CONSTRUCTION STANDARDS AND DETAILS

APPENDIX B
TRAFFIC SIGNAL SYSTEMS

CITY OF CONCORD
NEW HAMPSHIRE

2016

Traffic Signal Systems

A. Description

This work shall consist of the furnishing and complete installation of all equipment and materials in accordance with the City of Concord Construction Standards and Details to provide a complete operating intersection traffic signal including: traffic signal controller, controller cabinet and ancillary equipment, power service, mast arms and poles, foundations, electrical and signal cable, LED vehicular and pedestrian indications, LED blank out signs, emergency vehicle preemption, video vehicle detection system, communication equipment, and other items shown on the plan sheets and described in the List of Major Materials.

General

Work shall conform to the provisions of Section 616 of the NHDOT Standard Specifications, latest edition with amendments, except as modified or changed herein.

1. All work shall conform to the requirements of the New Hampshire Department of Transportation, Standard Drawings and Specifications, the Manual of Uniform Traffic Control Devices, and the City of Concord Construction Standards and Details.

2. The Contractor shall be responsible for signal maintenance during the contract. The Contractor shall furnish the City Engineer and Police Department with names and telephone numbers of persons to be contacted in case of a malfunction.

3. The Contractor shall submit to the City of Concord at least three copies of catalog cuts and/or shop drawings of the proposed equipment for review and approval prior to construction. Structural analysis of proposed traffic signal mast arms, stamped by a professional engineer registered in New Hampshire, shall be included in the submission. Soil borings and related assessment shall also be provided that verifies the mast arm foundation design.

4. The Contractor shall notify the City of Concord Fire Alarm/Traffic Division Section no less than 3 days prior to the following:
   a. The date of preliminary review of construction.
   b. The date of final inspection.

5. The Contractor shall make arrangements for the power service connection and be responsible for all charges incurred. Payment shall be forwarded to the City of Concord, Finance Department, 41 Green Street, Concord, NH 03301

6. No part of the signal shall be rendered operational until the entire system has been installed and tested in conformance to the specification. The signals shall not be rendered operational without the approval of the City of Concord.

7. The Contractor shall guarantee all materials, equipment and workmanship for a period of two years or for the manufacturer's guarantee period, whichever is greater, from the final acceptance date. All finish coatings on galvanized painted traffic signal hardware shall be inspected yearly and guaranteed not to chalk, peel, blister, or fade for a period of five (5) years from the final acceptance date.

Fire Preemption Operation

1. Upon release of fire pre-emption, the controller shall terminate the prempt phase with normal vehicle clearance intervals, followed by a return to the normal signal phasing sequence beginning with main street green.

2. The engineering, design, and integration of the fire pre-empt equipment and/or ancillary components shall be by the manufacturer of Opticom brand equipment in cooperation with the supplier of the signal controller and cabinet.

3. Optical detector location shall be verified in the field by the City of Concord Fire Alarm/Traffic Division Representative to assure optimum reception.

4. To assure proper conformance, the contractor shall contact the Fire Alarm Superintendent of the City of Concord's Fire Department, telephone number (603) 225-8667.

5. In cooperation with the Fire Department, the contractor shall make the necessary trial runs to ascertain proper timing and operation of the pre-emption system, to the satisfaction for the Fire Alarm Superintendent.

B. Materials

General

1. All vehicular signal lenses shall be 12 inches in size and all signal housings and visors shall be manufactured of polycarbonate. All pedestrian signal lenses shall have a countdown timer with minimum 9-inch digits and manufactured of polycarbonate or acrylic materials, unless noted otherwise.

2. All mast arm mounted signals and blank out signs shall be rigid mounted and shall have a 1/8 inch aircraft safety cable wrapped around the mast-arm and through the signal bracket and locked using a "U" cable clamp.

3. The exterior surface of all mast arms and posts, controller cabinets, signal heads, push buttons, video cameras, optical detectors, and other ancillary equipment exposed to public view, shall be painted semi-gloss black, unless noted otherwise.

4. The interior surface of signal visors, including louvers if used, shall be painted flat black.

5. All vehicular signals shall be equipped with 5± inch perforated flat-black back plates. The outside perimeter of each back plate shall be lined with a fluorescent-yellow 2-inch strip of Type IX or Type XI retroreflective sheeting to highlight each multi-section signal head.

List of Major Materials

A list of the recommended materials required to install the traffic signal system shall be included as an amendment to this specification. A partial list of materials recommended by the City of Concord is presented below; quantities shown are for illustrative purposes and shall be amended in accordance with the plan requirements.

1 - Cobalt Controller with Graphical Touch Display as manufactured by Econolite Control Products, Inc. The controller shall be capable of operating in NEMA TS1, NEMA TS2 type 1, and NEMA TS2 Type 2 cabinets. The controller shall include a Wireless Dongle and Ethernet Port, and 9 pin FSK Telemetry Module.

The cabinet shall be a size 6 NEMA TS2 Type-1 Econolite Control Products Plug-N-Go with 15-inch extension base. The Contractor shall arrange to have the controller cabinet shipped directly from manufacturer to Concord Fire Department, Fire Alarm/Traffic maintenance shop, where Contractor shall set up cabinet to run under load for 72 hours. Upon completion of this burn-in period, Contractor shall perform a complete test of the cabinet with Concord Fire Dept. personnel prior to installation in the field.

The cabinet shall be aluminum, painted semi-gloss black outside and white inside.

The cabinet shall include the following:

1. Continuously welded exterior seams.
2. Two shelves.
3. Main panel with twelve load switch positions, and six flash transfer relay positions.
4. Power panel with surge protection.
5. Power distribution panel with minimum of six power connectors.
6. SDLC terminal block with a minimum of five SDLC connecting cables.
7. One detector rack and associated loop interface panel shall be provided in each cabinet. Detector rack shall be capable of supporting up to sixteen vehicle detection channels and four preemption channels. Loop interface panel shall be MOV protected.
8. Auxiliary panel with AUTO/FLASH, STOP TIME, and CONTROLLER ON/OFF switches.
9. Police panel with SIGNALS ON/OFF, AUTO/FLASH, and AUTO/MANUAL switches and manual cord.
10. A telemetry interface harness and interface panel shall be supplied with each cabinet assembly. An EDCO Model PC642C-008D shall be supplied for communication line transient protection.
11. Twelve diagnostic type load switches.
12. One flasher.
13. Six flash-transfer relays.
14. One 16-channel MMU smart monitor with LCD display and ethernet port.
15. One shelf mounted cabinet power supply.
16. Four bus-interface units.
17. All cabinet back-panel components to be identified by label.
18. Three sets of cabinet wiring diagrams.

19. One electronic copy of cabinet wiring diagram on CD or DVD.

20. Video detection system, single camera, Aldis brand Gridsmart, to include the following:

    a. Gridsmart wide angle camera and all necessary mounting hardware and interconnecting cables. Camera-to-processor cable shall be shielded, burial-grade Cat5e.

    b. Gridsmart shelf-mounted detection processor and all manufacturer-recommended lightning arrestors and surge suppressors.

    c. Data Module and software license, latest version, including but not limited to the following functions: traffic counts module; realtime data module; pedestrian module; and alerts module.

21. Cabinet spares to include the following:

    a. One EDCO Model PC642C-008D.

    b. One flasher.

    c. One flash transfer relay.

    d. One 9-pin FSK Telemetry module.

    e. One cabinet power supply.

    f. One Smart MMU.

    g. One cooling fan assembly.

22. Heat lamp with thermostat and cooling fan with thermostat.

23. One SHDSL network extender kit, Zhone Model SNE2000G-KIT1US.

24. One utility grade, environmentally hardened, 10-port managed switch, RUGGEDCOM Model RS900G, or approved equal.

25. Two 12-inch LED lighting strips mounted to fan plenum.

26. One 12-inch LED lighting strip mounted under lowest shelf.

Following an interruption of power, all eight phase controllers shall start up in a flashing mode of operation (with Phases 2 and 6 flashing yellow, and all other phases flashing red). Automatic operations will start up at the beginning of the green period for main-line through traffic, Phases 2 and 6.

- Galvanized steel, semi-gloss black painted, double mast arm signal pole with foundation, with XX' and YY' signal arms, with 12' luminaire arm, with nut covers, Union Metal Manufacturing Company, Design 50400 Series, Valmont Industries, Inc., Design F283A, or approved equal.

- Galvanized steel, semi-gloss black painted mast arm signal pole with foundation, with XX' signal arm, with nut covers, Union Metal Manufacturing Co., Design 50400 Series, Valmont Industries, Inc., Design F283A, or approved equal.

- XX' pedestrian signal post with foundation, gloss black painted, Pelco square aluminum base PB-5335 with optional collar set screws and grounding lugs, factory

painted to option P33 gloss black, and Pelco PB-5102 spun aluminum pole, schedule 80, 4 1/2 inch OD, factory painted to P33 gloss black; or approved equal.

- One Way, 4 section, 12" adjustable mast arm mounted black polycarbonate signal housings with tunnel visors and 5" louvered reflectorized back plates, McCain, Econolite brand or approved equal.

- One Way, 3 section, 12" adjustable mast arm mounted black polycarbonate signal housings with tunnel visors and 5" louvered reflectorized back plates, McCain, Econolite brand or approved equal.

- One Way, 3 section, 12" adjustable pole mounted black polycarbonate signal housings with tunnel visors and 5" louvered reflectorized back plates, McCain, Econolite brand or approved equal.

- Pelco brand style "Astro Bracs" or approved equal.

- Red LED type traffic signal lamps, Dialight, GELcore, or approved equal.

- Yellow LED type traffic signal lamps, Dialight, GELcore, or approved equal.

- Green LED type traffic signal lamps, Dialight, GELcore, or approved equal.

- 16"x18" black polycarbonate pedestrian signal housing, McCain, Econolite brand or approved equal, pedestal top-mounted, single unit with solid hand symbol, solid walking symbol and 9" countdown timer digits, Dialight, GELcore brand LED modules or approved equal.

- 16"x18" black polycarbonate pedestrian signal housing, McCain, Econolite brand or approved equal, bracket-mounted, single unit with solid hand symbol, solid walking symbol and 9" countdown timer digits, Dialight, GELcore brand LED modules or approved equal.

- APS pedestrian push button station with push button confirmation, adjustable locator tone, vibrating button during WALK, custom audio messages and automatic sound adjustment to ambient sound levels, Polara EZ Communicator Navigator APS, 4-wire (EN4), with black base and front housings, countdown pedestrian sign (9x15, R10-3e) and saddle, arrow indicating direction to (and parallel with) crosswalk, braille street crossing on face plate, and custom street crossing message as specified or approved equals.

1 - Spare APS 4-Wire Push Button Station (EN4 PBS).

1 - Spare APS Ped Head Control Unit (PHCU4W)

- Polara NPA4x2-X adaptor for mounting two 9x12 Navigators on a 4" diameter pedestal pole, or approved equal.

- Polara EZ523-EZ Communicator Navigator push button station mounting extender, 6" or 12" as specified, or approved equal.

- Opticom Brand optical detector and ancillary equipment, Model 711 with mounting hardware, painted black.

- Opticom Fire Preempter Phase Selector, Model 762 only**.**

1 - Latest version of GTT Onsite software for Opticom.

#- Strobe Light, 120 V.A.C. with lexan optic lens, Whelen Model IS 3220 with high red dome, or approved equal. Mast arm mounted with nipple of sufficient height to assure visibility from all approaches. Mounting hardware to be painted black.

- Mast Arm mounted R 3-1 "No Right Turn" symbol blankout signs, 24"x24", with white LED arrow outline and red outline, black powdercoat frame and clear lens, Traffic Signs, Inc., M-Systems, Inc. Thin Light Blankout Sign, or approved equal.

1 - Video detection camera, painted white, Aldis brand Gridsmart, or approved equal.

1 - Spare Video detection camera, painted white, Aldis brand Gridsmart, or approved equal.

1 - Camera mount for luminaire arm or mast arm, galvanized steel, Pelco brand Astro-Brac, or approved equal.

- Camera mountings for mast arm, painted black, Pelco brand Astro-Brac, band mount with pan tilt, or approved equal.

- ASC/2M-1000 System Master, factory installed, including all required interface equipment and associated wiring and cables, such as, but not limited to, RS-232 auto-dial/auto-answer modem for Master-to-Aries communications via commercial telephone network, AC outlet for RS-232 modem, RJ-11 jack for telephone line, Master Power On/Off switch, Telemetry interface board and two FSK 4-wire telemetry modules installed in the Master. Current version of Aries System Software with license and user manual shall also be provided unless waived in writing by the Fire Alarm Superintendent.

1 - Electrical service connection, including installation of cabinet-mount power meter, Milbank Model U3741-XL-100-BL single phase 100 amp meter socket with 50 amp main breaker and lever bypass.

- Aluminum sign, 30" by 36", R10-11a, "NO TURN ON RED", rigidly mounted on mast arm using an Astro Brac or other similar rigid sign bracket.

- Aluminum sign, 78" by 16", D3-1 (MOD), WHITE ON GREEN, "Langley Pkwy ->", rigidly mounted on mast arm using an Astro Brac or other similar rigid sign bracket.

Mast Arm Mounted Signs

1. Mast arm mounted signs (Signs A, B, C and D on the traffic signal plan) shall conform to Item 615 and the provisions below.

2. All mast arm mounted signs shall be fabricated with Type VII (Diamond Grade) sheeting.

3. D3-1 Mast Arm Mounted Street Name signs:

   a. Type BB aluminum blank with rounded corners.

   b. Text and border shall be white on a green background.

   c. Text to be FHWA Standard Highway Signs standard: lettering for street names shall be 8B, upper/lower case; and lettering for Rd, St, Dr, Ave, Blvd, Pkwy, Ln, Pl, etc. shall be 6C, upper/lower case and bottom justified.

   d. Border to be 1" wide with 3" corner radii.

   e. All arrows shall be 8" x 8".

   f. Horizontal spacing between words, arrow and border shall be 6" minimum.

   g. Sign height shall be 16". Sign width shall be determined by the sign manufacturer based on the above lettering and spacing requirements, and rounded to the next-highest multiple of 6 inches.

   h. The center of the sign shall be mounted on the mast arm one half the sign width distance plus two feet out from the mast arm pole. The contractor shall field adjust this dimension for sign C to provide appropriate clearance from existing overhead utilities as applicable.

4. Furnishing and installing mast arm mounted signs, including necessary mounting hardware, is subsidiary to 616.

Coating System for City of Concord Signal Equipment

The coating system shall consist of hot-dip galvanizing and shop-applied paint for traffic signal hardware as shown on the plans or as directed. The requirements for the paint system, material properties, application, and handling shall conform to the provisions of NHDOT Specification Section 550 Structural Steel - Section 3.13 Shop Painting (coatings from paint system A or B may be selected), except as required herein, or approved otherwise.

Coating System: The coating system shall consist of the following generic type at the minimum coating thickness shown:

Coating	Description	Thickness (minimum)
Galvanized:	Hot-dip galvanizing	Per AASHTO

Pre-treatment	SP 1 Solvent Cleaning SP 8 Brush-off Blast Cleaning Phosphate cleaning (required when painting is more than 12 hours after galvanizing)	
Intermediate (force-cured)	708-NH 3.21,High Build Epoxy Polyamide	3 mils DFT
Finish (force-cured)	708-NH 3.81, Aliphatic Polyurethane	3 mils DFT

Hot-dip galvanizing: Hot-dip galvanizing shall conform to AASHTO M 111 (ASTM A 123) and AASHTO M232 (ASTM A 153) utilizing the dry kettle process in a bath of molten zinc containing nickel (0.05% to 0.09% by weight). Hardware may be mechanically galvanized in conformance with AASHTO M 298 (ASTM B 695) Class 50.

Phosphating: Phosphating, when required as described herein, shall conform to zinc phosphate coating (light) of galvanized steel, D.O.D. specification TT-C-490D, or approved equal, and shall be applied according to the manufacturer's recommendation.

Color: Each coat of paint shall be separately colored to contrast with other coats and to ensure complete coverage. The previous coat shall be hidden by a single application of each coat. The final color of the painted product shall be **BLACK** (semi-gloss) Federal Standard 595 Color #27038.

C. Construction Requirements

General

1. Minimum clearance to the bottom of overhead signal housings shall be sixteen (16) feet. Minimum clearance to the bottom of post-mounted vehicular signal housings shall be ten (10) feet. Minimum clearance to the bottom of pedestrian signal housings shall be eight (8) feet.

2. Signal heads mounted overhead on mast arms shall be positioned so that the red signal faces align horizontally, unless otherwise indicated on the plans.

3. All wiring splices shall be waterproofed.

4. Conduit risers shall be located on the opposite side of the utility pole from where the other utilities attach to the pole.

5. Pull wires/ropes of sufficient strength shall be placed in all conduits installed.

6. For the installation of all underground conduits, the road and sidewalk pavement shall be opened by an approved method. Care shall be taken to not lift adjacent pavement. If the contractor elects to saw pavement, no payment will be made for this work.

7. Traffic signal loops shall be placed a minimum 2' from manholes or catch basin frames to allow for the maintenance of the structure.

8. All controller cabinet foundations shall have a 3' x 4' concrete pad on the door side of the cabinet.

9. The contractor shall not be permitted to close down any traffic lanes during peak period hours without written approval from the City Engineer.

10. Any open area between the signal pole base and the foundation shall be grouted. Exposed edges of grout shall be neatly finished. A weep hole shall be placed in each grouted face of the foundation.

11. Plug all mounting holes in existing signal support poles otherwise abandoned due to signal head or pushbutton removal or repositioning.

12. All traffic signal hardware indicated to be removed and salvaged to the City shall be delivered in pre-existing working condition to the Concord Fire Alarm/Traffic Division office, unless otherwise specified. This includes signal heads, pushbuttons, controller hardware signal poles, mounting hardware, and other items as may be noted on the plans or as directed by the Engineer.

13. The face of each pushbutton shall be: placed parallel to the crosswalk which it serves; mounted 42" above the sidewalk surface; and located within 16" of the adjacent sidewalk. If the distance to the adjacent sidewalk exceeds 16", the contractor shall construct a 5' wide (minimum) sidewalk extension from the existing sidewalk to the base of the pole beneath the subject push button location. Sidewalk extensions shall be constructed of 3" bituminous concrete sidewalk with a 4" crushed gravel sub-base (subsidiary to 616).

Coating System for City of Concord Signal Equipment

The coating system shall consist of hot-dip galvanizing and shop-applied paint for traffic signal hardware as shown on the plans or as directed. The requirements for the paint system, material properties, application, and handling shall conform to the provisions of NHDOT Specification Section 550 Structural Steel - Section 3.13 Shop Painting (coatings from paint system A or B may be selected), except as required herein, or approved otherwise.

Components: All steel components except for anchor plates and stainless steel studs, shall be galvanized, pre-treated, and shop painted except as noted. Hardware need not be painted after galvanizing, except that the portions exposed to view after installation, such as bolt heads, ends, nuts, and washers, which shall be field painted accordingly. Touch-up and repairs shall be made using paint from the same batch run as used for the shop-applied coats and supplied by the shop applicator.

Pre-approval: Two 3-inch by 6-inch (approximate size) samples of material to be used in the work shall be galvanized and painted as specified herein and submitted to the City of Concord for approval or surface texture and color prior to full-production galvanizing and painting. The fabricator of the material shall provide the galvanizer with samples taken from the same material to be used in the work.

When phosphating is required, the phosphate applicator shall document in writing that the phosphating procedure is acceptable to the galvanizer and coating manufacturer prior to performing the work.

Contractor coordination: The fabricator shall send the drawings to the galvanizer for review to note considerations particular to the galvanizing process and to coordinate any proposed modifications to the fabricated material, prior to submission of shop drawings to the City for approval.

The fabricator shall notify the galvanizer if the chemical composition of the steel to be galvanized exceeds the following limits, in order to determine its suitability for processing: 0.26% carbon, 0.24% silicon, 0.05% phosphorous, and 1.35% manganese.

Pre-treatment and paint application: Paint coatings shall be shop applied to the galvanized product within 15 days of galvanizing. Paintings shall be performed inside a controlled environment meting applicable atmospheric requirements as recommended by the coating manufacturer. Prior to pre-treatment, rough areas of galvanizing shall be ground smooth to achieve a uniform galvanized surface to accept paint.

Pre-treatment:. Prior to painting, the galvanized surface shall receive pre-treatment consisting of SSPC-SP1, Solvent Cleaning, and SSPC-SP7, Brush-Off Blast Cleaning or abraded by approved mechanical means, to remove detrimental contaminants and to thoroughly roughen the entire surface and produce a uniform anchor profile of 1-2 mils. The required thickness of the zinc coating shall be maintained and checked prior to painting. The pre-treatment shall meet the paint manufacturer's requirements. An additional pre-treatment or tie coat may be considered if required by the paint manufacturer and approved by the City.

Blast cleaning: Blast cleaning shall be performed prior to the formation of "white rust" on the galvanized surface. If any "white rust" is detected by visual means, the galvanizing shall be stripped off and the steel re-galvanized in conformance with the specifications. "White rust" shall be as defined in the American Galvanizers Association, Inspection of Products Hot Dip Galvanized After Fabrication, Table IV.

Pre-treatment and Painting Methods: The galvanized steel product shall be pre-treated and painted by one of the following methods.

Method 1 (under 12 hrs.). The galvanized steel shall be pre-treated as per 3.12.3.1. The first coat of paint shall be applied within 12 hours of galvanizing and within 8 hours of blast cleaning (or surface abrasion by approved mechanical means).

Method 2 (over 12 hrs). When the galvanized steel is to be painted more than 12 hours after galvanizing, the steel shall be pre-treated as per 3.12.3.1 followed by a treatment of zinc phosphate applied within 8 hours of blast cleaning (or surface abrasion by approved mechanical means). The first coat of paint shall be applied within 12 hours of phosphating.

Intermediate and Finish Coats: The intermediate and finish coats shall be shop applied under atmospheric conditions meeting the following minimum requirements: air and steel temperature of 50°F above the dew point. The finish coat shall be spray applied.

Force Cure: The intermediate and finish paint coats shall each be force cured in a heated booth maintained at a minimum temperature of 150°F for 2 to 4 hours.

Handling: The finish shop-coated material shall be handled with care using nylon slings, padded cables, etc., as required to protect the finish coating. The paint applicator shall be responsible for the condition of the finish coating until the material arrives at the job site.

Field Touch-up and Repairs: Damaged galvanized surfaces shall be repaired by applying an organic zinc repair paint conforming to ASTM A 780 and recommended by the galvanizer. Galvanizing repair paint shall be 65 percent zinc by weight, minimum, and shall be brush applied. The thickness of the repair shall not be less than the coating thickness required by AASHTO M 111 or M 232, but not less than 3 mils DFT. Repair touch up shall not be permitted using aerosol spray, silver paint, bright paint or aluminum paints.

Damaged shop applied paint shall be repaired in conformance with the solvent cleaning and abrasion pre-treatment requirements of 3.12.3.1 and the paint manufacturer's recommendations, to a minimum thickness of the original system. Touch-ups shall be such that the repair is not noticeably visible from a distance of 6 feet.

One-Year Inspection: The finish shall be inspected yearly and guaranteed not to chalk, peel, blister or fade for a period of five (5) years after acceptance of the project.

D. Inspection Requirements

Preliminary Review

Prior to final inspection, the contractor shall have a preliminary review of the system with the City Engineer and representative of the Concord Fire Alarm/Traffic Division, to review and comment on the system.

Final Inspection

The contractor shall provide a qualified technician to be on hand to thoroughly inspect the system in the presence of the City Engineer and representative of the Concord Fire Alarm/Traffic Division. The intersection signal system shall be checked, reviewed, and confirmed that is satisfactory and operational as designed.