

SECTION 900 TRAFFIC CONTROL DEVICES AND STREET LIGHTING

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SECTION 900 TRAFFIC CONTROL DEVICES AND STREET LIGHTING**910.00 GENERAL**

The installation of traffic control devices and street lighting shall comply with all applicable portions, as from time to time amended, of the CDOT Standard Specifications for Road and Bridge Construction, the Manual on Uniform Traffic Control Devices (M.U.T.C.D.), United Power requirements, accepted plans, and additional requirements as listed in Attachment A. These STANDARDS AND SPECIFICATIONS and any other requirements determined by the Director of Streets and Fleet shall apply to all materials supplied, methods and procedures of work. The Director of Streets and Fleet must approve a traffic control device, sign layout plan, and a street lighting layout plan.

920.00 TRAFFIC CONTROL DEVICES**921.00 General**

Traffic control devices shall be installed on all new streets accepted by the City for maintenance as set in these STANDARDS AND SPECIFICATIONS.

922.00 Signs

922.01 Street Name Signs

Street name signs shall be purchased and installed by the Contractor or Developer. Sufficient signs and posts shall be provided to allow installation on two (2) corners of each intersection in business district, on principal arterials and on one corner in the residential areas, as directed by the Department of Streets and Fleet. Street names and fonts shall be Highway Gothic E/M non-AK Rev in compliance with the "Standard Highway Signs and Markings" book by FHWA.

City of Brighton - Example Standard and Specifications for Street Name Signs

Intersection Type	Sign Blank Size (30" Minimum on all Lengths)	Mounting	Recommended Minimum			
			Letter Height		Suffix (St, Ave, Ct, etc.)	
			Initial Upper-Case	Lower-Case	Initial Upper-Case	Lower-Case
Arterials at Signal lights with Logo	18" x as needed	Overhead	12 inches	9 inches	6 inches	4.5 inches
Multi Lane Arterials and all others directed by Streets and Fleet Department with Logo	10"x 48" (Words)	Post-mounted	8 inches	6 inches	4.5 inches	3.5 inches
	10" x 36" (Numbers)					
Arterials, Collectors, Locals and all others directed by Streets and Fleet Department with Logo	10" X as needed	Post-mounted	6 inches	4.5 inches	4 inches	3 inches
*Local with Logo	6" X as needed	Post-mounted	4 inches	3 inches	3 inches	2.25 inches
* On local two-lane streets with speed limits of 25 mph or less, 4-inch initial upper-case letters with 3-inch lower-case letters may be used with approval of the Director.						

When Logo is displayed, the height of the logo shall not exceed the upper-case letter height of the principal legend of the sign and located left of the street name.

The "as needed" sign length shall include sufficient length for the City logo. The logo shall be placed in the left face side of the sign and centered accordingly.

All non-illuminated street signs shall be aluminum 5052-H38 (Conversion coated) minimum thickness of .080.

Retroreflective sheeting for letters and background shall be required in accordance with the Manual on Uniform Traffic Control Devices (M.U.T.C.D.).

Unless directed otherwise by the Streets and Fleet Director, signs shall be installed on square stock tubing at eighteen (18) inches behind the curbwalk or curb and gutter, whichever is closest to the street. Anchors shall be galvanized (G90) 12GA steel with seven-sixteenths (7/16) inch diameter holes, one (1) inch on center, two-one fourth (2 ¼) inch square and three (3) feet in length. During installation, the anchors may only be between a minimum of four (4) and maximum of six (6) inches above the ground. Posts shall be of galvanized (G90) 12GA steel with seven-sixteenths (7/16) inch diameter holes, one (1) inch on center, two (2) inches square and to length to meet mounting requirements set forth in the M.U.T.C.D. There shall be a minimum of 2' clearance from the edge of roadway to edge of sign.

4" diameter PVC pipe sleeves shall be placed in concrete where sign posts are to be installed to accommodate sign post installation and replacement.

922.02 Illuminated Signs

Internally illuminated street name signs shall be furnished and installed by the Contractor or Developer. Illuminated signs shall be installed on each signalized traffic intersection and shall include city logo, any prefix, suffix, and address numbers.

922.02.01 Range of Dimensions

Street name signs shall have a viewable width of 4' to 11' in six inch increments. Street name sign viewable height shall be 18", 21", or 24". An alternate height between 15" and 30" may be permitted by the Director. Body depth of 5.4" on double face signs and 3.95" on single face signs or as otherwise approved by the Director.

Illuminated signs shall be single faced for mast arm installations, double faced for span wire installations. The viewable area shall fit standard MUTCD regulatory sign dimensions of 24"x24", 24"x30", 30"x30", and 30"x36".

922.02.01 Borders

Reserved.

922.02.02 Spacing

Refer to MUTCD

922.02.03 Arrows

Arrows shall be in accordance to the M.U.T.C.D. standards as illustrated in the Standard Highway Sign Handbook.

922.02.04 Color

Letters and numbers are to be white on an interstate blue background face. The City logo shall be white. Lenses shall be impact resistant UL approved white or clear polycarbonate with a minimum thickness of .125". Sign film shall be ultraviolet (UV) resistant.

922.02.05 Sign Housing

The street name sign shall be limited swinging. Sign fixture and panels shall withstand 90 mph wind loading, with structural requirements meeting AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" latest edition. Illuminated housing shall be constructed of 5052 H32 0.125" thick aluminum. Sign doors shall be fabricated from a single sheet of .125" 5052 H-32 aluminum. All seams shall be continuously welded to ensure a watertight seal. The design shall be rigidly constructed to resist torsional twist and warp. All ferrous parts shall be galvanized or cadmium plated. The external aluminum surfaces of the sign bodies and doors shall be polyester powder coated or have other approved protective coating. The double face sign shall feature doors on both sides for easy access. The front and back sign panels of the cage shall use a piano hinge or other approved hinge to join door to the body and open with downward motion for easy of accessibility to the LEDs. UL approved neoprene gaskets shall be installed between the sign panels frame and fixture housing to provide a watertight seal between the body, lens and door. Hardware shall be stainless steel. Door latches and keepers should feature a turn-lock style device to provide a secured attachment of the sign face to the case, and require minimal or no tools to open the sign. Screened weep holes are to be provided on the housing bottom for drainage. The overall weight of the completed sign assembly, including mounting brackets, shall not exceed 90 pounds.

922.02.06 Illumination Source

The entire surface of the sign panel shall be evenly illuminated. The illumination source shall be LED. The LED lights shall be rated for 60,000 hours and shall deliver at least 70% of the initial brightness for an additional two years on a prorated basis. Photoelectric controls are required and shall be the "hail resistant" type and of the load intended. Photoelectric cells shall be flush mounted. The reflectors shall have a minimum reflectance of 85%.

922.02.07 Final Layout

Final layout and lettering details are to be submitted to the City prior to fabrication.

922.03 Stop Signs

Stop signs shall be installed at all approaches to streets designated by the City as through streets. Stop signs shall be mounted on the same support posts as street name signs where possible.

922.04 Other Signs

Speed limit signs, school signs, and crosswalk signs shall be installed at locations designated by the Director of Streets and Fleet.

922.05 Private Street Signs

All subdivisions with private streets shall install private street signs as shown in Standard Details-Streets at all entrances to the private streets.

923.00 Striping

The Contractor shall submit a striping plan to the Director(s) for approval prior to beginning work. The striping plan shall meet the requirements for such work as outlined in the MUTCD. All temporary striping and markings of roadways shall consist of paint pavement marking materials conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction all striping and markings of roadways minus the top lift shall consist of paint pavement marking materials conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction. All striping of the top-lifted roadways shall consist of epoxy pavement marking material conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction. All markings of the top-lifted roadways shall consist of preformed thermoplastic marking material conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction, unless otherwise approved by the Director of Streets and Fleet. Standard twelve (12) inch wide stop bars shall be provided at all stop locations and intersections adjacent to schools, parks, commercial, and other areas as determined by the City. Crosswalks will be marked with two (2) foot by six (6) foot bars, and layout shall conform to current MUTCD requirements.

924.00 Sign Supports

All sign supports or posts shall conform to specifications for perforated square steel tubing and to Standard Specifications for Cold Rolled Carbon Steel Sheets, Commercial Quality, ASTM Designation A-366. The cross section will be square and consist of twelve (12) gauge steel (0.105" U.S.S. Gauge) carefully rolled to size and continuously welded at the corner and will conform to CDOT M&S Standards, Mounting Data, Standard Plan No. S-614-3. Sign sizes not included in this data shall be:

<u>Total Sign Area</u>	<u>Side Dimensions</u>
Less than 800 sq. inches	2" x 2"
800 to 1000 sq. inches	2" x 2"
Over 1000 sq. inch	CDOT S-614-3

The finished members shall be straight and have a smooth, uniform finish. It will be possible to telescope consecutive sizes of tubes freely with a minimum amount of play. All holes and cut-off ends shall be free from burrs. Seven-sixteenth (7/16) inch diameter holes shall be punched on one (1) inch centers on all sides of the tube. All posts shall be weather protected by galvanizing. Posts shall be formed from cold rolled steel strip that has been zinc coated and is commercial quality (1.25 oz.) conforming to ASTM Specification A-525.

925.00 Street Lighting Procedure To A High Source

930.00 TRAFFIC SIGNALS

931.00 Control of Work

931.01 Regulations and Code

All electrical equipment shall conform to the CDOT Standard Specifications for Road and Bridge Construction. In addition to requirements of the accepted plans, all material and work shall conform to the requirements of the NEC and these STANDARDS AND SPECIFICATIONS.

931.02 Inspection

The Director of Streets and Fleet shall make inspection of all material and work. All material delivered to the site shall be subject to inspection, prior to or during installation, as deemed necessary by the Director of Streets and Fleet. The Director of Streets and Fleet may request samples of certain materials from the factory or warehouse for testing purposes prior to delivery on the site. Material that has been rejected by the Director of Streets and Fleet shall not be delivered to the work site and any material rejected at the work site shall be immediately removed from the site. Failure by the Director Streets and Fleet to note faulty material or workman-ship during progress of the work *will not* relieve the Contractor of his responsibility for removing and/or replacing faulty materials at his own expense if any such materials are found at a later date.

Any work within the public right-of-way shall require two working days prior notice to the Director of Streets and Fleet by the Contractor or Developer.

Good housekeeping practices shall be used to keep all traffic signal elements, including the interior of the cabinet, organized and tidy.

931.03 Traffic Control

Refer to Section 141.08, Traffic Control, Barricades and Warning Signs, of these STANDARDS AND SPECIFICATIONS.

931.04 Equipment List and Drawings

The Contractor shall submit to the City for review and acceptance a listing of all materials and equipment that will be used in the work. The list shall include the name of manufacturer, size and catalog number of unit, and will be supplemented by other required data including detailed scale drawings and wiring diagrams of any nonstandard or special equipment and of any proposed deviation from the accepted plans. If required by the Director of Streets and Fleet, the Contractor shall provide samples of materials proposed for use.

All equipment listings and drawings shall be submitted to the Director of Streets and Fleet for review and acceptance. The Contractor shall perform no labor until the Director of Streets and Fleet has accepted all details and plans in writing to the Contractor.

All applicable portions of Section 141.00, Protection of Public and Utility Interests and Section 342.00, Protection of Existing Structures and Utilities, of these STANDARDS AND SPECIFICATIONS shall apply.

The Contractor shall furnish all materials, equipment and labor needed to install and maintain temporary traffic signals during progress of the work. All intersections presently signalized will be kept in operation until the new signal equipment is properly installed and ready for operation. If in the opinion of the Director of Streets and Fleet this is not possible because the installation of new equipment is in the same location as existing equipment, the Contractor shall not proceed with any work that will cause the present equipment to become inoperative until he has all necessary replacement equipment on hand.

Existing traffic signals shall be kept in operation except when shut down due to changing over and connecting to new equipment. Work shall be performed so that signals will be in operation at the close of each day's work, over weekends, and during times when the Contractor is not working. When a signal is shut down, the Director of Streets and Fleet shall be notified in writing six business days in advance of the proposed shut down.

931.05 Coordination with Other Agencies and Contractors

It shall be mandatory that the Contractor coordinate his conduit work with United Power and other applicable agencies to insure that all conduit installations and pull box installations are completed as quickly as possible.

931.06 Maintenance

The Contractor shall maintain the work during construction and until the work is accepted by the City. Maintenance will constitute continuous and effective work executed day by day, with sufficient equipment and personnel to complete the work in the shortest time and least disruptive manner.

931.07 Communications

All new signals shall connect to the City's traffic signal network. Signal upgrades, including adding equipment not previously installed, shall include the addition of communications to existing signals without communications. Communications shall be consistent with City of Brighton Information Technology Department's practices and policies and compatible with the Streets and Fleet Department's signal management software

932.00 Conduit

932.01 General

All underground conductors shall be run in conduit. Conduit shall be the rigid PVC type conforming to these STANDARDS AND SPECIFICATIONS. Conduit runs shown on the accepted plans are tentative as to routing and may be changed, as directed by the Director of Streets and Fleet, to avoid underground obstructions. Any change in location from those shown on the plans shall require the prior approval of the Director of Streets and Fleet and must be accurately recorded on "as-built" drawings in accordance with Section 161.00, Construction Plan Requirements, of these STANDARDS AND SPECIFICATIONS.

Excavations for conduit shall be two (2) inches wider than the outside diameter of the conduit. Backfilling of the conduit trenches shall be accomplished in accordance with all applicable portions of Section 350.00, Trenching, Backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

A nylon pull string shall be left in each conduit run for any future pulling of conductors. Conduit installation in existing paved areas shall be completed by boring; trenching in pavement must be approved in writing by the Director of Streets and Fleet.

932.02 Materials

Rigid PVC conduit shall be Schedule 40, Type 2, as specified in NEC, and will be manufactured as high-impact type conforming to industry standards and commercial standard No. CS-207-60. Each length of conduit and all PVC fittings (expansion joints, coupling, adapter, etc.) shall bear the label of Underwriters' Laboratories, Inc. Conduit shall be the size or sizes indicated on the accepted plans.

Rigid PVC conduit shall be cut with a hacksaw with all ends squared and trimmed after cutting to remove rough edges. Connections shall be the solvent weld type except where the connection is made to a steel conduit, in which case the coupling will be threaded on the metal conduit side. Solvent weld joints shall conform to the PVC manufacturer's recommendations. Rigid PVC conduit shall be used only for underground installations; all conduit used above ground shall be the rigid-galvanized-steel type.

A bare or green #10 AWG copper conductor shall be run continuously in all conduit used for traffic signal circuits. This wire shall be used for bonding and grounding purposes.

Existing underground conduit that is incorporated into a new system shall be cleaned and blown out with compressed air.

932.03 Installation

Conduit shall be laid to a depth of not less than thirty- (30) inches below the curb grade roadway construction. Conduit under railroad tracks will not be less than forty-two (42) inches below the bottom of the tie, and/or as specified by railroad code. It shall be the responsibility of the Contractor to obtain clearance from the railroad company prior to doing any work within the boundaries of the railroad right-of-way. The minimum size of conduit to be used shall be shown on the accepted plans or as required on the wire layout sheets. Conduit smaller than three-fourths (3/4) inch electrical trade size shall not be used unless otherwise specified on the accepted plans, except that grounding jumpers at service points may be enclosed in one-half (1/2) inch conduit.

It shall be the option of the Contractor to use at his own expense, larger size conduit if desired. Where larger size conduit is used, it shall be used for the entire length of the run from outlet to outlet. No reducing couplings shall be permitted in any conduit run. Conduits terminating in poles, cabinets, or pedestal bases shall extend a maximum of four (4) inches and a minimum of two (2) inches above the foundation vertically, or will be sloped toward hand holes in poles or base opening where transformer bases are used.

Conduit entering pull boxes shall terminate a minimum of one (1) inch and a maximum of three (3) inches inside the box wall. A two (2) inch minimum or four (4) inch maximum above the bottom, and shall be sloped to facilitate convenient pulling of the wires or cables. Conduit entering through the side of a pull box shall be located near the sides and ends of the box in order to leave the major portion of the box clear. Conduits shall enter freely through boxes for allowance of expansion and contraction. Conduit required to be terminated, stubbed, and plugged shall be shown on the plans as directed by the Director of Streets and Fleet. All conduit ends shall be capped with standard conduit caps until the wiring is started. When caps are removed, the threaded ends must be protected with approved insulated metal ground bushings. The location of all ends of conduit for future electrical circuits in curbs or structures shall be marked by a "Y", which is at least three (3) inches high, cut into the face of a curb, gutter, or wall directly above the conduit. These locations shall be shown on the "as built" drawings in accordance with Section 161.00, Construction Plan Requirements, of these STANDARDS AND SPECIFICATIONS.

Conduit bends, except for factory bends, shall have a radius of not less than six (6) times the inside diameter of the conduit. Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practicable. Conduit entering controller cabinets shall be packed with duct seal after wiring is installed to prevent the entrance of gases. Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.

Bends in all PVC conduit shall be made to conform to all appropriate sections of the NEC or local codes governing bending radius and number of bends allowed, as applicable, for rigid conduit.

At many locations on the City's streets, it is desirable to have conduit installed for future use. When PVC conduit is specified, a galvanized, 12-gauge sheet metal plate twelve (12) inches

square shall be placed over each conduit end. Each end shall be capped with PVC caps. Where a cap is indicated on the plans, a standard non-corrosive cap must be installed.

Conduit terminating within a foundation must extend from two (2) inches to four (4) inches above the foundation vertically, and be installed in such a way that it will slope towards the hole opening.

All galvanized rigid conduit terminations within pull boxes must be fitted with insulating bushings to prevent chafing of wire on exposed edges.

All conduit ends shall be capped with standard conduit caps until wiring is started. When caps are removed, threaded ends must be protected with approved insulated metal ground bushings or insulated bushings if the conduit run is not extended from the threaded end and sealed by duct seal material.

Pull boxes and other foundations shall be placed on a 6" thick layer of crushed rock or gravel to allow for drainage.

933.00 Cable and Conductors

933.01 General

Cable and conductors shall conform to the applicable specifications of the IMSA and to those specifications shown on the accepted plans or as approved by the Director of Streets and Fleet.

All wire furnished to or for the City shall carry the label of the Underwriter's Laboratories, Inc. This label must be present on each reel, coil or container of wire unless otherwise specifically approved by the Director of Streets and Fleet.

Insulated conductors will be shipped in splice-free continuous lengths, in cartons or on new-bolted-type non-returnable reels plainly and indelibly marked with the name of the manufacturer, net weight, size (AWG) and length of the wire. **ABSOLUTELY NO SPLICES OF ANY KIND WILL BE PERMITTED IN THE WIRE.** A heavy covering of cardboard or burlap will be used to protect the wire and reels, during shipment and handling.

933.02 Multi-conductor Cable

Where multi-conductor cable is required, IMSA Specification 19.1 polyethylene-insulated, polyvinyl chloride-sheathed signal cable will apply, except that the conductors will be stranded.

Conductor color-coding will conform to Table II of IMSA Specification 19.1 for unpaired conductor cables. Color-coding for tracers will run spiral and be impregnated into the conductor insulation.

933.03 Installation Methods - Wiring

Wiring must conform to appropriate articles of the NEC and NEMA Code. Wiring within cabinets, junction boxes, etc., shall be neatly arranged and laced. Flaxsoap, or other approved lubricants, may be used for inserting conductors in conduit. No splices of cable will be permitted in the conduit that is outside of pull boxes, splice boxes, standard or pedestals.

In all signal designs, separate conduits shall be shown for separate low voltage and high voltage conductors on the plan. Signal conductors must be run in conduits separate from the low voltage detector lead-in or from the telephone inter-connector.

Signal Conductor Type wire is prohibited from use for wiring signal heads.

All loop detector wires shall be pulled continuously for the full extent of the run from loop detectors to the cabinet with no splicing allowed in the runs. The contractor will perform his pulling operation in a manner so as to facilitate pulling the wire in continuous runs.

Required tags shall be furnished and installed by the contractor at cabinet locations, at pull boxes, and at terminating points, or as directed by the Director of Streets and Fleet. A permanent tag of fiber or PVC will be used for tagging all wires. Tags will be marked as indicated on the wire layout sheets and will indicate the direction of the run and pole number of other locations of termination points for the wire run. All spare wires shall be ohmmmed out, tagged, and identified as spare with appropriate numbers as shown on the layout sheets. The ends of the spares wires shall be pulled into the terminal compartment or cabinet.

All wiring between the controller and the signal faces shall be done with multi-conductor cable. The individual conductor will be 14 gauge stranded copper wire. Separate multi-conductor cables for each signal phase will be run around the intersection and marked with colored phasing tape at the controller and at each splice point in the pull boxes and pole bases.

Color-coding for individual conductors for Phase 2 controllers with pedestrian signals must conform to the specifications in Table 900-2:

TABLE 900-2

Conductor Color	Indication	Tape Color
For northbound and southbound vehicles:		
Green	Green	Red
Orange	Yellow	Red
Red	Red	Red
For eastbound and westbound vehicles:		
Green	Green	Blue
Orange	Yellow	Blue
Red	Red	Blue
For northbound and southbound pedestrian directions:		
Blue	Walk	Red + Yellow
Black	Don't Walk	Red + Yellow
For eastbound and westbound pedestrian directions:		
Blue	Walk	Blue + Yellow
Black	Don't Walk	Blue + Yellow
Also:		
White	Common signal	
White/Black Tracer	Unused	
For all split-phase controllers with pedestrian signals (Multi-pass controller)		
Green	Green	Red
Orange	Red	Red
Northbound left turns:		
Green	Green arrow	Red + White
Orange	Yellow arrow	Red + White
Southbound through vehicles:		
Green	Green	Green
Orange	Yellow	Green
Red	Red	Green
Southbound left turns:		
Green	Green arrow	Green + White
Orange	Yellow arrow	Green + White
Northbound and southbound pedestrians:		
Blue	Walk	Green + Red + Yellow
Black	Don't Walk	Green + Red + Yellow
Eastbound and westbound pedestrians:		
Blue	Walk	Orange + Blue + Yellow
Black	Don't Walk	Orange + Blue + Yellow

Unused conductors shall be folded back on the cable and securely taped.

933.04 Connections to Signal heads, Pushbuttons, and Traffic Controllers

All cable wires shall be secured to screw-type terminals in the traffic signal heads, pedestrian pushbuttons, and the traffic controller. The connectors shall be the spade-tongue type and affixed to the conductors using a tool designed specifically for the connection of the connectors to the conductors.

933.05 Wire Splicing

Splices shall only be made in pull boxes or pole bases. All splices made in pull boxes will be bundled together, and the bundle and all exposed conductors will be joined with a Buchanan crimp connector or approved equal..

. Loop detector, pedestrian button, and lead-in wire will run continuously from the loop detector to the controller terminals without splicing.

United Power shall make the electrical service connections. The Contractor shall furnish two conductor, 6-gauge wires from the controller to the pull box; leaving two (2) feet extra of wire in the pull box. The Contractor shall be responsible for coordinating the service connection with United Power.

933.06 Wire Bonding and Grounding

Metallic cable sheaths, conduit, metal poles and pedestals shall be bonded to form a continuous and effectively grounded system. Bonding jumpers will be #10 AWG copper wire, or larger, as required. Grounding of conduit and neutral at the service point will be #8 AWG copper wire, or larger, as required. At each controller, a ground rod (electrode) will be installed. Each ground rod will be a one-piece solid rod of the copper-weld type, a minimum of one-half (1/2) inch in diameter and eight (8) feet in length. This rod shall be driven into the ground to a minimum depth of seven (7) feet below the surface. The ground wire must be completely spliced together at the aforementioned termination points and will tie into the neutral bar at the service facility, load center cabinet, or control cabinet, to become a true and functioning common bond.

934.00 Service Systems**934.01** General

Service points shown on the accepted plans are approximate. The exact location will be determined in the field by the Contractor, the Director of Streets and Fleet, and United Power.

The Contractor shall furnish and install conduit and conductors to the service points as shown on the plans. Conduit for traffic signal service must not be less than two (2) inches in size. Conduit and wiring specified in the wire layout sheets and shown on the accepted plans shall be furnished and installed from service pole to the controller cabinet, or to the location shown on the accepted plans.

934.02 Service Pole

All conduit must be strapped to poles with rigid 2-hole straps and #8 or #9, one and one-half (1/2) inch long wood screws, or as shown on the accepted plans. Plumber's tape, wire nails, or other means of fastening conduit **WILL NOT BE PERMITTED**. Where necessary, conduits, covers, and gaskets shall be provided and installed.

All conduit in service installation above ground shall be a rigid galvanized steel type of the size specified on the plans. In areas where rigid steel conduit is coupled to rigid PVC conduit, which is in turn used for the underground portion of the service run, the joining of the two conduits will take place underground from two (2) inches to ten (10) inches below the surface.

The disconnect switch mounted in a weatherproof box shall be located on the service pole as designated on the plans.

The conduit shall be securely bonded to the service pole when deemed necessary by the Director of Streets and Fleet, and will be bonded in a like manner to the service pole ground system.

935.00 Concrete Foundations**935.01 General**

Foundations must be composed of concrete conforming to Section 400, Concrete Work, of these **STANDARDS AND SPECIFICATIONS**. Foundations for all poles, standards, pedestals, and cabinets as shown on the accepted plans, will rest on firm ground. Forms required in pouring bases shall be true to line and grade, rigid, and securely braced.

Both forms and ground that contact the concrete will be thoroughly moistened prior to pouring of the concrete. Conduit stubs and anchor bolts will be placed in proper position, alignment, and height, and be securely held in place by means of a template while concrete is being poured and until the concrete has properly set. After pouring concrete, the anchor bolts will be raised and lowered individually to eliminate air pockets and to allow proper alignment of the anchor bolts in the concrete prior to the setting of the concrete. Any deviations in the pouring of foundations proposed by the Contractor will require prior approval by the Director of Streets and Fleet.

935.02 Poles, Standards and Pedestal Foundations

Poles, standards, and pedestals will not be erected until the foundation concrete has set at least seven (7) days (foundations of high-strain poles will set a minimum of ten [10] days) and will be plumbed or raked as required and directed by the Director of Streets and Fleet.

Foundations for all poles will normally be the flush-top variety and shall be located as shown on the plans or as directed by the Director of Streets and Fleet. In each case, the maximum distance behind the curb for pole locations is desired. Consideration shall be given to placing poles at an intersection that is not built to its ultimate configuration. In locations where the roadway is not curbed, the top of the foundations will be six (6) and one-quarter (1/4) inches above the grade of the edge of the pavement. Where foundations are located in the sidewalk, the foundation will be two

(2) inches above the surface of the sidewalk, and expansion material will be placed between the foundation and the sidewalk, with the top of the expansion material level with the sidewalk surface. Foundations for traffic signal control cabinets that are located in sidewalks will rise above the sidewalk surface as shown on the plans.

The foregoing provisions are general descriptions for normal roadway conditions. In certain cases, special foundation requirements may be indicated on the accepted plans or required by the Director of Streets and Fleet; i.e., where heavy excavations, embankments, sloping (rip-rap) areas near roadways, or unusual soil conditions are encountered.

936.00 Traffic Signal Controllers Left To A High Source

936.01 Actuated Controllers

Traffic signal cabinets are to comply with ATC specifications and shall be compatible with NTCIP based distributed traffic signal systems. Unless otherwise noted in the bid document, all components, connections, and cables shall be supplied with the cabinet.

The signal supervisor shall be supplied a computer printout of the complete environmental testing results. After award the equipment supplier shall furnish a traffic engineer that will provide on-site instruction and installation programming of the ATC controller.

936.02 Cabinets

936.02.01 General

Traffic signal controller cabinets are to conform to the requirements for NEMA 3R rating, ITS Cabinet Standards latest version, and this specification. Where differences occur, this specification shall govern. Unless noted otherwise, Size 6 P44 cabinets shall be furnished.

The cabinet drawings shall be non-fading prints using the xerography method. No blue line drawings will be accepted. The cabinet shall be equipped with eight (8) flash blocks. The cabinet field terminals shall be silk screened with the appropriate phase / color designations.

936.02.01.01 Materials and Dimensions

Cabinets are to be fabricated from sheet aluminum alloy, 0.125 inch thick, meeting the requirements of ASTM 5052-H32.

Size "6" P44 cabinets shall be 55 inches high, 26 inches deep and 44.25 inches wide.

936.02.01.02 Construction

The cabinet top is to be constructed with a two inch slope from front to back. Cabinet seams are to meet all requirements for NEMA Type 4 enclosures. All cabinet seams are to be continuous weld. The main door opening is to be double flanged on all four sides. The cabinet shall incorporate a plug-n-go design that allows for easy maintenance and replacement of cabinet modules.

936.02.01.03 Doors

Cabinet main and rear doors to be full width, hinged on the right side when facing the cabinet. The main door opening is to be a minimum of 90% of the width and 80% of the height of the front surface of the cabinet. A stiffener plate, at least 15 inches long, 6 inches high and one-half inch deep, is to be welded across the inside of the main door. (The bottom of the door opening shall be at least 3 inches above the bottom of the cabinet.)

The main door hinge shall be continuous and bolted to the cabinet door using 1/4-20 stainless steel carriage bolts and ny-lock nuts. The hinge is to be attached so that no bolts or rivets are exposed. The hinges shall have a 0.120 inch diameter stainless steel hinge pin capped top and bottom to render it tamper proof. The main door shall include a door restraint capable of holding the door open at approximately 90, 120, and 150 degrees under windy conditions. The door restraint shall be attached to the main door and pivot to placement holes in the bottom flange of the door opening.

A three-point draw-roller type door latch is to be provided with push rods of at least 0.25 inch by 0.75 inch steel. Rollers are to be a minimum of 0.875 inches in diameter, be made of nylon, and have a 0.150 inch steel center. The handle on the main door is to be stainless steel with a three-quarter inch diameter shank. The handle shall rotate clockwise to open. The handle is to include a hasp for attachment of a padlock. The main door shall be equipped with a Corbin lock, No. 1548-1, or equivalent, and shall be provided with two keys. The lock shall be positioned so that the key shall not interfere with operation of the handle. The key shall turn counter-clockwise to unlock the door. The hinged police door compartment is to be provided with a Corbin lock, No. R357SGS, provided with one key, and the opening for the key shall have a cover that will swing out of the way for opening but shall fall back into place when key is removed, the purpose of the cover is to prevent bees, spiders, etc. from entering the police compartment.

The main door and the police door are to close against weatherproof and dustproof closed-cell neoprene gasket seals. The gasket material for doors is to be a minimum of 0.250 inches thick. The main door gasket is to be a minimum of 1.00 inch wide; the police door gasket is to be a minimum of 0.50 inch wide. Both gaskets are to be permanently bonded to the cabinet.

936.02.01.04 Shelves

Unless noted otherwise, cabinets to be provided with two "C" channels mounted vertically on the interior of the back and both side walls. All channel nuts used in the cabinet shall be the spring-loaded type. Mounting channels are to extend at least 3 inches from bottom to at least 3 inches from the cabinet top.

Cabinets are to be provided with two adjustable shelves. Shelves are to be at least 12 inches deep and extend the full width of the cabinet, with a 1/2 inch rear lip.

The bottom shelf shall be mounted so that the back panel of the cabinet can tip forward to allow access to the back of it without striking the bottom shelf or the roll out drawer. The detector rack shall be attached to the top shelf to the left side allowing enough room for a second detector rack to be mounted to the left if needed. The second shelf shall be mounted above the bottom shelf allowing enough room for ventilation of the detector rack and equipment. Cabling for the controller and monitor shall be routed to the bottom shelf. The power supply cabling will be routed to the top shelf.

936.02.01.05 Finish & Surface Preparation

Cabinets shall be provided with a natural aluminum finish. All surfaces are to be free from weld flash. Welds shall be smooth, neatly formed, and free from cracks, blow holes, and other irregularities. Any sharp edges or burrs shall be ground smooth. Care shall be taken during handling to prevent scratches or dents.

936.02.01.06 Mounting and Foundation

Cabinets are to be provided with internal mounting flanges for mounting on a base. All walls of the cabinet shall be folded under the cabinet at the base and each flange created shall be equal to or greater than 4".

Cabinet foundations shall be completely poured in one operation and must be composed of concrete conforming to Section 400, Concrete Work, of these STANDARDS AND SPECIFICATIONS. The ground mount cabinet will be the bench top type and will be as shown on the accepted plans or as directed by the Director of Streets and Fleet. Anchor bolts will be installed using the supplied template with the controller on a foundation that has been poured level so that the cabinet will set flush with the foundation.

As an alternative, the Director of Streets and Fleet may approve a fiberglass cabinet base.

Foundations around controllers shall be caulked both inside and outside the controller base to prevent water seepage.

936.02.01.07 Ventilation

The lower portion of the main cabinet door is to be louvered for ventilation intake. The air inlet shall be large enough to accommodate the air flow of the rated fans. Louvers must meet the NEMA rod entry test for 3R ventilated enclosures. A heavy duty, non-corrosive, vermin and insect proof, air filter is to be mounted on the inside of the main door. The air filter must be held firmly in place by a fixed bottom bracket and a spring loaded top bracket that allow easy removal for cleaning. The top of the cabinet is to include an exhaust air plenum with a vent screen having perforations no greater than 0.125 inches in diameter. A removable fan plate is to be mounted in the top of the cabinet that houses two fan assemblies with one thermostat.

936.02.01.08 Equipment Outlet

An 8 Position outlet strip is to be mounted to the left wall of the cabinet. All of the outlets must be positioned to allow connection of power transformers without obstructing other outlets on the strip. The outlet strip should be wired after the 15amp breaker and may contain its own surge protection or be wired after the EDCO surge arrestor but it must have surge protection. If it contains its own surge protection it shall be equal to or greater than the protection provided by the EDCO model SHA 1210. The outlet strip may be alternatively mounted to the back wall of the cabinet above the upper shelf.

936.02.01.09 Pull out Drawer

A 16" width pull-out, hinged-top drawer, having sliding tracks, is to be installed under the lower shelf. It shall be possible to lift this hinged platform in order to gain access to the interior of the drawer. Drawer shall be mounted underneath, on the left side of the lower shelf.

936.02.01.10 Din Rail

Two lengths of Din Rail are to be mounted to the left side of the cabinet with spring loaded channel nuts for the purpose of mounting additional equipment such as small power supplies, Ethernet switches, Radios etc. Rail should be at least 12" in length.

936.02.01.11 Lighting

Cabinet shall have Bivar LED lighting (or approved equal) at the top of the cabinet and underneath the bottom shelf to provide ample lighting to the shelves and back panel, as well as having a gooseneck lamp mounted to the cabinet door for flexible lighting.

936.02.02 Terminals and Facilities

Reserved

936.02.02.01 General

Cabinets are to be assembled and wired to accommodate the following:

- Main panel with 16 load switches, 8 flash transfer relays, 1 flasher, and 2 bus interface units.
- Power distribution panel on lower right side panel
- Detector rack for 16 channels of detection, 4 channels of preemption, and 1 bus interface unit mounted on the left side of the top shelf
- Power supply for bus interface units mounted on the top left side of the upper shelf, and shall have a 5amp minimum rating.
- One ATC controller and a Type-16 channel malfunction management unit on bottom shelf. An EDI MMU2-16LEip-E or approved equivalent MMU shall be provided with each cabinet.
- Police switch compartment on inside of main door
- Detector I/O panel mounted on the left side
- Two ventilation fans mounted in the cabinet top with an adjustable thermostat.
- LED lighting mounted at the top of cabinet, underneath bottom shelf and for a gooseneck lamp on door

- Loading capacitor/resistor circuit
- Equipment outlet strip

936.02.02.02 Main Panel

The main panel is to be constructed from 5052-H32 brushed aluminum of 0.090 inches minimum thickness and formed so as to minimize any flexing when plug-in components are installed.

Main panels are to be hinged at the bottom to allow easy access to all wiring on the rear of the panel. The panel is to be designed so it can easily be moved from vertical to a minimum of 60 degrees from vertical. The bottom of the panel is to be five to eight inches above the base of the cabinet. The exact distance will depend on the spacing of other cabinet components.

The main panel is to be fully wired in the following configuration:

Sixteen load switch sockets, 8 flash transfer relay sockets, one flasher socket, two main panel BIU rack slots, one detector rack each with one BIU, and one Type-16 MMU.

Load switches - Load switch 9, 10, 11, & 12 yellow outputs shall be loaded with 2.2 microfarad 400VDC (275VAC) Metalized Polypropylene capacitors with a 100k 2 watt resistor in parallel. The capacitor/resistor circuit is to be mounted on a separate panel mounted to the side or back of the cabinet and wired to the load switches, 8 additional capacitor/resistor circuits shall be provided on this panel to allow loading of additional outputs as needed for left turn phases etc.

All load switch and flash transfer relay sockets shall be labeled on the front of the main panel to match drawing designations.

All load switches are to be supported by a bracket extending at least half the length of the load switch.

Rack style mounting is to be provided to accommodate the required BIUs per the configuration listed. A dual-row, 64-pin female DIN 41612 Type B connector shall be provided for each BIU rack position. Card guides are to be provided for both edges of the BIU. Terminal and facilities BIU mounting is to be an integral part of the main panel. Detector rack BIU mounting is to be an integral part of the detector rack.

All BIU rack connectors are to have prewired address pins corresponding to the requirements of the TS2 specification. The address pins shall control the BIU mode of operation. BIUs shall be capable of being interchanged with no additional programming.

Main panels should have all field wires contained on one rows of horizontally mounted terminal blocks with a neutral buss bar mounted below the field wiring terminal blocks in such a manner as to not interfere with connections of the field wires to the terminal blocks but close enough to allow for convenient and neat connection of the neutral wires for each output. This buss bar shall extend the full length of the field wiring terminal blocks.

All field output circuits are to be terminated on an unfused screw type (#10 screw) terminal block with a minimum rating of 10 amps.

All field input/output (I/O) terminals shall be accomplished at the field terminals with the use of a screwdriver only. It shall also be possible to program which flasher circuit the phase shall be programmed to. It shall not be necessary to debus field terminal blocks for flash programming.

The main panel is to contain one labeled flasher socket capable of operating 25-amp, 2-pole, NEMA solid-state flashers. The flasher is to be supported by a bracket that extends at least half its length.

One RC network is to be wired in parallel with each group of three flash-transfer relays and any other relay coils.

All logic-level, ATC-controller and Malfunction Management Unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints are to identify the function of each terminal position, with two sets of prints provided per cabinet.

At a minimum, five 20-position terminal blocks are to be provided at the top of the main panel to provide access to the BIU/controller unit’s programmable and non-programmable I/O. Terminal blocks for DC signal interfacing shall have a number 6-32 x 7/32 inch screw as a minimum. All sixteen green/yellow/red load switch inputs, vehicle detector channel outputs one through sixteen and pedestrian detector inputs one through eight shall be terminated on the terminals and facilities panel. They shall be easily accessible.

The main panel is to incorporate a relay to remove +24 VDC from the common side of the load switches when the intersection is placed into flash. The relay is to have a momentary push-button to apply power to the load switch inputs for ease of troubleshooting.

936.02.02.03 Wiring and Cables

All main panel wiring shall be the size indicated below and is to be color-coded. As a minimum, colors shall be used to distinguish between different equipment. The following color code is provided as an example:

Green/Walk load switch output	Brown wire (14 gauge)
Yellow load switch output	Yellow wire (14 gauge)
Red/Don't Walk load switch output	Red wire (14 gauge)
MM (other than AC power)	Violet wire (22 gauge)
AC Line (power panel to main panel)	Black wire (8gauge)
AC Line (main panel)	Black wire (10 gauge)
AC Neutral (power panel to main panel)	White wire (8 gauge)
AC Neutral (main panel)	White wire (10 gauge)
Earth ground (power panel)	Green wire (8 gauge)
Logic ground	Gray wire (22 gauge)
Flash programming	Orange wire to flasher terminal, black wire to red or yellow field terminal (14 gauge)

An ATC controller power harness and connector shall be provided.

All cabinet configurations shall be provided with enough SLDC communication cables to allow full capabilities of that cabinet. One additional 6ft SDLC cable, capable of reaching any SLDC device, shall be supplied. Each communication cable connector shall be a 15-pin metal shell D subminiature type. The cable is to be shielded cable suitable for RS-485 communications. The additional SDLC cable connector is to be coupled to prevent dirt or moisture contamination. The SDLC cables shall be as small as possible and remain flexible throughout the NEMA temperature range of operation.

All main panels are to be prewired for a Type-16 Malfunction Management Unit.

Standard soldering and termination practices shall be followed. Wires soldered to .025 inch square posts are to be wrapped 270 degrees around the post. It is recommended that printed circuit boards or connectors be used with .025 inch squared posts. Great care shall be taken to prevent cold solder joints, solder bridges or shorts. Soldering shall be of the highest quality obtainable.

All wire (size 16 AWG or smaller) at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. Lap joint soldering is not acceptable.

All wiring is to be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections/splices are not acceptable.

All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable.

All wiring which passes through any metal panel shall be protected from abrasion by lining the hole with a grommet or similar material.

The grounding system in the cabinet is to be divided into three separate circuits (AC Neutral, Earth Ground, and Logic Ground). These ground circuits are to be connected together at a single point, using removable jumpers, as outlined in the ATC Standard.

All pedestrian push-button inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.

936.02.02.04 Power Panel

The power panel shall consist of a separate, wholly enclosed module, securely fastened to the right side wall of the cabinet. The power panel shall be wired to provide the necessary power to the cabinet, controller, Malfunction Management Unit, cabinet power supply and auxiliary equipment. It shall be manufactured from 0.090-inch, 5052-H32 aluminum with a removable plastic front cover.

The panel shall be of such design so as to allow a technician to access the main and auxiliary breakers without removing the front cover.

The power panel shall house the following components:

- A 5-amp equipment breaker which also functions as an on/off switch. This breaker shall supply power to the controller, MMU, cabinet power supply and auxiliary panels. The

equipment breaker shall be wired after the main breaker, transient protection and filtering.

- A 30 amp main breaker, which shuts off all power to the equipment breaker and all signal lights.
- A 15-amp auxiliary breaker. This breaker shall supply power to the fan, light and GFI outlet and shall be wired directly to the incoming power.
- All breakers shall be thermal magnetic type, UL listed for HACR service, with a minimum of 10,000 amp interrupting capacity.
- An EDCO model SHA 1210 or exact approved equivalent surge arrestor.
- A 50 amp, 125 VAC radio interference line filter.
- A normally-open, 60-amp, non-mercury contactor Struthers-Dunn model 418AXXL-120VAC or equivalent.
- A 7-position neutral bus bar capable of connecting three #12 wires per position. There shall be at least 5 positions, with no wires connected, available for field connections.
- A 7-position ground bus bar capable of connecting three #12 wires per position.
- A NEMA type 5-15GFI convenience outlet.
- A four position power connector wired such that incoming power from the utility can be routed to a UPS unit and then back to the main power input circuitry for the cabinet.

936.02.02.05 Auxiliary Cabinet Equipment

The cabinet is to be provided with 2 thermostatically controlled (adjustable between 80-150 degrees Fahrenheit) ventilation fans in the top of the cabinet plenum. The fans are to be ball bearing type fans and shall be capable of drawing a minimum of 100 cubic feet of air per minute each

An 8 Position outlet strip is to be mounted to the left wall of the cabinet above the upper shelf. All of the outlets must be positioned to allow connection of power transformers without obstructing other outlets on the strip. The outlet strip should be wired after the 15amp breaker and may contain its own surge protection or be wired after the EDCO surge arrestor but it must have surge protection. If it contains its own surge protection it shall be equal to or greater than the protection provided by the EDCO model SHA 1210.

Two sets of complete and accurate non-fading cabinet drawings are to be supplied with each cabinet.

All equipment supplied with the cabinet shall include one set of operating and service manuals per unit up to a maximum of ten sets per order.

936.02.02.06 Vehicle Detection Rack

A vehicle detector amplifier rack is to be provided in each cabinet. Detector racks are to support 16 channels of loop detection, two 2-channel preemption devices and one BIU and mounted on the top right side of the lower shelf.

The Pre-emption channels in the detector rack are to be cross wired in such a manner as to allow use of two 2-channel devices or one 4-channel device without any additional wiring or jumper cards.

Each cabinet is to contain detector interface panels for the purpose of connecting field loops and vehicle detector amplifiers. One 16-position interface panel shall be provided. The interface panel is to be secured to a mounting plate and attached to the left sidewall of the cabinet, no less than 12 inches above the bottom of the cabinet.

Interface panels shall allow for the connection of sixteen independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in cable ground wire.

Interface panels are to provide a 10-position terminal block to terminate the field wires for up to two 2-channel preemption devices.

Lightning protection devices are to be provided (EDCO SRA-16C, or EDCO SRA-6, or EDCO LCA-6 EDCO SRA 6LCA, or equivalent lightning protection device).

A cable consisting of 20 - 22 AWG twisted pair wires are to be provided to enable connection to and from the panel to a detector rack. All termination points shall be identified by a unique number and labeled on the panel.

Each detector rack is to accommodate rack mountable preemption devices such as Opticom™.

936.02.02.07 Cabinet Test Switches and Police Panel

The police door switch panel is to contain the following:

- **SIGNALS ON/OFF SWITCH.** In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
- **AUTO/FLASH SWITCH.** In the flash position, power shall not be removed from the controller and stop time is not to be applied. When the switch is returned to the Auto position the controller is to restart.
- **AUTO/MANUAL SWITCH.** Cabinet wiring is to include an AUTO/MANUAL switch and a terminal strip with a momentary push-button and coiled cord. Terminal strip is to be accessible only from the inside of the cabinet.
- **MANUAL PUSH BUTTON SWITCH.** An additional manual advance momentary push button switch mounted on and accessible through the police panel door is to operate with the

Auto/Manual switch.

- A MANUAL OPERATION interlock switch is to be mounted in the police panel in such a manner as to return the controller to AUTO operation in the case that the AUTO/MANUAL switch is left in the Manual position and the police panel door is closed.
- A door open/closed switch, connected to the BIU on Alarm 1, is to be provided. All toggle type switches are to be rated 5 amps. Single-(all the time) or double-pole switches may be provided, as required.
- Any exposed terminals or switch solder points are to be covered with insulating material in such a manner as to prevent accidental contact with live circuits by maintenance personnel, this may be shrink tubing.
- All switch functions must be permanently and clearly labeled.
- All wire routed to the police door-in-door switch panel is to be adequately protected against damage from repetitive opening and closing of the main door.
- All test switch panel wiring is to be connected to the main panel via a 15-pin AMP type connector.

936.02.03 Auxiliary Devices

936.02.03.01 Load Switches

Load switches are to be solid state and shall conform to the requirements of the ITS Cabinet Standards.

Signal load switches are to have a minimum rating of 20 amperes at 120 VAC for an incandescent lamp load. They shall be capable of handling a one cycle surge of 250 amperes at 125 degrees centigrade.

The front of the load switch is to be provided with three LED indicators to show the input signal from the controller to the load switch and three LEDs showing the load switch outputs. Twelve Reno A&E LS-200 or approved equivalent shall be provided with each cabinet.

Load switches are to be dedicated per phase. The use of load switches for other partial phases is not acceptable.

The full complement of load switches to be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

936.02.03.02 Flashers

The flashers are to be solid state and shall conform to the requirements of the ITS Cabinet Standards. Flashers shall be Reno A&E FL-200 or approved equivalent.

Flashing of field circuits for the purpose of intersection flash is to be accomplished by a separate flasher.

The flasher is to be rated at 25 amperes, double pole with a nominal flash rate of 60 FPM.

936.02.03.03 Flash Transfer Relays

All flash transfer relays are to meet the requirements of the ITS Cabinet Standards.

The coil of the flash transfer relay must be de-energized for flash operation. Contacts are to be rated at 30 amps resistive.

The full complement of relays is to be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

Flash Transfer Relays are to be a Struthers Dunn 21XBXP-120VAC, Reno A&E TR-200 or an approved equal.

936.02.03.04 Cabinet Power Supply

The cabinet power supply is to meet the requirements of the ITS Cabinet Standards. The power supply is to be a stand alone type. The power supply is to be mounted on top of the upper shelf at the left end.

The cabinet power supply is to provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs.

The cabinet power supply is to provide (on the front panel) jack plugs for access to the +24 VDC for test purposes.

The cabinet power supply shall have a minimum of a 5 amp rating.

936.02.03.05 24V Load Switch Control Relay

The relay used to control the 24VDC to the load switcher is to have a push button, which allows it to be mechanically energized.

936.02.04 Testing and Warranty

936.02.04.01 Testing

Each controller and cabinet assembly is to be tested as a complete entity under signal load for a minimum of 48 hours.

Each assembly is to be delivered with a signed document detailing the cabinet final tests performed.

The cabinet is to be assembled and tested by the controller manufacturer to ensure proper component integration and operation.

936.02.04.02 Warranty – The controller and Malfunction Management Unit is to be warranted by the manufacturer against mechanical and electrical defects for a period of two years. The manufacturer’s warranty is to be supplied in writing with each cabinet. Second party extended warranties are not acceptable.

The cabinet assembly and all other components are to be warranted for a period of one year.

936.03 DETECTION

936.03.01 General

Pedestrians shall be detected using pedestrian actuated push buttons. Detection shall be provided for vehicles and bicycles utilizing the roadway.

Vehicle video detection systems are to be used to detect vehicles and bicycles. Alternate systems may be required by the Director, especially if site conditions warrant using an alternate detection system, such as radar or infrared systems. Alternate systems shall be reviewed and approved by the Director.

936.03.02 Vehicle Video Detection Systems (VVDS)

VVDS uses one or more cameras and video analytics hardware and software to detect vehicle presence, provide a detection output, and generate volume, occupancy, and speed data.

VVDS shall:

- have software that allows local and remote configuration and monitoring
- display detection zones and detection activations overlaid on live video inputs

- allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones
- retain its programming in nonvolatile memory
- have configuration data that can be saved to a computer and restored from a saved file
- have all communication addresses be user programmable
- be directly compatible with ATC controllers
- include a machine vision processor that allows video analysis, presence detection, data collection, and interfaces for inputs and outputs as well as storage and reporting of collected vehicle detection data
- include a minimum of one Ethernet communications interface
- have an interface and connector conforming to Telecommunications Industry Association (TIA)-232 standards
- have a 10/100 Base TX connection Ethernet interface
- have all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA 568.

Devices are to be Federal Communications Commission (FCC)-certified. The FCC identification number shall be displayed on an external label and all detection system

devices operate within their FCC frequency allocation.

Cellular communication devices shall be compatible with the cellular carrier used by the agency responsible for system operation and maintenance.

System can be configured and monitored via one or more communications interface. Analog video inputs and outputs utilize BNC connectors. Detection output shall meet the requirements of ITS Cabinet Standards.

System shall operate using a nominal input voltage of 120 volts of alternating current (VAC) or shall supply a voltage converter.. Environmental test reports must demonstrate that voltage converters required for 120VAC operation were subjected to environmental testing complying with ITS Cabinet Standard as part of the functional system.

Equipment shall be permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.

All parts are to be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

All fasteners exposed to the elements shall be Type 304 or 316 passivated stainless steel.

Detector shall meet the environmental requirements of the ITS Cabinet Standard.

Detector shall provide a minimum detection accuracy of 98% when calculated in accordance with all criteria detailed in ITS Cabinet Standard and all subsections therein.

Detector shall meet the requirements for modes of operation defined in ITS Cabinet Standard.

Vehicle detection shall meet minimum total roadway segment accuracy levels of 95% for volume, 90% for occupancy, and 90% for speed for all lanes, up to the maximum number of lanes that the device can monitor as specified by the manufacturer.