

617 TRAFFIC SIGNALS

617.01 DESCRIPTION.

Traffic Signal work shall consist of furnishing all labor, equipment and materials and installing all electrical equipment, cabinets, conduits, manholes, pull boxes, wiring, cabinets, traffic signals, pedestrian signals, poles, and incidentals as shown in the contract documents, and as specified in this section for a complete working traffic signal system.

Wherever the word “provide” is used, it shall mean “furnish and install complete in place and ready for use.”

Items for traffic signal equipment shall consist of products of the same manufacturer, as far as practicable. The traffic signal system shall conform as to voltage, amperage, frequency, and type specified.

In order to provide the proposed lighting system the Contractor shall cooperate with the Potomac Electric Power Company (PEPCO). PEPCO will supply the power required for the locations outlined in the contract documents.

617.02 CODES AND STANDARDS

Material, equipment and installation shall conform to the following:

American Society for Testing and Materials (ASTM)

American National Standards Institute (ANSI)

Certified Ballast Manufacturers

Institute of Electrical and Electronic Engineers (IEEE)

Insulated Power Cable Engineers Association (IPCEA)

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA)

Underwriters Laboratories, Inc. (UL)

District of Columbia Electrical Code

National Electric Safety Code

United States of America Standards Institute (USASI)

Rules and Regulations of the Potomac Electric Power Company (PEPCO)

American Association of State Highway and Transportation Officials (AASHTO)

Electrical contractors must be bonded in the District and their electricians must have District licenses. The Contractor must secure a permit approved by the Electrical Engineer, D.C., prior to the beginning of any work, and the traffic signal work must at all times be

inspected by electrical inspectors and traffic signal technicians of the Department of Transportation (DDOT).

No work shall be covered or enclosed at any time prior to inspection.

The Contractor must have approved shop drawings, catalog cuts, and specifications available at the jobsite for inspection by the Chief Engineer and the Department's electrical inspector and traffic signal technician.

617.03 MATERIALS

(A) **GENERAL.** New first quality materials shall be furnished in conformance with [825](#). Material and equipment must be UL listed and labeled. All electrical parts, wire, and other elements of the traffic signal installations shall be of ample capacity to carry required current without excessive heating or causing an excessive drop in potential. Except as otherwise provided herein, each individual item of traffic signal equipment shall bear a nameplate or other type of indelible marking or brand that shall identify it as to type, catalog number, and manufacturer. This applies to hardware and miscellaneous materials.

(B) **COORDINATION WITH OTHER TRADES.** It shall be the responsibility of the Contractor to coordinate the location of equipment, conduit, devices, fixtures, etc., furnished and installed under other sections and by other trades to the extent that interference among such items is avoided. Relocation of items required as a result of failure of the Contractor to coordinate his work with the work of other trades shall be at the expense of the Contractor and at no additional cost to the District.

(C) **STANDARD PRODUCTS.** Unless otherwise indicated, materials furnished shall be standard products of a manufacturer regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design complying with the specification requirements.

Where materials, equipment, apparatus, or other products are specified by manufacturer, brand name, type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the bid. Specified materials shall be furnished.

(D) **SAMPLES.** When samples are required they shall be submitted to the Chief Engineer for approval within 8 weeks after award of contract or prior to start of work, properly marked for identification and free of expense to the District. The District reserves the right to mutilate or destroy any sample submitted when considered necessary for testing purposes. Samples not so mutilated or destroyed will be returned to the Contractor at his expense when no longer necessary for the performance of the contract.

The Contractor shall submit the following:

- (1) The name and manufacturer of the equipment he proposes to furnish.
- (2) Such data and descriptive materials as may be necessary for the mechanical trades in connection with maintenance.
- (3) All signal wiring or necessary diagrams and drawings for approval.
- (4) Any additional samples if deemed necessary.

- (E) **MATERIAL AND WORKMANSHIP.** Installation work shall be in accordance with the contract documents. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired by the Contractor in a manner meeting the approval of the Chief Engineer without additional compensation.

The contract documents indicate the extent and general arrangement of the conduit and wiring systems. If departures from the contract documents are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted as soon as possible to the Chief Engineer for approval. No departures shall be made without prior written approval.

Materials and items of work shall be as specified herein in [825](#), and/or in the contract documents.

- (F) **GUARANTY.** The Contractor shall guarantee all traffic signal work to be in accordance with contract requirements and free from defective or inferior materials, equipment, and workmanship for a period of 1 year from date of acceptance of the traffic signal work.

If, within the guaranty period, the Department finds that guaranteed work needs to be repaired or changed because of the use of materials, equipment, or workmanship which are inferior, defective or not in accordance with the terms of the contract, DDOT shall so inform the Contractor in writing and the Contractor shall promptly and without additional expense to the District: (1) Place in a satisfactory condition all such guaranteed work; (2) Make good all damage to equipment, the site, the structure, and/or related appurtenances, which is the result of such unsatisfactory guaranteed work; (3) Make good any work, materials, and equipment that are disturbed in fulfilling the guarantee.

Should the Contractor fail to proceed promptly in accordance with the guarantee, the District may cause such work to be done and the Contractor and the surety or sureties under the bond shall be jointly and severally liable for the cost of same.

617.04 CONTRACT PLANS AND MANUFACTURER'S DRAWINGS

- (A) **TRAFFIC SIGNAL PLANS.** These plans indicate the general arrangements of the traffic signal, pedestrian signals, circuits and conduits and the locations of poles and manholes. The contract documents are intended to show and describe the work entirely. However, every item necessary to complete the work may not be specifically shown or described. Incidentals not shown or specified, but necessary for the proper operation of the traffic signals at specific intersections or within the traffic signal system shall be included in the work. The Contractor shall be responsible for furnishing all materials for the installation, complete, so as to insure the successful operation of the signalized intersection or traffic signal system.
- (B) **MANUFACTURER'S DRAWINGS.** Manufacturer's drawings shall consist of all shop and installation drawings, catalogs, photometric curves, performance data, pole installation details, etc. The Contractor shall secure and/or prepare these drawings and submit them as required by [105.02](#) before purchasing materials or proceeding with construction. Shop drawings shall show complete details of construction for all portions of the work included. The Contractor shall check each drawing to insure conformance with the contract documents, and each drawing shall bear the Contractor's signature and

certification. Drawings and data not clearly identified will be returned without approval to the Contractor.

Transmittals accompanying all shop drawings shall contain names and addresses of the Contractor, subcontractors, and suppliers. Project title, reference to prior actions on submissions and specification reference shall also be indicated.

617.05 TRAFFIC SIGNAL CONTROLLER CABINET FOUNDATION

- (A) **DESCRIPTION.** The work consists of providing all labor, equipment and materials necessary to construct a foundation for the traffic signal controller cabinet, as shown on the contract documents, in conformance with the requirements for a Model 336SS Controller cabinet foundation, as detailed in the DDOT standard drawings, and in conformance with appropriate provisions of this specification. PCC Concrete for the foundations shall conform to [817.03 \(A\) Class F](#).

The foundations shall be installed 36 inches from the face of curb to centerline of foundation or as noted on the contract documents. Forms shall be true to line and grade. Conduit ends and anchor bolts shall be placed in proper position and to the proper height, and shall be held in place by means of template until the concrete sets. The foundation shall have five (5) conduits installed. A 2 inch conduit shall be installed through the foundation for the installation of the ground rod. A two inch (2") diameter conduit shall be routed toward the existing PEPCO manhole shown on the contract documents for electrical service. The third two inch (2") diameter conduit shall be routed toward the proposed DC manhole shown on the contract documents for the communications cable. The two four inch (4") diameter conduits shall be routed toward the proposed DC manhole shown on the contract documents for cables to traffic and pedestrian signal heads. The conduit shall extend a minimum of two inches (2") and a maximum for four inches (4") above the top of the finished foundation. The 3/4" diameter ground rod, #6 solid copper ground wire, and ground clamps, shall be included in the cost for this item. The anchor bolts shall be set to the correct location and project 3" above the foundation. The foundation shall be allowed to set for a minimum of 3 days before installing the cabinet. All material excavated and other debris shall become the property of the Contractor and shall be disposed of by him at no additional cost to the District.

All conduits shall be schedule 40 PVC. Each conduit installed to accommodate cable shall feature a radius sweep of 36 inches so as to meet the underground electrical conduit at the proper elevation beneath grade. In addition, the 3/4"inch copper clad ground rod shall be of sufficient length to ensure that a minimum length of 8 feet is driven into undisturbed soil.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Traffic Signal Controller Cabinet Foundation will be each. Payment will be made at the contract unit price for each Traffic Signal Controller Cabinet Foundation. The payment shall include the cost of excavation, PCC concrete, anchor bolts, ground rod, reinforcing steel, ground clamps, No. 6 solid ground wire and Schedule 40 conduits with the entire 36 inch sweep length where appropriate. The payment shall also include all labor, materials, equipment and incidentals necessary to complete the work specified herein and completely clean the site of all debris.

617.06 FOUNDATION FOR TRAFFIC SIGNAL POLE

- (A) **DESCRIPTION.** The Contractor shall furnish all labor, equipment and materials necessary to construct a foundation for a traffic signal pole or a pendant post streetlight pole as shown in the contract documents, in conformance with the standard drawings for a 15" diameter bolt circle pole foundation, and in conformance with appropriate provision of these specifications. PCC Concrete for the foundations shall conform to [817.03 \(A\) Class F](#).

The distance from the face of the curb to the centerline of the foundation shall be not less than 36 inches or as noted in the contract documents. Forms shall be true to line and grade. Conduit ends and anchor bolts shall be placed in proper position and shall be held in place by means of a template until the concrete sets. The foundation shall have three (3) conduits installed. All conduits shall be Schedule 40 PVC. A 1.5 inch diameter conduit shall be installed through the foundation for the installation of the ground rod. One 2 inch diameter and one 4 inch diameter conduit shall be routed from the foundation toward the manhole(s) designated in the contract documents. The conduits shall extend a minimum of 2 inches and a maximum of 4 inches above the grade of the foundations. Each conduit installed to accommodate cable shall feature a radius sweep of 36 inches so as to meet the underground electrical conduit at the proper elevation beneath grade.

The four anchor bolts shall be set at the correct location forming a 15 inch diameter bolt pattern as shown in the contract documents. Each bolt shall project 3 inches above the top of the foundation. Anchor bolts shall be in conformance with [822.06 \(B\)](#). The foundation shall be allowed to set for a minimum of 3 days before installing the transformer base. All excavated material and other debris shall become the property of the Contractor and shall be disposed of at no additional cost to the District.

The 3/4 inch diameter copper clad ground rod, the No 6 solid ground wire, and the ground clamps shall also be included. The ground rod shall be of sufficient length to ensure that a minimum length of 8 feet is driven into undisturbed soil.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Foundation For Traffic Signal Pole will be each. The payment for Foundation For Traffic Signal Pole will be at the contract unit cost for each foundation and will include excavation, PCC concrete, anchor bolts, ground rod, reinforcing steel, ground clamps, No. 6 solid copper ground wire and Schedule 40 conduits with the entire 36 inch sweep, where appropriate. The payment will also include all labor, materials, equipment, and incidentals necessary to complete the work specified herein and completely clean the site all debris.

617.07 ELECTRICAL CABLES FOR TRAFFIC SIGNALS

- (A) **DESCRIPTION.** The work consists of providing traffic signal cable for traffic signal intersections and the traffic signal system in conformance with the requirements of [621.11](#), Wiring Systems; [621.12](#), Cable Connections; [621.13](#), Circuit Identification; and these specifications. Electrical cables shall be looped in and out of controller cabinets, communications termination cabinets, manholes, hand boxes, poles and transformer bases to provide a minimum 3 feet of slack. Cable shall be pulled to ensure minimum stress on cables, conductors and connectors. All cable runs are to be continuous with no splices permitted in conduits, manholes, transformer bases, poles, or hand boxes.

Electrical cables for traffic signals shall be routed through conduits, manholes and overhead as shown in the contract documents or approved working drawings. Cable routings shall be adapted to match field changes resulting in conduit, manhole, foundation, controller, or hand box relocations.

The Contractor will be required to provide the following different types of cable in conjunction with this work; cable running between the controller and signal heads, detector lead-in cable, and twisted pair copper communications cable. Ground cable is addressed in conjunction with grounding and bonding, [Section 618](#).

(B) SPECIFICATIONS

1. Cable Between the Controller and Signal Heads

The cables running between the traffic signal controller and signal heads shall be 7 Conductor 14 AWG stranded cable conforming to the most recent requirements of the International Municipal Signal Association Inc. (IMSA) Specification No 19-1. A signal head shall be defined as a traffic signal head, pedestrian signal head, school or warning flasher, neon sign or fiber-optic electronic regulatory or lane control sign.

2. Detector Lead-in Cables

The cables running between the traffic signal controller and specified detection equipment shall be 4 conductors 18 AWG shielded, stranded cable. This cable is "Non IMSA spec" and frequently goes by the catalog code as No. 4C18 B7 OS-F. Detection equipment shall be defined as pedestrian push button, microwave vehicle detector or loop detector. Cables serving loop detectors shall be coiled in the appropriate hand box.

3. Communication Cables

Underground communications cable shall satisfy all of the requirements of IMSA 60-2 or REA PE-39. Aerial (overhead) communications cable shall meet all of the requirements of IMSA 40-2 or REA PE-22. Communications cable that runs partly overhead and underground shall meet the requirements of IMSA 60-2 or REA PE-39. DDOT uses 12 pair, 25 pair, 50 pair, and 100 pair communications cables in its traffic signal plant. Precise cable routing as with the number of pairs required are shown on each individual plan set. All signal conductors shall be color coded in accordance with IMSA Specification 19-1-1967, Table 2. The Contractor shall furnish a manufacturer's certification that the cables conform to the requirements of IMSA or ASTM Specifications referenced for each type of cable furnished.

4. Connectors and Terminals

Connections and terminals shall conform to the requirements of NEC 110 for the type of cables specified in the contract documents and shall conform to the manufacturer's recommendations.

(C) INSTALLATION PROCEDURES

The following wiring procedures will be strictly adhered to when wiring electrical devices to operate as part of a signalized intersection or traffic signal system.

1. All cable segments shall be identified with a waterproof tag securely affixed to the cable in the controller cabinet, all pull boxes, hand boxes, and manholes, and in all transformer bases.
2. All cable shall satisfactorily pass the megger tests. Cable failing the megger test shall be replaced by the Contractor at no cost to the District.
3. Cables shall be pulled through electrical conduits, manholes, controller cabinet, poles, and mast arms in accordance with the following procedures.
 - a. Cables shall be installed and pulled so as not to damage the cable or exceed the manufacturer's recommendations for bending radius or pulling tension.
 - b. Cables may be installed or removed in duct lines that may contain energizing cables. All duct rodding shall be performed with a non-conductive rod and appropriate safety precautions shall be followed.
 - c. Cables shall be pulled in and through the conduit with a cable grip designed to provide a firm hold on the exterior covering of the cable. Cable shall be pulled with a minimum of dragging on the ground or pavement.
 - d. Powdered soapstone, talc, or other approved lubricants may be used to facilitate the pulling of cable. In any event, lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer.
 - e. Cables shall be looped in and out of the controller cabinet, manholes, hand boxes, and poles to provide adequate slack and the minimum amount of stress on conductors and connectors. Cable runs shall be continuous with no splices in the conduit, manholes, hand boxes, transformer bases or anywhere along an overhead cable run.
 - f. No branch splices of cable shall be permitted between the traffic signal controller and any signal head, detection device, or communications facility. Straight splices of cable are permissible only with the approval of the Chief Engineer utilizing splice kits that totally encapsulate the cable and produce a waterproof splice.
 - g. Cables shall be racked neatly and securely supported in all manholes.
 1. Cables shall be identified with a waterproof tag securely affixed to all cables in each manhole, hand box, transformer base and controller or termination cabinet. The Contractor shall prepare and affix each cable tag. Traffic signal system cables entering or leaving a controller cabinet shall be tagged to identify the type of signal head (vehicle, pedestrian, flasher, electronic sign) or detection device (push button, microwave detector, loop detector) being serviced, and the signal head or detector number as defined by the signal configuration package or the traffic signal sequence of operation. Communications cable shall be identified by trunk and cable pair number. Identification tags shall contain the following minimum information:

CABLE No. 1, SIGNAL No. 1 – For cables servicing vehicle or pedestrian signal heads, flashers, electronic signs.

CABLE No. 2, PED P.B.A – for cables serving pedestrian push buttons

CABLE No. 3, HANDBOX A, LOOP L-1 – For cables to be spliced into specific loop detectors in designated hand boxes

CABLE No. 4, Microwave Det A – For cables servicing microwave vehicle detectors.

(D) VEHICLE SIGNAL HEADS

1. All cable shall contain 7 conductors.
2. The cable to be used shall be 14 AWG, stranded, THHN, manufactured according to the IMSA 19-1, specification.
3. The seven conductors are color coded as follows: Red, Orange, Green, Blue, Black, White, and White with a Black tracer.
 Note: Existing seven conductor cable may be color coded as follows in some cases: Red, Amber or Yellow, Green, Red w/Black Tracer, Black, Green w/ Black tracer, and White.
4. The conductor coded with white insulation will be the system neutral.
5. The conductors coded with Red, Orange, and Green or Red, Amber or Yellow and Green insulation will be used for vehicle signal heads controlling traffic moving in the north-south direction.
6. The conductors coded with Blue, Black, and White with a Black Tracer or Red with a Black Tracer, Black and Green with a Black Tracer will be used for vehicle signals heads controlling traffic in the east-west direction.
7. Unused conductors to each signal head will be reserved for use in the event that the sequence of operation is modified and additional sections are required, or if one or more of the conductors currently in use fail.
8. A separate segment of 7- conductor cable shall be routed from the traffic signal controller to each vehicle signal head. However, cable may be routed between the terminal blocks of two signal heads if the following criteria are satisfied:
 - a. the two vehicle signal heads must operate identically.
 - b. the two vehicle signal heads must be mounted on the same pole, or
 - c. one of the two vehicle signal heads must be pole-mounted and the other is mounted on a mast arm.
 - d. the cable shall not exist in the underground conduit network.
9. No branch splices of cable shall be permitted at any point between the traffic signal controller and the signal head, or between vehicles signal heads that are wired between their terminal blocks. Straight splices of cable shall not be made unless approved by the Chief, Traffic Signal System Division.

10. In the event of a cable malfunction involving new and existing cable installed by the Contractor in accordance with these policies, the following policies apply:
 - a. all new cable is required to be replaced if found defective or damaged.
 - b. if there are a sufficient number of unused conductors in the existing cable, they will be used in lieu of the defective conductors. The cable shall be tagged in the controller cabinet to indicate which conductors are defective.
 - c. if there are an insufficient number of unused conductors in the existing cable to replace the defective conductors, a new segment of 7 – conductor cable shall be pulled from the controller cabinet to the signal head.
 - d. under no circumstances will it be permissible to replace the defective segment of cable with a new segment of cable utilizing straight splices connecting the new with the old cable.
11. Unless otherwise specified in the contract documents, all cable for vehicle signal heads is to be furnished and installed by the traffic signal installation Contractor.
12. If inspection of the traffic signal work by District forces shows any unauthorized deviations from the provisions of this policy, the Contractor shall be obligated to make appropriate revisions at no cost to the District before final payment for the job is released.

(E) PEDESTRIAN SIGNAL HEADS

1. The provisions of [617.07 \(D\)](#) No. 1, 2, 3, 4, 7, 10, 11, 12 apply.
2. The conductors coded with red and green insulation will be used for pedestrian signal heads controlling pedestrian in the north-south direction.
3. The conductors coded with White w/Black tracer and Blue or Red w/Black tracer and Green w/Black tracer will be used for pedestrian signal heads controlling traffic in the east-west direction. The Orange and Black conductors shall be used together where additional conductors are required.
4. All new signal installations and modifications are to be designed so as to install a pair of pedestrian signal heads on the same pole. A separate segment of 7- conductor cable shall be routed from the traffic signal controller to each pair of pedestrian signal heads. The appropriate conductors and the system neutral are to be routed through the brackets to the terminal block of the signal head.
5. In instance where pedestrian signal heads on the same corner of the intersection must be mounted on separate poles, a separate segment of 7- conductor cable is to be routed to each pedestrian signal head.
6. No branch splices of cable shall be permitted at any point between the traffic signal controller and the signal head. Straight splices of cable shall not be made unless approved by the Chief, Traffic Signal System Division.

(F) PEDESTRIAN PUSH BUTTONS

1. All cables shall consist of 4 conductors.

2. The cable to be used shall be 18 AWG, stranded, twisted, shielded cable manufactured according to DDOT specifications.
3. A separate segment of cable shall be rerouted from the controller cabinet to each pedestrian push button.
4. In the event of a cable malfunction involving cable installed in accordance with these policies, a new segment of 4-conductor cable shall be pulled from the controller cabinet to the pedestrian push button. Under no circumstances will it be permissible to replace the defective segment of cable utilizing straight splices connecting the new with the old cable.
5. Unless otherwise specified in the contract documents, all cable is to be furnished and installed by the traffic signal installation contractor.
6. If inspection of the traffic signal work by District forces shows any unauthorized deviation from the provisions of this policy, the Contractor shall be obligated to make appropriate revisions at no cost to the District before final payment for the job is released.

(G) LOOP DETECTOR LEAD-IN CABLE

The provisions of items [617.07 \(F\)](#), 1, 2, 3, 4, 5, and 6 for pedestrian push buttons apply for loop detector lead in cable. In the aforementioned policy statements, the term pedestrian push button is to be replaced by the term loop detector hand box.

(H) MICROWAVE VEHICLE DETECTOR LEAD-IN CABLE

The provisions of item [617.07 \(F\)](#), 1, 2, 3, 4, 5, and 6 for pedestrian push buttons apply for microwave vehicle detection or lead-in cable. In the aforementioned policy statements, the term pedestrian push button shall be replaced by the term microwave vehicle detector.

(I) LOOP DETECTOR CABLE

1. All cable shall contain 1 conductor.
2. The cable to be used shall be 14 AWG, stranded, THNN manufactured according to the latest IMSA specifications.
3. The cable is to be routed from the loop detector hand box, around the slot cut into the pavement and back to the loop detector hand box.
4. The dimensions of the loop detector and the number of turns of cable required will be clearly identified in the contract documents.
5. The cable shall contain no splices other than those made with the shielded lead-in cable in the hand box.
6. In the event of a cable malfunction, a segment of 1 conductor cable shall be pulled in a newly cut pavement slot according to the provisions of item 3. Under no circumstances will it be permissible to replace the defective segment of cable utilizing straight splices connecting the new with the old cable.
7. Unless other specified in the plans, all cable is to be furnished and installed by the traffic signal installation contractor.

8. If inspection of the traffic signal work by the District forces shows any unauthorized deviation from the provisions of this policy, the Contractor shall be obligated to make appropriate revisions at no cost to the District before final payment for the job is released.
9. All splices between the loop detector cable and the loop detector lead-in cable shall be made in the loop detector hand box utilizing waterproof, encapsulating splice kits satisfying DDOT specifications.
10. Whenever practical, loop detectors shall be cut in the PCC roadway base before the surface course is applied. The megger test shall be given to the loop detector cable both before and after the surface course is applied. The loop detector shall be recut, at no cost to the District, if the cable fails the megger test. It will be permissible to cut the loop detector in the surface course after the surface course has been applied.

(J) FIBEROPTIC ELECTRONIC SIGNS

1. The provisions of [617.07 \(D\)](#) No. 1, 2, 3, 4, 7, 10, 11, 12 apply.
2. The color coded conductors used to operate the electronic signs are to be noted in the controller cabinet.
3. A separate segment of 7-conductor cable shall be routed from a designated traffic signal controller to each electronic sign.

No branch splices of cable shall be permitted at any point between the designated traffic signal controller and the electronic sign. Straight splices of cable shall not be made unless approved by the Chief, Traffic Signal Systems Division.

(K) FLASHING BEACONS FOR SCHOOL OR WARNING SIGNS

1. The provisions of [617.07 \(D\)](#) No. 1, 2, 3, 4, 7, 10, 11, 12 apply.
2. Unless otherwise noted, flashing beacons are to be installed in a pairs; one above and one below each sign.
3. A separate segment of 7-conductor cable is to be routed from the designated traffic signal controller to a control cabinet to be mounted on the pole to which the beacons are affixed. This cable will terminate at the terminal block be furnished and installed by the traffic signal installation contractor.
4. A separate segment of 7-conductor cable is to be routed from the terminal block of the pole mounted cabinet to each pair of flashing yellow beacons. Unless otherwise noted in the contract documents, this segment of cable will be furnished and installed by the Contractor.
5. The conductor color coded red will be routed from the controller through the pole mounted cabinet to the top beacon visible to northbound or southbound traffic.
6. The conductor color coded green will be routed from the controller through the pole mounted cabinet to the bottom beacon visible to northbound or southbound traffic.
7. The conductor color coded White w/Black tracer or Red w/Black tracer shall be routed from the controller through the pole mounted cabinet to the top beacon visible to eastbound or westbound traffic.

8. The conductor color coded Blue or Green w/Black tracer shall be routed from the controller through the pole mounted cabinet to the bottom beacon visible to eastbound or west bound traffic.

(L) TRAFFIC SIGNAL CABLE COLOR CODES.

1. 7 Conductor 14 AWG Stranded Cable

ISMA Cable Color Code:	Green	
	Orange	NB/SB Traffic
	Red	
	Blue	
	Black	EB/WB Traffic
	White/Black	
	WhiteAC-	

2. Old Cable Color Code:	Green	
	Yellow	NB/SB Traffic
	Red	
	Green/Black	
	Black	EB/WB Traffic
	Red/Black	
	White	AC-

(M) INSTALL TWISTED PAIR COMMUNICATION CABLE

1. Underground communications cables shall meet all requirements of IMSA 40-2 or REA PE-39. Aerial (overhead) communication cable shall meet all of the requirements of ISA 40-2 or REA PE-39. Communications cable runs that are partly overhead and underground shall meet the requirements of IMSA 60-2 or REA PE-39.
2. Cable shall be pulled in conduit with a cable grip designed to provide a firm hold on the exterior covering of the cable. Cable shall be pulled with a minimum of dragging on the ground or pavement. Powdered soapstone, talc or other approved lubricants shall be used to facilitate the pulling of the cable.
3. Communication cable shall also be installed on messenger cable when shown in the contract documents as overhead cable. Cable shall be looped in and out of controller cabinets, and ground-mounted termination cabinets at termination points or splice points as indicated in the contract documents.
4. Communications cable shall be installed for the traffic signal control system. Cable runs shall be continuous with no splices in the conduit, manhole, pull boxes, or overhead runs.
5. All large cables, over twenty-five (25) pairs, shall terminate in termination cabinets only. Connection between the terminating cabinets and the intersecting controllers

shall be made with twelve (12) or twenty-five (25) pair cables only as indicated on the Communications Cable Schematic Sheet of the contract documents.

6. The communications cable in an intersection controller shall be terminated by the Contractor on a terminal block mounted in the cabinet. The cable connection between the terminal block and the communication modem shall be through the controller's communication connector (C2).
 7. Cable ends shall be taped to exclude moisture and shall remain so until terminal equipment is attached by the Contractor. For cable connections in termination cabinets, connectors approved for outside use shall be used.
 8. Cables shall be looped in and out of controller cabinets, termination cabinets, manholes and pull boxes to provide adequate slack and the least amount of stress on the conductors and connectors.
 9. If an emergency cable condition exists, where a splice is permitted in underground and overhead runs, the splices shall be made in the appropriate manner using a waterproof splice kit conforming to the requirements of the National Electric Code (110b.14). Boxes or kits should be of sufficient size to allow free space to all conductors therein. All splices shall be capable of operation when submerged in water. All splices and conductors, including spares, shall be made waterproof and mechanically and electrically secure.
 10. Before any cable is pulled into the conduit, provisions shall be made to support the cable ends on racks in the manholes.
 11. Cable shall not be allowed to lie on the manhole floor.
 12. The channels that support the racks shall be securely fastened to the manhole wall with expansion bolts. The spacing between racks adjacent to the proposed cable joint shall be a minimum of 36 inches.
 13. Communication cable shall be furnished on reels and pulled with a minimum of dragging on the ground or pavement.
 14. Work shall also include the removal and disposal of existing communications cable that will be replaced by the new cable run.
 15. The Contractor shall disconnect the old and connect the new communications cable in all controller cabinets. The Contractor shall pull the cable into the cabinets.
 16. When modifying or upgrading existing signalized intersections, the Contractor shall not disconnect existing communications cable from the controller cabinet until new communications cable is terminated at the new controller cabinet, or until all new communications cables have been pulled, tested, and in place awaiting controller change out on the same foundation.
- (N) **MEASURE AND PAYMENT.** The unit of measure for Electrical Cable for Traffic Signals will be the linear foot. The number of linear feet will be the actual number of linear feet in place, including the loop-in-cable. The payment will be made at the contract unit price for the linear feet of Electrical Cable for Traffic Signals, and which price will include all labor, equipment, materials, and incidentals required to provide and test the cables, and to complete all work specified herein.

617.08 STEEL TRAFFIC SIGNAL POLE

- (A) **DESCRIPTION.** The work consists of providing Steel Traffic Signal Poles of the length specified in the contract documents. All holes necessary to allow for cable entry into signal heads, mast arms, and pedestrian and vehicular detection equipment shall be drilled and finished prior to the erection of the pole onto the transformer base. All holes must be made prior to the installation of any cable into the pole.

The Contractor shall set the pole on a leveled and trued transformer base with the holes in the pole base casting lining up with the holes on the top of the transformer base. The Contractor shall use the 1" x 3" galvanized steel bolts with nuts and washers, provided with the procurement of the transformer base, to attach the pole to the transformer base. The Contractor shall apply sufficient torque to ensure a secure, stable connection. Grounding the pole is unnecessary if the transformer base is grounded. The Contractor shall have the option of routing cable for signal heads and detection equipment through the pole before the pole is erected, or providing a means for installing cable without splices or damage after the pole is erected. After the bolts have been secured and tightened, the Contractor shall install the removable ornamental pole top finial and the four ornamental cast leaf bolt covers where specified in the contract documents.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Steel Traffic Signal Pole will be each. The payment for Steel Traffic Signal Pole will be paid at the contract unit price for each pole complete in place. The price will include all labor, equipment, tools, material and incidentals to complete the work specified herein.

617.09 TRAFFIC SIGNAL MAST ARM

- (A) **DESCRIPTION.** The work consists of providing Traffic Signal Mast Arms for traffic signal poles of the clamp-on type in the length specified in the contract documents with removable caps and clamps conforming to [Section 820](#) and the standard drawings.

The Contractor shall drill a hole in the pole at the point where the mast arm is to be mounted. The location of the hole is a function of the height of the bottom of the signal head to be installed on the mast arm above the pavement. The height above the pavement may be determined from the standard drawings. The hole shall be approximately 2 inches in diameter and of such size that the mast arm completely covers the entire hole. The edges of the hole shall be machined to remove burrs that may snag the cable.

The installation of the mast arm onto the pole shall be undertaken after all required cable has been pulled through the hole drilled into the pole. The Contractor shall route electrical cables through the interior of the mast arm and out of the hole(s) previously cut in the mast arm for the mast arm mount signal bracket(s). Being careful not to crimp any of the cable, the Contractor shall affix the mast arm to the pole using the clamp. The Contractor shall line up the hole in the clamp with the hole in the pole and make the attachment using the high strength galvanized connecting bolts. The bolts shall be tightened per manufacturer's specification to ensure a secure, tight installation. The Contractor shall apply a continuous bead of waterproof sealant at all.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Traffic Signal Mast Arm will be each. The payment for Traffic Signal Mast Arm will be paid at the contract unit price for

each mast arm complete in place. The payment will include all labor, equipment, tools, material and incidentals to complete the work specified herein.

617.10 LED SIGNAL MODULE

- (A) **DESCRIPTION.** The work consists of providing LED Signal Modules for traffic signals, warning flashers and pedestrian signals at locations specified in the contract documents. The LED Signal Modules shall conform to [Section 825](#) and installed according to the manufacturer's recommendations.

The following LED modules are used in the DDOT:

- 12 inch Red Ball LED Module
- 12 inch Yellow Ball LED Module
- 12 inch Green Ball LED Module
- 12 inch Red Arrow LED Module
- 12 inch Yellow Arrow LED Module
- 12 inch Green Arrow LED Module
- 12 inch Portland Orange Raised Hand LED Module
- 12 inch Lunar White Walking Person LED Module

The Contractor shall provide the LED Signal Modules at the locations specified in the contract documents. The contract may specify the procurement and delivery to the District. In that case, the Contractor shall be responsible for safe keeping and storage of the module at the Contractor's facility following receipt of the materials from the vendor. Payment to the Contractor by the District shall be authorized only after the module has been delivered to and remains within DDOT.

- (B) **MEASURE AND PAYMENT.** The unit of measure for LED Signal Module will be each. The payment for LED Signal Module will be paid at the contract unit price for each module complete in place or delivered to the District whichever is specified. The payment will include all labor, equipment, tools, material and incidentals to complete the work specified herein.

617.11 POLE MOUNTED VEHICULAR OR PEDESTRIAN TRAFFIC SIGNAL HEAD

- (A) **DESCRIPTION.** The work consists of providing Pole Mounted Vehicular or Pedestrian Traffic Signal Head, and upper and lower mounting brackets and hardware, as described herein. The traffic signal poles will be either steel traffic signal poles, pendant poles or Washington Standard poles. The work to be performed is as follows:
1. The Contractor shall drill a hole in the pole at the point where the upper signal head mounting bracket is to be installed. The hole shall be approximately one inch in diameter, and edges shall be machined to remove burrs that may snag cable.
 2. The Contractor shall prepare the signal head for attachment to the pole prior to arriving in the field at the intersection. The Contractor shall construct each signal head as described in the traffic signal sequence of operation. The appropriate LED

modules shall be inserted and affixed into the housing and wired to the signal head terminal block, in accordance with manufacturer's instructions. Tunnel visors may be attached at this time or after the signal head is erected.

3. Pole mounted one, two, three, four and five section signal heads shall feature sections mounted vertically one above the other. Connections between signal head sections shall be watertight and contain an opening through which cable can pass.

Pole mounted signal heads shall be outfitted with upper and lower mounting brackets. This assembly shall feature serrated locking washers at the signal head to prevent misalignment. This assembly shall be attached to the signal head and to the pole such that a watertight barrier results. This shall be accomplished through the use of washers and/or sealing compound at the pole. The assembly shall consist of 1-½ inch diameter steel tubes (nipples) threaded to fit into the pole plate and into the 90 degree ell leading to the signal head. The other end of the assembly shall be affixed to a universal pole plate into which the 1-½ inch diameter steel nipple can be screwed. The universal pole plate may constructed from cast aluminum and shall be structured to accept 1 inch wide stainless steel banding strapping above and below the nipple where the plate sits next to the pole. The 1-½ inch steel nipple shall be of sufficient length and configuration to match the hardware arrangement of this signal display being replaced and to situate the signal head equidistant from the pole as the signal display being replaced.

4. The field cable protruding through the hole in the pole is to be carefully routed through the mounting hardware into the signal head and connected to the proper terminals in the terminal block of the signal head. The Contractor shall make the proper electrical connections of the field cable to the terminal block and ascertain that the connections are secure and consistent with the approved traffic signal sequence of operation. The field cable shall be fitted with terminal lugs for attachment to the terminal block.
5. The Contractor shall mount the signal head assembly to the pole after carefully aligning the universal pole plate to the pole without damaging or crimping field cable. Each new signal head will be mounted so that the bottom of the signal head is at a height above grade equal to the signal head being replaced. The universal pole plate shall be affixed to the pole utilizing 1 inch wide stainless steel banding strapping two points on each pole plate, one above and one below where the nipple screws into the pole plate. The mounting shall be accomplished with banding tools specifically intended for securing banding strapping and with standard tools.
6. The Contractor shall ensure a secure fit of the assembly and confirm that the signal head operates in compliance with the approved traffic signal sequence of operation.

- (B) MEASURE AND PAYMENT.** The unit of measure for Pole Mounted Vehicular or Pedestrian Traffic Signal Head traffic signal head installed will be each. The payment will be made at the contract unit price for each signal head complete in place. The price will include the signal head housing, the upper and lower mounting brackets, universal pole plate, all miscellaneous hardware including terminal lugs, tunnel visors, stainless steel banding materials, and all labor, equipment and materials. The price shall also include insertion, affixing and wiring of the LED module into the signal head. The cost of the LED module is detailed in [617.10](#).

617.12 MAST ARM MOUNTED VEHICULAR TRAFFIC SIGNAL HEAD

(A) **DESCRIPTION.** The work consists of providing Mast Arm Mounted Vehicular Signal Heads, upper and lower mounting brackets and hardware, as described herein. After receiving the Chief Engineer's approval of catalog cuts, the Contractor shall procure vehicle signal head housings, vehicle signal back plates and mast arm mount signal brackets conforming to [825](#) and the standard drawings. The work to be performed is as follows:

1. The Contractor shall procure the materials described above.
2. The Contractor shall drill a hole in the mast arm at the point where the mast arm mount signal bracket is to be installed. The hole shall be approximately one inch in diameter, and edges shall be machined to remove burrs that may snag cable.
3. The Contractor shall prepare the signal head for attachment to the mast arm prior to arriving in the field at the intersection. The Contractor shall construct each signal head as described in the plans. The appropriate LED modules shall be inserted and affixed into the housing and wired to the signal head terminal block, in accordance with manufacturer's instructions. Tunnel visors may be attached at this time or after the signal head is erected.
4. Mast arm mounted one, three and four section traffic signal heads shall feature sections mounted one above the other. Mast arm mounted five section traffic signal heads shall feature two adjacent columns of two sections each mounted one above the other and one section mounted directly above the other two so that the total assembly is three sections tall and two sections wide and so that the center of the top section coincides with the line vertically dividing the two columns.
5. Mast arm mounted signal heads shall feature a back plate affixed to the signal head. Back plates are to be procured in accordance with the technical specifications contained in the contract documents. The back plate shall be secured to the signal head utilizing the hardware shown in the technical specifications and in accordance with the manufacturer's instructions.
6. Mast arm mounted signal heads shall be mounted to the mast arm at the point where the field cable exits the mast arm with a standard bracket assembly, procured in accordance with technical specifications contained in the contract.
7. All mounting hardware shall be affixed to the signal head to form a watertight joint in compliance with the manufacturers' installation instructions.
8. The existing field cable protruding through the hole in the mast arm is to be carefully routed through the mounting hardware into the signal head completely within the assembly and connected to the proper terminal in the terminal block of the signal head. The field cable shall be fitted with terminal lugs for attachment to the terminal block. The Contractor shall make proper electrical connections of the field cable to the terminal block and ascertain that the connections are secure and consistent with the approved traffic signal sequence of operation.
9. The Contractor shall mount the signal head assembly to the mast arm after carefully aligning the mast arm mount signal bracket to the pole without damaging or crimping field cable. Each new signal head shall be mounted so that the bottom of

the signal head is at a height above grade equivalent to the signal head being replaced. The Contractor shall tighten the stainless steel bands on the signal brackets to the mast arm to ensure a tight, secure fit utilizing specific banding tools and/or standard tools.

10. The Contractor shall make adjustments after the assembly is affixed to the mast arm to ensure proper alignment of the signal head.
11. The Contractor shall ensure a secure fit of the assembly and confirm that the signal head operates in compliance with the approved traffic signal sequence of operation.

(B) MEASURE AND PAYMENT. The unit of measure for Mast Arm Mounted Vehicular Signal Heads will be each. The payment will be made at the contract unit price for each signal head complete in place. The price will include the signal head housing, the complete mast arm mount signal bracket, the back plate, tunnel visor, terminal lugs, stainless steel banding materials, all miscellaneous hardware and all labor, equipment and materials. The price shall also include insertion, affixing and wiring of the LED module into the signal head. Payment for LED module shall be as per [617.10](#).

617.13 PEDESTRIAN PUSH BUTTON CONTROLS

(A) DESCRIPTION. The work consists of providing Pedestrian Push Button Controls as indicated in the contract documents and conforming to this specification and [825](#).

The Contractor shall drill a hole in a traffic signal pole at the point where the pedestrian push button is to be mounted. The height of the hole above ground level shall be consistent with the requirements of the Americans With Disabilities Act (ADA) and as shown in the contract documents.

The hole shall be no more than one inch in diameter and of such size that the pedestrian push button completely covers the entire hole. The edges of the hole shall be machined to remove burrs that may snag the cable.

The Contractor shall make electrical connections at the terminal block of the pedestrian push button. Appropriate conductor(s) from the 4-conductor 18 AWG lead in cable and a No. 6 bare copper ground cable shall be connected to the pedestrian push button. The ground wire shall be attached to the ground rod in the pole foundation.

After the cable is attached, the pedestrian push button shall be affixed to the metal pole utilizing three quarter inch wide stainless steel banding strapping at two points on each pedestrian push button, one above and one below the plunger. The Contractor shall apply a continuous bead of waterproof sealant around the push button at the pole to preclude the flow of moisture and debris to the back of the push button.

(B) MEASURE AND PAYMENT. The unit of measure for Pedestrian Push Button Controls will be each. Payment will be made at the contract unit price for each Pedestrian Push Button Control complete in place, and which payment will include the pedestrian push button, mounting and grounding materials and all labor, equipment, materials and incidentals required to prepare the pole, make electrical connections, and affix the pedestrian push button to the pole.

617.14 INDUCTIVE LOOP DETECTORS

(A) **DESCRIPTION.** The work consists of providing Inductive Loop Detectors as indicated in the contract documents. Inductive Loop Detectors shall consist of, but not be limited to, loop detection cable, loop detector slot sealant and waterproof, encapsulating splice kits in conformance with [825](#) and these specifications.

1. The Contractor shall furnish all labor, equipment and materials for the installation of inductive loop detector(s). Specific loop detectors locations and dimensions are as shown in the contract documents. The Contractor shall utilize [Standard Drawings 617.26](#) and [617.27](#) as the guideline to be followed for typical loop detector installation.

The Contractor shall be familiar with the installation procedures and materials to be utilized, and shall visit the site in advance of actual installation. The Contractor shall plan and schedule daily operations as to accomplish all preparatory tasks prior to commencing the actual installation at the proposed site and shall complete the installation of all loops in the same day.

Work shall consist of furnishing and installing loops, conduits and splices between loop detectors and lead-in cables, unless the Contractor can protect the unfinished loops and/or saw cuts from traffic. The Contractor shall furnish all required materials for the work and shall tests on the system satisfactorily, as detailed herein.

The Contractor shall notify the Chief Engineer when the loops are to be installed. The placement of loop wires, the megger test, and the sealing of the loops shall not be performed except in the presence of the Chief Engineer or Electrical Inspector.

Loop Layout – The Contractor shall lay out all vehicle loops and lead lines using spray paint, with or without template. No saw cutting of the pavement shall be done until the loop layout has been verified by the Chief Engineer. Loop locations as shown in the contract documents must be maintained.

Loop Installation – The saw cut for the lead-in to the hand box shall be made as close as possible to the curb without marring the curb. The pavement chase from the saw cut end to the curb shall be made with a punch or drill and not by excavating methods.

One ¾ inch conduit for each loop lead shall be installed under the pavement from end end of the saw cut to the handbox. The part of the curb above the pavement shall not be drilled or cut for conduit installation. A bronze bushing shall be installed on the conduit stub-out to prevent damage to top lead-in wires.

The conduit shall be installed in a direct line with the saw cut so that the wires entering the conduit shall not need to be bent. The cover over the conduit shall be of the same material that is used to seal the saw cut.

Self-propelled concrete cutting equipment shall be utilized. The machine shall have the capability of utilizing either a local or tank-supplied water source of adequate pressure to act as a blade coolant, lubricant, and slot cleaner. The diamond blades to be utilized for the saw cut shall provide a clean, well-defined 5/16 – inch width saw cut without damaging the adjacent area. The saw cut depth shall be 1-¾ inches. The

saw cuts shall be overlapped to provide full depth at all corners. All saw cuts requiring a right angle turnoff shall be cut at a diagonal to prevent sharp wire bends.

All cuts must be wired and sealed on the same day on which they are made. Loop installations shall not be made when the pavement is wet.

Vehicular traffic shall not pass over an open cut unless the cut is covered by a protective panel.

Immediately after the cutting operation, and just prior to the installation of the wire, the saw cuts shall be checked for the presence of jagged edges or protrusions; cleaned of all cutting dust, grit, oil and other contaminants; flushed by means of water stream; and cleared of water by means of an air stream. The blown air from the compressor shall be free of oil and water.

Care should be taken during the cleaning of the cuts to avoid blowing debris at passing pedestrians and motorists. It is imperative that the saw cut be clean and free of water before the wire installation proceeds.

Loop wires shall be installed from the hand box thru the turn in the loop cuts and back to the handbox in one continuous length, without in-line splices. The loop lead-in wires shall be twisted to provide a minimum of five (5) turns per foot from loop to pull box.

A minimum of thirty (30) feet of lead-in pair slack shall be coiled and left in the pull box for each loop. The wires for each detector shall be color coded for ease of identification of the separate loops.

The wire shall be type THHN #14 AWG minimum, stranded single conductor. All wire installations must be made without kinks, curls or other damage to the wire or its insulation. The Contractor shall replace any damaged wires at his expense.

The wire shall be installed as far down in the cut as possible. A blunt object, similar to a wooden paint stirrer, shall be used to seat the loop wire. In no case shall a screwdriver or other sharp tool be used for this purpose. The wire shall be held in place in the cut during installation by means of hold down strips. The hold down strips shall be approximately two (2) inches in length and placed approximately every two (2) feet. These strips shall be left in the cuts during pouring of the sealant. The strips shall be polyethylene foam sealant backers similar to Dow Chemicals Co. Ethafoam SB, or approved equal.

Prior to pouring the sealant, the loop detector shall be checked for continuity and resistance. In addition, the integrity of the installation shall be checked by applying a 1000 volts megger between each end of the loop lead-in and the nearest reliable electrical ground (e.g., streetlight, fire hydrant, etc.). In the event that no available ground exists, a suitable ground shall be established for the measurement (e.g., driven metal spike). The megger reading shall be in excess of 10 megohms under any condition. The inductance shall be between 60 and 100 microhenries.

The Contractor shall record the location and megger readings, and indicate satisfactory compliance with continuity check. Reading and test equipment data shall be submitted for the record. The Contractor shall utilize loop detector slot sealant as

per [822.11](#). The sealant shall not react with the cable insulation or adjacent pavement so as to create deterioration to these products.

The sealant shall be poured over the wire, half filling both the loop and lead in cuts. A check shall be made for air bubbles or material pile up and then the cuts are filled to roadway level. Excess sealant shall be removed by means of a squeegee. In all cases, there shall be neither a trough nor a mound formed.

The sealant when poured into a saw cut, shall completely surround the wires, displace all air in the cut and completely fill the area of the cut, except for that portion filled with the wire hold down material.

The Contractor shall allow sufficient time for the sealant to harden to accordance with manufacturer's instructions (minimum of two hours) before allowing traffic to move over the area unless it is covered by a protective panel. The Chief Engineer will determine when the hardening is acceptable.

The Contractor shall complete the loop detector installation by splicing in the hand box the loop detector cable with the loop detector lead-in cable. The splice kit used by the Contractor shall create a waterproof splice totally encapsulating all conductors. The Contractor shall maintain at least 3 feet of slack cable in both wires after splicing is completed.

Before leaving the site, the Contractor shall repeat the entire resistance and continuity test specified above. The report should be given to the Chief Engineer for comparison with the first report, and shall show no appreciable change.

- (B) MEASURE AND PAYMENT.** The unit of measure for Inductive Loop Detectors will be the linear foot of saw cut, excluding diagonal cuts to facilitate wire installation. The measure will include lead-in cuts to the face of curb. Payment will be made at the contract unit price for Inductive Loop Detectors. Payment will include all labor, materials, equipment and incidentals necessary complete the work specified herein.

617.15 MICROWAVE VEHICLE DETECTOR

- (A) DESCRIPTION.** The work consists of providing Microwave Vehicle Detectors at the locations indicated in the contract documents. The work also consist of providing a microwave detector isolation module for each Microwave Vehicle Detector with 12 VAC output conforming to this specification and [825](#).

The Contractor shall drill a hole in the pole at the point designated in the contract documents where the microwave vehicle detector is to be mounted. Typically, microwave detectors are mounted as high as possible on the designated pole. The hole shall be approximately one inch in diameter and of such size that the microwave vehicle detector completely covers the entire hole. The edges shall be machined to remove burrs that may snag the cable.

The Contractor shall pull the 4 conductor 18 AWG lead-in cable through the hole and make electrical connections with the appropriate conductors to the terminal block of the microwave vehicle detector.

After the cable is attached, the microwave vehicle detector shall be affixed to the metal pole utilizing one inch wide stainless steel banding strapping at two points on the

microwave vehicle detector, one above and one below the device. The Contractor shall apply a continuous bead of waterproof sealant around the microwave vehicle detector at the pole to preclude the flow of moisture and debris to the back of the detector.

The Contractor shall aim the microwave vehicle detector to point in the precisely desired direction, as instructed by the Chief Engineer. After proper orientation is obtained, the unit shall be secured to maintain the desired orientation according to manufacturer's specifications.

The Contractor shall install the microwave detection isolation module with 12 AC Output into the appropriate rack on the controller cabinet and make proper electrical connections.

The Contractor shall ensure that the pole mounted detector and the isolation module perform satisfactorily. After the traffic signal is energized and placed into service, the Contractor shall troubleshoot the system and fine tune the detector to produce the desired level of detection, as directed by the Chief Engineer.

- (B) MEASURE AND PAYMENT.** The unit of measure for Microwave Vehicle Detector with the microwave detector isolation module with 12 VAC output will be each. Payment will be made at the contract unit price for Microwave Vehicle Detector complete in place. The price will include the equipment, pole mounting hardware, and all labor, equipment, materials and incidentals required to install the equipment, make electrical connections and fine tune the detector to the satisfaction of the Chief Engineer.

617.16 TRAFFIC SIGNAL CONTROLLER AND CABINET

- (A) DESCRIPTION.** The work consists of providing Traffic Signal Controllers and Cabinets at locations indicated in the contract documents. Traffic Signal Controllers and Cabinets shall conform to the requirements of this specification and [825](#). Individual plans specific to each intersection and the traffic signal system will specify the type of cabinet and physical orientation of the cabinet.

The Contractor shall furnish all necessary labor, equipment, and materials to procure and install the controller and cabinet. Individuals tasked with wiring the cabinet must possess at least IMSA Level 2 certification and experience in working with the 170E type controller. No other Contractor employee will be permitted access to the cabinet or electronic components within the cabinet.

1. Specifications

The technical specifications for the Type 170E Traffic Signal Controller, the Module 336-SS Controller Cabinet, and all peripheral electronic components within the cabinet shall be as per [825](#). The Contractor shall procure controller equipment in strict conformance with those specifications. The Contractor must submit and the DDOT must approve catalogs cuts from individual vendors before procurement is undertaken.

2. Procurement, Acceptance and Programming

The Contractor shall accept delivery of the controller, cabinet, and component parts from the vendor and deliver to the Traffic Signal Construction Branch at the Rear of

1338 G Street S.E. DDOT technicians will inspect the delivered items and inform the Contractor of any deficiencies before DDOT accepts delivery of the controller.

DDOT technicians shall program the controller to operate the approved traffic signal sequence of operation required for the specific intersection. The technician shall remove all unused component parts from the controller and place them in inventory. The technicians will allow the programmed controller and cabinet assembly to operate properly without malfunction in the shop area for 72 consecutive hours before proclaiming the equipment suitable for field installation.

The Contractor will be notified to pick up the programmed controller and cabinet after the signal operation is properly programmed and the controller has run in the shop area. The Contractor will pick up the controller cabinet assembly from the Traffic Signal Construction Branch and deliver the equipment to the field job site for installation.

3. Field Installation Procedures

The Contractor shall set the controller cabinet assembly on the permanent foundation ensuring that the foundation anchor bolts penetrate the designated holes in the base of the cabinet. The Contractor shall ensure that the front and rear cabinet doors are oriented properly in accordance with instructions in the contract documents. The Contractor shall level the cabinet, if necessary, using stainless steel shims placed where appropriate between the base of the cabinet and the foundation. The Contractor shall utilize stainless steel washers and bolts to affix the leveled cabinet securely to the foundation. All four bolts shall be tightened to ensure a secure and stable fit on the concrete foundation.

The Contractor shall pull all cables through the conduits into the controller cabinet allowing a minimum of 10 feet of slack cable inside the cabinet. The Contractor shall attach an identifying, waterproof tag onto each cable identifying the specific field equipment being serviced by that particular cable run. The Contractor shall furnish and install a new No. 6 bare solid copper ground cable from the appropriate terminal in the controller cabinet to the ground rod extending above the top of the controller cabinet foundation.

The Contractor shall be responsible for scheduling and ensuring the completion of the installation of secondary electrical service cable into the controller cabinet by the Potomac Electric Power Company (PEPCO). The Contractor shall maintain constant communications with counterparts in PEPCO to ensure that PEPCO officials are apprised of the project schedule for the purpose of avoiding project delays attributable to secondary electrical service installation.

The Contractor shall terminate all traffic signal, electronic sign, school flasher, vehicular and pedestrian detector lead-in, closed circuit television, and communications cables at their appropriate place on the terminal block of the controller cabinet. The Contractor shall cut the cables pulled into the controller cabinet at the appropriate length, strip the conductors, and affix terminal lugs at the end of the conductors. All cables shall be dressed and arranged using cable ties in a neat, orderly manner in accordance with accepted industry standards.

The Contractor shall apply a generous quantity of duct seal into each conduit entering the cabinet to help regulate cabinet humidity and to impede the flow of moisture or other matter between the cabinet and the underground conduit/manhole network. The duct seal shall penetrate at least 4 inches into each conduit entering the cabinet and shall totally encapsulate the conduit and cables. The duct seal shall be installed after all cable is terminated and dressed.

The Contractor shall apply a generous bead of waterproof sealant inside and outside the controller cabinet at all points where the cabinet is in physical contact with the concrete controller cabinet foundation to preclude the flow of moisture and debris between the inside of the cabinet and the outside environment.

- (B) MEASURE AND PAYMENT.** The unit of measure for Traffic Signal Controller and Cabinet will be each. Payment will be made at the contract unit price for Traffic Signal Controller and Cabinet. Payment will include the cost of the controller, cabinet and all peripheral electronic components and all required labor, equipment, tools, materials and incidentals necessary to install the cabinet in the field and render the traffic signal operational in accordance with the approved traffic signal sequence of operation. The cost associated with arranging and providing secondary electrical service to the cabinet will be paid under [618.41](#)

617.17 REMOVE AND ABANDON TRAFFIC SIGNAL CONTROLLER CABINET FOUNDATION

- (A) DESCRIPTION.** The work consists of providing all labor, equipment, tools and materials necessary to remove and abandon traffic signal controller cabinet foundations.

The Contractor shall demolish and remove the foundation completely. The Contractor shall seal the conduit, remove the anchor bolts, and cut off the ground wire and ground rod. If the foundation is located within a tree space, the Contractor shall backfill the excavated area with approved material to grade. If the foundation is located within a paved area, the Contractor shall backfill with approved material to within 6 inches of grade and shall install a temporary asphalt patch. The Contractor may be directed to pave the foundation area with sidewalk material approved for the site. The paved area will be paid for under the appropriate items of work in the contract.

All materials removed shall become the property of the Contractor and will be disposed at no additional cost to the DDOT.

- (B) MEASURE AND PAYMENT.** The unit of measure for Remove and Abandon Traffic Signal Controller Cabinet Foundations will be each. Payment will be made at the contract unit price for each foundation removed. Payment will include all labor, equipment, tools, materials and all incidentals, including clean up at the job site, necessary to complete the work specified herein.

617.18 REMOVE TRAFFIC SIGNAL POLES AND TRAFFIC SIGNAL EQUIPMENT

- (A) DESCRIPTION.** The Contractor shall provide all labor, materials, and equipment necessary for Remove Traffic Signal Poles and Traffic Signal Equipment. The work will include, and be limited to the following: metal traffic signal poles, transformer bases,

mast arms, vehicle and pedestrian signal heads, pedestrian push buttons, microwave vehicle detectors, electronic signs, cables, and other equipment related to the traffic signal plant. Work shall not be begin until the replacement traffic signal is in service and operational, and until electrical service has been provided to the proposed signal controller and disconnected from the existing signal controller. The Chief Engineer must be satisfied that the proposed signal controller is operating with the approved traffic signal sequence of operation before existing equipment can be removed.

The Contractor shall remove all existing traffic and pedestrian signal heads, pedestrian push buttons, microwave vehicle detectors and other devices hanging on the pole and return them to the District Department of Transportation (DDOT). Care shall be taken to avoid damaging these devices, as they can be reused. The Contractor shall also remove all mounting hardware except stainless steel banding and return these items to DDOT.

The Contractor shall remove the existing traffic signal poles and 8 foot long mast arms and return these items to the DDOT. Poles and mast arms deemed by the Chief Engineer to be reusable shall be cleaned and painted before storage.

Static metal signs shall be removed from poles only after the Contractor has installed new replacement signs on the new poles.

Traffic signal equipment mounted on street light poles will be removed under this specification.

The Contractor shall remove all electrical cable between the previous controller cabinet foundation and each signal device. All cable is to be removed and discarded by the Contractor.

The Contractor shall clean up the area and ensure that all remnants of the former traffic signal including miscellaneous hardware are removed from the site.

- (B) MEASURE AND PAYMENT.** The unit of measure will be the Job. Payment will be made at the contract unit price without regard for the amount of materials to be removed from the intersection. Payment will include all labor, equipment, tools, materials, and all incidentals, including clean up at the job site and transportation of parts, necessary to complete the work specified herein.

617.19 REMOVE TRAFFIC SIGNAL CONTROLLER AND CABINET

- (A) DESCRIPTION.** The Contractor shall provide all labor, materials, and equipment necessary to remove the existing traffic signal controller and cabinet from the site. Work will not begin until the replacement controller is in service and operational and until power has been disconnected from the existing controller. No work will be performed until the Chief Engineer is satisfied that the proposed controller is satisfactorily operating with the approved traffic signal sequence of operation.

The Contractor shall carefully disconnect all field and communications cables from the cabinet, taking care to avoid damage to any part of the cabinet. Set screws in the terminal block shall be tightened. The Contractor shall disconnect the foundation bolts and lift the complete cabinet off the foundation and onto a vehicle suitable for transporting the

cabinet safely and securely back to the DDOT. The Contractor shall transport the entire cabinet to a facility designated by the Chief Engineer.

The Contractor shall clean up the area around the old cabinet foundation to ensure that all remnants of the old controller and cabinet including miscellaneous wire and hardware are removed from the site.

- (B) MEASURE AND PAYMENT.** The unit of measure for Remove Traffic Signal Controller and Cabinet will be each. Payment will be made at the contract unit price for each controller and cabinet removed. Payment will include all labor, equipment, tools, materials and incidentals, including clean up at the job site and transportation of the cabinet, necessary to complete the work specified herein.

617.20 REMOVE EXISTING SIGNAL HEAD

- (A) GENERAL.** The Contractor shall be required to remove signal heads conforming to one of the following characteristics:

1. 1 Section pedestrian signal heads featuring the DON'T WALK and the WALK message in the same section.
2. 3, 4, or 5 Section vehicle signal heads featuring one or more sections with 8 inch diameter lenses.
3. 3, 4, or 5 Section vehicle signal heads with all lenses 12", but the signal head is determined to be damaged beyond repair and incapable of accepting an LED Module. Potentially damaged signal heads will be identified by the Contractor and verified by the District of Columbia inspector before removal and subsequent replacement is undertaken.
4. 3, 4 or 5 Section vehicle signal heads with all lenses 12" featuring one or more indications for a left turn or right turn movement considered redundant to the primary left turn signal so as to achieve compliance with the Manual on Uniform Traffic Control Devices by displaying only one indication for the non-primary movement. The District will identify these for the Contractor prior to issuance of the Notice to Proceed.
5. 1 Section yellow beacons used for flashing warning signals with 8" lenses.
6. 1 Section yellow beacons used for flashing warning devices with 12" lenses, damaged beyond repair and incapable of accepting an LED Module or identified for replacement.

The Contractor shall disconnect internal wiring at the terminal block of the signal head after identifying the function of each conductor to ease subsequent reinstallation. The end of each conductor shall be taped to avoid accidental contact with a metallic surface during the removal and reinstallation processes. On pole mounted signal heads, the Contractor shall cut the banding material or disassemble the mounting brackets to detach the signal head, upper and lower mounting brackets, universal pole plate and banding material/brackets from the pole. On mast arm mounted signal heads, the Contractor shall cut the banding material and detach the bracket, banding material, and signal head from the mast arm. The Contractor shall route the existing cable carefully through and free of the signal head assembly. At

the conclusion of the removal process, only the cable shall remain protruding through the hole in the pole or mast arm.

For the purpose of this pay item, no distinction shall be made by number of signal sections in the signal head, mounting arrangement or type of mount. All materials removed from the pole or mast arm shall be discarded by the Contractor.

Under no circumstances will a Contractor perform any work on optically programmable vehicular or pedestrian signal heads.

- (B) MEASURE AND PAYMENT.** The unit of measure for Remove Existing Signal Head will be each. Payment will be made at the contract unit price per each signal head removed and payment will include all labor, equipment, tools, materials and all incidentals necessary to complete the work.

617.21 TRAFFIC SIGNAL REMOVAL, TEMPORARY INSTALLATION AND REINSTALLATION

- (A) GENERAL.** The Contractor shall remove the existing traffic signal equipment, traffic signal heads, pedestrian signals and mast arms located on streetlight poles or traffic signal poles that are to be removed and new foundations poured and poles installed. The Contractor will notify The DDOT Traffic Signal Engineer, (202) 671-2700, 48 hours in advance of removing and reinstalling traffic signals. The existing traffic signal heads shall be used for the temporary signals. The signal heads shall be mounted at the same height and oriented in the same direction as the existing signal heads removed from the pole. The signal heads will be installed on a 20 foot traffic signal pole and transformer base provided as part of this work. When the Contractor installs the new streetlight poles, the temporary poles and signals will be removed. The Contractor shall make and break all connections in the signal heads. DDOT Traffic Signal Technicians shall remove and install cable connections at the controller. All damage to the signal heads, cables or mounting hardware shall be repaired or replaced as directed by the Project Chief Engineer at no additional cost to the District of Columbia. Temporary Traffic Signal Foundation will be paid under item [618.27](#).
- (B) MEASURE AND PAYMENT.** The unit of measure for Traffic Signal Removal, Temporary Installation and Reinstallation will be each. Payment will be made at the contract price per each streetlight pole /traffic signal pole on a temporary foundation and all traffic required signal equipment on the pole, and payment will include all labor, equipment, tools, materials and all incidentals necessary to complete. The temporary foundations will be paid under [617.22](#).

617.22 PORTABLE TRAFFIC SIGNAL BASES

- (A) DESCRIPTION.** Work consists of furnishing, maintaining and moving portable concrete traffic signal bases, where required, for traffic signals within the limits of work. A 4-foot by 4-foot by 1-foot deep concrete type base shall be provided, unless otherwise approved by the Chief Engineer. The work also includes providing a length of 3" liquid-tight flexible orange non-metallic conduit 50 feet long for each portable traffic signal base. Work also includes removal of the bases from the job site when no longer required.

(B) MEASURE AND PAYMENT. The unit of measure for Portable Traffic Signal Bases will be each. The total number of bases shall be the maximum number required and used in any one phase of construction. Payment will be made at the contract bid price per each. This payment shall include furnishing, maintaining (at no additional cost to the District) and removal of all required Portable Traffic Signal Bases on the project.