5.0 INSTALLATION OF CABLE

5.1 General

5.1.1 The cables shall be installed in the conduit. The conduit must be continuous, reasonably dry, completely free of debris, and without sharp projections, edges or short bends. If so required by the Traffic Engineer, the Contractor shall demonstrate that the conduit is dry and free of debris by pulling a swab and/or mandrel through the conduit. The conductors shall be installed in such a manner and by such methods so as to insure against harmful stretching of the conductor or damage to the insulation and shall conform to the recommendations of the cable manufacturer. The Contractor shall furnish, at the request of the Traffic Engineer, at least two copies of the manufacturer's recommendations, which includes: methods of attaching pull cable, pulling tension per conductor size and per radius of conduit bend, and the type of lubricant to be used.

5.1.2 All cables in a given conduit run shall be pulled at the same time and the conductors shall be assembled to form one loop in such a manner that the pulling tension is distributed to all the cables. Long, hard pulls will necessitate the use of pulling eyes. For short runs, the cables may be gripped directly by the conductors by forming them into a loop to which the pull wire or rope can be attached. The insulation on each conductor shall be removed before the loop is formed. The method used will depend on the anticipated maximum pulling tension in each case.

5.1.3 In many instances, existing conduits which contain signal cable are to be used for the installation of new cables. In such locations, where new cables are to replace all existing cables, the existing cables may be used to pull in the new cables. At locations where new cables are to be added to existing cable runs, the existing cables shall first be pulled out, then replaced, adding the new cables to the existing cables to form one cable pull. Installation shall be done in such a way as to prevent damage to the existing and/or new cables. In the event of damage, the Contractor shall bear the responsibility of material and labor for replacement of defective cables.

5.1.4 All conduit runs shall be measured accurately and precisely for determining cable lengths to be installed. A measuring device shall be inserted into the conduit, and the length shall be measured (to the nearest foot) from entry point to exit point. All conduit run measurements shall take place in the presence of the Engineer or the Inspector. The Contractor shall record all cable measurements and include the distances in the as-built drawings. In locations where new cables are to replace existing cables, the Contractor may use the removed cables as a measuring device to determine the lengths of the removed cables to be installed, however, this does not relieve the Contractor of his responsibility to record accurate measurements of all cable lengths.

5.1.5 The manufacturer's recommended maximum pulling tensions shall not be exceeded under any circumstances. If so required by the Traffic Engineer, the Contractor shall insert a dynamometer in the pull wire as the cables are being pulled into the conduit to demonstrate that the maximum tensions are not being exceeded. The cable shall be fed freely off the reel into the conduit without making a reverse curve. At the pulling end, the pull wire and cables shall be drawn from the conduit in direct line with the conduit. Sheaves or other suitable devices shall be used as required to reduce any hazards to the cable during installation. The cables shall be adequately lubricated to reduce friction and further minimize possible damage. Such lubricants shall not be the grease or oil type used on lead sheathed cables, but shall be one of several commercially available wire pulling compounds that are suitable for P.V.C. sheathed cables. They shall consist of soap, talc, mica, or similar materials and shall be designed to have no deleterious effect on the cables being used.

5.1.6 The cables shall be neatly trained to their destinations in manholes, cabinets, pole bases, pullboxes, and all other terminations. The cable manufacturer's recommended values for the minimum bending radii to which cables may be bent for permanent training during installation shall be adhered to. These limits do not apply to conduit bends, sheaves or other curved surfaces around which these cables may be pulled under tension while being installed. Larger radius bends are required for such conditions.

5.2 Wire and Cable

5.2.1 All wire and cable shall conform to the requirements shown on the plans, except wire and cable specifically covered by other items of this contract. The minimum size of conductors shall be as indicated on the plans.

5.3 Controller Cabinet Wiring

5.3.1 Wiring for the controller shall consist of connecting to its terminals; (1) wires to signals, (2) wires to detectors, (3) the power wires, (4) the ground wires, (5) the pedestrian push-button wires, and (6) the interconnect wires. At the controller, the signal conductors from the field shall be stripped back and insulated solderless lugs crimped to wire. These "lugs" shall be inserted under the binder head screw and tightened securely. Other wiring for the controller shall be as required by the wiring diagrams and instructions furnished with the controller by the manufacturer.

5.3.2 All field wiring in cabinets shall be neately done. Incoming cables shall be trained to their destination and neatly laced together. All spare wires shall be trimmed, and neatly coiled with the ends taped. Detector lead-in cables shall have their insulation jackets removed from the terminal strip connection unsheathed to the bottom of the cabinet, and have the ground wires tied together in the bottom of the cabinet. Communication and detector lead-in cables shall be clearly identified by use of metal or plastic tags. For example: System Detector Eastbound Right Lane.

5.3.3 Pedestrian pushbuttons shall have a common ground wire that is completely isolated and independent from all other ground wires. This wire shall be connected to the designated terminal in the controller cabinet.

5.4 Signal Head Wiring

5.4.1 Wiring for the signal head shall consist of connecting the terminal block in each signal section to the common terminal block in each signal face to the terminal block in the signal-head terminal compartment. All such connecting wires shall be number twelve (12 ga.) stranded American Wire Guage. All conductors running from any terminal points located in the pole or transformer base to the signal-head terminal shall likewise be number twelve (12 ga.) stranded A.W.G. wire. The Contractor shall furnish the No. 12 ga. stranded A.W.G. wire for this task.

5.5 Terminals

5.5.1 Except for controllers, the ends of all stranded wires which are to be attached to terminal posts shall be provided with solderless terminal lugs that meet the requirements of the National Electrical Code. Terminal lugs on solid wires are prohibited.

5.6 Splices

5.6.1 Splices inside conduit runs and in loop detector T.H.W. wire are absolutely prohibited. Except for detector lead-in cables, all splices shall be made above ground. Splices in pullboxes are prohibited unless specific written permission has been issued by the Traffic Engineer.

5.6.2 Splicing methods shall be in accordance with good electrical practice and the cable manufacturer's recommendations. All materials used shall be high quality and specifically intended for these purposes. The cables shall be trained to their final position and cut to proper lengths. The jacket and insulation shall be removed as required. In doing this, use proper care to insure against nicking the conductors. The connector shall be installed tightly and all burrs, rough edges, etc. shall be removed. If required in the plans or by the Traffic Engineer, the connection also shall be soldered. Heat shall be applied by use of hot solder. Heating the connection with a direct flame will not be permitted. Care shall be used to protect the insulation when soldering. The entire surface shall be cleaned taking special care in cleaning the outside jacket in order to remove the wax finish. Before the first layer of tape is wrapped, the entire area shall be coated with an electric grade rubber cement. After this solvent has dried, the connection shall be insulated with electrical grade rubber splicing compound tape to proper thickness. This tape requires a pressure and temperature in service to complete its vulcanizing process and thus be stretched to 2/3 width when applied. The completed splice shall be covered with a half-lap layer of vinyl plastic electrical tape. This wrapping shall be smooth but the tape shall not be stretched more than necessary.

5.6.3 Splices in communications cables shall include the shield. Splices between cable pairs shall be made with scotchlock solderless connectors designed for this specific application. The completed splice shall be insulated with a re-enterable plastic splice case. Splices at points other than those shown on the plans may be made only with the written permission of the Traffic Engineer.

5.6.4 The Traffic Engineer shall select at random at least 5 splices to be thoroughly inspected. The Contractor shall, in the presence of the Traffic Engineer sectionalize the splice to expose the various layers of materials and the connector. The splice shall be thoroughly checked for compliance to these special provisions. The splice shall then be remade by the Contractor. This work shall not require extra payment, but is considered subsidiary to other items in the Contract. All of the splices selected for this inspection shall conform to the requirements of these special provisions. If any splices fail to meet these requirements, ten (10) more splices shall be selected at random by the Traffic Engineer for inspection.

5.7 Enclosed Wiring

5.7.1 All cables and signal conductor wire above the ground surface shall be enclosed in approved metal conduit up to but no closer than one foot of the lowest power conductor. Power-tap lines carried down poles shall be placed in metal conduit.

5.8 Identification of Signal Wires

5.8.1 IMSA color coded signal cable shall be used for all signal and interconnect systems. Colors shall be continuous from the point of origin to the point of terminatioin. Splices will be permitted only if same colors are spliced.

6.0 GROUNDING

6.1 There shall be a properly installed and connected ground rod for each controller cabinet and power drop to reduce any extraneous voltage to a safe level. The ground rod shall be located so as to minimize the length of the grounding-conductor run. All grounding circuits shall be substantial and permanent and shall be electrically continuous with an ohms-to-ground resistance not to exceed 10 ohms when tested by volt-ohm-meter.

6.2 Grounding Connectors and Electrodes

6.2.1 The grounding conductor shall be a No. 6 AWG standard copper wire. The conductor shall be bonded to ground rods. Ground rod electrodes shall be solid copper-bonded steel being at least 5/8 inch in diameter and shall be driven into the ground to a depth sufficient to provide the required resistance between electrodes and ground (10 ohms). All ground rods shall be a minimum of six feet long. When the location precludes driving a single ground rod to a depth of six feet or when a multiple ground rod matrix is used to obtain the required resistance to ground, ground rods shall be spaced at least six feet apart and bonded by a minimum No. 6 AWG copper wire. Connections to underground metallic conduit shall be considered sufficient for grounding requirements. Connection of grounding circuits to grounding electrodes shall be by devices which will ensure a positive, fail-safe grip between the conductor and the electrode (such as lugs or pressure connectors). No splice joint will be permitted in the grounding conductor.

7.0 LOOP VEHICLE DETECTOR INSTALLATION

7.1 This section specifies the Contractor's responsibility for the loop and lead-in installation for vehicle loop detectors. It is required that all work related to the installation of a particular loop, with the exception of the layout task, shall be completed in the same work day. loop installation work shall be performed during off-peak traffic hours. Loop installation shall not be made during any type of precipitation or when pavement is wet from landscape irrigation systems.

7.2 The installation of loop detectors shall occur as shown in the Plans. The lead-in saw cuts from the street to the pullbox shall maintain a minimum separation from other loops of 12 inches and a minimum separation of 6 inches from other lead-in saw cuts. The saw cut depth, as specified in the plans, shall be consistent, including the entry point into the curb. The maximum number of wires placed in a single saw slot shall be four (4) wires. All wires in saw slots shall be a minimum of one inch (1") below the street level grade. The maximum number of wires placed in any lead-in saw cut from the street to curb side shall be two (2).

7.3 The Contractor shall furnish the sealing compound for the loop detectors at his expense. Samples of the sealant and methods for sealant installation shall be submitted to the Engineer for his approval before any detector installation may begin. If a hot sealant is used, the temperature of the sealant shall be in a range that will not cause damage to the detector wires. Loop sealant shall completely fill the saw cut, but shall not be more than three inches (3") in width on the street surface. The Contractor shall be required, at his expense, to remove all excess sealant, otherwise the loop will not be considered as a completed item.

7.4 Detector lead-in cables shall be run continuously without splices from the curbside pullbox to the controller where possible. If splices must be made, they shall be made in a signal base. Splices shall be solder connected (including the ground wire) and the splice connection shall be insulated and waterproofed with scotchcoat materials. Splices at the curb side pullboxes shall also be made in the same manner. See Section 5.6 Splices. The Traffic Engineer shall approve any splice in detector cables.

7.5 Each detector loop shall penetrate the curb in a separate conduit.

NO.	REVISION	BY	DATE

DESIGNED BY: _____
DRAWN BY : _____
CHECKED BY: _____
SCALE: _____
DATE : _____

STATE OF TEXAS — WILLIAM H. MITCHELL — 57.5 — REGISTERED PROFESSIONAL ENGINEER

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GENERAL NOTES

Scale : NONE

SHEET NO. H
OF SHEETS
JOB NO.

TELEDYNE POST HADEN