of same cross-sectional area shall be provided for bonding and grounding jumpers.

(3) Conduits and neutral wires shall be grounded at service points as required in accordance with the NEC, using No. 6 AWG or equal for grounding conductors.

(4) Copper-clad steel or pure copper ground rod, 5/8-inch diameter by 8 feet long, shall be installed inside the cabinet foundation.

(5) Grounding rods shall use No. 6 AWG wire to connect to No. 8 AWG ground wire loop and power system neutral.

(G) Inspection and Testing.

(1) Before Installation. The equipment shall be given requisite factory tests and inspected by the contractor upon receipt and prior to installation, to determine that the workmanship and materials are free from defects.

(2) After Installation.

(a) Piezo sensors shall be tested after installation. Hard copy and digital format test results shall be furnished for each piezo sensor, showing:

1) Resistance: at least 1 megaohm.

2) Capacitance: between 5 and 20 nanofarads.

3) Dissipation Factor: less than 0.04.

(b) Loop sensors shall be tested after installation. Hard copy and digital format test results shall be furnished for each loop sensor, showing:

1) Induced voltage (V).

2) f = Frequency of Loop (kHz).

3) L = Inductance of Loop (μH).

4) R = Resistance of Loop (ohm).

5) Meg Test = Loop insulation resistance should be greater than 100 megaohms.

(c) The Contractor shall provide all testing equipment such as BK 875A or equivalent LCR meter, Fluke 75 or higher/equivalent multimeter, megohmmeter, and scope meter or oscilloscope for the above tests.

(d) Any defects discovered as a result of the sensor tests shall be corrected at no additional cost to the State.

(3) Acceptance of EVC System. The EVC System shall not be accepted and payment shall not be made until testing results requirements have been successfully met and the test results have been submitted to the State within 30 calendar days from the completion of sensor installation.

(H) Restoring Pavements and Other Improvements. Existing pavements and other improvements, such as driveways, sidewalks, curbs, and gutters disturbed by excavation shall be restored to their original condition. Replacement material equal to or better in quality than existing materials shall be used. Existing grades, thickness, texture, and color shall be matched whenever applicable.

(I) Warranty. New material and equipment for permanent construction shall be provided. Copies of manufacturer's warranty or warranties guaranteeing equipment free from defects in materials, design, and manufacturing, for not less than 12 months from the date of acceptance shall be furnished. Adjustment or repair of material and equipment under warranty shall be made within 24 hours from time of notification. Temporarily replacement of under-warranty material and equipment requiring factory corrections shall be made within 24 hours from time of notification. Factory-corrected or new material and equipment shall be installed no later than 30 days from time of notification.

658.04 Method of Measurement. The EVC System will be paid for on a lump sum basis. Measurement for payment will not apply.

658.05 Basis of Payment. The Engineer will pay for the accepted EVC System on a lump sum basis. Payment will be full compensation for the work prescribed in this section and the Contract Documents.

The Engineer will pay for the following pay item when included in the proposal schedule:

Pay Item	Pay Unit
EVC System	Lump Sum”

END OF SECTION 658